



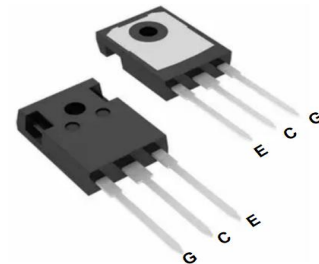
Features

- 650V, 50A IGBT
- Easy paralleling capability due to positive temperature coefficient in $V_{CE(SAT)}$
- Low EMI
- Low Gate Charge
- Low Saturation Voltage $V_{CE(SAT)}$
- Maximum junction temperature $T_{VJmax}=175^{\circ}C$



Application

- UPS
- EV-Charger
- Solar String Inverter
- Energy Storage Inverter



Key Performance and Package Parameters

Device	V_{CE}	I_C ($T_C = 25^{\circ}C$)	$V_{CE(SAT)}$ ($T_{VJ} = 25^{\circ}C$, $V_{GE} = 15V$)	V_F ($T_{VJ} = 25^{\circ}C$, $I_F = 40A$)	Package	Packing
APT45GR65B	650V	50A	1.6 V	1.85V	TO-247	30PCS

Absolute Maximum Ratings (@ $T_{VJ} = 25^{\circ}C$ unless otherwise specified)

Symbol	Parameter		Value	Units
V_{CE}	Collector emitter voltage		650	V
I_C	DC collector current ⁽¹⁾	$T_C = 25^{\circ}C$	80	A
		$T_C = 100^{\circ}C$	50	A
I_{CM}	Pulsed collector current	$T_C = 25^{\circ}C$	200	A
I_F	Maximum Diode forward current ⁽¹⁾	$T_C = 25^{\circ}C$	80	A
		$T_C = 100^{\circ}C$	50	A
I_{FM}	Diode pulsed current	$T_C = 25^{\circ}C$	200	A
V_{GE}	Gate-Emitter voltage	$T_{VJ} = 25^{\circ}C$	± 20	V
	Transient Gate-Emitter Voltage ($t_p \leq 10\mu s$, $D < 0.010$)	$T_{VJ} = 25^{\circ}C$	± 30	V
P_{tot}	Power Dissipation	$T_C = 25^{\circ}C$	250	W
		$T_C = 100^{\circ}C$	129	W
T_{VJ}	Operating Junction Temperature Range		-40 to +175	$^{\circ}C$
T_{STG}	Storage Temperature Range		-55 to +150	$^{\circ}C$



Thermal Resistance

Symbol	Parameter	Conditions	Max.	Unit
$R_{\theta JA}$	Thermal resistance: junction - ambient		40	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$	IGBT Thermal resistance: junction - case	IGBT	0.65	$^{\circ}\text{C}/\text{W}$
$R_{\theta JC}$	Diode Thermal resistance: junction - case	Diode	0.58	$^{\circ}\text{C}/\text{W}$

