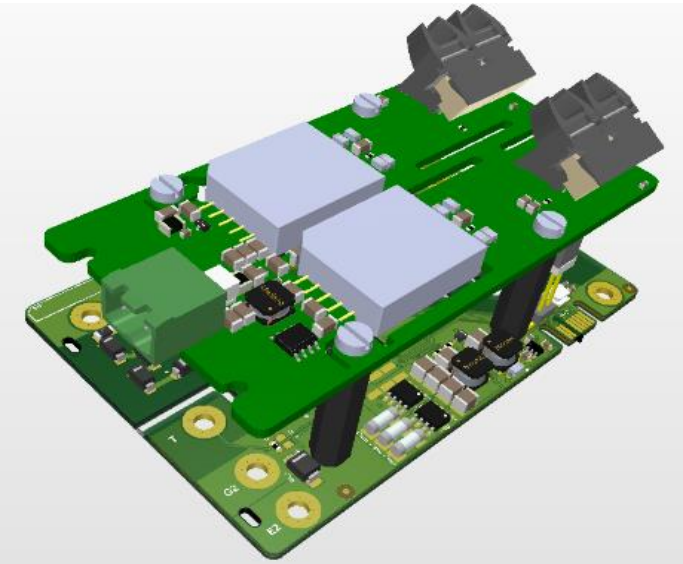
Dual Channel On-module E-SERIES Gate Drive Datasheet



This datasheet describes a 2-channel Gate Drive for LV100, XHP2, LinPack, nHPD2 modules in a compact form. The AE00 variant is suitable for use with IGBT and SiC modules up to 3300V and is designed to fit within the footprint of the module to minimise the overall size of the converter.
The gate drive is qualified to international standards.

Features

- Compatible with LV100, XHP2, LinPack, nHPD2 modules
- High current drive into gate: 32A/56A source, 30A sink
- 24V or 15V input voltage variants
- Operating temperature range: -40°C to +85°C
- Type I and type II short circuit protection
- Power supply undervoltage protection
- LED status indication
- IGBT thermistor (NTC) and gate drive temperature encoded onto the fibre-optic output
- Lead free design, RoHS compliant
- 12 months warranty
- TVS clamping diodes are not included

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	Notes	Units	Min	Typ	Max
Supply Voltage	15V input variant	V			16 5
	24V input variant	V			30 0

General Electrical Characteristics

All data refers to +25 °C unless otherwise stated

Parameter	Notes		Units	Min	Typ	Max
Nominal Supply Voltage (V_{DC})	A current limited supply (<2.0A) is recommended		V	14 5	15 0	15 5
			V	21 6	24 0	27 6
Supply current with 15V input	Without load, not switching, OFF		mA		110	120
	Operation at 3kHz into an IGBT module (equivalent to ~110nF capacitor)		mA		160	
Coupling capacitance	Primary to output		pF		5	8
Dielectric test voltage	50Hz AC for 10 seconds, primary to output		Vrms			7400
Gate peak current (I_{gpk})	Limited by gate resistors		A	-30 0		32.0/56.0
DC-DC Converter Peak Power (each gate channel)	Continuous operation, current is limited to prevent overload under abnormal conditions	24Vin	W			10 0
		15Vin	W			6 0
Operating voltage (V_{peak})	Primary to secondary side, AE17 is 1700V only		V			3300
Gate Monitor Level	Fault if gate voltage below this level at GMT		V	13 4	13 8	14 2
Undervoltage lockout for V_{gh}			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 (V_{gh})	Module on	V	V_{gh} -3%	15 to 22	V_{gh} +3%
Gate voltage (V_{gl})	Module off	V	V_{gl} +3%	-10 to -3	V_{gl} -3%
Turn-on gate resistance	Rg(on)	Ω	0 [1]	1.5 to 62	1000
Turn-off gate resistance	Rg(off)	Ω	0 [1]	1.5 to 62	1000
Soft-turn-off gate resistance	Rg(soft-off)	Ω	0 [1]	1.5 to 62	1000
Gate-emitter capacitance	Cge	nF	0		100

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

Nominal Timing Parameters

There are two standard variants of timing parameters (IGBT and SIC), these can be changed with 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

Physical Parameters

Parameter	Notes	Units	Min	Typ	Max
Length	All dimensions have a tolerance of +/- 0.5mm	mm			98
Width		mm			62
Height AE00		mm			47
Weight		g		80	
Screw torque	Maximum torque on gate, emitter and collector	Nm			2 0

