



June 2001

IGBT

FMC6G15US60

Compact & Complex Module

General Description

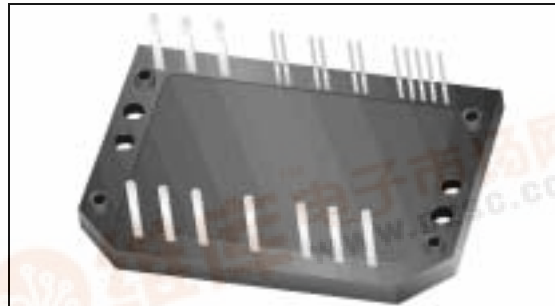
Fairchild's Insulated Gate Bipolar Transistor (IGBT) power modules provide low conduction and switching losses as well as short circuit ruggedness. They are designed for applications such as motor control, uninterrupted power supplies (UPS) and general inverters where short circuit ruggedness is a required feature.

Features

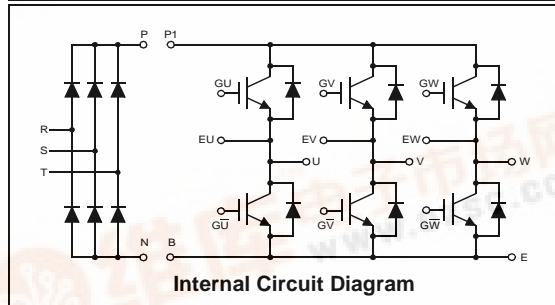
- UL Certified No. E209204
- Short circuit rated 10us @ $T_C = 100^\circ\text{C}$, $V_{GE} = 15\text{V}$
- High speed switching
- Low saturation voltage : $V_{CE(sat)} = 2.2\text{V}$ @ $I_C = 15\text{A}$
- High input impedance
- Built in 3 phase rectifier circuit
- Fast & soft anti-parallel FWD

Applications

- AC & DC motor controls
- General purpose inverters
- Robotics
- Servo controls



Package Code : 21PM-AA



Internal Circuit Diagram

Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ unless otherwise noted

	Symbol	Description	FMC7G15US60	Units
Inverter	V_{CES}	Collector-Emitter Voltage	600	V
	V_{GES}	Gate-Emitter Voltage	± 20	V
	I_C	Collector Current @ $T_C = 25^\circ\text{C}$	15	A
	$I_{CM(1)}$	Pulsed Collector Current	30	A
	I_F	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	15	A
	I_{FM}	Diode Maximum Forward Current	30	A
	P_D	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	45	W
	T_{SC}	Short Circuit Withstand Time @ $T_C = 100^\circ\text{C}$	10	us
Converter	V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
	I_O	Average Output Rectified Current	20	A
	I_{FSM}	Surge Forward Current @ 1Cycle at 60Hz, Peak value Non-Repetitive	200	A
	I^2t	1 Cycle Surge Current	164	A^2s
Common	T_J	Operating Junction Temperature	-40 to +150	$^\circ\text{C}$
	T_{STG}	Storage Temperature Range	-40 to +125	$^\circ\text{C}$
	V_{ISO}	Isolation Voltage @ AC 1minute	2500	V
Mounting Torque	Mounting part Screw	@ M4	1.25	N.m

Notes :

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



Electrical Characteristics of the 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}	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	--	--	± 100	nA

On Characteristics						
$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 15mA, V_{CE} = V_{GE}$	5.0	6.0	8.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 15A, V_{GE} = 15V$	--	2.2	2.8	V

Dynamic Characteristics						
C_{ies}	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V, f = 1MHz$	--	948	--	pF
C_{oes}	Output Capacitance		--	101	--	pF
C_{res}	Reverse Transfer Capacitance		--	33	--	pF

