



**MACMIC**

December 2011

**PRELIMINARY**

# MMG400D120UK6HN

1200V 400A IGBT Module

RoHS Compliant

## FEATURES

- High short circuit capability, self limiting short circuit current
- IGBT CHIP(T4 Fast Trench+Field Stop technology)
- $V_{CE(sat)}$  with positive temperature coefficient
- Fast switching and short tail current
- Free wheeling diodes with fast and soft reverse recovery
- Low switching losses
- $T_{vj\ max} = 175^{\circ}C$



## APPLICATIONS

- High frequency switching application
- Medical applications
- Motion/servo control
- UPS systems

## ABSOLUTE MAXIMUM RATINGS

*T<sub>c</sub>=25°C unless otherwise specified*

Symbol	Parameter	Test Conditions	Values	Unit
<b>IGBT</b>				
$V_{CES}$	Collector - Emitter Voltage	$T_{vj}=25^{\circ}C$	1200	V
$V_{GES}$	Gate - Emitter Voltage		$\pm 20$	V
$I_c$	DC Collector Current	$T_c=25^{\circ}C$	600	A
		$T_c=80^{\circ}C$	400	A
$I_{CM}$	Repetitive Peak Collector Current	$t_p=1ms$	800	A
$P_{tot}$	Power Dissipation Per IGBT		2100	W
<b>Diode</b>				
$V_{RRM}$	Repetitive Reverse Voltage	$T_{vj}=25^{\circ}C$	1200	V
$I_{F(AV)}$	Average Forward Current	$T_c=25^{\circ}C$	600	A
		$T_c=80^{\circ}C$	400	A
$I_{FRM}$	Repetitive Peak Forward Current	$t_p=1ms$	800	A
$I^2t$		$T_{vj} = 125^{\circ}C, t=10ms, V_R=0V$	25000	A <sup>2</sup> s

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### ELECTRICAL AND THERMAL CHARACTERISTICS $T_c=25^\circ\text{C}$ unless otherwise specified

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
<b>IGBT</b>						
$V_{GE(th)}$	Gate - Emitter Threshold Voltage	$V_{CE}=V_{GE}, I_C=16\text{mA}$	5.4	6	6.5	V
$V_{CE(sat)}$	Collector - Emitter Saturation Voltage	$I_C=400\text{A}, V_{GE}=15\text{V}, T_{Vj}=25^\circ\text{C}$		2.1	2.5	V
		$I_C=400\text{A}, V_{GE}=15\text{V}, T_{Vj}=125^\circ\text{C}$		2.5		V
$I_{CES}$	Collector Leakage Current	$V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_{Vj}=25^\circ\text{C}$			2	mA
		$V_{CE}=1200\text{V}, V_{GE}=0\text{V}, T_{Vj}=125^\circ\text{C}$			10	mA
