



August 2005

FMS6G20US60 Compact & Complex Module

Features

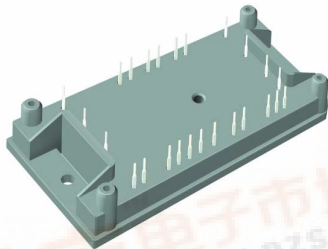
- Short Circuit Rated 10 μ s @ T_C = 100°C, V_{GE} = 15V
- High Speed Switching
- Low Saturation Voltage : V_{CE(sat)} = 2.1 V @ I_C = 20A
- High Input Impedance
- Built-in 3 Phase Rectifier Circuit
- Fast & Soft Anti-Parallel FWD
- Built-in NTC Thermistor

Application

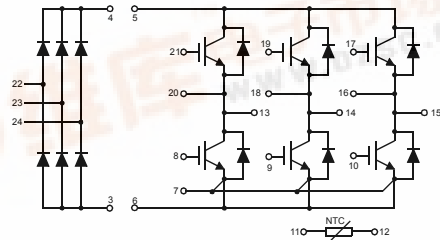
- AC & DC Motor Controls
- General Purpose Inverters
- Robotics
- Servo Controls

Description

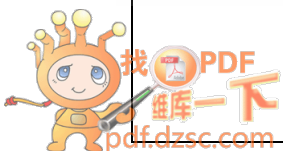
Fairchild IGBT Power Module provides low conduction and switching losses as well as short circuit ruggedness. It's designed for the applications such as motor control and general inverters where short-circuit ruggedness is required.



Package Code : 25PM-AA



Internal Circuit Diagram



Absolute Maximum Ratings T_C = 25°C unless otherwise noted

	Symbol	Description	FMS6G20US60	Units
Inverter	V _{CES}	Collector-Emitter Voltage	600	V
	V _{GES}	Gate-Emitter Voltage	± 20	V
	I _C	Collector Current @ T _C = 80°C	20	A
	I _{CM(1)}	Pulsed Collector Current	40	A
	I _F	Diode Continuous Forward Current @ T _C = 80°C	20	A
	I _{FM}	Diode Maximum Forward Current	40	A
	P _D	Maximum Power Dissipation @ T _C = 25°C	89	W
	T _{SC}	Short Circuit Withstand Time @ T _C = 100°C	10	µs
Converter	V _{RRM}	Repetitive Peak Reverse Voltage	1600	V
	I _O	Average Output Rectified Current	20	A
	I _{FSM}	Surge Forward Current @ 1Cycle at 60Hz, Peak value Non-Repetitive	200	A
	I ² t	Energy pulse @ 1Cycle at 60Hz	164	A ² s
Common	T _J	Operating Junction Temperature	-40 to +150	°C
	T _{STG}	Storage Temperature Range	-40 to +125	°C
	V _{ISO}	Isolation Voltage @ AC 1minute	2500	V
Mounting Torque		Mounting part Screw @ M4	2.0	N·m

Notes :

(1) Repetitive rating : Pulse width limited by max. junction temperature

Package Marking and Ordering Information

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FMS6G20US60	FMS6G20US60	25PM-AA	--	--	--

