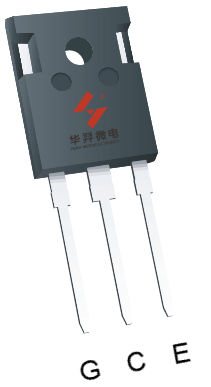
IGBT

Feature

- 1200V/40A
  $V_{CE(sat)}$= 1.45V(typ.) @I_C = 40A
- Positive temperature coefficient
- Fast Switching
- Low $V_{CE(sat)}$
- Reliable and Rugged
- Halogen Free and Green Devices Available
  (RoHS Compliant)

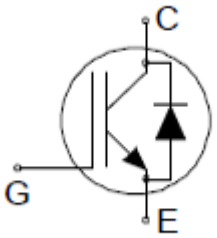
Pin Description



TO-247-3L

Applications

- UPS
- Motor drives
- PFC
- Portable power station



Ordering and Marking Information

W HYG40T120 XYMXXX	Package Code W:TO-247-3L Date Code XYMXXX

Note: HUAYI halogen free products contain molding compounds and 100% matte tin plate Termi-Nation finish;which are fully compliant with RoHS. HUAYI halogen free products meet or exceed the halogen free require-ments of IPC/JEDEC J-STD-020 for MSL classification at halogen free peak reflow temperature. HUAYI defines “Green” to mean halogen free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

HUAYI reserves the right to make changes, corrections, enhancements, modifications, and improvements to this pr -oduct and/or to this document at any time without notice.

Absolute Maximum Ratings

Symbol	Parameter		Rating	Unit
Common Ratings (Tc=25°C Unless Otherwise Noted)				
V_{CES}	Collector-Emitter Voltage		1200	V
V_{GES}	Gate-Emitter Voltage		±30	V
T_J	Junction Temperature Range		-55 to 175	°C
T_{STG}	Storage Temperature Range			°C
Mounted on Large Heat Sink				
I_{CM}	Pulsed Collector Current *	Tc=25°C	160	A
I_C	Continuous Collector Current	Tc=25°C	80	A
		Tc=100°C	40	A
I_{FM}	Diode Maximum Forward Current *	Tc=25°C	160	A
I_F	Diode Continuous Forward Current	Tc=25°C	80	A
		Tc=100°C	40	A
P_D	Power Dissipation @TC=25°C		833	W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (IGBT)		0.18	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case (Diode)		0.37	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient		40	°C/W

Note: *Repetitive rating: pulse width limited by max. junction temperature.

Electrical Characteristics(Tc =25°C Unless Otherwise Noted)

Symbol	Parameter	Test Conditions	HYG40T120F1DSW			Unit
			Min	Typ.	Max	
Static Characteristics*						
BV_{CES}	Collector-Emitter Breakdown Voltage	V_{GE}=0V,I_C=250μA	1200	-	-	V
I_{CES}	Collector-Emitter Leakage Current	V_{CE}=1200V,V_{GE}=0V	-	-	250	μA
$V_{GE(th)}$	Gate Threshold Voltage	V_{CE}=V_{GE},I_C=1mA	4.93	5.93	6.93	V
I_{GES}	Gate-Emitter Leakage Current	V_{GE}=±20V,V_{CE}=0V	-	-	±200	nA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE}=15V,I_C=40A T_J =25°C	-	1.45	1.80	V
		V_{GE}=15V,I_C=40A T_J =125°C	-	1.72	-	
		V_{GE}=15V,I_C=40A T_J =175°C	-	1.83	-	V
V_F	Diode Forward Voltage	I_F=40A,T_J=25°C	-	1.75	2.15	V
		I_F=40A,T_J=125°C	-	1.60	-	
		I_F=40A,T_J=175°C	-	1.52	-	V

Dynamic Characteristics						
C_{ies}	Input Capacitance	V_{GE}=0V	-	8408	-	pF
C_{oes}	Output Capacitance	V_{CE}=25V	-	197	-	
C_{res}	Reverse Transfer Capacitance	Frequency=1MHz	-	55	-	
Q_g	Total Gate Charge	V_{CC}=960V	-	300	-	nC
Q_{ge}	Gate- Emitter Charge	I_C=40A	-	77	-	
Q_{gc}	Gate- Collector Charge	V_{GE}=15V	-	111	-	
$t_{(SC)}$	Short circuit collector current Max.1000 short circuits, times between short circuits: ≥ 1.0s	V_{GE}=15V, V_{CC}≤600V T_J≤175°C	-	15	-	μs
IGBT Switching Characteristics, at T_J=25℃						
$t_{d(ON)}$	Turn-on Delay Time	I_C=40A V_{CC}=600V V_{GE}=15V R_g=5Ω T_J =25°C Inductive Load	-	44	-	ns
t_r	Turn-on Rise Time		-	72	-	
$t_{d(OFF)}$	Turn-off Delay Time		-	208	-	
t_f	Turn-off Fall Time		-	288	-	
E_{on}	Turn-On Switching Loss		-	1.62	-	mJ
E_{off}	Turn-Off Switching Loss		-	3.06	-	
E_{ts}	Total Switching Loss		-	4.68	-	
IGBT Switching Characteristics, at T_J=175℃						
$t_{d\ (ON)}$	Turn-on Delay Time	I_C=40A V_{CC}=600V V_{GE}=15V R_g=5Ω T_J =175°C Inductive Load	-	40	-	ns
t_r	Turn-on Rise Time		-	82	-	
$t_{d\ (OFF)}$	Turn-off Delay Time		-	252	-	
t_f	Turn-off Fall Time		-	332	-	
E_{on}	Turn-On Switching Loss		-	1.92	-	mJ
E_{off}	Turn-Off Switching Loss		-	3.65	-	
E_{ts}	Total Switching Loss		-	5.57	-	
Diode Characteristics, at T_J=25℃						
t_{rr}	Reverse Recovery Time	I_F=40A, di/dt=200A/μs	-	94	-	ns
Q_{rr}	Reverse Recovery Charge		-	225	-	nC
I_{rrm}	Reverse Recovery Current		-	9.7	-	A
Diode Characteristics, at T_J=175℃						
t_{rr}	Reverse Recovery Time	I_F=40A, di/dt=200A/μs	-	125	-	ns
Q_{rr}	Reverse Recovery Charge		-	277	-	nC
I_{rrm}	Reverse Recovery Current		-	11.2	-	A

Note: *Pulse test, pulse width ≤ 300us，duty cycle ≤ 2%.

