2SIS0400T2C0C-33
SCALE-iFlex Single Family

Advanced Information

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.

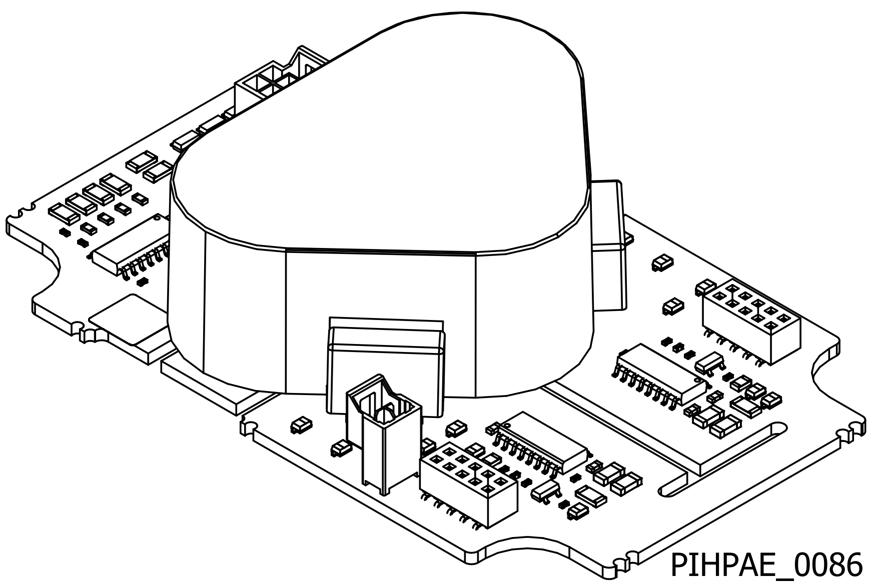

Figure 1. 3D-Picture.

