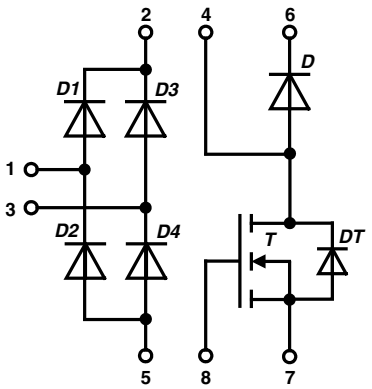
Power MOSFET Stage for Boost Converters

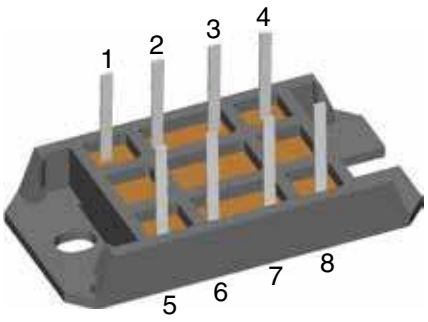
Module for Power Factor Correction

Single Phase Rectifier	Boost Diode	MOSFET
V_{RRM} = 1600 V	V_{RRM} = 600 V	V_{DSS} = 600 V
I_{DAV} = 106 A	I_{F25} = 60 A	I_{D25} = 50 A
I_{FSM} = 300 A	$V_{F\ (30A)}$ = 2.24 V	$R_{DS(on)}$ = 120 mΩ

Part name (Marking on product)

VUM33-06PH





Features:

- Package with DCB ceramic base plate
- Soldering connections for PCB mounting
- Isolation voltage 3600 V~
- Low $R_{DS(on)}$ Polar™ MOSFET
- Low package inductance for high speed switching
- SONIC™ boost diode
  - fast and soft reverse recovery
  - low operating forward voltage

Advantages:

- 3 functions in one package
- Output power up to 8 kW
- No external isolation
- Easy to mount with two screws
- Suitable for wave soldering
- High temperature and power cycling capability
- Fits easily to all available PFC controller ICs

Package:

- "V1-Pack" standard outline Insulated copper base plate

Application:

- Power factor pre-conditioner for SMPS, UPS, battery chargers and inverters
- Boost topology for SMPS including 1~ rectifier bridge
- Power supply for welding equipment

MOSFET T

Symbol	Definitions	Conditions		Ratings min.	typ.	max.	Unit
V_{DSS}	*drain source voltage*		T_{VJ} = 25°C			600	V
V_{GSS}	*max. DC gate voltage*	continuous				±20	V
V_{GSM}	*max. transient gate source voltage*	transient				±30	V
I_{D25}	*drain current*		T_C = 25°C			50	A
I_{D80}			T_C = 80°C			37	A
P_{tot}	*total power dissipation*		T_C = 80°C			500	W
$R_{DS(on)}$	*drain source on resistance*	I_D = 30 A; V_{GE} = 10 V	T_{VJ} = 25°C			120	mΩ
			T_{VJ} = 125°C			240	mΩ
$V_{GS(th)}$	*gate source threshold voltage*	I_C = 8 mA; V_{DS} = V_{GS}	T_{VJ} = 25°C	2.5		5.0	V
I_{DSS}	*drain source leakage current*	V_{DS} = V_{DSS}; V_{GS} = 0 V	T_{VJ} = 25°C			50	µA
			T_{VJ} = 125°C			500	µA
I_{GSS}	*gate source leakage current*	V_{GS} = ±20 V; V_{DS} = 0 V				±500	nA
C_{iss}	*input capacitance*	V_{DS} = 25 V; V_{GS} = 0 V; f = 1 MHz			8.0		nF
$Q_{G(on)}$	*total gate charge*	V_{DS} = 300 V; V_{GS} = 10 V; I_D = 50 A			165		nC
$t_{d(on)}$	*turn-on delay time*				56		ns
t_r	*current rise time*	inductive load	T_{VJ} = 25°C		12		ns
$t_{d(off)}$	*turn-off delay time*	V_{DS} = 380 V; I_D = 20 A			110		ns
t_f	*current fall time*	V_{GS} = 0/10 V; R_G = 4.7 Ω			12		ns
E_{on}	*turn-on energy per pulse*	$R_{G\,eff}$ = 5.5 Ω [1]			0.3		mJ
E_{off}	*turn-off energy per pulse*				0.16		mJ
$t_{d(on)}$	*turn-on delay time*				56		ns
t_r	*current rise time*	inductive load	T_{VJ} = 125°C		16		ns
$t_{d(off)}$	*turn-off delay time*	V_{DS} = 380 V; I_D = 20 A			144		ns
t_f	*current fall time*	V_{GS} = 0/10 V; R_G = 4.7 Ω			14		ns
E_{on}	*turn-on energy per pulse*	$R_{G\,eff}$ = 5.5 Ω [1]			0.47		mJ
E_{off}	*turn-off energy per pulse*				0.20		mJ
R_{thJC}	*thermal resistance junction to case*					0.14	K/W
R_{thJH}	*thermal resistance case to heatsink*	with heat transfer paste (IXYS test setup)			0.18	0.24	K/W