Typical Operating Characteristics

Figure 1: Power Dissipation

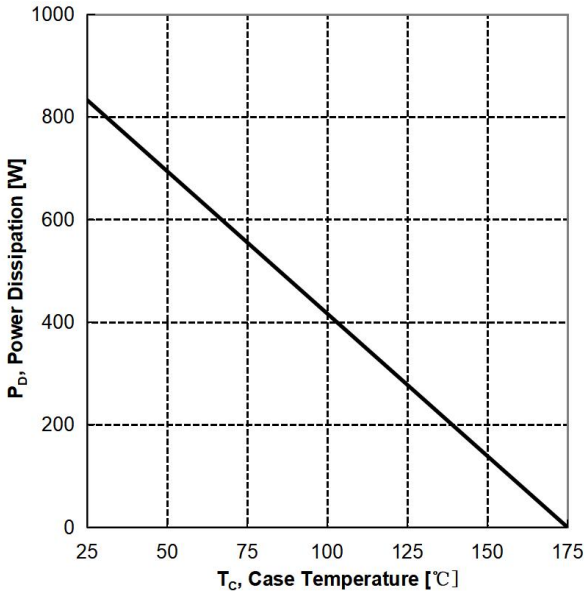


Figure 2: Collector Current vs. Case Temperature

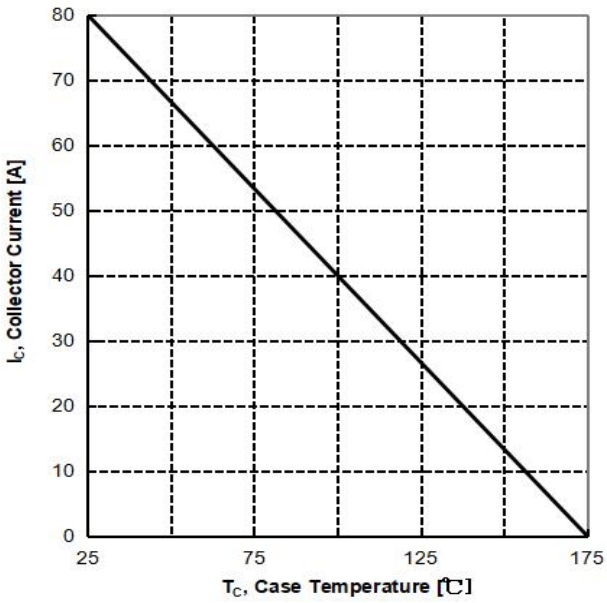


Figure 3: Safe Operation Area

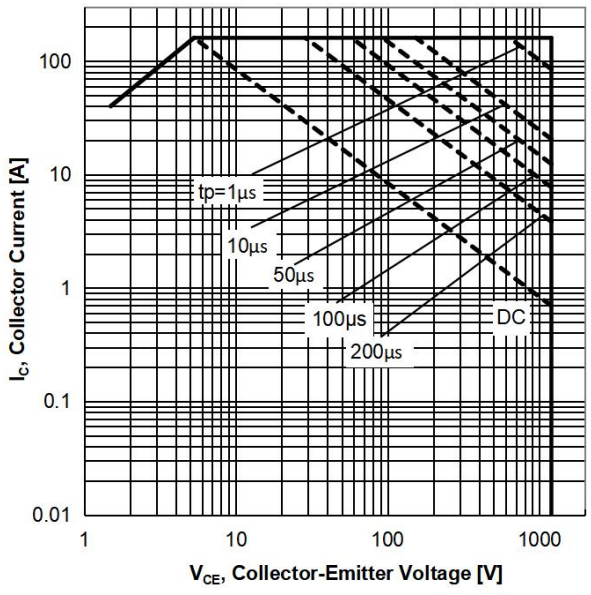


Figure 4: Typical Transfer Characteristics

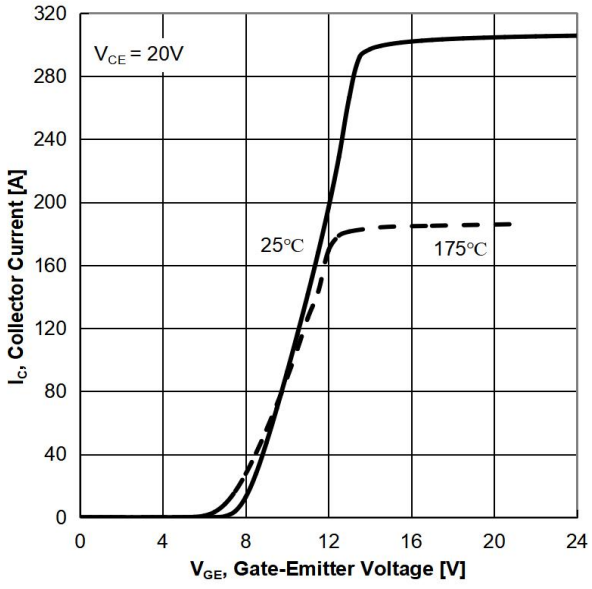


Figure 5: Typical Output Characteristics

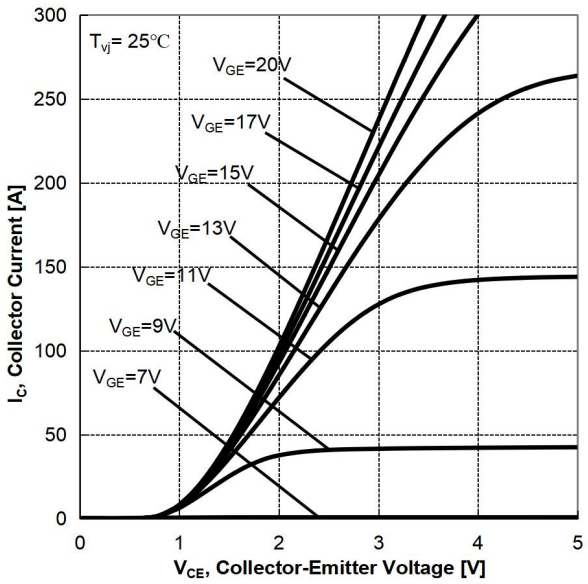


