



August 2005

# FMS7G15US60S

## Compact & Complex Module

### Features

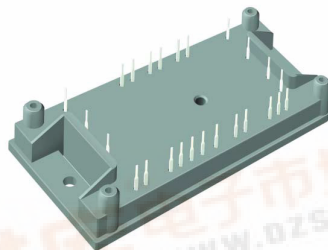
- Short Circuit Rated  $10\mu\text{s}$  @  $T_C = 100^\circ\text{C}$ ,  $V_{GE} = 15\text{V}$
- High Speed Switching
- Low Saturation Voltage :  $V_{CE(sat)} = 2.1\text{V}$  @  $I_C = 15\text{A}$
- High Input Impedance
- Built-in Brake & 1 Phase Rectifier Circuit
- Fast & Soft Anti-Parallel FWD
- Built-in NTC Thermistor

### Applications

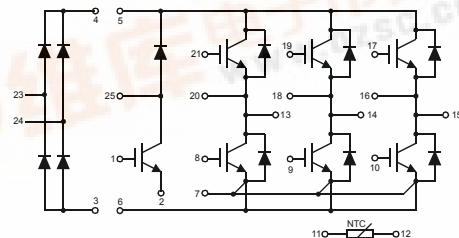
- AC & DC Motor Controls
- General Purpose Inverters
- Robotics
- Servo Controls

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

	Symbol	Description	FMS7G15US60S	Units
Inverter & Brake	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	15	A
	I <sub>CM</sub> (1)	Pulsed Collector Current	30	A
	I <sub>F</sub>	Diode Continuous Forward Current @ T <sub>C</sub> = 80°C	15	A
	I <sub>FM</sub>	Diode Maximum Forward Current	30	A
	P <sub>D</sub>	Maximum Power Dissipation @ T <sub>C</sub> = 25°C	73	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	20	A
	I <sub>FSM</sub>	Surge Forward Current @ 1Cycle at 60Hz, Peak value Non-Repetitive	200	A
	I <sup>2</sup> t	Energy pulse @ 1Cycle at 60Hz	164	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
FMS7G15US60S	FMS7G15US60S	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 <sub>CES</sub>	Collector-Emitter Breakdown Voltage	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA	600	--	--	V
ΔB <sub>V<sub>CES</sub></sub> / ΔT <sub>J</sub>	Temperature Coeff. of Breakdown Voltage	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA	--	0.6	--	V/°C
I <sub>CES</sub>	Collector Cut-Off Current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0V	--	--	250	μA
I <sub>GES</sub>	Gate - Emitter Leakage Current	V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0V	--	--	± 100	nA
On Characteristics						
V <sub>GE(th)</sub>	Gate - Emitter Threshold Voltage	I <sub>C</sub> = 15mA, V <sub>CE</sub> = V <sub>GE</sub>	5.0	6.5	8.5	V
V <sub>CE(sat)</sub>	Collector to Emitter Saturation Voltage	I <sub>C</sub> = 15A, V <sub>GE</sub> = 15V	--	2.1	2.7	V
Dynamic Characteristics						
C <sub>ies</sub>	Input Capacitance	V <sub>CE</sub> = 30V, V <sub>GE</sub> = 0V, f = 1MHz	--	935	--	pF
C <sub>oes</sub>	Output Capacitance		--	81	--	pF
C <sub>res</sub>	Reverse Transfer Capacitance		--	18	--	pF
Switching Characteristics						
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 300 V, I <sub>C</sub> = 15A, R <sub>G</sub> = 13Ω, V <sub>GE</sub> = 15V, Inductive Load, T <sub>C</sub> = 25°C	--	65	130	ns
t <sub>r</sub>	Rise Time		--	80	160	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	80	160	ns
t <sub>f</sub>	Fall Time		--	100	200	ns
E <sub>on</sub>	Turn-On Switching Loss		--	0.3	--	mJ
E <sub>off</sub>	Turn-Off Switching Loss		--	0.3	--	mJ
t <sub>d(on)</sub>	Turn-On Delay Time	V <sub>CC</sub> = 300 V, I <sub>C</sub> = 15A, R <sub>G</sub> = 13Ω, V <sub>GE</sub> = 15V, Inductive Load, T <sub>C</sub> = 125°C	--	70	140	ns
t <sub>r</sub>	Rise Time		--	80	160	ns
t <sub>d(off)</sub>	Turn-Off Delay Time		--	90	180	ns
t <sub>f</sub>	Fall Time		--	210	350	ns
E <sub>on</sub>	Turn-On Switching Loss		--	0.33	--	mJ
E <sub>off</sub>	Turn-Off Switching Loss		--	0.5	--	mJ
T <sub>sc</sub>	Short Circuit Withstand Time	V <sub>CC</sub> = 300 V, V <sub>GE</sub> = 15V @ T <sub>C</sub> = 100°C	10	--	--	μs
Q <sub>g</sub>	Total Gate Charge	V <sub>CE</sub> = 300 V, I <sub>C</sub> = 15A, V <sub>GE</sub> = 15V	--	45	60	nC
Q <sub>ge</sub>	Gate-Emitter Charge		--	9	15	nC
Q <sub>gc</sub>	Gate-Collector Charge		--	17	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 <sub>FM</sub>	Diode Forward Voltage	I <sub>F</sub> = 15A	T <sub>C</sub> = 25°C	--	1.9	2.8	V
			T <sub>C</sub> = 100°C	--	2.0	--	
t <sub>rr</sub>	Diode Reverse Recovery Time	I <sub>F</sub> = 15A di / dt = 30 A/μs	T <sub>C</sub> = 25°C	--	75	150	ns
			T <sub>C</sub> = 100°C	--	100	--	
I <sub>rr</sub>	Diode Peak Reverse Recovery Current		T <sub>C</sub> = 25°C	--	1.0	2.0	A
			T <sub>C</sub> = 100°C	--	1.3	--	
Q <sub>rr</sub>	Diode Reverse Recovery Charge		T <sub>C</sub> = 25°C	--	40	150	nC
			T <sub>C</sub> = 100°C	--	65	--	

