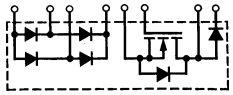
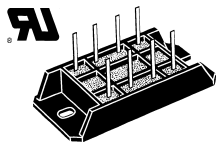
Rectifier Bridges for Power Factor Correction

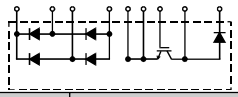
Power Stage for Boost Converters (Power Factor Correction)

1-phase PFC



Boost Module with MOSFET and Boost Diode, Rectifier Diodes

Type	V_{DSS} max. T_S = 25 °C V	$I_{D(cont)}$ T_S = 25 °C A	$R_{DS(on)}$ Ω	R_{thJS} max. K/W	P_D max. T_S = 25 °C W	V_{RRM} Boost Diode V	V_{RRM} Rectifier Diodes V	Page	Package
VUM 24-05N VUM 33-05N	500	35 47	0.12	0.38 0.21	325 595	600	800	F1 - 2 F1 - 6	



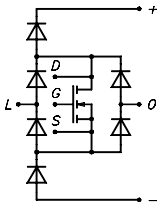
Boost Module with Ultra Fast IGBT and Boost Diode, Fast Rectifier Diodes

Type ➤ New	V_{CES} V	I_{C80} T_C = 80 °C IGBT A	I_{F80} T_C = 80 °C boost diode A	V_{RRM} V	I_{F80} T_C = 80 °C rect.diodes A	P_N U_N=110...240V mains power W	Page	Package
➤ VUI 9-06N7	600	25	22	1200	10	900...2100	F1 - 10	

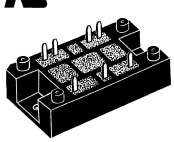
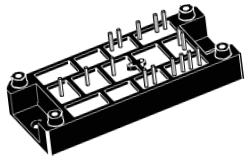
3-phase PFC

"Vienna Rectifier" circuit (patent pending)

- wide input voltage range
- sinusoidal mains input currents in phase with mains voltages
- boost converter operation:
  - input: three phase AC mains without neutral conductor
  - output: stabilized DC link with center point
- one module used per phase



For further information on this circuit please visit IXYS web site http://www.ixys.com

Type ➤ New	P_N kW 3~ U_n = 240/400 V T_C = 80 °C	soft start thyristor	Page	Package
➤ VUM25-05 ➤ VUM85-05	10 30	●	F1 - 13 F1 - 17	 V2-Package 

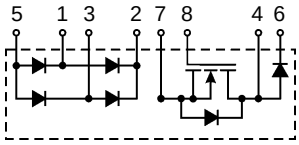
See also *1~ Rectifier Bridges section F4 - 1, Discrete NPT IGBTs section B5 -1 and HiPerFET™ F-Series section C1 IXFF24N100 products in isolated ISOPLUS i4-PAC.*

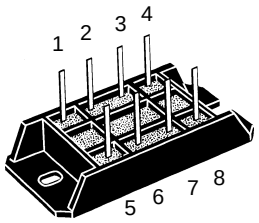
Power MOSFET Stage for Boost Converters

Module for Power Factor Correction

I_{D25} = 35 A
V_{DSS} = 500 V
$R_{DS(on)}$ = 0.12 Ω

$V_{RRM (Diode)}$ V	V_{DSS} V	Type
600	**500**	**VUM 24-05N**





Symbol		Test Conditions	Maximum Ratings	
V_{DSS}	MOSFET	T_{VJ} = 25°C to 150°C	500	V
V_{DGR}		T_{VJ} = 25°C to 150°C; R_{GS} = 10 kΩ	500	V
V_{GS}		Continuous	±20	V
I_D		T_S = 85°C	24	A
I_D		T_S = 25°C	35	A
I_{DM}		T_S = 25°C, t_p = ①	95	A
P_D		T_S = 85°C	170	W
I_S		V_{GS} = 0 V, T_S = 25°C	24	A
I_{SM}		V_{GS} = 0 V, T_S = 25°C, t_p = ①	95	A
V_{RRM}	Boost Diode		600	V
I_{dAV}		T_S = 85°C, rectangular δ = 0.5	40	A
I_{FSM}		T_{VJ} = 45°C, t = 10 ms (50 Hz)	300	A
		t = 8.3 ms (60 Hz)	320	A
		T_{VJ} = 150°C, t = 10 ms (50 Hz)	260	A
		t = 8.3 ms (60 Hz)	280	A
P		T_S = 85°C	36	W
V_{RRM}	Rectifier Diodes		800	V
I_{dAV}		T_S = 85°C, sinus 180°	40	A
I_{FSM}		T_{VJ} = 45°C, t = 10 ms (50 Hz)	300	A
		t = 8.3 ms (60 Hz)	320	A
		T_{VJ} = 150°C, t = 10 ms (50 Hz)	260	A
		t = 8.3 ms (60 Hz)	280	A
P		T_S = 85°C	33	W
T_{VJ}	Module		-40...+150	°C
T_{JM}			150	°C
T_{stg}			-40...+150	°C
V_{ISOL}		50/60 Hz t = 1 min	3000	V~
		I_{ISOL} ≤ 1 mA t = 1 s	3600	V~
M_d		Mounting torque (M5)	2-2.5/18-22	Nm/lb.in.
Weight			28	g

Features

- Package with DCB ceramic base plate
- Soldering connections for PCB mounting
- Isolation voltage 3600 V~
- Low $R_{DS(on)}$ HDMOS™ process
- Low package inductance for high speed switching
- Ultrafast boost diode
- Kelvin source for easy drive

Applications

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

Advantages

- 3 functions in one package
- Output power up to 5 kW
- No external isolation
- Easy to mount with two screws
- Suitable for wave soldering
- High temperature and power cycling capability
- Fits easiliy to all available PFC controller ICs

① Pulse width limited by T_{VJ}
IXYS reserves the right to change limits, test conditions and dimensions.

Symbol		Test Conditions (T_{VJ} = 25°C, unless otherwise specified)	Characteristic Values min.	typ.	max.	
V_{DSS}	MOSFET	V_{GS} = 0 V, I_D = 2 mA	500			V
$V_{GS(th)}$		V_{DS} = 20 V, I_D = 20 mA	2		5	V
I_{GSS}		V_{GS} = ±20 V, V_{DS} = 0 V			±500	nA
I_{DSS}		V_{DS} = 500 V, V_{GS} = 0 V			2	mA
$R_{DS(on)}$		T_{VJ} = 25°C			0.12	Ω
R_{Gint}		T_{VJ} = 25°C			1.5	Ω
g_{fs}		V_{DS} = 15 V, I_{DS} = 12 A		30		S
V_{DS}		I_{DS} = 24 A, V_{GS} = 0 V			1.5	V
$t_{d(on)}$		V_{DS} = 250 V, I_{DS} = 12 A, V_{GS} = 10 V			100	ns
$t_{d(off)}$		Zgen. = 1 Ω, L-load			220	ns
C_{iss}		V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0 V		8.5		nF
C_{oss}				0.9		nF
C_{rss}				0.3		nF
Q_g		V_{DS} = 250 V, I_D = 12 A, V_{GS} = 10 V		350		nC
R_{thJS}					0.38	K/W
V_F	Boost Diode	I_F = 22 A; T_{VJ} = 25°C			1.65	V
		T_{VJ} = 150°C			1.4	V
I_R		V_R = 600 V, T_{VJ} = 25°C			1.5	mA
		V_R = 480 V, T_{VJ} = 25°C			0.25	mA
		T_{VJ} = 125°C			7	mA
V_{T0}		For power-loss calculations only			1.14	V
r_T		T_{VJ} = 125°C			10	mΩ
I_{RM}		I_F = 30 A; $-di_F/dt$ = 240 A/µs				
		V_R = 350 V, T_{VJ} = 100°C		10	11	A
R_{thJS}					1.8	K/W
V_F	Rectifier Diodes	I_F = 20 A, T_{VJ} = 25°C			1.4	V
		T_{VJ} = 125°C			1.4	V
I_R		V_R = 800 V T_{VJ} = 25°C			0.25	mA
		V_R = 640 V, T_{VJ} = 125°C			2	mA
V_{T0}		For power-loss calculations only			1.05	V
r_T		T_{VJ} = 125°C			16	mΩ
R_{thJS}					2	K/W

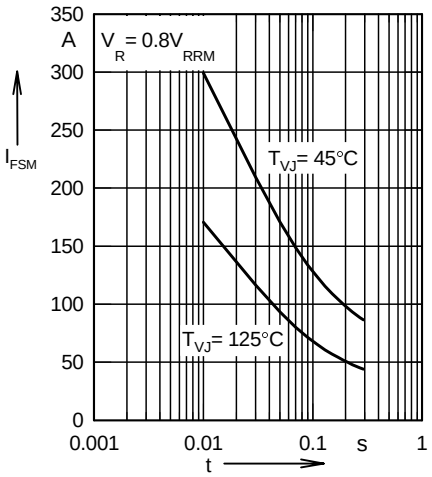


Fig. 1 Non-repetitive peak surge current (Rectifier Diodes)

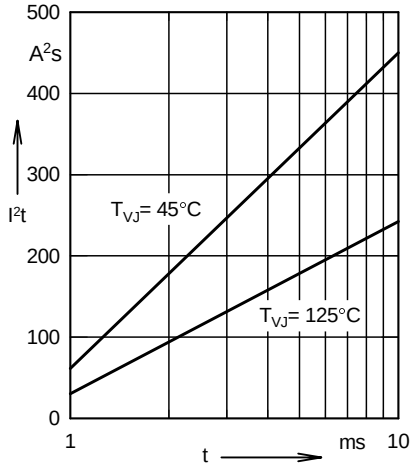
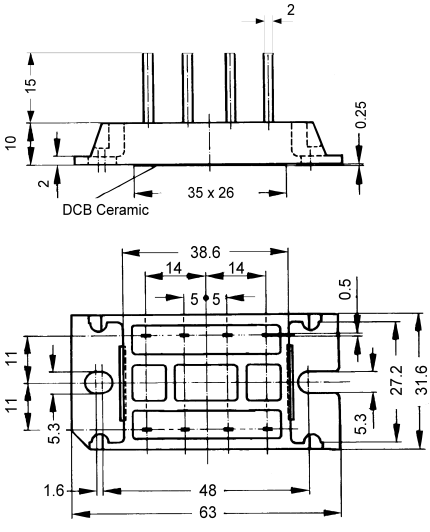


