

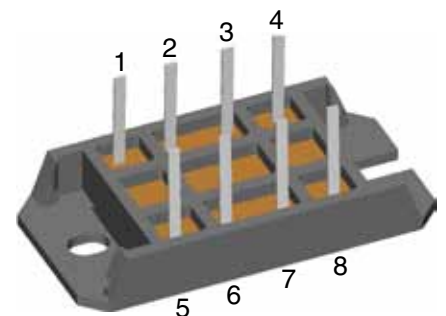
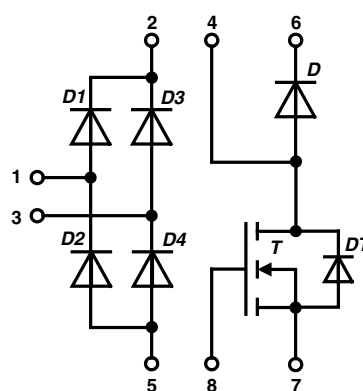
Power MOSFET Stage for Boost Converters

Module for Power Factor Correction

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

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				Ratings		
Symbol	Definitions	Conditions	min.	typ.	max.	Unit
V_{DSS}	drain source voltage		$T_{VJ} = 25^{\circ}C$		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		$T_C = 25^{\circ}C$		50	A
I_{D80}			$T_C = 80^{\circ}C$		37	A
P_{tot}	total power dissipation		$T_C = 80^{\circ}C$		500	W
$R_{DS(on)}$	drain source on resistance	$I_D = 30 A; V_{GE} = 10 V$	$T_{VJ} = 25^{\circ}C$ $T_{VJ} = 125^{\circ}C$		120 240	$m\Omega$ $m\Omega$
$V_{GS(th)}$	gate source threshold voltage	$I_C = 8 mA; V_{DS} = V_{GS}$	$T_{VJ} = 25^{\circ}C$	2.5	5.0	V
I_{DSS}	drain source leakage current	$V_{DS} = V_{DSS}; V_{GS} = 0 V$	$T_{VJ} = 25^{\circ}C$ $T_{VJ} = 125^{\circ}C$		50 500	μA μA
I_{GSS}	gate source leakage current	$V_{GS} = \pm 20 V; V_{DS} = 0 V$			± 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	inductive load $V_{DS} = 380 V; I_D = 20 A$ $V_{GS} = 0/10 V; R_G = 4.7 \Omega$ $R_{G\text{ eff}} = 5.5 \Omega$ ¹⁾	$T_{VJ} = 25^{\circ}C$	56		ns
t_r	current rise time			12		ns
$t_{d(off)}$	turn-off delay time			110		ns
t_f	current fall time			12		ns
E_{on}	turn-on energy per pulse			0.3		mJ
E_{off}	turn-off energy per pulse			0.16		mJ
$t_{d(on)}$	turn-on delay time	inductive load $V_{DS} = 380 V; I_D = 20 A$ $V_{GS} = 0/10 V; R_G = 4.7 \Omega$ $R_{G\text{ eff}} = 5.5 \Omega$ ¹⁾	$T_{VJ} = 125^{\circ}C$	56		ns
t_r	current rise time			16		ns
$t_{d(off)}$	turn-off delay time			144		ns
t_f	current fall time			14		ns
E_{on}	turn-on energy per pulse			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⁾ $R_{G\text{ eff}}$ includes the driver resistance of 0.8 Ω

Boost Diode D

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

²⁾ Test setup: MOSFET T driven with $R_{G\text{eff}} = 5.5 \Omega$ and $V_{GS} = 0/10 \text{ V}$
Input Rectifier Bridge D1 - D4

Symbol	Definitions	Conditions	Ratings			Unit	
			min.	typ.	max.		
V_{RRM}	max. repetitive reverse voltage				1600	V	
I_{DAV}	average forward output current	sine 180°			106	A	
I_{FAVM}	max. average forward current (per diode)	rect.; $d = 0.5$			57	A	
I_{F25}	forward current	DC			106	A	
I_{F80}	forward current	DC			71.5	A	
I_{FSM}	max. forward surge current	$t = 10 \text{ ms}; \text{ sine } 50 \text{ Hz}$			300	A	
					170	A	
I^2t	I^2t value for fusing	$t = 10 \text{ ms}; \text{ sine } 50 \text{ Hz}$			450	A^2s	
					240	A^2s	
P_{tot}	total power dissipation				110	W	
V_F	forward voltage	$I_F = 50 \text{ A}$			1.39	V	
					1.39	V	
I_R	reverse current	$V_R = V_{RRM}$			20	μA	
					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

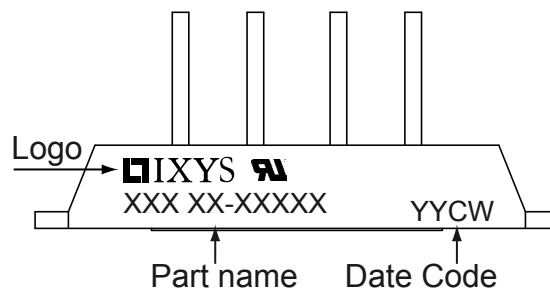
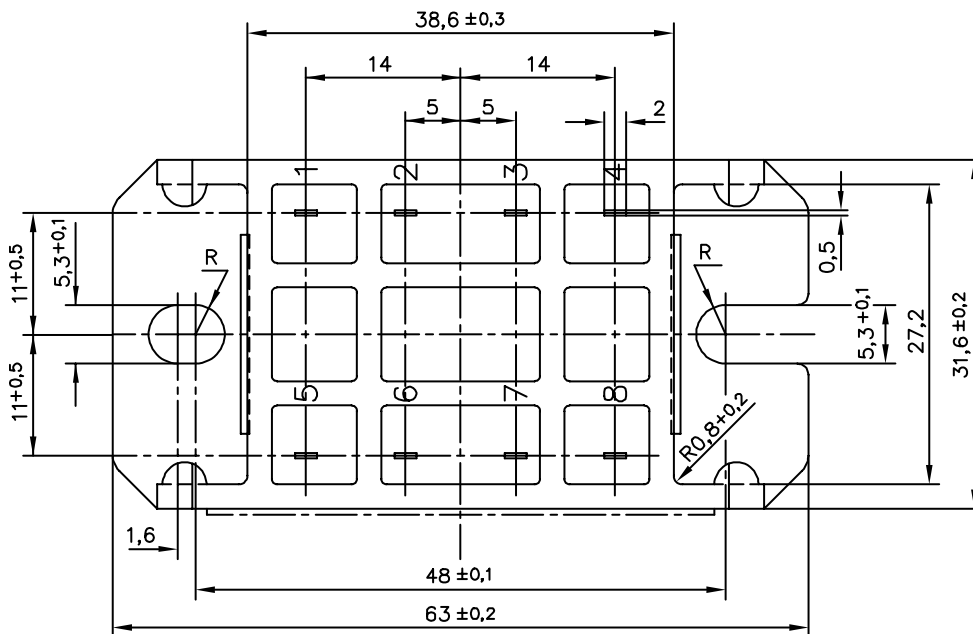
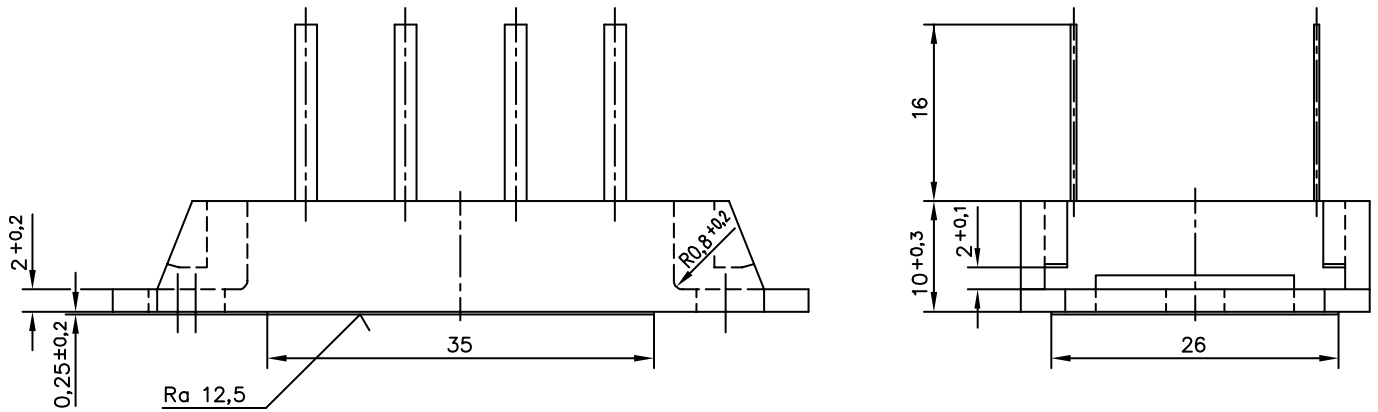
Module

Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
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	$I_{ISOL} \leq 1 \text{ mA}; 50/60 \text{ Hz}; 1 \text{ sec.}$			3600	V~
M_d	mounting torque (M5)		2		2.5	Nm
Weight				35		g

 $T_C = 25^\circ\text{C}$ 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

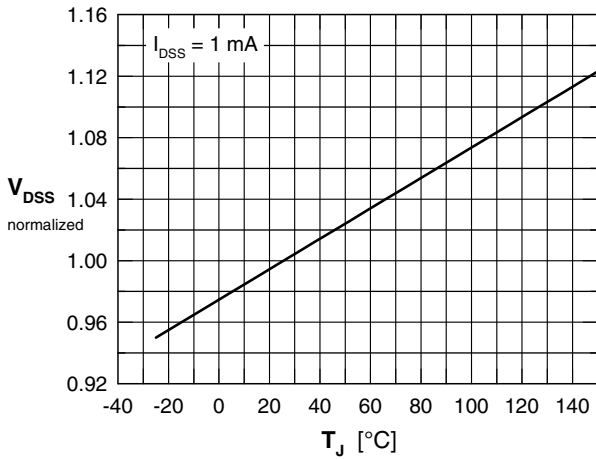


Fig. 1 Drain source breakdown voltage V_{DSS} versus junction temperature

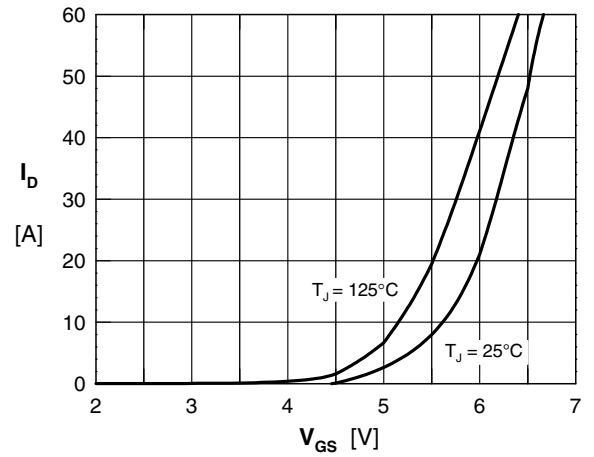


Fig. 2 Typical transfer characteristics

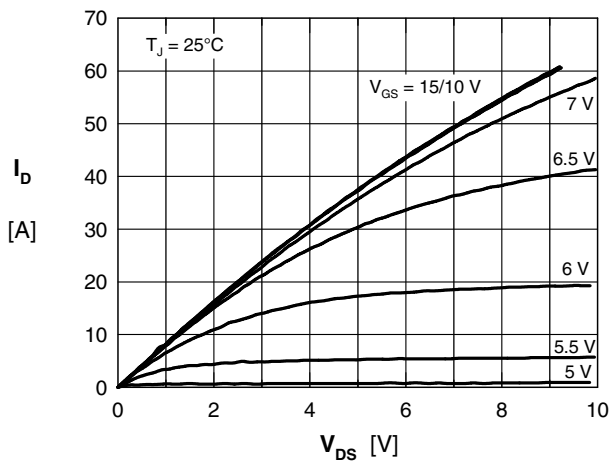


Fig. 3 Typical output characteristics

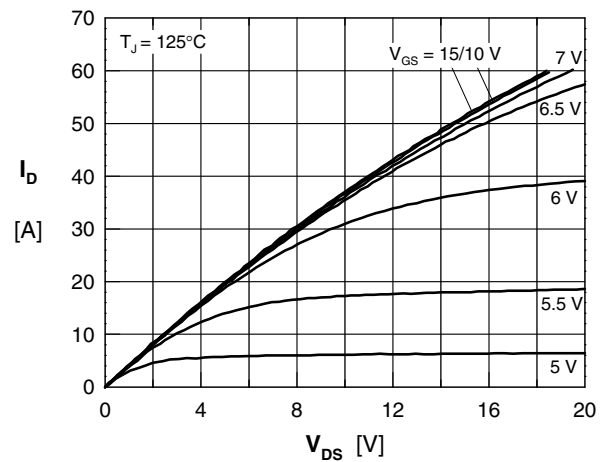


Fig. 4 Typical output characteristics

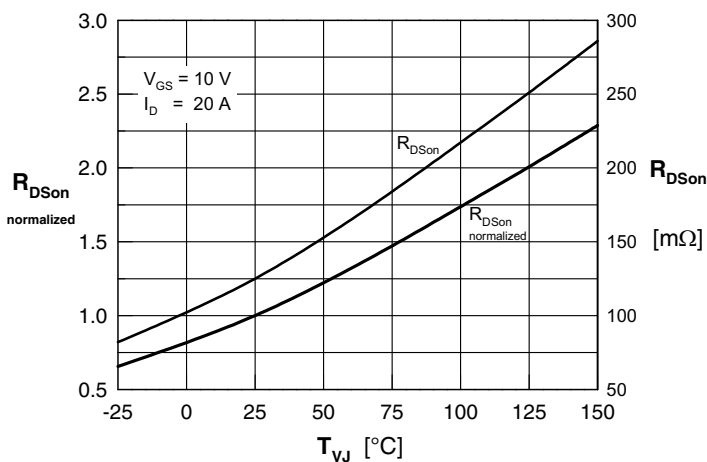


Fig. 5 Drain source on-state resistance $R_{DS(on)}$ versus junction temperature

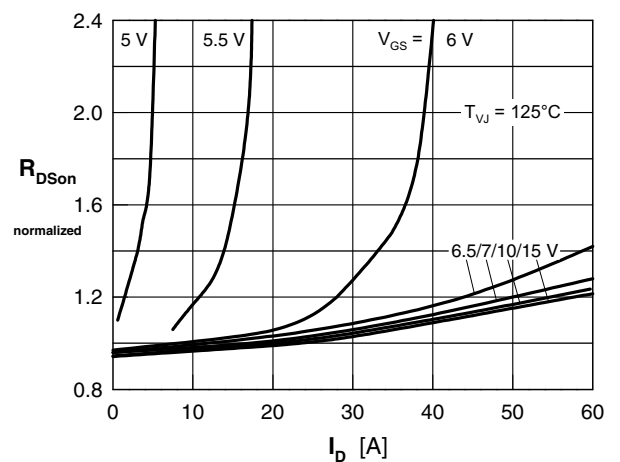


Fig. 6 Drain source on-state resistance $R_{DS(on)}$ versus I_D normalized to $R_{DS(on)}$ at $V_{GS} = 10 \text{ V}$ and $I_D = 20 \text{ A}$

