

# 2SIS0400T2C0C-33

## SCALE-iFlex Single Family

Isolated Master Control Gate Driver for Half-Bridge  
Power Modules in high voltage package up to 3300 V

# PRELIMINARY

### Product Highlights

#### Highly Integrated, Compact Footprint

- Ready-to-use gate driver solution for power modules up to 3300 V blocking voltage
- Electrical interface
- Optimized for use with Module Adapted Gate Driver 2SMS0220D2C0C
- -40 °C to +85 °C operating ambient temperature

#### Protection / Safety Features

- Undervoltage lock-out (UVLO)
- Supporting Short-Circuit-Dection and Advanced Active Clamping of the Module Adapted Gate Driver
- Applied double sided conformal coating

#### Full Safety and Regulatory Compliance

- 100% production partial discharge and HIPOT test of transformer
- Clearance and creepage distances between primary and secondary sides meet requirements for reinforced isolation according to IEC 61800-5-1.

### Green Package

- RoHS compliant

### Applications

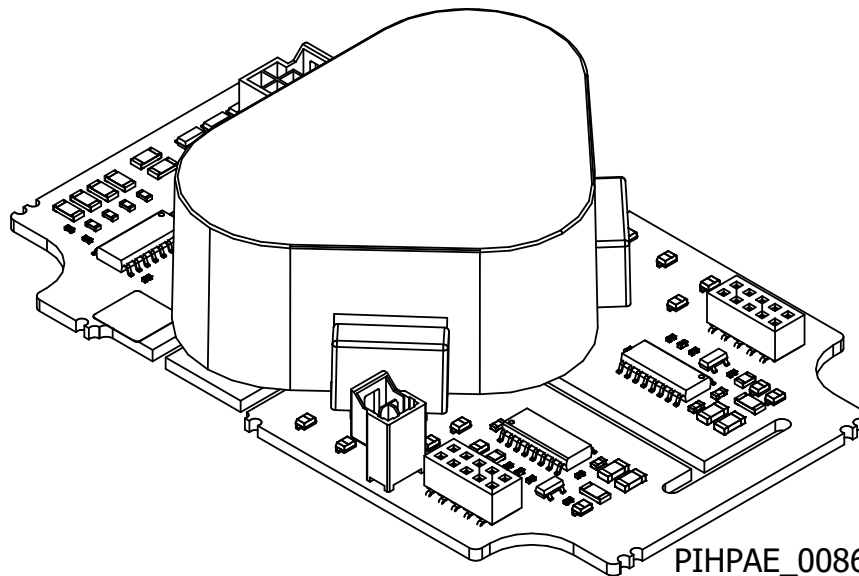
- Wind and photovoltaic power
- Traction inverter
- Industrial drives
- Other industrial applications

### Description

This datasheet describes the Isolated Master Control (IMC) of the SCALE-iFlex™ Single gate driver family which consists furthermore of a Module Adapted Gate Driver (MAG).

The IMC is designed for operation of power modules with a blocking voltage of up to 3300 V, whereas the MAGs are available in various variants optimized for different power modules of different suppliers and chip technologies in the voltage classes up to 3300 V.

SCALE-iFlex Single enables compact and easy controlling power modules providing high flexibility and system scalability with minimum development effort.



PIHPAE\_0086

Figure 1. 3D-Picture.

