4500V Dual Channel On-module
E-SERIES AE45 Gate Drive Datasheet

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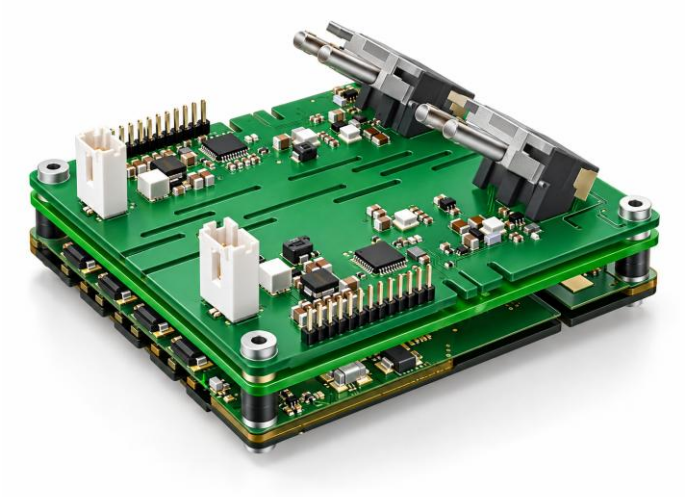

The AE45 gate drive series is a compact, high performance gate drive for 4500V modules in XHP3, HV100, HV Linpak and HVnHPD2 package types. The Gate driver is designed to control both IGBT and SiC MOSFET modules and is qualified to international standards.

Features

- Compatible with XHP3, HV100, HVLinpak, HVnHPD2 modules
- High current drive into gate: 56A source, 30A sink
- Wide input voltage range
- Operating temperature range: -40°C to +85°C
- Type I and type II short circuit protection
- Power supply undervoltage protection
- Vce Overshoot Clamp
- LED status indication
- Lead free design, RoHS compliant
- 12 months warranty

Standards (refer to table on next page for full details)

- EN 50155 compliant for railway applications (when conformally coated)
- Thermal shock and vibration to IEC 61373
- EMC compliant to EN 50121-3-2, EN 50121-5, IEC 61800-3

Absolute Maximum Ratings

Permanent damage may occur if the Absolute Maximum Ratings are exceeded.

Parameter (per channel)	Notes	Units	Value
Supply Voltage		V	36.0
Continuous DC link voltage (with clamping disabled)	Limited by transient voltage supressors (TVS)		
	Configured for 4500V IGBT modules	V	3385*

*this is 300V above the TVS datasheet minimum voltage at 1mA

General Electrical Characteristics

All data refers to +25 °C unless otherwise stated

Parameter	Notes	Units	Min	Typ	Max
Nominal Supply Voltage (V_{DC}) for baseboard	A current limited supply (<2.0A) is recommended	V	18.0	24.0	36.0
Supply current with 24V input	Without load, not switching, OFF 24Vin	W		1.3	1.7
	Operation at 3kHz into an IGBT module (equivalent to ~110nF capacitor) 24Vin	W		5	6
Gate peak current (I_{gpk})	Limited by gate resistors	A	-30.0		56
Output gate power (each channel)	Continuous operation, current is limited to prevent overload under abnormal conditio 24Vin	W			5.0
Operating voltage (V_{peak})	Primary to secondary side	V			3600
Gate Monitor Level	Fault if gate voltage below this level at Gate	V	13.4	13.8	14.2
Undervoltage lockout for V_{gh}	Relative to Gate Voltage High	V		V_{gh}-5	

Configurable Parameters, customer to advise nominal requirement

All data refers to +25 °C unless otherwise stated

Parameter	Notes	Units	Min	Typ	Max
Gate voltage High (V_{gh})	Module on (Vgh=target value +/-3%)	V	+15	+15	Vgl+30V [2]
Gate voltage Low (V_{gl})	Module off (Vgl=target value +/-3%)	V	-15	-10	-3
Turn-on gate resistance	Rg(on)	Ω	0 [1]	1.5 [3]	[3]
Turn-off gate resistance	Rg(off)	Ω	0 [1]	1.5 [3]	[3]
Soft-turn-off gate resistance	Rg(soft-off)	Ω	0 [1]	12 [3]	[3]
Gate-emitter capacitance	Cge (Cge=0 means not fitted)	nF	0	0	[3]
Desat Voltage	Adjustable to match device requirements	V	12		15