Standards Compliance

All data refers to +25°C unless otherwise stated

Test	Notes	Test Standard
Impulse test	18 kV 1.2/50 µs primary to output	Type test
Dielectric test	7.4 kVrms primary to output, 50 Hz, 60 sec	Type test
Partial discharge	≥2.6 kV rms extinction, <10 pC, input to output	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 core.	
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		°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: Amantys to advise	m			2000
Environmental compliance	Reach compliant				
	RoHS compliant				
Creepage	Protective separation (Mat. Grp. 2)	mm	31 3		
	Functional isolation (Mat. Grp. 2)	mm	15 6		
Clearance	Protective separation (Mat. Grp. 2)	mm	19 3		
	Functional isolation (Mat. Grp 2)	mm	10 5		

Power Supply Interface

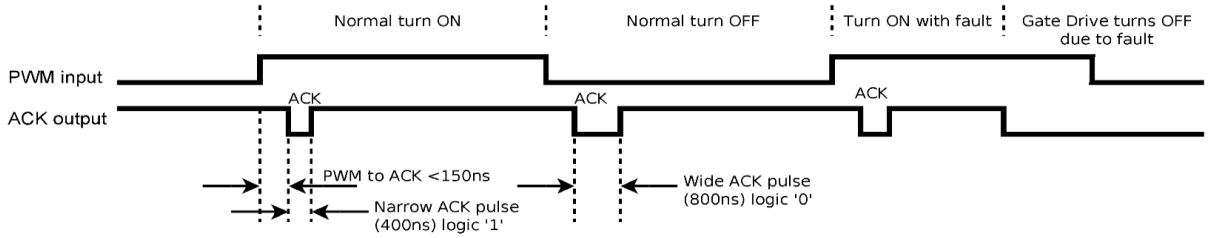
Manufacturer	Required Plug Part Number
Phoenix Contact	1925692 (FKC 2,5/ 2-ST-5,08-RF)
Poweronics part number	EC001150

Pin Number	
1	2
VDC	GND

Fibre-optic Interface (see picture to identify upper and lower interfaces)

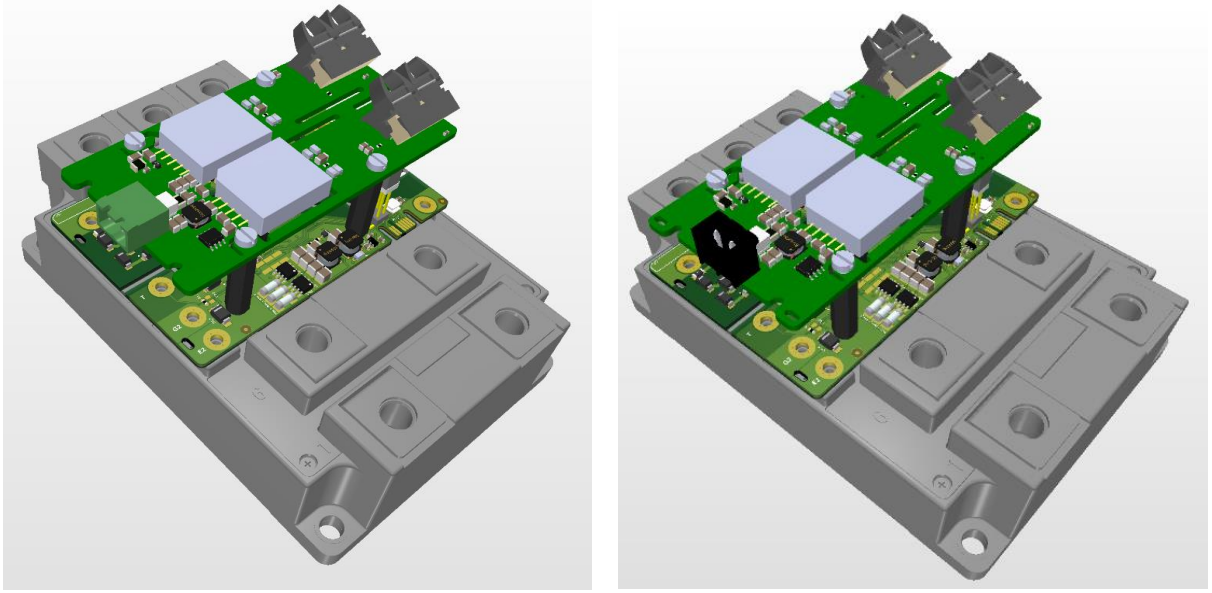
Interface	Description	Manufacturer	Part Number	Encoding
Optical input (PWM)	Receiver (Black)	Firecomms	FR50MWIR	Light ON = IGBT ON
Optical output (ACK)	Transmitter (Grey)	Firecomms	FT10MWLR	Light ON = OK, OFF = Fault

The feedback protocol on the optical output (ACK) is the Amantys compatibility mode. One ACK pulse for each PWM edge.
The gate drive and NTC temperature measurements are encoded into a Power Insight data packet (NALP frame).
The temperature measurements can be decoded by the Power Insight Adapter or FPGA design licensed from Poweronics.
The gate drive must be receiving incoming PWM pulses and sends the data by modulating the ACK pulse width.
At power up the application software part number is sent, followed by the temperature data continuously.
This information is transmitted from the lower gate drive only.