**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)	--	1.7	$^\circ\text{C}/\text{W}$
	$R_{\theta JC}$	Junction-to-Case (DIODE Part, per 1/6 Module)	--	2.5	$^\circ\text{C}/\text{W}$
Brake	$R_{\theta JC}$	Junction-to-Case (IGBT Part)	--	1.7	$^\circ\text{C}/\text{W}$
	$R_{\theta JC}$	Junction-to-Case (DIODE Part)	--	2.5	$^\circ\text{C}/\text{W}$
Converter	$R_{\theta JC}$	Junction-to-Case (DIODE Part, per 1/6 Module)	--	1.5	$^\circ\text{C}/\text{W}$
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

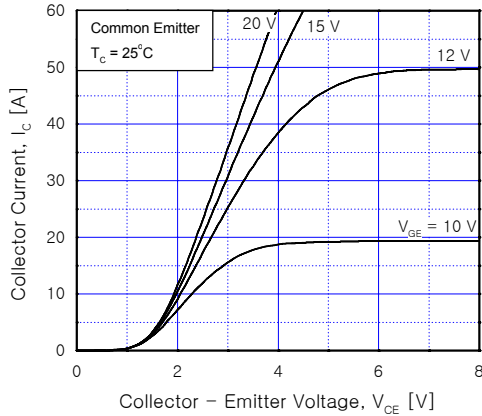


Figure 2. Typical Saturation Voltage Characteristics

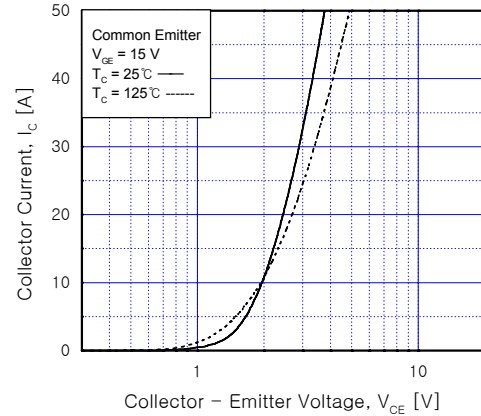


Figure 3. Saturation Voltage vs. Case Temperature at Variant Current Level

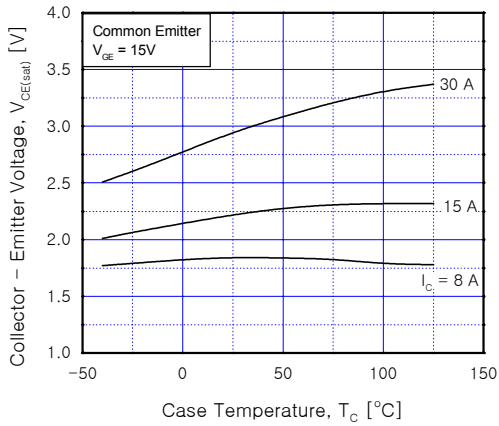


Figure 4. Transient Thermal Impedance

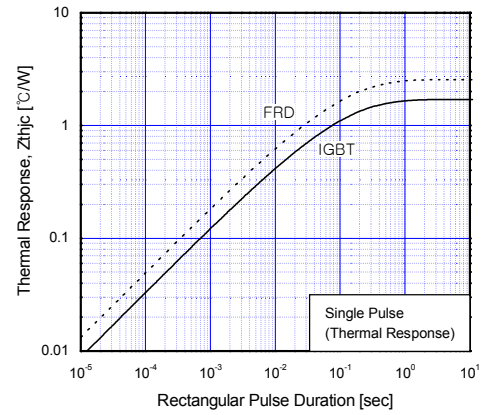


Figure 5. Saturation Voltage vs.  $V_{GE}$

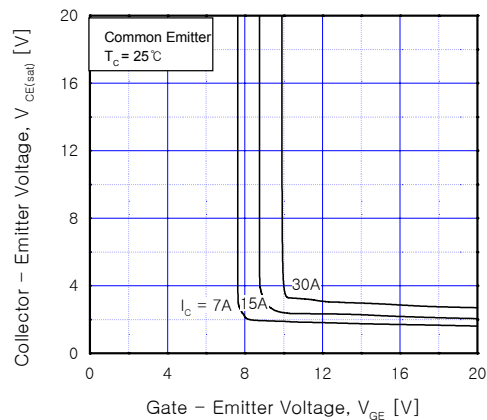
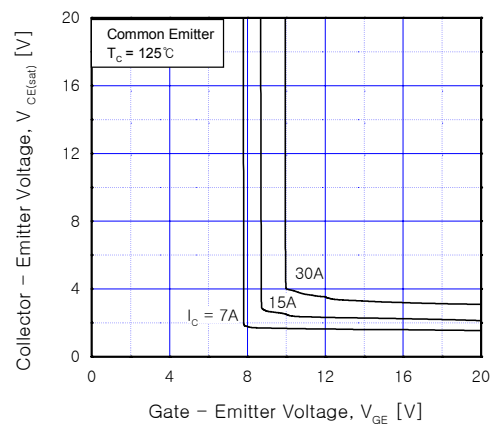