Figure 6: Typical Output Characteristics

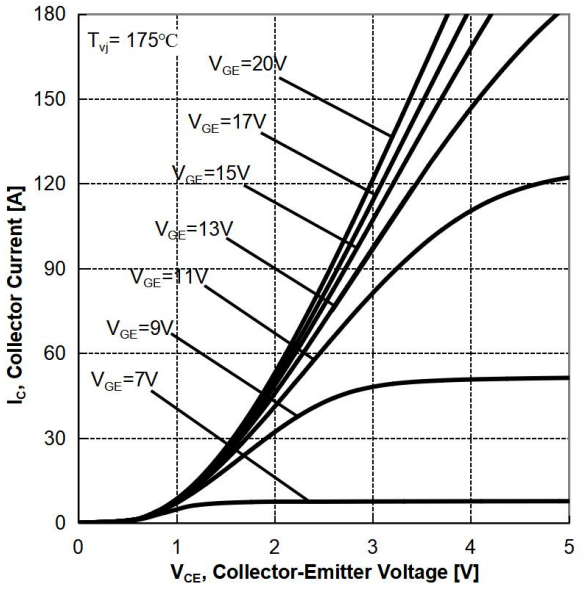


Figure 7: Typical Collector-Emitter Saturation Voltage vs. Junction Temperature

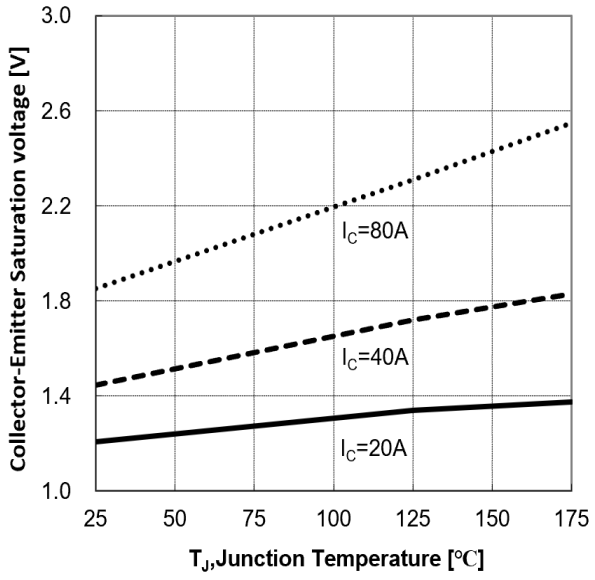


Figure 8: Typical Gate-Emitter Threshold Voltage vs. Junction Temperature

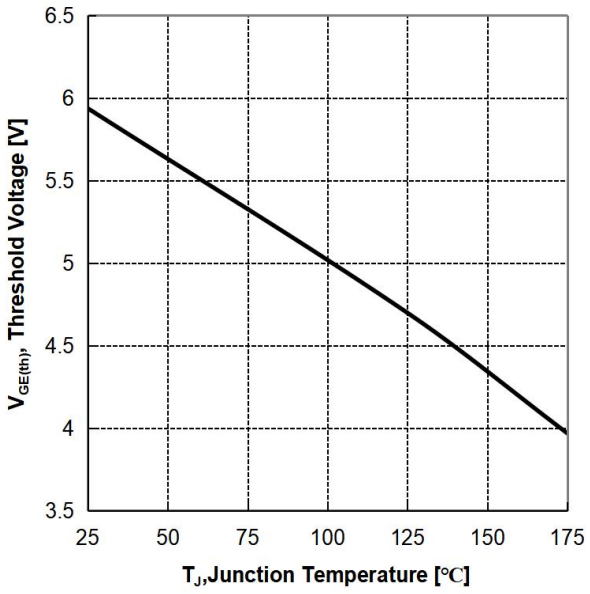


Figure 9: Typical Switching Times vs. Gate Resistor (T_J=25℃, V_{CE}=600V V_{GE}=15/0V, I_C=40A)