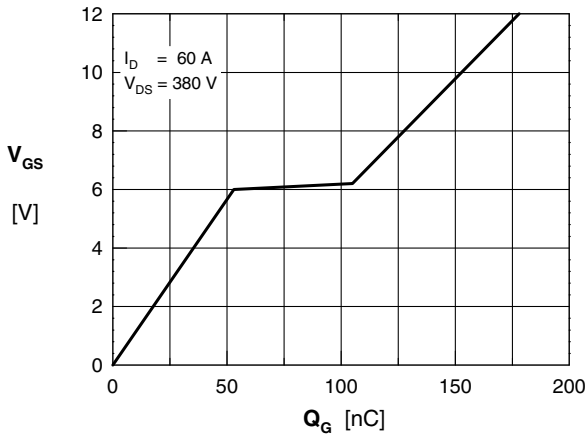


Fig. 7 Gate charge characteristics

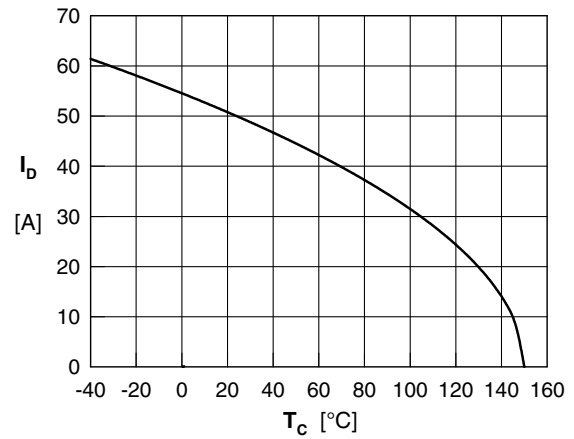


Fig. 8 Drain current I_D versus case temperature T_C

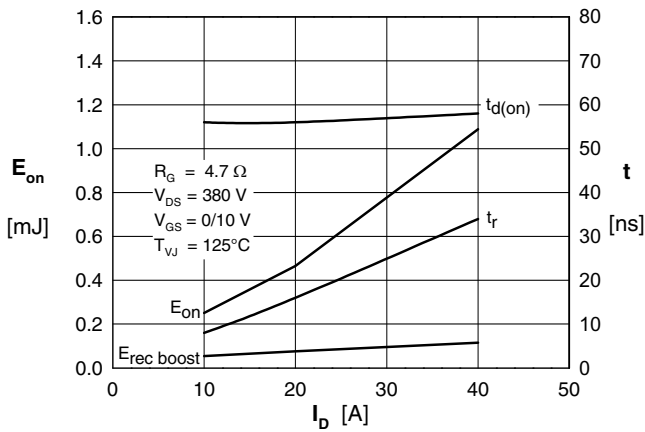


Fig. 9 Typ. turn-on energy and switching times versus drain current, inductive switching

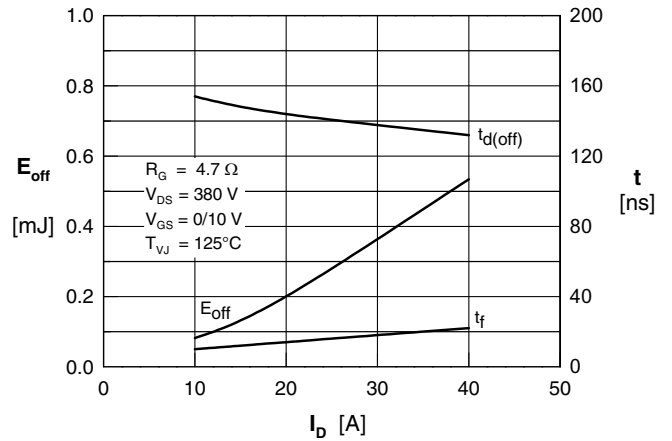


Fig. 10 Typ. turn-off energy and switching times versus drain current, inductive switching

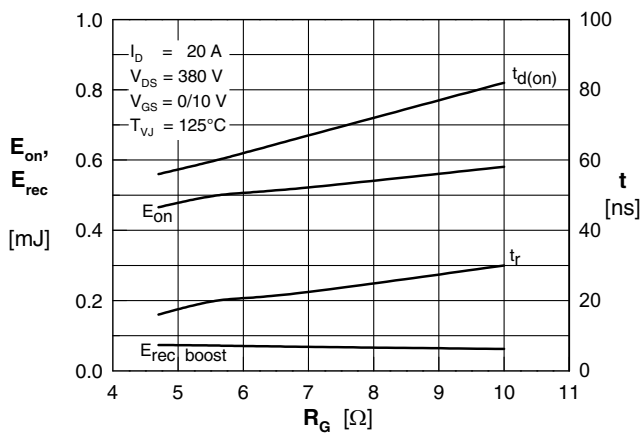


Fig. 11 Typ. turn-on energy and switching times versus gate resistor, inductive switching

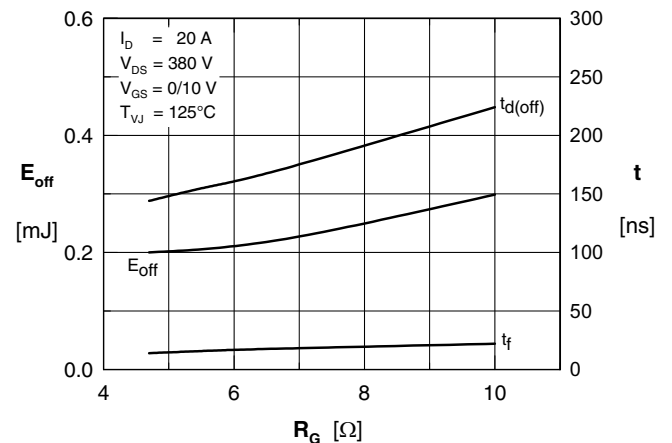


Fig. 12 Typ. turn-off energy and switching times versus gate resistor, inductive switching

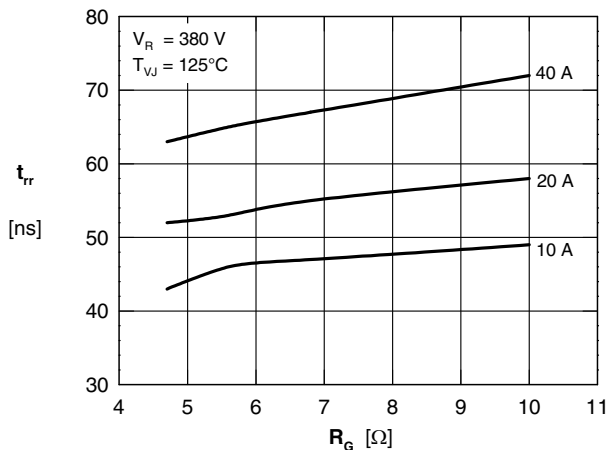


Fig. 13 Reverse recovery time t_{rr} of the boost diode versus R_G of boost MOSFET

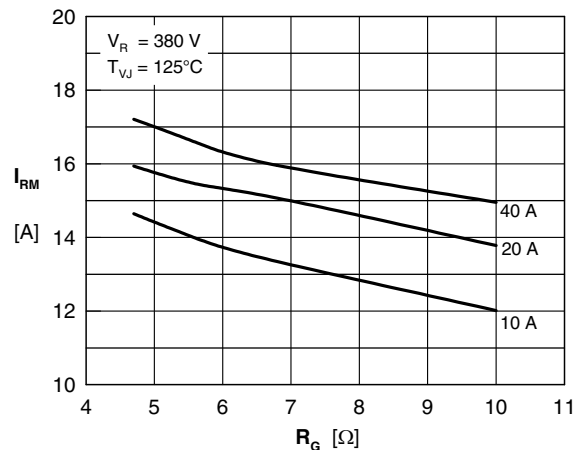


Fig. 14 Reverse recovery current I_{RM} of the boost diode versus R_G of the boost MOSFET

