RCA Solid State

DATABOOK

Power Devices for New Designs

- Power FETs
- Power Transistors
- Triacs and SCRs
- UFR Rectifiers

RCA Power Devices for New Designs

Table of Contents

This DATABOOK contains information on the full line of more than 1000 RCA solid-state power devices. A complete index of types is followed by five major data sections that provide detailed ratings and characteristics for:

Logic-Level Power MOSFETs—RCA has recently introduced a new series of low-threshold power MOSFETs, called logic-level FETs, or more simply, L^2FETs. These n-channel devices are unique in that they may be driven directly from a 5-volt logic-level source rather than the nominal 10 volts required for conventional power MOSFETs.

Power MOSFETs—RCA power MOSFETs are available in both n- and p-channel enhancement-mode types with drain-current (I_{DS}) ratings from 1 to 45 amperes, drain-to-source (V_{DS}) voltage ratings of 50 to 500 volts, and switching times in the nanosecond range.

Ultra-Fast-Recovery Rectifiers—Use of the latest state-of-the-art techniques assures excellent reliability for the RCA series of ultra-fast-recovery rectifiers. Additionally, critical characteristics of these series of devices are specially tailored for the output-rectifier stage of switching power supplies.

SwitchMax Power Transistors—The RCA "SwitchMax" series of silicon n-p-n transistors, employing a multiple epitaxial layer collector structure, are specifically designed for high-current, high-speed switching. SwitchMax transistors feature high-voltage capability, fast switching speeds, low saturation voltages, and high safe-operating-area (SOA) ratings; they are 100-percent tested for the parameters essential to the design of power-switching circuits.

Darlington Power Transistors—RCA power Darlingtons feature monolithic silicon construction and available in both n-p-n and p-n-p versions. They offer gain figures up to 20,000; a current range of 2 to 50 amperes and sustaining voltages from 40 to 450 volts. The high gain of these Darlingtons makes it possible for them to be driven directly from integrated circuits.

The final technical data sections present condensed data on **Standard Power Transistors**, **Triacs**, and **SCRs**. Following these sections, a cross-reference guide indicates recommended RCA replacements for more than 3400 popular industry types.

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When incorporating RCA Solid State Devices in equipment, it is recommended that the designer refer to "Operating Considerations for RCA Solid State Devices", Form No. 1CE-402, available on request from RCA Solid State Division, Box 3200, Somerville, N.J. 08876.

Printed in USA/6-84

PHC = Power Hybrid Circuit
PWF = Power MOSFET
PWT = Power Transistor

SCR = Silicon Controlled Rectifier
TRI = Triac
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Logic-Level Power MOSFETs
Technical Data

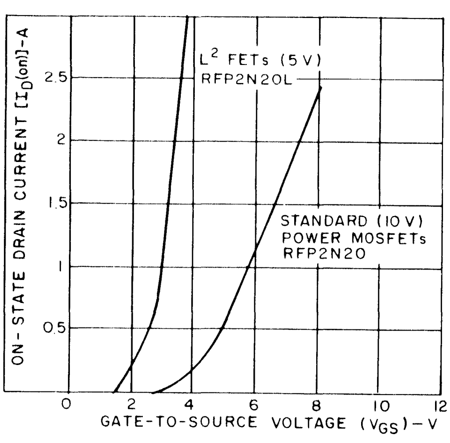
Logic-Level Power MOSFETs

RCA has developed a new series of power MOSFETs that feature a gate-oxide insulation only 50 nm thick — one-half the industry standard for power MOSFETs. The surface inversion of the MOS channel is a direct function of the gate-oxide thickness; consequently, the gate-to-source threshold voltage — i.e., the applied gate voltage required for uncompromised drain characteristics — on the new series of devices is only half that of conventional power MOSFETs.

The reduced gate-drive requirement allows on-off switching of the new MOSFETs directly from logic level voltage of 5 volts, rather than the nominal 10 volts required for conventional power MOSFETs with 100-nm-thick gate oxides. For this reason, the new devices are called *logic-level Fets* (or more simply L^2FETs). The L^2FETs feature the same low on-resistance characteristics, drain-current ratings, and blocking-voltage capability of corresponding types with the higher gate-drive requirements. In addition, the L^2FETs offer twice the transconductance and half the threshold-voltage temperature coefficient of conventional types having the same on-resistance and voltage ratings and demonstrate a comparable switching speed for the same gate-drive power.

The initial series of L^2FETs includes 32 n-channel types with drain-current ratings that range from 1 to 15 amperes, drain-to-source voltage ratings of 50 to 200 volts, and are totally interchangeable with corresponding standard power MOSFETs, but offer twice the gate sensitivity. They are supplied in three basic package styles: TO-3, TO-39, and TO-220 (plastic).

Note:
For a detailed explanation of Power MOSFET Switching Characteristics, refer to page 434.



Comparison of standard power MOSFETs and L^2FETs.

L^2FETs — N-Channel Types

RCA TYPE	PKG	I_D (A)	V_{DSS} (V)	P_D (W)	$r_{DS(on)}$ OHMS
•RFL1N08L	TO-39	1	80	8.33	1.40
•RFL1N10L	TO-39	1	100	8.33	1.40
•RFL1N12L	TO-39	1	120	8.33	2.15
•RFL1N15L	TO-39	1	150	8.33	2.15
•RFL1N18L	TO-39	1	180	8.33	3.65
•RFL1N20L	TO-39	1	200	8.33	3.65
RFL2N05L	TO-39	2	50	8.33	0.80
RFL2N06L	TO-39	2	60	8.33	0.80
•RFP2N08L	TO-220	2	80	25	1.25
•RFP2N10L	TO-220	2	100	25	1.25
•RFP2N12L	TO-220	2	80	25	2.00
•RFP2N15L	TO-220	2	100	25	2.00
•RFP2N18L	TO-220	2	180	25	3.50
•RFP2N20L	TO-220	2	200	25	3.50
RFP4N05L	TO-220	4	50	25	0.80
RFP4N06L	TO-220	4	60	25	0.80
•RFM8N18L	TO-3	8	180	60	0.60
•RFM8N20L	TO-3	8	200	60	0.60
•RFP8N18L	TO-220	8	180	60	0.60
•RFP8N20L	TO-220	8	200	60	0.60
RFM10N12L	TO-3	10	120	60	0.30
RFM10N15L	TO-3	10	150	60	0.30
RFP10N12L	TO-220	10	120	60	0.30
RFP10N15L	TO-220	10	150	60	0.30
•RFM12N08L	TO-3	12	80	100	0.20
•RFM12N10L	TO-3	12	100	100	0.20
•RFP12N08L	TO-220	12	80	75	0.20
•RFP12N10L	TO-220	12	100	75	0.20
RFM15N05L	TO-3	15	50	60	0.15
RFM15N06L	TO-3	15	60	60	0.15
RFP15N05L	TO-220	15	50	60	0.15
RFP15N06L	TO-220	15	60	60	0.15

• Available from stock. Others available second half of 1984.

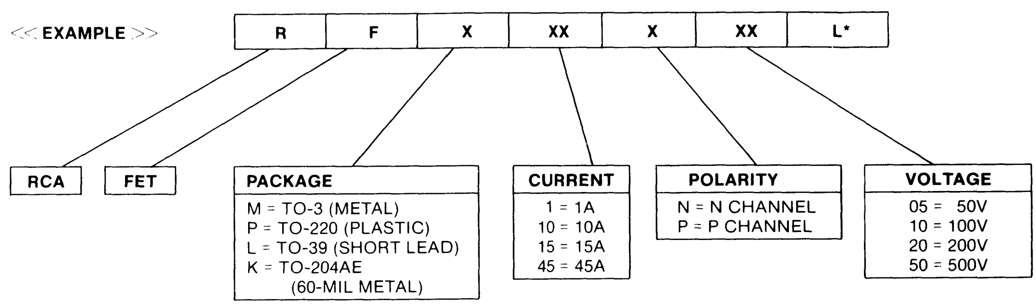
Special Features

- 5-Volt Gate Drive
- Compatible with QMOS Logic Circuits
- Compatible with Automotive Drive Requirements

Packaged Devices and Chips

The RCA power MOSFET product line currently includes more than 150 types. A coded type number indicates the current and voltage ratings, identifies n- or p-channel types, and specifies the package for RCA power MOSFETs. The devices are supplied in three basic package styles: TO-39, TO-220AB, and TO-3/TO-204MA/TO-204AE. Power MOSFET chips are also available for use in hybrid circuits. Chips may be purchased either in wafer form or as separate die.

RCA Power MOSFET Nomenclature System



*An "L" suffix is added for Logic-Level FETS.

Handling Precautions for MOSFETs

Insulated-Gate Field-Effect Transistors (MOSFETs) are susceptible to gate-insulation damage by the electrostatic discharge of energy through the devices. When handling a MOSFET, care should be exercised to assure that the static charge built in the handler's body capacitance is not discharged through the device. With proper handling and application procedures, however, MOS transistors are currently being extensively used in production by numerous equipment manufacturers in military, industrial, and consumer applications, with virtually no damage problems due to to electrostatic discharge.

MOSFETs can be handled safely if the following basic precautions are taken:

1. Prior to assembly into a circuit, all leads should be kept shorted together either by the use of metal shorting springs or by the insertion into conductive material such as "ECCOSORB* LD26" or equivalent.
2. When devices are removed by hand from their carriers, the hand being used should be grounded by any suitable means — for example, with a metallic wristband.
3. Tips of soldering irons should be grounded.
4. Devices should never be inserted into or removed from circuits with power on.
5. Gate Voltage Rating — Never exceed the gate-voltage rating of ±10 V•. Exceeding the rates V_{GS} can result in permanent damage to the oxide layer in the gate region.
6. Gate Termination — The gates of these devices are essentially capacitors. Circuits that leave the gate open-circuited or floating should be avoided. These conditions can result in turn-on of the devices due to voltage build-up on the input capacitor due to leakage currents or pickup.
7. Gate Protection — These devices do not have an internal monolithic zener diode from gate to source. If gate protection is required, an external zener is recommended.

*Trademark Emerson and Cumming, Inc.

• ±20 V for standard power MOSFETs.

RFL1N08L, RFL1N10L, RFP2N08L, RFP2N10L

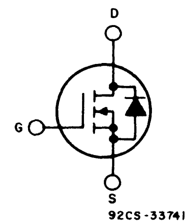
File Number **1510**

N-Channel Logic Level Power Field-Effect Transistors (L^2 FET)

1 and 2 A, 80 V and 100 V

$r_{DS(on)}$: 1.25 Ω and 1.4 Ω

Features:
- *Design optimized for 5 volt gate drive*
- *Can be driven directly from Q-MOS, N-MOS, TTL Circuits*
- *Compatible with automotive drive requirements*
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-CHANNEL ENHANCEMENT MODE

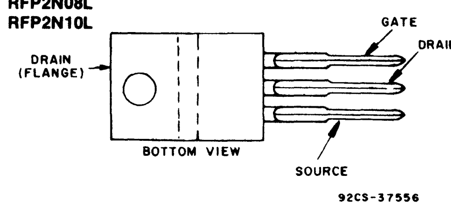
The RFL1N08L and RFL1N10L and the RFP2N08L and RFP2N10L are n-channel enhancement-mode silicon-gate power field-effect transistors specifically designed for use with logic level (5 volt) driving sources in applications such as programmable controllers, automotive switching, and solenoid drivers. This performance is accomplished through a special gate oxide design which provides full rated conduction at gate biases in the 3-5 volt range, thereby facilitating true on-off power control directly from logic circuit supply voltages.

The RFL-series types are supplied in the JEDEC TO-39 metal package and the RFP-series types in the JEDEC TO-220AB plastic package.

The RFL and RFP series were formerly RCA developmental numbers TA9524 and TA9525.

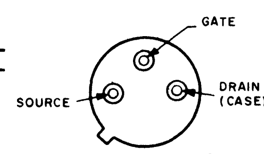
TERMINAL DESIGNATIONS

RFP2N08L
RFP2N10L



JEDEC TO-220AB
(See dimensional outline "N".)

RFL1N08L
RFL1N10L



JEDEC TO-39
(See dimensional outline "F".)

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFL1N08L	RFL1N10L		RFP2N08L	RFP2N10L	
DRAIN-SOURCE VOLTAGE	V_{DSS}	80	100		80	100	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ)	V_{DGR}	80	100		80	100	V
GATE-SOURCE VOLTAGE	V_{GS}			±10			V
DRAIN CURRENT, RMS Continuous	I_D	1	1		2	2	A
Pulsed	I_{DM}			5			A
POWER DISSIPATION @ T_C=25°C	P_T	8.33	8.33		25	25	W
Derate above T_C=25°C		0.0667	0.0667		0.2	0.2	W/°C
OPERATING AND STORAGE TEMPERATURE	T_J, T_{stg}			-55 to +150			°C

RFL1N08L, RFL1N10L, RFP2N08L, RFP2N10L

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS		LIMITS RFL1N08L RFP2N08L MIN.	MAX.	RFL1N10L RFP2N10L MIN.	MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DDS}	I_D=1 mA V_{GS}=0		80	—	100	—	V
Gate Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS} I_D=1 mA		1	2	1	2	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=65 V		—	1	—	—	μA
		V_{DS}=80 V		—	—	—	1	
		T_C=125° C V_{DS}=65 V		—	50	—	—	
		V_{DS}=80 V		—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±10 V V_{DS}=0		—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=1 A	RFP	—	1.25	—	1.25	V
		V_{GS}=5 V	RFL	—	1.4	—	1.4	
		I_D=2 A	RFP	—	3.0	—	3.0	
		V_{GS}=5 V	RFL	—	3.3	—	3.3	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=1 A	RFP	—	1.25	—	1.25	Ω
		V_{GS}=5 V	RFL	—	1.4	—	1.4	
Forward Transconductance	g_{fs}[a]	V_{DS}=15 V I_D=1 A		1400 (typ)		1400 (typ)		mmho
Input Capacitance	C_{iss}	V_{DS}=25 V		—	200	—	200	pF
Output Capacitance	C_{oss}	V_{GS}=0 V		—	80	—	80	
Reverse-Transfer Capacitance	C_{rss}	f=0.1 MHz		—	20	—	20	
Turn-On Delay Time	$t_d(on)$	V_{DD}=50 V		10(typ)	25	10(typ)	25	ns
Rise Time	t_r	I_D=1 A R_{gen}=∞		15(typ)	45	15(typ)	45	
Turn-Off Delay Time	$t_d(off)$	R_{gs}=6.25 Ω		25(typ)	45	25(typ)	45	
Fall Time	t_f	V_{GS}=5 V		20(typ)	25	20(typ)	25	
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFL1N08L, RFL1N10L		—	15	—	15	°C/W
		RFP2N08L, RFP2N10L		—	5	—	5	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFL1N08L RFP2N08L MIN.	MAX.	RFL1N10L RFP2N10L MIN.	MAX.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD}=1 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=2 A d_{IF}/d_t=50 A/μs	100(typ)		100(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFL1N08L, RFL1N10L, RFP2N08L, RFP2N10L

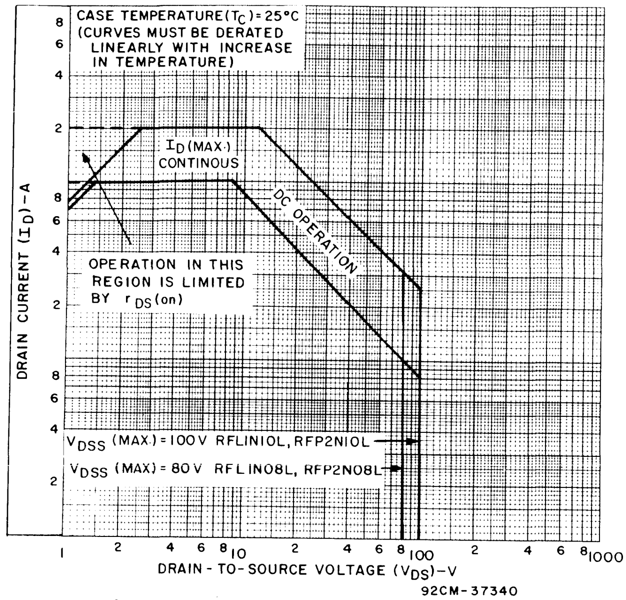


Fig. 1 — Maximum operating areas for all types.

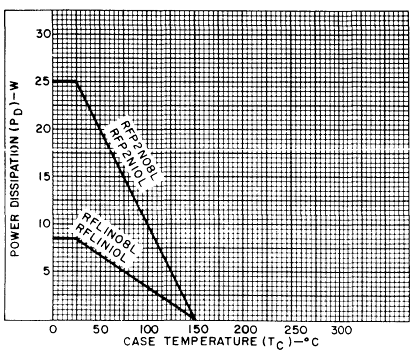


Fig. 2 — Power dissipation vs. temperature derating curve for all types.

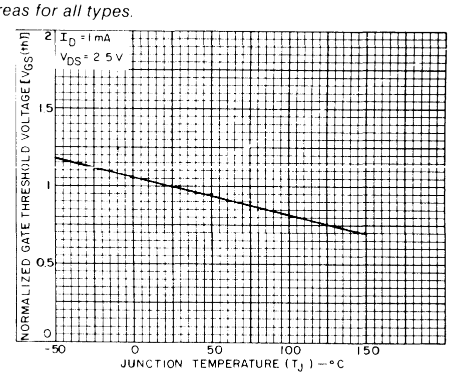


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

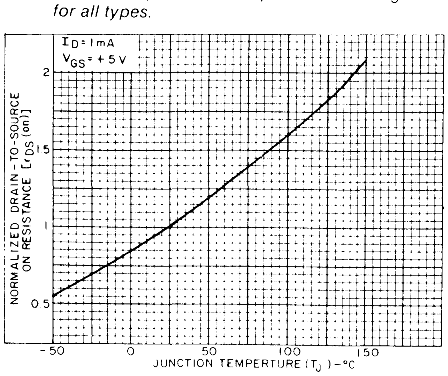


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

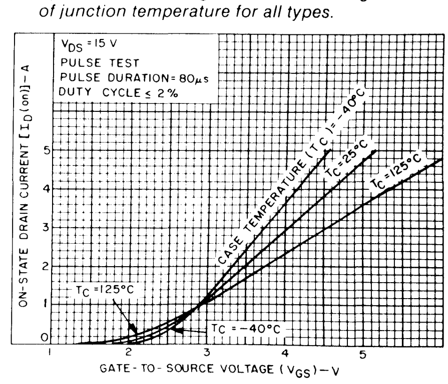


Fig. 5 — Typical transfer characteristics for all types.

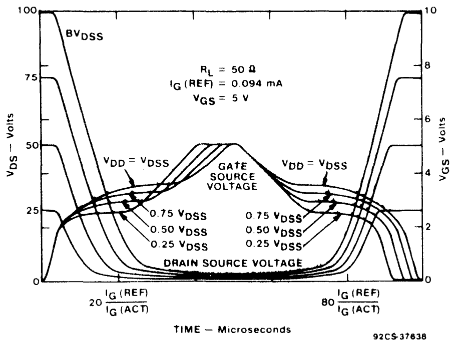


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

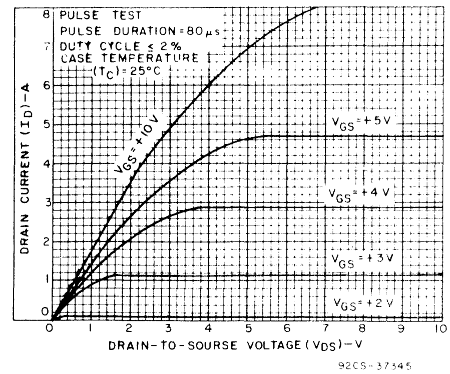


Fig. 7 — Typical saturation characteristics for all types.

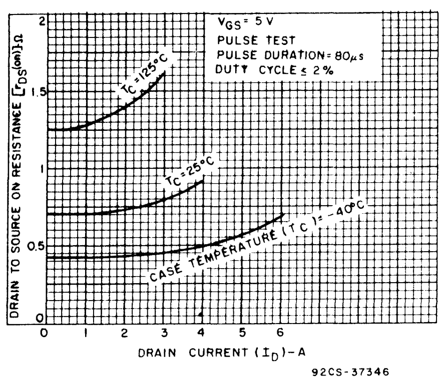


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

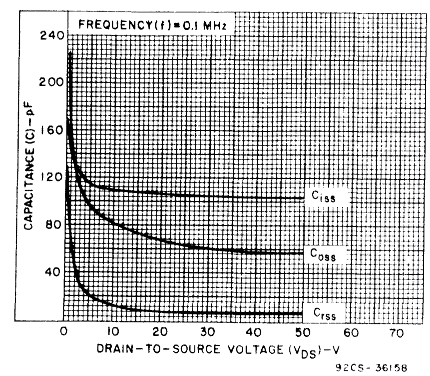


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

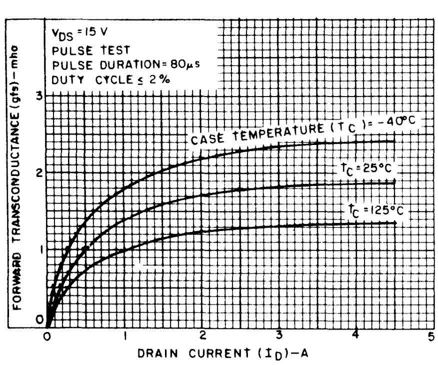


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

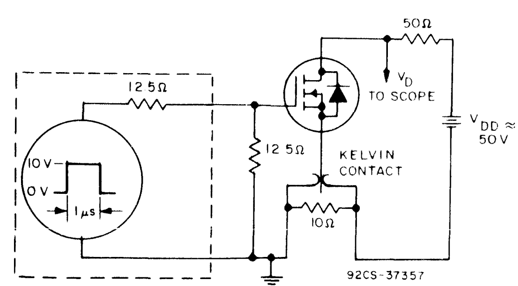


Fig. 11 — Switching Time Test Circuit.

RFL1N12L, RFL1N15L, RFP2N12L, RFP2N15L File Number **1513**

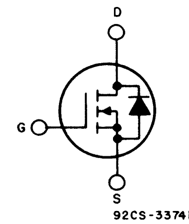
N-Channel Logic Level Power Field-Effect Transistors (L^2 FET)

1 and 2 A, 120 V and 150 V

$r_{DS(on)}$: 2 Ω and 2.15 Ω

Features:

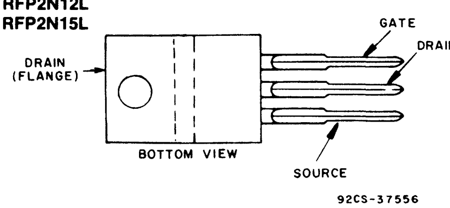
- *Design optimized for 5 volt gate drive*
- *Can be driven directly from Q-MOS, N-MOS, TTL Circuits*
- *Compatible with automotive drive requirements*
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-CHANNEL ENHANCEMENT MODE

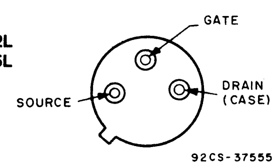
TERMINAL DESIGNATIONS

RFP2N12L
RFP2N15L



JEDEC TO-220AB
(See dimensional outline "N".)

RFL1N12L
RFL1N15L



JEDEC TO-39
(See dimensional outline "F".)

The RFL1N12L and RFL1N15L and the RFP2N12L and RFP2N15L are n-channel enhancement-mode silicon-gate power field-effect transistors specifically designed for use with logic level (5 volt) driving sources in applications such as programmable controllers, automotive switching, and solenoid drivers. This performance is accomplished through a special gate oxide design which provides full rated conduction at gate biases in the 3-5 volt range, thereby facilitating true on-off power control directly from logic circuit supply voltages.

The RFL-series types are supplied in the JEDEC TO-39 metal package and the RFP-series types in the JEDEC TO-220AB plastic package.

The RFL and RFP series were formerly RCA developmental numbers TA9528 and TA9529.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

	RFL1N12L	RFL1N15L		RFP1N12L	RFP2N15L	
DRAIN-SOURCE VOLTAGE .... V_{DSS}	120	150		120	150	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ) .... V_{DGR}	120	150		120	150	V
GATE-SOURCE VOLTAGE .... V_{GS}			±10			V
DRAIN CURRENT, RMS Continuous ...... I_D	1	1		2	2	A
Pulsed .... I_{DM}			5			A
POWER DISSIPATION @ T_C=25° C .... P_T	8.33	8.33		25	25	W
Derate above T_C=25° C	0.0667	0.0667		0.2	0.2	W/° C
OPERATING AND STORAGE TEMPERATURE .... T_j, T_{stg}			-55 to +150			° C

RFL1N12L, RFL1N15L, RFP2N12L, RFP2N15L

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS		LIMITS RFL1N12L RFP2N12L MIN.	MAX.	LIMITS RFL1N15L RFP2N15L MIN.	MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DDS}	I_D=1 mA V_{GS}=0		120	—	150	—	V
Gate Threshold Voltage	$V_{GS}(th)$	$V_{GS}=V_{DS}$ I_D=2 mA		1	2	1	2	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=100 V		—	1	—	—	μA
		V_{DS}=120 V		—	—	—	1	
		T_C=125° C V_{DS}=100 V		—	50	—	—	
		V_{DS}=120 V		—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	$V_{GS}=\pm10$ V V_{DS}=0		—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=1 A	RFP	—	2	—	2	V
		V_{GS}=5 V	RFL	—	2.15	—	2.15	
		I_D=2 A	RFP	—	6	—	6	
		V_{GS}=5 V	RFL	—	6.3	—	6.3	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=1 A	RFP	—	2	—	2	Ω
		V_{GS}=5 V	RFL	—	2.15	—	2.15	
Forward Transconductance	g_{fs}[a]	V_{DS}=15 V I_D=1 A		1400 (typ)		1400 (typ)		mmho
Input Capacitance	C_{iss}	V_{DS}=25 V		—	200	—	200	pF
Output Capacitance	C_{oss}	V_{GS}=0 V		—	80	—	80	
Reverse-Transfer Capacitance	C_{rss}	f=0.1 MHz		—	20	—	20	
Turn-On Delay Time	$t_d(on)$	V_{DD}=75 V		10(typ)	25	10(typ)	25	ns
Rise Time	t_r	I_D=1 A $R_{gen}=\infty$		10(typ)	45	10(typ)	45	
Turn-Off Delay Time	$t_d(off)$	R_{gs}=6.25 Ω		24(typ)	45	24(typ)	45	
Fall Time	t_f	V_{GS}=5 V		20(typ)	25	20(typ)	25	
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFL1N12L, RFL1N15L		—	15	—	15	°C/W
		RFP2N12L, RFP2N15L		—	5	—	5	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFL1N12L RFP2N12L MIN.	MAX.	LIMITS RFL1N15L RFP2N15L MIN.	MAX.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD}=1 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=2 A d_{IF}/d_t=50 A/μs	150(typ)		150(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFL1N12L, RFL1N15L, RFP2N12L, RFP2N15L

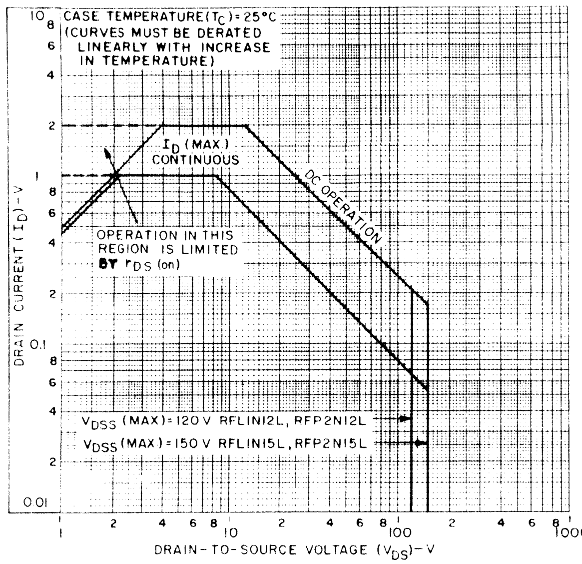


Fig. 1 — Maximum operating areas for all types.

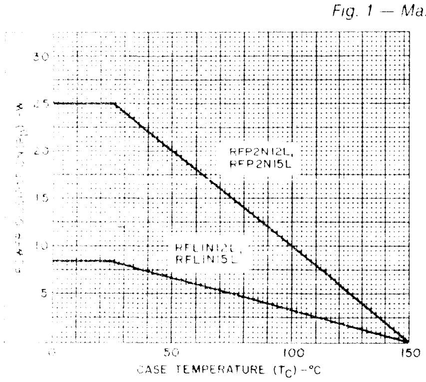


Fig. 2 — Power dissipation vs. case temperature derating curve for all types.

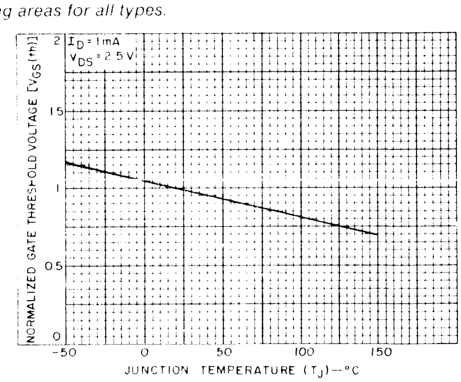


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

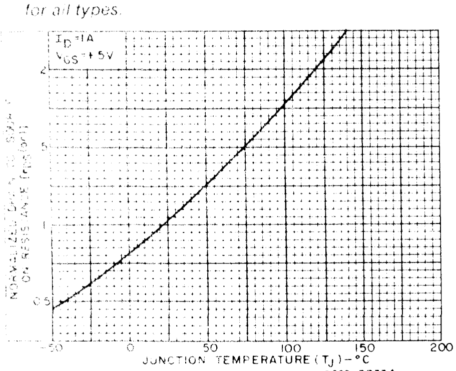


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

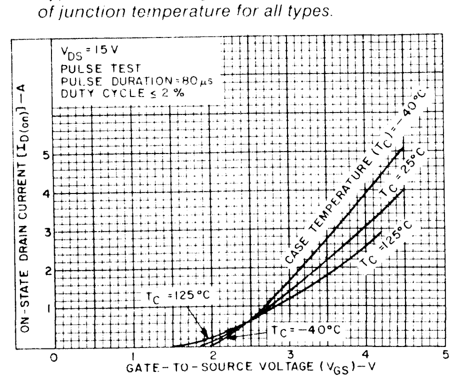


Fig. 5 — Typical transfer characteristics for all types.

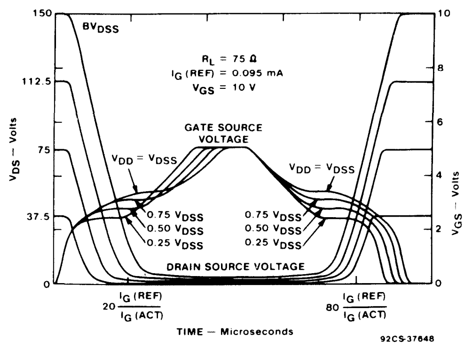


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

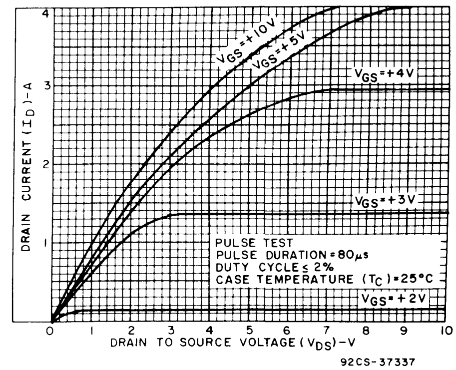


Fig. 7 — Typical saturation characteristics for all types.

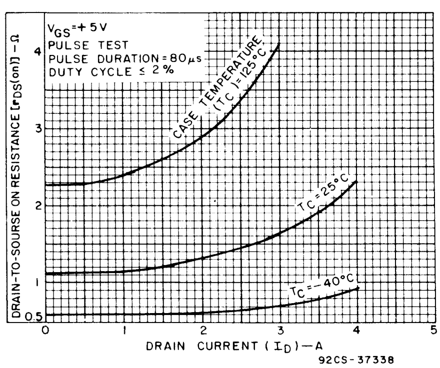


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

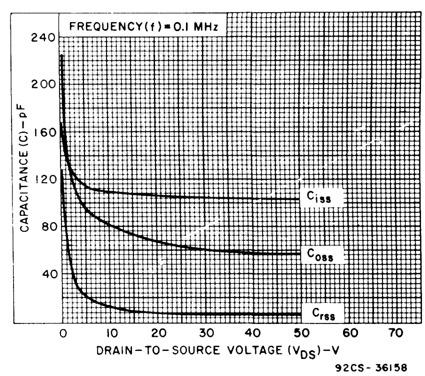


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

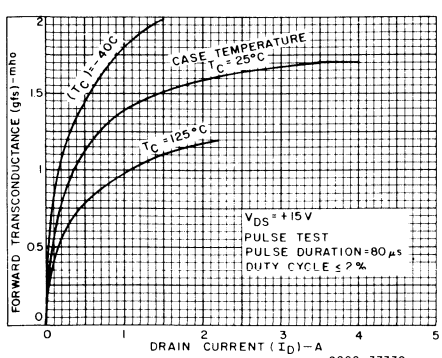


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

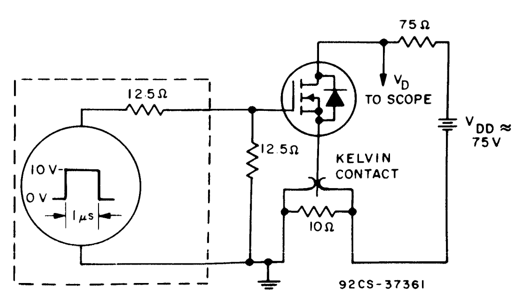


Fig. 11 — Switching Time Test Circuit.

RFL1N18L, RFL1N20L, RFP2N18L, RFP2N20L

File Number **1511**

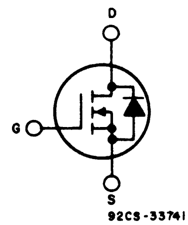
N-Channel Logic Level Power Field-Effect Transistors (L^2 FET)

1 and 2 A, 180 V and 200 V

$r_{DS(on)}$: 3.5 Ω and 3.65 Ω

Features:

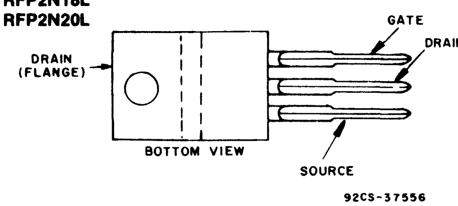
- *Design optimized for 5 volt gate drive*
- *Can be driven directly from Q-MOS, N-MOS, TTL Circuits*
- *Compatible with automotive drive requirements*
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-CHANNEL ENHANCEMENT MODE

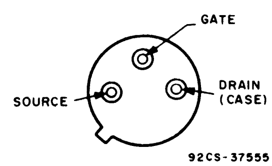
TERMINAL DESIGNATIONS

RFP2N18L
RFP2N20L



JEDEC TO-220AB
(See dimensional outline "N".)

RFL1N18L
RFL1N20L



JEDEC TO-39
(See dimensional outline "F".)

The RFL1N18L and RFL1N20L and the RFP2N18L and RFP2N20L are n-channel enhancement-mode silicon-gate power field-effect transistors specifically designed for use with logic level (5 volt) driving sources in applications such as programmable controllers, automotive switching, and solenoid drivers. This performance is accomplished through a special gate oxide design which provides full rated conduction at gate biases in the 3-5 volt range, thereby facilitating true on-off power control directly from logic circuit supply voltages.

The RFL-series types are supplied in the JEDEC TO-39 metal package and the RFP-series types in the JEDEC TO-220AB plastic package.

The RFL and RFP series were formerly RCA developmental numbers TA9532 and TA9533.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

	RFL1N18L	RFL1N20L		RFP2N18L	RFP2N20L	
DRAIN-SOURCE VOLTAGE .... V_{DSS}	180	200		180	200	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ) .... V_{DGR}	180	200		180	200	V
GATE-SOURCE VOLTAGE .... V_{GS}			±10			V
DRAIN CURRENT, RMS Continuous ...... I_D	1	1		2	2	A
Pulsed .... I_{DM}			4			A
POWER DISSIPATION @ T_C=25°C .... P_T	8.33	8.33		25	25	W
Derate above T_C=25°C	0.0667	0.0667		0.2	0.2	W/°C
OPERATING AND STORAGE TEMPERATURE .... T_j, T_{stg}			-55 to +150			°C

RFL1N18L, RFL1N20L, RFP2N18L, RFP2N20L

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25°C unless otherwise specified.*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS		LIMITS RFL1N18L RFP2N18L MIN.	MAX.	LIMITS RFL1N20L RFP2N20L MIN.	MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DDS}	I_D=1 mA, V_{GS}=0		180	—	200	—	V
Gate Threshold Voltage	$V_{GS}(th)$	$V_{GS}=V_{DS}$, I_D=1 mA		1	2	1	2	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=145 V		—	1	—	—	µA
		V_{DS}=160 V		—	—	—	1	µA
		T_C=125°C, V_{DS}=145 V		—	50	—	—	µA
		T_C=125°C, V_{DS}=160 V		—	—	—	50	µA
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±10 V, V_{DS}=0		—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=1 A, V_{GS}=5 V	RFP	—	3.5	—	3.5	V
			RFL	—	3.65	—	3.65	V
		I_D=2 A, V_{GS}=5 V	RFP	—	9	—	9	V
			RFL	—	9.3	—	9.3	V
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=1 A, V_{GS}=5 V	RFP	—	3.5	—	3.5	Ω
			RFL	—	3.65	—	3.65	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=15 V, I_D=1 A		1200 (typ)		1200 (typ)		mmho
Input Capacitance	C_{iss}	V_{DS}=25 V		—	200	—	200	pF
Output Capacitance	C_{oss}	V_{GS}=0 V		—	60	—	60	pF
Reverse-Transfer Capacitance	C_{rss}	f=0.1 MHz		—	20	—	20	pF
Turn-On Delay Time	$t_d(on)$	V_{DD}=100 V		10(typ)	25	10(typ)	25	ns
Rise Time	t_r	I_D=1 A, $R_{gen}=\infty$		10(typ)	30	10(typ)	30	ns
Turn-Off Delay Time	$t_d(off)$	R_{gs}=6.25 Ω		25(typ)	40	25(typ)	40	ns
Fall Time	t_f	V_{GS}=5 V		20(typ)	25	20(typ)	25	ns
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFL1N18L, RFL1N20L		—	15	—	15	°C/W
		RFP2N18L, RFP2N20L		—	5	—	5	°C/W

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFL1N18L RFP2N18L MIN.	MAX.	LIMITS RFL1N20L RFP2N20L MIN.	MAX.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD}=1 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=2 A, d_{IF}/d_t=50 A/µs	200(typ)		200(typ)		ns

[a]Pulsed: Pulse duration = 300 µs max., duty cycle = 2%.

RFL1N18L, RFL1N20L, RFP2N18L, RFP2N20L

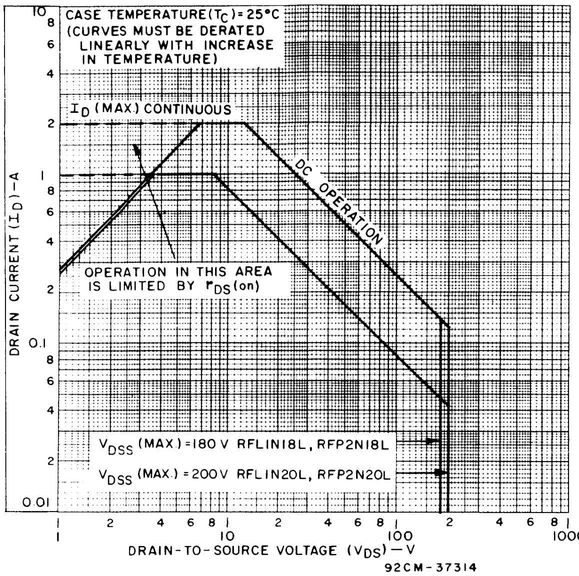


Fig. 1 — Maximum operating areas for all types.

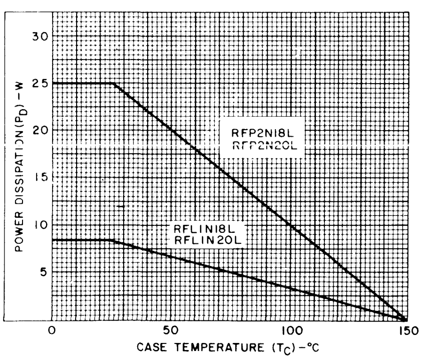


Fig. 2 — Power dissipation vs. temperature derating curve for all types.

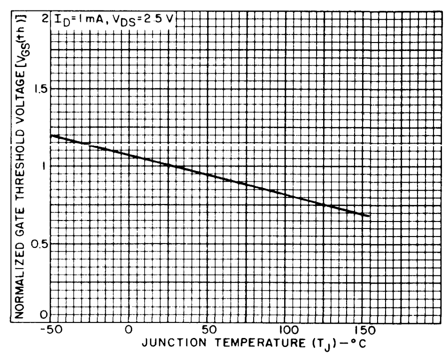


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

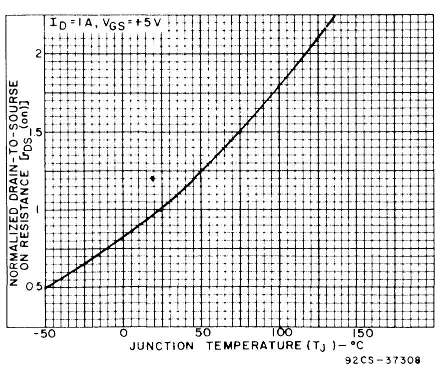


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

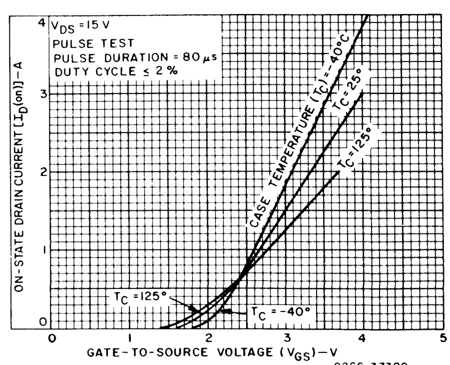


Fig. 5 — Typical transfer characteristics for all types.

RFL1N18L, RFL1N20L, RFP2N18L, RFP2N20L

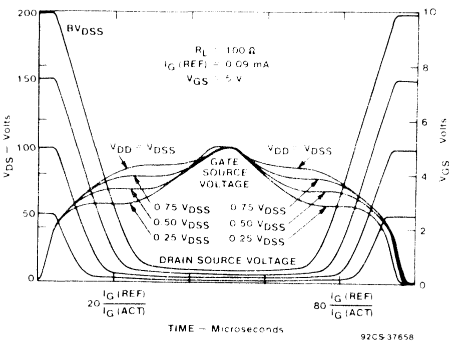


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

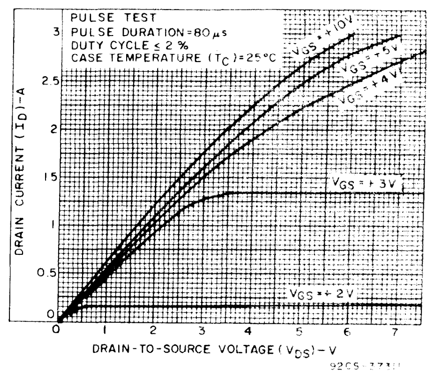


Fig. 7 — Typical saturation characteristics for all types.

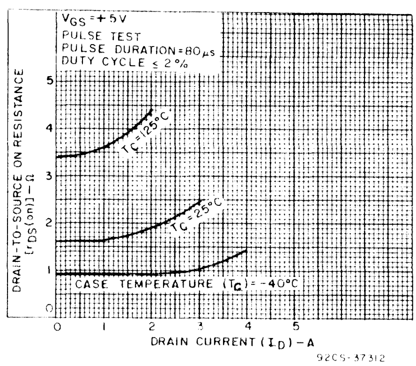


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

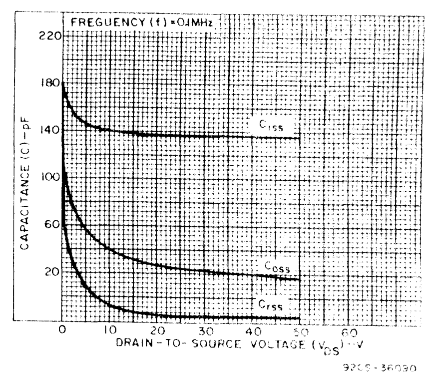


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

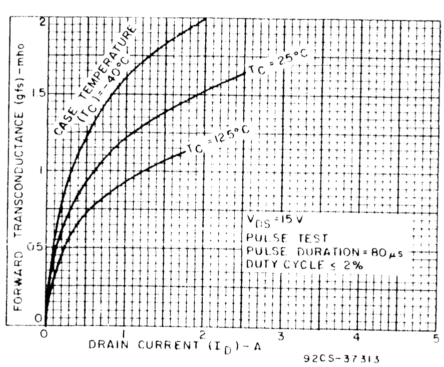


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

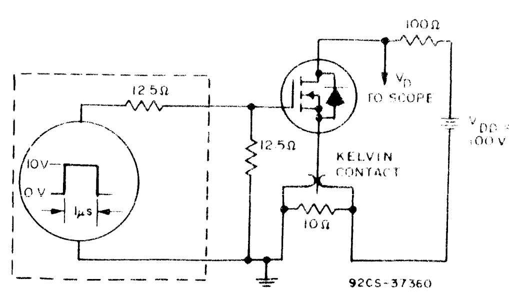


Fig. 11 — Switching Time Test Circuit

RFM8N18L, RFM8N20L, RFP8N18L, RFP8N20L

File Number **1514**

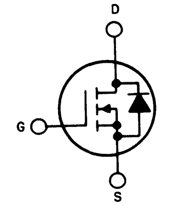
N-Channel Logic Level Power Field-Effect Transistors (L^2 FET)

8 A, 180 V and 200 V

$r_{DS(on)}$: 0.6 Ω

Features:

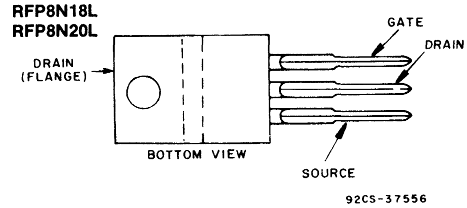
- *Design optimized for 5 volt gate drive*
- *Can be driven directly from Q-MOS, N-MOS, TTL Circuits*
- *Compatible with automotive drive requirements*
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-CHANNEL ENHANCEMENT MODE

TERMINAL DESIGNATIONS

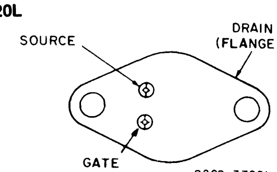
RFP8N18L
RFP8N20L



JEDEC TO-220AB

(See dimensional outline "N".)

RFM8N18L
RFM8N20L



JEDEC TO-204MA

(See dimensional outline "A".)

The RFM8N18L and RFM8N20L and the RFP8N18L and RFP8N20L are n-channel enhancement-mode silicon-gate power field-effect transistors specifically designed for use with logic level (5 volt) driving sources in applications such as programmable controllers, automotive switching, and solenoid drivers. This performance is accomplished through a special gate oxide design which provides full rated conduction at gate biases in the 3-5 volt range, thereby facilitating true on-off power control directly from logic circuit supply voltages.

The RFM-series types are supplied in the JEDEC TO-204MA steel package and the RFP-series types in the JEDEC TO-220AB plastic package.

The RFM and RFP series were formerly RCA developmental numbers TA9534 and TA9535.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

	RFM8N18L	RFM8N20L		RFP8N18L	RFP8N20L	
DRAIN-SOURCE VOLTAGE .... V_{DSS}	180	200		180	200	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ) .... V_{DGR}	180	200		180	200	V
GATE-SOURCE VOLTAGE .... V_{GS}			±10			V
DRAIN CURRENT, RMS Continuous ...... I_D			8			A
Pulsed .... I_{DM}			20			A
POWER DISSIPATION @ T_C=25° C .... P_T	75	75		60	60	W
Derate above T_C=25° C	0.6	0.6		0.48	0.48	W/° C
OPERATING AND STORAGE TEMPERATURE .... T_j, T_{stg}			-55 to +150			° C

RFM8N18L, RFM8N20L, RFP8N18L, RFP8N20L

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM8N18L RFP8N18L MIN.	MAX.	RFM8N20L RFP8N20L MIN.	MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DDS}	I_D=1 mA, V_{GS}=0	180	—	200	—	V
Gate Threshold Voltage	$V_{GS}(th)$	$V_{GS}=V_{DS}$, I_D=1 mA	1	2	1	2	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=145 V	—	1	—	—	μA
		V_{DS}=160 V	—	—	—	1	
		T_C=125° C, V_{DS}=145 V	—	50	—	—	
		T_C=125° C, V_{DS}=160 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	$V_{GS}=\pm10$ V, V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)^a$	I_D=4 A, V_{GS}=5 V	—	2.4	—	2.4	V
		I_D=8 A, V_{GS}=5 V	—	5.5	—	5.5	
Static Drain-Source On Resistance	$r_{DS}(on)^a$	I_D=4 A, V_{GS}=5 V	—	0.6	—	0.6	Ω
Forward Transconductance	g_{fs}^a	V_{DS}=10 V, I_D=4 A	5.9 (typ)		5.9 (typ)		mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	750	—	750	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	250	—	250	
Reverse-Transfer Capacitance	C_{rss}	f=0.1 MHz	—	70	—	70	
Turn-On Delay Time	$t_d(on)$	V_{DD}=100 V	15(typ)	45	15(typ)	45	ns
Rise Time	t_r	I_D=4 A	45(typ)	150	45(typ)	150	
Turn-Off Delay Time	$t_d(off)$	$R_{gen}=\infty$, R_{gs}=6.25 Ω	100(typ)	135	100(typ)	135	
Fall Time	t_f	V_{GS}=5 V	60(typ)	105	60(typ)	105	
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFM8N18L, RFM8N20L	—	1.67	—	1.67	°C/W
		RFP8N18L, RFP8N20L	—	2.083	—	2.083	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM8N18L RFP8N18L MIN.	MAX.	RFM8N20L RFP8N20L MIN.	MAX.	UNITS
Diode Forward Voltage	V_{SD}^a	I_{SD}=4 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A, d_{IF}/d_t=100 A/μs	250(typ)		250(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM8N18L, RFM8N20L, RFP8N18L, RFP8N20L

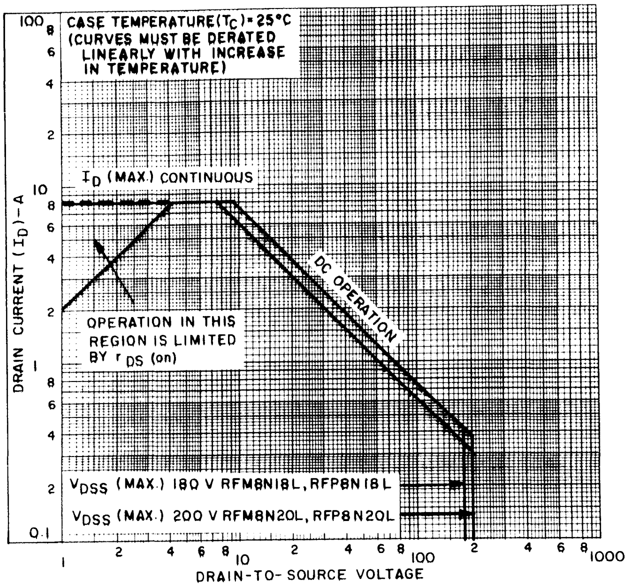


Fig. 1 — Maximum safe operating areas for all types.

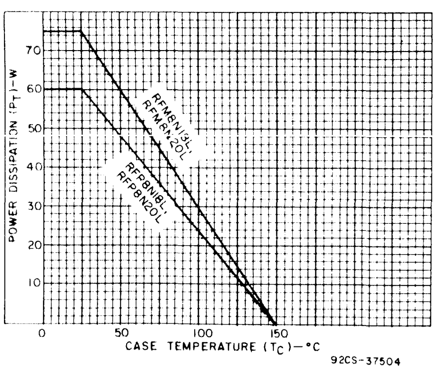


Fig. 2 — Power vs. temperature derating curve for all types.

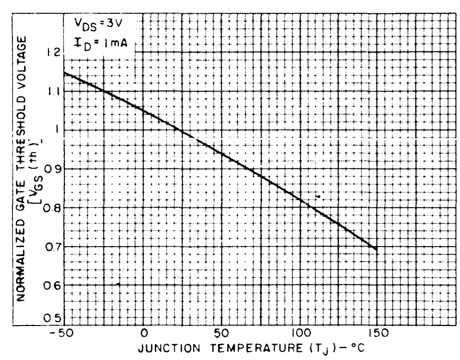


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

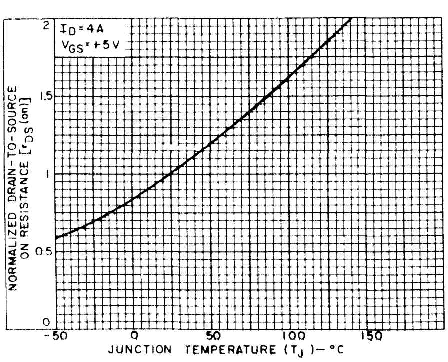


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

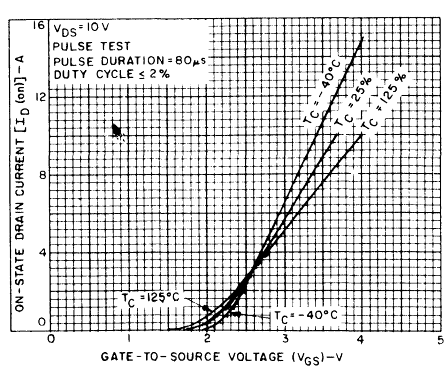


Fig. 5 — Typical transfer characteristics for all types.

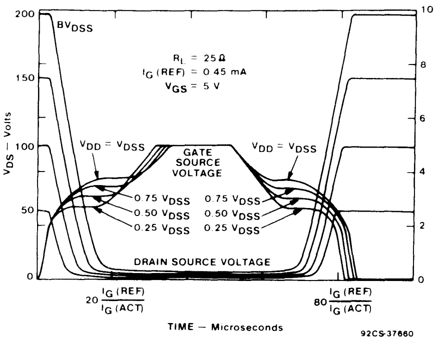


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

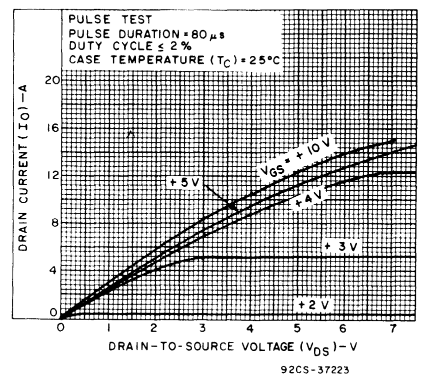


Fig. 7 — Typical saturation characteristics for all types.

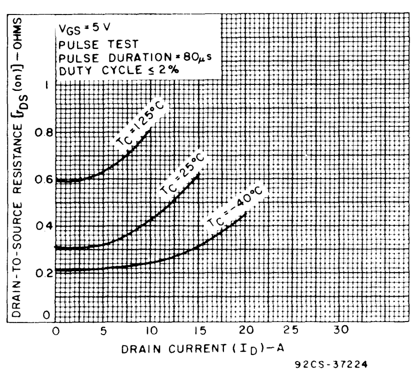


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

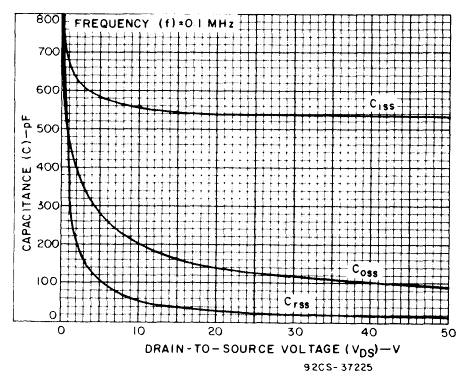


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

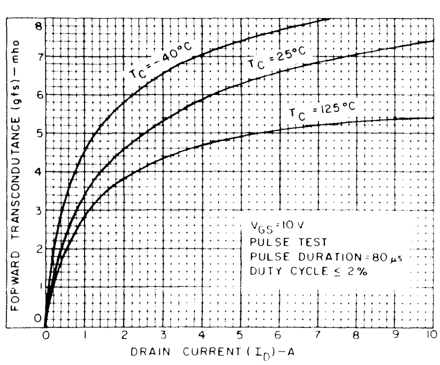


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

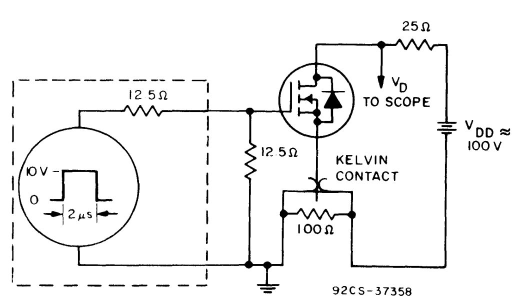


Fig. 11 — Switching Time Test Circuit.

RFM12N08L, RFM12N10L, RFP12N08L, RFP12N10L

File Number **1512**

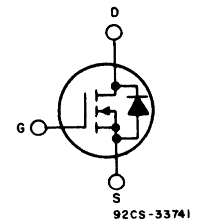
N-Channel Logic Level Power Field-Effect Transistors (L² FET)

12 A, 80 V and 100 V

$r_{DS(on)}$: 0.2 Ω

Features:

- *Design optimized for 5 volt gate drive*
- *Can be driven directly from Q-MOS, N-MOS, TTL Circuits*
- *Compatible with automotive drive requirements*
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-CHANNEL ENHANCEMENT MODE

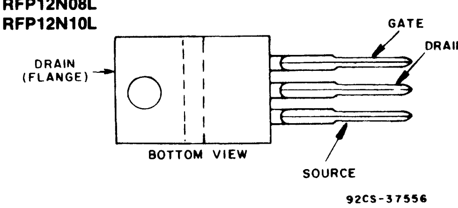
The RFM12N08L and RFM12N10L and the RFP12N08L and RFP12N10L are n-channel enhancement-mode silicon-gate power field-effect transistors specifically designed for use with logic level (5 volt) driving sources in applications such as programmable controllers, automotive switching, and solenoid drivers. This performance is accomplished through a special gate oxide design which provides full rated conduction at gate biases in the 3-5 volt range, thereby facilitating true on-off power control directly from logic circuit supply voltages.

The RFM-series types are supplied in the JEDEC TO-204MA steel package and the RFP-series types in the JEDEC TO-220AB plastic package.

The RFM and RFP series were formerly RCA developmental numbers TA9526 and TA9527.

TERMINAL DESIGNATIONS

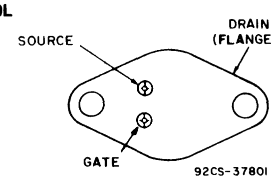
RFP12N08L
RFP12N10L



JEDEC TO-220AB

(See dimensional outline "N".)

RFM12N08L
RFM12N10L



JEDEC TO-204MA

(See dimensional outline "A".)

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFM12N08L	RFM12N10L		RFP12N08L	RFP12N10L	
DRAIN-SOURCE VOLTAGE	V_{DSS}	80	100		80	100	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ)	V_{DGR}	80	100		80	100	V
GATE-SOURCE VOLTAGE	V_{GS}			±10			V
DRAIN CURRENT, RMS Continuous	I_D			12			A
Pulsed	I_{DM}			30			A
POWER DISSIPATION @ T_C=25° C	P_T	75	75		60	60	W
Derate above T_C=25° C		0.6	0.6		0.48	0.48	W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}			-55 to +150			°C

RFM12N08L, RFM12N10L, RFP12N08L, RFP12N10L

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM12N08L RFP12N08L MIN.	MAX.	RFM12N10L RFP12N10L MIN.	MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DDS}	I_D=1 mA V_{GS}=0	80	—	100	—	V
Gate Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS} I_D=1 mA	1	2	1	2	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=65 V	—	1	—	—	μA
		V_{DS}=80 V	—	—	—	1	
		T_C=125° C V_{DS}=65 V	—	50	—	—	
		V_{DS}=80 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±10 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=6 A V_{GS}=5 V	—	1.2	—	1.2	V
		I_D=12 A V_{GS}=5 V	—	3.3	—	3.3	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=6 A V_{GS}=5 V	—	0.2	—	0.2	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V I_D=6 A	7 (typ)		7 (typ)		mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	750	—	750	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	325	—	325	
Reverse-Transfer Capacitance	C_{rss}	f=0.1 MHz	—	100	—	100	
Turn-On Delay Time	$t_d(on)$	V_{DD}=50 V	15(typ)	50	15(typ)	50	ns
Rise Time	t_r	I_D=6 A	70(typ)	150	70(typ)	150	
Turn-Off Delay Time	$t_d(off)$	R_{gen}=∞ R_{gs}=6.25 Ω	100(typ)	130	100(typ)	130	
Fall Time	t_f	V_{GS}=5 V	80(typ)	150	80(typ)	150	
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFM12N08L, RFM12N10L	—	1.67	—	1.67	°C/W
		RFP12N08L, RFP12N10L	—	2.083	—	2.083	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM12N08L RFP12N08L MIN.	MAX.	RFM12N10L RFP12N10L MIN.	MAX.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD}=6 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A d_{IF}/d_t=100 A/μs	150(typ)		150(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM12N08L, RFM12N10L, RFP12N08L, RFP12N10L

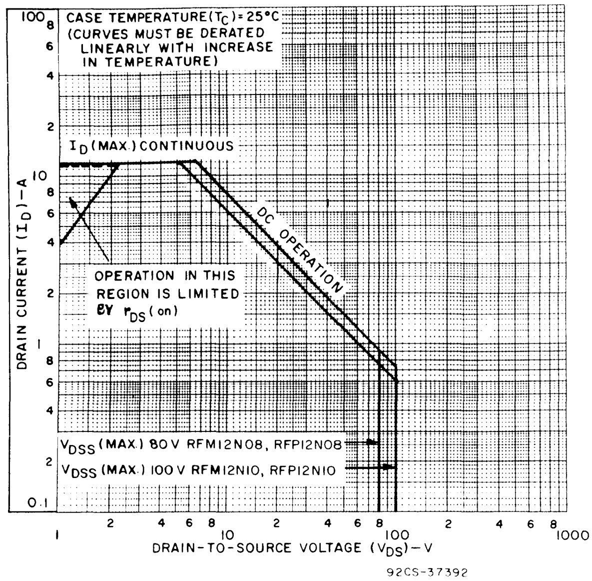


Fig. 1 — Maximum operating areas for all types.

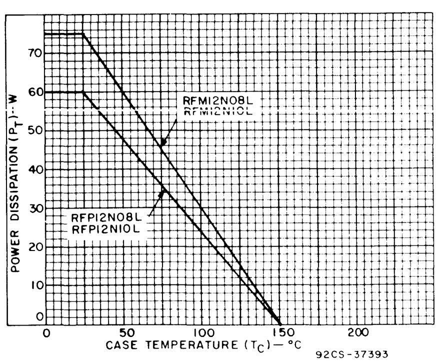


Fig. 2 — Power dissipation vs. temperature derating curve for all types.

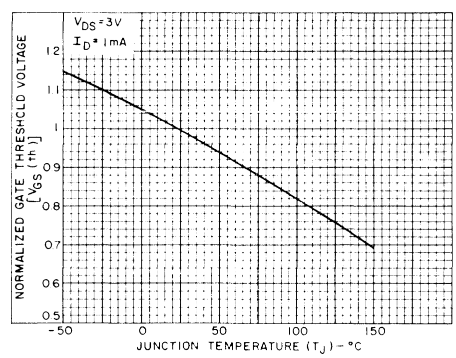


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

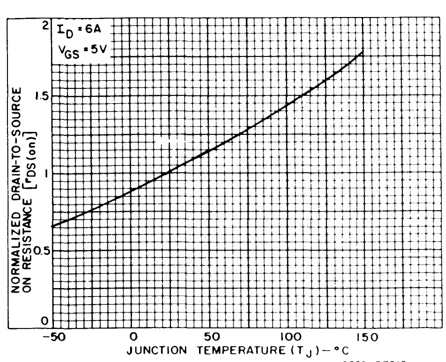


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

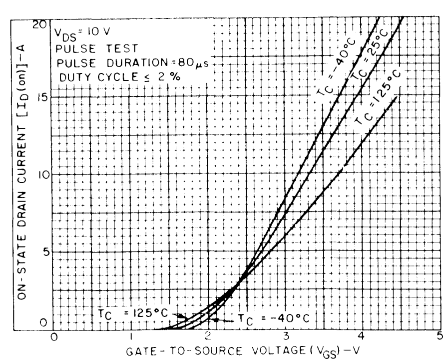


Fig. 5 — Typical transfer characteristics for all types.

RFM12N08L, RFM12N10L, RFP12N08L, RFP12N10L

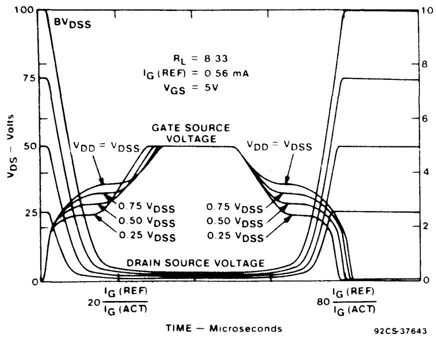


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

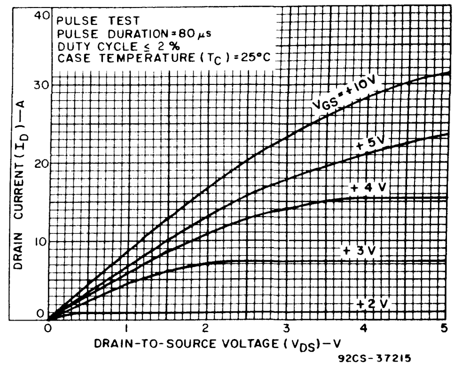


Fig. 7 — Typical saturation characteristics for all types.

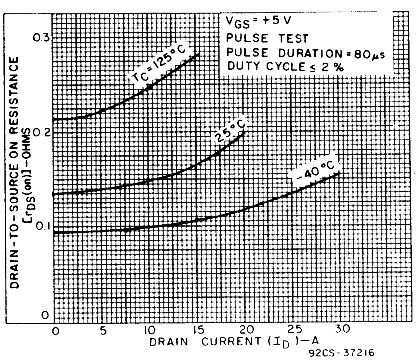


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

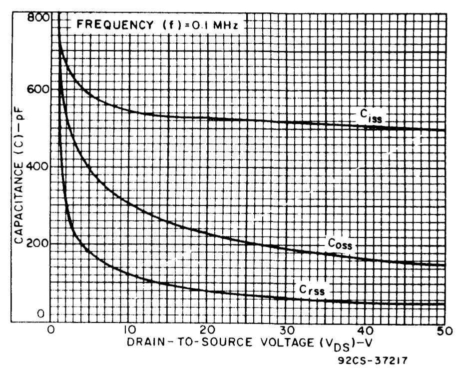


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

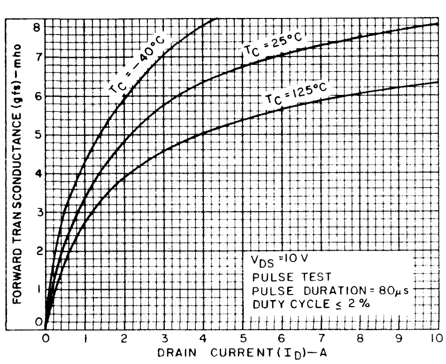


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

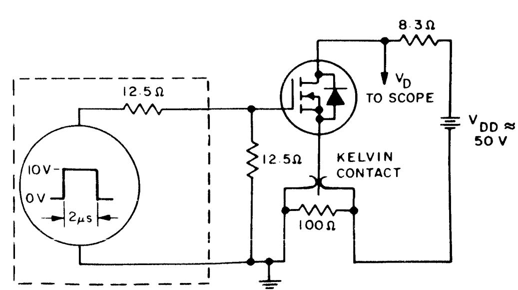


Fig. 11 — Switching Time Test Circuit.

Power MOSFETs

Technical Data

Power MOSFETs

RCA power MOS field-effect transistors offer unique features that make them especially useful in a wide variety of power-switching applications at frequencies up to several hundred kilohertz. Innovative design techniques and advanced processing technology are used to produce these state-of-the-art power switching devices. The RCA power MOSFET line includes the standard line of power MOSFETs, a newly announced line of low-threshold FETs, called logic-level field-effect transistors, or more simply, L^2FETS, and a series of conductivity-modulated FETs, called COMFETs, that considerably extend the voltage and current capabilities of the power MOSFET technology.

Because of its electrically isolated gate, a MOSFET can be described as a high-input-impedance, voltage-controlled device. As a majority-carrier semiconductor, a MOSFET stores no charge, and so can switch fast, faster than a bipolar device. But majority-carrier semiconductors also become more resistive as temperature increases. This effect, brought about by a phenomenon called carrier mobility (where mobility is a term that defines the average velocity of a carrier in terms of the electrical field imposed on it) causes the individual cells of the MOSFET to become more resistive at elevated temperatures and, therefore, makes the over-all MOSFET much less susceptible to the on-chip, localized thermal-runaway problems experienced by bipolar devices.

RCA power MOSFETs are available in both n and p-channel enhancement-mode types (L^2FETs are currently available in n-type only) with drain-current (I_{DS}) ratings from 1 to 45 amperes, drain-to-source voltage (V_{DS}) ratings of 50 to 500 volts, and switching times in the nanosecond range. Additional application advantages are offered by exceptionally low drain-to-source on resistances, r_{DS}(on), excellent thermal stability, and safe-operating-area ratings that are limited only by the dissipation capabilities of the devices.

Features

- **Fast switching speeds and low switching losses, both of which are independent of temperature.**
- **No storage time and, thus, no temperature-dependent delay times.**
- **High resistance to thermal runaway.**
- **Simple drive circuitry.**
- **Safe operating area limited only by device dissipation ratings.**
- **Stable gain and switching response over a wide temperature range.**

RCA POWER MOSFET NUMBERING SYSTEM

<<EXAMPLE>> R C A / F E T / X / XX / X / XX

PACKAGE	CURRENT	POLARITY	VOLTAGE
M=TO-3 (METAL)	1=1A	N=N CHAN	05= 50V
P=TO-220 (PLASTIC)	10=10A	P=P CHAN	10=100V
L=TO-39 (SHORT LEAD)	15=15A		20=200V
K=TO-204AE (60 MIL METAL)	42=42A		50=500V

Note:
For a detailed explanation of Power MOSFET Switching Characteristics, refer to page 434.

High-Reliability Power MOSFETs

RCA has developed an aggressive program to qualify power MOSFETs to MIL-S-19500. This plan includes qualification to the TXV level. This program has two parts, (a) a plan to qualify RCA devices to existing QPL specifications, and (b) a plan to proprose new QPL types to fill "product holes" in the existing MIL type matrix.

Authorization has already been received from DESC for RCA to generate data for qualification of types 2N6764 and 2N6766. This program is well underway and we anticipate qualification from DESC in June 1984.

Also, in the plan are seven additional RCA candidates for types already on the QPL, four original RCA QPL submissions on 60-volt N-channel types, four P-channel 100-V types and six logic-level N-channel types for 60-V, 100-V, and 200-V applications.

In addition to planned QPL types, RCA will offer high-reliability custom selections of all hermetic Power MOSFETs.

Power MOSFETs in TO-39 Package

TYPE	CHANNEL	I_D(A)	V_{DSS}	$r_{DS(on)}$
50V — 100 V				
RFL1N08	N	1.0	80	1.25
RFL1N10	N	1.0	100	1.25
*RFL1P08	P	1.0	80	3.50
*RFL1P10	P	1.0	100	3.50
RFL2N05	N	2.0	50	0.80
RFL2N06	N	2.0	60	0.80
120V — 200V				
RFL1N12	N	1.0	120	2.00
RFL1N15	N	1.0	150	2.00
RFL1N18	N	1.0	180	3.00
RFL1N20	N	1.0	200	3.00
RFL4N12	N	4.0	120	0.30
RFL4N15	N	4.0	150	0.30

*Planned for second half of 1984.

Power MOSFETs in TO-3 Package

TYPE	CHANNEL	I_D(A)	V_{DSS}	$r_{DS(on)}$
50V — 100 V				
RFM6P08	P	6.0	80	0.60
RFM6P10	P	6.0	100	0.60
RFM8P08	P	8.0	80	0.40
RFM8P10	P	8.0	100	0.40
IRF132	N	12.0	100	0.25
IRF133	N	12.0	60	0.25
RFM12N08	N	12.0	80	0.20
RFM12N10	N	12.0	100	0.20
RFM12P08	P	12.0	80	0.30
RFM12P10	P	12.0	100	0.30
IRF130	N	14.0	100	0.18
IRF131	N	14.0	60	0.18
RFM15N05	N	15.0	50	0.15
RFM15N06	N	15.0	60	0.15
RFM18N08	N	18.0	80	0.12
RFM18N10	N	18.0	100	0.12
RFK25P08	P	25.0	80	0.20
RFK25P10	P	25.0	100	0.20
RFM25N05	N	25.0	50	.085
RFM25N06	N	25.0	60	.085
RFK35N08	N	35.0	80	0.06
RFK35N10	N	35.0	100	0.06
RFK45N05	N	45.0	50	0.04
RFK45N06	N	45.0	60	0.04
120V — 200V				
RFM5P12	P	5.0	120	1.00
RFM5P15	P	5.0	150	1.00
RFM8N18	N	8.0	180	0.50
RFM8N20	N	8.0	200	0.50
RFM10N12	N	10.0	120	0.30
RFM10N15	N	10.0	150	0.30
*RFM10P12	P	10.0	120	0.50
*RFM10P15	P	10.0	150	0.50
RFM12N18	N	12.0	180	0.25
RFM12N20	N	12.0	200	0.25
RFM15N12	N	15.0	120	0.15
RFM15N15	N	15.0	150	0.15
IRF252	N	25.0	150	0.12
RFK25N18	N	25.0	180	0.15
RFK25N20	N	25.0	200	0.15
IRF251	N	30.0	150	.085
RFK30N12	N	30.0	120	.085
RFK30N15	N	30.0	150	.085
350V — 500V				
IRF422	N	2.0	500	4.00
IRF423	N	2.0	450	4.00
IRF420	N	2.5	500	3.00
IRF421	N	2.5	450	3.00
RFM3N45	N	3.0	450	3.00
RFM3N50	N	3.0	500	3.00
RFM4N35	N	4.0	350	2.00
RFM4N40	N	4.0	400	2.00
RFM6N45	N	6.0	450	1.50
RFM6N50	N	6.0	500	1.50
*RFM7N35	N	7.0	350	1.00
*RFM7N40	N	7.0	400	1.00
RFK10N45	N	10.0	450	0.85
RFK10N50	N	10.0	500	0.85
RFK12N35	N	12.0	350	0.50
RFK12N40	N	12.0	400	0.50

*Planned for second half of 1984.

Power MOSFETs in TO-220 Package

TYPE	CHANNEL	I_D(A)	V_{DSS}	$r_{DS(on)}$
50V — 100 V				
RFP2N08	N	2.0	80	1.25
RFP2N10	N	2.0	100	1.25
*RFP2P08	P	2.0	80	3.50
*RFP2P10	P	2.0	100	3.50
IRF512	N	3.5	100	0.80
IRF513	N	3.5	60	0.80
IRF510	N	4.0	100	0.60
IRF511	N	4.0	60	0.60
RFP4N05	N	4.0	50	0.80
RFP4N06	N	4.0	60	0.80
RFP6P08	P	6.0	80	0.60
RFP6P10	P	6.0	100	0.60
IRF522	N	7.0	100	0.40
IRF523	N	7.0	60	0.40
IRF520	N	8.0	100	0.30
IRF521	N	8.0	60	0.30
RFP8P08	P	8.0	80	0.40
RFP8P10	P	8.0	100	0.40
IRF532	N	12.0	100	0.25
IRF533	N	12.0	60	0.25
RFP12N08	N	12.0	80	0.20
RFP12N10	N	12.0	100	0.20
RFP12P08	P	12.0	80	0.30
RFP12P10	P	12.0	100	0.30
IRF530	N	14.0	100	0.18
IRF531	N	14.0	60	0.18
RFP15N05	N	15.0	50	0.15
RFP15N06	N	15.0	60	0.15
RFP18N08	N	18.0	80	0.12
RFP18N10	N	18.0	100	0.12
RFP25N05	N	25.0	50	.085
RFP25N06	N	25.0	60	.085
120V — 200V				
RFP2N12	N	2.0	120	2.00
RFP2N15	N	2.0	150	2.00
RFP2N18	N	2.0	180	3.00
RFP2N20	N	2.0	200	3.00
RFP5P12	P	5.0	120	1.00
RFP5P15	P	5.0	150	1.00
RFP8N18	N	8.0	180	0.50
RFP8N20	N	8.0	200	0.50
RFP10N12	N	10.0	120	0.30
RFP10N15	N	10.0	150	0.30
*RFP10P12	P	10.0	120	0.50
*RFP10P15	P	10.0	150	0.50
RFP12N18	N	12.0	180	0.25
RFP12N20	N	12.0	200	0.25
RFP15N12	N	15.0	120	0.15
RFP15N15	N	15.0	150	0.15
350V — 500V				
*RFP1N35	N	1.0	350	9.00
*RFP1N40	N	1.0	400	9.00
RFP3N45	N	3.0	450	3.00
RFP3N50	N	3.0	500	3.00
RFP4N35	N	4.0	350	2.00
RFP4N40	N	4.0	400	2.00
RFP6N45	N	6.0	450	1.50
RFP6N50	N	6.0	500	1.50
*RFP7N35	N	7.0	350	1.00
*RFP7N40	N	7.0	400	1.00

RFL1N08, RFL1N10, RFP2N08, RFP2N10

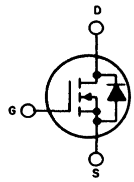
File Number **1385**

N-Channel Enhancement-Mode Power Field-Effect Transistors

1 and 2 A, 80 and 100 V

$r_{DS(on)}$: 1.25Ω and 1.4Ω

Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*

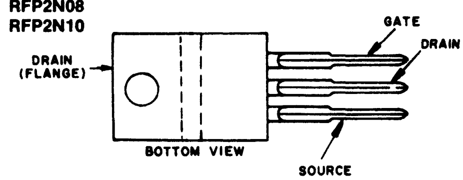


92CS-33741

N-CHANNEL ENHANCEMENT MODE

TERMINAL DESIGNATIONS

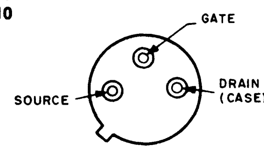
RFP2N08
RFP2N10



92CS-37556

JEDEC TO-220AB
(See dimensional outline "N".)

RFL1N08
RFL1N10



92CS-37555

JEDEC TO-39
(See dimensional outline "F".)

The RFL1N08 and RFL1N10 and the RFP2N08 and RFP2N10 are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFL-series types are supplied in the JEDEC TO-39 metal package and the RFP-series types in the JEDEC TO-220AB plastic package.

The RFL and RFP series were formerly RCA developmental numbers TA9282 and TA9283, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25°C):*

		RFL1N08	RFL1N10	RFP2N08	RFP2N10	
DRAIN-SOURCE VOLTAGE	V_{DSS}	80	100	80	100	V
DRAIN-GATE VOLTAGE (R_{GS}=1 MΩ)	V_{DGR}	80	100	80	100	V
GATE-SOURCE VOLTAGE	V_{GS}	±20				V
DRAIN CURRENT RMS Continuous	I_D	1	1	2	2	A
Pulsed	I_{DM}	5				A
POWER DISSIPATION @ T_C=25°C	P_T	8.33	8.33	25	25	W
Derate above T_C=25°C		0.0667	0.0667	0.2	0.2	W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}	-55 to +150				°C

RFL1N08, RFL1N10, RFP2N08, RFP2N10

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_c)=25° C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFL1N08 RFP2N08 Min.	LIMITS RFL1N08 RFP2N08 Max.	LIMITS RFL1N10 RFP2N10 Min.	LIMITS RFL1N10 RFP2N10 Max.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA, V_{GS}=0	80	—	100	—	V
Gate-Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS}, I_D=1 mA	2	4	2	4	V
Zero-Gate Voltage Drain Current	I_{DSS}	V_{DS}=65 V	—	1	—	—	μA
		V_{DS}=80 V	—	—	—	1	
		T_C=125° C, V_{DS}=65 V	—	50	—	—	
		V_{DS}=80 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V, V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=1 A, V_{GS}=10 V	—	1.25	—	1.25	V
		I_D=2 A, V_{GS}=10 V	—	3	—	3	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=1 A, V_{GS}=10 V, RFP	—	1.25	—	1.25	Ω
		RFL	—	1.4	—	1.4	
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V, I_D=1 A	400	—	400	—	mmho
Input Capacitance	C_{iss}	V_{DS}=25 V, V_{GS}=0 V, f = 0.1 MHz	—	150	—	150	pF
Output Capacitance	C_{oss}		—	80	—	80	
Reverse-Transfer Capacitance	C_{rss}		—	20	—	20	
Turn-On Delay Time	$t_d(on)$	V_{DD} = 50 V, I_D=1 A, R_{gen}=R_{gs}=50 Ω, V_{GS}=10 V	17(Typ)	25	17(Typ)	25	ns
Rise Time	t_r		30(Typ)	45	30(Typ)	45	
Turn-Off Delay Time	$t_d(off)$		30(Typ)	45	30(Typ)	45	
Fall Time	t_f		17(Typ)	25	17(Typ)	25	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	RFL1N08, RFL1N10	—	15	—	15	°C/W
		RFP2N08, RFP2N10	—	5	—	5	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFL1N08 RFP2N08 Min.	LIMITS RFL1N08 RFP2N08 Max.	LIMITS RFL1N10 RFP2N10 Min.	LIMITS RFL1N10 RFP2N10 Max.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD} = 1A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F = 2A, d_{IF}/d_t = 50A/μs	100(typ.)		100(typ.)		ns

[a]Pulsed: Pulse duration=300 μs max., duty cycle=2%.

RFL1N08, RFL1N10, RFP2N08, RFP2N10

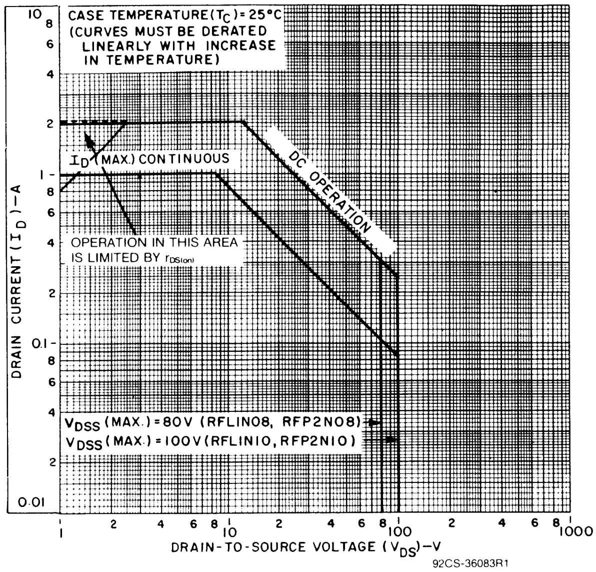


Fig. 1 - Maximum operating areas for all types.

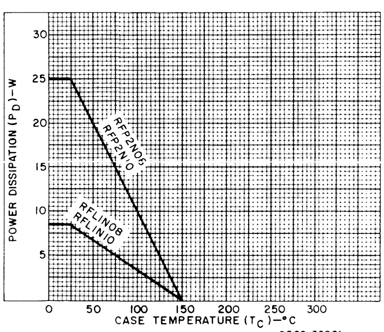


Fig. 2 - Power dissipation vs. temperature derating curve for all types.

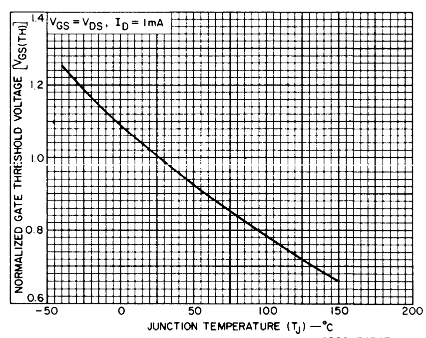


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

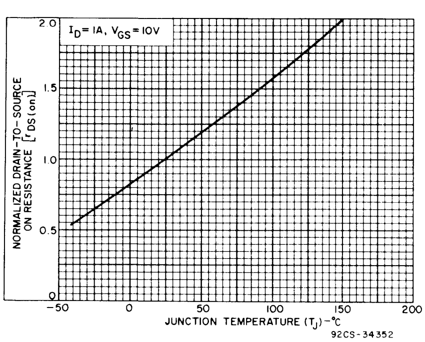


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

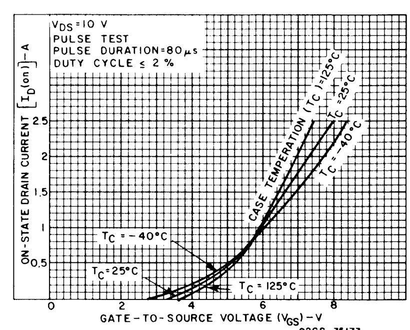


Fig. 5 - Typical transfer characteristics for all types.

RFL1N08, RFL1N10, RFP2N08, RFP2N10

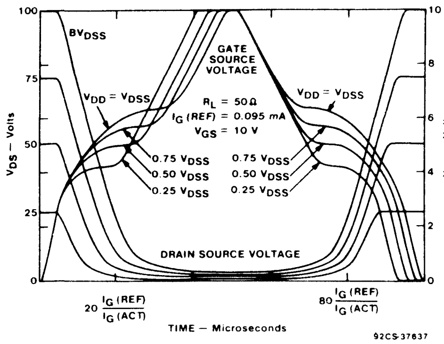


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

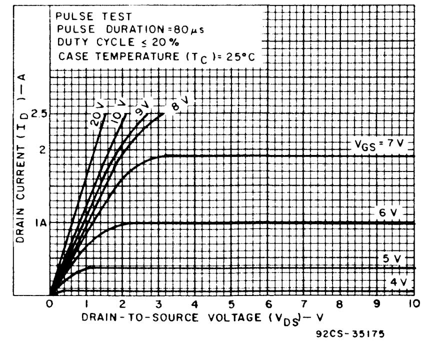


Fig. 7 - Typical saturation characteristics for all types.

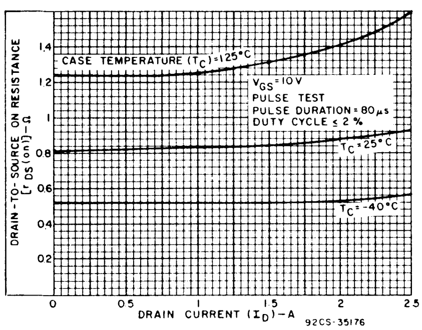


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

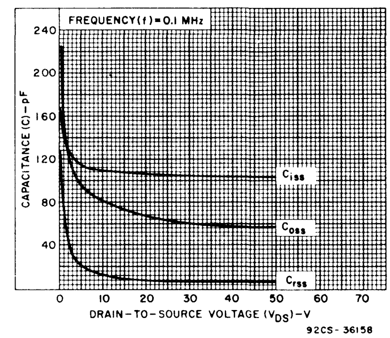


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

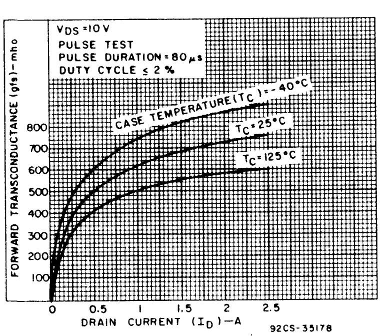


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

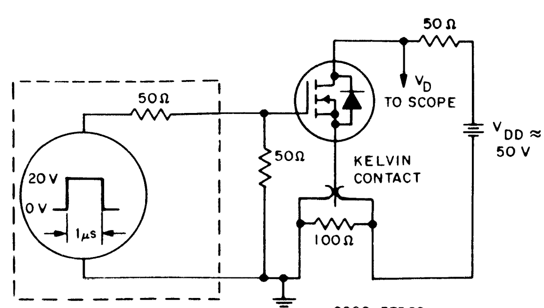


Fig. 11 - Switching Time Test Circuit.

RFL1N12, RFL1N15, RFP2N12, RFP2N15

File Number **1444**

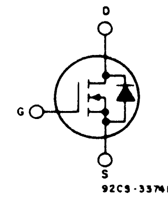
N-Channel Enhancement-Mode Power Field-Effect Transistors

1 and 2 Amperes 120 V — 150 V

$r_{DS}(on)$: 2.0Ω and 2.15Ω

Features:

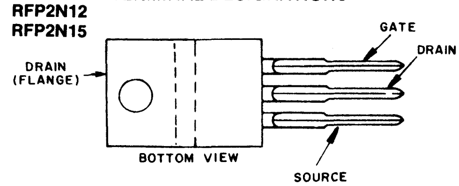
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-Channel Enhancement Mode

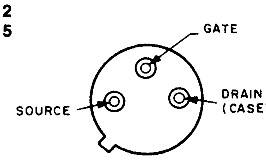
TERMINAL DESIGNATIONS

RFP2N12
RFP2N15



JEDEC TO-220AB
(See dimensional outline "N".)

RFL1N12
RFL1N15



JEDEC TO-39
(See dimensional outline "F".)

The RFL1N12 and RFL1N15 and the RFP2N12 and RFP2N15* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFL-series types are supplied in the JEDEC TO-39 metal package and the RFP-series types in the JEDEC TO-220AB plastic package.

*The RFL and RFP series were formerly RCA developmental numbers TA9196 and TA9213, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25°C):*

		RFL1N12	RFL1N15		RFP1N12	RFP2N15	
DRAIN-SOURCE VOLTAGE	V_{DSS}	120	150		120	150	V
DRAIN-GATE VOLTAGE (R_{GS}=1 MΩ)	V_{DGR}	120	150		120	150	V
GATE-SOURCE VOLTAGE	V_{GS}			±20			V
DRAIN CURRENT RMS Continuous	I_D	1A	1A		2A	2A	A
Pulsed	I_{DM}			5			A
POWER DISSIPATION							
@ T_C=25°C	P_T	8.33	8.33		25	25	W
Derate above T_C=25°C		0.0667	0.0667		0.2	0.2	W/°C
OPERATING AND STORAGE TEMPERATURE	T_J, T_{stg}			-55 to +150			°C

RFL1N12, RFL1N15, RFP2N12, RFP2N15

ELECTRICAL CHARACTERISTICS *at Case Temperature (T_c) = 25° C unless otherwise specified*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFL1N12 RFP2N12 MIN.	MAX.	LIMITS RFL1N15 RFP2N15 MIN.	MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D = 1 mA, V_{GS} = 0	120	—	150	—	V
Gate Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}$, I_D = 2 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 100 V	—	1	—	—	μA
		V_{DS} = 120 V	—	—	—	1	
		T_C = 125° C, V_{DS} = 100 V	—	50	—	—	
		T_C = 125° C, V_{DS} = 120 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS} = ± 20 V, V_{DS} = 0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D = 1 A, V_{GS} = 10 V	—	2	—	2	V
		I_D = 2 A, V_{GS} = 10 V	—	6	—	6	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D = 1 A, V_{GS} = 10 V, RFP	—	2	—	2	Ω
		I_D = 1 A, V_{GS} = 10 V, RFL	—	2.15	—	2.15	
Forward Transconductance	g_{fs}[a]	V_{DS} = 10 V, I_D = 1 A	400	—	400	—	mmho
Input Capacitance	C_{iss}	V_{DS} = 25 V, V_{GS} = 0 V, f = 0.1 MHz	—	150	—	150	pF
Output Capacitance	C_{oss}		—	80	—	80	pF
Reverse Transfer Capacitance	C_{rss}		—	20	—	20	pF
Turn-On Delay Time	$t_d(on)$	V_{DD} = 75 V, I_D = 1 A, $R_{gen} = R_{gs}$ = 50 Ω, V_{GS} = 10 V	17(typ.)	25	17(typ.)	25	ns
Rise Time	t_r		30(typ.)	45	30(typ.)	45	ns
Turn-Off Delay Time	$t_d(off)$		30(typ.)	45	30(typ.)	45	ns
Fall Time	t_f		17(typ.)	25	17(typ.)	25	ns
Thermal Resistance Junction-to-Case	$R\theta JC$	RFL1N12, RFL1N15	—	15	—	15	°C/W
		RFP2N12, RFP2N15	—	5	—	5	

[a] Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFL1N12, RFL1N15, RFP2N12, RFP2N15

ELECTRICAL CHARACTERISTICS (cont'd)

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFL1N12 RFP2N12 Min.	Max.	RFL1N15 RFP2N15 Min.	Max.	UNITS
Diode Forward Voltage	V_{SD} [a]	I_{SD} = 1A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F = 2A, d_{IF}/d_t = 50A/μs	150(typ.)		150(typ.)		ns

[a]Pulsed: Pulse duration = 300 μs duty cycle = 2%.

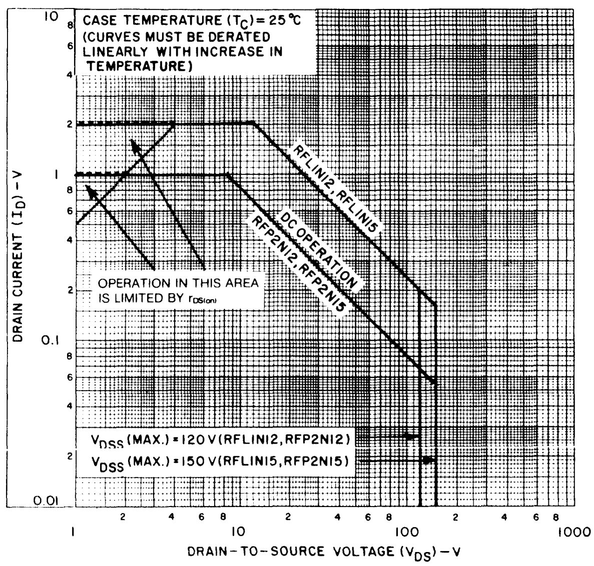


Fig. 1 — Maximum operating areas for all types.

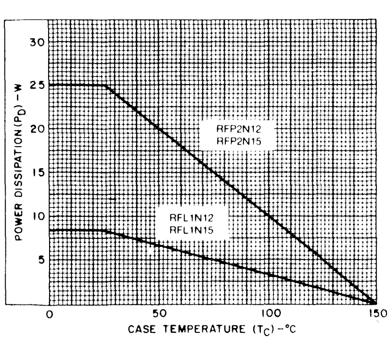


Fig. 2 — Power dissipation vs. case temperature derating curve for all types.

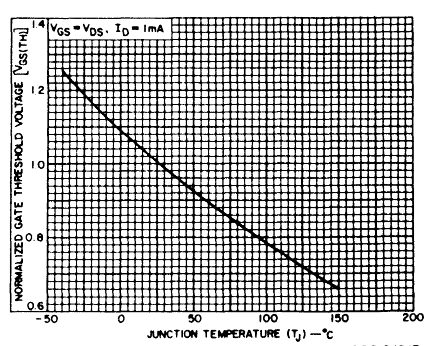


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

RFL1N12, RFL1N15, RFP2N12, RFP2N15

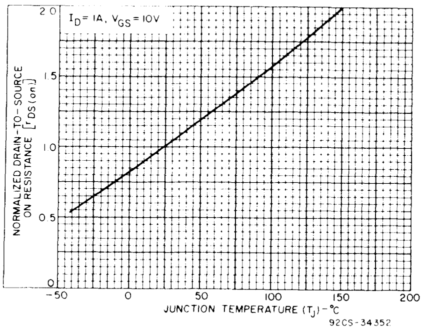


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

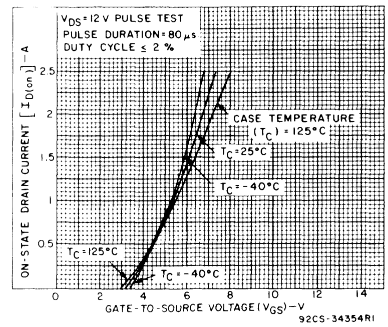


Fig. 5 — Typical transfer characteristics for all types.

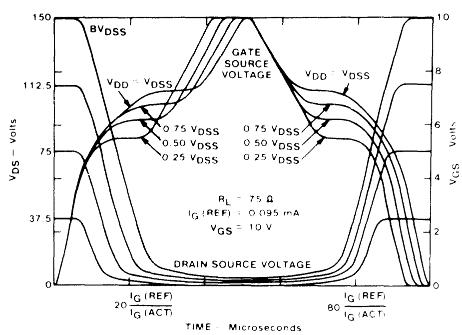


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

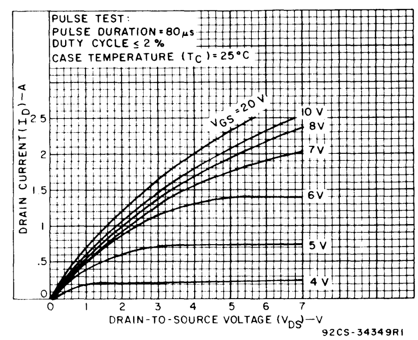


Fig. 7 — Typical saturation characteristics for all types.

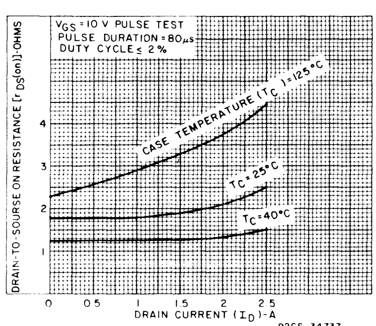


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

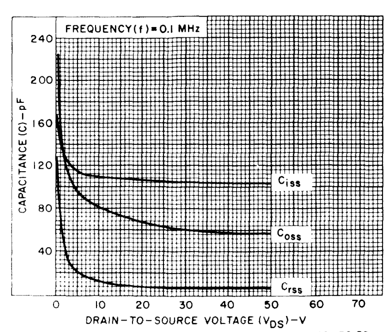


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

RFL1N12, RFL1N15, RFP2N12, RFP2N15

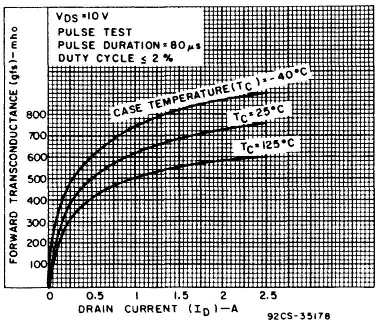


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

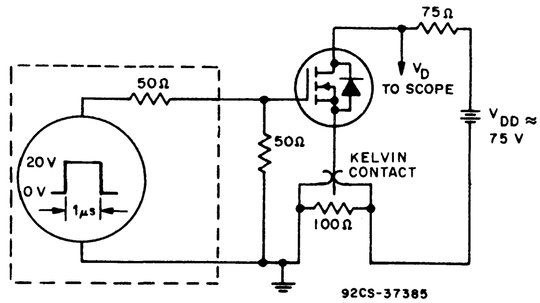


Fig. 11 — Switching Time Test Circuit.

File Number **1442**

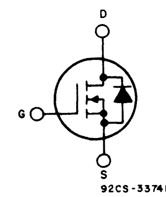
RFL1N18, RFL1N20, RFP2N18, RFP2N20

N-Channel Enhancement-Mode Power Field-Effect Transistors

1 and 2 A, 180 and 200 V
$r_{DS}(on)$: 3Ω and 3.15Ω

Features:

- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-CHANNEL ENHANCEMENT MODE

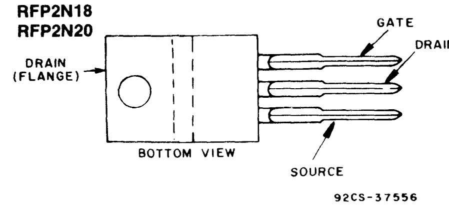
The RFL1N18 nd RFL1N20 and the RFP2N18 and RFP2N20 are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFL-series types are supplied in the JEDEC TO-39 metal package and the RFP-series types in the JEDEC TO-220AB plastic package.

The RFL and RFP series were formerly RCA developmental numbers TA9289 and TA9290, respectively.

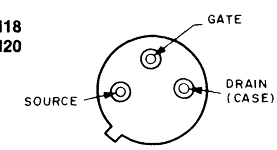
TERMINAL DESIGNATIONS

RFP2N18
RFP2N20



JEDEC TO-220AB
(See dimensional outline "N".)

RFL1N18
RFL1N20



JEDEC TO-39
(See dimensional outline "F".)

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFL1N18	RFL1N20	RFP2N18	RFP2N20	
DRAIN-SOURCE VOLTAGE	V_{DSS}	180	200	180	200	V
DRAIN-GATE VOLTAGE (R_{GS}=1 MΩ)	V_{DGR}	180	200	180	200	V
GATE-SOURCE VOLTAGE	V_{GS}	±20				V
DRAIN CURRENT RMS Continuous	I_D	1	1	2	2	A
Pulsed	I_{DM}	5				A
POWER DISSIPATION	P_T					
@ T_C=25° C		8.33	8.33	25	25	W
Derate above T_C=25° C		0.0667	0.0667	0.2	0.2	W/° C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}	-55 to +150				° C

RFL1N18, RFL1N20, RFP2N18, RFP2N20

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_c)=25° C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFL1N18 RFP2N18 Min.	LIMITS RFL1N18 RFP2N18 Max.	LIMITS RFL1N20 RFP2N20 Min.	LIMITS RFL1N20 RFP2N20 Max.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA, V_{GS}=0	180	—	200	—	V
Gate-Threshold Voltage	$V_{GS}(th)$	$V_{GS}=V_{DS}$, I_D=1 mA	2	4	2	4	V
Zero-Gate Voltage Drain Current	I_{DSS}	V_{DS}=145 V	—	1	—	—	μA
		V_{DS}=160 V	—	—	—	1	
		T_C=125° C, V_{DS}=145 V	—	50	—	—	
		V_{DS}=160 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V, V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=1 A, V_{GS}=10 V	—	3	—	3	V
		I_D=2 A, V_{GS}=10 V	—	8	—	8	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=1 A, V_{GS}=10 V — RFP	—	3	—	3	Ω
		RFL	—	3.15	—	3.15	
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V, I_D=1 A	400	—	400	—	mmho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	200	—	200	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	60	—	60	
Reverse-Transfer Capacitance	C_{rss}	f = 0.1 MHz	—	20	—	20	
Turn-On Delay Time	$t_d(on)$	V_{DD} = 100 V	15(Typ)	25	15(Typ)	25	ns
Rise Time	t_r	I_D=1 A	20(Typ)	30	20(Typ)	30	
Turn-Off Delay Time	$t_d(off)$	$R_{gen}=R_{gs}$=50 Ω	25(Typ)	40	25(Typ)	40	
Fall Time	t_f	V_{GS}=10 V	15(Typ)	25	15(Typ)	25	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	RFL1N18, RFL1N20	—	15	—	15	°C/W
		RFP2N18, RFP2N20	—	5	—	5	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFL1N18 RFP2N18 Min.	LIMITS RFL1N18 RFP2N18 Max.	LIMITS RFL1N20 RFP2N20 Min.	LIMITS RFL1N20 RFP2N20 Max.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD} = 1A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F = 2A, d_{IF}/d_t = 50A/μs	200(typ.)		200(typ.)		ns

[a]Pulsed: Pulse duration=300 μs max., duty cycle=2%.

RFL1N18, RFL1N20, RFP2N18, RFP2N20

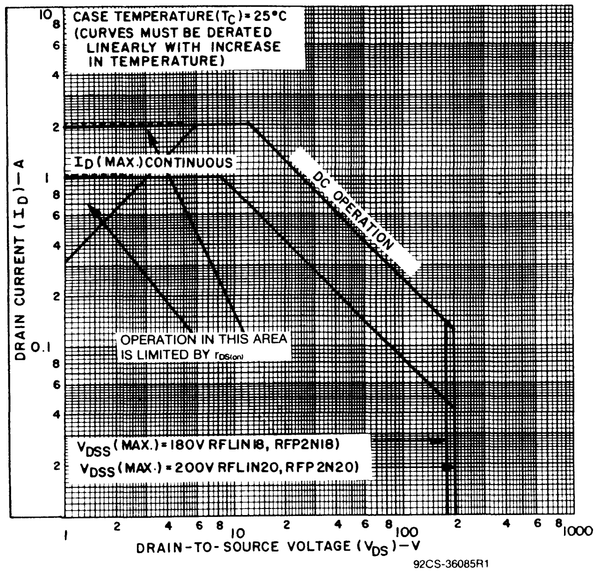


Fig. 1 - Maximum operating areas for all types.

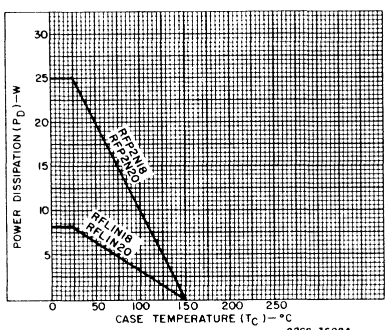


Fig. 2 - Power dissipation vs. case temperature derating curve for all types.

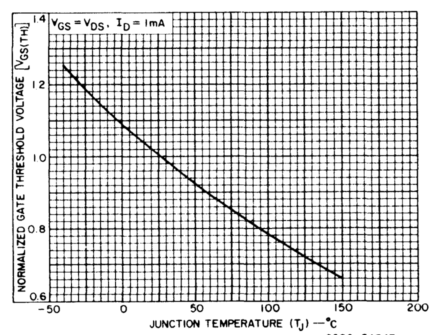


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

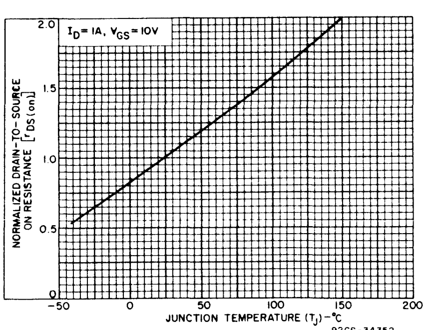


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

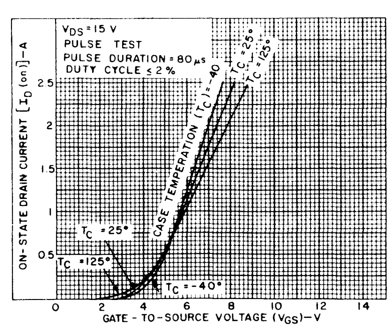


Fig. 5 - Typical transfer characteristics for all types.

RFL1N18, RFL1N20, RFP2N18, RFP2N20

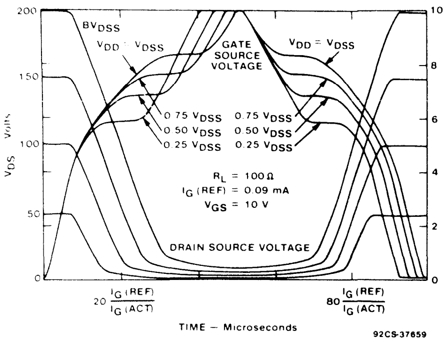


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

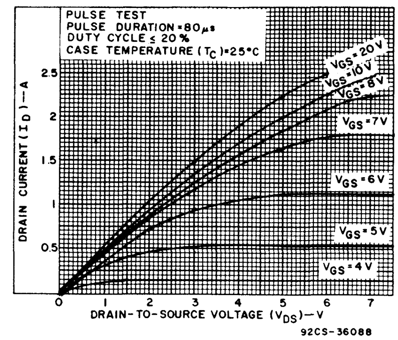


Fig. 7 - Typical saturation characteristics for all types.

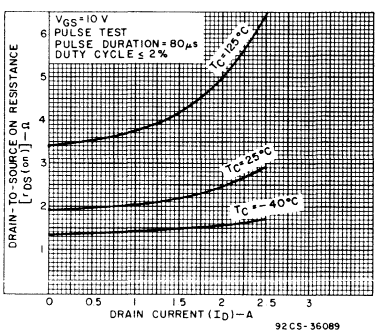


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

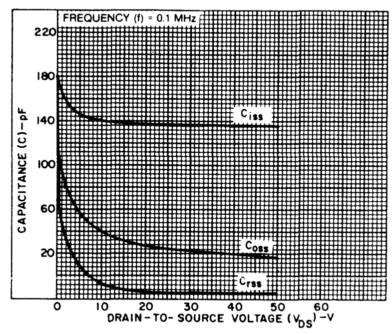


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

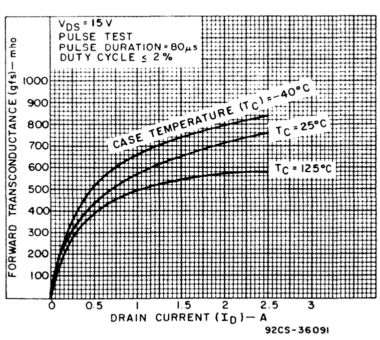


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

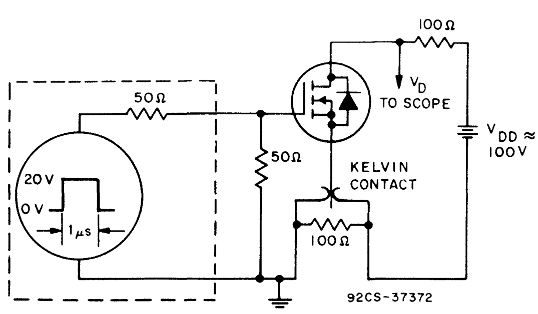


Fig. 11 — Switching Time Test Circuit.

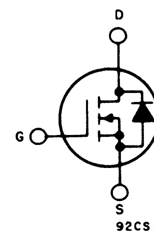
File Number **1497**

RFL2N05, RFL2N06, RFP4N05, RFP4N06

N-Channel Enhancement-Mode Power Field-Effect Transistors

2 and 4 Amperes, 50 V - 60 V
$r_{DS}(on)$ = 0.80Ω and 0.95Ω

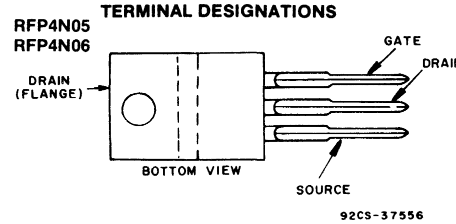
Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-CHANNEL ENHANCEMENT MODE

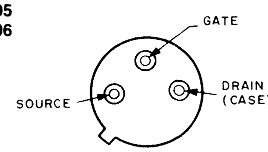
TERMINAL DESIGNATIONS

RFP4N05
RFP4N06



JEDEC TO-220AB
(See dimensional outline "N".)

RFL2N05
RFL2N06



JEDEC TO-39
(See dimensional outline "F".)

The RFL2N05 and RFL2N06 and the RFP4N05 and RFP4N06* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFL-series types are supplied in the JEDEC TO-39 metal package and the RFP-series types in the JEDEC TO-220AB plastic package.

*The RFL and RFP series were formerly RCA developmental numbers TA9378 and TA9379, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFL2N05	RFL2N06		RFP4N05	RFP4N06	
DRAIN-SOURCE VOLTAGE	V_{DSS}	50	60		50	60	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ)	V_{DGR}	50	60		50	60	V
GATE-SOURCE VOLTAGE	V_{GS}			±20			V
DRAIN CURRENT, RMS Continuous	I_D	2	2		4	4	A
Pulsed	I_{DM}			10			A
POWER DISSIPATION @ T_C=25°C	P_T	8.33	8.33		25	25	W
Derate above T_C=25°C		0.0667	0.0667		0.2	0.2	W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}			-55 to +150			°C

RFL2N05, RFL2N06, RFP4N05, RFP4N06

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFL2N05 RFP4N05 MIN.	LIMITS RFL2N05 RFP4N05 MAX.	LIMITS RFL2N06 RFP4N06 MIN.	LIMITS RFL2N06 RFP4N06 MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA V_{GS}=0	50	—	60	—	V
Gate Threshold Voltage	$V_{GS}(th)$	$V_{GS}=V_{DS}$ I_D=1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=40 V V_{DS}=50 V	— —	1 —	— —	— 1	μA
		T_C=125° C V_{DS}=40 V V_{DS}=50 V	— —	50 —	— —	— 50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)^a$	I_D=1 A V_{GS}=10 V	—	.8	—	.8	V
		I_D=2 A V_{GS}=10 V	—	2.0	—	2.0	
		I_D=4 A V_{DS}=15 V	—	4.8	—	4.8	
Static Drain-Source On Resistance	$r_{DS}(on)^a$	I_D=1 A, V_{GS}=10 V RFP	—	.8	—	.8	Ω
		I_D=1 A, V_{GS}=10 V RFL	—	.95	—	.95	
Forward Transconductance	g_{fs}^a	V_{DS}=10 V I_D=1 A	400	—	400	—	mmho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	150	—	150	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	85	—	85	
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	30	—	30	
Turn-On Delay Time	$t_d(on)$	V_{DD} = 30 V	6(typ)	15	6(typ)	15	ns
Rise Time	t_r	I_D=1 A	14(typ)	30	14(typ)	30	
Turn-Off Delay Time	$t_d(off)$	$R_{gen}=R_{gs}$=50 Ω	16(typ)	30	16(typ)	30	
Fall Time	t_f	V_{GS}=10 V	14(typ)	25	14(typ)	25	
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFL2N05, RFL2N06	—	15	—	15	°C/W
		RFP4N05, RFP4N06	—	5	—	5	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFL2N05 RFP4N05 Min.	LIMITS RFL2N05 RFP4N05 Max.	LIMITS RFL2N06 RFP4N06 Min.	LIMITS RFL2N06 RFP4N06 Max.	UNITS
Diode Forward Voltage	V_{SD}^a	I_{SD} = 1A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F = 2A d_{IF}/d_t = 50A/μs	100(typ.)		100(typ.)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFL2N05, RFL2N06, RFP4N05, RFP4N06

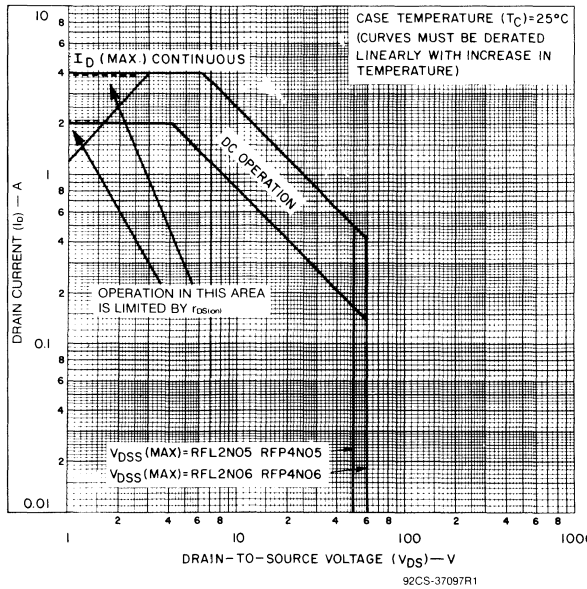


Fig. 1 — Maximum operating areas for all types.

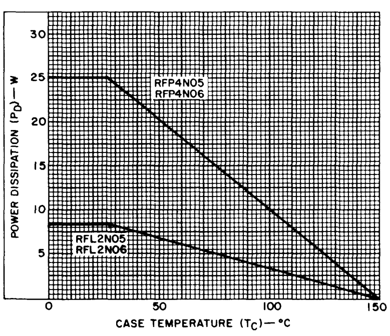


Fig. 2 — Power dissipation vs. case temperature derating curve for all types.

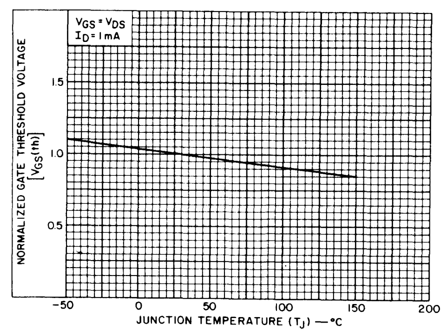


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

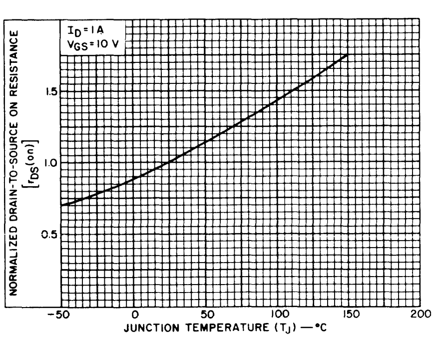


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

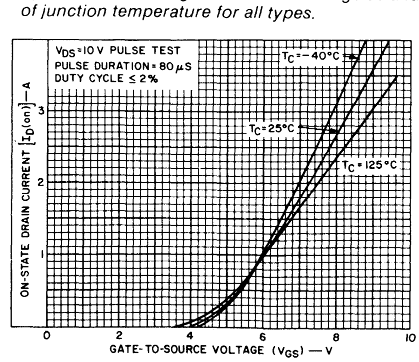


Fig. 5 — Typical transfer characteristics for all types.

RFL2N05, RFL2N06, RFP4N05, RFP4N06

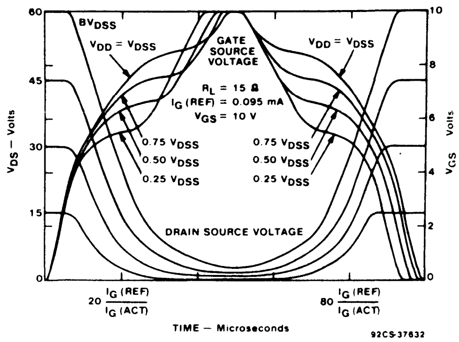


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

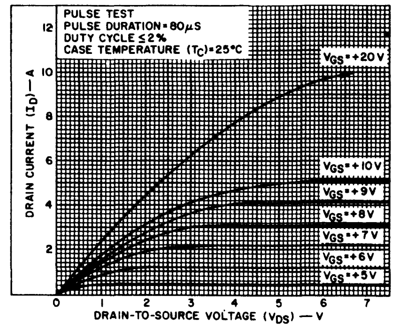


Fig. 7 — Typical saturation characteristics for all types.

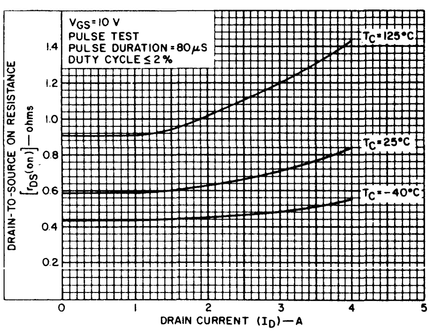


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

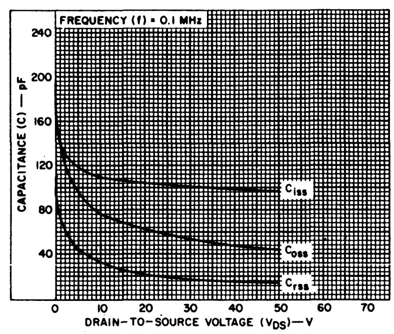


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

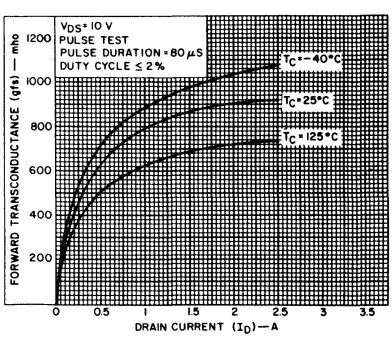


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

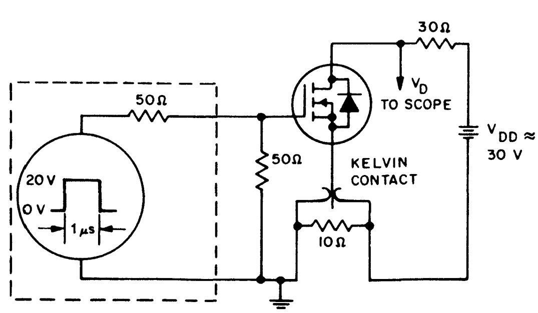


Fig. 11 — Switching Time Test Circuit.

File Number **1384**

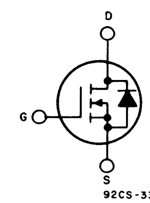
RFM3N45, RFM3N50, RFP3N45, RFP3N50

N-Channel Enhancement-Mode Power Field-Effect Transistors

3 A, 450 and 500 V

$r_{DS\,(on)}$: 3 Ω

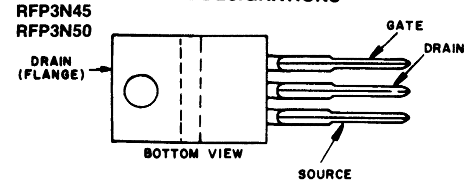
Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-CHANNEL ENHANCEMENT MODE

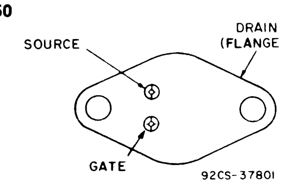
TERMINAL DESIGNATIONS

RFP3N45
RFP3N50



JEDEC TO-220AB
(See dimensional outline "N".)

RFM3N45
RFM3N50



JEDEC TO-204MA
(See dimensional outline "A".)

The RFM3N45 and RFM3N50 and the RFP3N45 and RFP3N50 are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-series types are supplied in the JEDEC TO-204MA steel package and the RFP-series types in the JEDEC TO-220AB plastic package.

The RFM and RFP series were formerly RCA developmental numbers TA9193 and TA9232, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

	RFM3N45	RFM3N50	All types	RFP3N45	RFP3N50	
DRAIN-SOURCE VOLTAGE .... V_{DSS}	450	500		450	500	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ) ... V_{DGR}	450	500		450	500	V
GATE-SOURCE VOLTAGE .... V_{GS}			±20			V
DRAIN CURRENT, RMS Continuous ..... I_D			3			A
Pulsed .... I_{DM}			5			A
POWER DISSIPATION @ T_C=25°C .... P_T	75	75		60	60	W
Derate above T_C=25°C	0.6	0.6		0.48	0.48	W/°C
OPERATING AND STORAGE TEMPERATURE .... T_j, T_{stg}			-55 to +150			°C

RFM3N45, RFM3N50, RFP3N45, RFP3N50

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_c)=25° C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM3N45 RFP3N45		LIMITS RFM3N50 RFP3N50		UNITS
			Min.	Max.	Min.	Max.	
Drain-Source Breakdown Voltage	BV_{DSS}	I_D = 1mA, V_{GS}=0	450	—	500	—	V
Gate-Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS}, I_D=1 mA	2	4	2	4	V
Zero-Gate Voltage Drain Current	I_{DSS}	V_{DS}=360 V	—	10	—	—	μA
		V_{DS}=400 V	—	—	—	10	
		T_C=125° C, V_{DS}=360 V	—	50	—	—	
		V_{DS}=400 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V, V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=1.5 A, V_{GS}=10 V	—	4.5	—	4.5	V
		I_D=3 A, V_{GS}=10 V	—	10.5	—	10.5	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=1.5 A, V_{GS}=10 V	—	3	—	3	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V, I_D=1.5 A	1	—	1	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V, V_{GS}=0 V, f=0.1 MHz	—	600	—	600	pF
Output Capacitance	C_{oss}		—	150	—	150	
Reverse-Transfer Capacitance	C_{rss}		—	50	—	50	
Turn-On Delay Time	$t_d(on)$	V_{DD}=250 V, I_D=1.5 A, R_{gen}=R_{gs}=50 Ω, V_{GS}=10 V	30(Typ)	45	30(Typ)	45	ns
Rise Time	t_r		40(Typ)	60	40(Typ)	60	
Turn-Off Delay Time	$t_d(off)$		90(Typ)	135	90(Typ)	135	
Fall Time	t_f		50(Typ)	75	50(Typ)	75	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	RFM3N45, RFM3N50	—	1.67	—	1.67	°C/W
		RFP3N45, RFP3N50	—	2.083	—	2.083	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM3N45 RFP3N45		LIMITS RFM3N50 RFP3N50		UNITS
			MIN.	MAX.	MIN.	MAX.	
Diode Forward Voltage	V_{SD}[a]	I_{SD}=1.5 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A, d_{IF}/d_t=100 A/μs	800(typ)		800(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM3N45, RFM3N50, RFP3N45, RFP3N50

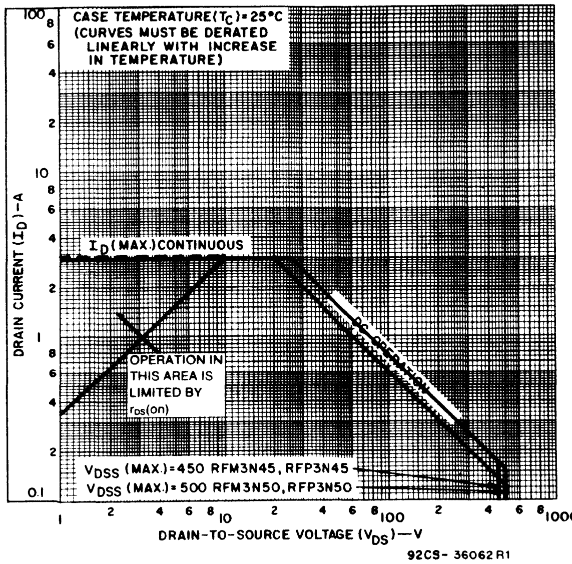


Fig. 1 - Maximum operating areas for all types.

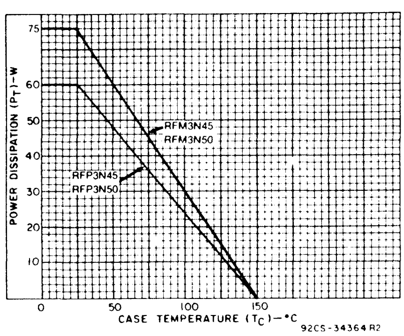


Fig. 2 - Power dissipation vs. temperature derating curve for all types.

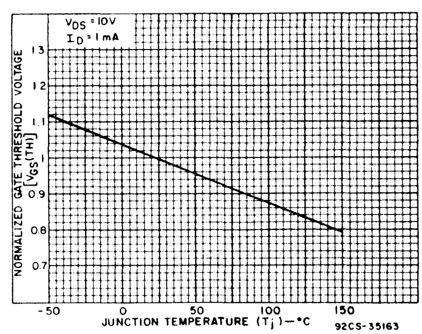


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

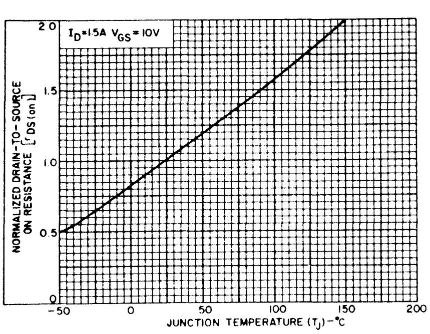


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

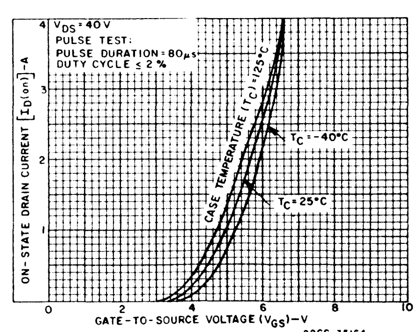


Fig. 5 - Typical transfer characteristics for all types.

RFM3N45, RFM3N50, RFP3N45, RFP3N50

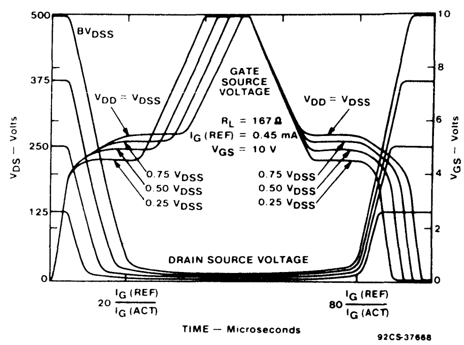


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

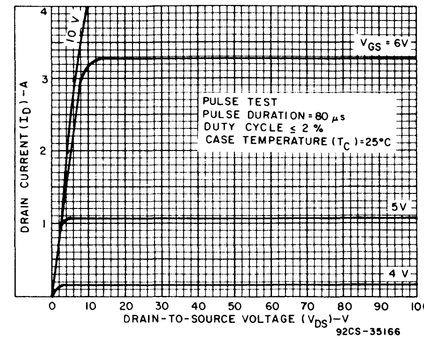


Fig. 7 - Typical saturation characteristics for all types.

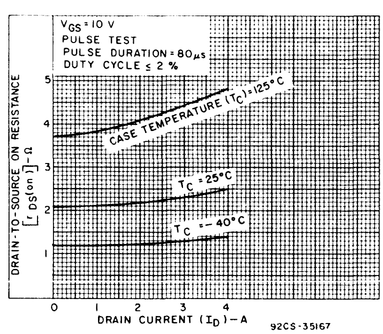


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

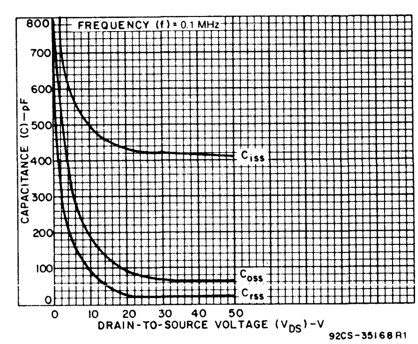


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

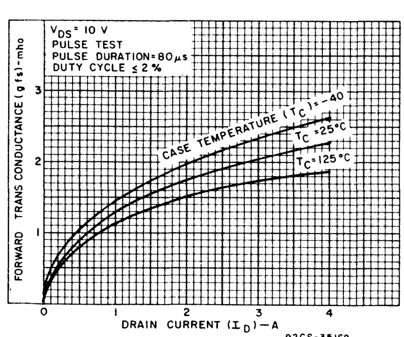


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

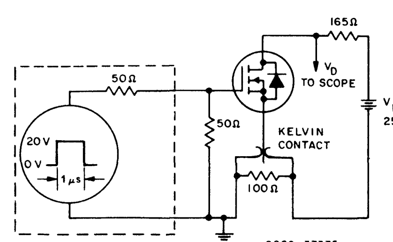


Fig. 11 — Switching Time Test Circuit

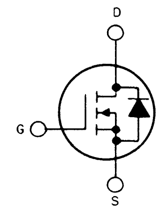
File Number **1462**

RFL4N12, RFL4N15

N-Channel Enhancement-Mode Power Field-Effect Transistors

4 A, 120 and 150 V
$r_{DS}(on)$: 0.45Ω

Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



92CS-33741

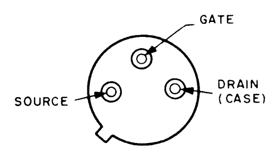
N-CHANNEL ENHANCEMENT MODE

The RFL4N12 and RFL4N15* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFL-series types are supplied in the JEDEC TO-39 metal package.

*The RFL4N12 and RFL4N15 series were formerly RCA developmental numbers TA9256A and TA9256B, respectively.

TERMINAL DESIGNATIONS



92CS-37555

JEDEC TO-39
(See dimensional outline "F".)

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFL4N12	RFL4N15	
DRAIN-SOURCE VOLTAGE	V_{DSS}	120	150	V
DRAIN-GATE VOLTAGE (R_{GS}=1 MΩ)	V_{DGR}	120	150	V
GATE-SOURCE VOLTAGE	V_{GS}	±20	±20	V
DRAIN CURRENT RMS Continuous	I_D	4	4	A
Pulsed	I_{DM}	15	15	A
POWER DISSIPATION @ T_C=25° C	P_T	8.33	8.33	W
Derate above T_C=25° C		0.0667	0.0667	W/° C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}	-55 to +150	-55 to +150	° C

RFL4N12, RFL4N15

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_c)=25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFL4N12 Min.	LIMITS RFL4N12 Max.	LIMITS RFL4N15 Min.	LIMITS RFL4N15 Max.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA, V_{GS}=0	120	—	150	—	V
Gate-Threshold Voltage	$V_{GS}(th)$	$V_{GS}=V_{DS}$, I_D=1 mA	2	4	2	4	V
Zero-Gate Voltage Drain Current	I_{DSS}	V_{DS}=100 V	—	1	—	—	μA
		V_{DS}=120 V	—	—	—	1	
		T_C=125°C					
		V_{DS}=100 V	—	50	—	—	
		V_{DS}=120 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V, V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=2 A, V_{GS}=10 V	—	0.8	—	0.8	V
		I_D=4 A, V_{GS}=10 V	—	3	—	3	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=2 A, V_{GS}=10 V	—	.45	—	.45	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V, I_D=2 A	1.5	—	1.5	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	650	—	650	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	230	—	230	
Reverse-Transfer Capacitance	C_{rss}	f = 0.1MHz	—	60	—	60	
Turn-On Delay Time	$t_d(on)$	V_{DD} = 75 V	40(typ)	60	40(typ)	60	ns
Rise Time	t_r	I_D=2 A	165(typ)	250	165(typ)	250	
Turn-Off Delay Time	$t_d(off)$	$R_{gen}=R_{gs}$=50 Ω	90(typ)	135	90(typ)	135	
Fall Time	t_f	V_{GS}=10 V	90(typ)	135	90(typ)	135	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	RFL4N12, RFL4N15	—	15	—	15	°C/W

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFL4N12 Min.	LIMITS RFL4N12 Max.	LIMITS RFL4N15 Min.	LIMITS RFL4N15 Max.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD} = 2A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F = 4A, d_{IF}/d_t = 100A/μs	200(typ.)		200(typ.)		ns

[a]Pulsed: Pulse duration=300 μs max., duty cycle=2%.

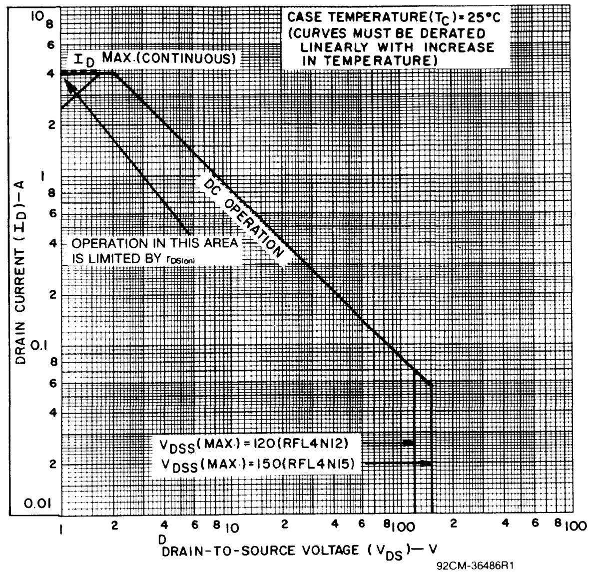


Fig. 1 - Maximum safe operating areas for all types.

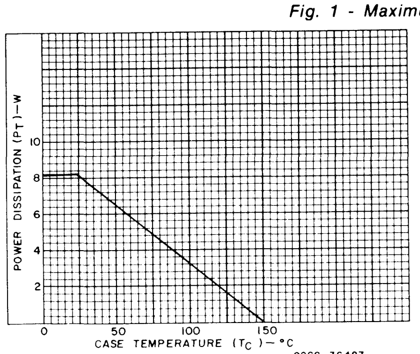


Fig. 2 - Power vs. temperature derating curve for all types.

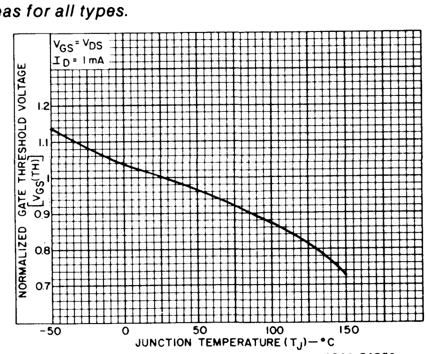


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

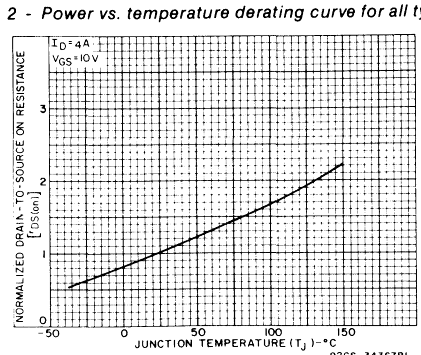


Fig. 4 - Normalized drain-to-source on resistance as a function of junction temperature for all types.

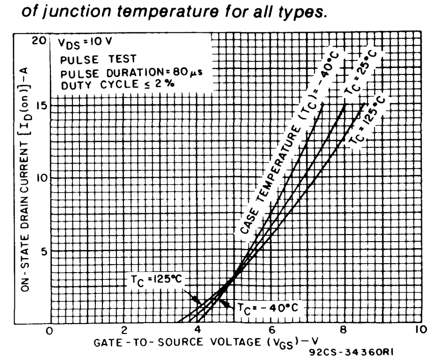


Fig. 5 - Typical transfer characteristics for all types.

RFL4N12, RFL4N15

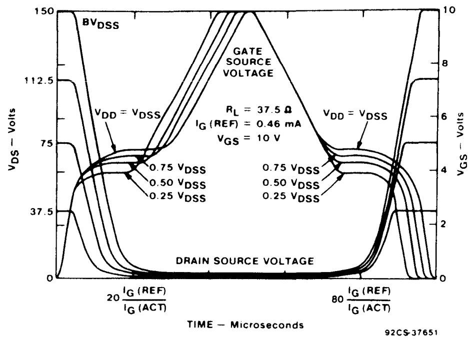


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

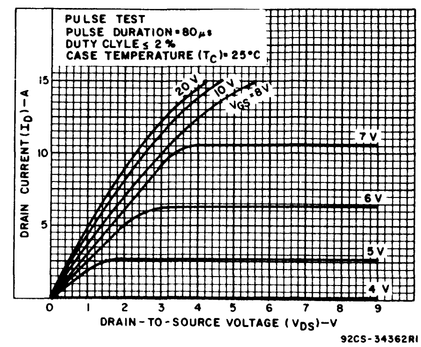


Fig. 7 - Typical saturation characteristics for all types.

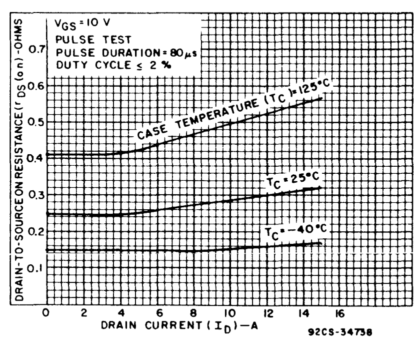


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

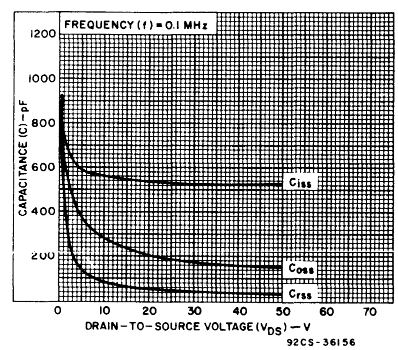


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

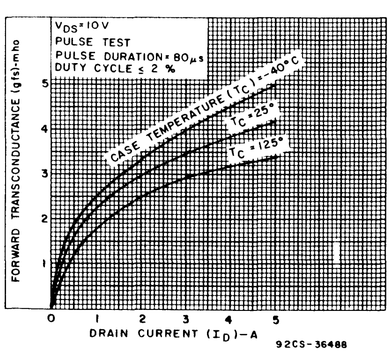


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

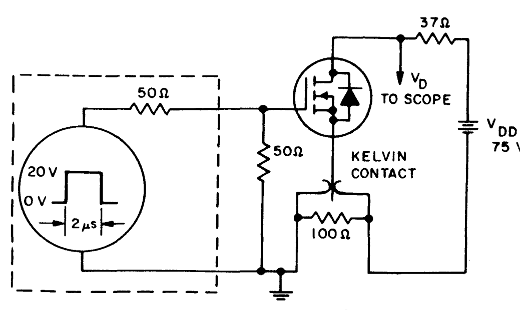


Fig. 11 - Switching Time Test Circuit.

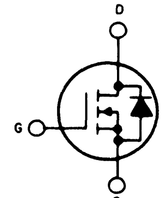
File Number **1491**

RFM4N35, RFM4N40, RFP4N35, RFP4N40

N-Channel Enhancement-Mode Power Field-Effect Transistors

4 A, 350 V and 400 V
$r_{DS}(on) = 2\ \Omega$

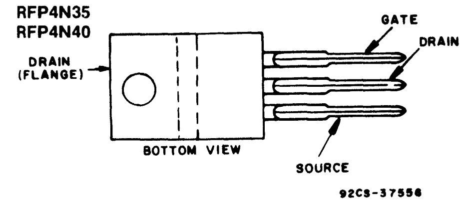
Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-CHANNEL ENHANCEMENT MODE

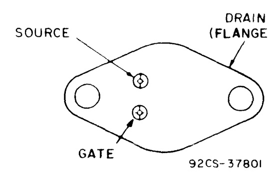
TERMINAL DESIGNATIONS

RFP4N35
RFP4N40



JEDEC TO-220AB
(See dimensional outline "N".)

RFM4N35
RFM4N40



JEDEC TO-204MA
(See dimensional outline "A".)

The RFM4N35 and RFM4N40 and the RFP4N35 and RFP4N40* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-series types are supplied in the JEDEC TO-204MA steel package and the RFP-series types in the JEDEC TO-220AB plastic package.

*The RFM and RFP series were formerly RCA developmental numbers TA9393 and TA9394, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFM4N35	RFM4N40		RFP4N35	RFP4N40	
DRAIN-SOURCE VOLTAGE	V_{DSS}	350	400		350	400	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ)	V_{DGR}	350	400		350	400	V
GATE-SOURCE VOLTAGE	V_{GS}			±20			V
DRAIN CURRENT, RMS Continuous	I_D			4			A
Pulsed	I_{DM}			8			A
POWER DISSIPATION @ T_C=25°C	P_T	75	75		60	60	W
Derate above T_C=25°C		0.6	0.6		0.48	0.48	W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}			-55 to +150			°C

RFM4N35, RFM4N40, RFP4N35, RFP4N40

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFM4N35 RFP4N35 MIN.	MAX.	LIMITS RFM4N40 RFP4N40 MIN.	MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D = 1 mA, V_{GS}=0	350	—	400	—	V
Gate Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS}, I_D=1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=280 V	—	10	—	—	μA
		V_{DS}=320 V	—	—	—	10	μA
		T_C=125° C, V_{DS}=280 V	—	50	—	—	μA
		T_C=125° C, V_{DS}=320 V	—	—	—	50	μA
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V, V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=2 A, V_{GS}=10 V	—	4	—	4	V
		I_D=4 A, V_{GS}=10 V	—	12	—	12	V
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=2 A, V_{GS}=10 V	—	2	—	2	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V, I_D=2 A	1	—	1	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V, V_{GS}=0 V, f=0.1 MHz	—	650	—	650	pF
Output Capacitance	C_{oss}		—	150	—	150	pF
Reverse Transfer Capacitance	C_{rss}		—	50	—	50	pF
Turn-On Delay Time	$t_d(on)$	V_{DD}=200 V, I_D=2 A, R_{gen}=R_{gs}=50 Ω, V_{GS}=10 V	12(typ)	45	12(typ)	45	ns
Rise Time	t_r		42(typ)	60	42(typ)	60	ns
Turn-Off Delay Time	$t_d(off)$		130(typ)	200	130(typ)	200	ns
Fall Time	t_f		62(typ)	100	62(typ)	100	ns
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFM4N35, RFM4N40	—	1.67	—	1.67	° C/W
		RFP4N35, RFP4N40	—	2.083	—	2.083	° C/W

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM4N35 RFP4N35 MIN.	MAX.	LIMITS RFM4N40 RFP4N40 MIN.	MAX.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD}=2 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A, d_{IF}/d_t=100 A/μs	800(typ)		800(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM4N35, RFM4N40, RFP4N35, RFP4N40

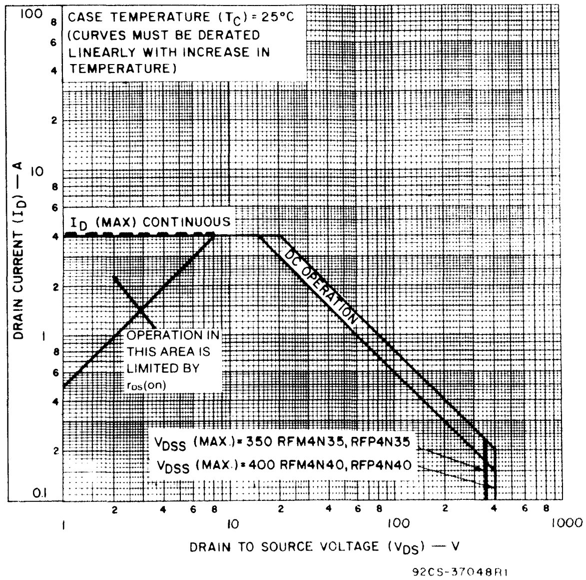


Fig. 1 — Maximum operating areas for all types.

