ALPHANUMERIC INDEX — CROSS-REFERENCE (Continued)

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
MJF127	MJF127		3-1016
MJF15030	MJF15030		3-1026
MJF15031	MJF15031		3-1026
MJF2955	MJF2955		—
MJF3055	MJF3055		—
MJF47	MJF47		3-1007
MJF6107	MJF6107		3-1022
MJH10012	MJH10012		3-596
MJH11017	MJH11017		3-1034
MJH11018	MJH11018		3-1034
MJH11019	MJH11019		3-1034
MJH11020	MJH11020		3-1034
MJH11021	MJH11021		3-1034
MJH11022	MJH11022		3-1034
MJH12004	MJH12004		3-644
MJH12005	MJH12005		—
MJH13090	MJH13090		3-688
MJH13091		MJH16010	3-758
MJH16002	MJH16002		3-976
MJH16002A	MJH16002A		3-734
MJH16004	MJH16004		3-976
MJH16006	MJH16006		3-742
MJH16006A	MJH16006A		3-750
MJH16008	MJH16008		3-742
MJH16010	MJH16010		3-758
MJH16010A	MJH16010A		3-766
MJH16012	MJH16012		3-758
MJH16018	MJH16018		3-782
MJH16032	MJH16032		3-984
MJH16034	MJH16034		3-984
MJH6282	MJH6282		3-1030
MJH6283	MJH6283		3-1030
MJH6284	MJH6284		3-1030
MJH6285	MJH6285		3-1030
MJH6286	MJH6286		3-1030
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MPS-U01A	MPS-U01A		3-1040
MPS-U02	MPS-U02		3-1042
MPS-U03	MPS-U03		3-1044
MPS-U04	MPS-U04		3-1044
MPS-U05	MPS-U05		3-1048
MPS-U06	MPS-U06		3-1048
MPS-U07	MPS-U07		3-1050
MPS-U10	MPS-U10		3-1052
MPS-U11		MPS-U10	3-1052
MPS-U12		MPS-U45	3-1055
MPS-U31		MPS-U06	3-1048
MPS-U45	MPS-U45		3-1055
MPS-U47		MPS-U06	3-1048
MPS-U51	MPS-U51		3-1058
MPS-U51A	MPS-U51A		3-1058
MPS-U52	MPS-U52		3-1060
MPS-U55	MPS-U55		3-1062
MPS-U56	MPS-U56		3-1062
MPS-U57	MPS-U57		3-1064

Industry Part Number	Motorola Direct Replacement	Motorola Similar Replacement	Page Number
MPS-U60	MPS-U60		3-1066
MPS-U95	MPS-U95		3-1068
MPSU01	MPS-U01		3-1040
MPSU01A	MPS-U01A		3-1040
MPSU02	MPS-U02		3-1042
MPSU03	MPS-U03		3-1044
MPSU04	MPS-U04		3-1044
MPSU05	MPS-U05		3-1048
MPSU06	MPS-U06		3-1048
MPSU07	MPS-U07		3-1050
MPSU10	MPS-U10		3-1052
MPSU11		MPS-U10	3-1052
MPSU12		MPS-U45	3-1055
MPSU45	MPS-U45		3-1055
MPSU51	MPS-U51		3-1058
MPSU51A	MPS-U51A		3-1058
MPSU52	MPS-U52		3-1060
MPSU55	MPS-U55		3-1062
MPSU56	MPS-U56		3-1062
MPSU57	MPS-U57		3-1064
MPSU60	MPS-U60		3-1066
MPSU95	MPS-U95		3-1068
NSD102		2N4923	3-79
NSD103		2N4923	3-79
NSD104		2N4923	3-79
NSD105		2N4923	3-79
NSD106		2N4923	3-79
NSD131		MJE340	3-876
NSD132		MJE340	3-876
NSD133		MJE340	3-876
NSD134		MJE340	3-876
NSD135		MJE340	3-876
NSD151		MJE800	3-888
NSD152		MJE800	3-888
NSD202		2N4919	3-75
NSD203		2N4919	3-75
NSD204		2N4919	3-75
NSD205		2N4919	3-75
NSD206		2N4919	3-75
NSD3439		MJE3439	3-908
NSD3440		MJE3440	3-908
NSDU01		MPS-U01	3-1040
NSDU01A		MPS-U01A	3-1040
NSDU05		MPS-U05	3-1048
NSDU06		MPS-U06	3-1048
NSDU07		MPS-U07	3-1050
NSDU45		MPS-U45	3-1055
NSDU51		MPS-U51	3-1058
NSDU51A		MPS-U51A	3-1058
NSDU55		MPS-U55	3-1062
NSDU56		MPS-U56	3-1062
NSDU57		MPS-U57	3-1064
NSE170		MJE170	3-862
NSE171		MJE171	3-862
NSE180		MJE180	3-862
NSE181		MJE181	3-862
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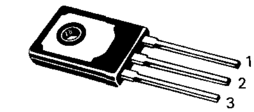
NSP2010		TIP42	3-1083
NSP2011		TIP42A	3-1083
NSP2021		TIP41A	3-1083

*Consult Motorola if a direct replacement is necessary.