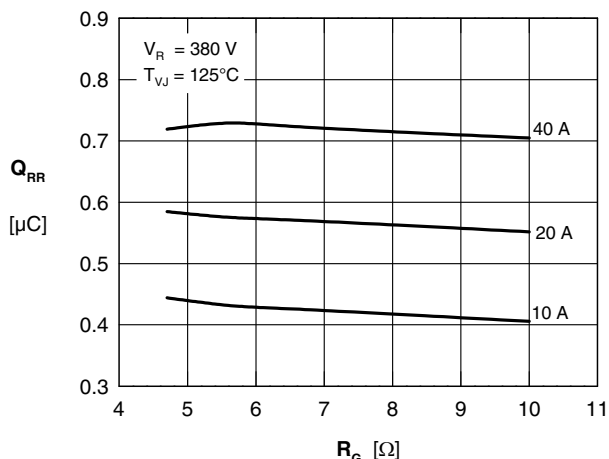


Fig. 15 Reverse recovery charge Q_{RR} of the boost diode versus R_G

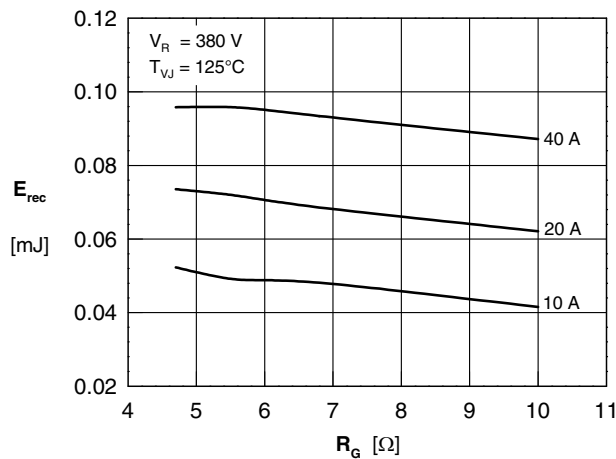


Fig. 16 Reverse recovery energy E_{rec} of the boost diode versus R_G

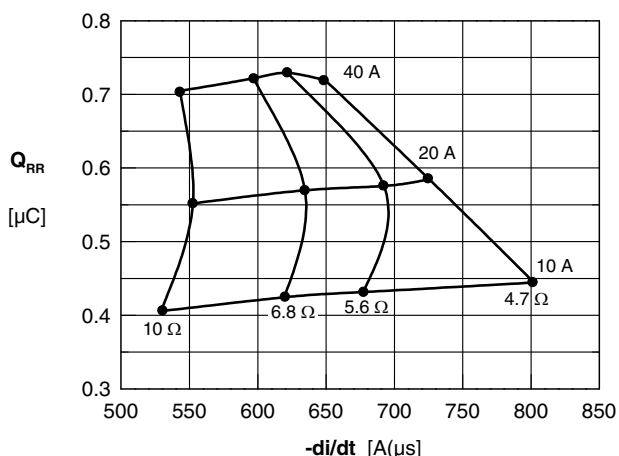


Fig. 17 Typ. turn off characteristics of the boost diode versus di/dt

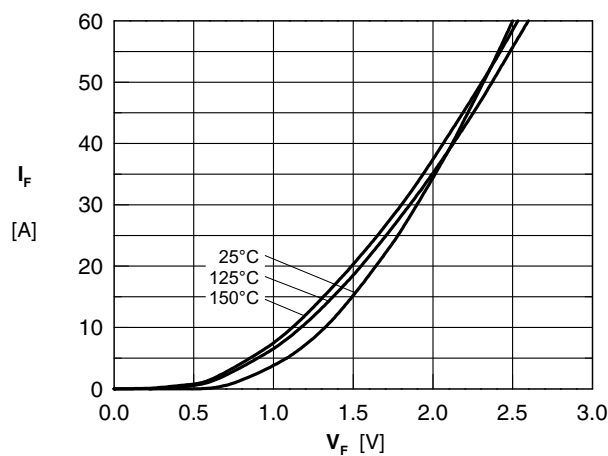


Fig. 18 Forward characteristics boost diode

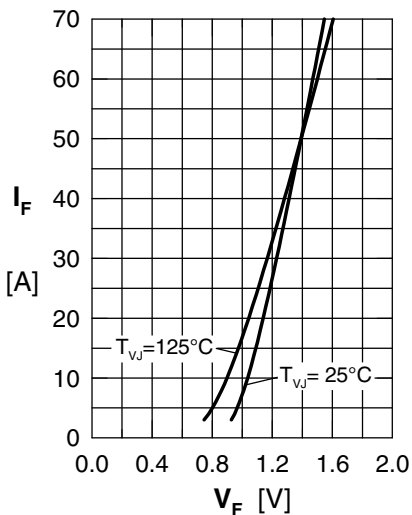


Fig. 19 Forward current vs. voltage drop of input rectifier diode

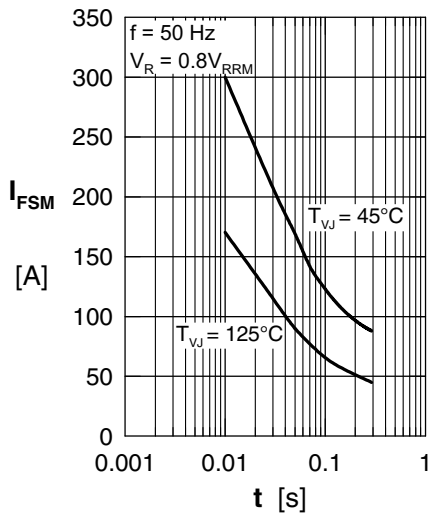


Fig. 20 Non-repetitive peak surge current (Rectifier Diodes)

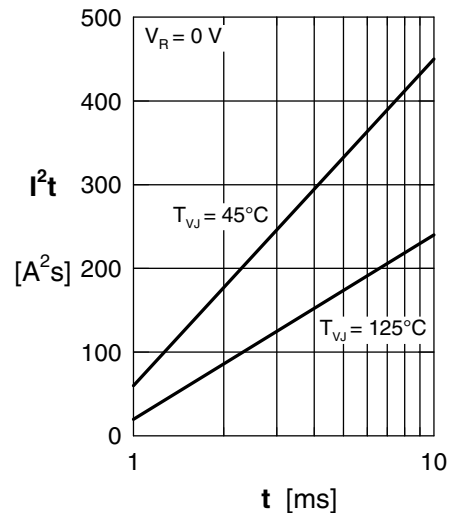


Fig. 21 I^2t for fusing (Rectifier Diodes)

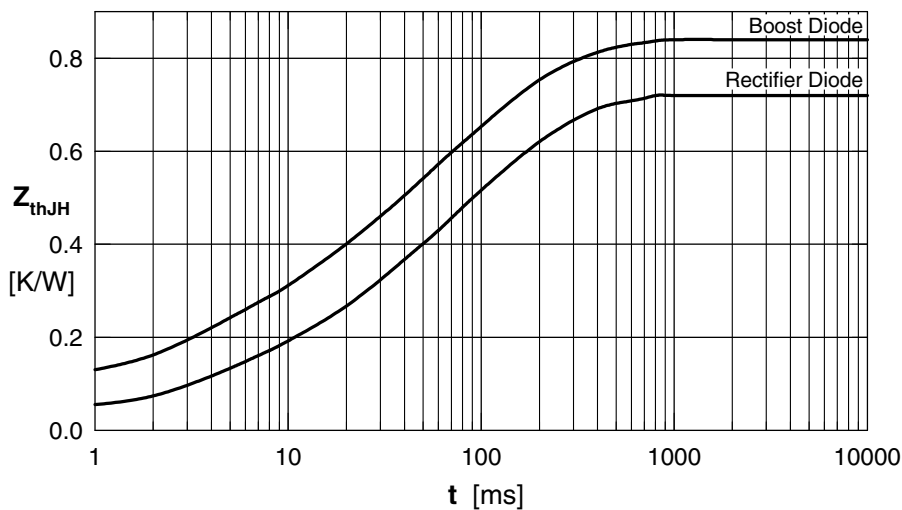


Fig. 22 Typ. transient thermal impedances of Boost Diode and Rectifier Diode

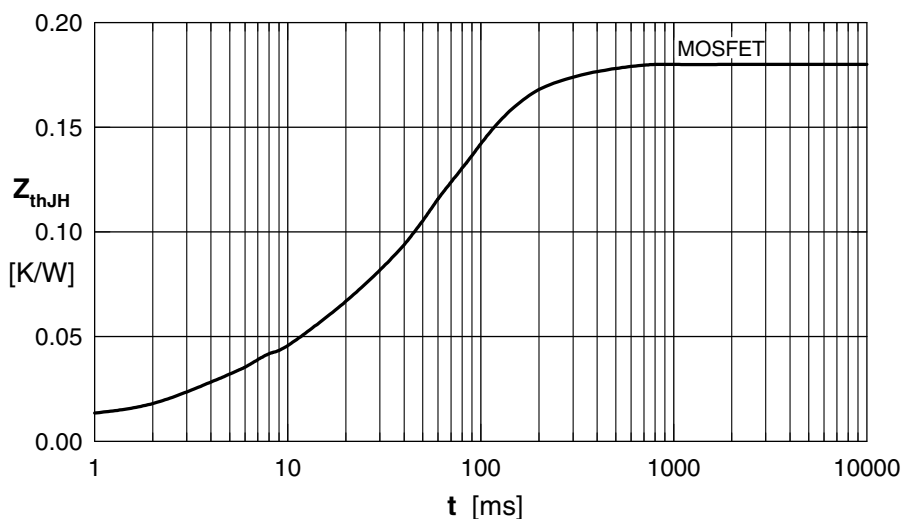


Fig. 23 Typ. transient thermal impedances of MOSFET

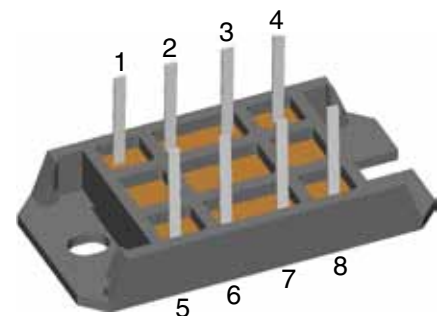
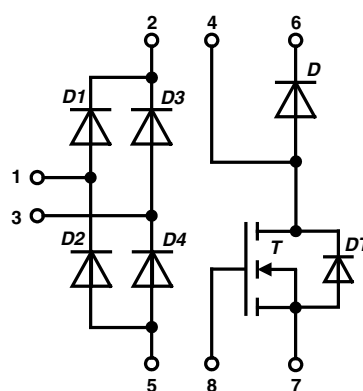
Power MOSFET Stage for Boost Converters

