

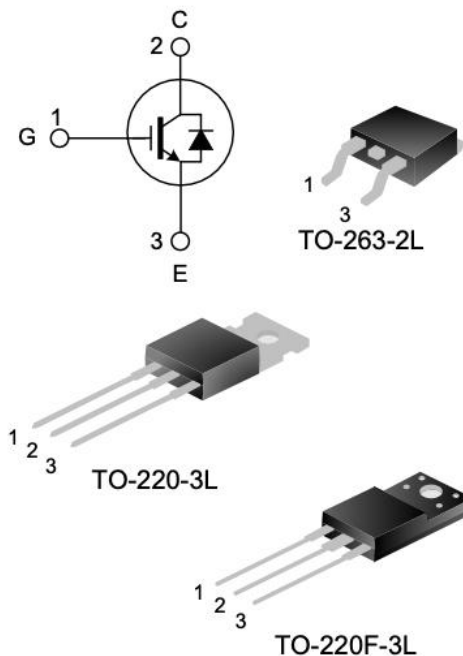
Feature

- 650V/20A
 $V_{CE(sat)} = 1.75V(\text{typ.}) @ I_C = 20A$
- Positive temperature coefficient
- Fast Switching
- Low $V_{CE(sat)}$
- Reliable and Rugged
- Halogen Free and Green Devices Available (RoHS Compliant)

Applications

- Motor drives
- UPS
- Boost
- Portable power station

Pin Description



Ordering and Marking Information

产品名称	封装形式	打印名称	包装方式
HYG20T65F1DHB	TO-263-2L	 B HYG20T65 XYMXXX	通用编带
HYG20T65F1DHP	TO-220-3L	 P HYG20T65 XYMXXX	通用管装
HYG20T65F1DHFL	TO-220F-3L	 LF HYG20T65 XYMXXX	通用管装

Note: HUAYI halogen free products contain molding compounds and 100% matte tin plate Termination finish; which are fully compliant with RoHS. HUAYI halogen free products meet or exceed the halogen free requirements 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 product 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		650	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	60	A
I _C	Continuous Drain Current	Tc=25°C	40	A
		Tc=100°C	20	A
I _{FM}	Diode Maximum Forward Current *	Tc=25°C	60	A
I _F	Diode Continuous Forward Current	Tc=25°C	40	A
		Tc=100°C	20	A
P _D	Power Dissipation @TC=25°C	HYG20T65F1DHB	167	W
		HYG20T65F1DHP	147	W
		HYG20T65F1DHLEF	54	W
R _{θJC}	Thermal Resistance, Junction-to-Case (IGBT)	HYG20T65F1DHB	0.90	°C/W
		HYG20T65F1DHP	1.02	°C/W
		HYG20T65F1DHLEF	2.80	°C/W
R _{θJC}	Thermal Resistance, Junction-to-Case (Diode)	HYG20T65F1DHB	1.20	°C/W
		HYG20T65F1DHP	2.05	°C/W
		HYG20T65F1DHLEF	3.11	°C/W
R _{θJA}	Thermal Resistance, Junction-to-Ambient	HYG20T65F1DHB	62.5	°C/W
		HYG20T65F1DHP	62.5	°C/W
		HYG20T65F1DHLEF	62.5	°C/W

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

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

Symbol	Parameter	Test Conditions	HYG20T65F1DHB/P/LF			Unit
			Min	Typ.	Max	
Static Characteristics*						
BV _{CES}	Collector-Emitter Breakdown Voltage	V _{GE} =0V, I _C =250μA	650	-	-	V
I _{CES}	Collector-Emitter Leakage Current	V _{CE} =650V, V _{GE} =0V	-	-	10	μA
V _{GE(th)}	Gate Threshold Voltage	V _{CE} =V _{GE} , I _C =1mA	4.1	5.1	6.1	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 =20A T _J =25°C	-	1.75	2.05	V
		V _{GE} =15V, I _C =20A T _J =125°C	-	2.13	-	V
		V _{GE} =15V, I _C =20A T _J =175°C	-	2.28	-	V
V _F	Diode Forward Voltage	I _F =20A, T _J =25°C	-	1.50	1.90	V
		I _F =20A, T _J =125°C	-	1.40	-	V
		I _F =20A, T _J =175°C	-	1.36	-	V
Dynamic Characteristics						
C _{ies}	Input Capacitance	V _{GE} =0V	-	780	-	pF
C _{oes}	Output Capacitance	V _{CE} =25V	-	46	-	
C _{res}	Reverse Transfer Capacitance	Frequency=1MHz	-	22	-	
Q _g	Total Gate Charge	V _{CC} =520V	-	45	-	nC
Q _{ge}	Gate- Emitter Charge	I _C =20A	-	9	-	
Q _{gc}	Gate- Collector Charge	V _{GE} =15V	-	22	-	
t _(sc)	Short circuit collector current Max.1000 short circuits, times between short circuits: ≥ 1.0s	V _{GE} =15V, V _{CC} ≤400V T _J ≤175°C	-	10	-	μs
IGBT Switching Characteristics, at T _J =25°C						
t _{d(ON)}	Turn-on Delay Time	I _C =20A V _{CC} =400V V _{GE} =15V	-	12	-	ns
t _r	Turn-on Rise Time		-	24	-	
t _{d(OFF)}	Turn-off Delay Time		-	40	-	
t _f	Turn-off Fall Time		-	68	-	
E _{on}	Turn-On Switching Loss	R _g =5Ω	-	0.26	-	mJ
E _{off}	Turn-Off Switching Loss	Inductive Load	-	0.39	-	
E _{ts}	Total Switching Loss		-	0.65	-	
IGBT Switching Characteristics, at T _J =175°C						
t _{d(ON)}	Turn-on Delay Time	I _C =20A V _{CC} =400V V _{GE} =15V	-	14	-	ns
t _r	Turn-on Rise Time		-	32	-	
t _{d(OFF)}	Turn-off Delay Time		-	81	-	
t _f	Turn-off Fall Time		-	60	-	
E _{on}	Turn-On Switching Loss	R _g =5Ω	-	0.40	-	mJ
E _{off}	Turn-Off Switching Loss	Inductive Load	-	0.57	-	
E _{ts}	Total Switching Loss		-	0.97	-	
Diode Characteristics, at T _J =25°C						
t _{rr}	Reverse Recovery Time	I _F =20A di/dt=200A/μs	-	53	-	ns
Q _{rr}	Reverse Recovery Charge		-	348	-	nC
I _{rrm}	Reverse Recovery Current		-	5.5	-	A
Diode Characteristics, at T _J =175°C						
t _{rr}	Reverse Recovery Time	I _F =20A di/dt=200A/μs	-	66	-	ns
Q _{rr}	Reverse Recovery Charge		-	432	-	nC
I _{rrm}	Reverse Recovery Current		-	6.8	-	A