Figure 6. Saturation Voltage vs.  $V_{GE}$



## Typical Performance Characteristics (Continued)

Figure 7. Capacitance Characteristics

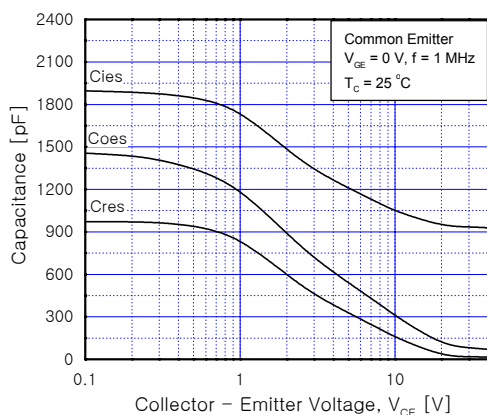


Figure 8. Turn-On Characteristics vs. Gate Resistance

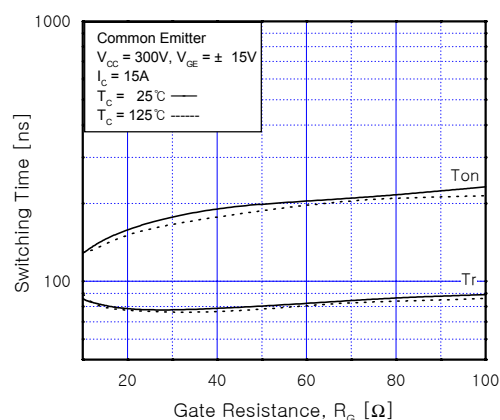


Figure 9. Turn-Off Characteristics vs. Gate Resistance

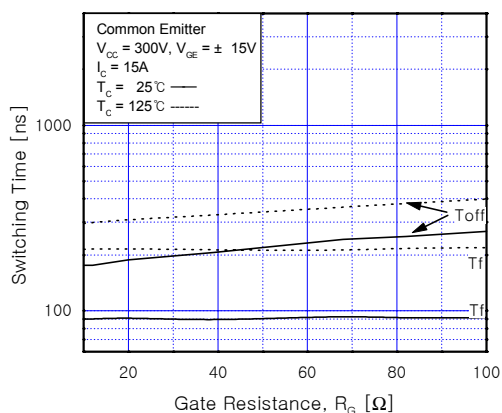


Figure 10. Switching Loss vs. Gate Resistance

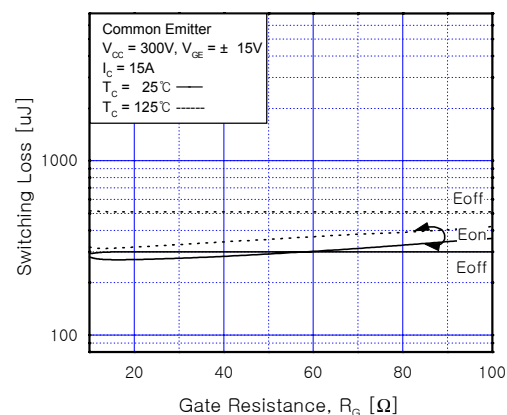


Figure 11. Turn-On Characteristics vs. Collector Current

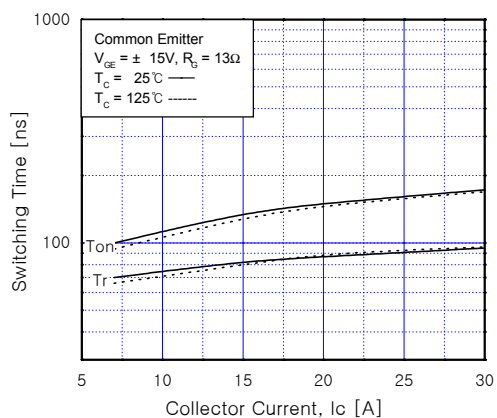
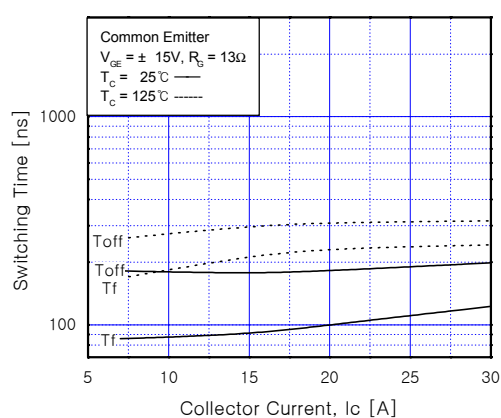