$I_{GES}$	Gate Leakage Current	$V_{CE}=0\text{V}, V_{GE} \pm 15\text{V}, T_{Vj}=125^\circ\text{C}$	-400		400	nA
$R_{Gint}$	Integrated Gate Resistor			1.9		$\Omega$
$Q_g$	Gate Charge	$V_{CE}=600\text{V}, I_C=400\text{A}, V_{GE}=15\text{V}$		1.9		$\mu\text{C}$
$C_{ies}$	Input Capacitance	$V_{CE}=25\text{V}, V_{GE}=0\text{V}, f=1\text{MHz}$		25		nF
$C_{res}$	Reverse Transfer Capacitance				1.4	
$t_{d(on)}$	Turn - on Delay Time	$V_{CC}=600\text{V}, I_C=400\text{A}, R_G=1.8\ \Omega, V_{GE}=\pm 15\text{V},$ Inductive Load	$T_{Vj}=25^\circ\text{C}$	170		ns
			$T_{Vj}=125^\circ\text{C}$	180		ns
			$T_{Vj}=150^\circ\text{C}$	190		ns
$t_r$	Rise Time		$T_{Vj}=25^\circ\text{C}$	75		ns
			$T_{Vj}=125^\circ\text{C}$	85		ns
			$T_{Vj}=150^\circ\text{C}$	90		ns
$t_{d(off)}$	Turn - off Delay Time	$V_{CC}=600\text{V}, I_C=400\text{A}, R_G=1.8\ \Omega, V_{GE}=\pm 15\text{V},$ Inductive Load	$T_{Vj}=25^\circ\text{C}$	440		ns
			$T_{Vj}=125^\circ\text{C}$	490		ns
			$T_{Vj}=150^\circ\text{C}$	520		ns
$t_f$	Fall Time		$T_{Vj}=25^\circ\text{C}$	45		ns
			$T_{Vj}=125^\circ\text{C}$	65		ns
			$T_{Vj}=150^\circ\text{C}$	75		ns
$E_{on}$	Turn - on Energy	$V_{CC}=600\text{V}, I_C=400\text{A}, R_G=1.8\ \Omega, V_{GE}=\pm 15\text{V},$ Inductive Load	$T_{Vj}=125^\circ\text{C}$	52		mJ
			$T_{Vj}=150^\circ\text{C}$	58		mJ
$E_{off}$	Turn - off Energy		$T_{Vj}=125^\circ\text{C}$	22		mJ
			$T_{Vj}=150^\circ\text{C}$	24		mJ
$I_{sc}$	Short Circuit Current	$t_{psc} \leq 10\ \mu\text{s}, V_{GE}=15\text{V}$ $T_{Vj}=125^\circ\text{C}, V_{CC}=600\text{V}$		1600		A
$R_{thJC}$	Junction-to-Case Thermal Resistance ( Per IGBT )				0.07	K /W
<b>Diode</b>						
$V_F$	Forward Voltage	$I_F=400\text{A}, V_{GE}=0\text{V}, T_{Vj}=25^\circ\text{C}$		1.65		V
		$I_F=400\text{A}, V_{GE}=0\text{V}, T_{Vj}=125^\circ\text{C}$		1.65		V
$t_{rr}$	Reverse Recovery Time	$I_F=400\text{A}, V_R=600\text{V}$		500		ns
$I_{RRM}$	Max. Reverse Recovery Current	$di_F/dt=-4000\text{A}/\mu\text{s}$		290		A
$E_{rec}$	Reverse Recovery Energy	$T_{Vj}=125^\circ\text{C}$		31		mJ
$R_{thJCD}$	Junction-to-Case Thermal Resistance ( Per Diode )				0.12	K /W