Typical Operating Characteristics

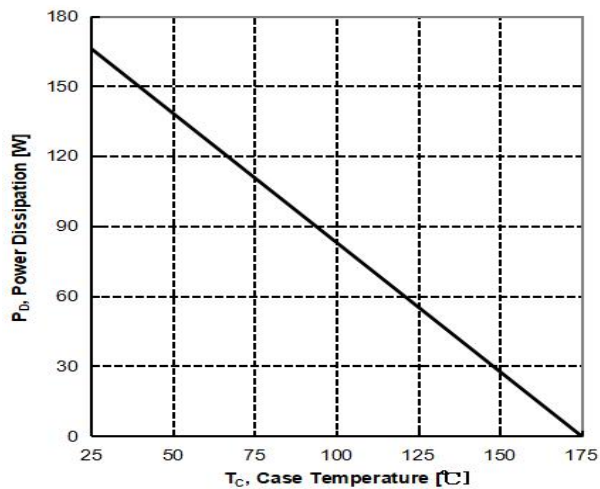
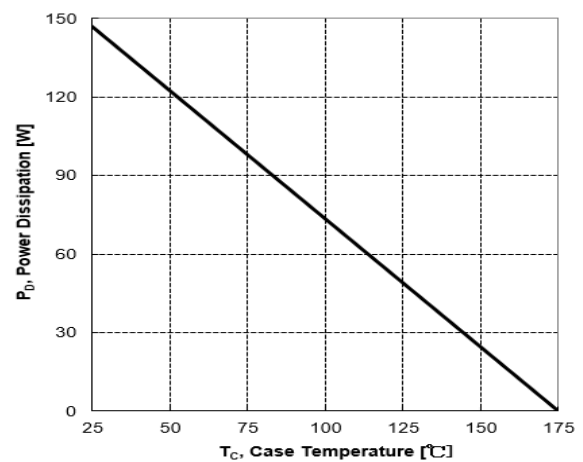
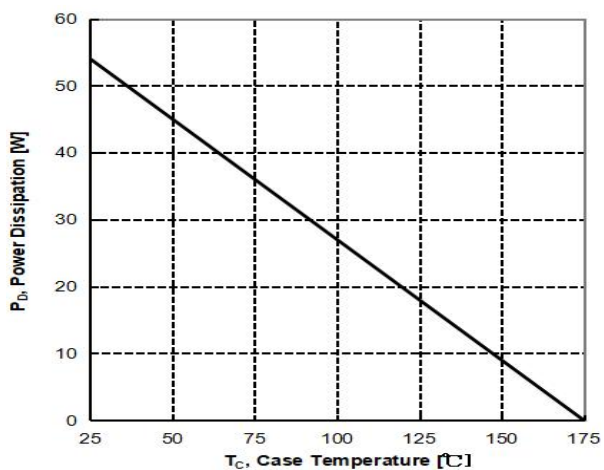
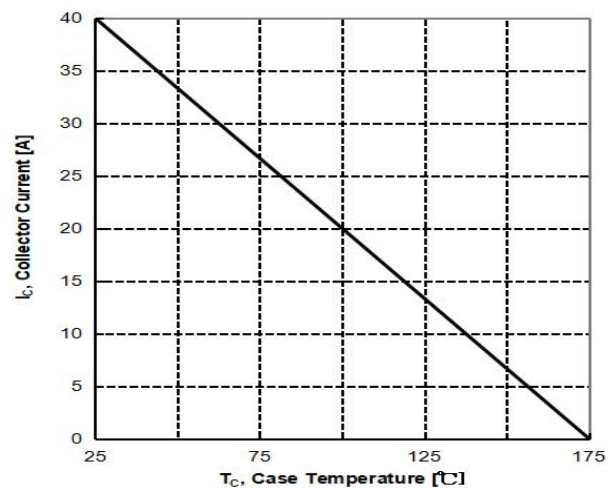
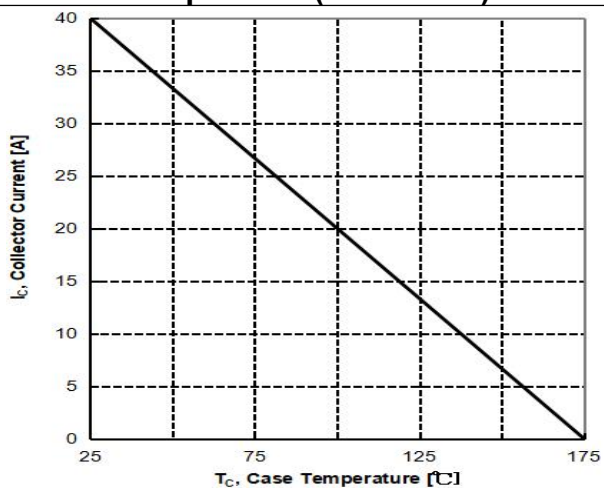
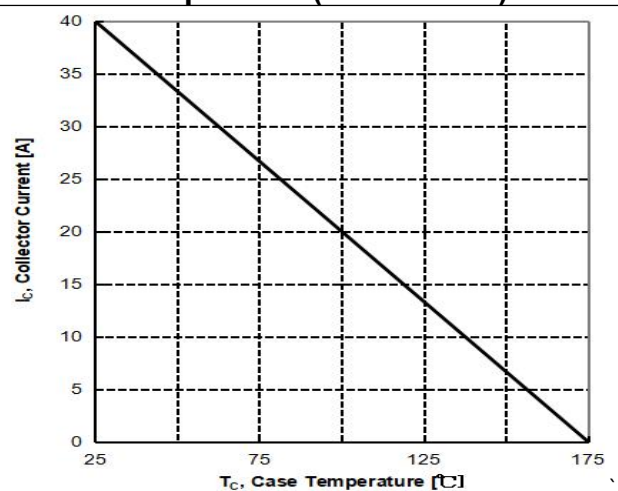
Figure 1: Power Dissipation(TO-263-2L)

Figure 2: Power Dissipation(TO-220-3L)

Figure 3: Power Dissipation(TO-220F-3L)

Figure 4: Collector Current vs. Case Temperature(TO-263-2L)

Figure 5: Collector Current vs. Case Temperature(TO-220-3L)

Figure 6: Collector Current vs. Case Temperature(TO-220F-3L)


Figure 7: Safe Operation Area(TO-263-2L)

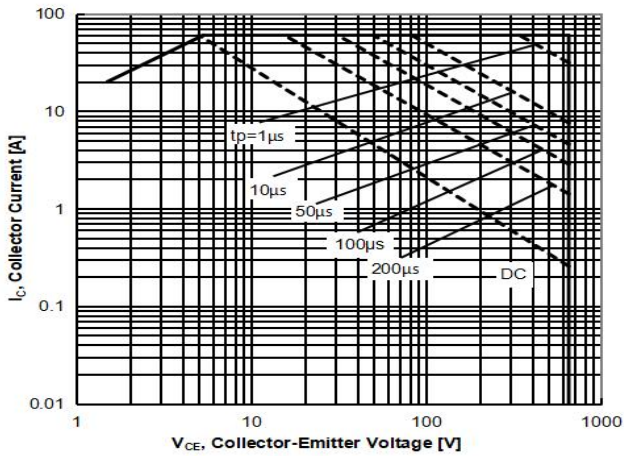


Figure 8: Safe Operation Area(TO-220-3L)

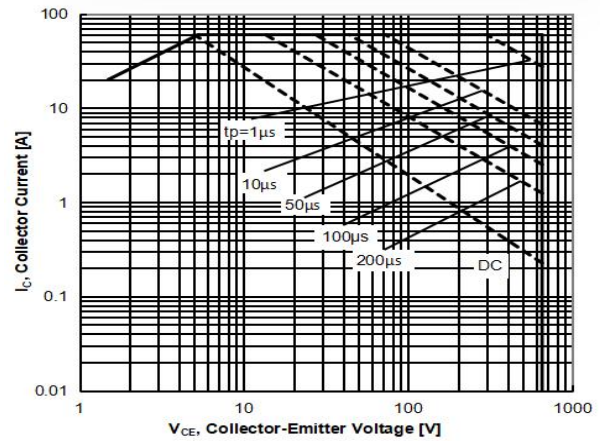


Figure 9: Safe Operation Area(TO-220F-3L)

