2SILT1200T2A0C-33
SCALE-iFlex LT Family

Isolated Master Control (IMC) for Driving Half-Bridge Power Modules with NTC Measurement via Electrical Interface

PRELIMINARY

Product Highlights

Highly Integrated, Compact Footprint

- Ready-to-use gate driver solution for power modules up to 3300 V blocking voltage
- Dual channel gate driver
- Optimized to be used with up to 4 Module Adapted Gate Driver 2SMLT0220D2C0C
- Flexible input supply voltage with 15 V_{DC} or 24 V_{DC}
- Up to 5.5 W output power per channel at maximum ambient temperature
- Electrical interface
- -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)
- NTC temperature sensing with reinforced isolated output signal (PWM-coded signal)
- Applied double sided conformal coating

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 with NTC gate driver family consists of an Isolated Master Control (IMC) unit that supports up to four Module Adapted Gate Drivers (MAGs) together with a cable set. The IMC 2SILT1200T2A0C-33 operates power modules that have a rated blocking voltage of up to 3300 V. The MAGs are matched to the specific power modules from a variety of suppliers.

The IMC 2SILT1200T2A0C-33 driver currently supports 2SMLT0220D2C0C designed for LV100 and XHP™ 2 module packages.

SCALE-iFlex LT with NTC enables easy paralleling of power modules providing high flexibility and system scalability.

Figure 1. Board Photo of 2SILT1200T2A0C-33.

Pin Functional Description

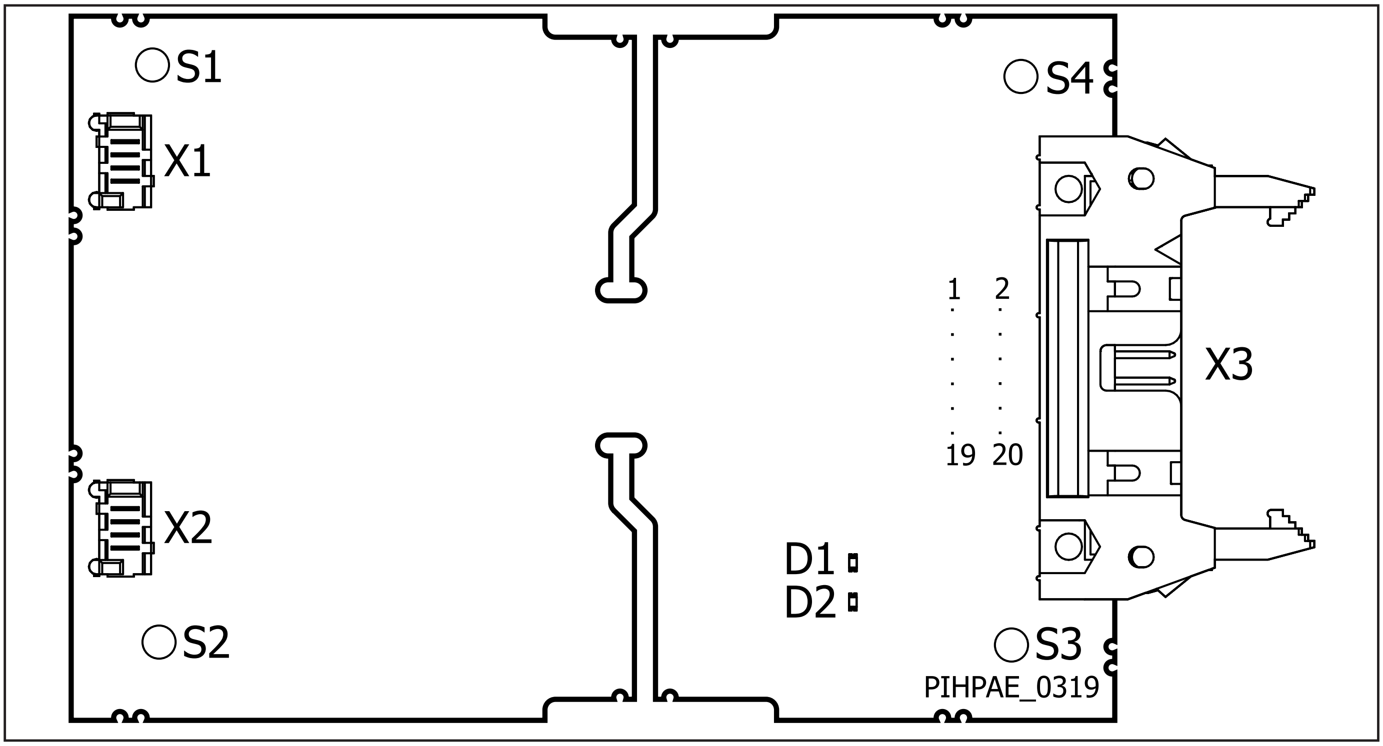

Figure 2. Pin Configuration.

