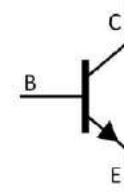


PRODUCT CHARACTERISTICS

BVCBO	700V
BVCEO	400V
HFE@5V2A	8-40
IC	12A

Symbol



APPLICATIONS

- Fluorescent lamp
- Electronic ballast
- Electronic transformer
- Switch mode power supply

FEATURES

- * $V_{CEO(SUS)}$ 400V
- * 700V Blocking Capability

ORDER INFORMATION

Order codes		Package	Packing
Halogen-Free	Halogen		
N/A	RST13009F	TO-220F	50 pieces/Tube
N/A	RST13009A	TO-220	50 pieces/Tube
N/A	RST13009W	TO-247S	30 pieces/Tube



ABSOLUTE MAXIMUM RATING

PARAMETER		SYMBOL	RATINGS	UNIT
Collector-Emitter Voltage		V_{CEO}	400	V
Collector-Emitter Voltage ($V_{BE}=-1.5V$)		V_{CEV}	700	V
Emitter Base Voltage		V_{EBO}	9	V
Collector Current	Continuous	I_C	12	A
	Peak (Note 3)	I_{CM}	24	A
Base Current	Continuous	I_B	6	A
	Peak (Note 3)	I_{BM}	12	A
Emitter Current	Continuous	I_E	18	A
	Peak (Note 3)	I_{EM}	36	A
Power Dissipation	TO-220	P_D	2	W
	TO-220F		0.7	W
	TO-247		80	W
Derate above 25°C	TO-220		16	mW/°C
	TO-220F		5.6	mW/°C
	TO-247		640	mW/°C
Junction Temperature		T_J	+150	°C
Storage Temperature		T_{STG}	-40 ~ +150	°C

Note: 1. Pulse Test: Pulse Width = 5ms, Duty Cycle $\leq 10\%$

2. 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.

3. Pulse Test: Pulse Width = 300 μ s, Duty Cycle = 2%

THERMAL DATA

PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	TO-220	θ_{JA}	54	°C/W
	TO-220F		62.5	°C/W
	TO-247		21	°C/W
Junction to Case	TO-220	θ_{JC}	4	°C/W
	TO-220F		3.13	°C/W
	TO-247		1.55	°C/W

■ ELECTRICAL CHARACTERISTICS ($T_C=25^\circ\text{C}$, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
OFF CHARACTERISTICS (Note)						
Collector- Emitter Sustaining Voltage	V_{CEO}	$I_C = 10\text{mA}$, $I_B = 0$	400			V
Collector Cutoff Current	I_{CEV}	$V_{BE(OFF)} = 1.5V_{DC}$			1	mA
V_{CBO} =Rated Value		$V_{BE(OFF)} = 1.5V_{DC}$, $T_C = 100^{\circ}\text{C}$			5	
Emitter Cutoff Current	I_{EBO}	$V_{EB} = 9V_{DC}$, $I_C = 0$			1	mA
ON CHARACTERISTICS (Note)						
DC Current Gain	h_{FE1}	$I_C = 5\text{A}$, $V_{CE} = 5\text{V}$			40	
	$h_{FE\ 2}$	$I_C = 8\text{A}$, $V_{CE} = 5\text{V}$			30	
Current-Emitter Saturation Voltage	$V_{CE(SAT)}$	$I_C = 5\text{A}$, $I_B = 1\text{A}$			1	V
		$I_C = 8\text{A}$, $I_B = 1.6\text{A}$			1.5	V
		$I_C = 12\text{A}$, $I_B = 3\text{A}$			3	V
		$I_C = 8\text{A}$, $I_B = 1.6\text{A}$, $T_C = 100^{\circ}\text{C}$			2	V
Base-Emitter Saturation Voltage	$V_{BE(SAT)}$	$I_C = 5\text{A}$, $I_B = 1\text{A}$			1.2	V
		$I_C = 8\text{A}$, $I_B = 1.6\text{A}$			1.6	V
		$I_C = 8\text{A}$, $I_B = 1.6\text{A}$, $T_C = 100^{\circ}\text{C}$			1.5	V
DYNAMIC CHARACTERISTICS						
Transition frequency	f_T	$I_C = 500\text{mA}$, $V_{CE} = 10\text{V}$, $f = 1\text{MHz}$	4			MHz
Output Capacitance	C_{OB}	$V_{CB} = 10\text{V}$, $I_E = 0$, $f = 0.1\text{MHz}$		180		pF
SWITCHING CHARACTERISTICS (Resistive Load, Table 1)						
Delay Time	t_{DLY}	$V_{CC} = 125\text{Vdc}$, $I_C = 8\text{A}$ $I_{B1} = I_{B2} = 1.6\text{A}$, $t_P = 25\mu\text{s}$ Duty Cycle $\leq 1\%$		0.06	0.1	μs
Rise Time	t_R			0.45	1	μs
Storage Time	t_S			1.3	3	μs
Fall Time	t_F			0.2	0.7	μs
Inductive Load, Clamped (Table 1, Fig. 13)						
Voltage Storage Time	t_S	$I_C=8\text{A}$, $V_{CLAMP}=300\text{V}$, $I_{B1}=1.6\text{A}$		0.92	2.3	μs
Crossover Time	t_C	$V_{BE(OFF)} = 5\text{V}$, $T_C = 100^{\circ}\text{C}$		0.12	0.7	μs

