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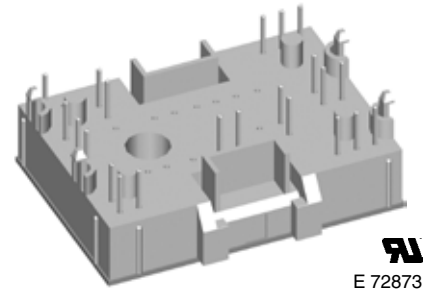
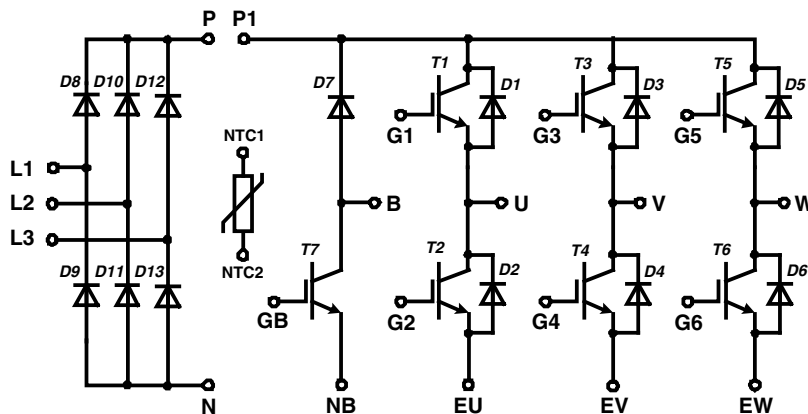
# Converter - Brake - Inverter Module

## Low Loss Trench IGBT

Three Phase Rectifier	Brake Chopper	Three Phase Inverter
$V_{RRM} = 1600 \text{ V}$	$V_{CES} = 1200 \text{ V}$	$V_{CES} = 1200 \text{ V}$
$I_{DAVM25} = 90 \text{ A}$	$I_{C25} = 29 \text{ A}$	$I_{C25} = 29 \text{ A}$
$I_{FSM} = 300 \text{ A}$	$V_{CE(sat)} = 1.7 \text{ V}$	$V_{CE(sat)} = 1.7 \text{ V}$

**Part name** (Marking on product)

MITB15WB1200TMH



Pin configuration see outlines.

### Features:

- High level of integration - only one power semiconductor module required for the whole drive
- Inverter with low loss Trench IGBTs
  - very low saturation voltage
  - positive temperature coefficient
  - short tail current
- Epitaxial free wheeling diodes with hiperfast soft reverse recovery
- Temperature sense included

### Application:

- AC motor drives
- Pumps, Fans
- Washing machines
- Air-conditioning system
- Inverter and power supplies

### Package:

- "Mini" package
- Assembly height is 17 mm
- Insulated base plate
- Pins suitable for wave soldering and PCB mounting
- Assembly clips available
  - IXKU 5-505 screw clamp
  - IXRB 5-506 click clamp
- UL registered E72873

**Output Inverter T1 - T6**

Symbol	Definitions	Conditions	Ratings			Unit	
			min.	typ.	max.		
$V_{CES}$	collector emitter voltage		$T_{VJ} = 150^{\circ}\text{C}$		1200	V	
$V_{GES}$	max. DC gate voltage	continuous			$\pm 20$	V	
$V_{GEM}$	max. transient collector gate voltage	transient			$\pm 30$	V	
$I_{C25}$	collector current		$T_C = 25^{\circ}\text{C}$		29	A	
$I_{C80}$			$T_C = 80^{\circ}\text{C}$		20	A	
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}\text{C}$		100	W	
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 15\text{ A}; V_{GE} = 15\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	1.7 2.0	2.2	V V	
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 0.5\text{ mA}; V_{GE} = V_{CE}$	$T_{VJ} = 25^{\circ}\text{C}$	5	5.5	6.5	V
$I_{CES}$	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		0.8	0.6	mA mA
$I_{GES}$	gate emitter leakage current	$V_{GE} = \pm 20\text{ V}$			150	nA	
$C_{ies}$	input capacitance	$V_{CE} = 25\text{ V}; V_{GE} = 0\text{ V}; f = 1\text{ MHz}$		1100		pF	
$Q_{G(on)}$	total gate charge	$V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 15\text{ A}$		92		nC	
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 600\text{ V}; I_C = 15\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 75\ \Omega$	$T_{VJ} = 25^{\circ}\text{C}$	55		ns	
$t_r$	current rise time			30		ns	
$t_{d(off)}$	turn-off delay time			320		ns	
$t_f$	current fall time			200		ns	
$E_{on}$	turn-on energy per pulse			1.2		mJ	
$E_{off}$	turn-off energy per pulse			1.3		mJ	
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 600\text{ V}; I_C = 15\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 75\ \Omega$	$T_{VJ} = 125^{\circ}\text{C}$	60		ns	
$t_r$	current rise time			35		ns	
$t_{d(off)}$	turn-off delay time			360		ns	
$t_f$	current fall time			340		ns	
$E_{on}$	turn-on energy per pulse			2		mJ	
$E_{off}$	turn-off energy per pulse			1.7		mJ	
<b>RBSOA</b>	reverse bias safe operating area	$V_{GE} = \pm 15\text{ V}; R_G = 75\ \Omega; I_C = 30\text{ A};$	$T_{VJ} = 125^{\circ}\text{C}$	$V_{CEK} \leq V_{CES} - L_S \cdot di/dt$		V	
<b><math>I_{SC}</math> (SCSOA)</b>	short circuit safe operating area	$V_{CE} = 720\text{ V}; V_{GE} = \pm 15\text{ V};$ $R_G = 75\ \Omega; t_p = 10\ \mu\text{s};$	$T_{VJ} = 125^{\circ}\text{C}$	68		A	
$R_{thJC}$	thermal resistance junction to case	(per IGBT)			1.2	K/W	
$R_{thCH}$	thermal resistance case to heatsink			0.4		K/W	

