2SIL1200T2A0(C)
SCALE-iFlex LT Family

Isolated Master Control (IMC) for Half-Bridge Power Modules
Electrical Interface

Product Highlights

Highly Integrated, Compact Footprint

- Dual channel gate driver
- Optimized for parallel connected power modules
- Supports up to 4 or 6 dual-channel power modules depending on the connected Module Adapted Gate Drivers
- Electrical interface
- Primary supply voltage of +15 V
- 10 W output power per channel at maximum ambient temperature
- -40 °C to 85 °C operating ambient temperature

Protection / Safety Features

- Supporting short circuit detection and advance active clamping of the Module Adapted Gate Driver.
- Undervoltage lock-out (UVLO) protection for primary-side (low-voltage) and secondary-side (high-voltage)
- Applied double sided conformal coating for 2SIL1200T2A0C.

Comprehensive Safety and Regulatory Compliance

- 100% production test for partial discharge and HIPOT test of transformer
- Creepage and clearance distances between primary and secondary sides meets IEC 61800-5-1 reinforced isolation requirements
- RoHS compliant

Applications

- Wind and photovoltaic power
- Industrial drives
- Traction inverter

Description

The SCALE-iFlex™ LT gate driver family consists of an Isolated Master Control (IMC) unit that supports Module Adapted Gate Drivers (MAGs) together with a cable set. The IMC is designed to operate with power modules that have a rated blocking voltage of up to 3300 V. The MAGs come in different formats, that match individual power modules from different suppliers.

SCALE-iFlex LT enables easy paralleling of up to 4 or 6 power modules depending on the connected MAGs providing high flexibility and system scalability.

Figure 1. Board Photo of 2SIL1200T2A0(C).

