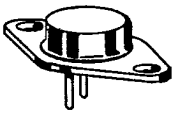
T-91-60

MIL-QUALIFIED PRODUCTS

Motorola MIL qualified components are ordered by adding suffix JAN, JTX, JTXV or JANS to the part numbers indicated in the following tables. Although Motorola will continue to supply components to the JAN specification where desired, this classification has been declared "inactive for new designs" per MIL-STD-19500. The higher level, JTX, is the recommended replacement.

CASE 79-04
TO-205AD (TO-39)



CASE 80
TO-213AA (TO-66)

Power Transistors

All listed power transistors are available with JAN, JTX and JTXV classifications except * = JAN and JTX only.

Bipolar

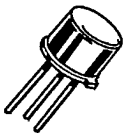
I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	h_{FE} @ Min/Max	@ I_C Amp	t_{on}/t_{off} µs Max	$V_{CE(sat)}$ Max Vdc	@ I_C/I_B Amp	P_D(Case) Watts @ 25°C
TO-204AA/AE (Formerly TO-3)									
8	250	2N6306*		15/75	3	0.6/3	0.8	3/0.6	125
	300	2N6671		29–Sep	5	0.5*/0.4*	1	5/1	150
	350	2N6308*		Oct–52	3	0.6/3	1.5	3/0.6	125
	400	2N6673		Aug–32	5	0.5*/0.4*	1	5/1	150
10	40	2N6383#	2N6648	1k/20k	5	2.5/10	2	5/0.01	100**
	60	2N3715	2N3791	50/150	1	—/2	1	5/0.5	150
		2N6384#	2N6649	1k/20k	5	2.5/10	2	5/0.01	100**
	80	2N3716	2N3792	50/150	1	—/2	1	5/0.5	150
		2N6385#	2N6650	1k/20k	5	2.5/10	2	5/0.01	100**
12	80	2N6058#	2N6051#	1k/18k	6	2/10	2	6/0.024	150
	100	2N6059#	2N6052#	1k/18k	6	2/10	2	6/0.024	150
15	300	2N6546		6/—	10	1/4.7	5	15/3	175
	400	2N6547		6/—	10	1/4.7	5	15/3	175
20	75	2N5039		20/—	10	0.5/2	1	10/1	140
	80	2N5303		15/60	10	0.9*/1*	1	10/1	200
			2N5745	15/60	10	1.5*/1*	1	10/1	200
		2N6283#	2N6286#	1250/18k	10	2/10	2	10/0.04	175
	90	2N5038		20/—	12	0.5/2	1	12/1.2	140
	100	2N6284#	2N6287#	1250/18k	10	2/10	2	10/0.04	175
25	100		2N6437	30/120	10	0.5/1.25	1	10/1	200
	120		2N6438	30/120	10	0.5/1.25	1	10/1	200
30	60	2N5302		15/60	15	2*/1*	1	15/1.5	200
			2N4399	15/60	15	—/2.1	1	15/1.5	200
50	60	2N5685	2N5683●	15/60	25	1.5/3	1	25/2.5	300
	80	2N5686●	2N5684●	15/60	25	1.5/3	1	25/2.5	300
	100		2N6378●	30/120	20	0.5/1.05	1	20/2	250
	100	2N6274●		30/120	20	0.5/1.05	1	20/2	250
	120		2N6379●	30/120	20	0.5/1.05	1	20/2	250
	150	2N6277●		30/120	20	0.5/1.05	1	20/2	250

t_r*/t_f*

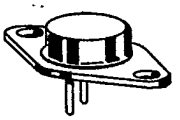
Darlington, ● TO-204AE; all others TO-204AA

** P_D = 85 for devices 2N6648, 2N6649 and 2N6650.

Power Transistors, Bipolar (Continued)



CASE 79-04
TO-205AD (TO-39)



CASE 80
TO-213AA (TO-66)