[1] $R_{G\,eff}$ includes the driver resistance of 0.8 Ω

Boost Diode D

Symbol	Definitions	Conditions		Ratings min.	typ.	max.	Unit
V_{RRM}	*max. repetitve reverse voltage*		T_{VJ} = 25°C			600	V
I_{F25}	*forward current*		T_C = 25°C			60	A
I_{F80}			T_C = 80°C			40	A
V_F	*forward voltage*	I_F = 30 A; V_{GE} = 0 V	T_{VJ} = 25°C			2.24	V
			T_{VJ} = 125°C			2.19	V
I_R	*reverse current*	$V_R = V_{RRM}$	T_{VJ} = 25°C			30	µA
			T_{VJ} = 125°C			2	mA
Q_{rr}	*reverse recovery charge*	V_R = 380 V			0.24		µC
I_{RM}	*max. reverse recovery current*	di_F/dt = -790 A/µs [2]	T_{VJ} = 25°C		11.7		A
t_{rr}	*reverse recovery time*	I_F = 20 A			43		ns
E_{rec}	*reverse recovery energy*				0.026		mJ
Q_{rr}	*reverse recovery charge*	V_R = 380 V			0.59		µC
I_{RM}	*max. reverse recovery current*	di_F/dt = -700 A/µs [2]	T_{VJ} = 125°C		15.9		A
t_{rr}	*reverse recovery time*	I_F = 20 A			55		ns
E_{rec}	*reverse recovery energy*				0.076		mJ
R_{thJC}	*thermal resistance junction to case*					0.72	K/W
R_{thJH}	*thermal resistance case to heatsink*	with heat transfer paste (IXYS test setup)			0.84	0.96	K/W

[2] Test setup: MOSFET T driven with $R_{G\,eff}$ = 5.5 Ω and V_{GS} = 0/10 V

Input Rectifier Bridge D1 - D4

Symbol	Definitions	Conditions		Ratings min.	typ.	max.	Unit
V_{RRM}	*max. repetitive reverse voltage*		T_{VJ} = 25°C			1600	V
I_{DAV}	*average forward output current*	sine 180°	T_C = 80°C			106	A
I_{FAVM}	*max. average forward current (per diode)*	rect.; d = 0.5	T_C = 80°C			57	A
I_{F25}	*forward current*	DC	T_C = 25°C			106	A
I_{F80}	*forward current*	DC	T_C = 80°C			71.5	A
I_{FSM}	*max. forward surge current*	t = 10 ms; sine 50 Hz	T_{VJ} = 45°C			300	A
			T_{VJ} = 125°C			170	A
I^2t	*I^2t value for fusing*	t = 10 ms; sine 50 Hz	T_{VJ} = 45°C			450	A^2s
			T_{VJ} = 125°C			240	A^2s
P_{tot}	*total power dissipation*		T_C = 80°C			110	W
V_F	*forward voltage*	I_F = 50 A	T_{VJ} = 25°C			1.39	V
			T_{VJ} = 150°C			1.39	V
I_R	*reverse current*	$V_R = V_{RRM}$	T_{VJ} = 25°C			20	µA
			T_{VJ} = 150°C			1.5	mA
R_{thJC}	*thermal resistance junction to case*	(per diode)				0.64	K/W
R_{thJH}	*thermal resistance case to heatsink*	with heat transfer paste (IXYS test setup)			0.72	0.85	K/W