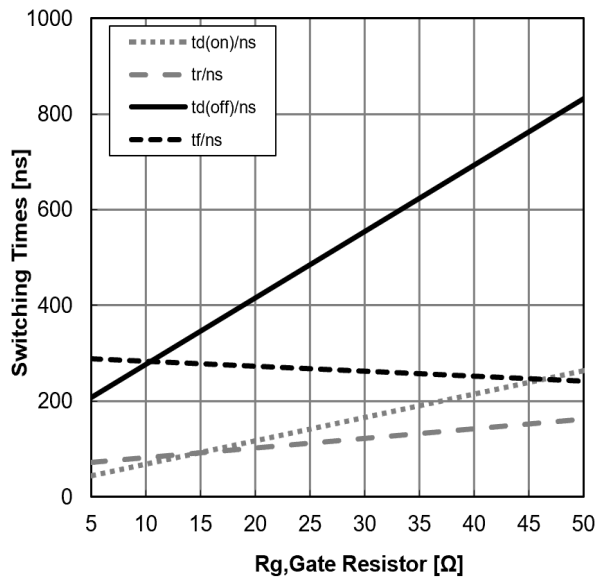


Figure 10: Typical Switching Energy vs. Gate Resistor (T_J=25℃, V_{CE}=600V V_{GE}=15/0V, I_C=40A)

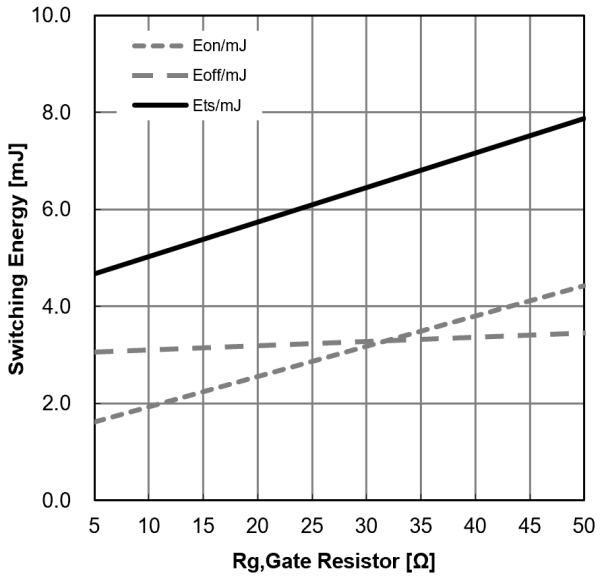


Figure 11: Typical Switching Times vs. Junction Temperature (V_{CE}=600V, V_{GE}=15/0V, I_C=40A,Rg=5Ω)

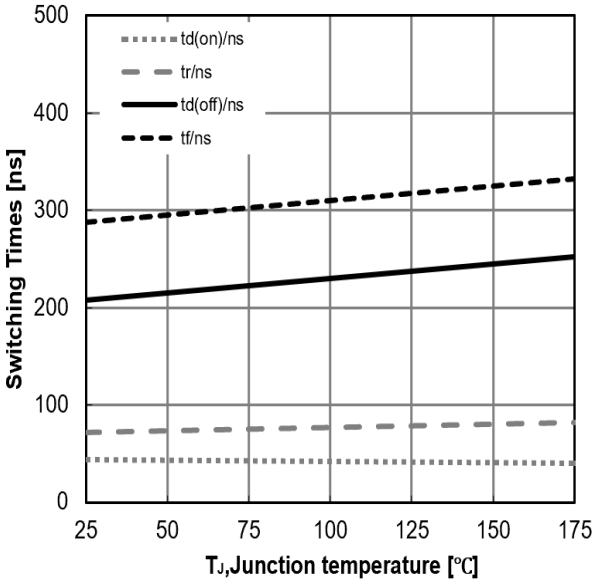


Figure 12: Typical Switching Energy vs. Junction Temperature (V_{CE}=600V, V_{GE}=15/0V, I_C=40A,Rg=5Ω)

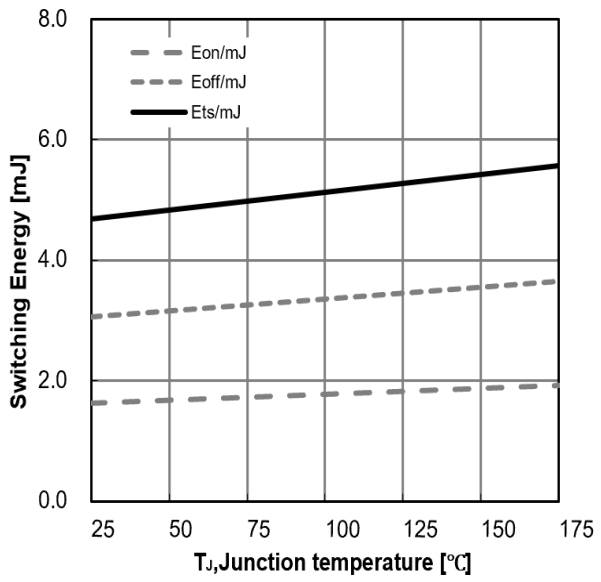


Figure 13: Typical Switching Times vs. Collector Current (T_J=25℃, V_{CE}=600V, V_{GE}=15/0V,Rg=5Ω)

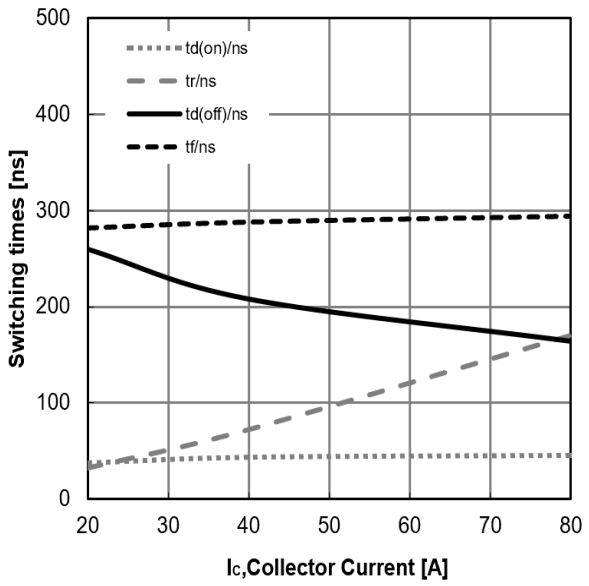


Figure 14: Typical Switching Energy vs. Collector Current (T_J=25℃, V_{CE}=600V, V_{GE}=15/0V,Rg=5Ω)