(2) TMC2 Reliability test was done under -45°C ~ 125°C

Electrical Characteristics of IGBT @ Inverter $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
Off Characteristics						
BV_{CES}	Collector-Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	600	--	--	V
$\frac{\Delta BV_{CES}}{\Delta T_J}$	Temperature Coeff. of Breakdown Voltage	$V_{GE} = 0V, I_C = 1mA$	--	0.6	--	V/ $^\circ\text{C}$
I_{CES}	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0V$	--	--	250	μA
I_{GES}	Gate - Emitter Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	--	--	± 100	nA
On Characteristics						
$V_{GE(th)}$	Gate - Emitter Threshold Voltage	$I_C = 20mA, V_{CE} = V_{GE}$	5.0	6.5	8.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 20A, V_{GE} = 15V$	--	2.1	2.7	V
Dynamic Characteristics						
C_{ies}	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V,$ $f = 1MHz$	--	1277	--	pF
C_{oes}	Output Capacitance		--	98	--	pF
C_{res}	Reverse Transfer Capacitance		--	21	--	pF
Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 20A,$ $R_G = 10\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 25^\circ\text{C}$	--	65	130	ns
t_r	Rise Time		--	100	200	ns
$t_{d(off)}$	Turn-Off Delay Time		--	80	160	ns
t_f	Fall Time		--	100	200	ns
E_{on}	Turn-On Switching Loss		--	0.45	--	mJ
E_{off}	Turn-Off Switching Loss		--	0.42	--	mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 20A,$ $R_G = 10\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 125^\circ\text{C}$	--	70	140	ns
t_r	Rise Time		--	100	200	ns
$t_{d(off)}$	Turn-Off Delay Time		--	110	220	ns
t_f	Fall Time		--	210	350	ns
E_{on}	Turn-On Switching Loss		--	0.5	--	mJ
E_{off}	Turn-Off Switching Loss		--	0.72	--	mJ
T_{sc}	Short Circuit Withstand Time	$V_{CC} = 300V, V_{GE} = 15V$ @ $T_C = 100^\circ\text{C}$	10	--	--	μs
Q_g	Total Gate Charge	$V_{CE} = 300V, I_C = 20A,$ $V_{GE} = 15V$	--	55	65	nC
Q_{ge}	Gate-Emitter Charge		--	10	15	nC
Q_{gc}	Gate-Collector Charge		--	20	30	nC

Electrical Characteristics of DIODE @ Inverter $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Units
V_{FM}	Diode Forward Voltage	$I_F = 20\text{A}$	$T_C = 25^\circ\text{C}$	--	1.9	2.8	V
			$T_C = 100^\circ\text{C}$	--	2.0	--	
t_{rr}	Diode Reverse Recovery Time	$I_F = 20\text{A}$ $di / dt = 40 \text{ A/us}$	$T_C = 25^\circ\text{C}$	--	75	150	ns
			$T_C = 100^\circ\text{C}$	--	110	--	
I_{rr}	Diode Peak Reverse Recovery Current		$T_C = 25^\circ\text{C}$	--	1.3	2.6	A
			$T_C = 100^\circ\text{C}$	--	1.8	--	
Q_{rr}	Diode Reverse Recovery Charge	$T_C = 25^\circ\text{C}$	--	50	195	nC	
		$T_C = 100^\circ\text{C}$	--	100	--		

Electrical Characteristics of DIODE @ Converter $T_C = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions		Min.	Typ.	Max.	Units
V_{FM}	Diode Forward Voltage	$I_F = 20\text{A}$	$T_C = 25^\circ\text{C}$	--	1.1	1.5	V
			$T_C = 100^\circ\text{C}$	--	1.0	--	
I_{RRM}	Repetitive Reverse Current	$V_R = V_{RRM}$	$T_C = 25^\circ\text{C}$	--	--	8	mA
			$T_C = 100^\circ\text{C}$	--	5	--	

Thermal Characteristics

	Symbol	Parameter	Typ.	Max.	Units
Inverter	$R_{\theta JC}$	Junction-to-Case (IGBT Part, per 1/6 Module)	--	1.4	$^\circ\text{C/W}$
	$R_{\theta JC}$	Junction-to-Case (DIODE Part, per 1/6 Module)	--	2.3	$^\circ\text{C/W}$
Converter	$R_{\theta JC}$	Junction-to-Case (DIODE Part, per 1/6 Module)	--	1.5	$^\circ\text{C/W}$
Weight		Weight of Module	60	--	g

NTC Thermistor Characteristics

	Symbol	Parameter	Tol.	Typ.	Units
Thermistor	R25	Rated Resistance @ $T_c = 25^\circ\text{C}$	+/- 5 %	4.7	$\text{K}\Omega$
	B(25/100)	B - Value	+/- 3 %	3530	

