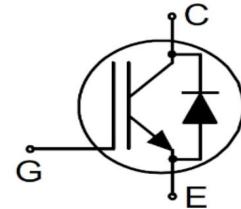




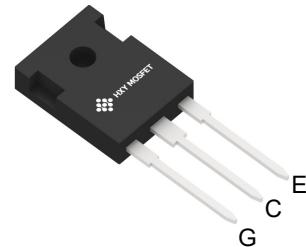
## Features

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



## Application

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



## Key Performance and Package Parameters

Device	$V_{CE}$	$I_c$ ( $T_c = 25^{\circ}\text{C}$ )	$V_{CE(SAT)}$ ( $T_{VJ} = 25^{\circ}\text{C}$ , $V_{GE} = 15\text{ V}$ )	$V_F$ ( $T_{VJ} = 25^{\circ}\text{C}$ , $I_F=40\text{A}$ )	Package	Packing
AFGHL50T65SQD	650V	50A	1.6 V	1.85V	TO-247	30PCS

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

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



### Thermal Resistance

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

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

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
<b>Static Characteristics</b>						
$V_{(BR)CES}$	Collector - Emitter Breakdown Voltage	$V_{GE} = 0\text{V}$ , $I_C = 0.5\text{mA}$	650	-	-	V
$V_{CESAT}$	Collector - Emitter Saturation Voltage	$V_{GE} = 15\text{V}$ , $I_C = 50\text{A}$	-	1.6	2.1	V
		$V_{GE} = 15\text{V}$ , $I_C = 50\text{A}$ , $T_{VJ} = 125^\circ\text{C}$	-	1.93	-	V
		$V_{GE} = 15\text{V}$ , $I_C = 50\text{A}$ , $T_{VJ} = 175^\circ\text{C}$	-	2.0	-	V
$V_F$	Diode forward voltage	$V_{GE} = 0\text{V}$ , $I_C = 50\text{A}$	-	1.85	-	V
		$V_{GE} = 0\text{V}$ , $I_C = 50\text{A}$ , $T_{VJ} = 125^\circ\text{C}$	-	1.6	-	V
		$V_{GE} = 0\text{V}$ , $I_C = 50\text{A}$ , $T_{VJ} = 175^\circ\text{C}$	-	1.45	-	V
$V_{GE(\text{th})}$	Gate-Emitter threshold voltage	$V_{GE} = V_{CE}$ , $I_C = 250\mu\text{A}$	3.2	4	4.8	V
$I_{CES}$	Zero Gate voltage Collector current	$V_{CE} = 650\text{V}$ , $V_{GE} = 0\text{V}$	-	-	50	$\mu\text{A}$
$I_{GES}$	Gate-Emitter leakage current	$V_{GE} = \pm 20\text{V}$ , $V_{CE} = 0\text{V}$	-	-	$\pm 100$	nA
$g_{fs}$	Transconductance	$V_{GE} = 20\text{V}$ , $I_C = 50\text{A}$	-	56	-	S

### Dynamic Characteristics

$C_{ies}$	Input Capacitance	$V_{GE} = 0\text{V}$ , $V_{CE} = 25\text{V}$ , $f = 1\text{MHz}$	-	1916	-	pF
$C_{oes}$	Output Capacitance		-	139	-	pF
$C_{res}$	Reverse Transfer Capacitance		-	13	-	pF
$Q_g$	Gate Charge	$V_{GE} = 0$ to $15\text{V}$ $V_{CE} = 520\text{V}$ , $I_C = 50\text{A}$	-	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	$V_{GE} = 15\text{V}$ , $V_{CC} = 400\text{V}$ $I_C = 50\text{A}$ , $R_{G(\text{off})} = 12\Omega$ , $R_{G(\text{on})} = 12\Omega$	-	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	$V_R = 400\text{V}$ , $I_F = 50\text{A}$ , $di/dt = 400\text{A}/\mu\text{s}$	-	56	-	ns
$Q_{rr}$	Reverse recovery charge		-	0.27	-	$\mu\text{C}$
$I_{rrm}$	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)