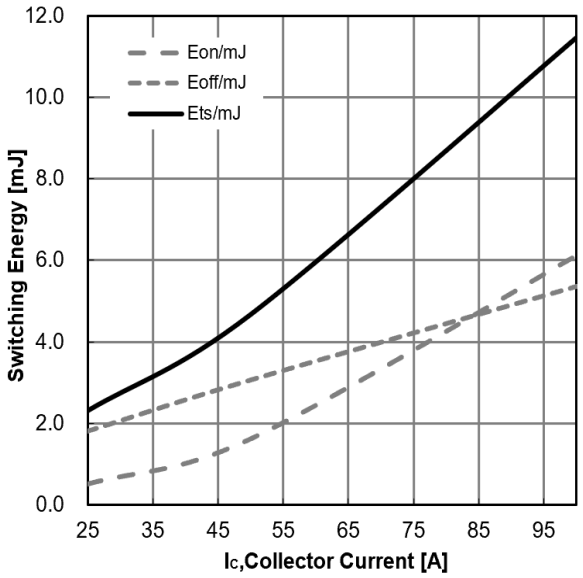


Figure 15: Typical Switching Times vs. VCE (T_J=25℃, V_{GE}=15V, I_C=50A,Rg=5Ω)

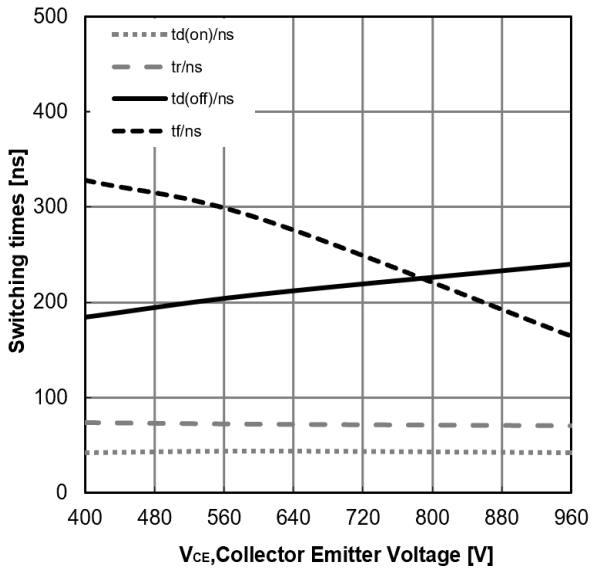


Figure 16: Typical Switching Energy vs. VCE (T_J=25℃, V_{GE}=15V, I_C=50A,Rg=5Ω)