Fig. 2 I^2t for fusing (Rectifier Diodes)

Dimensions in mm (1 mm = 0.0394")



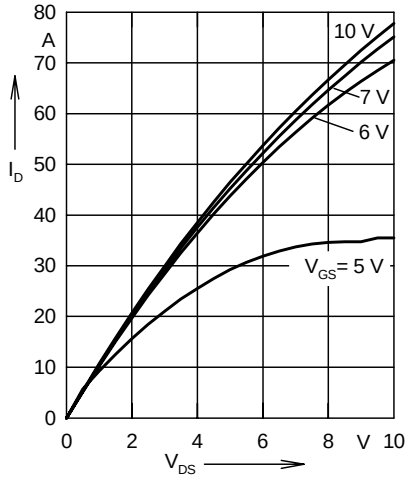


Fig. 3 Typ. output characteristic $I_D = f(V_{DS})$ (MOSFET)

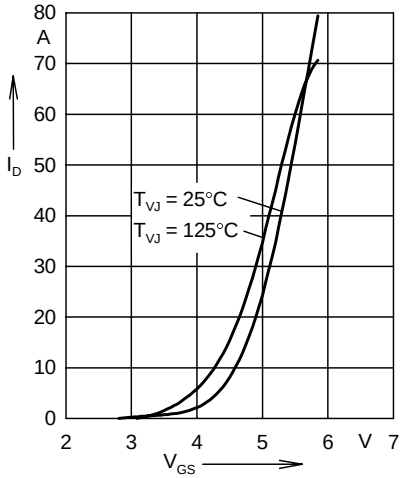


Fig. 4 Typ. transfer characteristics $I_D = f(V_{GS})$ (MOSFET)

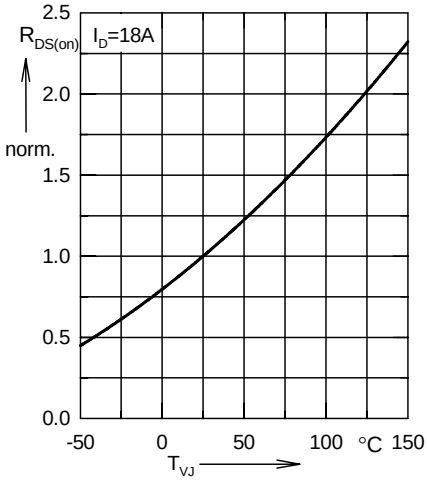


Fig. 5 Typ. normalized $R_{DS(on)} = f(T_{VJ})$ (MOSFET)

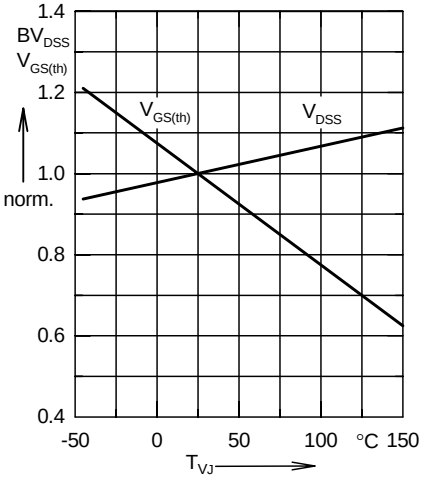


Fig. 6 Typ. normalized $BV_{DSS} = f(T_{VJ})$ $V_{GS(th)} = f(T_{VJ})$ (MOSFET)

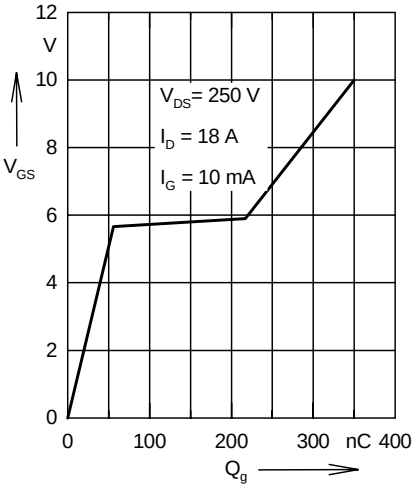


Fig. 7 Typ. turn-on gate charge characteristics, $V_{GS} = f(Q_g)$ (MOSFET)

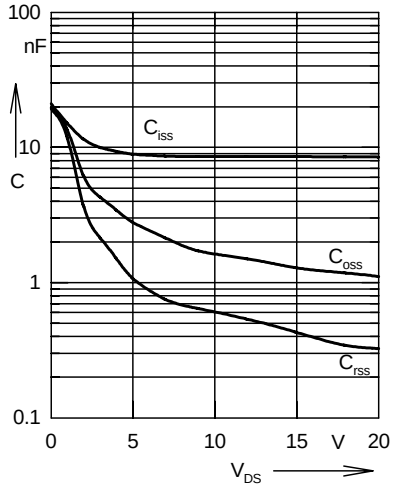


Fig. 8 Typ. capacitances $C = f(V_{DS})$, f = 1 MHz (MOSFET)

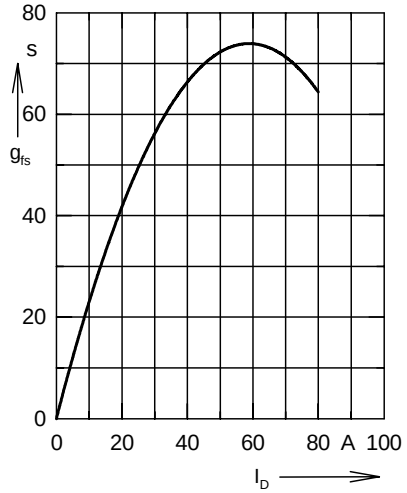


Fig. 9 Typ. transconductance, $g_{fs} = f(I_D)$ (MOSFET)

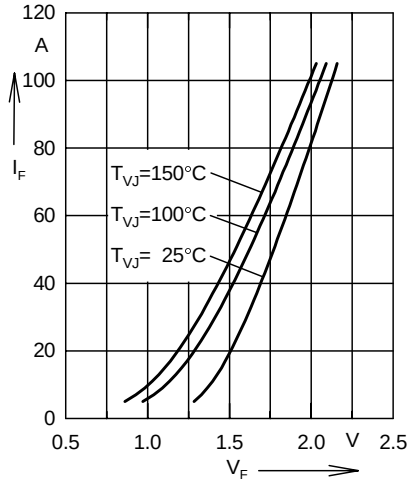


Fig. 10 Forward current versus voltage drop (Boost Diode)

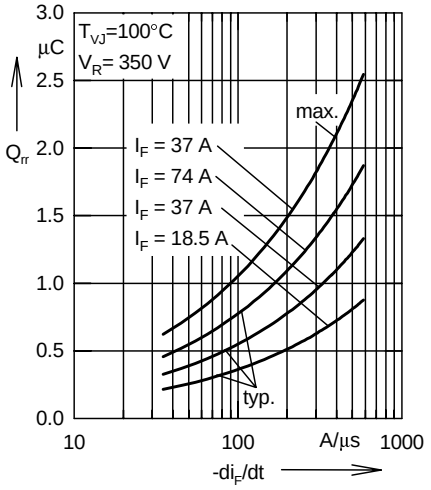


Fig. 11 Recovery charge versus $-di_F/dt$ (Boost Diode)

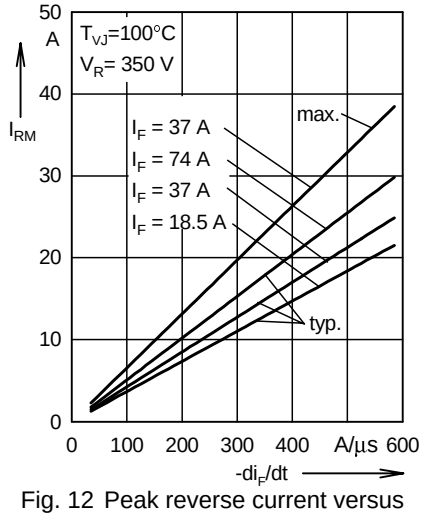


Fig. 12 Peak reverse current versus -di_F/dt (Boost Diode)

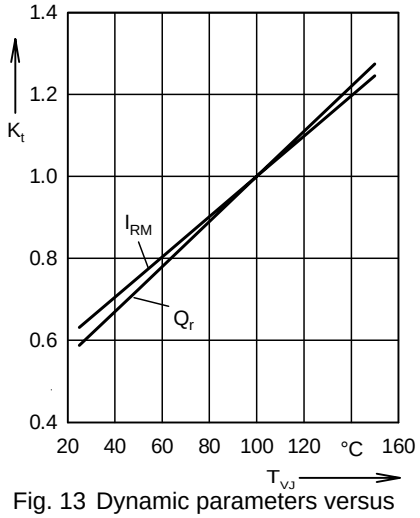


Fig. 13 Dynamic parameters versus junction temperature (Boost Diode)

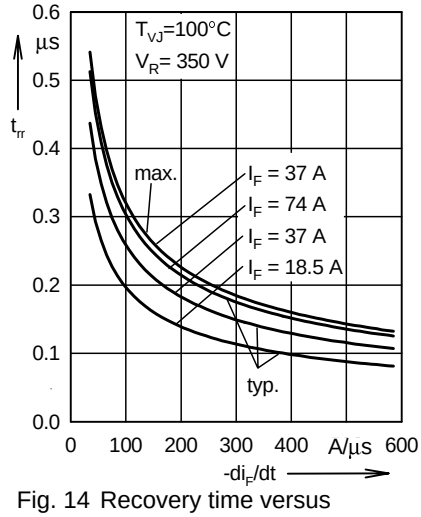


Fig. 14 Recovery time versus -di_F/dt (Boost Diode)

