TOSHIBA

DATA BOOK

VOLTAGE REGULATOR

1989

Preface

Most of electronic equipment ranging from such consumer equipment as VTR, color TV set, audio equipment to industrial equipment such as communication equipment, measuring equipment, OA machines have built-in power supply circuits incorporating various functions. For power supply circuits, not only improvement of control performance and further promotion of efficiency but also reduction in the number of components for miniaturization of equipment and cost reduction have been strongly demanded.

At present, Toshiba provides plentiful line-ups of power ICs ranging from three-terminal regulators, multi-functional regulators to switching regulator control ICs for the above-mentioned applications.

The line-ups of these power ICs have been further repleted this time as new items have been added. This manual has been compiled as "Regulator ICs Data Book" for your further favors. We shall be glad if this book serves as an aid for your designing electronic equipment.

The application examples contained in this manual are presented only as reference examples for use of Power ICs and no responsibility is assumed by Toshiba for problems relative to patents, which may result from their use. Any inquiries regarding the engineering contents of this manual shall be referred to the following section:

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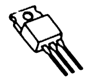
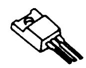
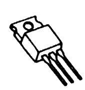
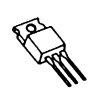
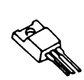
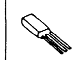
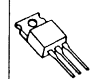
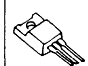
VOLTAGE REGULATOR

CONTENTS

1. Selection Guide

Three−Terminal Regulators

Polarity	Type Name	Vout TYP. (V)	Iout MAX. (mA)	V_{IN} MAX. (V)	V_{DROP} TYP.(V)	I_B TYP.(mA)	Tolerance	Pc Ta=25℃ (W)	Package	Equivalent	Outline
Positive Voltage Output	TA78DS05P TA78DS10P	5 10	30	60	0.2 (Io=10mA) Low Dropout	0.5	±10%	0.8	TO-92MOD		
	TA78DL05P TA78DL06P TA78DL08P TA78DL09P TA78DL10P TA78DL12P TA78DL15P	5 6 8 9 10 12 15	250	60	0.4 (Io=200mA) Low Dropout	0.5	±10%	Ta=25℃ : 1.5 Tc=25℃ : 20.8	TO-220AB		
	TA78DL05S TA78DL06S TA78DL08S TA78DL09S TA78DL10S TA78DL12S TA78DL15S	5 6 8 9 10 12 15	250	60	0.4 (Io=200mA) Low Dropout	0.5	±10%	Ta=25℃ : 2.0 Tc=25℃ : 20.8	TO-220IS		
	TA78L05S TA78L07S TA78L08S TA78L09S TA78L10S TA78L12S TA78L15S	5 7 8 9 10 12 15	100	35	1.7 (Io=40mA)	3	±4%	0.6	TO-92	78LXX	
	TA78L05F TA78L06F TA78L08F TA78L09F TA78L10F TA78L12F TA78L15F TA78L18F TA78L20F TA78L24F	5 6 8 9 10 12 15 18 20 24	150	35 40	1.7 (Io=40mA)	4	±5%	0.5	SOT-89	78LXX	
	TA78L005AP TA78L006AP TA78L007AP TA78L075AP TA78L008AP TA78L009AP TA78L010AP TA78L012AP TA78L132AP TA78L015AP TA78L018AP TA78L020AP TA78L024AP	5 6 7 7.5 8 9 10 12 13.2 15 18 20 24	150	35 40	1.7 (Io=40mA)	4	AP : ±4%	0.8	TO-92MOD	78LXX	
	TA78M05P TA78M06P TA78M08P TA78M09P TA78M10P TA78M12P TA78M15P TA78M18P TA78M20P TA78M24P	5 6 8 9 10 12 15 18 20 24	500	35 40	1.7 (Io=350mA)	5	±4%	Ta=25℃ : 1.5 Tc=25℃ : 20.8	TO-220AB	78MXX	
	TA78005AP TA78006AP TA78008AP TA78009AP TA78010AP TA78012AP TA78015AP TA78018AP TA78020AP TA78024AP	5 6 8 9 10 12 15 18 20 24	1,000	35 40	2.0 (Io=500mA)	5	±4%	Ta=25℃ : 1.5 Tc=25℃ : 20.8	TO-220AB	78XX	
	TA7805S TA7806S TA7808S TA7809S TA7810S TA7812S TA7815S TA7818S TA7820S TA7824S	5 6 8 9 10 12 15 18 20 24	1,000	35 40	2.0 (Io=500mA)	5	±4%	Ta=25℃ : 2 Tc=25℃ : 20.8	TO-220IS	78XX	
	TA76431S	Adjustable	Sink 150	37	—	0.4	±2%	0.8	TO-92MOD	431	

Polarity	Type Name	Vout TYP. (V)	Iout MAX. (mA)	V_{IN} MAX. (V)	V_{DROP} TYP.(V)	I_B TYP.(mA)	Tolerance	Pc Ta=25℃ (W)	Package	Equivalent	Outline
Negative Voltage Output	TA79L005P TA79L006P TA79L008P TA79L009P TA79L010P TA79L012P TA79L015P	−5 −6 −8 −9 −10 −12 −15	150	−35	1.7 (Io=40mA)	4	±4%	0.8	TO-92MOD	79LXX	
	TA79L018P TA79L020P TA79L024P	−18 −20 −24		−40							
	TA79005P TA79006P TA79008P TA79009P TA79010P TA79012P TA79015P	−5 −6 −8 −9 −10 −12 −15	1,000	−35	2.0 (Io=500mA)	5	±4%	Ta=25℃ : 1.5 Tc=25℃ : 20.8	TO-220AB	79XX	
	TA79018P TA79020P TA79024P	−18 −20 −24		−40							
	TA79005S TA79006S TA79008S TA79009S TA79010S TA79012S TA79015S	−5 −6 −8 −9 −10 −12 −15	1,000	−35	2.0 (Io=500mA)	5	±4%	Ta=25℃ : 2.0 Tc=25℃ : 20.8	TO-220IS	79XX	
	TA79018S TA79020S TA79024S	−18 −20 −24		−40							

PWM Control Circuits

Type Name	V_{IN} MAX.(V)	Iout MAX.(mA)	P_D (mW)	Outline	NOTE
TA76524P	40	100	750	DIP 16	SG3524 PIN Compatible
TA76494P/F	41/25	250/100	750/400	DIP 16/FLP 16	TL494 PIN Compatible

Multi Function Regulators

Type Name	Function	Vout TYP.(V)	Iout MAX.(mA)	V_{IN} MAX.(V)	P_D MAX.(W)	Outline	NOTE
TA7179P	Dual ±15V Tracking Regulator	±15	±100	±30	0.6	DIP 14	
TA7089P	General Purpose Voltage Regulator	3.3∼33	200	35	0.625	DIP 14	

2. Data Sheets

2-1 Three-Terminal Voltage Regulators

2-2 PWM Control Circuits

2-3 Multi Function Regulators

2. CONTENTS

2-1, Three-Terminal Voltage Regulators

○Positive Fixed Voltage Regulators

TA78005AP, TA78006AP, TA78008AP, TA78009AP, TA78010AP, TA78012AP, TA78015AP, TA78018AP, TA78020AP, TA78024AP

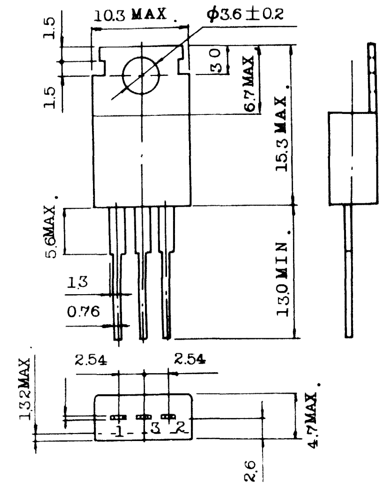
THREE TERMINAL POSITIVE VOLTAGE REGURATORS

5V, *6V, *8V, 9V, 10V, 12V, 15V, *18V, *20V, 24V

* Under development

- Suitable for C-MOS, TTL, the other Digital IC's Power Supply
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting
- Output Current in excess of 1A

Unit in mm



1. INPUT
2. OUTPUT
3. GND (CASE)

JEDEC	TO-220AB
EIAJ	SC-46
TOSHIBA	T3A-P

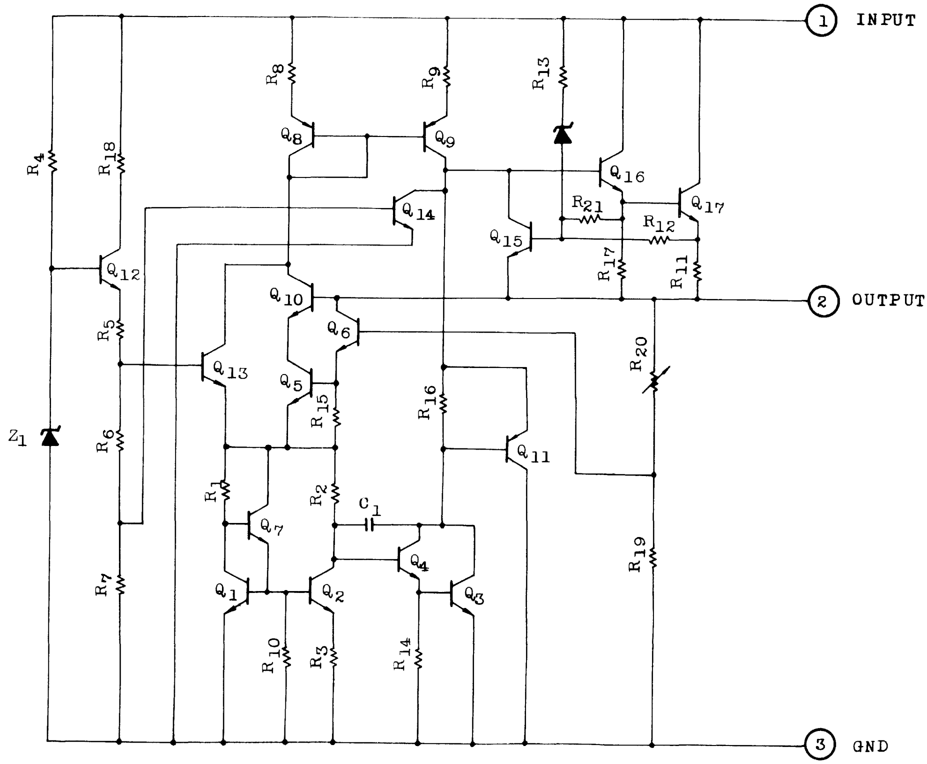
MOUNTING KIT No. AC75.

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage	TA78005AP ~ TA78015AP	V_{IN}	35	V
	TA78018AP ~ TA78024AP		40	
Power Dissipation (Note)		P_D	20.8	W
Operating Temperature		Topr	-30 ~ 75	°C
Storage Temperature		Tstg	-55 ~ 150	°C

Note : Tc=25°C

EQUIVALENT CIRCUIT



TA78005AP

ELECTRICAL CHARACTERISTICS (V_{IN}=10V, I_{OUT}=500mA, $0°C \leqq T_j \leqq 125°C$)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C, I_{OUT}=100mA		4.8	5.0	5.2	V
Input Regulation	Reg.line	1	T_j=25°C	$7.0V \leqq V_{IN} \leqq 2.5V$	-	3	100	mV
				$8.0V \leqq V_{IN} \leqq 12V$	-	1	50	
Load Regulation	Reg.load	1	T_j=25°C	$5mA \leqq I_{OUT} \leqq 1.4A$	-	15	100	mV
				$250mA \leqq I_{OUT} \leqq 750mA$	-	5	50	
Output Voltage	V_{OUT}	1	$7.0V \leqq V_{IN} \leqq 20V$ $5.0mA \leqq I_{OUT} \leqq 1.0A, P_O \leqq 15W$		4.75	-	5.25	V
Quiescent Current	I_B	1	T_j=25°C, I_{OUT}=5mA		-	4.2	8.0	mA
Quiescent Current Change	ΔI_B	1	$7.0V \leqq V_{IN} \leqq 25V$		-	-	1.3	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, $10Hz \leqq f \leqq 100kHz$ I_{OUT}=50mA		-	50	-	μV
Ripple Rejection	RR	1	f=120Hz, $8.0V \leqq V_{IN} \leqq 18V$ I_{OUT}=50mA, T_j=25°C		62	78	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, T_j=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	T_j=25°C		-	1.6	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, $0°C \leqq T_j \leqq 125°C$		-	-0.6	-	mV/deg

TA78006AP

ELECTRICAL CHARACTERISTICS (V_{IN}=11V, I_{OUT}=500mA, $0^{\circ}C \leq T_j \leq 125^{\circ}C$)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	$T_j=25^{\circ}C$, I_{OUT}=100mA		5.75	6.0	6.25	V
Input Regulation	Reg·line	1	$T_j=25^{\circ}C$	$8.0V \leq V_{IN} \leq 25V$	-	4	120	mV
				$9V \leq V_{IN} \leq 13V$	-	2	60	
Load Regulation	Reg·load	1	$T_j=25^{\circ}C$	$5mA \leq I_{OUT} \leq 1.4A$	-	15	120	mV
				$250mA \leq I_{OUT} \leq 750mA$	-	5	60	
Output Voltage	V_{OUT}	1	$8V \leq V_{IN} \leq 21V$ $5.0mA \leq I_{OUT} \leq 1.0A$, $P_O \leq 15W$		5.7	-	6.3	V
Quiescent Current	I_B	1	$T_j=25^{\circ}C$, I_{OUT}=5mA		-	4.3	8.0	mA
Quiescent Current Change	ΔI_B	1	$8.0V \leq V_{IN} \leq 25V$		-	-	1.3	mA
Output Noise Voltage	V_{NO}	1	$Ta=25^{\circ}C$, $10Hz \leq f \leq 100Hz$ I_{OUT}=50mA		-	55	-	μV
Ripple Rejection	RR	1	f=120Hz, $9V \leq V_{IN} \leq 19V$ I_{OUT}=50mA, $T_j=25^{\circ}C$		61	77	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, $T_j=25^{\circ}C$		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	$T_j=25^{\circ}C$		-	1.5	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, $0^{\circ}C \leq T_j \leq 125^{\circ}C$		-	-0.7	-	mV/deg

TA78008AP

ELECTRICAL CHARACTERISTICS (V_{IN}=14V, I_{OUT}=500mA, $0^\circ C \leq T_j \leq 125^\circ C$)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	$T_j=25^\circ C$, I_{OUT}=100mA		7.7	8.0	8.3	V
Input Regulation	Reg·line	1	$T_j=25^\circ C$	$10.5V \leq V_{IN} \leq 25V$	-	6	160	mV
				$11V \leq V_{IN} \leq 17V$	-	2	80	
Load Regulation	Reg·load	1	$T_j=25^\circ C$	$5mA \leq I_{OUT} \leq 1.4A$	-	12	160	mV
				$250mA \leq I_{OUT} \leq 750mA$	-	4	80	
Output Voltage	V_{OUT}	1	$10.5V \leq V_{IN} \leq 23V$ $5.0mA \leq I_{OUT} \leq 1.0A$, $P_O \leq 15W$		7.6	-	8.4	V
Quiescent Current	I_B	1	$T_j=25^\circ C$, I_{OUT}=5mA		-	4.3	8.0	mA
Quiescent Current Change	ΔI_B	1	$10.5V \leq V_{IN} \leq 25V$		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	$Ta=25^\circ C$, $10Hz \leq f \leq 100kHz$ I_{OUT}=50mA		-	70	-	μV
Ripple Rejection	RR	1	f=120Hz, $11.5V \leq V_{IN} \leq 21.5V$ I_{OUT}=50mA, $T_j=25^\circ C$		58	74	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, $T_j=25^\circ C$		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	$T_j=25^\circ C$		-	1.1	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, $0^\circ C \leq T_j \leq 125^\circ C$		-	-1.0	-	mV/deg

TA78009AP

ELECTRICAL CHARACTERISTICS (V_{IN}=15V, I_{OUT}=500mA, 0°C≦Tj≦125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C, I_{OUT}=100mA		8.64	9.0	9.36	V
Input Regulation	Reg.line	1	Tj=25°C	11.5V≦V_{IN}≦26V	-	7.0	180	mV
				13V≦V_{IN}≦19V	-	2.5	90	
Load Regulation	Reg.load	1	Tj=25°C	5mA≦I_{OUT}≦1.4A	-	12	180	mV
				250mA≦I_{OUT}≦750mA	-	4.0	90	
Output Voltage	V_{OUT}	1	11.5V≦V_{IN}≦2.6V 5.0mA≦I_{OUT}≦1.0A,Po≦15W		8.55	-	9.45	V
Quiescent Current	I_B	1	T_j=25°C, I_{OUT}=5mA		-	4.3	8.0	mA
Quiescent Current Change	ΔI_B	1	11.5V≦V_{IN}≦26V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz IOUT=50mA		-	75	-	μV
Ripple Rejection	RR	1	f=120Hz, 12.5V≦V_{IN}≦22.5V IOUT=50mA, Tj=25°C		56	72	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, Tj=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	Tj=25°C		-	1.0	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦Tj≦125°C		-	-1.1	-	mV/deg

TA78010AP

ELECTRICAL CHARACTERISTICS (V_{IN}=16V, I_{OUT}=500mA, 0°C≦T_j≦125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C, I_{OTU}=100mA		9.6	10.0	10.4	V
Input Regulation	Reg.line	1	Tj=25°C	12.5V≦V_{IN}≦27V	-	8	200	mV
				14V≦V_{IN}≦20V	-	2.5	100	
Load Regulation	Reg.load	1	Tj=25°C	5mA≦IOUT≦1.4A	-	12	200	mV
				250mA≦I_{OUT}≦750mA	-	4	100	
Output Voltage	V_{OUT}	1	12.5V≦V_{IN}≦25V 5.0mA≦I_{OUT}≦1.0A, P_o≦15W		9.5	-	10.5	V
Quiescent Current	I_B	1	T_j=25°C, I_{OUT}=5mA		-	4.3	8.0	mA
Quiescent Current Change	ΔI_B	1	12.5V≦V_{IN}≦27V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz I_{OUT}=50mA		-	8.0	-	μV
Ripple Rejection	RR	1	f=120Hz, 13.5V≦V_{IN}≦23.5V I_{OUT}=50mA, Tj=25°C		5.5	72	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, Tj=25°C		-	2.0	-	V
Short Circuit Current	I_{SC}	1	T_j=25°C		-	0.9	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦T_j≦125°C		-	-1.3	-	mV/deg

TA78012AP

ELECTRICAL CHARACTERISTICS (V_{IN}=19V, I_{OUT}=500mA, 0°C≦T_j≦125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C, I_{OUT}=100mA		11.5	12.0	12.5	V
Input Regulation	Reg.line	1	T_j=25°C	14.5V≦V_{IN}≦30V	-	10	240	mV
				16V≦V_{IN}≦22V	-	3	1 20	
Load Regulation	Reg.load	1	T_j=25°C	5mA≦I_{OUT}≦1.4A	-	12	240	mV
				250mA≦I_{OUT}≦750mA	-	4	120	
Output Voltage	V_{OUT}	1	14.5V≦V_{IN}≦27V 5.0mA≦I_{OUT}≦1.0A, P_o≦15W		11.4	-	12.6	V
Quiescent Current	I_B	1	T_j=25°C, I_{OUT}=5mA		-	4.3	8.0	mA
Quiescent Current Change	ΔI_B	1	14.5V≦V_{IN}≦30V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz I_{OUT}=50mA		-	90	-	μV
Repple Rejection	RR	1	f=120Hz, 15V≦V_{IN}≦25V I_{OUT}=50mA, T_j=25°C		55	71	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, T_j=25°C		-	2.0	-	V
Short Circuit Current	I_{SC}	1	T_j=25°C		-	0.7	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦T_j≦125°C		-	-1.6	-	mV/deg

TA78015AP

ELECTRICAL CHARACTERISTICS (V_{IN}=23V, I_{OUT}=500mA, 0°C≦T_j≦125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C, I_{OUT}=100mA		14.4	15.0	15.6	V
Input Regulation	Reg.line	1	T_j=25°C	17.5V≦V_{IN}≦30V	-	11	300	mV
				20V≦V_{IN}≦26V	-	3	150	
Load Regulation	Reg.load	1	T_j=25°C	5mA≦I_{OUT}≦1.4A	-	12	300	mV
				250mA≦I_{OUT}≦750mA	-	4	150	
Output Voltage	V_{OUT}	1	17.5V≦V_{IN}≦30V 5.0mA≦I_{OUT}≦1.0A, P_O≦15W		14.25	-	15.75	V
Quiescent Current	I_B	1	T_j=25°C, I_{OUT}=5mA		-	4.4	8.0	mA
Quiescent Current Change	ΔI_B	1	17.5V≧V_{IN}≧30V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz I_{OUT}=50mA		-	110	-	μV
Repple Rejection	RR	1	f=120Hz, 18.5V≦V_{IN}≦28.5V I_{OUT}=50mA, T_j=25°C		54	70	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, T_j=25°C		-	2.0	-	V
Short Circuit Current	I_{SC}	1	T_j=25°C		-	0.5	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦T_j≦125°C		-	-2.0	-	mV/deg

TA78018AP

ELECTRICAL CHARACTERISTICS (V_{IN}=27V, I_{OUT}=500mA, $0^{\circ}C \leq T_j \leq 125^{\circ}C$)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	$T_j=25^{\circ}C$, I_{OUT}=100mA		17.3	18.0	18.7	V
Input Regulation	Reg·line	1	$T_j=25^{\circ}C$	$21V \leq V_{IN} \leq 33V$	-	13	360	mV
				$24V \leq V_{IN} \leq 30V$	-	4	180	
Load Regulation	Reg·load	1	$T_j=25^{\circ}C$	$5mA \leq I_{OUT} \leq 1.4A$	-	12	360	mV
				$250mA \leq I_{OUT} \leq 750mA$	-	4	180	
Output Voltage	V_{OUT}	1	$21V \leq V_{IN} \leq 33V$ $5.0mA \leq I_{OUT} \leq 1.0A$, $P_O \leq 15W$		17.1	-	18.9	V
Quiescent Current	I_B	1	$T_j=25^{\circ}C$, I_{OUT}=5mA		-	4.5	8.0	mA
Quiescent Current Change	ΔI_B	1	$21V \leq V_{IN} \leq 33V$		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	$Ta=25^{\circ}C$, $10Hz \leq f \leq 100kHz$ I_{OUT}=50mA		-	125	-	μV
Ripple Rejection	RR	1	f=120Hz, $22V \leq V_{IN} \leq 32V$ I_{OUT}=50mA, $T_j=25^{\circ}C$		52	68	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, $T_j=25^{\circ}C$		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	$T_j=25^{\circ}C$		-	0.4	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, $0^{\circ}C \leq T_j \leq 125^{\circ}C$		-	-2.5	-	mV/deg

TA78020AP

ELECTRICAL CHARACTERISTICS (V_{IN}=29V, I_{OUT}=500mA, $0^{\circ}C \leq T_j \leq 125^{\circ}C$)

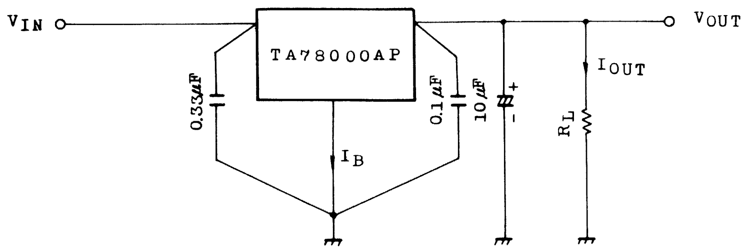
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	$T_j=25^{\circ}C$, I_{OUT}=100mA		19.2	20.0	20.8	V
Input Regulation	Reg·line	1	$T_j=25^{\circ}C$	$23V \leq V_{IN} \leq 35V$	-	15	400	mV
				$26V \leq V_{IN} \leq 32V$	-	5	200	
Load Regulation	Reg·load	1	$T_j=25^{\circ}C$	$5mA \leq I_{OUT} \leq 1.4A$	-	12	400	mV
				$250mA \leq I_{OUT} \leq 750mA$	-	4	200	
Output Voltage	V_{OUT}	1	$23V \leq V_{IN} \leq 35V$ $5.0mA \leq I_{OUT} \leq 1.0A$, $P_o \leq 15W$		19.0	-	21.0	V
Quiescent Current	I_B	1	$T_j=25^{\circ}C$, I_{OUT}=5mA		-	4.6	8.0	mA
Quiescent Current Change	ΔI_B	1	$23V \leq V_{IN} \leq 35V$		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	$Ta=25^{\circ}C$, $10Hz \leq f \leq 100kHz$ I_{OUT}=50mA		-	135	-	μA
Ripple Rejection	RR	1	f=120Hz, $24V \leq V_{IN} \leq 34V$ I_{OUT}=50mA, $T_j=25^{\circ}C$		50	66	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, $T_j=25^{\circ}C$		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	$T_j=25^{\circ}C$		-	0.4	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, $0^{\circ}C \leq T_j \leq 125^{\circ}C$		-	-3.0	-	mV/deg

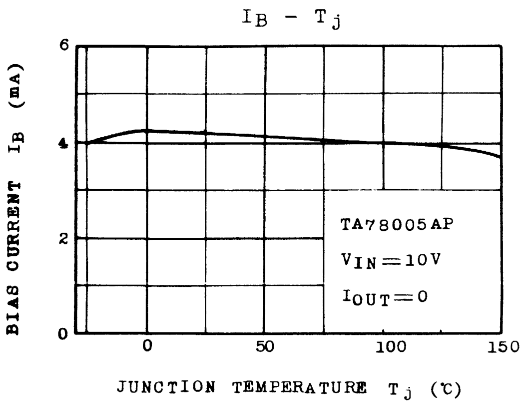
TA78024AP

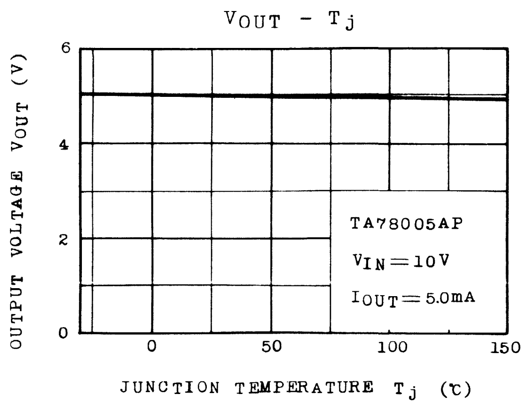
ELECTRICAL CHARACTERISTICS (V_{IN}=33V, I_{OUT}=500mA, 0°C ≦ T_j ≦ 125°C)

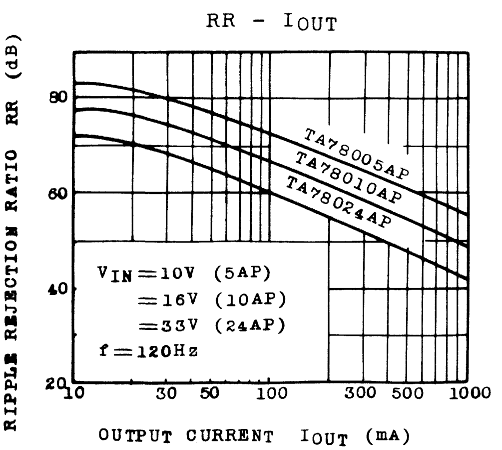
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C, I_{OUT}=100mA		23.0	24.0	25.0	V
Input Regulation	Reg.line	1	T_j=25°C	27V ≦ V_{IN} ≦ 38V	-	18	480	mV
				30V ≦ V_{IN} ≦ 36V	-	6	240	
Load Regulation	Reg.load	1	T_j=25°C	5mA ≦ I_{OUT} ≦ 1.4A	-	12	480	mV
				250mA ≦ I_{OUT} ≦ 750mA	-	4	240	
Output Voltage	V_{OUT}	1	27V ≦ V_{IN} ≦ 38V 5.0mA ≦ I_{OUT} ≦ 1.0A, Po ≦ 15W		22.8	-	25.2	V
Quiescent Current	I_B	1	T_j=25°C, I_{OUT}=5mA		-	4.6	8.0	mA
Quiescent Current Change	ΔI_B	1	27V ≧ V_{IN} ≦ 38V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz I_{OUT}=50mA		-	150	-	μV
Repple Rejection	RR	1	f=120Hz, 28V ≦ V_{IN} ≦ 38V I_{OUT}=50mA, Tj=25°C		50	66	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, T_j=25°C		-	2.0	-	V
Short Circuit Current	I_{SC}	1	T_j=25°C		-	0.3	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C ≦ T_j ≦ 125°C		-	-3.5	-	mV/deg

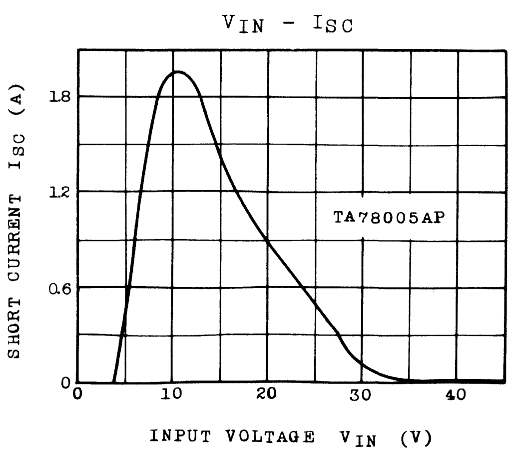
TEST CIRCUIT/STANDARD APPLICATION CIRCUIT

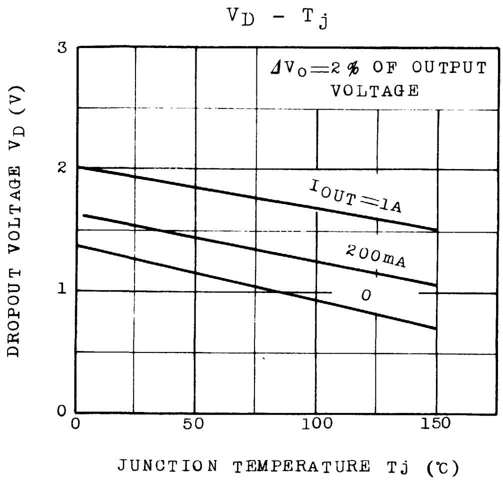


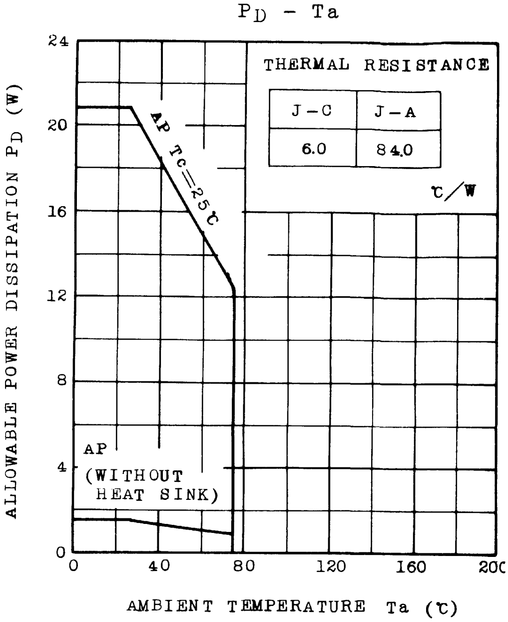


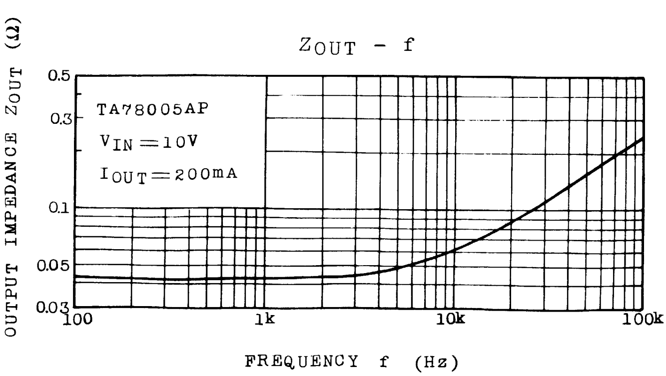







VD - Tj
ΔVO=2% OF OUTPUT VOLTAGE
IOUT=1A
200mA
0
DROPOUT VOLTAGE VD (V)
3
2
1
0
0
50
100
150
JUNCTION TEMPERATURE Tj (℃)

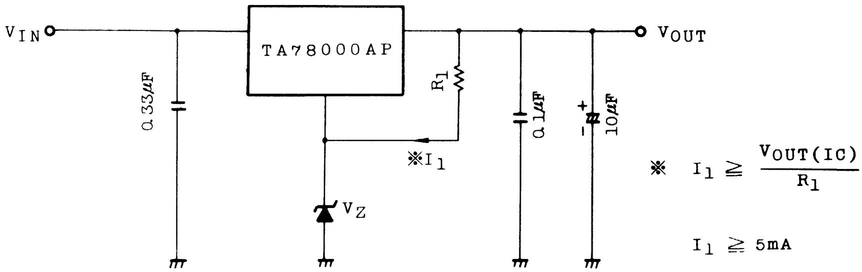

PD - Ta
THERMAL RESISTANCE
J-C
J-A
6.0
84.0
℃/W
AP Tc=25℃
AP (WITHOUT HEAT SINK)
ALLOWABLE POWER DISSIPATION PD (W)
24
20
16
12
8
4
0
0
40
80
120
160
200
AMBIENT TEMPERATURE Ta (℃)


ZOUT - f
TA78005AP
VIN=10V
IOUT=200mA
OUTPUT IMPEDANCE ZOUT (Ω)
0.5
0.3
0.1
0.05
0.03
100
1k
10k
100k
FREQUENCY f (Hz)

APPLICATION CIRCUITS

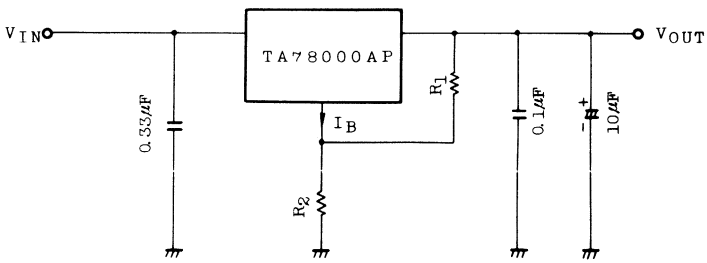
(1) VOLTAGE BOOST REGULATOR

(a) Voltage boost by use of zener diode



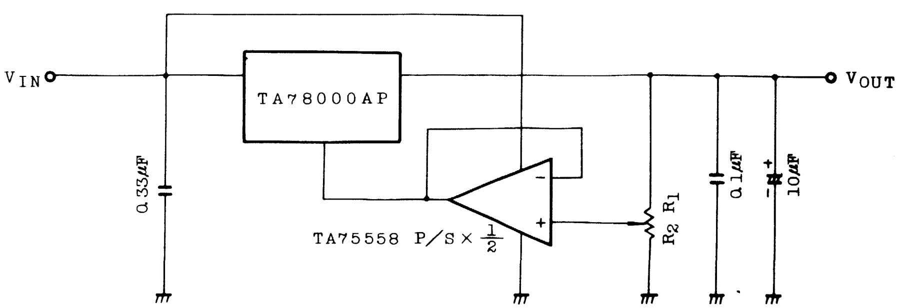
$V_{OUT} = V_{OUT(IC)} + V_Z$

(b) Voltage boost by use of resistor



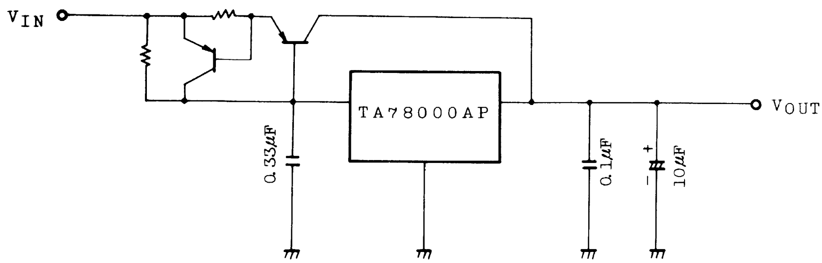
$V_{OUT} = V_{OUT(IC)} \left(1 + \frac{R_2}{R_1}\right) + R_2 \cdot I_B$

(c) Adjustable output regulator



$V_{OUT} = V_{OUT(IC)} \left(1 + \frac{R_2}{R_1}\right)$

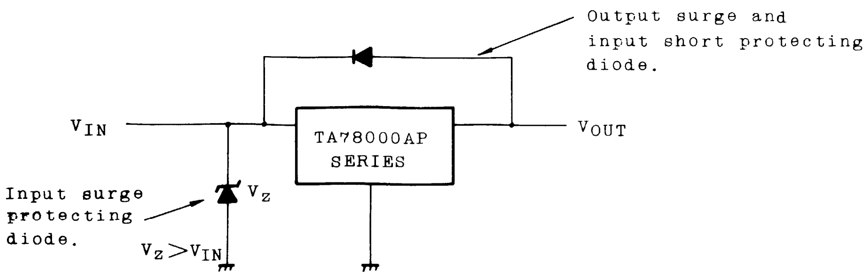
(2) CURRENT BOOST REGULATOR



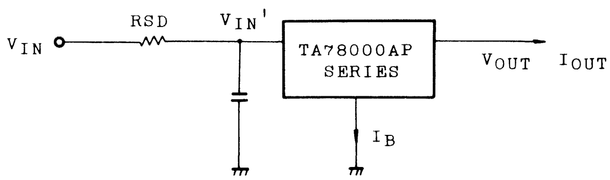
PRECAUTIONS ON APPLICATION

(1) In regard to GND, be careful not to apply a negative voltage to the input/output terminal. Further, special care is necessary in case of a voltage boost application.

(2) When a surge voltage exceeding maximum rating is applied to the input terminal or when a voltage in excess of the input terminal voltage is applied to the output terminal, the circuit may be destroyed.
Specially, in the latter case, great care is necessary
Further, if the input terminal shorts to GND in a state of normal operation, the output terminal voltage becomes higher than the input voltage (GND potential), and the electric charge of a chemical capacitor connected to the output terminal flows into the input side, which may cause the destruction of circuit.
In these cases, take such steps as a zener diode and a general silicon diode are connected to the circuit, as shown in the following figure.



(3) When the input voltage is too high, the power dissipation of three terminal regulator increases because of series regulator, so that the junction temperature rises. In such a case, it is recommended to reduce the power dissipation by inserting the power limiting resistor RSD in the input terminal, and to reduce the junction temperature as a result.



The power dissipation P_D of IC is expressed in the following equation.

$$P_D = (V_{IN}'-V_{OUT}) \cdot I_{OUT} + V_{IN}' \cdot I_B$$

If V_{IN}' is reduced below the lowest voltage necessary for the IC, the parasitic oscillation will be caused according to circumstances.
In determing the resistance value of R_{SD}, design with margin should be made by making reference to the following equation.

$$R_{SD} < \frac{V_{IN} - V_{IN}'}{I_{OUT} + I_B}$$

(4) Connect the input terminal and GND, and the output terminal and GND, by capacitor respectively. The capacitances should be determind experimentally because they depend on prented patterns. In particular, adequate investigation should be made so that there is no problem even at time of high or low temperature.

(5) Installation of IC for power supply
For obtaining high reliability on the heat sink design of the regulator IC, it is generally required to derate more than 20% of maximum junction temperature (Tj MAX.).
Further, full consideration should be given to the installation of IC to the heat sink.

(a) Heat sink design

The thermal resistance of IC itself is required from the viewpoint of the design of elements, but the thermal resistance from the IC package to the open air varies with the contact thermal resistance.
Table 1 shows how much the value of the contact thermal resistance ($Q_c + Q_s$) is changed by insulating sheet (mica) and heat sink grease.

TABLE

Unit: °C/W

PACKAGE	MODEL No.	TORQUE	MICA	$Q_c + Q_s$
TO-220AB	TA780×××AP	6kg.cm	Not Provided	0.3∿0.5(1.5∿2.0)
			Provided	2.0∿2.5(4.0∿6.0)

The figures given in parentheses denote the values at time of no grease.

The package of regulator IC serves as GND, therefore, usually use the value at time of "no mica."

(b) Silicon grease

When a circuit not exceeding maximum rating is designed, it is to be desired that the grease should be used if possible. If it is required that the contact thermal resistance is reduced from the viewpoint of the circuit design, it is recommended that the following methods be adopted.

A: Use Thercon (Fuji High Polymer Kogyo K.K.)

B: Use SC101 (Torei Silicon) or G-640 (GE), if grease is used.

(c) Torque

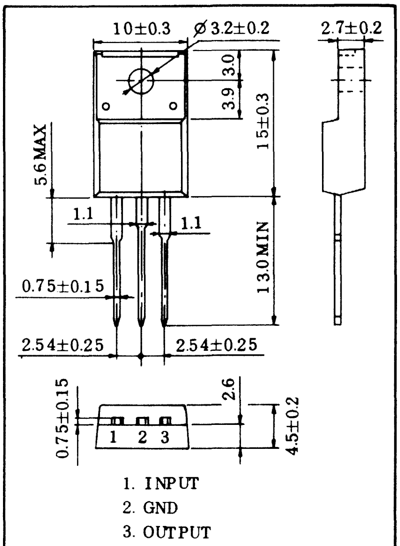
When installing IC on a heat sink or the like, tighten the IC with the torque of less than the rated value. If it is tightened with the torque in excess of the rated value, sometimes the internal elements of the IC are adversely affected. Therefore, great care should be given to the installing operation.
Further, if polycarbonate screws are used, the torque causes a change with the passage of time, which may lessen the effect of radiation.

TA7805S, TA7806S, TA7808S, TA7809S, TA7810S, TA7812S, TA7815S, TA7818S, TA7820S, TA7824S

THREE TERMINAL POSITIVE VOLTAGE REGULATORS

5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V

Unit in mm



JEDEC	—
EIAJ	SC−67
TOSHIBA	HSIP3−P−A

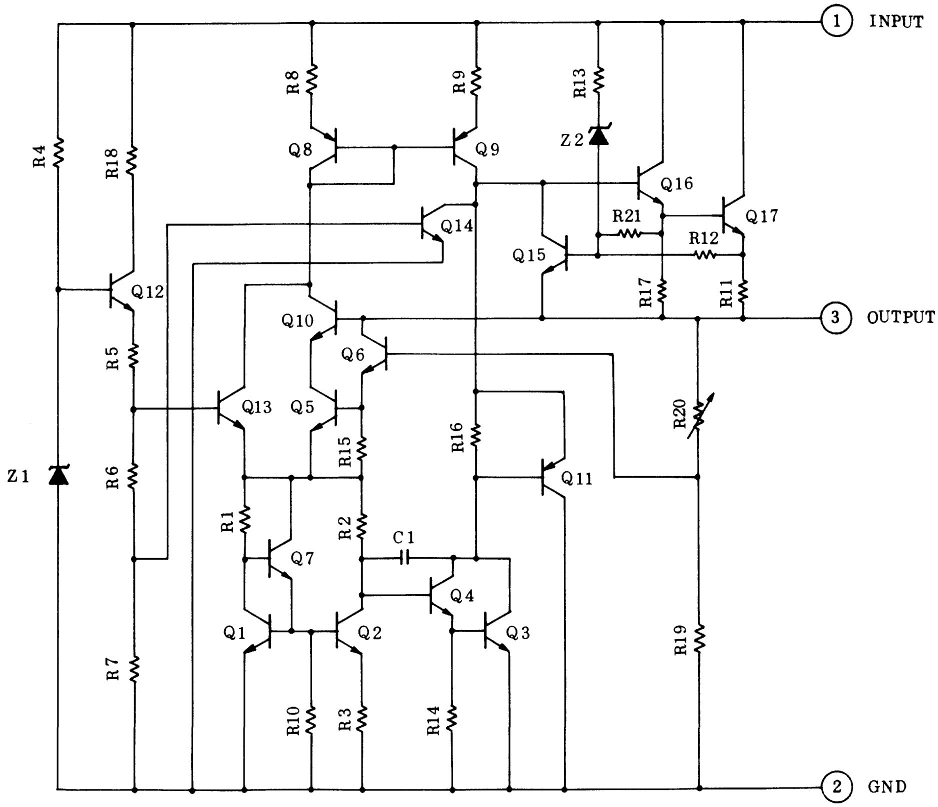
Weight: 1.7g

- Suitable for C-MOS, TTL, the other digital IC's power supply
- Internal thermal overload protection
- Internal short circuit current limiting
- Output current in excess of 1A
- Metal Fin (Tab) is fully covered with Mold Resin. (TO-220 (IS) package)

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage	TA7805S	V_{IN}	35	V
	TA7806S			
	TA7808S			
	TA7809S			
	TA7810S			
	TA7812S			
	TA7815S			
	TA7818S		40	
	TA7820S			
	TA7824S			
Power Dissipation		P_D	2	W
Power Dissipation (Tc=25°C)		P_D	20	W
Operating Temperature		T_{opr}	-30~75	°C
Storage Temperature		T_{stg}	-55~150	°C

EQUIVALENT CIRCUIT



TA7805S

ELECTRICAL CHARACTERISTICS (V_{IN}=10V, I_{OUT}=500mA, 0°C ≦ Tj ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		4.8	5.0	5.2	V
Line Regulation	Reg·line	1	Tj=25°C	7.0V ≦ V_{IN} ≦ 25V	-	3	100	mV
				8.0V ≦ V_{IN} ≦ 12V	-	1	50	
Load Regulation	Reg·load	1	Tj=25°C	5mA ≦ I_{OUT} ≦ 1.4A	-	15	100	mV
				250mA ≦ I_{OUT} ≦ 750mA	-	5	50	
Output Voltage	V_{OUT}	1	7.0V ≦ V_{IN} ≦ 20V 5.0mA ≦ I_{OUT} ≦ 1.0A, P_O ≦ 15W		4.75	-	5.25	V
Quiescent Current	I_B	1	Tj=25°C, I_{OUT}=5mA		-	4.2	8.0	mA
Quiescent Current Change	ΔI_B	1	7.0V ≦ V_{IN} ≦ 25V		-	-	1.3	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz I_{OUT}=50mA		-	50	-	μV
Ripple Rejection	RR	1	f=120Hz, 8.0V ≦ V_{IN} ≦ 18V I_{OUT}=50mA, Tj=25°C		62	78	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, Tj=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	Tj=25°C		-	1.6	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C ≦ Tj ≦ 125°C		-	-0.6	-	mV/deg

TA7806S

ELECTRICAL CHARACTERISTICS (V_{IN}=11V, I_{OUT}=500mA, 0°C≦Tj≦125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		5.75	6.0	6.25	V
Line Regulation	Reg·line	1	Tj=25°C	8.0V≦V_{IN}≦25V	-	4	120	mV
				9V≦V_{IN}≦13V	-	2	60	
Load Regulation	Reg·load	1	Tj=25°C	5mA≦I_{OUT}≦1.4A	-	15	120	mV
				250mA≦I_{OUT}≦750mA	-	5	60	
Output Voltage	V_{OUT}	1	8V≦V_{IN}≦21V 5.0mA≦I_{OUT}≦1.0A, P_O≦15W		5.7	-	6.3	V
Quiescent Current	I_B	1	Tj=25°C, I_{OUT}=5mA		-	4.3	8.0	mA
Quiescent Current Change	ΔI_B	1	8.0V≦V_{IN}≦25V		-	-	1.3	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz I_{OUT}=50mA		-	55	-	μV
Ripple Rejection	RR	1	f=120Hz, 9V≦V_{IN}≦19V I_{OUT}=50mA, Tj=25°C		61	77	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, Tj=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	Tj=25°C		-	1.5	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦Tj≦125°C		-	-0.7	-	mV/deg

TA7808S

ELECTRICAL CHARACTERISTICS (V_{IN}=14V, I_{OUT}=500mA, 0°C≦Tj≦125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		7.7	8.0	8.3	V
Line Regulation	Reg・line	1	Tj=25°C	10.5V≦V_{IN}≦25V	-	6	160	mV
				11V≦V_{IN}≦17V	-	2	80	
Load Regulation	Reg・load	1	Tj=25°C	5mA≦I_{OUT}≦1.4A	-	12	160	mV
				250mA≦I_{OUT}≦750mA	-	4	80	
Output Voltage	V_{OUT}	1	10.5V≦V_{IN}≦23V 5.0mA≦I_{OUT}≦1.0A, P_O≦15W		7.6	-	8.4	V
Quiescent Current	I_B	1	Tj=25°C, I_{OUT}=5mA		-	4.3	8.0	mA
Quiescent Current Change	ΔI_B	1	10.5V≦V_{IN}≦25V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz I_{OUT}=50mA		-	70	-	μV
Ripple Rejection	RR	1	f=120Hz, 11.5V≦V_{IN}≦21.5V I_{OUT}=50mA, Tj=25°C		58	74	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, Tj=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	Tj=25°C		-	1.1	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦Tj≦125°C		-	-1.0	-	mV/deg

TA7809S

ELECTRICAL CHARACTERISTICS (V_{IN}=15V, I_{OUT}=500mA, 0°C≦Tj≦125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		8.64	9.0	9.36	V
Line Regulation	Reg·line	1	Tj=25°C	11.5V≦V_{IN}≦26V	-	7	180	mV
				13V≦V_{IN}≦19V	-	2.5	90	
Load Regulation	Reg·load	1	Tj=25°C	5mA≦I_{OUT}≦1.4A	-	12	180	mV
				250mA≦I_{OUT}≦750mA	-	4	90	
Output Voltage	V_{OUT}	1	11.5V≦V_{IN}≦2.6V 5.0mA≦I_{OUT}≦1.0A, P_O≦15W		8.55	-	9.45	V
Quiescent Current	I_B	1	Tj=25°C, I_{OUT}=5mA		-	4.3	8.0	mA
Quiescent Current Change	ΔI_B	1	11.5V≦V_{IN}≦26V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz I_{OUT}=50mA		-	75	-	μV
Ripple Rejection	RR	1	f=120Hz, 12.5V≦V_{IN}≦22.5V I_{OUT}=50mA, Tj=25°C		56	72	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, Tj=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	Tj=25°C		-	1.0	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦Tj≦125°C		-	-1.1	-	mV/deg

TA7810S

ELECTRICAL CHARACTERISTICS (V_{IN}=16V, I_{OUT}=500mA, 0°C≦Tj≦125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		9.6	10.0	10.4	V
Line Regulation	Reg·line	1	Tj=25°C	12.5V≦V_{IN}≦27V	-	8	200	mV
				14V≦V_{IN}≦20V	-	2.5	100	
Load Regulation	Reg·load	1	Tj=25°C	5mA≦I_{OUT}≦1.4A	-	12	200	mV
				250mA≦I_{OUT}≦750mA	-	4	100	
Output Voltage	V_{OUT}	1	12.5V≦V_{IN}≦25V 5.0mA≦I_{OUT}≦1.0A, P_o≦15W		9.5	-	10.5	V
Quiescent Current	I_B	1	Tj=25°C, I_{OUT}=5mA		-	4.3	8.0	mA
Quiescent Current Change	ΔI_B	1	12.5V≦V_{IN}≦27V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz I_{OUT}=50mA		-	80	-	μV
Ripple Rejection	RR	1	f=120Hz, 13.5V≦V_{IN}≦23.5V I_{OUT}=50mA, Tj=25°C		55	72	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, Tj=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	Tj=25°C		-	0.9	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦Tj≦125°C		-	-1.3	-	mV/deg

TA7812S

ELECTRICAL CHARACTERISTICS (V_{IN}=19V, I_{OUT}=500mA, 0°C ≤ Tj ≤ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		11.5	12.0	12.5	V
Line Regulation	Reg·line	1	Tj=25°C	14.5V ≤ V_{IN} ≤ 30V	-	10	240	mV
				16V ≤ V_{IN} ≤ 22V	-	3	120	
Load Regulation	Reg·load	1	Tj=25°C	5mA ≤ I_{OUT} ≤ 1.4A	-	12	240	mV
				250mA ≤ I_{OUT} ≤ 750mA	-	4	120	
Output Voltage	V_{OUT}	1	14.5V ≤ V_{IN} ≤ 27V 5.0mA ≤ I_{OUT} ≤ 1.0A, P_o ≤ 15W		11.4	-	12.6	V
Quiescent Current	I_B	1	Tj=25°C, I_{OUT}=5mA		-	4.3	8.0	mA
Quiescent Current Change	ΔI_B	1	14.5V ≤ V_{IN} ≤ 30V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≤ f ≤ 100kHz I_{OUT}=50mA		-	90	-	μV
Ripple Rejection	RR	1	f=120Hz, 15V ≤ V_{IN} ≤ 25V I_{OUT}=50mA, Tj=25°C		55	71	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, Tj=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	Tj=25°C		-	0.7	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C ≤ Tj ≤ 125°C		-	-1.6	-	mV/deg

TA7815S

ELECTRICAL CHARACTERISTICS (V_{IN}=23V, I_{OUT}=500mA, 0°C ≦ Tj ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		14.4	15.0	15.6	V
Line Regulation	Reg·line	1	Tj=25°C	17.5V ≦ V_{IN} ≦ 30V	-	11	300	mV
				20V ≦ V_{IN} ≦ 26V	-	3	150	
Load Regulation	Reg·load	1	Tj=25°C	5mA ≦ I_{OUT} ≦ 1.4A	-	12	300	mV
				250mA ≦ I_{OUT} ≦ 750mA	-	4	150	
Output Voltage	V_{OUT}	1	17.5V ≦ V_{IN} ≦ 30V 5.0mA ≦ I_{OUT} ≦ 1.0A, P_O ≦ 15W		14.25	-	15.75	V
Quiescent Current	I_B	1	Tj=25°C, I_{OUT}=5mA		-	4.4	8.0	mA
Quiescent Current Change	ΔI_B	1	17.5V ≦ V_{IN} ≦ 30V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz I_{OUT}=50mA		-	110	-	μV
Ripple Rejection	RR	1	f=120Hz, 18.5V ≦ V_{IN} ≦ 28.5V I_{OUT}=50mA, Tj=25°C		54	70	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, Tj=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	Tj=25°C		-	0.5	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C ≦ Tj ≦ 125°C		-	-2.0	-	mV/deg

TA7818S

ELECTRICAL CHARACTERISTICS (V_{IN}=27V, I_{OUT}=500mA, 0°C ≦Tj≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		17.3	18.0	18.7	V
Line Regulation	Reg·line	1	Tj=25°C	21V ≦ V_{IN} ≦ 33V	-	13	360	mV
				24V ≦ V_{IN} ≦ 30V	-	4	180	
Load Regulation	Reg·load	1	Tj=25°C	5mA ≦ I_{OUT} ≦ 1.4A	-	12	360	mV
				250mA ≦ I_{OUT} ≦ 750mA	-	4	180	
Output Voltage	V_{OUT}	1	21V ≦ V_{IN} ≦ 33V 5.0mA ≦ I_{OUT} ≦ 1.0A, P_O ≦ 15W		17.1	-	18.9	V
Quiescent Current	I_B	1	Tj=25°C, I_{OUT}=5mA		-	4.5	8.0	mA
Quiescent Current Change	ΔI_B	1	21V ≦ V_{IN} ≦ 33V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz I_{OUT}=50mA		-	125	-	μV
Ripple Rejection	RR	1	f=120Hz, 22V ≦ V_{IN} ≦ 32V I_{OUT}=50mA, Tj=25°C		52	68	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, Tj=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	Tj=25°C		-	0.4	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C ≦ Tj ≦ 125°C		-	-2.5	-	mV/deg

TA7820S

ELECTRICAL CHARACTERISTICS (V_{IN}=29V, I_{OUT}=500mA, 0°C≦Tj≦125°C)

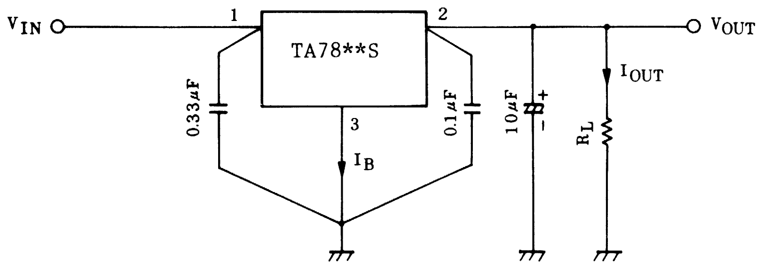
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		19.2	20.0	20.8	V
Line Regulation	Reg·line	1	Tj=25°C	23V≦V_{IN}≦35V	-	15	400	mV
				26V≦V_{IN}≦32V	-	5	200	
Load Regulation	Reg·load	1	Tj=25°C	5mA≦I_{OUT}≦1.4A	-	12	400	mV
				250mA≦I_{OUT}≦750mA	-	4	200	
Output Voltage	V_{OUT}	1	23V≦V_{IN}≦35V 5.0mA≦I_{OUT}≦1.0A, P_O≦15W		19.0	-	21.0	V
Quiescent Current	I_B	1	Tj=25°C, I_{OUT}=5mA		-	4.6	8.0	mA
Quiescent Current Change	ΔI_B	1	23V≦V_{IN}≦35V		-	-	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz I_{OUT}=50mA		-	135	-	μV
Ripple Rejection	RR	1	f=120Hz, 24V≦V_{IN}≦34V I_{OUT}=50mA, Tj=25°C		50	66	-	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, Tj=25°C		-	2.0	-	V
Short Circuit Current Limit	I_{SC}	1	Tj=25°C		-	0.4	-	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦Tj≦125°C		-	-3.0	-	mV/deg

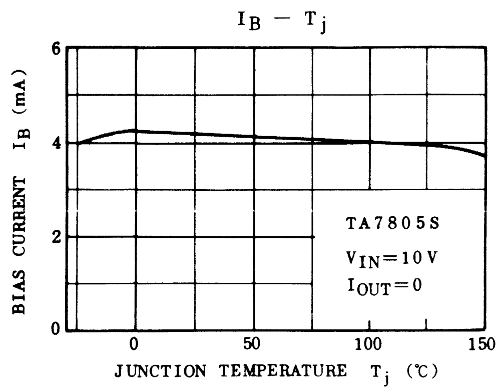
TA7824S

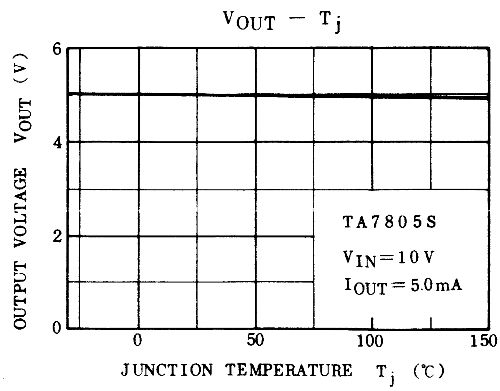
ELECTRICAL CHARACTERISTICS (V_{IN}=33V, I_{OUT}=500mA, 0°C≦Tj≦125°C)

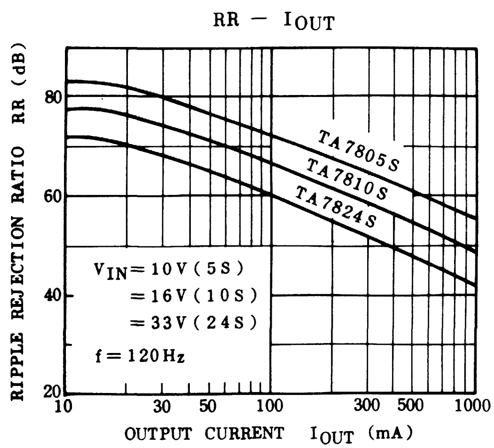
CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		23.0	24.0	25.0	V
Line Regulation	Reg·line	1	Tj=25°C	27V≦V_{IN}≦38V	–	18	480	mV
				30V≦V_{IN}≦36V	–	6	240	
Load Regulation	Reg·load	1	Tj=25°C	5mA≦I_{OUT}≦1.4A	–	12	480	mV
				250mA≦I_{OUT}≦750mA	–	4	240	
Output Voltage	V_{OUT}	1	27V≦V_{IN}≦38V 5.0mA≦I_{OUT}≦1.0A, P_O≦15W		22.8	–	25.2	V
Quiescent Current	I_B	1	Tj=25°C, I_{OUT}=5mA		–	4.6	8.0	mA
Quiescent Current Change	ΔI_B	1	27V≦V_{IN}≦38V		–	–	1.0	mA
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz I_{OUT}=50mA		–	150	–	μV
Ripple Rejection	RR	1	f=120Hz, 28V≦V_{IN}≦38V I_{OUT}=50mA, Tj=25°C		50	66	–	dB
Dropout Voltage	V_D	1	I_{OUT}=1.0A, Tj=25°C		–	2.0	–	V
Short Circuit Current Limit	I_{SC}	1	Tj=25°C		–	0.3	–	A
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT}=5mA, 0°C≦Tj≦125°C		–	-3.5	–	mV/deg

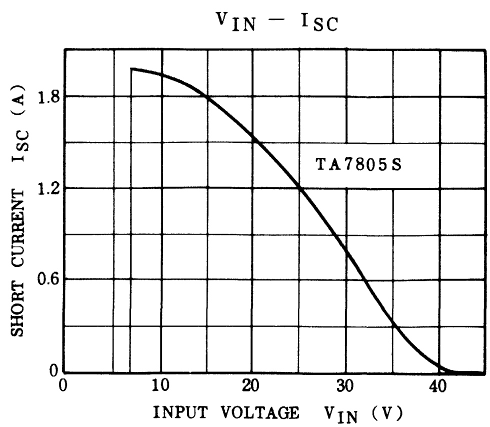
TEST CIRCUIT/STANDARD APPLICATION CIRCUIT

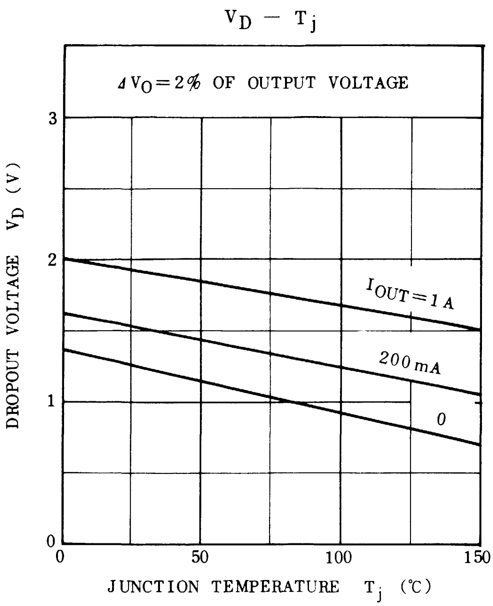


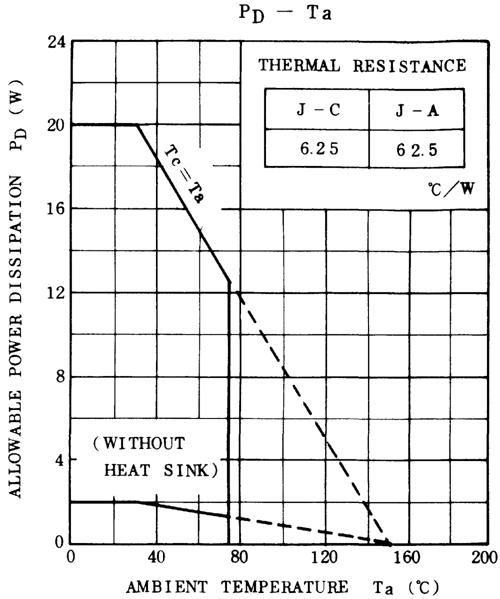


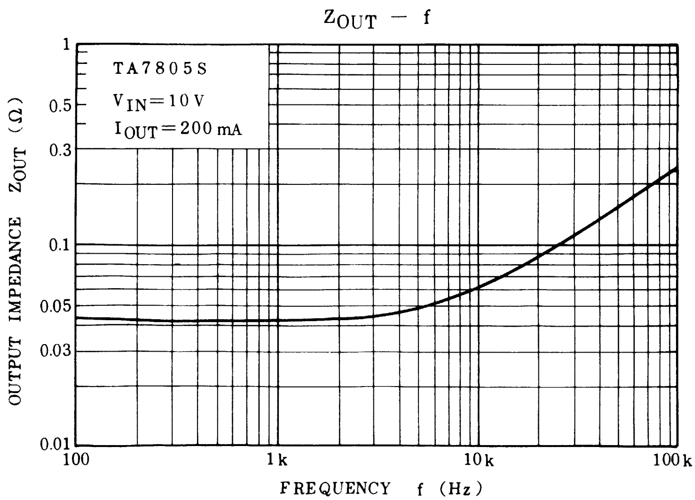







V_D − T_j
ΔV_O = 2% OF OUTPUT VOLTAGE
I_{OUT} = 1 A
200 mA
0
DROPOUT VOLTAGE V_D (V)
0
1
2
3
0
50
100
150
JUNCTION TEMPERATURE T_j (℃)

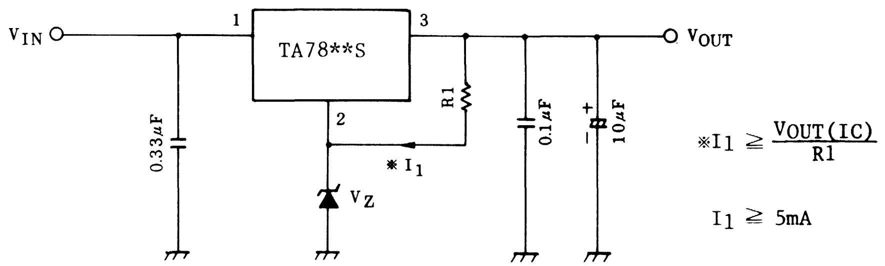

P_D − Ta
THERMAL RESISTANCE
J − C
J − A
6.25
62.5
℃/W
Tc = Ta
(WITHOUT HEAT SINK)
ALLOWABLE POWER DISSIPATION P_D (W)
0
4
8
12
16
20
24
0
40
80
120
160
200
AMBIENT TEMPERATURE Ta (℃)


Z_{OUT} − f
TA7805S
V_{IN} = 10 V
I_{OUT} = 200 mA
OUTPUT IMPEDANCE Z_{OUT} (Ω)
0.01
0.03
0.05
0.1
0.3
0.5
1
100
1 k
10 k
100 k
FREQUENCY f (Hz)

APPLICATION CIRCUITS

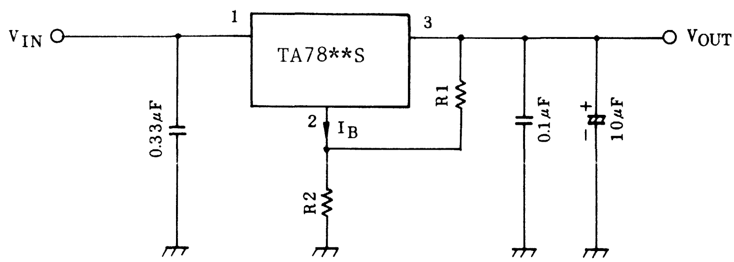
(1) VOLTAGE BOOST REGULATOR

(a) Voltage boost by use of zener diode



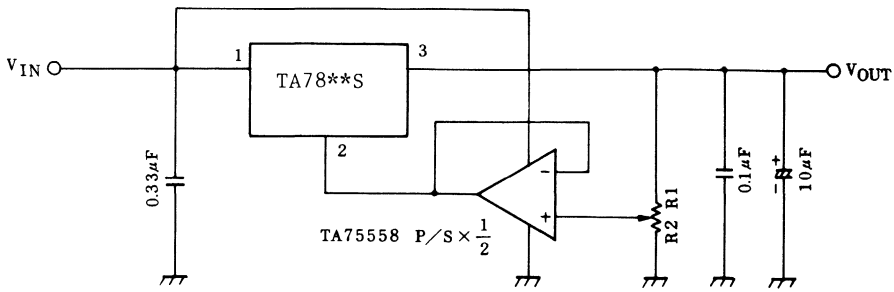
$V_{OUT}=V_{OUT(IC)}+V_Z$

(b) Voltage boost by use of resistor



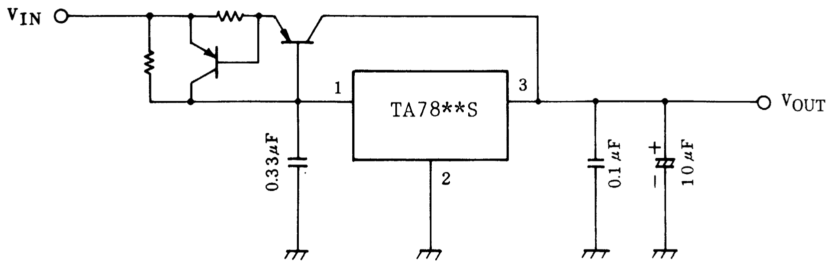
$V_{OUT}=V_{OUT(IC)}(1+\frac{R2}{R1})+R2\cdot I_B$

(c) Adjustable output regulator



$V_{OUT}=V_{OUT(IC)}(1+\frac{R2}{R1})$

(2) CURRENT BOOST REGULATOR



TA78DL05P/06P/08P/09P
TA78DL10P/12P/15P

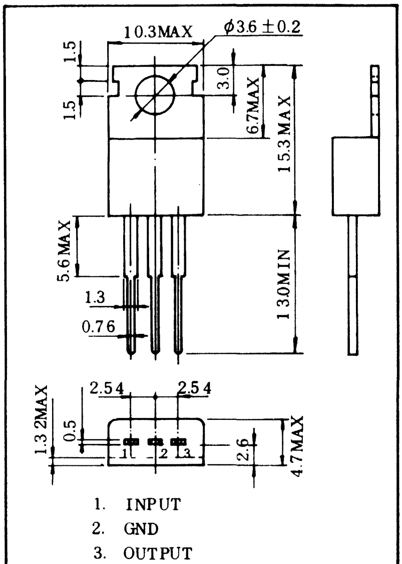
5V, 6V, 8V, 9V, 10V, 12V, 15V

LOW DROPOUT VOLTAGE REGULATOR.