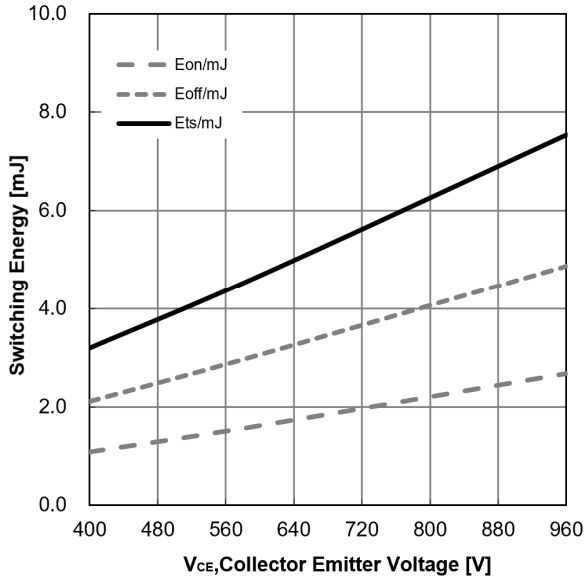


Figure 17: Typical Capacitance vs. Collector- Emitter Voltage

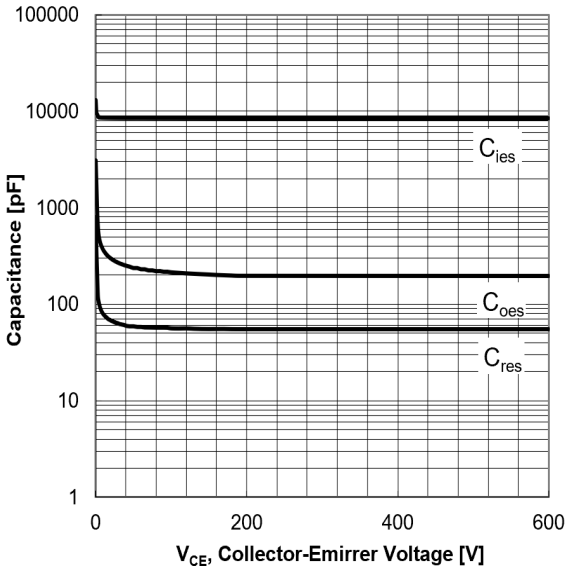


Figure 18: Typical Gate Charge

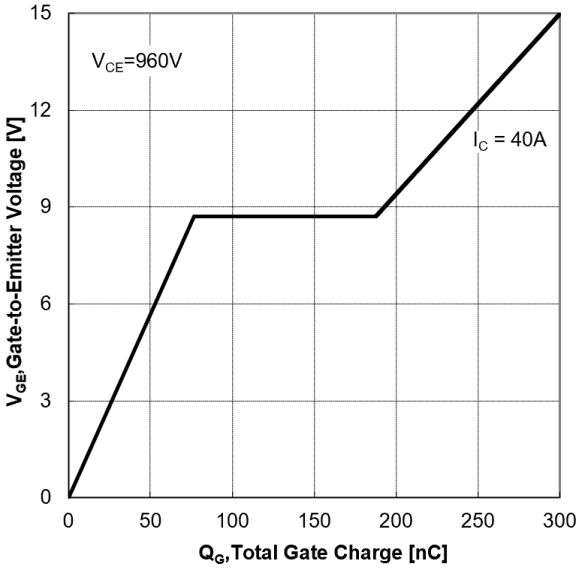


Figure 19: IGBT Transient Thermal Impedance vs. Pulse Width

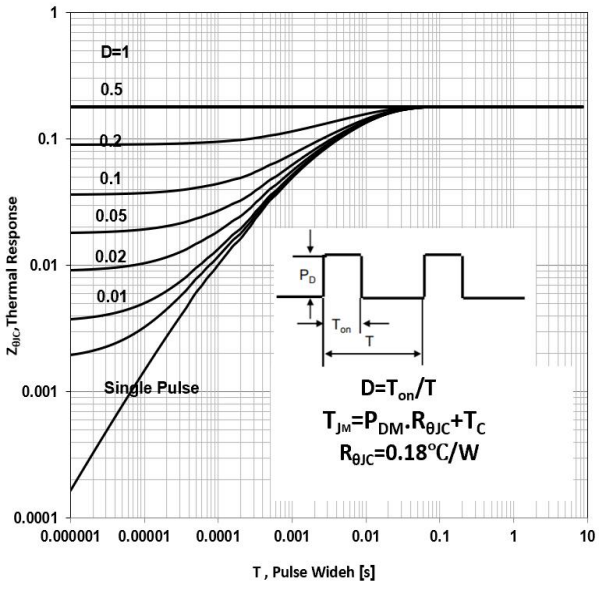


Figure 20: Diode Transient Thermal Impedance vs. Pulse Width

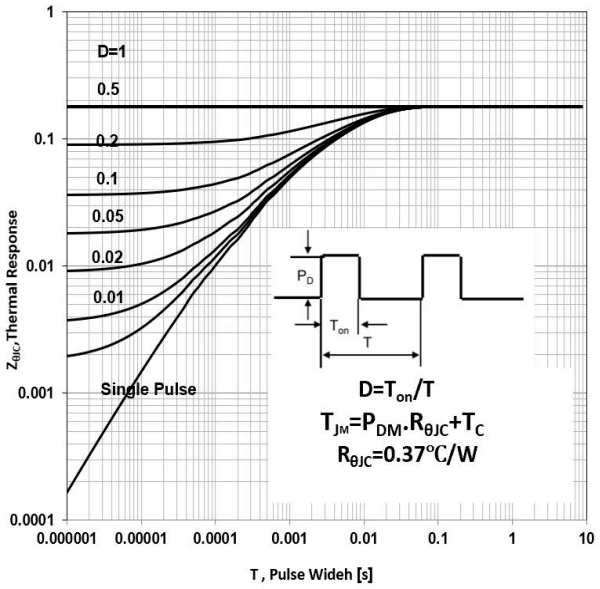
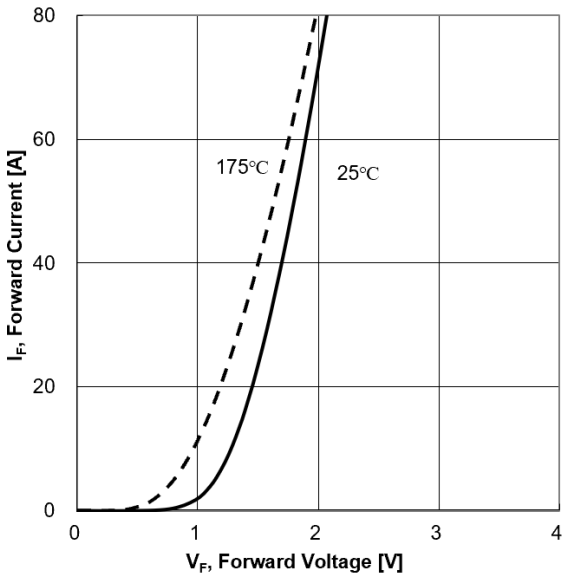
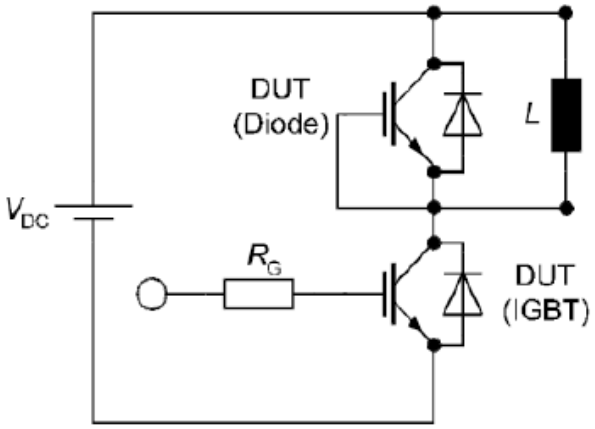
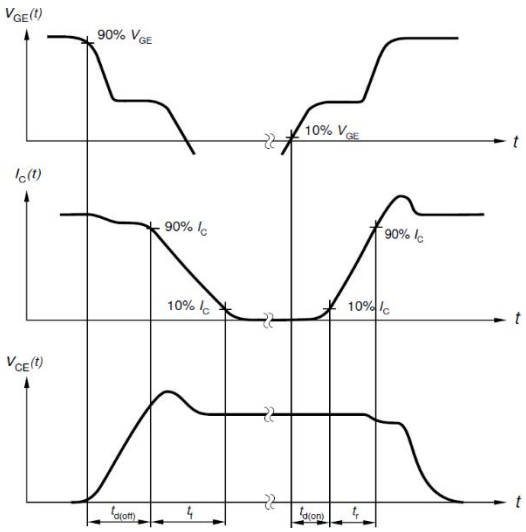