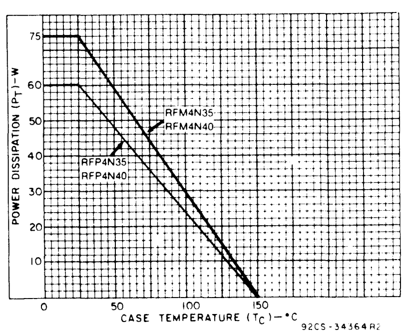


Fig. 2 — Power dissipation vs. temperature derating curve for all types.

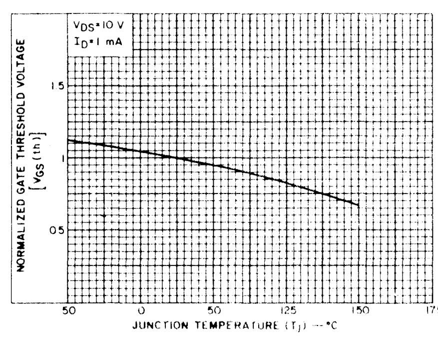


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

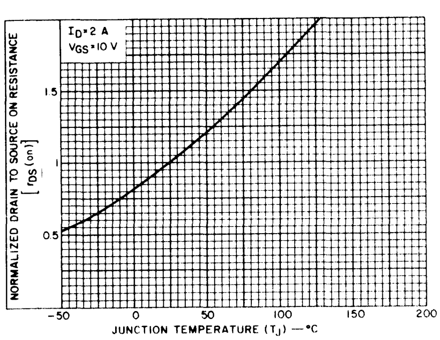


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

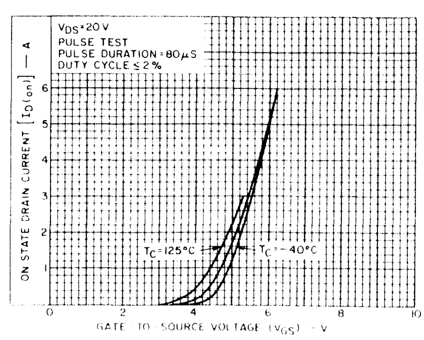


Fig. 5 — Typical transfer characteristics for all types.

RFM4N35, RFM4N40, RFP4N35, RFP4N40

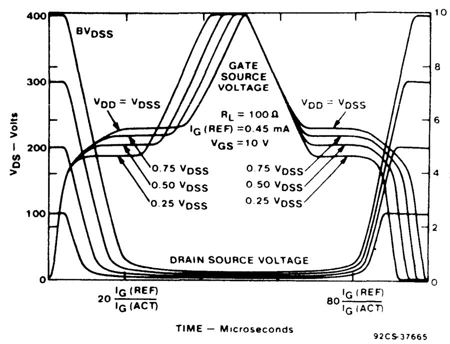


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

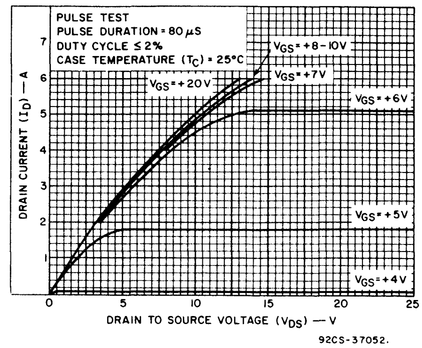


Fig. 7 — Typical saturation characteristics for all types.

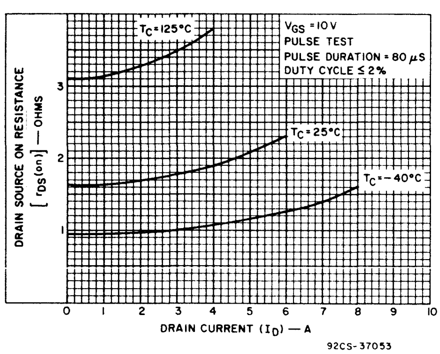


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

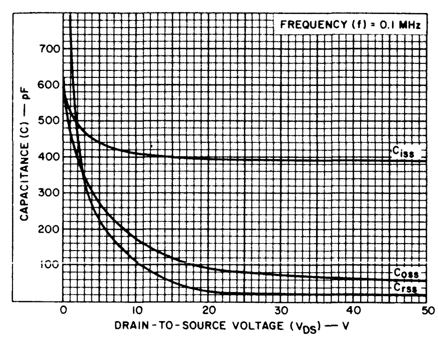


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

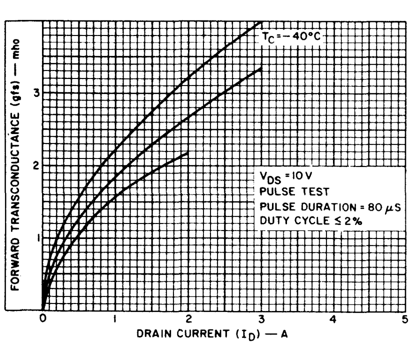


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

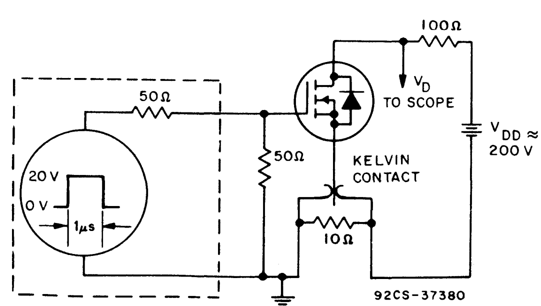


Fig. 11 — Switching Time Test Circuit

File Number **1463**

RFM5P12, RFM5P15, RFP5P12, RFP5P15

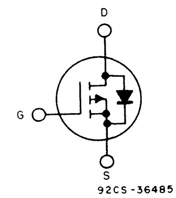
P-Channel Enhancement-Mode Power Field-Effect Transistors

5 A, 120 V — 150 V

$r_{DS}(on)$: 1Ω

Features:

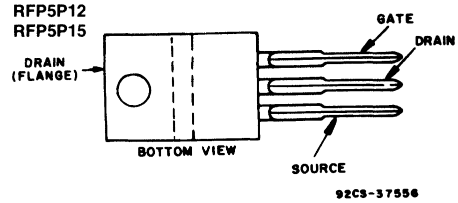
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



P-CHANNEL ENHANCEMENT MODE

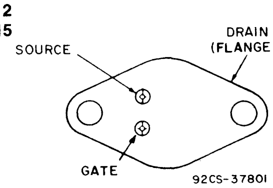
TERMINAL DESIGNATIONS

RFP5P12
RFP5P15



JEDEC TO-220AB
(See dimensional outline "N".)

RFM5P12
RFM5P15



JEDEC TO-204MA
(See dimensional outline "A".)

The RFM5P12 and RFM5P15 and the RFP5P12 and RFP5P15 * are P-Channel enhancement-mode silicon gate power field-effect transistors designed for high-speed applications such as switching regulators, switching converters, relay drivers, and drivers for high-power bipolar switching transistors.

The RFM-Series types are supplied in the JEDEC TO-204MA metal package and the RFP-Series types in the JEDEC TO-220AB plastic package. All these types are supplied without an internal gate Zener diode.

* The RFM and RFP series were formerly RCA developmental numbers TA9320 and TA9321 respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C = 25° C):*

		RFM5P12	RFM5P15	RFP5P12	RFP5P15	
DRAIN-SOURCE VOLTAGE	V_{DSS}	-120	-150	-120	-150	V
DRAIN-GATE VOLTAGE (R_{GS} = 1MΩ)	V_{DGR}	-120	-150	-120	-150	V
GATE-SOURCE VOLTAGE	V_{GS}	±20				V
DRAIN CURRENT RMS Continuous	I_D	5				A
Pulsed	I_{DM}	15				A
POWER DISSIPATION	P_T					
@ T_C = 25°C		75	75	60	60	W
Derate above T_C = 25°C		0.6	0.6	0.48	0.48	W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}	-55 to +150				°C

RFM5P12, RFM5P15, RFP5P12, RFP5P15

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM5P12 RFP5P12 Min.	Max.	LIMITS RFM5P15 RFP5P15 Min.	Max.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	$I_D = 1$ mA $V_{GS} = 0$	-120	—	-150	—	V
Gate-Threshold Voltage	$V_{GS(th)}$	$V_{GS} = V_{DS}$ $I_D = 1$ mA	-2	-4	-2	-4	V
Zero-Gate Voltage Drain Current	I_{DSS}	$V_{DS} = -100$ V	—	1	—	—	μA
		$V_{DS} = -120$ V	—	—	—	1	
		$T_C = 125°C$ $V_{DS} = -100$ V	—	50	—	—	
		$V_{DS} = -120$ V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	$V_{GS} = \pm 20$ V $V_{DS} = 0$	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS(on)}$[a]	$I_D = 2.5$ A $V_{GS} = -10$ V	—	-2.5	—	-2.5	V
		$I_D = 5$A $V_{GS} = -10$ V	—	-8	—	-8	
Static Drain-Source On Resistance	$r_{DS(on)}$[a]	$I_D = 2.5$ A $V_{GS} = -10$ V	—	1	—	1	Ω
Forward Transconductance	g_{fs}[a]	$V_{DS} = 10$ V $I_D = 2.5$ A	0.75	—	0.75	—	mho
Input Capacitance	C_{iss}	$V_{DS} = 25$ V		700	—	700	pF
Output Capacitance	C_{oss}	$V_{GS} = 0$ V	—	300	—	300	
Reverse-Transfer Capacitance	C_{rss}	f = 0.1 MHz	—	100	—	100	
Turn-On Delay Time	$t_{d(on)}$	$V_{DD} = 1/2\ BV_{DSS}$	20(typ.)	60	20(typ.)	60	ns
Rise Time	t_r	$I_D = 2.5$ A	36(typ.)	100	36(typ.)	100	
Turn-Off Delay Time	$t_{d(off)}$	$R_{gen} = R_{gs} = 50Ω$	63(typ.)	150	63(typ.)	150	
Fall Time	t_f	$V_{GS} = 10$ V	40(typ.)	100	40(typ.)	100	
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFM5P12, RFM5P15	—	1.67	—	1.67	°C/W
		RFP5P12, RFP5P15	—	2.083	—	2.083	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM5P12 RFP5P12 Min.	Max.	LIMITS RFM5P15 RFP5P15 Min.	Max.	UNITS
Diode Forward Voltage	V_{SD}[a]	$I_{SD} = 2.5$A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	$I_F = 4$A $d_{IF}/d_t = 100$A/μs	300(typ.)		300(typ.)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM5P12, RFM5P15, RFP5P12, RFP5P15

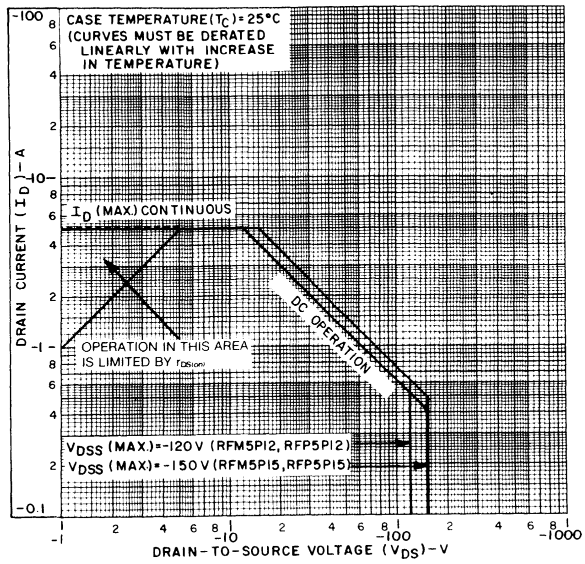


Fig. 1 - Maximum safe operating areas for all types.

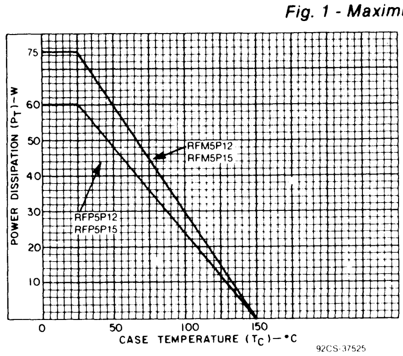


Fig. 2 - Power dissipation vs. temperature derating curve for all types.

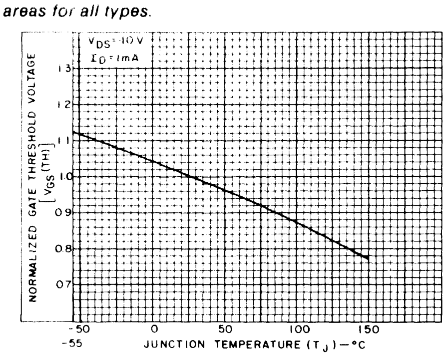


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

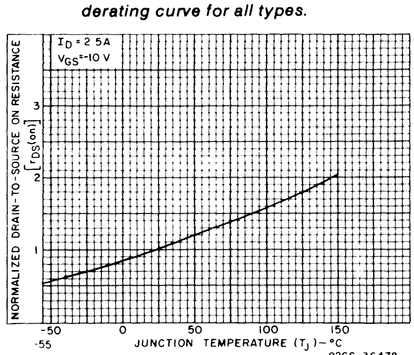


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

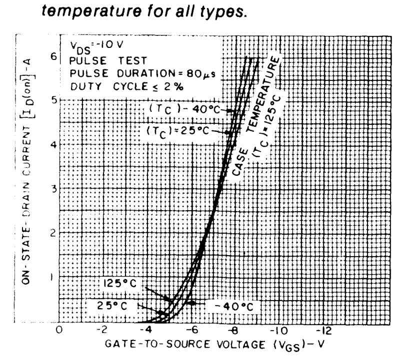


Fig. 5 - Typical transfer characteristics for all types.

RFM5P12, RFM5P15, RFP5P12, RFP5P15

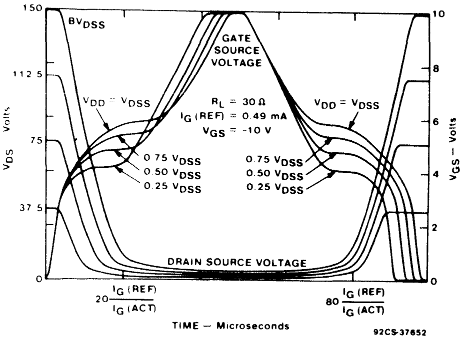


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

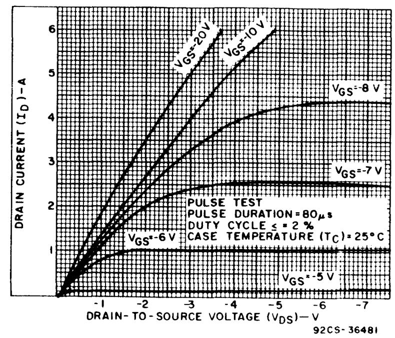


Fig. 7 - Typical saturation characteristics for all types.

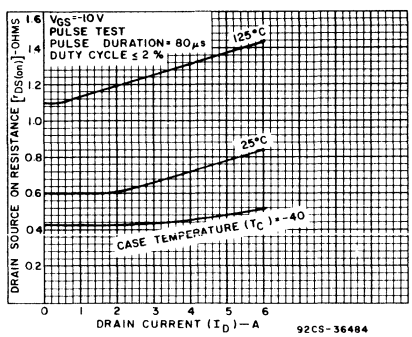


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

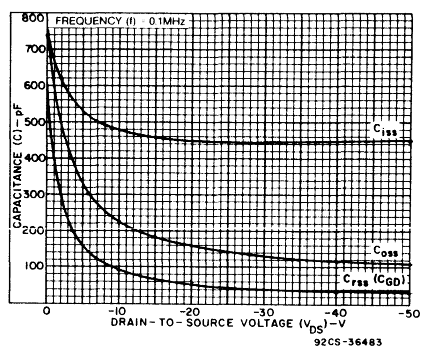


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

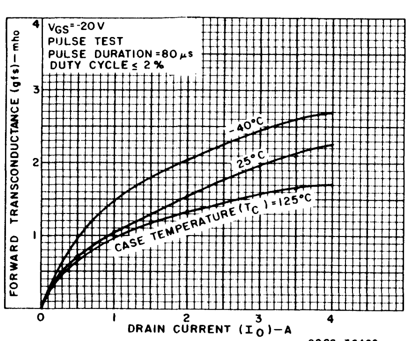


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

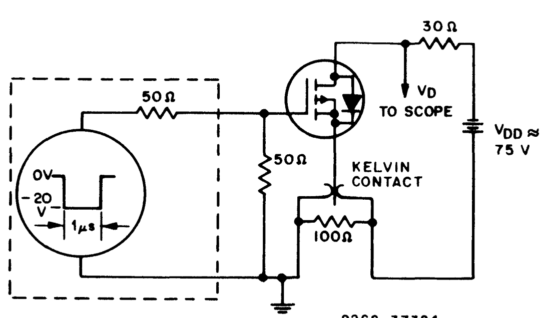


Fig. 11 - Switching Time Test Circuit.

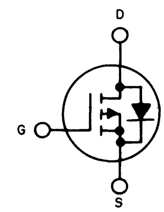
File Number **1490**

RFM6P08, RFM6P10, RFP6P08, RFP6P10

P-Channel Enhancement-Mode Power Field-Effect Transistors

6 A, 80 V — 100 V
$r_{DS}(on) = 0.6\ \Omega$

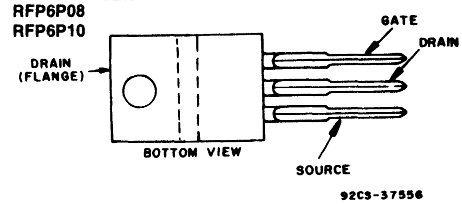
Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



P-CHANNEL ENHANCEMENT MODE

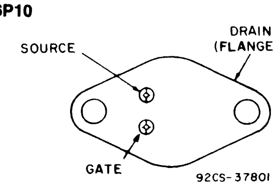
TERMINAL DESIGNATIONS

RFP6P08
RFP6P10



JEDEC TO-220AB
(See dimensional outline "N".)

RFM6P08
RFM6P10



JEDEC TO-204MA
(See dimensional outline "A".)

The RFM6P08 and RFM6P10 and the RFP6P08 and RFP6P10* are P-Channel enhancement-mode silicon-gate power field-effect transistors designed for high-speed applications such as switching regulators, switching converters, relay drivers, and drivers for high-power bipolar switching transistors.

The RFM-Series types are supplied in the JEDEC TO-204MA metal package and the RFP-Series types in the JEDEC TO-220AB plastic package. All these types are supplied without an internal gate Zener diode.

*The RFM and RFP series were formerly RCA developmental numbers TA9406 and TA9407, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFM6P08	RFM6P10		RFP6P08	RFP6P10	
DRAIN-SOURCE VOLTAGE	V_{DSS}	80	100		80	100	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ)	V_{DGR}	80	100		80	100	V
GATE-SOURCE VOLTAGE	V_{GS}			±20			V
DRAIN CURRENT, RMS Continuous	I_D			6			A
Pulsed	I_{DM}			20			A
POWER DISSIPATION @ T_C=25°C	P_T	75	75		60	60	W
Derate above T_C=25°C		0.6	0.6		0.48	0.48	W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}			-55 to +150			°C

RFM6P08, RFM6P10, RFP6P08, RFP6P10

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFM6P08 RFP6P08 MIN.	RFM6P08 RFP6P08 MAX.	RFM6P10 RFP6P10 MIN.	RFM6P10 RFP6P10 MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA V_{GS}=0	-80	—	-100	—	V
Gate Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS} I_D=1 mA	-2	-4	-2	-4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=-65 V V_{DS}=-80 V	— —	1 —	— —	— 1	μA
		T_C=125° C V_{DS}=-65 V V_{DS}=-80 V	— —	50 —	— —	— 50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=3 A V_{GS}=-10 V	—	-1.8	—	-1.8	V
		I_D=6 A V_{GS}=-10 V	—	-6	—	-6	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=3 A V_{GS}=-10 V	—	0.6	—	0.6	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V I_D=3 A	1	—	1	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	800	—	800	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	350	—	350	
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	150	—	150	
Turn-On Delay Time	$t_d(on)$	V_{DD} = 50 V	11(typ)	60	11(typ)	60	ns
Rise Time	t_r	I_D=3 A	48(typ)	100	48(typ)	100	
Turn-Off Delay Time	$t_d(off)$	R_{gen}=R_{gs}=50 Ω	102(typ)	150	102(typ)	150	
Fall Time	t_f	V_{GS}=10 V	70(typ)	100	70(typ)	100	
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFM6P08, RFM6P10	—	1.67	—	1.67	°C/W
		RFP6P08, RFP6P10	—	2.083	—	2.083	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM6P08 RFP6P08 MIN.	RFM6P08 RFP6P08 MAX.	RFM6P10 RFP6P10 MIN.	RFM6P10 RFP6P10 MAX.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD}=3 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A d_{IF}/d_t=50 A/μs	150(typ)		150(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM6P08, RFM6P10, RFP6P08, RFP6P10

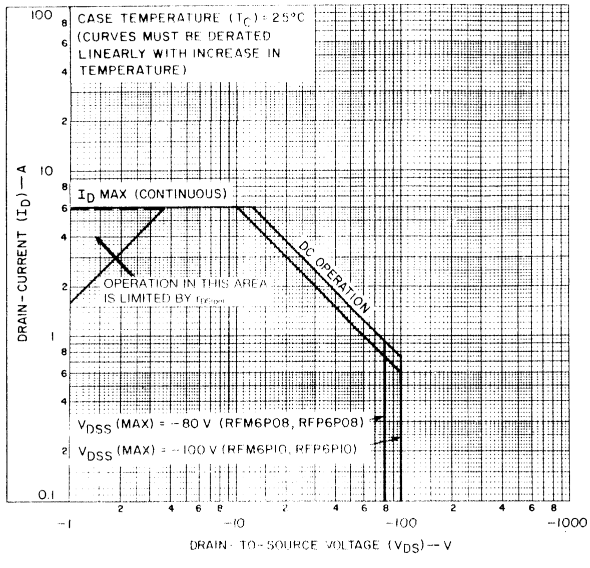


Fig. 1 — Maximum safe operating areas for all types.

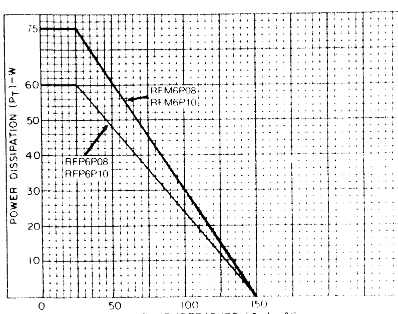


Fig. 2 — Power dissipation vs. temperature derating curve for all types.

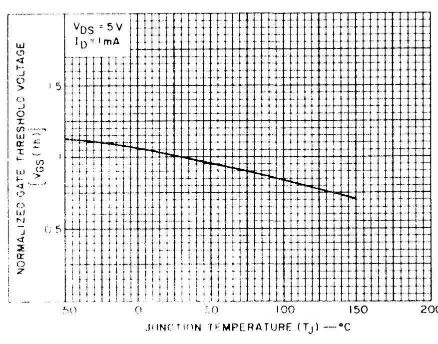


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

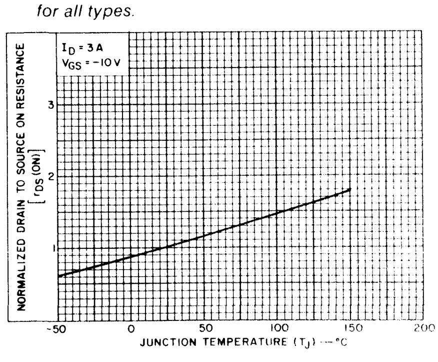


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

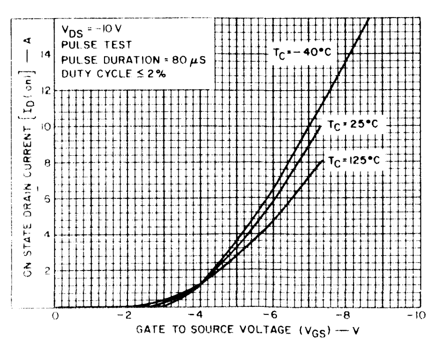


Fig. 5 — Typical transfer characteristics for all types.

RFM6P08, RFM6P10, RFP6P08, RFP6P10

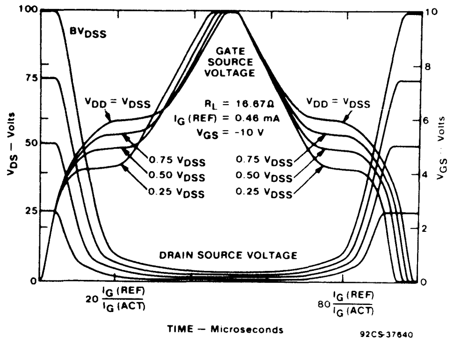


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

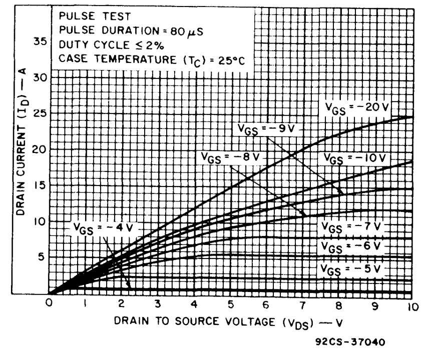


Fig. 7 — Typical saturation characteristics for all types.

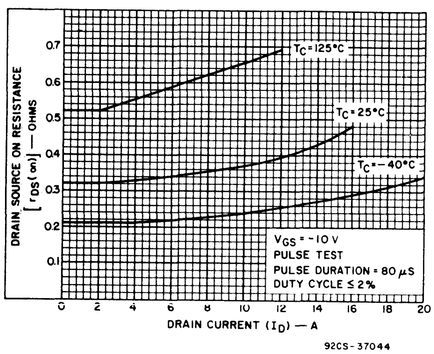


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

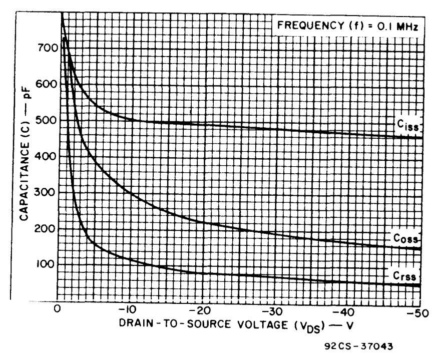


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

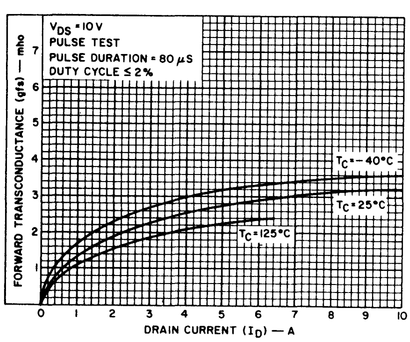


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

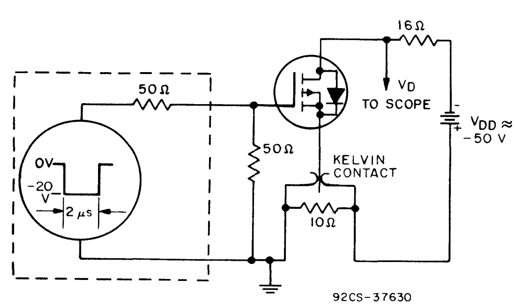


Fig. 11 - Switching Time Test Circuit.

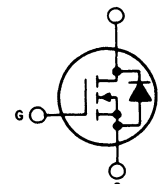
File Number **1494**

RFM6N45, RFM6N50, RFP6N45, RFP6N50

N-Channel Enhancement-Mode Power Field-Effect Transistors

6 A, 450 V and 500 V
$r_{DS}(on) = 1.5\ \Omega$

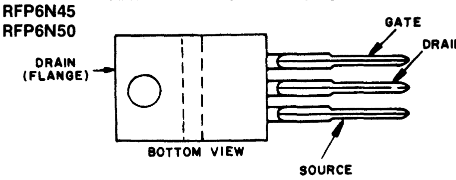
Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-CHANNEL ENHANCEMENT MODE

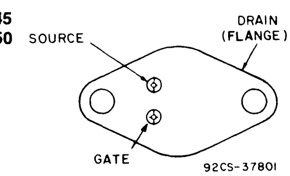
TERMINAL DESIGNATIONS

RFP6N45
RFP6N50



JEDEC TO-220AB
(See dimensional outline "N".)

RFM6N45
RFM6N50



JEDEC TO-204MA
(See dimensional outline "A".)

The RFM6N45 and RFM6N50 and the RFP6N45 and RFP6N50* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-series types are supplied in the JEDEC TO-204MA steel package and the RFP-series types in the JEDEC TO-220AB plastic package.

*The RFM and RFP series were formerly RCA developmental numbers TA9191 and TA9231, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

	RFM6N45	RFM6N50		RFP6N45	RFP6N50	
DRAIN-SOURCE VOLTAGE .... V_{DSS}	450	500		450	500	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ) .... V_{DGR}	450	500		450	500	V
GATE-SOURCE VOLTAGE .... V_{GS}			±20			V
DRAIN CURRENT, RMS Continuous ...... I_D			6			A
Pulsed .... I_{DM}			15			A
POWER DISSIPATION @ T_C=25°C .... P_T	100	100		75	75	W
Derate above T_C=25° C	0.8	0.8		0.6	0.6	W/°C
OPERATING AND STORAGE TEMPERATURE .... T_j, T_{stg}			-55 to +150			°C

RFM6N45, RFM6N50, RFP6N45, RFP6N50

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25°C unless otherwise specified.*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFM6N45 RFP6N45 MIN.	LIMITS RFM6N45 RFP6N45 MAX.	LIMITS RFM6N50 RFP6N50 MIN.	LIMITS RFM6N50 RFP6N50 MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D = 1mA V_{GS}=0	450	—	500	—	V
Gate Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS} I_D=1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=360 V V_{DS}=400 V	— —	10 —	— —	— 10	μA
		T_C=125°C V_{DS}=360 V V_{DS}=400 V	— —	50 —	— —	— 50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=3 A V_{GS}=10 V	—	4.5	—	4.5	V
		I_D=6 A V_{GS}=10 V	—	12	—	12	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=3 A V_{GS}=10 V	—	1.5	—	1.5	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V I_D=3 A	2	—	2	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	1500	—	1500	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	250	—	250	
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	100	—	100	
Turn-On Delay Time	$t_d(on)$	V_{DD} = 250 V	15(typ)	45	15(typ)	45	ns
Rise Time	t_r	I_D=3 A	40(typ)	80	40(typ)	80	
Turn-Off Delay Time	$t_d(off)$	R_{gen}=R_{gs}=50 Ω	190(typ)	300	190(typ)	300	
Fall Time	t_f	V_{GS}=10 V	60(typ)	100	60(typ)	100	
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFM6N45, RFM6N50	—	1.25	—	1.25	°C/W
		RFP6N45, RFP6N50	—	1.67	—	1.67	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM6N45 RFP6N45 Min.	LIMITS RFM6N45 RFP6N45 Max.	LIMITS RFM6N50 RFP6N50 Min.	LIMITS RFM6N50 RFP6N50 Max.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD} = 3A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F = 4A d_{IF}/d_t = 100A/μs	800(typ.)		800(typ.)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM6N45, RFM6N50, RFP6N45, RFP6N50

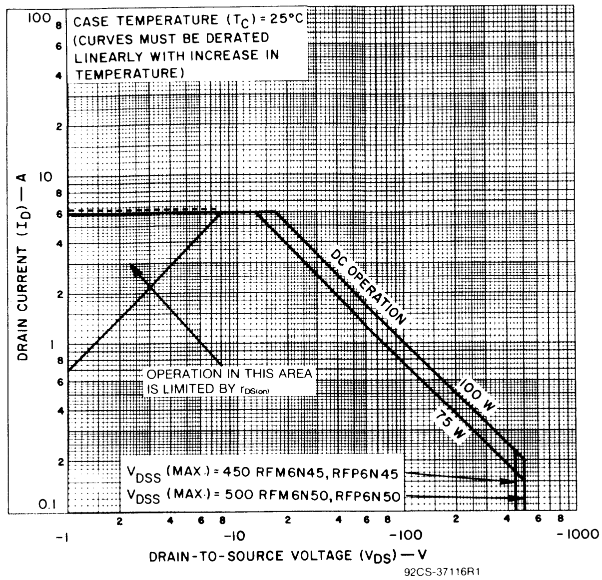


Fig. 1 — Maximum operating areas for all types.

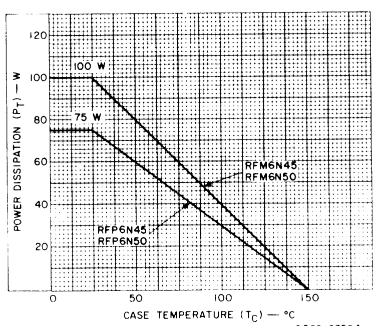


Fig. 2 — Power dissipation vs. temperature derating curve for all types.

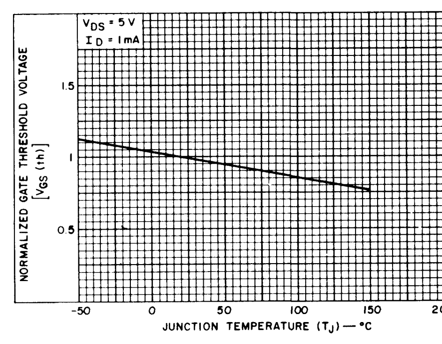


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

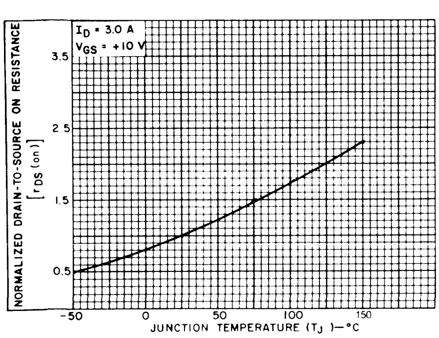


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types

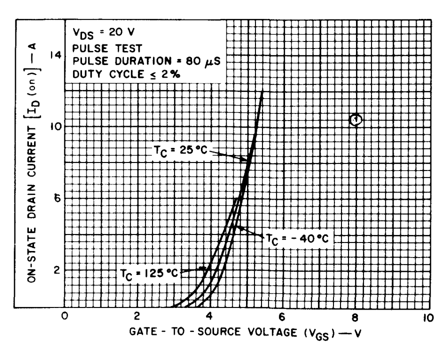


Fig. 5 — Typical transfer characteristics for all types.

RFM6N45, RFM6N50, RFP6N45, RFP6N50

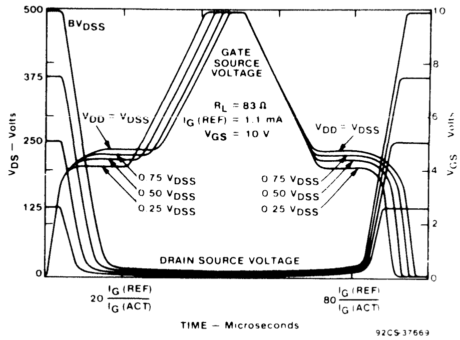


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

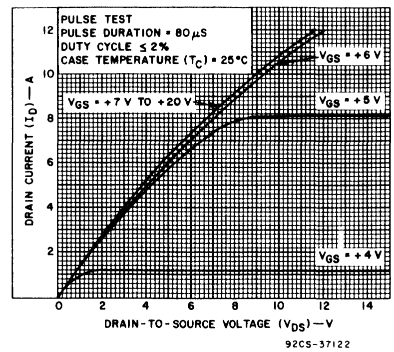


Fig. 7 — Typical saturation characteristics for all types.

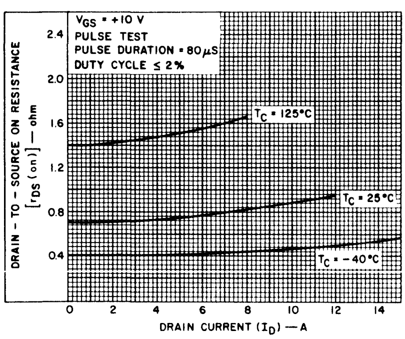


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

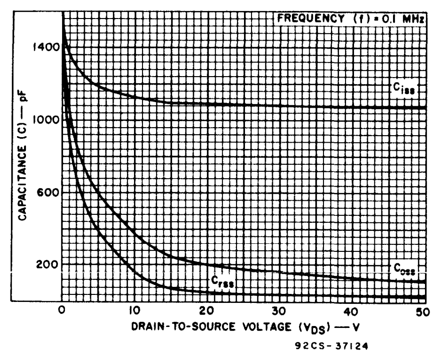


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

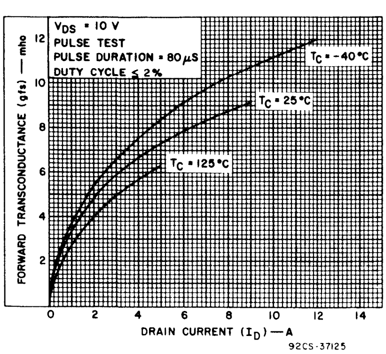


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

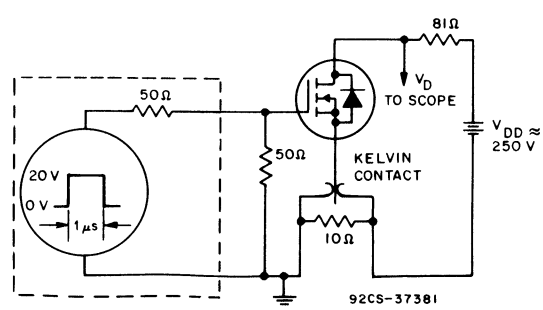


Fig. 11 — Switching Time Test Circuit.

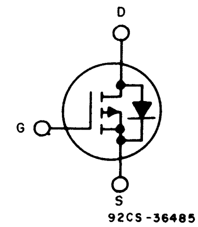
File Number **1496**

RFM8P08, RFM8P10, RFP8P08, RFP8P10

P-Channel Enhancement-Mode Power Field-Effect Transistors

8 A, -80 V and -100 V
$r_{DS}(on)$ = 0.4 Ω

Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



P-CHANNEL ENHANCEMENT MODE

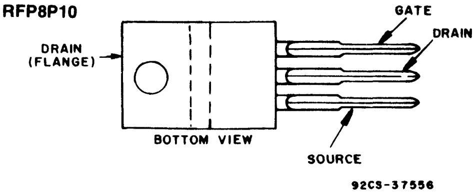
The RFM8P08 and RFM8P10 and the RFP8P08 and RFP8P10* are p-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-types are supplied in the JEDEC TO-204MA steel package and the RFP-types in the JEDEC TO-220AB plastic package.

*The RFM and RFP series were formerly RCA developmental numbers TA9410 and TA9411, respectively.

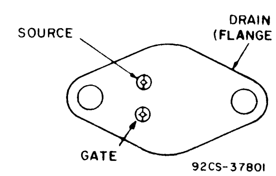
TERMINAL DESIGNATIONS

RFP8P08
RFP8P10



JEDEC TO-220AB
(See dimensional outline "N".)

RFM8P08
RFM8P10



JEDEC TO-204MA
(See dimensional outline "A".)

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFM8P08	RFM8P10		RFP8P08	RFP8P10	
DRAIN-SOURCE VOLTAGE	V_{DSS}	-80	-100		-80	-100	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ)	V_{DGR}	-80	-100		-80	-100	V
GATE-SOURCE VOLTAGE	V_{GS}			±20			V
DRAIN CURRENT, RMS Continuous	I_D			8			A
Pulsed	I_{DM}			20			A
POWER DISSIPATION @ T_C=25°C	P_T	100	100		75	75	W
Derate above T_C=25°C		0.8	0.8		0.6	0.6	W/°C
OPERATING AND STORAGE TEMPERATURE	T_J, T_{stg}			-55 to +150			°C

RFM8P08, RFM8P10, RFP8P08, RFP8P10

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFM8P08 RFP8P08 MIN.	MAX.	RFM8P10 RFP8P10 MIN.	MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA V_{GS}=0	-80	—	-100	—	V
Gate Threshold Voltage	$V_{GS}(th)$	$V_{GS}=V_{DS}$ I_D=1 mA	-2	-4	-2	-4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=-65 V V_{DS}=-80 V	— —	1 —	— —	— 1	μA
		T_C=125° C V_{DS}=-65 V V_{DS}=-80 V	— —	50 —	— —	— 50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=4 A V_{GS}=-10 V	—	-1.6	—	-1.6	V
		I_D=8 A V_{GS}=-10 V	—	-4.0	—	-4.0	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=4 A V_{GS}=-10 V	—	.4	—	.4	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=-10 V I_D=4 A	2	—	2	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	1500	—	1500	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	700	—	700	
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	240	—	240	
Turn-On Delay Time	$t_d(on)$	V_{DD} = 50 V	18(typ)	60	18(typ)	60	ns
Rise Time	t_r	I_D=4 A	70(typ)	150	70(typ)	150	
Turn-Off Delay Time	$t_d(off)$	$R_{gen}=R_{gs}$=50 Ω	166(typ)	275	166(typ)	275	
Fall Time	t_f	V_{GS}=-10 V	94(typ)	175	94(typ)	175	
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFM8P08, RFM8P08	—	1.25	—	1.25	°C/W
		RFP8P10, RFP8P10	—	1.67	—	1.67	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM8P08 RFP8P08 Min.	Max.	RFM8P10 RFP8P10 Min.	Max.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD} = 4A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F = 4A d_{IF}/d_t = 100A/μs	200(typ.)		200(typ.)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM8P08, RFM8P10, RFP8P08, RFP8P10

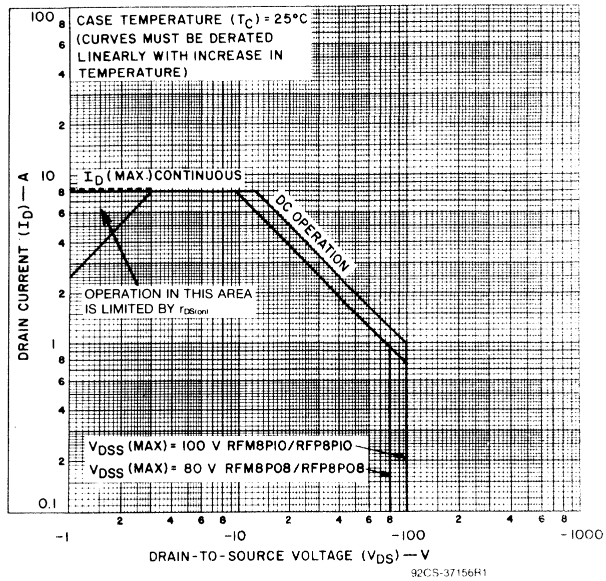


Fig. 1 — Maximum operating areas for all types.

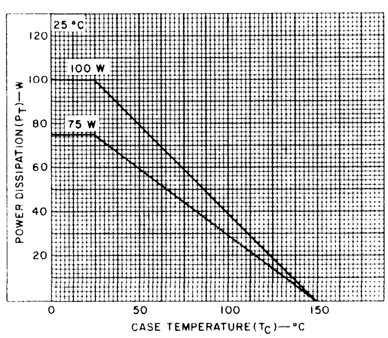


Fig. 2 — Power dissipation vs. case temperature derating curve for all types.

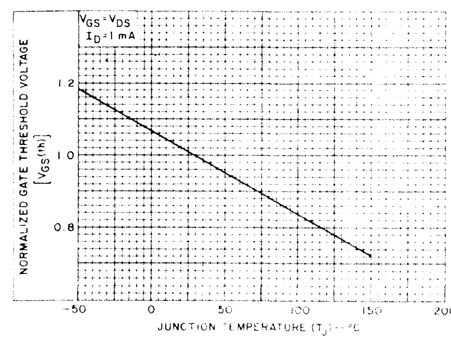


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

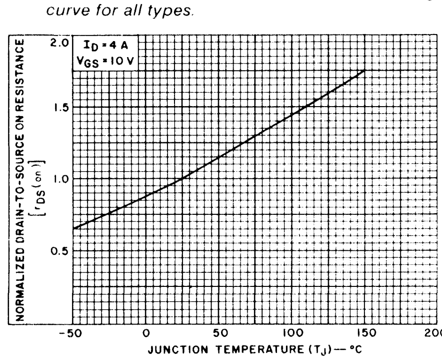


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

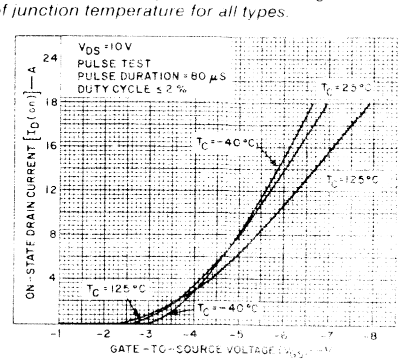


Fig. 5 — Typical transfer characteristics for all types.

RFM8P08, RFM8P10, RFP8P08, RFP8P10

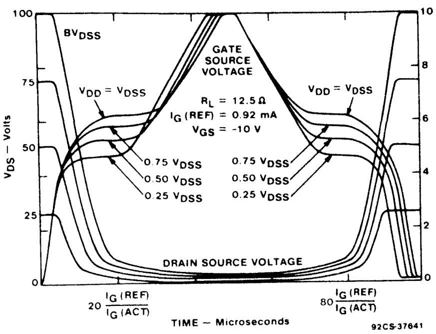


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

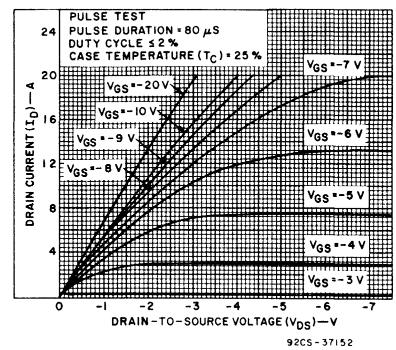


Fig. 7 — Typical saturation characteristics for all types.

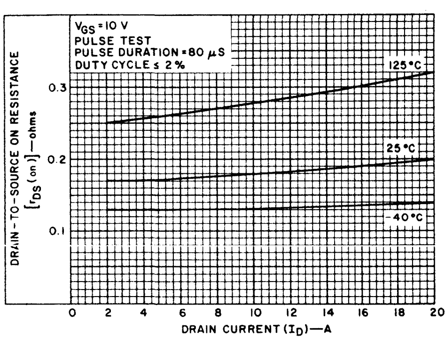


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

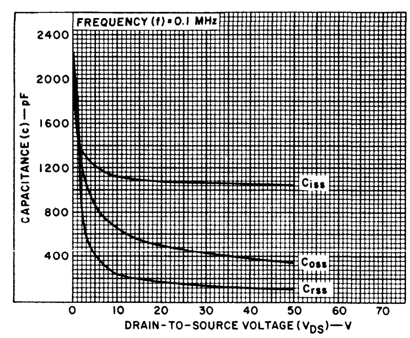


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

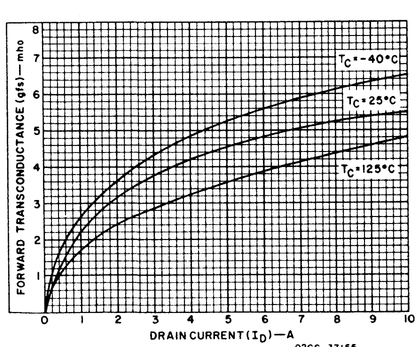


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

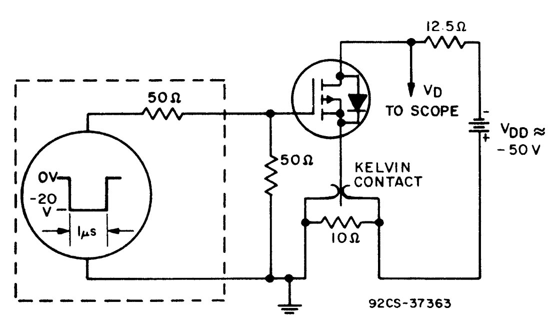


Fig. 11 — Switching Time Test Circuit.

File Number **1447**

RFM8N18, RFM8N20, RFP8N18, RFP8N20

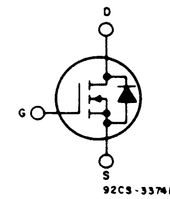
N-Channel Enhancement-Mode Power Field-Effect Transistors

8 A, 180 V — 200 V

$r_{DS}(on)$: 0.5 Ω

Features:

- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-Channel Enhancement Mode

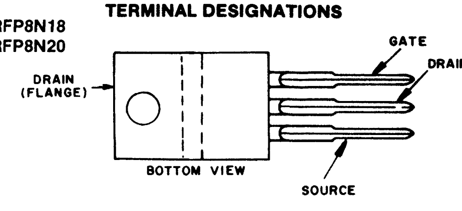
The RFM8N18 and RFM8N20 and the RFP8N18 and RFP8N20* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-types are supplied in the JEDEC TO-204MA steel package and the RFP-types in the JEDEC TO-220AB plastic package.

*The RFM and RFP series were formerly RCA developmental numbers TA9291 and TA9292, respectively.

TERMINAL DESIGNATIONS

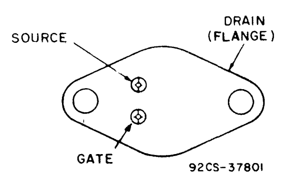
RFP8N18
RFP8N20



JEDEC TO-220AB

(See dimensional outline "N".)

RFM8N18
RFM8N20



JEDEC TO-204MA

(See dimensional outline "A".)

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25°C):*

		RFM8N18	RFM8N20	RFP8N18	RFP8N20	
DRAIN-SOURCE VOLTAGE	V_{DSS}	180	200	180	200	V
DRAIN-GATE VOLTAGE (R_{GS} = 1MΩ)	V_{DGR}	180	200	180	200	V
GATE-SOURCE VOLTAGE	V_{GS}	±20				V
DRAIN CURRENT RMS Continuous	I_D	8				A
Pulsed	I_{DM}	20				A
POWER DISSIPATION						
@ T_C = 25°C	P_T	75	75	60	60	W
Derate above T_C = 25°C		0.6	0.6	0.48	0.48	W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}	-55 to +150				°C

RFM8N18, RFM8N20, RFP8N18, RFP8N20

ELECTRICAL CHARACTERISTICS *At Case Temperature (T_c) = 25° C unless otherwise specified*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFM8N18 RFP8N18 MIN.	MAX.	LIMITS RFM8N20 RFP8N20 MIN.	MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D = 1 mA, V_{GS} = 0	180	—	200	—	V
Gate Threshold Voltage	$V_{GS(th)}$	V_{GS} = V_{DS}, I_D = 1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 145 V	—	1	—	—	μA
		V_{DS} = 160 V	—	—	—	1	
		T_C = 125° C, V_{DS} = 145 V	—	50	—	—	
		T_C = 125° C, V_{DS} = 160 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS} = ± 20 V, V_{DS} = 0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D = 4 A, V_{GS} = 10 V	—	2.0	—	2.0	V
		I_D = 8 A, V_{GS} = 10 V	—	5.5	—	5.5	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D = 4 A, V_{GS} = 10 V	—	0.5	—	0.5	Ω
Forward Transconductance	g_{fs}[a]	V_{DS} = 10 V, I_D = 4 A	1.5	—	1.5	—	mho
Input Capacitance	C_{iss}	V_{DS} = 25 V, V_{GS} = 0 V, f = 0.1MHz	—	750	—	750	pF
Output Capacitance	C_{oss}		—	250	—	250	
Reverse Transfer Capacitance	C_{rss}		—	70	—	70	
Turn-On Delay Time	$t_d(on)$	V_{DD} = 100 V, I_D = 4 A, R_{gen} = R_{gs} = 50 Ω, V_{GS} = 10 V	30(typ.)	45	30(typ.)	45	ns
Rise Time	t_r		100(typ.)	150	100(typ.)	150	
Turn-Off Delay Time	$t_d(off)$		90(typ.)	135	90(typ.)	135	
Fall Time	t_f		70(typ.)	105	70(typ.)	105	
Thermal Resistance Junction-to-Case	$R\theta JC$	RFM8N18, RFM8N20	—	1.67	—	1.67	°C/W
		RFP8N18, RFP8N20	—	2.083	—	2.083	

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM8N18, RFM8N20, RFP8N18, RFP8N20

ELECTRICAL CHARACTERISTICS (cont'd)

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFM8N18 RFP8N18		RFM8N20 RFP8N20		
			Min.	Max.	Min.	Max.	
Diode Forward Voltage	V_{SD} [a]	I_{SD} = 4A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F = 4A d_{IF}/d_t = 100A/µs	225(typ.)		225(typ.)		ns

[a]Pulsed: Pulse duration = 300 µs max., duty cycle = 2%.

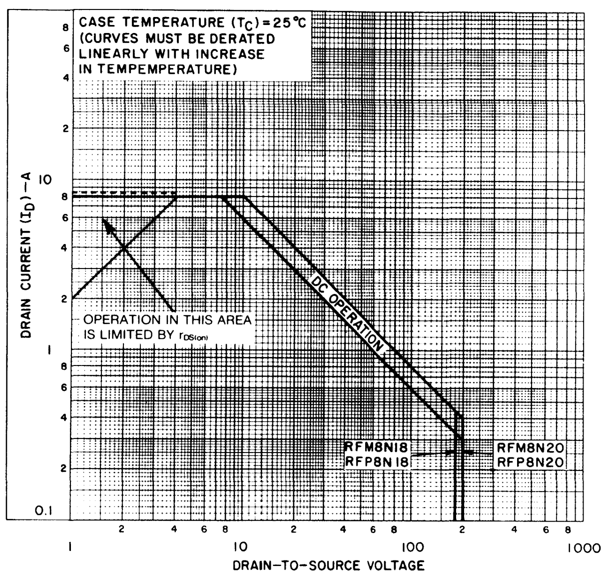


Fig. 1 — Maximum safe operating areas for all types.

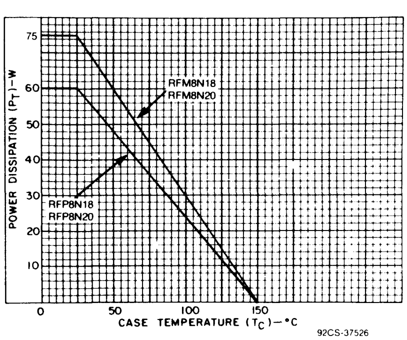


Fig. 2 — Power vs. temperature derating curve for all types.

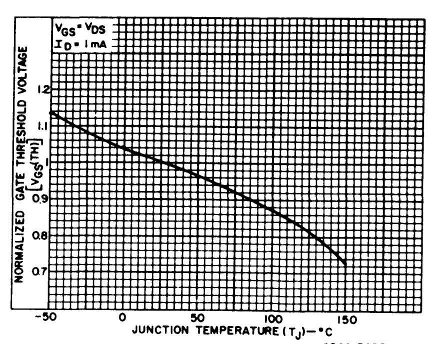


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

RFM8N18, RFM8N20, RFP8N18, RFP8N20

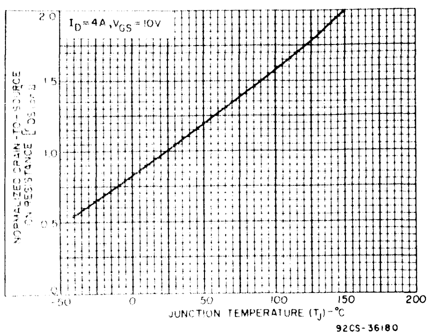


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

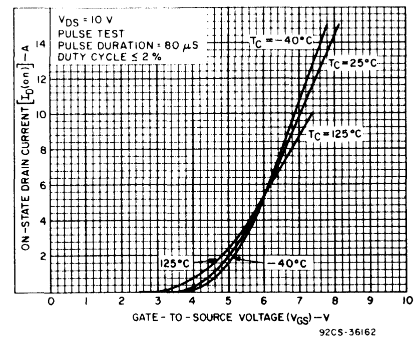


Fig. 5 — Typical transfer characteristics for all types.

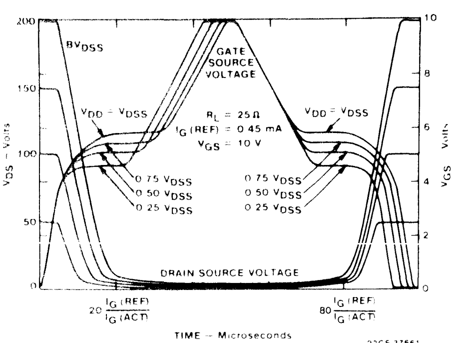


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

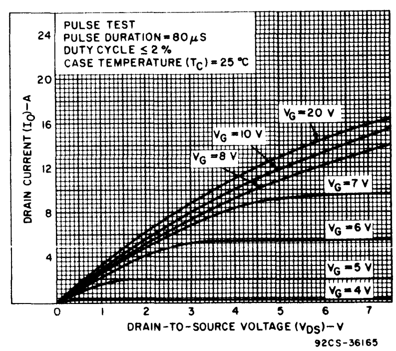


Fig. 7 — Typical saturation characteristics for all types.

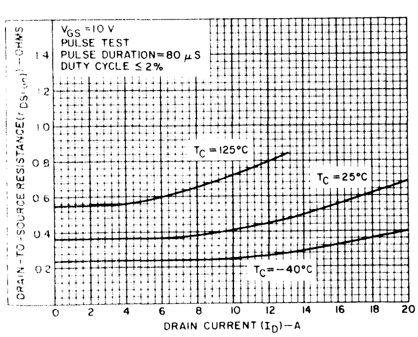


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

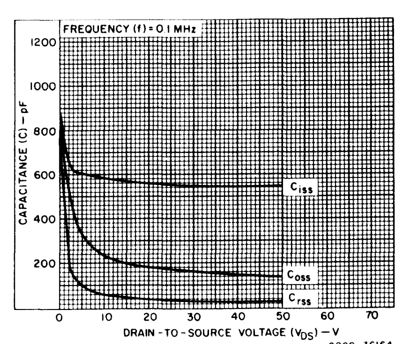


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

RFM8N18, RFM8N20, RFP8N18, RFP8N20

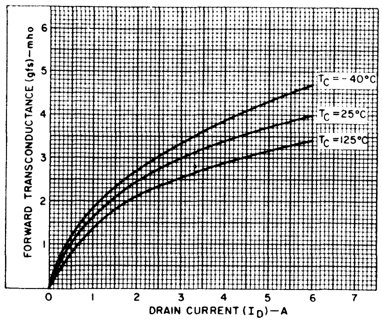


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

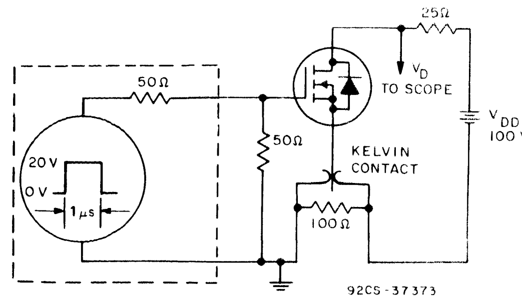


Fig. 11 — Switching Time Test Circuit.

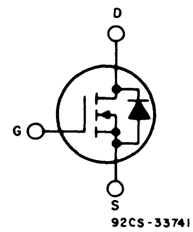
RFK10N45, RFK10N50

File Number **1493**

N-Channel Enhancement-Mode Power Field-Effect Transistors

10 A, 450 V - 500 V
$r_{DS}(on) = 0.85\ \Omega$

Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



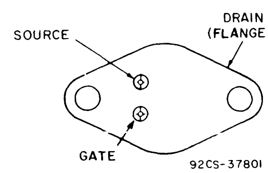
N-CHANNEL ENHANCEMENT MODE

The RFK10N45 and RFK10N50* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFK-types are supplied in the JEDEC TO-204AE steel package.

*The RFK10N45 and RFK10N50 types were formerly RCA developmental numbers TA9189A and TA9189B, respectively.

TERMINAL DESIGNATIONS



JEDEC TO-204AE
(See dimensional outline "D")

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFK10N45		RFK10N50	
DRAIN-SOURCE VOLTAGE	V_{DSS}	450		500	V
DRAIN-GATE VOLTAGE, R_{gs}=1 MΩ	V_{DGR}	450		500	V
GATE-SOURCE VOLTAGE	V_{GS}		±20		V
DRAIN CURRENT, RMS Continuous	I_D		10		A
Pulsed	I_{DM}		20		A
POWER DISSIPATION @ T_C=25°C	P_T		150		W
Derate above T_C=25°C			1.2		W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}		-55 to +150		°C

RFK10N45, RFK10N50

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFK10N45 MIN.	LIMITS RFK10N45 MAX.	LIMITS RFK10N50 MIN.	LIMITS RFK10N50 MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D = 1mA V_{GS}=0	450	—	500	—	V
Gate Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS} I_D=1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=360 V	—	10	—	—	μA
		V_{DS}=400 V	—	—	—	10	μA
		T_C=125°C V_{DS}=360 V	—	50	—	—	μA
		V_{DS}=400 V	—	—	—	50	μA
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=5 A V_{GS}=10 V	—	4.25	—	4.25	V
		I_D=10 A V_{GS}=10 V	—	10	—	10	V
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=5 A V_{GS}=10 V	—	0.85	—	0.85	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V I_D=5 A	5	—	5	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	3000	—	3000	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	600	—	600	pF
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	200	—	200	pF
Turn-On Delay Time	$t_d(on)$	V_{DD} = 0.5 BV_{DSS}	26(typ)	60	26(typ)	60	ns
Rise Time	t_r	I_D=5 A	50(typ)	100	50(typ)	100	ns
Turn-Off Delay Time	$t_d(off)$	R_{gen}=R_{gs}=50 Ω	525(typ)	900	525(typ)	900	ns
Fall Time	t_f	V_{GS}=10 V	105(typ)	180	105(typ)	180	ns
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFK10N45, RFK10N50 Series	—	0.83	—	0.83	°C/W

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFK10N45 Min.	LIMITS RFK10N45 Max.	LIMITS RFK10N50 Min.	LIMITS RFK10N50 Max.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD} = 5A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F = 4A d_{IF}/d_t = 100A/μs	950(typ.)		950(typ.)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFK10N45, RFK10N50

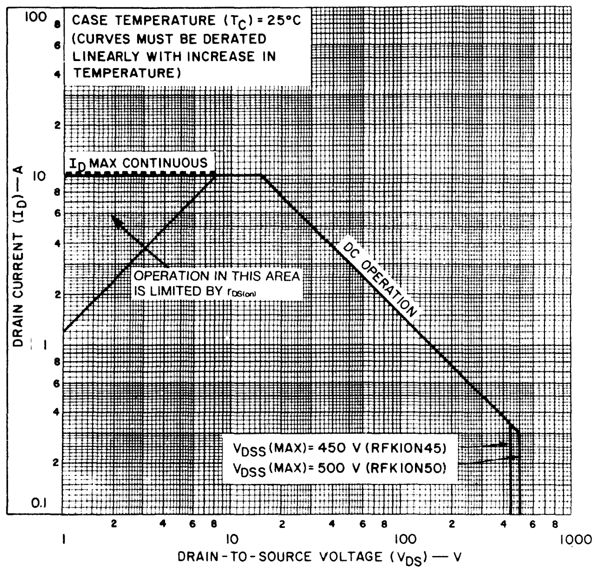


Fig. 1 — Maximum safe operating areas for all types.

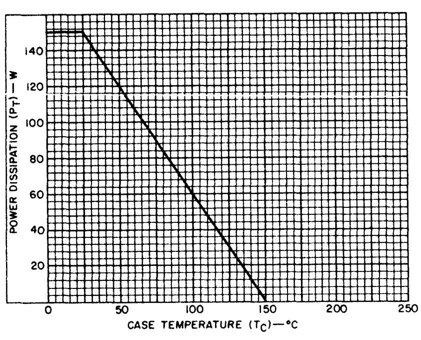


Fig. 2 — Power vs. temperature derating curve for all types.

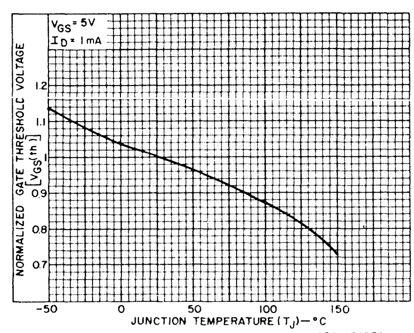


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

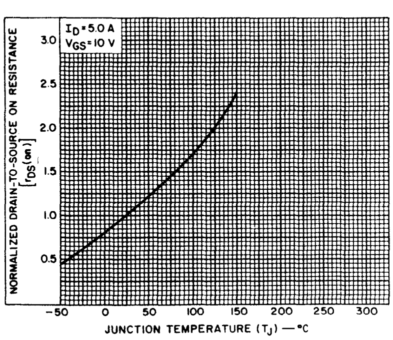


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

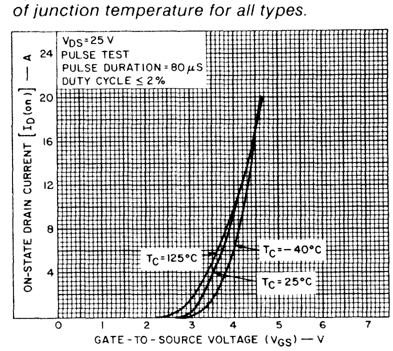


Fig. 5 — Typical transfer characteristics for all types.

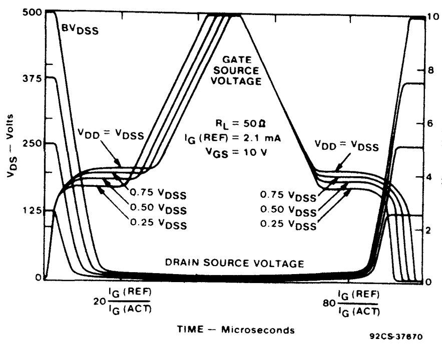


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

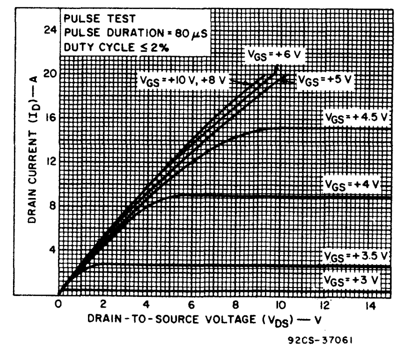


Fig. 7 — Typical saturation characteristics for all types.

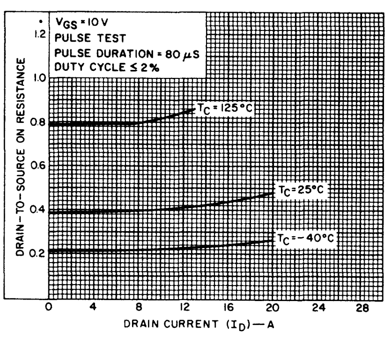


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

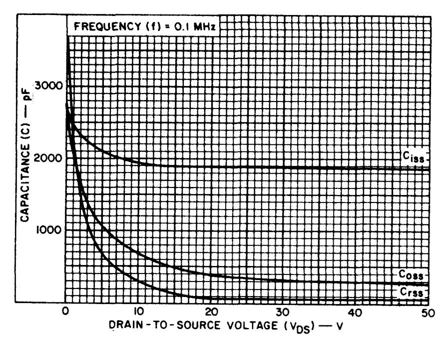


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

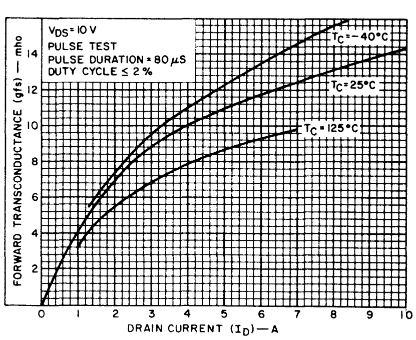


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

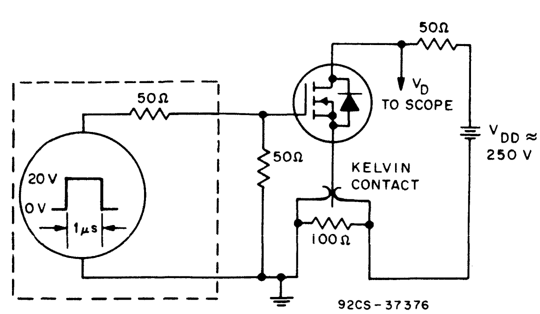


Fig. 11 - Switching Time Test Circuit.

RFM10N12, RFM10N15, RFP10N12, RFP10N15

File Number **1445**

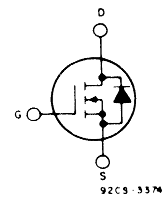
N-Channel Enhancement-Mode Power Field-Effect Transistors

10 A, 120 V — 150 V

$r_{DS}(on)$: 0.3 Ω

Features:

- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-Channel Enhancement Mode

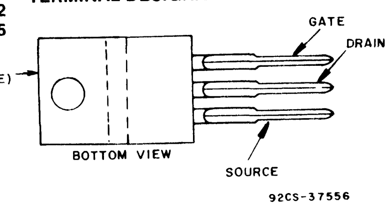
The RFM10N12 and RFM10N15 and the RFP10N12 and RFP10N15* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-types are supplied in the JEDEC TO-204MA steel package and the RFP-types in the JEDEC TO-220AB plastic package.

*The RFM and RFP series were formerly RCA developmental numbers TA9192 and TA9212, respectively.

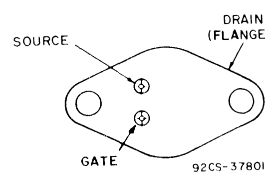
TERMINAL DESIGNATIONS

RFP10N12
RFP10N15



JEDEC TO-220AB
(See dimensional outline "N".)

RFM10N12
RFM10N15



JEDEC TO-204MA
(See dimensional outline "A".)

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFM10N12	RFM10N15		RFP10N12	RFP10N15	
DRAIN-SOURCE VOLTAGE	V_{DSS}	120	150		120	150	V
DRAIN-GATE VOLTAGE (R_{GS}=1 MΩ)	V_{DGR}	120	150		120	150	V
GATE-SOURCE VOLTAGE	V_{GS}			±20			V
DRAIN CURRENT, RMS Continuous	I_D			10			A
Pulsed	I_{DM}			25			A
POWER DISSIPATION @ T_C=25°C	P_T	75	75		60	60	W
Derate above T_C=25°C		0.6	0.6		0.48	0.48	W/°C
OPERATING AND STORAGE TEMPERATURE	T_J, T_{stg}			-55 to +150			°C

RFM10N12, RFM10N15, RFP10N12, RFP10N15

ELECTRICAL CHARACTERISTICS *At Case Temperature (T_c) = 25° C unless otherwise specified*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFM10N12 RFP10N12 MIN.	LIMITS RFM10N12 RFP10N12 MAX.	LIMITS RFM10N15 RFP10N15 MIN.	LIMITS RFM10N15 RFP10N15 MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D = 1 mA, V_{GS} = 0	120	—	150	—	V
Gate Threshold Voltage	$V_{GS(th)}$	V_{GS} = V_{DS}, I_D = 2 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 100 V	—	1	—	—	μA
		V_{DS} = 120 V	—	—	—	1	
		T_C = 125°C, V_{DS} = 100 V	—	50	—	—	
		T_C = 125°C, V_{DS} = 120 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS} = ± 20 V, V_{DS} = 0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D = 5 A, V_{GS} = 10 V	—	1.5	—	1.5	V
		I_D = 10 A, V_{GS} = 10 V	—	4	—	4	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D = 5 A, V_{GS} = 10 V	—	0.3	—	0.3	Ω
Forward Transconductance	g_{fs}[a]	V_{DS} = 10 V, I_D = 5 A	2	—	2	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	650	—	650	pF
Output Capacitance	C_{oss}	V_{GS} = 0 V	—	230	—	230	
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	60	—	60	
Turn-On Delay Time	$t_d(on)$	V_{DD}=75 V	40(typ.)	60	40(typ.)	60	ns
Rise Time	t_r	I_D = 5 A	165(typ.)	250	165(typ.)	250	
Turn-Off Delay Time	$t_d(off)$	R_{gen} = R_{gs} = 50 Ω	90(typ.)	135	90(typ.)	135	
Fall Time	t_f	V_{GS} = 10 V	90(typ.)	135	90(typ.)	135	
Thermal Resistance Junction-to-Case	$R\theta JC$	RFM10N12, RFM10N15	—	1.67	—	1.67	°C/W
		RFP10N12, RFP10N15	—	2.083	—	2.083	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM10N12 RFP10N12 MIN.	LIMITS RFM10N12 RFP10N12 MAX.	LIMITS RFM10N15 RFP10N15 MIN.	LIMITS RFM10N15 RFP10N15 MAX.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD}=5 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A, d_{IF}/d_t=100 A/μs	200(typ)		200(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM10N12, RFM10N15, RFP10N12, RFP10N15

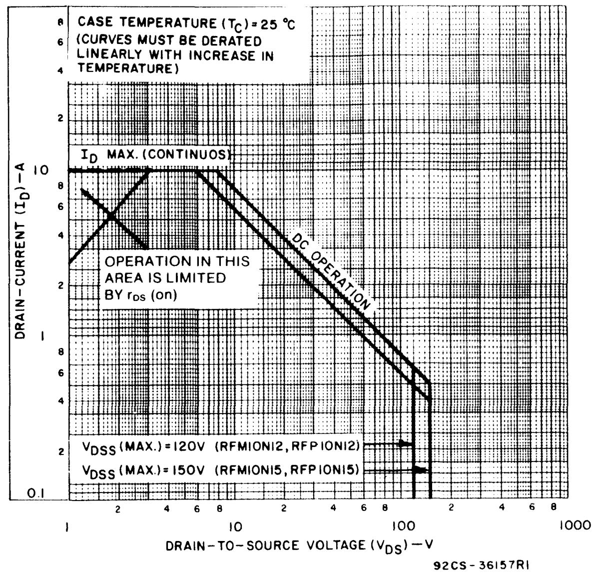


Fig. 1 — Maximum safe operating areas for all types.

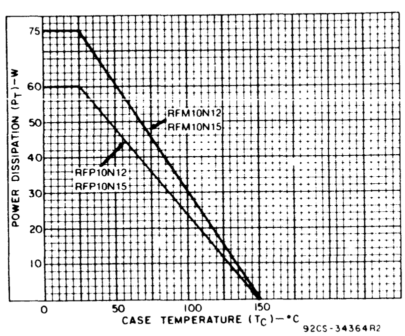


Fig. 2 — Power vs. temperature derating curve for all types.

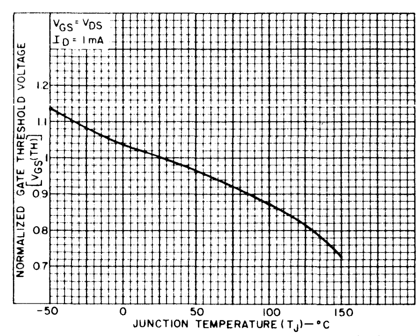


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

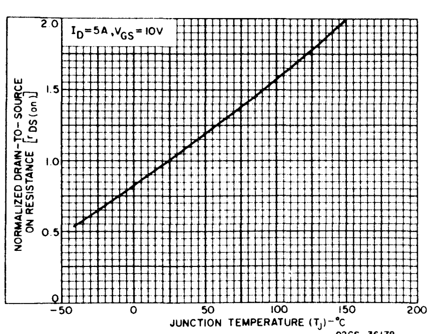


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

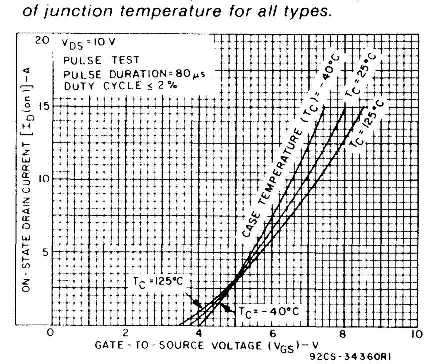


Fig. 5 — Typical transfer characteristics for all types.

RFM10N12, RFM10N15, RFP10N12, RFP10N15

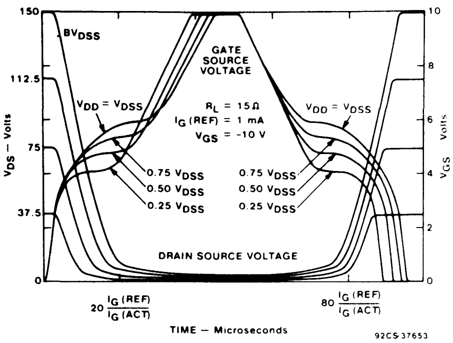


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

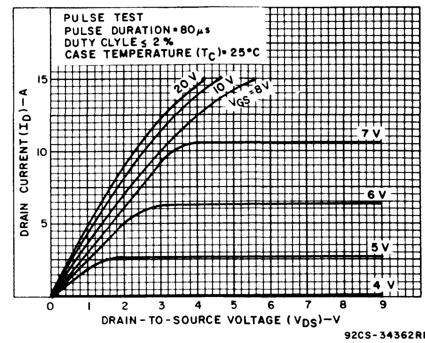


Fig. 7 — Typical saturation characteristics for all types.

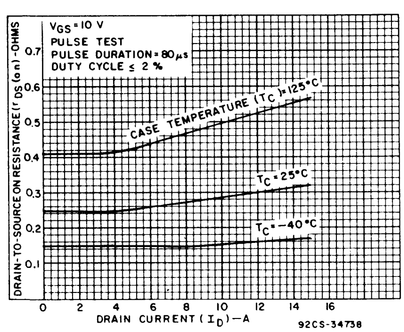


Fig. 8 - Typical drain-to-source on resistance as a function drain current for all types.

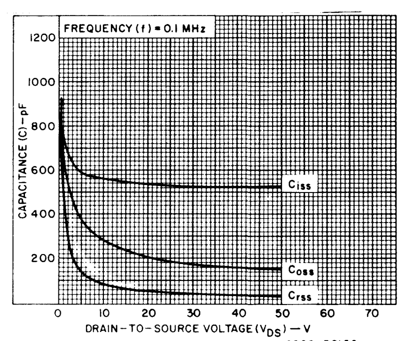


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

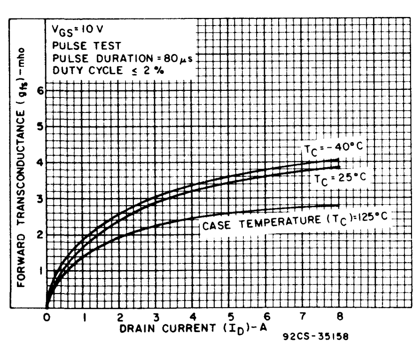


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

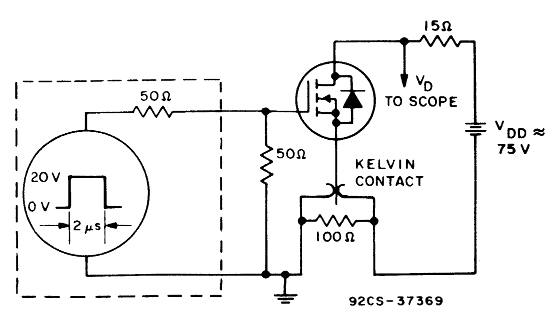


Fig. 11 — Switching Time Test Circuit

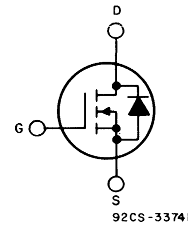
RFM12N08, RFM12N10, RFP12N08, RFP12N10 File Number **1386**

N-Channel Enhancement-Mode Power Field-Effect Transistors

12 A, 80 and 100 V

$r_{DS\ (on)}$: 0.2 Ω

Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-CHANNEL ENHANCEMENT MODE

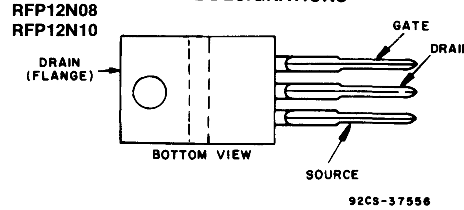
The RFM12N08 and RFM12N10 and the RFP12N08 and RFP12N10 are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-series types are supplied in the JEDEC TO-204MA steel package and the RFP-series types in the JEDEC TO-220AB plastic package.

The RFM and RFP series were formerly RCA developmental numbers TA9284 and TA9285.

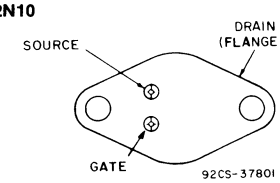
TERMINAL DESIGNATIONS

RFP12N08
RFP12N10



JEDEC TO-220AB
(See dimensional outline "N".)

RFM12N08
RFM12N10



JEDEC TO-204MA
(See dimensional outline "A".)

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

	RFM12N08	RFM12N10		RFP12N08	RFP12N10	
DRAIN-SOURCE VOLTAGE .... V_{DSS}	80	100		80	100	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ) ... V_{DGR}	80	100		80	100	V
GATE-SOURCE VOLTAGE .... V_{GS}			±20			V
DRAIN CURRENT, RMS Continuous ..... I_D			12			A
Pulsed .... I_{DM}			30			A
POWER DISSIPATION @ T_C=25°C .... P_T	75	75		60	60	W
Derate above T_C=25°C	0.6	0.6		0.48	0.48	W/°C
OPERATING AND STORAGE TEMPERATURE .... T_j, T_{stg}			-55 to +150			°C

RFM12N08, RFM12N10, RFP12N08, RFP12N10

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_c)=25° C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM12N08 RFP12N08 Min.	Max.	RFM12N10 RFP12N10 Min.	Max.	UNITS
Drain Source Breakdown Voltage	BV_{DSS}	I_D=1 mA V_{GS}=0	80	—	100	—	V
Gate-Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS} I_D=1 mA	2	4	2	4	V
Zero-Gate Voltage Drain Current	I_{DSS}	V_{DS}=65 V	—	1	—	—	μA
		V_{DS}=80 V	—	—	—	1	
		T_C=125° C V_{DS}=65 V	—	50	—	—	
		V_{DS}=80 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=6 A V_{GS}=10 V	—	1.2	—	1.2	V
		I_D=12 A V_{GS}=10 V	—	3.3	—	3.3	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=6 A V_{GS}=10 V	—	0.2	—	0.2	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V I_D=6 A	2	—	2	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	650	—	650	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	300	—	300	
Reverse-Transfer Capacitance	C_{rss}	f=0.1 MHz	—	100	—	100	
Turn-On Delay Time	$t_d(on)$	V_{DD}=50 V	45(Typ)	70	45(Typ)	70	ns
Rise Time	t_r	I_D=6 A	250(Typ)	375	250(Typ)	375	
Turn-Off Delay Time	$t_d(off)$	R_{gen}=R_{gs}=50 Ω	85(Typ)	130	85(Typ)	130	
Fall Time	t_f	V_{GS}=10 V	100(Typ)	150	100(Typ)	150	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	RFM12N08, RFM12N10	—	1.67	—	1.67	°C/W
		RFP12N08, RFP12N10	—	2.083	—	2.083	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM12N08 RFM12N10 MIN.	MAX.	RFP12N08 RFP12N10 MIN.	MAX.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD}=6 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A d_{IF}/d_t=100 A/μs	150(typ)		150(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM12N08, RFM12N10, RFP12N08, RFP12N10

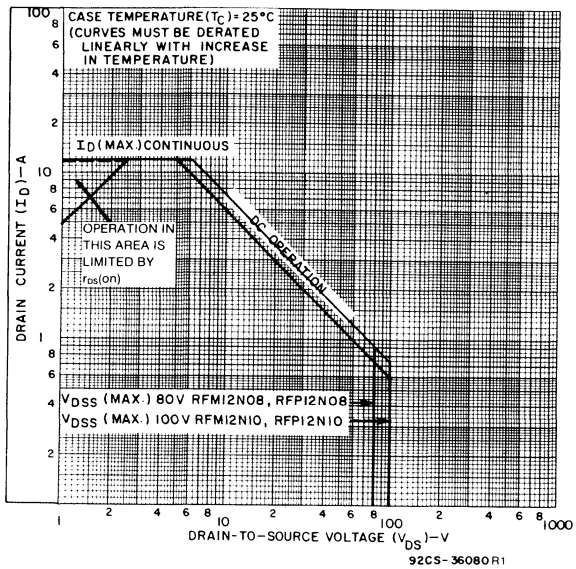


Fig. 1 - Maximum operating areas for all types.

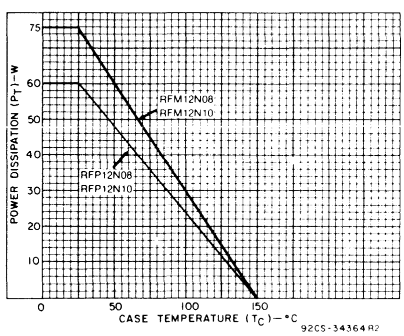


Fig. 2 - Power dissipation vs. temperature derating curve for all types.

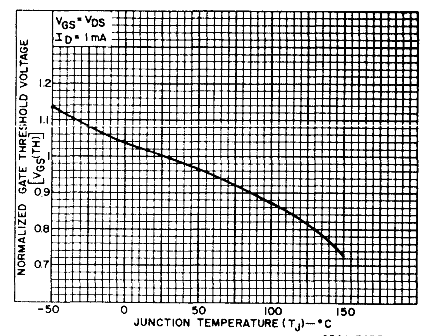


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

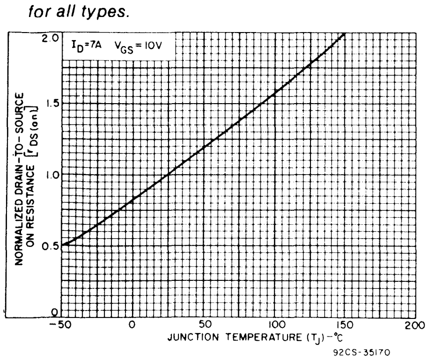


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

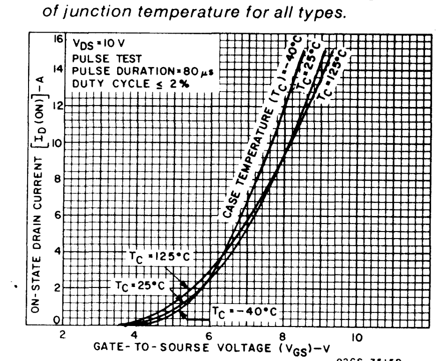


Fig. 5 - Typical transfer characteristics for all types.

RFM12N08, RFM12N10, RFP12N08, RFP12N10

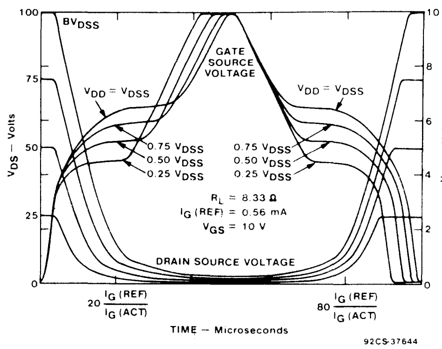


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

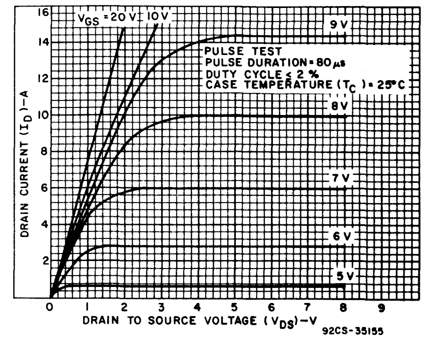


Fig. 7 - Typical saturation characteristics for all types.

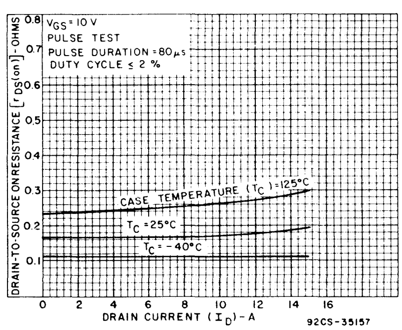


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

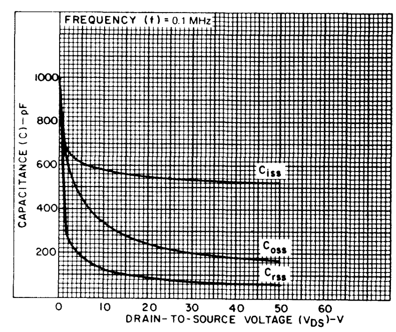


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

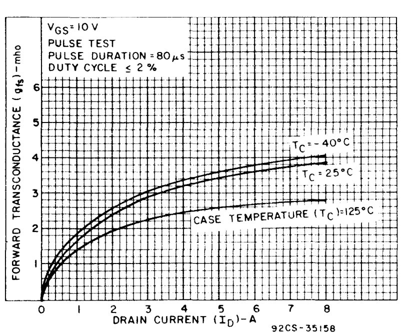


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

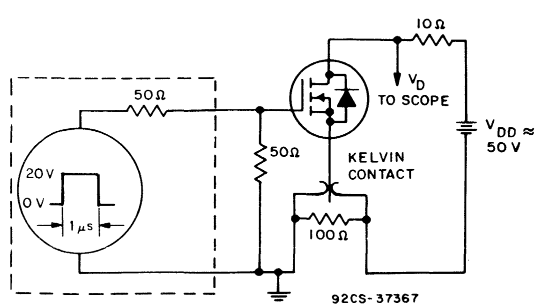


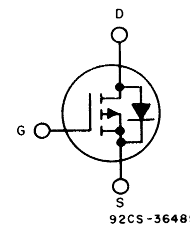
Fig. 11 — Switching Time Test Circuit

RFM12P08, RFM12P10, RFP12P08, RFP12P10 File Number **1495**

P-Channel Enhancement-Mode Power Field-Effect Transistors

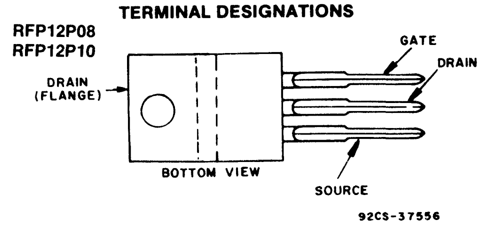
12 A, -80 V and -100 V
$r_{DS}(on)$ = 0.3 Ω

Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*

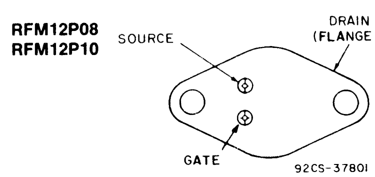


P-CHANNEL ENHANCEMENT MODE

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)



JEDEC TO-204MA
(See dimensional outline "A".)

The RFM12P08 and RFM12P10 and the RFP12P08 and RFP12P10* are p-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-types are supplied in the JEDEC TO-204MA steel package and the RFP-types in the JEDEC TO-220AB plastic package.

*The RFM and RFP series were formerly RCA developmental numbers TA9410 and TA9411, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

	RFM12P08	RFM12P10		RFP12P08	RFP12P10	
DRAIN-SOURCE VOLTAGE .... V_{DSS}	-80	-100		-80	-100	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ) .... V_{DGR}	-80	-100		-80	-100	V
GATE-SOURCE VOLTAGE .... V_{GS}			±20			V
DRAIN CURRENT, RMS Continuous ...... I_D			12			A
Pulsed .... I_{DM}			30			A
POWER DISSIPATION @ T_C=25°C .... P_T	100	100		75	75	W
Derate above T_C=25°C	0.8	0.8		0.6	0.6	W/°C
OPERATING AND STORAGE TEMPERATURE .... T_j, T_{stg}			-55 to +150			°C

RFM12P08, RFM12P10, RFP12P08, RFP12P10

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25°C unless otherwise specified.*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFM12P08 RFP12P08 MIN.	MAX.	RFM12P10 RFP12P10 MIN.	MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA V_{GS}=0	-80	—	-100	—	V
Gate Threshold Voltage	$V_{GS}(th)$	$V_{GS}=V_{DS}$ I_D=1 mA	-2	-4	-2	-4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=-65 V	—	1	—	—	μA
		V_{DS}=-80 V	—	—	—	1	μA
		T_C=125°C V_{DS}=-65 V	—	50	—	—	μA
		V_{DS}=-80 V	—	—	—	50	μA
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=6 A V_{GS}=-10 V	—	-1.8	—	-1.8	V
		I_D=12 A V_{GS}=-10 V	—	-4.8	—	-4.8	V
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=6 A V_{GS}=-10 V	—	.3	—	.3	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=-10 V I_D=6 A	2	—	2	—	mho
Input Capacitance	C_{iss}	V_{DS}=-25 V	—	1500	—	1500	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	700	—	700	pF
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	240	—	240	pF
Turn-On Delay Time	$t_d(on)$	V_{DD}=50 V	18(typ)	60	18(typ)	60	ns
Rise Time	t_r	I_D=6 A	90(typ)	175	90(typ)	175	ns
Turn-Off Delay Time	$t_d(off)$	$R_{gen}=R_{gs}$=50 Ω	144(typ)	275	144(typ)	275	ns
Fall Time	t_f	V_{GS}=-10 V	94(typ)	175	94(typ)	175	ns
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFM12P08, RFM12P10	—	1.25	—	1.25	°C/W
		RFP12P08, RFP12P10	—	1.67	—	1.67	°C/W

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM12P08 RFP12P08 MIN.	MAX.	RFM12P10 RFP12P10 MIN.	MAX.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD}=6 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A d_{IF}/d_t=100 A/μs	200(typ)		200(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM12P08, RFM12P10, RFP12P08, RFP12P10

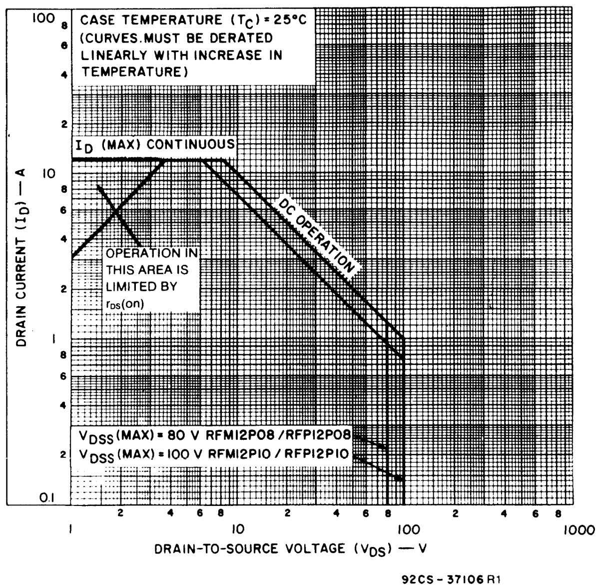


Fig. 1 — Maximum safe operating areas for all types.

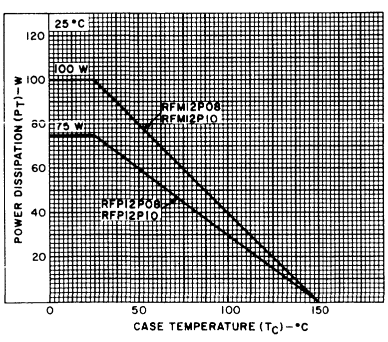


Fig. 2 — Power dissipation vs. case temperature derating curve for all types.

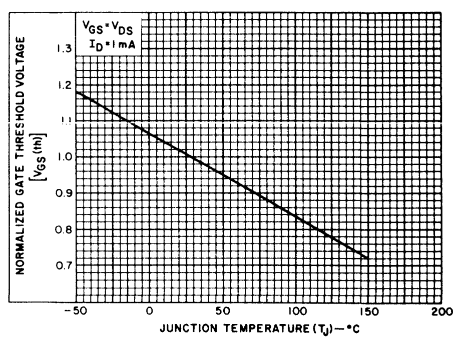


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

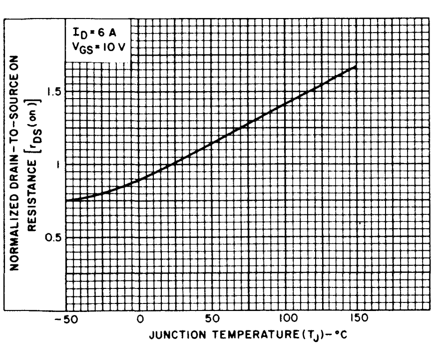


Fig. 4 — Normalized drain-to-source on resistance as a function of junction temperature for all types.

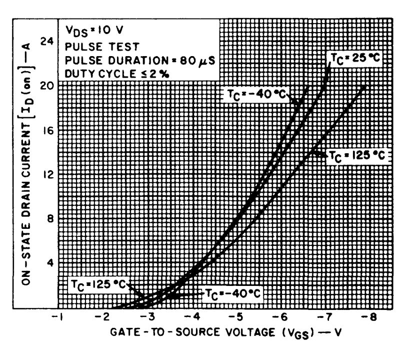


Fig. 5 — Typical transfer characteristics for all types.

RFM12P08, RFM12P10, RFP12P08, RFP12P10

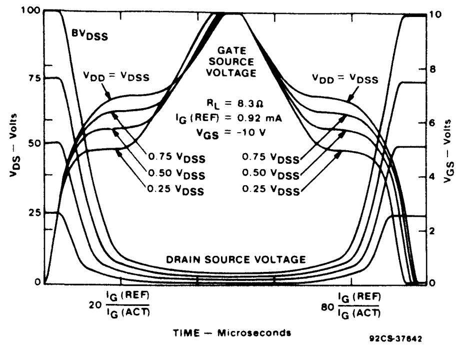


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

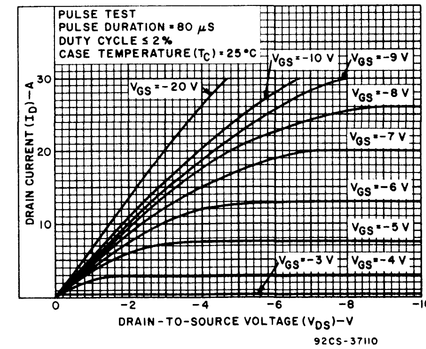


Fig. 7 — Typical saturation characteristics for all types.

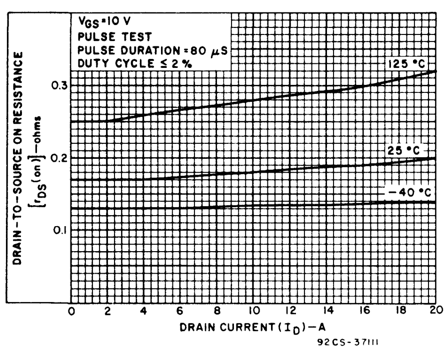


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

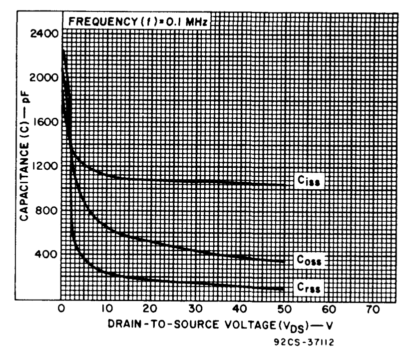


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

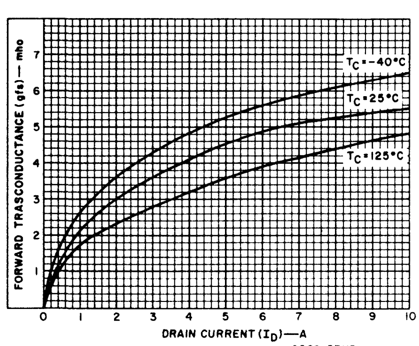


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

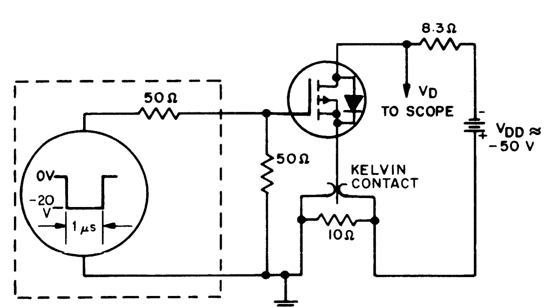


Fig. 11 — Switching Time Test Circuit

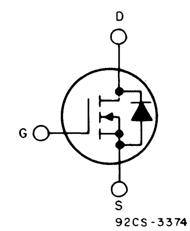
RFM12N18, RFM12N20, RFP12N18, RFP12N20

File Number **1461**

N-Channel Enhancement-Mode Power Field-Effect Transistors

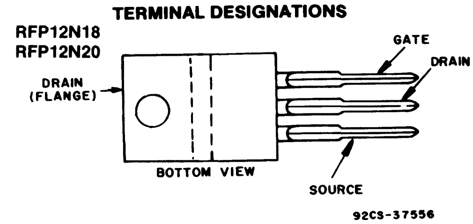
12 A, 180 and 200 V
$r_{DS}(on)$: 0.25 Ω

Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*

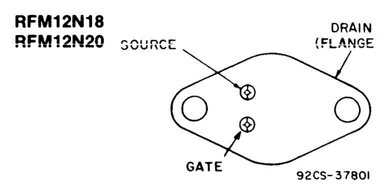


N-CHANNEL ENHANCEMENT MODE

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)



JEDEC TO-204MA
(See dimensional outline "A".)

The RFM12N18 and RFM12N20 and the RFP12N18 and RFP12N20* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-types are supplied in the JEDEC TO-204MA steel package and the RFP-types in the JEDEC TO-220AB plastic package.

*The RFM and RFP series were formerly RCA developmental numbers TA9293 and TA9294, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

	RFM12N18	RFM12N20		RFP12N18	RFP12N20	
DRAIN-SOURCE VOLTAGE .... V_{DSS}	180	200		180	200	V
DRAIN-GATE VOLTAGE (R_{GS}=1 MΩ) .. V_{DGR}	180	200		180	200	V
GATE-SOURCE VOLTAGE .... V_{GS}			±20			V
DRAIN CURRENT						
RMS Continuous .... I_D			12			A
Pulsed .... I_{DM}			30			A
POWER DISSIPATION						
@ T_C=25° C .... P_T	100	100		75	75	W
Derate above T_C=25° C	0.8	0.8		0.6	0.6	W/° C
OPERATING AND STORAGE						
TEMPERATURE .... T_j, T_{stg}			-55 to +150			°C

RFM12N18, RFM12N20, RFP12N18, RFP12N20

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_c)=25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM12N18 RFP12N18 Min.	Max.	LIMITS RFM12N20 RFP12N20 Min.	Max.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA, V_{GS}=0	180	—	200	—	V
Gate-Threshold Voltage	$V_{GS}(th)$	$V_{GS}=V_{DS}$, I_D=1 mA	2	4	2	4	V
Zero-Gate Voltage Drain Current	I_{DSS}	V_{DS}=145 V	—	1	—	—	μA
		V_{DS}=160 V	—	—	—	1	
		T_C=125°C, V_{DS}=145 V	—	50	—	—	
		V_{DS}=160 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V, V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)^a$	I_D=6 A, V_{GS}=10 V	—	1.5	—	1.5	V
		I_D=12 A, V_{GS}=10 V	—	3.6	—	3.6	
Static Drain-Source On Resistance	$r_{DS}(on)^a$	I_D=6 A, V_{GS}=10 V	—	0.25	—	0.25	Ω
Forward Transconductance	g_{fs}^a	V_{DS}=10 V, I_D=6 A	4	—	4	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	1250	—	1250	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	425	—	425	
Reverse-Transfer Capacitance	C_{rss}	f=1 MHz	—	125	—	125	
Turn-On Delay Time	$t_d(on)$	V_{DD}=100 V	35(typ)	50	35(typ)	50	ns
Rise Time	t_r	I_D=6 A	130(typ)	200	130(typ)	200	
Turn-Off Delay Time	$t_d(off)$	$R_{gen}=R_{gs}$=50 Ω	120(typ)	180	120(typ)	180	
Fall Time	t_f	V_{GS}=10 V	105(typ)	160	105(typ)	160	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	RFM12N18, RFM12N20	—	1.25	—	1.25	°C/W
		RFP12N18, RFP12N20	—	1.67	—	1.67	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM12N18 RFP12N18 MIN.	MAX.	LIMITS RFM12N20 RFP12N20 MIN.	MAX.	UNITS
Diode Forward Voltage	V_{SD}^a	I_{SD}=6 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A, d_{IF}/d_t=100 A/μs	325(typ)		325(typ)		ns

[a]Pulsed: Pulse duration=300 μs max., duty cycle=2%.

RFM12N18, RFM12N20, RFP12N18, RFP12N20

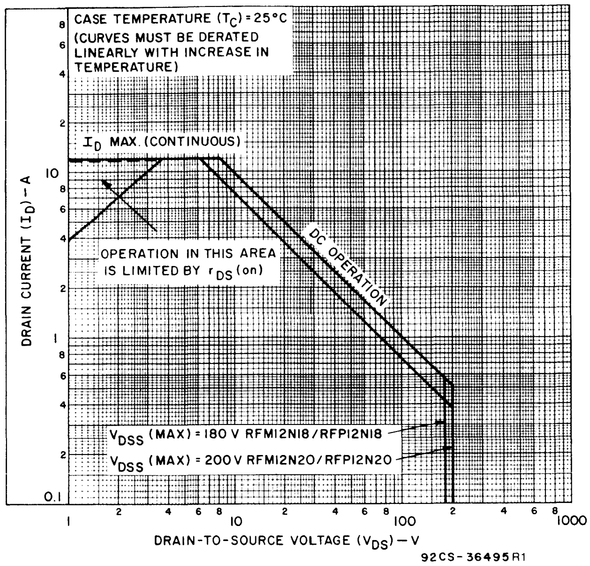


Fig. 1 - Maximum safe operating areas for all types.

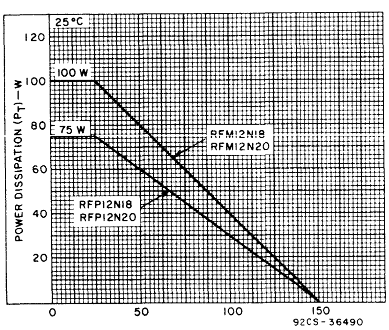


Fig. 2 - Power dissipation vs. case temperature derating curve for all types.

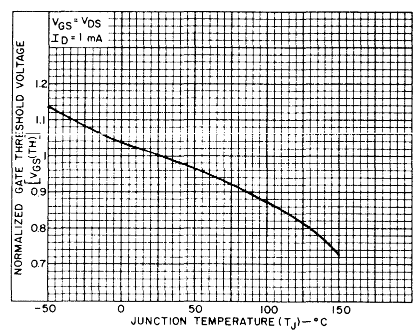


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

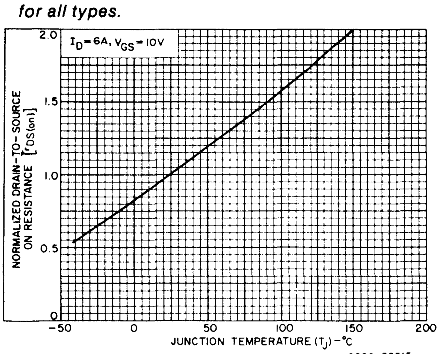


Fig. 4 - Normalized drain-to-source on resistance as a function of junction temperature for all types.

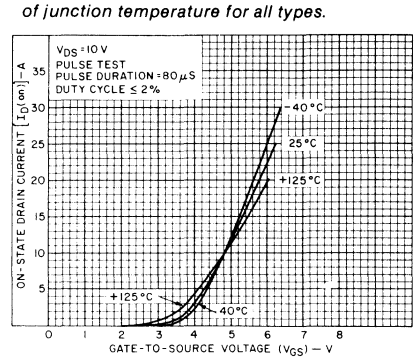


Fig. 5 - Typical transfer characteristics for all types.

RFM12N18, RFM12N20, RFP12N18, RFP12N20

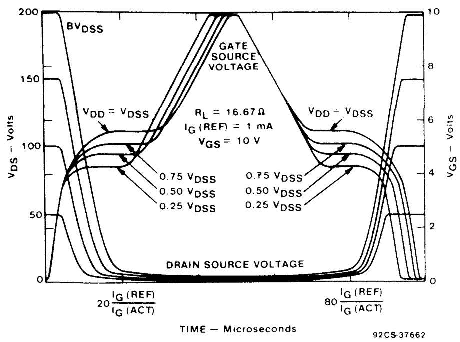


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

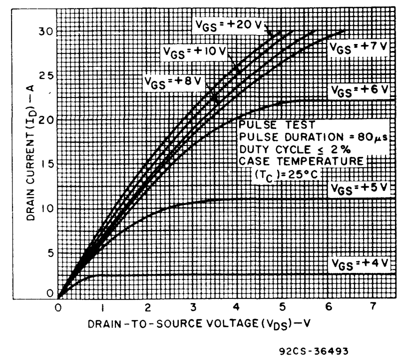


Fig. 7 - Typical saturation characteristics for all types.

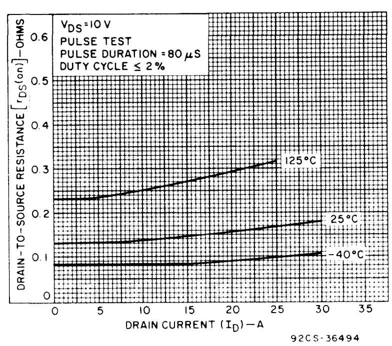


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

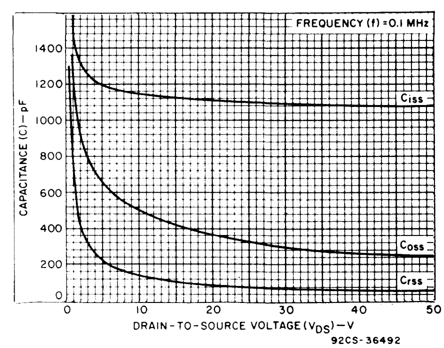


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

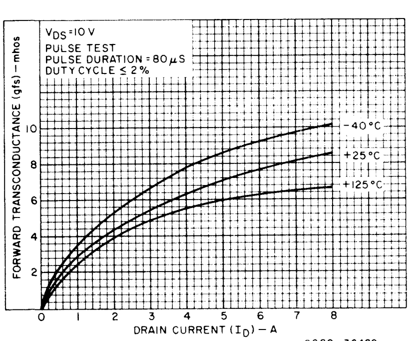


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

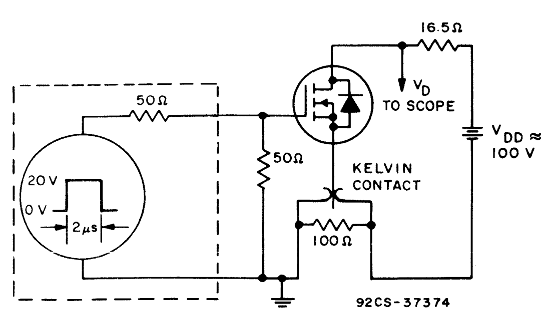


Fig. 11 — Switching Time Test Circuit

RFK12N35, RFK12N40

File Number **1515**

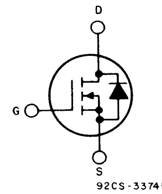
N-Channel Enhancement-Mode Power Field-Effect Transistors

12A, 350 V - 400 V

$r_{DS}(on)$ = 0.5 Ω

Features:

- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



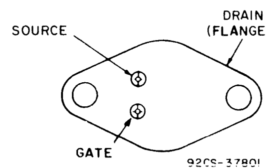
N-CHANNEL ENHANCEMENT MODE

The RFK12N35 and RFK12N40* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFK-types are supplied in the JEDEC TO-204AE steel package.

*The RFK12N35 and RFK12N40 types were formerly RCA developmental numbers TA9399A and TA9399B respectively.

TERMINAL DESIGNATIONS



JEDEC TO-204AE

(See dimensional outline "D")

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C = 25° C):*

		RFK12N35	RFK12N40	
DRAIN-SOURCE VOLTAGE	V_{DSS}	350	400	V
DRAIN-GATE VOLTAGE, R_{gs} = 1 MΩ	V_{DGR}	350	400	V
GATE-SOURCE VOLTAGE	V_{GS}	±20		V
DRAIN CURRENT, RMS Continuous	I_D	12		A
Pulsed	I_{DM}	24		A
POWER DISSIPATION @ T_C = 25°C	P_T	150		W
Derate above T_C = 25°C		1.2		W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}	-55 to +150		°C

RFK12N35, RFK12N40

ELECTRICAL CHARACTERISTICS, at Case Temperature (T_C) = 25° C unless otherwise specified.

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFK12N35 Min.	LIMITS RFK12N35 Max.	LIMITS RFK12N40 Min.	LIMITS RFK12N40 Max.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D = 1 mA V_{GS} = 0	350	—	400	—	V
Gate Threshold Voltage	$V_{GS}(th)$	V_{GS} = V_{DS} I_D = 1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 280 V	—	1	—	—	µA
		V_{DS} = 320 V	—	—	—	1	
		T_C = 125° C V_{DS} = 280 V	—	50	—	—	
		V_{DS} = 320 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS} = ± 20 V V_{DS} = 0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D = 6 A V_{GS} = 10 V	—	3	—	3	V
		I_D = 12 A V_{GS} = 10 V	—	10	—	10	
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D = 6A V_{GS} = 10 V	—	0.5	—	0.5	Ω
Forward Transconductance	g_{fs}[a]	V_{DS} = 10 V I_D = 6 A	4	—	4	—	mho
Input Capacitance	C_{iss}	V_{DS} = 25 V	—	3000	—	3000	pF
Output Capacitance	C_{oss}	V_{GS} = 0 V	—	900	—	900	
Reverse Transfer Capacitance	C_{rss}	f = 0.1 MHz	—	400	—	400	
Turn-On Delay Time	$t_d(on)$	V_{DD} = 200	30(typ)	50	30(typ)	50	ns
Rise Time	t_r	I_D = 6 A	105(typ)	150	105(typ)	150	
Turn-Off Delay Time	$t_d(off)$	R_{gen}=R_{gs}=50Ω	480(typ)	750	480(typ)	750	
Fall Time	t_f	V_{GS} = 10 V	140(typ)	200	140(typ)	200	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	RFK12N35, RFK12N40 Series	—	0.83	—	0.83	°C/W

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC		TEST CONDITIONS	LIMITS RFK12N35 Min.	LIMITS RFK12N35 Max.	LIMITS RFK12N40 Min.	LIMITS RFK12N40 Max.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD} = 6A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F = 4A, dI_F/dt = 100 A/µs	950 typ.		950 typ.		ns

[a]Pulsed: Pulse duration = 300 µs max., duty cycle = 2%.

RFK12N35, RFK12N40

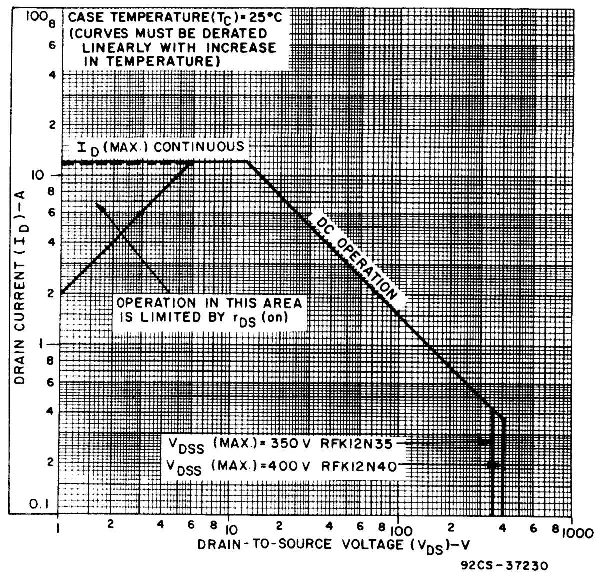


Fig. 1 - Maximum safe operating areas for all types.

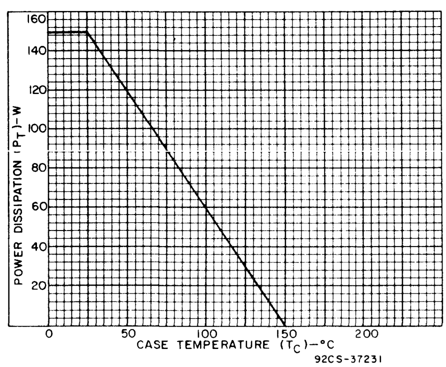


Fig. 2 - Power vs. temperature derating curve for all types.

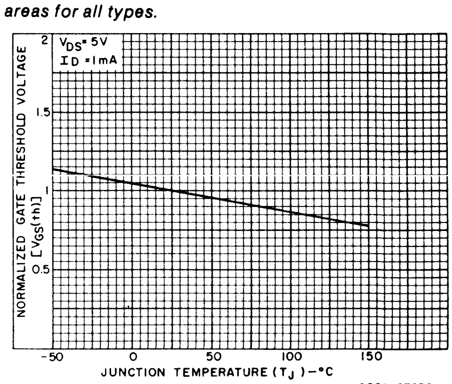


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

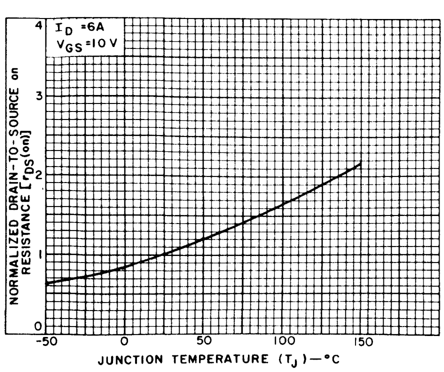


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

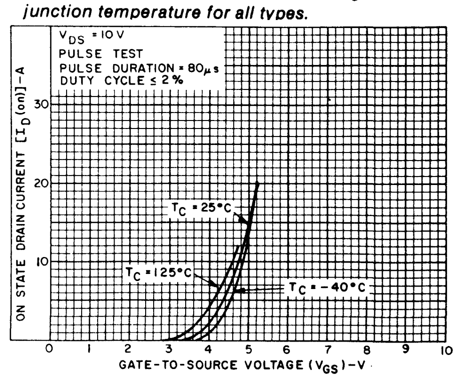


Fig. 5 - Typical transfer characteristics for all types.

RFK12N35, RFK12N40

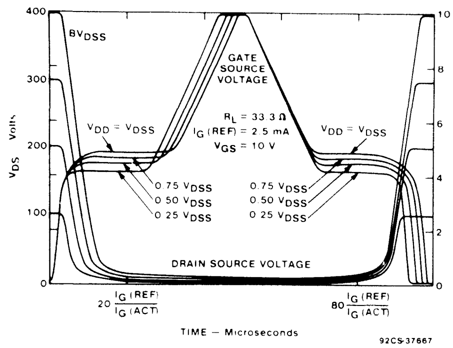


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

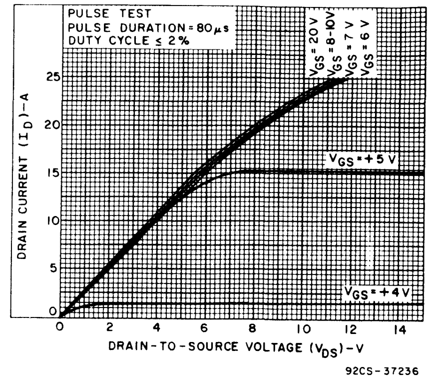


Fig. 7 - Typical saturation characteristics for all types.

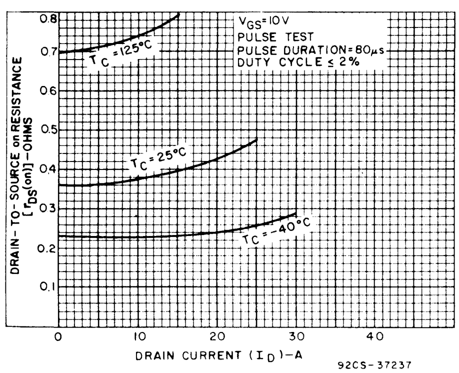


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

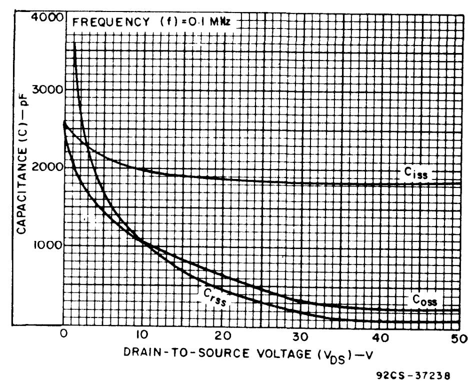


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

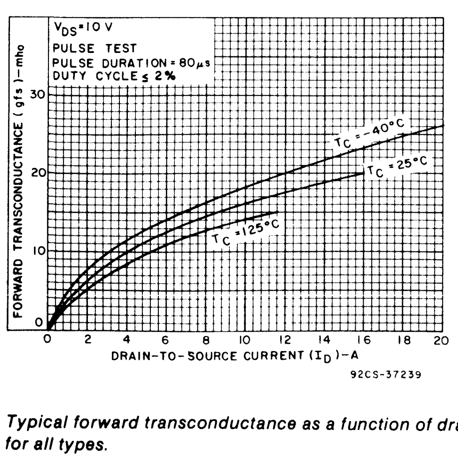


Fig. 10 - Typical forward transconductance as a function of drain for all types.

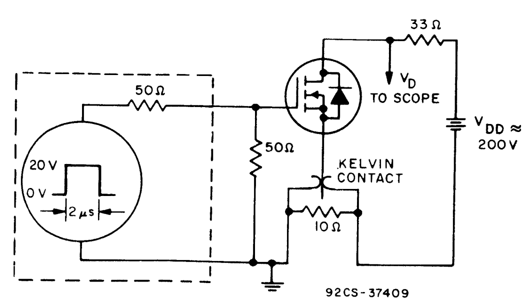


Fig. 11 - Switching Time Test Circuit.

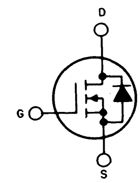
RFM15N05, RFM15N06, RFP15N05, RFP15N06

File Number **1478**

N-Channel Enhancement-Mode Power Field-Effect Transistors

15 A, 50 and 60 V
$r_{DS}(on)$: 0.15 Ω

Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-CHANNEL ENHANCEMENT MODE

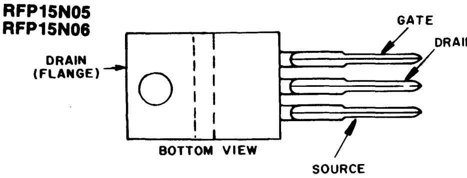
The RFM15N05 and RFM15N06 and the RFP15N05 and RFP15N06* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-series types are supplied in the JEDEC TO-204MA steel package and the RFP-series types in the JEDEC TO-220AB plastic package.

*The RFM and RFP series were formerly RCA developmental numbers TA9382 and TA9383, respectively.

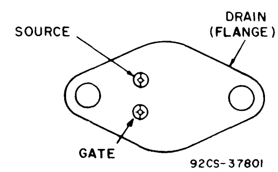
TERMINAL DESIGNATIONS

RFP15N05
RFP15N06



JEDEC TO-220AB
(See dimensional outline "N".)

RFM15N05
RFM15N06



JEDEC TO-204MA
(See dimensional outline "A".)

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

	RFM15N05	RFM15N06		RFP15N05	RFP15N06	
DRAIN-SOURCE VOLTAGE .... V_{DSS}	50	60		50	60	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ) ... V_{DGR}	50	60		50	60	V
GATE-SOURCE VOLTAGE .... V_{GS}			±20			V
DRAIN CURRENT, RMS Continuous ..... I_D			15			A
Pulsed .... I_{DM}			40			A
POWER DISSIPATION @ T_C=25°C .... P_T	75	75		60	60	W
Derate above T_C=25°C	0.6	0.6		0.48	0.48	W/°C
OPERATING AND STORAGE TEMPERATURE .... T_j, T_{stg}			-55 to +150			°C

RFM15N05, RFM15N06, RFP15N05, RFP15N06

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_c)=25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM15N05 RFP15N05 Min.	LIMITS RFM15N05 RFP15N05 Max.	LIMITS RFM15N06 RFP15N06 Min.	LIMITS RFM15N06 RFP15N06 Max.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA, V_{GS}=0	50	—	60	—	V
Gate-Threshold Voltage	$V_{GS}(th)$	$V_{GS}=V_{DS}$, I_D=1 mA	2	4	2	4	V
Zero-Gate Voltage Drain Current	I_{DSS}	V_{DS}=40 V	—	1	—	—	μA
		V_{DS}=50 V	—	—	—	1	
		T_C=125°C, V_{DS}=40 V	—	50	—	—	
		T_C=125°C, V_{DS}=50 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	$V_{GS}=\pm20$ V, V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)^a$	I_D=7.5 A, V_{GS}=10 V	—	1.125	—	1.125	V
		I_D=15 A, V_{GS}=10 V	—	2.5	—	2.5	
Static Drain-Source On Resistance	$r_{DS}(on)^a$	I_D=7.5 A, V_{GS}=10 V	—	0.15	—	0.15	Ω
Forward Transconductance	g_{fs}^a	V_{DS}=10 V, I_D=7.5 A	2	—	2	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V, V_{GS}=0 V, f=0.1 MHz	—	750	—	750	pF
Output Capacitance	C_{oss}		—	450	—	450	
Reverse-Transfer Capacitance	C_{rss}		—	180	—	180	
Turn-On Delay Time	$t_d(on)$	V_{DD}=30 V, I_D=7.5 A, $R_{gen}=R_{gs}$=50 Ω, V_{GS}=10 V	16(typ)	40	16(typ)	40	ns
Rise Time	t_r		100(typ)	175	100(typ)	175	
Turn-Off Delay Time	$t_d(off)$		72(typ)	175	72(typ)	175	
Fall Time	t_f		66(typ)	140	66(typ)	140	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	RFM15N05, RFM15N06	—	1.67	—	1.67	°C/W
		RFP15N05, RFP15N06	—	2.083	—	2.083	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM15N05 RFP15N05 MIN.	LIMITS RFM15N05 RFP15N05 MAX.	LIMITS RFM15N06 RFP15N06 MIN.	LIMITS RFM15N06 RFP15N06 MAX.	UNITS
Diode Forward Voltage	V_{SD}^a	I_{SD}=7.5 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A, d_{IF}/d_t=100 A/μs	100 (typ)		100(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM15N05, RFM15N06, RFP15N05, RFP15N06

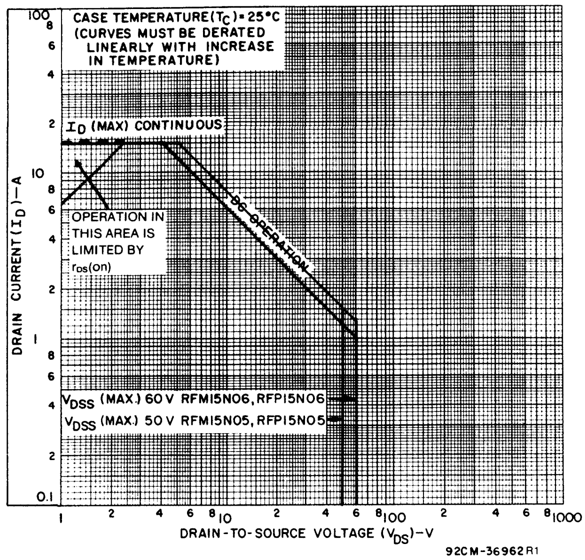


Fig. 1 - Maximum safe operating areas for all types.

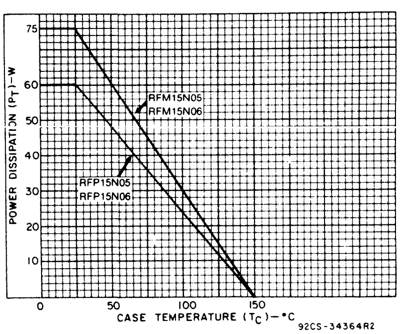


Fig. 2 - Power dissipation vs. case temperature derating curve for all types.

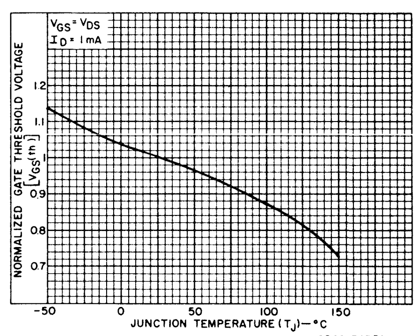


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

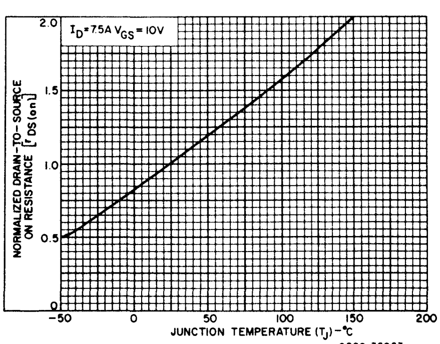


Fig. 4 - Normalized drain-to-source on resistance as a function of junction temperature for all types.

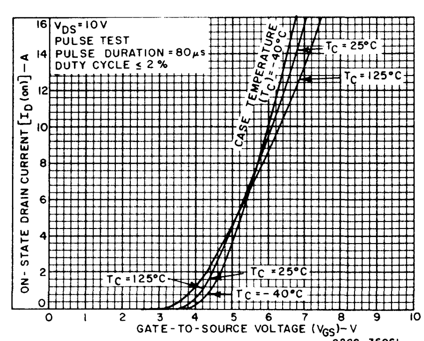


Fig. 5 - Typical transfer characteristics for all types.

RFM15N05, RFM15N06, RFP15N05, RFP15N06

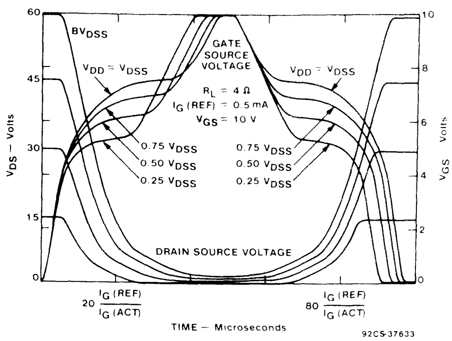


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

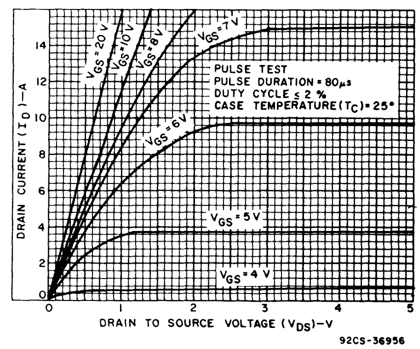


Fig. 7 - Typical saturation characteristics for all types.

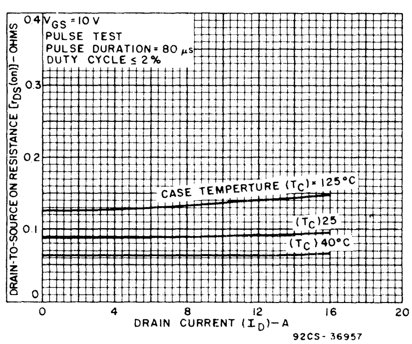


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

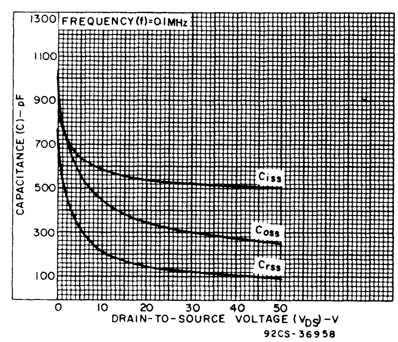


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

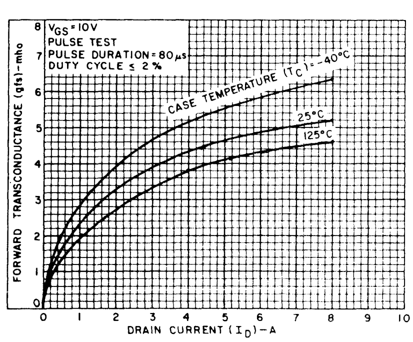


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

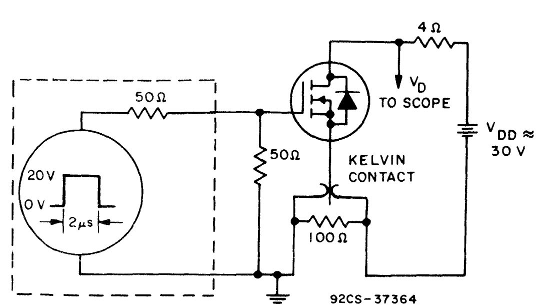


Fig. 11 — Switching Time Test Circuit

RFM15N12, RFM15N15, RFP15N12, RFP15N15

File Number **1443**

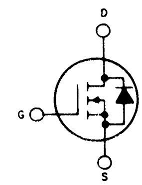
N-Channel Enhancement-Mode Power Field-Effect Transistors

15 A, 120 V — 150 V

$r_{DS}(on)$: 0.15 Ω

Features:

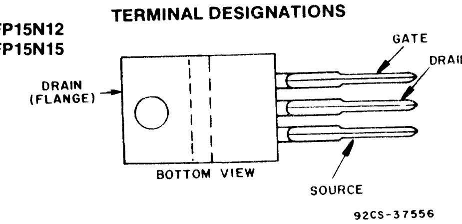
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-Channel Enhancement Mode

TERMINAL DESIGNATIONS

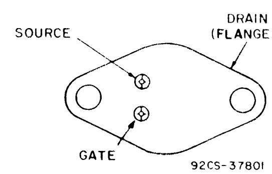
RFP15N12
RFP15N15



JEDEC TO-220AB

(See dimensional outline "N".)

RFM15N12
RFM15N15



JEDEC TO-204MA

(See dimensional outline "A".)

The RFM15N12 and RFM15N15 and the RFP15N12 and RFP15N15* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-types are supplied in the JEDEC TO-204MA steel package and the RFP-types in the JEDEC TO-220AB plastic package.

*The RFM and RFP series were formerly RCA developmental numbers TA9195 and TA9230, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25°C):*

		RFM15N12	RFM15N15		RFP15N12	RFP15N15	
DRAIN-SOURCE VOLTAGE	V_{DSS}	120	150		120	150	V
DRAIN-GATE VOLTAGE (R_{GS}=1 MΩ)	V_{DGR}	120	150		120	150	V
GATE-SOURCE VOLTAGE	V_{GS}			±20			V
DRAIN CURRENT RMS Continuous	I_D			15			A
Pulsed	I_{DM}			40			A
POWER DISSIPATION @ T_C=25°C	P_T	100	100		75	75	W
Derate above T_C=25°C		0.80	0.80		0.6	0.6	W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}			−55 to +150			°C

RFM15N12, RFM15N15, RFP15N12, RFP15N15

ELECTRICAL CHARACTERISTICS *At Case Temperature (T_c) = 25° C unless otherwise specified*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFM15N12 RFP15N12 MIN.	MAX.	LIMITS RFM15N15 RFP15N15 MIN.	MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D = 1 mA V_{GS} = 0	120	—	150	—	V
Gate Threshold Voltage	$V_{GS(th)}$	V_{GS} = V_{DS} I_D = 1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 100 V V_{DS} = 120 V T_C = 125° C V_{DS} = 100 V V_{DS} = 120 V	— — — —	1 — 50 —	— — — —	— 1 — 50	μA
Gate-Source Leakage Current	I_{GSS}	V_{GS} = ± 20 V V_{DS} = 0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)^a$	I_D = 7.5 A V_{GS} = 10 V	—	1.125	—	1.125	V
		I_D = 15 A V_{GS} = 10 V	—	3	—	3	
Static Drain-Source On Resistance	$r_{DS}(on)^a$	I_D = 7.5 A V_{GS} = 10 V	—	0.15	—	0.15	Ω
Forward Transconductance	g_{fs}^a	V_{DS} = 10 V I_D = 7.5 A	5	—	5	—	mho
Input Capacitance	C_{iss}	V_{DS} = 25 V	—	1450	—	1450	pF
Output Capacitance	C_{oss}	V_{GS} = 0 V	—	450	—	450	
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	150	—	150	
Turn-On Delay Time	$t_d(on)$	V_{DD}=75 V	50(typ.)	75	50(typ.)	75	ns
Rise Time	t_r	I_D = 7.5 A	150(typ.)	225	150(typ.)	225	
Turn-Off Delay Time	$t_d(off)$	R_{gen} = R_{gs} = 50 Ω	185(typ.)	280	185(typ.)	280	
Fall Time	t_f	V_{GS} = 10 V	125(typ.)	190	125(typ.)	190	
Thermal Resistance Junction-to-Case	RθJC	RFM15N12, RFM15N15	—	1.25	—	1.25	°C/W
		RFP15N12, RFP15N15	—	1.67	—	1.67	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM15N12 RFP15N12 MIN.	MAX.	LIMITS RFM15N15 RFP15N15 MIN.	MAX.	UNITS
Diode Forward Voltage	V_{SD}^a	I_{SD}=7.5 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A d_{IF}/d_t=100 A/μs	200(typ)		200(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM15N12, RFM15N15, RFP15N12, RFP15N15

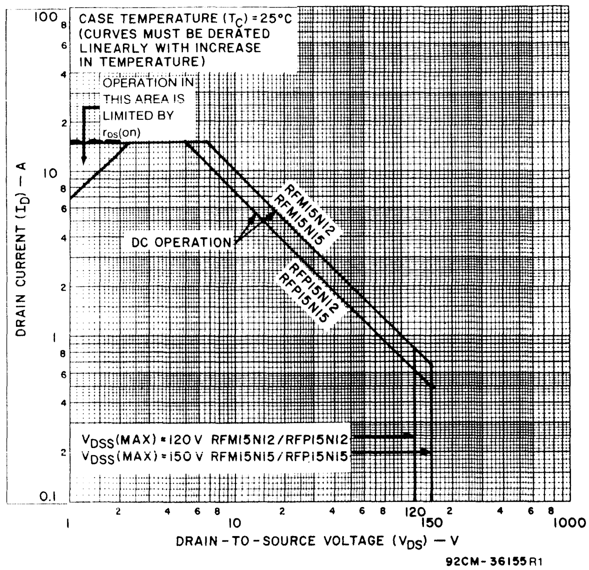


Fig. 1 — Maximum operating areas for all types.

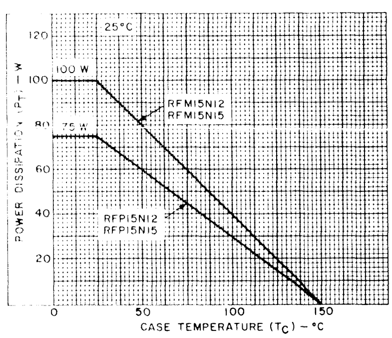


Fig. 2 — Power dissipation vs. case temperature derating curve for all types.

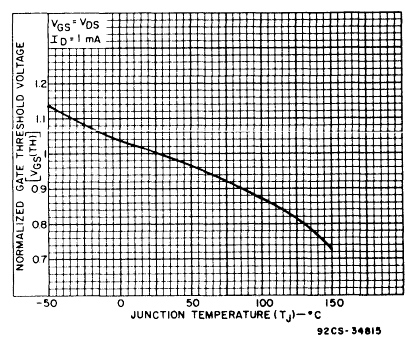


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

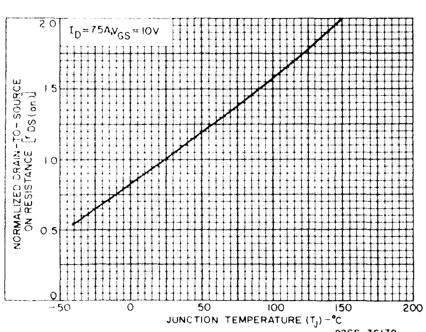


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

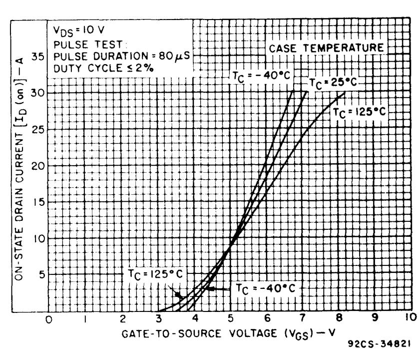


Fig. 5 — Typical transfer characteristics for all types.

RFM15N12, RFM15N15, RFP15N12, RFP15N15

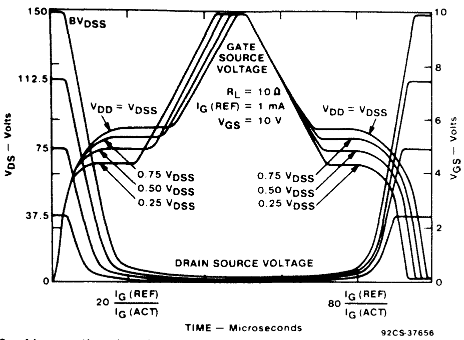


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

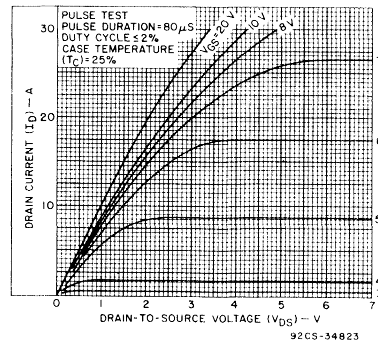


Fig. 7 — Typical saturation characteristics for all types.

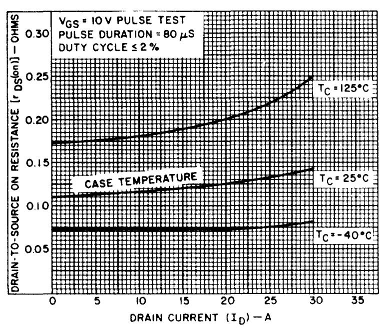


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

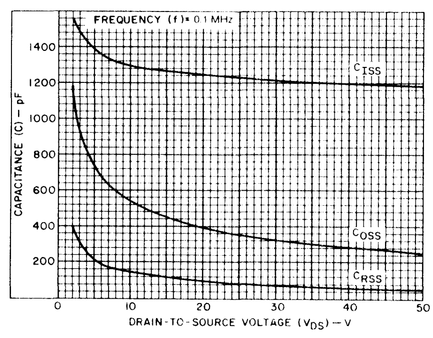


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

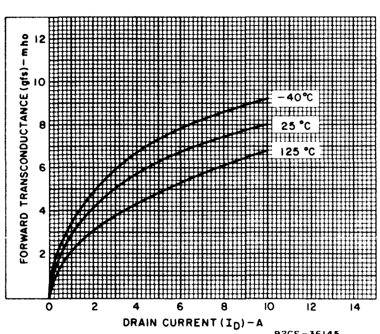


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

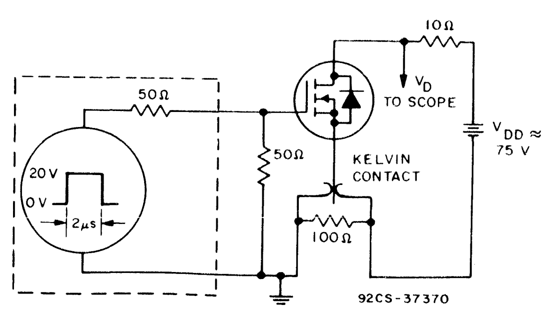


Fig. 11 — Switching Time Test Circuit

RFM18N08, RFM18N10, RFP18N08, RFP18N10

File Number **1446**

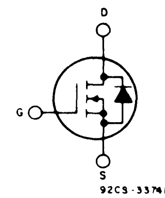
N-Channel Enhancment-Mode Power Field-Effect Transistors

18 A, 80 V — 100 V

r_{DS}(on): 0.12 Ω

Features:

- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



N-Channel Enhancement Mode

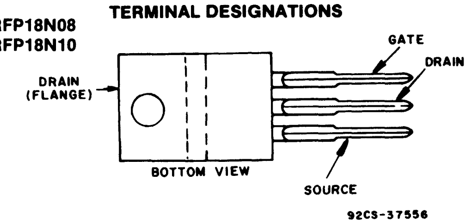
The RFM18N08 and RFM18N10 and the RFP18N08 and RFP18N10* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-types are supplied in the JEDEC TO-204MA steel package and the RFP-types in the JEDEC TO-220AB plastic package.