Notes

[1]: For values of R_g<Typ then C_{ge} must = 0. Module gate resistance + R_g must limit I_{gpk} to max/min values specified

[2]: Maximum gate voltage swing = 30V

[3]: Rg and Cge values can be specified based on data or testing. In-converter testing is always recommended

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Nominal Timing Parameters

Some can be changed by agreement from Poweronics

Parameter	Notes	Units	IGBT	SiC
Gate Monitor Time (GMT)	Time from PWM to gate voltage check	µs	20	5
Desaturation Detect Time	Time from PWM to desaturation check, type I SC	µs	3	2
Desaturation Filter Delay	Delay from desaturation to turn-off, type II SC	µs	4	0.48
Desaturation Fault Lockout	Time for which the IGBT is held off after fault	ms	17	17

note: the fault lockout time is fixed and cannot be changed

Gate drive configured for 4500V operation

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Parameter	Notes	Units	Min	Typ	Max
TVS datasheet 1mA threshold	Clamp enabled	V	3085		
TVS datasheet 1mA threshold	Clamp disabled	V	3385		
Max DC link	For short periods of time (< 5 minutes)	V	3400*		
Max DC link	For short periods of time (<1 second)	V	3685		

*design target, to be confirmed

Physical Parameters - single module variant

Parameter	Notes	Units	Min	Typ	Max
Length	All dimensions have a tolerance of +/- 0.5mm	mm			99.5
Width		mm			81
Height AE00		mm			32
Weight		g		15	
Screw torque	Maximum torque on gate, emitter and collector	Nm			2.0

note: dimensions of parallel variants are dependant on the module spacing

Standards Compliance

All data refers to +25°C unless otherwise stated

Test	Notes	Test Standard
Impulse test	Refer to Isolated DC-DC Converter Datasheet	Type test
Dielectric test	Refer to Isolated DC-DC Converter Datasheet	Type test
Partial discharge	Refer to Isolated DC-DC Converter Datasheet	Type test and production test
EMC Immunity		EN 50121-3-2 Rolling Stock
		EN 50121-5 Trackside
		IEC 61800-3 Variable Speed Drives
Electrostatic discharge	Air ±8 kV, contact ±6 kV, Perf Criterion B	IEC 61000-4-2
	ESD precations must be taken when handling the gate drive.	
Radiated immunity	10 V/m 80-2000 MHz, Perf Criterion A	IEC 61000-4-3
Fast burst immunity	±4 kV, Perf Criterion A	IEC 61000-4-4
Surge immunity	±2 kV, Perf Criterion B	IEC 61000-4-5
Conducted immunity	10 Vrms, Perf Criterion A	IEC 61000-4-6
Magnetic field immunity	100 A/m AC, 300 A/m DC, Perf Criterion A	IEC 61000-4-8
Damped osc. voltage	2.5 kV line-earth, Perf Criterion B	IEC 61000-4-12
Radiated emissions (E-field)	20-230/230-1000 MHz, 50/57 dBµV/m q-pk, 3 m	EN 55011 class A, group 1
Conducted emissions	0.15-0.5/0.5-30 MHz 99/93 dBµV/m quasi-pk	EN 55016-2-1

General specifications

All data refers to +25°C unless otherwise stated

Parameter	Notes	Units	Min	Typ	Max
Operating temperature	Maximum continuous power is derated above 80°C	°C	-40		85
Storage temperature		°C	-40		85
Humidity	Compliant to EN 50155 Railways Applications	%		85	95
	Electronic Equipment Used on Rolling Stock with conformal coating				
Material flammability rating	UL94V-0 rated				
Pollution degree	Class 2				
Maximum altitude	Derate above this: Poweronics to advise	m			2000
Environmental compliance	Reach compliant				
	RoHS compliant				
Creepage	Functional isolation (Mat. Grp. 2)	mm	27		
Clearance	Functional isolation (Mat. Grp 2)	mm	18		