## Pin Functional Description

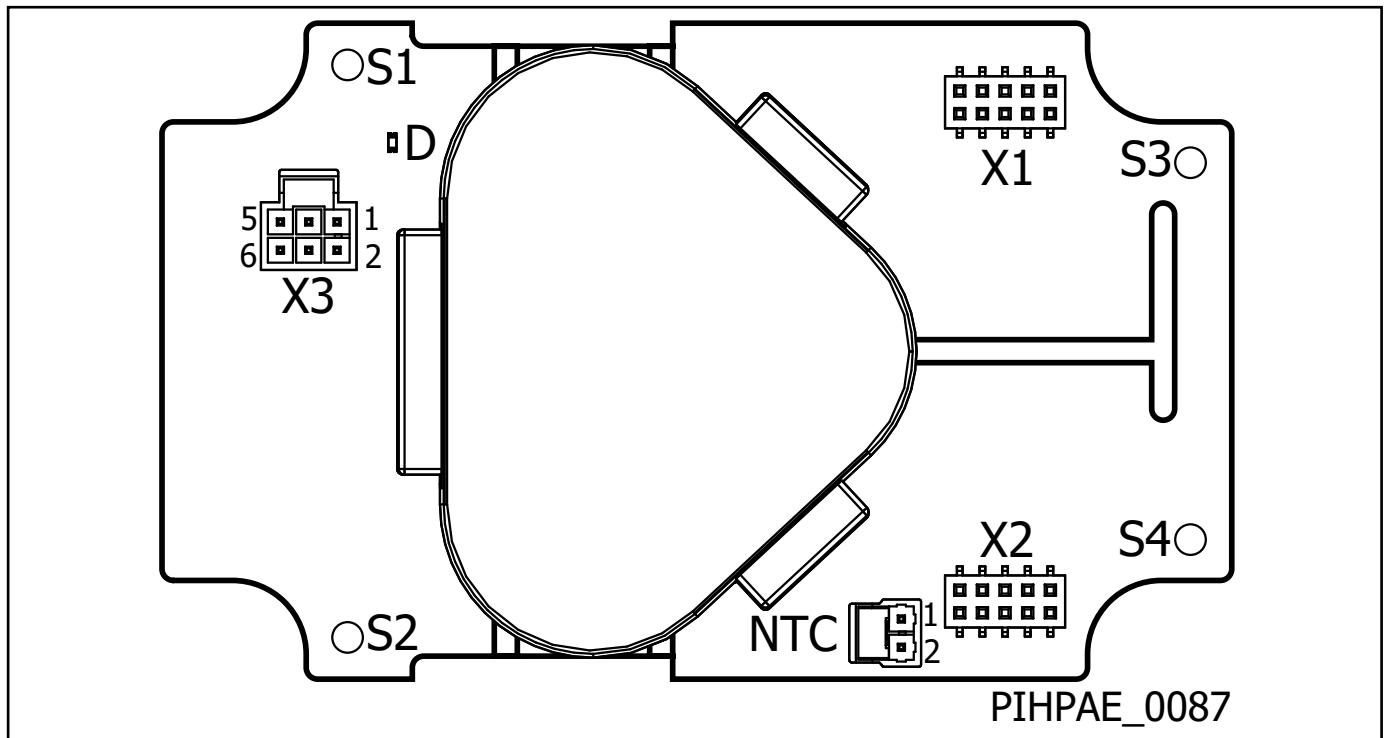


Figure 2. Pin Configuration.

### Connector X3

Connector from IMC to external system controller.

#### GND (Pin 1)

This pin is the connection for the primary-side ground potential.

#### VCC (Pin 2)

This pin is the primary-side supply voltage connection and it has to be used for supplying the SCALE-iFlex Single gate driver.

#### IN1 (Pin 6)

This pin is the command input for channel 1 (high-side switch).

#### IN2 (Pin 4)

This pin is the command input for channel 2 (low-side switch).

#### SO1 (Pin 5)

This pin is the status output for channel 1 (high-side switch).

#### SO2 (Pin 3)

This pin is the status output for channel 2 (low-side switch).

#### D

Optical indicator for monitoring the voltage  $V_{VCC}$ . During absence of  $V_{VCC}$  the indicator is OFF.

### Connection To MAG

#### Connector X1

Pin-header connector to MAG for gate driver channel 1 (high-side switch).

#### Connector X2

Pin-header connector to MAG for gate driver channel 2 (low-side switch).

#### NTC Connector

Connector to module-internal NTC (directly routed to MAG).

