

This datasheet describes the Amantys Gate Drive for IGBT modules (nHPD<sup>2</sup>, LinPak, LV100, XHP2) assembled as a 2-channel n-way solution. The gate drive incorporates protection features for the IGBT module and can be configured by the user for optimised operation in the power stack of the end application. Up to 6 IGBTs modules can be connected in parallel. The driver core can also support hybrid and full SiC modules.

- Support for Mitsubishi LV100, Infineon XHP2
  - Support for Hitachi nHPD<sup>2</sup> and ABB LinPak
  - High current drive into gate: 35A peak
  - 15V input voltage (24V option available on request)
  - Operating temperature range: -40°C to +85°C
  - Type I and type II short circuit protection
  - Power supply undervoltage protection
  - User configurable
  - Logging of fault events
  - LED status indication
  - EN 50155 compliant for railway applications (with conformal coating)
  - IEC 61800-5-1 compliant for variable speed drives
  - Thermal shock and vibration to IEC 61373
  - EMC compliant to EN 50121-3-2, EN 50121-5, IEC 61800-3
  - Lead free design, RoHS compliant
  - 12 months warranty
- Parameters shown in the tables below are per channel, so multiply by two for the total current and power dissipation.
- Picture shows 3 way variant for nHPD<sup>2</sup> as an example.

#### Absolute Maximum Ratings

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

Parameter (per channel)	Notes	Units	Min	Typ	Max
Supply Voltage	Configured for 24V input voltage	V			28
	Configured for 15V input voltage	V			16.5
DC link voltage	Limited by transient voltage suppressors (TVS)				
	Configured for 1700V IGBT modules	V			1420
	Configured for 3300V IGBT modules	V			2600

#### Power Supply Characteristics (15 V input mode)

All data refers to +25 °C unless otherwise stated

Parameter (per channel)	Notes	Units	Min	Typ	Max
Nominal Supply Voltage	A current limited supply (<2.0A) is recommended	V	14.5	15.0	15.5
Supply current	Without load, not switching, OFF	mA		125	150
	Operation at 3kHz into 1µF load with 330nF additional gate-emitter capacitance	mA		300	500

#### Power Supply Characteristics (24V input mode)

All data refers to +25 °C unless otherwise stated

Parameter (per channel)	Notes	Units	Min	Typ	Max
Nominal Supply Voltage	A current limited supply (<2.0A) is recommended	V	21.6	24.0	26.4
Supply current	Without load, not switching, OFF	mA		80	100
	Operation at 3kHz into 1µF load with 330nF gate-emitter capacitance	mA		200	300

### General Electrical Characteristics

All data refers to +25 °C unless otherwise stated

Parameter	Notes	Units	Min	Typ	Max
Under-voltage lockout threshold on 15V supply	Internal power supply of gate drive	V		12.9	
Coupling capacitance	Primary to output	pF		10	15
Dielectric test voltage	50Hz AC for 10 seconds, primary to output	V <sub>rms</sub>			7400
Gate voltage (IGBT on)		V	15.0		
Gate voltage (IGBT off)		V			-10
Gate peak current	Limited by gate output FETs.	A			35
DC-DC Converter Peak Power	Continuous operation with 24V input voltage	W			5
	Continuous operation with 15V input voltage	W			3

### Gate drive configured for 1700V operation

All data refers to +25 °C unless otherwise stated

Parameter	Notes	Units	Min	Typ	Max
Operating voltage (V <sub>peak</sub> )	Primary to secondary side	V			1700
Lower threshold for clamp		V		1200	
Peak clamped V <sub>ce</sub>		V	1650		

### Gate drive configured for 3300V operation

All data refers to +25 °C unless otherwise stated

Parameter	Notes	Units	Min	Typ	Max
Operating voltage (V <sub>peak</sub> )	Primary to secondary side	V			3300
Lower threshold for clamp		V		2600	
Peak clamped V <sub>ce</sub>		V	3200		

### Standards Compliance

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 precautions 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

Parameter	Notes	Units	Min	Typ	Max
Operating temperature		°C	-40		85
Storage temperature		°C	-40		85
Humidity	With conformal coating compliant to EN 50155 Railways Applications Electronic Equipment Used on Rolling Stock	%		85	95
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 (Baseboard Mat. Grp. 3a)	mm	44		
	Functional isolation (MIC Mat. Grp. 2)	mm	16		
Clearance	Protective separation (Baseboard Mat. Grp. 3a)	mm	20		
	Functional isolation (MIC Mat. Grp. 2)	mm	10.5		

### Power Supply Interface

Manufacturer	Part Number
METZ Connect	SP06502VBNF

Note: Please check polarity carefully, it is shown on the PCB.

Pin Number	
1	2
VDC	GND

### Fibre-optic Interface

Interface	Description	Manufacturer	Part Number
Optical input (PWM)	Receiver	Avago	AFBR-2529Z
Optical output (ACK)	Transmitter	Avago	AFBR-1529Z

### Gate Drive Transmit LED Drive Current

Note: the drive current of the transmit (ACK) LED on the gate drive can be driven with different drive currents that are configurable by the user.

