PHILIPS

Data handbook

Electronic
components
and materials

Semiconductors

Part 5 November 1982

Field-effect transistors

SEMICONDUCTORS

PART 5 - NOVEMBER 1982

FIELD-EFFECT TRANSISTORS

DATA HANDBOOK SYSTEM

Our Data Handbook System is a comprehensive source of information on electronic components, subassemblies and materials; it is made up of four series of handbooks each comprising several parts.

ELECTRON TUBES	BLUE
SEMICONDUCTORS	RED
INTEGRATED CIRCUITS	PURPLE
COMPONENTS AND MATERIALS	GREEN

The several parts contain all pertinent data available at the time of publication, and each is revised and reissued periodically.

Where ratings or specifications differ from those published in the preceding edition they are pointed out by arrows. Where application information is given it is advisory and does not form part of the product specification.

If you need confirmation that the published data about any of our products are the latest available, please contact our representative. He is at your service and will be glad to answer your inquiries.

SEMICONDUCTORS (RED SERIES)

The red series of data handbooks is comprised of the following parts:

S1 **Diodes**
Small-signal germanium diodes, small-signal silicon diodes, voltage regulator diodes(< 1,5 W), voltage reference diodes, tuner diodes, rectifier diodes

S2 **Power diodes, thyristors, triacs**
Rectifier diodes, voltage regulator diodes (> 1,5 W), rectifier stacks, thyristors, triacs

S3 **Small-signal transistors**

S4 **Low-frequency power transistors and hybrid IC modules**

S5 **Field-effect transistors**

S6 **R.F. power transistors and modules**

S7 **Microminiature semiconductors for hybrid circuits**

S8 **Devices for optoelectronics**
Photosensitive diodes and transistors, light-emitting diodes, displays, photocouplers, infrared sensitive devices, photoconductive devices.

S9 Taken into handbook T11 of the blue series

S10 **Wideband transistors and wideband hybrid IC modules**

INTEGRATED CIRCUITS (PURPLE SERIES)

The purple series of data handbooks is comprised of the following parts:

IC1	**Bipolar ICs for radio and audio equipment**
IC2	**Bipolar ICs for video equipment**
IC3	**ICs for digital systems in radio, audio and video equipment**
IC4	**Digital integrated circuits** LOCMOS HE4000B family
IC5	**Digital integrated circuits – ECL** ECL10 000 (GX family), ECL100 000 (HX family), dedicated designs
IC6*	**Professional analogue integrated circuits**
IC7	**Signetics bipolar memories**
IC8	**Signetics analogue circuits**
IC9	**Signetics TTL logic**

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* This handbook will be available by the end of 1982.

COMPONENTS AND MATERIALS (GREEN SERIES)

The green series of data handbooks is comprised of the following parts:

C1	**Assemblies for industrial use** PLC modules, PC20 modules, HNIL FZ/30 series, NORbits 60-, 61-, 90-series, input devices, hybrid ICs, peripheral devices
C2	**Television tuners, video modulators, surface acoustic wave filters**
C3	**Loudspeakers**
C4	**Ferroxcube potcores, square cores and cross cores**
C5	**Ferroxcube for power, audio/video and accelerators**
C6	**Electric motors and accessories** Permanent magnet synchronous motors, stepping motors, direct current motors
C7	**Variable capacitors**
C8	**Variable mains transformers**
C9	**Piezoelectric quartz devices** Quartz crystal units, temperature compensated crystal oscillators, compact integrated oscillators, quartz crystal cuts for temperature measurements
C10	**Connectors**
C11	**Non-linear resistors** Voltage dependent resistors (VDR), light dependent resistors (LDR), negative temperature coefficient thermistors (NTC), positive temperature coefficient thermistors (PTC)
C12	**Variable resistors and test switches**
C13	**Fixed resistors**
C14	**Electrolytic and solid capacitors**
C15	**Film capacitors, ceramic capacitors**
C16	**Piezoelectric ceramics, permanent magnet materials**

ELECTRON TUBES (BLUE SERIES)

The blue series of data handbooks is comprised of the following parts:

T1	**Tubes for r.f. heating**
T2	**Transmitting tubes for communications**
T3	**Klystrons, travelling-wave tubes, microwave diodes**
ET3	**Special Quality tubes, miscellaneous devices** (will not be reprinted)
T4	**Magnetrons**
T5	**Cathode-ray tubes** Instrument tubes, monitor and display tubes, C.R. tubes for special applications
T6	**Geiger-Müller tubes**
T7	**Gas-filled tubes** Segment indicator tubes, indicator tubes, dry reed contact units, thyratrons, industrial rectifying tubes, ignitrons, high-voltage rectifying tubes, associated accessories
T8	**Picture tubes and components** Colour TV picture tubes, black and white TV picture tubes, colour monitor tubes for data graphic display, monochrome monitor tubes for data graphic display, components for colour television, components for black and white television and monochrome data graphic display
T9	**Photo and electron multipliers** Photomultiplier tubes, phototubes, single channel electron multipliers, channel electron multiplier plates
T10	**Camera tubes and accessories, image intensifiers**
T11*	**Microwave components and assemblies**

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* Will become available in the course of 1982.

INDEX OF TYPE NUMBERS

Data Handbooks S1 to S10

The inclusion of a type number in this publication does not necessarily imply its availability.

type no.	book	section
AA119	S1	GD
AAZ15	S1	GD
AAZ17	S1	GD
AAZ18	S1	GD
BA220	S1	SD
BA221	S1	SD
BA223	S1	T
BA243	S1	T
BA244	S1	T
BA280	S1	T
BA314	S1	Vrg
BA315	S1	Vrg
BA316	S1	SD
BA317	S1	SD
BA318	S1	SD
BA379	S1	T
BA423	S1	T
BA481	S1	T
BA482	S1	T
BA483	S1	T
BA484	S1	T
BAS11	S1	SD
BAS16	S7/S1	Mm/SD
BAS17	S7/S1	Mm/Vrg
BAS18	S1	SD
BAS19	S7/S1	Mm/SD
BAS20	S7/S1	Mm/SD
BAS21	S7/S1	Mm/SD
BAT17	S7/S1	Mm/T
BAT18	S7/S1	Mm/T
BAT81	S1	T
BAT82	S1	T
BAT83	S1	T
BAT85	S1	T
BAV10	S1	SD
BAV18	S1	SD
BAV19	S1	SD
BAV20	S1	SD
BAV21	S1	SD
BAV45	S1	Sp
BAV70	S7/S1	Mm/SD
BAV99	S7/S1	Mm/SD
BAW56	S7/S1	Mm/SD
BAW62	S1	SD
BAX12	S1	SD
BAX12A	S1	SD
BAX14	S1	SD
BAX18	S1	SD
BB105B	S1	T
BB105G	S1	T
BB109G	S1	T
BB112	S1	T
BB119	S1	T
BB130	S1	T
BB204B	S1	T
BB204G	S1	T
BB212	S1	T
BB405B	S1	T
BB405G	S1	T
BB417	S1	T
BB809	S1	T
BB909A	S1	T
BB909B	S1	T
BBY31	S7/S1	Mm/T
BBY40	S7/S1	Mm/T
BC107	S3	Sm
BC108	S3	Sm
BC109	S3	Sm
BC146	S3	Sm
BC177	S3	Sm
BC178	S3	Sm
BC179	S3	Sm
BC200	S3	Sm
BC264A	S5	FET
BC264B	S5	FET

FET = Field-effect transistors
GD = Germanium diodes
Mm = Microminiature semiconductors for hybrid circuits
SD = Small-signal diodes
Sm = Small-signal transistors
Sp = Special diodes
T = Tuner diodes
Vrg = Voltage regulator diodes

type no.	book	section
BC264C	S5	FET
BC264D	S5	FET
BC327;A	S3	Sm
BC328	S3	Sm
BC337;A	S3	Sm
BC338	S3	Sm
BC368	S3	Sm
BC369	S3	Sm
BC375	S3	Sm
BC376	S3	Sm
BC546	S3	Sm
BC547	S3	Sm
BC548	S3	Sm
BC549	S3	Sm
BC550	S3	Sm
BC556	S3	Sm
BC557	S3	Sm
BC558	S3	Sm
BC559	S3	Sm
BC560	S3	Sm
BC635	S3	Sm
BC636	S3	Sm
BC637	S3	Sm
BC638	S3	Sm
BC639	S3	Sm
BC640	S3	Sm
BCF29;R	S7	Mm
BCF30;R	S7	Mm
BCF32;R	S7	Mm
BCF33;R	S7	Mm
BCF70;R	S7	Mm
BCF81;R	S7	Mm
BCV71;R	S7	Mm
BCV72;R	S7	Mm
BCW29;R	S7	Mm
BCW30;R	S7	Mm
BCW31;R	S7	Mm
BCW32;R	S7	Mm
BCW33;R	S7	Mm
BCW60*	S7	Mm
BCW61*	S7	Mm
BCW69;R	S7	Mm
BCW70;R	S7	Mm
BCW71;R	S7	Mm
BCW72;R	S7	Mm
BCW81;R	S7	Mm
BCW89;R	S7	Mm
BCX17;R	S7	Mm
BCX18;R	S7	Mm
BCX19;R	S7	Mm
BCX20;R	S7	Mm
BCX51	S7	Mm
BCX52	S7	Mm
BCX53	S7	Mm
BCX54	S7	Mm
BCX55	S7	Mm
BCX56	S7	Mm
BCX70*	S7	Mm
BCX71*	S7	Mm
BCY56	S3	Sm
BCY57	S3	Sm
BCY58	S3	Sm
BCY59	S3	Sm
BCY70	S3	Sm
BCY71	S3	Sm
BCY72	S3	Sm
BCY78	S3	Sm
BCY79	S3	Sm
BCY87	S3	Sm
BCY88	S3	Sm
BCY89	S3	Sm
BD131	S4	P
BD132	S4	P
BD135	S4	P
BD136	S4	P
BD137	S4	P
BD138	S4	P
BD139	S4	P
BD140	S4	P
BD201	S4	P
BD202	S4	P
BD203	S4	P
BD204	S4	P
BD226	S4	P
BD227	S4	P
BD228	S4	P
BD229	S4	P
BD230	S4	P
BD231	S4	P
BD233	S4	P
BD234	S4	P
BD235	S4	P
BD236	S4	P
BD237	S4	P
BD238	S4	P
BD291	S4	P
BD292	S4	P
BD293	S4	P
BD294	S4	P
BD295	S4	P
BD296	S4	P
BD329	S4	P
BD330	S4	P
BD331	S4	P
BD332	S4	P
BD333	S4	P
BD334	S4	P
BD335	S4	P
BD336	S4	P
BD337	S4	P
BD338	S4	P
BD433	S4	P
BD434	S4	P
BD435	S4	P
BD436	S4	P
BD437	S4	P
BD438	S4	P
BD645	S4	P
BD646	S4	P
BD647	S4	P

* = series
FET = Field-effect transistors
Mm = Microminiature semiconductors for hybrid circuits
P = Low-frequency power transistors
Sm = Small-signal transistors

type no.	book	section	type no.	book	section	type no.	book	section
BD648	S4	P	BD940	S4	P	BDT42C	S4	P
BD649	S4	P	BD941	S4	P	BDT60	S4	P
BD650	S4	P	BD942	S4	P	BDT60A	S4	P
BD651	S4	P	BD943	S4	P	BDT60B	S4	P
BD652	S4	P	BD944	S4	P	BDT60C	S4	P
BD675	S4	P	BD945	S4	P	BDT61	S4	P
BD676	S4	P	BD946	S4	P	BDT61A	S4	P
BD677	S4	P	BD947	S4	P	BDT61B	S4	P
BD678	S4	P	BD948	S4	P	BDT61C	S4	P
BD679	S4	P	BD949	S4	P	BDT62	S4	P
BD680	S4	P	BD950	S4	P	BDT62A	S4	P
BD681	S4	P	BD951	S4	P	BDT62B	S4	P
BD682	S4	P	BD952	S4	P	BDT62C	S4	P
BD683	S4	P	BD953	S4	P	BDT63	S4	P
BD684	S4	P	BD954	S4	P	BDT63A	S4	P
BD813	S4	P	BD955	S4	P	BDT63B	S4	P
BD814	S4	P	BD956	S4	P	BDT63C	S4	P
BD815	S4	P	BDT29	S4	P	BDT64	S4	P
BD816	S4	P	BDT29A	S4	P	BDT64A	S4	P
BD817	S4	P	BDT29B	S4	P	BDT64B	S4	P
BD818	S4	P	BDT29C	S4	P	BDT64C	S4	P
BD825	S4	P	BDT30	S4	P	BDT65	S4	P
BD826	S4	P	BDT30A	S4	P	BDT65A	S4	P
BD827	S4	P	BDT30B	S4	P	BDT65B	S4	P
BD828	S4	P	BDT30C	S4	P	BDT65C	S4	P
BD829	S4	P	BDT31	S4	P	BDT91	S4	P
BD830	S4	P	BDT31A	S4	P	BDT92	S4	P
BD839	S4	P	BDT31B	S4	P	BDT93	S4	P
BD840	S4	P	BDT31C	S4	P	BDT94	S4	P
BD841	S4	P	BDT32	S4	P	BDT95	S4	P
BD842	S4	P	BDT32A	S4	P	BDT96	S4	P
BD843	S4	P	BDT32B	S4	P	BDV64	S4	P
BD844	S4	P	BDT32C	S4	P	BDV64A	S4	P
BD933	S4	P	BDT41	S4	P	BDV64B	S4	P
BD934	S4	P	BDT41A	S4	P	BDV64C	S4	P
BD935	S4	P	BDT41B	S4	P	BDV65	S4	P
BD936	S4	P	BDT41C	S4	P	BDV65A	S4	P
BD937	S4	P	BDT42	S4	P	BDV65B	S4	P
BD938	S4	P	BDT42A	S4	P	BDV65C	S4	P
BD939	S4	P	BDT42B	S4	P	BDV91	S4	P

P = Low-frequency power transistors

type no.	book	section	type no.	book	section	type no.	book	section
BDV92	S4	P	BDX67	S4	P	BF419	S4	P
BDV93	S4	P	BDX67A	S4	P	BF422	S3	Sm
BDV94	S4	P	BDX67B	S4	P	BF423	S3	Sm
BDV95	S4	P	BDX67C	S4	P	BF450	S3	Sm
BDV96	S4	P	BDX77	S4	P	BF451	S3	Sm
BDW55	S4	P	BDX78	S4	P	BF457	S4	P
BDW56	S4	P	BDX91	S4	P	BF458	S4	P
BDW57	S4	P	BDX92	S4	P	BF459	S4	P
BDW58	S4	P	BDX93	S4	P	BF469	S4	P
BDW59	S4	P	BDX94	S4	P	BF470	S4	P
BDW60	S4	P	BDX95	S4	P	BF471	S4	P
BDX35	S4	P	BDX96	S4	P	BF472	S4	P
BDX36	S4	P	BDY90	S4	P	BF480	S3	Sm
BDX37	S4	P	BDY90A	S4	P	BF494	S3	Sm
BDX42	S4	P	BDY91	S4	P	BF495	S3	Sm
BDX43	S4	P	BDY92	S4	P	BF496	S3	Sm
BDX44	S4	P	BF180	S3	Sm	BF510	S7	Mm
BDX45	S4	P	BF181	S3	Sm	BF511	S7	Mm
BDX46	S4	P	BF182	S3	Sm	BF512	S7	Mm
BDX47	S4	P	BF183	S3	Sm	BF513	S7	Mm
BDX62	S4	P	BF198	S3	Sm	BF536	S7	Mm
BDX62A	S4	P	BF199	S3	Sm	BF550;R	S7	Mm
BDX62B	S4	P	BF200	S3	Sm	BF569	S7	Mm
BDX62C	S4	P	BF240	S3	Sm	BF579	S7	Mm
BDX63	S4	P	BF241	S3	Sm	BF622	S7	Mm
BDX63A	S4	P	BF245A	S5	FET	BF623	S7	Mm
BDX63B	S4	P	BF245B	S5	FET	BF660;R	S7	Mm
BDX63C	S4	P	BF245C	S5	FET	BF767	S7	Mm
BDX64	S4	P	BF246A	S5	FET	BF819	S4	P
BDX64A	S4	P	BF246B	S5	FET	BF857	S4	P
BDX64B	S4	P	BF246C	S5	FET	BF858	S4	P
BDX64C	S4	P	BF256A	S5	FET	BF859	S4	P
BDX65	S4	P	BF256B	S5	FET	BF869	S4	P
BDX65A	S4	P	BF256C	S5	FET	BF870	S4	P
BDX65B	S4	P	BF324	S3	Sm	BF871	S4	P
BDX65C	S4	P	BF370	S3	Sm	BF872	S4	P
BDX66	S4	P	BF410A	S5	FET	BF926	S3	Sm
BDX66A	S4	P	BF410B	S5	FET	BF936	S3	Sm
BDX66B	S4	P	BF410C	S5	FET	BF939	S3	Sm
BDX66C	S4	P	BF410D	S5	FET	BF960	S5	FET

FET = Field-effect transistors
Mm = Microminiature semiconductors for hybrid circuits
P = Low-frequency power transistors
Sm = Small-signal transistors

FET = Field-effect transistors
Mm = Microminiature semiconductors for hybrid circuits
RFP = R.F. power transistors and modules
RT = Tripler
Sm = Small-signal transistors
ThM = Thyristor Modules
WBM = Wideband hybrid IC modules
WBT = Wideband hybrid IC modules

type no.	book	section	type no.	book	section	type no.	book	section
BGY59	S10	WBM	BLW91	S6	RFP	BLY92C	S6	RFP
BGY60	S10	WBM	BLW95	S6	RFP	BLY93A	S6	RFP
BGY74	S10	WBM	BLW96	S6	RFP	BLY93C	S6	RFP
BGY75	S10	WBM	BLW98	S6	RFP	BLY94	S6	RFP
BLV10	S6	RFP	BLX13	S6	RFP	BLY97	S6	RFP
BLV11	S6	RFP	BLX13C	S6	RFP	BPW22A	S8	PDT
BLV20	S6	RFP	BLX14	S6	RFP	BPW44	S8	PDT
BLV21	S6	RFP	BLX15	S6	RFP	BPW45	S8	PDT
BLV25	S6	RFP	BLX39	S6	RFP	BPW50	S8	PDT
BLV30	S6	RFP	BLX65	S6	RFP	BPX25	S8	PDT
BLV31	S6	RFP	BLX66	S6	RFP	BPX29	S8	PDT
BLV32F	S6	RFP	BLX67	S6	RFP	BPX40	S8	PDT
BLV33	S6	RFP	BLX68	S6	RFP	BPX41	S8	PDT
BLV33F	S6	RFP	BLX69A	S6	RFP	BPX42	S8	PDT
BLV36	S6	RFP	BLX91A	S6	RFP	BPX47B/18	S8	PDT
BLV57	S6	RFP	BLX92A	S6	RFP	BPX47B/20	S8	PDT
BLW29	S6	RFP	BLX93A	S6	RFP	BPX47C/36	S8	PDT
BLW31	S6	RFP	BLX94A	S6	RFP	BPX70	S8	PDT
BLW32	S6	RFP	BLX94C	S6	RFP	BPX71	S8	PDT
BLW33	S6	RFP	BLX95	S6	RFP	BPX72	S8	PDT
BLW34	S6	RFP	BLX96	S6	RFP	BPX95C	S8	PDT
BLW50F	S6	RFP	BLX97	S6	RFP	BR100/03	S2	Th
BLW60	S6	RFP	BLX98	S6	RFP	BR101	S3	Sm
BLW60C	S6	RFP	BLY33	S6	RFP	BRY39	S3	Sm
BLW64	S6	RFP	BLY34	S6	RFP	BRY56	S3	Sm
BLW75	S6	RFP	BLY35	S6	RFP	BRY61	S7	Mm
BLW76	S6	RFP	BLY36	S6	RFP	BSR12;R	S7	Mm
BLW77	S6	RFP	BLY83	S6	RFP	BSR13;R	S7	Mm
BLW78	S6	RFP	BLY84	S6	RFP	BSR14;R	S7	Mm
BLW79	S6	RFP	BLY85	S6	RFP	BSR15;R	S7	Mm
BLW80	S6	RFP	BLY87A	S6	RFP	BSR16;R	S7	Mm
BLW81	S6	RFP	BLY87C	S6	RFP	BSR17;R	S7	Mm
BLW82	S6	RFP	BLY88A	S6	RFP	BSR30	S7	Mm
BLW83	S6	RFP	BLY88C	S6	RFP	BSR31	S7	Mm
BLW84	S6	RFP	BLY89A	S6	RFP	BSR32	S7	Mm
BLW85	S6	RFP	BLY89C	S6	RFP	BSR33	S7	Mm
BLW86	S6	RFP	BLY90	S6	RFP	BSR40	S7	Mm
BLW87	S6	RFP	BLY91A	S6	RFP	BSR41	S7	Mm
BLW89	S6	RFP	BLY91C	S6	RFP	BSR42	S7	Mm
BLW90	S6	RFP	BLY92A	S6	RFP	BSR43	S7	Mm

Mm = Microminiature semiconductors for hybrid circuits
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type no.	book	section	type no.	book	section	type no.	book	section
BSR50	S3	Sm	BT136*	S2	Tri	BUV82	S4	P
BSR51	S3	Sm	BT137*	S2	Tri	BUV83	S4	P
BSR52	S3	Sm	BT138*	S2	Tri	BUW84	S4	P
BSR56	S7	Mm	BT139*	S2	Tri	BUW85	S4	P
BSR57	S7	Mm	BT149*	S2	Th	BUX46;A	S4	P
BSR58	S7	Mm	BT151*	S2	Th	BUX47;A	S4	P
BSR60	S3	Sm	BT152*	S2	Th	BUX48;A	S4	P
BSR61	S3	Sm	BT153	S2	Th	BUX80	S4	P
BSR62	S3	Sm	BT154	S2	Th	BUX81	S4	P
BSS38	S3	Sm	BT155*	S2	Th	BUX82	S4	P
BSS50	S3	Sm	BTV24*	S2	Th	BUX83	S4	P
BSS51	S3	Sm	BTV34*	S2	Tri	BUX84	S4	P
BSS52	S3	Sm	BTV58*	S2	Th	BUX85	S4	P
BSS60	S3	Sm	BTW23*	S2	Th	BUX86	S4	P
BSS61	S3	Sm	BTW30S*	S2	Th	BUX87	S4	P
BSS62	S3	Sm	BTW31W*	S2	Th	BUX98	S4	P
BSS63;R	S7	Mm	BTW38*	S2	Th	BUY89	S4	P
BSS64;R	S7	Mm	BTW40*	S2	Th	BY184	S1	R
BSS68	S3	Sm	BTW42*	S2	Th	BY188G	S1	R
BSV15	S3	Sm	BTW43*	S2	Tri	BY223	S2	R
BSV16	S3	Sm	BTW45*	S2	Th	BY224*	S2	R
BSV17	S3	Sm	BTW47*	S2	Th	BY225*	S2	R
BSV52;R	S7	Mm	BTW58*	S2	Th	BY228	S1	R
BSV64	S3	Sm	BTW63*	S2	Th	BY229*	S2	R
BSV78	S5	FET	BTW92*	S2	Th	BY249	S2	R
BSV79	S5	FET	BTX18*	S2	Th	BY260*	S2	R
BSV80	S5	FET	BTX94*	S2	Tri	BY261*	S2	R
BSV81	S5	FET	BTY79*	S2	Th	BY277*	S2	R
BSW66A	S3	Sm	BTY87*	S2	Th	BY438	S1	R
BSW67A	S3	Sm	BTY91*	S2	Th	BY448	S1	R
BSW68A	S3	Sm	BU208A	S4	P	BY458	S1	R
BSX19	S3	Sm	BU326	S4	P	BY476	S1	R
BSX20	S3	Sm	BU326A	S4	P	BY477	S1	R
BSX45	S3	Sm	BU426	S4	P	BY478	S1	R
BSX46	S3	Sm	BU426A	S4	P	BY505	S1	R
BSX47	S3	Sm	BU433	S4	P	BY509	S1	R
BSX59	S3	Sm	BUS11;A	S4	P	BY527	S1	R
BSX60	S3	Sm	BUS12;A	S4	P	BY584	S1	R
BSX61	S3	Sm	BUS13;A	S4	P	BY609	S1	R
BSY95A	S3	Sm	BUS14;A	S4	P	BY610	S1	R

* = series
FET = Field-effect transistors
Mm = Microminiature semiconductors for hybrid circuits
P = Low-frequency power transistors

R = Rectifier diodes
Sm = Small-signal transistors
Th = Thyristors
Tri = Triacs

type no.	book	section	type no.	book	section	type no.	book	section
BYV20	S2	R	BYX46*	S2	R	BZY93*	S2	Vrg
BYV21*	S2	R	BYX49*	S2	R	BZY95*	S2	Vrg
BYV22	S2	R	BYX50*	S2	R	BZY96*	S2	Vrg
BYV23	S2	R	BYX52*	S2	R	CNX21	S8	PhC
BYV24	S2	R	BYX56*	S2	R	CNX35	S8	PhC
BYV27	S1	R	BYX71*	S2	R	CNX36	S8	PhC
BYV28	S1	R	BYX90	S1	R	CNX38	S8	PhC
BYV30*	S2	R	BYX91*	S1	R	CNY48	S8	PhC
BYV32*	S2	R	BYX94	S1	R	CNY50	S8	PhC
BYV92*	S2	R	BYX96*	S2	R	CNY52	S8	PhC
BYV95A	S1	R	BYX97*	S2	R	CNY53	S8	PhC
BYV95B	S1	R	BYX98*	S2	R	CNY57	S8	PhC
BYV95C	S1	R	BYX99*	S2	R	CNY57A	S8	PhC
BYV96D	S1	R	BZT03	S1	Vrg	CNY62	S8	PhC
BYV96E	S1	R	BZV10	S1	Vrf	CNY63	S8	PhC
BYW19*	S2	R	BZV11	S1	Vrf	CQ209S	S8	D
BYW25	S2	R	BZV12	S1	Vrf	CQ216X	S8	D
BYW29*	S2	R	BZV13	S1	Vrf	CQ216Y	S8	D
BYW30*	S2	R	BZV14	S1	Vrf	CQ327;R	S8	D
BYW31*	S2	R	BZV15*	S2	Vrg	CQ330;R	S8	D
BYW54	S1	R	BZV37	S1	Vrf	CQ331;R	S8	D
BYW55	S1	R	BZV46	S1	Vrg	CQ332;R	S8	D
BYW56	S1	R	BZV49	S1	Vrg	CQ427;R	S8	D
BYW92*	S2	R	BZV85	S1	Vrg	CQ430;R	S8	D
BYW93*	S2	R	BZW70*	S2	TS	CQ431;R	S8	D
BYW94*	S2	R	BZW86*	S2	TS	CQ432;R	S8	D
BYW95A	S1	R	BZW91*	S2	TS	CQL10	S8	LED
BYW95B	S1	R	BZX55	S1	Vrg	CQW10	S8	LED
BYW95C	S1	R	BZX70*	S2	Vrg	CQW11	S8	LED
BYW96D	S1	R	BZX75	S1	Vrg	CQW12	S8	LED
BYW96E	S1	R	BZX78*	S7/S1	Mm/Vrg	CQX10	S8	LED
BYX10	S1	R	BZX79*	S1	Vrg	CQX11	S8	LED
BYX22*	S2	R	BZX84*	S7/S1	Mm/Vrg	CQX12	S8	LED
BYX25*	S2	R	BZX87*	S1	Vrg	CQX51	S8	LED
BYX30*	S2	R	BZX90	S1	Vrf	CQX54	S8	LED
BYX32*	S2	R	BZX91	S1	Vrf	CQX55	S8	LED
BYX38*	S2	R	BZX92	S1	Vrf	CQX56	S8	LED
BYX39*	S2	R	BZX93	S1	Vrf	CQX57	S8	LED
BYX42*	S2	R	BZX94	S1	Vrf	CQX58	S8	LED
BYX45*	S2	R	BZY91*	S2	Vrg	CQX60	S8	LED

* = series
D = Displays
LED = Light emittting diodes
Mm = Microminiature semiconductors for hybrid circuits
PhC = Photocouplers
R = Rectifier diodes
TS = Transient suppressor diodes
Vrf = Voltage reference diodes
Vrg = Voltage regulator diodes

type no.	book	section
CQX61	S8	LED
CQX62	S8	LED
CQX63	S8	LED
CQX64	S8	LED
CQX65	S8	LED
CQX66	S8	LED
CQX67	S8	LED
CQX68	S8	LED
CQX74	S8	LED
CQX75	S8	LED
CQX76	S8	LED
CQX77	S8	LED
CQX78	S8	LED
CQY11B	S8	LED
CQY11C	S8	LED
CQY24B	S8	LED
CQY49B	S8	LED
CQY49C	S8	LED
CQY50	S8	LED
CQY52	S8	LED
CQY54	S8	LED
CQY58A	S8	LED
CQY89A	S8	LED
CQY94	S8	LED
CQY95	S8	LED
CQY96	S8	LED
CQY97	S8	LED
OA90	S1	GD
OA91	S1	GD
OA95	S1	GD
OM320	S10	WBM
OM321	S10	WBM
OM322	S10	WBM
OM323	S10	WBM
OM323A	S10	WBM
OM335	S10	WBM
OM336	S10	WBM
OM337	S10	WBM
OM337A	S10	WBM
OM339	S10	WBM
OM345	S10	WBM
OM350	S10	WBM
OM360	S10	WBM
OM361	S10	WBM
OM370	S10	WBM
OM931	S4	P
OM961	S4	P
ORP60	S8	Ph
ORP61	S8	Ph
ORP62	S8	Ph
ORP66	S8	Ph
ORP68	S8	Ph
ORP69	S8	Ph
OSB9110	S2	St
OSB9210	S2	St
OSB9410	S2	St
OSM9110	S2	St
OSM9210	S2	St
OSM9410	S2	St
OSM9510	S2	St
OSM9511	S2	St
OSM9512	S2	St
OSS9110	S2	St
OSS9210	S2	St
OSS9410	S2	St
PH2222;R	S3	Sm
PH2222A;R	S3	Sm
PH2369	S3	Sm
PH2907;R	S3	Sm
PH2907A;R	S3	Sm
PH40*	S2	R
PH70*	S2	R
RPY58A	S8	Ph
RPY82	S8	Ph
RPY84	S8	Ph
RPY85	S8	Ph
RPY86	S8	I
RPY87	S8	I
RPY88	S8	I
RPY89	S8	I
RPY90*	S8	I
RPY91*	S8	I
RPY93	S8	I
RPY96	S8	I
1N821;A	S1	Vrf
1N823;A	S1	Vrf
1N825;A	S1	Vrf
1N827;A	S1	Vrf
1N829;A	S1	Vrf
1N914	S1	SD
1N916	S1	SD
1N3879	S2	R
1N3880	S2	R
1N3881	S2	R
1N3882	S2	R
1N3889	S2	R
1N3890	S2	R
1N3891	S2	R
1N3892	S2	R
1N3899	S2	R
1N3900	S2	R
1N3901	S2	R
1N3902	S2	R
1N3903	S2	R
1N3909	S2	R
1N3910	S2	R
1N3911	S2	R
1N3912	S2	R
1N3913	S2	R
1N4001G	S1	R
1N4002G	S1	R
1N4003G	S1	R
1N4004G	S1	R
1N4005G	S1	R
1N4006G	S1	R
1N4007G	S1	R
1N4148	S1	SD
1N4150	S1	SD
1N4151	S1	SD
1N4154	S1	SD

FET = Field-effect transistors
GD = Germanium diodes
I = Infrared devices
LED = Light emitting diodes
P = Low-frequency power transistors
Ph = Photoconductive devices
R = Rectifier diodes
SD = Small-signal diodes
Sm = Small-signal transistors
St = Rectifier stacks
Vrf = Voltage reference diodes
WBM = Wideband hybrid IC modules

type no.	book	section
1N4446	S1	SD
1N4448	S1	SD
1N4531	S1	SD
1N4532	S1	SD
1N5059	S1	R
1N5060	S1	R
1N5061	S1	R
1N5062	S1	R
2N918	S10	WBT
2N929	S3	Sm
2N930	S3	Sm
2N1613	S3	Sm
2N1711	S3	Sm
2N1893	S3	Sm
2N2218	S3	Sm
2N2218A	S3	Sm
2N2219	S3	Sm
2N2219A	S3	Sm
2N2221	S3	Sm
2N2221A	S3	Sm
2N2222	S3	Sm
2N2222A	S3	Sm
2N2297	S3	Sm
2N2368	S3	Sm
2N2369	S3	Sm
2N2369A	S3	Sm
2N2483	S3	Sm
2N2484	S3	Sm
2N2904	S3	Sm
2N2904A	S3	Sm
2N2905	S3	Sm
2N2905A	S3	Sm
2N2906	S3	Sm
2N2906A	S3	Sm
2N2907	S3	Sm
2N2907A	S3	Sm
2N3019	S3	Sm
2N3020	S3	Sm
2N3053	S3	Sm
2N3375	S6	RFP
2N3553	S6	RFP
2N3632	S6	RFP
2N3822	S5	FET
2N3823	S5	FET
2N3866	S6	RFP
2N3903	S3	Sm
2N3904	S3	Sm
2N3905	S3	Sm
2N3906	S3	Sm
2N3924	S6	RFP
2N3926	S6	RFP
2N3927	S6	RFP
2N3966	S5	FET
2N4030	S3	Sm
2N4031	S3	Sm
2N4032	S3	Sm
2N4033	S3	Sm
2N4091	S5	FET
2N4092	S5	FET
2N4093	S5	FET
2N4123	S3	Sm
2N4124	S3	Sm
2N4125	S3	Sm
2N4126	S3	Sm
2N4391	S5	FET
2N4392	S5	FET
2N4393	S5	FET
2N4427	S6	RFP
2N4856	S5	FET
2N4857	S5	FET
2N4858	S5	FET
2N4859	S5	FET
2N4860	S5	FET
2N4861	S5	FET
2N5415	S3	Sm
2N5416	S3	Sm
61SV	S8	I
368BPY	S8	PDT
56201d	S4	A
56201j	S4	A
56230	S2	HE
56231	S2	HE
56245	S3,6,10	A
56246	S3,5,10	A
56253	S2	DH
56256	S2	DH
56261a	S4	A
56262A	S2	A
56264A	S2	A
56268	S2	DH
56290	S2	HE
56295	S2	A
56312	S2	DH
56313	S2	DH
56316	S2	A
56317	S2	A
56326	S4	A
56333	S4	A
56339	S4	A
56348	S2	DH
56350	S2	DH
56352	S4	A
56353	S4	A
56354	S4	A
56359b	S4	A
56359c	S4	A
56359d	S4	A
56360a	S4	A
56363	S2,S4	A
56364	S2,S4	A
56366	S2	A
56367	S2,S4	A
56368a	S4	A
56368b	S4	A
56369	S2,S4	A
56378	S4	A
56378	S4	A
56379	S4	A
56387a,b	S4	A

A = Accessories
DH = Diecast heatsinks
FET = Field-effect transistors
HE = Heatsink extrusions
I = Infrared devices
PDT = Photodiodes or transistors
R = Rectifier diodes
RFP = R.F. power transistors and modules
SD = Small-signal diodes
Sm = Small-signal transistors
WBT = Wideband hybrid IC modules

TYPE NUMBER SURVEY
CONVERSION LIST
SELECTION GUIDE

In this alphanumeric list we present all n-channel field-effect transistors mentioned in this handbook.

type number	envelope	± V_{DS} max. V	I_{DSS} mA
BC264A	TO-92 var.	30	2,0 - 4,5
BC624B			3,5 - 6,5
BC264C			5,0 - 8,0
BC264D			7,0 - 12,0
BF245A	TO-92 var.	30	2,0 - 6,5
BF245B			6,0 - 15,0
BF245C			12 - 25
BF246A	TO-92 var.	25	30 - 80
BF246B			60 - 140
BF246C			110-250
BF256A	TO-92 var.	30	3 - 7
BF256B			6 - 13
BF256C			11 - 18
BF410A	TO-92 var.	20*	0,7 - 3,0
BF410B			2,5 - 7,0
BF410C			6 - 12
BF410D			10 - 18
BF960	SOT-103	20	2 - 20
BF964	SOT-103	20	2 - 20
BF966	SOT-103	20	2 - 20
BF980	SOT-103	18	-
BF981	SOT-103	20	4 - 25
BF982	SOT-103	20	-
BFQ10	TO-71	30	0,5 - 10
BFQ11			
BFQ12			
BFQ13			
BFQ14			
BFQ15			
BFQ16			
BFR29	TO-72	30**	10 - 40
BFR84	TO-72	20	20 - 55

type number	envelope	±V_{DS} max. V	I_{DSS} mA
BFS21	SOT-52	30	> 1
BFS21A			
BFW10	TO-72	30	8 - 20
BFW11			4 - 10
BFW12	TO-72	30	1 - 5
BFW13			0,2 - 1,5
BFW61	TO-72	25	2 - 20
BSV78	TO-18	40	> 50
BSV79			> 20
BSV80			> 10
BSV81	TO-72	30**	–
2N3822	TO-72	50	2 - 10
2N3823	TO-72	30	4 - 20
2N3966	TO-72	30	> 2
2N4091	TO-18	40	> 30
2N4092			> 15
2N4093			> 8
2N4391	TO-18	40	> 50
2N4392			> 25
2N4393			> 5
2N4856	TO-18	40	> 50
2N4857		40	> 20
2N4858		40	> 8
2N4859		30	> 50
2N4860		30	> 20
2N4861		30	> 8

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* Asymmetrical.

** V_{DB}.

N-channel junction FETs available in SOT-23 envelopes. For full data please refer to Handbook S7 (microminiature semiconductors).

conventional type	nearest microminiature type and corresponding marking code (..)	V_{DS} V	I_{DSS} mA
BF410A	BF510 (S6)	20	0,7 - 3,0
BF410B	BF511 (S7)	20	2,5 - 7,0
BF410C	BF512 (S8)	20	6 - 12
BF410D	BF513 (S9)	20	10 - 18
BFW11	BFR30 (M1)	± 25	4 - 10
BFW12	BFR31 (M2)	± 25	1 - 5
BFW13	BFT46 (M3)	± 25	0,2 - 1,5
2N4856	BSR56 (M4)	± 40	50
2N4857	BSR57 (M5)	± 40	20 - 100
2N4858	BSR58 (M6)	± 40	8 - 80

Dual-gate N-channel MOS-FETs available in SOT-143 envelopes. For full data please see Handbook S7 (microminiature semiconductors).

conventional type	nearest microminiature type and corresponding marking code (..)	V_{DS} V	y_{fs} mA/V
BF960	BF989 (M89)	20	12
BF964	BF994 (M94)	20	17
BF966	BF996 (M96)	20	17
BF980	BF990 (M90)	18	19
BF981	BF991 (M91)	20	14
BF982	BF992 (M8)	20	25

N-channel junction field-effect transistors

type number	envelope	RATINGS			CHARACTERISTICS							remarks
		± V_{DS} V	P_{tot} at mW	T_{amb} °C	$-I_{GSS}$ max. nA	I_{DSS} min.-max. mA	$-V_{(P)GS}$ max. V	$\|y_{fs}\|$ min. f = 1 kHz mA/V	C_{rs} typ. pF	F typ. dB	V_n max. μV	
BC264A	TO-92 var.	30	300	25	10	2,0-4,5	> 0,5	2,5	1,2	0,5	—	hi-fi amplifiers and a.f. equipment
BC264B						3,5-6,5		3,0				
BC264C						5,0-8,0		3,5				
BC264D						7,0-12,0		4,0				
BF245A	TO-92 var.	30	300	75	5	2,0-6,5	8,0	3,0-6,5	1,1	1,5	—	d.c., l.f. and h.f. amp.
BF245B						6-15						
BF245C						12-25						
BF246A	TO-92	25	300	75	5	30-80	0,6-14,5	8	3,5	—	—	v.h.f. and u.h.f. amp. general purpose sw.
BF246B						60-140						
BF246C						110-250						
BF256A	TO-92 var.	30	300	75	5	3-7	—	4,5	0,7	7,5	—	v.h.f. and u.h.f. appl.
BF256B						6-13						
BF256C						11-18						
BF410A	TO-92 var.	20*	300	75	10	0,7-3,0	typ. 0,8	2,5	0,3	1,5	—	r.f. stages f.m. portables
BF410B						2,5-7,0	typ. 1,5	4,0				r.f. stages car radios
BF410C						6-12	typ. 2,2	6,0				r.f. stages mains radios
BF410D						10-18	typ. 3,0	7,0				mixer stages
BFW10	TO-72	30	300	25	0,1	8-20	8	3,5-6,5	0,6	< 2,5		broad band up to 300 MHz and differential amp.
BFW11						4-10	6	3,0-6,5				
BFW12	TO-72	30	150	110	0,1	1-5	2,5	2,0	< 0,8	—	0,5	low current-low voltage applications
BFW13						0,2-1,5	1,2	1,0				
BFW61	TO-72	25	300	25	1,0	2-20	8	2,0-6,5	< 2,0	—	—	general purpose amp.
2N3822	TO-72	50	300	25	0,1	2-10	6	3,0-6,5	< 3,0	< 5	—	general purpose h.f. amp.
2N3823	TO-72	30	300	25	0,5	4-20	8	3,5-6,5	< 2,0	< 2,5	—	industrial i.f./r.f. amp.

* Asymmetrical.

Dual-gate N-channel MOS-FETS

type number	envelope	RATINGS V_{DB} V_{SB} V	V_{DS} V	P_{tot} at T_{amb} mW	 °C	CHARACTERISTICS ± I_{GSS} max. pA	± $I_{G1\text{-}SS}$ ± $I_{G2\text{-}SS}$ max. nA	I_{DSS} mA	$-V_{(P)GS}$ $-V_{(P)G1\text{-}S}$ V	$\lvert y_{fs} \rvert$ f = 1 kHz min. mA/V	C_{rs} typ. fF	F max. dB	remarks
BF960*	SOT-103	–	20	225	75	–	50	2-20	< 3,5	9,5	25	2,8**	r.f. stage - UHF TV tuner
BF964*	SOT-103	–	20	225	75	–	50	2-20	< 2,5	15	25	2,8	r.f./mixer stage VHF TV tuner
BF966*	SOT-103	–	20	225	75	–	50	2-20	< 2,5	15	25	3,9	r.f. stage UHF TV tuner
BF980*	SOT-103	–	18	225	75	–	25	–	< 1,3	17	25	2,8**	r.f. stage UHF TV tuner
BF981*	SOT-103	–	20	225	75	–	50	4-25	< 2,5	10	20	2,0	r.f./mixer stage VHF TV tuner
BF982*	SOT-103	–	20	225	75	–	25	–	< 1,3	20	30	1,2**	r.f./mixer stage VHF TV tuner and FM radio tuner
BFR84*	TO-72	–	20	300	25	–	10	20-55	1,5-3,8	12	30	3,0	general industrial

N-channel junction field-effect transistors for switching

type number	envelope	RATINGS ± V_{DS} V	P_{tot} at T_{amb} mW	(T_{case}) °C	CHARACTERISTICS $-I_{GSS}$ (I_{SGO}) max. pA	I_{DSS} min. mA	$-V_{(P)GS}$ max. V	$r_{ds\ on}$ max. Ω	C_{rs} max. pF	t_{on} max. ns	t_{off} max. ns
BSV78	TO-18	40	350	25	250	50	11	25	5	10	10
BSV79						20	7,0	40		18	16
BSV80						10	5,0	60		30	32
2N3966	TO-72	30	300	25	100	2	6	220	1,5	120	100
2N4091	TO-18	40	1800	(25)	200	30	10	30	5	25	40
2N4092						15	7,0	50		35	60
2N4093						8	5,0	80		60	80
2N4391	TO-18	40	1800	(25)	100	50	10	30	3,5	15	20
2N4392						25	5,0	60			35
2N4393						5	3,0	100			50

N-channel junction field-effect transistors for switching

		RATINGS			CHARACTERISTICS						
type number	envelope	$\pm V_{DS}$	P_{tot} at T_{amb}		$-I_{GSS}$	I_{DSS}	$-V_{(P)GS}$	$r_{ds\ on}$	C_{rs}	t_{on}	t_{off}
					max.	min.	max.	max.	max.	max.	max.
		V	mW	°C	pA	mA	V	Ω	pF	ns	ns
2N4856	TO-18	40	360	25	250	50	10	25	8	9	25
2N4857		40				20	6	40		10	50
2N4858		40				8	4	60		20	100
2N4859		30				50	10	25		9	25
2N4860		30				20	6	40		10	50
2N4861		30				8	4	60		20	100

N-channel MOS-FET for switching

		RATINGS			CHARACTERISTICS					
type number	envelope	V_{DB} V_{SB}	P_{tot} at T_{amb}		$\pm I_{GSS}$	I_{DSX} I_{SDX}	$r_{ds\ on}$	r_{DSoff}	C_{rs}	C_{rd}
					max.	max.	max.	min.	max.	max.
		V	mW	°C	pA	nA	Ω	GΩ	pF	pF
BFR29	TO-72	30	200	25	10	—	—	—	0,7	—
BSV81	TO-72	30	200	25	10	1	100	10	0,5	0,5

N-channel junction field-effect transistors for differential amplifiers

		RATINGS					CHARACTERISTICS							
		individual transistor			total device		individual transistor			total device				
type number	envelope	$\pm V_{DS}$	P_{tot} at T_{amb}		P_{tot} at T_{amb}		$-I_{GSS}$	I_{DSS}	$-V_{(P)GS}$	$\lvert \Delta V_{GS} \rvert$	$\left\lvert \frac{d\Delta V_{GS}}{dT} \right\rvert$	$\left\lvert \Delta \frac{1}{g_{fs}} \right\rvert$	$\left\lvert \Delta \frac{g_{os}}{g_{fs}} \right\rvert$	CMRR
			mW	^{o}C	mW	^{o}C	max. pA	mA	max. V	max. mV	max. $\mu V/K$	max. Ω	max. $\mu V/V$	min. dB
BFQ10	TO-71	30	250	75	250	75	100	0,5-10	3,5	5	5	6	10	100
BFQ11										10	5	6	30	90
BFQ12										10	10	12	30	90
BFQ13										10	20	12	30	90
BFQ14										15	20	12	30	90
BFQ15										20	40	20	30	90
BFQ16										50	50	30	100	80
BFS21	SOT-52	30	300	25	30	100	–	> 1	6	20	75	15	1000	60
BFS21A										10	40	7,5	500	66

GENERAL

Type designation
Rating systems
Letter symbols
s-parameters
Tape

PRO ELECTRON TYPE DESIGNATION CODE FOR SEMICONDUCTOR DEVICES

This type designation code applies to discrete semiconductor devices – as opposed to integrated circuits –, multiples of such devices and semiconductor chips.

A basic type number consists of:

TWO LETTERS FOLLOWED BY A SERIAL NUMBER

FIRST LETTER

The first letter gives information about the material used for the active part of the devices.

A. GERMANIUM or other material with band gap of 0,6 to 1,0 eV.
B. SILICON or other material with band gap of 1,0 to 1,3 eV.
C. GALLIUM-ARSENIDE or other material with band gap of 1,3 eV or more.
R. COMPOUND MATERIALS (e.g. Cadmium-Sulphide).

SECOND LETTER

The second letter indicates the function for which the device is primarily designed.

A. DIODE; signal, low power
B. DIODE; variable capacitance
C. TRANSISTOR; low power, audio frequency ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
D. TRANSISTOR; power, audio frequency ($R_{th\ j\text{-}mb} \leqslant 15\ ^{o}C/W$)
E. DIODE; tunnel
F. TRANSISTOR; low power, high frequency ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
G. MULTIPLE OF DISSIMILAR DEVICES – MISCELLANEOUS; e.g. oscillator
H. DIODE; magnetic sensitive
L. TRANSISTOR; power, high frequency ($R_{th\ j\text{-}mb} \leqslant 15\ ^{o}C/W$)
N. PHOTO-COUPLER
P. RADIATION DETECTOR; e.g. high sensitivity phototransistor
Q. RADIATION GENERATOR; e.g. light-emitting diode (LED)
R. CONTROL AND SWITCHING DEVICE; e.g. thyristor, low power ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
S. TRANSISTOR; low power, switching ($R_{th\ j\text{-}mb} > 15\ ^{o}C/W$)
T. CONTROL AND SWITCHING DEVICE; e.g. thyristor, power ($R_{th\ j\text{-}mb} \leqslant 15\ ^{o}C/W$)
U. TRANSISTOR; power, switching ($R_{th\ j\text{-}mb} \leqslant 15\ ^{o}C/W$)
X. DIODE: multiplier, e.g. varactor, step recovery
Y. DIODE; rectifying, booster
Z. DIODE; voltage reference or regulator (transient suppressor diode, with third letter W)

SERIAL NUMBER

Three figures, running from 100 to 999, for devices primarily intended for consumer equipment.*
One letter (Z, Y, X, etc.) and two figures, running from 10 to 99, for devices primarily intended for industrial/professional equipment.*
This letter has no fixed meaning except W, which is used for transient suppressor diodes.

VERSION LETTER

It indicates a minor variant of the basic type either electrically or mechanically. The letter never has a fixed meaning, except letter R, indicating reverse voltage, e.g. collector to case or anode to stud.

SUFFIX

Sub-classification can be used for devices supplied in a wide range of variants called associated types. Following sub-coding suffixes are in use:

1. VOLTAGE REFERENCE and VOLTAGE REGULATOR DIODES: *ONE LETTER and ONE NUMBER*
   The LETTER indicates the nominal tolerance of the Zener (regulation, working or reference) voltage
   A. 1% (according to IEC 63: series E96)
   B. 2% (according to IEC 63: series E48)
   C. 5% (according to IEC 63: series E24)
   D. 10% (according to IEC 63: series E12)
   E. 20% (according to IEC 63: series E6)
   The number denotes the typical operating (Zener) voltage related to the nominal current rating for the whole range.
   The letter 'V' is used instead of the decimal point.

