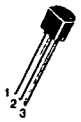
Small-Signal Bipolar Transistors



CASE 29-04
TO-226AA
(TO-92)

CASE 29 03
TO-226AE
(1 WATT TO 92)

Plastic-Encapsulated

Motorola's small-signal TO-226 plastic transistors encompass hundreds of devices with a wide variety of characteristics for general purpose, amplifier and switching applications. The popular high-volume package combines proven reliability, performance, economy and convenience to provide the perfect solution for industrial and consumer design problems. All devices are laser marked for ease of identification and shipped in antistatic containers, as part of Motorola's ongoing practice of maintaining the highest standards of quality and reliability.

Table 1. General-Purpose Transistors

The general-purpose transistors are designed for small-signal amplification from dc to low radio frequencies. They are also useful as oscillators and general purpose switches.

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts Min	f_T @ I_C MHz Min	mA	I_C mA Max	h_{FE} @ I_C Min	Max	mA	NF Max dB
TO-226AA (TO-92)										
BC546	BC556	CBE	65	150	10	100	120	450	2.0	10
BC546A	BC556A	CBE	65	150	10	100	120	220	2.0	10
BC546B	BC556B	CBE	65	150	10	100	180	450	2.0	10
MPS8098	MPS8598	EBC	60	150	10	200	100	300	1.0	—
MPSA05	MPSA55	EBC	60	100	10	500	50	—	100	—
MPS651	MPS751	EBC	60	75	50	2000	40	—	2000	—
BC182	BC212	CBE	50	200	10	100	120	460	2.0	10
MPS5209		EBC	50	30	0.5	50	100	300	0.1	3.0
MPS5210		EBC	50	30	0.5	50	200	600	0.1	2.0
BC237	BC307	CBE	45	150	10	100	120	460	2.0	10
BC547	BC557	CBE	45	150	10	100	120	450	2.0	10
BC547A	BC557A	CBE	45	150	10	100	120	220	2.0	10
BC547B	BC557B	CBE	45	150	10	100	180	450	2.0	10
BC547C	BC557C	CBE	45	150	10	100	380	800	2.0	10
BC317	BC320	CBE	45	250	10	150	110	450	2.0	10
MPSA20	MPSA70	EBC	40	125	5.0	100	40	400	5.0	—
MPS6531	MPS6534	EBC	40	390*	50	600	10	120	100	—
MPS2222	MPS2907	EBC	30	250	20	600	100	300	150	—
MPS3703	MPS3705	EBC	30	100	50	600	30	150	50	—
MPS3704	MPS3702	EBC	30	100	50	600	100	300	50	—
MPS6513	MPS6517	EBC	30	330*	10	100	90	180	2.0	—
BC548	BC558	CBE	30	300*	10	100	120	300	2.0	10
BC548A	BC558A	CBE	30	300*	10	100	120	220	2.0	10
BC548B	BC558B	CBE	30	300*	10	100	180	450	2.0	10
BC548C	BC558C	CBE	30	300	10	100	380	800	2.0	10
	2N5227	EBC	30	100	10	50	50	700	2.0	—
	2N5226	EBC	25	50	20	500	30	600	50	—
MPS6514	MPS6518	EBC	25	480*	10	100	150	300	2.0	—
MPS6515	MPS6519	EBC	25	480	10	100	250	500	2.0	—
MPS5172		EBC	25	120*	5.0	100	100	500	10	—
MPS6560	MPS6562	EBC	25	60	10	500	50	200	600	—
MPS6601	MPS6651	EBC	25	100	50	1000	30	150	1000	—
BC238	BC308	CBE	25	150	10	100	120	800	2.0	10
MPS5222		EBC	15	450	4.0	50	20	150	4.0	—
MPS5223		EBC	20	150	10	100	50	800	2.0	—

Table 2. Low-Noise and Good h_{FE} Linearity

These devices are designed to use on applications where good h_{FE} linearity and low noise characteristics are required: Instrumentation, Hi-Fi Preamplifier.

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts	h_{FE} Min	h_{FE} Max	@ I_C mA	V_T[1] mV Typ	NF[2] dB Max	f_T Typ MHz
TO-226AA (TO-92)									
—	MPS4249	EBC	60	100	—	10	—	3.0	100
—	2N5087	EBC	60	250	—	10	—	2.0	40
—	MPS4250A	EBC	60	250	—	10	—	2.0	250
—	2N5086	EBC	50	150	—	10	—	3.0	40
2N6428	—	EBC	50	250	650	0.1	3.0**	3.5***	100†
2N6428A	—	EBC	50	250	650	0.1	2.0**	3.0***	100†
BC239	BC309	CBE	45	120	800	2.0	9.5	2.0	240
BC414	BC416	CBE	45	180	800	2.0	8.0	2.5	250
BC550	BC560	CBE	45	180	800	2.0	8.0	2.5	250
BC550B	BC560B	CBE	45	180	460	2.0	8.0	2.5	250
BC550C	BC560C	CBE	45	380	800	2.0	8.0	2.5	250
BC651	—	EBC	45	380	1400	2.0	—	—	300
MPSA18	—	EBC	45	500	—	2.0	7.0	—	160
MPS3904	MPS3906	EBC	40	100	300	10	—	5.0	200
—	MPS4250	EBC	40	250	—	10	—	2.0	250
BC413	BC415	CBE	30	180	800	2.0	8.0	2.5	250
BC549	BC559	CBE	30	180	800	2.0	8.0	2.5	250
BC549B	BC559B	CBE	30	180	800	2.0	8.0	2.5	250
BC459C	BC459C	CBE	30	380	800	2.0	8.0	2.5	250
BC650	—	EBC	30	380	1400	2.0	—	—	300
2N4123	2N4125	EBC	30	50	150	2.0	—	6.0	300
2N5088	—	EBC	30	350	—	2.0	—	3.0	150
2N4124	2N4126	EBC	25	120	360	2.0	—	5.0	350
2N5089	—	EBC	25	450	—	2.0	—	2.0	150
—	MPS6523	EBC	25	300	—	2.0	—	3.0	340*

[1] V_T: Total Input Noise Voltage (see BC413 BC414 and BC415.BC416 Data Sheets) at R_S = 2.0 kΩ, I_C = 200 μA, V_{CE} = 5.0 Volts.
[2] N_F: Noise Figure at R_S = 2.0 k, I_C = 200 μA, V_{CE} = 5.0 Volts, f = 30 Hz to 15 kHz.
* "S" version.
** R_S = 10 kΩ, BW = 1.0 Hz, f = 100 MHz
*** R_S = 500 Ω, BW = 1.0 Hz, f = 10 MHz
† Min

Table 3. Darlington Transistors

Darlington amplifiers are cascade transistors used in applications requiring very high gain and input impedance. These devices have monolithic construction.

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts	I_C Max	h_{FE} Min	h_{FE} Max	I_C mA	Volts Max	$V_{CE(sat)}$ I_C mA	I_B mA	f_T Min	I_C
TO-226AA (TO-92)												
MPSA29	—	EBC	100	500	10K	—	100	1.4	100	0.1	125	10
BC372	—	EBC	100	1000	25K	160K	100	1.0	250	0.25	100	100
MPSA28	—	EBC	80	500	10K	—	100	1.4	100	0.1	125	10
BC373	—	EBC	80	1000	25K	160K	100	1.0	250	0.25	100	100
MPSA27	MPSA77	EBC	60	500	10K	—	100	1.5	100	0.1	125	10
BC618	—	CBE	55	1000	10K	50K	200	1.1	200	0.2	150	500
MPSA26	—	EBC	50	500	10K	—	100	1.5	100	0.1	125	10
MPSA25	MPSA75	EBC	40	500	10K	—	100	1.5	100	0.1	125	10
BC617	—	CBE	40	1000	20K	70K	200	1.1	200	0.2	150	500
2N6427	—	EBC	40	500	20K	200K	100	1.5	500	0.5	125	10
2N6426	—	EBC	40	500	30K	300K	100	1.5	500	0.5	125	10
MPSA14	MPSA64	EBC	30	500	20K	—	100	1.5	100	0.1	125	10
MPSA13	MPSA63	EBC	30	500	10K	—	100	1.5	100	0.1	125	10
BC517	—	CBE	30	400	30K	—	20	1.0	100	0.1	125	10
MPSA12	MPSA62	EBC	20	500	20K	—	10	1.0	10	0.01	125	10
TO-226AE (1 WATT TO-92)												
MPSW45	—	EBC	40	1000	25K	—	200	1.5	1000	2.0	100	200
MPSW14	MPSW64	EBC	30	1000	20K	—	100	1.5	100	0.1	125	10
MPSW13	MPSW63	EBC	30	1000	10K	—	100	1.5	100	0.1	125	10

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Table 4. High-Current Transistors

TO-226AA (TO-92) — P_D = 625 mW

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts	P_D mW 25°C Amb	I_C (mA) Cont	h_{FE} Min	h_{FE} Max	@ I_C mA	V_{CE} (Volts)	f_T Typical (MHz)
BC337	BC327	CBE	45	625	800	100	600	100	1.0	210
BC338	BC328	CBE	25	625	800	100	600	100	1.0	210
BC445	BC446	CBE	60	625	300	70	—	10	5.0	250/200[1]
BC447	BC448	CBE	80	625	300	70	—	10	5.0	250/200[1]
BC449	BC450	CBE	100	625	300	70	—	10	5.0	250/200[1]
BC485	BC486	CBE	45	625	1000	60	400	100	2.0	200/150[1]
BC487	BC488	CBE	60	625	1000	60	400	100	2.0	200/150[1]
BC489	BC490	CBE	80	625	1000	60	400	100	2.0	200/150[1]
MPSA05	MPSA55	EBC	60	625	500	50	—	100	1.0	150/175[1]
MPSA06	MPSA56	EBC	80	625	500	50	—	100	1.0	150/175[1]
MPS8099	MPS8599	EBC	80	625	500	75	—	100	5.0	200[1]
2N4409	—	EBC	50	625	250	60	400	10	1.0	200
2N4410	—	EBC	80	625	250	60	400	10	1.0	200
MPS650	MPS750	EBC	40	625	2000	75	—	1000	2.0	100
MPS651	MPS751	EBC	60	625	2000	75	—	1000	2.0	100
MPS8098	MPS8508	EBC	60	625	500	75	—	100	5.0	150

[1]Relevant to PNP.

TO-226AA (TO-92) — P_D = 800 mW

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts Min	I_C Amp Cont	h_{FE} @ I_C Min	mA	$V_{CE(sat)}$ Volts @ I_C Max	mA	@ I_B mA	f_T MHz @ I_C Min	mA
BF420	BF421	ECB	300	0.1	40	25	2.0	20	2.0	60	10
BF422	BF423	ECB	250	0.1	50	25	2.0	20	2.0	60	10
BC639	BC640	ECB	80	1.0	40	150	0.5	500	50	60	10
BC637	BC639	ECB	60	1.0	40	150	0.5	500	50	60	10
BC635	BC636	ECB	45	1.0	40	150	0.5	500	50	60	10
BC368	BC369	ECB	20	1.0	60	1000	0.5	1000	100	65	10

TO-226AE (TO-92) — P_D = 1 W

NPN	PNP	Pin Out	$V_{(BR)CEO}$ Volts Min	MHz f_T Min	@ I_C mA	I_C Max A	h_{FE} Min	h_{FE} Max	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	@ I_B mA
BDB01D	BDB02D	EBC	100	50	200	1.5	40	400	100	0.7	1000	100
BDC01D	BDC02D	ECB	100	50	200	1.5	40	400	100	0.7	1000	100
BDB01C	BDB02C	EBC	80	50	200	1.5	40	400	100	0.7	1000	100
BDC01C	BDC02C	ECB	80	50	200	1.5	40	400	100	0.7	1000	100
MPS6717	MPS6729	EBC	80	50	200	0.5	80	—	50	0.5	250	10
MPSW06	MPSW56	EBC	80	50	200	0.5	50	—	50	0.4	250	10
BDB01B	BDB02B	EBC	60	50	200	1.5	40	400	100	0.7	1000	100
BDC01B	BDC02B	ECB	60	50	200	1.5	40	400	100	0.7	1000	100
MPSW05	MPS6728	EBC	60	50	200	0.5	80	—	50	0.4	250	10
MPS6716	MPSW55	EBC	60	50	200	0.5	80	—	50	0.5	250	10
BDB01A	BDB02A	EBC	45	50	200	1.5	40	400	100	0.7	1000	100
BDC01A	BDC02A	ECB	45	50	200	1.5	40	400	100	0.7	1000	100
MPS6715	MPS6727	EBC	40	50	50	1.0	50	—	1000	0.5	1000	100
MPSW01A	MPSW51A	EBC	40	50	50	1.0	50	—	1000	0.5	1000	100
MPS6714	MPS6726	EBC	30	50	50	1.0	50	—	1000	0.5	1000	100
MPSW01	MPSW51	EBC	30	50	50	1.0	50	—	1000	0.5	1000	100

Table 5. High-Voltage Amplifier Transistors

These high-voltage transistors are designed for driving neon bulbs and Nixie* indicator tubes, for direct line operation, and for other applications requiring high-voltage capability at relatively low collector current. These devices are listed in order of decreasing breakdown voltage ($V_{(BR)CEO}$).

NPN Transistors

Device Type	Pin Out	$V_{(BR)CEO}$ Volts Min	I_C Amp Max	h_{FE} @ I_C Min	mA	V_F Volts @ I_C & I_B Max	mA	mA	f_T MHz @ I_C Min	mA
TO-226AA (TO-92)										
BF844	EBC	400	0.5	40	30	0.5	10	1.0	50	10
MPSA44	EBC	400	0.3	40	100	0.75	50	5.0	20	10
BF845	EBC	350	0.5	40	30	0.5	10	1.0	50	10
MPSA45	EBC	350	0.3	50	100	0.75	50	5.0	20	10
2N6516	EBC	350	0.5	30	30	0.2	10	1.0	40	10
BF393	EBC	300	0.5	40	10	0.2	20	2.0	50	10
MPSA42	EBC	300	0.5	40	30	0.5	20	2.0	50	10
2N6517	EBC	300	0.5	45	30	0.3	10	1.0	40	10
BF392	EBC	250	0.5	40	10	0.2	20	2.0	50	10
2N6515	EBC	250	0.5	50	30	0.3	10	1.0	40	10
BF391	EBC	200	0.5	40	10	0.2	20	2.0	50	10
MPSA43	EBC	200	0.5	40	10	0.4	20	2.0	50	10
2N5551	EBC	160	0.6	80	10	0.15	10	1.0	100	10
2N5550	EBC	140	0.6	60	10	0.15	10	1.0	100	10
MPSL01	EBC	100	0.15	20	30	0.2	10	1.0	40	10
TO-226AE (1 WATT TO-92)										
BDC05	ECB	300	0.5	40	25	2.0	20	2.0	60	10
MPS6735	EBC	300	0.3	40	10	2.0	20	2.0	50	10
MPSW10	EBC	300	0.3	40	30	0.75	30	3.0	45	10
MPSW42	EBC	300	0.3	40	30	0.5	20	2.0	50	10
BDC07	ECB	250	0.5	200	50	2.0	20	2.0	60	10
MPS6734	EBC	250	0.3	40	10	2.0	20	2.0	50	10
MPSW43	EBC	200	0.3	50	30	0.4	20	2.0	50	10
MPS6733	EBC	200	0.3	40	10	2.0	20	2.0	50	10

PNP Transistors

TO-226AA (TO-92)										
BF493S	EBC	350	0.5	40	10	20	20	2.0	50	10
2N6520	EBC	350	0.5	30	30	3.0	10	1.0	40	10
BF493	EBC	350	0.5	40	10	0.2	20	2.0	50	10
MPSA92	EBC	300	0.5	40	10	0.5	20	2.0	50	10
2N6519	EBC	300	0.5	45	30	0.3	10	1.0	40	10
BF492	EBC	250	0.5	40	10	0.2	20	2.0	50	10
BF491	EBC	200	0.5	40	10	0.2	20	2.0	50	10
MPSA93	EBC	200	0.5	40	10	0.4	20	2.0	50	10
2N5401	EBC	150	0.6	60	10	0.2	10	1.0	100	10
2N5400	EBC	120	0.6	40	10	0.2	10	1.0	100	10
MPSL51	EBC	100	0.5	40	50	0.25	10	1.0	50	10
TO-226AE (1 WATT TO-92)										
BDC06	ECB	300	0.5	40	25	2.0	20	2.0	60	10
MPSW92	EBC	300	0.3	25	30	0.5	20	2.0	50	10
BDC08	ECB	250	0.5	40	25	2.0	20	2.0	60	10
MPSW93	EBC	200	0.3	25	30	0.5	20	2.0	50	10

Table 6. RF Transistors

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The RF transistors are designed for Small Signal amplification from RF to VHF/UHF frequencies. They are also used as mixers and oscillators in the same frequency ranges. Several types are AGC characterized.

Device Type	Pin Out	$V_{(BR)CEO}$ Volts Min	I_C Max mA	h_{FE} Min	I_C mA	V_{CE} V	f_T Typ MHz	CRE/CRB pF Max	NF Typ dB	f MHz
NPN — TO-226AA (TO-92)										
BF373	BEC	45	100	38	7.0	10	720	0.32	—	—
BF241	CEB	40	25	35	1.0	10	470	0.34	2.5	100
BF240	CEB	40	25	65	1.0	10	600	0.34	2.5	100
BF224	CEB	30	50	30	7.0	10	600	0.28	2.5	100
MPSH32	BEC	30	30	27	4.0	5.0	300*	—	3.3*	45
MPSH24	BEC	30	100	30	8.0	10	400*	0.36	—	—
MPSH20	BEC	30	100	25	4.0	10	400*	—	—	—
MPSH07	EBC	30	25	20	3.0	10	400*	0.3	—	—
MPS3866	EBC	30	400	10	50	5.0	500*	—	—	—
BF371	BEC	30	100	38	7.0	10	720	0.23	—	—
MPSH11	BEC	25	25	60	4.0	10	660*	—	—	—
MPSH10	BEC	25	100	60	4.0	10	1500	0.7	—	—
BF375	BEC	25	100	35	1.0	10	800	0.6	4.0	100
BF374	BEC	25	100	70	1.0	10	800	0.6	4.0	100
BF199	CEB	25	100	40	7.0	10	750	0.35	2.5	35
MPSH30	BEC	20	50	20	4.0	5.0	300*	—	6.0*	100
BF959	CEB	20	100	40	20	10	800	0.65	3.0	200
BF254	CEB	20	100	65	1.0	10	260	0.9	1.7	1.0
MPSH17	BEC	15	100	25	5.0	10	1600	0.9	6.0*	200
MPS918	EBC	15	50	20	8.0	10	800	1.7	6.0*	60
MPS5179	EBC	12	50	25	3.0	1.0	2000	—	4.5*	200
MPS3563	EBC	12	50	20	8.0	10	800	1.7	6.0*	60
MPSH04	EBC	10	30	30	1.5	10	80*	—	2.0*	1.0
PNP — TO-226AA (TO-92)										
MPSH55	BEC	80	100	30	1.5	10	80	—	—	—
BF506	CBE	35	50	20	3.0	10	600	0.25	4.0	200
2N5208	BEC	25	50	20	2.0	10	300*	—	3.0*	100
MPSH81	BEC	20	50	60	5.0	10	700	0.85	—	—

*Max

Table 7. High-Speed Saturated Switching Transistors

The transistors listed in this table are specially optimized for high-speed saturated switches. They are heavily gold doped and processed to provide very short switching times and low output capacitance (below 6 pF). The transistors are listed in order of decreasing turn-on time (t_{on}).

Device Type	t_{on} ns Max	& t_{off} ns Max	@ I_C mA	$V_{(BR)CEO}$ Volts Min	h_{FE} @ I_C Min	mA	$V_{CE(sat)}$ Volts @ I_C Max	mA & I_B mA		f_T MHz @ I_C Min	mA
NPN — TO-226AA (TO-92)											
2N3904	70	250	10	40	100	10	0.2	10	1.0	300	10
2N3903	70	225	10	40	50	10	0.2	10	1.0	250	10
2N4401	35	225	10	40	40	10	0.4	10	1.0	250	20
2N4400	35	255	150	40	50	150	0.4	150	15	200	20
2N4264	25	35	10	15	40	10	0.22	10	1.0	300	10
2N4265	25	35	10	12	100	10	0.22	10	1.0	300	10
MPS3646	18	28	300	15	30	30	0.2	30	3.0	350	30
MPS2369	12	18	10	15	40	10	0.25	10	1.0	500	10
PNP — TO-226AA (TO-92)											
2N3638	75	170	300	25	20	300	0.25	50	2.5	100	50
2N3638A	75	170	300	25	20	300	0.25	50	2.5	150	50
2N3906	70	250	10	40	100	10	0.25	10	1.0	250	10
2N3905	70	225	10	40	100	10	0.25	10	1.0	200	10
2N4402	35	255	150	40	50	150	0.4	150	15	150	20
2N4403	35	225	150	40	100	150	0.4	150	15	200	20
MPS3640	25	35	50	12	30	10	0.2	10	1.0	500	10
MPS4258	15	20	10	12	30	50	0.15	10	1.0	700	10
2N5771	15	20	10	15	50	10	0.18	10	1.0	850	10

†$V_{(BR)EBO}$
*Typ

Table 8. Choppers

Devices are listed in decreasing ($V_{(BR)EBO}$)

Device Type	Pin Out	$V_{(BR)EBO}$ Volts Min	I_C Amp* Max	h_{FE} @ Min	I_C mA	$V_{CE(sat)}$ @ Volts Max	I_C mA	& I_B mA	f_T @ MHz Min	I_C mA
NPN — TO-226AA (TO-92)										
MPSA17	EBC	15	100	200	5.0	0.25	10	1.0	100	5.0
MPSA16	EBC	12	100	200	5.0	0.25	10	1.0	80	5.0

Table 9. Industrial Transistors

These devices are special products ranges intended for use in applications which require well specified high performing devices like high quality amplifier differential input, driver stage.