**Output Inverter D1 - D6**

Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$V_{RRM}$	max. repetitive reverse voltage		$T_{VJ} = 150^{\circ}\text{C}$		1200	V
$I_{F25}$	forward current		$T_C = 25^{\circ}\text{C}$		24	A
$I_{F80}$			$T_C = 80^{\circ}\text{C}$		16	A
$V_F$	forward voltage	$I_F = 15\text{ A}; V_{GE} = 0\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	2.3 1.9	2.7	V V
$Q_{rr}$	reverse recovery charge	$V_R = 600\text{ V}$ $di_F/dt = -420\text{ A}/\mu\text{s}$ $I_F = 15\text{ A}; V_{GE} = 0\text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$	2.3		$\mu\text{C}$
$I_{RM}$	max. reverse recovery current			19.6		A
$t_{rr}$	reverse recovery time			330		ns
$E_{rec}$	reverse recovery energy			0.68		mJ
$R_{thJC}$	thermal resistance junction to case	(per diode)			1.6	K/W
$R_{thCH}$	thermal resistance case to heatsink			0.55		K/W

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

**Brake T7**

Symbol	Definitions	Conditions	Ratings			Unit	
			min.	typ.	max.		
$V_{CES}$	collector emitter voltage		$T_{VJ} = 150^{\circ}\text{C}$		1200	V	
$V_{GES}$	max. DC gate voltage	continuous			$\pm 20$	V	
$V_{GEM}$	max. transient collector gate voltage	transient			$\pm 30$	V	
$I_{C25}$	collector current		$T_C = 25^{\circ}\text{C}$		29	A	
$I_{C80}$			$T_C = 80^{\circ}\text{C}$		20	A	
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}\text{C}$		100	W	
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 15\text{ A}; V_{GE} = 15\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	1.7 2.0	2.2	V V	
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 0.5\text{ mA}; V_{GE} = V_{CE}$	$T_{VJ} = 25^{\circ}\text{C}$	5	5.5	6.5	V
$I_{CES}$	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		0.8	0.6	mA mA
$I_{GES}$	gate emitter leakage current	$V_{GE} = \pm 20\text{ V}$			150	nA	
$C_{ies}$	input capacitance	$V_{CE} = 25\text{ V}; V_{GE} = 0\text{ V}; f = 1\text{ MHz}$		1100		pF	
$Q_{G(on)}$	total gate charge	$V_{CE} = 600\text{ V}; V_{GE} = 15\text{ V}; I_C = 15\text{ A}$		92		nC	
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 600\text{ V}; I_C = 15\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 75\ \Omega$	$T_{VJ} = 25^{\circ}\text{C}$	55		ns	
$t_r$	current rise time			30		ns	
$t_{d(off)}$	turn-off delay time			320		ns	
$t_f$	current fall time			200		ns	
$E_{on}$	turn-on energy per pulse			1.0		mJ	
$E_{off}$	turn-off energy per pulse			1.3		mJ	
$t_{d(on)}$	turn-on delay time	inductive load $V_{CE} = 600\text{ V}; I_C = 15\text{ A}$ $V_{GE} = \pm 15\text{ V}; R_G = 75\ \Omega$	$T_{VJ} = 125^{\circ}\text{C}$	60		ns	
$t_r$	current rise time			35		ns	
$t_{d(off)}$	turn-off delay time			360		ns	
$t_f$	current fall time			340		ns	
$E_{on}$	turn-on energy per pulse			1.6		mJ	
$E_{off}$	turn-off energy per pulse			1.7		mJ	
<b>RBSOA</b>	reverse bias safe operating area	$V_{GE} = \pm 15\text{ V}; R_G = 75\ \Omega; I_C = 30\text{ A};$	$T_{VJ} = 125^{\circ}\text{C}$	$V_{CEK} \leq V_{CES} - L_S \cdot di/dt$		V	
<b><math>I_{SC}</math> (SCSOA)</b>	short circuit safe operating area	$V_{CE} = 720\text{ V}; V_{GE} = \pm 15\text{ V};$ $R_G = 75\ \Omega; t_p = 10\ \mu\text{s};$ non-repetitive	$T_{VJ} = 125^{\circ}\text{C}$	68		A	
$R_{thJC}$	thermal resistance junction to case	(per IGBT)			1.2	K/W	
$R_{thCH}$	thermal resistance case to heatsink			0.4		K/W	