2. TRANSIENT SUPPRESSOR DIODES: *ONE NUMBER*
   The NUMBER indicates the maximum recommended continuous reversed (stand-off) voltage V_R. The letter 'V' is used as above.

3. CONVENTIONAL and CONTROLLED AVALANCHE RECTIFIER DIODES and THYRISTORS: *ONE NUMBER*
   The NUMBER indicates the rated maximum repetitive peak reverse voltage (V_{RRM}) or the rated repetitive peak off-state voltage (V_{DRM}), whichever is the lower. Reversed polarity is indicated by letter R, immediately after the number.

4. RADIATION DETECTORS: *ONE NUMBER,* preceded by a hyphen (–)
   The NUMBER indicates the depletion layer in µm. The resolution is indicated by a version LETTER.

5. ARRAY OF RADIATION DETECTORS and GENERATORS: *ONE NUMBER,* preceded by a stroke (/).
   The NUMBER indicates how many basic devices are assembled into the array.

→ * When these serial numbers are exhausted the serial number for consumer types may be extended to four figures, and that for industrial types to three figures.

RATING SYSTEMS

The rating systems described are those recommended by the International Electrotechnical Commission (IEC) in its Publication 134.

DEFINITIONS OF TERMS USED

Electronic device. An electronic tube or valve, transistor or other semiconductor device.

Note
This definition excludes inductors, capacitors, resistors and similar components.

Characteristic. A characteristic is an inherent and measurable property of a device. Such a property may be electrical, mechanical, thermal, hydraulic, electro-magnetic, or nuclear, and can be expressed as a value for stated or recognized conditions. A characteristic may also be a set of related values, usually shown in graphical form.

Bogey electronic device. An electronic device whose characteristics have the published nominal values for the type. A bogey electronic device for any particular application can be obtained by considering only those characteristics which are directly related to the application.

Rating. A value which establishes either a limiting capability or a limiting condition for an electronic device. It is determined for specified values of environment and operation, and may be stated in any suitable terms.

Note
Limiting conditions may be either maxima or minima.

Rating system. The set of principles upon which ratings are established and which determine their interpretation.

Note
The rating system indicates the division of responsibility between the device manufacturer and the circuit designer, with the object of ensuring that the working conditions do not exceed the ratings.

ABSOLUTE MAXIMUM RATING SYSTEM

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electronic device of a specified type as defined by its published data, which should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking no responsibility for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electronic devices in the equipment.

The equipment manufacturer should design so that, initially and throughout life, no absolute maximum value for the intended service is exceeded with any device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electronic devices in the equipment.

DESIGN MAXIMUM RATING SYSTEM

Design maximum ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under the worst probable conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device, taking responsibility for the effects of changes in operating conditions due to variations in the characteristics of the electronic device under consideration.

The equipment manufacturer should design so that, initially and throughout life, no design maximum value for the intended service is exceeded with a bogey device under the worst probable operating conditions with respect to supply voltage variation, equipment component variation, variation in characteristics of all other devices in the equipment, equipment control adjustment, load variation, signal variation and environmental conditions.

DESIGN CENTRE RATING SYSTEM

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electronic device of a specified type as defined by its published data, and should not be exceeded under normal conditions.

These values are chosen by the device manufacturer to provide acceptable serviceability of the device in average applications, taking responsibility for normal changes in operating conditions due to rated supply voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electronic devices.

The equipment manufacturer should design so that, initially, no design centre value for the intended service is exceeded with a bogey electronic device in equipment operating at the stated normal supply voltage.

LETTER SYMBOLS FOR TRANSISTORS AND SIGNAL DIODES

based on IEC Publication 148

LETTER SYMBOLS FOR CURRENTS, VOLTAGES AND POWERS

Basic letters

The basic letters to be used are:

I, i = current
V, v = voltage
P, p = power.

Lower-case basic letters shall be used for the representation of instantaneous values which vary with time.
In all other instances upper-case basic letters shall be used.

Subscripts

A, a	Anode terminal
(AV), (av)	Average value
B, b	Base terminal, for MOS devices: Substrate
(BR)	Breakdown
C, c	Collector terminal
D, d	Drain terminal
E, e	Emitter terminal
F, f	Forward
G, g	Gate terminal
K, k	Cathode terminal
M, m	Peak value
O, o	As third subscript: The terminal not mentioned is open circuited
R, r	As first subscript: Reverse. As second subscript: Repetitive. As third subscript: With a specified resistance between the terminal not mentioned and the reference terminal.
(RMS), (rms)	R.M.S. value
S, s	As first or second subscript: Source terminal (for FETS only) As second subscript: Non-repetitive (not for FETS) As third subscript: Short circuit between the terminal not mentioned and the reference terminal
X, x	Specified circuit
Z, z	Replaces R to indicate the actual working voltage, current or power of voltage reference and voltage regulator diodes.

Note: No additional subscript is used for d.c. values.

Upper-case subscripts shall be used for the indication of:

a) continuous (d.c.) values (without signal)

Example I_B

b) instantaneous total values

Example i_B

c) average total values

Example $I_{B(AV)}$

d) peak total values

Example I_{BM}

e) root-mean-square total values

Example $I_{B(RMS)}$

Lower-case subscripts shall be used for the indication of values applying to the varying component alone:

a) instantaneous values

Example i_b

b) root-mean-square values

Example $I_{b(rms)}$

c) peak values

Example I_{bm}

d) average values

Example $I_{b(av)}$

Note: If more than one subscript is used, subscript for which both styles exist shall either be all upper-case or all lower-case.

Additional rules for subscripts

Subscripts for currents

Transistors: If it is necessary to indicate the terminal carrying the current, this should be done by the first subscript (conventional current flow from the external circuit into the terminal is positive).

Examples: I_B, i_B, i_b, I_{bm}

Diodes: To indicate a forward current (conventional current flow into the anode terminal) the subscript F or f should be used; for a reverse current (conventional current flow out of the anode terminal) the subscript R or r should be used.

Examples: I_F, I_R, i_F, $I_{f(rms)}$

Subscripts for voltages

Transistors: If it is necessary to indicate the points between which a voltage is measured, this should be done by the first two subscripts. The first subscript indicates the terminal at which the voltage is measured and the second the reference terminal or the circuit node. Where there is no possibility of confusion, the second subscript may be omitted.

Examples: V_{BE}, v_{BE}, v_{be}, V_{bem}

Diodes: To indicate a forward voltage (anode positive with respect to cathode), the subscript F or f should be used; for a reverse voltage (anode negative with respect to cathode) the subscript R or r should be used.

Examples: V_F, V_R, v_F, V_{rm}

Subscripts for supply voltages or supply currents

Supply voltages or supply currents shall be indicated by repeating the appropriate terminal subscript.

Examples: V_{CC}, I_{EE}

Note: If it is necessary to indicate a reference terminal, this should be done by a third subscript

Example : V_{CCE}

Subscripts for devices having more than one terminal of the same kind

If a device has more than one terminal of the same kind, the subscript is formed by the appropriate letter for the terminal followed by a number; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

Examples: I_{B2} = continuous (d.c.) current flowing into the second base terminal

V_{B2-E} = continuous (d.c.) voltage between the terminals of second base and emitter

Subscripts for multiple devices

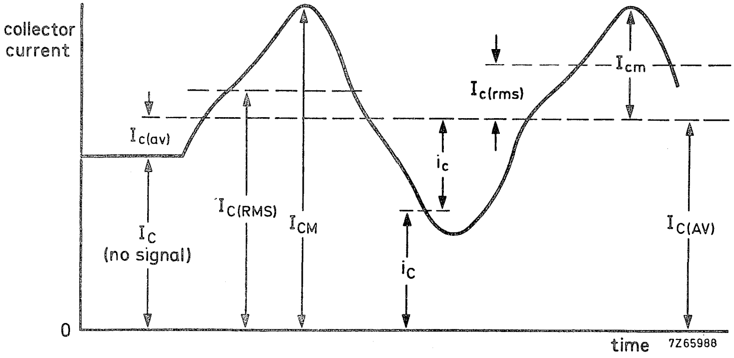
For multiple unit devices, the subscripts are modified by a number preceding the letter subscript; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

Examples: I_{2C} = continuous (d.c.) current flowing into the collector terminal of the second unit

V_{1C-2C} = continuous (d.c.) voltage between the collector terminals of the first and the second unit.

Application of the rules

The figure below represents a transistor collector current as a function of time. It consists of a continuous (d.c.) current and a varying component.



LETTER SYMBOLS FOR ELECTRICAL PARAMETERS

Definition

For the purpose of this Publication, the term "electrical parameter" applies to four-pole matrix parameters, elements of electrical equivalent circuits, electrical impedances and admittances, inductances and capacitances.

Basic letters

The following is a list of the most important basic letters used for electrical parameters of semiconductor devices.

B, b = susceptance; imaginary part of an admittance
C = capacitance
G, g = conductance; real part of an admittance
H, h = hybrid parameter
L = inductance
R, r = resistance; real part of an impedance
X, x = reactance; imaginary part of an impedance
Y, y = admittance;
Z, z = impedance;

Upper-case letters shall be used for the representation of:

a) electrical parameters of external circuits and of circuits in which the device forms only a part;

b) all inductances and capacitances.

Lower-case letters shall be used for the representation of electrical parameters inherent in the device (with the exception of inductances and capacitances).

Subscripts

General subscripts

The following is a list of the most important general subscripts used for electrical parameters of semiconductor devices:

F, f = forward; forward transfer
I, i (or 1) = input
L, l = load
O, o (or 2) = output
R, r = reverse; reverse transfer
S, s = source

Examples: Z_S, h_f, h_F

The upper-case variant of a subscript shall be used for the designation of static (d.c.) values.

Examples : h_{FE} = static value of forward current transfer ratio in common-emitter configuration (d.c. current gain)
R_E = d.c. value of the external emitter resistance.

Note: The static value is the slope of the line from the origin to the operating point on the appropriate characteristic curve, i.e. the quotient of the appropriate electrical quantities at the operating point.

The lower-case variant of a subscript shall be used for the designation of small-signal values.

Examples: h_{fe} = small-signal value of the short-circuit forward current transfer ratio in common-emitter configuration
$Z_e = R_e + jX_e$ = small-signal value of the external impedance

Note: If more than one subscript is used, subscripts for which both styles exist shall either be all upper-case or all lower-case

Examples: h_{FE}, y_{RE}, h_{fe}

Subscripts for four-pole matrix parameters

The first letter subscript (or double numeric subscript) indicates input, output, forward transfer or reverse transfer

Examples: h_i (or h_{11})
h_o (or h_{22})
h_f (or h_{21})
h_r (or h_{12})

A further subscript is used for the identification of the circuit configuration. When no confusion is possible, this further subscript may be omitted.

Examples: h_{fe} (or h_{21e}), h_{FE} (or h_{21E})

Distinction between real and imaginary parts

If it is necessary to distinguish between real and imaginary parts of electrical parameters, no additional subscripts should be used. If basic symbols for the real and imaginary parts exist, these may be used.

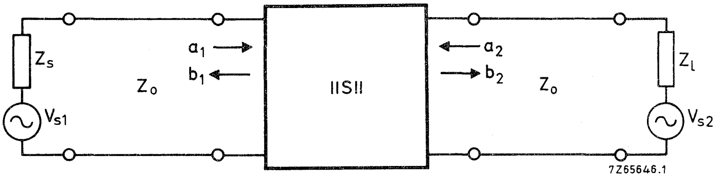
Examples: $Z_i = R_i + jX_i$
$y_{fe} = g_{fe} + jb_{fe}$

If such symbols do not exist or if they are not suitable, the following notation shall be used:

Examples: Re (h_{ib}) etc. for the real part of h_{ib}
Im (h_{ib}) etc. for the imaginary part of h_{ib}

SCATTERING PARAMETERS

In distinction to the conventional h, y and z-parameters, s-parameters relate to travelling wave conditions. The figure below shows a two-port network with the incident and reflected waves a_1, b_1, a_2 and b_2.



$$a_1 = \frac{V_{i1}}{\sqrt{Z_o}} \qquad a_2 = \frac{V_{i2}}{\sqrt{Z_o}} \qquad ^{1)}$$

$$b_1 = \frac{V_{r1}}{\sqrt{Z_o}} \qquad b_2 = \frac{V_{r2}}{\sqrt{Z_o}}$$

Z_o = characteristic impedance of the transmission line in which the two-port is connected.

V_i = incident voltage

V_r = reflected (generated) voltage

The four-pole equations for s-parameters are:

$$b_1 = s_{11}a_1 + s_{12}a_2$$

$$b_2 = s_{21}a_1 + s_{22}a_2$$

Using the subscripts i for 11, r for 12, f for 21 and o for 22, it follows that:

$$s_i = s_{11} = \left.\frac{b_1}{a_1}\right|_{a_2 = 0}$$

$$s_r = s_{12} = \left.\frac{b_1}{a_2}\right|_{a_1 = 0}$$

$$s_f = s_{21} = \left.\frac{b_2}{a_1}\right|_{a_2 = 0}$$

$$s_o = s_{22} = \left.\frac{b_2}{a_2}\right|_{a_1 = 0}$$

---

1) The squares of these quantities have the dimension of power.

The s-parameters can be named and expressed as follows:

$s_i = s_{11}$ = Input reflection coefficient.
The complex ratio of the reflected wave and the incident wave at the input, under the conditions $Z_l = Z_o$ and $V_{s2} = 0$.

$s_r = s_{12}$ = Reverse transmission coefficient.
The complex ratio of the generated wave at the input and the incident wave at the output, under the conditions $Z_s = Z_o$ and $V_{s1} = 0$.

$s_f = s_{21}$ = Forward transmission coefficient.
The complex ratio of the generated wave at the output and the incident wave at the input, under the conditions $Z_l = Z_o$ and $V_{s2} = 0$

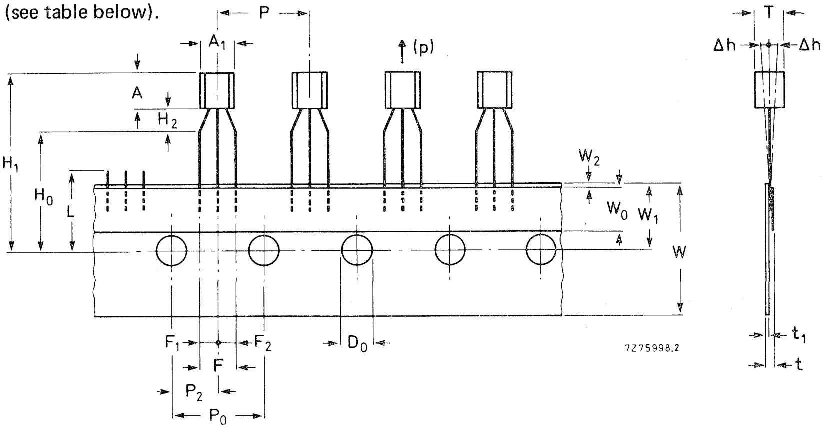
$s_o = s_{22}$ = Output reflection coefficient.
The complex ratio of the reflected wave and the incident wave at the output, under the conditions $Z_s = Z_o$ and $V_{s1} = 0$.

TO-92 VARIANT TRANSISTORS ON TAPE

MECHANICAL DATA

Dimensions in mm

Fig. 1 (see table below).



Item	Symbol	Specifications				Remarks
		min.	nom.	max.	tol.	
Body width	A_1	4,0		4,8		
Body height	A	4,8		5,2		
Body thickness	T	3,9		4,2		
Pitch of component	P		12,7		± 1	
Feed hole pitch	P_0		12,7		± 0,3	Cumulative pitch error 1,0 mm/20 pitch
Feed hole centre to component centre	P_2		6,35		± 0,4	To be measured at bottom of clinch
Distance between outer leads	F		5,08		+ 0,6 −0,2	
Component alignment	Δh		0	1		At centre of body
Tape width	W		18		± 0,5	
Hold-down tape width	W_0		6		± 0,2	
Hole position	W_1		9		+ 0,7 −0,5	
Hold-down tape position	W_2		0,5		± 0,2	
Lead wire clinch height	H_0		16		± 0,5	
Component height	H_1			32,25		
Length of snipped leads	L			11,0		
Feed hole diameter	D_0		4		± 0,2	
Total tape thickness	t			1,2		t_1 0,3-0,6
Lead-to-lead distance	F_1, F_2		2,54		+ 0,4 −0,1	
Clinch height	H_2			3		
Pull-out force	(p)	6N				

PACKING

The transistors are supplied on tape in boxes (ammopack) or on reels. The number per box or reel is 1600.

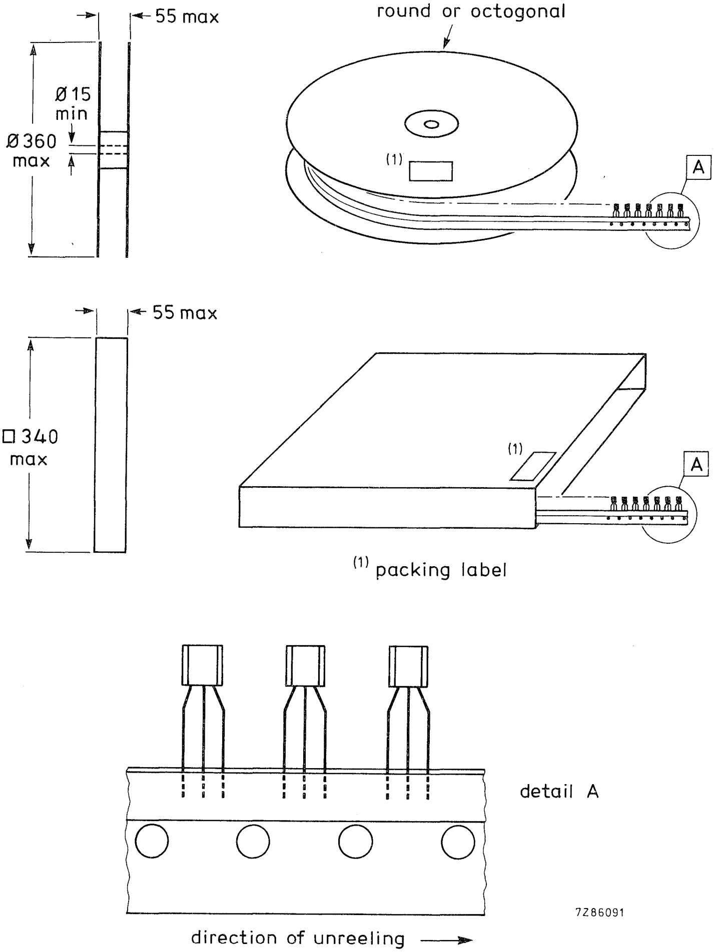


Fig. 2 Dimensions (in mm) of reel and box.

DROPOUTS

A maximum of 0,5% of the specified number of transistors in each packing may be missing. Up to 3 consecutive components may be missing provided the gap is followed by 6 consecutive components.

TAPE SPLICING

Slice the carrier tape on the back and/or front so that the feed hole pitch (P_0) is maintained (see Fig. 3).

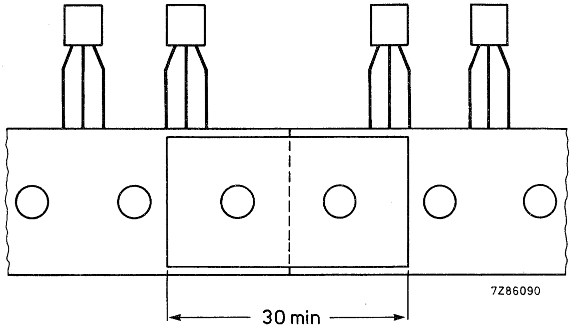


Fig. 3 Jointing tape with splicing patch.

J-FETS

N-CHANNEL SILICON FIELD-EFFECT TRANSISTORS

Symmetrical N-channel planar epitaxial junction field-effect transistors in a plastic TO-92 variant; intended for hi-fi amplifiers and other audio-frequency equipment.

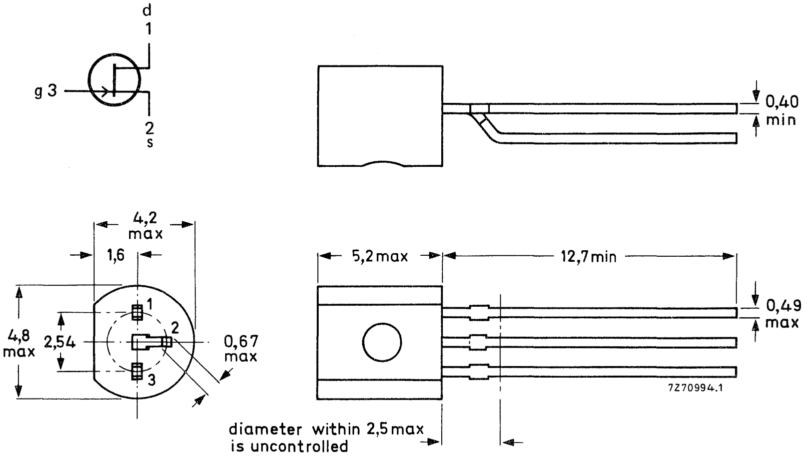
QUICK REFERENCE DATA

Drain-source voltage	$\pm V_{DS}$	max.	30	V
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	150	^oC
Drain current $V_{DS} = 15$ V; $V_{GS} = 0$	I_{DSS}		2 to 12	mA
Transfer admittance (common source) $V_{DS} = 15$ V; $V_{GS} = 0$; f = 1 kHz	$\lvert y_{fs} \rvert$	typ.	3,5	mA/V
Noise figure at $V_{DS} = 15$ V; $V_{GS} = 0$ f = 1 kHz; $R_G = 1\ M\Omega$	F	<	2	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92 variant.



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages				
Drain-source voltage	$\pm V_{DS}$	max.	30	V
Drain-gate voltage (open source)	V_{DGO}	max.	30	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30	V
Current				
Gate current	I_G	max.	10	mA
Power dissipation				
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Temperatures				
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,42	°C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BC264A	B	C	D	
Gate cut-off current							
$-V_{GS}$ = 20 V; V_{DS} = 0	$-I_{GSS}$	<	10	10	10	10	nA
Drain current 1)							
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	2,0	3,5	5,0	7,0	mA
		<	4,5	6,5	8,0	12,0	mA
Gate-source breakdown voltage							
$-I_G$ = 1 µA; V_{DS} = 0	$-V_{(BR)GSS}$	>	30	30	30	30	V
Gate-source voltage							
I_D = 200 µA ; V_{DS} = 15 V	$-V_{GS}$	>	0,4	0,4	0,4	0,4	V
I_D = 1,0 mA; V_{DS} = 15 V	$-V_{GS}$	>	0,2	–	–	–	V
		<	1,2	–	–	–	V
I_D = 1,5 mA; V_{DS} = 15 V	$-V_{GS}$	>	–	0,4	–	–	V
		<	–	1,4	–	–	V
I_D = 2,5 mA; V_{DS} = 15 V	$-V_{GS}$	>	–	–	0,5	–	V
		<	–	–	1,5	–	V
I_D = 3,5 mA; V_{DS} = 15 V	$-V_{GS}$	>	–	–	–	0,6	V
		<	–	–	–	1,6	V
Gate-source cut-off voltage							
I_D = 10 nA ; V_{DS} = 15 V	$-V_{(P)GS}$	>	0,5	0,5	0,5	0,5	V
y-parameters at T_{amb} = 25 °C							
V_{DS} = 15 V; V_{GS} = 0; f = 1 kHz							
Transfer admittance	$\lvert y_{fs} \rvert$	>	2,5	3,0	3,5	4,0	mA/V
V_{DS} = 15 V; $-V_{GS}$ = 1 V; f = 1 MHz							
Input capacitance	C_{is}	typ.	4,0				pF
Feedback capacitance	C_{rs}	typ.	1,2				pF
Output capacitance	C_{os}	typ.	1,6				pF
Noise figure at f = 1 kHz; R_G = 1 MΩ							
V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C	F	typ.	0,5				dB
		<	2				dB
Equivalent noise voltage at T_{amb} = 25 °C							
V_{DS} = 15 V; V_{GS} = 0; f = 10 Hz	$V_n/\sqrt{B}$	typ.	40				$nV/\sqrt{Hz}$

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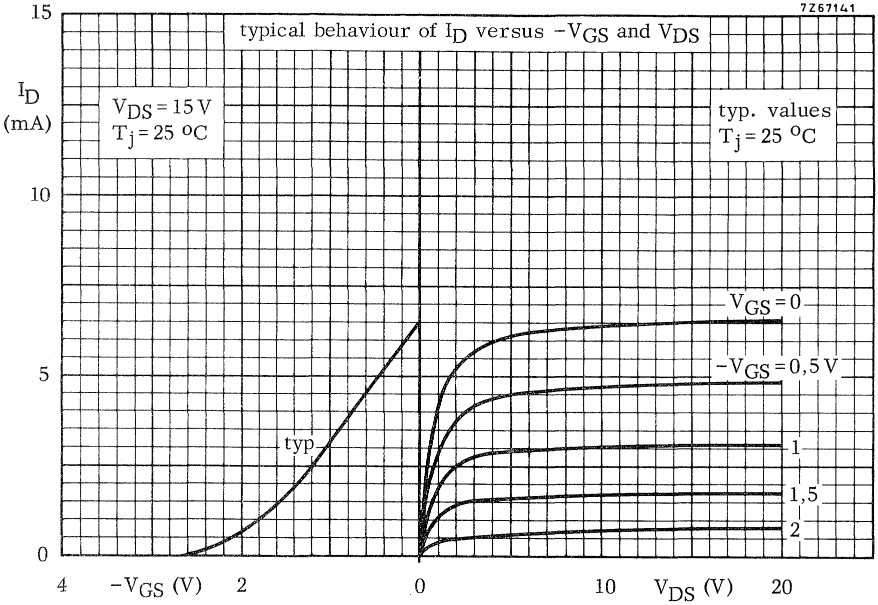
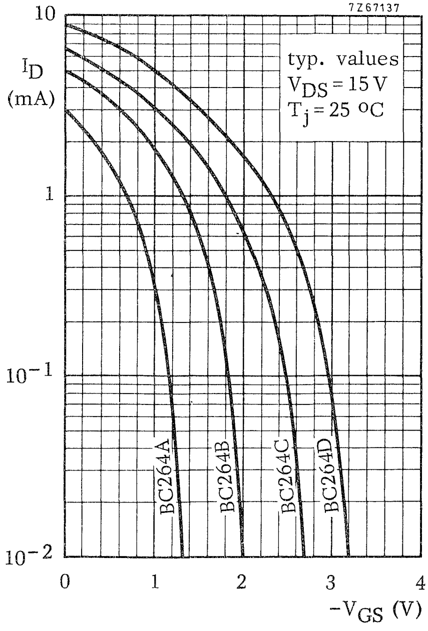
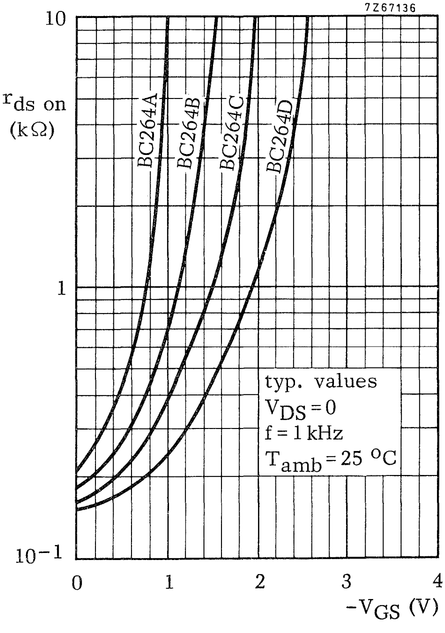
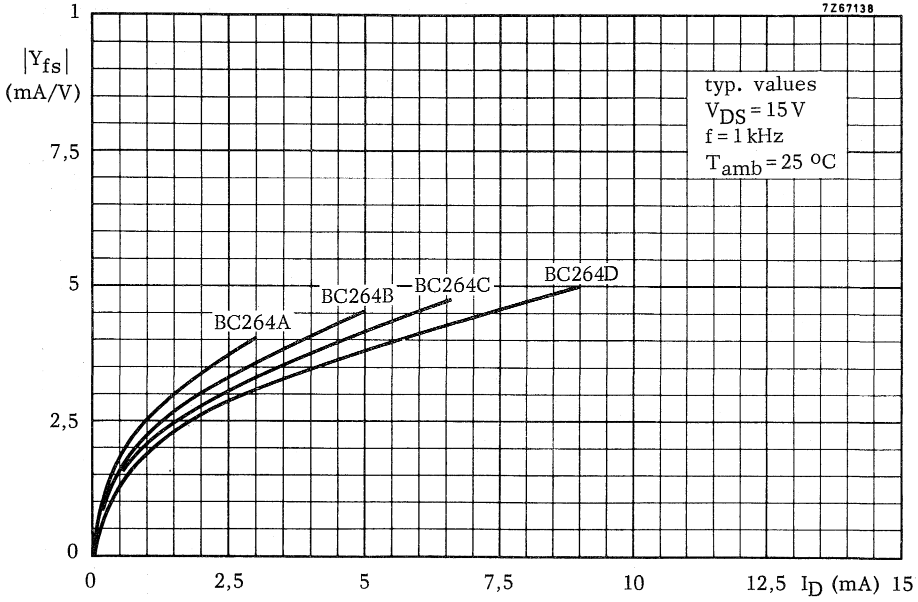
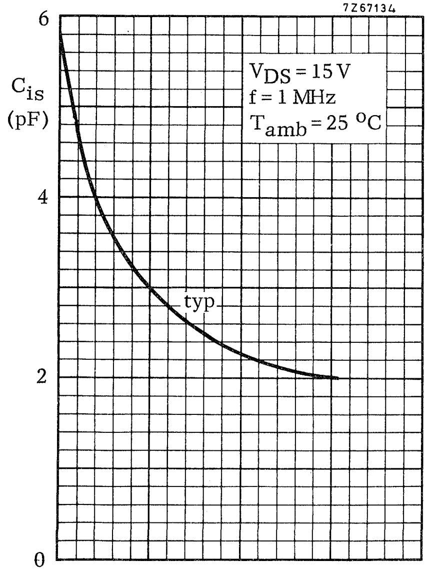
1) Measured under pulse conditions.

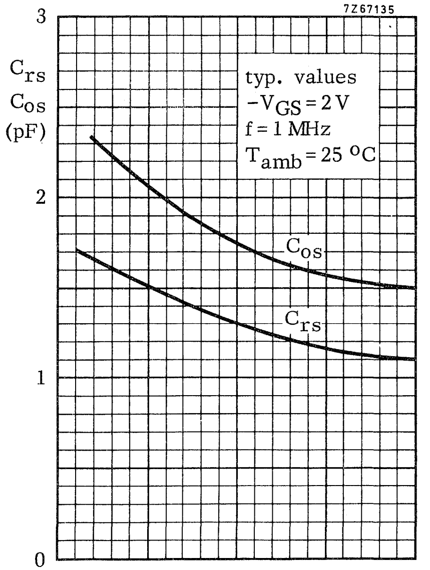

7Z67141
typical behaviour of I_D versus $-V_{GS}$ and V_{DS}
I_D (mA)
15
10
5
0
V_{DS} = 15 V
T_j = 25 °C
typ. values
T_j = 25 °C
V_{GS} = 0
$-V_{GS}$ = 0,5 V
1
1,5
2
typ
4
$-V_{GS}$ (V)
2
0
10
V_{DS} (V)
20

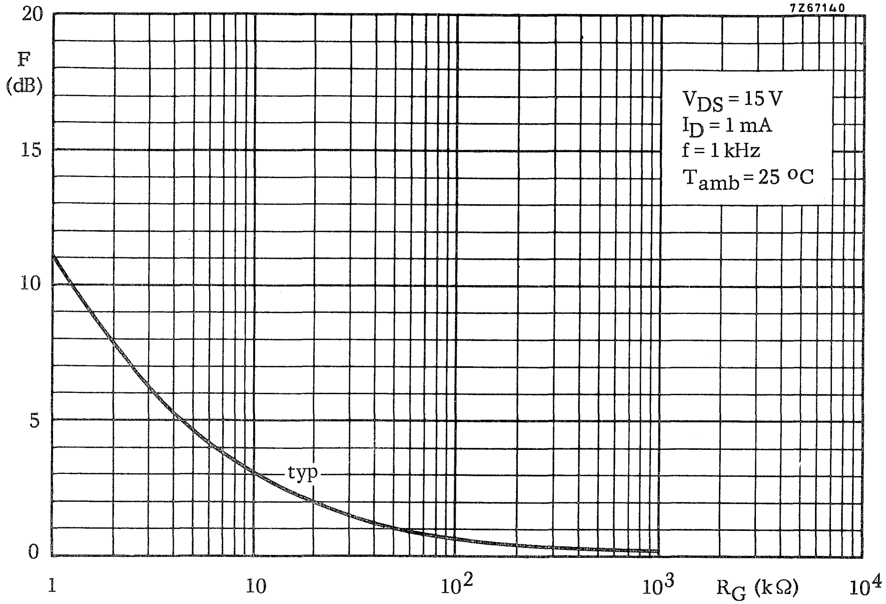

7Z67137
I_D (mA)
10
1
10^{-1}
10^{-2}
typ. values
V_{DS} = 15 V
T_j = 25 °C
BC264A
BC264B
BC264C
BC264D
0
1
2
3
4
$-V_{GS}$ (V)


7Z67136
$r_{ds\ on}$ (kΩ)
10
1
10^{-1}
BC264A
BC264B
BC264C
BC264D
typ. values
V_{DS} = 0
f = 1 kHz
T_{amb} = 25 °C
0
1
2
3
4
$-V_{GS}$ (V)


7Z67138
|Y_fs|
(mA/V)
1
7,5
5
2,5
0
typ. values
V_DS = 15 V
f = 1 kHz
T_amb = 25 °C
BC264A
BC264B
BC264C
BC264D
0
2,5
5
7,5
10
12,5
I_D (mA)
15


7Z67134
C_is
(pF)
6
4
2
0
V_DS = 15 V
f = 1 MHz
T_amb = 25 °C
typ
0
5
−V_GS (V)
10


7Z67135
C_rs
C_os
(pF)
3
2
1
0
typ. values
−V_GS = 2 V
f = 1 MHz
T_amb = 25 °C
C_os
C_rs
0
10
V_DS (V)
20


7Z67140
20
F
(dB)
15
10
5
0
1
10
10^2
10^3
R_G (kΩ)
10^4
V_{DS} = 15 V
I_D = 1 mA
f = 1 kHz
T_{amb} = 25 °C
typ

N-CHANNEL SILICON FIELD-EFFECT TRANSISTORS

General purpose symmetrical N-channel planar epitaxial junction field-effect transistors in a plastic TO-92 variant; intended for applications in l.f. and d.c. amplifiers, and in h.f. amplifiers.

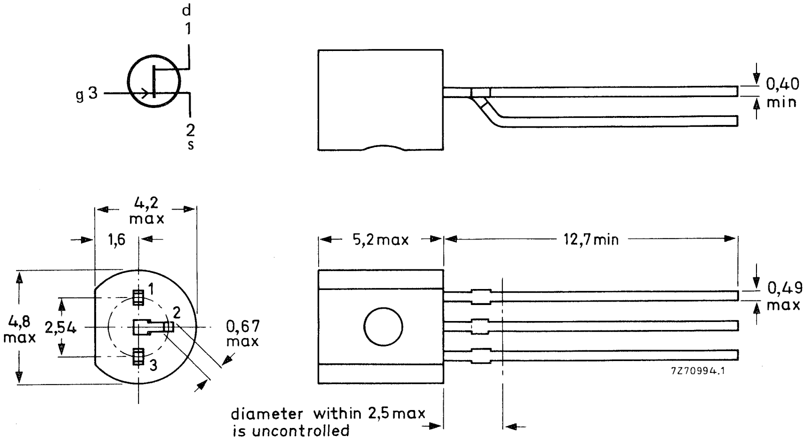
QUICK REFERENCE DATA

Drain-source voltage	$\pm V_{DS}$		max.	30	V
Gate-source voltage (open drain)	$-V_{GSO}$		max.	30	V
Total power dissipation up to T_{amb} = 75 °C	P_{tot}		max.	300	mW
		BF245A	B	C	
Drain current V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>2	6,0	12	mA
		$<6,5$	15,0	25	mA
Gate-source cut-off voltage I_D = 10 nA; V_{DS} = 15 V	$-V_{(P)GS}$		0,5 to 8,0		V
Feedback capacitance at f = 1 kHz V_{DS} = 20 V; $-V_{GS}$ = 1 V; T_{amb} = 25 °C	C_{rs}		typ.	1,1	pF
Transfer admittance (common source) V_{DS} = 15 V; V_{GS} = 0; f = 1 kHz; T_{amb} = 25 °C	$\lvert y_{fs} \rvert$		3,0 to 6,5		mA/V

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92 variant.



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages					
Drain-source voltage	$\pm V_{DS}$	max.	30	V	
Drain-gate voltage (open source)	V_{DGO}	max.	30	V	
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30	V	
Currents					
Drain current	I_D	max.	25	mA	
Gate current	I_G	max.	10	mA	
Power dissipation					
Power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	300	mW	
up to T_{amb} = 90 °C	P_{tot}	max.	300	mW	1)
Temperatures					
Storage temperature	T_{stg}		−65 to +150	°C	
Junction temperature	T_j	max.	150	°C	

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0, 25	°C/mW	
From junction to ambient	$R_{th\ j\text{-}a}$	=	0, 20	°C/mW	1)

---

1) Transistor mounted on printed circuit board, max. lead length 3 mm, mounting pad for drain lead minimum 10 mm x 10 mm.

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

		BF245A	B	C	
Gate cut-off current					
$-V_{GS}$ = 20 V; V_{DS} = 0	$-I_{GSS}$	< 5	5	5	nA
$-V_{GS}$ = 20 V; V_{DS} = 0; T_j = 125 °C	$-I_{GSS}$	< 0,5	0,5	0,5	μA
Drain current 1)					
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	> 2	6,0	12	mA
		< 6,5	15,0	25	mA
Gate-source breakdown voltage					
$-I_G$ = 1 μA; V_{DS} = 0	$-V_{(BR)GSS}$	> 30	30	30	V
Gate-source voltage					
I_D = 200 μA; V_{DS} = 15 V	$-V_{GS}$	> 0,4	1,6	3,2	V
		< 2,2	3,8	7,5	V
Gate-source cut-off voltage					
I_D = 10 nA; V_{DS} = 15 V	$-V_{(P)GS}$	0,5 to 8,0			V

y-parameters at T_{amb} = 25 °C (common source)

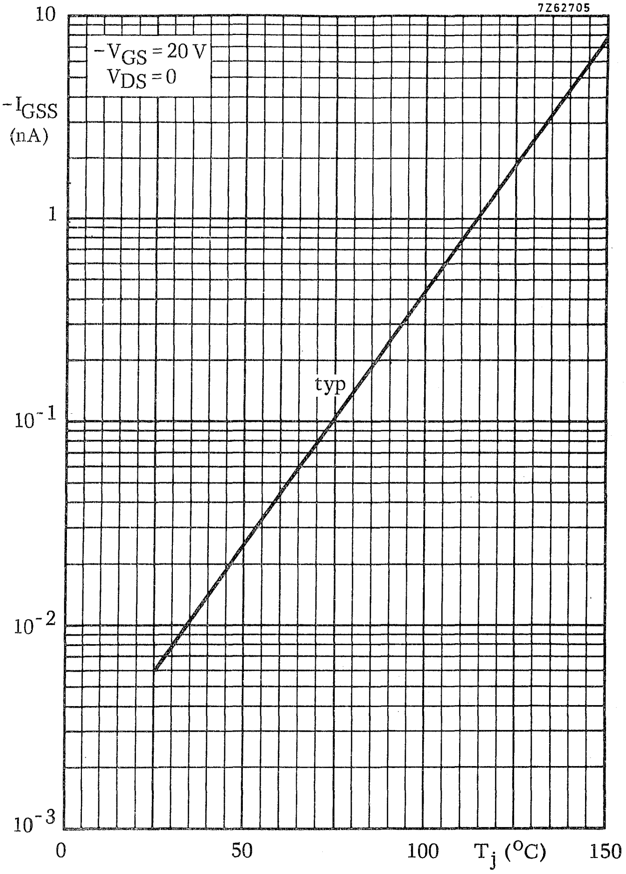
V_{DS} = 15 V; V_{GS} = 0					
f = 1 kHz	Transfer admittance	$\|y_{fs}\|$		3,0 to 6,5	mA/V
	Output admittance	$\|y_{os}\|$	typ.	25	μA/V
f = 200 MHz	Input conductance	g_{is}	typ.	250	μA/V
	Reverse transfer admittance	$\|y_{rs}\|$	typ.	1,4	mA/V
	Transfer admittance	$\|y_{fs}\|$	typ.	6	mA/V
	Output conductance	g_{os}	typ.	40	μA/V
V_{DS} = 20 V; $-V_{GS}$ = 1 V					
f = 1 MHz	Input capacitance	C_{is}	typ.	4,0	pF
	Feedback capacitance	C_{rs}	typ.	1,1	pF
	Output capacitance	C_{os}	typ.	1,6	pF

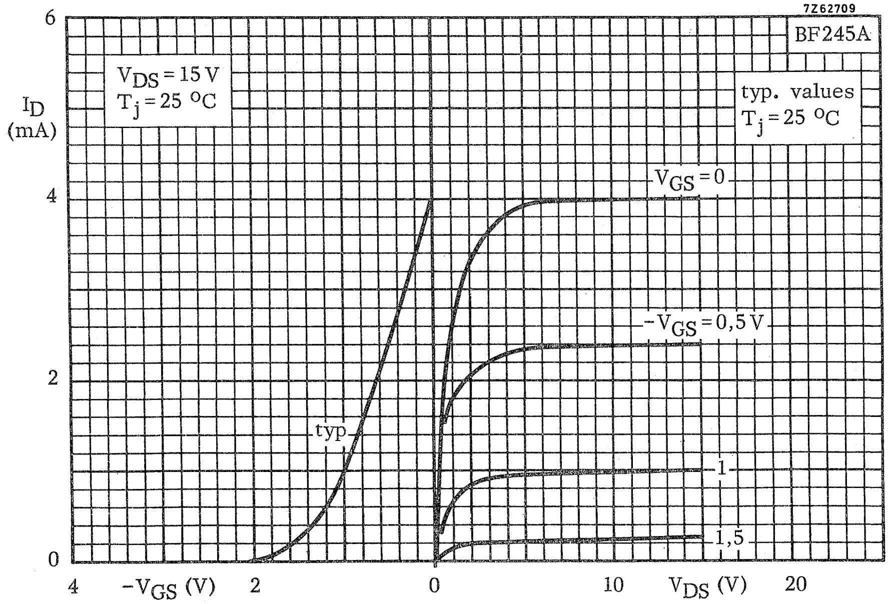
Cut-off frequency 2)				
V_{DS} = 15 V; V_{GS} = 0	f_{gfs}	typ.	700	MHz
Noise figure at f = 100 MHz; R_G = 1 kΩ (common source)				
V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C input tuned to minimum noise	F	typ.	1,5	dB

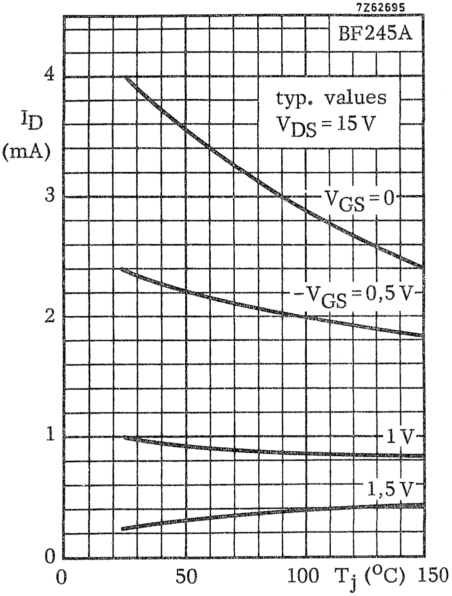
---

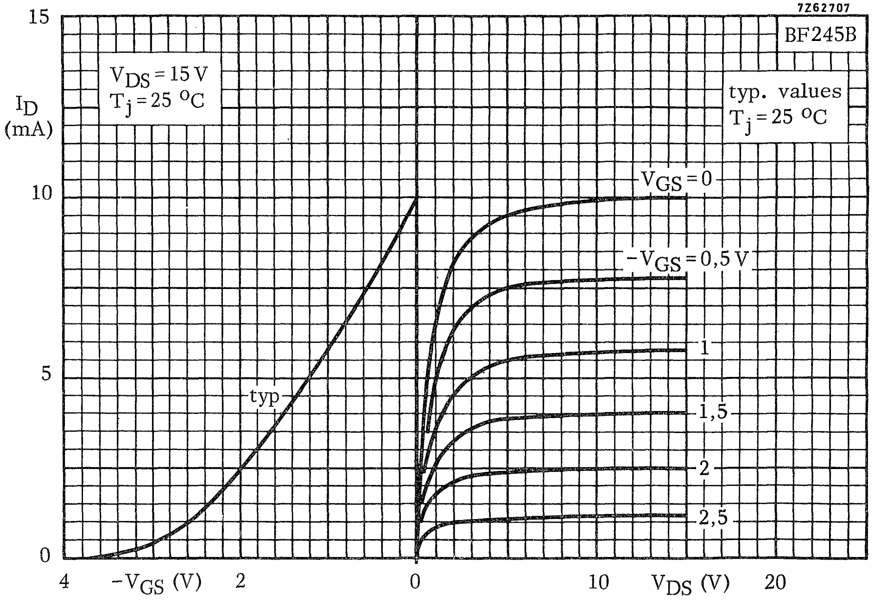
1) Measured under pulse condition: t_p = 300 μs; $\delta \leq 0,02$

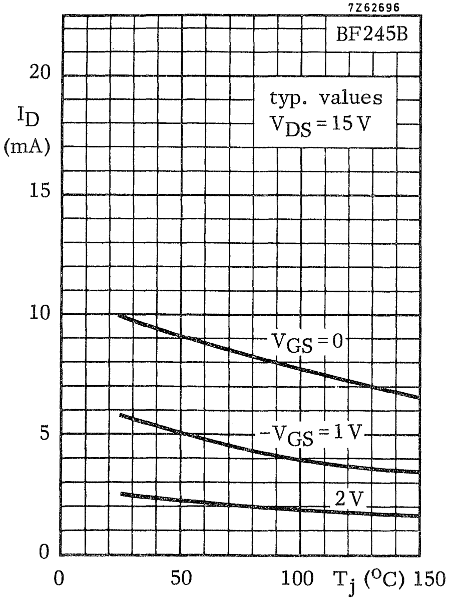
2) The frequency at which g_{fs} is 0,7 of its value at 1 kHz.