Tht TA78DL**P series consists of positive fixed output voltage regulator IC capable of sourcing current up to 250mA. Due to the features of low dropout voltage and low standby current, these devices are useful for battery powered equipment. This series includes current limiting, thermal shutdown, overvoltage protection, input fault protection and excessive transient protection circuits internally.

- Low Standby Current of 500μA Typical.
- Maximum Output Current Up to 250mA.
- Low Dropout Voltage of Less than 0.6V.
- Multi-protection: Reverse Connection of Power Supply, 60V Load Dump, Thermal Shut Down and Current Limiting.
- TO-220AB Package.

Unit in mm



JEDEC	SC-46
TOSHIBA	HSIP3-P

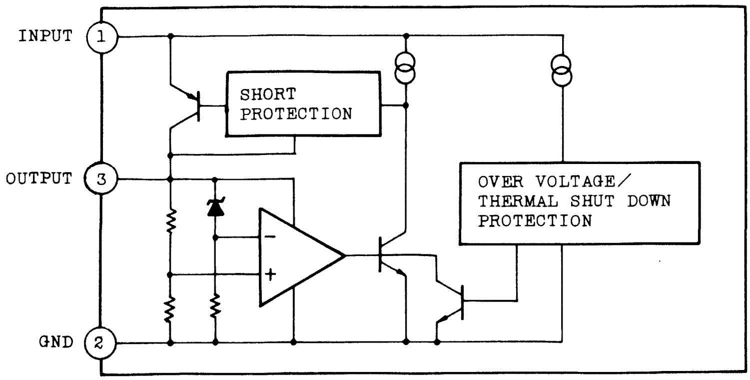
Mounting Kit No. AC75

Weight: 1.9g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Operating Input Voltage	V_{IN}	29	V
Input Voltage of Surge	V_{IN}	60 (1 sec)	V
Power Dissipation	P_D	20	W
Operating Temperature	Topr	-40~85	°C
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	-55~150	°C
Soldering Temperature	Tsol	260 (10 sec)	°C

BLOCK DIAGRAM



TA78DL05P

ELECTRICAL CHARACTERISTICS (V_{IN}=14V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=5.35~26V Ta=-40~85°C	4.5	5	5.5	V
Line Regulation	Reg. line	-	V_{IN}=9~16V	-	2	10	mV
		-	V_{IN}=6~26V	-	4	30	
Load Regulation	Reg. load	-	I_{OUT}=10~200mA	-	14	50	mV
Quiescent Current	I_B	-	I_{OUT} ≤10mA, V_{IN}=6~26V	-	0.5	1	mA
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	-	I_{OUT}=50mA	-	0.15	0.3	V
		-	I_{OUT}=200mA	-	0.4	0.6	
Max. Operating Voltage	V_{IN} MAX.	-		29	33	-	V

TA78DL06P

ELECTRICAL CHARACTERISTICS (V_{IN}=14V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=6.35~26V Ta=-40~85°C	5.4	6	6.6	V
Line Regulation	Reg. line	-	V_{IN}=10~17V	-	2	12	mV
		-	V_{IN}=7~26V	-	5	36	
Load Regulation	Reg. load	-	I_{OUT}=10~200mA	-	17	60	mV
Quiescent Current	I_B	-	I_{OUT} ≤10mA, V_{IN}=7~26V	-	0.55	-	mA
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	-	I_{OUT}=50mA	-	0.15	0.3	V
		-	I_{OUT}=200mA	-	0.4	0.6	
Max. Operating Voltage	V_{IN} MAX	-		29	33	-	V

TA78DL08P

ELECTRICAL CHARACTERISTICS (V_{IN}=16V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=8.35~26V Ta=-40~85°C	7.2	8	8.8	V
Line Regulation	Reg. line	-	V_{IN}=12~19V	-	3	16	mV
		-	V_{IN}=9~26V	-	6	45	
Load Regulation	Reg. load	-	I_{OUT}=10~200mA	-	22	80	mV
Quiescent Current	I_B	-	I_{OUT} ≤10mA, V_{IN}=9~26V	-	0.6	-	mA
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	-	I_{OUT}=50mA	-	0.15	0.3	V
		-	I_{OUT}=200mA	-	0.4	0.6	
Max. Operating Voltage	V_{IN} MAX	-		29	33	-	V

TA78DL09P

ELECTRICAL CHARACTERISTICS (V_{IN}=16V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=9.35~26V Ta=-40~85°C	8.1	9	9.9	V
Line Regulation	Reg. line	-	V_{IN}=13~20V	-	3	18	mV
		-	V_{IN}=10~26V	-	7	50	
Load Regulation	Reg. load	-	I_{OUT}=10~200mA	-	25	90	mV
Quiescent Current	I_B	-	I_{OUT} ≤10mA, V_{IN}=10~26V	-	0.65	-	mA
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	-	I_{OUT}=50mA	-	0.15	0.3	V
		-	I_{OUT}=200mA	-	0.4	0.6	
Max. Operating Voltage	V_{IN} MAX	-		29	33	-	V

TA78DL10P

ELECTRICAL CHARACTERISTICS (V_{IN}=16V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=10.35~26V Ta=-40~85°C	9	10	11	V
Line Regulation	Reg. line	-	V_{IN}=14~21V	-	4	20	mV
		-	V_{IN}=11~26V	-	8	60	
Load Regulation	Reg. load	-	I_{OUT}=10~200mA	-	28	100	mV
Quiescent Current	I_B	-	I_{OUT} ≤10mA, V_{IN}=11~26V	-	0.7	-	mA
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	-	I_{OUT}=50mA	-	0.15	0.3	V
		-	I_{OUT}=200mA	-	0.4	0.6	
Max. Operating Voltage	V_{IN} MAX	-		29	33	-	V

TA78DL12P

ELECTRICAL CHARACTERISTICS (V_{IN}=18V, I_{OUT}=10mA, Tj=25°C)

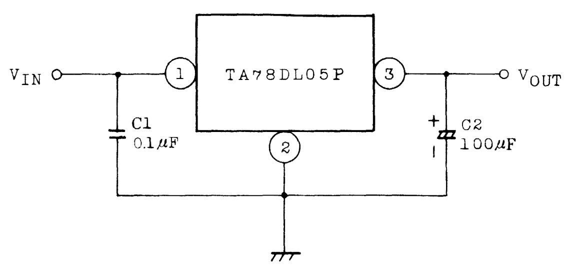
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=12.35~26V Ta=-40~85°C	10.8	12	13.2	V
Line Regulation	Reg. line	-	V_{IN}=16~23V	-	5	24	mV
		-	V_{IN}=13~26V	-	10	70	
Load Regulation	Reg. load	-	I_{OUT}=10~200mA	-	33	120	mV
Quiescent Current	I_B	-	I_{OUT} ≤10mA, V_{IN}=13~26V	-	0.8	-	mA
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	-	I_{OUT}=50mA	-	0.15	0.3	V
		-	I_{OUT}=200mA	-	0.4	0.6	
Max. Operating Voltage	V_{IN} MAX	-		29	33	-	V

TA78DL15P

ELECTRICAL CHARACTERISTICS (V_{IN}=20V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=15.35~26V Ta=-40~85°C	13.5	15	16.5	V
Line Regulation	Reg. line	-	V_{IN}=19~26V	-	6	30	mV
		-	V_{IN}=16~26V	-	12	80	
Load Regulation	Reg. load	-	I_{OUT}=10~200mA	-	40	150	mV
Quiescent Current	I_B	-	I_{OUT} ≤ 10mA, V_{IN}=16~26V	-	0.9	-	mA
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	-	I_{OUT}=50mA	-	0.15	0.3	V
		-	I_{OUT}=200mA	-	0.4	0.6	
Max. Operating Voltage	V_{IN} MAX	-		29	33	-	V

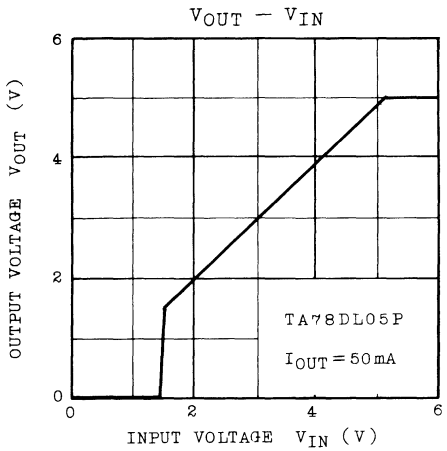
APPLICATION CIRCUIT

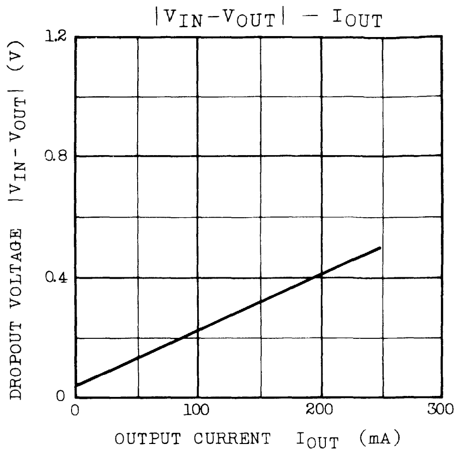


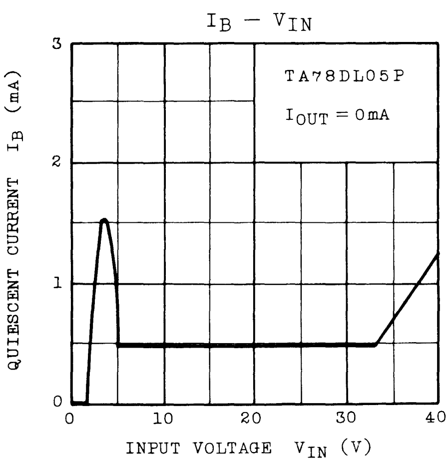
Capacitor C_2 must be guaranteed to operate of the temperature range that the regulator should be operated correctly.

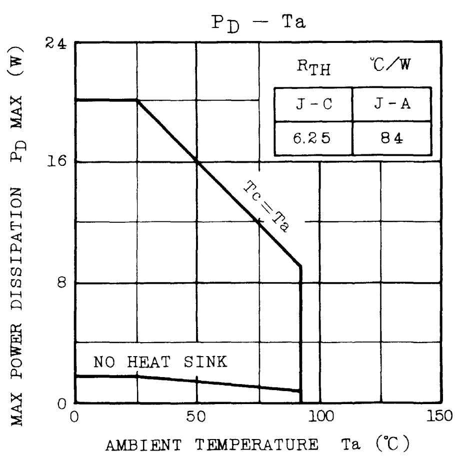
100μF is a suitable value to suppress the oscillation phenomenon at the output terminal.

TYPICAL CHARACTERISTICS









TA78DL05S/06S/08S/09S
TA78DL10S/12S/15S

LOW DROPOUT VOLTAGE REGULATOR.

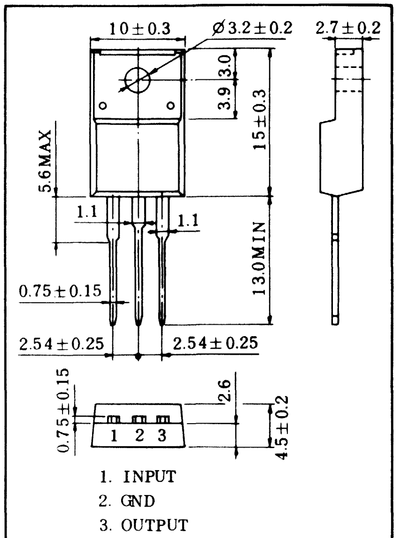
The TA78DL**S series consists of positive fixed output voltage regulator IC capable of sourcing current up to 250mA.

Due to the features of low dropout voltage and low standby current, these devices are useful for battery powered equipment.

This series includes current limiting, thermal shutdown, overvoltage protection, input fault protection and excessive transient protection circuits internally.

. Low Standby Current of 500μA Typical
. Maximum Output Current Up to 250mA
. Low Dropout Voltage of Less than 0.6V
. Multi-protection : Reverse Connection of Power Supply, 60V Load Dump, Thermal Shut Down and Current Limiting
. Metal Fin (Tab) is Fully Covered with Mold Resin. (TO-220 IS package)

Unit in mm



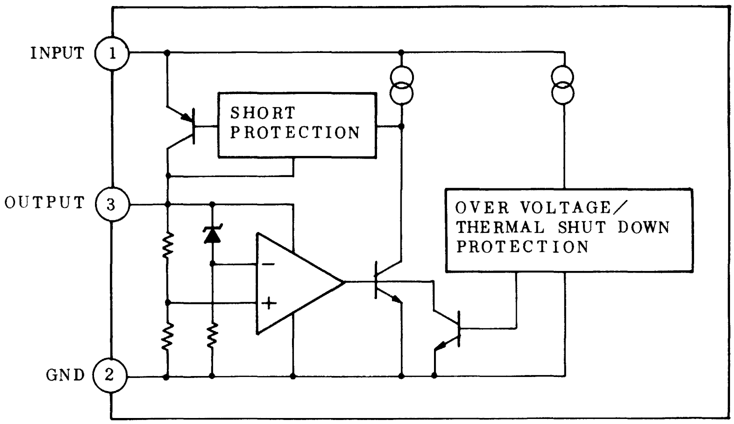
JEDEC	—
EIAJ	SC−67
TOSHIBA	HSIP3−P−A

Weight: 1.7g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Operating Input Voltage	V_{IN}	26	V
Input Voltage of Surge	V_{IN}	60	V
Power Dissipation	P_D	20	W
Operating Temperature	T_{opr}	-40~+85	°C
Junction Temperature	T_j	+150	°C
Storage Temperature	T_{stg}	-55~+150	°C
Soldering Temperature	T_{sol}	+260 (10sec)	°C

BLOCK DIAGRAM



TA78DL05S

ELECTRICAL CHARACTERISTICS (V_{IN}=14V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=5.35~26V Ta=-40~+85°C	4.5	5	5.5	V
Line Regulation	Reg.Line	-	V_{IN}=9~16V	-	2	10	mV
			V_{IN}=6~26V	-	4	30	
Load Regulation	Reg.Load	-	I_{OUT}=10~200mA	-	14	50	mV
Quiescent Current	I_B	-	$I_{OUT} \leq$ 10mA, V_{IN}=6~26V	-	0.5	1	mA
Dropout Voltage	V_{DROP}	-	I_{OUT}=50mA	-	0.15	0.3	V
			I_{OUT}=200mA	-	0.4	0.6	
Max. Operating Voltage	V_{IN}	-		26	33	-	V

TA78DL06S

ELECTRICAL CHARACTERISTICS (V_{IN}=14V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=6.35~26V Ta=-40~+85°C	5.4	6	6.6	V
Line Regulation	Reg.Line	-	V_{IN}=10~17V	-	2	12	mV
			V_{IN}=7~26V	-	5	36	
Load Regulation	Reg.Load	-	I_{OUT}=10~200mA	-	17	60	mV
Quiescent Current	I_B	-	I_{OUT} ≦10mA, V_{IN}=7~26V	-	0.55	-	mA
Dropout Voltage	V_{DROP}	-	I_{OUT}=50mA	-	0.15	0.3	V
			I_{OUT}=200mA	-	0.4	0.6	
Max. Operating Voltage	V_{IN}	-		26	33	-	V

TA78DL08S

ELECTRICAL CHARACTERISTICS (V_{IN}=16V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=8.35~26V Ta=-40~+85°C	7.2	8	8.8	V
Line Regulation	Reg.Line	-	V_{IN}=12~19V	-	3	16	mV
			V_{IN}=9~26V	-	6	45	
Load Regulation	Reg.Load	-	I_{OUT}=10~200mA	-	22	80	mV
Quiescnet Current	I_B	-	I_{OUT} ≦10mA, V_{IN}=9~26V	-	0.6	-	mA
Dropout Voltage	V_{DROP}	-	I_{OUT}=50mA	-	0.15	0.3	V
			I_{OUT}=200mA	-	0.4	0.6	
Max. Operating Voltage	V_{IN}	-		26	33	-	V

TA78DL09S

ELECTRICAL CHARACTERISTICS (V_{IN}=16V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	–	V_{IN}=9.35~26V Ta=-40~+85°C	8.1	9	9.9	V
Line Regulation	Reg.Line	–	V_{IN}=13~20V	–	3	18	mV
			V_{IN}=10~26V	–	7	50	
Load Regulation	Reg.Load	–	I_{OUT}=10~200mA	–	25	90	mV
Quiescent Current	I_B	–	I_{OUT} ≤10mA, V_{IN}=10~26V	–	0.65	–	mA
Dropout Voltage	V_{DROP}	–	I_{OUT}=50mA	–	0.15	0.3	V
			I_{OUT}=200mA	–	0.4	0.6	
Max. Operating Voltage	V_{IN}	–		26	33	–	V

TA78DL10S

ELECTRICAL CHARACTERISTICS (V_{IN}=16V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	–	V_{IN}=10.35~26V Ta=-40~+85°C	9	10	11	V
Line Regulation	Reg.Line	–	V_{IN}=14~21V	–	4	20	mV
			V_{IN}=11~26V	–	8	60	
Load Regulation	Reg.Load	–	I_{OUT}=10~200mA	–	28	100	mV
Quiescent Current	I_B	–	I_{OUT} ≤10mA, V_{IN}=11~26V	–	0.7	–	mA
Dropout Voltage	V_{DROP}	–	I_{OUT}=50mA	–	0.15	0.3	V
			I_{OUT}=200mA	–	0.4	0.6	
Max. Operating Voltage	V_{IN}	–		26	33	–	V

TA78DL12S

ELECTRICAL CHARACTERISTICS (V_{IN}=18V, I_{OUT}=10mA, Tj=25°C)

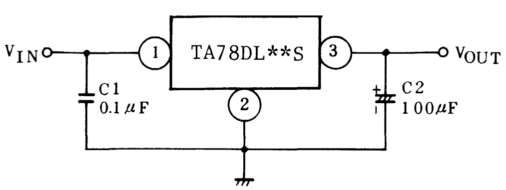
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=12.35~26V Ta=-40~+85°C	10.8	12	13.2	V
Line Regulation	Reg.Line	-	V_{IN}=16~23V	-	5	24	mV
			V_{IN}=13~26V	-	10	70	
Load Regulation	Reg.Load	-	I_{OUT}=10~200mA	-	33	120	mV
Quiescent Current	I_B	-	I_{OUT} ≤10mA, V_{IN}=13~26V	-	0.8	-	mA
Dropout Voltage	V_{DROP}	-	I_{OUT}=50mA	-	0.15	0.3	V
			I_{OUT}=200mA	-	0.4	0.6	
Max. Operating Voltage	V_{IN}	-		26	33	-	V

TA78DL15S

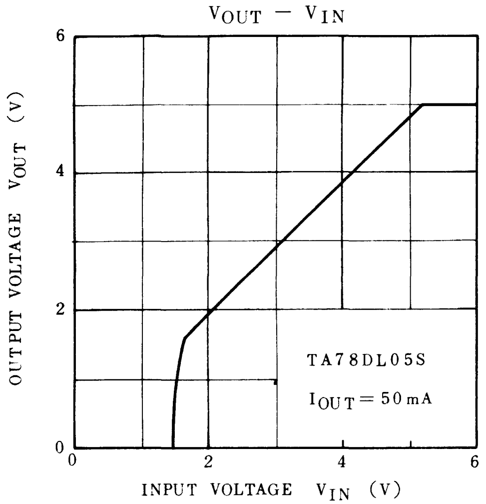
ELECTRICAL CHARACTERISTICS (V_{IN}=20V, I_{OUT}=10mA, Tj=25°C)

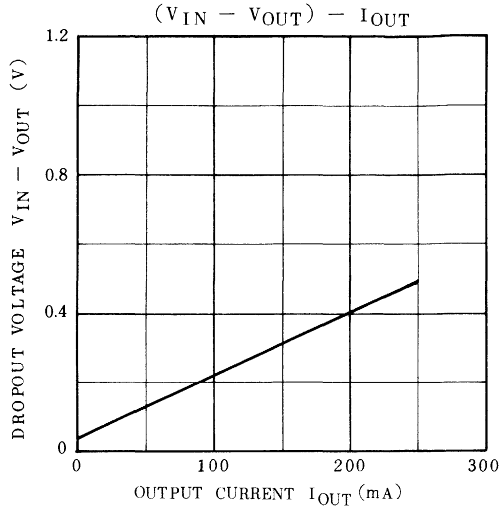
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=15.35~26V Ta=-40~+85°C	13.5	15	16.5	V
Line Regulation	Reg.Line	-	V_{IN}=19~26V	-	6	30	mV
			V_{IN}=16~26V	-	12	80	
Load Regulation	Reg.Load	-	I_{OUT}=10~200mA	-	40	150	mV
Quiescent Current	I_B	-	I_{OUT} ≤10mA, V_{IN}=16~26V	-	0.9	-	mA
Dropout Voltage	V_{DROP}	-	I_{OUT}=50mA	-	0.15	0.3	V
			I_{OUT}=200mA	-	0.4	0.6	
Max. Operating Voltage	V_{IN}	-		26	33	-	V

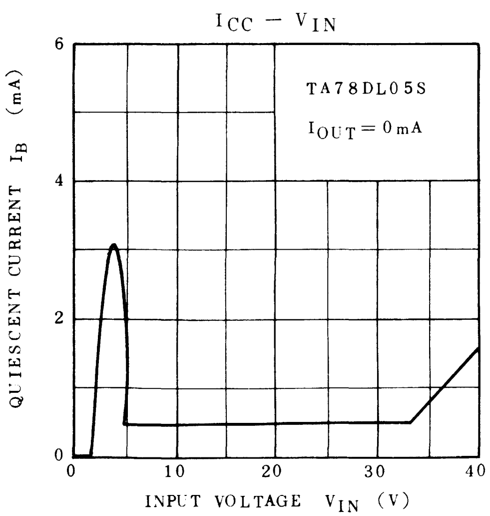
APPLICATION CIRCUIT

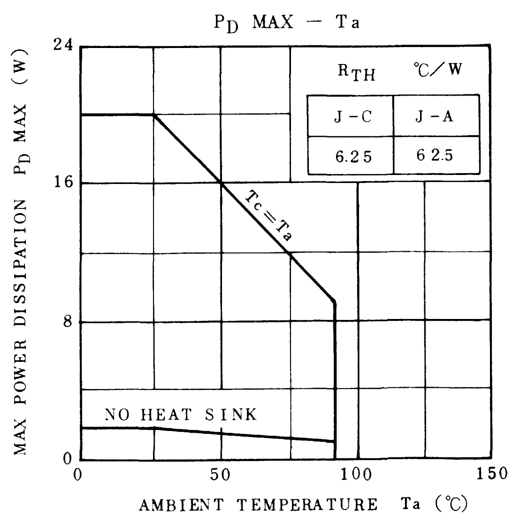


Capacitor C_2 must be guaranteed to operate of the temperature range that the regulator should be operated correctly.
100μF is a suitable value to suppress the oscillation phenomenon at the output terminal.


VOUT — VIN
OUTPUT VOLTAGE VOUT (V)
INPUT VOLTAGE VIN (V)
TA78DL05S
IOUT = 50 mA
0
2
4
6

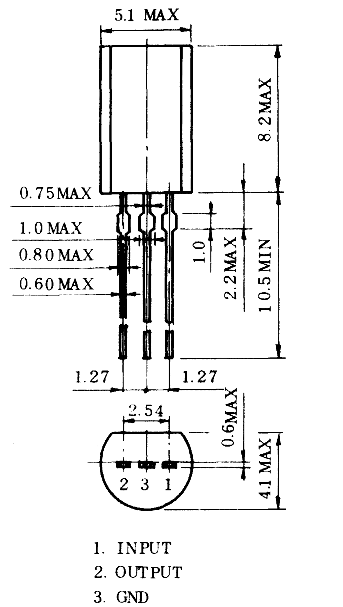

(VIN — VOUT) — IOUT
DROPOUT VOLTAGE VIN - VOUT (V)
OUTPUT CURRENT IOUT (mA)
0
0.4
0.8
1.2
100
200
300


ICC — VIN
QUIESCENT CURRENT IB (mA)
INPUT VOLTAGE VIN (V)
TA78DL05S
IOUT = 0 mA
0
2
4
6
10
20
30
40


PD MAX — Ta
MAX POWER DISSIPATION PD MAX (W)
AMBIENT TEMPERATURE Ta (℃)
RTH ℃/W
J-C
J-A
6.25
62.5
Tc=Ta
NO HEAT SINK
0
8
16
24
50
100
150

TA78DS05P/10P

Unit in mm



JEDEC	TO-92MOD
EIAJ	–
TOSHIBA	SSIP3-P

LOW DROPOUT VOLTAGE REGULATOR.

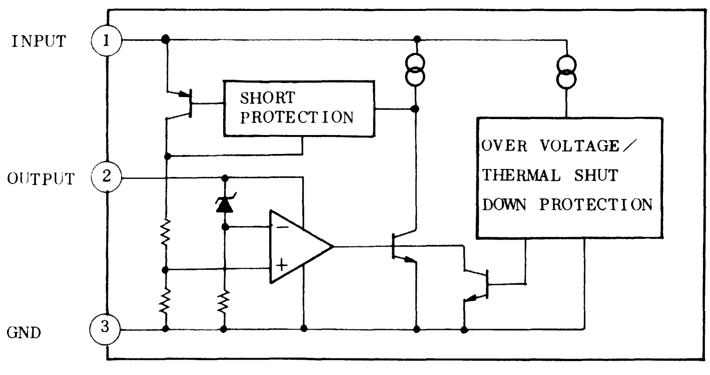
The TA78DSXXP series consists of positive fixed output voltage regulator IC capable of sourcing current up to 30mA. Due to the features of low dropout voltage and low standby current, these devices are useful for battery powered equipment. This series includes current limiting, thermal shoutdown, overvoltage protection, input fault protection and excessive transient protection circuits internally.

- Low Standby Current of 500μA Typical.
- Maximum Output Current Up to 30mA.
- Low Dropout Voltage of Less than 0.3V.
- Multi-protection : Reverse Connection of Power Supply, 60V Load Dump, Thermal Shut Down and Current Limiting.
- Available in the Plastic TO-92 MOD Package

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Operating Input Voltage	V_{IN}	29	V
Input Voltage of Surge	V_{IN}	60	V
Power Dissipation	P_D	800	mW
Operating Temperature	T_{opr}	-40~85	°C
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	-55~150	°C
Soldering Temperature	T_{sol}	260(10 sec)	°C

BLOCK DIAGRAM



TA78DS05P

ELECTRICAL CHARACTERISTICS

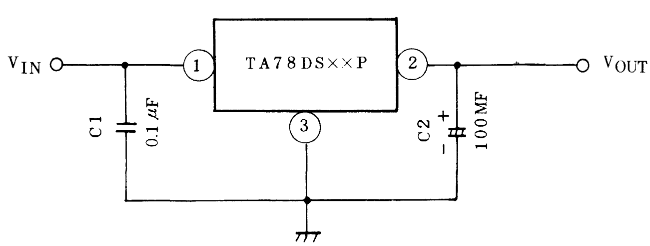
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=5.35~26V, Ta=-40~85°C	4.5	5	5.5	V
Line Regulation	$\Delta V_{OUT(1)}$	-	V_{IN}=9~16V	-	2	10	mV
			V_{IN}=6~26V	-	4	30	
Load Regulation	$\Delta V_{OUT(2)}$	-	I_{OUT}=5~30mA	-	14	50	mV
Quiescent Current	I_{CC}	-	$I_{OUT} \leq$ 5mA, V_{IN}=6~26V	-	0.5	1	mA
Propout Voltage	V_{DROP}	-	I_{OUT}=5mA	-	0.1	0.2	mA
			I_{OUT}=10mA	-	0.2	0.3	
Max. Operating Voltage	V_{IN}	-		29	33	-	V

TA78DS10P

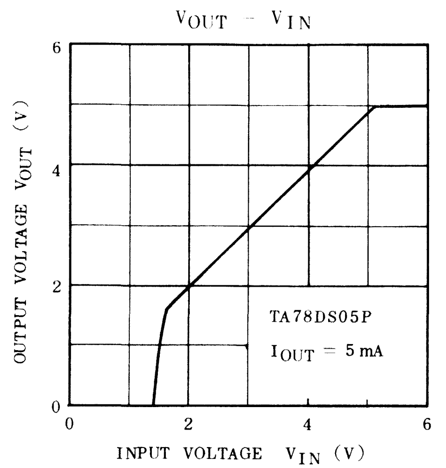
ELECTRICAL CHARACTERISTICS

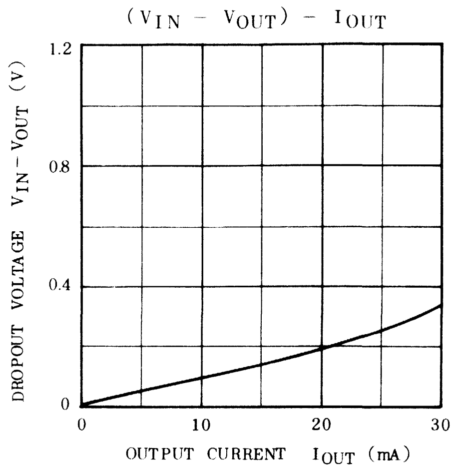
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=10.35~26V,Ta=-40~85°C	9	10	11	V
Line Regulation	$\Delta V_{OUT(1)}$	-	V_{IN}=14~21V	-	4	20	mV
			V_{IN}=11~26V	-	8	60	
Load Regulation	$\Delta V_{OUT(2)}$	-	I_{OUT}=5~30mA	-	28	100	mV
Quiescent Current	I_{CC}	-	$I_{OUT} \leq$ 5mA, V_{IN}=11~26V	-	0.7	-	mA
Propout Voltage	V_{DROP}	-	I_{OUT}=5mA	-	0.1	0.2	V
			I_{OUT}=10mA	-	0.2	0.3	
Max. Operating Voltage	V_{IN}	-		29	33	-	V

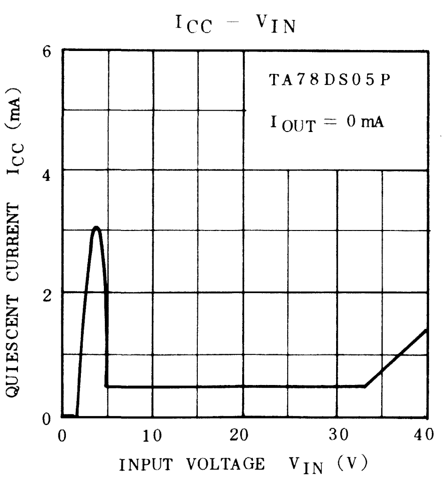
APPLICATION CIRCUIT

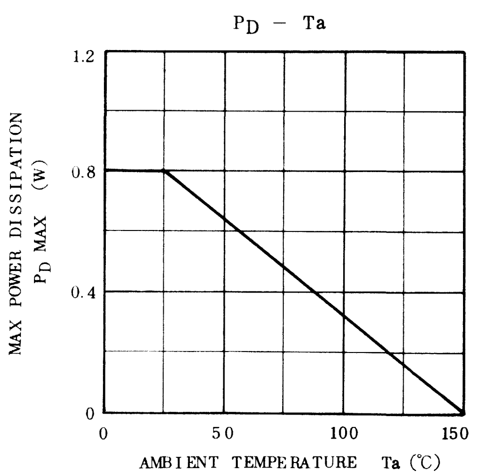


Capacitor C2 must be guaranteed to operate of the temperature range that the regulator should be operated correctly, 100μF is a suitable value to suppress the oscillation phonomenon at the output terminal.


VOUT - VIN
OUTPUT VOLTAGE VOUT (V)
INPUT VOLTAGE VIN (V)
TA78DS05P
IOUT = 5 mA
0
2
4
6


(VIN - VOUT) - IOUT
DROPOUT VOLTAGE VIN - VOUT (V)
OUTPUT CURRENT IOUT (mA)
1.2
0.8
0.4
0
10
20
30


ICC - VIN
QUIESCENT CURRENT ICC (mA)
INPUT VOLTAGE VIN (V)
TA78DS05P
IOUT = 0 mA
6
4
2
0
10
20
30
40


PD - Ta
MAX POWER DISSIPATION PD MAX (W)
AMBIENT TEMPERATURE Ta (℃)
1.2
0.8
0.4
0
50
100
150

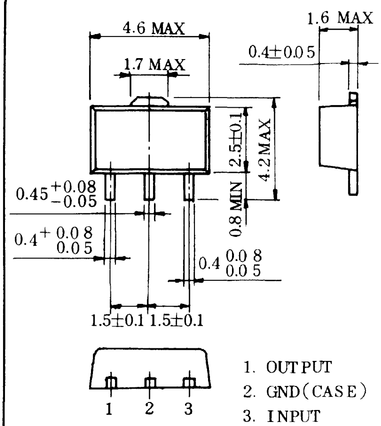
TA78L05F/06F/08F/09F/10F
TA78L12F/15F/18F/20F/24F

o 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V

3-TERMINAL POSITIVE VOLTAGE REGULATORS

- Best suited to power supply for TTL/C^2 MOS
- No external part needed
- Built-in thermal protective circuit
- Max. output current 150mA (T_j = 25°C)
- Packaged in POWER MINI

Unit in mm



Package width and length do not include mold protrusion. Allowable mold protrusion is 0.15mm.

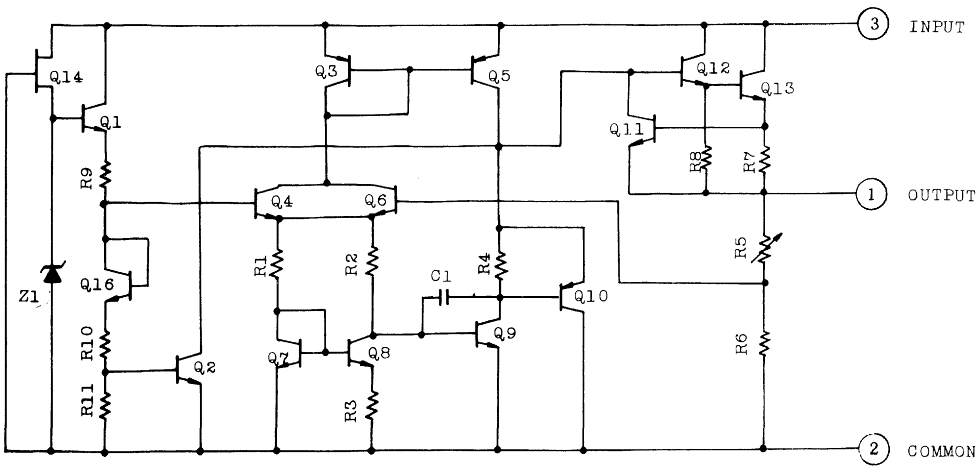
JEDEC	—
TOSHIBA	HSOP3-P

Weight: 0.05g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage	(5V ∿ 15V)	V_{IN}	35	V
	(18V ∿ 24V)	V_{IN}	40	V
Power Dissipation		P_D	500	mW
Operating Temperature		T_{opr}	-30 ∿ 75	°C
Storage Temperature		T_{stg}	-55 ∿ 150	°C

EQUIVALENT CIRCUIT



TA78L05F

ELECTRICAL CHARACTERISTICS

(V_{IN} = 10V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C		4.75	5.0	5.25	V
Line Regulation	Reg Line	1	T_j=25°C	7.0V ≦ V_{IN} ≦ 20V	-	55	150	mV
				8.0V ≦ V_{IN} ≦ 20V	-	45	100	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	11	60	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	5.0	30	
Output Voltage	V_{OUT}	1	7.0V ≦ V_{IN} ≦ 20V, 1.0mA ≦ I_{OUT} ≦ 40mA		4.65	-	5.35	V
			V_{IN} = 10V, 1.0mA ≦ I_{OUT} ≦ 70mA		4.65	-	5.35	
Quiescent Current	I_B	1	T_j = 25°C		-	3.1	6.0	mA
			T_j = 125°C		-	-	5.5	
Quiescent Current Change	ΔI_B	1	8.0V ≦ V_{IN} ≦ 20V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	40	-	μV
Long Term Stability	$\Delta V_{OUT} / \Delta t$	1			-	12	-	mV/ 1.0kHrs
Ripple Rejection Ratio	RR	2	f = 120Hz 8.0V ≦ V_{IN} ≦ 18V, T_j = 25°C		41	49	-	dB
Dropout Voltage	$\lvert V_{IN} - V_{OUT} \rvert$	1	T_j = 25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	-0.6	-	mV/°C

TA78L06F

ELECTRICAL CHARACTERISTICS

(V_{IN} = 11V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C		5.7	6.0	6.3	V
Line Regulation	Reg Line	1	T_j=25°C	8.1V ≦ V_{IN} ≦ 21V	-	50	150	mV
				9.0V ≦ V_{IN} ≦ 21V	-	45	110	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	12	70	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	5.5	35	
Output Voltage	V_{OUT}	1	8.1V ≦ V_{IN} ≦ 21V, 1.0mA ≦ I_{OUT} ≦ 40mA		5.58	-	6.42	V
			V_{IN} = 11V, 1.0mA ≦ I_{OUT} ≦ 70mA		5.58	-	6.42	
Quiescent Current	I_B	1	T_j = 25°C		-	3.1	6.0	mA
			T_j = 125°C		-	-	5.5	
Quiescent Current Change	ΔI_B	1	9.0V ≦ V_{IN} ≦ 20V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta = 25°C 10Hz ≦ f ≦ 100kHz		-	40	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	14	-	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	f = 120Hz 9.0V ≦ V_{IN} ≦ 19V, T_j = 25°C		39	47	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	T_j = 25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	-0.7	-	mV/°C

TA78L08F

ELECTRICAL CHARACTERISTICS

(V_{IN} = 14V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C		7.6	8.0	8.4	V
Line Regulation	Reg Line	1	T_j=25°C	10.5V ≦ V_{IN} ≦ 23V	-	20	175	mV
				11V ≦ V_{IN} ≦ 23V	-	12	125	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	15	80	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	7.0	40	
Output Voltage	V_{OUT}	1	10.5V ≦ V_{IN} ≦ 23V. 1.0mA ≦ I_{OUT} ≦ 40mA		7.44	-	8.56	V
			V_{IN} = 14V, 1.0mA ≦ I_{OUT} ≦ 70mA		7.44	-	8.56	
Quiescent Current	I_B	1	T_j = 25°C		-	3.1	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	11V ≦ V_{IN} ≦ 23V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	60	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	20	-	mV/ 1.0kHrs
Ripple Rejection Ratio	RR	2	f = 120Hz 12V ≦ V_{IN} ≦ 23V, T_j = 25°C		37	45	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	T_j = 25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	-0.8	-	mV/°C

TA78L09F

ELECTRICAL CHARACTERISTICS

(V_{IN} = 15V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C		8.55	9.0	9.45	V
Line Regulation	Reg Line	1	T_j=25°C	11.4V ≦ V_{IN} ≦ 24V	-	80	200	mV
				12V ≦ V_{IN} ≦ 24V	-	20	160	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	17	90	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	8.0	45	
Output Voltage	V_{OUT}	1	11.4V ≦ V_{IN} ≦ 24V, 1.0mA ≦ I_{OUT} ≦ 40mA		8.37	-	9.63	V
			V_{IN} = 15V, 1.0mA ≦ I_{OUT} ≦ 70mA		8.37	-	9.63	
Quiescent Current	I_B	1	T_j = 25°C		-	3.2	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	12V ≦ V_{IN} ≦ 24V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta = 25°C 10Hz ≦ f ≦ 100kHz		-	65	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	21	-	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	f = 120Hz, 12V ≦ V_{IN} ≦ 24V, T_j = 25°C		36	44	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	T_j = 25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	-0.85	-	mV/°C

TA78L10F

ELECTRICAL CHARACTERISTICS

(V_{IN} = 16V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C		9.5	10	10.5	V
Line Regulation	Reg Line	1	T_j=25°C	12.5V ≦ V_{IN} ≦ 25V	-	80	230	mV
				13V ≦ V_{IN} ≦ 25V	-	30	170	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	18	90	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	8.5	45	
Output Voltage	V_{OUT}	1	12.5V ≦ V_{IN} ≦ 25V, 1.0mA ≦ I_{OUT} ≦ 40mA		9.3	-	10.7	V
			V_{IN} = 16V, 1.0mA ≦ I_{OUT} ≦ 70mA		9.3	-	10.7	
Quiescent Current	I_B	1	T_j = 25°C		-	3.2	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	13V ≦ V_{IN} ≦ 25V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta = 25°C, 10Hz ≦ f ≦ 100kHz		-	70	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	22	-	mV/ 1.0kHrs
Ripple Rejection Ratio	RR	2	f = 120Hz, 13V ≦ V_{IN} ≦ 24V, T_j = 25°C		36	43	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	T_j = 25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	-0.9	-	mV/°C

TA78L12F

ELECTRICAL CHARACTERISTICS

(V_{IN} = 19V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C		11.4	12	12.6	V
Line Regulation	Reg Line	1	T_j=25°C	14.5V ≦ V_{IN} ≦ 27V	-	120	250	mV
				16V ≦ V_{IN} ≦ 27V	-	100	200	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	20	100	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	10	50	
Output Voltage	V_{OUT}	1	14.5V ≦ V_{IN} ≦ 27V, 1.0mA ≦ I_{OUT} ≦ 40mA		11.16	-	12.84	V
			V_{IN} = 19V, 1.0mA ≦ I_{OUT} ≦ 70mA		11.16	-	12.84	
Quiescent Current	I_B	1	T_j=25°C		-	3.2	6.5	mA
			T =125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	16V ≦ V_{IN} ≦ 27V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	80	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	24	-	mV/ 1.0kHrs
Ripple Rejection Ratio	RR	2	f = 120Hz, 15V ≦ V_{IN} ≦ 25V, T_j = 25°C		36	41	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	T_j=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	-1.0	-	mV/°C

TA78L15F

ELECTRICAL CHARACTERISTICS

(V_{IN} = 23V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C		14.25	15	15.75	V
Line Regulation	Reg Line	1	T_j=25°C	17.5V ≦ V_{IN} ≦ 30V	-	130	300	mV
				20V ≦ V_{IN} ≦ 30V	-	110	250	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	25	150	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	12	75	
Output Voltage	V_{OUT}	1	17.5V ≦ V_{IN} ≦ 30V, 1.0mA = I_{OUT} = 40mA		13.95	-	16.05	V
			V_{IN} = 23V, 1.0mA ≦ I_{OUT} ≦ 70mA		13.95	-	16.05	
Quiescent Current	I_B	1	T_j = 25°C		-	3.3	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	20V ≦ V_{IN} ≦ 30V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta = 25°C, 10Hz ≦ f ≦ 100kHz		-	90	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	30	-	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	f = 120Hz, 18.5V ≦ V_{IN} ≦ 28.5V, T_j = 25°C		34	40	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	T_j = 25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	-1.3	-	mV/°C

TA78L18F

ELECTRICAL CHARACTERISTICS

(V_{IN} = 27V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C		17.1	18	18.9	V
Line Regulation	Reg Line	1	T_j=25°C	21.4V ≦ V_{IN} ≦ 33V	–	32	325	mV
				22V ≦ V_{IN} ≦ 33V	–	27	275	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	–	30	170	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	–	15	75	
Output Voltage	V_{OUT}	1	21.4V ≦ V_{IN} ≦ 33V, 1.0mA ≦ I_{OUT} ≦ 40mA		16.74	–	19.26	V
			V_{IN} = 27V, 1.0mA ≦ I_{OUT} ≦ 70mA		16.74	–	19.26	
Quiescent Current	I_B	1	T_j = 25°C		–	3.3	6.5	mA
			T_j = 125°C		–	–	6.0	
Quiescent Current Change	ΔI_B	1	22V ≦ V_{IN} ≦ 33V		–	–	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		–	–	0.1	
Output Noise Voltage	V_{NO}	1	Ta = 25°C, 10Hz ≦ f ≦ 100kHz		–	150	–	μV
Long Term Stability	$\Delta V_{OUT} / \Delta t$	1			–	45	–	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	f = 120Hz, 23V ≦ V_{IN} ≦ 33V, T_j = 25°C		32	38	–	dB
Dropout Voltage	$\|V_{IN} - V_{OUT}\|$	1	T_j = 25°C		–	1.7	–	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		–	-1.5	–	mV/°C

TA78L20F

ELECTRICAL CHARACTERISTICS

(V_{IN} =29V, I_{OUT} =40mA, C_{IN} =0.33μF, C_{OUT} =0.1μF, 0°C ≦ T_j ≦125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C		19.0	20	21.0	V
Line Regulation	Reg Line	1	T_j=25°C	23.5V ≦ V_{IN} ≦ 35V	-	33	330	mV
				24V ≦ V_{IN} ≦ 35V	-	28	285	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	33	180	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	17	90	
Output Voltage	V_{OUT}	1	23.5V ≦ V_{IN} ≦ 35V, 1.0mA ≦ I_{OUT} ≦ 40mA		18.6	-	21.4	V
			V_{IN} = 29V, 1.0mA ≦ I_{OUT} ≦ 70mA		18.6	-	21.4	
Quiescent Current	I_B	1	T_j = 25°C		-	3.3	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	24V ≦ V_{IN} ≦ 35V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta = 25°C, 10Hz ≦ f ≦ 100kHz		-	170	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	49	-	mV/ 1.0kHrs
Ripple Rejection Ratio	RR	2	f = 120Hz, 25V ≦ V_{IN} ≦ 35V, T_j = 25°C		31	37	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	T_j = 25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	-1.7	-	mV/°C

TA78L24F

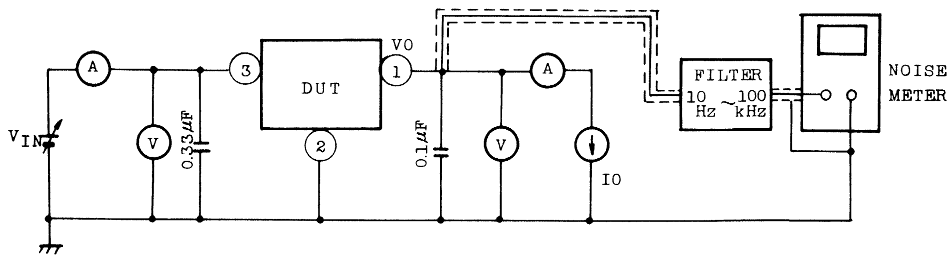
ELECTRICAL CHARACTERISTICS

(V_{IN} = 33V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C		22.8	24	25.2	V
Line Regulation	Reg Line	1	T_j=25°C	27.5V ≦ V_{IN} ≦ 38V	-	35	350	mV
				28V ≦ V_{IN} ≦ 38V	-	30	300	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	40	200	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	20	100	
Output Voltage	V_{OUT}	1	27.5V ≦ V_{IN} ≦ 38V, 1.0mA ≦ I_{OUT} ≦ 40mA		22.32	-	25.68	V
			V_{IN} = 33V, 1.0mA ≦ I_{OUT} ≦ 70mA		22.32	-	25.68	
Quiescent Current	I_B	1	T_j = 25°C		-	3.5	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	28V ≦ V_{IN} ≦ 38V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta = 25°C, 10Hz ≦ f ≦ 100kHz		-	200	-	μV
Long Term Stability	$\Delta V_{OUT} / \Delta t$	1			-	56	-	mV/ 1.0kHrs
Ripple Rejection Ratio	RR	2	f = 120Hz, 29V ≦ V_{IN} ≦ 39V, T_j = 25°C		31	35	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	1	T_j = 25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	T_{OUT} = 5mA		-	-2.0	-	mV/°C

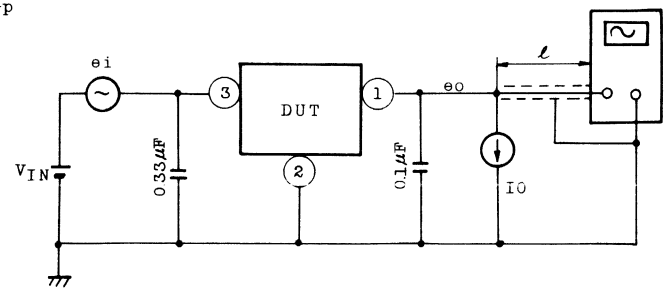
TEST CIRCUIT

1. V_{OUT}, Reg.line, Reg.load, I_B, ΔI_B, V_{NO}, $\Delta V_{OUT}/\Delta t$, $|V_{IN}-V_{OUT}|$, TC_{VO}

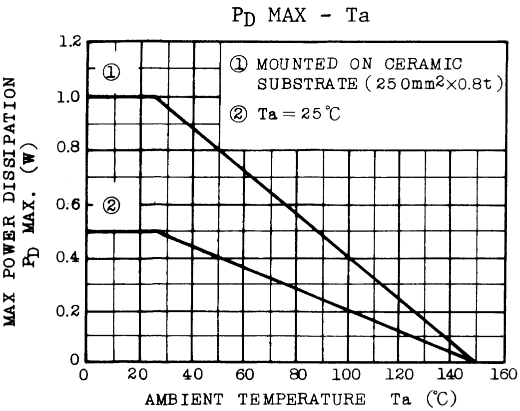


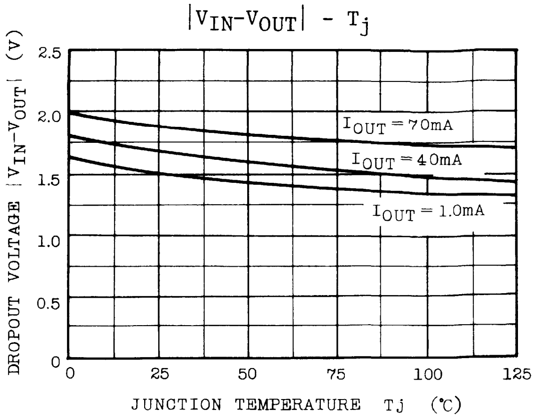
2. RR

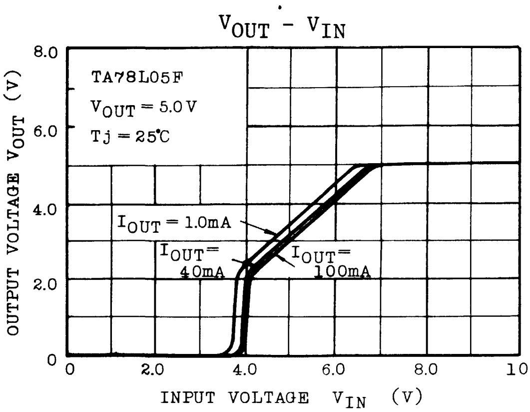
$ei = 1V_{p-p}$
$f = 120Hz$
$\ell \leq 30cm$

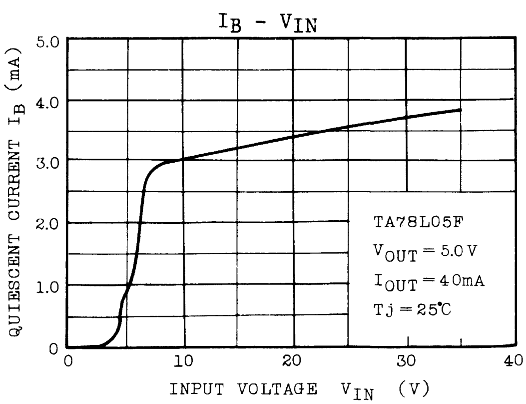


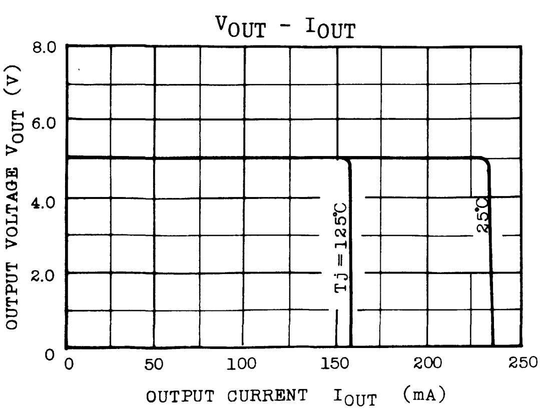
$$RR = 20\log\frac{ei}{eo} \text{ (dB)}$$


PD MAX - Ta
① MOUNTED ON CERAMIC SUBSTRATE (250mm²×0.8t)
② Ta = 25°C
MAX POWER DISSIPATION PD MAX. (W)
AMBIENT TEMPERATURE Ta (°C)
1.2
1.0
0.8
0.6
0.4
0.2
0
20
40
60
80
100
120
140
160


|VIN-VOUT| - Tj
IOUT = 70mA
IOUT = 40mA
IOUT = 1.0mA
DROPOUT VOLTAGE |VIN-VOUT| (V)
JUNCTION TEMPERATURE Tj (°C)
2.5
2.0
1.5
1.0
0.5
0
25
50
75
100
125

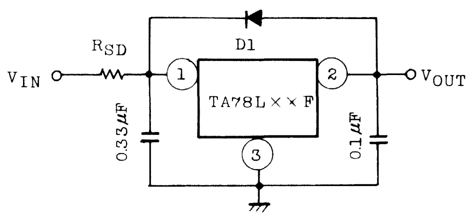

VOUT - VIN
TA78L05F
VOUT = 5.0V
Tj = 25°C
IOUT = 1.0mA
IOUT = 40mA
IOUT = 100mA
OUTPUT VOLTAGE VOUT (V)
INPUT VOLTAGE VIN (V)
8.0
6.0
4.0
2.0
0
10


IB - VIN
TA78L05F
VOUT = 5.0V
IOUT = 40mA
Tj = 25°C
QUIESCENT CURRENT IB (mA)
INPUT VOLTAGE VIN (V)
5.0
4.0
3.0
2.0
1.0
0
10
20
30
40


VOUT - IOUT
Tj = 125°C
25°C
OUTPUT VOLTAGE VOUT (V)
OUTPUT CURRENT IOUT (mA)
8.0
6.0
4.0
2.0
0
50
100
150
200
250

EXAMPLES OF TYPICAL CIRCUIT

(1) Example of Typical Circuit



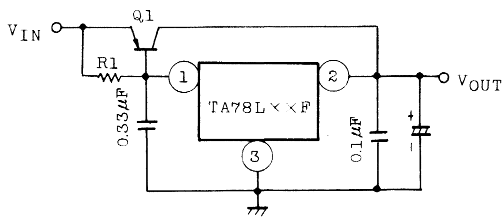
D_1 : IC protective diode

When surge voltage is applied to IC output terminal or $V_{IN} < V_{OUT}$ at the time of power ON/OFF, always connect the high speed switching diode D_1.

R_{SD}: Power limiting resistor

If V_{IN} is too high, always connect R_{SD} in order to reduce power consumption of IC.