Typical Performance Characteristics

Figure 1. Typical Output Characteristics

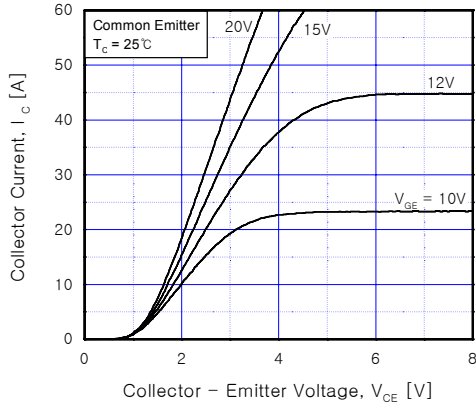


Figure 2. Typical Saturation Voltage Characteristics

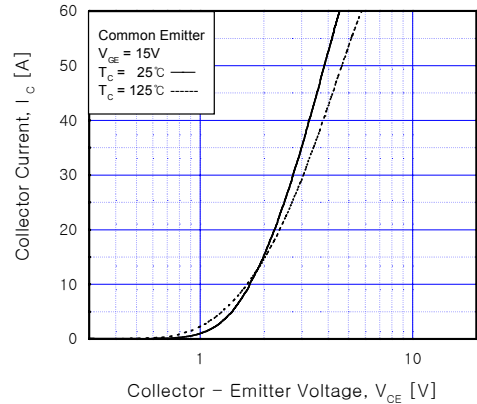


Figure 3. Saturation Voltage vs. Case Temperature at Variant Current Level

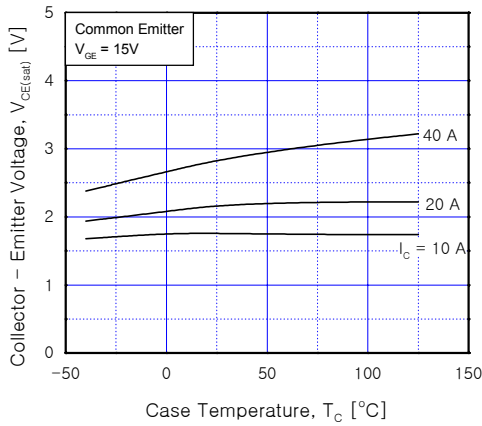


Figure 4. Transient Thermal Impedance

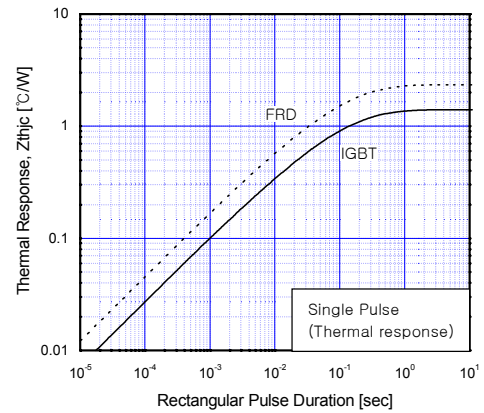


Figure 5. Saturation Voltage vs. V_GE

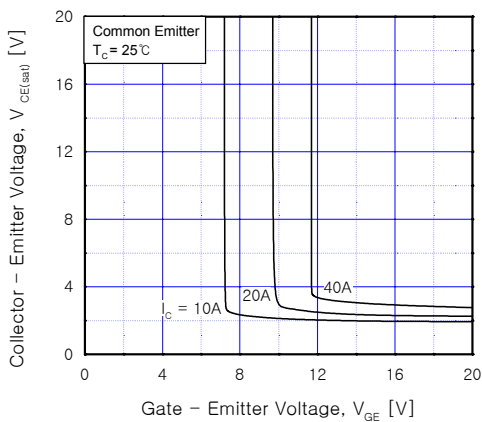
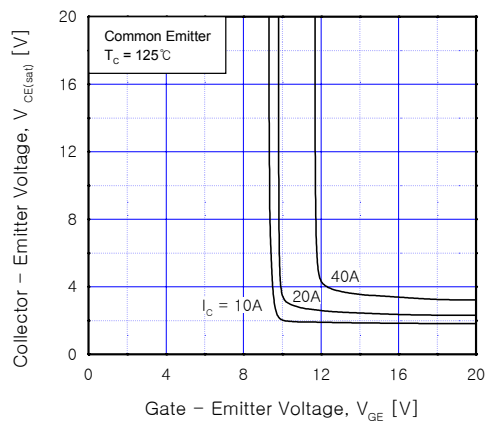


