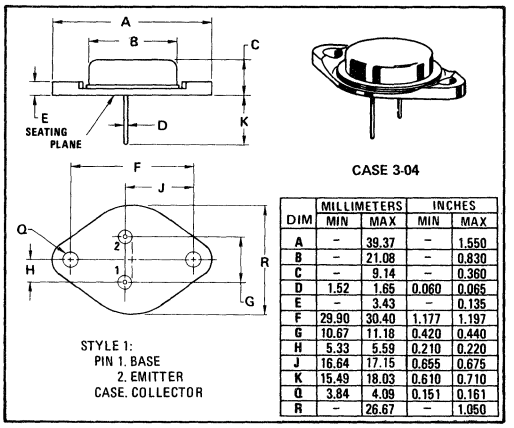
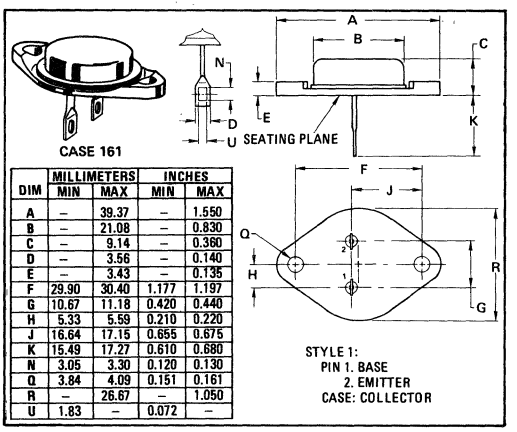
2N5435 (GERMANIUM) thru 2N5440

PNP germanium power switching transistors designed for high-current, fast-switching applications requiring low saturation voltage and excellent safe operating area.



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	–	39.37	–	1.550
B	–	21.08	–	0.830
C	–	9.14	–	0.360
D	1.52	1.65	0.060	0.065
E	–	3.43	–	0.135
F	29.90	30.40	1.177	1.197
G	10.67	11.18	0.420	0.440
H	5.33	5.59	0.210	0.220
J	16.64	17.15	0.655	0.675
K	15.49	18.03	0.610	0.710
Q	3.84	4.09	0.151	0.161
R	–	26.67	–	1.050



DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES MAX
A	–	39.37	–	1.550
B	–	21.08	–	0.830
C	–	9.14	–	0.360
D	–	3.56	–	0.140
E	–	3.43	–	0.135
F	29.90	30.40	1.177	1.197
G	10.67	11.18	0.420	0.440
H	5.33	5.59	0.210	0.220
J	16.64	17.15	0.655	0.675
K	15.49	17.27	0.610	0.680
N	3.05	3.30	0.120	0.130
Q	3.84	4.09	0.151	0.161
R	–	26.67	–	1.050
U	1.83	–	0.072	–

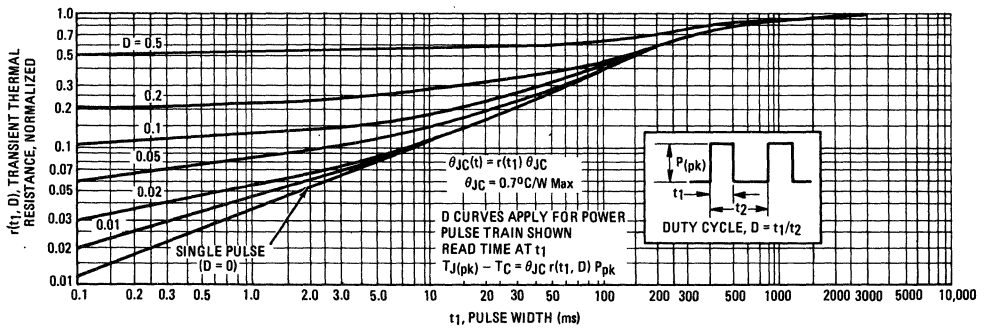
MAXIMUM RATINGS **

Rating	Symbol	2N5435 2N5438	2N5436 2N5439	2N5437 2N5440	Unit
Collector-Emitter Voltage	V_{CEO}	60	90	120	Vdc
Collector-Base Voltage	V_{CB}	80	110	140	Vdc
Emitter-Base Voltage	V_{EB}	2.5			Vdc
Collector Current — Continuous	I_C	60			Adc
Base Current — Continuous	I_B	12			Adc
Total Device Dissipation @ $T_C = 25°C$	P_D	120			Watts
Derate above 25°C		1.43			W/°C
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +110			°C