TABLE 8 — PLASTIC TO-225 Type (Formerly TO-127 Type)†

STYLE 2:
PIN 1. EMITTER
2. COLLECTOR
3. BASE



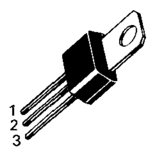
CASE 90-05 (TO-225AB)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s μs Max	Resistive Switching t_f μs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
5	50		MJE105	25/100	2					65
	60	MJE1100## MJE1101##	MJE1090##	750 min 750 min	3A 4A				1 1	70 70
	80	MJE1102## MJE1103##	MJE1092## MJE1093##	750 min 750 min	3A 4A				1 1	70 70
8	60	MJE6043##	MJE6040##	1k/20k	4	1.5 typ	1.5 typ	4	4#	75
	80	MJE6044##	MJE6041##	1k/20k	4	1.5 typ	1.5 typ	4	4#	75
	100	MJE6045##		1k/20k	4	1.5 typ	1.5 typ	4	4#	75
10	60	MJE2801 MJE3055	MJE2901 MJE2955	25/100 20/70	3 4				 2	90 90
12	40	2N5989		20/120	6	0.5 typ	0.25 typ	6	2	100
	80	2N5991		20/120	6	0.5 typ	0.25 typ	6	2	100
15	40	MJE1660		20/100	5				3	90
	60	MJE1661		20/100	5				3	90

$|h_{fe}|$ @ 1 MHz, ## Darlington
† Not recommended for new designs (check TO-220, Table 5 for alternates)

TABLE 9 — PLASTIC CASE 152†

STYLE 1:
PIN 1. EMITTER
2. BASE
3. COLLECTOR
(COLLECTOR CONNECTED TO TAB)



I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s μs Max	Resistive Switching t_f μs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C
0.5	300	MPS-U10	MPS-U60	30 min	0.03				60	10
0.8	40	MPS-U02	MPS-U52	30 min	0.5				150	10
1	120	MPS-U03		40 min	0.01				100	10
	180	MPS-U04		40 min	0.01				100	10
2	30	MPS-U01	MPS-U51	50 min	1				50	10
	40	MPS-U01A MPS-U45##	MPS-U51A MPS-U95##	50 min 4k min	1 1				50 100	10 10

Darlington

(continued)

† Not recommended for new designs (check TO-225, Table 7 or TO-220, Table 5 for alternates)

TABLE 11 — MILITARY SPECIFIED POWER TRANSISTORS (continued)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN/#	Device Type PNP/#	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	Resistive Switching t_f µs Max	Resistive Switching @ I_C Amp	f_T MHz Min	P_D (Case) Watts @ 25°C	Case JEDEC/MOT
15	400	**2N6547J,/525 TX**		12/60	5	4.7*		10	6	175	TO-204/1
		2N6675J,/537 TX, TXV**		8/20	10	2.5	0.5	10	15	175	TO-204AA/1
20	75	**2N5039J,/439 TX, TXV**		30/150	2	2*		10	60	140	TO-204/1
	80	**2N5303J,/456A TX, TXV**	**2N5745J,433 TX, TXV**	15/60	10	3*		10	2	200	TO-204/1
		2N6283J,/504 TX, TXV	**2N6286J,/505 TX, TXV**	1250/18k	10	10*		10	8	175	TO-204/1
	90	**2N5038J/439 TX, TXV**		50/200	2	2*		12	60	140	TO-204/1
	100	**2N6284J,/504 TX, TXV**	**2N6287J,/505 TX, TXV**	1250/18k	10	10*		10	8	175	TO-204/1
25	100		**2N6437J,/508 TX, TXV**	30/120	10	1		10	40	200	TO-204/1
	120		**2N6438J,/509 TX, TXV**	30/120	10	1		10	40	200	TO-204/1
30	60	**2N5302J,/456A TX, TXV**	**2N4399J,/433 TX, TXV**	15/60	15	3*		10	2	200	TO-204/1
50	60	**2N5685J,/464 TX, TXV**	**2N5683J,/466 TX, TXV**	15/60	25	3*		25	2	300	TO-204/197
	80	**2N5686J,/464 TX, TXV**	**2N5684J,/466 TX, TXV**	15/60	25	3*		25	2	300	TO-204/197
	100	**2N6274J,/514 TX, TXV**	**2N6378J,/515 TX, TXV**	30/120	20	1.05*		20	30	250	TO-204/197
	120		**2N6379J,/515 TX, TXV**	30/120	20	1.05*		20	30	250	TO-204/197
	150	**2N6277J,/514 TX, TXV****		30/120	20	1.05*		20	30	250	TO-204/197