**Brake Chopper D7**

Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$V_{RRM}$	max. repetitive reverse voltage		$T_{VJ} = 150^{\circ}\text{C}$		1200	V
$I_{F25}$	forward current		$T_C = 25^{\circ}\text{C}$		15	A
$I_{F80}$			$T_C = 80^{\circ}\text{C}$		10	A
$V_F$	forward voltage	$I_F = 15\text{ A}; V_{GE} = 0\text{ V}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	3.0 2.4	3.3	V V
$I_R$	reverse current	$V_R = V_{RRM}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		0.1	mA mA
$Q_{rr}$	reverse recovery charge	$V_R = 600\text{ V}$ $di_F/dt = \text{tbd A}/\mu\text{s}$ $I_F = 10\text{ A}; V_{GE} = 0\text{ V}$	$T_{VJ} = 125^{\circ}\text{C}$	tbd		$\mu\text{C}$
$I_{RM}$	max. reverse recovery current			tbd		A
$t_{rr}$	reverse recovery time			tbd		ns
$E_{rec}$	reverse recovery energy			tbd		$\mu\text{J}$
$R_{thJC}$	thermal resistance junction to case	(per diode)			2.5	K/W
$R_{thCH}$	thermal resistance case to heatsink			0.85		K/W

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

**Input Rectifier Bridge D8 - D11**

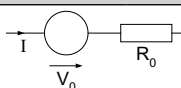
Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$V_{RRM}$	max. repetitive reverse voltage		$T_{VJ} = 25^{\circ}\text{C}$		1600	V
$I_{FAV}$	average forward current	sine $180^{\circ}$	$T_C = 80^{\circ}\text{C}$		22	A
$I_{DAVM}$	max. average DC output current	rect.; $d = 1/3$	$T_C = 80^{\circ}\text{C}$		61	A
$I_{FSM}$	max. forward surge current	$t = 10\text{ ms}$ ; sine 50 Hz	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		300 tbd	A A
$I^2t$	$I^2t$ value for fusing	$t = 10\text{ ms}$ ; sine 50 Hz	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$		450 tbd	$\text{A}^2\text{s}$ $\text{A}^2\text{s}$
$P_{tot}$	total power dissipation		$T_C = 25^{\circ}\text{C}$		50	W
$V_F$	forward voltage	$I_F = 30\text{ A}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	1.35 1.35	1.6	V V
$I_R$	reverse current	$V_R = V_{RRM}$	$T_{VJ} = 25^{\circ}\text{C}$ $T_{VJ} = 125^{\circ}\text{C}$	0.3	0.01	mA mA
$R_{thJC}$	thermal resistance junction to case	(per diode)			2.1	K/W
$R_{thCH}$	thermal resistance case to heatsink	(per diode)		0.7		K/W

**Temperature Sensor NTC**

Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$R_{25}$	resistance		$T_C = 25^{\circ}\text{C}$	4.75	5.0	$\text{k}\Omega$
$B_{25/50}$				3375		K