Pin Functional Description

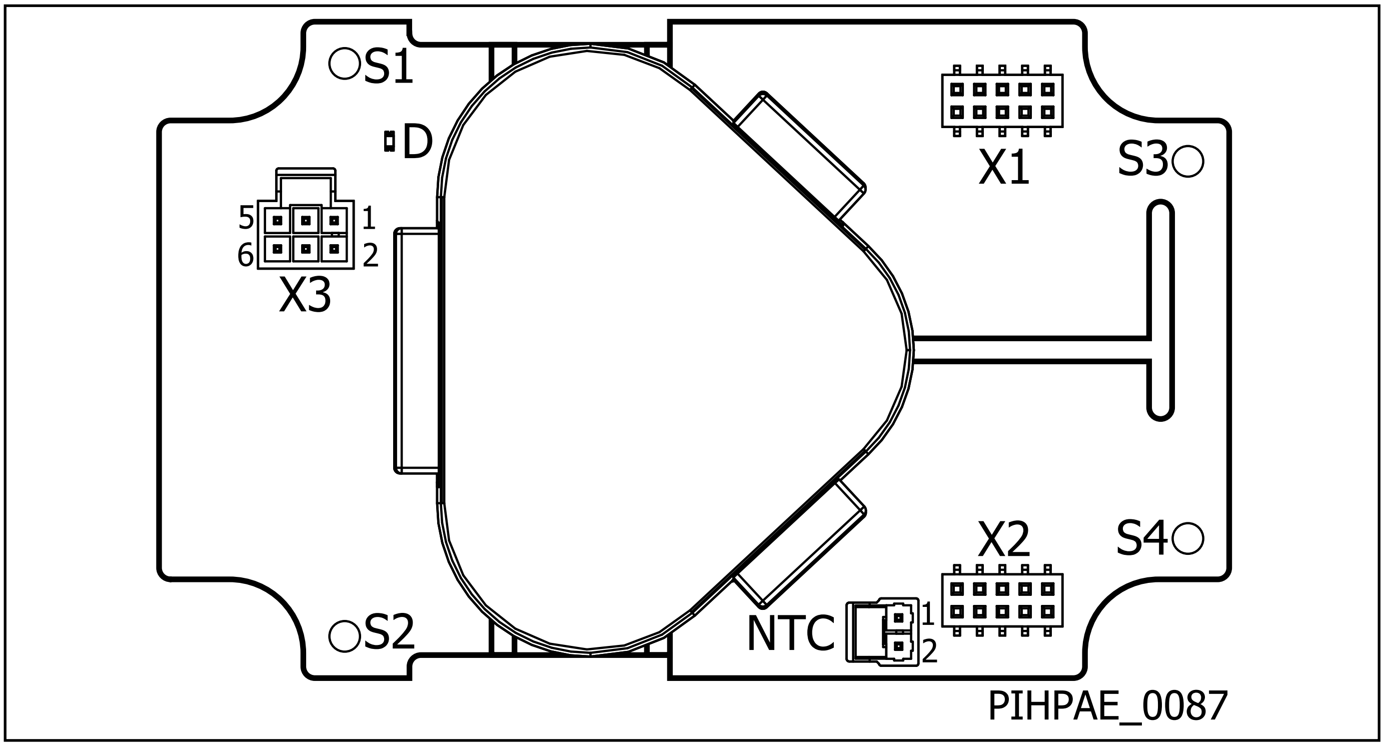

Figure 2. Pin Configuration.

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_{VCC}, 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.

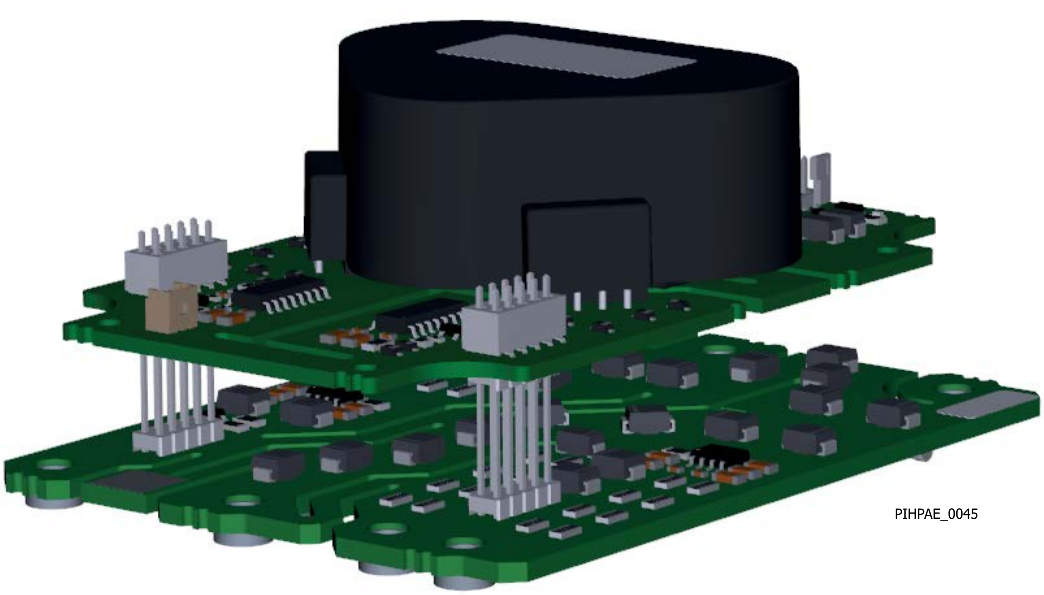

Figure 3. Assembly (Actual product may differ from illustration.).

PRELIMINARY
This document contains information on a new product. Specifications and information herein are subject to change without notice.