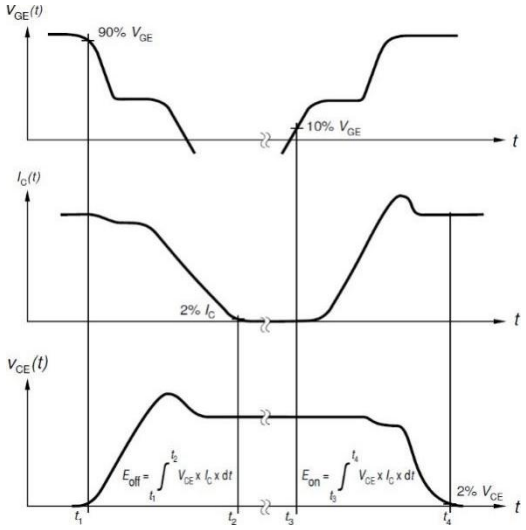
Figure 21: Typical Diode Forward Current vs. Forward Voltage



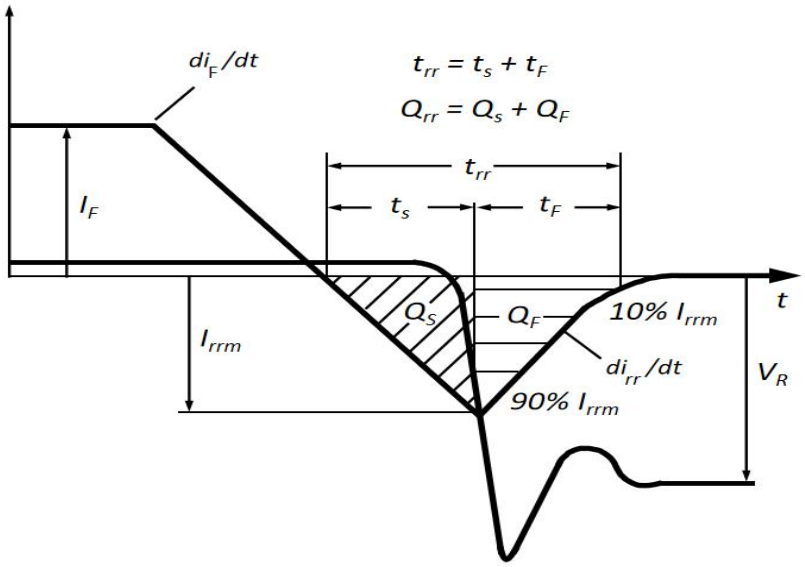
Switching Time Test Circuit







Definition of diode switching characteristics

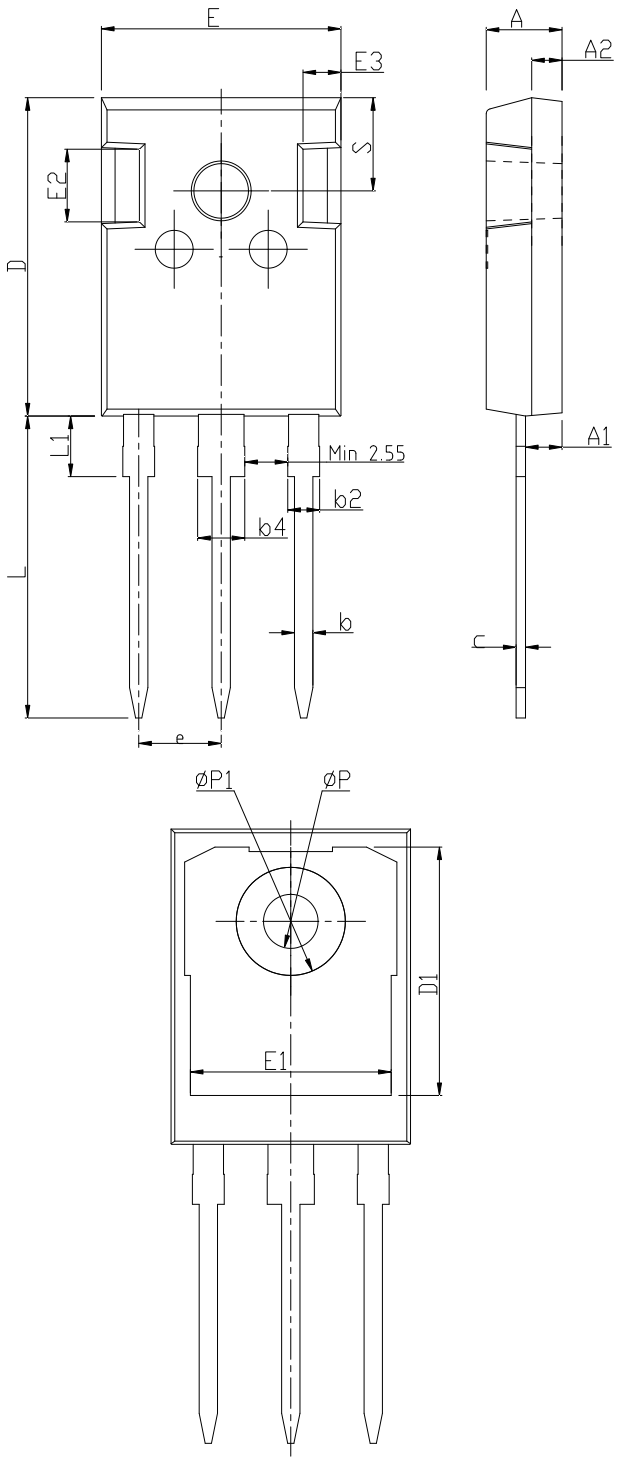


Device Per Unit

Package Type	Unit	Quantity
TO-247-3L	Tube	30

Package Information

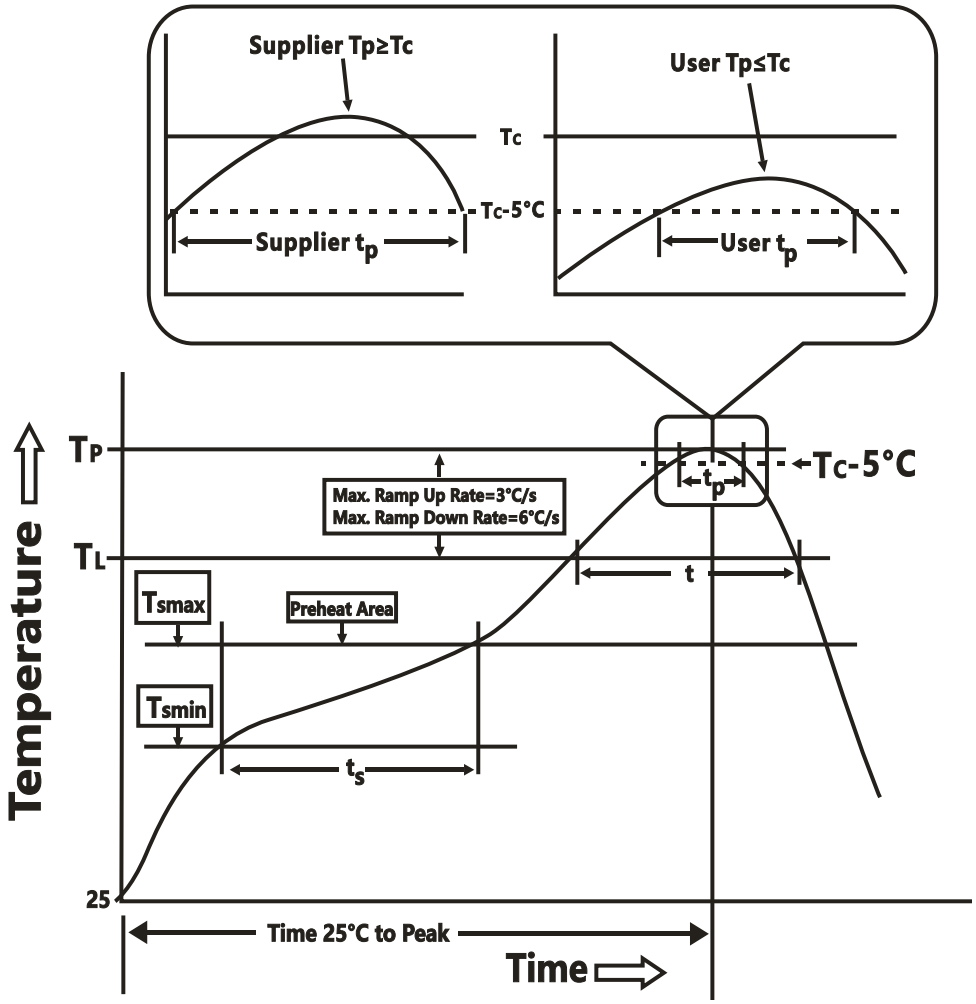
TO-247-3L



COMMON DIMENSIONS

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		

Classification Profile



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
Temperature min (T_{smin}) Temperature max (T_{smax}) Time (T_{smin} to T_{smax}) (t_s)	100 °C 150 °C 60-120 seconds	150 °C 200 °C 60-120 seconds
Average ramp-up rate (T_{smax} to T_P)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L) Time at liquidous (t_L)	183 °C 60-150 seconds	217 °C 60-150 seconds
Peak package body temperature (T_p)*	See Classification Temp in table 1	See Classification Temp in table 2
Time (t_P)** within 5°C of the specified classification temperature (T_c)	20** seconds	30** seconds

Average ramp-down rate (T_p to T_{smax})	6 °C/second max.	6 °C/second max.