#### Terminals Sx (x = 1 ... 4)

Dome positions for mechanical fixation of the IMC to the housing.

## Functional Description

The SCALE-iFlex Single is a dual channel gate driver, which consists of two parts:

- Isolated Master Control (IMC)
- Module Adapted Gate Driver (MAG)

The IMC is independent of the actual target power module voltage class. It provides reinforced isolation of the power supply up to a voltage class of 3300 V.

In contrast, the MAGs are particularly designed to operate specific power modules. Their characteristics match the requirements of the individual power modules.

The interconnection between the external system controller to the IMC is established with a cables connected to X3.

The SCALE-iFlex Single gate driver provides highest flexibility and is able to operate a single power module depending on actual application conditions.

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

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 secondary failure the attached MAG and/or IMC.

### Connector Terminals (X1 and X2)

The IMC has one connector terminal per channel.

The IMC needs to be connected to the secondary-side of the MAG.

IMC and MAG have to be mounted in a piggyback like depicted in Figure 3, i.e. direct connection to the pin-header, the channel assignment is mechanically determined. Channel 1 from the IMC shall be connected to channel 1 of the MAG (X1). Accordingly, channel 2 of the IMC with channel 2 of the MAG (X2).

### Screw Terminals (Sx)

The IMC is mechanically connected to the housing and fixed by screws.

### Power Supplies

The 2SIS0400T2C0C provides a power supply input. Here a typical supply voltage level of 15 V is required. The input VCC supplies the primary-side electronic of the gate driver and the integrated DC/DC converter, which generates the isolated voltage for the secondary-side gate driver channels. The positive rail of the gate driver channels has the voltage level  $V_{VISOx}$  and the negative rail the voltage level  $V_{COMx}$ . Both are referenced to the emitter potential at terminal E1 or E2 of the driven power semiconductor.

### 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 SOx of the gate driver. If the UVLO is present on the primary-side supply  $V_{VCCx}$ , both status output signals will be set to GND and both gate driver channels will be turned-off synchronously. In case of an UVLO on the secondary-side, the status signal of the respective channel will be set to GND and the corresponding power semiconductor will be turned-off.

### Inputs (X3)

The input logic of IN1 and IN2 is designed to work with 15 V logic levels to provide 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 corresponding gate with a propagation delay of  $t_{P(LH)}$  for the turn-on and  $t_{P(HL)}$  for the turn-off commands.

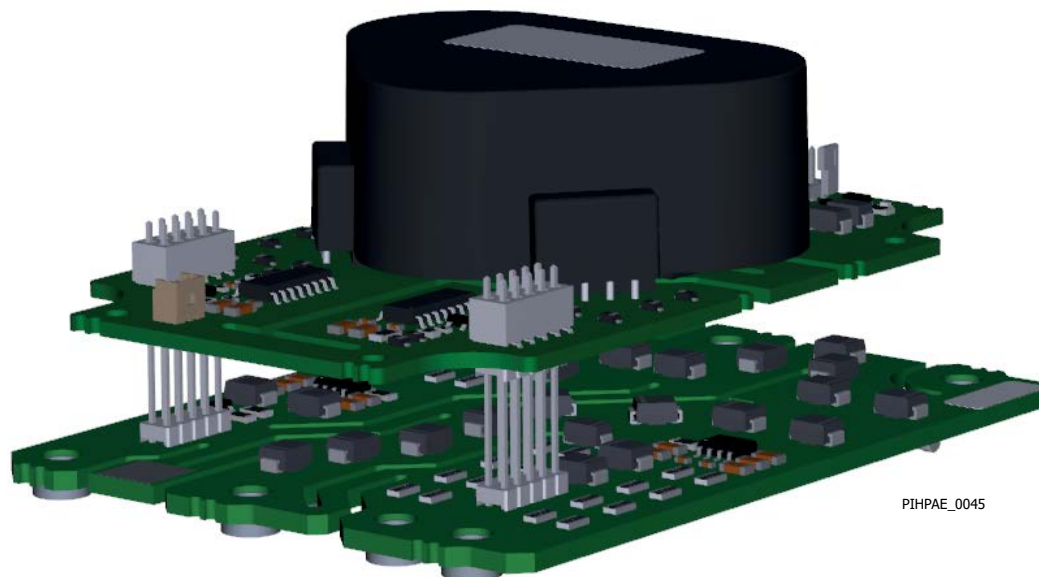


Figure 3. Assembly (Actual product may differ from illustration.).