(2) A. Current boosting circuit



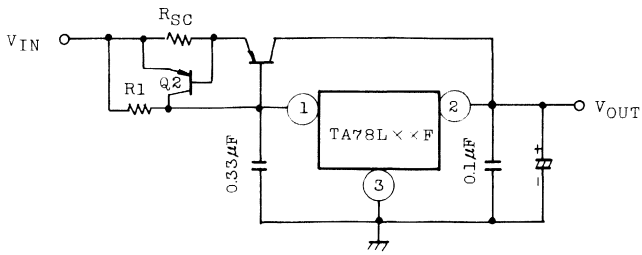
Use a required radiation plate for Q_1.

$$R_1 \leq \frac{V_{BE1}}{I_B\ MAX}$$

where, V_{BE1} : V_{BE} of external transistor Q_1

I_B MAX: Max. bias current of IC

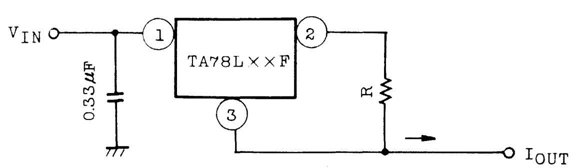
B. Current boosting circuit with output short-circuit protective circuit



$$R_{SC} = \frac{V_{BE2}}{I_{SC}}$$

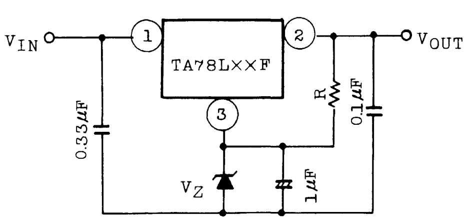
where, I_{SC}: Short-circuit current

(3) Constant-current circuit



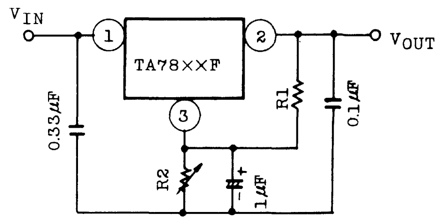
$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

(4) Voltage boosting circuit



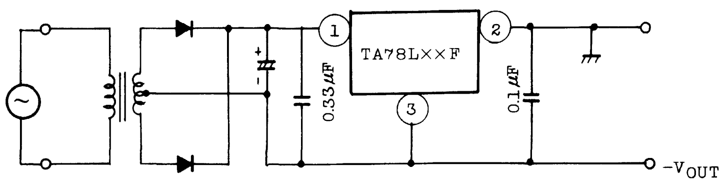
$V_{OUT} = V_Z + V_{OUT}$(of IC)

Apply current of several mA to R.

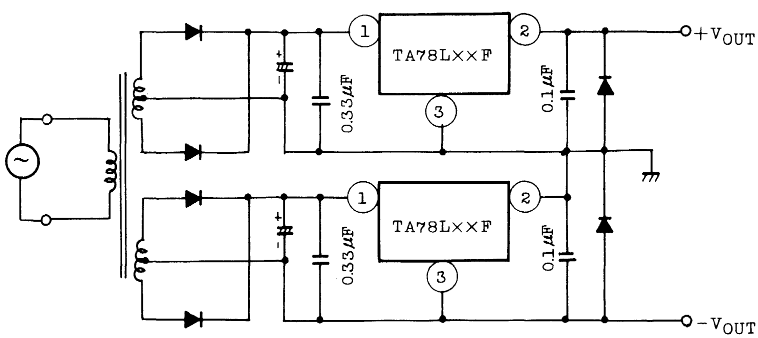


$$V_{OUT} = R_2\left(I_B + \frac{V_{OUT}(\text{of IC})}{R_1}\right) + V_{OUT}(\text{of IC})$$

(5) Negative power supply



(6) Positive/negative power supply



Precautions for Use

If high voltage in excess of output voltage (TYP. value) of IC is applied to its output terminal, IC may be destroyed. In this case, connect a Zener diode between the output terminal and GND to prevent application of excessive voltage. In particular, in such a current boosting circuit as shown in Application Circuit Example (2), if input voltage is suddenly applied by stages and furthermore, load is light, excessive voltage may be applied transiently to the output terminal of IC. In such a case as this, it may become necessary to increase capacity of output capacitor as appropriate, use a smaller R1 (a resistor for bypassing IC bias current) or gradually rise input voltage in addition to use of a Zener diode as mentioned above.

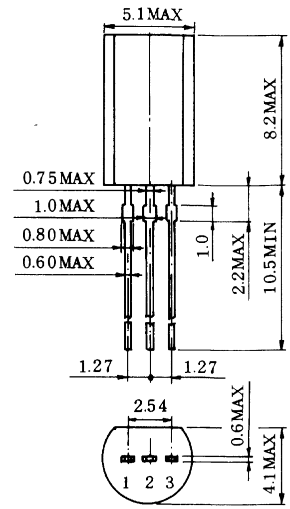
TA78L005AP, TA78L006AP, TA78L007AP, TA78L008AP, TA78L009AP, TA78L010AP, TA78L012AP, TA78L015AP, TA78L018AP, TA78L020AP, TA78L024AP, TA78L075AP, TA78L132AP

THREE TERMINAL POSITIVE REGULATORS

5V, 6V, 7V, 7.5V, 8V, 9V, 10V, 12V
13.2V, 15V, 18V, 20V, 24V.

- Suitable for TTL, DTL, HTL, C-MOS Power Supply
- Internal Short-Circuit Current Limiting
- Internal Thermal Overload Protection
- Maximum Output Current of 150mA (Tj=25°C)
- Plastic TO-92MOD Package

Unit in mm



1. OUTPUT
2. COMMON
3. INPUT

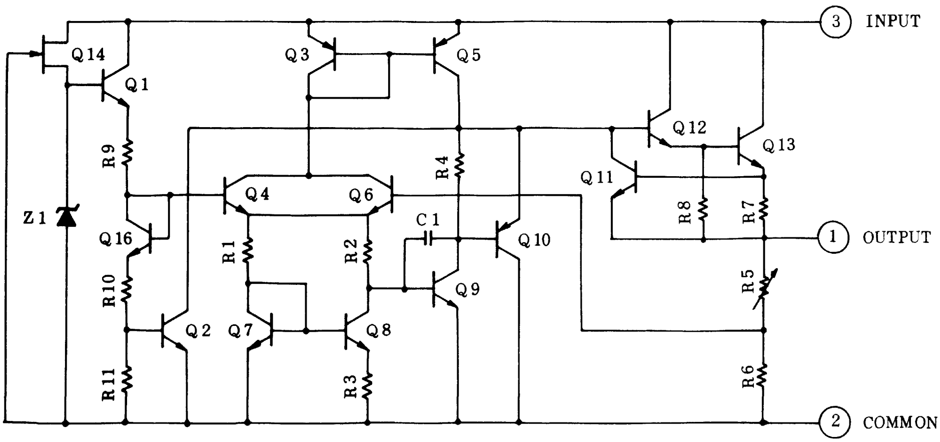
JEDEC	TO-92MOD
EIAJ	—
TOSHIBA	SSIP3-P

Weight: 0.36g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage	(5V~15V)	V_{IN}	35	V
	(18V~24V)		40	
Power Dissipation		P_D	800	mW
Operating Temperature		Topr	-30~75	°C
Storage Temperature		Tstg	-55~150	°C

EQUIVALENT CIRCUIT



TA78L005AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=10V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°C<Tj<125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		4.8	5.0	5.2	V
Input Regulation	Reg.line	1	Tj=25°C	7.0≦V_{IN}≦20V	-	55	150	mV
				8.0≦V_{IN}≦20V	-	45	100	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA≦I_{OUT}≦100mA	-	11	60	mV
				1.0mA≦I_{OUT}≦40mA	-	5.0	30	
Output Voltage	V_{OUT}	1	7.0V≦V_{IN}≦20V 1.0mA≦I_{OUT}≦40mA		4.75	-	5.25	V
			V_{IN}=10V 1.0mA≦I_{OUT}≦70mA		4.75	-	5.25	
Quiescent Current	I_B	1	Tj=25°C		-	3.1	6.0	mA
			Tj=125°C		-	-	5.5	
Quiescent Current Change	ΔI_B	1	8.0V≦V_{IN}≦20V		-	-	1.5	mA
			1.0mA≦I_{OUT}≦40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz		-	40	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	12	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=120Hz 8.0V≦V_{IN}≦18V, Tj=25°C		41	49	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-0.6	-	mV/°C

TA78L006AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=11V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°C<Tj<125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		5.76	6.0	6.24	V
Input Regulation	Reg.line	1	Tj=25°C	8.1V ≦ V_{IN} ≦ 21V	-	50	150	mV
				9.0V ≦ V_{IN} ≦ 21V	-	45	110	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	12	70	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	5.5	35	
Output Voltage	V_{OUT}	1	8.1V ≦ V_{IN} ≦ 21V 1.0mA ≦ I_{OUT} ≦ 40mA		5.7	-	6.3	V
			V_{IN}=11V 1.0mA ≦ I_{OUT} ≦ 70mA		5.7	-	6.3	
Quiescent Current	I_B	1	Tj=25°C		-	3.1	6.0	mA
			Tj=125°C		-	-	5.5	
Quiescent Current Change	ΔI_B	1	9.0V ≦ V_{IN} ≦ 20V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C 10Hz ≦ f ≦ 100kHz		-	40	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	14	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=120Hz 9.0V ≦ V_{IN} ≦ 19V, Tj=25°C		39	47	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-0.7	-	mV/°C

TA78L007AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=12V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°C<Tj<125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		6.72	7.0	7.28	V
Input Regulation	Reg.line	1	Tj=25°C	9.2V≦V_{IN}≦22V	-	50	160	mV
				10V≦V_{IN}≦22V	-	45	115	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA≦I_{OUT}≦100mA	-	13	75	mV
				1.0mA≦I_{OUT}≦40mA	-	6.0	40	
Output Voltage	V_{OUT}	1	9.2V≦V_{IN}≦22V 1.0mA≦I_{OUT}≦40mA		6.65	-	7.35	V
			V_{IN}=12V 1.0mA≦I_{OUT}≦70mA		6.65	-	7.35	
Quiescent Current	I_B	1	Tj=25°C		-	3.1	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	10V≦V_{IN}≦22V		-	-	1.5	mA
			1.0mA≦I_{OUT}≦40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz		-	50	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	17	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=120Hz 10V≦V_{IN}≦20V, Tj=25°C		37	46	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-0.75	-	mV/°C

TA78L075AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=13V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°<Tj<125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}		Tj=25°C		7.21	7.5	7.79	V
Input Regulation	Reg.line	1	Tj=25°C	9.8V ≦ V_{IN} ≦ 23V	-	40	170	mV
				10.5V ≦ V_{IN} ≦ 23V	-	40	120	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	14	80	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	6.5	40	
Output Voltage	V_{OUT}	1	9.8V ≦ V_{IN} ≦ 23V 1.0mA ≦ I_{OUT} ≦ 40mA		7.125	-	7.875	V
			V_{IN}=13V 1.0mA ≦ I_{OUT} ≦ 70mA		7.125	-	7.875	
Quiescent Current	I_B	1	Tj=25°C		-	3.1	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	10.5V ≦ V_{IN} ≦ 23V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	60	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	19	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=120Hz 11V ≦ V_{IN} ≦ 21V, Tj=25°C		37	45	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-0.75	-	mV/°C

TA78L008AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=14V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°C<Tj<125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		7.7	8.0	8.3	V
Input Regulation	Reg.line	1	Tj=25°C	10.5V ≦ V_{IN} ≦ 23V	-	20	175	mV
				11V ≦ V_{IN} ≦ 23V	-	12	125	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	15	80	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	7.0	40	
Output Voltage	V_{OUT}	1	10.5V ≦ V_{IN} ≦ 23V 1.0mA ≦ I_{OUT} ≦ 40mA		7.6	-	8.4	V
			V_{IN}=14V 1.0mA ≦ I_{OUT} ≦ 70mA		7.6	-	8.4	
Quiescent Current	I_B	1	Tj=25°C		-	3.1	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	11V ≦ V_{IN} ≦ 23V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	60	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	20	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=120Hz 12V ≦ V_{IN} ≦ 23V, Tj=25°C		37	45	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-0.8	-	mV/°C

TA78L009AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=15V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°C<Tj<125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		8.64	9.0	9.36	V
Input Regulation	Reg.line	1	Tj=25°C	11.4V ≦ V_{IN} ≦ 24V	-	80	200	mV
				12V ≦ V_{IN} ≦ 24V	-	20	160	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	17	90	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	8.0	45	
Output Voltage	V_{OUT}	1	11.4V ≦ V_{IN} ≦ 24V 1.0mA ≦ I_{OUT} ≦ 40mA		8.55	-	9.45	V
			V_{IN}=15V 1.0mA ≦ I_{OUT} ≦ 70mA		8.55	-	9.45	
Quiescent Current	I_B	1	Tj=25°C		-	3.2	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	11.5V ≦ V_{IN} ≦ 26V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	65	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	21	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=120Hz 12V ≦ V_{IN} ≦ 24V, Tj=25°C		36	44	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-0.85	-	mV/°C

TA78L010AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=16V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°C<Tj<125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		9.6	10	10.4	V
Input Regulation	Reg.line	1	Tj=25°C	12.5V ≦ V_{IN} ≦ 25V	-	80	230	mV
				13V ≦ V_{IN} ≦ 25V	-	30	170	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	18	90	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	8.5	45	
Output Voltage	V_{OUT}	1	12.5V ≦ V_{IN} ≦ 25V 1.0mA ≦ I_{OUT} ≦ 40mA		9.5	-	10.5	V
			V_{IN}=16V 1.0mA ≦ I_{OUT} ≦ 70mA		9.5	-	10.5	
Quiescent Current	I_B	1	Tj=25°C		-	3.2	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	13V ≦ V_{IN} ≦ 25V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C 10Hz ≦ f ≦ 100kHz		-	70	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	22	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=120Hz 13V ≦ V_{IN} ≦ 24V, Tj=25°C		36	43	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-0.9	-	mV/°C

TA78L012AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=19V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°C<Tj<125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		11.5	12	12.5	V
Input Regulation	Reg.line	1	Tj=25°C	14.5V≦V_{IN}≦27V	-	120	250	mV
				16V≦V_{IN}≦27V	-	100	200	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA≦I_{OUT}≦100mA	-	20	100	mV
				1.0mA≦I_{OUT}≦40mA	-	10	50	
Output Voltage	V_{OUT}	1	14.5V≦V_{IN}≦27V 1.0mA≦I_{OUT}≦40mA		11.4	-	12.6	V
			V_{IN}=19V 1.0mA≦I_{OUT}≦70mA		11.4	-	12.6	
Quiescent Current	I_B	1	Tj=25°C		-	3.2	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	16V≦V_{IN}≦27V		-	-	1.5	mA
			1.0mA≦I_{OUT}≦40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz		-	80	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	24	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=120Hz 15V≦V_{IN}≦25V, Tj=25°C		36	41	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-1.0	-	mV/°C

TA78L132AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=21V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°C<Tj<125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		12.67	13.2	13.73	V
Input Regulation	Reg.line	1	Tj=25°C	16V≦V_{IN}≦28V	-	125	270	mV
				17V≦V_{IN}≦28V	-	105	225	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≦I_{OUT}≦100mA	-	22	120	mV
				1.0mA ≦I_{OUT}≦40mA	-	11	60	
Output Voltage	V_{OUT}	1	16V≦V_{IN}≦28V 1.0mA ≦I_{OUT}≦40mA		12.54	-	13.86	V
			V_{IN}=21V 1.0mA ≦I_{OUT}≦70mA		12.54	-	13.86	
Quiescent Current	I_B	1	Tj=25°C		-	3.2	6.5	mA
			Tj=125°C		-	3.2	6.0	
Quiescent Current Change	ΔI_B	1	17V≦V_{IN}≦28V		-	-	1.5	mA
			1.0mA ≦I_{OUT}≦40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz		-	90	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	28	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=100Hz 17V≦V_{IN}≦27V, Tj=25°C		34	41	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-1.2	-	mV/°C

TA78L015AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=23V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°C<Tj<125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		14.4	15	15.6	V
Input Regulation	Reg.line	1	Tj=25°C	17.5V ≦ V_{IN} ≦ 30V	-	130	300	mV
				20V ≦ V_{IN} ≦ 30V	-	110	250	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	25	150	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	12	75	
Output Voltage	V_{OUT}	1	17.5V ≦ V_{IN} ≦ 30V 1.0mA ≦ I_{OUT} ≦ 40mA		14.25	-	15.75	V
			V_{IN}=23V 1.0mA ≦ I_{OUT} ≦ 70mA		14.25	-	15.75	
Quiescent Current	I_B	1	Tj=25°C		-	3.3	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	20V ≦ V_{IN} ≦ 30V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	90	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	30	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=120Hz 18.5V ≦ V_{IN} ≦ 28.5V, Tj=25°C		34	40	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-1.3	-	mV/°C

TA78L018AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=27V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°C<Tj<125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		17.3	18	18.7	V
Input Regulation	Reg.line	1	Tj=25°C	21.4V ≦ V_{IN} ≦ 33V	-	32	325	mV
				22V ≦ V_{IN} ≦ 33V	-	27	275	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	30	170	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	15	75	
Output Voltage	V_{OUT}	1	21.4V ≦ V_{IN} ≦ 33V 1.0mA ≦ I_{OUT} ≦ 40mA		17.1	-	18.9	V
			V_{IN}=27V 1.0mA ≦ I_{OUT} ≦ 70mA		17.1	-	18.9	
Quiescent Current	I_B	1	Tj=25°C		-	3.3	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	22V ≦ V_{IN} ≦ 33V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	150	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	45	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=120Hz 23V ≦ V_{IN} ≦ 33V, Tj=25°C		32	38	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-1.5	-	mV/°C

TA78L020AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=29V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°C<Tj<125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		19.2	20	20.8	V
Input Regulation	Reg.line	1	Tj=25°C	23.5V ≦ V_{IN} ≦ 35V	-	33	330	mV
				24V ≦ V_{IN} ≦ 35V	-	28	285	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	33	180	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	17	90	
Output Voltage	V_{OUT}	1	23.5V ≦ V_{IN} ≦ 35V 1.0mA ≦ I_{OUT} ≦ 40mA		19.0	-	21.0	V
			V_{IN}=29V 1.0mA ≦ I_{OUT} ≦ 70mA		19.0	-	21.0	
Quiescent Current	I_B	1	Tj=25°C		-	3.3	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	24V ≦ V_{IN} ≦ 35V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	170	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	49	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=120Hz 25V ≦ V_{IN} ≦ 35V, Tj=25°C		31	37	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-1.7	-	mV/°C

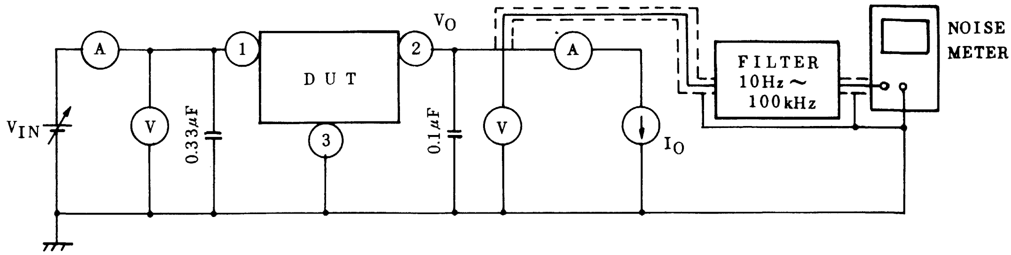
TA78L024AP ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=33V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, 0°C<Tj<125°C)

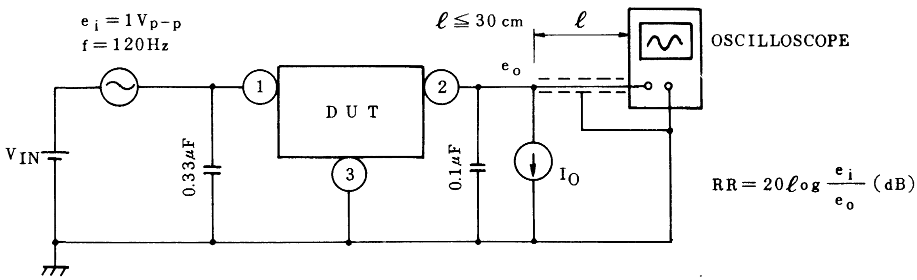
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		23	24	25	V
Input Regulation	Reg.line	1	Tj=25°C	27.5V≦V_{IN}≦38V	-	35	350	mV
				28V≦V_{IN}≦38V	-	30	300	
Load Regulation	Reg. load	1	Tj=25°C	1.0mA≦I_{OUT}≦100mA	-	40	200	mV
				1.0mA≦I_{OUT}≦40mA	-	20	100	
Output Voltage	V_{OUT}	1	27.5V≦V_{IN}≦38V 1.0mA≦I_{OUT}≦40mA		22.8	-	25.2	V
			V_{IN}=33V 1.0mA≦I_{OUT}≦70mA		22.8	-	25.2	
Quiescent Current	I_B	1	Tj=25°C		-	3.5	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	28V≦V_{IN}≦38V		-	-	1.5	mA
			1.0mA≦I_{OUT}≦40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz≦f≦100kHz		-	200	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	56	-	mV/1.0 KHrs
Ripple Rejection	RR	2	f=120Hz 29V≦V_{IN}≦39V, Tj=25°C		31	35	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TC_{VO}	1	I_{OUT}=5mA		-	-2.0	-	mV/°C

TEST CIRCUIT

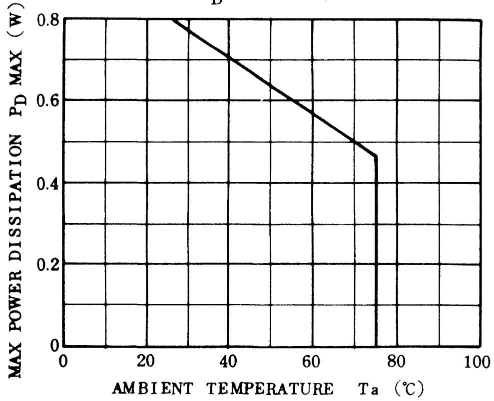
1. V_{OUT}, Reg.line, Reg.load, V_{OUT}, I_B, ΔI_B, V_{NO}, $\Delta V_{OUT}/\Delta t$, $|V_{IN}-V_{OUT}|$, TC_{VO}



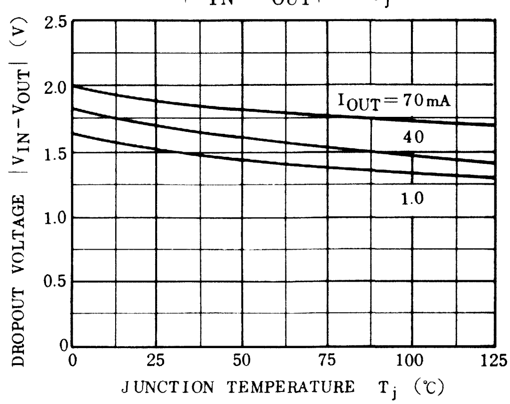
2. RR



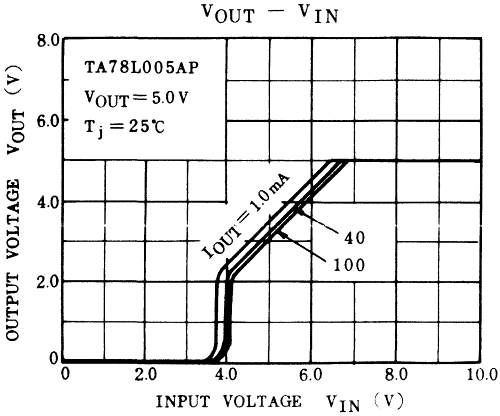
P_D MAX — Ta



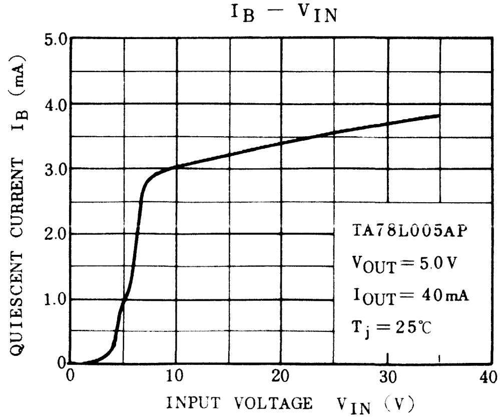
$|V_{IN} - V_{OUT}|$ — T_j



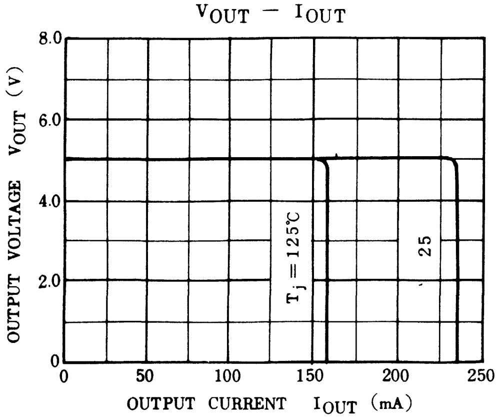
V_{OUT} — V_{IN}



I_B — V_{IN}

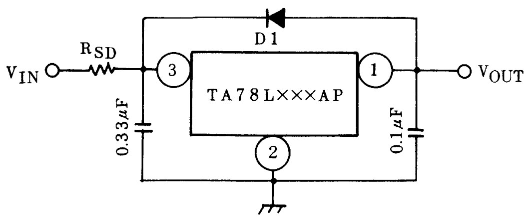


V_{OUT} — I_{OUT}



APPLICATION CIRCUIT

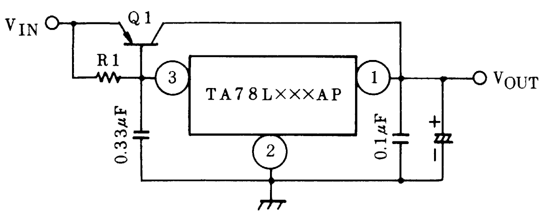
(1) STANDARD APPLICATION



D1 : Protection Diode
High speed diode D1 should be connected as shown in the figure if the condition $V_{IN} < V_{OUT}$ might occur by surge voltage or power supply ON/OFF.

R_{SD} : Power Limiting Resistor
For large V_{IN}, resistor R_{SD} is needed to limit IC power dissipation.

(2) A. CURRENT BOOST VOLTAGE REGULATOR



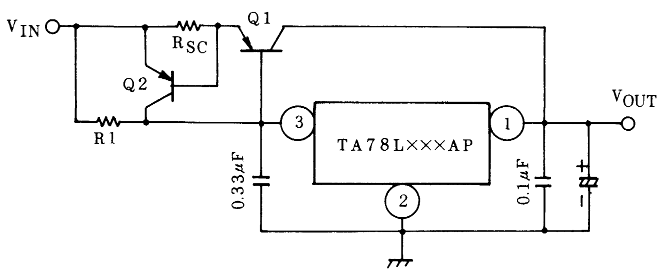
Heat sink is needed for Q1

$$R1 \leq \frac{V_{BE1}}{I_{B\ MAX}}$$

where, V_{BE1} : V_{BE} of external transistor Q1

$I_{B\ MAX}$: Quiescent current of IC.

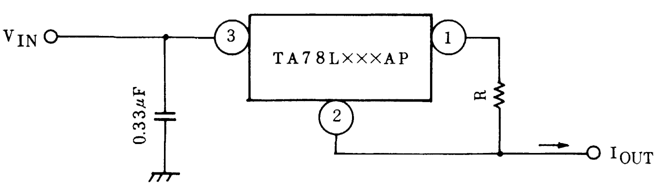
B. SHORT-CIRCUIT PROTECTION



$$R_{SC} = \frac{V_{BE2}}{I_{SC}}$$

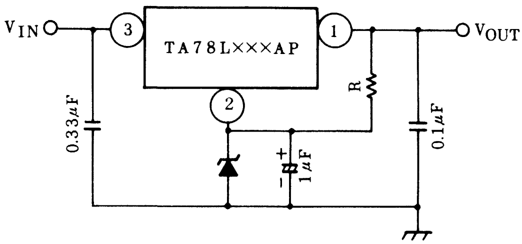
where, I_{SC} : Short-Circuit current

(3) CURRENT REGULATOR



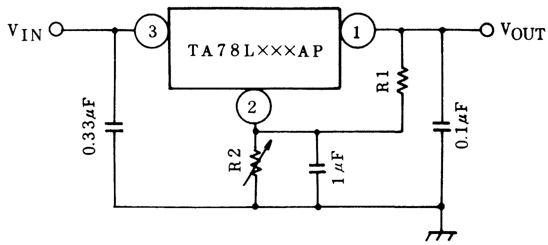
$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

(4) VOLTAGE BOOST REGULATOR



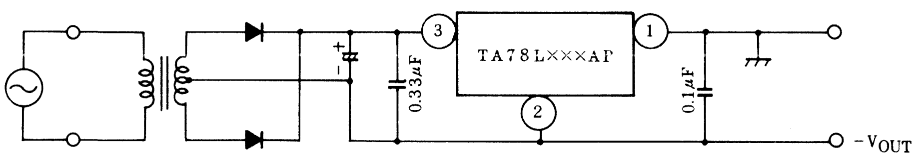
$V_{OUT}=V_Z+V_{OUT}$(of IC)

A little of current in resistor R is needed.

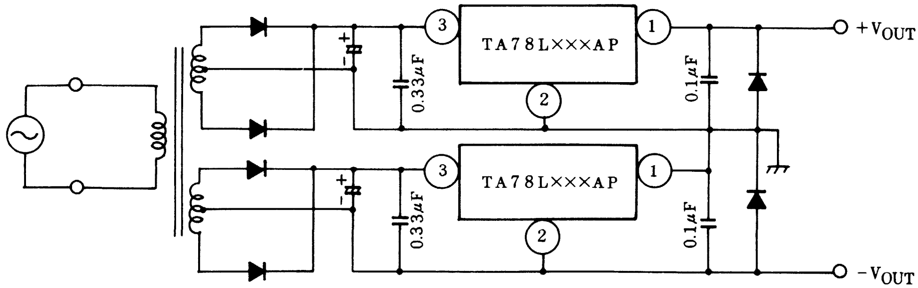


$$V_{OUT} = R2\left(I_B \cdot \frac{V_{OUT}(\text{of IC})}{R1}\right) + V_{OUT}(\text{of IC})$$

(5) NEGATIVE REGULATOR



(6) POSITIVE AND NEGATIVE REGULATOR



PRECAUTIONS FOR USE

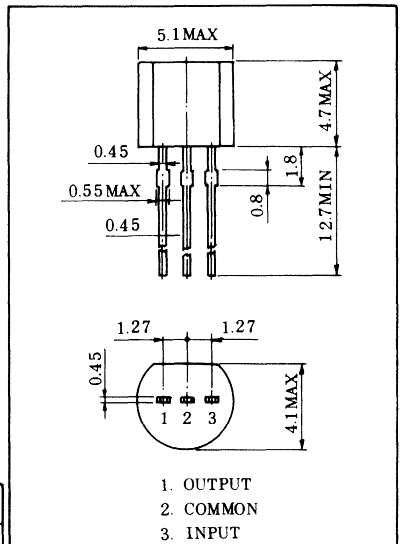
When such a high voltage as exceeds 10V beyond the fixed output voltage (TYP Value) of IC is applied to the output terminal of IC, the IC may be destroyed. In such a case, it is advised to prevent an excessive voltage from being applied to the IC by connecting a zener diode between the output terminal and the GND. Especially, in the current boost circuit as shown in Example (2) of Application Circuits, an input voltage may be suddenly applied to the output terminal of IC in the form of steps, and that in case of light load, an excessive voltage may be transiently applied to the output terminal of IC:
So that great care should be taken to this matter. In this case, in addition to the above, it may become necessary to consider such a countermeasure as the output capacitor in use is replaced with a capacitor of larger capacitance, or as R1 (a resistor for IC bias current or bypass) is replaced with a resistor of smaller resistance according to circumstances, or as the input voltage is gradually raised.

TA78L05S/07S/08S/09S
TA78L10S/12S/15S

THREE TERMINAL POSITIVE REGULATORS

5V, 7V, 8V, 9V 10V, 12V, 15V

Unit in mm



JEDEC	TO-92
EIAJ	SC—43
TOSHIBA	SSIP3-P-A

Weight: 0.21g

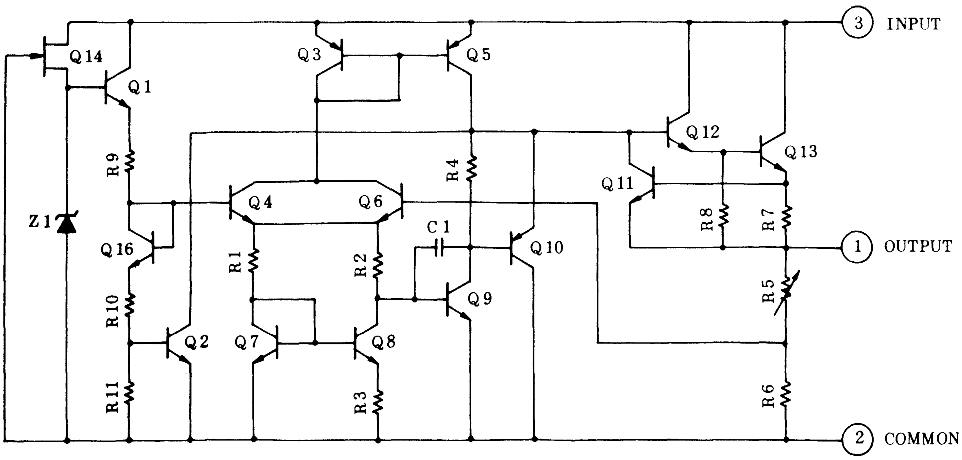
The TA78LXXS series of fixed voltage monolithic integrated circuit voltage regulators is designed for a wide range of applications.

- Suitable for TTL, DTL, HTL, C-MOS Power Supply
- Internal Short-Circuit Current Limiting
- Internal Thermal Overload Protection
- Maximum Output Current of 100mA (Tj=25°C)
- TO-92 Package

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Input Voltage	V_{IN}	35	V
Power Dissipation	P_D	600	mW
Operating Temperature	Topr	-30~75	°C
Storage Temperature	Tstg	-55~150	°C
Junction Temperature	Tj MAX	150	°C

EQUIVALENT CIRCUIT



TA78L05S ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=10V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF
0°C ≦ Tj ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		4.8	5.0	5.2	V
Line Regulation	Reg.line	1	Tj=25°C	7.0V ≤ V_{IN} ≤ 20V	-	55	150	mV
				8.0V ≤ V_{IN} ≤ 20V	-	45	100	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≤ I_{OUT} ≤ 100mA	-	11	60	mV
				1.0mA ≤ I_{OUT} ≤ 40mA	-	5.0	30	
Output Voltage	V_{OUT}	1	7.0 ≤ V_{IN} ≤ 20V 1.0mA ≤ I_{OUT} ≤ 40mA		4.75	-	5.25	V
			V_{IN}=10V 1.0mA ≤ I_{OUT} ≤ 70mA		4.75	-	5.25	
Quiescent Current	I_B	1	Tj=25°C		-	3.1	6.0	mA
			Tj=125°C		-	-	5.5	
Quiescent Current Change	ΔI_B	1	8.0V ≤ V_{IN} ≤ 20V		-	-	1.5	mA
			1.0mA ≤ I_{OUT} ≤ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≤ f ≤ 100kHz		-	40	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	12	-	mV/1.0 kHrs
Ripple Rejection	RR	2	f=120Hz, Tj=25°C 8.0V ≤ V_{IN} ≤ 18V		41	49	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TCV_O	1	I_{OUT}=5mA		-	-0.6	-	mV/°C

TA78L07S ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=12V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF 0°C ≤ Tj ≤ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		6.72	7.0	7.28	V
Line Regulation	Reg.line	1	Tj=25°C	9.2V ≤ V_{IN} ≤ 22V	-	50	160	mV
				10V ≤ V_{IN} ≤ 22V	-	45	115	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≤ I_{OUT} ≤ 100mA	-	13	75	mV
				1.0mA ≤ I_{OUT} ≤ 40mA	-	6.0	40	
Output Voltage	V_{OUT}	1	9.2 ≤ V_{IN} ≤ 22V 1.0mA ≤ I_{OUT} ≤ 40mA		6.65	-	7.35	V
			V_{IN}=12V 1.0mA ≤ I_{OUT} ≤ 70mA		6.65	-	7.35	
Quiescent Current	I_B	1	Tj=25°C		-	3.1	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	10V ≤ V_{IN} ≤ 22V		-	-	1.5	mA
			1.0mA ≤ I_{OUT} ≤ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≤ f ≤ 100kHz		-	50	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	17	-	mV/1.0 kHrs
Ripple Rejection	RR	2	f=120Hz, Tj=25°C 10V ≤ V_{IN} ≤ 20V		37	46	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TCV_O	1	I_{OUT}=5mA		-	-0.84	-	mV/°C

TA78L08S ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=14V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF
0°C ≤ Tj ≤ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		7.72	8.0	8.3	V
Line Regulation	Reg.line	1	Tj=25°C	10.5V ≤ V_{IN} ≤ 23V	-	20	175	mV
				11V ≤ V_{IN} ≤ 23V	-	12	125	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≤ I_{OUT} ≤ 100mA	-	15	80	mV
				1.0mA ≤ I_{OUT} ≤ 40mA	-	7.0	40	
Output Voltage	V_{OUT}	1	10.5 ≤ V_{IN} ≤ 23V 1.0mA ≤ I_{OUT} ≤ 40mA		7.6	-	8.4	V
			V_{IN}=14V 1.0mA ≤ I_{OUT} ≤ 70mA		7.6	-	8.4	
Quiescent Current	I_B	1	Tj=25°C		-	3.1	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	11V ≤ V_{IN} ≤ 23V		-	-	1.5	mA
			1.0mA ≤ I_{OUT} ≤ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≤ f ≤ 100kHz		-	60	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	20	-	mV/1.0 kHrs
Ripple Rejection	RR	2	f=120Hz, Tj=25°C 12V ≤ V_{IN} ≤ 23V		37	45	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TCV_O	1	I_{OUT}=5mA		-	-0.97	-	mV/°C

TA78L09S ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=15V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF
0°C ≦ Tj ≦ 125°C

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		8.64	9.0	9.36	V
Line Regulation	Reg.line	1	Tj=25°C	11.4V ≤ V_{IN} ≤ 24V	-	80	200	mV
				12V ≤ V_{IN} ≤ 24V	-	20	160	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≤ I_{OUT} < 100mA	-	17	90	mV
				1.0mA ≤ I_{OUT} < 40mA	-	8.0	45	
Output Voltage	V_{OUT}	1	11.4 ≤ V_{IN} ≤ 24V 1.0mA < I_{OUT} ≤ 40mA		8.55	-	9.45	V
			V_{IN}=15V 1.0mA ≤ I_{OUT} ≤ 70mA		8.55	-	9.45	
Quiescent Current	I_B	1	Tj=25°C		-	3.2	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	12V < V_{IN} < 24V		-	-	1.5	mA
			1.0mA ≤ I_{OUT} ≤ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≤ f ≤ 100kHz		-	65	-	μV
Long Term Stability	ΔV_{OUT} /Δt	1			-	21	-	mV/1.0 kHrs
Ripple Rejection	RR	2	f=120Hz, Tj=25°C 12V ≤ V_{IN} ≤ 24V		36	44	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TCV_O	1	I_{OUT}=5mA		-	-1.09	-	mV/°C

TA78L10S ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=16V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF
0°C ≦ Tj ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		9.6	10	10.4	V
Line Regulation	Reg.line	1	Tj=25°C	12.5V ≦ V_{IN} ≦ 25V	-	80	230	mV
				13V ≦ V_{IN} ≦ 25V	-	30	170	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	18	90	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	8.5	45	
Output Voltage	V_{OUT}	1	12.5 ≦ V_{IN} ≦ 25V 1.0mA ≦ I_{OUT} ≦ 40mA		9.5	-	10.5	V
			V_{IN}=16V 1.0mA ≦ I_{OUT} ≦ 70mA		9.5	-	10.5	
Quiescent Current	I_B	1	Tj=25°C		-	3.2	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	13V ≦ V_{IN} ≦ 25V		-	-	1.5	mA
			1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	70	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	22	-	mV/1.0 kHrs
Ripple Rejection	RR	2	f=120Hz, Tj=25°C 13V ≦ V_{IN} ≦ 24V		36	43	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TCV_O	1	I_{OUT}=5mA		-	-1.21	-	mV/°C

TA78L12S ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=19V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF
0°C ≦ Tj ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		11.5	12	12.5	V
Line Regulation	Reg.line	1	Tj=25°C	14.5V ≤ V_{IN} ≤ 27V	-	120	250	mV
				16V ≤ V_{IN} ≤ 27V	-	100	200	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≤ I_{OUT} ≤ 100mA	-	20	100	mV
				1.0mA ≤ I_{OUT} ≤ 40mA	-	10	50	
Output Voltage	V_{OUT}	1	14.5V ≤ V_{IN} ≤ 27V 1.0mA ≤ I_{OUT} ≤ 40mA		11.4	-	12.6	V
			V_{IN}=19V 1.0mA ≤ I_{OUT} ≤ 70mA		11.4	-	12.6	
Quiescent Current	I_B	1	Tj=25°C		-	3.2	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	16V ≤ V_{IN} ≤ 27V		-	-	1.5	mA
			1.0mA ≤ I_{OUT} ≤ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≤ f ≤ 100kHz		-	80	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	24	-	mV/1.0 kHrs
Ripple Rejection	RR	2	f=120Hz, Tj=25°C 15V ≤ V_{IN} ≤ 25V		36	41	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TCV_O	1	I_{OUT}=5mA		-	-1.45	-	mV/°C

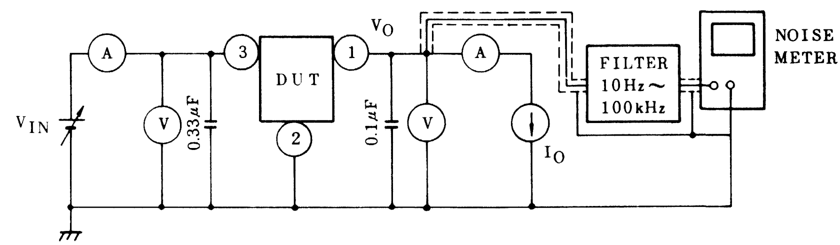
TA78L15S ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{IN}=23V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF
0°C ≦ Tj ≦ 125°C)

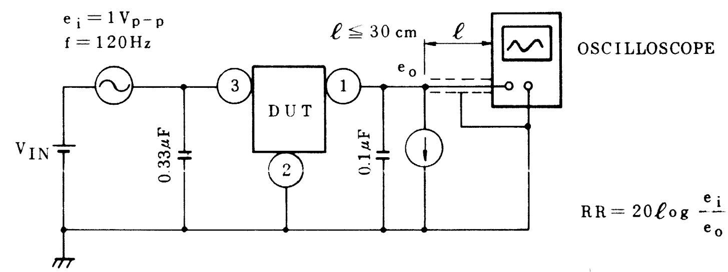
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	Tj=25°C		14.4	15	15.6	V
Line Regulation	Reg.line	1	Tj=25°C	17.5V ≤ V_{IN} ≤ 30V	-	130	300	mV
				20V ≤ V_{IN} ≤ 30V	-	110	250	
Load Regulation	Reg.load	1	Tj=25°C	1.0mA ≤ I_{OUT} ≤ 100mA	-	25	150	mV
				1.0mA ≤ I_{OUT} ≤ 40mA	-	12	75	
Output Voltage	V_{OUT}	1	17.5 ≤ V_{IN} ≤ 30V 1.0mA ≤ I_{OUT} ≤ 40mA		14.25	-	15.75	V
			V_{IN}=23V 1.0mA ≤ I_{OUT} ≤ 70mA		14.25	-	15.75	
Quiescent Current	I_B	1	Tj=25°C		-	3.3	6.5	mA
			Tj=125°C		-	-	6.0	
Quiescent Current Change	ΔI_B	1	20V ≤ V_{IN} ≤ 30V		-	-	1.5	mA
			1.0mA ≤ I_{OUT} ≤ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	1	Ta=25°C, 10Hz ≤ f ≤ 100kHz		-	90	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	30	-	mV/1.0 kHrs
Ripple Rejection	RR	2	f=120Hz, Tj=25°C 18.5V ≤ V_{IN} ≤ 28.5V		34	40	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	1	Tj=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	TCV_O	1	I_{OUT}=5mA		-	-1.82	-	mV/°C

TEST CIRCUIT

1. V_{OUT}, Reg.line, Reg.load, V_{OUT}, I_B, ΔI_B, V_{NO}, $\Delta V_{OUT}/\Delta t$, $|V_{IN}-V_{OUT}|$, TCV_O



2. RR



$$RR = 20\log\frac{e_i}{e_o}\ (dB)$$

TA78M05P/06P/08P/09P/10P
TA78M12P/15P/18P/20P/24P

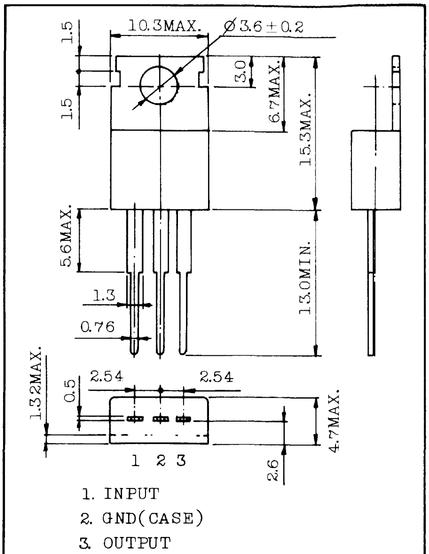
0.5A THREE TERMINAL POSITIVE VOLTAGE REGULATORS

5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V

The TA78MXXP series of fixed-voltage monolithic integrated circuit voltage regulators is designed for a wide range of applications. These regulators employ internal current-limitting, thermal-shutdown and safe-area compensation, making them essentially indestructible. One of these regulators can driver up to 0.5A of output current.

- Suitable for C-MOS, TTL and the other Digital IC's Power Supply.
- Output Current in Excess of 0.5A
- Internal Thermal Overload Protection
- Internal Short Circuit Current Limiting
- Package in the Plastic Case TO-220AB

Unit in mm



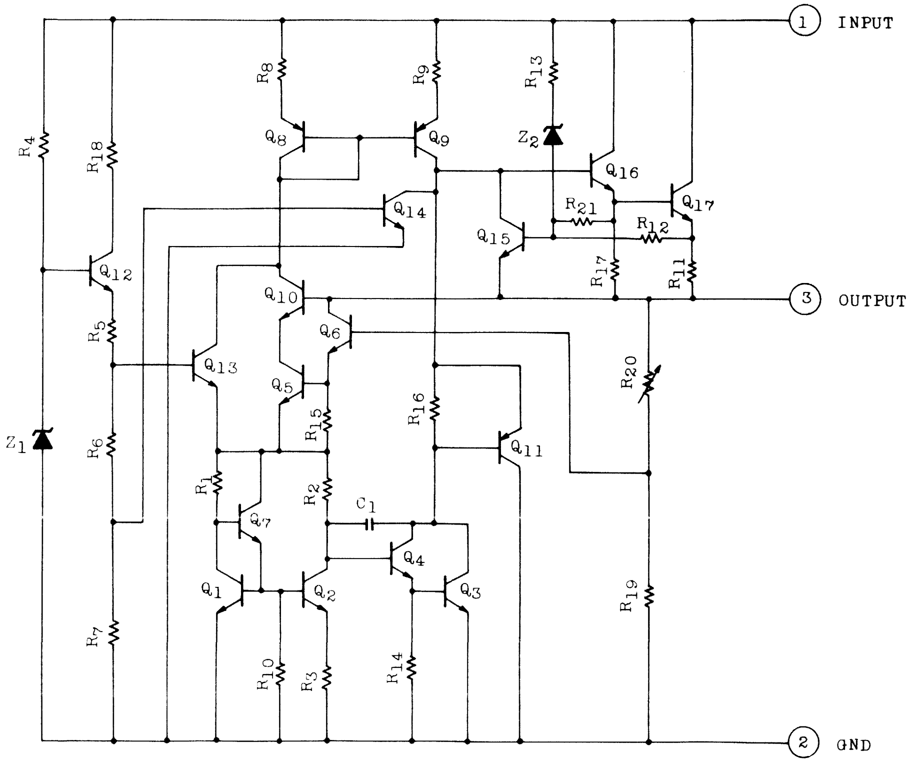
JEDEC	TO-220AB
EIAJ	SC-46
TOSHIBA	HSIP3-P

Mounting Kit No. AC75
Weight: 1.9g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage	TA78M05P	V_{IN}	35	V
	TA78M06P			
	TA78M08P			
	TA78M09P			
	TA78M10P			
	TA78M12P			
	TA78M15P			
	TA78M18P	V_{IN}	40	V
	TA78M20P			
	TA78M24P			
Power Dissipation		P_D	1.5	W
Power Dissipation (Tc=25°C)		P_D	20	W
Operating Junction Temperature Range		Topr	0~150	°C
Storage Temperature Range		Tstg	-55~150	°C

EQUIVALENT CIRCUIT



TA78M05P

ELECTRICAL CHARACTERISTICS

(V_{IN}=10V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		4.8	5.0	5.2	V
Line Regulation		Reg.Line	1	Tj=25°C	7V≦V_{IN}≦25V I_{OUT}=200mA	-	4	100	mV
					8V≦V_{IN}≦25V I_{OUT}=200mA	-	2	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	25	100	mV
					5mA≦I_{OUT}≦200mA	-	10	50	
Output Voltage		V_{OUT}	1	7V≦V_{IN}≦20V 5mA≦I_{OUT}≦350mA		4.75	-	5.25	V
Quiescent Current		I_B	1	Tj=25°C		-	4.5	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	8V≦V_{IN}≦25V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	50	200	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 8V≦V_{IN}≦18V		62	69	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	300	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage		TCVO	1	I_{OUT}=5mA		-	-0.6	-	mV/deg
Long-Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	20	mV/1.0 KHrs
Peak Output Current		Imax	1	Tj=25°C		-	700	-	mA

TA78M06P

ELECTRICAL CHARACTERISTICS

(V_{IN}=11V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		5.75	6.0	6.25	V
Line Regulation		Reg.Line	1	Tj=25°C	8V≦V_{IN}≦25V I_{OUT}=200mA	-	4	100	mV
					9V≦V_{IN}≦25V I_{OUT}=200mA	-	2	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	25	120	mV
					5mA≦I_{OUT}≦200mA	-	10	60	
Output Voltage		V_{OUT}	1	8V≦V_{IN}≦21V 5mA≦I_{OUT}≦350mA		5.7	-	6.3	V
Quiescent Current		I_B	1	Tj=25°C		-	4.5	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	9V≦V_{IN}≦25V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	55	220	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 9V≦V_{IN}≦19V		59	66	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	270	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-0.7	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	24	mV/1.0 KHrs
Peak Output Current		Imax	1	Tj=25°C		-	700	-	mA

TA78M08P

ELECTRICAL CHARACTERISTICS

(V_{IN}=14V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		7.7	8.0	8.3	V
Line Regulation		Reg.Line	1	Tj=25°C	10.5V≦V_{IN}≦25V I_{OUT}=200mA	–	5	100	mV
					11V≦V_{IN}≦25V I_{OUT}=200mA	–	3	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	–	26	160	mV
					5mA≦I_{OUT}≦200mA	–	10	80	
Output Voltage		V_{OUT}	1	10.5V≦V_{IN}≦23V 5mA≦I_{OUT}≦350mA		7.6	–	8.4	V
Quiescent Current		I_B	1	Tj=25°C		–	4.6	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	10.5V≦V_{IN}≦25V, I_{OUT}=200mA		–	–	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		–	–	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		–	60	250	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 11.5V≦V_{IN}≦21.5V		56	63	–	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		–	250	–	mA
Dropout Voltage		V_D	1	Ta=25°C		–	1.7	–	V
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5mA		–	-1.0	–	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			–	–	32	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		–	700	–	mA

TA78M09P

ELECTRICAL CHARACTERISTICS

(V_{IN}=15V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		8.64	9.0	9.36	V
Line Regulation		Reg.Line	1	Tj=25°C	11.5V≦V_{IN}≦26V I_{OUT}=200mA	-	5	100	mV
					13V≦V_{IN}≦26V I_{OUT}=200mA	-	3	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	26	180	mV
					5mA≦I_{OUT}≦200mA	-	10	90	
Output Voltage		V_{OUT}	1	11.5V≦V_{IN}≦24V 5mA≦I_{OUT}≦350mA		8.55	-	9.45	V
Quiescent Current		I_B	1	Tj=25°C		-	4.6	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	11.5V≦V_{IN}≦26V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	60	270	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 12.5V≦V_{IN}≦22.5V		56	63	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	250	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.1	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	36	mV/1.0 KHrs
Peak Output Current		Imax	1	Tj=25°C		-	700	-	mA

TA78M10P

ELECTRICAL CHARACTERISTICS

(V_{IN}=16V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYBMOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		9.6	10.0	10.4	V
Line Regulation		Reg.Line	1	Tj=25°C	12.5V≦V_{IN}≦26V I_{OUT}=200mA	-	6	100	mV
					14V≦V_{IN}≦26V I_{OUT}=200mA	-	3	50	
Load Regulation		Reg.Line	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	26	200	mV
					5mA≦I_{OUT}≦200mA	-	10	100	
Output Voltage		V_{OUT}	1	12.5V≦V_{IN}≦25V 5mA≦I_{OUT}≦350mA		9.5	-	10.5	V
Quiescent Current		I_B	1	Tj=25°C		-	4.7	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	12.5V≦V_{IN}≦26V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	65	280	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 13.5V≦V_{IN}≦23.5V		55	62	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	245	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.3	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	40	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

TA78M12P

ELECTRICAL CHARACTERISTICS

(V_{IN}=19V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		11.5	12.0	12.5	V
Line Regulation		Reg.Line	1	Tj=25°C	14.5V≦V_{IN}≦30V I_{OUT}=200mA	-	7	100	mV
					16V≦V_{IN}≦30V I_{OUT}=200mA	-	3	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	27	240	mV
					5mA≦I_{OUT}≦200mA	-	10	120	
Output Voltage		V_{OUT}	1	14.5V≦V_{IN}≦27V 5mA≦I_{OUT}≦350mA		11.4	-	12.6	V
Quiescent Current		I_B	1	Tj=25°C		-	4.8	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	14.5V≦V_{IN}≦30V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	70	300	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 15V≦V_{IN}≦25V		55	62	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	240	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-1.6	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	48	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

TA78M15P

ELECTRICAL CHARACTERISTICS

(V_{IN}=23V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		14.4	15.0	15.6	V
Line Regulation		Reg.Line	1	Tj=25°C	17.5V≦V_{IN}≦30V I_{OUT}=200mA	-	8	100	mV
					20V≦V_{IN}≦30V I_{OUT}=200mA	-	4	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	27	300	mV
					5mA≦I_{OUT}≦200mA	-	10	150	
Output Voltage		V_{OUT}	1	17.5V≦V_{IN}≦30V 5mA≦I_{OUT}≦350mA		14.25	-	15.75	V
Quiescent Current		I_B	1	Tj=25°C		-	4.8	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	17.5V≦V_{IN}≦30V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	80	450	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 18.5V≦V_{IN}≦28.5V		54	61	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	240	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-2.0	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	60	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

TA78M18P

ELECTRICAL CHARACTERISTICS

(V_{IN}=27V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		17.3	18.0	18.7	V
Line Regulation		Reg.Line	1	Tj=25°C	21V≦V_{IN}≦33V I_{OUT}=200mA	-	9	100	mV
					24V≦V_{IN}≦33V I_{OUT}=200mA	-	5	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	28	360	mV
					5mA≦I_{OUT}≦200mA	-	10	180	
Output Voltage		V_{OUT}	1	21V≦V_{IN}≦33V 5mA≦I_{OUT}≦350mA		17.1	-	18.9	V
Quiescent Current		I_B	1	Tj=25°C		-	4.8	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	21V≦V_{IN}≦33V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	90	490	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 22V≦V_{IN}≦32V		53	60	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	240	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-2.5	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	72	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

TA78M20P

ELECTRICAL CHARACTERISTICS

(V_{IN}=29V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		19.2	20.0	20.8	V
Line Regulation		Reg.Line	1	Tj=25°C	23V≦V_{IN}≦35V I_{OUT}=200mA	-	10	100	mV
					24V≦V_{IN}≦35V I_{OUT}=200mA	-	6	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	28	400	mV
					5mA≦I_{OUT}≦200mA	-	10	200	
Output Voltage		V_{OUT}	1	23V≦V_{IN}≦35V 5mA≦I_{OUT}≦350mA		19.0	-	21.0	V
Quiescent Current		I_B	1	Tj=25°C		-	4.9	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	23V≦V_{IN}≦35V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	95	540	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 24V≦V_{IN}≦34V		53	60	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	240	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-3.0	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	80	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

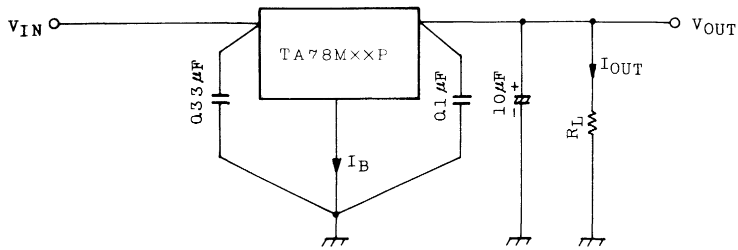
TA78M24P

ELECTRICAL CHARACTERISTICS

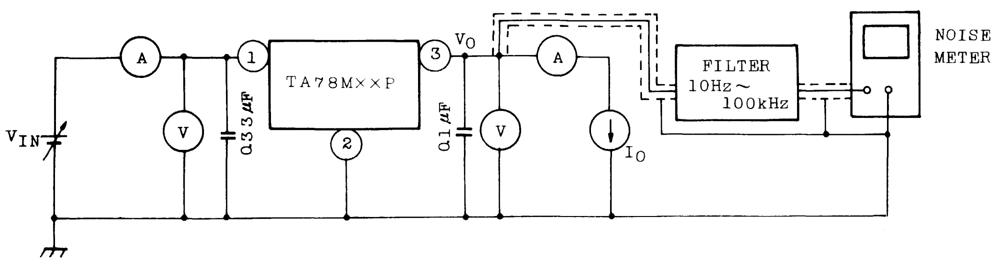
(V_{IN}=33V, I_{OUT}=350mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=0.1μF, unless otherwise noted)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C		23.0	24.0	25.0	V
Line Regulation		Reg.Line	1	Tj=25°C	27V≦V_{IN}≦38V I_{OUT}=200mA	-	12	100	mV
					28V≦V_{IN}≦38V I_{OUT}=200mA	-	7	50	
Load Regulation		Reg.Load	1	Tj=25°C	5mA≦I_{OUT}≦500mA	-	30	480	mV
					5mA≦I_{OUT}≦200mA	-	10	240	
Output Voltage		V_{OUT}	1	27V≦V_{IN}≦38V 5mA≦I_{OUT}≦350mA		22.8	-	25.2	V
Quiescent Current		I_B	1	Tj=25°C		-	5.0	8.0	mA
Quiescent Current Change	Line	ΔI_{BI}	1	27V≦V_{IN}≦38V, I_{OUT}=200mA		-	-	0.8	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦350mA		-	-	0.5	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	115	650	μV
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=100mA 28V≦V_{IN}≦38V		50	57	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C, V_{IN}=35V		-	240	-	mA
Dropout Voltage		V_D	1	Ta=25°C		-	1.7	-	V
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5mA		-	-3.5	-	mV/deg
Long Term Stability		$\Delta V_{OUT}/\Delta t$	1			-	-	96	mV/1.0 KHrs
Peak Output Current		I_{max}	1	Tj=25°C		-	700	-	mA

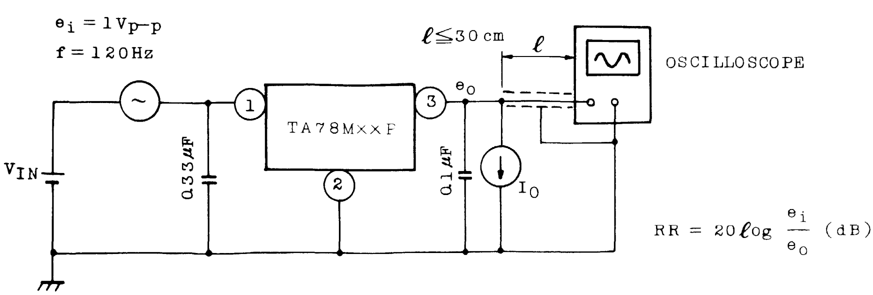
TEST CIRCUIT 1 / STANDARD APPLICATION



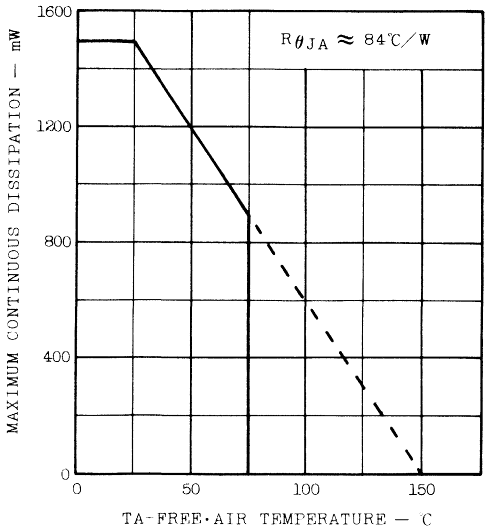
TEST CIRCUIT 2 V_{NO}



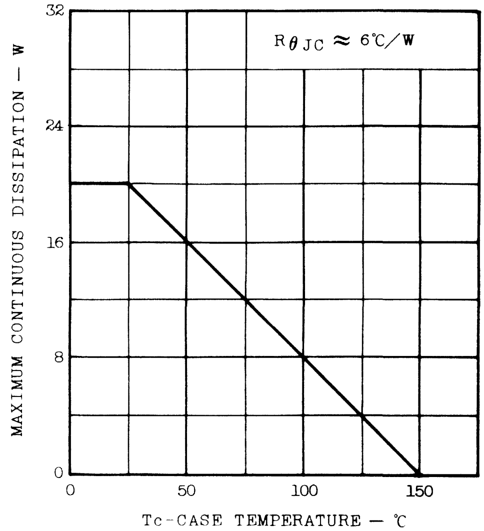
TEST CIRCUIT 3 R.R.