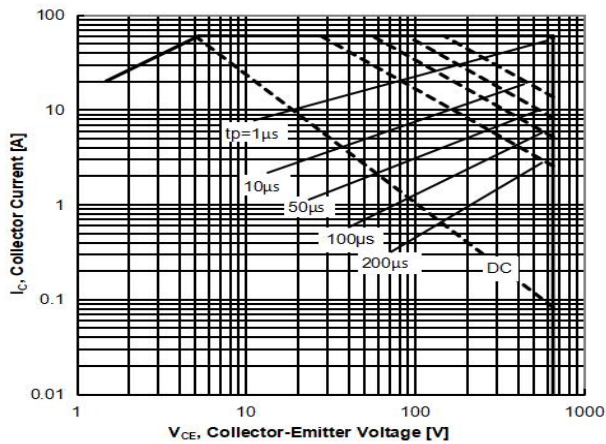


Figure 10: Typical Transfer Characteristics

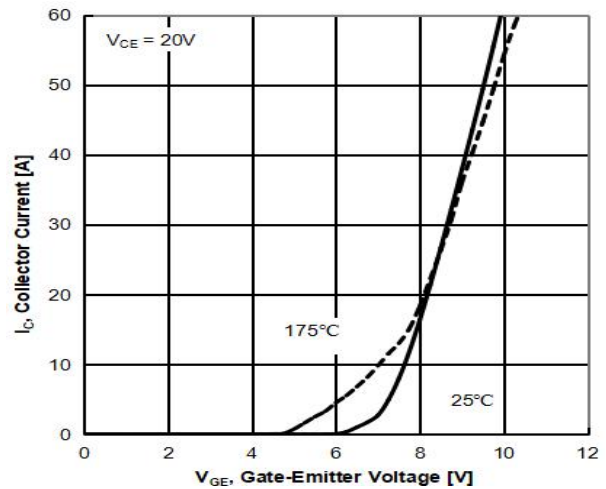


Figure 11: Typical Output Characteristics

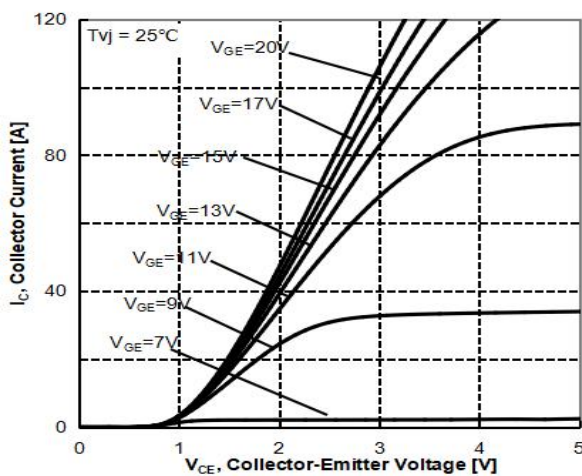


Figure 12: Typical Output Characteristics

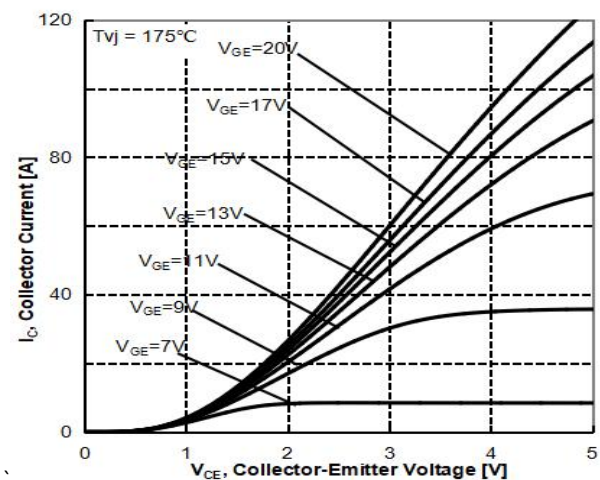


Figure 13: Typical Collector-Emitter Saturation Voltage vs. Junction Temperature

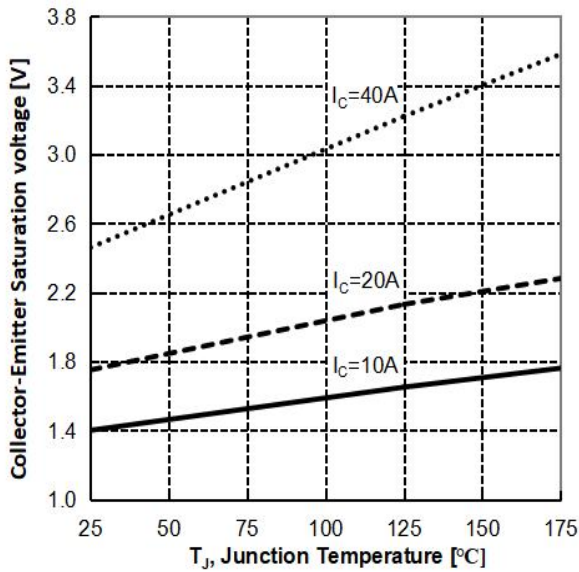


Figure 14: Typical Gate-Emitter Threshold Voltage vs. Junction Temperature

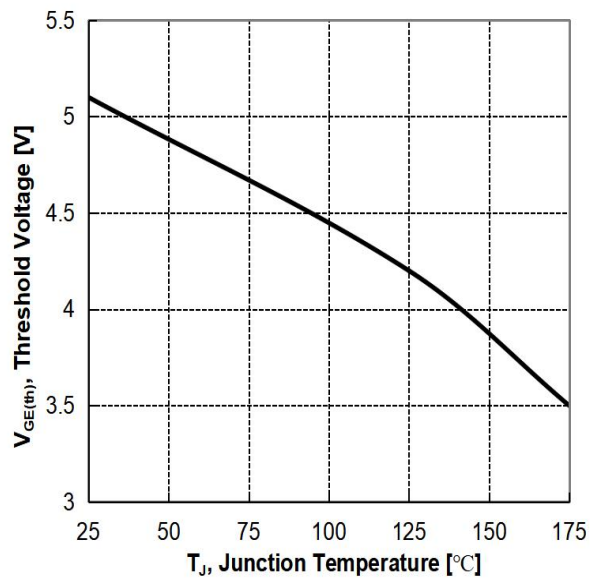


Figure 15: Typical Switching Times vs. Gate Resistor ($T_J=25^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=20\text{A}$)

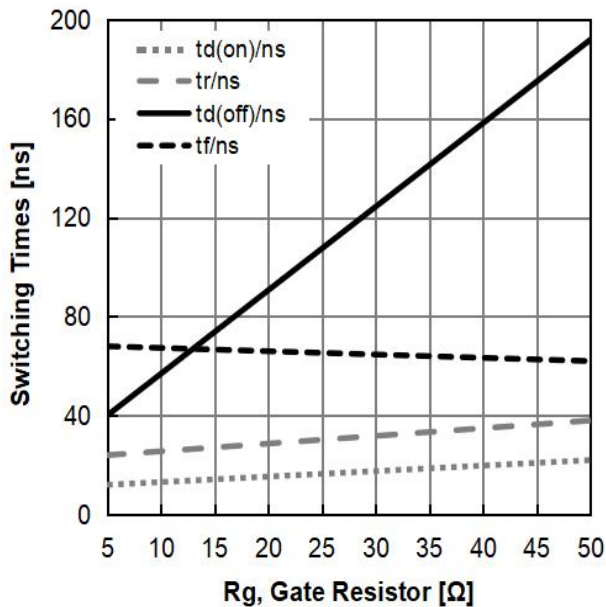


Figure 16: Typical Switching Energy vs. Gate Resistor ($T_J=25^\circ\text{C}$, $V_{CE}=400\text{V}$, $V_{GE}=15/0\text{V}$, $I_C=20\text{A}$)