Pin Functional Description

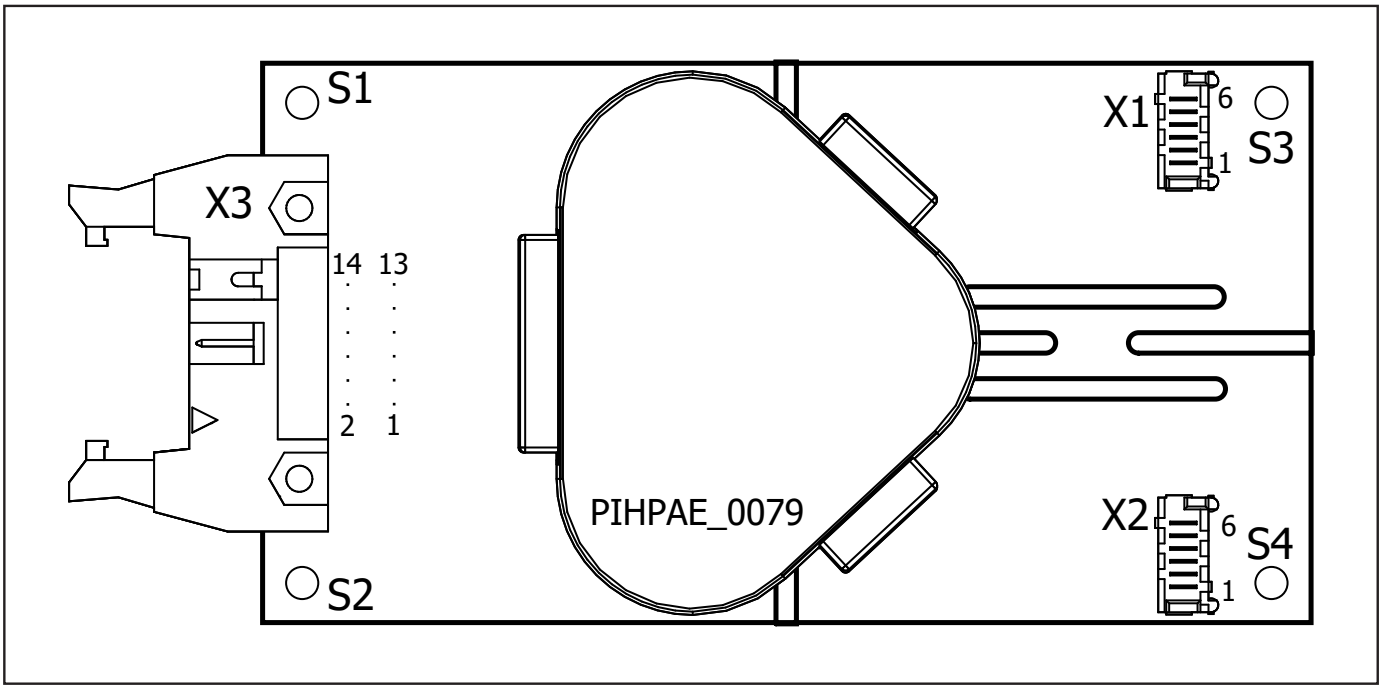


Figure 2. Pin Configuration.

Connector X3

HARTING 09185146903 Eject Latch Header Assembly at X3; Connection from IMC to superior controller.

VDC (Pins 1, 3)
This pin is the primary-side 15 V supply voltage connection the integrated DC/DC converter which supplies the secondary sides.

VCC (Pin 5)
This pin is the primary-side 15 V supply voltage connection for the primary-side electronic.

IN1 (Pin 13)
This pin is the command input for channel 1.

SO1 (Pin 11)
This pin is the status output for channel 1.

IN2 (Pin 9)
This pin is the command input for channel 2.

SO2 (Pin 7)
This pin is the status output for channel 2.

GND (Pins 2, 4, 6, 8, 10, 12, 14)
These pins are the connection for the primary-side ground potential. All primary-side signals refer to these pins

Connector X1

MOLEX 90779-0002 Picoflex Header; Connection from IMC to MAG for gate driver channel 1.

Connector X2

MOLEX 90779-0002 Picoflex Header; Connection from IMC to MAG for gate driver channel 2.

Functional Description of 2SIL1200T2A0(C)

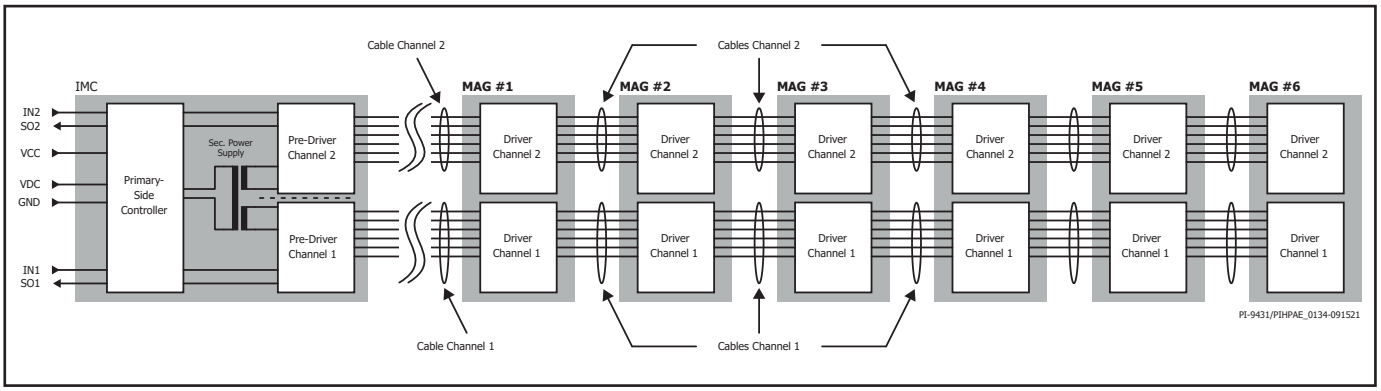


Figure 3. Functional Block Diagram.

The SCALE-iFlex LT is a dual channel gate driver, which consists of three parts according to Figure 3:

- Isolated Master Control (IMC)
- Module Adapted Gate Drivers (MAG)
- Cables

The IMC 2SIL1200T2A0(C) is independent of the actual target power module voltage class. It operates with various power modules up to a blocking voltage of 3300 V, and provides reinforced isolation between primary and either secondary sides as well as basic isolation between both secondary sides.

In contrast, the MAGs are particularly designed to operate with specific power modules such as 100 mm x 140 mm dual modules. Their characteristics match the requirements of the individual power modules.