**Module**

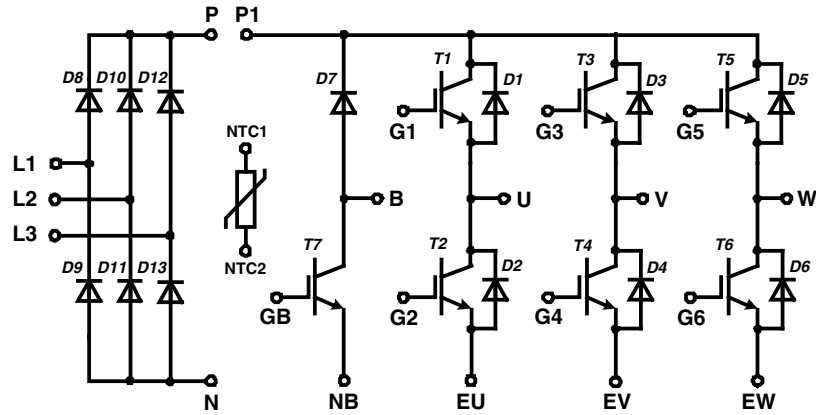
Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$T_{VJ}$	operating temperature		-40		125	$^{\circ}\text{C}$
$T_{VJM}$	max. virtual junction temperature				150	$^{\circ}\text{C}$
$T_{stg}$	storage temperature		-40		125	$^{\circ}\text{C}$
$V_{ISOL}$	isolation voltage	$I_{ISOL} \leq 1\text{ mA}$ ; 50/60 Hz			2500	V~
<b>CTI</b>	comparative tracking index				-	
$F_C$	mounting force		40		80	N
$d_S$	creep distance on surface		12.7			mm
$d_A$	strike distance through air		12			mm
<b>Weight</b>				35		g

**Equivalent Circuits for Simulation**


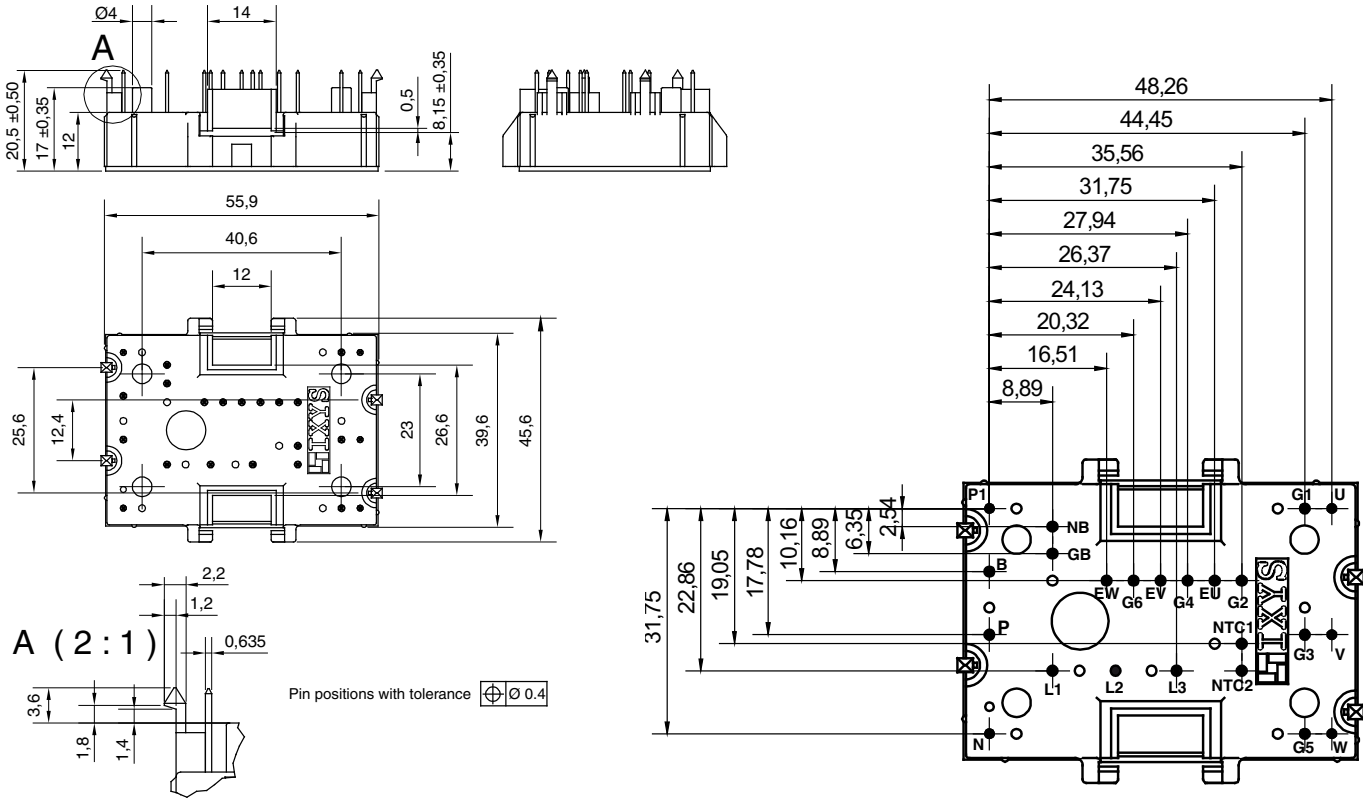
Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
$V_0$	rectifier diode	D8 - D13	$T_{VJ} = 125^{\circ}\text{C}$	0.9		V
$R_0$				16		$\text{m}\Omega$
$V_0$	IGBT	T1 - T6	$T_{VJ} = 125^{\circ}\text{C}$	1.0		V
$R_0$				67		$\text{m}\Omega$
$V_0$	free wheeling diode	D1 - D6	$T_{VJ} = 125^{\circ}\text{C}$	1.15		V
$R_0$				50		$\text{m}\Omega$
$V_0$	IGBT	T7	$T_{VJ} = 125^{\circ}\text{C}$	1.0		V
$R_0$				67		$\text{m}\Omega$
$V_0$	free wheeling diode	D7	$T_{VJ} = 125^{\circ}\text{C}$	1.6		V
$R_0$				53		$\text{m}\Omega$