The lifetime of the transmit LED can be prolonged by driving with a lower current.

LED Drive Configuration	Units	LED Current	Comments
LED Drive Level 1	mA	1.82	Longest lifetime for LED
LED Drive Level 2	mA	2.73	
LED Drive Level 3	mA	3.64	
LED Drive Level 4	mA	4.55	
LED Drive Level 5	mA	6.37	

### LED Status Indication

Note: The gate drive has two status LEDs that communicate the status of the gate drive

LED	Behaviour	Status
Green	Lit continuously	Supply OK
Green	Flashing 1Hz	Gate drive receiving PWM input
Red	Lit continuously	Power supply below minimum voltage
Red	Flashing intermittently	Short circuit gate-emitter or power supply fault
Red	Flashing 1Hz	Short circuit condition in converter
Green/Red	Both lit continuously	PLD not programmed (LEDs will be dimly lit)
Green/Red	Flashing simultaneously	PLD programmed with test design
Green/Red	Both off	No supply or LEDs are broken

### Measured Parameters

Name	Comment	Units	Resolution
Gate drive temperature	On board temperature	°C	±1.0
+15V supply rail	Secondary side voltage	V	±0.01
V <sub>ge</sub> On	V <sub>ge</sub> when the power device is turned on	V	±0.01
V <sub>ge</sub> Off	V <sub>ge</sub> when the power device is turned off	V	±0.01
V <sub>ce</sub> On	V <sub>ce</sub> when the power device is turned on; i.e. the saturation voltage	V	±0.01
V <sub>ce</sub> Off	V <sub>ce</sub> when the power device is turned off	V	±1.0
Product Code		String	
Serial Number		String	
Software Part Numbers [0 - 9]	Part number strings for up to 10 software components included in this product	String	
Build Date	Date of configuration	YYYYMM	

### Event Counters

The gate drive records the events below on board the gate drive. The event counters can be viewed using a Power Insight Adapter and the Power Insight Configurator.

Event	Description
Type I short circuit	Report of type I short circuit count
Type II short circuit	Report of type II short circuit count
Undervoltage lockout	Report of undervoltage lockout protection count
Oversvoltage clamp activation	Report of oversvoltage clamp activation count
Number of switching cycles	Report of number of switching cycle count

**Configurable Parameters**

Note: The gate drive can be configured by using a Power Insight Adapter and the Power Insight Configurator Software

Name	Comment
Gate On Resistor	Turn-on resistor value
Gate Off Resistor	Turn-off resistor value
High Vce Gate Off Resistor	Turn-off resistor value when Vce above threshold
Gate Soft Turn Off	Turn-off resistor value under fault condition
Gate-Emitter Capacitor	Capacitance between gate and emitter
Fault Lock out time	After fault time before gate drive can be switched
Desaturation Detection Times	Four time windows are defined during which the Vce comparators are checked
Desaturation Detection Voltages Level mode	Desaturation detection comparator voltages, three Vce monitors and one diode chain 2 or 3-level mode operation

Refer to the Power Insight Configurator for values and the Gate Drive Technical Manual for further details.

**Resistor Range**

The default set of resistors on the driver core allow setting of turn-on and turn-off resistors in the following ranges.

#	Rgon	Rgoff	#	Rgon	Rgoff	#	Rgon	Rgoff	#	Rgon	Rgoff
0	n/a	n/a	16	1.95	4.10	32	0.90	2.13	48	0.62	1.40
1	27.00	56.00	17	1.82	3.82	33	0.87	2.05	49	0.60	1.37
2	15.00	22.00	18	1.73	3.46	34	0.85	1.94	50	0.59	1.32
3	9.64	15.79	19	1.62	3.26	35	0.82	1.88	51	0.58	1.29
4	6.80	12.00	20	1.52	3.06	36	0.79	1.81	52	0.56	1.26
5	5.43	9.88	21	1.43	2.90	37	0.77	1.75	53	0.55	1.23
6	4.68	7.76	22	1.38	2.68	38	0.75	1.67	54	0.54	1.19
7	3.99	6.82	23	1.31	2.56	39	0.73	1.62	55	0.53	1.16
8	3.90	8.20	24	1.30	2.73	40	0.73	1.69	56	0.53	1.20
9	3.41	7.15	25	1.24	2.61	41	0.71	1.64	57	0.52	1.17
10	3.10	5.97	26	1.20	2.43	42	0.70	1.57	58	0.51	1.14
11	2.78	5.40	27	1.15	2.33	43	0.68	1.53	59	0.50	1.11
12	2.48	4.87	28	1.09	2.23	44	0.66	1.48	60	0.49	1.09
13	2.27	4.48	29	1.05	2.14	45	0.64	1.44	61	0.48	1.07
14	2.13	3.99	30	1.02	2.02	46	0.63	1.39	62	0.48	1.04
15	1.97	3.72	31	0.98	1.95	47	0.62	1.36	63	0.47	1.02

For paralleling multiple modules, especially 1700V Mitsubishi LV100, these values may not be low enough.

Please ask Amantys if different values are required.

The selection for soft turn-off resistors and high Vce turn-off resistors is the same as Rgoff.