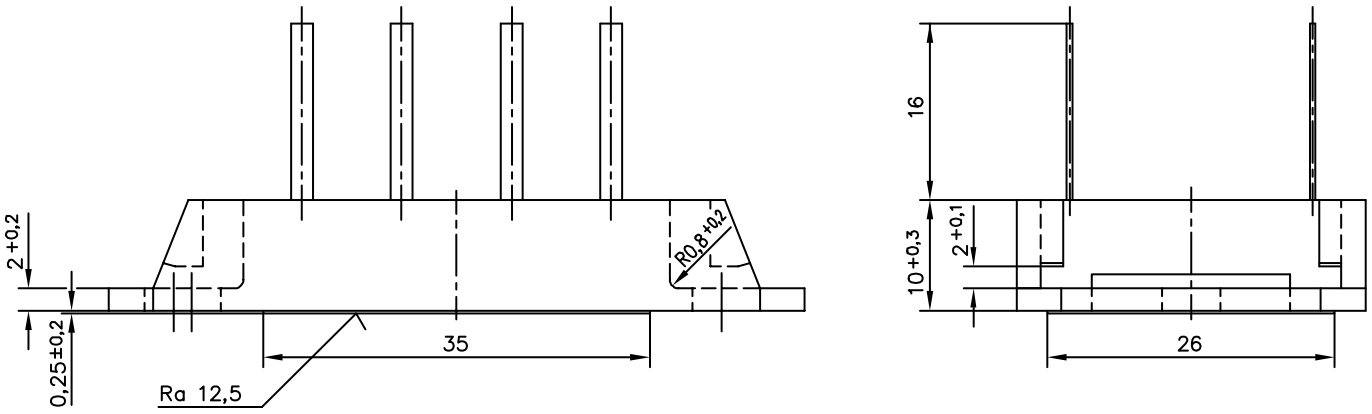
Module

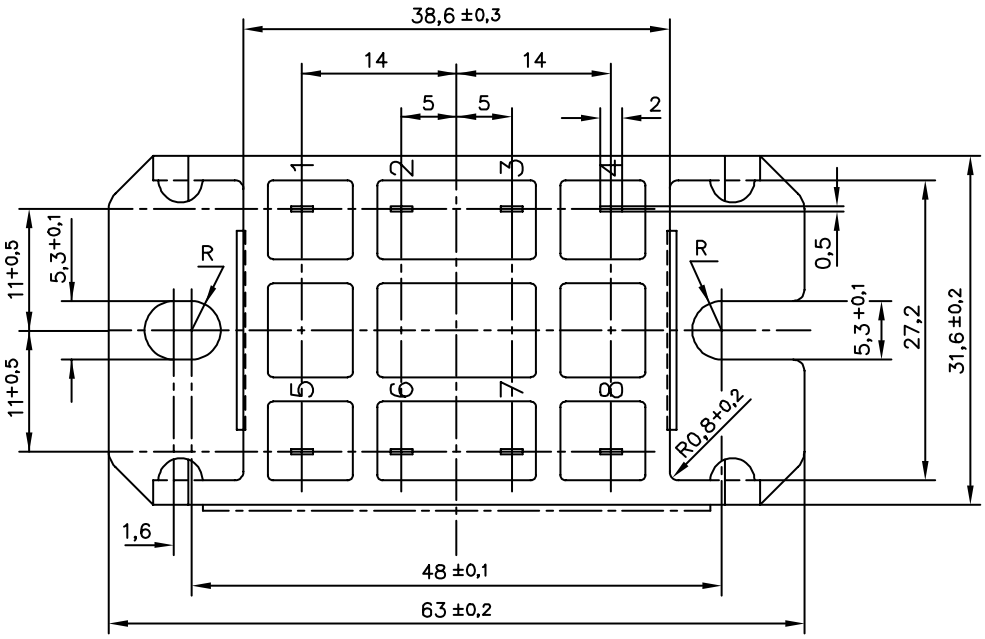
Symbol	Definitions	Conditions	Ratings min.	typ.	max.	Unit
T_{VJ}	*operating temperature*		-40		150	°C
T_{VJM}	*max. virtual junction temperature*		-40		150	°C
T_{stg}	*storage temperature*		-40		125	°C
V_{ISOL}	*isolation voltage*	$I_{ISOL} \leq$ 1 mA; 50/60 Hz; 1 sec.			3600	V~
M_d	*mounting torque (M5)*		2		2.5	Nm
Weight				35		g

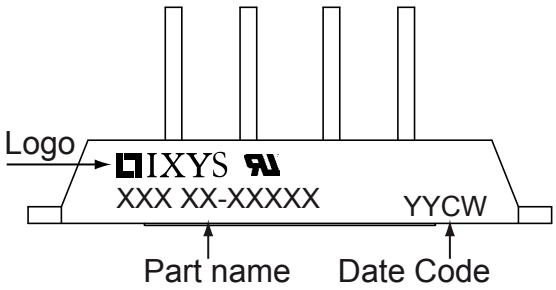
T_C = 25°C unless otherwise stated

Outline Drawing

Dimensions in mm (1 mm = 0.0394“)







Product Ordering

Ordering	Part Name	Marking on Product	Delivering Mode	Base Qty	Ordering Code
Standard	VUM 33-06PH	VUM 33-06PH	Box	10	508843