Figure 12. Turn-Off Characteristics vs. Collector Current



## Typical Performance Characteristics (Continued)

Figure 13. Switching Loss vs. Collector Current

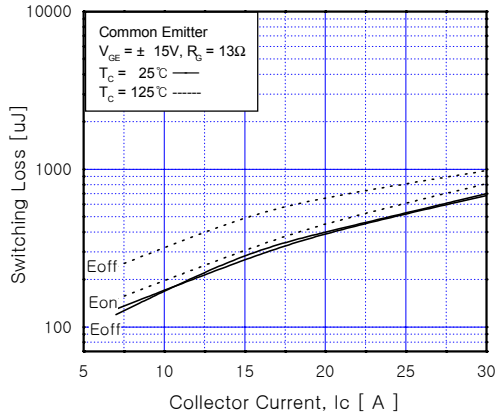


Figure 14. Gate Charge Characteristics

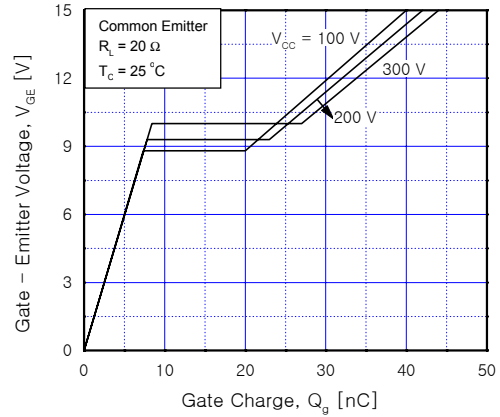


Figure 15. SOA Characteristics

