



MJE13005-Q

NPN SILICON TRANSISTOR

NPN SILICON POWER TRANSISTORS

■ DESCRIPTION

These devices are designed for high-voltage, high-speed power switching inductive circuits where fall time is critical. They are particularly suited for 115 and 220 V SWITCHMODE.

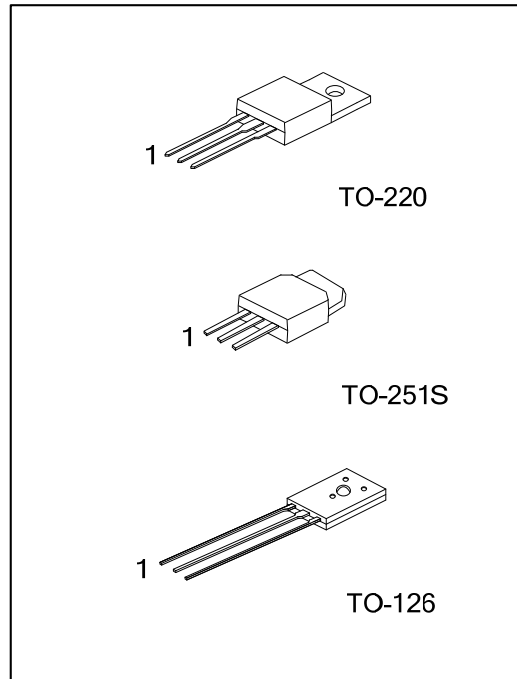
■ FEATURES

- * $V_{CE0(SUS)} = 400\text{ V}$
- * Reverse bias SOA with inductive loads @ $T_C = 100^\circ\text{C}$
- * Inductive switching matrix 2 to 4 Amp, 25 and 100°C
 $t_c @ 3\text{A}, 100^\circ\text{C}$ is 180 ns (Typ)
- * 700V blocking capability
- * SOA and switching applications information

■ APPLICATIONS

- * Switching regulator's, inverters
- * Motor controls
- * Solenoid/Relay drivers
- * Deflection circuits

■ ORDERING INFORMATION



Ordering Number		Package	Pin Assignment			Packing
Lead Free	Halogen Free		1	2	3	
MJE13005L-x-T60-K	MJE13005G-x-T60-K	TO-126	B	C	E	Bulk
MJE13005L-x-TA3-T	MJE13005G-x-TA3-T	TO-220	B	C	E	Tube
MJE13005L-x-TMS-T	MJE13005G-x-TMS-T	TO-251S	B	C	E	Tube

Note: Pin Assignment: B: Base C: Collector E: Emitter

<p>MJE13005L-x-TA3-T</p> <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Rank</p> <p>(4) Green Package</p>	<p>(1) T: Tube, K: Bulk, R: Tape Reel</p> <p>(2) TA3: TO-220 TMS: TO-251S, T60: TO-126</p> <p>(3) x: refer to Classification of h_{FE1}</p> <p>(4) L: Lead Free, G: Halogen Free and Lead Free</p>
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■ MARKING

TO-220 / TO-251S	TO-126

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	RATINGS	UNIT
Collector-Emitter Voltage		$V_{CEO(SUS)}$	400	V
Collector-Emitter Voltage ($V_{BE}=0$)		V_{CES}	700	V
Collector-Base Voltage		V_{CBO}	700	V
Emitter Base Voltage		V_{EBO}	9	V
Collector Current	Continuous	I_C	4	A
	Peak (1)	I_{CM}	8	A
Base Current	Continuous	I_B	2	A
	Peak (1)	I_{BM}	4	A
Emitter Current	Continuous	I_E	6	A
	Peak (1)	I_{EM}	12	A
Power Dissipation at $T_A=25^\circ\text{C}$	TO-126	P_D	40	W
	TO-251S		50	
	TO-220		75	
Derate above 25°C	TO-126		320	mW/ $^\circ\text{C}$
	TO-251S		400	
	TO-220		600	
Operating and Storage Junction Temperature		T_J, T_{STG}	-65 ~ +150	$^\circ\text{C}$

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-126	θ_{JA}	89	$^\circ\text{C/W}$
	TO-251S		110	
	TO-220		62.5	
Junction to Case	TO-126	θ_{JC}	3.125	$^\circ\text{C/W}$
	TO-251S		2.5	
	TO-220		1.67	