Note: Pulse Test: Pulse Width = 300 μs , Duty Cycle = 2%

■ TYPICAL CHARACTERISTICS

Fig. 1 Forward Bias Safe Operating Area

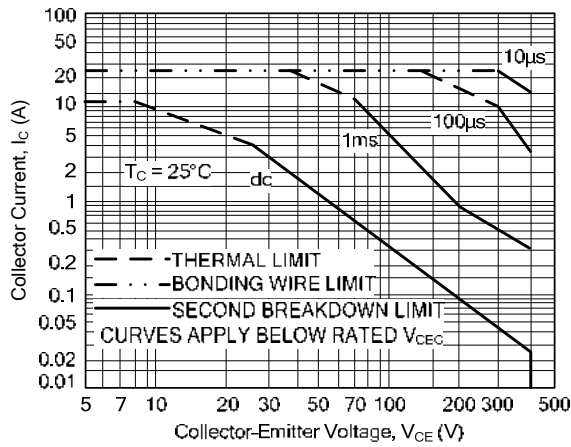


Fig. 2 Reverse Bias Switching Safe Operating Area

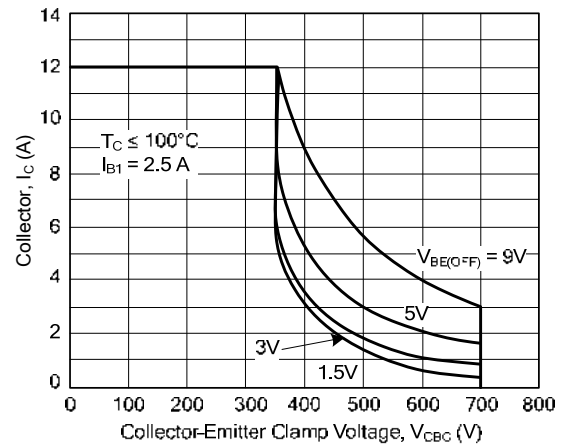


Fig. 3 Forward Bias Power Derating

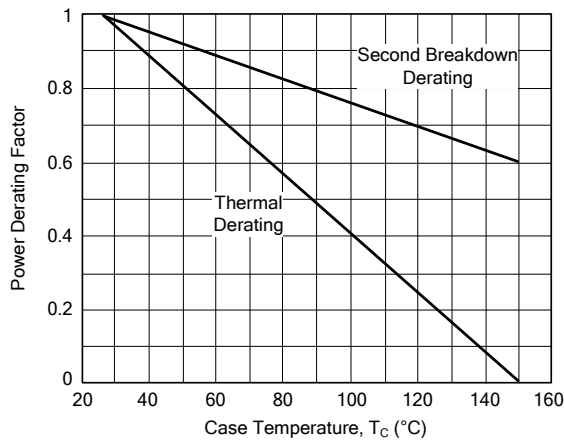
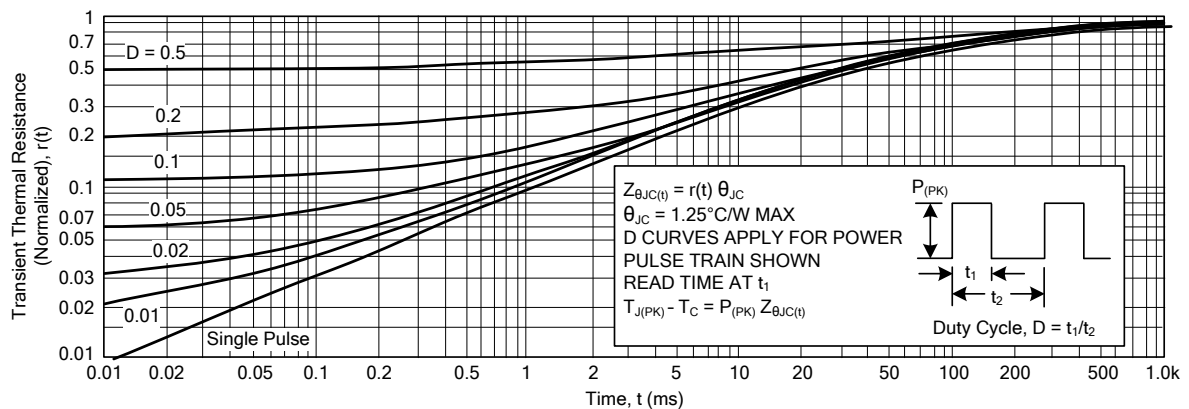