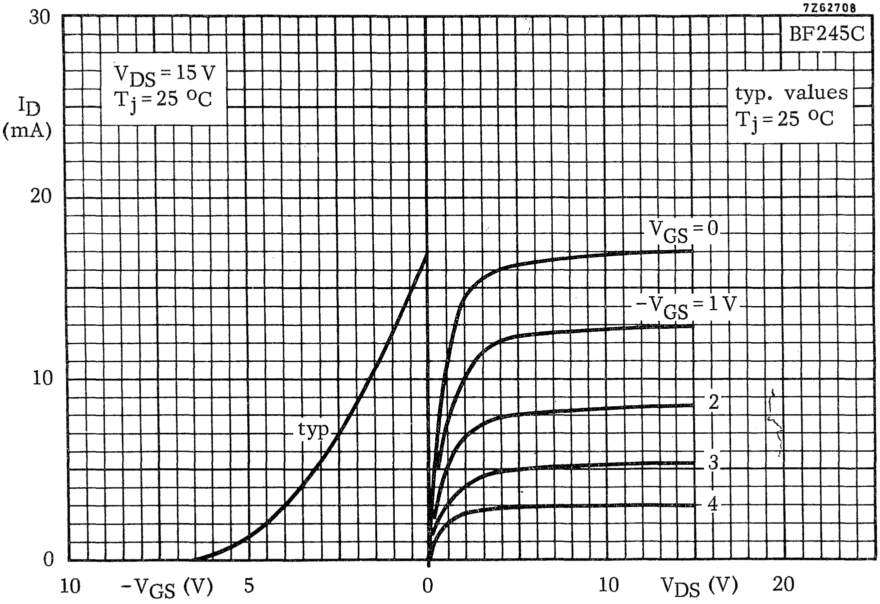

7Z62705
10
1
10^{-1}
10^{-2}
10^{-3}
$-I_{GSS}$ (nA)
$-V_{GS} = 20$ V
$V_{DS} = 0$
typ
0
50
100
T_j (^oC)
150

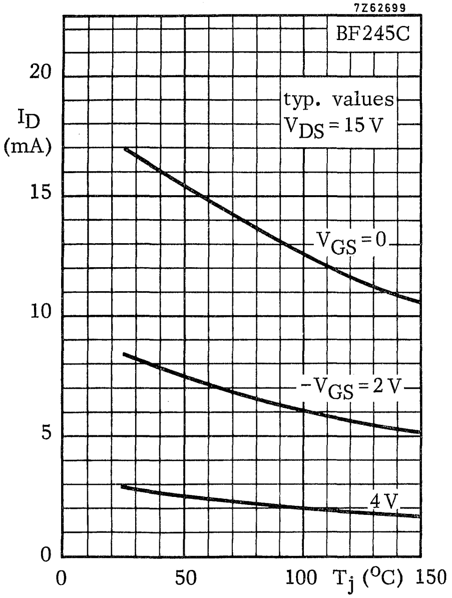

7Z62709
BF245A
$V_{DS} = 15$ V
$T_j = 25$ °C
I_D (mA)
6
4
2
0
typ. values
$T_j = 25$ °C
$V_{GS} = 0$
$-V_{GS} = 0{,}5$ V
1
1,5
typ
4
$-V_{GS}$ (V)
2
0
10
V_{DS} (V)
20

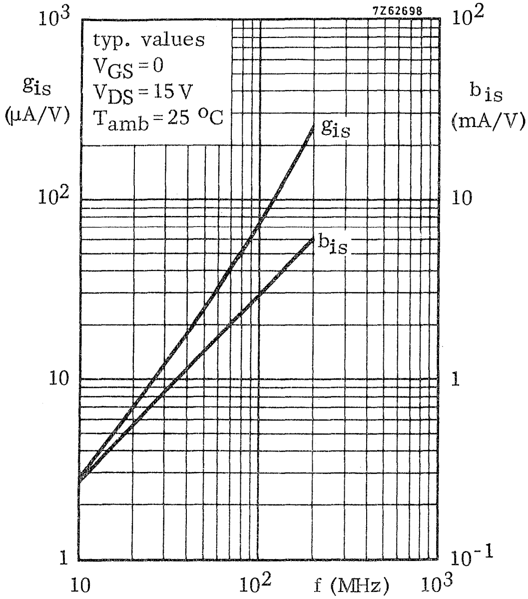

7Z62695
BF245A
4
I_D (mA)
3
2
1
0
typ. values
$V_{DS} = 15$ V
$V_{GS} = 0$
$-V_{GS} = 0{,}5$ V
1 V
1,5 V
0
50
100
T_j (°C)
150

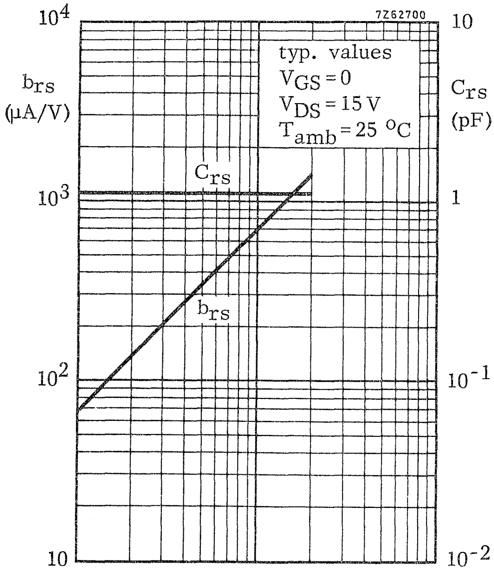

7Z62707
BF245B
V_{DS} = 15 V
T_j = 25 °C
typ. values
T_j = 25 °C
I_D (mA)
15
10
5
0
typ
V_{GS} = 0
$-V_{GS}$ = 0,5 V
1
1,5
2
2,5
4
$-V_{GS}$ (V)
2
0
10
V_{DS} (V)
20

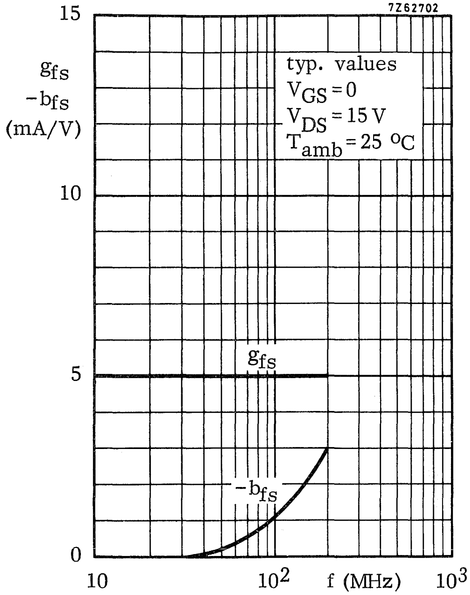

7Z62696
BF245B
typ. values
V_{DS} = 15 V
I_D (mA)
20
15
10
5
0
V_{GS} = 0
$-V_{GS}$ = 1 V
2 V
0
50
100
T_j (°C)
150

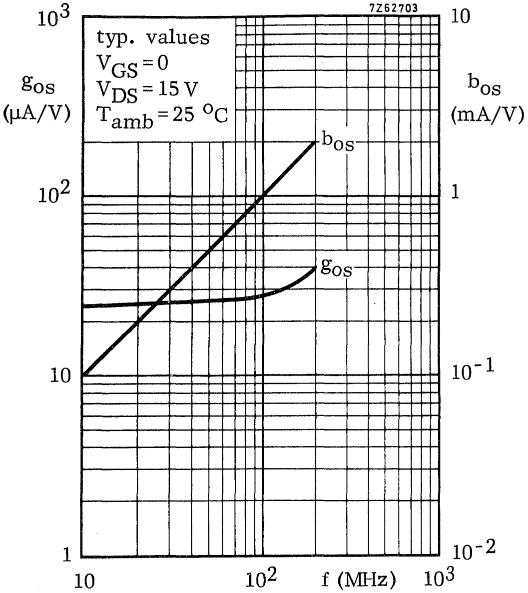

7Z62708
BF245C
30
20
10
0
ID
(mA)
V_{DS} = 15 V
T_j = 25 °C
typ. values
T_j = 25 °C
V_{GS} = 0
$-V_{GS}$ = 1 V
2
3
4
typ
10
$-V_{GS}$ (V)
5
0
10
V_{DS} (V)
20

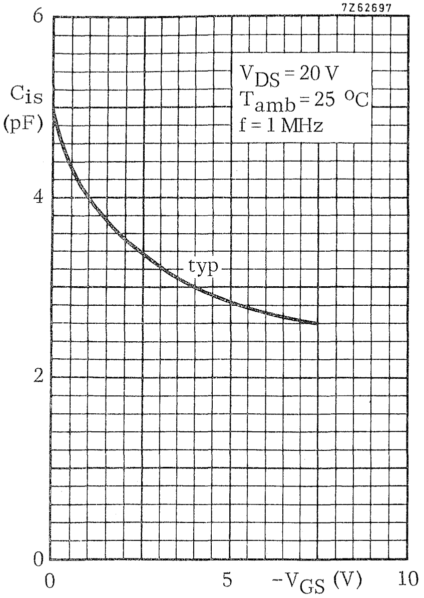

7Z62699
BF245C
20
15
10
5
0
ID
(mA)
typ. values
V_{DS} = 15 V
V_{GS} = 0
$-V_{GS}$ = 2 V
4 V
0
50
100
T_j (°C)
150

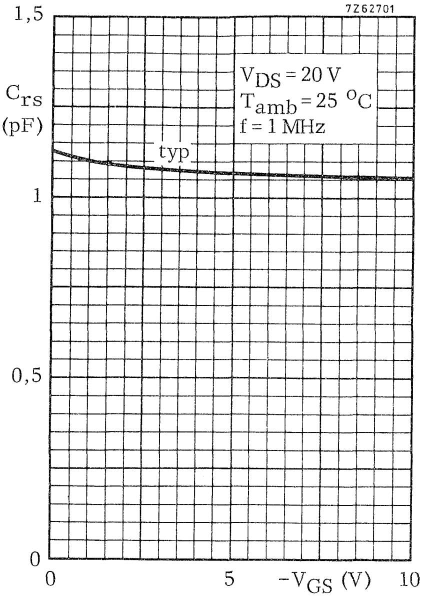

7Z62698
typ. values
$V_{GS} = 0$
$V_{DS} = 15$ V
$T_{amb} = 25$ °C
g_{is} (µA/V)
b_{is} (mA/V)
g_{is}
b_{is}
10^3
10^2
10
1
10^2
10
1
10^{-1}
10
10^2
f (MHz)
10^3

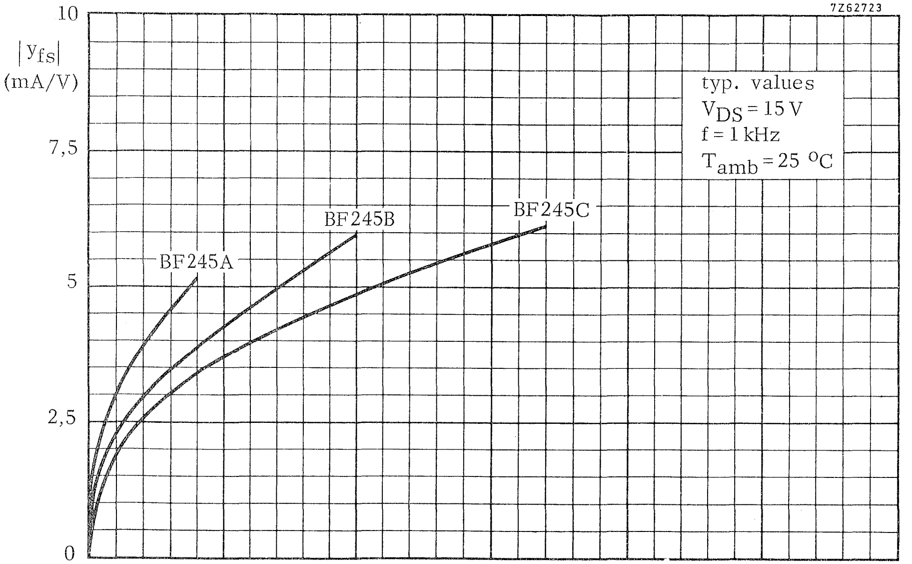

7Z62700
typ. values
$V_{GS} = 0$
$V_{DS} = 15$ V
$T_{amb} = 25$ °C
b_{rs} (µA/V)
C_{rs} (pF)
C_{rs}
b_{rs}
10^4
10^3
10^2
10
10
1
10^{-1}
10^{-2}
10
10^2
f (MHz)
10^3

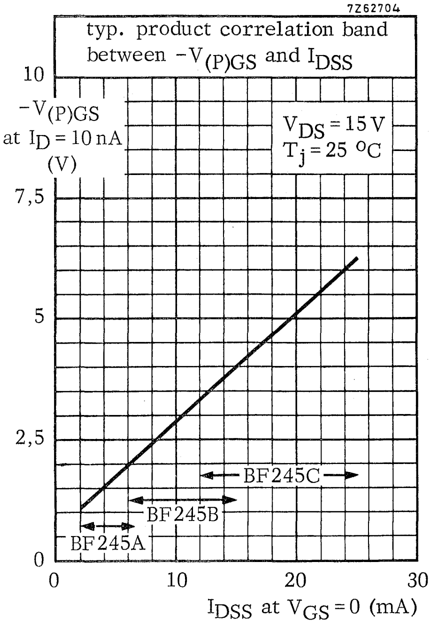

7Z62702
15
10
5
0
g_{fs}
$-b_{fs}$
(mA/V)
typ. values
$V_{GS} = 0$
$V_{DS} = 15$ V
$T_{amb} = 25$ °C
g_{fs}
$-b_{fs}$
10
10^2
f (MHz)
10^3

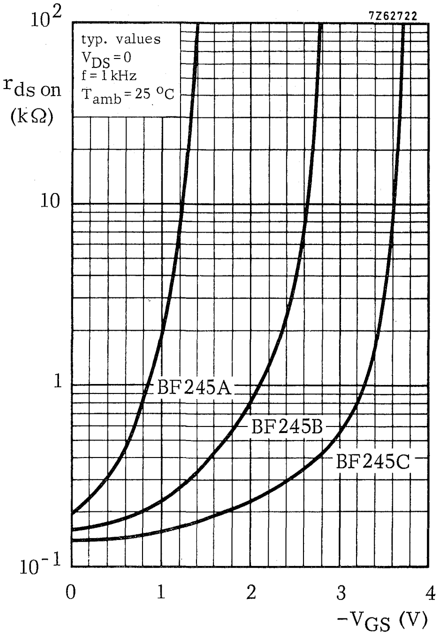

7Z62703
10^3
10^2
10
1
g_{os}
(μA/V)
typ. values
$V_{GS} = 0$
$V_{DS} = 15$ V
$T_{amb} = 25$ °C
b_{os}
g_{os}
10
1
10^{-1}
10^{-2}
b_{os}
(mA/V)
10
10^2
f (MHz)
10^3

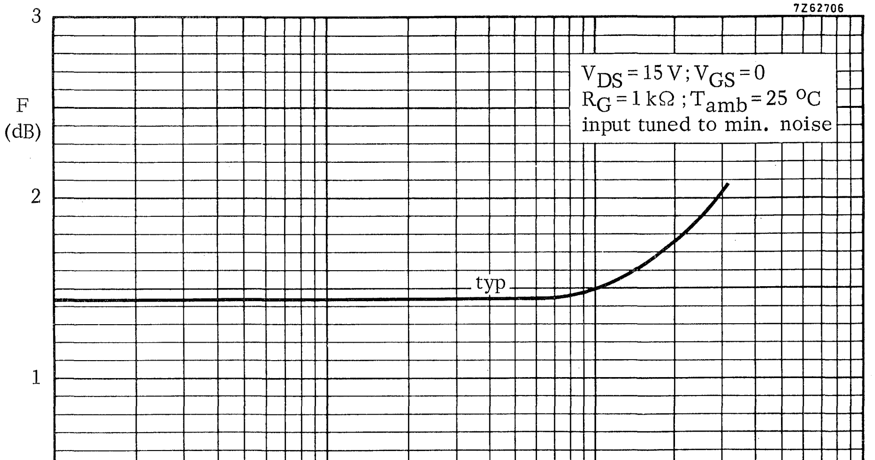

7Z62697
C_{is}
(pF)
6
4
2
0
$V_{DS} = 20$ V
$T_{amb} = 25$ °C
f = 1 MHz
typ
0
5
$-V_{GS}$ (V)
10


7Z62701
C_{rs}
(pF)
1,5
1
0,5
0
$V_{DS} = 20$ V
$T_{amb} = 25$ °C
f = 1 MHz
typ
0
5
$-V_{GS}$ (V)
10


7Z62723
$|y_{fs}|$
(mA/V)
10
7,5
5
2,5
0
typ. values
$V_{DS} = 15$ V
f = 1 kHz
$T_{amb} = 25$ °C
BF245A
BF245B
BF245C
0
5
10
15
20
25
I_D (mA)
30


7Z62704
typ. product correlation band between $-V_{(P)GS}$ and I_{DSS}
$-V_{(P)GS}$ at $I_D = 10$ nA (V)
$V_{DS} = 15$ V
$T_j = 25$ °C
10
7,5
5
2,5
0
BF245C
BF245B
BF245A
0
10
20
30
I_{DSS} at $V_{GS} = 0$ (mA)


7Z62722
typ. values
$V_{DS} = 0$
f = 1 kHz
$T_{amb} = 25$ °C
$r_{ds\ on}$ (kΩ)
10^2
10
1
10^{-1}
BF245A
BF245B
BF245C
0
1
2
3
4
$-V_{GS}$ (V)


7Z62706
F (dB)
3
2
1
0
$V_{DS} = 15$ V; $V_{GS} = 0$
$R_G = 1$ kΩ; $T_{amb} = 25$ °C
input tuned to min. noise
typ
1
10
10^2
f (MHz)
10^3

N-CHANNEL SILICON FIELD-EFFECT TRANSISTORS

Symmetrical n-channel planar epitaxial junction field-effect transistors in plastic TO-92 variants, intended for v.h.f. and u.h.f. amplifiers, mixers, and general purpose switching.

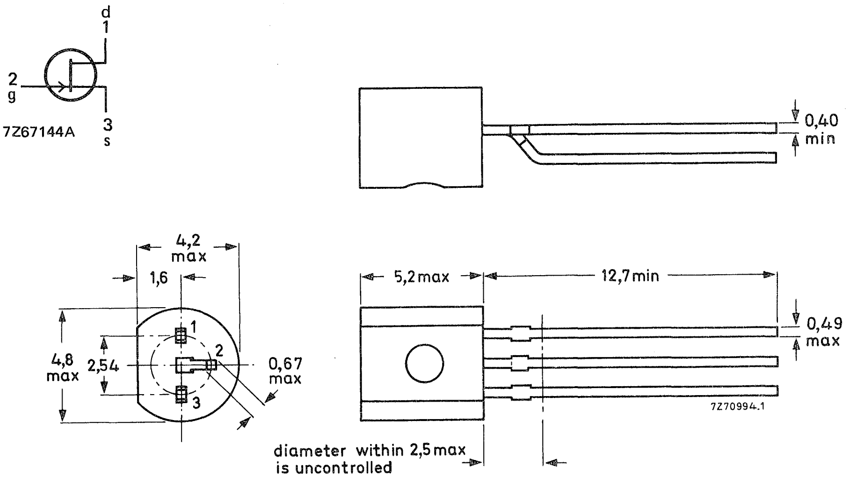
QUICK REFERENCE DATA

			BF246A	B	C	
Drain-source voltage	$\pm V_{DS}$	max.	25			V
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	300			mW
Drain current V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	30	60	110	mA
		<	80	140	250	mA
Gate-source cut-off voltage I_D = 10 nA; V_{DS} = 15 V	$-V_{(P)GS}$		0,6 to 14,5			V
Feedback capacitance at f = 1 kHz I_D = 10 mA; V_{DS} = 15 V	C_{rs}	typ.	3,5			pF
Transfer admittance (common source) I_D = 10 mA; V_{DS} = 15 V; f = 1 kHz	$\lvert y_{fs} \rvert$	>	8			mA/V

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92 variant.



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$\pm V_{DS}$	max.	25	V
Drain-gate voltage (open source)	V_{DGO}	max.	25	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25	V
Gate current	I_G	max.	10	mA
Total power dissipation				
up to T_{amb} = 75 °C	P_{tot}	max.	300	mW
up to T_{amb} = 90 °C*	P_{tot}	max.	300	mW
Storage temperature	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	250	K/W
From junction to ambient*	$R_{th\ j\text{-}a}$	=	200	K/W

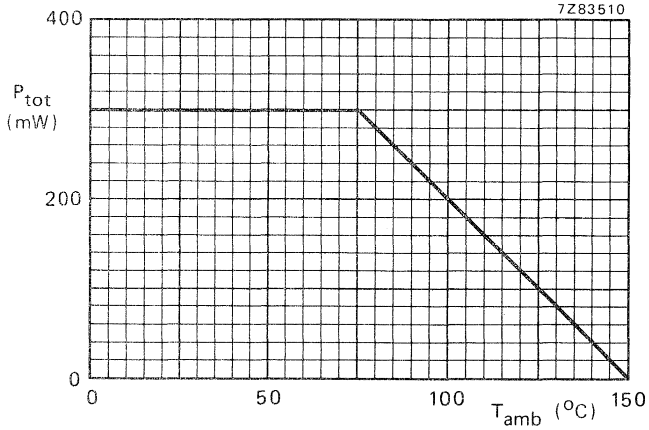


Fig. 2 Maximum permissible power dissipation as a function of ambient temperature.

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* Transistor mounted on printed-circuit board, maximum lead length 3 mm, mounting pad for drain lead minimum 10 mm x 10 mm.

CHARACTERISTICS

T_{amb} = 25 °C

			BF246A	B	C	
Gate cut-off current						
$-V_{GS}$ = 15 V; V_{DS} = 0	$-I_{GSS}$	<	5	5	5	nA
Drain current*						
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	30	60	110	mA
		<	80	140	250	mA
Gate-source breakdown voltage						
$-I_G$ = 1 μA; V_{DS} = 0	$-V_{(BR)GSS}$	>	25	25	25	V
Gate-source voltage						
I_D = 200 μA; V_{DS} = 15 V	$-V_{GS}$	>	1,5	3,0	5,5	V
		<	4,0	7,0	12,0	V
Gate-source cut-off voltage						
I_D = 10 nA; V_{DS} = 15 V	$-V_{(P)GS}$		0,6 to 14,5			V
y-parameters (common source)						
I_D = 10 mA; V_{DS} = 15 V; f = 1 kHz						
Transfer admittance	$\lvert y_{fs} \rvert$	>	8			mA/V
		typ.	17			mA/V
Feedback capacitance	C_{rs}	typ.	3,5			pF
I_D = 10 mA; V_{DS} = 15 V; f = 1 MHz						
Input capacitance	C_{is}	typ.	11			pF
Output capacitance	C_{os}	typ.	5			pF
Cut-off frequency**						
V_{DS} = 15 V; V_{GS} = 0	f_{gfs}	typ.	450			MHz

---

* Measured under pulse conditions: t_p = 300 μs; $\delta \leqslant 0{,}02$.

** The frequency at which g_{fs} is 0,7 of its value at 1 kHz.

N-CHANNEL SILICON FIELD-EFFECT TRANSISTORS

Symmetrical N-channel planar epitaxial junction field-effect transistors in a plastic TO-92 variant; intended for v.h.f. and u.h.f. applications.

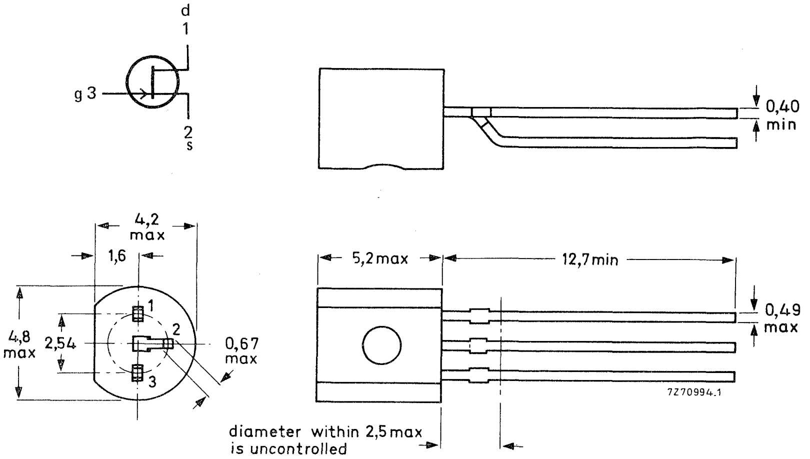
QUICK REFERENCE DATA

		BF256A	B	C	
Drain-source voltage	± V_{DS}		max.	30	V
Gate-source voltage (open drain)	$-V_{GSO}$		max.	30	V
Total power dissipation up to T_{amb} = 75 °C	P_{tot}		max.	300	mW
Drain current V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	> 3	6	11	mA
		< 7	13	18	mA
Feedback capacitance at f = 1 MHz V_{DS} = 20 V; $-V_{GS}$ = 1 V; T_{amb} = 25 °C	C_{rs}		typ.	0,7	pF
Transfer admittance (common source) V_{DS} = 15 V; V_{GS} = 0; f = 1 kHz; T_{amb} = 25 °C	$\|y_{fs}\|$		>	4,5	mA/V
Power gain at f = 800 MHz V_{DS} = 15 V; R_S = 47 Ω	G_p		typ.	11	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92 variant.



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Drain-source voltage	$\pm V_{DS}$	max.	30	V	
Drain-gate voltage (open source)	V_{DGO}	max.	30	V	
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30	V	

Current

Gate current	I_G	max.	10	mA	

Power dissipation

Total power dissipation up to $T_{amb} = 75\ ^oC$	P_{tot}	max.	300	mW	
up to $T_{amb} = 90\ ^oC$	P_{tot}	max.	300	mW	1)

Temperatures

Storage temperature	T_{stg}	-65 to +150		^oC	
Junction temperature	T_j	max.	150	^oC	

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0,25	$^oC/mW$	
From junction to ambient	$R_{th\ j-a}$	=	0,20	$^oC/mW$	1)

---

1) Transistor mounted on printed circuit board, max. lead length 3 mm, mounting pad for drain lead minimum 10 mm x 10 mm.

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Gate cut-off current					
$-V_{GS}$ = 20 V; V_{DS} = 0	$-I_{GSS}$	<	5	nA	

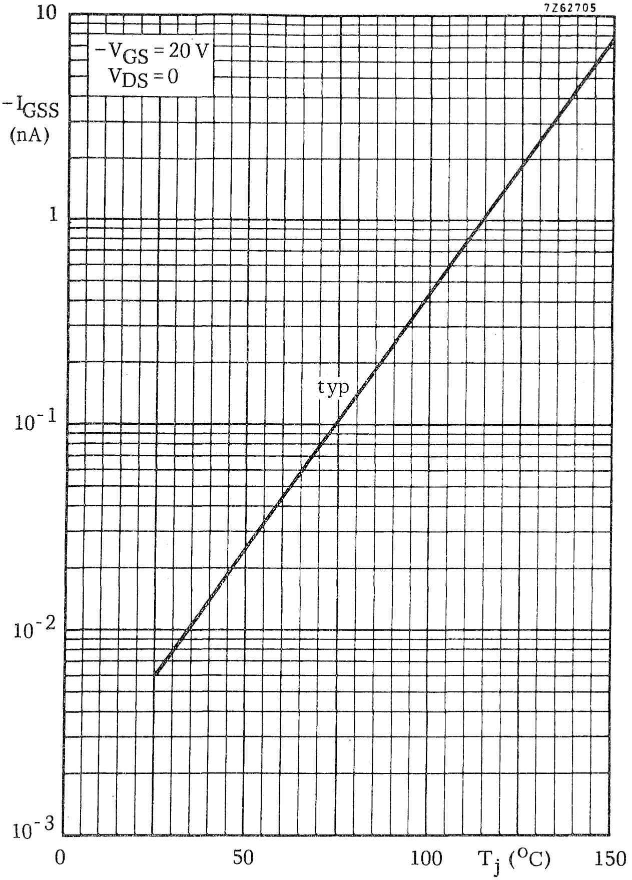
			BF256A	B	C		
Drain current							
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	3	6	11	mA	1)
		<	7	13	18	mA	1)

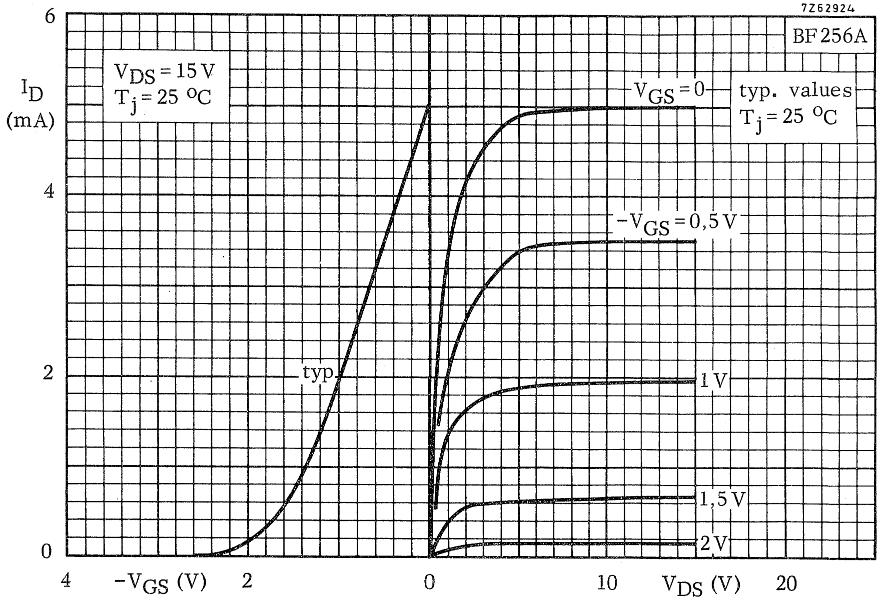
Gate-source breakdown voltage					
$-I_G$ = 1 μA; V_{DS} = 0	$-V_{(BR)GSS}$	>	30	V	
Gate-source voltage					
I_D = 200 μA; V_{DS} = 15 V	$-V_{GS}$		0,5 to 7,5	V	
y-parameters (common source)					
Transfer admittance at f = 1 kHz V_{DS} = 15 V; V_{GS} = 0	$\lvert y_{fs} \rvert$	>	4,5	mA/V	1)
		typ.	5	mA/V	1)
Output capacitance at f = 1 MHz V_{DS} = 20 V; V_{GS} = 0	C_{os}	typ.	1,2	pF	
Feedback capacitance at f = 1 MHz V_{DS} = 20 V; $-V_{GS}$ = 1 V	C_{rs}	typ.	0,7	pF	
Cut-off frequency					
V_{DS} = 15 V; V_{GS} = 0	f_{gfs}	typ.	1	GHz	2)
Noise figure at f = 800 MHz					
V_{DS} = 10 V; R_S = 47 Ω	F	typ.	7,5	dB	
Power gain at f = 800 MHz					
V_{DS} = 15 V; R_S = 47 Ω	G_p	typ.	11	dB	

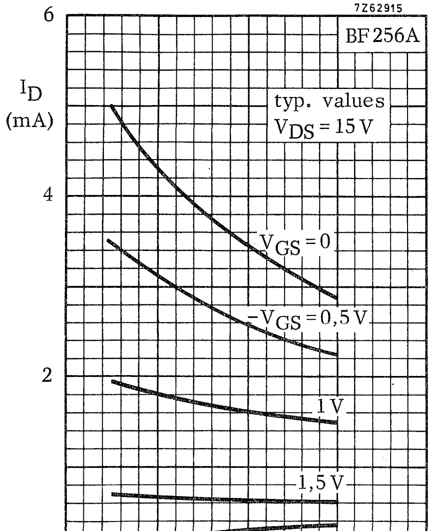
---

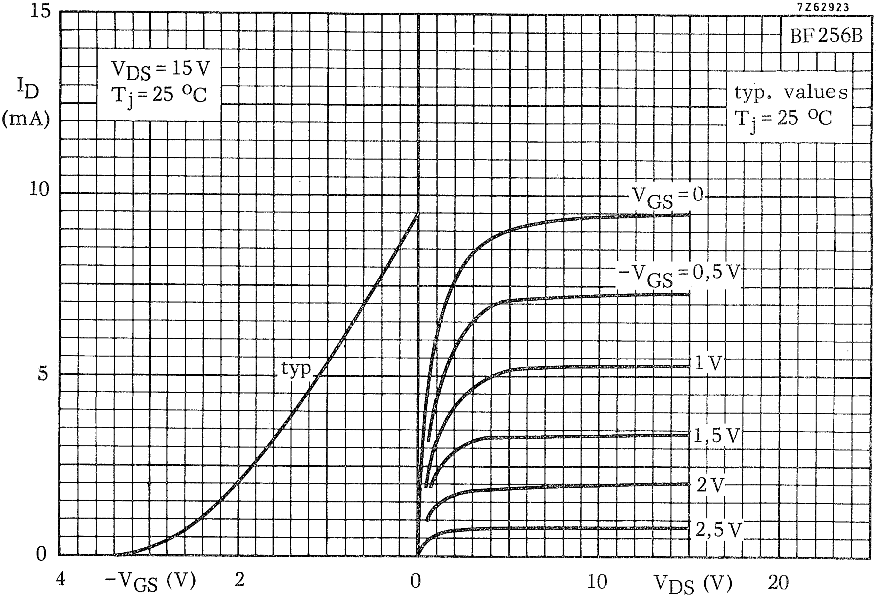
1) Measured under pulse conditions: t_p = 300 μs; $\delta \leq 0{,}02$

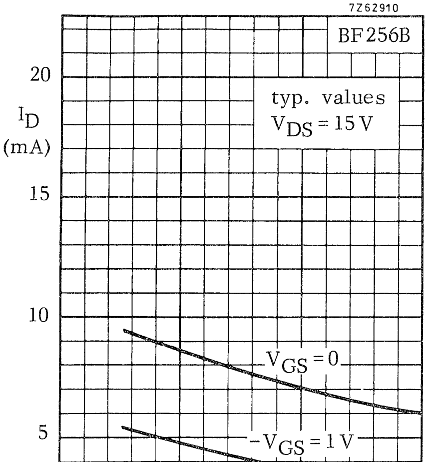
2) The frequency at which g_{fs} is 0,7 of its value at 1 kHz.

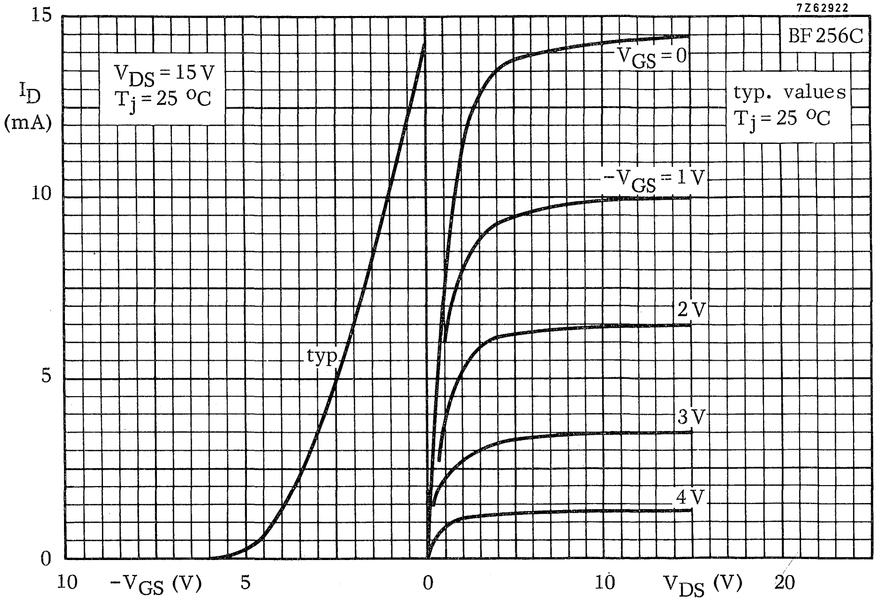

7Z62705
10
1
10^{-1}
10^{-2}
10^{-3}
$-I_{GSS}$ (nA)
$-V_{GS} = 20$ V
$V_{DS} = 0$
typ
0
50
100
T_j (°C)
150

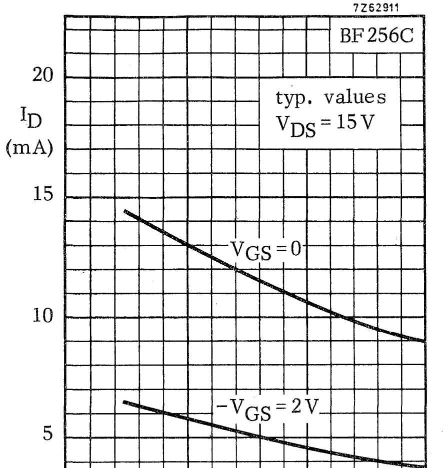

7Z62924
BF256A
V_{DS} = 15 V
T_j = 25 °C
I_D (mA)
6
4
2
0
typ.
V_{GS} = 0
typ. values
T_j = 25 °C
$-V_{GS}$ = 0,5 V
1 V
1,5 V
2 V
4
$-V_{GS}$ (V)
2
0
10
V_{DS} (V)
20

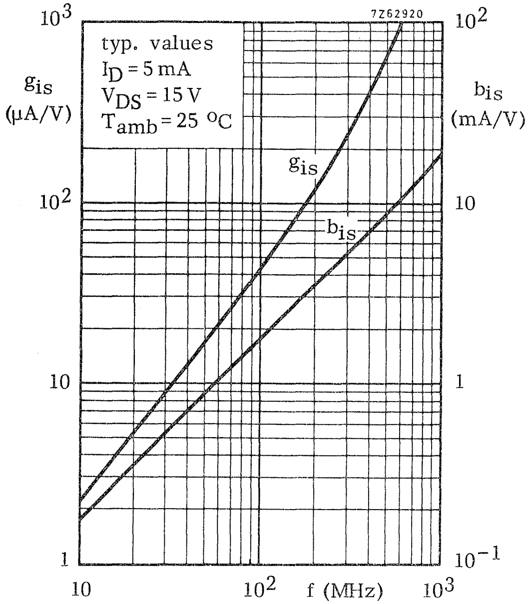

7Z62915
BF256A
I_D (mA)
6
4
2
0
typ. values
V_{DS} = 15 V
V_{GS} = 0
$-V_{GS}$ = 0,5 V
1 V
1,5 V
2 V
0
100
T_j (°C)
200

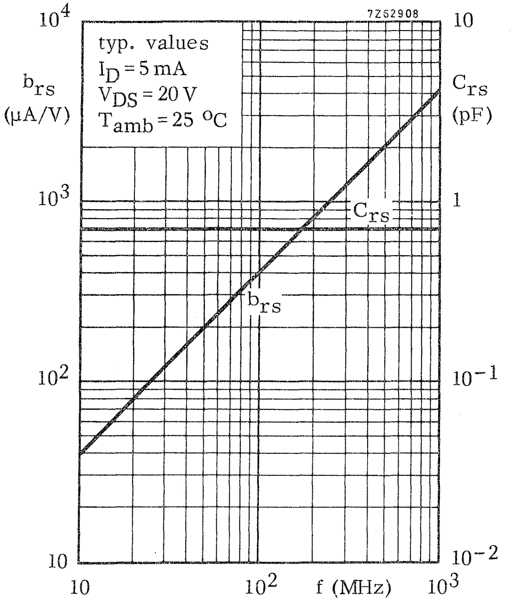

7Z62923
BF256B
V_{DS} = 15 V
T_j = 25 °C
I_D (mA)
15
10
5
0
typ.
typ. values
T_j = 25 °C
V_{GS} = 0
$-V_{GS}$ = 0,5 V
1 V
1,5 V
2 V
2,5 V
4
$-V_{GS}$ (V)
2
0
10
V_{DS} (V)
20

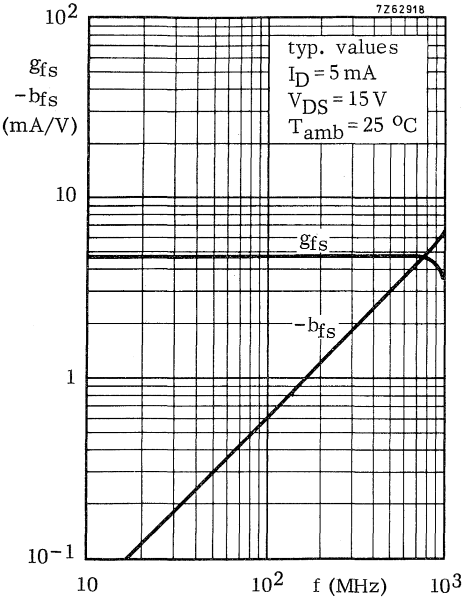

7Z62910
BF256B
typ. values
V_{DS} = 15 V
I_D (mA)
20
15
10
5
0
V_{GS} = 0
$-V_{GS}$ = 1 V
2 V
0
50
100
T_j (°C)
150

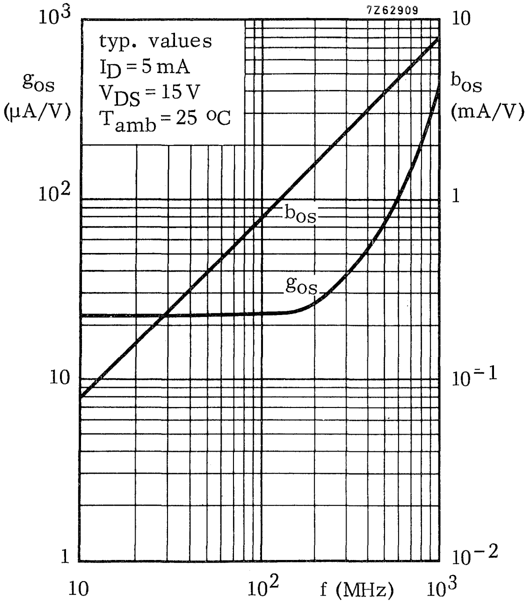

7Z62922
BF256C
I_D (mA)
15
10
5
0
V_{DS} = 15 V
T_j = 25 °C
typ
V_{GS} = 0
$-V_{GS}$ = 1 V
2 V
3 V
4 V
typ. values
T_j = 25 °C
10
$-V_{GS}$ (V)
5
0
10
V_{DS} (V)
20

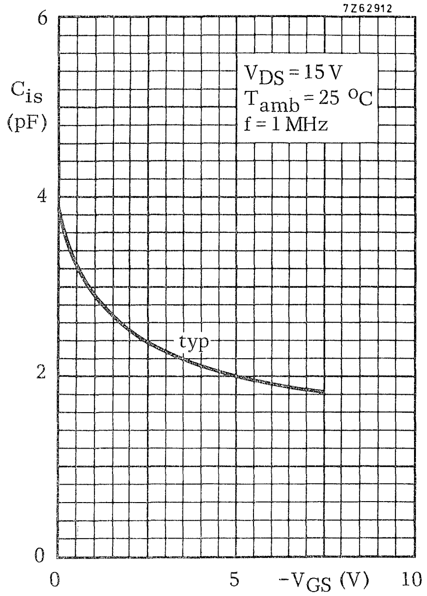

7Z62911
BF256C
I_D (mA)
20
15
10
5
0
typ. values
V_{DS} = 15 V
V_{GS} = 0
$-V_{GS}$ = 2 V
4 V
0
50
100 T_j (°C) 150

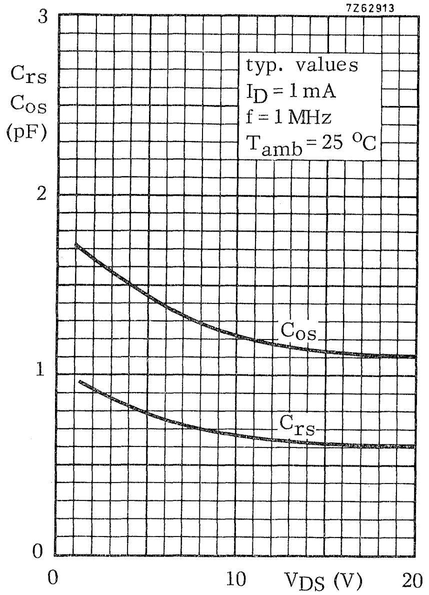

7Z62920
typ. values
$I_D = 5$ mA
$V_{DS} = 15$ V
$T_{amb} = 25$ °C
g_{is} (µA/V)
b_{is} (mA/V)
g_{is}
b_{is}
10^3
10^2
10
1
10^2
10
1
10^{-1}
10
10^2
f (MHz)
10^3

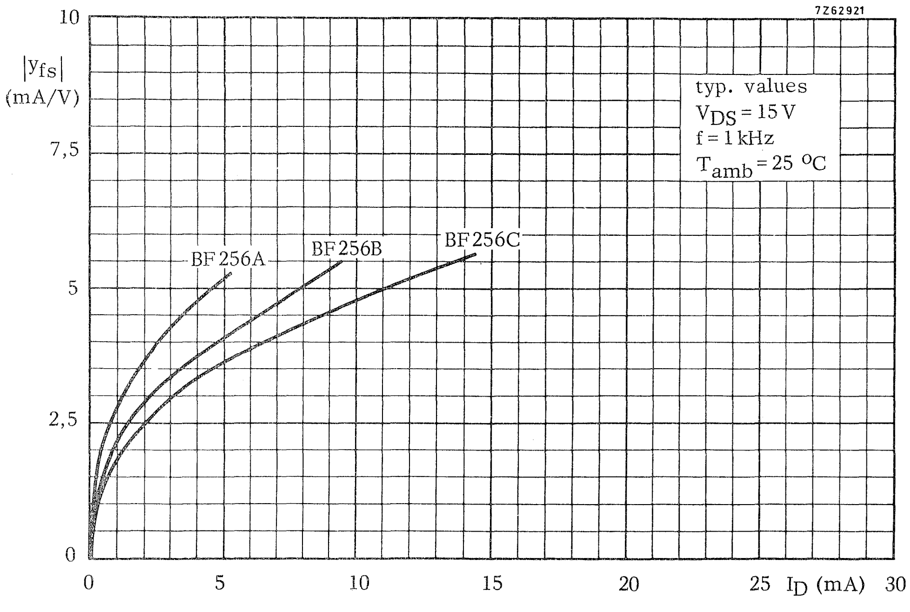

7Z62908
typ. values
$I_D = 5$ mA
$V_{DS} = 20$ V
$T_{amb} = 25$ °C
b_{rs} (µA/V)
C_{rs} (pF)
C_{rs}
b_{rs}
10^4
10^3
10^2
10
10
1
10^{-1}
10^{-2}
10
10^2
f (MHz)
10^3

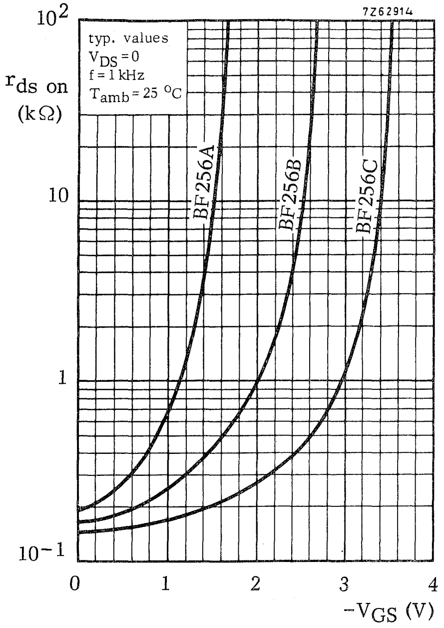

7Z62918
10^2
g_{fs}
$-b_{fs}$
(mA/V)
10
1
10^{-1}
typ. values
$I_D = 5$ mA
$V_{DS} = 15$ V
$T_{amb} = 25$ °C
g_{fs}
$-b_{fs}$
10
10^2
f (MHz)
10^3

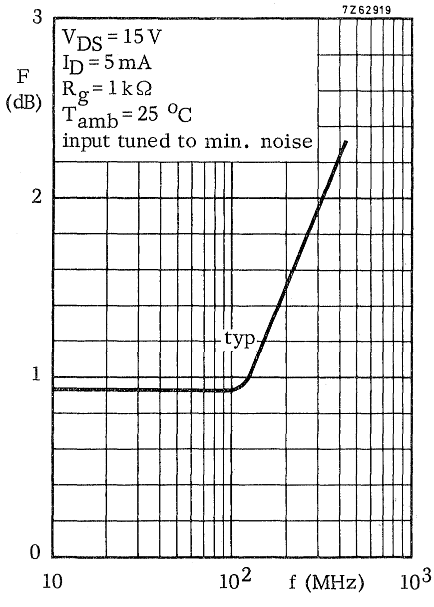

7Z62909
10^3
g_{os}
(μA/V)
10^2
10
1
10
b_{os}
(mA/V)
1
10^{-1}
10^{-2}
typ. values
$I_D = 5$ mA
$V_{DS} = 15$ V
$T_{amb} = 25$ °C
b_{os}
g_{os}
10
10^2
f (MHz)
10^3

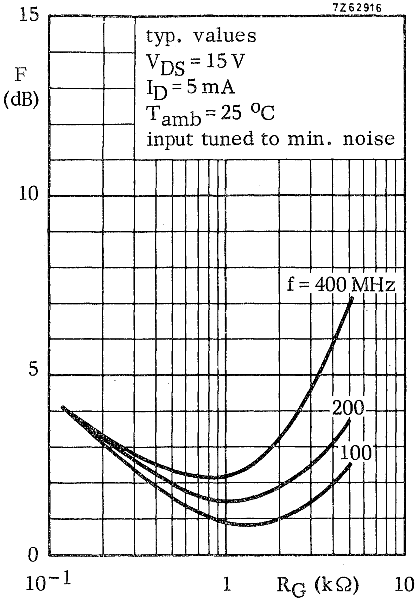

7Z62912
C_{is}
(pF)
6
4
2
0
V_{DS} = 15 V
T_{amb} = 25 °C
f = 1 MHz
typ
0
5
$-V_{GS}$ (V)
10


7Z62913
C_{rs}
C_{os}
(pF)
3
2
1
0
typ. values
I_D = 1 mA
f = 1 MHz
T_{amb} = 25 °C
C_{os}
C_{rs}
0
10
V_{DS} (V)
20


7Z62921
10
$|y_{fs}|$
(mA/V)
7,5
5
2,5
0
typ. values
V_{DS} = 15 V
f = 1 kHz
T_{amb} = 25 °C
BF256A
BF256B
BF256C
0
5
10
15
20
25
I_D (mA)
30


7Z62914
typ. values
$V_{DS} = 0$
f = 1 kHz
$T_{amb} = 25\ ^{o}C$
$r_{ds\ on}$ (kΩ)
10^2
10
1
10^{-1}
BF256A
BF256B
BF256C
0
1
2
3
4
$-V_{GS}$ (V)


7Z62919
$V_{DS} = 15\ V$
$I_D = 5\ mA$
$R_g = 1\ kΩ$
$T_{amb} = 25\ ^{o}C$
input tuned to min. noise
F (dB)
3
2
1
0
typ
10
10^2
f (MHz)
10^3


7Z62916
typ. values
$V_{DS} = 15\ V$
$I_D = 5\ mA$
$T_{amb} = 25\ ^{o}C$
input tuned to min. noise
F (dB)
15
10
5
0
f = 400 MHz
200
100
10^{-1}
1
R_G (kΩ)
10

N-CHANNEL SILICON FIELD-EFFECT TRANSISTORS

Asymmetrical N-channel planar epitaxial junction field-effect transistors in a plastic TO-92 variant; intended for applications up to the v.h.f. range.
These FETs can be supplied in four I_{DSS} groups. Special features are the low feedback capacitance and the low noise figure. Thanks to these special features the BF410 is very suitable for applications such as the r.f. stages in f.m. portables (type A), car radios (type B) and mains radios (type C) or the mixer stage (type D).