Switching Characteristics						
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 15A, R_G = 13\Omega, V_{GE} = 15V, \text{Inductive Load}, T_C = 25^\circ\text{C}$	--	17	--	ns
t_r	Rise Time		--	33	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	44	65	ns
t_f	Fall Time		--	118	200	ns
E_{on}	Turn-On Switching Loss		--	0.32	--	mJ
E_{off}	Turn-Off Switching Loss		--	0.36	--	mJ
E_{ts}	Total Switching Loss	--	0.68	0.95	mJ	
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 15A, R_G = 13\Omega, V_{GE} = 15V, \text{Inductive Load}, T_C = 125^\circ\text{C}$	--	20	--	ns
t_r	Rise Time		--	34	--	ns
$t_{d(off)}$	Turn-Off Delay Time		--	48	70	ns
t_f	Fall Time		--	212	350	ns
E_{on}	Turn-On Switching Loss		--	0.34	--	mJ
E_{off}	Turn-Off Switching Loss		--	0.7	--	mJ
E_{ts}	Total Switching Loss	--	1.04	1.45	mJ	
T_{sc}	Short Circuit Withstand Time	$V_{CC} = 300V, V_{GE} = 15V @ T_C = 100^\circ\text{C}$	10	--	--	us
Q_g	Total Gate Charge	$V_{CE} = 300V, I_C = 15A, V_{GE} = 15V$	--	42	60	nC
Q_{ge}	Gate-Emitter Charge		--	7	10	nC
Q_{gc}	Gate-Collector Charge		--	17	24	nC

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
V_{FM}	Diode Forward Voltage	$I_F = 15\text{A}$	$T_C = 25^\circ\text{C}$	--	1.9	2.8	V
			$T_C = 100^\circ\text{C}$	--	2.0	--	
t_{rr}	Diode Reverse Recovery Time		$T_C = 25^\circ\text{C}$	--	75	130	ns
			$T_C = 100^\circ\text{C}$	--	100	--	
I_{rr}	Diode Peak Reverse Recovery Current	$I_F = 15\text{A}$ $di / dt = 30 \text{ A/us}$	$T_C = 25^\circ\text{C}$	--	1.0	1.8	A
			$T_C = 100^\circ\text{C}$	--	1.3	--	
Q_{rr}	Diode Reverse Recovery Charge		$T_C = 25^\circ\text{C}$	--	40	100	nC
			$T_C = 100^\circ\text{C}$	--	70	--	

Electrical Characteristics of the 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)	--	2.77	$^\circ\text{C/W}$
	$R_{\theta JC}$	Junction-to-Case (DIODE Part, per 1/6 Module)	--	3.5	$^\circ\text{C/W}$
Converter	$R_{\theta JC}$	Junction-to-Case (DIODE Part, per 1/6 Module)	--	2.7	$^\circ\text{C/W}$
Weight		Weight of Module	60	--	g