Time is measured at the gate drive and does not include propagation delay or pulse distortion of fibre-optic transceivers

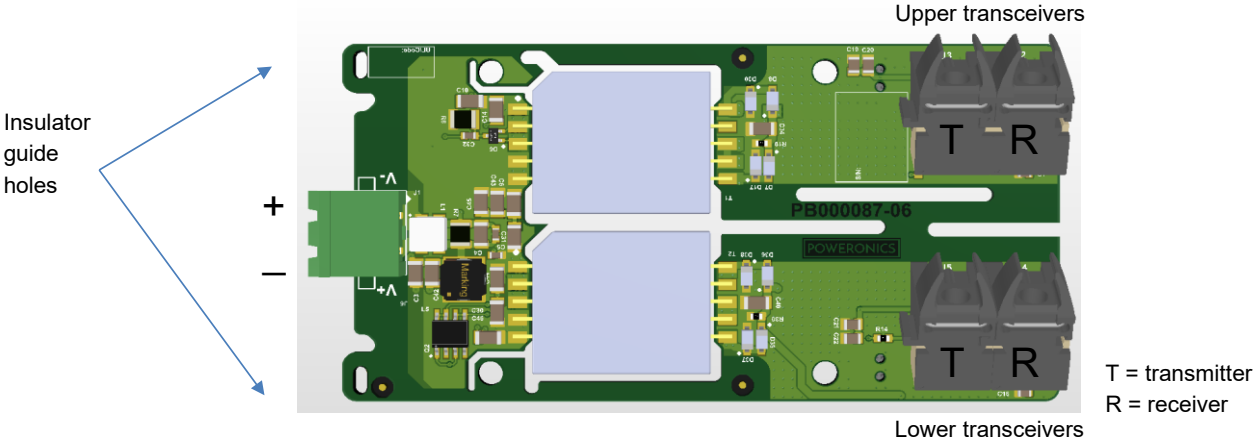
Mechanical Drawing
Please ask for 3D model (PDF or STEP file) when planning converter layout.



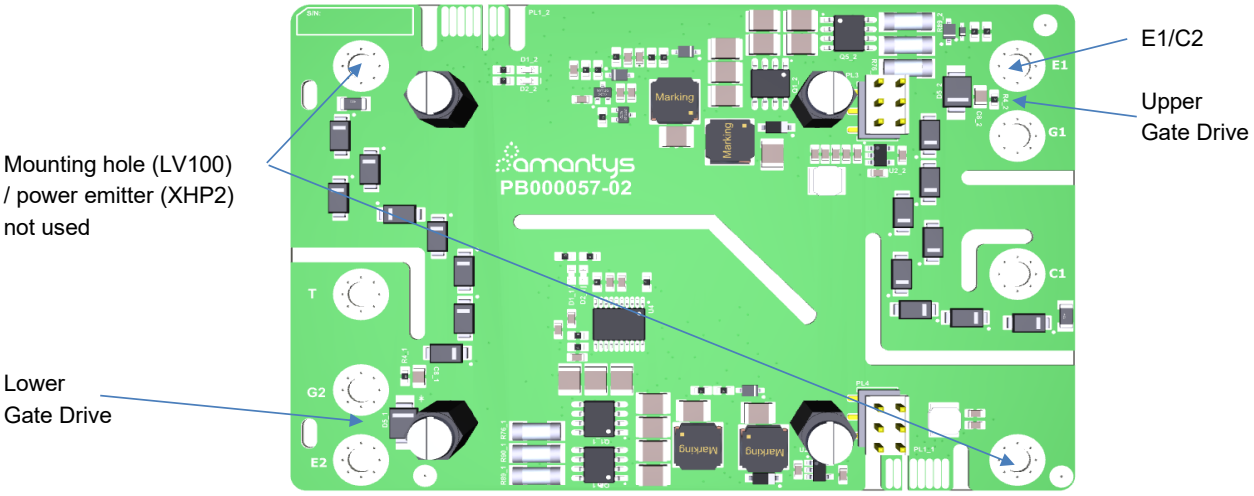
Gate Drive Assembly on IGBT Module (a) without insulator, (b) with insulator (order code PB000107-01)

Note: If IGBTs are mounted closer than 9mm apart then an insulator PCB can be used between gate drives to maintain clearance distance between adjacent modules.

