Converter - Brake - Inverter Module
NPT IGBT

Single Phase Rectifier	Brake Chopper	Three Phase Inverter
V_{RRM} = 1600 V	V_{CES} = 600 V	V_{CES} = 600 V
I_{DAVM25} = 65 A	I_{C25} = 29 A	I_{C25} = 29 A
I_{FSM} = 550 A	$V_{CE(sat)}$ = 2.1 V	$V_{CE(sat)}$ = 2.1 V

Part name (Marking on product)

MIAA20WE600TMH
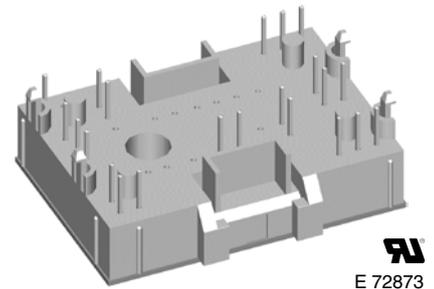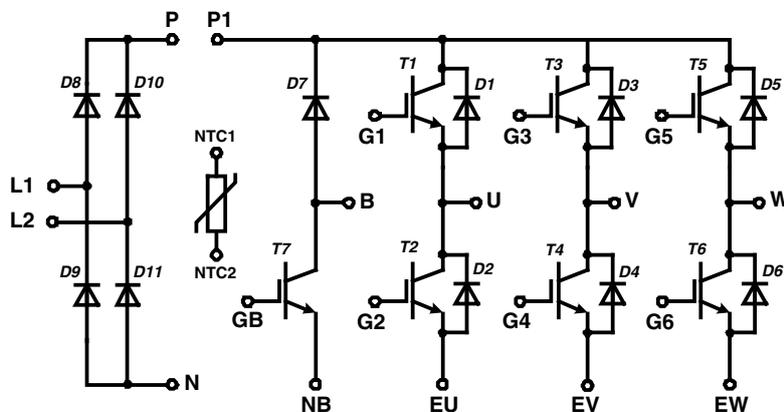
E 72873

Pin configuration see outlines.

Features:
- High level of integration - only one power semiconductor module required for the whole drive
- Inverter with NPT IGBTs
  - low saturation voltage
  - positive temperature coefficient
  - fast switching
  - 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

IXYS reserves the right to change limits, test conditions and dimensions.

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Ouput Inverter T1 - T6

Symbol	Definitions	Conditions		min.	typ.	max.	Unit
					Ratings		
V_{CES}	collector emitter voltage		$T_{VJ} = 150°C$			600	V
V_{GES}	max. DC gate voltage	continuous				±20	V
V_{GEM}	max. transient collector gate voltage	transient				±30	V
I_{C25}	collector current		$T_C = 25°C$			29	A
I_{C80}			$T_C = 80°C$			20	A
P_{tot}	total power dissipation		$T_C = 25°C$			100	W
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 20 A; V_{GE} = 15 V$	$T_{VJ} = 25°C$		2.1	2.7	V
			$T_{VJ} = 125°C$		2.4		V
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 0.5 A; V_{GE} = V_{CE}$	$T_{VJ} = 25°C$	4.5	5.5	6.5	V
I_{CES}	collector emitter leakage current	$V_{CE} = V_{CES}; V_{GE} = 0 V$	$T_{VJ} = 25°C$			1.1	mA
			$T_{VJ} = 125°C$		1.3		mA
I_{GES}	gate emitter leakage current	$V_{GE} = ±20 V$				150	nA
C_{ies}	input capacitance	$V_{CE} = 25 V; V_{GE} = 0 V; f = 1 MHz$			900		pF
$Q_{G(on)}$	total gate charge	$V_{CE} = 300 V; V_{GE} = 15 V; I_C = 20 A$			76		nC
$t_{d(on)}$	turn-on delay time				35		ns
t_r	current rise time				45		ns
$t_{d(off)}$	turn-off delay time	inductive load	$T_{VJ} = 25°C$		155		ns
t_f	current fall time	$V_{CE} = 300 V; I_C = 20 A$			75		ns
E_{on}	turn-on energy per pulse	$V_{GE} = ±15 V; R_G = 47 \Omega$			0.39		mJ
E_{off}	turn-off energy per pulse				0.4		mJ
$t_{d(on)}$	turn-on delay time				35		ns
t_r	current rise time				45		ns
$t_{d(off)}$	turn-off delay time	inductive load	$T_{VJ} = 125°C$		165		ns
t_f	current fall time	$V_{CE} = 300 V; I_C = 20 A$			150		ns
E_{on}	turn-on energy per pulse	$V_{GE} = ±15 V; R_G = 47 \Omega$			0.6		mJ
E_{off}	turn-off energy per pulse				0.54		mJ
RBSOA	reverse bias safe operating area	$V_{GE} = ±15 V; R_G = 47 \Omega; I_C = 40 A$ $T_{VJ} = 125°C$	$V_{CEK} \le V_{CES}$-L_S·d_I/dt				V
I_{SC} (SCSOA)	short circuit safe operating area	$V_{CE} = 360 V; V_{GE} = ±15 V$; $R_G = 47 \Omega; t_p = 10$ µs; non-repetitive	$T_{VJ} = 125°C$		90		A
R_{thJC}	thermal resistance junction to case	(per IGBT)				1.3	K/W
R_{thCH}	thermal resistance case to heatsink				0.45		K/W