QUICK REFERENCE DATA

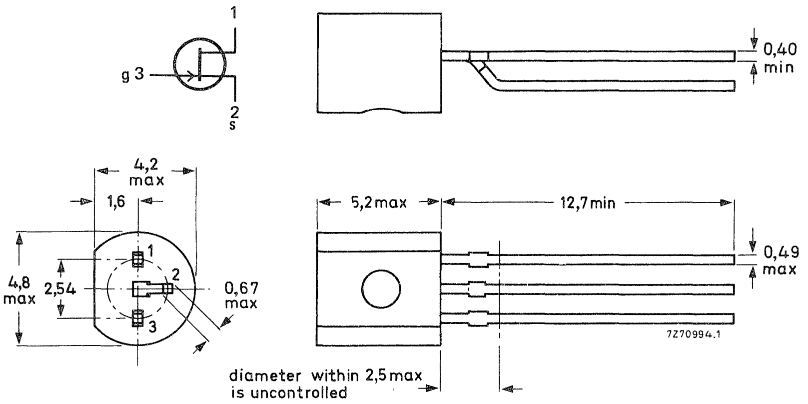
Drain-source voltage	V_{DS}	max.	20	V
Drain current (d.c. or average)	I_D	max.	30	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	300	mW

			BF410A	B	C	D	
Drain current V_{DS} = 10 V; V_{GS} = 0	I_{DSS}	>	0,7	2,5	6	10	mA
		<	3,0	7,0	12	18	mA
Transfer admittance (common source) V_{DS} = 10 V; V_{GS} = 0; f = 1 kHz	$\|y_{fs}\|$	>	2,5	4	6	7	mA/V
Feedback capacitance V_{DS} = 10 V; V_{GS} = 0	C_{rs}	typ.	0,3	0,3	–	–	pF
V_{DS} = 10 V; I_D = 5 mA	C_{rs}	typ.	–	–	0,3	0,3	pF
Noise figure at optimum source admittance G_S = 1 mA/V; $-B_S$ = 3 mA/V; f = 100 MHz V_{DS} = 10 V; V_{GS} = 0	F	typ.	1,5	1,5	–	–	dB
V_{DS} = 10 V; I_D = 5 mA	F	typ.	–	–	1,5	1,5	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92 variant.



RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	20	V
Drain-gate voltage (open source)	V_{DGO}	max.	20	V
Drain current (d.c. or average)	I_D	max.	30	mA
Gate current	$\pm I_G$	max.	10	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	300	mW
Storage temperature	T_{stg}	−65 to + 150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,25	°C/mW

STATIC CHARACTERISTICS

T_{amb} = 25 °C

			BF410A	B	C	D	
Gate cut-off current $-V_{GS}$ = 0,2 V; V_{DS} = 0	$-I_{GSS}$	<	10	10	10	10	nA
Gate-drain breakdown voltage I_S = 0; $-I_D$ = 10 μA	$-V_{(BR)GDO}$	>	20	20	20	20	V
Drain current V_{DS} = 10 V; V_{GS} = 0	I_{DSS}	>	0,7	2,5	6	10	mA
		<	3,0	7,0	12	18	mA
Gate-source cut-off voltage I_D = 10 μA; V_{DS} = 10 V	$-V_{(P)GS}$	typ.	0,8	1,5	2,2	3	V

DYNAMIC CHARACTERISTICS

Measuring conditions (common source): V_{DS} = 10 V; V_{GS} = 0; T_{amb} = 25 °C for **BF410A** and **B**
V_{DS} = 10 V; I_D = 5 mA; T_{amb} = 25 °C for **BF410C** and **D**

y-parameters (common source)			BF410A	B	C	D	
Input capacitance at f = 1 MHz	C_{is}	$<$	5	5	5	5	pF
Input conductance at f = 100 MHz	g_{is}	typ.	100	90	60	50	µA/V
Feedback capacitance at f = 1 MHz	C_{rs}	typ.	0,3	0,3	0,3	0,3	pF
		$<$	0,4	0,4	0,4	0,4	pF
Transfer admittance at f = 1 kHz	$\lvert y_{fs} \rvert$	$>$	2,5	4,0	4,0	3,5	mA/V
V_{GS} = 0 instead of I_D = 5 mA	$\lvert y_{fs} \rvert$	$>$	–	–	6,0	7,0	mA/V
Transfer admittance at f = 100 MHz	$\lvert y_{fs} \rvert$	typ.	3,5	5,5	5,0	5,0	mA/V
Output capacitance at f = 1 MHz	C_{os}	$<$	3	3	3	3	pF
Output conductance at f = 1 MHz	g_{os}	$<$	60	80	100	120	µA/V
Output conductance at f = 100 MHz	g_{os}	typ.	35	55	70	90	µA/V
Noise figure at optimum source admittance G_S = 1 mA/V; $-B_S$ = 3 mA/V; f = 100 MHz	F	typ.	1,5	1,5	1,5	1,5	dB

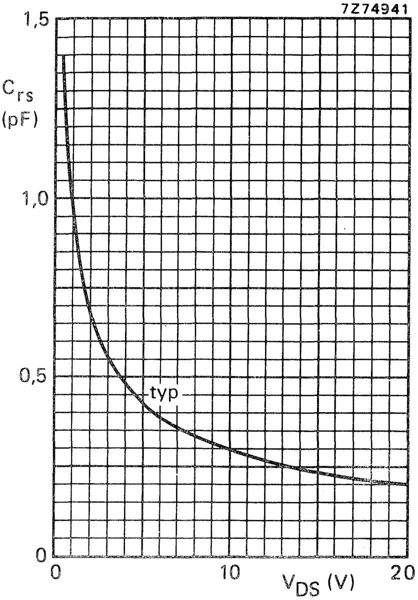


Fig. 2 $V_{GS} = 0$ for BF410A and BF410B; $I_D = 5$ mA for BF410C and BF410D; f = 1 MHz; $T_{amb} = 25$ °C.

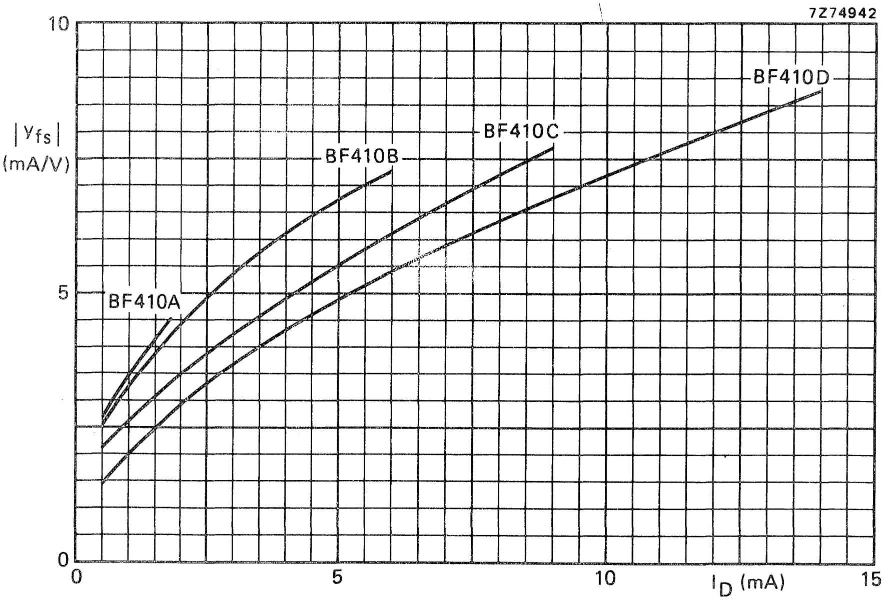


Fig. 3 $V_{DS} = 10$ V; f = 1 kHz; $T_{amb} = 25$ °C; typical values.

DUAL N-CHANNEL FETS

Dual symmetrical n-channel silicon planar epitaxial junction field-effect transistors in a TO-71 metal envelope, with electrically insulated gates and a common substrate connected to the envelope; intended for high performance low level differential amplifiers.

QUICK REFERENCE DATA

Characteristics measured at $T_{amb} = 25\ ^{o}C$; $I_D = 200\ \mu A$; $V_{DG} = 15\ V$

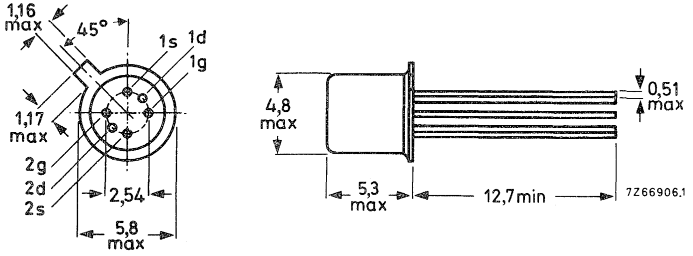
		BFQ10	11	12	13	14	15	16	
Difference in gate current	$\lvert \Delta I_G \rvert$	< 10	10	10	10	10	10	10	pA
Gate-source voltage difference	$\lvert \Delta V_{GS} \rvert$	< 5	10	10	10	15	20	50	mV
Thermal drift of gate-source voltage difference	$\left\lvert \frac{d\Delta V_{GS}}{dT} \right\rvert$	< 5	5	10	20	20	40	50	μV/K
Transfer conductance ratio	$\frac{g_{1fs}}{g_{2fs}}$	> 0,98 < 1,02	0,98 1,02	0,98 1,02	0,98 1,02	0,98 1,02	0,95 1,05	0,95 1,05	
Difference in transfer impedance	$\left\lvert \Delta \frac{1}{g_{fs}} \right\rvert$	< 6	6	12	12	12	20	30	Ω
Difference in penetration factor	$\left\lvert \Delta \frac{g_{os}}{g_{fs}} \right\rvert$	< 10	30	30	30	30	30	100	μV/V
Common mode rejection ratio	CMRR	> 100	90	90	90	90	90	80	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-71.

All leads insulated from the case.



RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Drain-source voltage	$\pm V_{DS}$	max.	30	V
Drain-gate voltage (open source)	V_{DGO}	max.	30	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30	V
Voltage between gate 1 and gate 2	$\pm V_{1G-2G}$	max.	40	V

Currents

Drain current	I_D	max.	30	mA
Gate current	I_G	max.	10	mA

Power dissipation

Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	250	mW

Temperatures

Storage temperature	T_{stg}		-65 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0,5	°C/mW

CHARACTERISTICS (total device) $T_{amb} = 25\ ^{o}C$ unless otherwise specified

Measured at: $I_D = 200\ \mu A$; $V_{DG} = 15\ V$ except for drain current ratio.

			BFQ10	11	12	13	14	15	16	
Drain current ratio [1]										
$V_{DG} = 15\ V$; $V_{GS} = 0$	$\frac{I_{1D-1SS}}{I_{2D-2SS}}$	>	0,97	0,95	0,95	0,95	0,92	0,90	0,80	
		<	1,03	1,05	1,05	1,05	1,08	1,10	1,20	
Difference in gate current	$\lvert \Delta I_G \rvert$	<	10	10	10	10	10	10	10	pA
Gate-source voltage difference	$\lvert \Delta V_{GS} \rvert$	<	5	10	10	10	15	20	50	mV
Thermal drift of gate-source voltage difference	$\left\lvert \frac{d\ \Delta V_{GS}}{dT} \right\rvert$	<	5	5	10	20	20	40	50	$\mu V/^{o}C$
Transfer conductance ratio	$\frac{g_{1fs}}{g_{2fs}}$	>	0,98	0,98	0,98	0,98	0,98	0,95	0,95	
		<	1,02	1,02	1,02	1,02	1,02	1,05	1,05	
Difference in transfer impedance [2]	$\left\lvert \Delta \frac{1}{g_{fs}} \right\rvert$	<	6	6	12	12	12	20	30	Ω
Difference in penetration factor [3]	$\left\lvert \Delta \frac{g_{os}}{g_{fs}} \right\rvert$	<	10	30	30	30	30	30	100	$\mu V/V$
Common mode rejection ratio [4]	CMRR	>	100	90	90	90	90	90	80	dB

---

[1] Measured under pulse conditions.

[2] The difference in transfer impedance is equal to the ratio of the change of the gate-source voltage difference to the change of drain current, at constant drain-gate voltage.

$$\left(\Delta \frac{1}{g_{fs}} = \frac{d\ \Delta V_{GS}}{d\ I_D} \text{ at } V_{DG} = \text{constant}\right)$$

[3] The difference in penetration factor is equal to the ratio of the change of the gate-source voltage difference to the change of drain-gate voltage, at constant drain current.

$$\left(\Delta \frac{g_{os}}{g_{fs}} = \frac{d\ \Delta V_{GS}}{d\ V_{DG}} \text{ at } I_D = \text{constant}\right)$$

[4] Common mode rejection ratio

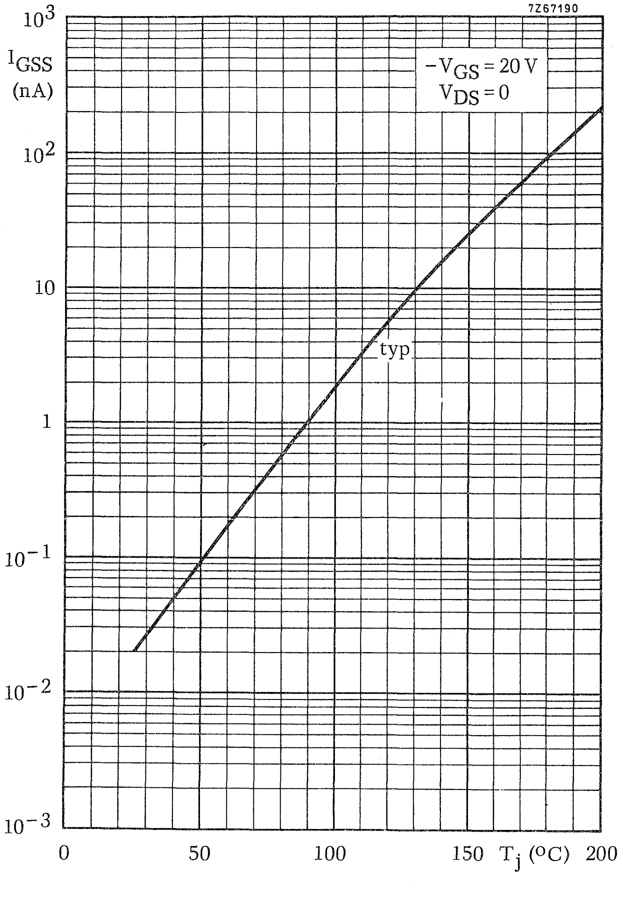
$$\text{CMRR (in dB)} = -20 \log \left\lvert \Delta \frac{g_{os}}{g_{fs}} \right\rvert$$

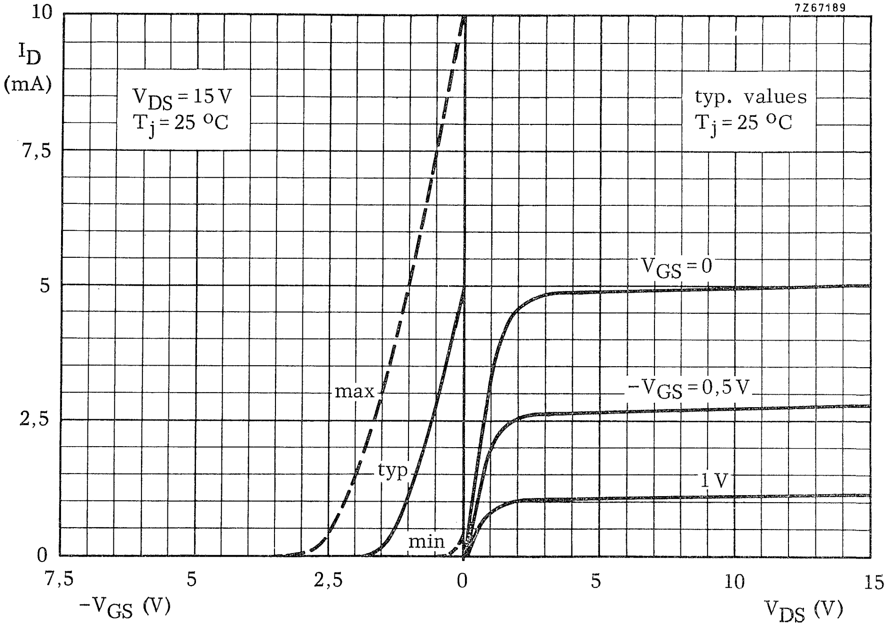
CHARACTERISTICS (Individual transistor) T_{amb} = 25 °C unless otherwise specified

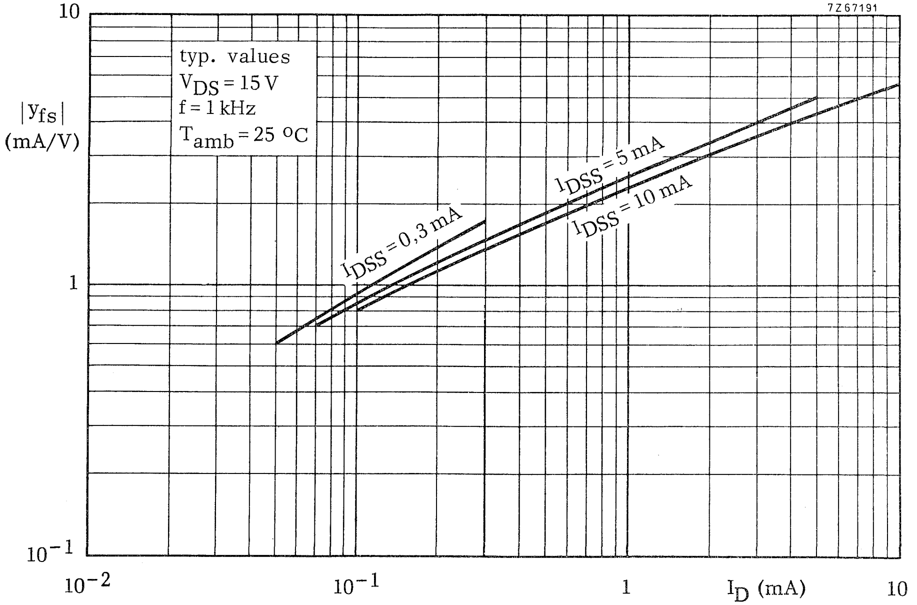
Gate cut-off current				
$-V_{GS}$ = 20 V; V_{DS} = 0	$-I_{GSS}$	<	100	pA
$-V_{GS}$ = 20 V; V_{DS} = 0; T_{amb} = 125 °C	$-I_{GSS}$	<	20	nA
Gate current				
I_D = 200 μA; V_{DG} = 15 V; T_{amb} = 125 °C	I_G	<	10	nA
Drain current				
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}		0,5 to 10	mA [1]
Gate-source voltage				
I_D = 200 μA; V_{DG} = 15 V	$-V_{GS}$	<	2,7	V
Gate-source cut-off voltage				
I_D = 1 nA; V_{DG} = 15 V	$-V_{(P)GS}$		0,5 to 3,5	V
Transfer conductance at f = 1 kHz				
I_D = 200 μA; V_{DG} = 15 V	g_{fs}	>	1,0	mA/V
Output conductance at f = 1 kHz				
I_D = 200 μA; V_{DG} = 15 V	g_{os}	<	5	μA/V
Input capacitance at f = 1 MHz				
I_D = 200 μA; V_{DG} = 15 V	C_{is}	<	8	pF [2]
Feedback capacitance at f = 1 MHz				
I_D = 200 μA; V_{DG} = 15 V	C_{rs}	<	1,0	pF [2]
Equivalent noise voltage				
I_D = 200 μA; V_{DS} = 15 V B = 0,6 to 100 Hz	V_n	<	0,5	μV

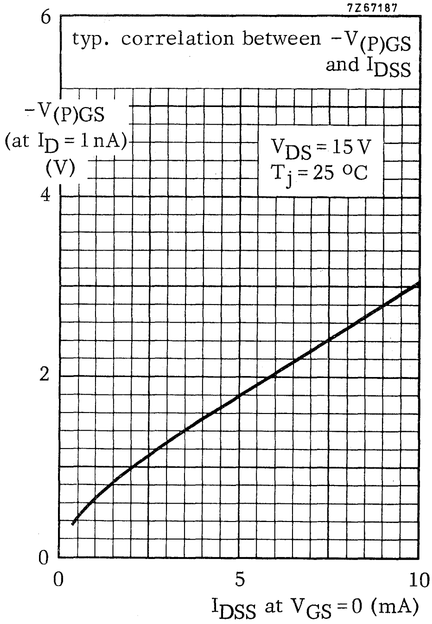
---

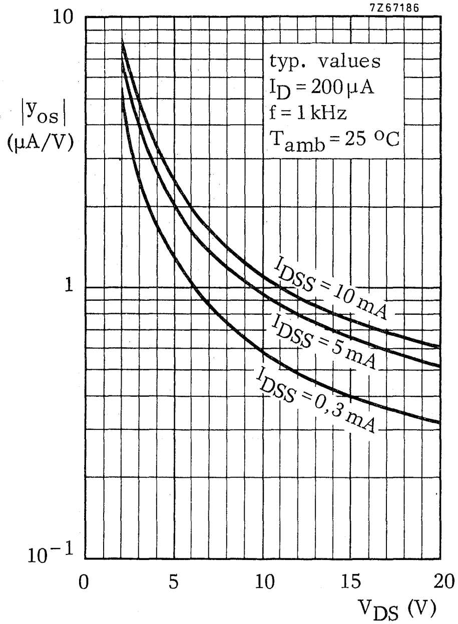
1) Measured under pulse conditions.
2) Measured with case grounded.

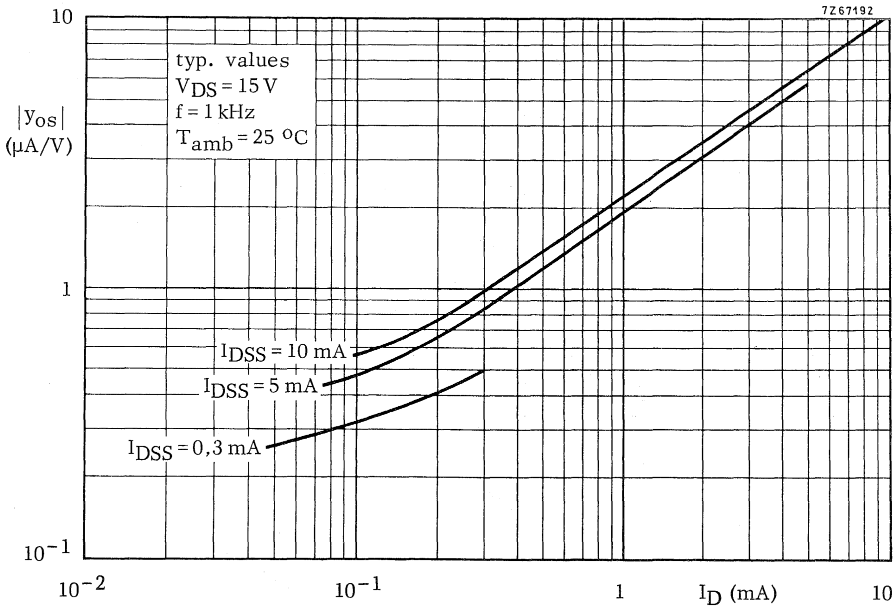

7Z67190
10^3
I_{GSS} (nA)
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
$-V_{GS} = 20$ V
$V_{DS} = 0$
typ
0
50
100
150
T_j (°C)
200

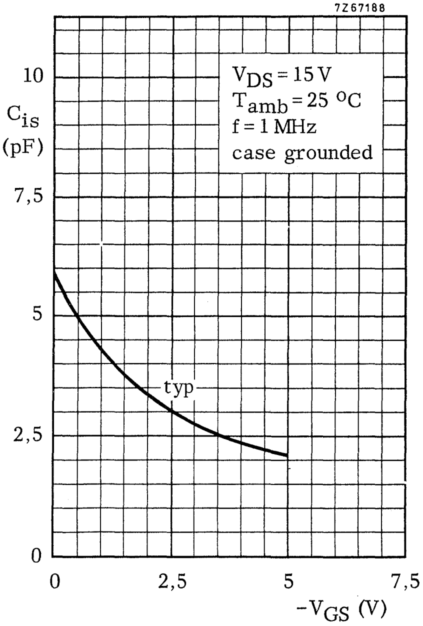

7Z67189
10
I_D
(mA)
7,5
5
2,5
0
V_{DS} = 15 V
T_j = 25 °C
typ. values
T_j = 25 °C
V_{GS} = 0
$-V_{GS}$ = 0,5 V
1 V
max
typ
min
7,5
5
2,5
0
5
10
15
$-V_{GS}$ (V)
V_{DS} (V)

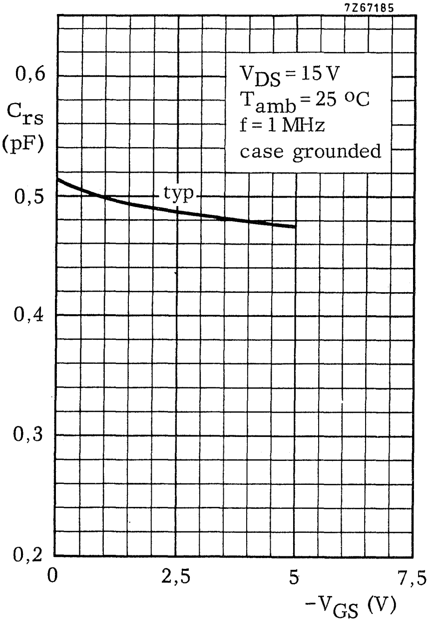

7Z67191
10
1
10^{-1}
$|y_{fs}|$
(mA/V)
typ. values
V_{DS} = 15 V
f = 1 kHz
T_{amb} = 25 °C
I_{DSS} = 0,3 mA
I_{DSS} = 5 mA
I_{DSS} = 10 mA
10^{-2}
10^{-1}
1
I_D (mA)
10

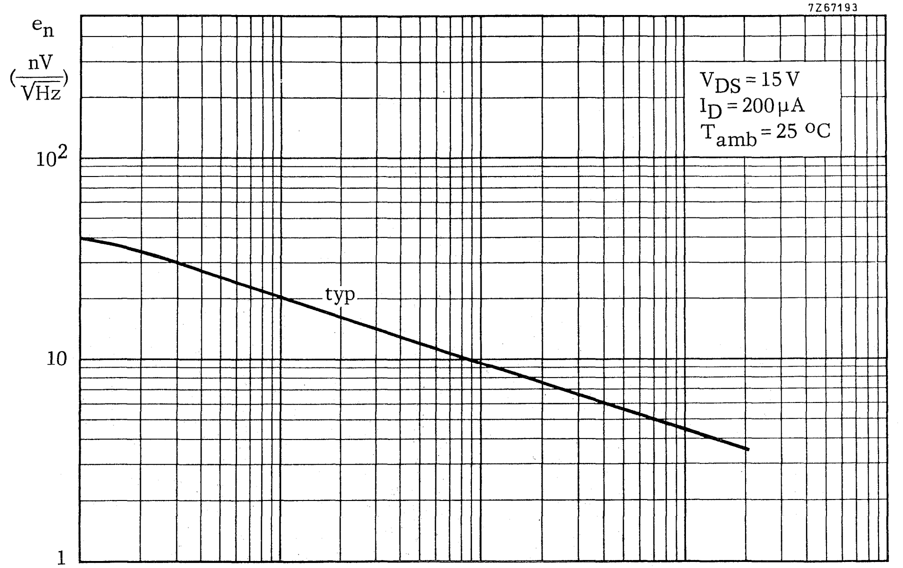

7Z67187
typ. correlation between $-V_{(P)GS}$ and I_{DSS}
$-V_{(P)GS}$ (at $I_D = 1$ nA) (V)
$V_{DS} = 15$ V
$T_j = 25$ °C
6
4
2
0
0
5
10
I_{DSS} at $V_{GS} = 0$ (mA)


7Z67186
typ. values
$I_D = 200$ µA
f = 1 kHz
$T_{amb} = 25$ °C
$|y_{os}|$ (µA/V)
10
1
10^{-1}
$I_{DSS} = 10$ mA
$I_{DSS} = 5$ mA
$I_{DSS} = 0,3$ mA
0
5
10
15
20
V_{DS} (V)


7Z67192
typ. values
$V_{DS} = 15$ V
f = 1 kHz
$T_{amb} = 25$ °C
$|y_{os}|$ (µA/V)
10
1
10^{-1}
$I_{DSS} = 10$ mA
$I_{DSS} = 5$ mA
$I_{DSS} = 0,3$ mA
10^{-2}
10^{-1}
1
I_D (mA)
10


7Z67188
V_{DS} = 15 V
T_{amb} = 25 °C
f = 1 MHz
case grounded
C_{is} (pF)
10
7,5
5
2,5
0
typ
0
2,5
5
7,5
$-V_{GS}$ (V)


7Z67185
V_{DS} = 15 V
T_{amb} = 25 °C
f = 1 MHz
case grounded
C_{rs} (pF)
0,6
0,5
0,4
0,3
0,2
typ
0
2,5
5
7,5
$-V_{GS}$ (V)


7Z67193
e_n $(\frac{nV}{\sqrt{Hz}})$
V_{DS} = 15 V
I_D = 200 μA
T_{amb} = 25 °C
10^2
10
1
typ
10
10^2
10^3
10^4
f (Hz)
10^5

MATCHED N-CHANNEL FETS

Matched pair of symmetrical n-channel silicon planar epitaxial junction field-effect transistors in TO-72 metal envelopes, mounted together in a metal S-clip.

These devices are intended for low level differential amplifiers.

QUICK REFERENCE DATA

Characteristics measured at T_{amb} = 25 °C; I_D = 0,5 mA; V_{DG} = 15 V

			BFS21	BFS21A	
Gate cut-off current	I_G	<	0,5	0,5	nA
Gate -source voltage difference	$\lvert\Delta V_{GS}\rvert$	<	20	10	mV
Thermal drift of gate-source voltage difference	$\left\lvert\frac{d\Delta V_{GS}}{dT}\right\rvert$	<	75	40	µV/K
Difference in transfer impedance	$\left\lvert\Delta\frac{1}{g_{fs}}\right\rvert$	<	15	7,5	Ω
Difference in penetration factor	$\left\lvert\Delta\frac{g_{os}}{g_{fs}}\right\rvert$	<	1	0,5	mV/V
Common mode rejection ratio	CMRR	>	60	66	dB

MECHANICAL DATA

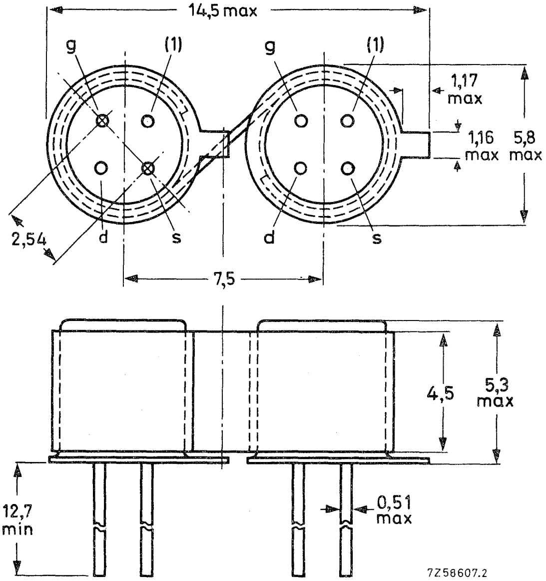
SOT-52 (see page 2)

TOTAL DEVICE

Dimensions in mm

MECHANICAL DATA

SOT-52



(1) = shield lead (connected to case).

Maximum lead diameter is guaranteed only for 12,7 mm.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage between any 2 terminals	V	max.	30	V
Drain current	I_D	max.	4	mA
Gate current	I_G	max.	0,5	mA
Total power dissipation up to T_{amb} = 100 °C	P_{tot}	max.	30	mW
Operating ambient temperature	T_{amb}	−20 to + 100		°C

CHARACTERISTICS (total device) T_{amb} = 25 °C unless otherwise specified

		BFS21	BFS21A	
Drain current ratio				
V_{DG} = 15 V; V_{GS} = 0; T_j = 25 °C	$\frac{I_{D1-S1S}}{I_{D2-S2S}}$	$>$ 0.95 $<$ 1.05	0.95 1.05	
Gate-source voltage difference				
I_D = 500 μA; V_{DG} = 15 V	$\lvert\Delta V_{GS}\rvert$	$<$ 20	10	mV
I_D = 100 μA; V_{DG} = 15 V	$\lvert\Delta V_{GS}\rvert$	$<$ 20	10	mV
Thermal drift of gate-source voltage difference				
I_D = 500 μA; V_{DG} = 15 V	$\left\lvert\frac{d\ \Delta V_{GS}}{dT}\right\rvert$	$<$ 75	40	μV/°C
I_D = 100 μA; V_{DG} = 15 V	$\left\lvert\frac{d\ \Delta V_{GS}}{dT}\right\rvert$	$<$ 75	40	μV/°C
Change of gate-source voltage difference with ambient temperature				
T_{amb} = 25 to 100 °C				
I_D = 500 μA; V_{DG} = 15 V	$\lvert\Delta V_{GS}(T_{amb2}) - \Delta V_{GS}(T_{amb1})\rvert$	$<$ 6	3	mV
I_D = 100 μA; V_{DG} = 15 V	$\lvert\Delta V_{GS}(T_{amb2}) - \Delta V_{GS}(T_{amb1})\rvert$	$<$ 6	3	mV
Difference of penetration factors [1]				
I_D = 500 μA; V_{DG} = 15 V	$\left\lvert\Delta \frac{g_{os}}{g_{fs}}\right\rvert$	$<$ 1	0.5	10^{-3}
I_D = 100 μA; V_{DG} = 15 V	$\left\lvert\Delta \frac{g_{os}}{g_{fs}}\right\rvert$	$<$ 1	0.5	10^{-3}
Difference of transfer impedances [2]				
I_D = 500 μA; V_{DG} = 15 V	$\left\lvert\Delta \frac{1}{g_{fs}}\right\rvert$	$<$ 15	7.5	Ω
I_D = 100 μA; V_{DG} = 15 V	$\left\lvert\Delta \frac{1}{g_{fs}}\right\rvert$	$<$ 75	37.5	Ω

---

[1] The difference between the penetration factors is equal to the ratio of the change of the gate-source voltage difference to the change of drain-gate voltage, at constant drain current.

$$(\Delta \frac{g_{os}}{g_{fs}} = \frac{d\ \Delta V_{GS}}{d\ V_{DG}} \text{ at } I_D = \text{constant})$$

[2] The difference between the transfer impedances is equal to the ratio of the change of the gate-source voltage difference to the change of drain current, at constant drain-gate voltage.

$$(\Delta \frac{1}{g_{fs}} = \frac{d\ \Delta V_{GS}}{d\ I_D} \text{ at } V_{DG} = \text{constant})$$

CHARACTERISTICS (continued) (total device)

Common mode rejection ratio [1]			BFS21	BFS21A	
I_D = 500 μA; V_{DG} = 15 V	CMRR	>	60	66	dB
I_D = 100 μA; V_{DG} = 15 V	CMRR	>	60	66	dB

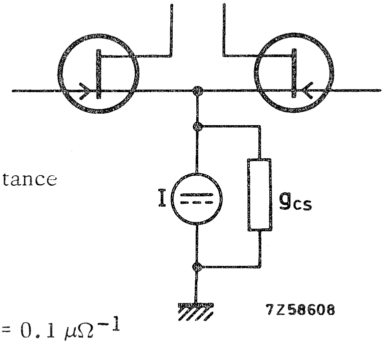
INDIVIDUAL TRANSISTOR

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Drain-source voltage	$\pm V_{DS}$	max.	30	V
Drain-gate voltage (open source)	V_{DGO}	max.	30	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30	V
Currents				
Drain current	I_D	max.	20	mA
Gate current	I_G	max.	10	mA
Power dissipation				
Total power dissipation up to T_{amb} = 25°	P_{tot}	max.	300	mW
Temperatures				
Storage temperature	T_{stg}		-65 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air
(for individual transistor without S-clip) $R_{th\ j\text{-}a}$ = 0.59 °C/mW



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[1] Common mode rejection ratio

$$(CMRR)^{-1} = \Delta \frac{g_{os}}{g_{fs}} + \frac{1}{2} g_{cs} \Delta \frac{1}{g_{fs}}$$

where g_{cs} in this formula is the output conductance of the summing current source.

The guaranteed values of CMRR apply at g_{cs} = 0.1 $\mu\Omega^{-1}$

CHARACTERISTICS (individual transistor) $T_{amb} = 25\,^{o}C$ unless otherwise specified

Gate cut-off current				
$I_D = 500\ \mu A$; $V_{DS} = 15\ V$	I_G	<	0.5	nA
$I_D = 500\ \mu A$; $V_{DS} = 15\ V$; $T_{amb} = 100\ ^{o}C$	I_G	<	25	nA
Drain current				
$V_{DS} = 15\ V$, $V_{GS} = 0$, $T_j = 25\ ^{o}C$	I_{DSS}	>	1	mA
Gate-source cut-off voltage				
$I_D = 0.5\ nA$, $V_{DS} = 15\ V$	$-V_{(P)GS}$	<	6	V
Transfer conductance at f = 1 kHz				
$I_D = 500\ \mu A$; $V_{DS} = 15\ V$	g_{fs}	>	1.0	$m\Omega^{-1}$
Output conductance at f = 1 kHz				
$I_D = 500\ \mu A$; $V_{DS} = 15\ V$	g_{os}	<	15	$\mu\Omega^{-1}$
Input capacitance at f = 1 MHz				
$I_D = 500\ \mu A$; $V_{DS} = 15\ V$	C_{is}	<	5	pF
Feedback capacitance at f = 1 MHz				
$I_D = 500\ \mu A$; $V_{DS} = 15\ V$	C_{rs}	<	0.75	pF
Equivalent noise voltage				
f = 10 Hz				
$I_D = 500\ \mu A$; $V_{DS} = 15\ V$	$V_n/\sqrt{B}$	<	200	$nV/\sqrt{Hz}$
$V_{DS} = 15\ V$, $V_{GS} = 0$	$V_n/\sqrt{B}$	<	75	$nV/\sqrt{Hz}$

N-CHANNEL SILICON FETS

Symmetrical n-channel silicon planar epitaxial junction field-effect transistors in TO-72 metal envelopes with the shield lead connected to the case. The transistors are designed for broad band amplifiers (0 to 300 MHz). Their very low noise at low frequencies makes these devices very suitable for differential amplifiers, electro-medical and nuclear detector preamplifiers.

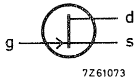
QUICK REFERENCE DATA

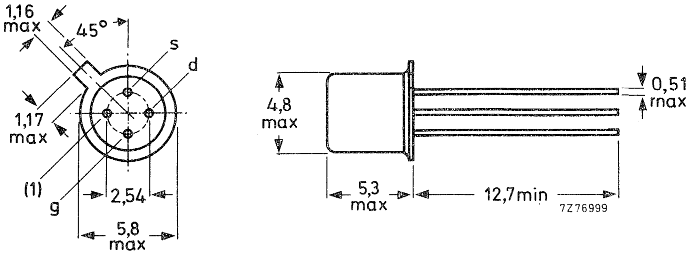
Drain-source voltage	$\pm V_{DS}$	max.	30		V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30		V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300		mW
			BFW10	**BFW11**	
Drain current		>	8	4	mA
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	<	20	10	mA
Gate-source cut-off voltage I_D = 0,5 nA; V_{DS} = 15 V	$-V_{(P)GS}$	<	8	6	V
Feedback capacitance at f = 1 MHz V_{DS} = 15 V; V_{GS} = 0	C_{rs}	<	0,80	0,80	pF
Transfer admittance (common source) V_{DS} = 15 V; V_{GS} = 0; f = 200 MHz	$\lvert y_{fs} \rvert$	>	3,2	3,2	mA/V
Noise figure at V_{DS} = 15 V; V_{GS} = 0 f = 100 MHz; R_G = 1 kΩ	F	<	2,5	2,5	dB
Equivalent noise voltage f = 10 Hz	$V_n/\sqrt{B}$	<	75	75	$nV/\sqrt{Hz}$

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-72.





(1) = shield lead connected to case

Accessories: 56246 (distance disc).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Drain-source voltage	$\pm V_{DS}$	max.	30	V
Drain-gate voltage (open source)	V_{DGO}	max.	30	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30	V

Currents

Drain current	I_D	max.	20	mA
Gate current	I_G	max.	10	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW

Temperatures

Storage temperature	T_{stg}	−65 to +200		°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	0.59	°C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BFW10	BFW11	
Gate cut-off current					
$-V_{GS}$ = 20 V; V_{DS} = 0	$-I_{GSS}$	<	0.1	0.1	nA
$-V_{GS}$ = 20 V; V_{DS} = 0; T_j = 150 °C	$-I_{GSS}$	<	0.5	0.5	µA
Drain current [1]					
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	8	4	mA
		<	20	10	mA
Gate-source voltage					
I_D = 400 µA; V_{DS} = 15 V	$-V_{GS}$	>	2.0		V
		<	7.5		V
I_D = 50 µA; V_{DS} = 15 V	$-V_{GS}$	>		1.25	V
		<		4.0	V
Gate-source cut-off voltage					
I_D = 0.5 nA; V_{DS} = 15 V	$-V_{(P)GS}$	<	8	6	V
y parameters					
V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C					
f = 1 kHz Transfer admittance	$\|y_{fs}\|$	>	3.5	3.0	mA/V
		<	6.5	6.5	mA/V
Output admittance	$\|y_{os}\|$	<	85	50	µA/V
f = 1 MHz Input capacitance	C_{is}	typ.	4	4	pF
		<	5	5	pF
Feedback capacitance	C_{rs}	typ.	0.6	0.6	pF
		<	0.80	0.80	pF
f = 200 MHz Transfer admittance	$\|y_{fs}\|$	>	3.2	3.2	mA/V
Input conductance	g_{is}	<	800	800	µA/V
Output conductance	g_{os}	<	200	100	µA/V
Noise figure at f = 100 MHz; R_G = 1 kΩ					
V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C input tuned to minimum noise	F	<	2.5	2.5	dB
Equivalent noise voltage					
V_{DS} = 15 V; V_{GS} = 0; T_{amb} = 25 °C					
f = 10 Hz	$V_n/\sqrt{B}$	<	75	75	nV/$\sqrt{Hz}$

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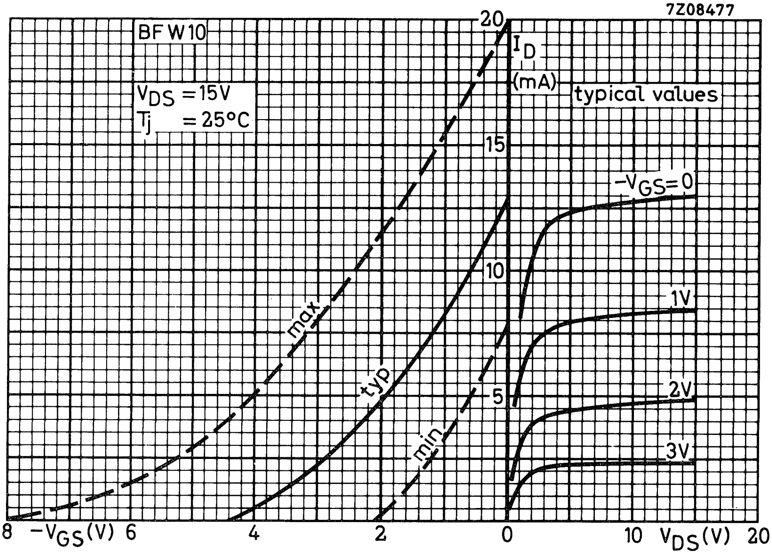
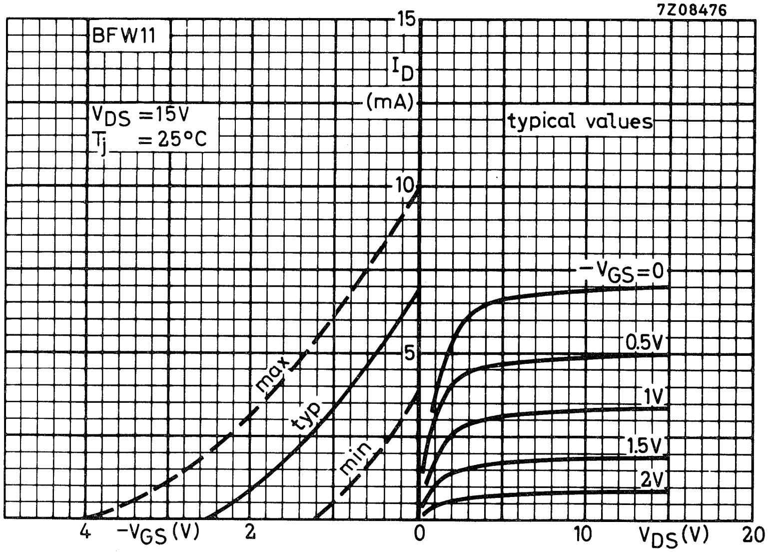
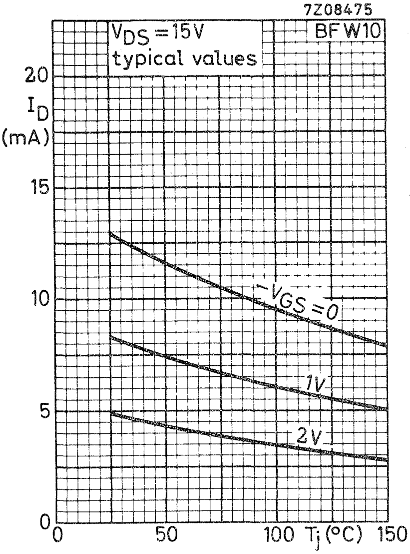
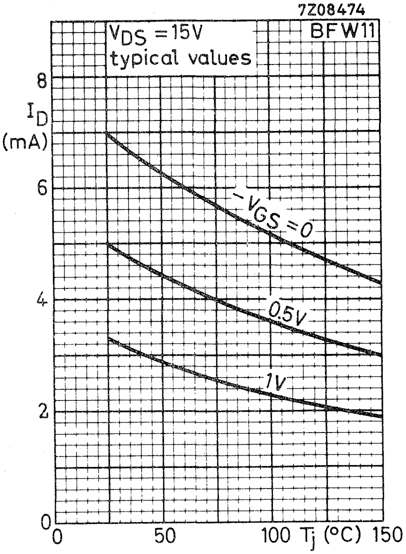
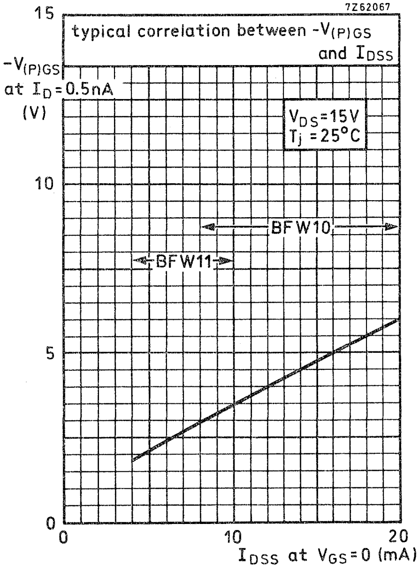
[1] Measured under pulse conditions.