NPN	PNP	Pin Out	$V_{(BR)CEO}$ (Volts)	I_C (mA) Cont	h_{FE} @ Min	Max	I_C (mA)	& V_{CE} (Volts)	f_T Typ (MHz)	Typ (dB)	t_{on} ns Typ	t_{off} ns Typ
TO-226AA (TO-92)												
—	MPS2907A	EBC	60	600	100	—	10	10	200*	—	45	100
BCX59	BCX79	CBE	45	200	120	630	2.0	5.0	250	2.0	75	600/350
MPS2222A	—	EBC	40	600	75	—	10	10	300*	—	30	270
BCX58	BCX78	CBE	32	200	120	630	2.0	5.0	250	2.0	75	600/350

*f_T Min

Table 10. Telecom Transistors

These devices are special product ranges intended for use in Telecom application which require an excellent long term reliability.

Device Type	Pin Out	$V_{(BR)CEO}$ Volts	P_D mW 25°C Amb	I_C (mA) Cont	h_{FE} Min	Max	I_C (mA)	V_{CE} (V)	f_T Min MHz
NPN — TO-226AA (TO-92)									
P2N2222	CBE	30	625	600	75	—	10	10	250
P2N2222A	CBE	40	625	600	75	—	10	10	300
(1)PBF259,S	EBC	300	625	500	25	—	1.0	10	40
(1)PBF259R,RS	CBE	300	625	500	25	—	1.0	10	40
PNP — TO-226AA (TO-92)									
P2N2907	CBE	40	625	600	75	—	10	10	200
P2N2907A	CBE	60	625	600	100	—	10	10	200
(2)PBF493,S	EBC	300	625	500	40	—	1.0	10	40
(2)PBF493R,RS	CBE	300	625	500	40	—	1.0	10	40

(1) "S" version, h_{FE} Min 60 @ I_C = 20 mA, V_{CE} = 10 V.
(2) "S" version, h_{FE} Min 40 @ I_C = 0.1 mA, V_{CE} = 1.0 V.

Small-Signal Metal Packaged Transistors

T-91-60

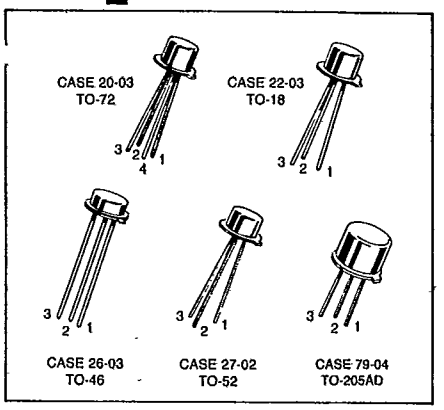


Table 11. General-Purpose Transistors

These transistors are designed for dc to VHF amplifier applications, general-purpose switching applications, and complementary circuitry. Devices are listed in decreasing order of $V_{(BR)CEO}$ within each package group.

Device Type	$V_{(BR)CEO}$ Volts Min	f_T MHz Min	@ I_C mA	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C mA
NPN — TO-206AA (TO-18)							
2N2896	90	120	50	1000	60	200	150
2N720A	80	50	50	150	40	120	150
2N3700#	80	80	1.0	1000	50	—	500
2N2895	65	120	50	1000	40	120	150
2N910	60	60	50	1000	75	—	10
2N956	50	70	50	—	40	120	150
2N2897	45	100	50	1000	50	200	150
2N915	50	250	10	30	50	200	10
BC107	45	150	10	200	110	450	2.0
BC107A	45	150	10	200	110	220	2.0
BC107B	45	150	10	200	200	450	2.0
BC107C	45	150	10	200	420	800	2.0
BCY59	45	125	10	200	120	630	2.0
BCY59-IX	45	125	10	200	250	460	2.0
BCY59-VII	45	125	10	200	120	220	2.0
BCY59-VIII	45	125	10	200	180	310	2.0
BCY59-X	45	125	10	200	380	630	2.0
2N2218#	40	250	20	800	40	120	150
2N2221A#	40	250	20	800	40	120	150
2N2222A#	40	300	20	800	100	300	150
2N3946	40	300	10	200	50	150	10
2N3947	40	300	10	300	100	300	10
2N718	40	50	50	—	40	120	150
BCY58	32	125	10	200	120	630	2.0
BCY58-IX	32	125	10	200	250	460	2.0
BCY58-VII	32	125	10	200	120	220	2.0
BCY58-VIII	32	125	10	200	180	310	2.0
BCY58-X	32	125	10	200	380	630	2.0
2N2221	30	250	20	800	40	120	150
2N2222#	30	250	20	800	100	300	150
2N3302	30	250	50	500	100	300	150
2N916*	25	300	10	—	50	200	10
BC108	25	150	10	100	110	800	2.0
BC108A	25	150	10	100	110	220	2.0
BC108B	25	150	10	100	200	450	2.0
BC108C	25	150	10	100	420	800	2.0
BC109	25	150	10	100	200	800	2.0
BC109A	25	150	10	100	110	220	2.0
BC109B	25	150	10	100	200	450	2.0
BC109C	25	150	10	100	420	800	2.0
2N706	15	200	10	50	20	—	10
2N706A	15	200	10	50	20	60	—
2N706B	15	200	10	50	20	60	—

#JAN JANTX JANTXV available

Table 11. General-Purpose Transistors (continued)

T-91-60

Device Type	$V_{(BR)CEO}$ Volts Min	f_T MHz Min	@ I_C mA	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C mA
NPN — TO-205AD (TO-39)							
2N1711	80	70	50	—	100	300	150
2N694	80	50	50	150	40	120	150
2N3019#	80	100	50	1000	100	300	150
2N3020	80	80	50	1000	40	120	150
BSX47-10	80	50	20	1000	63	160	100
BSX47-16	80	50	20	1000	100	250	100
BSX47-6	80	50	20	1000	40	100	100
2N1893	80	50	50	500	40	120	150
2N2102	65	60	50	1000	40	120	150
BC141	60	50	50	1000	40	400	100
BC141-10	60	50	50	1000	63	160	100
BC141-16	60	50	50	1000	100	250	100
2N697	60	—	—	150	40	120	150
BSX46-10	60	50	20	1000	63	160	100
BSX46-16	60	50	20	1000	100	250	100
BSX46-6	60	50	20	1000	40	100	100
2N3053A	60	100	50	700	50	250	150
2N3073	60	130	50	500	30	130	50
2N1613#	50	60	50	500	40	120	150
2N2270	45	100	50	1000	50	200	150
2N2219A#	40	300	20	800	100	300	150
2N3053	40	100	50	700	50	250	150
2N697	40	—	—	200	40	120	150
BC140	40	50	50	1000	40	400	100
BC140-10	40	50	50	1000	63	160	100
BC140-16	40	50	50	1000	100	250	100
BSX45-10	40	50	20	1000	63	160	100
BSX45-16	40	50	20	1000	100	250	100
BSX45-6	40	50	20	1000	40	100	100
BFY50	35	60	50	1000	30	—	150
2N2218#	30	250	20	800	40	120	150
2N2219#	30	250	20	800	100	300	150
2N3300	30	250	50	500	100	300	150
BFY51	30	50	50	1000	40	—	150
BFY52	20	50	50	1000	50	—	150
NPN — TO-205AD (TO-46)							
2N5581**	40	250	20	800	40	120	150
2N5582**	40	300	20	800	100	300	150
NPN — TO-205AD (TO-52)							
MM3903	40	250	10	200	50	150	10
MM3904	40	300	10	200	100	300	10
PNP — TO-206AA (TO-18)							
2N4026	80	100	50	1000	15	—	100
2N4027	80	100	50	1000	10	—	100
2N4028	80	150	50	1000	40	—	100
2N4029	80	150	50	1000	25	—	100
2N2906A#	60	200	50	600	40	120	150
2N2907A	60	200	50	600	100	300	150
2N3250A#	60	250	10	200	50	150	10
2N3251A#	60	300	10	200	100	300	10
2N718A	50	60	50	500	40	300	150
BC177	45	200	10	200	120	460	2.0
BC177A	45	200	10	200	120	220	2.0
BC177B	45	200	10	200	180	460	2.0
BC177C	45	200	10	200	380	800	2.0
BCY79	45	10	200	200	100	600	10
BCY79-IX	45	180	10	200	250	460	2.0
BCY79-VII	45	180	10	200	120	220	2.0
BCY79-VIII	45	180	10	200	180	310	2.0
BCY79-X	45	180	10	200	380	630	2.0
2N2906#	40	200	50	600	40	120	150
2N2907#	40	200	50	600	100	300	150
2N3250	40	250	10	200	50	150	10
2N3251	40	300	10	200	100	300	10
BCY70	40	250	10	200	50	—	10

**JAN JANTX ava lable #JAN JANTX JANTXV available

0037 C-04

Table 11. General-Purpose Transistors (continued)

Device Type	$V_{(BR)CEO}$ Volts Min	f_T MHz Min	@ I_C mA	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C mA
PNP — TO-206AA (TO-18) (continued)							
2N3135	35	200	50	500	40	125	50
BCY78-IX	32	180	10	200	250	460	2.0
BCY78-VII	32	180	10	200	120	220	2.0
BCY78-VIII	32	180	10	200	180	310	2.0
BCY78-X	32	180	10	200	380	630	2.0
BC178	25	200	10	200	120	800	2.0
BC178A	25	200	10	200	120	220	2.0
BC178B	25	200	10	200	180	460	2.0
BC178C	25	200	10	200	380	800	2.0
BCY72	25	250	10	200	50	—	10
BC179	20	200	10	200	180	800	2.0
BC179A	20	200	10	200	120	220	2.0
BC179B	20	200	10	200	180	460	2.0
BC179C	20	200	10	200	380	800	2.0
2N3249	12	300	20	200	35	—	100
PNP — TO-205AD (TO-39)							
MM5007	100	30	50	2000	50	250	250
2N4031	80	100	50	1000	10	—	100
2N4033#	80	150	50	1000	25	—	100
BSV17-10	80	50	50	1000	63	160	100
BSV17-16	80	50	50	1000	40	100	100
MM5006	80	30	50	2000	50	250	200
BFX40	75	100	50	1000	85	—	100
BFX41	75	100	50	1000	40	—	100
2N4036	65	60	50	1000	40	140	150
2N4037	65	60	50	1000	40	—	150
2N2904A#	60	200	50	600	40	120	150
2N2905A	60	200	50	600	100	300	150
2N3073	60	130	50	500	30	130	50
2N4030	60	100	50	1000	15	—	100
2N4032	60	150	50	1000	40	—	100
BC161	60	50	50	1000	40	400	100
BC161-10	60	50	50	1000	63	160	100
BC161-16	60	50	50	1000	100	250	100
BC161-6	60	50	50	1000	40	100	100
BSV16-10	60	50	50	1000	63	160	100
BSV16-16	60	50	50	1000	100	250	100
BSV16-6	60	50	50	1000	40	100	100
MM5005	60	30	50	2000	50	250	150
2N4890	40	100	50	1000	50	250	150
2N1132A	40	60	50	600	30	90	150
2N2904#	40	200	50	600	40	120	150
2N2905#	40	200	50	600	100	300	150
BC160	40	50	50	1000	40	400	100
BC160-10	40	50	50	1000	63	160	100
BC160-16	40	50	50	1000	100	250	100
BC160-6	40	50	50	1000	40	100	100
BSV15-10	40	50	50	1000	63	160	100
BSV15-16	40	50	50	1000	100	250	100
BSV15-6	40	50	50	1000	40	100	100
MM4037	40	60	50	1000	50	250	150
2N1132	35	60	50	600	30	90	150
PNP — TO-205AD (TO-46)							
2N3485A**	60	200	50	600	40	120	150
2N3486A**	60	200	50	600	100	300	150
2N3485	40	200	50	600	40	120	150
2N3486	40	200	50	600	100	300	150
PNP — TO-205AD (TO-52)							
MM3906	40	250	10	200	100	300	10
MM3905	40	200	10	200	50	150	10

*JAN available **JAN/JANTX available #JAN/JANTX/JANTXV available

Table 12. High-Gain/Low-Noise Transistors

These transistors are characterized for high-gain and low-noise applications. Devices are listed in decreasing order of NF.

Device Type	NF Wideband Typ* Max dB	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C μA mA*	f_T MHz Min	@ I_C mA
NPN — TO-206AA (TO-18)								
2N2484#	8.0*	60	50	100	500	10	15	0.05
2N930A	3.0	45	30	100	300	10	45	0.5
2N930**	3.0	45	30	100	300	10	30	0.5
PNP — TO-206AA (TO-18)								
2N3962	10	60	200	100	450	1.0*	40	0.5
2N3963	10	80	200	100	450	1.0*	40	0.5
2N3965	8.0	60	200	250	600	1.0*	50	0.5
2N3964	4.0	45	200	250	600	1.0*	50	0.5
2N3798	3.5	60	50	150	450	500	30	0.5
2N3799	2.5	60	50	300	900	500	30	0.5
PNP — TO-206AB (TO-46)								
2N2605#	4.0	45	30	100	300	10	30	0.5

Table 13. High-Voltage/High-Current Transistors

The following table lists Motorola standard devices that have high Collector-Emitter Breakdown Voltage. Devices are listed in decreasing order of $V_{(BR)CEO}$ within each package type.

Device Type	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA	f_T MHz Min	@ I_C mA
NPN — TO-206AA (TO-18)									
2N6431	300	50	50	30	0.5	20	2.0	50	10
BSS73	300	500	40	30	0.5	50	5.0	100	20
BSS72	250	500	40	30	0.5	50	5.0	100	20
2N6430	200	50	50	30	0.5	20	2.0	50	10
BSS71	200	500	40	30	0.5	50	5.0	100	20
BC394	180	500	30	10	0.3	10	1.0	50	20
NPN — TO-205AD (TO-39)									
2N3439#	350	1000	40	20	0.5	50	4.0	15	10
2N5058	300	150	35	30	1.0	30	3.0	30	10
BF259	300	100	25	30	1.0	30	6.0	110	30
2N3440#	250	1000	40	20	0.5	50	4.0	15	10
2N4927	250	50	20	30	2.0	30	3.0	30	10
2N5059	250	150	30	30	1.0	30	3.0	30	10
MM3003	250	50	20	10	—	—	—	150	10
BF258	250	100	25	30	1.0	30	6.0	110	30
BSS78	250	500	40	30	0.4	30	3.0	70	20
2N4926	200	50	20	30	2.0	30	3.0	30	10
MM3002	200	50	20	10	—	—	—	150	10
MM3009	180	400	40	10	—	—	—	50	20
MM3001	150	200	20	10	—	—	—	150	10
2N3500#	150	300	40	150	0.4	150	15	150	20
2N3501#	150	300	100	150	0.4	150	15	150	20
3N3114	150	200	30	30	1.0	50	5.0	40	30
BSW68A	150	2000	30	500	1.0	500	150	—	—
2N5682	120	1000	40	250	0.6	250	25	30	100
BSW67A	120	2000	30	500	1.0	500	150	—	—
2N3498#	100	500	40	150	0.6	300	30	150	20
2N3499#	100	500	100	150	0.6	300	30	150	20
2N5681	100	1000	40	250	0.6	250	25	30	100
2N657	100	—	300	200	4.0	200	40	—	—
MM3007	100	2500	50	250	0.35	150	15	50	50
2N4239	80	3000	30	250	0.3	500	50	2.0	100
MM3006	80	2500	50	200	0.35	150	15	50	50

#JAN/JANTX/JANTXV available **JAN/JTX

SMALL-SIGNAL BIPOLAR TRANSISTORS — METAL (continued)

T-91-60

Table 13. High-Voltage/High-Current Transistors (continued)

Device Type	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min @	I_C mA	$V_{CE(sat)}$ Volts Max @	I_C mA &	I_B mA	f_T MHz Min @	I_C mA
NPN — TO-205AD (TO-39) (continued)									
3N4238	60	3000	30	250	0.3	500	50	2.0	100
MM3005	60	2500	50	150	0.35	150	15	50	50
2N4237	40	3000	30	250	0.3	500	50	2.0	100
PNP — TO-206AA (TO-18)									
2N6433	300	500	30	30	0.5	20	20	50	10
BSS76	300	500	35	30	0.5	50	5.0	100	20
BSS75	250	500	35	30	0.5	50	5.0	100	20
2N6432	200	1000	30	30	0.5	20	2.0	50	10
BSS74	200	500	35	30	0.5	50	5.0	100	20
BC393	180	500	50	10	0.3	10	1.0	50	20
2N3497	120	100	40	10	0.35	10	1.0	150	20
2N3496	80	100	40	10	0.3	10	1.0	200	20
PNP — TO-205AD (TO-39)									
2N3494	80	100	40	10	0.3	10	1.0	200	20
2N3495	120	100	40	10	0.35	10	1.0	150	20
2N3635#	140	1000	100	50	0.5	50	5.0	200	30
2N3636#	175	1000	50	50	0.5	50	5.0	150	30
2N3637#	175	1000	100	50	0.5	50	5.0	200	30
2N3743#	300	50	25	30	8.0	30	3.0	30	10
2N4234	40	3000	30	250	0.6	1000	125	3.0	100
2N4235	60	3000	30	250	0.6	1000	125	3.0	100
2N4236	80	3000	30	250	0.6	1000	125	3.0	100
2N4928	100	100	25	10	0.5	10	1.0	100	20
2N4929	150	500	25	10	0.5	10	1.0	100	20
2N4930#	200	500	20	20	5.0	10	1.0	20	20
2N4931#	250	500	20	20	5.0	10	1.0	20	20
2N5415#	200	1000	30	50	2.5	50	5.0	15	10
2N5416#	300	1000	30	50	2.5	50	5.0	15	10
2N5679	100	1000	40	250	0.6	250	25	30	100
2N5680	120	1000	40	250	0.6	250	25	30	100
2N3634#	140	1000	50	50	0.5	50	5.0	150	30
MM4000	100	100	20	20	0.6	10	1.0	—	—
MM4001	150	500	20	10	0.6	10	1.0	—	—
MM4002	200	500	20	10	5.0	10	1.0	—	—
MM4003	250	500	20	10	5.0	10	1.0	—	—
MM5005	60	2000	50	150	0.5	150	15	30	50
MM5006	80	2000	50	200	0.5	150	15	30	50
MM5007	100	2000	50	250	0.5	150	15	30	50

#JAN JANTX JANTXV available

Table 14. High-Frequency Amplifiers/Oscillators

The transistors shown are designed for use as both oscillators and amplifiers at UHF and VHF frequencies. Devices are listed in decreasing order of $V_{(BR)CEO}$ with each line.

Device Type	$V_{(BR)CEO}$ Volts Min	h_{FE} Min @	I_C mA	G_{pe} dB Min	NF dB Max @	f MHz	f_T MHz Min @	I_C mA	C_{obo} pF Max
NPN — TO-206AF (TO-72)									
2N918†	15	20	3.0	15	6.0	60	600	4.0	1.7
PNP — TO-206AF (TO-72)									
2N3307	35	40	2.0	17	4.5	200	300	2.0	1.3
2N3308	25	25	2.0	17	6.0	200	300	2.0	1.6
2N4261#	15	30	10	—	—	—	1600	10	2.5
2N4260	15	30	10	—	—	—	2000	10	2.5

†JAN/JANTX/JANTXV/JANS available #JAN/JANTX/JANTXV available

Table 15. Switching Transistors

The following devices are intended for use in general-purpose switching and amplifier applications. Within each package group shown, the devices are listed in order of decreasing turn-on time (t_{on}).