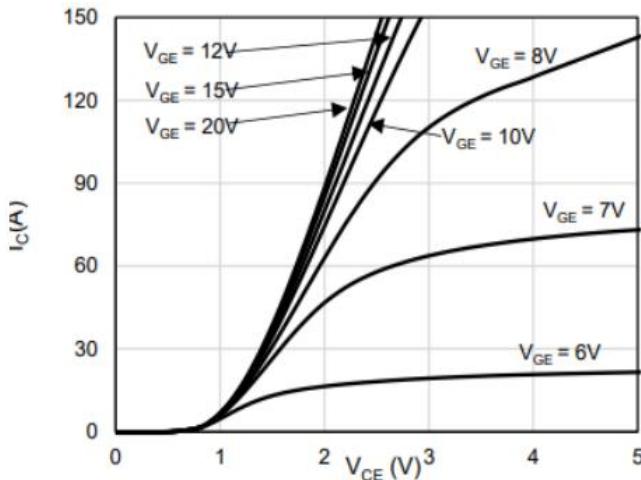


Fig.2 Typical Output characteristics (175°C)

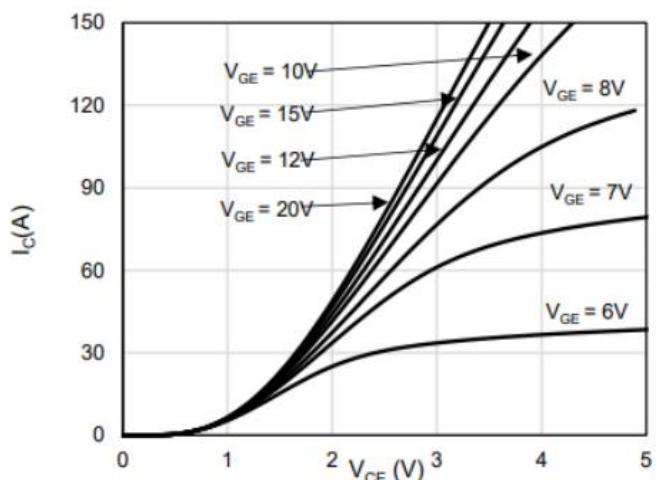


Fig.3 Forward Bias Safe Operating Area

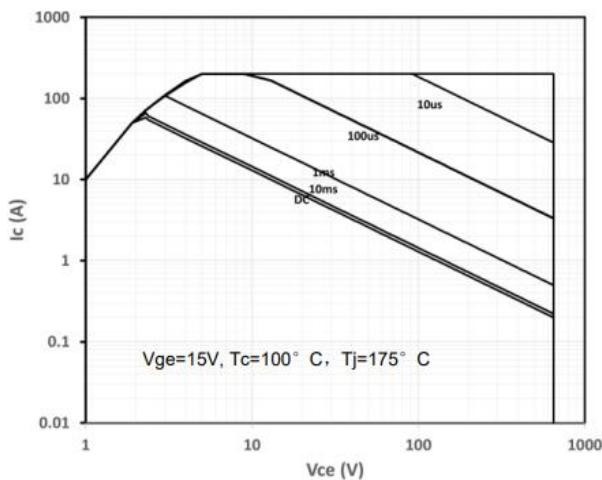


Fig.4 Transfer characteristics

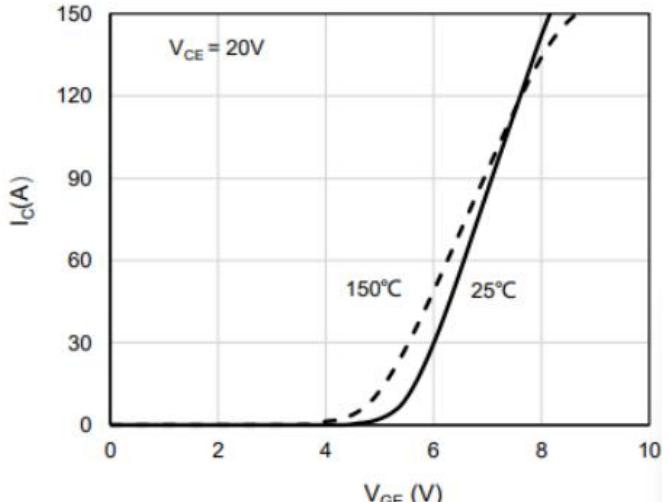