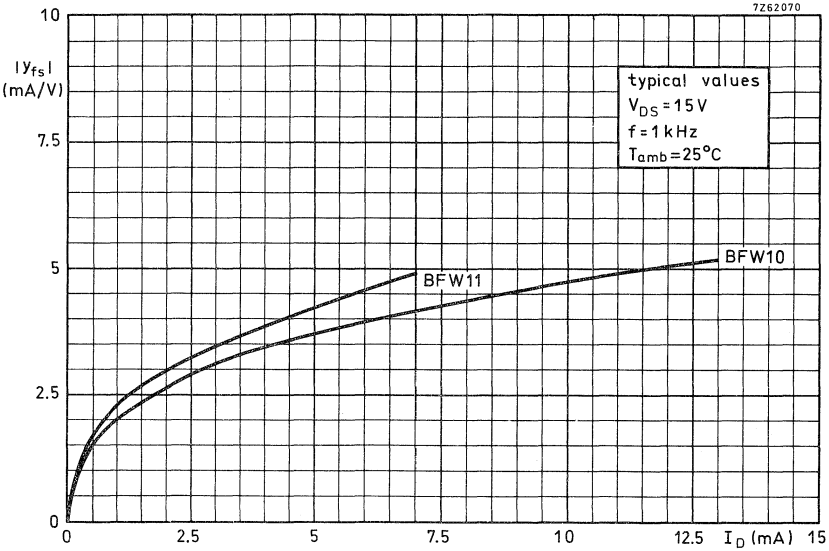

7Z08477
BF W10
V_{DS} = 15V
T_j = 25°C
I_D (mA)
typical values
20
15
10
5
0
max
typ
min
$-V_{GS}$ = 0
1V
2V
3V
8
$-V_{GS}$ (V)
6
4
2
10
V_{DS} (V)
20

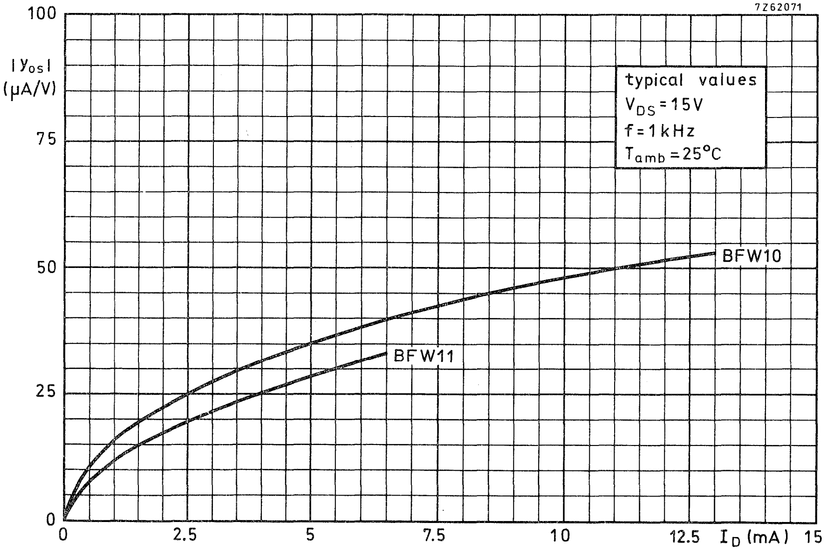

7Z08476
BFW11
V_{DS} = 15V
T_j = 25°C
I_D (mA)
typical values
15
10
5
0
max
typ
min
$-V_{GS}$ = 0
0.5V
1V
1.5V
2V
4
$-V_{GS}$ (V)
2
10
V_{DS} (V)
20

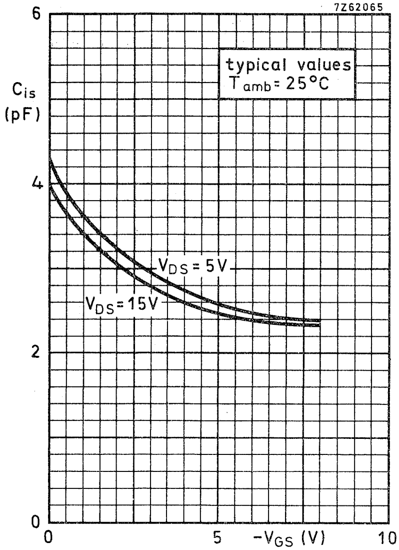

7Z08475
VDS = 15V
typical values
BFW10
ID
(mA)
20
15
10
5
0
0
50
100
Tj (°C)
150
-VGS = 0
1V
2V

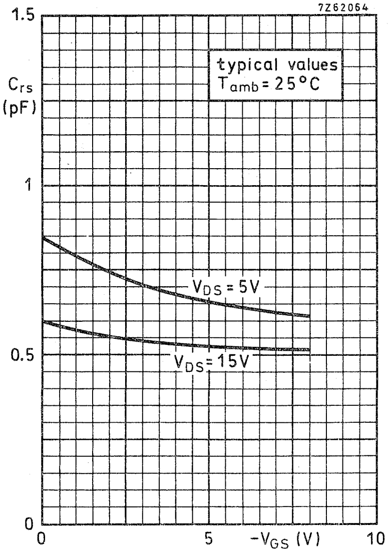

7Z08474
VDS = 15V
typical values
BFW11
ID
(mA)
8
6
4
2
0
0
50
100
Tj (°C)
150
-VGS = 0
0.5V
1V

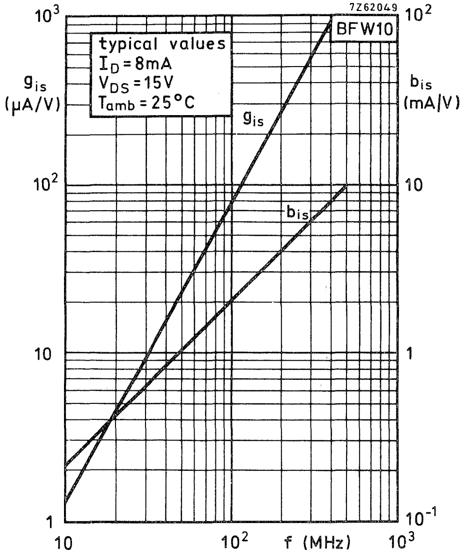

7Z62067
typical correlation between -V(P)GS and IDSS
-V(P)GS at ID = 0.5nA (V)
15
10
5
0
0
10
20
IDSS at VGS = 0 (mA)
VDS = 15V
Tj = 25°C
BFW10
BFW11

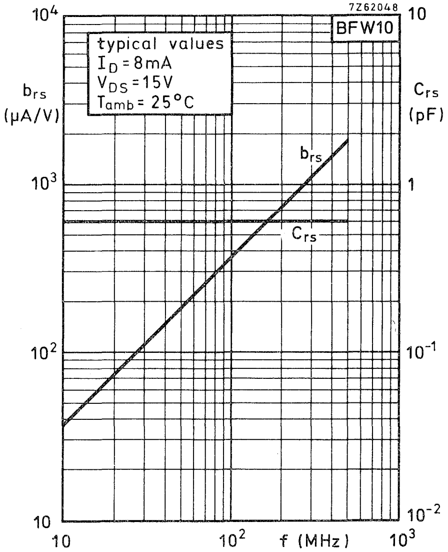

7Z62070
10
|y_{fs}|
(mA/V)
7.5
5
2.5
0
0
2.5
5
7.5
10
12.5
I_D (mA)
15
typical values
V_{DS} = 15 V
f = 1 kHz
T_{amb} = 25 °C
BFW10
BFW11

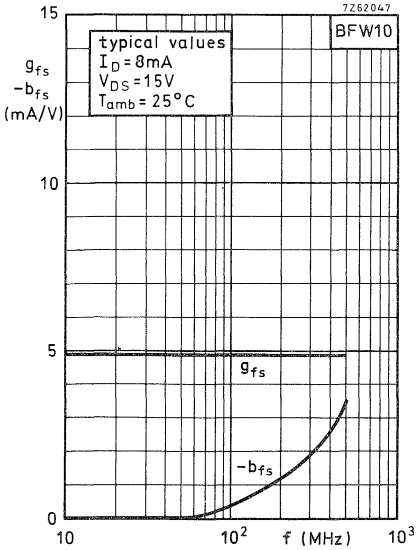

7Z62071
100
|y_{os}|
(μA/V)
75
50
25
0
0
2.5
5
7.5
10
12.5
I_D (mA)
15
typical values
V_{DS} = 15 V
f = 1 kHz
T_{amb} = 25 °C
BFW10
BFW11

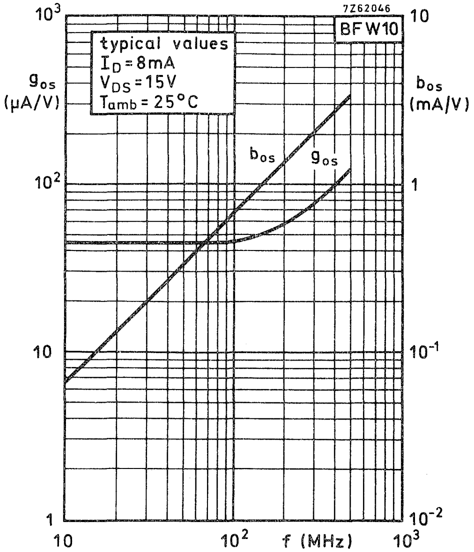

7Z62065
6
4
2
0
Cis
(pF)
typical values
Tamb = 25°C
VDS = 5V
VDS = 15V
0
5
−VGS (V)
10

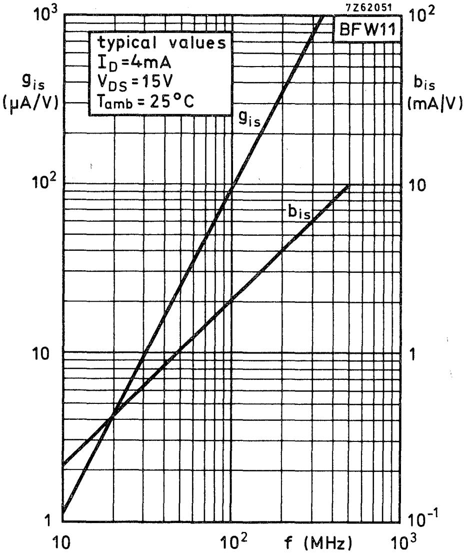

7Z62064
1.5
1
0.5
0
Crs
(pF)
typical values
Tamb = 25°C
VDS = 5V
VDS = 15V
0
5
−VGS (V)
10

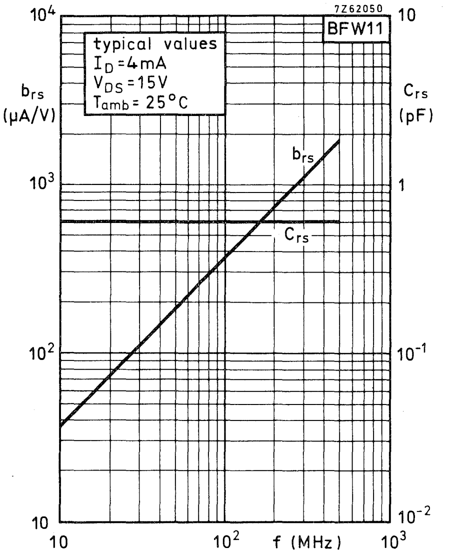

7Z62049
BFW10
typical values
$I_D = 8 mA$
$V_{DS} = 15 V$
$T_{amb} = 25 °C$
g_{is} (μA/V)
b_{is} (mA/V)
g_{is}
b_{is}
10^3
10^2
10
1
10^2
10
1
10^{-1}
10
10^2
f (MHz)
10^3

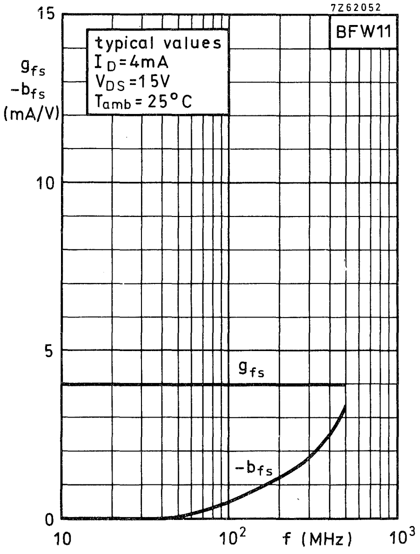

7Z62048
BFW10
typical values
$I_D = 8 mA$
$V_{DS} = 15 V$
$T_{amb} = 25 °C$
b_{rs} (μA/V)
C_{rs} (pF)
b_{rs}
C_{rs}
10^4
10^3
10^2
10
10
1
10^{-1}
10^{-2}
10
10^2
f (MHz)
10^3

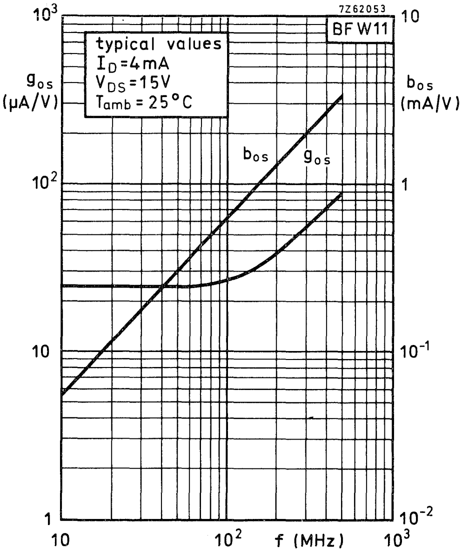

7Z62047
BFW10
typical values
$I_D = 8 mA$
$V_{DS} = 15 V$
$T_{amb} = 25 °C$
g_{fs} $-b_{fs}$ (mA/V)
g_{fs}
$-b_{fs}$
15
10
5
0
10
10^2
f (MHz)
10^3

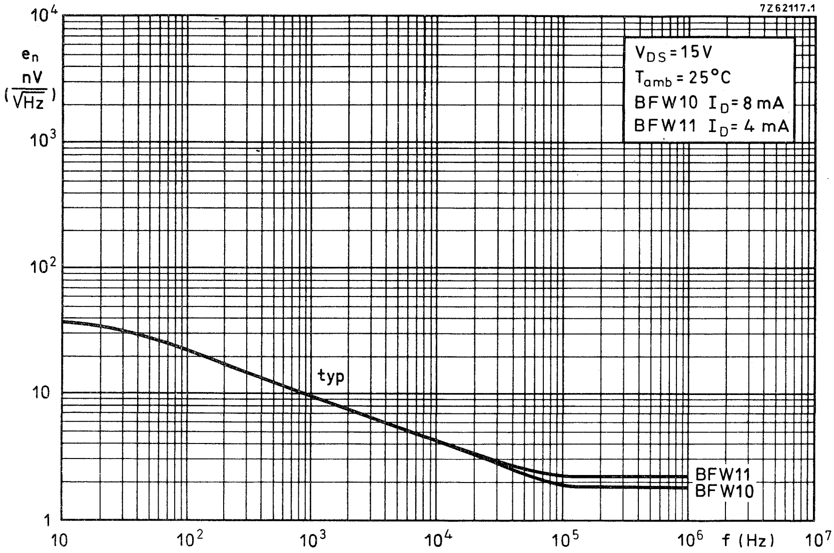

7Z62046
BFW10
typical values
$I_D = 8 mA$
$V_{DS} = 15 V$
$T_{amb} = 25 °C$
g_{os} (μA/V)
b_{os} (mA/V)
b_{os}
g_{os}
10^3
10^2
10
1
10
1
10^{-1}
10^{-2}
10
10^2
f (MHz)
10^3

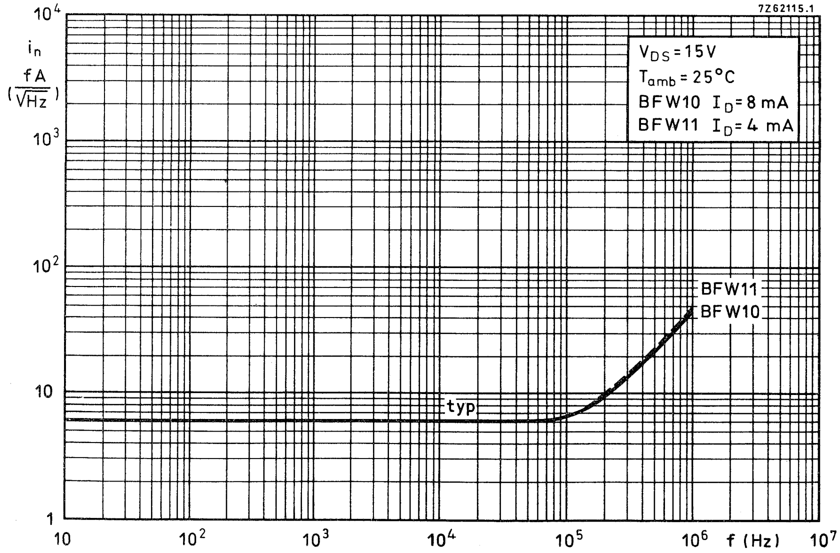

7Z62051
BFW11
typical values
I_D = 4 mA
V_{DS} = 15 V
T_{amb} = 25 °C
g_{is} (μA/V)
b_{is} (mA/V)
g_{is}
b_{is}
10^3
10^2
10
1
10^2
10
1
10^{-1}
10
10^2
f (MHz)
10^3

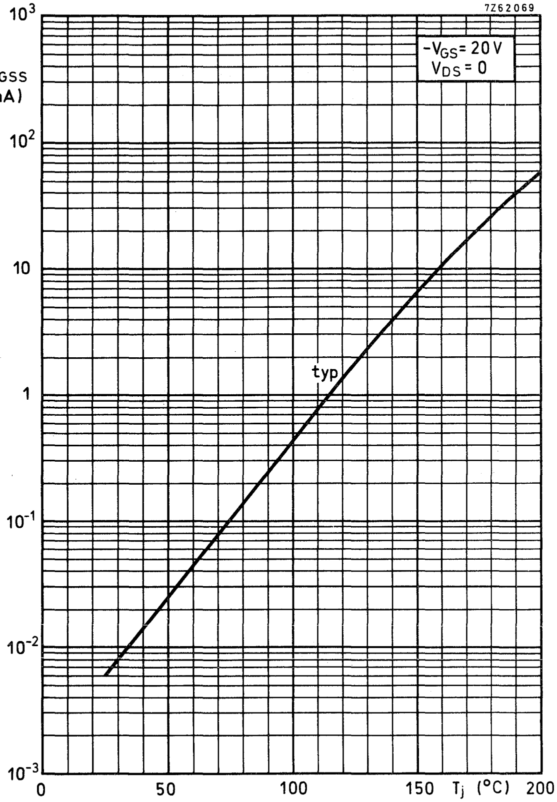

7Z62050
BFW11
typical values
I_D = 4 mA
V_{DS} = 15 V
T_{amb} = 25 °C
b_{rs} (μA/V)
C_{rs} (pF)
b_{rs}
C_{rs}
10^4
10^3
10^2
10
10
1
10^{-1}
10^{-2}
10
10^2
f (MHz)
10^3


7Z62052
BFW11
typical values
I_D = 4 mA
V_{DS} = 15 V
T_{amb} = 25 °C
g_{fs} $-b_{fs}$ (mA/V)
g_{fs}
$-b_{fs}$
15
10
5
0
10
10^2
f (MHz)
10^3


7Z62053
BFW11
typical values
I_D = 4 mA
V_{DS} = 15 V
T_{amb} = 25 °C
g_{os} (μA/V)
b_{os} (mA/V)
b_{os}
g_{os}
10^3
10^2
10
1
10
1
10^{-1}
10^{-2}
10
10^2
f (MHz)
10^3


7Z62117.1
e_n
nV
($\sqrt{Hz}$)
10^4
10^3
10^2
10
1
V_{DS} = 15 V
T_{amb} = 25 °C
BFW10 I_D = 8 mA
BFW11 I_D = 4 mA
typ
BFW11
BFW10
10
10^2
10^3
10^4
10^5
10^6
f (Hz)
10^7


7Z62115.1
i_n
fA
($\sqrt{Hz}$)
10^4
10^3
10^2
10
1
V_{DS} = 15 V
T_{amb} = 25 °C
BFW10 I_D = 8 mA
BFW11 I_D = 4 mA
typ
BFW11
BFW10
10
10^2
10^3
10^4
10^5
10^6
f (Hz)
10^7


7Z62069
I_{GSS} (nA)
10^3
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
$-V_{GS} = 20$ V
$V_{DS} = 0$
typ
0
50
100
150
T_j (°C)
200

N-CHANNEL SILICON FETS

Symmetrical n-channel silicon planar epitaxial junction field-effect transistors in TO-72 metal envelopes with the shield lead connected to the case. The transistors are intended for battery powered equipment and other low current-low voltage applications.

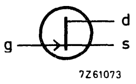
QUICK REFERENCE DATA

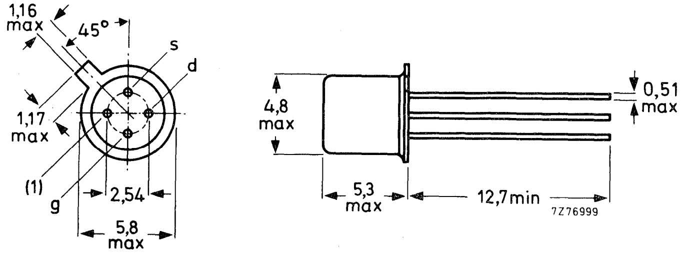
Drain-source voltage	$\pm V_{DS}$	max.	30		V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30		V
Total power dissipation up to T_{amb} = 110 °C	P_{tot}	max.	150		mW
			BFW12	**BFW13**	
Drain current V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	$>$ $<$	1 5	0,2 1,5	mA mA
Gate-source cut-off voltage I_D = 0,5 nA; V_{DS} = 15 V	$-V_{(P)GS}$	$<$	2,5	1,2	V
Feedback capacitance at f = 1 MHz V_{DS} = 15 V; V_{GS} = 0	C_{rs}	$<$	0,80	0,80	pF
Transfer admittance (common source) V_{DS} = 15 V; I_D = 200 μA; f = 1 kHz	$\|y_{fs}\|$	$>$	0,5	0,5	mA/V
Equivalent noise voltage V_{DS} = 15 V; I_D = 200 μA B = 0,6 to 100 Hz	V_n	$<$	0,5	0,5	μV

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-72.





(1) = shield lead connected to case

Accessories: 56246 (distance disc).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Drain-source voltage	$\pm V_{DS}$	max.	30	V
Drain-gate voltage (open source)	V_{DGO}	max.	30	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30	V

Currents

Drain current	I_D	max.	10	mA
Gate current	I_G	max.	5	mA

Power dissipation

Total power dissipation up to $T_{amb} = 110\ ^{o}C$	P_{tot}	max.	150	mW

Temperatures

Storage temperature	T_{stg}	−65 to	+200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	0.59	°C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

			BFW12	BFW13	
Gate cut-off current					
$-V_{GS} = 10$ V; $V_{DS} = 0$	$-I_{GSS}$	<	0.1	0.1	nA
$-V_{GS} = 10$ V; $V_{DS} = 0$; $T_j = 150$ °C	$-I_{GSS}$	<	0.1	0.1	μA
Drain current [1]					
$V_{DS} = 15$ V; $V_{GS} = 0$	I_{DSS}	>	1	0.2	mA
		<	5	1.5	mA
Gate-source voltage					
$I_D = 50$ μA; $V_{DS} = 15$ V	$-V_{GS}$	>	0.5	0.1	V
		<	2.0	1.0	V
Gate-source cut-off voltage					
$I_D = 0.5$ nA; $V_{DS} = 15$ V	$-V_{(P)GS}$	<	2.5	1.2	V
y parameters at f = 1 kHz; $T_{amb} = 25$ °C					
$V_{DS} = 15$ V; $V_{GS} = 0$					
Transfer admittance	$\lvert y_{fs} \rvert$	>	2.0	1.0	mA/V
Output admittance	$\lvert y_{os} \rvert$	<	30	10	μA/V
$V_{DS} = 15$ V; $I_D = 500$ μA					
Transfer admittance	$\lvert y_{fs} \rvert$	>	1.5	-	mA/V
Output admittance	$\lvert y_{os} \rvert$	<	10	-	μA/V
$V_{DS} = 15$ V; $I_D = 200$ μA					
Transfer admittance	$\lvert y_{fs} \rvert$	>	0.5	0.5	mA/V
Output admittance	$\lvert y_{os} \rvert$	<	5	5	μA/V
f = 1 MHz; $T_{amb} = 25$ °C					
$V_{DS} = 15$ V; $V_{GS} = 0$					
Input capacitance	C_{iss}	<	5	5	pF
Feedback capacitance	C_{rs}	<	0.80	0.80	pF
Equivalent noise voltage					
$V_{DS} = 15$ V; $I_D = 200$ μA; $T_{amb} = 25$ °C B = 0.6 to 100 Hz	V_n	<	0.5	0.5	μV

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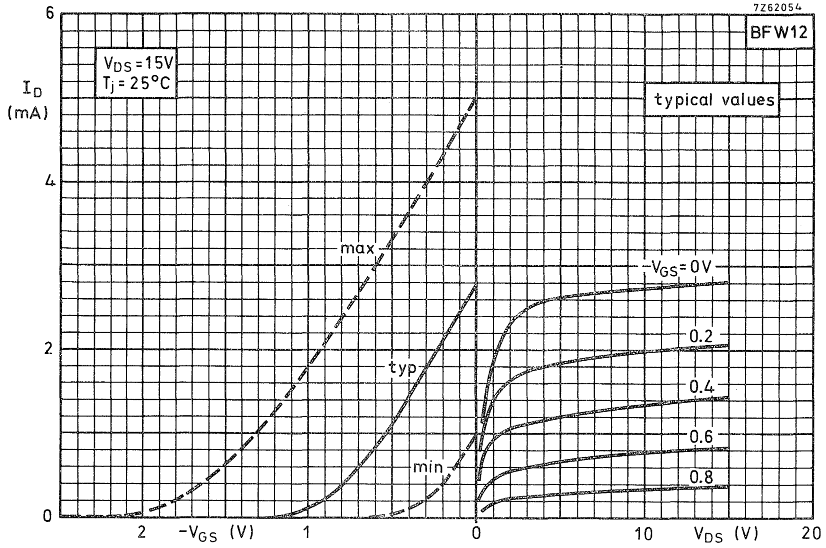
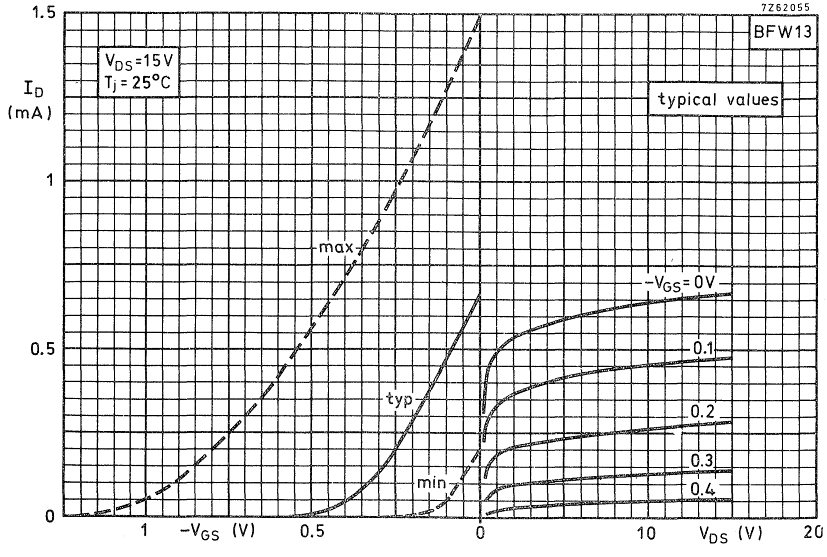
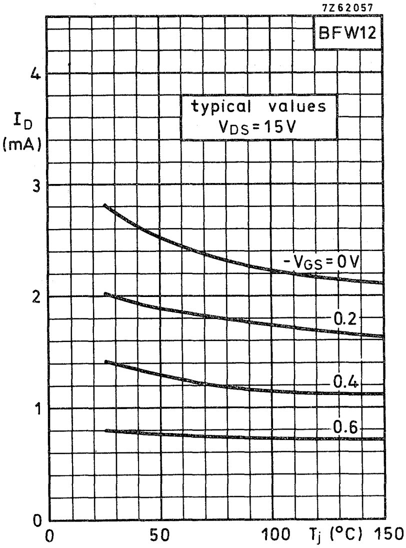
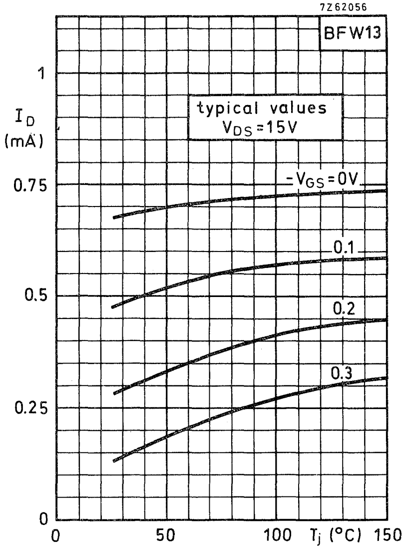
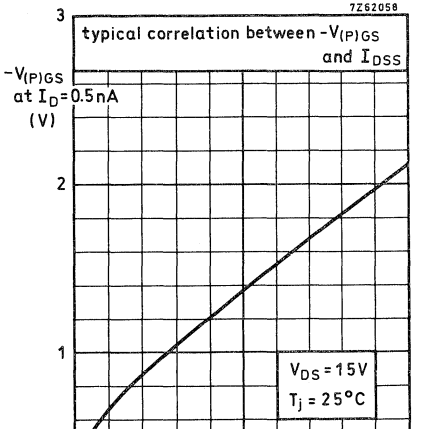
[1] Measured under pulse conditions.

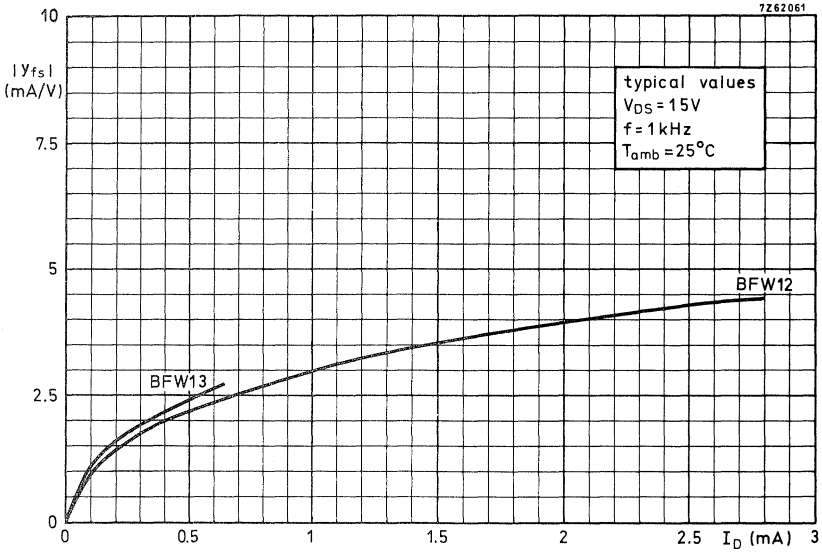

7Z62054
BFW12
V_{DS} = 15 V
T_j = 25°C
I_D (mA)
6
4
2
0
typical values
max
typ
min
$-V_{GS}$ = 0 V
0.2
0.4
0.6
0.8
2
$-V_{GS}$ (V)
1
0
10
V_{DS} (V)
20

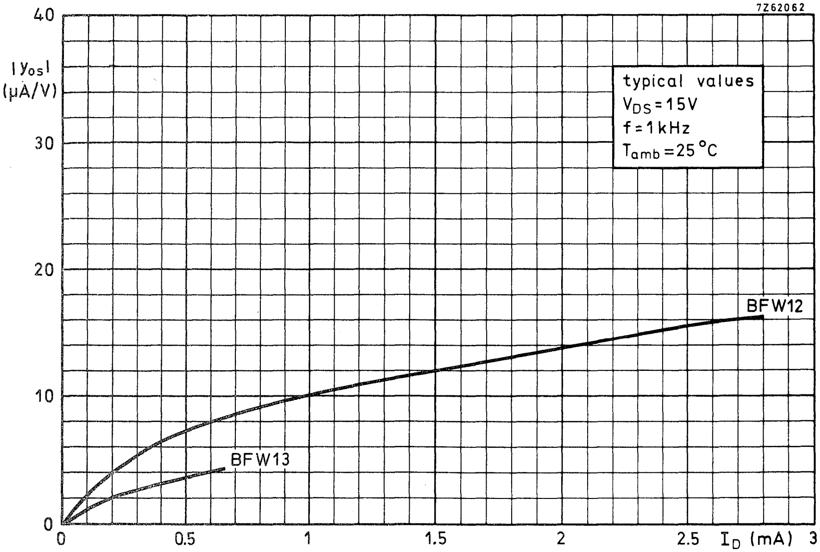

7Z62055
BFW13
V_{DS} = 15 V
T_j = 25°C
I_D (mA)
1.5
1
0.5
0
typical values
max
typ
min
$-V_{GS}$ = 0 V
0.1
0.2
0.3
0.4
1
$-V_{GS}$ (V)
0.5
0
10
V_{DS} (V)
20

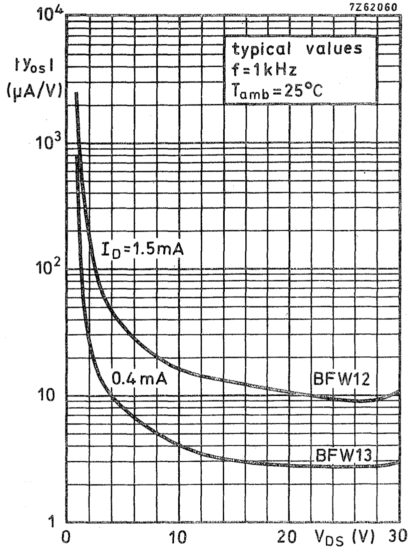

7Z62057
BFW12
typical values
V_{DS} = 15V
I_D
(mA)
4
3
2
1
0
0
50
100
T_j (°C)
150
$-V_{GS}$ = 0V
0.2
0.4
0.6

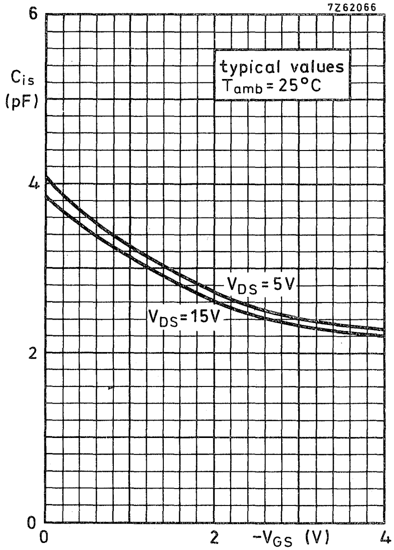

7Z62056
BFW13
typical values
V_{DS} = 15V
I_D
(mA)
1
0.75
0.5
0.25
0
0
50
100
T_j (°C)
150
$-V_{GS}$ = 0V
0.1
0.2
0.3

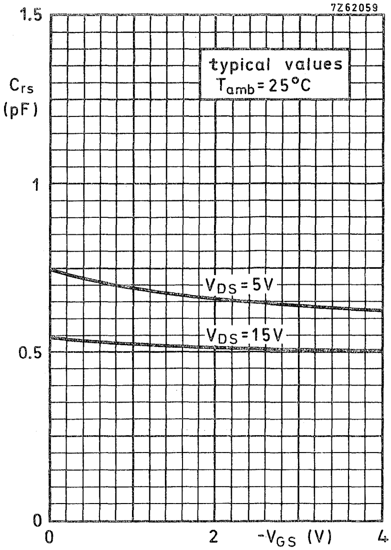

7Z62058
typical correlation between $-V_{(P)GS}$ and I_{DSS}
$-V_{(P)GS}$
at I_D = 0.5nA
(V)
3
2
1
0
0
2.5
5
I_{DSS} at V_{GS} = 0 (mA)
V_{DS} = 15V
T_j = 25°C
BFW12
BFW13

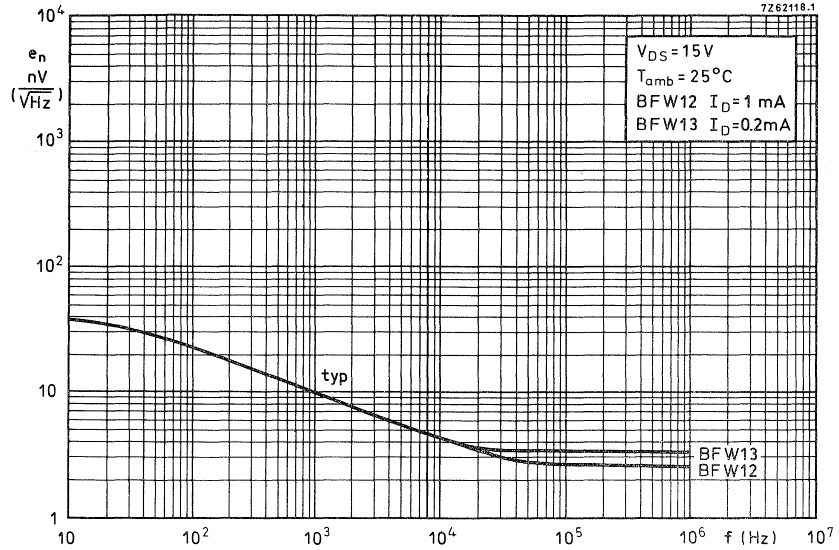

7Z62061
10
|y_{fs}|
(mA/V)
7.5
5
2.5
0
0
0.5
1
1.5
2
2.5
I_D (mA)
3
typical values
V_{DS} = 15 V
f = 1 kHz
T_{amb} = 25 °C
BFW12
BFW13

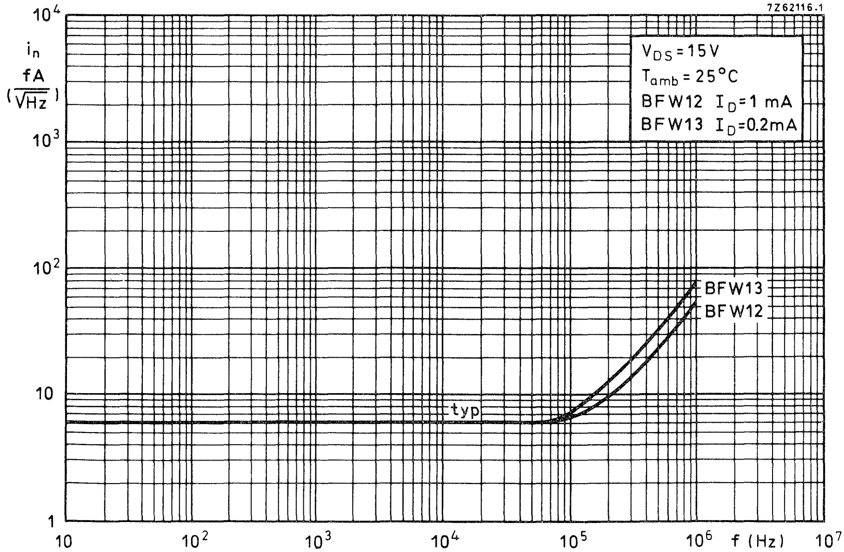

7Z62062
40
|y_{os}|
(μA/V)
30
20
10
0
0
0.5
1
1.5
2
2.5
I_D (mA)
3
typical values
V_{DS} = 15 V
f = 1 kHz
T_{amb} = 25 °C
BFW12
BFW13

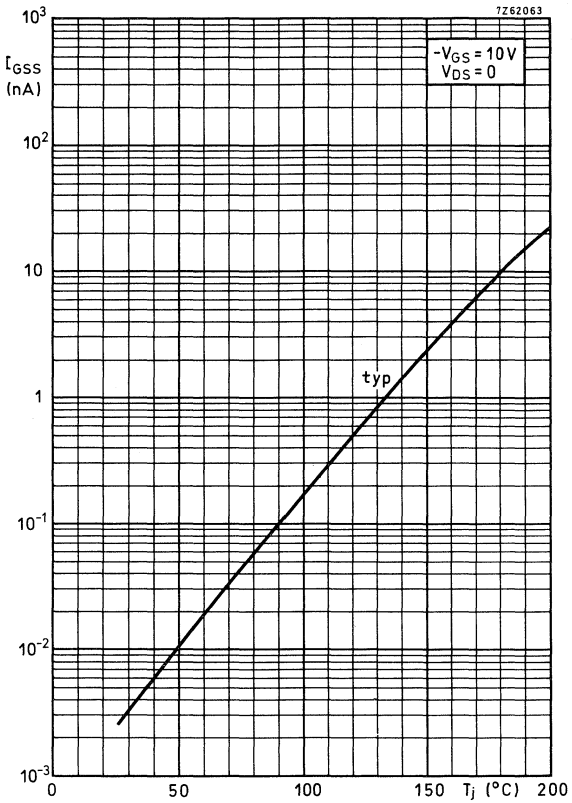

7Z62060
10^4
$|y_{os}|$
(μA/V)
10^3
10^2
10
1
typical values
f = 1 kHz
T_{amb} = 25°C
I_D = 1.5 mA
0.4 mA
BFW12
BFW13
0
10
20
V_{DS} (V)
30


7Z62066
6
C_{is}
(pF)
4
2
0
typical values
T_{amb} = 25°C
V_{DS} = 5V
V_{DS} = 15V
0
2
$-V_{GS}$ (V)
4


7Z62059
1.5
C_{rs}
(pF)
1
0.5
0
typical values
T_{amb} = 25°C
V_{DS} = 5V
V_{DS} = 15V
0
2
$-V_{GS}$ (V)
4


7Z62118.1
e_n
$(\frac{nV}{\sqrt{Hz}})$
10^4
10^3
10^2
10
1
$V_{DS} = 15 V$
$T_{amb} = 25°C$
BFW12 I_D = 1 mA
BFW13 I_D = 0.2mA
typ
BFW13
BFW12
10
10^2
10^3
10^4
10^5
10^6
f (Hz)
10^7


7Z62116.1
i_n
$(\frac{fA}{\sqrt{Hz}})$
10^4
10^3
10^2
10
1
$V_{DS} = 15 V$
$T_{amb} = 25°C$
BFW12 I_D = 1 mA
BFW13 I_D = 0.2mA
BFW13
BFW12
typ
10
10^2
10^3
10^4
10^5
10^6
f (Hz)
10^7


7Z62063
10^3
I_{GSS} (nA)
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
$-V_{GS} = 10$ V
$V_{DS} = 0$
typ
0
50
100
150
T_j (°C)
200

N-CHANNEL SILICON FET

Symmetrical n-channel silicon planar epitaxial junction field-effect transistor in a TO-72 metal envelope with the shield lead connected to the case. The transistor is designed for general purpose amplifiers.

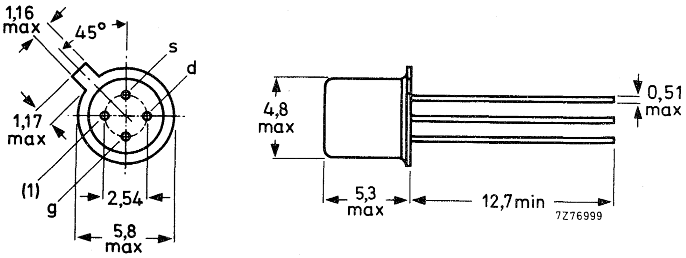
QUICK REFERENCE DATA

Drain-source voltage	$\pm V_{DS}$	max.	25	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Drain current V_{DS} = 15 V; V_{GS} = 0	I_{DSS}		2 to 20	mA
Gate-source cut-off voltage I_D = 1,0 nA; V_{DS} = 15 V	$-V_{(P)GS}$	$<$	8	V
Feedback capacitance at f = 1 MHz V_{DS} = 15 V; V_{GS} = 0	C_{rs}	$<$	2,0	pF
Transfer admittance (common source) V_{DS} = 15 V; V_{GS} = 0; f = 10 MHz	$\lvert y_{fs} \rvert$	$>$	1,6	mA/V

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-72.



(1) = shield lead connected to case

Accessories: 56246 (distance disc).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$\pm V_{DS}$	max.	25	V
Drain-gate voltage (open source)	V_{DGO}	max.	25	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	25	V
Drain current	I_D	max.	20	mA
Gate current	I_G	max.	10	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Storage temperature	T_{stg}		−65 to + 200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\,j\text{-}a}$	=	590	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Gate cut-off currents				
$-V_{GS}$ = 20 V; V_{DS} = 0	$-I_{GSS}$	<	1,0	nA
$-V_{GS}$ = 20 V; V_{DS} = 0; T_j = 150 °C	$-I_{GSS}$	<	1,0	μA
Drain current*				
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}		2 to 20	mA
Gate-source voltage				
I_D = 200 μA; V_{DS} = 15 V	$-V_{GS}$		0,5 to 7,5	V
Gate-source cut-off voltage				
I_D = 1,0 nA; V_{DS} = 15 V	$-V_{(P)GS}$	<	8	V
y-parameters (common source)				
V_{DS} = 15 V; V_{GS} = 0				
Transfer admittance at f = 1 kHz	$\lvert y_{fs} \rvert$		2,0 to 6,5	mA/V
at f = 10 MHz		>	1,6	mA/V
Output admittance at f = 1 kHz	$\lvert y_{os} \rvert$	<	85	μA/V
Input capacitance at f = 1 MHz	C_{is}	<	6	pF
Feedback capacitance at f = 1 MHz	C_{rs}	<	2,0	pF

---

* Measured under pulse conditions.

N-CHANNEL FETS

Silicon symmetrical n-channel junction field-effect transistors in TO-18 metal envelopes with the gate connected to the case. The transistors are intended for switching applications. The devices have the feature: low 'on' resistance at zero gate voltage.

QUICK REFERENCE DATA

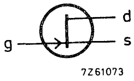
Drain-source voltage	$\pm V_{DS}$	max.		40		V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.		350		mW
			BSV78	**BSV79**	**BSV80**	
Drain current V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	50	20	10	mA
Gate-source cut-off voltage I_D = 1 nA; V_{GS} = 15 V	$-V_{(P)GS}$	>	3,75	2,0	1,0	V
		<	11	7,0	5,0	V
Drain-source resistance (on) at f = 1 kHz I_D = 0; V_{GS} = 0	$r_{ds\ on}$	<	25	40	60	Ω
Feedback capacitance at f = 1 MHz V_{DS} = 0; $-V_{GS}$ = 10 V	C_{rs}	<	5	5	5	pF
Turn-on time	t_{on}	<	10	18	30	ns
Turn-off time	t_{off}	<	10	16	32	ns

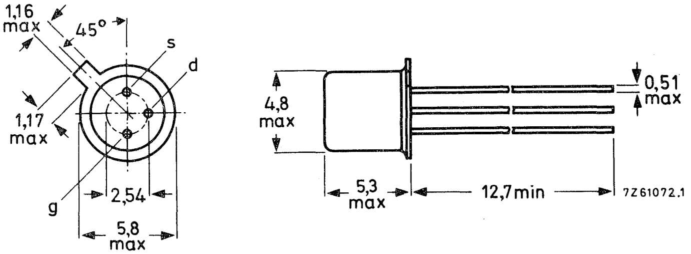
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Gate connected to case





Accessories: 56246 (distance disc).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$\pm V_{DS}$	max.	40	V
Drain-gate voltage (open source)	V_{DGO}	max.	40	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	40	V
Forward gate current	I_G	max.	50	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	350	mW
Storage temperature	T_{stg}	−65 to + 200		°C
Operating junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	430	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Gate cut-off current				
$-V_{GS}$ = 20 V; V_{DS} = 0	$-I_{GSS}$	<	0.25	nA
$-V_{GS}$ = 20 V; V_{DS} = 0; T_j = 150 °C	$-I_{GSS}$	<	0.5	μA
Drain cut-off current				
V_{DS} = 15 V; $-V_{GS}$ = 12 V	I_{DSX}	<	0.25	nA
V_{DS} = 15 V; $-V_{GS}$ = 12 V; T_j = 150 °C	I_{DSX}	<	0.5	μA

			BSV78	BSV79	BSV80	
Drain current						
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	50	20	10	mA
Gate-source cut-off voltage						
I_D = 1 nA; V_{DS} = 15 V	$-V_{(P)GS}$	>	3.75	2.0	1.0	V
		<	11	7.0	5.0	V
Gate-source voltage						
I_D = 1.5 μA; V_{DS} = 15 V	$-V_{GS}$	>	3.5	1.75	0.75	V
		<	10	6.0	4.0	V
Drain-source voltage (on)						
I_D = 20 mA; V_{GS} = 0	V_{DSon}	<	500			mV
I_D = 10 mA; V_{GS} = 0	V_{DSon}	<		400		mV
I_D = 5 mA; V_{GS} = 0	V_{DSon}	<			325	mV
Drain-source resistance (on) at f = 1 kHz						
I_D = 0; V_{GS} = 0	$r_{ds\,on}$	<	25	40	60	Ω
y parameters at f = 1 MHz (common source)						
$-V_{GS}$ = 10 V; V_{DS} = 0						
Input capacitance	C_{is}	<	10	10	10	pF
Feedback capacitance	C_{rs}	<	5	5	5	pF

Switching times (see Fig. 2)

Turn-on time when switched from
$-V_{GSMoff} = 11$ V to $I_{Don} = 20$ mA; $V_{DD} = 10$ V **(BSV78)**
$-V_{GSMoff} = 7$ V to $I_{Don} = 10$ mA; $V_{DD} = 10$ V **(BSV79)**
$-V_{GSMoff} = 5$ V to $I_{Don} = 5$ mA; $V_{DD} = 10$ V **(BSV80)**

			BSV78	**BSV79**	**BSV80**	
delay time	t_d	<	5	10	10	ns
rise time	t_r	<	5	8	20	ns
turn-on time	t_{on}	<	10	18	30	ns

Turn-off time when switched from
$I_{Don} = 20$ mA to $-V_{GSMoff} = 11$ V; $V_{DD} = 10$ V **(BSV78)**
$I_{Don} = 10$ mA to $-V_{GSMoff} = 7$ V; $V_{DD} = 10$ V **(BSV79)**
$I_{Don} = 5$ mA to $-V_{GSMoff} = 5$ V; $V_{DD} = 10$ V **(BSV80)**

			BSV78	**BSV79**	**BSV80**	
fall time	t_f	<	6	11	24	ns
storage time	t_s	<	4	5	8	ns
turn-off time	t_{off}	<	10	16	32	ns

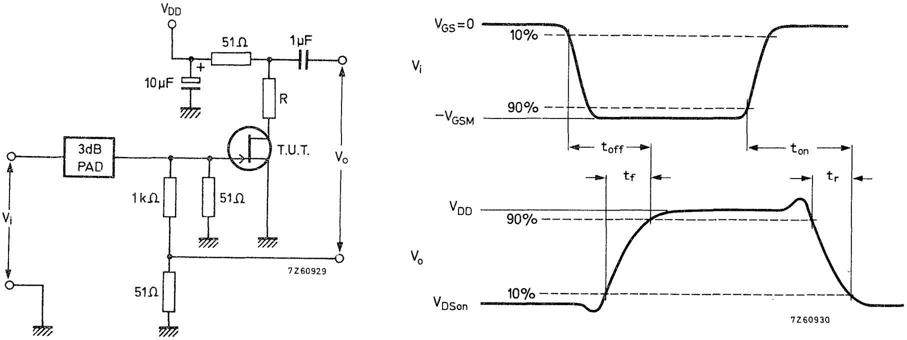


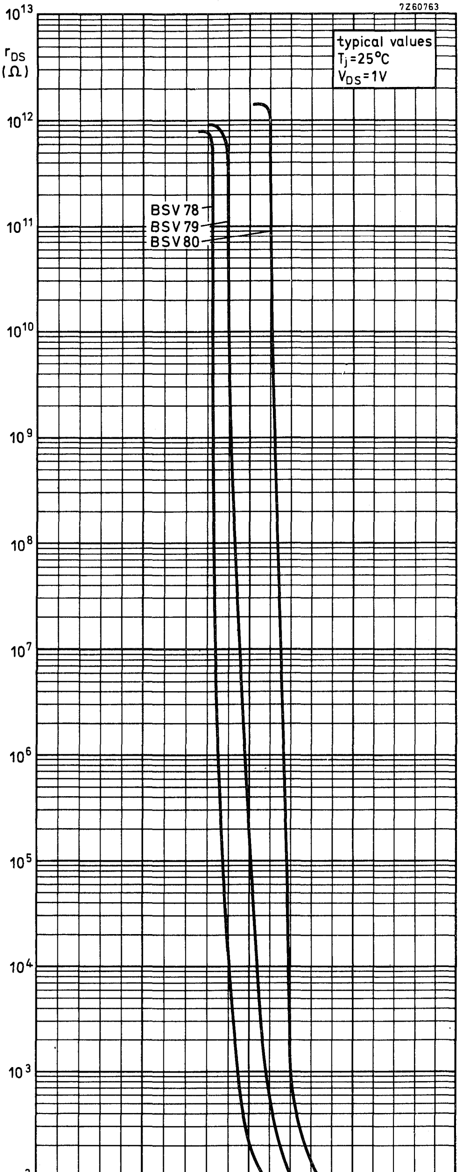
Fig. 2 Switching times test circuit and input and output waveforms.