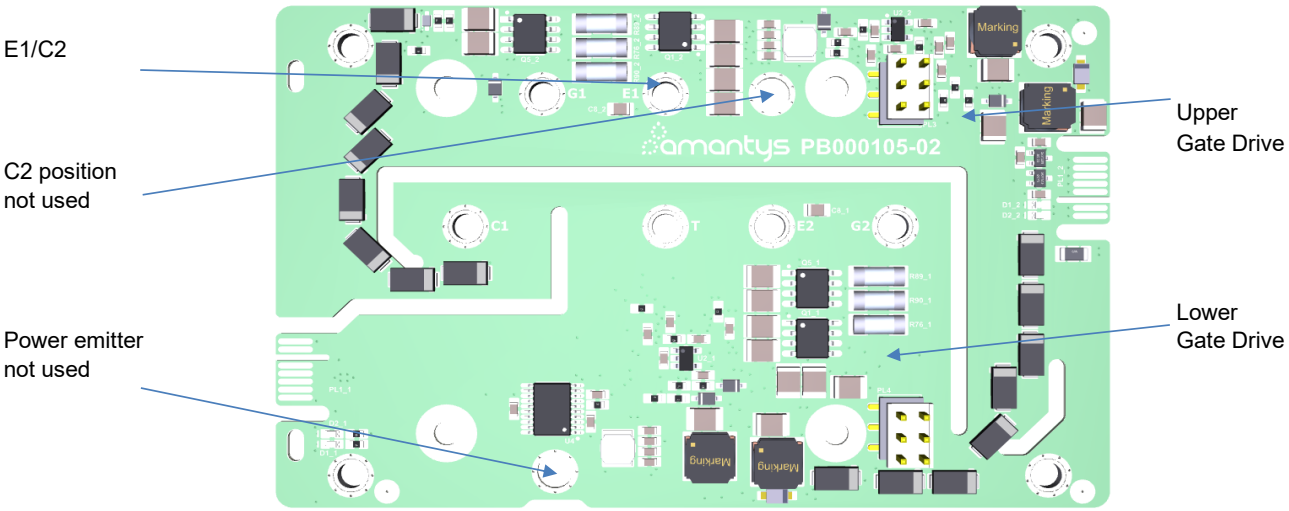
Top view of top board showing fibre-optic transceivers and power input connector
See appendix 1 for Torroidal transformer version - only for Existing Projects/Designs



Top view of LV100 bottom board showing IGBT connections



Top View of nHPD2 bottom board showing IGBT connections



Note: To avoid shorting copper tracks on the PCB, the screw head including any washer must not exceed the available metallic terminal pad of the bottom board. The meximum diameter is 7.0mm.

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

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

Ordering Information

A	E	0	0	N	C	L	A	9	S	0	-	x	x	x	x	x

xxxxx	Unique resistor configuration manifest number
coating	0 = uncoated, C = conformal coating
paralleling	S = single module Pnxxx = Parallel n modules xxx pitch in mm
	A7 - 15V, horizontal connector, torroidal tx, existing designs only
	A8 - 15V, vertical connector, torroidal tx, existing designs only
	B8 - 15V, vertical connector, dual-tx, new designs
	B9 - 24V, vertical connector, dual-tx, new designs
converter	Level 2 = 2-level protection 3 = 3-level protection
current rating	A = 32A peak B = 56A peak
module	N = nHPD2 / LinPak M = LV100 / XHP2
Module Voltage	00 = up to 3300V 33 = 3300V
Platform	E = E-Series
Switch Technology	A = Si IGBT S = SiC MOSFET

Notes

Horizontal power connector may be an option, however modules must be spaced to avoid interference between the power connector and fibre-optic tranceivers on the adjacent module. The insulator PCB cannot be used.

Broadcomm fibre-optic transceivers may be used if Firecomms parts are not available.

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The data contained herein is intended exclusively for qualified engineers who are experienced with, and trained in, working with high voltage apparatus which involves risk to life. Strict compliance with all relevant safety regulations for the target application is essential. Any handling of electronic devices is subject to the general specifications for protecting electrostatic sensitive devices according to international standard IEC 747-1, Chapter IX or European standard EN 100015 (i.e. the workplace, tool, operating environment, etc. must comply with these standards). Failure to comply may lead to the product becoming damaged.

Appendix 1 - Torroidal transformer version
Only for existing designs - NOT FOR NEW DESIGN