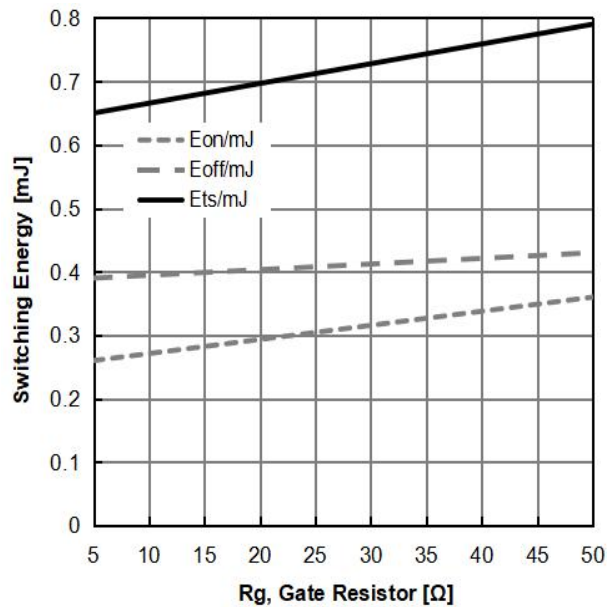


Figure 17: Typical Switching Times vs. Junction Temperature ($V_{CE}=400V$, $V_{GE}=15/0V$, $I_C=20A$)

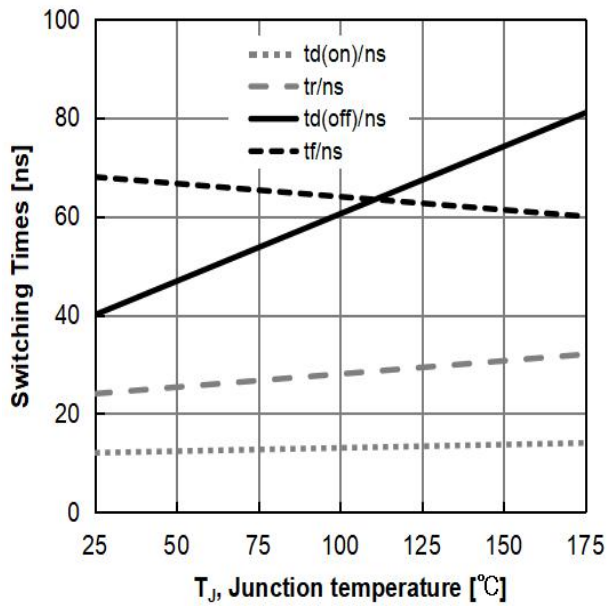


Figure 18: Typical Switching Energy vs. Junction Temperature ($V_{CE}=400V$, $V_{GE}=15/0V$, $I_C=20A$)

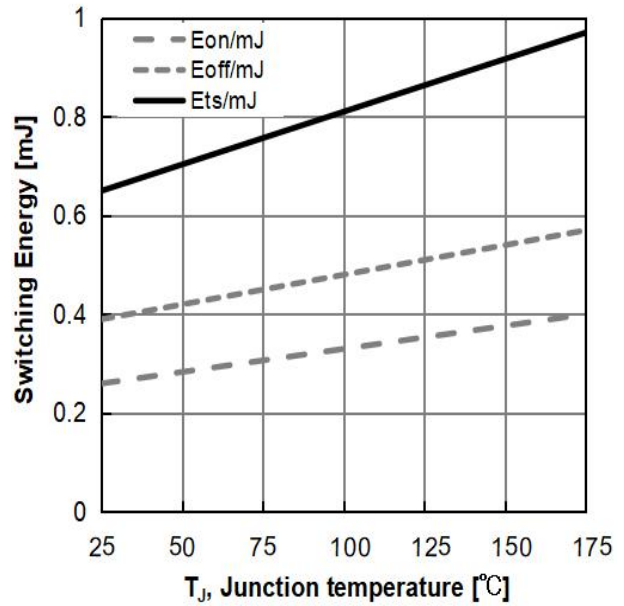


Figure 19: Typical Switching Times vs. Collector Current ($T_J=25^{\circ}C$, $V_{CE}=400V$, $V_{GE}=15/0V$)

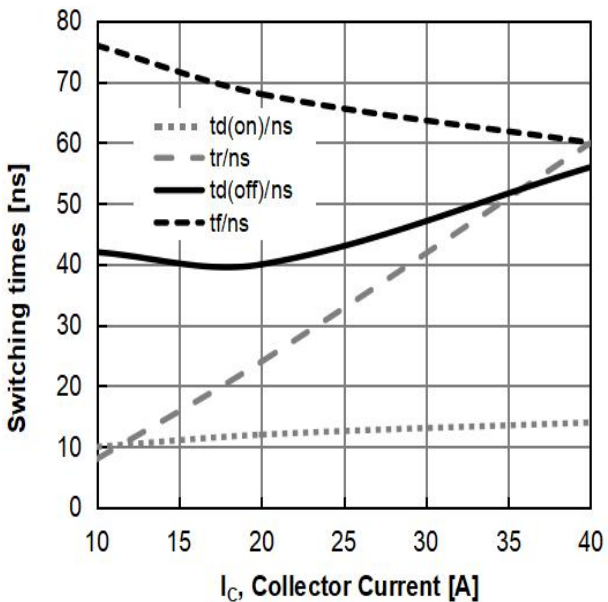


Figure 20: Typical Switching Energy vs. Collector Current ($T_J=25^{\circ}C$, $V_{CE}=400V$, $V_{GE}=15/0V$)

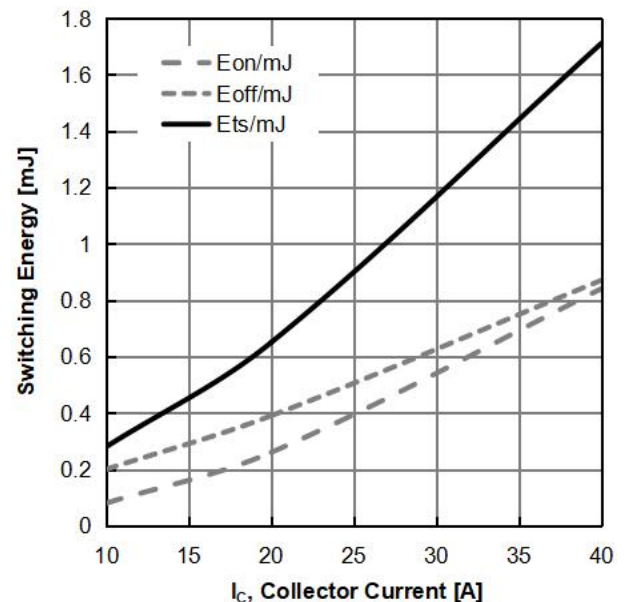


Figure 21: Typical Switching Times vs. VCE ($T_J=25^{\circ}\text{C}$, $V_{GE}=15/0\text{V}$, $I_C=20\text{A}$)