Fig. 4 Typical Thermal Response [$Z_{\theta JC}(t)$]



■ TYPICAL CHARACTERISTICS(Cont.)

Fig. 5 DC Current Gain

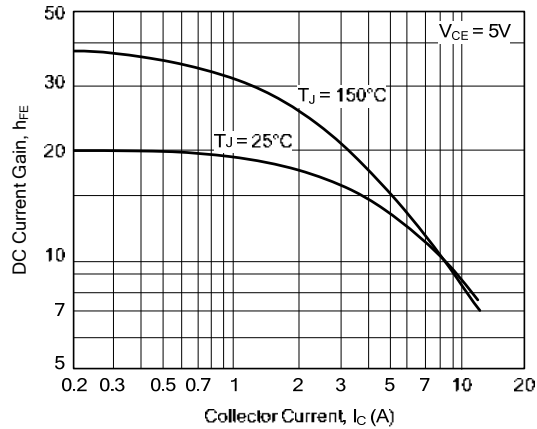


Fig. 6 Collector Saturation Region

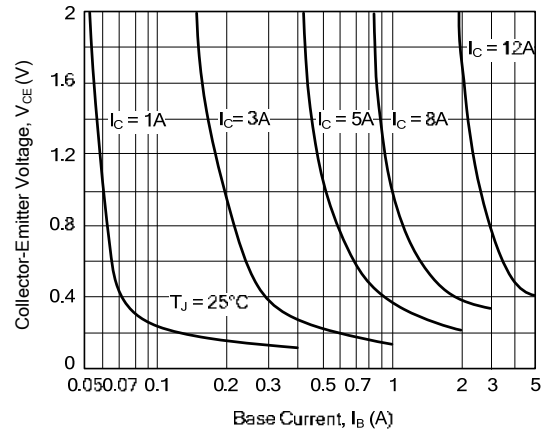


Fig. 7 Base-Emitter Saturation Voltage

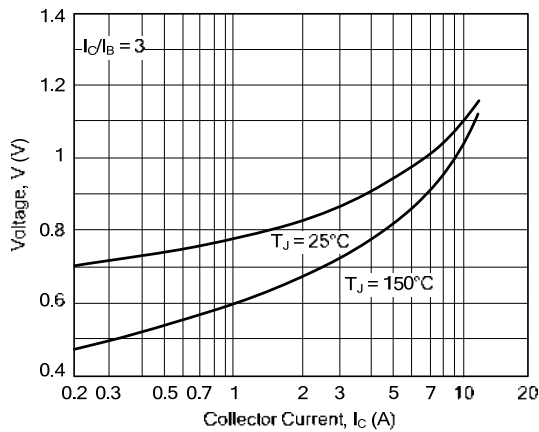


Fig. 8 Collector-Emitter Saturation Voltage

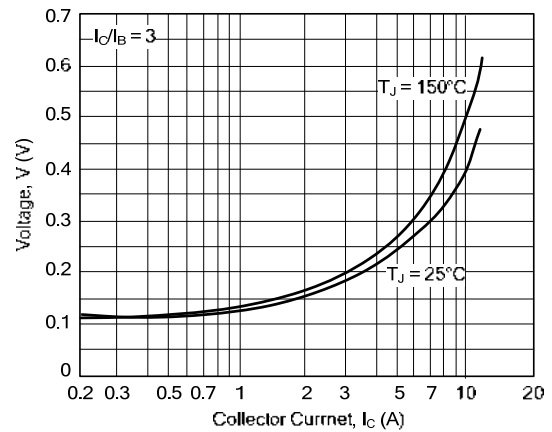


Fig. 9 Collector Cutoff Region

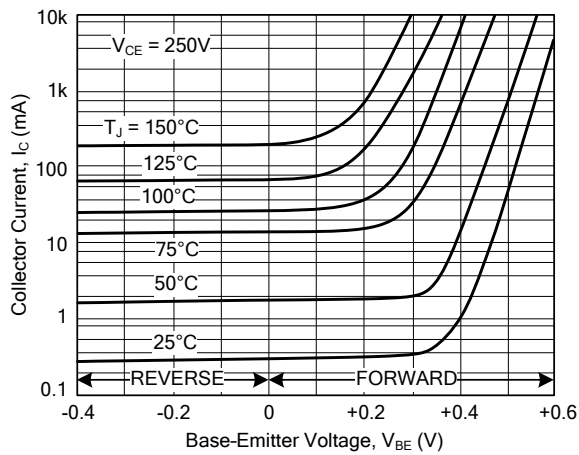
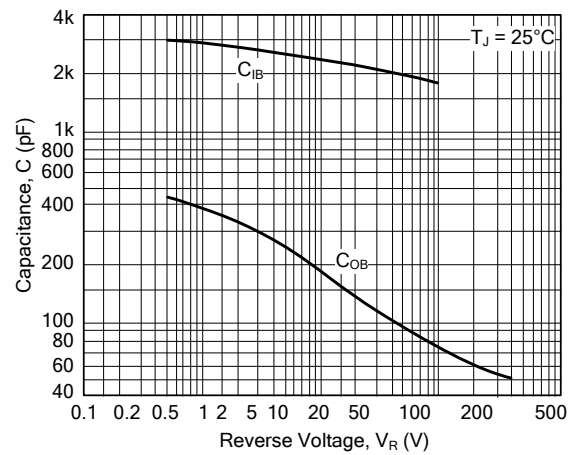