Output Inverter D1 - D6

Symbol	Definitions	Conditions		min.	typ.	max.	Unit
					Ratings		
V_{RRM}	max. repetitve reverse voltage		$T_{VJ} = 150°C$			600	V
I_{F25}	forward current		$T_C = 25°C$			37	A
I_{F80}			$T_C = 80°C$			24	A
V_F	forward voltage	$I_F = 20 A; V_{GE} = 0 V$	$T_{VJ} = 25°C$		1.95	2.2	V
			$T_{VJ} = 125°C$		1.65		V
Q_{rr}	reverse recovery charge				0.58		µC
I_{RM}	max. reverse recovery current	$V_R = 300 V$			10.7		A
t_{rr}	reverse recovery time	di_F/dt = -370 A/µs	$T_{VJ} = 125°C$		110		ns
E_{rec}	reverse recovery energy	$I_F = 20 A; V_{GE} = 0 V$			60		µJ
R_{thJC}	thermal resistance junction to case	(per diode)				1.6	K/W
R_{thCH}	thermal resistance case to heatsink				0.55		K/W

$T_C = 25°C$ unless otherwise stated

IXYS reserves the right to change limits, test conditions and dimensions.

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Brake T7

Symbol	Definitions	Conditions		min.	typ.	max.	Unit
					Ratings		
V_{CES}	collector emitter voltage		$T_{VJ} = 150°C$			600	V
V_{GES}	max. DC gate voltage	continuous				±20	V
V_{GEM}	max. transient collector gate voltage	transient				±30	V
I_{C25}	collector current		$T_C = 25°C$			29	A
I_{C80}			$T_C = 80°C$			20	A
P_{tot}	total power dissipation		$T_C = 25°C$			100	W
$V_{CE(sat)}$	collector emitter saturation voltage	$I_C = 20$ A; $V_{GE} = 15$ V	$T_{VJ} = 25°C$		2.1	2.7	V
			$T_{VJ} = 125°C$		2.4		V
$V_{GE(th)}$	gate emitter threshold voltage	$I_C = 0.5$ A; $V_{GE} = V_{CE}$	$T_{VJ} = 25°C$	4.5	5.5	6.5	V
I_{CES}	collector emitter leakage current	$V_{CE} = V_{CES}$; $V_{GE} = 0$ V	$T_{VJ} = 25°C$			1.0	mA
			$T_{VJ} = 125°C$		0.8		mA
I_{GES}	gate emitter leakage current	$V_{GE} = ±20$ V				150	nA
C_{ies}	input capacitance	$V_{CE} = 25$ V; $V_{GE} = 0$ V; f = 1 MHz			900		pF
$Q_{G(on)}$	total gate charge	$V_{CE} = 300$ V; $V_{GE} = 15$ V; $I_C = 20$ A			76		nC
$t_{d(on)}$	turn-on delay time				35		ns
t_r	current rise time				45		ns
$t_{d(off)}$	turn-off delay time	inductive load	$T_{VJ} = 25°C$		155		ns
t_f	current fall time	$V_{CE} = 300$ V; $I_C = 20$ A			75		ns
E_{on}	turn-on energy per pulse	$V_{GE} = ±15$ V; $R_G = 47$ Ω			0.39		mJ
E_{off}	turn-off energy per pulse				0.4		mJ
$t_{d(on)}$	turn-on delay time				35		ns
t_r	current rise time				45		ns
$t_{d(off)}$	turn-off delay time	inductive load	$T_{VJ} = 125°C$		165		ns
t_f	current fall time	$V_{CE} = 300$ V; $I_C = 20$ A			150		ns
E_{on}	turn-on energy per pulse	$V_{GE} = ±15$ V; $R_G = 47$ Ω			0.6		mJ
E_{off}	turn-off energy per pulse				0.54		mJ
RBSOA	reverse bias safe operating area	$V_{GE} = ±15$ V; $R_G = 47$ Ω; $I_C = 40$ A $T_{VJ} = 125°C$	$V_{CEK} \le V_{CES} - L_S \cdot d_I / dt$				V
I_{SC} **(SCSOA)**	short circuit safe operating area	$V_{CE} = 360$ V; $V_{GE} = ±15$ V; $R_G = 47$ Ω; $t_p = 10$ µs; non-repetitive	$T_{VJ} = 125°C$		90		A
R_{thJC}	thermal resistance junction to case	(per IGBT)				1.3	K/W
R_{thCH}	thermal resistance case to heatsink				0.45		K/W

