



August 2005

# FMS6G10US60 Compact & Complex Module

## Features

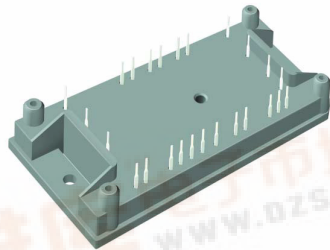
- Short Circuit Rated 10 $\mu$ s @ T<sub>C</sub> = 100°C, V<sub>GE</sub> = 15V
- High Speed Switching
- Low Saturation Voltage : V<sub>CE(sat)</sub> = 2.1 V @ I<sub>C</sub> = 10A
- High Input Impedance
- Built-in 3 Phase Rectifier Circuit
- Fast & Soft Anti-Parallel FWD
- Built-in NTC Thermistor

## Applications

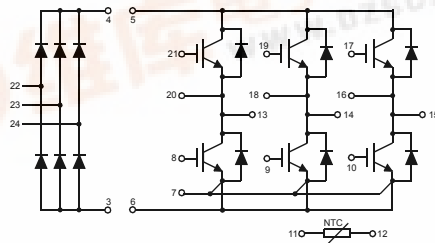
- AC & DC Motor Controls
- General Purpose Inverters
- Robotics
- Servo Controls
- UPS

## 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<sub>C</sub> = 25°C unless otherwise noted

	Symbol	Description	FMS6G10US60	Units
Inverter	V <sub>CES</sub>	Collector-Emitter Voltage	600	V
	V <sub>GES</sub>	Gate-Emitter Voltage	± 20	V
	I <sub>C</sub>	Collector Current @ T <sub>C</sub> = 80°C	10	A
	I <sub>CM (1)</sub>	Pulsed Collector Current	20	A
	I <sub>F</sub>	Diode Continuous Forward Current @ T <sub>C</sub> = 80°C	10	A
	I <sub>FM</sub>	Diode Maximum Forward Current	20	A
	P <sub>D</sub>	Maximum Power Dissipation @ T <sub>C</sub> = 25°C	66	W
	T <sub>SC</sub>	Short Circuit Withstand Time @ T <sub>C</sub> = 100°C	10	µs
Converter	V <sub>RRM</sub>	Repetitive Peak Reverse Voltage	1600	V
	I <sub>O</sub>	Average Output Rectified Current	10	A
	I <sub>FSM</sub>	Surge Forward Current @ 1Cycle at 60Hz, Peak value Non-Repetitive	100	A
	I <sup>2</sup> t	Energy pulse @ 1Cycle at 60Hz	42	A <sup>2</sup> s
Common	T <sub>J</sub>	Operating Junction Temperature	-40 to +150	°C
	T <sub>STG</sub>	Storage Temperature Range	-40 to +125	°C
	V <sub>ISO</sub>	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
FMS6G10US60	FMS6G10US60	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
<b>Off Characteristics</b>						
$BV_{CES}$	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	$\mu A$
$I_{GES}$	Gate - Emitter Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	--	--	$\pm 100$	nA
<b>On Characteristics</b>						
$V_{GE(th)}$	Gate - Emitter Threshold Voltage	$I_C = 10mA, V_{CE} = V_{GE}$	5.0	6.5	8.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 10A, V_{GE} = 15V$	--	2.1	2.7	V
<b>Dynamic Characteristics</b>						
$C_{ies}$	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V,$ $f = 1MHz$	--	710	--	pF
$C_{oes}$	Output Capacitance		--	57	--	pF
$C_{res}$	Reverse Transfer Capacitance		--	12	--	pF
<b>Switching Characteristics</b>						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 10A,$ $R_G = 20\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 25^\circ\text{C}$	--	65	130	ns
$t_r$	Rise Time		--	65	130	ns
$t_{d(off)}$	Turn-Off Delay Time		--	80	160	ns
$t_f$	Fall Time		--	100	200	ns
$E_{on}$	Turn-On Switching Loss		--	0.15	--	mJ
$E_{off}$	Turn-Off Switching Loss		--	0.2	--	mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 10A,$ $R_G = 20\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 125^\circ\text{C}$	--	70	140	ns
$t_r$	Rise Time		--	60	120	ns
$t_{d(off)}$	Turn-Off Delay Time		--	90	180	ns
$t_f$	Fall Time		--	200	350	ns
$E_{on}$	Turn-On Switching Loss		--	0.16	--	mJ
$E_{off}$	Turn-Off Switching Loss		--	0.3	--	mJ
$T_{sc}$	Short Circuit Withstand Time	$V_{CC} = 300V, V_{GE} = 15V$ @ $T_C = 100^\circ\text{C}$	10	--	--	$\mu s$
$Q_g$	Total Gate Charge	$V_{CE} = 300V, I_C = 10A,$ $V_{GE} = 15V$	--	35	50	nC
$Q_{ge}$	Gate-Emitter Charge		--	8	15	nC
$Q_{gc}$	Gate-Collector Charge		--	12	20	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	$I_F = 10\text{A}$	$T_C = 25^\circ\text{C}$	--	1.9	2.8	V
			$T_C = 100^\circ\text{C}$	--	2.0	--	
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 10\text{A}$ $di/dt = 20\text{ A}/\mu\text{s}$	$T_C = 25^\circ\text{C}$	--	85	150	ns
			$T_C = 100^\circ\text{C}$	--	110	--	
$I_{rr}$	Diode Peak Reverse Recovery Current		$T_C = 25^\circ\text{C}$	--	0.7	1.4	A
			$T_C = 100^\circ\text{C}$	--	1.0	--	
$Q_{rr}$	Diode Reverse Recovery Charge	$T_C = 25^\circ\text{C}$	--	30	105	nC	
		$T_C = 100^\circ\text{C}$	--	55	--		