Electrical Characteristics (@ $T_{VJ} = 25^{\circ}\text{C}$ unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
Static Characteristics						
V _{(BR)CES}	Collector - Emitter Breakdown Voltage	V _{GE} = 0V , I _C = 0.5mA	650	-	-	V
V _{CESAT}	Collector - Emitter Saturation Voltage	V _{GE} = 15V , I _C = 50A	-	1.6	2.1	V
		V _{GE} = 15V , I _C = 50A ,T _{VJ} = 125°C	-	1.93	-	V
		V _{GE} = 15V , I _C = 50A ,T _{VJ} = 175°C	-	2.0	-	V
V _F	Diode forward voltage	V _{GE} = 0V , I _C = 50A	-	1.85	-	V
		V _{GE} = 0V , I _C = 50A ,T _{VJ} = 125°C	-	1.6	-	V
		V _{GE} = 0V , I _C = 50A ,T _{VJ} = 175°C	-	1.45	-	V
V _{GE(th)}	Gate-Emitter threshold voltage	V _{GE} = V _{CE} , I _C = 250μA	3.2	4	4.8	V
I _{CES}	Zero Gate voltage Collector current	V _{CE} = 650V , V _{GE} = 0V	-	-	50	μA
I _{GES}	Gate-Emitter leakage current	V _{GE} = ±20V , V _{CE} = 0V	-	-	±100	nA
g _{fs}	Transconductance	V _{GE} = 20V , I _C = 50A	-	56	-	S
Dynamic Characteristics						
C _{ies}	Input Capacitance	V _{GE} = 0V, V _{CE} = 25V, f = 1MHz	-	1916	-	pF
C _{oes}	Output Capacitance		-	139	-	pF
C _{res}	Reverse Transfer Capacitance		-	13	-	pF
Q _g	Gate Charge	V _{GE} = 0 to 15V V _{CE} = 520V, I _C = 50A	-	71	-	nC
Q _{ge}	Gate to Emitter charge		-	10	-	nC
Q _{gc}	Gate to Collector charge		-	21	-	nC
Switching Characteristics						
t _{d(on)}	Turn-On DelayTime	V _{GE} = 15V, V _{CC} = 400V I _C = 50A, R _{G(off)} = 12Ω,R _{G(on)} = 12Ω	-	17	-	ns
t _r	Turn-On Rise Time		-	30	-	ns
t _{d(off)}	Turn-Off DelayTime		-	110	-	ns
t _f	Turn-Off Fall Time		-	34	-	ns
E _{on}	Turn-on energy		-	1.35	-	mJ
E _{off}	Turn-off energy		-	0.51	-	mJ
E _{ts}	Total switching energy		-	1.86	-	mJ
Diode Recovery Characteristics						
T _{rr}	Reverse recovery time	V _R = 400 V, I _F = 50 A, di/dt = 400 A/μS	-	56	-	ns
Q _{rr}	Reverse recovery charge		-	0.27	-	μC
I _{rrm}	Peak reverse recovery current		-	8	-	A

Notes: 1. The max Collector current rating is package limited



Typical Performance Characteristics

Fig.1 Typical Output characteristics (25°C)

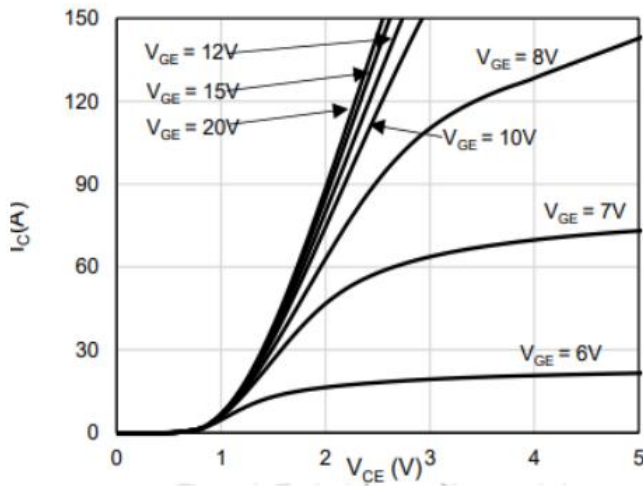


Fig.2 Typical Output characteristics (175°C)

