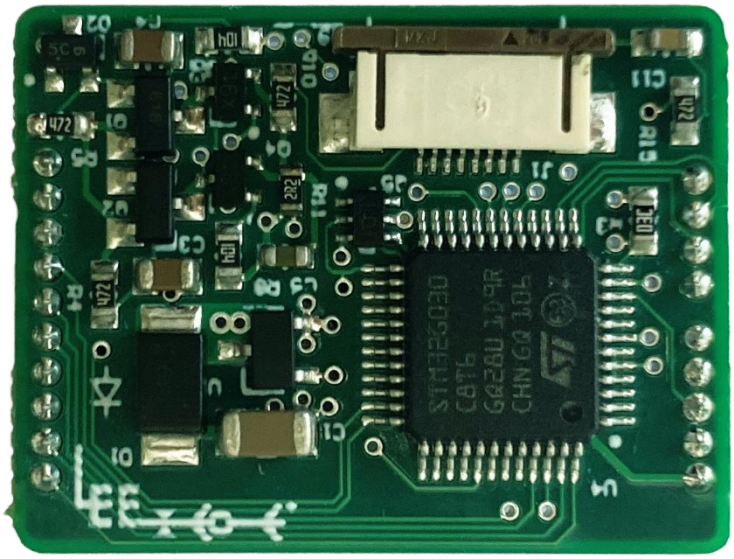
DISC PUMP DRIVE PCB (UEKA0300000A):

USER MANUAL



THE LEE COMPANY

www.theleeco.com

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1. DISCLAIMER

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2. SPECIAL NOTICES

Throughout this User Manual, special notices relating to the safe and correct operation of the General Purpose Disc Pump Drive PCB are formatted and highlighted as follows:

CAUTION

Instructions to ensure correct operation of the equipment and/or for avoiding damage to the equipment.

WARNING

Instructions relating to the safety of the operator and avoiding injury.

3. INTRODUCTION

3.1. Piezoelectric Disc Pump

The Lee Company's disc pumps are a multi-award winning technology which makes use of advances in the field of non-linear acoustics to offer the following unique features:

- silent operation
- ultra-smooth flow
- millisecond responsiveness
- compact form factor
- high-precision controllability

In contrast to conventional air pumping mechanisms (such as diaphragm and piston pumps), the disc pumps do not rely on the bulk compression of air within a cavity. Instead, the disc pump generates a high amplitude, high frequency acoustic standing wave within a specially designed acoustic cavity. The operating frequency varies part-to-part and with pump operating conditions (e.g. temperature, pressure, etc). A dedicated drive circuit is therefore required to identify and track this frequency over time.

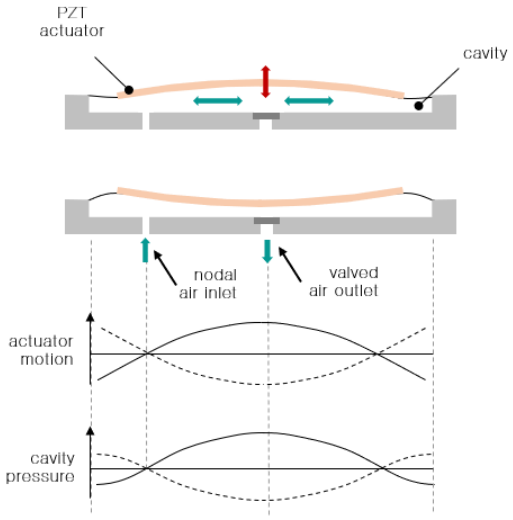


Figure 1. A schematic of the disc pump

Figure 1 shows a simplified schematic: the out-of-plane motion of the actuator drives in-plane (radial) motion of the gas in the cavity and creates a standing pressure wave, resulting in the oscillating cavity pressure shown. The motion of the actuator is highly exaggerated: there is virtually no net volume change of the cavity during operation and at any given point in time there exists both a region of compression and a region of rarefaction within the cavity.