T-91-60

Device Type	t_{on} ns & Max	t_{off} ns Max	@ I_C mA	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} @ Min	I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	I_B mA	f_t MHz Min	I_C mA
NPN — TO-206AA (TO-18)												
2N3012	60	75	30	12	200	20	100	0.5	100	10	—	—
2N708	40	70	10	15	30	30	10	0.4	10	1.0	300	10
2N2540	40	40	150	30	—	100	150	0.45	150	15	250	20
2N914**	40	40	200	15	150	12	10	0.7	200	20	300	20
2N2481	40	55	100	15	150	40	10	0.4	100	10	—	—
2N4014	35	60	500	50	1000	35	500	0.52	500	50	300	50
2N4013	35	60	500	30	1000	35	500	0.42	500	50	300	50
2N834	35	40	10	40	200	25	10	0.4	50	5.0	350	10
2N835	35	40	10	40	200	—	—	0.4	50	5.0	350	10
2N2501	15	25	300	20	—	10	500	0.3	50	5.0	350	10
2N2369	12	18	100	15	500	20	100	0.25	10	1.0	500	10
2N3011	15	20	30	12	500	12	100	0.5	100	10	400	20
2N3013	15	25	300	15	500	15	300	0.5	300	30	350	30
2N3014	16	25	30	20	500	25	100	0.35	100	10	350	30
2N2369A†	12	18	10	15	200	40	10	0.2	10	1.0	500	10
2N2368	12	—	10	15	200	20	10	0.25	10	1.0	400	10
2N3227	12	18	100	20	50	30	100	0.25	10	1.0	500	10
BSX20	7.0	18	100	15	500	20	10	0.25	10	1.0	400	10
NPN — TO-205AD (TO-39)**												
2N5320	80	800	500	75	2000	30	500	0.5	500	50	—	—
2N5321	80	800	500	50	2000	40	500	0.8	500	50	—	—
2N3444**	50	70	500	50	—	20	500	0.6	500	50	175	50
2N3253**	50	70	500	40	—	25	500	0.6	500	50	175	50
2N3735#	48	60	1000	50	1500	20	1000	0.5	500	50	250	50
2N3734	48	60	1000	50	1500	30	1000	0.5	500	50	250	50
2N3252	45	70	500	30	—	30	500	0.5	500	50	200	50
2N3506#	45	90	1500	40	3000	40	1500	1.0	1500	150	60	100
2N3507#	45	90	1500	50	3000	30	1500	1.0	1500	150	60	100
BSX60	40	70	500	30	1000	30	500	0.5	500	50	—	—
2N5859	36	70	100	40	2000	15	1000	0.7	1000	100	25	50
2N3725	35	60	500	50	2000	35	500	0.52	500	50	300	50
2N3724	35	60	500	30	2000	35	500	0.42	500	50	300	50
BSX59	35	60	500	45	1000	25	500	0.5	500	50	—	—
MM5262	30	60	1000	40	2000	25	1000	0.8	1000	100	350(typ)	50
2N5861	25	60	500	50	2000	25	500	0.5	500	50	200	50
NPN — TO-205AD (TO-46)												
2N3737#	48	60	1000	50	1500	20	1000	0.5	500	50	250	50
2N3648	16	18	150	15	500	30	150	0.4	150	15	450	15
NPN — TO-205AD (TO-52)												
MM1748A	10	15	10	—	150	20	10	—	—	—	600	5.0
PNP — TO-206AA (TO-18)												
2N2894	60	90	30	12	200	40	30	0.2	30	3.0	400	30
2N869A**	50	80	30	18	200	40	30	0.2	30	3.0	400	10
2N3546	40	30	50	12	—	25	50	0.25	50	5.0	700	10
2N4208	15	20	10	12	200	30	10	0.15	10	1.0	700	10
MM4258	15	20	10	12	200	30	10	0.15	10	1.0	700	10
2N4209	15	20	10	15	200	50	10	0.6	50	5.0	850	10

Table 15. Switching Transistors (continued)

Device Type	t_{on} ns Max & t_{off} ns Max	@ I_C mA	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	@ I_B mA	f_T MHz Min	I_C mA
PNP — TO-205AD (TO-39)											
2N4036	110	700	150	65	1000	40	150	0.65	150	15	60	50
2N5322	100	1000	500	75	2000	30	500	0.7	500	50	—	—
2N5323	100	1000	500	50	2000	40	500	1.2	500	50	—	—
2N4406	75	225	1000	80	1500	20	1000	0.7	1000	100	150	50
2N4407	75	225	1000	80	1500	30	1000	0.7	1000	100	150	50
2N3245	55	165	500	50	1000	30	500	0.6	500	50	150	50
2N3244	50	185	500	40	1000	50	500	0.5	500	50	175	50
2N4453**	50	80	30	18	200	25	100	0.5	100	10	400	10
2N3467#	40	90	500	40	100	40	500	0.5	500	50	175	50
2N3468#	40	90	500	50	1000	25	500	0.6	500	50	150	50
2N4404	40	210	500	80	1000	30	500	0.5	500	50	200	50
2N4405**	40	210	500	80	1000	50	500	0.5	500	50	200	50
2N5022	40	90	500	—	500	25	1000	0.8	1000	100	170	50
2N5023	40	90	500	—	500	40	1000	0.7	1000	100	200	50
2N2800	34	270	150	35	800	25	500	1.2	500	50	120	50
2N3764	11.5	65	100	40	1500	30	1000	0.9	1000	100	180	50
2N3765	11.5	65	100	60	1500	20	1000	0.9	1000	100	150	50
2N3762#	11.5	65	100	40	1500	30	1000	0.9	1000	100	180	50
2N3763#	11.5	65	100	60	1500	20	1000	0.9	1000	100	150	50

**JAN JANTX available #JAN JANTX JANTXV available †JAN JANTX JANTXV JANS available

Table 16. Choppers

Devices are listed in decreasing $V_{(BR)EBO}$.

PNP — TO-206AB (TO-46)

Device	$V_{(BR)EBO}$ Min	$V_{(BR)ECO}$	$h_{FE(inv)}$ Min	Offset Voltage $V_{EC(ofs)}$ Max (mV)	On-State Resistance $r_{ec(on)}$ Max (Ω)
2N2946A	40	35	20	0.5	8.0
2N2946	40	35	3.0	0.8	8.0
2N5230	30	20	15	0.5	8.0
2N2945A	25	20	30	1.0	6.0
2N2945	25	20	4.0	1.0	35

Table 17. High-Gain Darlington Transistors

NPN — TO-206AF (TO-72)

Device	$V_{(BR)CB10}$	$V_{(BR)CE20}$	$V_{(BR)E2B10}$	h_{FE} Min	h_{FE} Max	I_C
2N2723	80	60	12	2000	10000	10
2N2785	60	40	15	2000	20000	100
NPN — TO-206AA (TO-18)						
MM6427	40	50	12	10000	—	100

Small-Signal Field-Effect Transistors

T-91-60

JFETs

JFETs operate in the depletion mode. They are available in both P- and N-channel are are offered in both metal and plastic packages. Applications include general-purpose amplifiers, switches and choppers, and RF amplifiers and mixers. These devices are economical and very rugged. The drain and source are interchangeable on many typical FETs.

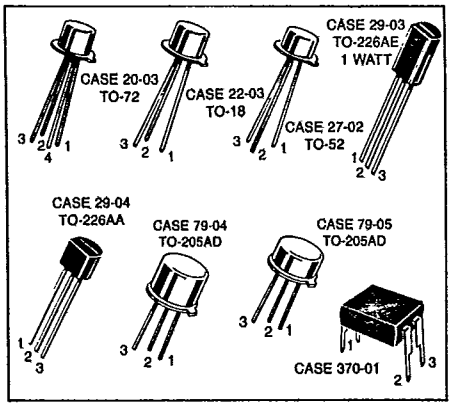


Table 1. Low-Frequency/Low-Noise

P-Channel JFETs

Package TO-	Device	$\lvert Re\ Y_{fs}\rvert$ (mmho) Min	$\lvert Re\ Y_{os}\rvert$ (μmho) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
72	2N3909	1.0	100	32	16	20	0.3	7.9	0.3	15
92	MPF2608	1.0	—	17	—	30	1.0	4.0	0.9	4.5
92	2N5460	1.0	50	7.0	2.0	40	0.75	6.0	1.0	5.0
92	2N5463	1.0	75	7.0	2.0	60	0.5	4.0	1.0	5.0
72	2N3330	1.5	40	20	—	20	—	6.0	2.0	6.0
92	MPF3330	1.5	40	20	—	20	—	6.0	2.0	6.0
92	2N5461	1.5	50	7.0	2.0	40	1.0	7.5	2.0	9.0
92	2N5464	1.5	75	7.0	2.0	60	0.8	4.5	2.0	9.0
92	2N5462	2.0	50	7.0	2.0	40	1.8	9.0	4.0	16
92	2N5465	2.0	75	7.0	2.0	60	1.5	6.0	4.0	16
72	2N3331	2.0	100	20	—	20	—	8.0	5.0	15
72	2N3909A	2.2	100	9.0	3.0	20	0.3	7.9	1.0	15
92	J271	6.0	200	32	8.0	30	0.5	2.0	2.0	15

N-Channel JFETs

Package TO-	Device	$\lvert Re\ Y_{fs}\rvert$ (mmho) Min	@ f (MHz)	$\lvert Re\ Y_{os}\rvert$ (μmho) Max	@ f (MHz)	C_{iss} (pF) Max	C_{rss} (pF) Max	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
18	2N3370	0.3	30	15	30	20	3.0	40	—	3.2	0.1	0.6
92	J201	0.5	20	1.0[t]	20	5.0[t]	2.0[t]	40	0.3	1.5	0.2	1.0
18	2N4339	0.8	15	15	15	7.0	3.0	50	0.6	1.8	0.5	1.5
92	MPF4339	0.8	15	15	15	7.0	3.0	50	0.6	1.8	0.5	1.5
18	2N3460	0.8	20	5.0	30	18	6.0	50	—	1.8	0.2	1.0
18	2N3438	0.8	20	5.0	30	18	6.0	50	—	2.3	0.2	1.0
72	2N4220	1.0	15	10	15	6.0	2.0	30	—	4.0	0.5	3.0
72	2N4220A	1.0	15	10	15	6.0	2.0	30	—	4.0	0.5	3.0

t = typical

Table 1. Low-Frequency/Low-Noise (continued)

N-Channel JFETs (continued)

Package TO-	Device	$\|Y_{fs}\|$ (mmho) Min	@ f (MHz)	$\|Y_{os}\|$ (μmho) Max	@ f (MHz)	C_{iss} (pF) Max	C_{rss} (pF) Max	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
18	2N4348	0.6	0.001	5.0	0.001	6.0	2.0	50	0.3	1.0	0.2	0.6
92	J202	1.0	20	3.5t	20	5.0t	2.0t	40	0.8	4.0	0.9	4.5
72	2N5359	1.2	15	10	15	6.0	2.0	40	0.8	4.0	0.6	1.6
18	2N4340	1.3	15	30	15	7.0	3.0	50	1.0	3.0	1.2	3.6
72	2N5360	1.4	15	20	15	6.0	2.0	40	0.8	4.0	0.5	2.5
92	2N5458	1.5	15	50	15	7.0	3.0	25	1.0	7.0	2.0	9.0
72	2N5361	1.5	15	20	15	6.0	2.0	40	1.0	6.0	2.5	5.0
92	J203	1.5	20	10t	20	5.0t	2.0t	40	2.0	10	4.0	20
18	2N3459	1.5	20	20	30	18	6.0	50	—	3.4	0.8	4.0
72	2N3821	1.5	15	10	15	6.0	3.0	50	—	4.0	0.5	2.5
92	MPF3821	1.5	15	10	15	6.0	3.0	50	—	4.0	0.5	2.5
18	2N3437	1.5	20	20	30	18	6.0	50	—	4.8	0.8	4.0
92	2N5457	2.0	15	50	15	7.0	3.0	25	0.5	6.0	1.0	5.0
92	2N5459	2.0	15	50	15	7.0	3.0	25	2.0	8.0	4.0	16
72	2N4221	2.0	15	20	15	6.0	2.0	30	—	6.0	2.0	6.0
92	MPF4221	2.0	15	20	15	6.0	2.0	30	—	6.0	2.0	6.0
72	2N4221A	2.0	15	20	15	6.0	2.0	30	—	6.0	2.0	6.0
72	2N3822	2.0	15	20	15	6.0	3.0	50	—	6.0	2.0	10
92	MPF3822	2.0	15	20	15	6.0	3.0	50	—	6.0	2.0	10
18	2N4341	2.0	15	60	15	7.0	3.0	50	2.0	6.0	3.0	9.0
72	2N4222	2.5	15	40	15	6.0	2.0	30	—	8.0	5.0	15
72	2N4222A	2.5	15	40	15	6.0	2.0	30	—	8.0	5.0	15
92	MPF4222A	2.5	15	40	15	6.0	2.0	30	—	8.0	5.0	15
18	2N4398	12t	0.001	—	—	14	3.5	40	0.5	3.0	5.0	30
72	2N4118	80	0.001	5.0	10	3.0	1.5	40	1.0	3.0	80	240
92	MPF4118	80	0.001	5.0	10	3.0	1.5	40	1.0	3.0	80	240
72	2N4118A	80	0.001	5.0	10	3.0	1.5	40	1.0	3.0	80	240
92	MPF4118A	80	0.001	5.0	10	3.0	1.5	40	1.0	3.0	80	240

t = typical

Table 2. High-Frequency Amplifiers

N-Channel JFETs

Package TO-	Device	$\|Y_{fs}\|$ (mmho) Min	@ f (MHz)	$\|Y_{os}\|$ (μmho) Max	@ f (MHz)	C_{iss} (pF) Max	C_{rss} (pF) Max	NF (dB) Max	NF @ RG = 1K f (MHz)	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max
92	2N5669	1.6	100	100	100	7.0	3.0	2.5	100	25	1.0	6.0	4.0	10
92	MPF102	1.6	100	200	100	7.0	3.0	—	—	25	—	8.0	2.0	20
92	2N3819	1.6	100	—	—	8.0	4.0	—	—	25	—	8.0	2.0	20
92	2N5668	1.0	100	50	100	7.0	3.0	2.5	100	25	0.2	4.0	1.0	5.0
92	MPF4224	1.7	200	200	200	6.0	2.0	—	—	30	0.1	8.0	2.0	20
92	2N5484	2.5	100	75	100	5.0	1.0	3.0	100	25	0.3	3.0	1.0	5.0
92	2N5670	2.5	100	150	100	7.0	3.0	2.5	100	25	2.0	8.0	8.0	20

Table 2. High-Frequency Amplifiers (continued)

N-Channel JFETs (continued)

Package TO-	Device	$Re\|Y_{fs}\|$ (mmho) Min	@ f (MHz)	$Re\|Y_{os}\|$ (μmho) Max	@ f (MHz)	C_{iss} (pF) Max	C_{rss} (pF) Max	NF (dB) Max	@ RG = 1K f (MHz)	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	$V_{GS(off)}$ (V) Min	Max	I_{DSS} (mA) Min	Max
92	2N5246	2.5	400	100	400	4.5	1.0	—	—	30	0.5	4.0	1.5	7.0
92	MPF4223	2.7	200	200	200	6.0	2.0	5.0	200	30	0.1	8.0	3.0	18
92	2N5485	3.0	400	100	400	5.0	1.0	4.0	400	25	1.0	4.0	4.0	10
92	J305	3.0t	400	80t	100	3.0t	0.8t	4.0t	400	30	0.5	3.0	1.0	8.0
72	2N3823	3.2	200	200	200	6.0	2.0	2.5	100	30	—	8.0	4.0	20
92	2N5486	3.5	400	100	400	5.0	1.0	4.0	400	25	2.0	6.0	8.0	20
72	2N4416	4.0	400	100	400	4.0	0.8	4.0	400	30	2.0	6.0	5.0	15
92	J300	4.5	0.001	200	0.001	5.5	1.1	—	—	25	—	1.0*	6.0	30
92	JF1033B	4.5	0.001	—	—	—	—	2.5	100	20	1.0	8.0	2.5	6.0
92	JF1033S	4.5	0.001	—	—	—	—	2.5	100	20	1.0	8.0	5.0	12
92	JF1033Y	4.5	0.001	—	—	—	—	2.5	100	20	1.0	8.0	10	20
72	2N4416A	4.0	400	100	400	4.0	0.8	4.0	400	30	2.0	6.0	5.0	15
92	2N5245	4.0	400	100	400	4.5	1.0	4.0	400	30	1.0	6.0	5.0	15
92	2N5247	4.0	400	150	400	4.5	1.0	4.0	400	30	1.5	8.0	8.0	24
92	J304	4.2t	400	80t	100	3.0t	0.8t	4.0t	400	30	2.0	6.0	5.0	15
52	U308	10	0.001	150	100	5.0	2.5	3.0t	450	25	1.0	6.0	12	60
52	U309	10	0.001	150	100	5.0	2.5	3.0t	450	25	1.0	4.0	12	30
52	U310	10	0.001	150	100	5.0	2.5	3.0t	450	25	2.5	6.0	24	60
92	J308	12t	100	250t	100	7.5	2.5	1.5t	100	25	1.0	6.5	12	60
92	J309	12t	100	250t	100	7.5	2.5	1.5t	100	25	1.0	4.0	12	30
92	J310	12t	100	250t	100	7.5	2.5	1.5t	100	25	2.0	6.5	24	60

t = typical
*$V_{GS(f)}$

Table 3. Switches and Choppers

P-Channel JFETs

Package TO-	Device	$r_{ds(on)}$ (Ω) Max	@ I_D (μA)	$V_{GS(off)}$ (V) Min	Max	I_{DSS} (mA) Min	Max	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	C_{iss} (pF) Max	C_{rss} (pF) Max	t_{on} (ns) Max	t_{off} (ns) Max
92	MPF970	100	1.0	5.0	12	15	100	30	12	5.0	8.0	25
92	MPF971	250	1.0	1.0	7.0	2.0	80	30	12	5.0	10	120
72	2N3993	150	—	4.0	9.5	10	—	25	16	4.5	—	—
72	2N3994	300	—	1.0	5.5	2.0	—	25	16	4.5	—	—
92	J174	85	—	5.0	10	2.0	100	30	—	—	—	—
92	J175	125	—	3.0	6.0	7.0	60	30	—	—	—	—
92	J176	250	—	1.0	4.0	2.0	25	30	—	—	—	—
92	J177	300	—	0.8	2.5	1.5	20	30	—	—	—	—

N-Channel JFETs

18	MFE2012	10	—	3.0	10	100	—	25	50	20	16	37
18	MFE2011	15	1.0	1.0	10	40	—	25	50	20	10	20
18	2N4859A	25	—	2.0	6.0	50	—	30	10	4.0	8.0	20
92	MPF4859A	25	—	2.0	6.0	50	—	30	10	4.0	8.0	20
18	2N4856A	25	—	4.0	10	50	—	40	10	4.0	8.0	20

SMALL-SIGNAL FIELD-EFFECT TRANSISTORS (continued)

T-91-60

Table 3. Switches and Choppers (continued)

N-Channel JFETs (continued)

Package TO-	Device	$r_{ds(on)}$ (Ω) Max	@ I_D (μA)	$V_{GS(off)}$ (V) Min	Max	I_{DSS} (mA) Min	Max	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	C_{iss} (pF) Max	C_{rss} (pF) Max	t_{on} (ns) Max	t_{off} (ns) Max
92	MPF4856A	25	—	4.0	10	50	—	40	10	4.0	8.0	20
18	2N4856	26	—	4.0	10	50	—	40	10	8.0	9.0	25
92	MPF4856	25	—	4.0	10	50	—	40	10	8.0	9.0	25
18	2N4859	25	—	4.0	10	50	—	30	18	8.0	9.0	25
92	MPF4859	25	—	4.0	10	50	—	30	18	8.0	9.0	25
18	MFE2010	25	1.0	0.5	10	15	—	25	50	20	10	35
18	2N4391	30	1.0	4.0	10	50	150	40	14	3.5	15	20
92	MPF4391	30	1.0	4.0	10	60	130	20	10	3.5	15	20
92	2N5638	30	1.0	—	(12)	50	—	30	10	4.0	9.0	15
18	2N4091	30	1.0	5.0	10	30	—	40	16	5.0	25	40
92	MPF4091	30	1.0	5.0	10	30	—	40	16	5.0	25	40
92	J111	30	1.0	3.0	10	20	—	35	10[t]	5.0[t]	13	35
18	MFE2006	30	1.0	−5.0	−10	30	—	−30	16	5.0	20	40
18	2N3970	30	1.0	4.0	10	50	150	40	25	6.0	20	30
92	MPF3970	30	1.0	4.0	10	50	150	40	25	6.0	20	30
92	MPF4857A	40	—	2.0	6.0	20	100	40	10	3.5	10	40
18	2N4860A	40	—	2.0	6.0	20	100	30	10	3.5	10	40
92	MPF4860A	40	—	2.0	6.0	20	100	30	10	3.5	10	40
18	2N4857	40	—	2.0	6.0	20	100	40	18	8.0	10	50
18	2N4857A	40	—	2.0	6.0	20	100	40	18	8.0	10	50
92	MPF4857	40	—	2.0	6.0	20	100	40	18	8.0	10	50
18	2N4860	40	—	2.0	6.0	20	100	30	18	8.0	10	50
92	MPF4860	40	—	2.0	6.0	20	100	30	18	8.0	10	50
18	2N4092	50	1.0	2.0	7.0	15	—	40	16	5.0	35	60
92	J112	50	1.0	1.0	5.0	5.0	—	35	10[t]	5.0[t]	13[t]	35[t]
18	MFE2005	50	1.0	−2.0	−8.0	15	—	−30	16	5.0	35	60
18	2N4392	60	1.0	2.0	5.0	25	75	40	14	3.5	15	35
92	MPF4392	60	1.0	2.0	5.0	25	75	20	10	3.5	15	35
18	2N4858A	60	1.0	0.8	4.0	8.0	80	40	10	3.5	16	80
92	MPF4858A	60	1.0	0.8	4.0	8.0	80	40	10	3.5	16	80
18	2N4861A	60	—	0.8	4.0	8.0	80	30	10	3.5	16	80
92	MPF4861A	60	—	0.8	4.0	8.0	80	30	10	3.5	16	80
92	2N5639	60	1.0	—	(8.0)[t]	25	—	30	10	4.0	14	30
18	2N3971	60	1.0	2.0	5.0	25	75	40	25	6.0	30	60
18	2N4858	60	—	0.8	4.0	8.0	80	40	18	8.0	20	100
92	MPF4858	60	—	0.8	4.0	8.0	80	40	18	8.0	20	100
18	2N4861	60	—	0.8	4.0	8.0	80	30	18	8.0	20	100
92	MPF4861	60	—	0.8	4.0	8.0	80	30	18	8.0	20	100
18	2N4093	80	1.0	1.0	5.0	80	—	40	16	5.0	60	80
18	MFE2004	80	1.0	−1.0	−6.0	8.0	—	−30	16	5.0	60	80
18	2N4393	100	1.0	0.5	3.0	5.0	30	40	14	3.5	15	50
92	MPF4393	100	1.0	0.5	3.0	5.0	30	20	10	3.5	15	55
92	2N5640	100	1.0	—	(6.0)	5.0	—	30	10	4.0	18	45
18	2N3972	100	1.0	0.5	3.0	5.0	30	40	25	6.0	80	100
92	MPF3972	100	1.0	0.5	3.0	5.0	30	40	25	6.0	80	100
92	J113	100	1.0	0.5	3.0	2.0	—	35	10[t]	5.0[t]	13[t]	35[t]

SMALL-SIGNAL FIELD-EFFECT TRANSISTORS (continued)

T-91-60

Table 3. Switches and Choppers (continued)

N-Channel JFETs (continued)

Package TO-	Device	$r_{ds(on)}$ (Ω) Max	$r_{ds(on)}$ @ I_D (μA)	$V_{GS(off)}$ (V) Min	$V_{GS(off)}$ (V) Max	I_{DSS} (mA) Min	I_{DSS} (mA) Max	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	C_{iss} (pF) Max	C_{rss} (pF) Max	t_{on} (ns) Max	t_{off} (ns) Max
92	2N555	150	—	—	1.0*	15	—	25	5.0	1.2	10	25
92	BF246	—	—	0.5	14	10	300	25	—	—	—	—
92	BF246A	35t	1.0	1.5	4.0	30	80	25	—	—	—	—
92	BF246B	50t	1.0	3.0	7.0	60	140	25	—	—	—	—
92	BF246C	65t	1.0	5.5	12	110	250	25	—	—	—	—
92	J107	8.0	—	0.5	4.5	100	—	25	—	—	—	—
92	J108	8.0	—	3.0	10	80	—	25	—	—	—	—
92	J109	12	—	2.0	6.0	40	—	25	—	—	—	—
92	J110	18	—	0.5	4.0	10	—	25	—	—	—	—

t = typical *$V_{GS(f)}$

MOSFETs T-91-60

MOSFETs are available in either depletion/enhancement or enhancement mode (in general, depletion/enhancement devices are operated in the depletion mode and are referred to as depletion devices). They are available in both N- and P-channel, and both single gate and dual gate construction. Some MOSFETs are also offered with input diode protection which reduces the chance of damage from static charge in handling.