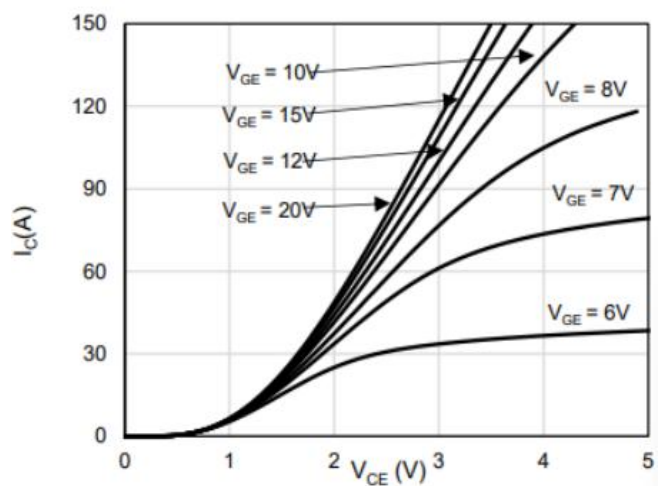


Fig.3 Forward Bias Safe Operating Area

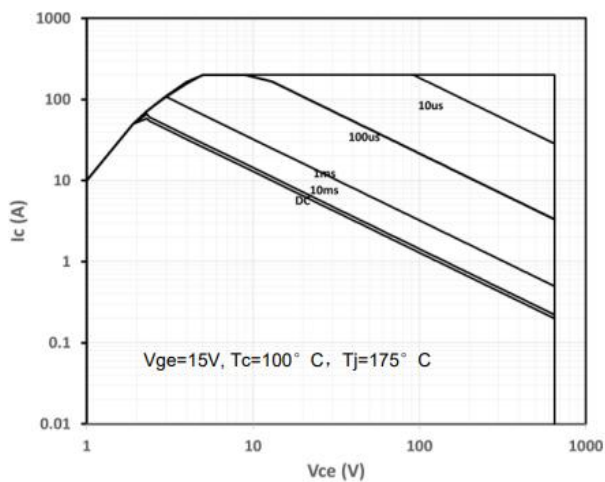


Fig.4 Transfer characteristics

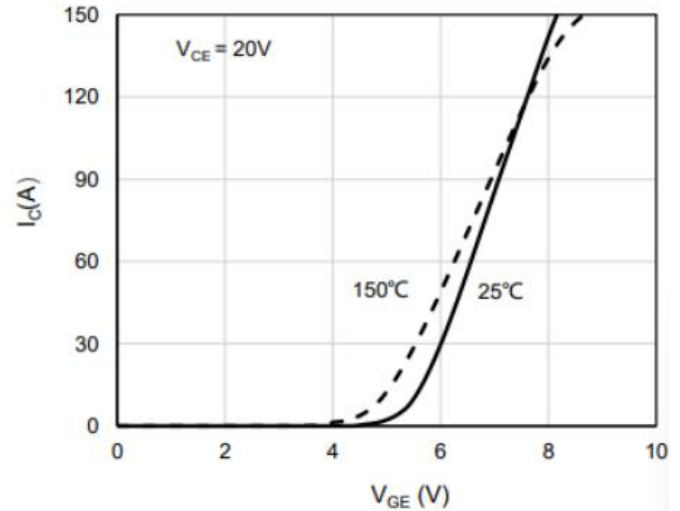


Fig.5 Gate charge

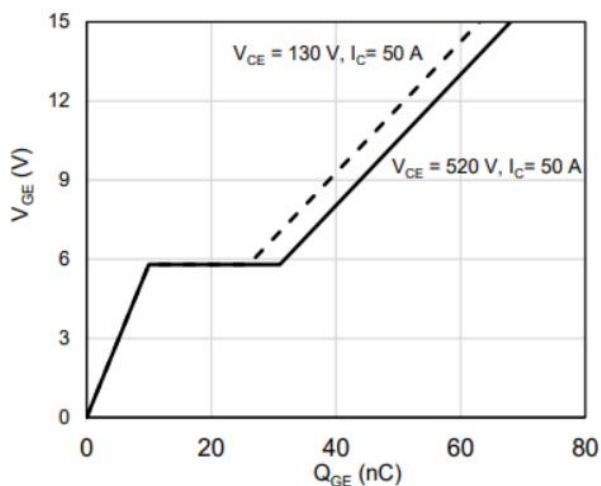


Fig.6 Typical capacitance

