

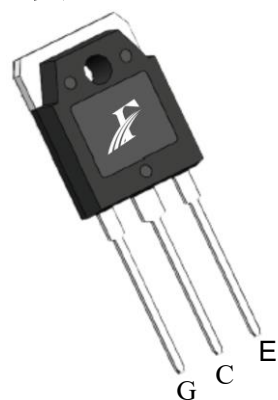
主要参数 MAIN CHARACTERISTICS

I_c (100°C)	40 A
V_{CES}	650 V
$V_{cesat-typ}$ (@ $I_c=40A$)	1.51 V

用途 APPLICATIONS

逆变电源	Inverter power supply
不间断电源	UPS
电机驱动	Motor drive
电焊机	Welding Machines
PFC电路	PFC Circuits
中高开关频率变频器	Medium-high switching frequency converter

封装形式 Package

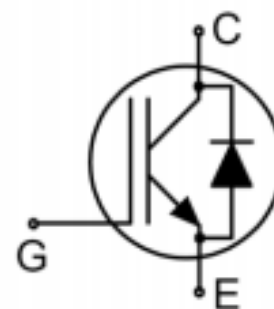


TO-3PN
FHA series

产品特性 FEATURES

Trench-FS 技术	Trench Field Stop technology
低栅极电荷	Low gate charge
低开关损耗	Low Switching losses
低 V_{CEsat}	Low V_{CEsat}
RoHS 产品	RoHS product
带有反向并行快回复二极管	With anti-parallel fast recovery diode
正温度系数	Positive temperature coefficient
高可靠性	High reliability

等效电路 Equivalent Circuit



绝对最大额定值 ABSOLUTE RATINGS ($T_c=25^\circ C$)

项目 parameter	符号 Symbol	数值 Value	单位 Unit
最高集电极-发射极直流电压 Collector-Emmitter Voltage	V_{CE}	650	V
连续集电极极电流 Collector Current-continuous	I_c	($T_c=25^\circ C$) 80 ($T_c=100^\circ C$) 40	A
最大脉冲集电极极电流 (注1) Collector Current – pulse (note 1)	I_{CM}	160	A
二极管连续正向电流 Diode Continuous Forward Current	I_F	($T_c=25^\circ C$) 40 ($T_c=100^\circ C$) 20	A
二极管最大正向电流 Diode Maximum Forward Current	I_{FM}	80	A
最高栅极发射极电压 Gate-Emmitter Voltage	V_{GE}	± 30	V
短路耐受时间 Short circuit withstand time $V_{GE}=15V$, $V_{CC}\leq 400V$, Allowed number of short circuits < 1000, Times between short circuits: $\geq 1.0s$, $T_J \leq 175^\circ C$	t_{sc}	3.0	us
耗散功率 Power Dissipation ($T_c=25^\circ C$)	P_D	298	W
最高结温及存储温度 Operating and Storage Temperature Range	T_J, T_{STG}	-55~+175	$^\circ C$
引线最高焊接温度 Maximum Lead Temperature for Soldering Purposes	T_L	260	$^\circ C$

注1: 集极电流由最高结温限制

Note1: Collector current limited by maximum junction temperature

电特性 ELECTRICAL CHARACTERISTICS(at T_C= 25°C, unless otherwise specified)

项目 Parameter	符号 Symbol	测试条件 Tests conditions	最小 Min	典型 Typ	最大 Max	单位 Units
关态特性 Off –Characteristics						
集电极-发射极击穿电压 Collector-Emmitter Voltage	BV _{CES}	V _{GE} =0V, I _C =250uA	650	-	-	V
击穿电压温度特性 Breakdown Voltage Temperature Coefficient	ΔBV _{CES} /ΔT _J	I _C =1mA, referenced to 25°C	-	0.65	-	V/°C
零栅压下集电极漏电流 Zero Gate Voltage Collector Current	I _{CES}	V _{CE} =650V, V _{GE} =0V	-	-	600	nA
栅极体漏电流 Gate-Emitter leakage current	I _{GES(F/R)}	V _{CE} =0V, V _{GE} =±30V	-	-	±200	nA
通态特性 On-Characteristics						
阈值电压 Gate-Emmitter Threshold Voltage	V _{GE(th)}	V _{CE} = V _{GE} , I _C =1mA	4.9	6.0	6.5	V
饱和压降 Collector-Emmitter saturation Voltage	V _{CESAT}	V _{GE} =15V, I _C =40A, T _J =25°C T _J =125°C T _J =175°C	- - -	1.51 1.80 1.90	1.85 - -	V
动态特性 Dynamic Characteristics						
开启延迟时间 Turn-On delay time	td(on)	V _{GE} =15V, V _{CC} =400V, I _C =40A, R _G =10Ω, T _J =25°C, Inductive Load	-	30	-	ns
上升时间 Turn-On rise time	tr		-	66	-	ns
关断延迟时间 Turn-Off delay time	td(off)		-	138	-	ns
下降时间 Turn-Off Fall time	tf		-	52	-	ns
开启损耗 Turn-on energy	Eon		-	1.0	-	mJ
关断损耗 Turn-off energy	Eoff		-	0.7	-	
总的开关损耗 Total switching energy	Ets		-	1.7	-	
开启延迟时间 Turn-On delay time	td(on)	V _{GE} =15V, V _{CC} =400V, I _C =40A, R _G =10Ω, T _J =175°C, Inductive Load	-	23	-	ns
上升时间 Turn-On rise time	tr		-	60	-	ns
关断延迟时间 Turn-Off delay time	td(off)		-	173	-	ns
下降时间 Turn-Off Fall time	tf		-	64	-	ns
开启损耗 Turn-on energy	Eon		-	1.28	-	mJ
关断损耗 Turn-off energy	Eoff		-	1.04	-	
总的开关损耗 Total switching energy	Ets		-	2.32	-	
栅极电荷总量 Total Gate Charge	Qg	V _{CE} =520V, I _C =40A, V _{GE} =15V	-	110	-	nC
栅极-发射极电荷 Gate-emitter charge	Qge		-	52	-	
栅极-集电极电荷 Gate-collector charge	Qgc		-	23	-	
集电极短路电流 Short circuit collector current (最大值100sc; 短路时间间隔: ≥1.0s)	I _{C(sc)}	V _{GE} =15V, V _{CC} ≤400V, t _{sc} ≤3us, T _J ≤175°C		320		A
栅极电阻 Gate Resistance	Rg	f=1.0MHz, V _{CE} OPEN	-	3.0	-	Ω
输入电容 Input capacitance	Cies	V _{CE} =25V, V _{GE} =0V, f=1.0MHz	-	2225	-	pF
输出电容 Output capacitance	Coes		-	90	-	
反向传输电容 Reverse transfer capacitance	Cres		-	27	-	