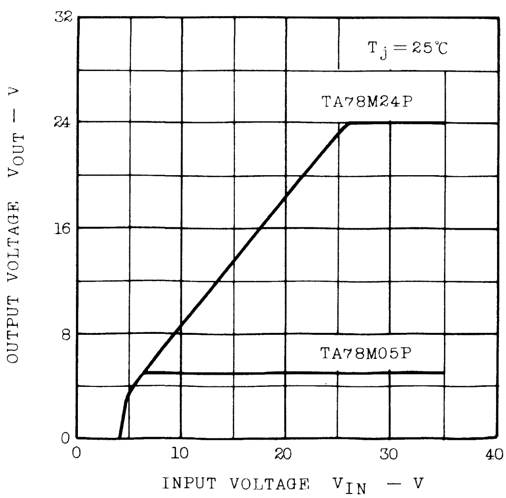
FREE・AIR TEMPERATURE
DISSIPATION DERATING CURVE



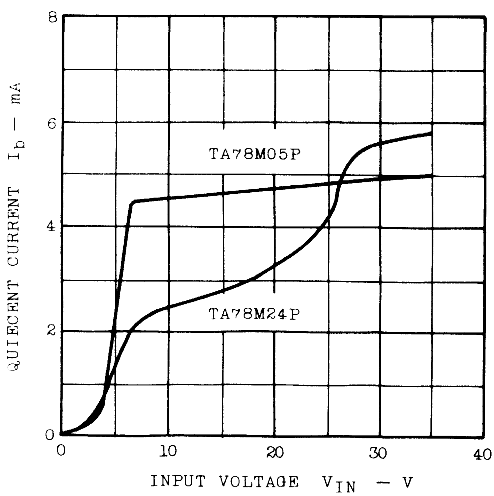
CASE TEMPERATURE
DISSIPATION DERATING CURVE

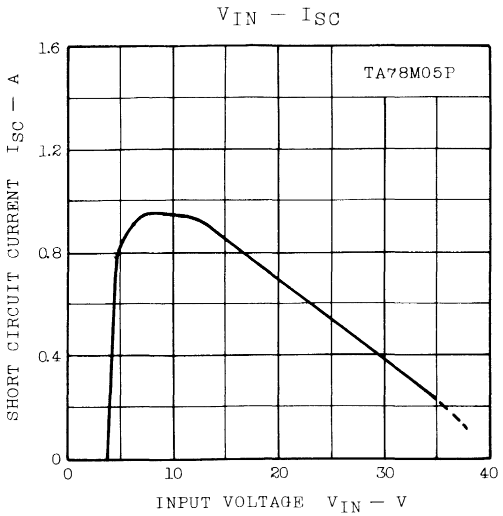


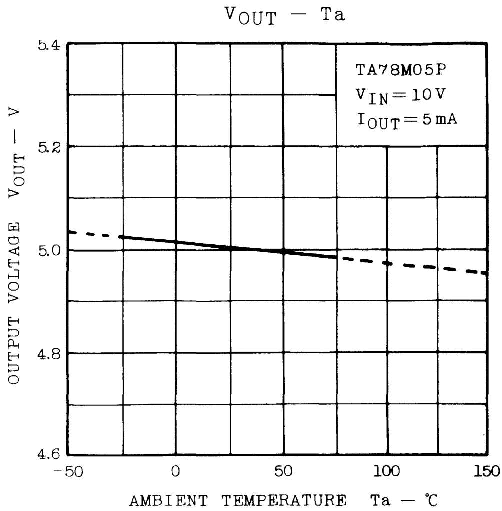
V_{IN} — V_{OUT}

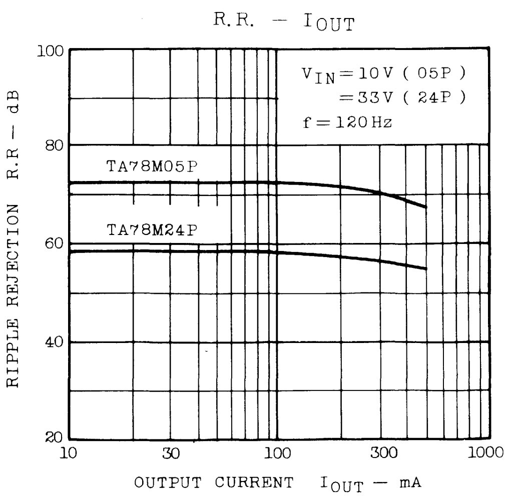


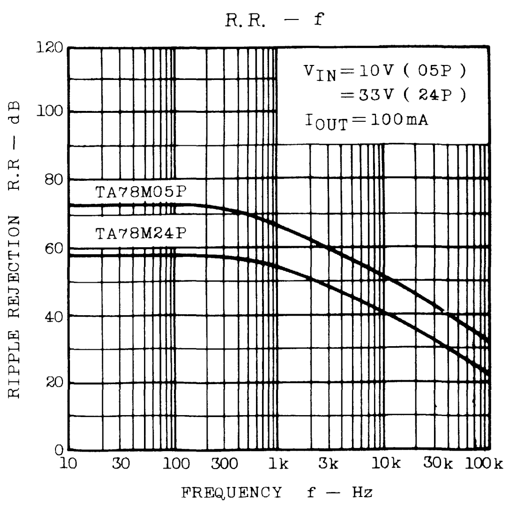
V_{IN} — I_b




VIN — ISC
TA78M05P
SHORT CIRCUIT CURRENT ISC — A
INPUT VOLTAGE VIN — V
1.6
1.2
0.8
0.4
0
0
10
20
30
40


VOUT — Ta
TA78M05P
VIN=10V
IOUT=5mA
OUTPUT VOLTAGE VOUT — V
AMBIENT TEMPERATURE Ta — ℃
5.4
5.2
5.0
4.8
4.6
-50
0
50
100
150

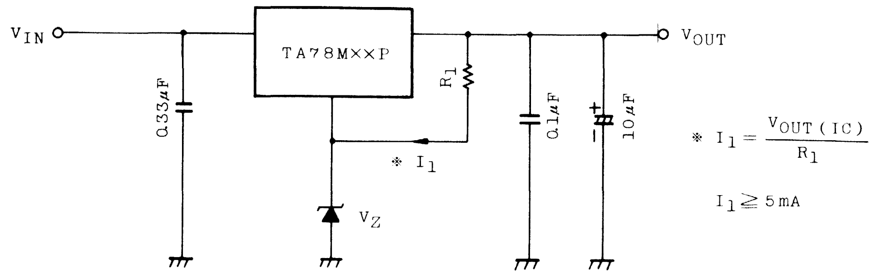

R.R. — IOUT
VIN=10V (05P)
=33V (24P)
f=120Hz
TA78M05P
TA78M24P
RIPPLE REJECTION R.R — dB
OUTPUT CURRENT IOUT — mA
100
80
60
40
20
10
30
100
300
1000


R.R. — f
VIN=10V (05P)
=33V (24P)
IOUT=100mA
TA78M05P
TA78M24P
RIPPLE REJECTION R.R — dB
FREQUENCY f — Hz
120
100
80
60
40
20
0
10
30
100
300
1k
3k
10k
30k
100k

APPLICATION CIRCUITS

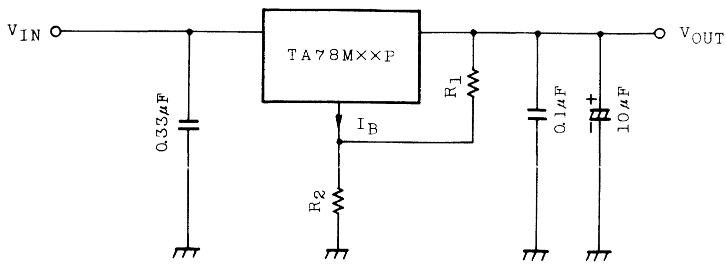
(1) VOLTAGE BOOST REGULATOR

(a) Voltage boost by use of zener diode



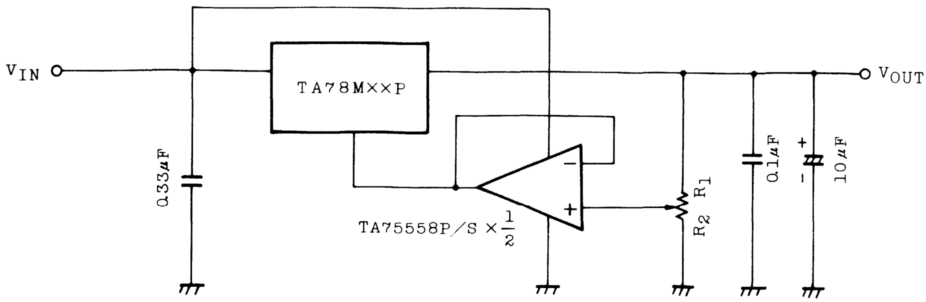
$$V_{OUT}=V_{OUT(IC)}+V_Z$$

(b) Voltage boost by use of resistor



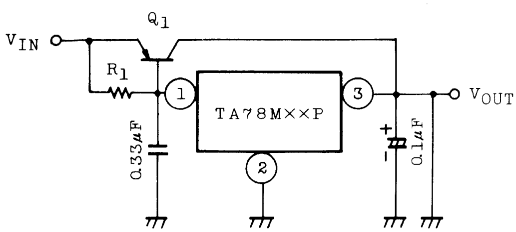
$$V_{OUT}=V_{OUT(IC)}\left(1+\frac{R2}{R1}\right)+R2\cdot I_B$$

(c) Adjustable output regulator



$$V_{OUT}=V_{OUT(IC)}\left(1+\frac{R2}{R1}\right)$$

(2) CURRENT BOOST VOLTAGE REGULATOR



Heat sink is needed for Q1

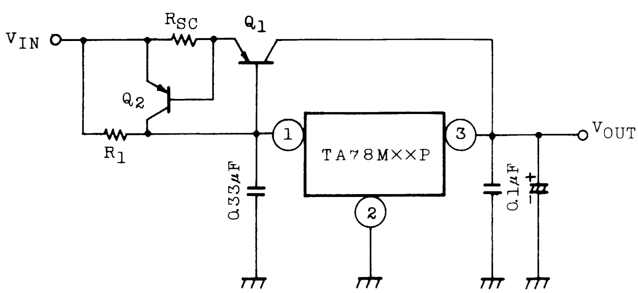
$$R_1 \leq \frac{V_{BE1}}{I_{B\,MAX}}$$

where,

V_{BE1} : V_{BE} of external transistor Q1.

$I_{B\,MAX}$: Quiescent current of IC.

(3) SHORT-CIRCUIT PROTECTION

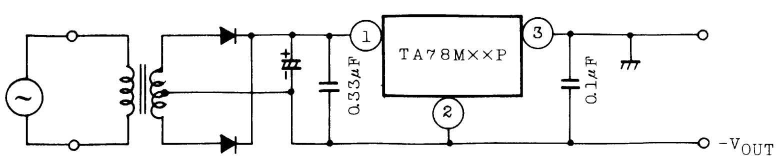


$$R_{SC} = \frac{V_{BE2}}{I_{SC}}$$

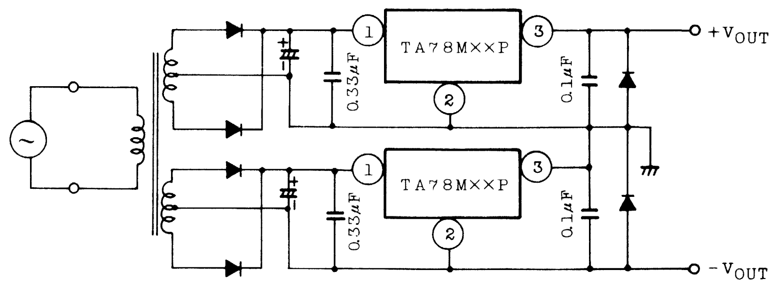
where,

I_{SC} : Short-circuit current

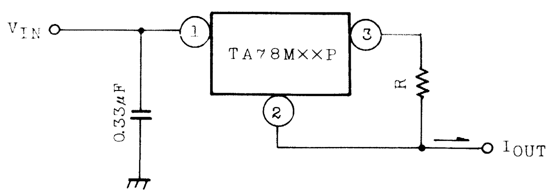
(4) NEGATIVE REGULATOR



(5) POSITIVE AND NEGATIVE REGULATOR



(6) CURRENT REGULATOR

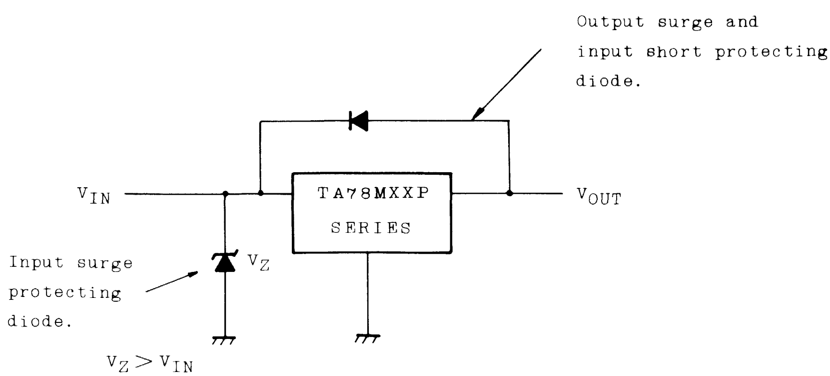


$$I_{OUT} = \frac{V_{OUT}}{R} + I_B$$

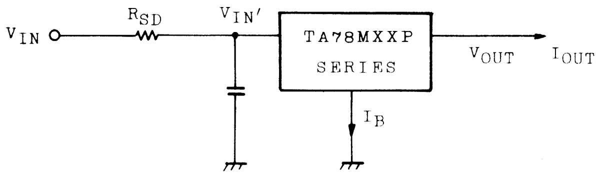
PRECAUTIONS ON APPLICATION

(1) In regard to GND, be careful not to apply a negative voltage to the input/output terminal. Further, special care is necessary in case of a voltage boost application.

(2) When a surge voltage exceeding maximum rating is applied to the input terminal or when a voltage in excess of the input terminal voltage is applied to the output terminal, the circuit may be destroyed.
Specially, in the latter case, great care is necessary.
Further, if the input terminal sorts to GND in a state of normal operation, the output terminal voltage becomes higher than the input voltage (GND potential), and the electric charge of a chemical capacitor connected to the output terminal flows into the input side, which may cause the destruction of circuit.
In these cases, take such steps as a zener diode and a general silicon diode are connected to the circuit, as shown in the following figure.



(3) When the input voltage is too high, the power dissipation of three terminal regulator increases because of series regulator, so that the junction temperature rises. In such a case, it is recommended to reduce the power dissipation by inserting the power limiting resistor RSD in the input terminal, and to reduce the junction temperature as a result.



The power dissipation P_D of IC is expressed in the following equation.

$$P_D = (V_{IN}' - V_{OUT}) \cdot I_{OUT} + V_{IN}' \cdot I_B$$

If V_{IN}' is reduced below the lowest voltage necessary for the IC, the parasitic oscillation will be caused according to circumstances.
In determing the resistance value of R_{SD}, design with margin should be made by making reference to the following equation.

$$R_{SD} < \frac{V_{IN} - V_{IN}'}{I_{OUT} + I_B}$$

(4) Connect the input terminal and GND, and the output terminal and GND, by capacitor respectively. The capacitances should be determined experimentally because they depend on prented patterns. In particular, adequate investigation should be made so that there is no problem even at time of high or low temperature.

(5) Installation of IC for power supply
For obtaining high reliability on the heat sink design of the regulator IC, it is generally required to derate more than 20% of maximum junction temperature (Tj MAX.).
Further, full consideration should be given to the installation of IC to the heat sink.

(a) Heat sink design

The thermal resistance of IC itself is required from the viewpont of the design of elements, but the thermal resistance from the IC package to the open air varies with the contact thermal resistance.
Table 1 shows how much the value of the contact thermal resistance (Q_c+Q_s) is changed by insulating sheet (mica) and heat sink grease.

TABLE Unit: °C/W

PACKAGE	MODEL No.	TORQUE	MICA	Q_c + Q_s
TO-220AB	TA78M00P	6kg·cm	Not Provided	0.3 0.5(1.5~2.0)
			Provided	2.0 2.5(4.0~6.0)

The figures given in parentheses denote the values at time of no grease.
The package of regulator IC serves as GND, therefore, usually use the value at time of "no mica".

(b) Silicon grease

When a circuit not exceeding maximum rating is designed, it is to be desired that the grease should be used if possible. If it is required that the contace thermal resistance is reduced from the viewpoint of the circuit design, it is recommended that the following methods be adopted.
A: Use UG6260 (TOSHIBA CORPORATION), if grease is used.

(c) Torque

When installing IC on a heat sink or the like, tighten the IC with the torque of less than the rated value. If it is tightened with the torque in excess of the rated value, sometimes the internal elements of the IC are adversely affected. Therefore, great care should be given to the installing operation.

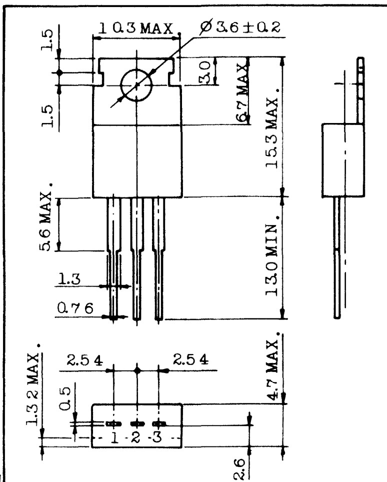
TA79005P, TA79006P, TA79008P, TA79009P, TA79010P, TA79012P, TA79015P, TA79018P, TA79020P, TA79024P

1A THREE TERMINAL NEGATIVE VOLTAGE REGULATORS

-5V, -6V, -8V, -9V, -10V, -12V, -15V, -18V, -20V, -24V

- Suitable for C-MOS, TTL, and the other Digital IC Power Supply
- Internal Thermal Overload Protecting
- Internal Short Circuit Current Limiting
- Output Current in Excess of 1.0A
- Package in the Plastic Case TO-220AB

Unit in mm



1. GND
2. INPUT(CASE)
3. OUTPUT

JEDEC	TO−220AB
EIAJ	SC−46
TOSHIBA	HSIP3−P

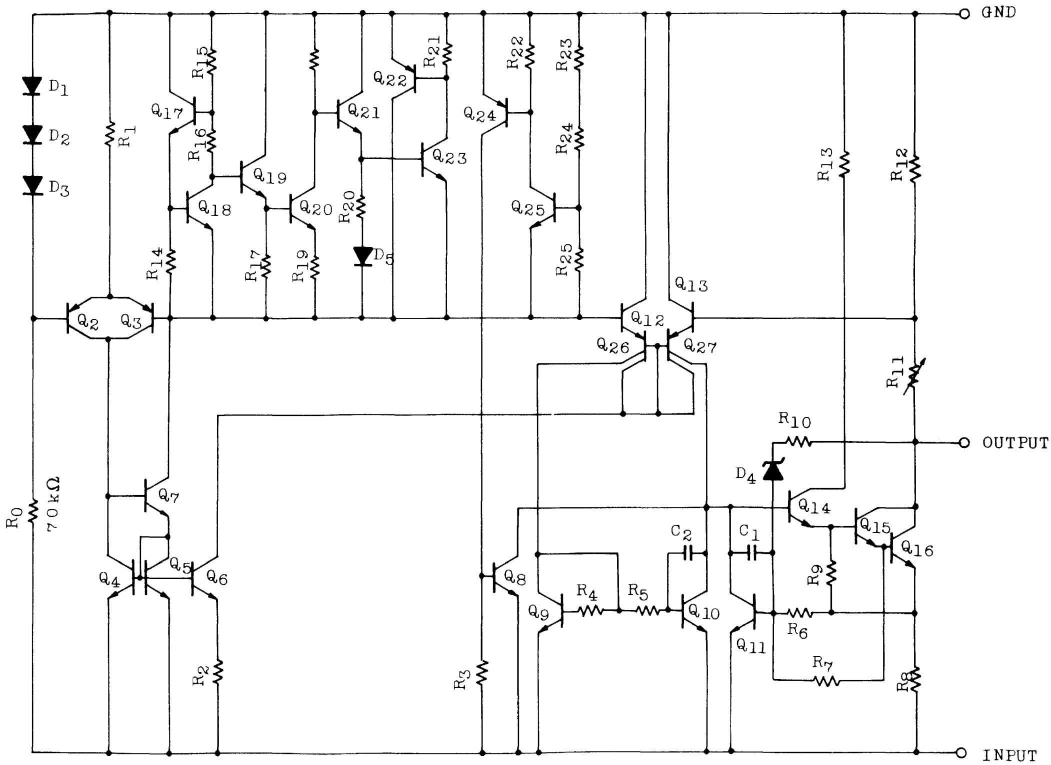
Mounting Kit No. AC75

Weight: 1.9g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage	TA79005P	V_{IN}	-35	V
	TA79006P			
	TA79008P			
	TA79009P			
	TA79010P			
	TA79012P			
	TA79015P			
	TA79018P	V_{IN}	-40	V
	TA79020P			
	TA79024P			
Power Dissipation (Tc=25°C)		P_D	20	W
Operating Temperature		Topr	-30 ~ 75	°C
Storage Temperature		Tstg	-55 ~ 125	°C

EQUIVALENT CIRCUIT



TA79005P

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, (V_{IN}=-10V, I_{OUT}=500mA, 0°C ≦ Tj ≦ 125°C, C_{IN}=0.33μF, C_{OUT}=1.0μF)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-5.2	-5.0	-4.8	V
Line Regulation		Reg·Line	1	Tj=25°C	-8V ≧ V_{IN} ≧ -12V	-	7.0	50	mV
					-7V ≧ V_{IN} ≧ -25V	-	35	100	mV
Load Regulation		Reg·Load	1	Tj=25°C	5mA ≦ I_{OUT} ≦ 1.5A	-	11	100	mV
					250mA ≦ I_{OUT} ≦ 750mA	-	4.0	50	mV
Output Voltage		V_{OUT}	1	-7V ≧ V_{IN} ≧ -20V 5mA ≦ I_{OUT} ≦ 1.0A		-5.25	-	-4.75	V
Quiescent Current		I_B	1	Tj=25°C		-	4.3	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-7V ≧ V_{IN} ≧ -25V		-	-	1.3	mA
	Load	ΔI_{BO}	1	1.0A ≦ I_{OUT} ≦ 5mA		-	-	0.8	mA
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	40	-	μVrms
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		63	70	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	0.6	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79006P

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, (V_{IN}=-11V, I_{OUT}=500mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=1.0μF)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-6.25	-6.0	-5.75	V
Line Regulation		Reg·Line	1	Tj=25°C	-9V≧V_{IN}≧-13V	-	9.0	60	mV
					-8V≧V_{IN}≧-25V	-	43	120	mV
Load Regulation		Reg·Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	13	120	mV
					250mA≦I_{OUT}≦750mA	-	5.0	60	mV
Output Voltage		V_{OUT}	1	-8V≧V_{IN}≧-21V, 5mA≦I_{OUT}≦1.0A		-6.3	-	-5.7	V
Quiescent Current		I_B	1	Tj=25°C		-	4.3	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-8V≧V_{IN}≧-25V		-	-	1.3	mA
	Load	ΔI_{BO}	1	1.0A≦I_{OUT}≦5mA		-	-	0.8	mA
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	45	-	μVrms
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		61	68	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	0.7	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79008P

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, (V_{IN}=-14V, I_{OUT}=500mA, 0°C ≦Tj≦125°C
C_{IN}=0.33μF, C_{OUT}=1.0μF)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-8.3		-7.7	V
Line Regulation		Reg・Line	1	Tj=25°C	-11V≧ V_{IN} ≧-17V	-	11	80	mV
					010.5V≧V_{IN}≧-25V	-	47	160	mV
Load Regulation		Reg・Load	1	Tj=25°C	5mA ≦I_{OUT} ≦1.5A	-	26	160	mV
					250mA ≦I_{OUT} ≦750mA	-	9.0	80	mV
Output Voltage		V_{OUT}	1	-10.5V≧V_{IN}≧ -23V 5mA ≦I_{OUT} ≦1.0A		-8.4	-	-7.6	V
Quiescent Current		I_B	1	Tj=25°C		-	4.3	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-10.5V≧V_{IN}≧-25V		-	-	1.0	mA
	Load	ΔI_{BO}	1	1.0A≦I_{OUT}≦5mA		-	-	0.8	mA
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz ≦f ≦100kHz		-	52	-	μVrms
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		59	66	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	1.0	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79009P

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, (V_{IN}=-15V, I_{OUT}=500mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=1.0μF)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-9.3	-9.0	-8.7	V
Line Regulation		Reg·Line	1	Tj=25°C	-13V≧V_{IN}≧-19V	-	11	82	mV
					-11.5V≧V_{IN}≧-26V	-	48	162	mV
Load Regulation		Reg·Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	33	162	mV
					250mA≦I_{OUT}≦750mA	-	11.0	82	mV
Output Voltage		V_{OUT}	1	-11.5V≧V_{IN}≧-24V 5mA≦I_{OUT}≦1.0A		-9.4	-	-8.6	V
Quiescent Current		I_B	1	Tj=25°C		-	4.3	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-13V≧V_{IN}≧-26.5V		-	-	1.0	mA
	Load	ΔI_{BO}	1	1.0A≦I_{OUT}≦5mA		-	-	0.8	mA
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	60	-	μVrms
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		57	64	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	1.1	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79010P

ELECTRICAL CHARACTERISTICS

- Unless otherwise specified, (V_{IN}=-16V, I_{OUT}=500mA, 0°C≦Tj≦125°C
C_{IN}=0.33μF, C_{OUT}=1.0μF)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-10.4	-10	-9.6	V
Line Regulation		Reg・Line	1	Tj=25°C	-14V≧V_{IN}≧-20V	-	12	90	mV
					-12.5V≧V_{IN}≧-27V	-	50	180	mV
Load Regulation		Reg・Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	40	180	mV
					250mA≦I_{OUT}≦750mA	-	13.0	90	mV
Output Voltage		V_{OUT}	1	-12.5V≧V_{IN}≧-25V 5mA≦I_{OUT}≦1.0A		-10.5	-	-9.5	V
Quiescent Current		I_B	1	Tj=25°C		-	4.4	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-14V≧V_{IN}≧-27.5V		-	-	1.0	mA
	Load	ΔI_{BO}	1	1.0A≦I_{OUT}≦5mA		-	-	0.8	mA
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	65	-	μVrms
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		57	63	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	1.3	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79012P

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, (V_{IN}=-19V, I_{OUT}=500mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=1.0μF)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-12.5	-12	-11.5	V
Line Regulation		Reg·Line	1	Tj=25°C	-16V≧V_{IN}≧-22V	-	13	120	mV
					-14.5V≧V_{IN}≧-30V	-	55	240	mV
Load Regulation		Reg·Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	46	240	mV
					250mA≦I_{OUT}≦750mA	-	17	120	mV
Output Voltage		V_{OUT}	1	-14.5V≧V_{IN}≧-27V 5mA≦I_{OUT}≦1.0A		-12.6	-	-11.4	V
Quiescent Current		I_B	1	Tj=25°C		-	4.4	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-14.5V≧V_{IN}≧-30V		-	-	1.0	mA
	Load	ΔI_{BO}	1	1.0A≦I_{OUT}≦5mA		-	-	0.8	mA
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	75	-	μVrms
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		54	61	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	1.6	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79015P

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, (V_{IN}=-23V, I_{OUT}=500mA, 0°C ≦ Tj ≦ 125°C, C_{IN}=0.33μF, C_{OUT}=1.0μF)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-15.6	-15	-14.4	V
Line Regulation		Reg·Line	1	Tj=25°C	-20V ≧ V_{IN} ≧ -26V	-	14	150	mV
					-17.5V ≧ V_{IN} ≧ -30V	-	57	300	mV
Load Regulation		Reg·Load	1	Tj=25°C	5mA ≦ I_{OUT} ≦ 1.5A	-	68	300	mV
					250mA ≦ I_{OUT} ≦ 750mA	-	25	150	mV
Output Voltage		V_{OUT}	1	-17.5V ≧ V_{IN} ≧ -30V 5mA ≦ I_{OUT} ≦ 1.0A		-15.75	-	-14.25	V
Quiescent Current		I_B	1	Tj=25°C		-	4.4	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-17.5V ≧ V_{IN} ≧ -30V		-	-	1.0	mA
	Load	ΔI_{BO}	1	1.0A ≦ I_{OUT} ≦ 5mA		-	-	0.8	mA
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	90	-	μVrms
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		53	60	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	2.0	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79018P

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, (V_{IN}=-27V, I_{OUT}=500mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=1.0μF)

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-18.7	-18	-17.3	V
Line Regulation		Reg·Line	1	Tj=25°C	-24V≧V_{IN}≧-30V	-	25	180	mV
					-21V≧V_{IN}≧-33V	-	80	360	mV
Load Regulation		Reg·Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	110	360	mV
					250mA≦I_{OUT}≦750mA	-	55	180	mV
Output Voltage		V_{OUT}	1	-21V≧V_{IN}≧-33V 5mA≦I_{OUT}≦1.0A		-18.85	-	-17.15	V
Quiescent Current		I_B	1	Tj=25°C		-	4.5	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-21V≧V_{IN}≧-33V		-	-	1.0	mA
	Load	ΔI_{BO}	1	1.0A≦I_{OUT}≦5mA		-	-	0.8	mA
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	110	-	μVrms
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		52	59	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	2.5	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79020P

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, (V_{IN}=-30V, I_{OUT}=500mA, 0°C≦Tj≦125°C, C_{IN}=0.33μF, C_{OUT}=1.0μF)

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-20.8	-20	-19.2	V
Line Regulation		Reg·Line	1	Tj=25°C	-26V≧V_{IN}≧-32V	-	28	180	mV
					-24V≧VIN≧-35V	-	104	360	mV
Load Regulation		Reg·Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	130	360	mV
					250mA≦I_{OUT}≦750mA	-	70	180	mV
Output Voltage		V_{OUT}	1	-24V≧V_{IN}≧-35V 5mA≦I_{OUT}≦1.0A		-21.0	-	-19.0	V
Quiescent Current		I_B	1	Tj=25°C		-	4.6	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-25V≧V_{IN}≧-36.5V		-	-	1.0	mA
	Load	ΔI_{BO}	1	1.0A≦I_{OUT}≦5mA		-	-	0.8	mA
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	140	-	μVrms
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		50	57	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	3.0	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79024P

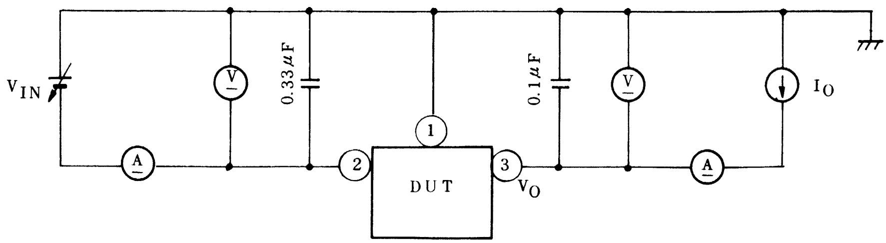
ELECTRICAL CHARACTERISTICS

Unless otherwise specified, (V_{IN}=-33V, I_{OUT}=500mA, 0°C ≦ Tj ≦ 125°C, C_{IN}=0.33μF, C_{OUT}=1.0μF)

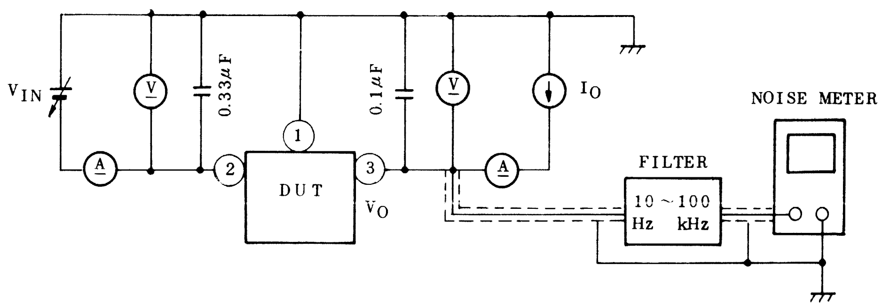
CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-25.0	-24	-23.0	V
		Reg·Line	1	Tj=25°C	-30V ≧ V_{IN} ≧ -36V	-	31	240	mV
					-27V ≧ V_{IN} ≧ -38V	-	118	480	mV
Load Regulation		Reg·Load	1	Tj=25°C	5mA ≦ I_{OUT} ≦ 1.5A	-	150	480	mV
					250mA ≦ I_{OUT} ≦ 750mA	-	85	240	mV
Output Voltage		V_{OUT}	1	-38V ≧ V_{IN} ≧ -27V 5mA ≦ I_{OUT} ≦ 1.0A		-25.2	-	-22.8	V
Quiescent Current		I_B	1	Tj=25°C		-	4.6	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-27V ≧ V_{IN} ≧ -38V		-	-	1.0	mA
	Load	ΔI_{BO}	1	1.0A ≦ I_{OUT} ≦ 5mA		-	-	0.8	mA
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	170	-	μVrms
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		49	56	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	3.5	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TEST CIRCUIT

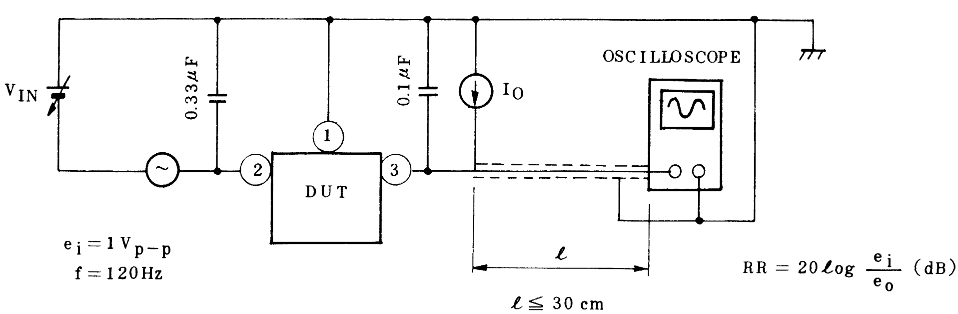
1. V_{OUT}, Reg.Line, Reg.Load, V_{OUT}, I_B, ΔI_B, $\Delta V_{OUT}/\Delta t$, $|V_{IN}-V_{OUT}|$, TC_{VO}



2. V_{no}



3. RR

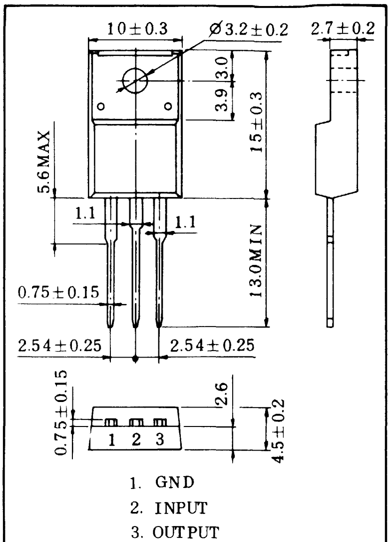


TA79005S, TA79006S, TA79008S, TA79009S, TA79010S, TA79012S, TA79015S, TA79018S, TA79020S, TA79024S

1A THREE TERMINAL NEGATIVE VOLTAGE REGULATORS
-5V, -6V, -8V, -9V, -10V, -12V, -15V, -18V,
-20V, -24V

. Suitable for C-MOS, TTL, and the other Digital IC Power Supply
. Internal Thermal Overload Protecting
. Internal Short Circuit Current Limiting
. Output Current in Excess of 1.0A
. Metal Fin (Tab) is fully covered with Mold Resin. (TO-220 IS package)

Unit in mm



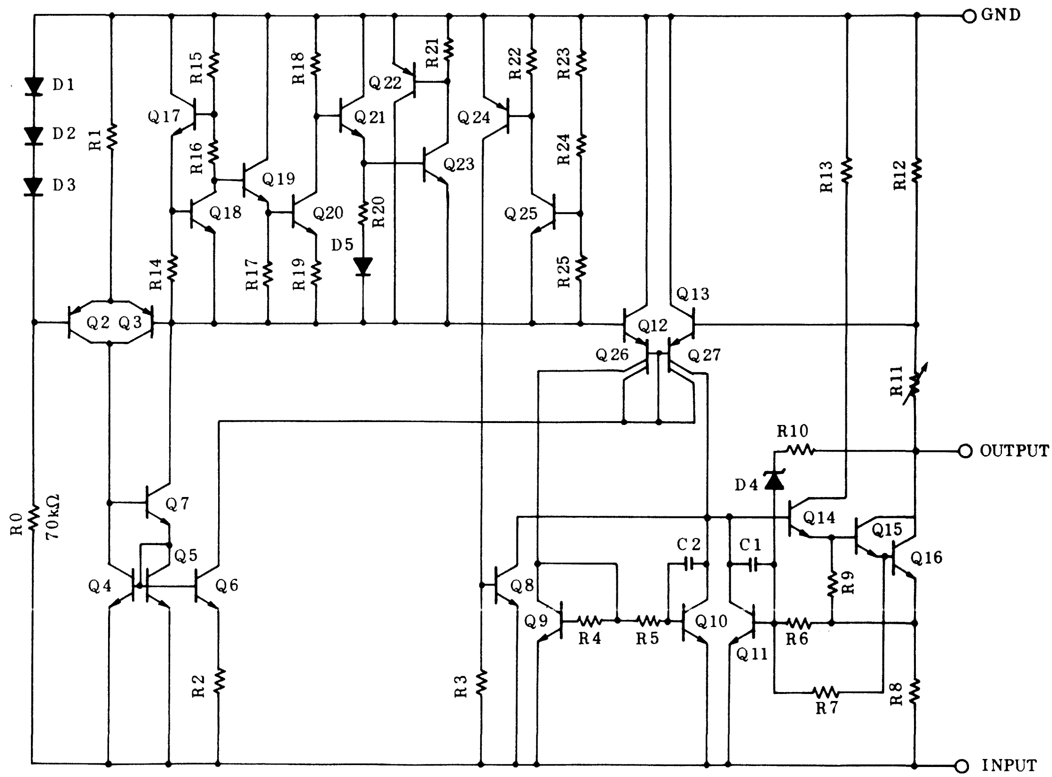
JEDEC	—	
EIAJ	SC—67	
TOSHIBA	HSIP3-P-A	

Weight: 1.7g

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage	TA79005S	V_{IN}	-35	V
	TA79006S			
	TA79008S			
	TA79009S			
	TA89010S			
	TA79012S			
	TA79015S			
	TA79018S	V_{IN}	-40	
	TA79020S			
	TA79024S			
Power Dissipation		P_D	2	W
Power Dissipation (Tc=25°C)		P_D	20.8	W
Operating Temperature		T_{opr}	-30~75	°C
Storage Temperature		T_{stg}	-55~125	°C

EQUIVALENT CIRCUIT



TA79005S

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{IN}=-10V, I_{OUT}=500mA, 0°C≦Tj≦125°C
C_{IN}=0.33μF, C_{OUT}=1.0μF

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-5.2	-5.0	-4.8	V
Line Regulation		Reg·Line	1	Tj=25°C	-8V≧V_{IN}≧-12V	-	7	50	mV
					-7V≧V_{IN}≧-25V	-	35	100	
Load Regulation		Reg·Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	11	100	mV
					250mA≦I_{OUT}≦750mA	-	4	50	
Output Voltage		V_{OUT}	1	-7V≧V_{IN}≧-20V 5mA≦I_{OUT}≦1.0A		-5.25	-	-4.75	V
Quiescent Current		I_B	1	Tj=25°C		-	4.3	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-7V≧V_{IN}≧-25V		-	-	1.3	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦1.0A		-	-	0.8	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	40	-	μVrms
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		63	70	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	0.6	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79006S

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{IN}=-11V, I_{OUT}=500mA, 0°C≦Tj≦125°C
C_{IN}=0.33μF, C_{OUT}=1.0μF

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-6.25	-6.0	-5.75	V
Line Regulation		Reg·Line	1	Tj=25°C	-9V ≧V_{IN}≧-13V	-	9	60	mV
					-8V ≧V_{IN}≧ -25V	-	43	120	
Load Regulation		Reg·Load	1	Tj=25°C	5mA ≦I_{OUT}≦1.5A	-	13	120	mV
					250mA≦I_{OUT}≦750mA	-	5	60	
Output Voltage		V_{OUT}	1	-8V≧V_{IN}≧-21V 5mA≦I_{OUT}≦1.0A		-6.3	-	-5.7	V
Quiescent Current		I_B	1	Tj=25°C		-	4.3	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-8V≧V_{IN}≧-25V		-	-	1.3	mA
	Load	ΔI_{BO}	1	5mA ≦I_{OUT}≦1.0A		-	-	0.8	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	45	-	μV_{rms}
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		61	68	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	0.7	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79008S

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{IN}=-14V, I_{OUT}=500mA, 0°C≦Tj≦125°C
C_{IN}=0.33μF, C_{OUT}=1.0μF

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-8.3	-8.0	-7.7	V
Line Regulation		Reg·Line	1	Tj=25°C	-11V≧V_{IN}≧-17V	-	11	80	mV
					-10.5V≧V_{IN}≧-25V	-	47	160	
Load Regulation		Reg·Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	26	160	mV
					250mA≦I_{OUT}≦750mA	-	9	80	
Output Voltage		V_{OUT}	1	-10.5V≧V_{IN}≧-23V 5mA≦I_{OUT}≦1.0A		-8.4	-	-7.6	V
Quiescent Current		I_B	1	Tj=25°C		-	4.3	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-10.5V≧V_{IN}≧-25V		-	-	1.0	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦1.0A		-	-	0.8	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	52	-	μV_{rms}
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		59	66	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	1.0	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79009S

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{IN}=-15V, I_{OUT}=500mA, 0°C≦Tj≦125°C
C_{IN}=0.33μF, C_{OUT}=1.0μF

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-9.3	-9.0	-8.7	V
Line Regulation		Reg·Line	1	Tj=25°C	-13V≧V_{IN}≧-19V	-	11	82	mV
					-11.5V≧V_{IN}≧-26V	-	48	162	
Load Regulation		Reg·Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	33	162	mV
					250mA≦I_{OUT}≦750mA	-	11	82	
Output Voltage		V_{OUT}	1	-11.5V≧V_{IN}≧-24V 5mA≦I_{OUT}≦1.0A		-9.4	-	-8.6	V
Quiescent Current		I_B	1	Tj=25°C		-	4.3	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-13V≧V_{IN}≧-26.5V		-	-	1.0	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦1.0A		-	-	0.8	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	60	-	μV_{rms}
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		57	64	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	1.1	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79010S

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{IN}=-16V, I_{OUT}=500mA, 0°C≦Tj≦125°C
C_{IN}=0.33μF, C_{OUT}=1.0μF

CHARACTERISTIC		SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-10.4	-10	-9.6	V
Line Regulation		Reg·Line	1	Tj=25°C	-14V≧V_{IN}≧-20V	-	12	90	mV
					-12.5V≧V_{IN}≧-27	-	50	180	
Load Regulation		Reg·Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	40	180	mV
					250mA≦I_{OUT}≦750mA	-	13	90	
Output Voltage		V_{OUT}	1	-12.5V≧V_{IN}≧-25V 5mA≦I_{OUT}≦1.0A		-10.5	-	-9.5	V
Quiescnet Current		I_B	1	Tj=25°C		-	4.4	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-14V≧V_{IN}≧-27.5V		-	-	1.0	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦1.0A		-	-	0.8	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	65	-	μV_{rms}
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		57	63	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	1.3	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79012S

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{IN}=-19V, I_{OUT}=500mA, 0°C ≦ Tj ≦ 125°C
C_{IN}=0.33μF, C_{OUT}=1.0μF

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-12.5	-12	-11.5	V
Line Regulation		Reg·Line	1	Tj=25°C	-16V ≧ V_{IN} ≧ -22V	-	13	120	mV
					-14.5V ≧ V_{IN} ≧ -30V	-	55	240	
Load Regulation		Reg·Load	1	Tj=25°C	5mA ≦ I_{OUT} ≦ 1.5A	-	46	240	mV
					250mA ≦ I_{OUT} ≦ 750mA	-	17	120	
Output Voltage		V_{OUT}	1	-14.5V ≧ V_{IN} ≧ -27V 5mA ≦ I_{OUT} ≦ 1.0A		-12.6	-	-11.4	V
Quiescent Current		I_B	1	Tj=25°C		-	4.4	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-14.5V ≧ V_{IN} ≧ -30V		-	-	1.0	mA
	Load	ΔI_{BO}	1	5mA ≦ I_{OUT} ≦ 1.0A		-	-	0.8	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz ≦ f ≦ 100kHz		-	75	-	μV_{rms}
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		54	61	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	1.6	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79015S

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{IN}=-23V, I_{OUT}=500mA, 0°C≦Tj≦125°C
C_{IN}=0.33μF, C_{OUT}=1.0μF

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-15.6	-15	-14.4	V
Line Regulation		Reg·Line	1	Tj=25°C	-20V≧V_{IN}≧-26V	-	14	150	mV
					-17.5V≧V_{IN}≧-30V	-	57	300	
Load Regulation		Reg·Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	68	300	mV
					250mA≦I_{OUT}≦750mA	-	25	150	
Output Voltage		V_{OUT}	1	-17.5V≧V_{IN}≧-30V 5mA≦I_{OUT}≦1.0A		-15.75	-	-14.25	V
Quiescent Current		I_B	1	Tj=25°C		-	4.4	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-17.5V≧V_{IN}≧-30V		-	-	1.0	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦1.0A		-	-	0.8	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	90	-	μV_{rms}
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		53	60	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	2.0	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79018S

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{IN}=-27V, I_{OUT}=500mA, 0°C≦Tj ≦125°C

C_{IN}=0.33μF, C_{OUT}=1.0μF

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-18.7	-18	-17.3	V
Line Regulation		Reg·Line	1	Tj=25°C	-24V ≧V_{IN} ≧-30V	-	25	180	mV
					-33V ≧VIN≧-21V	-	80	360	
Load Regulation		Reg·Load	1	Tj=25°C	5mA ≦I_{OUT} ≦1.5A	-	110	360	mV
					250mA ≦I_{OUT} ≦750mA	-	55	180	
Output Voltage		V_{OUT}	1	-21V≧V_{IN}≧-33V 5mA ≦I_{OUT} ≦1.0A		-18.85	-	-17.15	V
Quiescent Current		I_B	1	Tj=25°C		-	4.5	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-21V≧V_{IN} ≧-33V		-	-	1.0	mA
	Load	ΔI_{BO}	1	5mA ≦I_{OUT} ≦1.0A		-	-	0.8	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f ≦100kHz		-	110	-	μV_{rms}
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		52	59	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	2.5	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79020S

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{IN}=-30V, I_{OUT}=500mA, 0°C≦Tj≦125°C
C_{IN}=0.33μF, C_{OUT}=1.0μF

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-20.8	-20	-19.2	V
Line Regulation		Reg·Line	1	Tj=25°C	-26V≧V_{IN}≧-32V	-	28	180	mV
					-24V≧V_{IN}≧-35V	-	104	360	
Load Regulation		Reg·Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	130	360	mV
					250mA≦I_{OUT}≦750mA	-	70	180	
Output Voltage		V_{OUT}	1	-24V≧V_{IN}≧-35V 5mA≦I_{OUT}≦1.0A		-21.0	-	-19.0	V
Quiescent Current		I_B	1	Tj=25°C		-	4.6	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-25V≧V_{IN}≧-36.5V		-	-	1.0	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦1.0A		-	-	0.8	
Output Noise Voltage		V_{NO}	2	_a=25°C, 10Hz≦f≦100kHz		-	140	-	μV_{rms}
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		50	57	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	3.0	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TA79024S

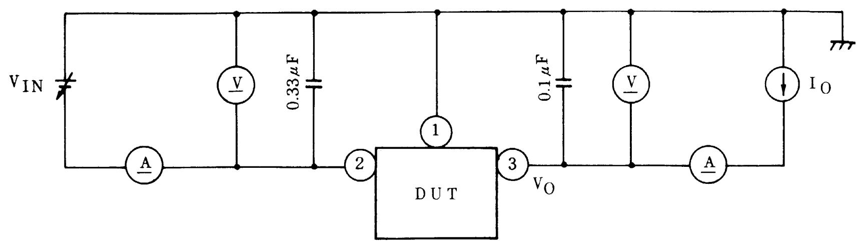
ELECTRICAL CHARACTERISTICS

Unless otherwise specified, V_{IN}=-33V, I_{OUT}=500mA, 0°C≦Tj≦125°C
C_{IN}=0.33μF, C_{OUT}=1.0μF

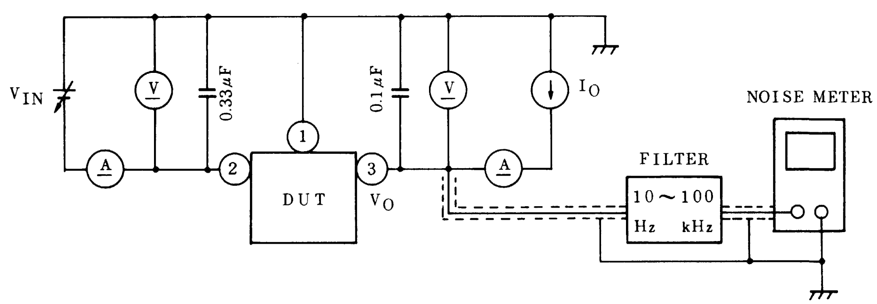
CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage		V_{OUT}	1	Tj=25°C, I_{OUT}=100mA		-25.0	-24	-23.0	V
Line Regulation		Reg·Line	1	Tj=25°C	-30V≧V_{IN}≧-36V	-	31	240	mV
					-27V≧VIN≧-38V	-	118	480	
Load Regulation		Reg·Load	1	Tj=25°C	5mA≦I_{OUT}≦1.5A	-	150	480	mV
					250mA≦I_{OUT}≦750mA	-	85	240	
Output Voltage		V_{OUT}	1	-27V≧V_{IN}≧-38V 5mA≦I_{OUT}≦1.0A		-25.2	-	-22.8	V
Quiescent Current		I_B	1	Tj=25°C		-	4.6	8.0	mA
Quiescent Current Charge	Line	ΔI_{BI}	1	-27V≧V_{IN}≧-38V		-	-	1.0	mA
	Load	ΔI_{BO}	1	5mA≦I_{OUT}≦1.0A		-	-	0.8	
Output Noise Voltage		V_{NO}	2	Ta=25°C, 10Hz≦f≦100kHz		-	170	-	μVrms
Ripple Rejection		RR	3	f=120Hz, I_{OUT}=20mA		49	56	-	dB
Short Circuit Current Limit		I_{SC}	1	Tj=25°C		-	1.9	-	A
Average Temperature Coefficient of Output Voltage		T_{CVO}	1	I_{OUT}=5.0mA		-	3.5	-	mV/deg
Dropout Voltage		V_D	1	Tj=25°C, I_{OUT}=1.0A		-	2.0	-	V

TEST CIRCUIT

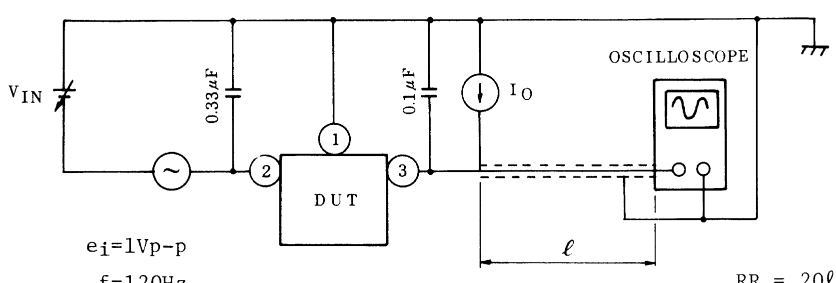
1. V_{OUT}, Reg·Line, Reg·load, V_{OUT}, I_B, ΔI_B, $\Delta V_{OUT}/\Delta t$, $|V_{IN}-V_{OUT}|$, TCV_O



2. V_{no}



3. RR



e_i=1Vp-p

f=120Hz

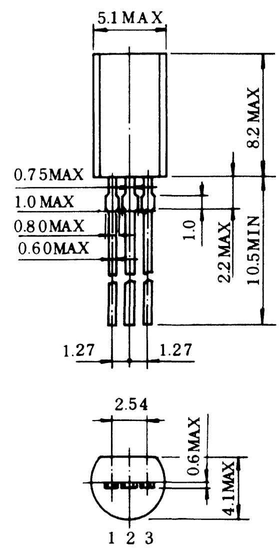
$$RR = 20\log\frac{e_i}{e_o}\ (dB)$$

TA79L005P, TA79L006P, TA79L008P, TA79L009P, TA79L010P, TA79L012P, TA79L015P, TA79L018P, TA79L020P, TA79L024P

o 5V, 6V, 8V, 9V, 10V, 12V, 15V, 18V, 20V, 24V
3-TERMINAL NEGATIVE VOLTAGE REGULATORS

- Best suited to a power supply for TTL and C^2 MOS
- Built-in overcurrent protective circuit
- Built-in thermal protective circuit
- Max. output current 150mA (Tj = 25°C)
- Packaged in TO-92MOD

Unit in mm



1. GND
2. INPUT
3. OUTPUT

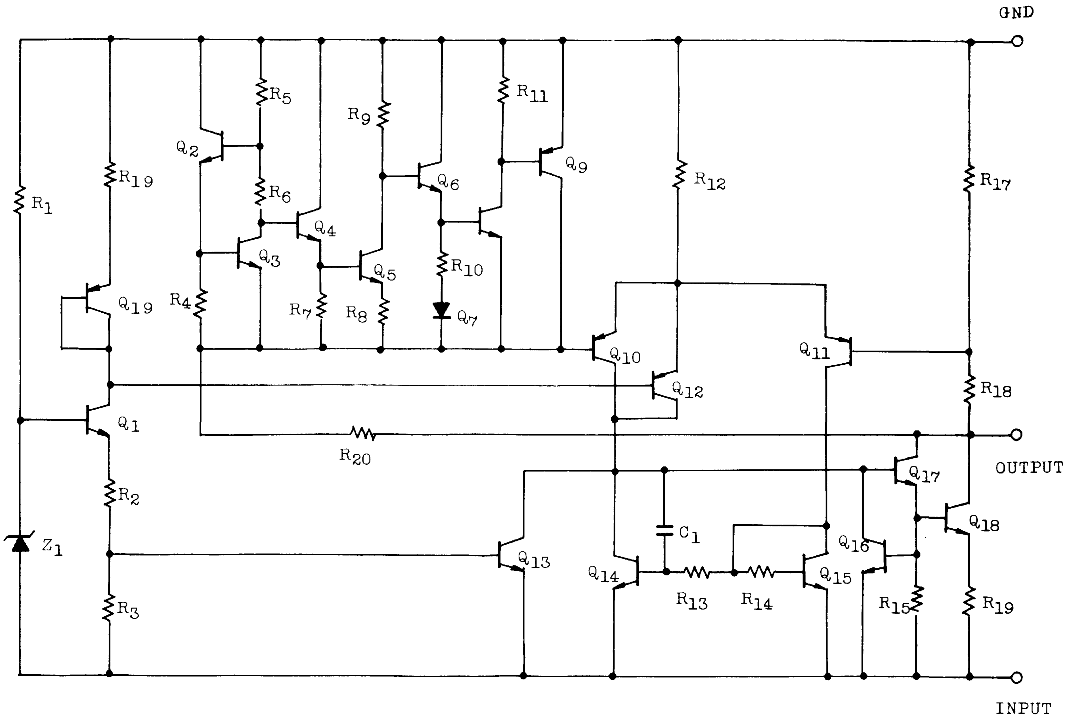
JEDEC	–
TOSHIBA	SSIP3-P

Weight: 0.36g

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Input Voltage	TA79L005P	V_{IN}	-35	V
	TA79L006P			
	TA79L008P			
	TA79L009P			
	TA79L010P			
	TA79L012P			
	TA79L015P			
	TA79L018P		-40	
	TA79L020P			
	TA79L024P			
Power Dissipation (Tc=25°C)		P_D	800	mW
Operating Temperature		T_{opr}	-30 ∿ 75	°C
Storage Temperature		T_{stg}	-55 ∿ 150	°C

EQUIVALENT CIRCUIT



TA79L005P

ELECTRICAL CHARACTERISTICS

(V_{IN} = -10V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j=25°C		-5.2	-5.0	-4.8	V
Line Regulation	Reg Line	1	T_j=25°C	-7.0V ≧ V_{IN} ≧ -20V	-	55	150	mV
				-8.0V ≧ V_{IN} ≧ -20V	-	45	100	
Load Regulation	Reg Load	1	T_j=25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	11	60	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	5.0	30	
Output Voltage	V_{OUT}	1	-7.0 ≧ V_{IN} ≧ -20V 1.0mA ≦ I_{OUT} ≦ 40mA		-5.25	-	-4.75	V
			V_{IN} = -10V 1.0mA ≦ I_{OUT} ≦ 70mA		-5.25	-	-4.75	
Quiescent Current	I_B	1	T_j = 25°C		-	3.1	6.0	mA
			T_j = 125°C		-	-	5.5	
Quiescent Current Change	ΔI_{BI}	1	-8.0V ≧ V_{IN} ≧ -20V		-	-	1.5	mA
	ΔI_{BO}	1	1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	3	Ta = 25°C 10Hz ≦ f ≦ 100kHz		-	40	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	12	-	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	-8.0V ≧ V_{IN} ≧ -18V T_j = 25°C, f = 120Hz		41	49	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	1	T_j = 25°C, I_{OUT} = 40mA		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	0.6	-	mV/°C

TA79L006P

ELECTRICAL CHARACTERISTICS

(V_{IN} = -11V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j = 25°C		-6.24	-6.0	-5.76	V
Line Regulation	Reg Line	1	T_j = 25°C	-8.1V ≧ V_{IN} ≧ -21V	-	50	150	mV
				-9.0V ≧ V_{IN} ≧ -21V	-	45	110	
Load Regulation	Reg Load	1	T_j = 25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	12	70	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	5.5	35	
Output Voltage	V_{OUT}	1	-8.1V ≧ V_{IN} ≧ -21V 1.0mA ≦ I_{OUT} ≦ 40mA		-6.3	-	-5.7	V
			V_{IN} = -11V 1.0mA ≦ I_{OUT} ≦ 70mA		-6.3	-	-5.7	
Quiescent Current	I_B	1	T_j = 25°C		-	3.1	6.0	mA
			T_j = 125°C		-	-	5.5	
Quiescent Current Change	ΔI_{BI}	1	-9.0V ≧ V_{IN} ≧ -21V		-	-	1.5	mA
	ΔI_{BO}	1	1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	3	Ta = 25°C 10Hz ≦ f ≦ 100kHz		-	40	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	14	-	mV/ 1.0kHrs
Ripple Rejection Ratio	RR	2	-9.0V ≧ V_{IN} ≧ -19V T_j = 25°C, f = 120Hz		39	47	-	dB
Dropout Voltage	$\lvert V_{IN} - V_{OUT} \rvert$	1	T_j = 25°C, I_{OUT} = 40mA		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	0.7	-	mV/°C

TA79L008P

ELECTRICAL CHARACTERISTICS

(V_{IN} = -14V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j = 25°C		-8.3	-8.0	-7.7	V
Line Regulation	Reg Line	1	T_j = 25°C	-10.5V ≧ V_{IN} ≧ -23V	-	20	175	mV
				-11V ≧ V_{IN} ≧ -23V	-	12	125	
Load Regulation	Reg Load	1	T_j = 25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	15	80	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	7.0	40	
Output Voltage	V_{OUT}	1	-10.5V ≧ V_{IN} ≧ -23V 1.0mA ≦ I_{OUT} ≦ 40mA		-8.4	-	-7.6	V
			V_{IN} = -14V 1.0mA ≦ I_{OUT} ≦ 70mA		-8.4	-	-7.6	
Quiescent Current	I_B	1	T_j = 25°C		-	3.1	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_{BI}	1	-11V ≧ V_{IN} ≧ -23V		-	-	1.5	mA
	ΔI_{BO}	1	1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	3	Ta = 25°C 10Hz ≦ f ≦ 100kHz		-	60	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	20	-	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	-12V ≧ V_{IN} ≧ -23V T_j = 25°C, f = 120Hz		37	45	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	T_j = 25°C, I_{OUT} = 40mA		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	0.8	-	mV/°C

TA79L009P

ELECTRICAL CHARACTERISTICS

(V_{IN} = -15V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j = 25°C		-9.36	-9.0	-8.64	V
Line Regulation	Reg Line	1	T_j = 25°C	-11.4V ≧ V_{IN} ≧ -24V	-	80	200	mV
				-12V ≧ V_{IN} ≧ -24V	-	20	160	
Load Regulation	Reg Load	1	T_j = 25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	17	90	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	8.0	45	
Output Voltage	V_{OUT}	1	-11.4V ≧ V_{IN} ≧ -24V 1.0mA ≦ I_{OUT} ≦ 40mA		-9.45	-	-8.55	V
			V_{IN} = -15V 1.0mA ≦ I_{OUT} ≦ 70mA		-9.45	-	-8.55	
Quiescent Current	I_B	1	T_j = 25°C		-	3.2	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_{BI}	1	-12V ≧ V_{IN} ≧ -24V		-	-	1.5	mA
	ΔI_{BO}	1	1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	3	Ta = 25°C 10Hz ≦ f ≦ 100kHz		-	65	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	21	-	mV/ 1.0kHrs
Ripple Rejection Ratio	RR	2	-12V ≧ V_{IN} ≧ -24V T_j = 25°C, f = 120Hz		36	44	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	T_j = 25°C, I_{OUT} = 40mA		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	0.85	-	mV/°C