Connector X3

AMPHENOL FCI 71922-120LF (or similar) Eject Latch Header Assembly at X3; Connection from IMC to superior controller.

VCC (Pins 1, 3)
This pin is the primary-side 24 V supply voltage connection. Either VCC or V15 has to be used for supplying the 2SILT1200T2A0C-33.

V15 (Pin 5, 7)
This pin is the primary-side 15 V supply voltage connection. Either VCC or V15 has to be used for supplying the 2SILT1200T2A0C-33.

IN1 (Pin 15)
This pin is the command input for channel 1.

SO1 (Pin 13)
This pin is the status output for channel 1.

IN2 (Pin 11)
This pin is the command input for channel 2.

SO2 (Pin 9)
This pin is the status output for channel 2.

TPM (Pin 17)
This is the measurement output for the NTC temperature sensing.

GND (Pins 2, 4, 6, 8, 10, 12, 14, 16, 18, 19, 20)
These pins are the connection for the primary-side ground potential. All primary-side signals refer to these pins

Connector X1

Connection from IMC to MAG for gate driver channel 1.

Connector X2

Connection from IMC to MAG for gate driver channel 2.

LED

D1

Red optical indicator.

D2

Green optical indicator.

Functional Description of 2SILT1200T2A0C-33

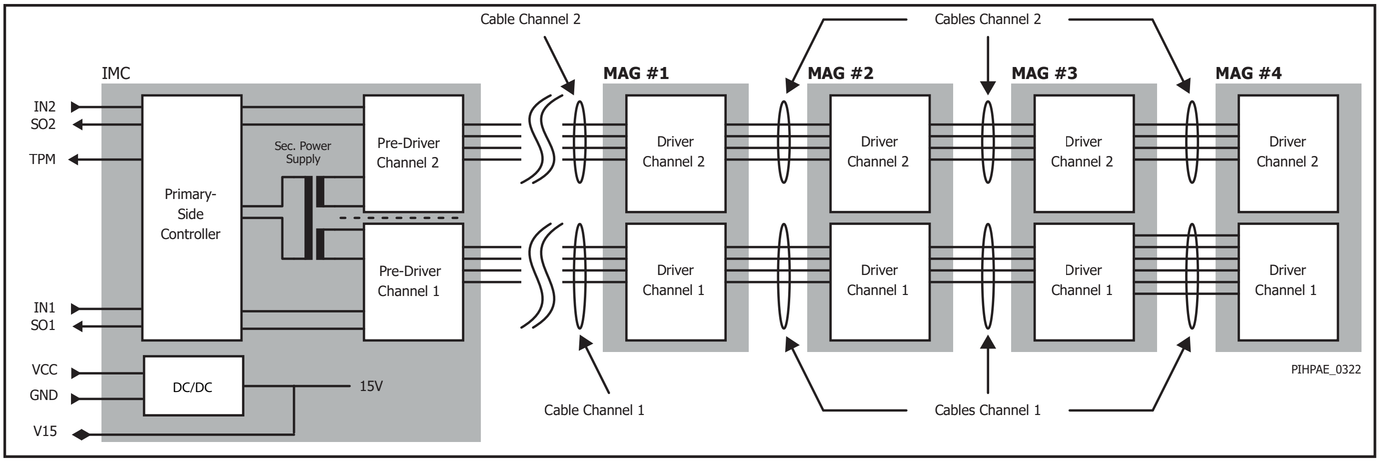

Figure 3. Functional Block Diagram.

The SCALE-iFlex LT with NTC 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 2SILT1200T2A0C-33 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 with NTC gate driver provides the highest flexibility and is able to operate single or up to four 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 switch(es) and, in conjunction as a secondary failure, the attached MAG and/or IMC.

Power Supplies (Primary-Side X3)

The 2SILT1200T2A0C-33 provides two independent power supply inputs. The first input VCC accepts a non-isolated fixed supply voltage V_{VCC}, and the second input V15 accepts a non-isolated fixed supply voltage V_{V15}.

Only one supply input is allowed to be used at any time. In case the supply voltage at terminal VCC is used, a regulated voltage of typical 15 V is present at terminal V15. It represents the internal reference voltage for all primary-side functions. Additionally, it can be used as a 15 V output. Accordingly, an external load is allowed at V15 in case the VCC terminal is used as a supply and the external load together with the gate output loads does not lead to a temperature higher than the maximum allowed surface temperature.