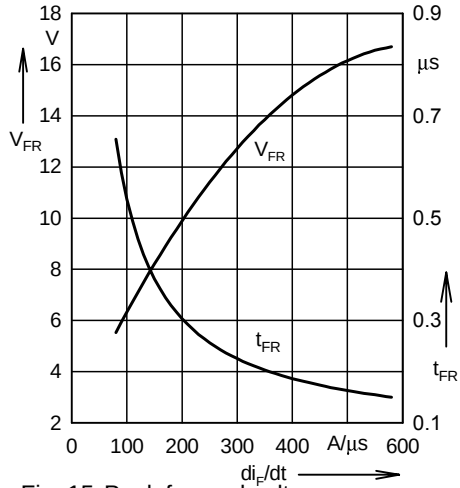


Fig. 15 Peak forward voltage versus -di_F/dt (Boost Diode)

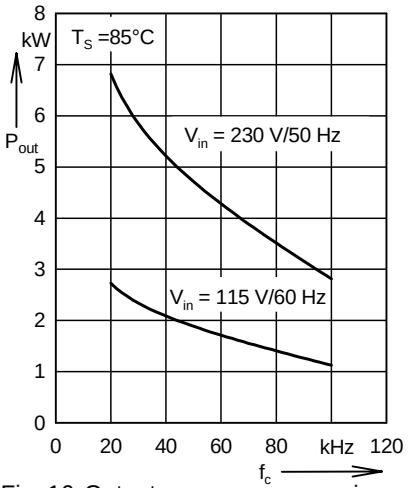


Fig. 16 Output power versus carrier frequency (Module)

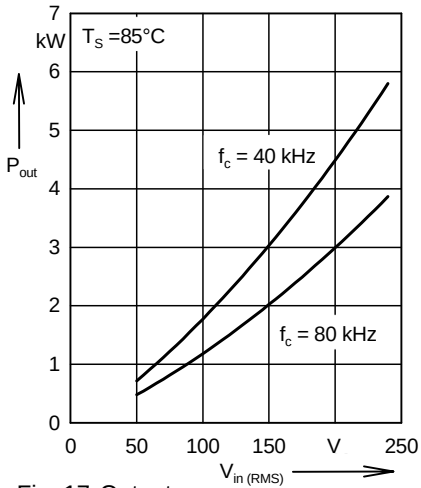


Fig. 17 Output power versus mains voltage

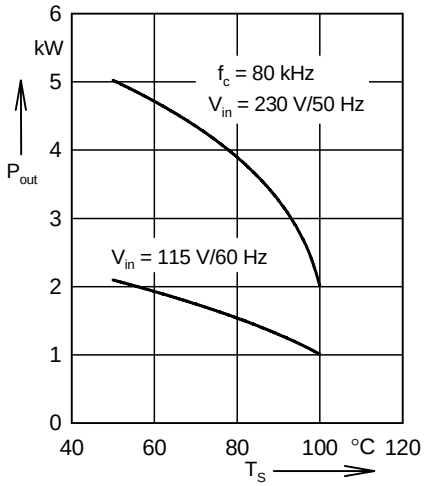


Fig. 18 Output power versus heatsink temperature (Module)

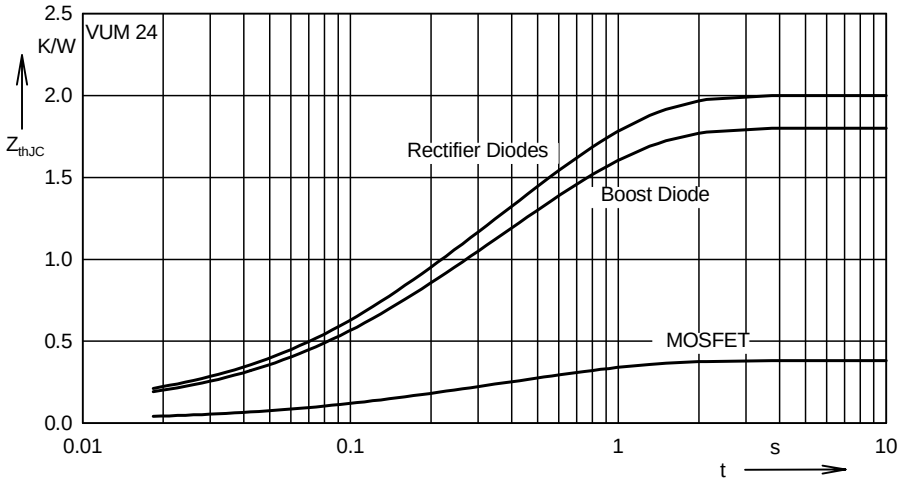


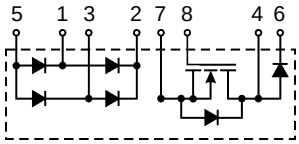
Fig. 19 Transient thermal impedance junction to case for all devices

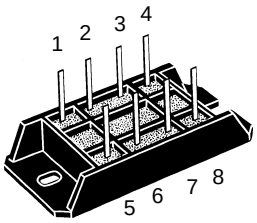
Power MOSFET Stage for Boost Converters

Module for Power Factor Correction

I_{D25} = 47 A
V_{DSS} = 500 V
$R_{DS(on)}$ = 0.12 Ω

$V_{RRM (Diode)}$ V	V_{DSS} V	Type
600	**500**	**VUM 33-05N**





Symbol		Test Conditions	Maximum Ratings	
V_{DSS}	MOSFET	T_{VJ} = 25°C to 150°C	500	V
V_{DGR}		T_{VJ} = 25°C to 150°C; R_{GS} = 10 kΩ	500	V
V_{GS}		Continuous	±20	V
I_D		T_S = 85°C	33	A
I_D		T_S = 25°C	47	A
I_{DM}		T_S = 25°C, t_p = ①	130	A
P_D		T_S = 85°C	310	W
I_S		V_{GS} = 0 V, T_S = 25°C	33	A
I_{SM}		V_{GS} = 0 V, T_S = 25°C, t_p = ①	130	A
V_{RRM}	Boost Diode		600	V
I_{FAV}		T_S = 85°C, rectangular δ = 0.5	33	A
I_{FSM}		T_{VJ} = 45°C, t = 10 ms (50 Hz)	300	A
		t = 8.3 ms (60 Hz)	320	A
		T_{VJ} = 150°C, t = 10 ms (50 Hz)	260	A
		t = 8.3 ms (60 Hz)	280	A
P		T_S = 85°C	59	W
V_{RRM}	Rectifier Diodes		800	V
I_{dAV}		T_S = 85°C, sinus 180°	54	A
I_{FSM}		T_{VJ} = 45°C, t = 10 ms (50 Hz)	300	A
		t = 8.3 ms (60 Hz)	320	A
		T_{VJ} = 150°C, t = 10 ms (50 Hz)	260	A
		t = 8.3 ms (60 Hz)	280	A
P		T_S = 85°C	50	W
T_{VJ}	Module		-40...+150	°C
T_{JM}			150	°C
T_{stg}			-40...+150	°C
V_{ISOL}		50/60 Hz t = 1 min	3000	V~
		I_{ISOL} ≤ 1 mA t = 1 s	3600	V~
M_d		Mounting torque (M5)	2-2.5/18-22	Nm/lb.in.
Weight			28	g

Features

- Package with DCB ceramic base plate
- Soldering connections for PCB mounting
- Isolation voltage 3600 V~
- Low $R_{DS(on)}$ HDMOS™ process
- Low package inductance for high speed switching
- Ultrafast boost diode
- Kelvin source for easy drive

Applications

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

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 easiliy to all available PFC controller ICs

① Pulse width limited by T_{VJ}
IXYS reserves the right to change limits, test conditions and dimensions.

Symbol		Test Conditions (T_{VJ} = 25°C, unless otherwise specified)	Characteristic Values min.	typ.	max.	
V_{DSS}	MOSFET	V_{GS} = 0 V, I_D = 2 mA	500			V
$V_{GS(th)}$		V_{DS} = 20 V, I_D = 20 mA	2		5	V
I_{GSS}		V_{GS} = ±20 V, V_{DS} = 0 V			±500	nA
I_{DSS}		V_{DS} = 500 V, V_{GS} = 0 V			2	mA
$R_{DS(on)}$		T_{VJ} = 25°C			0.12	Ω
R_{Gint}		T_{VJ} = 25°C			1.5	Ω
g_{fs}		V_{DS} = 15 V, I_{DS} = 12 A		30		S
V_{DS}		I_{DS} = 24 A, V_{GS} = 0 V			1.5	V
$t_{d(on)}$		V_{DS} = 250 V, I_{DS} = 12 A, V_{GS} = 10 V			100	ns
$t_{d(off)}$		Zgen. = 1 Ω, L-load			220	ns
C_{iss}		V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0 V		8.5		nF
C_{oss}				0.9		nF
C_{rss}				0.3		nF
Q_g		V_{DS} = 250 V, I_D = 12 A, V_{GS} = 10 V		350		nC
R_{thJS}					0.21	K/W
V_F	Boost Diode	I_F = 33 A; T_{VJ} = 25°C			1.75	V
		T_{VJ} = 150°C			1.5	V
I_R		V_R = 600 V, T_{VJ} = 25°C			1.5	mA
		V_R = 480 V, T_{VJ} = 25°C			0.25	mA
		T_{VJ} = 125°C			7	mA
V_{T0}		For power-loss calculations only			1.21	V
r_T		T_{VJ} = 125°C			9	mΩ
I_{RM}		I_F = 30 A; $-di_F/dt$ = 240 A/µs				
		V_R = 350 V, T_{VJ} = 100°C		10	11	A
R_{thJS}					1.1	K/W
V_F	Rectifier Diodes	I_F = 20 A, T_{VJ} = 25°C			1.5	V
		T_{VJ} = 125°C			1.5	V
I_R		V_R = 800 V T_{VJ} = 25°C			0.25	mA
		V_R = 640 V, T_{VJ} = 125°C			2	mA
V_{T0}		For power-loss calculations only			1.18	V
r_T		T_{VJ} = 125°C			12	mΩ
R_{thJS}					1.3	K/W