TA79L010P

ELECTRICAL CHARACTERISTICS

(V_{IN} = -16V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j = 25°C		-10.4	-10.0	-9.6	V
Line Regulation	Reg Line	1	T_j = 25°C	-12.5V ≧ V_{IN} ≧ -25V	-	80	230	mV
				-13V ≧ V_{IN} ≧ -25V	-	30	170	
Load Regulation	Reg Load	1	T = 25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	18	90	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	8.5	45	
Output Voltage	V_{OUT}	1	-12.5V ≧ V_{IN} ≧ -25V 1.0mA ≦ I_{OUT} ≦ 40mA		-10.5	-	-9.5	V
			V_{IN} = -16V 1.0mA ≦ I_{OUT} ≦ 70mA		-10.5	-	-9.5	
Quiescent Current	I_B	1	T_j = 25°C		-	3.2	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_{BI}	1	-13V ≧ V_{IN} ≧ -25V		-	-	1.5	mA
	ΔI_{BO}	1	1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	3	Ta = 25°C 10Hz ≦ f ≦ 100kHz		-	70	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	22	-	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	-13V ≧ V_{IN} ≧ -24V T_j = 25°C, f = 120Hz		36	43	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	T_j = 25°C, I_{OUT} = 40mA		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	0.9	-	mV/°C

TA79L012P

ELECTRICAL CHARACTERISTICS

(V_{IN} = -19V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j = 25°C		-12.5	-12.0	-11.5	V
Line Regulation	Reg Line	1	T_j = 25°C	-14.5V ≧ V_{IN} ≧ -27V	-	120	250	mV
				-16V ≧ V_{IN} ≧ -27V	-	100	200	
Load Regulation	Reg Load	1	T_j = 25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	20	100	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	10	50	
Output Voltage	V_{OUT}	1	-14.5V ≧ V_{IN} ≧ -27V 1.0mA ≦ I_{OUT} ≦ 40mA		-12.6	-	-11.4	V
			V_{IN} = -19V 1.0mA ≦ I_{OUT} ≦ 70mA		-12.6	-	-11.4	
Quiescent Current	I_B	1	T_j = 25°C		-	3.2	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_{BI}	1	-16V ≧ V_{IN} ≧ -27V		-	-	1.5	mA
	ΔI_{BO}	1	1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	3	Ta = 25°C 10Hz ≦ f ≦ 100kHz		-	80	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	24	-	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	-15V ≧ V_{IN} ≧ -25V T_j = 25°C, f = 120Hz		37	42	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	T_j = 25°C, I_{OUT} = 40mA		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	1.0	-	mV/°C

TA79L015P

ELECTRICAL CHARACTERISTICS

(V_{IN} = -23V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j = 25°C		-15.6	-15.0	-14.4	V
Line Regulation	Reg Line	1	T_j = 25°C	-17.5V ≧ V_{IN} ≧ -30V	-	130	300	mV
				-20V ≧ V_{IN} ≧ -30V	-	110	250	
Load Regulation	Reg Load	1	T_j = 25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	25	150	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	12	75	
Output Voltage	V_{OUT}	1	-17.5V ≧ V_{IN} ≧ -30V 1.0mA ≦ I_{OUT} ≦ 40mA		-15.75	-	-14.25	V
			V_{IN} = -23V 1.0mA ≦ I_{OUT} ≦ 70mA		-15.75	-	-14.25	
Quiescent Current	I_B	1	T_j = 25°C		-	3.3	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_{BI}	1	-20V ≧ V_{IN} ≧ -30V		-	-	1.5	mA
	ΔI_{BO}	1	1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	3	Ta = 25°C 10Hz ≦ f ≦ 100kHz		-	90	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	30	-	mV/ 1.0kHrs
Ripple Rejection Ratio	RR	2	-18.5V ≧ V_{IN} ≧ -28.5V T_j = 25°C, f = 120Hz		34	39	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	T_j = 25°C, I_{OUT}=40mA		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	1.3	-	mV/°C

TA79L018P

ELECTRICAL CHARACTERISTICS

(V_{IN} = -27V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j = 25°C		-18.7	-18.0	-17.3	V
Line Regulation	Reg Line	1	T_j = 25°C	-20.7V ≧ V_{IN} ≧ -33V	-	32	325	mV
				-21V ≧ V_{IN} ≧ -33V	-	27	275	
Load Regulation	Reg Load	1	T_j = 25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	30	170	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	15	75	
Output Voltage	V_{OUT}	1	-20.9V ≧ V_{IN} ≧ -33V 1.0mA ≦ I_{OUT} ≦ 40mA		-18.9	-	-17.1	V
			V_{IN} = -27V 1.0mA ≦ I_{OUT} ≦ 70mA		-18.9	-	-17.1	
Quiescent Current	I_B	1	T_j = 25°C		-	3.3	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_{BI}	1	-21V ≧ V_{IN} ≧ -33V		-	-	1.5	mA
	ΔI_{BO}	1	1.0mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	3	Ta = 25°C 10Hz ≦ f ≦ 100kHz		-	150	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	45	-	mV/ 1.0kHrs
Ripple Rejection Ratio	RR	2	-23V ≧ V_{IN} ≧ -33V T_j = 25°C, f = 120Hz		33	48	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	T_j = 25°C, I_{OUT} = 40mA		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	1.5	-	mV/°C

TA79L020P

ELECTRICAL CHARACTERISTICS

(V_{IN} = -29V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j = 25°C		-20.8	-20.0	-19.2	V
Line Regulation	Reg Line	1	T_j = 25°C	-23.5V ≧ V_{IN} ≧ -35V	-	33	330	mV
				-24V ≧ V_{IN} ≧ -35V	-	28	285	
Load Regulation	Reg Load	1	T_j = 25°C	1.0mA ≦ I_{OUT} ≦ 100mA	-	33	180	mV
				1.0mA ≦ I_{OUT} ≦ 40mA	-	17	90	
Output Voltage	V_{OUT}	1	-23.5V ≧ V_{IN} ≧ 35V 1.0mA ≦ I_{OUT} ≦ 40mA		-21.0	-	-19.0	V
			V_{IN} = -29V 1.0mA ≦ I_{OUT} ≦ 70mA		-21.0	-	-19.0	
Quiescent Current	I_B	1	T_j = 25°C		-	3.3	6.5	mA
			T_j = 125°C		-	-	6.0	
Quiescent Current Change	ΔI_{BI}	1	-24V ≧ V_{IN} ≧ -35V		-	-	1.5	mA
	ΔI_{BO}	1	10mA ≦ I_{OUT} ≦ 40mA		-	-	0.1	
Output Noise Voltage	V_{NO}	3	Ta = 25°C 10Hz ≦ f ≦ 100kHz		-	170	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1			-	49	-	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	-27V ≧ V_{IN} ≧ -35V T_j = 25°C, f = 120Hz		31	37	-	dB
Dropout Voltage	$\lvert V_{IN}-V_{OUT}\rvert$	1	T_j = 25°C, I_{OUT} = 40mA		-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA		-	1.7	-	mV/°C

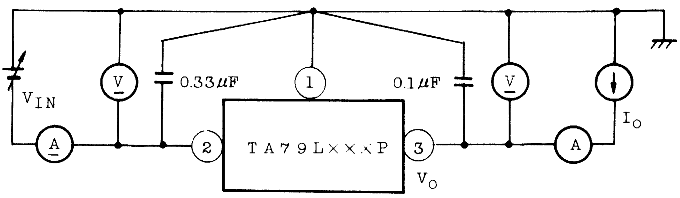
TA79L024P

ELECTRICAL CHARACTERISTICS

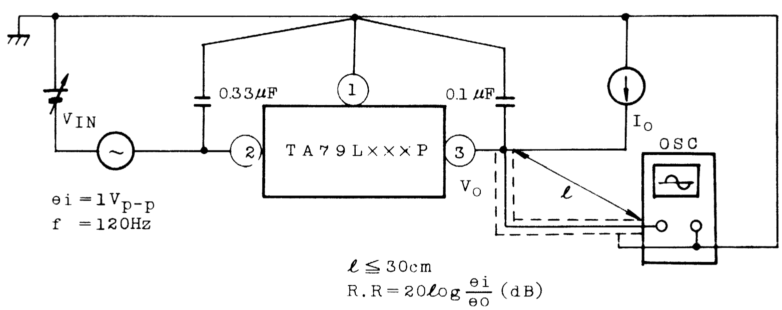
(V_{IN} = -33V, I_{OUT} = 40mA, C_{IN} = 0.33μF, C_{OUT} = 0.1μF, 0°C ≦ T_j ≦ 125°C)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	T_j = 25°C	-25.0	-24.0	-23.0	V
Line Regulation	Reg Line	1	T_j = 25°C, -27V ≧ V_{IN} ≧ -38V	-	35	350	mV
			T_j = 25°C, -28V ≧ V_{IN} ≧ -38V	-	30	300	
Load Regulation	Reg Load	1	T_j = 25°C, 1.0mA ≦ I_{OUT} ≦ 100mA	-	40	200	mV
			T_j = 25°C, 1.0mA ≦ I_{OUT} ≦ 40mA	-	20	100	
Output Voltage	V_{OUT}	1	-27V ≧ V_{IN} ≧ -38V, 1.0mA ≦ I_{OUT} ≦ 40mA	-25.2	-	-22.8	V
			V_{IN} = -33V, 10mA ≦ I_{OUT} ≦ 70mA	-25.2	-	-22.8	
Quiescent Current	I_B	1	T_j = 25°C	-	3.5	6.5	mA
			T_j = 125°C	-	-	6.0	
Quiescent Current Change	ΔI_{BI}	1	-28V ≧ V_{IN} ≧ -38V	-	-	1.5	mA
	ΔI_{BO}	1	1.0mA ≦ I_{OUT} ≦ 40mA	-	-	0.1	
Output Noise Voltage	V_{NO}	3	Ta = 25°C, 10Hz ≦ f ≦ 100kHz	-	200	-	μV
Long Term Stability	$\Delta V_{OUT}/\Delta t$	1		-	56	-	mV/1.0kHrs
Ripple Rejection Ratio	RR	2	-29V ≧ V_{IN} ≧ -35V, T_j = 25°C, f = 120Hz	31	47	-	dB
Dropout Voltage	$\|V_{IN}-V_{OUT}\|$	1	T_j = 25°C, I_{OUT} = 40mA	-	1.7	-	V
Average Temperature Coefficient of Output Voltage	T_{CVO}	1	I_{OUT} = 5mA	-	2.0	-	mV/°C

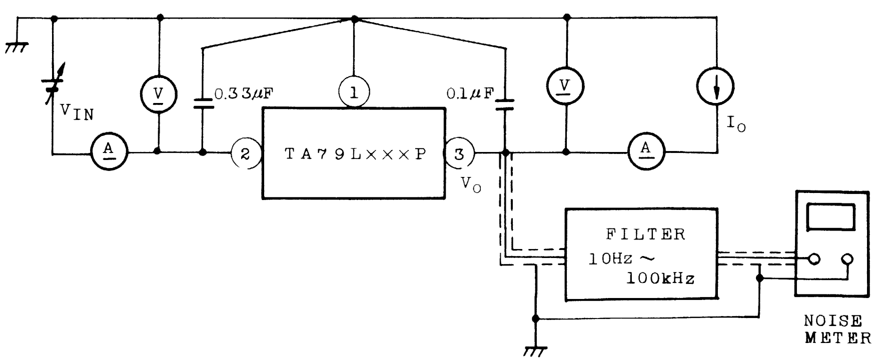
TEST CIRCUIT 1 V_{OUT}, Reg.line, Reg.load, I_B, ΔI_B, $\Delta V_{OUT}/\Delta t$, $|V_{IN}-V_{OUT}|$, T_{CVO}



TEST CIRCUIT 2 RR



TEST CIRCUIT 3 V_{NO}



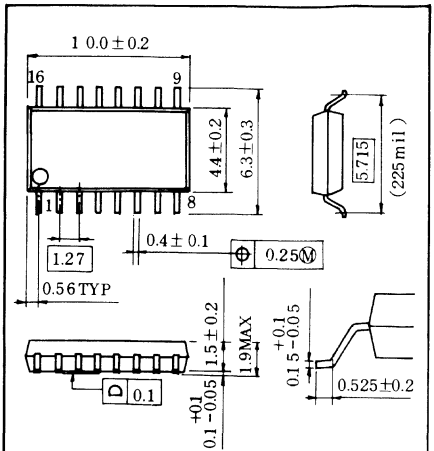
TA76494F

o GENERAL USE SWITCHING REGULATOR (494 TYPE)

The TA76494F is an IC for 494 type switching regulator, with 5V reference voltage, built-in error amplifier, saw tooth wave generating circuit, dead time adjusting comparater, flip-flop, and output buffer.

- Wide same phase range of the error amplifier
- Built-in 100mA output buffer
- Dead time is adjustable
- Built-in low supply voltage protective circuit

Unit in mm



Package width and length do not include mold protrusion.
Allowable mold protrusion is 0.15mm.

JEDEC	—
TOSHIBA	SOP16-P-225

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	25	V
Error Amplifier Input Voltage	V_{ICM}	V_{CC} + 0.3	V
Output Voltage	V_{CER}	25	V
Output Current	I_C	100	mA
Power Dissipation	P_D	400	mW
Operating Temperature	T_{opr}	-30 ∿ 75	°C
Storage Temperature	T_{stg}	-55 ∿ 150	°C

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN	TYP	MAX	UNIT
Supply Voltage	V_{CC}	7	-	25	V
Output Voltage	V_{CER}	-0.3	-	25	V
Output Current (per one stage of output unit)	I_C	-	-	100	mA
Error Amplifier Sink Current	I_{OAMP}	-	-	-0.3	mA
Timing Capacitor	C_T	0.47	-	10000	nF
Timing Resistor	R_T	1.8	-	500	kΩ
Oscillation Frequency	f_{OSC}	1	-	300	kHz
Operating Temperature	T_{opr}	-20	-	70	°C

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{CC}=15V, f_{OSC}=10kHz)

REFERENCE VOLTAGE UNIT

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{ref}	I_{ref}=1mA, Ta=25°C	4.75	5.00	5.25	V
Input Stability	Reg IN	7V ≦ V_{CC} ≦ 25V, I_{ref} = 1mA, Ta = 25°C	-	8	25	mV
Load stability	Reg L	1mA ≦ I_{ref} ≦ 10mA, Ta=25°C	-	1	15	mV
Output Voltage Temp. Change	Tc V_{ref}	-20°C≦Ta≦75°C, I_{ref} = 1mA	-	0.01	0.03	%/°C
Output Short-Circuit Current	I_s	V_{ref}=0	-	50	-	mA

OSCILLATION UNIT

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Oscillation Frequency Set Value	f_{osc}	C_T=0.001μF, R_T=30kΩ	-	40	-	kHz
Oscillation Frequency Setting Accuracy	f_{DIV}	C_T=0.001μF, R_T=30kΩ	-	3.0	-	%
Frequency Input Stability	Δf_{VIN}	7V ≦V_{CC} ≦40V, Ta = 25°C	-	0.1	-	%
Frequency Temp. Change	Δf_{Ta}	0°C ≦ Ta ≦ 70°C	-	1	2	%

PAUSE PERIOD ADJUSTING UNIT

CHARACTERISTIC	SYMBOL	TEST CONDITON	MIN.	TYP.	MAX.	UNIT
Input Bias Current	I_{IND}	0 ≦ V_{IN} ≦ 5.25V PIN 4	-	-2	-10	μA
Max. Duty (Each Output Stage)	D_y MAX	V_{in}=0, CT=0.1μF, R_T=12kΩ	45	48	-	%
Input Threshold Voltage 1	V_{TH-1}	Output pulse 0% duty	-	2.8	3.3	V
Input Threshold Voltage 2	V_{TH-2}	Output pulse max. duty	0	-	-	V

ERROR AMPLIFIER I, II

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Offset Voltage	V_{IO}	V_O PIN 3 = 2.5V	-	2	10	mV
Input Offset Current	I_{IO}	V_O PIN 3 = 2.5V	-	5.0	250	nA
Input Bias Current	I_{IB}	V_O PIN 3 = 2.5V	-	0.1	1	μA
Common Mode Input Voltage Range	CMV_{IN}	7V ≦ V_{CC} ≦ 25V	0.3	-	V_{CC}-2	V
Open loop Gain	G_V	V_O PIN 3 = 0.5∿3.5V, R_L=2kΩ	70	95	-	dB
Unity Gain Frequency	f_o	V_O PIN 3 = 0.5∿3.5V, R_L=2kΩ	-	350	-	kHz
Common Mode Rejection Ratio	CMRR	V_{CC} = 25V	65	90	-	dB
Output Sink Current	I_{SINK}	V_O PIN 3 = 0.7V	0.3	0.7	-	mA
Output Source Current	I_{SOURCE}	V_O PIN 3 = 3.5V	-2	-10	-	mA

PWM COMPARATOR

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Threshold Voltage	V_{TH}	Zero duty cycle	-	4	4.5	V
Input Sink Current	I_I	V_O PIN 3=0.7V	0.3	0.7	-	mA

OUTPUT UNIT

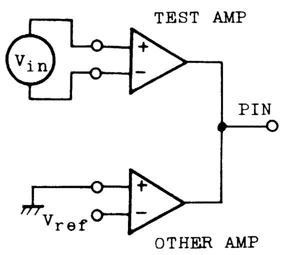
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current		I_{CER}	V_{CE}=25V, V_{CC}=25V Emitter grounded	-	-	100	μA
Emitter Cut-off Current		$I_{E(OFF)}$	V_{CC}=V_C=25V, V_E=0V Emitter follower	-	-	-100	
Emitter Saturation Voltage (Emitter grounded)		$V_{SAT(C)}$	I_C=50mA, V_E=0V	-	0.95	1.3	V
Collector Saturation Voltage (Emitter follower)		$V_{SAT(E)}$	I_E=-50mA, V_C=15V	-	1.6	2.5	
Output Voltage Rise Time (Emitter grounded)		t_r 1		-	100	200	ns
Output Voltage Fall Time (Emitter follower)		t_f 1		-	25	100	
Output Voltage Rise Time (Emitter follower)		t_f 2		-	100	200	
Output Voltage Fall Time (Emitter grounded)		t_f 2		-	40	100	
Output Control Input Operating Current	"L" State	I_{OCL}	$V_{OC} \leqq 0.4V$	-	10	-	μA
	"H" State	I_{OCH}	$V_{OC} = V_{ref}$	-	0.2	3.5	mA

CURRENT CONSUMPTION (TOTAL)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Standby Current	$I_{CC(S \cdot B)}$	V_{CC}=15V, Other terminal opened	-	8	12.5	mA
Bias Current	I_{CC} total	V_{PN} 4=2V, C_T=0.01μF R_T=12kΩ, V_{CC}=15V	-	10	-	

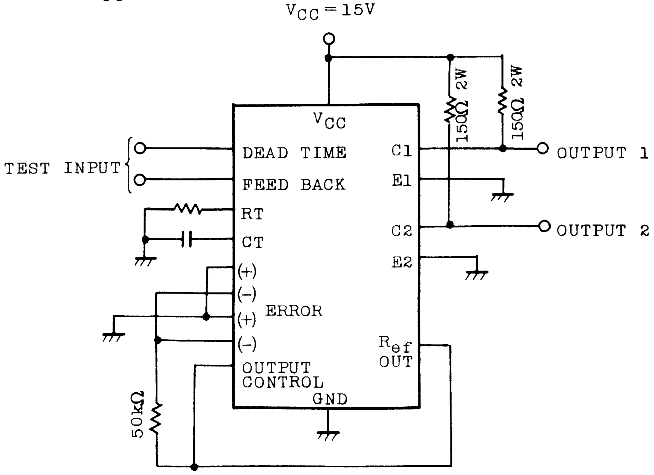
TEST CIRCUIT 1

(Error Amplifier)



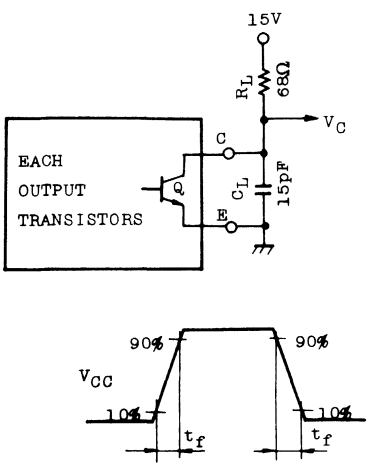
TEST CIRCUIT 2

(Pause time adjusting unit, feedback circuit and I_{CC} total)



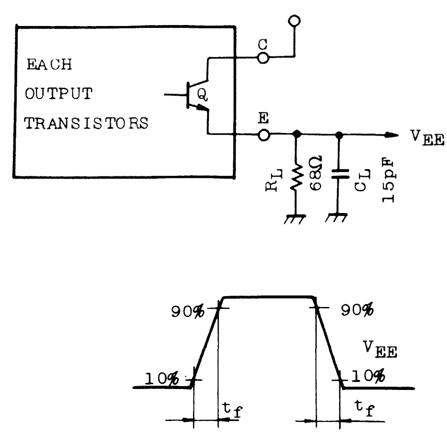
TEST CIRCUIT 3

(Test with the output unit and emitter grounded)

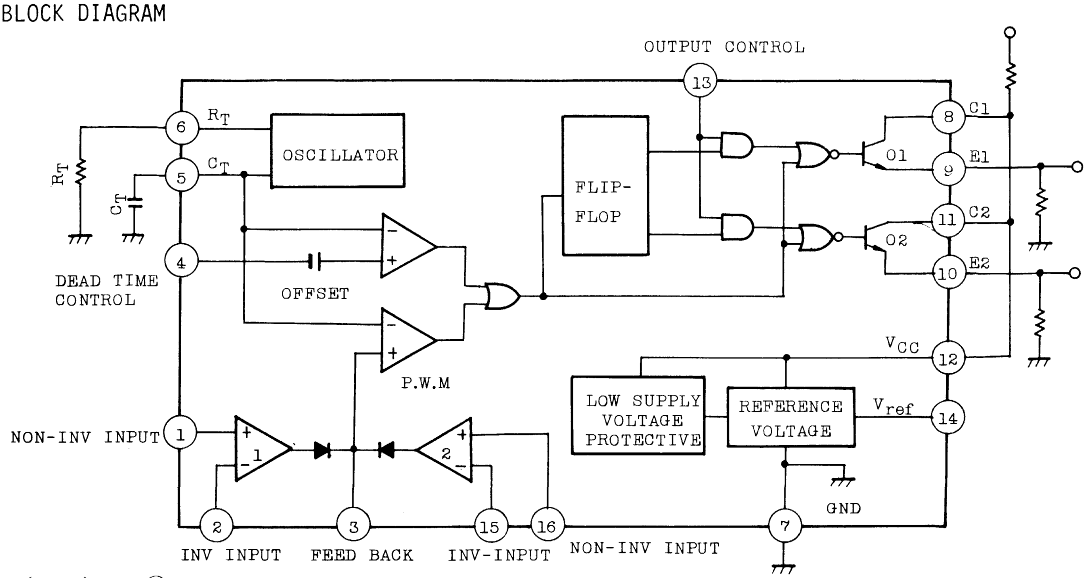


TEST CIRCUIT 4

(Test with the output unit and emitter followed)

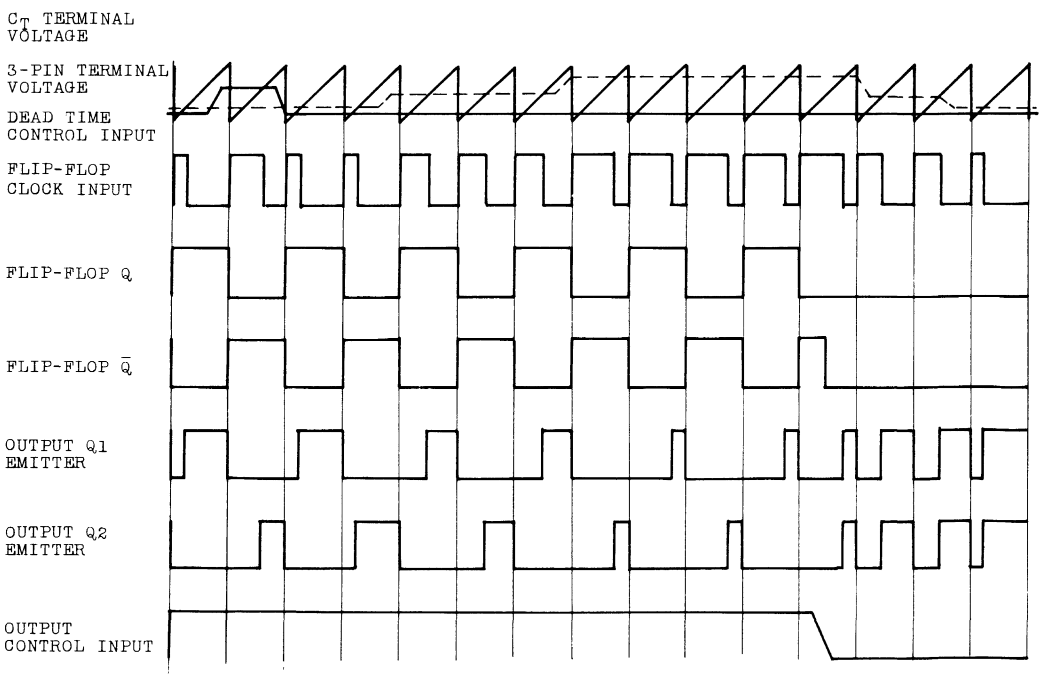


BLOCK DIAGRAM



(Note) PIN ⑬ BECOMES SINGLE MODE AT "L" AND PUSH-PULL MODE AT "H".

OPERATING WAVEFORM

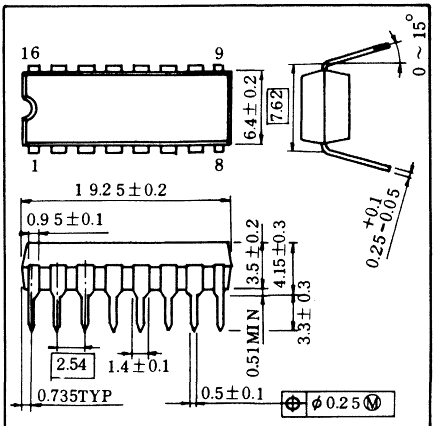


TA76494P

o GENERAL USE SWITCHING REGULATOR (494 TYPE)

The TA76494P is an IC for 494 type switching regulator, with 5V reference voltage, built-in error amplifier, saw tooth wave generating circuit, dead time adjusting comparater, flipflop, and output buffer.

- Wide same phase range of the error amplifier
- Built-in 250mA output buffer
- Dead time is adjustable
- Built-in low supply voltage protective circuit



Package width and length do not include mold protrusion.
Allowable mold protrusion is 0.15mm.

JEDEC	—
TOSHIBA	DIP16−P−300A

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	41	V
Error Amplifier Input Voltage	V_{ICM}	$V_{CC}+0.3$	V
Output Voltage	V_{CER}	41	V
Output Current	I_C	250	mA
Power Dissipation	P_D	750	mW
Operating Temperature	T_{opr}	-30 ∿ 75	°C
Storage Temperature	T_{stg}	-55 ∿ 150	°C

RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN	TYP	MAX	UNIT
Supply Voltage	V_{CC}	7	-	40	V
Output Voltage	V_{CER}	-0.3	-	40	V
Output Current (per one stage of output unit)	I_C	-	-	200	V
Error Amplifier Sink Current	I_{OAMP}	-	-	-0.3	mA
Timing Capacitor	C_T	0.47	-	10000	nF
Timing Resistor	R_T	1.8	-	500	kΩ
Oscillation Frequency	f_{OSC}	1	-	300	kHz
Operating Temperature	T_{opr}	-20	-	70	°C

ELECTRICAL CHARACTERISTICS

REFERENCE VOLTAGE UNIT

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{ref}	I_{ref}=1mA, Ta=25°C	4.75	5.00	5.25	V
Input Stability	$R_{eg\ IN}$	7V ≦ V_{CC} ≦ 25V, I_{ref}=1mA, Ta=25°C	-	8	25	mV
Load Stability	$R_{eg\ L}$	1mA ≦ I_{ref} ≦ 10mA, Ta=25°C	-	1	15	
Output Voltage Temp. Change	Tc V_{ref}	-20°C ≦ Ta ≦ 75°C, I_{ref}=1mA	-	0.01	0.03	%/°C
Output Short-Circuit Current	I_S	V_{ref}=0	-	50	-	mA

OSCILLATION UNIT

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Oscillation Frequency Set Value	f_{CSC}	C_T=0.001μF, R_T=30kΩ	-	40	-	kHz
Oscillation Frequency Setting Currency	f_{DIV}	C_T=0.001μF, R_T=30kΩ	-	3.0	-	%
Frequency Input Stability	f_{VIN}	7V ≦ V_{CC} ≦ 25V, Ta=25°C	-	0.1	-	
Frequency Temp. Change	f_{Ta}	0°C ≦ Ta ≦ 70°C	-	1	2	

PAUSE PERIOD ADJUSTING UNIT

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Bias Current	I_{IND}	0 ≦ V_{IN} ≦ 5.25V PIN 4	-	-2	-10	μA
Max. Duty (Each Output Stage)	Dy MAX	V_{IN}=0, CT=0.1μF, R_T=12kΩ	45	48	-	%
Input Threshold Voltage 1	V_{TH-1}	Output pulse 0% duty	-	2.8	3.3	V
Input Threshold Voltage 2	V_{TH-2}	Output pulse max. duty	0	-	-	

ERROR AMPLIFIER I, II

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Offset Voltage	V_{IO}	V_O PIN 3=2.5V	-	2	10	mA
Input Offset Current	I_{IO}	V_O PIN 3=2.5V	-	5.0	250	nA
Input Bias Current	I_{IB}	V_O PIN 3=2.5V	-	0.1	1	μA
I-phase Input Voltage Range	CMR_{IN}	7V ≦ V_{CC} ≦ 25V	0.3	-	V_{CC}-2	V
Open Load Gain	G_V	V_O PIN 3=0.5∿3.5V, R_L=2kΩ	70	95	-	dB
Unity Gain Frequency	f_O	V_O PIN 3=0.5∿3.5V, R_L=2kΩ	-	350	-	kHz
In-phase Signal Removing Ratio	CMR_R	V_{CC}=25V	65	90	-	dB
Output Sink Current	I_O+	V_O PIN 3=0.7V	0.3	0.7	-	mA
Output Source Current	I_O+	V_O PIN 3=3.5V	-2	-10	-	

PWM COMPARATOR

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Threshold Voltage	V_{TH}	Zero duty cycle	-	4	4.5	V
Input Sink Current	I_I	V_O PIN 3 = 0.7V	0.3	0.7	-	mA

OUTPUT UNIT

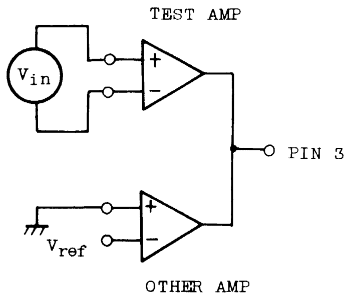
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Collector Cut-off Current		I_{CER}	V_{CE}=25V, V_{CC}=25V Emitter grounded	-	-	100	μA
Emitter Cut-off Current		$I_{E(OFF)}$	V_{CC}=V_C=25V, V_E=0V Emitter follower	-	-	-100	μA
Emitter Saturation Voltage (Emitter grounded)		$V_{SAT(C)}$	I_C = 50mA, V_E = 0V	-	0.95	1.3	V
Collector Saturation Voltage (Emitter follower)		$V_{SAT(E)}$	I_E=-50mA, V_C = 15V	-	1.6	2.5	V
Output Voltage Rise Time (Emitter grounded)		t_r 1		-	100	200	ns
Output Voltage Fall Time (Emitter follower)		t_f 1		-	25	100	
Output Voltage Rise Time (Emitter follower)		t_f 2		-	100	200	ns
Output Voltage Fall Time (Emitter grounded)		t_f 2		-	40	100	
Output Control Input Operating Current	"L" State	I_{OCL}	V_{OC} ≦ 0.4V	-	10	-	μA
	"H" State	I_{OCH}	V_{OC} = V_{ref}	-	0.2	3.5	mA

CURRENT CONSUMPTION (TOTAL)

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Standby Current	$I_{CC(S \cdot B)}$	V_{CC} = 15V, Other terminal opened	-	8	12.5	mA
Bias Current	I_{CC} total	$V_{PIN\ 4}$ = 2V, C_T = 0.01μF R_T = 12kΩ, V_{CC} = 15V	-	10	-	mA

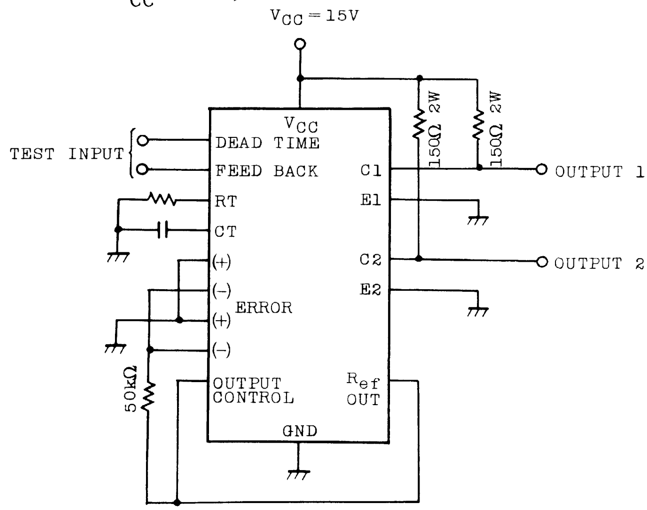
TEST CIRCUIT 1

(Error Amplifier)



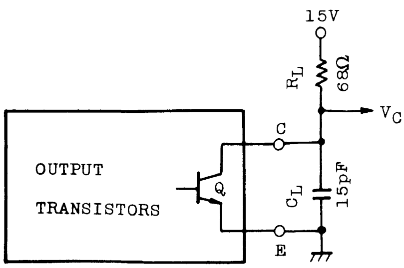
TEST CIRCUIT 2

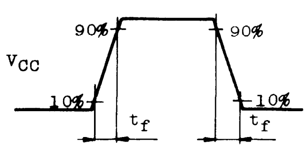
(Pause time adjusting unit, feedback circuit and I_{CC} total)



TEST CIRCUIT 3

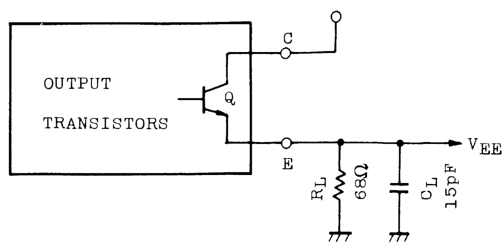
(Test with the output unit and emitter grounded)

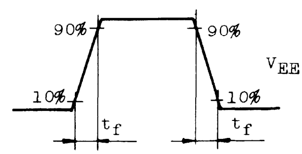




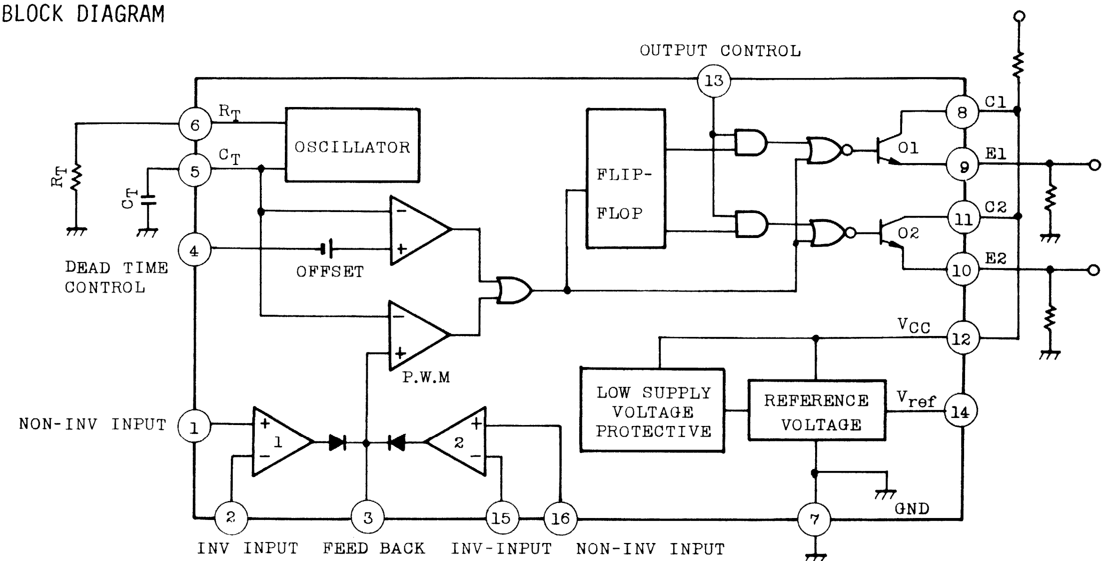
TEST CIRCUIT 4

(Test with the output unit and emitter followed)



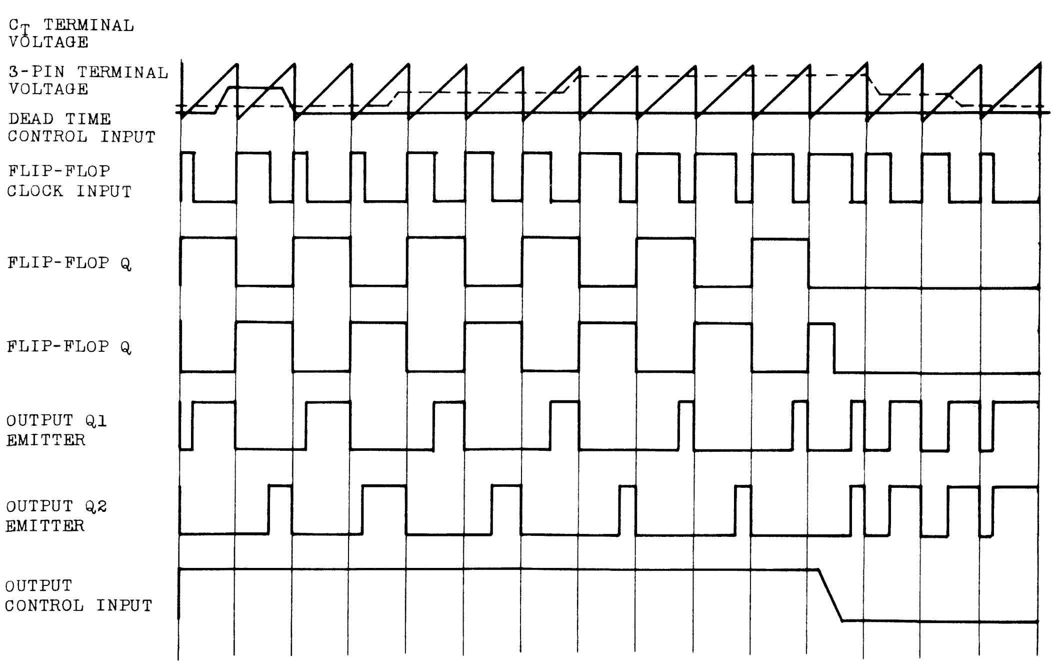


BLOCK DIAGRAM



(Note) PIN◯ BECOMES SINGLE MODE AT "L" AND PUSH-PULL MODE AT "H".

OPERATING WAVEFORM



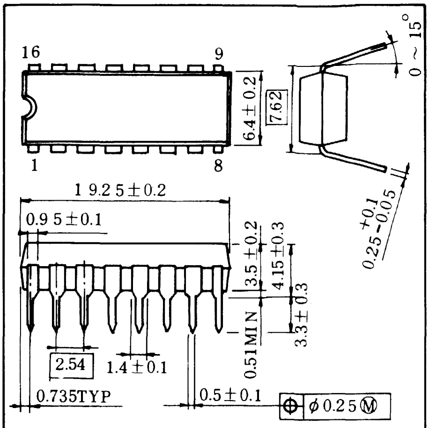
TA76524P

o GENERAL PURPOSE SWITCHING REGULATOR (3524 TYPE)

The TA76524P is an IC developed for constant voltage power supply by switching system. This switching regulator assures high level of conversion efficiency.

- Pulse width modulation (P.W.M.) system
- Output in single-end or push-pull system is possible.
- Low current consumption at no-load
  : 5mA (standard)
- Computible with SG3524

Unit in mm



Package width and length do not include mold protrusion.
Allowable mold protrusion is 0.15mm.

JEDEC	–
TOSHIBA	DIP16–P–300A

Weight : 1.0g

MAXIMUM RATINGS (Ta=25°C)

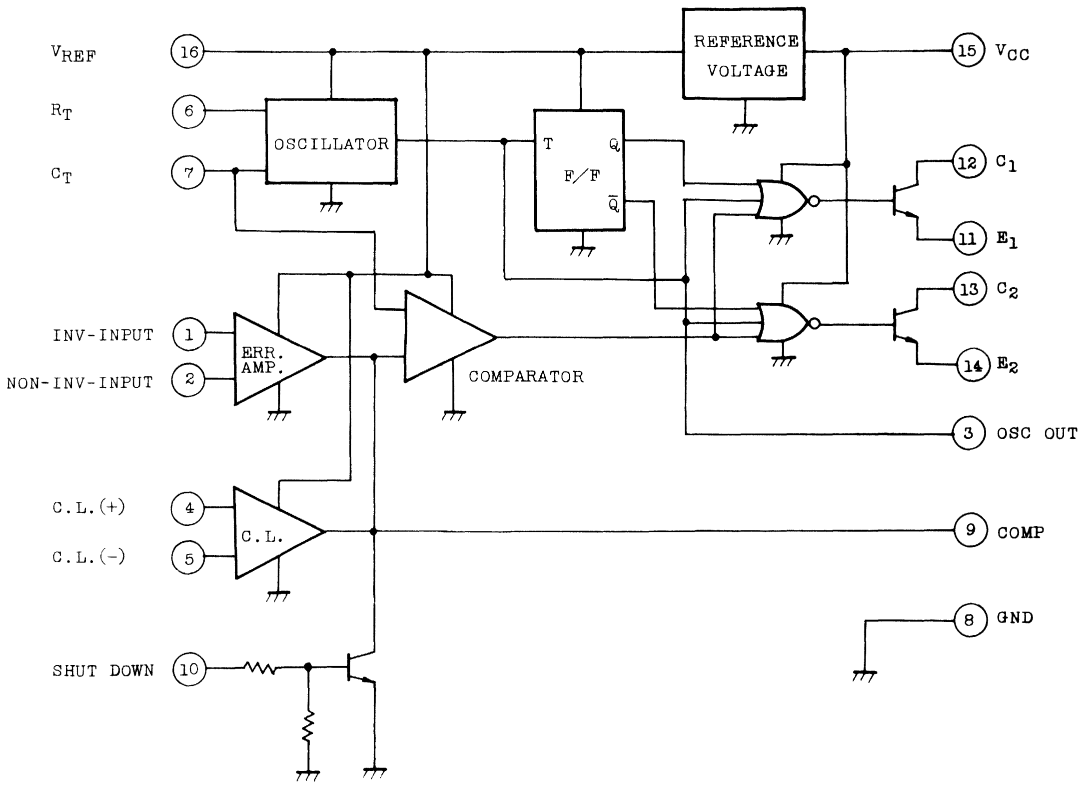
CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage (Note 1,2)	V_{CC}	40	V
Collector Output Current	I_C	100	mA
Reference Output Current	I_{REF}	50	mA
C_T Terminal Current	I_{CT}	5	mA
Power Consumption (Note3)	P_D	750	mW
Operating Temperature	T_{opr}	-30 ∿ 75	°C
Storage Temperature	T_{stg}	-55 ∿ 125	°C

Note 1. Voltage between V_{CC} - GND terminal.

2. 5V can be used with V_{CC} and V_{REF} terminals shorted. At this time, max. is 6V.

3. Reduce 6mW every time when temperature rises by 1°C.

BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS (V_{CC}=20V, f=20kHz, Ta=25°C)

REFERENCE VOLTAGE UNIT

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reference Voltage	V_{REF}		4.6	5.0	5.4	V
Input Regulation	Reg.Line	V_{CC}=8∿40V	-	10	30	mA
Refresh Rejection	R.R.	f = 120Hz	-	66	-	dB
Output Regulation	Reg.Load	I_O = 0∿20mA	-	20	50	mV
Output Voltage Temp. Coefficient	TC_{VO}	Ta = 0∿70°C	-	0.3	1.0	%
		Ta = −30∿75°C	-	0.4	1.36	
Output Short-Circuit Current	I_{SC}	V_{REF} = 0 1 sec (Max.)	-	100	-	mA

ERROR AMPLIFIER UNIT

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN	TYP	MAX.	UNIT
Input Offset Voltage	V_{IO}	V_{IC} = 2.5V	-	2	10	mV
Input Bias Current	I_I	V_{IC} = 2.5V	-	1	10	μA
Open Loop Voltage Gain	G_{VO}		60	80	-	dB
Common Mode Input Voltage Range	MV_{IN}	Ta = 25°C	1.8	-	3.4	V
Common Mode Rejection Ratio	CMRR		-	70	-	dB
Bandwidth	BW		-	3	-	MHz
Output Voltage Swing	V_{Op-p}	Ta = 25°C	0.5	-	3.8	V

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Max. Oscillation Frequency	$f_{MAX.}$	C_T = 0.001μF, R_T = 2kΩ	-	450	-	kHz
Frequency Accuracy	$f_{S.D.}$	V_{CC}=8∿40V, R_T=1.8∿100kΩ C=Const.	-	5	-	%
Frequency Stability	$f/\Delta V_{CC}$	V_{CC} = 8∿40V	-	0.4	-	%
	$f/\Delta Ta$	Ta = 0∿70°C	-	5	-	%
		Ta = −30∿75°C	-	7	-	
Output Voltage Swing	V_{O3}	3 PIN	-	3.5	-	V
Output Pulse Width	t_p	C_T = 0.01μF, 3 pins	-	0.5	-	μs

COMPARATOR UNIT

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Max. Duty Cycle	D_{MAX}		45	-	-	%
Fresh Hold Voltage	$V_{TH\ 0}$	duty = 0	-	1.0	-	V
	V_{THMAX}	duty = Max.	-	3.5	-	
Input Bias Current	I_I		-	-1	-	μA

CURRENT LIMITER UNIT

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Input Voltage Range	V_{IS}		-0.7 ∿ 1.0	-	-	V
Sense Voltage	V_S	9 Pin = 2V, V(1Pin-2Pin) ≧ 50mV, Ta=25°C	180	200	220	mV
Sense Voltage Temp. Coefficient	TC_{VS}	Ta = -30 ∿ 75°C	-	0.2	-	mV/°C

OUTPUT UNIT

CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Collector/Emitter Breakdown Voltage	V_{CE}		40	-	-	V
Output Leak Current	I_{CO}	V_{CE} = 40V	-	0.01	50	μA
Output Saturation Voltage	$V_{CE}(sat)$	I_C = 50mA	-	1	2	V
Emitter Output Voltage	V_E	V_C = 20V, I_E = -250μA	17	18	-	V
Rise Time	t_r	R_C = 2kΩ	-	0.2	-	μs
Fall Time	t_f		-	0.1	-	

TOTAL DEVICE

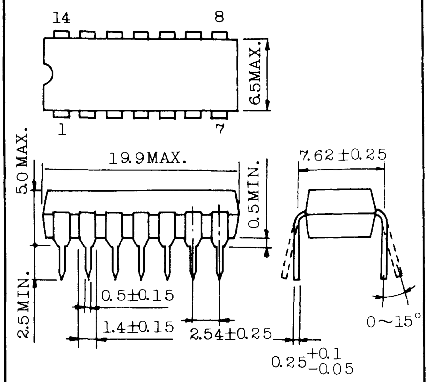
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Bias Current	I_B	V_{CC} = 40V	-	5	10	mA

TA7089P

GENERAL PURPOSE VOLTAGE REGULATOR.

COMMUNICATION AND INDUSTRIAL USE

Unit in mm



Lead pitch is 2.54 and tolerance is ±0.25 against theoretical center of each lead that is obtained on the basis of No.1 and No.14 leads.

JEDEC	–
TOSHIBA	3D14A-P

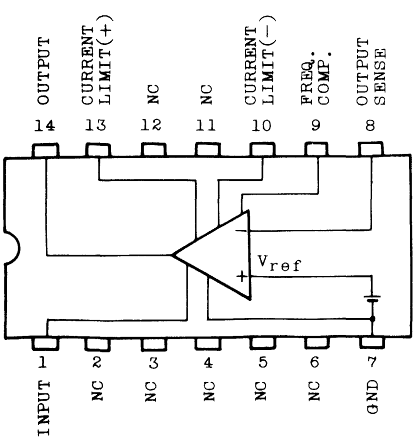
- **Low Output Impedance** : Z_O =40mΩ (Typ.)
- **High Ripple Rejection** : RR=48dB(Typ.)
- **Build in Current Limitting Circuit**
- **Low Drop Out Voltage** : $|V_{IN}-V_{OUT}|$=1.8V
- **High Output Current** : I_{OUT}=200mA(Max.)
- **Output Current Up to 5A Can be Supplied by Connecting External Transistor.**
- **The TA7089P is Easily Mounted on a Printed Circuit Board, and is Provided with 14 Pin Output, 7 Pin GND and 1 Pin Input for Application as a Power Supply for Digital IC.**

MAXIMUM RATINGS

CHARACTERISTIC	SYMBOL	RATING	UNIT
Input Voltage	V_{IN}	35	V
Terminal Voltage 8	V_8	7	V
Output Current	I_{OUT}	-200	mA
Power Dissipation	P_D	600	mW
Operating Temperature	Topr	-30 ~ 75	°C
Storage Temperature	Tstg	-55 ~ 125	°C

PIN CONNECTION

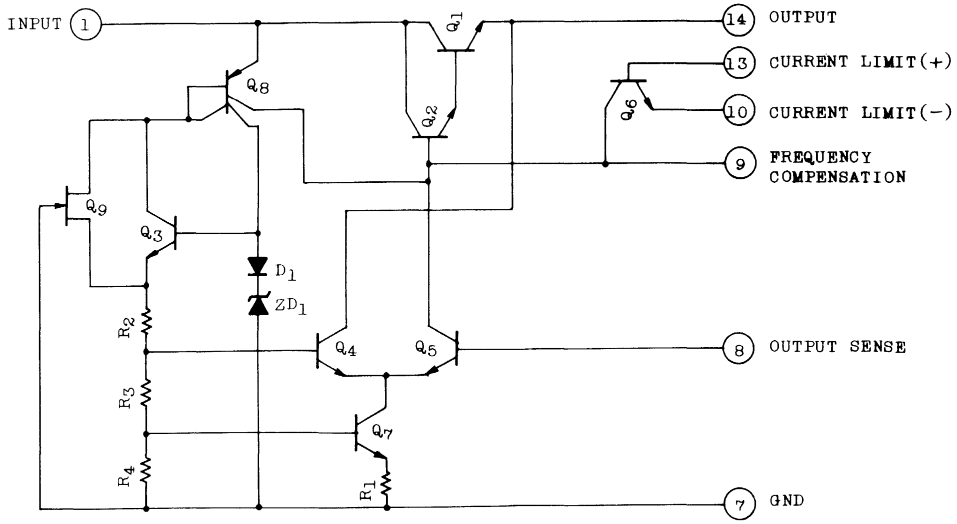
TOP VIEW



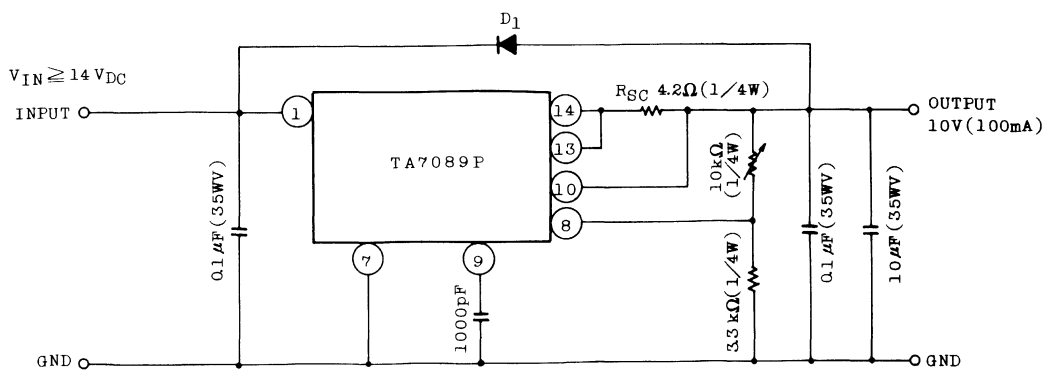
ELECTRICAL CHARACTERISTICS (Ta=25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Input Voltage	V_{IN}	1	-	7	-	35	V
Output Voltage	V_{OUT}	1	$7 < V_{IN} < 35V$ $I_{OUT}=50mA$	3.3	0	33	V
Drop Output Voltage	$\|V_{IN}-V_{OUT}\|$	1	$R_{SC}=0$, $I_{OUT}=200mA$	2.0	1.8	-	V
Reference, Voltage	V_{ref}	1	$7 < V_{IN} < 35V$ $I_{OUT}=0mA$	2.7	3.0	3.3	V
Bias Current	I_B	1	$7 < V_{IN} < 35V$ $V_{OUT}=0mA$	1.5	3	6	mA
Ripple Rejection	RR	2	$V_{IN}=14V$, f=1kHz $V_{OUT}=10V$, $I_{OUT}=50mA$	40	48	-	dB
Output Voltage Temperature Coefficient	TC_{VO}	1	-	-	±0.02	-	%/°C
Output Current	I_{OUT}	1	-	-	-	-200	mA
Output Impedance	Z_o	3	$V_{IN}=14V$, f=1kHz $V_{OUT}=10V$, $I_{OUT}=50mA$	-	40	150	mΩ
Input Regulation	Reg·line	1	$I_{OUT}=50mA$ $15 < V_{IN} < 35V$	-	-	300	mV
Load Regulation	Reg·load	1	$V_{IN}=15V$ $50 < I_{OUT} < 200mA$	-	-	60	mV

EQUIVALENT CIRCUIT



STANDARD APPLICATION CIRCUIT (10V, -100mA)

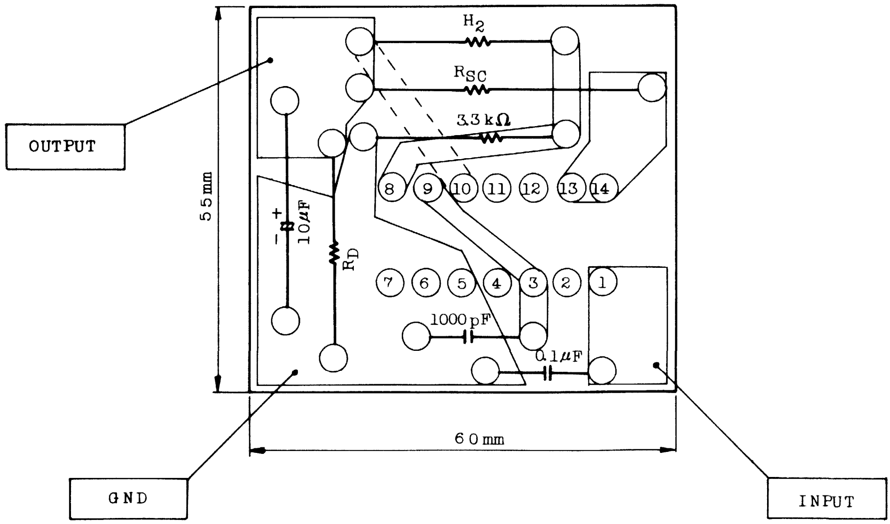


Note : IC Protecting Diode

When the surge voltage is applied to the IC output or when V_{IN}^{+} becomes more than V_{OUT}^{+}(C_{IN} V_{OUT}) at times of power ON or OFF.
It is required to cannot high speed diodes between input and output terminals.

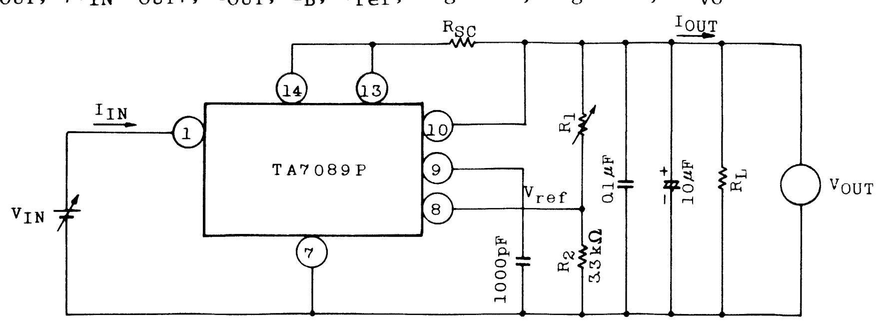
STANDARD PRINT BOARD

PATTERN



TEST CIRCUIT

1. V_{IN}, V_{OUT}, $|V_{IN}-V_{OUT}|$, I_{OUT}, I_B, V_{ref}, Reg·line, Reg·load, TC_{VO}

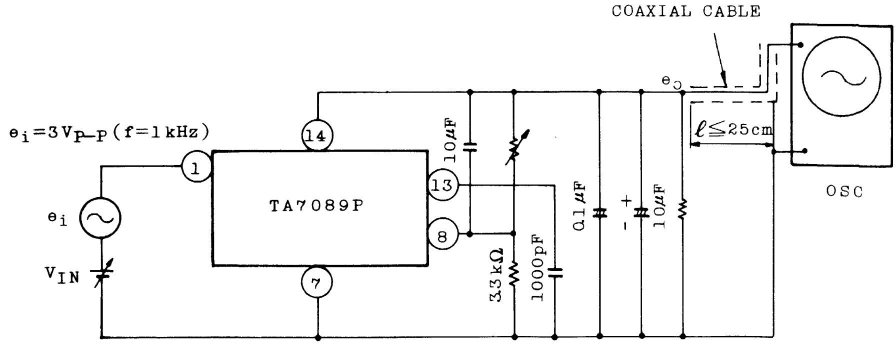


$$V_{OUT} = \frac{R_1+R_2}{R_2} \times V_{ref}$$

$$I_B = I_{IN}-I_{OUT}$$

$$TC_{VO} = \frac{V_{OUT}(75°C)-V_{OUT}(-30°C)}{V_{OUT}(25°C) \times 105} \times 100\ (\%/°C)$$

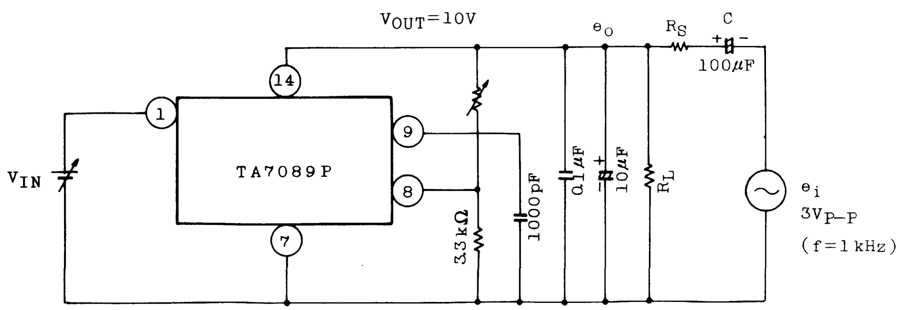
2. RR



Ripple Rejection

$$RR = 20 \ell og\ 10 \left(\frac{e_i}{e_o}\right) \quad (dB)$$

3. Z_o



Z_o Calculation Method

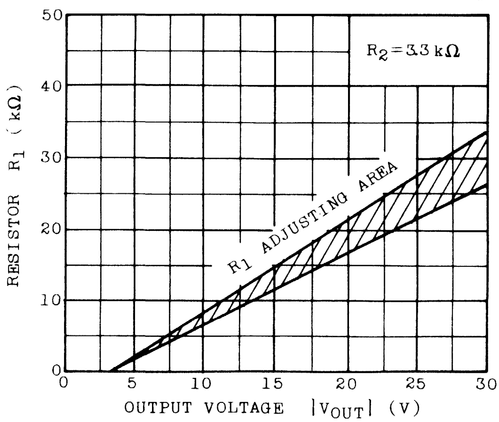
$$e_o = \frac{e_i}{R_S+Z_o} \cdot Z_o$$

$$R_S \gg Z_o$$

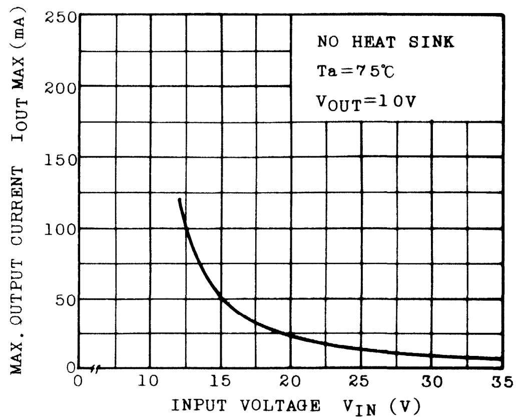
$$e_o = \frac{e_i}{R_S} \cdot Z_o$$

Therefore, $Z_o = \frac{e_o}{e_i} \cdot R_S \quad (\Omega)$

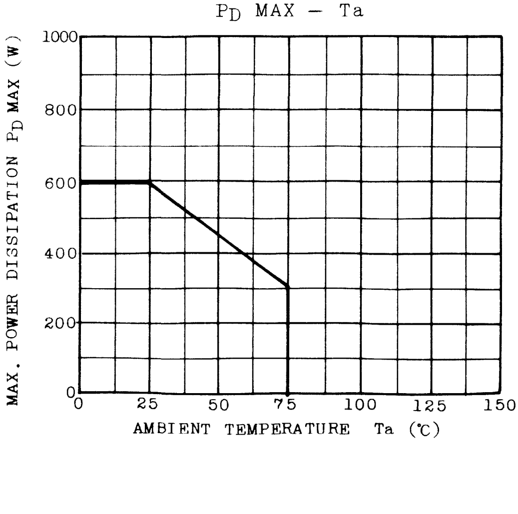
DECISION CHART OF RESISTOR R_1



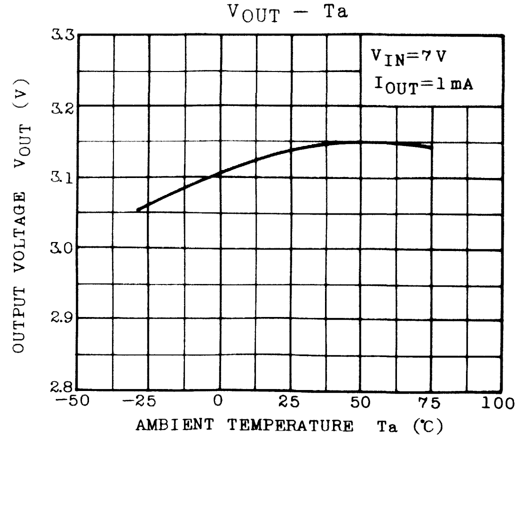
I_{OUT} MAX – V_{IN}

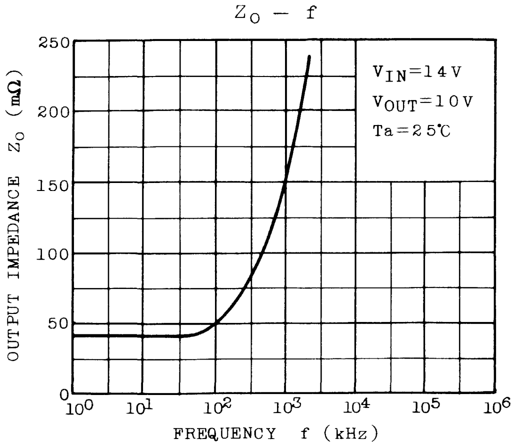


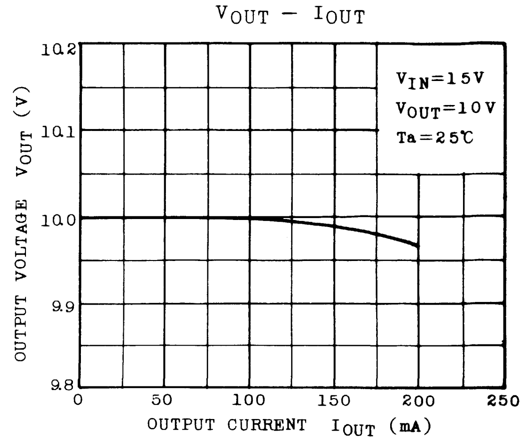
P_D MAX – Ta

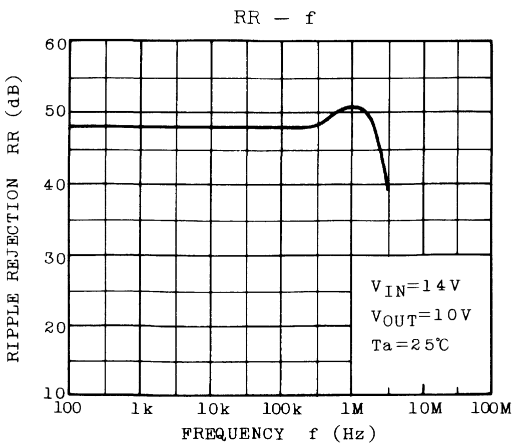


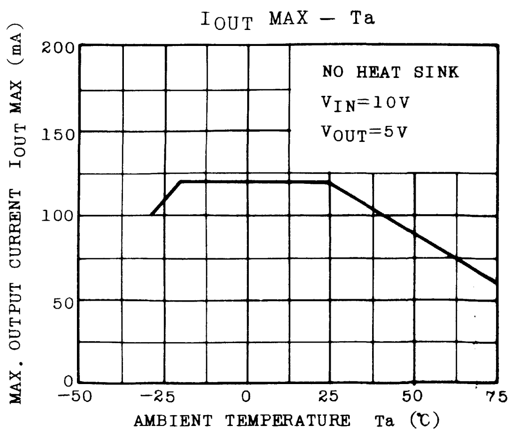
V_{OUT} – Ta



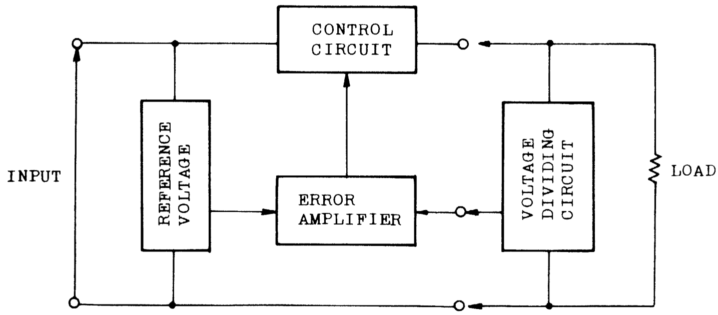

Zo — f
V IN=14V
V OUT=10V
Ta=25℃
OUTPUT IMPEDANCE Zo (mΩ)
250
200
150
100
50
0
10^0 10^1 10^2 10^3 10^4 10^5 10^6
FREQUENCY f (kHz)


VOUT — IOUT
V IN=15V
V OUT=10V
Ta=25℃
OUTPUT VOLTAGE VOUT (V)
10.2
10.1
10.0
9.9
9.8
0 50 100 150 200 250
OUTPUT CURRENT IOUT (mA)


RR — f
V IN=14V
V OUT=10V
Ta=25℃
RIPPLE REJECTION RR (dB)
60
50
40
30
20
10
100 1k 10k 100k 1M 10M 100M
FREQUENCY f (Hz)


IOUT MAX — Ta
NO HEAT SINK
V IN=10V
V OUT=5V
MAX. OUTPUT CURRENT IOUT MAX (mA)
200
150
100
50
0
−50 −25 0 25 50 75
AMBIENT TEMPERATURE Ta (℃)

BLOCK DIAGRAM

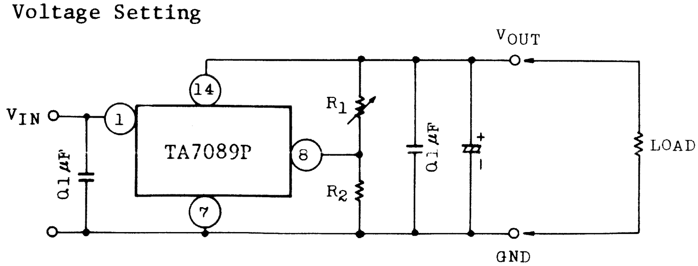


METHOD OF USE AND GENERAL PRECAUTIONS

1. Input Voltage Range

   The TA7089P can be used at 7 ~ 35V.