Module for Power Factor Correction

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

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			Unit
			min.	typ.	max.	
V_{DSS}	drain source voltage		$T_{VJ} = 25^{\circ}C$		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		$T_C = 25^{\circ}C$		50	A
I_{D80}			$T_C = 80^{\circ}C$		37	A
P_{tot}	total power dissipation		$T_C = 80^{\circ}C$		500	W
$R_{DS(on)}$	drain source on resistance	$I_D = 30 A; V_{GE} = 10 V$	$T_{VJ} = 25^{\circ}C$ $T_{VJ} = 125^{\circ}C$		120 240	m Ω m Ω
$V_{GS(th)}$	gate source threshold voltage	$I_C = 8 mA; V_{DS} = V_{GS}$	$T_{VJ} = 25^{\circ}C$	2.5	5.0	V
I_{DSS}	drain source leakage current	$V_{DS} = V_{DSS}; V_{GS} = 0 V$	$T_{VJ} = 25^{\circ}C$ $T_{VJ} = 125^{\circ}C$		50 500	μA μA
I_{GSS}	gate source leakage current	$V_{GS} = \pm 20 V; V_{DS} = 0 V$			± 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	inductive load $V_{DS} = 380 V; I_D = 20 A$ $V_{GS} = 0/10 V; R_G = 4.7 \Omega$ $R_{G\text{ eff}} = 5.5 \Omega$ ¹⁾	$T_{VJ} = 25^{\circ}C$		56	ns
t_r	current rise time				12	ns
$t_{d(off)}$	turn-off delay time				110	ns
t_f	current fall time				12	ns
E_{on}	turn-on energy per pulse				0.3	mJ
E_{off}	turn-off energy per pulse				0.16	mJ
$t_{d(on)}$	turn-on delay time	inductive load $V_{DS} = 380 V; I_D = 20 A$ $V_{GS} = 0/10 V; R_G = 4.7 \Omega$ $R_{G\text{ eff}} = 5.5 \Omega$ ¹⁾	$T_{VJ} = 125^{\circ}C$		56	ns
t_r	current rise time				16	ns
$t_{d(off)}$	turn-off delay time				144	ns
t_f	current fall time				14	ns
E_{on}	turn-on energy per pulse				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⁾ $R_{G\text{ eff}}$ includes the driver resistance of 0.8 Ω

Boost Diode D

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

²⁾ Test setup: MOSFET T driven with $R_{G\text{eff}} = 5.5 \Omega$ and $V_{GS} = 0/10 \text{ V}$
Input Rectifier Bridge D1 - D4

Symbol	Definitions	Conditions	Ratings			Unit	
			min.	typ.	max.		
V_{RRM}	max. repetitive reverse voltage				1600	V	
I_{DAV}	average forward output current	sine 180°			106	A	
I_{FAVM}	max. average forward current (per diode)	rect.; $d = 0.5$			57	A	
I_{F25}	forward current	DC			106	A	
I_{F80}	forward current	DC			71.5	A	
I_{FSM}	max. forward surge current	$t = 10 \text{ ms}; \text{ sine } 50 \text{ Hz}$			300	A	
					170	A	
I^2t	I^2t value for fusing	$t = 10 \text{ ms}; \text{ sine } 50 \text{ Hz}$			450	A^2s	
					240	A^2s	
P_{tot}	total power dissipation				110	W	
V_F	forward voltage	$I_F = 50 \text{ A}$			1.39	V	
					1.39	V	
I_R	reverse current	$V_R = V_{RRM}$			20	μA	
					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

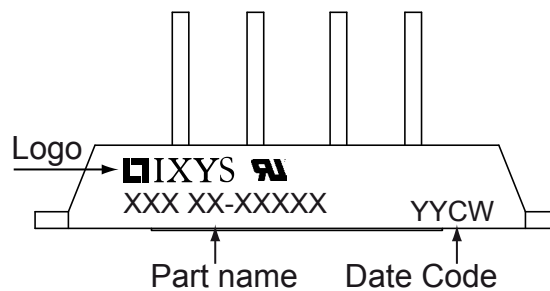
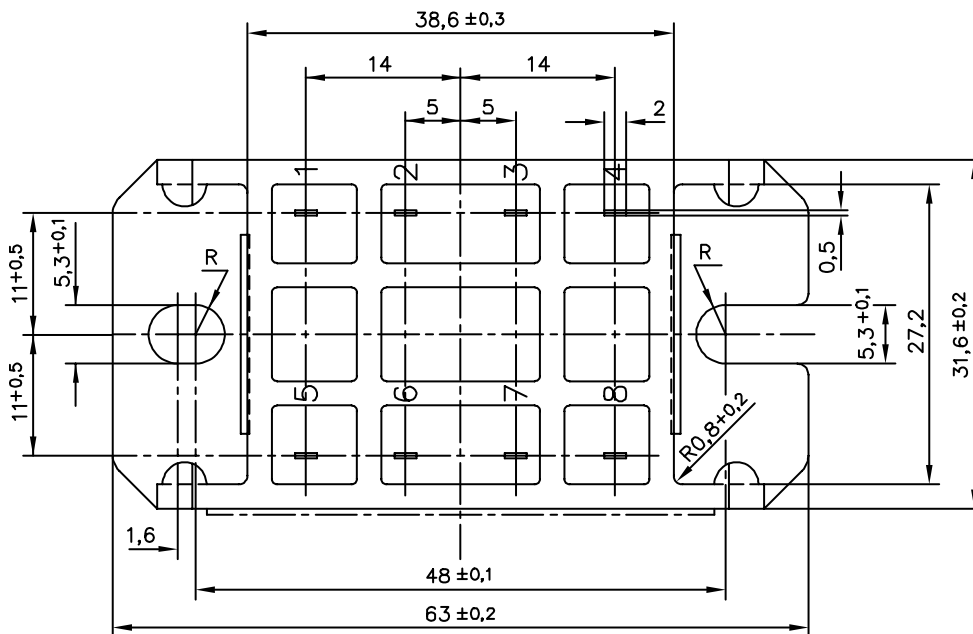
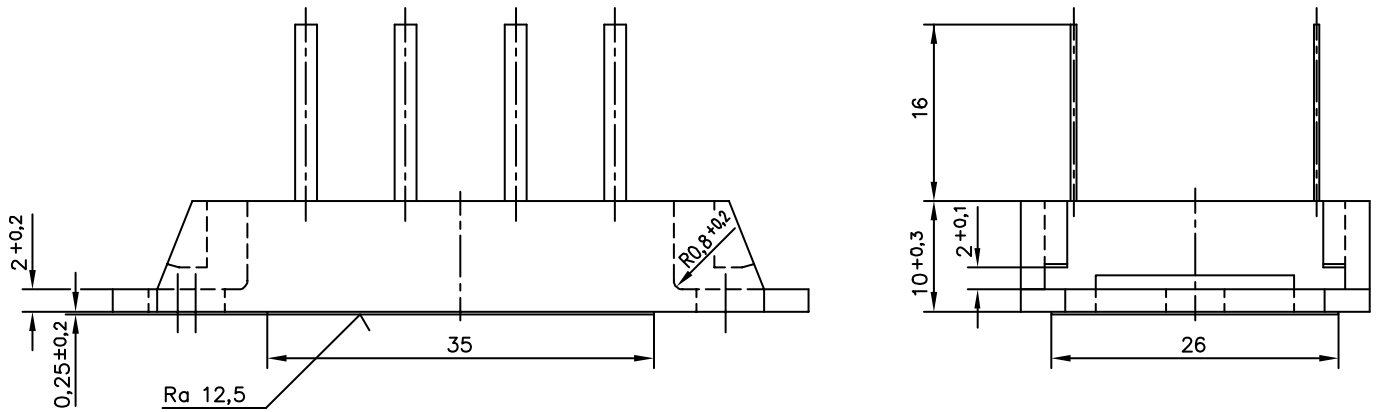
Module

