TYPE	MATERIAL	POLARITY	REPLACEMENT	PAGE NUMBER	USE	MAXIMUM RATINGS						ELECTRICAL CHARACTERISTICS								
						P_D @ 25°C	Ref Point	T_J °C	V_{CB} (volts)	V_{CE-} (volts)	Subscript	h_{FE} @ I_C (min)	(max)	Units	$V_{CE(SAT)}$ @ I_C (volts)	Units	h_{f-}	Subscript	f_- Units	Subscript
2N3962	S	P			AFA	0.36W	A	200	60	60	0	100	300	10*	0.25	10M	100	E	40M	T
2N3963	S	P			AFA	0.36W	A	200	80	80	0	100	300	10*	0.25	10M	100	E	40M	T
2N3964	S	P			AFA	0.36W	A	200	45	45	0	250	500	10*	0.25	10M	250	E	50M	T
2N3965	S	P			AFA	0.36W	A	200	60	60	0	250	500	10*	0.25	10M	250	E	50M	T
2N3966 thru 2N3972	Field Effect Transistors, see Table on Page 1-166																			
2N3973	S	N	2N4400	5-34	MSC	0.36W	A	150	60	30	0	35	100	10M	0.3	0.15A			200M	T
2N3974	S	N	2N4401	5-34	MSC	0.36W	A	150	60	30	0	55	200	10M	0.3	0.15A			200M	T
2N3975	S	N	2N4400	5-34	MSC	0.36W	A	150	60	30	0	35	100	10M	0.3	0.15A			200M	T
2N3976	S	N	2N4401	5-34	MSC	0.36W	A	150	60	30	0	55	200	10M	0.3	0.15A			200M	T
2N3977	S	P			CHP	0.4W	A	200	15	10	0	40		5.0M	0.1	5.0M			1.0M	T
2N3978	S	P			CHP	0.4W	A	200	25	20	0	30		5.0M	0.15	5.0M			1.0M	T
2N3979	S	P			CHP	0.4W	A	200	40	35	0	20		5.0M	0.15	5.0M			1.0M	T
2N3980	Unijunction Transistor, see Table on Page 1-174																			
2N3981	S	N			HSS	0.8W	A	200	60	30	0	30	120	0.15A	0.4	0.15A			250M	T
2N3982	S	N			HSS	0.8W	A	200	50	20	0	40	140	0.15A	0.4	0.15A			250M	T
2N3983	S	N			RFC	0.2W	A	150	30	12	0	30		4.0M					500M	T
2N3984	S	N			RFC	0.2W	A	150	30	12	0	20		4.0M					400M	T
2N3985	S	N			RFC	0.2W	A	150	30	12	0	20		4.0M					300M	T
2N3986 thru 2N3992	Thyristors, see Table on Page 1-154																			
2N3993																				
2N3994	Field Effect Transistor, see Table on Page 1-166																			
2N3995	G	P	2N2929	9-33	RFA	0.3W	A	100	20	12	0	40	200	2.0M			150	E	0.6G	T
2N3996	S	N			PHS	2.0W	A	200	100	80	0	40	120	1.0A	0.25	1.0A			40M	T
2N3997	S	N			PHS	2.0W	A	200	100	80	0	80	240	1.0A	0.25	1.0A			40M	T
2N3998	S	N			PHS	2.0W	A	200	100	80	0	40	120	1.0A	0.25	1.0A			40M	T
2N3999	S	N			PHS	2.0W	A	200	100	80	0	80	240	1.0A	0.25	1.0A			40M	T
2N4000	S	N			PHS	1.0W	A	200	100	80	0	30	120	0.5A	0.3	0.5A			40M	T
2N4001	S	N			PHS	1.0W	A	200	120	100	0	40	120	0.5A	0.3	0.5A			40M	T
2N4002	S	N			LPA	4.0W	A		100	80	0	20	80	15A			30	E	30M	B
2N4003	S	N			LPA	4.0W	A		120	100	0	20	80	15A			30	E	30M	B
2N4004	S	N			LPA	1.2W	A		100	80	0	30	150	10A					30M	B
2N4005	S	N			LPA	1.2W	A		120	100	0	30	150	10A					30M	B
2N4006	S	P			AFA	400M	A	200	10	6.0	0						40	E	20M	T
2N4007	S	P			MSA	400M	A	200	20	15	0						30	E	15M	T
2N4008	S	P			MSA	400M	A	200	35	30	0						20	E	15M	T
2N4009	Matched Pair 2N4006																			
2N4010	Matched Pair 2N4007																			
2N4011	Matched Pair 2N4008																			
2N4012	S	N		9-110	LPA	11.6W	C	200	65	40	0	4.0	40	1.0A	1.0	0.25A			400M	T
2N4013	S	N		8-257	HSS	360M	A	200	60	40	0		150	100M					300M	T
2N4014	S	N		8-257	HSS	360M	A	200	80	50	0		150	100M					300M	T