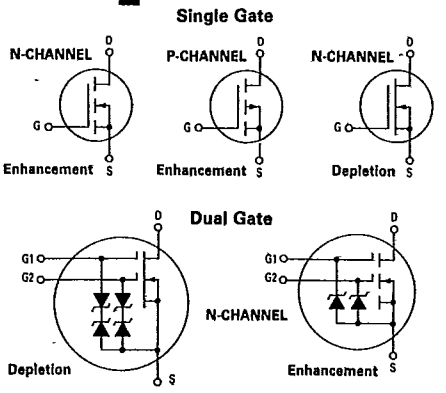


Table 4. Dual Gate

These devices are especially suited for RF amplifier and mixer applications in TV tuners, radio, etc. The Dual Gate construction also allows easy AGC control with very low power.

N-Channel MOSFETs

Package TO-	Device	$\|Y_{fs}\|$ (mmho) Min	@ f (MHz)	$\|Y_{os}\|$ (μmho) Max	@ f (MHz)	C_{iss} (pF) Max	C_{rss} (pF) Max	NF (dB) Max	@ RG = 1K f (MHz)	$V_{(BR)GSS}$ $V_{(BR)GDO}$ (V) Min	$V_{GS(off)}$ (V) Min	Max	I_{DSS} (mA) Min	Max
72	MFE521	10	0.001	—	—	4.0	0.02	3.5	200	10	0.5	2.0	5.0	20
72	MFE211	17	0.001	—	—	—	0.05	3.5	200	±6.0	−0.2	−5.5	6.0	40
72	MFE212	17	0.001	—	—	—	0.05	4.0	45	±6.0	−0.2	−5.5	6.0	40
72	MFE203	7.0	0.001	—	—	4.3t	0.03	4.5	200	±6.0	−0.2	−5.0	3.0	11
72	MFE201	8.0	0.001	—	—	4.5t	0.03	4.5	200	±6.0	−0.2	−5.0	6.0	30
72	MFE202	8.0	0.001	—	—	4.3t	0.03	4.5	200	±6.0	−0.2	−5.0	6.0	30
72	MFE120	8.0	0.001	—	—	7.0	0.023	5.0	105	±7.0	—	−4.0	2.0	18
72	MFE121	10	0.001	—	—	6.0	0.023	5.0	60	±7.0	—	−4.0	5.0	30
72	MFE122	8.0	0.001	—	—	7.0	0.023	5.0	200	±7.0	—	−4.0	2.0	20
72	MFE131	8.0	0.001	—	—	7.0	0.05	5.0	200	±7.0	—	−4.0	3.0	30
72	MFE204	10	0.001	—	—	—	0.03	5.0	400	25	−0.2	−4.0	6.0	30
72	MFE130	8.0	0.001	—	—	7.0	0.05	5.0	105	±7.0	—	−4.0	3.0	30
72	MFE209	10	0.001	—	—	7.0	0.03	6.0	500	±7.0	−0.1	−4.0	5.0	30
72	MFE131	8.0	0.001	—	—	7.0	0.05	5.0	100	±7.0	—	−4.0	3.0	30

t = typical

Table 5. Single Gate Low-Frequency/Low-Noise

P-Channel MOSFETs

Package TO-	Device	$\|Y_{fs}\|$ (mmho) Min	(μmho) Max	C_{iss} (pF) Max	C_{rss} (pF) Max	$V_{(BR)DSS}$ (V) Min	$V_{GS(th)}$ (V) Min	Max	I_{DSS} (mA) Min	Max
72	3N155	1.0	60	5.0	1.3	−35	−1.5	−3.2	—	−1.0
72	3N156	1.0	60	5.0	1.3	−35	−3.0	−5.0	—	−1.0
72	3N157	1.0	60	5.0	1.3	−35	−1.5	−3.2	—	−1.0
72	3N158A	1.0	60	5.0	1.3	−25	−2.0	−6.0	—	−20
18	MFE823	1.0	—	6.0	1.5	−50	−3.0	−5.0	—	−0.25

N-Channel MOSFETs

18	2N3796	0.4	1.8	7.0	0.8	25	—	−7.0	2.0	6.0
18	MFE825	0.5	—	4.0	0.7	20	—	—	1.0	25
72	2N4351	1.0	—	5.0	1.3	25	1.0	5.0	—	10
72	3N169	1.0	—	5.0	1.3	25	0.5	1.5	—	10
72	3N170	1.0	—	5.0	1.3	25	1.0	2.0	—	10
72	3N171	1.0	—	5.0	1.3	25	1.5	3.0	—	10
18	2N3797	1.5	—	8.0	0.8	25	—	−7.0	2.0	6.0

Table 6. Switches and Choppers

TO-226AA (TO-92)
N-CHANNEL

Device	$r_{DS(on)}$ @		$V_{GS(th)}$ V		$V_{(BR)DSS}$	C_{iss}	C_{rss}	t_{on}	t_{off}
	Ω	I_D A			V	pF	pF	ns	ns
	Max		Min	Max	Min	Max	Max	Max	Max
VN0300L	1.2	1.0	0.8	2.5	30	100	25	30	30
2N7000	5.0	0.5	0.8	3.0	60	60	5.0	10	10
BS170	5.0	0.2	0.8	3.0	60	25 Typ	3.0 Typ	10	10
VN0610LL	5.0	0.5	0.8	2.5	60	60	5.0	10	10
VN1706L	6.0	0.5	0.8	2.0	170	125	20	16	30
VN2406L	6.0	0.5	0.8	2.0	240	125	20	16	30
BSS89	6.4	0.25	1.0	2.7	200	90	3.5	15	15
BS107A	6.4	0.25	1.0	3.0	200	70 Typ	6.0 Typ	15	15
MPF9200	6.4	0.25	1.0	4.0	200	90	10	15	15
2N7008	7.5	0.5	1.0	2.5	60	50	5.0	20	20
VN2222LL	7.5	0.5	0.6	2.5	60	60	5.0	10	10
BS108	8.5	0.1	0.3	2.0	200	90	8.0	8.0 Typ	10 Typ
VN1710L	10	0.5	0.8	2.0	170	125	20	16	50
VN2410L	10	0.5	0.8	2.0	240	125	20	16	50
MPF4150†	12	0.1	1.0	6.0	150	125	15	—	—
BS107	14	0.2	1.0	3.0	200	70 Typ	6.0 Typ	15	15
2N4351*	300	—	1.0	5.0	25	5.0	1.3	110	160
MPF480	80	0.01	0.5	3.0	80	8.0	7.0	20	20
MPF481	140	0.01	0.5	3.0	180	8.0	7.0	20	20
P-CHANNEL									
2N4352*	600	—	−1.0	−5.0	−25	5.0	1.3	110	160
TO-226AE (1 WATT TO-92)									
N-CHANNEL									
MPF930	1.4	1.0	1.0	3.5	35	70	18	15	15
MPF960	1.7	1.0	1.0	3.5	60	70	18	15	15
MPF6659	1.8	1.0	0.8	2.0	35	50	10	5.0	5.0
MPF990	2.0	1.0	1.0	3.5	90	70	18	15	15
MPF6660	3.0	1.0	0.8	2.0	60	50	10	5.0	5.0
MPF6661	4.0	1.0	0.8	2.0	90	50	10	5.0	5.0
MPF910	5.0	0.5	0.8	2.5	60	50	10	10	10
MPF89	6.4	0.25	1.0	2.7	200	90	3.5	15	15

Table 6. Switches and Choppers (continued)

CASE 370-01 (FET DIP)
N-CHANNEL

Device	$r_{DS(on)}$ @ Ω Max	@ mA	$V_{(BR)DSS}$ @ Volt Min	$I_{D(on)}$ V_{GS} = 10 V V_{DS} = 5.0 V Amp	G_{fs} @ mhos Min	@ 5.0 V Amp	C_{iss} @ 25 V pF Max	C_{oss} @ 25 V pF Max	C_{rss} @ 25 V pF Max	$t_{d(on)}$ ns Max	t_r ns Max	$t_{d(off)}$ ns Max	t_f ns Max
IRFD120	0.3	600	100	1.3	0.9	0.6	600	400	100	40	70	100	70
IRFD123	0.4	600	60	1.1	0.9	0.6	600	400	100	40	70	100	70
IRFD110	0.6	800	100	1.0	0.8	0.8	200	100	25	20	25	25	20
IRFD113	0.8	800	60	0.8	0.8	0.8	200	100	25	20	25	25	20
IRFD220	0.8	400	200	0.8	0.5	0.4	600	300	80	40	60	100	60
IRFD223	1.2	400	150	0.7	0.5	0.4	600	300	80	40	60	100	60
IRFD213	2.4	300	150	0.45	0.3	0.5	150	80	25	15	25	15	15
IRFD210	1.5	600	200	0.6	0.3	0.5	150	80	25	15	25	15	15
IRFD1Z0	2.4	250	100	0.5	0.25	0.25	70	30	10	20	25	25	20
IRFD1Z3	3.2	250	60	0.4	0.25	0.25	70	30	10	20	25	25	20
P-CHANNEL													
IRFD9120	0.6	800	100	1.0	0.8	0.8	450	350	100	50	100	100	100
IRFD9123	0.8	800	60	0.8	0.8	0.8	450	350	100	50	100	100	100
IRFD9110	1.2	300	100	0.7	0.6	0.3	250	100	35	30	60	40	40
IRFD9112	1.2	300	100	0.6	0.6	0.3	250	100	35	30	60	40	40

TO-205AD (TO-39)
N-CHANNEL

Device	$r_{DS(on)}$ @ Ω Max	@ I_D A	$V_{GS(th)}$ V Min	Max	$V_{(BR)DSS}$ V Min	C_{iss} pF Max	C_{rss} pF Max	t_{on} ns Max	t_{off} ns Max
VN0300B	1.2	1.0	0.8	2.5	30	100	25	30	30
MFE930	1.4	1.0	1.0	3.5	35	70	18	15	15
MFE960	1.7	1.0	1.0	3.5	60	70	18	15	15
2N6659	1.8	1.0	0.8	2.0	35	50	10	5.0	5.0
MFE990	2.0	1.0	1.0	3.5	90	70	18	15	15
2N6660	3.0	1.0	0.8	2.0	60	50	10	5.0	5.0
2N6661	4.0	1.0	0.8	2.0	90	50	10	5.0	5.0
MFE910	5.0	0.5	0.8	2.5	60	50	10	10	10
VN1706B	6.0	0.5	0.8	2.0	170	125	20	16	30
VN2406B	6.0	0.5	0.8	2.0	240	125	20	16	30
MFE9200††	6.4	0.25	1.0	4.0	200	90	10	15	15
VN1710B	10	0.5	0.8	2.0	170	125	20	16	57
VN2410B	10	0.5	0.8	2.0	240	125	20	16	57

††TO-18 — Case Style 12

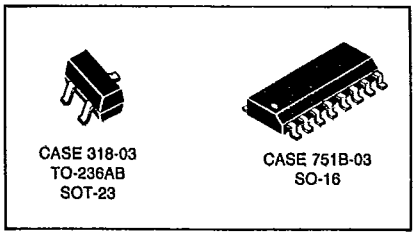
SMALL-SIGNAL FIELD-EFFECT TRANSISTORS (continued)

Table 6. Switches and Choppers (continued)

TO-205AF (TO-72)
N-CHANNEL

Device	$r_{DS(on)}$ Ω Max	@ I_D A	$V_{GS(th)}$ V Min	Max	$V_{(BR)DSS}$ V Min	C_{iss} pF Max	C_{rss} pF Max	t_{on} ns Max	t_{off} ns Max
2N6796	0.18	8.0	2.0	4.0	100	900	150	105	85
IRFF130	0.18	8.0	2.0	4.0	100	800	150	200	250
IRFF133	0.25	7.0	2.0	4.0	60	800	150	200	250
2N6788	0.3	3.5	2.0	4.0	100	600	100	110	110
IRFF120	0.3	6.0	2.0	4.0	100	600	100	110	170
2N6798	0.4	5.5	2.0	4.0	200	900	150	80	90
IRFF123	0.4	5.0	2.0	4.0	60	600	100	110	170
IRFF230	0.4	5.5	2.0	4.0	200	150	150	80	90
2N6782	0.6	3.5	2.0	4.0	100	200	25	40	45
IRFF110	0.6	3.5	2.0	4.0	100	200	25	45	45
IRFF233	0.6	4.5	2.0	4.0	150	800	150	80	90
2N6790	0.8	3.5	2.0	4.0	200	600	80	90	100
IRFF113	0.8	3.0	2.0	4.0	60	200	25	45	45
IRFF220	0.8	3.5	2.0	4.0	200	600	80	100	160
2N6800	1.0	3.0	2.0	4.0	400	900	80	65	90
IRFF330	1.0	3.5	2.0	4.0	400	900	80	65	90
IRFF223	1.2	3.0	2.0	4.0	150	600	80	100	160
2N6784	1.5	2.25	2.0	4.0	200	200	25	35	50
2N6802	1.5	3.5	2.0	4.0	500	900	60	60	85
IRFF210	1.5	2.2	2.0	4.0	200	150	25	40	30
IRFF333	1.5	3.0	2.0	4.0	350	900	80	65	90
IRFF430	1.5	2.75	2.0	4.0	500	800	60	60	85
IRFF313	1.5	1.15	2.0	4.0	350	150	15	30	25
IRFF433	2.0	2.25	2.0	4.0	450	800	60	60	85
IRFF213	2.4	1.8	2.0	4.0	150	150	25	40	30
IRFF310	3.6	1.35	2.0	4.0	400	150	15	30	25
P-CHANNEL									
IRFF9123	0.8	−3.5	2.0	4.0	−60	450	100	151	200

Small-Signal Surface Mount Devices



CASE 318-03
TO-236AB
SOT-23

CASE 751B-03
SO-16

Bipolar Transistors — SOT-23

Table 1. General-Purpose

Pinout: 1-Base, 2-Emitter, 3-Collector
Devices are listed in order of descending breakdown voltage.

Device	Marking	$V_{(BR)CEO}$	h_{FE}			f_T
			Min	Max	@ I_C (mA)	Min (MHz)
BC846AL	1A	65	110	220	2.0	100
BC846BL	1B	65	200	450	2.0	100
BSS82BL	CH	60	40	120	150	100
BC817-16L	6A	45	100	250	100	200
BC817-25L	6B	45	160	400	100	200
BC817-40L	6C	45	250	600	100	200
BC847AL	1E	45	110	220	2.0	100
BC847BL	1F	45	200	450	2.0	100
BC847CL	1G	45	420	800	2.0	100
BCX70KL	AK	45	100	—	50	125
BCX70JL	AJ	45	90	—	50	125
BCW72L	K2	45	200	450	2.0	—
BCX70HL	AH	45	70	—	50	125
BCX70GL	AG	45	60	220	50	125
MMBT930L	1X	45	150	—	0.5	30
BCW71L	K1	45	110	220	2.0	—
BCX19L	U1	45	40	—	500	200
MMBC1623L7L	L7	40	300	600	1.0	200
MMBC1623L6L	L6	40	200	400	1.0	200
MMBC1623L5L	L5	40	135	270	1.0	200
BSS79CL	CF	40	100	300	150	250
MMBT2222AL	1P	40	40	—	500	200
MMBC1623L4L	L4	40	90	180	1.0	200
MMBC1623L3L	L3	40	60	120	1.0	200
BSS79BL	CE	40	40	120	150	250
MMBTA20L	1C	40	40	400	5.0	125
MMBT4123L	5B	30	25	—	50	250
MMBC1622D7L	D7	35	300	600	0.5	100
MMBC1622D6L	D6	35	200	400	0.5	100
BCW60AL	AA	32	60	—	50	125
BCW60DL	AD	32	100	—	50	125
BCW65AL	EA	32	100	250	100	100
BCW60CL	AC	32	90	—	50	125
BCW60BL	AB	32	70	—	50	125
BC848AL	1J	30	110	220	2.0	100
BC848BL	1K	30	200	450	2.0	100
BC848CL	1L	30	420	800	2.0	100
MMBC1009F1L	F1	25	30	60	0.5	150
MMBC1009F3L	F3	25	60	120	0.5	150
BC818-16L	6E	25	100	250	100	200
BC818-25L	6F	25	160	400	100	200
BC818-40L	6G	25	250	600	100	200
BCX20L	U2	25	100	600	100	—
BCW33L	D3	20	420	—	2.0	—
BCW31L	D1	20	110	220	2.0	—

Table 1. General-Purpose (continued)

Device	Marking	$V_{(BR)CEO}$	h_{FE}			f_T
			Min	Max	@ I_C (mA)	Min (MHz)
PNP						
MMBT8599L	2W	80	75	—	100	150
BC856AL	3A	65	125	250	2.0	100
BC856BL	3B	65	220	475	2.0	100
MMBT8598L	2K	60	75	—	100	150
BSS82CL	CM	60	100	300	150	100
MMBA811C8L	C8	45	450	900	5.0	50
BC807-16L	5A	45	100	250	100	200
BC807-25L	5B	45	160	400	100	200
BC807-40L	5C	45	250	600	100	200
BC857AL	3E	45	125	250	2.0	100
BC857BL	3F	45	220	475	2.0	100
BC857CL	3G	45	420	800	2.0	100
BCX71KL	BK	45	100	—	50	—
MMBA811C7L	C7	45	300	600	5.0	50
BCX71JL	BJ	45	100	—	50	—
BCW70L	H2	45	215	500	2.0	—
MMBA811C6L	C6	45	200	400	5.0	50
BCW68GL	DG	45	60	—	500	100
MMBA811C5L	C5	45	135	270	5.0	50
BCW69L	H1	45	120	260	2.0	—
BCX71GL	BG	45	60	—	50	—
BCW68FL	DF	45	35	—	500	100
BCX17L	T1	45	100	600	100	100
MMBA812M7L	M7	40	300	600	1.0	150
MMBA812M6L	M6	40	200	400	1.0	150
MMBA812M5L	M5	40	135	270	1.0	150
MMBA812M4L	M4	40	90	180	1.0	150
MMBA812M3L	M3	40	60	120	1.0	150
BSS80BL	CH	40	40	120	150	200
BSS80CL	CJ	40	100	30	150	200
MMBTA70L	2C	40	40	400	5.0	125
BCW61DL	BD	32	110	—	50	—
BCW61CL	BC	32	100	—	50	—
BCW67CL	EC	32	100	—	500	100
BCW61BL	BB	32	80	—	50	—
BCW67BL	DB	32	60	—	500	100
BCW61AL	BA	32	60	—	50	—
BCW67AL	DA	32	35	—	500	100
BC808-16L	5E	25	100	250	100	200
BC808-25L	5F	25	160	400	100	200
BC808-40L	5G	25	250	600	100	200
BC858AL	3J	30	125	250	2.0	100
BC858BL	3K	30	220	475	2.0	100
BC858CL	3L	30	420	800	2.0	100
MMBT4125L	ZD	30	25	—	50	200
BCX18L	T2	25	40	—	500	—
MMBTA55L	AL	25	30	—	500	100
BCW30L	C2	20	215	500	2.0	—
BCW29L	C1	20	120	260	2.0	—

Table 2. Switching Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	Switching Time (ns) t_{on}	Switching Time (ns) t_{off}	$V_{(BR)CEO}$	h_{FE} Min	h_{FE} Max	h_{FE} @ I_C (mA)	f_T Min (MHz)
NPN								
MMBT2369L	1J	12	18	15	20	—	100	—
BSV52L	B2	12	18	12	40	120	10	400
MMBT2222L	1B	35	385	30	30	—	500	250
MMBT2222AL	1P	35	385	40	40	—	500	200
MMBT4401L	2X	35	255	40	40	—	500	250
MMBT3903L	1Y	70	225	40	15	—	100	250
MMBT3904L	1A	70	250	40	30	—	100	200
PNP								
MMBT3640L	2J	25	35	12	20	—	50	500
MMBT4403L	2T	35	225	40	90	180	1.0	150
MMBT2907L	2B	45	100	40	30	—	500	200
MMBT2907AL	2F	45	100	60	50	—	500	200
MMBT3906L	2A	70	300	40	100	300	10	250

Table 3. VHF/UHF Amplifiers, Mixers, Oscillators

Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	$V_{(BR)CEO}$	C_{ob} Max (pF)	f_T Min (GHz)	f_T @ I_C (mA)
NPN					
MMBTH10L	3E	25	0.7	0.65	4.0
MMBC1321Q3L	Q3	25	1.8	0.6	2.0
MMBC1321Q4L	Q4	25	1.8	0.6	2.0
MMBC1321Q5L	Q5	25	1.8	0.6	2.0
MMBT918L	3B	15	1.7	0.6	4.0
MMBTH24L	3A	30	0.36	0.4	8.0
PNP					
MMBTH81L	3D	20	0.85	0.6	5.0

Table 4. Choppers

Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	$V_{(BR)EBO}$	$V_{(BR)CEO}$	h_{FE} Min	h_{FE} Max	h_{FE} @ I_C (mA)
PNP						
MMBT404L	2M	12	24	30	400	12
MMBT404AL	2N	25	35	30	400	12

Table 5. Darlingtons

Pinout: 1-Base, 2-Emitter, 3-Collector
Devices are listed in order of descending h_{FE}.