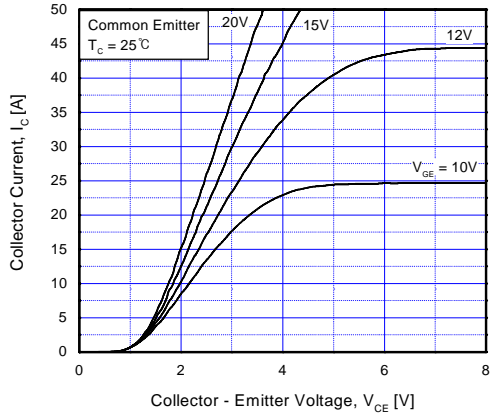


Fig 1. Typical Output Characteristics

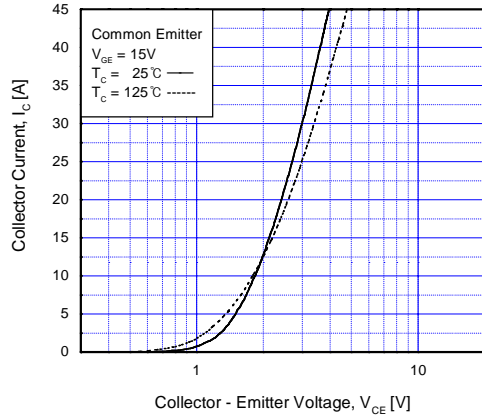


Fig 2. Typical Saturation Voltage Characteristics

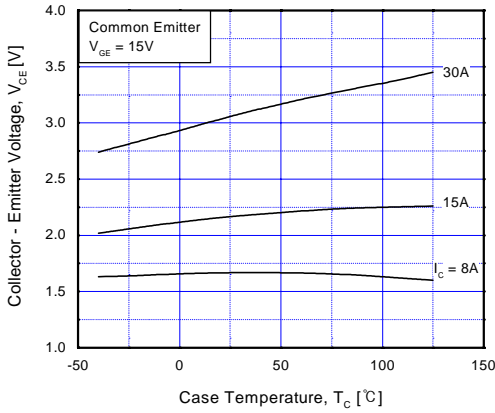


Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level

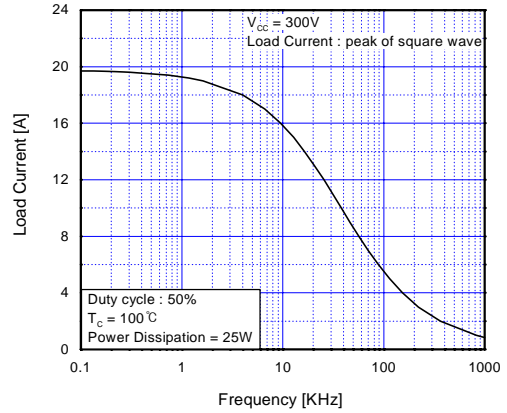


Fig 4. Load Current vs. Frequency

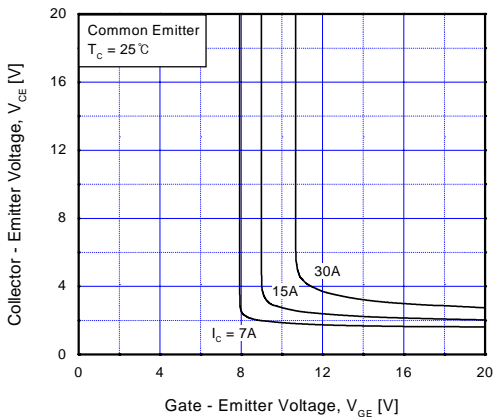


Fig 5. Saturation Voltage vs. V_{GE}

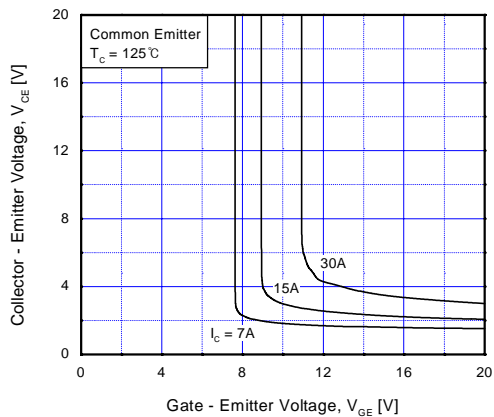