Brake Chopper D7

Symbol	Definitions	Conditions		min.	typ.	max.	Unit
					Ratings		
V_{RRM}	max. repetitive reverse voltage		$T_{VJ} = 150°C$			600	V
I_{F25}	forward current		$T_C = 25°C$			37	A
I_{F80}			$T_C = 80°C$			24	A
V_F	forward voltage	$I_F = 20$ A; $V_{GE} = 0$ V	$T_{VJ} = 25°C$		1.95	2.2	V
			$T_{VJ} = 125°C$		1.65		V
I_R	reverse current	$V_R = V_{RRM}$	$T_{VJ} = 25°C$			0.1	mA
			$T_{VJ} = 125°C$		0.4		mA
Q_{rr}	reverse recovery charge				0.58		µC
I_{RM}	max. reverse recovery current	$V_R = 300$ V			10.7		A
t_{rr}	reverse recovery time	$di_F / dt = -370$ A/µs	$T_{VJ} = 125°C$		110		ns
E_{rec}	reverse recovery energy	$I_F = 20$ A; $V_{GE} = 0$ V			60		µJ
R_{thJC}	thermal resistance junction to case	(per diode)				1.6	K/W
R_{thCH}	thermal resistance case to heatsink				0.55		K/W

$T_C = 25°C$ unless otherwise stated

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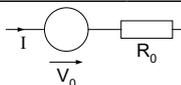
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Input Rectifier Bridge D8 - D11

Symbol	Definitions	Conditions		min.	typ.	max.	Unit
V_{RRM}	max. repetitive reverse voltage		$T_{VJ} = 25°C$			1600	V
I_{FAV}	average forward current	sine 180°	$T_C = 80°C$			39	A
I_{DAVM}	max. average DC output current	rect.; d = ½	$T_C = 80°C$			42	A
I_{FSM}	max. forward surge current	t = 10 ms; sine 50 Hz	$T_{VJ} = 25°C$			550	A
			$T_{VJ} = 125°C$			tbd	A
I^2t	I²t value for fusing	t = 10 ms; sine 50 Hz	$T_{VJ} = 25°C$			1270	A²s
			$T_{VJ} = 125°C$			tbd	A²s
P_{tot}	total power dissipation		$T_C = 25°C$			100	W
V_F	forward voltage	$I_F = 30$ A	$T_{VJ} = 25°C$		1.2	1.5	V
			$T_{VJ} = 125°C$		1.3		V
I_R	reverse current	$V_R = V_{RRM}$	$T_{VJ} = 25°C$			0.03	mA
			$T_{VJ} = 125°C$		0.3		mA
R_{thJC}	thermal resistance junction to case	(per diode)				1.2	K/W
R_{thCH}	thermal resistance case to heatsink	(per diode)			0.4		K/W

Temperature Sensor NTC

Symbol	Definitions	Conditions		min.	typ.	max.	Unit
R_{25}	resistance		$T_C = 25°C$	4.75	5.0	5.25	kΩ
$B_{25/50}$					3375		K