2N4015	S	P			DFA	0.4W	A	200	60	60	0	135	350	1.0M	0.25	50M	135	E	200M	T
2N4016	S	P			DFA	0.4W	A	200	60	60	0	135	350	1.0M	0.25	50M	135	E	200M	T
2N4017	S	P			AFA	600M	A	200	80	80	0	100	500	1.0M					40M	T
2N4018	S	P			AFA	400M	A	200	60	60	0						100	E	7.0M	E
2N4019	S	P			AFA	400M	A	200	45	45	0						250	E	50M	T
2N4020	S	P			DFA	0.4W	A	200	45	45	0	250	500	10*	0.25	10M	250	E	50M	T
2N4021	S	P			DFA	0.4W	A	200	60	60	0	100	350	10*	0.25	10M	100	E	40M	T
2N4022	S	P			DFA	0.4W	A	200	60	60	0	250	500	10*	0.25	10M	250	E	50M	T
2N4023	S	P			DFA	0.4W	A	200	45	45	0	250	500	10*	0.25	10M	250	E	50M	T
2N4024	S	P			DFA	0.4W	A	200	60	60	0	100	350	10*	0.25	10M	100	E	40M	T
2N4025	S	P			DFA	0.4W	A	200	60	60	0	250	500	10*	0.25	10M	250	E	50M	T
2N4026	S	P			AFA	0.5W	A	200	60	60	0	40	120	0.1A	1.0	1.0A			100M	T
2N4027	S	P			AFA	0.5W	A	200	80	80	0	40	120	0.1A	0.5	0.5A			100M	T
2N4028	S	P			AFA	0.5W	A	200	60	60	0	100	300	0.1A	1.0	1.0A			150M	T
2N4029	S	P			AFA	0.5W	A	200	80	80	0	100	300	0.1A	0.5	0.5A			150M	T
2N4030	S	P			AFA	0.8W	A	200	60	60	0	40	120	0.1A	1.0	1.0A			100M	T
2N4031	S	P			AFA	0.8W	A	200	80	80	0	40	120	0.1A	0.5	0.5A			100M	T
2N4032	S	P			AFA	0.8W	A	200	60	60	0	100	300	0.1A	1.0	1.0A			150M	T
2N4033	S	P			AFA	0.8W	A	200	80	80	0	100	300	0.1A	0.5	0.5A			150M	T
2N4034	S	P			HSS	0.36W	A	200	40	40	0	70	200	10M	0.13	1.0M	50	E	400M	T
2N4035	S	P			HSS	0.36W	A	200	40	40	0	150	300	10M	0.13	1.0M	150	E	450M	T
2N4036	S	P			MSS	5.0W	A	200	90	65	0	40	140	0.15A					60M	T
2N4037	S	P			MSS	1.0W	A	200	60	40	0	50	250	0.15A					60M	T
2N4040	S	N			HPA	17.5W	C	200	60	40	0	10	80	0.1A	2.0	1.0A			400M	T
2N4041	S	N			HPA	10W	C	200	60	40	0	10	80	75M	2.0	0.5A			400M	T
2N4042	S	N			DFA	0.3W	C	200	60	60	0	200	600	10*	0.35	1.0M			200M	T
2N4043	S	N			DFA	0.3W	C	200	45	45	0	80	800	10*	0.35	1.0M			150M	T
2N4044	S	N			DFA	0.4W	C	200	60	60	0	200	600	10*	0.35	1.0M			200M	T
2N4045	S	N			DFA	0.4W	C	200	45	45	0	80	800	10*	0.35	1.0M			150M	T
2N4046	S	N		8-296	HSS	800M	A	200	50	30	0		150	100M					250M	T
2N4047	S	N		8-296	HSS	800M	A	200	80	50	0		150	100M					250M	T
2N4048	G	P		7-152	LPA	170W	C	110	45	30	0	60	120	15A	0.30	60A			2.0K	E
2N4049	G	P		7-152	LPA	170W	C	110	60	45	0	60	120	15A	0.30	60A			2.0K	E
2N4050	G	P		7-152	LPA	170W	C	110	75	60	0	60	120	15A	0.30	60A			2.0K	E
2N4051	G	P		7-152	LPA	170W	C	110	45	30	0	60	180	15A	0.30	60A			2.0K	E
2N4052	G	P		7-152	LPA	170W	C	110	60	45	0	60	180	15A	0.30	60A			2.0K	E
2N4053	G	P		7-152	LPA	170W	C	110	75	60	0	60	180	15A	0.30	60A			2.0K	E
2N4054	S	N			LPA	6.25W	C	150	300	300	0	30	90	50M	5.0	75M			15M	T
2N4055	S	N			LPA	6.25W	C	150	250	250	0	30	90	50M	5.0	75M			15M	T
2N4056	S	N			LPA	6.25W	C	150	200	200	0	30	90	50M	5.0	75M			15M	T
2N4057	S	N			LPA	6.25W	C	150	150	150	0	30	90	50M	5.0	75M			15M	T
2N4058	S	P	MPS6522	5-113	AFC	0.25W	A	150	30	30	0	100	400	0.1M	0.7	10M	100	E		
2N4059	S	P	MPS6516	5-113	AFC	0.25W	A	150	30	30	0	45	660	1.0M	0.7	10M	45	E		