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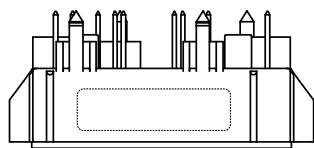
**Circuit Diagram**



**Outline Drawing** Dimensions in mm (1 mm = 0.0394")



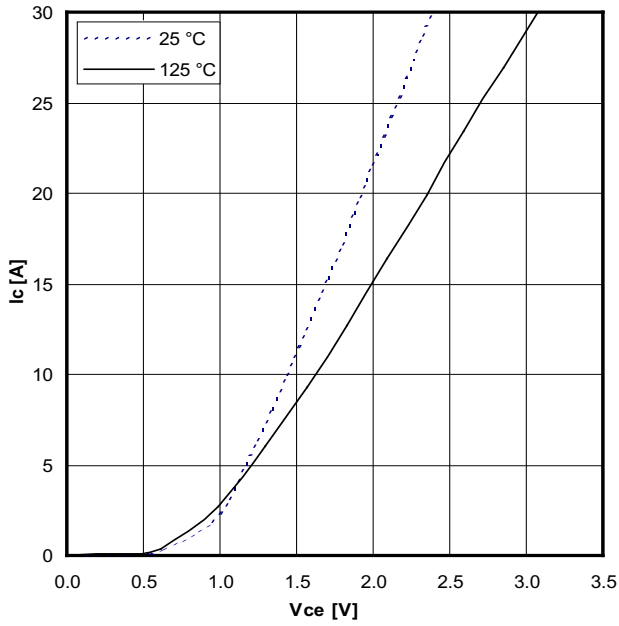
**Product Marking**



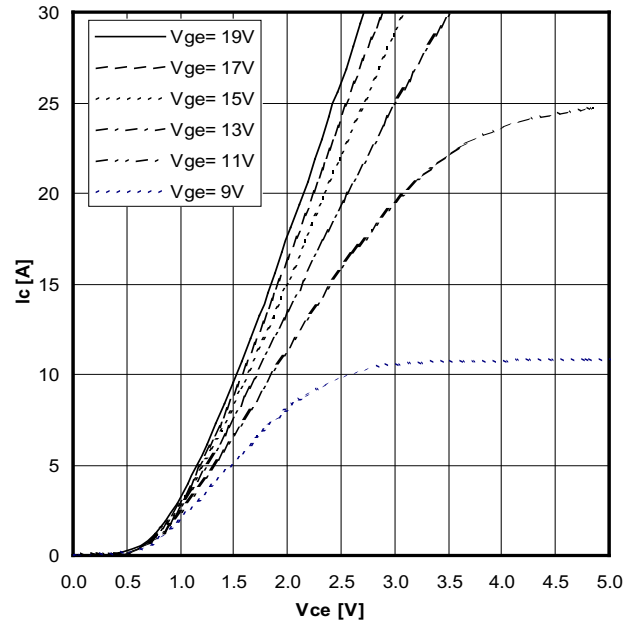
**Part number**

- M = Module
- I = IGBT
- T = Trench
- A = Gen<sup>3</sup> / low loss
- 10 = Current Rating [A]
- WB = 6-Pack + 3- Rectifier Bridge & Brake Unit
- 1200 = Reverse Voltage [V]
- T = NTC
- MH = MiniPack2