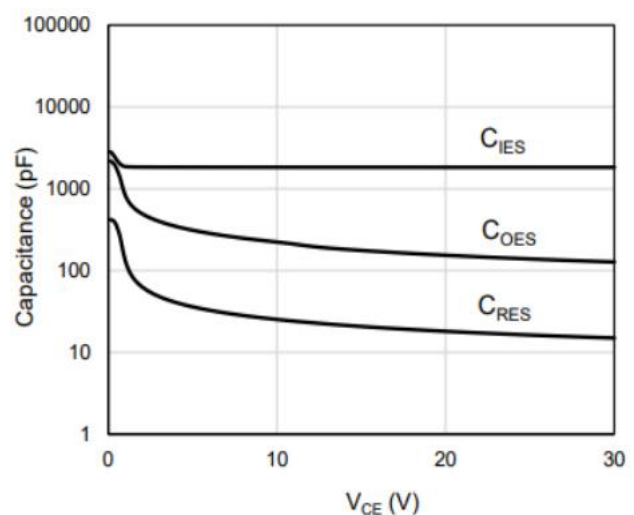




Fig.7 Vcesat vs. Junction Temperature

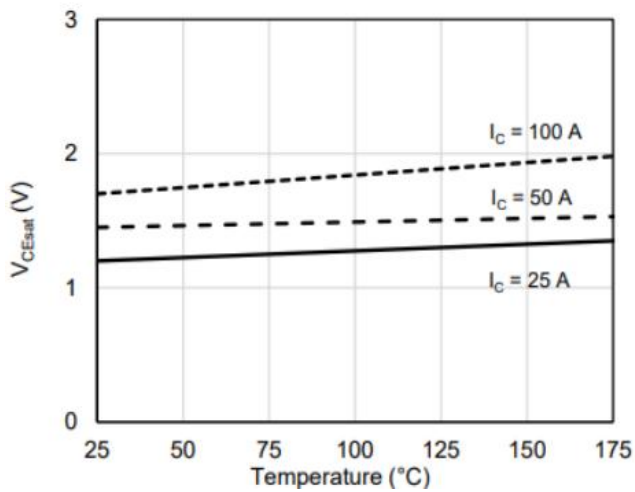


Fig.8 Typical diode VF vs. IF Characteristics

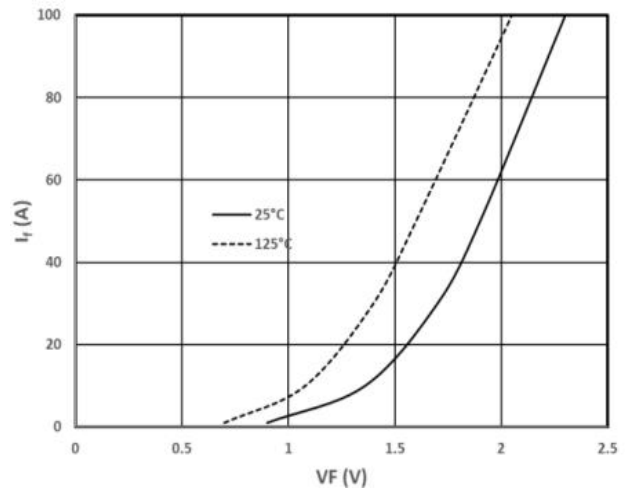


Fig.9 Threshold voltage vs. Junction temperature

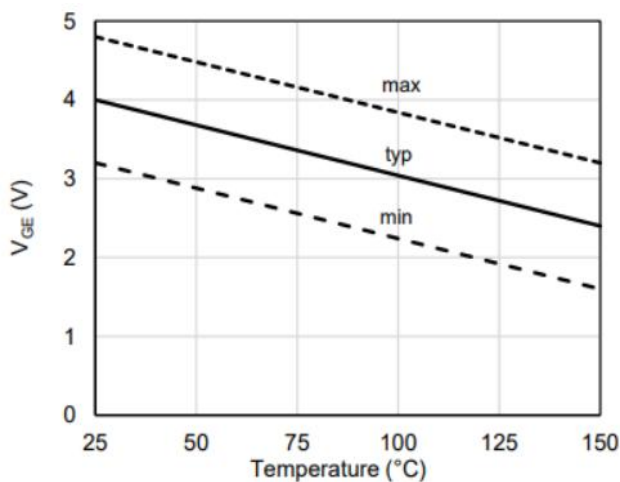