**Outputs (X3)**

The gate driver provides status feedbacks SO1 and SO2. The status feedback signal stays at  $V_{VCC}$  under no-fault condition. 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, the status feedback is set to GND potential for a duration of  $t_{blk}$ . In 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.

**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 on signal is applied to the respective inputs after the fault status has disappeared.

It should be noted that the response time  $t_{res}$  is dependent on the DC-link voltage. It remains constant over a wide range of the higher DC-link voltage range and increases at lower DC-link voltages.

**Conformal Coating**

The electronic components of the gate driver 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.

## Maximum Ratings

Parameter	Symbol	Conditions $T_A = -40\text{ }^{\circ}\text{C to }85\text{ }^{\circ}\text{C}$	Min	Max	Units
<b>Absolute Maximum Ratings<sup>1</sup> - 2SIS0400T2C0C-33</b>					
Primary-Side Supply Voltage	$V_{VCC}$	VCC to GND	0	16	V
Primary-Side Supply Current	$I_{VCC}$			660	mA
Logic Input Voltage	$V_{INx}$	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
Gate Output Power Per Channel	$P_{Gx,max}$	See Note 4		3	W
DC-Link Voltage	$V_{DC-Link}$	Switching operation		2500V for 60s or 2200V continuously	$V_{DC}$
Operating Voltage Primary-Side to Secondary-Side	$V_{op}$	Transient only		3300	$V_{pk}$
Switching Frequency	$f_{SW,max}$			25	kHz
Common-Mode-Transient Immunity	$ dv/dt $			50	kV/ $\mu$ s
Storage Temperature <sup>2</sup>	$T_{st}$		-40	50	$^{\circ}\text{C}$
Operating Ambient Temperature	$T_A$		-40	85	$^{\circ}\text{C}$
Surface Temperature <sup>3</sup>	$T_{surf}$			125	$^{\circ}\text{C}$
Relative Humidity	$H_r$	No condensation		93	%
Altitude of Operation	$A_{op}$	Operation above this level requires a voltage derating to ensure proper isolation coordination.		2000	m

## Recommended Operating Conditions

Parameter	Symbol	Conditions $T_A = -40\text{ }^{\circ}\text{C to }85\text{ }^{\circ}\text{C}$	Min	Typ	Max	Units
<b>Power Supply</b>						
Primary-Side Supply Voltage	$V_{VCC}$	VCC to GND	14.5	15	15.5	V