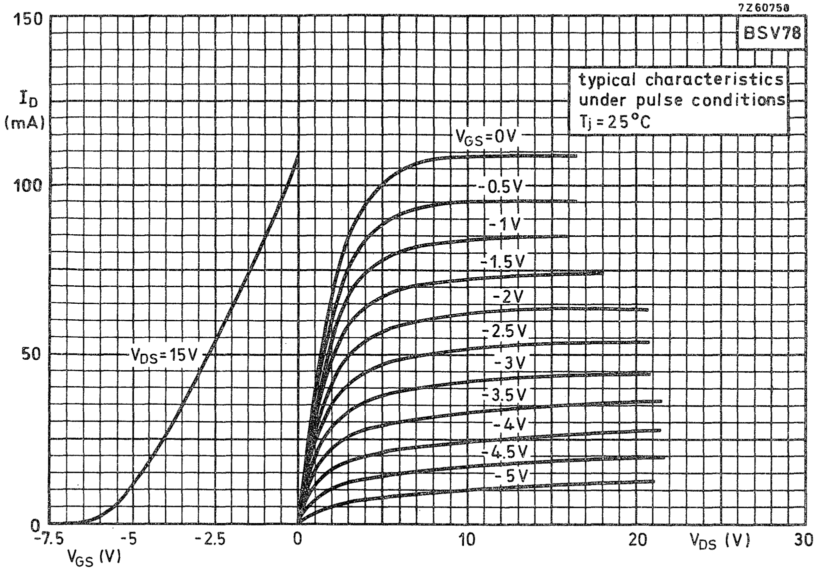
$$R = \frac{10 - V_{DSon}\,(\text{V})}{I_{Don}\,(\text{A})} - 51$$

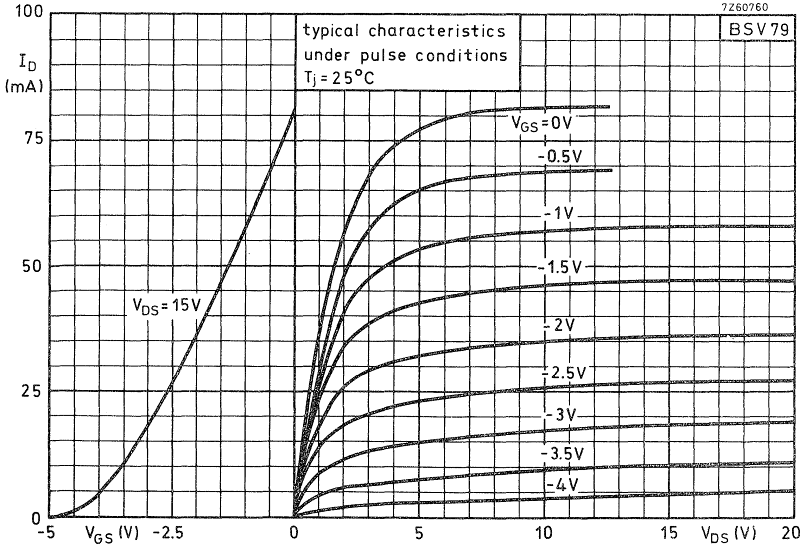
		BSV78	**BSV79**	**BSV80**
R	=	424	909	1885 Ω

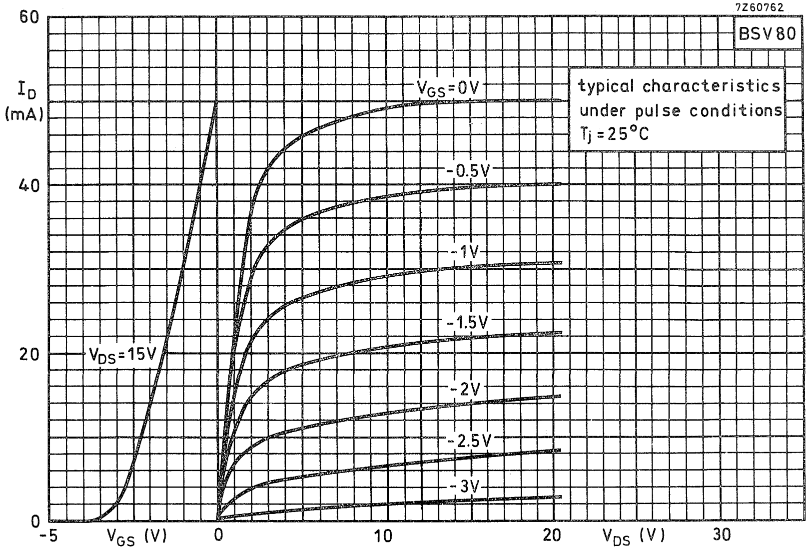
Pulse generator:
$R_i = 50\ \Omega$
$t_r < 0{,}5$ ns
$t_f < 5$ ns

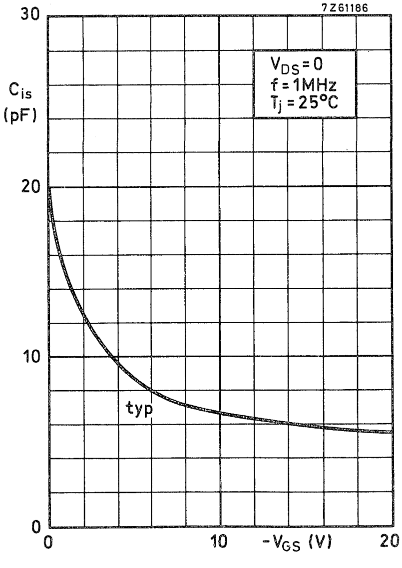
Oscilloscope:
$R_i = 50\ \Omega$
$t_r < 1$ ns
$t_f < 1$ ns

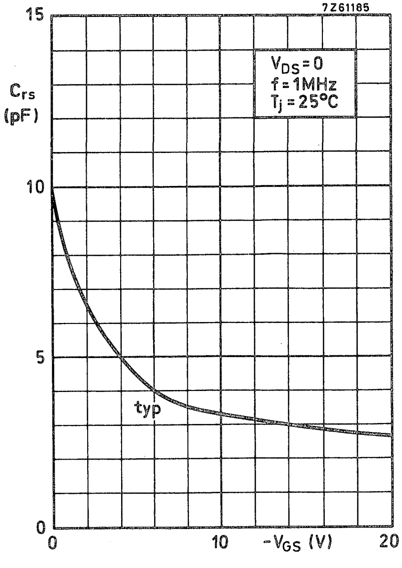

7Z60763
10^{13}
r_{DS}
(Ω)
10^{12}
10^{11}
10^{10}
10^{9}
10^{8}
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10
-15
-10
-5
0
V_{GS} (V)
5
typical values
$T_j = 25°C$
$V_{DS} = 1V$
BSV 78
BSV 79
BSV 80

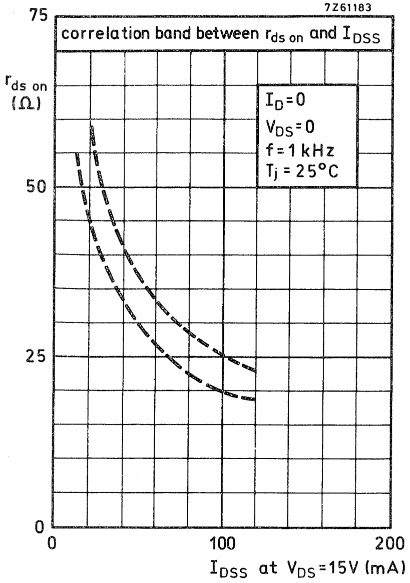

7Z60750
BSV78
typical characteristics
under pulse conditions
$T_j = 25°C$
I_D (mA)
150
100
50
0
$V_{DS} = 15V$
$V_{GS} = 0V$
-0.5V
-1V
-1.5V
-2V
-2.5V
-3V
-3.5V
-4V
-4.5V
-5V
-7.5
-5
-2.5
0
10
20
30
V_{GS} (V)
V_{DS} (V)

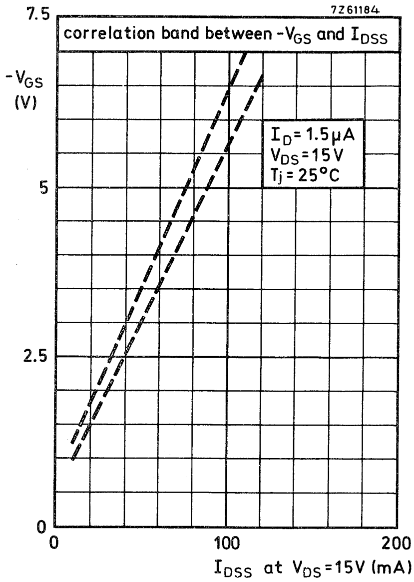

7Z60760
BSV79
typical characteristics
under pulse conditions
$T_j = 25°C$
I_D (mA)
100
75
50
25
0
$V_{DS} = 15V$
$V_{GS} = 0V$
-0.5V
-1V
-1.5V
-2V
-2.5V
-3V
-3.5V
-4V
-5
V_{GS} (V)
-2.5
0
5
10
15
V_{DS} (V)
20


7Z60762
BSV80
typical characteristics under pulse conditions
T_j = 25°C
60
40
20
0
I_D (mA)
V_{GS} = 0V
-0.5V
-1V
-1.5V
-2V
-2.5V
-3V
V_{DS} = 15V
-5
V_{GS} (V)
0
10
20
V_{DS} (V)
30


7Z61186
V_{DS} = 0
f = 1MHz
T_j = 25°C
30
20
10
0
C_{is} (pF)
typ
0
10
$-V_{GS}$ (V)
20


7Z61185
V_{DS} = 0
f = 1MHz
T_j = 25°C
15
10
5
0
C_{rs} (pF)
typ
0
10
$-V_{GS}$ (V)
20


7Z61183
correlation band between $r_{ds\ on}$ and I_{DSS}
$I_D = 0$
$V_{DS} = 0$
f = 1 kHz
$T_j = 25°C$
$r_{ds\ on}$ (Ω)
75
50
25
0
0
100
200
I_{DSS} at $V_{DS} = 15V$ (mA)


7Z61184
correlation band between $-V_{GS}$ and I_{DSS}
$I_D = 1.5 \mu A$
$V_{DS} = 15V$
$T_j = 25°C$
$-V_{GS}$ (V)
7.5
5
2.5
0
0
100
200
I_{DSS} at $V_{DS} = 15V$ (mA)

N-CHANNEL JUNCTION FIELD-EFFECT TRANSISTOR

Symmetrical n-channel, depletion type, silicon junction field-effect transistor, designed primarily for small-signal general purpose high-frequency amplifier applications. The 2N3822 features low gate leakage current and low input capacitance.

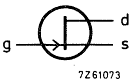
QUICK REFERENCE DATA

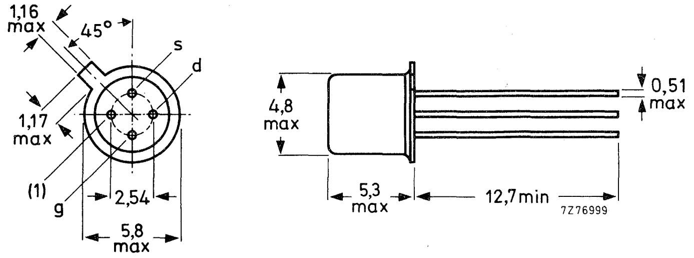
Drain-source voltage	$\pm V_{DS}$	max.	50	V
Gate-source voltage	$-V_{GS}$	max.	50	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Drain current				
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}		2 to 10	mA
Transfer admittance (common source)				
V_{DS} = 15 V; V_{GS} = 0; f = 1 kHz	$\lvert y_{fs} \rvert$		3,0 to 6,5	mA/V
V_{DS} = 15 V; V_{GS} = 0; f = 100 MHz	$\lvert y_{fs} \rvert$	>	3,0	mA/V

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-72.





(1) Shield lead connected to case.

Accessories: 56246 (distance disc).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$\pm V_{DS}$	max.	50	V
Drain-gate voltage	V_{DG}	max.	50	V
Gate-source voltage	$-V_{GS}$	max.	50	V
Gate current (d.c.)	I_G	max.	10	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Storage temperature	T_{stg}	−65 to + 200		°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	590	K/W

CHARACTERISTICS with source connected to case for all measurements

T_{amb} = 25 °C unless otherwise specified

Gate cut-off current				
$-V_{GS}$ = 30 V; V_{DS} = 0	$-I_{GSS}$	<	0,1	nA
$-V_{GS}$ = 30 V; V_{DS} = 0; T_{amb} = 150 °C	$-I_{GSS}$	<	0,1	µA
Drain current *				
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}		2 to 10	mA
Gate-source breakdown voltage				
$-I_G$ = 1 µA; V_{DS} = 0	$-V_{(BR)GSS}$	>	50	V
Gate-source voltage				
V_{DS} = 15 V; I_D = 200 µA	$-V_{GS}$		1 to 4	V
Gate-source cut-off voltage				
V_{DS} = 15 V; I_D = 0,5 nA	$-V_{(P)GS}$	<	6	V

Small-signal common source characteristics

V_{DS} = 15 V; V_{GS} = 0

Transfer admittance *				
f = 1 kHz	$\lvert y_{fs} \rvert$		3,0 to 6,5	mA/V
f = 100 MHz	$\lvert y_{fs} \rvert$	>	3,0	mA/V
Output admittance at f = 1 kHz *	$\lvert y_{os} \rvert$	<	20	µA/V
Input capacitance at f = 1 MHz	C_{is}	<	6	pF
Feedback capacitance at f = 1 MHz	C_{rs}	<	3	pF
Noise figure V_{DS} = 15 V; V_{GS} = 0; R_G = 1 MΩ f = 10 Hz; B = 5 Hz	F	<	5	dB
Equivalent input noise voltage V_{DS} = 15 V; V_{GS} = 0 f = 10 Hz; B = 5 Hz	V_n	<	200	$nV/\sqrt{Hz}$

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* Measured under pulse conditions: t_p = 100 ms; $\delta \leqslant 0{,}1$.

N-CHANNEL JUNCTION FIELD-EFFECT TRANSISTOR

Symmetrical n-channel, depletion type, silicon planar epitaxial junction field-effect transistor in a TO-72 metal envelope, intended for v.h.f. amplifier and mixer applications in industrial service.

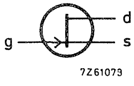
QUICK REFERENCE DATA

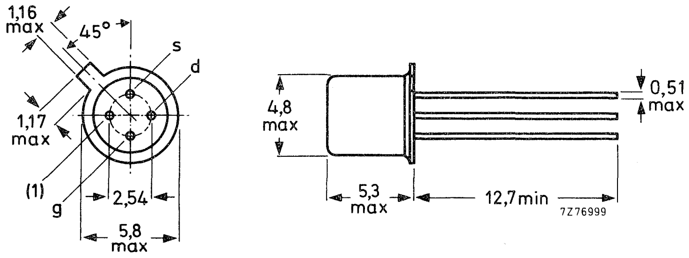
Drain-source voltage	$\pm V_{DS}$	max.	30	V
Gate-source voltage	$-V_{GS}$	max.	30	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Drain current V_{DS} = 15 V; V_{GS} = 0	I_{DSS}		4 to 20	mA
Feedback capacitance at f = 1 MHz V_{DS} = 15 V; V_{GS} = 0	C_{rs}	<	2	pF
Transfer admittance (common source) V_{DS} = 15 V; V_{GS} = 0; f = 200 MHz	$\lvert y_{fs} \rvert$	>	3,2	mA/V
Noise figure at f = 100 MHz V_{DS} = 15 V; V_{GS} = 0; R_G = 1 kΩ	F	<	2,5	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-72.





(1) Shield lead connected to case.

Accessories: 56246 (distance disc).

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	$\pm V_{DS}$	max.	30 V
Drain-gate voltage	V_{DG}	max.	30 V
Gate-source voltage	$-V_{GS}$	max.	30 V
Gate current (d.c.)	I_G	max.	10 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300 mW
Storage temperature	T_{stg}		−65 to + 200 °C
Junction temperature	T_j	max.	200 °C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	590 K/W

CHARACTERISTICS with source and shield connected to case for all measurements

T_{amb} = 25 °C unless otherwise specified

Gate cut-off current			
$-V_{GS} = 20$ V; $V_{DS} = 0$	$-I_{GSS}$	$<$	0,5 nA
$-V_{GS} = 20$ V; $V_{DS} = 0$; $T_{amb} = 150$ °C	$-I_{GSS}$	$<$	0,5 µA
Drain current *			
$V_{DS} = 15$ V; $V_{GS} = 0$	I_{DSS}		4 to 20 mA
Gate-source breakdown voltage			
$-I_G = 1$ µA; $V_{DS} = 0$	$-V_{(BR)GSS}$	$>$	30 V
Gate-source voltage			
$I_D = 400$ µA; $V_{DS} = 15$ V	$-V_{GS}$		1,0 to 7,5 V
Gate-source cut-off voltage			
$V_{DS} = 15$ V; $I_D = 0{,}5$ nA	$-V_{(P)GS}$	$<$	8 V

Small-signal common source characteristics

$V_{DS} = 15$ V; $V_{GS} = 0$

Transfer admittance *			
f = 1 kHz	$\lvert y_{fs} \rvert$		3,5 to 6,5 mA/V
f = 200 MHz	$\lvert y_{fs} \rvert$	$>$	3,2 mA/V
Output admittance at f = 1 kHz *	$\lvert y_{os} \rvert$	$<$	35 µA/V
Input capacitance at f = 1 MHz	C_{is}	$<$	6 pF
Feedback capacitance at f = 1 MHz	C_{rs}	$<$	2 pF
Real part of input conductance at f = 200 MHz	$Re(y_{is})$	$<$	0,8 mA/V
Real part of output conductance at f = 200 MHz	$Re(y_{os})$	$<$	0,2 mA/V
Noise figure at f = 100 MHz			
$V_{DS} = 15$ V; $V_{GS} = 0$; $R_G = 1$ kΩ	F	$<$	2,5 dB

---

* Measured under pulse conditions: $t_p = 100$ ms; $\delta \leqslant 0{,}1$.

N-CHANNEL SILICON FET

Symmetrical n-channel planar epitaxial junction field-effect transistor in a TO-72 metal envelope with the shield lead connected to the case. The transistor is suitable in a variety of low power switching applications, e.g. in multiplexing systems.

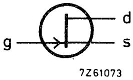
QUICK REFERENCE DATA

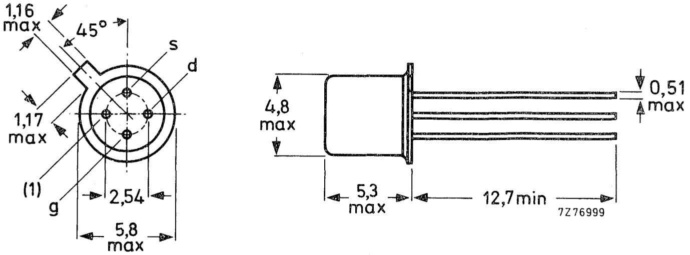
Drain-source voltage	$\pm V_{DS}$	max.	30	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30	V
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Drain current V_{DS} = 20 V; V_{GS} = 0	I_{DSS}	>	2	mA
Gate-source cut-off voltage I_D = 10 nA; V_{DS} = 10 V	$-V_{(P)GS}$		4 to 6	V
Feedback capacitance at f = 1 MHz V_{DS} = 0; V_{GS} = 7 V	C_{rs}	<	1,5	pF
Drain-source resistance (on) at f = 1 kHz V_{GS} = 0; I_D = 0	$r_{ds\ on}$	<	220	Ω

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-72.





(1) = shield lead connected to case

Accessories: 56246 (distance disc).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Drain-source voltage	$\pm V_{DS}$	max.	30	V
Drain-gate voltage (open source)	V_{DGO}	max.	30	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	30	V
Current				
Gate current	I_G	max.	10	mA
Power dissipation				
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW
Temperatures				
Storage temperature	T_{stg}		−55 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j-a}$	=	0.59	°C/mW

CHARACTERISTICS $T_j = 25\ ^oC$ unless otherwise specified

Gate cut-off current				
$-V_{GS} = 20\ V;\ V_{DS} = 0$	$-I_{GSS}$	<	0.1	nA
Drain current				
$V_{DG} = 20\ V;\ I_S = 0$	I_{DGO}	<	0.1	nA
$V_{DG} = 20\ V;\ I_S = 0;\ T_{amb} = 150\ ^oC$	I_{DGO}	<	0.2	µA
Drain current [1]				
$V_{DS} = 20\ V;\ V_{GS} = 0$	I_{DSS}	>	2	mA
Gate-source breakdown voltage				
$-I_G = 1.0\ \mu A;\ V_{DS} = 0$	$-V_{(BR)GS}$	>	30	V
Gate-source voltage				
$I_D = 10\ nA;\ V_{DS} = 10\ V$	$-V_{(P)GS}$		4 to 6	V
Drain-source voltage				
$I_D = 1.0\ mA;\ V_{GS} = 0$	V_{DS}	<	0.25	V
Drain cut-off current				
$V_{DS} = 10\ V;\ -V_{GS} = 7.0\ V$	I_D	<	1.0	nA
$V_{DS} = 10\ V;\ -V_{GS} = 7.0\ V;\ T_{amb} = 150\ ^oC$	I_D	<	2.0	µA
Drain-source resistance (on) at f = 1 kHz				
$V_{GS} = 0;\ I_D = 0$	$r_{ds\ on}$	<	220	Ω
Input capacitance at f = 1 MHz				
$V_{DS} = 20\ V;\ V_{GS} = 0$	C_{is}	<	6	pF
Feedback capacitance at f = 1 MHz				
$V_{DS} = 0;\ V_{GS} = 7\ V$	C_{rs}	<	1.5	pF

CHARACTERISTICS (continued)

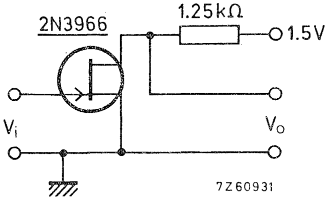
Switching times

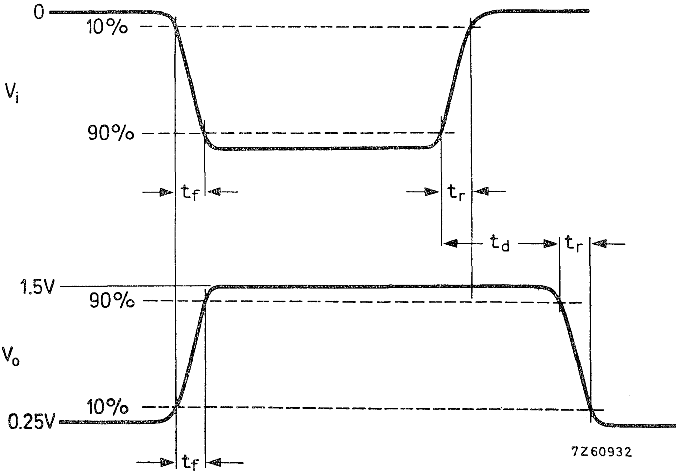
$V_{DD} = 1.5$ V; $I_{D\,on} = 1.0$ mA

$V_{GS\,on} = 0$; $-V_{GS\,off} = 6$ V

delay time	t_d	<	20	ns
rise time	t_r	<	100	ns
turn off time	t_{off}	<	100	ns

Test circuit:





Pulse generator:

$t_r < 1.0$ ns
$t_f < 1.0$ ns
$t_p = 1.0$ µs
$\delta < 0.5$
$R_S = 50\ \Omega$

Oscilloscope:

$t_r < 10$ ns
$R_i > 5$ MΩ
$C_i < 10$ pF

N-CHANNEL FETS

Silicon symmetrical n-channel depletion type junction field-effect transistors in TO-18 metal envelopes with the gate connected to the case. The transistors are intended for low power switching applications in industrial service.

QUICK REFERENCE DATA

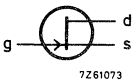
			2N4091	2N4092	2N4093	
Drain-source voltage	$\pm V_{DS}$	max.	40			V
Total power dissipation up to $T_{case} = 25\ ^\circ C$	P_{tot}	max	1,8			W
Drain current $V_{DS} = 20$ V; $V_{GS} = 0$	I_{DSS}	>	30	15	8	mA
Gate-source cut-off voltage $I_D = 1$ nA; $V_{DS} = 20$ V	$-V_{(P)GS}$	>	5,0	2,0	1,0	V
		<	10	7,0	5,0	V
Drain-source resistance (on) at f = 1 kHz $I_D = 0$; $V_{GS} = 0$	$r_{ds\ on}$	<	30	50	80	Ω
Feedback capacitance at f = 1 MHz $V_{DS} = 0$; $-V_{GS} = 20$ V	C_{rs}	<	5,0			pF
Turn-off time $V_{DD} = 3,0$ V; $V_{GS} = 0$ $I_D = 6,6$ mA; $-V_{GSM} = 12$ V 2N4091	t_{off}	<	40			ns
$I_D = 4,0$ mA; $-V_{GSM} = 8$ V 2N4092	t_{off}	<		60		ns
$I_D = 2,5$ mA; $-V_{GSM} = 6$ V 2N4093	t_{off}	<			80	ns

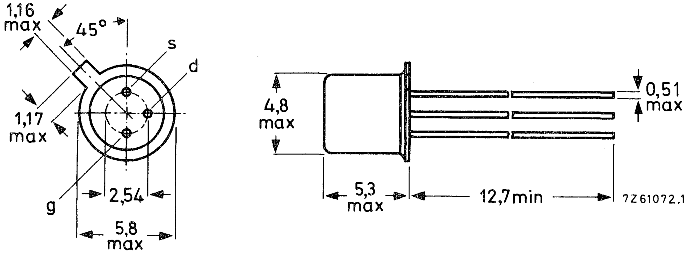
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Gate connected to case





Accessories: 56246 (distance disc).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages

Drain-source voltage	$\pm V_{DS}$	max.	40	V
Drain-gate voltage (open source)	V_{DGO}	max.	40	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	40	V

Current

Forward gate current (d.c.)	I_G	max.	10	mA

Power dissipation

Total power dissipation up to T_{case} = 25 °C	P_{tot}	max.	1.8	W

Temperatures

Storage temperature	T_{stg}	−55 to	+200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to case in free air	$R_{th\ j-c}$	=	0.1	°C/mW

CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

Drain current				
V_{DG} = 20 V; I_S = 0	I_{DGO}	<	0.2	nA
V_{DG} = 20 V; I_S = 0; T_{amb} = 150 °C	I_{DGO}	<	0.4	µA
Source current				
V_{SG} = 20 V; I_D = 0	I_{SGO}	<	0.2	nA

			2N4091	2N4092	2N4093	
Drain cut-off current						
V_{DS} = 20 V; $-V_{GS}$ = 12 V	I_{DSX}	<	0.2	–	–	nA
V_{DS} = 20 V; $-V_{GS}$ = 8 V	I_{DSX}	<	–	0.2	–	nA
V_{DS} = 20 V; $-V_{GS}$ = 6 V	I_{DSX}	<	–	–	0.2	nA
V_{DS} = 20 V; $-V_{GS}$ = 12 V; T_{amb} = 150 °C	I_{DSX}	<	0.4	–	–	µA
V_{DS} = 20 V; $-V_{GS}$ = 8 V; T_{amb} = 150 °C	I_{DSX}	<	–	0.4	–	µA
V_{DS} = 20 V; $-V_{GS}$ = 6 V; T_{amb} = 150 °C	I_{DSX}	<	–	–	0.4	µA
Gate-source breakdown voltage						
$-I_G$ = 1.0 µA; V_{DS} = 0	$-V_{(BR)GSS}$	>	40	40	40	V
Drain current 1)						
V_{DS} = 20 V; V_{GS} = 0	I_{DSS}	>	30	15	8	mA
Gate-source cut-off voltage						
I_D = 1 nA; V_{DS} = 20 V	$-V_{(P)GS}$	>	5.0	2.0	1.0	V
		<	10	7.0	5.0	V
Drain-source voltage (on)						
I_D = 6.6 mA; V_{GS} = 0	V_{DSon}	<	0.2	–	–	V
I_D = 4.0 mA; V_{GS} = 0	V_{DSon}	<	–	0.2	–	V
I_D = 2.5 mA; V_{GS} = 0	V_{DSon}	<	–	–	0.2	V
Drain- source resistance (on)						
I_D = 1.0 mA; V_{GS} = 0	r_{DSon}	<	30	50	80	Ω
Drain-source resistance (on) at f = 1 kHz						
I_D = 0; V_{GS} = 0	$r_{ds\ on}$	<	30	50	80	Ω

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1) Measured under pulsed conditions: $t_p \leq 300$ µs; $\delta \leq 0.03$

CHARACTERISTICS (continued) T_{amb} = 25 °C unless otherwise specified

y-parameters at f = 1 MHz (common source)

Input capacitance

V_{DS} = 20 V ; V_{GS} = 0	C_{is}	<	16	pF

Feedback capacitance

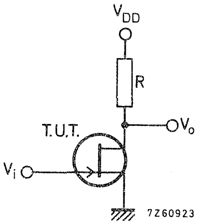
V_{DS} = 0 ; $-V_{GS}$ = 20 V	C_{rs}	<	5	pF

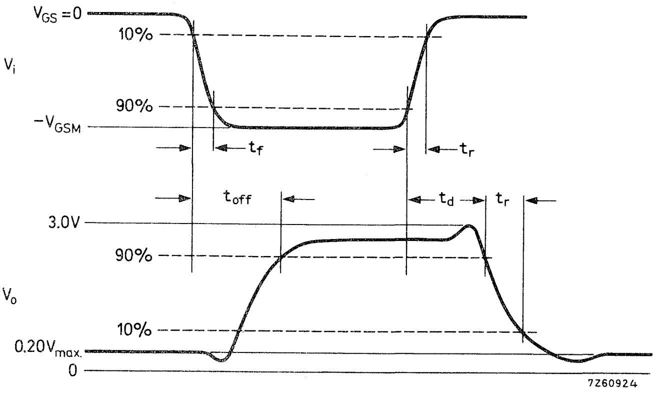
Switching times

V_{DD} = 3,0 V; V_{GS} = 0

			2N4091	2N4092	2N4093	
	I_D	=	6,6	4,0	2,5	mA
	$-V_{GSM}$	=	12	8	6	V
Delay time	t_d	<	15	15	20	ns
Rise time	t_r	<	10	20	40	ns
Turn-off time	t_{off}	<	40	60	80	ns

Test circuit:





$$R = \frac{2,8}{I_D}$$

Pulse generator:

t_r	<	1	ns
t_f	<	1	ns
t_p	=	1,0	µs
δ	=	0,1	
R_S	=	50	Ω

Oscilloscope:

t_r	<	0,4	ns
R_i	>	9,8	MΩ
C_i	<	1,7	pF

N-CHANNEL FETS

Silicon symmetrical n-channel depletion type junction field-effect transistors in TO-18 metal envelopes with the gate connected to the case. The transistors are intended for low power, chopper or switching, application in industrial service.

QUICK REFERENCE DATA

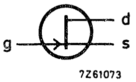
			2N4391	2N4392	2N4393	
Drain-source voltage	$\pm V_{DS}$	max.	40			V
Total power dissipation up to T_{case} = 25 °C	P_{tot}	max.	1,8			W
Drain current V_{DS} = 20 V; V_{GS} = 0	I_{DSS}	>	50	25	5	mA
Gate-source cut-off voltage I_D = 1 nA; V_{DS} = 20 V	$-V_{(P)GS}$	>	4,0	2,0	0,5	V
		<	10	5,0	3,0	V
Drain-source resistance (on) at f = 1 kHz I_D = 1 mA; V_{GS} = 0	$r_{ds\ on}$	<	30	60	100	Ω
Feedback capacitance at f = 1 MHz V_{DS} = 0; $-V_{GS}$ = 12 V **2N4391** V_{DS} = 0; $-V_{GS}$ = 7 V **2N4392** V_{DS} = 0; $-V_{GS}$ = 5 V **2N4393**	C_{rs}	<	3,5	3,5	3,5	pF
Turn-off time V_{DD} = 10 V; V_{GS} = 0 I_D = 12 mA; $-V_{GSM}$ = 12 V	t_{off}	<	20	–	–	ns
I_D = 6,0 mA; $-V_{GSM}$ = 7 V	t_{off}	<	–	35	–	ns
I_D = 3,0 mA; $-V_{GSM}$ = 5 V	t_{off}	<	–	–	50	ns

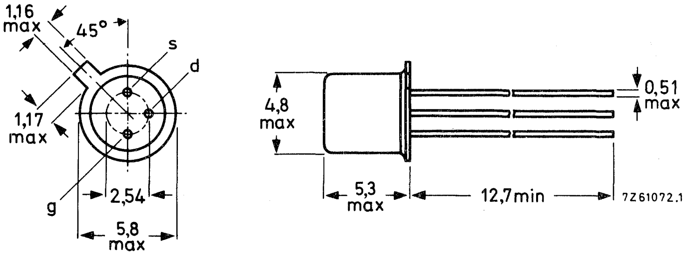
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18.

Gate connected to case





Accessories: 56246 (distance disc).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages				
Drain-source voltage	$\pm V_{DS}$	max.	40	V
Drain-gate voltage (open source)	V_{DGO}	max.	40	V
Gate-source voltage	$-V_{GSO}$	max.	40	V
Current				
Gate current (d.c.)	I_G	max.	50	mA
Power dissipation				
Total power dissipation up to T_{case} = 25 °C	P_{tot}	max.	1.8	W
Temperatures				
Storage temperature	T_{stg}	−65 to	200	°C
Junction temperature	T_j	max.	200	°C
Thermal resistance				
From junction to case in free air	$R_{th\ j\text{-}c}$	=	0.1	°C/mW

CHARACTERISTICS T_{amb} = 25 °C unless otherwise specified

Gate cut-off current			
$-V_{GS}$ = 20 V; V_{DS} = 0	$-I_{GSS}$ <	0.1	nA
$-V_{GS}$ = 20 V; V_{DS} = 0; T_{amb} = 150 °C	$-I_{GSS}$ <	0.2	μA

Drain cut-off current		2N4391	2N4392	2N4393	
V_{DS} = 20 V; $-V_{GS}$ = 12 V	I_{DSX} <	0.1	–	–	nA
V_{DS} = 20 V; $-V_{GS}$ = 7 V	I_{DSX} <	–	0.1	–	nA
V_{DS} = 20 V; $-V_{GS}$ = 5 V	I_{DSX} <	–	–	0.1	nA
V_{DS} = 20 V; $-V_{GS}$ = 12 V; T_{amb} = 150 °C	I_{DSX} <	0.2	–	–	μA
V_{DS} = 20 V; $-V_{GS}$ = 7 V; T_{amb} = 150 °C	I_{DSX} <	–	0.2	–	μA
V_{DS} = 20 V; $-V_{GS}$ = 5 V; T_{amb} = 150 °C	I_{DSX} <	–	–	0.2	μA

CHARACTERISTICS (continued) T_{amb} = 25 °C unless otherwise specified

			2N4391	2N4392	2N4393	
Drain current [1]						
V_{DS} = 20 V; V_{GS} = 0	I_{DSS}	>	50	–	–	mA
		<	150	–	–	mA
V_{DS} = 20 V; V_{GS} = 0	I_{DSS}	>	–	25	–	mA
		<	–	75	–	mA
V_{DS} = 20 V; V_{GS} = 0	I_{DSS}	>	–	–	5	mA
		<	–	–	30	mA
Gate-source breakdown voltage						
$-I_G$ = 1 µA; V_{DS} = 0	$-V_{(BR)GSS}$	>	40	40	40	V
Gate-source voltage						
I_G = 1 mA; V_{DS} = 0	V_{GSon}	<	1.0	1.0	1.0	V
Gate-source cut-off voltage						
I_D = 1 nA; V_{DS} = 20 V	$-V_{(P)GS}$	>	4.0	2.0	0.5	V
		<	10	5.0	3.0	V
Drain-source voltage (on)						
I_D = 12 mA; V_{GS} = 0	V_{DSon}	<	0.4	–	–	V
I_D = 6.0 mA; V_{GS} = 0	V_{DSon}	<	–	0.4	–	V
I_D = 3.0 mA; V_{GS} = 0	V_{DSon}	<	–	–	0.4	V
Drain-source resistance (on)						
I_D = 1 mA; V_{GS} = 0	r_{DSon}	<	30	60	100	Ω
Drain-source resistance (on) at f = 1 kHz						
I_D = 0; V_{GS} = 0	r_{dson}	<	30	60	100	Ω
y parameters at f = 1 MHz (common source)						
Input capacitance						
V_{DS} = 20 V; V_{GS} = 0	C_{is}	<	14	14	14	pF
Feedback capacitance						
$-V_{GS}$ = 12 V; V_{DS} = 0	C_{rs}	<	3.5	–	–	pF
$-V_{GS}$ = 7 V; V_{DS} = 0	C_{rs}	<	–	3.5	–	pF
$-V_{GS}$ = 5 V; V_{DS} = 0	C_{rs}	<	–	–	3.5	pF

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[1] measured under pulsed conditions: t_p = 100 µs; δ = 0.01

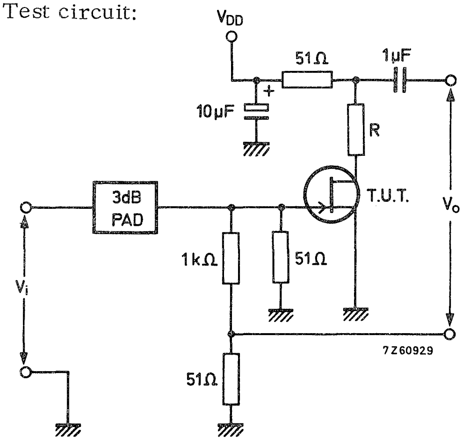
CHARACTERISTICS (continued) Tamb = 25 °C unless otherwise specified

Switching times

V_{DD} = 10 V; V_{GS} = 0

			2N4391	2N4392	2N4393	
	I_D	=	12	6.0	3.0	mA
	$-V_{GSM}$	=	12	7	5	V
Rise time	t_r	<	5	5	5	ns
Turn on time	t_{on}	<	15	15	15	ns
Fall time	t_f	<	15	20	30	ns
Turn off time	t_{off}	<	20	35	50	ns

Test circuit:



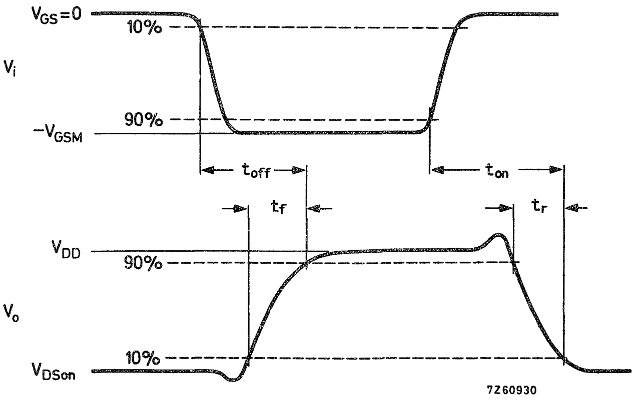
$$R = \frac{9.6}{I_D} - 51\,\Omega$$

Pulse generator:

t_r < 0.5 ns
t_f < 0.5 ns
t_p = 100 μs
δ = 0.01

Oscilloscope:

R_i = 50 Ω



N-CHANNEL FETS

Silicon symmetrical n-channel depletion type junction field-effect transistors in TO-18 metal envelopes with the gate connected to the case. The transistors are intended for low power, chopper or switching, applications in industrial service.

QUICK REFERENCE DATA

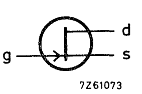
Drain-source voltage	**2N4856 to 2N4858**	$\pm V_{DS}$	max.		40		V
	2N4859 to 2N4861	$\pm V_{DS}$	max.		30		V
Total power dissipation up to $T_{amb} = 25\ ^{o}C$		P_{tot}	max.		360		mW
				2N4856 **2N4859**	**2N4857** **2N4860**	**2N4858** **2N4861**	
Drain current $V_{DS} = 15\ V$; $V_{GS} = 0$		I_{DSS}	>	50	20	8	mA
Gate-source cut-off voltage			>	4	2	0,8	V
$I_D = 0{,}5\ nA$; $V_{DS} = 15\ V$		$-V_{(P)GS}$	<	10	6	4	V
Drain-source resistance (on) at f = 1 kHz $I_D = 0$; $V_{GS} = 0$		$r_{ds\ on}$	<	25	40	60	Ω
Feedback capacitance at f = 1 MHz $V_{DS} = 0$; $-V_{GS} = 10\ V$		C_{rs}	<		8		pF
Turn-off time $V_{DD} = 10\ V$; $V_{GS} = 0$							
$I_D = 20\ mA$; $-V_{GSM} = 10\ V$	**2N4856; 2N4859**	t_{off}	<		25		ns
$I_D = 10\ mA$; $-V_{GSM} = 6\ V$	**2N4857; 2N4860**	t_{off}	<		50		ns
$I_D = 5\ mA$; $-V_{GSM} = 4\ V$	**2N4858; 2N4861**	t_{off}	<		100		ns

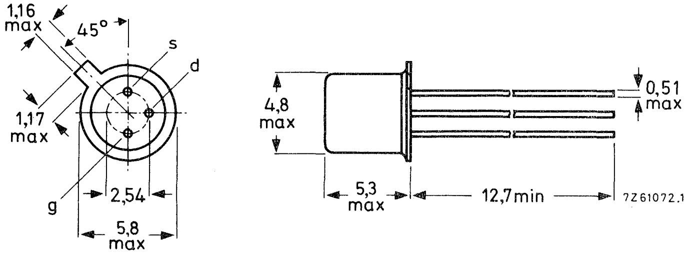
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-18

Gate connected to case





Accessories: 56246 (distance disc).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltages			2N4856 2N4857 2N4858	2N4859 2N4860 2N4861	
Drain-source voltage	$\pm V_{DS}$	max.	40	30	V
Drain-gate voltage (open source)	V_{DGO}	max.	40	30	V
Gate-source voltage (open drain)	$-V_{GSO}$	max.	40	30	V

Current				
Gate current (d.c.)	I_G	max.	50	mA

Power dissipation				
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	360	mW

Temperatures				
Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	200	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0.49	°C/mW

CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

			2N4856 2N4857 2N4858	2N4859 2N4860 2N4861	
Gate cut-off current					
$-V_{GS}$ = 20 V; V_{DS} = 0	$-I_{GSS}$	<	0.25	–	nA
$-V_{GS}$ = 15 V; V_{DS} = 0	$-I_{GSS}$	<	–	0.25	nA
$-V_{GS}$ = 20 V; V_{DS} = 0; T_{amb} = 150 °C	$-I_{GSS}$	<	0.5	–	μA
$-V_{GS}$ = 15 V; V_{DS} = 0; T_{amb} = 150 °C	$-I_{GSS}$	<	–	0.5	μA
Drain cut-off current					
V_{DS} = 15 V; $-V_{GS}$ = 10 V	I_{DSX}	<	0.25	0.25	nA
V_{DS} = 15 V; $-V_{GS}$ = 10 V; T_{amb} = 150 °C	I_{DSX}	<	0.5	0.5	μA

			2N4856 2N4859	2N4857 2N4860	2N4858 2N4861	
Drain current [1]						
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	>	50	20	8	mA
	I_{DSS}	<	–	100	80	mA

		2N4856 2N4857 2N4858	2N4859 2N4860 2N4861	
Gate-source breakdown voltage				
$-I_G$ = 1 μA; V_{DS} = 0	$-V_{(BR)GSS}$	40	30	V

			2N4856 2N4859	2N4857 2N4860	2N4858 2N4861	
Gate-source cut-off voltage						
I_D = 0.5 nA; V_{DS} = 15 V	$-V_{(P)GS}$	>	4	2	0.8	V
		<	10	6	4	V
Drain-source voltage (on)						
I_D = 20 mA; V_{GS} = 0	V_{DSon}	<	0.75	–	–	V
I_D = 10 mA; V_{GS} = 0	V_{DSon}	<	–	0.50	–	V
I_D = 5 mA; V_{GS} = 0	V_{DSon}	<	–	–	0.50	V
Drain-source resistance (on) at f = 1 kHz						
I_D = 0; V_{GS} = 0	r_{dson}	<	25	40	60	Ω

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[1] measured under pulse conditions: t_p = 100 ms; $\delta \leq 0.1$

y-parameters (common source)

$V_{DS} = 0$; $-V_{GS} = 10$ V; f = 1 MHz

Input capacitance	C_{is}	<	18	pF
Feedback capacitance	C_{rs}	<	8	pF

Switching times (see Figs 2 and 3)

$V_{DD} = 10$ V; $V_{GS} = 0$

			2N4856 2N4859	2N4857 2N4860	2N4858 2N4861	
Drain current	I_D	=	20	10	5	mA
Gate-source voltage (peak value)	$-V_{GSM}$	=	10	6	4	V
Delay time	t_d	<	6	6	10	ns
Rise time	t_r	<	3	4	10	ns
Turn-off time	t_{off}	<	25	50	100	ns

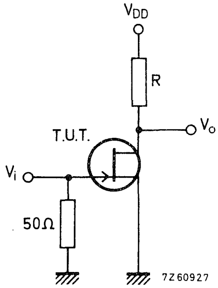


Fig. 2 Switching times test circuit.

	2N4856 2N4859	2N4857 2N4860	2N4858 2N4861	
R =	464	953	1910	Ω

Pulse generator:

$t_r \leqslant$ 1 ns

$t_f \leqslant$ 1 ns

δ = 0,02

Z_o = 50 Ω

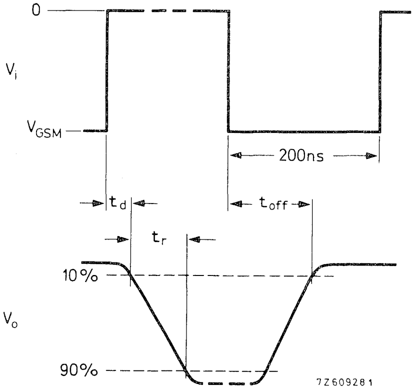


Fig. 3 Input and output waveforms.

Oscilloscope:

$t_r \leqslant 0{,}75$ ns

$R_i \geqslant$ 1 MΩ

$C_i \leqslant$ 2,5 pF

MOS-FETS

SILICON N-CHANNEL DUAL GATE MOS-FET

Depletion type field-effect transistor in a plastic X-package with source and substrate interconnected, intended for use in u.h.f. applications in television tuners and professional communication equipment.

This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

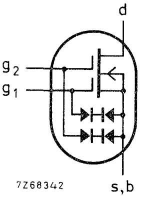
QUICK REFERENCE DATA

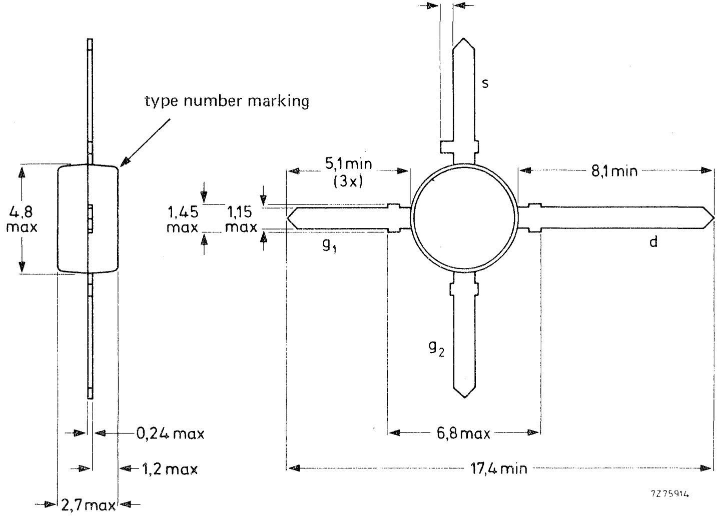
Drain-source voltage	V_{DS}	max.	20	V
Drain current (peak value)	I_{DM}	max.	30	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	225	mW
Junction temperature	T_j	max.	150	°C
Transfer admittance at f = 1 kHz I_D = 7 mA; V_{DS} = 10 V; + $V_{G2\text{-}S}$ = 4 V	$\lvert y_{fs} \rvert$	typ.	12	mA/V
Feedback capacitance at f = 1 MHz I_D = 7 mA; V_{DS} = 10 V; + $V_{G2\text{-}S}$ = 4 V	C_{rs}	typ.	25	fF
Noise figure at G_S = 2 mA/V I_D = 7 mA; V_{DS} = 10 V; + $V_{G2\text{-}S}$ = 4 V; f = 800 MHz	F	typ.	2,8	dB
Power gain at f = 800 MHz I_D = 7 mA; V_{DS} = 10 V; + $V_{G2\text{-}S}$ = 4 V; G_S = 2 mA/V; G_L = 1 mA/V	G_p	typ.	16,5	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-103.