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 °C to 85 °C	Min	Max	Units
Absolute Maximum Ratings[1] - 2SIS0400T2C0C-33					
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	$V_{DC\text{-}Link}$	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/µs
Storage Temperature[2]	T_{st}		-40	50	°C
Operating Ambient Temperature	T_A		-40	85	°C
Surface Temperature[3]	T_{surf}			125	°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 °C to 85 °C	Min	Typ	Max	Units
Power Supply						
Primary-Side Supply Voltage	V_{VCC}	VCC to GND	14.5	15	15.5	V

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Electrical Characteristics - 2SIS0400T2C0C-33

Parameter	Symbol	Conditions T_A = +25 °C		Min	Typ	Max	Units
Electrical Characteristics							
Supply Current	I_{VCC}	V_{VCC} = 15 V, MAG connected, without load			89		mA
		V_{VCC} = 15 V, MAG connected, 100 nF load per channel, f_{SW} = 25 kHz, 50 % duty cycle			364		mA
Turn-On Threshold	V_{IH}				10.4		V
Turn-Off Threshold	V_{IL}				4.9		V
Input Impedance	R_{INx}				4.5		kΩ
Status Output Voltage	V_{SOx}	SOx to GND , I_{SOX} < 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)	$UVLO_{VCC}$	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	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}	V_{VCC} = 15 V, Referenced to V_{COMx}, without load			24.5		V
		V_{VCC} = 15 V, Referenced to VEx, fsw = 25 kHz, PGx = 1.5 W, 50% duty cycle			24.1		
Coupling Capacitance	C_{io}	Primary-side to secondary-side, total per channel			19		pF
Turn-on Delay	$t_{P(LH)}$	V_{th-on},INx to 50% of $V_{GE(on)}$, no-load attached			89		ns
Turn-off Delay	$t_{P(HL)}$	V_{th-off},INx to 50% of $V_{GE(off)}$, no-load attached			77		ns
Transmission Delay of Fault State	t_{SOX}				400		ns
Blocking Time	t_{blk}	Delay to clear fault state			22		ms

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Parameter	Symbol	Conditions T_A = +25 °C	Min	Typ	Max	Units
Electrical Characteristics - 2SIS0400T2C0C-33						
Test Voltage	$V_{iso,PS}$	Primary-side to secondary-side, 50 Hz, 60 s	9100			V_{RMS}
	$V_{iso,SS}$	Secondary-side to secondary-side, 50 Hz, 60 s	6700			
Partial Discharge Extinction Voltage	$V_{PD,PS}$	Primary-side to secondary-side	4125			kV_{pk}
	$V_{PD,SS}$	Secondary-side to secondary-side	3677			
Creepage Distance (on PCB)	CPG_{PS}	Primary-side to secondary-side	44			mm
	CPG_{SS}	Secondary-side to secondary-side	22			
Clearance Distance	CLR_{PS}	Primary-side to secondary-side	22			mm
	CLR_{SS}	Secondary-side to secondary-side	8			
Mechanical Characteristics						
Mounting Holes	d_{hole}	Diameter of screw holes		3		mm
Screw Header/Washer diameter	d_{M3}	Terminals Sx			8.0	mm
Bending	l_{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 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