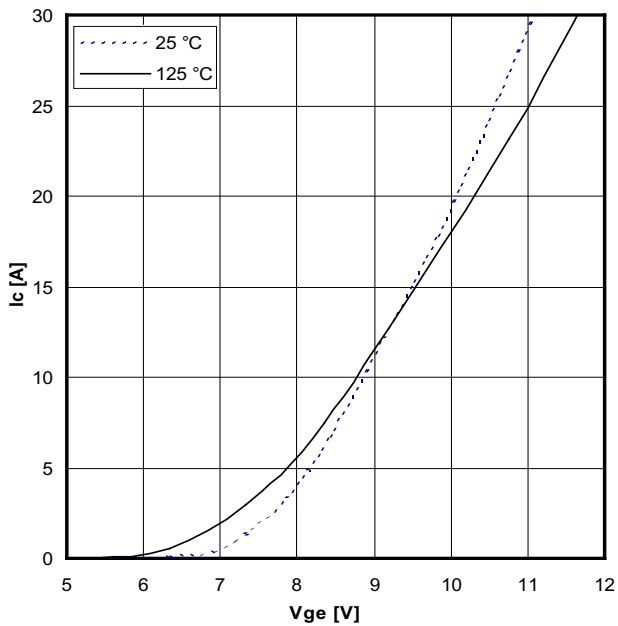
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Standard	MITB 15 WB 1200 TMH	MITB15WB1200TMH	Box	20	502893



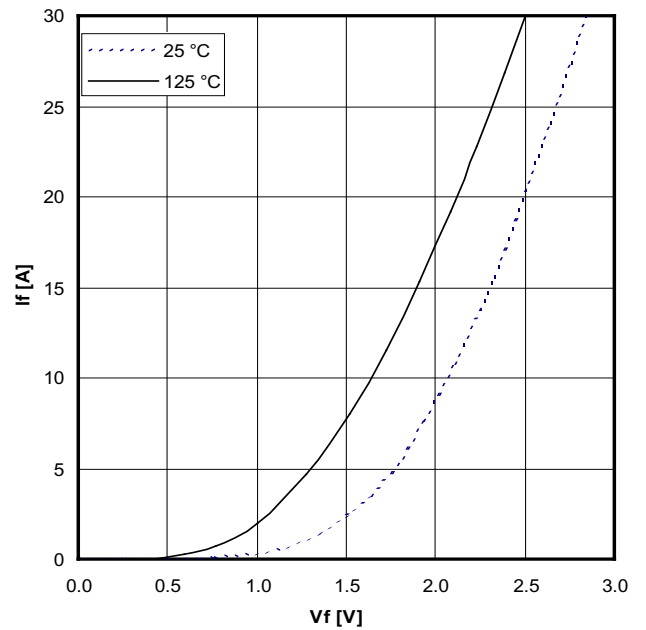
Typical output characteristics,  $V_{GE} = 15V$



Typical output characteristics ( $125^\circ C$ )