RATINGS

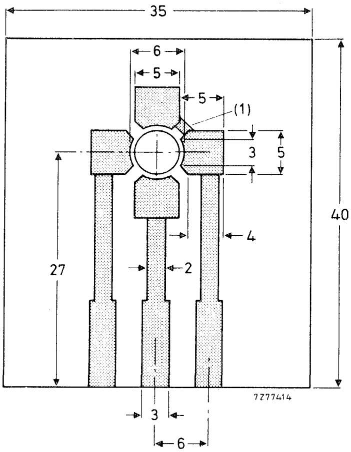
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	20	V
Drain current (d.c. or average)	I_D	max.	20	mA
Drain current (peak value)	I_{DM}	max.	30	mA
Gate 1 - source current	$\pm I_{G1-S}$	max.	10	mA
Gate 2 - source current	$\pm I_{G2-S}$	max.	10	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	225	mW
Storage temperature	T_{stg}	−65 to +150		°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on the printed-circuit board	$R_{th\ j-a}$	=	335 K/W

Dimensions in mm



(1) Connection made by
a strip or Cu wire.

Fig. 2 Single-sided 35 μm Cu-clad epoxy fibre-glass printed-circuit board, thickness 1,5 mm. Tracks are fully tin-lead plated. Board in horizontal position for R_{th} measurement.

STATIC CHARACTERISTICS

T_{amb} = 25 °C

Gate cut-off currents			
$\pm V_{G1\text{-}S} = 5$ V; $V_{G2\text{-}S} = V_{DS} = 0$	$\pm I_{G1\text{-}SS}$	<	50 nA
$\pm V_{G2\text{-}S} = 5$ V; $V_{G1\text{-}S} = V_{DS} = 0$	$\pm I_{G2\text{-}SS}$	<	50 nA
Gate-source breakdown voltages			
$\pm I_{G1\text{-}SS} = 10$ mA; $V_{G2\text{-}S} = V_{DS} = 0$	$\pm V_{(BR)G1\text{-}SS}$		6,0 to 20 V
$\pm I_{G2\text{-}SS} = 10$ mA; $V_{G1\text{-}S} = V_{DS} = 0$	$\pm V_{(BR)G2\text{-}SS}$		6,0 to 20 V
Drain current*			
$V_{DS} = 10$ V; $V_{G1\text{-}S} = 0$; $+V_{G2\text{-}S} = 4$ V	I_{DSS}		2 to 20 mA
Gate-source cut-off voltages			
$I_D = 20\ \mu$A; $V_{DS} = 10$ V; $+V_{G2\text{-}S} = 4$ V	$-V_{(P)G1\text{-}S}$	<	2,7 V
$I_D = 20\ \mu$A; $V_{DS} = 10$ V; $V_{G1\text{-}S} = 0$	$-V_{(P)G2\text{-}S}$	<	2,7 V

DYNAMIC CHARACTERISTICS

Measuring conditions (common source): $I_D = 7$ mA; $V_{DS} = 10$ V; $+V_{G2\text{-}S} = 4$ V; $T_{amb} = 25$ °C

Transfer admittance at f = 1 kHz	$\lvert y_{fs} \rvert$	> typ.	9,5 mA/V 12 mA/V
Input capacitance at gate 1; f = 1 MHz	$C_{ig1\text{-}s}$	typ.	1,8 pF
Input capacitance at gate 2; f = 1 MHz	$C_{ig2\text{-}s}$	typ.	1,0 pF
Feedback capacitance at f = 1 MHz	C_{rs}	typ.	25 fF
Output capacitance at f = 1 MHz	C_{os}	typ.	0,9 pF
Noise figure at $G_S = 2$ mA/V			
f = 200 MHz	F	typ.	1,6 dB
f = 800 MHz	F	typ.	2,8 dB
Power gain at $G_S = 2$ mA/V			
$G_L = 0{,}5$ mA/V; f = 200 MHz	G_p	typ.	23 dB
$G_L = 1$ mA/V; f = 800 MHz	G_p	typ.	16,5 dB

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* Measured under pulse conditions.

SILICON N-CHANNEL DUAL GATE MOS-FET

Depletion type field-effect transistor in a plastic X-package with source and substrate interconnected, intended for v.h.f. applications in television tuners, especially in r.f. stages and mixer stages in S-channel tuners. The device is also suitable for use in professional communication equipment.

This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

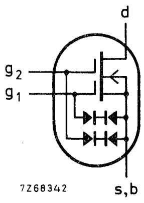
QUICK REFERENCE DATA

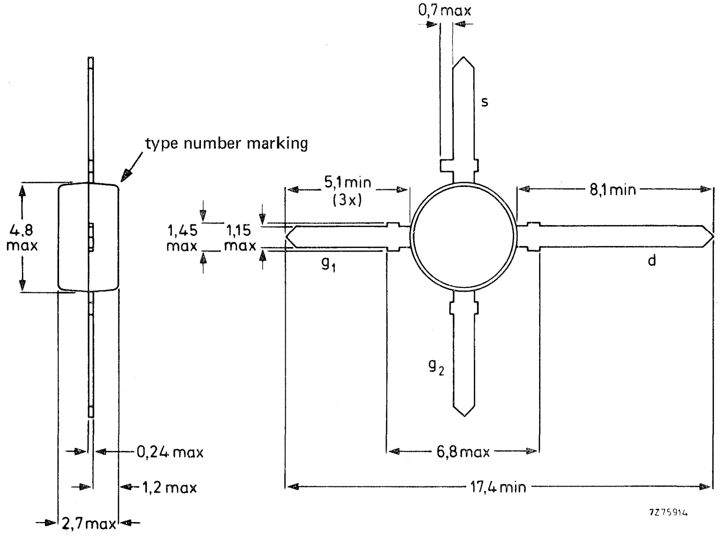
Drain-source voltage	V_{DS}	max.	20	V
Drain-current	I_D	max.	30	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	225	mW
Junction temperature	T_j	max.	150	°C
Transfer admittance at f = 1 kHz I_D = 10 mA; V_{DS} = 15 V; $+V_{G2\text{-}S}$ = 4 V	$\lvert y_{fs} \rvert$	typ.	17	mA/V
Feedback capacitance at f = 1 MHz I_D = 10 mA, V_{DS} = 15 V; $+V_{G2\text{-}S}$ = 4 V	C_{rs}	typ.	25	fF
Noise figure at G_S = 2 mA/V I_D = 10 mA; V_{DS} = 15 V; $+V_{G2\text{-}S}$ = 4 V; f = 200 MHz	F	typ.	1,5	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-103.





RATINGS

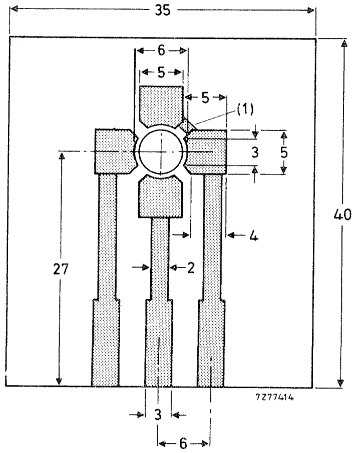
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	20	V
Drain-current (d.c. or average)	I_D	max.	30	mA
Gate 1 - source current	$\pm I_{G1\text{-}S}$	max.	10	mA
Gate 2 - source current	$\pm I_{G2\text{-}S}$	max.	10	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	225	mW
Storage temperature	T_{stg}	−65 to	+150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on the printed-circuit board (see Fig. 2)	$R_{th\ j\text{-}a}$	=	335	K/W

Dimensions in mm



(1) Connection made by a strip or Cu wire.

Fig. 2 Single-sided 35 μm Cu-clad epoxy fibre-glass printed-circuit board, thickness 1,5 mm. Tracks are fully tin-lead plated. Board in horizontal position for R_{th} measurement.

STATIC CHARACTERISTICS

$T_{amb} = 25\ ^{o}C$

Gate cut-off currents			
$\pm V_{G1\text{-}S} = 5$ V; $V_{G2\text{-}S} = V_{DS} = 0$	$\pm I_{G1\text{-}SS}$	$<$	50 nA
$\pm V_{G2\text{-}S} = 5$ V; $V_{G1\text{-}S} = V_{DS} = 0$	$\pm I_{G2\text{-}SS}$	$<$	50 nA
Gate-source breakdown voltages			
$\pm I_{G1\text{-}SS} = 10$ mA; $V_{G2\text{-}S} = V_{DS} = 0$	$\pm V_{(BR)G1\text{-}SS}$		6,0 to 20 V
$\pm I_{G2\text{-}SS} = 10$ mA; $V_{G1\text{-}S} = V_{DS} = 0$	$\pm V_{(BR)G2\text{-}SS}$		6,0 to 20 V
Drain current*			
$V_{DS} = 15$ V; $V_{G1\text{-}S} = 0$; $+V_{G2\text{-}S} = 4$ V	I_{DSS}		2 to 20 mA
Gate-source cut-off voltages			
$I_D = 20\ \mu A$; $V_{DS} = 15$ V; $+V_{G2\text{-}S} = 4$ V	$-V_{(P)G1\text{-}S}$	$<$	2,5 V
$I_D = 20\ \mu A$; $V_{DS} = 15$ V; $V_{G1\text{-}S} = 0$	$-V_{(P)G2\text{-}S}$	$<$	2,0 V

DYNAMIC CHARACTERISTICS

Measuring conditions (common source); $I_D = 10$ mA; $V_{DS} = 15$ V; $+V_{G2\text{-}S} = 4$ V; $T_{amb} = 25\ ^{o}C$

Transfer admittance at f = 1 kHz	$\lvert y_{fs} \rvert$	$>$ typ.	15 mA/V 17 mA/V
Input capacitance at gate 1; f = 1 MHz	$C_{ig1\text{-}s}$	typ. $<$	2,5 pF 3,0 pF
Input capacitance at gate 2; f = 1 MHz	$C_{ig2\text{-}s}$	typ.	1,2 pF
Feedback capacitance at f = 1 MHz	C_{rs}	typ. $<$	25 fF 35 fF
Output capacitance at f = 1 MHz	C_{os}	typ. $<$	1,0 pF 1,3 pF
Noise figure at $G_S = 2$ mA/V f = 200 MHz	F	typ. $<$	1,5 dB 2,8 dB
Power gain at $G_S = 2$ mA/V $G_L = 0,5$ mA/V; f = 200 MHz	G_p	typ.	25 dB

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* Measured under pulse conditions.

SILICON N-CHANNEL DUAL GATE MOS-FET

Depletion type field-effect transistor in a plastic X-package with source and substrate interconnected, intended for u.h.f. applications in television tuners and professional communication equipment.

This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

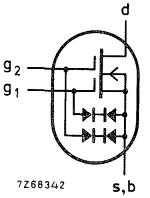
QUICK REFERENCE DATA

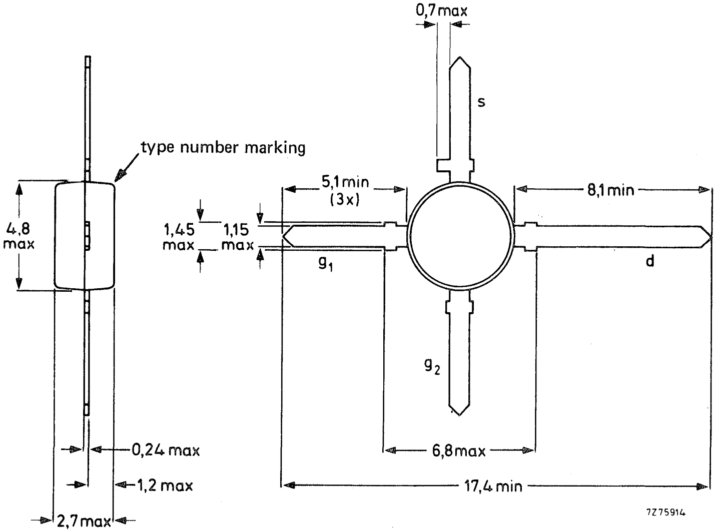
Drain-source voltage	V_{DS}	max.	20 V
Drain-current	I_D	max.	30 mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	225 mW
Junction temperature	T_j	max.	150 °C
Transfer admittance at f = 1 kHz I_D = 10 mA; V_{DS} = 15 V; $+V_{G2\text{-}S}$ = 4 V	$\lvert y_{fs}\rvert$	typ.	17 mA/V
Feedback capacitance at f = 1 MHz I_D = 10 mA; V_{DS} = 15 V; $+V_{G2\text{-}S}$ = 4 V	C_{rs}	typ.	25 fF
Noise figure at G_S = 2 mA/V I_D = 10 mA; V_{DS} = 15 V; $+V_{G2\text{-}S}$ = 4 V; f = 800 MHz	F	typ.	2,8 dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-103.





RATINGS

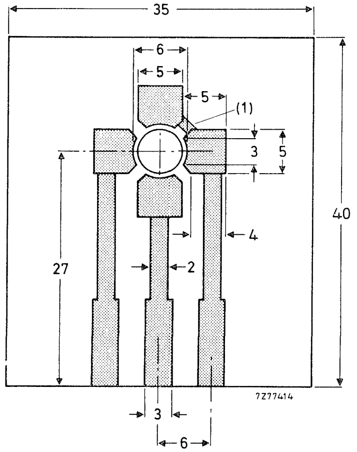
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain source voltage	V_{DS}	max.	20	V
Drain current (d.c. or average)	I_D	max.	30	mA
Gate 1 - source current	$\pm I_{G1\text{-}S}$	max.	10	mA
Gate 2 - source current	$\pm I_{G2\text{-}S}$	max.	10	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	225	mW
Storage temperature	T_{stg}	−65 to	+150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on the printed-circuit board (see Fig. 2) $R_{th\,j\text{-}a}$ = 335 K/W

Dimensions in mm



(1) Connection made by a strip or Cu wire.

Fig. 2 Single-sided 35 μm Cu-clad epoxy fibre-glass printed-circuit board, thickness 1,5 mm. Tracks are fully tin-lead plated. Board in horizontal position for R_{th} measurement.

STATIC CHARACTERISTICS

$T_{amb} = 25\ ^{o}C$

Gate cut-off currents			
$\pm V_{G1\text{-}S} = 5$ V; $V_{G2\text{-}S} = V_{DS} = 0$	$\pm I_{G1\text{-}SS}$	<	50 nA
$\pm V_{G2\text{-}S} = 5$ V; $V_{G1\text{-}S} = V_{DS} = 0$	$\pm I_{G2\text{-}SS}$	<	50 nA
Gate-source breakdown voltages			
$\pm I_{G1\text{-}SS} = 10$ mA; $V_{G2\text{-}S} = V_{DS} = 0$	$\pm V_{(BR)G1\text{-}SS}$		6,0 to 20 V
$\pm I_{G2\text{-}SS} = 10$ mA; $V_{G1\text{-}S} = V_{DS} = 0$	$\pm V_{(BR)G2\text{-}SS}$		6,0 to 20 V
Drain current*			
$V_{DS} = 15$ V; $V_{G1\text{-}S} = 0$; $+V_{G2\text{-}S} = 4$ V	I_{DSS}		2 to 20 mA
Gate-source cut-off voltages			
$I_D = 20\ \mu A$; $V_{DS} = 15$ V; $+V_{G2\text{-}S} = 4$ V	$-V_{(P)G1\text{-}S}$	<	2,5 V
$I_D = 20\ \mu A$; $V_{DS} = 15$ V; $V_{G1\text{-}S} = 0$	$-V_{(P)G2\text{-}S}$	<	2,0 V

DYNAMIC CHARACTERISTICS

Measuring conditions (common source): $I_D = 10$ mA; $V_{DS} = 15$ V; $+V_{G2\text{-}S} = 4$ V; $T_{amb} = 25\ ^{o}C$

Transfer admittance at f = 1 kHz	$\lvert y_{fs} \rvert$	> typ.	15 mA/V 17 mA/V
Input capacitance at gate 1; f = 1 MHz	$C_{ig1\text{-}s}$	typ. <	2,2 pF 2,6 pF
Input capacitance at gate 2; f = 1 MHz	$C_{ig2\text{-}s}$	typ.	1,1 pF
Feedback capacitance at f = 1 MHz	C_{rs}	typ. <	25 fF 35 fF
Output capacitance at f = 1 MHz	C_{os}	typ. <	0,8 pF 1,2 pF
Noise figure at $G_S = 2$ mA/V			
f = 200 MHz	F	typ.	1,5 dB
f = 800 MHz	F	typ. <	2,8 dB 3,9 dB
Power gain at $G_S = 2$ mA/V			
$G_L = 0,5$ mA/V; f = 200 MHz	G_p	typ.	25 dB
$G_L = 1$ mA/V; f = 800 MHz	G_p	typ.	18 dB

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* Measured under pulse conditions.

SILICON N-CHANNEL DUAL GATE MOS-FET

Depletion type field-effect transistor in a plastic X-package with source and substrate interconnected, intended for u.h.f. applications, such as u.h.f. television tuners, with 12 V supply voltage.

This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

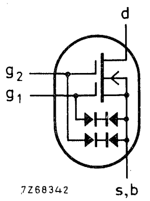
QUICK REFERENCE DATA

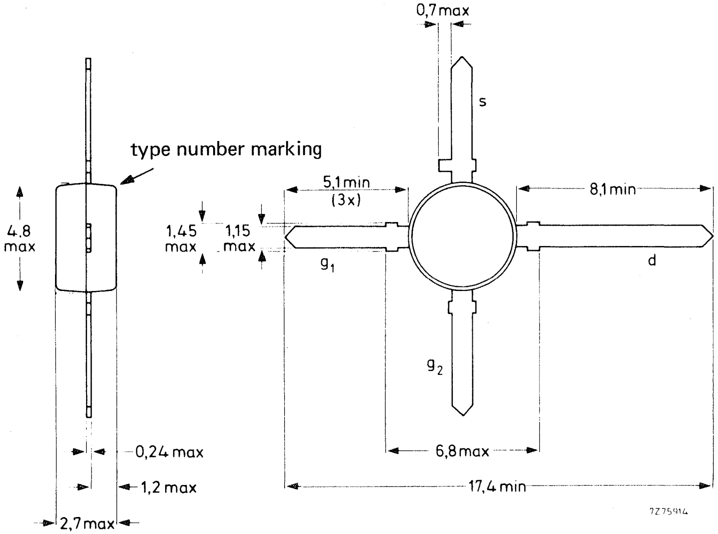
Drain-source voltage	V_{DS}	max.	18	V
Drain current	I_D	max.	30	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	225	mW
Junction temperature	T_j	max.	150	°C
Transfer admittance at f = 1 kHz I_D = 10 mA; V_{DS} = 10 V; $+V_{G2\text{-}S}$ = 4 V	$\lvert y_{fs}\rvert$	typ.	19	mA/V
Feedback capacitance at f = 1 MHz I_D = 10 mA; V_{DS} = 10 V; $+V_{G2\text{-}S}$ = 4 V	C_{rs}	typ.	25	fF
Noise figure at G_S = 5 mA/V I_D = 10 mA; V_{DS} = 10 V; $+V_{G2\text{-}S}$ = 4 V; f = 800 MHz	F	typ.	2,8	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-103.





RATINGS

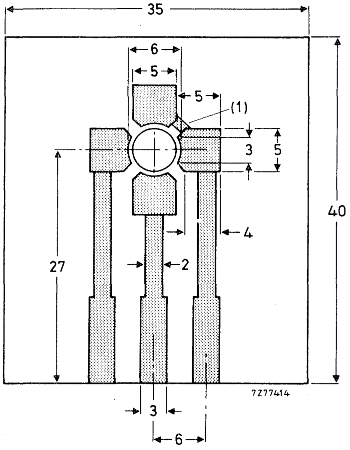
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	18	V
Drain current (d.c. or average)	I_D	max.	30	mA
Gate 1 - source current	$\pm I_{G1\text{-}S}$	max.	10	mA
Gate 2 - source current	$\pm I_{G2\text{-}S}$	max.	10	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	225	mW
Storage temperature	T_{stg}		−65 to +150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on the printed-circuit board (see Fig. 2) $R_{th\ j\text{-}a}$ = 335 K/W

Dimensions in mm



(1) Connection made by a strip or Cu wire.

Fig. 2 Single-sided 35 μm Cu-clad epoxy fibre-glass printed-circuit board, thickness 1,5 mm. Tracks are fully tin-lead plated. Board in horizontal position for R_{th} measurement.

STATIC CHARACTERISTICS

$T_{amb} = 25\ ^{o}C$

Gate cut-off currents			
$\pm V_{G1\text{-}S} = 7\ V;\ V_{G2\text{-}S} = V_{DS} = 0$	$\pm I_{G1\text{-}SS}$	$<$	25 nA
$\pm V_{G2\text{-}S} = 7\ V;\ V_{G1\text{-}S} = V_{DS} = 0$	$\pm I_{G2\text{-}SS}$	$<$	25 nA
Gate-source breakdown voltages			
$\pm I_{G1\text{-}SS} = 10\ mA;\ V_{G2\text{-}S} = V_{DS} = 0$	$\pm V_{(BR)G1\text{-}SS}$	$>$	8 V
$\pm I_{G2\text{-}SS} = 10\ mA;\ V_{G1\text{-}S} = V_{DS} = 0$	$\pm V_{(BR)G2\text{-}SS}$	$>$	8 V
Gate-source cut-off voltages			
$I_D = 20\ \mu A;\ V_{DS} = 10\ V;\ +V_{G2\text{-}S} = 4\ V$	$-V_{(P)G1\text{-}S}$	$<$	1,3 V
		$>$	0,2 V
$I_D = 20\ \mu A;\ V_{DS} = 10\ V;\ V_{G1\text{-}S} = 0$	$-V_{(P)G2\text{-}S}$	$<$	1,1 V
		$>$	0,2 V

DYNAMIC CHARACTERISTICS

Measuring conditions (common source): $I_D = 10\ mA;\ V_{DS} = 10\ V;\ +V_{G2\text{-}S} = 4\ V;\ T_{amb} = 25\ ^{o}C$

Transfer admittance at f = 1 kHz	$\lvert y_{fs} \rvert$	$>$	17 mA/V
		typ.	19 mA/V
Input capacitance at gate 1; f = 1 MHz	$C_{ig1\text{-}s}$	$<$	3,0 pF
		typ.	2,6 pF
Feedback capacitance at f = 1 MHz	C_{rs}	$<$	35 fF
		typ.	25 fF
Output capacitance at f = 1 MHz	C_{os}	$<$	1,3 pF
		typ.	1,1 pF
Noise figure at f = 800 MHz; $G_S = 5$ mA/V	F	$<$	3,9 dB
		typ.	2,8 dB

SILICON N-CHANNEL DUAL GATE MOS-FET

Depletion type field-effect transistor in a plastic X-package with source and substrate interconnected, intended for v.h.f. applications, such as v.h.f. television tuners, f.m. tuners and professional communication equipment.

This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

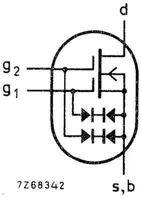
QUICK REFERENCE DATA

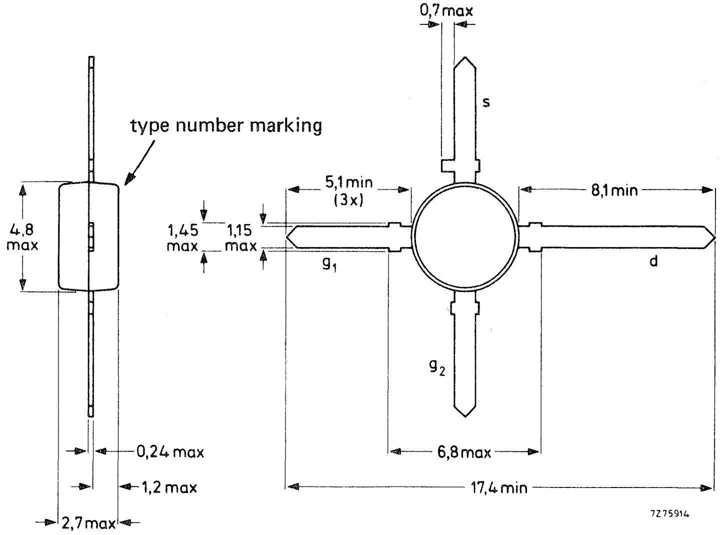
Drain-source voltage	V_{DS}	max.	20	V
Drain current	I_D	max.	20	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	225	mW
Junction temperature	T_j	max.	150	°C
Transfer admittance at f = 1 kHz I_D = 10 mA; V_{DS} = 10 V; $+V_{G2\text{-}S}$ = 4 V	$\lvert y_{fs} \rvert$	typ.	14	mA/V
Feedback capacitance at f = 1 MHz I_D = 10 mA; V_{DS} = 10 V; $+V_{G2\text{-}S}$ = 4 V	C_{rs}	typ.	20	fF
Noise figure at optimum source admittance I_D = 10 mA; V_{DS} = 10 V; $+V_{G2\text{-}S}$ = 4 V; f = 200 MHz	F	typ.	0,7	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-103.





RATINGS

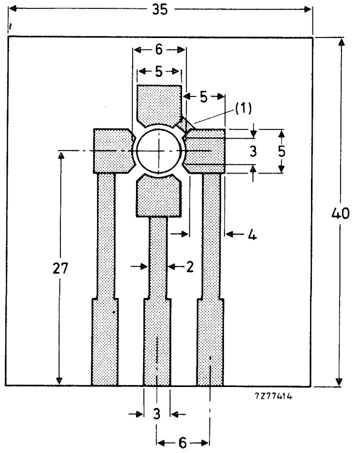
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	20	V
Drain current (d.c. or average)	I_D	max.	20	mA
Drain current (peak value)	I_{DM}	max.	30	mA
Gate 1 - source current	$\pm I_{G1\text{-}S}$	max.	10	mA
Gate 2 - source current	$\pm I_{G2\text{-}S}$	max.	10	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	225	mW
Storage temperature	T_{stg}		–65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on the printed-circuit board (see Fig. 2)	$R_{th\ j\text{-}a}$	=	335	K/W

Dimensions in mm



(1) Connection made by a strip or Cu wire.

Fig. 2 Single-sided 35 μm Cu-clad epoxy fibre-glass printed-circuit board, thickness 1,5 mm. Tracks are fully tin-lead plated. Board in horizontal position for R_{th} measurement.

STATIC CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Gate cut-off currents				
$\pm V_{G1\text{-}S} = 5$ V; $V_{G2\text{-}S} = V_{DS} = 0$	$\pm I_{G1\text{-}SS}$	$<$	50	nA
$\pm V_{G2\text{-}S} = 5$ V; $V_{G1\text{-}S} = V_{DS} = 0$	$\pm I_{G2\text{-}SS}$	$<$	50	nA
Gate-source breakdown voltages				
$\pm I_{G1\text{-}SS} = 10$ mA; $V_{G2\text{-}S} = V_{DS} = 0$	$\pm V_{(BR)G1\text{-}SS}$	$>$	6	V
$\pm I_{G2\text{-}SS} = 10$ mA; $V_{G1\text{-}S} = V_{DS} = 0$	$\pm V_{(BR)G2\text{-}SS}$	$>$	6	V
Drain current				
$V_{DS} = 10$ V; $V_{G1\text{-}S} = 0$; $+V_{G2\text{-}S} = 4$ V; $T_j = 25$ °C	I_{DSS}		4 to 25	mA
Gate-source cut-off voltages				
$I_D = 20\ \mu$A; $V_{DS} = 10$ V; $+V_{G2\text{-}S} = 4$ V	$-V_{(P)G1\text{-}S}$	$<$	2,5	V
$I_D = 20\ \mu$A; $V_{DS} = 10$ V; $V_{G1\text{-}S} = 0$	$-V_{(P)G2\text{-}S}$	$<$	2,5	V

DYNAMIC CHARACTERISTICS

Measuring conditions (common source): $I_D = 10$ mA; $V_{DS} = 10$ V; $+V_{G2\text{-}S} = 4$ V; $T_{amb} = 25$ °C

Transfer admittance at f = 1 kHz	$\lvert y_{fs} \rvert$	$>$ typ.	10 14	mA/V mA/V
Input capacitance at gate 1; f = 1 MHz	$C_{ig1\text{-}s}$	typ.	2,1	pF
Input capacitance at gate 2; f = 1 MHz	$C_{ig2\text{-}s}$	typ.	1,0	pF
Feedback capacitance at f = 1 MHz	C_{rs}	typ.	20	fF
Output capacitance at f = 1 MHz	C_{os}	typ.	1,1	pF
Noise figure at f = 100 MHz; $G_S = 1$ mA/V	F	typ. $<$	0,7 1,7	dB dB
Noise figure at f = 200 MHz; $G_S = 2$ mA/V	F	typ. $<$	1,0 2,0	dB dB
Transducer gain at f = 100 MHz; $G_S = 1$ mA/V; $G_L = 0{,}5$ mA/V	G_{tr}	typ.	29	dB
Transducer gain at f = 200 MHz; $G_S = 2$ mA/V; $G_L = 0{,}5$ mA/V	G_{tr}	typ.	26	dB

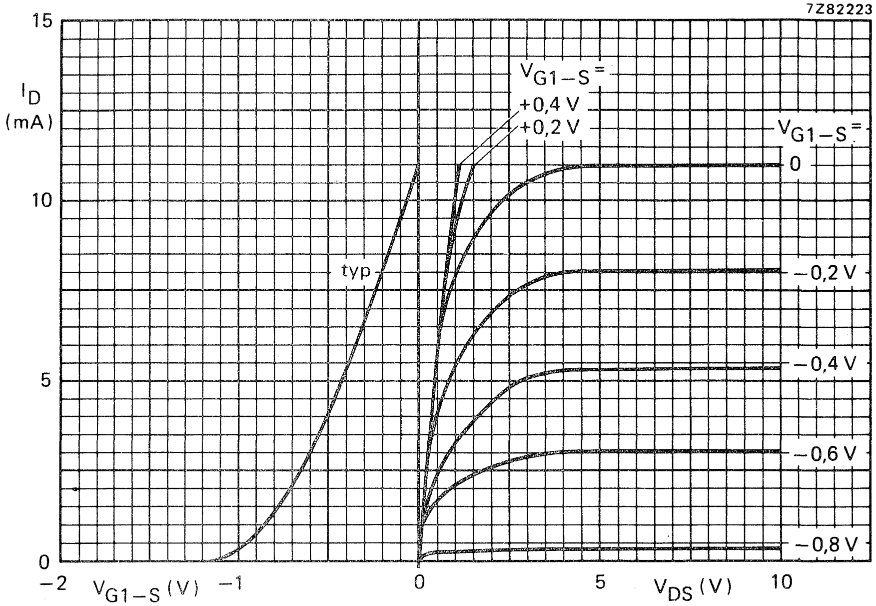


Fig. 3 **Left-hand graph:** V_{DS} = 10 V; $V_{G2\text{-}S}$ = + 4 V; T_{amb} = 25 °C. **Right-hand graph:** $V_{G2\text{-}S}$ = +4 V; T_{amb} = 25 °C.

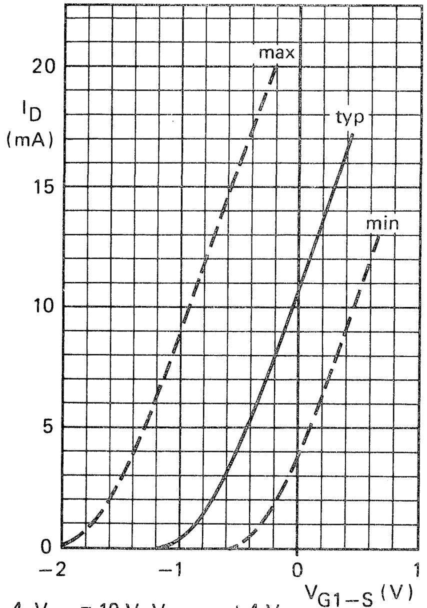


Fig. 4 V_{DS} = 10 V; $V_{G2\text{-}S}$ = + 4 V; T_{amb} = 25 °C.

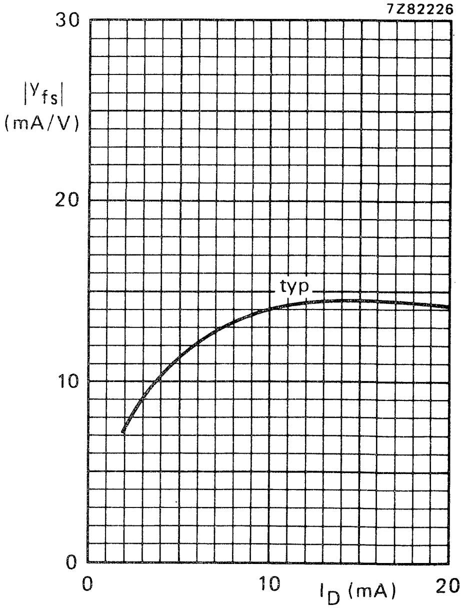


Fig. 5 V_{DS} = 10 V; $V_{G2\text{-}S}$ = + 4 V; f = 1 kHz; T_{amb} = 25 °C.

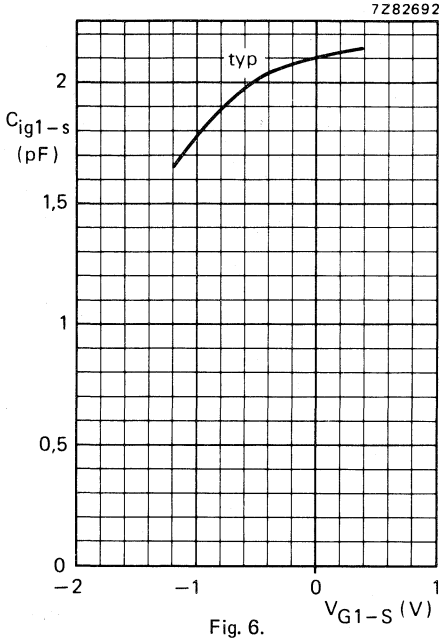


Fig. 6.

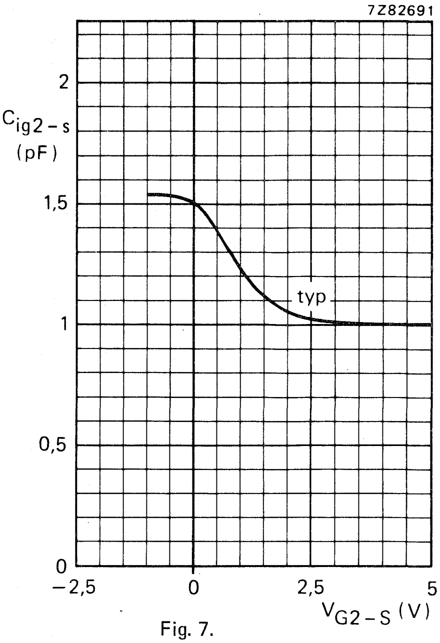


Fig. 7.

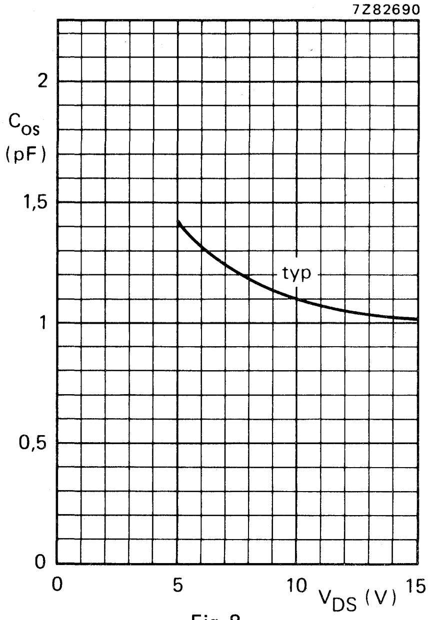


Fig. 8.

Measuring conditions:

Fig. 6 $V_{DS} = 10$ V; $V_{G2\text{-}S} = +4$ V; f = 1 MHz; $T_{amb} = 25$ °C.

Fig. 7 $V_{DS} = 10$ V; $V_{G1\text{-}S} = 0$; f = 1 MHz; $T_{amb} = 25$ °C.

Fig. 8 $V_{G2\text{-}S} = +4$ V; $I_D = 10$ mA; f = 1 MHz; $T_{amb} = 25$ °C.

Measuring conditions for Figs 9 to 12: V_{DS} = 10 V; I_D = 10 mA; $V_{G2\text{-}S}$ = + 4 V; T_{amb} = 25 °C.

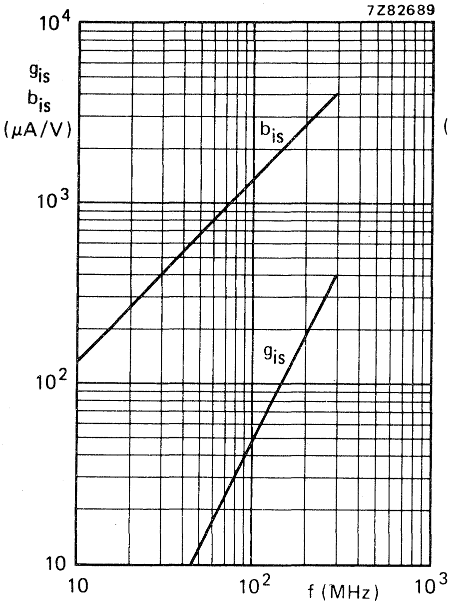


Fig. 9.

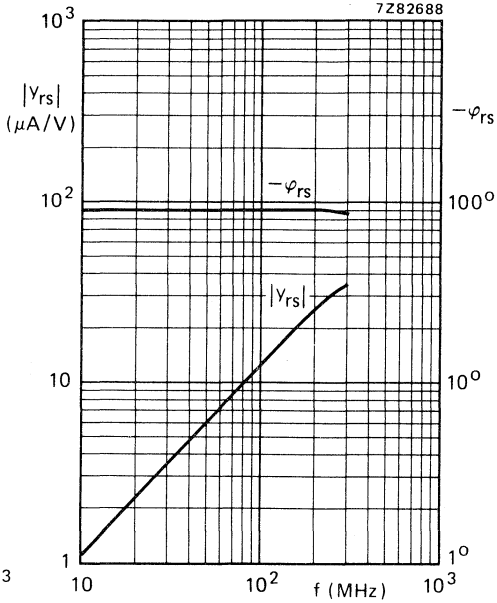


Fig. 10.

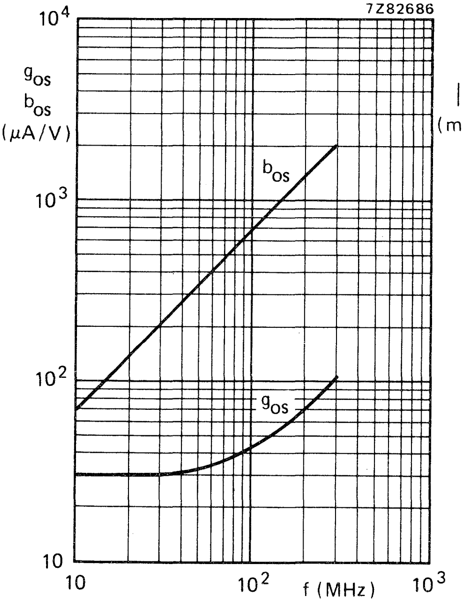


Fig. 11.

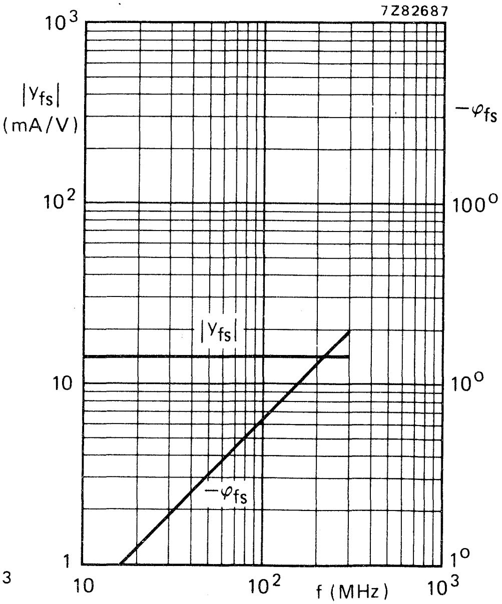


Fig. 12.

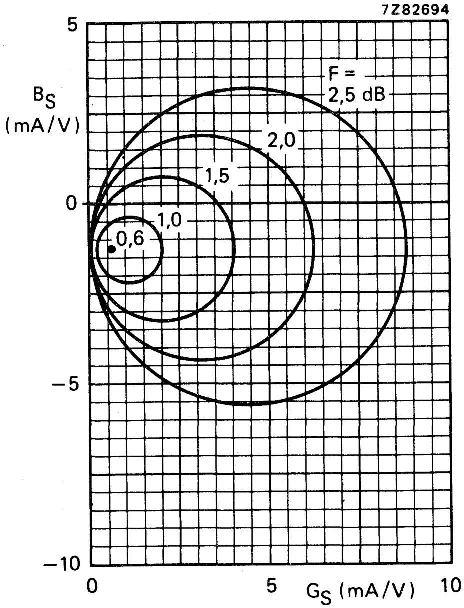


Fig. 13 V_{DS} = 10 V; $V_{G2\text{-}S}$ = + 4 V; I_D = 10 mA; f = 100 MHz; T_{amb} = 25 °C; circles of typical constant noise figures.

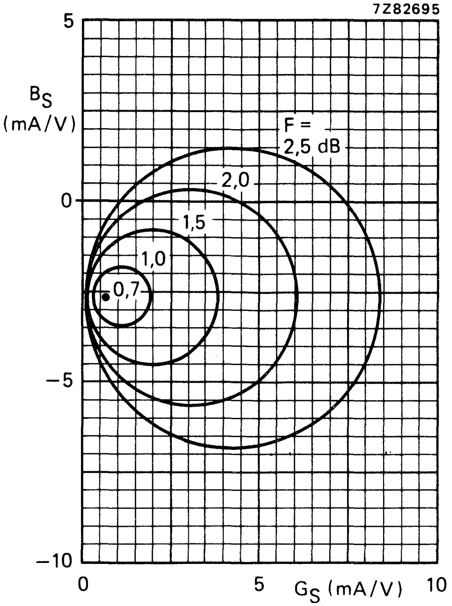
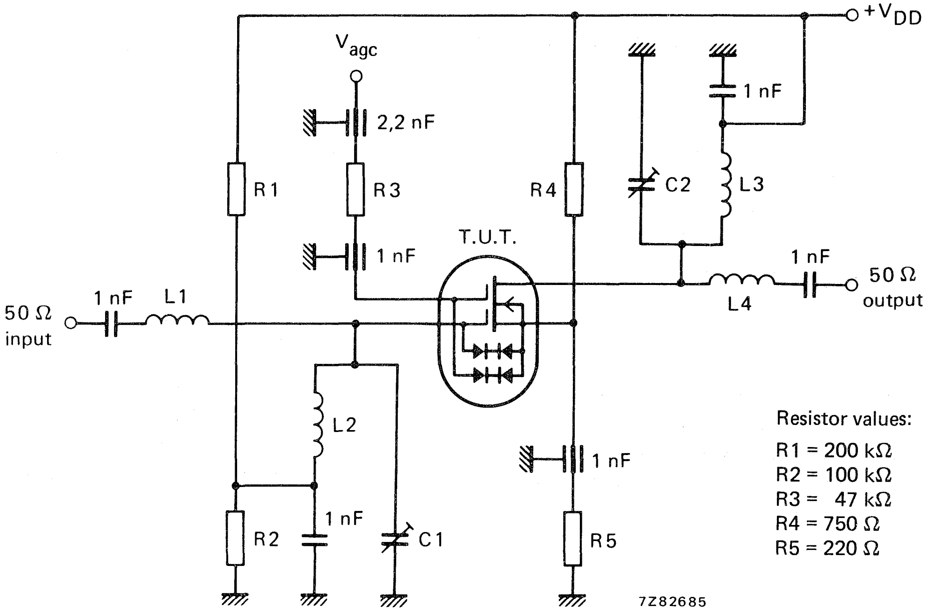


Fig. 14 V_{DS} = 10 V; $V_{G2\text{-}S}$ = + 4 V; I_D = 10 mA; f = 200 MHz; T_{amb} = 25 °C; circles of typical constant noise figures.



Resistor values:

R1 = 200 kΩ
R2 = 100 kΩ
R3 = 47 kΩ
R4 = 750 Ω
R5 = 220 Ω

Fig. 15 Automatic gain control test circuit at f = 200 MHz (see also Fig. 16). V_{DD} = 16 V; G_S = 2 mA/V; G_L = 0,5 mA/V.

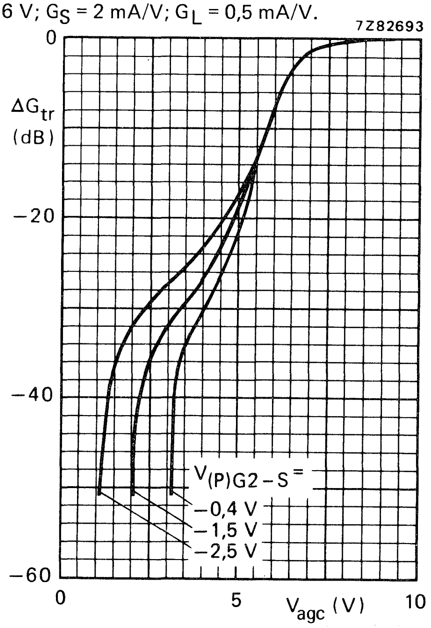


Fig. 16 V_{DD} = 16 V; f = 200 MHz; T_{amb} = 25 °C; typical values; see also Fig. 15.

SILICON N-CHANNEL DUAL GATE MOS-FET

Depletion type field-effect transistor in a plastic X-package with source and substrate interconnected, intended for v.h.f. applications, such as v.h.f. television tuners, f.m. tuners, with 12 V supply voltage.

This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

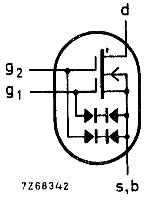
QUICK REFERENCE DATA

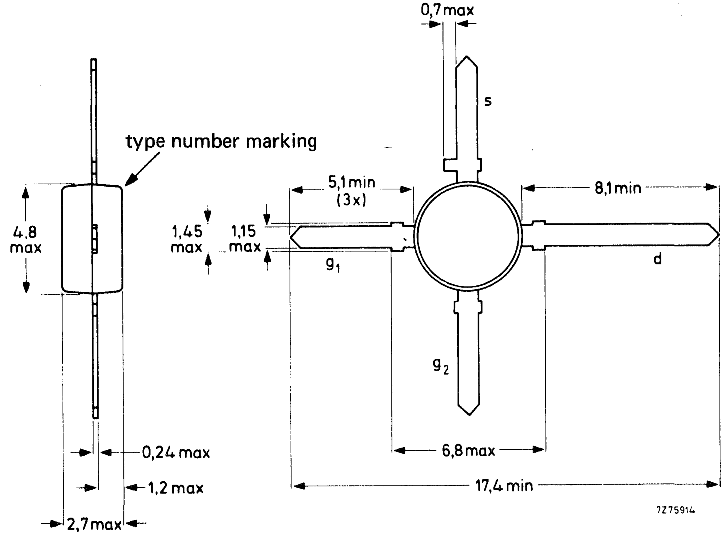
Drain-source voltage	V_{DS}	max.	20	V
Drain current	I_D	max.	40	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	225	mW
Junction temperature	T_j	max.	150	°C
Transfer admittance at f = 1 kHz I_D = 15 mA; V_{DS} = 10 V; $+V_{G2\text{-}S}$ = 4 V	$\|y_{fs}\|$	typ.	25	mA/V
Feedback capacitance at f = 1 MHz I_D = 15 mA; V_{DS} = 10 V; $+V_{G2\text{-}S}$ = 4 V	C_{rs}	typ.	30	fF
Noise figure at G_S = 2 mA/V I_D = 15 mA; V_{DS} = 10 V; $+V_{G2\text{-}S}$ = 4 V; f = 200 MHz	F	typ.	1,2	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT-103.





RATINGS

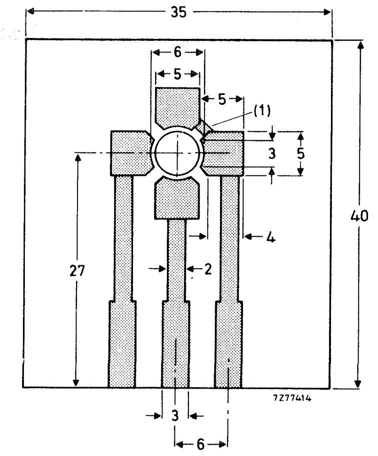
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Drain-source voltage	V_{DS}	max.	20	V
Drain current (d.c. or average)	I_D	max.	40	mA
Gate 1 - source current	$\pm I_{G1\text{-}S}$	max.	10	mA
Gate 2 - source current	$\pm I_{G2\text{-}S}$	max.	10	mA
Total power dissipation up to T_{amb} = 75 °C	P_{tot}	max.	225	mW
Storage temperature	T_{stg}		−65 to + 150	°C
Junction temperature	T_j	max.	150	°C

THERMAL RESISTANCE

From junction to ambient in free air mounted on the printed-circuit board (see Fig. 2) $R_{th\,j\text{-}a}$ = 335 K/W

Dimensions in mm



(1) Connection made by a strip or Cu wire.