Fig.10 Switching Energy Loss vs. collector current

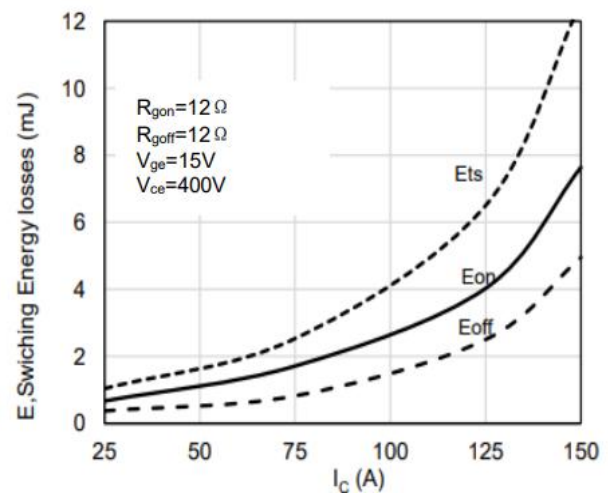


Fig.11 Switching Energy Loss vs. Rg

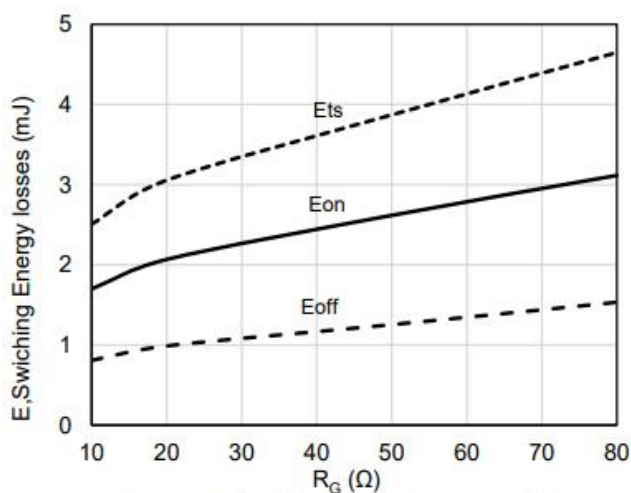


Fig.12 Transient Thermal Impedance IGBT

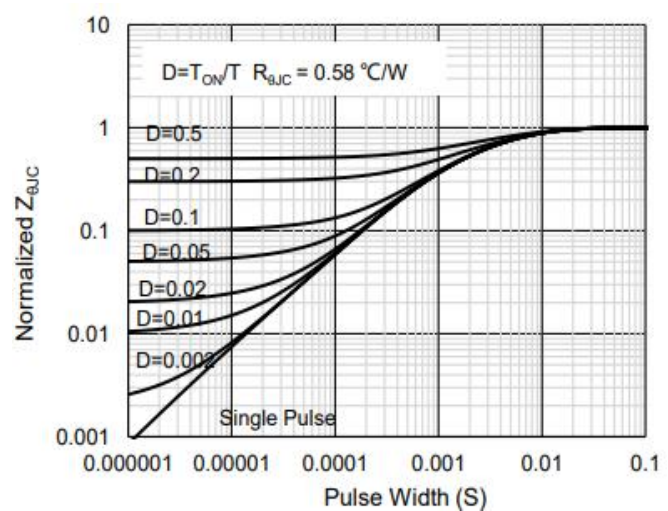
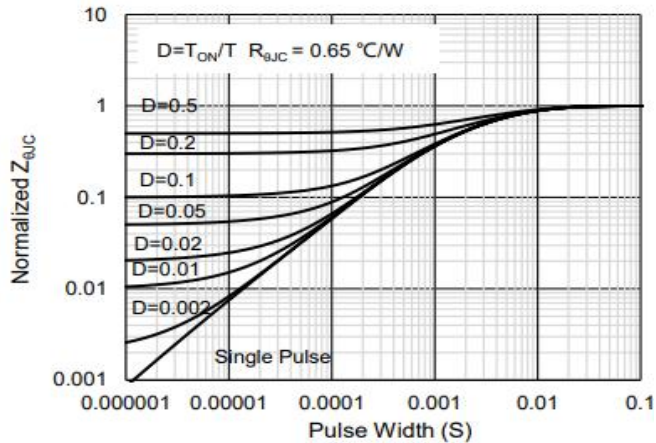