**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	$I_F = 10\text{A}$	$T_C = 25^\circ\text{C}$	--	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)	--	1.9	$^\circ\text{C}/\text{W}$
	$R_{\theta JC}$	Junction-to-Case (DIODE Part, per 1/6 Module)	--	2.9	$^\circ\text{C}/\text{W}$
Converter	$R_{\theta JC}$	Junction-to-Case (DIODE Part, per 1/6 Module)	--	2.5	$^\circ\text{C}/\text{W}$
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

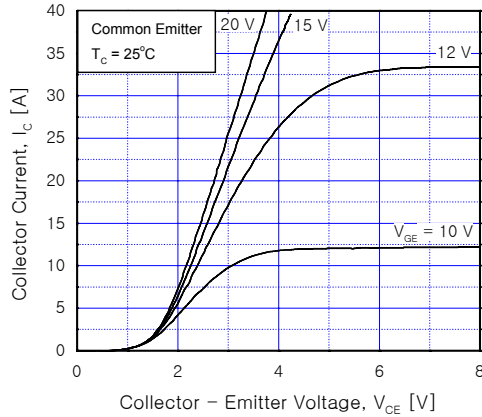


Figure 2. Typical Saturation Voltage Characteristics

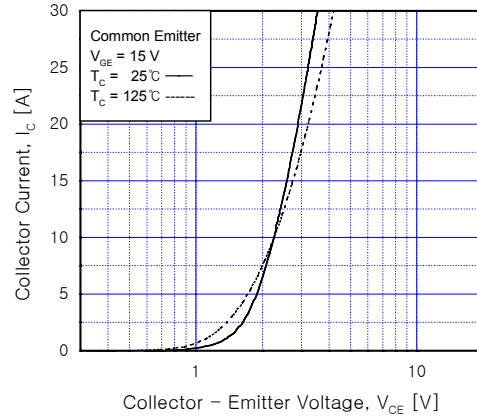