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	θ_{JC}	0.7	°C/W

FIGURE 1 – THERMAL RESPONSE



**Maximum Ratings for MP5435 Series are the Same as the 2N5435 Series.

ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)**

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector-Emitter Breakdown Voltage (I_C = 0.1 Adc, I_B = 0)	2N5435, 2N5438	BV_{CEO}	60	-	Vdc
	2N5436, 2N5439		90	-	
	2N5437, 2N5440		120	-	
Collector Cutoff Current		I_{CEX}			mAdc
(V_{CE} = 80 Vdc, $V_{BE(off)}$ = 0.2 Vdc)	2N5435, 2N5438		-	10	
(V_{CE} = 110 Vdc, $V_{BE(off)}$ = 0.2 Vdc)	2N5436, 2N5439		-	10	
(V_{CE} = 140 Vdc, $V_{BE(off)}$ = 0.2 Vdc)	2N5437, 2N5440		-	10	
(V_{CE} = 80 Vdc, $V_{BE(off)}$ = 0.2 Vdc, T_C = +85°C)	2N5435, 2N5438		-	30	
(V_{CE} = 110 Vdc, $V_{BE(off)}$ = 0.2 Vdc, T_C = +85°C)	2N5436, 2N5439		-	30	
(V_{CE} = 140 Vdc, $V_{BE(off)}$ = 0.2 Vdc, T_C = +85°C)	2N5437, 2N5440		-	30	
Collector Cutoff Current (V_{CB} = 2.0 Vdc, I_E = 0)		I_{CBO}	-	200	μAdc
Emitter Cutoff Current (V_{BE} = 2.5 Vdc, I_C = 0)		I_{EBO}	-	500	mAdc
ON CHARACTERISTICS					
DC Current Gain*		h_{FE}*			
(I_C = 25 Adc, V_{CE} = 2.0 Vdc)	2N5435, 2N5436, 2N5437		20	60	
	2N5438, 2N5439, 2N5440		40	120	
(I_C = 60 Adc, V_{CE} = 2.0 Vdc)	2N5435, 2N5436, 2N5437		10	-	
	2N5438, 2N5439, 2N5440		15	-	
Collector-Emitter Saturation Voltage*		$V_{CE(sat)}$*			Vdc
(I_C = 60 Adc, I_B = 6.0 Adc)	2N5435, 2N5436, 2N5437		-	0.75	
	2N5438, 2N5439, 2N5440		-	0.50	
Base-Emitter Saturation Voltage*		$V_{BE(sat)}$*			Vdc
(I_C = 60 Adc, I_B = 6.0 Adc)	2N5435, 2N5436, 2N5437		-	1.2	
	2N5438, 2N5439, 2N5440		-	0.9	
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain–Bandwidth Product (I_C = 5.0 Adc, V_{CE} = 5.0 Vdc, f = 100 kHz)		f_T	350	-	kHz
SWITCHING CHARACTERISTICS					
Rise Time	(I_C = 25 Adc, I_{B1} = 2.5 Adc, I_{B2} = 2.5 Adc) (See Figure 4)	t_r	-	12	μs
Storage Time		t_s	-	10	μs
Fall Time		t_f	-	8.0	μs

**Electrical Characteristics for MP5435 series are the same as the 2N5435 series.
* To avoid excessive heating of the collector junction, perform test with pulse method.