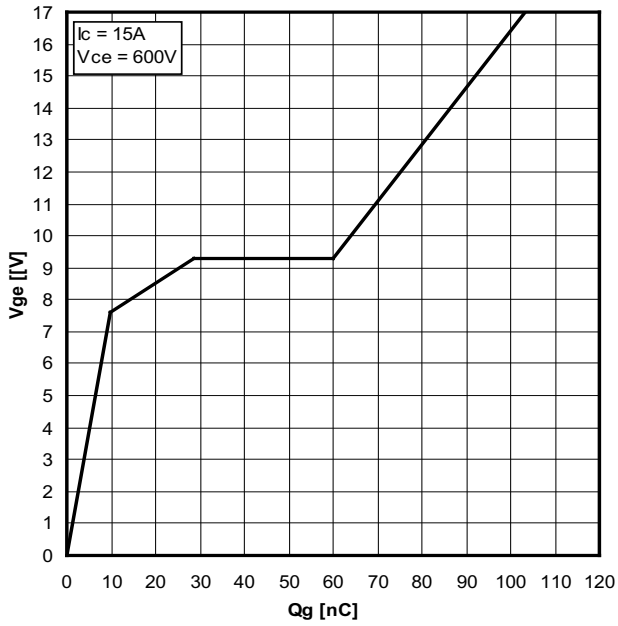


Typical transfer characteristics

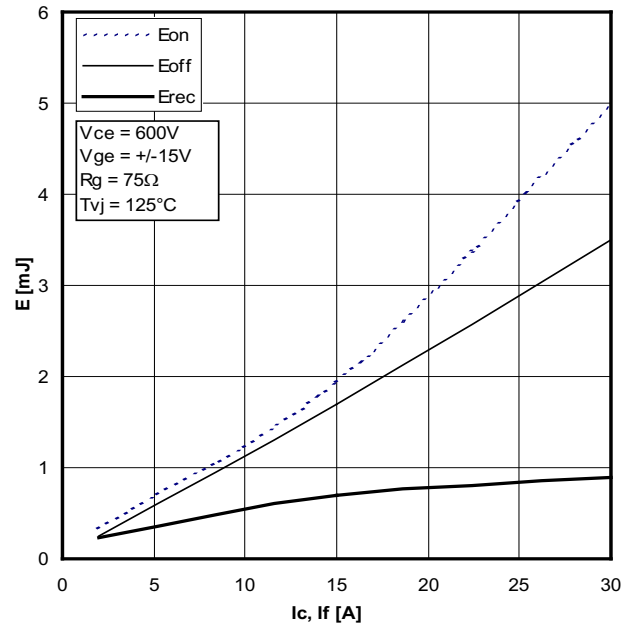


Typical forward characteristics of freewheeling diode

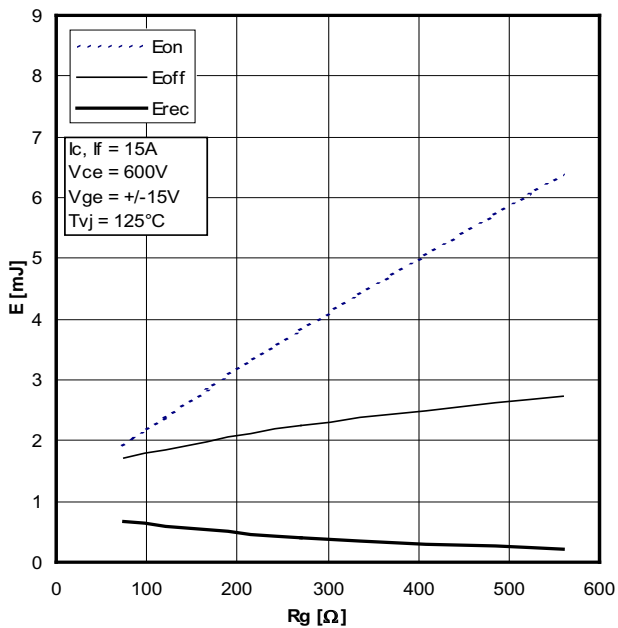
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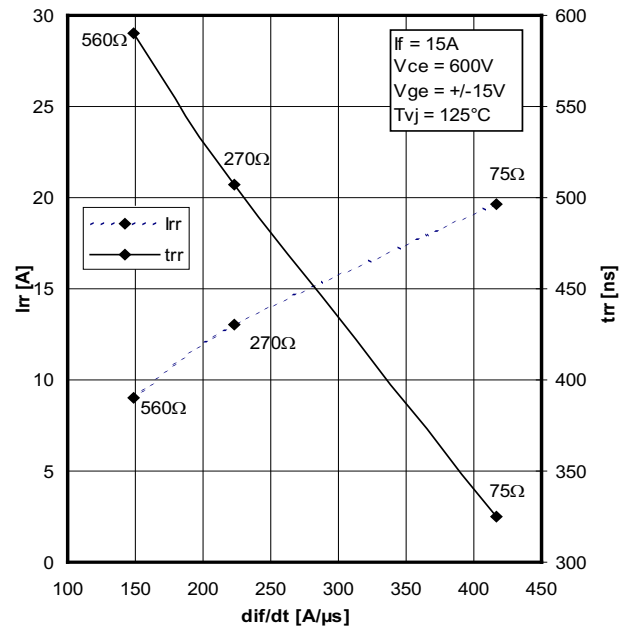
Typical turn on gate charge