■ ELECTRICAL CHARACTERISTICS (T_C=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS (Note 1)						
Collector-Emitter Sustaining Voltage	V _{CEO(SUS)}	I _C =10mA, I _B =0	400			V
Collector Cutoff Current	I _{CBO}	V _{CBO} =Rated Value, V _{BE(OFF)} =1.5V			1	mA
		V _{CBO} =Rated Value, V _{BE(OFF)} =1.5V, T _C =100°C			5	
Emitter Cutoff Current	I _{EBO}	V _{EB} =9V, I _C =0			1	mA
SECOND BREAKDOWN						
Second Breakdown Collector Current with base forward biased	I _{S/B}				See Fig. 11	
Clamped Inductive SOA with Base Reverse Biased	RBSOA				See Fig. 12	
ON CHARACTERISTICS (Note 1)						
DC Current Gain	h _{FE1}	I _C =0.5A, V _{CE} =5V	15		50	
	h _{FE2}	I _C =1A, V _{CE} =5V	10		60	
	h _{FE3}	I _C =2A, V _{CE} =5V	8		40	
Collector-Emitter Saturation Voltage	V _{CE(SAT)}	I _C =1A, I _B =0.2A		0.12	0.5	V
		I _C =2A, I _B =0.5A		0.18	0.6	V
		I _C =4A, I _B =1A		0.7	1	V
		I _C =2A, I _B =0.5A, T _a =100°C			1	V
Base-Emitter Saturation Voltage	V _{BE(SAT)}	I _C =1A, I _B =0.2A		0.85	1.2	V
		I _C =2A, I _B =0.5A		0.92	1.6	V
		I _C =2A, I _B =0.5A, T _C =100°C			1.5	V
DYNAMIC CHARACTERISTICS						
Current-Gain-Bandwidth Product	f _T	I _C =500mA, V _{CE} =10V, f=1MHz	4			MHz
Output Capacitance	C _{OB}	V _{CB} =10V, I _E =0, f=0.1MHz		65		pF
SWITCHING CHARACTERISTICS						
Resistive Load (Table 1)						
Delay Time	t _D	V _{CC} =125V, I _C =2A, I _{B1} =I _{B2} =0.4A, t _p =25μs, Duty Cycle≤1%		0.025	0.1	μs
Rise Time	t _R			0.3	0.7	μs
Storage Time	t _S				6	μs
Fall Time	t _F			0.4	0.9	μs

Note: 1. Pulse Test: Pulse Width=5ms, Duty Cycle≤10%

2. Pulse Test: P_W=300μs, Duty Cycle≤2%

■ CLASSIFICATION OF h_{FE1}

RANK	A	B	C	D	E
RANGE	15 ~ 20	20 ~ 25	25 ~ 30	30 ~ 40	40 ~ 50

APPLICATION INFORMATION

Table 1. Test Conditions for Dynamic Performance

Reverse Bias Safe Operating Area and Inductive Switching		Resistive Switching
Test Circuits	<p>DUTY CYCLE $\leq 10\%$ $t_r, t_f \leq 10\text{ns}$</p> <p>Note: PW and V_{cc} Adjusted for Desired I_c R_B Adjusted for Desired I_{B1}</p>	<p>*SELECTED FOR $\geq 1\text{kV}$</p>
Circuit Values	<p>Coil Data : $V_{CC}=20\text{V}$ FERROXCUBE core #6656 Full Bobbin (~ 16 Turns) #16</p> <p>GAP for 200μH/20 A $L_{\text{COIL}}=200\mu\text{H}$ $V_{\text{CLAMP}}=300\text{V}$</p>	<p>$V_{CC}=125\text{V}$ $R_C=62\Omega$ $D1=1\text{n}5820$ or Equiv. $R_B=22\Omega$</p>
Test Waveforms	<p>OUTPUT WAVEFORMS</p> <p>t_1 Adjusted to Obtain I_c</p> $t_1 = \frac{L_{\text{COIL}}(I_{\text{CPK}})}{V_{\text{CC}}}$ $t_2 = \frac{L_{\text{COIL}}(I_{\text{CPK}})}{V_{\text{CLAMP}}}$ <p>Test Equipment Scope-Tektronics 475 or Equivalent</p>	<p>$t_r, t_f < 10\text{ns}$ Duty Cycle=1.0% R_B and R_C adjusted for desired I_B and I_C</p>

RESISTIVE SWITCHING PERFORMANCE

Fig. 1 Turn-On Time

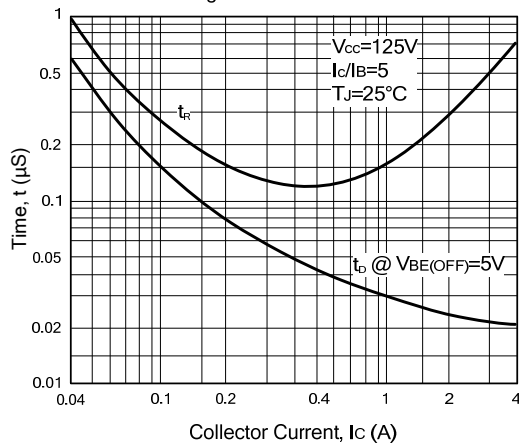


Fig. 2 Turn-Off Time

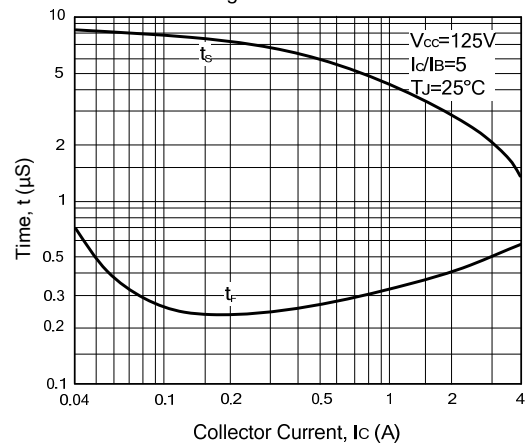


Fig. 3 Typical Thermal Response [$Z_{\theta JC}(t)$]