Fig 6. Saturation Voltage vs. V_{GE}

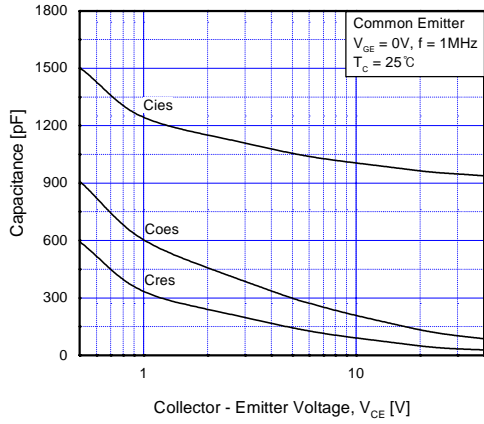


Fig 7. Capacitance Characteristics

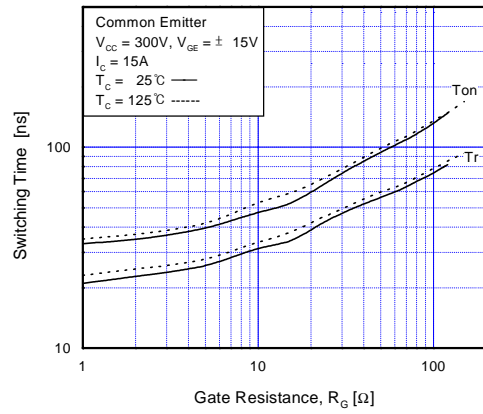


Fig 8. Turn-On Characteristics vs. Gate Resistance

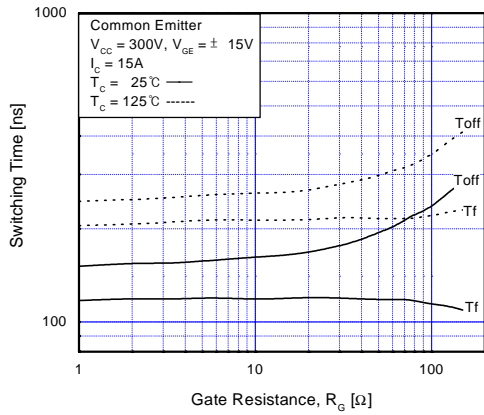


Fig 9. Turn-Off Characteristics vs. Gate Resistance

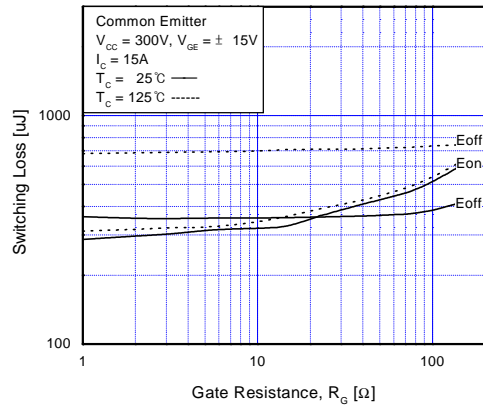


Fig 10. Switching Loss vs. Gate Resistance

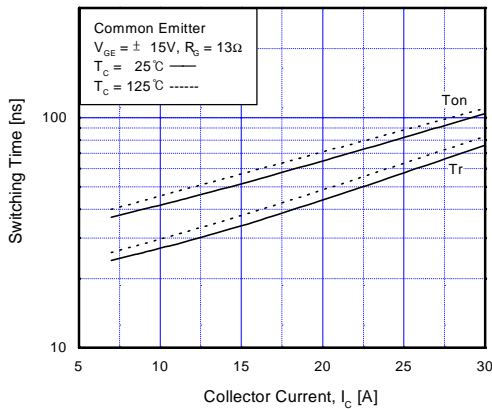