Figure 3. Saturation Voltage vs. Case Temperature at Variant Current Level

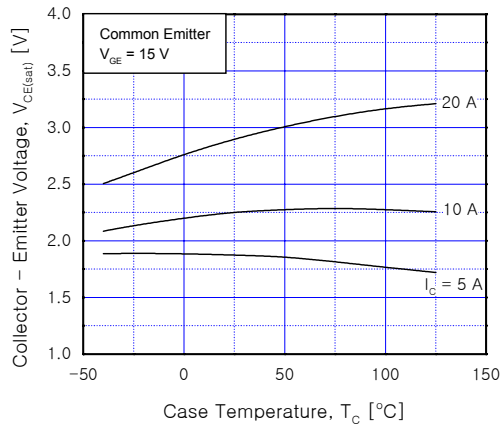


Figure 4. Transient Thermal Impedance

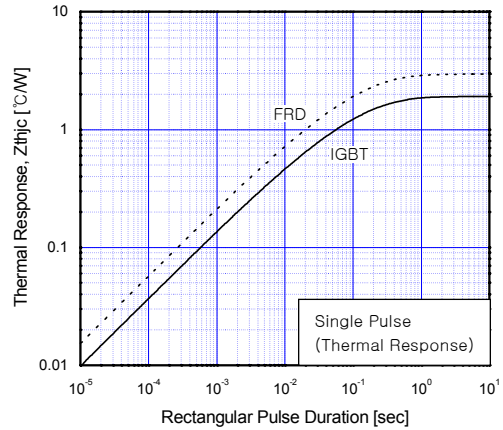


Figure 5. Saturation Voltage vs. V\_GE

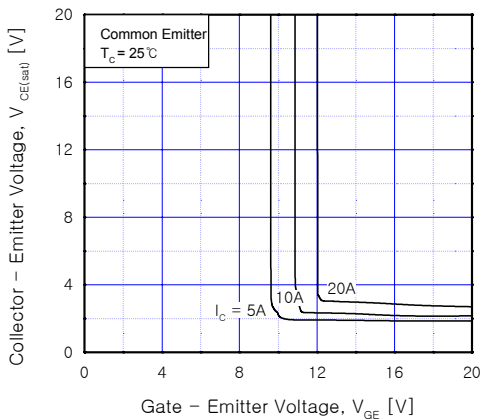
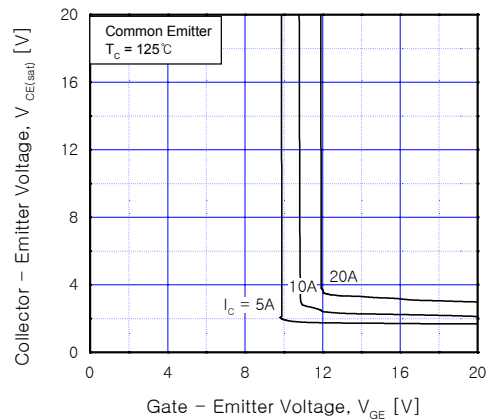
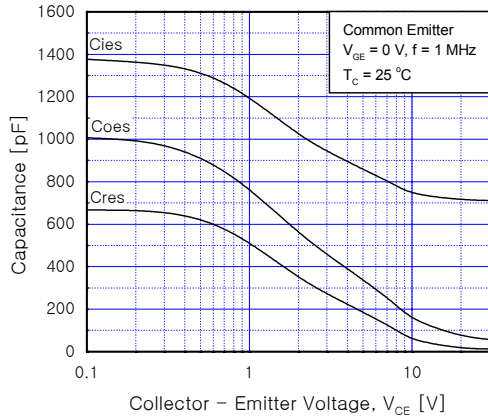


Figure 6. Saturation Voltage vs. V\_GE

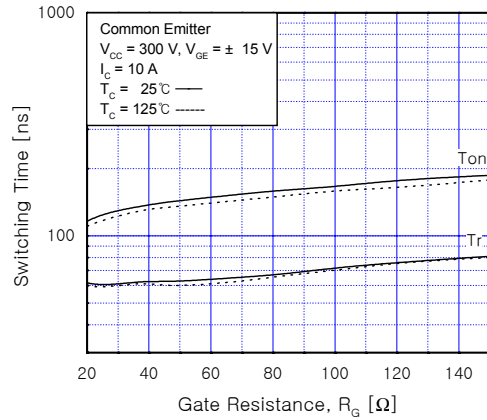


## Typical Performance Characteristics (Continued)

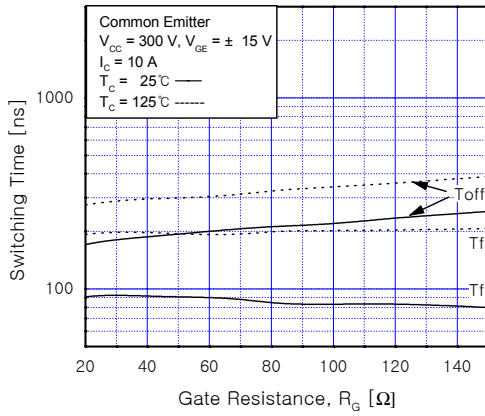
**Figure 7. Capacitance Characteristics**