MIL-S-19500 Detailed Spec. shown by Device Type

* t_{off}

** Consult Factory for qualification status.

TABLE 12 — POWER DARLINGTONS

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} Min/Max	@ I_C Amp	Resistive Switching t_s µs Max	Resistive Switching t_f µs Max	Resistive Switching @ I_C Amp	$\|h_{fe}\|$ @ 1 MHz Min	P_D (Case) Watts @ 25°C	Case JEDEC/MOT
2	40	**MPS-U45**	**MPS-U95**	4k min	1				100	10	/152
	60	**TIP110**	**TIP115**	1k min	1	2 typ	1 typ	1	25	50	TO-220/221A
	80	**TIP111**	**TIP116**	1k min	1	2 typ	1 typ	1	25	50	TO-220/221A
	100	**TIP112**	**TIP117**	1k min	1	2 typ	1 typ	1	25	50	TO-220/221A
		MJD112	**MJD117**	1000 min	2	1.7 typ	1.3 typ	2	25	20	TO-252/369A-04
		MJE270	**MJE271**	1.5k min	0.12				6	25	TO-225AA/77

(continued)

TABLE 12 — POWER DARLINGTONS (continued)

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			$\lvert h_{fe} \rvert$ @ 1 MHz Min	P_D (Case) Watts @ 25°C	Case JEDEC/MOT
		NPN	PNP			t_s μs Max	t_f μs Max	@ I_C Amp			
50	90	MJ11030	MJ11031	400 min	50					300	TO-204/197
	120	MJ11032	MJ11033	400 min	50					300	TO-204/197
	400	MJ10015•		10 min	40	2.5	0.5	20	10	250	TO-204/197
	500	BUT34• MJ10016•		15 min 10 min	32 40	3 2.5	1.5 0.5	32 20	 10	250 250	TO-204/197 TO-204/197
56	400	BUT33•		20 min	36	3.3	1.6	36		250	TO-204/197
60	200	MJ10020•		75/1k min	15	3.5	0.5	30		250	TO-204/197
	250	MJ10021•		75/1k min	15	3.5	0.5	30		250	TO-204/197

• Darlington with speed-up diode.

TABLE 13 — POWER SWITCHING TRANSISTORS

V_{CEO} < 200 V

I_CCont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type		h_{FE} Min/Max	@ I_C Amp	Resistive Switching			f_T MHz Min	P_D (Case) Watts @ 25°C	Case JEDEC/MOT
		NPN	PNP			t_s μs Max	t_f μs Max	@ I_C Amp			
0.8	40	MPS-U02	MPS-U52	30 min	0.5				150	10	—/152
1	120	MPS-U03		40 min	0.1				100	10	—/152
	180	MPS-U04		40 min	0.1				100	10	—/152
2	30	MPS-U01	MPS-U51	50 min	1				50	10	—/152
	40	MPS-U01A MPS-U45#	MPS-U51A MPS-U95#	50 min 4k min	1 1				50 100	10 10	—/152 —/152
	60	MPS-U05	MPS-U55	60 min	0.25				50	10	—/152
	80	MPS-U06	MPS-U56	60 min	0.25				50	10	—/152
	100	MPS-U07	MPS-U57	60 min	0.25				50	10	—/152
3	40		2N3719 2N3867	25/180 40/200	2 2	0.4* 0.4*		1 1	60 60	6 6	TO-205AA/31 TO-205AA/31
	60		2N3720 2N3868	25/180 30/150	2 2	0.4* 0.4*		1 1	60 60	6 6	TO-205AA/31 TO-205AA/31
	80		2N6303	30/150	2	0.4*		1	60	6	TO-205AA/31

Darlington   * t_{off} @ 1 MHz   (continued)