Symbol	Definitions	Conditions	Ratings			Unit
			min.	typ.	max.	
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	$I_{ISOL} \leq 1 \text{ mA}; 50/60 \text{ Hz}; 1 \text{ sec.}$			3600	V~
M_d	mounting torque (M5)		2		2.5	Nm
Weight				35		g

 $T_C = 25^\circ\text{C}$ 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

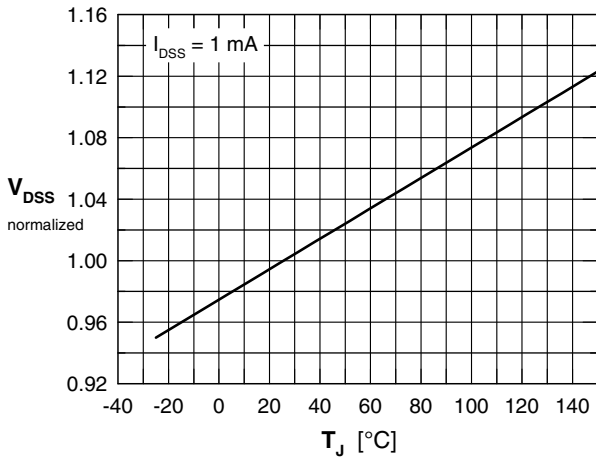


Fig. 1 Drain source breakdown voltage V_{DSS} versus junction temperature

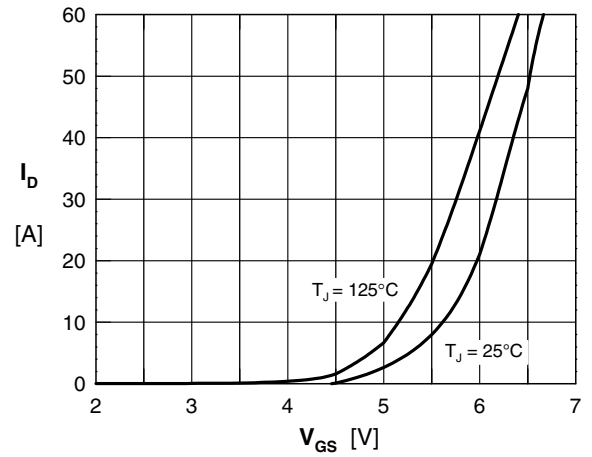


Fig. 2 Typical transfer characteristics

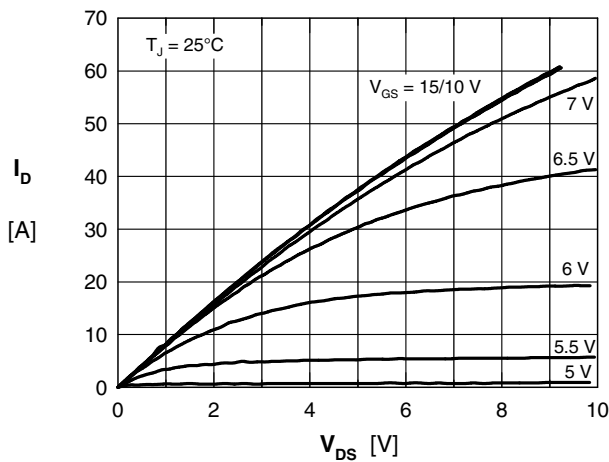


Fig. 3 Typical output characteristics

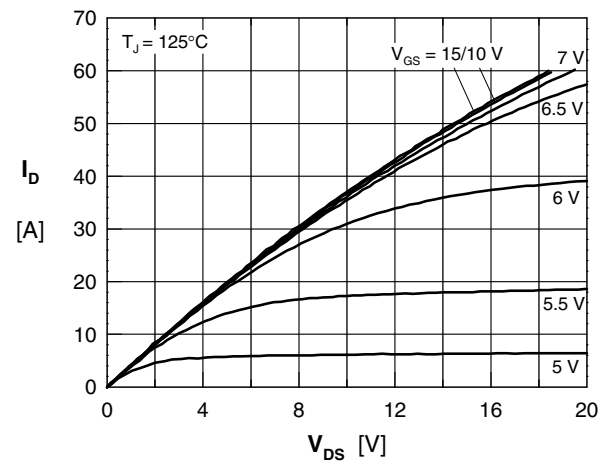


Fig. 4 Typical output characteristics

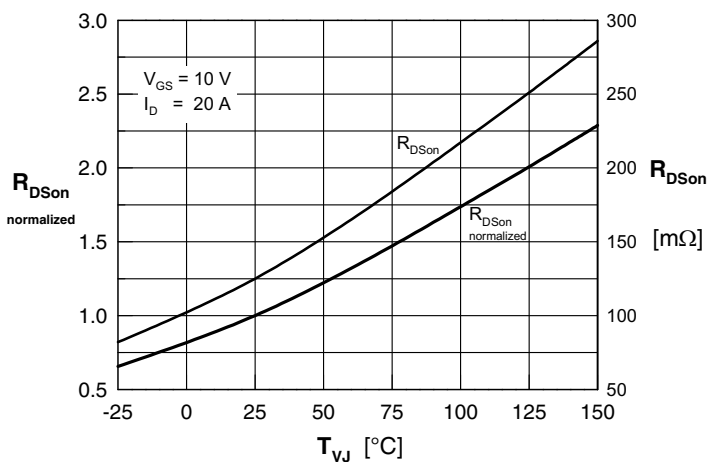


Fig. 5 Drain source on-state resistance $R_{DS(on)}$ versus junction temperature

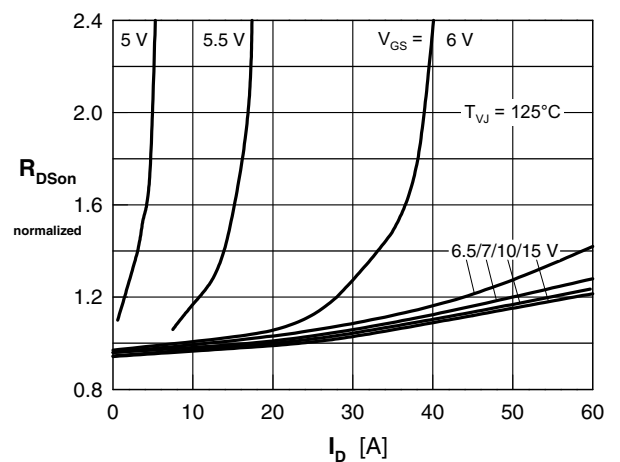


Fig. 6 Drain source on-state resistance $R_{DS(on)}$ versus I_D normalized to $R_{DS(on)}$ at $V_{GS} = 10 \text{ V}$ and $I_D = 20 \text{ A}$