*The RFM and RFP series were formerly RCA developmental numbers TA9286 and TA9287, respectively.

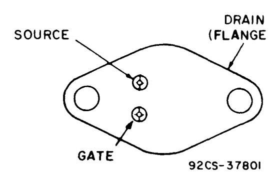
TERMINAL DESIGNATIONS

RFP18N08
RFP18N10



JEDEC TO-220AB
(See dimensional outline "N".)

RFM18N08
RFM18N10



JEDEC TO-204MA
(See dimensional outline "A".)

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25°C):*

		RFM18N08	RFM18N10	RFP18N08	RFP18N10	
DRAIN-SOURCE VOLTAGE	V_{DSS}	80	100	80	100	V
DRAIN-GATE VOLTAGE (R_{GS}=1 MΩ)	V_{DGR}	80	100	80	100	V
GATE-SOURCE VOLTAGE	V_{GS}	±20 (all types)				V
DRAIN CURRENT RMS Continuous	I_D	18 (all types)				A
Pulsed	I_{DM}	45 (all types)				A
POWER DISSIPATION						
@ T_C=25°C	P_T	100	100	75	75	W
Derate above T_C=25°C		0.8	0.8	0.6	0.6	W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}	−55 to +150 (all types)				°C

RFM18N08, RFM18N10, RFP18N08, RFP18N10

ELECTRICAL CHARACTERISTICS *At Case Temperature (T_c) = 25° C unless otherwise specified*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFM18N08 RFP18N08 MIN.	MAX.	LIMITS RFM18N10 RFP18N10 MIN.	MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D = 1 mA V_{GS} = 0	80	—	100	—	V
Gate Threshold Voltage	$V_{GS(th)}$	V_{GS} = V_{DS} I_D = 1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 65 V	—	1	—	—	μA
		V_{DS} = 80 V	—	—	—	1	
		T_C = 125° C V_{DS} = 65 V	—	50	—	—	
		V_{DS} = 80 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS} = ± 20 V V_{DS} = 0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)^a$	I_D = 9 A V_{GS} = 10 V	—	1.08	—	1.08	V
		I_D = 18 A V_{GS} = 10 V	—	3.0	—	3.0	
Static Drain-Source On Resistance	$r_{DS}(on)^a$	I_D = 9 A V_{GS} = 10 V	—	0.12	—	0.12	Ω
Forward Transconductance	g_{fs}^a	V_{DS} = 10 V I_D = 9 A	5	—	5	—	mho
Input Capacitance	C_{iss}	V_{DS} = 25 V	—	1500	—	1500	pF
Output Capacitance	C_{oss}	V_{GS} = 0 V	—	750	—	750	
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	300	—	300	
Turn-On Delay Time	$t_d(on)$	V_{DD}=50 V	60(typ.)	90	60(typ.)	90	ns
Rise Time	t_r	I_D = 9 A	300(typ.)	450	300(typ.)	450	
Turn-Off Delay Time	$t_d(off)$	R_{gen} = R_{gs} = 50 Ω	150(typ.)	225	150(typ.)	225	
Fall Time	t_f	V_{GS} = 10 V	150(typ.)	225	150(typ.)	225	
Thermal Resistance Junction-to-Case	RθJC	RFM18N08, RFM18N10	—	1.25	—	1.25	°C/W
		RFP18N08, RFP18N10	—	1.67	—	1.67	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFM18N08 RFM18N10 MIN.	MAX.	LIMITS RFP18N08 RFP18N10 MIN.	MAX.	UNITS
Diode Forward Voltage	V_{SD}^a	I_{SD}=9 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A d_{IF}/d_t=100 A/μs	150(typ)		150(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM18N08, RFM18N10, RFP18N08, RFP18N10

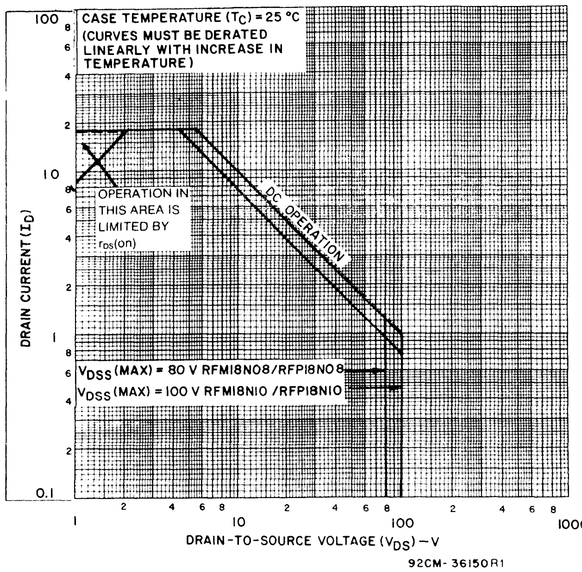


Fig. 1 — Maximum operating areas for all types.

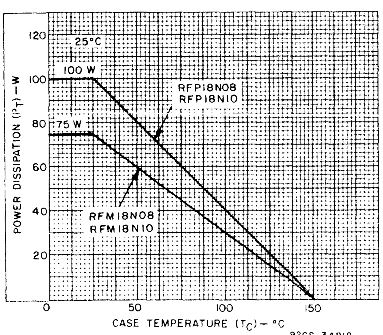


Fig. 2 — Power dissipation vs. case temperature derating curve for all types.

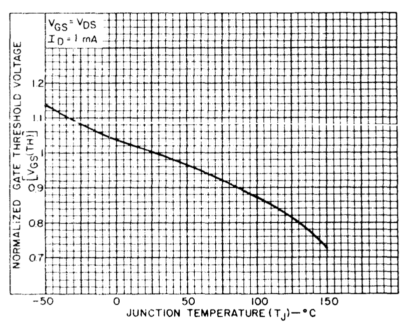


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

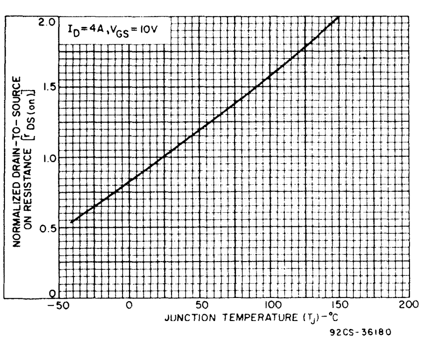


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

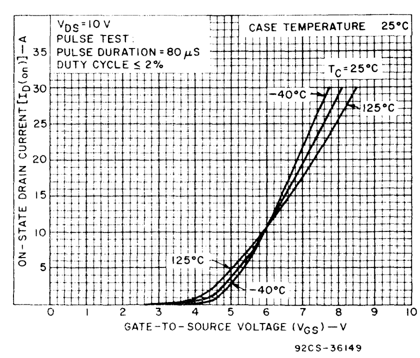


Fig. 5 — Typical transfer characteristics for all types.

RFM18N08, RFM18N10, RFP18N08, RFP18N10

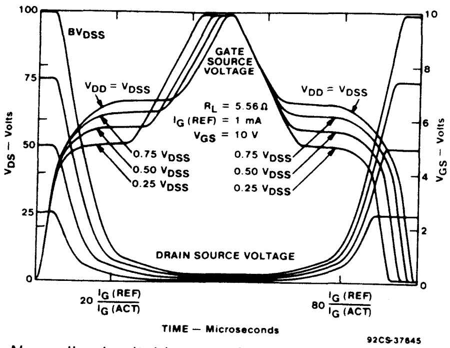


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

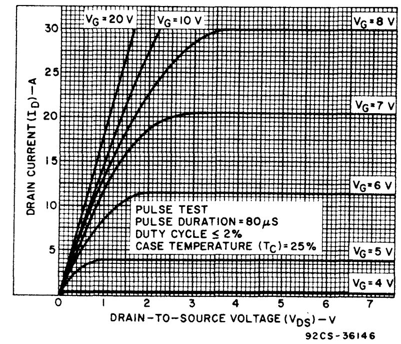


Fig. 7 — Typical saturation characteristics for all types.

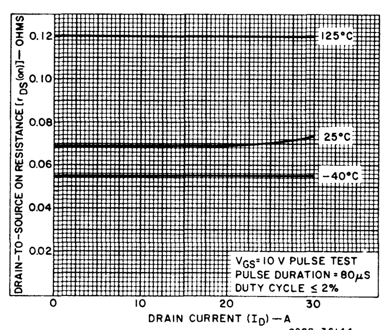


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

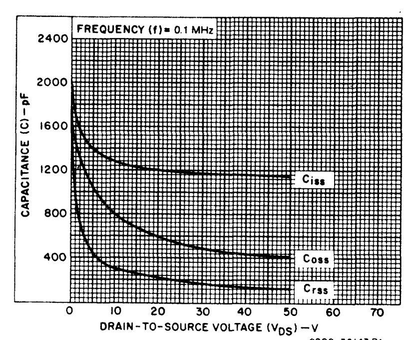


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

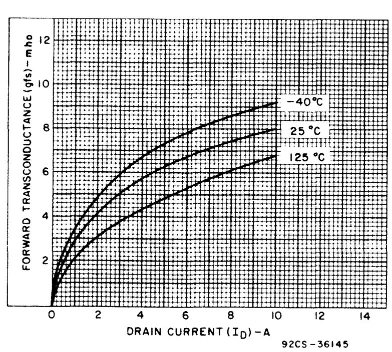


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

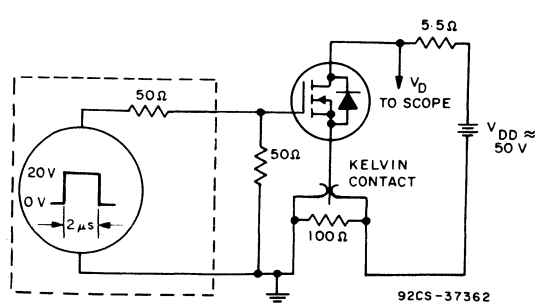


Fig. 11 — Switching Time Test Circuit

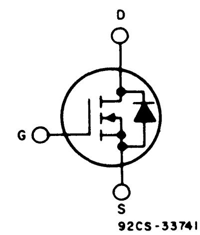
RFM25N05, RFM25N06, RFP25N05, RFP25N06

File Number **1492**

N-Channel Enhancement-Mode Power Field-Effect Transistors

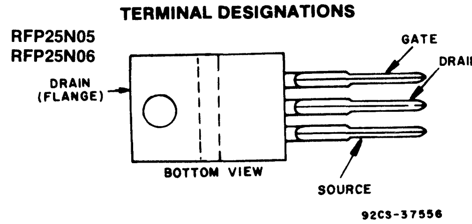
25 A, 50 V — 60 V
$r_{DS}(on) = 0.085\ \Omega$

Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*

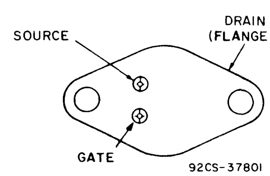


N-CHANNEL ENHANCEMENT MODE

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)



JEDEC TO-204MA
(See dimensional outline "A".)

The RFM25N05 and RFM25N06 and the RFP25N05 and RFP25N06* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFM-types are supplied in the JEDEC TO-204MA steel package and the RFP-types in the JEDEC TO-220AB plastic package.

*The RFM and RFP series were formerly RCA developmental numbers TA9386 and TA9387, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFM25N05	RFM25N06		RFP25N05	RFP25N06	
DRAIN-SOURCE VOLTAGE	V_{DSS}	50	60		50	60	V
DRAIN-GATE VOLTAGE (R_{gs}=1 MΩ)	V_{DGR}	50	60		50	60	V
GATE-SOURCE VOLTAGE	V_{GS}			±20			V
DRAIN CURRENT, RMS Continuous	I_D			25			A
Pulsed	I_{DM}			60			A
POWER DISSIPATION @ T_C=25°C	P_T	100	100		75	75	W
Derate above T_C=25°C		0.8	0.8		0.6	0.6	W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}			-55 to +150			°C

RFM25N05, RFM25N06, RFP25N05, RFP25N06

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFM25N05 RFP25N05		RFM25N06 RFP25N06		
			MIN.	MAX.	MIN.	MAX.	
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA V_{GS}=0	50	—	60	—	V
Gate Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS} I_D=1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=40 V	—	1	—	—	μA
		V_{DS}=50 V	—	—	—	1	
		T_C=125°C V_{DS}=40 V	—	50	—	—	
		V_{DS}=50 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)^a$	I_D=12.5 A V_{GS}=10 V	—	1.06	—	1.06	V
		I_D=25 A V_{GS}=10 V	—	2.5	—	2.5	
Static Drain-Source On Resistance	$r_{DS}(on)^a$	I_D=12.5 A V_{GS}=10 V	—	.085	—	.085	Ω
Forward Transconductance	g_{fs}^a	V_{DS}=10 V I_D=12.5 A	5	—	5	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	1700	—	1700	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	900	—	900	
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	400	—	400	
Turn-On Delay Time	$t_d(on)$	V_{DD}=30 V	18(typ)	60	18(typ)	60	ns
Rise Time	t_r	I_D=12.5 A	120(typ)	225	120(typ)	225	
Turn-Off Delay Time	$t_d(off)$	R_{gen}=R_{gs}=50 Ω	123(typ)	225	123(typ)	225	
Fall Time	t_f	V_{GS}=10 V	123(typ)	200	123(typ)	200	
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFM25N05, RFM25N06	—	1.25	—	1.25	°C/W
		RFP25N05, RFP25N06	—	1.67	—	1.67	

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFM25N05 RFP25N05		RFM25N06 RFP25N06		
			MIN.	MAX.	MIN.	MAX.	
Diode Forward Voltage	V_{SD}^a	I_{SD}=12.5 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A d_{IF}/d_t=100 A/μs	150(typ)		150(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFM25N05, RFM25N06, RFP25N05, RFP25N06

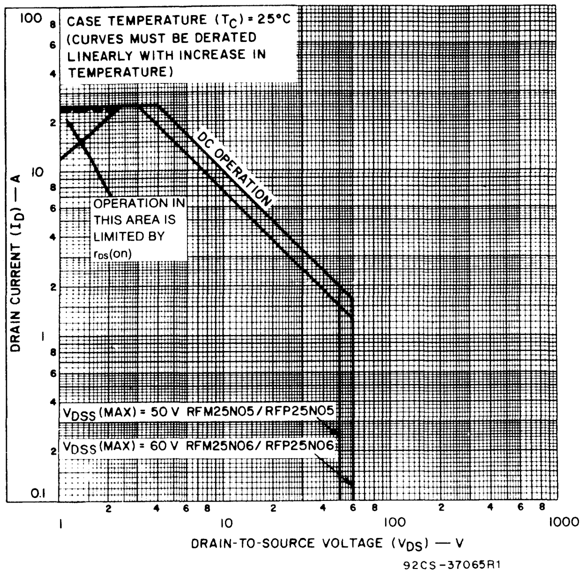


Fig. 1 — Maximum operating areas for all types.

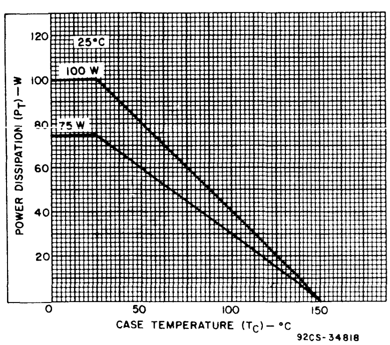


Fig. 2 — Power dissipation vs. case temperature derating curve for all types.

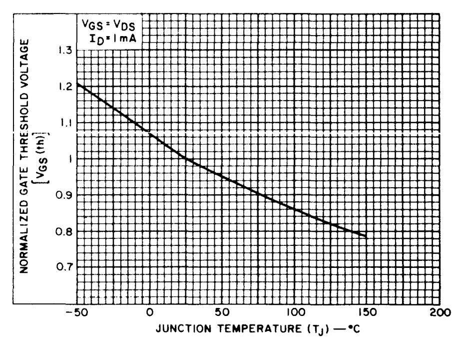


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

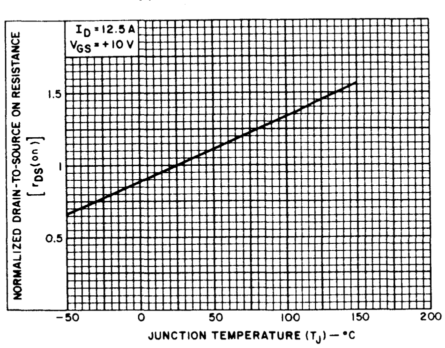


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

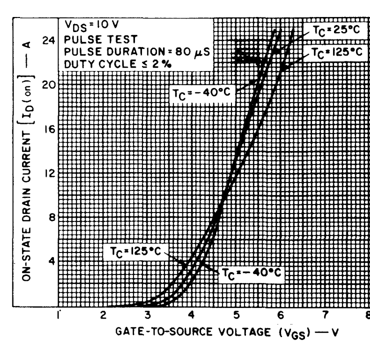


Fig. 5 — Typical transfer characteristics for all types.

RFM25N05, RFM25N06, RFP25N05, RFP25N06

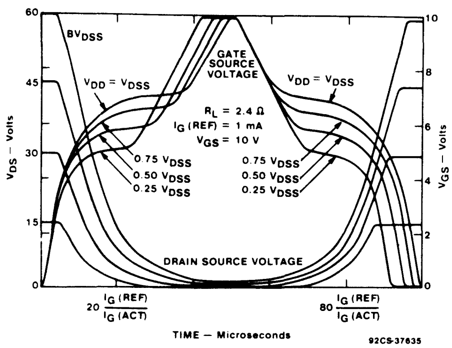


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

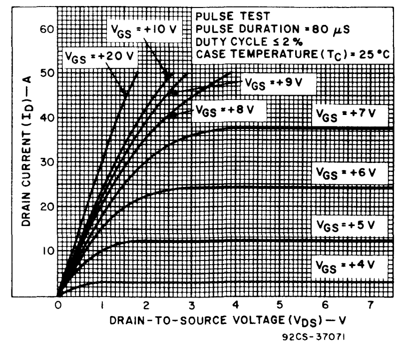


Fig. 7 — Typical saturation characteristics for all types.

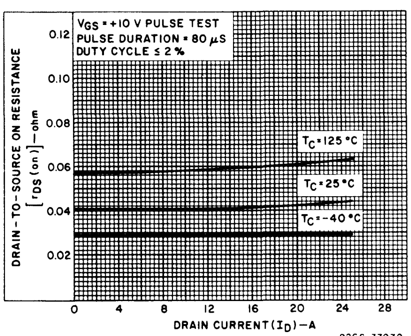


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

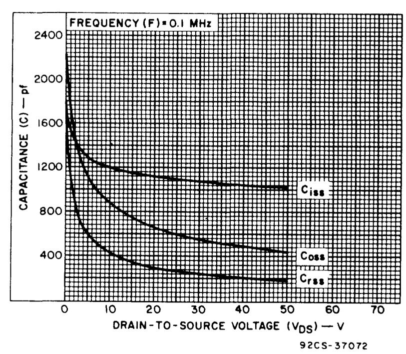


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

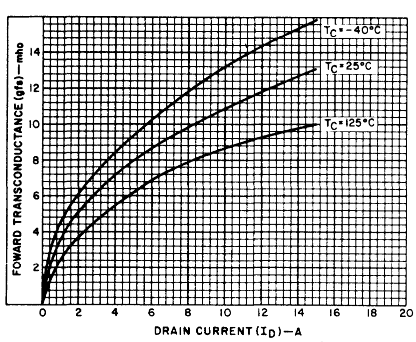


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

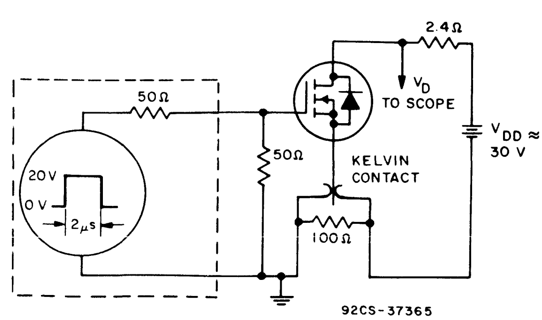


Fig. 11 — Switching Time Test Circuit

RFK25P08, RFK25P10

File Number **1516**

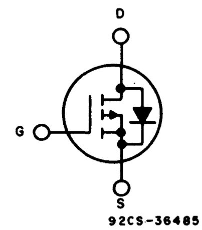
P-Channel Enhancement-Mode Power Field-Effect Transistors

25 A, −100 V - −80 V

$r_{DS}(on)$=0.20 Ω

Features:

- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



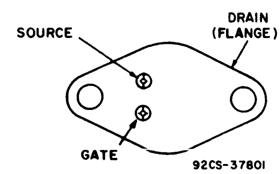
P-CHANNEL ENHANCEMENT MODE

The RFK25P10 and RFK25P08* are p-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFK-types are supplied in the JEDEC TO-204AE steel package.

*The RFK25P10 and RFK25P08 types were formerly RCA developmental numbers TA9412A and TA9412B, respectively.

TERMINAL DESIGNATIONS



JEDEC TO-204AE

(See dimensional outline "D")

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFK25P10	RFK25P08	
DRAIN-SOURCE VOLTAGE	V_{DSS}	−100	−80	V
DRAIN-GATE VOLTAGE, R_{GS}=1 MΩ)	V_{DGR}	−100	−80	V
GATE-SOURCE VOLTAGE	V_{GS}	±20		V
DRAIN CURRENT, RMS Continuous	I_D	25		A
Pulsed	I_{DM}	60		A
POWER DISSIPATION	P_T			
@ T_C = 25° C		150		W
Derate above T_C=25° C		1.2		W/° C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}	−55 to +150		° C

RFK25P08, RFK25P10

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25°C unless otherwise specified.*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFK25P10		RFK25P08		
			MIN.	MAX.	MIN.	MAX.	
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA V_{GS}=0	-100	—	-80	—	V
Gate Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS} I_D=1 mA	-2	-4	-2	-4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=-80 V	—	1	—	—	μA
		V_{DS}=-65 V	—	—	—	1	μA
		T_C=125°C V_{DS}=-80 V	—	50	—	—	μA
		V_{DS}=-65 V	—	—	—	50	μA
Gate-Source Leakage Current	I_{GSS}	V_{GS}= ± 20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)^a$	I_D=12.5 A V_{GS}=-10 V	—	-2.5	—	-2.5	V
		I_D=25 A V_{GS}=-10 V	—	-6	—	-6	V
Static Drain-Source On Resistance	$r_{DS}(on)^a$	I_D=12.5 A V_{GS}=-10 V	—	0.2	—	0.2	Ω
Forward Transconductance	g_{fs}^a	V_{DS}=-10 V I_D=12.5 A	4	—	4	—	mho
Input Capacitance	C_{iss}	V_{DS}=-25 V	—	3000	—	3000	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	1500	—	1500	pF
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	500	—	500	pF
Turn-On Delay Time	t_d (on)	V_{DD}=-50 V	35(typ)	50	35(typ)	50	ns
Rise Time	t_r	I_D=12.5 A	165(typ)	250	165(typ)	250	ns
Turn-Off Delay Time	t_d (off)	R_{gen}=R_{gs}=50 Ω	270(typ)	400	270(typ)	400	ns
Fall Time	t_f	V_{GS}=-10 V	165(typ)	250	165(typ)	250	ns
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	RFK25P10, RFK25P08	—	0.83	—	0.83	°C/W

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFK25P10		RFK25P08		
			Min.	Max.	Min.	Max.	
Diode Forward Voltage*	V_{SD}^a	I_{SD}=12.5 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A d_{IF}/d_t=100 A/μs	300 typ.		300 typ.		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFK25P08, RFK25P10

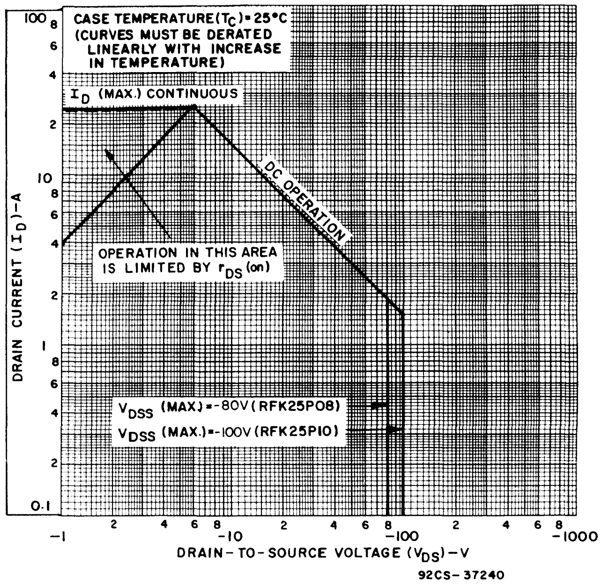


Fig. 1 - Maximum safe operating areas for all types.

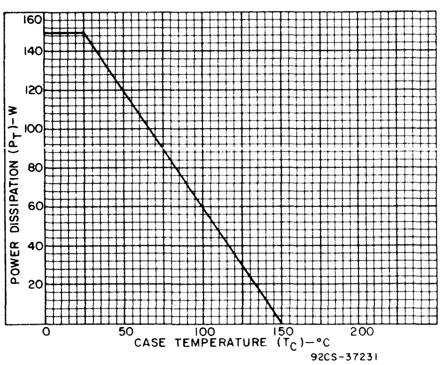


Fig. 2 - Power dissipation vs. temperature derating curve for all types.

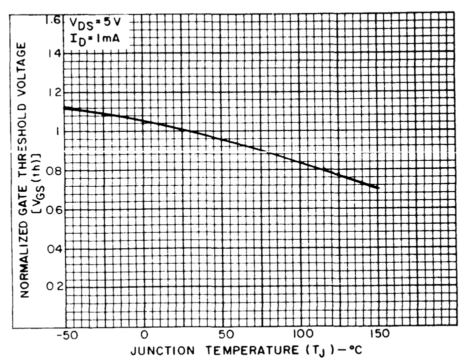


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

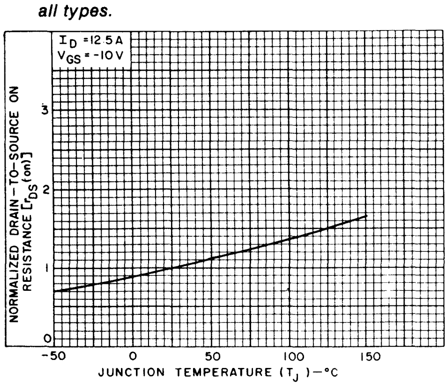


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

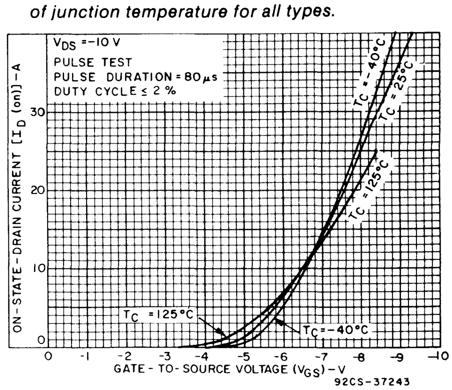


Fig. 5 - Typical transfer characteristics for all types.

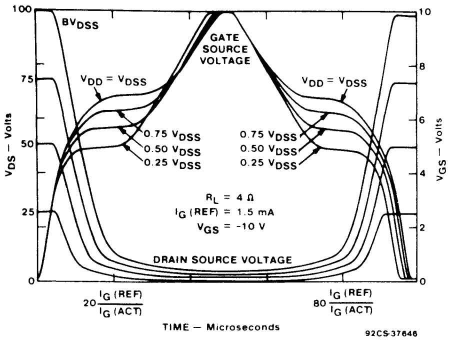


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

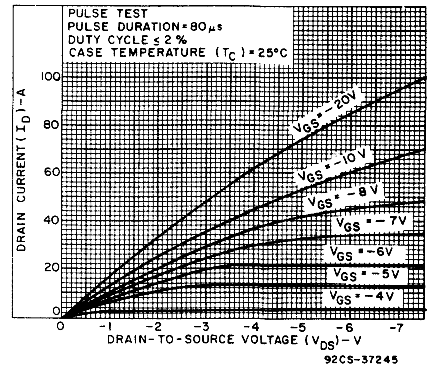


Fig. 7 - Typical saturation characteristics for all types.

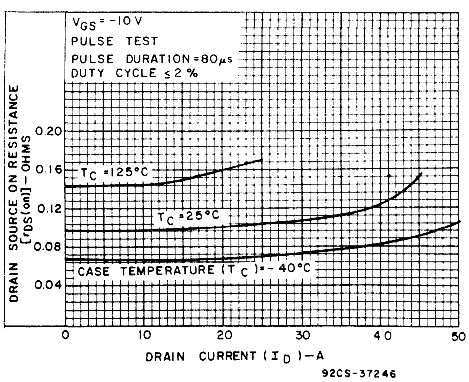


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

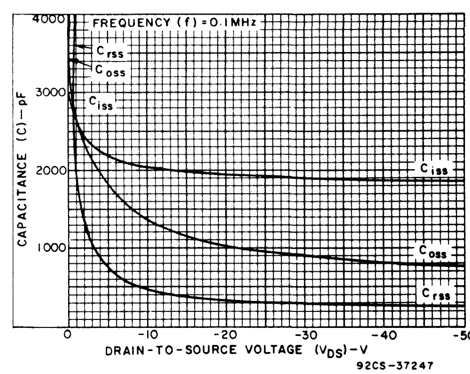


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

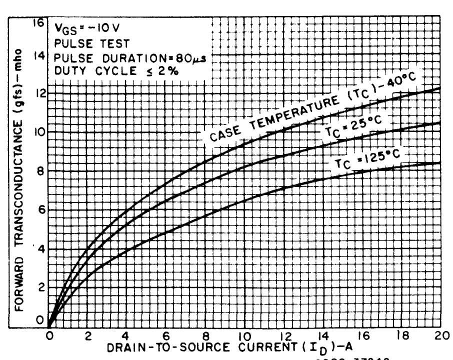


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

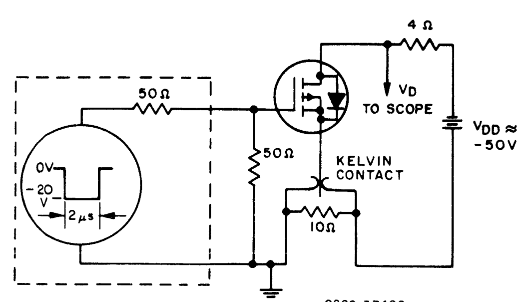


Fig. 11 - Switching time test circuit.

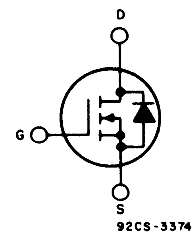
RFK25N18, RFK25N20

File Number **1500**

N-Channel Enhancement-Mode Power Field-Effect Transistors

25 A, 180 V - 200 V
$r_{DS}(on)$ = 0.15 Ω

Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



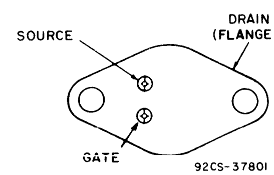
N-CHANNEL ENHANCEMENT MODE

The RFK25N18 and RFK25N20* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFK-types are supplied in the JEDEC TO-204AE steel package.

*The RFK25N18 and RFK25N20 types were formerly RCA developmental numbers TA9295A and TA9295B, respectively.

TERMINAL DESIGNATIONS



JEDEC TO-204AE

(See dimensional outline "D")

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFK25N18		RFK25N20	
DRAIN-SOURCE VOLTAGE	V_{DSS}	180		200	V
DRAIN-GATE VOLTAGE, R_{gs}=1 MΩ	V_{DGR}	180		200	V
GATE-SOURCE VOLTAGE	V_{GS}		±20		V
DRAIN CURRENT, RMS Continuous	I_D		25		A
Pulsed	I_{DM}		60		A
POWER DISSIPATION @ T_C=25°C	P_T		150		W
Derate above T_C=25°C			1.2		W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}		-55 to +150		°C

RFK25N18, RFK25N20

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFK25N18 MIN.	RFK25N18 MAX.	RFK25N20 MIN.	RFK25N20 MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA V_{GS}=0	180	—	200	—	V
Gate Threshold Voltage	$V_{GS}(th)$	$V_{GS}=V_{DS}$ I_D=1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=145 V V_{DS}=160 V	— —	1 —	— —	— 1	μA
		T_C=125° C V_{DS}=145 V V_{DS}=160 V	— —	50 —	— —	— 50	μA
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=12.5 A V_{GS}=10 V	—	1.875	—	1.875	V
		I_D=25 A V_{GS}=10 V	—	5	—	5	V
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=12.5 A V_{GS}=10 V	—	.15	—	.15	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V I_D=12.5 A	7	—	7	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	3500	—	3500	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	900	—	900	pF
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	400	—	400	pF
Turn-On Delay Time	$t_d(on)$	V_{DD}=100 V	40(typ)	80	40(typ)	80	ns
Rise Time	t_r	I_D=12.5 A	150(typ)	225	150(typ)	225	ns
Turn-Off Delay Time	$t_d(off)$	$R_{gen}=R_{gs}$=50 Ω	300(typ)	400	300(typ)	400	ns
Fall Time	t_f	V_{GS}=10 V	120(typ)	200	120(typ)	200	ns
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFK25N18, RFK25N20 Series	—	0.83	—	0.83	°C/W

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFK25N18 MIN.	RFK25N18 MAX.	RFK25N20 MIN.	RFK25N20 MAX.	UNITS
Diode Forward Voltage	V_{SD}[a]	I_{SD}=12.5 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A d_{IF}/d_t=100 A/μs	300(typ)		300(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFK25N18, RFK25N20

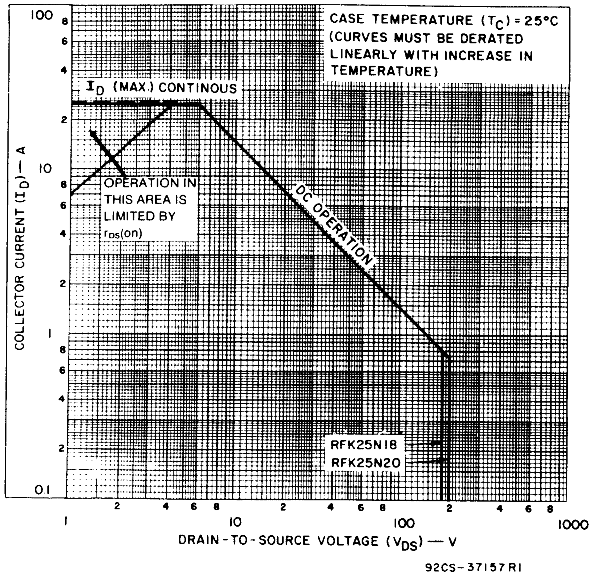


Fig. 1 — Maximum safe operating areas for all types.

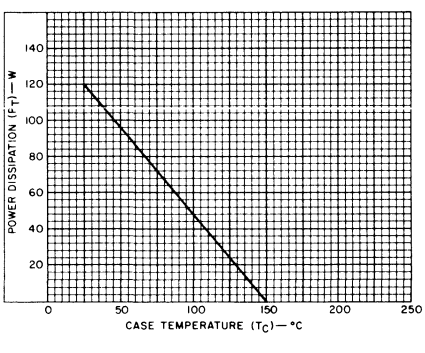


Fig. 2 — Power vs. temperature derating curve for all types.

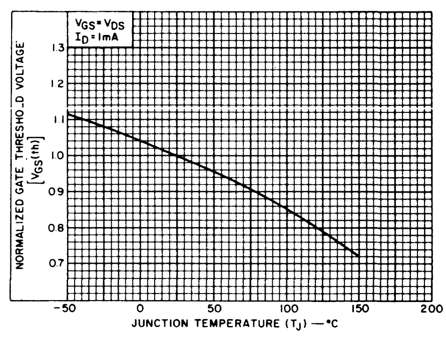


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

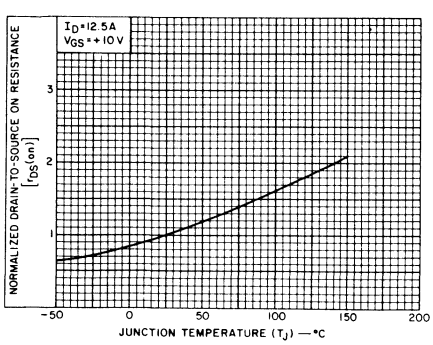


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

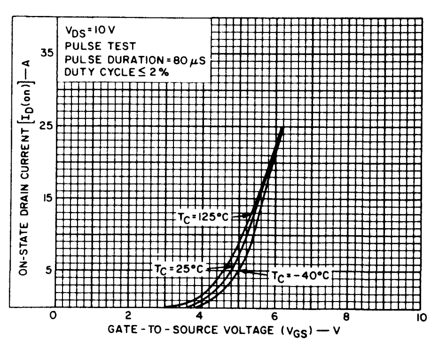


Fig. 5 — Typical transfer characteristics for all types.

RFK25N18, RFK25N20

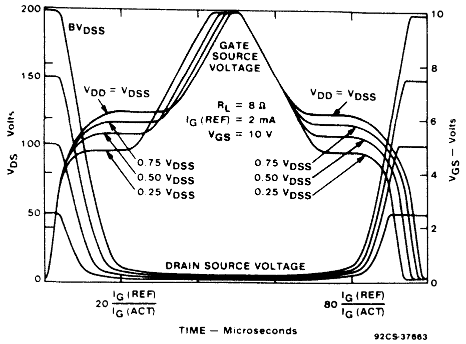


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

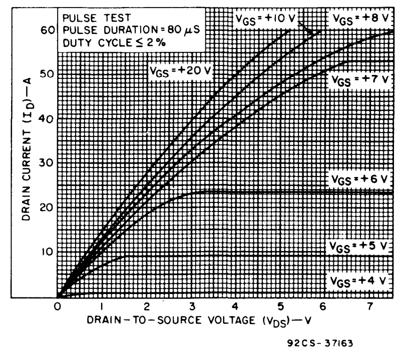


Fig. 7 — Typical saturation characteristics for all types.

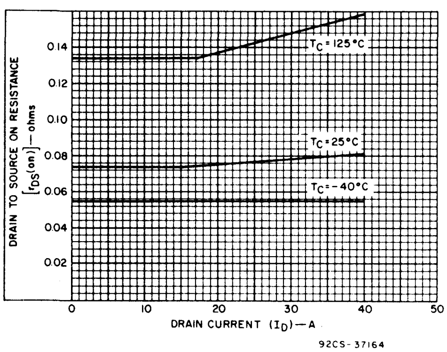


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

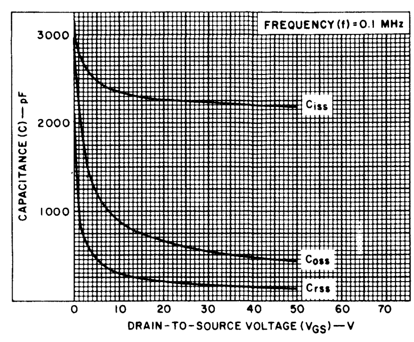


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

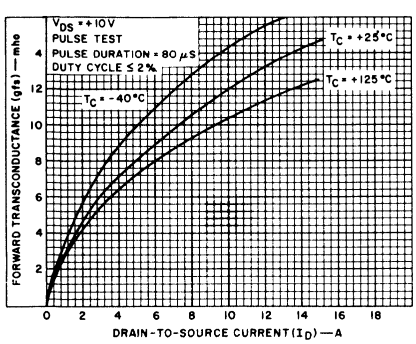


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

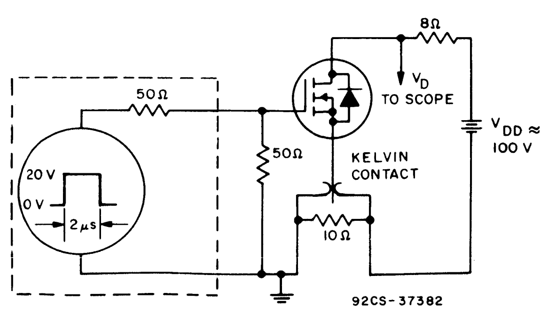


Fig. 11 — Switching Time Test Circuit

RFK30N12, RFK30N15

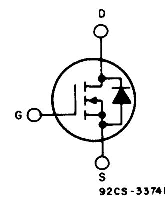
File Number **1455**

N-Channel Enhancement-Mode Power Field-Effect Transistors

30 A, 120 V - 150 V
$r_{DS}(on)=0.085\ \Omega$

Features:

- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



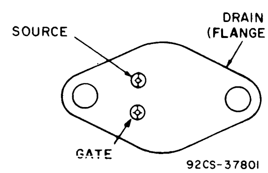
N-CHANNEL ENHANCEMENT MODE

The RFK30N12 and RFK30N15* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFK-types are supplied in the JEDEC TO-204AE steel package.

*The RFK30N12 and RFK30N15 types were formerly RCA developmental numbers TA9188A and TA9188B, respectively.

TERMINAL DESIGNATIONS



JEDEC TO-204AE

(See dimensional outline "D")

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFK30N12	RFK30N15	
DRAIN-SOURCE VOLTAGE	V_{DSS}	120	150	V
DRAIN-GATE VOLTAGE, R_{gs}=1 MΩ	V_{DGR}	120	150	V
GATE-SOURCE VOLTAGE	V_{GS}	±20		V
DRAIN CURRENT, RMS Continuous	I_D	30		A
Pulsed	I_{DM}	100		A
POWER DISSIPATION @T_C=25° C	P_T	120		W
Derate above T_C=25° C		1.2		W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}	-55 to +125		°C

RFK30N12, RFK30N15

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFK30N12 MIN.	LIMITS RFK30N12 MAX.	LIMITS RFK30N15 MIN.	LIMITS RFK30N15 MAX.	UNITS
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA, V_{GS}=0	120	—	150	—	V
Gate Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS}, I_D=1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=100 V	—	1	—	—	μA
		V_{DS}=120 V	—	—	—	1	
		T_C=125° C, V_{DS}=100 V	—	50	—	—	
		T_C=125° C, V_{DS}=120 V	—	—	—	50	
Gate-Source Leakage Current	I_{GSS}	V_{GS}= ± 20 V, V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)^a$	I_D=15 A, V_{GS}=10 V	—	1.275	—	1.275	V
		I_D=30 A, V_{GS}=10 V	—	3	—	3	
Static Drain-Source On Resistance	$r_{DS}(on)^a$	I_D=15 A, V_{GS}=10 V	—	0.085	—	0.085	Ω
Forward Transconductance	g_{fs}^a	V_{DS}=10 V, I_D=15 A	10	—	10	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V, V_{GS}=0 V, f=0.1 MHz	—	3000	—	3000	pF
Output Capacitance	C_{oss}		—	1200	—	1200	
Reverse Transfer Capacitance	C_{rss}		—	500	—	500	
Turn-On Delay Time	$t_d(on)$	V_{DD}=75V, I_D=15 A, R_{gen}=R_{gs}=50 Ω, V_{GS}=10 V	75(typ)	115	75(typ)	115	ns
Rise Time	t_r		420(typ)	630	420(typ)	630	
Turn-Off Delay Time	$t_d(off)$		300(typ)	450	300(typ)	450	
Fall Time	t_f		250(typ)	375	250(typ)	375	
Thermal Resistance Junction-to-Case	$R_{\theta JC}$	RFK30N12, RFK30N15 Series	—	0.83	—	0.83	°C/W

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFK30N12 MIN.	LIMITS RFK30N12 MAX.	LIMITS RFK30N15 MIN.	LIMITS RFK30N15 MAX.	UNITS
Diode Forward Voltage	V_{SD}^a	I_{SD}=15 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A, d_{IF}/d_t=100 A/μs	200(typ)		200(typ)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFK30N12, RFK30N15

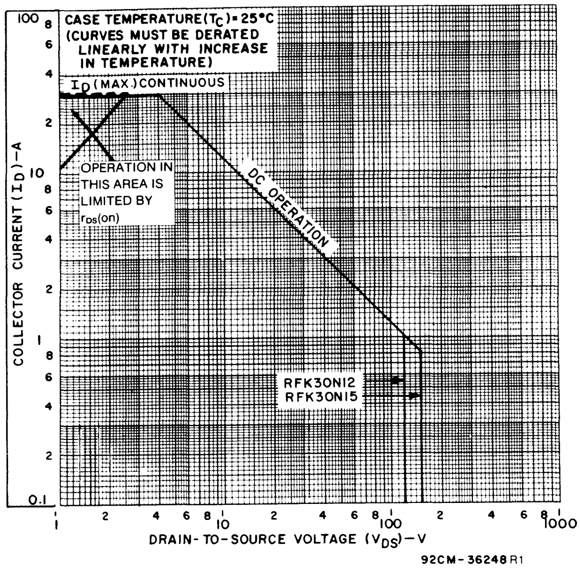


Fig. 1 - Maximum safe operating areas for all types.

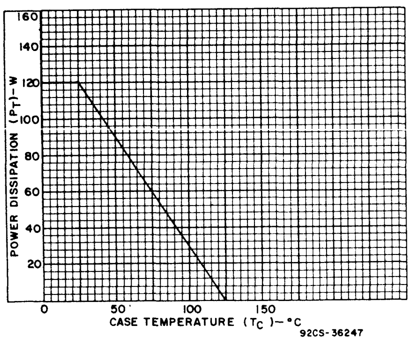


Fig. 2 - Power vs. temperature derating curve for all types.

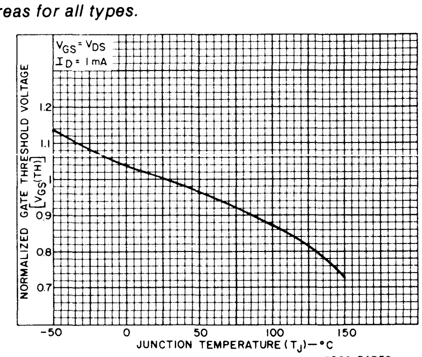


Fig. 3 - Typical normalized gate threshold voltage as a function of junction temperature for all types.

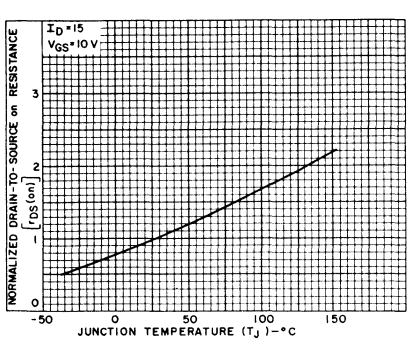


Fig. 4 - Normalized drain-to-source on resistance to junction temperature for all types.

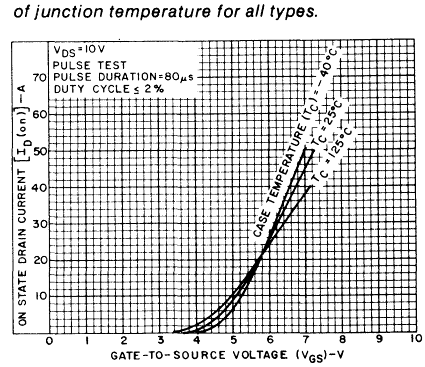


Fig. 5 - Typical transfer characteristics for all types.

RFK30N12, RFK30N15

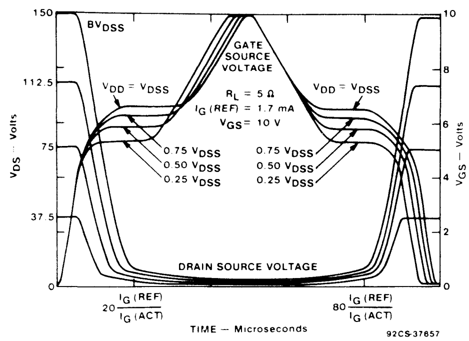


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

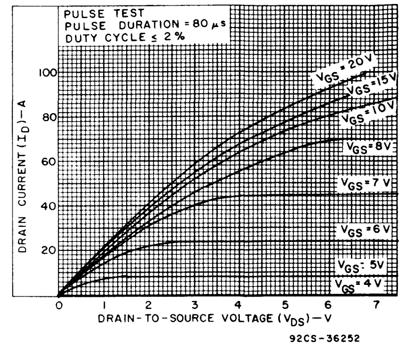


Fig. 7 - Typical saturation characteristics for all types.

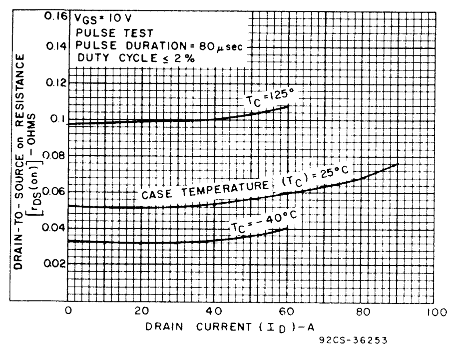


Fig. 8 - Typical drain-to-source on resistance as a function of drain current for all types.

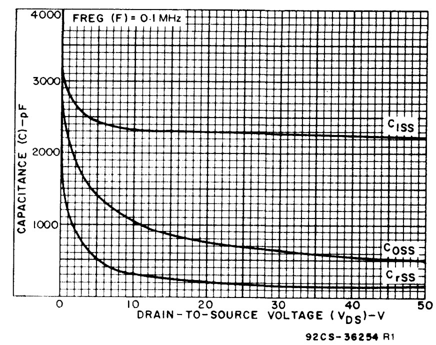


Fig. 9 - Capacitance as a function of drain-to-source voltage for all types.

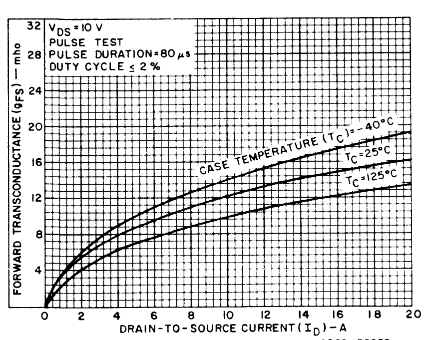


Fig. 10 - Typical forward transconductance as a function of drain current for all types.

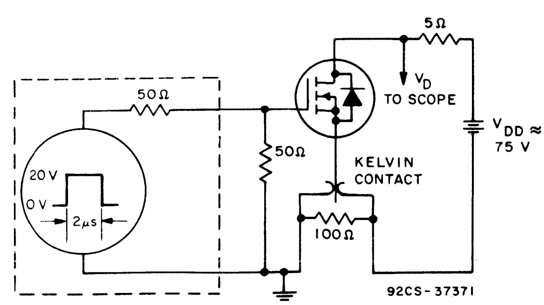


Fig. 11 — Switching Time Test Circuit

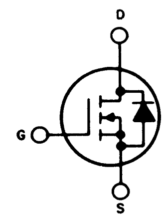
RFK35N08, RFK35N10

File Number **1499**

N-Channel Enhancement-Mode Power Field-Effect Transistors

35 A, 80 V - 100 V
$r_{DS}(on) = 0.06\ \Omega$

Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



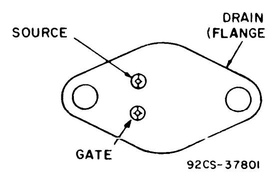
N-CHANNEL ENHANCEMENT MODE

The RFK35N08 and RFK35N10* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFK-types are supplied in the JEDEC TO-204AE steel package.

*The RFK35N08 and RFK35N10 types were formerly RCA developmental numbers TA9288A and TA9288B, respectively.

TERMINAL DESIGNATIONS



JEDEC TO-204AE

(See dimensional outline "D")

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFK35N08		RFK35N10	
DRAIN-SOURCE VOLTAGE	V_{DSS}	80		100	V
DRAIN-GATE VOLTAGE, R_{gs}=1 MΩ	V_{DGR}	80		100	V
GATE-SOURCE VOLTAGE	V_{GS}		±20		V
DRAIN CURRENT, RMS Continuous	I_D		35		A
Pulsed	I_{DM}		100		A
POWER DISSIPATION @ T_C=25°C	P_T		150		W
Derate above T_C=25°C			1.2		W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}		-55 to +150		°C

RFK35N08, RFK35N10

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFK35N08		RFK35N10		
			MIN.	MAX.	MIN.	MAX.	
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA V_{GS}=0	80	—	100	—	V
Gate Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS} I_D=1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=65 V V_{DS}=80 V	— —	1 —	— —	— 1	µA
		T_C=125°C V_{DS}=65 V V_{DS}=80 V	— —	50 —	— —	— 50	µA
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=17.5 A V_{GS}=10 V	—	1.05	—	1.05	V
		I_D=35 A V_{GS}=10 V	—	3.5	—	3.5	V
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=17.5 A V_{GS}=10 V	—	.06	—	.06	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V I_D=17.5 A	10	—	10	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	3000	—	3000	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	1500	—	1500	pF
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	600	—	600	pF
Turn-On Delay Time	$t_d(on)$	V_{DS}=50 V	45(typ)	100	45(typ)	100	ns
Rise Time	t_r	I_D=17.5 A	225(typ)	450	225(typ)	450	ns
Turn-Off Delay Time	$t_d(off)$	R_{gen}=R_{gs}=50 Ω	240(typ)	450	240(typ)	450	ns
Fall Time	t_f	V_{GS}=10 V	165(typ)	350	165(typ)	350	ns
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFK35N08, RFK35N10 Series	—	0.83	—	0.83	°C/W

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS				UNITS
			RFK35N08		RFK35N10		
			MIN.	MAX.	MIN.	MAX.	
Diode Forward Voltage	V_{SD}[a]	I_{SD}=17.5 A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F=4 A d_{IF}/d_t=100 A/µs	200(typ)		200(typ)		ns

[a]Pulsed: Pulse duration = 300 µs max., duty cycle = 2%.

RFK35N08, RFK35N10

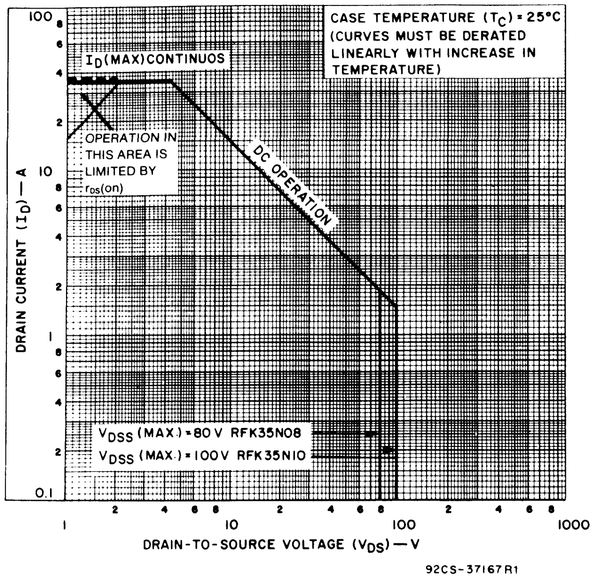


Fig. 1 — Maximum safe operating areas for all types.

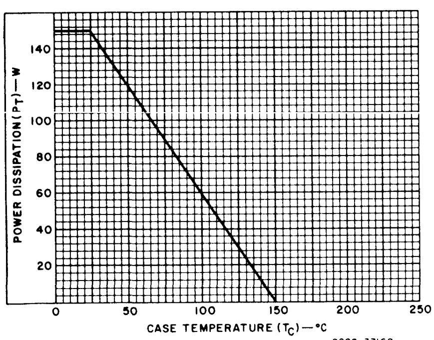


Fig. 2 — Power vs. temperature derating curve for all types.

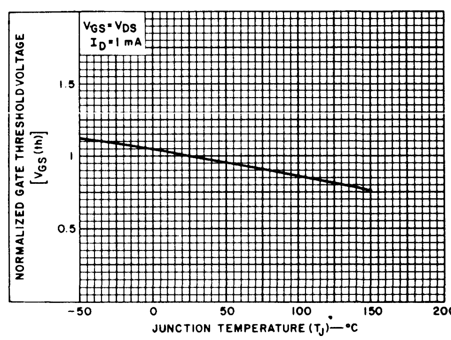


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

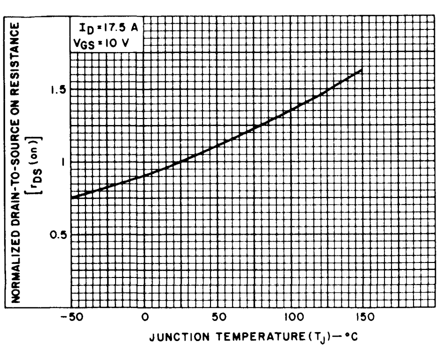


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

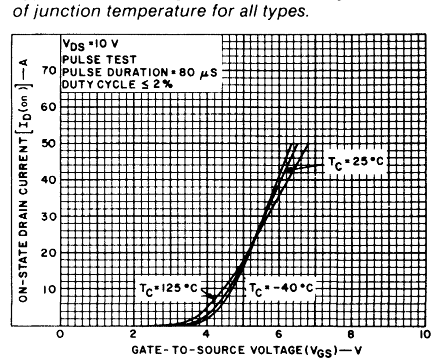


Fig. 5 — Typical transfer characteristics for all types.

RFK35N08, RFK35N10

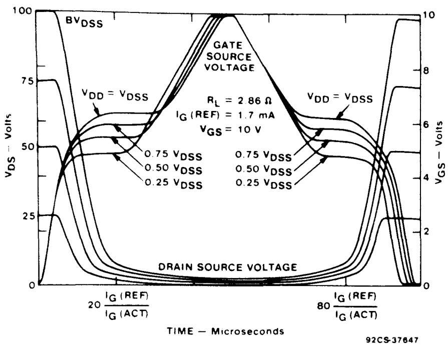


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

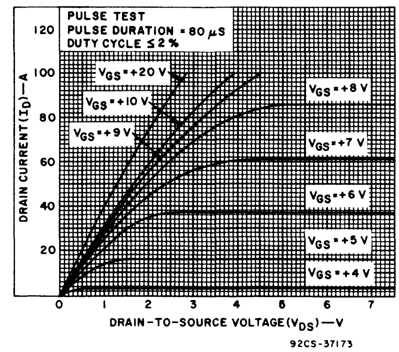


Fig. 7 — Typical saturation characteristics for all types.

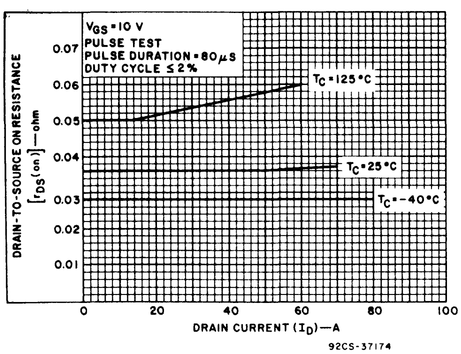


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

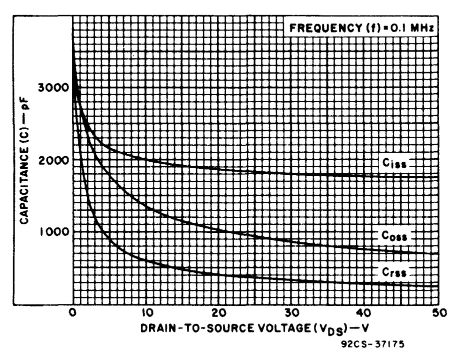


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

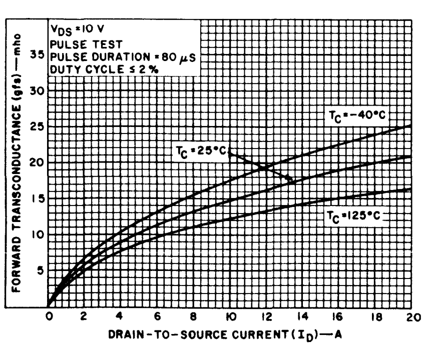


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

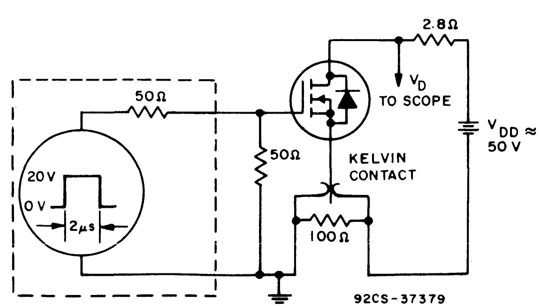


Fig. 11 — Switching Time Test Circuit.

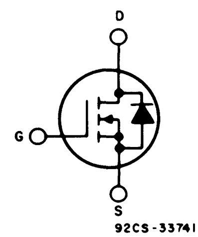
RFK45N05, RFK45N06

File Number **1498**

N-Channel Enhancement-Mode Power Field-Effect Transistors

45 A, 50 V - 60 V
$r_{DS}(on) = 0.040\ \Omega$

Features:
- *SOA is power-dissipation limited*
- *Nanosecond switching speeds*
- *Linear transfer characteristics*
- *High input impedance*
- *Majority carrier device*



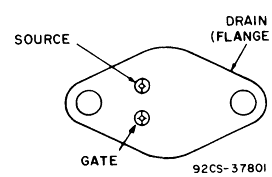
N-CHANNEL ENHANCEMENT MODE

The RFK45N05 and RFK45N06* are n-channel enhancement-mode silicon-gate power field-effect transistors designed for applications such as switching regulators, switching converters, motor drivers, relay drivers, and drivers for high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

The RFK-types are supplied in the JEDEC TO-204AE steel package.

*The RFK45N05 and RFK45N06 types were formerly RCA developmental numbers TA9388A and TA9388B, respectively.

TERMINAL DESIGNATIONS



JEDEC TO-204AE
(See dimensional outline "D")

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C=25° C):*

		RFK45N05		RFK45N06	
DRAIN-SOURCE VOLTAGE	V_{DSS}	50		60	V
DRAIN-GATE VOLTAGE, R_{gs}=1 MΩ	V_{DGR}	50		60	V
GATE-SOURCE VOLTAGE	V_{GS}		±20		V
DRAIN CURRENT, RMS Continuous	I_D		45		A
Pulsed	I_{DM}		100		A
POWER DISSIPATION @ T_C=25°C	P_T		150		W
Derate above T_C=25°C			1.2		W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}		-55 to +150		°C

RFK45N05, RFK45N06

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C unless otherwise specified.*

CHARACTERISTICS	SYMBOL	TEST CONDITIONS	LIMITS RFK45N05		LIMITS RFK45N06		UNITS
			MIN.	MAX.	MIN.	MAX.	
Drain-Source Breakdown Voltage	BV_{DSS}	I_D=1 mA V_{GS}=0	50	—	60	—	V
Gate Threshold Voltage	$V_{GS}(th)$	V_{GS}=V_{DS} I_D=1 mA	2	4	2	4	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS}=40 V V_{DS}=50 V	— —	1 —	— —	— 1	μA
		T_C=125°c V_{DS}=40 V V_{DS}=50 V	— —	50 —	— —	— 50	μA
Gate-Source Leakage Current	I_{GSS}	V_{GS}=±20 V V_{DS}=0	—	100	—	100	nA
Drain-Source On Voltage	$V_{DS}(on)$[a]	I_D=22.5 A V_{GS}=10 V	—	0.9	—	0.9	V
		I_D=45 A V_{GS}=10 V	—	3.6	—	3.6	V
Static Drain-Source On Resistance	$r_{DS}(on)$[a]	I_D=22.5 A V_{GS}=10 V	—	.04	—	.04	Ω
Forward Transconductance	g_{fs}[a]	V_{DS}=10 V I_D=22.5 A	10	—	10	—	mho
Input Capacitance	C_{iss}	V_{DS}=25 V	—	3000	—	3000	pF
Output Capacitance	C_{oss}	V_{GS}=0 V	—	1800	—	1800	pF
Reverse Transfer Capacitance	C_{rss}	f=0.1 MHz	—	750	—	750	pF
Turn-On Delay Time	$t_d(on)$	V_{DD} = 30 V	40(typ)	80	40(typ)	80	ns
Rise Time	t_r	I_D=22.5 A	310(typ)	475	310(typ)	475	ns
Turn-Off Delay Time	$t_d(off)$	R_{gen}=R_{gs}=50 Ω	220(typ)	350	220(typ)	350	ns
Fall Time	t_f	V_{GS}=10 V	240(typ)	375	240(typ)	375	ns
Thermal Resistance Junction-to-Case	$R\theta_{JC}$	RFK45N05, RFK45N06 Series	—	0.83	—	0.83	°C/W

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS RFK45N05		LIMITS RFK45N06		UNITS
			Min.	Max.	Min.	Max.	
Diode Forward Voltage	V_{SD}[a]	I_{SD} = 22.5A	—	1.4	—	1.4	V
Reverse Recovery Time	t_{rr}	I_F = 4A d_{IF}/d_t = 100A/μs	150(typ.)		150(typ.)		ns

[a]Pulsed: Pulse duration = 300 μs max., duty cycle = 2%.

RFK45N05, RFK45N06

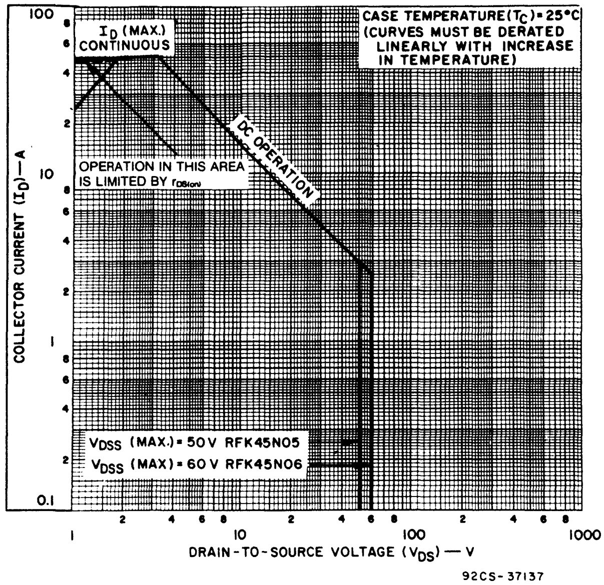


Fig. 1 — Maximum safe operating areas for all types.

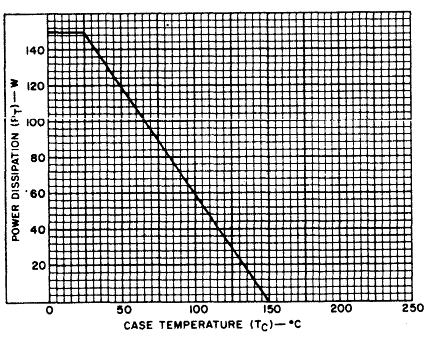


Fig. 2 — Power vs. temperature derating curve for all types.

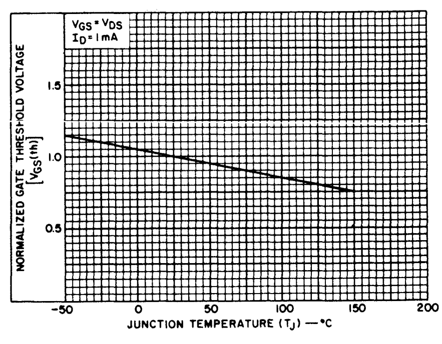


Fig. 3 — Typical normalized gate threshold voltage as a function of junction temperature for all types.

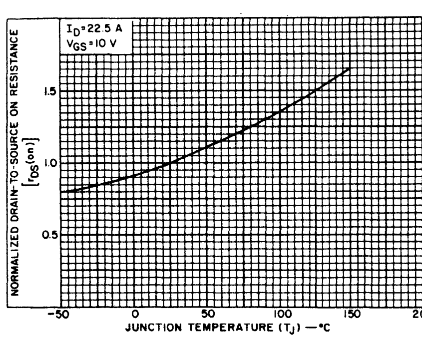


Fig. 4 — Normalized drain-to-source on resistance to junction temperature for all types.

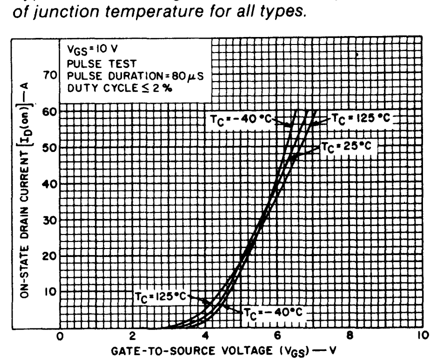


Fig. 5 — Typical transfer characteristics for all types.

RFK45N05, RFK45N06

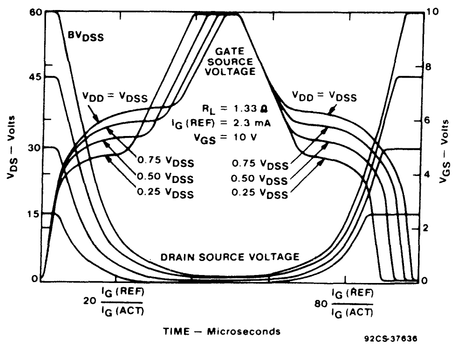


Fig. 6 - Normalized switching waveforms for constant gate-current drive.

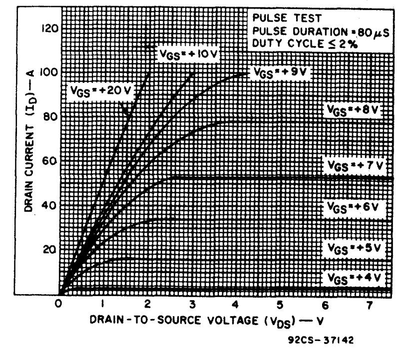


Fig. 7 — Typical saturation characteristics for all types.

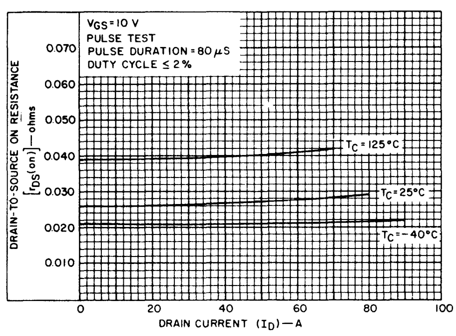


Fig. 8 — Typical drain-to-source on resistance as a function of drain current for all types.

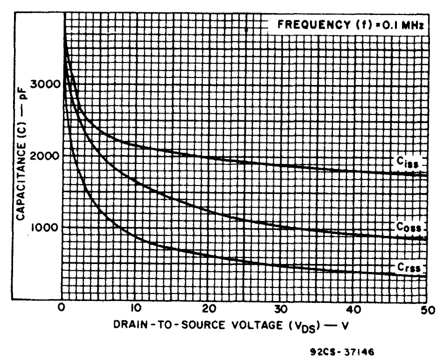


Fig. 9 — Capacitance as a function of drain-to-source voltage for all types.

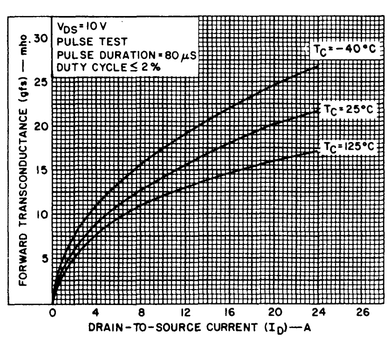


Fig. 10 — Typical forward transconductance as a function of drain current for all types.

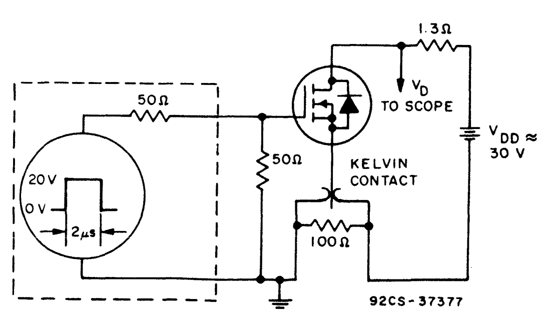


Fig. 11 - Switching Time Test Circuit.

IRF130-133, IRF251-253, IRF420-423,
IRF510-513, IRF520-523, IRF530-533

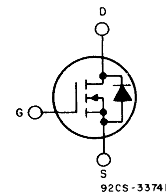
File Number **1469**

N-Channel Enhancement-Mode Silicon Gate Power Field-Effect Transistors

3.5-14 A, 60-500 V

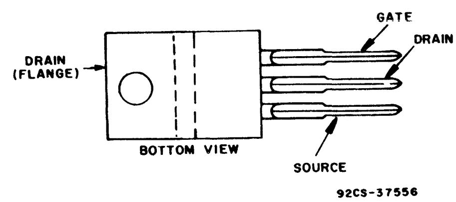
Features:

- *Silicon gate for fast switching speeds - specified switching times at elevated temperatures*
- *Rugged - SOA is power-dissipation limited*
- *Low drive requirement, $V_{GS(th)}$ = 4 V (max.)*



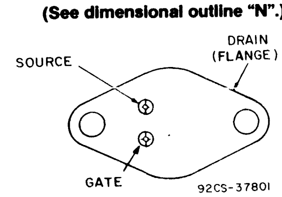
N-CHANNEL ENHANCEMENT MODE

TERMINAL DESIGNATIONS



JEDEC TO-220AB

(See dimensional outline "N".)



JEDEC TO-204AE,AA

(See dimensional outlines"D & E")

The n-channel enhancement-mode silicon-gate power field-effect transistors are designed for high-voltage, high-speed power-switching applications, such as line-operated switching regulators, converters, solenoid and relay drivers.

MAXIMUM RATINGS, *Absolute-Maximum Values (T_C = 25° C):*

DRAIN-SOURCE VOLTAGE	V_{DSS}	See Table 2, TO-204AA, AE	V
		See Table 3, TO-220AB	V
GATE-SOURCE VOLTAGE	V_{GS}	± 20	V
DRAIN CURRENT	I_D	See Table 2, TO-204AA, AE	A
		See Table 3, TO-220AB	A
POWER DISSIPATION @ T_C = 25°C	P_T	See Table 2, TO-204AA, AE	W
		See Table 3, TO-220AB	W
Derate above T_C = 25°C		See Table 2, TO-204AA, AE	W/°C
		See Table 3, TO-220AB	W/°C
OPERATING AND STORAGE TEMPERATURE	T_j, T_{stg}	-55 to +150	°C
THERMAL CHARACTERISTICS			
THERMAL RESISTANCE (Junction-to-Case)	$R_{\theta JC}$	See Table 2, TO-204AA, AE	°C/W
		See Table 3, TO-220AB	°C/W
MAXIMUM LEAD TEMPERATURE FOR SOLDERING PURPOSES, 1/8 in. from case for 5 seconds	T_L	275	°C

IRF130-133, IRF251-253, IRF420-423, IRF510-513, IRF520-523, IRF530-533

Table 2 - TO-204AA, AE (Formerly TO-3)

Device	MAXIMUM RATINGS					ELECTRICAL CHARACTERISTICS						
	V_{DSS} (Volts)	I_D (Amp)	P_T (Watts)	Derating Factor W/°C	$R_{\theta JC}$ °C/W	$r_{DS(on)}$ (Ohm) Max.	@ I_D (Amp)	$V_{GS(th)}$ (Volts) Min./Max.	g_{fs} (mho) Min.	t_{on} (ns) Typ.	t_{off} (ns) Typ.	@ I_D (Amp)
IRF130	100	14	75	0.6	1.67	0.18	8	2/4	4	115	130	8
IRF131	60											
IRF132	100	12				0.25						
IRF133	60											
* IRF251	150	30	150	1.2	0.833	.085	15		8	500	550	15
* IRF253	150	25				.120						
IRF420	500	2.5	40	0.32	3.12	3.0	1.5		1	105	210	1.5
IRF421	450											
IRF422	500	2.0										
IRF423	450											

* 60 mil leads

Table 3 - TO-220AB

Device	MAXIMUM RATINGS					ELECTRICAL CHARACTERISTICS						
	V_{DSS} (Volts)	I_D (Amp)	P_T (Watts)	Derating Factor W/°C	$R_{\theta JC}$ °C/W	$r_{DS(on)}$ (Ohm) Max.	@ I_D (Amp)	$V_{GS(th)}$ (Volts) Min./Max.	g_{fs} (mho) Min.	t_{on} (ns) Typ.	t_{off} (ns) Typ.	@ I_D (Amp)
IRF510	100	4	20	0.16	6.25	0.6	2	2/4	1	75	155	2
IRF511	60											
IRF512	100	3.5				0.8						
IRF513	60											
IRF520	100	8	40	0.32	3.12	0.3	4		1.5	90	145	4
IRF521	60											
IRF522	100	7				0.4						
IRF523	60											
IRF530	100	14	75	0.6	1.67	0.18	8		4	115	130	8
IRF531	60											
IRF532	100	12				0.25						
IRF533	60											

Ultra-Fast-Recovery Rectifiers
Technical Data

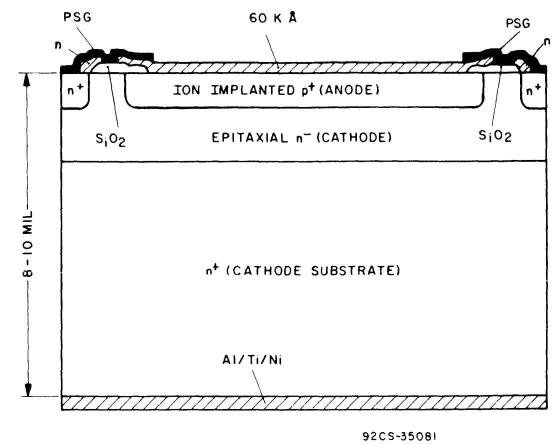
Ultra-Fast-Recovery Rectifiers

Basic Design Features

The latest state-of-the-art processing technology is employed in the manufacture of the new series of RCA ultra-fast-recovery (35-ns) rectifiers. The cathode region is created by the growth of an n^- epitaxial layer onto a low-resistivity n^+ substrate. The anode region is formed by ion implantation and high-temperature diffusion. Aluminum metal on the anode provides for aluminum wire bonding. Trimetal (aluminum-titanium-nickel) evaporated onto the cathode surface provides cathode metallization for high-temperature solder mounting.

Modern planar technology is used to form the edges of the rectifier structure. The structure features an n^+ "channel stopper," an evaporated metal field shield, and an ion trap to assure reverse-bias stability. The p-n junction is insulated by a silicon-dioxide (SiO_2) layer. A phosphorous-doped silicon-glass overcoat provides mechanical protection during assembly.

The resultant structure features low forward voltage drops, excellent bias stability, low dissipation, and very short reverse-recovery times (less than 35 ns).

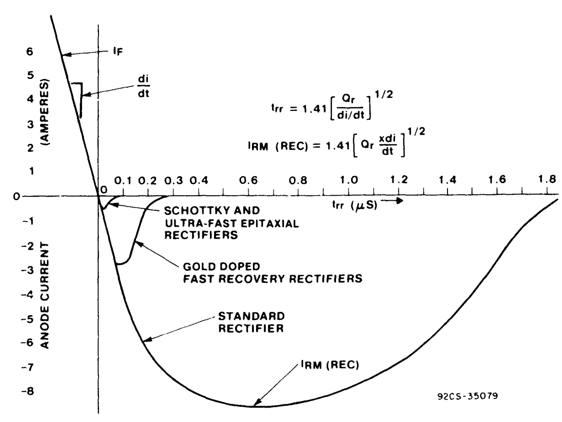


Planar, high-speed, glass-passivated pellet structure used in RCA ultra-fast-recovery rectifiers.

Circuit Benefits

RCA ultra-fast-recovery rectifiers offer several important benefits for use in high-speed power-switching circuits. These benefits include:

- Decrease in the short-circuit energy that impinges on the power switches
- Less RFI generation in the rectifier filter system
- Reduction in, or elimination of, the RC damping networks frequently required with Schottky and ordinary fast-recovery rectifiers
- Dissipations that are 20 to 30 percent less than those in ordinary fast-recovery rectifiers
- Breakdown voltages three to five times greater than those of Schottky rectifiers



Relative reverse-recovery-time (t_{rr}) characteristics of various rectifier structures. Curves show the excellent recovery behavior of the RCA ultra-fast epitaxial structure.

Special Attributes

The RUR series of ultra-fast-recovery rectifiers feature a passivated epitaxial structure that combines the advantages of fast switching speed, low forward-voltage drop, good breakdown capability, and wide operating temperature range. The low stored charge and attendant fast reverse-recovery behavior of these rectifiers minimize electrical noise generation and, in many circuits, markedly reduce the turn-on dissipation of associated power switching transistors. These attributes make RUR-series types excellent choices for use in switching power supplies.

Fast Switching Speeds

Thin anode and cathode regions in the RUR series of RCA ultra-fast-recovery rectifiers limit the build up of excess charge during forward conduction. Gold doping causes this minimal charge to be dissipated quickly during the recovery period so that the recovery time of RUR-series rectifiers is comparable to that of Schottky rectifiers.

Breakdown-Voltage Tradeoff

The vertical structure used in RCA ultra-fast rectifiers is optimized for high-speed switching capability, achieved as a tradeoff against reverse-voltage breakdown capability. As a result, the ultra-fast-recovery series are suitable for use as output rectifiers in 100-kHz switching power supplies that provide outputs of 5 to 48 volts. Despite the trade-off for switching speed, the RUR-series rectifiers have a breakdown capability three to five times greater than that of Schottky rectifiers with similar recovery times.

Low Forward-Voltage Drop

Precise manufacturing control of the anode and cathode vertical structure makes possible low forward-voltage drops — typically less than 0.9 volt at the rated current — significantly lower than those of conventional high-voltage fast-recovery rectifiers.

Temperature Capability

The low forward voltage drop of the ultra-fast-recovery rectifiers permit safe operation of these devices at case temperatures of 125°C at the rated average forward current. At this case temperature, the RUR-810 series rectifiers can operate safely at average currents up to 8 amperes or at peak currents up to 16 amperes in an output circuit with a 50 per cent duty cycle.

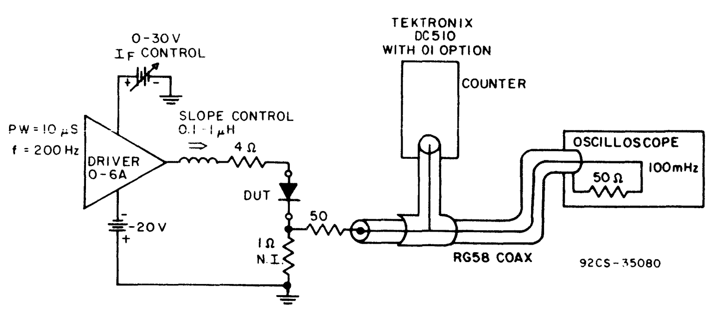
Hybrid-Circuit Compatibility

RCA ultra-fast-recovery rectifiers incorporate several construction features that are ideal for mounting the rectifier pellets in hybrid circuits, as follows:

- The trimetal cathode metallization is particularly suited for high-temperature solder mounting. (A eutectic solder bond formed with 95/5 lead-tin solder at a temperature of 320°C is recommended.)
- The aluminum anode metallization facilitates aluminum wire bonding.
- The glass-passivated planar structure assures excellent mechanical protection during processing.
- Large bonding surfaces (3600 mils^2 on 8-ampere types, 10,000 mils^2 on 15-ampere types) are available.

Recovery-Time Measurement Method

Reverse-recovery-time (t_{rr}) measurements are, to some extent, dependent upon the circuit configuration in which the measurement is made and the level of current from which the device must recover. The test-circuit configuration and the test method used in the recovery measurements on the RCA ultra-fast-recovery rectifiers assures realistic current levels and various rates of change of current (-di/dt).



Test circuit used for reverse-recovery-time measurements.

RUR-810, RUR-815, RUR-820

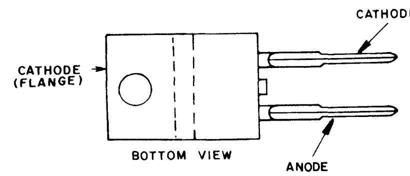
File Number **1355**

8-A, High Speed, High Efficiency Epitaxial Silicon Rectifiers

Features:
- *Ultra fast recovery time (<35 ns)*
- *Low forward voltage*
- *Low thermal resistance*
- *Planar design*
- *Wire-bonded construction*

Applications:
- *General Purpose*
- *Power switching circuits to 100 kHz*
- *Output rectification in switching power supplies*

TERMINAL DESIGNATIONS



JEDEC TO-220AC

(See dimensional outline "O".)

The RCA RUR-810, RUR-815, and RUR-820* are low forward voltage drop ultra fast-recovery rectifiers (trr <35 ns). They use a glass passivated ion-implanted epitaxial construction.

These devices are intended for use as output rectifiers and fly wheel diodes in a variety of high-frequency pulse-width modulated and switching regulators. Their low stored charge and attendant fast reverse-recovery behavior minimize electrical noise generation and in many circuits markedly reduce the turn-on dissipation of the associated power switching transistors.

All are supplied in TO-220AC plastic packages.

*Formerly RCA Dev. No. TA9223A, TA9223B, and TA9223C, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RUR-810	RUR-815	RUR-820	
VRM	100	150	200	V
IF (Average)				
T_A = 25°C (No Heat Sink)		3		A
T_A = 25°C (With Heat Sink)[a]		8		A
T_C = 125°C		8		A
IFSM (surge)				
8.3ms, 1/2 cycle, non-repetitive		100		A
Tstg, T_J		-55 to 150		°C
T_L (Lead temperature during soldering)				
At distance > 1/8in. (3.17mm) from case for 10 S max.		260		°C

(a) Wakefield type 295 heat sink with convection cooling

RUR-810, RUR-815, RUR-820

ELECTRICAL CHARACTERISTICS

CHARAC-TERISTICS	TEST CONDITIONS T_J °C	Voltage V_R V	Current i_F A	LIMITS RUR-810 Min.	RUR-810 Max.	RUR-815 Min.	RUR-815 Max.	RUR-820 Min.	RUR-820 Max.	UNITS
i_R	25	100		—	5	—	—	—	—	μA
		150		—	—	—	5	—	—	
		200		—	—	—	—	—	5	
	100	100		—	400	—	—	—	—	
		150		—	—	—	400	—	—	
		200		—	—	—	—	—	400	
V_F	25		8	—	0.95	—	0.95	—	1	V
	100		8	—	0.89	—	0.89	—	0.94	
t_{rr}	25		2(a)	—	35	—	35	—	35	ns
$R_{\theta JC}$				—	2.25	—	2.25	—	2.25	°C/W
$R_{\theta JA}$				—	60	—	60	—	60	
C_J	25	10	0	40 Typ.		40 Typ.		40 Typ.		pF

(a) $di_F/dt > 40A/\mu s$, I_{RM} (rec) $< 1A$, $I_{RR} = 0.25A$

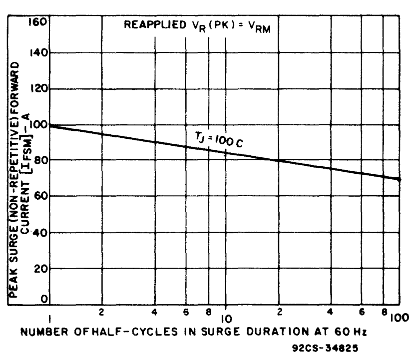


Fig. 1 — Peak surge forward current vs. surge duration.

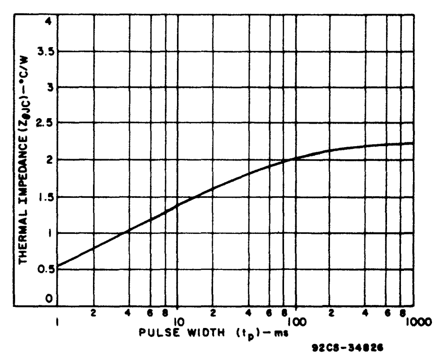


Fig. 2 — Thermal impedance vs. pulse width.

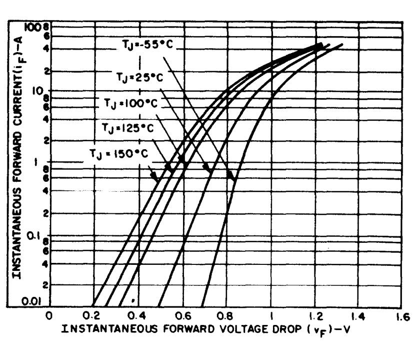


Fig. 3 — Typical forward current vs. forward-voltage drop.

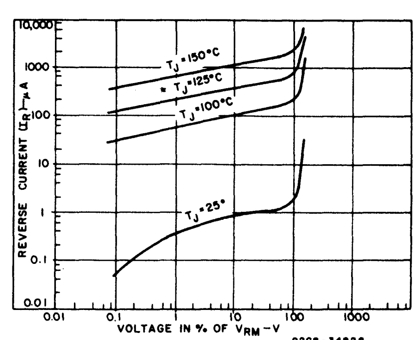


Fig. 4 — Typical reverse current vs. voltage.

RUR-D810, RUR-D815, RUR-D820

File Number **1356**

Dual 8-A, High-Speed, High Efficiency Epitaxial Silicon Rectifiers

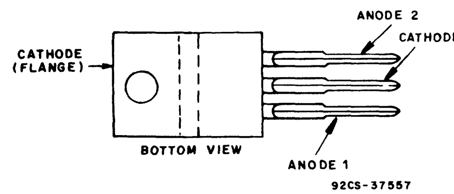
Features:

- *Ultra fast recovery time [<35 ns]*
- *Low forward voltage*
- *Low thermal resistance*
- *Planar design*
- *Wire-bonded construction*

Applications:

- *General Purpose*
- *Power switching circuits to 100 kHz*
- *Full-wave rectification*

TERMINAL DESIGNATIONS



JEDEC TO-220AB

(See dimensional outline "N".)

The RCA RUR-D810, RUR-D815, and RUR-D820* are low forward voltage drop ultra fast-recovery rectifiers (trr <35 ns). They use a glass passivated ion-implanted epitaxial construction.

These devices are intended for use as output rectifiers and fly wheel diodes in a variety of high-frequency pulse-width modulated and switching regulators. Their low stored charge and attendant fast reverse recovery behavior minimize electrical noise generation and in many circuits markedly reduce the turn-on dissipation of the associated power switching transistors.

All are supplied in TO-220AB plastic packages.

*Formerly RCA Dev. No. TA9224A, TA9224B, and TA9224C, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values, per Junction:*

	RUR-D810	RUR-D815	RUR-D820	
VRM	100	150	200	V
IF (Average)				
T_A = 25°C (No Heat Sink)		3		A
T_A = 25°C (With Heat Sink)[a]		8		A
T_C = 125°C		8		A
IFSM (surge)				
8.3ms, 1/2 cycle, non-repetitive		100		A
Tstg, T_J		−55 to 150		°C
T_L (Lead temperature during soldering)				
At distance > 1/8in. (3.17mm) from case for 10 S max.		260		°C

(a) Wakefield type 295 heat sink with convection cooling

RUR-D810, RUR-D815, RUR-D820

ELECTRICAL CHARACTERISTICS, per junction

CHARAC-TERISTICS	TEST CONDITIONS			LIMITS						UNITS
	T_J °C	Voltage V_R V	Current I_F A	RUR-D810 Min.	RUR-D810 Max.	RUR-D815 Min.	RUR-D815 Max.	RUR-D820 Min.	RUR-D820 Max.	
i_R	25	100		—	5	—	—	—	—	μA
		150		—	—	—	5	—	—	
		200		—	—	—	—	—	5	
	100	100		—	400	—	—	—	—	
		150		—	—	—	400	—	—	
		200		—	—	—	—	—	400	
V_F	25		8	—	0.95	—	0.95	—	1	V
	100		8	—	0.89	—	0.89	—	0.94	
t_{rr}	25		8(a)	—	35	—	35	—	35	ns
$R_{\theta JC}$				—	2.25	—	2.25	—	2.25	°C/W
$R_{\theta JA}$				—	60	—	60	—	60	
C_J	25	10	0	40 Typ.		40 Typ.		40 Typ.		pF

(a) $di_F/dt > 40A/\mu s$, I_{RM} (rec) $< 1A$, $I_{RR} = 0.25A$

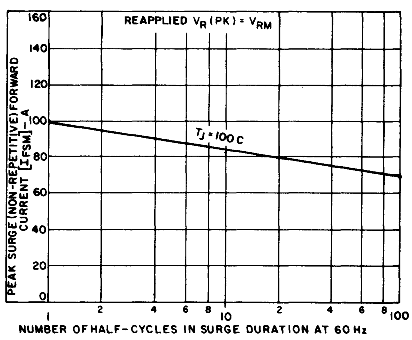


Fig. 1 — Peak surge foward current vs. surge duration.

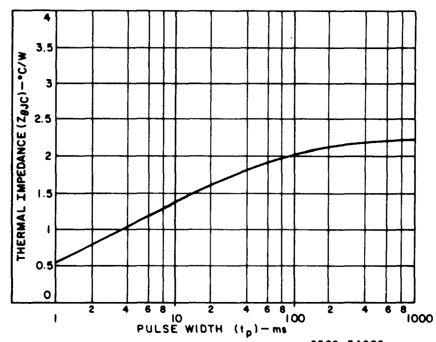


Fig. 2 - Thermal impedance vs. pulse width (per junction).

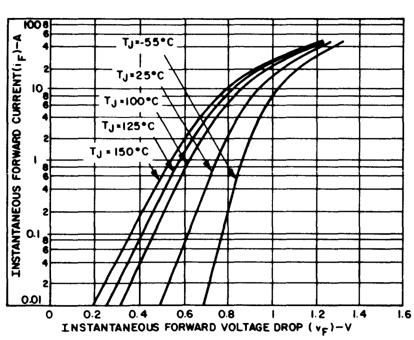


Fig. 3 — Typical forward current vs. forward-voltage drop.

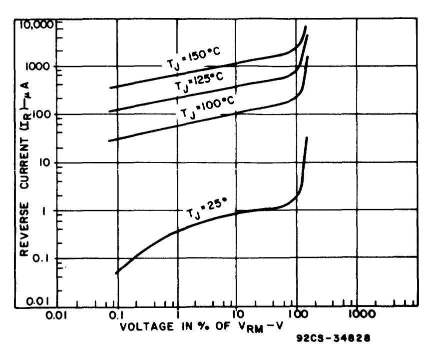


Fig. 4 — Typical reverse current vs. voltage.

RUR-D1610, RUR-D1615, RUR-D1620

File Number **1383**

Dual 16-A, High-Speed, High Efficiency Epitaxial Silicon Rectifiers

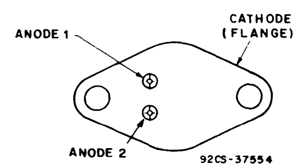
Features:

- *Ultra fast recovery time (< 35 ns)*
- *Low forward voltage*
- *Low thermal resistance*
- *Planar design*
- *Wire-bonded construction*

Applications:

- *General purpose*
- *Power switching circuits to 100 kHz*
- *Full-wave rectification*

TERMINAL DESIGNATIONS



JEDEC TO-204MA
(See dimensional outline "A".)

The RCA RUR-D1610, RUR-D1615 and RUR-D1620• are low forward voltage drop, ultra fast-recovery rectifiers (t_{rr}< 35 ns). They use an ion-implanted planar epitaxial construction.

These devices are intended for use as output rectifiers and fly wheel diodes in a variety of high-frequency pulse-width modulated power supplies, amplifiers and switching regulators. Their low stored charge and attendant fast reverse recovery behavior minimize electrical noise generation and, in many circuits, markedly reduce the turn-on dissipation of the associated power switching transistors.

All are supplied in steel JEDEC TO-204MA hermetic packages.

•Formerly RCA Developmental Nos. TA9226A, B and C respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values, per Junction:*

	RUR-D1610	RUR-D1615	RUR-D1620	
V_{RM}	100	150	200	V
I_F (Average)				
T_A = 25°C (No Heat Sink)		6		A
T_A = 25°C (With Heat Sink)■		16		A
T_C = 125°C		16		A
I_{FSM} (surge)				
8.3 ms, 1/2 cycle, non-repetitive		275		A
Thermal Resistance (J-C)		1.5		°C/W
Thermal Resistance (J-C) Total		1.2		°C/W
Thermal Resistance (J-A)		30		°C/W
T_{stg}, T_J		-55 to 150		°C
T_L (Lead temperature during soldering)				
At distance > 1/8 in. (3.17 mm) from case for 10 s max.		260		°C

■ Wakefield type 621 heat sink with convection cooling

RUR-D1610, RUR-D1615, RUR-D1620

ELECTRICAL CHARACTERISTICS, per junction

CHARACTERISTICS	TEST CONDITIONS			LIMITS						UNITS
	T_J °C	Voltage V_R V	Current I_F A	RUR-D1610 Min.	RUR-D1610 Max.	RUR-D1615 Min.	RUR-D1615 Max.	RUR-D1620 Min.	RUR-D1620 Max.	
i_R	25	100		—	15	—	—	—	—	μA
		150		—	—	—	15	—	—	
		200		—	—	—	—	—	15	
	100	100		—	1.5	—	—	—	—	mA
		150		—	—	—	1.5	—	—	
		200		—	—	—	—	—	1.5	
V_F	25		16	—	0.95	—	0.95	—	1	V
	125		16	—	0.83	—	0.83	—	0.88	
t_{rr}	25		4(a)	—	35	—	35	—	35	ns
RθJC				—	1.5	—	1.5	—	1.5	°C/W
RθJA				—	30	—	30	—	30	
C_J	25	10	0	80 Typ.		80 Typ.		80 Typ.		pF

(a) $di_F/dt > 40A/\mu s$, $I_{RM}(rec) < 1A$, $I_{RR} = 0.25A$

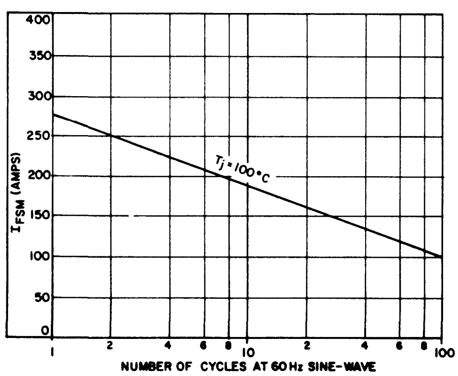


Fig. 1 - Peak surge forward current vs. surge duration.

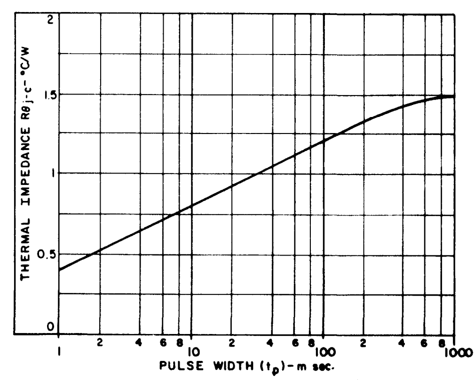


Fig. 2 - Thermal impedance vs. pulse width (per junction).

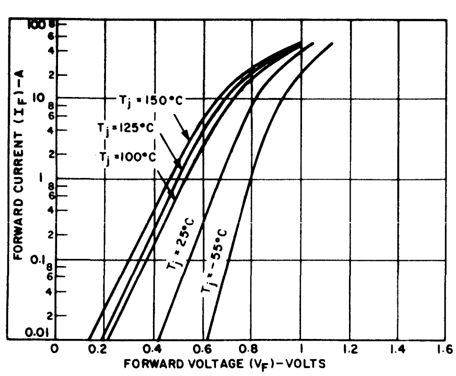


Fig. 3 - Typical forward current vs. forward-voltage drop.

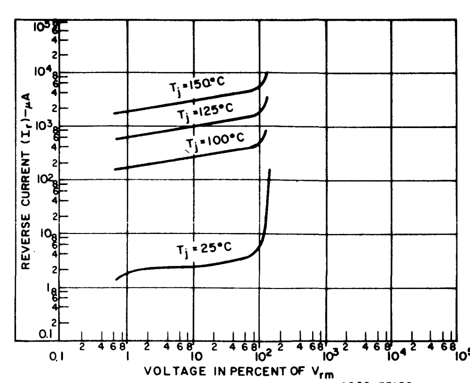


Fig. 4 - Typical reverse current vs. voltage.

BYW51-100, BYW51-150, BYW51-200

File Number **1412**

Dual 8-A, High-Speed, High Efficiency Epitaxial Silicon Rectifiers

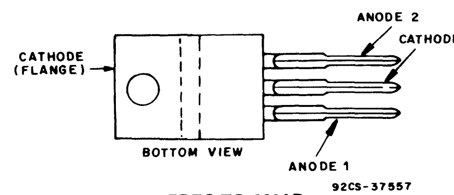
Features:

- *Ultra fast recovery time (< 35 ns)*
- *Low forward voltage*
- *Low thermal resistance*
- *Planar design*
- *Wire-bonded construction*

Applications:

- *General purpose*
- *Power switching circuits to 100 kHz*
- *Full-wave rectification*

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

The BYW51 series devices are low forward voltage drop, ultra-fast-recovery rectifiers (trr< 35 ns). They use a planar ion-implanted epitaxial construction.

These devices are intended for use as output rectifiers and fly-wheel diodes in a variety of high-frequency pulse-width-modulated and switching regulators. Their low stored charge and attendant fast reverse-recovery behavior minimize electrical noise generation and in many circuits markedly reduce the turn-on dissipation of the associated power switching transistors.

All are supplied in TO-220AB plastic packages.

MAXIMUM RATINGS, *Absolute-Maximum Values, per Junction:*

	BYW 51-100	BYW 51-150	BYW 51-200	
V_{RRM}	100	150	200	V
V_{RSM}	110	165	220	V
I_{FRM}, $t_p < 10\ \mu s$	100	100	100	A
I_F(RMS), total	20	20	20	A
I_F(Average), total T_C = 125°C, δ = 0.5	20	20	20	A
I_{FSM}(Surge) t_p = 10 ms, sinusoidal	100	100	100	A
P_D, T_C = 125°C	20	20	20	W
T_j	-40 + 150	-40 + 150	-40 + 150	°C
T_L (Lead temperature during soldering) At distance > 1/8 in. (3.17 mm) from case for 10 S max.	260	260	260	°C

BYW51-100, BYW51-150, BYW51-200

ELECTRICAL CHARACTERISTICS, per junction

CHARACTERISTICS	TEST CONDITIONS			LIMITS						UNITS
	T_J °C	Voltage V_R V	Current i_F A	BYW51-100 Min.	BYW51-100 Max.	BYW51-150 Min.	BYW51-150 Max.	BYW51-200 Min.	BYW51-200 Max.	
i_R	25	100		—	5	—	—	—	—	μA
		150		—	—	—	5	—	—	
		200		—	—	—	—	—	5	
	100	100		—	1	—	—	—	—	mA
		150		—	—	—	1	—	—	
		200		—	—	—	—	—	1	
V_F	25		8	—	0.95	—	0.95	—	0.95	V
	100		8	—	0.89	—	0.89	—	0.89	
t_{rr}	25		1(a)	—	35	—	35	—	35	ns
$R_{\theta JC}$, per leg				—	2.5		2.5	—	2.5	°C/W
$R_{\theta JC}$, total				—	1.3	—	1.3	—	1.3	
$R_{\theta JA}$				—	60	—	60	—	60	
C_J	25	10	0	All types (typ.) 40						pF

(a) $di_F/dt > 50A/\mu s$, $I_{RM}(rec) < 1A$, $I_{RR} = 0.25A$

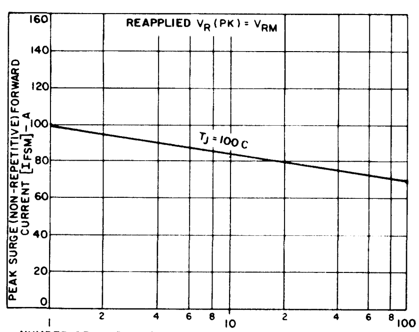


Fig. 1 - Peak surge forward current vs. surge duration.

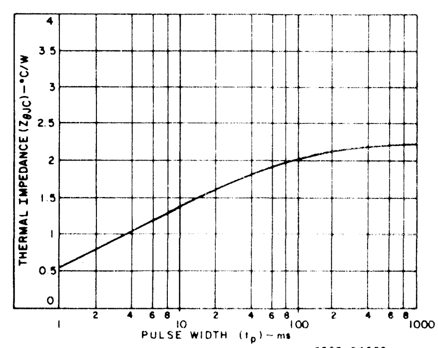


Fig. 2 - Thermal impedance vs. pulse width (per junction).

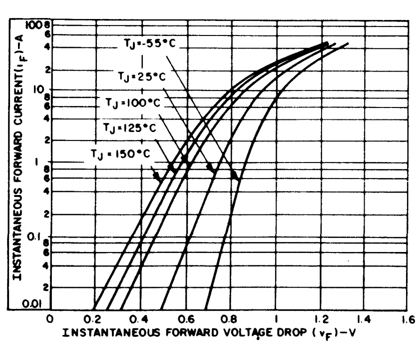


Fig. 3 - Typical forward current vs. forward-voltage drop.

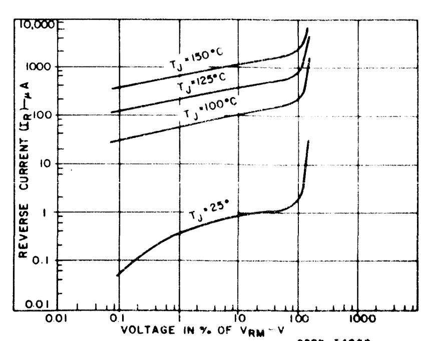


Fig. 4 - Typical reverse current vs. voltage.

SwitchMax Power Transistors
Technical Data

Multiple Epitaxial, Double-Diffused Structure

SwitchMax transistors use a multiple epitaxial layer collector to achieve the necessary voltage field gradient control essential to good switching safe-operating area (SOA) without compromising either the switching speeds or saturation voltage V_{CE}(sat).

Two graded n-type layers, epitaxially grown on a heavily doped n_+ substrate, provide the voltage capability for the switching SOA (clamped Es/b) requirement. A third n-type layer, carefully controlled to give the required breakdown-voltage ($V_{(BR)CBO}$) capability, is then grown over the second layer, completing the collector structure.

Ion implantation of the p- base dopant achieves the necessary precise control of resistivity and depth of the base layer diffusion. The fine geometry emitter is then deposited and diffused into the structure.

Optimized emitter geometries, wide base, controlled lifetimes, and graded multiple n- collector layers all enhance the ruggedness of SwitchMax transistors.

Clamped Reverse-Bias Safe Operating Area (Clamped Es/b)

Considerations of switching efficiency and power economy generally dictate that the normal operating load line of an inverter switch be resistive or capacitive. However, extremes of operation such as start up surges, overloads, short circuits, step load changes, can easily drive the load line inductive.

For this reason, clamped Es/b or inductive-load turn-off SOA is an important design parameter for a high voltage switch. In the RCA SwitchMax families, concern for this parameter was the main driving force for the multiple epitaxial collector design.

Forward-Bias Safe Operating Area

Forward-bias second breakdown ($I_{S/b}$) is an important limit parameter for all linear transistor applications. In switching applications it can become important whenever a significant excursion of the load line into the active area occurs. An example of such an excursion is the turn-on transients produced in the start up of some inverters with uncharged filter capacitors.

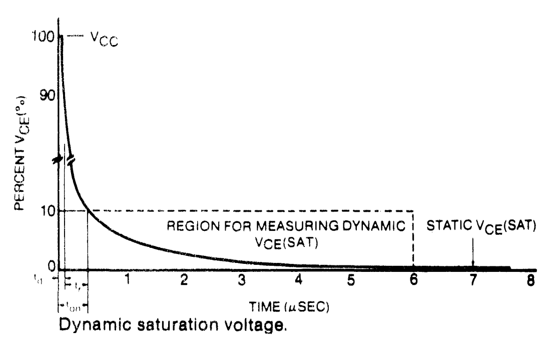
SwitchMax transistors have excellent $I_{S/b}$ capability due to the structural techniques already mentioned, particularly the sophisticated geometry permitted by the metal system and the wide base widths allowed by the ion implantation and controlled lifetime processes.

Dynamic Saturation Voltage

RCA SwitchMax power transistors offer lower dynamic saturation characteristics than other presently available high-speed transistors. The dynamic saturation voltage is the collector emitter voltage measured during the time interval between 10% of the supply voltage and the steady-state saturation voltage.

This measure of the instantaneous voltage provides a useful method to determine how rapidly the collector approaches V_{CE}(sat) after the transistor has reached it's classical turn-on time, which is the 10% V_{CE} point.

For power supplies operated at high collector supply voltages, a high dynamic saturation voltage can cause appreciable device dissipation. Thus, the improved performance capability exhibited by SwitchMax-series transistors permits greater operating efficiency over power supplies built with other high-speed transistors.



Dynamic saturation voltage.

Transistor Classification Chart

I_C(sat)		1A	4A	5A	5A	6A	8A	10A	15A	25A
V_{CEV}	260 V	—	—	—	—	—	—	—	—	2N6686
	280 V	—	—	—	—	—	—	—	—	2N6687
	300 V	—	—	—	—	—	—	—	—	2N6688*
	450 V	2N6771Δ	—	2N6671■	—	—	—	2N6674■	2N6676■	—
		BUW40Δ	—	2N6738Δ	—	—	—	—	—	—
		—	—	BUW41Δ	—	—	—	—	—	—
	550 V	2N6772Δ	—	2N6672	—	—	—	—	2N6677	—
		BUW40AΔ	—	2N6739Δ	—	—	—	—	—	—
		—	—	BUW41AΔ	—	—	—	—	—	—
	650 V	2N6773Δ	—	2N6673■	—	—	—	2N6675■	2N6678■	—
		BUW40BΔ	—	2N6740Δ	—	—	—	—	—	—
		—	—	BUW41BΔ	—	—	—	—	—	—
	800 V	—	BUX31	—	2N6751	BUX32	BUX33	—	—	—
		—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—
	850 V	—	—	—	2N6752	—	—	—	—	—
	900 V	—	BUX31A	—	2N6753	BUX32A	BUX33A	—	—	—
		—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—
	1000 V	—	BUX31B	—	2N6754	BUX32B	BUX33B	—	—	—
		—	—	—	—	—	—	—	—	—
		—	—	—	—	—	—	—	—	—
Characteristics	**Temp., T_C**	**Limits**								
I_{CEV} (max) at $V_{CE}=V_{CEV}$	25°C	0.1 mA	0.1 mA	0.1 mA	0.1 mA	0.1 mA	0.1 mA	0.1 mA	0.1 mA	0.05 mA
	100°C	—	1 mA	—	1 mA	1 mA	1 mA	2 mA	1 mA	—
	125°C	1 mA	—	1 mA	—	—	—	—	—	0.5 mA
V_{CE}(sat)(max) at I_C (sat)	25°C	1 V	1 V	1 V	1 V	1 V	1 V	1 V	1 V	1.5 V
	100°C	—	1.5 V	—	1.5 V	1.5 V	1.5 V	2 V	2 V	—
	125°C	2 V	—	2 V	—	—	—	—	—	1.5 V
t_r (max) at I_C (sat)	25°C	0.2 μs	0.45 μs	0.5 μs	0.45 μs	0.45 μs	0.45 μs	0.6 μs	0.6 μs	0.35 μs
	100°C	—	0.6 μs	—	0.6 μs	0.6 μs	0.6 μs	1 μs	1 μs	—
	125°C	0.5 μs	—	0.8 μs	—	—	—	—	—	0.6 μs
t_s (max) at I_C (sat)	25°C	2.5 μs	3 μs	2.5 μs	3 μs	3 μs	3 μs	2.5 μs	2.5 μs	0.8 μs
	100°C	—	4 μs	—	4 μs	4 μs	4 μs	4 μs	4 μs	—
	125°C	4.5 μs	—	4 μs	—	—	—	—	—	2.5 μs
t_f (max) at I_C (sat)	25°C	0.4 μs	0.4 μs	0.4 μs	0.4 μs	0.4 μs	0.4 μs	0.5 μs	0.5 μs	0.5 μs
	100°C	—	0.7 μs	—	0.7 μs	0.7 μs	0.7 μs	1 μs	1 μs	—
	125°C	1.3 μs	—	0.8 μs	—	—	—	—	—	0.8 μs
t_c (max) at I_C (sat)	25°C	0.4 μs	0.4 μs	0.4 μs	0.4 μs	0.4 μs	0.4 μs	0.5 μs	0.5 μs	0.5 μs
	100°C	—	0.8 μs	—	0.8 μs	0.8 μs	0.8 μs	0.8 μs	0.8 μs	—
	125°C	1.3 μs	—	0.8 μs	—	—	—	—	—	0.8 μs

All SwitchMax transistors are supplied in JEDEC TO-204MA/TO-3 packages, except as noted below:

ΔSupplied in JEDEC TO-220AB plastic package.

*I_C (sat) = 20 A.

■MIL Approved:
MIL-S-19500/536 — 2N6671, 2N6673
MIL-S-19500/537 — 2N6674, 2N6675
MIL-S-19500/538 — 2N6676, 2N6678

2N6671, 2N6672, 2N6673

File Number **1090**

5-A SwitchMax Power Transistors

High-Voltage N-P-N Types for Off-Line Power Supplies and Other High-Voltage Switching Applications

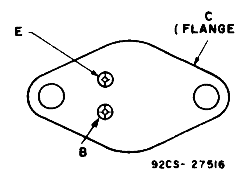
Features:

- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* *V_{CEX} = 350 V to 450 V*
- *Low $V_{CE}(sat)$ at I_C = 5 A*
- *Steel hermetic TO-204MA package*

Applications:

- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "A".)

The RCA-2N6671, 2N6672, and 2N6673• SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for use in off-line power supplies and are also well suited for use in a wide range of inverter or converter circuits and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of industrial high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 125°C to provide information necessary for worst-case design.

The RCA-2N6671, 2N6672, and 2N6673 series transistors are supplied in steel JEDEC TO-204MA hermetic packages.

•Formerly RCA8767, RCA8767A, and RCA8767B, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6671	2N6672	2N6673	
* V_{CEV}				
V_{BE} = −1.5 V	450	550	650	V
* V_{CEX} (Clamped)				
V_{BE} = −1.5 V	350	400	450	V
* V_{CEO}	300	350	400	V
* V_{EBO}		8		V
$I_C(sat)$		5		A
* I_C		8		A
I_{CM}		10		A
* I_B		4		A
* P_T				
T_C up to 25°C		150		W
T_C above 25°C, derate linearly		0.86		W/°C
* T_{stg}, T_J		−65 to 200		°C
* T_L				
At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.		235		°C

* In accordance with JEDEC registration data.

2N6671, 2N6672, 2N6673

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc V_{CE}	TEST CONDITIONS VOLTAGE V dc V_{BE}	TEST CONDITIONS CURRENT A dc I_C	TEST CONDITIONS CURRENT A dc I_B	LIMITS 2N6671 Min.	LIMITS 2N6671 Max.	LIMITS 2N6672 Min.	LIMITS 2N6672 Max.	LIMITS 2N6673 Min.	LIMITS 2N6673 Max.	UNITS
$T_C = 25^oC$											
* I_{CEV}	450	−1.5			–	0.1	–	–	–	–	mA
	550	−1.5			–	–	–	0.1	–	–	mA
	650	−1.5			–	–	–	–	–	0.1	mA
* I_{EBO}		−8	0		–	2	–	2	–	2	mA
* $V_{CEO}(sus)$[b]			0.2[a]	0	300	–	350	–	400	–	V
* h_{FE}	3		5[a]		10	40	10	40	10	40	
* $V_{BE}(sat)$			5[a]	1	–	1.6	–	1.6	–	1.6	V
* $V_{CE}(sat)$			5[a]	1	–	1	–	1	–	1	V
			8[a]	4	–	2	–	2	–	2	V
* V_{CEX}[b] (Clamped $E_{S/b}$) L=170 μH, R_{BB}=5 Ω		−5	5	1[e]	350	–	400	–	450	–	V
		−5	8	3[e]	200	–	250	–	300	–	V
* $I_{S/b}$	25		6		1	–	1	–	1	–	s
* $\|h_{fe}\|$ f=5 MHz	10		0.2		3	12	3	12	3	12	
f_T	10		0.2		15	60	15	60	15	60	MHz
* C_{obo} f=0.1 MHz	10[c]				50	300	50	300	50	300	pF
* t_d[d]			5	1	–	0.1	–	0.1	–	0.1	μs
* t_r[d]			5	1	–	0.5	–	0.5	–	0.5	μs
* t_s[d]			5	1[e]	–	2.5	–	2.5	–	2.5	μs
* t_f[d]			5	1[e]	–	0.4	–	0.4	–	0.4	μs
* t_c V_{CC}=125 V, L=170 μH, R_C=25 Ω Collector clamped to V_{CEX}			5	1[e]	–	0.4	–	0.4	–	0.4	μs
$T_C = 125^oC$											
* I_{CEV}	450	−1.5			–	1	–	–	–	–	mA
	550	−1.5			–	–	–	1	–	–	mA
	650	−1.5			–	–	–	–	–	1	mA
* $V_{CE}(sat)$			5[a]	1	–	2	–	2	–	2	V
* t_r[d]			5	1	–	0.8	–	0.8	–	0.8	μs
* t_s[d]			5	1[e]	–	4	–	4	–	4	μs
* t_f[d]			5	1[e]	–	0.8	–	0.8	–	0.8	μs
* t_c V_{CC}=125 V, L=170 μH, R_C=25 Ω Collector clamped to V_{CEX}			5	1[e]	–	0.8	–	0.8	–	0.8	μs
* $R_{\theta JC}$					–	1.17	–	1.17	–	1.17	°C/W

* In accordance with JEDEC registration data.
[a] Pulsed: pulse duration = 300 μs, duty factor ≤ 2%.
[b] CAUTION: The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} MUST NOT be measured on a curve tracer.
[c] V_{CB} value.
[d] V_{CC} = 125 V, t_p = 20 μs.
[e] $I_{B_1} = -I_{B_2}$

2N6671, 2N6672, 2N6673

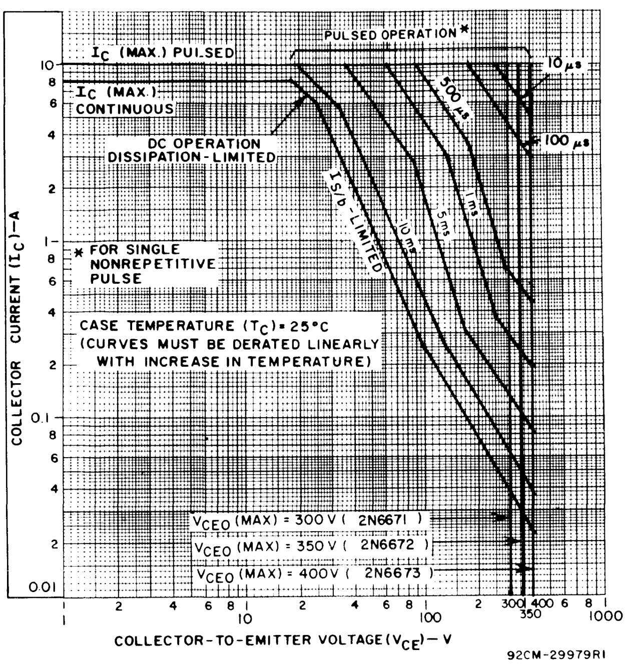


Fig. 1 – Maximum operating areas for all types (T_C = 25°C).

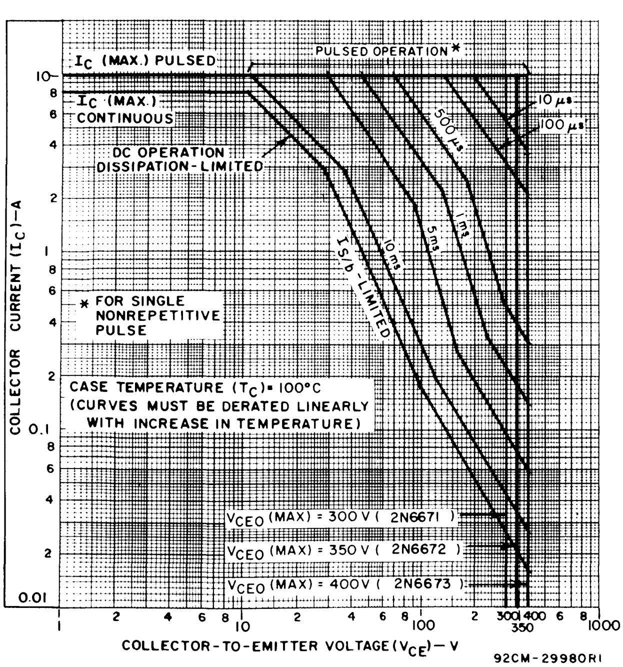


Fig. 2 – Maximum operating areas for all types (T_C = 100°C).

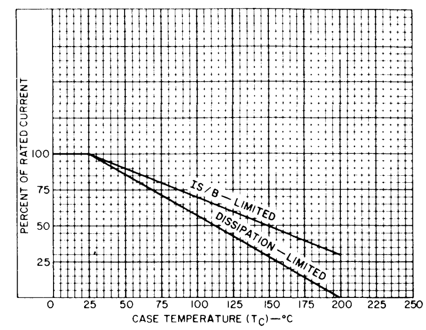


Fig. 3 – Dissipation and $I_{S/b}$ derating curves for all types.

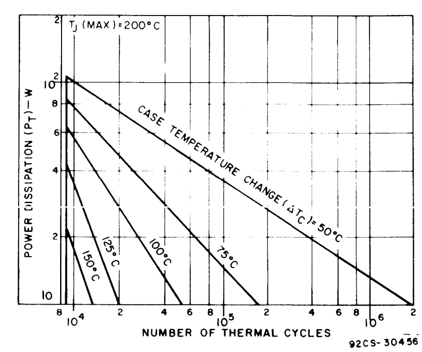


Fig. 4 – Thermal-cycling chart for all types.

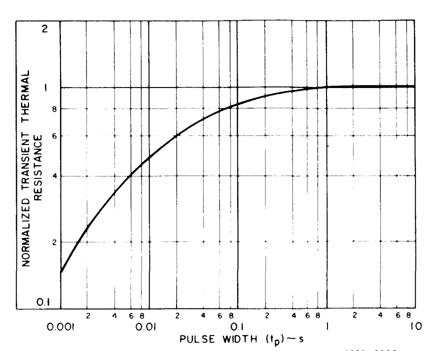


Fig. 5 – Typical thermal-response characteristic for all types.

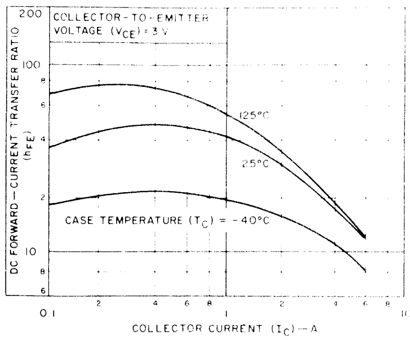


Fig. 6 – Typical dc beta characteristics for all types.

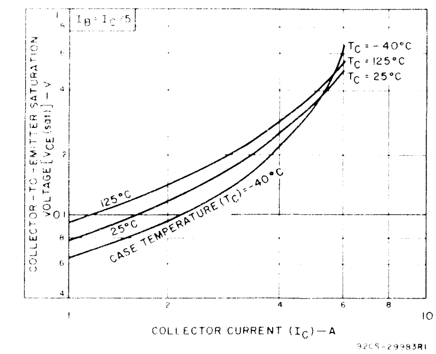


Fig. 7 – Typical collector-to-emitter saturation voltage as a function of collector current for all types.

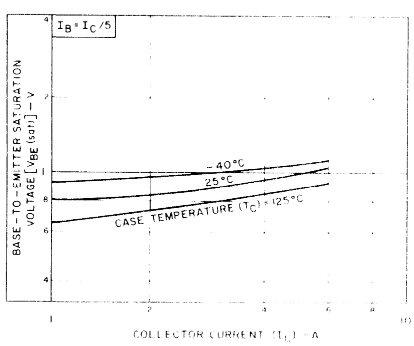


Fig. 8 – Typical base-to-emitter saturation voltage as a function of collector current for all types.

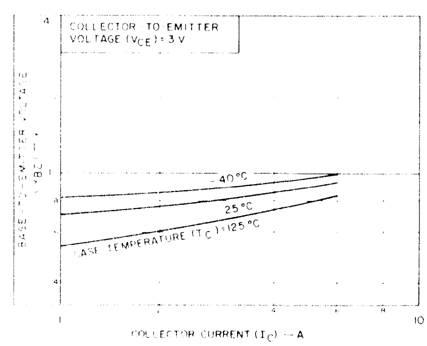


Fig. 9 – Typical base-to-emitter voltage as a function of collector current for all types.

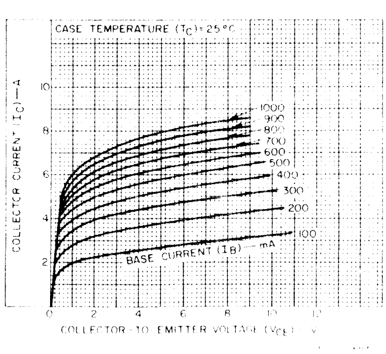


Fig. 10 – Typical output characteristics for all types.

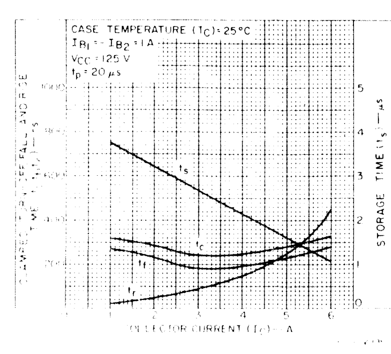


Fig. 11 – Typical saturated switching time characteristics for all types.

2N6671, 2N6672, 2N6673

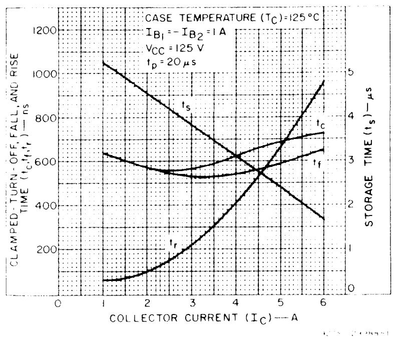


Fig. 12 – Typical saturated switching time characteristics for all types.

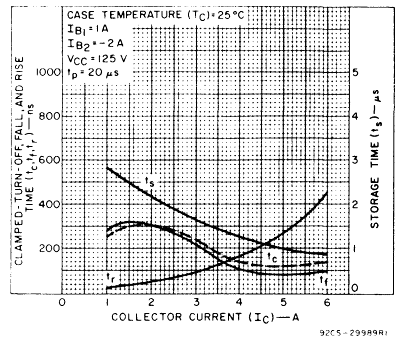


Fig. 13 – Typical saturated switching time characteristics for all types.

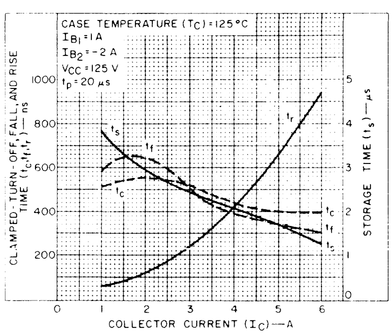


Fig. 14 – Typical saturated switching time characteristics for all types.

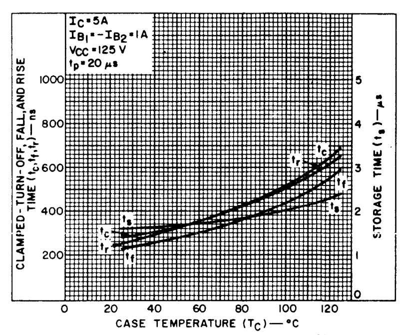


Fig. 15 – Typical saturated switching time characteristics as a function of case temperature for all types.

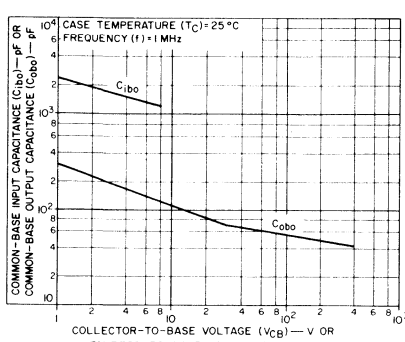


Fig. 16 – Typical common-base input or output capacitance characteristics as a function of collector-to-base voltage or emitter-to-base voltage for all types.

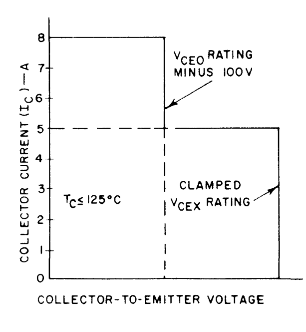


Fig. 17 – Maximum operating conditions for switching between saturation and cutoff.

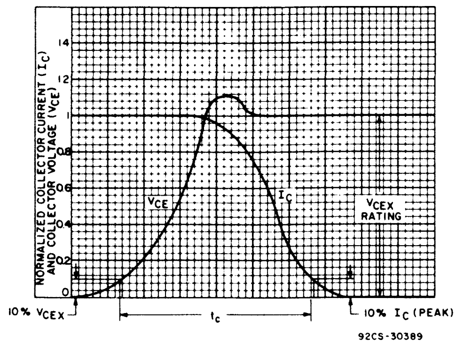


Fig. 18 — Oscilloscope display for measurement of clamped induction switching time (t_c).

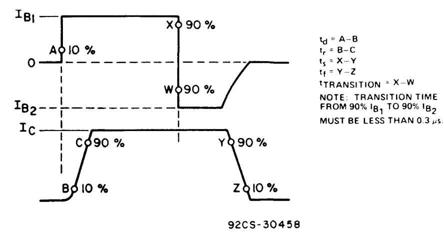


Fig. 19 — Phase relationship between input and output currents showing reference points for specification of switching times.

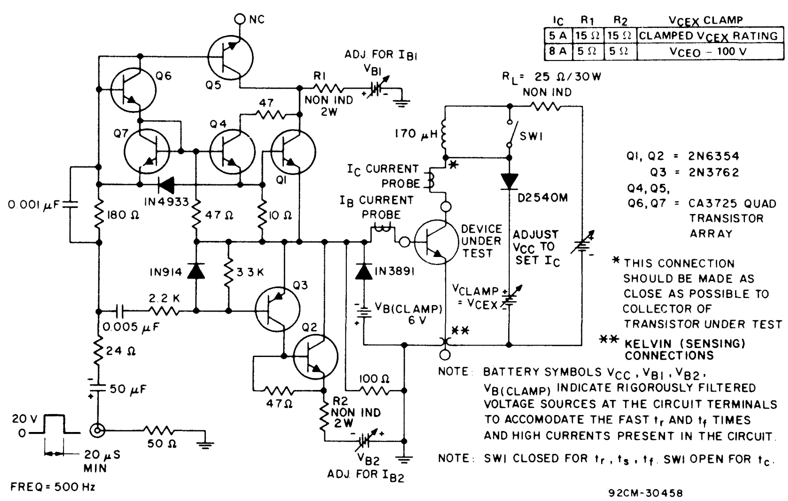


Fig. 20 — Circuit for measuring switching times.

2N6674, 2N6675

File Number **1164**

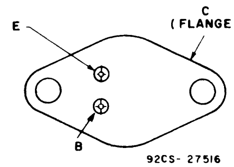
10-A SwitchMax Power Transistors

High-Voltage N-P-N Types for Off-Line Power Supplies and Other High-Voltage Switching Applications

Features:
- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* *V_{CEX} = 350 V to 450 V*
- *Low V_{CE} (sat) at I_C = 10 A*
- *Steel hermetic TO-204MA package*

Applications:
- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "A".)

The RCA 2N6674 and 2N6675• SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for off-line power supplies, converter circuits, and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 100°C to provide information necessary for worst-case design.

The 2N6674 and 2N6675 transistors are supplied in steel JEDEC TO-204MA hermetic packages.

•Formerly RCA Dev. Type Nos. TA9114D and TA9114E, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6674	2N6675	
* V_{CEV}			
V_{BE} = -1.5 V	450	650	V
* V_{CEX}(Clamped)			
V_{BE} = -1.5 V	350	450	V
* V_{CEO}	300	400	V
* V_{EBO}	7	7	V
I_C(sat)	10	10	A
* I_C	15	15	A
I_{CM}	20	20	A
* I_B	5	5	A
* P_T			
T_C up to 25°C	175	175	W
T_C above 25°C, derate linearly	1	1	W/°C
* T_{stg}, T_J	-65 to 200	-65 to 200	°C
* T_L			
At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.	235	235	°C

*In accordance with JEDEC registration data.

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		2N6674		2N6675		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
T_C=25° C									
* I_{CEV}	450	-1.5			—	0.1	—	—	mA
	650	-1.5			—	—	—	0.1	
* I_{EBO}		-7	0		—	2	—	2	
* $V_{CEO}(sus)$[b]			0.2[a]	0	300	—	400	—	V
* h_{FE}	2		10[a]		8	20	8	20	
* $V_{BE}(sat)$			10[a]	2	—	1.5	—	1.5	V
* $V_{CE}(sat)$			10[a]	2	—	1	—	1	
			15[a]	5	—	5	—	5	
V_{CEX}[b] (Clamped $E_{S/b}$) L=50 μH, R_{BB}=2 Ω		-4	10	2	350	—	450	—	
$I_{S/b}$	30		5.9		1	—	1	—	s
	100		0.25		1	—	1	—	
* $\|h_{fe}\|$ f=5 MHz	10		1		3	10	3	10	
f_T	10		1		15	50	15	50	MHz
* C_{obo} f=0.1 MHz	10[c]				150	500	150	500	pF
* t_d[d]		-6	10	2	—	0.1	—	0.1	μs
* t_r[d]		-6	10	2	—	0.6	—	0.6	
* t_s[d]		-6	10	2[e]	—	2.5	—	2.5	
* t_f[d]		-6	10	2[e]	—	0.5	—	0.5	
* t_c V_{CC}=135 V, L=50 μH, $R_C \leq$ 13.5 Ω, Collector clamped to V_{CEX}		-6	10	2[e]	—	0.5	—	0.5	
T_C=100° C									
* I_{CEV}	450	-1.5			—	1	—	—	mA
	650	-1.5			—	—	—	1	
* $V_{CE}(sat)$			10[a]	2	—	2	—	2	V
* t_r[d]		-6	10	2	—	1	—	1	μs
* t_s[d]		-6	10	2[e]	—	4	—	4	
* t_f[d]		-6	10	2[e]	—	1	—	1	
* t_c V_{CC}=135 V, L=50 μH, $R_C \leq$ 13.5 Ω, Collector clamped to V_{CEX}		-6	10	2[e]	—	0.8	—	0.8	
* $R_{\theta JC}$	10		5		—	1	—	1	°C/W

[a]Pulsed: pulse duration=300 μs, duty factor ≤ 2%.

[b]CAUTION: The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} MUST NOT be measured on a curve tracer.

*In accordance with JEDEC registration data.

[c]V_{CB} value.

[d]V_{CC}=135 V, t_p=20 μs.

[e]$I_{B1}=-I_{B2}$.

2N6674, 2N6675

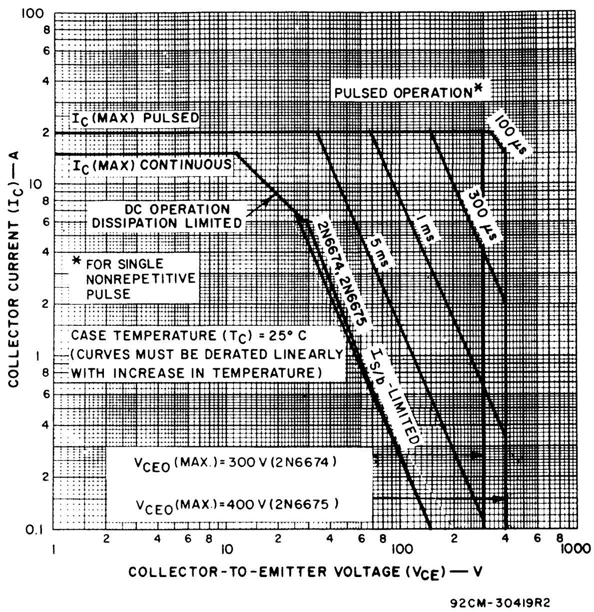


Fig. 1 - Maximum operating areas for all types (T_C=25°C).

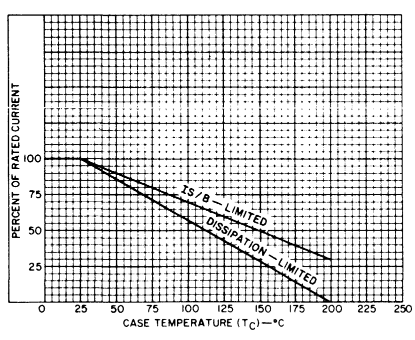


Fig. 2 - Dissipation and $I_{S/b}$ derating curves for all types.

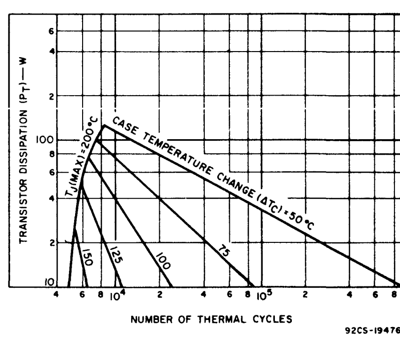


Fig. 3 - Thermal-cycling for all types.

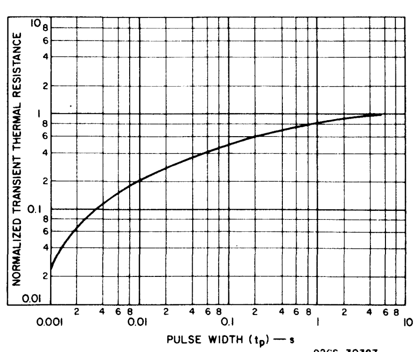


Fig. 4 - Typical thermal-response characteristic for all types.

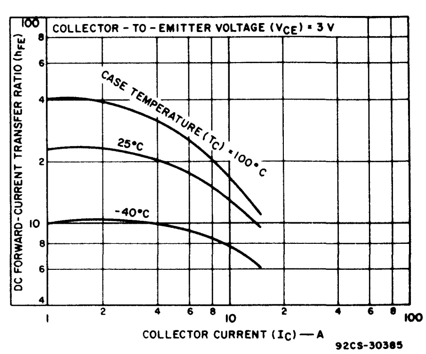


Fig. 5 - Typical dc beta characteristics for all types.

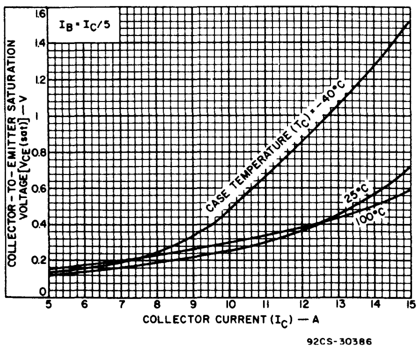


Fig. 6 - Typical collector-to-emitter saturation voltage characteristics for all types.

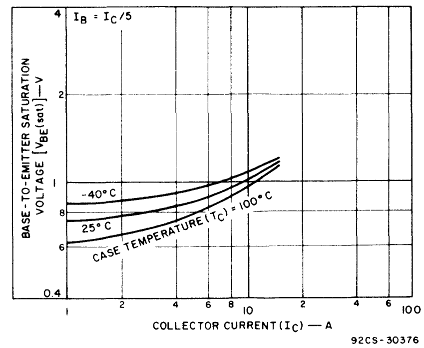


Fig. 7 - Typical base-to-emitter saturation voltage characteristics for all types.

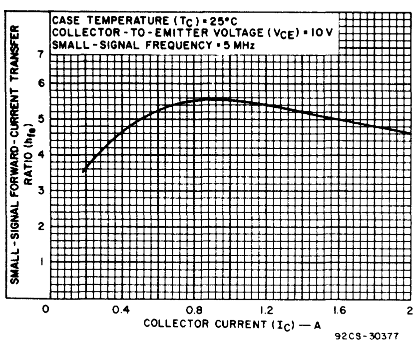


Fig. 8 - Typical small-signal forward current transfer ratio characteristic for all types (f=5 MHz).

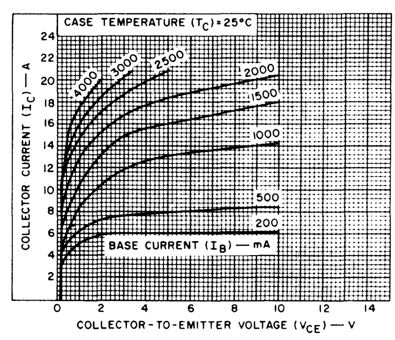


Fig. 9 - Typical output characteristics for all types.

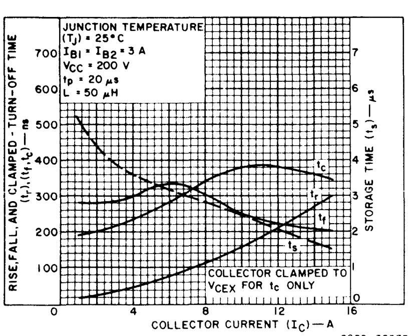


Fig. 10 - Typical saturated-switching-time characteristics at T_J=25°C as a function of collector current for all types.

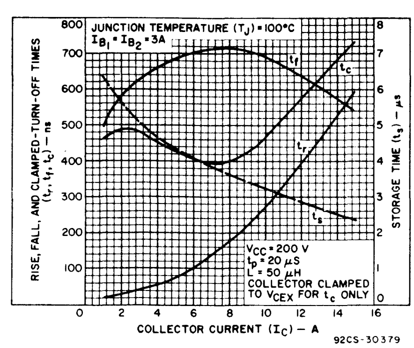


Fig. 11 - Typical saturated-switching-time characteristics at T_J=100°C as a function of collector current for all types.

2N6674, 2N6675

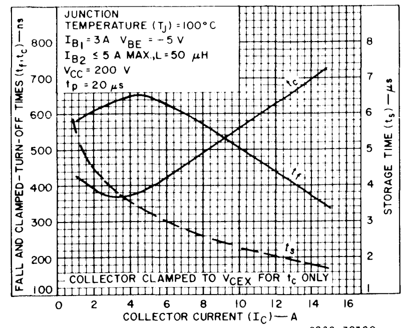


Fig. 12 - Typical saturated-switching-time characteristics at T_J=100°C as a function of collector current for all types.

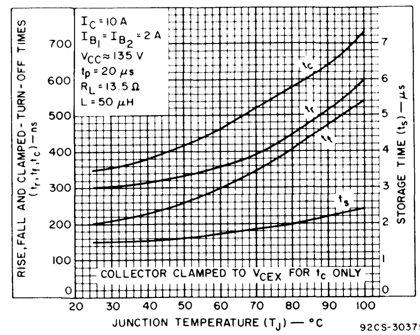


Fig. 13 - Typical saturated-switching-time characteristics as a function of junction temperature for all types.

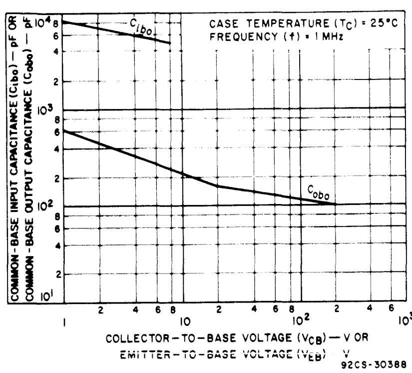


Fig. 14 - Typical common-base input (C_{ibo}) or output (C_{obo}) capacitance characteristics for all types.

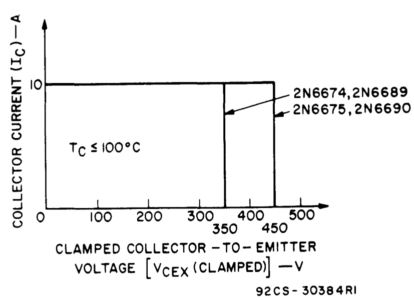


Fig. 15 - Maximum operating conditions for switching between saturation and cutoff for all types.

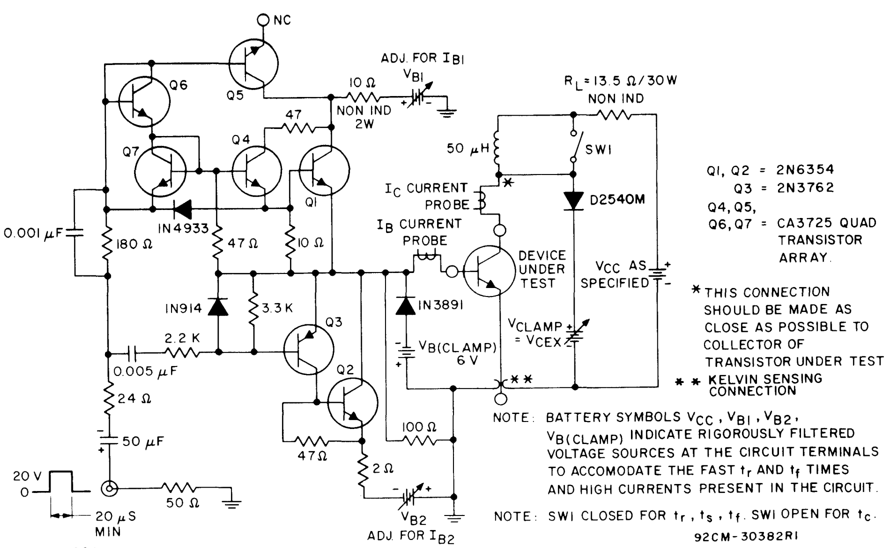


Fig. 16 - Circuit for measuring switching times.