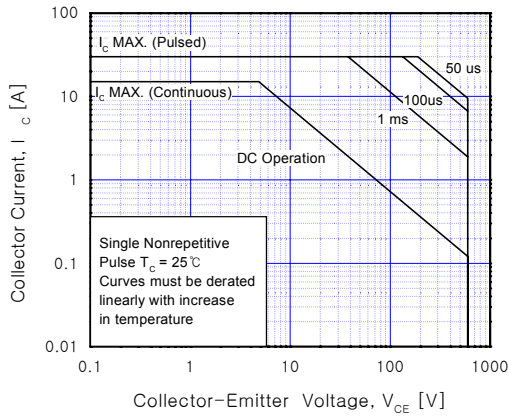


Figure 16. RBSOA Characteristics

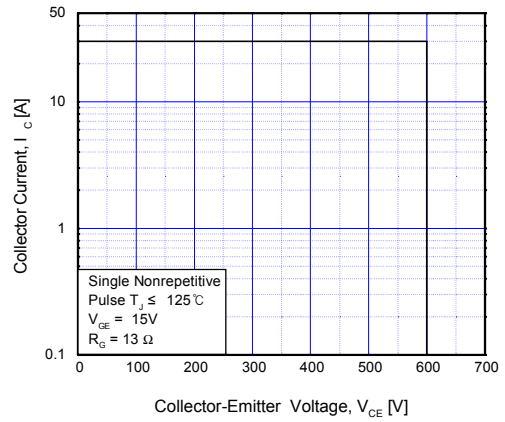


Figure 17. Forward Characteristics

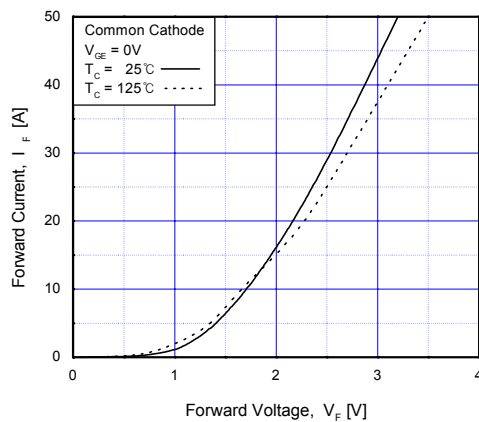
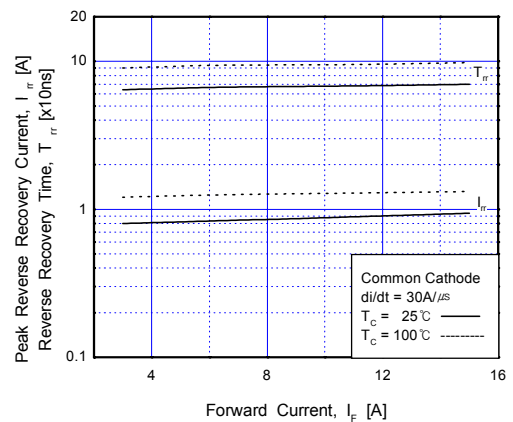
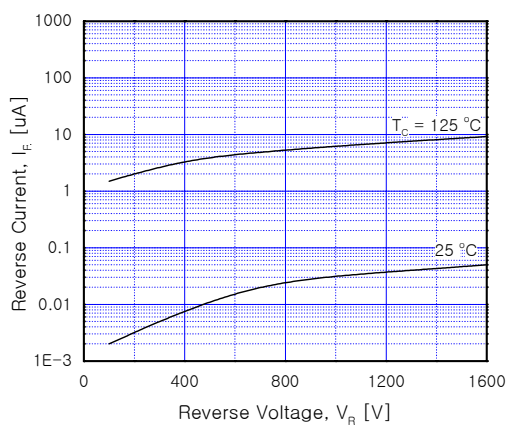
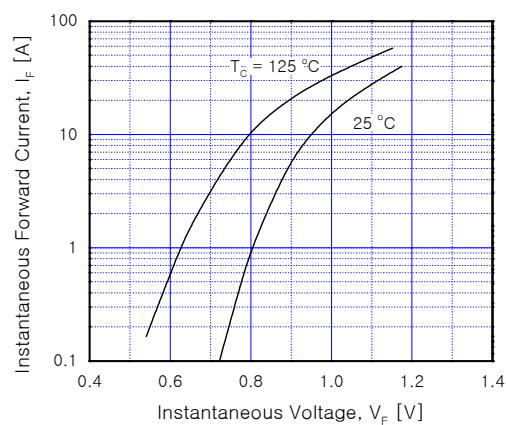
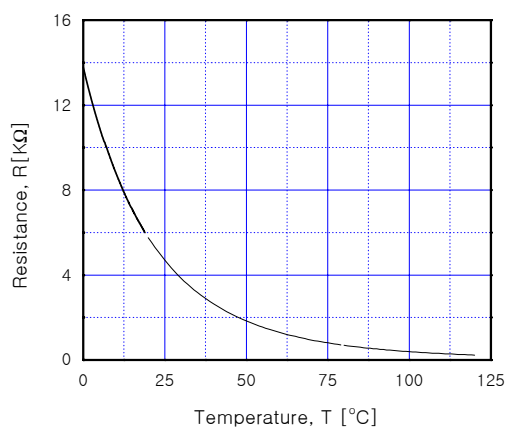