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

20100921b

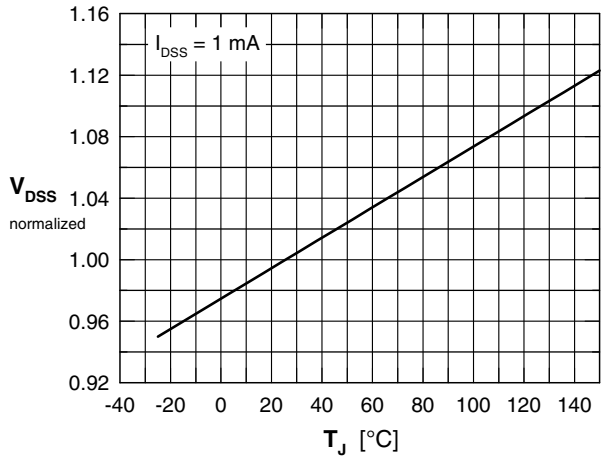


Fig. 1 Drain source breakdown voltage V_{DSS} versus junction temperature

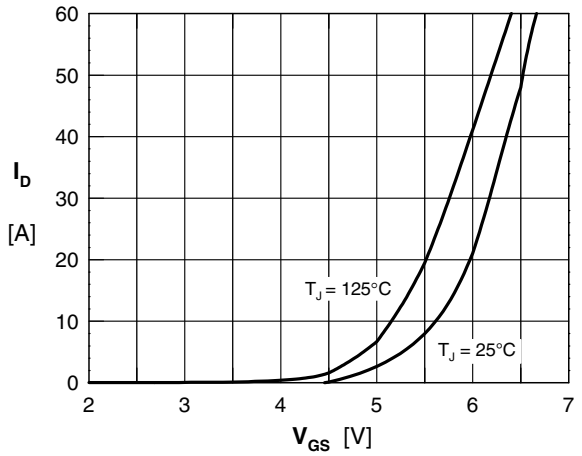


Fig. 2 Typical transfer characteristics

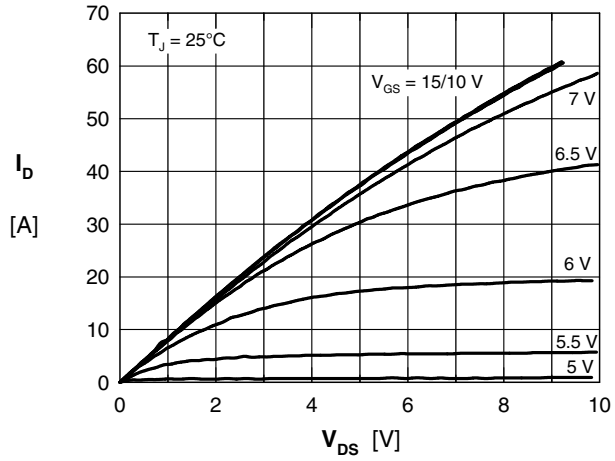


Fig. 3 Typical output characteristics

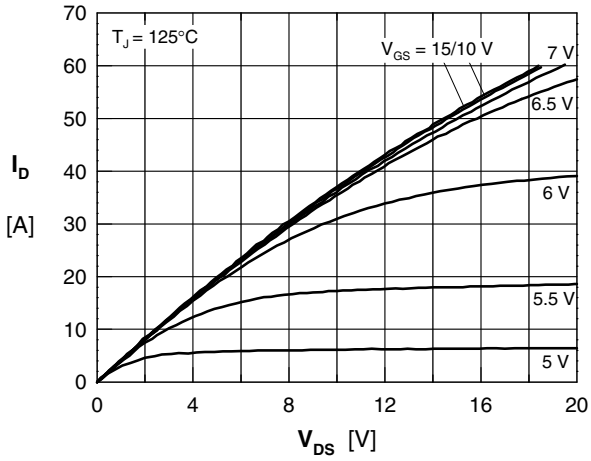


Fig. 4 Typical output characteristics

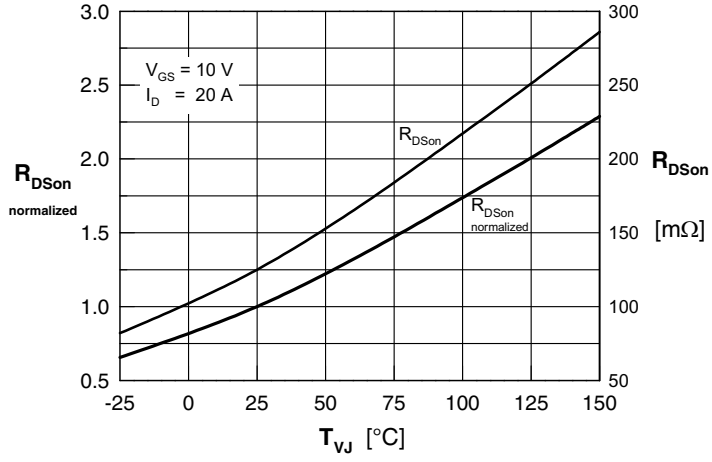


Fig. 5 Drain source on-state resistance R_{DSon} versus junction temperature

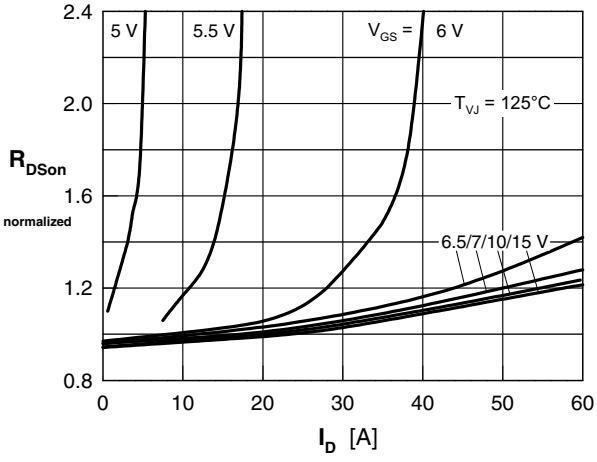