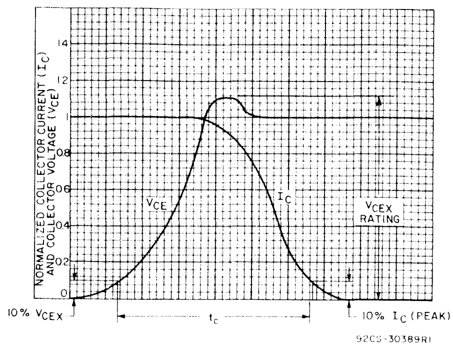


Fig. 17 - Oscilloscope display for normalized measurement of clamped inductive switching time (t_c).

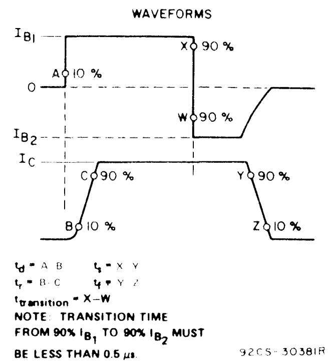


Fig. 18 - Phase relationship between input and output currents showing reference points for specification of switching times.

2N6676, 2N6677, 2N6678

File Number **1165**

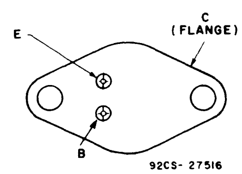
15-A SwitchMax Power Transistors

High-Voltage N-P-N Types for Off-Line Power Supplies and Other High-Voltage Switching Applications

Features:
- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* V_{CEX} *= 350 V to 450 V*
- *Low* $V_{CE}(sat)$ *at* I_C *= 10 A*
- *Steel hermetic TO-204MA package*

Applications:
- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "A".)

The RCA 2N6676 and 2N6677 and 2N6678• SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for off-line power supplies, converter circuits, and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 100°C to provide information necessary for worst-case design.

The 2N6676, 2N6677 and 2N6678 transistors are supplied in steel JEDEC TO-204MA hermetic packages.

•Formerly RCA Dev. Type Nos. TA9114A, TA9114B and TA9114C, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6676	2N6677	2N6678	
* V_{CEV}				
V_{BE} = −1.5 V	450	550	650	V
* V_{CEX}(Clamped)				
V_{BE} = −1.5 V	350	400	450	V
* V_{CEO}	300	350	400	V
* V_{EBO}		8		V
I_C(sat)		15		A
* I_C		15		A
I_{CM}		20		A
* I_B		5		A
* P_T				
T_C up to 25°C		175		W
T_C above 25°C, derate linearly		1		W/°C
* T_{stg}, T_J		−65 to 200		°C
* T_L				
At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.		235		°C

*In accordance with JEDEC registration data.

ELECTRICAL CHARACTERISTICS

2N6676, 2N6677, 2N6678

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6676 Min.	Max.	2N6677 Min.	Max.	2N6678 Min.	Max.	UNITS
T_C=25° C											
* I_{CEV}	450	-1.5			—	0.1	—	—	—	—	mA
	550	-1.5			—	—	—	0.1	—	—	
	650	-1.5			—	—	—	—	—	0.1	
* I_{EBO}		-8	0		—	2	—	2	—	2	
* $V_{CEO}(sus)^b$			0.2[a]	0	300	—	350	—	400	—	V
* h_{FE}	3		15[a]		8	—	8	—	8	—	
* $V_{BE}(sat)$			15[a]	3	—	1.5	—	1.5	—	1.5	V
* $V_{CE}(sat)$			15[a]	3	—	1	—	1	—	1	
			15[a]	3	—	1.5	—	1.5	—	1.5	
V_{CEX}^b (Clamped $E_{S/b}$) L=50 μH, R_{BB}=2 Ω		-6	15	3	350	—	400	—	450	—	
$I_{S/b}$	30		5.9		1	—	1	—	1	—	s
	100		0.25		1	—	1	—	1	—	
* $\|h_{fe}\|$ f=5 MHz	10		1		3	10	3	10	3	10	
f_T	10		1		15	50	15	50	15	50	MHz
* C_{obo} f=0.1 MHz	10[c]				150	500	150	500	150	500	pF
* t_d^d		-6	15	3	—	0.1	—	0.1	—	0.1	μs
* t_r^d		-6	15	3	—	0.6	—	0.6	—	0.6	
* t_s^d		-6	15	3[e]	—	2.5	—	2.5	—	2.5	
* t_f^d		-6	15	3[e]	—	0.5	—	0.5	—	0.5	
* t_c^f V_{CC}=200 V, L=50 μH, $R_C \leq$ 13.5 Ω		-6	15	3[e]	—	0.5	—	0.5	—	0.5	
T_C=100° C											
* I_{CEV}	450	-1.5			—	1	—	—	—	—	mA
	550	-1.5			—	—	—	1	—	—	
	650	-1.5			—	—	—	—	—	1	
* $V_{CE}(sat)$			15[a]	3	—	2	—	2	—	2	V
* t_r^d		-6	15	3	—	1	—	1	—	1	μs
* t_s^d		-6	15	3[e]	—	4	—	4	—	4	
* t_f^d		-6	15	3[e]	—	1	—	1	—	1	
* t_c^f V_{CC}=200 V, L=50 μH, $R_C \leq$ 13.5 Ω		-6	15	3[e]	—	0.8	—	0.8	—	0.8	
* $R_{\theta JC}$	10		5		—	1	—	1	—	1	°C/W

[a]Pulsed: pulse duration=300 μs, duty factor ≤ 2%.

[b]CAUTION: The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} MUST NOT be measured on a curve tracer.

*In accordance with JEDEC registration data.

[c]V_{CB} value.

[d]V_{CC}=200 V, t_p=20 μs.

[e]$I_{B1}=-I_{B2}$.

[f]Collector clamped to V_{CEX}.

2N6676, 2N6677, 2N6678

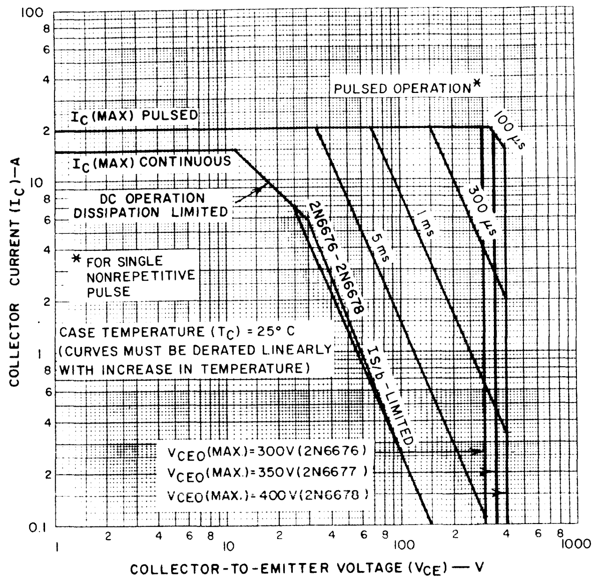


Fig. 1 - Maximum operating areas for all types (T_C=25° C).

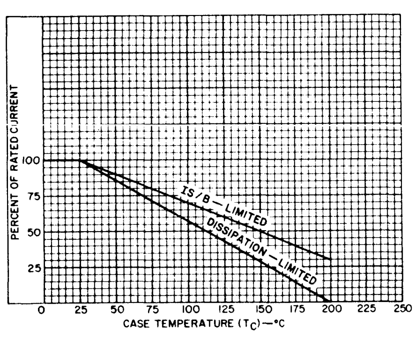


Fig. 2 - Dissipation and $I_{S/b}$ derating curves for all types.

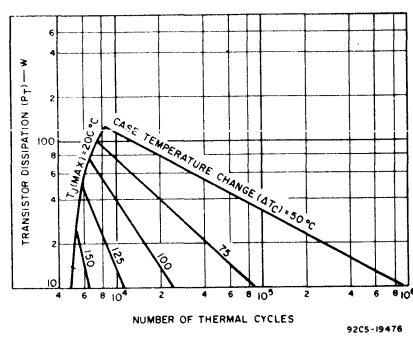


Fig. 3 - Thermal-cycling for all types.

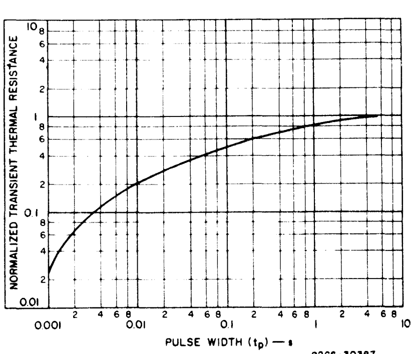


Fig. 4 - Typical thermal-response characteristic for all types.

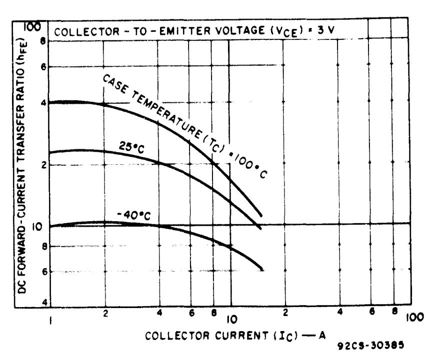


Fig. 5 - Typical dc beta characteristics for all types.

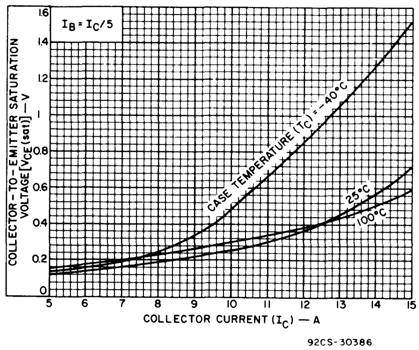


Fig. 6 - *Typical collector-to-emitter saturation voltage characteristics for all types.*

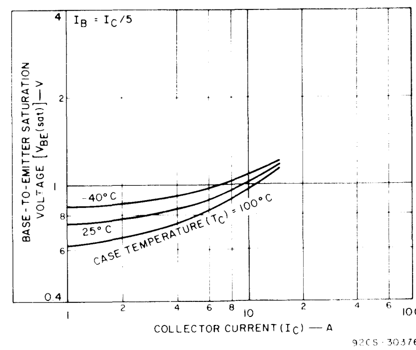


Fig. 7 - *Typical base-to-emitter saturation voltage characteristics for all types.*

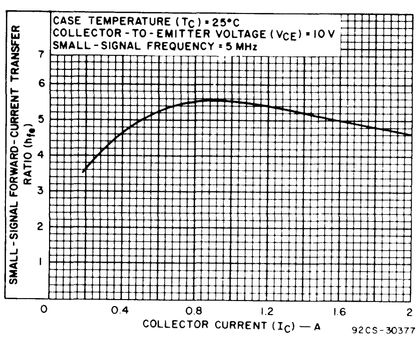


Fig. 8 - *Typical small-signal forward current transfer ratio characteristic for all types (f=5 MHz).*

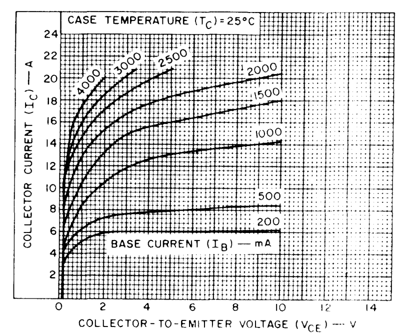


Fig. 9 - *Typical output characteristics for all types.*

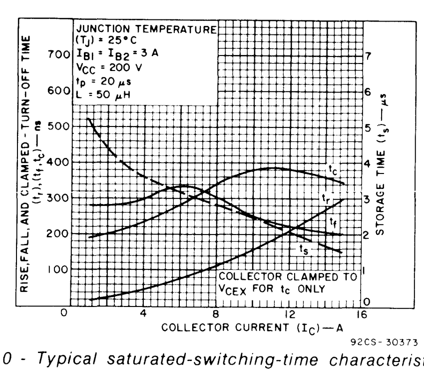


Fig. 10 - *Typical saturated-switching-time characteristics at T_J=25°C as a function of collector current for all types.*

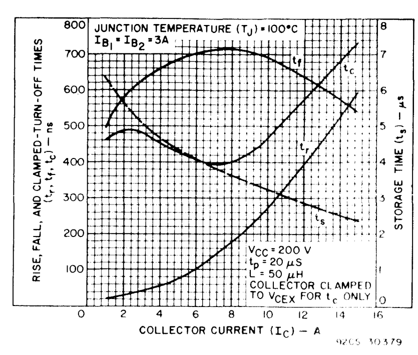


Fig. 11 - *Typical saturated-switching-time characteristics at T_J=100°C as a function of collector current for all types.*

2N6676, 2N6677, 2N6678

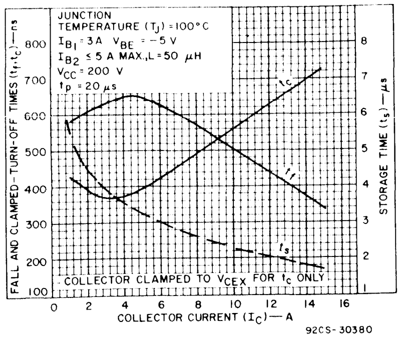


Fig. 12 - Typical saturated-switching-time characteristics at $T_J = 100°C$ as a function of collector current for all types.

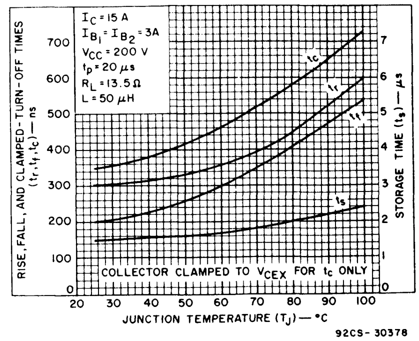


Fig. 13 - Typical saturated-switching-time characteristics as a function of junction temperature for all types.

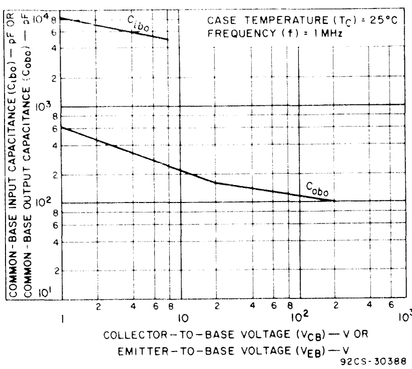


Fig. 14 - Typical common-base input (C_{ibo}) or output (C_{obo}) capacitance characteristics for all types.

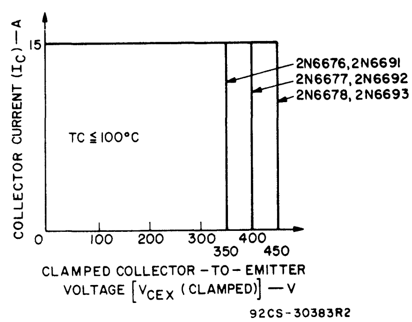


Fig. 15 - Maximum operating conditions for switching between saturation and cutoff for all types.

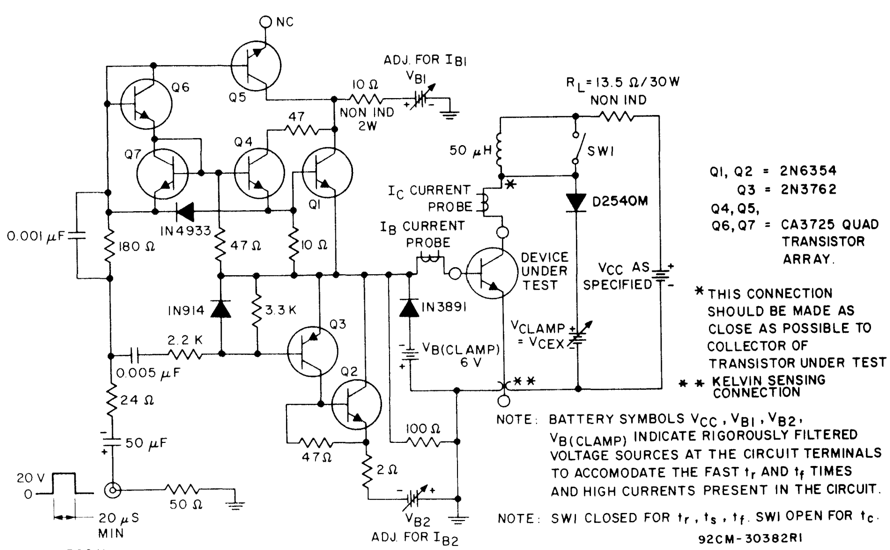


Fig. 16 - Circuit for measuring switching times.

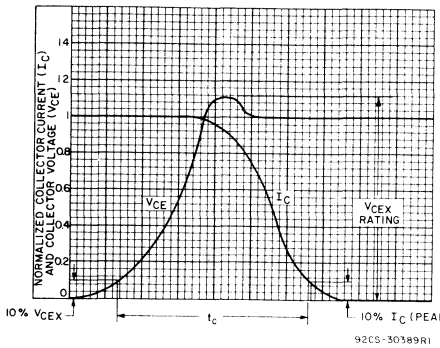


Fig. 17 - Oscilloscope display for normalized measurement of clamped inductive switching time (t_c).

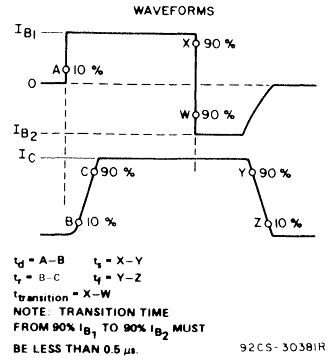


Fig. 18 - Phase relationship between input and output currents showing reference points for specification of switching times.

2N6686, 2N6687, 2N6688

File Number **1171**

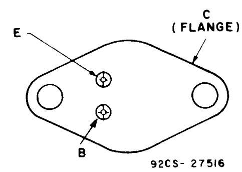
25-A SwitchMax Power Transistors

N-P-N Types for
Power Supplies and Other High-Voltage
Switching Applications

Features:

- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *Low V_{CE} (sat)*
- *Steel hermetic TO-204MA Package*

TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "A".)

The RCA-2N6686, 2N6687, and 2N6688• SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for converters, inverters, pulse-width-modulated regulators and a variety of power switching circuits. These high-current, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 125°C as well as at 25°C, to provide information necessary for worst-case design.

The 2N6686, 2N6687, and 2N6688 transistors are supplied in steel JEDEC TO-204MA hermetic packages.

•Formerly RCA Dev. Type Nos. TA9119A, TA9119B, TA9119C, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6686	2N6687	2N6688	
* V_{CEV} V_{BE} = −1.5 V	260	280	300	V
* V_{CEX}(Clamped) V_{BE} = −1.5 V	210	230	250	V
* V_{CEO}	160	180	200	V
* V_{EBO}		8		V
I_C(sat)	25	25	20	A
* I_C	25	25	20	A
I_{CM}		50		A
* I_B		8		A
* P_T				
T_C up to 25°C		200		W
T_C above 25°C, derate linearly		1.14		W/°C
* T_{stg}, T_J		−65 to 200		°C
* T_L				
At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.		235		°C

* In accordance with JEDEC registration data.

2N6686, 2N6687, 2N6688

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6686 Min.	Max.	2N6687 Min.	Max.	2N6688 Min.	Max.	UNITS
$T_C = 25°C$											
* I_{CEV}	260 280 300	−1.5 −1.5 −1.5			– – –	50 – –	– – –	– 50 –	– – –	– – 50	μA
* I_{EBO}		−8	0		–	100	–	100	–	100	
* V_{CEO}(sus)**b**			0.2[a]	0	160	–	180	–	200	–	V
* h_{FE}	2 2 2 2		1[a] 10[a] 20[a] 25[a]		30 25 – 15	– 100 – –	30 25 – 15	– 100 – –	25 20 15 –	– 80 – –	
* V_{BE}(sat)			20[a] 25[a]	2 2.5	– –	– 1.8	– –	– 1.8	– –	1.8 –	V
* V_{CE}(sat)			20[a] 25[a]	2 2.5	– –	– 1.5	– –	– 1.5	– –	1.5 –	
* V_{CEX}**b** (Clamped $E_{S/b}$) L=25 μH, R_{BB}=10 Ω		−4	25	3	210	–	230	–	250	–	
$I_{S/b}$	18		1.1		1	–	1	–	1	–	s
* $\|h_{fe}\|$ f=5 MHz	10		1		4	20	4	20	4	20	
f_T	10		1		20	100	20	100	20	100	MHz
* C_{obo} f=0.1 MHz	10[c]				300	650	300	650	300	650	pF
* t_d**d**		−4	20 25	2 2.5	– –	– 0.1	– –	– 0.1	– –	0.1 –	μs
* t_r**d**		−4	20 25	2 2.5	– –	– 0.35	– –	– 0.35	– –	0.35 –	
* t_s**d**		−4	20 25	2[e] 2.5[e]	– –	– 1	– –	– 1	– –	1 –	
* t_f**d**		−4	20 25	2[e] 2.5[e]	– –	– 0.25	– –	– 0.25	– –	0.25 –	
* t_c V_{CC}=80 V, L=25 μH, $R_C \leq 4\ \Omega$, Collector clamped to V_{CEX}		−4 −4	20 25	3[e] 3[e]	– –	– 0.5	– –	– 0.5	– –	0.5 –	

2N6686, 2N6687, 2N6688

ELECTRICAL CHARACTERISTICS (cont'd)

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc V_{CE}	TEST CONDITIONS: VOLTAGE V dc V_{BE}	TEST CONDITIONS: CURRENT A dc I_C	TEST CONDITIONS: CURRENT A dc I_B	LIMITS 2N6686 Min.	LIMITS 2N6686 Max.	LIMITS 2N6687 Min.	LIMITS 2N6687 Max.	LIMITS 2N6688 Min.	LIMITS 2N6688 Max.	UNITS
T_C = 125°C											
* I_{CEV}	260 280 300	−1.5 −1.5 −1.5			– – –	0.5 – –	– – –	– 0.5 –	– – –	– – 0.5	mA
* $V_{CE}(sat)$			20[a] 25[a]	2 2.5	– –	– 1.5	– –	– 1.5	– –	1.5 –	V
* t_r[d]		−4	20 25	2 2.5	– –	– 0.6	– –	– 0.6	– –	0.6 –	µs
* t_s[d]		−4	20 25	2 2.5[e]	– –	– 2.5	– –	– 2.5	– –	2.5 –	µs
* t_f[d]		−4	20 25	2 2.5[e]	– –	– 0.8	– –	– 0.8	– –	0.8 –	µs
* t_c V_{CC}=80 V, L=25 µH, $R_C \leq 4\,\Omega$, Collector Clamped to V_{CEX}		−4 −4	20 25	3[e] 3[e]	– –	– 0.8	– –	– 0.8	– –	0.8 –	µs
* $R_{\theta JC}$	10		5		–	0.875	–	0.875	–	0.875	°C/W

* In accordance with JEDEC registration data.

[a] Pulsed: pulse duration = 300 µs, duty factor ≤ 2%.

[b] **CAUTION:** The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} **MUST NOT** be measured on a curve tracer.

[c] V_{CB} value.

[d] V_{CC} = 80 V, t_p = 20 µs

[e] $I_{B_1} = -I_{B_2}$

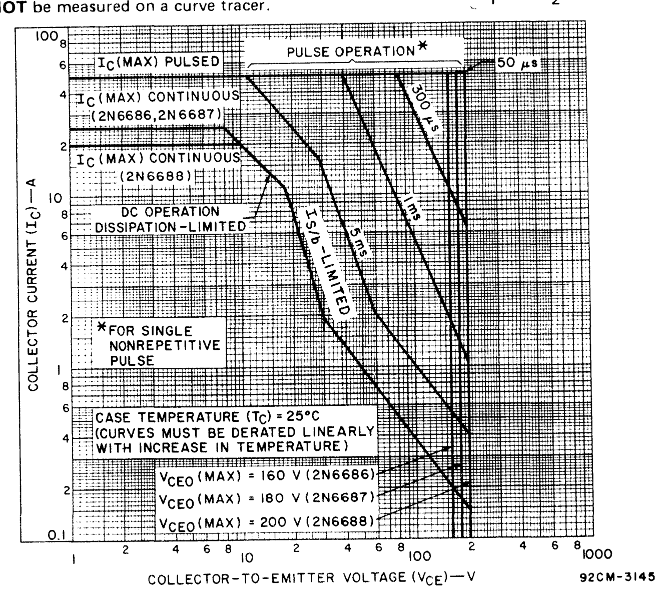


Fig. 1-Maximum operating areas for all types (T_C = 25°C).

2N6686, 2N6687, 2N6688

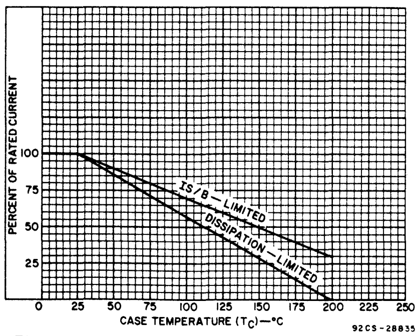


Fig. 2-Dissipation and $I_{S/b}$ derating curves for all types.

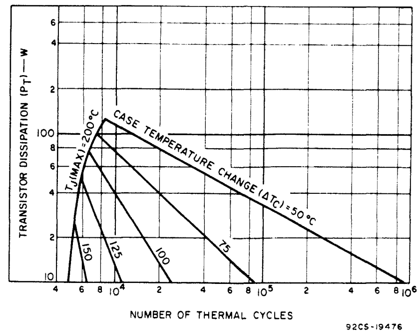


Fig. 3-Thermal-cycling chart for all types.

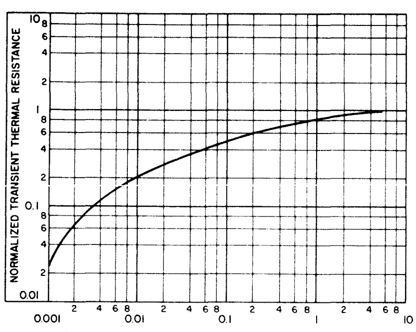


Fig. 4-Typical thermal-response characteristic for all types.

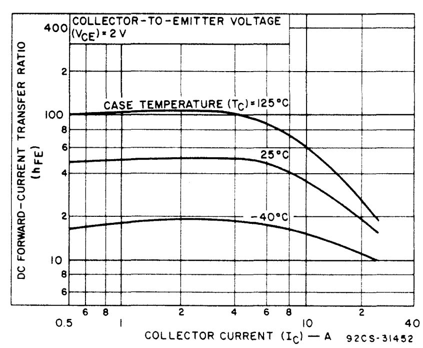


Fig. 5-Typical dc beta characteristics for all types.

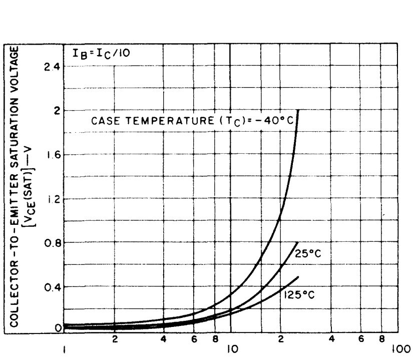


Fig. 6-Typical collector-to-emitter saturation voltage characteristics for all types.

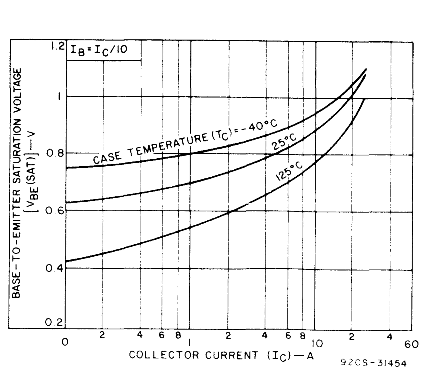


Fig. 7-Typical base-to-emitter saturation voltage characteristic for all types.

2N6686, 2N6687, 2N6688

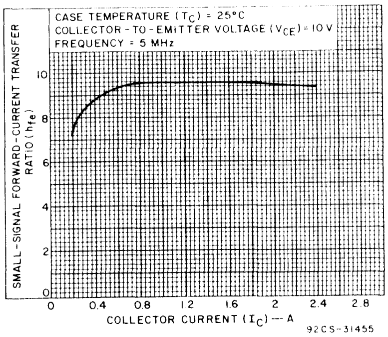


Fig. 8-Typical small-signal forward-current transfer ratio characteristic for all types (f = 5 MHz).

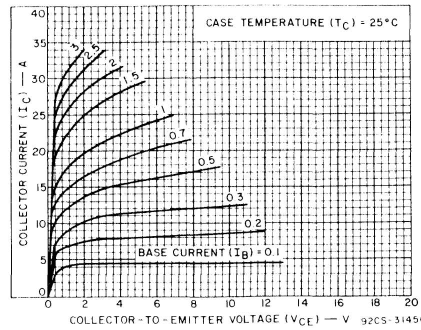


Fig. 9-Typical output characteristics for all types.

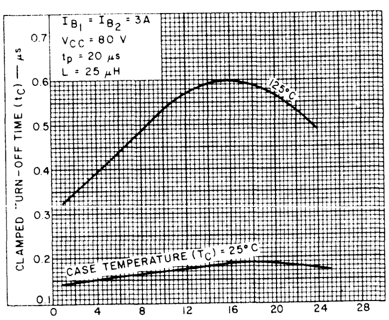


Fig. 10-Typical clamped turn-off time characteristics for all types.

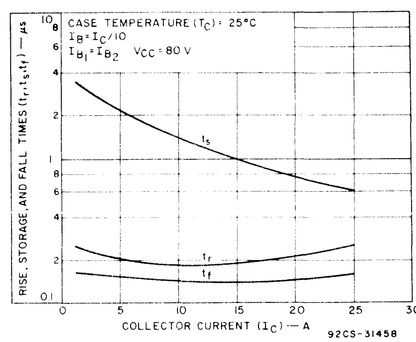


Fig. 11-Typical saturated-switching-time characteristics as a function of collector current for all types.

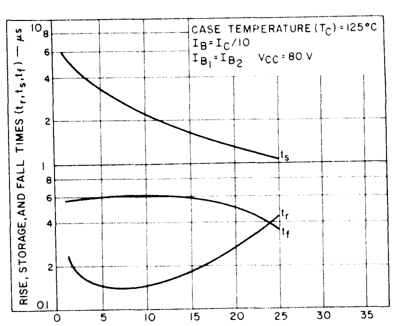


Fig. 12-Typical saturated-switching-time characteristics at T_C = 125°C as a function of collector current for all for all types.

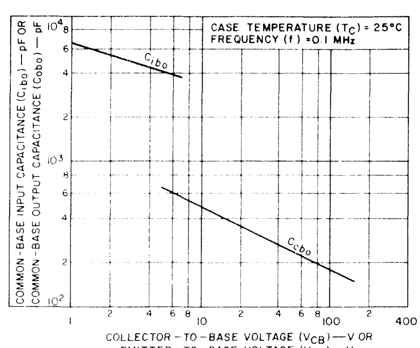


Fig. 13-Typical common-base input (C_{ibo}) or output (C_{obo}) capacitance characteristic for all types.

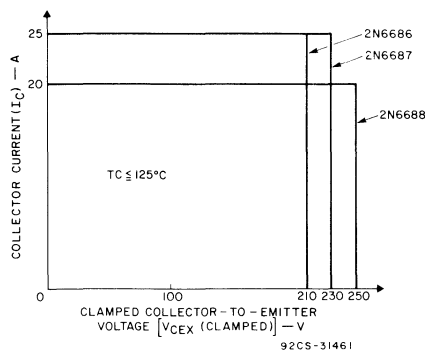


Fig. 14-Maximum operating conditions for switching between saturation and cutoff for all types.

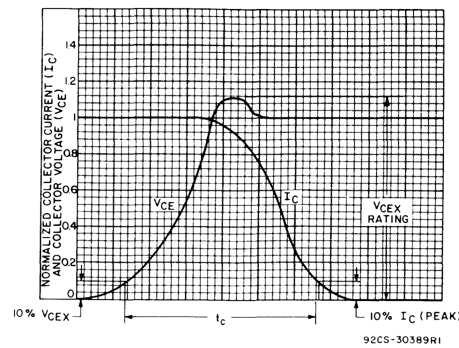


Fig. 15-Oscilloscope display for normalized measurement of clamped inductive switching time (t_C).

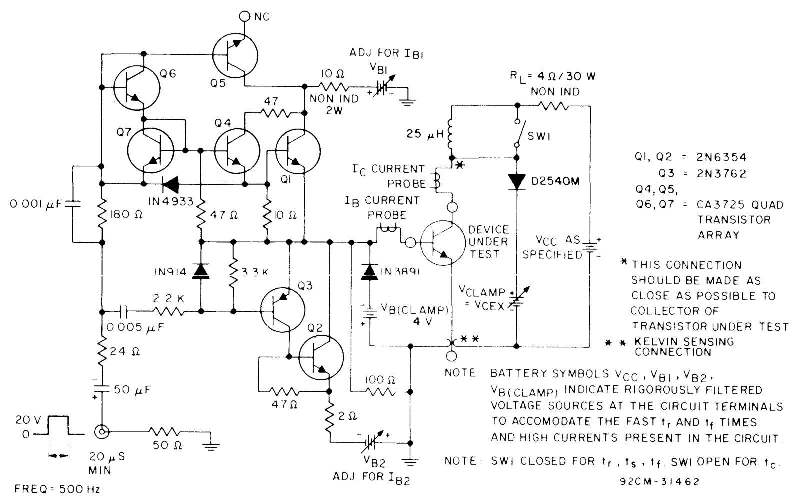


Fig. 16-Circuit for measuring switching times.

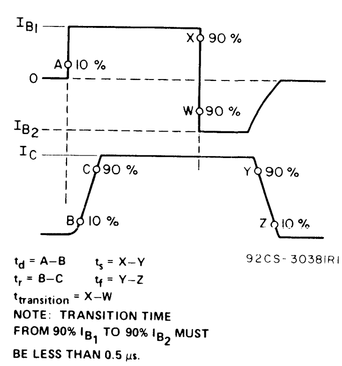


Fig. 17-Phase relationship between input and output currents showing reference points for specification of switching times.

2N6738, 2N6739, 2N6740

File Number **1291**

5-A SwitchMax Power Transistors

High-Voltage N-P-N Types for Off-Line Power Supplies and Other High-Voltage Switching Applications

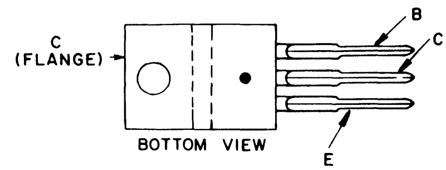
Features:

- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* *V_{CEX} = 350 V to 450 V*
- *Low V_{CE} (sat) at I_C = 5 A*
- *VERSAWATT package*

Applications:

- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



JEDEC TO-220AB

(See dimensional outline "N".)

The RCA 2N6738 and 2N6739 and 2N6740• SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for off-line power supplies and are also well suited for use in a wide range of inverter or converter circuits and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of industrial high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 125°C to provide information necessary for worst-case design.

The RCA-2N6738, 2N6739, and 2N6740 series transistors are supplied in the JEDEC TO-220AB package.

•Formerly RCA Dev. Type Nos. TA9141A, TA9141B, and TA9141C, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6738	2N6739	2N6740	
* V_{CEV}				
V_{BE}=−1.5 V	450	550	650	V
* V_{CEX}(Clamped)				
V_{BE}=−1.5 V	350	400	450	V
* V_{CEO}	300	350	400	V
* V_{EBO}		8		V
I_C(sat)		5		A
* I_C		8		A
I_{CM}		10		A
* I_B		4		A
* P_T				
T_C up to 25°C		100		W
T_C above 25°C, derate linearly		0.8		W/°C
* T_{stg}, T_J		−65 to 150		°C
* T_L				
At distance ≥ 1/8" in. (3.17 mm) from seating plane for 10 s max.		235		°C

*In accordance with JEDEC registration data.

ELECTRICAL CHARACTERISTICS

2N6738, 2N6739, 2N6740

CHARAC-TERISTIC	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6738 Min.	Max.	2N6739 Min.	Max.	2N6740 Min.	Max.	UNITS
T_C=25° C											
* I_{CEV}	450	−1.5			—	0.1	—	—	—	—	mA
	550	−1.5			—	—	—	0.1	—	—	
	650	−1.5			—	—	—	—	—	0.1	
* I_{EBO}		−8	0		—	2	—	2	—	2	
* V_{CEO}(sus)[b]			0.2[a]	0	300	—	350	—	400	—	V
* h_{FE}	3		5[a]		10	40	10	40	10	40	
* V_{BE}(sat)			5[a]	1	—	1.6	—	1.6	—	1.6	V
* V_{CE}(sat)			5[a]	1	—	1	—	1	—	1	
			8[a]	4	—	2	—	2	—	2	
* V_{CEX}[b] (Clamped $E_{S/b}$) L=170 μH, R_{BB}=5 Ω		−5	5	1[e]	350	—	400	—	450	—	V
		−5	8	3[e]	200	—	250	—	300	—	
* $I_{S/b}$	25		4		0.5	—	0.5	—	0.5	—	s
* $\lvert h_{fe}\rvert$ f=5 MHz	10		0.2		3	12	3	12	3	12	
f_T	10		0.2		15	60	15	60	15	60	MHz
* C_{obo} f=0.1 MHz	10[c]				50	300	50	300	50	300	pF
* t_d[d]			5	1	—	0.1	—	0.1	—	0.1	μs
* t_r[d]			5	1	—	0.5	—	0.5	—	0.5	
* t_s[d]			5	1[e]	—	2.5	—	2.5	—	2.5	
* t_f[d]			5	1[e]	—	0.4	—	0.4	—	0.4	
* t_c V_{CC}=125 V, L=170 μH, R_C=25 Ω Collector clamped to V_{CEX}			5	1[e]	—	0.4	—	0.4	—	0.4	
T_C=125° C											
* I_{CEV}	450	−1.5			—	1	—	—	—	—	mA
	550	−1.5			—	—	—	1	—	—	
	650	−1.5			—	—	—	—	—	1	
* V_{CE}(sat)			5[a]	1	—	2	—	2	—	2	V
* t_r[d]			5	1	—	0.8	—	0.8	—	0.8	μs
* t_s[d]			5	1[e]	—	4	—	4	—	4	
* t_f[d]			5	1[e]	—	0.8	—	0.8	—	0.8	
* t_c V_{CC}=125 V, L=170 μH, R_C=25 Ω Collector clamped to V_{CEX}			5	1[e]	—	0.8	—	0.8	—	0.8	
* $R_{\theta JC}$	10		5		—	1.25	—	1.25	—	1.25	°C/W
$R_{\theta JA}$					—	70	—	70	—	70	°C/W

*In accordance with JEDEC registration data.

[a]Pulsed: pulse duration = 300 μs, duty factor ≤ 2%.

[b]CAUTION: The sustaining voltage V_{CEO}(sus) and V_{CEX} MUST NOT be measured on a curve tracer.

[c]V_{CB} value.

[d]V_{CC} = 125 V, t_p = 20 μs.

[e]I_{B_1} = $-I_{B_2}$.

2N6738, 2N6739, 2N6740

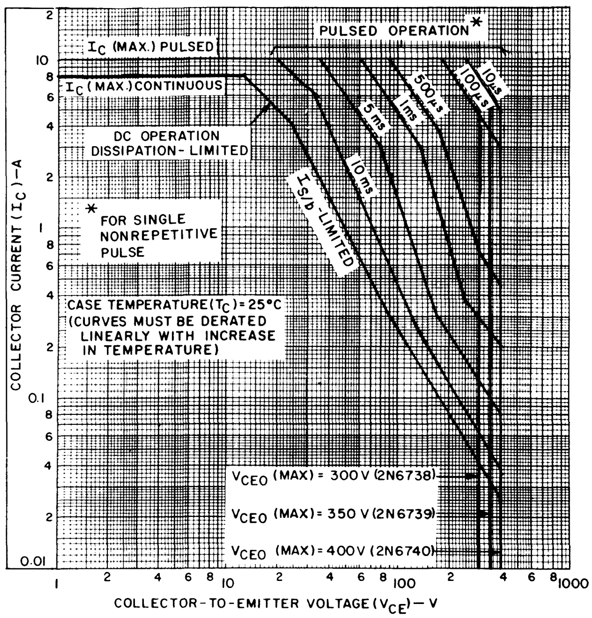


Fig. 1 - Maximum operating areas for all types (T_C=25° C).

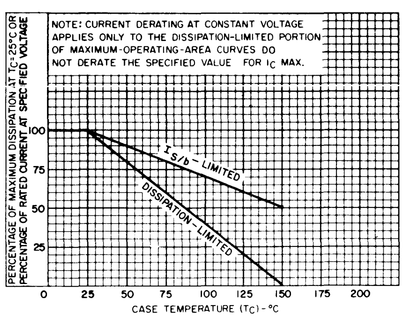


Fig. 2 - Dissipation and derating curve for all types.

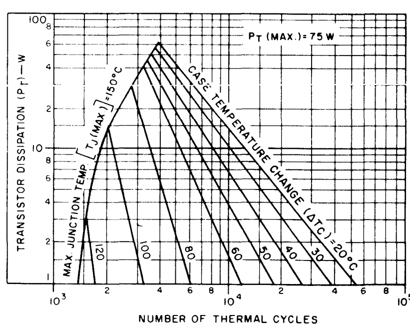


Fig. 3 - Thermal-cycling rating chart for all types.

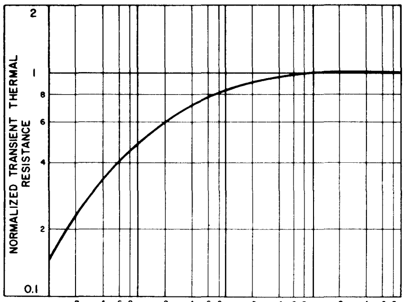


Fig. 4 - Typical thermal-response characteristic for all types.

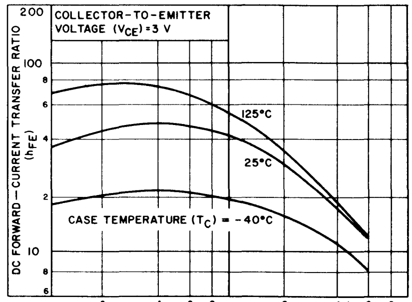
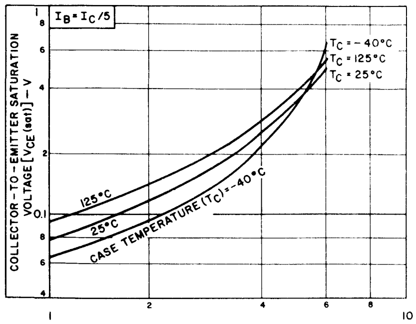
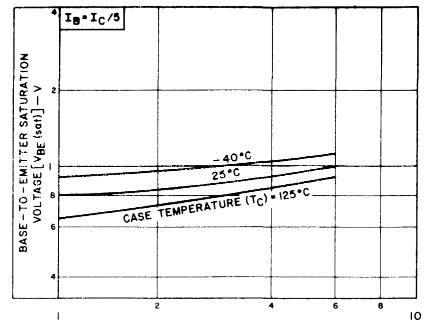


Fig. 5 - Typical dc beta characteristics for all types.



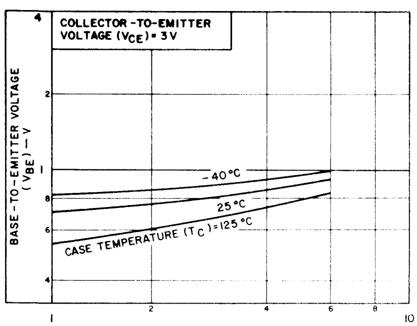
92CS-29983R1

Fig. 6 - Typical collector-to-emitter saturation voltage as a function of collector current for all types.



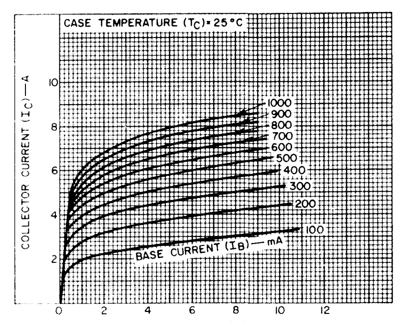
92CS-29984

Fig. 7 - Typical base-to-emitter saturation voltage as a function of collector current for all types.



92CS-29985

Fig. 8 - Typical base-to-emitter voltage as a function of collector current for all types.



92CS-29986

Fig. 9 - Typical output characteristics for all types.

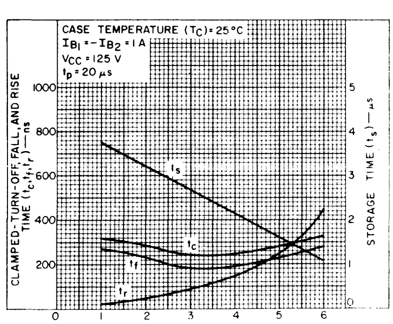
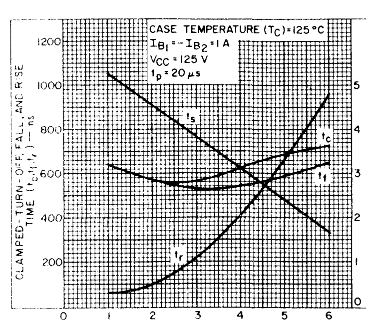


Fig. 10 - Typical saturated switching time characteristics for all types.



92CS-29988R1

Fig. 11 - Typical saturated switching time characteristics for all types.

2N6738, 2N6739, 2N6740

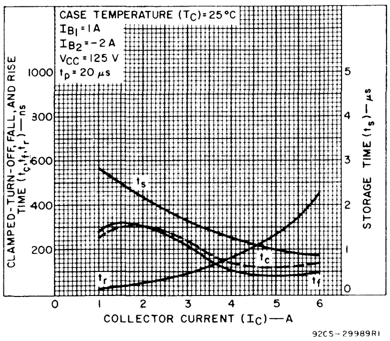


Fig. 12 - Typical saturated switching time characteristics for all types.

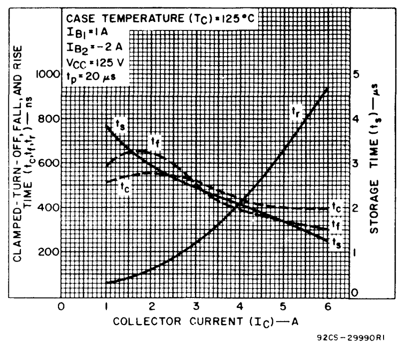


Fig. 13 - Typical saturated switching time characteristics for all types.

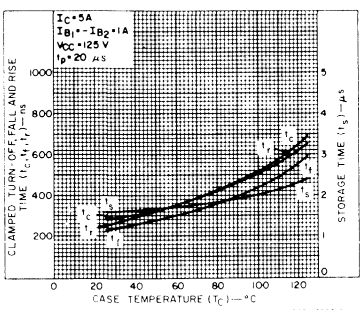


Fig. 14 - Typical saturated switching time characteristics as a function of case temperature for all types.

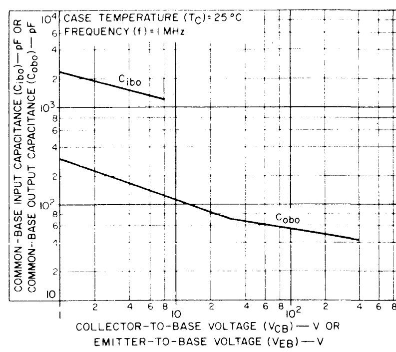


Fig. 15 - Typical common-base input or output capacitance characteristics as a function of collector-to-base voltage or emitter-to-base voltage for all types.

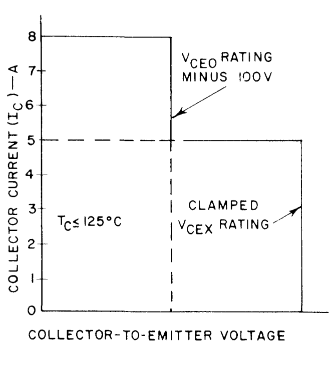


Fig. 16 - Maximum operating conditions for switching between saturation and cutoff.

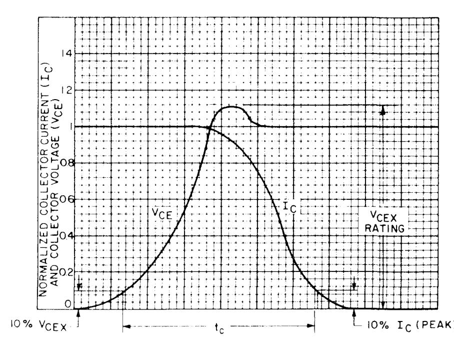


Fig. 17 - Oscilloscope display for measurement of clamped induction switching time (t_C).

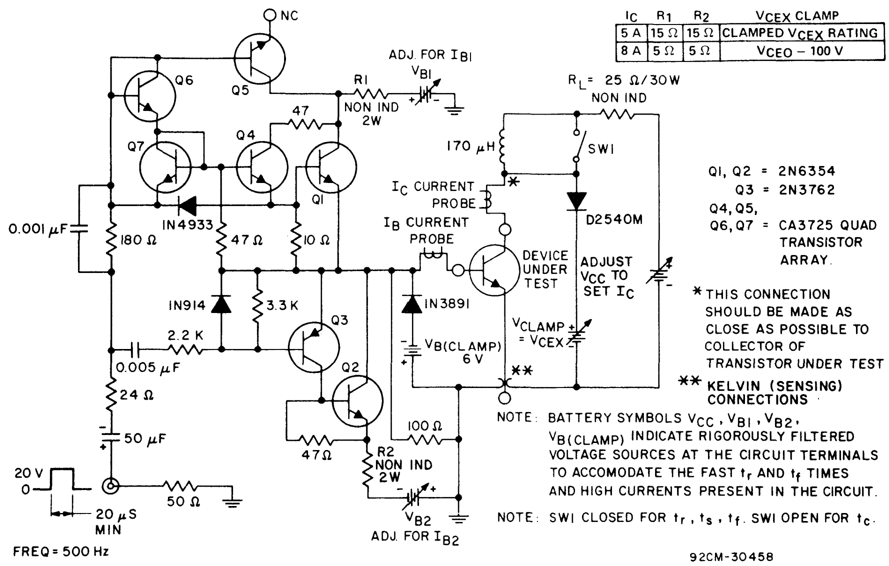


Fig. 18 - Circuit for measuring switching times.

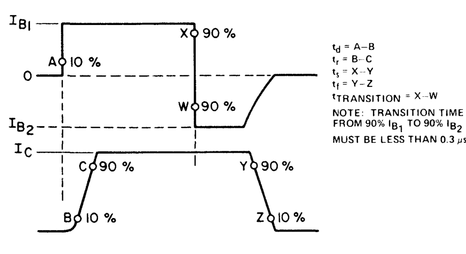


Fig. 19 - Phase relationship between input and output currents showing reference points for specification of switching times.

2N6751, 2N6752, 2N6753, 2N6754

File Number **1244**

5-A SwitchMax Power Transistors

High-Voltage N-P-N Types for 240 V Off-Line Power Supplies and Other High-Voltage Switching Applications

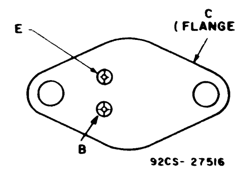
Features:

- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* *V_{CEX} = 450 V — 550 V*
- *Low V_{CE} (sat) at I_C = 5 A*
- *Steel hermetic TO-204MA package*

Applications:

- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "B".)

The RCA-2N6751, 2N6752, 2N6753 and 2N6754 Switch-Max series• of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for off-line power supplies and are also well suited for use in a wide range of inverter or converter circuits and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 100°C to provide information necessary for worst-case design.

The 2N6751, 2N6752, 2N6753, and 2N6754 series transistors are supplied in steel JEDEC TO-204MA hermetic packages.

•Formerly TA9153, TA9153A, TA9153B,

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6751	2N6752	2N6753	2N6754	
* V_{CEV}					
V_{BE} = −1.5 V	800	850	900	1000	V
* V_{CEX}(Clamped)					
V_{BE} = −1.5 V	450	500	550	550	V
* V_{CEO}	400	450	500	500	V
* V_{EBO}	8				V
I_C(sat)	5				A
* I_C	10				A
I_{CM}	10				A
* I_B	5				A
* P_T					
$T_C \leq 25°C$	150				W
$T_C \geq 25°C$, derate linearly	1				W/°C
* T_J	−65 to 175				°C
* T_{stg}	−65 to 200				°C
* T_L					
At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.	235				°C

* In accordance with JEDEC registration data.

2N6751, 2N6752, 2N6753, 2N6754

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc		TEST CONDITIONS: CURRENT A dc		LIMITS: 2N6751		LIMITS: 2N6752		UNITS
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
T_C = 25°C									
* I_{CEV}	800	−1.5			—	0.1	—	—	mA
	850	−1.5			—	—	—	0.1	mA
* I_{EBO}		−8	0		—	2	—	2	mA
* $V_{CEO}(sus)$[b]			0.2[a]	0	400	—	450	—	V
* h_{FE}	3		5[a]		8	40	8	40	
* $V_{BE}(sat)$			5[a]	1	—	1.3	—	1.3	V
* $V_{CE}(sat)$			5[a]	1	—	1	—	1	V
			10[a]	3	—	3	—	3	V
V_{CEX}[b] (Clamped $E_{S/b}$) L = 170 µH		−6	5	1[c]	450	—	500	—	V
$t_{S/b}$	30		5		1	—	1	—	s
* $\lvert h_{fe} \rvert$ f = 5 MHz	10		0.2		3	12	3	12	
f_T	10		0.2		15	60	15	60	MHz
* C_{obo} f = 0.1 MHz	10[d]				50	250	50	250	pF
* t_d[e]		−6	5	1	—	0.1	—	0.1	µs
* t_r[e]		−6	5	1	—	0.4	—	0.4	µs
* t_s[e]		−6	5	1[c]	—	3	—	3	µs
* t_f[e]		−6	5	1[c]	—	0.4	—	0.4	µs
* t_c V_{CC} = 250 V, L = 170 µH, R_C = 50 Ω, Collector clamped to V_{CEX}		−6	5	1[c]	—	0.4	—	0.4	µs
T_C = 100°C									
* I_{CEV}	800	−1.5			—	1	—	—	mA
	850	−1.5			—	—	—	1	mA
* $V_{CE}(sat)$			5[a]	1	—	1.5	—	1.5	V
* t_r[e]		−6	5	1	—	0.6	—	0.6	µs
* t_s[e]		−6	5	1[c]	—	5	—	5	µs
* t_f[e]		−6	5	1[c]	—	0.7	—	0.7	µs
* t_c V_{CC} = 250 V, L = 170 µH, R_C = 50 Ω, Collector clamped to V_{CEX}		−6	5	1[c]	—	0.7	—	0.7	µs
* $R_{\theta JC}$	10		5		—	1	—	1	°C/W

* In accordance with JEDEC registration data.

[a] Pulsed duration = 300 µs, duty factor ≤ 2%.

[b] **CAUTION:** The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} *MUST NOT* be measured on a curve tracer.

[c] $I_{B_1} = -I_{B_2}$ [d] V_{CB} value [e] V_{CC} = 250 V, tp = 20 µs

2N6751, 2N6752, 2N6753, 2N6754

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc V_{CE}	TEST CONDITIONS VOLTAGE V dc V_{BE}	TEST CONDITIONS CURRENT A dc I_C	TEST CONDITIONS CURRENT A dc I_B	LIMITS 2N6753 Min.	LIMITS 2N6753 Max.	LIMITS 2N6754 Min.	LIMITS 2N6754 Max.	UNITS
T_C = 25°C									
* I_{CEV}	900	−1.5			—	0.1	—	—	mA
	1000	−1.5			—	—	—	0.1	mA
* I_{EBO}		−8	0		—	2	—	2	mA
* $V_{CEO}(sus)$[b]			0.2[a]	0	500	—	500	—	V
* h_{FE}	3		5[a]		8	40	8	40	
* $V_{BE}(sat)$			5[a]	1	—	1.3	—	1.3	V
* $V_{CE}(sat)$			5[a]	1	—	1	—	1	V
			10[a]	3	—	3	—	3	V
V_{CEX}[b] (Clamped $E_{S/b}$) L = 170 μH		−6	5	1[c]	550	—	550	—	V
$I_{S/b}$	30		5		1	—	1	—	s
* $\|h_{fe}\|$ f = 5 MHz	10		0.2		3	12	3	12	
f_T	10		0.2		15	60	15	60	MHz
* C_{obo} f = 0.1 MHz	10[d]				50	250	50	250	pF
* t_d[e]		−6	5	1	—	0.1	—	0.1	μs
* t_r[e]		−6	5	1	—	0.4	—	0.4	μs
* t_s[e]		−6	5	1[c]	—	3	—	3	μs
* t_f[e]		−6	5	1[c]	—	0.4	—	0.4	μs
* t_c V_{CC} = 250 V, L = 170 μH, R_C = 50 Ω, Collector clamped to V_{CEX}		−6	5	1[c]	—	0.4	—	0.4	μs
T_C = 100°C									
* I_{CEV}	900	−1.5			—	1	—	—	mA
	1000	−1.5			—	—	—	1	mA
* $V_{CE}(sat)$			5[a]	1	—	1.5	—	1.5	V
* t_r[e]		−6	5	1	—	0.6	—	0.6	μs
* t_s[e]		−6	5	1[c]	—	5	—	5	μs
* t_f[e]		−6	5	1[c]	—	0.7	—	0.7	μs
* t_c V_{CC} = 250 V, L = 170 μH, R_C = 50 Ω, Collector clamped to V_{CEX} *		−6	5	1[c]	—	0.7	—	0.7	μs
* $R_{\theta JC}$	10		5		—	1	—	1	°C/W

* In accordance with JEDEC registration data.

[a] Pulsed duration = 300 μs, duty factor ≤ 2%.

[b] **CAUTION:** The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} *MUST NOT* be measured on a curve tracer.

[c] $I_{B_1} = -I_{B_2}$ [d] V_{CB} value [e] V_{CC} = 250 V, t_p = 20 μs

2N6751, 2N6752, 2N6753, 2N6754

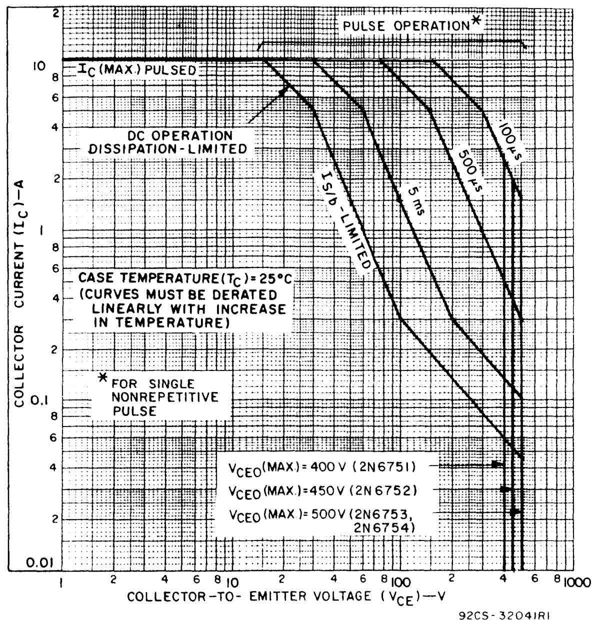


Fig. 1—Maximum operating areas for all types (T_C).

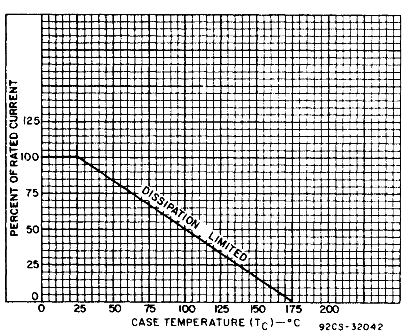


Fig. 2—Dissipation derating curve for all types.

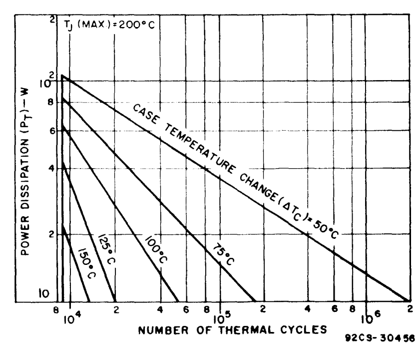


Fig. 3—Thermal-cycling chart for all types.

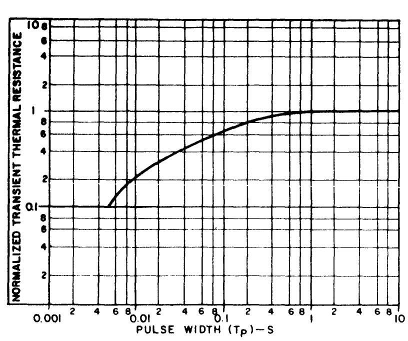


Fig. 4—Typical thermal-response characteristic for all types.

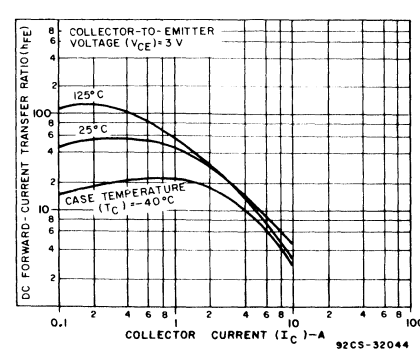


Fig. 5—Typical dc beta characteristics for all types.

2N6751, 2N6752, 2N6753, 2N6754

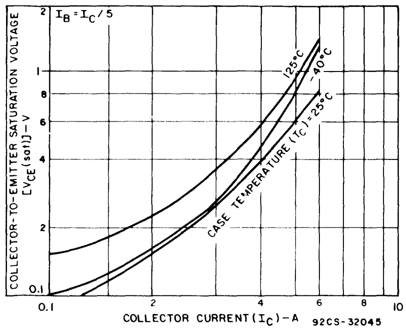


Fig. 6—Typical collector-to-emitter saturation voltage as a function of collector current for all types.

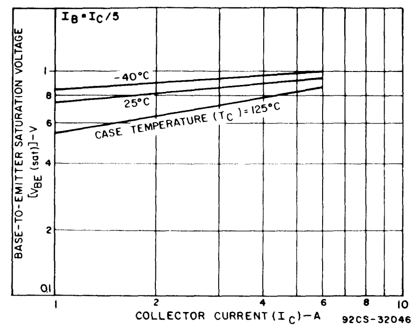


Fig. 7—Typical base-to-emitter saturation voltage as a function of collector current for all types.

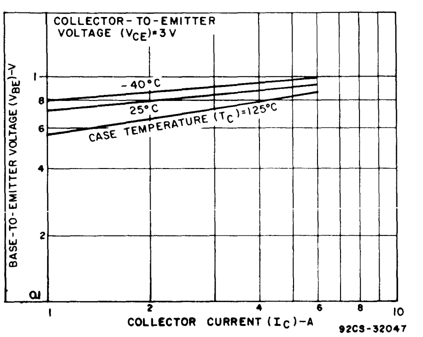


Fig. 8—Typical base-to-emitter voltage as a function of collector current for all types.

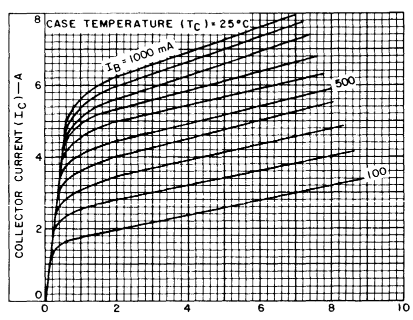


Fig. 9—Typical output characteristics for all types.

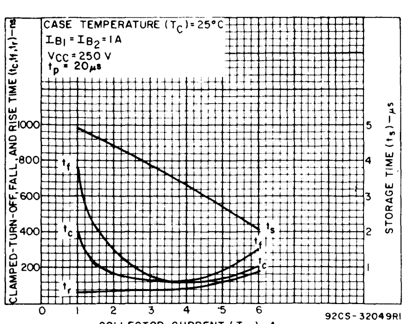


Fig. 10—Typical saturated switching time characteristics for all types.

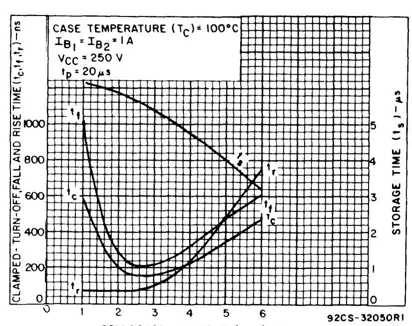


Fig. 11—Typical saturated switching time characteristics for all types.

2N6751, 2N6752, 2N6753, 2N6754

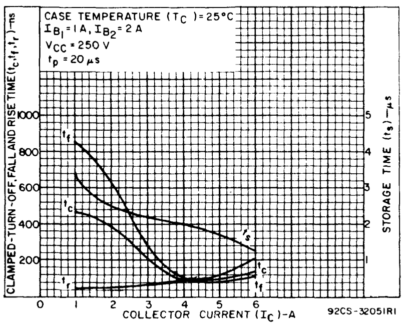


Fig. 12—Typical saturated switching time characteristics for all types.

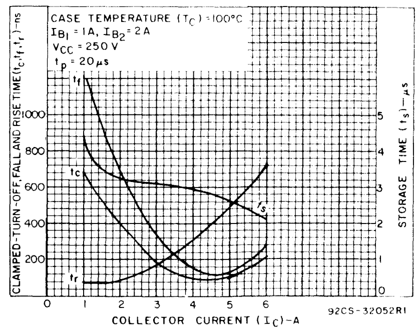


Fig. 13—Typical saturated switching time characteristics for all types.

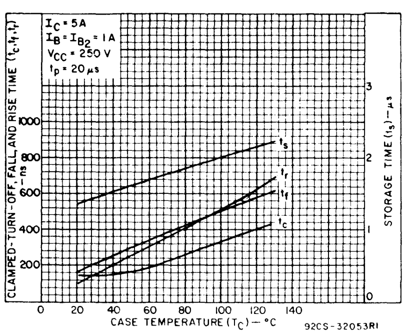


Fig. 14—Typical saturated switching time characteristics as a function of case temperature for all types.

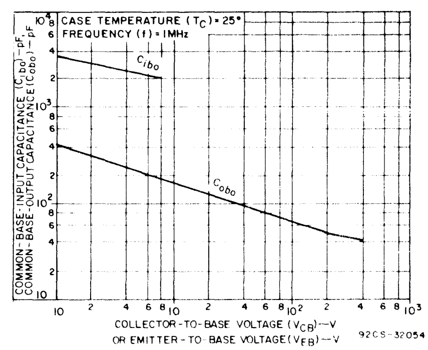


Fig. 15—Typical common-base input or output capacitance characteristics as a function of collector-to-base voltage or emitter-to-base voltage for all types.

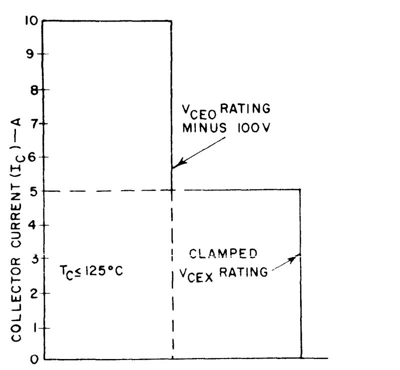


Fig. 16—Maximum operating conditions for switching between saturation and cutoff.

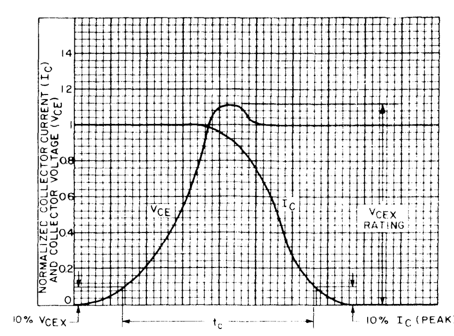


Fig. 17—Oscilloscope display for measurement of clamped induction switching time (t_C).

2N6751, 2N6752, 2N6753, 2N6754

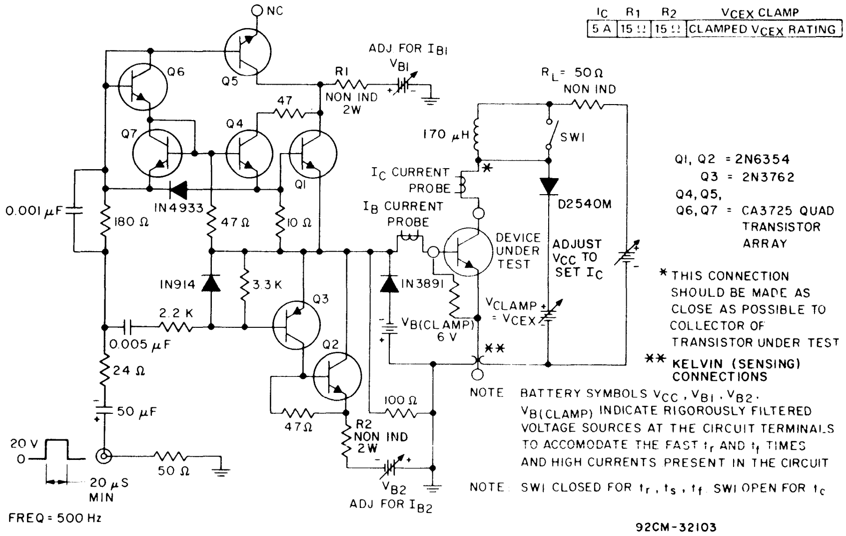


Fig. 18—Circuit for measuring switching times.

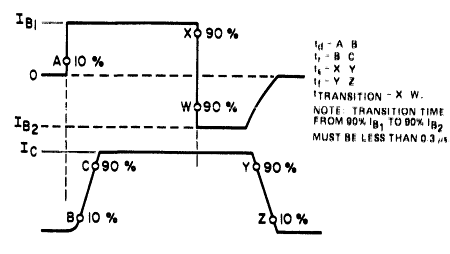


Fig. 19—Phase relationship between input and output currents showing reference points for specification of switching times.

File Number **1292**

2N6771, 2N6772, 2N6773

1-A SwitchMax VERSAWATT Transistors

High-Voltage N-P-N Types for Off-Line Power Supplies and Other High-Voltage Switching Applications

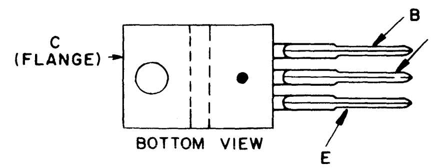
Features:

- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* *V_{CEX} = 350 V to 450 V*
- *Low V_{CE} (sat) at I_C = 1 A*
- *VERSAWATT package*

Applications:

- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



JEDEC TO-220AB

(See dimensional outline "N".)

The RCA-2N6771, 2N6772, and 2N6773• SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for off-line power supplies and are also well suited for use in a wide range of inverter or converter circuits and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of high-power switching circuits.

Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 125°C to provide information necessary for worst-case design.

The RCA-2N6771, 2N6772, and 2N6773 series transistors are supplied in the JEDEC TO-220AB VERSAWATT plastic packages.

•Formerly RCA8863A, RCA8863B, and RCA8863C, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6771	2N6772	2N6773	
* V_{CEV}				
V_{BE}=−1.5 V	450	550	650	V
* V_{CEX}(Clamped)				
V_{BE}=−1.5 V	350	400	450	V
* V_{CEO}	300	350	400	V
* V_{EBO}		8		V
I_C(sat)		1		A
* I_C		1		A
I_{CM}		2		A
* I_B		0.6		A
* P_T				
T_C up to 25°C		40		W
T_C above 25°C, derate linearly		0.32		W/°C
* T_{stg}, T_J		−65 to 150		°C
* T_L				
At distance ≥ 1/8" in. (3.17 mm) from seating plane for 10 s max.		235		°C

*In accordance with JEDEC registration data.

2N6771, 2N6772, 2N6773

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc V_{CE}	VOLTAGE V dc V_{BE}	CURRENT A dc I_C	CURRENT A dc I_B	LIMITS 2N6771 Min.	2N6771 Max.	2N6772 Min.	2N6772 Max.	2N6773 Min.	2N6773 Max.	UNITS
T_C=25° C											
* I_{CEV}	450	−1.5			—	0.1	—	—	—	—	mA
	550	−1.5			—	—	—	0.1	—	—	
	650	−1.5			—	—	—	—	—	0.1	
* I_{EBO}		−8	0		—	2	—	2	—	2	
* V_{CEO}(sus)[b]			0.2[a]	0	300	—	350	—	400	—	V
* V_{CE}(sat)			1[a]	0.2	—	1.0	—	1.0	—	1.0	
* V_{BE}(sat)			1[a]	0.2	—	1.2	—	1.2	—	1.2	
* h_{FE}	3		0.3[a]		20	100	20	100	20	100	
	3		1[a]		10	50	10	50	10	50	
* V_{CEX}[b] (Clamped $E_{S/b}$) L=450 µH, R_{BB}=50 Ω		−5	1	0.1[e]	350	—	400	—	450	—	V
* $I_{S/b}$	100		0.4		0.5	—	0.5	—	0.5	—	s
* $\|h_{fe}\|$ f=1 MHz	10		0.2		10	50	10	50	10	50	
f_T	10		0.2		10	50	10	50	10	50	MHz
* C_{obo} f=0.1 MHz	10[c]				20	60	20	60	20	60	pF
* t_d[d]			1	0.2	—	0.05	—	0.05	—	0.05	µs
* t_r[d]			1	0.2	—	0.4	—	0.4	—	0.4	
* t_s[d]			1	0.2[e]	—	2.5	—	2.5	—	2.5	
* t_f[d]			1	0.2[e]	—	0.6	—	0.6	—	0.6	
* t_c V_{CC}=200 V, L=450 µH, R_C=200 Ω Collector clamped to V_{CEX}			1	0.2[e]	—	0.6	—	0.6	—	0.6	
T_C=125° C											
* I_{CEV}	450	−1.5			—	1	—	—	—	—	mA
	550	−1.5			—	—	—	1	—	—	
	650	−1.5			—	—	—	—	—	1	
* V_{CE}(sat)			1[a]	0.2	—	2	—	2	—	2	V
* t_r[d]			1	0.2	—	0.8	—	0.8	—	0.8	µs
* t_s[d]			1	0.2[e]	—	4.5	—	4.5	—	4.5	
* t_f[d]			1	0.2[e]	—	1.5	—	1.5	—	1.5	
* t_c V_{CC}=200 V, L=450 µH, R_C=200 Ω Collector clamped to V_{CEX}			1	0.2[e]	—	1.5	—	1.5	—	1.5	
* $R_{\theta JC}$	20		1		—	3.12	—	3.12	—	3.12	°C/W
$R_{\theta JA}$					—	70	—	70	—	70	°C/W

*In accordance with JEDEC registration data.
[a]Pulsed: pulse duration = 300 µs, duty factor ≤ 2%.
[b]CAUTION: The sustaining voltage V_{CEO}(sus) and V_{CEX} MUST NOT be measured on a curve tracer.
[c]V_{CB} value.
[d]V_{CC} = 200 V, t_p = 20 µs.
[e]$I_{B1} = -I_{B2}$.

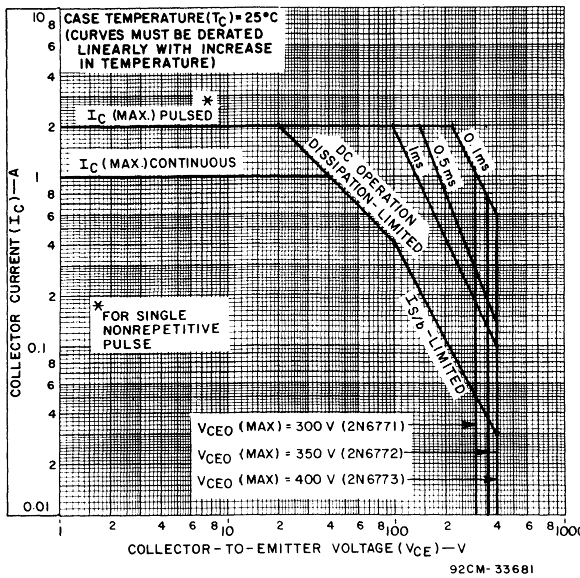


Fig. 1 - Maximum operating areas for all types.

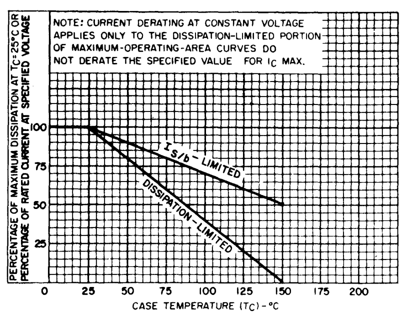


Fig. 2 - Derating curve for all types.

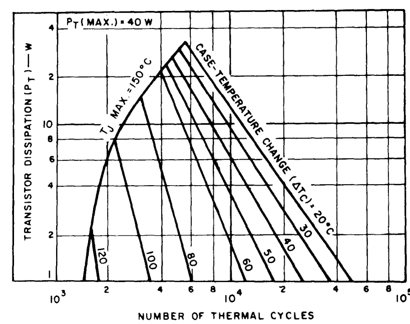


Fig. 3 - Thermal-cycling rating chart for all types.

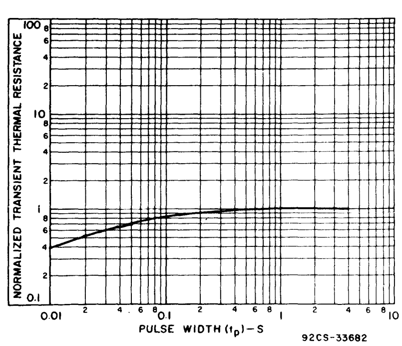


Fig. 4 - Typical thermal-response characteristics for all types.

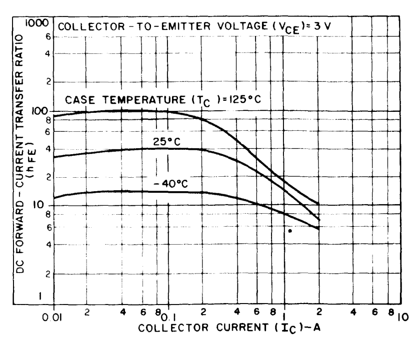


Fig. 5 - Typical dc beta characteristics for all types.

2N6771, 2N6772, 2N6773

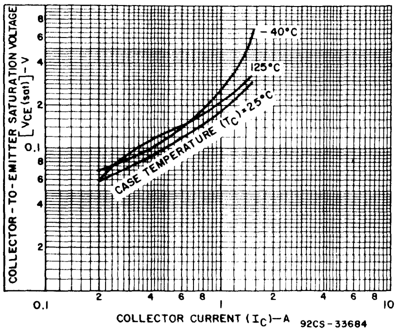


Fig. 6 - Typical collector-to-emitter saturation voltage as a function of collector current for all types.

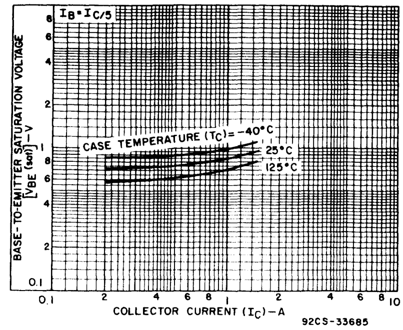


Fig. 7 - Typical base-to-emitter saturation voltage as a function of collector current for all types.

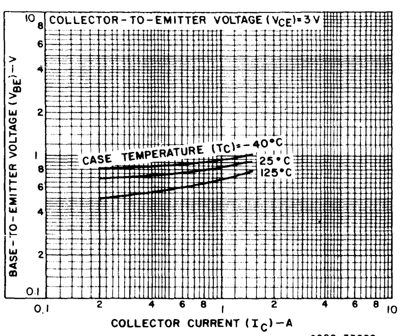


Fig. 8 - Typical base-to-emitter voltage as a function of collector current for all types.

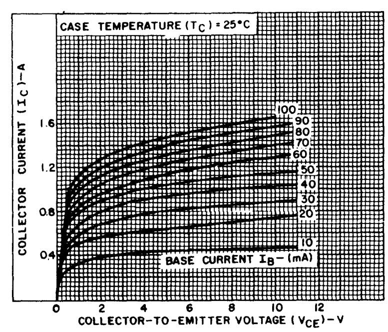


Fig. 9 - Typical output characteristics for all types.

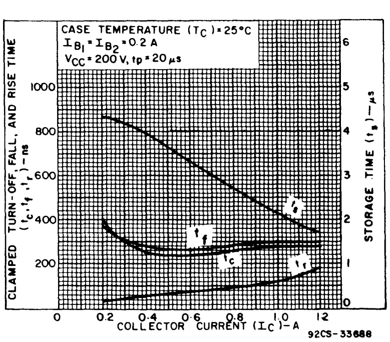


Fig. 10 - Typical saturated-switching-time characteristics for all types.

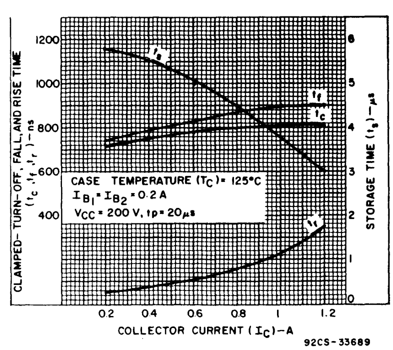


Fig. 11 - Typical saturated-switching-time characteristics as a function of collector current for all types.

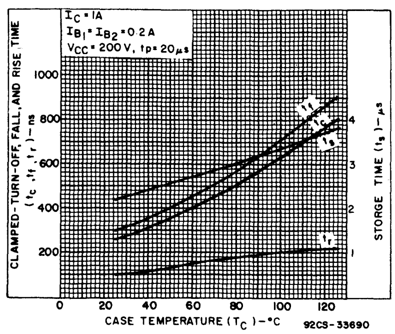


Fig. 12 - Typical saturated-switching-time characteristics as a function of case temperature for all types.

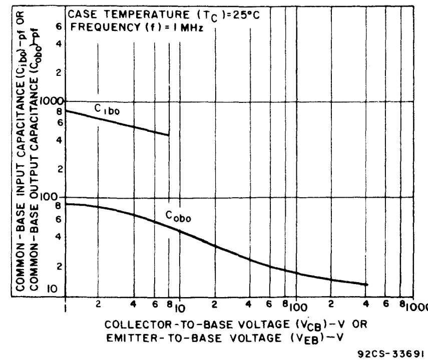


Fig. 13 - Typical common-base input or output capacitance characteristics as a function of collector-to-base voltage or emitter-to-base voltage for all types.

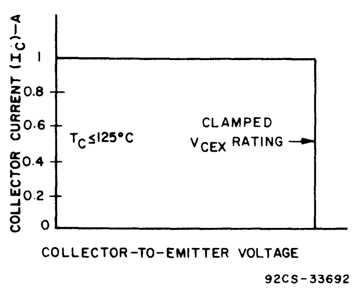


Fig. 14 - Maximum operating conditions for switching between saturation and cutoff.

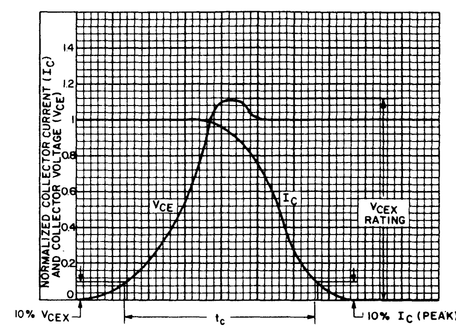


Fig. 15 - Oscilloscope display for measurement of clamped induction switching time (t_C).

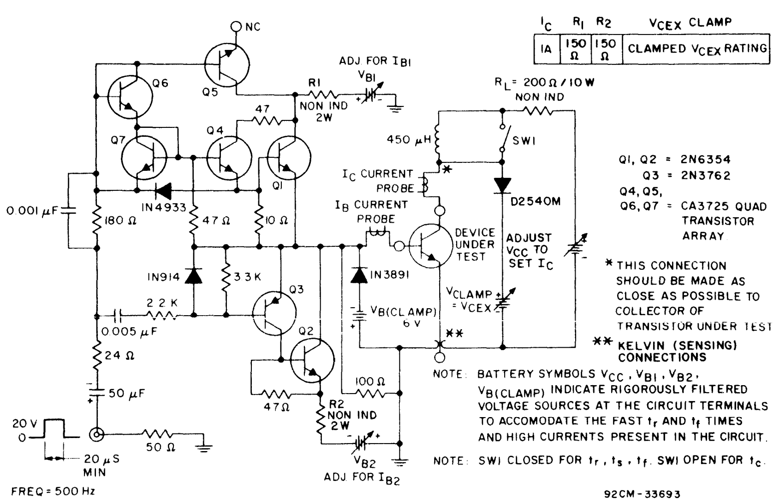


Fig. 16 - Circuit for measuring switching times.

2N6771, 2N6772, 2N6773

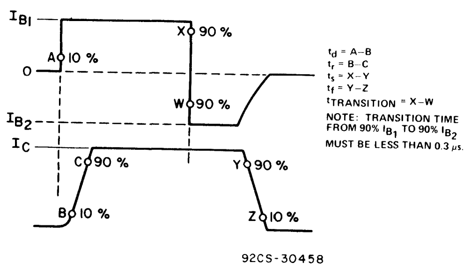


Fig. 17 - Phase relationship between input and output currents showing reference points for specification of switching times.

File Number **1308**

BUW40, BUW40A, BUW40B

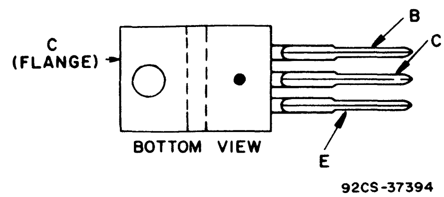
1-A SwitchMax VERSAWATT Transistors

High-Voltage N-P-N Types for Off-Line Power Supplies and Other High-Voltage Switching Applications

Features:
- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* *V_{CEX} = 350 V to 450 V*
- *Low V_{CE} (sat) at I_C = 1 A*
- *VERSAWATT package*

Applications:
- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

The RCA-BUW40, BUW40A, and BUW40B SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for off-line power supplies and are also well suited for use in a wide range of inverter or converter circuits and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-percent tested for parameters that are essential to the design of high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 125°C to provide information necessary for worst-case design.

The RCA-BUW40, BUW40A, and BUW40B series transistors are supplied in the JEDEC TO-220AB VERSAWATT plastic packages.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BUW40	BUW40A	BUW40B	
V_{CER}, R_{BE} = 100 Ω	350	400	450	V
V_{CEV}				
V_{BE} = -1.5 V	450	550	650	V
$V_{CEX(Clamped)}$				
V_{BE} = -1.5 V	350	400	450	V
V_{CEO}	300	350	400	V
V_{EBO}		8		V
$I_{C(sat)}$		1		A
I_C		1		A
I_{CM}		2		A
I_B		0.6		A
P_T				
T_C up to 25°C		40		W
T_C above 25°C, derate linearly		0.32		W/°C
T_{stg}, T_J		-65 to 150		°C
T_L				
At distance ≥ 1/8" in. (3.17 mm) from seating plane for 10 s max.		235		°C

BUW40, BUW40A, BUW40B

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc		TEST CONDITIONS CURRENT A dc		LIMITS BUW40		LIMITS BUW40A		LIMITS BUW40B		UNITS
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
T_C=25° C											
I_{CEV}	450	−1.5			—	0.1	—	—	—	—	mA
	550	−1.5			—	—	—	0.1	—	—	
	650	−1.5			—	—	—	—	—	0.1	
I_{EBO}		−8	0		—	2	—	2	—	2	
$V_{CEO}(sus)$[b]			0.2[a]	0	300	—	350	—	400	—	V
$V_{CE}(sat)$			1[a]	0.2	—	1.0	—	1.0	—	1.0	
$V_{BE}(sat)$			1[a]	0.2	—	1.2	—	1.2	—	1.2	
h_{FE}	3		0.3[a]		20	100	20	100	20	100	
	3		1[a]		10	50	10	50	10	50	
V_{CEX}[b] (Clamped $E_{S/b}$) L=450 μH, R_{BB}=50 Ω		−5	1	0.1[e]	350	—	400	—	450	—	V
$I_{S/b}$	100		0.4		0.5	—	0.5	—	0.5	—	s
$\|h_{fe}\|$ f=1 MHz	10		0.2		10	50	10	50	10	50	
f_T	10		0.2		10	50	10	50	10	50	MHz
C_{obo} f=0.1 MHz	10[c]				20	60	20	60	20	60	pF
t_d[d]			1	0.2	—	0.05	—	0.05	—	0.05	μs
t_r[d]			1	0.2	—	0.4	—	0.4	—	0.4	
t_s[d]			1	0.2[e]	—	2.5	—	2.5	—	2.5	
t_f[d]			1	0.2[e]	—	0.6	—	0.6	—	0.6	
t_c V_{CC}=200 V, L=450 μH, R_C=200 Ω Collector clamped to V_{CEX}			1	0.2[e]	—	0.6	—	0.6	—	0.6	
T_C=125° C											
I_{CEV}	450	−1.5			—	1	—	—	—	—	mA
	550	−1.5			—	—	—	1	—	—	
	650	−1.5			—	—	—	—	—	1	
$V_{CE}(sat)$			1[a]	0.2	—	2	—	2	—	2	V
t_r[d]			1	0.2	—	0.8	—	0.8	—	0.8	μs
t_s[d]			1	0.2[e]	—	4.5	—	4.5	—	4.5	
t_f[d]			1	0.2[e]	—	1.5	—	1.5	—	1.5	
t_c V_{CC}=200 V, L=450 μH, R_C=200 Ω Collector clamped to V_{CEX}			1	0.2[e]	—	1.5	—	1.5	—	1.5	
$R_{\theta JC}$	20		1		—	3.12	—	3.12	—	3.12	°C/W
$R_{\theta JA}$					—	70	—	70	—	70	°C/W

[a]Pulsed: pulse duration = 300 μs, duty factor ≤ 2%.
[b]CAUTION: The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} MUST NOT be measured on a curve tracer.
[c]V_{CB} value.
[d]V_{CC} = 200 V, t_p = 20 μs.
[e]$I_{B_1} = -I_{B_2}$.

BUW40, BUW40A, BUW40B

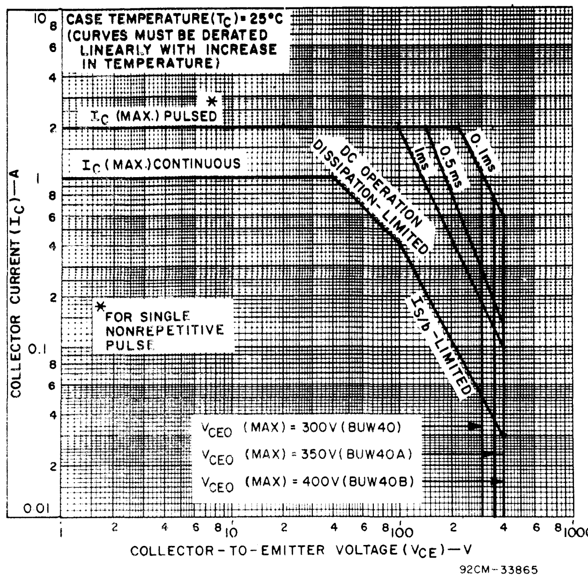


Fig. 1 - Maximum operating areas for all types.

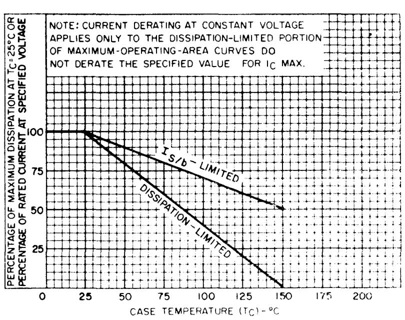


Fig. 2 - Derating curve for all types.

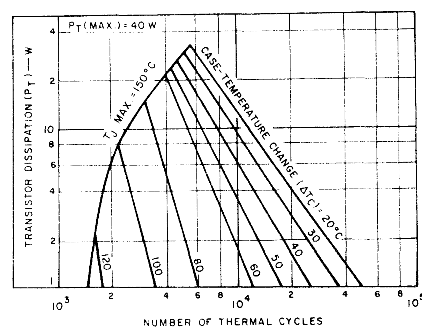


Fig. 3 - Thermal-cycling rating chart for all types.

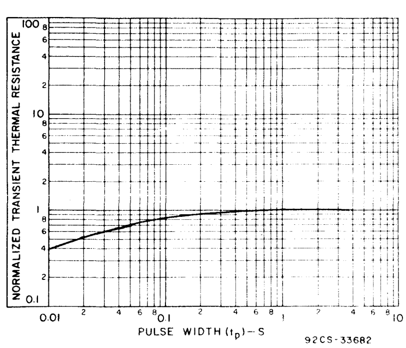


Fig. 4 - Typical thermal-response characteristics for all types.

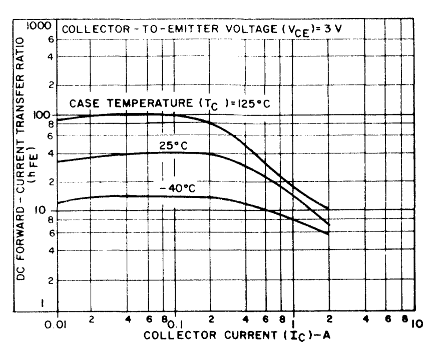


Fig. 5 - Typical dc beta characteristics for all types.

BUW40, BUW40A, BUW40B

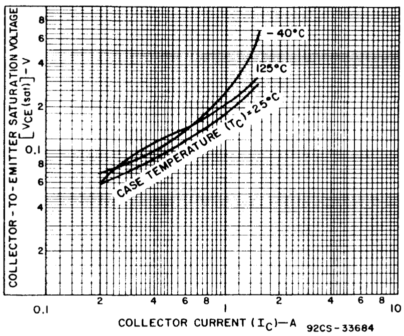


Fig. 6 - Typical collector-to-emitter saturation voltage as a function of collector current for all types.

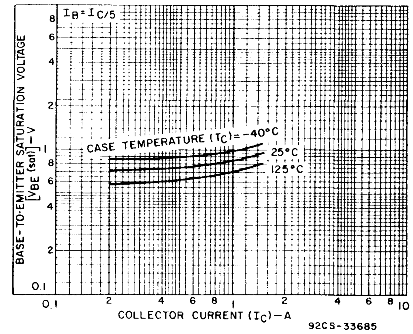


Fig. 7 - Typical base-to-emitter saturation voltage as a function of collector current for all types.

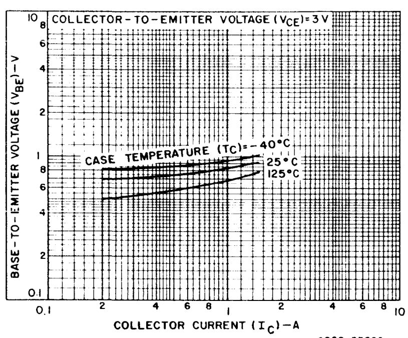


Fig. 8 - Typical base-to-emitter voltage as a function of collector current for all types.

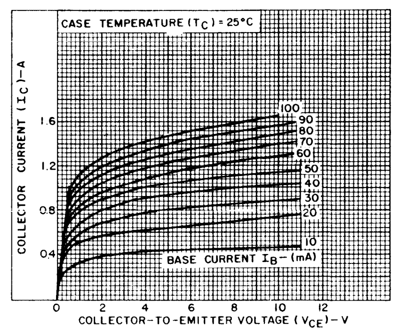


Fig. 9 - Typical output characteristics for all types.

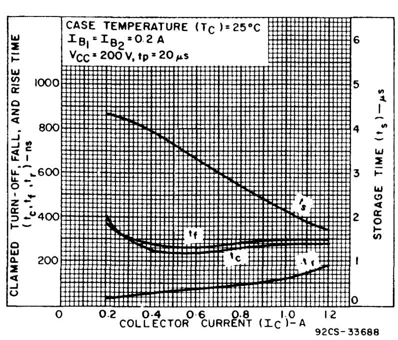


Fig. 10 - Typical saturated switching time charactieristics for all types.

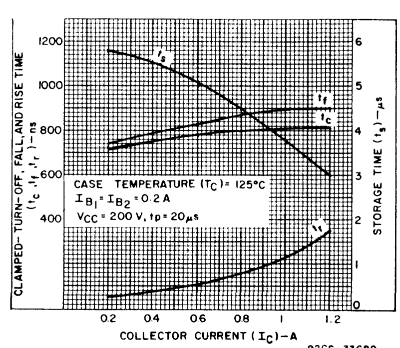


Fig. 11 - Typical saturated-switching-time characteristics as a function of collector current for all types.

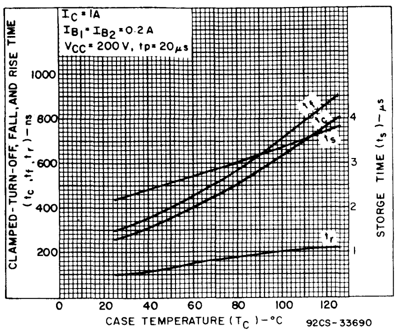


Fig. 12 - Typical saturated-switching-time characteristics as a function of case temperature for all types.

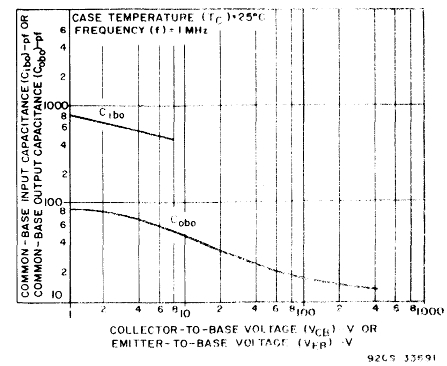


Fig. 13 - Typical common-base input or output capacitance characteristics as a function of collector-to-base voltage or emitter-to-base voltage.

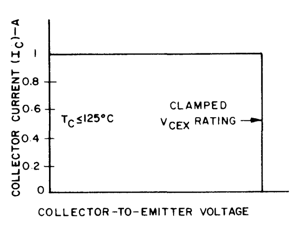


Fig. 14 - Maximum operating conditions for switching between saturation and cutoff.

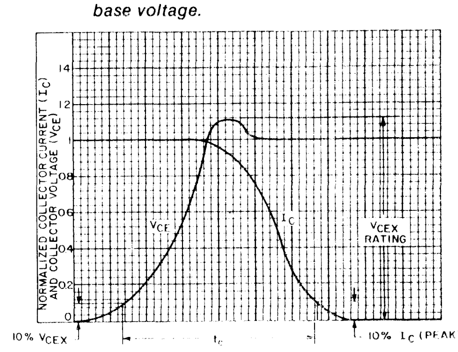


Fig. 15 - Oscilloscope display for measurement of clamped induction switching time (t_c).

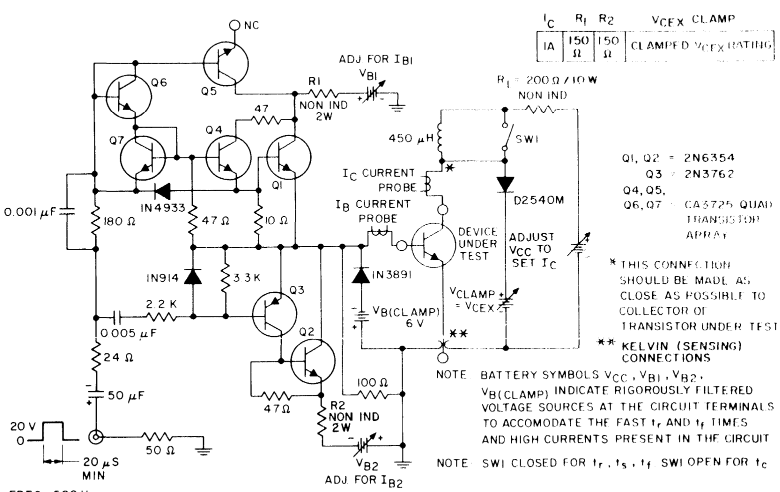


Fig. 16 - Circuit for measuring switching times.

BUW40, BUW40A, BUW40B

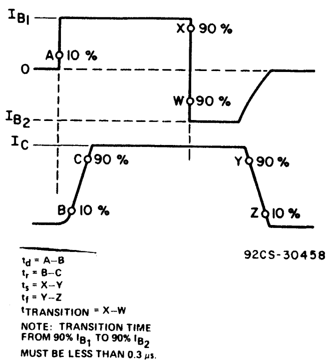


Fig. 17 - Phase relationship between input and output currents showing reference points for specification of switching times.

File Number **1275**

BUW41, BUW41A, BUW41B

5-A SwitchMax Power Transistors

High-Voltage N-P-N Types for Off-Line Power Supplies and Other High-Voltage Switching Applications

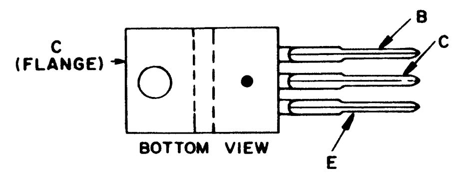
Features:

- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* *V_{CEX} = 350 V to 450 V*
- *Low V_{CE} (sat) at I_C = 5 A*
- *VERSAWATT package*

Applications:

- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



92CS-37394

JEDEC TO-220AB

(See dimensional outline "N".)

The RCA-BUW41, BUW41A and BUW41B SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for use in off-line power supplies and are also well suited for use in a wide range of inverter or converter circuits and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of industrial high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 125°C to provide information necessary for worst-case design.

The BUW41, BUY41A and BUY41B series transistors are supplied in JEDEC TO-220AB (RCA VERSAWATT) plastic package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BUW41	BUW41A	BUW41B	
V_{CER}, R_{BE} = 100Ω	350	400	450	V
V_{CEV}				
V_{BE} = −1.5 V	450	550	650	V
V_{CEX} (clamped)				
V_{BE} = −1.5 V	350	400	450	V
V_{CEO}	300	350	400	V
V_{EBO}		8		V
I_C(sat)		5		A
I_C		8		A
I_{CM}		10		A
I_B		4		A
P_T				
T_C up to 25°C		100		W
T_C above 25°C, derate linearly		0.8		W/°C
T_{stg}, T_J		-65 to 150		°C
T_L				
At distance ≥ 1/8 in. (3.17 mm) from seating plane for 10 s max.		235		°C

BUW41, BUW41A, BUW41B

ELECTRICAL CHARACTERISTICS

Characteristic	Test Conditions: Voltage V dc		Current A dc		Limits: BUW41		BUW41A		BUW41B		Units
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
T_C = 25° C											
I_{CEV}	450	—1.5			—	0.1	—	—	—	—	mA
	550	—1.5			—	—	—	0.1	—	—	
	650	—.5			—	—	—	—	—	0.1	
I_{EBO}		—8	0		—	2	—	2	—	2	
$V_{CEO}(sus)$[b]			0.2[a]	0	300	—	350	—	400	—	V
h_{FE}	3		5[a]		10	40	10	40	10	40	
$V_{BE}(sat)$			5[a]	1	—	1.6	—	1.6	—	1.6	V
$V_{CE}(sat)$			5[a]	1	—	1	—	1	—	1	
			8[a]	4	—	2	—	2	—	2	
V_{CEX}[b] (Clamped $E_{S/b}$) L = 170 µH		—5	5	1[e]	350	—	400	—	450	—	
R_{BB} = 5 Ω		—5	8	3[e]	200	—	250	—	300	—	
$I_{S/b}$	25		4		0.5	—	0.5	—	0.5	—	s
$\|h_{fe}\|$ f=5 MHz	10		0.2		3	12	3	12	3	12	
f_T	10		0.2		15	60	15	60	15	60	MHz
C_{obo} f=0.1 MHz	10[c]				50	300	50	300	50	300	pF
t_d[d]			5	1	—	0.1	—	0.1	—	0.1	µs
t_r[d]			5	1	—	0.5	—	0.5	—	0.5	
t_s[d]			5	1[e]	—	2.5	—	2.5	—	2.5	
t_f[d]			5	1[e]		0.4	—	0.4	—	0.4	
t_c V_{CC} = 125 V, L = 170 µH, R_C = 25 Ω Collector clamped to V_{CEX}			5	1[e]	—	0.4	—	0.4	—	0.4	

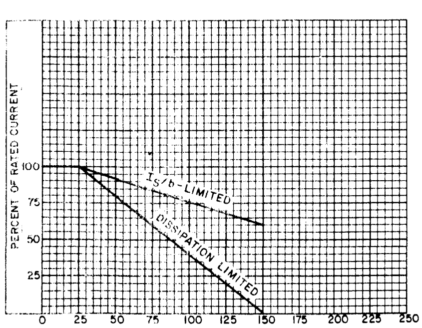


Fig.2 - Dissipation and $I_{S/b}$ derating curves for all types.

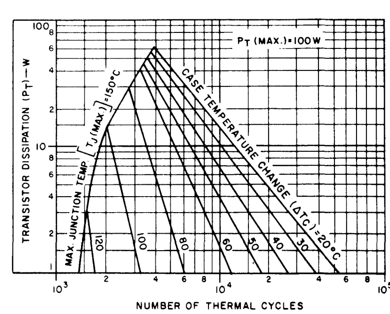


Fig.3 - Thermal-cycling chart for all types.

BUW41, BUW41A, BUW41B

ELECTRICAL CHARACTERISTICS Continued

Characteristic	Test Conditions: Voltage V dc V_{CE}	V_{BE}	Current A dc I_C	I_B	Limits: BUW41 Min.	Max.	BUW41A Min.	Max.	BUW41B Min.	Max.	Units
T_C = 125° C											
I_{CEV}	450	—1.5			—	1	—	—	—	—	mA
	550	—1.5			—	—	—	1	—	—	mA
	650	—1.5			—	—	—	—	—	1	mA
V_{CE}(sat)			5[a]	1	—	2	—	2	—	2	V
t_r[d]			5	1	—	0.8	—	0.8	—	0.8	μs
t_s[d]			5	1[e]	—	4	—	4	—	4	μs
t_f[d]			5	1[e]	—	0.8	—	0.8	—	0.8	μs
t_c V_{CC}= 125 V, L=170 μH, R_C = 25 Ω Collector clamped to V_{CEX}			5	1[e]	—	0.8	—	0.8	—	0.8	μs
$R_{\theta JC}$					—	1.25	—	1.25	—	1.25	°C/W
$R_{\theta JA}$					—	70	—	70	—	70	°C/W

[a]Pulsed: pulse duration = 300 μs, duty factor ≤2%.
[b]CAUTION: The sustaining voltage V_{CEO}(sus) and V_{CEX} MUST NOT be measured on a curve tracer.
[c]V_{CB}value.
[d]V_{CC}=125 V, t_p=20 μs.
[e]I_{B1}= $-I_{B2}$.

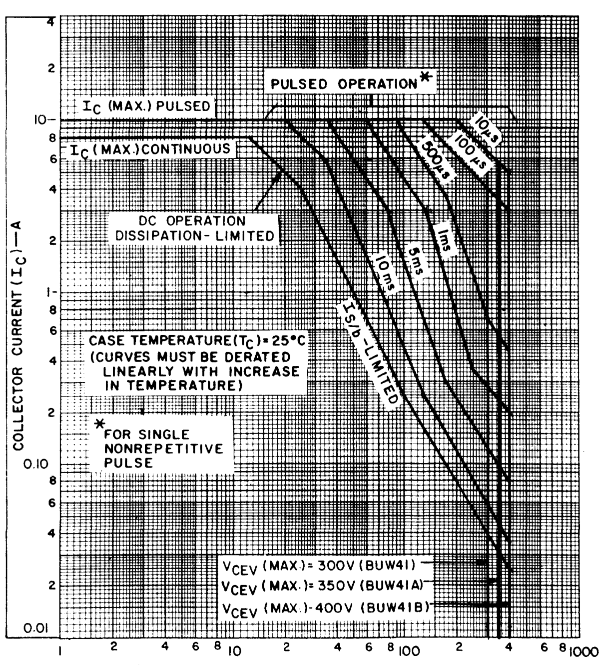


Fig.1 - Maximum operating areas for all types [T_C = 25° C].

BUW41, BUW41A, BUW41B

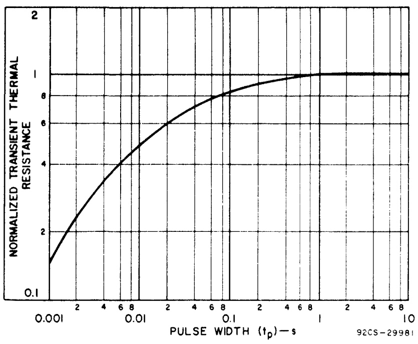


Fig.4 - Typical thermal-response characteristic for all types.

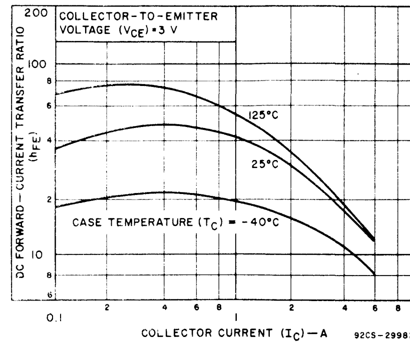


Fig.5 - Typical dc beta characteristics for all types.

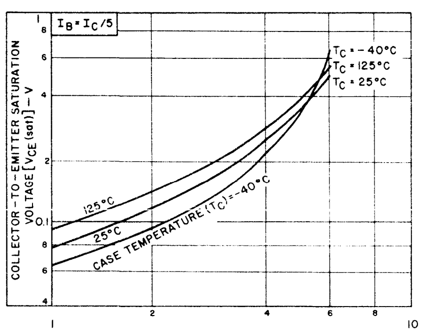


Fig.6 - Typical collector-to-emitter saturation voltage as a function of collector current for all types.

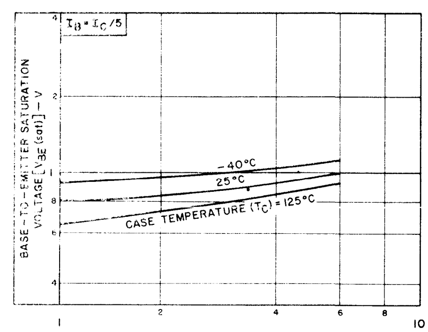


Fig.7 - Typical base-to-emitter saturation voltage as a function of collector current for all types.

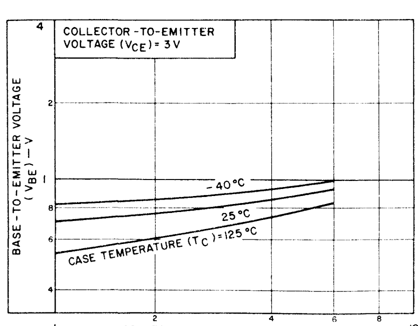


Fig.8 - Typical base-to-emitter voltage as a function of collector current for all types.

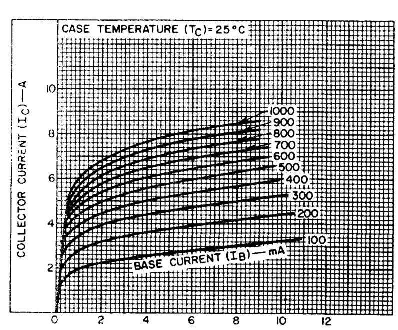


Fig.9 - Typical output characteristics for all types.

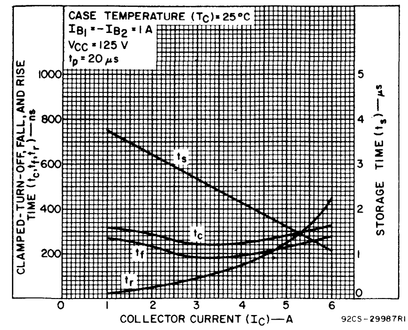


Fig.10 - Typical saturated switching time characteristics for all types.

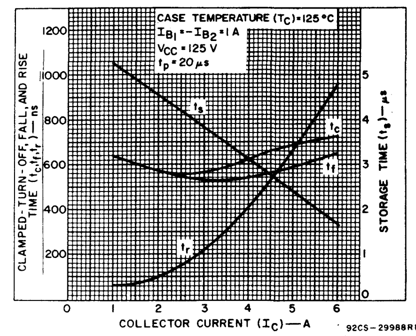


Fig.11 - Typical saturated switching time characteristics for all types.

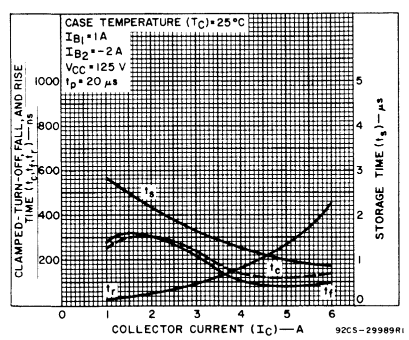


Fig.12 - Typical saturated switching time characteristics for all types.

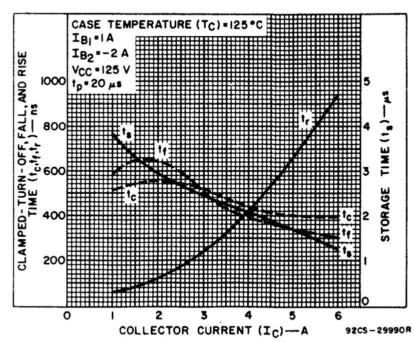


Fig.13 - Typical saturated switching time characteristics for all types.

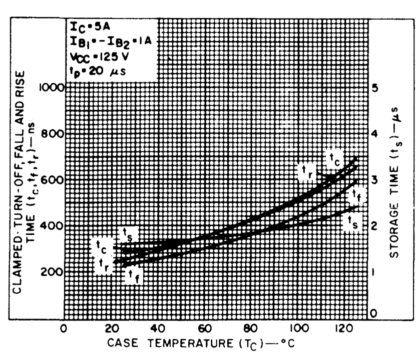


Fig.14 - Typical saturated switching time characteristics as a function of case temperature for all types.

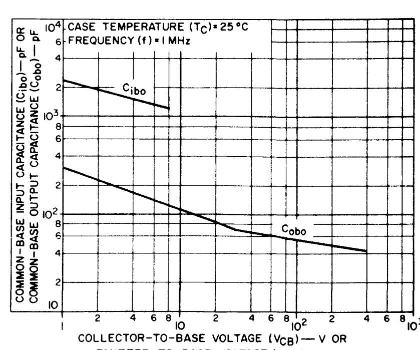


Fig.15 - Typical common-base input or output capacitance characteristics as a function of collector-to-base voltage or emitter-to-base voltage for all types.

BUW41, BUW41A, BUW41B

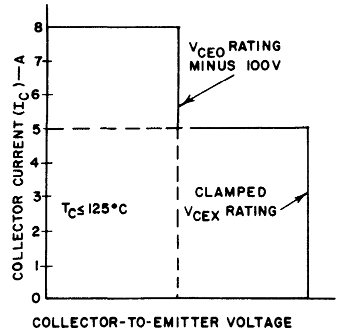


Fig.16 - Maximum operating conditions for switching between saturation and cutoff.

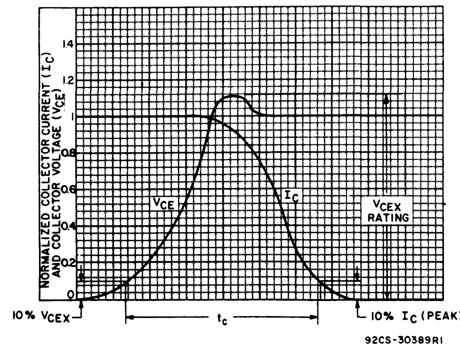
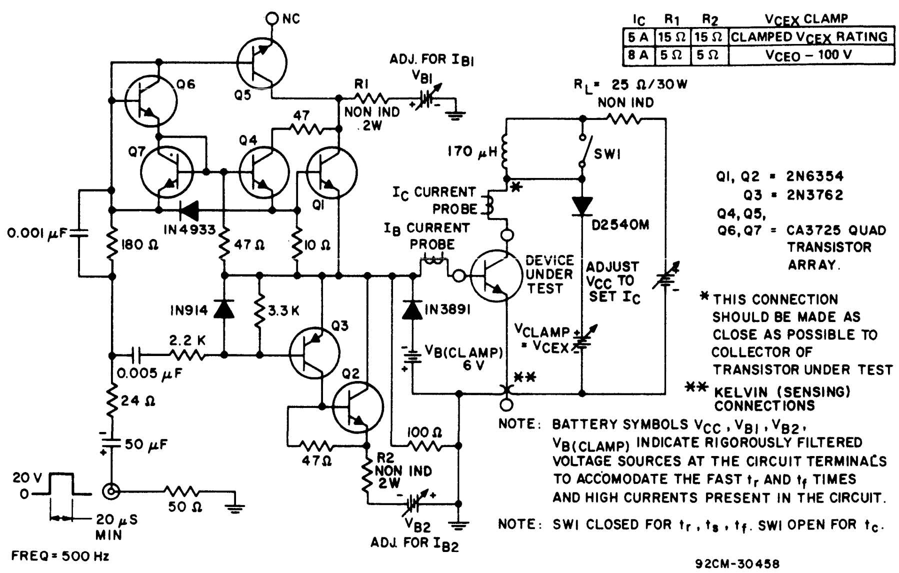


Fig.17 - Oscilloscope display for measurement of clamped induction switching time [t_c].



I_C	R_1	R_2	V_{CEX} CLAMP
5 A	15 Ω	15 Ω	CLAMPED V_{CEX} RATING
8 A	5 Ω	5 Ω	V_{CEO} − 100 V

Fig.18 - Circuit for measuring switching times.

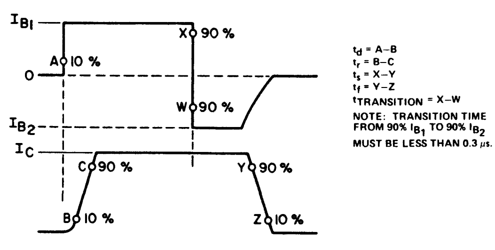


Fig.19 - Phase relationship between input and output currents showing reference points for specification of switching times.

File Number **1283**

BUX31, BUX31A, BUX31B

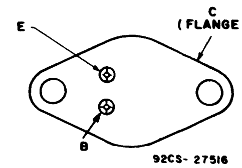
4-A SwitchMax Power Transistors

High-Voltage N-P-N Types for 240 V Off-Line Power Supplies and Other High-Voltage Switching Applications

Features:

- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* V_{CEX} = 450 V — 550 V
- *Low* $V_{CE}(sat)$ *at* I_C = 4 A
- *Steel hermetic TO-204MA package*

TERMINAL DESIGNATIONS



JEDEC TO-204MA
(See dimensional outline "B".)

The RCA-BUX31 SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for use in off-line power supplies and are also well suited for use in a wide range of inverter or converter circuits and pulse-width-modulated regulators. These high-voltage, high speed transistors are 100-per-cent tested for parameters that are essential to the design of industrial high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 100°C to provide information necessary for worst-case design.

The BUX31-series transistors are supplied in steel JEDEC TO-204MA hermetic packages.

Applications

- *Off-Line Power Supplies*
- *High-Voltage Inverters*
- *Switching Regulators*

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BUX31	BUX31A	BUX31B	
V_{CEV}				
V_{BE} = —1.5 V	800	900	1000	V
V_{CER}				
$R_{BE} \leq 10\ \Omega$	800	900	1000	V
V_{CEX} (Clamped)				
V_{BE} = —1.5 V	450	500	550	V
V_{CEO}	400	450	500	V
V_{EBO}		8		V
$I_C(sat)$		4		A
I_C		8		A
I_{CM}		10		A
I_B		4		A
P_T				
T_C up to 25°C		150		W
T_C above 25°C, derate linearly		1.0		W/°C
T_J		—65 to 175		°C
T_{stg}		—65 to 200		°C
T_L				
At distance ≥ 1/16 in. (1.58 mm) from seating plane for 10 s max.		235		°C

BUX31, BUX31A, BUX31B

ELECTRICAL CHARACTERISTICS

Characteristic	Test Conditions Voltage V dc V_{CE}	V_{BE}	Current A dc I_C	I_B	Limits BUX31 Min.	Max.	BUX31A Min.	Max.	BUX31B Min.	Max.	Units
T_C = 25° C											
I_{CEV}	800	—1.5			—	0.1	—	—	—	—	mA
	900	—1.5			—	—	—	0.1	—	—	
	1000	—1.5			—	—	—	—	—	0.1	
I_{CER} $R_{BE} \leq 10\ \Omega$	800				—	0.2	—	—	—	—	
	900				—	—	—	0.2	—	—	
	1000				—	—	—	—	—	0.2	
I_{IEBO}		—8	0		—	2	—	2	—	2	
$V_{CEO}(sus)$ [b]			0.2[a]	0	400	—	450	—	500	—	V
h_{FE}	3		4		8	40	8	40	8	40	
$V_{BE}(sat)$			4	0.8	—	1.3	—	1.3	—	1.3	V
$V_{CE}(sat)$			4	0.8	—	1	—	1	—	1	
			8	2	—	2	—	2	—	2	
V_{CEX} [b] (Clamped $E_{S/b}$) L = 170 μH		—5	4	0.8[e]	450	—	500	—	550	—	
$I_{S/b}$	30		5		1	—	1	—	1	—	s
$\|h_{fe}\|$ f=5 MHz	10		0.2		3	12	3	12	3	12	
f_T	10		0.2		15	60	15	60	15	60	MHz
C_{obo} f=0.1 MHz	10[c]				50	250	50	250	50	250	pF
t_d [d]			4	0.8	—	0.1	—	0.1	—	0.1	μs
t_r [d]			4	0.8	—	0.45	—	0.45	—	0.45	
t_s [d]			4	0.8[e]	—	3.0	—	3.0	—	3.0	
t_f [d]			4	0.8[e]		0.4	—	0.4	—	0.4	
t_c V_{CC}=250V, L=170 μH, R_C = 50Ω Collector clamped to V_{CEX}			4	0.8[e]	—	0.4	—	0.4	—	0.4	

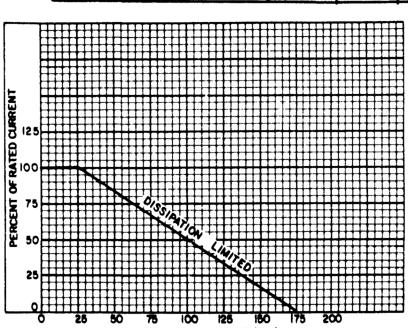


Fig.1 - Dissipation derating curve for all types.

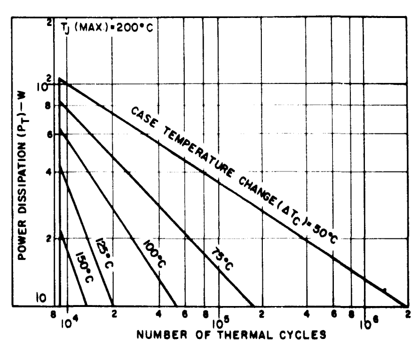


Fig.2 - Thermal-cycling chart for all types.

BUX31, BUX31A, BUX31B

ELECTRICAL CHARACTERISTICS (Continued)

Characteristic	Test Conditions				Limits						Units
	Voltage V dc		Current A dc		BUX31		BUX31A		BUX31B		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
T_C = 100° C											
I_{CEV}	800	—1.5			—	1	—	—	—	—	mA
	900	—1.5			—	—	—	1	—	—	mA
	1000	—1.5			—	—	—	—	—	1	mA
I_{CER} $R_{BE} \leq 10\Omega$	800				—	3	—	—	—	—	mA
	900				—	—	—	3	—	—	mA
	1000				—	—	—	—	—	3	mA
$V_{CE}(sat)$			4	0.8	—	1.5	—	1.5	—	1.5	V
t_r[d]			4	0.8	--	0.6	—	0.6	—	0.6	μs
t_s[d]			4	0.8[e]	—	4	—	4	—	4	μs
t_f[d]			4	0.8[e]	—	0.7	—	0.7	—	0.7	μs
t_c V_{CC}=250V, L=170 μH, R_C = 50Ω Collector clamped to V_{CEX}			4	0.8[e]	—	0.8	—	0.8	—	0.8	μs
$R_{\theta JC}$	10	5			—	1.0	—	1.0	—	1.0	°C/W

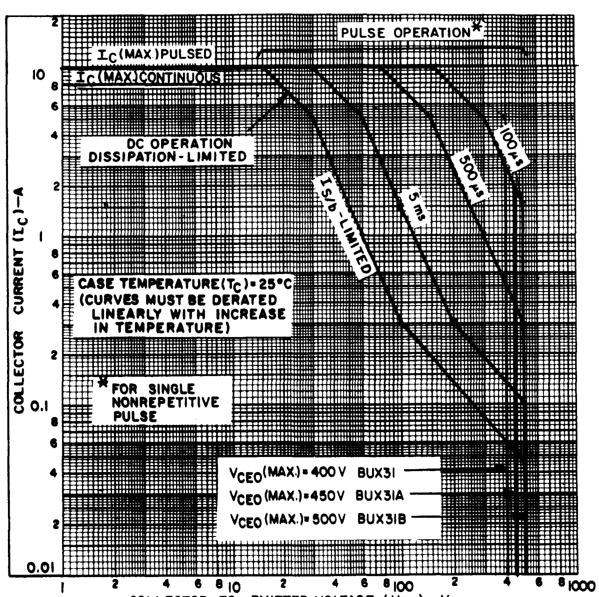
[a]Pulsed: pulse duration = 300 μs, duty factor ≤2%.

[b]CAUTION: The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} MUST NOT be measured on a curve tracer.

[c]V_{CB} value.

[d]V_{CC}=250 V, t_p=20 μs.

[e]I_{B1} = $-I_{B2}$.



92CM-33446

Fig.3 - Maximum operating areas for all types [T_C].

BUX31, BUX31A, BUX31B

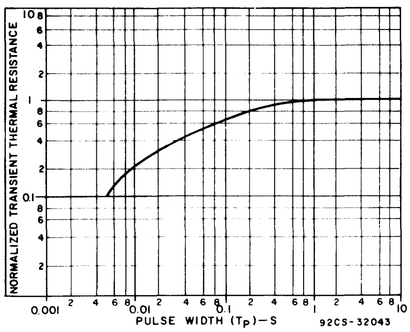


Fig.4 - Typical thermal-response characteristic for all types.

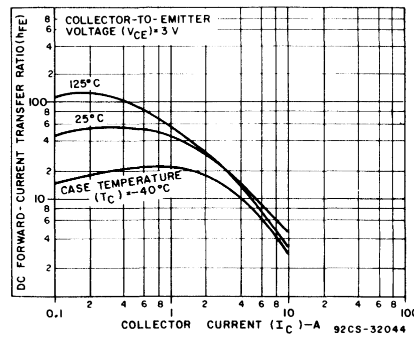


Fig.5 - Typical dc beta characteristics for all types.

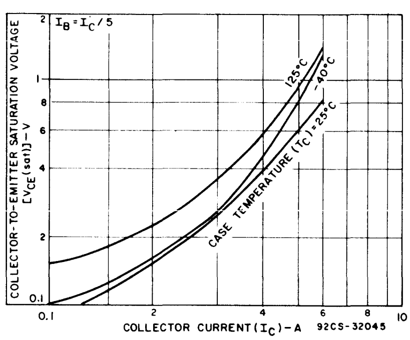


Fig.6 - Typical collector-to-emitter saturation voltage as a function of collector current for all types.

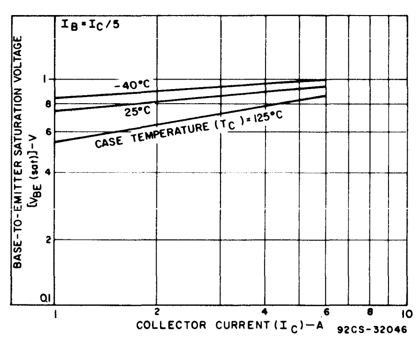


Fig.7 - Typical base-to-emitter saturation voltage as a function of collector current for all types.

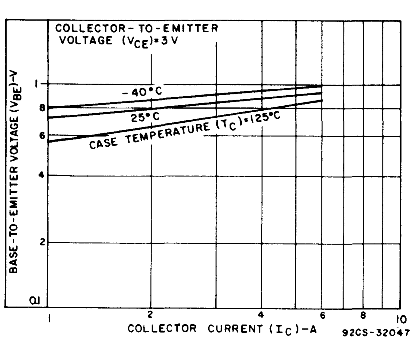


Fig.8 - Typical base-to-emitter voltage as a function of collector current for all types.

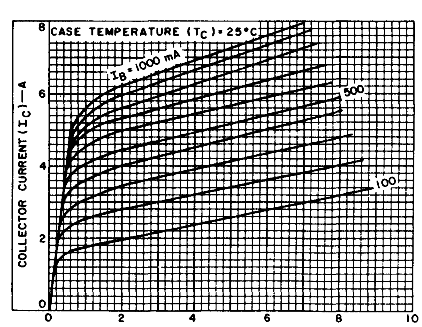


Fig.9 - Typical output characteristics for all types.

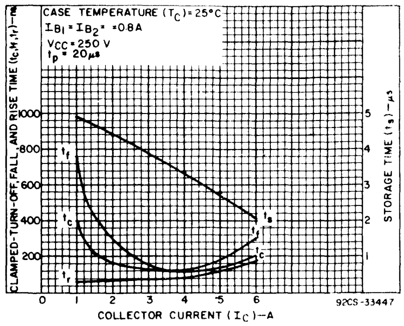


Fig.10 - Typical saturated switching time characteristics for all types.

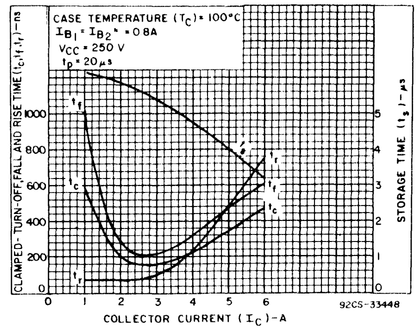


Fig.11 - Typical saturated switching time characteristics for all types.

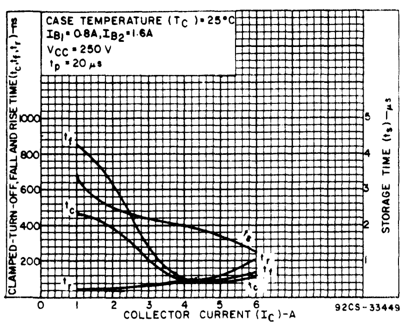


Fig.12 - Typical saturated switching time characteristics for all types.

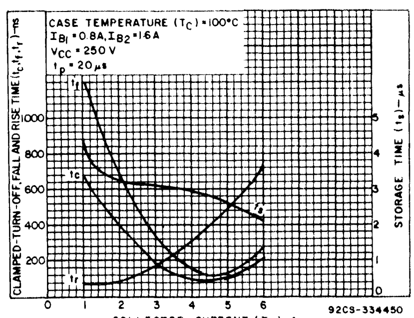


Fig.13 - Typical saturated switching time characteristics for all types.

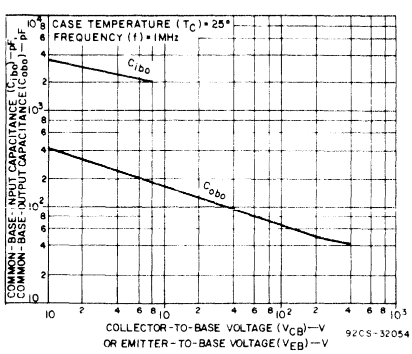


Fig.14 - Typical common-base input or output capacitance characteristics as a function of collector-to-base voltage or emitter-to-base voltage for all types.

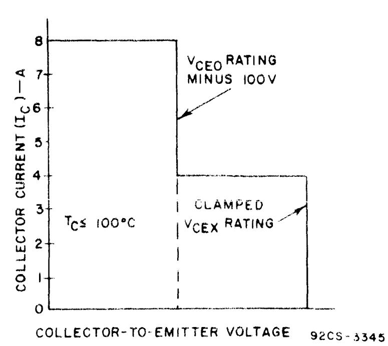


Fig.15 - Maximum operating conditions for switching between saturation and cutoff.

BUX31, BUX31A, BUX31B

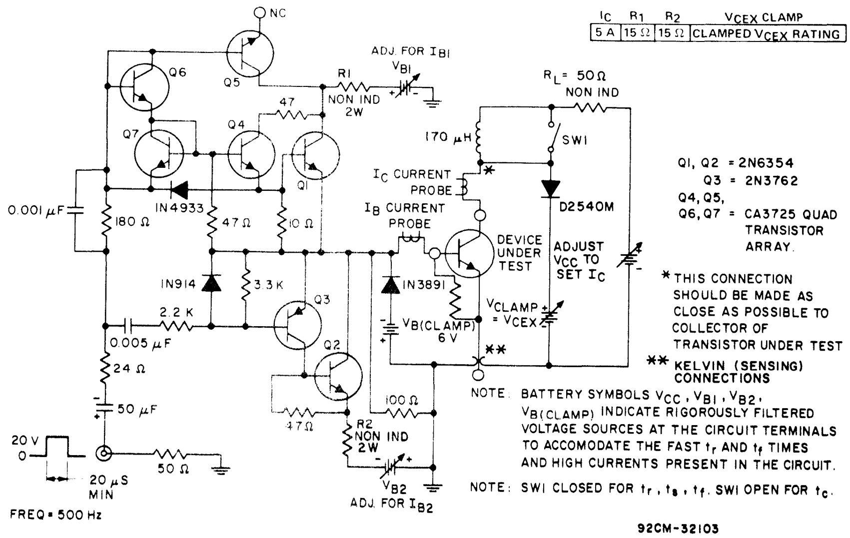


Fig.16 - Circuit for measuring switching times.

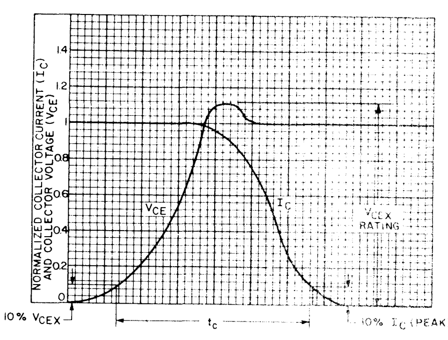


Fig.17 - Oscilloscope display for measurement of clamped induction switching time[t_c].

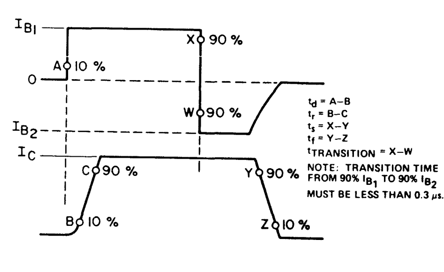


Fig.18 - Phase relationship between input and output currents showing reference points for specification of switching times.

File Number **1285**

BUX32, BUX32A, BUX32B

6-A SwitchMax Power Transistors

High-Voltage N-P-N Types for 240 V Off-Line Power Supplies and Other High-Voltage Switching Applications

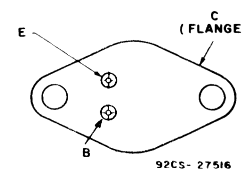
Features:

- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* *V_{CEX} = 450 V — 550 V*
- *Low V_{CE} (sat) at I_C = 6 A*
- *Steel hermetic TO-204MA package*

Applications:

- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "B".)

The BUX32 SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for use in off-line power supplies and are also well suited for use in a wide range of inverter or converter circuits and pulse-width-modulated regulators. These high-voltage, high speed transistors are 100-per-cent tested for parameters that are essential to the design of industrial high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 100°C to provide information necessary for worst-case design.

The BUX32-series transistors are supplied in steel JEDEC TO-204MA hermetic packages.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BUX32	BUX32A	BUX32B	
V_{CEV}				
V_{BE}=−1.5 V	800	900	1000	V
V_{CER} $R_{BE} \leq 10\ \Omega$	800	900	1000	V
V_{CEX} (Clamped)				
V_{BE}=−1.5 V	450	500	550	V
V_{CEO}	400	450	500	V
V_{EBO}		8		V
I_C(sat)		6		A
I_C		8		A
I_{CM}		10		A
i_B		4		A
P_T				
T_C up to 25°C		150		W
T_C above 25°C, derate linearly		1.0		W/°C
T_J		-65 to 175		°C
T_{stg}		-65 to 200		°C
T_L				
At distance ≧ 1/16 in. (1.58 mm) from seating plane for 10 s max.		235		°C

BUX32, BUX32A, BUX32B

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		BUX32		BUX32A		BUX32B		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
$T_C=25°C$											
I_{CEV}	800	-1.5			—	0.1	—	—	—	—	mA
	900	-1.5			—	—	—	0.1	—	—	
	1000	-1.5			—	—	—	—	—	0.1	
I_{CER} $R_{BE} \leq 10\ \Omega$	800				—	0.2	—	—	—	—	
	900				—	—	—	0.2	—	—	
	1000				—	—	—	—	—	0.2	
I_{EBO}		-8	0		—	2	—	2	—	2	
$V_{CEO}(sus)$[b]			0.2[a]	0	400	—	450	—	500	—	V
h_{FE}	3		6		8	40	8	40	8	40	
$V_{BE}(sat)$			6	1.2	—	1.3	—	1.3	—	1.3	V
$V_{CE}(sat)$			6	1.2	—	1	—	1	—	1	
			8	2	—	2	—	2	—	2	
V_{CEX}[b] (Clamped $E_{S/b}$) L=170 µH		-5	6	1.2[e]	450	—	500	—	550	—	
$I_{S/b}$	30		5		1	—	1	—	1	—	s
$\lvert h_{fe} \rvert$ f=5 MHz	10		0.2		3	12	3	12	3	12	
f_T	10		0.2		15	60	15	60	15	60	MHz
C_{obo} f=0.1 MHz	10[c]				50	250	50	250	50	250	pF
t_d[d]			6	1.2	—	0.1	—	0.1	—	0.1	µs
t_r[d]			6	1.2	—	0.45	—	0.45	—	0.45	
t_s[d]			6	1.2[e]	—	3.0	—	3.0	—	3.0	
t_f[d]			6	1.2[e]	—	0.4	—	0.4	—	0.4	
t_c V_{CC}=250 V, L=170 µH, R_C=50 Ω Collector clamped to V_{CEX}			6	1.2[e]	—	0.4	—	0.4	—	0.4	
$T_C=100°C$											
I_{CEV}	800	-1.5			—	1	—	—	—	—	mA
	900	-1.5			—	—	—	1	—	—	
	1000	-1.5			—	—	—	—	—	1	
I_{CER} $R_{BE} \leq 10\ \Omega$	800				—	3	—	—	—	—	
	900				—	—	—	3	—	—	
	1000				—	—	—	—	—	3	
$V_{CE}(sat)$			6	1.2	—	1.5	—	1.5	—	1.5	V
t_j[d]			6	1.2	—	0.6	—	0.6	—	0.6	µs
t_s[d]			6	1.2[e]	—	4	—	4	—	4	
t_f[d]			6	1.2[e]	—	0.7	—	0.7	—	0.7	
t_c V_{CC}=250 V, L=170 µH, R_C=50 Ω Collector clamped to V_{CEX}			6	1.2[e]	—	0.8	—	0.8	—	0.8	

BUX32, BUX32A, BUX32B

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		BUX32		BUX32A		BUX32B		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
$R_{\theta JC}$	10	5			—	1.0	—	1.0	—	1.0	°C/W

[a]Pulsed; pulse duration=300 μs, duty factor ≤ 2%.
[b]CAUTION: The sustaining voltage V_{CEO}(sus) and V_{CEX} MUST NOT be measured on a curve tracer.
[c]V_{CB} value.
[d]V_{CC}=250 V, t_p=20 μs.
[e]$I_{B_1}=-I_{B_2}$.

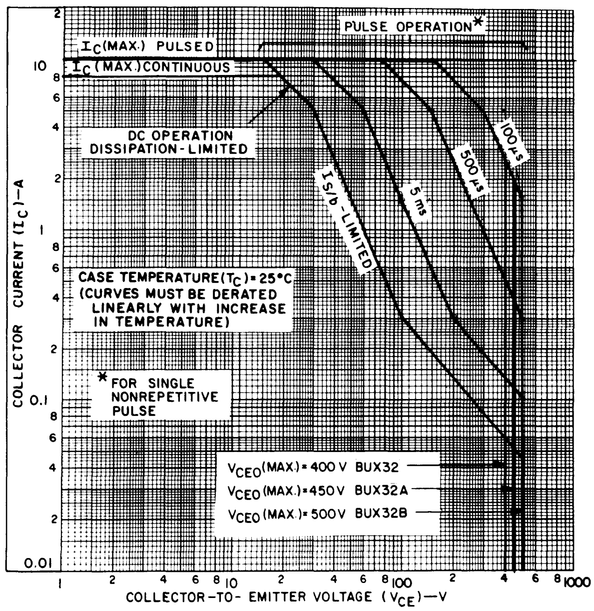


Fig. 1 - Maximum operating areas for all types (T_C).

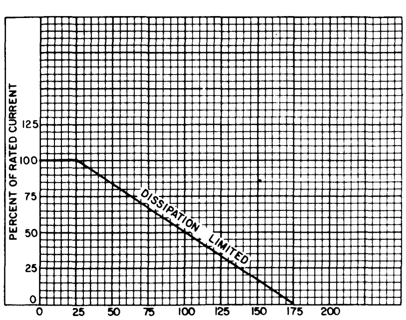


Fig. 2 - Dissipation derating curve for all types.

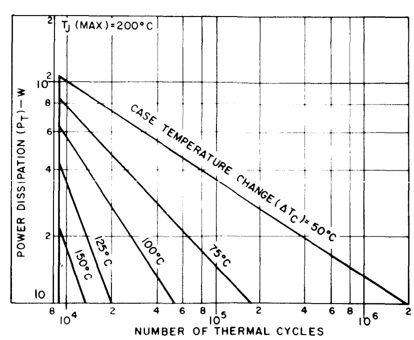


Fig. 3 - Thermal-cycling chart for all types.

BUX32, BUX32A, BUX32B

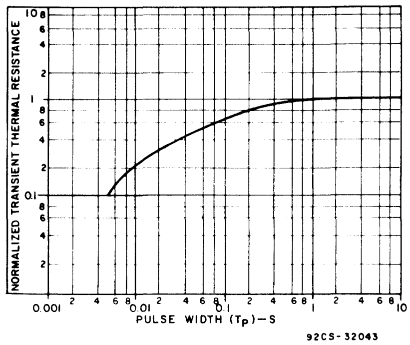


Fig. 4 - Typical thermal-response characteristic for all types.

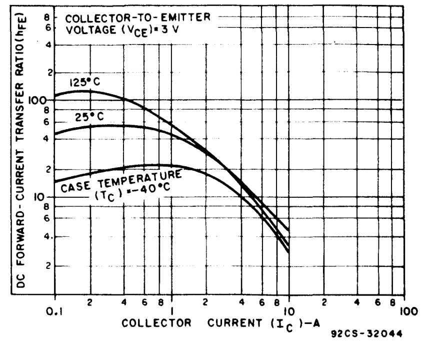


Fig. 5 - Typical dc beta characteristics for all types.

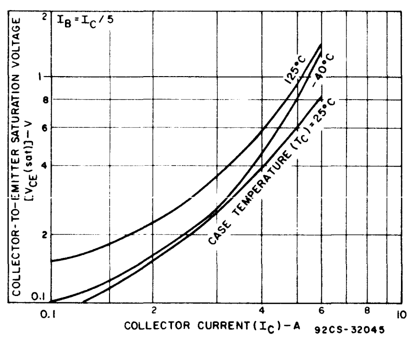


Fig. 6 - Typical collector-to-emitter saturation voltage as a function of collector current for all types.

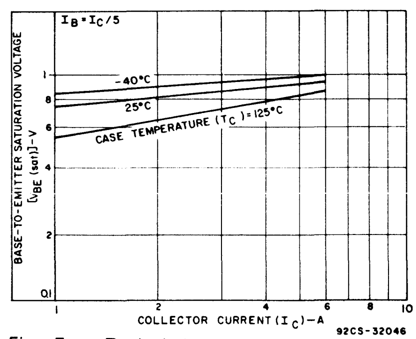


Fig. 7 - Typical base-to-emitter saturation voltage as a function of collector current for all types.