Fig 11. Turn-On Characteristics vs. Collector Current

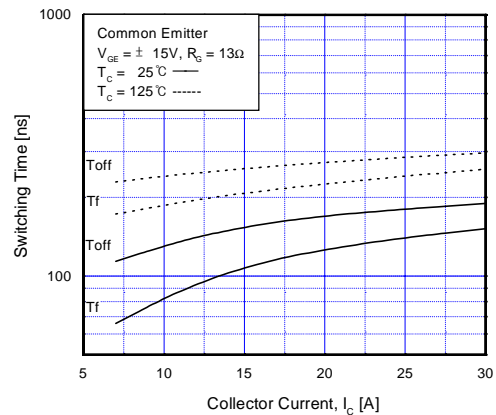


Fig 12. Turn-Off Characteristics vs. Collector Current

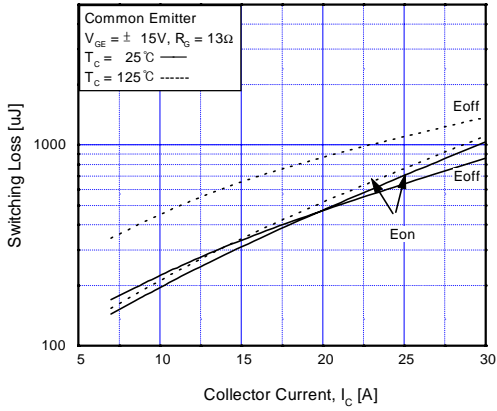


Fig 13. Switching Loss vs. Collector Current

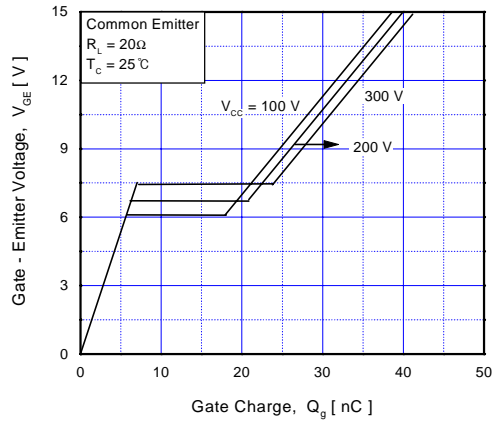


Fig 14. Gate Charge Characteristics

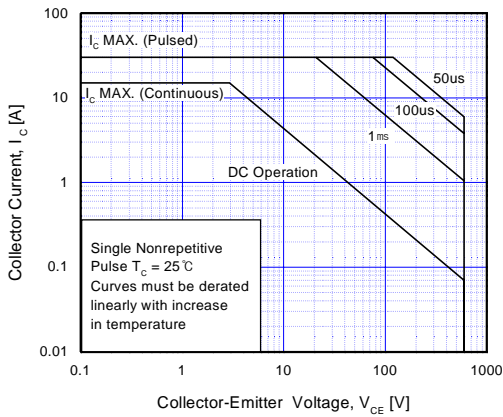


Fig 15. SOA Characteristics

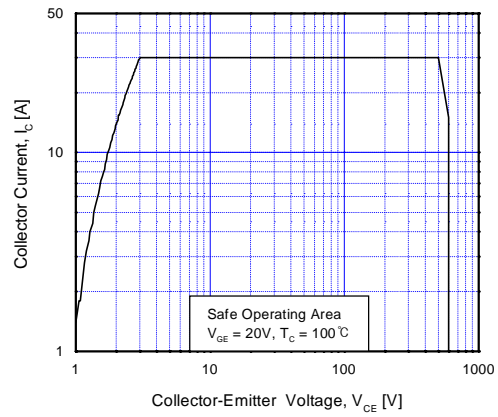


Fig 16. Turn-Off SOA Characteristics