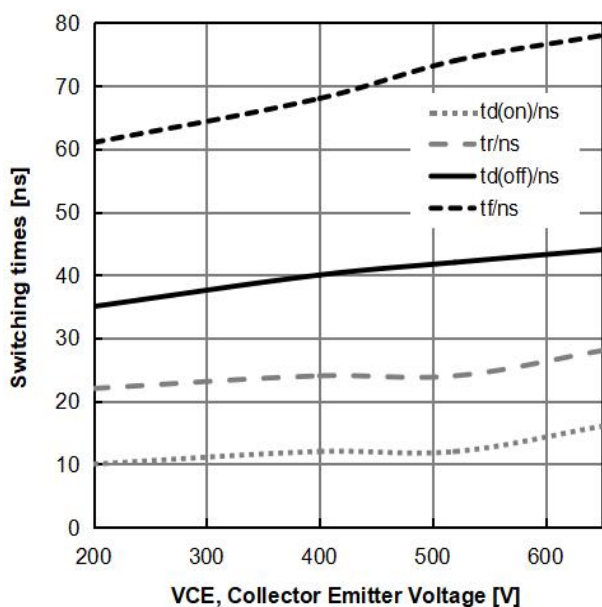


Figure 22: Typical Switching Energy vs. VCE ($T_J=25^{\circ}\text{C}$, $V_{GE}=15/0\text{V}$, $I_C=20\text{A}$)

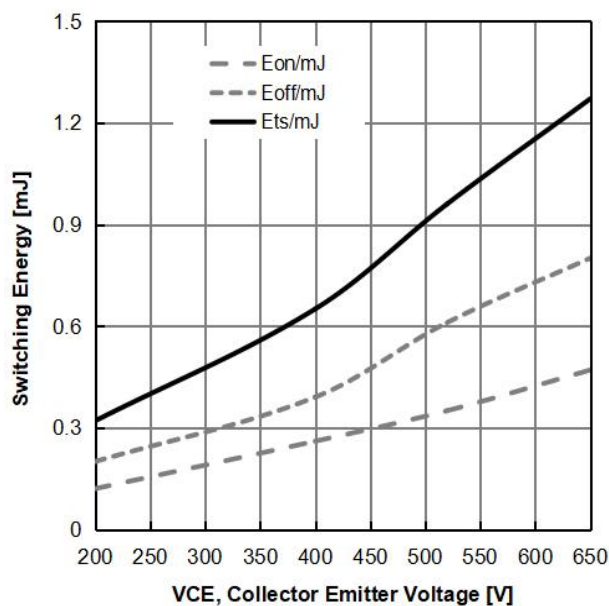


Figure 23: Typical Gate Charge

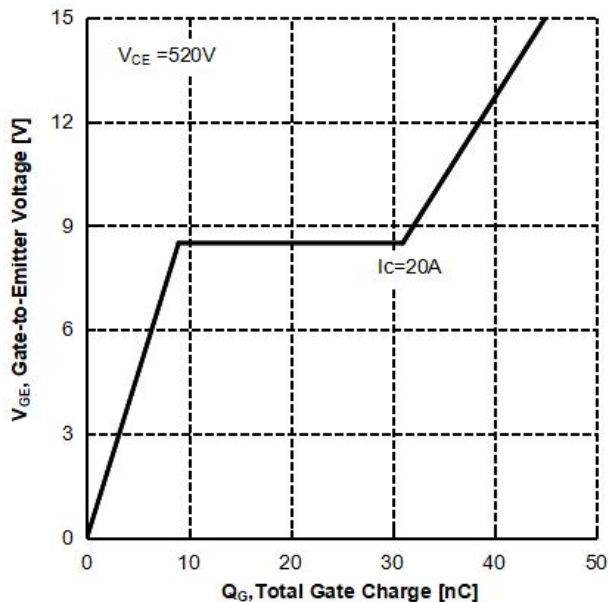


Figure 24: Typical Capacitance vs. Collector- Emitter Voltage

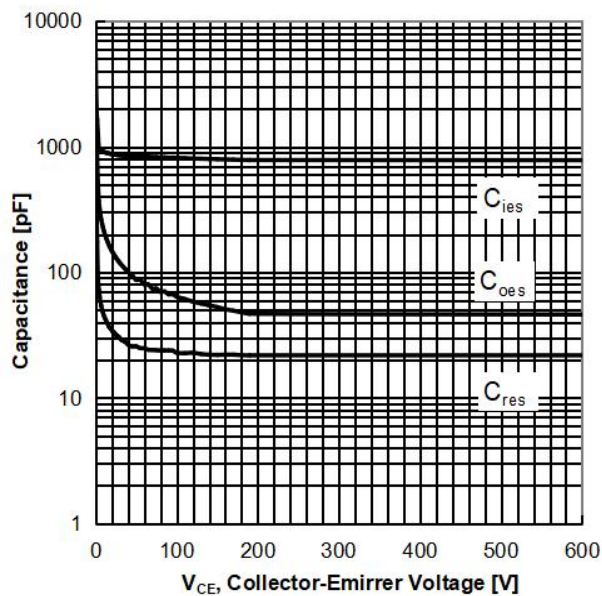


Figure 25: IGBT Transient Thermal Impedance vs. Pulse Width(TO-263-2L)

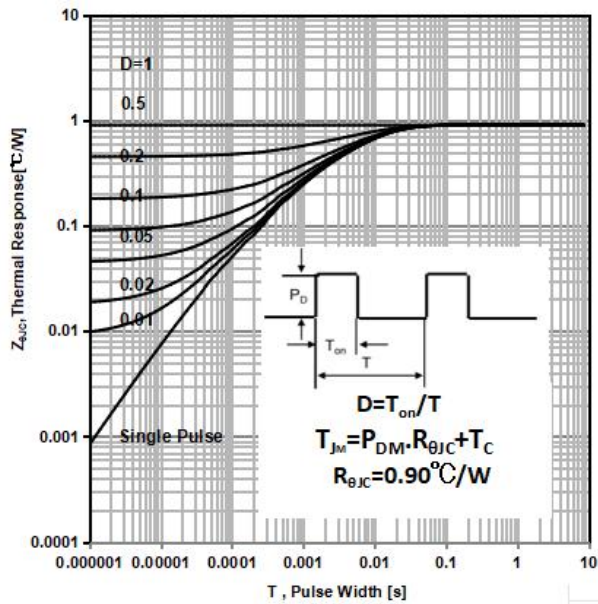


Figure 26: IGBT Transient Thermal Impedance vs. Pulse Width(TO-220-3L)

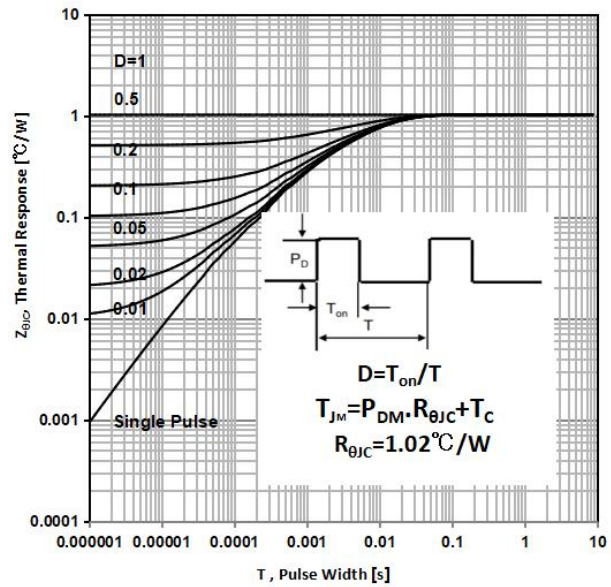


Figure 27: IGBT Transient Thermal Impedance vs. Pulse Width(TO-220F-3L)