Device	Marking	$V_{(BR)CEO}$	$V_{CE(sat)}$ Max (V)	h_{FE} Min	h_{FE} Max	h_{FE} @ I_C (mA)
NPN						
MMBTA14L	1N	30	1.5	20K	—	100
MMBT6427L	1V	40	1.5	14K	140K	500
MMBTA13L	1M	30	1.5	10K	—	100
PNP						
MMBTA64L	2V	30	1.5	20K	—	100
MMBTA63L	2U	30	1.5	10K	—	100

Table 6. Low-Noise Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector
Devices are listed in order of ascending NF.

Device	Marking	NF Typ (dB)	$V_{(BR)CEO}$	h_{FE} Min	h_{FE} Max	h_{FE} @ I_C (mA)	f_T Min (MHz)
NPN							
MMBT5088L	1Q	1.0	30	300	—	10	50
MMBT5089L	1R	1.0	30	400	—	10	50
MMBT2484L	1U	3.0	60	—	800	10	15
MMBT6428L	1K	3.0	50	250	—	10	100
MMBT6429L	1L	3.0	45	500	—	10	100
BC849BL	2B	4.0*	30	200	450	2.0	100
BC849CL	2C	4.0*	30	420	800	2.0	100
BC850BL	2F	4.0*	45	200	450	2.0	100
BC850CL	2G	4.0*	45	420	800	2.0	100
PNP							
MMBT5086L	2P	1.0	50	150	—	10	40
MMBT5087L	2Q	1.0	50	250	—	10	40
BC859AL	4A	4.0*	30	100	220	2.0	100
BC859BL	4B	4.0*	30	200	450	2.0	100
BC859CL	4C	4.0*	30	420	800	2.0	100
BC860AL	4E	4.0*	45	100	220	2.0	100
BC860BL	4F	4.0*	45	200	450	2.0	100
BC860CL	4G	4.0*	45	420	800	2.0	100

*Max

Table 7. High-Voltage Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector
Devices are listed in order of descending breakdown voltage.

Device	Marking	$V_{(BR)CEO}$	h_{FE} Min	h_{FE} Max	h_{FE} @ I_C (mA)	f_T Min (MHz)
NPN						
MMBT6517L	1Z	350	15	—	100	40
MMBTA42L	1D	300	40	—	30	50
MMBTA43L	1E	200	40	—	30	50
MMBC1654N5L	N5	160	50	130	15	120
MMBC1654N6L	N6	160	100	220	15	120
MMBC1654N7L	N7	160	150	330	15	120
MMBT5550L	1F	160	30	—	50	100
MMBT5551L	G1	160	30	—	50	100
PNP						
MMBT6520L	2Z	350	15	—	100	40
MMBTA92L	2D	300	25	—	30	50
MMBTA93L	2E	200	25	—	30	50
MMBT5401L	2L	150	50	—	50	100

Table 8. Drivers

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Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	$V_{(BR)CEO}$	h_{FE}			f_T
			Min	Max	@ I_C (mA)	Min (MHz)
NPN						
MMBTA06L	1G	80	50	—	100	100
BSS64L	AM	80	20	80	4	50
MMBTA05L	1H	60	50	—	100	100
PNP						
BSS63L	BM	100	30	—	25	50
MMBTA55L	2H	60	50	—	100	50
MMBTA56L	2G	80	50	—	100	50

Table 9. RF Transistors

Pinout: 1-Base, 2-Emitter, 3-Collector

Device	Marking	f_T			NF			MAG			f
		Typ (GHz)	I_C (mA)	V_{CE} (V)	Typ (dB)	@ I_C (mA)	V_{CE} (V)	Typ (dB)	@ I_C (mA)	V_{CE} (V)	(MHz)
NPN											
MMBR571L	7X	8.0	50	10	2.0	5.0	6.0	16.5*	5.0	6.0	500
MMBR911L	7P	6.0	30	10	2.0	10	10	17*	10	5.0	500
MMBR930L	7C	5.5	30	5.0	1.9	2.0	5.0	11	30	5.0	500
BFR92L	P1	3.0	14	10	3.0	3.0	1.5	—	—	—	500
BFR93L	R1	3.0	30	5.0	2.5	2.0	5.0	—	—	—	30
MMBR931L	7D	3.5	1.0	1.0	4.3	0.5	1.0	10	1.0	1.0	1000
MMBR2060L	7E	2.5	20	1.0	2.0	1.5	10	13	20	10	450
MMBR5179L	7H	1.5	5.0	6.0	4.0	1.5	6.0	11	5.0	6.0	450
MMBR920L	7B	4.5	14	10	2.4	2.0	10	15	2.0	10	500
MMBR901L	7A	4.0	15	10	1.9	5.0	6.0	16	5.0	6.0	1000
MMBR941L	7Y	8.0	15	6.0	1.7	5.0	6.0	12.5	5.0	6.0	2000
MMBR951L	7Z	7.5	30	6.0	1.7	5.0	6.0	12.5	5.0	6.0	2000
MMBR5031L	7G	2.0	5.0	6.0	1.9	1.0	6.0	17	1.0	6.0	450
MMBR2857L	7K	1.2	4.0	10	3.0	1.5	6.0	12.5	1.5	6.0	450
BFS17L	E1	1.0	2.0	5.0	5.0	2.0	5.0	—	—	—	30
PNP											
MMBR536L	7R	5.5	20	5.0	4.5	10	5.0	—	—	—	500
MMBR4957L	7F	2.0	2.0	10	3.0	2.0	10	17	2.0	10	450

*GNF

Table 10. Bipolar Quad Transistors — SO-16

Device	$V_{(BR)CEO}$	$V_{(BR)CBO}$	h_{FE}		f_T		Package
			Min	@ I_C mA	MHz Min	@ I_C (mA)	
MMPQ2222	40	60	30	300	350*	20	SO-16
MMPQ2222A	40	75	40	500	350*	20	SO-16
MMPQ2369	15	40	20	100	450	10	SO-16
MMPQ2907	40	40	30	300	350*	50	SO-16
MMPQ2907A	50	60	50	500	350*	50	SO-16
MMPQ3467	40	40	20	500	125	50	SO-16
MMPQ3725	40	60	25	500	250	50	SO-16
MMPQ3725A	50	70	30	500	200	50	SO-16
MMPQ3762	40	40	20	1000	150	50	SO-16

*Typ

Field-Effect Transistors — SOT-23

Table 11. RF JFETs

Pinout: 1-Drain, 2-Source, 3-Gate

Device	Marking	NF		Y_{fs}			$V_{(BR)GSS}$
		Typ (dB)	f (MHz)	Min (mmhos)	Max (mmhos)	V_{DS} (V)	
N-CHANNEL							
MMBFU310L	6C	1.5	1.0	10	18	10	−25
MMBF112L	TV	3.0**	—	1.0	7.5	10	−25
MMBF5484L	6B	2.0	100	3.0	6.0	15	−25
MMBF5486L	6H	2.0	100	4.0	8.0	15	−25
MMBF4416L	6A	2.0	100	4.5	7.5	15	−30
MMBFJ310L	6T	4.0	450	8.0	18	10	−25

**Max

Table 12. General-Purpose JFETs

Pinout: 1-Drain, 2-Source, 3-Gate

Device	Marking	$V_{(BR)GSS}$	Y_{fs}			I_{DSS}	
			Min (mmhos)	Max (mmhos)	V_{DS} (V)	Min (mA)	Max (mA)
N-CHANNEL							
MMBF5457L	6D	25	1.0	5.0	15	1.0	5.0
MMBF5459L	6L	25	2.0	6.0	15	4.0	16
P-CHANNEL							
MMBF5460L	6E	−40	1.0	4.0	−15	1.0	5.0

Table 13. Choppers/Switches, JFETs

Pinout: 1-Drain, 2-Source, 3-Gate

Device	Marking	$r_{DS(on)}$ Max (Ohms)	t_{off} Max (ns)	$V_{(BR)GSS}$	$V_{GS(off)}$		I_{DSS}	
					Min (V)	Max (V)	Min (mA)	Max (mA)
N-CHANNEL								
MMBF4391L	6J	30	20	30	−4.0	−10	50	150
BSR56L	M4	25	25	40	−4.0	−10	50	—
MMBF4860L	6F	40	50	30	−2.0	−6.0	20	100
BSR57L	M5	40	50	40	−2.0	−6.0	20	100
MMBF4392L	6K	60	35	30	−2.0	−5.0	25	75
BSR58L	M6	60	100	40	−0.8	−4.0	8.0	80
MMBF4393L	6G	100	50	30	−0.5	−3.0	5.0	30
P-CHANNEL								
MMBFJ175L	6W	125	30(t)	−30	3.0	6.0	−7.0	−60
MMBFJ177L	6Y	300	45(t)	−30	0.8	2.5	−1.5	−20

Table 14. TMOS FETs

Pinout: 1-Gate, 2-Source, 3-Drain

Device	Marking	$r_{DS(on)}$		V_{DSS}	$V_{GS(th)}$		Switching Time	
		Ohm	mA		Min (V)	Max (V)	t_{on} ns	t_{off} ns
N-CHANNEL								
MMBF170L	6Z	5.0	200	60	0.8	3.0	10	10
BSS123L	SA	6.0	100	100	0.8	2.8	20	40
2N7002	702	7.5	500	60	1.0	2.5	20	20

Table 15. Zener Diodes

Zener Diodes are offered in two popular series. The MMBZ5226 has the same specifications as the standard axial leaded 1N5226 series. The BCX84 series is identical to popular European series SOT-23's.

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Pinout: 1-Anode, 2-NC, 3-Cathode (V_F = 0.9 V Max @ I_F = 10 mA for all types.)

Device	Marking	Test Current I_{ZT} mA	Zener Voltage V_Z (±5%) Nominal	Z_{ZK} I_Z = 0.25 mA Ω Max	Z_{ZT} $I_Z = I_{ZT}$ @ 10% Mod Ω Max	Max I_R μA @	V_R V
MMBZ5226BL	8A	20	3.3	1600	28	25	1
MMBZ5227BL	8B	20	3.6	1700	24	15	1.0
MMBZ5228BL	8C	20	3.9	1900	23	10	1.0
MMBZ5229BL	8D	20	4.3	2000	22	5.0	1.0
MMBZ5230BL	8E	20	4.7	1900	19	5.0	2.0
MMBZ5231BL	8F	20	5.1	1600	17	5.0	2.0
MMBZ5232BL	8G	20	5.6	1600	11	5.0	3.0
MMBZ5233BL	8H	20	6.0	1600	7.0	5.0	3.5
MMBZ5234BL	8J	20	6.2	1000	7.0	5.0	4.0
MMBZ5235BL	8K	20	6.8	750	5.0	3.0	5.0
MMBZ5236BL	8L	20	7.5	500	6.0	3.0	6.0
MMBZ5237BL	8M	20	8.2	500	8.0	3.0	6.5
MMBZ5238BL	8N	20	8.7	600	8.0	3.0	6.5
MMBZ5239BL	8P	20	9.1	600	10	3.0	7.0
MMBZ5240BL	8Q	20	10	600	17	3.0	8.0
MMBZ5241BL	8R	20	11	600	22	2.0	8.4
MMBZ5242BL	8S	20	12	600	30	1.0	9.1
MMBZ5243BL	8T	9.5	13	600	13	0.5	9.9
MMBZ5244BL	8U	9	14	600	15	0.1	10
MMBZ5245BL	8V	8.5	15	600	16	0.1	11
MMBZ5246BL	8W	7.8	16	600	17	0.1	12
MMBZ5247BL	8X	7.4	17	600	19	0.1	13
MMBZ5248BL	8Y	7.0	18	600	21	0.1	14
MMBZ5249BL	8Z	6.6	19	600	23	0.1	14
MMBZ5250BL	81A	6.2	20	600	25	0.1	15
MMBZ5251BL	81B	5.6	22	600	29	0.1	17
MMBZ5252BL	81C	5.2	24	600	33	0.1	18
MMBZ5253BL	81D	5.0	25	600	35	0.1	19
MMBZ5254BL	81E	4.6	27	600	41	0.1	21
MMBZ5255BL	81F	4.5	28	600	44	0.1	21
MMBZ5256BL	81G	4.2	30	600	49	0.1	23
MMBZ5257BL	81H	3.8	33	700	58	0.1	25

Pinout: 1-Anode, 2-NC, 3-Cathode

Device	Marking	V_{Z1} Volts		V_{Z2} Volts		V_{Z3} Volts @ I_Z mA					Max I_R		Z_{ZT} (ohms) (max)
		Min	Max	Min	Max	Min	Max	I_{Z1}	I_{Z2}	I_{Z3}	@ V_R (Volts)	I_R (μA)	@ $I_Z = I_{Z1}$
BZX84C3V3L	Z14	3.1	3.5	2.3	2.9	3.6	4.2	5.0	1.0	20	1.0	5.0	95
BZX84C4V3L	W9	4.0	4.6	3.3	4	4.4	5.1	5.0	1.0	20	1.0	3.0	90
BZX84C4V7L	Z1	4.4	5.0	3.7	4.7	4.5	5.4	5.0	1.0	20	2.0	3.0	80
BZX84C5V1L	Z2	4.8	5.4	4.2	5.3	5.0	5.9	5.0	1.0	20	2.0	2.0	60
BZX84C5V6L	Z3	5.2	6.0	4.8	6.0	5.2	6.3	5.0	1.0	20	2.0	1.0	40
BZX84C6V2L	Z4	5.8	6.6	5.6	6.6	5.8	6.8	5.0	1.0	20	4.0	3.0	10
BZX84C6V8L	Z5	6.4	7.2	6.3	7.2	6.4	7.4	5.0	1.0	20	4.0	2.0	15
BZX84C7V5L	Z6	7.0	7.9	6.9	7.9	7.0	8.0	5.0	1.0	20	5.0	1.0	15
BZX84C8V2L	Z7	7.7	8.7	7.6	8.7	7.7	8.0	5.0	1.0	20	5.0	0.7	15
BZX84C9V1L	Z8	8.5	9.6	8.4	9.6	8.5	9.7	5.0	1.0	20	6.0	0.5	15
BZX84C10L	Z9	9.4	10.6	9.3	10.6	9.4	10.7	5.0	1.0	20	7.0	0.2	20
BZX84C11L	Y1	10.4	11.6	10.2	11.6	10.4	11.8	5.0	1.0	20	8.0	0.1	20
BZX84C12L	Y2	11.4	12.7	11.2	12.7	11.4	12.9	5.0	1.0	20	8.0	0.1	25
BZX84C13L	Y3	12.4	14.1	12.3	14	12.5	14.2	5.0	1.0	20	8.0	0.1	30
BZX84C15L	Y4	13.8	15.6	13.7	15.5	13.9	15.7	5.0	1.0	20	10.5	0.05	30
BZX84C16L	Y5	15.3	17.1	15.2	17	15.4	17.2	5.0	1.0	20	11.2	0.05	40
BZX84C18L	Y6	16.8	19.1	15.7	19	16.9	19.2	5.0	1.0	20	12.6	0.05	45
BZX84C20L	Y7	18.8	21.2	18.7	21.1	18.9	21.4	5.0	1.0	20	14	0.05	55
BZX84C22L	Y8	20.8	23.3	20.7	23.2	20.9	23.4	5.0	1.0	20	15.4	0.05	55
BZX84C24L	Y9	22.8	25.6	22.7	25.5	22.9	25.7	5.0	1.0	20	16.8	0.05	70
BZX84C27L	Y10	25.1	28.9	25	28.9	25.2	29.3	2.0	0.5	10	18.9	0.05	80(1)
BZX84C30L	Y11	28	32	27.8	32	28.1	32.4	2.0	0.5	10	21	0.05	80(1)
BZX84C33L	Y12	31	35	30.8	35	31.1	35.4	2.0	0.5	10	23.1	0.05	80(1)

NOTE: (1) rdiff @ I_Z = 2.0 mA

Multiple Devices

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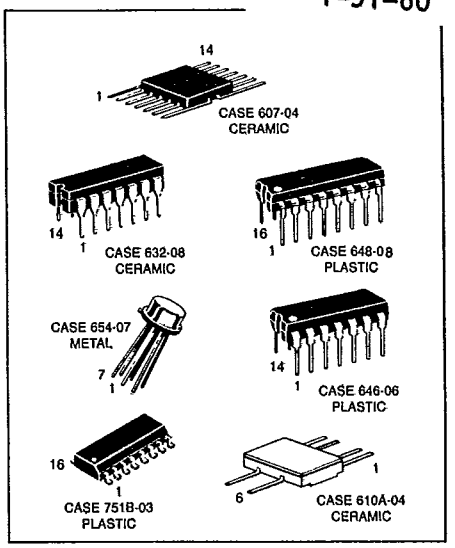


Bipolar Devices

The trend in electronic system design is toward the use of integrated circuits — to reduce component cost, assembly cost, and equipment cost. But ICs still aren't all things to all people, and for those circuit designs where ICs are not available, there is a noticeable swing towards the use of multiple devices.*

Motorola is reacting to this expanding market requirement by making available a large selection of quad, dual, Darlington transistors, and diode arrays for off-the-shelf delivery. The chips used in the Quad and Dual transistors are those that have emerged as the most popular ones for discrete transistor applications. But even beyond that, Motorola offers its entire vast repertoire of discrete small-signal transistors for multiple-device packaging. For special applications where the devices in these tables might not quite fit the design requirements, special configurations can be supplied with quick turnaround time and at low premiums.

Specification Tables

The following short form specifications include Quad and Dual bipolar transistors listed in alphanumeric order. Some columns denote two different types of data indicated by either **bold** or *italic* typeface. See key and headings for proper identification. This applies to Table 1 and 2 of this section only.