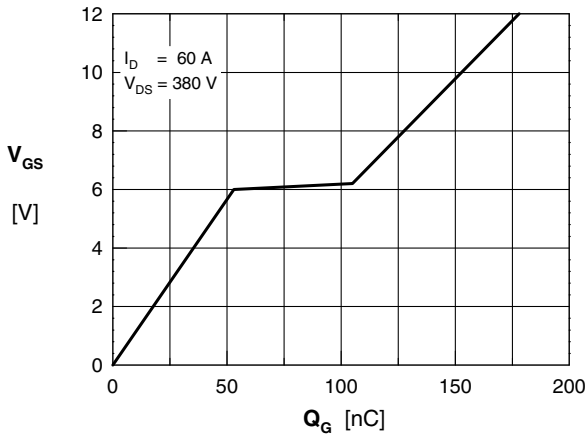


Fig. 7 Gate charge characteristics

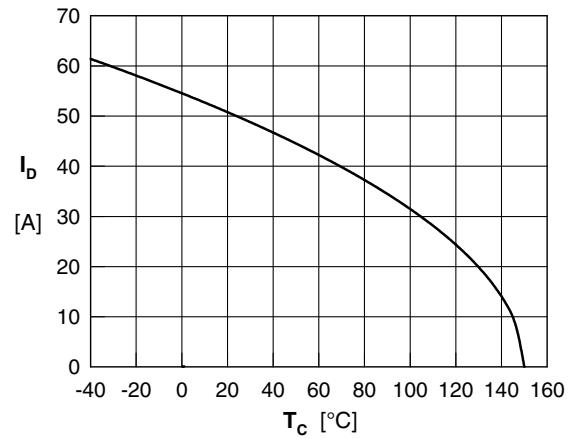
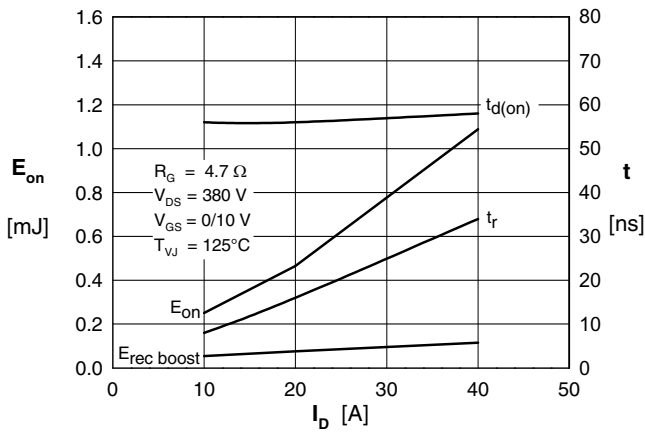

 Fig. 8 Drain current I_D versus case temperature T_C


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

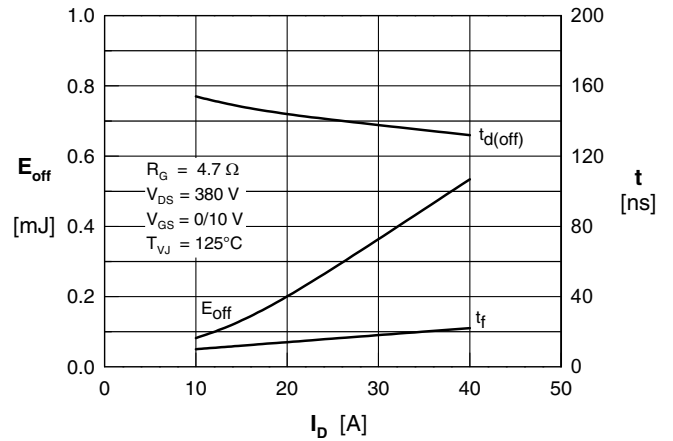


Fig. 10 Typ. turn-off energy and switching times versus drain current, inductive switching

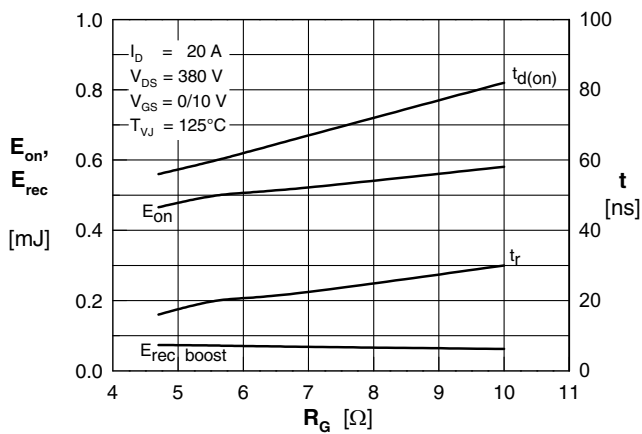


Fig. 11 Typ. turn-on energy and switching times versus gate resistor, inductive switching

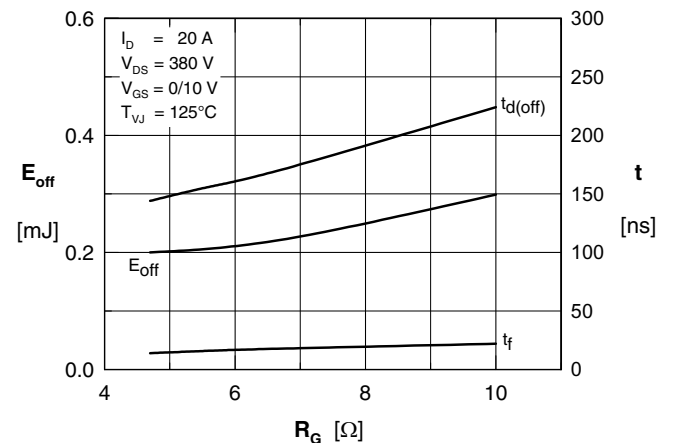


Fig. 12 Typ. turn-off energy and switching times versus gate resistor, inductive switching

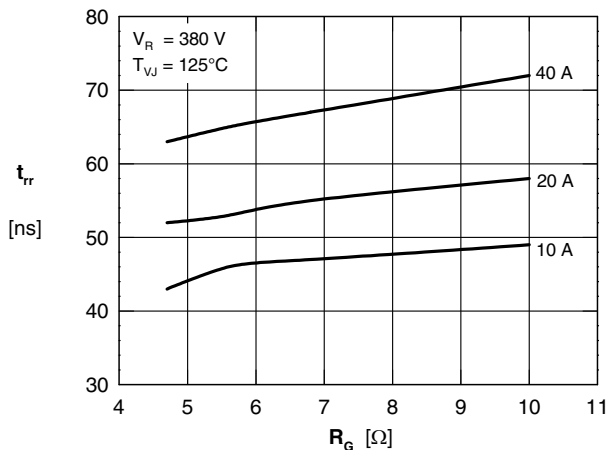


Fig. 13 Reverse recovery time t_{rr} of the boost diode versus R_G of boost MOSFET

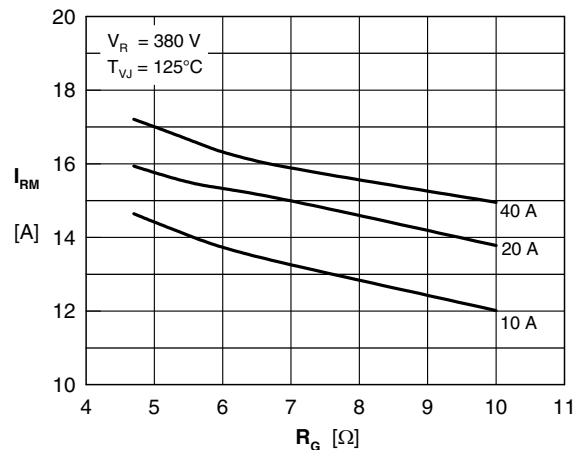


Fig. 14 Reverse recovery current I_{RM} of the boost diode versus R_G of the boost MOSFET