MOTOROLA
SEMICONDUCTOR
TECHNICAL DATA

MPS-U95

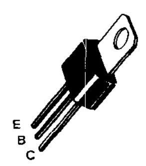
NOT RECOMMENDED FOR NEW DESIGNS

PNP SILICON DARLINGTON AMPLIFIER TRANSISTOR

. . . *designed for amplifier and driver applications.*

- High DC Current Gain —
  h_{FE} = 25,000 (Min) @ I_C = 200 mAdc
  15,000 (Min) @ I_C = 500 mAdc
- Collector-Emitter Breakdown Voltage —
  $V_{(BR)CES}$ = 40 Vdc (Min) @ I_C = 100 μAdc
- Low Collector-Emitter Saturation Voltage —
  $V_{CE(sat)}$ = 1.5 Vdc @ I_C = 1.0 Adc
- Monolithic Construction for High Reliability
- Complement to NPN MPS-U45

PNP SILICON DARLINGTON TRANSISTOR



3

MAXIMUM RATINGS

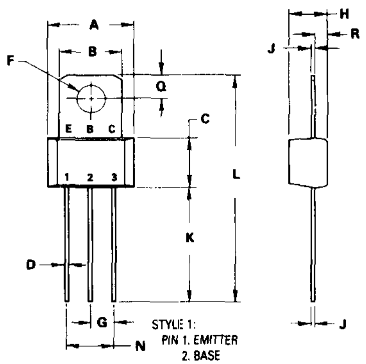
Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}(1)	40	Vdc
Collector-Emitter Voltage	V_{CES}	40	Vdc
Collector-Base Voltage	V_{CB}	50	Vdc
Emitter-Base Voltage	V_{EB}	10	Vdc
Collector Current -Continuous	I_C	2.0	Adc
Total Power Dissipation @ $T_A = 25^oC$ Derate above 25°C	P_D	1.0 8.0	Watt mW/°C
Total Power Dissipation @ $T_C = 25^oC$ Derate above 25°C	P_D	10 80	Watts mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to +150	°C

THERMAL CHARACTERISTICS

Characteristic	*Symbol*	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$(2)	125	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	12.5	°C/W

(1) Due to the monolithic construction of this device, breakdown voltages of both transistor elements are identical, $V_{(BR)CES}$ is tested in lieu of $V_{(BR)CEO}$ in order to avoid errors caused by noise pickup. The voltage measured during the $V_{(BR)CES}$ test is the $V_{(BR)CEO}$ of the output transistor.

(2) $R_{\theta JA}$ *is measured with the device soldered into a typical printed circuit board.*



STYLE 1:
PIN 1. EMITTER
2. BASE
3. COLLECTOR
(COLLECTOR CONNECTED TO TAB)

NOTE:
1. LEADS WITHIN 0.15 mm(0.006) TOTAL OF TRUE POSITION AT CASE, AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	9.14	9.53	0.360	0.375
B	6.60	7.24	0.260	0.285
C	5.41	5.66	0.213	0.223
D	0.38	0.53	0.015	0.021
F	3.18	3.33	0.125	0.131
G	2.54 BSC		0.100 BSC	
H	3.94	4.19	0.155	0.165
J	0.36	0.41	0.014	0.016
K	11.63	12.70	0.458	0.500
L	24.58	25.53	0.968	1.005
N	5.08 BSC		0.200 BSC	
Q	2.39	2.69	0.094	0.106
R	1.14	1.40	0.045	0.055

CASE 152-02

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 100 μAdc, V_{BE} = 0)	$V_{(BR)CES}$	40	–	–	Vdc
Collector-Base Breakdown Voltage (I_C = 100 μAdc, I_E = 0)	$V_{(BR)CBO}$	50	–	–	Vdc
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)	$V_{(BR)EBO}$	10	–	–	Vdc
Collector Cutoff Current (V_{CB} = 30 Vdc, I_E = 0)	I_{CBO}	–	–	100	nAdc
Emitter Cutoff Current (V_{EB} = 8.0 Vdc, I_C = 0)	I_{EBO}	–	–	100	nAdc
ON CHARACTERISTICS(1)					
DC Current Gain	h_{FE}				–
(I_C = 200 mAdc, V_{CE} = 5.0 Vdc)		25,000	43,000	150,000	
(I_C = 500 mAdc, V_{CE} = 5.0 Vdc)		15,000	41,000	–	
(I_C = 1.0 Adc, V_{CE} = 5.0 Vdc)		4,000	35,000	–	
Collector-Emitter Saturation Voltage (I_C = 1.0 Adc, I_B = 2.0 mAdc)	$V_{CE(sat)}$	–	1.0	1.5	Vdc
Base-Emitter Saturation Voltage (I_C = 1.0 Adc, I_B = 2.0 mAdc)	$V_{BE(sat)}$	–	1.85	2.0	Vdc
Base-Emitter On Voltage (I_C = 1.0 Adc, V_{CE} = 5.0 Vdc)	$V_{BE(on)}$	–	1.7	2.0	Vdc
DYNAMIC CHARACTERISTICS					
Small-Signal Current Gain (1) (I_C = 200 mAdc, V_{CE} = 5.0 Vdc, f = 100 MHz)	$\|h_{fe}\|$	0.5	1.6	–	–
Collector Base Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)	C_{cb}	–	2.5	12	pF