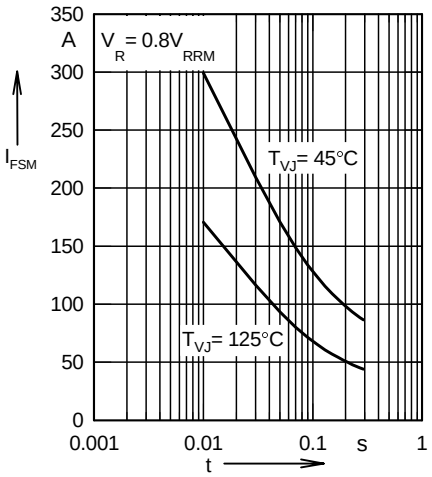


Fig. 1 Non-repetitive peak surge current (Rectifier Diodes)

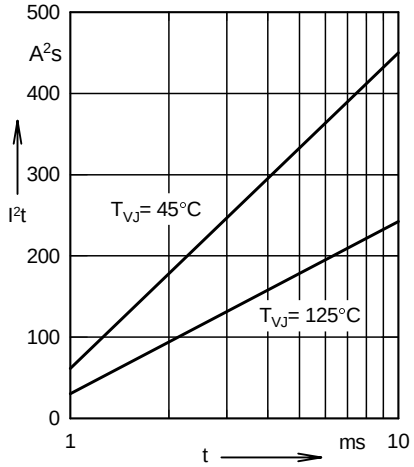
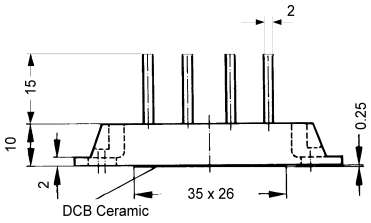
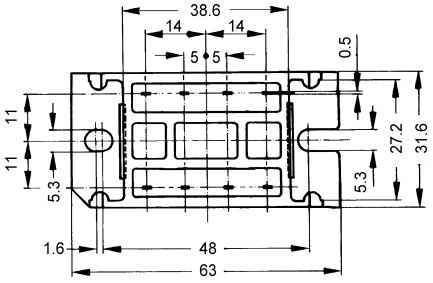


Fig. 2 I^2t for fusing (Rectifier Diodes)

Dimensions in mm (1 mm = 0.0394")





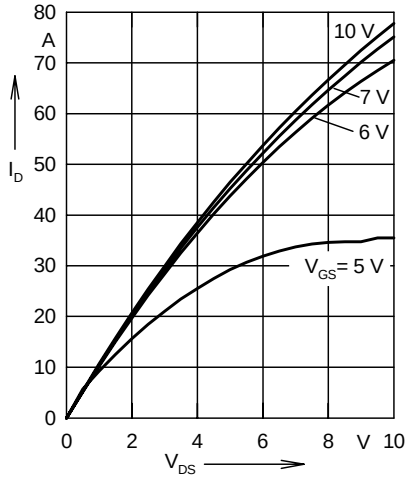


Fig. 3 Typ. output characteristic $I_D = f(V_{DS})$ (MOSFET)

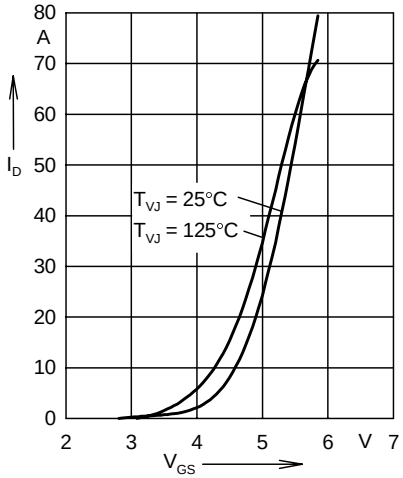


Fig. 4 Typ. transfer characteristics $I_D = f(V_{GS})$ (MOSFET)

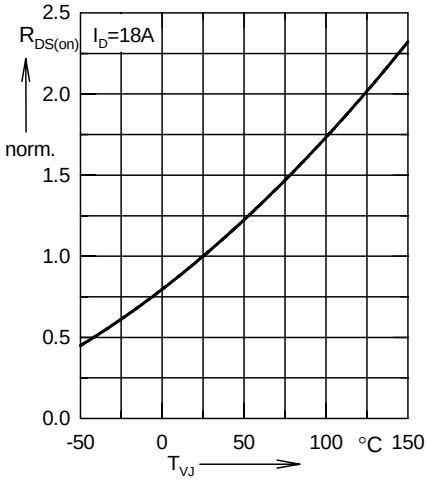


Fig. 5 Typ. normalized $R_{DS(on)} = f(T_{VJ})$ (MOSFET)

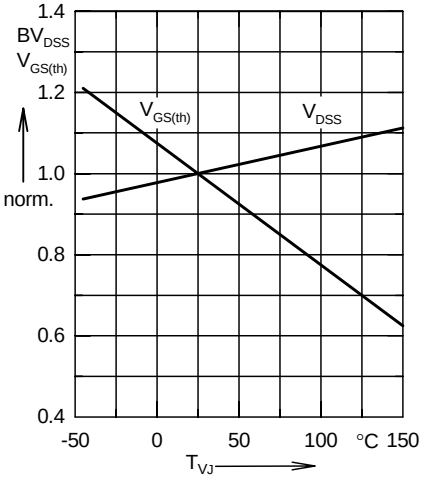


Fig. 6 Typ. normalized $BV_{DSS} = f(T_{VJ})$ $V_{GS(th)} = f(T_{VJ})$ (MOSFET)

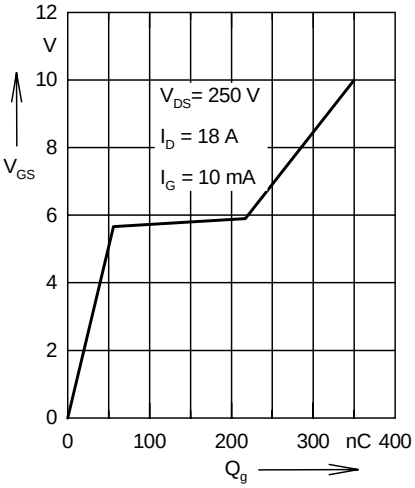


Fig. 7 Typ. turn-on gate charge characteristics, $V_{GS} = f(Q_g)$ (MOSFET)

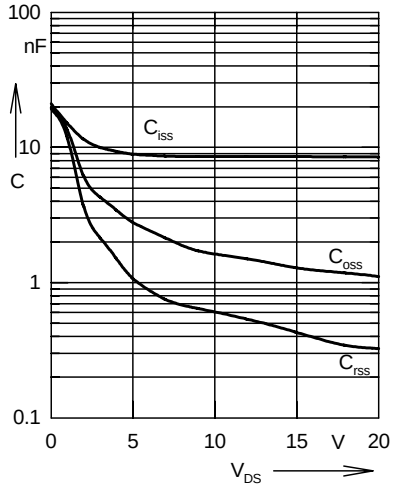


Fig. 8 Typ. capacitances $C = f(V_{DS})$, f = 1 MHz (MOSFET)

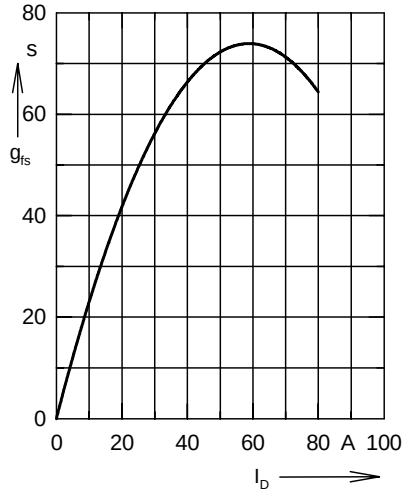


Fig. 9 Typ. transconductance, $g_{fs} = f(I_D)$ (MOSFET)

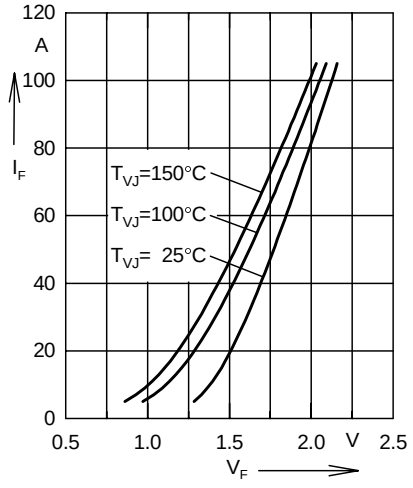


Fig. 10 Forward current versus voltage drop (Boost Diode)

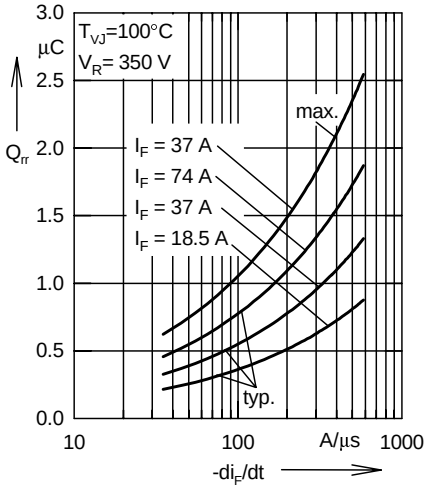


Fig. 11 Recovery charge versus $-di_F/dt$ (Boost Diode)

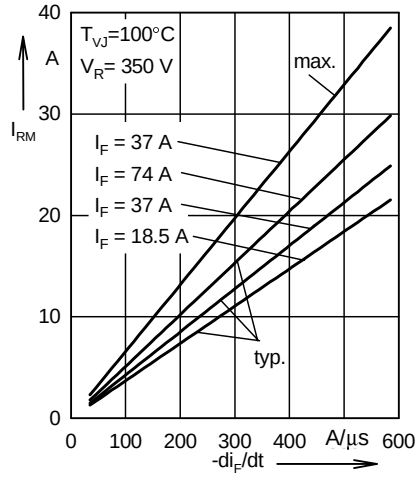


Fig. 12 Peak reverse current versus $-di_F/dt$ (Boost Diode)