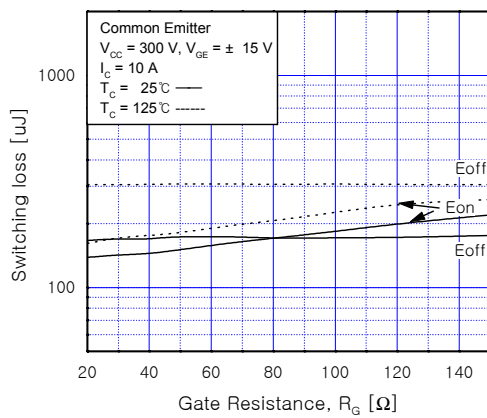
**Figure 8. Turn-On Characteristics vs. Gate Resistance**



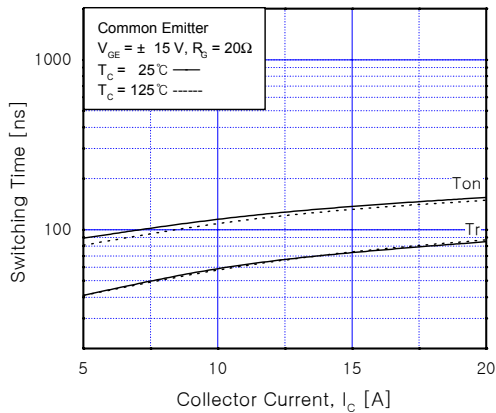
**Figure 9. Turn-Off Characteristics vs. Gate Resistance**



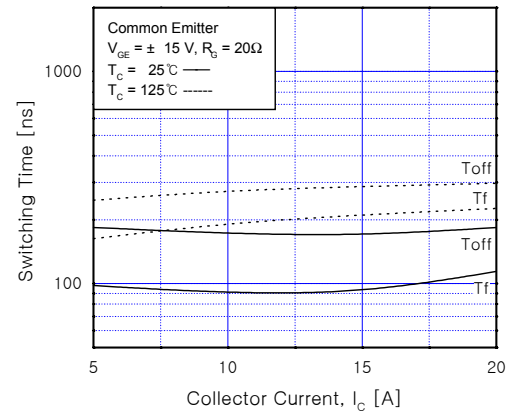
**Figure 10. Switching Loss vs. Gate Resistance**