It should be mentioned that when input supply V15 is used, the VCC terminal must be left floating.

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_{V15}, 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. Additionally the input signal IN1 and IN2 are filtered.

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_{V15} with pull-up resistors. They stay at V_{V15} 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”.

Screw Terminals

The 2SILT1200T2A0C-33 can be mounted within the system using screws at locations S1 to S4.

Short-Circuit Detection

In case of a detected short-circuit of the driven power module the monitored semiconductor is switched off immediately and a fault signal is transmitted to the status output SOx after a delay t_{SOx}.

The fault feedback is automatically reset after the blocking time t_{BLK}. The semiconductor is turned-on again as soon as the next turn-on command signal is applied to the respective inputs after the fault status has disappeared.

NTC Temperature Measurement

Each MAG senses the NTC temperature of the attached power module. This signal is forwarded to the IMC and can be accessed at TPM on X3 interface connector. If more than one MAG is used, only the signal of the highest NTC temperature is considered. The temperature signal at terminal TPM is pulse-width modulated with a fixed carrier frequency f_{TPM}. To eliminate unintended noise, a filter is implemented in the read-out circuitry. The resulting filter time is given with t_{TPM}. Additionally, a transmission delay of $t_{TPM,dly}$ applies from NTC temperature measurement to TPM.

Note: The NTC temperature does not represent the junction temperature of any of the semiconductor dies within the power module. Instead, it is a good indication of the baseplate temperature of the power module.

Mounting Instruction

The IMC can be mounted at a suitable location within the target application using four M3 screw holes S1 to S4. It is recommended to place the IMC out of any hot-spot area (e.g. heat sinks). Cable length between IMC and MAG of up to 0.5 m allows a high level of design freedom. Alternatively, the IMC and MAG can be also mounted in a piggyback.

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

SCALE-iFlex LT with NTC 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. 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 Micro-MaTch from TE Connectivity e.g. 75mm Micro-Match MOW-MOW.

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 2SILT1200T2A0C-33 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.

Absolute Maximum Ratings

Parameter	Symbol	Conditions T_A = -40 °C to 85 °C	Min	Max	Units
Absolute Maximum Ratings[1]					
Primary-Side Supply Voltage	V_{VCC}	Either VCC or V15 must be connected	0	26	V
	V_{V15}		0	16	
Primary-Side Supply Current	I_{VCC}	Average supply current at full load		TBD	mA
Logic Input Voltage (Command Signal)	V_{INx}	INx to GND	0	V_{V15} + 0.5	V
Logic Output Voltage (Status Signal)	V_{SOx}	SOx to GND	0	V_{V15} + 0.5	V
Temperature Output Voltage (NTC Measurement)	V_{TPM}	TPM to GND		V_{V15} + 0.5	V
Status Output Current[2]	I_{SOx}	SOx to GND, fault condition, total current	0	20	mA
Temperature Output Current	I_{TMP}	TPM to GND, total current	0	100	mA
Output Power Per Channel[3]	P_{Gx}			5.5	W
Switching Frequency	f_{SW}			25	kHz
Operating Voltage Primary-Side to Secondary-Side	V_{OP}	Transient only		3300	V
		Limited to 60 s		2500	
		Permanently applied		2200	
Test Voltage Primary-Side to Secondary-Side	$V_{ISO(PS)}$	50 Hz, 60 s		9100	V
Test Voltage Secondary-Side to Secondary-Side[4]	$V_{ISO(SS)}$	50 Hz, 60 s		6700	V
Common-Mode Transient Immunity	|dv/dt|			50	kV/μs
Storage Temperature[5]	T_{ST}		-40	50	°C
Operating Ambient Temperature	T_A		-40	85	°C
Surface Temperature[6]	T			125	°C
Relative Humidity	H_R	No condensation		95	%
Altitude of Operation[7]	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_{VCC}	VCC to GND	22.8	24	25.2	V
	V_{V15}	V15 to GND	14.5	15	15.5	