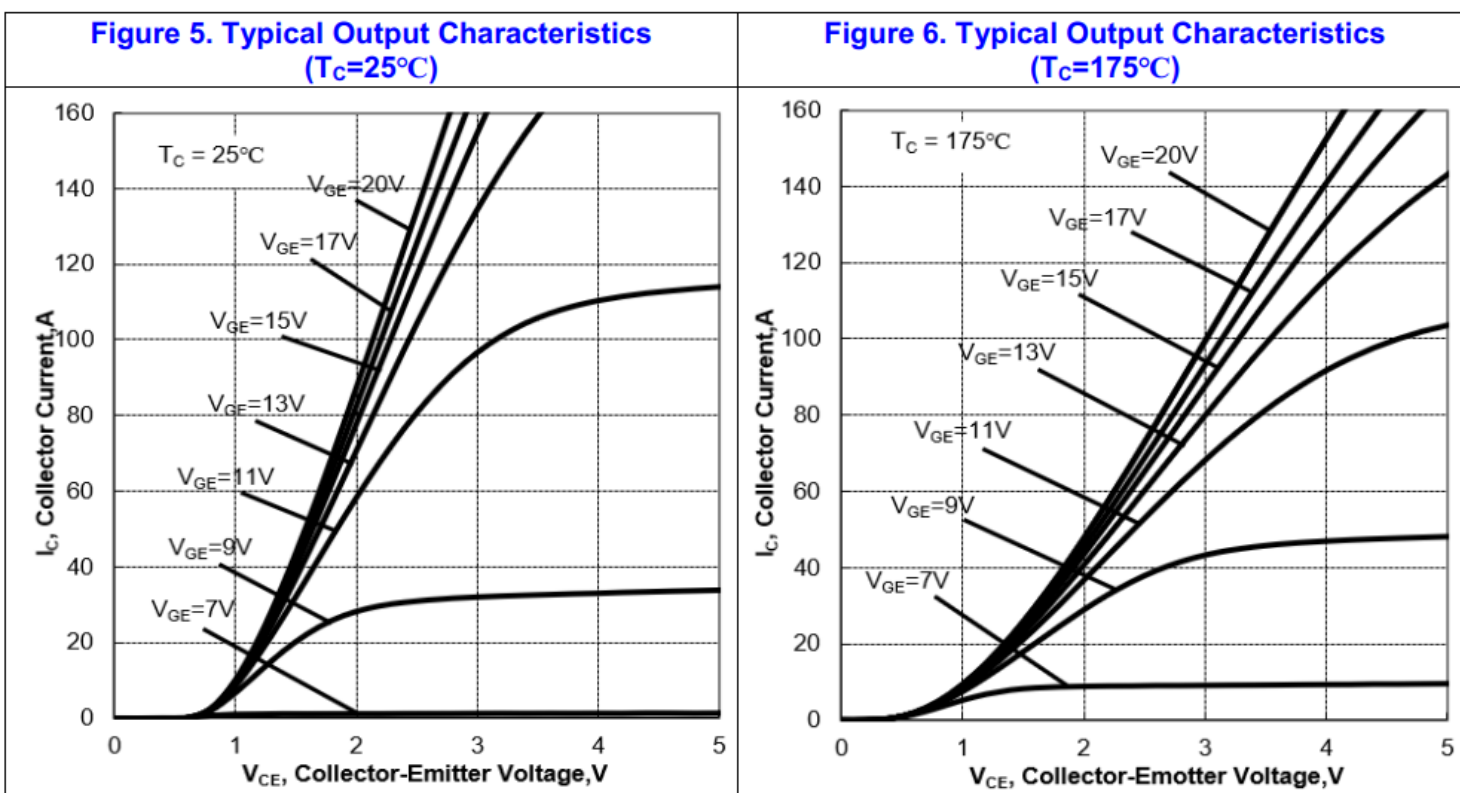
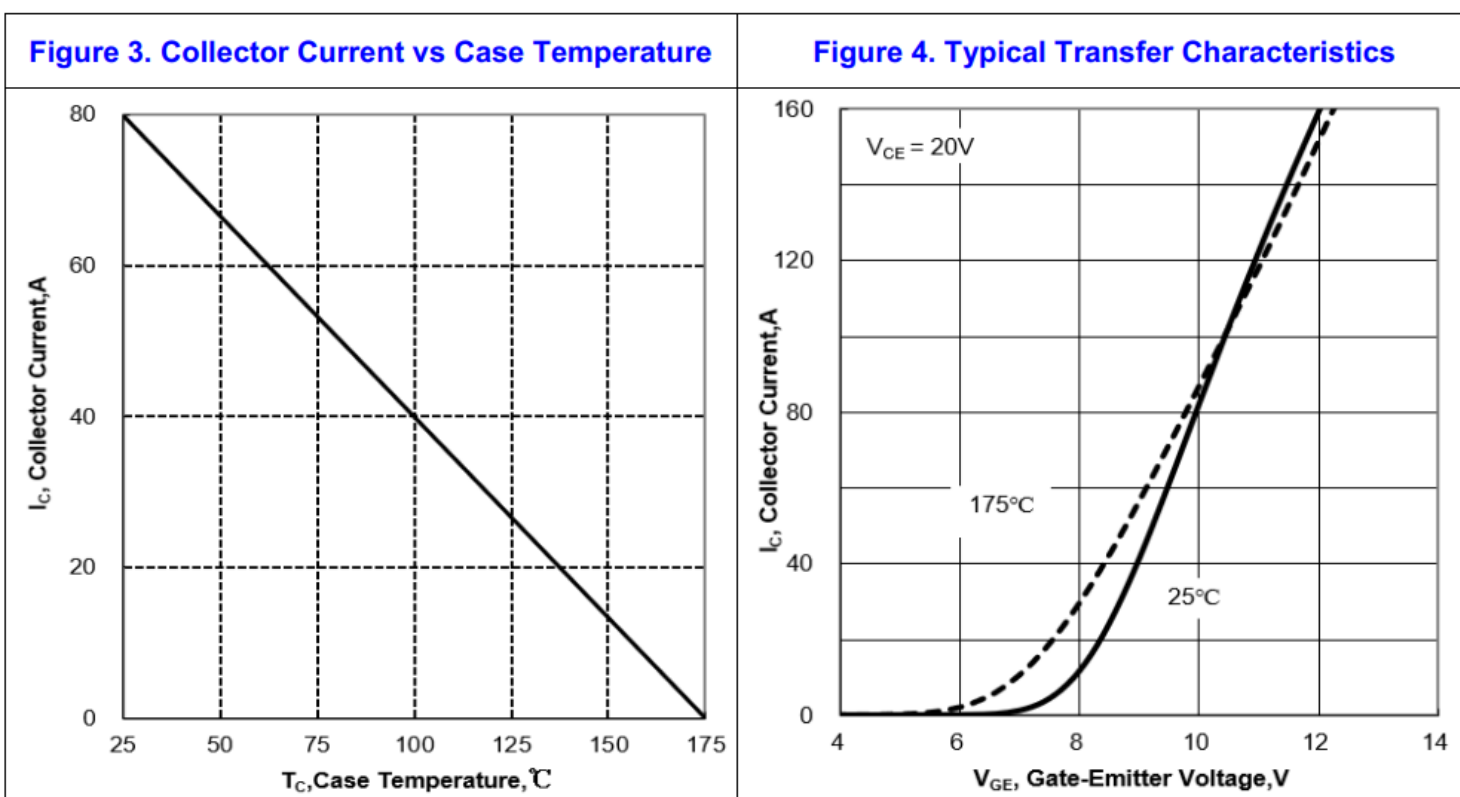
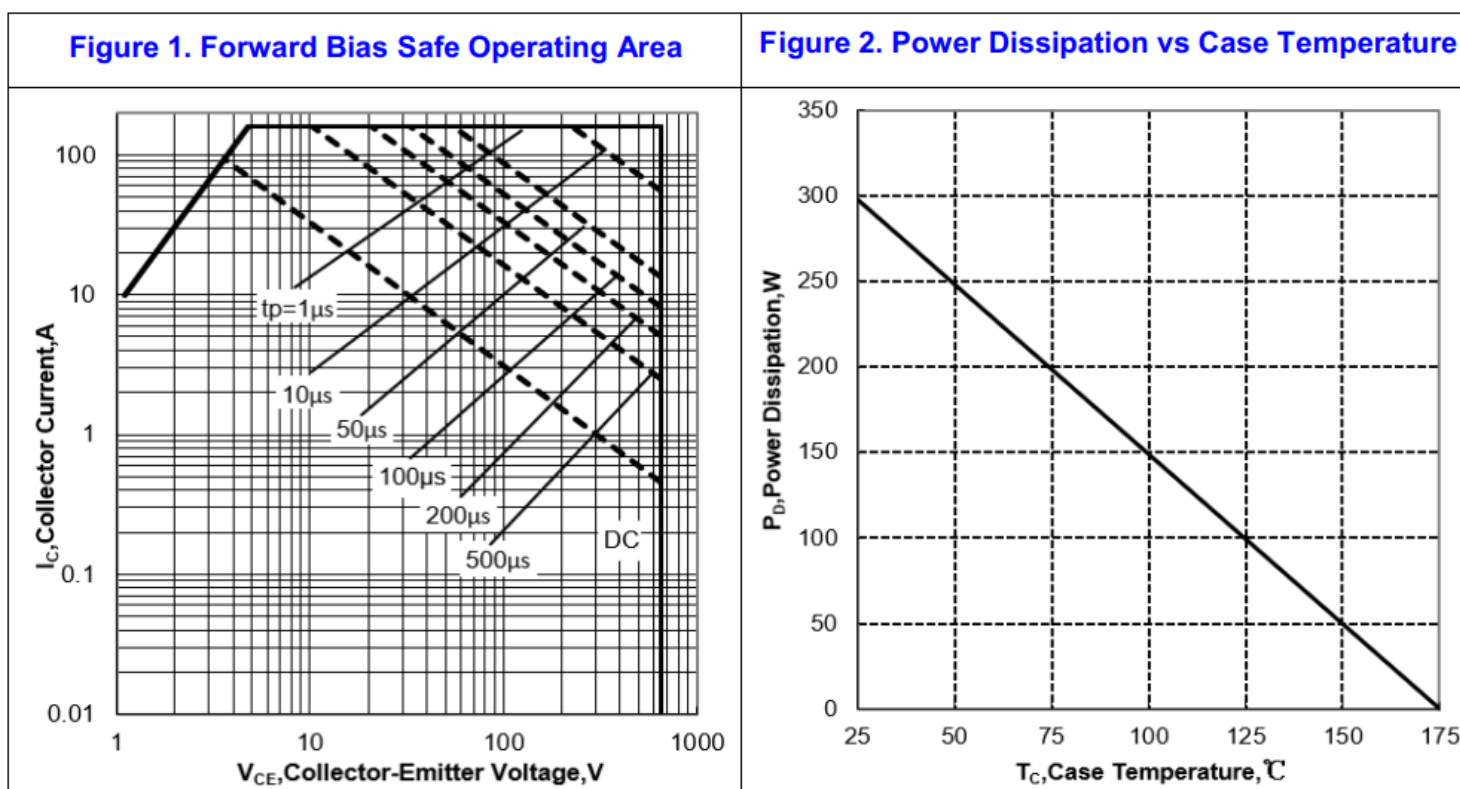
二极管特性 Diode characteristics						
项目 Parameter	符号 Symbol	测试条件 Tests conditions	最小 Min	典型 Typ	最大 Max	单位 Units
正向压降 Diode Forward Voltage	V_{FM}	$I_F=40A$	-	2.0	2.5	V
反向恢复时间 Reverse recovery time	trr	$I_F=20A,$ $dI/dt=200A/\mu s,$ $T_J=25^\circ C$	-	97	-	ns
反向恢复电流 Reverse recovery current	Irr		-	1.8	-	A
反向恢复电荷 Reverse recovery charge	Qrr		-	109	-	nC
反向恢复时间 Reverse recovery time	trr	$I_F=40A,$ $dI/dt=200A/\mu s,$ $T_J=25^\circ C$	-	127	-	ns
反向恢复电流 Reverse recovery current	Irr		-	4.8	-	A
反向恢复电荷 Reverse recovery charge	Qrr		-	326	-	nC
反向恢复时间 Reverse recovery time	trr	$I_F=20A,$ $dI/dt=200A/\mu s,$ $T_J=175^\circ C$	-	147	-	ns
反向恢复电流 Reverse recovery current	Irr		-	7.8	-	A
反向恢复电荷 Reverse recovery charge	Qrr		-	742	-	nC
反向恢复时间 Reverse recovery time	trr	$I_F=40A,$ $dI/dt=200A/\mu s,$ $T_J=175^\circ C$	-	158	-	ns
反向恢复电流 Reverse recovery current	Irr		-	9	-	A
反向恢复电荷 Reverse recovery charge	Qrr		-	870	-	nC

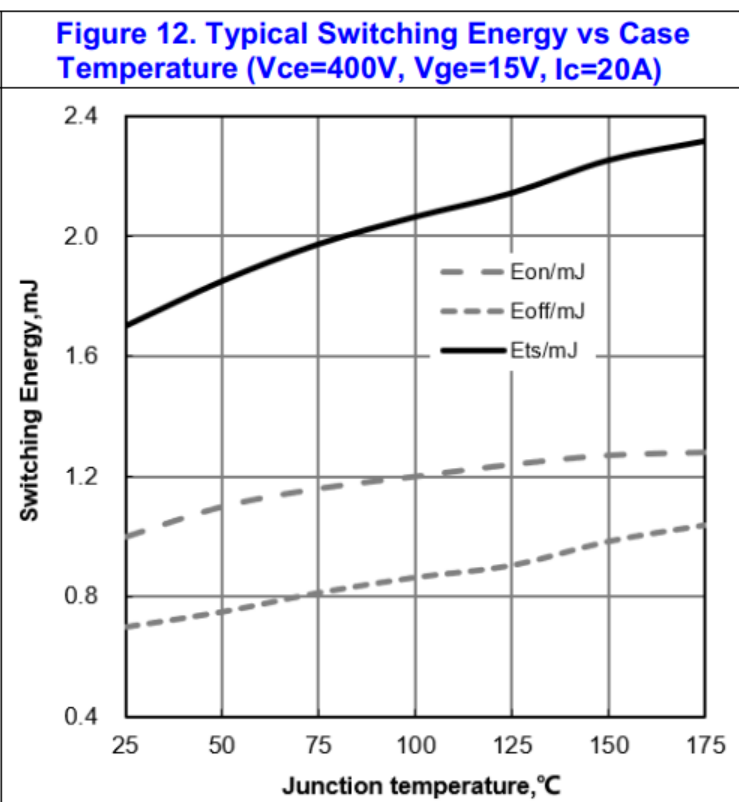
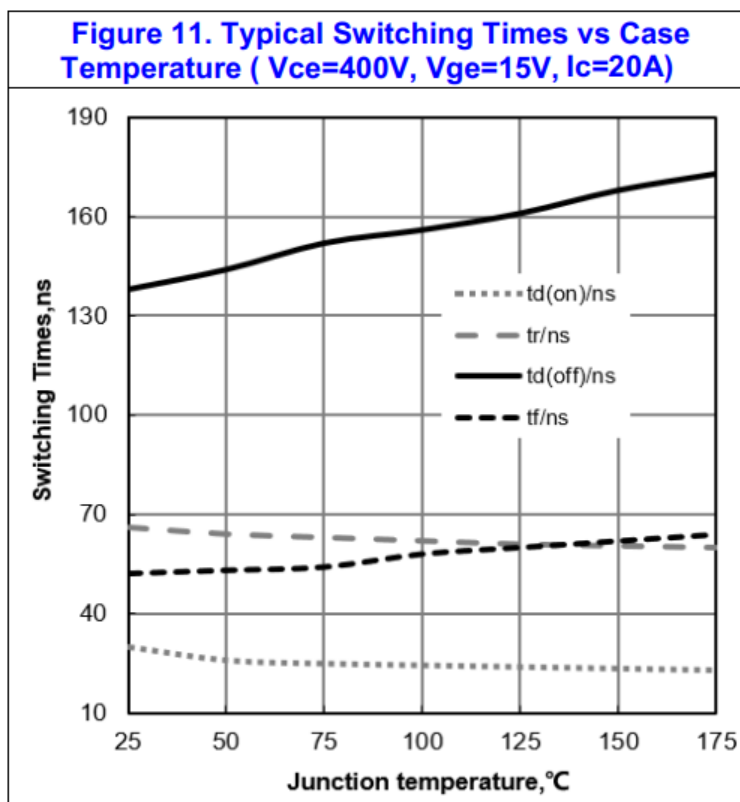
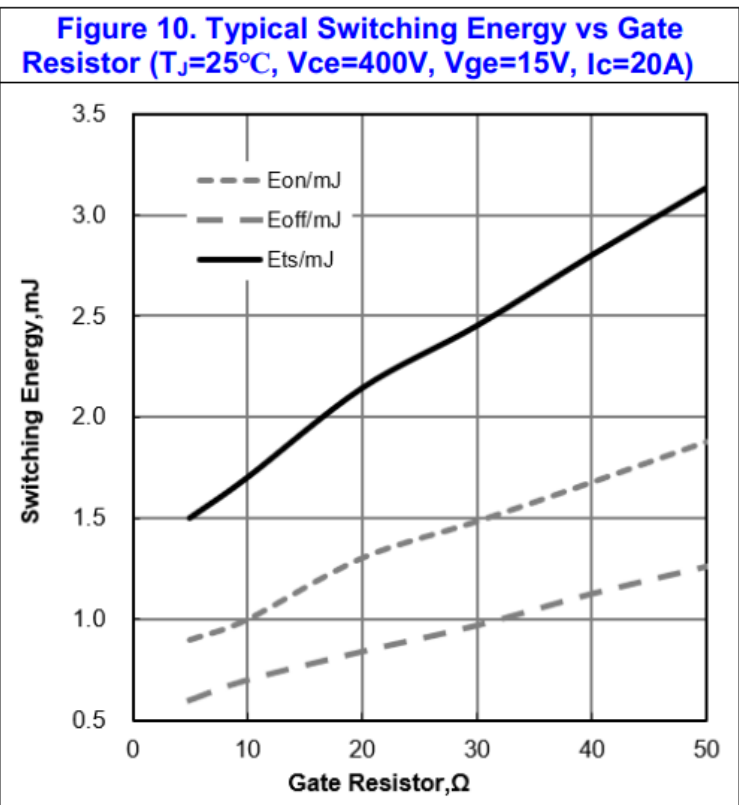
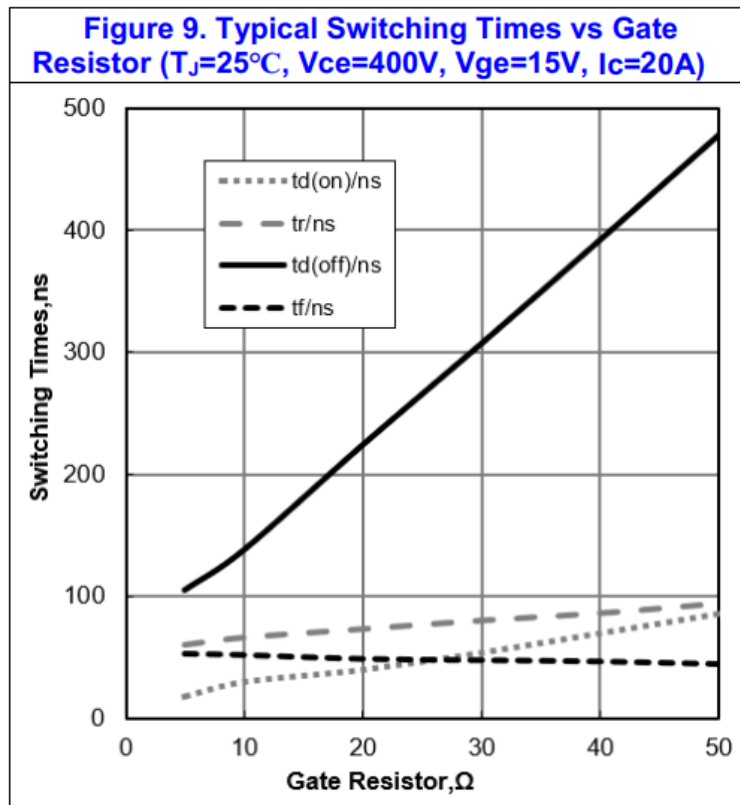
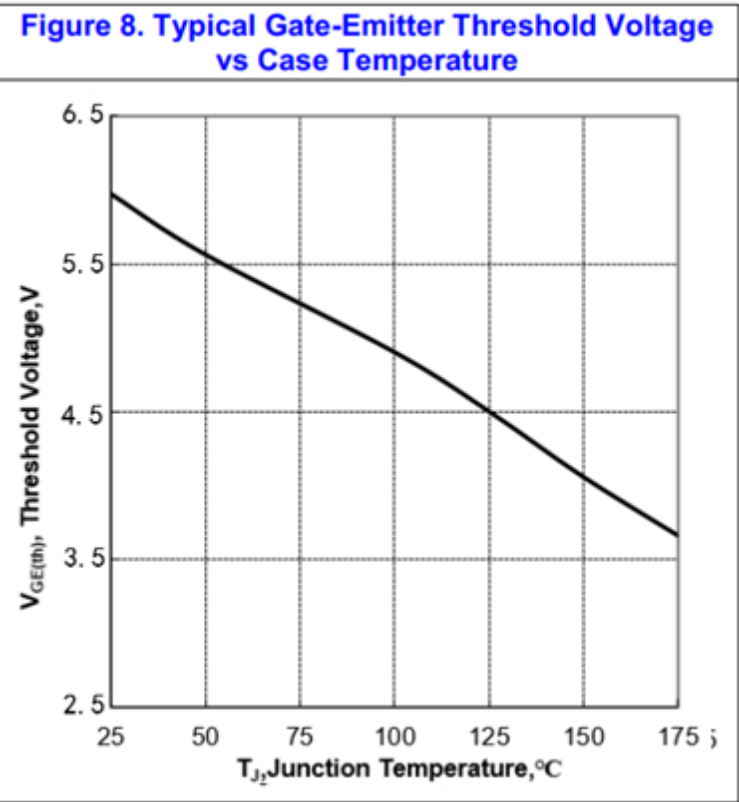
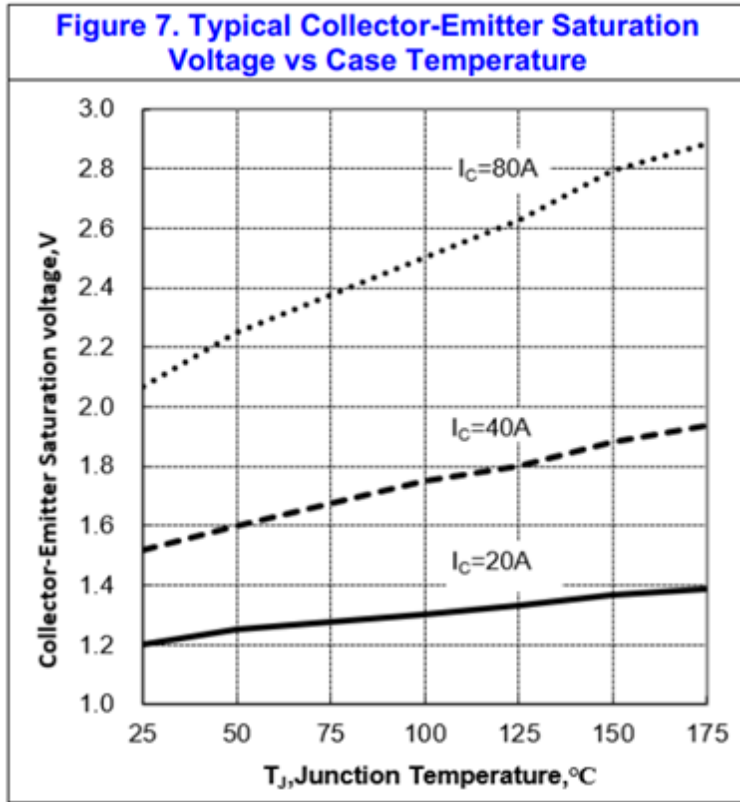
热特性 THERMAL CHARACTERISTIC

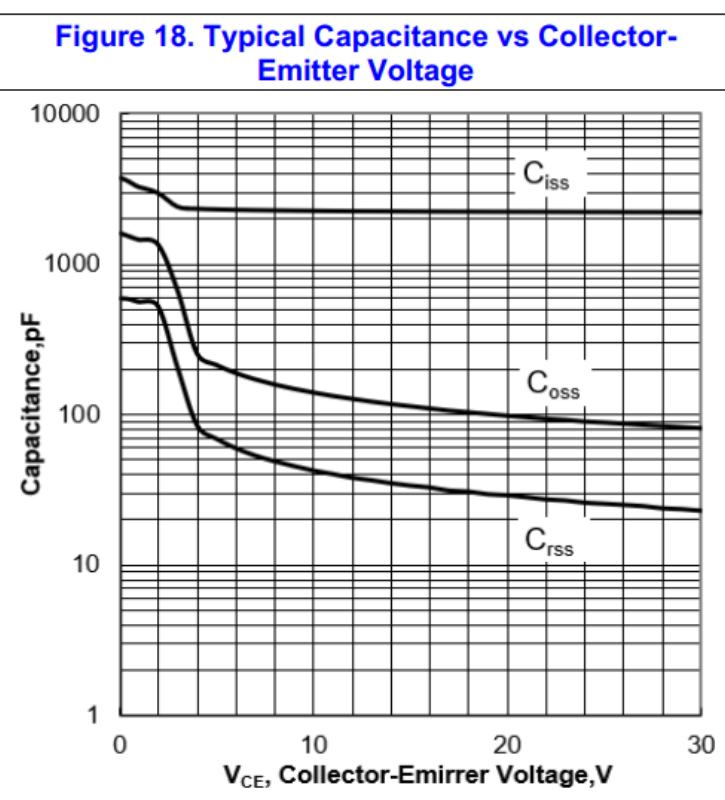
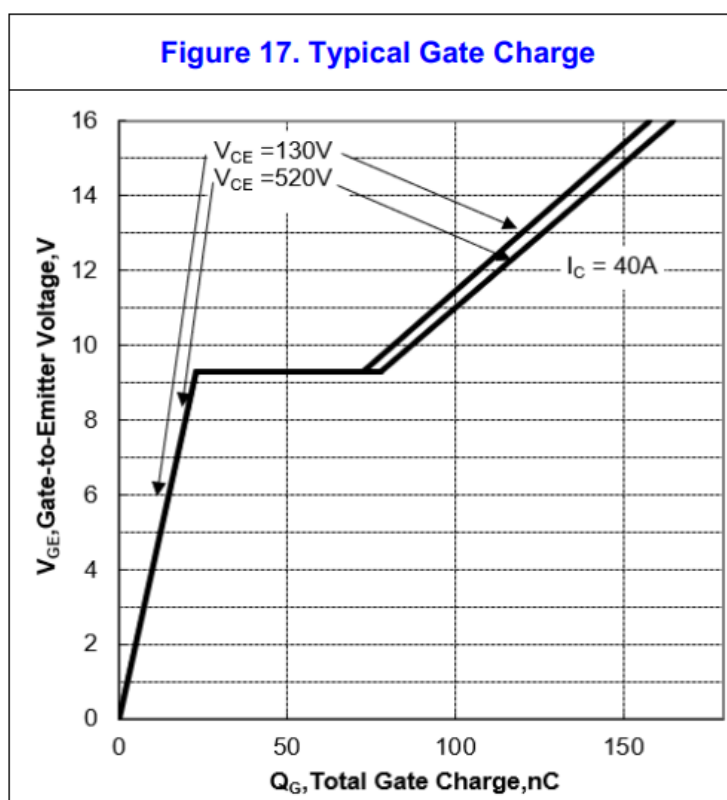
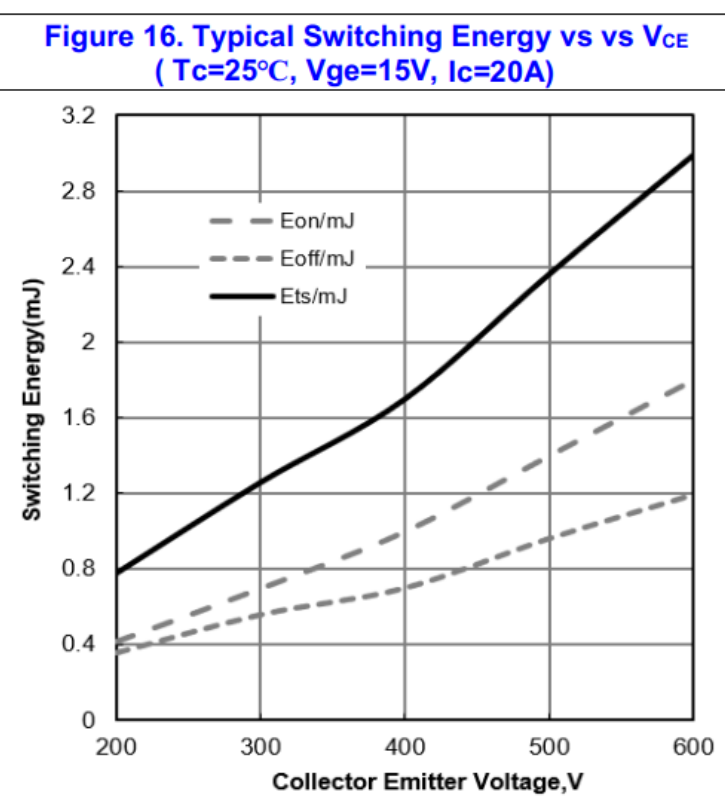
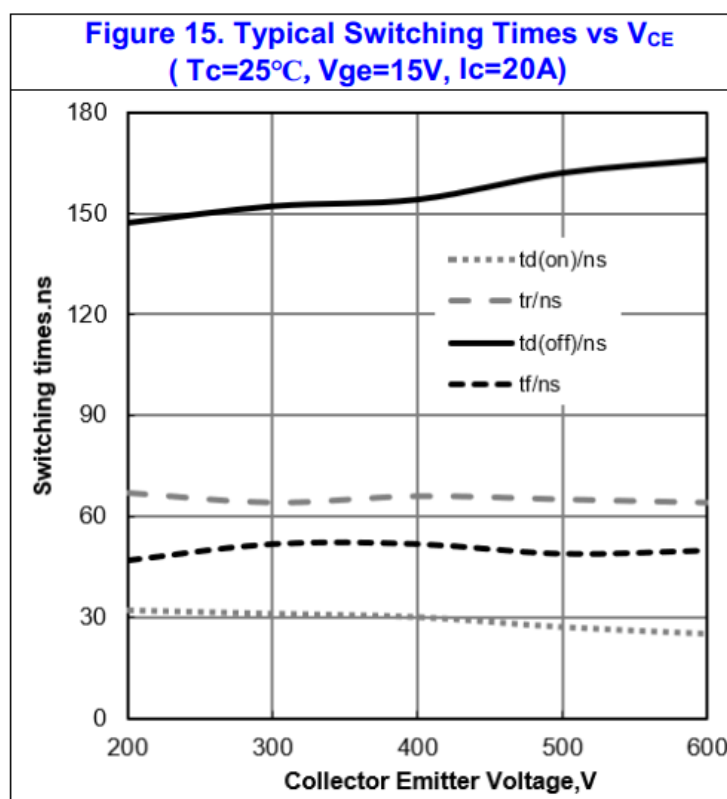
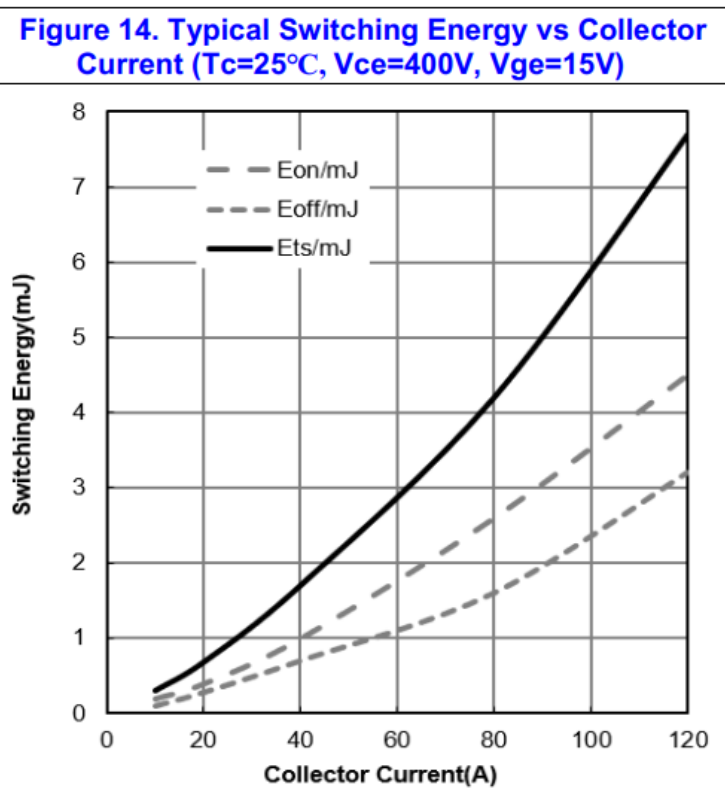
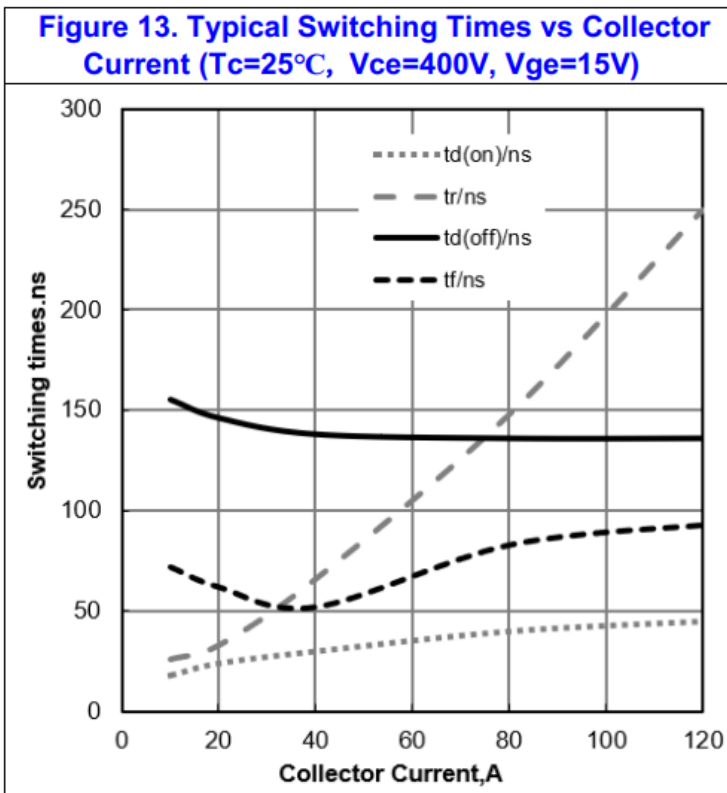
项目 Parameter	符号 Symbol	数值 Value	单位 Unit
结到管壳的热阻 (IGBT) Thermal Resistance, Junction to Case (IGBT)	Rth(j-c)	0.5	$^\circ C/W$
结到管壳的热阻 (Diode) Thermal Resistance, Junction to Case (Diode)	Rth(j-c)	0.8	$^\circ C/W$
结到环境的热阻 Thermal Resistance, Junction to Ambient	Rth(j-A)	40	$^\circ C/W$

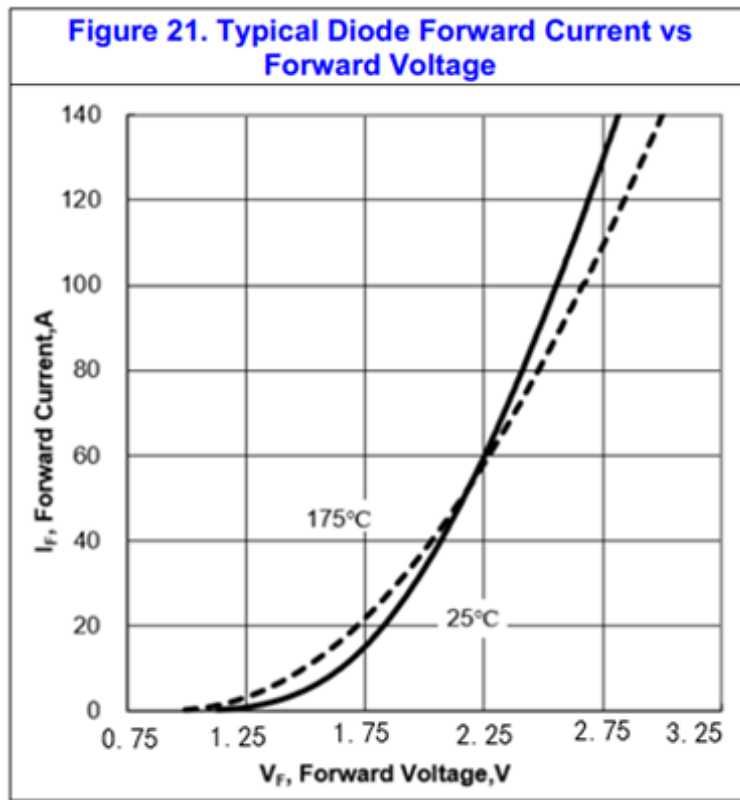
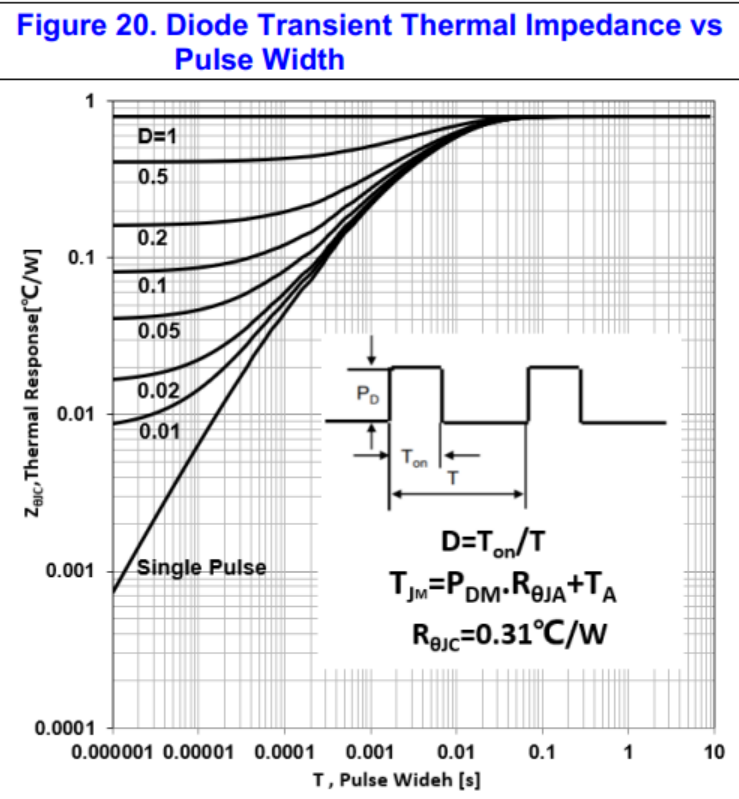
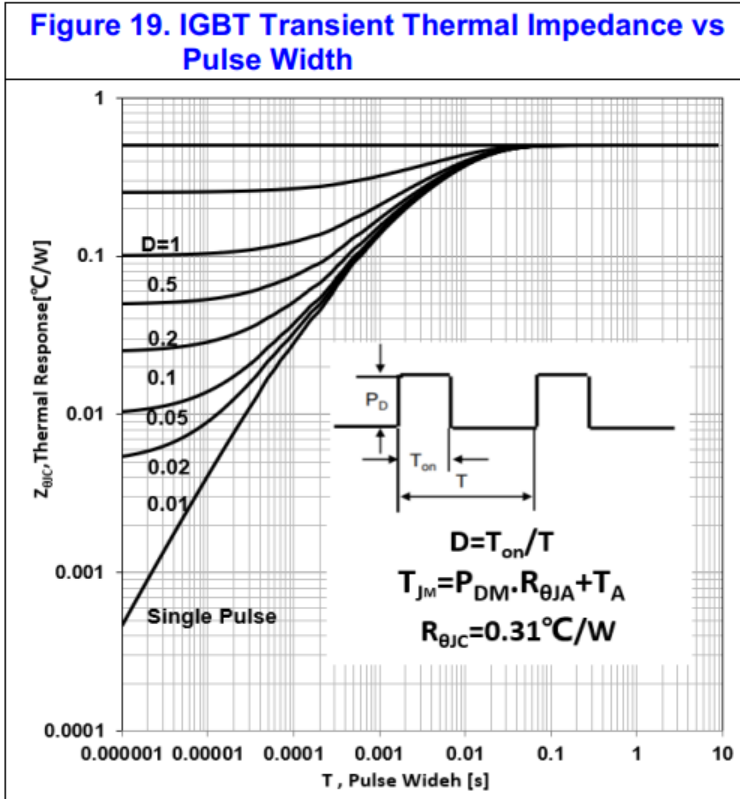
特性曲线

(ELECTRICAL CHARACTERISTICS (curves))

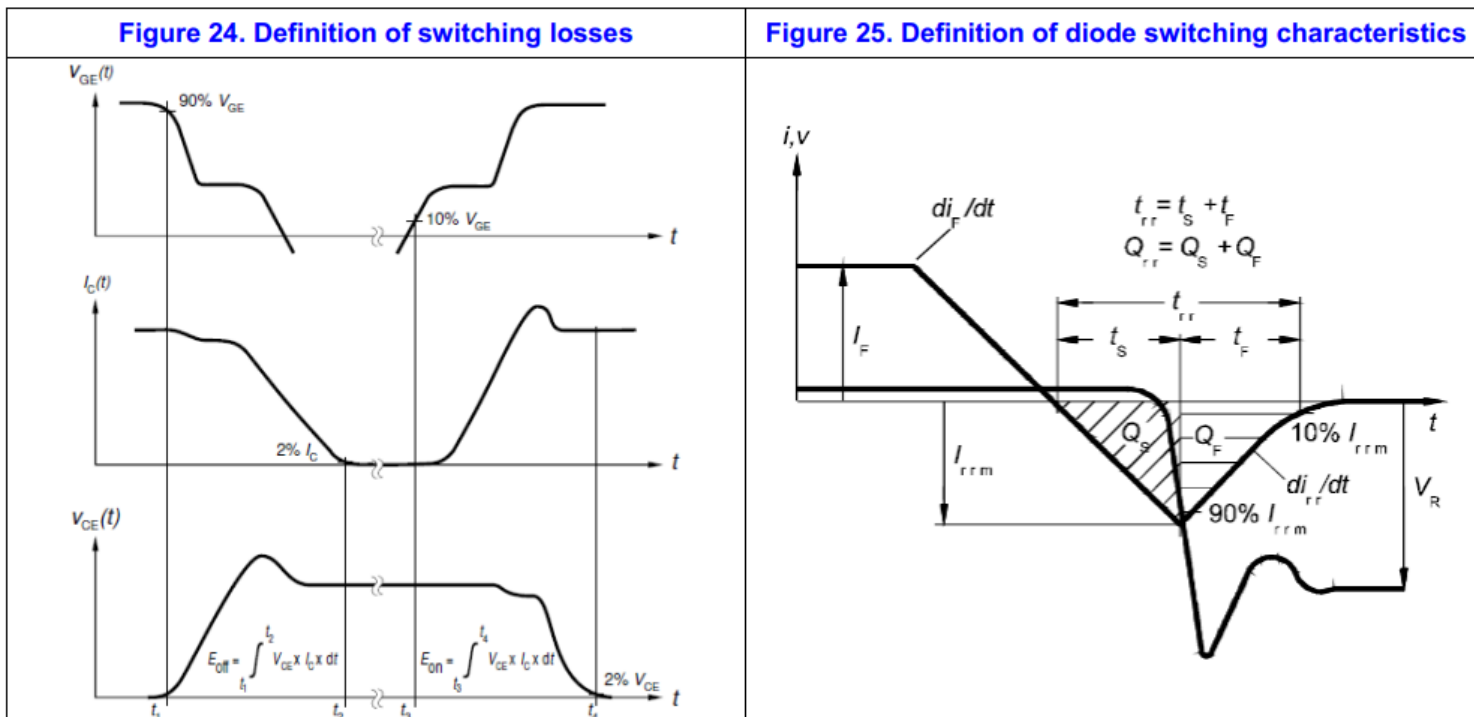
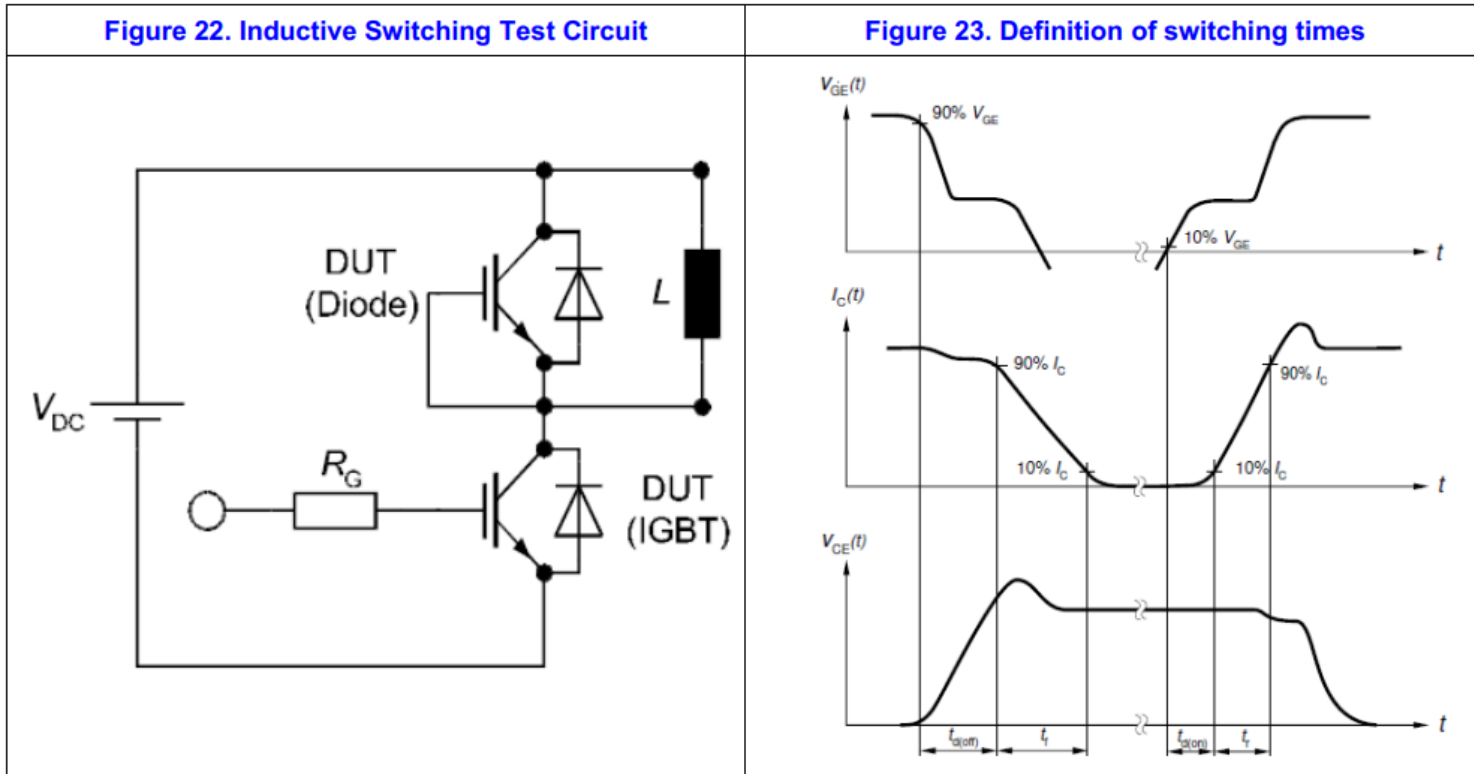




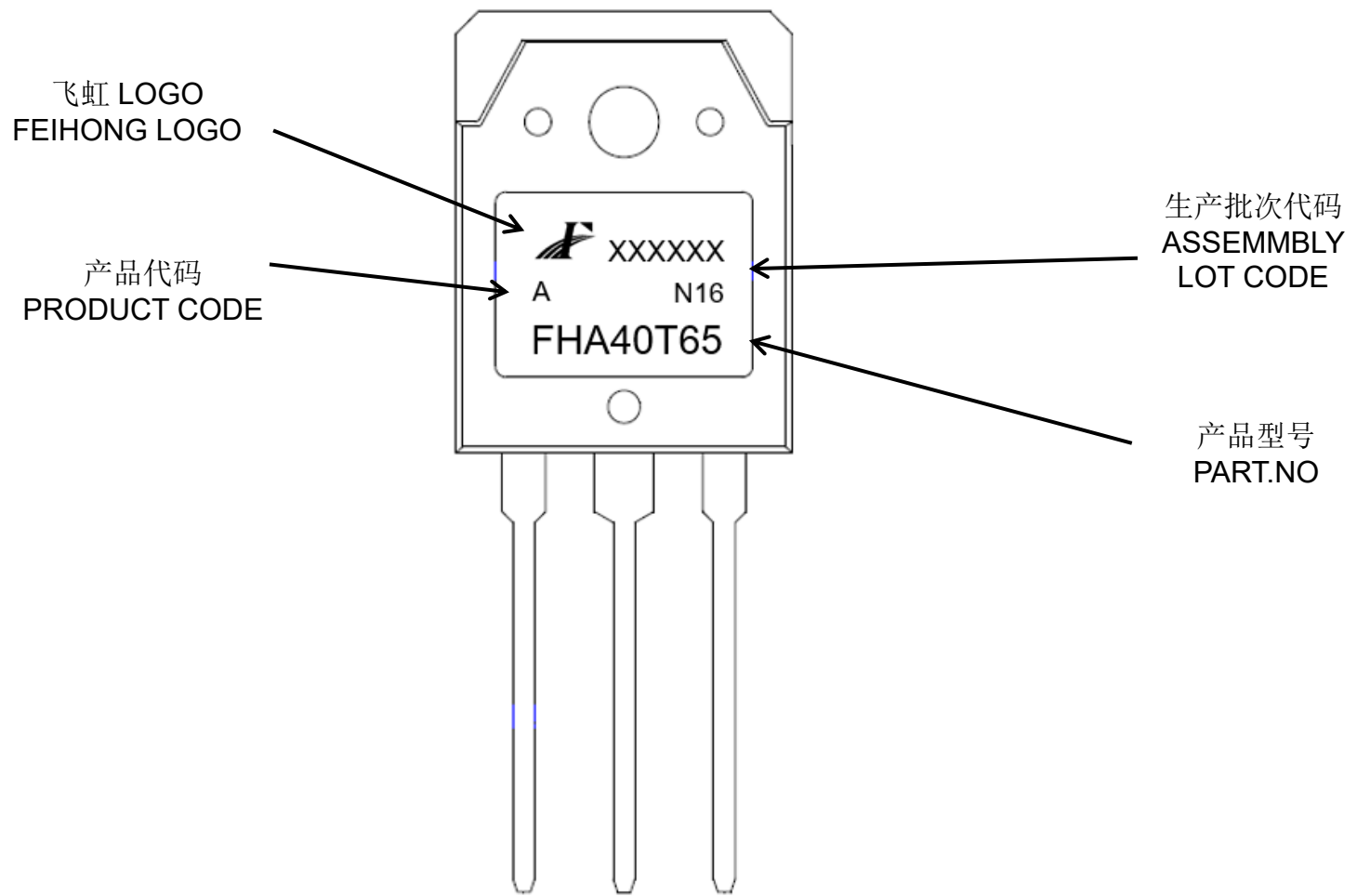




Test Circuit and Waveform



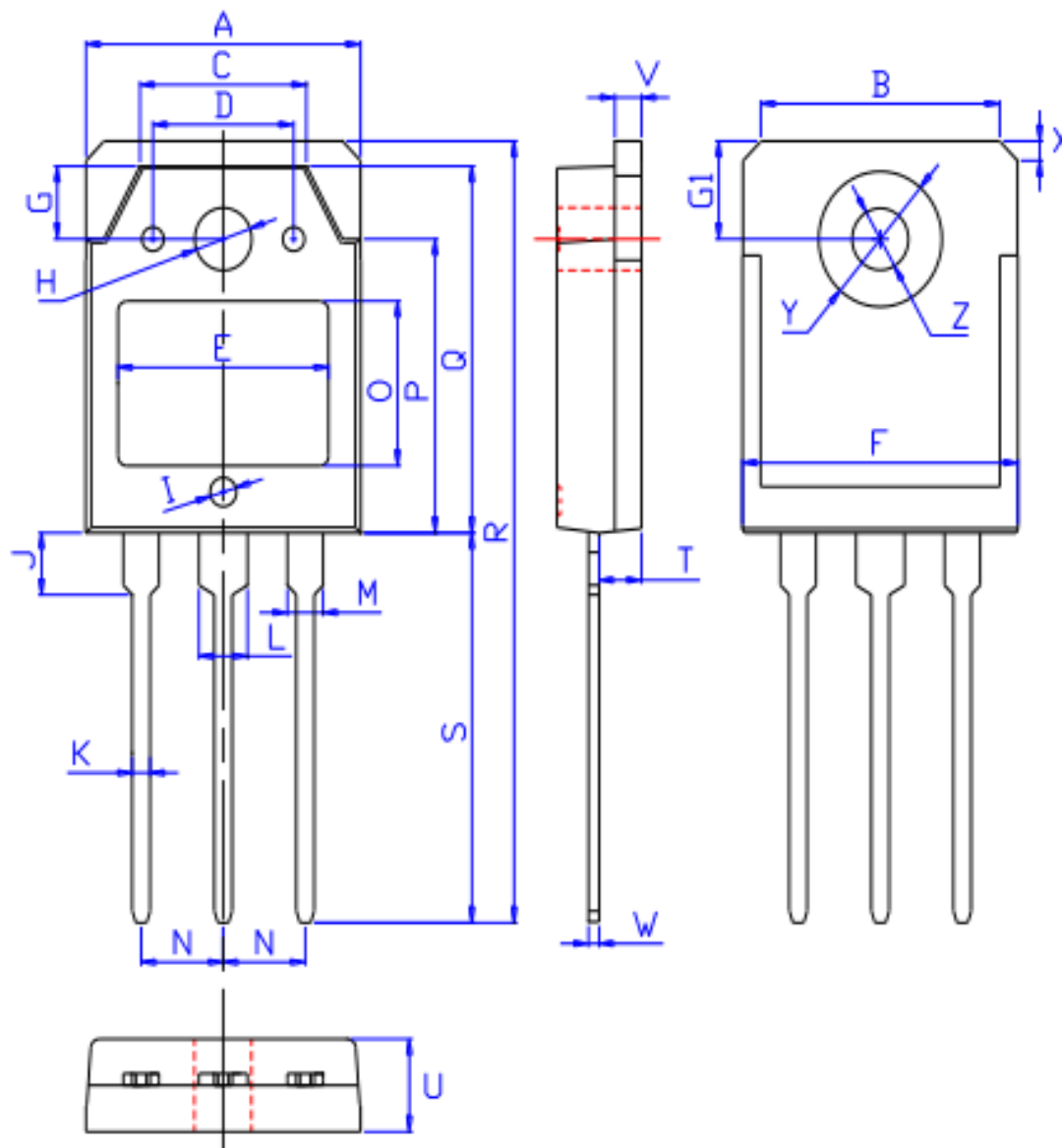
印记 Marking:



外形尺寸:

Package Dimension:

TO-3PN



DIM	MILLIMETERS
A	15.60±0.30
B	13.60±0.30
C	9.50±0.30
D	8.00±0.30
E	11.85±0.30
F	15.65±0.30
G	3.80±0.30
G1	5.00±0.30
H	φ 3.50±0.30
I	φ 1.50±0.30 深 0.15±0.15
J	3.20±0.30
K	1.00±0.15
L	3.10±0.15
M	2.10±0.15
N	5.45±0.30
O	8.40±0.30
P	13.90±0.30
Q	18.70±0.30
R	40.00±0.60
S	20.00±0.40
T	2.40±0.30
U	4.80±0.30
V	1.50±0.15
W	0.60±0.15
X	1.80±0.40
Y	7.00±0.30
Z	3.20±0.30

(Units: mm)