QUICK SELECTOR GUIDES — SILICON HIGH-SPEED SWITCHING AND GENERAL PURPOSE TRANSISTORS

The following two tables categorize the silicon devices included in this section into two classifications — those intended for general-purpose switching and amplifier applications, and those recommended primarily for high-speed saturated switching purposes.

Only the preferred devices — those that merit first consideration for new designs — are listed. In each table, the devices are grouped in voltage and current ranges. The voltage given is the minimum collector-emitter breakdown voltage (BV_{CEO}). The current range columns represent operating current values for which optimum current gain (h_{FE}) and/or collector-emitter saturation voltage ($V_{CE(sat)}$) are specified in the data sheets.

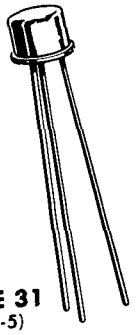
SATURATED SWITCHING TRANSISTORS (SILICON)
Current versus Voltage

BV_{CEO} Min Volts	OPTIMUM COLLECTOR CURRENT											
	0 to 10 mA		10 mA to 100 mA		100 mA to 500 mA		500 mA to 1.0 A		1.0 A to 3.0 A		3.0 A to 5.0 A	
	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP	NPN	PNP
0 ↓ 19	2N3010 2N3493 MM709 MM1748	2N2894 2N3546 2N4411	2N2369A 2N3009 2N3010 2N3011 2N3013 2N3210 2N3211	2N2894 2N3546	2N3009 2N3013 2N3510 2N3511 2N3647 2N3648		2N3303		2N3303			
20 ↓ 29	2N702 2N703		2N2501 2N3014 2N3227 2N3508 2N3509		2N2476 2N2477 2N2501 2N2847 2N2848							
30 ↓ 39			2N2537 2N2538 2N2539 2N2540		2N2537 2N2538 2N2539 2N2540 2N2845 2N2846 2N3015 2N3724 2N4013 2N4046		2N3252 2N3724 2N3734 2N3736 2N4013 2N4046		2N3734 2N3736			
40 ↓ 59			2N3725 2N4014		2N3725 2N4014 2N4047	2N3467 2N3468	2N3253 2N3444 2N3725 2N3735 2N3737 2N4014 2N4047	2N3467 2N3468 2N3762 2N3764	2N3444 2N3735 2N3737	2N3762 2N3764	2N3506 2N3507	
60 79								2N3763 2N3765		2N3763 2N3765		

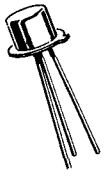
2N3724 (SILICON)
2N3725
2N4013
2N4014

V_{CEO} = 30 to 50 V
I_C = 1A
f_T = 300 MHz

NPN silicon annular low-power transistors primarily designed for high-speed saturated switching applications.



CASE 31