The interconnection between the external system controller and the IMC, from the IMC to the first MAG as well as between the MAGs is established with cables to allow a large degree of mechanical flexibility for the positioning of the devices.

The SCALE-iFlex LT gate driver provides the highest flexibility and is able to operate single or up to four or six power modules in parallel depending on actual application conditions and selected MAGs.

The operation of channel 1 and channel 2 of the gate driver is independent of each other. The insertion of dead-time, to avoid synchronous or overlapping switching of the driven power switches, has to be generated in the external system controller.

Note: Synchronous or overlapping switching of top and bottom switches within a half-bridge leg may damage or destroy the driven power switche(s) and, in conjunction as secondary failure, the attached MAG and/or IMC.

Power Supplies (Primary-Side X3)
The 2SIL1200T2A0(C) provides two power supply inputs. For both a typical supply voltage level of 15 V is required.

The first input VDC supplies the integrated DC/DC converter, which generates the isolated voltage for the secondary-side gate driver channels (IMC and MAGs).

The second input VCC supplies the primary-side electronic of the IMC. It is mandatory to supply VDC and VCC from the same source.

Undervoltage Monitoring
The supply voltages are closely monitored. In case of an under voltage condition (UVLO), a failure signal will be provided on the status output SO1/SO2 of the gate driver. If the UVLO is present on the primary-side supply V_{VCC}, both status output signals will be set to GND and all gate driver channels will be turned off synchronously.

In case of an UVLO on the secondary-side of the IMC, the status signal of the respective channel will be set to GND and the corresponding power semiconductor(s) will be turned off.

Note: An UVLO event on a MAG will only turn off the affected MAG immediately. All other paralleled power semiconductors of the related channel are turned off after the delay $t_{OFF(MAG)}$.

Signal Inputs (Primary-Side X3)
The input logic of IN1 and IN2 is designed to work with 15 V logic levels to provide a sufficient signal/noise ratio. Both inputs have positive logic and are edge-triggered.

Gate driver signals are transferred from the IN1 and IN2 pins to the gate of the attached MAG(s) with a propagation delay of $t_{P(LH)}$ for the turn-on and $t_{P(HL)}$ for the turn-off commands.

Status Outputs (Primary-Side X3)
The status feedback signals SO1 and SO2 are open-drain outputs and must be connected to V_{VCC} with pull-up resistors. They stay at V_{VCC} under no-fault conditions. In case of a fault, e.g. detected short-circuit of the driven power module or an under voltage lock-out (UVLO) condition on the secondary-side or any MAG, the status feedback is set to GND potential for a duration of t_{BLK}. In the case of a primary-side UVLO condition, both status feedback signals remain at GND during the UVLO and are extended by t_{BLK}. During this time, no gate signals will be transmitted to the respective gate driver channel.

IMC Output (Secondary-Side X1, X2)
The IMC provides per channel an output connector towards the first MAG. Details on recommended routing and general mounting are given in section "Mounting Instruction".

Cables
SCALE-iFlex LT gate driver requires a set of cables to establish the electrical connection between the IMC and the first MAG as well as between paralleled MAGs. The usage of cables allows for a flexible positioning of the IMC within the application. Furthermore, it allows adapting to various pitches between paralleled power modules.

Screw Terminals
The 2SIL1200T2A0(C) can be mounted within the system using screws at locations S1 to S4.

Maximum Ratings

Parameter	Symbol	Conditions T_A = -40 °C to 85 °C	Min	Max	Units
Absolute Maximum Ratings[1]					
Primary-Side Supply Voltage	V_{VDC}	VDC and VCC must be applied in parallel to GND	0	16	V
	V_{VCC}		0	16	
Primary-Side Supply Current	I_{VDC}	Average supply current at full load		1800	mA
Logic Input Voltage (Command Signal)	V_{INx}	INx to GND	0	V_{VCC} + 0.5	V
Logic Output Voltage (Status Signal)	V_{SOx}	SOx to GND	0	V_{VCC} + 0.5	V
Status Output Current[2]	I_{SOx}	SOx to GND		20	mA
Output Power Per Channel[3]	P_X			10	W
Switching Frequency	f_{SW}			10	kHz
Operating Voltage Primary-Side to Secondary-Side	V_{OP}	Transient applied		3300	V
		Permanently applied		2500	
Test Voltage Primary-Side to Secondary-Side	$V_{ISO(PS)}$	50 Hz, 60 s		9100	V
Test Voltage Secondary-Side to Secondary-Side	$V_{ISO(SS)}$	50 Hz, 60 s		6000	V
Common-Mode Transient Immunity	|dv/dt|			50	kV/µs
Storage Temperature[4]	T_{ST}		-40	50	°C
Operating Ambient Temperature	T_A		-40	85	°C
Surface Temperature[5]	T			125	°C
Relative Humidity	H_R	No condensation		93	%
Altitude of Operation[6]	A_{OP}			2000	m