Rectification of the alternating cavity pressure is the key to delivering useful pump performance and device lifetime. The Lee Company has addressed this need by developing a family of innovative valve designs based on lightweight polymer valve flaps.

The disc pump technology is protected by a portfolio of both patent applications and granted patents.

3.2.The General Purpose Disc Pump Drive PCB

Following initial testing with the Piezoelectric Disc Pump Evaluation Kit, customers may elect to use the General Purpose Disc Pump Drive PCB [UEKA0300000A] in their own product design. This allows customers to forgo the time and effort required to design and integrate their own Disc Pump drive circuit and firmware. The General Purpose Drive PCB handles the specific pump drive requirements and provides a variety of easy-to-use interfaces, which enable simple integration with test systems, prototype devices, and final products.

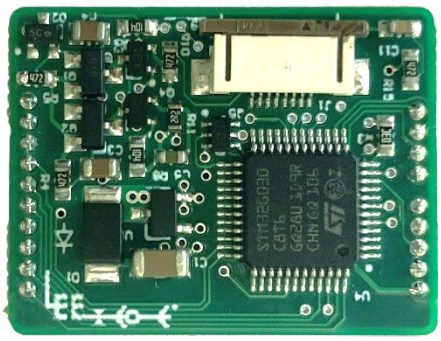


Figure 2. The General Purpose Disc Pump Drive PCB

For the most basic use case, a three-wire connection (supply voltage, ground and analog control) is all that is needed. For more sophisticated use cases, the Drive PCB can be controlled over a TTL-level serial UART link.

The Drive PCB also implements closed-loop control (e.g. of pressure, vacuum or flow). Customers can provide analog sensor input (e.g. measured pressure or flow) to any of the PCB's three analog inputs for this purpose.

The Drive PCB can act as an I2C master, allowing communication with a selection of digital sensors, although it does not support I2C control by another master device.

This manual provides information to aid the integration of the General Purpose Disc Pump Drive PCB with your system.

4. SAFETY

WARNING

The equipment described in this document is intended for use by skilled and competent personnel only. Further, the equipment is provided in a 'bare' format enabling users to integrate it into test fixtures, prototypes and product assemblies.

The user should satisfy themselves that the equipment is, and remains fit for, the intended use. The user accepts that The Lee Company shall not be held responsible or liable for any injury, damage or loss to property, person or otherwise, resulting from use of the equipment.

In order to aid assessment of the safety of the equipment, the following indicative electrical data are provided:

A.C. voltage on the PCB: 120 Vpp max. (at 20 – 22 kHz)

D.C. voltage on the PCB: 60 V max.

All disc pumps emit ultrasound in operation. The following data are provided for operation at maximum power (1.4W) at a distance of 30cm:

Sound pressure level: 70-80 dB SPL @ 30 cm typ. (at 20-22 kHz)[1]

1. Equivalent to <10 phon per ISO 226:2003 and related studies, 30 cm equivalent measurement distance

WARNING

Take care during use of the General Purpose Disc Pump Drive PCB not to create short circuits between exposed conductive parts of the PCBs. Short circuits may lead to malfunctioning and heating.

5. DRIVE PCB OVERVIEW

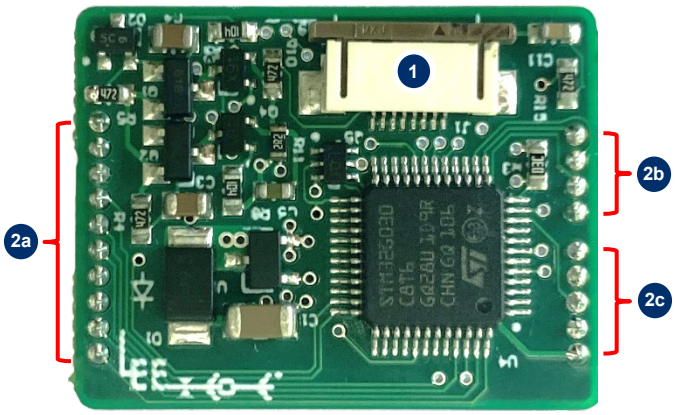


Figure 3. General Purpose Disc Pump Drive PCB interfaces

Item	Description	Details
1	Pump “Flexi Tail” Connector	The drive board is equipped with an FCC for connecting the disc pump.
2	Drive PCB Mating Connectors	The board uses three connectors for communications, sensor inputs and power. The connectors are 1.27mm pitch, single-in-line headers. 2a, 2b and 2c are 10, 4, and 5-way headers respectively for a total of 19-pin header.