Module

Symbol	Definitions	Conditions	min.	typ.	max.	Unit
T_{VJ}	operating temperature		-40		125	°C
T_{VJM}	max. virtual junction temperature				150	°C
T_{stg}	storage temperature		-40		125	°C
V_{ISOL}	isolation voltage	$I_{ISOL} \leq 1$ mA; 50/60 Hz			2500	V~
CTI	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
Weight				35		g

Equivalent Circuits for Simulation

Symbol	Definitions	Conditions		min.	typ.	max.	Unit
V_0	rectifier diode	D8 - D11	$T_{VJ} = 125°C$		0.9		V
R_0					6		mΩ
V_0	IGBT	T1 - T6	$T_{VJ} = 125°C$		1.1		V
R_0					40		mΩ
V_0	free wheeling diode	D1 - D6	$T_{VJ} = 125°C$		1.25		V
R_0					12		mΩ
V_0	IGBT	T7	$T_{VJ} = 125°C$		1.1		V
R_0					60		mΩ
V_0	free wheeling diode	D7	$T_{VJ} = 125°C$		1.25		V
R_0					25		mΩ

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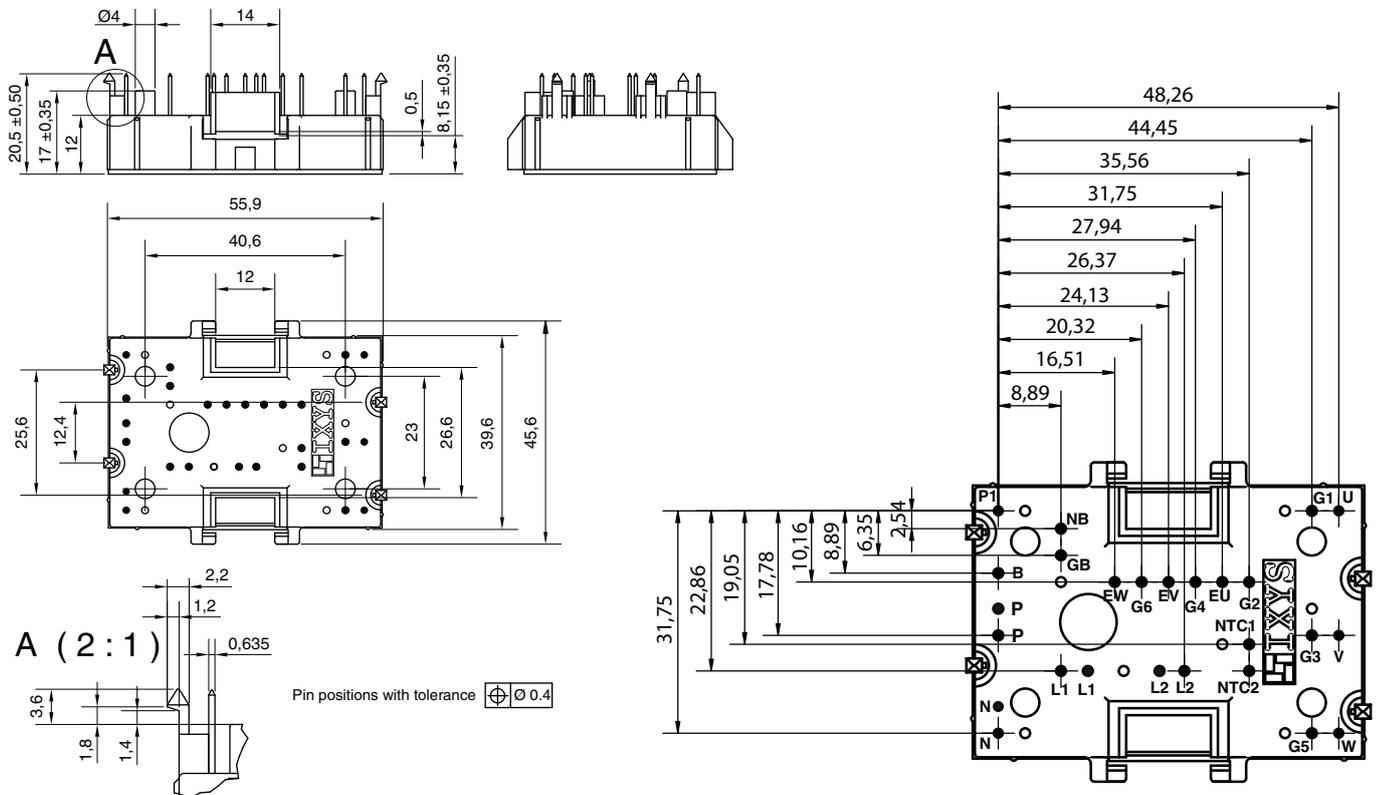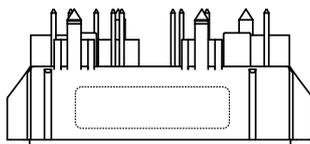
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Circuit Diagram
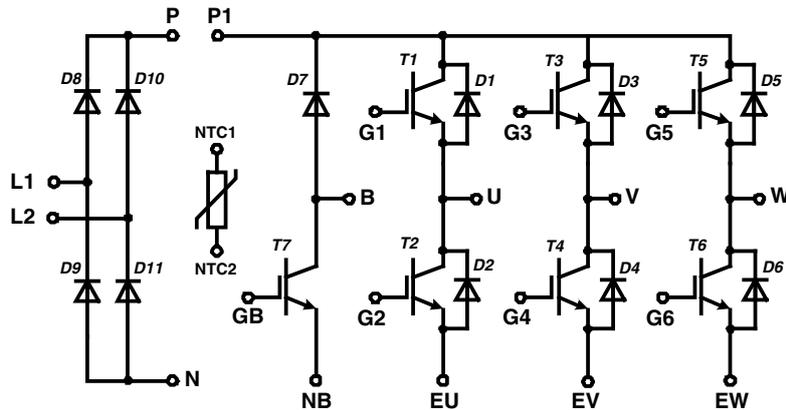
Outline Drawing