Recommended Operating Conditions

Parameter	Symbol	Conditions T_A = -40 °C to 85 °C	Min	Typ	Max	Units
Power Supply						
Primary-Side Supply Voltage	V_{VDC}	VDC to GND	14.5	15	15.5	V
	V_{VCC}	VCC to GND	14.5	15	15.5	
Status Output Current	V_{SOx}			5		mA

NOTES:

1. Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device.
2. The status output current must be limited by external pull-up resistors located on the host board.
3. Actually achievable maximum power depends on several parameters and may be lower than the given value. It has to be validated in the final system. It is mainly limited by the maximum allowed surface temperature.
4. The storage temperature inside the original package or in case the coating material of coated products may touch external parts must be limited to the given value. Otherwise, it is limited to 85°C.
5. The component surface temperature, which may strongly vary depending on the actual operating conditions, must be limited to the given value to ensure long-term reliability of the product.
6. Operation above this level requires a voltage derating to ensure long-term reliability of the product.

Characteristics

Parameter	Symbol	Conditions V_{VDC} = V_{VCC} = 15 V, T_A = 25 °C		Min	Typ	Max	Units
Power Supply							
Supply Current	I_{VDC}	P_X = 265 mW, non-switching			126		mA
		P_X = 10 W, f_{SW} = 10 kHz, 50 % duty cycle			1160		mA
	I_{VCC}	P_X = 265 mW, non-switching			16		mA
		f_{SW} = 10 kHz			17		mA
Power Supply Monitoring Threshold (Primary-Side)	$UVLO_{VCC}$	Referenced to GND	Clear fault (resume operation)	11.6	12.6	13.6	V
			Set fault (suspend operation)	11.0	12.0	13.0	
			Hysteresis	0.35			
Power Supply Monitoring Threshold (Secondary-Side)	$UVLO_{VISOx}$	Referenced to respective terminal E1 or E2[7]	Clear fault (resume operation)	11.6	12.6	13.6	V
			Set fault (suspend operation)	11.0	12.0	13.0	
			Hysteresis	0.35			
	$UVLO_{COMx}$		Clear fault (resume operation)		-5.15		V
			Set fault (suspend operation)		-4.85		
			Hysteresis		0.3		
Output Voltage (Secondary-Side)	V_{VISOx}	Referenced to V_{COMx}, P_X = 265 mW, non-switching			24.4		V
		Referenced to V_{COMx}, P_X = 10 W, f_{SW} = 10 kHz, 50% duty cycle			22.8		
Coupling Capacitance	C_{IO}	Primary-side to secondary-side, total per channel			19		pF
Logic Inputs and Status Outputs							
Input Impedance	R_{INx}			3.8	3.9	4.0	kΩ
Turn-On Threshold	$V_{TH-ON(INx)}$	INx to GND			9.2		V
Turn-Off Threshold	$V_{TH-OFF(INx)}$	INx to GND			4.5		V
Turn-On Pulse Suppression[8]	$V_{PULSE(ON)(INx)}$	INx to GND			270		ns
Turn-Off Pulse Suppression[8]	$V_{PULSE(OFF)(INx)}$	INx to GND			80		ns
Status Output Voltage	V_{SOx}	Fault condition, SOAx current ≤ 5mA				0.7	V

NOTES:
7. Local emitter terminals are not routed outside of the IMC.
8. Pulse width shorter than the given values are suppressed (not processed up to the gate-emitter terminals).

Characteristics (cont.)