Table 1. General Purpose Disc Pump Drive PCB interface details

6. INSTALLATION

6.1.Mechanical - Drive PCB dimensions

The dimensions of the General Purpose Disc Pump Drive PCB are shown below.

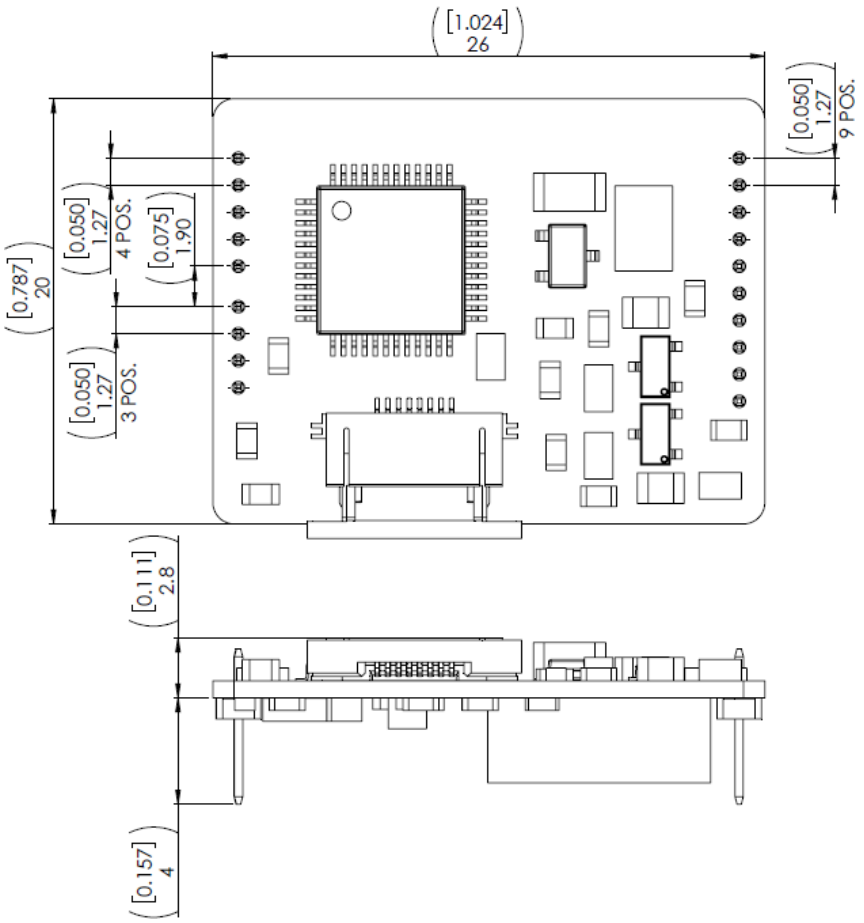


Figure 4. Drive PCB Geometry. Dimensions in mm [inches]

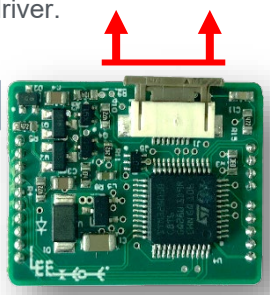
6.2.Electrical - Pump “Flexi Tail” Connector

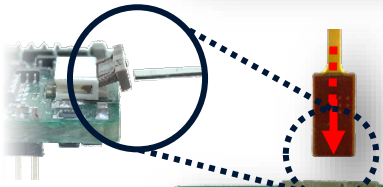
The disc pump uses an FFC (flat flex connector) compatible with most 8-way 0.5mm pitch FFC connectors. The General Purpose Disc Pump Drive PCB has such a connector, and it is important that the disc pump “Flexi Tail” is properly seated in this connector.