Fig.5 Gate charge

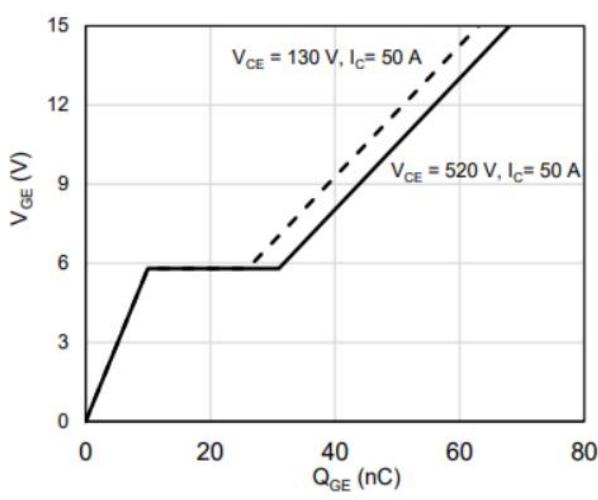


Fig.6 Typical capacitance

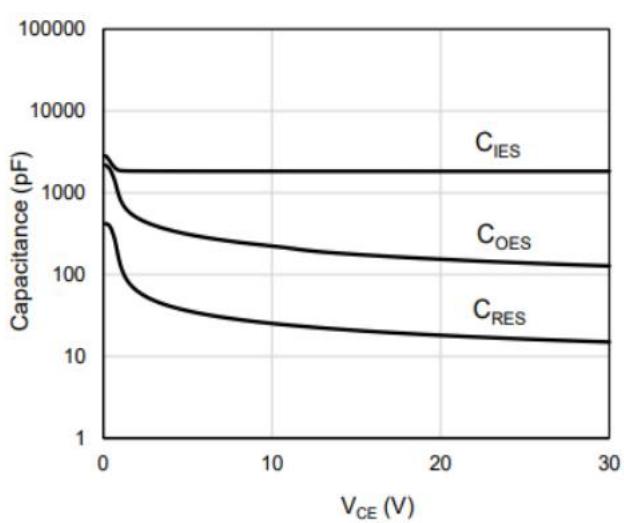




Fig.7  $V_{CEsat}$  vs. Junction Temperature

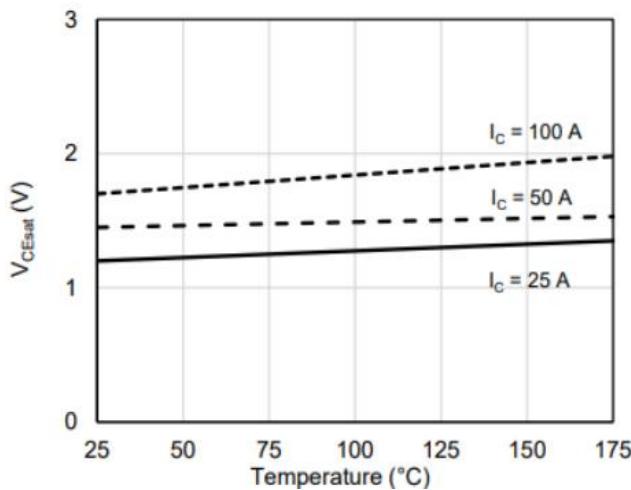


Fig.9 Threshold voltage vs. Junction temperature