Time 25°C to peak temperature	6 minutes max.	8 minutes max.
*Tolerance for peak profile temperature (T_p) is defined as a supplier minimum and a user maximum. ** Tolerance for time at peak profile temperature (t_p) is defined as a supplier minimum and a user maximum.		

Table 1.Sn-Pb Eutectic Process – Classification Temperatures (Tc)

Package Thickness	**Volume mm³ <350**	**Volume mm³ ⩾350**
＜2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

Table 2.Pb-free Process – Classification Temperatures (Tc)

Package Thickness	**Volume mm³ <350**	**Volume mm³ 350-2000**	**Volume mm³ ⩾2000**
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm – 2.5 mm	260 °C	250 °C	245 °C
⩾2.5 mm	250 °C	245 °C	245 °C

Reliability Test Program

Test item	Method	Description
HTRB	JESD-22, A108	168/500 Hrs, Bias @ 150°C
HTGB	JESD-22, A108	168 /500 Hrs, 100%V_{GE} @ 150°C
PCT	JESD-22, A102	96 Hrs, 100%RH, 2atm, 121°C
TCT	JESD-22, A104	250/500 Cycles, -55°C~150°C

Revision History

HYG40T120F1DSW

Revision:2024-05-15，Rev.1.0

Revision	Date	Change Information
1.0	2024-05-15	Official version released

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