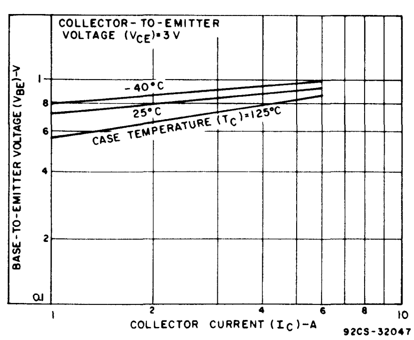


Fig. 8 - Typical base-to-emitter voltage as a function of collector current for all types.

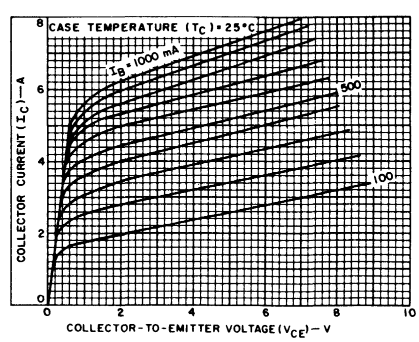


Fig. 9 - Typical output characteristics for all types.

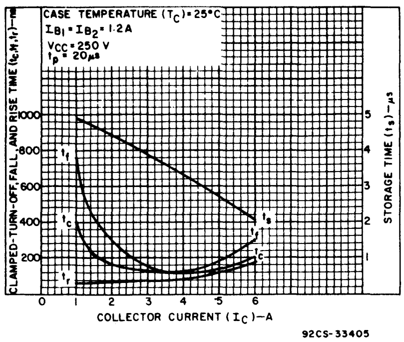


Fig. 10 - Typical saturated switching time characteristics for all types.

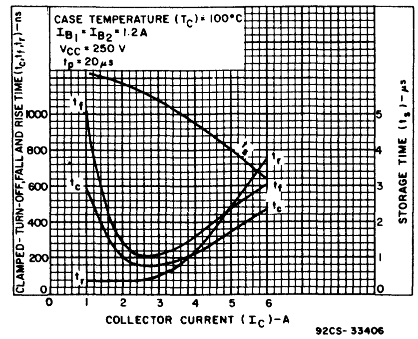


Fig. 11 - Typical saturated switching time characteristics for all types.

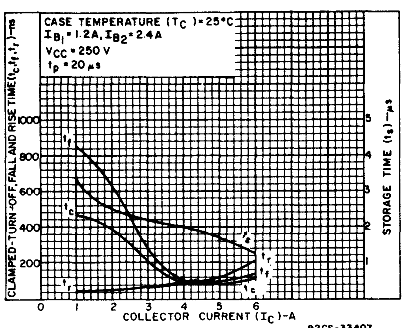


Fig. 12 - Typical saturated switching time characteristics for all types.

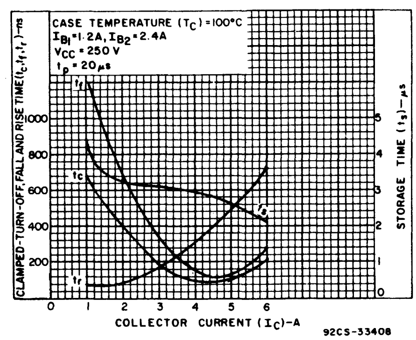


Fig. 13 - Typical saturated switching time characteristics for all types.

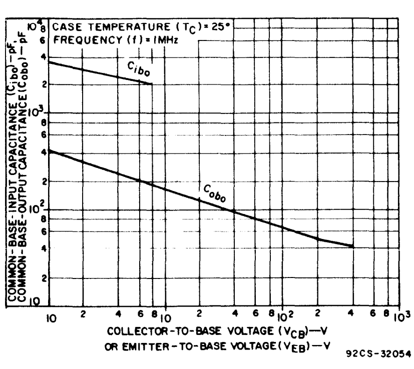


Fig. 14 - Typical common-base input or output capacitance characteristics as a function of collector-to-base voltage or emitter-to-base voltage for all types.

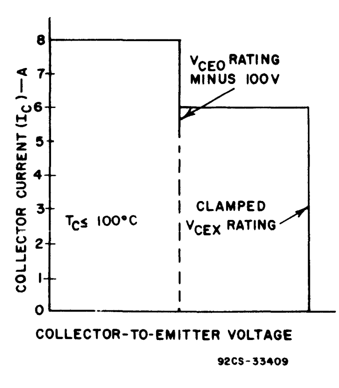


Fig. 15 - Maximum operating conditions for switching between saturation and cutoff.

BUX32, BUX32A, BUX32B

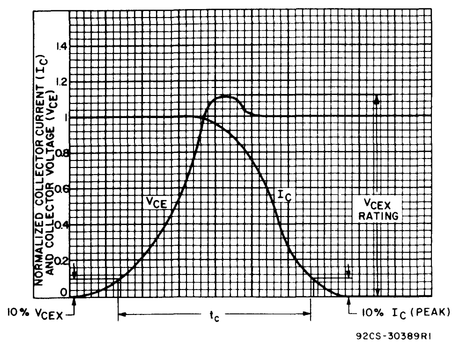


Fig. 16 - Oscilloscope display for measurement of clamped induction switching time (t_C).

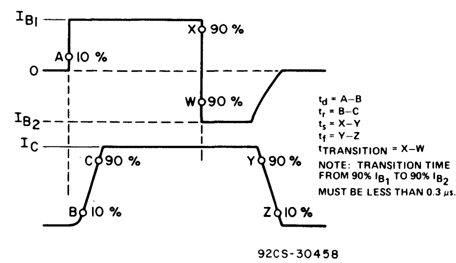


Fig. 17 - Phase relationship between input and output current showing reference points for specification of switching times.

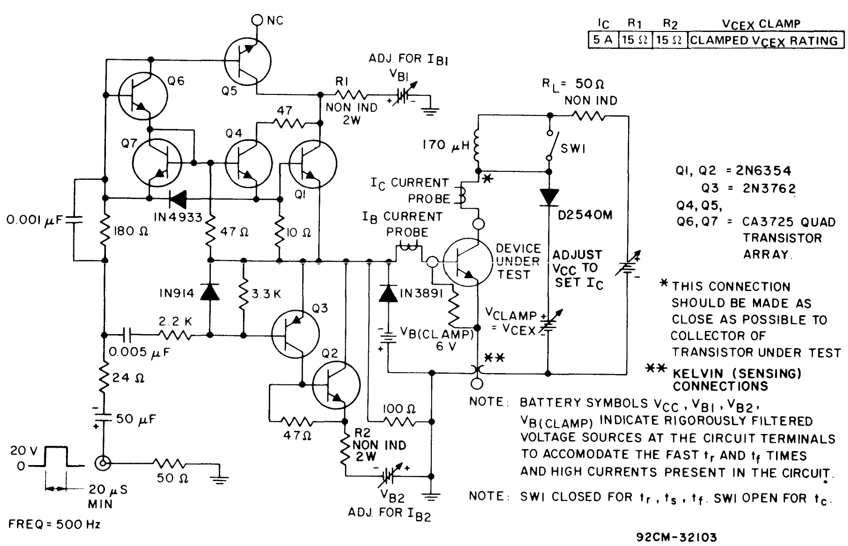


Fig. 18 - Circuit for measuring switching times.

File Number **1354**

BUX33, BUX33A, BUX33B

8-A SwitchMax Power Transistors

High-Voltage N-P-N Types for 240 V Off-Line Power Supplies and Other High-Voltage Switching Applications

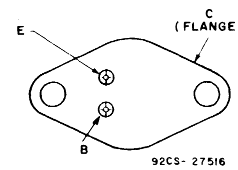
Features:

- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* V_{CEX} = 450 V — 550 V
- *Low* V_{CE}*(sat) at* I_C = 8 A
- *Steel hermetic TO-204MA package*

Applications:

- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "B".)

The BUX33 SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for use in off-line power supplies and are also well suited for use in a side range of inverter or converter circuits and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of industrial high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 100°C to provide information necessary for worst-case design.

The BUX33-series transistors are supplied in steel JEDEC TO-204MA hermetic packages.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BUX33	BUX33A	BUX33B	
V_{CEV}				
V_{BE} = 1.5 V	800	900	1000	V
V_{CER} $R_{BE} \leq 10\ \Omega$	800	900	1000	V
V_{CEX} (Clamped)				
V_{BE} = −1.5 V	450	500	550	V
V_{CEO}	400	450	500	V
V_{EBO}		8		V
I_C(sat)		8		A
I_C		12		A
I_{CM}		15		A
I_B		4		A
P_T				
T_C up to 25°C		150		W
T_C above 25°C, derate linearly		1.0		W/°C
T_J		−65 to 175		°C
T_{stg}		−65 to 200		°C
T_L				
At distance ≧ 1/16 in. (1.58 mm) from seating plane for 10 s max.		235		°C

BUX33, BUX33A, BUX33B

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc		TEST CONDITIONS CURRENT A dc		LIMITS BUX33		LIMITS BUX33A		LIMITS BUX33B		UNITS
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
T_C = 25° C											
I_{CEV}	800	−1.5			—	0.1	—	—	—	—	mA
	900	−1.5			—	—	—	0.1	—	—	
	1000	−1.5			—	—	—	—	—	0.1	
I_{CER} $R_{BE} \leq 10\ \Omega$	800				—	0.2	—	—	—	—	
	900				—	—	—	0.2	—	—	
	1000				—	—	—	—	—	0.2	
I_{EBO}		−8	0		—	2	—	2	—	2	
$V_{CEO}(sus)$[b]			0.2[a]	0	400	—	450	—	500	—	V
h_{FE}	3		8		6	40	6	40	6	40	
$V_{BE}(sat)$			8	2	—	1.3	—	1.3	—	1.3	V
$V_{CE}(sat)$			8	2	—	1	—	1	—	1	
			12	3	—	4	—	4	—	4	
V_{CEX}[b] (Clamped $E_{S/b}$) L = 170 μH		−5	8	2	450	—	500	—	550	—	
$I_{S/b}$	30		5		1	—	1	—	1	—	s
$\lvert h_{fe} \rvert$ f = 5 MHz	10		0.2		3	12	3	12	3	12	
f_T	10		0.2		15	60	15	60	15	60	MHz
C_{obo} f = 0.1 MHz	10[c]				50	250	50	250	50	250	pF
t_d[d]			8	2	—	0.1	—	0.1	—	0.1	μs
t_r[d]			8	2	—	0.45	—	0.45	—	0.45	
t_s[d]			8	2[e]	—	3.0	—	3.0	—	3.0	
t_f[d]			8	2[e]	—	0.4	—	0.4	—	0.4	
t_c V_{CC} = 240 V, L = 170 μH, R_C = 30 Ω Collector clamped to V_{CEX}			8	2[e]	—	0.4	—	0.4	—	0.4	
T_C = 100° C											
I_{CEV}	800	−1.5			—	1	—	—	—	—	mA
	900	−1.5			—	—	—	1	—	—	
	1000	−1.5			—	—	—	—	—	1	
I_{CER} $R_{BE} \leq 10\ \Omega$	800				—	3	—	—	—	—	
	900				—	—	—	3	—	—	
	1000				—	—	—	—	—	3	
$V_{CE}(sat)$			8	2	—	1.5	—	1.5	—	1.5	V
t_d[d]			8	2	—	0.6	—	0.6	—	0.6	μs
t_s[d]			8	2[e]	—	4	—	4	—	4	
t_f[d]			8	2[e]	—	0.7	—	0.7	—	0.7	
t_c V_{CC} = 240 V, L = 170 μH, R_C = 30 Ω Collector clamped to V_{CEX}			8	2[e]	—	0.8	—	0.8	—	0.8	
$R\theta_{JC}$	10	5			—	1.0	—	1.0	—	1.0	°C/W

[a]Pulsed; pulse duration = 300 μs, duty factor $\leq$ 2%.
[b]CAUTION; The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} MUST NOT be measured on a curve tracer.
[c]V_{CB} value.
[d]V_{CC} = 240 V, t_p = 20 μs.
[e]$I_{B1} = -I_{B2}$.

BUX33, BUX33A, BUX33B

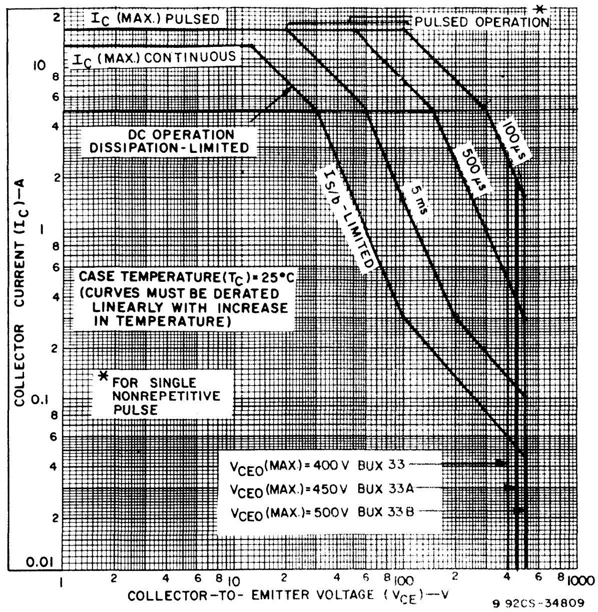


Fig. 1 — Maximum operating areas for all types (TC).

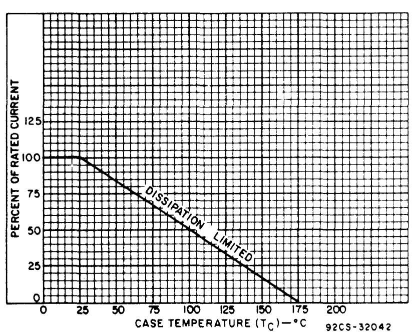


Fig. 2 — Dissipation derating curve for all types.

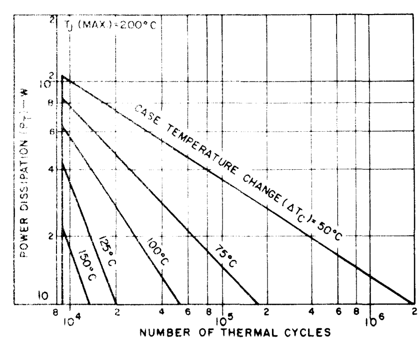


Fig. 3 — Thermal-cycling chart for all types.

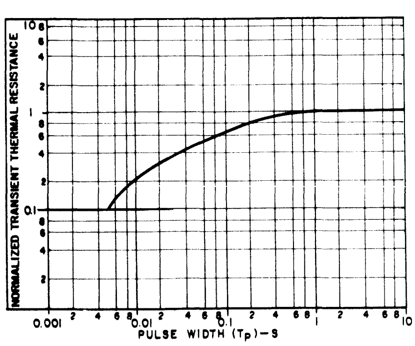


Fig. 4 — Typical thermal-response characteristic for all types.

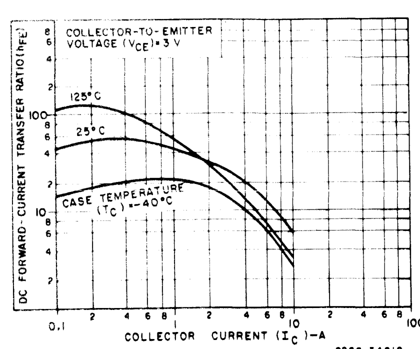


Fig. 5 — Typical dc beta characteristics for all types.

BUX33, BUX33A, BUX33B

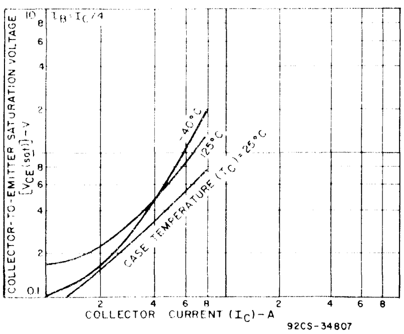


Fig. 6 — Typical collector-to-emitter saturation voltage for all types

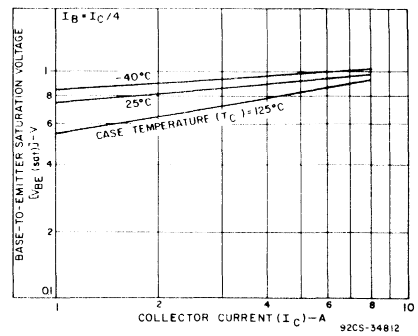


Fig. 7 — Typical base-to-emitter saturation voltage as a function of collector current for all types.

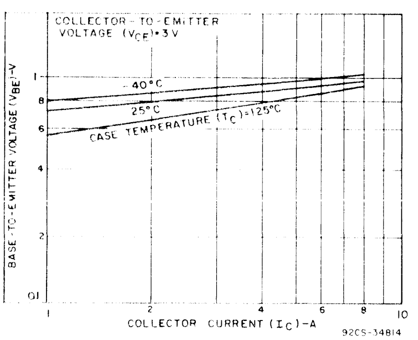


Fig. 8 — Typical base-to-emitter voltage as a function of collector current for all types.

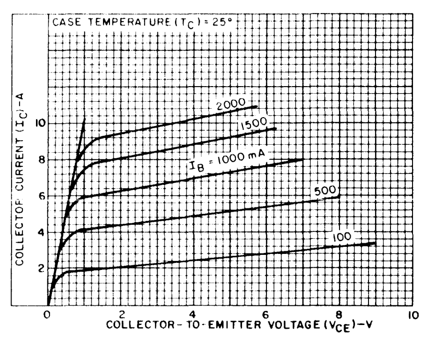


Fig. 9 — Typical output characteristics for all types.

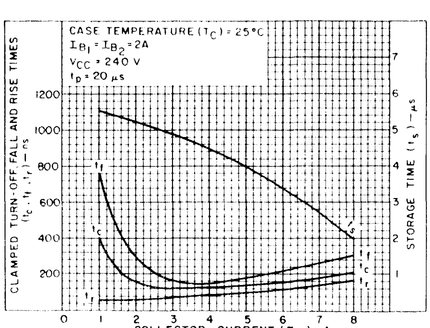


Fig. 10 — Typical saturated switching time characteristics for all types.

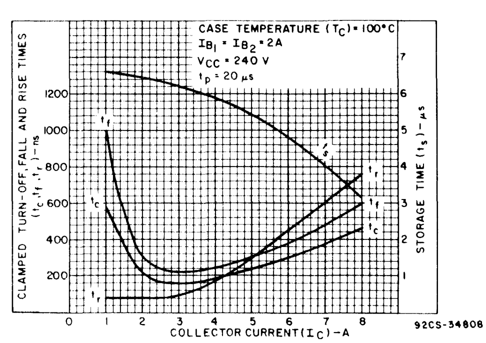


Fig. 11 — Typical saturated switching time characteristics for all types.

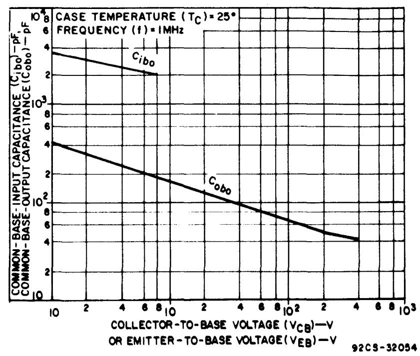


Fig. 12 — Typical common-base input or output capacitance characteristics as a function of collector-to-base voltage or emitter-to-base voltage for all types.

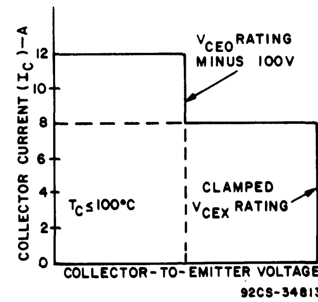


Fig. 13 — Maximum operating conditions for switching between saturation and cutoff.

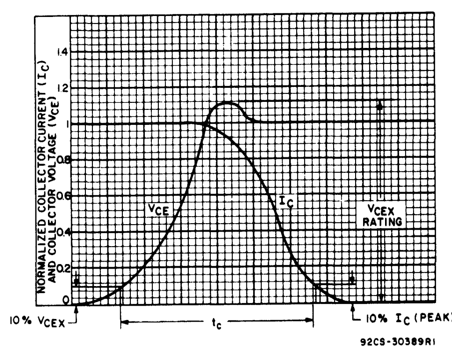


Fig. 14 — Oscilloscope display for measurement of clamped induction switching time (t_c).

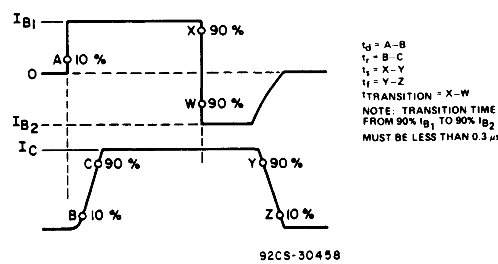


Fig. 15 — Phase relationship between input and output current showing reference points for specification of switching times.

BUX33, BUX33A, BUX33B

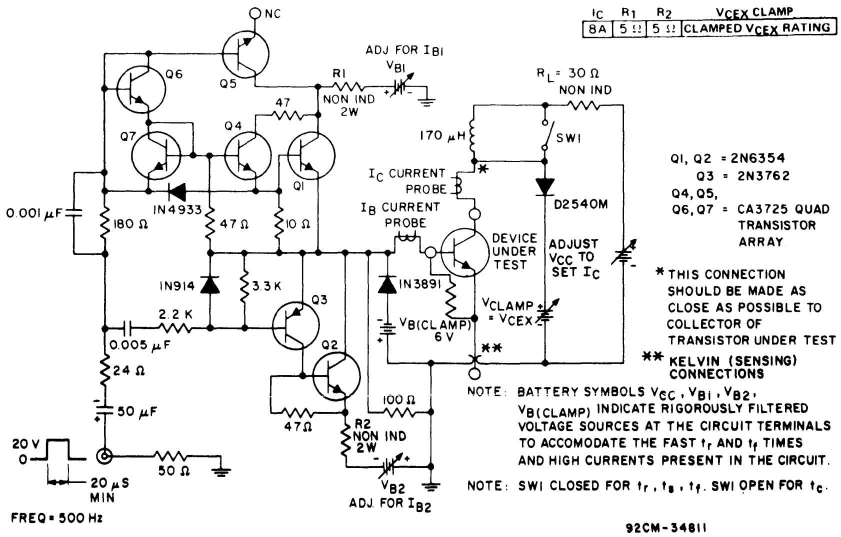
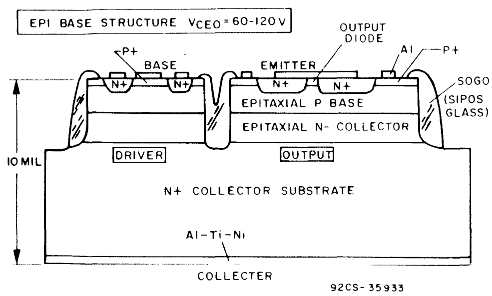


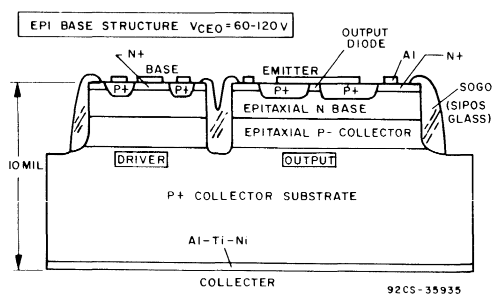
Fig. 16 — Circuit for measuring switching times.

Darlington Power Transistors
Technical Data

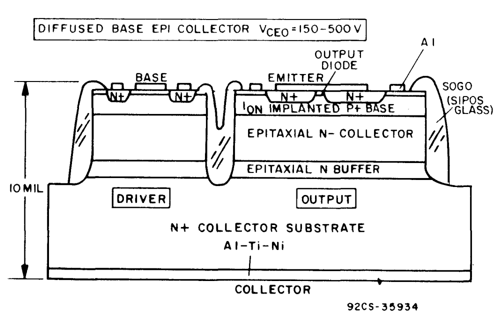
Darlington Power Transistors



Epitaxial Base n-p-n Darlington.



Epitaxial Base p-n-p Darlington.



Diffused Base Epitaxial Collector n-p-n Darlington.

Design Features

The latest state-of-the-art processing technology is employed in the manufacture of RCA n-p-n and p-n-p power Darlingtons.

- Epitaxial-base structures are used for low to medium-voltage n-p-n and p-n-p Darlingtons. The base region of an n-p-n device is created by the growth of a p-type epitaxial layer on an n-type epitaxial layer that has been grown onto a low-resistivity n+ substrate. The emitter is diffused using a phosphorous source. The p+ base contacts, resistors, and output diode are formed by ion-implanted boron and high-temperature diffusion.

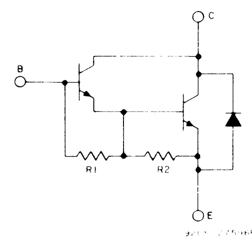
  Similarly, the base region of a p-n-p Darlington is created by the growth of an n-type layer on a p-type epitaxial layer and a low-resistivity p+ substrate. The emitter is formed by ion-implanted boron and high-temperature diffusion. The n+ base contacts, resistors, and output diode are formed by ion-implanted phosphorus and high-temperature diffusion.

- High-voltage n-p-n Darlingtons use diffused-base epitaxial-collector structures. The collector region is created by epitaxial n- and n layers grown on a low-resistivity n+ substrate. The base is formed by ion-implanted boron, and the emitter by phosphorous deposition, both driven in by high-temperature diffusion. The p+ base contacts, resistors, and output diode are formed by ion-implanted boron and high-temperature diffusion.
- Aluminum metallization on the emitter and base contacts provides for aluminum wire bonding. Trimetal (aluminum-titanium-nickel) evaporated onto the collector surface provides collector metallization for high-temperature solder mounting.
- Glass passivation is used over the collector-base junctions to assure reverse-bias stability, resistance to moisture penetration, and to provide mechanical protection during assembly.
- The output diode in all structures is located in the emitter bond-pad area.
- The RCA9203 Darlington features no output diode and no R2, and is used for special circuit applications.

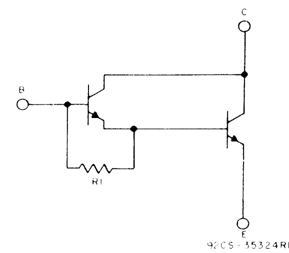
Hybrid Circuit Compatibility

RCA Darlingtons incorporate several construction features that are ideal for mounting the Darlington pellets in hybrid circuits as follows:

- The trimetal collector metallization is particularly suited for high-temperature solder mounting. (A eutectic solder bond formed with 95/5 lead-tin solder at a temperature of 320° C is recommended).
- The aluminum emitter and base metallization facilitates aluminum wire bonding.
- The glass-passivated structure assures excellent mechanical protection during processing.
- Large bonding surfaces are available on all types.



Conventional Darlington.



RCA9203 Darlington.

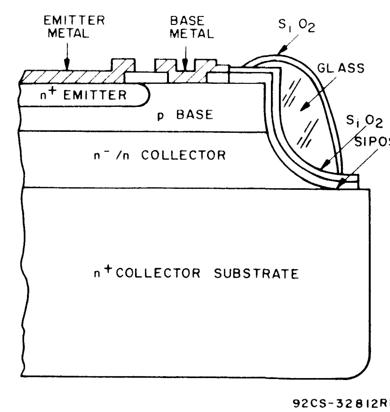
SIPOS-Oxide-Glass-Oxide (SOGO) Passivation System

In any high voltage device, fringing electric fields at the junction boundaries must be properly managed, insulated, and terminated. Otherwise mobile ionic contaminants can cause erratic device leakage, unstable voltage breakdown, and ultimate device failure.

RCA has developed a multilayer passivation system called SOGO to meet the performance requirements of high-voltage devices. The first layer is of Semi Insulating Polycrystalline Oxygen-doped Silicon (SIPOS). The resistivity of the SIPOS can be precisely controlled during deposition as required by the device design.

A silicon dioxide (SiO_2) layer is then grown on top of the SIPOS to serve as buffer layer between the SIPOS and the lead alumino-silicate thick glass layer used to seal the junction and provide the actual mechanical protection with good thermal match to the silicon. A final layer of the SiO_2 over the glass protects the glass from chemical attack during subsequent processing.

The result of this passivation technique is typical V_{CBO} and V_{CEV} leakages of less than 1 μ at 25° C, less than 1 mA at 150° C and at rated voltages of up to 1000 volts, depending on device design.



SOGO passivation system.

Selection Matrix

Type	I_C (A)	V_{CEO} (V)	h_{FE} @	I_C (A)	V_{CE} (V)	P_T (W)	Pkg.	File No.
RCA8766 Family (n-p-n)								
RCA8766	10	350	100 min.	6	3	150	TO-204MA	973
RCA8766A	10	350	100 min.	4	3	150	TO-204MA	973
RCA8766B	10	400	100 min.	6	3	150	TO-204MA	973
RCA8766C	10	400	100 min.	4	3	150	TO-204MA	973
RCA8766D	10	450	100 min.	6	3	150	TO-204MA	973
RCA8766E	10	450	100 min.	4	3	150	TO-204MA	973
RCA 9421 (n-p-n) Complementary To RCA 9422 Family								
TIP110	2	60	1000 min.	1	4	50	TO-220AB	1336
TIP111	2	80	1000 min.	1	4	50	TO-220AB	1336
TIP112	2	100	1000 min.	1	4	50	TO-220AB	1336
RCA 9422 (p-n-p) Complementary To RCA 9421 Family								
TIP115	2	-60	1000 min.	-1	-4	50	TO-220AB	1387
TIP116	2	-80	1000 min.	-1	-4	50	TO-220AB	1387
TIP117	2	-100	1000 min.	-1	-4	50	TO-220AB	1387
RCA9201, RCA9202, RCA9203 (n-p-n)								
RCA9201A	5	150	750 min.	3	2.5	65	TO-220AB	1415
RCA9201B	5	200	750 min.	3	2.5	65	TO-220AB	1415
RCA9201C	5	250	750 min.	3	2.5	65	TO-220AB	1415
RCA9202A	4	300	750 min.	2	3	65	TO-220AB	1414
RCA9202B	4	350	750 min.	2	3	65	TO-220AB	1414
RCA9202C	4	400	750 min.	2	3	65	TO-220AB	1414
RCA9203A	4	250	500 min.	2	3	50	TO-220AB	1413
RCA9203B	4	300	500 min.	2	3	50	TO-220AB	1413
RCA9203C	4	350	500 min.	2	3	50	TO-220AB	1413
RCA9228 (n-p-n) Complementary To RCA9229 Family								
RCA9228A	50	60	2000 min.	25	3	300	TO-3 Mod.	1437
RCA9228B	50	80	2000 min.	25	3	300	TO-3 Mod.	1437
RCA9228C	50	100	2000 min.	25	3	300	TO-3 Mod.	1437
RCA9229 (p-n-p) Complementary To RCA9228 Family								
RCA9229A	50	-60	2000 min.	-25	-3	300	TO-3 Mod.	1438
RCA9229B	50	-80	2000 min.	-25	-3	300	TO-3 Mod.	1438
RCA9229C	50	-100	2000 min.	-25	-3	300	TO-3 Mod.	1438
2N6284 Family (n-p-n) Complementary To 2N6287 Family								
2N6057	12	60	750 min.	6	3	150	TO-204MA	1185
2N6282	20	60	750 min.	10	4	160	TO-204MA	1001
2N6058	12	80	750 min.	6	3	150	TO-204MA	1185
2N6283	20	80	750 min.	10	4	160	TO-204MA	1001
2N6059	12	100	750 min.	6	3	150	TO-204MA	1185
2N6284	20	100	750 min.	10	4	160	TO-204MA	1001
2N6287 Family (p-n-p) Complementary To 2N6284 Family								
2N6050	12	-60	750 min.	-6	-3	150	TO-204MA	1185
2N6285	20	-60	750 min.	-10	-4	160	TO-204MA	1001
2N6051	12	-80	750 min.	-6	-3	150	TO-204MA	1185
2N6286	20	-80	750 min.	-10	-4	160	TO-204MA	1001
2N6052	12	-100	750 min.	-6	-3	150	TO-204MA	1185
2N6287	20	-100	750 min.	-10	-4	160	TO-204MA	1001

Selection Matrix

Type	I_C (A)	V_{CEO} (V)	h_{FE} @	I_C (A)	V_{CE} (V)	P_T (W)	Pkg.	File No.
2N6385 Family (n-p-n) Complementary To 2N6650 Family								
2N6383	10	40	1000 min.	5	3	100	TO-204MA	609
BDX83	10	45	1000 min.	5	3	125	TO-204MA	955
2N6055	8	60	750 min.	4	3	100	TO-204MA	563
2N6384	10	60	1000 min.	5	3	100	TO-204MA	609
2N6576	15	60	2000 min.	4	3	120	TO-204MA	1152
BDX83A	10	60	1000 min.	5	3	125	TO-204MA	955
RCA1000	5	60	1000 min.	3	3	90	TO-204MA	594
2N6056	8	80	750 min.	4	3	100	TO-204MA	563
2N6385	10	80	1000 min.	5	3	100	TO-204MA	609
BDX83B	10	80	1000 min.	5	3	125	TO-204MA	563
RCA1001	5	80	1000 min.	3	3	90	TO-204MA	594
2N6577	15	90	2000 min.	4	3	120	TO-204MA	1152
BDX83C	10	100	1000 min.	5	3	125	TO-204MA	563
2N6578	15	120	2000 min.	4	3	120	TO-204MA	1152
2N6388 Family (n-p-n) Complementary To 2N6668 Family								
2N6386	8	40	1000 min.	3	3	65	TO-220AB	610
BDX33	10	45	750 min.	4	3	70	TO-220AB	693
2N6043	8	60	1000 min.	4	4	75	TO-220AB	1151
2N6387	10	60	1000 min.	5	3	65	TO-220AB	610
BDX33A	10	60	750 min.	4	3	70	TO-220AB	693
TIP100	8	60	1000 min.	3	4	80	TO-220AB	1152
TIP120	8	60	1000 min.	3	3	65	TO-220AB	998
2N6044	8	80	1000 min.	4	4	75	TO-220AB	1151
2N6388	10	80	1000 min.	5	3	65	TO-220AB	610
BDX33B	10	80	750 min.	3	3	70	TO-220AB	693
TIP101	8	80	1000 min.	3	4	80	TO-220AB	1153
TIP121	8	80	1000 min.	3	3	65	TO-220AB	998
2N6045	8	100	1000 min.	4	4	75	TO-220AB	1151
BDX33C	10	100	750 min.	3	3	70	TO-220AB	693
TIP102	8	100	1000 min.	3	4	80	TO-220AB	1153
BDX33D	10	120	750 min.	3	3	70	TO-220AB	693
TIP122	8	100	1000 min.	3	3	65	TO-220AB	998
2N6530 Family (n-p-n)								
2N6530	8	80	1000-10,000	5	3	65	TO-220AB	873
2N6531	8	100	500-10,000	3	3	65	TO-220AB	873
2N6532	8	100	1000-10,000	5	3	65	TO-220AB	873
2N6533	8	120	1000-10,000	3	3	65	TO-220AB	873
2N6650 Family (p-n-p) Complementary To 2N6385 Family								
2N6648	10	-40	1000-20,000	-5	-3	70	TO-204MA	1013
2N6649	10	-60	1000-20,000	-5	-3	70	TO-204MA	1013
2N6650	10	-80	1000-20,000	-5	-3	70	TO-204MA	1013
2N6668 Family (p-n-p) Complementary To 2N6388 Family								
2N6666	8	-40	1000 min.	-3	-3	65	TO-220AB	1069
BDX34	10	-45	750 min.	-4	-3	70	TO-220AB	694
BDX34A	10	-60	750 min.	-4	-3	70	TO-220AB	694
2N6667	10	-60	1000 min.	-5	-3	65	TO-220AB	1069
TIP125	8	-60	1000 min.	-3	-3	65	TO-220AB	997
BDX34B	10	-80	750 min.	-3	-3	70	TO-220AB	694
2N6668	10	-80	1000 min.	-5	-3	65	TO-220AB	1069
TIP126	8	-80	1000 min.	-3	-3	65	TO-220AB	997
BDX34C	10	-100	750 min.	-3	-3	70	TO-220AB	694
TIP127	8	-100	1000 min.	-3	-3	65	TO-220AB	997

2N6043, 2N6044, 2N6045

File Number **1151**

8-Ampere N-P-N Darlington Power Transistors

60-, 80-, 100-Volts, 75 Watts
Gain of 1000 at 4 A (2N6043, 2N6044)
Gain of 1000 at 3 A (2N6045)

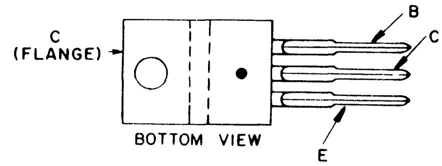
Features:

- Operates from IC without predriver
- High reverse second-breakdown capability

Applications:

- Power switching
- Hammer drivers
- Audio amplifiers
- Series and shunt regulators

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

The 2N6043, 2N6044, and 2N6045 are monolithic silicon n-p-n Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits. These devices are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package.

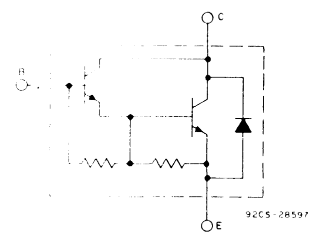


Fig. 1 – Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6043	2N6044	2N6045	
* V_{CBO}	60	80	100	V
$V_{CEO}(sus)$	60	80	100	V
* V_{EBO}		5		V
* I_C		8		A
I_{CM}		16		A
* I_B		0.12		A
* P_T:				
$T_C \geqslant 25^oC$		75		W
$T_C > 25^oC$		See Fig. 2		
* T_{stg}, T_J		−65 to 150		^oC
* T_L				
At distances ⩾ 1/8 in. (3.17 mm) from case for 10 s max.		235		^oC

* In accordance with JEDEC registration data.

2N6043, 2N6044, 2N6045

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6043 MIN.	MAX.	2N6044 MIN.	MAX.	2N6045 MIN.	MAX.	UNITS
* I_{CEO}	100			0	–	–	–	–	–	20	µA
	80			0	–	–	–	20	–	–	µA
	60			0	–	20	–	–	–	–	µA
* I_{CEV}	100	−1.5			–	–	–	–	–	20	µA
	80	−1.5			–	–	–	20	–	–	µA
	60	−1.5			–	20	–	–	–	–	µA
T_C=125°C	100	−1.5			–	–	–	–	–	200	µA
	80	−1.5			–	–	–	200	–	–	µA
	60	−1.5			–	200	–	–	–	–	µA
* I_{EBO}		5		0	–	2	–	2	–	2	mA
* V_{CEO}(sus)			0.1[a]	0	60	–	80	–	100	–	V
I_{CBO}	100[b]				–	–	–	–	–	20	µA
	80[b]				–	–	–	20	–	–	µA
	60[b]				–	20	–	–	–	–	µA
* h_{FE}	4		4		1000	20,000	1000	20,000	–	–	
	4		3		–	–	–	–	1000	20,000	
	4		8		100	–	100	–	100	–	
* V_{BE}	4		4		–	2.8	–	2.8	–	–	V
	4		3		–	–	–	–	–	2.8	V
* V_{BE}(sat)			8	0.08	–	4.5	–	4.5	–	4.5	V
* V_{CE}(sat)			4	0.016	–	2	–	2	–	–	V
			3	0.012	–	–	–	–	–	2	V
			8	0.08	–	4	–	4	–	4	V
V_F			−8[a]		–	4	–	4	–	4	V
* h_{fe} f=1 kHz	4		3		300	–	300	–	300	–	
* $\|h_{fe}\|$ f=1 MHz	4		3		4	–	4	–	4	–	
* C_{obo} f=1 MHz	10[b]				–	200	–	200	–	200	pF
$I_{S/b}$ t=1 s, nonrep.	30				2.5	–	2.5	–	2.5	–	A
$R_{\theta JC}$					–	1.67	–	1.67	–	1.67	°C/W

* In accordance with JEDEC registration data.
[a] Pulsed: Pulse duration = 300 µs, duty factor = 1.8%.
[b] V_{CB} value.

2N6043, 2N6044, 2N6045

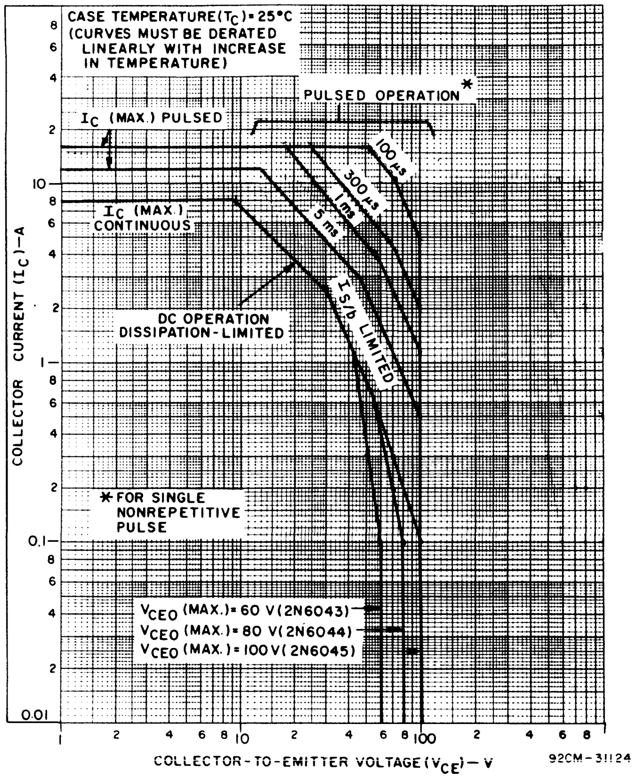


Fig. 2 — Maximum operating areas for all types (T_C = 25°C).

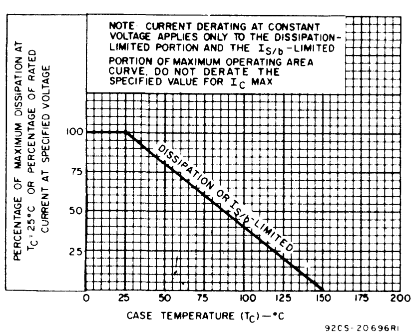


Fig. 3 — Derating curve for all types.

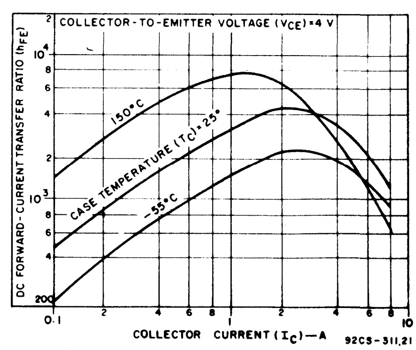


Fig. 4 — Typical dc beta characteristics for all types.

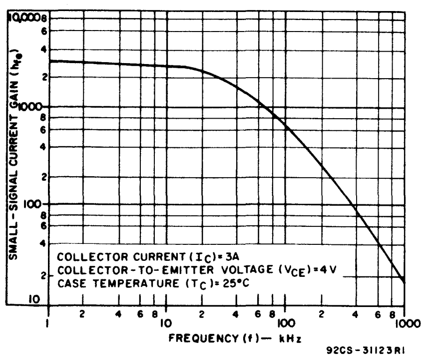


Fig. 5 — Typical small-signal gain for all types.

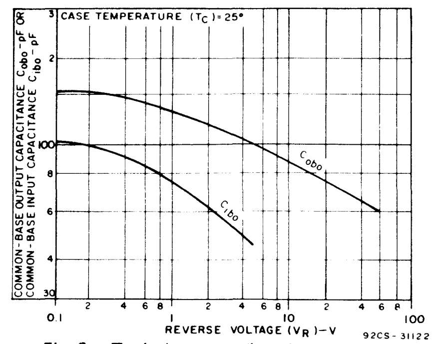


Fig. 6 — Typical common-base input or output capacitance characteristics as a function of reverse voltage for all types.

2N6050, 2N6051, 2N6052, 2N6057, 2N6058, 2N6059

File Number **1185**

12-Ampere Complementary P-N-P and N-P-N Monolithic Darlington Power Transistors

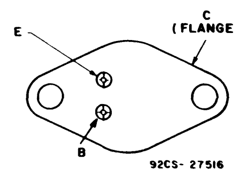
60-80-100 Volts, 150 Watts
Gain of 7000 (Typ.) at 5 A (2N6050, 2N6051, 2N6052)
Gain of 4000 (Typ.) at 5 A (2N6057, 2N6058, 2N6059)

Features:

- Operates from IC without predriver
- High reverse second-breakdown capability
- Monolithic construction
- High voltage ratings:

$V_{CEO}(sus)$ = 60 V Min. – 2N6050•, 2N6057
= 80 V Min. – 2N6051•, 2N6058
= 100 V Min. – 2N6052•, 2N6059

TERMINAL DESIGNATIONS



JEDEC TO-204MA
(See dimensional outline "A".)

The RCA-2N6050, 2N6051, and 2N6052 p-n-p types and the 2N6057, 2N6058, and 2N6059 n-p-n types are complementary monolithic silicon Darlington transistors designed for general purpose amplifier and low-speed switching applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits. These devices are supplied in the JEDEC TO-204MA hermetic steel package.

Applications:

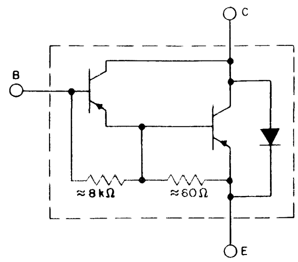
- Power switching
- Hammer drivers
- Series and shunt regulators
- Audio amplifiers

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6050• 2N6057	2N6051• 2N6058	2N6052• 2N6059	
* V_{CBO}	60	80	100	V
* $V_{CEO}(sus)$	60	80	100	V
* V_{EBO}		5		V
* I_C		12		A
* I_{CM}		20		A
* I_B		0.2		A
* P_T				
$T_C \leqslant 25^{\circ}C$		150		W
$T_C > 25^{\circ}C$ Derate linearly		0.857		W/°C
* T_{stg}, T_J		–65 to 200		°C
* T_L				
At distances ⩾1/16 in. (1.58 mm) from case for 10 s max.		235		°C

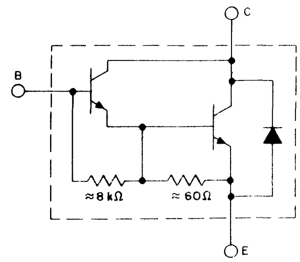
* In accordance with JEDEC registration data. • For p-n-p devices, voltage and current values are negative.

2N6050, 2N6051, 2N6052, 2N6057, 2N6058, 2N6059



92CS-29129

Fig. 1 – Schematic diagram for 2N6050, 2N6051, and 2N6052.



92CS-29128

Fig. 2 – Schematic diagram for 2N6057, 2N6058, and 2N6059.

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		2N6050● 2N6057		2N6051● 2N6058		2N6052● 2N6059		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* I_{CEO}	30			0	—	1	—	—	—	—	mA
	40			0	—	—	—	1	—	—	
	50			0	—	—	—	—	—	1	
* I_{CEX}	60	−1.5			—	0.5	—	—	—	—	
	80	−1.5			—	—	—	0.5	—	—	
	100	−1.5			—	—	—	—	—	0.5	
T_C = 150°C	60	−1.5			—	5	—	—	—	—	
	80	−1.5			—	—	—	5	—	—	
	100	−1.5			—	—	—	—	—	5	
* I_{EBO}		−5	0		—	2	—	2	—	2	mA
* $V_{CEO}(sus)$			0.1[a]	0	60	—	80	—	100	—	V
* h_{FE}	3		12[a]		100	—	100	—	100	—	
	3		6[a]		750	18,000	750	18,000	750	18,000	
* $V_{CE}(sat)$			12[a]	0.12	—	3	—	3	—	3	V
			6[a]	0.024	—	2	—	2	—	2	
* V_{BE}	3		6[a]		—	2.8	—	2.8	—	2.8	V
* $V_{BE}(sat)$			12[a]	0.12	—	4	—	4	—	4	V
* h_{fe} f = 1 kHz	3		5		300	—	300	—	300	—	
* $\|h_{fe}\|$ f = 1 MHz	3		5		4	—	4	—	4	—	
* C_{ob} V_{CB} = 10 V, I_E = 0, f = 0.1 MHz 2N6050-52					—	500	—	500	—	500	pF
2N6057-59					—	300	—	300	—	300	
$I_{S/b}$ t = 1 s, nonrep.	30				5	—	5	—	5	—	A
$R_{\theta JC}$					—	1.17	—	1.17	—	1.17	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%. ● For p-n-p devices, voltage and current values are negative.

* In accordance with JEDEC registration data.

2N6050, 2N6051, 2N6052, 2N6057, 2N6058, 2N6059

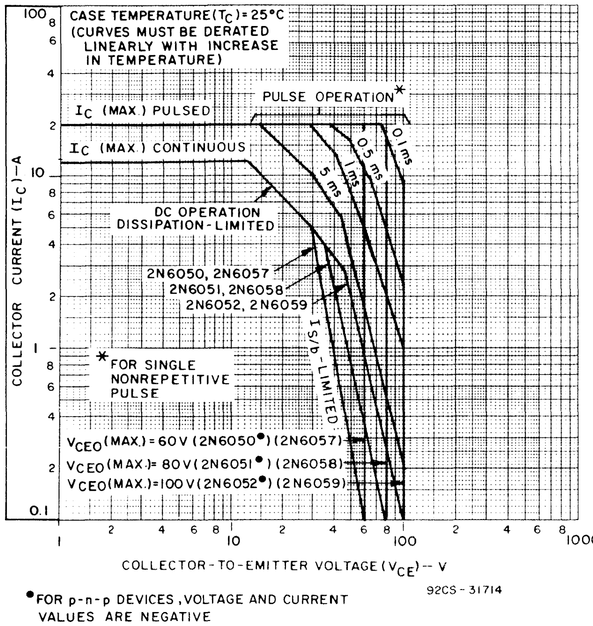


Fig. 3 — Maximum operating areas for all types.

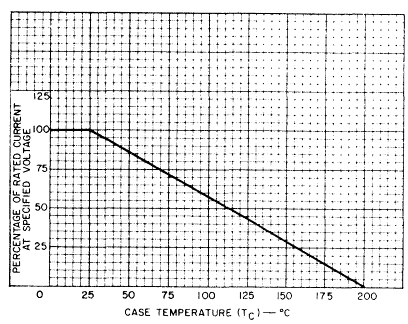


Fig. 4 — Current derating curve for all types.

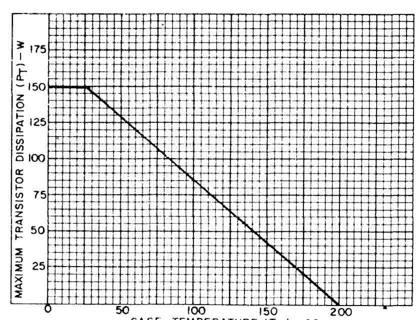


Fig. 5 — Power derating curve for all types.

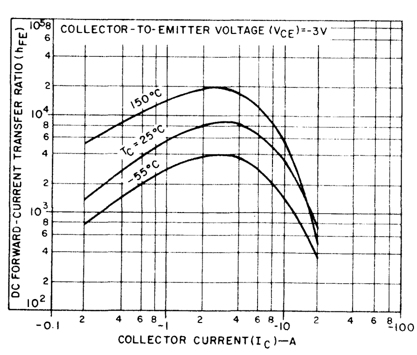


Fig. 6 — Typical dc beta characteristics for 2N6050, 2N6051, and 2N6052.

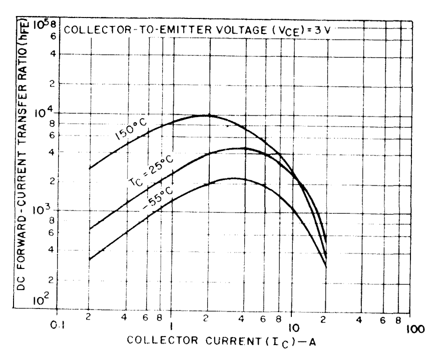


Fig. 7 — Typical dc beta characteristics for 2N6057, 2N6058, and 2N6059.

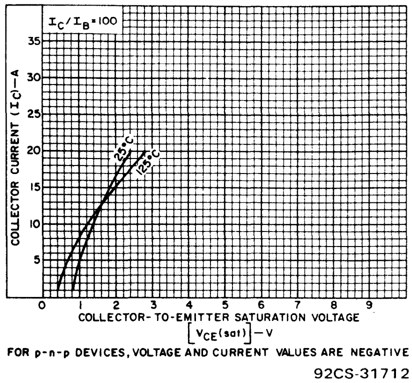


Fig. 8 — Typical saturation characteristics for all types.

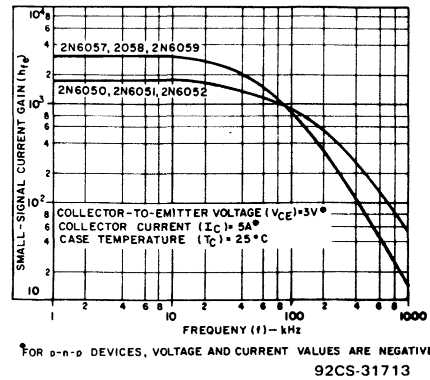


Fig. 9 — Typical small-signal current gain for all types.

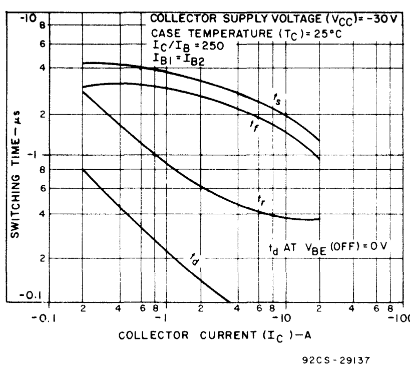


Fig. 10 — Typical switching times for 2N6050, 2N6051, and 2N6052.

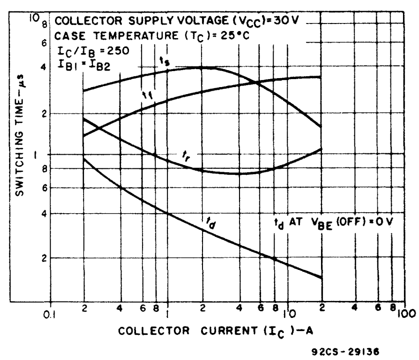


Fig. 11 — Typical switching times for 2N6057, 2N6058, and 2N6059.

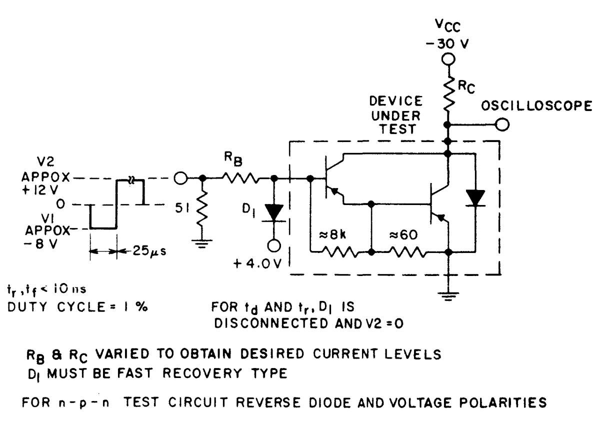


Fig. 12 — Switching times test circuit.

2N6055, 2N6056 File Number **563**

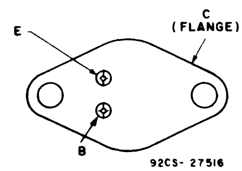
8-Ampere Silicon N-P-N Darlington Power Transistors

60- and 80-Volt, 100-Watt Types
With Gain of 750 at 4 Amperes

Features:
- Operation from IC without predriver
- Low leakage at high temperature
- High reverse-second-breakdown capability

Applications:
- Power switching
- Hammer drivers
- Audio amplifiers
- Series and shunt regulators

TERMINAL DESIGNATIONS



JEDEC TO-204MA
(See dimensional outline "A".)

The RCA-2N6055 and 2N6056 are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double epitaxial construction of these devices provides good forward and reverse second-breakdown capability. Their high gain makes it possible for them to be driven directly from integrated circuits.

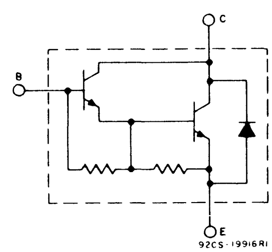


Fig. 1 – Schematic diagram of 2N6055 and 2N6056 Darlington power transistors.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6055	2N6056	
* V_{CBO}	60	80	V
$V_{CER(sus)}$			
R_{BE} = 100 Ω	60	80	V
* V_{CEO}	60	80	V
$V_{CEV(sus)}$			
V_{BE} = −1.5 V	60	80	V
* V_{EBO}	5	5	V
* I_C	8	8	A
I_{CM}	16	16	A
* I_B	120	120	mA
* P_T			
$T_C \leq 25°C$	100	100	W
$T_C > 25°C$	– See Figs. 2 and 4 –		
* T_{stg}, T_J	—— −65 to +200 ——		°C
* T_L			
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	—— 235 ——		°C

* In accordance with JEDEC registration format JS-6 RDF-2.

2N6055, 2N6056

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)= 25°C Unless Otherwise Specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS						LIMITS				UNITS
	DC VOLTAGE V			DC CURRENT A			2N6055		2N6056		
	V_{CE}	V_{EB}	V_{BE}	I_C	I_E	I_B	MIN.	MAX.	MIN.	MAX.	
* I_{CEO}	30					0	–	0.5	–	–	mA
	40					0	–	–	–	0.5	
I_{CEX}	60		−1.5				–	0.5	–	–	
	80		−1.5				–	–	–	0.5	
I_{CEX} T_C = 150°C	60		−1.5				–	5	–	–	
	80		−1.5				–	–	–	5	
* I_{EBO}		5		0			–	2	–	2	mA
* h_{FE}	3			8[a]			100	–	100	–	
	3			4[a]			750	18,000	750	18,000	
V_{CEO}(sus)				0.1[a]			60[a]	–	80[a]	–	V
V_{CER}(sus) R_{BE} = 100 Ω				0.1[a]			60[a]	–	80[a]	–	
V_{CEX}(sus)			−1.5	0.1[a]			60[a]	–	80[a]	–	
* V_{CE}(sat)				4[a]		0.016	–	2	–	2	V
				8[a]		0.08	–	3	–	3	
* V_{BE}	3			4[a]			–	2.8	–	2.8	V
V_{BE}(sat)				8[a]		0.08	–	4	–	4	
* $\|h_{fe}\|$ f = 1 MHz	3			3			4	–	4	–	
* C_{obo} f = 0.1 MHz, V_{CB} = 10 V					0		–	200	–	200	pF
* h_{fe} f = 1 kHz	3			3			300	–	300	–	
$E_{S/b}$[b] L = 12 mH, R_{BE} = 100 Ω			−1.5	5			150	–	150	–	mJ
$I_{S/b}$ t = 1 s, non rep.	33.3						3	–	3	–	A
	40						–	–	2	–	
$R_{\theta JC}$							–	1.75	–	1.75	°C/W

* In accordance with JEDEC registration data format JS-6 RDF-2.

a Pulsed: Pulse duration = 300 μs, duty factor = 2%.

b $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse bias conditions. $E_{S/b} = 1/2LI^2$, where L is a series load or leakage inductance and I is the peak collector current.

2N6055, 2N6056

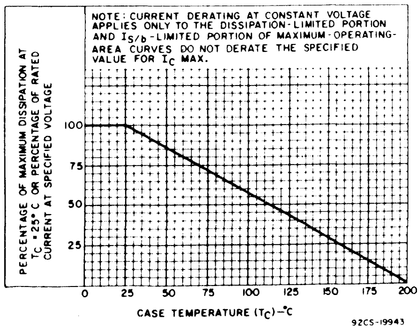


Fig.2 — Derating curve for both types.

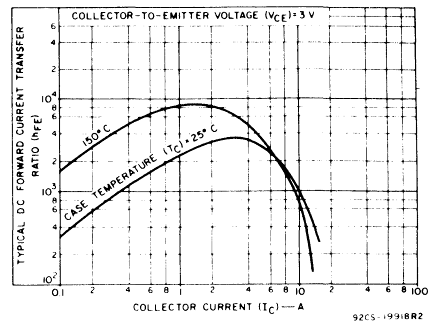


Fig.3 — Typical dc beta characteristics for both types.

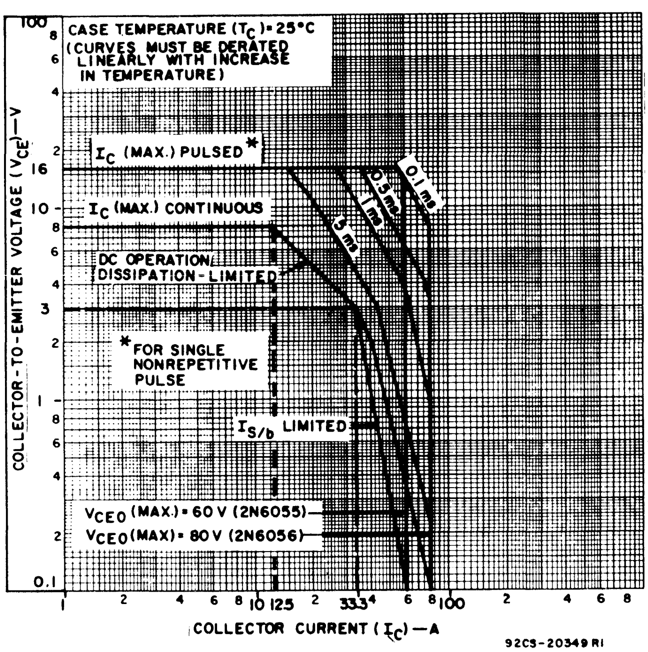


Fig.4 — Maximum operating areas for types 2N6055 and 2N6056.

2N6055, 2N6056

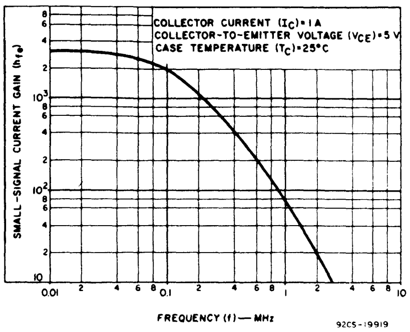


Fig.5 – Typical small-signal gain for both types.

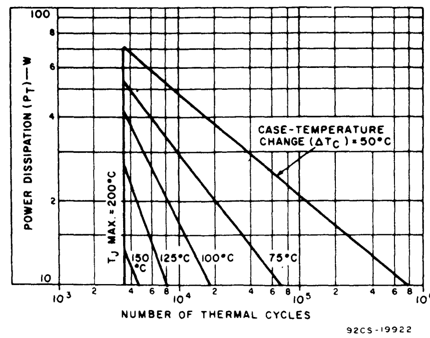


Fig.6 – Thermal-cycling rating chart for both types.

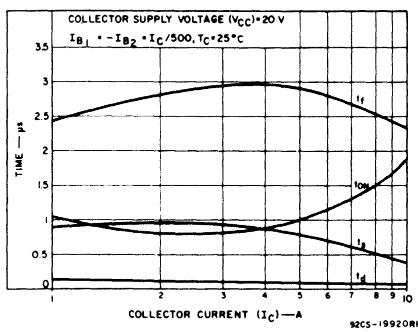


Fig.7 – Typical saturated switching-time characteristics for both types.

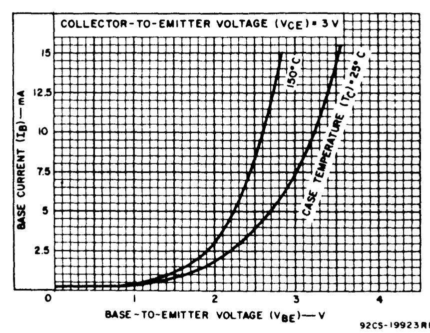


Fig.8 – Typical input characteristics for both types.

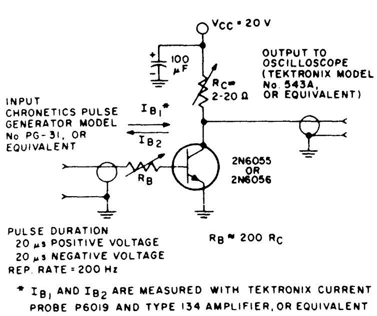


Fig.9 – Circuit used to measure saturated switching times.

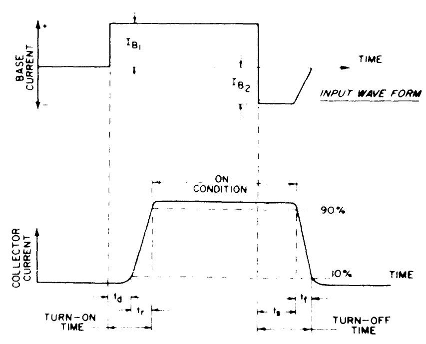


Fig.10 – Phase relationship between input current and output current showing reference points for specification of switching times (test circuit shown in Fig.8).

2N6055, 2N6056

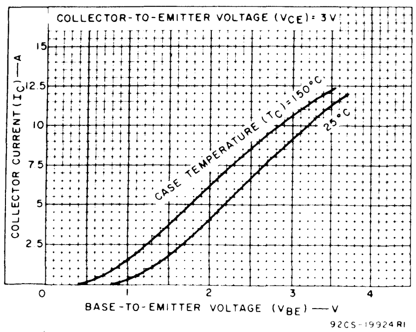


Fig. 11 – Typical transfer characteristics for both types.

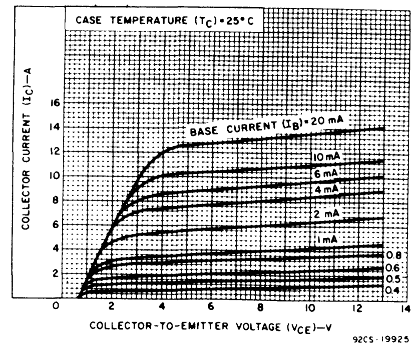


Fig. 12 – Typical output characteristics for both types.

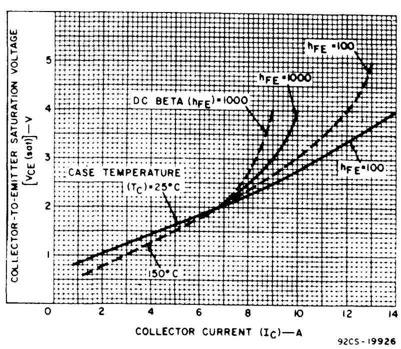


Fig. 13 – Typical saturation-voltage characteristics for both types.

File Number **1001**

2N6282, 2N6283, 2N6284, 2N6285, 2N6286, 2N6287

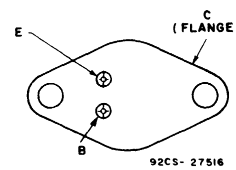
20-Ampere Complementary N-P-N and P-N-P Monolithic Darlington Power Transistors

60-80-100 Volts, 160 Watts
Gain of 2400 (Typ.) at 10 A (2N6282, 2N6283, 2N6284)
Gain of 3500 (Typ.) at 10 A (2N6285, 2N6286, 2N6287)

Features:

- **Operates from IC without predriver**
- **High reverse second-breakdown capability**
- **Monolithic construction**

TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "A".)

The RCA-2N6282, 2N6283, and 2N6284 and the 2N6285, 2N6286, and 2N6287 are complementary n-p-n and p-n-p monolithic silicon Darlington transistors designed for general-purpose amplifier and low-speed switching applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits.

- **High voltage ratings:**
  $V_{CEO}(sus)$ = **60 V Min. – 2N6282, 2N6285•**
  = **80 V Min. – 2N6283, 2N6286•**
  = **100 V Min. – 2N6284, 2N6287•**

Applications:

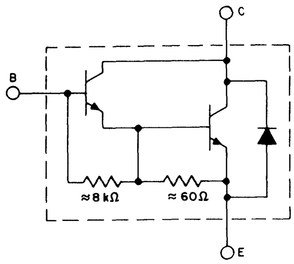
- **Power switching**
- **Hammer drivers**
- **Series and shunt regulators**
- **Audio amplifiers**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6282 2N6285•	2N6283 2N6286•	2N6284 2N6287•	
* V_{CBO}	60	80	100	V
* $V_{CEO}(sus)$	60	80	100	V
* V_{EBO}	5	5	5	V
* I_C	20	20	20	A
* I_{CM}	40	40	40	A
* I_B	0.5	0.5	0.5	A
* P_T				
$T_C \leq 25^\circ C$	160	160	160	W
$T_C > 25^\circ C$ Derate linearly		0.915		$W/^\circ C$
* Tstg, TJ		−65 to 200		$^\circ C$
* T_L				
At distances ≥1/16 in. (1.58 mm) from case for 10 s max.		235		$^\circ C$

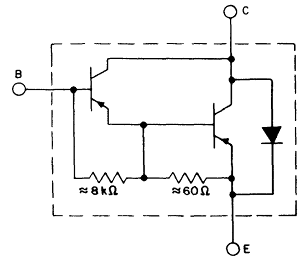
* In accordance with JEDEC registration data.
• For p-n-p devices, voltage and current values are negative.

2N6282, 2N6283, 2N6284, 2N6285, 2N6286, 2N6287



92CS-29128

Fig. 1 – Schematic diagram for 2N6282, 2N6283, and 2N6284.



92CS-29129

Fig. 2 – Schematic diagram for 2N6285, 2N6286, and 2N6287.

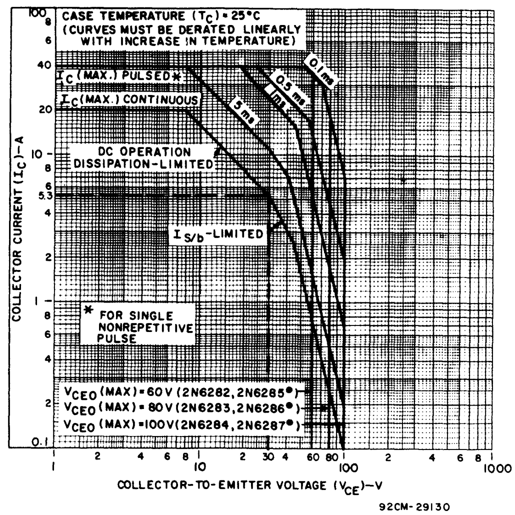
ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		2N6282 2N6285•		2N6283 2N6286•		2N6284 2N6287•		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* I_{CEO}	30			0	–	1	–	–	–	–	mA
	40			0	–	–	–	1	–	–	
	50			0	–	–	–	–	–	1	
* I_{CEX}	60	−1.5			–	0.5	–	–	–	–	
	80	−1.5			–	–	–	0.5	–	–	
	100	−1.5			–	–	–	–	–	0.5	
T_C = 150°C	60	−1.5			–	5	–	–	–	–	
	80	−1.5			–	–	–	5	–	–	
	100	−1.5			–	–	–	–	–	5	
* I_{EBO}		−5	0		–	2	–	2	–	2	mA
* $V_{CEO}(sus)$			0.1[a]	0	60	–	80	–	100	–	V
* h_{FE}	3		20[a]		100	–	100	–	100	–	
	3		10[a]		750	18,000	750	18,000	750	18,000	
* $V_{CE}(sat)$			20[a]	0.2	–	3	–	3	–	3	V
			10[a]	0.04	–	2	–	2	–	2	
* V_{BE}	3		10[a]		–	2.8	–	2.8	–	2.8	V
* $V_{BE}(sat)$			20[a]	0.2	–	4	–	4	–	4	V
* h_{fe} f = 1 kHz	3		10		300	–	300	–	300	–	
* $\|h_{fe}\|$ f = 1 MHz	3		10		4	–	4	–	4	–	
* C_{ob} V_{CB} = 10 V, I_E 0, f = 0.1 MHz 2N6282-84					–	400	–	400	–	400	pF
2N6285-87					–	600	–	600	–	600	
$I_{S/b}$ t = 1 s, nonrep.	30				5.3	–	5.3	–	5.3	–	A
$R_{\theta JC}$						1.09	–	1.09	–	1.09	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%. • For p-n-p devices, voltage and current values are negative.

* In accordance with JEDEC registration data.

2N6282, 2N6283, 2N6284, 2N6285, 2N6286, 2N6287



• FOR p-n-p DEVICES, VOLTAGE AND CURRENT VALUES ARE NEGATIVE

Fig. 3 — Maximum operating areas for all types.

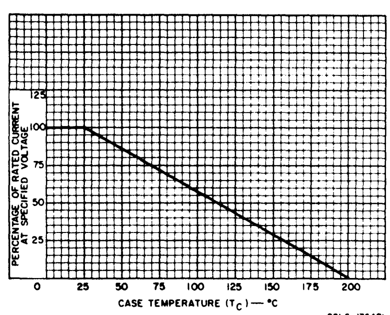


Fig. 4 — Current derating curve for all types.

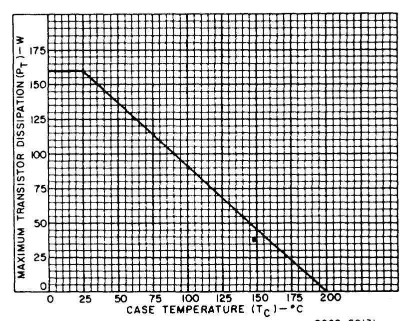


Fig. 5 — Power derating curve for all types.

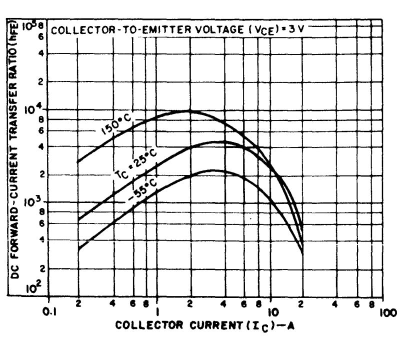


Fig. 6 — Typical dc beta characteristics for 2N6282, 2N6283, and 2N6284.

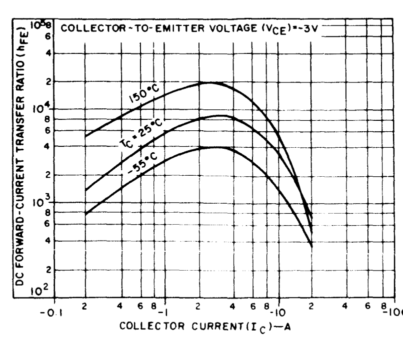


Fig. 7 — Typical dc beta characteristics for 2N6285, 2N6286, and 2N6287.

2N6282, 2N6283, 2N6284, 2N6285, 2N6286, 2N6287

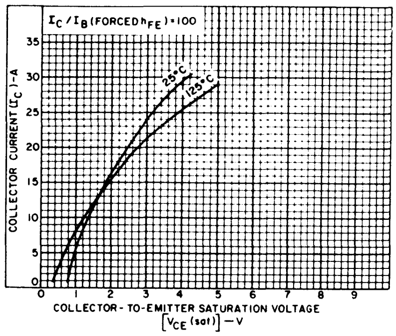


Fig. 8 – Typical saturation characteristics for all types.

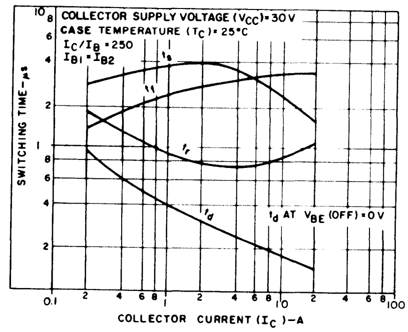


Fig. 9 – Typical switching times for 2N6282, 2N6283, and 2N6284.

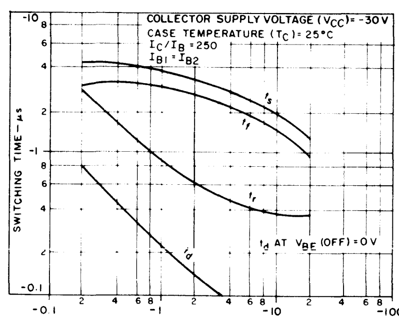


Fig. 10 – Typical switching times for 2N6285, 2N6286, and 2N6287.

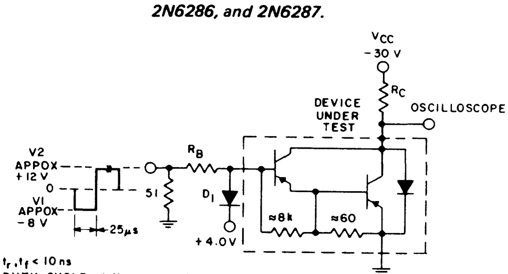


Fig. 11 - Switching times test circuit.

File Number **609**

2N6383, 2N6384, 2N6385

10-Ampere N-P-N Darlington Power Transistors

40-60-80 Volts, 100 Watts
Gain of 1000 at 5 A

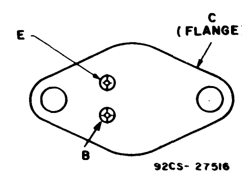
Features:

- **Operates from IC without predriver**
- **Low leakage at high temperature**
- **High reverse second-breakdown capability**

Applications:

- **Power switching**
- **Audio amplifiers**
- **Hammer drivers**
- **Series and shunt regulators**

TERMINAL DESIGNATIONS



JEDEC TO-204MA
(See dimensional outline "A".)

The 2N6383, 2N6384, and 2N6385● are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double epitaxial construction of these devices provides good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

● Formerly RCA Dev. Nos. TA8349, TA8486, and TA8348.

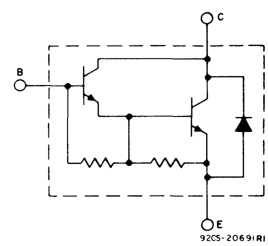


Fig.1 — Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6385	2N6384	2N6383	
* V_{CBO}	80	60	40	V
$V_{CER}(sus)$				
R_{BE} = 100 Ω	80	60	40	V
* $V_{CEO}(sus)$	80	60	40	V
* V_{CEX}				
V_{BE} = −1.5 V, R_{BB} = 100 Ω	80	60	40	V
* V_{EBO}	5	5	5	V
* I_C	10	10	10	A
I_{CM}	15	15	15	A
* I_B	0.25	0.25	0.25	A
* P_T				
$T_C \leq 25^oC$	100	100	100	W
$T_C > 25^oC$		See Fig.2		
* T_{stg}, T_J		−65 to +200		^oC
* T_L				
At distances ≥ 1/32 in. (0.8mm) from seating plane for 10 s max.		235		^oC

* In accordance with JEDEC registration data format JS-6 RDF-2.

2N6383, 2N6384, 2N6385

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARAC-TERISTIC SYMBOL	TEST CONDITIONS VOLTAGE V dc			CURRENT A dc		LIMITS 2N6385		2N6384		2N6383		UNITS
	V_{CE}	V_{EB}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
* I_{CEO}	80				0	–	1	–	–	–	–	mA
	60				0	–	–	–	1	–	–	
	40				0	–	–	–	–	–	1	
* I_{CEV}	80		−1.5			–	0.3	–	–	–	–	
	60		−1.5			–	–	–	0.3	–	–	
	40		−1.5			–	–	–	–	–	0.3	
T_C = 150°C	80		−1.5			–	3	–	–	–	–	
	60		−1.5			–	–	–	3	–	–	
	40		−1.5			–	–	–	–	–	3	
* I_{EBO}		5		0		–	5	–	5	–	5	mA
* $V_{CEO}(sus)$				0.2[a]	0	80	–	60	–	40	–	V
* $V_{CER}(sus)$ R_{BE}=100Ω				0.2[a]		80	–	60	–	40	–	
$V_{CEV}(sus)$			−1.5	0.2[a]		80	–	60	–	40	–	
* h_{FE}	3			5[a]		1000	20,000	1000	20,000	1000	20,000	
	3			10[a]		100	–	100	–	100	–	
* V_{BE}	3			5[a]		–	2.8	–	2.8	–	2.8	V
	3			10[a]		–	4.5	–	4.5	–	4.5	
* $V_{CE}(sat)$				5[a]	0.01[a]	–	2	–	2	–	2	V
				10[a]	0.1[a]	–	3	–	3	–	3	
V_F				−10		–	4	–	4	–	4	
* h_{fe} f = 1 kHz	5			1		1000	–	1000		1000	–	
* $\|h_{fe}\|$ f = 1 MHz	5			1		20	–	20	–	20	–	
* C_{obo} f = 1 MHz	V_{CB} = 10				I_E=0	–	200	–	200	–	200	pF
$I_{S/b}$ t=1 s, non rep.	75					0.22	–	–	–	–	–	A
	55					–	–	0.55	–	–	–	
	30					3.33	–	3.33	–	3.33	–	
$R_{\theta JC}$						–	1.75	–	1.75	–	1.75	°C/W

a Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

* In accordance with JEDEC registration data format JS-6 RDF-2.

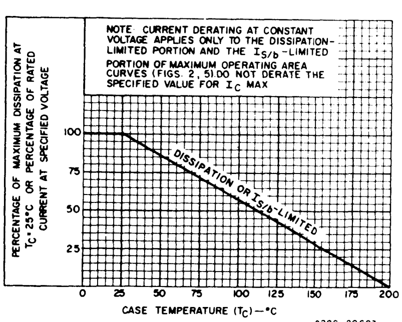


Fig.2 — Derating curves for all types.

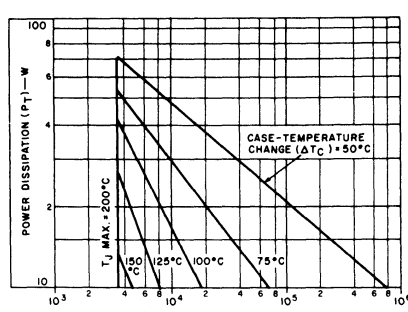


Fig.3 — Thermal-cycling rating chart for all types.

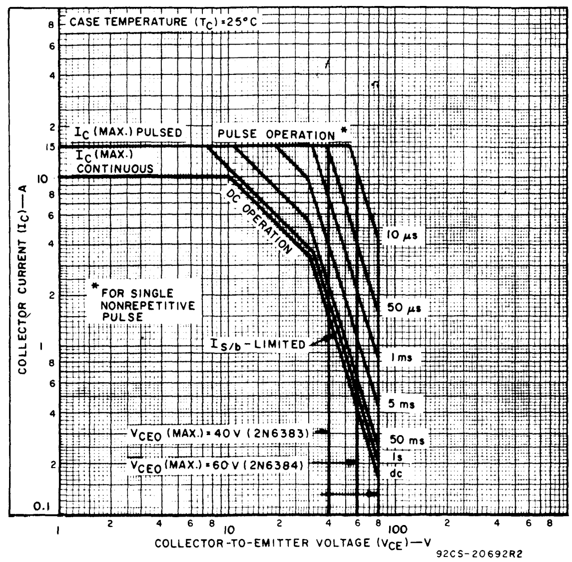


Fig.4 — Maximum operating area for all types.

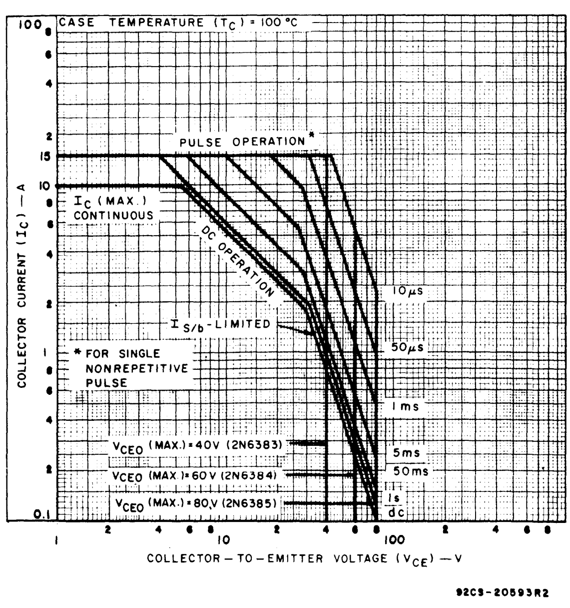


Fig.5 — Maximum operating area for all types.

2N6383, 2N6384, 2N6385

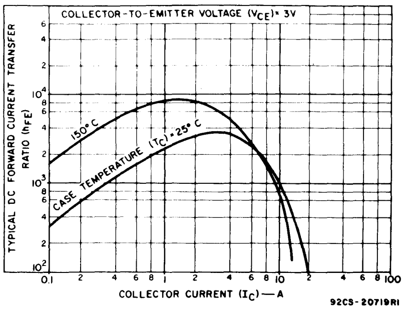


Fig.6 — Typical dc-beta characteristics for all types.

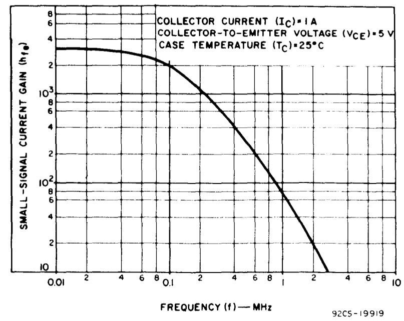


Fig.7 — Typical small-signal gain for all types.

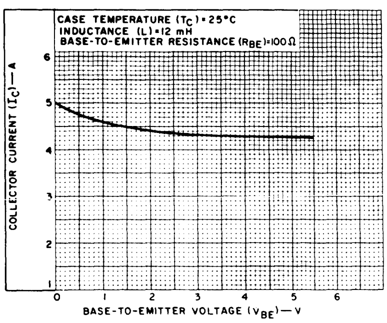


Fig.8 — Minimum values of reverse-bias second breakdown characteristic ($E_{S/b}$) for all types.

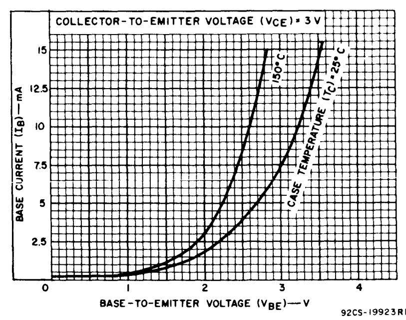


Fig.9 — Typical saturated switching time characteristics for all types.

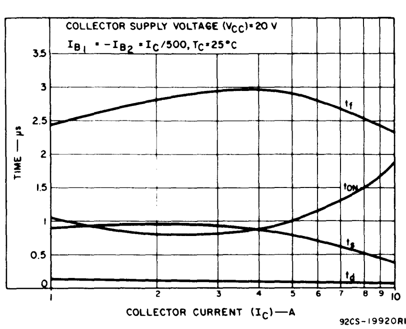


Fig.10 — Typical input characteristics for all types.

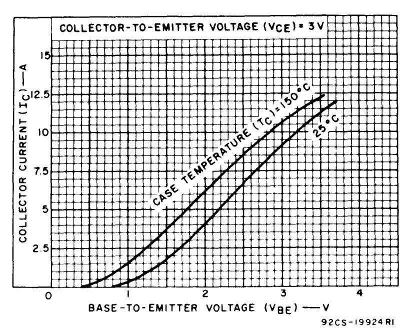


Fig.11 — Typical transfer characteristics for all types.

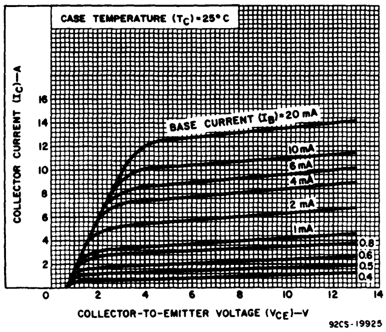


Fig. 12 — Typical output characteristics for all types.

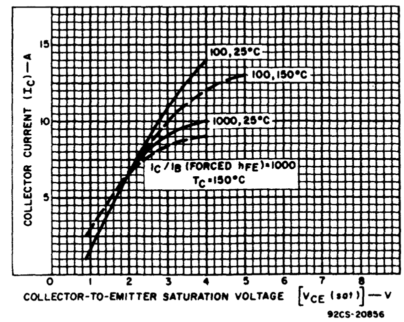


Fig. 13 — Typical saturation characteristics for all types.

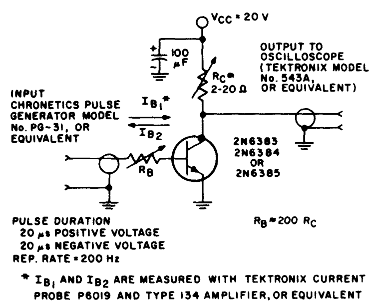


Fig. 14 — Circuit used to measure saturated-switching times.

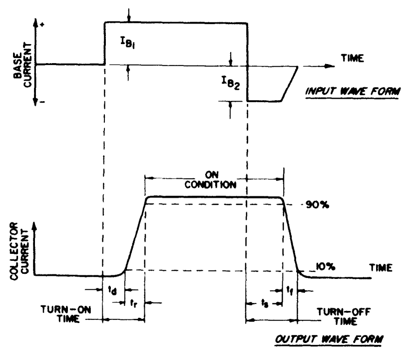


Fig. 15 — Phase relationship between input current and output current showing reference points for specification of switching times (test circuit shown in Fig. 14).

2N6386, 2N6387, 2N6388

File Number **610**

10-Ampere N-P-N Darlington Power Transistors

40-60-80 Volts, 65 Watts
Gain of 1000 at 5 A (2N6387, 2N6388)
Gain of 1000 at 3 A (2N6386)

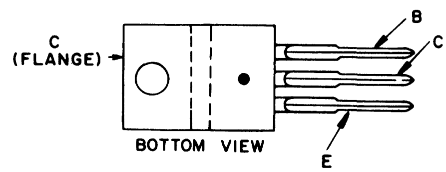
Features:

- **Operates from IC without predriver**
- **High reverse second-breakdown capability**

Applications:

- **Power switching** ■ **Audio amplifiers**
- **Hammer drivers**
- **Series and shunt regulators**

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

The 2N6386, 2N6387, and 2N6388● are monolithic silicon n-p-n Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits. The 2N6386 is complementary to the RCA8203 and the 2N6666, the 2N6387 is complementary to the 2N6667, and the 2N6388 is complementary to the 2N6668. These devices are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package.

● Formerly RCA Dev. Nos. TA8202, TA8485, and TA8201, respectively.

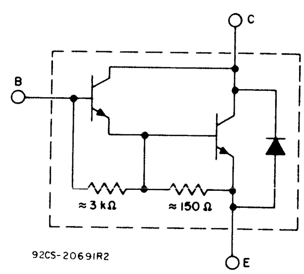


Fig.1 – Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6386	2N6387	2N6388	
* V_{CBO}	40	60	80	V
$V_{CER}(sus)$				
$R_{BE} = 100\ \Omega$	40	60	80	V
$V_{CEO}(sus)$	40	60	80	V
* $V_{CEV}(sus)$				
$V_{BE} = -1.5$ V	40	60	80	V
* V_{EBO}	5	5	5	V
* I_C	8	10	10	A
I_{CM}	15	15	15	A
* I_B	0.25	0.25	0.25	A
* P_T				
$T_C \leqslant 25^oC$	65	65	65	W
$T_C > 25^oC$		See Fig.2		
* T_{stg}, T_J		−65 to +150		^oC
* T_L At distances $\geqslant$ 1/8 in. (3.17 mm) from case for 10 s max.		235		^oC

* In accordance with JEDEC registration data format JS-6 RDF-2.

2N6386, 2N6387, 2N6388

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6386 MIN.	MAX.	2N6387 MIN.	MAX.	2N6388 MIN.	MAX.	UNITS
* I_{CEO}	80			0	–	–	–	–	–	1	mA
	60			0	–	–	–	1	–	–	
	40			0	–	1	–	–	–	–	
* I_{CEV}	80	−1.5			–	–	–	–	–	0.3	
	60	−1.5			–	–	–	0.3	–	–	
	40	−1.5			–	0.3	–	–	–	–	
T_C = 125°C	80	−1.5			–	–	–	–	–	3	
	60	−1.5			–	–	–	3	–	–	
	40	−1.5			–	3	–	–	–	–	
* I_{EBO}		5	0		–	5	–	5	–	5	mA
* $V_{CEO}(sus)$			0.2[a]	0	40	–	60	–	80	–	V
$V_{CER}(sus)$ R_{BE} = 100 Ω			0.2[a]		40	–	60	–	80	–	
$V_{CEV}(sus)$		−1.5	0.2[a]		40	–	60	–	80	–	
* h_{FE}	3		3[a]		1000	20,000	–	–	–	–	
	3		5[a]		–	–	1000	20,000	1000	20,000	
	3		8[a]		100	–	–	–	–	–	
	3		10[a]		–	–	100	–	100	–	
* V_{BE}	3		3[a]		–	2.8	–	–	–	–	V
	3		5[a]		–	–	–	2.8	–	2.8	
	3		8[a]		–	4.5	–	–	–	–	
	3		10[a]		–	–	–	4.5	–	4.5	
* $V_{CE}(sat)$			3[a]	0.006[a]	–	2	–	–	–	–	V
			5[a]	0.01[a]	–	–	–	2	–	2	
			8[a]	0.08[a]	–	3	–	–	–	–	
			10[a]	0.1[a]	–	–	–	3	–	3	
V_F			−8[a]		–	4	–	–	–	–	V
			−10[a]		–	–	–	4	–	4	
* h_{fe} f = 1 kHz	5		1		1000	–	1000	–	1000	–	
* $\|h_{fe}\|$ f = 1 MHz	5		1		20	–	20	–	20	–	
* C_{ob} V_{CB} = 10 V, f = 1 MHz					–	200	–	200	–	200	pF
$I_{S/b}$ t = 1 s, nonrep.	25				2.6	–	2.6	–	2.6	–	A
$R_{\theta JC}$					–	1.92	–	1.92	–	1.92	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.
* In accordance with JEDEC registration data format JS-6 RDF-2.

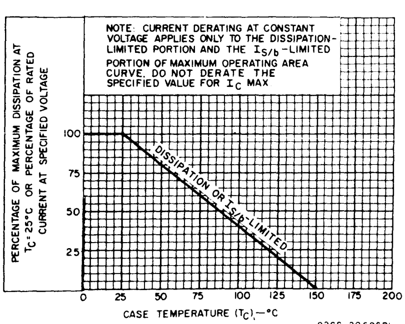


Fig.2 — Derating curve for all types.

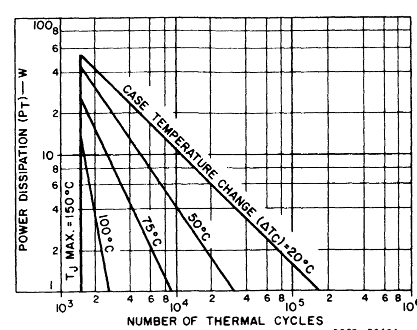


Fig.3 — Thermal-cycling rating chart for all types.

2N6386, 2N6387, 2N6388

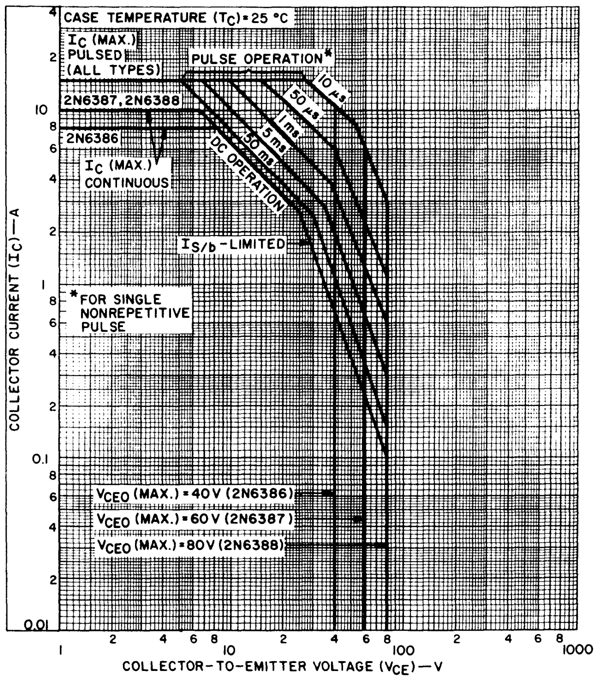


Fig.4 — Maximum operating areas for all types.

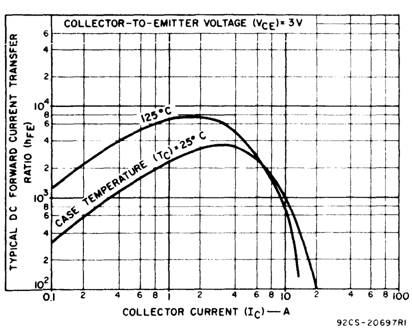


Fig.5 — Typical dc-beta characteristics for all types.

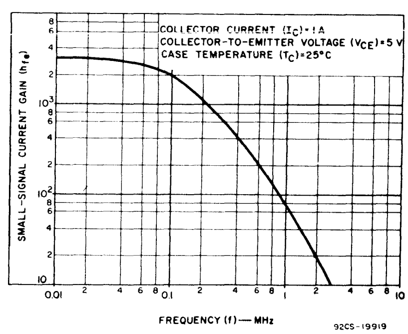


Fig.6 — Typical small-signal gain for all types.

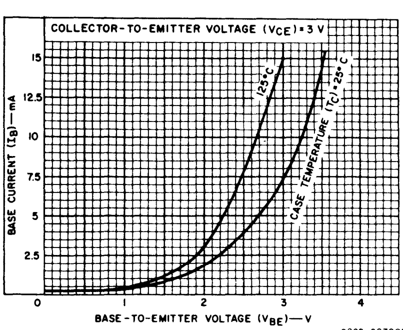


Fig.7 — Typical input characteristics for all types.

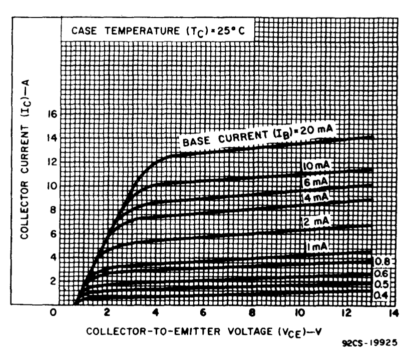


Fig.8 — Typical output characteristics for all types.

2N6386, 2N6387, 2N6388

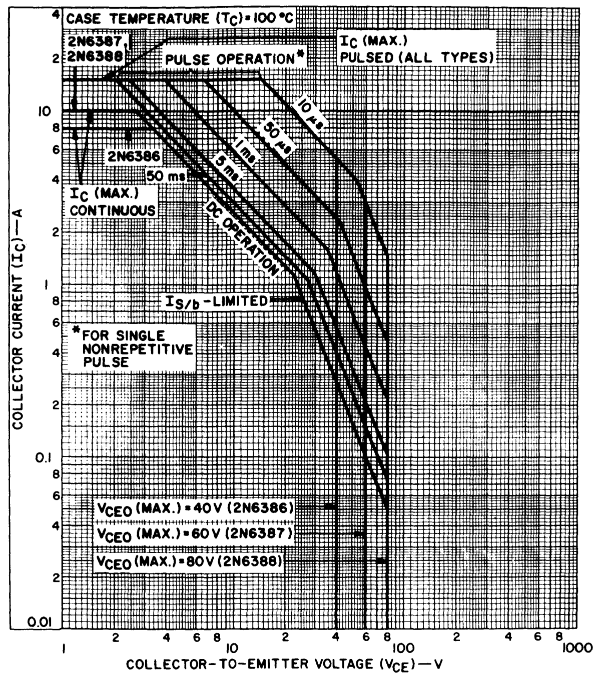


Fig.9 — Maximum operating areas for all types at $T_C = 100^oC$.

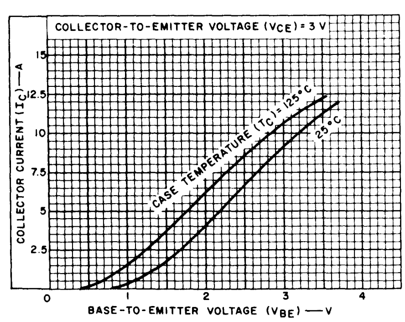


Fig.10 — Typical transfer characteristics for all types.

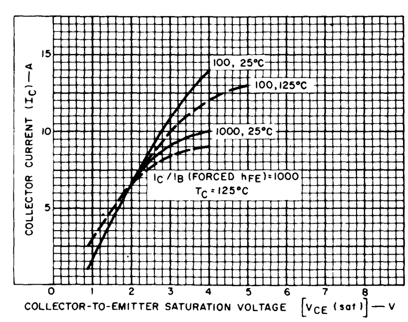


Fig.11 — Typical saturation characteristics for all types.

2N6386, 2N6387, 2N6388

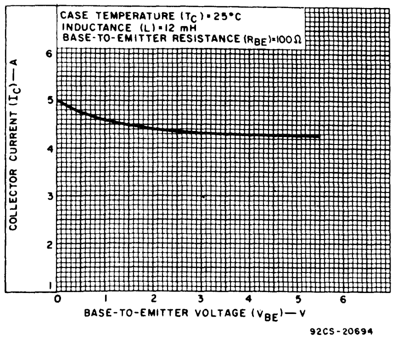


Fig.12 — Minimum values of reverse-bias second breakdown characteristic ($E_{S/b}$) for all types.

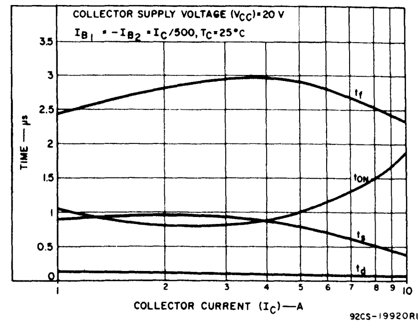


Fig.13 — Typical saturated switching-time characteristics for all types.

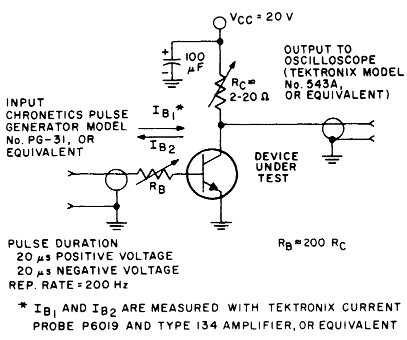


Fig.14 — Circuit used to measure saturated switching times.

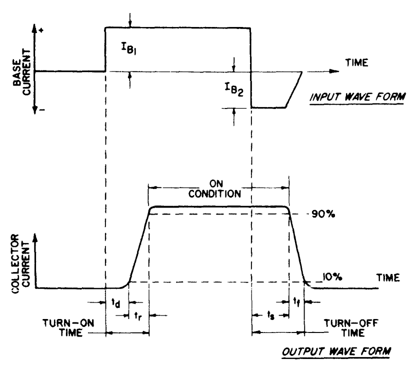


Fig.15 — Phase relationship between input current and output current showing reference points for specification of switching times.

File Number **873**

2N6530, 2N6531, 2N6532, 2N6533

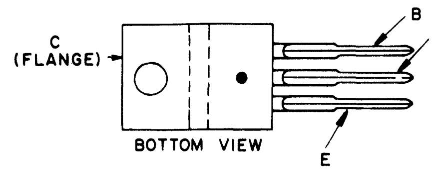
8-Ampere N-P-N Darlington Power Transistors

80, 100, 120 Volts, 60 Watts
Gain of 1000 at 5 A (2N6530, 2N6532)
Gain of 1000 at 3 A (2N6533)
Gain of 500 at 3 A (2N6531)

Features:
- **Operate from IC without predriver**
- **Low leakage at high temperature**
- **High reverse second-breakdown capability**

Applications:
- **Power switching**
- **Hammer drivers**
- **Series and shunt regulators**
- **Audio amplifiers**

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

The RCA-2N6530, 2N6531, 2N6532, and 2N6533● are monolithic n-p-n silicon Darlington transistors designed for power applications at low and medium frequencies. The double epitaxial construction of these devices provides good forward and reverse second-breakdown characteristics. Their high gain allows them to be driven directly from integrated circuits.

● Formerly RCA Dev. Nos. TA8904C, TA8904D, TA8904B, and TA8904A, respectively.

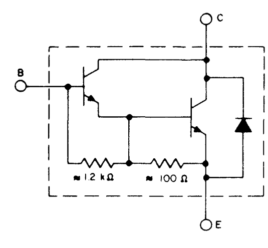


Fig. 1—Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6530	2N6531	2N6532	2N6533	
$^*V_{CBO}$	80	100	100	120	V
$V_{CER}(sus)$					
$R_{BE} = 100\ \Omega$	80	100	100	120	V
$V_{CEO}(sus)$	80	100	100	120	V
$^*V_{CEV}(sus)$					
$V_{BE} = -1.5$ V	80	100	100	120	V
$^*V_{EBO}$	5	5	5	5	V
$^*I_C$	8	8	8	8	A
I_{CM}	15	15	15	15	A
$^*I_B$	0.25	0.25	0.25	0.25	A
$^*P_T$					
Up to 25°C	65	65	65	65	W
Above 25°C	See Fig. 3				
$^*T_J, T_{stg}$	−65 to +150				°C
$^*T_L$					
At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.	235				°C

* In accordance with JEDEC registration data format JS-6, RDF-4.

2N6530, 2N6531, 2N6532, 2N6533

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		2N6530		2N6531		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}	80 100			0 0	– –	1 –	– –	– 1	
* I_{CEV}	80 100	−1.5 −1.5			– –	0.5 –	– –	– 0.5	mA
* T_C = 125°C	80 100	−1.5 −1.5			– –	5 –	– –	– 5	
I_{EBO}		−5	0		–	5	–	5	mA
* h_{FE}	3 3 3		5[a] 3[a] 8[a]		1,000 – 100	10,000 – 5,000	– 500 100	– 10,000 5,000	
V_{CEO}(sus)			0.2	0	80[b]	–	100[b]	–	
V_{CER}(sus) R_{BE} = 100 Ω			0.2		80[b]	–	100[b]	–	V
* V_{CEV}(sus)		−1.5	0.2		80[b]	–	100[b]	–	
V_{BE}	3 3 3		5[a] 3[a] 8[a]		– – –	2.8 – 4.5*	– – –	– 2.8 4.5*	V
V_{CE}(sat)			3[a] 5[a] 8[a]	0.006 0.01 0.08	– – –	– 2 3*	– – –	3 – 3*	V
V_F			5[a] 8[a]		– –	– 5	– –	4 –	V
h_{fe} f = 1 kHz	5		1		1,000	–	1,000	–	
* $\|h_{fe}\|$ f = 1 MHz	5		1		20	–	20	–	
C_{obo} V_{CB} = 10 V f = 1 MHz					–	200	–	200	pF
* $I_{S/b}$ t = 0.5 s, nonrep.	24				2.7	–	2.7	–	A
$E_{S/b}$ L = 12 mH R_{BE} = 100 Ω		−1.5	4.5		120	–	120	–	mJ
$R_{\theta JC}$					–	1.92	–	1.92	°C/W

* In accordance with JEDEC registration data format JS-6, RDF-4.

[a] Pulsed, pulse duration = 300 μs, duty factor ≤ 2%.

[b] *CAUTION:* Sustaining voltages V_{CEO}(sus), V_{CER}(sus), and V_{CEV}(sus) *MUST NOT* be measured on a curve tracer.

2N6530, 2N6531, 2N6532, 2N6533

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS VOLTAGE V dc		TEST CONDITIONS CURRENT A dc		LIMITS 2N6532		LIMITS 2N6533		UNITS
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}	120 100			0 0	– –	– 1	– –	1 –	
* I_{CEV}	120 100	−1.5 −1.5			– –	– 0.5	– –	0.5 –	mA
* T_C = 125°C	120 100	−1.5 −1.5			– –	– 5	– –	5 –	
I_{EBO}		−5	0		–	5	–	5	mA
* h_{FE}	3 3 3		3[a] 5[a] 8[a]		– 1,000 100	– 10,000 5,000	1,000 – 100	10,000 – 5,000	
V_{CEO}(sus)			0.2	0	100[b]	–	120[b]	–	
V_{CER}(sus) R_{BE} = 100 Ω			0.2		100[b]	–	120[b]	–	V
* V_{CEV}(sus)		−1.5	0.2		100[b]	–	120[b]	–	
V_{BE}	3 3 3		3[a] 5[a] 8[a]		– – –	– 2.8 4.5*	– – –	2.8 – 4.5*	V
V_{CE}(sat)			3[a] 5[a] 8[a]	0.006 0.01 0.08	– – –	– 2 3*	– – –	2 – 3*	V
V_F			5[a] 8[a]		– –	– 5	– –	4 –	V
h_{fe} f = 1 kHz	5		1		1,000	–	1,000	–	
* $\|h_{fe}\|$ f = 1 MHz	5		1		20	–	20	–	
C_{obo} V_{CB} = 10 V f = 1 MHz					–	200	–	200	pF
* $I_{S/b}$ t = 0.5 s, nonrep.	24				2.7	–	2.7	–	A
$E_{S/b}$ L = 12 mH R_{BE} = 100 Ω		−1.5	4.5		120	–	120	–	mJ
$R_{\theta JC}$					–	1.92	–	1.92	°C/W

* In accordance with JEDEC registration data format JS-6, RDF-4.

[a] Pulsed, pulse duration = 300 μs, duty factor ⩽ 2%.

[b] *CAUTION:* Sustaining voltages V_{CEO}(sus), V_{CER}(sus), and V_{CEV}(sus) *MUST NOT* be measured on a curve tracer.

2N6530, 2N6531, 2N6532, 2N6533

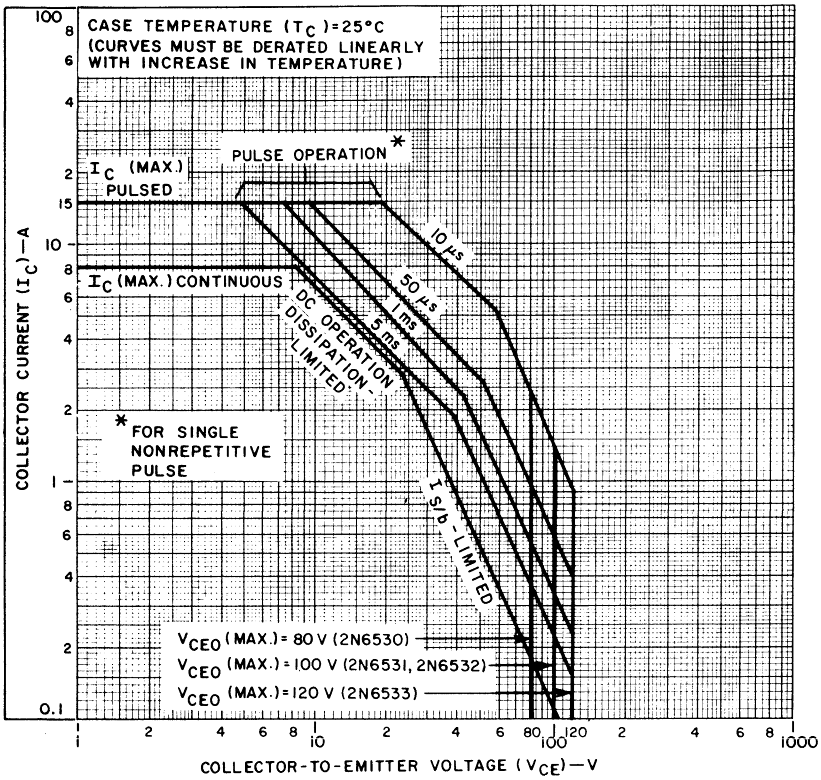


Fig. 2—Maximum operating areas for all types at case temperature of 25°C.

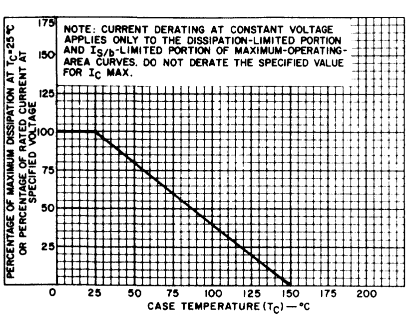


Fig. 3—Dissipation derating curve for all types.

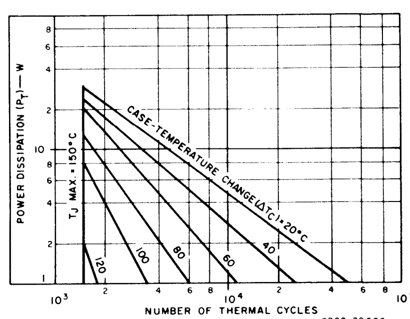


Fig. 4—Thermal-cycling rating chart for all types.

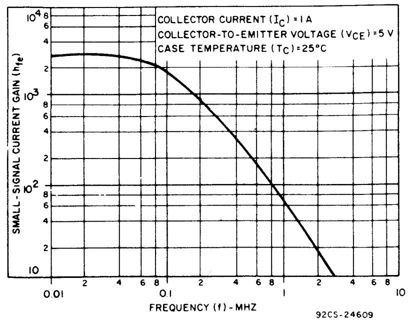


Fig. 5— Typical small-signal current gain for all types.

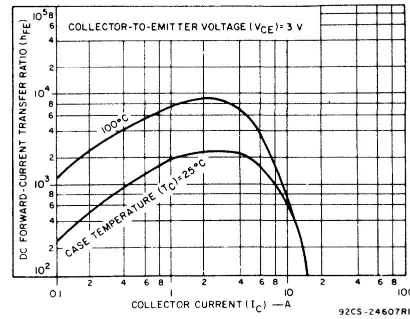


Fig. 6— Typical dc beta characteristics for all types.

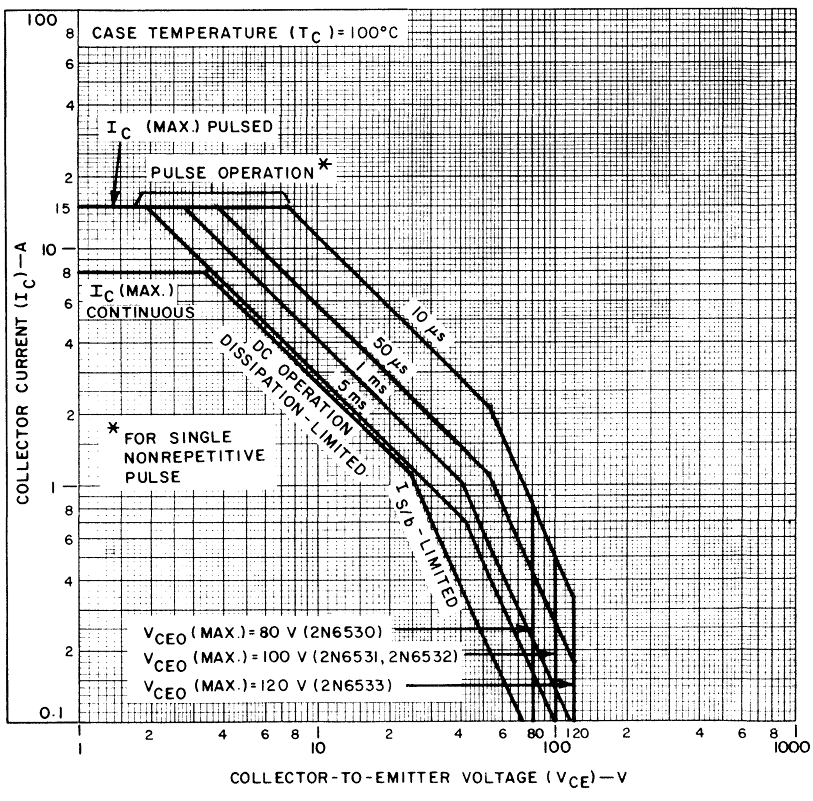


Fig. 7—Maximum operating areas for all types at case temperature of 100°C.

2N6530, 2N6531, 2N6532, 2N6533

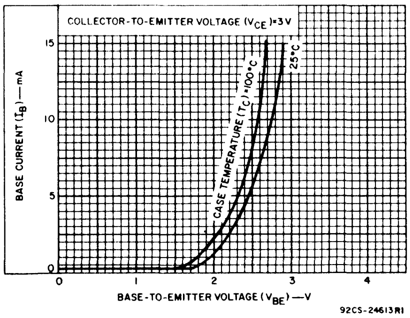


Fig. 8— Typical input characteristics for all types.

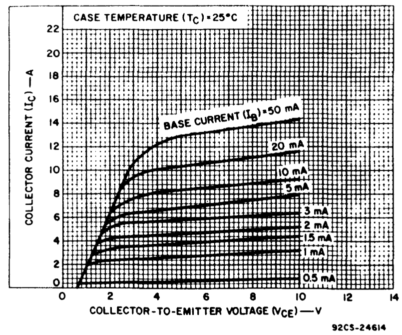


Fig. 9— Typical output characteristics for all types.

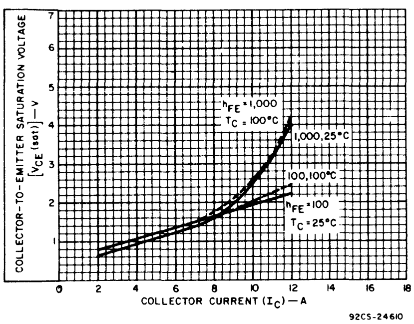


Fig. 10— Typical saturation characteristics for all types.

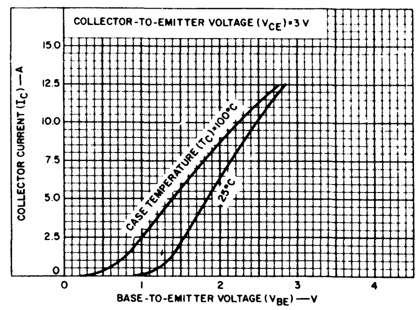


Fig. 11— Typical transfer characteristics for all types.

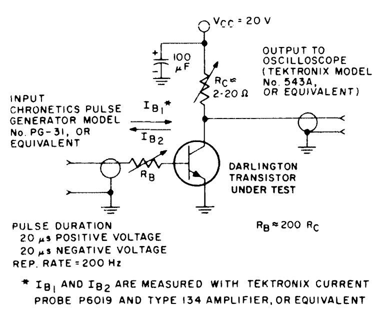


Fig. 12— Circuit used to measure saturated switching times.

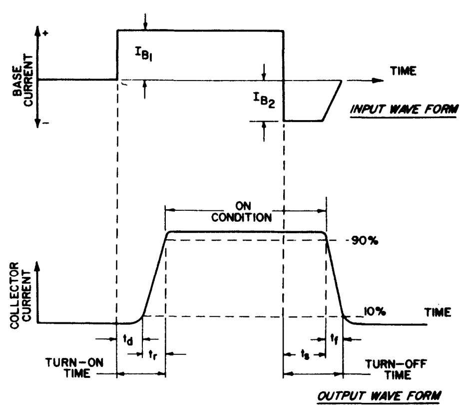


Fig. 13— Phase relationship between input current and output current, showing reference points for specification of switching times.

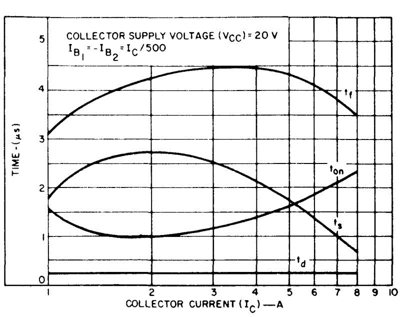


Fig. 14— Typical saturated switching-time characteristics for all types.

File Number **1152**

2N6576, 2N6577, 2N66578

15-Ampere N-P-N Darlington Power Transistors

60, 90, 120 Volts, 120 Watts
Gain of 2000 at 4 A

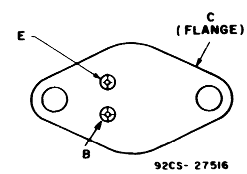
Features:

- Operates from IC without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

Applications:

- Power switching
- Audio amplifiers
- Hammer drivers
- Series and shunt regulators

TERMINAL DESIGNATIONS



JEDEC TO-204MA
(See dimensional outline "A".)

The 2N6576, 2N6577, and 2N6578 are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double epitaxial construction of these devices provides good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

All types utilize the steel JEDEC TO-204MA/TO-3 hermetic package.

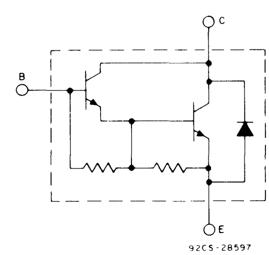


Fig. 1 – Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6576	2N6577	2N6578	
* V_{CBO}	60	90	120	V
* $V_{CEO}(sus)$	60	90	120	V
* V_{EBO}		7		V
* I_C		15		A
I_{CM}		30		A
* I_B		0.25		A
* P_T				
$T_C \leqslant 25°C$		120		W
$T_C > 25°C$		See Fig. 2		
* T_{stg}, T_J		−65 to 200		°C
* T_L				
At distances $\geqslant$ 1/32 in. (0.8 mm) from seating plane for 10 s max.		235		°C

* In accordance with JEDEC registration data.

2N6576, 2N6577, 2N66578

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

	CHARACTERISTIC SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{EB}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6576 MIN.	MAX.	2N6577 MIN.	MAX.	2N6578 MIN.	MAX.	UNITS
*	I_{CBO}	60[a]					–	0.5	–	–	–	–	
		90[a]					–	–	–	0.5	–	–	
		120[a]					–	–	–	–	–	0.5	
*	I_{CEO}	60				0	–	1	–	–	–	–	
		90				0	–	–	–	1	–	–	
		120				0	–	–	–	–	–	1	mA
	I_{CER}	60					–	5	–	–	–	–	
	R_{BE} = 10K	90					–	–	–	5	–	–	
*	T_C=150°C	120					–	–	–	–	–	5	
	I_{CEX}	60		–1.5			–	5	–	–	–	–	
	T_C=175°C	90		–1.5			–	–	–	5	–	–	
		120		–1.5			–	–	–	–	–	5	
*	I_{EBO}		7		0		–	7.5	–	7.5	–	7.5	mA
*	V_{CEO}(sus)				0.2[b]	0	60	–	90	–	120	–	V
*	h_{FE}	3			0.4[b]		200	–	200	–	200	–	
		3			4[b]		2000	20000	2000	20000	2000	20000	
		3			10[b]		500	5000	500	5000	500	5000	
		4			15[b]		100	–	100	–	100	–	
*	V_{BE}(sat)			10	0.1[b]		–	3.5	–	3.5	–	3.5	V
				15	0.15[b]		–	4.5	–	4.5	–	4.5	
*	V_{CE}(sat)				10[b]	0.1	–	2.8	–	2.8	–	2.8	
					15[b]	0.15	–	4	–	4	–	4	V
	V_F				–15		–	4.5	–	4.5	–	4.5	
*	h_{fe} f=1 MHz	3			3		4	40	4	40	4	40	
*	t_d[c]				10	0.1	–	0.15	–	0.15	–	0.15	
*	t_r[c]				10	0.1	–	1	–	1	–	1	μs
*	t_s[c]				10	0.1[d]	–	2	–	2	–	2	
*	t_f[c]				10	0.1[d]	–	7	–	7	–	7	
	$I_{S/b}$ t=1 s, non rep.	20					6	–	6	–	6	–	A
	$R_{\theta JC}$						–	1.46	–	1.46	–	1.46	°C/W

* In accordance with JEDEC registration data.
[a] V_{CB} value.
[b] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.
[c] V_{CC} = 30 V, t_p = 300 μs, duty cycle = 2%.
[d] $I_{B_1} = -I_{B_2}$.

2N6576, 2N6577, 2N66578

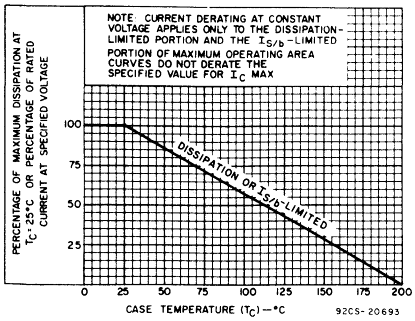


Fig. 2 — Derating curves for all types.

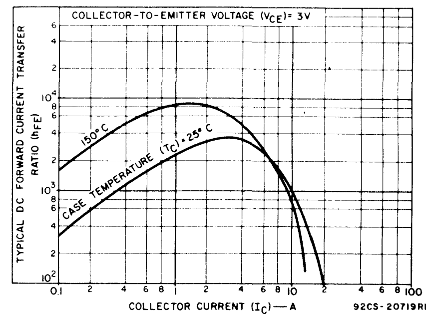


Fig. 3 — Typical dc-beta characteristics for all types.

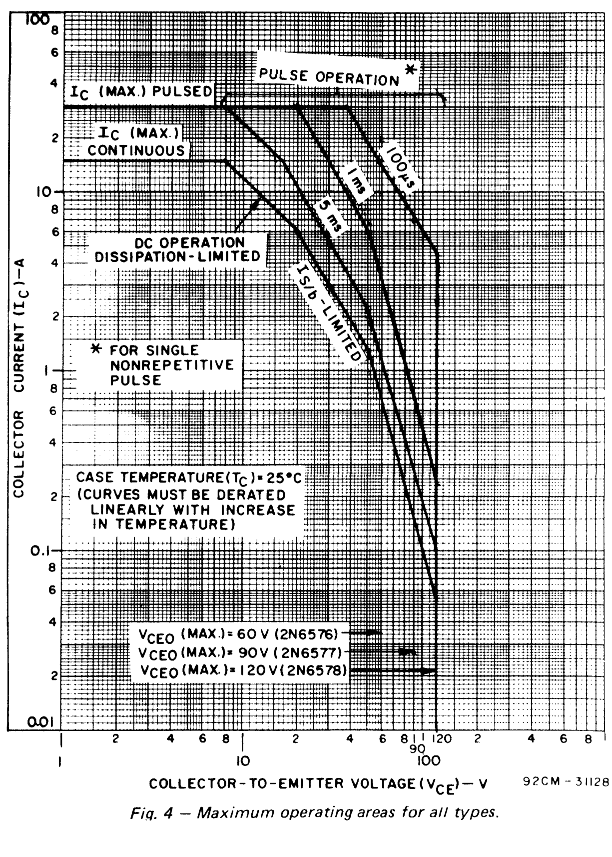


Fig. 4 — Maximum operating areas for all types.

2N6576, 2N6577, 2N66578

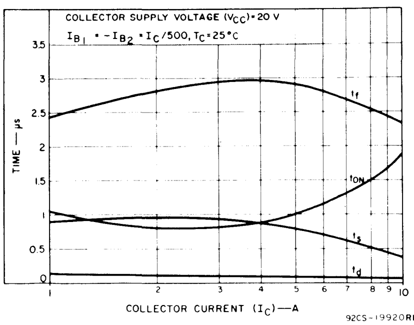


Fig. 5 — Typical saturated switching time characteristics for all types.

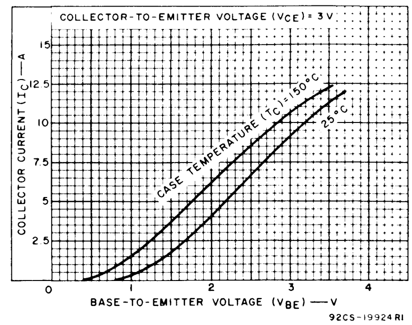


Fig. 6 — Typical transfer characteristics for all types.

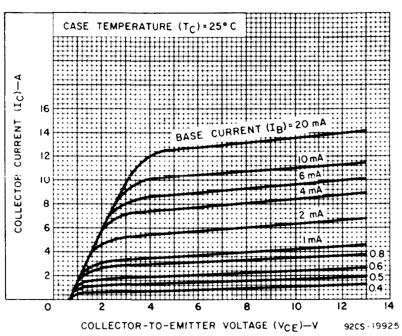


Fig. 7 — Typical output characteristics for all types.

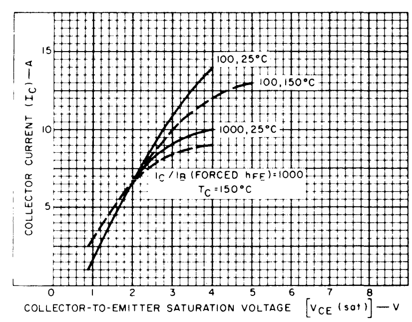


Fig. 8 — Typical saturation characteristics for all types.

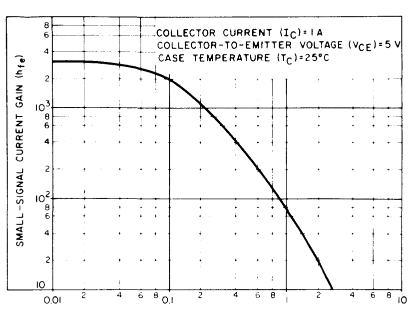


Fig. 9 — Typical small-signal gain for all types.

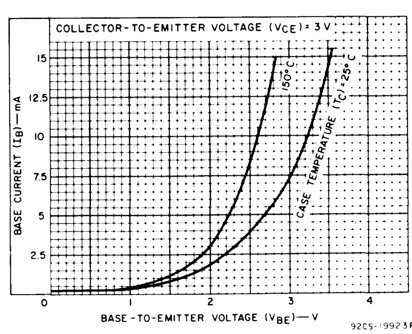


Fig. 10 — Typical input characteristics for all types.

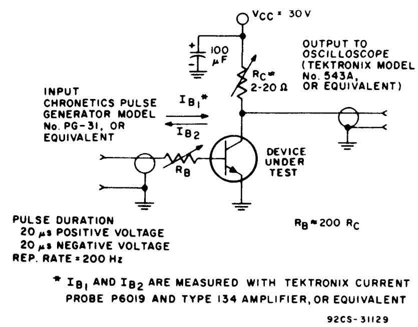
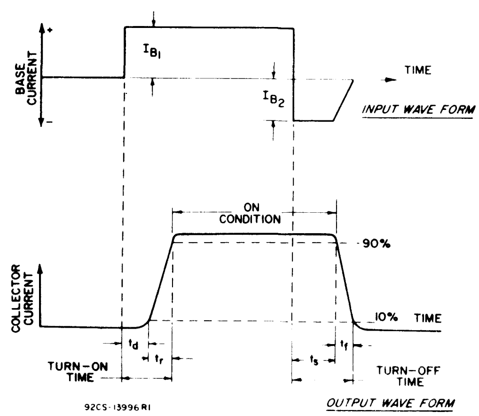


Fig. 11 – Circuit used to measure saturated-switching times.



2N6648, 2N6649, 2N6650

File Number **1013**

10-Ampere P-N-P Darlington Power Transistors

40-60-80 Volts, 70 Watts
Gain of 1000 at 5 A

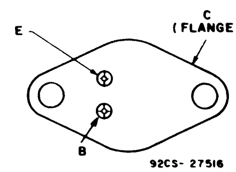
Features:

- Operates from IC without predriver
- High reverse second-breakdown capability

Applications:

- Power switching ■ Audio amplifiers
- Hammer drivers
- Series and shunt regulators

TERMINAL DESIGNATIONS



JEDEC TO-204MA
(See dimensional outline "A".)

The 2N6648, 2N6649 and 2N6650● are monolithic silicon p-n-p Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits. They are complementary to the 2N6383, 2N6384, and 2N6385▲.

The 2N6648, 2N6649, and 2N6650 are supplied in hermetic steel JEDEC TO-204MA packages.

● Formerly RCA Dev. Nos. TA8351, TA8488, and TA8350, respectively.

▲ Technical data for 2N6383, 2N6384, and 2N6385 are given in RCA bulletin File No. 609.

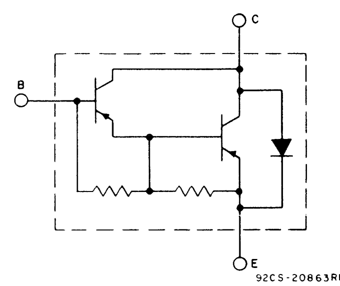


Fig. 1 – Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6648	2N6649	2N6650	
* V_{CBO}	–40	–60	–80	V
V_{CER}(sus) R_{BE} = 100 Ω	–40	–60	–80	V
* V_{CEO}(sus)	–40	–60	–80	V
V_{CEV}(sus) V_{BE} = –1.5 V	–40	–60	–80	V
* V_{EBO}	–5	–5	–5	V
* I_C	–10	–10	–10	A
I_{CM}	–15	–15	–15	A
* I_B	–0.25	–0.25	–0.25	A
* P_T				
$T_C \leqslant 25^oC$	70	70	70	W
$T_C > 25^oC$ Derate linearly		0.56		W/^{o}C
* T_{stg}, T_J		–65 to +150		^{o}C
* T_L At distances ⩾ 1/32 in. (0.8 mm) from seating plane for 10 s max.		235		^{o}C

* In accordance with JEDEC registration data format (JS-6 RDF-4)

2N6648, 2N6649, 2N6650

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc		TEST CONDITIONS CURRENT A dc		LIMITS 2N6648		LIMITS 2N6649		LIMITS 2N6650		UNITS
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
I_{CEO}	−40 −60 −80			0 0 0	– – –	−1 – –	– – –	– −1 –	– – –	– – −1	mA
* I_{CEV}	−40 −60 −80	1.5 1.5 1.5			– – –	−0.3 – –	– – –	– −0.3 –	– – –	– – −0.3	
T_C = 150°C	−40 −60 −80	1.5 1.5 1.5			– – –	−3 – –	– – –	– −3 –	– – –	– – −3	
* I_{EBO}		5	0		–	−10	–	−10	–	−10	mA
* $V_{CEO}(sus)$			−0.2[a]	0	−40	–	−60	–	−80	–	V
$V_{CER}(sus)$ R_{BE} = 100 Ω			−0.2[a]		−40	–	−60	–	−80	–	
$V_{CEV}(sus)$		1.5	−0.2[a]		−40	–	−60	–	−80	–	
* h_{FE}	−3 −3		−5[a] −10[a]		1000 100	20,000 –	1000 100	20,000 –	1000 100	20,000 –	
V_{BE}	−3 −3		−5[a] −10[a]		– –	−2.8 −4.5*	– –	−2.8 −4.5*	– –	−2.8 −4.5*	V
$V_{CE}(sat)$			−5[a] −10[a]	−0.01[a] −0.1[a]	– –	−2 −3*	– –	−2 −3*	– –	−2 −3*	V
V_F			10[a]		–	4	–	4	–	4	V
h_{fe} f = 1 kHz	−5		−1		1000	–	1000	–	1000	–	
* $\|h_{fe}\|$ f = 1 MHz	−5		−1		20	–	20	–	20	–	
$E_{S/b}$ L = 3 mH, R_{BE} = 100 Ω		1.5	−4.5		30	–	30	–	30	–	mJ
$I_{S/b}$ t = 1 s, nonrep.	−35 −25				−1 −2.8	– –	−1 −2.8	– –	−1 −2.8	– –	A
$R_{\theta JC}$					–	1.75	–	1.75	–	1.75	°C/W

* In accordance with JEDEC registration data format (JS-6 RDF-4).

a Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

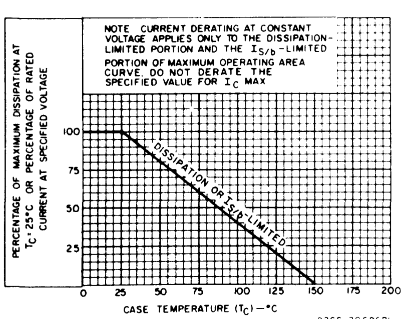


Fig.2 — Derating curve for all types.

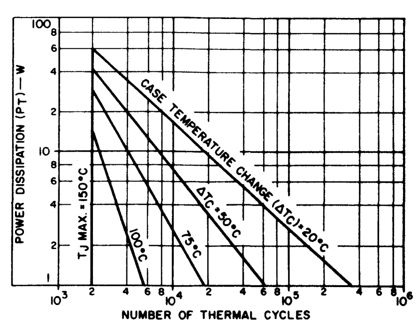


Fig.3 — Thermal-cycling rating chart for all types.

2N6648, 2N6649, 2N6650

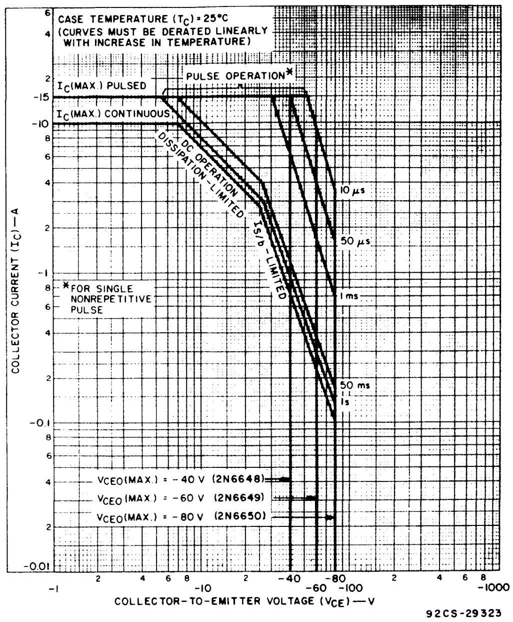


Fig.4 — Maximum operating areas for all types.

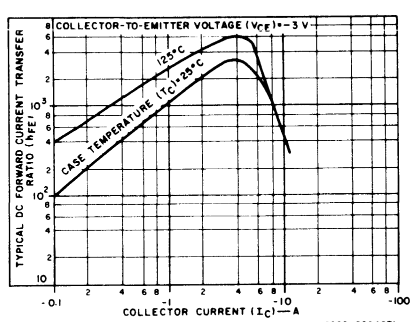


Fig.5 — Typical dc beta characteristics for all types.

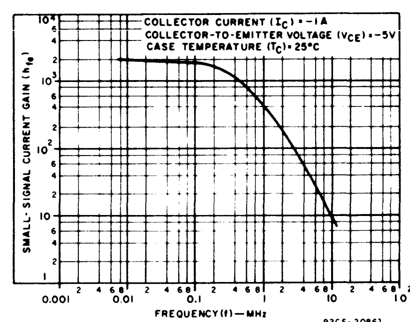


Fig.6 — Typical small-signal gain for all types.

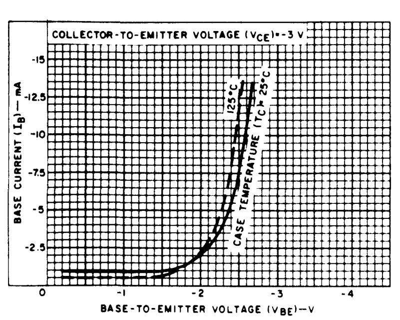


Fig.7 — Typical input characteristics for all types.

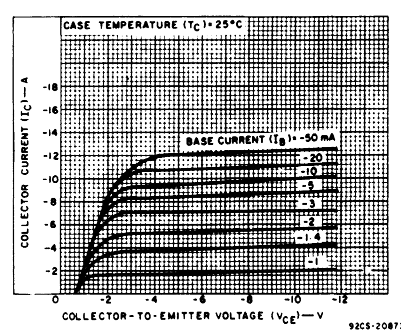


Fig.8 — Typical output characteristics for all types.

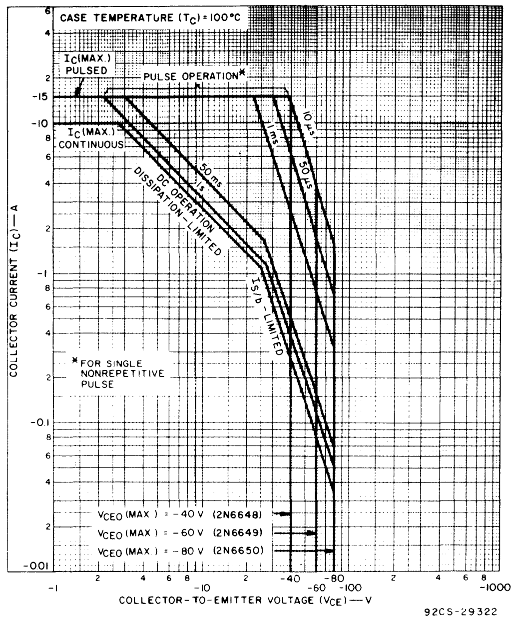


Fig.9 — Maximum operating areas for all types at $T_C = 100^oC$.

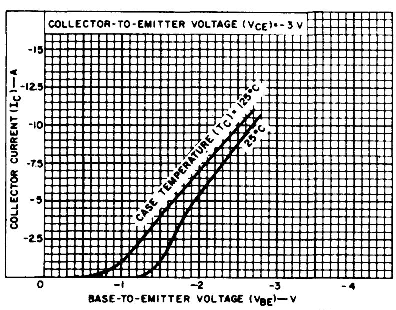


Fig. 10 — Typical transfer characteristics for all types.

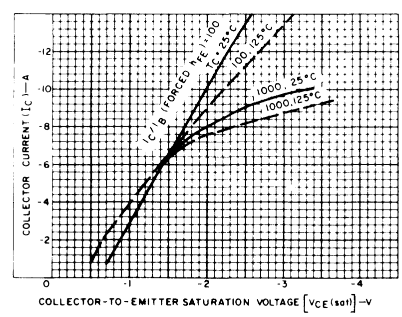


Fig. 11 — Typical saturation characteristics for all types.

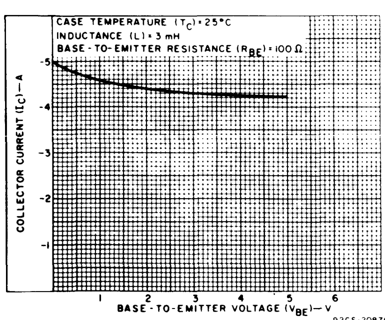


Fig. 12 — Minimum values of reverse-bias second breakdown characteristic ($E_{S/b}$) for all types.

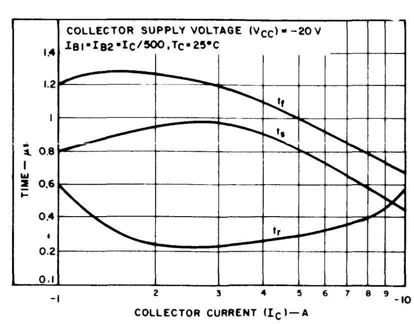


Fig. 13 — Typical saturated switching-time characteristics for all types.

2N6648, 2N6649, 2N6650

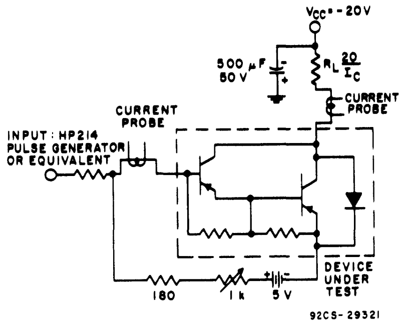


Fig. 14 – Circuit used to measure saturated switching times.

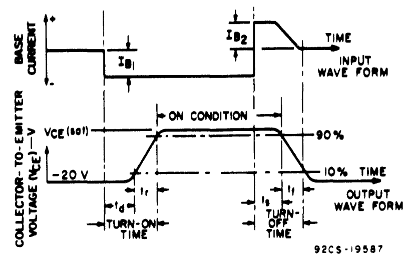


Fig. 15 – Phase relationship between input current and output current showing reference points for specification of switching times.

File Number **1069**

2N6666, 2N6667, 2N6668

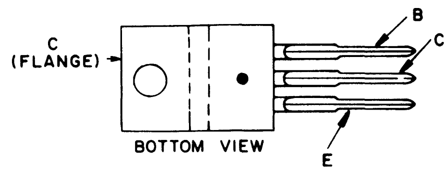
10-Ampere P-N-P Darlington Power Transistors

40-60-80 Volts, 65 Watts
Gain of 1000 at 3 A (2N6666)
Gain of 1000 at 5 A (2N6667, 2N6668)

Features:
- **Operates from IC without predriver**
- **High reverse second-breakdown capability**

Applications:
- **Power switching**
- **Audio amplifiers**
- **Hammer drivers**
- **Series and shunt regulators**

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

The 2N6666, 2N6667 and 2N6668● are monolithic silicon p-n-p Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits. They are complementary to the 2N6386, 2N6387 and 2N6388▲.

These devices are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package.

●Formerly RCA Dev. Nos. TA8204, TA8487 and TA8203, respectively.
▲Technical data for 2N6386-2N6388 are given in RCA Bulletin File No. 610.

Optional lead configurations are available upon request. For information, contact your nearest RCA Sales Office.

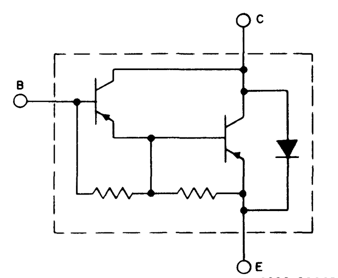


Fig. 1 — Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	2N6666	2N6667	2N6668	
* V_{CBO}	−40	−60	−80	V
V_{CER}(sus)				
R_{BE} = 100 Ω	−40	−60	−80	V
V_{CEO}(sus)	−40	−60	−80	V
V_{CEV}(sus)				
V_{BE} = −1.5 V	−40	−60	−80	V
* V_{EBO}	−5	−5	−5	V
* I_C	−8	−10	−10	A
I_{CM}	−15	−15	−15	A
* I_B	−0.25	−0.25	−0.25	A
* P_T				
$T_C \leq 25°C$	65	65	65	W
$T_C > 25°C$ ... derate linearly		0.52		W/°C
* T_{stg}, T_J		−65 to +150		°C
* T_L				
At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235		°C

*In accordance with JEDEC registration data format (JS-6 RDF-4).