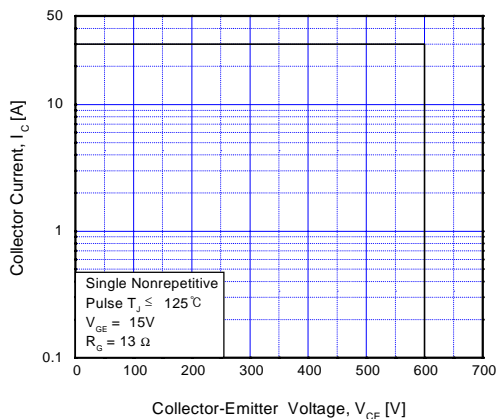


Fig 17. RBSOA Characteristics

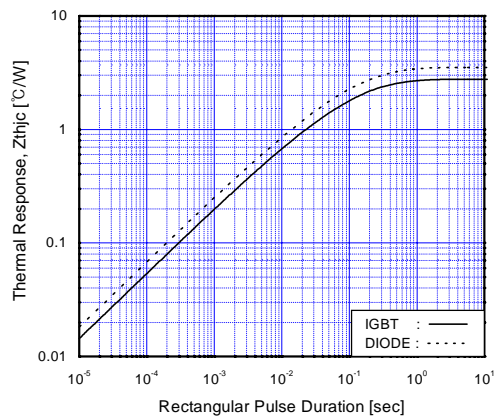


Fig 18. Transient Thermal Impedance

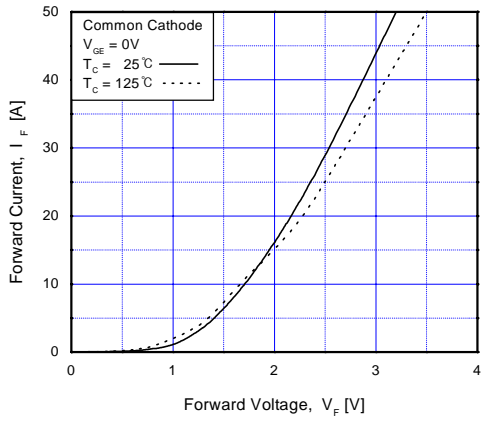


Fig 19. Forward Characteristics

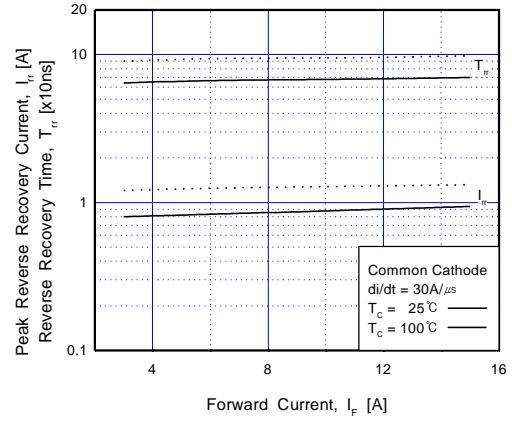
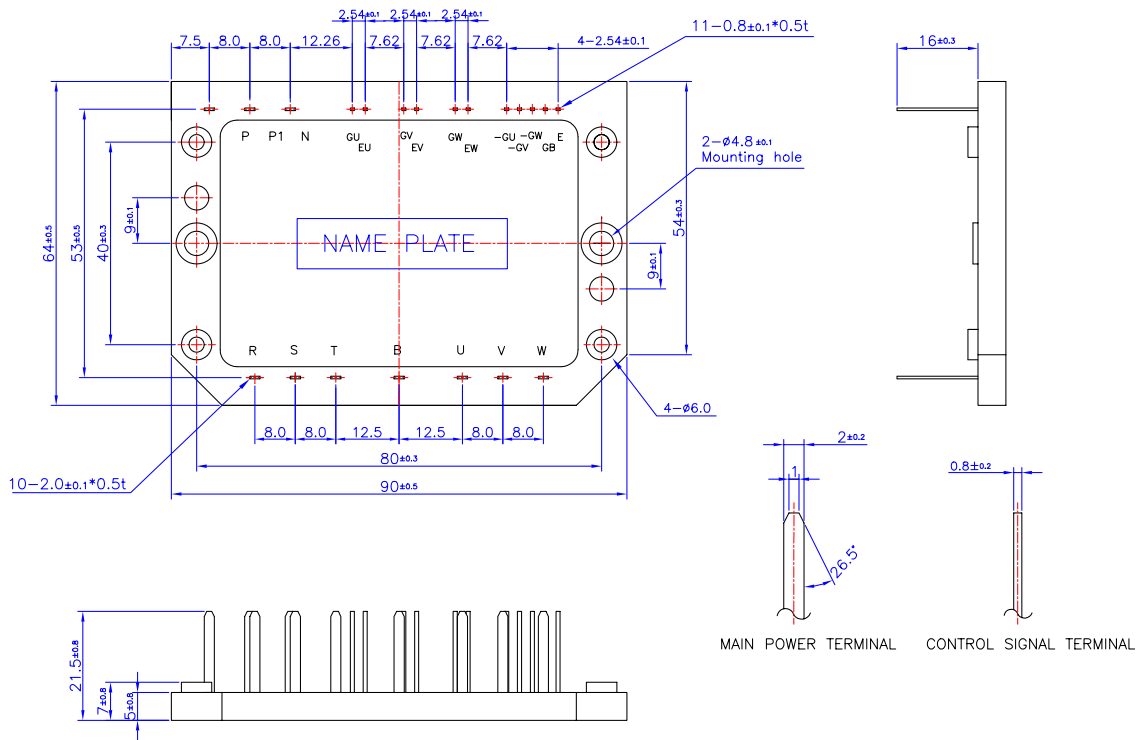


Fig 20. Reverse Recovery Characteristics

Package Dimension

21PM-AA (FS PKG CODE BJ)



Dimensions in Millimeters

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