Characteristics

Parameter	Symbol	Conditions V_{VCC} = 24 V, T_A = 25 °C	Conditions (sub)	Min	Typ	Max	Units
Power Supply							
Supply Current	I_{VCC}	2SILT1200T2A0C-33 with 1 MAG, without load			80		mA
		2SILT1200T2A0C-33 with 1 MAG, f_{SW} = 3 kHz, P_{Gx} = 1 W (Gate power per channel), 50% duty cycle			186		
		2SILT1200T2A0C-33 with 4 MAGs, without load			140		
		2SILT1200T2A0C-33 with 4 MAG, f_{SW} = 3 kHz, P_{Gx} = 4 W (Gate power per channel), 50% duty cycle			561		
Power Supply Monitoring Threshold (Primary-Side)	$UVLO_{V15}$	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)[8]	$UVLO_{VISOx}$	Referenced to respective terminal E1 or E2	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}	2SILT1200T2A0C-33 with 4 MAG, without load			25.1		V
		2SILT1200T2A0C-33 with 4 MAG, f_{SW} = 3 kHz, P_{Gx} = 4 W (Gate power per channel), 50% duty cycle			24.4		
Coupling Capacitance	C_{IO}	Primary-side to secondary-side, channel 1 (low-side)			14		pF
		Primary-side to secondary-side, channel 2 (high-side)			18		
Logic Inputs and Status Outputs							
Input Impedance	R_{INx}	INx to GND			7.8		kΩ
Turn-On Threshold	$V_{TH-ON(INx)}$	INx to GND			TBD		V
Turn-Off Threshold	$V_{TH-OFF(INx)}$	INx to GND			TBD		V
SOx Pull-Up Resistor to V_{V15}[9]	R_{SOx}				10		kΩ
TPM Measurements							
TPM Carrier Frequency	f_{TPM}				1		Hz
TPM Measurement Tolerance		At 25 °C excluding NTC tolerance			3.5		K
Transmission Characterisitcs		2.5 % ≤ DUT_{TPM} ≤ 97.5%		TBD			

Characteristics (cont.)

Parameter	Symbol	Conditions V_{VCC} = 24 V, T_A = 25 °C	Min	Typ	Max	Units
Timing Characteristics						
Turn-On Delay	$t_{P(LH)}$	50% INx to 10% VGE		700		ns
Turn-Off Delay	$t_{P(HL)}$	50% INx to 90% VGE		650		ns
Turn-On Pulse Suppression	$t_{PULSE(ON)(Inx)}$	INx to GND		TBD		ns
	$t_{PULSE(OFF)(Inx)}$	INx to GND		TBD		
Transmission Delay of Fault State	t_{SOX}	From IMC error detection to SOx		6		us
Blocking Time	t_{BLK}	After secondary-side fault detection		20		ms
Electrical Isolation						
Test Voltage[10]	$V_{ISO(PS)}$	Primary-side to secondary-side	9100			V_{RMS}
	$V_{ISO(SS)}$	Secondary-side to secondary-side	6700			V_{RMS}
Partial Discharge Extinction Voltage[11]	$P_{D(PS)}$	Primary-side to secondary-side	4125			V_{PK}
	$P_{D(SS)}$	Secondary-side to secondary-side	3670			V_{PK}
Creepage Distance	CPG_{P-S}	Primary-side to secondary-side	44			mm
	CPG_{S-S}	Secondary-side to secondary-side	22			mm
Clearance Distance	CLR_{P-S}	Primary-side to secondary-side	16			mm
	CLR_{S-S}	Secondary-side to secondary-side	8.7			mm
Mounting						
Mounting Holes	D_{HOLE}	Diameter of screw hole S1 – S4		3.2		mm
Mounting Torque	M	Screw M3		TBD		
Bending	I_{BEND}	According to IPC			0.75	%

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. This value applies to the transformer. The test voltage cannot be applied to the product itself due to the active clamping and desaturation protection circuits.
5. 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.
6. 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.
7. Operation above this level requires a voltage derating to ensure long-term reliability of the product.
8. These values refer to the driver’s internal emitter reference which is not connected to the external emitter/source for driver versions where the positive rail is controlled to 15 V.
9. A pull-up resistor connects SOx to V15 on the driver board.
10. The transformer of every production sample has undergone 100% testing at the given value for 1s.
11. Partial discharge measurement is performed on each transformer.