Figure 6. Saturation Voltage vs. V_GE



Typical Performance Characteristics (Continued)

Figure 7. Capacitance Characteristics

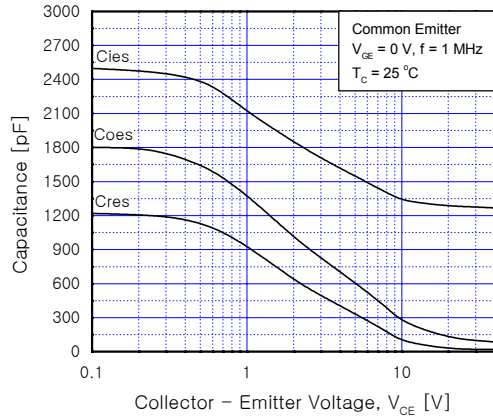


Figure 8. Turn-On Characteristics vs. Gate Resistance

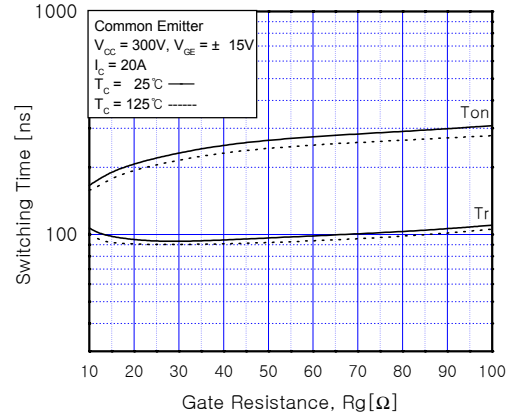


Figure 9. Turn-Off Characteristics vs. Gate Resistance

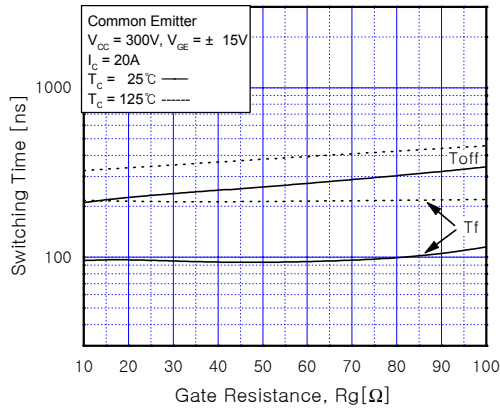


Figure 10. Switching Loss vs. Gate Resistance

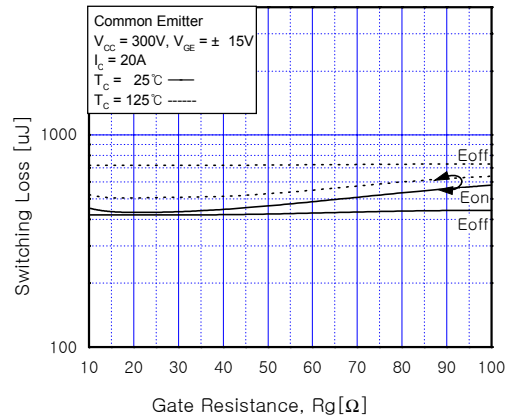


Figure 11. Turn-On Characteristics vs. Collector Current

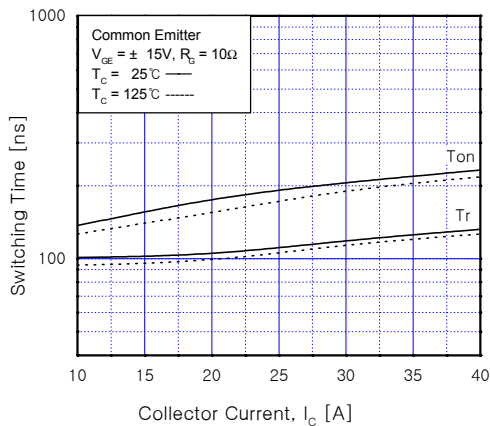
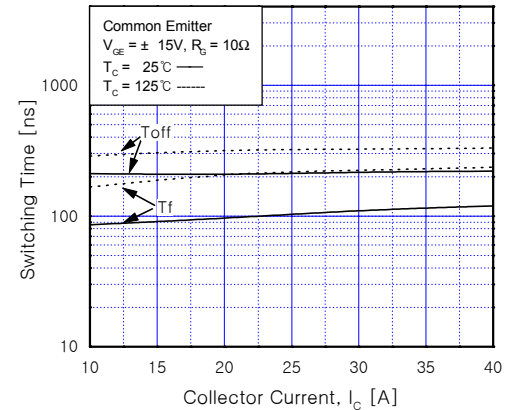


Figure 12. Turn-Off Characteristics vs. Collector Current



Typical Performance Characteristics (Continued)