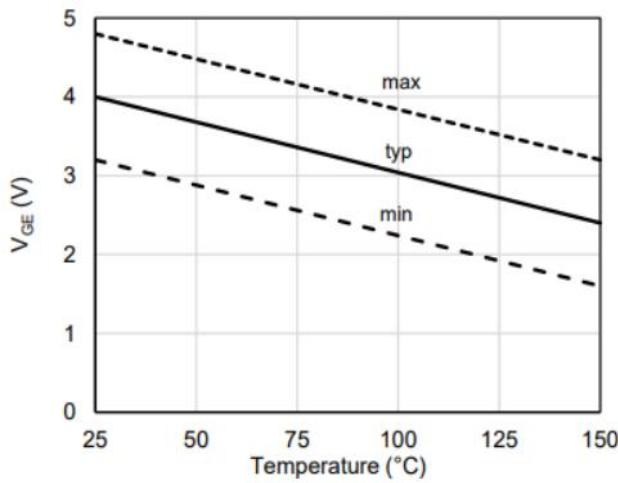


Fig.11 Switching Energy Loss vs.  $R_g$

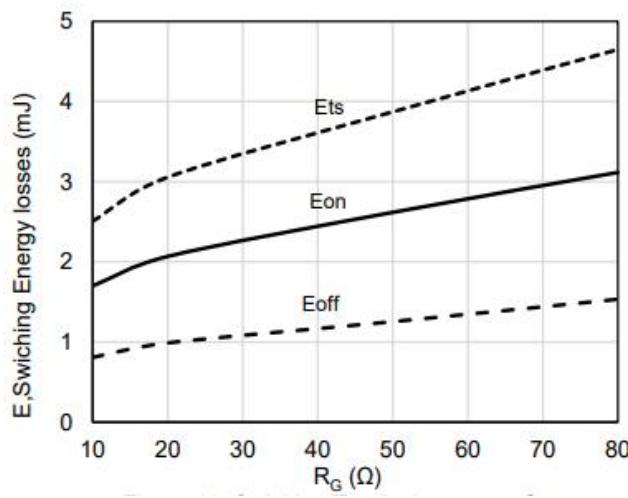


Fig.8 Typical diode VF vs. IF Characteristics

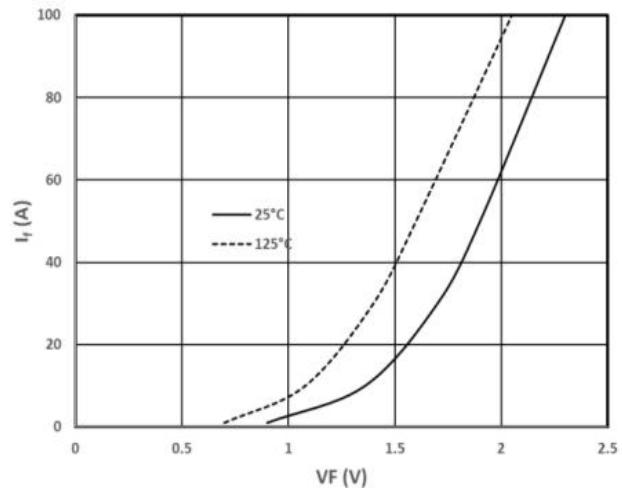


Fig.10 Switching Energy Loss vs. collector current