Fig. 6 Drain source on-state resistance R_{DSon} versus I_D normalized to R_{DSon} at V_{GS} = 10 V and I_D = 20 A

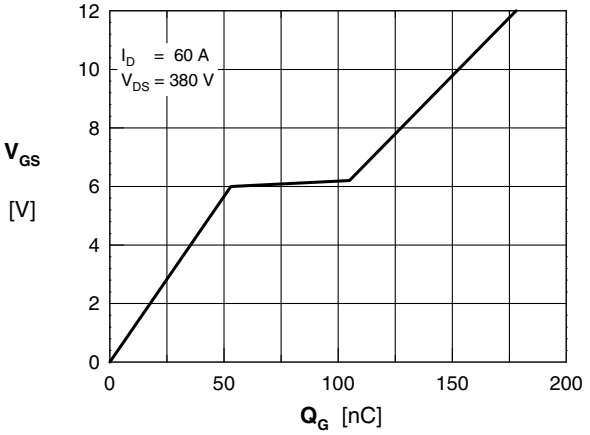


Fig. 7 Gate charge characteristics

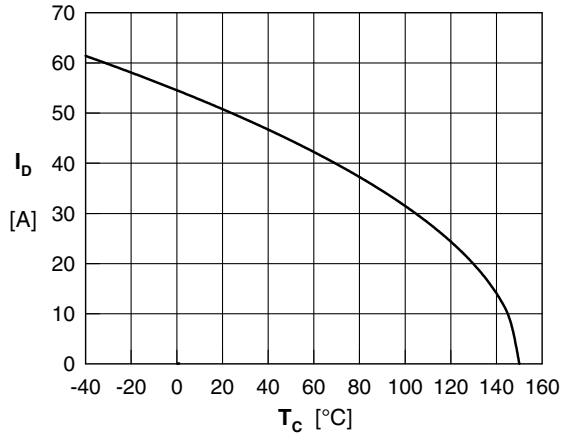


Fig. 8 Drain current I_D versus case temperature T_C

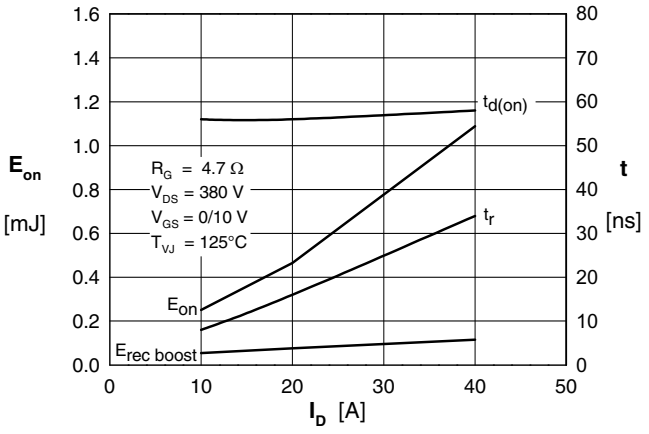


Fig. 9 Typ. turn-on energy and switching times versus drain current, inductive switching

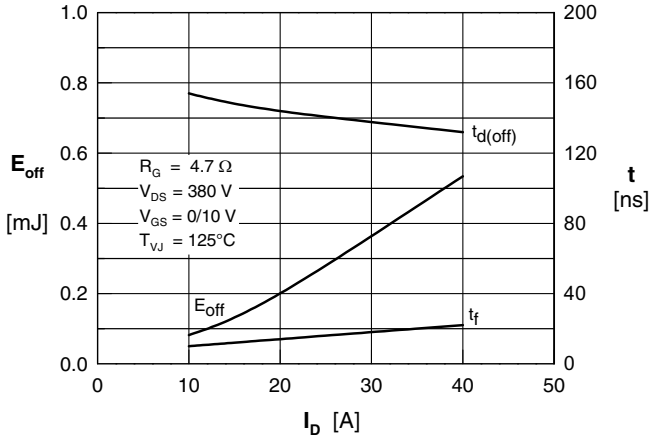


Fig. 10 Typ. turn-off energy and switching times versus drain current, inductive switching