Dimensions in mm (1 mm = 0.0394")

Pin positions with tolerance ⊕ Ø 0.4

Product Marking

**Part number**

M = Module
I = IGBT
A = IGBT (NPT)
A = Gen 1 / std
20 = Current Rating [A]
WE = 6-Pack + 1~ Rectifier Bridge & Brake Unit
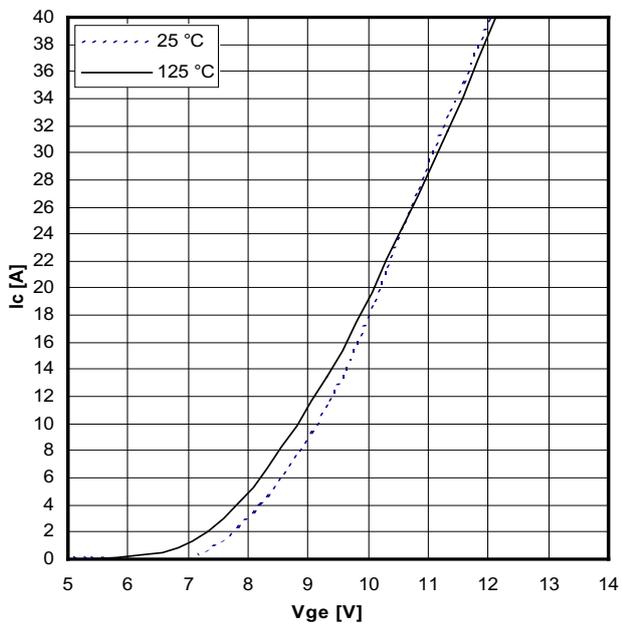600 = Reverse Voltage [V]
T = NTC
MH = MiniPack2

Ordering	Part Name	Marking on Product	Delivering Mode	Base Qty	Ordering Code
Standard	MIAA 20 WE 600 TMH	MIAA20WE600TMH	Box	20	504708