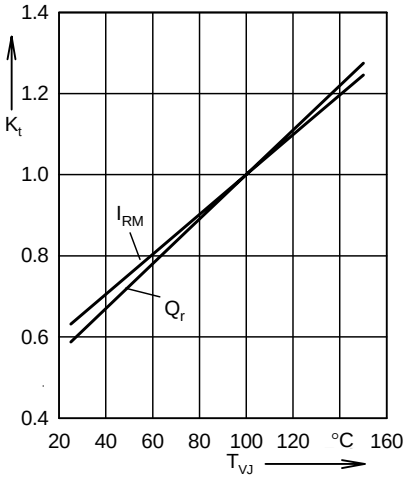


Fig. 13 Dynamic parameters versus junction temperature (Boost Diode)

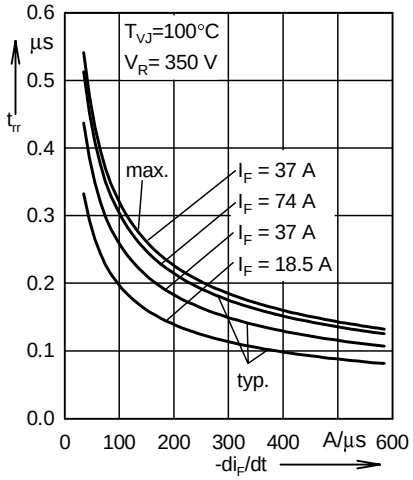


Fig. 14 Recovery time versus $-di_F/dt$ (Boost Diode)

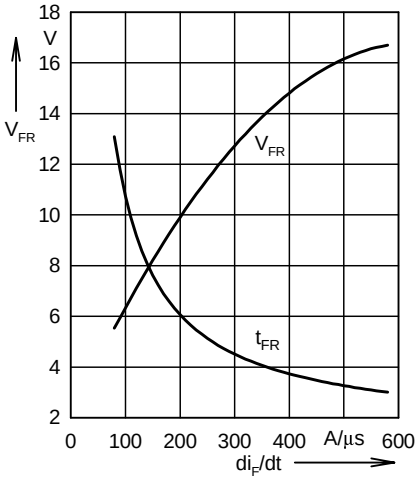


Fig. 15 Peak forward voltage versus $-di_F/dt$ (Boost Diode)

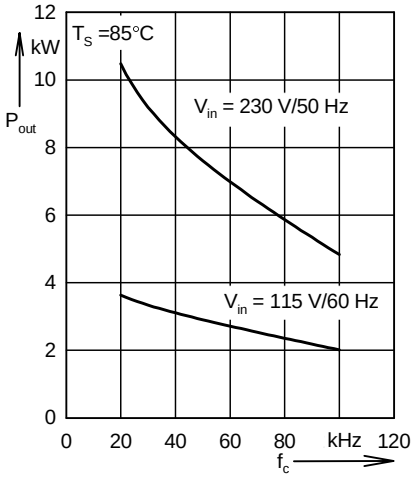


Fig. 16 Output power versus carrier frequency (Module)

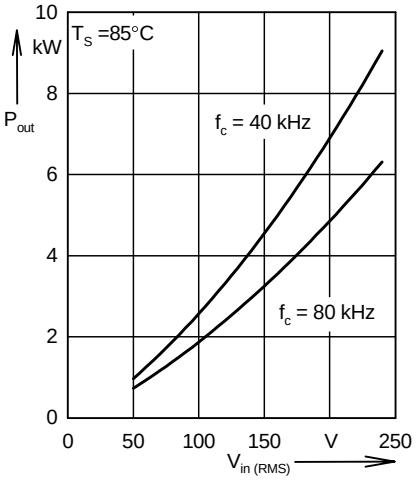


Fig. 17 Output power versus mains voltage

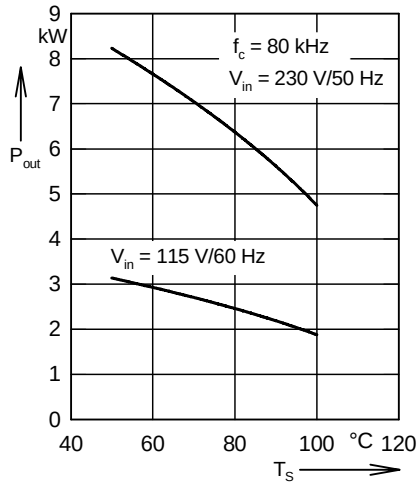


Fig. 18 Output power versus heatsink temperature (Module)

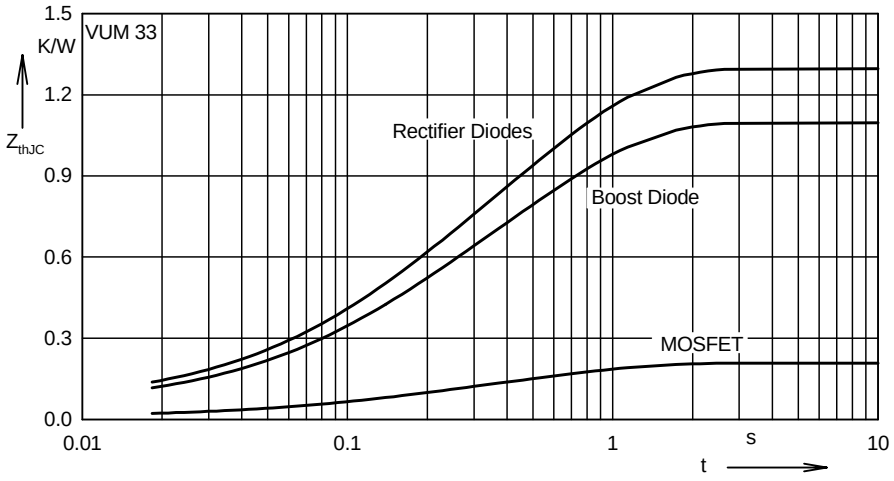


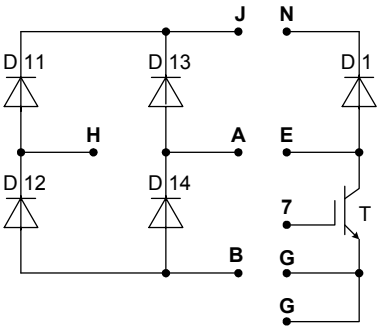
Fig. 19 Transient thermal impedance junction to case for all devices

Rectifier Module for Power Factor Correction

V_{RRM} = 1200 V
I_{FAV25} = 15 A

V_{CES} = 600 V
I_{C25} = 37 A

Fast Single Phase Rectifier
Ultra Fast Boost Chopper



Typical Rectified Mains Power

P_n = 900 W at V_n = 110 V

P_n = 2100 W at V_n = 240 V

at V_{DC} = 400 V, f_T = 75 kHz, T_C = 80°C

Input Rectifier Bridge D11 - D14

Symbol	Conditions	Maximum Ratings	
V_{RRM}		1200	V
I_{FAV25}	T_C = 25°C; sine 180°	15	A
I_{FAV80}	T_C = 80°C; sine 180°	10	A
I_{FSM}	T_{VJ} = 25°C; t = 10 ms sine 50 Hz	75	A

Symbol	Conditions		Characteristic Values (T_{VJ} = 25°C, unless otherwise specified) min.	typ.	max.	
V_F	I_F = 10 A	T_{VJ} = 25°C		1.4	1.8	V
		T_{VJ} = 125°C		1.6		V
I_R	$V_R = V_{RRM}$	T_{VJ} = 25°C			0.05	mA
		T_{VJ} = 125°C		0.5		mA
t_{rr}	V_R = 100 V; I_F = 10 A; -di/dt = 5 A/µs			1		µs
R_{thJC}	(per diode)				2.5	K/W
R_{thJS}	with heat transfer paste			tbd		K/W

Application

- single phase rectification with power factor correction (PFC)
- low harmonic content of mains current
- mains current and voltage in phase
- wide input voltage range, controlled output voltage

Features

- high level of integration - only one power semiconductor module required for the whole PFC rectifier
- standard PFC control ICs useable
- fast rectifier diodes for enhanced EMC behaviour
- NPT IGBT with low saturation voltage, ultra fast switching capability, high RBSOA and short circuit ruggedness
- internally **series connected** HiPerFRED™ free wheeling diode for fast and soft reverse recovery at high switching frequency
- package with insulated DCB base and soldering pins for PCB mounting

006

Chopper T

Symbol	Conditions	Maximum Ratings	
V_{CES}	T_{VJ} = 25°C to 150°C	600	V
V_{GES}	Continous	±20	V
I_{C25}	T_C = 25°C	37	A
I_{C80}	T_C = 80°C	25	A
RBSOA	V_{CE} = 600 V; R_G = 10 Ω; T_{VJ} = 125°C Clamped inductive load; L = 100 µH	I_{CM} = 100 $V_{CEK} \le V_{CES}$	A
t_{SC}	V_{CE} = 600 V; V_{GE} = ±15 V; R_G = 10 Ω; T_{VJ} = 125°C; non-repetitive	10	µs