2N6666, 2N6667, 2N6668

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS 2N6666 MIN.	MAX.	2N6667 MIN.	MAX.	2N6668 MIN.	MAX.	UNITS
I_{CEO}	−80			0	–	–	–	–	–	−1	mA
	−60			0	–	–	–	−1	–	–	
	−40			0	–	−1	–	–	–	–	
* I_{CEV}	−80	1.5			–	–	–	–	–	−0.3	
	−60	1.5			–	–	–	−0.3	–	–	
	−40	1.5			–	−0.3	–	–	–	–	
T_C = 125°C	−80	1.5			–	–	–	–	–	−3	
	−60	1.5			–	–	–	−3	–	–	
	−40	1.5			–	−3	–	–	–	–	
I_{EBO}		5	0		–	−10	–	−10	–	−10	mA
* V_{CEO}(sus)			−0.2[a]	0	−40	–	−60	–	−80	–	V
V_{CER}(sus) R_{BE} = 100 Ω			−0.2[a]		−40	–	−60	–	−80	–	
V_{CEV}(sus)		1.5	−0.2[a]		−40	–	−60	–	−80	–	
* h_{FE}	−3		−3[a]		1000	20,000	–	–	–	–	
	−3		−5[a]		–	–	1000	20,000	1000	20,000	
	−3		−8[a]		100	–	–	–	–	–	
	−3		−10[a]		–	–	100	–	100	–	
V_{BE}	−3		−3[a]		–	−2.8	–	–	–	–	V
	−3		−5[a]		–	–	–	−2.8	–	−2.8	
	−3		−8[a]		–	−4.5	–	–	–	–	
	−3		−10[a]		–	–	–	−4.5	–	−4.5	
* V_{CE}(sat)			−3[a]	−0.006[a]	–	−2	–	–	–	–	V
			−5[a]	−0.01[a]	–	–	–	−2	–	−2	
			−8[a]	−0.08[a]	–	−3	–	–	–	–	
			−10[a]	−0.1[a]	–	–	–	−3	–	−3	
V_F			8[a]		–	4	–	–	–	–	V
			10[a]		–	–	–	4	–	4	
h_{fe} f = 1 kHz	−5		−1		1000	–	1000	–	1000	–	
* $\|h_{fe}\|$ f = 1 MHz	−5		−1		20	–	20	–	20	–	
$E_{s/b}$ L = 3 mH, R_{BE} = 100 Ω		1.5	−4.5		30	–	30	–	30	–	mJ
$I_{S/b}$ t = 1 s, nonrep.	−20				−3.2	–	−3.2	–	−3.2	–	A
$R_{\theta JC}$					–	1.92	–	1.92	–	1.92	°C/W

[a]Pulsed: Pulse duration = 300 μs, duty factor = 2%.
*In accordance with JEDEC registration data format (JS-6 RDF-4).

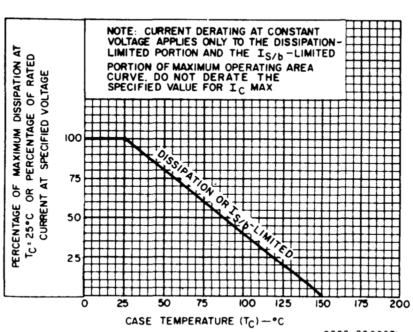


Fig. 2 — Derating curve for all types.

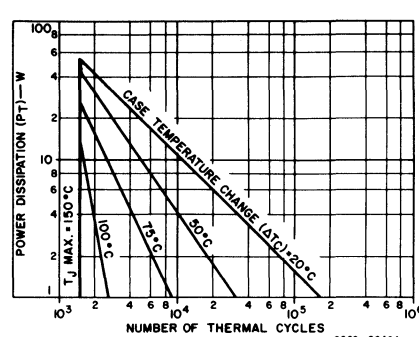


Fig. 3 — Thermal-cycling rating chart for all types.

2N6666, 2N6667, 2N6668

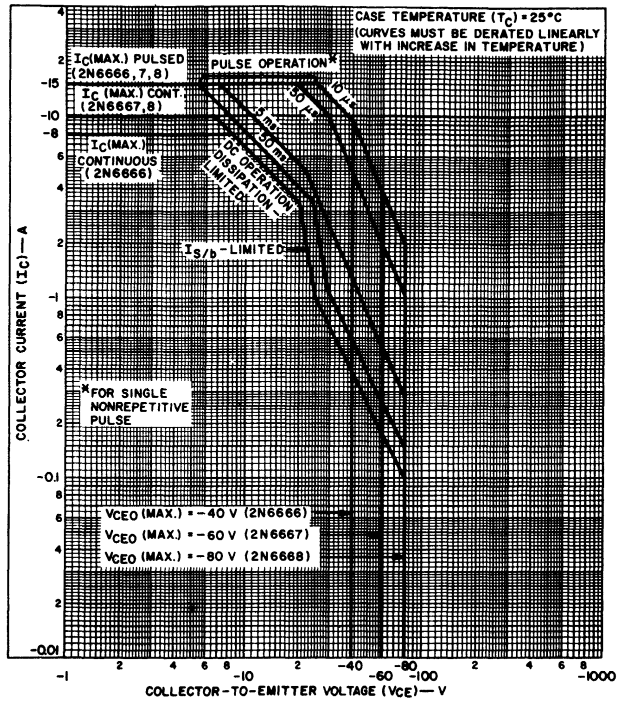


Fig. 4 — Maximum operating areas for all types at T_C=25° C.

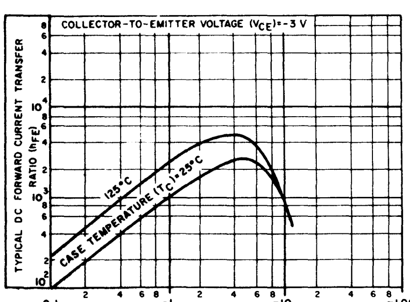


Fig. 5 — Typical dc beta characteristics for all types.

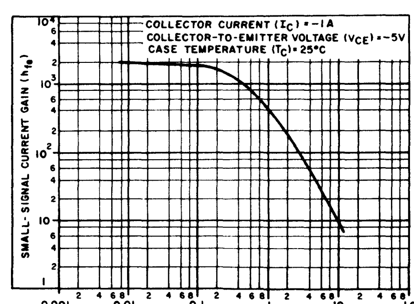


Fig. 6 — Typical small-signal gain for all types.

2N6666, 2N6667, 2N6668

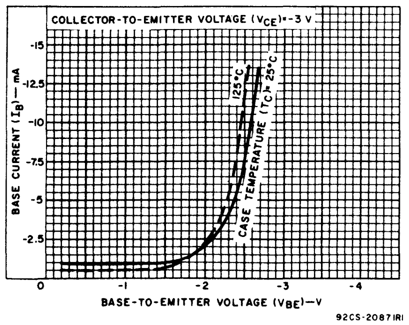


Fig. 7 — Typical input characteristics for all types.

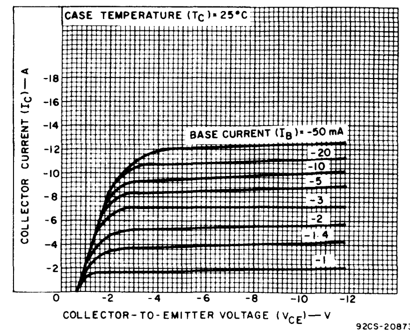


Fig. 8 — Typical output characteristics for all types.

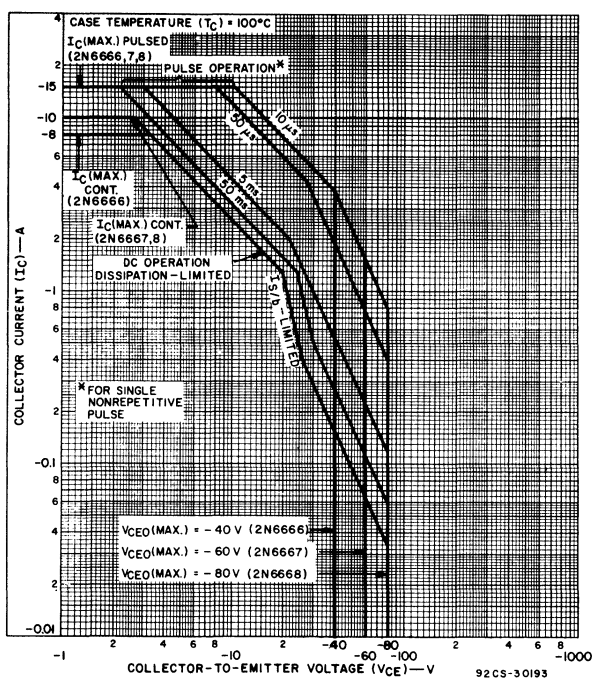


Fig. 9 — Maximum operating areas for all types at T_C=100°C.

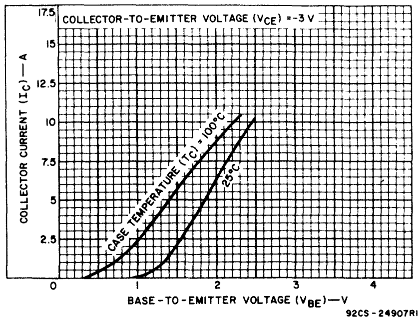


Fig. 10 — Typical transfer characteristics for all types.

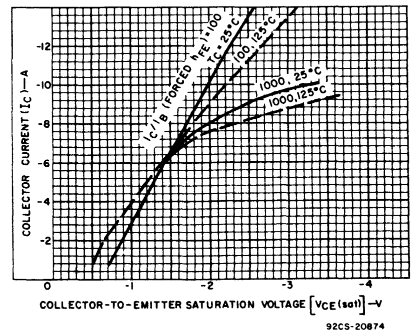


Fig. 11 — Typical saturation characteristics for all types.

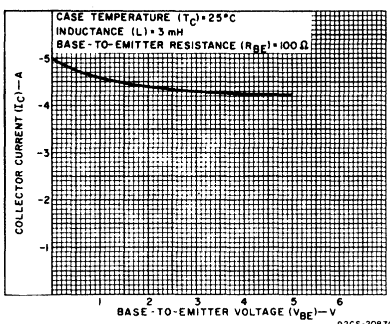


Fig. 12 — Minimum values of reverse-bias second breakdown characteristic ($E_{S/b}$) for all types.

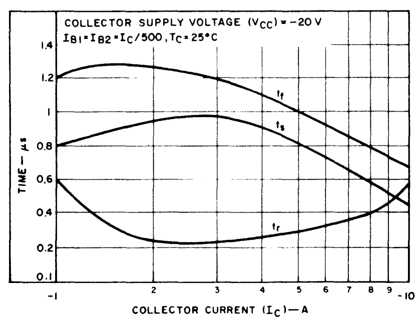


Fig. 13 — Typical saturated switching-time characteristics for all types.

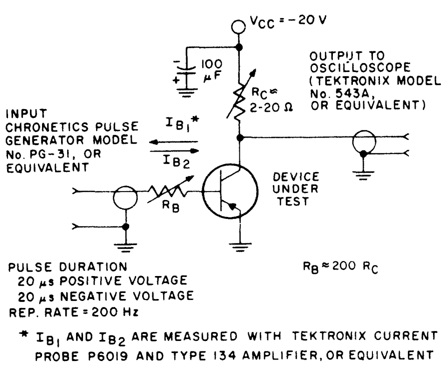


Fig. 14 — Circuit used to measure saturated switching times.

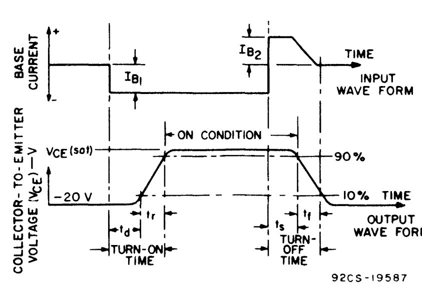


Fig. 15 — Phase relationship between input current and output current showing reference points for specification of switching times.

BD643, BD645, BD647, BD649

File Number **1241**

8-Ampere N-P-N Darlington Power Transistors

45-60-80 Volts, 70 Watts
Gain of 750 at 3A

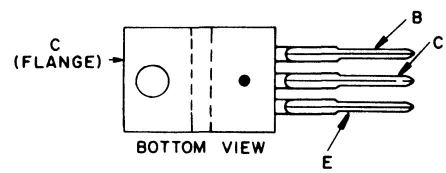
Features:

- Operates from IC without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

Applications:

- Power switching
- Hammer drivers
- Series and shunt regulators
- Audio amplifiers

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

The RCA-BD643, BD645, BD647, and BD649 are monolithic silicon n-p-n Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220AB (VERSAWATT) plastic package.

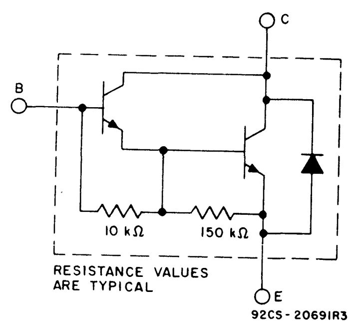


Fig. 1—Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BD643	BD645	BD647	BD649	
V_{CBO}	45	60	80	100	V
$V_{CEO}(sus)$	45	60	80	100	V
V_{EBO}	5				V
I_C	8				A
I_{CM}	12				A
I_B	0.15				A
P_T					
$T_C \leq 25°C$	62.5				W
$T_C > 25°C$	Derate linearly 0.5				W/°C
T_{stg}, T_J	−55 to 150				°C
T_L					
At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.	235				°C

BD643, BD645, BD647, BD649

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc			CUR-RENT A dc	BD643		BD645		
	V_{CB}	V_{CE}	V_{BE}	I_C	Min.	Max.	Min.	Max.	
I_{CEO}		20 30			— —	0.5 —	— —	— 0.5	mA
I_{CBO}	45 60				— —	0.2 —	— —	— 0.2	mA
T_C = 100°C	45 60				— —	2 —	— —	— 2	mA
I_{EBO}			—5	0	—	2	—	2	mA
$V_{(BR)CEO}$				0.1[a]	45	—	60	—	V
$V_{(BR)CBO}$				0.005	45	—	60	—	V
$V_{(BR)EBO}$ I_E = 2 mA					5	—	5	—	V
h_{FE}		3 3 3		0.5[a] 3[a] 6[a]	1500[b] 750 750[b]	— — —	1500[b] 750 750[b]	— — —	
V_{BE}		3		3[a]	—	2.5	—	2.5	V
$V_{CE}(sat)$ I_B = 12 mA				3[a]	—	2	—	2	V
f_T f = 1 MHz		3 3		3 3	1 10[b]	— —	1 10[b]	— —	MHz
$R_{\theta JC}$					—	2	—	2	°C/W

[a] Pulsed; pulse duration = 200 μs, duty factor = 1%. [b] Typical value.

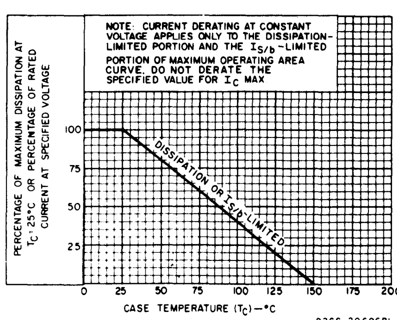


Fig. 2—Derating curve for all types.

BD643, BD645, BD647, BD649

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc			CURRENT A dc	LIMITS BD647		BD649		UNITS
	V_{CB}	V_{CE}	V_{BE}	I_C	Min.	Max.	Min.	Max.	
I_{CEO}		40			—	0.5	—	—	mA
		50			—	—	—	0.5	
I_{CBO}	80				—	0.2	—	—	
	100				—	—	—	0.2	
T_C = 100°C	80				—	2	—	—	
	100				—	—	—	2	
I_{EBO}			−5	0	—	2	—	2	
$V_{(BR)CEO}$				0.1[a]	80	—	100	—	V
$V_{(BR)CBO}$				0.005	80	—	100	—	
$V_{(BR)EBO}$ I_E = 2 mA					5	—	5	—	
h_{FE}		3		0.5[a]	1500[b]	—	1500[b]	—	
		3		3[a]	750	—	750	—	
		3		6[a]	750[b]	—	750[b]	—	
V_{BE}		3		3[a]	—	2.5	—	2.5	V
$V_{CE}(sat)$ I_B = 12 mA				3[a]	—	2	—	2	
f_T f = 1 MHz		3		3	1	—	1	—	MHz
		3		3	10[b]	—	10[b]	—	
$R_{\theta JC}$					—	2	—	2	°C/W

[a] Pulsed; pulse duration = 200 μs, duty factor = 1%.

[b] Typical value.

BD643, BD645, BD647, BD649

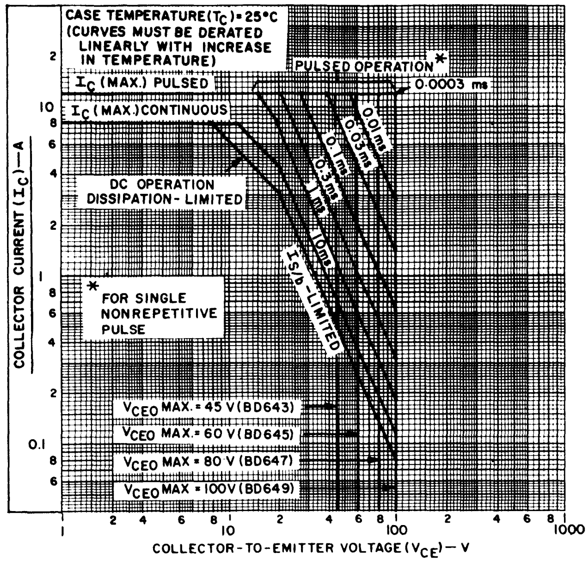


Fig. 3—Maximum operating area for all types.

BD895, BD895A, BD897, BD897A, BD899, BD899A, BD901 File Number **1240**

8-Ampere N-P-N Darlington Power Transistors

45-60-80-100-Volts, 70 Watts

Gain of 750 at 4 A
(BD895A, BD897A, BD899A)

Gain of 750 at 3 A
(BD895, BD897, BD899, BD901)

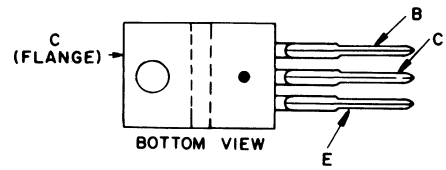
Features:

- **Operated from IC without predriver**
- **Low Leakage at high temperature**
- **High reverse second-breakdown capability**

Applications:

- **Power Switching**
- **Hammer drivers**
- **Series and shunt regulators**
- **Audio amplifiers**

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

The RCA-BD895, BD895A, BD897, BD897A, BD899, BD899A, and BD901 are monolithic silicon n-p-n Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220AB (VERSAWATT) plastic package.

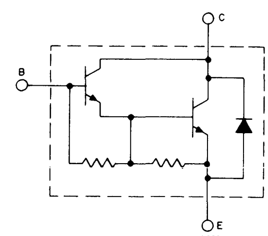


Fig. 1—Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BD895 BD895A	BD897 BD897A	BD899 BD899A	BD901 —	
V_{CBO}	45	60	80	100	V
$V_{CEO}(sus)$	45	60	80	100	V
V_{EBO}	5				V
I_C	8				A
I_B	0.1				A
P_T					
$T_C \leqslant 25°C$	70				W
$T_C > 25°C$	Derate linearly 0.56				W/°C
T_{stg}, T_J	−65 to 150				°C
T_L					
At distances ⩾ 1/8 in. (3.17 mm) from case for 10 s max	235				°C

BD895, BD895A, BD897, BD897A, BD899, BD899A, BD901

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS: VOLTAGE V dc			CURRENT A dc		LIMITS: BD895 BD895A		BD897 BD897A		UNITS
	V_{CB}	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}		20			0	—	500	—	—	μA
		30			0	—	—	—	500	
I_{CBO}	45					—	0.2	—	—	mA
	60					—	—	—	0.2	
T_C = 100°C	45					—	2	—	—	
	60					—	—	—	2	
I_{EBO}			−5	0		—	2	—	2	
V_{CEO}(sus)				0.1[a]	0	45	—	60	—	V
h_{FE} BD895,BD897		3		3[a]		750	—	750	—	
BD895A,BD897A		3		4[a]		750	—	750	—	
V_{BE} BD895,BD897		3		3[a]		—	2.5	—	2.5	V
BD895A,BD897A		3		4[a]		—	2.5	—	2.5	
V_{CE}(sat) BD895 BD897				3[a]	0.012	—	2.5	—	2.5	
BD895A,BD897A				4[a]	0.016	—	2.8	—	2.8	
h_{fe} f = 1 MHz		3		3		1	—	1	—	
$R_{\theta JC}$						—	1.78	—	1.78	°C/W

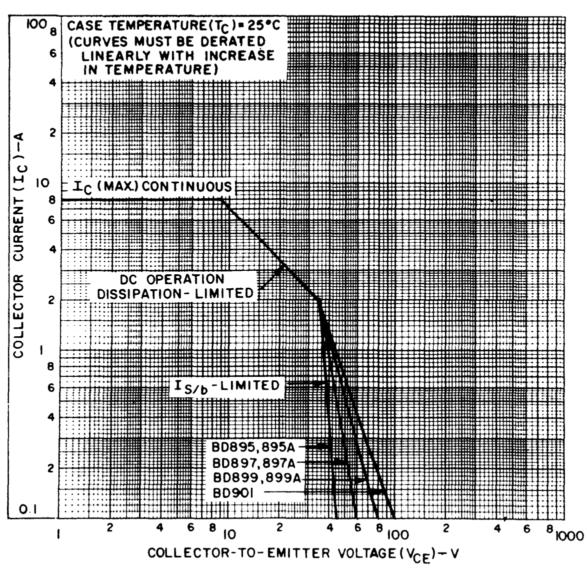


Fig. 2—Maximum operating areas for all types.

BD895, BD895A, BD897, BD897A, BD899, BD899A, BD901

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS					LIMITS				UNITS
	VOLTAGE V dc			CURRENT A dc		BD899 BD899A		BD901		
	V_{CB}	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}		40			0	—	500	—	—	µA
		50			0	—	—	—	500	
I_{CBO}	80					—	0.2	—	—	mA
	100					—	—	—	0.2	
T_C = 100°C	80					—	2	—	—	
	100					—	—	—	2	
I_{EBO}			−5	0		—	2	—	2	
$V_{CEO}(sus)$				0.1[a]	0	80	—	100	—	V
h_{FE} BD899,BD901		3		3[a]		750	—	750	—	
BD899A only		3		4[a]		750	—	—	—	
V_{BE} BD899,BD901		3		3[a]		—	2.5	—	2.5	V
BD899A only		3		4[a]		—	2.5	—	—	
$V_{CE}(sat)$ BD899 BD901				3[a]	0.012	—	2.5	—	2.5	
BD899A only				4[a]	0.016	—	2.8	—	—	
h_{fe} f = 1 MHz		3		3[a]		1	—	1	—	
$R_{\theta JC}$						—	1.78	—	1.78	°C/W

[a] Pulsed: Pulse duration = 300 µs, duty factor = 1.8%.

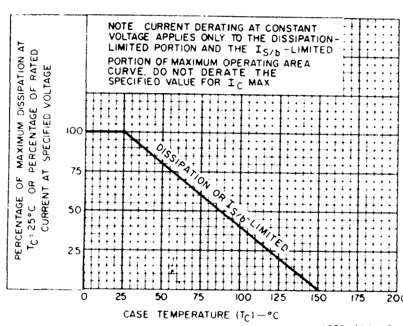


Fig. 3—Derating curve for all types.

File Number **693**

BDX33, BDX33A, BDX33B, BDX33C, BDX33D

10-Ampere N-P-N Darlington Power Transistors

45-60-80-100-120 Volts, 70 Watts

Gain of 750 at 4 A (BDX33, BDX33A)
Gain of 750 at 3 A (BDX33B, BDX33C, BDX33D)

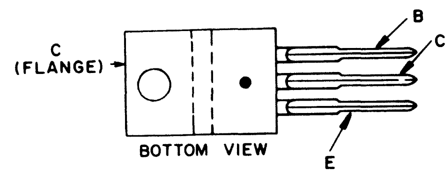
Features:

- Operates from IC without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

Applications:

- Power switching
- Hammer drivers
- Series and shunt regulators
- Audio amplifiers

TERMINAL DESIGNATIONS



92CS-37394

JEDEC TO-220AB
(See dimensional outline "N".)

The RCA-BDX33, BDX33A, BDX33B, BDX33C, and BDX33D are monolithic silicon Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits.

The BDX33, BDX33A, BDX33B, and BDX33C are complementary to the BDX34, BDX34B, and BDX34C, described in File 694.

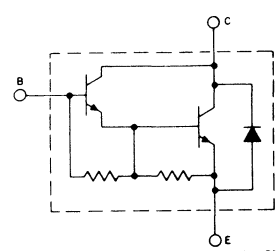


Fig. 1 – Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BDX33	BDX33A	BDX33B	BDX33C	BDX33D	
V_{CBO}	45	60	80	100	120	V
$V_{CER}(sus)$ (R_{BE}) = 100 Ω	45	60	80	100	120	V
$V_{CEO}(sus)$	45	60	80	100	120	V
$V_{CEX}(sus)$ V_{BE} = −1.5 V	45	60	80	100	120	V
V_{EBO}	5	5	5	5	5	V
I_C	10	10	10	10	10	A
I_B	0.25	0.25	0.25	0.25	0.25	A
P_T						
$T_C \leq 25°C$	70	70	70	70	70	W
$T_C > 25°C$	Derate linearly 0.56					W/°C
T_{stg}, T_J	−65 to +150					°C
T_L At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.	235					°C

BDX33, BDX33A, BDX33B, BDX33C, BDX33D

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc			CURRENT A dc	LIMITS BDX33		BDX33A		BDX33B		UNITS
	V_{CB}	V_{CE}	V_{BE}	I_C	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CEO}		40			–	–	–	–	–	0.5	
		30			–	–	–	0.5	–	–	
		20			–	0.5	–	–	–	–	
T_C = 100°C		40			–	–	–	–	–	10	
		30			–	–	–	10	–	–	
		20			–	10	–	–	–	–	mA
I_{CBO}	80				–	–	–	–	–	1	
	60				–	–	–	1	–	–	
	45				–	1	–	–	–	–	
T_C = 100°C	80				–	–	–	–	–	5	
	60				–	–	–	5	–	–	
	45				–	5	–	–	–	–	
I_{EBO}			−5	0	–	10	–	10	–	10	mA
$V_{CEO}(sus)$				0.1[a]	45	–	60	–	80	–	
$V_{CER}(sus)$ (R_{BE}) = 100 Ω				0.1[a]	45	–	60	–	80	–	V
$V_{CEV}(sus)$			−1.5	0.1[a]	45	–	60	–	80	–	
h_{FE}		3		3[a]	–	–	–	–	750	–	
		3		4[a]	750	–	750	–	–	–	
V_{BE}		3		3[a]	–	–	–	–	–	2.5	V
		3		4[a]	–	2.5	–	2.5	–	–	
$V_{CE}(sat)$ I_B = 0.006				3[a]	–	–	–	–	–	2.5	V
I_B = 0.008				4[a]	–	2.5	–	2.5	–	–	
V_F				8	–	4	–	4	–	4	V
h_{fe} f = 1 kHz		5		1	1000	–	1000	–	1000	–	
$\|h_{fe}\|$ f = 1.0 MHz		5		1	20	–	20	–	20	–	
$E_{S/b}$[b] R_{BE} = 100 Ω, L = 12 mH			−1.5	4.5	120	–	120	–	120	–	mJ
$I_{S/b}$ t_p = 0.5 s non-rep.		25			2.8	–	2.8	–	2.8	–	A
		36			1	–	1	–	1	–	
$R_{\theta JC}$					–	1.78	–	1.78	–	1.78	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

[b] $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse bias conditions. $E_{S/b}$ = $1/2LI^2$ where L is a series load or leakage inductance and I is the peak collector current.

BDX33, BDX33A, BDX33B, BDX33C, BDX33D

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc			TEST CONDITIONS CURRENT A dc		LIMITS BDX33C		LIMITS BDX33D		UNITS
	V_{CB}	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}		60 50			0 0	– –	– 0.5	– –	0.5 –	
T_C = 100°C		60 50			0 0	– –	– 10	– –	10 –	mA
I_{CBO}	120 100					– –	– 1	– –	1 –	
T_C = 100°C	120 100					– –	– 5	– –	5 –	
I_{EBO}			−5	0		–	10	–	10	mA
V_{CEO}(sus)				0.1[a]	0	100	–	120	–	
V_{CER}(sus) (R_{BE}) = 100 Ω				0.1[a]		100	–	120	–	V
V_{CEV}(sus)			−1.5	0.1[a]		100	–	120	–	
h_{FE}		3		3[a]		750	–	750	–	
V_{BE}		3		3[a]		–	2.5	–	2.5	V
V_{CE}(sat)				3[a]	0.006	–	2.5	–	2.5	V
V_F				8		–	4	–	4	V
h_{fe} f = 1 kHz		5		1		1000	–	1000	–	
$\|h_{fe}\|$ f = 1.0 MHz		5		1		20	–	20	–	
$E_{S/b}$[b] R_{BE} = 100 Ω L = 12 mH			−1.5	4.5		120	–	120	–	mJ
$I_{S/b}$ t_p = 0.5 s non-rep.		25 36				2.8 1	– –	2.8 1	– –	A
$R_{\theta JC}$						–	1.78	–	1.78	°C/W

a Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

b $E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse bias conditions. $E_{S/b} = 1/2LI^2$ where L is a series load or leakage inductance and I is the peak collector current.

BDX33, BDX33A, BDX33B, BDX33C, BDX33D

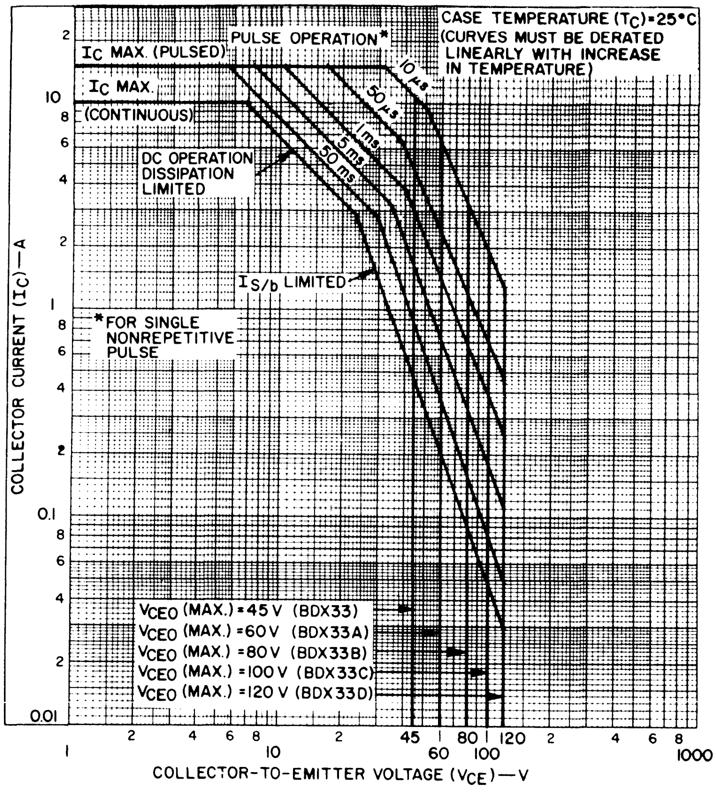


Fig. 2 – Maximum operating areas for BDX33-series types.

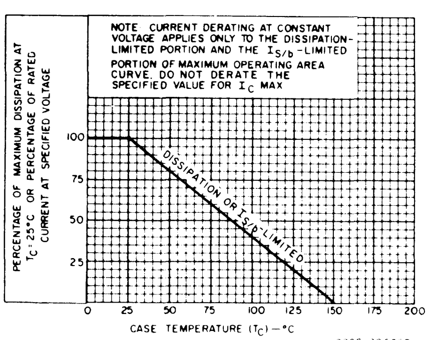


Fig. 3 – Derating curve for all types.

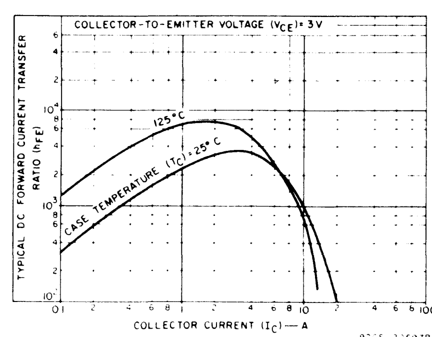


Fig. 4 – Typical dc-beta characteristics for all types.

BDX33, BDX33A, BDX33B, BDX33C, BDX33D

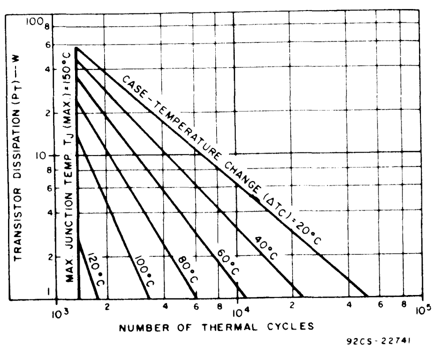


Fig. 5 – Thermal-cycling rating chart for all types.

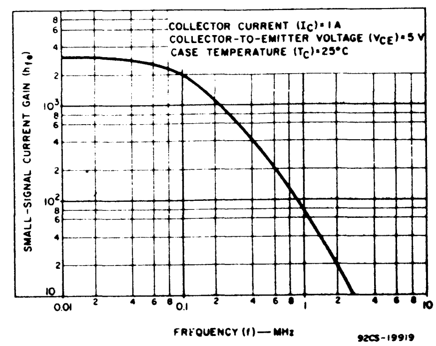


Fig. 6 – Typical small-signal gain for all types.

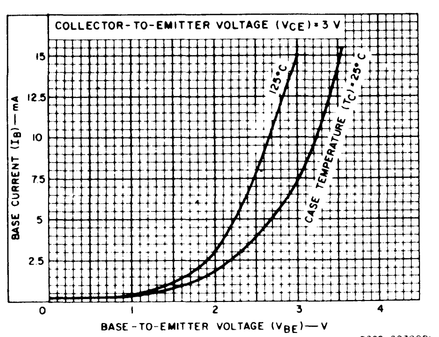


Fig. 7 – Typical input characteristics for all types.

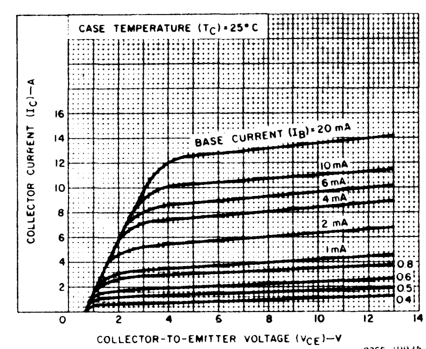


Fig. 8 – Typical output characteristics for all types.

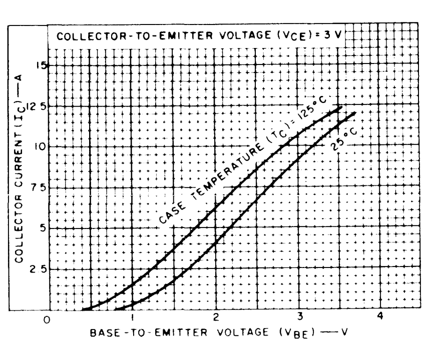


Fig. 9 – Typical transfer characteristics for all types.

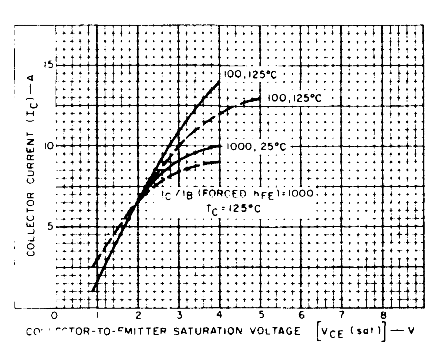


Fig. 10 – Minimum values of reverse-bias second breakdown characteristic ($E_{S/b}$) for all types.

BDX33, BDX33A, BDX33B, BDX33C, BDX33D

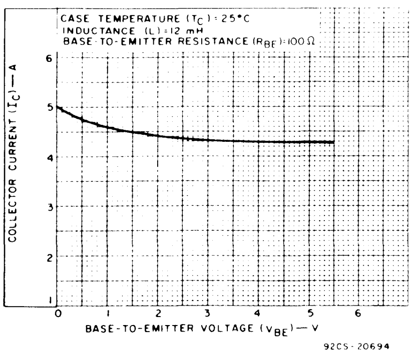


Fig. 11 – Typical saturation characteristics for all types.

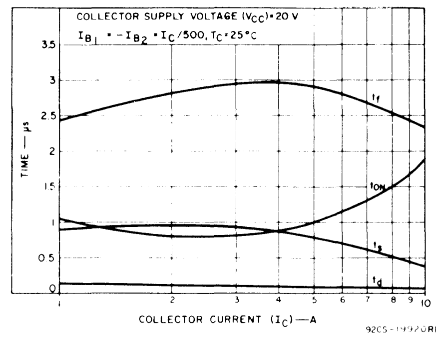


Fig. 12 – Typical saturated switching-time characteristics for all types.

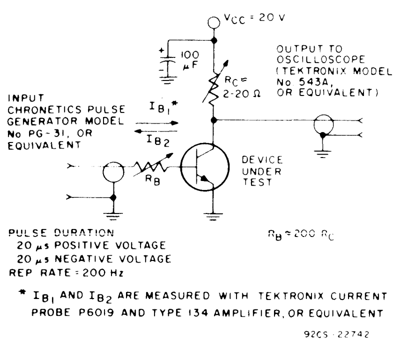


Fig. 13 – Circuit used to measure saturated switching times.

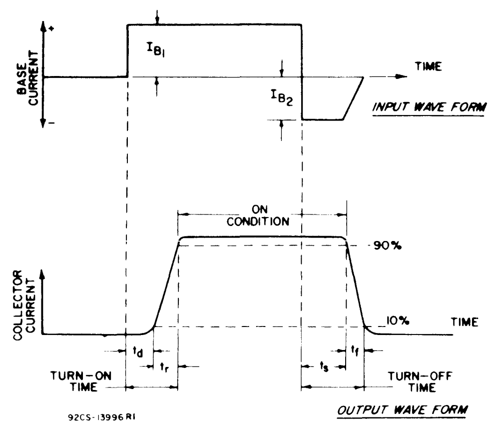


Fig. 14 – Phase relationship between input current and output current showing reference points for specifications of switching times (test circuit shown in Fig. 13).

File Number **694**

BDX34, BDX34A, BDX34B, BDX34C, BDX34D

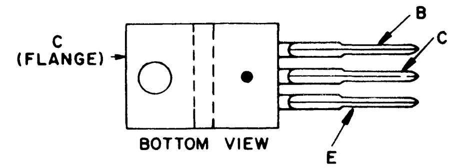
10-Ampere P-N-P Darlington Power Transistors

45-60-80-100-120 Volts, 70 Watts
Gain of 750 at 4 A (BDX34, BDX34A)
Gain of 750 at 3 A (BDX34B, BDX34C, BDX34D)

Features:
- *Operates from IC without predriver*
- *Low leakage at high temperature*
- *High reverse second-breakdown capability*

Applications:
- *Power switching*
- *Hammer drivers*
- *Series and shunt regulators*
- *Audio amplifiers*

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

The BDX34, BDX34A, BDX34B, BDX34C, and BDX34D are monolithic p-n-p silicon Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits. They are complementary to the BDX33, BDX33A, BDX33B, BDX33C, and BDX33D described in RCA Bulletin File No. 693.

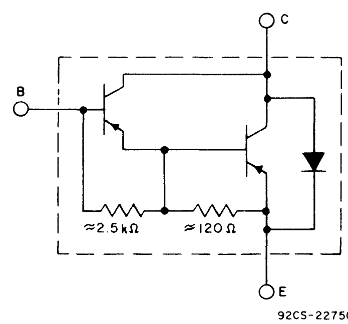


Fig. 1 - Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BDX34	BDX34A	BDX34B	BDX34C	BDX34D	
V_{CBO}	-45	-60	-80	-100	-120	V
$V_{CER}(sus)$ (R_{BE})=100 Ω	-45	-60	-80	-100	-120	V
$V_{CEO}(sus)$	-45	-60	-80	-100	-120	V
$V_{CEX}(sus)$ V_{BE}=-1.5 V	-45	-60	-80	-100	-120	V
V_{EBO}			-5			V
I_C			-10			A
I_B			-0.25			A
P_T $T_C \leq 25°C$			70			W
$T_C > 25°C$			Derate linearly 0.56			W/°C
T_{stg}, T_J			-65 to +150			°C
T_L At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.			235			°C

BDX34, BDX34A, BDX34B, BDX34C, BDX34D

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25°C Unless Otherwise Specified*

CHARAC-TERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc			CUR-RENT A dc	BDX34		BDX34A		BDX34B		
	V_{CB}	V_{CE}	V_{BE}	I_C	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CEO}		-40			—	—	—	—	—	-0.5	
		-30			—	—	—	-0.5	—	—	
		-20			—	-0.5	—	—	—	—	
T_C=100°C		-40			—	—	—	—	—	-10	
		-30			—	—	—	-10	—	—	
		-20			—	-10	—	—	—	—	
I_{CBO}	-80				—	—	—	—	—	-1	mA
	-60				—	—	—	-1	—	—	
	-45				—	-1	—	—	—	—	
T_C=100°C	-80				—	—	—	—	—	-5	
	-60				—	—	—	-5	—	—	
	-45				—	-5	—	—	—	—	
I_{EBO}			5	0	—	-10	—	-10	—	-10	
V_{CEO}(sus)				-0.1[a]	-45	—	-60	—	-80	—	
V_{CER}(sus) (R_{BE})=100 Ω				-0.1[a]	-45	—	-60	—	-80	—	V
V_{CEV}(sus)			1.5	-1.0[a]	-45	—	-60	—	-80	—	
h_{FE}		-3		-3[a]	—	—	—	—	750	—	
		-3		-4[a]	750	—	750	—	—	—	
V_{BE}		-3		-3[a]	—	—	—	—	—	-2.5	
		-3		-4[a]	—	-2.5	—	-2.5	—	—	
V_{CE}(sat) I_B=-0.006 A				-3[a]	—	—	—	—	—	-2.5	V
=-0.008 A				-4[a]	—	-2.5	—	-2.5	—	—	
V_F				-8	—	-4	—	-4	—	-4	
h_{fe} (f=1.0 kHz)		-5		-1	1000	—	1000	—	1000	—	
$\|h_{fe}\|$ (f=1.0 MHz)		-5		-1	20	—	20	—	20	—	
$E_{S/b}$[b] L=3 mH R_{BE}=100 Ω			1.5	-4.5	30	—	30	—	30	—	mJ
$I_{S/b}$		-20			-3.5	—	-3.5	—	-3.5	—	A
t_p=0.5s non-rep.		-33			-1	—	-1	—	-1	—	
$R_{\theta JC}$					—	1.78	—	1.78	—	1.78	°C/W

[a]Pulsed: Pulse duration=300 μs, duty factor=1.8%.

[b]$E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse bias conditions.

$E_{S/b}=\frac{1}{2}LI^2$ where L is a series load or leakage inductance and I is the peak collector current.

BDX34, BDX34A, BDX34B, BDX34C, BDX34D

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C)=25° C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc			CURRENT A dc	LIMITS BDX34C		BDX34D		UNITS
	V_{CB}	V_{CE}	V_{BE}	I_C	Min.	Max.	Min.	Max.	
I_{CEO}		-60			—	—	—	-0.5	mA
		-50			—	-0.5	—	—	mA
T_C=100° C		-60			—	—	—	-10	mA
		-50			—	-10	—	—	mA
I_{CBO}	-120				—	—	—	-1	mA
	-100				—	-1	—	—	mA
T_C=100° C	-120				—	—	—	-5	mA
	-100				—	-5	—	—	mA
I_{EBO}			5	0	—	-10	—	-10	mA
V_{CEO}(sus)				-0.1[a]	-100	—	-120	—	V
V_{CER}(sus) (R_{BE})=100 Ω				-0.1[a]	-100	—	-120	—	V
V_{CEV}(sus)			1.5	-1.0[a]	-100	—	-120	—	V
h_{FE}		-3		-3[a]	750	—	750	—	
V_{BE}		-3		-3[a]	—	-2.5	—	-2.5	V
V_{CE}(sat) I_B=-0.006 A				-3[a]	—	-2.5	—	-2.5	V
V_F				-8	—	-4	—	-4	V
h_{fe} (f=1.0 kHz)		-5		-1	1000	—	1000	—	
$\|h_{fe}\|$ (f=1.0 MHz)		-5		-1	20	—	20	—	
$E_{S/b}$[b] L=3 mH R_{BE}=100 Ω			1.5	-4.5	30	—	30	—	mJ
$I_{S/b}$ t_p=0.5 s non-rep.		-20			-3.5	—	-3.5	—	A
		-33			-1	—	-1	—	A
$R_{\theta JC}$					—	1.78	—	1.78	°C/W

[a]Pulsed: Pulse duration=300 μs, duty factor=1.8%.

[b]$E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse bias conditions.

$E_{S/b}=\frac{1}{2}LI^2$ where L is a series load or leakage inductance and I is the peak collector current.

BDX34, BDX34A, BDX34B, BDX34C, BDX34D

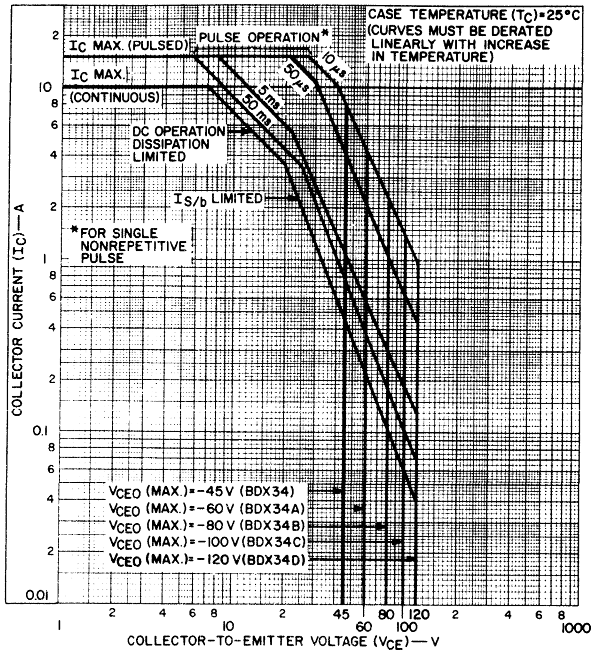


Fig. 2 - Maximum operating areas for BDX34-series types.

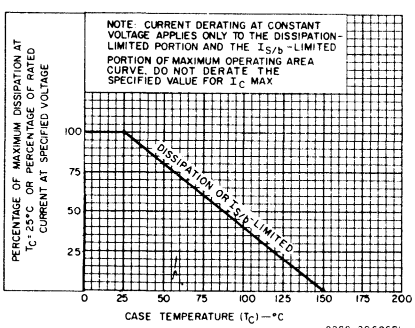


Fig. 3 - Current derating curve for all types.

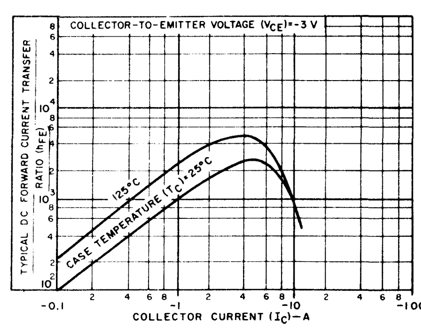


Fig. 4 - Typical dc beta characteristics for all types.

BDX34, BDX34A, BDX34B, BDX34C, BDX34D

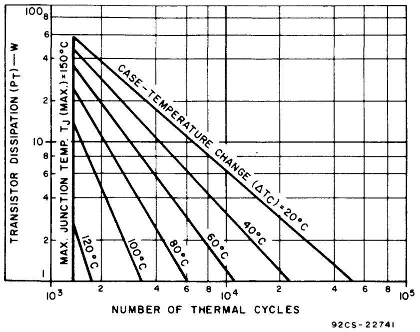


Fig. 5 - Thermal-cycling rating chart for all types.

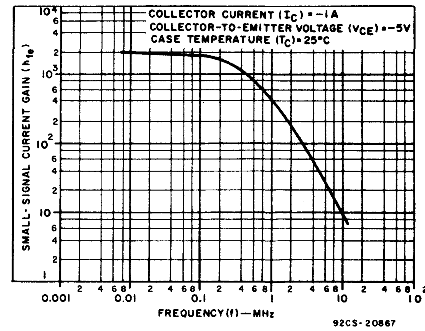


Fig. 6 - Typical small-signal gain for all types.

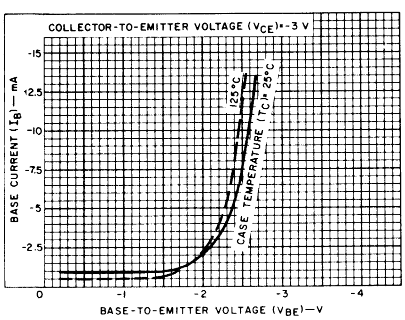


Fig. 7 - Typical input characteristics for all types.

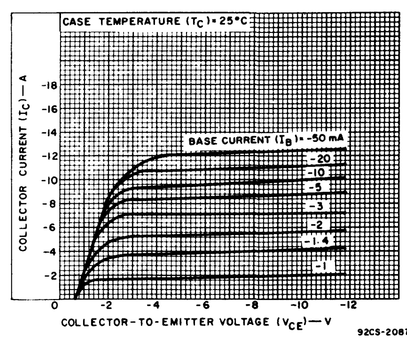


Fig. 8 - Typical output characteristics for all types.

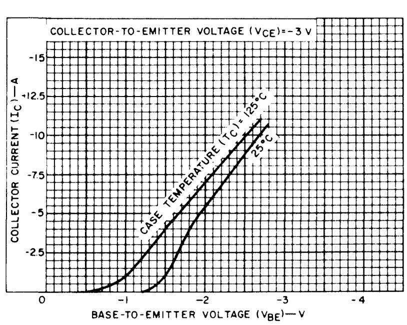


Fig. 9 - Typical transfer characteristics for all types.

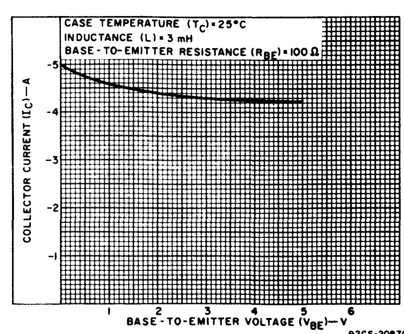


Fig. 10 - Minimum values of reverse-bias second breakdown characteristic $[E_{S/b}]$ for all types.

BDX34, BDX34A, BDX34B, BDX34C, BDX34D

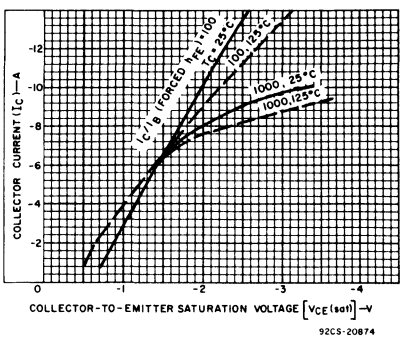


Fig. 11 - Typical saturation characteristics for all types.

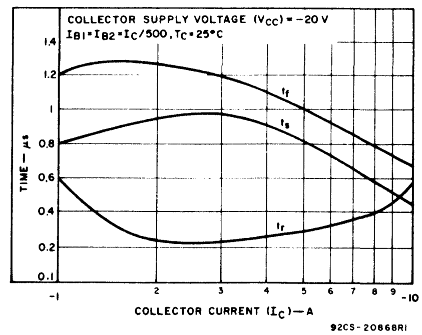


Fig. 12 - Typical saturated switching-time characteristics for all types.

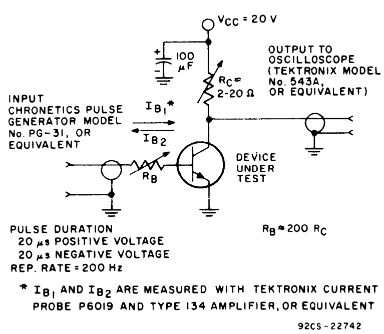


Fig. 13 - Circuit used to measure saturated switching times.

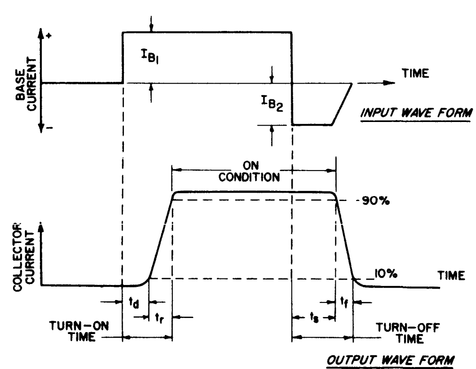


Fig. 14 - Phase relationship between input current and output current showing reference points for specifications of switching.

File Number **1213**

BDX53, BDX53A, BDX53B, BDX53C

8-Ampere N-P-N Darlington Power Transistors

45-60-80-100 Volts, 60 Watts
Gain of 750 at 3 A

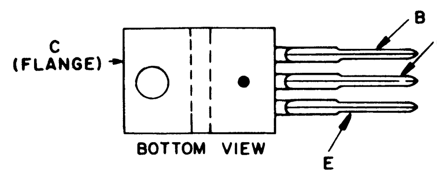
Features:

- **Operates from IC without predriver**
- **Low leakage at high temperature**
- **High reverse second-breakdown capability**

Applications:

- **Power switching**
- **Hammer drivers**
- **Series and shunt regulators**

TERMINAL DESIGNATIONS



92CS-37394

JEDEC TO-220AB
(See dimensional outline "N".)

The RCA-BDX53, BDX53A, BDX53B, and BDX53C monolithic silicon Darlington transistors are designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits.

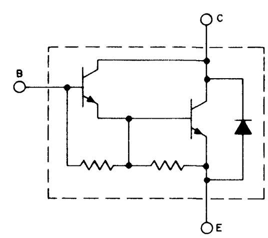


Fig. 1—Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BDX53	BDX53A	BDX53B	BDX53C	
V_{CBO}	45	60	80	100	V
$V_{CEO}(sus)$	45	60	80	100	V
V_{EBO}		5			V
I_C		8			A
I_B		0.2			A
P_T					
$T_C \leq 25°C$		60			W
$T_C > 25°C$		Derate linearly 0.48			W/°C
T_{stg}, T_J		−65 to +150			°C
T_L					
At distances ≥1/18 in. (3.17 mm) from case for 10 s max		235			°C

BDX53, BDX53A, BDX53B, BDX53C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERSTIC	TEST CONDITIONS					LIMITS				UNITS
	VOLTAGE V dc			CURRENT A dc		BDX53		BDX53A		
	V_{CB}	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}		22			0	—	500	—	—	μA
		30			0	—	—	—	500	μA
I_{CBO}	45					—	200	—	—	μA
	60					—	—	—	200	μA
I_{EBO}			−5	0		—	2	—	2	mA
V_{CEO}(sus)				0.1[a]	0	45	—	60	—	V
h_{FE}		3		3[a]		750	—	750	—	
V_{BE}(sat)				3[a]	0.012	—	2.5	—	2.5	V
V_{CE}(sat)				3[a]	0.012	—	2	—	2	V
V_F				3[b]		—	1.8	—	1.8	V
				8[b]		2.5[c]	—	2.5[c]	—	V
$R_{\theta JC}$						—	2.08	—	2.08	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.5%. [b] I_F value. [c] Typical value.

ELECTRTICAL CHARACTERICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS					LIMITS				UNITS
	VOLTAGE V dc			CURRENT A dc		BDX53B		BDX53C		
	V_{CB}	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}		40			0	—	500	—	—	μA
		50			0	—	—	—	500	μA
I_{CBO}	80					—	200	—	—	μA
	100					—	—	—	200	μA
I_{EBO}			−5	0		—	2	—	2	mA
V_{CEO}(sus)				0.1[a]	0	80	—	100	—	V
h_{FE}		3		3[a]		750	—	750	—	
V_{BE}(sat)				3[a]	0.012	—	2.5	—	2.5	V
V_{CE}(sat)				3[a]	0.012	—	2	—	2	V
V_F				3[b]		—	1.8	—	1.8	V
				8[b]		2.5[c]	—	2.5[c]	—	V
$R_{\theta JC}$						—	2.08	—	2.08	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.5%. [b] I_F value. [c] Typical value.

BDX53, BDX53A, BDX53B, BDX53C

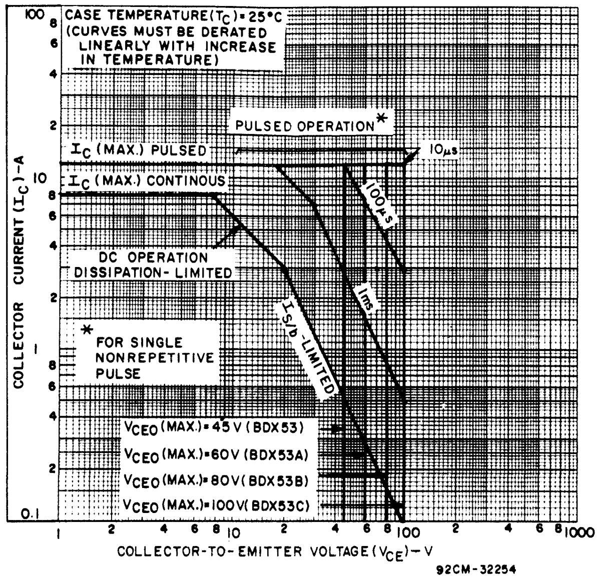


Fig. 2—Maximum operating areas for all types.

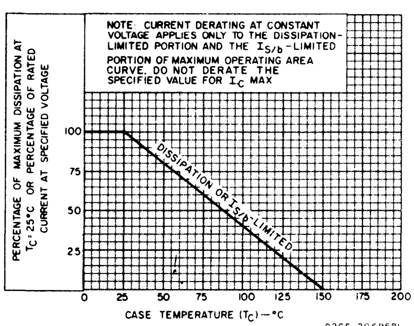


Fig. 3—Derating curve for all types.

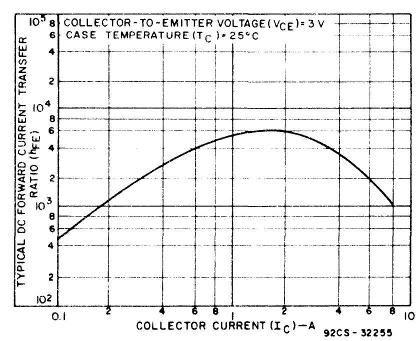


Fig. 4—Typical dc-beta characteristics for all types.

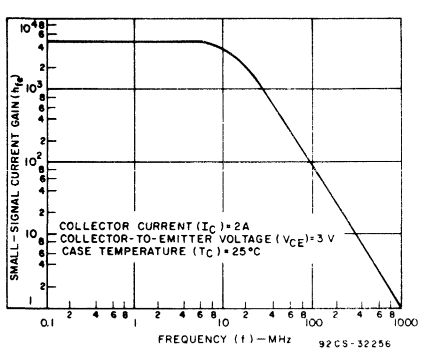


Fig. 5—Typical small-signal gain for all types.

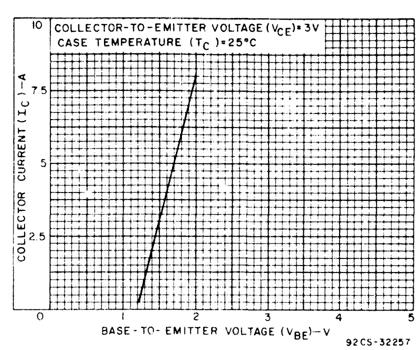


Fig. 6—Typical transfer characteristics for all types.

BDX53, BDX53A, BDX53B, BDX53C

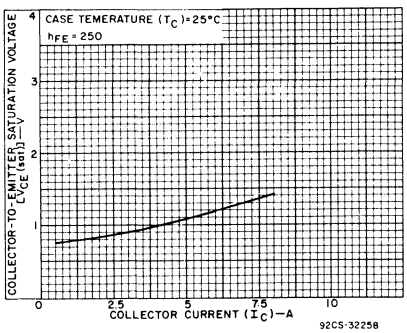


Fig. 7—Typical saturation characteristics for all types.

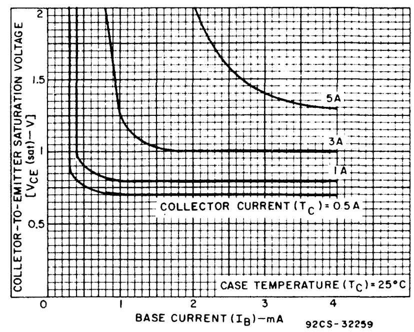


Fig. 8—Typical saturation characteristics for all types.

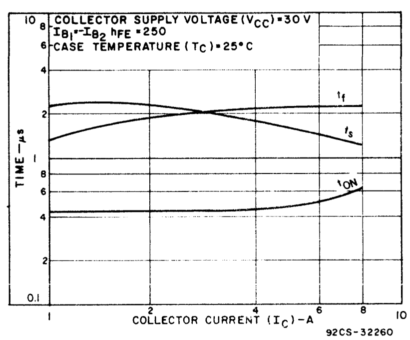


Fig. 9—Typical saturated switching-time characteristics for all types.

File Number **955**

BDX83, BDX83A, BDX83B, BDX83C

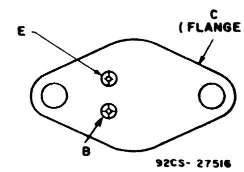
15-Ampere N-P-N Darlington Power Transistors

40-60-80-100 Volts, 125 Watts
Gain of 1000 at 5 Amperes

Features:
- Operates from IC without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

Applications:
- Power switching
- Hammer drivers
- Series and shunt regulators
- Audio amplifiers

TERMINAL DESIGNATIONS



JEDEC TO-204MA
(See dimensional outline "A".)

The RCA-BDX83, BDX83A, BDX83B, and BDX83C are monolithic silicon Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits.

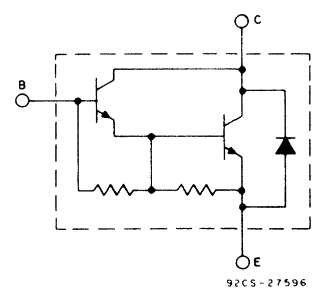


Fig. 1—Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values.*

	BDX83	BDX83A	BDX83B	BDX83C	
V_{CBO}	45	60	80	100	V
$V_{CEO}(sus)$	45	60	80	100	V
V_{EBO}	5	5	5	5	V
I_C	10	10	10	10	A
I_{CM}	15	15	15	15	A
I_B	0.25	0.25	0.25	0.25	A
P_T					
$T_C \leq 25^oC$	125	125	125	125	W
$T_C > 25^oC$	Derate linearly at 0.714 W/^oC				
T_{stg}, T_J	−65 to +200				^oC
T_L					
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	235				^oC

BDX83, BDX83A, BDX83B, BDX83C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARAC-TERISTIC SYMBOL	TEST CONDITIONS					LIMITS				UNITS
	VOLTAGE V dc			CURRENT A dc		BDX83		BDX83A		
	V_{CE}	V_{EB}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}	20				0	–	1	–	–	mA
	30				0	–	–	–	1	
I_{CEV}	45		−1.5			–	0.5	–	–	
	60		−1.5			–	–	–	0.5	
T_C = 150°C	45		−1.5			–	3	–	–	
	60		−1.5			–	–	–	3	
I_{EBO}		5		0		–	5	–	5	mA
$V_{CEO}(sus)$				0.1[a]	0	45	–	60	–	V
h_{FE}	3			1[a]		750	–	750	–	
	3			5[a]		1000	–	1000	–	
	3			10[a]		250	–	250	–	
V_{BE}	3			5[a]		–	2.8	–	2.8	V
	3			10[a]		–	4.5	–	4.5	
$V_{CE}(sat)$				5[a]	0.01[a]	–	2	–	2	V
V_F				−10		–	4	–	4	
h_{fe} f = 1 kHz	5			1		1000	–	1000	–	
$\|h_{fe}\|$ f = 1 MHz	5			1		20	–	20	–	
$E_{S/b}$[b] L = 12 mH, R_{BE} = 100 Ω			−1.5	4.5		120	–	120	–	mJ
$I_{S/b}$ t = 1 s, non rep.	35					2.2	–	–	–	A
	50					–	–	0.9	–	
	30					4.16	–	4.16	–	
$R_{\theta JC}$						–	1.4	–	1.4	°C/W

[a]Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

[b]$E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse-bias conditions. $E_{S/b}$ = ½LI^2 where L is a series load or leakage inductance, and I is the peak collector current.

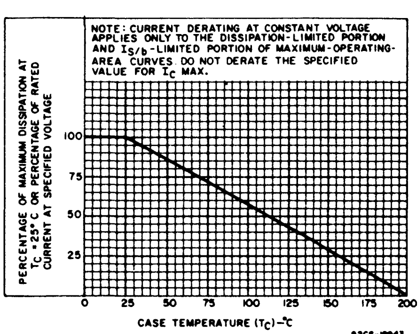


Fig. 2—Derating curves for all types.

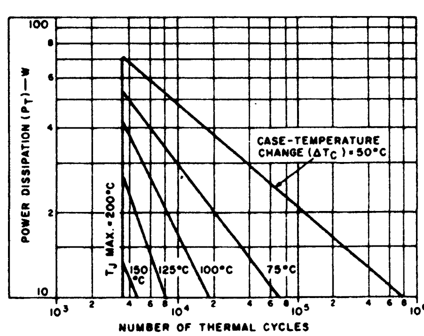


Fig. 3—Thermal-cycling rating chart for all types.

BDX83, BDX83A, BDX83B, BDX83C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC SYMBOL	TEST CONDITIONS: VOLTAGE V dc			CURRENT A dc		LIMITS: BDX83B		BDX83C		UNITS
	V_{CE}	V_{EB}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CEO}	40				0	–	1	–	–	mA
	50				0	–	–	–	1	
I_{CEV}	80		−1.5			–	0.5	–	–	
	100		−1.5			–	–	–	0.5	
T_C = 150°C	80		−1.5			–	3	–	–	
	100		−1.5			–	–	–	3	
I_{EBO}		5		0		–	5	–	5	mA
V_{CEO}(sus)				0.1[a]	0	80	–	100	–	V
h_{FE}	3			1[a]		750	–	750	–	
	3			5[a]		1000	–	1000	–	
	3			10[a]		250	–	250	–	
V_{BE}	3			5[a]		–	2.8	–	2.8	V
	3			10[a]		–	4.5	–	4.5	
V_{CE}(sat)				5[a]	0.01[a]	–	2	–	2	V
V_F				−10		–	4	–	4	
h_{fe} f = 1 kHz	5			1		1000	–	1000	–	
$\|h_{fe}\|$ f = 1 MHz	5			1		20	–	20	–	
$E_{S/b}$[b] L = 12 mH, R_{BE} = 100 Ω			−1.5	4.5		120	–	120	–	mJ
$I_{S/b}$ t = 1 s, non rep.	70					0.37	–	–	–	A
	85					–	–	0.25	–	
	30					4.16	–	4.16	–	
$R_{\theta JC}$						–	1.4	–	1.4	°C/W

[a]Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

[b]$E_{S/b}$ is defined as the energy at which second breakdown occurs under specified reverse-bias conditions. $E_{S/b} = ½LI^2$ where L is a series load or leakage inductance, and I is the peak collector current.

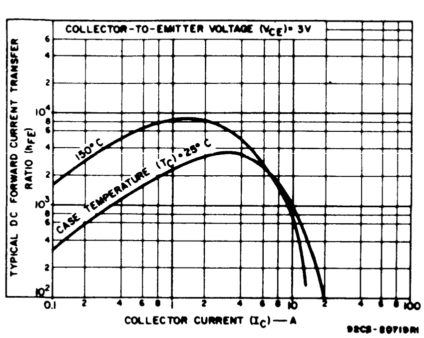


Fig. 4—Typical dc-beta characteristics for all types.

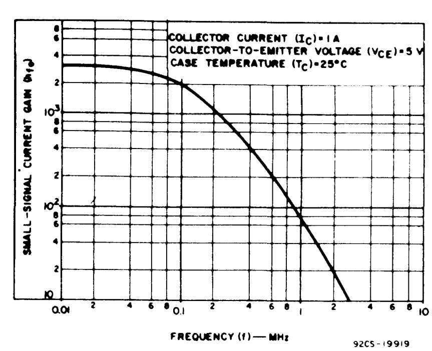
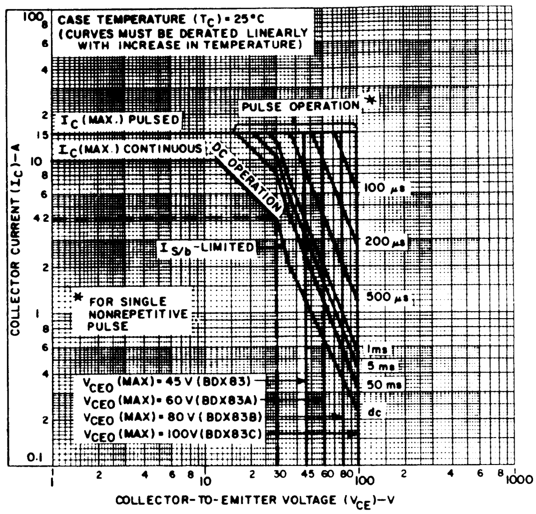


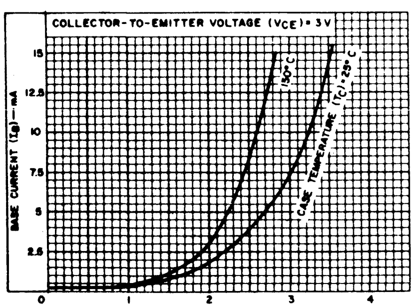
Fig. 5—Typical small-signal gain for all types.

BDX83, BDX83A, BDX83B, BDX83C



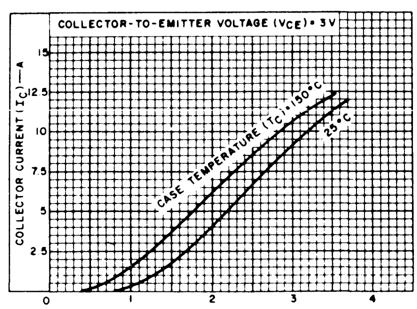
92CM-29144

Fig. 6—Maximum operating area for all types.



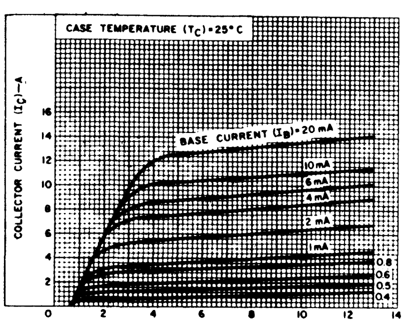
92CS-19923R1

Fig. 7—Typical input characteristics for all types.



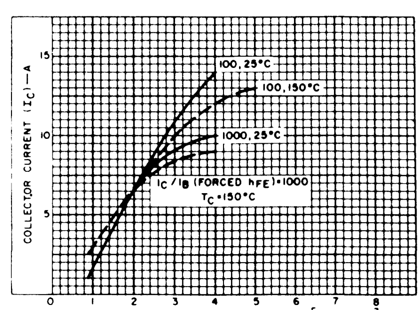
92CS-19924R1

Fig. 8—Typical transfer characteristics for all types.



92CS-19925

Fig. 9—Typical output characteristics for all types.



92CS-20856

Fig. 10—Typical saturation characteristics for all types.

BDX83, BDX83A, BDX83B, BDX83C

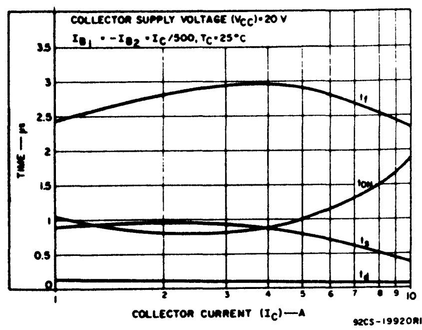


Fig. 11—Typical saturated switching time characteristics for all types.

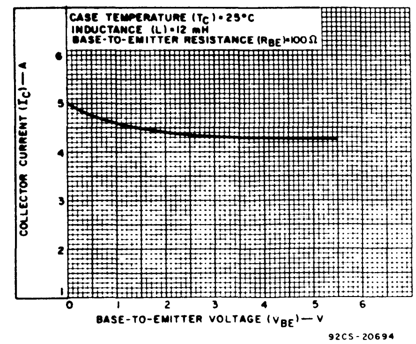


Fig. 12—Minimum values of reverse-bias second-breakdown characteristic ($E_{S/b}$) for all types.

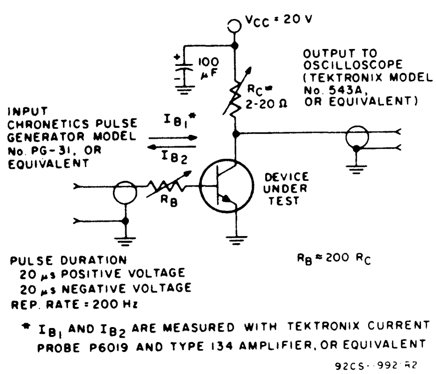


Fig. 13—Circuit used to measure saturated-switching times.

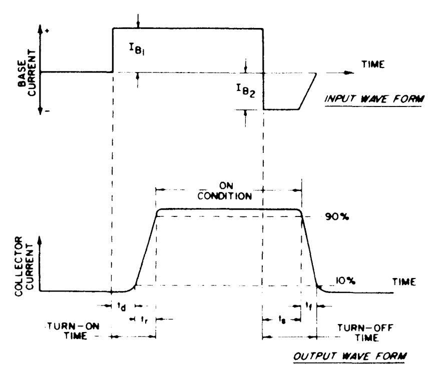


Fig. 14— Phase relationship between input current and output current showing reference points for specification of switching times.

BU323, BU323A

File Number **1312**

10-Ampere N-P-N Monolithic Darlington Power Transistors

350, 400 Volts, 175 Watts
Gain of 150 at 6 A

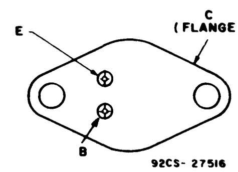
Features:

- *Operates from IC without predriver*
- *High voltage breakdown*
- *High reverse second-breakdown capability*

Applications:

- *Power switching*
- *Solenoid drivers*
- *Automotive ignition*
- *Series and shunt regulators*

TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "A".)

The BU323 and BU323A are monolithic n-p-n silicon Darlington transistors designed for automotive electronic power applications..

These dėvices provide good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

The BU323 and BU323A are supplied in the JEDEC TO-204MA hermetic steel package.

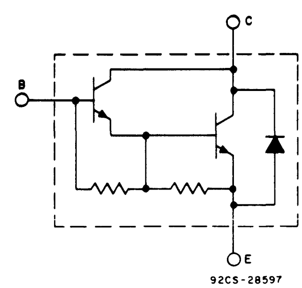


Fig. 1-Schematic diagram for both types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BU323		BU323A	
V_{CBO}	500		600	V
$V_{CER}(sus)$				
R_{BE}=100 Ω	400		475	V
$V_{CEO}(sus)$	350		400	V
V_{EBO}	8		8	V
I_C	10		10	A
I_{CM}	16		16	A
I_B	3		3	A
P_T				
$T_C \leq 25°C$	175		175	W
$T_C > 25°C$		See Fig. 2		
T_{stg}, T_J		-65 to +200		°C
T_L				
At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235		°C

BU323, BU323A

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) 25° C unless otherwise specified*

CHARACTERISTIC	TEST CONDITIONS				LIMITS				UNITS
	VOLTAGE V dc		CURRENT A dc		BU323		BU323A		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	
I_{CER}	400				—	1	—	—	mA
R_{BE}=100 Ω	475				—	—	—	1	
I_{EBO}		-6	0		—	40	—	40	
I_{CBO}	500[b]				—	1	—	—	
	600[b]				—	—	—	1	
V_{CER}(sus) R_{BE}=100 Ω L=500 μH			4		400	—	475	—	V
V_{CEO}(sus)			0.2[a]	0	350	—	400	—	
h_{FE}	6		3[a]		300	—	300	—	
	6		6[a]		150	2000	150	2000	
	6		10[a]		50	—	50	—	
V_{CE}(sat)			3[a]	0.06[a]	—	1.5	—	1.5	V
			6[a]	0.12[a]	—	1.7	—	1.7	
			10[a]	0.30[a]	—	2.7	—	2.7	
T_C=-40° C			6[a]	0.12[a]	—	2.0	—	2.0	
V_{BE}(sat)			6[a]	0.12	—	2.2	—	2.2	V
			10[a]	0.30	—	3	—	3	
T_C=-40° C			6[a]	0.12	—	2.4	—	2.4	
V_{BE}(On)	6		10[a]		—	2.5	—	2.5	
V_F			10[a]		—	3.5	—	3.5	
C_{ob} f=100 kHz	10[b]				—	350	—	350	pF
$I_C^2L/2$ (See Fig. 10)					550	—	550	—	mJ
t_s $I_{B1}=I_{B2}$	12[c]		6	0.3	—	15	—	15	μs
t_f $I_{B1}=I_{B2}$	12[c]		6	0.3	—	15	—	15	
$\|h_{fe}\|$ f=1 MHz	5		1		10	—	10	—	
$I_{S/b}$ t=1 s, nonrep.	50				3.5	—	3.5	—	A
$R_{\theta JC}$					—	1	—	1	°C/W

[a]Pulsed: Pulse duration=300 μs, duty factor=1.8%.
[b]V_{CB} value.
[c]V_{CC} value.

BU323, BU323A

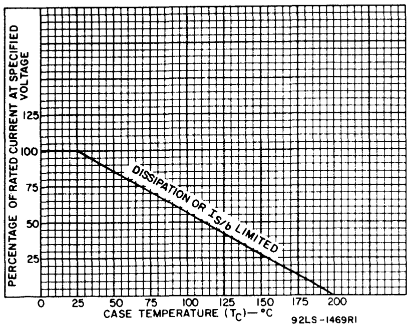


Fig. 2-Dissipation derating curve for both types.

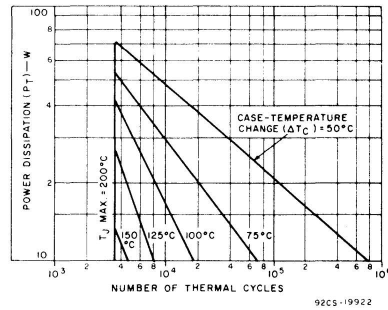


Fig. 3-Thermal-cycling rating chart for both types.

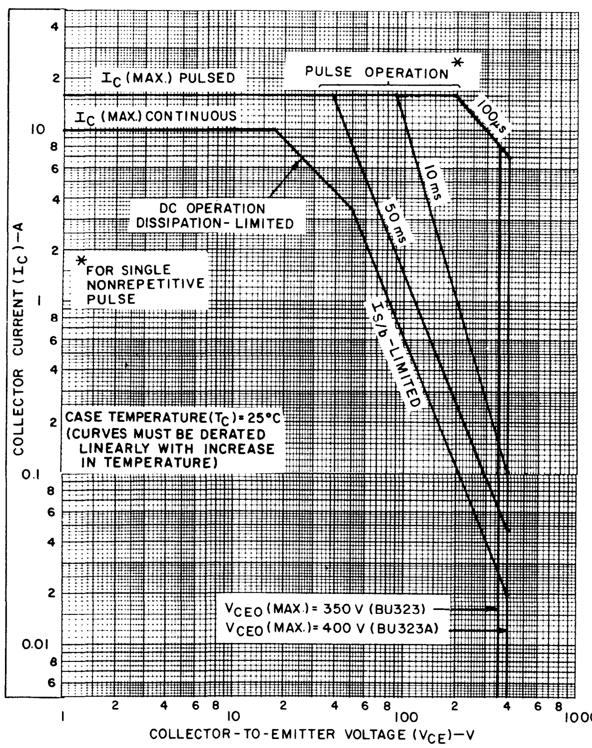


Fig. 4-Maximum operating areas for both types.

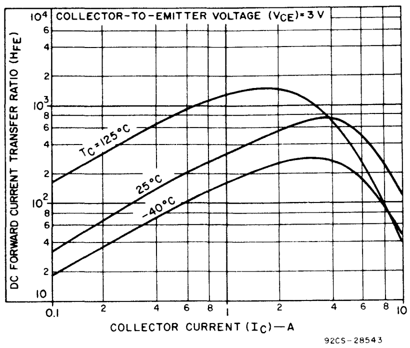


Fig. 5-Typical DC beta characteristics for both types.

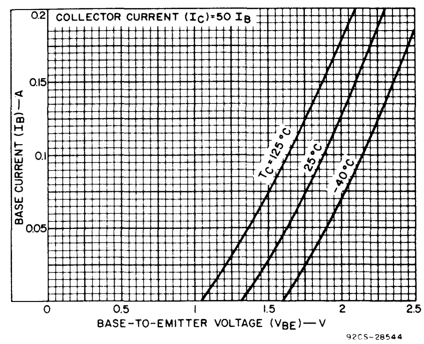


Fig. 6-Typical input characteristics for both types.

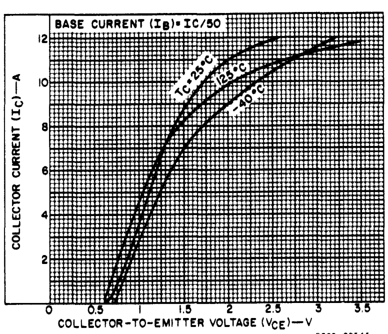


Fig. 7-Typical output characteristics for both types.

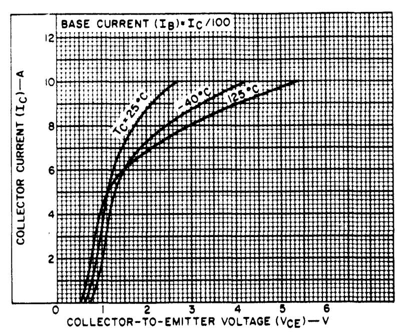


Fig. 8-Typical output characteristics for both types.

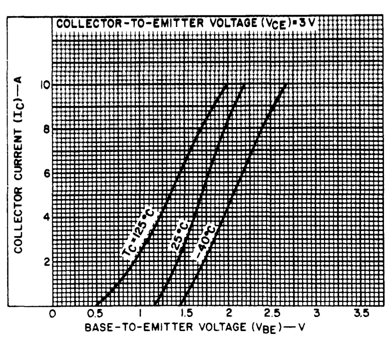
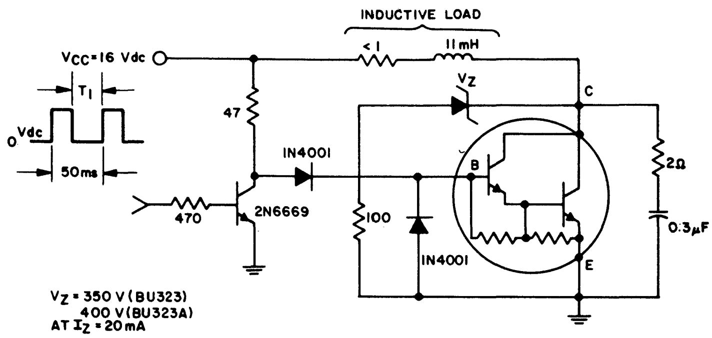


Fig. 9-Typical transfer characteristics for both types.

BU323, BU323A



T_1 TO BE SELECTED SUCH THAT I_C REACHES 10 Adc BEFORE SWITCH-OFF

NOTE FIGURE 10 SPECIFIES ENERGY HANDLING CAPABILITIES FOR AN AUTOMOTIVE IGNITION CIRCUIT.

92CM-34054

Fig. 10-Ignition test circuit.

File Number **1243**

BUX37

15-Ampere N-P-N Monolithic Darlington Power Transistor

400 V , 35 W
Gain of 20 at 15A

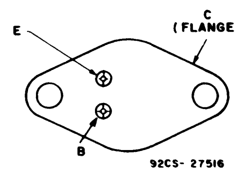
Features:

- *High reverse second-breakdown capability*

Applications:

- *Power switching*
- *Solenoid drivers*
- *Automotive ignition*
- *Series and shunt regulators*

TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "A".)

The RCA-BUX37 is a monolithic n-p-n silicon Darlington transistor designed for automotive electronic power applications. The pi-nu construction of this device provides good forward and reverse second-breakdown capability.

The RCA-BUX37 is supplied in the steel JEDEC TO-204MA hermetic package.

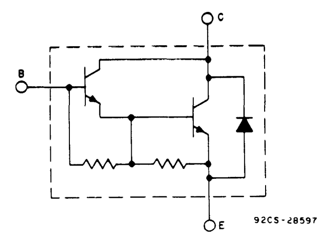


Fig. 1—Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

$V_{CEO}(sus)$	400	V
V_{EBO}	7	V
I_C	15	A
I_B	4	A
P_T		
$T_C \leq 100°C$	35	W
$T_C > 100°C$	Derate Linearly 0.7	W/°C
T_{stg}, T_J	−65 to 150	°C
T_L		
At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.	235	°C

BUX37

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS				LIMITS		UNITS
	VOLTAGE V dc		CURRENT A dc		BUX37		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	
I_{CEO}	400			0	—	0.25	mA
$V_{CEO}(sus)$[b] L = 1.5 mH			5[a]	0	400	—	V
$V_{(BR)EBO}$ I_E = 50 mA			0		7	—	V
h_{FE}	5		15[a]		20	—	
$V_{BE}(sat)$			10[a]	0.15	—	2.7	V
T_C = −40°C			10[a]	0.15	—	3.5	V
$V_{CE}(sat)$			7[a]	0.07	—	1.5	V
			10[a]	0.15	—	2	V
T_C = −40°C			10[a]	0.15	—	2.9	V
$R_{\theta JC}$					—	1.5	°C/W

[a] Pulsed; pulse duration = 300 μs, duty factor ≤2%.

[b] **CAUTION:** The sustaining voltage $V_{CEO}(sus)$ *MUST NOT* be measured on a curve tracer.

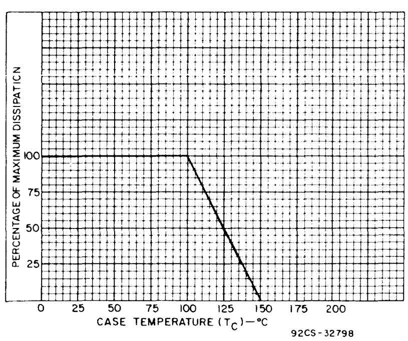


Fig. 2—Derating curve.

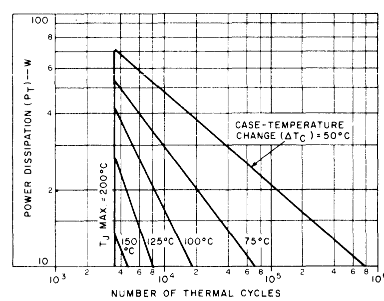


Fig. 3—Thermal-cycling rating chart.

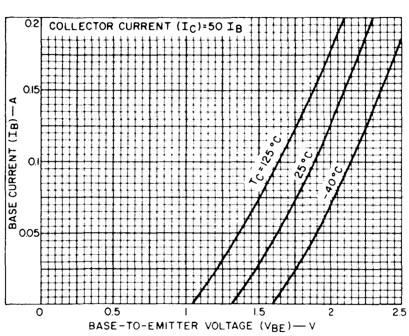


Fig. 4—Typical input characteristics.

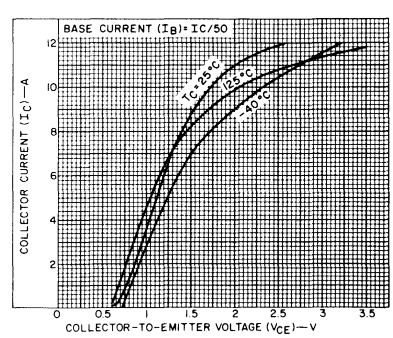


Fig. 5—Typical output characteristics.

BUX37

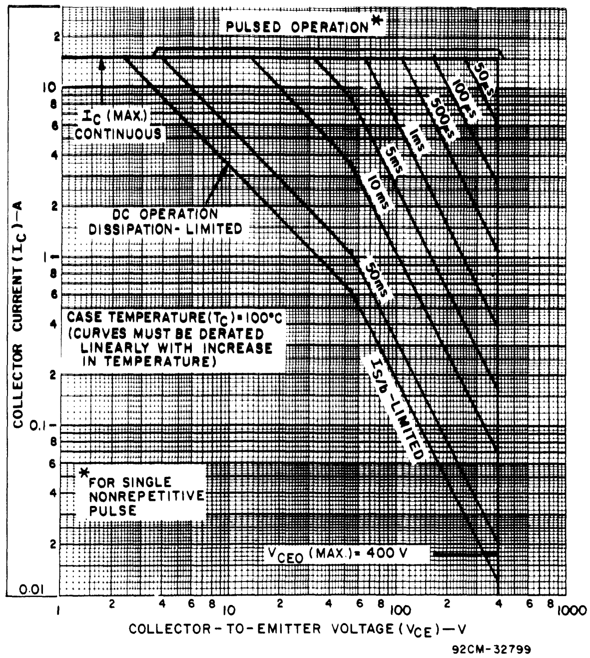


Fig. 6—Maximum operating areas (T_C = 100°C).

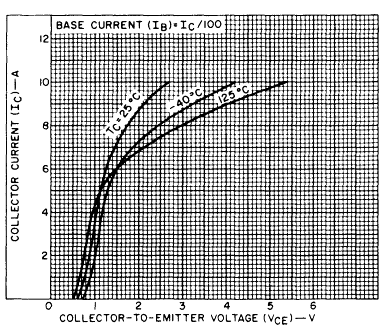


Fig. 7—Typical output characteristics.

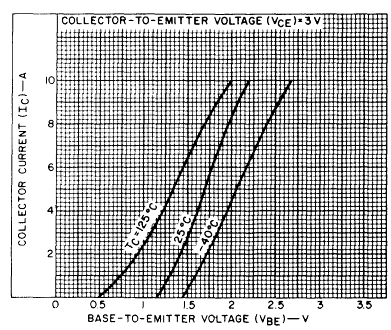


Fig. 8—Typical transfer characteristics.

RCA8766 Series

File Number **973**

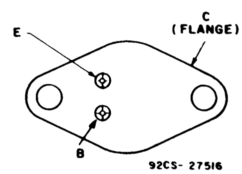
10-Ampere N-P-N Monolithic Darlington Power Transistors

350, 400, 450 Volts, 150 Watts
Gain of 100 at 4, 6A

Features:
- Operates from IC without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

Applications:
- Power switching
- Solenoid drivers
- Automotive Ignition
- Series and shunt regulators

TERMINAL DESIGNATIONS



JEDEC TO-204MA
(See dimensional outline "A".)

The RCA-8766 Series• are monolithic n-p-n silicon Darlington transistors designed for automotive electronic power applications. The pi-nu construction of these devices provides good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

The devices in the series differ primarily in voltage ratings and in the current at which the dc gain is specified.

• Formerly RCA Dev. Nos. TA8766 Series.

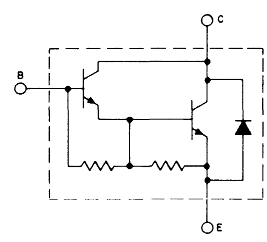


Fig. 1 – Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RCA8766 RCA8766A	RCA8766B RCA8766C	RCA8766D RCA8766E	
V_{CBO}	350	400	450	V
$V_{CER}(sus)$				
$R_{BE} = 50\ \Omega$	350	400	450	V
$V_{CEO}(sus)$	350	400	450	V
V_{EBO}	5	5	5	V
I_C	10	10	10	A
I_{CM}	15	15	15	A
I_B	1	1	1	A
P_T				
$T_C \leq 25^\circ C$	150	150	150	W
$T_C > 25^\circ C$		See Fig. 2		
T_{stg}, T_J		−65 to +175		°C
T_L				
At distances ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235		°C

RCA8766 Series

ELECTRICAL CHARACTERISTICS, *at Case Temperature (T_C) 25°C unless otherwise specified*

CHARACTERISTIC	TEST CONDITIONS			LIMITS						UNITS
	VOLTAGE V dc	CURRENT A dc		RCA8766 RCA8766A		RCA8766B RCA8766C		RCA8766D RCA8766E		
	V_{CE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CER}	350			–	1	–	–	–	–	
R_{BE} = 50 Ω	400			–	–	–	1	–	–	
	450			–	–	–	–	–	1	mA
T_C = 150°C	350			–	10	–	–	–	–	
	400			–	–	–	10	–	–	
	450			–	–	–	–	–	10	
I_{EBO} V_{BE} = −5 V		0		–	60	–	60	–	60	mA
V_{CEO}(sus)		0.2[a]	0	350	–	400	–	450	–	V
h_{FE}										
RCA8766	3	6[a]		100	–	–	–	–	–	
RCA8766A	3	4[a]		100	–	–	–	–	–	
RCA8766B	3	6[a]		–	–	100	–	–	–	
RCA8766C	3	4[a]		–	–	100	–	–	–	
RCA8766D	3	6[a]		–	–	–	–	100	–	
RCA8766E	3	4[a]		–	–	–	–	100	–	
V_{BE}										
RCA8766	3	6[a]		–	2.5	–	–	–	–	
RCA8766A	3	4[a]		–	2.5	–	–	–	–	
RCA8766B	3	6[a]		–	–	–	2.5	–	–	V
RCA8766C	3	4[a]		–	–	–	2.5	–	–	
RCA8766D	3	6[a]		–	–	–	–	–	2.5	
RCA8766E	3	4[a]		–	–	–	–	–	2.5	
V_{CE}(sat)										
RCA8766		6[a]	0.2[a]	–	1.5	–	–	–		
RCA8766A		4[a]	0.133[a]	–	1.5	–	–	–		
RCA8766B		6[a]	0.2[a]	–	–	–	1.5	–		
RCA8766C		4[a]	0.133[a]	–	–	–	1.5	–	–	V
RCA8766D		6[a]	0.2[a]	–	–	–	–	–	1.5	
RCA8766E		4[a]	0.133[a]	–	–	–	–	–	1.5	
All Types		8[a]	0.5[a]	–	2.5	–	2.5	–	2.5	
V_F		7[a]		–	2	–	2	–	2	V
$\|h_{fe}\|$ f = 1 MHz	5	1		10	–	10	–	10	–	
$I_{S/b}$ t = 1 s, nonrep.	30			5	–	5	–	5	–	A
$R_{\theta JC}$				–	1	–	1		1	°C/W

[a] Pulsed: Pulse duration = 300 μs, duty factor = 1.8%.

RCA8766 Series

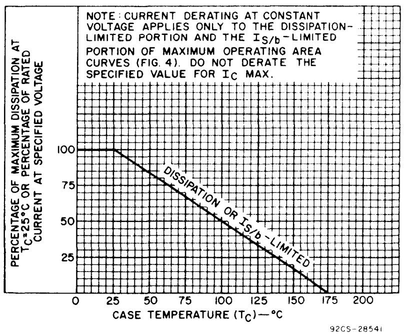


Fig. 2 — Derating curves for all types.

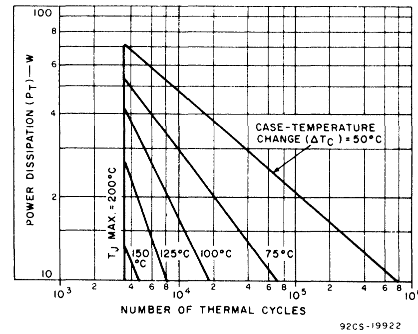


Fig. 3 — Thermal-cycling rating chart for all types.

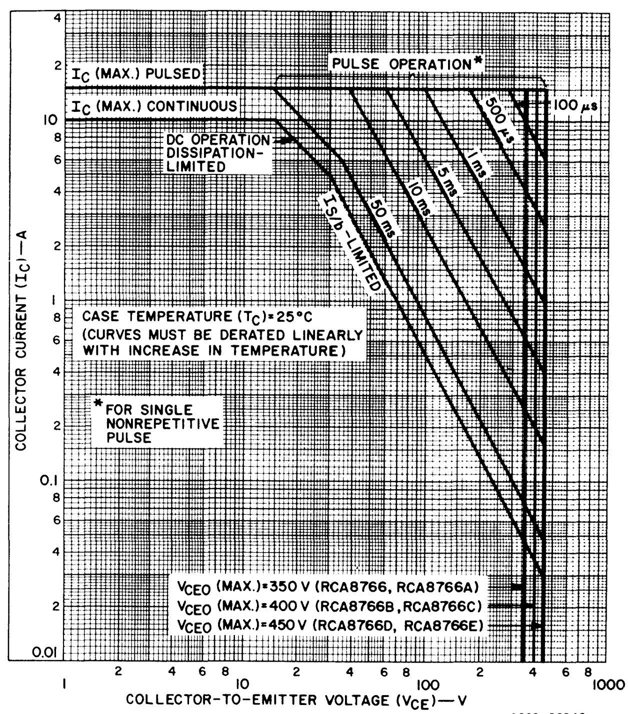


Fig. 4 — Maximum operating areas for all types.

RCA8766 Series

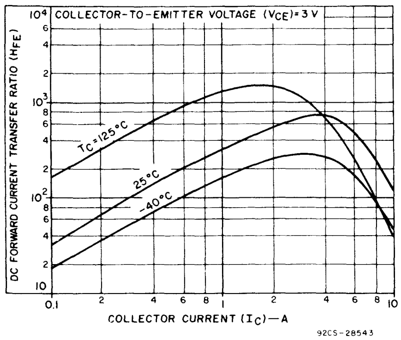


Fig. 5 — Typical DC beta characteristics for all types.

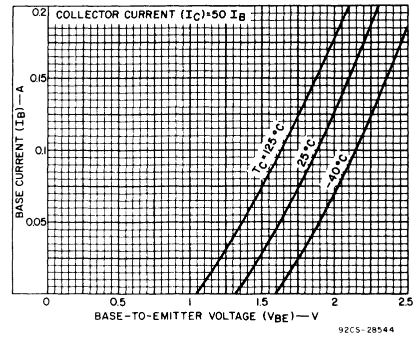


Fig. 6 — Typical input characteristics for all types.

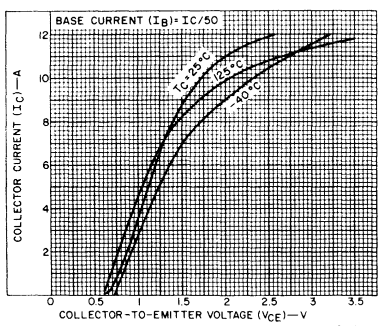


Fig. 7 — Typical output characteristics for all types.

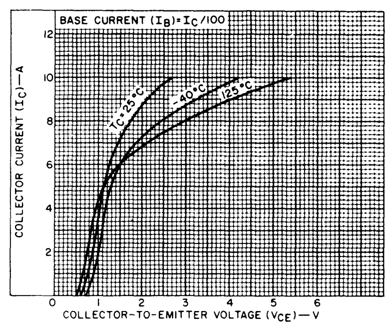


Fig. 8 — Typical output characteristics for all types.

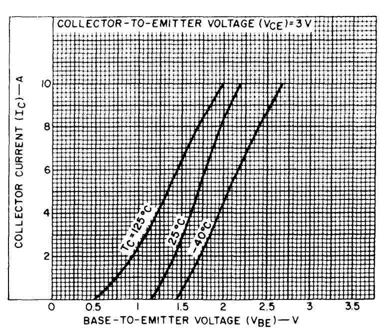


Fig. 9 — Typical transfer characteristics for all types.

RCA-1000, RCA-1001 File Number **594**

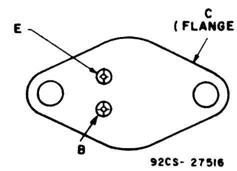
8-Ampere Silicon N-P-N Darlington Power Transistors

For Use as Output Devices in General-Purpose Switching and Amplifier Applications

Features:

- **High dc current gain:** **h_{FE} = 1000 min. at I_C = 3 A**
- **Monolithic construction with built-in base-emitter shunt resistors**

TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "A".)

RCA-1000 and 1001 are monolithic silicon n-p-n Darlington transistors intended for medium-power applications as output devices. The double epitaxial construction of these units provides good forward and reverse second-breakdown capability. Their high gain makes it possible for them to be driven directly from integrated circuits.

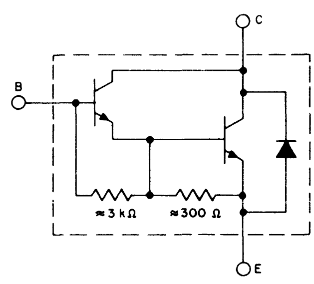


Fig. 1—Schematic diagram of RCA-1000 and RCA-1001 Darlington power transistors.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		RCA-1000	RCA-1001	
COLLECTOR-TO-BASE VOLTAGE:				
With emitter open	V_{CBO}	60	80	V
COLLECTOR-TO-EMITTER VOLTAGE:				
With base open	V_{CEO}	60	80	V
EMITTER-TO-BASE VOLTAGE:				
With collector open	V_{EBO}	5	5	V
COLLECTOR CURRENT:	I_C			
Continuous		8	8	A
Pulsed		15	15	A
BASE CURRENT (Continuous)	I_B	0.1	0.1	A
TRANSISTOR DISSIPATION:	P_T			
At case temperatures up to 25°C		90	90	W
At case temperatures above 25°C, derate linearly at		0.515		W/°C
TEMPERATURE RANGE:				
Storage & Operating (Junction)		−55 to +200		°C
LEAD TEMPERATURE (During Soldering):				
At distance ≥ 1/8 in. (3.17 mm) from case to 10 s max.		235		°C

RCA-1000, RCA-1001

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: DC VOLTAGE (V) V_{CB}	V_{CE}	V_{BE}	DC CURRENT (A) I_C	I_B	LIMITS: RCA-1000 MIN.	RCA-1000 MAX.	RCA-1001 MIN.	RCA-1001 MAX.	UNITS
Collector Cutoff Current: With base open	I_{CEO}		30			0	–	500	–	–	μA
			40			0	–	–	–	500	
With external base-to-emitter resistance (R_{BE}) = 1 kΩ	I_{CER}	60					–	1	–	–	mA
		80					–	–	–	1	
At T_C = 150°C		60					–	5	–	–	
		80					–	–	–	5	
Emitter Cutoff Current	I_{EBO}			5	0		–	2	–	2	mA
Collector-to-Emitter Breakdown Voltage	$V_{(BR)CEO}$				0.1[a]	0	60	–	–	–	V
					0.1[a]	0	–	–	80	–	
DC Forward Current Transfer Ratio	h_{FE}		3		3		1000	–	1000	–	
			3		4		750	–	750	–	
Base-to-Emitter Voltage	V_{BE}		3		3[a]		–	2.5	–	2.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE}(sat)$				3[a]	0.012	–	2	–	2	V
					8[a]	0.04	–	4	–	4	
Thermal Resistance (Junction-to-Case)	$R_{\theta JC}$						–	1.94	–	1.94	°C/W

[a] Pulsed: Pulse duration ≤ 300 μs, duty factor ≤ 2%.

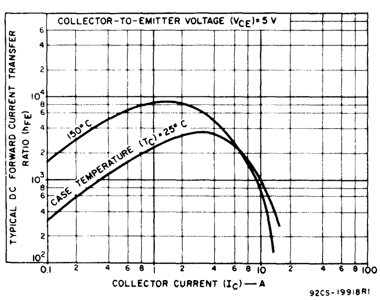


Fig.2—Typical dc beta characteristics for both types.

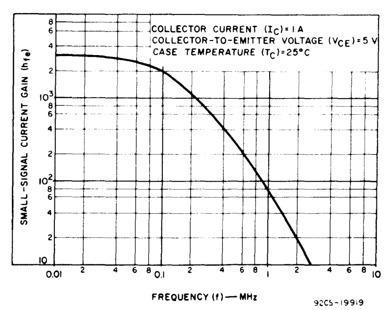


Fig.3—Typical small-signal gain for both types.

RCA-1000, RCA-1001

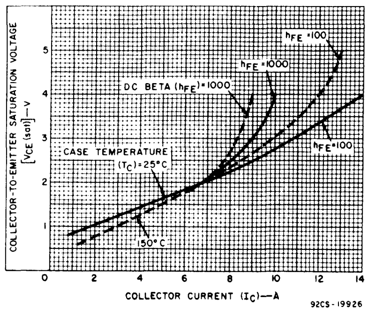


Fig.4–Typical saturation characteristics for both types.

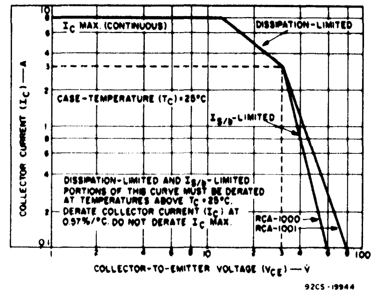


Fig.5–DC safe-area-of-operation for both

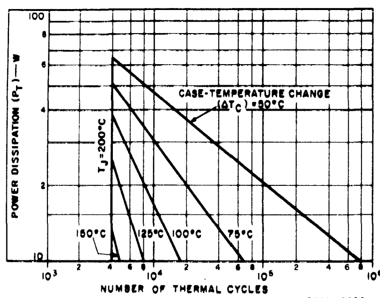


Fig.6–Thermal-cycling rating chart for both

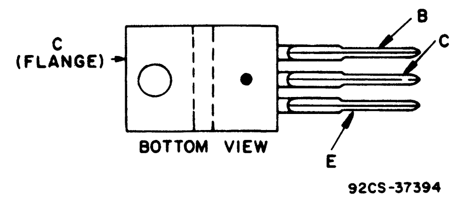
File Number **1415**

RCA9201A, RCA9201B, RCA9201C

5-Ampere N-P-N Darlington Power Transistors

150, 200 and 250 Volts, 65 Watts, Gain of 750 at 3A

TERMINAL DESIGNATIONS



JEDEC TO-220AB

(See dimensional outline "N".)

Features

- *Direct IC input without predriver*
- *Low leakage at high temperature*
- *Hard glass passivation*
- *Wire bonded construction*

Applications

- *General purpose*
- *Small engine ignition*
- *Voltage regulator*

The RCA9201A, RCA9201B, and RCA9201C• are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double diffused construction of these devices provides good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220AB VERSAWATT package.

•Formerly RCA Dev. No. TA9201A, TA9201B and TA9201C, respectively.

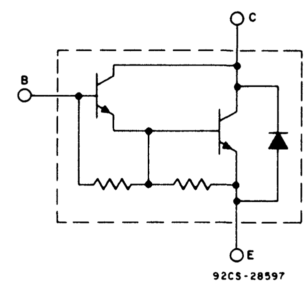


Fig. 1 - Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RCA9201A	RCA9201B	RCA9201C	UNITS
V_{CBO}	150	200	250	V
$V_{CEO(sus)}$	150	200	250	V
V_{EBO}	5	5	5	V
I_C	5	5	5	A
I_{CM}	10	10	10	A
I_B	0.2	0.2	0.2	A
P_T:				
T_C up to 25°C	65	65	65	W
T_C above 25°C ... Derate linearly at		0.52		W/°C
T_{stg}, T_J		-65 to 150		°C
T_L				
At distance ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235		°C

RCA9201A, RCA9201B, RCA9201C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25° C*

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	Voltage V dc		Current A dc		RCA9201A		RCA9201B		RCA9201C		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CBO} $I_E = 0$	150[a]	—	—	—	—	0.2	—	—	—	—	mA
	200[a]	—	—	—	—	—	—	0.2	—	—	
	250[a]	—	—	—	—	—	—	—	—	0.2	
I_{CEO}	100	—	—	0	—	0.5	—	—	—	—	
	150	—	—	0	—	—	—	0.5	—	—	
	200	—	—	0	—	—	—	—	—	0.5	
I_{EBO}	—	-5	0	—	—	5	—	5	—	5	mA
$V_{CEO}(sus)$[c]	—	—	.03[b]	0	150	—	200	—	250	—	V
h_{FE}	2.5	—	3[b]	—	750	—	750	—	750	—	
	2.5	—	4[b]	—	—	—	—	—	500	—	
	2.5	—	5[b]	—	500	—	500	—	250	—	
V_{BE}	2.5	—	4[b]	—	—	2.5	—	2.5	—	2.5	V
$V_{CE}(sat)$	—	—	3b	.007	—	1.5	—	1.5	—	1.5	V
	—	—	4b	.01	—	—	—	—	—	1.5	
	—	—	5b	.01	—	2.5	—	2.5	—	—	
C_{obo} V_{CB} = 10 V f = 1 MHz	—	—	—	—	120 Typ.		120 Typ.		120 Typ.		pF
$I_{s/b}$ t = 0.5 s non-rep. pulse	30	—	—	—	2.16	—	2.16	—	2.16	—	A
$R_{\theta JC}$	—	—	—	—	—	1.92	—	1.92	—	1.92	°C/W

[a]V_{CB} value.
[b]Pulsed, pulse duration = 300 μs, duty factor $\leq$ 2%.
[c]Caution: Sustaining voltage, $V_{CEO}(sus)$, must not be measured on a curve tracer.

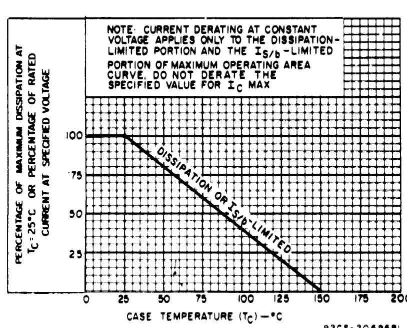


Fig. 2 - Derating curve for all types.

RCA9201A, RCA9201B, RCA9201C

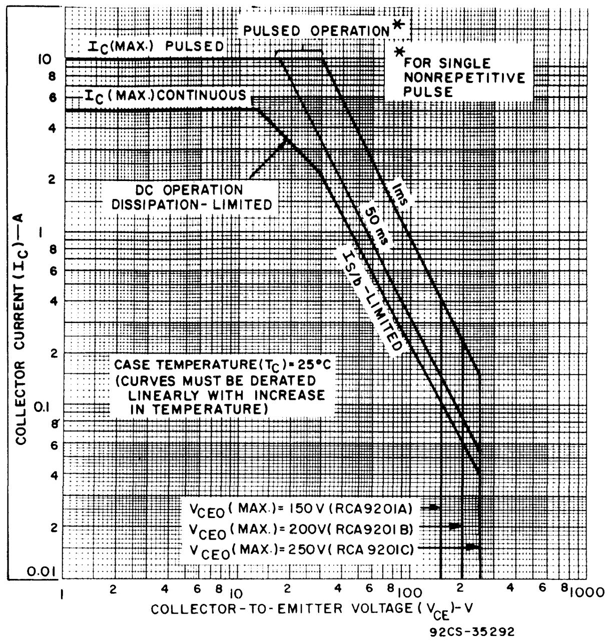


Fig. 3 - Maximum operating areas for all types.

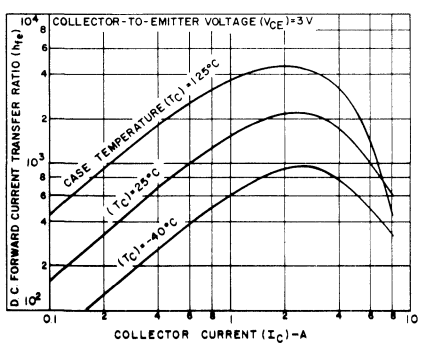


Fig. 4 - Typical dc beta characteristics for all types.

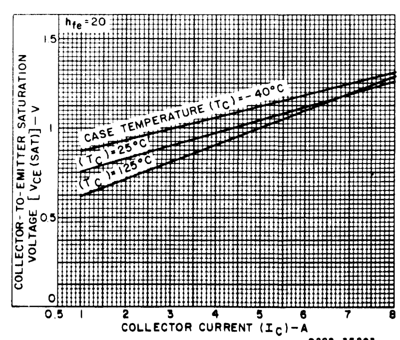


Fig. 5 - Typical saturation characteristics for all types.

RCA9201A, RCA9201B, RCA9201C

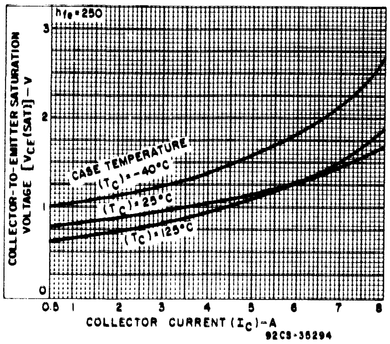


Fig. 6 - Typical saturation characteristics for all types.

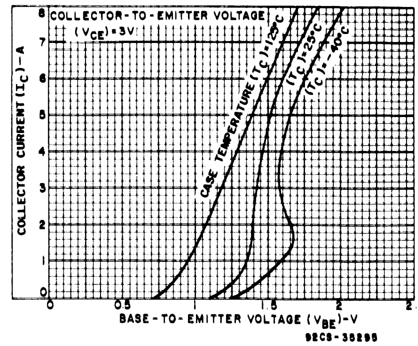


Fig. 7 - Typical transfer characteristics for all types.

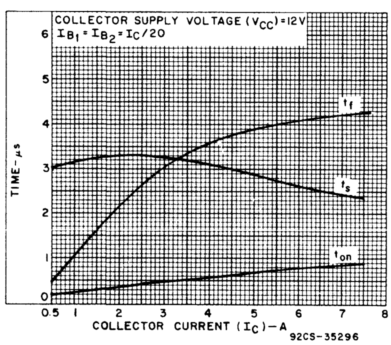


Fig. 8 - Typical saturated switching characteristics for all types.

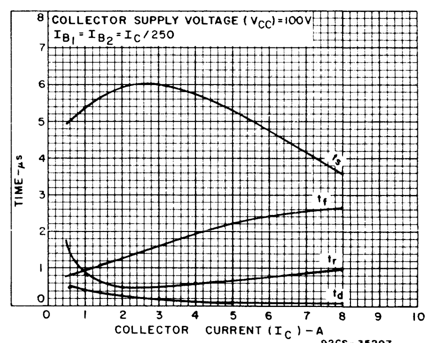


Fig. 9 - Typical saturated switching characteristics for all types.

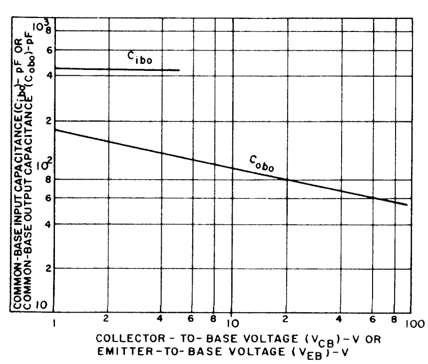


Fig. 10 - Typical common-base input (Cibo) or output (Cobo) capacitance characteristics (all types).

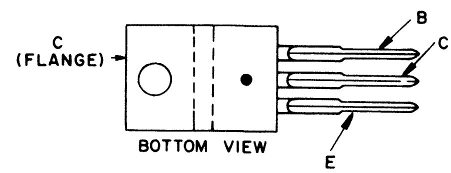
File Number **1414**

RCA9202A, RCA9202B, RCA9202C

4-Ampere N-P-N Darlington Power Transistors

300, 350 and 400 Volts, 65 Watts, Gain of 750 at 2A

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

Features

- *Direct IC input without predriver*
- *Low leakage at high temperature*
- *Hard glass passivation*
- *Wire bonded construction*

Applications

- *General purpose*
- *Small engine ignition*
- *Voltage regulator*

The RCA9202A, RCA9202B, and RCA9202C• are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double diffused construction of these devices provides good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220AB VERSAWATT package.

•Formerly RCA Dev. No. TA9202A, TA9202B and TA9202C, respectively.

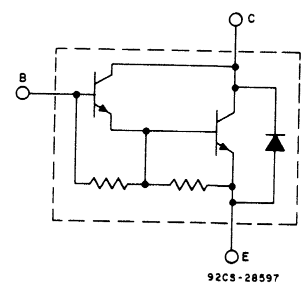


Fig. 1 - Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RCA9202A	RCA9202B	RCA9202C	UNITS
V_{CBO}	300	350	400	V
$V_{CEO}(sus)$	300	350	400	V
V_{EBO}	5	5	5	V
I_C	4	4	4	A
I_{CM}	8	8	8	A
I_B	0.25	0.25	0.25	A
P_T:				
T_C up to 25°C	65	65	65	W
T_C above 25°C ... Derate linearly at		0.52		W/°C
T_{stg}, T_J		-65 to 150		°C
T_L				
At distance ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235		°C

RCA9202A, RCA9202B, RCA9202C

ELECTRICAL CHARACTERISTICS, *At Case Temperature (Tc) = 25° C*

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	Voltage V dc		Current A dc		RCA9202A		RCA9202B		RCA9202C		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CBO} $I_E = 0$	300[a]	—	—	—	—	0.2	—	—	—	—	mA
	350[a]	—	—	—	—	—	—	0.2	—	—	
	400[a]	—	—	—	—	—	—	—	—	0.2	
I_{CEO}	250	—	—	0	—	0.5	—	—	—	—	
	300	—	—	0	—	—	—	0.5	—	—	
	350	—	—	0	—	—	—	—	—	0.5	
I_{EBO}	—	-5	0	—	—	10	—	10	—	10	mA
$V_{CEO}(sus)$[c]	—	—	.03[b]	0	300	—	350	—	400	—	V
h_{FE}	3.0	—	2[b]	—	750	—	750	—	750	—	
	3.0	—	3[b]	—	—	—	—	—	500	—	
	3.0	—	4[b]	—	500	—	500	—	250	—	
V_{BE}	3.0	—	4[b]	—	—	2.5	—	2.5	—	2.5	V
$V_{CE}(sat)$	—	—	2b	.1	—	1.5	—	1.5	—	1.5	V
	—	—	3b	.15	—	1.5	—	1.5	—	1.5	
	—	—	4b	.2	—	1.5	—	1.5	—	1.5	
C_{obo} $V_{CB} = 10$ V f = 1 MHz	—	—	—	—	100 Typ.		100 Typ.		100 Typ.		pF
$I_{s/b}$ t = 0.5 s non-rep. pulse	50	—	—	—	1.3	—	1.3	—	1.3	—	A
$R_{\theta JC}$	—	—	—	—	—	1.92	—	1.92	—	1.92	°C/W

[a]V_{CB} value.
[b]Pulsed, pulse duration = 300 μs, duty factor ≤ 2%.
[c]Caution: Sustaining voltage, $V_{CEO}(sus)$, must not be measured on a curve tracer.

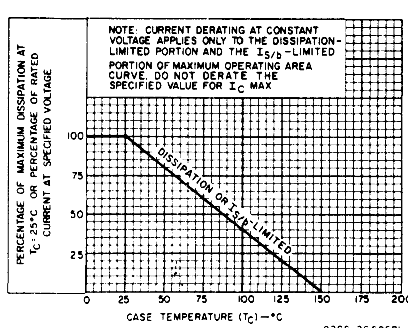


Fig. 2 - Derating curve for all types.

RCA9202A, RCA9202B, RCA9202C

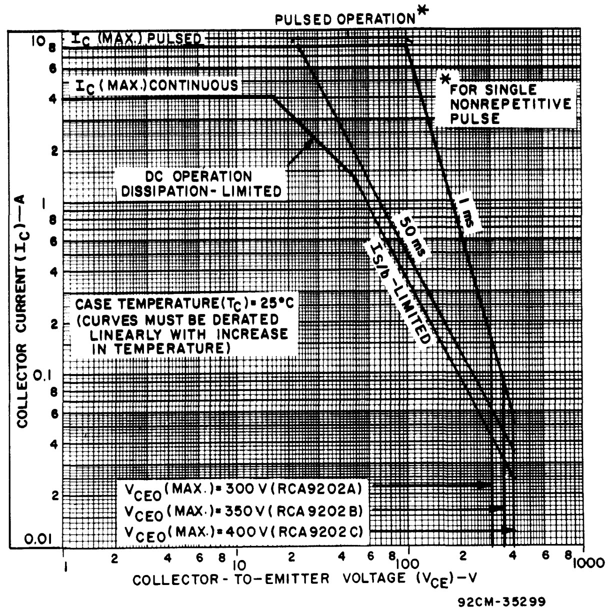


Fig. 3 - Maximum operating areas for all types.

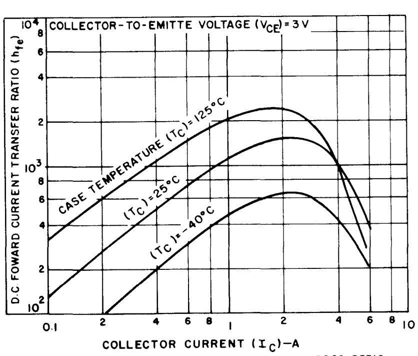


Fig. 4 - Typical dc beta characteristics for all types.

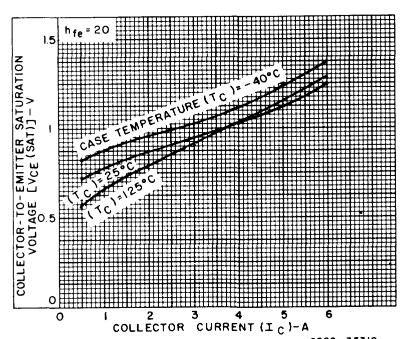


Fig. 5 - Typical saturation characteristics for all types.

RCA9202A, RCA9202B, RCA9202C

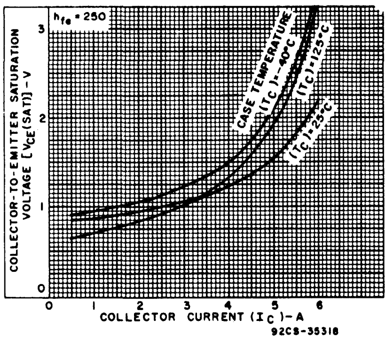


Fig. 6 - Typical saturation characteristics for all types.

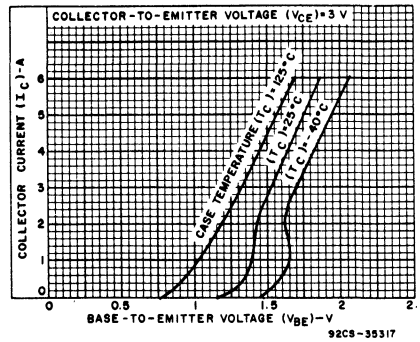


Fig. 7 - Typical transfer characteristics for all types.

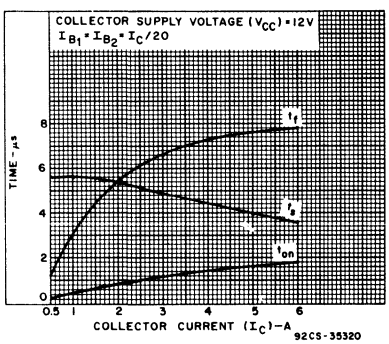


Fig. 8 - Typical saturated switching characteristics for all types.

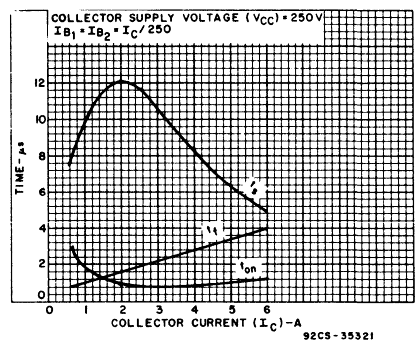


Fig. 9 - Typical saturated switching characteristics for all types.

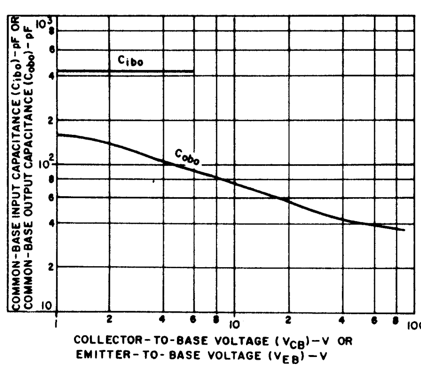


Fig. 10 - Typical common-base input (C_{ibo}) or output (C_{obo}) capacitance characteristics (all types).

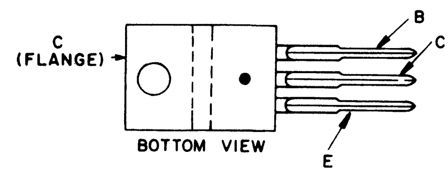
File Number **1413**

RCA9203A, RCA9203B, RCA9203C

4-Ampere N-P-N Darlington Power Transistors

250, 300 and 350 Volts, 50 Watts, Gain of 500 at 2A

TERMINAL DESIGNATIONS



JEDEC TO-220AB

(See dimensional outline "N".)

Features

- *Direct IC input without predriver*
- *No R_2, no anti-parallel diode*
- *Hard glass passivation*
- *Wire bonded construction*

Applications

- *General purpose*
- *Small engine ignition*
- *Voltage regulator*

The RCA9203A, RCA9203B, and RCA9203C• are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double diffused construction of these devices provides good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220AB VERSAWATT package.

•Formerly RCA Dev. No. TA9203A, TA9203B and TA9203C, respectively.

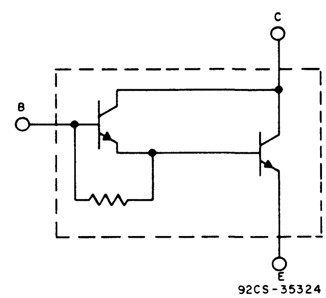


Fig. 1 - Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RCA9203A	RCA9203B	RCA9203C	UNITS
V_{CBO}	250	300	350	V
$V_{CEO}(sus)$	250	300	350	V
V_{EBO}	9	9	9	V
I_C	4	4	4	A
I_{CM}	6	6	6	A
I_B	0.25	0.25	0.25	A
P_T:				
T_C up to 25°C	50	50	50	W
T_C above 25°C ... Derate linearly at		0.4		W/°C
T_{stg}, T_J		-65 to 150		°C
T_L				
At distance ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235		°C

RCA9203A, RCA9203B, RCA9203C

ELECTRICAL CHARACTERISTICS, *At Case Temperature* (T_C) = 25° C

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	Voltage V dc		Current A dc		RCA9203A		RCA9203B		RCA9203C		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CBO} $I_E = 0$	250[a]	—	—	—	—	0.2	—	—	—	—	mA
	300[a]	—	—	—	—	—	—	0.2	—	—	
	350[a]	—	—	—	—	—	—	—	—	0.2	
I_{CEO}	200	—	—	0	—	0.5	—	—	—	—	
	250	—	—	0	—	—	—	0.5	—	—	
	300	—	—	0	—	—	—	—	—	0.5	
I_{EBO}	—	-9	0	—	—	1	—	1	—	1	mA
$V_{CEO}(sus)$[c]	—	—	.03[b]	0	250	—	300	—	350	—	V
h_{FE}	3.0	—	2[b]	—	500	—	500	—	500	—	
	3.0	—	4[b]	—	100	—	100	—	100	—	
V_{BE}	3.0	—	4[b]	—	—	2.5	—	2.5	—	2.5	V
$V_{CE}(sat)$	—	—	2b	.1	—	1.5	—	1.5	—	1.5	V
	—	—	4b	.2	—	2.0	—	2.0	—	2.0	
C_{obo} V_{CB} - 10 V f = 1 MHz	—	—	—	—	100 Typ.		100 Typ.		100 Typ.		pF
$I_{s/b}$ t = 0.5 s non-rep. pulse	40	—	—	—	1.25	—	1.25	—	1.25	—	A
$R_{\theta JC}$	—	—	—	—	—	2.5	—	2.5	—	2.5	°C/W

[a] V_{CB} value.

[b] Pulsed, pulse duration = 300 μs, duty factor $\leq$ 2%.

[c] Caution: Sustaining voltage, $V_{CEO}(sus)$, must not be measured on a curve tracer.

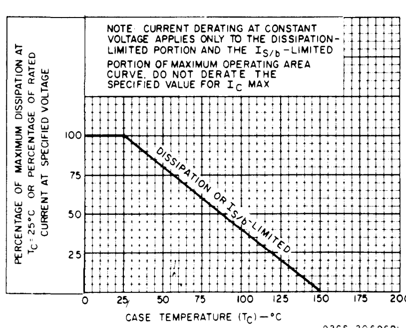


Fig. 2 - Derating curve for all types.

RCA9203A, RCA9203B, RCA9203C

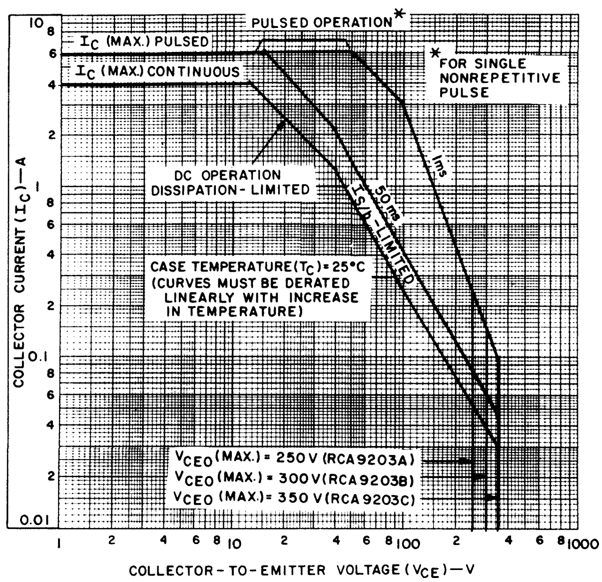


Fig. 3 - Maximum operating areas for all types.

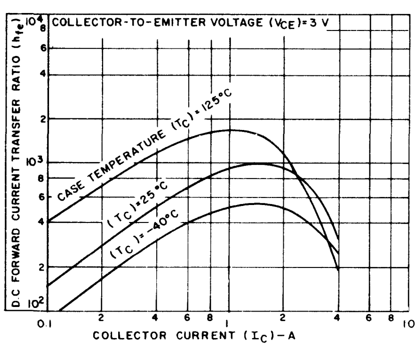


Fig. 4 - Typical dc beta characteristics for all types.

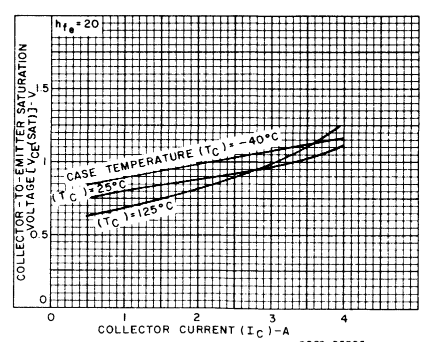


Fig. 5 - Typical saturation characteristics for all types.

RCA9203A, RCA9203B, RCA9203C

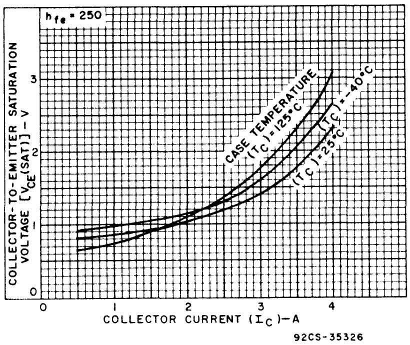


Fig. 6 - Typical saturation characteristics for all types.

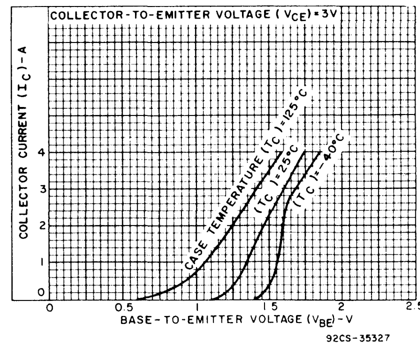


Fig. 7 - Typical transfer characteristics for all types.

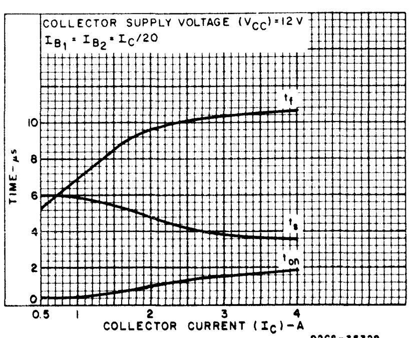


Fig. 8 - Typical saturated switching characteristics for all types.

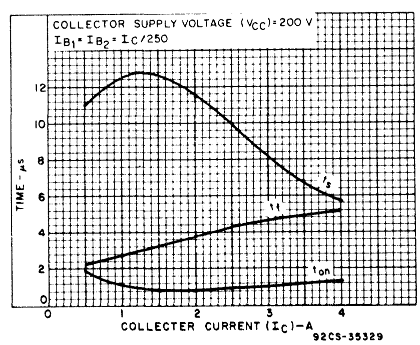


Fig. 9 - Typical saturated switching characteristics for all types.

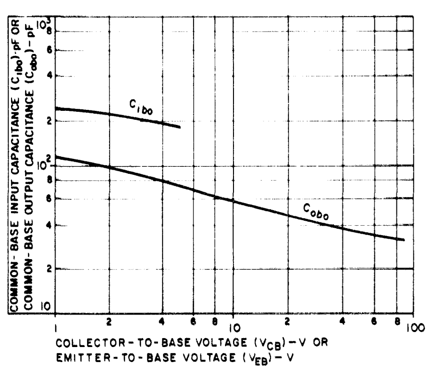


Fig. 10 - Typical common-base input (C_{ibo}) or output (C_{obo}) capacitance characteristics (all types).

File Number **1448**

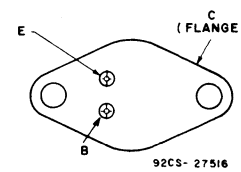
RCA9228A, RCA9228B, RCA9228C, RCA9228D
RCA9229A, RCA9229B, RCA9229C, RCA9229D

50-A Complementary High Current, Medium Voltage N-P-N and P-N-P Silicon Darlington Power Transistors

Features:
- *300 W at 25° C case temperature*
- *50-A rated collector current*
- *Hard glass passivation*
- *Wire-bonded construction*

Applications:
- *General purpose*
- *Low-speed switching*
- *DC motor control*

TERMINAL DESIGNATIONS



JEDEC TO-204MA

(See dimensional outline "D".)

The RCA-9228 Series and the RCA-9229 Series* complementary n-p-n and p-n-p silicon Darlington transistors designed for general-purpose amplifier and low-speed switching applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits.

*The RCA9228 and RCA9229 Series were formerly RCA developmental numbers TA9228 and TA9229, respectively.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	RCA9228A RCA9229A•	RCA9228B RCA9229B•	RCA9228C RCA9229C•	RCA9228D RCA9229D•
V_{CBO}	60	80	100	120
V_{CEO}(sus)	60	80	100	120
V_{EBO}	5			
I_C	50			
I_B	1			
P_T				
$T_C \leq 25°C$	300			
$T_C > 25°C$ ... Derate linearly	2.4			
T_{stg}, T_J	-65 to +150			
T_L				
At distances > 1/8 in. (3.17 mm) from case for 10 s max.	235			

• For p-n-p devices, voltage and current values are negative.

RCA9228A, RCA9228B, RCA9228C, RCA9228D
RCA9229A, RCA9229B, RCA9229C, RCA9229D

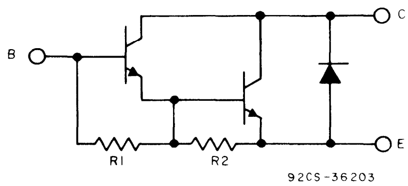


Fig. 1 - Schematic diagram for RCA9228 Series.

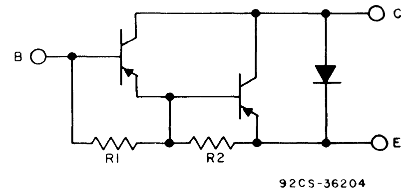


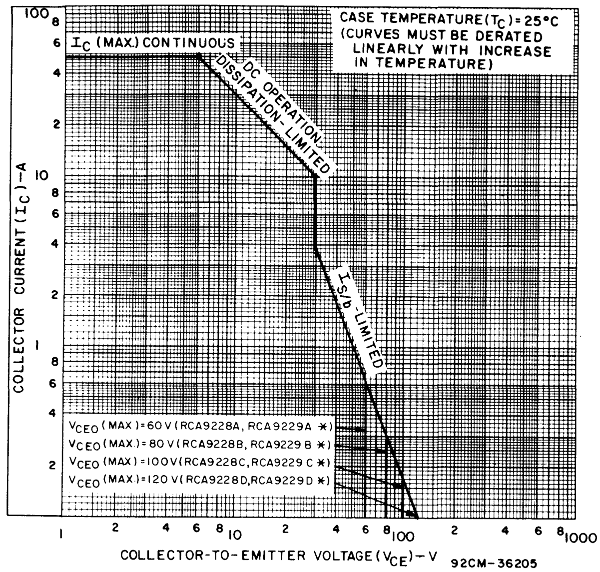
Fig. 2 - Schematic diagram for RCA9229 Series.

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25° C Unless Otherwise Specified*

CHARAC-TERISTIC	TEST CONDITIONS				LIMITS								UNITS
	VOLTAGE V dc		CURRENT A dc		RCA9228A RCA9229A•		RCA9228B RCA9229B•		RCA9228C RCA9229C•		RCA9228D RCA9229D•		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CEO}	50				—	0.5	—	—	—	—	—	—	mA
	70				—	—	—	0.5	—	—	—	—	
	90				—	—	—	—	—	0.5	—	—	
	110				—	—	—	—	—	—	—	0.5	
I_{EBO}		-5			—	5	—	5	—	5	—	5	mA
V_{CEO}	(a)		0.1(b)		60	—	80	—	100	—	120	—	V
h_{FE}	3		25		2000	—	2000	—	2000	—	2000	—	
	3		50		400	—	400	—	400	—	400	—	
$V_{BE}(sat)$			25	0.1	—	2.5		2.5	—	2.5	—	2.5	V
			50	0.2	—	3.5	—	3.5	—	3.5	—	3.5	
$V_{CE}(sat)$			25	0.1	—	2	—	2	—	2	—	2	V
			50	0.2	—	3	—	3	—	3	—	3	
$I_{S/b}$ t = 0.5 sec.	30				10	—	10	—	10	—	10	—	A
$R_{\theta JC}$					—	0.416	—	0.416	—	0.416	—	0.416	°C/W
Typical Values C_{ob} V_{CB} = 10 V													
RCA9228 Series					Typ.	300	Typ.	300	Typ.	300	Typ.	300	pF
RCA9229 Series					Typ.	600	Typ.	600	Typ.	600	Typ.	600	
h_{fe} 1 MHz	3		10		Typ.	5	Typ.	5	Typ.	5	Typ.	5	

(a) CAUTION: Sustaining voltage $V_{CEO}(sus)$ MUST NOT be measured on a curve tracer.
(b) Pulsed: Pulse duration = 300 μs, duty factor < 2%.
• For p-n-p devices, voltage and current values are negative.

RCA9228A, RCA9228B, RCA9228C, RCA9228D
RCA9229A, RCA9229B, RCA9229C, RCA9229D



*FOR p-n-p DEVICES, VOLTAGE AND CURRENT VALUES ARE NEGATIVE

Fig. 3 - Maximum operating areas for all types.

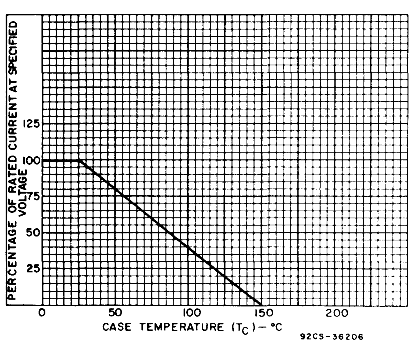


Fig. 4 - Current derating curve for all types.

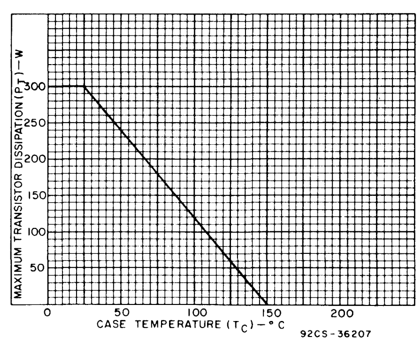


Fig. 5 - Power derating curve for all types.

RCA9228A, RCA9228B, RCA9228C, RCA9228D
RCA9229A, RCA9229B, RCA9229C, RCA9229D

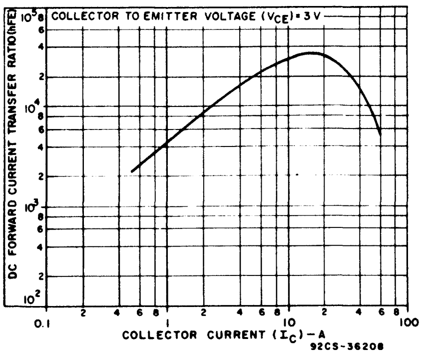


Fig. 6 - Typical dc beta characteristics for RCA9228 Series.

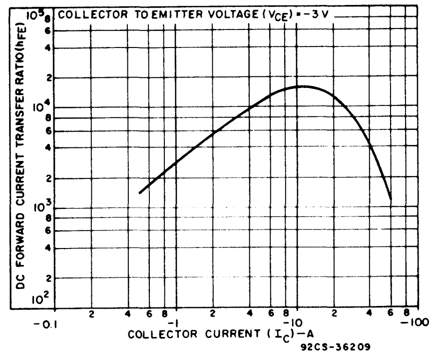


Fig. 7 - Typical dc beta characteristics for RCA9229 Series.

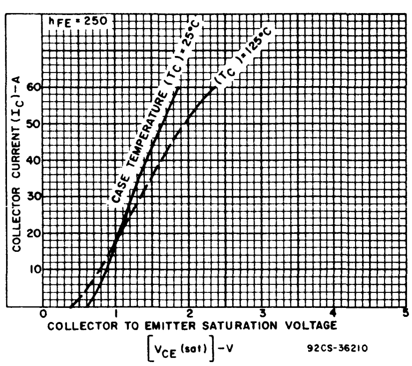


Fig. 8 - Typical saturation characteristics for RCA9228 Series.

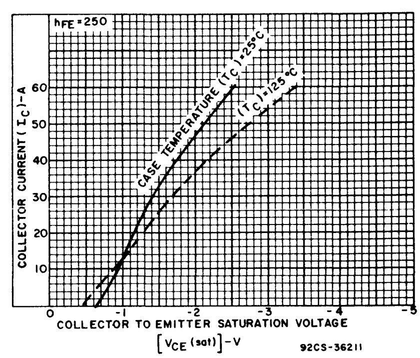


Fig. 9 - Typical saturation characteristics for RCA9229 Series.

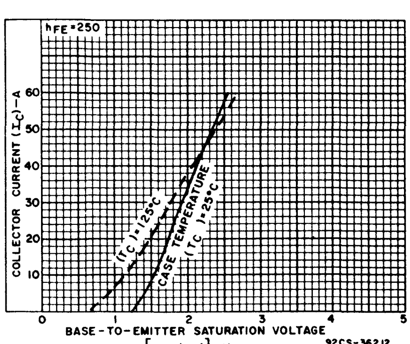


Fig. 10 - Typical saturation characteristics for RCA9228 Series.

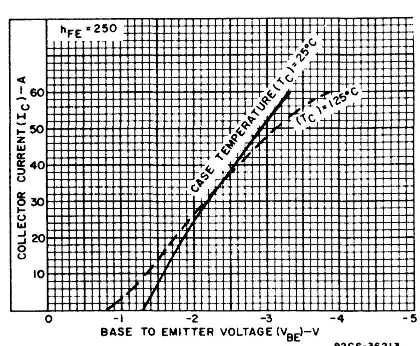


Fig. 11 - Typical saturation characteristics for RCA9229 Series.

File Number **1153**

TIP100, TIP101, TIP102

8-Ampere N-P-N Darlington Power Transistors

60, 80, and 100 Volts, 80 Watts
Gain of 1000 at 3 A

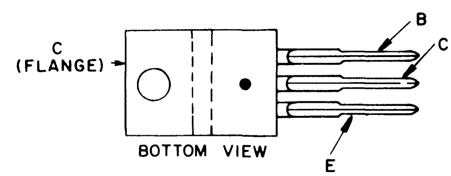
Features:

- **Operates from IC without predriver**
- **Low leakage at high temperature**
- **High reverse second-breakdown capability**

Applications:

- **Power switching**
- **Hammer drivers**
- **Audio amplifiers**
- **Series and shunt regulators**

TERMINAL DESIGNATIONS



92CS-37394

JEDEC TO-220AB
(See dimensional outline "N".)