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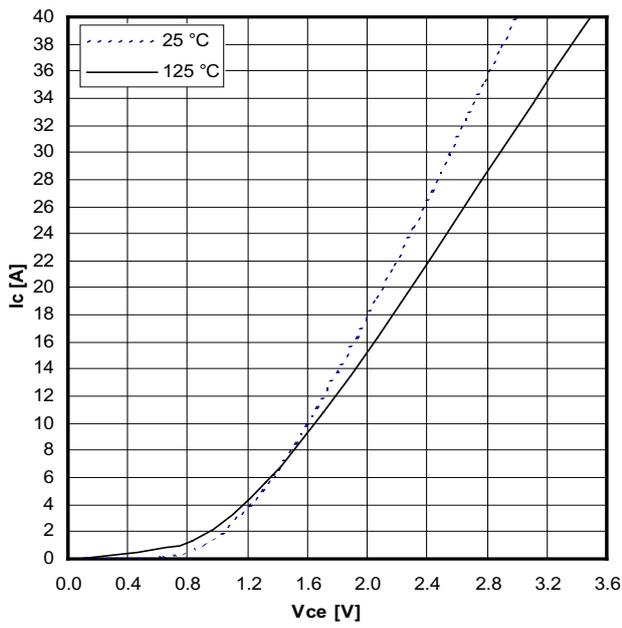
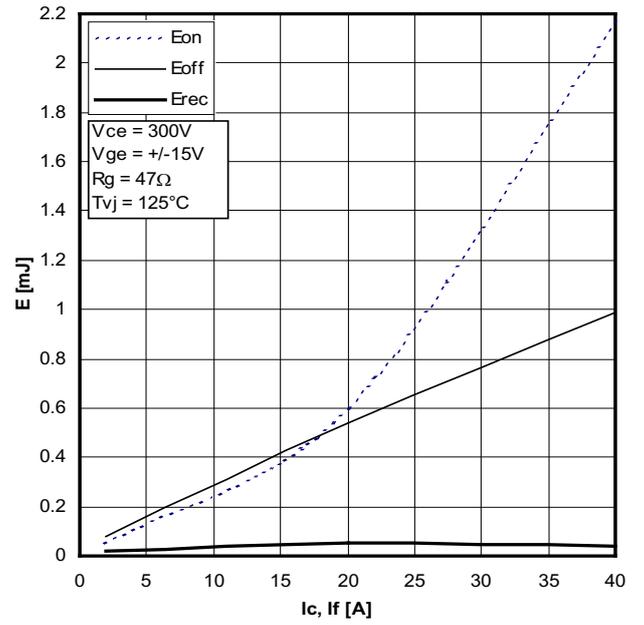Typical output characteristics, V_{GE} = 15 V
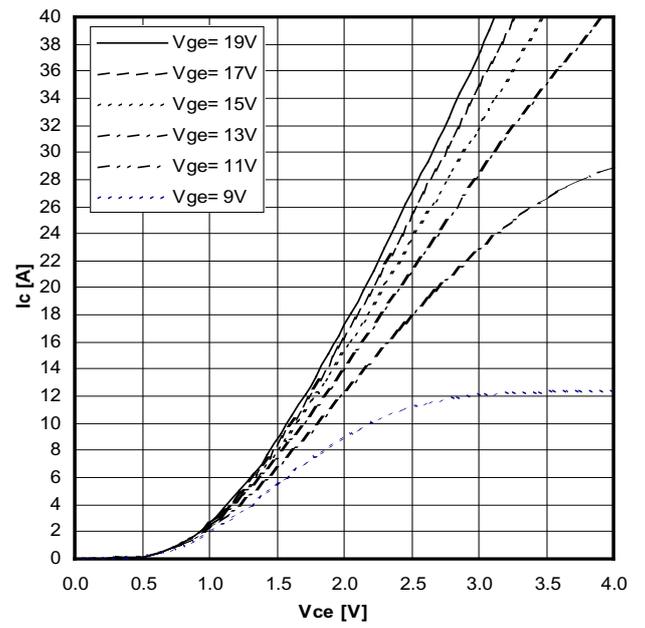
Typical output characteristics (125°C)