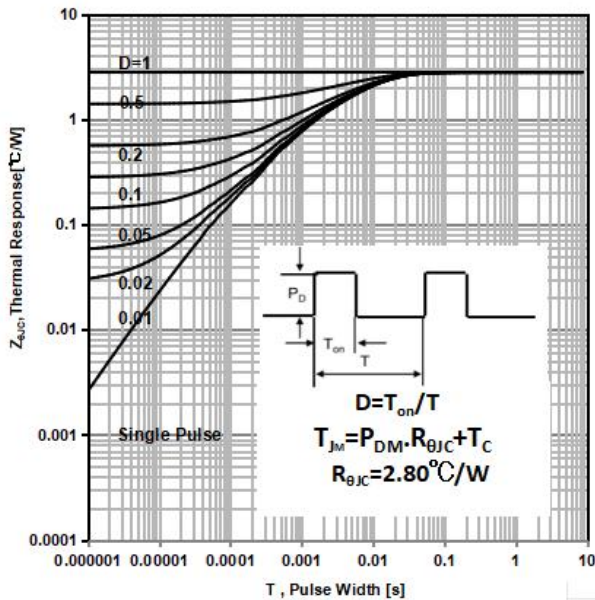


Figure 28: Diode Transient Thermal Impedance vs. Pulse Width(TO-263-2L)

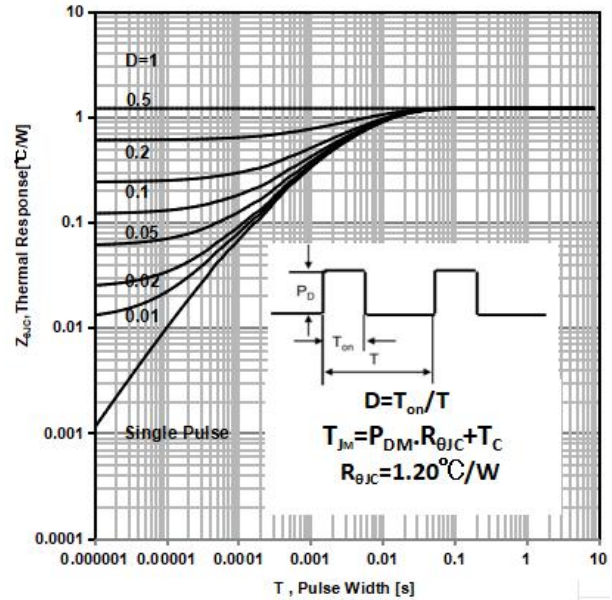


Figure 29: Diode Transient Thermal Impedance vs. Pulse Width(TO-220-3L)

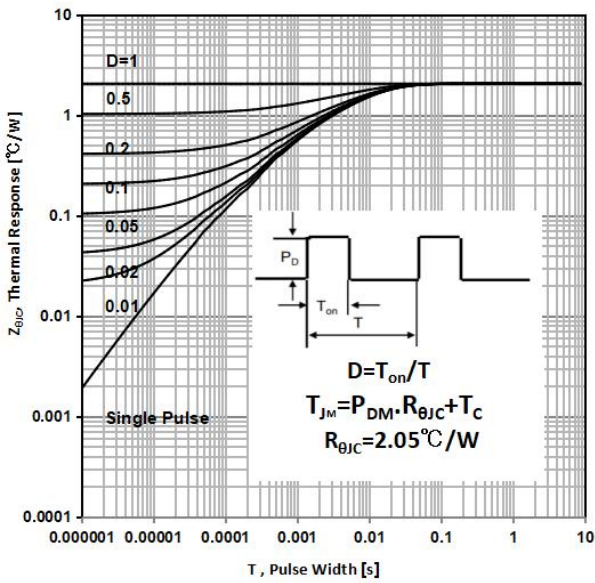


Figure 30: Diode Transient Thermal Impedance vs. Pulse Width(TO-220F-3L)

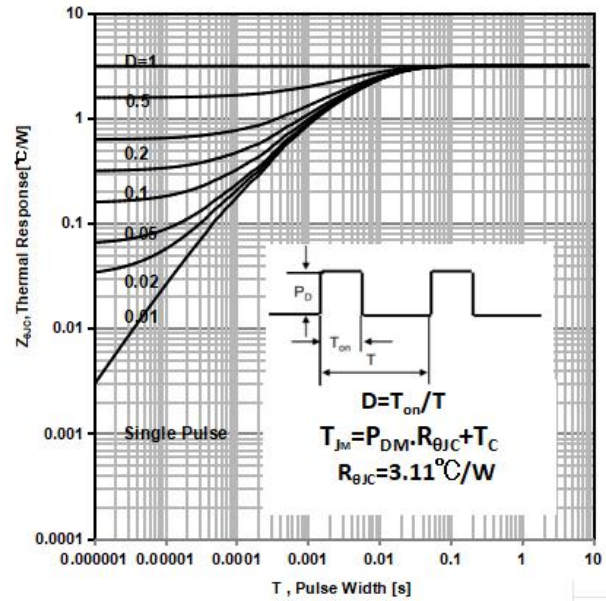
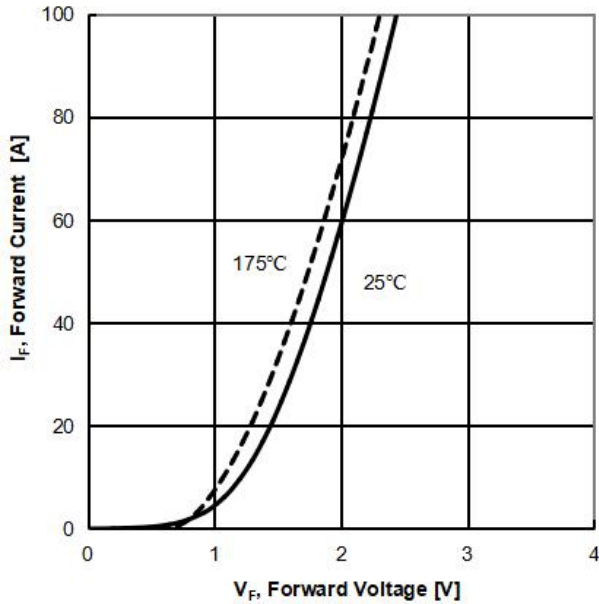
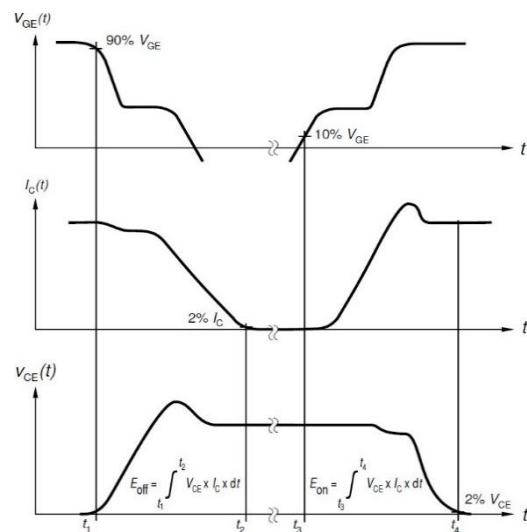
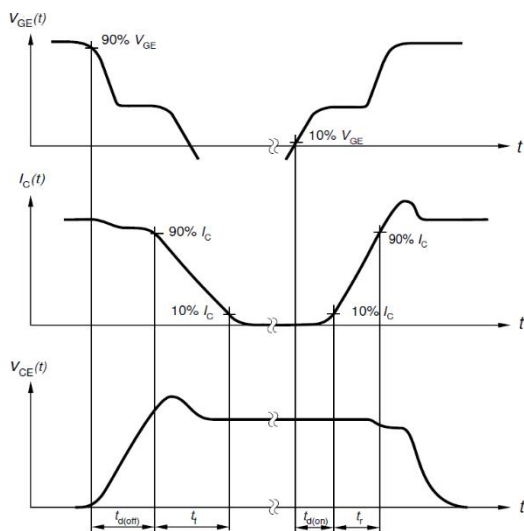
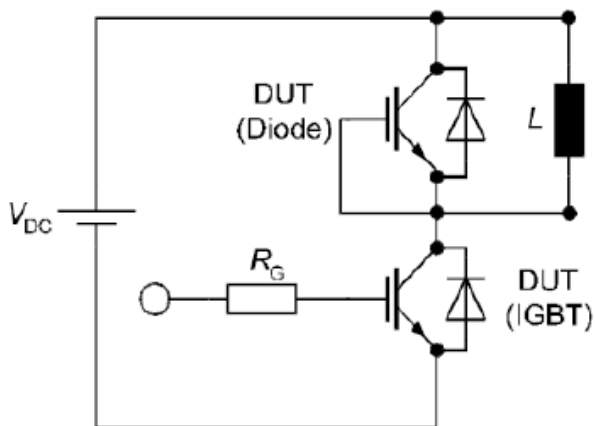