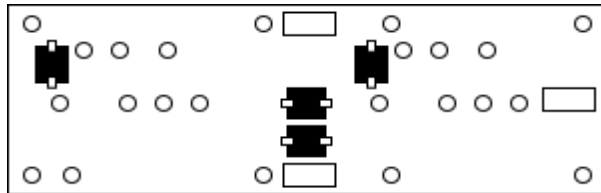
**Physical Parameters**

Parameter	Notes	Units	Min	Typ	Max
Length	All dimensions have a tolerance of +/- 0.5mm	mm	200.0		[1]
Width		mm			66.0
Height		mm		65.0	
Weight		g		300	
Screw torque	Maximum torque on gate, emitter and collector	Nm			2.0

[1] Note: length subject to module spacing, height depends on voltage variant for creepage and clearance, not including cable mounted power connector.

**Board Stackup (bottom to top)**

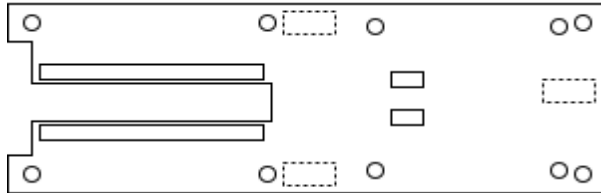
Please ask Amantys for 3D model when planning converter layout.



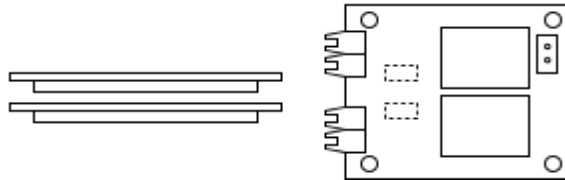
BOTTOM (near to IGBT)

Module Interface Card  
with common-mode chokes

nHPD<sup>2</sup> or LinPak shown  
here, but could be  
LV100 or XHP2



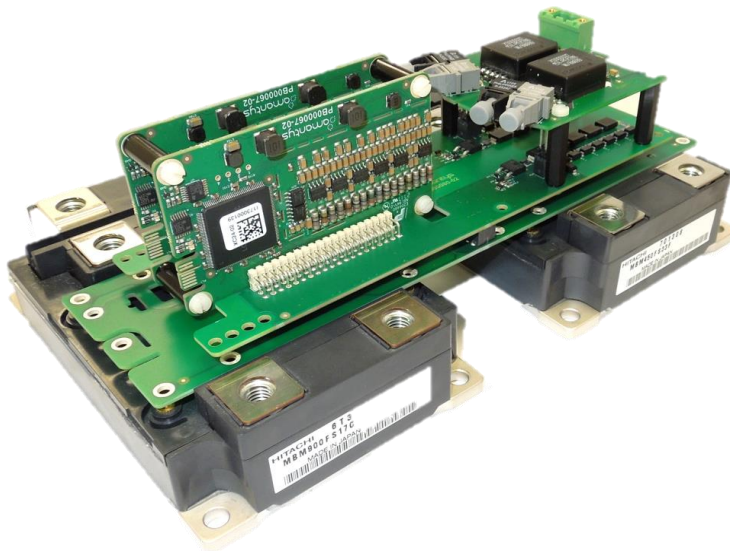
Distribution board with transorbs  
and measurement chain



2-off Core Gate Drives  
mounted vertically

PSU and fibre-optic interface board

TOP



Example of 2-way solution  
mounted on IGBTs with 40mm  
spacing.

**Ordering Information**

Gate Drive and Distribution Board Assembly

Part Number	AV17WXXY-ZZZZ	1700V transorbs on the distribution board
	AV33WXXY-ZZZZ	3300V transorbs on the distribution board
where	W = 2 for standard core with fixed gate voltage, 3 for variable gate voltage	
	XX = A8 for 15V input, A9 for 24V input	
	Y = 0 (uncoated) or C (coated)	
	ZZZZ = specific part number for each specific customer configuration	

Compatible Module Interface Cards

Amantys Part Number	Description
XB000089-02	nHPD <sup>2</sup> module interface card for two modules in parallel
XB000090-02	nHPD <sup>2</sup> module interface card for 3 modules in parallel
XB000091-01	LV100 module interface card for two modules in parallel with 40mm spacing
XB000095-01	nHPD <sup>2</sup> module interface card for four modules in parallel with 4mm spacing
XB000100-01	LV100 module interface card for three modules in parallel with 10mm spacing
XB000104-01	nHPD <sup>2</sup> module interface card for six modules in parallel with no spacing
XB000105-01	nHPD <sup>2</sup> module interface card for five modules in parallel with no spacing
XB000108-01	nHPD <sup>2</sup> module interface card for three modules in parallel with 2mm spacing
XB000114-01	LV100 module interface card for six modules in parallel with 1.8mm spacing
XB000115-01	LV100 module interface card for three modules in parallel with 1.8mm spacing
XB000118-01	nHPD <sup>2</sup> module interface card for three modules in parallel with 10mm spacing

Please ask Amantys for 3D STEP files to check module spacing

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