Figure 13. Switching Loss vs. Collector Current

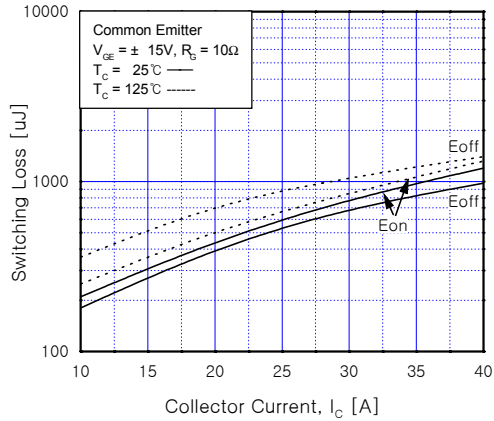


Figure 14. Gate Charge Characteristics

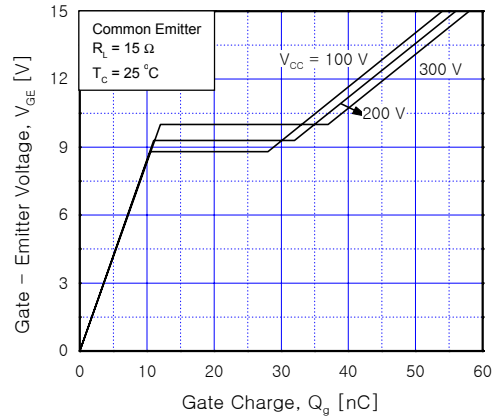


Figure 15. SOA Characteristics

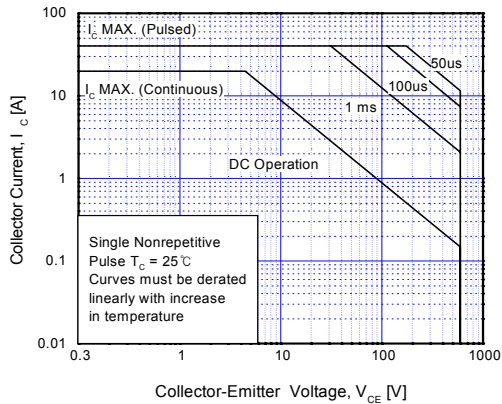


Figure 16. RBSOA Characteristics

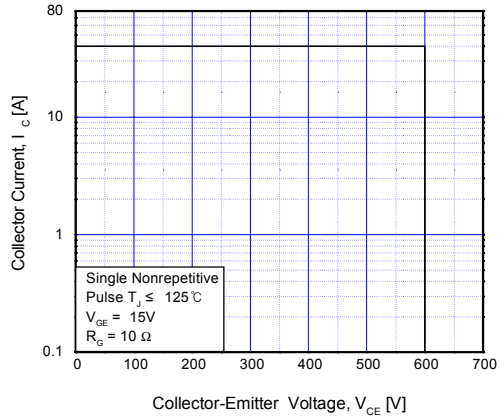


Figure 17. Forward Characteristics

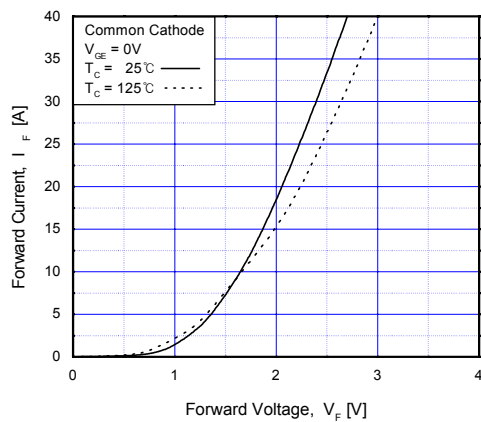
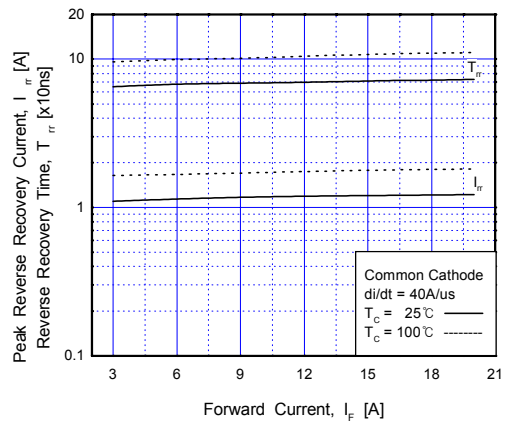


Figure 18. Reverse Recovery Characteristics



Typical Performance Characteristics (Continued)