I_C Cont Amps Max	$V_{CEO(sus)}$ Volts Min	Device Type NPN	Device Type PNP	Resistive Switching h_{FE} @ I_C Min/Max | Amp	Resistive Switching t_{on}/t_{off} µs Max	$V_{CE(sat)}$ @ I_C/I_B Max Vdc | A/mA		P_D(Case) Watts @ 25°C
TO-205AA (Formerly TO-5)									
3	40		2N3867S	40/200	1.5	65*/100*	0.75	1.5/150	10
	60		2N3868S	30/150	1.5	65*/100*	0.75	1.5/150	10
TO-205AD (Formerly TO-39)									
5	100	2N5339	2N6193	60/240	2	100*/200*	0.7	2/200	1
TO-213AA (Formerly TO-66)									
1	300	2N3739		40/200	0.1	1.5/3.5	0.75	0.1/10	20
4	60		2N3740	30/120	0.25	0.4/1	0.4	0.25/25	25
		2N3766		40/160	0.5	0.25/2.5	1	0.5/50	25
	80		2N3741	30/120	0.25	0.4/1	0.4	0.25/250	25
		2N3767		40/160	0.5	0.25/2.5	1	0.5/50	25
8	60	2N6300#	2N6298#	750/18k	4	2/8	4	4/16	75+
	80	2N6301#	2N6299#	750/18k	4	2/8	4	4/16	75+

Darlington; + $T_C = 0°C$ for devices 2N6300, 2N6301

t_r*/t_f*

MOSFETs (TMOS)

N-Channel — Case 1-06 TO-204AA (TO-3)

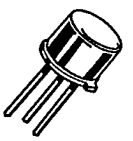
$V_{(BR)DSS}$ (Volts) Min	$r_{DS(on)}$ (Ohms) Max @ I_D (Amps)		Device	I_D (Amps) Max	C_{lss} pF Max	P_D* (Watts) Max
500	1.5	3	2N6762	4.5	800	75
	0.4	7.75	2N6770	12	3000	150
400	1	3.5	2N6760	5.5	800	75
	0.3	9	2N6768	14	3000	150
200	0.4	6	2N6758	9	800	75
	0.085	19	2N6766	30	3000	150
100	0.18	9	2N6756	14	800	75
	0.055	24	2N6764	38	3000	150

* @ 25°C

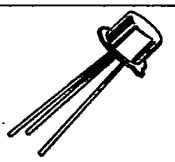
MIL-Qualified Products (Continued)

Small-Signal Transistors, Bipolar

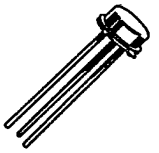
All devices in the following tables are qualified to JAN, JTX and JTXV levels, except:
• = JAN only
* = JAN/JTX only
** = JAN/JTX/JTXV/JANS



CASE 79-04
TO-205AD (TO-39)



CASE 22-03
TO-206AA (TO-18)



CASE 26-03
TO-206AB (TO-46)

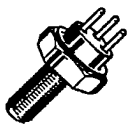
CASE 27-02
TO-206AC (TO-52)

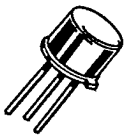
CASE 20-03
TO-206AF (TO-72)