1.

Ensure the connector is fully open, by sliding the brown clasp of the connector horizontally out from the driver.

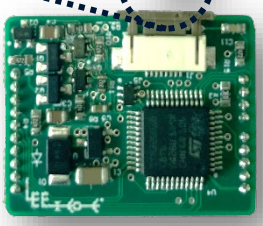
2.



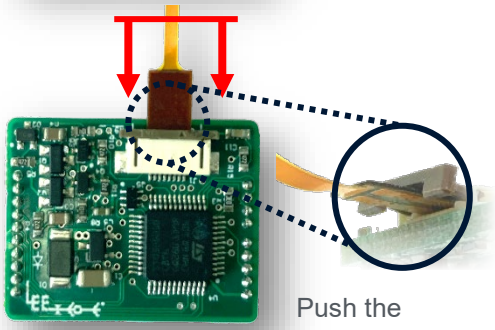


Slide the Disc Pump “Flexi Tail” into the connector housing. Initially some friction is felt, continue pushing the connector in until a hard stop is reached.

3.

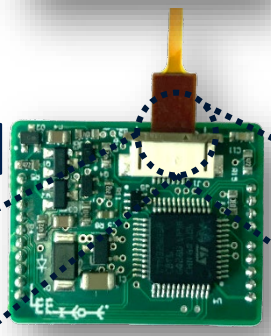


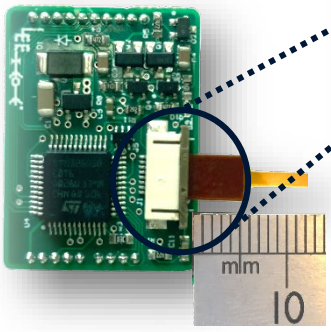
4.

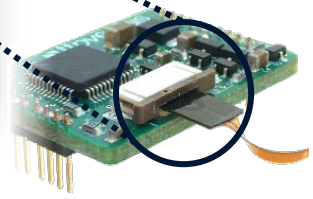


Push the connector closed, applying even pressure to each end.

5.







Visually inspect the connection, ~5mm should be exposed which would verify that the “Flexi Tail” is properly seated into the connector.

Figure 5. Connecting a pump to the Drive PCB

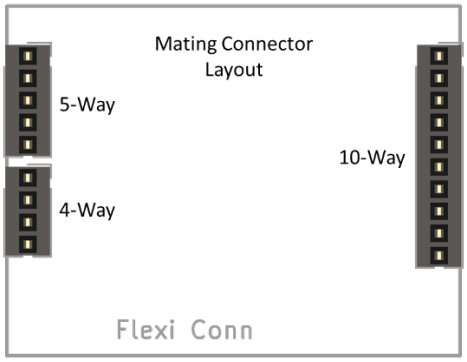
6.3.Electrical - Drive PCB Mating Connectors

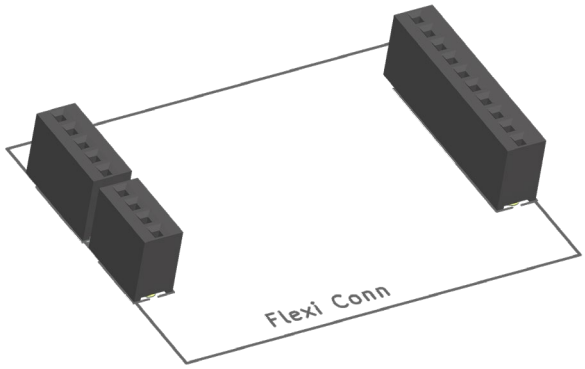
The General Purpose Disc Pump Drive PCB uses three, 1.27mm pitch, single-in-line, pin headers to form the 19-pin header. Specifically, 4, 5, and 10-way headers. The 4 and 5-way headers are spaced by 1.5x the normal 1.27mm spacing so that the PCB can only be mounted in a mating 19-socket connector in the correct orientation.