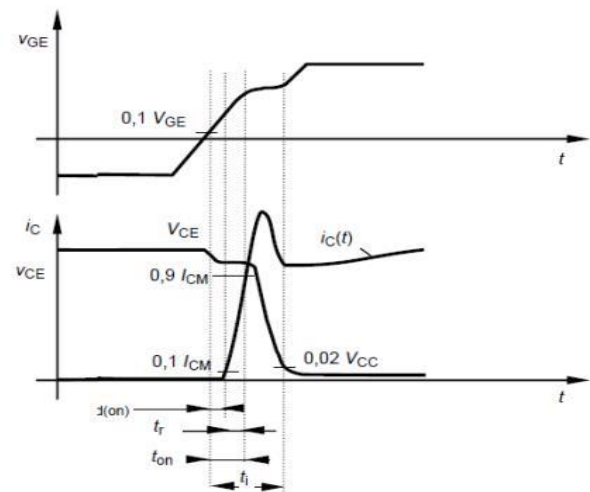
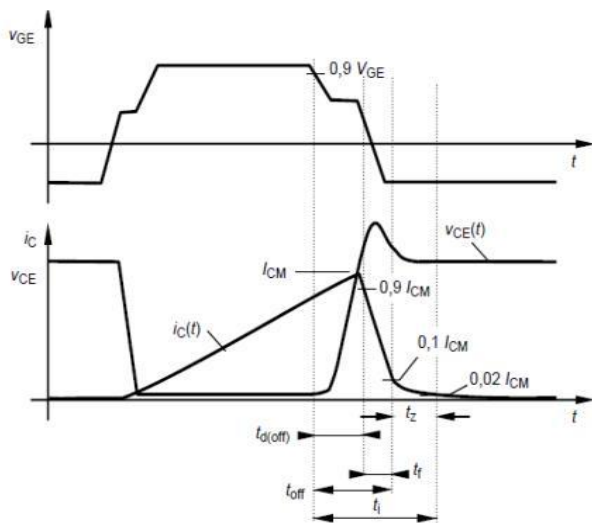