2. Output Voltage Setting



Output voltage is set by resistor R1 (See resistor-output voltage characteristic diagram.)

If $V_{OUT} = \frac{V_{ref}\ (R_1+R_2)}{R_2}$

Where, $V_{ref}=3V$

$R_2=3.3k\Omega$

Output voltage is

$$\begin{cases} V_{OUT}=0.9 \times 10^{-3} \times R_1+3\,(V) \\ V_{IN} > V_{OUT}+2 \end{cases}$$

Output voltage setting range is 3.3 ~ 33V.

3. Power Dissipation

Internal power dissipation P_D in IC at normal operation is

$$P_D = V_{IN} \times I_B + (V_{IN} - V_{OUT}) \times I_{OUT}$$

Where, (I_B : Bias Current, V_{IN} : Input Voltage, V_{OUT} : Output Voltage, I_{OUT} : Output Current)

Power dissipation at output shorted condition.

$$P_D = (I_{SC} + I_B) V_{IN}$$

Max. Power dissipation P_D MAX. must be as follows :

$$P_D \text{ MAX.} < \frac{T_j \text{ MAX} - Ta}{R_{th}}$$

Where, T_j MAX. ; Junction Temperature

Ta ; Ambient Temperature

R_{th} ; Thermal Resistance

T_j MAX. and R_{th} of the TA7089P are ;

T_j MAX. = 125°C

R_{th}=165°C/W (Free Air)

4. Rang of Output Current

Rang of output current is 0 ~ 200mA.

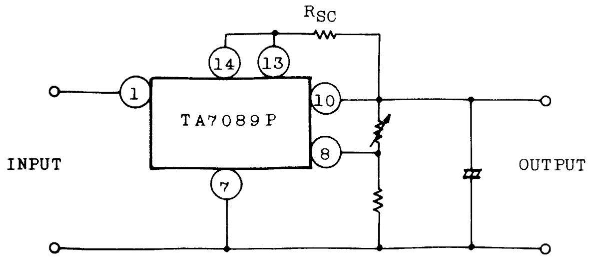
When output current is above 200mA, use external transistors.

(See Application circuits.)

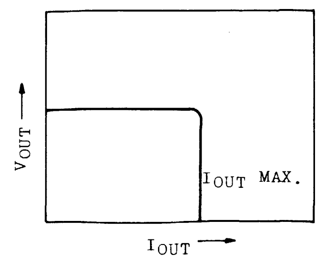
5. Control of Output Current

The TA7089P has a build-in output current limitting transistor and is therefore capable of constant current and fold back current limitting.

The constant current is limited as shown in the following diagrams.



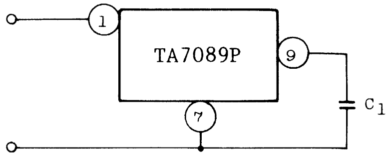
OVER CURRENT PROTECTIVE CHARACTERISTICS



Output current is limited at a point where voltage in RSC drops to voltage between the transistor base and emitter V_{BE} (about 0.65V at T_j=25°C)

$$R_{SC} = \frac{V_{BE}}{I_{OUT\ MAX.}} \qquad \text{Where,} \quad V_{BE} \doteqdot V_{BE}(T_j=25°C) - 2 \times 10^{-3}\ (T_j-25)$$

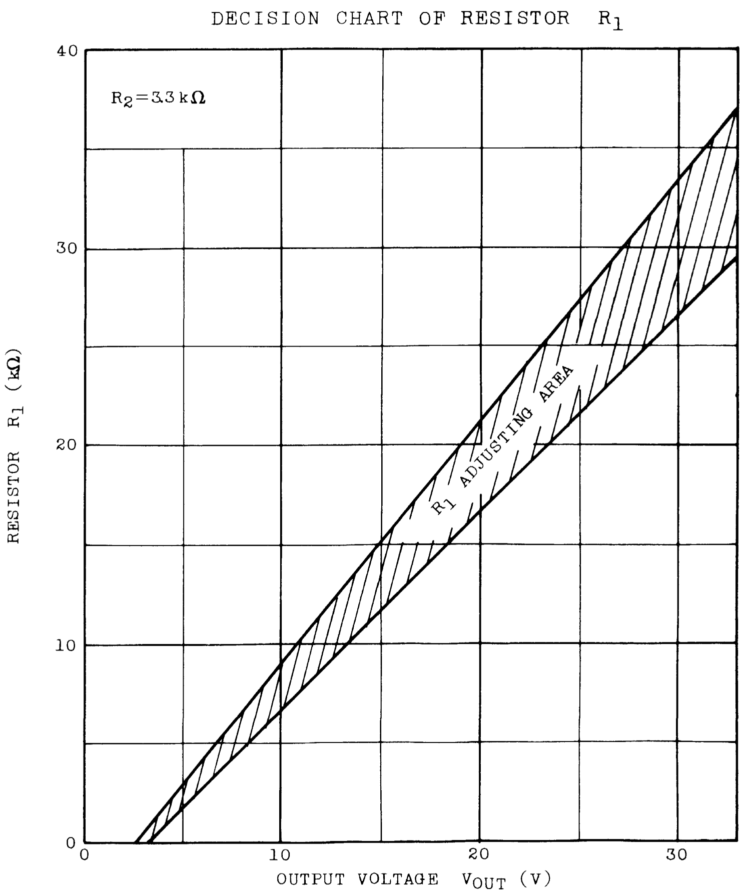
6. Phase Compensating Capacitor



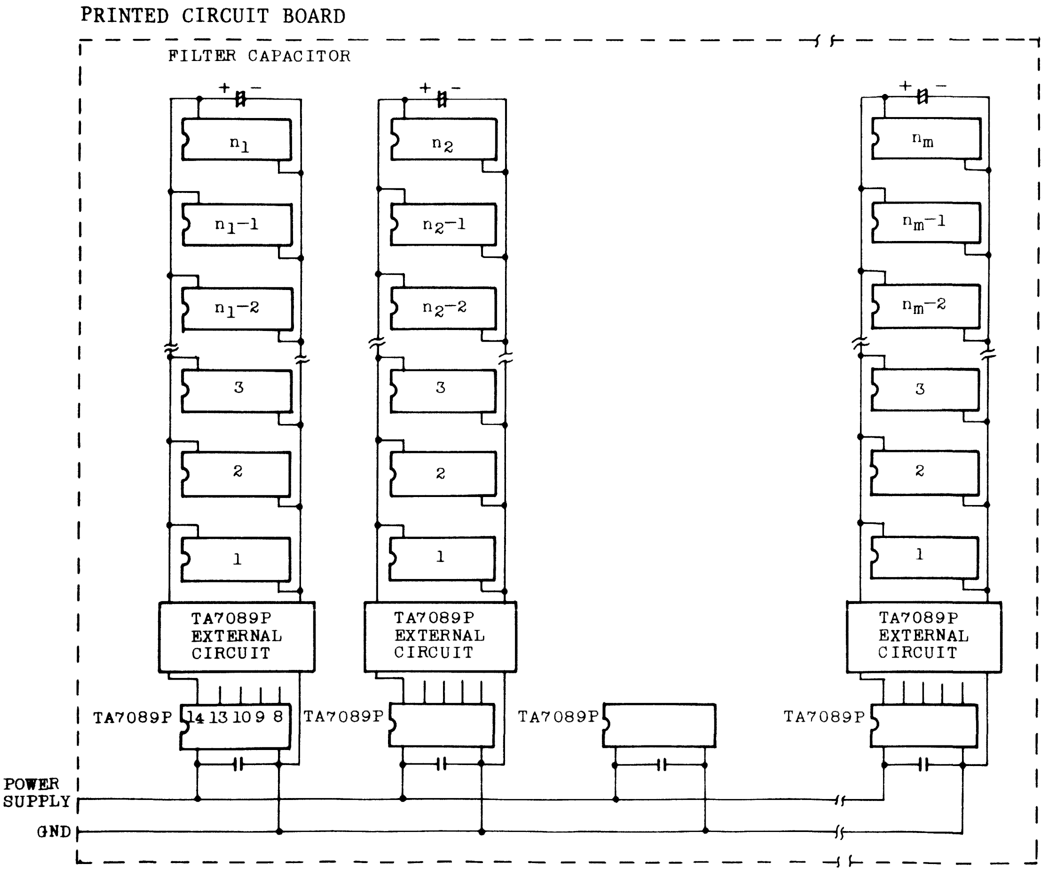
Select a capacitor having capacity 0.1μF-1000pF according to the external wiring conditions. Normally, use a capacitor at 1000pF.

7. Output Capacitors

Output capacitors of 10μF and 0.1μF shall be mounted parallelly.


DECISION CHART OF RESISTOR R_1
$R_2 = 3.3\,k\Omega$
R_1 ADJUSTING AREA
RESISTOR R_1 ($k\Omega$)
OUTPUT VOLTAGE V_{OUT} (V)
0
10
20
30
40
0
10
20
30

BASIC EXAMPLE OF 10μF MOUNTING OF TA7089P ON PRINTED CIRCUIT BOARD
(LOCAL REGULATOR APPLICATION)

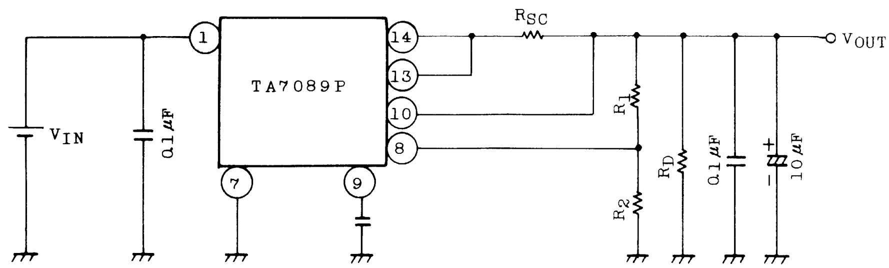


ADVANTAGES

- Mutual effect between raws can be ignored.
- Adjustment is simple as malfunction due to noise is reduced.
- Pattern design is simple as the pin arrangement is 14 pins for output, 7 pins for GND and 1 pin for input.
- THL. IC, TTL. IC and other supply voltages can be incorporated into a same printed circuit board.

APPLICATION (1)

1. Circuit Diagram



2. Decision of Circuit Constant

Circuit specification

. Output Voltage V_{OUT}=6V

. Max. Output Current I_{OUT} MAX.=50mA

. Output Limitting Current I_{SC}=70mA

Decision of voltage dividing resistors R_1 and R_2

A resistor of 3.3kΩ is used as R_2 by considering current balance of a differential amplifier.

R_1 is obtained from the following expression or the resistor R_1 set-up table.

$$V_{OUT} = \frac{R_1+R_2}{R_2} \times V_{ref}$$

V_{ref} is in the range of 2.7~3.3V from the specification.

When R_1 is obtained through calculation according to the above, it is $2.7k\Omega \leq R_1 \leq 4.4k\Omega$

Further, 3~4kΩ is obtained from the R_1 set up table.

Therefore, Resistor R_1 would be 3kΩ (fixed) + 1kΩ (variable resistor).

Decision of R_{SC}.

Current limitting resistor RSC value is obtained from the following expression :

$V_{BE} = R_{SC} \times I_{SC}$

V_{BE} : Base to emitter voltage of an internal current limitting transistor.

A value at $T=T_j$ is applied.

Assuming that a value of V_{BE} (at $T_j=125°C$) is 0.45V, R_{SC} is 6.4Ω when $I_{SC}=70mA$ is substituted.

Decision of Min. Input Voltage

Min. input voltage V_{IN} MIN. which is required to operate this circuit is

V_{IN} MIN.$=V_{OUT}+|V_{IN}-V_{OUT}|+V_R$

V_R : Voltage between R_{SC}

Where, $V_{OUT}=6V$

$|V_{IN}-V_{OUT}|=2V$ (from the Electrical characteristic table)

$V_R=0.65V$

Therfore, V_{IN} MIN.=8.65V

Decision of R_D

R_D is dummy resistor used to flow current constantly in order to operate the circuit stability.

Required current is approximately 3mA.

$$R_D = \frac{V_{OUT}}{3mA} \doteqdot 1.8k\Omega$$

Calculation of P_D

At the normal condition, max. power dissipation of IC is obtained from the following expression :

$$P_D=V_{IN}\times I_B+(V_{IN}-V_{OUT})\times I_{OUT}$$

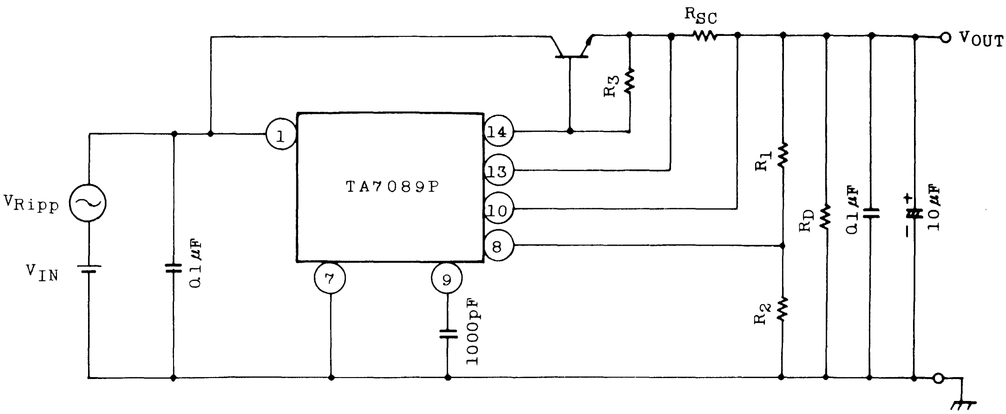
Power dissipation at load shorted condition is obtained from the following expression :

$$P_D=V_{IN}\times I_B+(V_{IN}-V_R)\times I_{SC}$$

Designing should be made carefully by calculating power dissipation at time of load shorted, input voltage and transformers so that P_D MAX. is not exceeded.

APPLICATION (2) CURRENT BOOST CIRCUIT EXAMPLE

1. CIRCUIT



2. Decision of Circuit Constants

Circuit Specification

. Output Voltage V_{OUT} 5V

. Max. Output Current I_{OUT} MAX. 1A

. Current Limitting Protection Circuit

. Decision of Voltage Dividing Resistors R_1 and R_2

A resistor of 3.3k is used as R_2 by considering current balance of a differential amplifier.

R_1 is obtained from the following expression :

$$V_{OUT} = \frac{R_1+R_2}{R_2} \times V_{ref}$$

When the resistor R_1 setting table (2) is used,

R_1 = 1.5kΩ~3kΩ

Therefore, R_1 would be 1.5kΩ (fixed) + 2kΩ (variable).

. Decision of R_{SC}

$$V_{BE} = R_{SC} \times I_{SC}$$

Assuming that

I_{SC}=1.2A

V_{BE}=0.65V

$$R_{SC} = \frac{V_{BE}}{I_{SC}} = \frac{0.45V\ (T_j=125°C)}{1.2} = 0.4\ (\Omega)$$

Rated capacity is

$0.65V \times 1.2A = 0.78$ (W)

$R_{SC}=0.4\Omega$ (1W)

. Decision of Min. Input Voltage

Obtaind Min. input voltage of the circuit.

V_{IN} MIN = V_{OUT} + $|V_{IN} - V_{OUT}|$ + V_{BE} + V_R

V_R : Voltage between R_{SC}

when, V_{OUT}, $|V_{IN} - V_{OUT}|$, V_{BE}, V_R

expression, V_{IN} MIN = 5.0 + 2.0 + 0.7 + 0.6

= 8.3 (V)

Further, as the catalog standard is 7V or above,

V_{IN} MIN = 8.3 (V)

. Decision of R_3

Resistor R_3 is to be inserted for stabilizing the circuit and several mA would be sufficient.

When the circuit is designed by assuming that current is 5mA.

$$R_3 = \frac{V_{BE}}{5mA} = \frac{0.7V}{5mA} \fallingdotseq 150\ (\Omega)$$

. Decision of R_D

Resistor R_D is used to apply dummy current and functions to stabilize the circuit together with R_3.

1 ~ 10mA is generally accepted. The design is made here at 5mA.

$$R_D = \frac{V_{OUT}}{I_D} = \frac{5V}{5mA} = 1\ (k\Omega)$$

Summary

R_2	3.3kΩ
R_1	1.5kΩ (fixed) + 2kΩ (variable)
R_{SC}	0.4Ω (1W)
R_3	150Ω
R_D	1kΩ
V_{IN} MIN.	8.3V

3. Parastic Oscillation Prevention

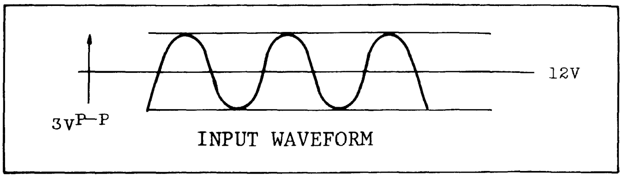
To prevent a parastic oscillation, insert a capacitor of about 0.1μF into the input and output sides. It would be effective when the capacitor is insert as close as to IC terminals.

4. Example of Output Voltage Ripple Value Calculation

Assuming that input ripple voltage is 3 V_{p-p} AC,

$$V_{IN} = 10V_{DC} + 3V_{p-p}\ AC$$

However, actual mean value of full load input voltage when voltage fluctuation at the transformer primary side is considered is 12V DC.



Obtain output ripple voltage.

As Reg. in is min. 40(dB) from the standard data table,

(Output ripple voltage) = 30mV_{p-p} AC.

5. Selection of Power Transistor

Full Load Input Voltage	12V (AVG)
Output Voltage	5V
Output Current	1A

When P_D MAX. is obtained from the above data,

$$P_D\ MAX = (12-5) \times 1$$
$$= 7\ (W)$$

However, when power dissipation resulted from output short is calculated.

$$P_D\ MAX = 12 \times 1.2 = 14.4\ (W)$$

2SD867 (or equivalent) is selected this time from TOSHIBA SEMICONDUCTOR HAND BOOK.

6. Design of Heat Sink

1) Design of power transistor radiation

From the 2SD 867 data table (TOSHIBA SEMICONDUCTOR HAND BOOK)

$$R_{th(j-c)} = \frac{150-25}{100} = 1.25°C/W$$

Therefore, $R_{th(j-a)} = 1.25+1.0+R_{th(f)}$

(It is assumed that $R_{th(s)}+R_{th(c)}=1.0°C/W$)

P_D MAX = 14.4W
T_j MAX = 150°C
Ta=60°C (Including temperature rise in device)

From the above data,

$$R_{th(j-a)} = \frac{T_j\ MAX - Ta}{P_D\ MAX} = \frac{150-60}{14.4} = 6.2°C/W$$

Accordingly, thermal resistance required for a heat sink is,

$$R_{th(f)} = R_{th(j-a)} - R_{th(j-c)} - R_{th(s)} - R_{th(c)}$$
$$= 6.2 - 1.25 - 1.0$$
$$= 3.95°C/W$$

When an $A\ell$ heat sink is used, size required can be seen as follows from TOSHIBA SEMICONDUCTOR HAND BOOK :

100mm × 170mm × 2mm

Further, in actual designing it is a general practice to derate T_j MAX taking reliability into consideration.

2) Design of IC Heat Sinking

Max. power consumed in IC is obtained from the following expression :

$$P_D\ MAX = (V_{IN}\ MAX - V_{BE(1)}) \times \left(\frac{I_{SC} - V_{BE(2)}/R_3}{h_{FE(MIN)}} + \frac{V_{BE(2)}}{R_3} + I_B\ MAX\right)$$

Assuming that

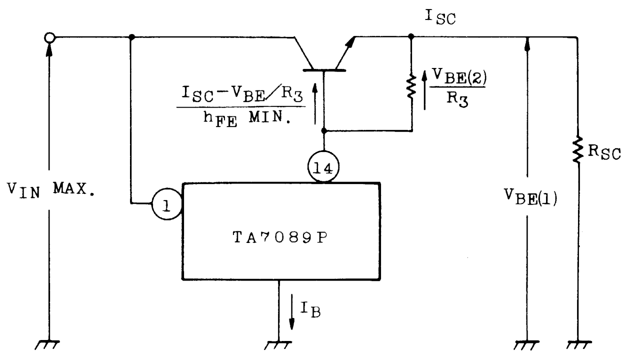
$V_{BE(1)}$: V_{BE} of current limitting internal transistor = 0.65V

$V_{BE(2)}$: V_{BE} of power transistor = 0.65V

h_{FE} MIN : Min. value of h_{FE} of power transistor (at $I_C=I_{SC}$) ≑ 40

I_B MAX : Max. value of bias current of TA7089P = 6mA

P_D MAX is above 504mW.



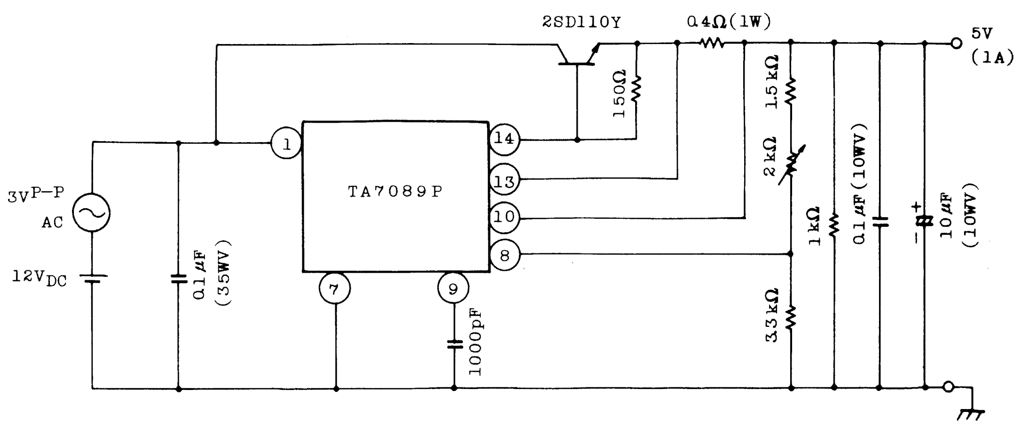
7. Application

Specification

V_{IN}	$12V_{DC} + 3V^{P-P}AC$
V_{OUT}	$5V_{DC} + 30mV^{P-P}AC$
I_L MAX	1.2A

Current limitting protection circuit

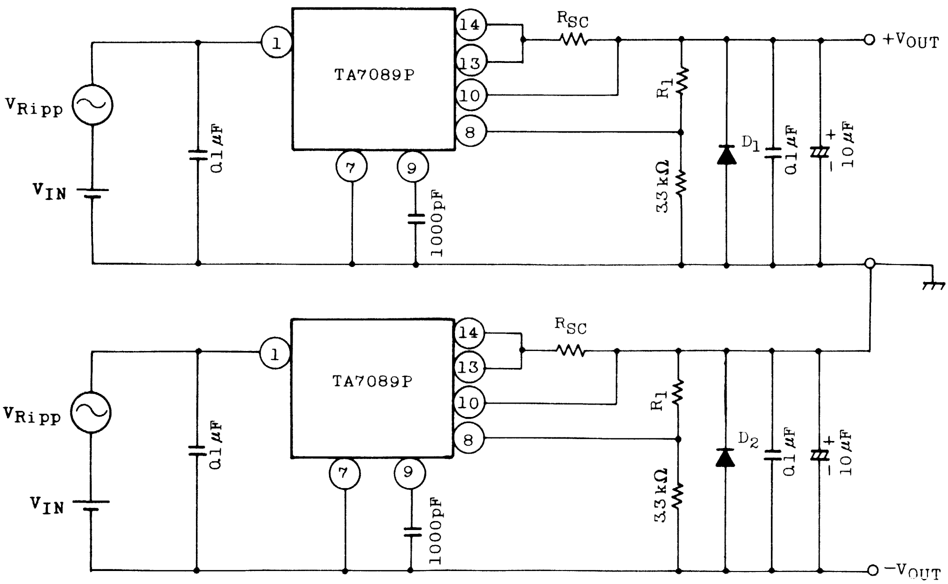
Example 1. Current Boost Circuit



2SD876 Heat Sink ($R_{th(f)}$ = 3.95°C/W)

100 × 170 × 2mm Aℓ

Example 2.   Positive and Negative Power Supplied



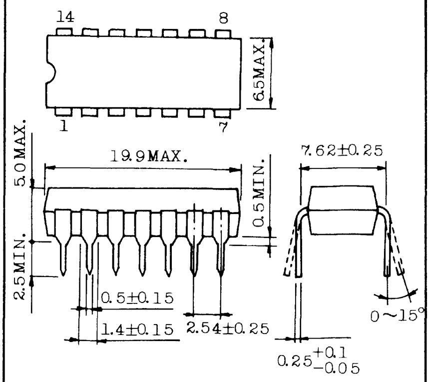
Use diodes having less forward voltage drop for D_1 and D_2.

TA7179P

DUAL ±15V TRACKING REGULATOR

- Output Voltage of ±15V with Tracking Characteristic.
- Excellent Input and Load Regulation :
  - Reg. line=5mV(Typ.) (V_{IN}=18 ~ 30V)
  - Reg. Load=5mV(Typ.) (I_{OUT}=0 ~ 50mA)
- High Ripple Rejection : RR=75dB(Typ.)
- Output Current Up to 100mA (Max.)
- Excellent Temperature Stability :
  - TC_{VO}=0.007%/deg.(Typ.)
- Designed Especially for Use Operational Amplifier Power Regulator.
- Built-in Overcurrent Protective Circuit.

Unit in mm



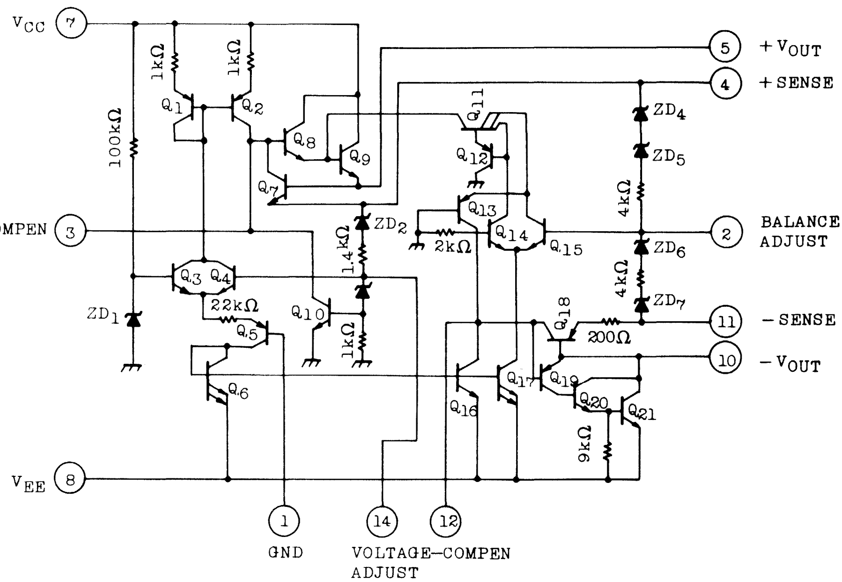
Lead pitch is 2.54 and tolerance is ±0.25 against theoretical center of each lead that is obtained on the basis of No.1 and No.14 leads.

JEDEC	—
TOSHIBA	3D14A-P

MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Input Voltage	$+V_{IN}$	30	V
	$-V_{IN}$	-30	
Output Current	$+I_{OUT}$	-100	mA
	$-I_{OUT}$	+100	
Power Dissipation	P_D	625	mW
Operating Temperature	T_{opr}	-30 ~ 75	°C
Storage Temperature	T_{stg}	-50 ~ 150	°C

EQUIVALENT CIRCUIT



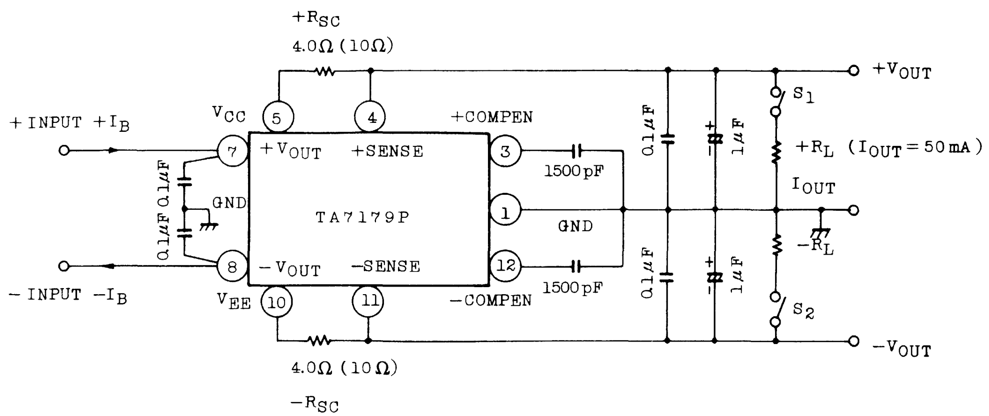
ELECTRICAL CHARACTERISTICS

(Unless otherwise specified, V_{CC}=20V, V_{EE}=-20V, $\pm I_{OUT}$=0, $R_{SC}^{+}=R_{SC}^{-}$=4Ω, Ta=25°C)

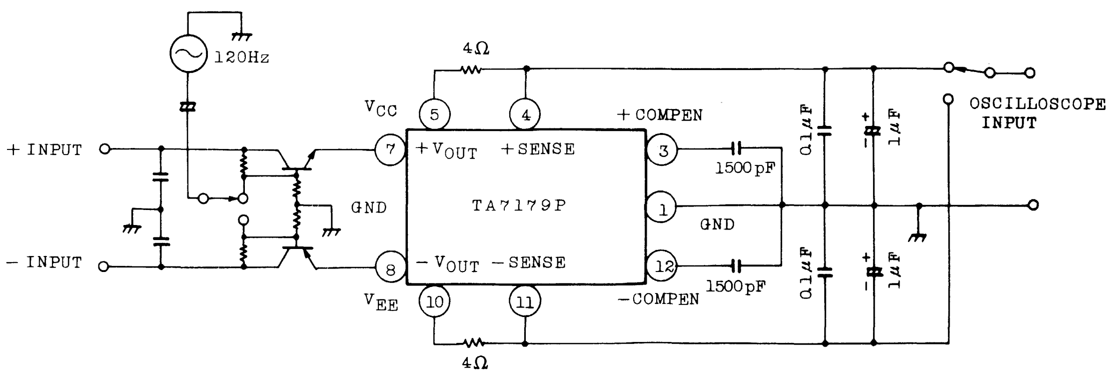
CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	1	-	±14.5	±15.0	±15.5	V
Drop Output Voltage	$\lvert V_{IN}-V_{OUT} \rvert$	-	I_{OUT}=100mA	2.0	-	-	V
Output Voltage Balance	V_{BAL}	-	-	-	±50	±150	mV
Input Regulation	Reg·line	1	V_{IN}=18 ~ 30V	-	5	-	mV
Load Regulation	Reg·load	1	I_{OUT}=0 ~ 50mA	-	5	-	mV
Output Voltage Variable Range	V_{OUT}-R	-	-	±8.0	-	±2.0	V
Ripple Rejection	RR	2	f=120Hz 2V_{p-p}	-	75	-	dB
Output Voltage Temperature Coefficient	TC_{VO}	1	-	-	0.007	-	%/deg
Output Short-Circuit Current	I_{SC}	1	R_{SC}=10Ω	40	60	80	mA
Positive Stand-by Current	I_B^{+}	1	-	-	2.4	4.0	mA
Negative Stand-by Current	I_B^{-}	1	-	-	1.0	3.0	mA
Long-Time Stability	$\Delta V_{OUT}/\Delta t$	1	-	-	0.2	-	%/1000 hr

TEST CIRCUIT

1. V_{OUT}, V_{BAL}, Reg·line, Reg·load, TC_{VO}, I_{SC}, $I_B^+ \cdot I_B^-$, $\Delta V_{OUT}/\Delta t$

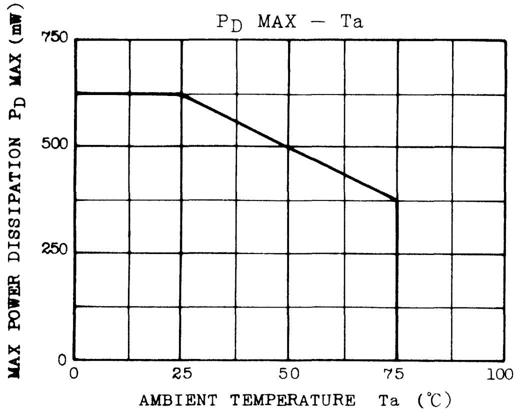


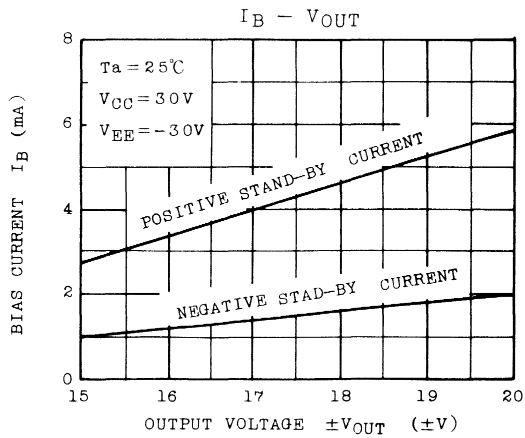
2. RR

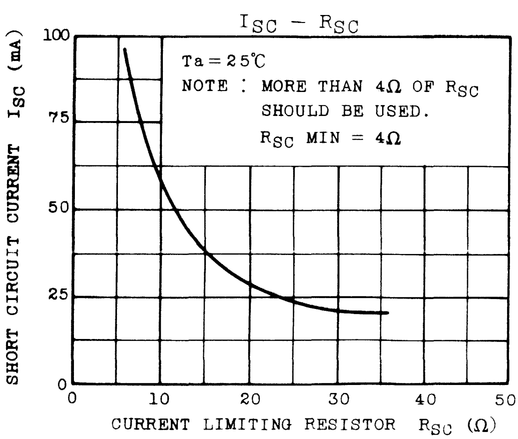


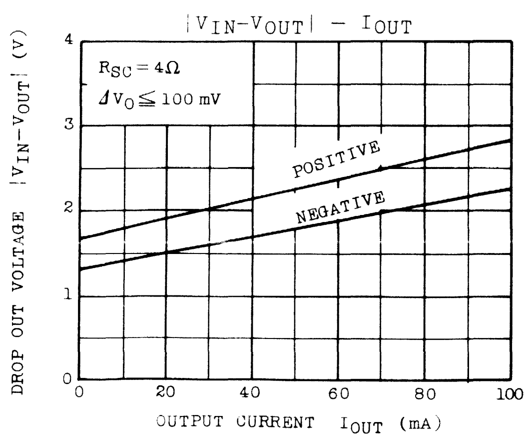
V_{CC}=+20V, V_{EE}=-20V, $e_i=2V_{P-P}$ (f=120Hz)

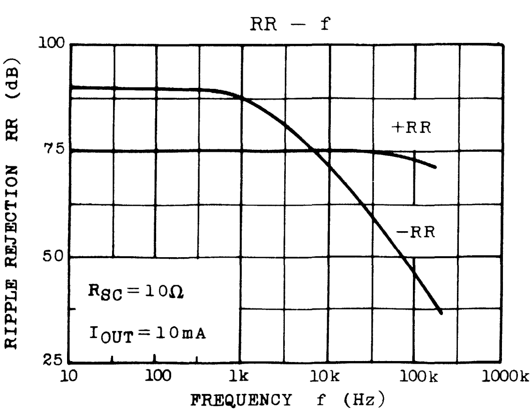
$$RR = 20\log \frac{e_o}{e_i} \text{ (dB)}$$


PD MAX — Ta
MAX POWER DISSIPATION PD MAX (mW)
750
500
250
0
0
25
50
75
100
AMBIENT TEMPERATURE Ta (℃)


IB — VOUT
Ta = 25℃
VCC = 30V
VEE = −30V
POSITIVE STAND-BY CURRENT
NEGATIVE STAD-BY CURRENT
BIAS CURRENT IB (mA)
8
6
4
2
0
15
16
17
18
19
20
OUTPUT VOLTAGE ±VOUT (±V)

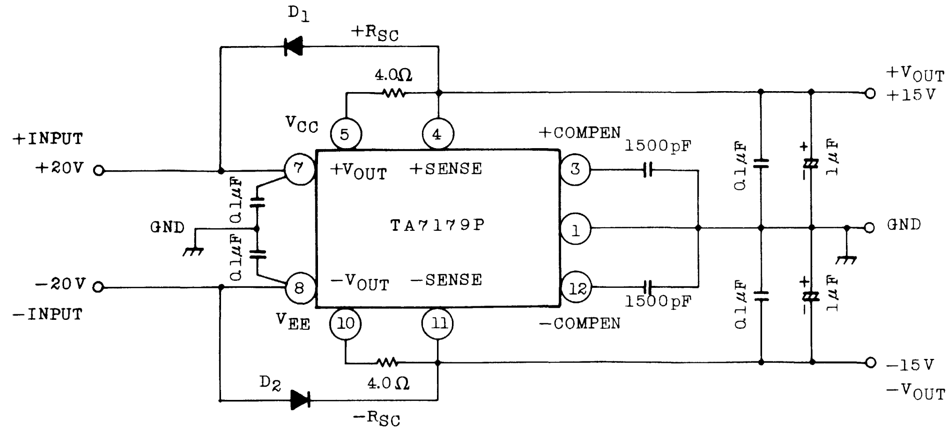

ISC — RSC
Ta = 25℃
NOTE : MORE THAN 4Ω OF RSC
SHOULD BE USED.
RSC MIN = 4Ω
SHORT CIRCUIT CURRENT ISC (mA)
100
75
50
25
0
0
10
20
30
40
50
CURRENT LIMITING RESISTOR RSC (Ω)


|VIN−VOUT| — IOUT
RSC = 4Ω
ΔVO ≦ 100 mV
POSITIVE
NEGATIVE
DROP OUT VOLTAGE |VIN−VOUT| (V)
4
3
2
1
0
0
20
40
60
80
100
OUTPUT CURRENT IOUT (mA)


RR — f
+RR
−RR
RSC = 10Ω
IOUT = 10mA
RIPPLE REJECTION RR (dB)
100
75
50
25
10
100
1k
10k
100k
1000k
FREQUENCY f (Hz)

APPLICATION CIRCUIT

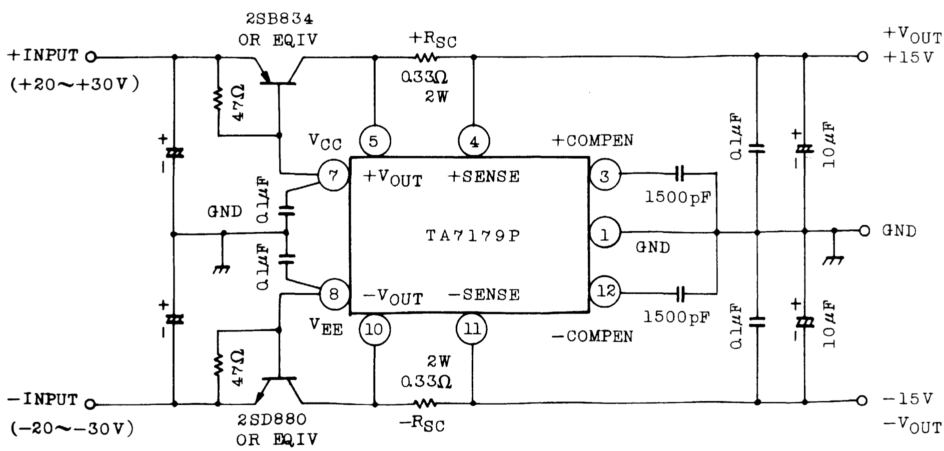
1. STANDARD APPLICATION CIRCUIT



D_1, D_2 : IC protecting diodes

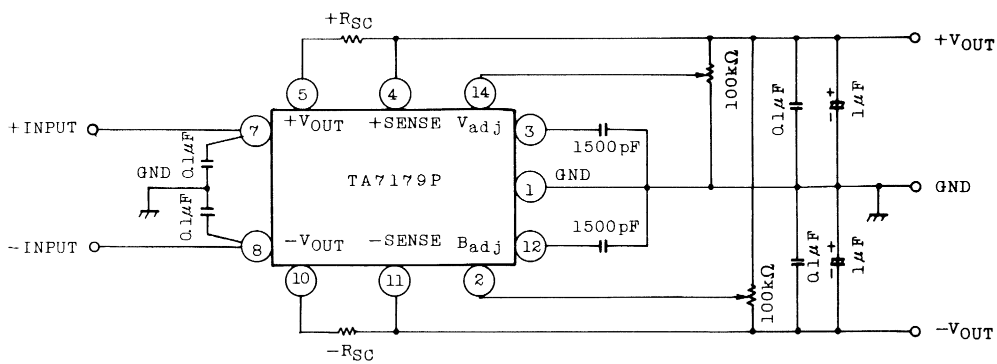
when the surge voltage is applied to the IC output or when V_{IN}^+ becomes less than V_{OUT}^+ ($V_{IN}^- > V_{OUT}^-$) at time of power ON or OFF, connect a high speed switching diodes for circuit protection.

2. CURRENT BOOST CIRCUIT·······±1.5A Regulator

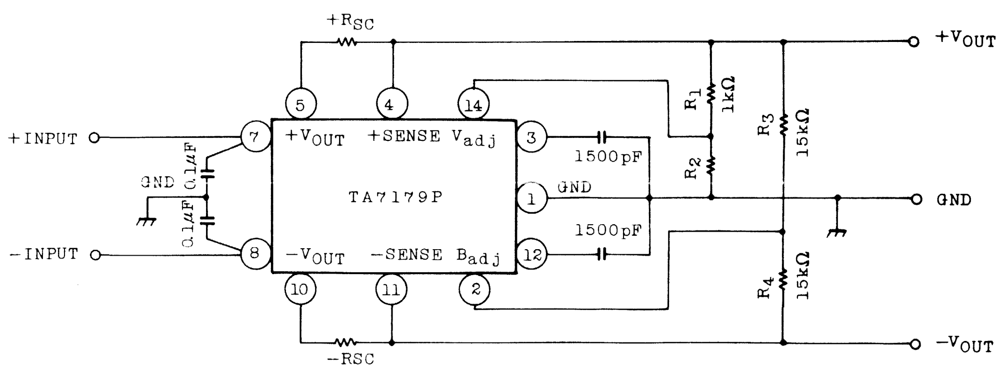


Pay attention to heat sinking design.

3. VOLTAGE AND BALENCE SET-UP CIRCUIT



4. OUTPUT VOLTAGE CHANGING CIRCUIT



Output voltage of the TA7179P can be changed to ±8.0V by connecting a resistor of R_2. For the relationship between output voltage and R_2 see table shown below.

$\pm V_{OUT}$ (V)	R_2 (kΩ)
14.0	1.2
12.0	1.8
10.0	3.5
8.0	∞

APPLICATION NOTE

1. GENERAL DESCRIPTION

When a general purpose regulator IC is used as a power supply for OP AMP, 2 pieces of IC, each of which has positive or negative output voltage of +15V or -15V, are required.

If 2 pieces of IC having positive or negative output voltage are used, the latch-up design at the positive power supply side becomes complicated and therefore, use of these 2 ICs is not desirable. Further, a circuit using OP AMP generally demands high precision in many cases, and various excellent characteristics such as excellent temperature characteristic, excellent stability against fluctuation in supply voltage as well as fluctuation in load and the like are demanded to its power circuit.

There is SVRR (SUPPLY VOLTAGE REJECTION RATIO) for OP AMP against fluctuation in supply voltage, which specifies occurrence of OFF SET resulted from supply voltage fluctuation.

The TA7179P is the optimum monolithic IC as a power supply for OP AMP with excellent temperature stability input and load regulation, and its positive and negative output voltage have tracking characteristic (characteristic in which positive and negative voltage fluctuate symmetrically against 0 level; that is, output current at the positive side only increases and output voltage at the negative side drops following drop in output voltage at the positive side).

As the TA7179P has tracking characteristic, even when an absolute value of output voltage fluctuates, frequencies of OFF SET of OP AMP resulted from fluctuation in output voltage decrease.

The TA7179P is a regulator IC used for OP AMP, having such features as high ripple compression characteristic, a built-in overcurrent protective circuit and high output current (100mA) in addition to these characteristics.

Further, the range of working supply voltage of OP AMP is ±5 ~ 18V although it is normally operated at ±15V.

The TA7179P has been so designed that its output voltages other than ±15V can be obtained through simple external arrangement.

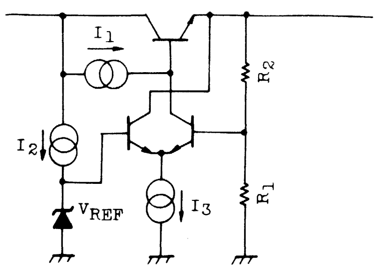
2. CIRCUIT OPERATION

1) Tracking Regulator

On a general regulator, an output transistor is controlled by comparing voltage obtained by dividing V_{OUT} according to resistance ratio between R_1 and R_2 with reference voltage generated by a reference voltage generating circuit in the regulator as shown in Fig. 1.

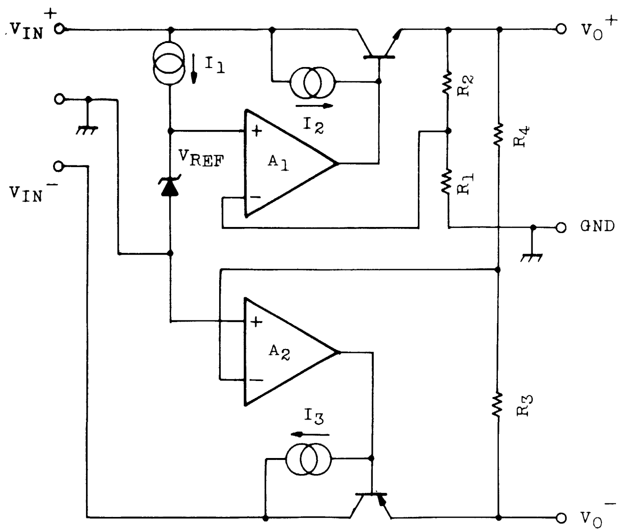
However, even when 2 power supplies for positive and negative output voltages are provided by using 2 regulator ICs, they can only control respective output voltages independently and have no tracking characteristic. So, when either one of the positive and negative power supplies is provided with an independent control mechanism and + and - output voltages are divided by high precision equal resistors as shown in Fig. 2, and output voltages are controlled by comparing voltage at the divided middle point with GND potential, tracking characteristic is obtained.

In Fig. 2, the positive power supply side is controlled independently with the negative power supply side followed the positive power supply side but it is also possible to control the negative power supply side but it is also possible to control the negative power supply side and have the positive power supply side follow the negative power supply side.



$$V_{OUT}=V_{REF}\cdot\frac{R_1+R_2}{R_1}$$

Fig. 1



$$V_O^{+} = V_{REF} \cdot \frac{R_1 + R_2}{R_1}$$

R_3 and R_4 are high precision equal resistors.

Fig. 2

2) Internal Configuration

One of the characteristics reguired for the tracking regulator is balance of output voltages. Balance in output voltages from positive and negative power supplies is virtually decided by relative accuracy of resistors R_3 and R_4 in Fig. 2, which divide positive and negative output voltages. The TA7179P uses not only resistors but also zener diodes for dividing output voltages.

Further, the circuit is so designed that the positive power supply side is controlled independently and the negative power supply side follows the positive power supply side.

The simplified internal circuit is shown in Fig. 3.

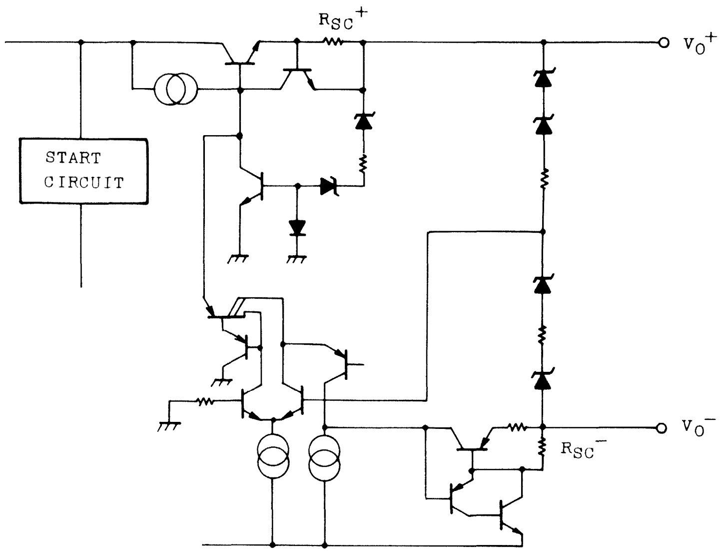


Fig. 3

3. PRECAUTIONS FOR USE

1) Setting Output Voltage

Output voltage of the TA7179P is fixed at ±15V but can be varied by connecting resistors externally.

Examples of the circuit are shown in the application circuit examples (3) and (4).

Output voltage V_{OUT} in the circuit example (4) is expressed by the following expression:

$$V_{OUT} = (V_Z+V_{BE})\left(\frac{R1}{R2}+1\right) + V_{BE}\cdot R1 \text{ (V)} \quad \cdots\cdots\cdots\cdots 1)$$

where, V_Z = 6.7V±0.1V

V_{BE} = 0.6 ~ 0.7V

R_1 External resistor (1kΩ)

R_2 External resistor

2) Power Dissipation

Power dissipation of the TA7179P is expressed by the following expression:

$$P_D \doteqdot (V_{IN}^+ - V_O^+) \cdot I_L^+ + (|V_{IN}^-| - |V_O^-|) \cdot |I_L^-| + V_{IN}^+ \cdot I_B^+ + |V_{IN}^-| \cdot |I_B^-| \quad \cdots\cdots 2)$$

where, V_{IN}^+ : Positive Input Voltage
V_{IN}^- : Negative Input Voltage
I_B^+ : Positive Bias Current
I_B^- : Negative Bias Current

Max. power dissipation is 625mW. As P_D increases when output voltage is dropped or input voltage is raised, max. load current decreases as it is restricted by max. power dissipation.

The following are required for the high reliability design:

. If P_D of the TA7179P has a margin when h_{FE} of the output transistor drops at time of current boost?

. When output is shorted, power dissipation may increase and IC can be damaged. If the overcurrent protective circuit is properly set up?

. Derating should be set at about 80%, if possible, so that junction temperature does not exceed T_j MAX of IC even when rise in ambient temperature is taken into consideration.

. When the TA7179P is connected to a printed circuit board, etc., a board pattern area should be provided to improve radiation effect as high as possible.

3) Max. Input Voltage

Max. input voltage of the TA7179P is ±30V. If input voltage exceeds this max. value momentarily, IC can be damaged. When AC input voltage is improperly regulated or when many power supplies are connected at the same time and there is the possibility for fluctuation of input voltage according to state of their loads, zener diodes should be connected parallelly to the input terminals of IC.

4) Surge Protection

As the input and output voltage terminal lines tend to be extended, surge voltage may be applied to them. It may possibly be applied to not only these lines but also GND of a device. If there is any high-tension circuit, surge absorbing diodes should be connected to terminals to which surge voltage may possibly applied.

5) Input and Output Capacitors

In order to prevent parasitic oscillation which is caused by feedback through the input as well as output lines, capacitors of about 0.1μ should be connected to the input and output terminals of the TA7179P.

It is necessary to connect these capacitors close to the terminals of this IC.

Further, this also applies to phase compensating capacitors. As optimum capacitor values vary depending upon wiring state, wiring should be properly adjusted so that optimum capacitor values can be obtained.

3. New Products

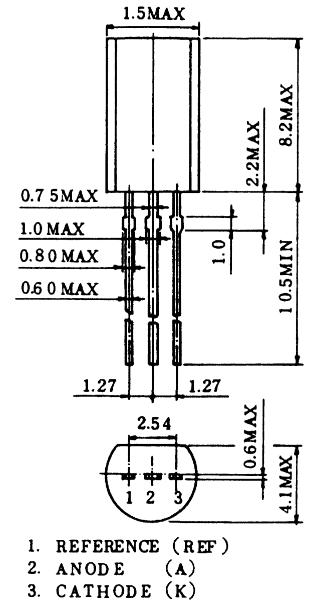
TA76431S
TA8003S
TA8004S

TA76431S

ADJUSTABLE PRECISION SHUNT REGULATOR

- Precision Reference Voltage: V_{REF}=2.495V±2%
- Small Temperature Coefficient: $|\alpha V_{REF}|$=46ppm/°C (NOTE)
- Adjustable Output Voltage: $V_{REF} \leqq V_{OUT} \leqq 36V$
- Low Dynamic Output Impedance: $|Z_{KA}|$=0.15Ω (Typ.)