Typical transfer characteristics

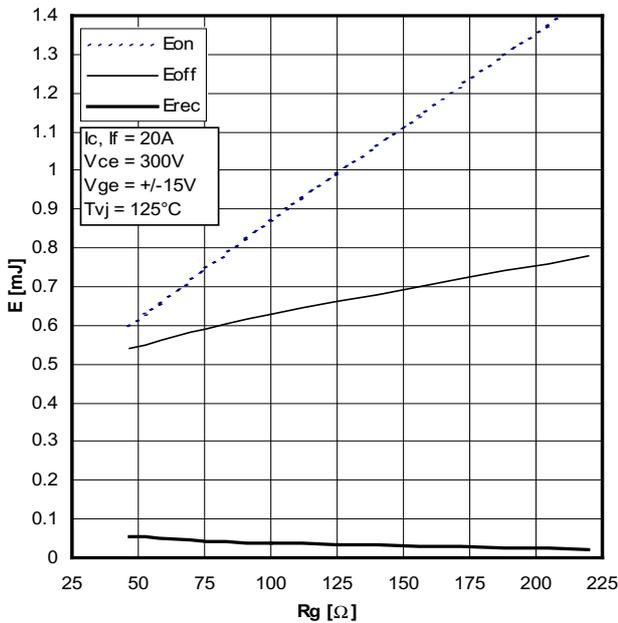Typical forward characteristics of freewheeling diode

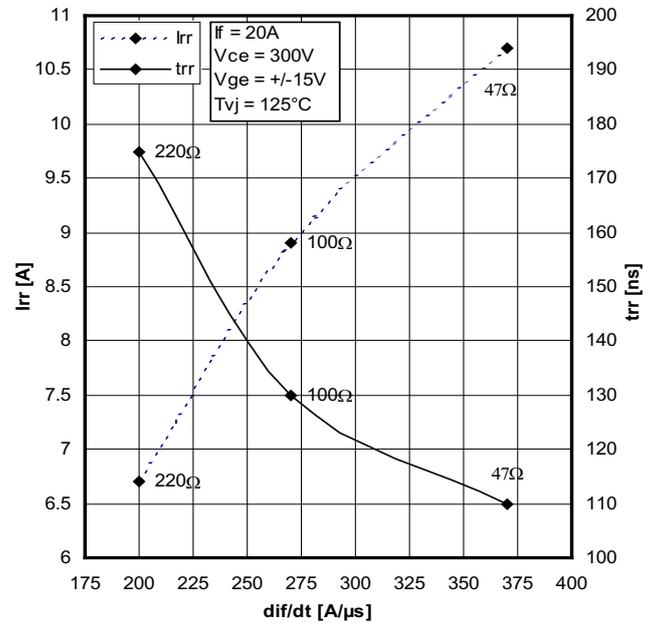IXYS reserves the right to change limits, test conditions and dimensions.

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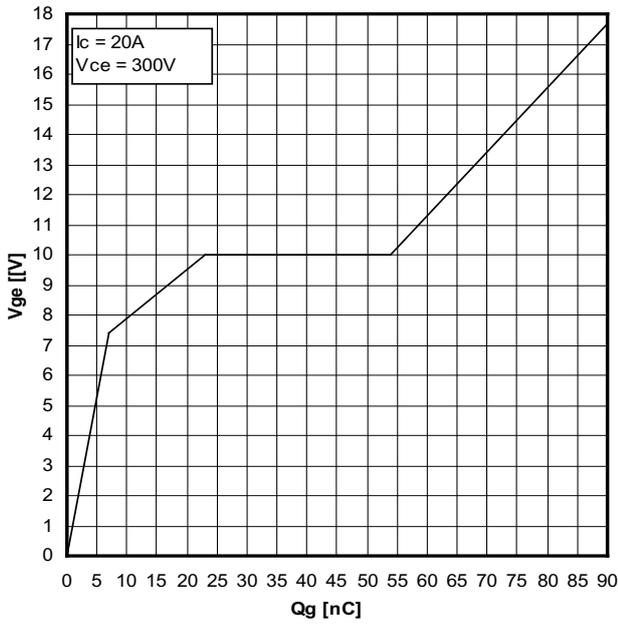
Typical turn on gate charge

Plot: Vge [V] vs Qg [nC]. Ic = 20A, Vce = 300V

Typical switching energy versus collector current

Plot: E [mJ] vs Ic, If [A]. Eon, Eoff, Erec. Vce = 300V, Vge = +/-15V, Rg = 47Ω, Tvj = 125°C

Typical switching energy versus gate resistance

Plot: E [mJ] vs Rg [Ω]. Eon, Eoff, Erec. Ic, If = 20A, Vce = 300V, Vge = +/-15V, Tvj = 125°C

Typical turn-off characteristics of free wheeling diode

Plot: Irr [A], trr [ns] vs dif/dt [A/µs]. Irr, trr. If = 20A, Vce = 300V, Vge = +/-15V, Tvj = 125°C