Parameter	Symbol	Conditions V_{VDC} = V_{VCC} = 15 V, T_A = 25 °C	Min	Typ	Max	Units
Timing Characteristics						
Turn-On Delay	$t_{P(LH)}$	$V_{TH(ON)(INx)}$ to 90% of $V_{GE(ON)}$, no-load attached (from IMC input to MAG output)		240		ns
Turn-Off Delay	$t_{P(HL)}$	$V_{TH(OFF)(INx)}$ to 10% of $V_{GE(ON)}$, no-load attached (from IMC input to MAG output)		240		ns
Turn-Off Delay After MAG Fault	$t_{OFF(MAG)}$	Delay from any MAG fault detection until turn-off of all other MAGs		3.5		us
Transmission Delay of Fault State	t_{SOX}	From IMC short-circuit detection to SOx		5.5		us
Blocking Time	t_{BLK}	After secondary-side fault detection		98		ms
Electrical Isolation						
Test Voltage[9]	$V_{ISO(PS)}$	Primary-side to secondary-side	9100			V_{RMS}
	$V_{ISO(SS)}$	Secondary-side to secondary-side	6589			V_{RMS}
Partial Discharge Extinction Voltage[10]	$P_{D(PS)}$	Primary-side to secondary-side	4125			V_{PK}
	$P_{D(SS)}$	Secondary-side to secondary-side	3670			V_{PK}
Creepage Distance	$CPG_{P-S(PCB)}$	Primary-side to secondary-side, on PCB (Material category IIIa)	50			mm
	$CPG_{P-S(TRF)}$	Primary-side to secondary-side, on transformer (Material category I)	29			mm
	$CPG_{S-S(PCB)}$	Secondary-side to secondary-side, on PCB (Material category IIIa)	25			mm
	$CPG_{S-S(TRF)}$	Secondary-side to secondary-side, on transformer (Material category I)	25			mm
Clearance Distance	CLR_{P-S}	Primary-side to secondary-side	22			mm
	CLR_{S-S}	Secondary-side to secondary-side	12.7			mm
Mounting						
Mounting Holes	D_{HOLE}	Diameter of screw hole S1 – S4		3.2		mm
Bending	I_{BEND}	According to IPC			0.75	%

NOTES:
9. The transformer of every production sample has undergone 100% testing at the given value for 1s.
10. Partial discharge measurement is performed on each transformer.

Mounting Instruction

The IMC can be mounted at a suitable location within the target application using the four screw holes S1 to S4. It is recommended to place the IMC out of any hot-spot area (e.g. heat sinks). Cable lengths between IMC and MAG of up to 0.5 m allow a high level of design freedom.

Note that the isolation coordination must be respected, e.g. plastic screws and/or spacers may be used if the support is electrically conducting (S1 and S2 are located close to primary side potential while S3 and S4 are located close to secondary-side potentials).

To avoid mechanical stress of the IMC during and after the mounting process, any bending or warping force imposed to the IMC must not lead to a vaulting or twisting of the housing of 0.75 % per axis.

Cables

Several cable connections have to be established for proper system operation. These are:

- Cable from the system level controller to the primary-side IMC interface X3.
- Cables from the secondary-side IMC interface to the first MAG (one per channel).
- In case of paralleling of power modules, the cables from one MAG to another MAG (one per channel).

The cables between IMC and MAG and between MAGs are ribbon cables from the MOLEX picoflex family. The part number from MOLEX is 9231506xx where as xx is the cable length in cm. The following lengths are available: xx=15, 19, 20, 22, 25, 28, 30, 35, 40, 55.

All connections shall be assembled in non-powered status of the system only. The cable from IMC (connector X3) to the system level controller is not part of the SCALE-iFlex LT gate driver and has to be provided by the designer of the system. It is recommended to route the cable with minimum parasitic coupling from the controller to the IMC. Parasitic coupling in particular to any potential of the secondary-side of the IMC has to be avoided. Otherwise, increased common-mode currents may circulate, which may cause interferences with command, measurement and/or status feedback signals.

The cables should not touch the PCB area to avoid contact with hot surfaces. The cable from the IMC (connectors X1/X2) to the first MAG has to be isolated from surrounding potentials including the frame of the inverter system. The minimum required distance to such potentials is 30 mm. A larger distance might be required depending on actual application conditions and applied isolation standards. The maximum length of the cable is 0.5 m. Beyond this length, degradation or timing variations of the command and/or status feedback signals may occur. The isolation can be established for instance with spacers or isolation sleeves.