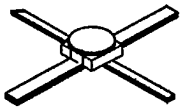
General Purpose

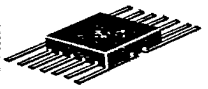
Package	Device Number	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} @ Min	Max	I_C, mA	$V_{CE(sat)}$ @ Volts Max	I_C/I_B mA
NPN								
TO-206AA (TO-18)	2N3700**	80	1000	50	200	500	0.5	500/50
	2N2484	60	50	200	500	0.01	0.3	1.0/0.1
	2N2221A	50	800	35	150	1	1.2	150/15
	2N2222A	50	800	75	325	1	1.2	150/15
	2N930*	45	30	100	300	0.01	1	10/0.5
	2N718A	30	500	40	120	150	1.5	150/15
	2N2221	30	800	25	150	1	1.3	150/15
	2N2222	30	800	50	325	1	1.3	150/15
	2N916•	25	50	50	200	10	0.5	10/1.0
TO-205AD (TO-39)	2N3019S**	80	1000	100	300	150	0.2	150/15
	2N2219A**	50	800	100	300	150	0.3	150/15
	2N2218A	50	800	40	120	150	0.3	150/15
	2N1613	30	500	40	120	150	1.5	150/15
	2N2218	30	800	40	120	150	0.4	150/15
	2N2219	30	800	100	300	150	0.4	150/15
TO-206AB (TO-46)	2N5581*	50	800	40	120	150	0.3	150/15
	2N5582*	50	800	100	300	150	0.3	150/15
PNP								
TO-206AA (TO-18)	2N2906A	60	600	40	120	150	0.4	150/15
	2N2907A**	60	600	100	300	150	0.4	150/15
	2N3250A	60	200	50	150	10	0.25	10/1.0
	2N3251A	60	200	100	300	10	0.25	10/1.0
	2N2906	40	600	40	120	150	0.4	150/15
	2N2907	40	600	100	300	150	0.4	150/15
T0-205AD (TO-39)	2N3057A	80	1000	50	200	500	0.5	500/50
	2N4033	80	1000	100	300	100	0.15	150/15
	2N4405*	80	500	100	300	150	0.2	150/15
	2N2905A**	60	600	100	300	1	0.4	150/15
	2N2904A	60	600	40	120	1	0.4	150/15
	2N2904	40	600	40	120	1	0.4	150/15
	2N2905	40	600	100	300	1	0.4	150/15
	2N1132•	40	600	30	90	150	1.5	150/15
TO-206AB (TO-46)	2N3485A*	60	600	40	120	150	0.4	150/15
	2N3486A*	60	600	100	300	150	0.4	150/15
	2N2605**	60	30	100	400	10	0.3	10/0.5

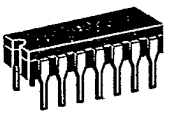
Small-Signal Transistors, Bipolar (Continued)

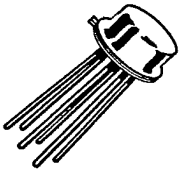

CASE 36


CASE 79-04


CASE 303-01


CASE 607-04


CASE 632-08


CASE 654-07

High-Frequency Amplifiers/Oscillators

The transistors shown are designed for use as both oscillators and amplifiers at UHF and VHF frequencies.

Package	Device Number	$V_{(BR)CEO}$ Volts Min	h_{FE} Min	@ I_C mA	G_{pe} dB Min	NF dB Max	@ f MHz	$\|h_{fe}\|$ Min	@ f MHz	C_{obo} pF Max
NPN										
TO-206AF	2N918**	15	20	3	15	6	60	6	100	1.7
PNP										
TO-206AF	2N4261	15	30	10	—	—	—	15	100	2.5

Switching Transistors

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

Package	Device Number	t_{on} ns Max	& t_{off} ns Max	@ I_C mA	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min	h_{FE} Max	@ I_C mA	$V_{CE(sat)}$ Volts Max	@ I_C mA	& I_B mA
NPN												
TO-206AA	2N914*	40	40	200	15	150	30	120	10	0.3	10	1
	2N708	40	75	10	15	—	40	120	10	0.4	10	1
	2N2481	40	55	100	15	—	40	120	10	0.25	10	1
	2N2369A**	12	18	10	15	200	40	120	10	0.2	10	1
	2N3227	12	18	10	20	200	100	300	10	0.2	10	1
TO-205AD	2N3444S*	35•	30•	500	50	1000	20	60	500	0.6	500	50
	2N3253S*	35•	30•	500	40	1000	25	75	500	0.6	500	50
	2N3735**	—	60	1000	50	1500	20	80	1000	0.9	1000	100
	2N3506	30•	35•	1500	40	3000	40	200	1500	1	1500	150
	2N3507	30•	35•	1500	50	3000	30	150	1500	1	1500	150
	2N3737**	—	60	1000	50	1500	20	80	1000	0.9	1000	100
TO-206AC	2N3013	15	25	300	20	300	35	120	30	0.18	30	3
	2N4449	12	18	10	15	200	40	120	10	0.2	10	1
PNP												
TO-206AA	2N869A*	50	80	30	18	200	40	120	10	0.15	10	1
TO-205AD	2N3634**	400	600	50	140	1000	50	150	50	0.6	50	5
	2N3635**	400	600	50	140	1000	100	300	50	0.6	50	5
	2N3636**	400	600	50	175	1000	50	150	50	0.6	50	5
	2N3637	400	600	50	175	1000	100	300	50	0.6	50	5
	2N4033	25•	35•	500	80	1000	100	300	100	0.15	150	15
	2N3467	30•	30•	500	40	1000	40	120	500	0.6	500	50
	2N3468	30•	30•	500	50	1000	25	75	500	0.6	500	50
	2N3762	35•	35•	1000	40	1500	30	120	1000	0.9	1000	100
	2N3763	35•	35•	1000	60	1500	20	80	1000	0.9	1000	100
	2N4405	25•	50•	500	80	500	100	300	150	0.2	150	15
TO-206AC	2N4453	50	80		18	200	40	120	30	0.15	10	1
TO-206AB	2N3764	35•	35•	1	40	1500	30	120	1000	0.9	1000	100
	2N3765	35•	35•	1	60	1500	20	80	1000	0.9	1000	100