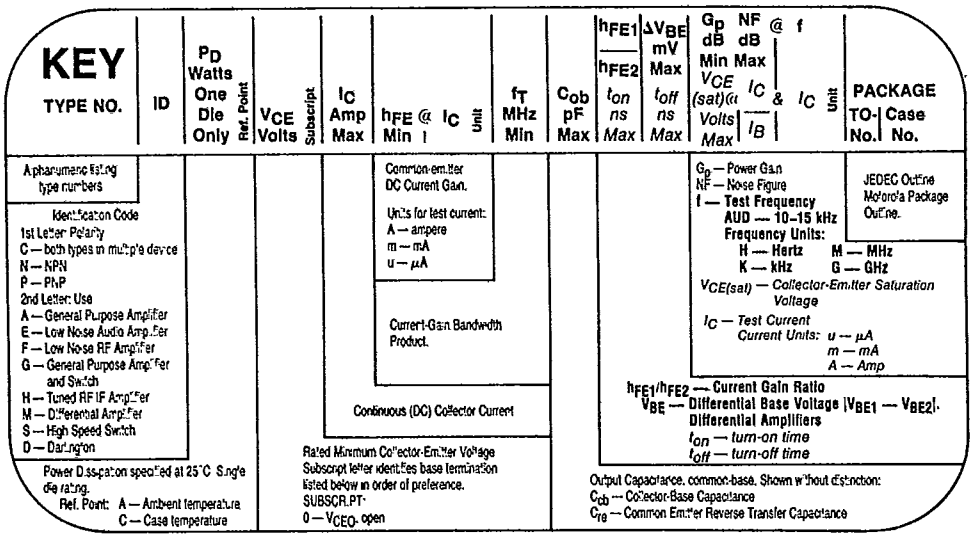


Table 1. Bipolar Transistors — Quads

TYPE NO.	ID	PD Watts One Die Only	VCE- Volts	IC Amp Max	hFE @ IC Min		fT MHz Min Typ*	Cob pF Max Typ*	hFE1/hFE2 ton ns Max Typ*	ΔVBE mV Max toff ns Max Typ*	Gp dB Min VCE (sat) @ Volts Max	NF @ dB Max Typ* IC/IB	f IC	PACKAGE TO-No.	PACKAGE Case No.
2N6987	PA	0.525 A	60 O	0.6	50	500 m	250	8.0	45	300	0.4	10	150 m		632
2N6988	PA	0.525 A	60 O	0.6	50	500 m	250	8.0	45	300	0.4	10	150 m		607
2N6989	NA	0.525 A	50 O	0.8	30	500 m	250	8.0	35	300	0.3	10	150 m		632
2N6990	NA	0.525 A	50 O	0.8	30	500 m	250	8.0	35	300	0.3	10	150 m		607
MHQ918	NA	0.65	15	0.05	20	3.0 m	600	2.0	—	—	0.4	10	10 m	116	632
MHQ2222	NA	0.65	30 O	0.5	30	300 m	200	8.0	25*	250*	0.4	10	15 m	116	632
MHQ2369	NS	0.5 A	15 O	0.5	40	10 m	450	4.0	9.0*	15*	0.25	10	10 m	116	632
MHQ2906	PG	0.65 A	40 O	0.6	40	150 m	200	8.0	30*	100*	0.4	10	150 m	116	632
MHQ2907†	PG	0.65 A	40 O	0.6	100	150 m	200	8.0	30*	100*	0.4	10	150 m	116	632
MHQ3467†	PS	0.9 A	40 O	1.0	20	500 m	125	25	40	90	0.5	10	500 m	116	632
MHQ3546	PS	0.5 A	12 O	0.2	30	10 m	600	6.0	0.15*	25*	0.25	10	10 m	116	632
MHQ3798	PA	0.5 A	40 O	0.05	150	0.1 m	60	4.0				3.0*	AUD	116	632
MHQ4002A	NS	0.75 A	45 O	1.5	30	500 m	200	10	40	75	0.52	10	500 m	116	632
MHQ4013††	NS	0.75 A	40 O	1.5	35	500 m	200	10	35	60	0.52	10	500 m	116	632
MHQ4014	NS	0.75 A	45 O	1.5	35	500 m	200	10	35	60	0.52	10	500 m	116	632
MHQ6002	CA	0.65 A	30 O	0.5	100	150 m	200	8.0	30*	225*	0.4	10	150 m	116	632
MPQ1000	NA	0.65 A	20 O	0.5	50	10 m	175	8.0			0.5	10	150 m		646
MPQ2221	NA	0.65 A	30 O	0.5	40	150 m	200	8.0	25*	250*	0.4	10	150 m		646
MPQ2222	NA	0.65 A	30 O	0.5	100	150 m	200	8.0	25*	250*	0.4	10	150 m		646
MPQ2222A	NA	0.65 A	30 O	0.5	100	150 m	200	8.0	25*	250*	0.4	10	150 m		646
MPQ2369	NS	0.5 A	15 O	0.5	40	10 m	450	4.0	9.0*	15*	0.25	10	10 m		646
MPQ2483	NA	0.625 A	40 O	0.05	150	1.0 m	50					3.0*	AUD		646
MPQ2484	NA	0.625 A	40 O	0.05	300	1.0 m	50					2.0*	AUD		646
MPQ2906	PA	0.65 A	40 O	0.6	40	150 m	200	8.0	30*	100*	0.4	10	150 m		646
MPQ2907	PA	0.65 A	40 O	0.6	100	150 m	200	8.0	30*	100*	0.4	10	150 m		646
MPQ2907A	PA	0.65 A	60 O	0.6	100	150 m	200	8.0	30*	100*	0.4	10	150 m		646
MPQ3467	PS	0.75 A	40 O	1.0	20	500 m	125	25	40	90	0.5	10	500 m		646
MPQ3546	PA	0.5 A	12 O	0.2	30	10 m	600	6.0	15*	25*	0.25	10	10 m		646
MPQ3725†	NS	1.0 A	40 O	1.0	25	500 m	250	10	35	60	0.45	10	500 m		646
MPQ3725A	NS	1.0 A	50 O	1.0	30	500 m	200	10	3.5	60	0.45		500 m		646
MPQ3762	PS	0.75 A	40 O	1.5	35	150 m	150	15	50	120	0.55	10	500 m		646
MPQ3798	PA	0.625 A	40 O	0.05	150	0.1 m	60	4.0				3.0*	AUD		646
MPQ3799	PA	0.625 A	60 O	0.05	300	0.1 m	60	4.0				2.0*	AUD		646
MPQ3904	NG	0.5 A	40 O	0.2	75	10 m	250	4.0	37*	136*	0.2	10	10 m		646
MPQ3906	PG	0.5 A	40 O	0.2	75	10 m	200	4.5	43*	155*	0.25	10	10 m		646
MPQ6001	CG	0.65 A	30 O	0.5	40	150 m	200	8.0	30*	225*	0.4	10	150 m		646
MPQ6002	CG	0.65 A	30 O	0.5	100	150 m	200	8.0	30*	225*	0.4	10	150 m		646
MPQ6100	CA	0.5 A	40 O	0.05	75	1.0 m	50	4.0				4.0*	AUD		646
MPQ6100A	CA	0.5 A	45 O	0.05	150	1.0 m	50	4.0				4.0*	AUD		646
MPQ6426	ND	0.5 A	30 O	0.5	10K	100 m	125	8.0	—	—	1.5	10	100 m		646
MPQ6427	ND	0.5 A	40 O	0.5	10K	100 m	125	8.0	—	—	1.5	10	100 m		646
MPQ6501	CG	0.65 A	30 O	0.5	40	150 m	200	8.0	30*	225*	0.4	10	150 m		646
MPQ6502	CG	0.65 A	30 O	0.5	100	150 m	200	8.0	30*	225*	0.4	10	150 m		646
MPQ6600	CA	0.5 A	40 O	0.05	75	1.0 m	50	4.0				4.0*	AUD		646
MPQ6600A	CA	0.5 A	45 O	0.05	150	1.0 m	50	4.0			0.25	4.0	1.0 m		646
MPQ6700	CA	0.5 A	40 O	0.2	70	10 m	200	4.5			0.25	4.0	1.0 m		646
MPQ6842	CA	0.75 A	40 O	0.5	70	10 m	300	4.5	45	150	0.15	10	0.5 m		646
MPQ7041	NA	0.75 A	150 O	0.5	25	1.0 m	50	5.0			0.5	10	20 m		646
MPQ7042	NA	0.75 A	200 O	0.5	25	1.0 m	50	5.0			0.5	10	20 m		646
MPQ7043	NA	0.75 A	250 O	0.5	25	1.0 m	50	5.0			0.5	10	20 m		646
MPQ7091	PA	0.75 A	150 O	0.5	25	1.0 m	50	5.0			0.5	10	20 m		646
MPQ7092	PA	0.75 A	200 O	0.5	25	1.0 m	50	5.0			0.5	10	20 m		646
MPQ7093	PA	0.75 A	250 O	0.5	35	10 m	50	5.0			0.5	10	20 m		646
MQ918	NA	0.55 A	15 O	0.05	50	3.0 m	600	1.7				6.0	60 M		607
MQ982	PA	0.4 A	50 O	0.6	40	150 m	200	8.0			0.5	10	150 m		607

†H, HX, and HXV Suffixes also available.
††MHQ4013 is electrically equivalent to MHQ3725.
Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

T-91-60

Table 1. Bipolar Transistors — Quads (continued)

TYPE NO.	I_D	P_D Watts One Die Only	V_{CE} Volts		I_C Amp Max	h_{FE} @ I_C Min		f_T MHz Min Typ*	C_{ob} pF Max Typ*	h_{FE1}/h_{FE2}	ΔV_{BE} mV Max	G_p dB Min	NF @ f dB Max Typ*		I_C	PACKAGE	
										t_{on} ns	t_{off} ns	V_{CE} (sat) @	I_C / I_B			TO-No.	Case No.
										Max Typ*	Max Typ*	Volts Max					
MQ1120	PA	0.4 A	30	O	0.5	50	10 m	200	8.0			0.1	10	10 m			607
MQ1129	NA	0.4 A	30	O	0.5	100	10 m	200	8.0			0.15	10	10 m			607
MQ2218	NA	0.4 A	30	O	0.5	40	150 m	200	8.0			0.4	10	150 m			607
MQ2218A	NA	0.6 A	40	O	0.5	40	150 m	200	8.0			0.4	10	150 m			607
MQ2219	NA	0.6 A	30	O	0.5	100	150 m	200	8.0			0.3	10	150 m			607
MQ2219A	NA	0.4 A	30	O	0.5	100	150 m	200	8.0			0.3	10	150 m			607
MQ2369	NS	0.4 A	15	O	0.5	40	10 m	500	4.0	15	20	0.25	10	10 m			607
MQ2484	NE	0.4 A	60	O	0.03	100	10 u	260*	6.0				3.0	AUD			607
MQ2905A	PG	0.4 A	60	O	0.6	100	150 m	300	8.0	42	130	0.4	10	150 m			607
MQ3251	PA	0.4 A	40	O	0.05	100	10 m	300	6.0			0.25	10	10 m			607
MQ3467	PS	0.4 A	40	O	1.0	20	500 m	150	20	40	110	0.5	10	500 m			607
MQ3725	NS	0.4 A	40	O	1.0	50	100 m	200	10	45	75	0.26	10	100 m			607
MQ3762	PS	0.4 A	40	O	1.5	20	1.0 A	150	20	40	110	1.0	10	1.0 A			607
MQ3798	PA	0.4 A	60	O	0.05	150	100 u	450*	4.0			0.2	10	1.0 m			607
MQ6001	CG	0.4 A	30	O	0.5	40	150 m	200	8.0	60	350	0.4	10	150 m			607
MQ7001	PA	0.4 A	30	O	0.6	70	1.0 m	200	8.0			0.4	10	150 m			607
MQ7003	NA	0.4 A	40	O	0.05	50	10 m	200	6.0			0.35	10	1.0 m			607
MQ7007	PA	0.4 A	40	O	0.2	30	1.0 m	300	8.0			1.0	10	50 m			607
MQ7021	CG	0.4 A	40	O	0.05	50	10 m	200	6.0	28*	72*	0.35	10	10 m			607
2N5146	PA	0.4 A	40	O	1.5	20	1.0 A	150	20	40	110	1.0	10	1.0 A			607

Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

Table 2. Bipolar Transistors — Dual

TYPE NO.	I_D	P_D Watts One Die Only	V_{CE} Volts		I_C Amp Max	h_{FE} @ I_C Min		f_T MHz Min Typ*	C_{ob} pF Max Typ*	h_{FE1}/h_{FE2}	ΔV_{BE} mV Max	G_p dB Min	NF @ f dB Max Typ*		I_C	PACKAGE	
										t_{on} ns	t_{off} ns	V_{CE} (sat) @	I_C / I_B			TO-No.	Case No.
										Max Typ*	Max Typ*	Volts Max					
BFX11	PM	0.4 A	45	O	0.05	80	50 m	130	8.0	0.8	5.0	0.25	20	50 m		78	654
BFX15	NM	0.5 A	40	O	0.5	60	100 u	50	15	0.9	5.0	1.0	10	1.0 m		78	654
BFX36	PM	0.4 A	60	O	0.05	100	10 u	40	6.0	0.9	3.0	0.25	20	10 m		78	654
BFY81	NM	0.4 A	45	O	0.03	100	100 u	60	6.0	0.8	10	0.35	10	1.0 m		78	654
MD708	NG	0.55 A	15	O	0.2	40	10 m	300	5.0	35	75	0.2	10	10 m			654
MD708A	NM	0.55 A	15	O	0.2	40	10 m	300	5.0	0.9	5.0	0.2	10	10 m			654
MD708AF	NM	0.55 A	15	O	0.2	40	10 m	300	5.0	—	—	0.85	10	100 m			654
MD708B	NM	0.55 A	15	O	0.2	40	10 m	300	5.0	0.8	10	0.2	10	10 m			654
MD708BF	NM	0.55 A	15	O	0.2	40	10 m	300	5.0	—	—	0.85	10	100 m			654
MD708F	NM	0.55 A	15	O	0.2	40	10 m	300	5.0	—	—	0.85	10	100 m			654
MD918A	NM	0.55 A	15	O	0.05	50	3.0 m	600	1.7	0.9	5.0		6.0	60 M			654
MD918AF	NM	0.35 A	15	O	0.05	50	3.0 m	600	1.7	0.9	5.0		6.0	60 M			610A
MD918B	NM	0.55 A	15	O	0.05	50	3.0 m	600	1.7	0.8	10		6.0	60 M			654
MD918	NM	0.55 A	15	O	0.05	50	30 m	600	1.7	0.8	10		6.0	60 m			654
MD982,F	PA	0.4 A	50	O	0.6	40	150 m	200	8.0			0.5	10	150 m			610A
MD984	PA	0.575 A	20	O	0.2	25	10 m	250				0.5	10	50 m			654
MD985	CA	0.575 A	30	O	0.5	40	150 m	200	8.0			0.5	10	150 m			654
MD986	CA	0.55 A	15	O	0.2	25	10 m	200	4.0			0.5	10	50 m			654
MD1121	NM	0.575 A	30	O	0.5	50	10 m	200	8.0	0.9	10	0.1	10	10 m			654
MD1121F	NM	0.35 A	30	O	0.5	50	10 m	200	8.0	0.9	10	0.1	10	10 m			654
MD1122F	NM	0.35 A	30	O	0.5	50	20 m	200	8.0	0.9	5.0	0.1	10	10 m			654
MD1132	NM	0.3 A	15	O	0.05	50	1.0 m	600	1.7	0.9	5.0	0.4	10	10 m			654
MD2060F	NM	0.35 A	60	O	0.5	30	0.1 m	100	15	0.9	5.0	0.1	8.0	10 m			610A
MD1122	NM	0.575 A	30	O	0.5	50	10 m	250	3.5	0.8	5.0	0.1	10	10 m			654
MD1123	NM	0.575 A	40	O	0.2	50	10 m	250	3.5	0.8	10	0.18	10	0.1 m			654
MD1130	NM	0.575 A	40	O	0.2	100	10 m	200	3.5	0.9	5.0	0.18	5	1.0 m			654
MD3467	NG	0.6 A	40	O	1.5	20	500 m	150	80	40	120	0.5	10	500 m			654
MD4260	NH	0.55 A	12	O	0.05	30	10 m	1000	2.5	0.8	10	0.3	10	10 m			654
MD4261	NH	0.55 A	12	O	0.05	30	10 m	1000	2.5	0.8	10	0.3	10	10 m			654

Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

Table 2. Bipolar Transistors — Duals (continued)

TYPE NO.	I_D	P_D Watts One Die Only	V_{CE} Volts	I_C Amp Max	h_{FE} @ I_C Min		f_T MHz Min Typ*	C_{ob} pF Max Typ*	h_{FE1}/h_{FE2}	ΔV_{BE} mV Max	G_p dB Min	NF @ dB Max Typ*	f	PACKAGE	
									t_{on} ns Max Typ*	t_{off} ns Max Typ*	V_{CE} (sat) @ Volts Max	I_C / I_B	I_C	TO-No.	Case No.
MD2218	NG	0.575 A	30 O	0.5	40	150 m	200	8.0	60	350	0.4	10	150 m		654
MD2218A	NG	0.575 A	30 O	0.5	40	150 m	200	8.0	45	310	0.3	10	150 m		654
MD2218AF	NG	0.35 A	30 O	0.5	40	150 m	200	8.0	45	310	0.3	10	150 m		610A
MD2219	NG	0.575 A	30 O	0.5	50	150 m	200	8.0	—	—	0.35	10	300 m		654
MD2219A	NG	0.575 A	30 O	0.5	100	150 m	200	8.0	45	310	0.3	10	150 m		654
MD2219AF	NG	0.35 A	30 O	0.5	100	150 m	200	8.0	45	310	0.3	10	150 m		610A
MD2369	NS	0.55 A	15 O	0.5	40	10 m	500	4.0	15	20	0.25	10	10 m		654
MD2369A	NM	0.55 A	15 O	0.5	40	10 m	500	4.0	0.9	5.0	0.25	10	10 m		654
MD2369AF	NM	0.35 A	15 O	0.5	40	10 m	500	4.0	0.9	5.0	0.25	10	10 m		610A
MD2369B	NM	0.55 A	15 O	0.5	40	10 m	500	4.0	0.8	10	0.25	10	10 m		654
MD2369BF	NM	0.35 A	15 O	0.5	40	10 m	500	4.0	0.8	10	0.25	10	10 m		610A
MD2904	PG	0.575 A	40 O	0.6	40	150 m	200	8.0	45	130	0.4	10	150 m		654
MD2904A	PG	0.575 A	60 O	0.6	40	150 m	200	8.0	45	130	0.4	10	150 m		654
MD2904AF	PG	0.35 A	60 O	0.6	40	150 m	200	8.0	45	130	0.4	10	150 m		610A
MD2905	PG	0.575 A	40 O	0.6	100	150 m	200	8.0	45	130	0.4	10	150 m		654
MD2905A	PG	0.575 A	60 O	0.6	100	150 m	200	8.0	45	130	0.4	10	150 m		654
MD2905AF	PG	0.35 A	60 O	0.6	100	150 m	200	8.0	45	130	0.4	10	150 m		610A
MD3250	PA	0.575 A	40 O	0.2	50	1.0 m	200	6.0			0.25	10	10 m		654
MD3250A	PM	0.575 A	40 O	0.2	50	1.0 m	200	6.0	0.9	5.0	0.25	10	10 m		654
MD3250AF	PM	0.35 A	40 O	0.2	50	1.0 m	200	6.0	0.9	5.0	0.25	10	10 m		610A
MD3251	PA	0.575 A	40 O	0.2	100	1.0 m	250	6.0			0.25	10	10 m		654
MD3251A	PM	0.575 A	40 O	0.2	100	1.0 m	250	6.0	0.9	5.0	0.25	10	10 m		654
MD3251AF	PM	0.35 A	40 O	0.2	100	1.0 m	250	6.0	0.9	5.0	0.25	10	10 m		610A
MD3409	NM	0.575 A	30 O	0.5	50	10 m	200	8.0	0.8	10	0.15	10	10 m		654
MD3410	NM	0.575 A	30 O	0.5	50	10 m	200	8.0	0.9	10	0.15	10	10 m		654
MD3725	NS	0.6 A	40 O	1.0	50	100 m	200	10	45	75	0.26	10	100 m		654
MD3725F	NS	0.35 A	40 O	1.0	50	100 m	200	10	45	75	0.26	10	100 m		610A
MD3762	PS	0.6 A	40 O	1.5	20	1.0 A	150	20	40	110	1.0	10	1.0 A		654
MD3762F	PS	0.35 A	40 O	1.5	20	1.0 A	150	20	40	110	1.0	10	1.0 A		610A
MD5000	PH	0.3 A	15 O	0.05	20	3.0 m	600	1.7			15		200 M		654
MD5000A	PM	0.3 A	15 O	0.05	20	3.0 m	600	1.7	0.9	5.0	15		200 M		654
MD5000B	PM	0.3 A	15 O	0.05	20	3.0 m	600	1.7	0.8	10	15		200 M		654
MD6001	CG	0.575 A	30 O	0.5	40	150 m	200	8.0	60	350	0.4	10	150 m		654
MD6001F	CG	0.35 A	30 O	0.5	40	150 m	200	8.0	60	350	0.4	10	150 m		610A
MD6002	CG	0.575 A	30 O	0.5	100	150 m	200	8.0	60	350	0.4	10	150 m		654
MD6002F	CG	0.35 A	30 O	0.5	100	150 m	200	8.0	60	350	0.4	10	150 m		610A
MD6003	CG	0.575 A	30 O	0.5	20	150 m	200	—			0.59	10	300 m		654
MD6100	CA	0.5 A	45 O	0.05	100	0.1 m	30	4.0			0.25	10	1.0 m		654
MD6100F	CA	0.35 A	45 O	0.05	100	0.1 m	30	4.0			0.25	10	10 m		610A
MD7000	NA	0.575 A	30 O	0.5	70	150 m	200	8.0			0.4	10	150 m		654
MD7001	PA	0.6 A	30 O	0.6	70	150 m	200	8.0			0.4	10	150 m		654
MD7001F	PA	0.35 A	30 O	0.6	70	150 m	200	8.0			0.4	10	150 m		610A
MD7002	NA	0.575 A	40 O	0.03	40	100 u	200	6.0			0.35	10	10 m		654
MD7002A	NM	0.575 A	40 O	0.03	40	100 u	200	6.0	0.75	25	0.35	10	10 m		654
MD7002B	NM	0.575 A	40 O	0.03	40	100 u	200	6.0	0.85	15	0.35	10	10 m		654
MD7003	NA	0.55 A	40 O	0.05	50	10 m	200	6.0			0.35	10	1.0 m		654
MD7003A	NM	0.55 A	40 O	0.05	50	10 m	200	6.0	0.75	25	0.35	10	1.0 m		654
MD7003B	NM	0.55 A	40 O	0.05	50	10 m	200	6.0	0.85	15	0.35	10	1.0 m		654

Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

Table 2. Bipolar Transistors — Duals (continued)