Figure 19. Rectifier (Converter) Characteristics

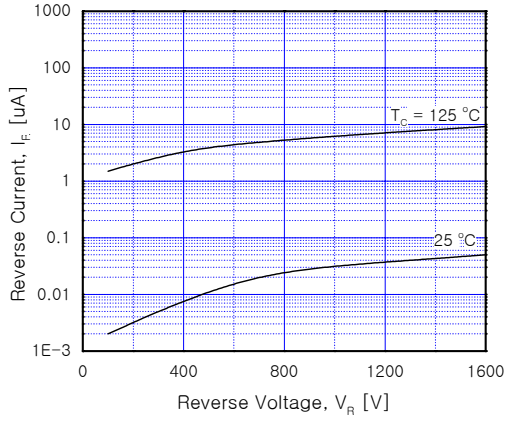


Figure 20. Rectifier (Converter) Characteristics

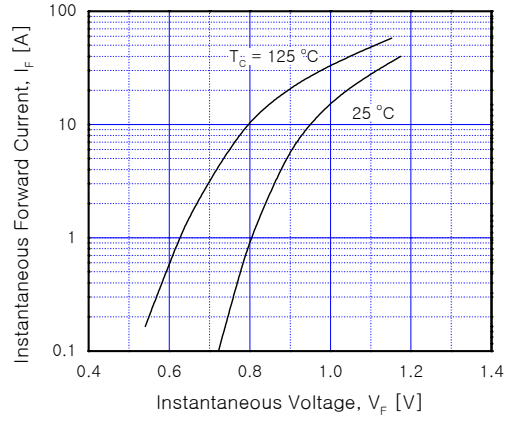
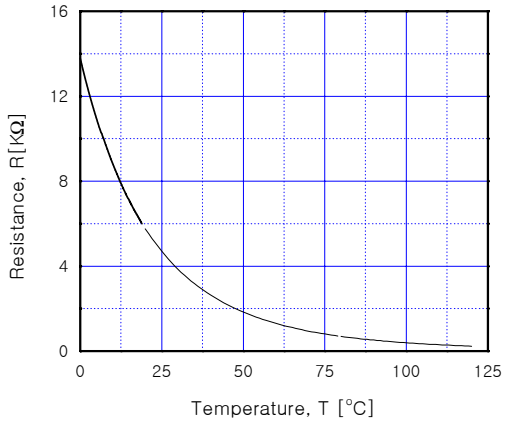
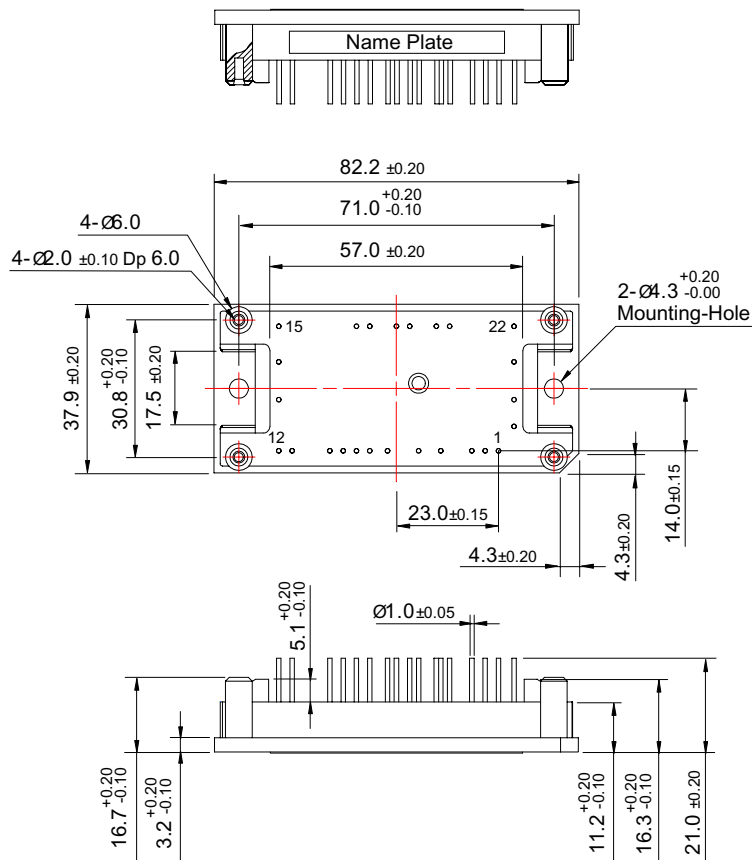


Figure 21. NTC Characteristics



Mechanical Dimensions

25PM-AA



- Pin Coordinate

Pin #No	Coordinate	
	x	y
1	0.0	0.0
2	-3.0	0.0
3	-6.0	0.0
4	-13.0	0.0
5	-18.0	0.0
6	-25.0	0.0
7	-29.0	0.0
8	-32.0	0.0
9	-35.0	0.0
10	-38.0	0.0
11	-46.5	0.0
12	-49.5	0.0
13	-49.5	11.5
14	-49.5	20.0
15	-49.5	28.0
16	-32.0	28.0
17	-29.0	28.0
18	-23.0	28.0
19	-20.0	28.0
20	-14.0	28.0
21	-11.0	28.0
22	3.5	28.0
23	3.5	20.0
24	3.5	11.5
25	3.5	5.5

* datum pin : #1

* Pin Tilt : ±0.15

Dimensions in Millimeters

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CoolFET™	GlobalOptoisolator™	MicroPak™	QT Optoelectronics™	TruTranslation™
CROSSVOLT™	GTO™	MICROWIRE™	Quiet Series™	UHC™
DOME™	HiSeC™	MSX™	RapidConfigure™	UltraFET®
EcoSPARK™	I ² C™	MSXPro™	RapidConnect™	UniFET™
E ² C MOS™	i-Lo™	OCX™	μSerDes™	VCX™
EnSigna™	ImpliedDisconnect™	OCXPro™	SILENT SWITCHER®	Wire™
FACT™	IntelliMAX™	OPTOLOGIC®	SMART START™	
FACT Quiet Series™		OPTOPLANAR™	SPM™	
Across the board. Around the world.™		PACMAN™	Stealth™	
The Power Franchise®		POP™	SuperFET™	
Programmable Active Droop™		Power247™	SuperSOT™-3	
		PowerEdge™	SuperSOT™-6	

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