* = JAN/JTX t_r•/t_f•

** = JAN/JTX/JTXV/JANS. All others, JAN/JTX/JTXV.

T-91-60

High-Voltage/High-Current Transistors

This 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.

Package	Device Number	$V_{(BR)CEO}$ Volts Min	I_C mA Max	h_{FE} Min/Max @	I_C mA	$V_{CE(sat)}$ Volts Max @	I_C mA &	I_B mA
NPN								
TO-205AD	2N3439	350	1000	40/160	20	0.5	50	4
	2N3440	250	1000	40/160	20	0.5	50	4
	2N3500**	150	300	40/120	150	0.4	150	15
	2N3501**	150	300	100/300	150	0.4	150	15
	2N3498**	100	500	40/120	150	0.6	300	30
	2N3499**	100	500	100/300	150	0.6	300	30
PNP								
TO-205AD	2N5416S	350	1000	30/120	50	2	50	5
	2N3743	300	50	50/200	30	1.2	30	3
	2N4931	250	50	50/200	30	1.2	30	3
	2N5415S	200	1000	30/120	50	2	50	5
	2N4930	200	50	50/200	30	1.2	30	3
	2N3637**	175	1000	100/300	50	0.6	50	5
	2N3636**	175	1000	50/150	50	0.6	50	5
	2N3635**	140	1000	100/300	50	0.6	50	5
	2N3634**	140	1000	50/150	50	0.6	50	5

Multiple Transistors

These multiple small-signal transistors include devices intended for amplifier and switching applications.

Device Number	Maximum Ratings			Electrical Characteristics						
	V_{CEO} V	I_C mA	$P_{D(Total)}$ W	I_{CBO} µA Max	h_{FE} Min/Max @	I_C mA	$V_{CE(sat)}$ Volts Min @	I_C mA &	I_B mA	
QUAD — NPN Case 632-02										
2N6989	50	800	1.5	0.01	100/300	150	0.3	150	15	
Case 607-04										
2N6990	50	800	0.4	0.01	100/300	150	0.3	150	15	
QUAD — PNP Case 632-02										
2N6987	60	600	1.5	0.01	100/300	150	0.4	150	15	
Case 607-04										
2N6988	60	600	0.4	0.01	100/300	150	0.4	150	15	
DUAL — NPN Case 654-07										
2N2060**	60	500	0.5	0.002	30/90	0.1	0.3	0.5	5	
2N3819**	60	30	0.5	0.002	300/1000	0.1	0.3	1	0.1	
2N3820**	60	30	0.5	0.002	150/600	0.1	0.3	1	0.1	
2N3810**	60	50	0.6	0.01	150/450	0.1	0.2	0.1	0.1	
2N3811**	60	50	0.6	0.01	300/900	0.1	0.2	0.1	0.1	
2N4854	40	600	0.6	0.01	100/300	150	0.4	150	15	
2N5793	40	600	0.6	0.01	40/120	150	0.6	150	15	
2N5794	40	600	0.6	0.01	100/300	150	0.6	150	15	
2N5795	60	600	0.6	0.02	40/150	150	0.4	150	15	
2N5796	60	600	0.6	0.02	100/300	150	0.4	150	15	

** = JAN/JTX/JTXV/JANS. All others, JAN/JTX/JTXV.

Small-Signal Transistors, JFETs

Amplifiers, TO-206AF

All are low-frequency amplifiers except 2N3823 and 2N4416A which are suitable for VHF/UHF amplification.