T-91-60

TYPE NO.	I_D	P_D Watts One Die Only	V_{CE} Volts		I_C Amp Max	h_{FE} @ I_C Min		f_T MHz Min Typ*	C_{ob} pF Max Typ*	$\frac{h_{FE1}}{h_{FE2}}$	ΔV_{BE} mV Max	G_p dB Min	NF @ f dB Max Typ*		I_C	PACKAGE TO-No.	PACKAGE Case No.
										t_{on} ns Max Typ*	t_{off} ns Max Typ*	V_{CE} (sat) @ Volts Max	I_C / I_B				
MD7004	NA	0.55 A	13	O	0.2	30	10 m	675*	4.0			0.4	10	10 m			654
MD7005	PA	0.55 A	12	O	0.05	30	3.0 m	650	3.0			0.4	10	10 m			654
MD7007	PA	0.575 A	40	O	0.2	30	1.0 m	300	8.0			1.0	10	50 m			654
MD7007A	PM	0.575 A	50	O	0.2	30	1.0 m	300	8.0	0.75	20	1.0	10	50 m			654
MD7007B	PM	0.575 A	60	O	0.2	30	1.0 m	300	8.0	0.85	10	1.0	10	50 m			654
MD7007BF	PM	0.35 A	40	O	0.2	30	1.0 m	300	8.0	0.85	10	1.0	10	50 m			610A
MD7021	CG	0.55 A	40	O	0.05	50	10 m	200	6.0	28*	72*	0.35	10	10 m			654
MD7021F	CG	0.35 A	40	O	0.05	50	10 m	200	6.0	28*	72*	0.35	10	10 m			610A
MD8001	NM	0.575 A	40	O	0.03	100	1.0 m	260*	2.6*		15						654
MD8002	NM	0.575 A	40	O	0.03	100	1.0 m	260*	2.6*		15						654
MD8003	NM	0.575 A	40	O	0.03	100	1.0 m	260*	2.6*		15						654
2N2060	NM	0.5 A	60	O	0.5	30	100 u	60	15	0.9	5.0		8.0	1000 H	78		654
2N2223	NM	0.5 A	60	O	0.5	25	100 u	50	15	0.8	15	1.2	10	50 m	78		654
2N2223A	NM	0.5 A	60	O	0.5	25	100 u	50	15	0.9	5.0	1.2	10	50 m	78		654
2N2453	NM	0.5 A	30	O	0.05	80	10 u	60	8.0	0.9	3.0		7.0	1000 H	78		654
2N2453A	NM	0.5 A	50	O	0.05	80	10 u	60	8.0	0.9	3.0		4.0	1000 H	78		654
2N2480A	NM	0.3 A	40	O	0.5	50	1.0 m	50	18	0.8	5.0	1.3	10	50 m	78		654
2N2639	NM	0.3 A	45	O	0.03	50	10 u	80	8.0	0.9	5.0		4.0	AUD	78		654
2N2640	NM	0.3 A	45	O	0.03	50	10 u	80	8.0	0.8	10		4.0	AUD	78		654
2N2641	NE	0.3 A	45	O	0.03	50	10 u	80	8.0				4.0	AUD	78		654
2N2642	NM	0.3 A	45	O	0.03	100	10 u	80	8.0	0.9	5.0		4.0	AUD	78		654
2N2643	NM	0.3 A	45	O	0.03	100	10 u	80	8.0	0.8	10		4.0	AUD	78		654
2N2644	NE	0.3 A	45	O	0.03	100	10 u	80	8.0				4.0	AUD	78		654
2N2652	NM	0.3 A	60	O	0.5	50	1.0 m	60	15	0.85	3.0	1.2	10	50 m	78		654
2N2652A	NM	0.3 A	60	O	0.5	50	1.0 m	60	15	0.9	3.0		8.0	1000 H	78		654
2N2721	NM	0.3 A	60	O	0.04	30	0.1 m	80	6.0	0.8	10	1.0	10	10 m	78		654
2N2722	NM	0.3 A	45	O	0.04	50	1.0 u	100	6.0	0.9	5.0	1.0	20	10 m	78		654
2N2903	NM	0.6 C	30	O	0.05	125	1.0 m	60	8.0	0.8	10		7.0	1000 H	78		654
2N2913	NE	0.3 A	45	O	0.03	60	10 u	60	6.0				4.0	AUD			654
2N2914	NE	0.3 A	45	O	0.03	150	10 u	60	6.0				3.0	AUD			654
2N2915	NM	0.3 A	45	O	0.03	60	10 u	60	6.0	0.9	5.0		4.0	AUD			654
2N2916	NM	0.3 A	45	O	0.03	150	10 u	60	6.0	0.9	5.0		3.0	AUD			654
2N2917	NM	0.3 A	45	O	0.03	60	10 u	60	6.0	0.8	10		4.0	AUD			654
2N2918	NM	0.3 A	45	O	0.03	150	10 u	60	6.0	0.8	10		3.0	AUD			654
2N2919	NM	0.3 A	60	O	0.03	60	10 u	60	6.0	0.9	5.0		4.0	AUD			654
2N2920	NM	0.3 A	60	O	0.03	150	10 u	60	6.0	0.9	5.0		3.0	AUD			654
2N4854	CG	0.3 A	40	O	0.6	35	0.3 m	200	—	—	—	—	8.0	100 u			654
2N4855	CG	0.3 A	40	O	0.6	20	0.3 m	200	—	—	—	—	8.0	100 u			654
2N3043	NM	0.25 A	45	O	0.03	100	10 u	30	8.0	0.9	5.0		5.0	AUD			610A
2N3044	NM	0.25 A	45	O	0.03	100	10 u	30	8.0	0.8	10		5.0	AUD			610A
2N3045	NE	0.25 A	45	O	0.03	100	10 u	30	8.0				5.0	AUD			610A
2N3048	NE	0.25 A	45	O	0.03	50	10 u	30	8.0				5.0	AUD			610A
2N3425	NA	0.3	15		0.05	30	10 m	300	6.0								654
2N3726	PE	0.4 A	45	O	0.3	135	1.0 m	200	8.0	0.9	5.0		4.0	1000 H			654
2N3727	PE	0.4 A	45	O	0.3	135	1.0 m	200	8.0	0.9	2.5		4.0	1000 H			654
2N3806	PE	0.5 A	60	O	0.05	150	0.1 m	100	4.0				7.0	100 H			654
2N3807	PE	0.5 A	60	O	0.05	300	0.1 m	100	4.0				4.0	100 H			654
2N3808	PM	0.5 A	60	O	0.05	150	0.1 m	100	4.0	0.8	5.0		7.0	100 H			654
2N3809	PM	0.5 A	60	O	0.05	300	0.1 m	100	4.0	0.8	5.0		4.0	100 H			654
2N3810	PM	0.5 A	60	O	0.05	150	0.1 m	100	4.0	0.9	3.0		7.0	100 H			654
2N3810A	PM	0.5 A	60	O	0.05	150	0.1 m	100	4.0	0.95	1.5		3.0	100 H			654
2N3811	PM	0.5 A	60	O	0.05	300	0.1 m	100	4.0	0.9	3.0		4.0	100 H			654
2N3811A	PM	0.5 A	60	O	0.05	300	0.1 m	100	4.0	0.95	1.5		1.5	100 H			654

Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

MULTIPLE DEVICES (continued)

Table 2. Bipolar Transistors — Duals (continued)

TYPE NO.	I_D	P_D Watts One Die Only	V_{CE} Volts		I_C Amp Max	h_{FE} @ I_C Min		f_T MHz Min Typ*	C_{ob} pF Max Typ*	h_{FE1}/h_{FE2} t_{on} ns Max Typ*	ΔV_{BE} mV Max t_{off} ns Max Typ*	G_p dB Min V_{CE} (sat) @ Volts Max	NF @ f dB Max Typ* I_C/I_B	I_C	PACKAGE TO-No.	PACKAGE Case No.
2N3817	PM	0.5 A	60	O	0.05	300	0.1 m	100	4.0	0.9	3.0		4.0	100 H		610A
2N3838	CE	0.25 A	40	O	0.6	100	150 m	200	8.0	*50*	*340*		8.0	1000 H		610A
2N4015	PM	0.4 A	60	O	0.3	135	1.0 m	200	8.0	0.9	5.0		4.0	1000 H		654
2N4016	PM	0.4 A	60	O	0.3	135	1.0 m	200	8.0	0.9	2.5		4.0	1000 H		654
2N4854	CE	0.3 A	40	O	0.6	100	150 m	200	8.0	*60*	*350*		8.0	1000 H		654
2N4855	CE	0.3 A	40	O	0.6	40	150 m	200	8.0	*60*	*350*		8.0	1000 H		654
2N4937	PM	0.6 A	40	O	0.05	50	1.0 m	300	5.0	0.9	3.0		4.0	AUD		654
2N4938	PM	0.6 A	40	O	0.05	50	1.0 m	300	5.0	0.8	5.0		4.0	AUD		654
2N4939	PE	0.6 A	40	O	0.05	50	1.0 m	300	5.0				40	AUD		654
2N4941	PM	0.6 A	40	O	0.05	50	1.0 m	300	5.0	0.9	3.0		4.0	AUD		610A
2N5793	NG	0.5 A	40	O	0.6	40	150 m	200	8.0	*45*	*310*	*0.3*	*10*	*150 m*		654
2N5794	NG	0.5 A	40	O	0.6	100	150 m	200	8.0	*45*	*310*	*0.3*	*10*	*150 m*		654
2N5795	NG	0.5 A	60	O	0.6	40	150 m	200	8.0	*47*	*140*	*0.4*	*10*	*150 m*		654
2N5796	NG	0.5 A	60	O	0.6	100	150 m	200	8.0	*47*	*140*	*0.4*	*10*	*150 m*		654

Some columns show 2 different types of data indicated by either **bold** or *italic* typefaces. See key and headings.

Surface Mount Multiples

Table 3. Bipolar Quad Transistors — SO-16

Device	$V_{(BR)CEO}$	$V_{(BR)CBO}$	h_{FE} Min	h_{FE} @ I_C mA	f_T MHz Min	f_T @ I_C (mA)	Package
MMPQ2222	40	60	30	300	350*	20	751B
MMPQ2222A	40	75	40	500	350*	20	751B
MMPQ2369	15	40	20	100	450	10	751B
MMPQ2907	40	40	30	300	350*	50	751B
MMPQ2907A	50	60	50	500	350*	50	751B
MMPQ3467	40	40	20	500	125	50	751B
MMPQ3725	40	60	25	500	250	50	751B
MMPQ3725A	50	70	30	500	200	50	751B
MMPQ3762	40	40	20	1000	150	50	751B

*Typ

Table 4. TMOS FETs — Quads

N-CHANNEL TMOS QUAD — CASE 646-06 (14-PIN DIP)

Device	$r_{DS(on)}$ @ Ω Max	@ I_D A	$V_{GS(th)}$ V Min	$V_{GS(th)}$ V Max	$V_{(BR)DSS}$ V Min	C_{iss} pF Max	C_{rss} pF Max	t_{on} ns Max	t_{off} ns Max
MFQ930P	1.4	1.0	1.0	3.5	35	70	18	15	15
MFQ960P	1.7	1.0	1.0	3.5	60	70	18	15	15

N-CHANNEL TMOS QUAD — CASE 648-06 (16-PIN DIP)

Device	$r_{DS(on)}$ @ Ω Max	@ mA	$V_{(BR)DSS}$ Volt Min	$I_{D(on)}$ V_{GS} = 10 V V_{DS} = 5.0 V Amp	G_{fs} @ mhos Min	@ 5.0 V Amp	C_{iss} @ 25 V pF Max	C_{oss} @ 25 V pF Max	C_{rss} @ 25 V pF Max	$t_{d(on)}$ ns Max	t_r ns Max	$t_{d(off)}$ ns Max	t_f ns Max
IRFE110	0.6	800	100	1.0	0.8	0.8	200	100	25	20	25	25	20
IRFE113	0.8	800	60	0.8	0.8	0.8	200	100	25	20	25	25	20

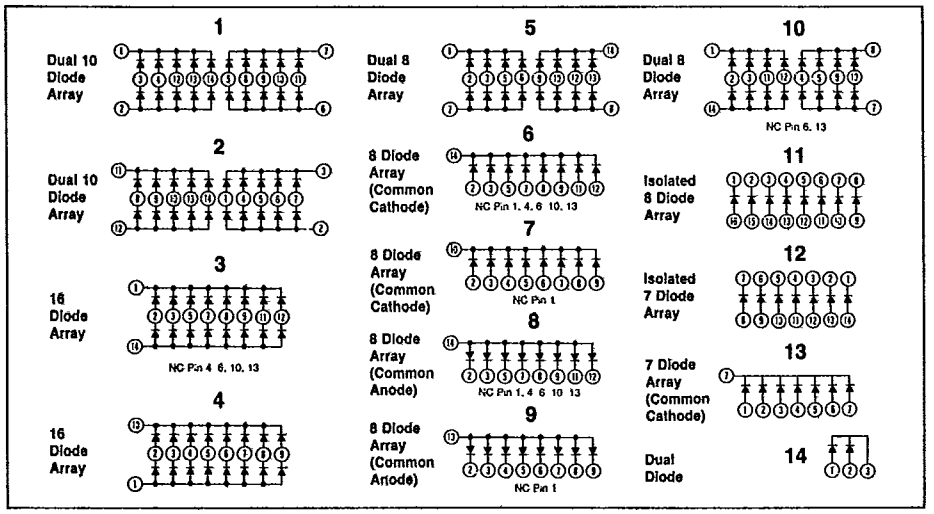
P-CHANNEL TMOS QUAD — CASE 648-06 (16-PIN DIP)

IRFE9120	0.8	800	100	1.0	0.8	0.8	450	350	100	50	100	100	100
IRFE9123	0.6	800	60	0.8	0.8	0.8	450	350	100	50	100	100	100

Multiple Switching Diodes

Multiple diode configurations utilize monolithic structures fabricated by the planar process. They are designed to satisfy fast switching requirements as in core driver and encoding/decoding applications where their monolithic configurations offer lower cost, higher reliability and space savings.

Diode Array Diagrams



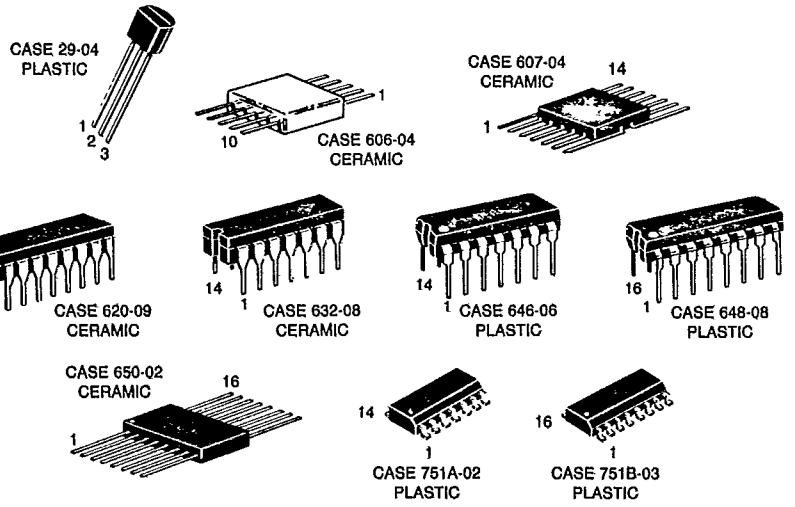


Table 5. Diode Arrays

Device	Function	Pin Connections	
		Package	Diagram No.
MAD130C	Dual 10 Diode Array	632-02	1
MAD130P	Dual 10 Diode Array	646-06	1
MMAD130	Dual 10 Diode Array	751A-02	2
MAD1103C	16 Diode Array	632-02	3
MAD1103F	16 Diode Array	606-04	4
MAD1103P	16 Diode Array	646-06	3
MMAD1103	16 Diode Array	751A-02	3
MAD1104C	Dual 8 Diode Array	632-02	5
MAD1104F	Dual 8 Diode Array	607-04	5
MAD1104P	Dual 8 Diode Array	646-06	5
MMAD1104	Dual 8 Diode Array	751A-02	5
MAD1105C	8 Diode Common Cathode Array	632-02	6
MAD1105F	8 Diode Common Cathode Array	606-04	7
MAD1105P	8 Diode Common Cathode Array	646-06	6
MMAD1105	8 Diode Common Cathode Array	751A-02	6
MAD1106C	8 Diode Common Anode Array	632-02	8
MAD1106F	8 Diode Common Anode Array	606-04	9
MAD1106P	8 Diode Common Anode Array	646-06	8
MMAD1106	8 Diode Common Anode Array	751A-02	8
MAD1107C	Dual 8 Diode Array	632-02	10
MAD1107F	Dual 8 Diode Array	607-04	10
MAD1107P	Dual 8 Diode Array	646-06	10
MMAD1107	Dual 8 Diode Array	751A-02	10
MAD1108C	8 Isolated Diode Array	620-02	11
MAD1108F	8 Isolated Diode Array	650-02	11
MAD1108P	8 Isolated Diode Array	648-06	11
MMAD1108	8 Isolated Diode Array	751B-03	11
MAD1109C	7 Isolated Diode Array	632-02	12
MAD1109F	7 Isolated Diode Array	607-04	12
MAD1109P	7 Isolated Diode Array	646-06	12
MMAD1109	7 Isolated Diode Array	751A-02	12
MMAD1185	7 Diode Common Cathode Array	751A-02	13

Table 6. Dual Diodes

Device	$V_{(BR)}$ Volts @ $I_{(BR)}$		I_R	@ V_R	V_F Volts @ I_F		C @ V_R = 0	t_{rr}	Package	Diagram No.
	Min	μA	Max	Volts	Min/Max	mA	pF (Max)	ns Max		
MSD6100	100	100	100	50	0.67/0.82	10	1.5	4.0	TO-226AA	14
MSD6101	50	100	100	40	0.67/0.82	10	2.0	10	(TO-92)	14
MSD6102	70	100	100	50	0.67/1.0	10	3.0	100		14
MSD6150	70	100	100	50	—/1.0	10	8.0	100		14

Devices for Hi-Rel and Military Applications

T-91-60

JAN, JANTX, JANTXV, and JANS

Motorola offers over 650 devices listed in QPL-19500, and is certified to supply small-signal bipolar devices to ALL FOUR quality levels of MIL-S-19500.

The following tables list the Motorola discrete devices and slash-sheet number as they appear on the Qualified Products List.

Table 1. Switching and High-Frequency Transistors (MIL-S-19500)

2N703 JAN . . . . . /153	2N2905 JAN,JTX,JTXV . . . . . /290	2N3506 JAN,JTX,JTXV. . . . . /349
2N706 JAN. . . . . /120	2N2905A JAN,JTX,JTXV. . . . . /290	2N3507 JAN,JTX,JTXV. . . . . /349
2N708 JAN,JTX . . . . . /312	2N2905AL JANS . . . . . /	2N3634 JAN,JTX,JTXV. . . . . /357
2N718A JAN,JTX,JTXV . . . . . /181	2N2906 JAN,JTX,JTXV . . . . . /291	2N3635 JAN,JTX,JTXV. . . . . /357
2N869A JAN,JTX . . . . . /283	2N2906A JAN,JTX,JTXV. . . . . /291	2N3636 JAN,JTX,JTXV. . . . . /357
2N914 JAN,JTX . . . . . /373	2N2907 JAN,JTX,JTXV . . . . . /291	2N3637 JAN,JTX,JTXV. . . . . /357
2N916 JAN. . . . . /271	2N2907A JAN,JTX,JTXV,JANS . . . . /291	2N3700 JAN,JTX,JTXV. . . . . /391
2N918 JAN,JTX,JTXV,JANS. . . . . /301	2N2944A JAN,JTX,JTXV. . . . . /	2N3735 JAN,JTX,JTXV. . . . . /395
2N930 JAN,JTX . . . . . /253	2N2945A JAN,JTX,JTXV. . . . . /	2N3737 JAN,JTX,JTXV. . . . . /395
2N1132 JAN . . . . . /177	2N2946A JAN,JTX,JTXV. . . . . /	2N3743 JAN,JTX,JTXV. . . . . /397
2N1613 JAN,JTX,JTXV. . . . . /181	2N3013 JAN,JTX . . . . . /287	2N3762 JAN,JTX,JTXV. . . . . /396
2N2218 JAN,JTX,JTXV. . . . . /251	2N3019,S JAN,JTX,JTSV . . . . . /391	2N3763 JAN,JTX,JTXV. . . . . /396
2N2218A JAN,JTX,JTXV. . . . . /251	2N3250A JAN,JTX,JTXV. . . . . /323	2N3764 JAN,JTX,JTXV. . . . . /396
2N2219 JAN,JTX,JTXV. . . . . /251	2N3251A JAN,JTX,JTXV. . . . . /323	2N3765 JAN,JTX,JTXV. . . . . /396
2N2219A JAN,JTX,JTXV. . . . . /251	2N3253 JAN . . . . . /347	2N4033 JAN,JTX,JTXV. . . . . /511
2N22219AL JANS . . . . . /	2N3444 JAN,JTX . . . . . /347	2N4261 JAN,JTX,JTXV. . . . . /511
2N2221 JAN,JTX,JTXV. . . . . /255	2N3467 JAN,JTX,JTXV . . . . . /348	2N4405 JAN,JTX,JTXV. . . . . /488
2N2221A JAN,JTX,JTXV. . . . . /255	2N3468 JAN,JTX,JTXV . . . . . /348	2N4449 JAN,JTX,JTXV. . . . . /317
2N2222 JAN,JTX,JTXV. . . . . /255	2N3485A JAN,JTX . . . . . /392	2N4453 JAN,JTX . . . . . /283
2N2222A JAN,JTX,JTXV,JANS . . . . /225	2N3486A JAN,JTX . . . . . /392	2N4930 JAN,JTX,JTXV. . . . . /397
2N2369A JAN,JTX,JTXV,JANS . . . . /317	2N3498 JAN,JTX,JTXV . . . . . /366	2N4931 JAN,JTX,JTXV. . . . . /397
2N2481 JAN,JTX . . . . . /268	2N3499 JAN,JTX,JTXV . . . . . /366	2N5581 JAN,JTX . . . . . /423
2N2904 JAN,JTX,JTXV. . . . . /290	2N3500 JAN,JTX,JTXV . . . . . /366	2N5582 JAN,JTX . . . . . /423
2N2904A JAN,JTX,JTXV. . . . . /	2N3501 JAN,JTX,JTXV . . . . . /366	

Table 2. Multiple Devices (MIL-S-19500)

2N2060 JAN,JTX,JTXV. . . . . /270	2N3811 JAN,JTX,JTXV . . . . . /336	2N5794 JAN,JTX,JTXV. . . . . /495
2N2919 JAN,JTX,JTXV. . . . . /355	2N4854 JAN,JTX,JTXV . . . . . /421	2N5795 JAN,JTX,JTXV. . . . . /496
2N2920 JAN,JTX,JTXV. . . . . /355	2N5793 JAN,JTX,JTXV . . . . . /495	2N5796 JAN,JTX,JTXV. . . . . /496
2N3810 JAN,JTX,JTXV. . . . . /336		

Table 3. Field-Effect Transistors (MIL-S-19500)

2N2608 JAN . . . . . /295	2N3823 JAN,JTX,JTXV . . . . . /375	2N4860 JAN,JTX,JTXV. . . . . /385
2N2609 JAN . . . . . /296	2N4856 JAN,JTX,JTXV . . . . . /385	2N4861 JAN,JTX,JTXV. . . . . /385
2N3330 JAN,JTX . . . . . /378	2N4857 JAN,JTX,JTXV . . . . . /385	2N4091 JAN,JTX,JTXV. . . . . /431
2N3821 JAN,JTX,JTXV. . . . . /375	2N4858 JAN,JTX,JTXV . . . . . /385	2N4092 JAN,JTX,JTXV. . . . . /431
2N3822 JAN,JTX,JTXV. . . . . /375	2N4859 JAN,JTX,JTXV . . . . . /385	2N4093 JAN,JTX,JTXV. . . . . /431

CECC

All CECC types are available to assessment levels E, F, L

Table 4. Qualified Types

2N1613	2N2219	2N2222A	2N3019	2N2906	2N3439	2N5416
2N1711	2N2219A	2N2368	2N2904	2N2906A	2N3440	BC107-108-109
2N1893	2N2221	2N2369	2N2904A	2N2907	2N3501	CV9507
2N2218	2N2221A	2N2369A	2N2905	2N2907A	2N4033	PO7726
2N2218A	2N2222	2N2484	2N2905A	2N2894	2N5415	

Qualified products to CECC 50,000

Tuning and Switching Diodes

Tuning Diodes — A wide range of voltage-variable capacitance diodes for electronic tuning and control of RF circuits from HF through UHF.