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## MODULE CHARACTERISTICS

$T_C=25^{\circ}\text{C}$  unless otherwise specified

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$T_{vj\ max}$	Max. Junction Temperature				175	$^{\circ}\text{C}$
$T_{vj\ op}$	Operating Temperature		-40		150	$^{\circ}\text{C}$
$T_{stg}$	Storage Temperature		-40		125	$^{\circ}\text{C}$
$V_{isol}$	Insulation Test Voltage	AC, $t=1\text{min}$		3000		V
CTI	Comparative Tracking Index		350			
Torque	Module-to-Sink	Recommended (M6)	3		5	$\text{N}\cdot\text{m}$
Torque	Module Electrodes	Recommended (M6)	2.5		5	$\text{N}\cdot\text{m}$
Weight				300		g

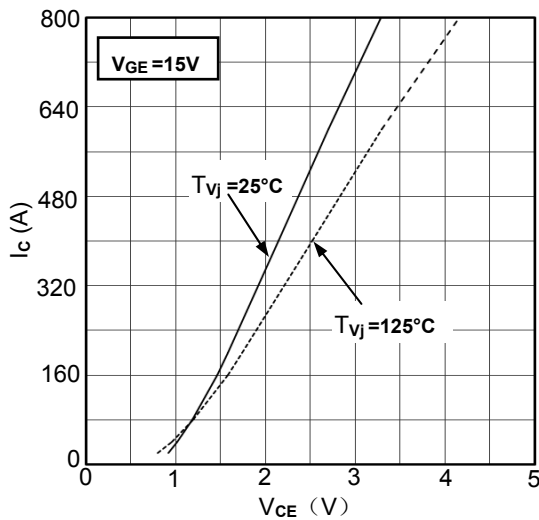


Figure1. Typical Output Characteristics

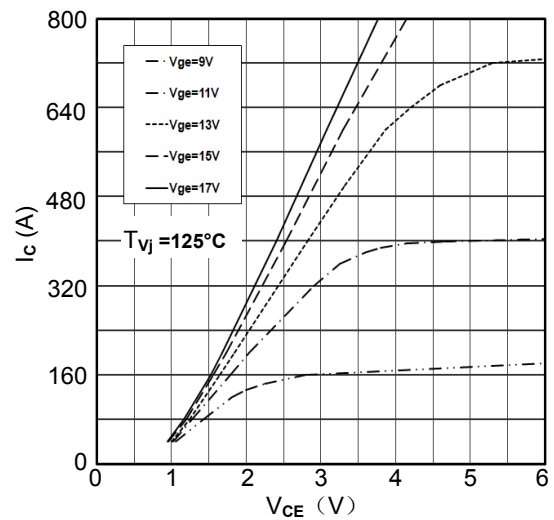


Figure2. Typical Output Characteristics

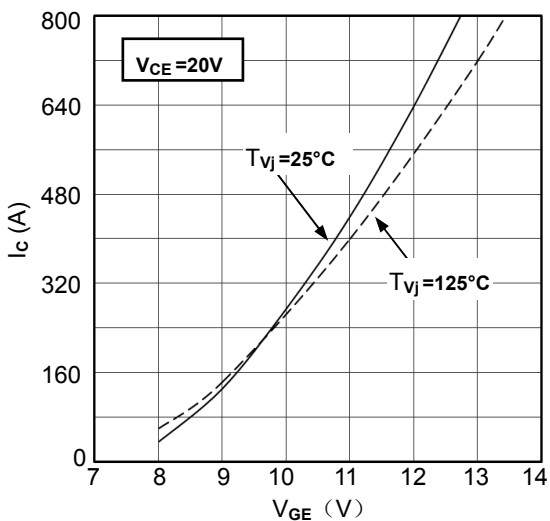


Figure3. Typical Transfer characteristics

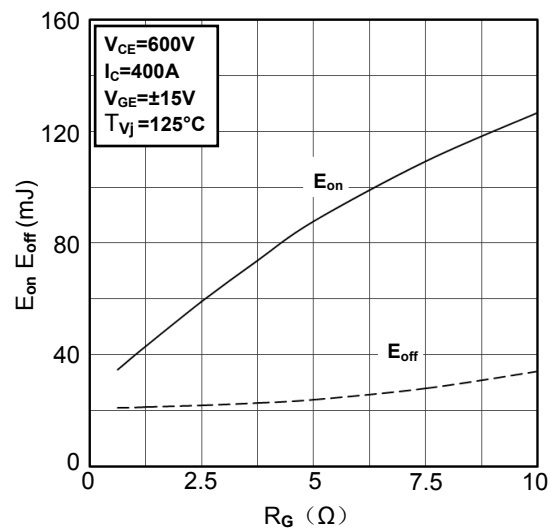


Figure4. Switching Energy vs. Gate Resistor

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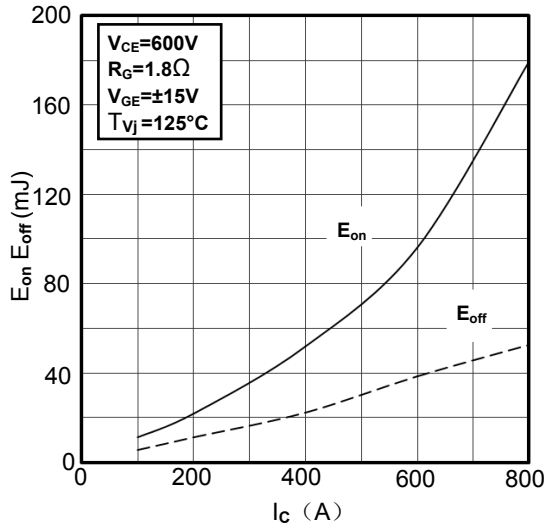