Product Dimensions

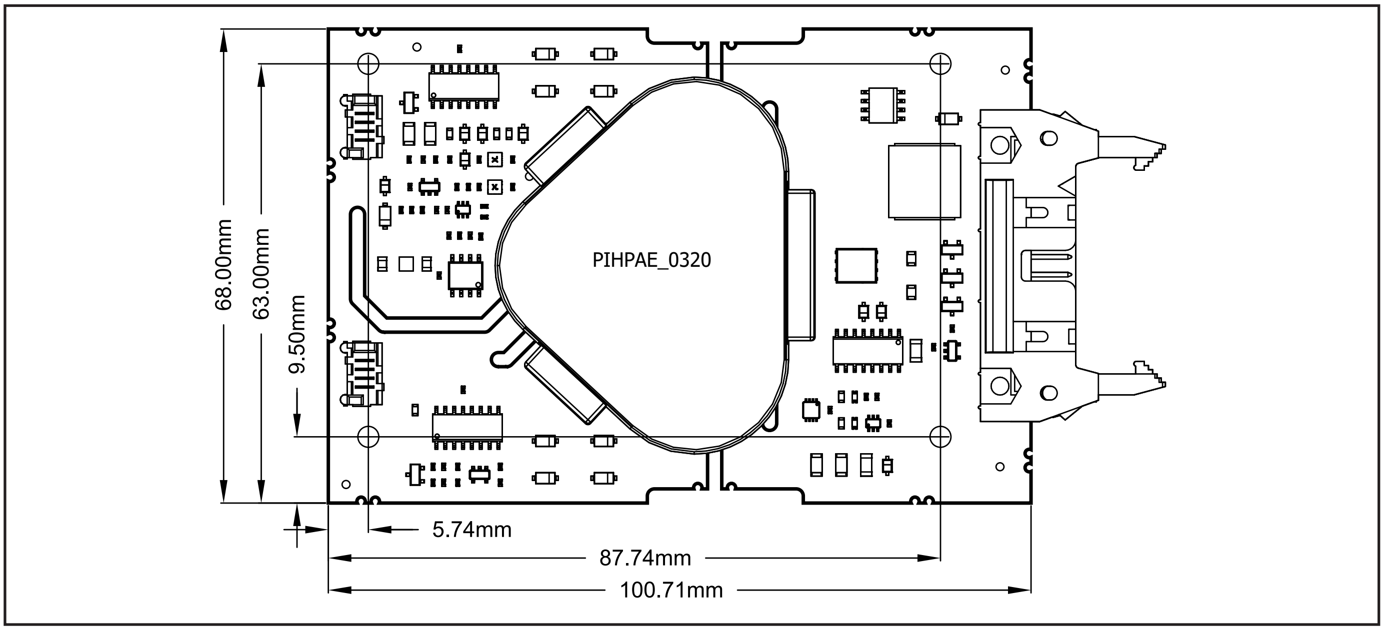

Figure 4. Top View

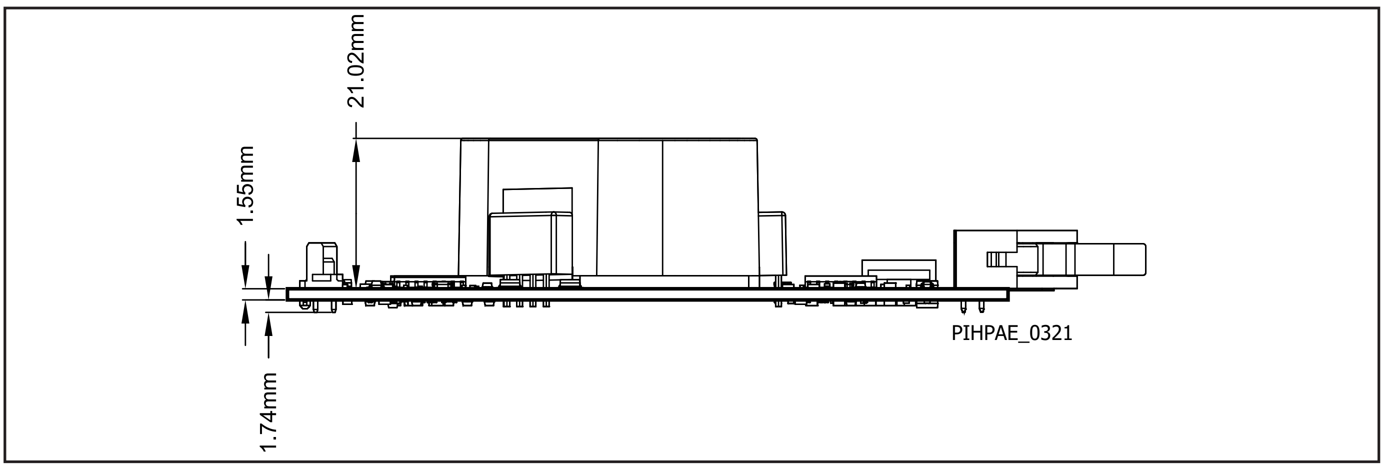

Figure 5. Side View.

Product Details

Part Number	Voltage Class	Coating
2SILT1200T2A0C-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.

Revision	Notes	Date
A	Preliminary Datasheet.	05/23

For the latest updates, visit our website: www.power.com

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