Symbol	Conditions	Characteristic Values (T_{VJ} = 25°C, unless otherwise specified) min.	typ.	max.	
$V_{CE(sat)}$	I_C = 10 A; V_{GE} = 15 V ; T_{VJ} = 25°C		1.5	1.8	V
	T_{VJ} = 125°C		1.6		V
$V_{GE(th)}$	I_C = 1 mA; V_{GE} = V_{CE}	3		5	V
I_{CES}	V_{CE} = V_{CES}; V_{GE} = 0 V; T_{VJ} = 25°C			0.04	mA
	T_{VJ} = 125°C		1		mA
I_{GES}	V_{CE} = 0 V; V_{GE} = ±20 V			100	nA
$t_{d(on)}$	Inductive load, T_{VJ} = 125°C V_{CE} = 400 V; I_C = 10 A V_{GE} = ±15 V; R_G = 10 Ω		30		ns
t_r			50		ns
$t_{d(off)}$			320		ns
t_f			70		ns
E_{on}			0.60		mJ
E_{off}			0.31		mJ
C_{ies}	V_{CE} = 25 V; V_{GE} = 0 V; f = 1 MHz		1600		pF
Q_{Gon}	V_{CE} = 480 V; V_{GE} = 15 V; I_C = 10 A		140		nC
R_{thJC}				0.96	K/W
R_{thJS}	with heat transfer paste		tbd		K/W

Chopper D1

Symbol	Conditions	Maximum Ratings	
V_{RRM}	T_{VJ} = 25°C to 150°C	600	V
I_{F25}	T_C = 25°C	35	A
I_{F80}	T_C = 80°C	22	A

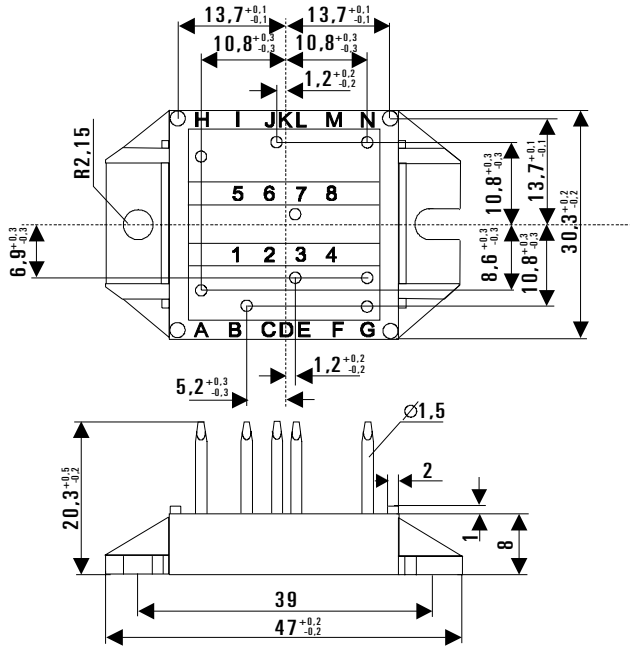
Symbol	Conditions	Characteristic Values (T_{VJ} = 25°C, unless otherwise specified) min.	typ.	max.	
V_F	I_F = 10 A; T_{VJ} = 25°C		2.2	3.2	V
	T_{VJ} = 125°C			2.4	V
I_R	V_R = V_{RRM}; T_{VJ} = 25°C			0.1	mA
	T_{VJ} = 125°C		0.1		mA
I_{RM}	I_F = 10 A; di_F/dt = -400 A/µs; T_{VJ} = 125°C		tbd		A
t_{rr}	V_R = 400 V		tbd		ns
R_{thJC}				1.15	K/W
R_{thJS}	with heat transfer paste		tbd		K/W

Module

Symbol	Conditions	Maximum Ratings	
T_{VJ}		-40...+150	°C
T_{stg}		-40...+125	°C
V_{ISOL}	$I_{ISOL} \leq 1$ mA; 50/60 Hz; t = 1 min	3000	V~
M_d	Mounting torque (M4)	1.5 - 2.0	Nm

Symbol	Conditions (T_{VJ} = 25°C, unless otherwise specified)	Characteristic Values min.	typ.	max.	
d_S	Creepage distance on surface	tbd			mm
d_A	Strike distance through air	tbd			mm
Weight	typ.		18		g

Dimensions in mm (1 mm = 0.0394")

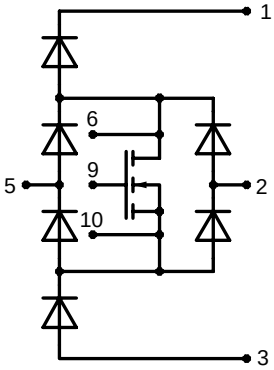


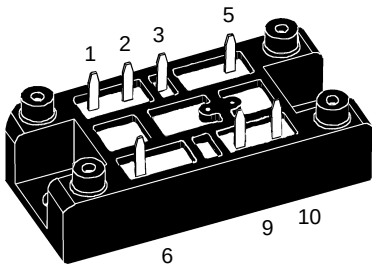
Rectifier Module
for Three Phase Power Factor Correction

Using fast recovery epitaxial diodes and MOSFET

V_{DSS} = 500 V
I_{D25} = 35 A
$R_{DS(on)}$ = 0.12 Ω

$V_{RRM (Diode)}$ V	V_{DSS} V	Type
600	**500**	**VUM 25-05E**





Symbol		Test Conditions		Maximum Ratings	
V_{DSS}	MOSFET	T_{VJ} = 25°C to 150°C		500	V
V_{DGR}		T_{VJ} = 25°C to 150°C; R_{GS} = 10 kΩ		500	V
V_{GS}		Continuous		±20	V
I_D		T_S = 85°C		24	A
I_D		T_S = 25°C		35	A
I_{DM}		T_S = 25°C, t_p = ①		95	A
P_D		T_S = 85°C		170	W
I_S		V_{GS} = 0 V, T_S = 25°C		24	A
I_{SM}		V_{GS} = 0 V, T_S = 25°C, t_p = ①		95	A
V_{RRM}	Diodes			600	V
I_{dAV}		T_S = 85°C, rectangular δ = 0.5		40	A
I_{FSM}		T_{VJ} = 45°C,	t = 10 ms (50 Hz)	300	A
			t = 8.3 ms (60 Hz)	320	A
		T_{VJ} = 150°C,	t = 10 ms (50 Hz)	260	A
			t = 8.3 ms (60 Hz)	280	A
P		T_S = 85°C		36	W
T_{VJ}	Module			-40...+150	°C
T_{JM}				150	°C
T_{stg}				-40...+150	°C
V_{ISOL}		50/60 Hz	t = 1 min	3000	V~
		I_{ISOL} ≤ 1 mA	t = 1 s	3600	V~
M_d		Mounting torque (M5)		2-2.5/18-22	Nm/lb.in.
Weight				35	g

Features

- Package with DCB ceramic base plate
- Soldering connections for PCB mounting
- Isolation voltage 3600 V~
- Low $R_{DS(on)}$ HDMOS™ process
- Low package inductance for high speed switching
- Ultrafast diodes
- Kelvin source for easy drive

Applications

- Three phase input rectifier with power factor correction consisting of three modules VUM 25-05
- For power supplies, UPS, SMPS, drives, welding etc.

Advantages

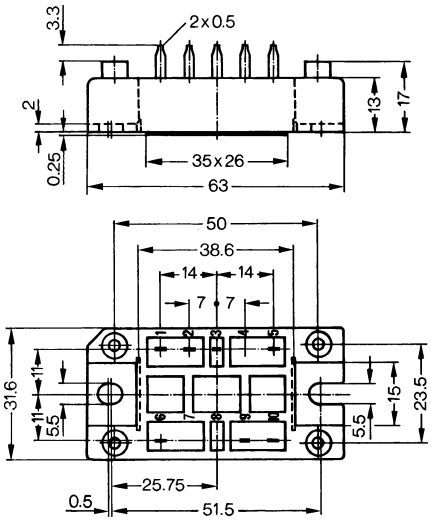
- Reduced harmonic content of input currents corresponding to standards
- Rectifier generates maximum DC power with a given AC fuse
- Wide input voltage range
- No external isolation
- Easy to mount with two screws
- Suitable for wave soldering
- High temperature and power cycling capability

① Pulse width limited by T_{VJ}
IXYS reserves the right to change limits, test conditions and dimensions.

826

Symbol		Test Conditions (T_{VJ} = 25°C, unless otherwise specified)	Characteristic Values min.	typ.	max.	
V_{DSS}	MOSFET	V_{GS} = 0 V, I_D = 2 mA	500			V
$V_{GS(th)}$		V_{DS} = 20 V, I_D = 20 mA	2		5	V
I_{GSS}		V_{GS} = ±20 V, V_{DS} = 0 V			±500	nA
I_{DSS}		V_{DS} = 500 V, V_{GS} = 0 V			2	mA
$R_{DS(on)}$		T_{VJ} = 25°C			0.12	Ω
R_{Gint}		T_{VJ} = 25°C			1.5	Ω
g_{fs}		V_{DS} = 15 V, I_{DS} = 12 A		30		S
V_{DS}		I_{DS} = 24 A, V_{GS} = 0 V			1.5	V
$t_{d(on)}$		V_{DS} = 250 V, I_{DS} = 12 A, V_{GS} = 10 V			100	ns
$t_{d(off)}$		Zgen. = 1 Ω, L-load			220	ns
C_{iss}		V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0 V		8.5		nF
C_{oss}				0.9		nF
C_{rss}				0.3		nF
Q_g		V_{DS} = 250 V, I_D = 12 A, V_{GS} = 10 V		350		nC
R_{thJS}					0.38	K/W
V_F	Diodes	I_F = 22 A; T_{VJ} = 25°C			1.65	V
		T_{VJ} = 150°C			1.4	V
I_R		V_R = 600 V, T_{VJ} = 25°C			1.5	mA
		V_R = 480 V, T_{VJ} = 25°C			0.25	mA
		T_{VJ} = 125°C			7	mA
V_{T0}		For power-loss calculations only			1.14	V
r_T		T_{VJ} = 125°C			10	mΩ
I_{RM}		I_F = 30 A; $-di_F/dt$ = 240 A/µs				
		V_R = 350 V, T_{VJ} = 100°C		10	11	A
R_{thJS}					1.8	K/W

Dimensions in mm (1 mm = 0.0394")