The RCA-TIP100, TIP101 and TIP102 are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double epitaxial construction of these devices provides good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220 AB (RCA VERSAWATT) plastic package.

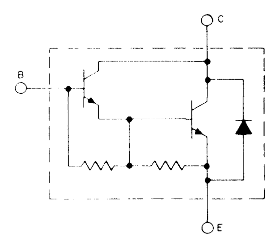


Fig. 1 – Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TIP100	TIP101	TIP102	
V_{CBO}	60	80	100	V
$V_{CEO}(sus)$	60	80	100	V
V_{EBO}		5		V
I_C		8		A
I_{CM}		15		A
I_B		1		A
P_T:				
T_C up to 25°C		80		W
T_C above 25°C . . . Derate linearly at		0.64		W/°C
T_{stg}, T_J		−65 to 150		°C
T_L:				
At distance ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235		°C

TIP100, TIP101, TIP102

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARAC-TERISTIC	TEST CONDITIONS				LIMITS						UNITS
	Voltage V dc		Current A dc		TIP100		TIP101		TIP102		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CBO} $I_E = 0$	60 80 100				– – –	50 – –	– – –	– 50 –	– – –	– – 50	μA
I_{CEO}	30 40 50			0 0 0	– – –	50 – –	– – –	– 50 –	– – –	– – 50	μA
I_{EBO}		–5	0		–	8	–	8	–	8	mA
$V_{CEO}(sus)$			0.03[b]	0	60	–	80	–	100	–	V
h_{FE}	4 4		3[b] 8[b]		1000 200	20,000 –	1000 200	20,000 –	1000 200	20,000 –	
V_{BE}	4		8[b]		–	2.8	–	2.8	–	2.8	V
$V_{CE}(sat)$			3[b] 8[b]	0.006 0.08	– –	2 2.5	– –	2 2.5	– –	2 2.5	V
V_F			–10		–	2.8	–	2.8	–	2.8	V
t_d[c] t_r[c] t_s[c] t_f[c]			8 8 8 8	0.08 0.08 0.08[d] 0.08[d]	0.035 typ. 0.35 typ. 1.8 typ. 2.45 typ.		0.035 typ. 0.35 typ. 1.8 typ. 2.45 typ.		0.035 typ. 0.35 typ. 1.8 typ. 2.45 typ.		μs
$I_{S/b}$ t=0.15 s non-rep. pulse	40				2	–	2	–	2	–	A
$R_{\theta JC}$					–	1.56	–	1.56	–	1.56	°C/W

[a] V_{CB} value. [b] Pulsed: Pulse duration = 300 μs, duty factor ⩽2%. [c] V_{CC} = 40 V [d] $I_{B_1} = -I_{B_2}$.

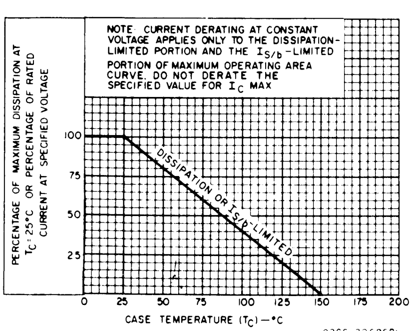


Fig. 2 — Derating curve for all types.

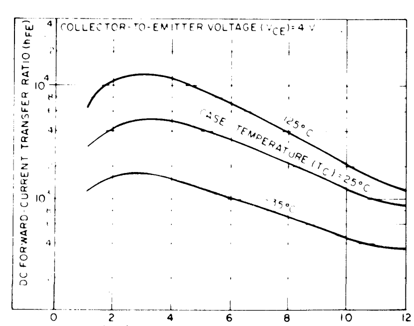


Fig. 3 — Typical dc-beta characteristics for all types.

TIP100, TIP101, TIP102

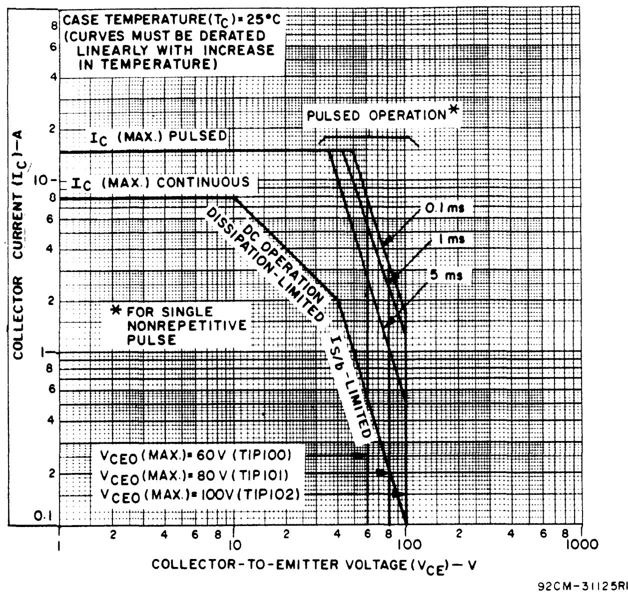


Fig. 4 — Maximum operating areas for all types (T_C = 25°C).

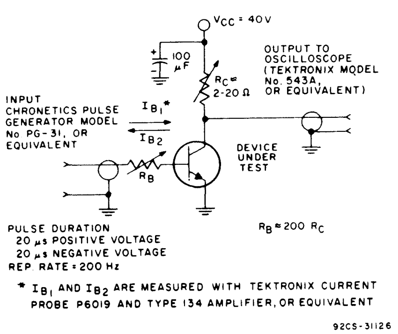


Fig. 5 — Circuit used to measure saturated switching times.

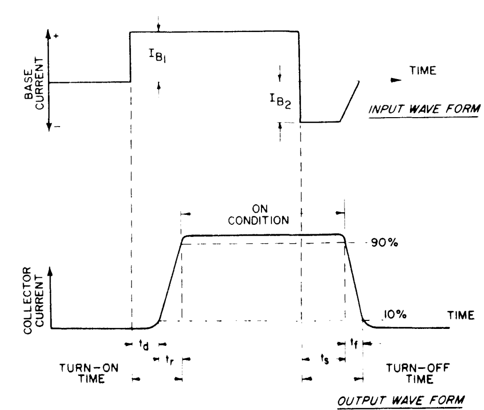


Fig. 6 — Phase relationship between input current and output current showing reference points for specification of switching times.

TIP110, TIP111, TIP112

File Number **1336**

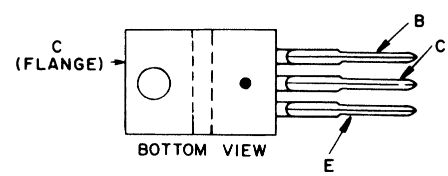
2-Ampere N-P-N Darlington Power Transistors

For Low and Medium Frequency Power Switching, Hammer Driver, Audio Amplifier, and Series and Shunt Regulator Applications

Features:

- *Operates from IC without predriver*
- *Gain of 1000 at 1A*
- *Low leakage at high temperatures*
- *Designed for completementary use with TIP-115, 116, and 117*
- *Hard glass passivation*
- *Wire-bonded construction*

TERMINAL DESIGNATIONS



JEDEC TO-220AB

(See dimensional outline "N".)

The RCA-TIP110, TIP111 and TIP112 series monolithic n-p-n silicon Darlington transistors are designed for low and medium frequency power applications. The double epitaxial construction of these devices provides good forward bias second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220AB (RCA VERSAWATT) plastic package.

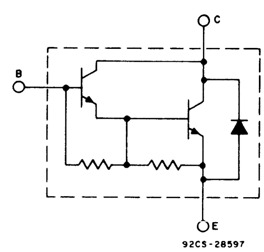


Fig. 1 - Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute Maximum Values:*

	TIP110	TIP111	TIP112	UNITS
V_{CBO}	60	80	100	V
$V_{CEO}(sus)$	60	80	100	V
V_{EBO}		5		V
I_C		2		A
I_{CM}		4		A
I_B		0.05		A
P_T:				
T_C up to 25°C		50		W
T_C above 25°C ... Derate linearly at		0.4		W/°C
T_{stg}, T_J		-65 to 150		°C
T_L				
At distance 1/8 in. (3.17 mm) from case for 10 s max.		260		°C

TIP110, TIP111, TIP112

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) =25° C*

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	Voltage V dc		Current A dc		TIP110		TIP111		TIP112		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
I_{CBO} I_E= 0	60[a] 80[a] 100[a]	— — —	— — —	— — —	— — —	1 — —	— — —	— 1 —	— — —	— — 1	mA
I_{CEO}	30 40 50	— — —	— — —	0 0 0	— — —	2 — —	— — —	— 2 —	— — —	— — 2	mA
I_{EBO}	—	-5	0	—	—	2	—	2	—	2	mA
V_{CEO}(sus)	—	—	0.03[b]	0	60	—	80	—	100	—	V
h_{FE}	4 4	— —	1[b] 2[b]	— —	1000 500	— —	1000 500	— —	1000 500	— —	—
V_{BE}	4	—	2[b]	—	—	2.8	—	2.8	—	2.8	V
V_{CE}(sat)	—	—	2[b]	0.008	—	2.5	—	2.5	—	2.5	V
C_{obo}	10[a]	—	—	—	—	100	—	100	—	100	pf
$\|h_{fe}\|$ f = 1.0 mHz	10	—	0.75	—	25 TYP.		25 TYP.		25 TYP.		—
$I_{S/b}$ t = 0. 5 s non-rep. pulse	40	—	—	—	1.25	—	1.25	—	1.25	—	A
$R_{\theta JC}$	—	—	—	—	—	2.5	—	2.5	—	2.5	°C/W
$R_{\theta JA}$	—	—	—	—	—	62.5	—	62.5	—	62.5	°C/W

[a] V_{CB} value. [b] Pulsed: Pulsed duration = 300 μs, duty factor ≤2%.

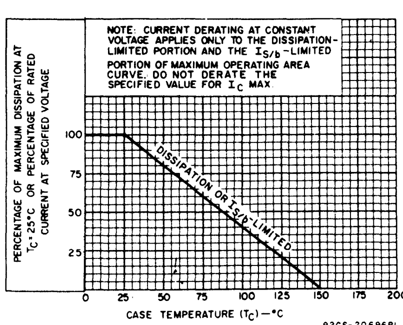


Fig. 2 - Derating curve for all types.

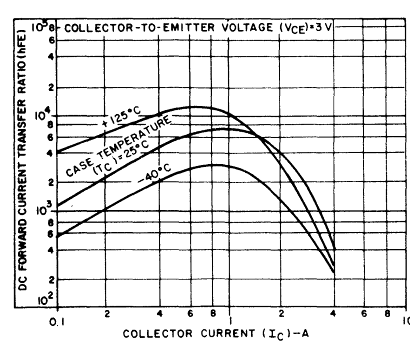


Fig. 3 - Typical dc-beta characteristics for all types.

TIP110, TIP111, TIP112

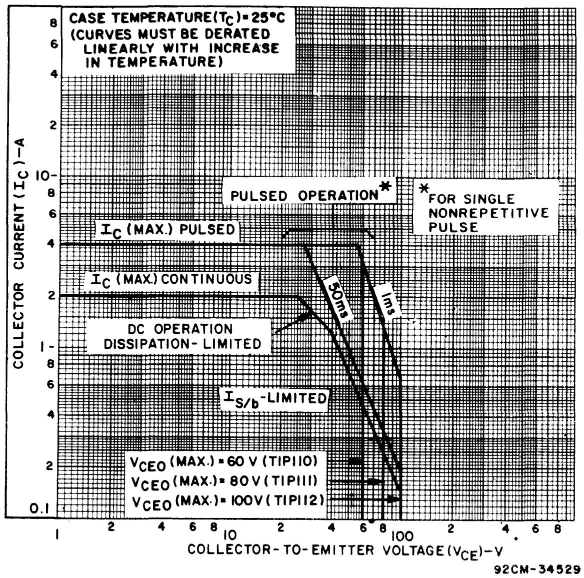


Fig. 4 - Maximum operating areas for all types (T_C = 25° C).

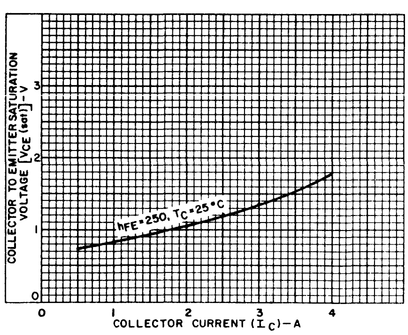


Fig. 5 - Typical saturation characteristics for all types.

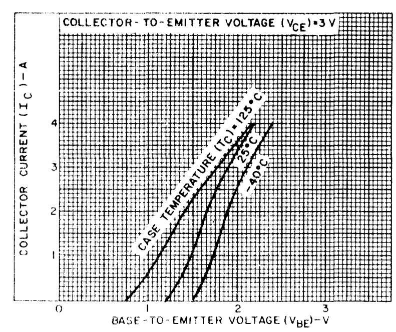


Fig. 6 - Typical transfer characteristics for all types.

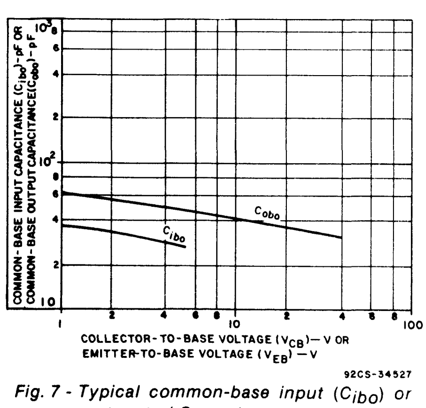


Fig. 7 - Typical common-base input (C_{ibo}) or output (C_{obo}) capaciatance characteristic (all types).

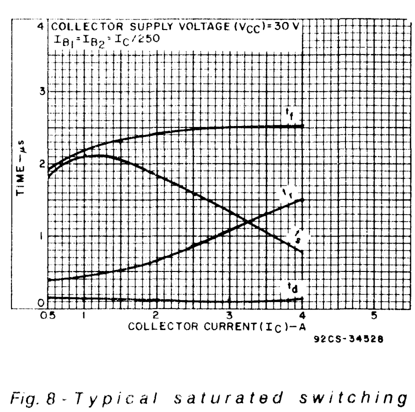


Fig. 8 - Typical saturated switching characteristics (all types).

TIP110, TIP111, TIP112

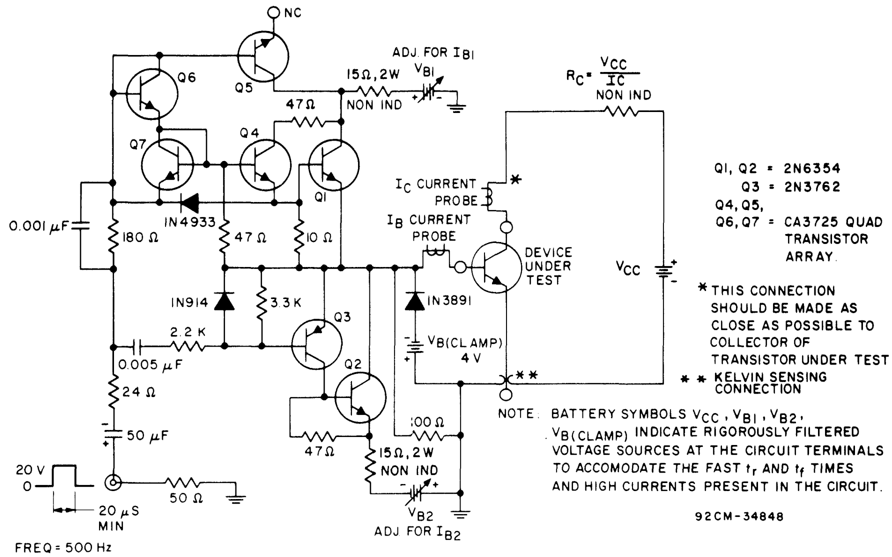


Fig. 9 - Circuit for measuring switching times.

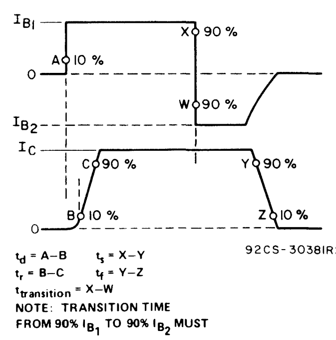


Fig. 10 - Phase relationship between input and output currents showing reference points for specification of switching times.

TIP115, TIP116, TIP117

File Number **1387**

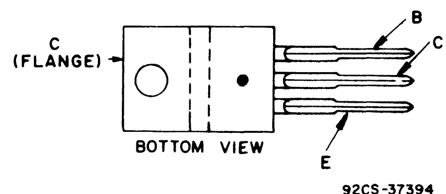
2-Ampere P-N-P Darlington Power Transistors

For Low and Medium Frequency Power Switching, Hammer Driver, Audio Amplifier, and Series and Shunt Regulator Applications

Features:

- *Operates from IC without predriver*
- *Gain of 1000 at 1A*
- *Low leakage at high temperatures*
- *Designed for completementary use with TIP110, TIP111 and TIP112*
- *Hard glass passivation*
- *Wire-bonded construction*

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

The RCA-TIP115, TIP116, and TIP117 series are monolithic p-n-p silicon Darlington transistors designed for low and medium frequency power applications. The double epitaxial construction of these devices provides good forward bias second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220AB (RCA VERSAWATT) plastic package.

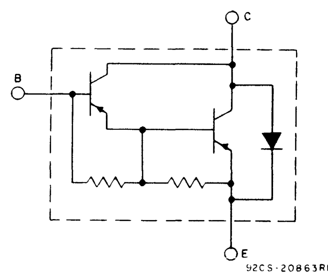


Fig. 1 - Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute Maximum Values:*

	TIP115	TIP116	TIP117	UNITS
V_{CBO}	60	80	100	V
$V_{CEO}(sus)$	60	80	100	V
V_{EBO}		5		V
I_C		2		A
I_{CM}		4		A
I_B		0.05		A
P_T:				
T_C up to 25°C		50		W
T_C above 25°C ... Derate linearly at		0.4		W/°C
T_{stg}, T_J		-65 to 150		°C
T_L				
At distance 1/8 in. (3.17 mm) from case for 10 s max.		260		°C

TIP115, TIP116, TIP117

ELECTRICAL CHARACTERISTICS, At Case Temperature (Tc) = 25° C

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	Voltage V dc		Current A dc		TIP115		TIP116		TIP117		
	V_{CE}	V_{BE}	I_C	I_B	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	
I_{CBO} I_E = 0	-60[a]	—	—	—	—	-1	—	—	—	—	mA
	-80[a]	—	—	—	—	—	—	-1	—	—	
	-100[a]	—	—	—	—	—	—	—	—	-1	
I_{CEO}	-30	—	—	0	—	-2	—	—	—	—	
	-40	—	—	0	—	—	—	-2	—	—	
	-50	—	—	0	—	—	—	—	—	-2	
I_{EBO}	—	5	0	—	—	-2	—	-2	—	-2	mA
$V_{CEO}(sus)$	—	—	-0.03[b]	0	-60	—	-80	—	-100	—	V
h_{FE}	-4	—	-1[b]	—	1000	—	1000	—	1000	—	—
	-4	—	-2[b]	—	500	—	500	—	500	—	
V_{BE}	-4	—	-2[b]	—	—	-2.8	—	-2.8	—	-2.8	V
$V_{CE}(sat)$	—	—	-2[b]	-0.008	—	-2.5	—	-2.5	—	-2.5	
C_{obo}	-10[a]	—	—	—	—	100	—	100	—	100	pF
h_{fe} f = 1.0 mHz	-10	—	-0.75	—	25 TYP.		25 TYP.		25 TYP.		—
$I_{S/b}$ t ≐ 0, 5 s non-rep. pulse	-40	—	—	—	-1.25	—	-1.25	—	-1.25	—	A
$R_{\theta JC}$	—	—	—	—	—	2.5	—	2.5	—	2.5	°C/W
$R_{\theta JA}$	—	—	—	—	—	62.5	—	62.5	—	62.5	

[a] V_{CB} value.

[b] Pulsed: Pulsed duration = 300 μs, duty factor ≤ 2%.

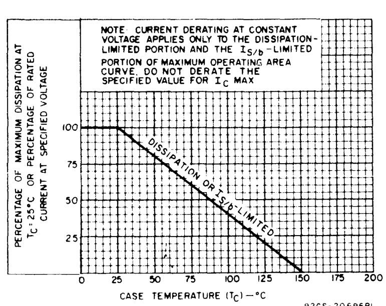


Fig. 2 - Derating curve for all types.

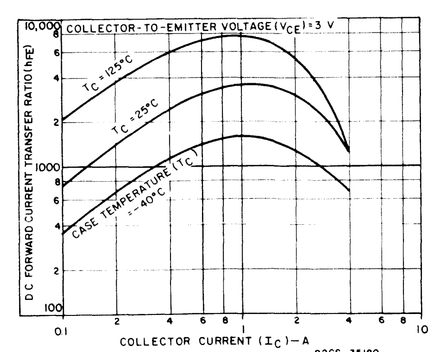


Fig. 3 - Typical dc-beta characteristics for all types.

TIP115, TIP116, TIP117

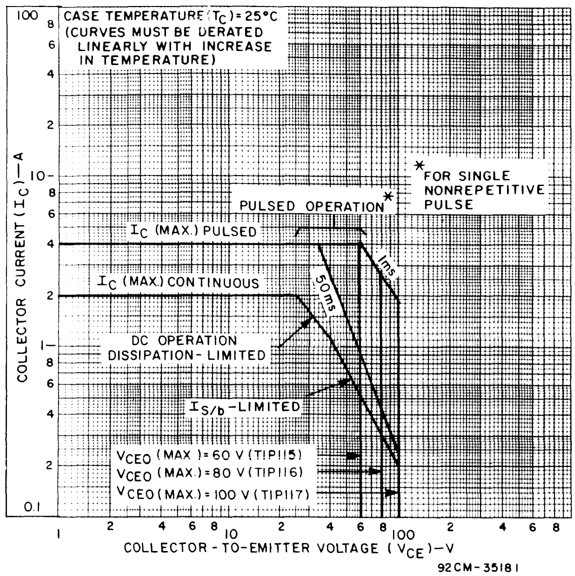


Fig. 4 - Maximum operating areas for all types (Tc = 25° C).

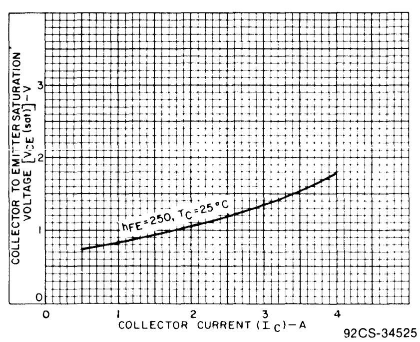


Fig. 5 - Typical saturation characteristics for all types.

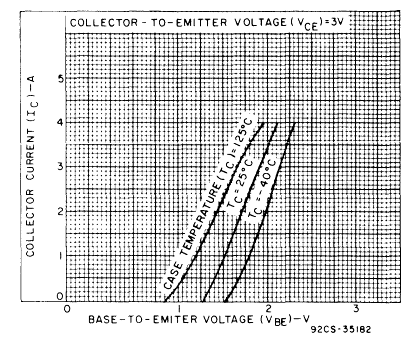


Fig. 6 - Typical transfer characteristics for all types.

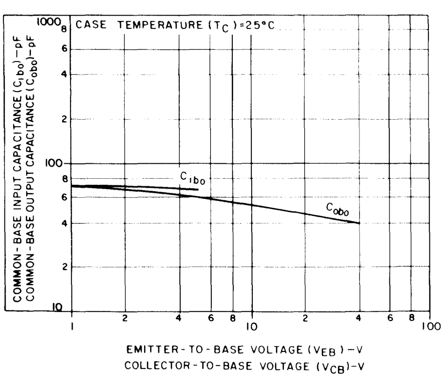


Fig. 7 - Typical common-base input (Cibo) or output (Cobo) capaciatance characteristic (all types).

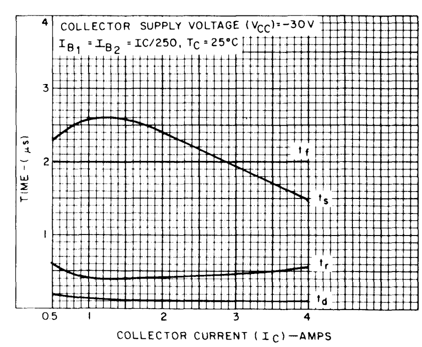


Fig. 8 - Typical saturated switching characteristics (all types).

TIP115, TIP116, TIP117

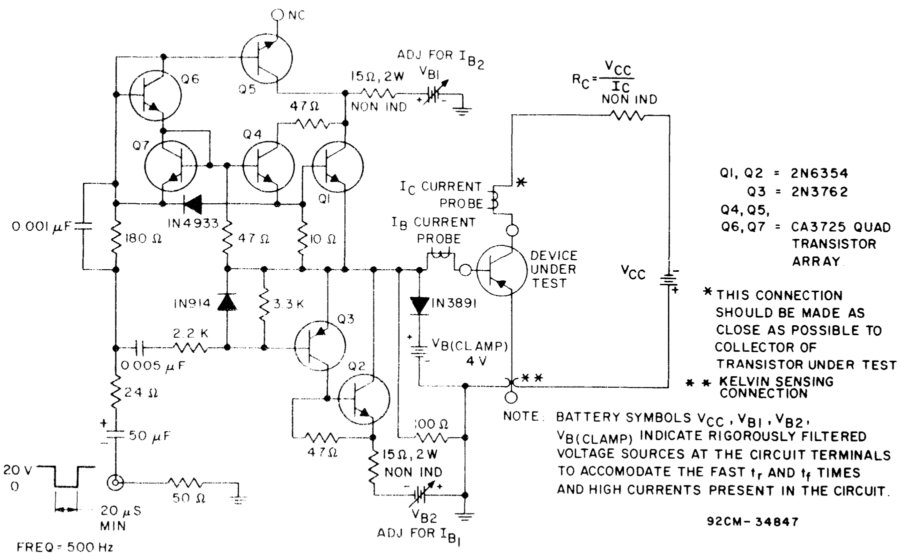
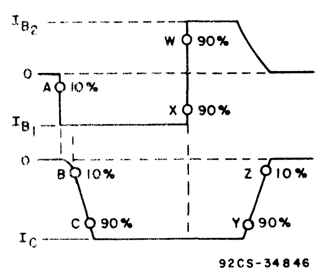


Fig. 9 - Circuit for measuring switching times.



t_d = A–B t_s = X–Y
t_r = B–C t_f = Y–Z
$t_{transition}$ = X–W
NOTE: TRANSITION TIME FROM 90% I_{B1} TO 90% I_{B2} MUST BE LESS THAN 0.5 μs.

Fig. 10 - Phase relationship between input and output currents showing reference points for specification of switching times.

TIP120, TIP121, TIP122 File Number **998**

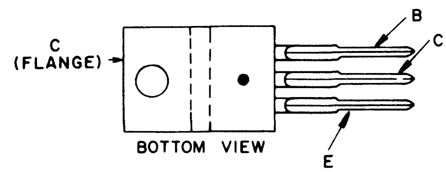
8-Ampere N-P-N Darlington Power Transistors

60, 80, and 100 Volts, 65 Watts
Gain of 1000 at 0.5 A
Gain of 1000 at 3 A

Features:
- Operates from IC without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

Applications:
- Power switching
- Audio amplifiers
- Hammer drivers
- Series and shunt regulators

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

The RCA-TIP120, TIP121 and TIP122 are monolithic n-p-n silicon Darlington transistors designed for low- and medium-frequency power applications. The double epitaxial construction of these devices provides good forward and reverse second-breakdown capability; their high gain makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220AB VERSAWATT package.

The TIP120, TIP121 and TIP122 are n-p-n complements of the TIP125, TIP126 and TIP127 described in RCA data bulletin File 997.

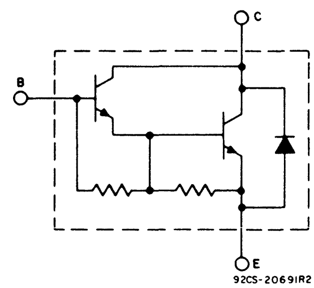


Fig. 1 – Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TIP120	TIP121	TIP122	
V_{CBO}	60	80	100	V
V_{CER} (sus)				
R_{BE} = 100 Ω	60	80	100	V
V_{CEO} (sus)	60	80	100	V
V_{CEV} (sus)				
V_{BE} = −1.5 V	60	80	100	V
V_{EBO}	5	5	5	V
I_C	8	8	8	A
I_{CM}	10	10	10	A
I_B	0.25	0.25	0.25	A
P_T:				
T_C up to 25°C	65	65	65	W
T_C above 25°C ... Derate linearly at		0.52		W/°C
T_{stg}, T_J		−65 to 150		°C
T_L				
At distance ≥ 1/8 in. (3.17 mm) from case for 10 s max.		235		°C

TIP120, TIP121, TIP122

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	Voltage V dc		Current A dc		TIP120		TIP121		TIP122		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CBO} I_E=0	60				–	0.2	–	–	–	–	mA
	80				–	–	–	0.2	–	–	
	100				–	–	–	–	–	0.2	
I_{CEO}	30			0	–	0.5	–	–	–	–	
	40			0	–	–	–	0.5	–	–	
	50			0	–	–	–	–	–	0.5	
I_{EBO}		−5	0		–	2	–	2	–	2	mA
V_{CEO}(sus)			0.2[a]	0	60	–	80	–	100	–	V
h_{FE}	3		3[a]		1000	–	1000	–	1000	–	
	3		0.5[a]		1000	–	1000	–	1000	–	
V_{BE}	3		3[a]		–	2.5	–	2.5	–	2.5	V
V_{CE}(sat)			3[a]	0.012	–	2	–	2	–	2	V
			5[a]	0.02	–	3	–	3	–	3	
h_{fe} f=1 kHz	5		1		1000	–	1000	–	1000	–	
$\|h_{fe}\|$ f=1 MHz	5		1		20	–	20	–	20	–	
C_{obo} V_{CB}=10 V f=1 MHz					–	200	–	200	–	200	pF
$E_{S/b}$ L=12 mH, R_{BE}=100 Ω		−1.5	4.5		120	–	120	–	120	–	mJ
$I_{S/b}$ t=0.5 s non-rep. pulse	25				2.6	–	2.6	–	2.6	–	A
$R_{\theta JC}$					–	1.92	–	1.92	–	1.92	°C/W

[a] Pulsed, pulse duration = 300 μs, duty factor ⩽ 2%.

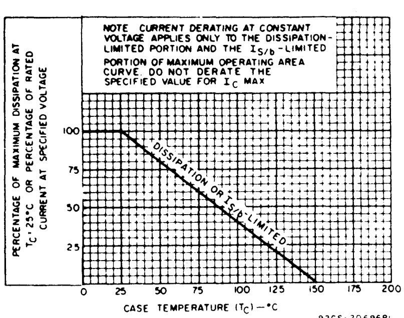


Fig. 2 — Derating curve for all types.

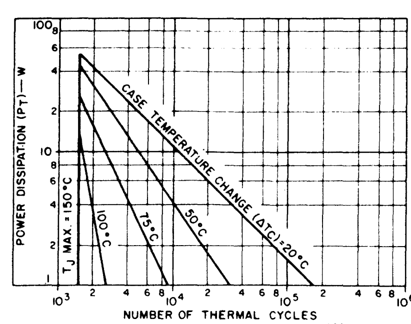


Fig. 3 — Thermal-cycling rating chart for all types.

TIP120, TIP121, TIP122

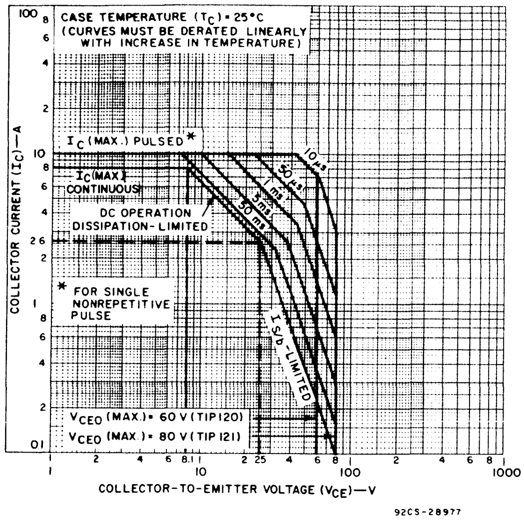


Fig. 4 – Maximum operating areas for TIP120 and TIP121.

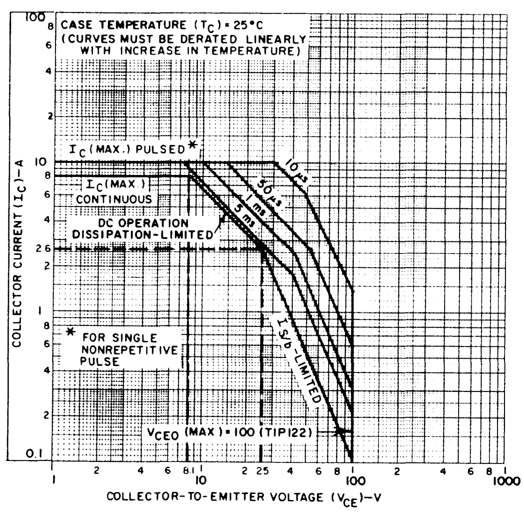


Fig. 5 – Maximum operating areas for TIP122.

TIP120, TIP121, TIP122

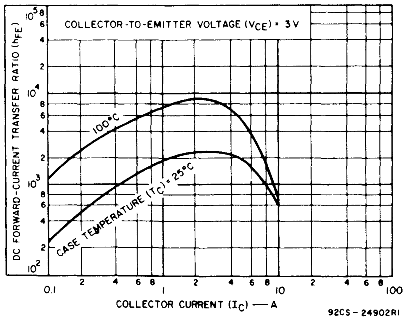


Fig. 6 — Typical dc beta characteristics for all types.

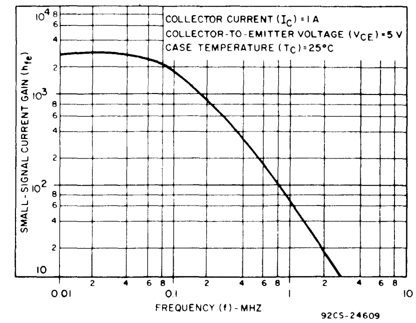


Fig. 7 — Typical small-signal current gain for all types.

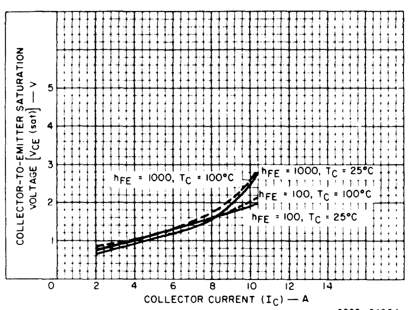


Fig. 8 — Typical saturation characteristics for all types.

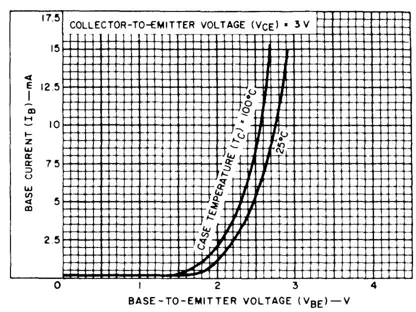


Fig. 9 — Typical input characteristics for all types.

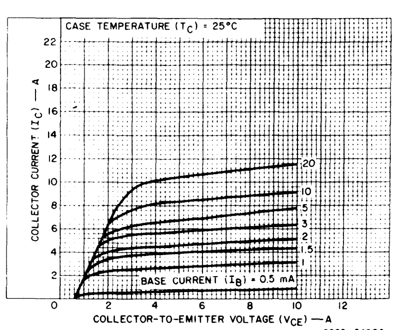


Fig. 10 — Typical output characteristics for all types.

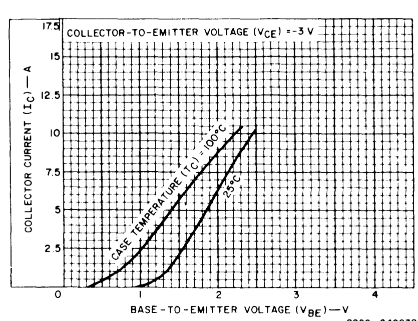


Fig. 11 — Typical transfer characteristics for all types.

TIP120, TIP121, TIP122

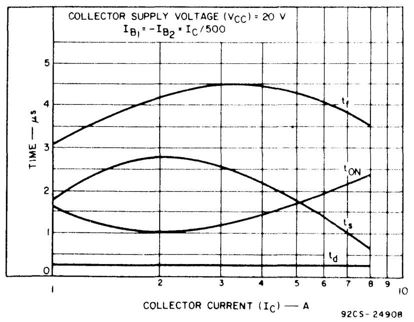


Fig. 12 – Typical saturated switching characteristics for all types.

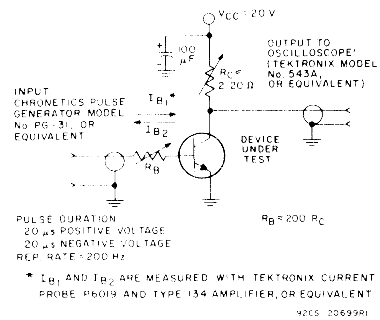


Fig. 13 – Circuit used to measure saturated switching times.

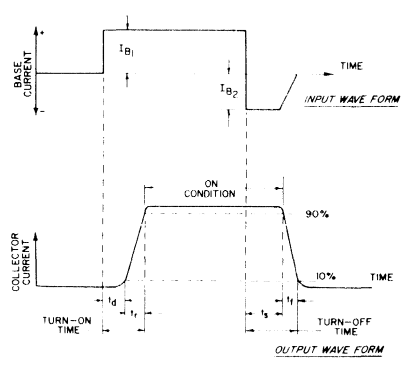


Fig. 14 – Phase relationship between input current and output current showing reference points for specification of switching times.

File Number **997**

TIP125, TIP126, TIP127

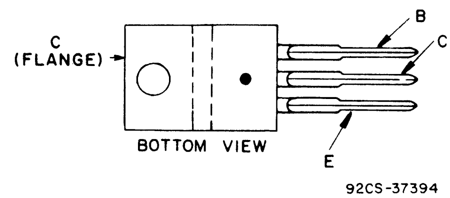
8-Ampere P-N-P Darlington Power Transistors

−60, −80, and −100 Volts, 65 Watts
Gain of 1000 at −3 A
Gain of 500 at −0.75 A

Features:
- Operates from IC without predriver
- Low leakage at high temperature
- High reverse second-breakdown capability

Applications:
- Power switching
- Audio amplifiers
- Hammer drivers
- Series and shunt regulators

TERMINAL DESIGNATIONS



JEDEC TO-220AB
(See dimensional outline "N".)

The RCA-TIP125, TIP126 and TIP127 are monolithic silicon p-n-p Darlington transistors designed for low- and medium-frequency power applications. The high gain of these devices makes it possible for them to be driven directly from integrated circuits.

These devices are supplied in the JEDEC TO-220AB straight-lead version of the VERSAWATT package. Optional lead configurations are available upon request. For information, contact your nearest RCA Sales Office.

The TIP125, TIP126 and TIP127 are p-n-p complements of the TIP120, TIP121 and TIP122 described in RCA data bulletin File 998.

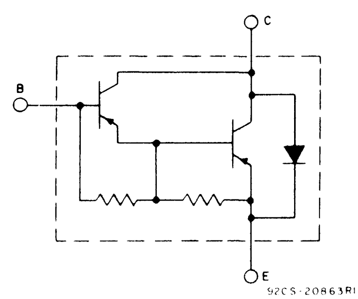


Fig. 1 – Schematic diagram for all types.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	TIP125	TIP126	TIP127	
V_{CBO}	−60	−80	−100	V
$V_{CEO}(sus)$	−60	−80	−100	V
V_{EBO}	−5	−5	−5	V
I_C	−8	−8	−8	A
I_{CM}	−15	−15	−15	A
I_B	−0.25	−0.25	−0.25	A
P_T:				
$T_C \leqslant 25^oC$	65	65	65	W
$T_C > 25^oC$ . . . Derate linearly at		0.52		W/^oC
T_{stg}, T_J		−65 to 150		^oC
T_L				
At distance 1/8 in. (3.17 mm) from case for 10 s max.		235		^oC

TIP125, TIP126, TIP127

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C*

CHARACTERISTIC	TEST CONDITIONS			LIMITS						UNITS
	Voltage V dc	Current A dc		TIP125		TIP126		TIP127		
	V_{CE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
I_{CEO}	−30		0	–	−0.5	–	–	–	–	mA
	−40		0	–	–	–	−0.5	–	–	
	−50		0	–	–	–	–	–	−0.5	
I_{EBO} V_{BE}=5 V		0		–	−10	–	−10	–	−10	mA
V_{CEO}(sus)		−0.03[a]	0	−60	–	−80	–	−100	–	V
h_{FE}	−3	−0.75[a]		500	–	500	–	500	–	
	−3	−3[a]		1000	–	1000	–	1000	–	
V_{BE}	−3	−3[a]		–	−2.5	–	−2.5	–	−2.5	V
V_{CE}(sat)		−3[a]	−0.012	–	−2	–	−2	–	−2	V
		−5[a]	−0.02	–	−4	–	−4	–	−4	
h_{fe} f=1 kHz	−5	−1		1000	–	1000	–	1000	–	
$\|h_{fe}\|$ f=1 MHz	−5	−1		20	–	20	–	20	–	
$I_{S/b}$ t=1-s nonrep. pulse	−20			−3.2	–	−3.2	–	−3.2	–	A
$R_{\theta JC}$				–	1.92	–	1.92	–	1.92	°C/W

[a] Pulsed: Pulse duration ≤ 300 μs, duty factor ≤ 2%.

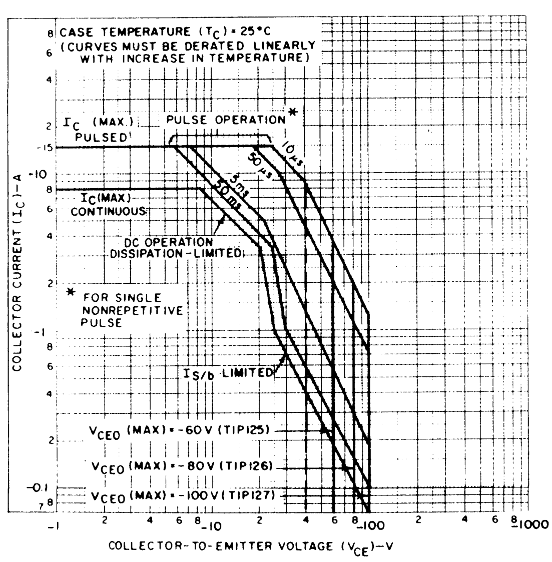


Fig. 2 — Maximum operating areas for all types.

TIP125, TIP126, TIP127

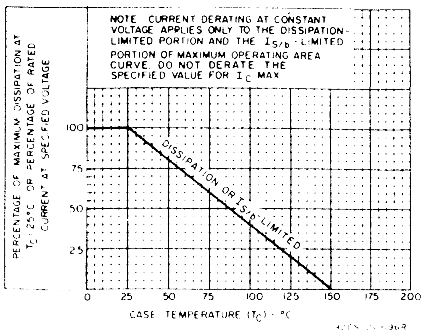


Fig. 3 – Dissipation derating curve for all types.

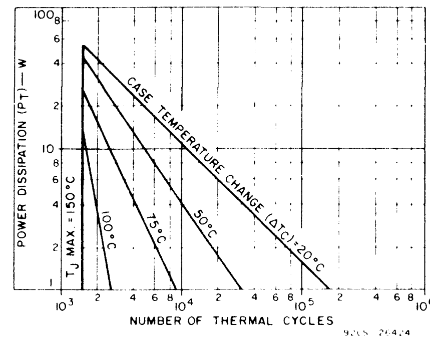


Fig. 4 – Thermal-cycling rating chart for all types.

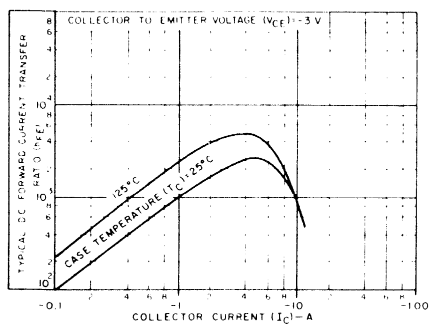


Fig. 5 – Typical dc beta characteristics for all types.

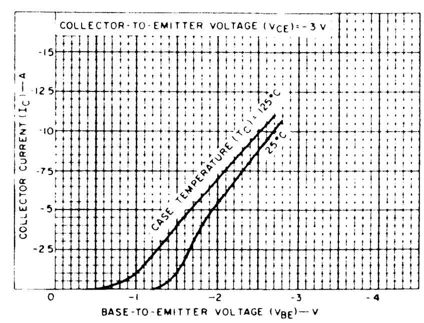


Fig. 6 – Typical transfer characteristics for all types.

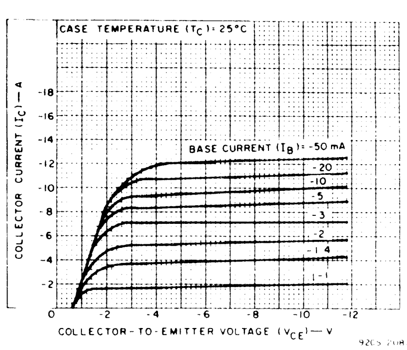


Fig. 7 – Typical output characteristics for all types.

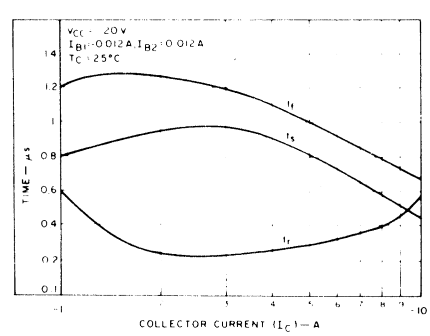


Fig. 8 – Typical saturated switching-time characteristics for all types.

TIP125, TIP126, TIP127

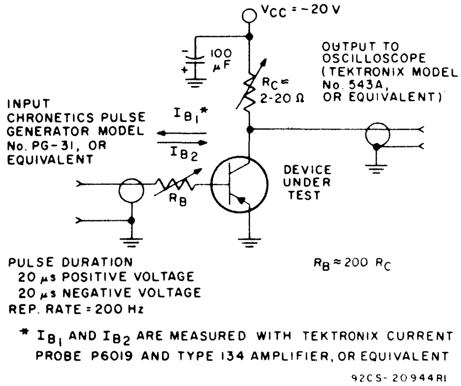


Fig. 9 – Circuit used to measure saturated switching times.

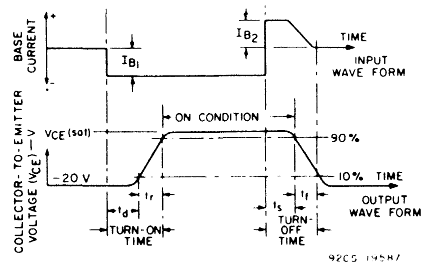


Fig. 10 – Phase relationship between input current and output voltage showing reference points for specification of switching times.

Power Transistors
Technical Data

RCA Standard Power Transistors

Information shown on RCA standard power transistors in this section is in chart format. For a data bulletin on a particular type, request the data-bulletin File Number shown at the right side of each chart.

Data bulletins are available from the RCA Sales Office in your locale or by writing to — RCA Solid State Division, Box 3200, Somerville, N.J. 08876.

High-Speed Switching Power Transistors

Type No.	$V_{CEO}(sus)$ V	$V_{CER}(sus)$ V	P_T W	h_{FE}** at V_{CE} = 10 V, Current—mA: 0.01	0.1	10	50	150	500	$V_{CE}(sat)$—V	I_C mA	I_B mA	t_r µs	t_f µs	File No.
2N2102 FAMILY (n-p-n) Complementary to 2N4036 Family; f_t = 120 MHz min.; P_T to 7 W max.															**JEDEC TO-205MD/TO-39 Package**
40389	40	50	5	—	—	—	—	50-250	—	1.4	150	15	—	—	**960**
2N697	—	50	2	—	—	—	—	40-120	—	1.5	150	15	—	—	**16**
2N1613	—	50	3	—	20 min.	35 min.	—	40-120	20 min.	1.5	150	15	30Δ	—	**106**
2N3053	40	50	5	—	—	—	—	50-250	—	1.4	150	15	—	—	**960**
2N2270	45	60	5	—	—	—	—	50-200	—	0.9	150	15	—	—	**24**
2N3053A	60	70	5	—	—	—	—	50-250	—	0.3	150	15	—	—	**960**
2N2102	65	80	5	10 min.	20 min.	35 min.	—	40-120	25 min.	0.5	150	15	30Δ	—	**106**
2N1893	80	100	3	—	20 min.	35 min.	—	40-120	—	5	150	15	—	—	**34**
2N2405	90	140	5	—	—	35 min.	—	60-200	—	0.5	150	15	—	—	**34**
AUDIO TYPES															
40314	40	—	5	—	—	—	70-350	—	—	1.4	150	15	—	—	**962**
40317	40	—	5	—	—	40-200	—	—	—	—	—	—	—	—	**962**
40407	50	—	1	—	40-200 @ 1 mA	—	—	—	—	—	—	—	—	—	**219**
40408	90	—	1	—	—	40-200	—	—	—	1.4	150	15	—	—	**219**
40409	—	90	3	—	—	—	—	50-250	—	1.4	150	15	—	—	**219**

Type No.	$V_{CEO}(sus)$ V	$V_{CEX}(sus)$ V	P_T W	h_{FE}	I_C A	V_{CE} V	$V_{CE}(sat)$—V	I_C A	I_B A	t_r µs	t_f µs	
2N3879 FAMILY (n-p-n) f_T to 60 MHz min.; P_T = 35 W max.												**JEDEC TO-213MA/TO-66 Package**
2N3878	50	65‡	35	40-200	0.5	2	2	4	0.4	—	—	**766**
2N5202	50	75‡	35	10-100	4	1.2	1.2	4	0.4	0.4	0.4	**766**
40375■	50	65‡	5.8	40-200	0.5	2	2	4	0.4	—	—	**766**
2N3879*	75	90‡	35	20-80	4	5	1.2	4	0.4	0.4	0.4	**766**
2N6500	90	110‡	35	15-60	3	2	1.5	3	0.3	0.4	0.5	**766**
2N4036 FAMILY (p-n-p) Complementary to 2N2102 Family; f_T = 60 MHz min.; P_T to 7 W max.												**JEDEC TO-205MD/TO-39 Package**
40391•	-40	-60‡	3.5	50-250	-150m	-10	-1.4	-150m	-15m	—	—	**216**
2N4037	-40	-60‡	7	50-250	-150m	-10	-1.4	-150m	-15m	—	—	**216**
2N4036	-65	-85‡	7	40-140	-150m	-10	-0.65	-150m	-15m	0.07	0.1	**216**
2N4314	-65	-85‡	7	50-250	-150m	-10	-1.4	-150m	-15m	—	—	**216**
AUDIO TYPES												
40319	-40	—	5	35-200	-50m	-4	-1.4	-150m	-15m	—	—	**962**
40406	-50	—	1	30-200	-0.1m	-10	—	—	—	—	—	**219**
40362	—	-70‡	5	35-200	-50m	-4	-1.4	-50m	-5m	—	—	**962**
40410	—	-90‡	3	50-250	-150m	-4	-1.4	-150m	-15m	—	—	**219**

**All audio types except 40407, h_{FE} measured at V_{CE} = 4 V; 40407, h_{FE} measured at V_{CE} = 10 V.

•40391 - 2N4037 with Heat Radiator. Radiator improves $R_{\theta JA}$ from 175° C/W to 50° C/W.

Δ$t_d + t_r + t_f$, units are ns.

■40375 - 2N3878 with Heat Radiator. Radiator improves $R_{\theta JA}$ from 70° C/W to 30° C/W.

‡V_{CER}(sus).

*JAN types available.

High-Speed Switching Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEX}(sus) V	P_T W	h_{FE}	h_{FE} I_C A	h_{FE} V_{CE} V	V_{CE}(sat)—V	V_{CE}(sat) I_C A	V_{CE}(sat) I_B A	t_r µs	t_f µs	File No.
2N5038 FAMILY (n-p-n) f_T to 80 MHz min.; P_T = 140 W max.												**JEDEC TO-204MA/TO-3 Package**
BDY92	60	80	40	30-120	5	5	0.5	5	0.5	—	0.2	**1289**
BDY55	60	100	117	20-70	4	4	1.1	4	0.4	0.5	2	**1215**
2N5039•	75	120	140	20-100	10	5	1	10	1	0.5	0.5	**698**
BDY91	80	100	40	30-120	5	5	0.5	5	0.5	—	0.2	**1289**
2N5038*	90	150	140	20-100	12	5	1	12	1.2	0.5	0.5	**698**
BDY90	100	120	40	30-120	5	5	0.5	5	0.5	—	0.2	**1289**
2N6496	110	130‡	140	12-100	8	2	1	8	0.8	0.5	0.5	**698**
2N6354	120	130	140	10-100	10	2	1	10	1	0.3	0.2	**582**
BDY56	120	150	117	20-70	4	4	1.1	4	0.4	0.5	2	**1215**
2N5320 FAMILY (n-p-n) Complementary to 2N5322 Family f_T = 50 MHz min.; P_T to 10 W max.												**JEDEC TO-205MD/TO-39 Package**
2N5321	50	75**	10	40-250	500m	4	0.8	500m	50m	80Δ	800#	**325**
2N5320	75	100**	10	30-130	500m	4	0.5	500m	50m	80Δ	800	**325**
AUDIO TYPES												
RCA1A03	—	95‡	10	70-300	300m	4	0.8	300m	30m	—	—	**651**
2N5322 FAMILY (p-n-p) Medium Power, General Purpose Complementary to 2N5320 Family; f_T = 50 MHz min.; P_T to 10 W max.												**JEDEC TO-205MD/TO-39 Package**
2N5323	-50	-75**	10	40-250	-500m	-4	-1.2	-500m	-50m	100Δ	1000#	**325**
2N5322	-75	-100**	10	30-130	-500m	-4	-0.7	-500m	-50m	100Δ	1000#	**325**
AUDIO TYPES												
RCA1A04	—	-95‡	10	70-300	-300m	-4	-0.8	-300m	-30m	—	—	**651**
2N5671 FAMILY (n-p-n) f_T = 50 MHz min.; P_T to 175 W max.												**JEDEC TO-204MA/TO-3 Package**
BDY57A	80	120	175	20-60	10	4	1.4	10	1	1■	2•	**1209**
2N5671*	90	120	140	20-100	15	2	0.75	15	1.2	0.5■	0.5	**383**
BUX39	90	120	120	15-45	12	4	1.6	20	2.5	1.5■	0.3	**1211**
2N5672*	120	150	140	20-100	15	2	0.75	15	1.2	0.5■	0.5	**383**
BUX10A	125	160	150	20-60	10	2	1.5	20	2	1.5■	0.2	**1216**
BUX40A	125	160	120	15-45	10	4	1.6	15	1.88	1.2■	0.4	**1217**
BUX20A	125	160	140	20-60	20	2	0.8	20	2	0.7■	0.5	**1264**
2N6033 FAMILY (n-p-n) f_T = 50 MHz min.; P_T = 140 W max.												**Mod. TO-3 Package**
2N6032*	90	120	140	10-50	50	2.6	1.3	50	5	1	0.5	**462**
2N6033*	120	150	140	10-50	40	2	1	40	4	1	0.5	**462**
2N6480 FAMILY (n-p-n) Radiation Hardened f_T = 100 MHz min.; P_T = 87 W max.												**RADIAL Package with Isolated Collector**
2N6479	60	80‡	87	20-300	12	2	0.75	12	1.2	0.4	0.2	**702**
2N6480	80	100‡	87	20-300	12	2	0.75	12	1.2	0.4	0.2	**702**
2N6678 FAMILY (n-p-n) f_T = 50 MHz min.; P_T to 100 W max.												**JEDEC TO-204MA/TO-3 Package**
TIP562	300	—	100	20 min.	1	4	2	15	5	0.5	0.3	**1212**
TIP563	400	—	100	20 min.	1	4	2	15	5	0.5	0.3	**1212**

*JAN types available
‡V_{CER}(sus)
m = mA value
**V_{CEV}(sus)
Δt_{ON}, units are ns
#t_{OFF}, units are ns
■t_{ON}
•t_{OFF}

High-Speed Switching Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEX}(sus) V	P_T W	h_{FE}	I_C A	V_{CE} V	V_{CE}(sat)—V	I_C A	I_B A	t_r µs	t_f µs	File No.
2N6704 FAMILY (n-p-n) f_T to 50 MHz min.; P_T = 50 W max.												**JEDEC TO-220AB Plastic Package**
2N6702	90	140	50	20	5	2	0.8	5	0.5	0.25	0.5	1187
BUW64A	90	140	50	20	5	2	0.8	5	0.5	0.25	0.5	1199
2N6703	110	160	50	20	5	2	0.8	5	0.5	0.25	0.5	1187
BUW64B	110	160	50	20	5	2	0.8	5	0.5	0.25	0.5	1199
2N6704	130	180	50	20	4	2	0.7	4	0.4	0.25	0.5	1187
BUW64C	130	180	50	20	4	2	0.7	4	0.4	0.25	0.5	1199

High-Voltage Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEV}(sus) V	P_T W	h_{FE}	I_C A	V_{CE} V	V_{CE}(sat)—V	I_C A	I_B A	f_T (Typ.) MHz	File No.
2N3439 FAMILY (n-p-n) Complementary to 2N5414 Family; P_T to 10 W max.											**JEDEC TO-205MD/TO-39 Package**
40346	—	175‡	10	25 min.	0.01	10	0.5	0.01	0.001		211
2N3440*	250	300‡	10	40-160	0.02	10	0.5	0.05	0.004		64
2N4064■	250	—	10	40-160	0.02	10	0.5	0.05	0.004		64
40390■	250	—	3.5	40-160	0.02	10	0.5	0.05	0.004		64
2N3439*	350	400‡	10	40-160	0.02	10	0.5	0.05	0.004		64
2N4063■	350	—	10	40-160	0.02	10	0.5	0.05	0.004	25	64
40385■	350	—	10	40-160	0.02	10	0.5	0.05	0.004		215
AUDIO TYPES											
40412	—	250‡	10	40 min.	0.03	20	—	—	—		211
40321	—	300‡	5	25-200	0.02	10	—	—	—		962
40327	—	300‡	5	40-250	0.02	10	—	—	—		962
2N3585 FAMILY (n-p-n) Complementary to 2N6213 Family; P_T to 40 W max.											**JEDEC TO-213MA/TO-66 Package**
2N5050	125	—	40	25-100	0.75	5	1	0.75	0.1		1098
2N5051	150	—	40	25-100	0.75	5	1	0.75	0.1		1098
BUX67	150	200	35	10-150	1	5	2.5	1	0.15		871
2N3583	175	250‡	35	40 min.	0.1	10	5	1	0.125		138
40374■	175	250‡	5.8	40-200	0.75	10	5	1	0.125		138
2N5052	200	—	40	25-100	0.75	5	1	0.75	0.1		1098
BUX67A	250	300	35	10-150	1	5	2.5	1	0.15		871
2N3584*	250	300‡	35	40 min.	0.1	10	0.75	1	0.125		138
2N3585*	300	400‡	35	40 min.	0.1	10	0.75	1	0.125		138
2N4240	300	400‡	35	30-150	1	10	1	0.75	0.075	25	138
40850	300	400‡	35	25 min.	0.75	10	2	2	0.4		984
BUX67B	300	350	35	10-150	1	5	2.5	1	0.15		871
BUX67C	350	400	35	10-150	1	5	2.5	1	0.15		871
AUDIO TYPES											
RCA1E02	175	200‡	35	30-150	0.3	2	—	—	—		653
40313	—	300‡	35	40 min.	0.5	10	—	—	—		962
40318	—	300‡	35	50 min.	0.5	10	—	—	—		962
40322	—	300‡	35	75 min.	0.5	10	—	—	—		962

■40390 - 2N3440 with heat radiator. Radiator improves $R_{\theta JA}$ from 150° C/W to 45° C/W
■40374 - 2N3583 with heat radiator. Radiator improves $R_{\theta JA}$ from 175° C/W to 50° C/W
■2N4064 - 2N3440 with flange
■40385 - high-reliability 2N3439

*JAN types available
‡V_{CER}(sus)
■2N4063 - 2N3439 with flange

High-Voltage Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEV}(sus) V	P_T W	h_{FE}	h_{FE} I_C A	h_{FE} V_{CE} V	V_{CE}(sat)—V	V_{CE}(sat) I_C A	V_{CE}(sat) I_B A	f_T (Typ.) MHz	File No.
2N5240 FAMILY (n-p-n) P_T to 150 W max.											**JEDEC TO-204MA/TO-3 Package**
BUX16	200	250	100	15-130	0.4	10	2.5	2	0.25		**800**
BD550B	250	275‡	150	10-50	2	4	2	2	0.25		**1109**
2N5239	225	250‡	100	20-80	2	10	2.5	2	0.25		**321**
2N5838	250	275	100	8-40	3	2	1	3	0.375		**410**
BUX16A	250	325	100	15-130	0.4	10	2.5	2	0.25		**800**
2N5839	275	300	100	10-50	2	3	1.5	2	0.2	5	**410**
2N5240	300	350‡	100	20-80	2	10	2.5	2	0.25		**321**
BUX16B	300	375	100	15-130	0.4	10	2.5	2	0.25		**800**
2N5840	350	375	100	10-50	2	3	1.5	2	0.2		**410**
BUX16C	350	425	100	15-130	0.4	10	2.5	2	0.25		**800**
RCA413	325	—	125	20-80	0.5	5	0.8	0.5	0.05		**1281**
40852	350	375‡	100	12 min.	1.2	1	3	4	0.8		**964**
AUDIO TYPES											
RCA1B04	200	225‡	150	15-75	2	5	2	2	0.25		**908**
RCA1B05	250	275‡	150	15-75	2	5	2	2	0.25		**908**
2N5415 FAMILY Complementary to 2N3439 Family P_T to 10 W max.											**JEDEC TO-205MD/TO-39 Package**
BFT28	-100	-150‡	5	20 min.	-10	-10	-0.6	-10	-1		**815**
BFT19	-150	-200‡	5	20 min.	-50	-10	-2.5	-30	-3		**683**
BFT28A	-150	-200‡	5	20 min.	-10	-10	-0.6	-10	-1		**815**
BFT28B	-200	-250‡	5	20 min.	-10	-10	-5	-10	-1		**815**
2N5415	-200	—	10	30-150	-50	-10	-2.5	-50	-5	35	**336**
BFT19A	-250	-300‡	5	20 min.	-50	-10	-2.5	-30	-3		**683**
BFT28C	-250	-300‡	5	20 min.	-10	-10	-5	-10	-1		**815**
2N5416	-300	-350‡	10	30-120	-50	-10	-2	-50	-5		**336**
BFT19B	-350	-400‡	5	20 min.	-50	-10	-2.5	-30	-3		**683**
2N6079 FAMILY (n-p-n) P_T = 45 W max.											**JEDEC TO-213MA/TO-66 Package**
2N6078	250	275Φ	45	12-70	1.2	1	0.5	1.2	0.2		**492**
2N6077	275	300Φ	45	12-70	1.2	1	0.5	1.2	0.2	7	**492**
2N6079	350	375Φ	45	12-50	1.2	1	0.5	1.2	0.2		**492**
40851	350	375‡	45	12 min.	1.2	1	3	4	0.8		**964**
2N6213 FAMILY (n-p-n) Complementary to 2N3585 Family P_T to 35 W max.											**JEDEC TO-213MA/TO-66 Package**
BUX66	-150	-200	35	10-150	-1	-5	-2.5	-1	-0.15		**870**
2N6420	-175	—	20	40-200	-0.5	-10	-5	-1	-0.125		**1100**
2N6211*	-225	-275	35	10-100	-1	-2.8	-1.4	-1	-0.125		**507**
BUX66A	-250	-300	35	10-150	-1	-5	-2.5	-1	-0.15	30	**870**
2N6421	-250	—	20	25-100	-1	-10	-0.75	-1	-0.125		**1100**
2N6212*	-300	-350	35	10-100	-1	-3.2	-1.6	-1	-0.125		**507**
BUX66B	-300	-350	35	10-150	-1	-5	-2.5	-1	-0.15		**870**

*JAN types available
‡V_{CER}(sus)
ΦV_{CEX}(sus)

High-Voltage Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEV}(sus) V	P_T W	h_{FE}	h_{FE} I_C A	h_{FE} V_{CE} V	V_{CE}(sat)—V	V_{CE}(sat) I_C A	V_{CE}(sat) I_B A	f_T (Typ.) MHz	File No.
2N6213 FAMILY (n-p-n) High-Voltage, Medium Power, (Cont'd) Complementary to 2N3585 Family; P_T to 35 W max.											**JEDEC TO-213MA/TO-66 Package**
2N6422	-300	—	20	25-100	-1	-10	-0.75	-1	-0.125		**1100**
2N6423	-300	—	20	30-150	-0.75	-10	-1	-0.75	-0.075		**1100**
2N6213*	-350	-400	35	10-100	-1	-4	-2	-1	-0.125		**507**
BUX66C	-350	-400	35	10-150	-1	-5	-2.5	-1	-0.15	30	**870**
2N6214	-400	-450	35	10-100	-1	-5	-2.5	-1	-0.125		**507**
AUDIO TYPE											
RCA1E03	-175	-200‡	35	30-150	-0.3	-2	—	—	—		**653**
2N6251 FAMILY (n-p-n) High-Voltage Switch P_T to 175 W max.											**JEDEC TO-204MA/TO-3 Package**
BUX17	150	250	150	15 min.	4	3	2	10	2		**818**
2N6249	200	225	175	10-50	10	3	1.5	10	1		**523**
BUX17A	250	350	150	15 min.	4	3	2	10	2		**818**
2N6250	275	300	175	8-50	10	3	1.5	10	1.25	6	**523**
BUX17B	300	400	150	15 min.	4	3	3	8	1.5		**818**
40854	300	325‡	175	8 min.	10	4	3	16	3.2		**964**
2N6251	350	375	175	6-50	10	3	1.5	10	1.67		**523**
BUX17C	350	450	150	15 min.	4	3	3	8	1.5		**818**
2N6308 FAMILY (n-p-n) High-Voltage Switching P_T = 125 W max.											**JEDEC TO-204MA/TO-3 Package**
2N6306*	250	350‡	125	15-75	3	5	0.8	3	0.6		**885**
2N6307	300	400‡	125	15-75	3	5	1	8	2	15	**885**
2N6308*	350	450‡	125	12-60	3	5	1.5	8	2.67		**885**
2N6510 FAMILY (n-p-n) High Voltage, High Current Switch P_T = 150 W max.											**JEDEC TO-204MA/TO-3 Package**
2N6510	200	250‡	120	10-50	3	3	1.5	3	0.6		**848**
BUX18	200	300	120	15-100	1	5	1.5	6	1.2		**862**
RCA410	200	—	125	30-90	1	5	0.8	1	0.1		**509**
2N6511	250	300‡	120	10-50	4	3	1.5	4	0.8		**848**
BUX18A	275	450	120	15-100	1	5	1.5	5	1		**862**
2N6512	300	350‡	120	10-50	4	3	1.5	4	0.8		**848**
2N6514	300	350‡	120	10-50	4	3	1.5	4	0.8		**848**
BU126	300	750	80	15-60	1	5	5	4	1	2	**968**
RCA411	300	—	125	30-90	1	5	0.8	1	0.1		**510**
BUX18B	325	600	125	15-100	1	5	1.5	4	0.8		**862**
RCA423	325	—	125	30-90	1	5	0.8	1	0.1		**1281**
RCA431	325	—	125	15-35	2.5	5	0.7	2.5	0.5		**1281**
2N6513	350	400‡	120	10-50	5	3	1.5	5	1		**848**
BUX18C	375	750	120	15-100	1	5	1.5	4	0.8		**862**
AUDIO TYPES											
RCA1B06	100	120‡	150	10-50	4	4	2	4	0.8		**648**
RCA1B09	250	275‡	150	40 min.	2	5	1	2	0.2		**908**

*JAN types available

‡V_{CER}(sus)

High-Voltage Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEV}(sus) V	P_T W	h_{FE}	h_{FE}: I_C A	h_{FE}: V_{CE} V	$V_{CE(sat)}$—V	$V_{CE(sat)}$: I_C A	$V_{CE(sat)}$: I_B A	f_T (Typ.) MHz	File No.
2N6673 SwitchMax FAMILY (n-p-n) P_T to 150 W max.											**JEDEC TO-204MA/TO-3 Package**
BUX42	250	300$^{\Phi}$	120	15-45	4	4	1.2	4	0.4		**1218**
2N6542	300	650	100	12-60	1.5	2	1	3	0.6		**1096**
2N6544	300	650	125	12-60	2.5	3	1.5	5	1		**1096**
2N6671■*	300	450	150	10 min.	5	3	1	5	1		**1090**
BUX43	325	400$^{\Phi}$	120	15-60	3	4	1	3	0.375	20	**1214**
2N6672■	350	550	150	10 min.	5	3	1	5	1		**1090**
2N6673■*	400	650	150	10 min.	5	3	1	5	1		**1090**
BUX14	400	450$^{\Phi}$	150	15-60	3	4	1.5	6	1.2		**1203**
BUX44	400	450$^{\Phi}$	120	15-45	2	4	2	4	0.8		**1210**
2N6678 SwitchMax FAMILY (n-p-n) P_T to 175 W max.											**JEDEC TO-204MA/TO-3 Package**
BUX41N	160	220$^{\Phi}$	120	15-45	8	4	1.2	8	0.8		**1222**
BUX41	200	250$^{\Phi}$	120	15-45	5	4	1.2	5	0.5		**1222**
BUX12	250	300$^{\Phi}$	150	20-60	5	4	1	5	0.5		**1229**
2N6546	300	650	175	12-60	5	2	1.5	10	2		**1096**
2N6674■*	300	450	175	8-20	10	2	1	10	2	20	**1164**
2N6676■*	300	450	175	8 min.	15	3	1	15	3		**1165**
BUX13	325	400$^{\Phi}$	150	15-60	4	4	0.8	4	0.8		**1230**
2N6677■	350	550	175	8 min.	15	3	1	15	3		**1165**
2N6675■*	400	650	175	8-20	10	2	1	10	2		**1164**
2N6678■*	400	650	175	8 min.	15	3	1	15	3		**1165**
2N6688 SwitchMax FAMILY (n-p-n) P_T = 200 W max.											**JEDEC TO-204MA/TO-3 Package**
RCA6340	140	—	200	12 min.	25	2.5	1.8	25	2.5		**1205**
RCA6341	150	—	200	12 min.	25	2.5	1.8	25	2.5		**1205**
2N6686■	160	260	200	15 min.	25	2	1.5	25	2.5		**1171**
BDY58R	160	250$^{\Phi}$	175	20-60	10	4	1.4	10	1		**1206**
2N6687■	180	280	200	15 min.	25	2	1.5	25	2.5	45	**1171**
BUX11A	190	250$^{\Phi}$	200	20-60	8	2	0.6	8	0.8		**1352**
2N6688■	200	300	200	15 min.	20	2	1.5	20	2		**1171**
BUX21	200	250$^{\Phi}$	250	20-60	12	2	0.6	12	1.2		**1172**
2N6740 SwitchMax FAMILY (n-p-n) P_T = 100 W max.											**JEDEC TO-220AB Package**
2N6738	300	450	100	10-40	5	3	1	5	1		**1291**
BUW41	300	450	100	10-40	5	—	—	—	—		**1275**
2N6739	350	550	100	10-40	5	3	1	5	1	30	**1291**
BUW41A	350	550	100	10-40	5	—	—	—	—		**1275**
2N6740	400	650	100	10-40	5	3	1	5	1		**1291**
BUW41B	400	650	100	10-40	—	—	—	—	—		**1275**

■SwitchMax transistor
*JAN types available
$^{\Phi}V_{CEX}$(sus)

High-Voltage Power Transistors

Type No.	$V_{CEO}(sus)$ V	$V_{CEV}(sus)$ V	P_T W	h_{FE}	h_{FE} I_C A	h_{FE} V_{CE} V	$V_{CE}(sat)$—V	$V_{CE}(sat)$ I_C A	$V_{CE}(sat)$ I_B A	f_T (Typ.) MHz	File No.
2N6754 SwitchMax FAMILY (n-p-n) High Current, High Voltage P_T = 150 W max.											**JEDEC TO-204MA/TO-3 Package**
BUY69C	200	500^{Φ}	100	15	2.5	10	3.3	8	2.5		**1237**
BUY69B	325	800^{Φ}	100	15	2.5	10	3.3	8	2.5		**1237**
BUX97	350	700^{Φ}	60 @ 75°C	10-20	1	5	3	4	1.25		**1288**
2N6751■	400	800	150	8-40	5	3	1	5	1		**1244**
BUX32■	400	800	150	8-40	6	3	1	6	1.2		**1285**
BUX31■	400	800	150	8-40	4	3	1	4	0.8		**1283**
BUY69A	400	1000^{Φ}	100	15	2.5	10	3.3	8	2.5		**1237**
BUX47	400	1000^{Φ}	107	3	3	3	1.5	6	1.2		**1284**
BUX97A	400	800^{Φ}	60 @ 75°C	10-70	1	5	3	4	1.25		**1288**
2N6545	400	850	125	12-60	2.5	3	1.5	5	1	20	**1096**
2N6752■	450	850	150	8-40	5	3	1	5	1		**1244**
BUX97B	450	800^{Φ}	60 @ 75°C	10-70	1	5	3	4	1.25		**1288**
BUX32A■	450	900	150	8-40	6	3	1	6	1.2		**1285**
BUX31A■	450	900	150	8-40	4	3	1	4	0.8		**1283**
2N6753■	500	900	150	8-40	5	3	1	5	1		**1244**
BUX15	500	500^{Φ}	150	15-60	2	4	1	4	0.8		**1227**
BUX45	500	500^{Φ}	120	14-45	1	4	2	2	0.4		**1231**
2N6754■	500	1000	150	8-40	5	3	1	5	1		**1244**
BUX32B■	500	1000	150	8-40	6	3	1	6	1.2		**1285**
BUX31B■	500	1000	150	8-40	4	3	1	4	0.8		**1283**
2N6773 SwitchMax FAMILY (n-p-n) High Current, High Voltage P_T = 40 W max.											**JEDEC TO-204MA Package**
2N6771■	300	450	40	10-50	1	3	1	1	0.2		**1292**
BUW40■	300	450	40	20-100	0.3	—	—	—	—		**1308**
2N6772■	350	550	40	10-50	1	3	1	1	0.2		**1292**
BUW40A■	350	550	40	20-100	0.3	—	—	—	—		**1308**
2N6773■	400	650	40	10-50	1	3	1	1	0.2	25	**1292**
BUW40B■	400	650	40	20-100	0.3	—	—	—	—		**1308**
TIP47	250	—	40	10 min.	1	10	1	1	0.2		**978**
TIP48	300	—	40	10 min.	1	10	1	1	0.2		**978**
TIP49	350	—	40	10 min.	1	10	1	1	0.2		**978**
TIP50	400	—	40	10 min.	1	10	1	1	0.2		**978**

■SwitchMax transistor

$^{\Phi}V_{CEX}(sus)$

General-Purpose Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEV}(sus) V	P_T W	h_{FE}	I_C A	V_{CE} V	$V_{CE(sat)}$—V	I_C A	I_B A	f_T (Typ.) MHz	File No.
2N1482 FAMILY (n-p-n) P_T to 8.75 W max.											**JEDEC TO-205MA/TO-5 Package**
2N1479*	40	60	5	20-60	0.2	4	1.4	0.2	0.02		**135**
2N1481*	40	60	5	35-100	0.2	4	1.4	0.2	0.02		**135**
2N1700	40	60	5	20-80	0.1	4	1	0.1	0.01		**141**
40347	40	60	8.75	25-100	0.45	4	1	0.45	0.045	1.5	**88**
2N1480*	55	100	5	20-60	0.2	4	1.4	0.2	0.02		**135**
2N1482*	55	100	5	35-100	0.2	4	1.4	0.2	0.02		**135**
40348	65	90	8.75	30-125	0.3	4	0.75	0.3	0.03		**88**
2N1490 FAMILY (n-p-n) P_T to 75 W max.											**JEDEC TO-204MA/TO-3 Package**
2N1487*	40	60	75	15-45	1.5	4	—	—	—		**139**
2N1489*	40	60	75	25-75	1.5	4	—	—	—		**139**
2N1702	40	60	75	15-60	0.8	4	20	5	2	1	**141**
2N1488*	55	100	75	15-45	1.5	4	—	—	—		**139**
2N1490*	55	100	75	25-75	1.5	4	—	—	—		**139**
2N3054 FAMILY (n-p-n) P_T to 50 W max.											**JEDEC TO-213MA/TO-66 Package**
2N6260	40	50^{Φ}	29	20-100	1.5	4	1.5	1.5	0.15		**527**
40250	40	50^{Φ}	29	25-100	1.5	4	1.5	1.5	0.15		**112**
BDX24	40	50^{Φ}	29	25-100	1.5	4	1.5	1.5	0.15		**1286**
2N3054	55	90^{Φ}	25	25-150	0.5	4	1	0.5	0.05		**527**
BDY71	55	90^{Φ}	29	80-200	0.5	4	1	0.5	0.05		**859**
40372	55	90^{Φ}	5.8	25-100	0.5	4	1	0.5	0.05		**527**
2N6261	80	90^{Φ}	50	25-100	1.5	2	0.5	1.5	0.15	1	**527**
AUDIO TYPES											
40310	35	—	29	20-120	1	2	—	—	—		**962**
40324	35	—	29	10-120	1	2	—	—	—		**962**
40316	—	40‡	29	20-120	1	2	—	—	—		**962**
40312	—	60‡	29	20-120	1	2	—	—	—		**962**
2N3055 FAMILY (n-p-n) P_T to 150 W max.											**JEDEC TO-204MA/TO-3 Package**
2N6371	40	50	117	15-60	8	4	1.5	8	0.8		**1077**
40251	40	50	117	15-60	8	4	1.5	8	0.8		**112**
BD142	45	50	115	12.5-160	4	4	1.1	4	0.4		**701**
2N6253	45	55	115	20-70	3	4	1	3	0.3		**1077**
BD181	45	55‡	117	20-70	3	4	1	3	0.3		**700**
2N3055* **Hometaxial**	60	90	115	20-70	4	4	1.1	4	0.4		**1077**
BD182	60	70‡	117	20-70	4	4	1	4	0.4	1.5	**700**
2N6254	80	90	150	20-70	5	2	0.5	5	0.5		**1077**
BD183	80	85‡	117	20-70	3	4	1	3	0.3		**700**
AUDIO TYPES											
40325	35	35	117	12-60	8	4	1.5	8	0.8		**962**
40363	—	70‡	115	20-70	4	4	1.1	4	0.4		**962**
BDX23	—	85‡	115	20-70	4	4	1	4	0.4		**1287**

*JAN types available
‡V_{CER}(sus)
$^{\Phi}V_{CEX}$(sus)

General-Purpose Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEV}(sus) V	P_T W	h_{FE}	I_C A	V_{CE} V	V_{CE}(sat)—V	I_C A	I_B A	f_T (Typ.) MHz	File No.
2N3441 FAMILY (n-p-n) P_T to 50 W max.											**JEDEC TO-213MA/TO-66 Package**
2N6263	120	140^{Φ}	20	20-100	0.5	4	1.2	0.5	0.05		**529**
40373■	140	150^{Φ}	25	25-100	0.5	4	1	0.5	0.05		**529**
2N3441*	140	160^{Φ}	25	25-100	0.5	4	1	0.5	0.05	0.8	**529**
2N6264	150	170^{Φ}	50	20-60	1	2	0.5	1	0.1		**529**
40913■	150	170^{Φ}	50	20-60	1	2	0.5	1	0.1		**529**
2N3442 FAMILY (n-p-n) P_T to 150 W max.											**JEDEC TO-204MA/TO-3 Package**
2N4347	120	140^{Φ}	100	15-60	2	4	1	2	0.2		**528**
2N3442*	140	160^{Φ}	117	20-70	3	4	1	3	0.3	0.4	**528**
2N6262	150	170^{Φ}	150	20-70	3	2	0.5	3	0.3		**528**
2N3716 FAMILY (n-p-n) **Complementary to 2N6247 Family** P_T to 150 W max.											**JEDEC TO-204MA/TO-3 Package**
2N6569	40	$45^{\ddagger}$	115	15-200	4	3	1.5	4	0.4		**994**
2N4913	40	—	87.5	25-100	2.5	2	0.75	2.5	0.25		**1067**
2N3055	60	$70^{\ddagger}$	115	20-70	4	4	1.1	4	0.4		**994**
2N3715	60	—	150	50-150	1	2	0.8	5	0.5		**1058**
2N4914	60	—	87.5	25-100	2.5	2	0.75	2.5	0.25		**1067**
2N5873	60	—	115	20-100	2.5	4	1	4	0.4		**1066**
2N5877	60	—	150	20-100	4	4	1	5	0.5	6	**1065**
BD311	60	—	150	25 min.	5	4	1	5	0.5		**1261**
BD313	80	—	150	25 min.	4	4	1	5	0.5		**1261**
2N3716	80	—	150	50-150	1	2	0.8	5	0.5		**1058**
2N4915	80	—	87.5	25-100	2.5	2	0.75	2.5	0.25		**1067**
2N5874	80	—	115	20-100	2.5	4	1	4	0.4		**1066**
2N5878	80	—	150	20-100	4	4	1	5	0.5		**1065**
2N3771 FAMILY (n-p-n) P_T to 250 W max.											**JEDEC TO-204MA/TO-3 Package**
2N3771*	40	50^{Φ}	150	15-60	15	4	2	15	1.5		**974**
2N3772*	60	80^{Φ}	150	15-60	10	4	1.4	10	1		**974**
RCS258	60	80^{Φ}	250	15-60	10	4	1.4	10	1		**974**
BDY29	75	90^{Φ}	220	15-60	15	2	1.2	15	1.5	1.5	**819**
AUDIO TYPE 40411	—	$90^{\ddagger}$	150	35-100	4	4	0.8	4	0.4		**219**
2N3773 FAMILY (n-p-n) P_T to 250 W max.											**JEDEC TO-204MA/TO-3 Package**
2N4348	120	140^{Φ}	120	15-60	5	4	1	5	0.5		**526**
2N3773	140	160^{Φ}	150	15-60	8	4	1.4	8	0.8	0.7	**526**
BDY37	140	160^{Φ}	150	15-60	8	4	1.4	8	0.8		**863**
BDY37A	140	160^{Φ}	250	15-60	8	2	1	8	0.8		**1256**
2N6259	150	170^{Φ}	250	15-60	8	2	1	8	0.8		**526**

*JAN types available

■40373-2N3441 with Heat Radiator
40913-2N6264 with Heat Radiator
Radiator improves $R_{\theta JA}$ from 65° C/W to 30° C/W

‡V_{CER}(sus)

ΦV_{CEX}(sus)

General-Purpose Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEV}(sus) V	P_T W	h_{FE}	h_{FE} I_C A	h_{FE} V_{CE} V	$V_{CE(sat)}$—V	$V_{CE(sat)}$ I_C A	I_B A	f_T (Typ.) MHz	File No.
2N5298 PLASTIC (n-p-n) **Complementary to 2N6107 Family** P_T = 36 W max.											**JEDEC TO-220** Package**
2N5295	40	60	36	30-120	1	4	1	1	0.1		**322**
2N5296	40	60	36	30-120	1	4	1	1	0.1		**322**
RCA3054	55	90	36	25-100	0.5	4	1	0.5	0.05		**618**
2N5297	60	80	36	20-80	1.5	4	1	1.5	0.15		**322**
2N5298	60	80	36	20-80	1.5	4	1	1.5	0.15	1	**322**
2N5293	70	80	36	30-120	0.5	4	1	0.5	0.05		**322**
2N5294	70	80	36	30-120	0.5	4	1	0.5	0.05		**322**
AUDIO TYPE											
40631	—	45‡	36	20-70	2	4	1	2	0.2		**965**
2N5303 FAMILY (n-p-n) P_T to 200 W max.											**JEDEC TO-204MA/TO-3 Package**
2N5301	40	—	200	15-60	15	3	0.75	10	1		**1029**
2N5302*	60	—	200	15-60	15	3	0.75	10	1		**1029**
2N5885	60	—	200	20-100	10	4	1	15	1.5		**1041**
2N6326	60	—	200	12 min.	15	4	3	30	7.5		**1040**
2N5881	60	—	160	20-100	6	4	4	15	3.75	8	**1065**
2N5303*	80	—	200	15-60	10	2	1.5	15	1.5		**1029**
2N5886	80	—	200	20-100	10	4	1	15	1.5		**1041**
2N6327	80	—	200	12 min.	15	4	3	30	7.5		**1040**
2N5882	80	—	160	20-100	6	4	4	15	3.75		**1065**
2N5496 PLASTIC FAMILY (n-p-n) **Complementary to 2N6107 Family** P_T = 50 W max.											**JEDEC TO-220** Package**
2N5490	40	60	50	20-100	2	4	1	2	0.2		**353**
2N5491	40	60	50	20-100	2	4	1	2	0.2		**353**
2N5494	40	60	50	20-100	3	4	1	3	0.3		**353**
2N5495	40	60	50	20-100	3	4	1	3	0.3		**353**
2N5492	55	75	50	20-100	2.5	4	1	2.5	0.25	1	**353**
2N5493	55	75	50	20-100	2.5	4	1	2.5	0.25		**353**
2N5496	70	90	50	20-100	3.5	4	1	3.5	0.35		**353**
2N5497	70	90	50	20-100	3.5	4	1	3.5	0.35		**353**
2N5783 FAMILY (p-n-p) P_T = 10 W max.											**JEDEC TO-205MA/TO-5 Package**
2N5783	-40	-45‡	10	20-100	-1.6	-2	-1	-1.6	-0.16		**413**
2N5782	-50	-65‡	10	20-100	-1.2	-2	-0.75	-1.2	-0.12	20	**413**
2N5781	-65	-80‡	10	20-100	-1	-2	-0.5	-1	-0.1		**413**
2N5786 FAMILY (n-p-n) **Complementary to 2N5783 Family** P_T = 10 W max.											**JEDEC TO-205MA/TO-5 Package**
2N5786	40	45‡	10	20-100	1.6	2	1	1.6	0.6		**413**
2N5785	50	65‡	10	20-100	1.2	2	0.75	1.2	0.12	1.5	**413**
2N5784	65	80‡	10	20-100	1	2	0.5	1	0.1		**413**

*JAN types available
‡V_{CER}(sus)

**TO-220AA Package:
2N5293
2N5295
2N5297

**TO-220AB Package:
2N5294 2N5492
2N5296 2N5494
2N5298 2N5496
2N5490 RCA3054

General-Purpose Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEV}(sus) V	P_T W	h_{FE}	h_{FE}: I_C A	h_{FE}: V_{CE} V	V_{CE}(sat)—V	V_{CE}(sat): I_C A	V_{CE}(sat): I_B A	f_T (Typ.) MHz	File No.
2N5954 FAMILY (p-n-p) Complementary to 2N6372 Family P_T to 75 W max.											**JEDEC TO-213MA/TO-66 Package**
2N5956	-40	-50‡	40	20-100	-3	-4	-1	-3	-0.3		**675**
40831■	-40	-50‡	40	20-100	-3	-4	-1	-3	-0.3		**675**
2N4898	-40	—	25	20-100	-0.5	-1	-0.6	-1	-0.1		**1150**
2N6312	-40	—	75	25-100	-1.5	-4	-0.7	-1.5	-0.15		**1102**
2N5955	-60	-70‡	40	20-100	-2.5	-4	-1	-2.5	-0.25		**675**
2N4899	-60	—	25	20-100	-0.5	-1	-0.6	-1	-0.1		**1150**
2N6313	-60	—	75	25-100	-1.5	-4	-0.7	-1.5	-0.15	10	**1102**
2N4900	-80	—	25	20-100	-0.5	-1	-0.6	-1	-0.1		**1150**
2N6314	-80	—	75	25-100	-1.5	-4	-0.7	-1.5	-0.15		**1102**
2N5954	-80	-90Φ	40	20-100	-2	-4	-1	-2	-0.2		**675**
40829■	-80	-90Φ	5.8	20-100	-2	-4	-1	-2	-0.2		**675**
2N6467	-100	-110Φ	40	15-150	-1.5	-4	-1.2	-1.5	-0.15		**888**
2N6468	-120	-130Φ	40	15-150	-1.5	-4	-1.2	-1.5	-0.15		**888**
2N6103 PLASTIC FAMILY (n-p-n) P_T = 75 W max.											**JEDEC TO-220** Package**
2N6102	40	45‡	75	15-60	8	4	2.5	16	3.2		**485**
2N6103	40	45‡	75	15-60	8	4	2.5	16	3.2		**485**
BD278	45	55‡	75	15-75	4	4	1	4	0.4		**969**
BD278A	45	55‡	75	15-75	4	4	1	4	0.4		**969**
2N6098	60	65‡	75	20-80	4	4	2.5	10	2		**485**
2N6099	60	65‡	75	20-80	4	4	2.5	10	2	1.5	**485**
RCA3055	60	70‡	75	20-70	4	4	1.1	4	0.4		**618**
2N6100	70	75‡	75	20-80	5	4	2.5	10	2		**485**
AUDIO TYPE											
RCA1C09	65	75‡	75	20-120	4	4	1	4	0.4		**645**
2N6107 PLASTIC FAMILY (p-n-p) Complementary to 2N5298, 2N5496, and 2N6292 Families P_T to 70 W max.											**JEDEC TO-220** Package**
41501	-25	-35Φ	40	25 min.	-1	-4	-1	-1	-0.1		**770**
2N6110	-30	-40Φ	40	30-150	-3	-4	-1	-3	-0.3		**676**
2N6111	-30	-40Φ	40	30-150	-3	-4	-1	-3	-0.3		**676**
TIP30	-40	—	30	15-150	-1	-4	-0.7	-1	-0.125		**988**
TIP32	-40	—	40	10-50	-3	-4	-1.2	-3	-0.375		**987**
2N6124	-45	—	40	25-100	-1.5	-2	-0.6	-1.5	-0.15		**1149**
BD240	-45	-55‡	30	40 min.	-0.2	-4	-0.7	-1	-0.2		**670**
BD242	-45	-55‡	40	25 min.	-1	-4	-1.2	-3	-0.6		**672**
BD277	-45	—	70	30-150	-1.75	-2	-0.5	-1.75	-0.1		**667**
BD534	-45	—	50	25 min.	-2	-2	-0.8	-2	-0.2		**1236**
BD796	-45	—	65	25 min.	-3	-2	-1	-3	-0.3		**1242**
BD202	-45	—	60	30 min.	-1	-2	-1	-3	-0.3		**1282**
2N6108	-50	-60Φ	40	30-150	-2.5	-4	-1	-2.5	-0.25		**676**
2N6109	-50	-60Φ	40	30-150	-2.5	-4	-1	-2.5	-0.25		**676**

‡V_{CER}(sus)
ΦV_{CEX}(sus)
■40831 - 2N5956 with Heat Radiator
40829 - 2N5954 with Heat Radiator
Radiator improves $R_{\theta JA}$ from 65° C/W to 30° C/W.

**TO-220AA Package
2N6098
2N6100
2N6102
2N6108
2N6110

**TO-220AB Package

2N6099	2N6109
2N6101	2N6111
2N6103	41501
BD278	TIP30
BD278A	TIP32
RCA1C09	All BD Series
RCA3055	

General-Purpose Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEV}(sus) V	P_T W	h_{FE}	I_C A	V_{CE} V	V_{CE}(sat)—V	I_C A	I_B A	f_T (Typ.) MHz	File No.
2N6107 PLASTIC FAMILY (p-n-p) (Cont'd) Complementary to 2N5298, 2N5496, and 2N6292 Families; P_T to 70 W max.											**JEDEC TO-220** Package**
BD240A	-60	-70‡	30	40 min.	-0.2	-4	-0.7	-0.2	-1		**670**
BD242A	-60	-70‡	40	25 min.	-1	-4	-1.2	-3	-0.6		**672**
TIP30A	-60	—	30	40 min.	-0.2	-4	-0.7	-1	-0.125		**988**
TIP32A	-60	—	40	25 min.	-1	-4	-1.2	-3	-0.375		**987**
2N6125	-60	—	40	25-100	-1.5	-2	-0.6	-1.5	-0.15		**1149**
BD536	-60	—	50	25 min.	-2	-2	-0.8	-2	-0.2		**1236**
BD798	-60	—	65	25 min.	-3	-2	-1	-3	-0.3		**1242**
BD204	-60	—	60	30 min.	-1	-2	-1	-3	-0.3		**1282**
2N6106	-70	-80Φ	40	30-150	-2	-4	-1	-2	-0.2		**676**
2N6107	-70	-80Φ	40	30-150	-2	-4	-1	-2	-0.2		**676**
BD240B	-80	-90‡	30	40 min.	-0.2	-4	-0.7	-0.2	-1		**670**
BD242B	-80	-90‡	40	25 min.	-1	-4	-1.2	-3	-0.6		**672**
2N6126	-80	—	40	20-80	-1.5	-2	-0.6	-1.5	-0.15		**1149**
BD538	-80	—	50	25 min.	-2	-2	-0.8	-2	-0.2		**1236**
BD800	-80	—	65	15 min.	-3	-2	-1	-3	-0.3	10	**1242**
TIP30B	-80	—	30	15-150	-1	-4	-0.7	-1	-0.125		**988**
TIP32B	-80	—	40	10-50	-3	-4	-1.2	-3	-0.375		**987**
2N6475	-100	-110Φ	40	15-150	-1.5	-4	-1.2	-1.5	-0.15		**676**
TIP30C	-100	—	30	15-150	-1	-4	-0.7	-1	-0.125		**988**
TIP32C	-100	—	40	10-50	-3	-4	-1.2	-3	-0.375		**987**
BD802	-100	—	65	15 min.	-3	-2	-1	-3	-0.3		**1242**
BD240C	-100	-115‡	30	40 min.	-0.2	-4	-0.7	-0.2	-1		**670**
BD242C	-100	-115‡	40	25 min.	-1	-4	-1.2	-3	-0.6		**672**
2N6476	-120	-130Φ	40	15-150	-1.5	-4	-1.2	-1.5	-0.15		**676**
AUDIO TYPES											
RCA1C11	-40	-50‡	40	50-250	-1.5	-4	-1	-1.5	-0.075		**642**
RCA1C06	-50	-60‡	40	20-120	-3	-4	-1	-3	-0.3		**644**
RCA1C04	-100	-120‡	40	50-250	-1	-4	-1	-1	-0.1		**652**
RCA1C13	-120	-140‡	40	40-250	-1	-2	—	—	—		**652**
2N6247 FAMILY (p-n-p) Complementary to 2N3716 and 2N6472 Families; P_T to 160 W max.											**JEDEC TO-204MA/TO-3 Package**
2N6469	-40	-50‡	125	20-150	-5	-4	-1.3	-5	-0.5		**677**
2N6594	-40	45‡	115	15-200	-4	-3	-1.5	-4	-0.4		**994**
2N4904	-40	—	87.5	25-100	-2.5	-2	-1	-2.5	-0.25		**1068**
2N5871	-60	—	115	20-100	-2.5	-4	-2	-7	-1.75		**1066**
2N5875	-60	—	150	20-100	-4	-4	-3	-10	-2.5		**1065**
2N5879	-60	—	160	20-100	-6	-4	-4	-15	-3.75	16	**1064**
2N6246	-60	-70‡	125	20-100	-7	-4	-1.3	-7	-0.7		**677**
BDX18	-60	-70‡	115	20-70	-4	-4	-1.1	-4	-0.4		**994**
MJ2955	-60	-70‡	150	20-70	-4	-4	-1.1	-4	-0.4		**994**
2N4905	-60	—	87.5	25-100	-2.5	-2	-1	-2.5	-0.25		**1068**
2N3791	-60	—	150	30-150	-1	-2	-1	-5	-0.5		**1059**

‡V_{CER}(sus)
ΦV_{CEX}(sus)

**TO-220AA Package
2N6106

**TO-220AB Package
2N6107
RCA1C06
RCA1C11
TIP30A
TIP32A
All BD Series

General-Purpose Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEV}(sus) V	P_T W	h_{FE}	I_C A	V_{CE} V	V_{CE}(sat)—V	I_C A	I_B A	f_T (Typ.) MHz	File No.
2N6247 FAMILY (p-n-p) (Cont'd) Complementary to 2N3716 and 2N6472 Families; P_T to 160 W max.											**JEDEC TO-204MA/TO-3 Package**
BD312	-60	—	150	25 min.	-5	-4	-1	-5	-0.5		**1261**
BD314	-80	—	150	25 min.	-4	-4	-1	-5	-0.5		**1261**
2N5872	-80	—	115	20-100	-2.5	-4	-2	-7	-1.75		**1066**
2N5876	-80	—	150	20-100	-4	-4	-3	-10	-2.5		**1065**
2N5880	-80	—	160	20-100	-6	-4	-4	-15	-3.75	16	**1065**
2N6247	-80	-90‡	125	20-100	-6	-4	-1.3	-6	-0.6		**677**
2N4906	-80	—	87.5	25-100	-2.5	-2	-1	-2.5	-0.25		**1068**
2N3792	-80	—	150	50-150	-1	-2	-1	-5	-0.5		**1059**
2N6248	-100	-110‡	125	20-100	-5	-4	-1.3	-5	-0.5		**677**
2N6292 FAMILY (n-p-n) Complementary to 2N6107 Family; P_T to 65 W max.											**JEDEC TO-220** Package**
41500	25	35Φ	40	25 min.	1	4	1	1	0.1		**772**
2N6288	30	40Φ	40	30-150	3	4	1	3	0.3		**676**
2N6289	30	40Φ	40	30-150	3	4	1	3	0.3		**676**
TIP29	40	—	30	15-150	1	4	0.7	1	0.125		**990**
TIP31	40	—	40	10-50	3	4	1.2	3	0.375		**991**
BD239	40	55‡	30	40 min.	0.2	4	0.7	1	0.2		**669**
BD241	45	55‡	40	25 min.	1	4	1.2	3	0.6		**671**
2N6121	45	—	40	25-100	1.5	2	0.6	1.5	0.15		**1149**
BD533	45	—	50	25 min.	2	2	0.8	2	0.2		**1236**
BD795	45	—	65	25 min.	3	2	1	3	0.3		**1242**
BD201	45	—	60	30 min.	1	2	1	3	0.3		**1282**
2N6290	50	60	40	30-150	2.5	4	1	2.5	0.25		**676**
2N6291	50	60	40	30-150	2.5	4	1	2.5	0.25		**676**
BD239A	60	70‡	30	40 min.	0.2	4	0.7	1	0.2		**669**
BD241A	60	70‡	40	25 min.	1	4	1.2	3	0.6	8	**671**
TIP29A	60	—	30	15-150	1	4	0.7	1	0.125		**990**
TIP31A	60	—	40	10-50	3	4	1.2	3	0.375		**991**
2N6122	60	—	40	25-100	1.5	2	0.6	1.5	0.15		**1149**
BD535	60	—	50	25 min.	2	2	0.8	2	0.2		**1236**
BD797	60	—	65	25 min.	3	2	1	3	0.3		**1242**
BD203	60	—	60	30 min.	1	2	1	3	0.3		**1282**
2N6292	70	80	40	30-150	2	4	1	2	0.2		**676**
2N6293	70	80	40	30-150	2	4	1	2	0.2		**676**
BD239B	80	90‡	30	40 min.	0.2	4	0.7	1	0.2		**669**
BD241B	80	90‡	40	25 min.	1	4	1.2	3	0.6		**671**
2N6123	80	—	40	20-80	1.5	2	0.6	1.5	0.15		**1149**
BD537	80	—	50	25 min.	2	2	0.8	2	0.2		**1236**
BD799	80	—	65	15 min.	3	2	1	3	0.3		**1242**
TIP29B	80	—	30	15-150	1	4	0.7	1	0.125		**990**
TIP31B	80	—	40	10-50	3	4	1.2	3	0.375		**991**

‡V_{CER}(sus)
ΦV_{CEX}(sus)

**TO-220AA Package
2N6289
2N6291
2N6293

**TO-220AB Package
2N6288
2N6290
2N6292
TIP29, A, B
TIP31, A, B
All BD Series
41500
RCA1C05
RCA1C10
2N6121
2N6122

General-Purpose Power Transistors

Type No.	$V_{CEO(sus)}$ V	$V_{CEV(sus)}$ V	P_T W	h_{FE}	h_{FE} I_C A	h_{FE} V_{CE} V	$V_{CE(sat)}$—V	$V_{CE(sat)}$ I_C A	$V_{CE(sat)}$ I_B A	f_T (Typ.) MHz	File No.
2N6292 FAMILY (n-p-n) (Cont'd) Complementary to 2N6107 Family P_T to 65 W max.											**JEDEC TO-220AB Package**
2N6473	100	110$^{\Phi}$	40	15-150	1.5	4	1.2	1.5	0.15		**676**
TIP29C	100	—	30	15-150	1	4	0.7	1	0.125		**990**
TIP31C	100	—	40	10-50	3	4	1.2	3	0.375		**991**
2N6474	120	130$^{\Phi}$	40	15-150	1.5	4	1.2	1.5	0.15		**676**
BD239C	100	115‡	30	40 min.	0.2	4	0.7	1	0.2		**669**
BD241C	100	115‡	40	25 min.	1	4	1.2	3	0.6		**671**
BD801	100	—	65	15 min.	3	2	1	3	0.3	4	**1242**
AUDIO TYPES											
RCA1C10	40	50	40	50-250	1.5	4	1	1.5	0.075		**642**
RCA1C05	50	60	40	20-120	3	4	1	3	0.3		**644**
RCA1C03	100	120‡	40	50-250	1	4	1	1	0.1		**652**
RCA1C12	120	140‡	40	40-250	1	2	—	—	—		**642**
2N6374 FAMILY (n-p-n) Complementary to 2N5954 Family P_T to 75 W max.											**JEDEC TO-213MA/TO-66 Package**
2N6374	40	50	40	20-100	3	4	1	3	0.3		**675**
2N4231A	40	—	75	25-100	1.5	2	0.7	1.5	0.15		**1102**
2N6373	60	70	40	20-100	2.5	4	1	2.5	0.25		**675**
2N4232A	10	—	75	25-100	1.5	2	0.7	1.5	0.15		**1102**
2N6372	80	90	40	20-100	2	4	1	2	0.2	4	**675**
2N4233A	80	—	75	25-100	1.5	2	0.7	1.5	0.15		**1102**
2N6465	100	110	40	15-150	1.5	4	1.2	1.5	0.15		**888**
2N6466	120	130	40	15-150	1.5	4	1.2	1.5	0.15		**888**
2N6472 FAMILY (n-p-n) Complementary to 2N6247 Family P_T = 125 W max.											**JEDEC TO-204MA/TO-3 Package**
2N6470	40	50‡	125	20-150	5	4	1.3	5	0.5		**677**
2N6471	60	70‡	125	20-150	5	4	1.3	5	0.5	8	**677**
2N6472	80	90‡	125	20-150	5	4	1.3	5	0.5		**677**
2N6478 FAMILY (n-p-n) P_T to 50 W max.											**JEDEC TO-220AB Package**
2N6477	120	140	50	25-150	1	4	1	1	0.1		**680**
2N6478	140	160	50	25-150	1	4	1	1	0.1	0.8	**680**
RCA3441	140	160	36	20-150	0.5	4	1.2	5	0.05		**666**
2N6488 FAMILY (n-p-n) Complementary to 2N6491 Family P_T to 75 W max.											**JEDEC TO-220AB Package**
2N6486	40	50$^{\Phi}$	75	20-150	5	4	1.3	5	0.5		**678**
TIP41	40	—	65	15-150	3	4	2	6	0.6		**992**
2N6129	40	—	50	20-100	2.5	4	1.4	7	3		**1233**
BD243	45	55‡	65	30 min.	0.3	4	1.5	6	1		**673**
2N6487	60	70$^{\Phi}$	75	20-150	5	4	1.3	5	0.5		**678**
TIP41A	60	—	65	15-150	3	4	2	6	0.6		**992**

‡V_{CER}(sus)

$^{\Phi}V_{CEX}$(sus)

General-Purpose Power Transistors

Type No.	V_{CEO}(sus) V	V_{CEV}(sus) V	P_T W	h_{FE}	h_{FE} I_C A	h_{FE} V_{CE} V	V_{CE}(sat)—V	V_{CE}(sat) I_C A	V_{CE}(sat) I_B A	f_T (Typ.) MHz	File No.
2N6488 FAMILY (n-p-n) (Cont'd) Complementary to 2N6491 Family P_T to 75 W max.											**JEDEC TO-220AB Package**
BD243A	60	70‡	65	30 min.	0.3	4	1.5	6	1		**673**
2N6130	60	—	50	20-100	2.5	4	1.4	7	3		**1233**
2N6488	80	90Φ	75	20-150	5	4	1.3	5	0.5		**678**
TIP41B	80	—	65	15-150	3	4	2	6	0.6		**992**
BD243B	80	90‡	65	30 min.	0.3	4	1.5	6	1		**673**
2N6131	80	—	50	20-100	2.5	4	1.8	7	3	8	**1233**
TIP41C	100	—	65	15-150	3	4	2	6	0.6		**992**
BD243C	100	115‡	65	30 min.	0.3	4	1.5	6	1		**673**
AUDIO TYPES											
RCA1C07	65	75‡	75	20-120	4	4	1	4	0.4		**646**
BD501B	80	85‡	75	20-120	3.5	4	1	3.5	0.35		**1108**
2N6491 FAMILY (p-n-p) Complementary to 2N6488 Family P_T to 75 W max.											**JEDEC TO-220AB Package**
2N6489	-40	-50Φ	75	20-150	-5	-4	-1.3	-5	-0.5		**678**
TIP42	-40	—	65	15-150	-3	-4	-2	-6	-0.6		**996**
2N6132	-40	—	50	20-100	-2.5	-4	-1.4	-7	-3		**1233**
BD244	-45	-55‡	65	30 min.	-0.3	-4	-1.5	-6	-1		**674**
BD500	-50	-55‡	75	15-90	-5	-4	-1	-5	-0.5		**1108**
2N6490	-60	-70Φ	75	20-150	-5	-4	-1.3	-5	-0.5		**678**
BD244A	-60	-70‡	65	30 min.	-0.3	-4	-1.5	-6	-1		**674**
TIP42A	-60	—	65	15-150	-3	-4	-2	-6	-0.6		**996**
2N6133	-60	—	50	20-100	-2.5	-4	-1.4	-7	-3		**1233**
2N6134	-80	—	50	20-100	-2.5	-4	-1.8	-7	-3	8	**1233**
2N6491	-80	-90Φ	75	20-150	-5	-4	-1.3	-5	-0.5		**678**
BD500B	-80	-85‡	75	15-90	-3.5	-4	-1	-3.5	-0.35		**1108**
BD244B	-80	-90‡	65	30 min.	-0.3	-4	-1.5	-6	-1		**674**
BD244C	-100	-115‡	65	30 min.	-0.3	-4	-1.5	-6	-1		**674**
TIP42B	-80	—	65	15-150	-3	-4	-2	-6	-0.6		**996**
TIP42C	-100	—	65	15-150	-3	-4	-2	-6	-0.6		**996**
AUDIO TYPE											
RCA1C08	-65	-75‡	75	20-120	-4	-4	-1	-4	-0.4		**644**

ΦV_{CEX}(sus)
‡V_{CER}(sus)

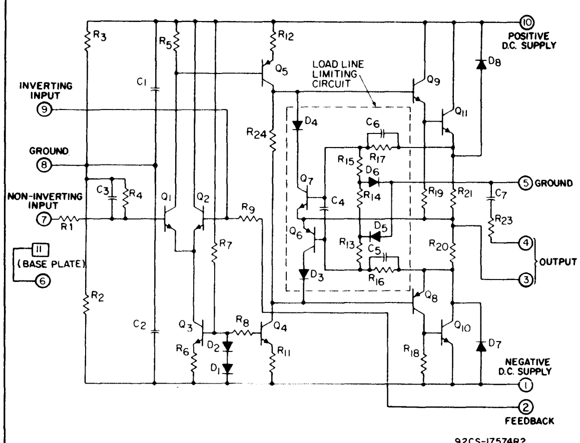
General-Purpose Power Transistors

Type No.	$V_{CEO}(sus)$ V	$V_{CEV}(sus)$ V	P_T W	h_{FE}			$V_{CE}(sat)$—V			f_T (Typ.) MHz	File No.
					I_C A	V_{CE} V		I_C A	I_B A		
2N8638 FAMILY (n-p-n) Complementary to RCA9116 Family P_T to 250 W max.											**JEDEC TO-204MA/TO-3 Package**
BD751	90	100‡	200	15-60	7.5	2	1.5	7.5	0.75		**1251**
2N5632	100	—	150	25-100	5	2	1	7.5	0.75		**1094**
RCA8638E	100	110‡	200	25-100	10	2	0.8	7.5	0.75		**1060**
2N5629	100	—	200	25-100	8	2	1	10	1		**1141**
BD550	100	130‡	150	15-75	4	4	2	4	0.5		**1109**
BD751B	100	110‡	250	15-60	7.5	2	1.5	7.5	0.75		**1251**
BD751A	120	130‡	200	25-100	5	2	1	5	0.5		**1251**
RCA8638D	120	130‡	200	25-150	5	2	1	5	0.5		**1060**
2N5633	120	—	150	20-80	5	2	1	7.5	0.75	4	**1094**
2N5630	120	—	200	20-80	8	2	1	10	1		**1141**
BD751C	130	140‡	250	25-100	5	2	1	5	0.5		**1251**
RCA3773	140	150‡	150	15-60	8	4	1.4	8	0.8		**1060**
MJ15001	140	—	200	25-150	4	2	1	4	0.4		**1093**
MJ15003	140	150‡	250	25-150	5	2	1	5	0.5		**1060**
2N5631	140	—	200	15-60	8	2	1	10	1		**1141**
2N5634	140	—	150	15-60	5	2	1	7.5	0.75		**1094**
RCA8638C	140	—	200	25-150	5	2	1	5	0.5		**1060**
RCA9116 FAMILY (p-n-p) Complementary to RCA8638 Family P_T to 250 W max.											**JEDEC TO-204MA/TO-3 Package**
BD750	-90	-100‡	200	15-60	-7.5	-2	-1.5	-7.5	-0.75		**1251**
BD750B	-100	-110‡	250	15-60	-7.5	-2	-1.5	-7.5	-0.75		**1251**
BD750A	-120	-130‡	200	25-100	-5	-2	-1	-5	-0.5		**1251**
BD750C	-130	-140‡	250	25-100	-5	-2	-1	-5	-0.5		**1251**
2N6609	-140	160Φ	150	15-60	-8	-4	-1.4	-8	-0.8	4	**1061**
MJ15002	-140	—	200	25-150	-4	-2	-1	-4	-0.4		**1093**
MJ15004	-140	-150‡	250	25-150	-5	-2	-1	-5	-0.5		**1060**
RCA9116C	-140	-150‡	200	25-150	-5	-2	-1	-5	-0.5		**1061**
RCA9116D	-120	-130‡	200	25-150	-5	-2	-1	-5	-0.5		**1061**
RCA9116E	-100	-110‡	200	25-100	-7.5	-2	-0.8	-7.5	-0.75		**1061**
RCA9166 FAMILY (n-p-n) P_T to 250 W max.											**JEDEC TO-204MA Package**
RCA9166B	200	225‡	250	30 min.	3	4	1	3	0.3		**1293**
MJ15022	200	225‡	250	15-60	8	4	1.4	8	0.8	7	**1293**
RCA9166A	250	275‡	250	30 min.	3	4	1	3	0.3		**1293**
MJ15024	250	275‡	250	15-60	8	4	1.4	8	0.8		**1293**

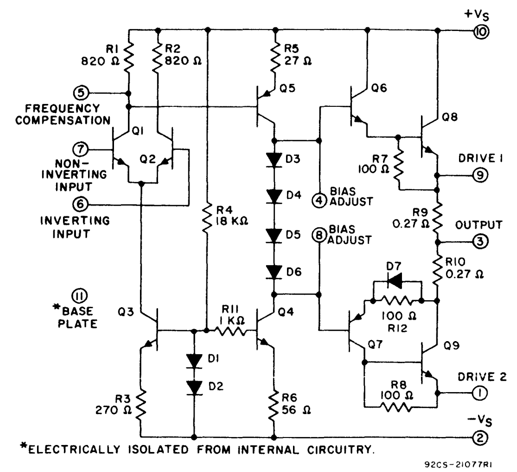
‡$V_{CER}(sus)$
Φ$V_{CEX}(sus)$

Power Hybrid Circuits

HC2000H



HC2500

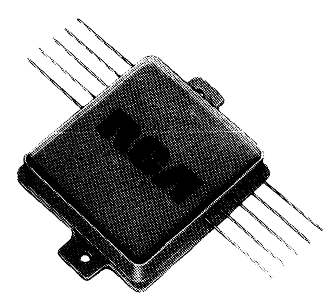


Features

- Operation from either single or split power supplies
- Output currents up to 7 A; power output up to 100 W
- Bandwidth of 30 kHz at 60 W
- Adjustable idling current
- Direct coupling to load
- Built-in load-line limiting circuit to protect amplifier from short-circuiting output terminals (HC2000H)

Recommended Applications

- Servo amplifiers
- Audio power amplifiers
- Driven inverters
- Power operational amplifiers
- Deflection amplifiers
- Solenoid drivers
- Similar linear-amplifier power applications
- Rugged, hermetic metal packages with heavy leads



Power Hybrid Circuit
(See dimensional outline "V".)

RCA Family	V_S* Max. (V)	I_{OUT} (Peak) (A)	BW @ 60 W (kHz)	P_{OUT} (RMS) W	IMD (200 mW) %	Output Protection Network	Frequency Compensation	Operating Mode	Commutating Diodes	File No.
HC2000H	75	7	30	Up to 100	0.6	Yes	LC Filter on Output	Class B	Yes	566
HC2500	75	7	30	Up to 100	0.06	No	Capacitor on Sig. Terminals	Class AB	No	681

• Power Supply: Single, 30 to 75 V; Split, ± 15 to 37.5 V   Operating Temperature Range: -55° C to +125° C
Socket for both types: RCA part DF-293A,
Electronic Essentials, 210 Elizabeth St., New York, N.Y. 10012, Part No. MS5-1000, or equiv.

Triacs
Technical Data

Types of RCA Triacs

RCA triacs are grouped on the basis of on-state current ratings and package. Each group includes several series of devices that may be categorized, primarily according to gate characteristics, as standard or general-purpose types, sensitive-gate types, or zero-voltage switched types. Types within each series differ only in off-state voltage ratings.

Information shown on RCA Triacs is in chart format. For a data bulletin on a particular type, request the data-bulletin File Number shown at the bottom of each chart.

Data bulletins are available from the RCA Sales Office in your locale or by writing to — RCA Solid State Division, Box 3200, Somerville, N.J. 08876.

Type	Operating Characteristics
Standard	• $I_T(RMS)$ = 2.5 to 40 A • V_{DROM} = 50 to 600 V • Generally characterized for operation in all four modes • $I_{GT}(max)$ = 25 to 80 mA for I^+ and III^- modes = 40 to 80 mA for I^+ and III^- modes
Sensitive-Gate	• $I_T(RMS)$ = 2.5 A • V_{DROM} = 100 to 500 V • Characterized for operation in all four modes • $I_{GT}(max)$ = 3 or 4 mA for most types (all modes)
Zero-voltage-switched	• $I_T(RMS)$ = 2.5 to 40 A • V_{DROM} = 200 to 600 V • Characterized for operation in I^+ and III^+ modes only • $I_{GT}(max)$ = 45 mA for all types (I^+ and III^+ modes)

Silicon Triacs

Product Matrix

RCA Triacs			TO-205MA/TO-5 Modified				TO-202AB VERSATAB		TO-202AB VERSATAB		TO-213MA /TO-66	
Standard	I_T (RMS)		2.5A	2.5A	2.5A	2.5A	2.5A	2.5A	2.5A	2.5A	6A	15A
	I_{TSM} (60 Hz)		25A	25A	25A	25A	25A	25A	25A	25A	100A	100A
	V_{DROM} (V)	100	T2300A	T2301A	T2302A	2N5754	T2320A	T2327A	T2322A	T2323A		
		200	T2300B	T2301B	T2302B	2N5755	T2320B	T2327B	T2322B	T2323B	T2700B	T4700B
		400	T2300D	T2301D	T2302D	2N5756	T2320D	T2327D	T2322D	T2323D	T2700D	T4700D
		500					T2320E	T2327E	T2322E	T2323E		
		600				2N5757						
	I_{GT} (mA)	I^+, III^-	3	4	10	25	3	5	10	25	25	30
		I^-, III^+	3	4	10	40	3	5	10	40	40	80
	V_{GT} (V)	All Modes	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.5
Zero Voltage Switch■	V_{DROM} (V)	200									T2706B	
		400									T2706D	
	I_{GT} (mA)	I^+, III^+									45	
	V_{GT} (V)	I^+, III^+									1.5	
File No. (Data Sheet)			911			414	1042				351	300

RCA Triacs			TO-220AB VERSAWATT				Press-Fit (TO-203AA)		Stud		Isolated Stud	
Standard	I_T (RMS)		6A	8A	8A	8A*	10A	15A	10A	15A	10A	15A
	I_{TSM} (60 Hz)		60A	100A	100A	100A	100A	100A	100A	100A	100A	100A
	V_{DROM} (V)	100		T2800A	T2802A							
		200	T2500B	T2800B	T2802B	T2850B	2N5567	2N5571	2N5569	2N5573	T4121B	T4120B
		300		T2800C	T2802C						T4121D	T4120D
		400	T2500D	T2800D	T2802D	T2850D	2N5568	2N5572	2N5570	2N5574		
		500		T2800E	T2802E							
		600		T2800M	T2802M	T2850M	T4101M	T4100M	T4111M	T4110M	T4121M	T4120M
	I_{GT} (mA)	I^+, III^-	25	25	50	25	25	50	25	50	25	50
		I^-, III^+	60	60		60	40	80	40	80	40	80
	V_{GT} (V)	All Modes	2.5	2.5	2.5•	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Zero Voltage Switch■	V_{DROM} (V)	200	T2506B		T2806B	T2856B		T4106B	T4117B	T4116B		T4126B
		400	T2506D		T2806D	T2856D		T4106D	T4117D	T4116D		T4126D
		600			T2806M			T4106M	T4117M	T4116M		T4126M
	I_{GT} (mA)	I^+, III^+	45		45	45		45	45	45		45
	V_{GT} (V)	I^+, III^+	1.5		1.5	1.5		1.5	1.5	1.5		1.5
File No. (Data Sheet)			615	1314		1168	457	458	457	458	457	458

■Refer to File No. 406 for data on the zero voltage switch types.
*ISOWATT - Mounting tab electrically isolated from electrodes.
•I^+, III^- only.

Product Matrix

RCA Triacs			TO-220AB VERSAWATT							
Standard	I_T (RMS)		6A	10A	6A	8A	10A	12A	12A	12A
	I_{TSM} (60 Hz)		80A	120A	80A	100A	110A	115A	120A	120A
	V_{DROM} (V)	200	SC141B	SC146B			BTA22B	BTA23B	2N6342A	2N6346A
		300			BTA20C	BTA21C	BTA22C	BTA23C		
		400	SC141D	SC146D	BTA20D	BTA21D	BTA22D	BTA23D	2N6343A	2N6347A
		500	SC141E	SC146E	BTA20E	BTA21E	BTA22E	BTA23E		
		600	SC141M	SC146M			BTA22M	BTA23M	2N6344A	2N6348A
	I_{GT} (mA)	I^+, III^-	50	50	80	35	25	25	50	50
		I^-, III^+	50•	50•			60	60		75
	V_{GT} (V)	All Modes	2.5	2.5	4	2.5	2.5	2.5	2	2.5
File No. (Data Sheet)			1167		1298	1299	1300	1301	1084	

•I^- only.

RCA Triacs			TO-220AB VERSAWATT	
Standard	I_T (RMS)		15 A	15 A
	I_{TSM} (60 Hz)		150 A	150 A
	V_{DROM} (V)	200	MAC15-4	MAC15A-4
		300	MAC15-6	MAC15A-6
		500	MAC15-8	MAC15A-8
	I_{GT} (mA)	I^+, III^-	50	50
		I^-, III^+	—	75
	V_{GT} (V)	All Modes	2	2.5
File No. (Data Sheet)			1086	

RCA Triacs			TO-220AB VERSAWATT		Press-Fit		Stud		Isolated Stud	
Standard	I_T (RMS)		16A	16A	30A	30A	30A	40A	30A	40A
	I_{TSM} (60 Hz)		150A	150A	300A	300A	300A	300A	300A	300A
	V_{DROM} (V)	200	T6000B	T6001B	T6401B	2N5441	T6411B	2N5444	T6421B	T6420B
		400	T6000D	T6001D	T6401D	2N5442	T6411D	2N5445	T6421D	T6420D
		600	T6000M	T6001M	T6401M	2N5443	T6411M	2N5446	T6421M	T6420M
	I_{GT} (mA)	I^+, III^-	50	80	50	50	50	50	50	50
		I^-, III^+	80		80	80	80	80	80	80
	V_{GT} (V)	All Modes	2.5	3	2.5	2.5	2.5	2.5	2.5	2.5
Zero Voltage Switch■	V_{DROM} (V)	200	T6006B		T6407B	T6406B	T6417B	T6416B		T6426B
		400	T6006D		T6407D	T6406D	T6417D	T6416D		T6426D
		600	T6006M		T6407M	T6406M	T6417M	T6416M		T6426M
	I_{GT} (mA)	I^+, III^+	45		45	45	45	45		45
	V_{GT} (V)	All Modes	1.5		1.5	1.5	1.5	1.5		1.5
File No. (Data Sheet)			1004		459	593	459	593	459	593

■Refer to File No. 406 for data on the zero voltage switch types.

Silicon Controlled Rectifiers (SCR's)
Technical Data

Types of RCA SCR's

RCA silicon controlled rectifiers are grouped on the basis of package and on-state current ratings. Each group includes standard, sensitive-gate, and inverter (fast-turn-off) SCR's. The family classifications are determined on the basis of on-state current ratings, gate characteristics, switching times, and package configuration. Each family may include several series of types that differ primarily in gate characteristics and switching times. The types within each series differ only in off-state voltage ratings.

Information shown on RCA SCR's is in chart format. For a data bulletin on a particular type, request the data-bulletin File Number shown at the bottom of each chart.

Data bulletins are available from the RCA Sales Office in your locale or by writing to — RCA Solid State Division, Box 3200, Somerville, N.J. 08876

Type	Operating Characteristics
Standard	• I_T(RMS) = 5 to 35 A • V_{DROM} = 25 to 600 V • I_{GT}(max) = 15 to 80 mA • V_{GT}(max) = 1.5 to 3 V • dv/dt(min) = 10 to 200 V/μs
Sensitive-Gate	• I_T(RMS) = 4 to 10 A • V_{DROM} = 15 to 800 V • I_{GT}(max) = 0.2 to 0.5 mA • V_{GT}(max) = 0.8 to 1.5 V • dv/dt(min) = 2 V/μs
Inverter (Fast-Turn-Off)	• I_T(RMS) = 3 to 35 A • V_{DROM} = 50 to 600 V • I_{GT}(max) = 2 to 180 mA • V_{GT}(max) = 1.5 to 4 V • dv/dt(min) = 20 to 200 V/μs • t_q = 4 to 1.5μs

Silicon Controlled Rectifiers

Product Matrix

RCA SCR's		TO-202AB VERSATAB		TO-220AB VERSAWATT		TO-213MA/ TO-66		TO-220AB VERSAWATT	Low-Profile Mod. TO-205MA/TO-5
I_T (RMS)		FTO* 3A	4A	4A	4A	5A	FTO* 5A	FTO* 5A	7A
I_{TSM} (60 Hz)		20A	20A	35A	35A	60A	80A	80A	100A
V_{DROM}	15			S2060Q	S2061Q				
	30			S2060Y	S2061Y				
	50	S3060F	C106F	S2060F	S2061F				
	100	S3060A	C106A	S2060A	S2061A				
	200	S3060B	C106B	S2060B	S2061B	2N3228	S3700B	S5800B	S2600B
	300		C106C	S2060C	S2061C			S5800C	
	400	S3060D	C106D	S2060D	S2061D	2N3525	S3700D	S5800D	S2600D
	500		C106E	S2060E	S2061E			S5800E	
	600	S3060M	C106M	S2060M	S2061M	2N4101	S3700M	S5800M	S2600M
I_{GT} (mA)		2	0.2	0.2	0.5	15	40	50	15
V_{GT} (V)		1.5	0.8	0.8	0.8	2	3.5	2.5	1.5
File No. (Data Sheet)		1307	1005	654	654	114	306	1051	496

RCA SCR's		TO-220AB VERSAWATT					TO-204MA /TO-3	Press-Fit TO-203AA		Stud	
I_T (RMS)		8A	10A	10A	12A	16A	12.5A	20A	35A	20A	35A
I_{TSM} (60 Hz)		100A	100A	120A	125A	160A	200A	200A	350A	200A	350A
V_{DROM},	25			S4060U							
V_{RROM} (V)	50	C122F	S2800F	S4060F	2N6394	2N6400					
	100	C122A	S2800A	S4060A	2N6395	2N6401	2N3668	S6200A	2N3870	S6210A	2N3896
	200	C122B	S2800B	S4060B	2N6396	2N6402	2N3669	S6200B	2N3871	S6210B	2N3897
	300	C122C	S2800C	S4060C							
	400	C122D	S2800D	S4060D	2N6397	2N6403	2N3670	S6200D	2N3872	S6210D	2N3898
	500	C122E	S2800E	S4060E							
	600	C122M	S2800M	S4060M	2N6398	2N6404	2N4103	S6200M	2N3873	S6210M	2N3899
	700		S2800S	S4060S							
	800			S4060N							
I_{GT} (mA)		25	15	0.2	30	30	40	15	40	15	40
V_{GT} (V)		1.5	1.5	1.5	1.5	1.5	2	2	2	2	2
File No. (Data Sheet)		1173	890	1306	891	892	116	418	578	418	578

*FTO - Fast Turn-off.

Product Matrix

RCA SCR's		Isolated Stud		TO-208MA/TO-48			
					Pulse Modulator	FTO*	FTO*
I_T (RMS)		20A	35A	25A	35A	35A	35A
I_{TSM} (60 Hz)		200A	350A	150A	150A	180A	180A
V_{DROM}	25			2N681			
V_{RROM} (V)	50			2N682			2N3654
	100	S6220A	S6420A	2N683		2N3650	2N3655
	150			2N684			
	200	S6220B	S6420B	2N685		2N3651	2N3656
	250			2N686			
	300			2N687		2N3652	2N3657
	400	S6220D	S6420D	2N688		2N3653	2N3658
	500			2N689			
	600	S6220M	S6420M	2N690	S6493M	S7410M	S7412M
	800						
I_{GT} (mA)		15	40	25	80	180	180
V_{GT} (V)		2	2	3	2	3	2
File No. (Data Sheet)		418	578	96	247	408	724

*FTO - Fast Turn-off.