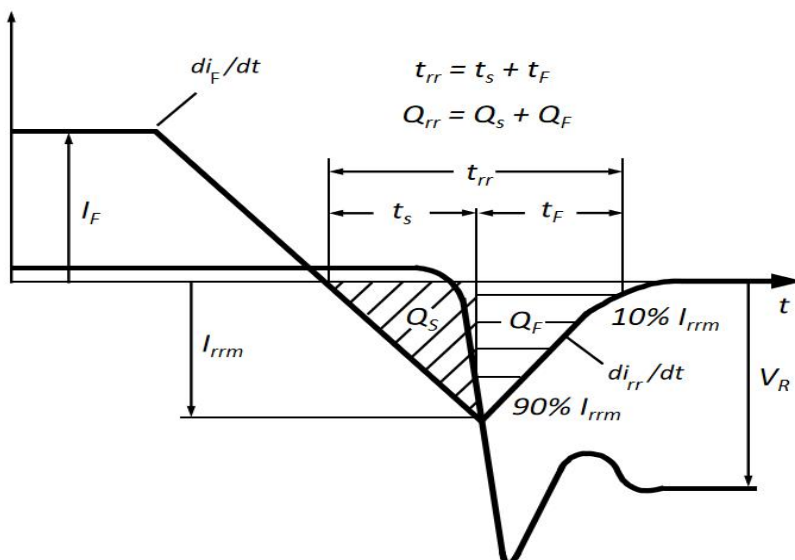
Figure 31: Typical Diode Forward Current vs. Forward Voltage



Switching Time Test Circuit



Definition of diode switching characteristics

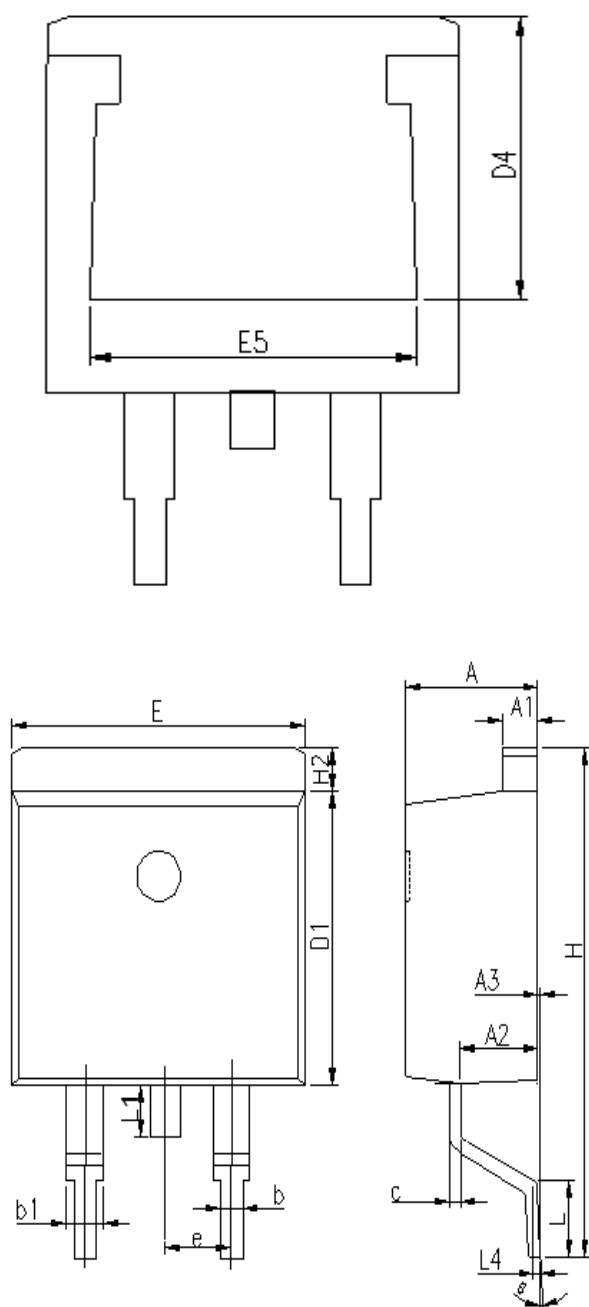


Device Per Unit

Package Type	Unit	Quantity
TO-263-2L	Reel	800

Package Information

TO-263-2L



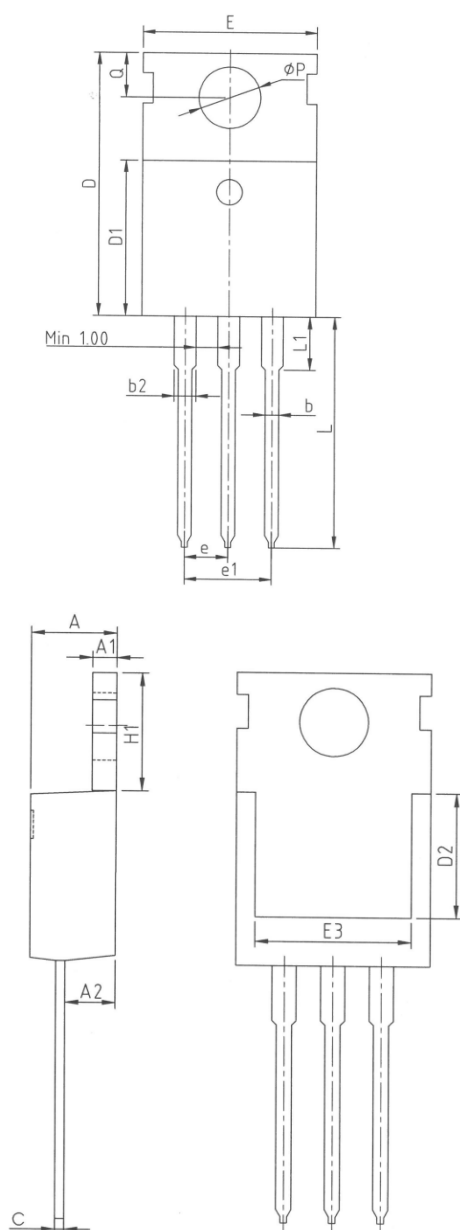
COMMON DIMENSIONS			
SYMBOL	mm		
	MIN	NOM	MAX
A	4.37	4.57	4.77
A1	1.22	1.27	1.42
A2	2.49	2.69	2.89
A3	0	0.13	0.25
b	0.70	0.81	0.96
b1	1.17	1.27	1.47
c	0.30	0.38	0.53
D1	8.50	8.70	8.90
D4	6.60	-	-
E	9.86	10.16	10.36
E5	7.06	-	-
e	2.54 BSC		
H	14.70	15.10	15.50
H2	1.07	1.27	1.47
L	2.00	2.30	2.60
L1	1.40	1.55	1.70
L4	0.25 BSC		
θ	0°	5°	9°