Unit in mm



JEDEC	TO-92MOD
EIAJ	—
TOSHIBA	SSIP3-P

Weight: 0.36g

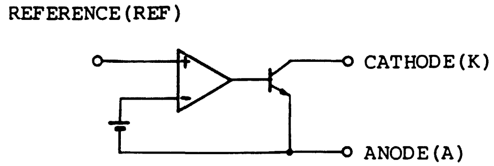
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Cathode Voltage	V_{KA}	37	V
Cathode Current	I_K	-100~150	mA
Reference Voltage	V_{REF}	7	V
Reference Current	I_{REF}	50	μA
Reference-Anode Reverse Current	I_{REF}	10	mA
Power Dissipation	P_D	800	mW
Operating Temperature	T_{opr}	-40~85	°C
Storage Temperature	T_{stg}	-55~150	°C

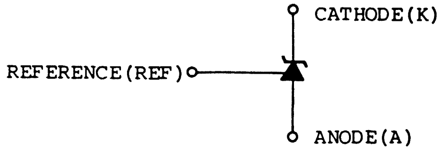
RECOMMENDED OPERATING CONDITIONS

CHARACTERISTIC	SYMBOL	MIN.	TYP.	MAX.	UNIT
Cathode Voltage	V_{KA}	V_{REF}	-	36	V
Cathode Current	I_K	1	-	100	mA
Operating Temperature	T_{opr}	-40	-	85	°C

FUNCTIONAL BLOCK DIAGRAM



CIRCUIT SYMBOL

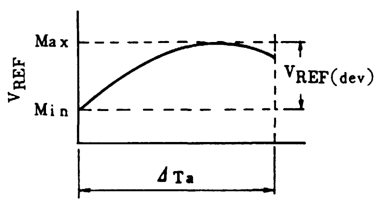


ELECTRICAL CHARACTERISTICS ($Ta=25°C$, $I_K=10mA$)

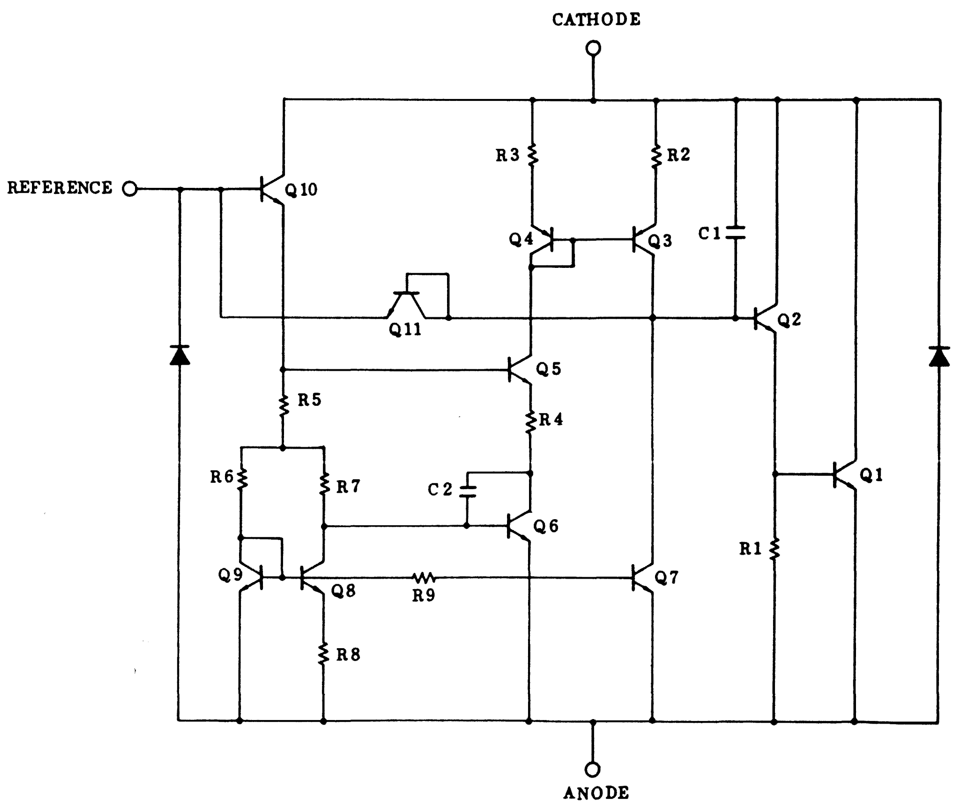
CHARACTERISTIC	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Reference Voltage	V_{REF}	$V_{KA}=V_{REF}$	2.440	2.495	2.550	V
Deviation of Referance Input Voltage Over Temperature	$V_{REF}(dev)$ (Note)	$0°C \leq Ta \leq 70°C$, $V_{KA}=V_{REF}$	-	8	17	mV
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage	$\Delta V_{REF}/\Delta V$	$V_{REF} \leq V_{KA} \leq 10V$	-	0.8	2.7	mV/V
		$10V \leq V_{KA} \leq 36V$	-	0.5	2.0	
Reference Input Current	I_{REF}	$V_{KA}=V_{REF}$	-	1.4	4	μA
Deviation of Reference Input Current Over Temperature	$I_{REF}(dev)$ (Note)	$0°C \leq Ta \leq 70°C$, $V_{KA}=V_{REF}$ R1=10kΩ, R2=∞	-	0.3	1.2	μA
Minimum Cathode Current for Regulation	I_{Kmin}	$V_{KA}=V_{REF}$	-	0.4	1.0	mA
Off-State Cathode Current	I_{Koff}	$V_{KA}=36V$, $V_{REF}=0V$	-	-	1.0	μA
Dynamic Impedance	$\|Z_{KA}\|$	$V_{KA}=V_{REF}$, $f \leq 1kHz$ $1mA \leq I_K \leq 100mA$	-	0.15	0.5	Ω

Note: The deviation parameters $V_{REF}(dev)$ and $I_{REF}(dev)$ are difined as the maximum variation of the V_{REF} and I_{REF} over the rated temperature range.
The average temperature coefficient of the V_{REF} is defined as;

$$|\alpha V_{REF}| = \frac{\frac{V_{REF}(dev)}{V_{REF}@25°C} \times 10^6}{\Delta Ta} \quad (ppm/°C)$$

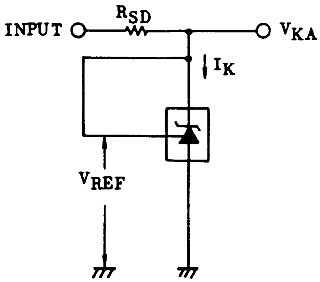


EQUIVALENT CIRCUIT

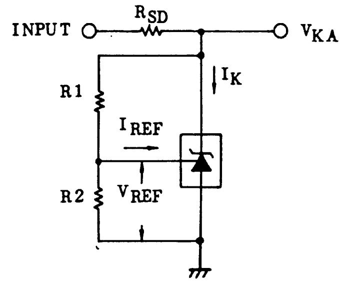


TEST PARAMETER

(1) $V_{KA}=V_{REF}$ MODE

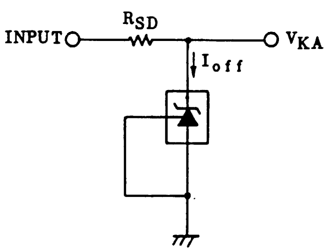


(2) $V_{KA}>V_{REF}$ MODE



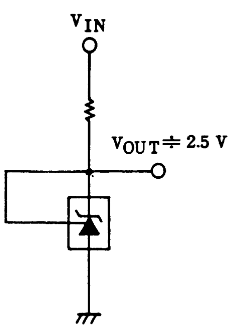
$$V_{KA} = V_{REF}\left(1+\frac{R1}{R2}\right) + I_{REF} \cdot R1$$

(3) OFF-STATE MODE

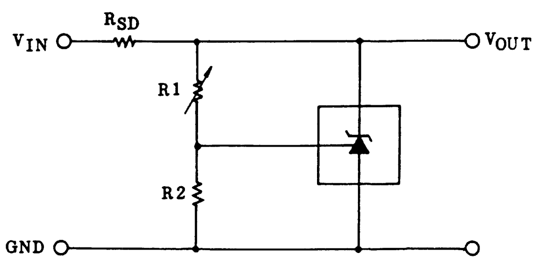


TYPICAL APPLICATIONS

(1) 2.5V REFERENCE

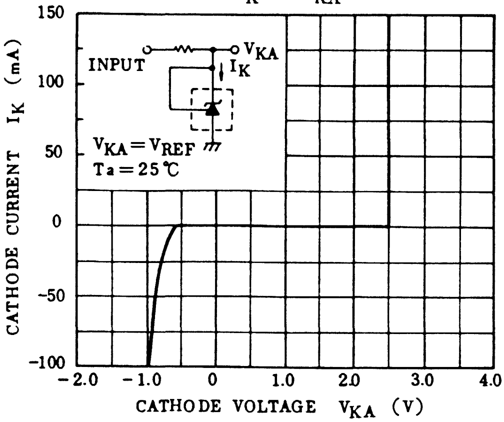


(2) SHUNT REGULATOR

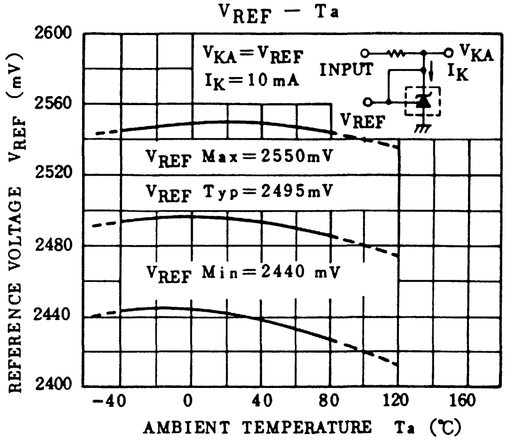


$$V_{OUT} = V_{REF}\left(1+\frac{R1}{R2}\right) + I_{REF} \cdot R1$$

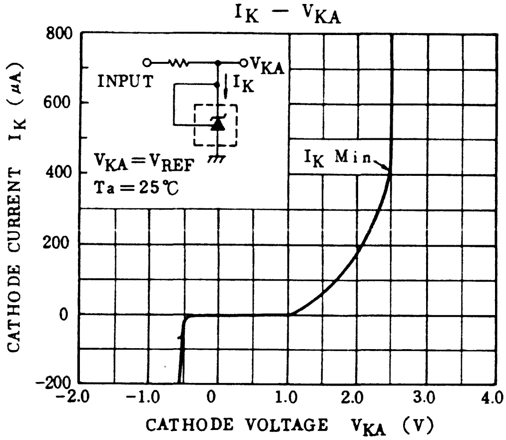
$I_K - V_{KA}$



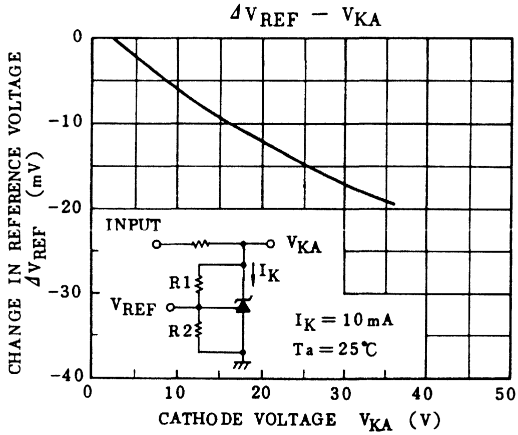
$V_{REF} - Ta$



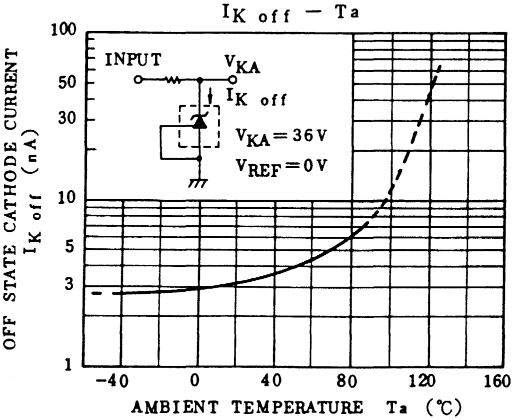
$I_K - V_{KA}$



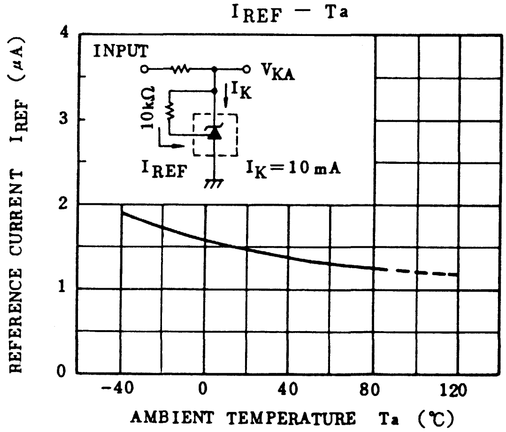
$\Delta V_{REF} - V_{KA}$

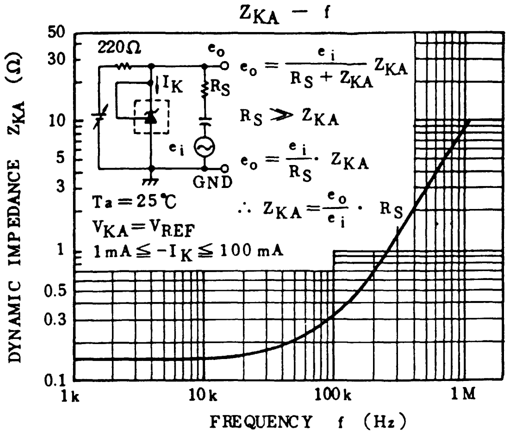


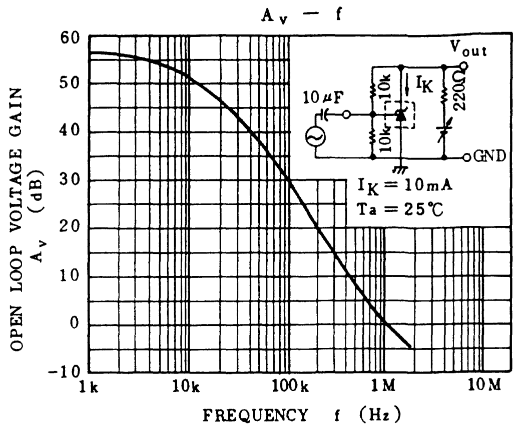
$I_{K\,off} - Ta$

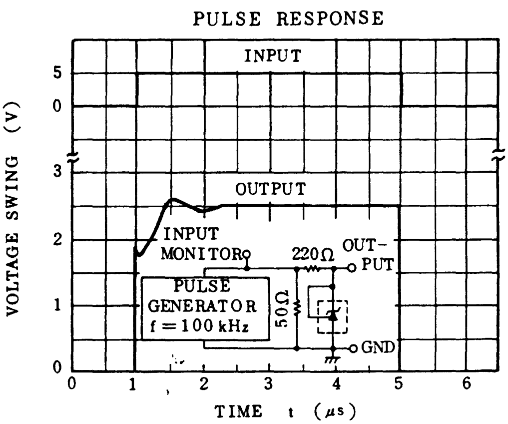


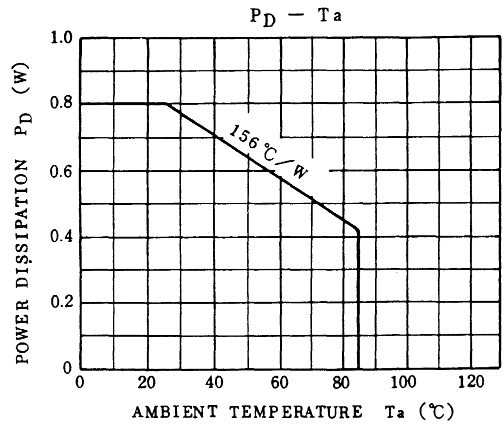
$I_{REF} - Ta$

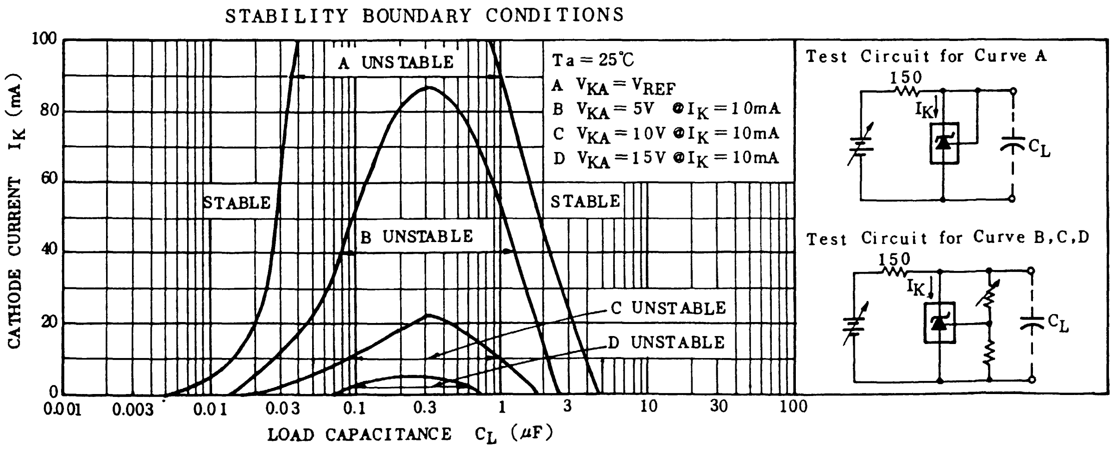



Z_{KA} − f
DYNAMIC IMPEDANCE Z_{KA} (Ω)
FREQUENCY f (Hz)
220Ω
e_o
I_K
R_S
e_i
GND
$e_o = \frac{e_i}{R_S + Z_{KA}} Z_{KA}$
$R_S \gg Z_{KA}$
$e_o = \frac{e_i}{R_S} \cdot Z_{KA}$
$\therefore Z_{KA} = \frac{e_o}{e_i} \cdot R_S$
Ta = 25℃
$V_{KA} = V_{REF}$
1 mA ≦ $-I_K$ ≦ 100 mA


A_v − f
OPEN LOOP VOLTAGE GAIN A_v (dB)
FREQUENCY f (Hz)
V_{out}
10 μF
10k
10k
I_K
220Ω
GND
I_K = 10 mA
Ta = 25℃


PULSE RESPONSE
VOLTAGE SWING (V)
TIME t (μs)
INPUT
OUTPUT
INPUT MONITOR
220Ω
OUT-PUT
PULSE GENERATOR f = 100 kHz
50Ω
GND


P_D − Ta
POWER DISSIPATION P_D (W)
AMBIENT TEMPERATURE Ta (℃)
156 ℃/W


STABILITY BOUNDARY CONDITIONS
CATHODE CURRENT I_K (mA)
LOAD CAPACITANCE C_L (μF)
A UNSTABLE
STABLE
B UNSTABLE
STABLE
C UNSTABLE
D UNSTABLE
Ta = 25℃
A $V_{KA} = V_{REF}$
B V_{KA} = 5V @ I_K = 10 mA
C V_{KA} = 10V @ I_K = 10 mA
D V_{KA} = 15V @ I_K = 10 mA
Test Circuit for Curve A
150
I_K
C_L
Test Circuit for Curve B, C, D
150
I_K
C_L

TA8003S

5V LOW DROPOUT VOLTAGE REGULATOR WITH ON/OFF SWITCH

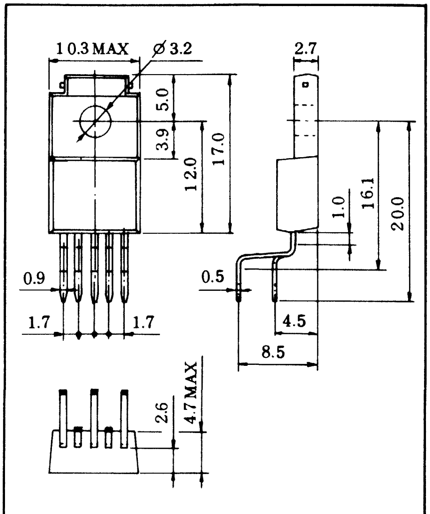
The TA8003S is a 5V positive regulator IC with Maximum output current of 400mA, provided with an output ON/OFF control terminal.

This regulator has various features such as low input-output differential voltage, low standby current, etc.

And multi-protection function are provided.

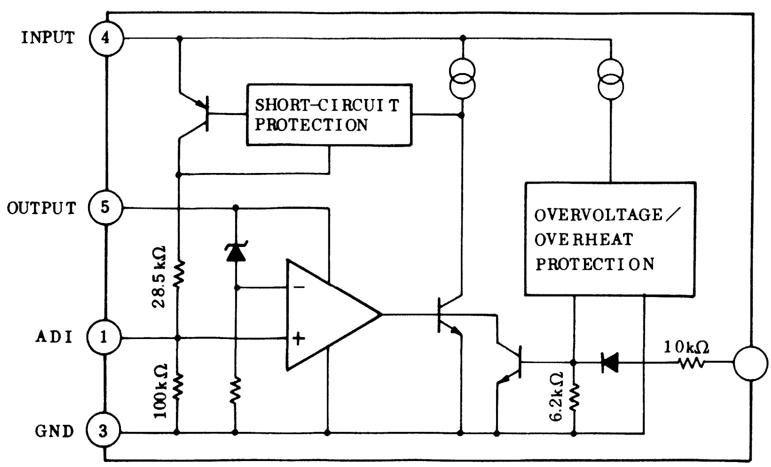
- Low standby current : 800μA(Typ.)
- Maximum output current : 400mA(Max.)
- Low input-output dropout voltage : 0.6V(Max.)
- Multi-protection : Inverse connection/overvoltage Protection/Overheat protection/ Short-circuit protection
- Output voltage adjustable
- Output ON/OFF controllable
- TO-220(IS) Fully mold package

Unit in mm



JEDEC	—
TOSHIBA	ZIP 5-P

BLOCK DIAGRAM



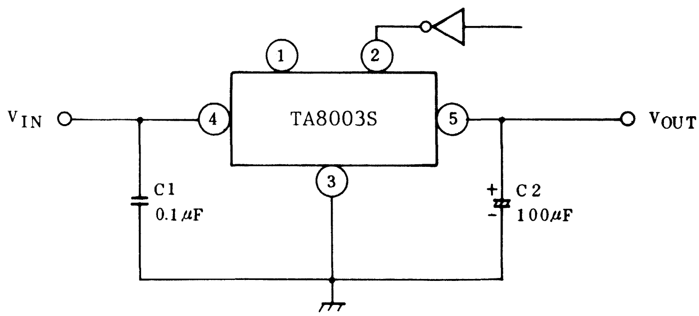
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Input Voltage	V_{IN}	-26~60	V
Power Dissipation	P_D	20	W
Operating Temperature	Topr	-40~85	°C
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	-55~150	°C
Lead Temperature (Duration)	Tsol	260 (10 sec)	°C

ELECTRICAL CHARACTERISTICS (V_{IN}=14V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	-	V_{IN}=5.35~26V Ta=-40~85°C	4.5	5	5.5	V
Line Regulation	$\Delta V_{OUT(1)}$	-	V_{IN}=10~17V	-	1	10	mV
			V_{IN}=7~26V	-	2	30	
Load Regulation	$\Delta V_{OUT(2)}$	-	I_{OUT}=10~200mA	-	30	60	mV
Quiescent Current	I_{CC}	-	$I_{OUT} \leqq 10$mA V_{IN}=6~26V	-	1.0	2.0	mA
Dropout Voltage	V_{DROP}	-	I_{OUT}=50mA	-	0.1	0.3	V
			I_{OUT}=200mA	-	0.25	0.6	
Maximum Operating Input Voltage	V_{IN}	-		29	33	-	V
DIS Input Voltage	V_{IH}	-		3	-	-	V

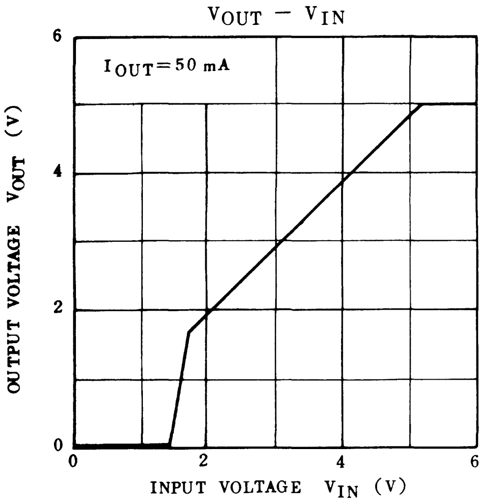
EXAMPLE OF APPLICATION CIRCUIT

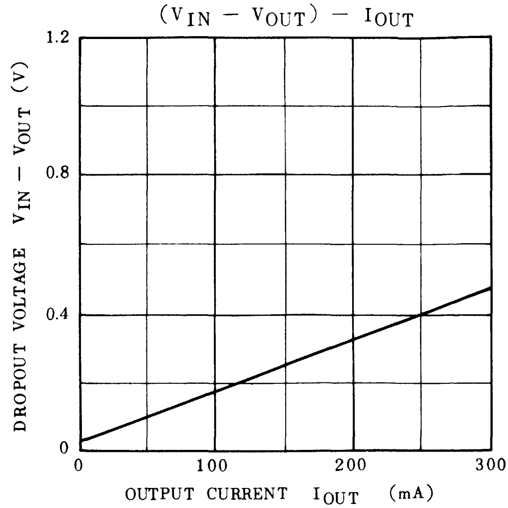


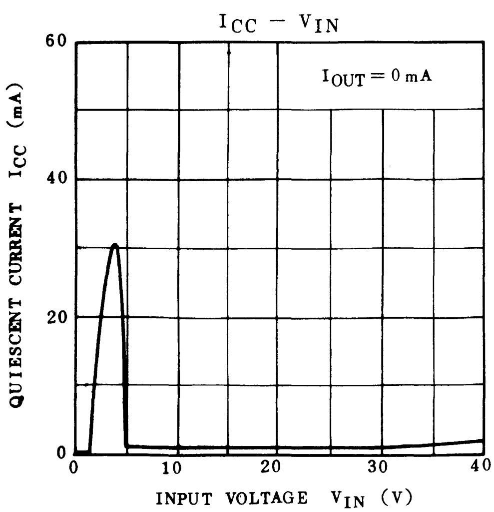
Capacitor C2 must be guaranteed to operate of the temperature range that the regulator should be operated correctly.
100μF is a suitable value to suppress the oscillation phonomenon at the output terminal.

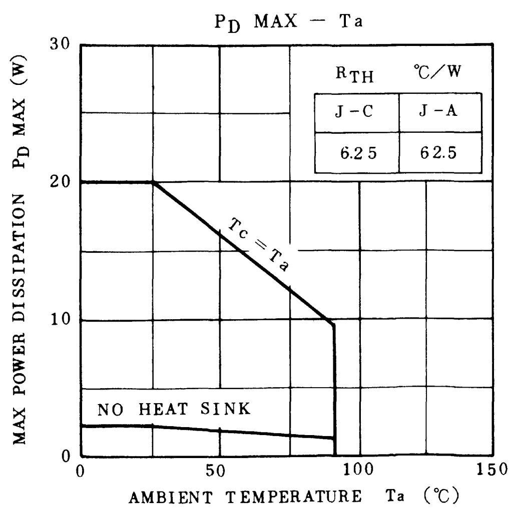
PIN DESCRIPTIONS

PIN No.	SYMBOL	DESCRIPTION
1	ADJ	Output voltage adjusting terminal. Voltage can be increased with inserting a resistor between the ADJ and OUT pins and decreased with inserting a resistor between the ADJ and GND pins.
2	DIS	Output ON/OFF control terminal. Output is turned ON when this pin is opened or put at "L" level and OFF at "H" level.
3	GND	Ground terminal
4	IN	Power supply terminal
5	OUT	5V output terminal with maximum output current of 400mA.


VOUT — VIN
IOUT=50 mA
OUTPUT VOLTAGE VOUT (V)
INPUT VOLTAGE VIN (V)
0
2
4
6


(VIN — VOUT) — IOUT
DROPOUT VOLTAGE VIN — VOUT (V)
OUTPUT CURRENT IOUT (mA)
1.2
0.8
0.4
0
100
200
300


ICC — VIN
IOUT = 0 mA
QUIESCENT CURRENT ICC (mA)
INPUT VOLTAGE VIN (V)
60
40
20
0
10
20
30
40


PD MAX — Ta
RTH ℃/W
J-C J-A
6.25 62.5
Tc = Ta
NO HEAT SINK
MAX POWER DISSIPATION PD MAX (W)
AMBIENT TEMPERATURE Ta (℃)
30
20
10
0
50
100
150

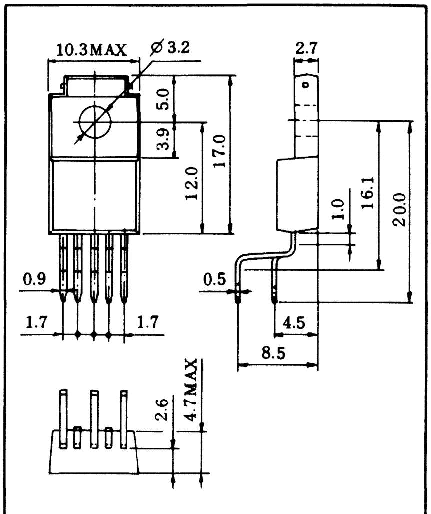
TA8004S

5V LOW DROPOUT VOLTAGE REGULATOR WITH RESET TIMER

The TA8004S is a 5V positive regulator with maximum output current of 300mA with reset timer.
This regulator generates a reset signal when the power source is turned ON, or the 5V output voltage lower to 85% or less of a prescribed level due to external disturbance, etc.
This regulator has various features such as low input-output dropout voltage, low standby current, etc. And multi-protection function are provided.

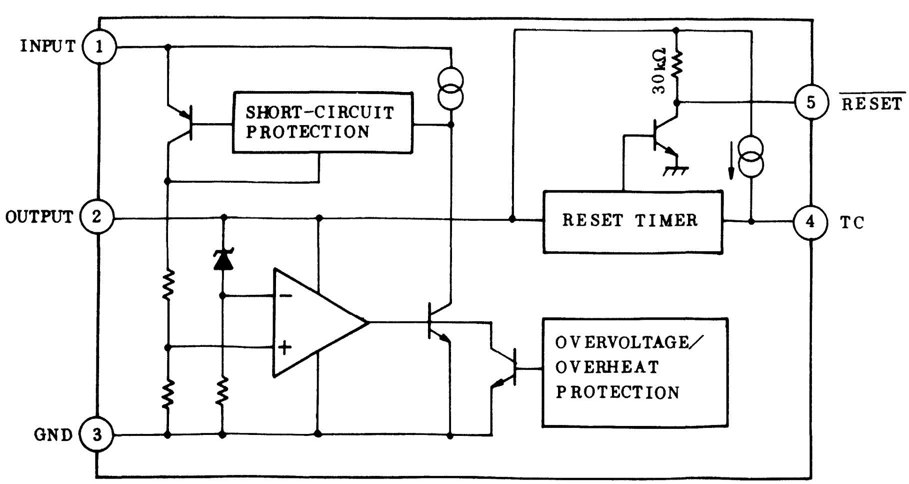
. Maximum output current : 300mA(Max.)
. Low input-output dropout voltage : 0.6V(Max.)
. Multi-protection : Inverse connection/overvoltage Protection/Overheat protection/ Short-circuit protection
. Built-in power-on reset timer
. TO-220(IS) Full molded package

Unit in mm



JEDEC	—
TOSHIBA	ZIP5-P

BLOCK DIAGRAM



MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Input Voltage	V_{IN}	-26~60	V
Power Dissipation	P_D	20	W
Operating Temperature	Topr	-40~85	°C
Junction Temperature	Tj	150	°C
Storage Temperature	Tstg	-55~150	°C
Lead Temperature·Time	Tsol	260 (10 sec)	°C

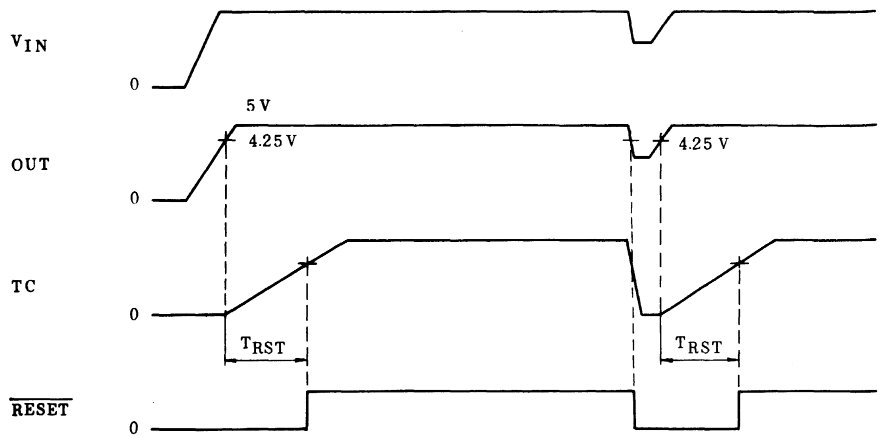
ELECTRICAL CHARACTERISTICS (V_{IN}=14V, I_{OUT}=10mA, Tj=25°C)

CHARACTERISTIC	SYMBOL	PIN	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage	V_{OUT}	OUT	V_{IN}=5.35~26V Ta=-40~85°C	4.5	5	5.5	V
Line Regulation	$\Delta V_{OUT(1)}$	OUT	V_{IN}=10~17V	-	2	20	mV
			V_{IN}=7~26V	-	4	40	
Load Regulation	$\Delta V_{OUT(2)}$	OUT	I_{OUT}=10~150mA	-	50	100	mV
Quiescent Current	I_{CC}		$I_{OUT} \leq$ 10mA V_{IN}=6~26V	-	2	4	mA
Dropout Voltage	V_{DROP}	IN/OUT	I_{OUT}=50mA	-	0.1	0.3	V
			I_{OUT}=150mA	-	0.25	0.6	
Maximum Operating Input Voltage	V_{IN}	IN		29	33	-	V
Output Voltage	V_{OL}	$\overline{RST}$		-	-	0.5	V
Output Leakage Current	I_{LEAK}	$\overline{RST}$		-	-	10	μA
Threshold Voltage	V_{TH}	TC		-	60%×V_{REG}	-	V
Output Current	I_{OH}	TC		5	10	20	μA
Reset Detection Voltage	V_{TH}	OUT		-	85%×V_{REG}	-	V
Reset Timer Time	T_{RST}	$\overline{RST}$		-	0.3×C_T	-	

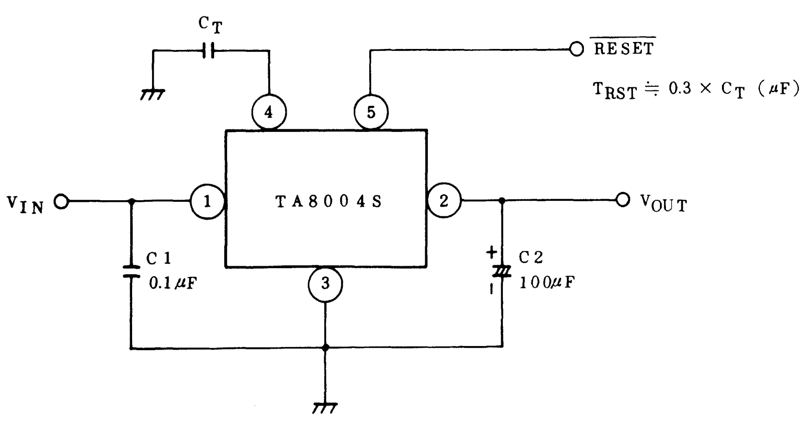
PIN DESCRIPTIONS

PIN No.	SYMBOL	DESCRIPTION
1	IN	Power supply terminal.
2	OUT	5V output terminal with Maximum output current of 300mA.
3	GND	Ground terminal.
4	TC	Reset timer setting terminal. A capacitor is connected between this terminal and GND.
5	$\overline{\text{RESET}}$	Collector terminal of an NPN transistor with built-in pull-up resistor. This pin is put at LOW level at output voltage below 85% of a prescribed level and after output voltage becomes above 85% of a prescribed level, a reset signal for the time set at the TC terminal.

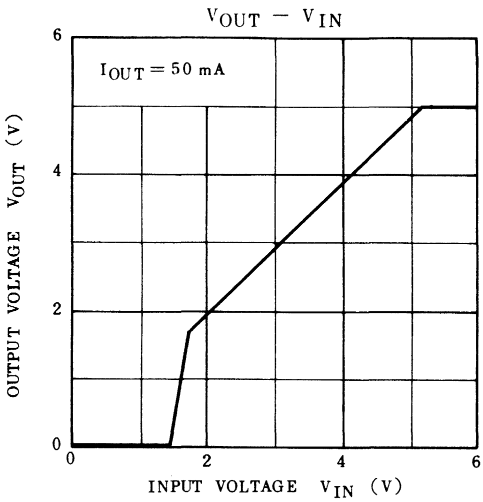
TIMING CHART

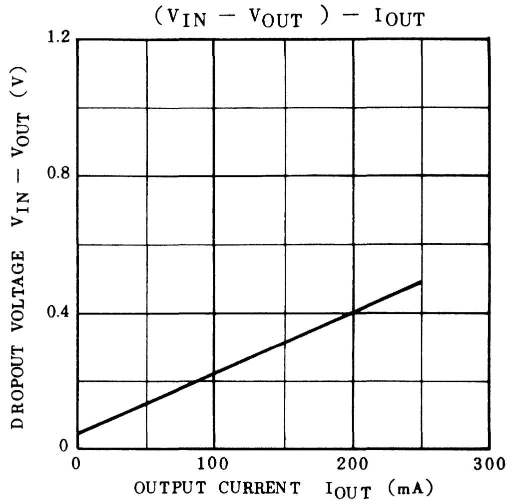


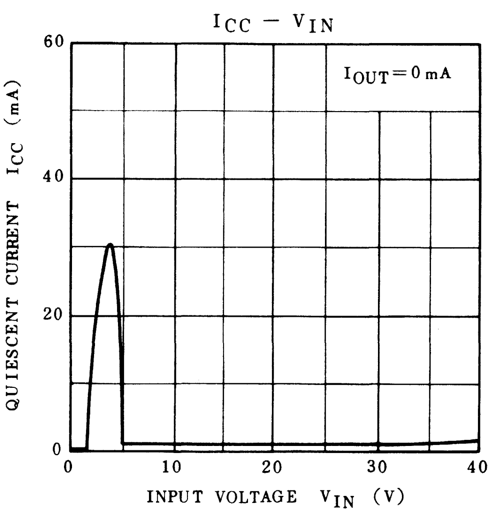
EXAMPLE OF APPLICATION CIRCUIT

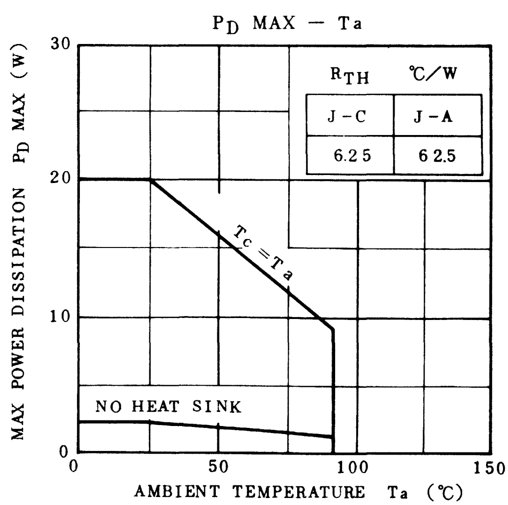


Capacitor C2 must be guaranteed to operate of the temperature range that the regulator should be operated correctly.
100μA is a suitable value to suppress the oscillation phonomenon at the output terminal.


V_{OUT} − V_{IN}
I_{OUT} = 50 mA
OUTPUT VOLTAGE V_{OUT} (V)
INPUT VOLTAGE V_{IN} (V)
0
2
4
6


(V_{IN} − V_{OUT}) − I_{OUT}
DROPOUT VOLTAGE V_{IN} − V_{OUT} (V)
OUTPUT CURRENT I_{OUT} (mA)
1.2
0.8
0.4
0
100
200
300


I_{CC} − V_{IN}
I_{OUT}=0 mA
QUIESCENT CURRENT I_{CC} (mA)
INPUT VOLTAGE V_{IN} (V)
60
40
20
0
10
20
30
40


P_D MAX − Ta
R_{TH} ℃/W
J − C
J − A
6.25
62.5
$T_c = T_a$
NO HEAT SINK
MAX POWER DISSIPATION P_D MAX (W)
AMBIENT TEMPERATURE Ta (℃)
30
20
10
0
50
100
150

4. Packing Information

To deliver flat IC packages, three package method are available: the same stick packages as the ordinary DIP type, taping, and embossed taping.

1. Stick Specifications for Flat Packages

- Shape and dimensions (Example: FLP type)

Material : Antistatic treated chloride vinyl
No. of IC's : 8-pin → 100 IC's/stick
14-/16-pin → 50 IC's/stick

* Both sides are fitted with synthetic-rubber stoppers.

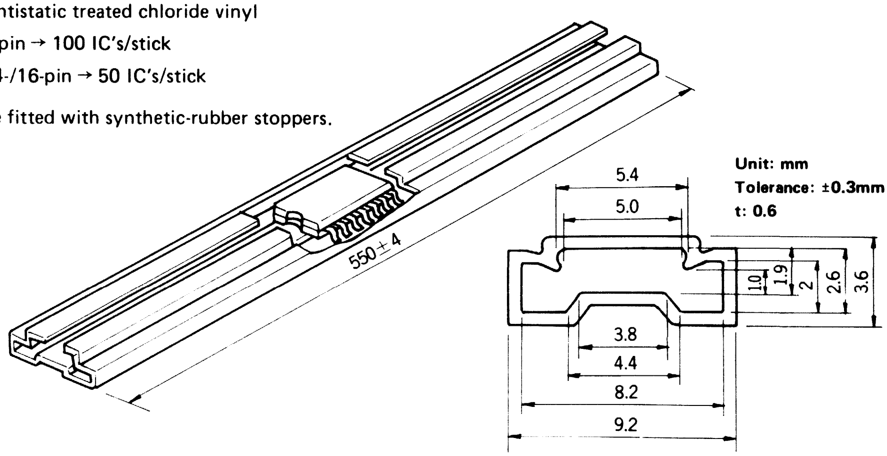


Fig. 1 Dimensions of Toshiba FLP bipolar IC stick

2. Taping Specifications for Flat Packages

(1) Tape shape and dimensions (Fig. 2)

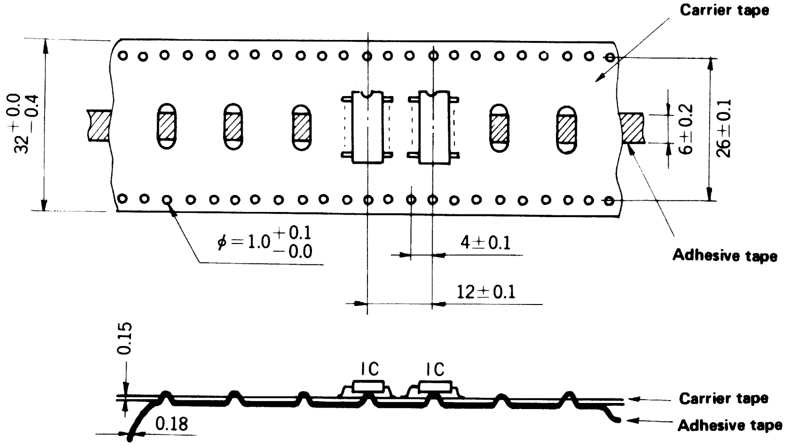


Fig. 2 Taping

(2) Winding reel shape and dimensions (Fig. 3)

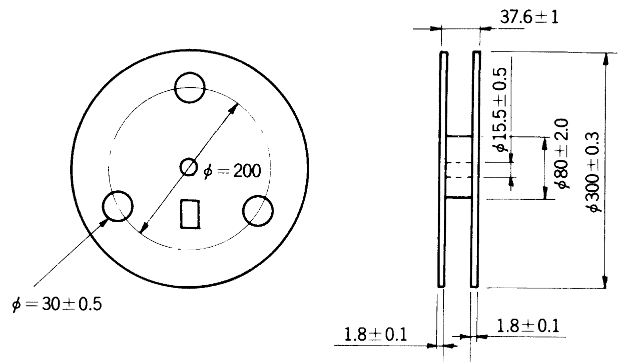


Fig. 3 Reel for taping

(3) Direction of tape winding (Fig. 4)

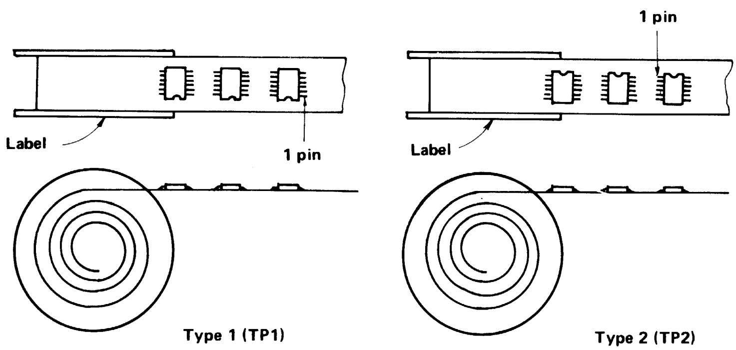


Fig. 4 Direction of tape winding

(4) Standard quantity

The standard unit is 2,000 IC's per reel.

Kindly place orders in quantities equal to multiples of 2,000.

(An exception is 1,000-IC reels. For motor IC's, these include PFP16)

(5) How to order

When ordering flat-type bipolar IC's on taping, specify the product name, taping direction, and quantity as follows:

(Example)

TD62003F TP1 12,000

- 12,000 — Quantity (see item 4 above)
- TP1 — Type of taping
- TD62003F — Product name

3. Embossed Taping Specifications for Flat Packages

(1) General information

Generally, for embossed taping packaging specifications and related matters for bipolar flat package IC's, applicable are EIAJ (RC-1009B) and JEDEC (EIA-481A).

(2) Tape shape and dimensions

a) Types TE1204, 1208 (Fig. 5)

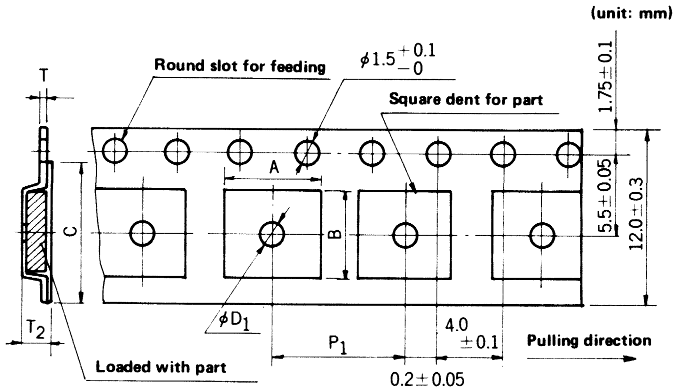


Fig. 5 Embossed taping types TE1204 and 1208

b) Types TE1604, 1608, 1612 (Fig. 6)

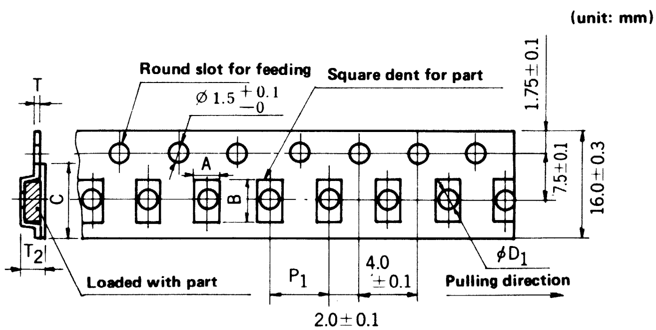


Fig. 6 Embossed taping types TE1604, 1608 and 1612

c) Types TE2412, 2416, 2420 (Fig. 7)

(unit: mm)

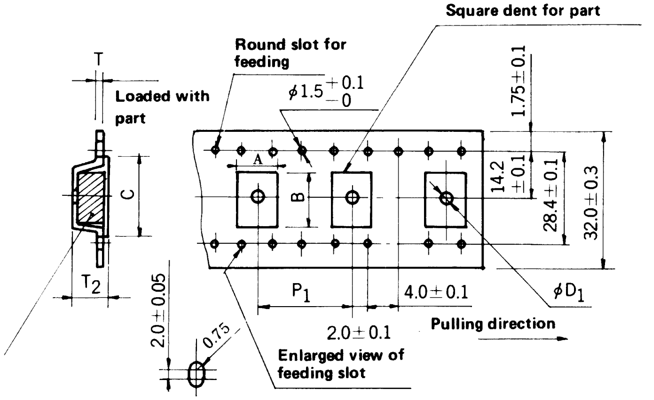


Fig. 7 Embossed taping types TE2412, 2416 and 2420

d) Types TE3212, 3216, 3220, 3224, 3228, 3232 (Fig. 8)

(unit: mm)

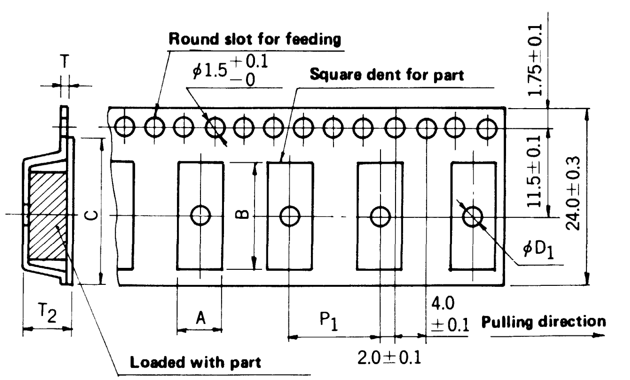


Fig. 8 Embossed taping types TE3212, 3216, 3220, 3224, 3228, and 3232

- For IC package shapes, the IC types listed above are selected, and the dimensions of A, B, C, D1, P1, T, and T2 are determined for packages. Please understand that, as for the standards for type selection and determination of dimensions, EIAJ [RC-1009B] is generally applied, with some exceptions involving handling.

(3) Seal tape dimensions

- Seal tape dimensions are appropriately determined for IC package shaped.

(4) Reel shape and dimensions (Fig. 9)

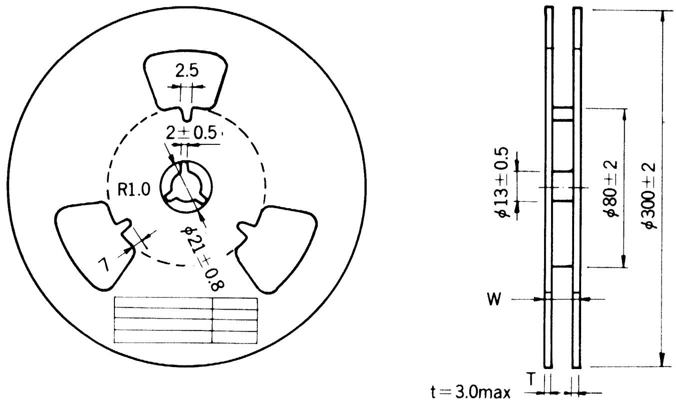


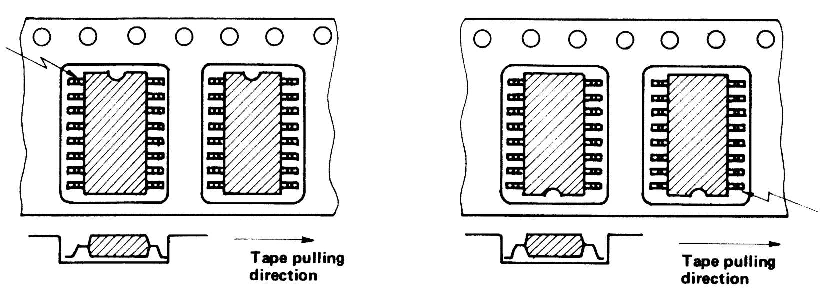
Fig. 9 Reel for embossed taping

- Length W varies with tape types as follows:

Tape shape	W	Reel
TE12□□ Type	12.4 $^{+2.0}_{-0}$	
TE16□□ Type	16.4 $^{+2.0}_{-0}$	R33
TE24□□ Type	24.4 $^{+2.0}_{-0}$	R53
TE32□□ Type	32.4 $^{+2.0}_{-0}$	R74

(5) Sealing direction (Fig. 10)

(Standard sealing direction)



Type L (EL) Type R (ER)

Fig. 10 Winding direction for embossed taping

- Two sealing methods, types L and R, are applicable. The use of the standard direction type L (EL) can be recommended.

(6) How to order

- When ordering IC's on embossed taping, specify the product name, type of taping, sealing direction, and quantity as follows.

(Example) An order for 10,000 TD62003F IC's on embossed taping, sealing direction L:

TD62003F (FL) 10000

- 10000 — Quantity *
- L — Sealing direction (L or R)
- F — Type of taping
- TD62003F — Name of IC

* One reel contains 2,000 IC's. Please specify in multiples of 2,000.

(7) Transport and maintenance

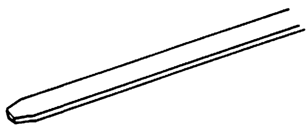
- During transportation, take care to avoid subjecting the tape to heavy vibration.
- As for transportation and storage, keep the goods away from direct sunlight and at ambient temperatures below 45°C to prevent aging of seal tape separation resistance, and/or tape deformation.

4-4 Packing for Power Mini-Package

- A Plastic tray is available from Toshiba for packages applicable to diversified small-quantity production.

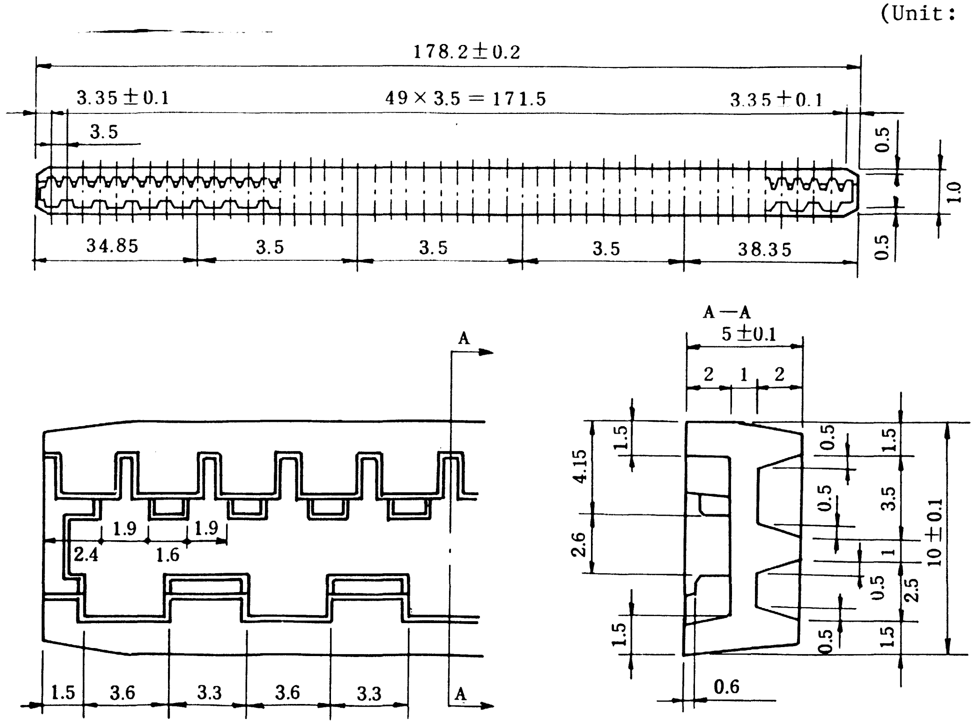
- One tray contains 25 pcs.

External view of plastic tray



Dimensions of plastic tray (Fig. 13)

(Unit: mm)



4-5 Taping Specification for Power Mini Package

(1) Scope

This standard prescribes the taping specification for power mini (equivalent to SOT-89) type regulator ICs.

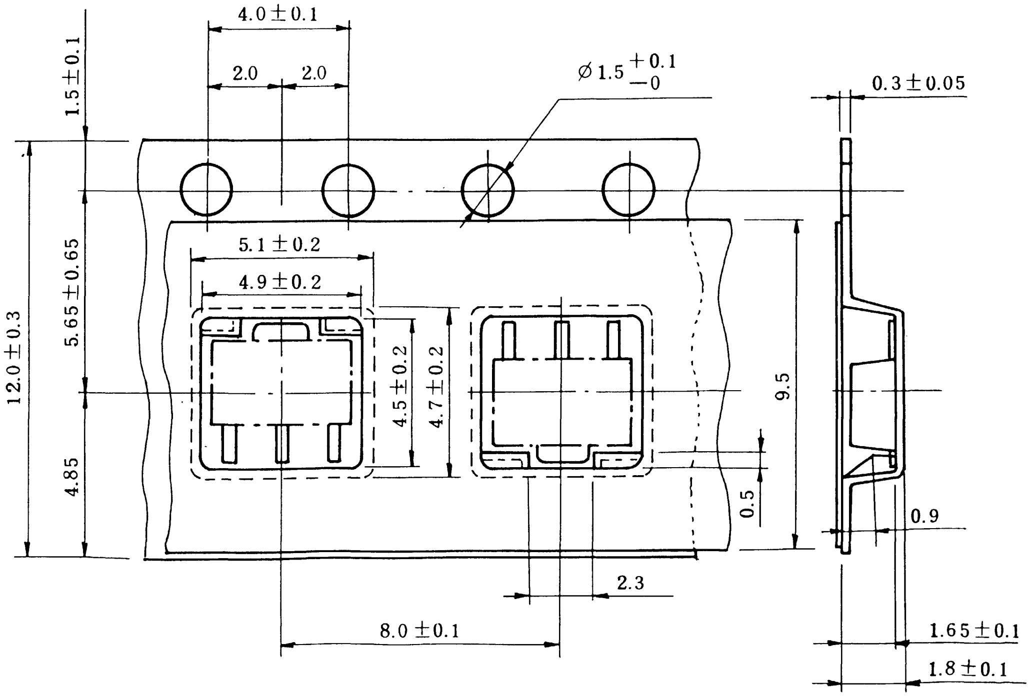
(2) Dimensions of taping

(2)-1 Tolerance for accumulated pitch is ±0.2 or below at 10 pitches.

(2)-2 Material of tape Plastic

(2)-3 Dimensions (Fig. 14)

(Unit: mm)



(2)-4 Related matters

(2)-4-1 Product taping rejection rate

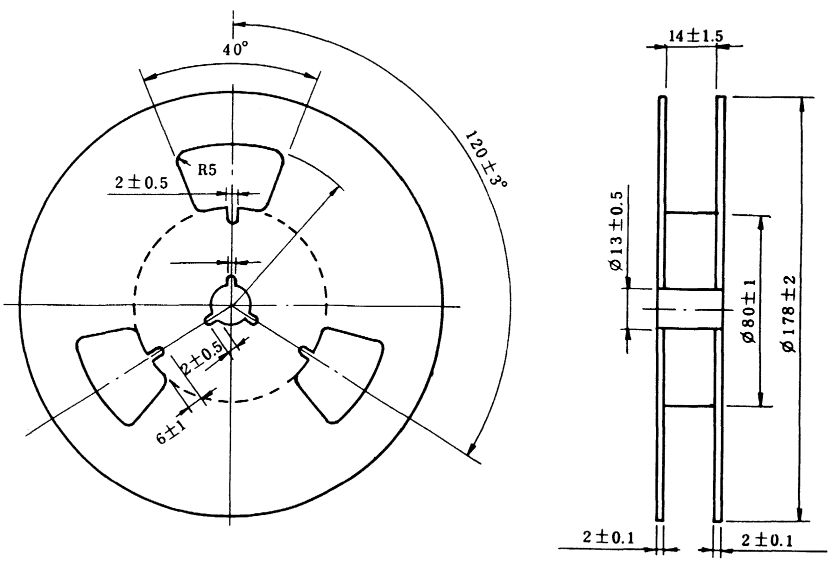
Item	Standard
Continuous product omission	0
Discontinuous product omission Product in reverse direction Back side product Different product	0.2% max./reel

(2)-4-2 Electrical characteristics

- Electrical characteristics of taped Power Mini ICs are prescribed in the individual specification.

(3) Reel

(3)-1 Dimensions (Fig. 15)



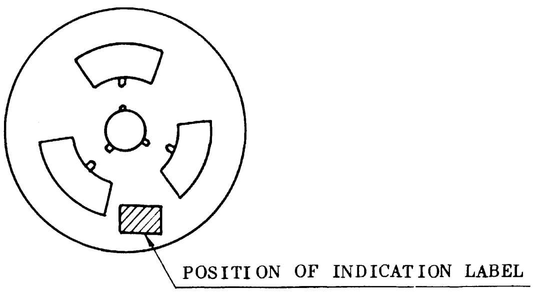
(3)-2 Material

- Paper

(4) Packing method

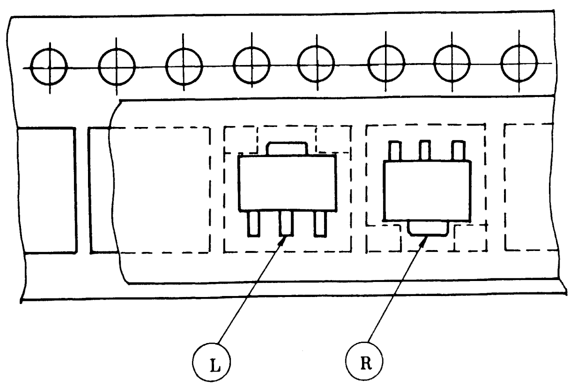
(4)-1 Example of indicating method (Fig. 16)

Type Name	TA78LXXF
Q'ty	1000 pcs
Lot No.	
Shape	

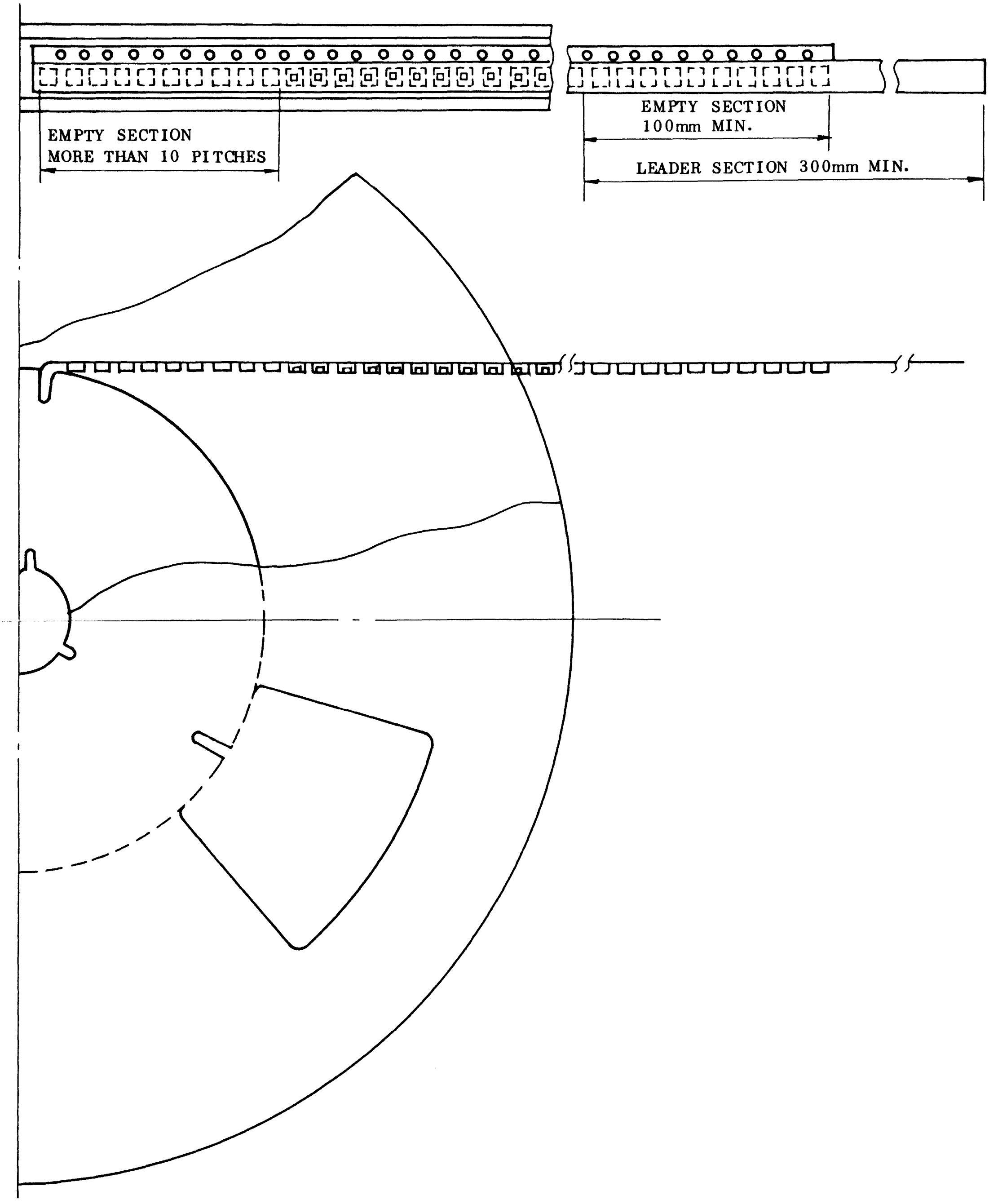


(4)-2 Feeding direction (Fig, 17)

- L shall be TE12L.
- R shall be TE12R.