Fig.13 Transient Thermal Impedance Diode

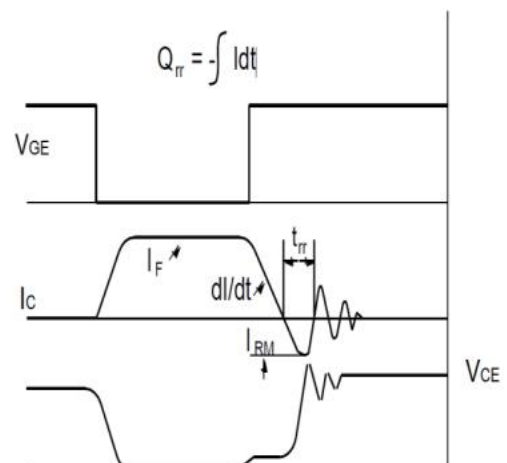
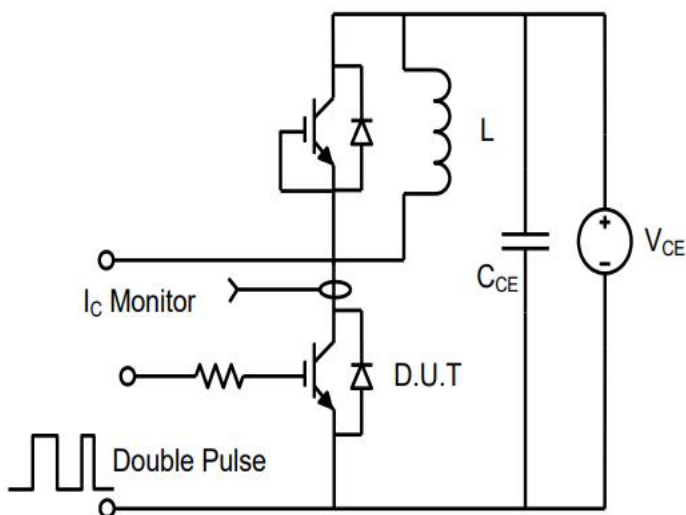


Test Circuit

Switching Test Circuit & Waveforms

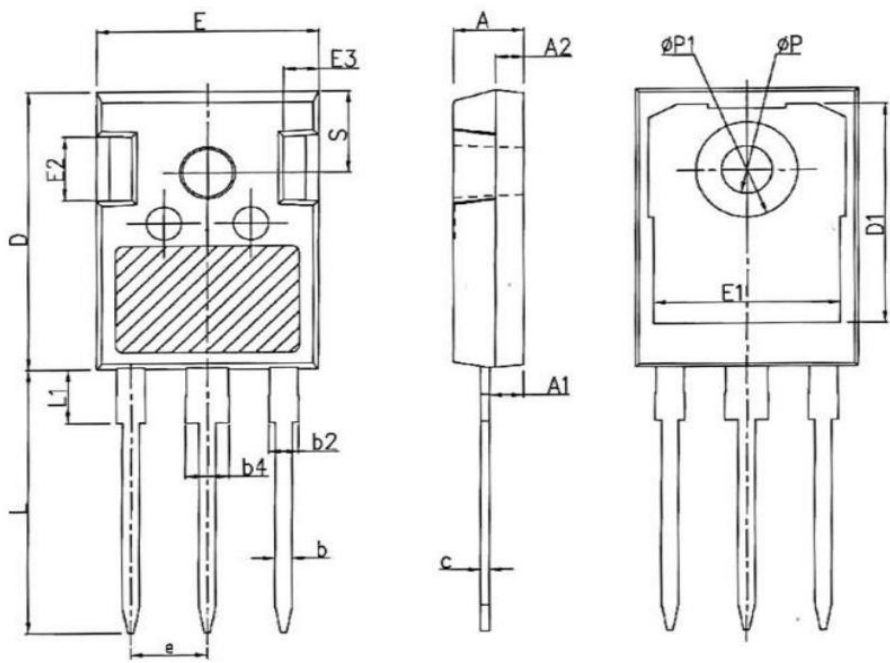


Diode Recovery Test Circuit & Waveforms





Package Mechanical Data(TO-247)



SYMBOL	mm		
	MIN	NOM	MAX
A	4.80	5.00	5.20
A1	2.21	2.41	2.59
A2	1.85	2.00	2.15
b	1.11	1.21	1.36
b2	1.91	2.01	2.21
b4	2.91	3.01	3.21
c	0.51	0.61	0.75
D	20.70	21.00	21.30
D1	16.25	16.55	16.85
E	15.50	15.80	16.10
E1	13.00	13.30	13.60
E2	4.80	5.00	5.20
E3	2.30	2.50	2.70
e	5.44BSC		
L	19.62	19.92	20.22
L1	-	-	4.30
ΦP	3.40	3.60	3.80
$\Phi P1$	-	-	7.30
S	6.15BSC		



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