## Electrical Characteristics - 2SIS0400T2C0C-33

Parameter	Symbol	Conditions T <sub>A</sub> = +25 °C		Min	Typ	Max	Units
Electrical Characteristics							
Supply Current	I <sub>VCC</sub>	V <sub>VCC</sub> = 15 V, MAG connected, without load V <sub>VCC</sub> = 15 V, MAG connected, 100 nF load per channel, f <sub>SW</sub> = 25 kHz, 50 % duty cycle			89		mA
					364		
Turn-On Threshold	V <sub>IH</sub>				10.4		V
Turn-Off Threshold	V <sub>IL</sub>				4.9		V
Input Impedance	R <sub>INx</sub>				4.5		kΩ
Status Output Voltage	V <sub>SOx</sub>	SOx to GND , I <sub>SOx</sub> < 0.5 mA, no-fault condition, internal 4.7 kΩ pull-up resistor is connected to VCC		11			V
Power Supply Monitoring Threshold (Primary-Side)	UVLO <sub>VCC</sub>	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 <sub>VISOx</sub>	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 <sub>COMx</sub>		Clear fault (resume operation)		-5.15		V
			Set fault (suspend operation)		-4.85		
			Hysteresis		0.3		
Output Voltage (Secondary-Side)	V <sub>VISOx</sub>	V <sub>VCC</sub> = 15 V, Referenced to V <sub>COMx</sub> , without load			24.5		V
		V <sub>VCC</sub> = 15 V, Referenced to VEx, fsw = 25 kHz, PGx = 1.5 W, 50% duty cycle			24.1		
Coupling Capacitance	C <sub>io</sub>	Primary-side to secondary-side, total per channel			19		pF
Turn-on Delay	t <sub>P(LH)</sub>	V <sub>th-on</sub> ,INx to 50% of V <sub>GE(on)</sub> , no-load attached			89		ns
Turn-off Delay	t <sub>P(HL)</sub>	V <sub>th-off</sub> ,INx to 50% of V <sub>GE(off)</sub> , no-load attached			77		ns
Transmission Delay of Fault State	t <sub>SOX</sub>				400		ns
Blocking Time	t <sub>blk</sub>	Delay to clear fault state			22		ms

Parameter	Symbol	Conditions T <sub>A</sub> = +25 °C	Min	Typ	Max	Units
Electrical Characteristics - 2SIS0400T2C0C-33						
Test Voltage	V <sub>iso,PS</sub>	Primary-side to secondary-side, 50 Hz, 60 s	9100			V <sub>RMS</sub>
	V <sub>iso,SS</sub>	Secondary-side to secondary-side, 50 Hz, 60 s	6700			
Partial Discharge Extinction Voltage	V <sub>PD,PS</sub>	Primary-side to secondary-side	4125			kV <sub>pk</sub>
	V <sub>PD,SS</sub>	Secondary-side to secondary-side	3677			
Creepage Distance (on PCB)	CPG <sub>PS</sub>	Primary-side to secondary-side	44			mm
	CPG <sub>SS</sub>	Secondary-side to secondary-side	22			
Clearance Distance	CLR <sub>PS</sub>	Primary-side to secondary-side	22			mm
	CLR <sub>SS</sub>	Secondary-side to secondary-side	8			
Mechanical Characteristics						
Mounting Holes	d <sub>hole</sub>	Diameter of screw holes		3		mm
Screw Header/Washer diameter	d <sub>M3</sub>	Terminals Sx			8.0	mm
Bending	l <sub>bend</sub>	According to IPC			0.75	%

## NOTES:

1. Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device.
2. 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 65 °C.
3. The component surface temperature, which may strongly vary depending on the actual operating conditions, must be limited to the given value for coated gate driver versions to ensure long-term reliability of the coating material.
4. Actually achievable maximum power depends on several parameters and has to be validated in the final system. It is mainly limited by the maximum allowed surface temperature.