**Figure 11. Turn-On Characteristics vs. Collector Current**

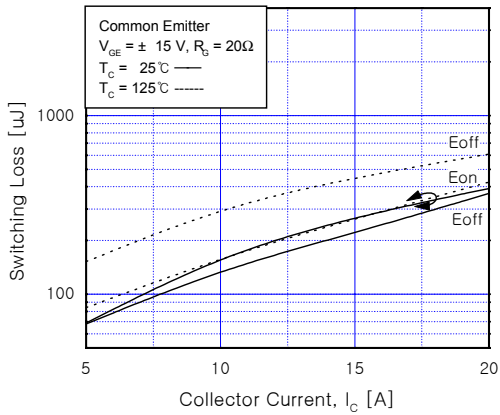


**Figure 12. Turn-Off Characteristics vs. Collector Current**

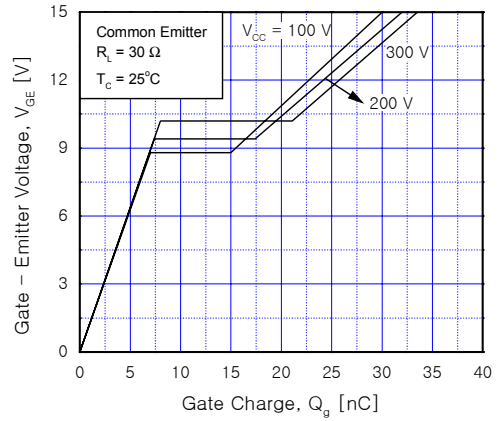


## Typical Performance Characteristics (Continued)

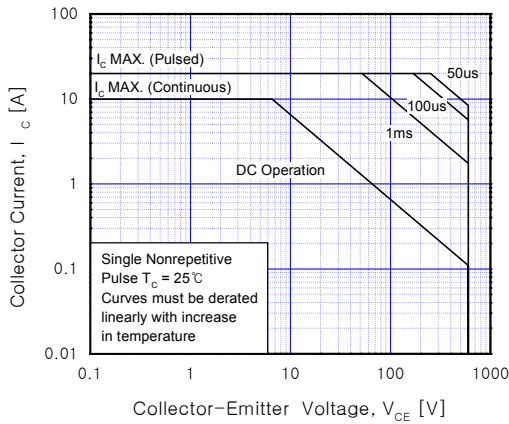
**Figure 13. Switching Loss vs. Collector Current**



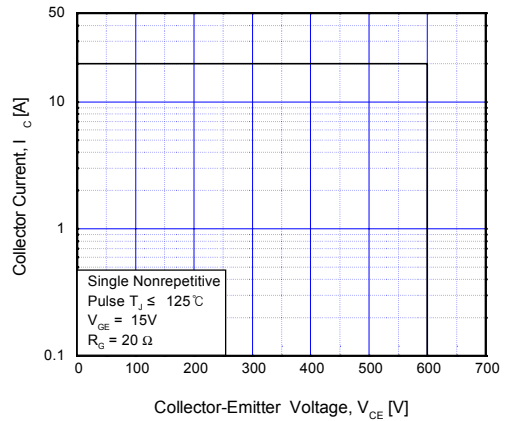
**Figure 14. Gate Charge Characteristics**



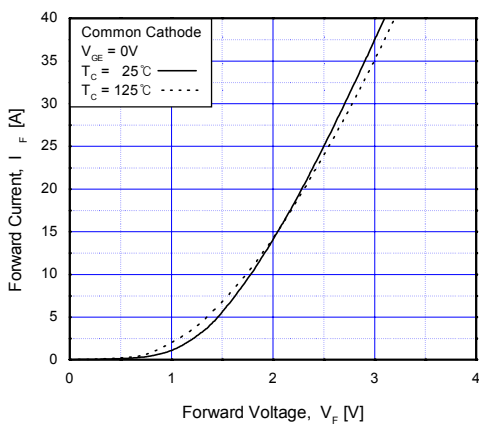
**Figure 15. SOA Characteristics**



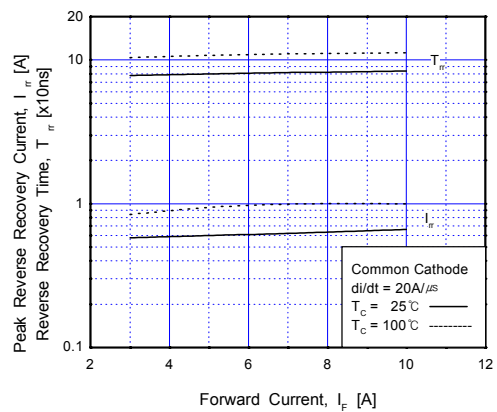
**Figure 16. RBSOA Characteristics**



**Figure 17. Forward Characteristics**



**Figure 18. Reverse Recovery Characteristics**



Typical Performance Characteristics (Continued)