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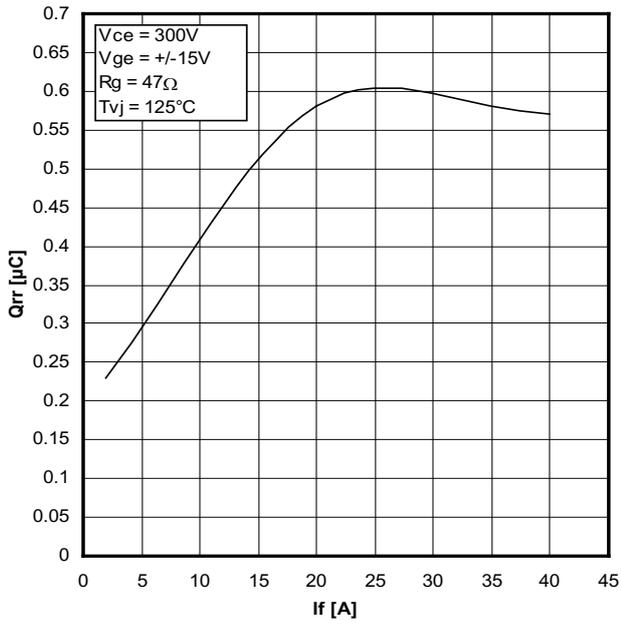
Typical turn-off characteristics of free wheeling diode
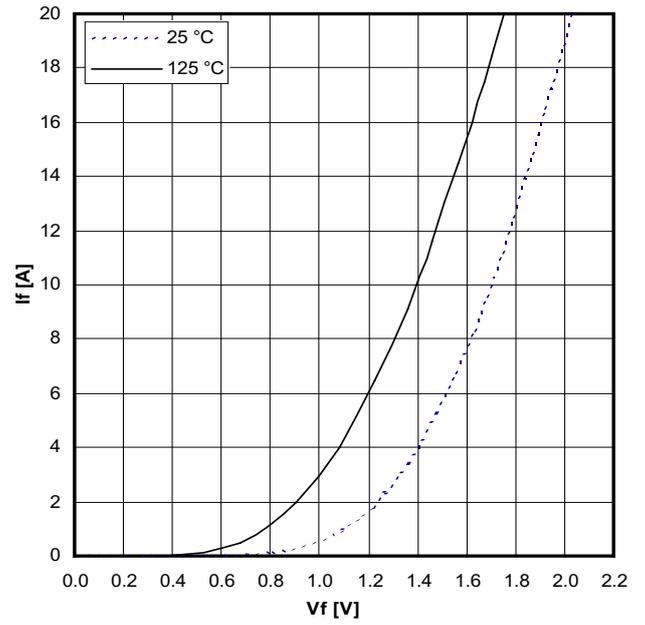
Typical forward characteristics of brake diode
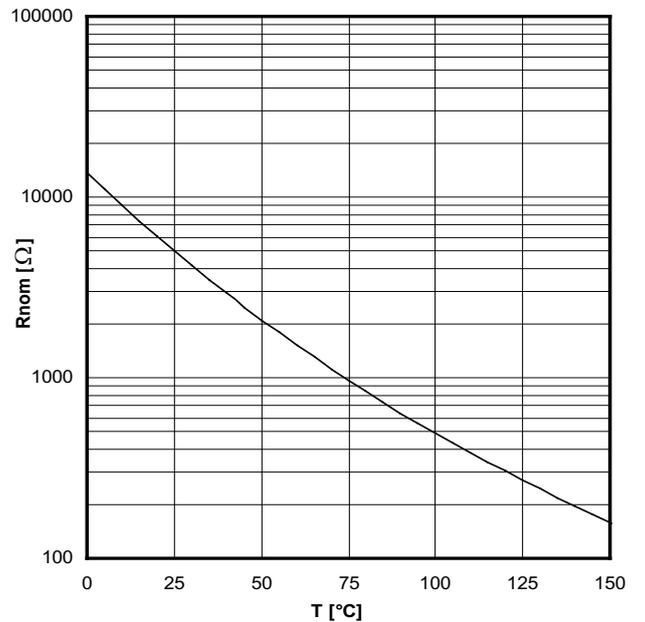
Typical thermistor resistance versus temperature