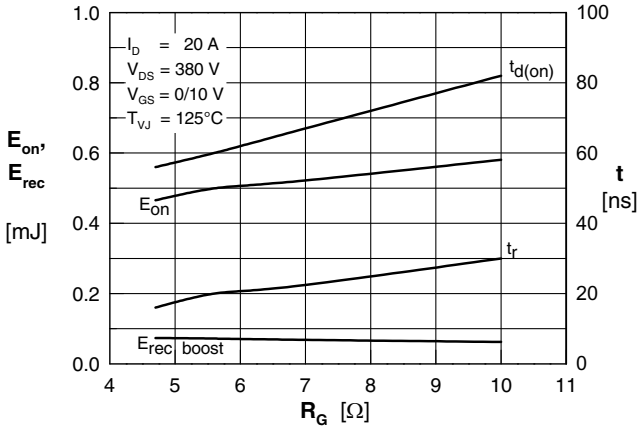


Fig. 11 Typ. turn-on energy and switching times versus gate resistor, inductive switching

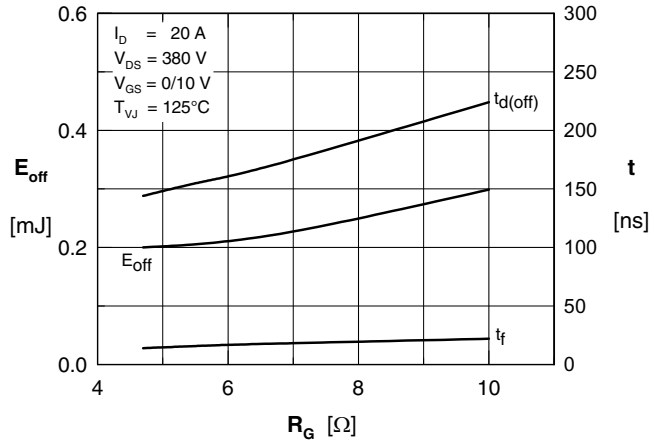


Fig. 12 Typ. turn-off energy and switching times versus gate resistor, inductive switching

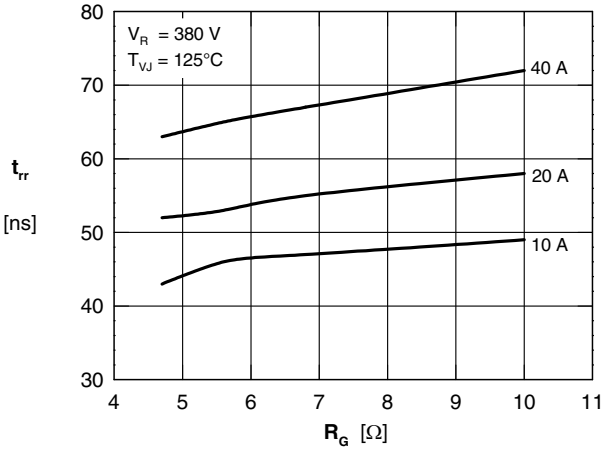


Fig. 13 Reverse recovery time t_{rr} of the boost diode versus R_G of boost MOSFET

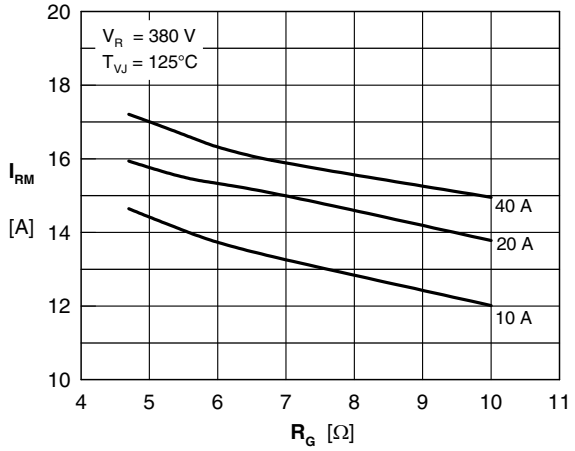


Fig. 14 Reverse recovery current I_{RM} of the boost diode versus R_G of the boost MOSFET