Fig. 2 Single-sided 35 μm Cu-clad epoxy fibre-glass printed-circuit board, thickness 1,5 mm. Tracks are fully tin-lead plated. Board in horizontal position for R_{th} measurement.

STATIC CHARACTERISTICS

$T_{amb} = 25\ ^{o}C$

Gate cut-off currents				
$\pm V_{G1\text{-}S} = 7\ V;\ V_{G2\text{-}S} = V_{DS} = 0$	$\pm I_{G1\text{-}SS}$	$<$	25	nA
$\pm V_{G2\text{-}S} = 7\ V;\ V_{G1\text{-}S} = V_{DS} = 0$	$\pm I_{G2\text{-}SS}$	$<$	25	nA
Gate-source breakdown voltages				
$\pm I_{G1\text{-}SS} = 10\ mA;\ V_{G2\text{-}S} = V_{DS} = 0$	$\pm V_{(BR)G1\text{-}SS}$	$>$	8	V
$\pm I_{G2\text{-}SS} = 10\ mA;\ V_{G1\text{-}S} = V_{DS} = 0$	$\pm V_{(BR)G2\text{-}SS}$	$>$	8	V
Gate-source cut-off voltages				
$I_D = 20\ \mu A;\ V_{DS} = 10\ V;\ +V_{G2\text{-}S} = 4\ V$	$-V_{(P)G1\text{-}S}$	$<$	1,3	V
$I_D = 20\ \mu A;\ V_{DS} = 10\ V;\ V_{G1\text{-}S} = 0$	$-V_{(P)G2\text{-}S}$	$<$	1,1	V

DYNAMIC CHARACTERISTICS

Measuring conditions (common source): $I_D = 15\ mA;\ V_{DS} = 10\ V;\ +V_{G2\text{-}S} = 4\ V;\ T_{amb} = 25\ ^{o}C$

Transfer admittance at f = 1 kHz	$\lvert y_{fs} \rvert$	$>$	20	mA/V
		typ.	25	mA/V
Input capacitance at gate 1; f = 1 MHz	$C_{ig1\text{-}s}$	typ.	4,0	pF
Input capacitance at gate 2; f = 1 MHz	$C_{ig2\text{-}s}$	typ.	1,7	pF
Feedback capacitance at f = 1 MHz	C_{rs}	typ.	30	fF
Output capacitance at f = 1 MHz	C_{os}	typ.	2,0	pF
Noise figure at f = 200 MHz; $G_S = 2$ mA/V	F	typ.	1,2	dB

N-CHANNEL INSULATED GATE MOS-FET

Depletion type field-effect transistor in a TO-72 metal envelope with the substrate connected to the case. It is intended for linear applications in the audio as well as the i.f. and v.h.f. frequency region, and in cases where high input impedance, low gate leakage currents and low noise figures are of importance.

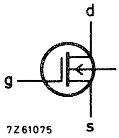
QUICK REFERENCE DATA

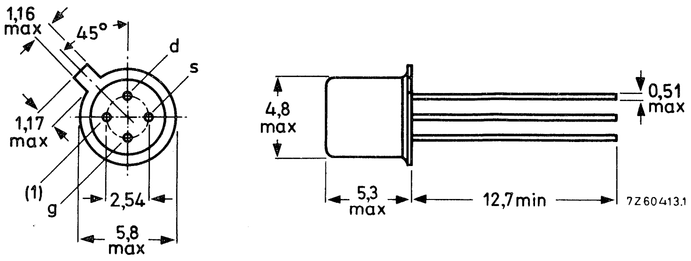
Drain-substrate voltage	V_{DB}	max.	30	V
Gate-substrate voltage (continuous)	$\pm V_{GB}$	max.	10	V
Drain current $V_{DS} = 15$ V; $V_{GS} = 0$	I_{DSS}		10 to 40	mA
Transfer admittance $I_D = 5$ mA; $V_{DS} = 15$ V; f = 1 kHz	$\lvert y_{fs} \rvert$	>	6	mA/V
Feedback capacitance $I_D = 5$ mA; $V_{DS} = 15$ V; f = 1 MHz	C_{rs}	<	0,7	pF
Noise figure at f = 200 MHz $I_D = 5$ mA; $V_{DS} = 15$ V; $T_{amb} = 25\ ^{\circ}C$ $G_S = 1$ mA/V; $B_S = B_{Sopt}$	F	<	5	dB
Equivalent noise voltage at f = 1 kHz $I_D = 5$ mA; $V_{DS} = 15$ V; $T_{amb} = 25\ ^{\circ}C$	$V_n/\sqrt{B}$	typ.	100	$nV/\sqrt{Hz}$

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-72.





(1) = substrate (b) connected to case

Accessories: 56246 (distance disc).

Note

To safeguard the gates against damage due to accumulation of static charge during transport or handling, the leads are encircled by a ring of conductive rubber which should be removed just after the transistor is soldered into the circuit.

RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

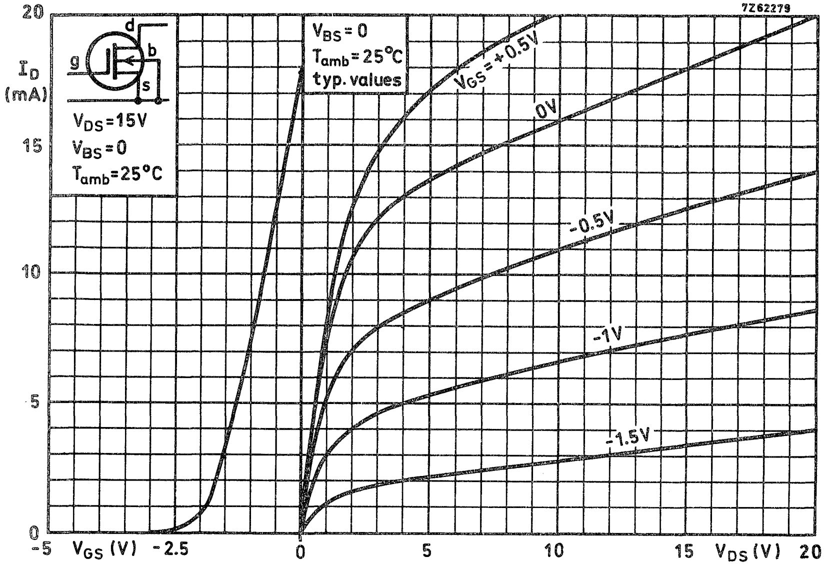
Drain-substrate voltage	V_{DB}	max.	30	V
Source-substrate voltage	V_{SB}	max.	30	V
Gate-substrate voltage (continuous)	$\pm V_{GB}$	max.	10	V
Repetitive peak gate to all other terminals voltage $V_{SB} = V_{DB} = 0$; $f > 100$ Hz	V_{G-N}	max. min.	15 −15	V V
Drain current (d.c.)	I_D	max.	20	mA
Drain current (peak value) $t_p = 20$ ms; $\delta = 0{,}1$	I_{DM}	max.	50	mA
Total power dissipation up to $T_{amb} = 25$ °C	P_{tot}	max.	200	mW
Storage temperature	T_{stg}	−65 to + 125		°C
Junction temperature	T_j	max.	125	°C

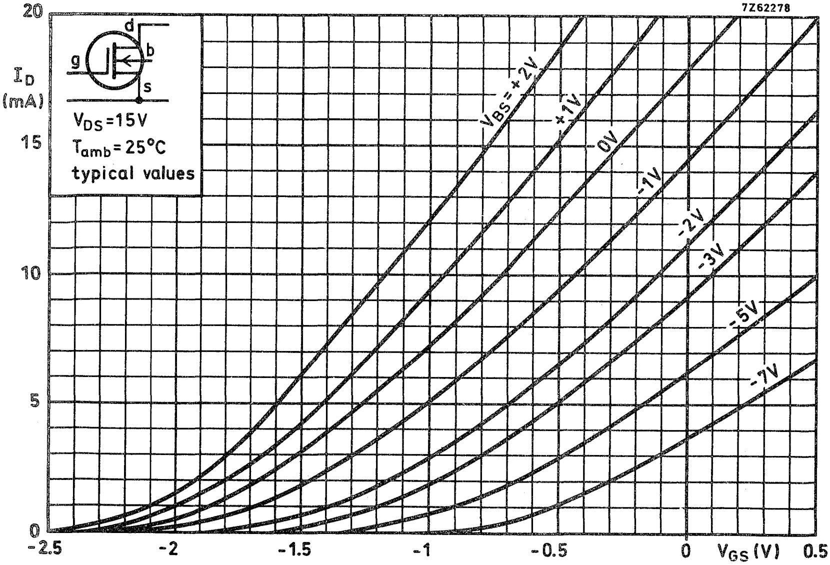
THERMAL RESISTANCE

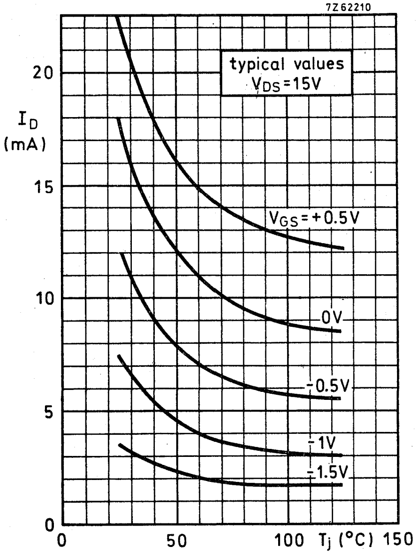
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	500	K/W

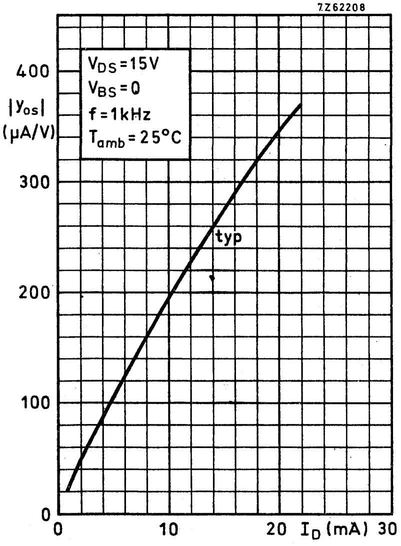
CHARACTERISTICS T_j = 25 °C unless otherwise specified

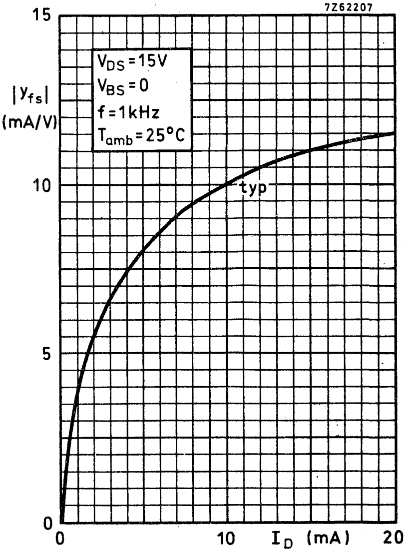
Gate currents; V_{BS} = 0				
$-V_{GS}$ = 10 V; V_{DS} = 0	$-I_{GSS}$	<	10	pA
V_{GS} = 10 V; V_{DS} = 0	I_{GSS}	<	10	pA
$-V_{GS}$ = 10 V; V_{DS} = 0; T_j = 125 °C	$-I_{GSS}$	<	200	pA
V_{GS} = 10 V; V_{DS} = 0; T_j = 125 °C	I_{GSS}	<	200	pA
Bulk currents; V_{GB} = 0				
$-V_{BD}$ = 30 V; I_S = 0	$-I_{BDO}$	<	10	µA
$-V_{BS}$ = 30 V; I_D = 0	$-I_{BSO}$	<	10	µA
Drain current				
V_{DS} = 15 V; V_{GS} = 0	I_{DSS}	10 to	40	mA
Gate-source voltage				
I_D = 100 nA; V_{DS} = 15 V	$-V_{GS}$	0.5 to	3.5	V
Gate-source cut-off voltage				
I_D = 100 nA ; V_{DS} = 15 V	$-V_{(P)GS}$	<	4	V
y parameters T_{amb} = 25 °C				
I_D = 5 mA; V_{DS} = 15 V				
Transfer admittance at f = 1 kHz	$\lvert y_{fs} \rvert$	>	6	mA/V
Output admittance at f = 1 kHz	$\lvert y_{os} \rvert$	<	0.4	mA/V
Input capacitance at f = 1 MHz	C_{is}	<	5	pF
Feedback capacitance at f = 1 MHz	C_{rs}	<	0.7	pF
Output capacitance at f = 1 MHz	C_{os}	<	3	pF
Noise figure at f = 200 MHz T_{amb} = 25 °C				
I_D = 5 mA; V_{DS} = 15 V				
G_S = 1 mΩ^{-1}; B_S = B_{Sopt}	F	<	5	dB
Equivalent noise voltage T_{amb} = 25 °C				
I_D = 5 mA; V_{DS} = 15 V; f = 120 Hz	$V_n/\sqrt{B}$	typ.	300	nV/$\sqrt{Hz}$
f = 1 kHz	$V_n/\sqrt{B}$	typ.	100	nV/$\sqrt{Hz}$
f = 10 kHz	$V_n/\sqrt{B}$	typ.	35	nV/$\sqrt{Hz}$

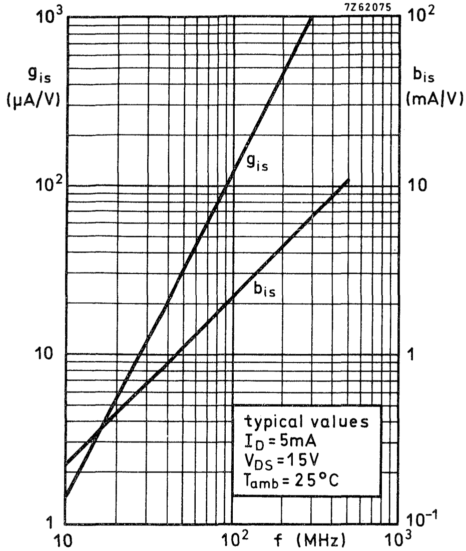

7Z62279
20
15
10
5
0
I_D (mA)
d
g
b
s
V_DS=15V
V_BS=0
T_amb=25°C
V_BS = 0
T_amb = 25°C
typ. values
V_GS = +0.5V
0V
-0.5V
-1V
-1.5V
-5
V_GS (V)
-2.5
0
5
10
15
V_DS (V)
20

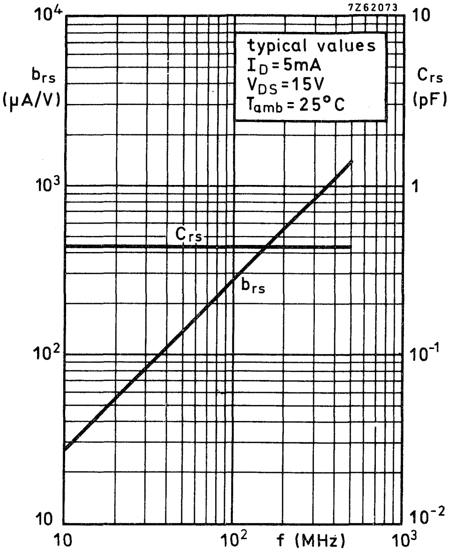

7Z62278
20
15
10
5
0
I_D (mA)
d
g
b
s
V_DS =15V
T_amb = 25°C
typical values
V_BS = +2V
+1V
0V
-1V
-2V
-3V
-5V
-7V
-2.5
-2
-1.5
-1
-0.5
0
V_GS (V)
0.5

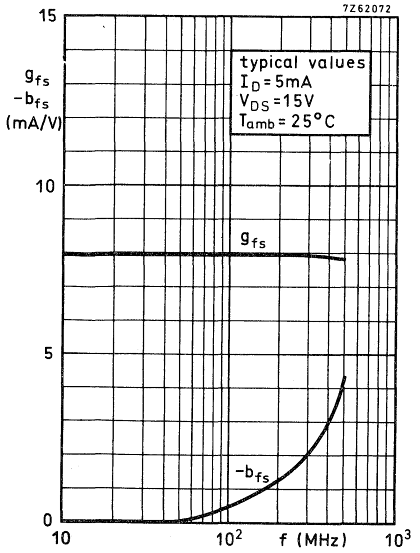

7Z62210
typical values
V_{DS}=15V
I_D (mA)
20
15
10
5
0
0
50
100
T_j (°C)
150
V_{GS}=+0.5V
0V
-0.5V
-1V
-1.5V

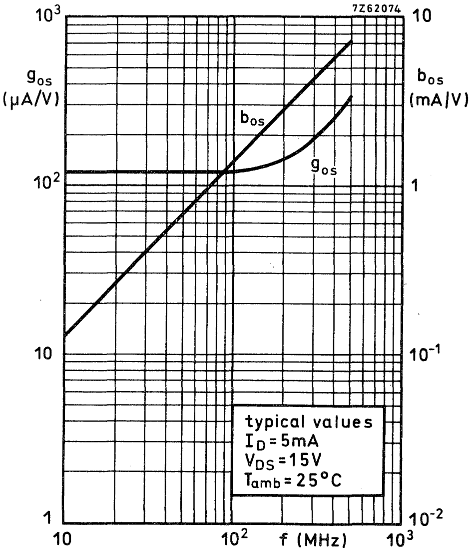

7Z62208
V_{DS}=15V
V_{BS}=0
f=1kHz
T_{amb}=25°C
$|y_{os}|$ (μA/V)
400
300
200
100
0
0
10
20
I_D (mA)
30
typ

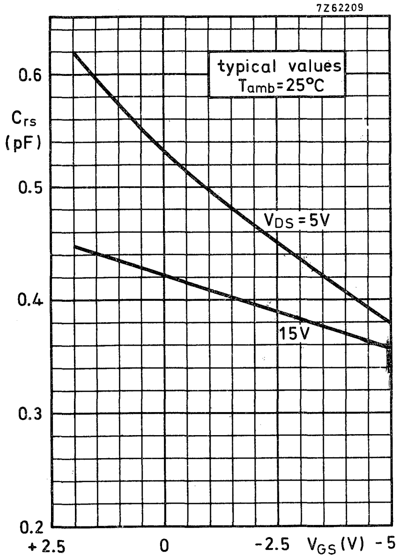

7Z62207
V_{DS}=15V
V_{BS}=0
f=1kHz
T_{amb}=25°C
$|y_{fs}|$ (mA/V)
15
10
5
0
0
10
I_D (mA)
20
typ

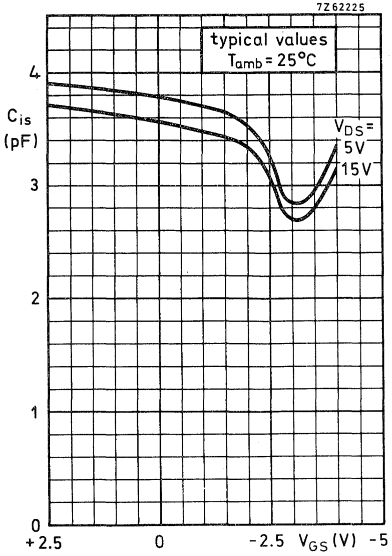

7Z62075
g_{is} (µA/V)
b_{is} (mA/V)
10^3
10^2
10
1
10^2
10
1
10^{-1}
g_{is}
b_{is}
typical values
$I_D = 5mA$
$V_{DS} = 15V$
$T_{amb} = 25°C$
10
10^2
f (MHz)
10^3


7Z62073
b_{rs} (µA/V)
C_{rs} (pF)
10^4
10^3
10^2
10
10
1
10^{-1}
10^{-2}
typical values
$I_D = 5mA$
$V_{DS} = 15V$
$T_{amb} = 25°C$
C_{rs}
b_{rs}
10
10^2
f (MHz)
10^3


7Z62072
g_{fs}
$-b_{fs}$
(mA/V)
15
10
5
0
typical values
$I_D = 5mA$
$V_{DS} = 15V$
$T_{amb} = 25°C$
g_{fs}
$-b_{fs}$
10
10^2
f (MHz)
10^3


7Z62074
g_{os} (µA/V)
b_{os} (mA/V)
10^3
10^2
10
1
10
1
10^{-1}
10^{-2}
b_{os}
g_{os}
typical values
$I_D = 5mA$
$V_{DS} = 15V$
$T_{amb} = 25°C$
10
10^2
f (MHz)
10^3


7Z62209
typical values
T_{amb} = 25°C
C_{rs}
(pF)
0.6
0.5
0.4
0.3
0.2
V_{DS} = 5V
15V
+2.5
0
-2.5
V_{GS} (V)
-5


7Z62225
typical values
T_{amb} = 25°C
C_{is}
(pF)
4
3
2
1
0
V_{DS} =
5V
15V
+2.5
0
-2.5
V_{GS} (V)
-5

SILICON N-CHANNEL DUAL IG-MOS-FET

Depletion type field-effect transistor in a TO-72 metal envelope with source and substrate connected to the case, intended for a wide range of v.h.f. applications, such as v.h.f. television tuners, f.m. tuners, as well as for applications in communication, instrumentation and control.

This MOS-FET tetrode is protected against excessive input voltage surges by integrated back-to-back diodes between gates and source.

The tetrode configuration, a series arrangement of two gate controlled channels, offers:
a) very low feedback capacitance providing the possibility of more than 40 dB gain control in r.f. amplifiers requiring negligible a.g.c. power.
b) excellent signal handling capability over the entire gain control range.
c) low noise figure combined with high gain.

QUICK REFERENCE DATA

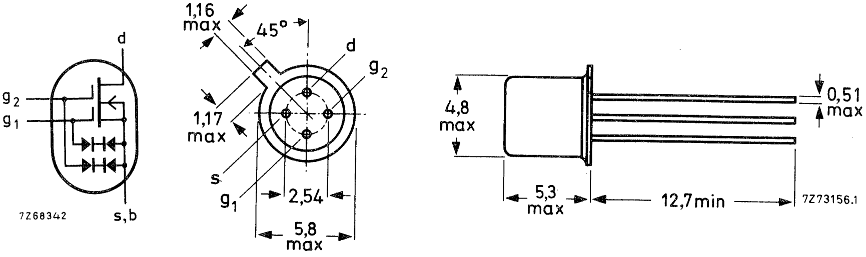
Drain-source voltage	V_{DS}	max.	20	V
Drain current	I_D	max.	50	mA
Total power dissipation up to $T_{amb} = 25\ ^oC$	P_{tot}	max.	300	mW
Junction temperature	T_j	max.	175	^oC
Transfer admittance at f = 1 kHz $I_D = 10$ mA; $V_{DS} = 10$ V; $+V_{G2-S} = 4$ V	$\lvert y_{fs} \rvert$	typ.	15	mA/V
Feedback capacitance at f = 1 MHz $I_D = 10$ mA; $V_{DS} = 10$ V; $+V_{G2-S} = 4$ V	C_{rs}	typ.	30	fF
Noise figure at optimum source admittance $I_D = 10$ mA; $V_{DS} = 10$ V; $+V_{G2-S} = 4$ V $G_S = 1{,}2$ mA/V; $-B_S = 5{,}7$ mA/V; f = 200 MHz	F	typ.	2,3	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-72.

Source and substrate connected to the case.



Accessories: 56246 (distance disc).

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC 134)

Voltage

Drain-source voltage	V_{DS}	max.	20	V

Currents

Drain current (d.c. or average)	I_D	max.	50	mA
Drain current (peak value)	I_{DM}	max.	100	mA
Gate 1-source current	$\pm I_{G1\text{-}S}$	max.	10	mA
Gate 2-source current	$\pm I_{G2\text{-}S}$	max.	10	mA

Power dissipation

Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	300	mW

Temperatures

Storage temperature	T_{stg}		−65 to +175	°C
Junction temperature	T_j	max.	175	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,5	°C/mW

STATIC CHARACTERISTICS

T_{amb} = 25 °C unless otherwise specified

Gate cut-off currents				
$\pm V_{G1-S} = 5$ V; $V_{G2-S} = V_{DS} = 0$	$\pm I_{G1-SS}$	<	10	nA
$\pm V_{G1-S} = 5$ V; $V_{G2-S} = V_{DS} = 0$; $T_j = 150$ °C	$\pm I_{G1-SS}$	<	10	µA
$\pm V_{G2-S} = 5$ V; $V_{G1-S} = V_{DS} = 0$	$\pm I_{G2-SS}$	<	10	nA
$\pm V_{G2-S} = 5$ V; $V_{G1-S} = V_{DS} = 0$; $T_j = 150$ °C	$\pm I_{G2-SS}$	<	10	µA
Gate-source breakdown voltages				
$\pm I_{G1-SS} = 0{,}1$ mA; $V_{G2-S} = V_{DS} = 0$	$\pm V_{(BR)G1-SS}$		6,0 to 20	V
$\pm I_{G2-SS} = 0{,}1$ mA; $V_{G1-S} = V_{DS} = 0$	$\pm V_{(BR)G2-SS}$		6,0 to 20	V
Drain current				
$V_{DS} = 10$ V; $V_{G1-S} = 0$; $+V_{G2-S} = 4$ V	I_{DSS}		20 to 55	mA [1]
Gate 1-source voltage				
$I_D = 10$ mA; $V_{DS} = 10$ V; $+V_{G2-S} = 4$ V	$-V_{G1-S}$		0,6 to 2,1	V
Gate-source cut-off voltages				
$I_D = 10$ µA ; $V_{DS} = 10$ V; $+V_{G2-S} = 4$ V	$-V_{(P)G1-S}$		1,5 to 3,8	V
$I_D = 10$ µA ; $V_{DS} = 10$ V; $V_{G1-S} = 0$	$-V_{(P)G2-S}$		1,5 to 3,4	V

---

[1] Measured under pulse conditions.

DYNAMIC CHARACTERISTICS

Measuring conditions (common source): I_D = 10 mA; V_{DS} = 10 V; $+V_{G2-S}$ = 4 V; T_{amb} = 25 °C

Transfer admittance at f = 1 kHz	$\|y_{fs}\|$	$>$ typ.	12 15	mA/V mA/V
Input capacitance at f = 1 MHz	C_{is}	typ.	5, 5	pF
Feedback capacitance at f = 1 MHz	C_{rs}	typ.	30	fF
Output capacitance at f = 1 MHz	C_{os}	typ.	3, 5	pF
Noise figure at optimum source admittance				
G_S = 0, 95 mA/V; $-B_S$ = 5, 0 mA/V; f = 100 MHz	F	typ.	1, 9	dB
G_S = 1, 20 mA/V; $-B_S$ = 5, 7 mA/V; f = 200 MHz	F	typ. $<$	2, 3 3, 0	dB dB
Cross modulation at f = 200 MHz				
Wanted signal at f_o = 197, 5 MHz Unwanted signal at f_{int} = 202, 5 MHz				
Interference voltage at g_1 for K = 1%	V_{int}	typ.	100	mV [1]

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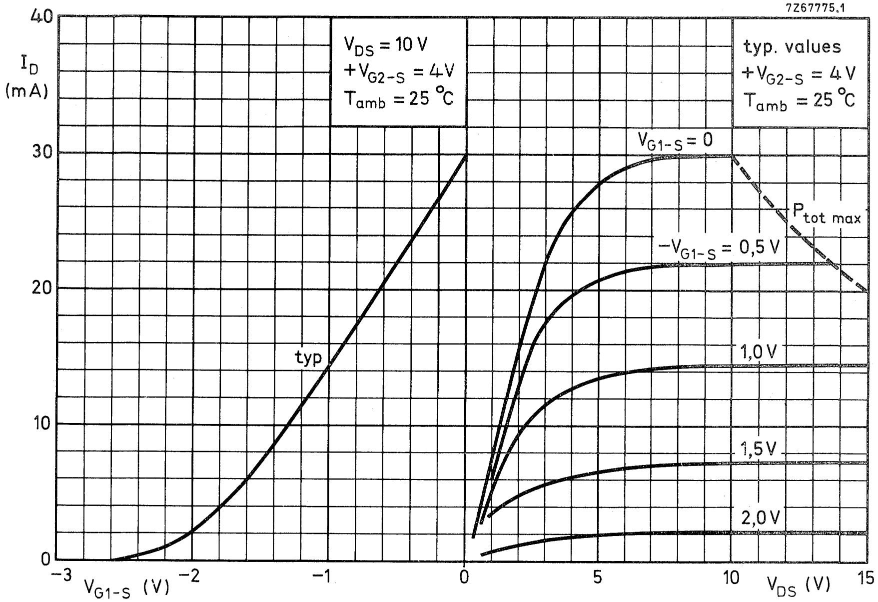
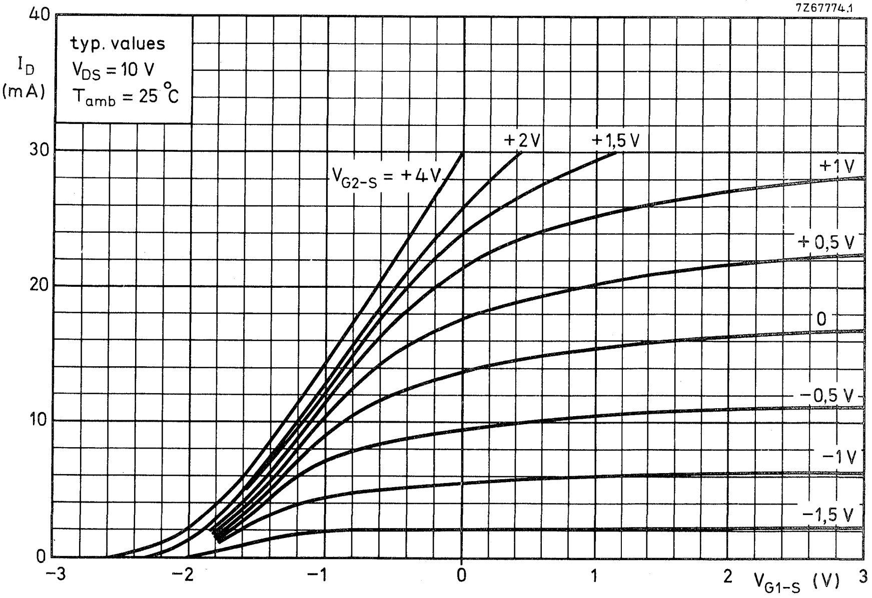
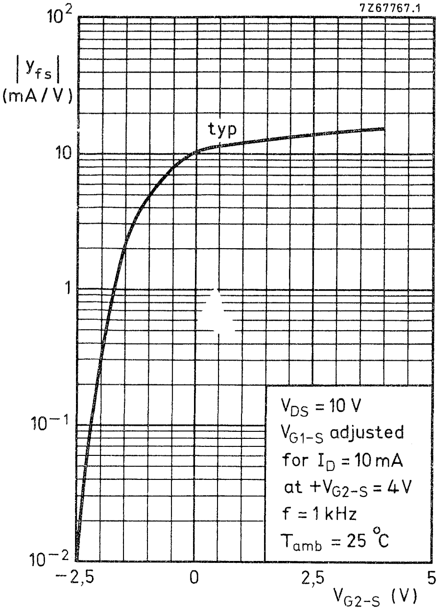
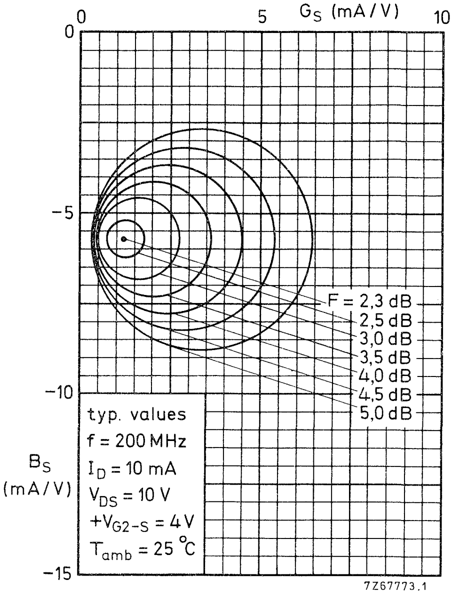
[1] Cross modulation is defined here as the voltage at g_1 of an unwanted signal with 80% modulation depth, giving 0, 8% modulation depth on the wanted signal (a. m. definition).


7Z67775.1
I_D (mA)
40
30
20
10
0
V_{DS} = 10 V
$+V_{G2-S}$ = 4 V
T_{amb} = 25 °C
typ
−3
V_{G1-S} (V)
−2
−1
0
typ. values
$+V_{G2-S}$ = 4 V
T_{amb} = 25 °C
V_{G1-S} = 0
$P_{tot\ max}$
$-V_{G1-S}$ = 0,5 V
1,0 V
1,5 V
2,0 V
5
10
V_{DS} (V)
15


7Z67774.1
I_D (mA)
40
30
20
10
0
typ. values
V_{DS} = 10 V
T_{amb} = 25 °C
V_{G2-S} = +4 V
+2 V
+1,5 V
+1 V
+0,5 V
0
−0,5 V
−1 V
−1,5 V
−3
−2
−1
0
1
2
V_{G1-S} (V)
3





circles of constant noise figure

N-CHANNEL IG-MOS-FET

Symmetrical depletion type field-effect transistor in a TO-72 metal envelope with the substrate connected to the case. It is intended for chopper and other special switching applications, e.g. timing circuits, multiplex circuits, etc. The features are a very low drain-source 'on' resistance, a very high drain-source 'off' resistance and low feedback capacitances.

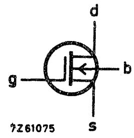
QUICK REFERENCE DATA

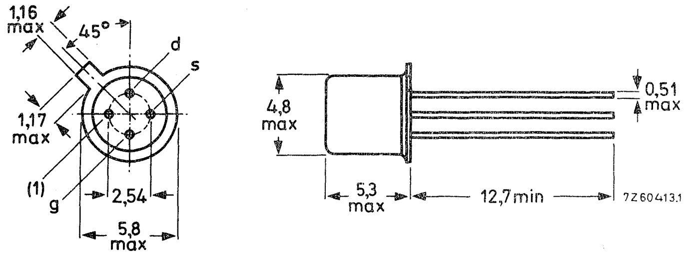
Drain-source resistance (on) at f = 1 kHz $V_{DS} = 0$; $V_{GS} = 5$ V; $V_{BS} = 0$	$r_{ds\ on}$	<	50 Ω
Drain-source resistance (off) $V_{DS} = 10$ V; $-V_{GS} = 5$ V; $V_{BS} = 0$	r_{DSoff}	>	10 GΩ
Feedback capacitance at f = 1 MHz $-V_{GS} = 5$ V; $V_{DS} = 0$; $I_B = 0$	C_{rs}	<	0,5 pF
$-V_{GD} = 5$ V; $V_{SD} = 0$; $I_B = 0$	C_{rd}	<	0,5 pF

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-72.





(1) = substrate connected to case.

Accessories: 56246 (distance disc).

Note

To safeguard the gates against damage due to accumulation of static charge during transport or handling, the leads are encircled by a ring of conductive rubber which should be removed just after the transistor is soldered into the circuit.

RATINGS Limiting values in accordance with the Absolute Maximum System (IEC134)

Voltages

Drain-substrate voltage	V_{DB}	max.	30	V
Source-substrate voltage	V_{SB}	max.	30	V
Gate-substrate voltage (continuous)	V_{GB}	max. min.	10 −10	V V
Repetitive peak gate to all other terminals voltage $V_{SB} = V_{DB} = 0$; $f > 100$ Hz	$V_{G\text{-}N}$	max. min.	15 −15	V V
Non-repetitive peak gate to all other terminals voltage $V_{SB} = V_{DB} = 0$; $t < 10$ ms	$V_{G\text{-}N}$	max. min.	50 −50	V V

Currents

Drain current (peak value) $t_r = 20$ ms; $\delta = 0,1$	I_{DM}	max.	50	mA
Source current (peak value) $t_r = 20$ ms; $\delta = 0,1$	I_{SM}	max.	50	mA

Power dissipation

Total power dissipation up to $T_{amb} = 25$ °C	P_{tot}	max.	200	mW

Temperatures

Storage temperature	T_{stg}	−65 to	+125	°C
Junction temperature	T_j	max.	125	°C

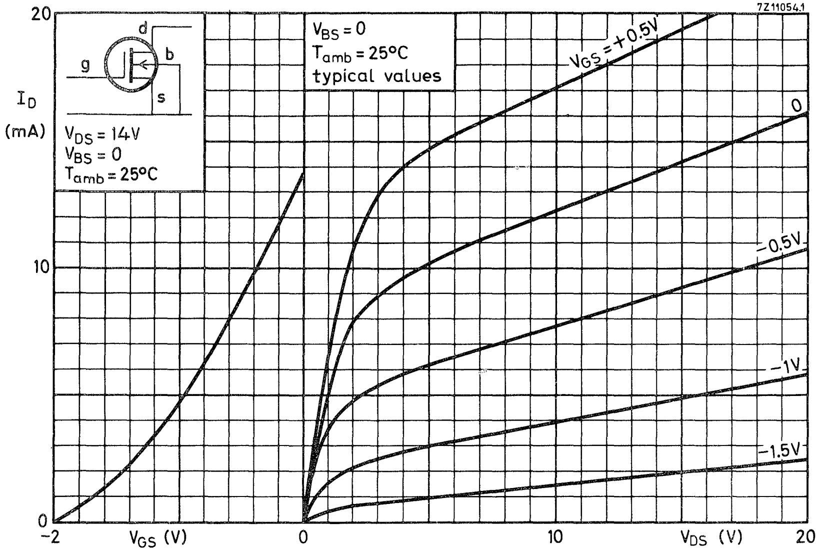
THERMAL RESISTANCE

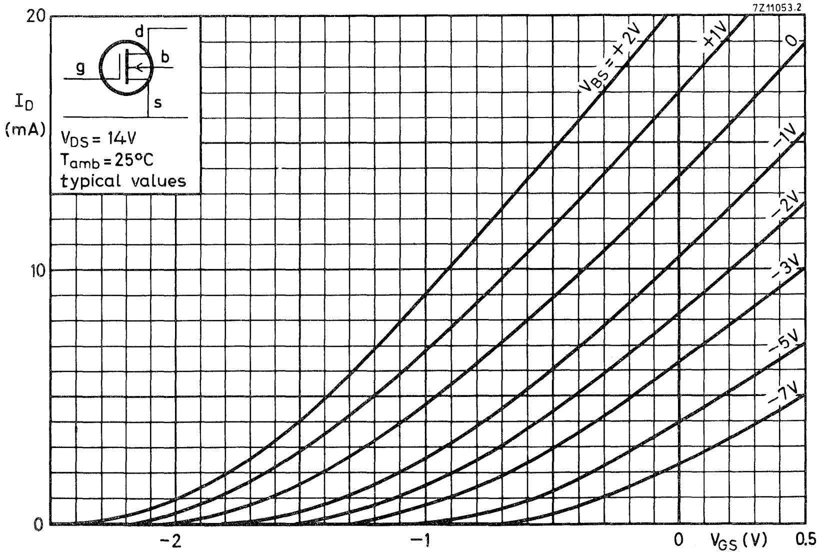
From junction to ambient in free air	$R_{th\ j\text{-}a}$	=	0,5	°C/mW

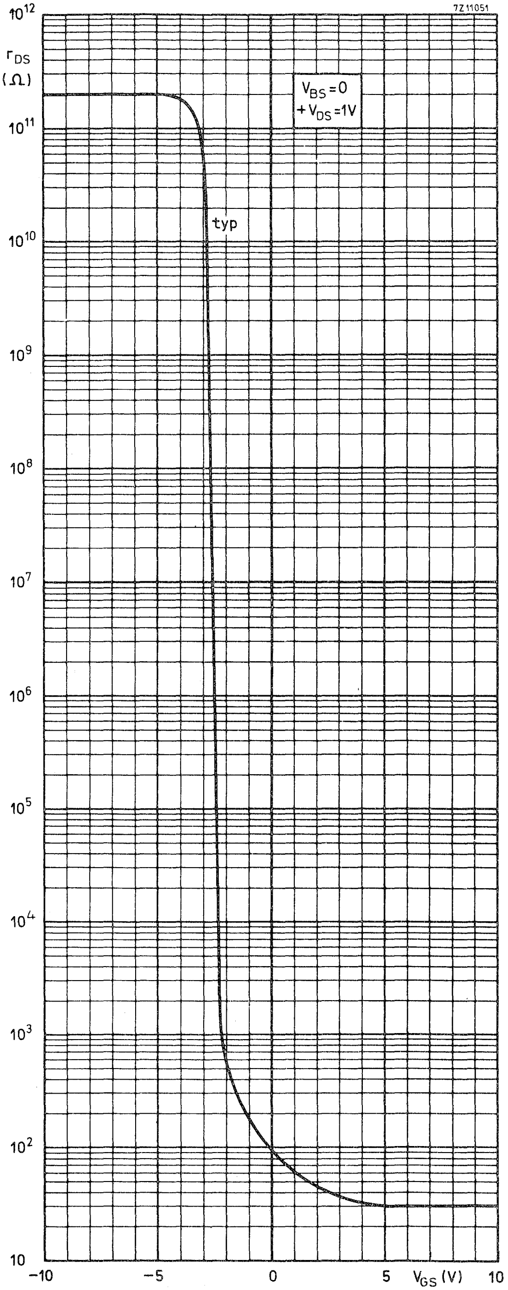
CHARACTERISTICS

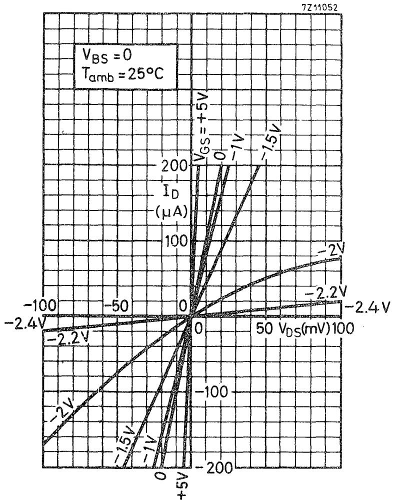
T_j = 25 °C unless otherwise specified

Drain cut-off currents; $V_{BS} = 0$				
$V_{DS} = 10$ V; $-V_{GS} = 5$ V	I_{DSX}	<	1	nA
$V_{DS} = 10$ V; $-V_{GS} = 5$ V; $T_j = 125$ °C	I_{DSX}	<	1	µA
Source cut-off currents; $V_{BD} = 0$				
$V_{SD} = 10$ V; $-V_{GD} = 5$ V	I_{SDX}	<	1	nA
$V_{SD} = 10$ V; $-V_{GD} = 5$ V; $T_j = 125$ °C	I_{SDX}	<	1	µA
Gate currents; $V_{BS} = 0$				
$-V_{GS} = 10$ V; $V_{DS} = 0$	$-I_{GSS}$	<	10	pA
$V_{GS} = 10$ V; $V_{DS} = 0$	I_{GSS}	<	10	pA
$-V_{GS} = 10$ V; $V_{DS} = 0$; $T_j = 125$ °C	$-I_{GSS}$	<	200	pA
$V_{GS} = 10$ V; $V_{DS} = 0$; $T_j = 125$ °C	I_{GSS}	<	200	pA
Bulk currents; $V_{GB} = 0$				
$-V_{BD} = 30$ V; $I_S = 0$	$-I_{BDO}$	<	10	µA
$-V_{BS} = 30$ V; $I_D = 0$	$-I_{BSO}$	<	10	µA
Drain-source resistance (on) at f = 1 kHz; $V_{BS} = 0$				
$V_{GS} = 0$; $V_{DS} = 0$	$r_{ds on}$	<	100	Ω
$V_{GS} = 0$; $V_{DS} = 0$; $T_j = 125$ °C	$r_{ds on}$	<	150	Ω
$+V_{GS} = 5$ V; $V_{DS} = 0$	$r_{ds on}$	<	50	Ω
Drain-source resistance (off)				
$-V_{GS} = 5$ V; $V_{DS} = 10$ V; $V_{BS} = 0$	r_{DSoff}	>	10	GΩ
Feedback capacitances at f = 1 MHz				
$-V_{GS} = 5$ V; $V_{DS} = 0$; $I_B = 0$	C_{rs}	<	0,5	pF
$-V_{GD} = 5$ V; $V_{SD} = 0$; $I_B = 0$	C_{rd}	<	0,5	pF
Gate to all other terminals capacitance at f = 1 MHz				
$-V_{GB} = 5$ V; $V_{SB} = V_{DB} = 0$	C_{g-n}	<	6	pF


7Z11054.1
I_D (mA)
20
10
0
-2
V_GS (V)
0
10
V_DS (V)
20
d
b
g
s
V_DS = 14V
V_BS = 0
T_amb = 25°C
V_BS = 0
T_amb = 25°C
typical values
V_GS = +0.5V
0
-0.5V
-1V
-1.5V


7Z11053.2
I_D (mA)
20
10
0
-2
-1
0
V_GS (V)
0.5
d
b
g
s
V_DS = 14V
T_amb = 25°C
typical values
V_BS = +2V
+1V
0
-1V
-2V
-3V
-5V
-7V


7Z11051
10^{12}
r_{DS}
(Ω)
10^{11}
10^{10}
10^9
10^8
10^7
10^6
10^5
10^4
10^3
10^2
10
$V_{BS} = 0$
$+V_{DS} = 1V$
typ
−10
−5
0
5
V_{GS} (V)
10


7Z11052
$V_{BS} = 0$
$T_{amb} = 25°C$
$V_{GS} = +5V$
0
−1V
−1.5V
200
I_D
(μA)
100
−2V
−2.2V
−2.4V
−100
−50
0
0
50
V_{DS}(mV)
100
−2.4V
−2.2V
−100
−2V
−1.5V
−1V
0
+5V
−200

SOLDERING RECOMMENDATIONS SOT-37
SOLDERING RECOMMENDATIONS SOT-103
ACCESSORIES

SOLDERING RECOMMENDATIONS SOT-37

Transistors in SOT-37 envelopes may be mounted with leads flat (Fig. 1) or bent (Figs 2 and 3). Different soldering procedures apply for the different styles of mounting.

FLAT-LEAD MOUNTING

Soldering by hand

Avoid putting any force on the leads during or just after soldering.

Solder the three leads one at a time, *not* simultaneously.

Proceed from one lead to the adjacent lead, *not* to the opposite one.

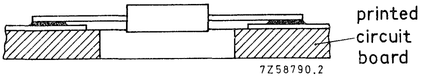


Fig. 1

Solder temperature	max.	300 °C
Soldering time	max.	5 s
Solder-to-case distance	min.	2 mm

BENT-LEAD MOUNTING

If leads are bent, all three may be soldered simultaneously if desired.

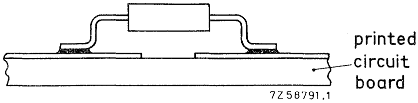


Fig. 2

Solder temperature	max.	300 °C
Soldering time	max.	10 s

DIP OR WAVE SOLDERING

When dip or wave soldering, the maximum allowable temperature of the solder is 260 °C. This temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds. The device may be mounted up to the lead projections, but the temperature of the body must not exceed the specified storage maximum.

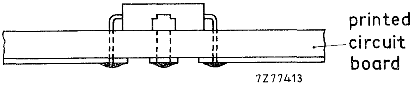


Fig. 3

Solder temperature	max.	260 °C
Soldering time	max.	5 s

SOLDERING RECOMMENDATIONS SOT-103

Transistors in SOT-103 envelopes may be mounted with leads flat (Fig. 1) or bent (Figs 2 and 3). Different soldering procedures apply for the different styles of mounting.

FLAT-LEAD MOUNTING

Soldering by hand

Avoid putting any force on the leads during or just after soldering.

Solder the four leads one at a time, *not* simultaneously.

Proceed from one lead to the adjacent lead, *not* to the opposite one.

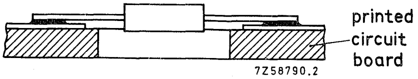


Fig. 1

Solder temperature	max.	300	°C
Soldering time	max.	5	s
Solder-to-case distance	min.	2	mm

BENT-LEAD MOUNTING

If leads are bent, all four may be soldered simultaneously if desired.

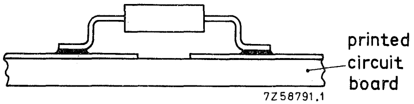


Fig. 2

Solder temperature	max.	300	°C
Soldering time	max.	10	s

DIP OR WAVE SOLDERING

When dip or wave soldering, the maximum allowable temperature of the solder is 260 °C. This temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds. The device may be mounted up to the lead projections, but the temperature of the body must not exceed the specified storage maximum.

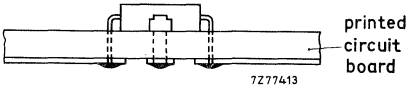


Fig. 3

Solder temperature	max.	260	°C
Soldering time	max.	5	s

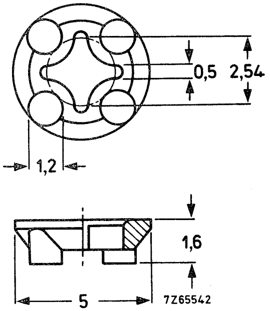
DISTANCE DISC

MECHANICAL DATA

Dimensions in mm

Fig. 2 **56246** for **TO-18** or **TO-72**

Insulating material.



TEMPERATURE

Maximum permissible temperature	T	max. 100 °C

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