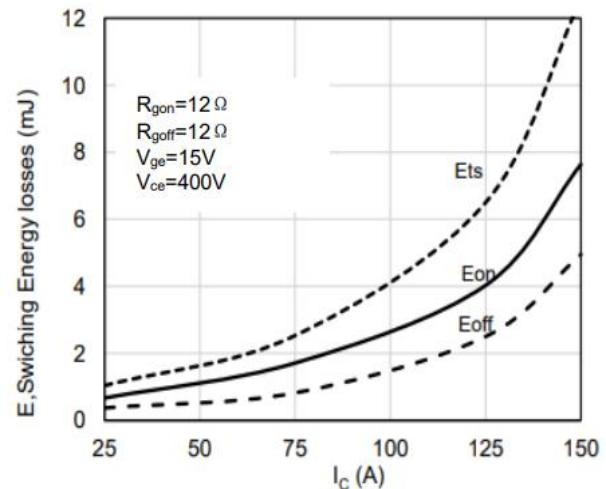


Fig.12 Transient Thermal Impedance IGBT

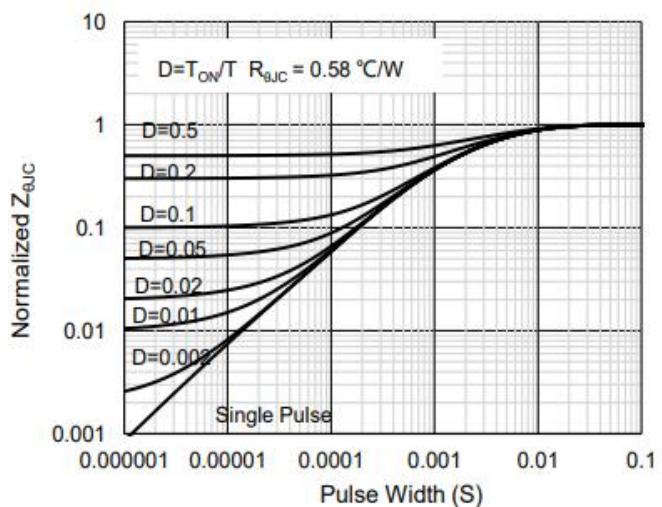
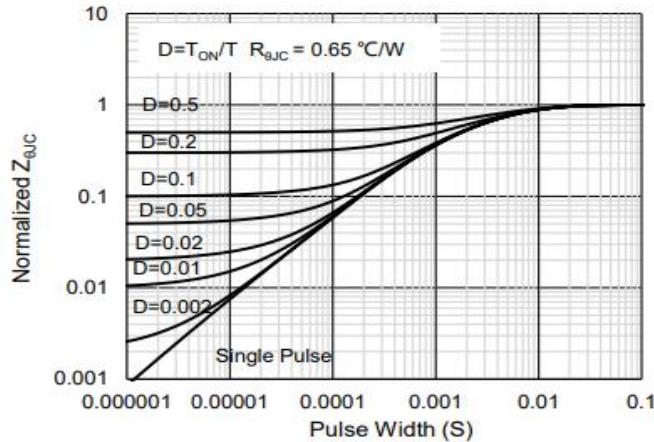


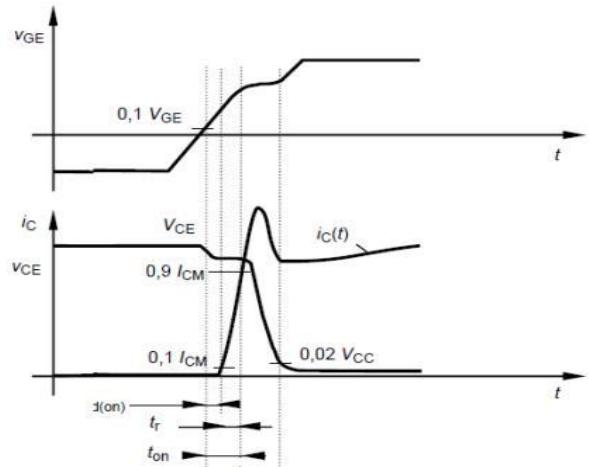
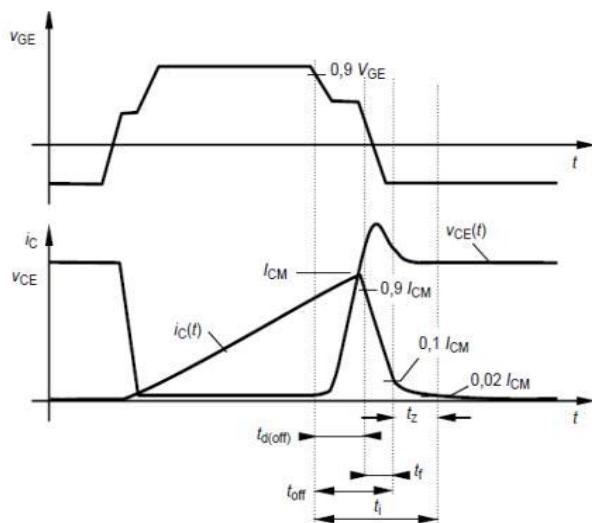