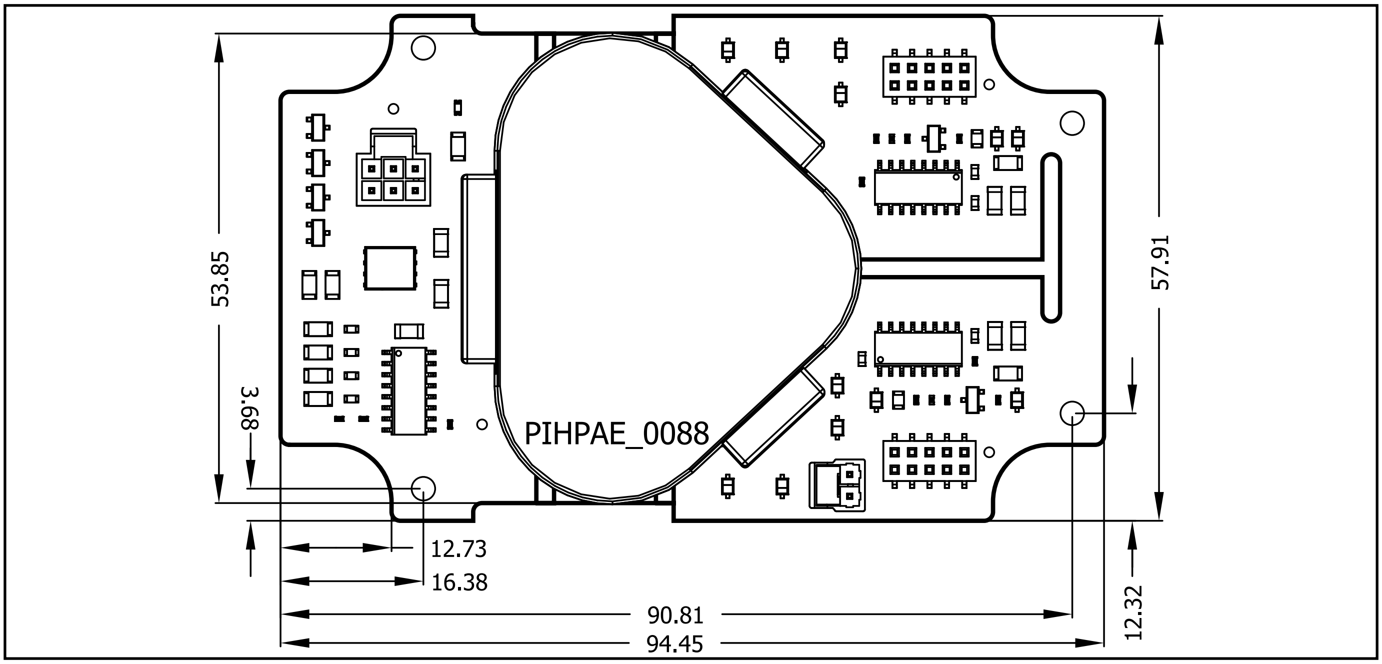

Figure 4. Top View.

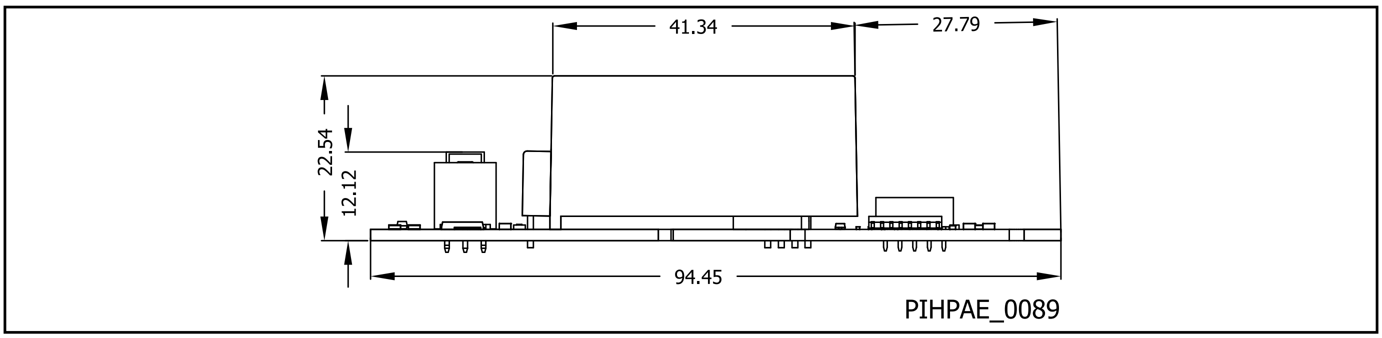

Figure 5. Side View.

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

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

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