(TO-5)
2N3724
2N3725



CASE 22
(TO-18)
2N4013
2N4014

MAXIMUM RATINGS

Rating	Symbol	2N4013 2N3724	2N4014 2N3725	Unit
Collector-Emitter Voltage	V_{CEO}	30	50	Vdc
Collector-Base Voltage	V_{CB}	50	80	Vdc
Emitter-Base Voltage	V_{EB}	6.0		Vdc
Collector Current	I_C	1.0		Adc
Total Device Dissipation @ T_A = 25°C	P_D	800	360	mW
Derate above 25°C		4.6	2.06	mW/°C
Total Device Dissipation @ T_C = 25°C	P_D	3.5	1.2	Watts
Derate above 25°C		20	6.85	mW/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +200		°C

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

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage* (I_C = 10 mAdc, I_B = 0)	2N3724, 2N4013	BV_{CEO}*	30	-	Vdc
	2N3725, 2N4014		50	-	
Collector-Emitter Breakdown Voltage (I_C = 10 μAdc, V_{BE} = 0)	2N3724, 2N4013	BV_{CES}	50	-	Vdc
	2N3725, 2N4014		80	-	
Collector-Base Breakdown Voltage (I_C = 10 μAdc, I_E = 0)	2N3724, 2N4013	BV_{CBO}	50	-	Vdc
	2N3725, 2N4014		80	-	
Emitter-Base Breakdown Voltage (I_E = 10 μAdc, I_C = 0)		BV_{EBO}	6.0	-	Vdc
Collector Cutoff Current (V_{CE} = 50 Vdc, V_{BE} = 0)	2N3724, 2N4013	I_{CES}	-	10	μAdc
(V_{CE} = 80 Vdc, V_{BE} = 0)	2N3725, 2N4014		-	10	
Collector Cutoff Current (V_{CB} = 40 Vdc, I_E = 0)	2N3724, 2N4013	I_{CBO}	-	1.7	μAdc
(V_{CB} = 40 Vdc, I_E = 0, T_A = 100°C)	2N3724, 2N4013		-	120	
(V_{CB} = 60 Vdc, I_E = 0)	2N3725, 2N4014		-	1.7	
(V_{CB} = 60 Vdc, I_E = 0, T_A = 100°C)	2N3725, 2N4014		-	120	
Base Current (V_{CE} = 50 Vdc, V_{BE} = 0)	2N3724, 2N4013	I_B	-	10	μAdc
(V_{CE} = 80 Vdc, V_{BE} = 0)	2N3725, 2N4014		-	10	
ON CHARACTERISTICS					
DC Current Gain* (I_C = 10 mAdc, V_{CE} = 1.0 Vdc)		h_{FE}*	30	-	-
(I_C = 100 mAdc, V_{CE} = 1.0 Vdc)			60	150	
(I_C = 300 mAdc, V_{CE} = 1.0 Vdc)			40	-	
(I_C = 500 mAdc, V_{CE} = 1.0 Vdc)			35	-	
(I_C = 800 mAdc, V_{CE} = 2.0 Vdc)	2N3724, 2N4013		25	-	
	2N3725, 2N4014		20	-	
(I_C = 1.0 Adc, V_{CE} = 5.0 Vdc)	2N3724, 2N4013		30	-	
	2N3725, 2N4014		25	-	
(I_C = 100 mAdc, V_{CE} = 1.0 Vdc, T_A = -55°C)	2N3724, 2N4013		30	-	
(I_C = 500 mAdc, V_{CE} = 1.0 Vdc, T_A = -55°C)			20	-	