Matching 4, 5, and 10-way 1.27mm pitch, single-in-line sockets should be chosen to form a mating female connector for the General Purpose Disc Pump Drive PCB. Each socket should be able to accept a pin at least 3.2mm long.

No.	Harwin	Multicomp	GCT
4	M50-3030442	MC-SVT1-S04-G	BD080-04-A-0230-L-D
5	M50-3030542	MC-SVT1-S05-G	BD080-05-A-0230-L-D
10	M50-3031042	MC-SVT1-S10-G	BD080-10-A-0230-L-D

Table 2. Drive PCB pin header mating connectors





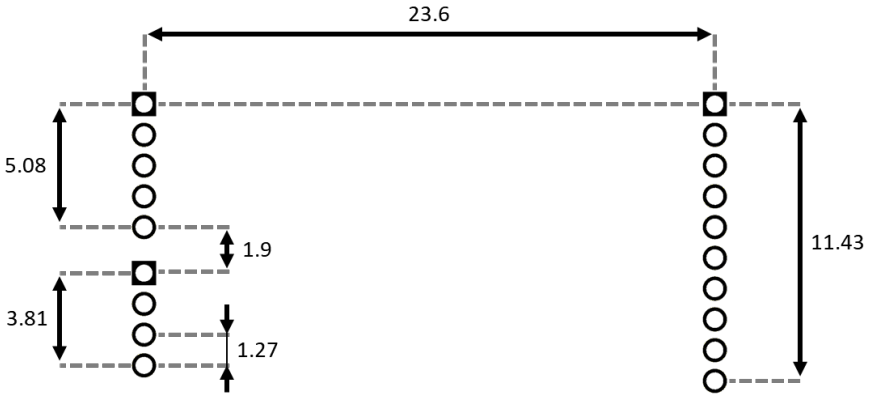
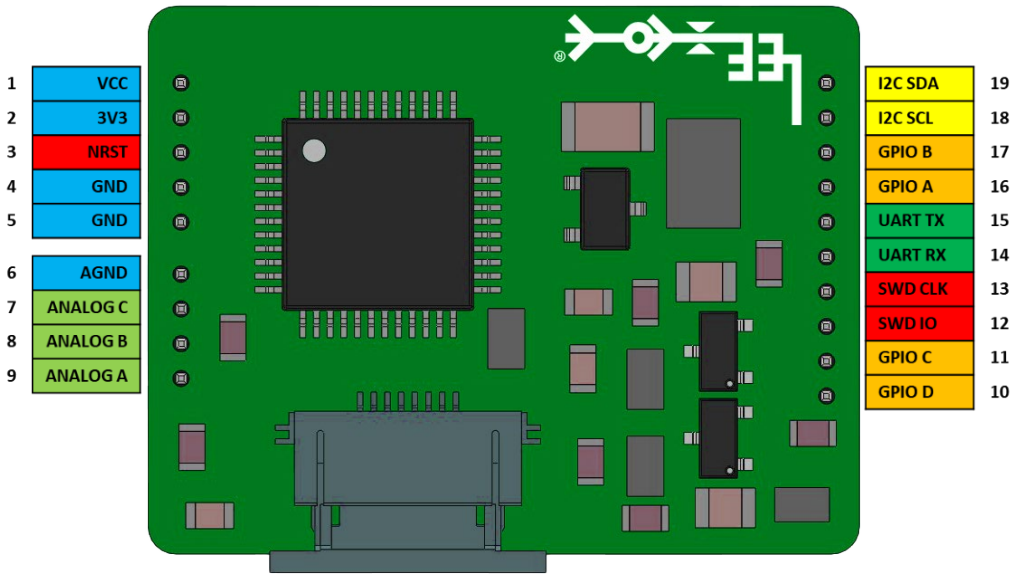