Fig.13 Transient Thermal Impedance Diode

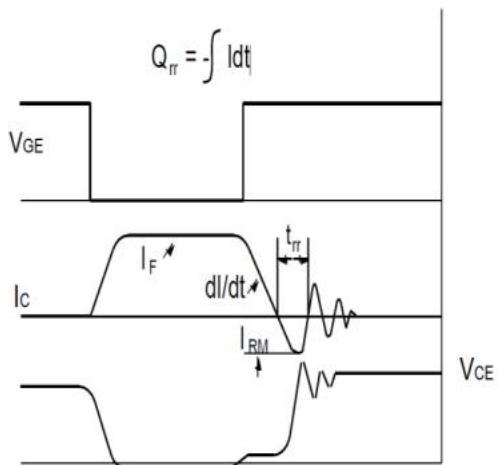
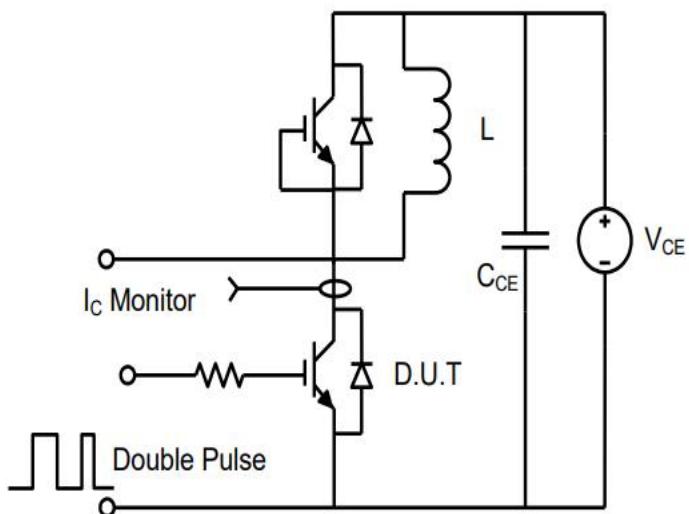


## Test Circuit

Switching Test Circuit & Waveforms

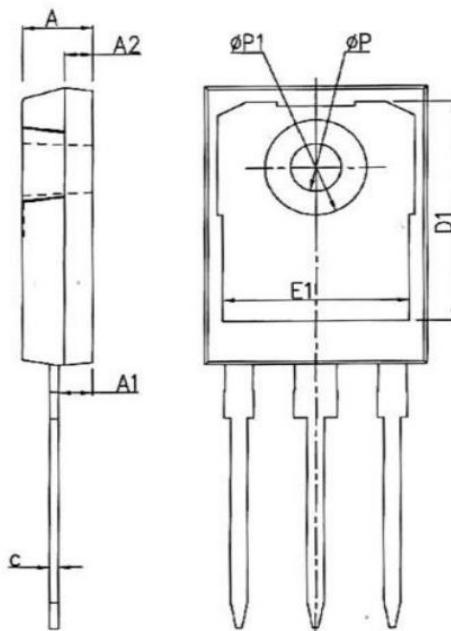
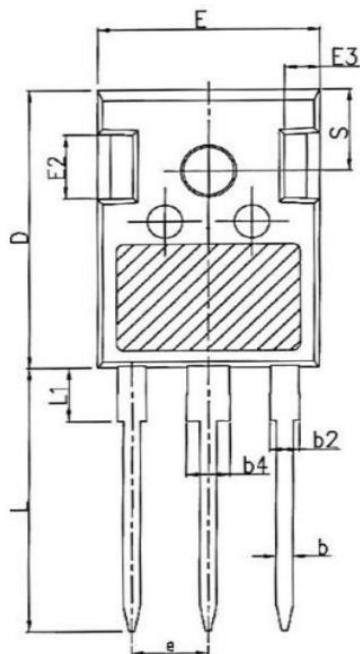


Diode Recovery Test Circuit & Waveforms





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
ΦP1	—	—	7.30
S	6.15BSC		



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