Fig. 10 Capacitance



■ RESISTIVE SWITCHING PERFORMANCE

Fig. 11. Turn-On Time

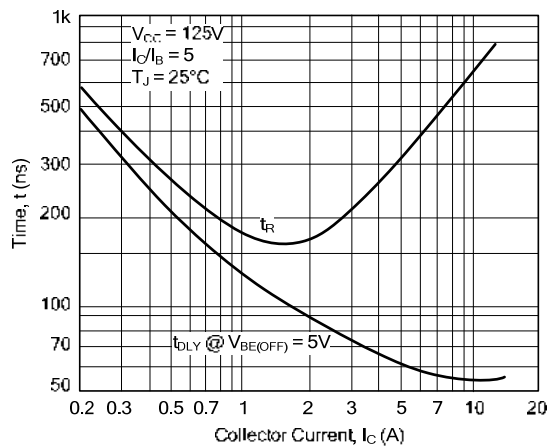


Fig. 12 Turn-Off Time

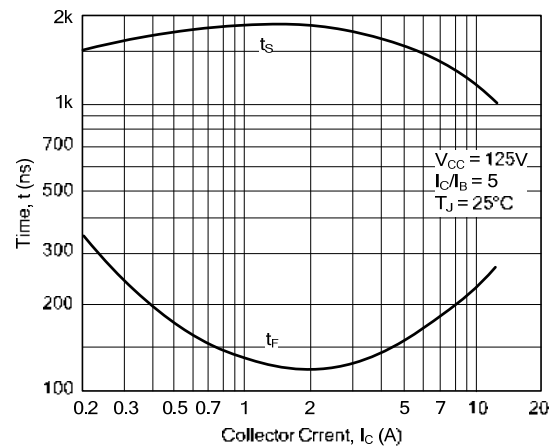
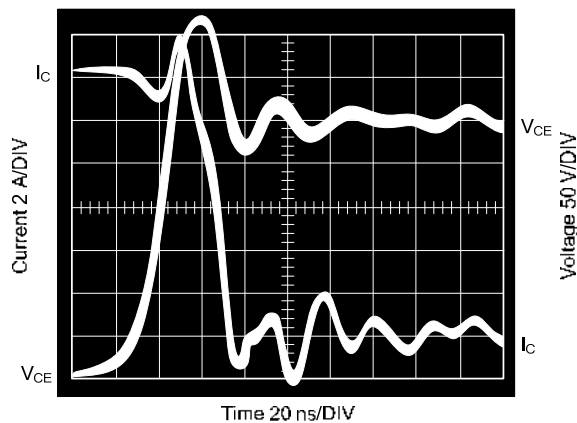
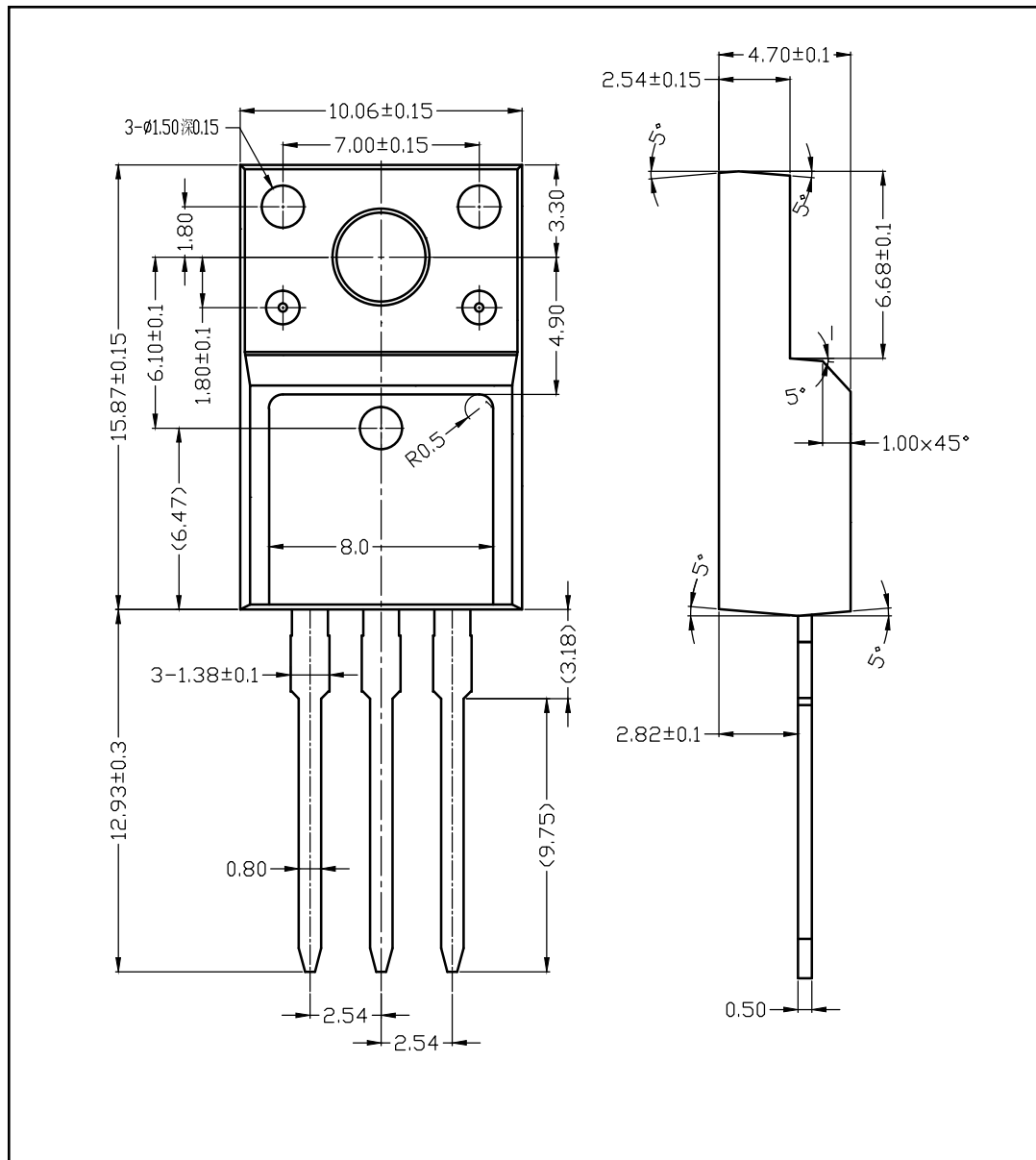