Typical switching energy versus collector current

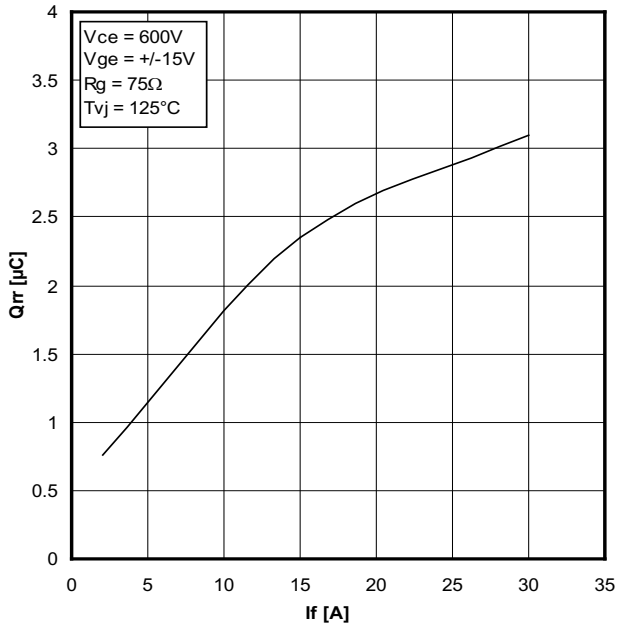


Typical switching energy versus gate resistance

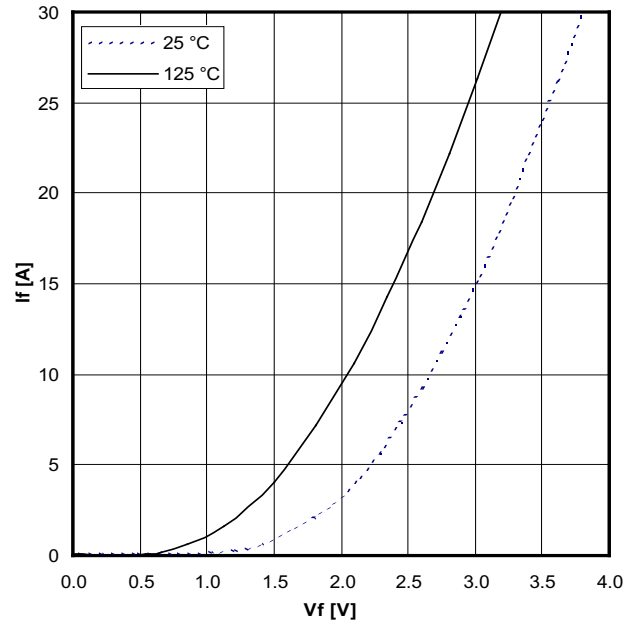


Typical turn-off characteristics of free wheeling diode

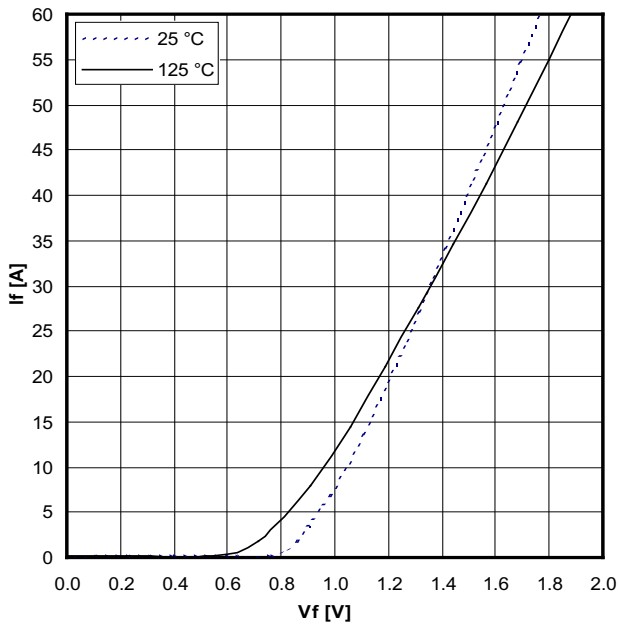




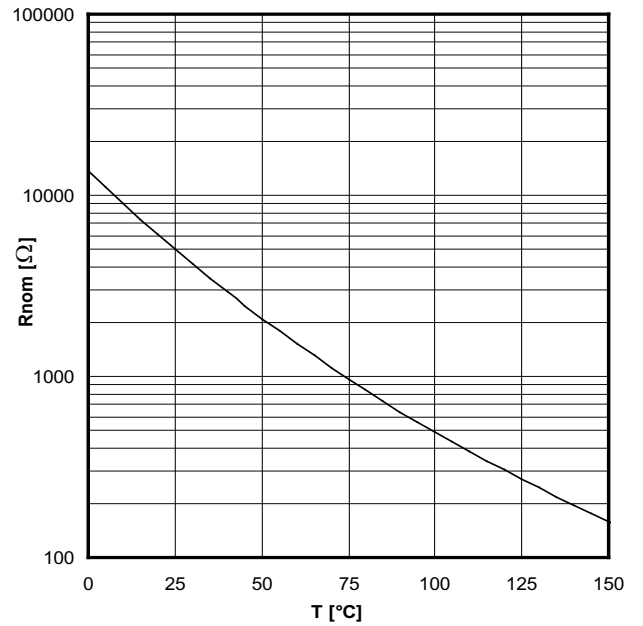
Typical turn-off characteristics of free wheeling diode



Typical forward characteristics of brake diode



Typical forward characteristics per rectifier



Typical thermistor resistance versus temperature