CROSS REFERENCE

Power MOSFETs

Industry Type	RCA Replacement Type
BUZ 10B	RFP15N05
BUZ 14	RFK45N05
BUZ 14A	RFK45N05
BUZ 14B	RFM25N05
BUZ 14C	RFM15N05
BUZ 14D	RFM15N05
BUZ 20	RFP12N10
BUZ 20A	RFP12N10
BUZ 20B	RFP12N10
BUZ 23	RFM12N10
BUZ 23A	RFM15N12
BUZ 23B	RFM10N12
BUZ 24B	RFK30N12
BUZ 30	RFP8N20
BUZ 32	RFP12N20
BUZ 32A	RFP10N15
BUZ 32B	RFP8N20
BUZ 32C	RFP8N18
BUZ 33	RFM8N20
BUZ 33A	RFM8N20
BUZ 33B	RFM10N15
BUZ 35	RFM12N20
BUZ 35A	RFM10N15
BUZ 41A	RFP6N50
BUZ 41B	RFP6N45
BUZ 42	RFP6N50
BUZ 42A	RFP6N45
BUZ 42B	RFP3N50
BUZ 42C	RFP3N45
BUZ 42D	RFP3N50
BUZ 44A	RFM6N50
BUZ 44B	RFM6N45
BUZ 45A	RFK10N50
BUZ 46	RFM6N50
BUZ 46A	RFM6N45
BUZ 46B	RFM3N50
BUZ 60	RFP7N40
BUZ 60A	RFP7N35
BUZ 60B	RFP7N40
BUZ 60C	RFP7N35
BUZ 60D	RFP7N40
BUZ 63	RFM7N40
BUZ 63A	RFM7N35
BUZ 63B	RFM7N40
BUZ 63C	RFM7N35
BUZ 63D	RFM7N40
BUZ 71A	RFP15N05
D84CK1	RFP15N05
D84CK2	RFP15N06
D84CL1	RFP12N08
D84CL2	RFP12N10
D84CM1	RFP8N18
D84CM2	RFP8N18
D84CN1	RFP8N18
D84CN2	RFP8N20
D84CQ1	RFP4N35
D84CQ2	RFP4N40
D84CR1	RFP3N45
D84CR2	RFP3N50
D84DK1	RFP15N05
D84DK2	RFP15N06
D84DL1	RFP18N08
D84DL2	RFP18N10
D84DM1	RFP10N12
D84DM2	RFP10N15
D84DN1	RFP12N18
D84DN2	RFP12N20
D84DQ1	RFP7N35
D84DQ2	RFP7N40
D84DR1	RFP6N45

Industry Type	RCA Replacement Type
D84DR2	*RFP6N50
D84EK1	RFP25N05
D84EK2	RFP25N06
D84EM1	RFP15N12
D84EM2	RFP15N15
D86DK1	RFM15N05
D86DK2	RFM15N06
D86DL1	RFM18N08
D86DL2	RFM18N10
D86DM1	RFM10N12
D86DM2	RFM10N15
D86DN1	RFM12N18
D86DN2	RFM12N20
D86DQ1	RFM7N35
D86DQ2	RFM7N40
D86DR1	RFM6N45
D86DR2	RFM6N50
D86EK1	RFM25N05
D86EK2	RFM25N06
D86EL1	RFM35N08
D86EL2	RFM35N10
D86EM1	RFM15N12
D86EM2	RFM15N15
D86EN1	RFK25N18
D86EN2	RFK25N20
D86EQ1	RFK12N35
D86EQ2	RFK12N40
D86ER1	RFK10N45
D86ER2	RFK10N50
D86FK1	RFK45N05
D86FK2	RFK45N06
D86FL1	RFK35N08
D86FL2	RFK35N10
D86FM1	RFK30N12
D86FM2	RFK30N15
D86FQ1	RFK12N35
D86FQ2	RFK12N40
IRFF110	RFL4N12
IRFF111	RFL4N12
IRFF112	RFL4N12
IRFF113	RFL4N12
IRFF120	RFL4N12
IRFF121	RFL4N12
IRFF122	RFL4N12
IRFF123	RFL4N12
IRF120	RFM12N10
IRF121	RFM15N06
IRF122	RFM12N10
IRF123	RFM15N06
IRF130	IRF130
IRF541	RFP25N06
IRF543	RFP25N06
IRF131	IRF131
IRF132	IRF132
IRF133	IRF133
IRF140	RFK35N10
IRF141	*RFM25N06
IRF142	RFK35N10
IRF143	*RFM25N06
IRF150	RFK35N10
IRF151	RFK45N06
IRF152	RFK35N10
IRF153	RFK45N06
IRF220	RFM8N20
IRF221	RFM10N15
IRF222	RFM8N20
IRF223	RFM10N15
IRF230	RFM12N20
IRF231	RFM10N15
IRF232	RFM8N20

Industry Type	RCA Replacement Type
IRF233	RFM10N15
IRF240	RFK25N20
IRF241	RFM15N15
IRF242	RFM12N20
IRF243	RFM15N15
IRF251	IRF251
IRF252	RFK25N20
IRF253	IRF253
IRF320	RFM7N40
IRF321	RFM7N35
IRF322	RFM7N40
IRF323	RFM7N35
IRF330	RFM7N40
IRF331	RFM7N35
IRF332	RFM7N40
IRF333	RFM7N35
IRF340	RFK12N40
IRF341	RFK12N35
IRF342	RFK12N40
IRF343	RFK12N35
IRF420	IRF420
IRF421	IRF421
IRF422	IRF422
IRF423	IRF423
IRF430	*RFM6N50
IRF431	RFM6N45
IRF432	RFM6N50
IRF433	RFM6N45
IRF440	RFK10N50
IRF441	RFK10N45
IRF442	RFK10N50
IRF443	RFK10N45
IRF510	IRF510
IRF511	IRF511
IRF512	IRF512
IRF513	IRF513
IRF520	IRF520
IRF521	IRF521
IRF522	IRF522
IRF523	IRF523
IRF530	IRF530
IRF531	IRF531
IRF532	IRF532
IRF533	IRF533
IRF610	RFP8N20
IRF611	RFP10N15
IRF612	RFP8N20
IRF613	RFP10N15
IRF620	RFP8N20
IRF621	RFP8N18
IRF622	RFP8N20
IRF623	RFP8N18
IRF631	RFP10N15
IRF632	RFP8N20
IRF633	RFP10N15
IRF641	RFP15N15
IRF643	RPF15N15
IRF710	RFP4N40
IRF711	RFP4N35
IRF712	RFP4N40
IRF713	RFP4N35
IRF722	RFP4N40
IRF723	RFP4N35
IRF730	RFP7N40
IRF731	RFP7N35
IRF732	RFP7N40
IRF733	RFP7N35
IRF820	RFP3N50
IRF821	RFP3N45

Power MOSFETs

Industry Type	RCA Replacement Type
IRF822	RFP3N50
IRF823	RFP3N45
IRF830	RFP6N50
IRF831	RFP6N45
IRF832	RFP6N50
IRF833	RFP6N45
IRF9130	RFM12P10
IRF9131	RFM12P08
IRF9132	RFM8P10
IRF9133	RFM8P08
IRF9510	RFP5P12
IRF9511	RFP5P12
IRF9512	RFP5P12
IRF9513	RFP5P12
IRF9520	RFP6P10
IRF9521	RFP6P08
IRF9522	RFP6P10
IRF9523	RFP6P08
IRF9530	RFP12P10
IRF9531	RFP12P08
IRF9532	RFP8P10
IRF9533	RFP8P08
IRF9611	RFP5P15
IRF9613	RFP5P15
IRF9621	RFP5P15
IRF9623	RFP5P15
IRF9631	RFP8P15
IRF9633	RFP5P15
MTM10N05	RFM15N05
MTM10N06	RFM15N06
MTM10N08	RFM12N08
MTM10N10	RFM12N10
MTM10N12	RFM10N12
MTM10N15	RFM10N15
MTM12N05	RFM15N05
MTM12N06	RFM15N06
MTM12N08	RFM12N08
MTM12N10	RFM12N10

Industry Type	RCA Replacement Type
MTM12N18	RFM12N18
MTM12N20	RFM12N20
MTM15N05	RFM15N05
MTM15N06	RFM15N06
MTM15N12	RFM15N12
MTM15N15	RFM15N15
MTM15N35	RFK12N35
MTM15N40	RFK12N40
MTM2N45	RFM3N45
MTM2N50	RFM3N50
MTM20N08	RFM18N08
MTM20N10	RFM18N10
MTM25N05	RFM25N05
MTM25N06	RFM25N06
MTM3N35	RFM4N35
MTM3N40	RFM4N40
MTM4N45	RFM6N45
MTM4N50	RFM6N50
MTM5N18	RFM8N18
MTM5N20	RFM8N20
MTM5N35	RFM7N35
MTM5N40	RFM7N40
MTM7N12	RFM8N18
MTM7N15	RFM8N18
MTM7N18	RFM8N18
MTM7N20	RFM8N18
MTM8N08	RFM8N18
MTM8N10	RFM8N18
MTM8N12	RFM10N12
MTM8N15	RFM10N15
MTM8N18	RFM8N18
MTM8N20	RFM8N20
MTP1N45	RFP3N45
MTP1N50	RFP3N50
MTP10N05	RFP15N05
MTP10N06	RFP15N06
MTP10N08	RFP12N08
MTP10N10	RFP12N10

Industry Type	RCA Replacement Type
MTP10N12	RFP10N12
MTP10N15	RFP10N15
MTP12N05	RFP15N05
MTP12N06	RFP15N06
MTP12N08	RFP12N08
MTP12N10	RFP12N10
MTP12N18	RFP12N18
MTP12N20	RFP12N20
MTP15N05	RFP15N05
MTP15N06	RFP15N06
MTP15N12	RFP15N12
MTP15N15	RFP15N15
MTP2N35	RFP4N35
MTP2N40	RFP4N40
MTP2N45	RFP3N45
MTP2N50	RFP3N50
MTP20N08	RFP18N08
MTP20N10	RFP18N10
MTP25N05	RFP25N05
MTP25N06	RFP25N06
MTP3N35	RFP4N35
MTP3N40	RFP4N40
MTP4N45	RFP6N45
MTP4N50	RFP6N50
MTP5N18	RFP8N18
MTP5N20	RFP8N20
MTP5N35	RFP7N35
MTP5N40	RFP7N40
MTP7N12	RFP8N18
MTP7N15	RFP8N18
MTP7N18	RFP8N18
MTP7N20	RFP8N20
MTP8N08	RFP8N18
MTP8N10	RFP8N18
MTP8N12	RFP10N12
MTP8N15	RFP10N15
MTP8N18	RFP8N18
MTP8N20	RFP8N20

Power Transistors

Industry Type	RCA Replacement Type
2N656	2N2102
2N697	2N697
2N699	2N2102
2N1132	2N4037
2N1132A	2N4037
2N1565	40408
2N1565A	40408
2N1573	40409
2N1574	40409
2N1613	2N1613
2N1714	2N1480
2N1889	2N2102
2N1893	2N1893
2N1974	40408
2N1975	40408
2N1984	40408
2N1985	40408
2N1986	2N3053
2N1987	2N697
2N1990	2N3440
2N2034	2N5784
2N2102	2N2102
2N2193	2N1613
2N2194	2N2102
2N2195	2N697
2N2195A	2N697
2N2217	2N697
2N2218	2N697
2N2243	2N1893
2N2243A	2N1893
2N2270	2N2270
2N2297	2N1613
2N2297S	2N1613
2N2303	40314
2N2405	2N2405
2N2410	2N3053
2N2537	2N2270
2N2800	40406
2N2846	2N697
2N2848	2N697
2N2863	2N5321
2N2864	2N3053
2N2868	2N3053
2N2958	2N697
2N3020	2N1893
2N3024	2N4904
2N3025	2N4905
2N3026	2N4905
2N3036	2N5320
2N3053	2N3053
2N3054	2N3054
2N3055	2N3055
2N3108	2N2102
2N3110	2N3053
2N3114	2N3440
2N3122	2N5321
2N3133	2N4036
2N3134	2N4037
2N3171	2N6254
2N3172	2N6246
2N3173	2N6247
2N3174	2N6248
2N3183	2N6246
2N3184	2N6246
2N3185	2N6247

Industry Type	RCA Replacement Type
2N3195	2N6246
2N3196	2N6248
2N3196	2N6246
2N3197	2N6247
2N3198	2N6248
2N3202	2N5783
2N3203	2N5781
2N3208	2N5783
2N3224	2N5415
2N3225	2N5415
2N3226	2N6253
2N3233	2N3442
2N3234	2N3055
2N3235	2N3055
2N3236	2N6254
2N3237	2N5302
2N3238	2N5882
2N3239	2N5882
2N3240	2N5882
2N3244	2N5323
2N3245	2N5323
2N3292	2N697
2N3418	2N5320
2N3439	2N3439
2N3440	2N3440
2N3441	2N3441
2N3442	2N3442
2N3444	2N5321
2N3445	2N6471
2N3446	2N6472
2N3447	2N6471
2N3448	2N6472
2N3583	2N3583
2N3584	2N3584
2N3585	2N3585
2N3665	2N1893
2N3712	2N3440
2N3713	2N3715
2N3714	2N3716
2N3715	2N3715
2N3716	2N3716
2N3719	2N5323
2N3720	2N5322
2N3738	2N3584
2N3739	2N3585
2N3740	2N5955
2N3741	2N5954
2N3742	2N3439
2N3743	2N5416
2N3766	2N3879
2N3767	2N6372
2N3771	2N3771
2N3772	2N3772
2N3773	2N3773
2N3774	2N5783
2N3775	2N5781
2N3778	2N5783
2N3779	2N5781
2N3782	2N5783
2N3788	2N5840
2N3789	2N3791
2N3790	2N3792
2N3791	2N3791
2N3792	2N3792
2N3795	2N5415

Industry Type	RCA Replacement Type
2N3863	2N3055
2N3864	2N3442
2N3865	2N6262
2N3879	2N3879
2N3902	2N6308
2N3945	2N2102
2N4000	2N5320
2N4030	2N4036
2N4036	2N4036
2N4037	2N4037
2N4070	2N6306
2N4071	2N6306
2N4111	2N4914
2N4113	2N4915
2N4130	2N3055
2N4231	2N4231A
2N4231A	2N4231A
2N4232	2N4232A
2N4232A	2N4232A
2N4233	2N4233A
2N4233A	2N4233A
2N4234	2N5783
2N4235	2N5782
2N4236	2N5781
2N4237	2N5786
2N4238	2N5785
2N4239	2N5784
2N4240	2N4240
2N4347	2N4347
2N4387	2N5956
2N4388	2N5955
2N4404	2N1893
2N4405	2N2405
2N4438	2N3439
2N4890	2N4037
2N4898	2N4898
2N4899	2N4899
2N4900	2N4900
2N4907	2N6246
2N4908	2N6246
2N4909	2N6247
2N4910	2N6260
2N4911	2N3054
2N4912	2N6261
2N4926	2N3440
2N4927	2N3440
2N4928	2N5415
2N4929	2N5415
2N4930	2N5415
2N4931	2N5416
2N5038	2N5038
2N5039	2N5039
2N5050	2N5050
2N5051	2N5051
2N5052	2N5052
2N5058	2N3439
2N5059	2N3440
2N5091	2N5416
2N5092	2N3439
2N5110	2N5783
2N5157	2N5840
2N5241	2N6513
2N5264	2N6510
2N5279	2N3439
2N5280	2N4036

Power Transistors

Industry Type	RCA Replacement Type
2N5281	2N5415
2N5282	2N5416
2N5301	2N5301
2N5302	2N5302
2N5303	2N5303
2N5305	BDY29
2N5344	2N6211
2N5345	2N6212
2N5427	2N6372
2N5429	2N6465
2N5466	2N6671
2N5467	2N6671
2N5598	2N5202
2N5600	2N6500
2N5602	2N3879
2N5604	2N6500
2N5606	2N3879
2N5608	2N3879
2N5610	2N6500
2N5612	2N6500
2N5614	2N5039
2N5616	2N5038
2N5618	2N5038
2N5620	2N6496
2N5622	2N5039
2N5624	2N5038
2N5626	2N5038
2N5628	2N6496
2N5633	2N5633
2N5634	2N5634
2N5660	2N6077
2N5661	2N6079
2N5664	2N6077
2N5665	2N6079
2N5672	2N5672
2N5687	40412
2N5732	2N5671
2N5734	2N5671
2N5737	2N6246
2N5738	2N6248
2N5739	2N5878
2N5745	2N5745
2N5758	2N3442
2N5759	2N3442
2N5760	2N3442
2N5838	2N5838
2N5839	2N5839
2N5840	2N5840
2N5861	2N5321
2N5864	2N4036
2N5865	2N4036
2N5867	2N6246
2N5871	2N5871
2N5872	2N5872
2N5873	2N5873
2N5874	2N5874
2N5875	2N5875
2N5876	2N5876
2N5877	2N5877
2N5878	2N5778
2N5879	2N5879
2N5880	2N5880
2N5881	2N5881
2N5882	2N5882
2N5885	2N5885

Industry Type	RCA Replacement Type
2N5886	2N5886
2N5888	2N6247
2N5929	2N5671
2N5930	2N5672
2N5932	2N5671
2N5933	2N5672
2N5935	2N6032
2N5936	2N6033
2N5970	2N6472
2N5971	2N6472
2N5972	2N6472
2N5974	2N6489
2N5975	2N6490
2N5976	2N6491
2N5977	2N6486
2N5978	2N6487
2N5979	2N6488
2N5980	2N6489
2N5981	2N6490
2N5982	2N6491
2N5983	2N6486
2N5984	2N6487
2N5985	2N6488
2N5986	2N6489
2N5987	2N6490
2N5988	2N6491
2N5989	2N6486
2N5990	2N6487
2N5991	2N6488
2N6029	RCA9116E
2N6030	RCA9116D
2N6031	2N6609
2N6043	2N6043
2N6044	2N6044
2N6045	2N6045
2N6050	2N6050
2N6051	2N6051
2N6052	2N6052
2N6054	2N6650
2N6055	2N6055
2N6056	2N6056
2N6057	2N6057
2N6058	2N6058
2N6059	2N6059
2N6077	2N6077
2N6078	2N6078
2N6079	2N6079
2N6107	2N6107
2N6109	2N6109
2N6111	2N6111
2N6121	2N6121
2N6122	2N6122
2N6123	2N6123
2N6124	2N6124
2N6125	2N6125
2N6126	2N6126
2N6129	2N6129
2N6130	2N6130
2N6131	2N6131
2N6132	2N6132
2N6133	2N6133
2N6134	2N6134
2N6211	2N6211
2N6212	2N6212
2N6213	2N6213

Industry Type	RCA Replacement Type
2N6226	2N6248
2N6229	RCA9116E
2N6230	RCA9116D
2N6231	MJ15004
2N6233	2N3583
2N6234	2N3584
2N6235	2N3585
2N6246	2N6246
2N6247	2N6247
2N6248	2N6248
2N6249	2N6249
2N6250	2N6250
2N6251	2N6251
2N6253	2N6253
2N6257	2N3771
2N6262	2N6262
2N6270	2N5671
2N6271	2N5672
2N6282	2N6282
2N6283	2N6283
2N6284	2N6284
2N6285	2N6285
2N6286	2N6286
2N6287	2N6287
2N6288	2N6288
2N6290	2N6290
2N6292	2N6292
2N6302	RCA3773
2N6306	2N6306
2N6307	2N6307
2N6308	2N6308
2N6312	2N6312
2N6313	2N6313
2N6314	2N6314
2N6326	2N6326
2N6327	2N6327
2N6338	2N5672
2N6339	2N5672
2N6359	2N4348
2N6360	2N4348
2N6371	2N6371
2N6383	2N6383
2N6384	2N6384
2N6385	2N6385
2N6386	2N6386
2N6387	2N6387
2N6388	2N6388
2N6420	2N6420
2N6421	2N6421
2N6422	2N6422
2N6423	2N6423
2N6424	2N6211
2N6425	2N6212
2N6461	2N3439
2N6486	2N6486
2N6487	2N6487
2N6488	2N6488
2N6489	2N6489
2N6490	2N6490
2N6491	2N6491
2N6542	2N6542
2N6543	2N6673
2N6544	2N6544
2N6545	2N6545
2N6546	2N6546

Power Transistors

Industry Type	RCA Replacement Type
2N6569	2N6569
2N6576	2N6576
2N6577	2N6577
2N6578	2N6578
2N6579	2N6675
2N6580	2N6675
2N6581	2N6675
2N6582	2N6677
2N6583	2N6678
2N6594	2N6594
2N6648	2N6648
2N6649	2N6649
2N6650	2N6650
2N6666	2N6666
2N6667	2N6667
2N6668	2N6668
2N6671	2N6671
2N6672	2N6672
2N6673	2N6673
2N6674	2N6674
2N6675	2N6675
2N6676	2N6676
2N6677	2N6677
2N6678	2N6678
2N6686	2N6686
2N6687	2N6687
2N6688	2N6688
2N6702	2N6702
2N6703	2N6703
2N6704	2N6704
2N6738	2N6738
2N6739	2N6739
2N6740	2N6740
2N6751	2N6751
2N6752	2N6752
2N6753	2N6753
2N6754	2N6754
2SA489	2N6107
2SA490	2N6109
2SA503	2N4314
2SA512	2N4314
2SA560	2N4314
2SA597	2N4037
2SA814	2N6476
2SA815	2N6475
2SB502A	2N5954
2SB503A	2N5955
2SB530	2N6248
2SB531	2N6247
2SB558	2N6248
2SB595	2N6475
2SB596	2N6107
2SC481	2N2102
2SC482	2N1613
2SC485	2N1893
2SC512	2N2102
2SC558	BUX17A
2SC560	2N2405
2SC779	2N3584
2SC782	2N3585
2SC782A	2N3585
2SC783	2N3583
2SC789	2N6292
2SC790	2N6290
2SC792	BUX16B

Industry Type	RCA Replacement Type
2SC1173	2N6288
2SC1195	BUX16
2SC1576	BUX16
2SD102	2N6261
2SD129	2N6372
2SD130	2N3054
2SD234	RCA3054
2SD235	RCA3054
2SD369	2N3055
2SD371	2N6254
2SD404C	2N6288
2SD424	2N6262
2SD425	2N3442
2SD427	2N4347
2SD428	2N4348
2SD523	2N6384
2SD524	2N6385
2SD526	2N6292
2SD552	BUX17A
73T2	40392
100T2	2N4347
104T2	2N6253
108T2	2N5039
109T2	2N6354
182T2A	BUX16
182T2B	BUX16
182T2C	BUX16
183T2A	BUX16
183T2B	BUX16
183T2C	BUX16
184T2A	BUX16
184T2B	BUX16
184T2C	BUX16
185T2A	BUX16A
185T2B	BUX16A
185T2C	BUX16A
40250	40250
40251	40251
40594	RCA1A03
40595	RCA1A04
40833	S2600M
40871	RCA1C03
40872	RCA1C04
40980	RCA1C11
BC119	2N697
BC120	2N697
BC139	40406
BC140	2N5321
BC141	2N5320
BC142	40408
BC143	RCA1A04
BC144	RCA1A03
BC160	2N5323
BC161	2N5322
BC185	2N3053
BC286	2N2102
BC287	2N4036
BC300	2N1893
BC301	2N2102
BC302	2N2270
BC303	2N4314
BC310	2N1893
BC311	2N4314
BC323	2N5320
BC324	2N5320

Industry Type	RCA Replacement Type
BC340	2N3053
BC341	2N3053A
BC342	2N2102
BC343	2N4036
BC344	2N2405
BC345	2N4036
BC360	40319
BC361	2N4036
BC441	2N5320
BC460	2N5323
BC461	2N5322
BCW44	40408
BCW45	40362
BCW79-16	2N4037
BCW80-16	2N4037
BCY40	2N4037
BCY54	2N4036
BD65	BDX83A
BD65A	BDX83B
BD115	BF258
BD116	2N3055
BD141	2N4347
BD144	BUX18C
BD148	BDY71
BD149	BDY71
BD160	2N6510
BD162	40250
BD163	2N6260
BD166	BD240
BD167	BD239A
BD168	BD240A
BD169	BD239B
BD170	BD240B
BD175	BD239
BD176	BD240
BD177	BD239A
BD178	BD240A
BD179	BD239B
BD180	BD240B
BD185	BD239
BD186	BD240
BD187	BD239
BD188	BD240
BD189	BD239A
BD190	BD240A
BD191	2N3054
BD192	2N6260
BD195	BD243
BD196	BD244
BD197	BD243A
BD198	BD244A
BD199	BD243B
BD200	BD244B
BD201	BD243
BD202	BD244
BD203	BD243A
BD204	BD244A
BD205	2N6486
BD206	2N6489
BD207	2N6487
BD208	2N6490
BD213-45	2N6486
BD213-60	2N6487
BD213-80	2N6488
BD214-45	2N6489

Power Transistors

Industry Type	RCA Replacement Type
BD214-60	2N6490
BD214-80	2N6491
BD215	2N3584
BD216	2N3585
BD244A	BD244A
BD244B	BD244B
BD244C	BD244C
BD245	2N6486
BD245A	2N6487
BD245B	2N6488
BD246	2N6489
BD246A	2N6490
BD246B	2N6491
BD253	BUX31
BD253A	BUX31
BD253B	BUX31
BD253C	BUX31A
BD260	2N3584
BD261	2N3584
BD264	2N6667
BD264A	2N6668
BD264B	BDX34C
BD265	2N6387
BD265A	2N6388
BD265B	BDX33C
BD266	BDX34A
BD266A	BDX34C
BD266A	BDX34B
BD267	BDX33A
BD267A	BDX33B
BD267B	BDX33C
BD268	BDX34A
BD268A	BDX34B
BD269	BDX33A
BD269A	BDX33B
BD271	BD241
BD272	BD242
BD273	BD241A
BD274	BD242A
BD275	BD241B
BD276	BD242B
BD301	BD243
BD302	BD244
BD303	BD243A
BD304	BD244A
BD311	2N6471
BD312	2N6246
BD313	2N6472
BD314	2N6247
BD315	2N6472
BD316	2N6247
BD317	2N6472
BD318	2N6248
BD342	2N6569
BD343	2N6594
BD350A	BDX18
BD351A	2N3055
BD401	BUW64A
BD403	BUW64B
BD539	BD241
BD539A	BD241A
BD539B	BD241B
BD539C	BD241C
BD540	BD242
BD540A	BD242A
BD540B	BD242B
BD540C	BD242C
BD543	2N6486
BD543A	2N6487
BD543B	2N6488
BD544	2N6489
BD544A	2N6490
BD544B	2N6491
BD545	2N6486
BD545A	2N6487
BD545B	2N6488
BD546	2N6489
BD546A	2N6490
BD546B	2N6491
BD566	2N6667
BD566A	2N6668
BD567	2N6387
BD567A	2N6388
BD575	BD241
BD576	BD242
BD577	BD241A
BD578	BD242A
BD579	BD241B
BD580	BD242B
BD581	BD241C
BD582	BD242C
BD585	BD241
BD586	BD242
BD587	BD241A
BD588	BD242A
BD589	BD241B
BD590	BD242B
BD591	BD241C
BD592	BD242C
BD595	BD243
BD596	BD244
BD597	BD243A
BD598	BD244A
BD599	BD243B
BD600	BD244B
BD601	BD243C
BD602	BD244C
BD605	2N6486
BD606	2N6489
BD607	2N6487
BD608	2N6490
BD609	2N6488
BD610	2N6491
BD633	RCA1C10
BD634	RCA1C11
BD635	RCA1C03
BD636	RCA1C04
BD637	RCA1C03
BD638	RCA1C04
BD644	BDX34
BD646	BDX34A
BD648	BDX34B
BD661	2N6486
BD661K	BD243
BD662	2N6489
BD662K	BD244
BD663B	2N6486
BD664	2N6489
BD675	BDX33
BD676	BDX34
BD677	BDX33A
BD678	BDX34A
BD679	BDX33B
BD680	BDX34B
BD695A	BDX33
BD696A	BDX34
BD697	BDX33A
BD697A	BDX33A
BD698	BDX34A
BD698A	BDX34A
BD699	BDX33B
BD699A	BDX33B
BD700	BDX34B
BD700A	BDX34B
BD701	BDX33C
BD702	BDX34C
BD705	2N6486
BD706	2N6489
BD707	2N6487
BD708	2N6490
BD709	2N6488
BD710	2N6491
BD795	BD243
BD796	BD244
BD797	BD243A
BD798	BD244A
BD799	BD243B
BD800	BD244B
BD801	BD243C
BD802	BD244C
BD805	2N6486
BD806	2N6489
BD807	2N6487
BD808	2N6490
BD809	2N6488
BD810	2N6491
BD895	BD895
BD895A	BD895A
BD896	BD896
BD896A	BD896A
BD897	BD897
BD897A	BD897A
BD898	BD898
BD898A	BD898A
BD899	BD899
BD899A	BD899A
BD900	BD900
BD900A	BD900A
BD901	BD901
BD902	BD902
BD905	2N6486
BD906	2N6489
BD907	2N6487
BD908	2N6490
BD909	2N6488
BD910	2N6491
BD933	BD239
BD934	BD240
BD935	BD239A
BD936	BD240A
BD937	BD239B
BD938	BD240B
BD939	BD239C
BD940	BD240C
BD941	2N6474

Power Transistors

Industry Type	RCA Replacement Type
BD942	2N6476
BD943	2N6288
BD944	2N6111
BD945	2N6288
BD946	2N6111
BD947	2N6290
BD948	2N6109
BD949	BD241A
BD950	BD242A
BD951	BD241B
BD952	BD242B
BD953	BD241C
BD954	BD242C
BD955	2N6474
BD956	2N6476
BDT62	BDX34A
BDT62A	BDX34B
BDT62B	BDX34C
BDT63	BDX33A
BDT63A	BDX33B
BDT63B	BDX33C
BDT63C	BDX33D
BDT91	2N6487
BDT92	2N6490
BDT93	2N6488
BDT94	2N6491
BDW21	2N6569
BDW21A	2N3055
BDW22	2N6469
BDW22A	2N6246
BDW22B	2N6247
BDW22C	2N6248
BDW23	BDX33
BDW23A	BDX33A
BDW23B	BDX33B
BDW23C	BDX33C
BDW25-4	2N6466
BDW25-6	2N6466
BDW25-10	2N6466
BDW51	2N6470
BDW51A	2N6471
BDW51B	2N6472
BDW52	2N6469
BDW52A	2N6264
BDW52B	2N6247
BDW52C	2N6248
BDW73	BDX33
BDW74	BDX34
BDW93	BDX33
BDW93A	BDX33A
BDW93B	BDX33B
BDW93C	BDX33C
BDW94	BDX34
BDW94A	BDX34A
BDW94B	BDX34B
BDW94C	BDX34C
BDX14	2N5954
BDX16	BUX66
BDX27	2N3879
BDX28	2N3879
BDX30	2N6500
BDX51B	2N6472
BDX54	BDX34
BDX54A	BDX34A
BDX54B	BDX34B

Industry Type	RCA Replacement Type
BDX54C	BDX34C
BDX60	2N6254
BDX61	2N3055
BDX62	2N6649
BDX62A	2N6650
BDX63	2N6384
BDX63A	2N6385
BDX64	BDX84A
BDX64A	BDX84B
BDX64B	BDX84C
BDX65B	BDX83C
BDX66	2N6285
BDX66A	2N6286
BDX66B	2N6287
BDX67	2N6282
BDX67A	2N6283
BDX67B	2N6284
BDX77	BD243B
BDX78	BD244B
BDX85	2N6383
BDX85B	2N6056
BDX87	BDX83
BDX87A	BDX83A
BDX87B	BDX83B
BDX87C	BDX83C
BDX91	2N4914
BDX92	2N4905
BDX93	2N4915
BDX94	2N4906
BDY10	2N6253
BDY11	2N3055
BDY12	BUX16
BDY13	BUX16
BDY15	BUX16
BDY17	BUX16
BDY20	BUX16
BDY23	2N4914
BDY24	2N4915
BDY25A	BUX16
BDY25B	BUX16
BDY25C	BUX16
BDY26A	BUX16
BDY26B	BUX16
BDY26C	BUX16
BDY27A	BUX16
BDY27B	BUX16
BDY27C	BUX16
BDY28A	BUX16A
BDY28B	BUX16A
BDY28C	BUX16A
BDY34	BD241
BDY38	2N6253
BDY39	2N3055
BDY42	BUX18A
BDY43	BUX18B
BDY44	BUX18C
BDY45	BUX17A
BDY46	BUX27B
BDY55	BDY55
BDY55	2N5039
BDY56	2N5038
BDY57	BDY57A
BDY58	BDY58R
BDY73	2N3055
BDY74	2N4347

Industry Type	RCA Replacement Type
BDY76	2N3772
BDY77	2N3773
BDY78	2N6373
BDY79	2N3583
BDY80A	2N5296
BDY81A	2N5298
BDY82A	2N6111
BDY83A	2N6109
BDY91	2N5038
BDY92	2N5039
BDY93	BU126
BDY94	BU126
BDY95	BU126
BDY96	2N6513
BDY97	2N6512
BDY98	2N6511
BDY99	2N6511
BF111	2N3440
BF137	BF257
BF157	BF257
BF174	BF257
BF178	40412
BF179	BF257
BF179A	BF257
BF179B	BF258
BF179C	BF258
BF305	BF257
BF322	40317
BF323	40319
BF336	BF258
BF337	BP258
BF338	BF258
BF355	2N3440
BF390	BF259
BFR19	2N1613
BFR21	2N1893
BFR22	2N2102
BFR23	2N4036
BFR24	2N4037
BFR56	2N5321
BFR57	BF257
BFR58	BF258
BFR59	BF259
BFR77	2N1893
BFR78	2N2405
BFS91A	2N4036
BFS92	2N4036
BFS93	2N4314
BFS94	2N4037
BFS95	2N4037
BFT32	2N2405
BFT33	40409
BFT34	2N2405
BFT35	2N4314
BFT36	40410
BFT39	40409
BFT44	BF259
BFT45	BF258
BFT60	2N4037
BFT61	2N4037
BFW24	2N2102
BFW26	2N697
BFW33	2N1893
BFW44	BFT19
BFW45	BF257

Power Transistors

Industry Type	RCA Replacement Type
BFX17	2N3053
BFX29	2N4036
BFX30	2N4036
BFX39	2N4036
BFX69	2N697
BFX69A	2N1613
BFX74	2N4037
BFX74A	2N4314
BFX85	2N2405
BFX87	2N4036
BFX88	2N4037
BFX91	BFT28B
BFX98	BF257
BFY17	40317
BFY33	2N697
BFY34	2N697
BFY43	BF257
BFY44	2N2102
BFY45	40408
BFY50	2N697
BFY51	2N697
BFY52	2N3053
BFY55	2N697
BFY56	2N2102
BFY57	BF257
BFY67	2N3053
BFY67A	2N1613
BFY70	2N3053
BFY94	2N3053
BSS15	2N5320
BSS16	2N5321
BSS17	2N5322
BSS18	2N5323
BSS30	2N2102
BSS32	2N2405
BSS45	2N5320
BSS46	2N5322
BSS48	2N3440
BSS49	2N3439
BSV15	2N4037
BSV15-6	2N4037
BSV15-10	2N4037
BSV16	2N4314
BSV16-6	2N4314
BSV17	2N5322
BSV69	2N5321
BSV77	2N5321
BSV84	2N1893
BSW23	2N4037
BSW39	2N1893
BSX22	2N5321
BSX23	2N5320
BSX40	2N4037
BSX45	2N3053
BSX46	2N2102
BSX47	2N1893
BSX59	2N5321
BSX60	2N5321
BSX61	2N5321
BSX72	2N3053
BSX95	2N1613
BSY25	2N697
BSY44	2N2102
BSY45	2N1893
BSY46	2N2102

Industry Type	RCA Replacement Type
BSY53	2N697
BSY55	2N1893
BSY68	2N2405
BSY81	2N697
BSY83	2N697
BSY85	2N1893
BSY87	2N2102
BSY91	2N697
BU102	BUX18B
BU104	2N6671
BU104DP	2N6738
BU109	2N6671
BU109DP	2N6738
BU111	2N6512
BU112	2N6672
BU114	2N6510
BU116	2N6671
BU121	BUX18
BU129	BUX18C
BU134	2N6672
BU135	2N6510
BU136	2N6510
BU137	2N6754
BU218	2N5039
BU222	2N6513
BU222A	2N6513
BU311	BUX17
BU312	BUX17
BU322	RCA8766E
BU323	RCA8766D
BU323A	RCA8766D
BU332A	RCA8766E
BU406	2N6738
BU406H	2N6738
BU407	2N6738
BU408	2N6738
BU409	2N6738
BU606	2N6671
BU607	2N6671
BU608	2N6671
BUS11	BUX31A
BUS11A	BUX31B
BUS12	BUX32A
BUS12A	BUX32B
BUV10	2N5672
BUV11N	2N6686
BUV23	2N6677
BUV24	2N6678
BUW24	2N6542
BUW34	BUX32
BUW35	BUX32
BUW36	BUX32A
BUW44	2N6678
BUW57	2N5672
BUW58	2N6686
BUW66	RCA8766B
BUW67	RCA8766
BUW73	2N6676
BUW74	2N6674
BUW75	2N6674
BUW76	BUX32
BUW77	BUX32
BUX10	BUX10A
BUX11	BUX11
BUX12	BUX12

Industry Type	RCA Replacement Type
BUX13	BUX13
BUX14	BUX14
BUX15	BUX15
BUX20	BUX20A
BUX26	2N6510
BUX27	BUX18C
BUX28	RCA8766A
BUX39	BUX39
BUX40	BUX40A
BUX42	BUX42
BUX43	BUX43
BUX44	BUX44
BUX46	BUX31A
BUX47A	BUX32A
BUX48A	2N6752
BUX63	2N6079
BUX80	BUX32
BUX81	BUX32B
BUX82	BUX31
BUX83	BUX31B
BUX97	BUX31
BUX97A	BUX31
BUX97B	BUX31A
BUX407H	2N6738
BUY18S	2N6671
BUY20	2N6671
BUY21	2N6671
BUY21A	2N6671
BUY22	2N6673
BUY23	2N6673
BUY23A	2N6673
BUY35	2N6511
BUY43	BDY71
BUY46	2N3053
BUY51A	2N5039
BUY52A	2N5671
BUY53A	2N5038
BUY54A	2N5672
BUY55	2N5239
BUY56	2N5239
BUY66	BU126
BUY67	BU126
BUY69A	BUX31B
BUY69B	BUX31
BUY69C	BUX31
BUY70A	BUX31B
BUY70B	BUX31
BUY70C	BUX31
BUY72	2N5239
BUY74	BUX18A
BUY75	BUX18C
BUY76	BU126
BUY77	BUX18A
BUY78	BUX18C
BUY79	BU126
BUY94	BUX31
BUY95	BUX31
BUY96	BUX31
D42C1	2N6288
D42C2	2N6288
D42C3	2N6288
D42C4	2N6290
D42C5	2N6290
D42C6	2N6290
D42C7	2N6292

Power Transistors

Industry Type	RCA Replacement Type
D42C8	2N6292
D42C9	2N6292
D42C10	2N6292
D42C11	2N6292
D42C12	2N6292
D43C1	2N6111
D43C2	2N6111
D43C3	2N6111
D43C4	2N6109
D43C5	2N6109
D43C6	2N6109
D43C7	2N6107
D43C8	2N6107
D43C9	2N6107
D43C10	2N6107
D43C11	2N6107
D43C12	2N6107
D44C1	2N6288
D44C2	2N6288
D44C3	2N6288
D44C4	2N6290
D44C5	2N6290
D44C6	2N6290
D44C7	2N6292
D44C8	2N6292
D44C9	2N6292
D44C10	2N6292
D44C11	2N6292
D44C12	BD239B
D44E1	2N6386
D44E2	2N6387
D44H1	2N6288
D44H2	2N6288
D44H4	2N6290
D44H5	2N6290
D44H7	2N6292
D44H8	2N6292
D44H10	2N6292
D44H11	2N6292
D44TD3	2N6671
D44TD4	2N6772
D44TD5	2N6773
D44TE3	2N6738
D44TE4	2N6739
D44TE5	2N6740
D45C1	2N6111
D45C2	2N6111
D45C3	2N6111
D45C4	2N6109
D45C5	2N6109
D45C6	2N6109
D45C7	2N6107
D45C8	2N6107
D45C9	2N6107
D45C10	2N6107
D45C11	2N6107
D45C12	BD240B
D45E1	2N6666
D45E2	2N6667
D45E3	2N6668
D45H1	2N6111
D45H2	2N6111
D45H4	2N6109
D45H5	2N6109
D45H7	2N6107

Industry Type	RCA Replacement Type
D45H8	2N6107
D45H10	2N6107
D45H11	2N6107
D64VE3	2N6671
D64VE4	2N6672
D64VE5	2N6673
D64VP3	2N6674
D64VP4	2N6675
D64VP5	2N6675
D64VS3	2N6674
D64VS4	2N6675
DTS410	RCA410
DTS411	RCA411
DTS413	RCA413
DTS423	RCA423
DTS431	RCA431
ESM16	2N6671
ESM16A	2N6672
ESM16B	2N6673
ESM113	2N6384
ESM114	2N6385
ESM159	2N6649
ESM160	2N6650
ESM191	2N6673
ESM213	2N6687
ESM214	2N6388
ESM217	2N6387
ESM218	2N6388
ESM259	2N6667
ESM260	2N6668
ESM261	2N6667
ESM262	2N6668
FT411	RCA411
FT413	RCA413
FT423	RCA423
FT431	RCA431
GSRU15030	2N6774
GSRU15035	2N6775
GSRU15050	2N6776
GSTU4030	2N6671
GSTU4035	2N6672
GSTU4040	2N6673
GSTU6030	2N6674
GSTU6035	2N6675
GSTU6040	2N6675
GSTU8030	2N6674
GSTU8035	2N6675
GSTU10030	2N6674
GSTU10035	2N6675
GSTU10040	2N6675
GSTU18040	2N6675
MJ400	2N3585
MJ410	RCA410
MJ411	RCA411
MJ413	RCA413
MJ423	RCA423
MJ424	BUX16C
MJ425	BUX18C
MJ431	RCA431
MJ450	2N6246
MJ480	2N6470
MJ481	2N6471
MJ490	2N6246
MJ491	2N6246
MJ802	RCS258

Industry Type	RCA Replacement Type
MJ900	2N6649
MJ901	2N6650
MJ920	2N6649
MJ931	2N6650
MJ1000	RCA1000
MJ1001	RCA1001
MJ1200	2N6384
MJ1201	2N6385
MJ1800	2N5838
MJ2249	2N3879
MJ2250	2N3879
MJ2251	2N3584
MJ2252	2N3585
MJ2253	2N5955
MJ2254	2N5954
MJ2267	2N6246
MJ2268	2N6246
MJ2500	2N6050
MJ2501	2N6051
MJ2801	2N6371
MJ2840	2N3055
MJ2841	2N6254
MJ2901	2N6246
MJ2940	2N6246
MJ2941	2N6247
MJ2955	MJ2955
MJ3000	2N6057
MJ3010	BUX16B
MJ3010	2N6058
MJ3011	BUX16B
MJ3026	2N5839
MJ3027	2N5840
MJ3028	2N5840
MJ3029	BUX16A
MJ3030	BUX16C
MJ3101	2N3878
MJ3201	BUX67A
MJ3202	2N3585
MJ3430	2N5840
MJ3583	2N6211
MJ3584	2N6212
MJ3701	2N5956
MJ3760	BU126
MJ3761	BU126
MJ3771	2N3771
MJ3772	2N3772
MJ3773	2N3773
MJ3885	2N6212
MJ4000	2N6384
MJ4001	2N6385
MJ4010	2N6649
MJ4011	2N6650
MJ4030	2N6285
MJ4031	2N6286
MJ4032	2N6287
MJ4033	2N6282
MJ4034	2N6283
MJ4035	2N6284
MJ4240	2N6212
MJ4502	RCA9116E
MJ5415	2N5415
MJ5416	2N5416
MJ5600	2N3772
MJ5601	RCS258
MJ5602	2N3773

Power Transistors

Industry Type	RCA Replacement Type
MJ5603	2N3773
MJ6000	2N3772
MJ6002	2N3773
MJ6302	2N3773
MJ11028	RCA9228A
MJ11029	RCA9229A
MJ11030	RCA9228C
MJ11031	RCA9229C
MJ11032	RCA9228C
MJ11033	RCA9229C
MJ13014	2N6751
MJ13015	2N6751
MJ13070	2N6673
MJ13080	2N6673
MJ13090	2N6675
MJ15001	MJ15001
MJ15002	MJ15002
MJ15003	MJ15003
MJ15004	MJ15004
MJ16002	2N6752
MJ16004	2N6752
MJ16006	2N6752
MJ16008	2N6752
MJ16010	2N6675
MJ16012	2N6675
MJE13002	2N6771
MJE13003	2N6773
MJE13004	2N6740
MJE13005	2N6740
MJE13006	2N6740
MJE13007	2N6740
MJE15028	2N6704
MM3005	2N2405
MM4000	BFT28
MM4001	BFT28A
MM4002	BFT28B
MM4003	BFT28C
MM5005	2N4036
PMD10K60	2N6057
PMD10K100	2N6059
PMD11K60	2N6050
PMD11K80	2N6051
PMD11K100	2N6051
PMD12K40	2N6383
PMD12K60	2N6384
PMD12K80	2N6385
PMD13K40	2N6648
PMD13K60	2N6649
PMD13K80	2N6650
PMD1601K	2N6282
PMD1602K	2N6283
PMD1603K	2N6284
PMD1701K	2N6285
PMD1702K	2N6286
PMD1703K	2N6287
SDT410	RCA410
SDT411	RCA411
SDT413	RCA413
SDT423	RCA423
SDT431	RCA431
SDT1405	2N6675
SDT6901	2N6078
SDT6902	2N6078
SDT6903	2N6078
SDT6904	2N6078

Industry Type	RCA Replacement Type
SDT6905	2N6078
SDT6906	2N6078
SDT6907	2N6078
SDT6908	2N6078
SDT7601	2N5039
SDT7602	2N5039
SDT7603	2N5038
SDT7604	2N6496
SDT7605	2N6249
SDT7607	2N5039
SDT7608	2N5039
SDT7609	2N5038
SDT7610	2N6354
SDT7731	2N6470
SDT7732	2N6471
SDT7733	2N6472
SDT9201	2N3055
SDT9202	2N6254
SDT9203	2N4348
SDT9204	2N4348
SDT9205	2N3055
SDT9206	2N3055
SDT9207	2N6254
SDT9208	2N4348
SDT9209	2N4348
SDT9210	2N6253
SDT9702	2N4348
SDT9703	2N4348
SDT9704	2N6254
SDT9705	2N4348
SDT9706	2N4348
SDT9707	2N3055
SDT9801	2N6254
SDT9802	2N6254
SDT9803	2N6254
SDT9804	2N3773
SDT12303	2N6674
SDT13301	2N6675
SDT13302	2N6675
SDT13303	2N6675
SDT14304	2N6674
SDT40304	2N6671
SDT40305	2N6672
SE9300	TIP120
SE9301	TIP121
SE9302	TIP122
SE9303	2N6384
SE9304	2N6385
SPC410	RCA410
SPC411	RCA411
SPC413	RCA413
SPC423	RCA423
SPC431	RCA431
STA9000	2N6671
STA9001	2N6672
STA9002	2N6674
STA9003	2N6675
STA9004	2N6676
STA9005	2N6678
STS410	RCA410
STS411	RCA411
STS413	RCA413
STS423	RCA423
STS431	RCA431
SVT7510	2N6673

Industry Type	RCA Replacement Type
SVT7511	2N6671
SVT7512	2N6671
SVT7513	2N6672
SVT7514	2N6673
SVT7515	2N6674
SVT7516	2N6674
SVT7517	2N6675
SVT7518	2N6675
SVT7519	2N6752
SVT7520	2N6752
SVT7521	2N6751
SVT7522	2N6752
SVT7523	2N6672
SVT7524	2N6673
SVT7525	2N6752
SVT7530	2N6751
SVT7531	2N6751
SVT7532	2N6752
SVT7533	2N6672
SVT7534	2N6673
SVT7535	2N6752
SVT7553	2N6677
SVT7554	2N6678
SVT7563	2N6677
SVT7564	2N6678
SVT7573	2N6677
SVT7574	2N6678
T1484	2N697
T1492	40407
T2493	2N1613
TIP29	TIP29
TIP29A	TIP29A
TIP29B	TIP29B
TIP29C	TIP29C
TIP30	TIP30
TIP30A	TIP30A
TIP30B	TIP30B
TIP30C	TIP30C
TIP31	TIP31
TIP31A	TIP31A
TIP31B	TIP31B
TIP31C	TIP31C
TIP32	TIP32
TIP32A	TIP32A
TIP32C	TIP32C
TIP41	TIP41
TIP41A	TIP41A
TIP41B	TIP41B
TIP41C	TIP41C
TIP42	TIP42
TIP42A	TIP42A
TIP42B	TIP32B
TIP42C	TIP42C
TIP47	TIP47
TIP48	TIP48
TIP49	TIP49
TIP50	TIP50
TIP75	2N6738
TIP75A	2N6738
TIP75B	2N6738
TIP75C	2N6740
TIP100	TIP100
TIP111	TIP111
TIP112	TIP112
TIP115	TIP115

Power Transistors

Industry Type	RCA Replacement Type
TIP116	TIP116
TIP117	TIP117
TIP120	TIP120
TIP121	TIP121
TIP122	TIP122
TIP125	TIP125
TIP127	TIP127
TIP130	BDX33A
TIP131	BDX33B
TIP132	BDX33C
TIP135	BDX34A
TIP136	BDX34B
TIP137	BDX34C
TIP140	2N6387
TIP141	2N6530
TIP142	2N6531
TIP145	2N6666
TIP146	2N6667
TIP525	2N6668
TIP527	2N6674

Industry Type	RCA Replacement Type
TIP531	2N6250
TIP532	2N6675
TIP535	BUX17A
TIP536	2N6674
TIP537	2N6675
TIP538	2N6250
TIP539	2N6250
TIP544	2N6248
TIP546	2N6469
TIP554	2N6671
TIP555	2N6672
TIP556	2N6683
TIP562	TIP562
TIP563	TIP563
TIP620	2N6383
TIP621	2N6384
TIP622	2N6385
TIP640	2N6384
TIP641	2N6385
TIP642	2N6385

Industry Type	RCA Replacement Type
TIP645	2N6666
TIP646	2N6667
TIP3054	RCA3054
TS2218	2N1613
TS2904	40406
UMT1006	2N6672
UMT1007	2N6673
UMT1009	2N6675
UMT1011	2N6675
UMT1012	2N6675
UMT1203	2N6738
UMT1204	2N6740
UMT2008	2N6674
UMT3584	2N6771
UMT3585	2N6771
UMT13004	2N6738
UMT13006	2N6738
UMT13007	2N6740
UMT23005	2N6740

Triacs

Industry Type	RCA Replacement Type
2N6139	2N5569
2N6140	2N5570
2N6141	T4111M
2N6142	2N5569
2N6143	2N5570
2N6144	T4111M
2N6145	T4120B
2N6146	T4120D
2N6147	T4120M
2N6151	T2800B
2N6152	T2800D
2N6153	T2800M
2N6154	T2802B
2N6155	T2802D
2N6156	T2802M
2N6157	T6401B
2N6158	T6401D
2N6159	T6401M
2N6160	T6411B
2N6161	T6411D
2N6162	T6411M
2N6163	T6421B
2N6164	T6421D
2N6165	T6421M
2N6342	2N6342A
2N6343	2N6343A
2N6344	2N6344A
2N6346	2N6346A
2N6347	2N6347A
2N6348	2N6348A
6T06	T2700B
6T08	T4700B
6T16	T2700B
6T18	T4700B
6T26	T2700B
6T28	T4700B
6T36	T2700D
6T38	T4700D
6T46	T2700D
6T48	T4700D
40525	T2300A
40526	T2300B
40527	T2300D
40528	T2302A
40529	T2302B
40530	T2302D
40575	T4700B
40576	T4700D
40660	T6401B
40661	T6401D
40662	T6411B
40663	T6411D
40668	T2800B
40669	T2800D
40670	T2800M
40671	T6401M
40672	T6411M
40688	T6420B
40689	T6420D
40690	T6420M
40691	T2301B
40692	T2301D
40715	T4706B
40716	T4706D
40722	T2806D
40727	T2706B
40728	T2706D
40766	T2301A
40795	T4101M
40796	T4111M
40797	T4100M
40798	T4110M
40799	T4121B
40800	T4121D
40801	T4121M
40802	T4120B
40803	T4120D
40804	T4120M
40805	T6421B
40806	T6421D
40807	T6421M
40900	T2850A
40901	T2850B
40902	T2850D
41014	T2500B
41015	T2500D
BRT0340	T2700D
BRT0405	T4700B
BRY41-100	2N5754
BRY41-200	2N5755
BRY41-300	2N5756
BRY41-400	2N5757
BRY41-500	2N5757
BRY45-100	2N5754
BRY45-200	2N5755
BRY45-300	2N5756
BRY45-400	2N5757
BRY45-500	2N5757
BT137-500	T2800E
BT137-600	T2800M
BT138-500	2N6348A
BT138-600	2N6348A
BT139-500	MAC15A8
BT139-600	MAC15A8
BTR0205	T2700B
BTR0210	T2700B
BTR0220	T2700B
BTR0230	T2700D
BTR0240	T2700D
BTR0305	T2700B
BTR0310	T2700B
BTR0320	T2700B
BTR0330	T2700D
BTR0410	T4700B
BTR0420	T4700B
BTR0430	T4700D
BTR0440	T4700D
BTS0305	2N5567
BTS0310	2N5567
BTS0320	2N5567
BTS0330	2N5568
BTS0340	2N5568
BTS0350	T4101M
BTS0360	T4101M
BTS0405	2N5567
BTS0410	2N5567
BTS0420	2N5567
BTS0430	2N5568
BTS0440	2N5568
BTS0450	T4101M
BTS0460	T4101M
BTS0505	2N5571
BTS0510	2N5571
BTS0520	2N5571
BTS0530	2N5572
BTS0540	2N5572
BTS0550	T4100M
BTS0560	T4100M
BTS0605	2N5441
BTS0610	2N5441
BTS0620	2N5441
BTS0630	2N5442
BTS0640	2N5442
BTS0650	2N5443
BTS0660	2N5443
BTU0305	2N5569
BTU0310	2N5569
BTU0320	2N5569
BTU0330	2N5570
BTU0340	2N5570
BTU0350	T4111M
BTU0360	T4111M
BTU0405	2N5569
BTU0410	2N5569
BTU0420	2N5569
BTU0430	2N5570
BTU0440	2N5570
BTU0450	T4111M
BTU0460	T4111M
BTU0505	2N5573
BTU0510	2N5573
BTU0520	2N5573
BTU0530	2N5574
BTU0540	2N5574
BTU0550	T4110M
BTU0560	T4110M
BTU0605	T6411B
BTU0610	T6411B
BTU0620	T6411B
BTU0630	T6411D
BTU0640	T6411D
BTU0650	T6411M
BTU0660	T6411M
BTV0405	T4121B
BTV0410	T4121B
BTV0420	T4121B
BTV0430	T4121D
BTV0440	T4121D
BTV0450	T4121M
BTV0460	T4121M
BTW10-100	T2700B
BTW10-200	T2700B
BTW10-300	T2700D
BTW10-400	T2700D
BTW11-100	T2700B
BTW11-200	T2700B
BTW11-300	T2700D
BTW11-400	T2700D
BTW12-100	2N5567
BTW12-200	2N5567
BTW12-300	2N5568
BTW12-400	2N5568
BTW12-500	T4101M
BTW13-100	2N5569
BTW13-200	2N5569

Triacs

Industry Type	RCA Replacement Type
BTW13-300	2N5570
BTW13-400	2N5570
BTW13-500	T4111M
BTW14-100	T4700B
BTW14-200	T4700B
BTW14-300	T4700D
BTW14-400	T4700D
BTW15-100	2N5567
BTW15-200	2N5567
BTW15-300	2N5568
BTW15-400	2N5568
BTW15-500	T4101M
BTW16-100	2N5569
BTW16-200	2N5569
BTW16-300	2N5570
BTW16-400	2N5570
BTW16-500	T4111M
BTW18-100	2N5571
BTW18-200	2N5571
BTW18-300	2N5572
BTW18-400	2N5572
BTW18-500	T4101M
BTW19-100	2N5571
BTW19-200	2N5571
BTW19-300	2N5572
BTW19-400	2N5572
BTW19-500	T4101M
BTW20-100	T6411B
BTW20-200	T6411B
BTW20-300	T6411D
BTW20-400	T6411D
BTW20-500	T6411M
BTX94-400	T6411D
BTX94-500	T6411M
BTX94-600	T6411M
BTX0505	T4120B
BTX0510	T4120B
BTX0520	T4120B
BTX0530	T4120D
BTX0540	T4120D
BTX0550	T4120M
BTX0560	T4120M
BTX0600	T6421M
BTX0605	T6421B
BTX0610	T6421B
BTX0620	T6421B
BTX0630	T6421D
BTX0640	T6421D
BTX0650	T6421M
H103SC	T2301A
H103SD	T2301A
H103SG	T2302A
H103SH	T2303A
H103SS	T2300A
H113SC	T2301A
H113SD	T2301A
H113SG	T2302A
H113SH	2N5754
H113SS	T2300A
H123SD	T2301B
H123SH	2N5755
H123SS	T2300B
H124SC	T2301B
H133SC	T2301D
H133SD	T2301D
H133SG	T2302D
H133SH	2N5756
H133SS	T2300D
H143SC	T2301D
H143SD	T2301D
H143SG	T2302D
H143SH	2N5756
H143SS	2N5757
H153SH	2N5757
H163SH	2N5757
HB26	2N5755
HB46	2N5756
IT06	T2850A
IT08	T2850A
IT16	T2850A
IT18	T2850A
IT26	T2850B
IT28	T2850B
IT36	T2850D
IT38	T2850D
IT46	T2850D
IT48	T2850D
L2003M3	T2300B
L2003M5	T2301B
L2003M7	T2302B
L2003M9	2N5755
L4003M3	T2300D
L4003M5	T2301D
L4003M7	T2302D
L4003M9	2N5756
MAC40688	T6420B
MAC40689	T6420D
MAC40690	T6420M
MAC40797	T4100M
MAC40798	T4110M
MAC-5-1	2N5569
MAC-5-2	2N5569
MAC-5-3	2N5569
MAC-5-4	2N5569
MAC-5-5	2N5570
MAC-5-6	2N5570
MAC-5-7	T4111M
MAC-5-8	T4111M
MAC-15-4	MAC-15-4
MAC-15-6	MAC-15-6
MAC-15-8	MAC-15-8
MAC-15A-4	MAC-15A-4
MAC-15A-6	MAC-15A-6
MAC-15A-8	MAC-15A-8
MAC-35-1	T6401B
MAC-35-2	T6401B
MAC-35-3	T6401B
MAC-35-4	T6401B
MAC-35-6	T6401D
MAC-35-7	T6401M
MAC-36-1	T6411B
MAC-36-2	T6411B
MAC-36-3	T6411B
MAC-36-4	T6411B
MAC-36-5	T6411B
MAC-36-6	T6411D
MAC-36-7	T6411M
MAC-37-1	T6401B
MAC-37-2	T6401B
MAC-37-3	T6401B
MAC-37-4	T6401B
MAC-37-5	T6401D
MAC-37-6	T6401D
MAC-37-7	T6401M
MAC-38-1	T6411B
MAC-38-2	T6411B
MAC-38-3	T6411B
MAC-38-4	T6411B
MAC-38-5	T6411D
MAC-38-6	T6411D
MAC-38-7	T6411M
PS10	2N5567
PS15	2N5567
PS16	2N5567
PS635	2N3873
PT06	2N5567
PT08	2N5567
PT18	2N5567
PT025	T6401B
PT026	2N5567
PT028	2N5567
PT030	T6401B
PT036	2N5568
PT038	2N5568
PT040	2N5441
PT046	2N5568
PT048	2N5568
PT056	T4101M
PT058	T4101M
PT066	T4101M
PT068	T4101M
PT110	2N5567
PT115	2N5571
PT125	T6401B
PT130	T6401B
PT140	2N5441
PT210	2N5567
PT215	2N5571
PT225	T6401B
PT230	T6401B
PT240	2N5441
PT310	2N5568
PT315	2N5572
PT325	T6401D
PT330	T6401D
PT340	2N5442
PT410	2N5568
PT415	2N5572
PT425	T6401D
PT430	T6401D
PT440	2N5442
PT510	T4101M
PT515	T4100M
PT525	T6401M
PT530	T6401M
PT540	2N5443
PT610	T4101M
PT615	T4100M
PT625	T6401M
PT630	T6401M
Q2001MS2	T2302B
Q2006L4	T2850B
Q2008	T4121B
Q2010	T4121B
Q2015	T4120B

Triacs

Industry Type	RCA Replacement Type	Industry Type	RCA Replacement Type	Industry Type	RCA Replacement Type
Q2025	T6421B	SC51B	2N5571	SC241D	2N5568
Q2040	T6420B	SC51D	2N5572	SC241E12	T4101M
Q4003LA	T2850D	SC51E	T4100M	SC241E13	T4101M
Q4004LA	T2850D	SC51F	2N5571	SC241E	T4101M
Q4006	T4121D	SC60B2	T6421B	SC245B2	T4121B
Q4006L4	T2850D	SC60B12	T6411B	SC245B12	2N5569
Q4008	T4121D	SC60B13	T6411B	SC245B13	2N5569
Q4010	T4121D	SC60B22	T6421B	SC245B22	T4121B
Q4015	T4120D	SC60B23	T6421B	SC245B23	T4121B
Q4025	T6421D	SC60B	T6411B	SC245B	2N5569
Q4040	T6420D	SC60D2	T6421D	SC245D2	T4121D
Q5006L4	T2850D	SC60D12	T6411D	SC245D12	2N5570
Q5008	T4121M	SC60D13	T6411D	SC245D13	2N5570
Q5010	T4121M	SC60D22	T6421D	SC245D22	T4121D
Q5015	T4120M	SC60D23	T6421D	SC245D23	T4121D
Q5025	T6421M	SC60D	T6411D	SC245D	2N5570
Q5040	T6420M	SC60E2	T6421M	SC245E2	T4121M
Q6008	T4121M	SC60E12	T6411M	SC245E12	T4111M
Q6010	T4121M	SC60E13	T6411M	SC245E13	T4111M
Q6015	T6420M	SC60E22	T6421M	SC245E22	T4121M
Q6025	T6421M	SC60E23	T6421M	SC245E23	T4121M
Q60406A	T6420A	SC60E	T6411M	SC245E	T4111M
SC35A	2N5569	SC61B12	T6401B	SC246B12	2N5567
SC35B	2N5569	SC61B13	T6401B	SC246B13	2N5567
SC35D	2N5570	SC61B	T6401B	SC246B	2N5567
SC35F	2N5569	SC61D12	T6401D	SC246D12	2N5568
SC36A	2N5567	SC61D13	T6401D	SC246D13	2N5568
SC36B	2N5567	SC61D	T6401D	SC246D	2N5568
SC36D	2N5568	SC61E12	T6401M	SC246E12	T4101M
SC36F	2N5567	SC61E13	T6401M	SC246E13	T4101M
SC40A	2N5569	SC61E	T6401M	SC246E	T4101M
SC40B2	T4121B	SC136A	T2322A	SC250B2	T4120M
SC40B	2N5569	SC136B	T2322B	SC250B12	2N5573
SC40D2	T4121D	SC136D	T2322D	SC250B13	2N5573
SC40D	2N5570	SC141B	SC141B	SC250B22	T4120B
SC40E2	T4121M	SC141D	SC141D	SC250B	2N5573
SC40E	T4111M	SC141E	SC141E	SC250D2	T4120D
SC40F	2N5569	SC141M	SC141M	SC250D12	2N5574
SC41A	2N5567	SC146B	SC146B	SC250D13	2N5574
SC41B	2N5567	SC146D	SC146D	SC250D22	T4120D
SC41D	2N5568	SC146E	SC146E	SC250D	2N5574
SC41E	T4101M	SC146M	SC146M	SC250E2	T4120M
SC41F	2N5567	SC240B2	T4121B	SC250E12	T4110M
SC45A	2N5569	SC240B12	2N5569	SC250E13	T4110M
SC45B2	T4121B	SC240B13	2N5569	SC250E22	T4120M
SC45B	2N5569	SC240B22	T4121B	SC250E	T4110M
SC45D2	T4121D	SC240B23	T4121B	SC251B12	2N5571
SC45D	2N5570	SC240B	2N5569	SC251B13	2N5571
SC45E2	T4121M	SC240D2	T4121D	SC251B	2N5571
SC45E	T4111M	SC240D12	2N5570	SC251D12	2N5572
SC45F	2N5569	SC240D13	2N5570	SC251D13	2N5572
SC46A	2N5567	SC240D22	T4121D	SC251D	2N5572
SC46B	2N5567	SC240D23	T4121D	SC251E12	T4100M
SC46D	2N5568	SC240D	2N5570	SC251E13	T4100M
SC46E	T4101M	SC240E2	T4121M	SC251E	T4100M
SC46F	2N5567	SC240E12	T4111M	SPT06	2N5569
SC50A	2N5573	SC240E13	T4121M	SPT08	2N5569
SC50B2	T4120B	SC240E22	T4121M	SPT10	2N5569
SC50B	2N5573	SC240E23	T4121M	SPT15	2N5573
SC50D2	T4120D	SC240E	T4121M	SPT16	2N5569
SC50D	2N5574	SC241B12	2N5567	SPT18	2N5569
SC50E2	T4120M	SC241B13	2N5567	SPT025	T6411B
SC50E	2N5573	SC241B	2N5567	SPT26	2N5569
SC50F	2N5573	SC241D12	2N5568	SPT28	2N5569
SC51A	2N5571	SC241D13	2N5567	SPT030	T6411B

Triacs

Industry Type	RCA Replacement Type
SPT36	2N5570
SPT38	2N5570
SPT40	2N5444
SPT46	2N5570
SPT48	2N5570
SPT56	T4111M
SPT58	T4111M
SPT68	T4111M
SPT110	2N5569
SPT115	2N5573
SPT125	T6411B
SPT130	T6411B
SPT140	2N5444
SPT210	2N5569
SPT215	2N5573
SPT225	T6411B
SPT230	T6411B
SPT240	2N5444
SPT310	2N5570
SPT315	2N5574
SPT325	T6411D
SPT330	T6411D
SPT340	2N5445
SPT410	2N5570
SPT415	2N5574
SPT430	T6411D
SPT440	2N5445
SPT510	T4111M
SPT515	T4110M
SPT525	T6411M
SPT530	T6411M
SPT540	2N5446
SPT610	T4111M
SPT615	T4110M
SPT625	T6411M
SPT630	T6411M
SPT640	2N5446
TAG136	T2322D
TAG-200-100	T2302A
TAG-200-200	T2302B
TAG-200-400	T2302D
TAG-202-100	T2302A
TAG-202-200	T2302B
TAG-202-400	T2302D
TAG-202A-100	T2302A
TAG-202A-200	T2302B
TAG-202A-400	T2302D
TAG-203-100	T2301A
TAG-203-200	T2301B
TAG-203-400	T2301D
TAG-203A-100	T2301A
TAG-203A-200	T2301B
TAG-203A-400	T2301D
TAG-204-100	T2300A
TAG-204-200	T2300B
TAG-204-400	T2300D
TAG-204A-100	T2300A
TAG-204A-200	T2300B
TAG-204A-400	T2300D
TAG-206-100	T2302A
TAG-206-200	T2302B
TAG-206-400	T2302D

Industry Type	RCA Replacement Type
TAG-220-200	T2500B
TAG-220-400	T2500D
TAG-224-200	T2800B
TAG-224-400	T2802D
TAG-224-600	T2802M
TAG-225-200	T2800B
TAG-225-400	T2800D
TAG-225-600	T2800M
TAG-240-200	T2850B
TAG-240-400	T2850D
TAG-241-200	T2850D
TAG-245-200	T2850B
TAG-245-400	T2850D
TAG-246-200	T2850B
TAG-246-400	T2850D
TAG-255-200	T6000B
TAG-255-400	T6000D
TAG-255-600	T6000M
TAG-255A-200	T6000B
TAG-255A-400	T6000D
TAG-255A-600	T6000M
TAG-260-200	T2700B
TAG-260-400	T2700D
TAG-261-200	T2700B
TAG-261-400	T2700D
TAG-265-200	T4700B
TAG-265-400	T4700D
TAG-266-200	T4700B
TAG-266-400	T4700D
TAG-280-200	T6000B
TAG-280-400	T6000D
TAG-280-600	T6000M
TDAL113A	2N5754
TDAL113S	T2300B
TDAL223A	2N5756
TIC20	2N5567
TIC21	2N5568
TIC22	2N5569
TIC23	2N5570
TIC226B	T2800B
TIC226D	T2800D
TIC236B	2N6346A
TIC236D	2N6347A
TIC250B	T6401B
TIC250D	T6401D
TIC250E	T6401M
TIC250M	T6401M
TIC252B	T6411B
TIC252D	T6411D
TIC252E	T6411M
TIC252M	T6411M
TIC260B	T6401B
TIC260D	T6401D
TIC260E	T6401M
TIC260M	T6401M
TIC262B	T6411B
TIC262D	T6411D
TIC262E	T6411M
TIC262M	T6411M
TIC270B	2N5441
TIC270D	2N5442
TIC270E	2N5443

Industry Type	RCA Replacement Type
TIC270M	2N5443
TIC272B	2N5444
TIC272D	2N5445
TIC272E	2N5446
TIC272M	2N5446
TRAL1110D	2N5569
TRAL1115D	2N5573
TRAL1125D	T6411B
TRAL1130D	T6421B
TRAL1140D	T6420B
TRAL2210D	2N5570
TRAL2215D	2N5574
TRAL2225D	T6421D
TRAL2230D	T6421D
TRAL2240D	T6420D
TX01A10	T2700B
TXC01A20	T2700B
TXC01A40	T2700D
TXC01B10	T2700B
TXC01B20	T2700B
TXC01B40	T2700D
TXC01C10	T2700B
TXC01C20	T2700B
TXC01C40	T2700D
TXC01D10	T2700B
TXC01D20	T2700B
TXC01D40	T2700D
TXC01E10	T2700B
TXC01E40	T2700D
TXC01F10	T2700B
TXC01F20	T2700B
TXC01F40	T2700D
TXC10E20	T2700B
TXD98A20	2N5573
TXD98A40	2N5574
TXD98A50	T4110M
TXD99A20	2N5569
TXD99A40	2N5570
TXD99A50	T4111M
TXE99A20	T6411B
TXE99A50	T6411M
TXE99140	T6411D
TYAL113B	T2500B
TYAL113M	T2801B
TYAL116C	T2500B
TYAL118B	T2800B
TYAL118M	T2802B
TYAL223B	T2500D
TYAL223C	T2500D
TYAL223M	T2801D
TYAL226B	T2500D
TYAL226C	T2500D
TYAL226M	T2801D
TYAL228B	T2800D
TYAL228C	T2800D
TYAL228M	T2801D
TYAL1110B	T2800B
TYAL1110C	T2800B
TYAL1110M	T2801B
TYAL2210B	T2800D
TYAL2210C	T2800D
TYAL2210M	T2802D

Silicon Controlled Rectifiers

Industry Type	RCA Replacement Type
10RC10AS24	2N3650
10RC20AS24	2N3650
10RC30AS24	2N3651
10RC40AS24	2N3652
10RC50AS24	S7410M
10RC60AS24	S7410M
16RC10A	2N683
16RC10AS24	2N3650
16RC20A	2N685
16RC20AS24	2N3651
16RC30A	2N687
16RC30AS24	2N3652
16RC40A	2N688
16RC40AS24	2N3653
16RC50A	2N689
16RC60A	2N690
16RC60AS24	S7410M
16RC540AS24	S7410M
40216	S6493M
40553	S3700B
40554	S3700D
40555	S3700M
40654	S2600B
40655	S2600D
40735	S7410M
40749	S6200M
40750	S6200B
40751	S6200D
40752	S6200M
40753	S6210A
40754	S6210B
40755	S6210D
40756	S6210M
40757	S6220A
40758	S6220B
40759	S6220D
40760	S6220M
40833	S2600M
40867	S2800A
40868	S2800B
40869	S2800D
BT102-300R	S2800C
BT102-500R	S2800E
BTW30-300	2N3657
BTW30-400	2N3658
BTW31-300	2N3657
BTW31-400	2N3658
BTW31-500	S7412M
BTW31-600	S7412M
BTX31-100	S7310B
BTX31-200	S7310B
BTX31-400	S7310D
BTX31-500	S7310M
BTX31-600	S7310M
BTX32-100	S7310B
BTX32-400	S7310D
BTX32-500	S7310M
BTX32-600	S7310M
BTX33-100	S6210A
BTX33-200	S6210B
BTX33-400	S6210D
BTX33-500	S6210M
BTX70-100	S6210A
BTX70-200	S6210B
BTX70-400	S6210D

Industry Type	RCA Replacement Type
BTX70-500	S6210M
BTX70-600	S6210M
BTX71-100	S7310B
BTX71-200	S7310B
BTX71-400	S7310D
BTX71-500	S7310M
BTX71-600	S7310M
BTX72-100	S7310M
BTX72-200	S7310M
BTX72-400	S7310M
BTX72-500	S7310M
BTX72-600	S7310M
BTX73-110	2N683
BTX73-200	2N685
BTX73-400	2N688
BTX73-500	2N690
BTX73-500	2N689
BTX74-100	S6210A
BTX74-200	S6210B
BTX74-400	S6210D
BTX74-500	S6210M
BTX74-600	S6210M
BTX3600	S6210M
C20A	S6210A
C20B	S6210B
C20C	S6210C
C20D	S6210D
C20F	S6210A
C20U	S6210A
C22A	S6200A
C22B	S6200B
C22C	S6200C
C22F	S6200A
C22U	S6200A
C30A	2N3896
C30B	2N3897
C30C	2N3898
C30D	2N3898
C30P	2N3896
C30U	2N3896
C31A	2N3896
C31B	2N3897
C31C	2N3898
C31D	2N3898
C31P	2N3896
C31U	2N3896
C32A	2N3870
C32B	2N3871
C32D	2N3872
C32F	2N3870
C32U	2N3870
C33A	2N3870
C33B	2N3871
C33C	2N3872
C33D	2N3872
C33F	2N3870
C33U	2N3870
C34A2	2N3650
C34B2	2N3651
C34C2	2N3652
C34D2	2N3653
C34E2	S7410M
C34F2	2N3650
C35A	2N683
C35B	2N685

Industry Type	RCA Replacement Type
C35C	2N687
C35D	2N688
C35E	2N689
C35F	2N682
C35G	2N684
C35H	2N686
C35M	2N690
C35U	2N681
C38A	2N683
C38B	2N685
C38C	2N687
C38D	2N688
C38E	2N689
C38F	2N682
C38G	2N684
C38M	2N686
C38U	2N681
C40A	2N3650
C40B	2N3651
C40C	2N3652
C40D	2N3653
C40E	S7410M
C40F	2N3650
C40G	2N3654
C40H	2N3652
C40U	2N3650
C106A	C106A
C106B	C106B
C106C	C106C
C106D	C106D
C106E	C106E
C106F	C106F
C122A	C122A
C122B	C122B
C122C	C122C
C122D	C122D
C122E	C122E
C122F	C122F
C122M	C122M
C140A	2N3650
C140B	2N3651
C140C	2N3652
C140D	2N3653
C140F	2N3654
C141A	2N3655
C141B	2N3656
C141C	2N3657
C141D	2N3658
C141F	2N3654
C220A2	S6220A
C220A	S6210A
C220B2	S6220B
C220B	S6210B
C220C2	S6200D
C220C	S6210D
C220D2	S6220D
C220E2	S6220M
C220E	S6210M
C220F2	S6220A
C220F	S6210A
C220U2	S6220A
C220U	S6210A
C222A	S6200A
C222B	S6200D
C222C	S6200D

Silicon Controlled Rectifiers

Industry Type	RCA Replacement Type
C222D	S6200D
C222E	S6200M
C222F	S6200A
C222U	S6100A
CS5-2T	2N3228
CS5-4T	2N3525
CS5-5-5T	2N4101
CS10-1M	S6200A
CS10-1N	S6210A
CS10-2M	S6200B
CS10-02M	S6200A
CS10-2N	S6210B
CS10-02N	S6210A
CS10-4M	S6200D
CS10-4N	S6210D
CS10-05M	S6200A
CS10-05N	S6210A
CS10-6M	S6200M
CS10-6N	S6210D
CS20-1M	S6200A
CS20-1N	S6210A
CS20-2M	S6200B
CS20-2N	S6210B
CS20-4M	S6200D
CS20-4N	S6210D
CS20-05M	S6200A
CS20-05N	S6210A
CS20-6M	S6200M
CS20-6N	S6210M
CS35-1M	2N3896
CS35-1N	2N3896
CS35-2M	2N3871
CS35-02M	2N3870
CS35-2N	2N3897
CS35-02N	2N3896
CS35-4M	2N3872
CS35-4N	2N3898
CS35-05M	2N3870
CS35-05N	2N3896
CS35-6M	2N3873
CS35-6N	2N3899
EC106A1	C106A
EC106B1	C106B
EC106M1	C106M
IR140A	2N3650
IR140B	2N3651
IR140C	2N3652
IR140D	2N3653
IR140F	2N3654
IR141A	2N3655
IR141B	2N3656
IR141C	2N3657
IR141D	2N3658
IR141F	2N3654
MCR1718-5	2N3653
MCR1718-6	2N3653
MCR1718-7	S7410M
MCR1718-8	S7410M
MCR2818-7	S6200M
MCR3818-3	S6200A
MCR3818-5	S6200D
MCR3835-1	2N3870
MCR3835-2	2N3870
MCR3835-3	2N3870
MCR3835-4	2N3871
MCR3835-5	2N3871
MCR3835-6	2N3872
MCR3835-7	2N3873
MCR3835-8	2N3873
MCR3838-1	S6200A
MCR3918-1	S6210A
MCR3918-3	S6210A
MCR3918-5	S6210D
MCR3918-7	S6210M
MCR3935-1	2N3896
MCR3935-2	2N3896
MCR3935-3	2N3896
MCR3935-4	2N3897
MCR3935-5	2N3898
MCR3935-6	2N3898
MCR3936-7	2N3899
MCR39835-8	2N3899
NL-570M	2N690
NL-C35A	2N683
NL-C35B	2N685
NL-C35C	2N687
NL-C35D	2N688
NL-C35E	2N689
NL-C35G	2N684
NL-C35H	2N686
NL-C35M	2N689
NL-C40A	2N3650
NL-C40B	2N3651
NL-C40C	2N3652
NL-C40D	2N3654
NL-C40E	S7410M
NL-C40G	2N3651
NL-C40H	2N3652
PS08	S6200A
PS18	S6200A
PS020	S6200A
PS28	S6200B
PS035	2N3870
PS38	S6200D
PS48	S6200D
PS58	S6200M
PS68	S6200M
PS120	S6200M
PS135	2N3870
PS220	S6200B
PS235	2N3871
PS320	S6200D
PS335	2N3872
PS420	S6200D
PS435	2N3872
PS530	S6200M
PS535	2N3873
PS620	S6200M
RCA106A	S2060A
RCA106B	S2060B
RCA106D	S2060D
RCA106E	S2060E
RCA106F	S2060F
RCA106M	S2060M
RCA106Q	S2060Q
RCA106Y	S2060Y
RCA107A	S2061A
RCA107B	S2061B
RCA107C	S2061C
RCA107D	S2061D
RCA107E	S2061E
RCA107F	S2061F
RCA107M	S2061M
RCA107Q	S2061Q
RCA107Y	S2061Y
RTS0202	S6200A
RTS0205	S6200A
RTS0210	S6200A
RTS0220	S6200B
RTS0230	S6200D
RTS0240	S6200D
RTS0250	S6200M
RTS0260	S6200M
RTS0502	S6200A
RTS0505	S6200A
RTS0510	S6200A
RTS0520	S6200B
RTS0530	S6200D
RTS0540	S6200D
RTS0550	S6200M
RTS0602	S6200A
RTS0605	S6200A
RTS0610	S6200A
RTS0620	S6200B
RTS0630	S6200D
RTS0640	S6200D
RTS0650	S6200M
RTS0660	S6200M
RTU0102	S6210A
RTU0105	S6210A
RTU0110	S6210A
RTU0120	S6210B
RTU0130	S6210D
RTU0140	S6210D
RTU0150	S6210M
RTU0160	S6210M
RTU0202	2N3896
RTU0205	2N3896
RTU0210	2N3896
RTU0220	2N3897
RTU0230	2N3898
RTU0240	2N3898
RTU0602	2N3896
RTU0605	2N3896
RTU0610	2N3896
RTU0620	2N3897
RTU0630	2N3898
RTU0640	2N3898
RTU0650	2N3899
RTU0660	2N3899
RTU0705	2N3896
RTU0710	2N3896
RTU0720	2N3897
RTU0730	2N3898
RTU0740	2N3898
RTU0750	2N3899
RTU0760	2N3899
S100G6	S6200A
S0525G	2N3870
S1003RS2	S2060A
S1003RS3	S2061A
S1006B	S6220A
S1006H	S6210A
S1008B	S6220A
S1008G	S6200A

Silicon Controlled Rectifiers

Industry Type	RCA Replacement Type
S1008H	S6210A
S1010B	S6220A
S1010G	S6200A
S1010H	S6210A
S1016B	S6220A
S1016G	S6200A
S1016H	S6210A
S1025H	2N3870
S1025H	2N3896
S1035G	2N3870
S1035H	2N3896
S2003RS2	S2060B
S2003RS3	S2061B
S2006B	S6220B
S2006G	S6200B
S2006H	S6210B
S2008B	S6220B
S2008G	S6200B
S2008H	S6210B
S2010B	S6220B
S2010G	S6200B
S2010H	S6210B
S2016B	S6220B
S2016G	S6200B
S2016H	S6210B
S2025G	2N3871
S2025H	2N3897
S2035G	2N3871
S2035H	2N3897
S4006B	S6220D
S4006G	S6200D
S4006H	S6210D
S4010B	S6220D
S4010G	S6200D
S4010H	S6210D
S4016B	S6220D
S4016G	S6200D
S4016H	S6210D
S4025G	2N3872
S4025H	2N3898
S4035G	2N3872
S4035H	2N3898
S6003RS2	S2060M
S6003RS3	S2061M
S6006B	S6220M
S6006G	S6200M

Industry Type	RCA Replacement Type
S6006H	S6210M
S6008G	S6200M
S6008H	S6210M
S6010B	S6220M
S6010G	S6200M
S6010H	S6210M
S6016B	S6220M
S6016G	S6200M
S6016H	S6210M
S6025G	2N3873
S6025H	2N3899
S6035G	2N3873
S6035H	2N3899
SPS08	S6210A
SPS18	S6210A
SPS20	S6210A
SPS28	S6210B
SPS38	S6210D
SPS48	S6210D
SPS58	S6210D
SPS68	S6210M
SPS120	S6210A
SPS220	S6210B
SPS320	S6210D
SPS420	S6210D
SPS520	S6210M
SPS620	S6210M
TAG-6-100	2N3668
TAG-6-200	2N3669
TAG-6-400	2N3670
TAG-6-500	2N4103
TAG-6-600	2N4103
TAG-10-100	S7310B
TAG-10-200	S7310B
TAG-10-400	S7310D
TAG-10-500	S7310M
TAG-10-600	S7310M
TAG-15-100	S6210A
TAG-15-200	S6210B
TAG-15-400	S6210D
TAG-15-500	S6210M
TAG-15-600	S6210M
TAG-20-100	S6210A
TAG-20-200	S6210B
TAG-20-400	S6210D
TAG-20-500	S6210M

Industry Type	RCA Replacement Type
TAG-20-600	S6210M
TAG-35-100	S6410A
TAG-35-200	S6410B
TAG-35-400	S6410D
TAG-35-500	S6410M
TAG-35-600	S6410M
TIC106A	S2060A
TIC106B	S2060B
TIC106C	S2060C
TIC106D	S2060D
TIC106F	S2060F
TIC106Y	S2060Y
TIC116A	C112A
TIC116B	C122B
TIC116D	C122D
TIC116E	C122E
TIC116F	C122F
TIC116M	C122M
TIC122A	C122A
TIC122B	C122B
TIC122C	C122C
TIC122D	C122D
TIC122E	C122E
TIC122F	C122F
TIC126A	2N6395
TIC126B	2N6396
TIC126C	S6397
TIC126D	2N6397
TIC126E	S6398
TIC126F	2N6348A
TIC126M	2N6398
TY507	C122A
TY510	S2800F
TY1007	C122A
TY1010	S2800A
TY2007	C122B
TY2010	S2800B
TY3007	C122C
TY3010	S2800C
TY4007	C122D
TY4010	S2800D
TY5007	C122E
TY5010	S2800E
TY6007	C122M
TY6010	S2800M

Ultra-Fast-Recovery Rectifiers

Industry Type	RCA Replacement Type
BYV32-50	RUR D810
BYV32-100	RUR D810
BYV32-150	RUR D815
BYV32-200	RUR D820
BYW29-50	RUR 810
BYW29-100	RUR 810
BYW29-150	RUR 815
BYW29-200	RUR 820
BYW51-50	BYW51-50
BYW51-100	BYW51-100
BYW51-150	BYW51-150
BYW51-200	BYW51-200
BYW80-50	RUR 810
BYW80-100	RUR 810
BYW80-150	RUR 815
BYW80-200	RUR 820

Industry Type	RCA Replacement Type
FE8A	RUR 810
FE8B	RUR 810
FE8C	RUR 815
FE8D	RUR 810
FE16A	RUR D810
FE16B	RUR D810
FE16C	RUR D815
FE16D	RUR D820
FT410	RCA410
MUR805	RUR 810
MUR810	RUR 810
MUR815	RUR 815
MUR1605CT	RUR D810
MUR1610CT	RUR D810
MUR1615CT	RUR D815
SES5401	RUR 810

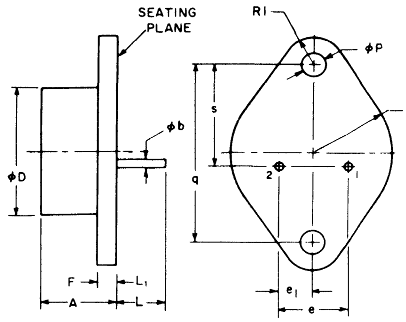
Industry Type	RCA Replacement Type
SES5401C	RUR D810
SES5402	RUR 810
SES5402C	RUR D810
SES5403	RUR 815
SES5403C	RUR D815
UES1401	RUR 810
UES1402	RUR 810
UES1403	RUR 815
UES2401	RUR D810
UES2402	RUR D810
UES2403	RUR D815
VEH1402	RUR 810
VHE1401	RUR 810
VHE1403	RUR 820
VHE1404	RUR 820

Appendix

Page

Dimensional Outlines

JEDEC TO-204MA
(Formerly JEDEC TO-3) **A**



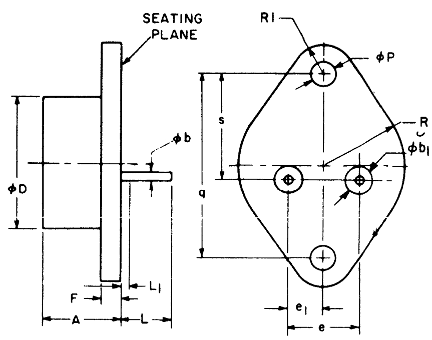
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.250	0.450	6.35	11.35	
φb	0.038	0.043	0.96	1.092	1
φD	—	0.875	—	22.22	
e	0.420	0.440	10.67	11.17	2
e_1	0.205	0.225	5.21	5.71	2
F	0.060	0.135	1.53	3.42	
L	0.312	0.500	7.93	12.70	
L_1	—	0.050	—	1.27	1
φP	0.151	0.161	3.836	4.089	
q	1.177	1.197	29.90	30.40	
R	0.495	0.525	12.58	13.33	
R_1	0.131	0.188	3.33	4.77	
s	0.655	0.675	16.64	17.14	

92CS-15222R3

Notes:
1: φb applies between L_1 and L. Diameter is uncontrolled in L_1.

2: These dimensions should be measured at points 0.050 in. (1.270 mm) to 0.055 in. (1.397 mm) below seating plane. When gage is not used, measurement will be made at seating plane.

JEDEC TO-204MA
(Formerly JEDEC TO-3)
200 mil diameter pin isolation **B**



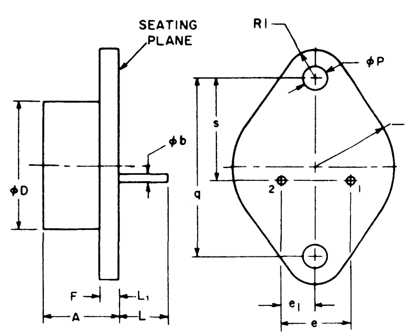
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.250	0.450	6.35	11.35	
φb	0.038	0.043	0.96	1.092	1
$φb_1$	0.200 NOM.		5.08 NOM.		
φD	—	0.875	—	22.22	
e	0.420	0.440	10.67	11.17	2
e_1	0.205	0.225	5.21	5.71	2
F	0.060	0.135	1.53	3.42	
L	0.312	0.500	7.93	12.70	
L_1	—	0.050	—	1.27	1
φP	0.151	0.161	3.836	4.089	
q	1.177	1.197	29.90	30.40	
R	0.495	0.525	12.58	13.33	
R_1	0.131	0.188	3.33	4.77	
s	0.655	0.675	16.64	17.14	

92CS-32102

Notes:
1: φb applies between L_1 and L. Diameter is uncontrolled in L_1.

2: These dimensions should be measured at points 0.050 in. (1.270 mm) to 0.055 in. (1.397 mm) below seating plane. When gage is not used, measurement will be made at seating plane.

JEDEC TO-204AE **C**



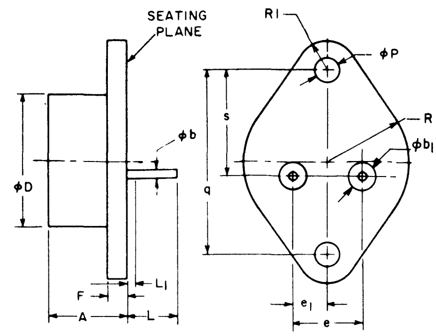
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.250	0.450	6.4	11.4	
φb	0.057	0.063	1.45	1.60	
φD	—	0.875	—	22.22	
e	0.420	0.440	10.67	11.17	
e_1	0.205	0.225	5.21	5.71	
F	0.060	0.135	1.53	3.42	
L	0.440	0.480	11.18	12.19	
φP	0.151	0.161	3.84	4.08	
q	1.187	BSC	30.15	BSC	
R	0.495	0.525	12.58	13.33	
R_1	0.131	0.188	3.33	4.77	
s	0.655	0.675	16.64	17.14	

92CS-36443R1

Dimensional Outlines

JEDEC TO-204AE
141 mil diameter pin isolation

D

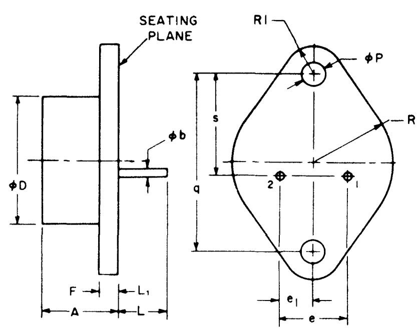


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.250	0.450	6.4	11.4	
ϕb	0.057	0.063	1.45	1.60	
ϕb_1	0.141 NOM.		3.58 NOM.		
ϕD	—	0.875	—	22.22	
e	0.420	0.440	10.67	11.17	
e_1	0.205	0.225	5.21	5.71	
F	0.060	0.135	1.53	3.42	
L	0.440	0.480	11.18	12.19	
ϕP	0.151	0.161	3.84	4.08	
q	1.187	BSC	30.15	BSC	
R	0.495	0.525	12.58	13.33	
R_1	0.131	0.188	3.33	4.77	
s	0.655	0.675	16.64	17.14	

92CS-37523

JEDEC TO-204AA

E

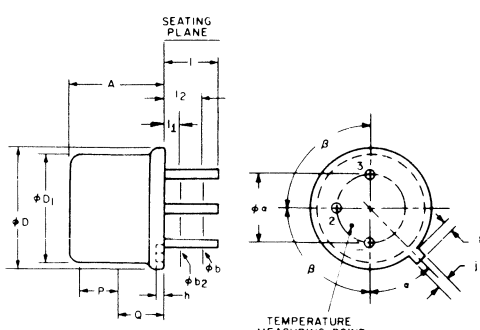


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.250	0.450	6.4	11.4	
ϕb	0.038	0.043	0.966	1.092	
ϕD	—	0.875	—	22.22	
e	0.420	0.440	10.67	11.17	
e_1	0.205	0.225	5.21	5.71	
F	—	0.135	—	3.42	
L	0.312	—	7.93	—	
ϕP	0.151	0.161	3.84	4.08	
q	1.187	BSC	30.15	BSC	
R	—	0.525	—	13.33	
R_1	—	0.188	—	4.77	
s	0.655	0.675	16.64	17.14	

92CS-37249

TO-205MA/TO-5
TO-205MD/TO-39

F



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
ϕa	0.190	0.210	4.83	5.33	
A	0.240	0.260	6.10	6.60	
ϕb	0.016	0.021	0.406	0.533	2
ϕb_2	0.016	0.019	0.406	0.483	2
ϕD	0.350	0.370	8.89	9.40	
ϕD_1	0.305	0.335	8.00	8.51	
h	0.009	0.041	0.229	1.04	
j	0.028	0.034	0.711	0.864	
k	0.029	0.040	0.737	1.02	3
L (TO-5)	1.500	1.750	38.10	44.45	2
L (TO-39)	0.500	0.750	12.70	19.05	2
l_1	—	0.0 50	—	1.27	2
l_2	0.250	—	6.35	—	2
P	0.100	—	2.54	—	1
Q					4
α	45° NOMINAL		—	—	
β	90° NOMINAL		—	—	

92CS-37723

Notes:

1: This zone is controlled for automatic handling. The variation in actual diameter within this zone shall not exceed 0.010 in. (0.254 mm).

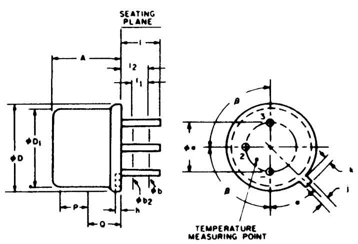
2: (Three leads) ϕb_2 applies between l_1 and l_2. ϕb applies between l_2 and l. Diameter is uncontrolled in l_1.

3: Measured from maximum diameter of the actual device.

4: Details of outline in this zone optional.

Dimensional Outlines

"MOD. TO-5" G

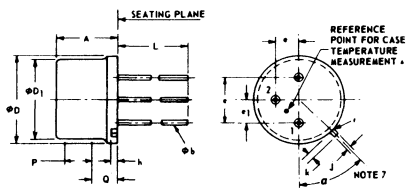


Note 1: Details of outline in this zone optional.

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
ϕa	.190	.210	4.83	5.33	
A	.240	.260	6.10	6.60	
ϕb	.017	.021	.44	.53	
ϕD	.335	.366	8.51	9.30	
ϕD_1	—	.330	8.13	8.38	
h	.015	.035	.38	.89	
j	.028	.035	.71	.89	
k	.029	.045	.74	1.14	
l	.975	1.025	24.76	26.03	
P	.100	—	2.54	—	
Q	—	—	—	—	1
α	45° NOMINAL				
β	50° NOMINAL				

92CS-37697

"LOW-PROFILE TO-5" H



Notes

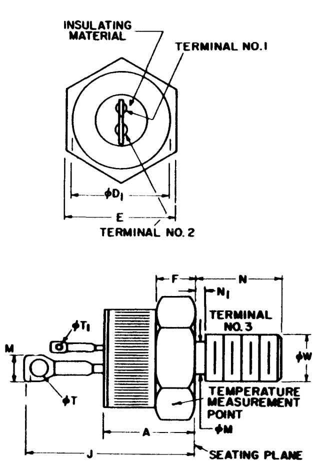
1: This zone is controlled for automatic handling. The variation in actual diameter within the zone shall not exceed .012 in. (.279 mm).
2: (Three leads) ϕb applies between seating plane and 1.015 in. (25.78 mm)
3: Measured from maximum diameter of the actual device.
4: Leads having maximum diameter .021 in. (.533 mm) measured at the seating plane of the device shall be within .007 in. (.178 mm) of their true positions relative to the maximum-width tab.
5: The device may be measured by direct methods or by the gage and gaging procedure described on gage drawing GS-1 of JEDEC publication 12E, May 1964.
6: Details of outline in this zone optional.
7: Tab centerline.

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	.160	.180	4.06	4.57	
ϕb	.017	.021	.432	.533	2
ϕD	.335	.366	9.017	9.296	
ϕD_1	.323	.335	8.204	8.51	
e	.190	.210	4.83	5.33	
e_1	.100 TRUE POSITION		2.54 TRUE POSITION		4, 5
h	.015	.035	.381	.889	
j	.028	.035	.711	.889	5
k	.029	.045	.737	1.14	3, 5
L	.985	1.015	25.02	25.78	2
P	.100	—	2.54	—	1
Q	—	—	—	—	6
r	—	.007	—	.179	
α	42°	48°	—	—	5, 7

92CS-34150

▲CASE TEMPERATURE MEASUREMENT
The specified temperature-reference point should be used when making temperature measurements. A low-mass temperature probe or thermocouple having wire no larger than AWG No. 26 should be attached at the temperature reference point.

TO-208MA/TO-48 I



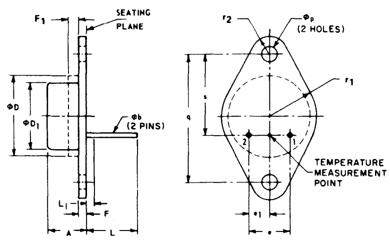
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.330	0.505	9.4	12.8	
ϕD_1	—	0.544	—	13.81	
E	0.544	0.562	13.82	14.28	
F	0.113	0.200	2.87	5.08	
J	0.950	1.100	24.13	27.94	
ϕM	0.220	0.249	5.59	6.32	
M	0.215	0.225	5.46	5.71	
N	0.422	0.453	10.72	11.50	
N_1	—	0.090	—	2.28	
ϕT_1	0.058	0.068	1.47	1.73	
ϕT	0.138	0.148	3.50	3.75	
ϕW	1/4-28	UNF-2A	1/4-28	UNF-2A	1

92CS-15208R5

Note:
1: ϕW is pitch diameter of coated threads.
REF: Screw-thread Standards for Federal Services, Handbook H28, Part I. Recommended Torque: 35 in.lbf (0.4 kgf-m). Maximum Torque: 50 in-lbf (0.57 kgf-m).

Dimensional Outlines

TO-213MA/TO-66 J

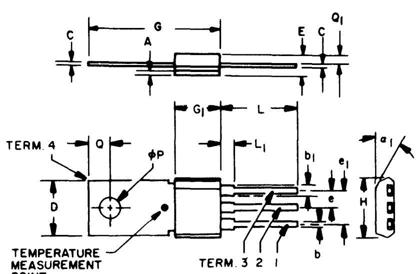


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.250	0.340	6.35	8.63	
ϕb	0.028	0.034	0.712	0.863	
ϕD	—	0.620	—	15.74	1
ϕD_1	0.470	0.500	11.94	12.70	
e	0.190	0.210	4.83	5.33	2
e_1	0.093	0.107	2.37	2.71	2
F	0.050	0.075	1.27	1.90	
F_1	—	0.050	—	1.27	1
L	0.360	0.500	9.15	12.70	
L_1	—	0.050	—	1.27	3
ϕp	0.142	0.152	3.607	3.860	
q	0.958	0.962	24.334	24.434	
R	—	0.350	—	8.89	
R_1	0.115	0.145	2.93	3.68	
s	0.570	0.590	14.48	14.98	

92CM-34147

Notes:
1: Body contour is optional within zone defined by ϕD and F_1.
2: These dimensions should be measured at points 0.050 in. (1.27 mm) to 0.55 in. (1.40 mm) below seating plane. When gage is not used, measurements will be made at seating plane.
3. ϕb applies between L_1 and L. Diameter is uncontrolled in L_1.
4: The seating plane of header shall be flat within 0.001 in. (0.025 mm) concave to 0.004 in. (0.10 mm) convex inside a 0.520 in. (13.21 mm) diameter circle on the center of the header and flat within 0.001 in. (0.025 mm) concave to 0.006 in. (0.15mm) convex overall.

TO-202AB VERSATAB K



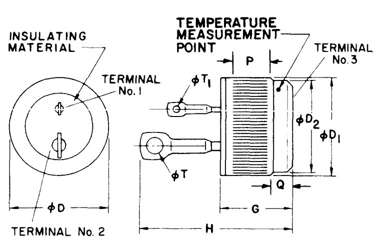
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	—	0.05	—	1.270	1
b	0.023	0.029	0.584	0.736	
b_1	0.045	0.055	1.143	1.397	1
c	0.018	0.026	0.457	0.660	
D	0.305	0.325	7.747	8.255	
E	0.130	0.150	3.302	3.810	
e	0.095	0.105	2.413	2.667	
e_1	0.190	0.210	4.826	5.334	
G	0.760	0.840	19.31	21.33	
G_1	0.230	0.250	5.842	6.350	
H	0.330	0.370	8.382	9.398	
L	0.400	0.450	10.16	11.43	
L_1	0.050	0.100	1.27	2.54	1, 2
ϕP	0.123	0.127	3.124	3.225	
Q	0.120	0.130	3.048	3.302	
Q_1	0.039	0.050	0.990	1.270	
α_1	—	50°	—	50°	1

92CS-24062R6

TEMPERATURE MEASUREMENT:
1/16 in. (1.58 mm) from plastic encapsulation on either mounting flange (terminal No. 4) or anode lead (terminal No. 2)

Notes:
1: Package contour optional within dimensions specified.
2: Lead dimensions uncontrolled in this zone.
3: Controlling dimensions: inch.

TO-203AA L
PRESS-FIT 6-, 10-, AND 15-A TRIACS: 20- AND 35-A SCR's



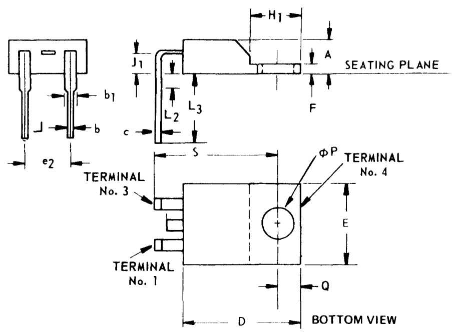
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
ϕD	—	0.510	—	12.95	1
ϕD_1	0.501	0.505	12.726	12.827	2
ϕD_2	0.465	0.475	11.82	12.06	
G	0.330	0.380	8.39	9.65	
H	—	0.800	—	20.32	
P	0.100	—	2.54	—	2
Q	0.080	0.097	2.04	2.46	
ϕT	0.065	0.090	1.66	2.28	3, 4
ϕT_1	0.035	0.068	0.89	1.72	

92CS-23134R1

Notes:
1: Outline contour is optional within zone defined by ϕ D and G min. and H max.
2: Straight knurl surface.
3: Elongated hole in terminal is optional
4: Contour and orientation of terminal 1 and terminal 2 are not defined.
5: Terminal 1 to be shorter than terminal 2 for identification.

Dimensional Outlines

TO-220AA
VERSAWATT **M**

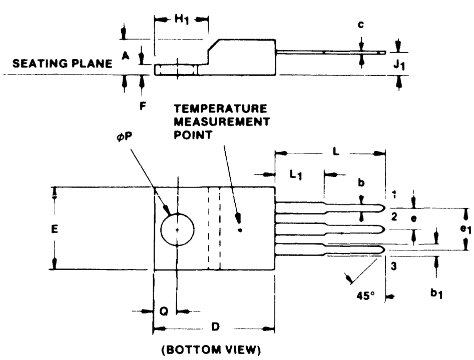


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.140	0.190	3.56	4.82	
b	0.020	0.045	0.51	1.14	
b_1	0.045	0.070	1.14	1.77	
c	0.015	0.025	0.38	0.63	
D	0.560	0.625	14.23	15.87	
E	0.380	0.420	9.66	10.66	1
e_2	0.190	0.210	4.83	5.33	2
F	0.045	0.055	1.14	1.39	
H_1	0.230	0.270	5.85	6.85	1
J_1	0.080	0.115	2.04	2.92	
L_2	—	0.050	—	1.27	
L_3	0.360	0.422	9.15	10.71	
ϕP	0.139	0.147	3.531	3.733	
Q	0.100	0.120	2.54	3.04	
S	0.580	0.610	14.74	15.49	

92CS-37524

Notes:
1: Tab contour optional within H_1 and E.
2: Position of lead to be measured 0.050 - 0.055 in. (1.270 -1.397 mm) below seating plane.

TO-220AB
VERSAWATT **N**

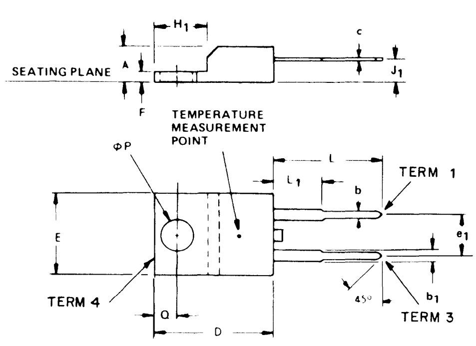


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.140	0.190	3.56	4.82	
b	0.020	0.045	0.51	1.14	
b_1	0.045	0.070	1.14	1.77	
c	0.015	0.025	0.38	0.63	
D	0.560	0.625	14.23	15.87	
E	0.380	0.420	9.66	10.66	1
e	0.090	0.110	2.29	2.79	
e_1	0.190	0.210	4.83	5.33	2
F	0.045	0.055	1.14	1.39	
H_1	0.230	0.270	5.85	6.85	1
J_1	0.080	0.115	2.04	2.92	
L	0.500	0.562	12.70	14.27	
L_1	—	0.250	—	6.35	
ϕP	0.139	0.161	3.531	4.089	
Q	0.100	0.120	2.54	3.04	

92CS-34697

Notes:
1: Tab contour optional within H_1 and E.
2: Position of lead to be measured 0.250 - 0.255 in. (6.350 -6.477 mm) from case.

TO-220AC
VERSAWATT **O**



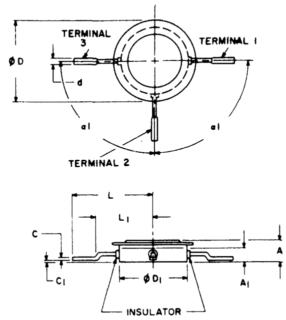
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.140	0.190	3.56	4.82	
b	0.020	0.045	0.51	1.14	
b_1	0.045	0.070	1.14	1.77	
c	0.015	0.025	0.38	0.63	
D	0.560	0.625	14.23	15.87	
E	0.380	0.420	9.66	10.66	1
e_1	0.190	0.210	4.83	5.33	
F	0.045	0.055	1.14	1.39	
H_1	0.230	0.270	5.85	6.85	1
J_1	0.080	0.115	2.04	2.92	
L	0.500	0.562	12.70	14.27	
L_1	—	0.250	—	6.35	
ϕP	0.139	0.161	3.531	4.089	
Q	0.100	0.120	2.54	3.04	

92CS-34830

Notes:
1: Tab contour optional within H_1 and E.

Dimensional Outlines

RADIAL PACKAGE — P

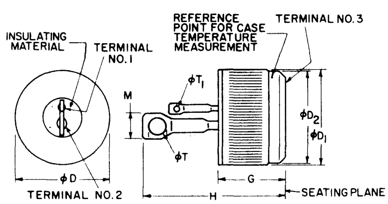


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	—	0.200	—	5.08	
A_1	—	0.125	—	3.17	1
C	0.015	0.019	0.38	0.48	
C_1	—	0.015	—	0.38	
ϕD	—	0.710	—	18.03	
ϕD_1	0.615	0.660	15.62	17.52	1
d	0.042	0.046	1.06	1.16	
L	—	0.706	—	17.90	
L_1	—	0.510	—	12.95	
α_1	90° ± 2°		90° ± 2°		

92CS-20224

Note:
1: Controlled area of the diameter does not include the brazed area around the ceramic and terminal 2.

PRESS-FIT — Q
25-, 30-, AND 40-A TRIACS

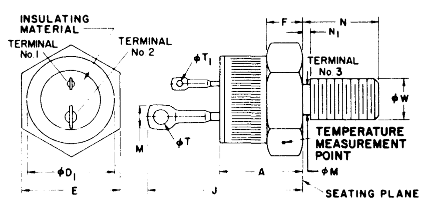


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
G	—	0.380	—	9.65	
ϕD	0.501	0.510	12.73	12.95	
ϕD_1	—	0.505	—	12.83	1
ϕD_2	0.465	0.475	11.81	12.07	
H	0.825	1.000	20.95	25.40	
M	0.215	0.225	5.46	5.71	
ϕT_1	0.058	0.068	1.47	1.73	
ϕT	0.138	0.148	3.51	3.75	

92CS-15207R4

Note:
1: Outer diameter of knurled surface.

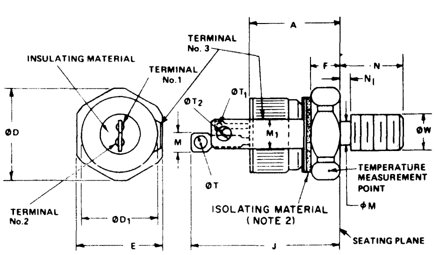
STUD — R
6-, 10-, AND 15-A TRIACS; 20- AND 35-A SCR's



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.330	0.505	8.40	12.80	
ϕD_1	—	0.544	—	13.81	
E	0.544	0.562	13.82	14.28	
F	0.113	0.200	2.87	5.08	
J	—	0.950	—	24.13	
ϕM	0.220	0.249	5.59	6.32	
M	—	0.155	—	3.94	
N	0.422	0.453	10.72	11.50	
N_1	—	0.090	—	2.28	
ϕT_1	0.058	0.068	1.47	1.73	
ϕT	0.080	0.090	2.03	2.29	
ϕW	1/4-28	UNF-2A	1/4-28	UNF-2A	1

92CS-23135R2

ISOLATED-STUD — S
25-, 30-, AND 40-A TRIACS



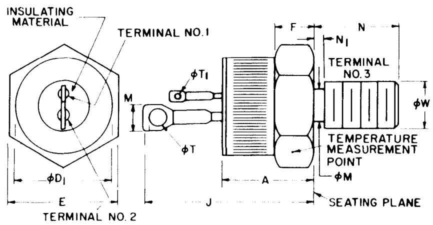
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	—	0.673	—	17.09	
ϕD	0.604	0.614	15.34	15.59	
ϕD_1	0.501	0.505	12.72	12.82	
E	0.551	0.557	13.99	14.14	
F	0.100	0.185	2.50	4.69	
J	—	1.298	—	32.96	
ϕM	0.220	0.249	5.59	6.32	
M	0.210	0.230	5.33	5.84	
M_1	0.200	0.210	5.08	5.33	
N	0.422	0.452	10.72	11.48	
N_1	—	0.090	—	2.28	
ϕT_1	0.058	0.068	1.47	1.73	
ϕT	0.138	0.148	3.50	3.75	
ϕT_2	0.138	0.148	3.50	3.75	
ϕW	1/4-28	UNF-2A	1/4-28	UNF-2A	1

92CS-29311R3

Note:
1: ϕW is pitch diameter of coated threads.
REF: Screw-Thread Standards for Federal Services, Handbook H28, Part 1. Recommended Torque: 36 in.lbf (0.4 kgf-m). Maximum Torque: 50 in.lbf (0.57 kgf-m).

Dimensional Outlines

STUD — T
25-, 30-, AND 40-A TRIACS



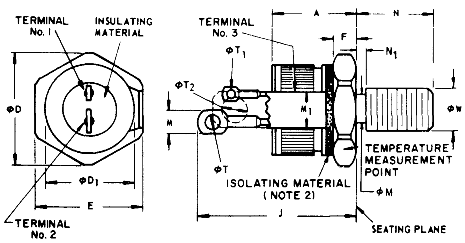
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	0.330	0.505	9.4	12.8	
ϕD_1	—	0.544	—	13.81	
E	0.544	0.562	13.82	14.28	
F	0.113	0.200	2.87	5.08	
J	0.950	1.100	24.13	27.94	
ϕM	0.220	0.249	5.59	6.32	
M	0.215	0.225	5.46	5.71	
N	0.422	0.453	10.72	11.50	
N_1	—	0.090	—	2.28	
ϕT_1	0.058	0.068	1.47	1.73	
ϕT	0.138	0.148	3.50	3.75	
ϕW	1/4-28	UNF-2A	1/4-28	UNF-2A	1

92CS-15208R5

Notes

1: ϕW is pitch diameter of coated threads. REF: Screw-Thread Standards for Federal Services, Handbook H28, Part 1. Recommended Torque: 35 in.lbf (0.4 kgf-m). Maximum Torque: 50 in-lbf (0.57 kgf-m).

ISOLATED STUD — U
6-, 10-, AND 15-A TRIACS; 20- AND 35-A SCR's



WARNING: The ceramic used in these packages contains beryllium oxide. Do not crush, grind, or abrade these portions because the dust resulting from such action may be hazardous if inhaled. Disposal should be by burial.

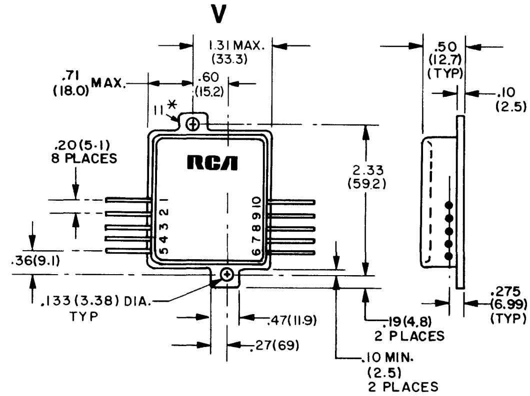
SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN.	MAX.	MIN.	MAX.	
A	—	0.673	—	17.09	
ϕD	0.604	0.614	15.34	15.50	
ϕD_1	0.501	0.505	12.72	12.82	
E	0.551	0.557	13.99	14.14	
F	0.100	0.185	2.50	4.69	
J	—	1.055	—	26.79	
ϕM	0.220	0.249	5.59	6.32	
M	—	0.155	—	3.94	
M_1	0.200	0.210	5.08	5.33	
N	0.422	0.452	10.72	11.48	
N_1	—	0.090	—	2.28	
ϕT_1	0.058	0.068	1.47	1.73	
ϕT	0.080	0.090	2.03	2.29	
ϕT_2	0.138	0.148	3.50	3.75	
ϕW	1/4-28	UNF-2A	1/4-28	UNF-2A	1

92CS-23133R4

Notes:

1: ϕW is pitch diameter of coated threads. REF: Screw-Thread Standards for Federal Services, Handbook H28, Part I. Recommended Torque: 35 in.lbf (0.4 kgf-m). Maximum Torque: 50 in-lbf (0.57 kgf-m).

HYBRID-CIRCUIT PACKAGE — V



92CS-37519

DIMENSIONS IN INCHES AND MILLIMETERS (VALUES IN PARENTHESES)

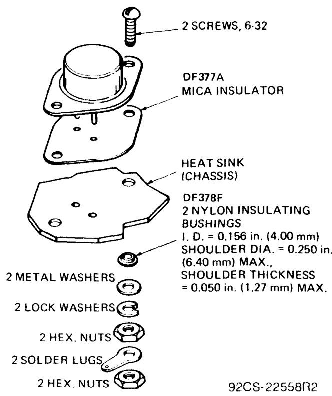
Typical lead length equals 0.75 (19.0).

***For HC2000H, Terminal 11 is internally connected to Terminal 6**

For HC2500, Terminal 11 is electrically isolated from internal circuitry.

Suggested Hardware and Mounting Arrangements

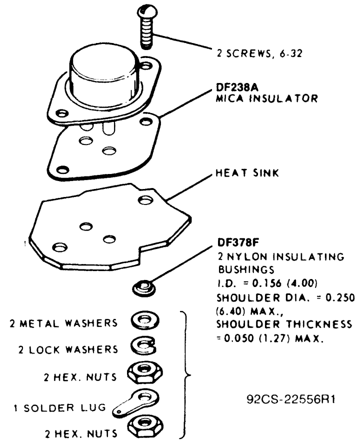
TO-204MA/TO-3
TO-204AA



92CS-22558R2

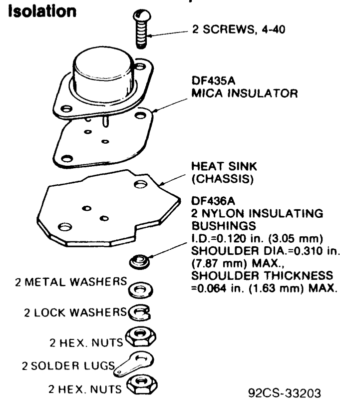
NOTE: MAXIMUM TORQUE APPLIED TO MOUNTING FLANGE IS 12 in. lbs. (0.14 kgf m).

TO-204AE



92CS-22556R1

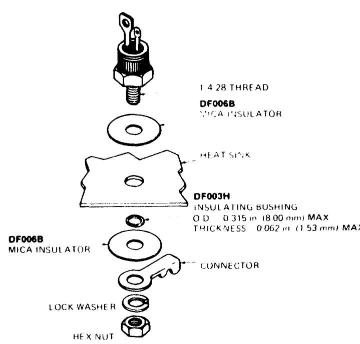
TO-204MA/TO-3
With 200-mil diameter pin Isolation



92CS-33203

NOTE: MAXIMUM TORQUE APPLIED TO MOUNTING FLANGE IS 8 in. lbs. (0.09 kgf m).

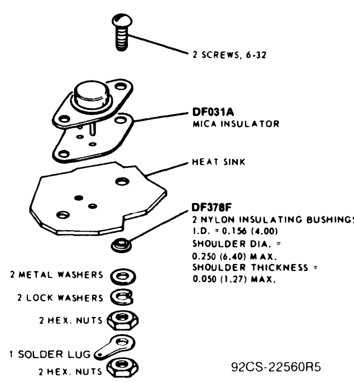
TO-208MA/TO-48



92CS-22640R2

Maximum torque: 50 in.-lb (0.58 kgf m)

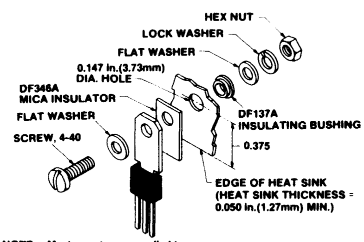
TO-213MA/TO-66



92CS-22560R5

Note: Maximum torque applied to mounting flange is 12 in.-lb. (0.14 kgfm)

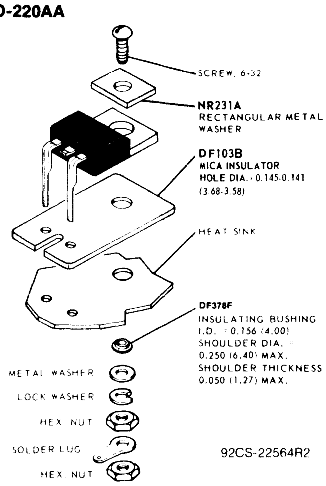
TO-202AB



NOTE: Maximum torque applied to mounting flange is 8 in.-lb (0.09 kgf-m)

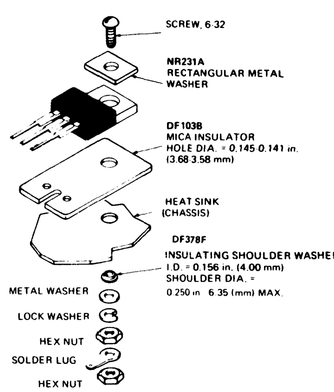
92CS-27777R1

TO-220AA



92CS-22564R2

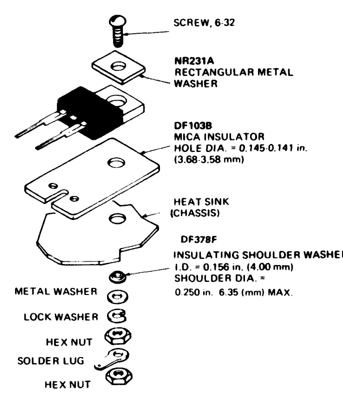
TO-220AB



92CS-34689

NOTE: MAXIMUM TORQUE APPLIED TO MOUNTING FLANGE IS 8 in.-lbs. (0.09 kgf m).

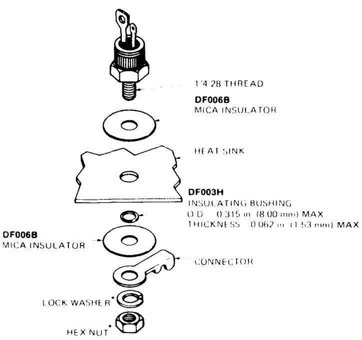
TO-220AC



92CS-34829

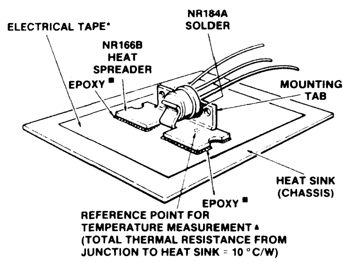
Suggested Hardware and Mounting Arrangements

Stud and Isolated-Stud Triacs and SCR's

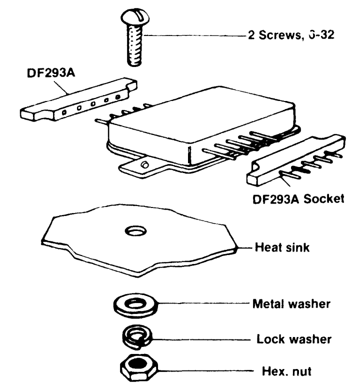


Maximum torque: 50 in.-lb (0.58 kgf-m)
*Only hardware required for Isolated-Stud package

"LOW-Profile TO-5" with Heat Spreader

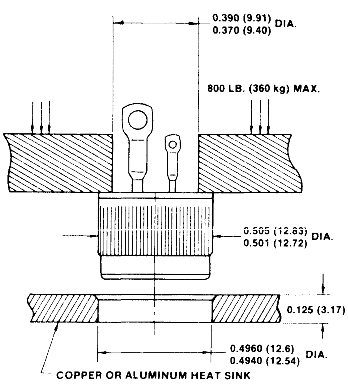


Power Hybrid Circuit Package

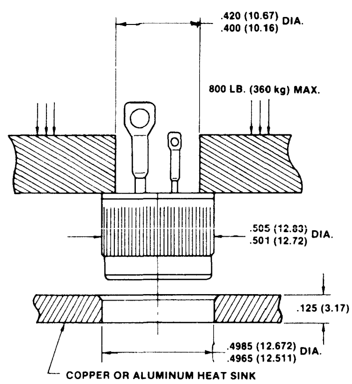


Note: Maximum torque applied to mounting flange is 24 in-lb (0.3 kgf-m).
DF293A is a socket to enable simple connection of this module. 92CS-27782RI

TO-203AA
6-, 10-, and 15-A Triacs, 20- and 35-A SCR's



Press-Fit
25-, 30-, and 40-A Triacs



Case-to-Heat Sink Thermal Resistance for Different Mounting Arrangements-Triacs and SCR's

Package	Type of Mounting Employed	Thermal Resistance-°C/W
Stud & Isolated-Stud	Directly mounted on heat sink with or without the use of heat-sink compound.	0.6
Stud	Mounted on heat sink with a 0.004 to 0.006 in. (0.102 to 0.152 mm) thick mica insulating washer used between unit and heat sink.	
	Without heat sink compound	2.5
	With heat sink compound	1.5
Press-Fit	Press-fitted into heat sink. Minimum required thickness of heat sink = 1/8 in. (3.17 mm).	0.5
	Soldered directly to heat sink, (60-40 solder which has a melting point of 188°C should be used. Heating time should be sufficient to cause solder to flow freely).	0.1 to 0.35

Press-Fit Triacs and SCR's

MOUNTING CONSIDERATIONS

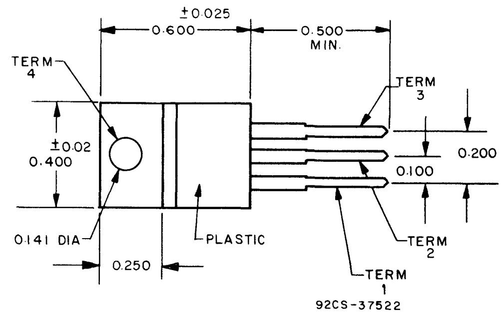
Mounting of press-fit package types depends upon an interference fit between the thyristor case and the heat sink. As the thyristor is forced into the heat-sink hole, metal from the heat sink flows into the knurl voids of the thyristor case. The resulting close contact between the heat sink and the thyristor case assures low thermal and electrical resistances.

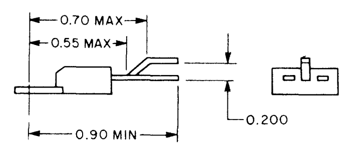
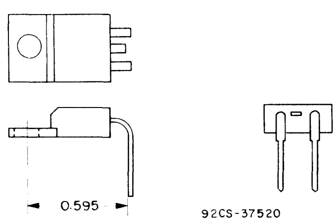
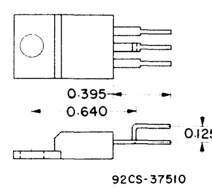
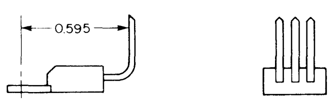
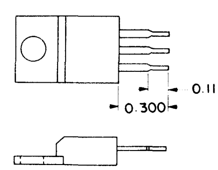
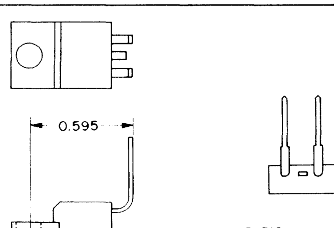
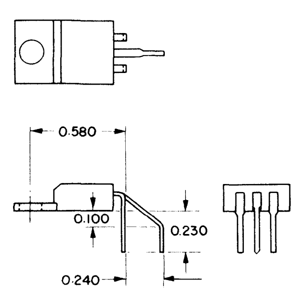
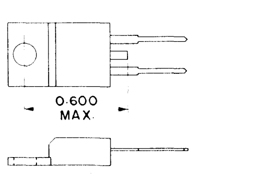
A recommended mounting method, Press-Fit (TO-203AA) or Press-Fit (25-, 30-, and 40-A triacs) shows press-fit knurl and heat-sink hole dimensions. If these dimensions are maintained, a "worst-case" condition of 0.0085 in. (0.2159 mm) interference fit will allow press-fit insertion below the maximum allowable insertion force of 800 pounds. A slight chamfer in the heat-sink hole will help center and guide the press-fit package properly into the heat sink. The insertion tool should be a hollow shaft having an inner diameter of 0.380 ± 0.010 in. (9.65 ± 0.254 mm) for PF-1 package, and 0.410 ± 0.010 in. (10.41 ± 0.254 mm) for PF-2 package and an outer diameter of 0.500 in (12.70 mm). These dimensions provide sufficient clearance for the leads and assure that no direct force will be applied to the glass seal of the thyristor.

The press-fit package is not restricted to a single mounting arrangement; direct soldering and the use of epoxy adhesives have been successfully employed. The press-fit case is tin-plated to facilitate direct soldering to the heat sink. A 60-40 solder should be used and heat should be applied only long enough to allow the solder to flow freely.

Lead Forms for RCA Plastic Power Packages

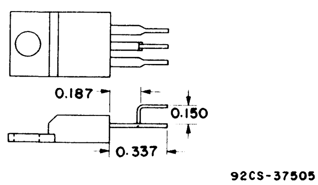
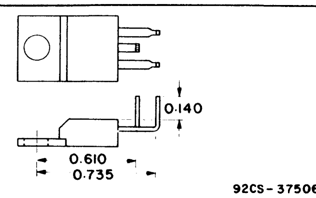
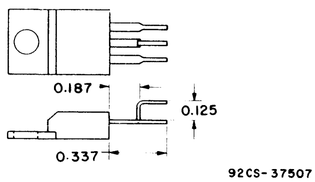
TO-220 (VERSAWATT)



Lead Form No.	Outline	Lead Form No.	Outline
6200		6226	
6201		6255	
6203		6258	
6204		6261	
6206			

Lead Forms for RCA Plastic Power Packages

TO-220 (VERSAWATT) [cont'd]

Lead Form No.	Outline	Lead Form No.	Outline
6263		6265	
6264			

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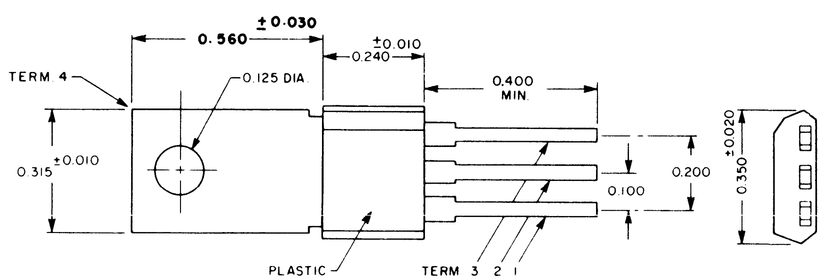

Top View

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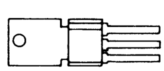
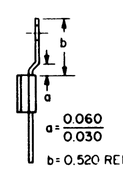
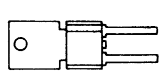
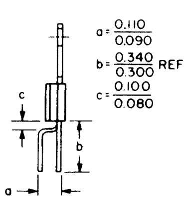
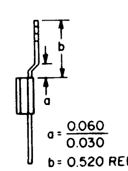
Type 1		Type 12	
Type 3			
Type 11		Type 32	

Application Note Abstracts

Power Transistors

AN-4509 ....8 pages
Compact 5-Volt Power Supplies Using High-Voltage Power Transistors
The use of low-cost, industrial-type, high voltage power transistors and fast-recovery rectifiers to achieve size and weight reductions and efficiency improvements in 5-volt dc power supplies with output currents of 50 amperes or more are discussed. The supplies described, like those used in high-reliability aerospace applications, use switching rather than dissipating regulators to eliminate the need for a 60-Hz power transformer and heat sinks for the transistors. A complete switching-regulator power supply is described in detail.

AN-4573 ....6 page
Testing for Forward-Bias Second Breakdown in Power Transistors
The design of a non-destructive forward-bias second-breakdown test facility that determines the forward-bias second-breakdown safe-operating locus for power transistors is described. Detailed schematic diagrams of test circuits that can be used to test devices with collector-current ratings up to 2.5 amperes and sustaining collector-to-emitter voltage [V_{CEO}(sus)] ratings up to 300 volts, or with ratings to 5 amperes and 100 volts, are given.

AN-4612 ....4 pages
Thermal-Cycling Rating System for Silicon Power Transistors
The basic causes of thermal fatigue in silicon power transistors are analyzed, and a rating chart that makes it possible for a circuit designer to avoid such failures during the operating life of his equipment is described. Examples are provided on the use of this chart to determine the transistor operating conditions required to assure a desired thermal-cycling capability and to determine whether the thermal-cycling capability is adequate for the requirements of a given application.

AN-6145 ....8 pages
A Test Set for Nondestructive Safe-Area Measurements Under High-Voltage, High-Current Conditions
The determination of the safe-operating area of power transistors at high volt/ampere products under pulsed and repetitive-pulsed conditions, nondestructively, is made possible by the test set described in this Note. System philosophy, design, construction, and operation are detailed.

AN-6163 ....12 pages
Quantitative Measurement of Thermal-Cycling Capability of Silicon Power Transistors
This Note discusses the methods used to test the thermal-cycling capability of power transistors. A brief description of thermal fatigue, application requirements, and rating charts is given. A detailed discussion of the practical design and construction of thermal-cycling racks is also included along with actual test conditions for various power transistor types. Acceleration factors, failure indicators, failure mechanisms, and real-time control of thermal-cycling capability of factory products are discussed. Some information is also given on hermetic versus plastic-package thermal-cycling reliability.

AN-6249 ....6 pages
Real-Time Controls of Silicon Power-Transistor Reliability
This Note compares the traditional, classical approach to the reliability-assurance testing of power transistors with a newer classification of testing: Real-Time Control, RTC. The classical approach is commonly referred to as Group B, and involves a series of mechanical, environmental, and life stress tests. RTC involves a continuous, systematic evaluation and control in "real time" of basic, potential failure mechanisms. It is an important supplement to a total program of reliability assurance.

AN-6281 ....6 pages
Accurate Measurement of Sustaining Voltage of Power Transistors — A Pulsed-Breakdown Test Set
Several techniques for the measurement of the primary (sustaining) breakdown voltage of power transistors are in common use today. The characteristics and limitations of these test methods frequently make rapid and accurate sustaining-voltage readings on power transistors difficult or impossible. The test set described in this Note fills the need for accurate, laboratory-type, sustaining-voltage measuring equipment, although circuitry used in the test set design may be adapted to high-speed testing equipment as well. A complete parts list and calibration sequence are given.

AN-6320 ....8 pages
Radiation-Hardness Capability of RCA Silicon Power Transistors
The types of radiation damage that might be experienced by a power device and the tests used to determine the design most effective in preventing these types of damage are described.

AN-6330 ....12 pages
A Safe-Area Rating System for Power Inverters Handling Capacitive and Inductive Loads
Although transistor power inverters have classically been evaluated with resistive loads, the reliability of practical inverters often depends on inductive and capacitive loads and associated starting transient considerations. This Note describes a safe-area rating system for transistors and relates this system to self-excited single-transformer, self-excited double transformer, and driven inverters operating into resistive, capacitive, and inductive loads under both steady-state and starting conditions.

AN-6423 ....8 pages
Thirty-Watt (RMS) True Complementary — Symmetry Audio Amplifier Using BDX33 and BDX34 Darlington Transistors
Monolithic-silicon Darlington transistors designed for low- and medium-frequency power applications are especially suitable for audio-output applications. This Note describes the design and performance of an audio amplifier that incorporates such devices.

AN-6425 ....8 pages
Automatic Analyzer for Determining Safe Operating Area of Power Transistors
The safe operating area is one of the most important ratings of a power transistor, yet only a few methods exist to evaluate it. The method presented in this Note allows description of the safe operating area for both dc and pulse operation without subjecting the transistor to breakdown. Botn n-p-n and p-n-p transistors in hermetic or plastic packages can be evaluated, and the complete safe-area curve can be automatically described in a short time.

AN-6605 ....16 pages
Application of RCA Power Devices in Off-Line, High-Frequency Inverter/Converter Circuits
The current trend in power inverter/converter design is to use high-frequency switching techniques and direct operation off the available utility lines (i.e., 110 or 220 volts). The use of higher operating frequencies reduce the magnetic materials required and the size of the filter capacitors. This Note discusses the use of RCA power transistors and SCR's in selected high-frequency inverter/converter applications.

AN-6624 ....16 pages
Voltage Limitations of Power Transistors
This Note summarizes the primary factors that determine the voltage limitations of power transistors used in common-emitter circuits with typical base-to-emitter circuit terminations. The material presented defines terms and the various operating regions of the transistor as shown in typical volt-ampere characteristics, develops the analytic relations defining operation in each of the regions, and relates each of the operating regions to the physical actions taking place within the transistor structure.

AN-6679 ....32 pages
Theoretical Relationships in Capacitive-Discharge Ignition Systems
There has been both confusion and exaggeration concerning the electrical performance of capacitive-discharge, or CD, ignition systems. The theoretical relationships developed in this Note allow the analysis of the fundamentals of this type of ignition system and an evaluation of the maximum performance levels attainable. Three types of systems, the diode-clamped system, the free-ringing system (no diode clamp) and the free-ringing single-cycle system are analyzed and compared.

AN-6688 ....20 pages
A Practical Approach to an Audio-Amplifier Design
This Note discusses general considerations, design requirements, and performance for a 20-watt, hi-fi amplifier.

AN-6741 ....8 pages
RCA 15-Ampere SwitchMax Power Transistors in a 340-Watt 20kHz Flyback Converter
This Note describes the use of the RCA 2N6676, a 15-ampere SwitchMax power transistor, as a driven pulse-width-modulated fly-back-converter stage, the final power-output stage, in a 20-kHZ off-line power converter that provides 340 watts of output power. Adjunct circuitry, such as the driver stage, reverse-bias amplifier, and overvoltage and overcurrent protection circuits, are also discussed.

Application Note Abstracts

Power Transistors

AN-6743 . . . . 16 pages
900-Watt, Off-the-Line, Half-Bridge Converter Using Only Two 15-Ampere 'SwitchMax' High-Voltage Power Transistors
To examine and demonstrate the capabilities of RCA's new series of 'SwitchMax' power transistors in a typical switching application, a 900-watt half-bridge converter was constructed and studied. The circuit switches at a 20-kilohertz rate and with minimal alterations can operate from either 120 or 240 volts. It was built using conventional circuitry but in a non-compact modular format so that it would be easily accessible for instrumentation connections and component or design alteration. The power switches used are the RCA-2N6678 'SwitchMax' 15-ampere [$I_{CE(sat)}$] 450-volt (V_{CEX}) high-speed transistors.

AN-6744 . . . . 6 pages
Low-Cost High-Power Audio Amplifiers Using the RCA 8638 and RCA 9116 Transistor Families
This Note discusses the basic considerations and requirements for design of the output stage for class AB audio amplifiers using devices selected from the RCA 8638 and RCA9116 families, depending on the output desired. Operation with load impedances other than eight ohms is also discussed for the various power categories.

AN-6760 . . . . 12 pages
A 230-Watt, 40-kHz, Off-Line Forward Converter Using One SwitchMax Transistor
The increased availability of reliable high-current, high-voltage, fast switches, such as RCA's SwitchMax series devices, and the development of functional pulse-width-modulating integrated circuits have greatly reduced the cost of the off-line medium-power, high-frequency forward converters used in the production of precisely conditioned low-voltage power. This Note describes the possibilities of the forward-converter circuit and demonstrates the performance of the RCA 2N6673 SwitchMax transistor in a 230-watt 15-volt 15-ampere off-line converter operating at 40 kHz from a 120-volt 60-cycle line.

AN-6800 . . . . 6 pages
A Test Set for Measuring h_{fe} and f_T as a Function of Collector Current
This Application Note describes a technique and test circuit, the Swept-I_C Test Set, that measures the h_{fe} characteristic of a power transistor at a fixed test frequency while the collector current, I_C, is "swept," or varied, repetitively, at a linear rate, from zero to a predetermined maximum.

AN-6819 . . . . 8 pages
The SwitchMax Transistor
The SwitchMax transistor families, designed for high-frequency off-line switching power supplies, converters, switching regulators and pulse-widthmodulated amplifiers, are rated for 5, 10, 15, and 25-ampere operating currents. They have high safe-operating-area (SOA) ratings in both the forward-bias and inductive turn-off (clamped $E_{S/b}$) modes. These capabilities are combined with V_{CEO} ratings of up to 500 volts, and V_{CEV} ratings to 1000 volts.

AN-6820 . . . . 8 pages
Typical Switching Speed Versus Temperature Data for SwitchMax Transistors Under Non-JEDEC Conditions
Since the introduction of the SwitchMax power-transistor line in 1978, a great amount of study of device behavior in special situations has resulted in the accumulation of a large volume of switching-speed data on hundreds of devices. This Note distills the data into a qualitative picture of SwitchMax-device performance at other than JEDEC-registered switching-test conditions.

AN-6827 . . . . 4 pages
40-Watt Automotive Audio-Power Booster
In recent years, there has been a growing demand for higher power-output capability in automotive tape and audio systems. One of the factors limiting output capability is the 12-volt automotive-system voltage. This Note describes the combination of a dc-to-dc regulated up-converter and a simple and economical output amplifier that will deliver 40 watts into a 4-ohm load.

AN-6828 . . . . 4 pages
In-Socket, High-Temperature, Dynamic Testing of Power Transistors
The measurement, at elevated temperatures, of dynamic parameters such as switching time, is a problem in in-chamber facilities because of the critical nature of lead length and dress. A solution to this problem, the approach described in this Note, involves the location of a source of heat at the socket of the device under test. This "hot-socket" method, in which controlled amounts of power are supplied to the socket heaters, is adaptable to curve-tracer measurements where IR drops are critical at high current. Kelvin connections are used at the collector and emitter terminals, mandating a five-terminal socket.

AN-6857 . . . . 4 pages
20-Ampere Monolithic-Darlington Power Transistors in a Sine-Wave-Inverter Output Stage
This Note describes the use of the type 2N6284 power transistor, a 20-ampere, n-p-n, monolithic darlington, and its complement, the type 2N6287 (p-n-p), as low-cost high-output-power single-ended power inverters. Either transistor can be used with equivalent performance results; the choice of type is dependent only upon the polarity of the dc voltage supply available.

An-6866 . . . . 6 pages
Practical Aspects of Voltage-Breakdown Testing of Power Transistors and Darlingtons
In specifying voltage-breakdown requirements for power transistors and power darlingtons, a customer will choose a limit which he feels will protect his application. However, during the testing of the product to verify this limit, either the manufacturer or the customer may damage the device. This Note reviews the common methods of measurement of avalanche breakdown voltage. It points out why damage occurs to power transistors as a result of these measurements and suggests methods that may reduce the incidence of damage. The Note also points out that avalanche breakdown testing is performed at voltages beyond the maximum ratings of the device and that such testing should only be undertaken after all necessary precautions have been taken, and with a complete understanding of the risks.

AN-6896 . . . . 8 pages
Safe Operating Area and the Design of Reliable Audio Power Amplifiers
The reilability of an audio power amplifier can depend on the designer's understanding of the Safe Operating Area, SOA, of the transistors employed, and his freedom to implement safeguards against the failure of those devices. The designer can overcome the limits placed by economics and other factors on this freedom, while assuring optimum reliability and performance from his designs, by working within the constraints imposed by the SOA ratings. This Note discusses the use of these ratings through example, and the protection circuits required in a proper design.

AN-6904 . . . . 12 pages
One-Hundred-Watt True-Complementary-Symmetry Audio Amplifier Using BD750 and BD751 Silicon Transistors
The BD750 and BD751 series of power transistors are complementary p-n-p and n-p-n series, respectively, selected from the ballasted epitaxial-base silicon transistor families, RCA8638 and RCA9116. They feature high-dissipation capability, low saturation voltage, maximum safe-operating area, a gain-bandwidth product (f_T) higher than 4 MHz, and high gain at high current levels. The transistors are especially suitable for use in the output stage of true-complementary high power audio amplifiers.

Power Hybrid Circuits

AN-4483 . . . . 6 pages
General Application Considerations for the RCA-HC2000H Hybrid Linear Power Amplifier
This Note briefly describes the RCA HC-2000H hybrid linear amplifier and discusses such operating considerations as dc and ac power dissipation, efficiency as a function of frequency, protection against excessive load variations and reactive loads, and heat-sink requirements.

AN-4782 . . . . 6 pages
General Application Considerations for the RCA-HC2000H Power Hybrid Operational Amplifier
The RCA-HC2000H is a power hybrid operational amplifier that can deliver 100 watts rms to a 4-ohm load at a maximum peak current of 7 amperes. It operates from a maximum power-supply voltage of 75 volts (single ended) or ±37.5 volts (split). The low-profile package is light in weight and can be used with either printed-circuit-board connections or commercially available 0.110-inch quick-disconnect push-on terminals. This Note briefly describes the HC2000H and discusses some general application considerations for this amplifier.

Application Note Abstracts

Thyristors (SCR's and Triacs)

AN-3697 .... 8 pages
Triac Power-Control Applications
This Note describes triac operating characteristics and provides guidance in the use of triacs in specific applications: incandescent lamp controls, light-activated controls, motor controls, heat controls, and a proportional integral-cycle control.

AN-4242 .... 16 pages
A Review of Thyristor Characteristics and Applications
This Note describes the operation, ratings, characteristics and typical applications of thyristors. The basic operation of a thyristor is explained by use of a two-transistor analogy. The significance of voltage and temperature ratings is pointed out. Thyristor gate characteristics, switching behavior, and triggering techniques are described. Use of thyristors in typical power-control applications is discussed.

AN-4745 .... 6 pages
Analysis and Design of Snubber Networks for dv/dt Suppression in Thyristor Circuits
When a triac is used to control an inductive load, voltages with high rates of change (dv/dt) can be generated that can cause a non-gated turn-on of the triac. The result is a loss of control of power to the load. The simplest method of suppressing this dv/dt stress is to place a series RC network across the main terminals of the triac. The design of this network, commonly called a snubber network, must take into account the peak voltage that can be allowed in the circuit and the maximum dv/dt stress that the device can withstand. This Note analyzes the RC network design and contains graphs that allow a designer to select a snubber to fit a given application.

AN-6054 .... 6 pages
Triac Power Controls for Three-Phase Systems
The growing demand for solid-state switching of ac power in heating controls and other industrial applications has resulted in the increasing use of triac circuits in the control of three-phase power. This Note explains a basic approach to the design of triac control circuits for use in the switching of three-phase power. The basic design rules employed in this approach are outlined, an integrated-circuit zero-voltage switch specifically intended for use in triac triggering is briefly described, and the necessity for, and methods of isolation of, the dc logic circuitry in power controls for three-phase systems are pointed out. Recommended configurations are then shown for power-control circuits intended for use with both inductive and resistive balanced three-phase loads, and the specific design requirements for each type of loading condition are discussed.

AN-6096 .... 8 pages
Solid-State Approaches to Cooking-Range Control
As a result of decreasing semiconductor costs, advanced system-cost analysis by appliance manufacturers, and increased consumer consciousness, various solid-state range-control designs can be applied in today's appliance market. This Note presents various solid-state design approaches available to the range-control designer.

AN-6141 .... 6 pages
Power Switching Using Solid-State Relays
Solid-state relays make use of a semiconductor device for control of ac or dc power. Since, in most ac applications, the semiconductor element chosen for power control is the triac, this Note describes the triac as a power-switching element. Advantages and disadvantages of the active element over the electromechanical relay are discussed in general terms. Basic parameters, such as surge in-rush capability, transient-voltage ratings, suppression network, turn-off consideration and the different modes of triac gating are also discussed. AC power control is covered by various circuit designs for ON/OFF control, zero-voltage switching, and line-voltage isolation.

ICAN-6182 .... 28 pages
Features and Applications of RCA Integrated-Circuit Zero - Voltage Switches (CA3058, CA3059 and CA3079)
RCA-CA3058, CA3059 and CA3079 zero-voltage switches are monolithic integrated circuits designed primarily for use as trigger circuits for thyristors in ac power-control and power-switching applications.

These integrated-circuit switches operate from ac input voltages of 24, 120, 208 to 230, or 277 volts at 50, 60, or 400 Hz. Zero-voltage switches trigger the thyristors at zero-voltage points in the supply-voltage cycle. Consequently, transient load-current surges and radio-frequency interference are substantially reduced. Zero-voltage switches also reduce the rate of change of on-state current (di/dt) in the thyristor being triggered and can be adapted for use in a variety of control functions by use of an internal differential comparator to detect the difference between two externally developed voltages.

AN-6286 .... 8 pages
Latching, Gate-Trigger Circuits Using Thyristors for Machine Control Applications
This Note describes a variety of approaches to the development of a solid-state, latching gate drive for the control of ac loads; the solid-state device used is the thyristor. The solid-state circuits described have fewer undesirable characteristics than electro-mechanical devices and are smaller and lighter.

AN-6288 .... 2 pages
Thyristors in Capacitive Discharge (CD) Ignition Systems
This Note describes the requirements of small-engine ignition systems (those deriving electrical energy from a flywheel alternator system), automotive or battery-powered systems, and the ac line-operated igniters. The merits of both capacitive and inductive systems are compared. Both systems are described in terms of performance and limitations. Practical circuits are shown.

AN-6438 .... 24 pages
Surge Capability of SCR's, Triacs, and Rectifiers
This Note provides the designer with an easy way to derive, from the published sinusoidal capability of any semiconductor, its triangular surge capability for stress durations between 0.5 and 20 milliseconds, and thereby helps him select the most suitable fuse to protect the semiconductor of interest.

AN-6452 .... 16 pages
A New Practical Fuse-Thyristor Coordination Method
This Note describes the possibilities of protecting a semiconductor by fusing—when and how a fuse can be used and how much protection is afforded. Cases for which fuse protection is not possible, or for which only partial protection is feasible are also discussed. Fuse selection methods are described.

AN-6687 .... 6 pages
Latching Voltage and Current in Thyristors
Triacs are normally used for the switching of ac load current in on-off applications and for phase control of power to a load. Their design permits gating signals of positive or negative polarity with respect to main terminal one to initiate turn-on of load currents of either polarity. However, the gate triggering sensitivity and turn-on requirements in each of the four modes are normally not equal, and there may be preferred modes of operation

The purpose of this Note is to describe the sensitivity levels of each mode relative to turn on, and to relate preferred modes of operation of RCA triacs to circuit applications.

AN-6689 .... 12 pages
Circuit-Commutated Turn-Off Time of Thyristors
Thyristor turn-off is one of the most difficult semiconductor parameters to determine because of its strong dependency on many variables, such as junction temperature, gate bias, and anode-voltage and anode-current waveforms. Because of this strong dependency, it makes no sense to specify the turn-off time of a thyristor without specifying precisely the conditions under which that time was determined. But it is impossible to choose a set of conditions that will match the interests of all present or potential purchasers of the device. Therefore, the need for a new concept for measuring the circuit commutated turn-off time of thyristors.

The turn-off-time measurement method described in this Note is very different from the conventional, complex turn-off-time specification mentioned above; it is a very basic method intended to measure the turn-off time as a simple parameter under conditions that are not critical for measurement precision and that can be easily reproduced by any thyristor user. Data are provided to assure correct interpretation of the new measurement, inherent turn-off-time, T_{Qi}.

AN-6936 .... 8 pages
Triac Gate Characteristics and Drive Considerations
This Note provides information concerning more reliable pulsed triggering of RCA triacs. It describes triac gate triggering and employs equivalent circuits to illustrate the gate trigger process. Gate characteristics of the triac are discussed and the critical turn-on period is defined. Data is presented showing the time dependence of gate drive, the relationship between gate sensitivity and main-terminal voltage, and the dependence of latching current on gate drive current. Finally, recommendations are given for safe, reliable pulse firing.

Explanation of Power MOSFET Switching Characteristics

Switching Characteristics

A Power MOSFET is usually considered as a gate-voltage controlled device. In reality, an appreciable current must be provided in order to switch the device. In measurements of the switching characteristics of RCA power MOSFETs, the gate current is used as the input parameter.

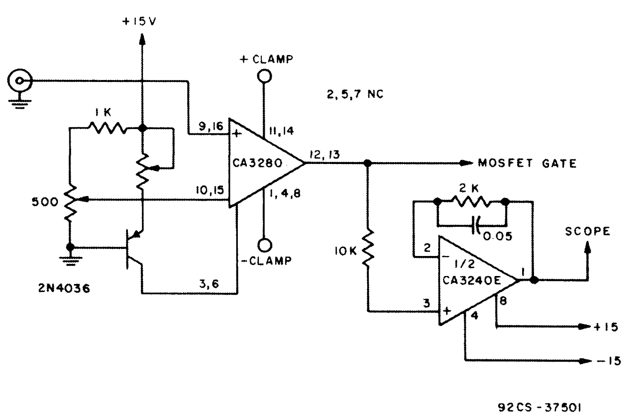
A family of curves is presented for a constant load resistance with V_{DD} varied. Gate drive during switching transitions is a constant current with voltage compliance limits of 0 and 10 volts (0 and 5 volts for L^2FETs). This new format is a plot of drain voltage and gate voltage as a function of normalized time. Time is normalized by the value of gate driving current. The normalization shows excellent agreement with data over five orders of magnitude, and is bounded on one extreme by gate propagation effects and on the other by transition time self-heating (typically tens of nanoseconds to hundreds of microseconds).

Test Circuit — The heart of the switching-time test circuit is an RCA CA3280 integrated-circuit operational transconductance amplifier (OTA) operated as a comparator. An OTA is a current output circuit where the output current and output transconductance are programmed by the amplifier bias current (I_{ABC}). Internal chip circuit feedback assures an extremely high output impedance within a compliance range established by the supply voltages. The CA3280 is actually two OTA's in parallel.

A value of I_{ABC} is established from the collector of a 2N4036 transistor. The current into the load (the gate of the MOSFET under test) may be varied between $+I_{ABC}$ and $-I_{ABC}$ times a constant of proportionality (approx. a0.9). The actual value depends upon the input differential input voltage. As a comparator, the differential voltage is large, resulting in saturated behavior of $\pm I_{ABC}$. If the gate voltage comes within a volt of the rail voltages, this current goes to zero, producing a clamping voltage. These supply voltages are adjusted to clamp 0 volts and +10 volts for the normal n-channel MOSFET (0 volts and +5 volts for L^2FETs). The behavior of the CA3280 IC is excellent from submicroamperes to about 2-1/2 ma. Higher current may be achieved by stacking many CA3280 packages atop one another and soldering the leads to parallel the chips rather than wiring many sockets. This arrangement may require an increase in the bypass capacitor values.

An RCA CA3240E BiMOS input op amp is used as a unity-gain follower. Otherwise, the 1-megohm or 10-megohm shunting impedance of the scope would load the high-impedance circuitry associated with the MOSFET gate.

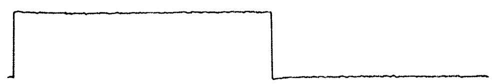
Test Conditions and Waveforms — The input test signal applied to the CA3280 OTA is supplied by a pulse generator set for an on-time duration of 50 μs and a repetition rate of approximately 25-ms (about 0.2% duty cycle). The $\pm$ clamp voltages are set to the appropriate values. The power MOSFET load resistor is chosen to equal the maximum rated voltage divided by the maximum rated current.



Test circuit used to measure switching characteristics of RCA power MOSFETs.

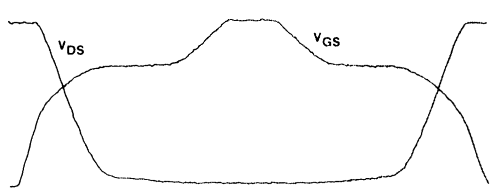
Explanation of Power MOSFET Switching Characteristics

Test waveforms for measurement of switching characteristics of standard power MOSFETs. (Time base for waveforms is 100 microseconds full scale.)

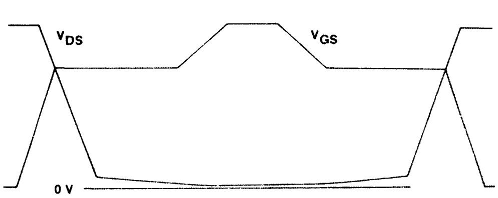


Input test signal applied to CA3280 (2 volts peak).

Power MOSFET gate-current waveform (±1 mA).



Power MOSFET gate voltage (10 volts peak) and drain voltage (150 volts peak-to-peak) waveforms.



Linear approximation of power MOSFET gate- and drain-voltage waveforms.

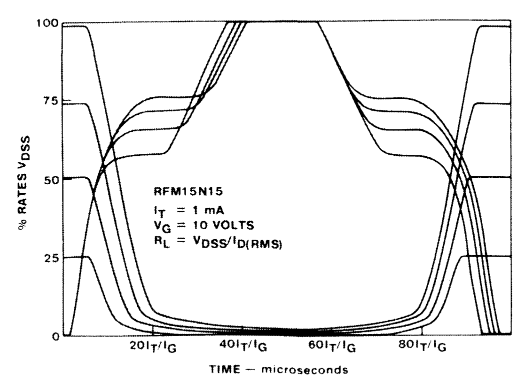
With a low value of drain supply voltages, the gate voltage is observed while adjusting I_{ABC}. A convenient set of conditions occurs when a short dwell time of several microseconds exists at the + 10-volt level (+ 5-volt level for L^2FETs). Minor adjustments may be desired for I_{ABC} as the drain supply voltage is increased to the maximum rate value.

There are some features of the gate and drain voltage waveforms which should be noted.

1. The waveforms during the positive gate current time are symmetrical to those during the negative gate current time.

   Exceptions occur for very fast or very slow switching, and for non-symmetrical current drive.
2. The drain voltage waveform contains a rather steep slope with a fairly constant dv/dt over most of the drain voltage excursion.
3. The drain voltage contains a rather shallow slope with a fairly constant dv/dt over the remainder of the drain voltage excursion.
4. The drain transition voltage (defined as the intercept of the gate and drain voltage curves above two near straight lines) typically occurs when the drain voltage equals the sum of the gate voltage (at that instant of time) plus the product of the drain current times $r_{DS(on)}$.
5. The gate voltage waveform contains three near straight line segments during the positive gate current transition time.

Family of Characterization Curves — The published switching data on RCA power MOSFETs include a family of gate and drain voltage curves in which the drain supply voltage is fixed at four values. The ordinate is 10 volts (5 volts for L^2FETs) full scale for the gate voltage and is normalized to 100% of the maximum rated drain-voltage curves. All four sets of

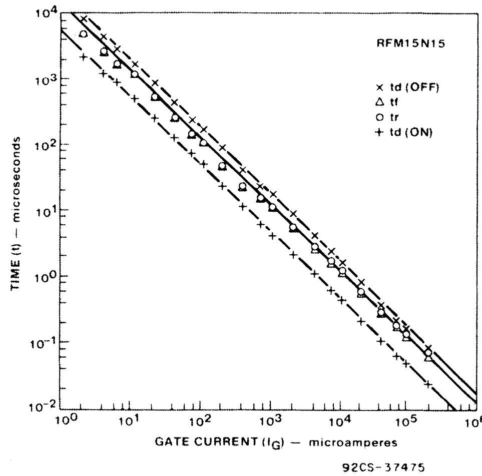


Family of switching-characterization curves for an RCA power MOSFET.

Explanation of Power MOSFET Switching Characteristics

curves are taken with a predetermined gate current, $\pm I_T$. The abscissa is also normalized to 100 (I_T/I_G) microseconds full scale, where I_G is the actual gate drive current. With this family of characteristic curves, switching behavior may be readily predicted for almost any driving circuit provided the load is resistive.

Characterization-Curve Limits — The gate and drain voltage switching waveforms can be scaled in an inverse manner with gate current. This scaling shows that the switching-time range over which the characterization can be applied is very impressive. For gate currents of the order of amperes, the device response will be slowed by gate propagation delay. This delay, of course, degrades the linear switching relationship to gate current. The characterization, however, is valid over many decades of gate current so that all but a very few applications can be described by the family of switching characterization curves.



Linearly, sealed correlation curves show that switching characterization curves are valid over five decades of gate current.

Asymmetrical Current Drive — The positive and negative gate drive will often be dissimilar. The scaling of course must reflect this condition. At other times, the gate current varies with amplitude. This is always true when driving from a pulse generator of fixed resistance. Piece-wise linear methods will yield the gate current, which will permit the proper piece-wise linear scaling. This could be done in the following manner:

1. Mark eleven small x's along the gate waveform, dividing it into 10 equal voltage segments; for example, $V_S = 0, 1, 2, \ldots 9, 10$ volts.
2. Draw a vertical line through each X the full height of the gate waveform, creating 10 time segments.
3. If the driving-pulse amplitude is 0 to 10 volts with an internal resistance of 100 ohms, the piece-wise linear gate current for each time segment can be calculated, $I_{g1} = (10\text{-}0.5)/100 = 95$ mA, $I_{g2} = (10\text{-}1.5)/100 = 85$ mA, etc.
4. Then each waveform is scaled within the pertinent time segment by the proper gate current.
5. Smooth the curves.
6. Create 10 more time segments for the right half of the gate waveform corresponding to an average gate voltage of 9.5, 8.5, . . . 1.5, 0.5 volts. Call these segments 11, 12, . . . 19, 20.
7. In that the pulse-generator voltage is now zero volts, calculate I_g as:
   $I_g 11 = (0\text{-}9.5)/100 = -95$ mA, $I_{g12} = (0\text{-}8.5)/100 = -85$ mA, etc.
8. Repeat 4 and 5. L^2FETs would be treated with smaller voltage segments.

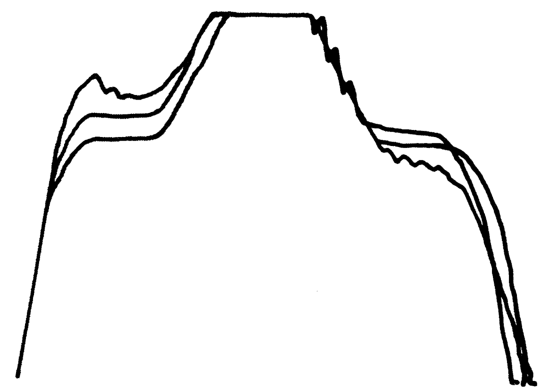
Generally, the gate-voltage plateau will not be located at the middle of the pulse-generator amplitude (5 volts). As a result, rise and fall times measured this way experience differing gate currents and are "non-symmetrical". This type of measurement will also lead one to observe temperature sensitivities, load-current sensitivities, and device-to-device variability, all of which are more circuit dependent than device dependent.

Explanation of Power MOSFET Switching Characteristics

Gate-Voltage Propagation Effects — Most power-MOSFET applications need switch no faster than tenths of a microsecond. Should faster switching be required, it must be understood that the power MOSFET appears as a distributed network of many cells when used for very fast switching.

The thousands of individual MOSFET cells are connected in parallel with highly conductive metal for the sources and drains. However, the gates are paralleled with a moderately conductive film of doped polysilicon. As a result, a very steep voltage wavefront applied to the gate pad will bias those cells close by, but a delay will occur for turn on or turn off. Because of the nonlinear "input capacitance" of each cell, the delay cannot be characterized by a pure number of so many nanoseconds.

At present, most manufacturers characterize typical switching speed for a single test condition. The test conditions are usually chosen to present the most favorable result. Therefore, this is usually near the upper limit of usefulness.



Curves show the increasing effect of gate-voltage propagation.

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