Note: Partial discharge may occur within the cable and/or isolation sleeve depending on actual application conditions, which might lead to a degradation of the isolation. Proper routing of the cable and selection of the isolation sleeve are mandatory.

The cable connection from one MAG to another MAG should be kept as small as technically feasible. By this, typically no particular requirements concerning the isolation are given. In case the cable is in close proximity to other potentials (e.g. corresponding opposite channel, system frame), additional measures to ensure proper isolation distances have to be established. In any case, a minimum distance of 30 mm is required for such potentials. A larger distance might be required depending on actual application conditions and applied isolation standards. Using an isolation sleeve at reduced distances is not allowed due to parasitic cross-coupling effects.

Note: Missing cable connections especially between MAGs will not lead to a failure signal at the IMC terminal X3 and will therefore not be detected by the gate driver.

Conformal Coating

The electronic components of the gate driver 2SIL1200T2A0C are protected by a layer of acrylic conformal coating with a typical thickness of 50µm using ELPEGUARD SL 1307 FLZ/2 from Lackwerke Peters on both sides of the PCB. This coating layer increases the product reliability when exposed to contaminated environments.

Note: Standing water (e.g. condensate water) on top of the coating layer is not allowed as this water will diffuse over time through the layer. Eventually it will form a thin film of conducting nature between PCB surface and coating layer, which will cause leakage currents. Such currents may lead to a disturbance of the performance of the gate driver.