Device	$\|Y_{fs}\|$ (μmho) Min @ f (kHz)	$\|Y_{os}\|$ (μmho) Min @ f (kHz)	C_{iss} (pF) Max	C_{rss} (pF) Max	NF (dB) Max @ R_G=1 MΩ f (kHz)	$V_{(BR)}$ (V) Min	$V_{GS(off)}$ (V) Min | Max	I_{DSS} (mA) Min | Max
P-Channel								
2N3330*	1500 @ 1	40 @ 1	20	—	3 @ 1	20	— | 6	2 | 6
2N3331*	2000 @ 1	100 @ 1	20	—	4 @ 1	20	— | 8	5 | 15
N-Channel								
2N3821	1500 @ 1	10 @ 1	6	3	2.5 @ 0.01	50	— | 4	0.5 | 2.5
2N3822	3000 @ 1	20 @ 1	6	3	2.5 @ 0.01	50	— | 6	2 | 10
2N3823	3500 @ 1	35 @ 1	6	2	2.5 @ 1	30	— | 8	4 | 20
2N4416A	4500 @ 1	50 @ 1	4	0.8	4 @ 400	35	2.5 | 6	5 | 15

Switches and Choppers, TO-206AA — N-Channel

Device	$r_{ds(on)}$ (Ω) Max @ I_D mA	$V_{GS(off)}$ (V) Min | Max	I_{DSS} (mA) Min | Max	$V_{(BR)}$ (V) Min	C_{iss} (pF) Max	C_{rss} (pF) Max	t_{on} (ns) Max	t_{off} (ns) Max
2N4856*	25 @ 0	4 | 10	50 | —	40	18	8	6	25
2N4857	40 @ 0	2 | 6	20 | 100	40	18	8	6	50
2N4858	60 @ 0	0.8 | 4	8 | 80	40	18	8	10	100

RF Transistors, Bipolar NPN

Power, V_{CC} = 28 Vdc

Device Number	Frequency MHz, Max	P_{out} W @ P_{in} W (Max)	η G_{pe} dB (min)	Package
2N3553	175	2.5 @ 0.25	65	79-04 (TO-39)
2N3375	400	3 @ 1	65	36-03 (TO-60)
2N3866,A**	400	1 @ 0.15	45	79-034 (TO-39)

Small-Signal

	Maximum Ratings			Electrical Characteristics					
Device Number	V_{CEO} V	I_C mA	P_T mW	h_{FE} Min/Max @ I_C mA	nF dB Min/Max @ f GHz		G_{pe} dB Min/Max @ f GHz	
Case 303-1								
2N6603	15	30	300	30/200 @ 15	1.0/2.5 @ 1		15/21 @ 1	
2N6604	15	50	350	30/200 @ 30	1.5/3.0 @ 1		15/21 @ 1	
Case TO-206AF								
2N2857**	15	40	300	30/150 @ 3	—/4.5 @ 0.45		12.5/21 @ 0.45	
2N4957	30	30	200	30/165 @ 5	—/3.0 @ 0.45		17/25 @ 0.45	
Case TO-205AD								
2N5109	20	400	1000	40/150 @ 50	—/3.5 @ 0.2		11/— @ 0.2	
Case TO-18								
2N3960	12	—	400	60/300 @ 10	— @ —		— @	

Designed for high-speed current-mode logic switching — $|h_{fe}|$ = 13 @ 100 MHz, $V_{CE(sat)}$ = 0.2 V, C_{obo} = C_{ib} = 2.5 pF Max

* = JAN/JTX, ** = JAN/JTX/JTXV/JANS. All others, JAN/JTX/JTXV