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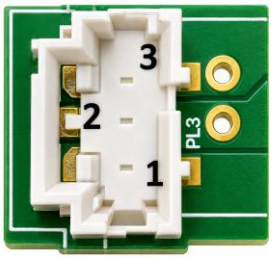
Power Supply Interface Options

Interface	Description	Manufacturer	Part Number
Input	3 way connector	TE Connectivity (Tyco)	5-103908-2, 3P w/o hold down vertical 2.54 mm pitch
Input	2 way connector	Phoenix	1956085, 2P w/o hold down vertical

Power Supply Input Connections

		Pin Number		
		1	2	3
TE Connectivity / Tyco	5-1375582-2	0V	VDC	0V



Note: Each gate driver channel requires a dedicated, galvanically isolated power supply (one supply per channel). The power supply must meet the specified input voltage, output power, and insulation requirements of the gate driver.

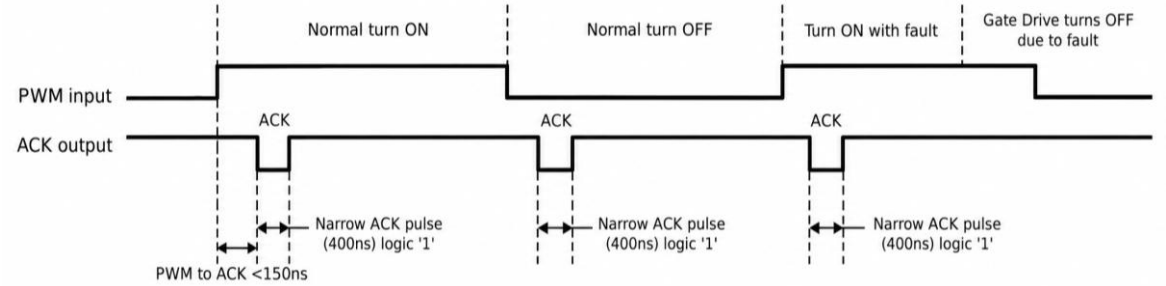
For optimal performance and compatibility, Poweronics recommends using the ASDxx isolated DC/DC converter, which is designed to meet these requirements. Both 15V and 24V variants of DC/DC converter are suitable.

Fibre-optic Interface

Interface	Description	Manufacturer	Part Number	Encoding
Optical input (PWM)	Receiver (Black)	Firecomms	FR50MWIR	Light ON = IGBT ON
Optical output (ACK)	Transmitter (Grey)	Firecomms	FT10MWLR	Light ON = OK, OFF = Fault
Optical input (PWM)	Receiver	Broadcom	AFBR-2549SZ	Light ON = IGBT ON
Optical output (ACK)	Transmitter	Broadcom	AFBR-1549SZ	Light ON = OK, OFF = Fault

Feedback and Acknowledgement

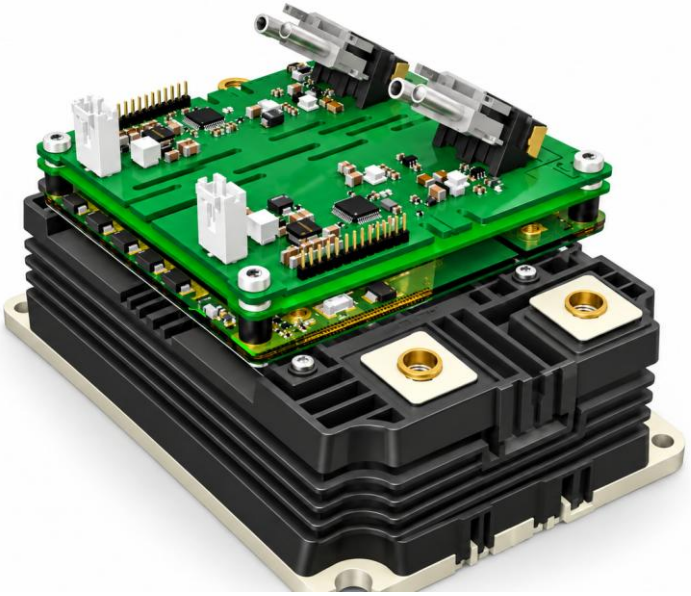
The feedback protocol on the optical output (ACK) is the compatibility mode. One ACK pulse for each PWM edge.