Figure 5. Switching Energy vs. Collector Current

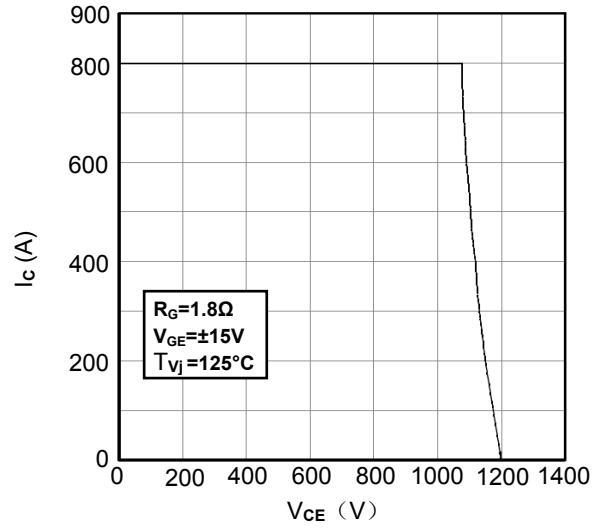


Figure 6. Reverse Biased Safe Operating Area

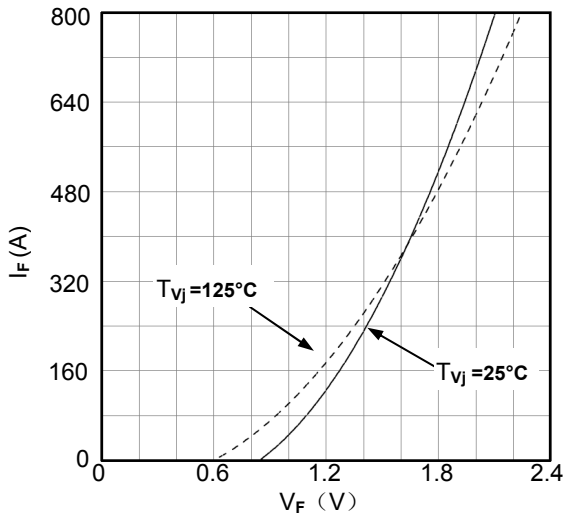


Figure 7. Diode Forward Characteristics

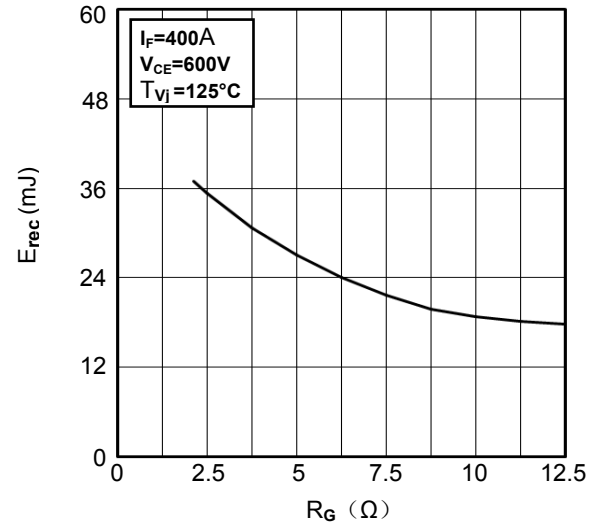


Figure 8. Switching Energy vs. Gate Resistor

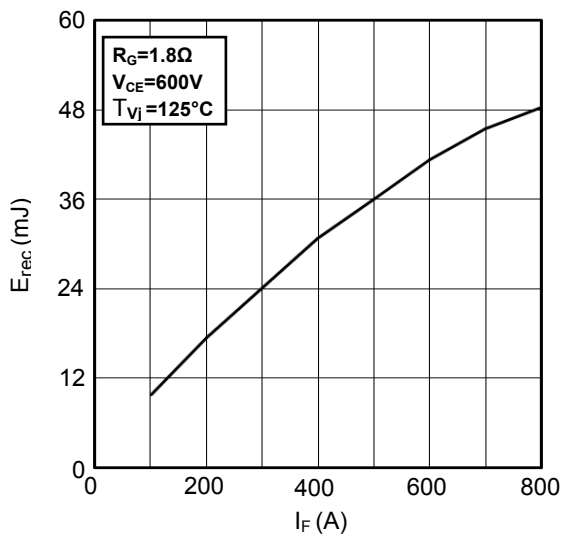


Figure 9. Switching Energy vs. Forward Current

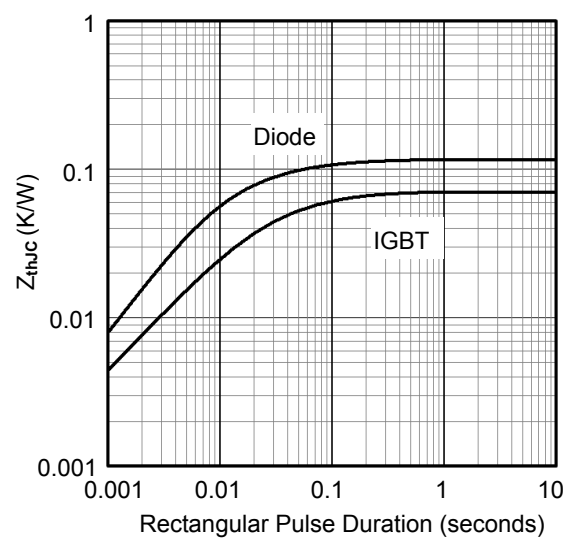


Figure 10. Transient Thermal Impedance