2N3724, 2N3725 — 2N4013, 2N4014 (continued)

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

Characteristic		Symbol	Min	Max	Unit
ON CHARACTERISTICS (continued)					
Collector-Emitter Saturation Voltage*		$V_{CE(sat)}$*			Vdc
(I_C = 10 mAdc, I_B = 1.0 mAdc)			-	0.25	
(I_C = 100 mAdc, I_B = 10 mAdc)	2N3724, 2N4013		-	0.20	
	2N3725, 2N4014		-	0.26	
(I_C = 300 mAdc, I_B = 30 mAdc)	2N3724, 2N4013		-	0.32	
	2N3725, 2N4014		-	0.40	
(I_C = 500 mAdc, I_B = 50 mAdc)	2N3724, 2N4013		-	0.42	
	2N3725, 2N4014		-	0.52	
(I_C = 800 mAdc, I_B = 80 mAdc)	2N3724, 2N4013		-	0.65	
	2N3725, 2N4014		-	0.80	
(I_C = 1.0 Adc, I_B = 100 mAdc)	2N3724, 2N4013		-	0.75	
	2N3725, 2N4014		-	0.95	
Base-Emitter Saturation Voltage*		$V_{BE(sat)}$*			Vdc
(I_C = 10 mAdc, I_B = 1.0 mAdc)			-	0.76	
(I_C = 100 mAdc, I_B = 10 mAdc)			-	0.86	
(I_C = 300 mAdc, I_B = 30 mAdc)			-	1.1	
(I_C = 500 mAdc, I_B = 50 mAdc)			0.9	1.2	
(I_C = 800 mAdc, I_B = 80 mAdc)			-	1.5	
(I_C = 1.0 Adc, I_B = 100 mAdc)			-	1.7	
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain—Bandwidth Product (I_C = 50 mAdc, V_{CE} = 10 Vdc, f = 100 MHz)		f_T	300	-	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 140 kHz)	2N3724, 2N4013	C_{ob}	-	12	pF
	2N3725, 2N4014		-	10	
Input Capacitance (V_{BE} = 0.5 Vdc, I_C = 0, f = 140 kHz)		C_{ib}	-	55	pF
SWITCHING CHARACTERISTICS					
Turn-On Time	(V_{CC} = 30 Vdc, $V_{BE(off)}$ = 3.8 Vdc, I_C = 500 mAdc, I_{B1} = 50 mAdc) (See Figure 1)	t_{on}	-	35	ns
Delay Time		t_d	-	10	ns
Rise Time		t_r	-	30	ns
Turn-Off Time	(V_{CC} = 30 Vdc, I_C = 500 mAdc, I_{B1} = I_{B2} = 50 mAdc) (See Figure 1)	t_{off}	-	60	ns
Storage Time		t_s	-	50	ns
Fall Time	2N3724, 2N4013	t_f	-	25	ns
	2N3725, 2N4014		-	30	

* Pulse Test: Pulse Width = 300 μs, Duty Cycle = 1.0%.

FIGURE 1 — SWITCHING TIMES TEST CIRCUIT