Figure 19. Rectifier (Converter) Characteristics

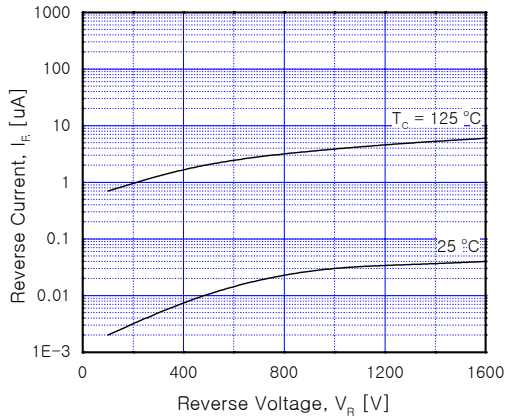


Figure 20. Rectifier (Converter) Characteristics

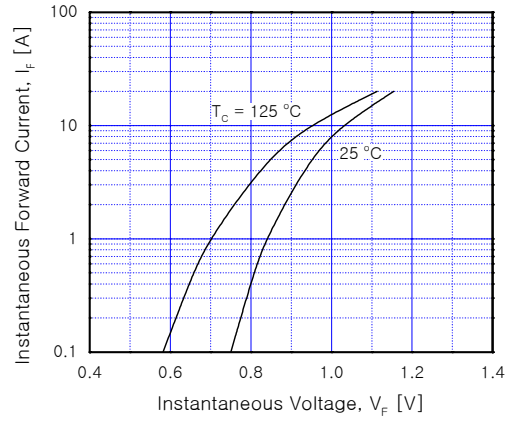
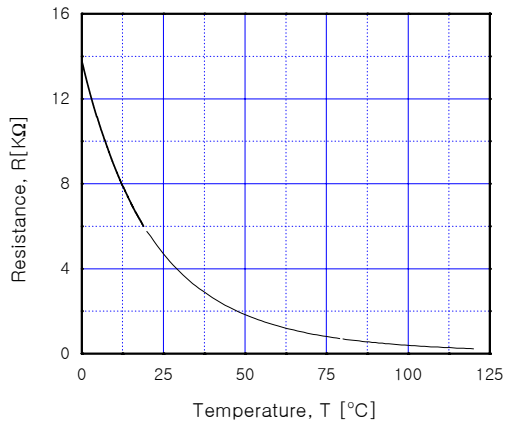


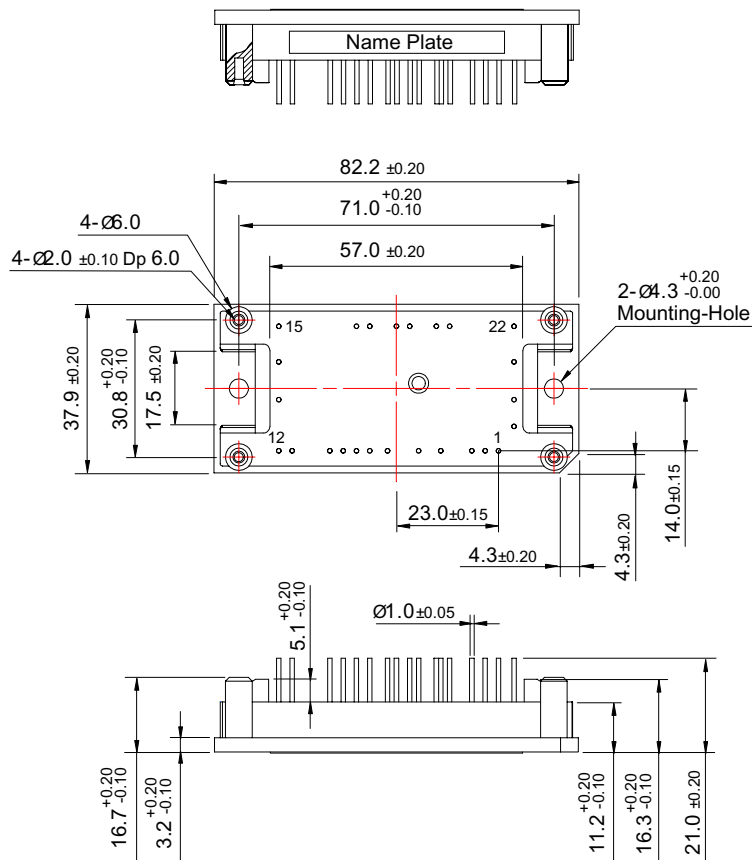
Figure 21. NTC Characteristics





## 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 <sup>2</sup> C™	MSXPro™	RapidConnect™	UniFET™
E <sup>2</sup> 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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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## PRODUCT STATUS DEFINITIONS

### Definition of Terms

Datasheet Identification	Product Status	Definition
Advance Information	Formative or In Design	This datasheet contains the design specifications for product development. Specifications may change in any manner without notice.
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