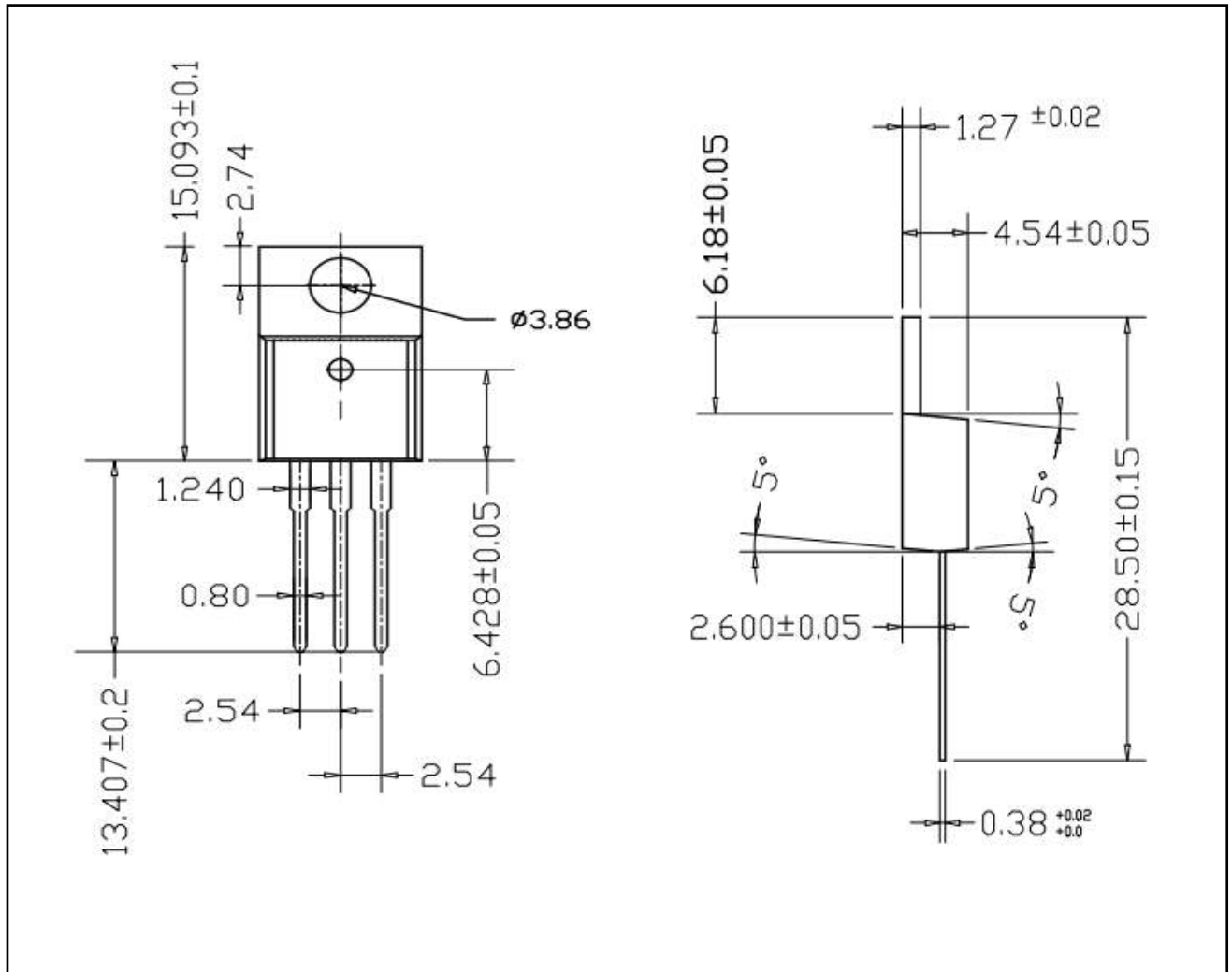
Fig. 13 Typical Inductive Switching Waveforms (at 300V and 12A with $I_{B1} = 2.4A$ and $V_{BE(off)} = 5V$)



■ TO-220F-3L PACKAGE OUTLINE DIMENSIONS



■ TO-220-3L PACKAGE OUTLINE DIMENSIONS



■ TO-247-3L PACKAGE OUTLINE DIMENSIONS