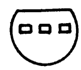
(5) Leader and empty sections (Fig. 18)



1. Scope

This specification provides the requirements for the radial taping package of TO-92 type three terminal voltage regurator for use in automatic insertion machine.

Table 1 Package No. and Pin Configuration

Positive REG	Package No.	SSIP3-P-A	
	Pin configuration	 1 2 3	1. OUTPUT 2. COMMON 3. INPUT
	Example device No.	TA78L05S	

2. Product Naming System

Type of package for shipment is classified by a symbol suffixed to a product name. The method of classification is as example below.
(This method, however, does not apply to product of which electrical characteristic differ from the TOSHIBA standard specification.)

[Example]

TA78L05S TPE1

① ② ── ② Indicates the taping specifications.

└── ① TOSHIBA's house No.

3. Taping Specifications

The taping is classified as shown in the table below according to the taping method and packaging method.

Table 2 Taping Specifications

Taping spec.	Taping Classification		Packaging Classification		Packaged Quantity (pcs)	Weight (g)
	Taping in forward direction	Taping in reverse direction	Ammo Pack Fan Fold Box	Reel		
TPE1	○			○	2,000	
TPER1		○		○	2,000	
TPE2	○		○		3,000	

4. Tape Dimensions

Tape is prepared in dimensions shown in Table 3, Fig. 1 and Fig. 2 using 2 kinds of taping classifications shown in Table 2 as the standard.

Table 3 Tape Dimensions (Common to Forward & Reverse Directions)

Unit in mm

Item	Symbol	Value & Tolerance	Remarks
Body width	A1	5.1 MAX.	
Body height	A	4.7 MAX.	
Body thickness	T	4.1 MAX.	
Lead wire diameter	d	0.45° MAX.	
Lead wire (tape portion)	ℓ1	2.5 MIN.	
Pitch of component	P	12.7±1.0	

Item	Symbol	Value & Tolerance	Remarks
Feed hole pitch	P0	12.7±0.3	1
Hole center to component center	P2	6.35±0.4	
Lead-to-lead distance	F1/F2	$2.5^{+0.6}_{-0.3}$	
Component alignment (1)	Δh	0±2.0	
Component alignment (2)	ΔP	0±1.0	
Tape width	W	$18.0^{+1.0}_{-0.5}$	
Hold-down tape width	W0	6.0±0.3	
Hole position	W1	$9.0^{+0.75}_{-0.5}$	
Hold-down tape position	W2	0.5 MAX.	
Height of component from tape center	H	20 MAX.	
Lead wire clinch height	H0	16.0±0.5	
Component height	H1	32.25 MAX.	
Feed hole diameter	D0	4.0±0.2	
Total tape thickness	t	0.6±0.2	2
Length of snipped lead	L1	11.0 MAX.	

Note 1. Accumulated pitch tolerance is +1mm/20 pitch.

2. Board is 0.4±0.1mm in thickness.

4.1 Taping in forward direction

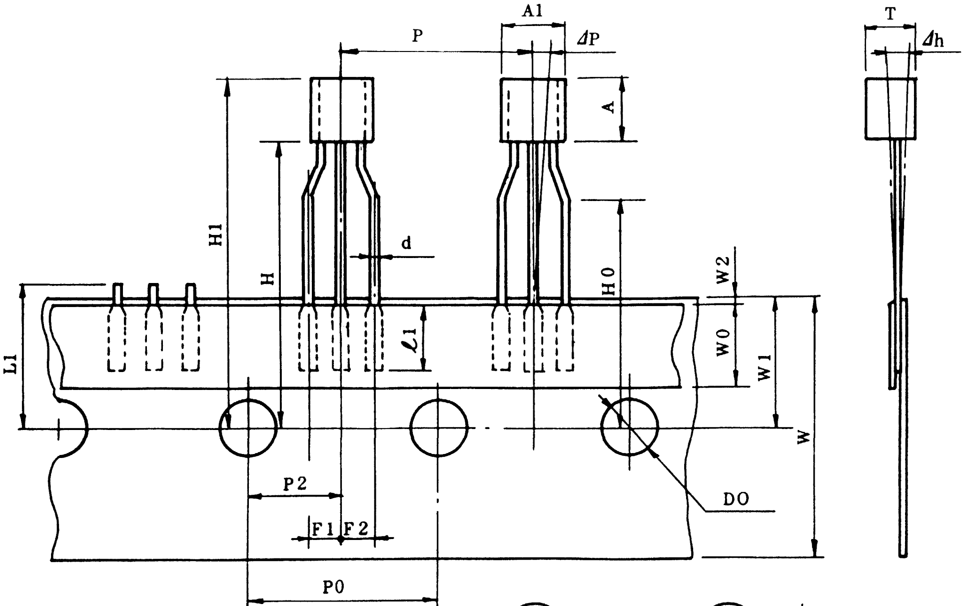


Fig.1 Taping in Forward Direction

4.2 Taping in reverse direction

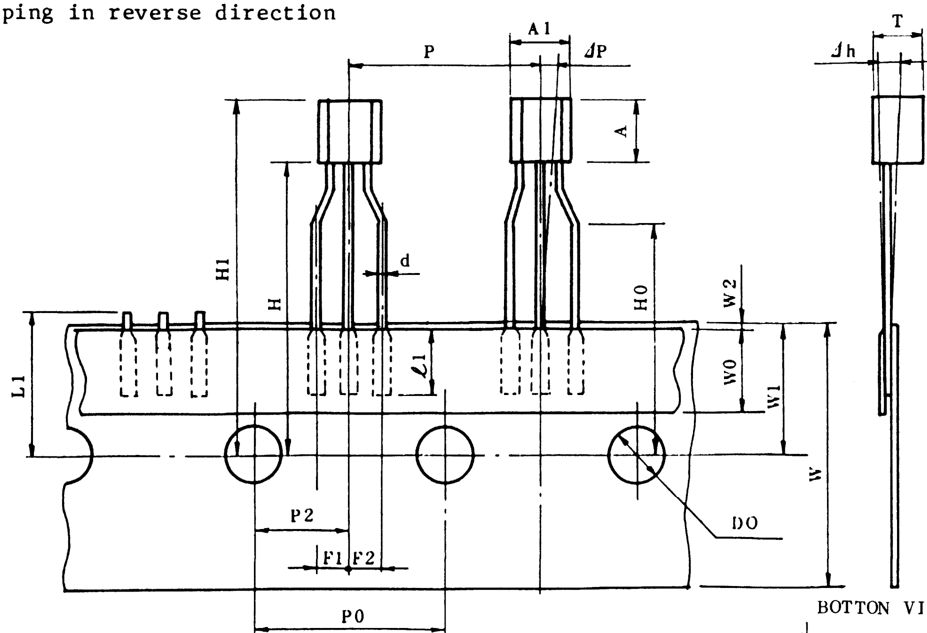


Fig.2 Taping in Reverse Direction

5. Packaging Method

5.1 Reel (TPE1, TPER1)

1) Reel dimensions

2) Pull-out polarity (Name of first-out electrode)

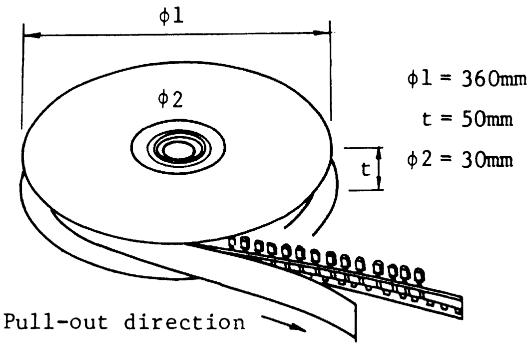


Fig.3 Winding Method and Dimensions of Reel

Table 4 Pull-out Polarity

Taping sepc.	TA78L05S SSIP3-P-A
Taping in forward direction (TPE1)	OUTPUT
Taping in reverse direction (TPER1)	INPUT

5.2 Ammo Pack (TPE2)

1) Ammo Pack Method

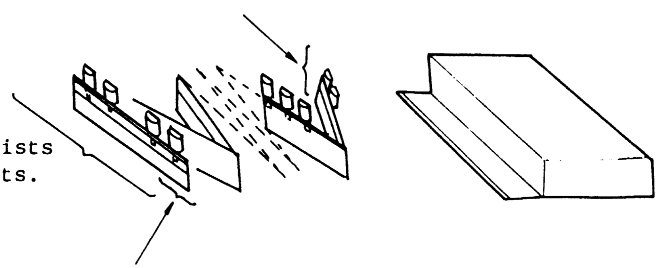
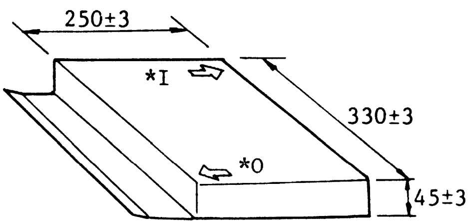


Fig.4 Ammo Pack Method

① Fold the taping in zigzag for every 25 elements in the tape dimensions shown in section 4.

② Remove more than 4 elements at the begining and ending of the taping.

2) Dimensions of package



(Unit in mm)

* shows a first-out electrode of a leads.

(Example)

O: Output first-out

I: Input first-out

Fig.5 Ammo Pack

3) Indication of pull-out polarity

(Symbol indication)

Table 5 Indication of Pull-out Polarity

	TA78L05S
	SSIP3-P-A
Abbreviation	I
	O

I: Input first-out

O: Output first-out

6. Other Standards

6.1 How to splice tape

A tape is cut and spliced with a splicing tape as illustrated below (when a tape is completed or cut).

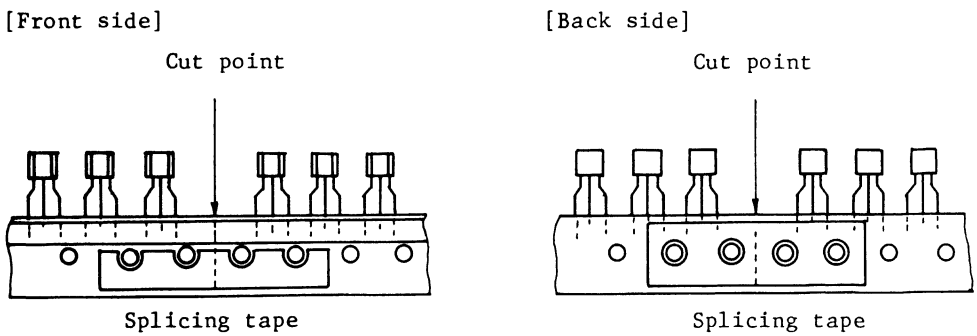


Fig.6 How to Splice Tape

6.2 Accuracy of splice

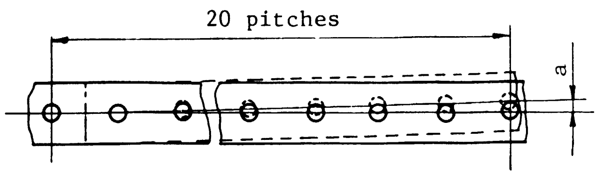


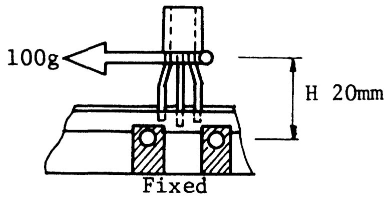
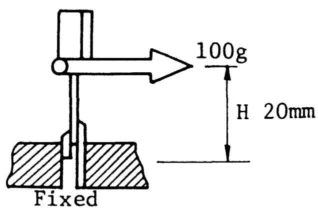
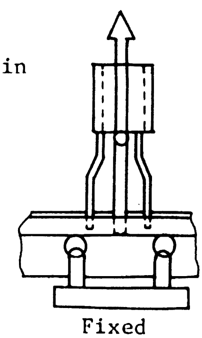
Fig.7 Splicing Accuracy

Dimension of "a" must be less than 1mm/20 pitches.

6.3 Falling off of element

Falling off of element must be less than 3 continuous elements.

6.4 Taping element adherent strength test

Item	Test Method	Performance
Lead wire strength	i) Lateral direction  Apply a load of 100g in the direction of arrow for 3±1 sec.	The taping specifications must be satisfied.
	ii) Longitudinal direction  Apply a load of 100g in the direction of arrow for 3±1 sec.	The taping specifications must be satisfied.
Adhesiveness	i) Strength test Apply a load in the direction of arrow. 	More than 500. Howver, lead wires should not shift or come off.
	ii) Life test Leave the taping in normak temperature and humidity for 6 months.	Performance in i) must be satisfied.

1. Scope

This specification provides the requirements for the redial taping package of TO-92 modify type three terminal voltage requrator for use in automatic insertion machine.

Table 1 Package No. and Pin Configuration

Positive REG	Package No.	SSIP3-P	
	Pin configuration	1 2 3	1. OUTPUT 2. COMMON 3. INPUT
	Example device No.	TA78L005AP	
Negative REG	Package No.	SSIP3-P	
	Pin Configuration	1 2 3	1. COMMON 2. INPUT 3. OUTPUT
	Example device No.	TA79L005P	

2. Product Naming System

Type of package for shipment is classified by a symbol suffixed to a product name. The method of classification is as example below.
(This method, however, does not apply to product of which electrical characteristics differ from the TOSHIBA standard specification.)

[Example]

TA78L005AP TPE5

① ②--------② Indicates the taping specifications.

└--------------------① TOSHIBA's house No.

3. Taping Specifications

The taping is classified as shown in the table below according to the taping method and packaging method.

Table 2 Taping Specifications

Taping spec.	Taping Classification		Packaging Classification		Packaged Quantity (pcs)	Weight (g)
	Taping in forward direction	Taping in reverse direction	Ammo Pack Fan Fold Box	Reel		
TPE5	○			○	2,000	
TPER5		○		○	2,000	
TPE6	○		○		2,000	

4. Tape Dimensions

Tape is prepared in dimensions shown in Table 3, Fig. 1 and Fig. 2 using 2 kinds of taping classifications shown in Table 2 as the standard.

Table 3 Tape Dimensions (Common to Forward & Reverse Directions)

Unit in mm

Item	Symbol	Value & Tolerance	Remarks
Body width	A1	5.1 MAX.	
Body height	A	8.2 MAX.	
Body thickness	T	4.1 MAX.	
Lead wire diameter	d	0.60° MAX.	
Lead wire (tape portion)	ℓ1	3.5 MIN.	
Pitch of component	P	12.7±1.0	

Item	Symbol	Value & Tolerance	Remarks
Feed hole pitch	P0	12.7±0.3	1
Hole center to component center	P2	6.35±0.4	
Lead-to-lead distance	F1/F2	$2.5^{+0.6}_{-0.3}$	
Component alignment (1)	Δh	0±2.0	
Component alignment (2)	ΔP	0±1.0	
Tape width	W	$18.0^{+1.0}_{-0.5}$	
Hold-down tape width	W0	6.0±0.3	
Hole position	W1	9.0±0.5	
Hold-down tape position	W2	0.5 MAX.	
Height of component from tape center	H	20 MAX.	
Lead wire clinch height	H0	$16.3^{+0.2}_{-0.8}$	
Component height	H1	32.25 MAX.	
Feed hole diameter	D0	4.0±0.2	
Total tape thickness	t	0.6±0.2	2
Length of snipped lead	L1	11.0 MAX.	
Center lead wire (tape portion)	ℓ2	2.1 TYP.	

Note 1. Accumulated pitch tolerance is +1mm/20 pitch.

2. Board is 0.4±0.1mm in thickness.

4.1 Taping in forward direction

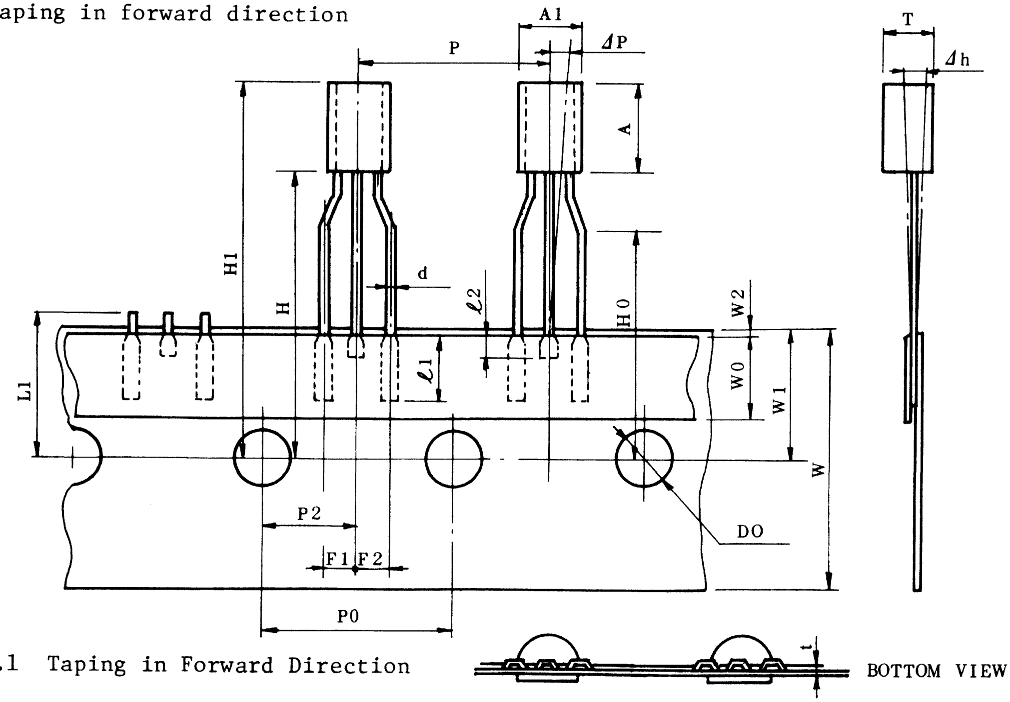


Fig.1 Taping in Forward Direction

4.2 Taping in reverse direction

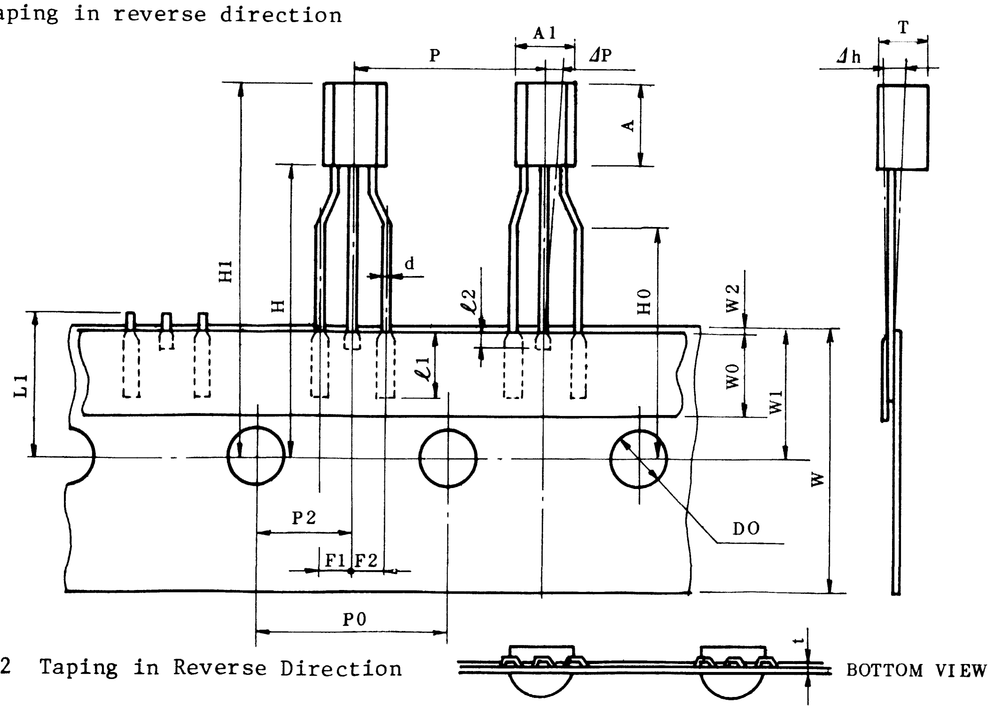


Fig.2 Taping in Reverse Direction

5. Packaging Method

5.1 Reel (TPE5, TPER5)

1) Reel dimensions

2) Pull-out polarity (Name of first-out electrode)

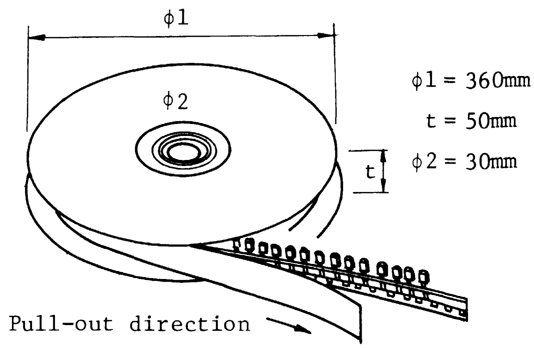


Fig.3 Winding Method and Dimensions of Reel

Table 4 Pull-out Polarity

Taping spec.	TA78LXXXAP	TA79LXXXP
	SSIP3-P	SSIP3-P
Taping in forward direction (TPE5)	OUTPUT	COMMON
Taping in reverse direction (TPER5)	INPUT	OUTPUT

5.2 Ammo Pack (TPE6)

1) Ammo Pack Method

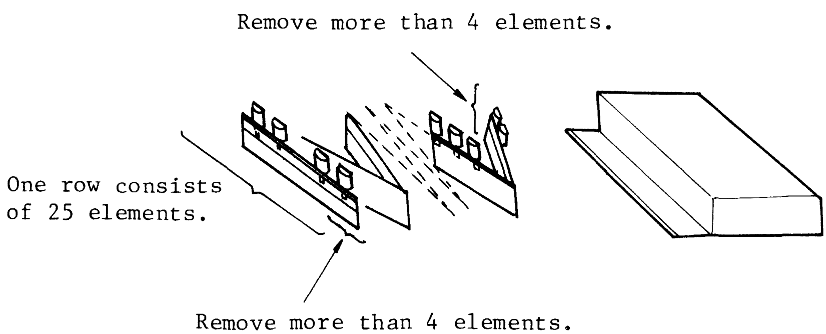
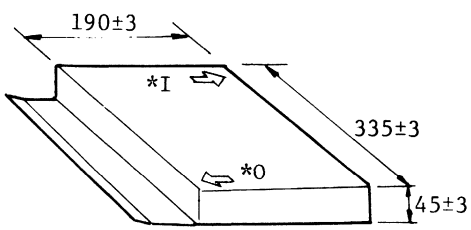


Fig.4 Ammo Pack Method

① Fold the taping in zigzag for every 25 elements in the tape dimensions shown in section 4.

② Remove more than 4 elements at the begining and ending of the taping.

2) Dimensions of package



(Unit in mm)

* shows a first-out electrode of a leads.

(Example)

O: Output first-out

I: Input first-out

Fig.5 Ammo Pack

3) Indication of pull-out polarity

(Symbol indication)

Table 5 Indication of Pull-out Polarity

	TA78LXXXAP	TA79LXXXP
	SSIP3-P	SSIP3-P
Abbreviation	I	O
	O	C

I: Input first-out

O: Output first-out

C: Common first-out

6. Other Standards

6.1 How to splice tape

A tape is cut and spliced with a splicing tape as illustrated below (when a tape is completed or cut).

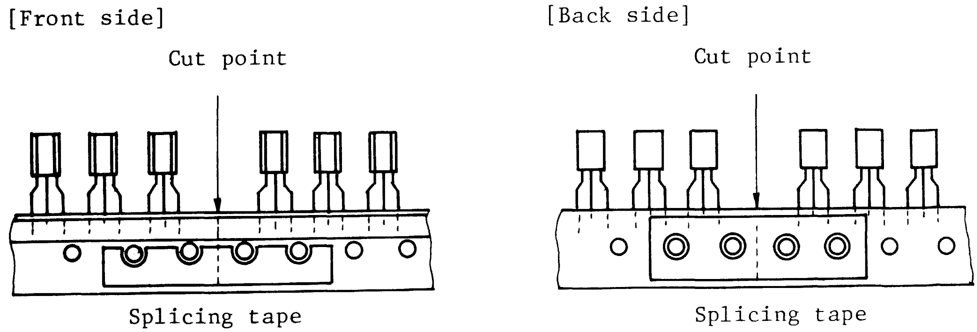


Fig.6 How to Splice Tape

6.2 Accuracy of splice

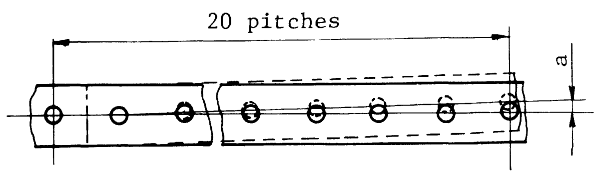


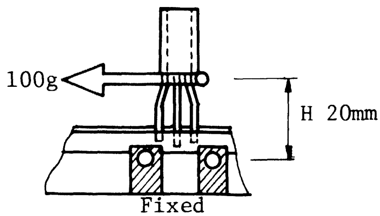
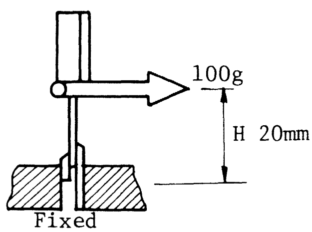
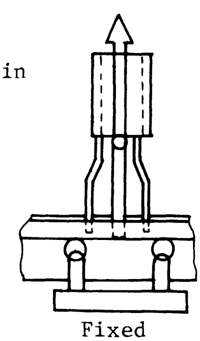
Fig.7 Splicing Accuracy

Dimension of "a" must be less than 1mm/20 pitches.

6.3 Falling off of element

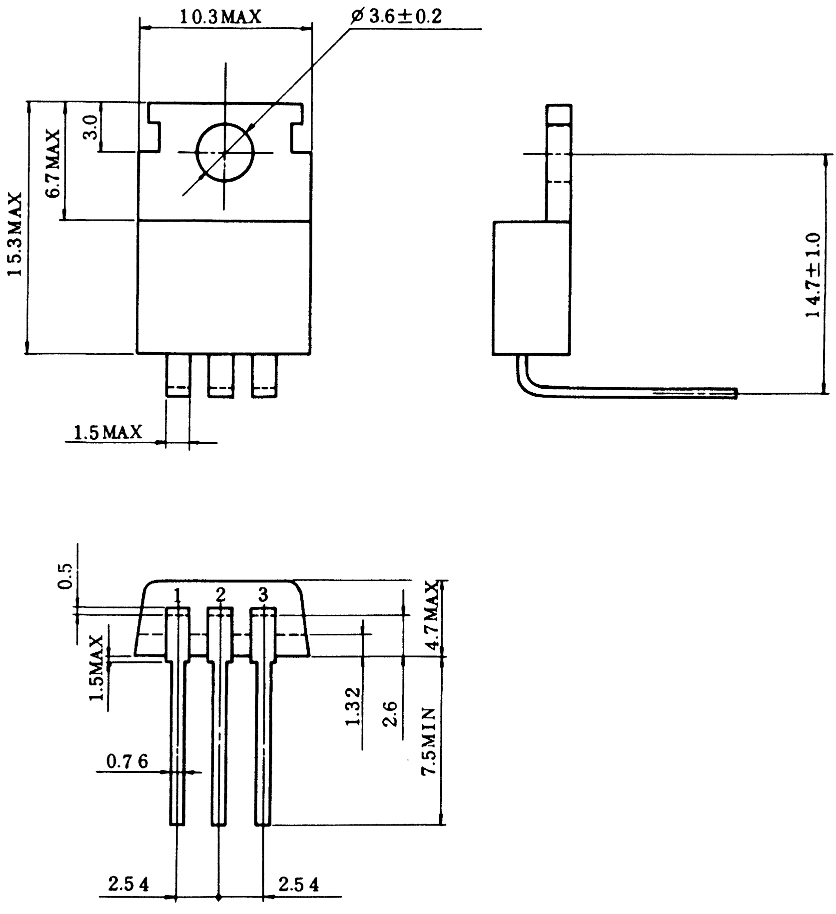
Falling off of element must be less than 3 continuous elements.

6.4 Taping element adherent strength test

Item	Test Method	Performance
Lead wire strength	i) Lateral direction  Apply a load of 100g in the direction of arrow for 3±1 sec.	The taping specifications must be satisfied.
	ii) Longitudinal direction  Apply a load of 100g in the direction of arrow for 3±1 sec.	The taping specifications must be satisfied.
Adhesiveness	i) Strength test Apply a load in the direction of arrow. 	More than 500g. Howver, lead wires should not shift or come off.
	ii) Life test Leave the taping in normak temperature and humidity for 6 months.	Performance in i) must be satisfied.

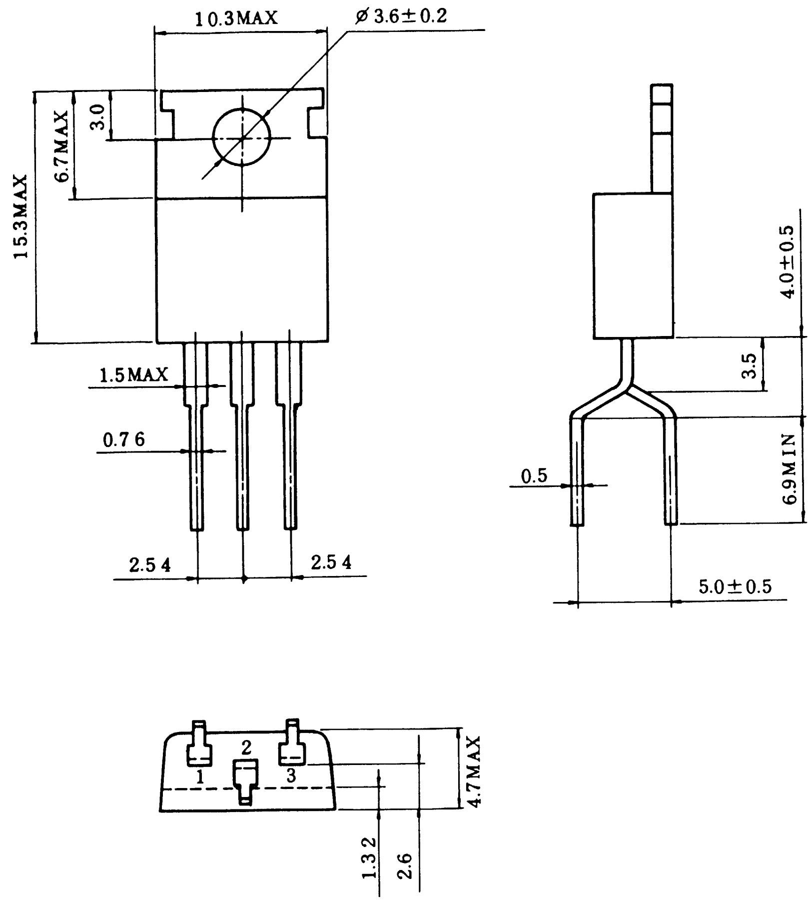
5. To-220AB Package Lead Forming Option

Unit in mm



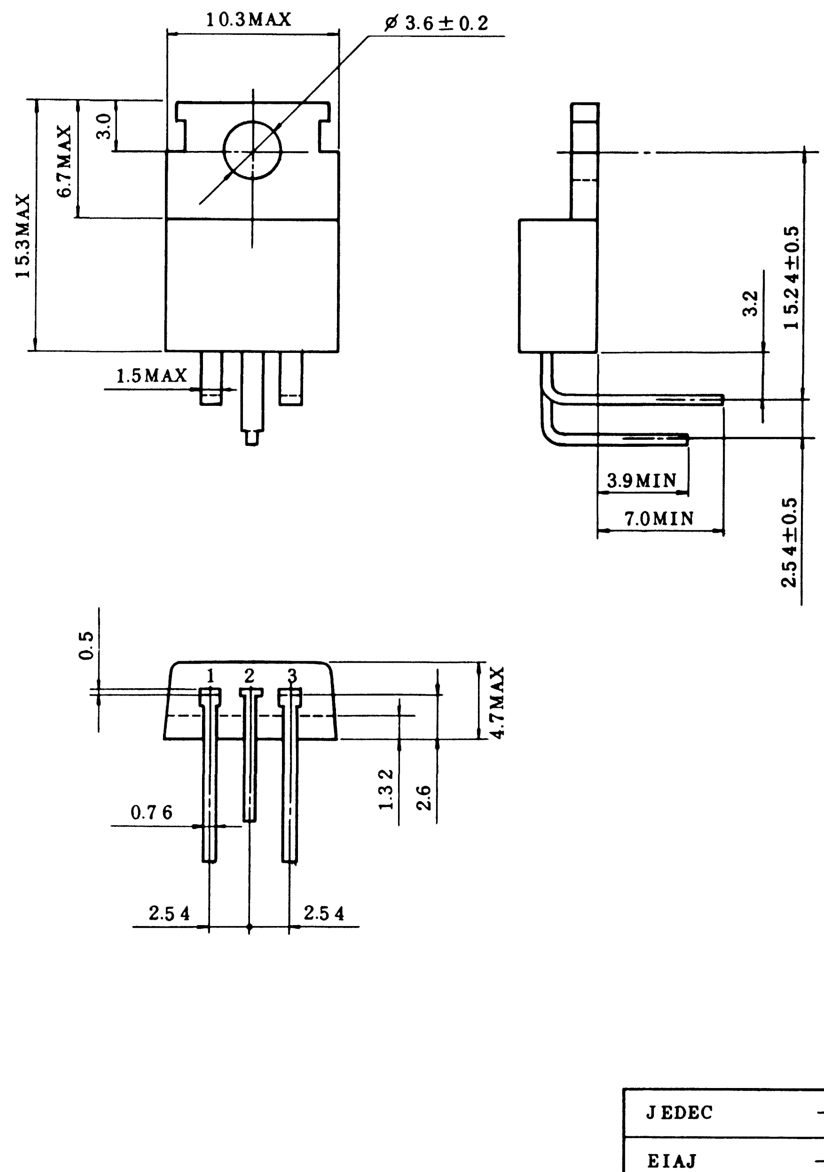
JEDEC	—
EIAJ	—
TOSHIBA	2-10A102A

Unit in mm



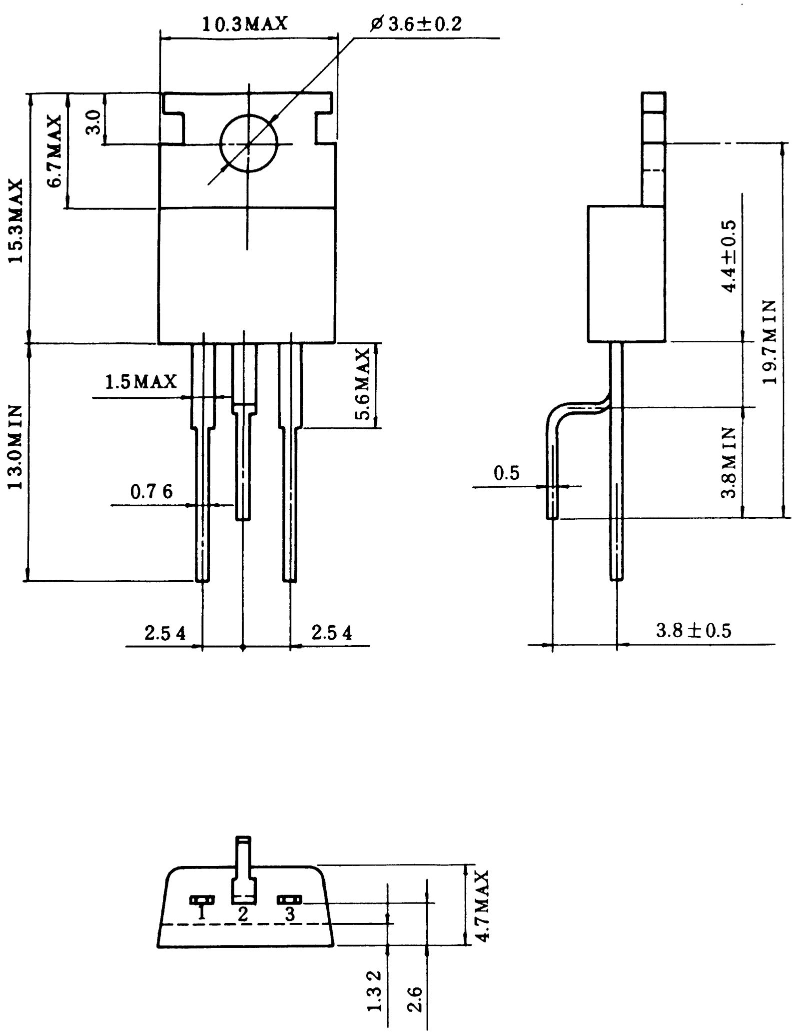
JEDEC	—
EIAJ	—
TOSHIBA	2-10A106A

Unit in mm



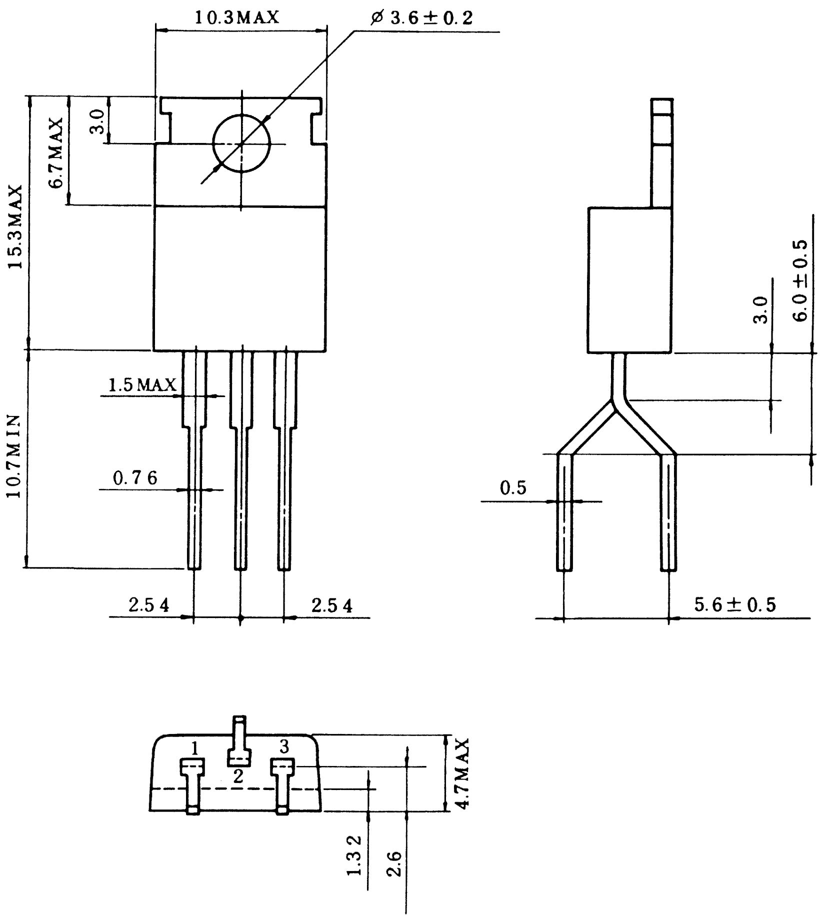
JEDEC	—
EIAJ	—
TOSHIBA	2-10A108A

Unit in mm



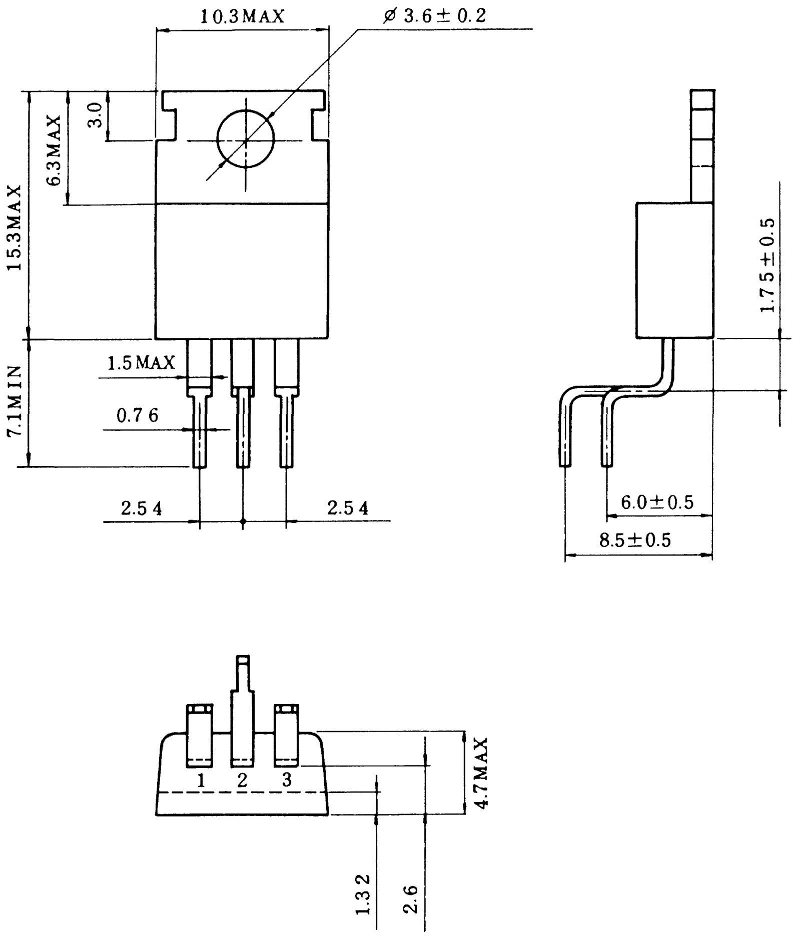
JEDEC	—
EIAJ	—
TOSHIBA	2-10A113A

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	2-10A120A

Unit in mm



JEDEC	—
EIAJ	—
TOSHIBA	2-10A130A

6. Handling Precautions for Surface Mounting Device

6. MOUNTING METHODS

6-1 Flat package (FLP)

(1) Mounting methods

The mounting methods that have been so far used for mini mold transistors and other surface mounting devices are also applicable to mounting Toshiba FLP Bipolar ICs. Use various mounting methods available selectively according to purpose.

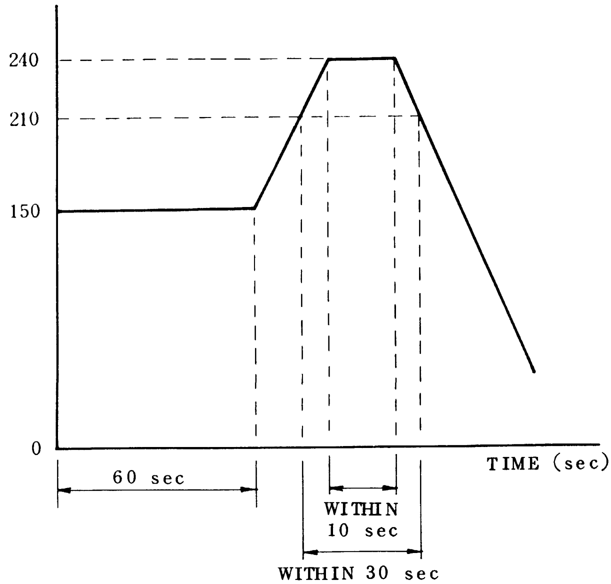
(1)-1 Method using a soldering iron

Fix FLP IC with flux, adhesives, etc. and solder it using a soldering iron with a fine pointed end and a solder in 0.5mmϕ or less at 260°C for 10 sec. or less and 350°C for 3 sec. or less. This method is not suited for mass production and should be restricted to laboratory use or repairs on the circuits.

(1)-2 Reflow soldering method

This is the most general method used for surface mounting device (IC, transistor, diode, resistor, etc.) on substrates and is suited for mass production. First, coat solder paste on the parts of a substrate where parts are mounted. When FLP IC is placed on it, IC is fixed with the solder paste. This solder is then melted and adhered through a temperature-controlled heating device (heating plate, conveyor type heater, etc.). 210°C~240°C will be an effective temperature range in this case. This method has a merit that the position shift caused when solder is melted is automatically corrected. A recommended temperature profile of the reflow method is shown in Fig. 19.
When the reflow method is used, substrates, etc. must be thoroughly preheated to remove their thermal strains. Further, when a infrared heater is used, the utmost care must be taken to temperature control by taking heat absorbing effect of black resin into consideration.

Fig. 19 Recommended Temperature Profile for Reflow Method



(1)-3 Conductive paste method

This method uses conductive paste instead of solder for mounting parts. This conductive paste is epoxy resin with gold or silver mixed. First, coat the paste on the contact section, arrange parts to be mounted, and heat them at 100°C~150°C for 1~3 hours. Now, the work is completed.

However, when compared with the soldering method, this method is inferior in the reliability of adhesion and it is therefore necessary to perform the work with the utmost care.

(2) Cautions for use

In using Toshiba FLP Bipolar ICs, it is necessary not only to observe cautions for using ordinary DIP Bipolar ICs but also to follow cautions shown below.

(2)-1 Temperature at soldering

ICs are exposed to high temperature when they are soldered. Basically, the lead section shall be soldered at 260°C for 10 sec. or less or at 350°C for 3 sec. or less in case of the soldering iron method, while atmospheric temperature around the resin surface shall be 240°C for 10 sec. or less and temperature at the lead section shall be 240°C for 10 sec. or less in case of the reflow method.
However, if resin is left under high temperature for a long time, its reliability may be adversely affected and it is therefore advisable to complete soldering in a short time as could as possible to prevent high temperature of resin.
Further, when an infrared heater is used, temperature may rise locally and therefore, it should be avoided to apply directly to the resin surface.

(2)-2 Kind of flux and cleaning

Flux in activated rosin composition is generally used for soldering. Whenever completing the soldering, wash away flux. If it is left, corrosion of leads or other problems may be caused. Especially, in case of chlorine flux its reliability can possible be affected adversely by residual chlorine and therefore, it should be avoided to use this type of flux.

(2)-3 Moisture resistance

FLP IC is generally thin in mold resin and short in a distance from the external lead to IC chip and therefore, when compared with ordincary DIP IC, there is a certain difference in threshold values of them in a moisture resistance test. Therefore, after Toshiba FLP Bipolar IC has been mounted on a printed wiring board (PWB), it should be avoided to use it in the state where the surface of IC is exposed directly to the air but the moisture preventive coating should be applied to IC.

However, when FLP Bipolar IC is used as a hybrid IC and is enclosed in a hermetic seal, coating is not required. Further, when it is sealed with resin after mounted, a resin having small coefficient of thermal expansion should be selected. However, it is another method to use a viscous resin as a buffer coat to minimize that effect. In any case, select a resin or coating material after consulting maker.

(2)-4 Pin-to-pin bridging

FLP IC has a narrower pin-to-pin space than ordinary DIP IC and pin-to-pin bridging is apt to be caused during soldering. Furthermore, there is the large possibility for pin-tp-pin short circuitry by adhesion of conductive dust and it is therefore necessary to carefully check these points.

(2)-5 Lead strength

As the leads of FLP IC are thinner than the leads of ordinary DIP IC and furthermore, they are formed in L-shape in order to mount on a flat substrate, if they are straightened, their strength may deteriorate.
If they are deformed as bending, tensile, torsional or other stress is applied, it is more difficult to restore them than DIP IC.

6-2 Power Mini Package

(1) General cautions

(1)-1 The external resin section of Power Mini Package is smaller in size than the package of conventional equivalent IC and there may be a certain different value between them in the marginal moisture resistance test.
Therefore, when used in the high temperature and high humidity conditions, it is necessary to coat the surface and circumference of IC with resin, etc.

(1)-2 Removal of flux after soldered

After Power Mini Package has been soldered on substrate, it is necessary to remove adhered flux by a treatment. If flux is left unremoved, the leads can be corroded by flux components or compound and it is therefore necessary to wash out residual flux.
Further, avoid to use inorganic flux as it is difficult to wash it away.

(1)-3 Handling of lead formed products

Leads of Power Mini IC among surface mounting devices may be deformed by a small force as IC itself is small in size. To prevent this, the following cautions shall be observed:

- Do not directly grasp IC with a bare hand but using a collect or equivalent jig, mount it on a substrate. Further, this method prevents contamination (by oil) on the lead soldered surface and makes it easy to carry out soldering.

- Do not apply a force more than 500g to the resin and lead sections when cleaning the PWB. Or the disconnection, improper soldering, etc. of leads may result.

- Ultrasonic washing of substrates
  When cleaning the PWB, avoid ultrasonic washing as could as possible. If it is unavoidable, wash it for a short time with an ultrasonic of small power.

(2) Cautions for mounting

- Preheating

When mounting Power Mini IC, preheating is needed.
The following preheating methods are available:

(2)-1 Preheating by heater

Heat to 100~150°C for more than 2 min. with an infrated heater or heating plate. If temperature rises rapidly (when it rises in a short time), internal chip may be damaged and therefore, temperature should be raised as gradually as possible.

(2)-2 Lamp heat method

This is a heating method using a parabolic type infrared lamp. Likewise in (2)-1, avoid rapid temperature raise by adjusting the focus of an infrared lamp, power, distance, etc.

(2)-3 Other methods

There are available the hot air heating and other methods. Basically, Power Mini IC shall be preheated under the conditions of 100~150°C for more than 2 min. as shown in (2)-1, above.

(3) Cautions for soldering

(3)-1 Allowable time and temperature for soldering

The relationship between allowable time and temperature (hot plate, solder) of soldering is as follows. Conditions shall be set up within the standard. (The soldering shall be performed according to the reflow method.)

- Power Mini IC

  Solder temperature 240°C .... within 10 sec.

  (However, the preheating process and number of soldering should be set limits to only one time.)

(3)-2 Solder to be used

Use a solder having a low melting point as could as possible. A solder that is generally used is a 6/3 or 6/4 solder having a melting point of about 190°C. Further, actual soldering conditions are generally 220°C~240°C for 3~5 sec.

Cautions for Solder Printing

When solder paste is printed according to the metal mask method, use newly compounded solder as could as possible so that to get the good quality of the finished solder joint. Further, in this solder printing, print thickness above 200mm is preferred.

(3)-3 Soldering using soldering iron

When ICs are soldered using a soldering iron, the device cannot be positioned accurately and damage of package is often caused so this method should therefore be restricted to laboratory use or repairs. When a soldering iron is used, pay attention to the following points:

- Temperature at the iron tip (when soldering) 260°C for 3 sec. or less
- Diameter of the iron tip 1mm or less
- The iron tip should not directly touch the resin section.

(3)-4 Relationship among soldering, preheating time and temperature

Relationship among preheating time, soldering time, and temperature is summarized and shown in Fig. 20.

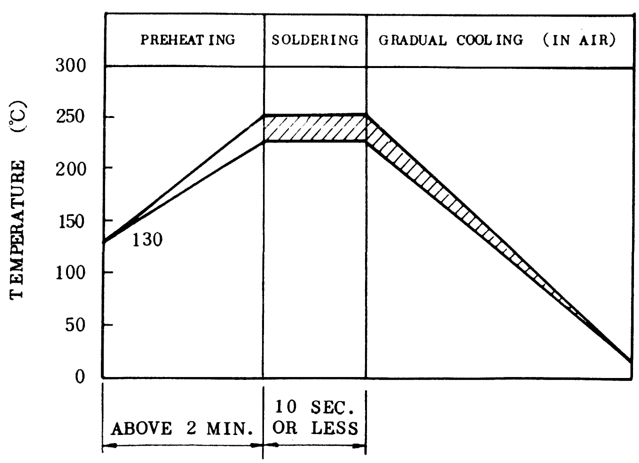


Fig.20 Reflow soldering method

(4) Power Mini IC (Equivalent to SOT-89)

Shown in Fig. 21 is an outline drawing of Power Mini IC. The resin section is as small as 2.8mm (length) 4.5mm (width) 1.5mm (thickness) with the fin (Ground terminal) projected directly to the outside. This IC can be soldered directly to a substrate and large collector power dissipation can be obtained. This IC is of flat package type with the three leads arranged on the same edge, and is easily mountable on a substrate. Fig. 21-(2) also shows its device marking example.

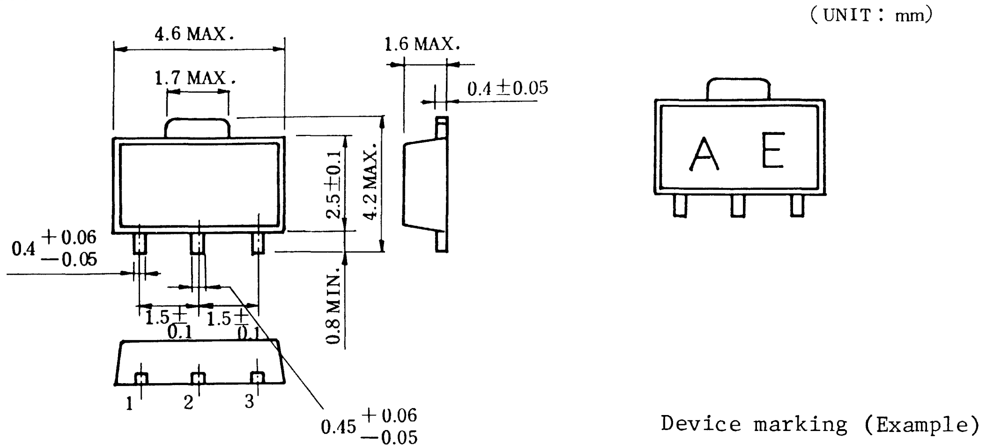


Fig.21 Power Mini IC Outline Drawing (equivalent to SOT-89)

Fig. 22 shows the recommended mounting pads. As power dissipation is largely affected by the area of the fin (Ground) connecting pad, it is advantageous to take the Ground pad area as wide as possible.

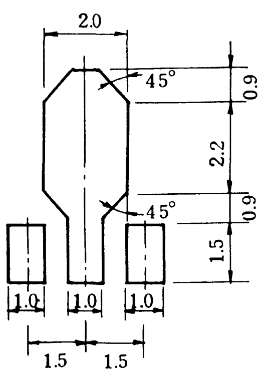


Fig.22 Recommended mounting pads

(5) Power dissipation (Pcmax) of Power Mini IC at free standing application is 500mW. However, when mounted on a substrate, thermal radiation from the fin to the substrate becomes large and power dissipation increases to as large as 1.0W~2.0W and a circuit design equivalent to TO-92MOD (800~900mW) or TO-126 (1.0~1.2W) becomes possible. Fig. 23 shows examples of allowable power dissipation of TA78L05F.

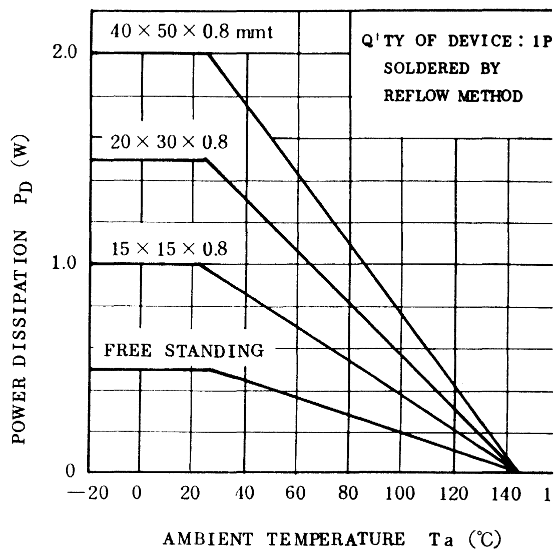


Fig.23 P_D(max) - Ta characteristic wher mounted on aluminium/ceramic substrate

Caution for Power Dissipation (in Transient State)

When used in a motor drive application, both power dissipation that can be applied in a short time and power dissipation under the steady state operation should be considered for the circuit design. The relationship between power dissipation and pulse width under the transient state is shown in Fig. 24.

(5)-1 Power Mini IC

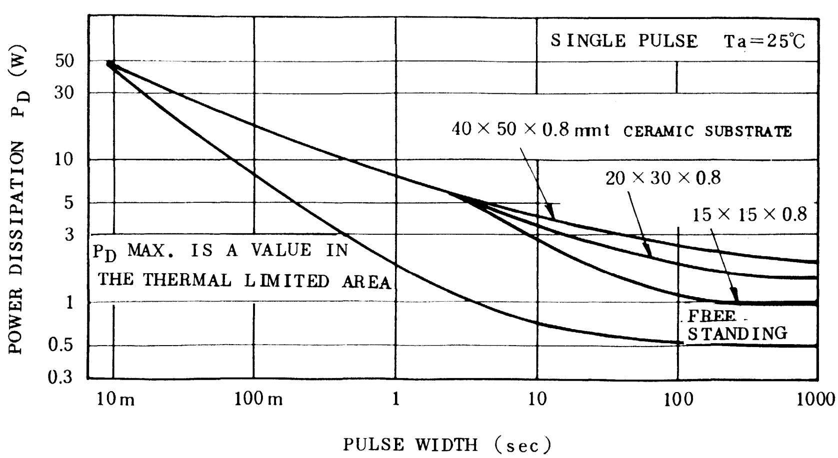


Fig.24 Power Dissipation in Transient State

7. Others

7-1 Thermal Consideration for Three-Terminal Regulator IC

7-2 Manufacturers Cross-reference Table

7-1 Thermal considerations for three-terminal regulator IC

(1) Power dissipation

Power dissipation of 3-terminal regulator IC is given by Expression (1).

$$P_D = V_{IN} \times I_B + (V_{IN} - V_{OUT}) \times I_{OUT} \quad \text{.............................} \quad (1)$$

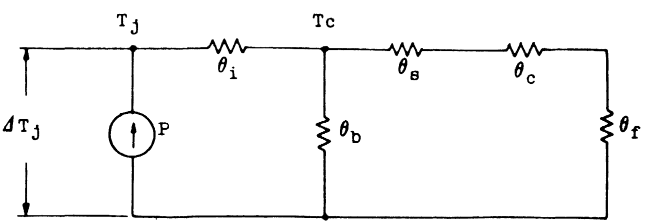
(2) Maximum power dissipation and thermal design

Maximum power dissipation (P_D MAX) of 3-terminal regulator IC is given by Expression (2) and (3) according to total thermal resistance (θja) from the junction to the ambient (open air) that is decided by ambient temperature (Ta) in which Power IC is used, maximum junction temperature (Tj MAX) of Power IC, and radiation condition that will be described below.

$$P_D \text{ MAX(Ta)} = \frac{Tj \text{ MAX} - Ta}{\theta_{ja}} \text{ (W)} \quad \text{..................................} \quad (2)$$

$$P_D \text{ MAX(Tc)} = \frac{Tj \text{ MAX} - Tc}{\theta_{jc}} \text{ (W)} \quad \text{..................................} \quad (3)$$

Then, a path to conduct heat generated in the inside of Power IC to the ambient is expressed by thermal resistance and thermal capacitance and in the thermally steady state it can be expressed by the equivalent circuit shown in Fig. 1



θi: Internal thermal resistance (from the junction to the package (Fin))
θb: External thermal resistance (from the package directly to the ambient)
θs: Thermal resistance of insulator.
θc: Contact thermal resistance (between the fin and the Heatsink)
θf: Thermal resistance of Heatsink

Fig.1 Thermal equivalent circuit

Total thermal resistance θja from the junction to ambient is given by Expression (4) from the equivalent circuit in Fig. 1.

$$\theta_{ja} = \theta_i + \frac{\theta_b(\theta_s + \theta_c + \theta_f)}{\theta_b + \theta_s + \theta_c + \theta_f} \quad \cdots\cdots (4)$$

TO-92 type regulator generally does not use a heatsink and therefore, θja will becomes as follows:

$$\theta_{ja} = \theta_i + \theta_b \quad \cdots\cdots (5)$$

Therefore, on a data sheet for TO-92 type 3-terminal regulator, maximum power dissipation at Ta=25°C is listed. However, unless otherwise specified, it shows a value given by Expression (6) from θja and Tj MAX given by Expression (5).

$$P_C\ MAX(Ta=25°C) = \frac{Tj\ MAX - 25}{\theta_{ja}} = \frac{Tj\ MAX - 25}{\theta_i + \theta_b} \quad \cdots\cdots (6)$$

Further, on a data sheet for TO-220 type 3-terminal regulator, maximum power dissipation at Tc=25°C is listed. This is a value when an infinite heatsink is used and it will be

$$\theta_s + \theta_c + \theta_f = \frac{1}{\infty} \quad \cdots\cdots (7)$$

Expression (1) will become

$$\theta_{ja} = \theta_i = \theta_{jc} \quad \cdots\cdots (8)$$

Therefore, maximum power dissipation of regulator IC in TO-220 shows a value given by the following expression:

$$P_C\ MAX(Tc=25°C) = \frac{Tj\ MAX - 25}{\theta_{jc}} = \frac{Tj\ MAX - 25}{\theta_i} \quad \cdots\cdots (9)$$

In view of above, thermal design to satisfy maximum ratings becomes possible by obtaining maximum allowable power dissipation and actual power consumption.

Manufacturers Cross-reference Table

Output Current	Toshiba Products	Reference Number									
		NEC	Matsushita	Hitachi	JRC	Mitsubishi	Sanyo	FAIRCHILD	N/S	MOTOROLA	T/I
1A	TA78000AP TA7800S	μPC7800H	AN7800	HA17800P	NJM7800A	M5F7800L	LA7800	μA7800UC	LM7800	MC7800CT	μA7800CKC
0.5A	TA78M00P	μPC78M00H	AN78M00	HA178M00P	NJM78M00A	M5F78M00L	LA78M00	μA78M00UC		MC78M00CT	μA78M00CKC
0.15A 0.1A	TA78L000AP TA78L00S*	μPC78L00H	AN78L00	HA178L00P	NJM78L00A	M5278L00		μA78L00AWC	LM78L00CZ	MC78L00CP	μA78L00CLP
1A	TA79000P TA79000S*	μPC7900H	AN7900	HA17900P	NJM7900A	M5F7900L		μA7900UC	LM7900	MC7900CT	μA7900CKC
0.1A	TA79L000P	μPC79L00J	AN79L00		NJM79L00A					MC79L00CP	μA79L00CLP
0.1A Shunt Regulator	TA76431S*	μPC1093			NJM431			μA431	LM336		TL431

*New Product

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Beavertown, OR 97006, U.S.A.
Tel.: (503) 629-0818 Fax: (503) 629-0827
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