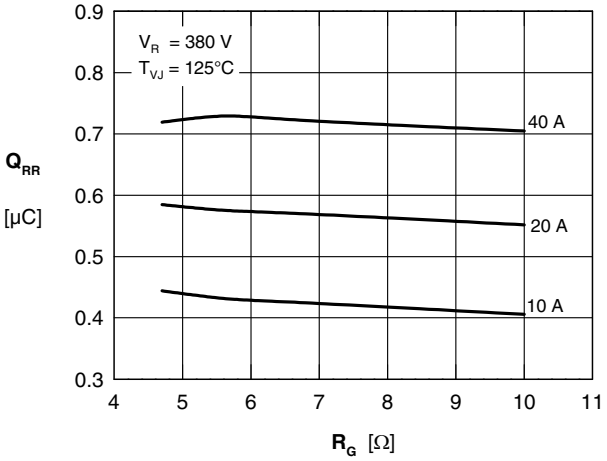


Fig. 15 Reverse recovery charge Q_{RR} I_{RM} of the boost diode versus R_G

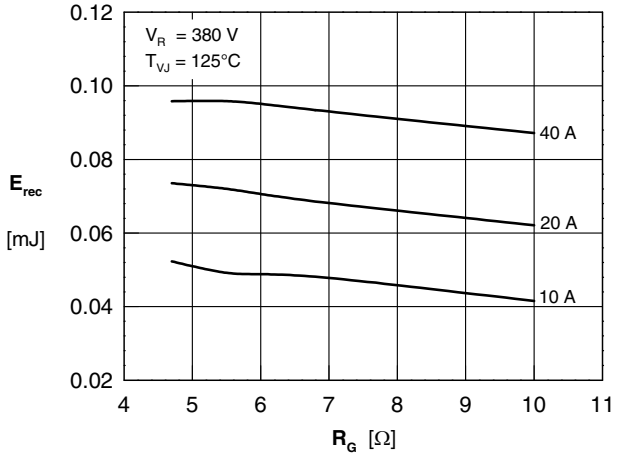


Fig. 16 Reverse recovery energy E_{rec} of the boost diode versus R_G

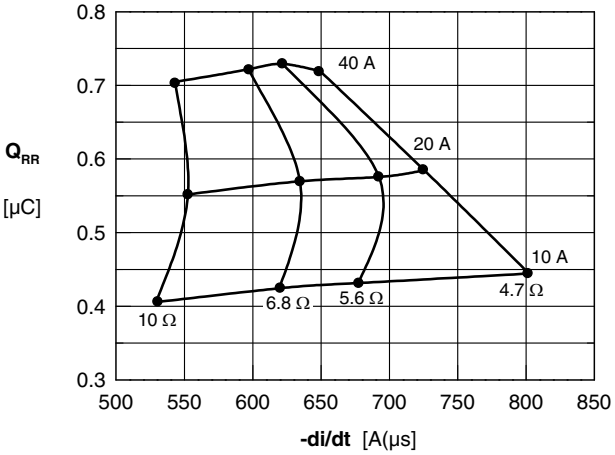


Fig. 17 Typ. turn off characteristics of the boost diode versus di/dt

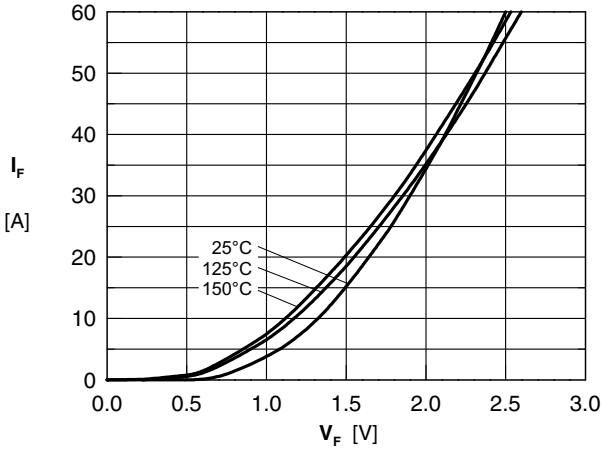


Fig. 18 Forward characteristics boost diode

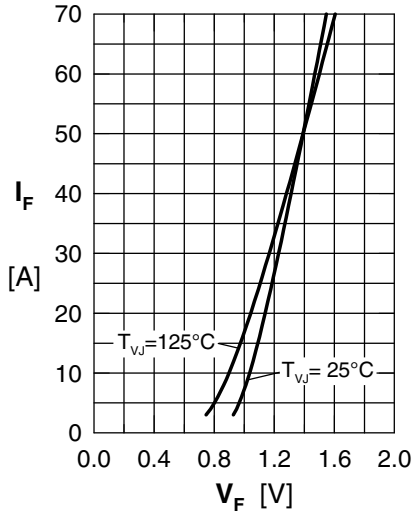


Fig. 19 Forward current vs. voltage drop of input rectifier diode

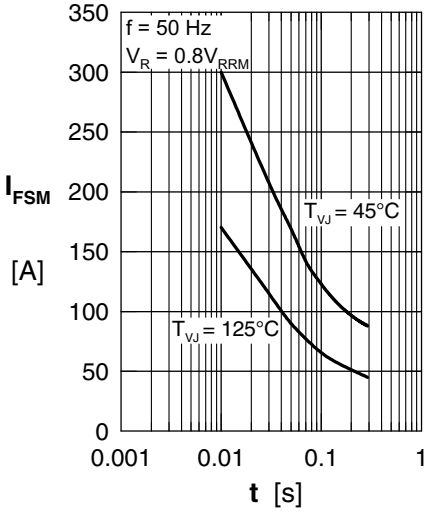


Fig. 20 Non-repetitive peak surge current (Rectifier Diodes)