Hot Carrier Diodes — For high-efficiency VHF and UHF switching and mixer applications.

PIN Diodes — Particularly useful for bandswitching and detector circuits in the VHF range.

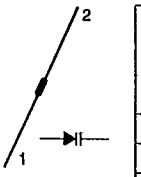
Tuning Diodes — Abrupt Junction

Table 1. General-Purpose Glass

Motorola supplies voltage-variable capacitance diodes serving the entire range of frequencies from HF through UHF. Used in RF receivers and transmitters, they have a variety of applications, including:

- Phase-locked loop tuning systems
- Local oscillator tuning
- Tuned RF preselectors
- RF filters
- RF phase shifters
- RF amplifiers
- Automatic frequency control
- Video filters and delay lines
- Harmonic Generators
- FM modulators

Two families of devices are available: Abrupt Junction and Hyper Abrupt Junction. The Abrupt Junction family includes devices suitable for virtually all tuned-circuit and narrow-range tuning applications throughout the spectrum. The Hyper Abrupt family exhibits higher capacitance, and a much larger capacitance ratio. It is particularly well suited for wider-range applications such as AM/FM radio and TV tuning.



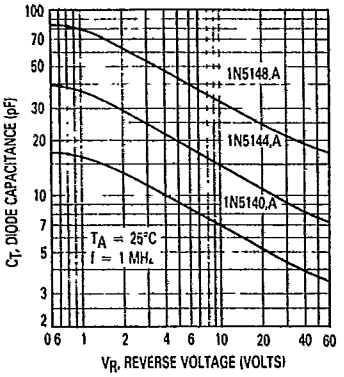
CASE 51-02
DO-204AA
(DO-7)

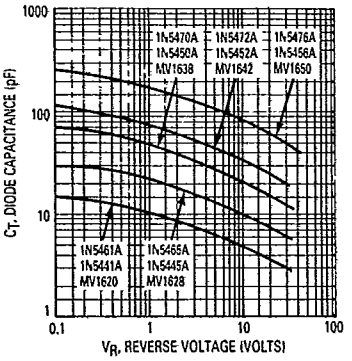
- High Q
- Capacitance TOL
  10% — No Suffix
  5% — Suffix A

C_T Nominal Capacitance pF ±10% @ V_R = 4 V f = 1 MHz	60 Volts Cap Ratio C4/C60 Min	Q @ 4 V 50 MHz Min	Device Type
6.8	2.7	350	1N5139,A
8.2			
10	2.8	300	1N5140,A
12	2.8	300	1N5141,A
15	2.8	250	1N5142,A
18	2.8	250	1N5143,A
20			
22	3.2	200	1N5144,A
27	3.2	200	1N5145,A
33	3.2	200	1N5146,A
39	3.2	200	1N5147,A
47	3.2	200	1N5148,A
56			
68			
82			
100			

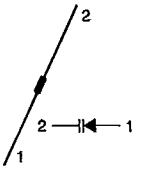
TYPICAL CHARACTERISTICS

Diode Capacitance versus Reverse Voltage





• Premium 30 V • Very High Q • Guaranteed High CR • Capacitance TOL 10% – A, 5% – B, 2% – C	• High Q • Controlled CR • Capacitance TOL 10% – A, 5% – B, 2% – C	• General-Purpose

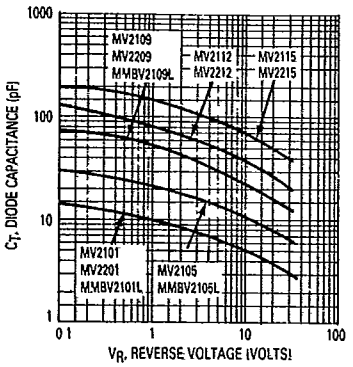


CASE 51-02
DO-204AA
(DO-7)

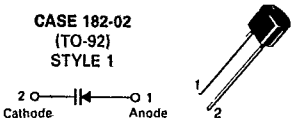
Maximum Working Voltage						Maximum Working Voltage			
30 Volts						20 Volts			
Cap Ratio C2/C30 Min	Q @ 4 V 50 MHz Min	Device Type	Cap Ratio C2/C30 Min	Q @ 4 V 50 MHz Min	Device Type	Cap Ratio C2/C20 Min	Q @ 4 V 50 MHz Min	Device Type	C_T Nominal pF ±10% @ V_R = 4 V f = 1 MHz
2.7	600	1N5461A	2.5	450	1N5441A	2	300	MV1620	6.8
2.8	600	1N5462A	2.5	450	1N5442A	2	300	MV1622	8.2
2.8	550	1N5463A	2.6	400	1N5443A	2	300	MV1624	10
2.8	550	1N5464A	2.6	400	1N5444A	2	300	MV1626	12
2.8	550	1N5465A	2.6	450	1N5445A	2	250	MV1628	15
2.9	500	1N5466A	2.6	350	1N5446A	2	250	MV1630	18
2.9	500	1N5467A	2.6	350	1N5447A	2	250	MV1632	20
2.9	500	1N5468A	2.6	350	1N5448A	2	250	MV1634	22
2.9	500	1N5469A	2.6	350	1N5449A	2	200	MV1636	27
2.9	500	1N5470A	2.6	350	1N5450A	2	200	MV1638	33
2.9	450	1N5471A	2.6	300	1N5451A	2	200	MV1640	39
2.9	400	1N5472A	2.6	250	1N5452A	2	200	MV1642	47
2.9	300	1N5473A	2.6	200	1N5453A	2	150	MV1644	56
2.9	250	1N5474A	2.7	175	1N5454A	2	150	MV1646	68
2.9	225	1N5475A	2.7	175	1N5455A	2	150	MV1648	82
2.9	200	1N5476A	2.7	175	1N5456A	2	150	MV1650	100

TYPICAL CHARACTERISTICS

Diode Capacitance versus Reverse Voltage



CASE 182-02
(TO-92)
STYLE 1



CASE 318-03
(TO-236AB)
STYLE 8

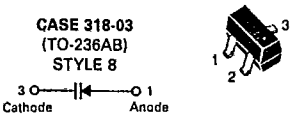
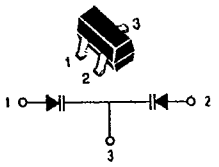


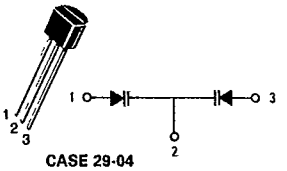
Table 2. General-Purpose Plastic

		• Low-Cost • High Volume			• Lower Cost • General-Purpose			• Low-Cost • High Volume		
		Maximum Working Voltage								
		30 Volts			25 Volts			30 Volts		
		CASE 182-02 2-Lead TO-92						CASE 318-02 TO-236AA		
		Cap Ratio C2/C30 Min	Q @ 4 V 50 MHz Min	Device Type	Cap Ratio C1/C10 Min	Q @ 4 V 50 MHz Min	Device Type C_T ±20%	Cap Ratio C2/C30 Min	Q @ 4 V 50 MHz Typ	Device Type
C_T Nominal Capacitance pF ±10% @ V_R = 4 V f = 1 MHz	6.8	2.5	450	MV2101	1.9	300	MV2201	2.5	400	MMBV2101L
	8.2	2.5	450	MV2102				2.5	350	MMBV2102L
	10	2.5	400	MV2103	2	200	MV2203	2.5	350	MMBV2103L
	12	2.5	400	MV2104				2.5	350	MMBV2104L
	15	2.5	400	MV2105	2	200	MV2205	2.5	350	MMBV2105L
	18	2.5	350	MV2106				2.5	300	MMBV2106L
	22	2.5	350	MV2107	2	150	MV2207	2.5	300	MMBV2107L
	27	2.5	300	MV2108				2.5	250	MMBV2108L
	33	2.5	200	MV2109	2	150	MV2209	2.5	200	MMBV2109L
	39	2.5	150	MV2110						
	47	2.5	150	MV2111	2	100	MV2211			
	56	2.6	150	MV2112						
	68	2.6	150	MV2113	2	100	MV2213			
	82	2.6	100	MV2114						
	100	2.6	100	MV2115	2	50	MV2215			

Table 3. Dual Diodes



CASE 318-03
(TO-236AB)
STYLE 9



CASE 29-04
TO-226AA
(TO-92)
STYLE 15

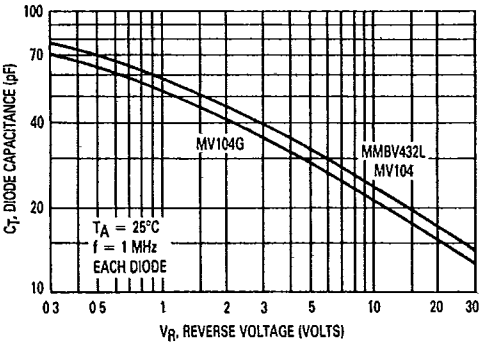
- High Q
- Guaranteed Capacitance Range
- Monolithic Dual

Maximum Working Voltage

32 Volts

C_T Capacitance pF @ V_R			Cap Ratio C3/C30 Min	Q @ 3 V 50 MHz Min	Device Type
Min	Max	Volts			
34	39	3	2.5	100	MV104G(1)
37	42	3	2.5	100	MV104(1)
43	48.1	2	1.5*	100	MMBV432L(2)

(1) Case 29 (2) Case 318 *C2.C8

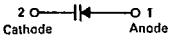


Tuning Diodes Hyper-Abrupt Junction

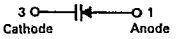
T-91-60

Table 4. For FM Radio and TV

CASE 182-02
(TO-92)
STYLE 1



CASE 318-03
(TO-236AB)
STYLE 8



- High Q
- Guaranteed Capacitance Range

Maximum Working Voltage: 30 Volts

C_T Capacitance pF Min	C_T Capacitance pF Max	@ V_R Volts	Cap Ratio C3/C25 Min	Q @ 3 V 50 MHz Typ	Device Type
1.8	2.8	25	4	350	MMBV105GL*
20	25	3	4.5	300	MMBV3102L*
26	32	3	5	250	MMBV109L*
26	32	3	5	250	MV209**

*Case 318 **Case 182

TYPICAL CHARACTERISTICS

Diode Capacitance versus Reverse Voltage

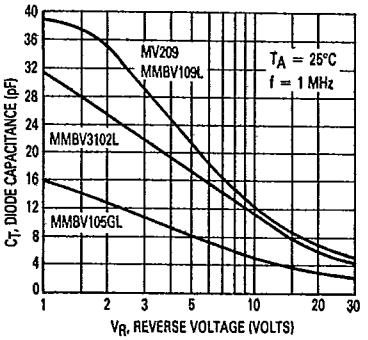
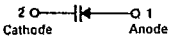


Table 5. For AM Radio



CASE 182-02
(TO-92)
STYLE 1

- High Capacitance Ratio
- Guaranteed Diode Capacitance
- Close Matching

C_T V_R=1 V, f=1 MHz pF Min	C_T V_R=1 V, f=1 MHz pF Max	$V_{BR(R)}$ Min	Q @ 1 Vdc, 1 MHz = 150 (Min) Cap Ratio Min	@ V_R Volts	Device Type
440	560	12	15	1/8	MVAM108
400	520	15	12	1/9	MVAM109
440	560	18	15	1/15	MVAM115
440	560	28	15	1/25	MVAM125

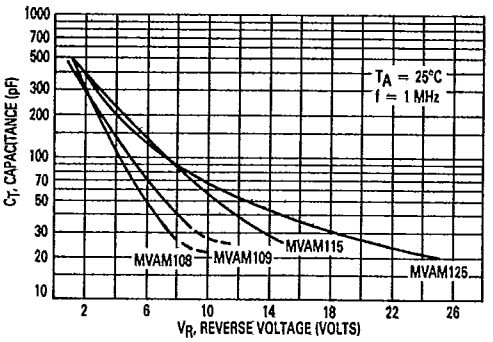
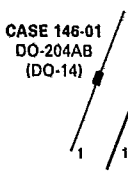
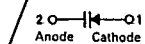


Table 6. For High Capacitance and High Reliability Applications

100% Screening to High Rel electrical and environmental specifications, H suffix.



CASE 146-01
DO-204AB
(DO-14)



CASE 51-02
DO-204AA
(DO-7)

- Hyper-Abrupt
- High Tuning Ratio
- High Rel — Suffix H

Maximum Working Voltage: 12 Volts

C_T, Nominal Capacitance pF Nom ± 20%	@ V_R Volts	Cap Ratio C2/C10 Min	Q @ 2 V 1 MHz Min	Device Type Case 51	Device Type Case 146
120	2	10	200	MV1404,H	
175	2	10	200	MV1403,H	
250	2	10	200	MV1405,H	
550*	1	14(1)	200		MV1401,H

*±15% (1)Cap Ratio for C1-C10 V

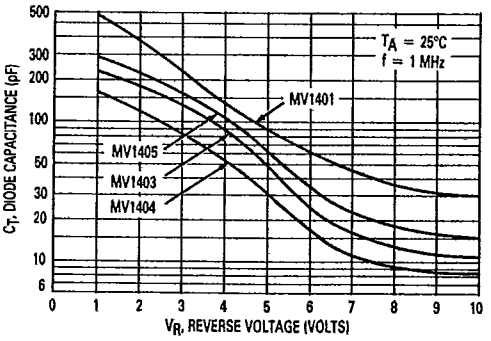
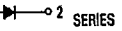


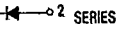
Table 7. Hot-Carrier (Schottky) Diodes

T-91-60

CASE 318-03
(TO-236AB)

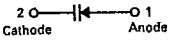
STYLE 8 SINGLE

STYLE 11  SERIES

STYLE 19  SERIES

Hot-Carrier diodes are ideal for VHF and UHF mixer and detector applications as well as many higher frequency applications. They provide stable electrical characteristics by eliminating the point-contact diode presently used in many applications.

CASE 182-02
(TO-92)
STYLE 1

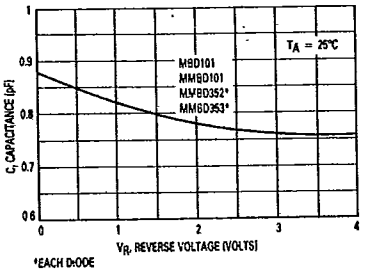


$V_{(BR)R}$ I_R = 10 μA Volts Min	C_T f = 1 MHz pF Max	V_R @ Volts	V_F I_F = 10 mA Volts Max	I_R nA Max	V_R @ Volts	Device Type
CASE 182, STYLE 1						
4	1	0	0.6	250	3	MBD101L
20	1.5	15	0.6	200	15	MBD201L
30	1.5	15	0.6	200	25	MBD301L
50	1	20	1.2	200	25	MBD501L
70	1	20	1.2	200	35	MBD701L
CASE 318, STYLE 8						
4	1	0	0.6	250	3	MMBD101L
20	1.5	15	0.6	200	15	MMBD201L
30	1.5	15	0.6	200	25	MMBD301L
50	1	20	1.2	200	25	MMBD501L
70	1	20	1.2	200	35	MMBD701L
DUAL DIODES, CASE 318						
4	1	0	0.6	250	3	MMBD352L*
4	1	0	0.6	250	3	MMBD353L**

*Style 11 **Style 19

TYPICAL CHARACTERISTICS

Capacitance versus Reverse Voltage



*EACH DIODE

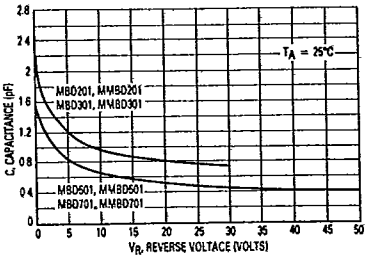
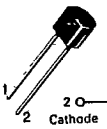
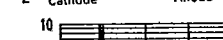


Table 8. PIN Switching Diodes

. . . designed for VHF band switching and general-purpose switching.



CASE 182-02
(TO-92)
STYLE 1



CASE 318-03
(TO-236AB)
STYLE 8

SINGLE

$V_{(BR)R}$ I_R = 10 μAdc Volts Min	R_S I_F = 10 mAdc f = 100 MHz Ohms Max	C_T V_R = 20 V f = 1 MHz pF Max	Device Type
CASE 182, STYLE 1			
20	0.85	2	MPN3404
200	1	1	MPN3700
CASE 318, STYLE 8			
35	0.7	1	MMBV3401L
200	1	1	MMBV3700L

Signal and Switching Diodes

SOT-23 Surface Mount Diode Configurations

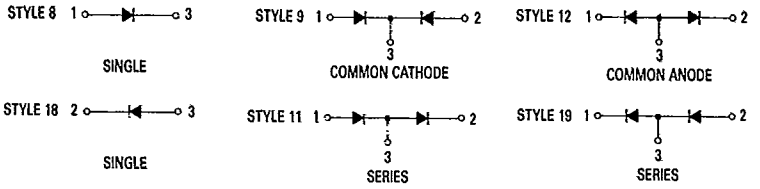


Table 9. General-Purpose Switching Diodes

Device	Marking	$V_{(BR)R}$ Min (V)	$V_{(BR)R}$ @ I_{BR} (μA)	I_R Max (μA)	I_R @ V_R (V)	V_F Min (V)	V_F Max (V)	V_F @ I_F (mA)	C_T Max (pF)	t_{rr} Max (ns)	Pin Out Case Style
SINGLES											
MMBD6050L	5A	70	100	0.1	50	0.85	1.1	100	2.5	4.0	8
MMBD914L	5D	100	100	5.0	75		1.0	10	4.0	4.0	8
BAS16L	A6	75	100	1.0	75		1.3	100	2.0	4.0	8
BAL99L	TF	70	10	2.5	70		1.1	50	1.5	4.0	18
DUALS											
MBAV70L	A4X	70	100	5.0	70		1.1	50	1.5	15	9
MBAW56L	A1X	70	100	2.5	70		1.1	50	1.5	15	12
MBAV99L	A7X	70	100	2.5	70		1.1	50	1.5	15	11
MBAV74	JAX	50	5.0	0.1	50		1.0	100	2.0		9
MMBD2835XL	A3X	35	100	0.1	30		1.0	10	4.0	15	12
MMBD2836XL	A2X	75	100	0.1	50		1.0	10	4.0	15	12
MMBD2837XL	A5X	35	100	0.1	30		1.0	10	4.0	15	9
MMBD2838XL	A6X	75	100	0.1	50		1.0	10	4.0	15	9
MMBD6100L	5B	70	100	0.1	50	0.85	1.1	100	2.5	15	9
MMBD7000L	5C	100	100	0.3	50	0.75	1.1	100	1.5	15	11