Figure 18. Reverse Recovery Characteristics

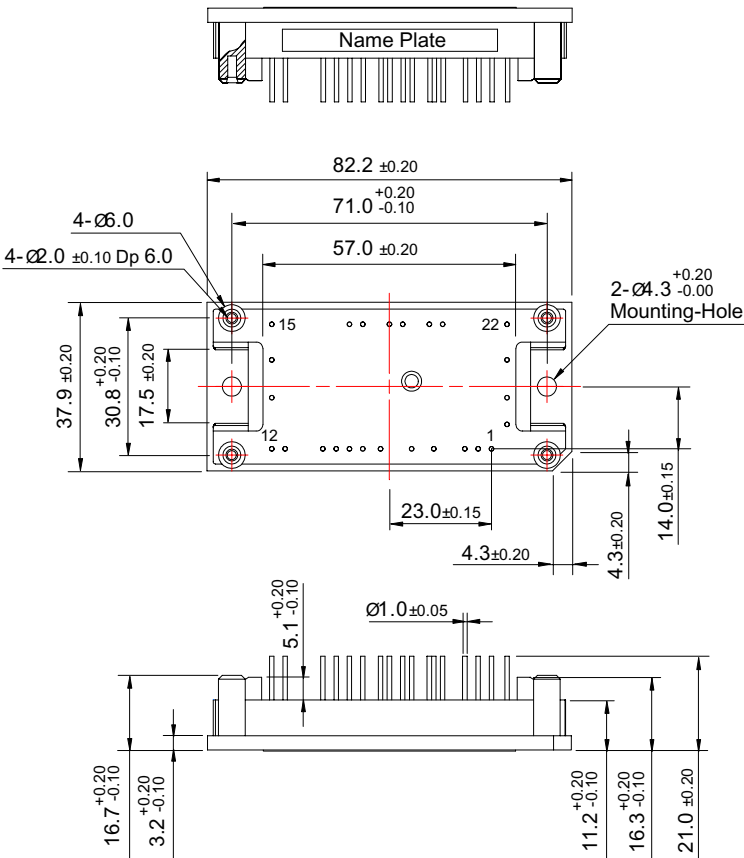


**Typical Performance Characteristics** (Continued)**Figure 19. Rectifier (Converter) Characteristics****Figure 20. Rectifier (Converter) Characteristics****Figure 21. NTC Characteristics**



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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## PRODUCT STATUS DEFINITIONS

### Definition of Terms

Datasheet Identification	Product Status	Definition
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