(1)Pulse Test: Pulse Width ≤ 300 μs, Duty Cycle ≤ 2.0%.

3

Uniwatt Darlington transistors can be used in any number of low power applications, such as relay drivers, motor control and as general purpose amplifiers. As an audio amplifier these devices, when used as a complementary pair, can drive 3.5 watts into a 3.2 ohm speaker using a 14 volt supply with less than one percent distortion. Because of the high gain the base drive requirement is as low as 1 mA in this application. They are also useful as power drivers for high current application such as voltage regulators.

FIGURE 1 – DC CURRENT GAIN

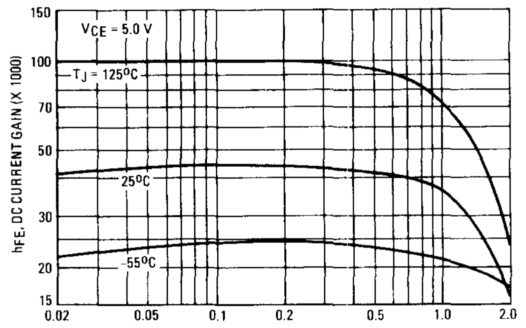


FIGURE 2 – SMALL-SIGNAL CURRENT GAIN

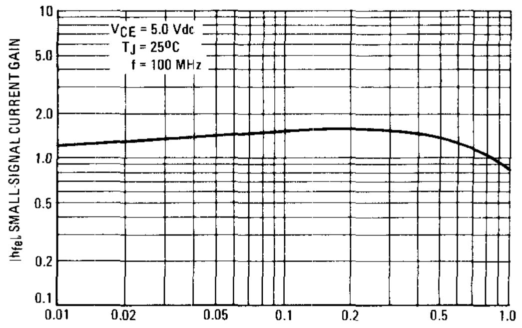


FIGURE 3 – "ON" VOLTAGES

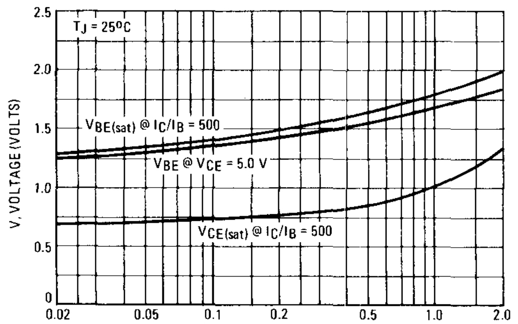
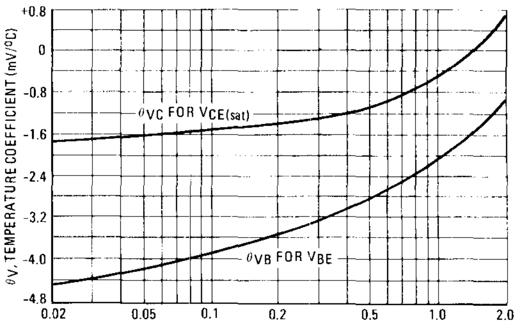
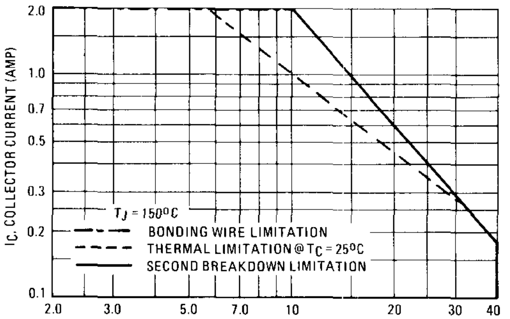


FIGURE 4 – TEMPERATURE COEFFICIENT



3

FIGURE 5 – DC SAFE OPERATING AREA



There are two limitations on the power handling ability of a transistor: junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 5 is based on $T_{J(pk)}$ = 150°C; T_C is variable depending on conditions. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown.