

TP060U060EQ

N-CHANNEL IGBT

Package

MAIN CHARACTERISTICS

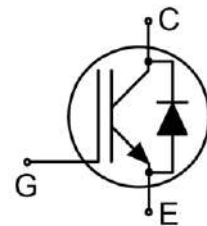
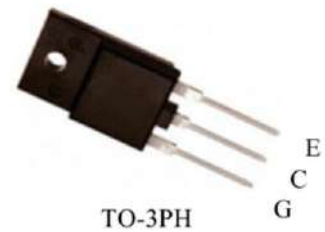
I_C	60 A
V_{CES}	600V
$V_{cesat-typ}(V_{ge}=15V)$	1.9V

APPLICATIONS

- Welding converters
- Power Factor Correction
- Air Condition

FEATURES

- Low gate charge
- Trench FS Technology,
- RoHS product



ORDER MESSAGE

Order codes				Marking	Package
Halogen-Tube	Halogen-Free-Tube	Halogen-Reel	Halogen-Free-Reel		
TP060U060EQ-GA-B	TP060U060EQ-GA-BR	N/A	N/A	060U060EQ	TO-3PH
TP060U060EQ-GE-B	TP060U060EQ-GE-BR	N/A	N/A	060U060EQ	TO-247

ABSOLUTE RATINGS (T_c=25°C)

Parameter	Symbol	Value		Unit
		TO-247	TO-3PH	
Collector-Emmitter Voltage	V _{ces}	600	600	V
Collector Current-continuous	I _C T=25°C	120	120	A
	I _C T=100°C	60	60	A
Collector Current – pulse (note 1)	I _{CM}	200	200	A
Diode RMS forward current	I _F T=25°C	80	80	A
	I _F T=100°C	40	40	A
Diode pulse current	I _{FSM}	160	160	A
Gate-Emmitter Voltage	V _{GES}	±20	±20	V
Transient Gate-Emmitter Voltage(t _p ≤10us)	V _{GES}	±30	±30	V
Turn-off safe area	-	200	200	A
Power Dissipation	P _D T _C =25°C	454	136	W
Operating and Storage Temperature Range	T _J , T _{STG}	-55~+175		°C
Maximum Lead Temperature for Soldering Purposes	T _L	300		°C

*Collector current limited by maximum junction temperature

Notes:

1: Pulse width limited by maximum junction temperature

ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Tests conditions	Min	Typ	Max	Units
Off –Characteristics						
Collector-Emmitter Voltage	BV_{CES}	$I_C=250\mu A, \quad V_{GE}=0V$	600	-	-	V
Zero Gate Voltage Collector Current	I_{CES}	$V_{CE}=600V, \quad V_{GE}=0V$	-	-	25	μA
Gate-body leakage current, forward	I_{GESF}	$V_{CE}=0V, \quad V_{GE} =20V$	-	-	200	nA
Gate-body leakage current, reverse	I_{GESR}	$V_{CE}=0V, \quad V_{GE} =-20V$	-	-	-200	nA
On-Characteristics						
Gate Threshold Voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, \quad I_C=250\mu A$	4.0	-	6.0	V
Collector-Emmitter saturation Voltage	V_{CESAT}	$V_{GE}=15V, \quad I_C=60A, \quad T_C=25^{\circ}C$	-	1.9	2.5	V
		$V_{GE}=15V, \quad I_C=60A, T_C=175^{\circ}C$	-	2.2	-	V
Dynamic Characteristics						
Input capacitance	C_{ies}	$V_{CE}=25V, \quad V_{GE}=0V, \quad f=1.0MHz$	-	3510	-	pF
Output capacitance	C_{oes}		-	244	-	pF
Reverse transfer capacitance	C_{res}		-	81	-	pF
Total Gate Charge	Q_g	$V_{CC}=480V, \quad I_c=60A, \quad V_{GE}=15V \quad T_C=25^{\circ}C$	-	132	-	nC
Gate to emitter charge	Q_{ge}		-	33	-	
Gate to collector charge	Q_{gc}		-	55	-	

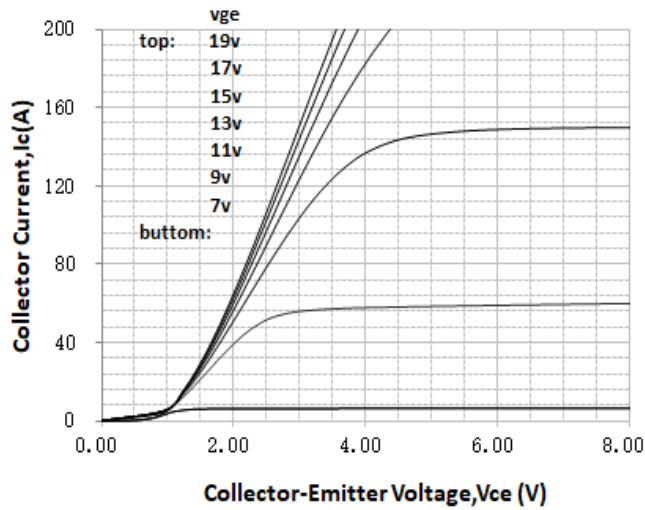
Parameter	Symbol	MAX		Unit
		TO-247	TO-3PH	
Thermal Resistance, Junction to Case IGBT	$R_{th(j-c)}$	0.33	1.1	$^\circ C/W$
Thermal Resistance, Junction to Ambient	$R_{th(j-A)}$	40	40	$^\circ C/W$

ELECTRICAL CHARACTERISTICS

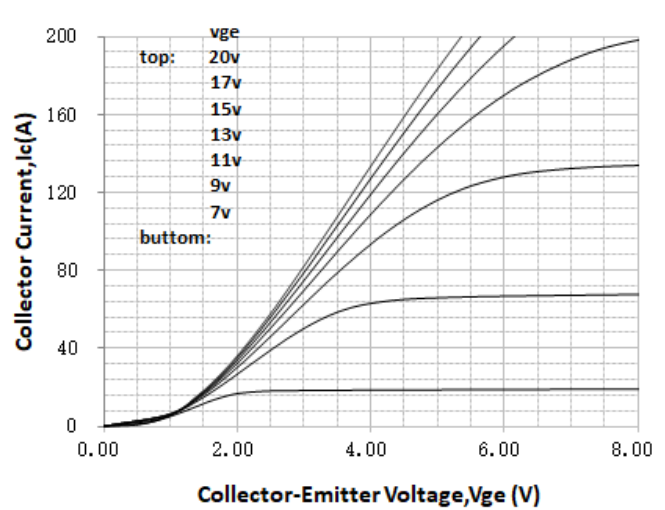
Switching Characteristics						
Parameter	Symbol	Tests conditions	Min	Typ	Max	Units
Turn-On delay time	t _{d(on)}	V _{CC} =400V,I _c =60A,R _G =10Ω V _{GE} =15 V, T _C =25℃	-	36	-	ns
Turn-On rise time	t _r		-	96	-	ns
Turn-Off delay time	t _{d(off)}		-	101	-	ns
Turn-Off Fall time	t _f		-	55	-	ns
Turn-On energy	E _{on}		-	1.65	-	mJ
Turn-off energy	E _{off}		-	1.14	-	mJ
Total switching energy	E _{tot}		-	2.79	-	mJ
Turn-On delay time	t _{d(on)}	V _{CC} =400V,I _c =60A,R _G =10Ω V _{GE} =15 V, T _C =175℃	-	33	-	ns
Turn-On rise time	t _r		-	108	-	ns
Turn-Off delay time	t _{d(off)}		-	130	-	ns
Turn-Off Fall time	t _f		-	105	-	ns
Turn-On energy	E _{on}		-	1.9	-	mJ
Turn-off energy	E _{off}		-	1.55	-	mJ
Total switching energy	E _{tot}		-	3.45	-	mJ
Anti-Parallel Diode Characteristics and Maximum Ratings						
Drain-Source Diode Forward Voltage	V _F	V _{GE} =0V, I _F =30A,T _C =25℃	-	1.7	2.1	V
		V _{GE} =0V, I _F =30A,T _C =175℃	-	1.5	-	V
Diode Reverse recovery time	t _{rr}	V _{GE} =0V, V _R =400V, I _F =30A dI _F /dt=200A/μs T _C =25℃	-	40	-	ns
Diode Reverse recovery charge	Q _{rr}		-	26.4	-	nC
Diode Reverse recovery Current	I _{R_{RRM}}		-	1.16	-	A
Diode Reverse recovery time	t _{rr}	V _{GE} =0V, V _R =400V, I _F =30A dI _F /dt=200A/μs T _C =175℃	-	184	-	ns
Diode Reverse recovery charge	Q _{rr}		-	386	-	nC
Diode Reverse recovery Current	I _{R_{RRM}}		-	3.8	-	A

ELECTRICAL CHARACTERISTICS (curves)

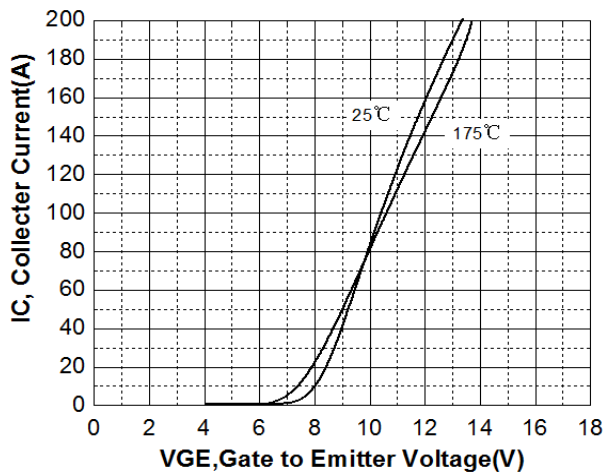
Output Characteristics (25°C)



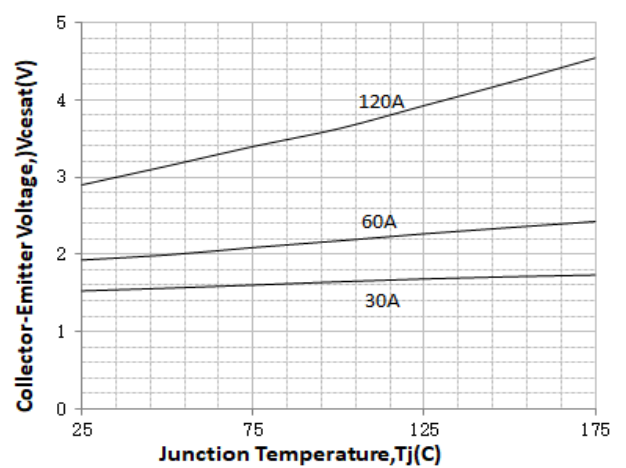
Output Characteristics (175°C)



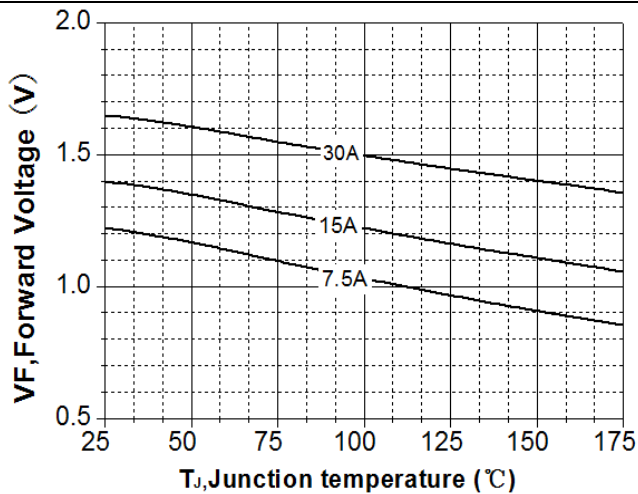
Transfer Characteristics



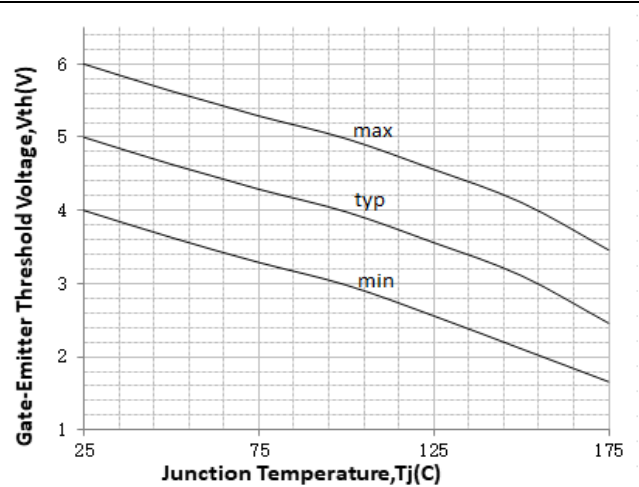
Vcesat vs. Tj



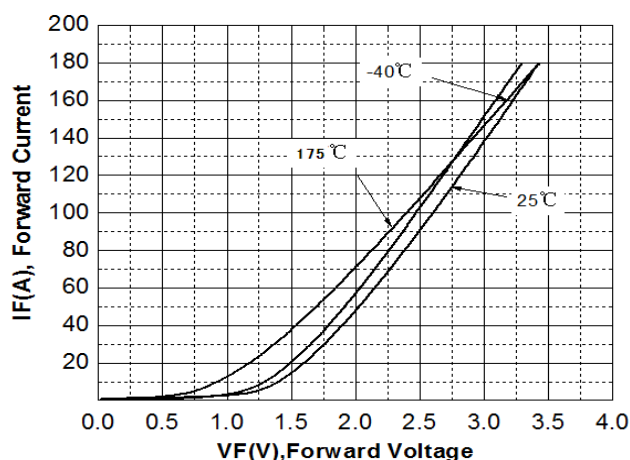
VF vs. Tj



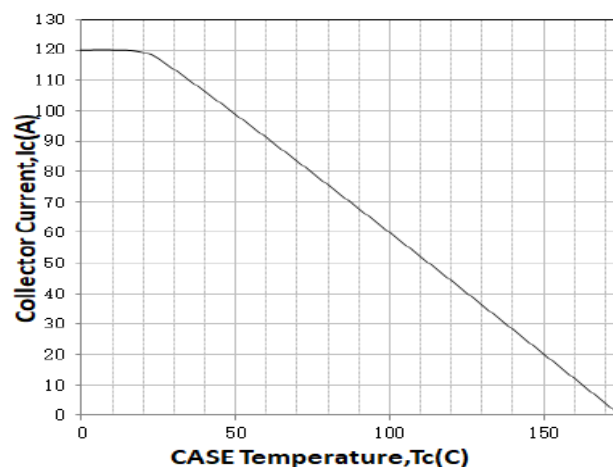
VTH vs. Tj



Diode Characteristic

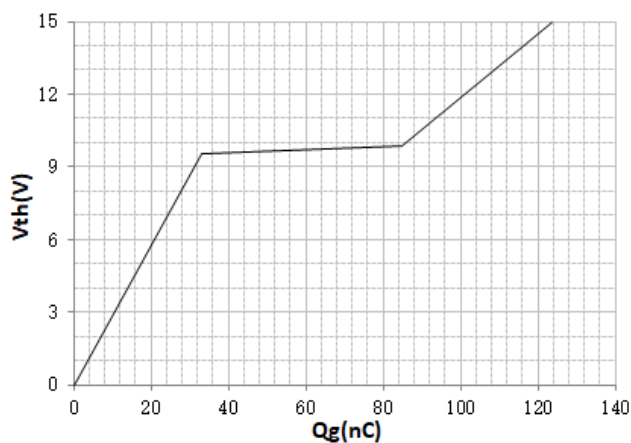


Collector current vs.case temperature



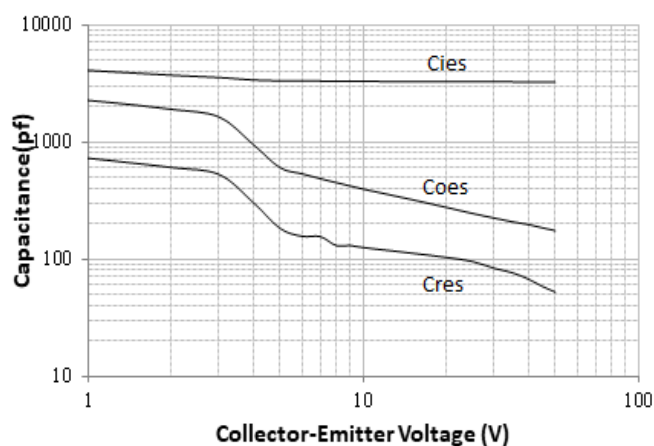
Gate Charge Characteristics

$V_{GE}=15\text{V}$, $V_{CC}=480\text{V}$, $I_C=60\text{A}$



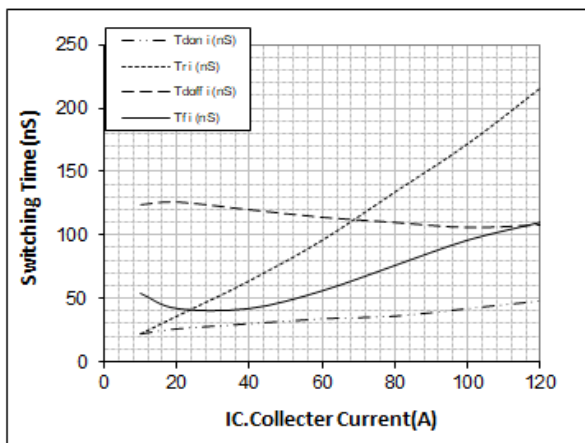
Capacitance Characteristic

$V_{GE}=0\text{V}$, $f=1.0\text{MHz}$



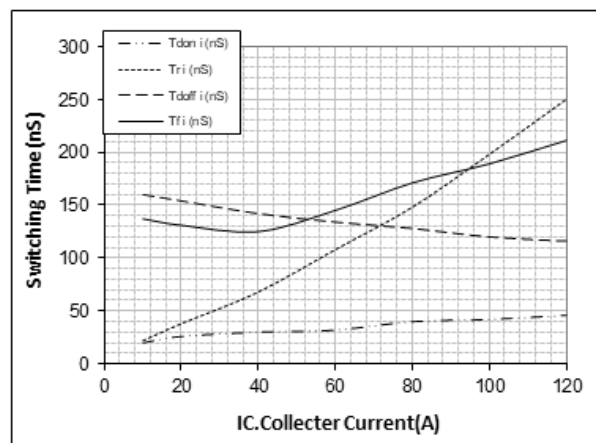
Switching Time vs. $I_C(25^\circ\text{C})$

$V_{CE}=400\text{V}$, $V_{GE}=15\text{V}$, $R_G=10\Omega$



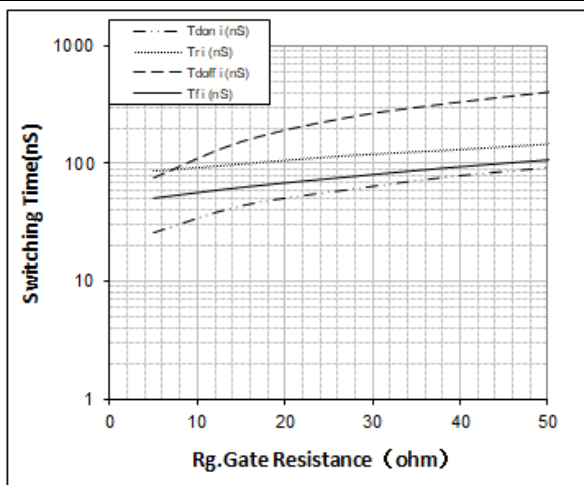
Switching Time vs. $I_C(175^\circ\text{C})$

$V_{CE}=400\text{V}$, $V_{GE}=15\text{V}$, $R_G=10\Omega$



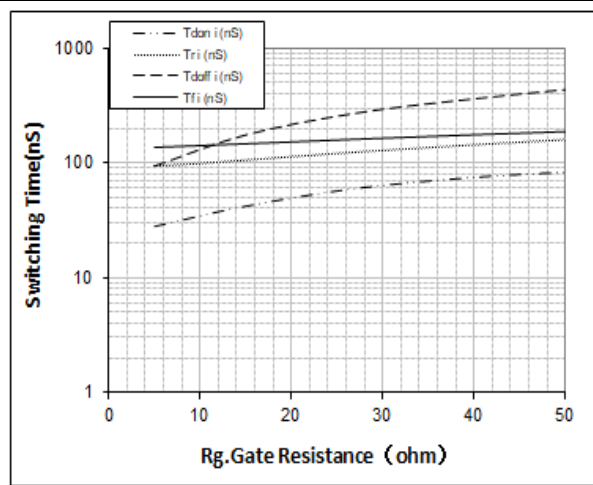
Switching Time vs. Rg(25°C)

VGE=15V, VCE=400V, IC=60A



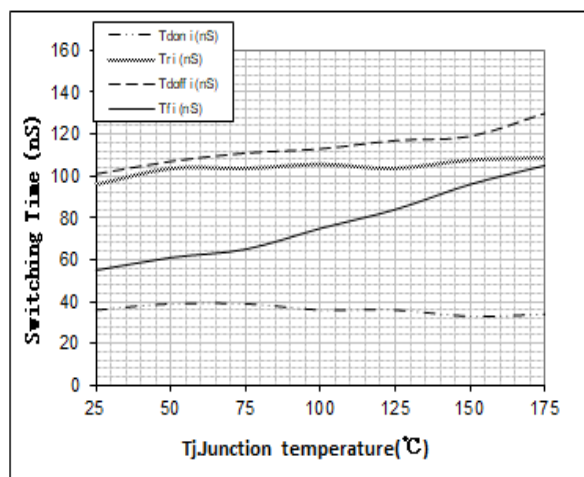
Switching Time vs. Rg(175°C)

VGE=15V, VCE=400V, IC=60A



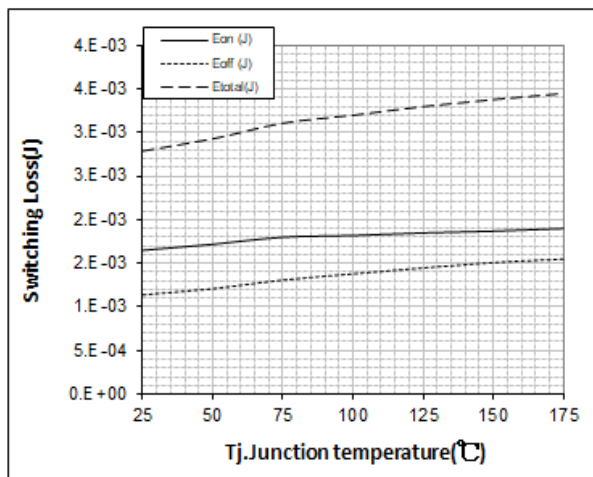
Switching Time vs. Tj

VGE=15V, VCE=400V, IC=60A, Rg=10Ω



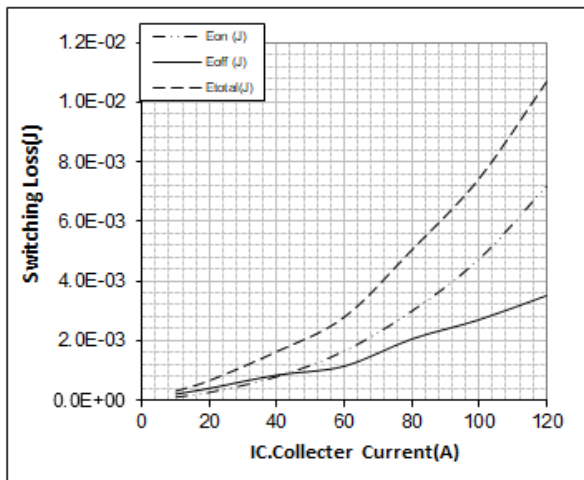
Switching Loss vs. Tj

VGE=15V, VCE=400V, IC=60A, Rg=10Ω



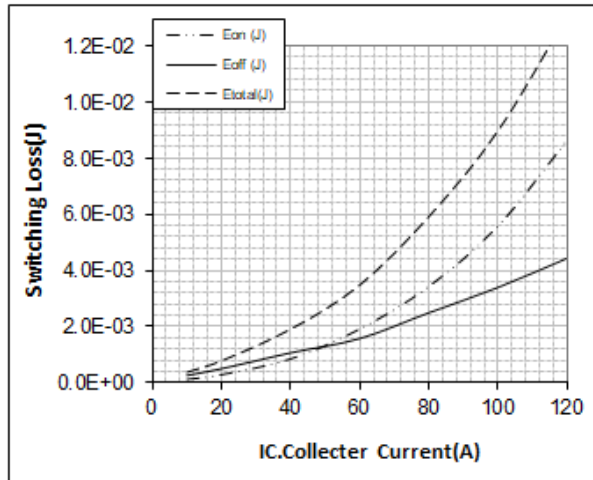
Switching Loss vs. IC(25°C)

VGE=15V, VCE=400V, Rg=10Ω



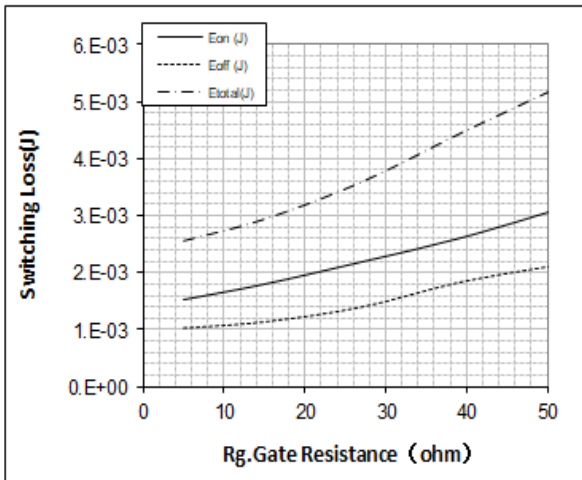
Switching Loss vs. IC(175°C)

VGE=15V, VCE=400V, Rg=10Ω



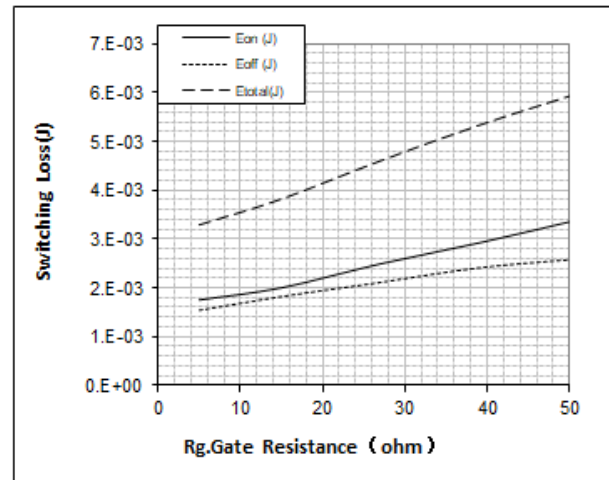
Switching Loss vs. Rg(25°C)

VGE=15V, VCE=400V, IC=60A

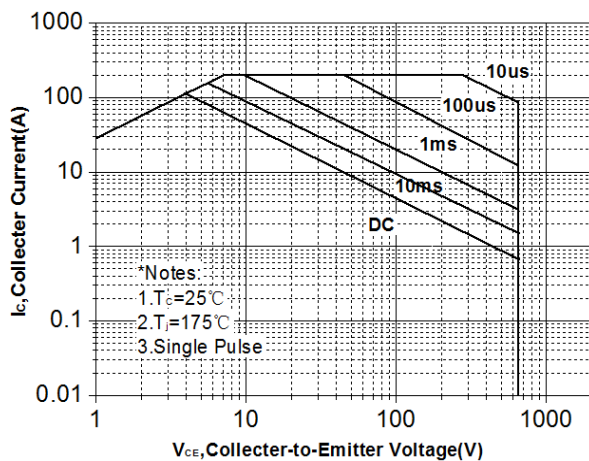


Switching Loss vs. Rg(175°C)

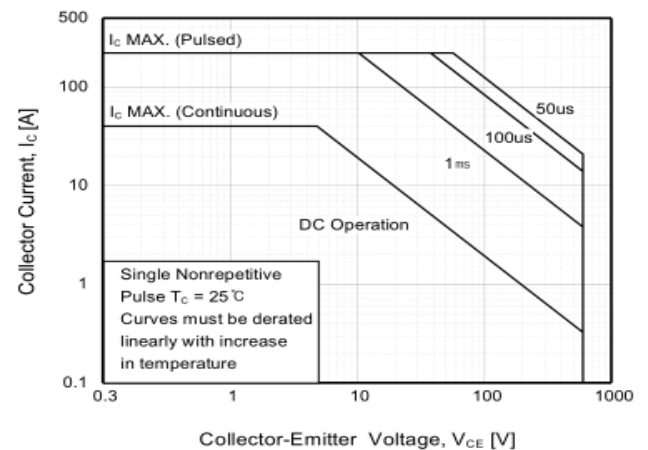
VGE=15V, VCE=400V, IC=60A



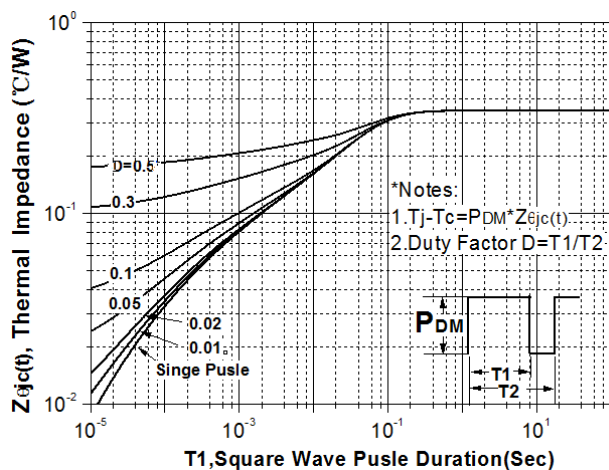
Forward Bias SOA(TO-247)



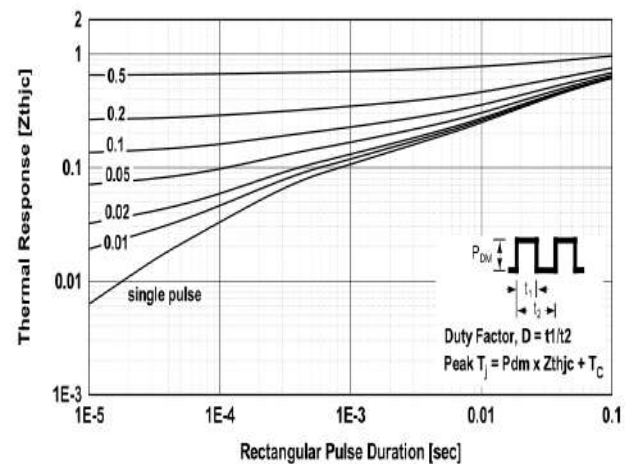
Forward Bias SOA(TO-3PH)



Normalized Maximum Transient Thermal Impedance for IGBT(RJC) TO-247



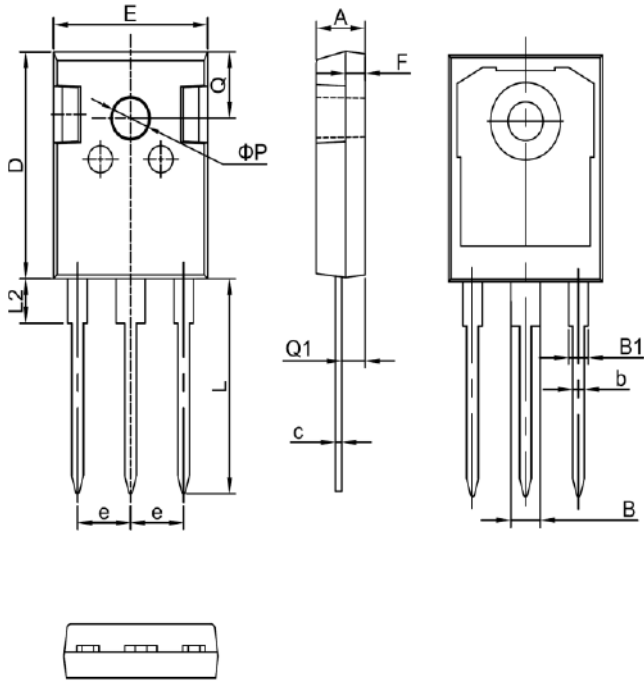
Normalized Maximum Transient Thermal Impedance for IGBT(RJC) TO-3PH



PACKAGE MECHANICAL DATA

Unit : mm

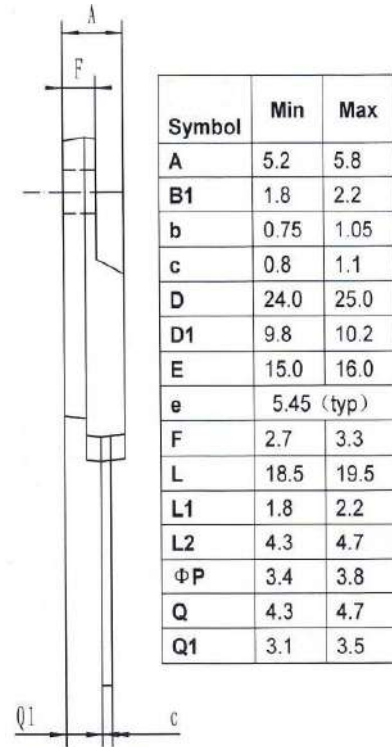
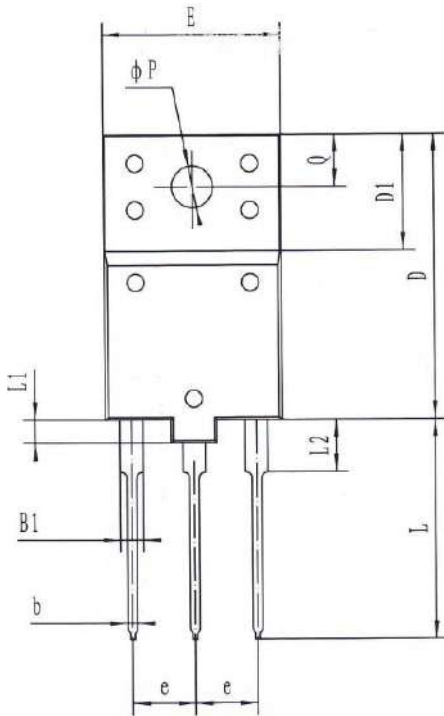
TO-247



symbol	MIN	MAX
A	4.90	5.10
B	2.95	3.35
B1	1.95	2.35
b	1.15	1.35
c	0.50	0.70
D	20.90	21.10
E	15.70	15.90
e	5.34	5.54
F	1.90	2.10
L	19.40	20.40
L2	4.03	4.23
Q	6.00	6.40
Q1	2.30	2.50
P	3.50	3.70

PACKAGE MECHANICAL DATA

TO-3PH



Symbol	Min	Max
A	5.2	5.8
B1	1.8	2.2
b	0.75	1.05
c	0.8	1.1
D	24.0	25.0
D1	9.8	10.2
E	15.0	16.0
e	5.45 (typ)	
F	2.7	3.3
L	18.5	19.5
L1	1.8	2.2
L2	4.3	4.7
ΦP	3.4	3.8
Q	4.3	4.7
Q1	3.1	3.5