## Product Dimensions

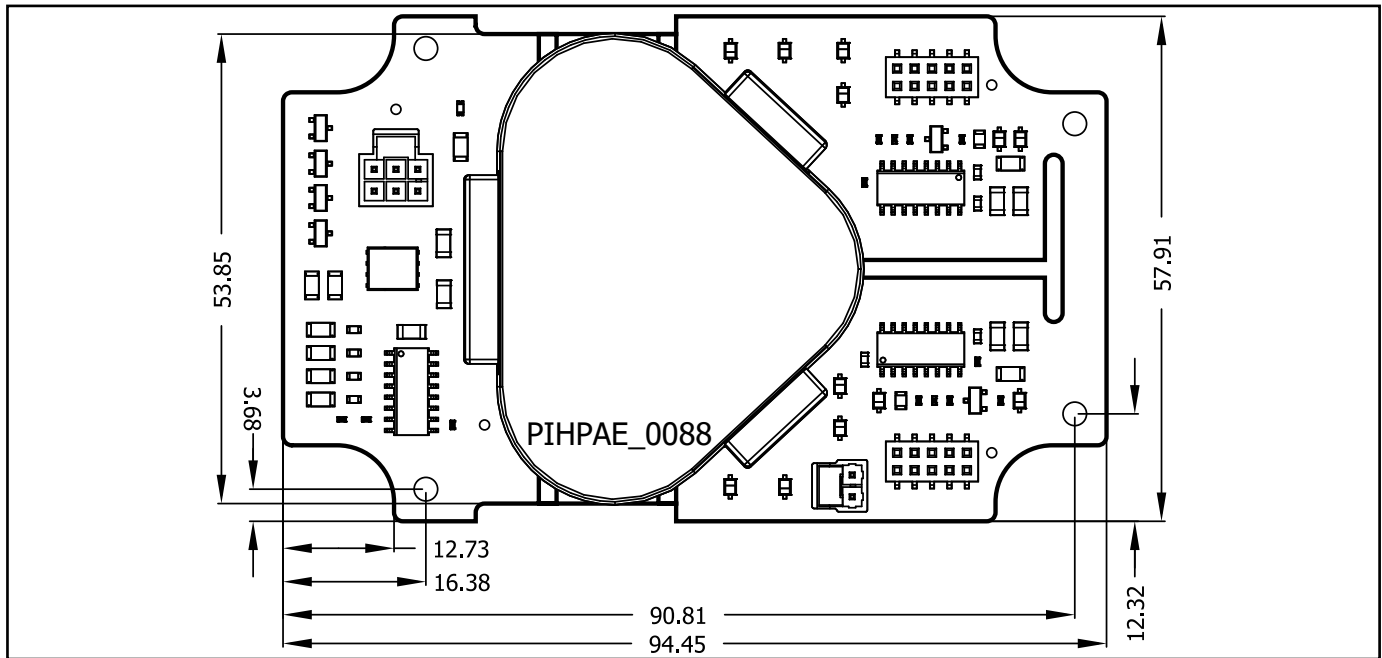


Figure 4. Top View.

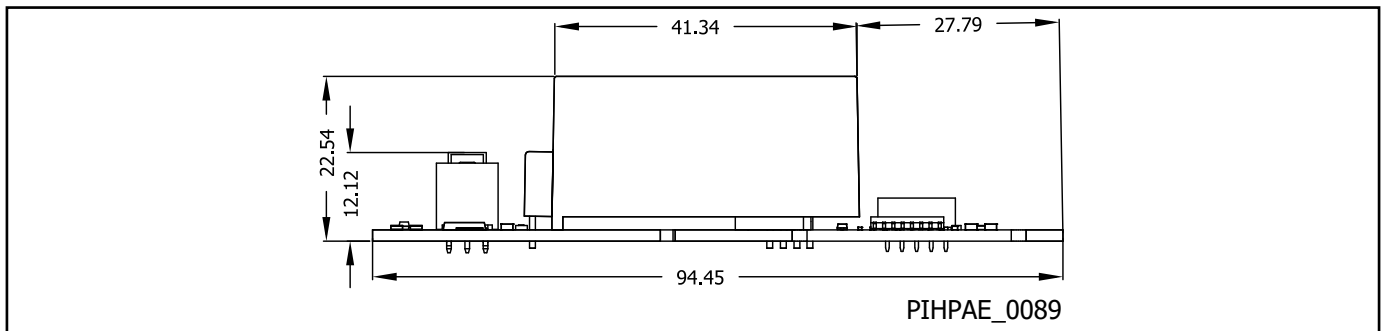


Figure 5. Side View.

## Product Details

Part Number	Power Module	Voltage Class	Current Class	Package	Power Device Supplier
2SIS0400T2C0C-33	N.A.	3300 V	N.A.	XHP2, LV100	N.A.

## 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.



## Notes

Revision	Notes	Date
A	Preliminary.	09/21

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