Time is measured at the gate drive and does not include any propagation delay or pulse distortion of the fibre-optic transceivers
Alternative pulse width of 800ns is available on request.

Mechanical Drawing

Please ask for 3D model (PDF or STEP file) when planning converter layout.



Gate Drive Assembly on IGBT Module

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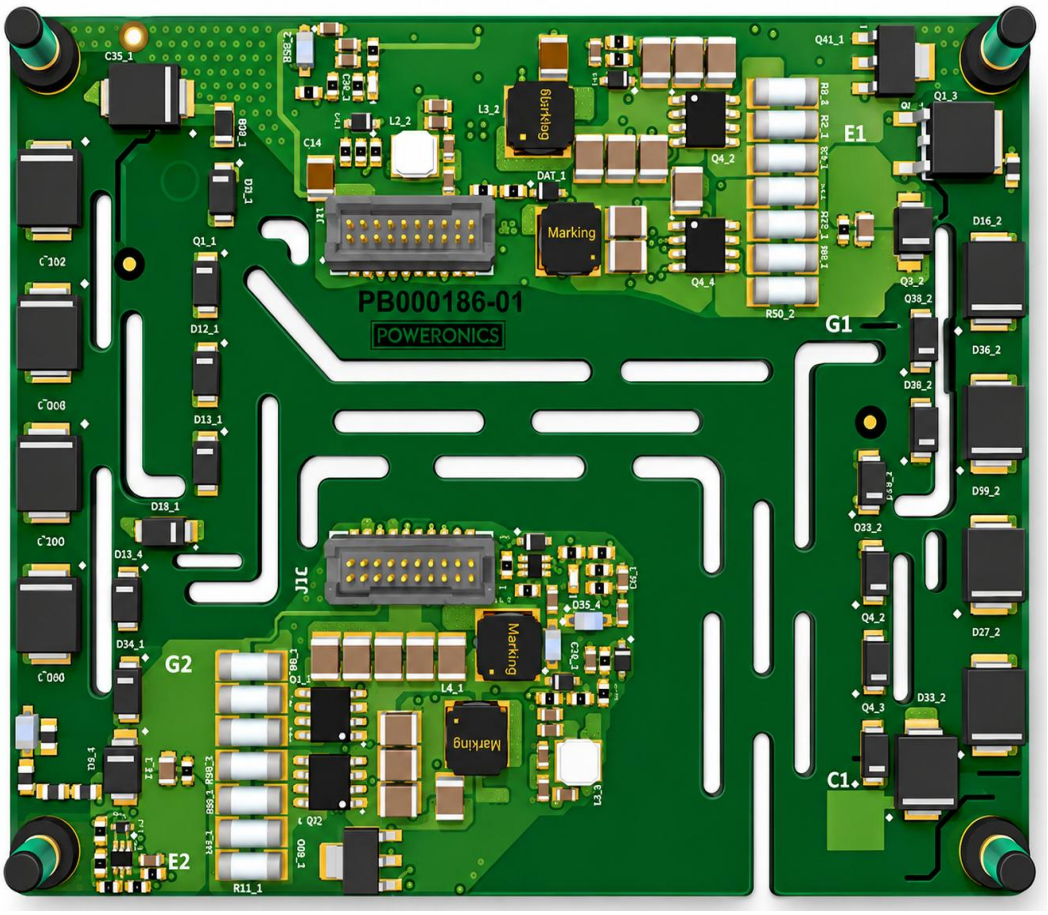
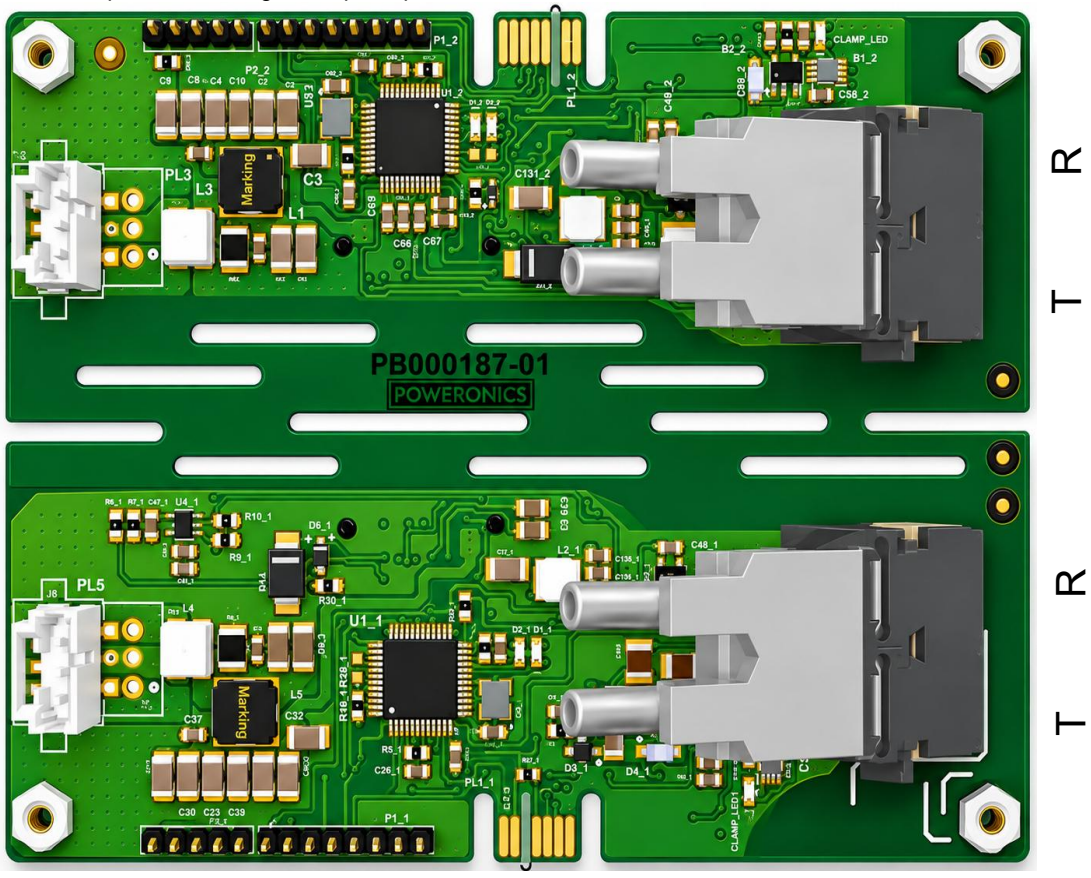
Top view of bottom board showing gate resistor, connection terminals, TVS diodes, Desat chain