Product Dimensions

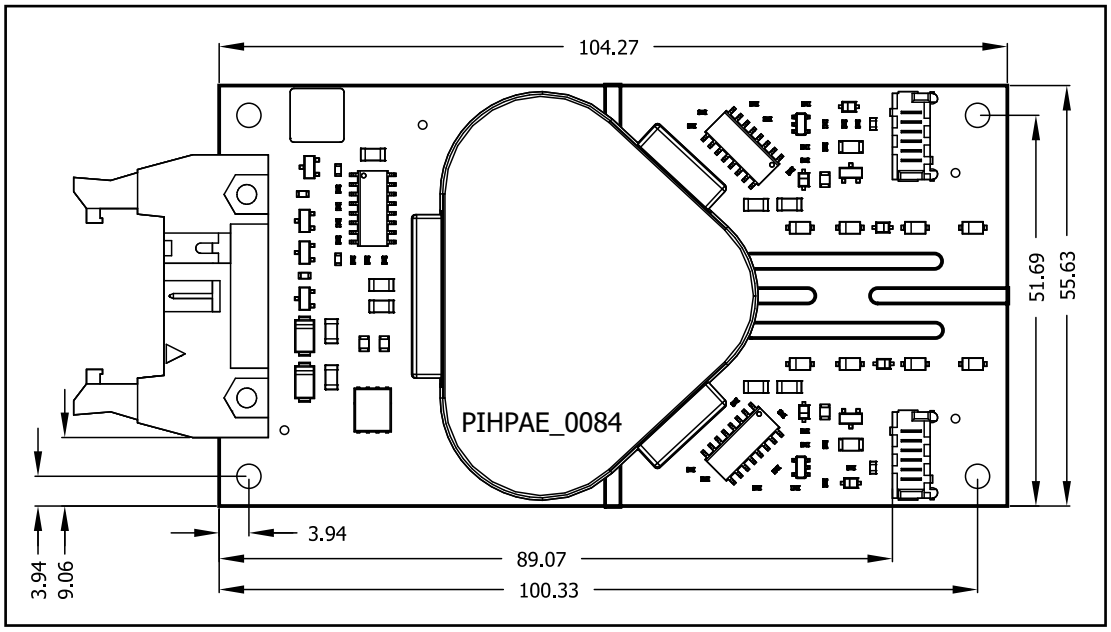


Figure 4. Top View

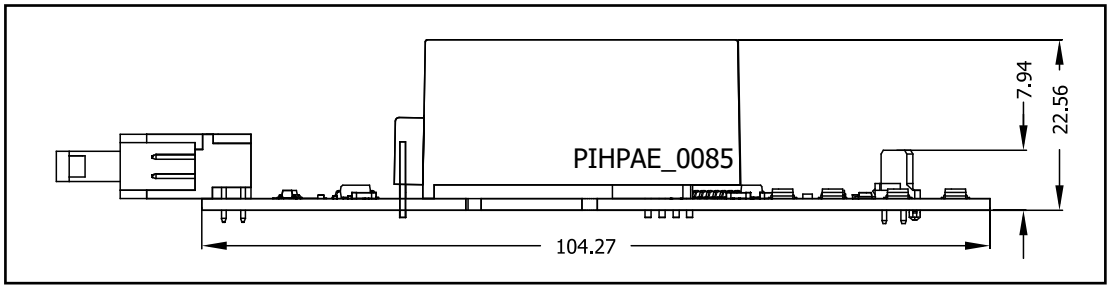


Figure 5. Side View.

Product Details

Part Number	Voltage Class	Coating
2SIL1200T2A0-33	3300 V	Uncoated
2SIL1200T2A0C-33	3300 V	Coated

Transportation and Storage Conditions

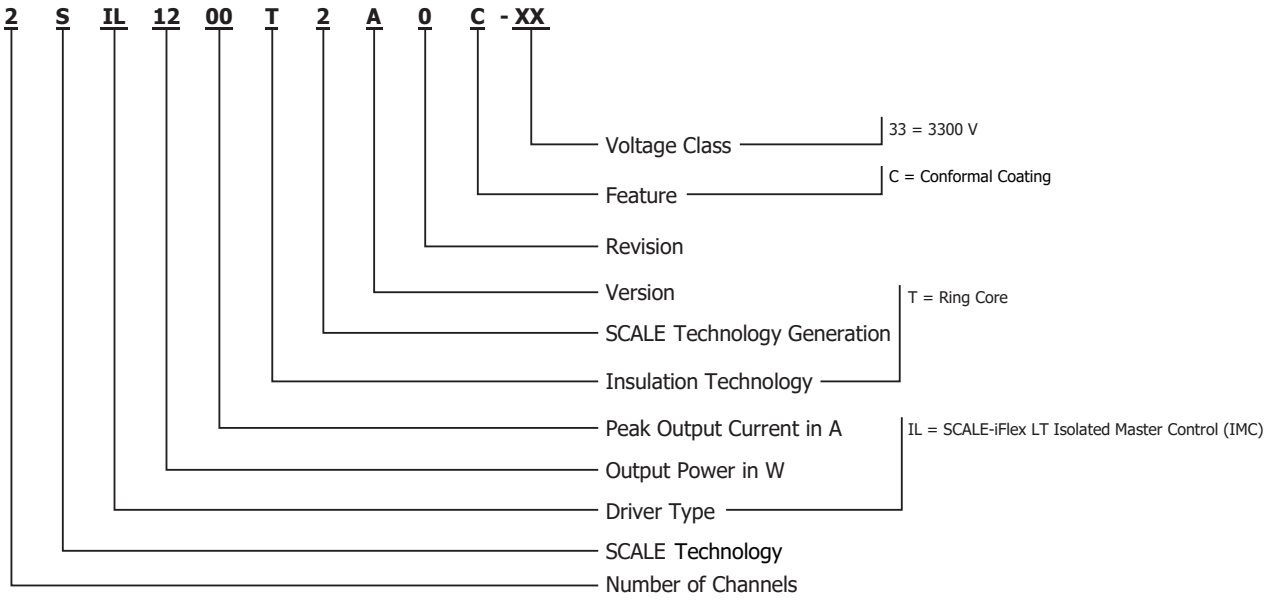
For transportation and storage conditions refer to Power Integrations' Application Note AN-1501.

RoHS Statement

We hereby confirm that the product supplied does not contain any of the restricted substances according Article 4 of the RoHS Directive 2011/65/EU in excess of the maximum concentration values tolerated by weight in any of their homogeneous materials.

Additionally, the product complies with RoHS Directive 2015/863/EU (known as RoHS 3) from 31 March 2015, which amends Annex II of Directive 2011/65/EU.

Part Ordering Information Table IMC



Revision	Notes	Date
A	Final Datasheet.	10/22

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