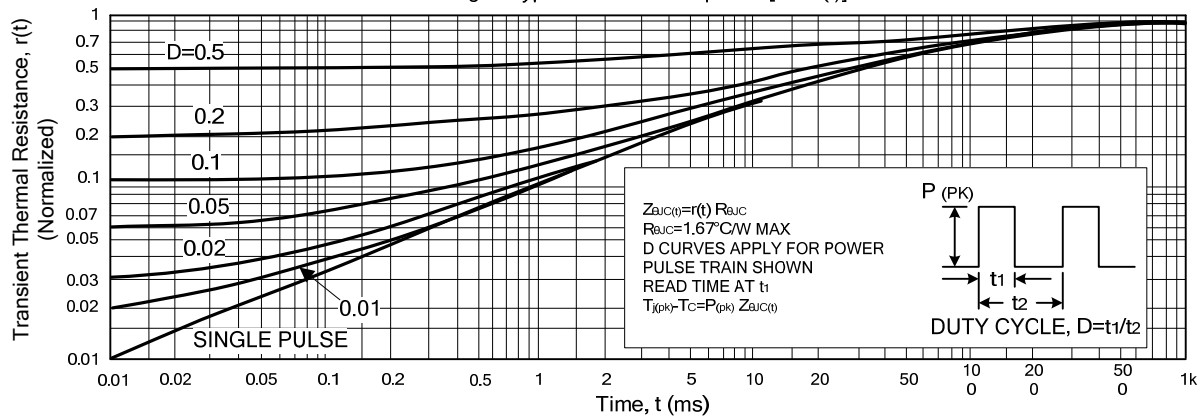


Fig. 4 Forward Bias Safe Operating Area

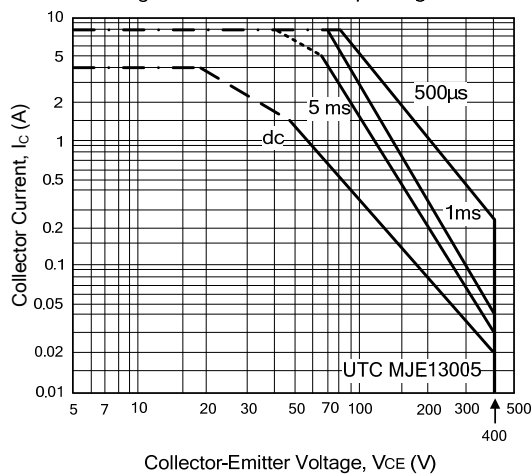
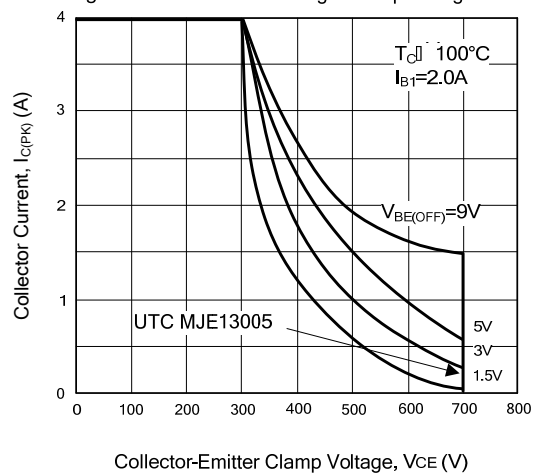
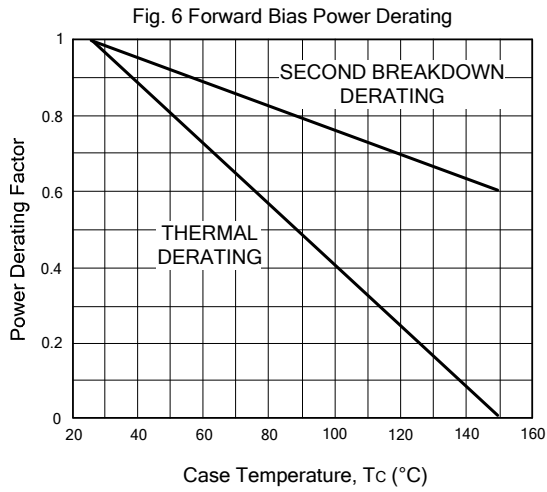


Fig. 5 Reverse Bias Switching Safe Operating Area



■ RESISTIVE SWITCHING PERFORMANCE(Cont.)



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