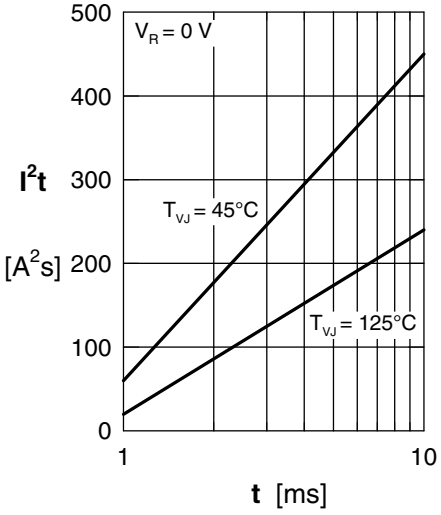


Fig. 21 I^2t for fusing (Rectifier Diodes)

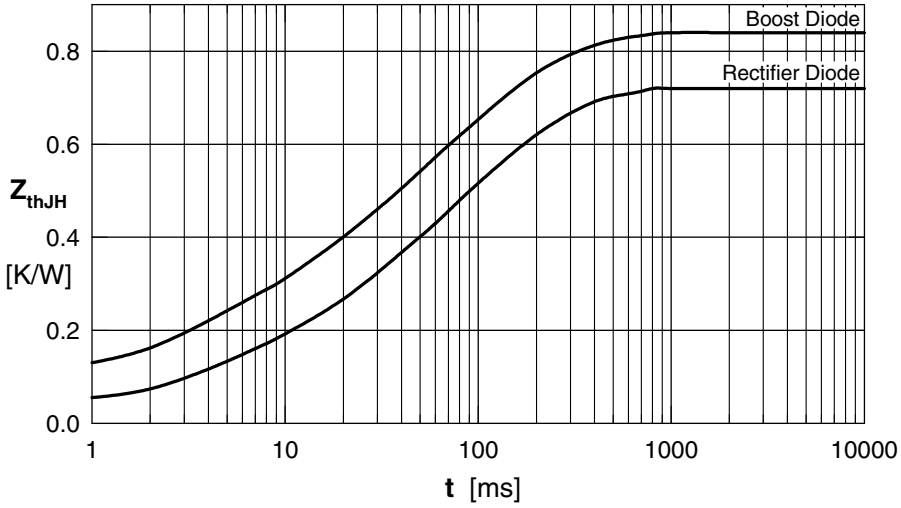


Fig. 22
Typ. transient thermal impedances of Boost Diode and Rectifier Diode

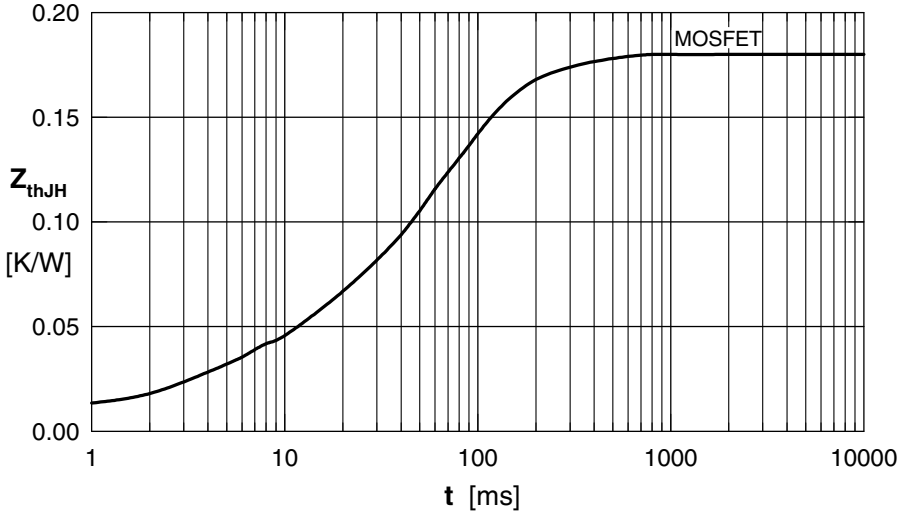


Fig. 23
Typ. transient thermal impedances of MOSFET