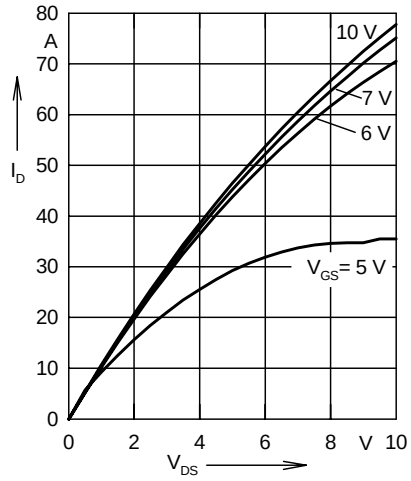


Fig. 1 Typ. output characteristic $I_D = f(V_{DS})$ (MOSFET)

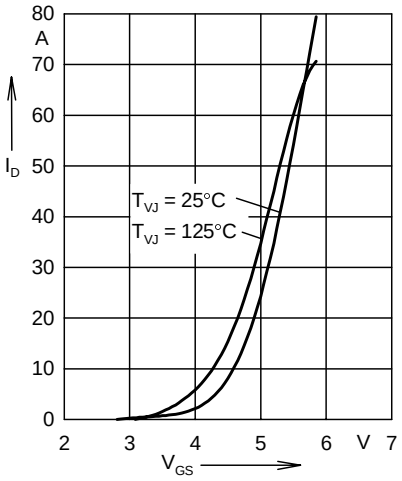


Fig. 2 Typ. transfer characteristics $I_D = f(V_{GS})$ (MOSFET)

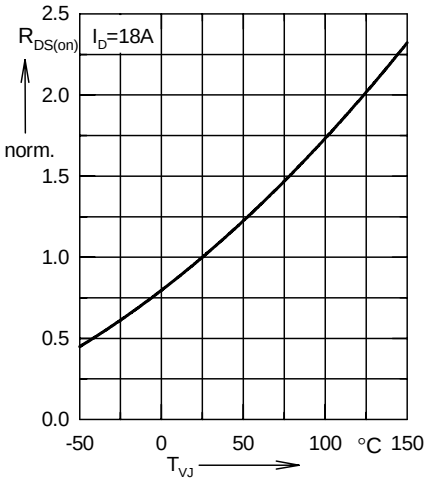


Fig. 3 Typ. normalized $R_{DS(on)} = f(T_{VJ})$ (MOSFET)

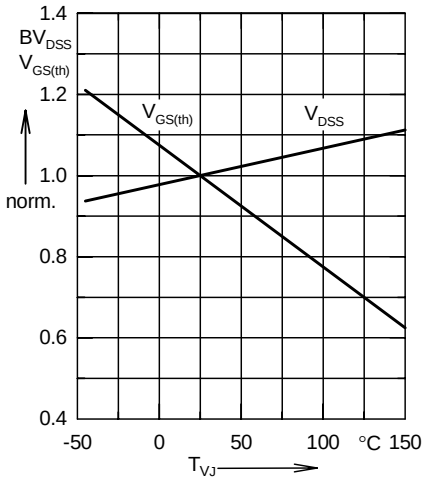


Fig. 4 Typ. normalized $BV_{DSS} = f(T_{VJ})$ $V_{GS(th)} = f(T_{VJ})$ (MOSFET)

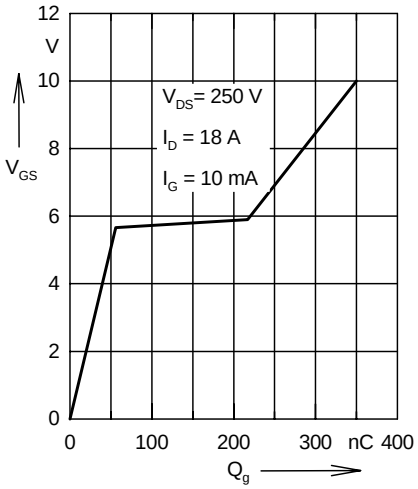


Fig. 5 Typ. turn-on gate charge characteristics, $V_{GS} = f(Q_g)$ (MOSFET)

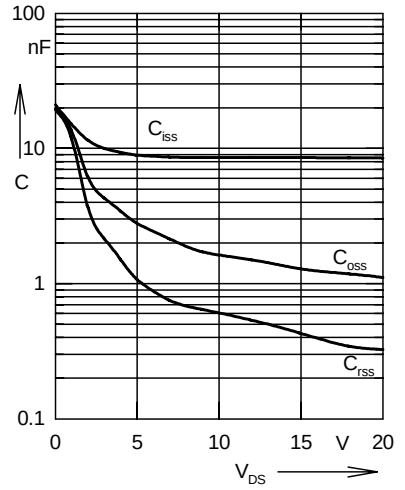


Fig. 6 Typ. capacitances $C = f(V_{DS})$, f = 1 MHz (MOSFET)

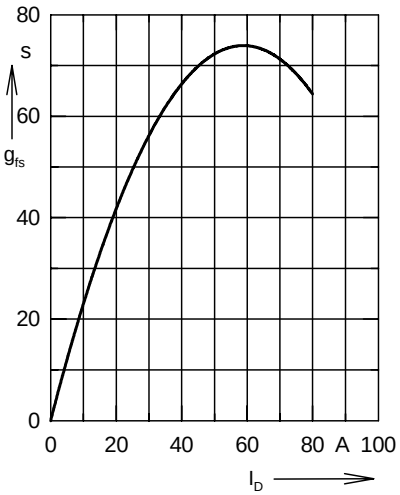


Fig. 7 Typ. transconductance, $g_{fs} = f(I_D)$ (MOSFET)

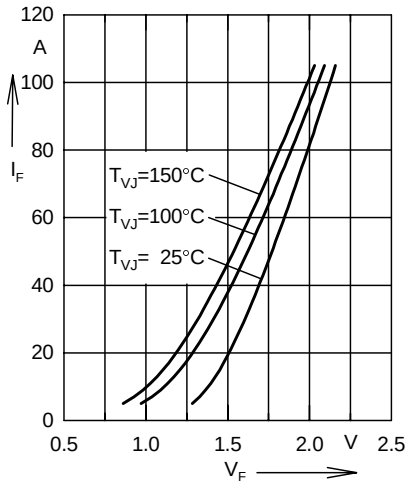


Fig. 8 Forward current versus voltage drop (Diodes)

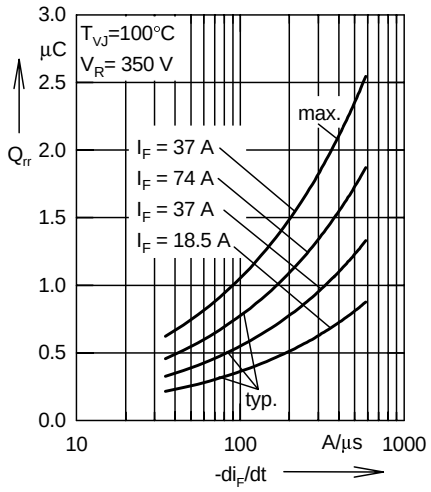


Fig. 9 Recovery charge versus $-di_F/dt$ (Diodes)

826

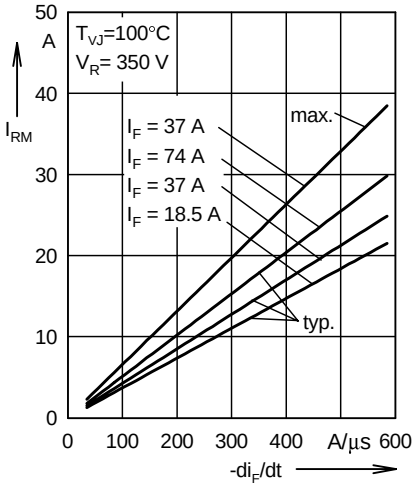


Fig. 10 Peak reverse current versus $-di_F/dt$ (Diodes)

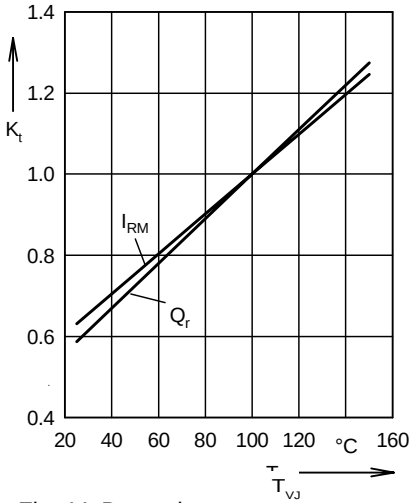


Fig. 11 Dynamic parameters versus junction temperature (Diodes)

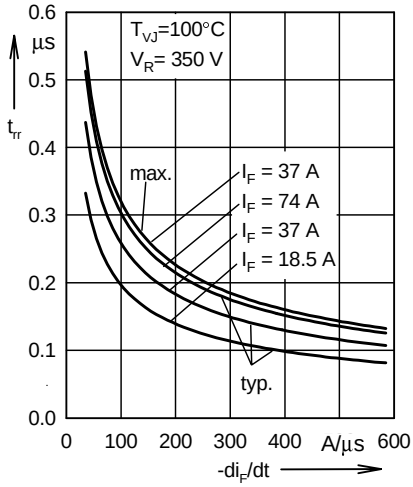


Fig. 12 Recovery time versus $-di_F/dt$ (Diodes)

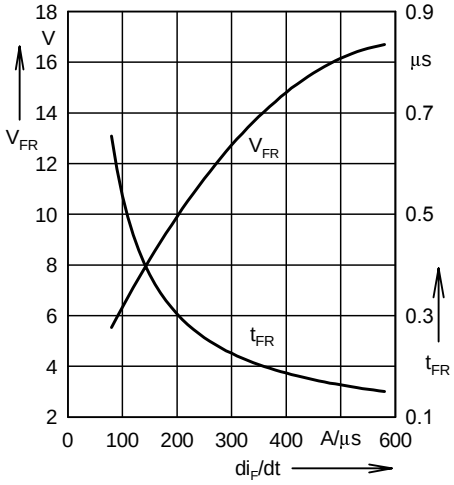


Fig. 13 Peak forward voltage versus $-di_F/dt$ (Diodes)