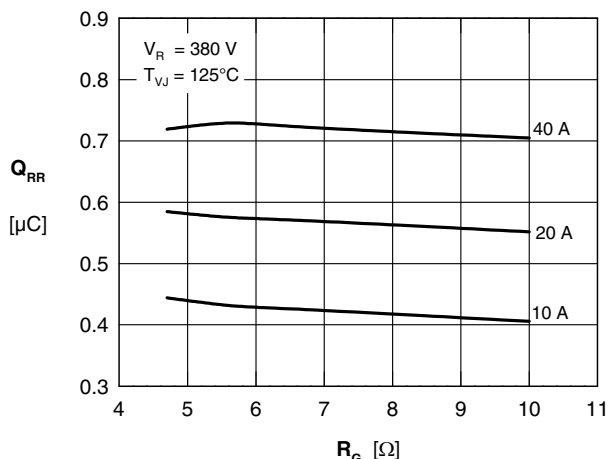


Fig. 15 Reverse recovery charge Q_{RR} of the boost diode versus R_G

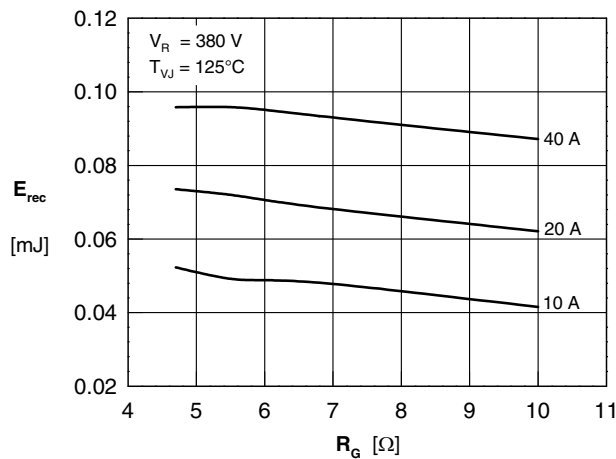


Fig. 16 Reverse recovery energy E_{rec} of the boost diode versus R_G

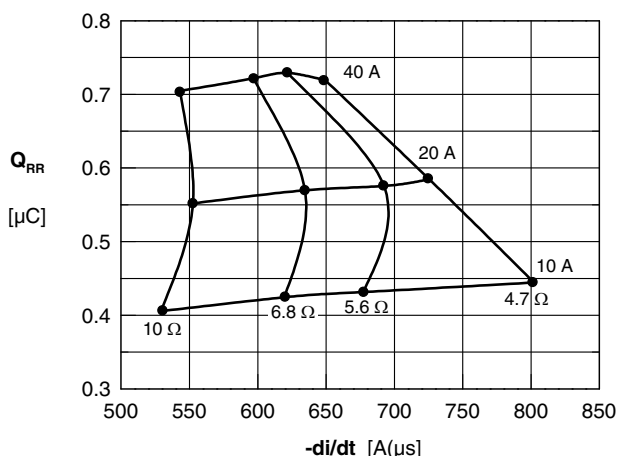


Fig. 17 Typ. turn off characteristics of the boost diode versus di/dt

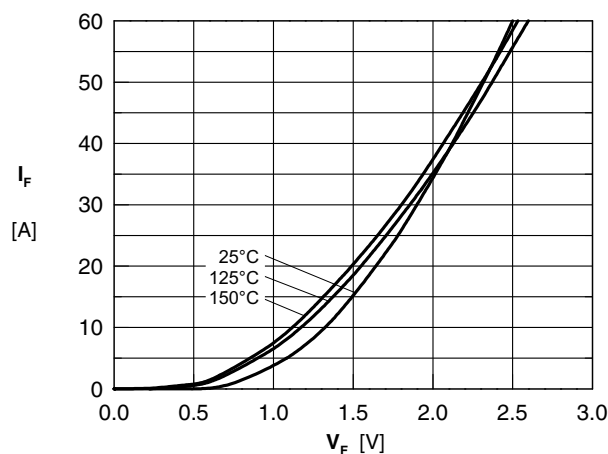


Fig. 18 Forward characteristics boost diode

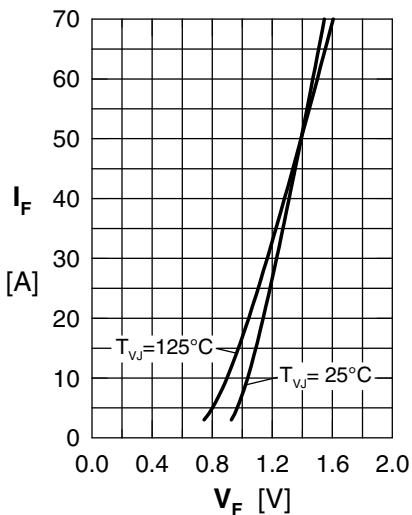


Fig. 19 Forward current vs. voltage drop of input rectifier diode

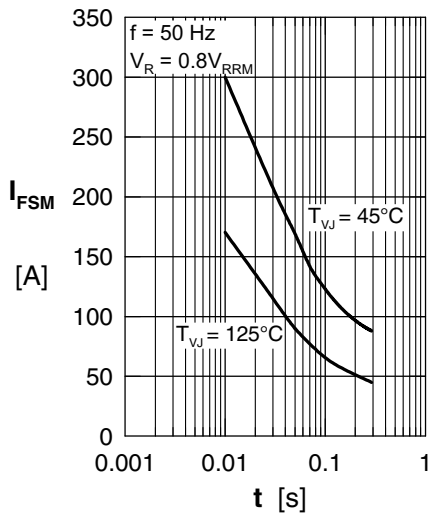


Fig. 20 Non-repetitive peak surge current (Rectifier Diodes)

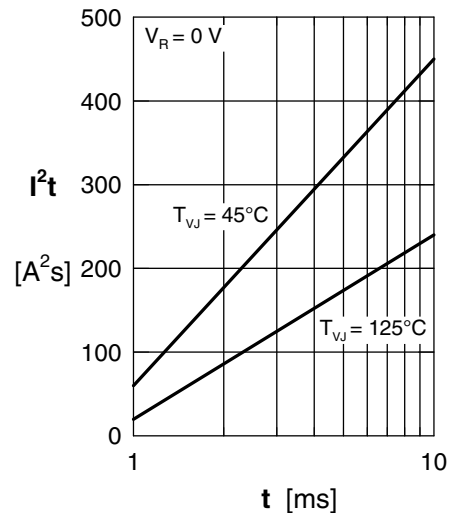


Fig. 21 I^2t for fusing (Rectifier Diodes)

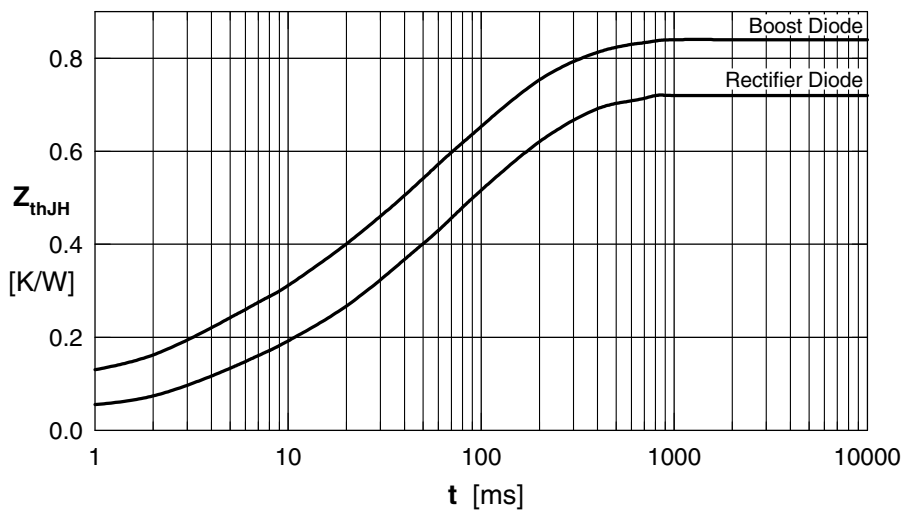


Fig. 22 Typ. transient thermal impedances of Boost Diode and Rectifier Diode

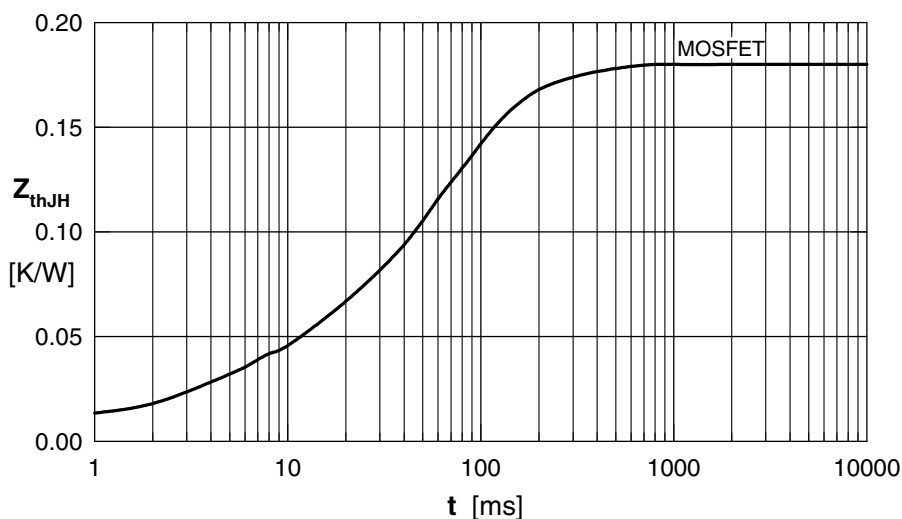


Fig. 23 Typ. transient thermal impedances of MOSFET