Device Per Unit

Package Type	Unit	Quantity
TO-220-3L	Reel	50

Package Information

TO-220-3L



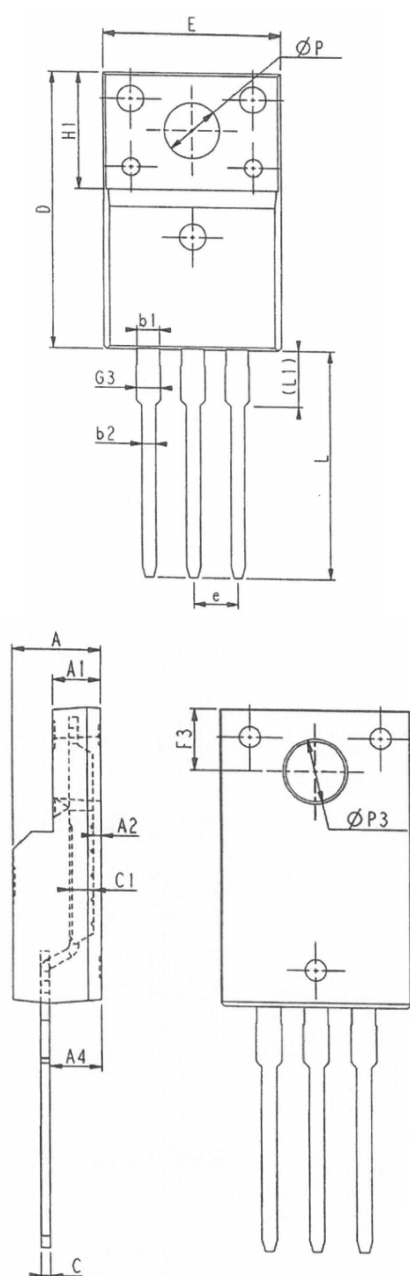
COMMON DIMENSIONS			
SYMBOL	mm		
	MIN	NOM	MIN
A	4.37	4.57	4.70
A1	1.25	1.30	1.40
A2	2.20	2.40	2.60
b	0.70	0.80	0.95
b2	1.17	1.27	1.47
c	0.45	0.50	0.60
D	15.10	15.60	16.10
D1	8.80	9.10	9.40
D2	5.50	6.30	7.10
E	9.70	10.00	10.30
E3	7.00	7.80	8.60
e	2.54 BSC		
e1	5.08 BSC		
H1	6.25	6.50	6.85
L	12.75	13.50	13.80
L1	-	3.10	3.40
ΦP	3.40	3.60	3.80
Q	2.60	2.80	3.00

Device Per Unit

Package Type	Unit	Quantity
TO-220F-3L	Reel	50

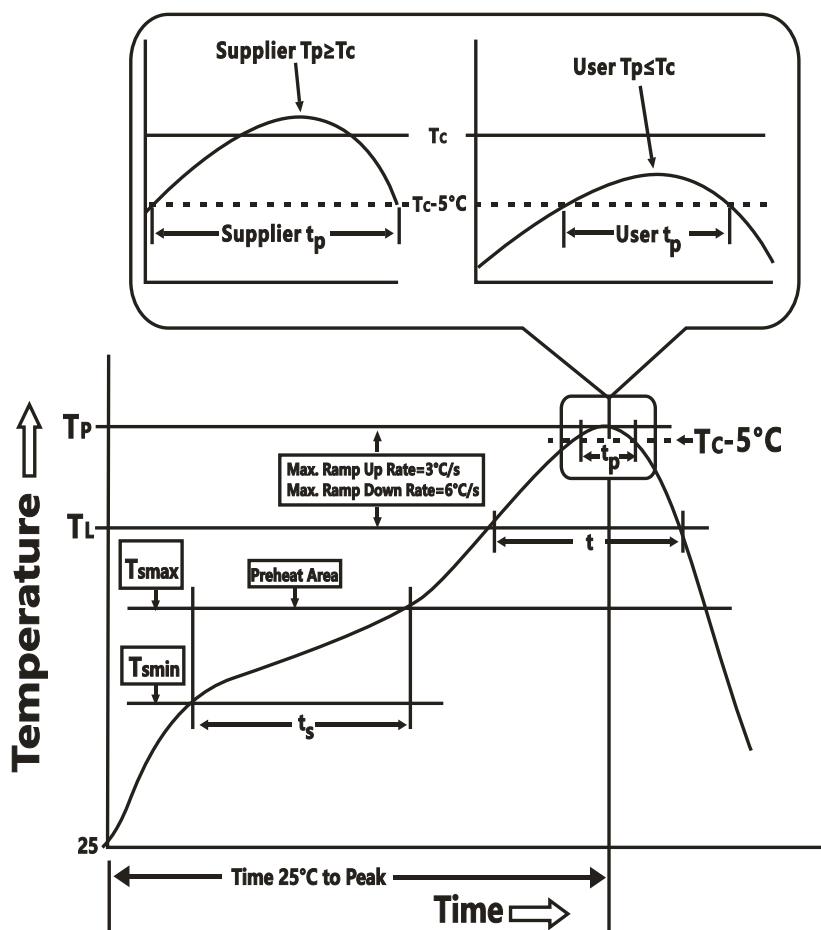
Package Information

TO-220F-3L



COMMON DIMENSIONS			
SYMBOL	mm		
	MIN	NOM	MAX
E	9.96	10.16	10.36
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2	0.30	0.45	0.60
A4	2.56	2.76	2.96
c	0.40	0.50	0.60
c1	1.20	1.30	1.35
D	15.57	15.87	16.13
H1	6.48	6.70	6.90
e	2.54BSC		
L	12.68	12.98	13.28
L1	3.03	3.23	3.43
ΦP	3.03	3.18	3.38
ΦP3	3.15	3.45	3.65
F3	3.15	3.30	3.45
G3	1.25	1.35	1.47
b1	1.18	1.28	1.43
b2	0.70	0.80	0.91

Classification Profile



Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
Temperature min (T_{smin})	100 °C	150 °C
Temperature max (T_{smax})	150 °C	200 °C
Time (T_{smin} to T_{smax}) (T_s)	60-120 seconds	60-120 seconds
Average ramp-up rate (T_{smax} to T_P)	3 °C/second max.	3°C/second max.
Liquidous temperature (T_L)	183 °C	217 °C
Time at liquidous (t_L)	60-150 seconds	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 (T_c)

Package Thickness	Volume mm ³ <350	Volume mm ³ ≥350
<2.5 mm	235 °C	220 °C
≥2.5 mm	220 °C	220 °C

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

Package Thickness	Volume mm ³ <350	Volume mm ³ 350-2000	Volume mm ³ ≥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%VGE @ 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

HYG20T65F1DHB/P/LF

Revision:2025-02-15, Rev.1.2

Revision	Date	Change Information
1.0	2023-10-17	Official version released
1.1	2024-11-15	Update template
1.2	2025-02-15	Update template

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