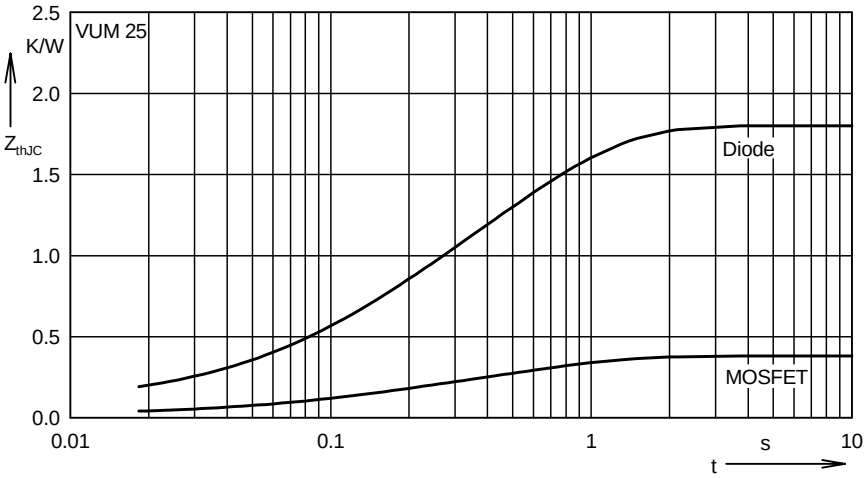


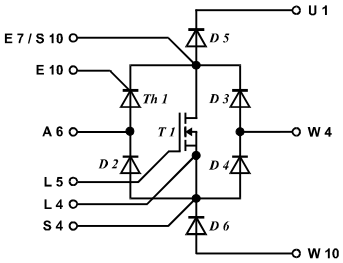
Fig. 14 Transient thermal impedance junction to case for all devices

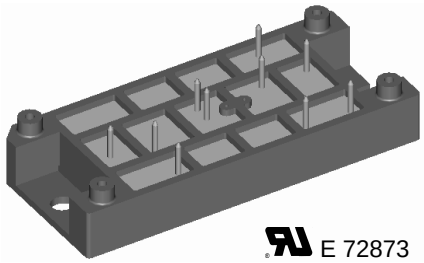
Rectifier Module
for Three Phase Power Factor Correction

V_{DSS} = 500 V
I_{D25} = 130 A
$R_{DS(on)}$ = 36 mΩ

Preliminary data

V_{RRM} (FAST Diode) V	$V_{RRM, DRM}$ (Diode, Thyr.) V	V_{DSS} (MOSFET) V	Type
600	500	500	VUM 85-05A





Symbol	Conditions		Maximum Ratings	
MOSFET T 1				
V_{DSS}	T_{VJ} = 25°C to 150°C		500	V
V_{DGR}	T_{VJ} = 25°C to 150°C; R_G = 1 MΩ		500	V
V_{GSM}	Transient		±30	V
V_{GS}	Continuous		±20	V
I_D	T_C = 100°C, T_{VJ} = 125°C		60	A
I_{D25}	T_C = 25°C, T_{VJ} = 150°C		130	A
I_{DM}	T_C = 25°C, T_{VJ} = 150°C		520	A
E_{AR}	T_C = 25°C		60	mJ
P_{tot}	T_C = 25°C		1380	W
Single Phase Bridge Th1, D2, D3, D4				
V_{RRM},V_{DRM}			500	V
I_{DAV}	T_{VJ} = 150°C, T_C = 100°C		47	A
I_{FSM}, I_{TSM}	T_{VJ} = 45°C,	t = 10 ms (50 Hz)	320	A
		t = 8.3 ms (60 Hz)	340	A
	T_{VJ} = 150°C,	t = 10 ms (50 Hz)	280	A
		t = 8.3 ms (60 Hz)	300	A
P_{tot}	T_C = 25°C; per diode		90	W
Fast Diodes D5, D6				
V_{RRM}			600	V
I_{FAV}	T_{VJ} = 150°C, T_C = 100°C, rectangular δ = 0.5		31	A
I_{FSM}	T_{VJ} = 45°C, t = 10 ms (50 Hz)		250	A
P_{tot}	T_C = 25°C		95	W
Module				
T_{VJ}			-40...+150	°C
T_{JM}			150	°C
T_{stg}			-40...+125	°C
V_{ISOL}	I_{ISOL} ≤ 1 mA	50/60 Hz	3600	V~
M_d	Mounting torque (M5)		2-2.5/18-22	Nm/lb.in.
Weight			80	g

Features

- Package with DCB ceramic base plate
- Soldering connections for PCB mounting
- Isolation voltage 3600 V~
- Low $R_{DS(on)}$ HDMOS™ process
- Low package inductance for high speed switching
- Ultrafast diodes
- Kelvin source for easy drive
- UL recognized

Applications

- Three phase PFC by Kolar circuit
- Three phase input rectifier with power factor correction consisting of three modules VUM 85-05
- For power supplies, UPS, SMPS, drives, welding etc.

Advantages

- Reduced harmonic content of input currents corresponding to standards
- Rectifier generates maximum DC power with a given AC fuse
- Wide input voltage range
- No external isolation
- Easy to mount with two screws
- Suitable for wave soldering
- High temperature and power cycling capability

Symbol	Conditions	Characteristic Values (T_{VJ} = 25°C, unless otherwise specified) min.	typ.	max.	
	MOSFET T 1				
$V_{GS(th)}$	V_{DS} = ±20 V, I_D = 30 mA	2	3	4	V
I_{GSS}	V_{GS} = ±20 V, V_{DS} = 0 V			±1.5	µA
I_{DSS}	V_{DS} = V_{DSS}, V_{GS} = 0 V		0.5	1.4	mA
	V_{DS} = 0,8•V_{DSS}, V_{GS} = 0 V, T_{VJ} = 125°C		1	7	mA
$R_{DS(on)}$	I_D = ½ I_{D25}, V_{GS} = 10 V, pulse test t ≤ 300 µs, d ≤ 2%			36	mΩ
g_{fs}	V_{DS} = 10 V, I_D = ½ I_{D25}, t = < 300 µs	75	145		S
$t_{d(on)}$	V_{DS} = ½ V_{DSS}, I_D = ½ I_{D25}, V_{GS} = 15 V		16	25	ns
t_r	R_G = 1 Ω, L = 100 µH, T_{VJ} = 125°C		33	45	ns
$t_{d(off)}$			65	80	ns
t_f			30	40	ns
C_{iss}	V_{DS} = 25 V, f = 1 MHz, V_{GS} = 0 V		30		nF
C_{oss}			3		nF
C_{rss}			1		nF
Q_g	V_{DS} = ½ V_{DSS}, I_D = ½ I_{D25}, V_{GS} = 15 V		945	1120	nC
Q_{gs}			195	280	nC
Q_g			435	595	nC
R_{thJC}				0.09	K/W
R_{thCH}			0.05		K/W
	Single Phase Bridge Th1, D2, D3, D4				
V_F, V_T	I_F, I_T = 45 A, T_{VJ} = 25°C			1.50	V
	T_{VJ} = 125°C			1.55	V
I_{RRM}, I_{DRM}	V_D, V_R = V_{DRM}, V_{RRM}, T_{VJ} = 25°C		0.5	1.4	mA
	V_D, V_R = 0,8•V_{DRM}, V_{RRM}, T_{VJ} = 125°C		1	7	mA
V_{T0}	For power-loss calculations only			0.85	V
r_T	T_{VJ} = 150°C			14	mΩ
V_{GT}	V_D = 6 V			1.5	V
I_{GT}				100	mA
V_{GD}	V_D = $^2/_3$ V_{DRM}, T_{VJ} = 150°C			0.2	V
I_{GD}				5	mA
V_{RGM}				10	V
I_H	V_D = 6 V, R_{GK} = ∞			200	mA
I_L	I_G = 0.45 A, di_G/dt = 0.45 A/µs, t_p = 10 µs			450	mA
$(di/dt)_{cr}$	I_G = 0.45A, di_G/dt = 0.45A/µs, t_p = 200µs, f = 50Hz				
	V_D = $^2/_3V_{DRM}$, T_{VJ} = 150°C, I_T = 45 A, repetitive			150	A/µs
	I_G = 0.45A, di_G/dt = 0.45A/µs, t_p = 200µs, f = 50Hz				
	V_D = $^2/_3V_{DRM}$, T_{VJ} = 150°C, I_T = I_{DAV}, non-repetitive			500	A/µs
t_{gd}	I_G = 0.45 A, di_G/dt = 0.45 A/µs, V_D = ½ V_{DRM}			2	µs
t_q	I_T = 20 A, di/dt = -10 A/µs, V_R = 100 V, V_D = $^2/_3V_{DRM}$	150			µs
	t_p = 200 µs, dv/dt = 15 V/µs, T_{VJ} = 150°C				
P_{GM}	I_T = $I_{d(AV)}$, T_{VJ} = 150°C t_p = 30 µs			10	W
	t_p = 300 µs			5	W
P_{GAVM}				0,5	W
R_{thJC}	DC per diode / thyristor			1.3	K/W
R_{thCH}	DC per diode / thyristor		0.4		K/W

Symbol	Conditions	Characteristic Values (T_{VJ} = 25°C, unless otherwise specified) min.	typ.	max.
	Fast Diodes D 5, D 6			
V_F	I_F = 30 A; T_{VJ} = 25°C			2.70 V
	T_{VJ} = 125°C			1.85 V
I_R	V_R = 600 V, T_{VJ} = 25°C			0.5 mA
	T_{VJ} = 125°C			1 mA
V_{T0}	For power-loss calculations only			1.23 V
r_T	T_{VJ} = 150°C			9.8 mΩ
I_{RM}	I_F = 50 A; di/dt = 100 A/µs			
	V_R = 100 V, T_{VJ} = 100°C		3	3.5 A
t_{rr}	I_F = 1 A, V_R = 30 V, di/dt = 200 A/µs		25	30 ns
R_{thJC}	DC per diode			1.3 K/W
R_{thCH}	DC per diode		0.4	K/W

Dimensions in mm (1 mm = 0.0394")