FIGURE 2 – POWER-TEMPERATURE DERATING CURVE

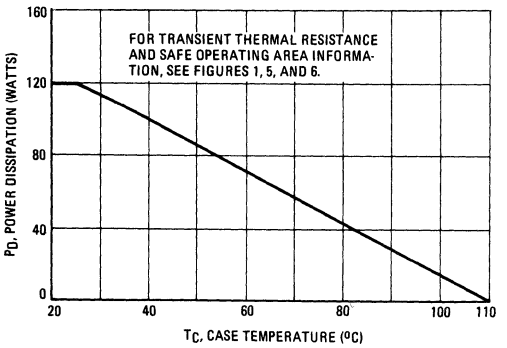


FIGURE 3 – SWITCHING TIMES

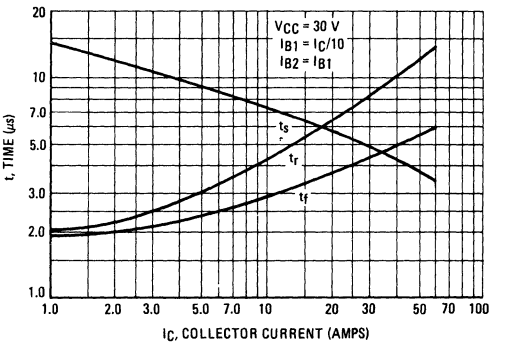


FIGURE 4 – SWITCHING TIME TEST CIRCUIT

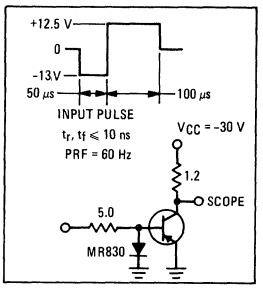
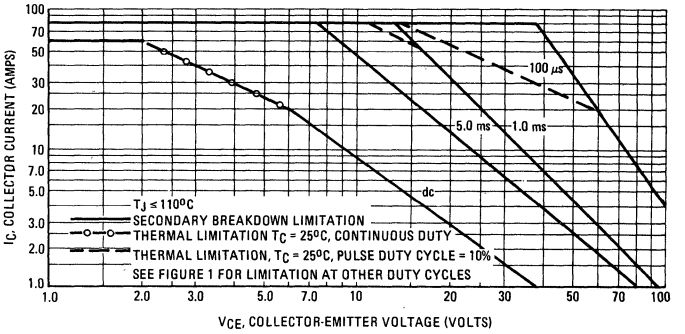


FIGURE 5 – ACTIVE REGION SAFE OPERATING AREA



There are two limitations on the power handling ability of a transistor: junction temperature and secondary 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 $T_{J(pk)} = 110°C$; T_C is variable depending on conditions. Pulse curves are valid for duty cycles to 10% provided $T_{J(pk)} < 110°C$. $T_{J(pk)}$ may be calculated from the data in Figure 1. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by secondary breakdown.

FIGURE 6 – CLAMPED INDUCTIVE SAFE OPERATING AREA

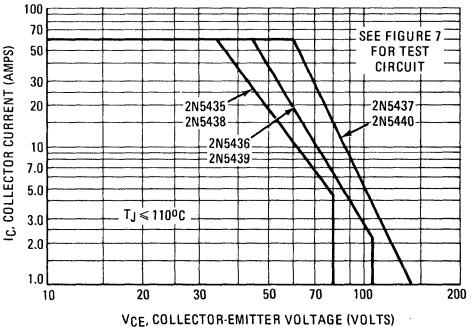


FIGURE 7 – CLAMPED INDUCTIVE SAFE OPERATING AREA TEST CIRCUIT

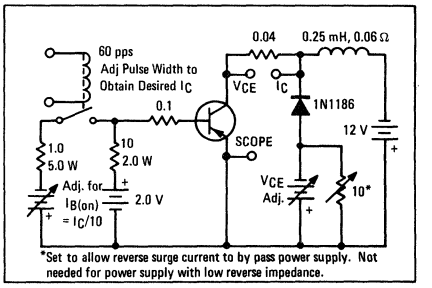


FIGURE 8 – DC CURRENT GAIN

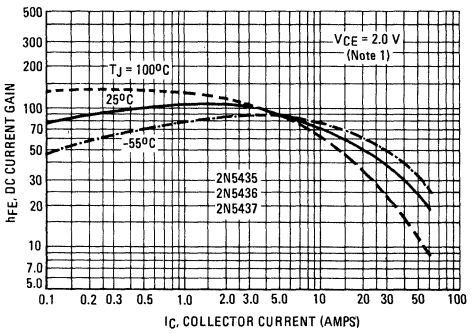
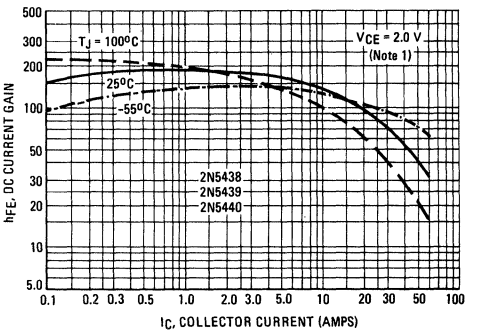


FIGURE 9 – DC CURRENT GAIN



NOTE 1: Data is obtained from pulse tests and adjusted to nullify the effect of I_{CBO}.