Top view of top board showing fibre-optics, power connector



T = transmitter
R = receiver

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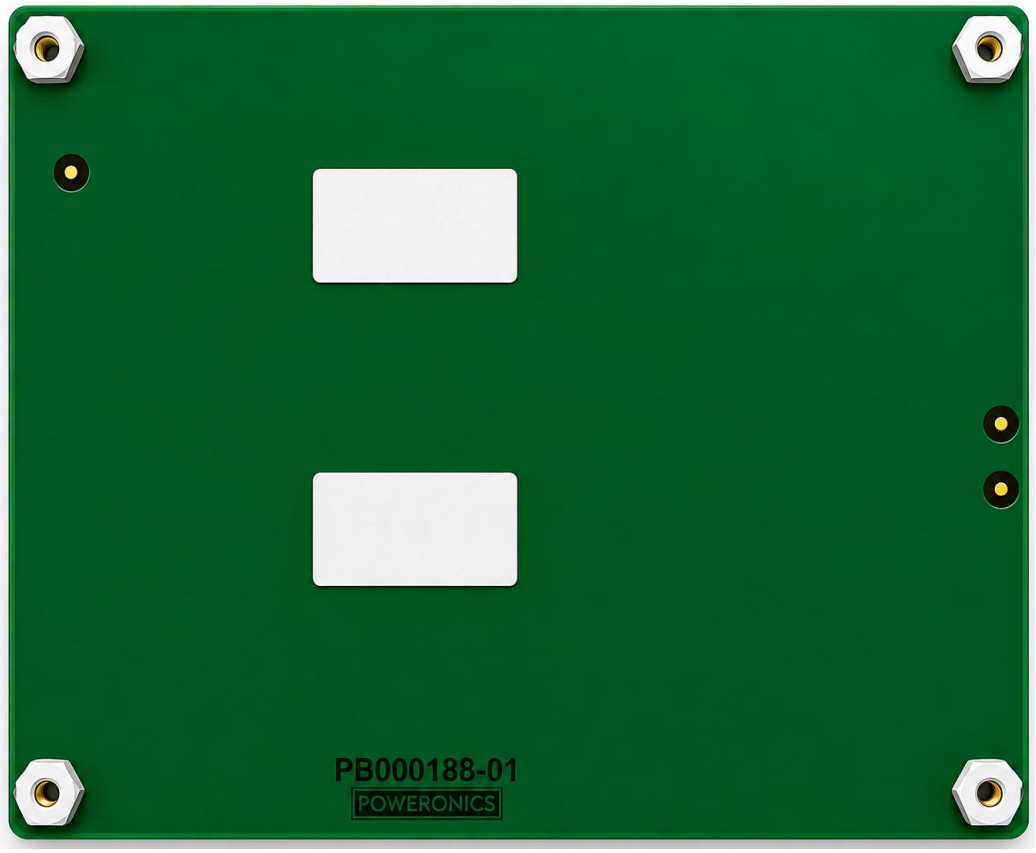
Top view of the isolation board showing how the connector passes through the board.



LED Status Indication

Each channel of the gate drive has two LEDs that communicate the status of the gate drive

LED	Behaviour	Status
Green	Lit continuously	Supply OK
Red	Lit continuously	Power supply below minimum voltage (under-voltage) or fault
Red	Lit for few seconds, ajustable	TVS event

When the fault is removed the red LED will stay on until the board is power cycled.

Ordering Information

A	E	45	K	B	2	B7	SNXXX	0	-	xxxxx
1	2	3	4	5	6	7	8	9		10

No.	Field	Code	Options
1	Switch technology	A	A = Si IGBT, S = SiC
2	Gate drive platform	E	E = E-Series
3	Module voltage	45	45 = 4500 V
4	Module	K	K = XHP3
5	Current rating	B	B = 56 A peak
6	Short-circuit response	2	2 = 2-level protection, 3 = 3-level protection *
7	Input connector	B7	B6 = vertical 2-way Phoenix connector, B7 = vertical 3-pin Tyco power connector
8	Paralleling	SNXXX	S = single module, Pnxxx = n modules in parallel at xxx mm pitch
9	Coating	0	0 = uncoated, C = conformal coating
10	Configuration manifest	xxxxx	Unique configuration manifest number

*Note:

A) 2-Level Fault: The gate driver detects a fault, turns the gate voltage to Gate Voltage Low (V_{gl}) and reports it by turning off the fibre-optic signal. It also locks out the gate driver output for the specified duration defined in the "Nominal Timing Parameters" table.

B) 3-Level Fault: The gate driver detects a fault and reports it by turning off the fibre-optic signal. However, unlike a 2-level fault, it does not automatically turn the gate voltage to V_{gl} or lock out the gate driver output, allowing the gate driver to continue operating.

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