FIGURE 10 – COLLECTOR SATURATION REGION

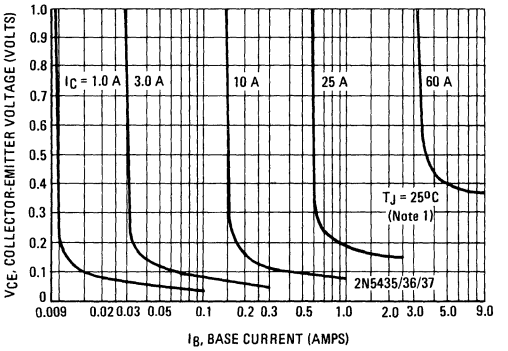


FIGURE 11 – COLLECTOR SATURATION REGION

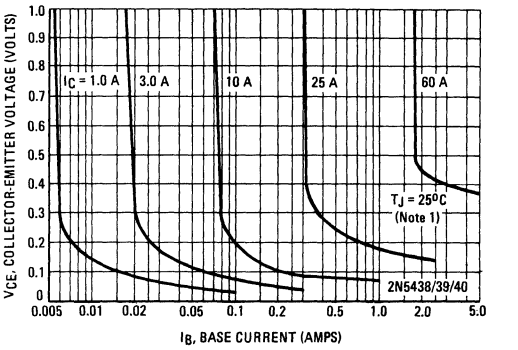


FIGURE 12 – EFFECTS OF BASE-EMITTER RESISTANCE

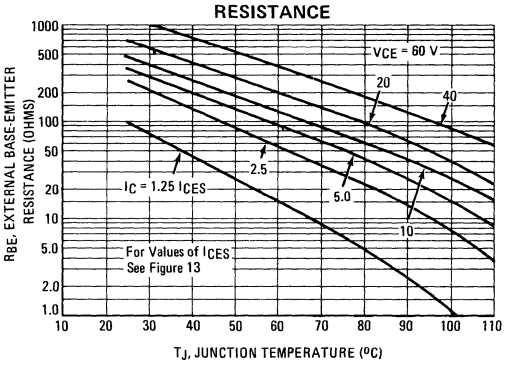


FIGURE 13 – COLLECTOR CUTOFF REGION

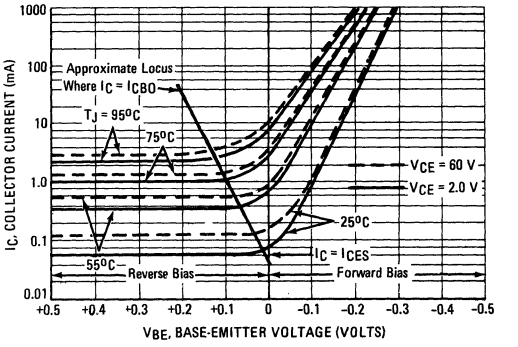


FIGURE 14 – "ON" VOLTAGES

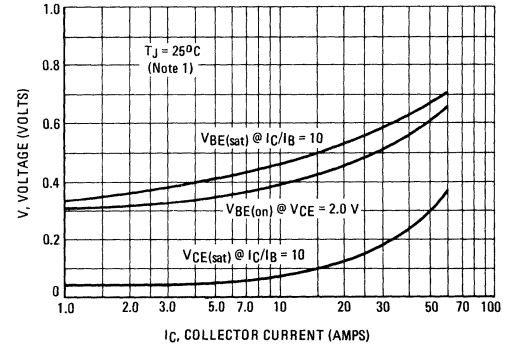


FIGURE 15 – TEMPERATURE COEFFICIENTS