Figure 6. Drive PCB mating connections

6.4.Electrical - Drive PCB Pinout



Pin No.	Pin Name	Function	Min	Max	Unit
1	VCC	Power Supply	3.5	5.5	V
2	3V3	3V3 from the on-board voltage regulator.		50	mA
3	NSRT	Onboard microcontroller reset. Active low. Used with pins 12 & 13 to load custom firmware.	0	3.3	V
4-5	GND	Power ground.			
6	AGND	Analog ground.			
7-9	ANALOG C-A	3x high impedance analog inputs	0	3.3	V
10	GPIO D	Pump enable digital toggle signal. Has internal pull-up. *(Used for ON/OFF motherboard switch)*	0	5	V
11	GPIO C	General purpose IO. No function with the default firmware.	0	5	V
12	SWD IO	Onboard microcontroller, software debug IO	0	3.3	V
13	SWD CLK	Onboard microcontroller, software debug clock	0	3.3	V
14	UART RX	The receive connection for the serial comms.	0	5	V
15	UART TX	The transmit connection for the serial comms.	0	3.3	V
16	GPIO A	Pump enable digital toggle signal. Has internal pull-up. *(Exposed as GPIO A on motherboard)*	0	5	V
17	GPIO B	General purpose IO. No function with the default firmware.	0	5	
18	I2C SCL	I2C master clock[1]	0	5	V
19	I2C SDA	I2C master data[1]	0	5	V

Figure 7. Drive PCB Pinout

[1] Note that the PCB does not support control by another I2C master device. The I2C function enables control of peripheral devices when connected to the Evaluation Kit Motherboard PCB.

7. SYSTEM OPERATION

7.1.Preparing the system for first use

- Remove the Drive PCB from protective the ESD bag
- Optional: Use The Lee Company Evaluation Kit to configure the Drive PCB
- Seat the Drive PCB into a matching connector
- Connect the pump

7.2.System control interfaces

The system provides multiple options for controlling the pump:

- Analog control
- Digital control over UART

7.3.Analog control

Pins 7 to 9 of the General Purpose Disc Pump Drive PCB have a 0 to 3.3 V analog input. A single analog input can be configured to control pump drive power (“open-loop” control). Or multiple analog inputs can be used together, for instance, one to measure the output from a pressure sensor, and another to receive a target pressure. The Drive PCB can then be configured to perform closed loop control between the two analog inputs.

This functionality can be configured using the UART interface, refer to The Lee Company Technical Guide ‘Communications Technical Guide: Piezoelectric Disc Pumps’ for more information.

7.4.Digital control

The digital UART interface can be used to control the PCB, without any reliance on the analog inputs. Refer to The Lee Company Technical Guide ‘TG003: PCB Serial Communications Guide’ for more information.

GPIO A and B can be used to toggle the pump ON/OFF. The Drive PCB applies an internal pull-up so these pins can be left floating. Changing the state of either pin toggles the pumps ON/OFF state.

7.5.Disc Pump Control App

The Disc Pump Control App can be used to configure and control the Drive PCB while mounted to a Lee Company Evaluation Kit Motherboard PCB – for example, to set the control mode and associated parameters.

If desired, configuration settings can be saved to the Drive PCB for use on power up, enabling the Disc Pump Control App to be used as a production configuration tool prior to installing the Drive PCB in the final system.

Refer to the ‘Piezoelectric Disc Pump Evaluation Kit User Manual’ for further information on using the Drive PCB, Motherboard and Pump Control App together.

8. ACCESSORIES

The following accessories are available for the General Purpose Disc Pump Drive PCB.

8.1.UACX0500100E (Breakout PCB)

The Breakout PCB allows the General Purpose Disc Pump Drive PCB to be connected easily to two 0.1” (2.54 mm) single inline headers, suitable for integration with 0.1” prototype board, enabling rapid prototyping and testing at the start of the development process.

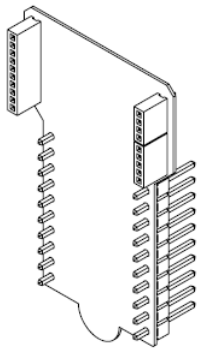


Figure 8: Breakout board

Materials: Printed circuit board FCB

9. SUPPORT

The Lee Company website (www.theleeco.com/discpumps) provides technical information, FAQs, troubleshooting and documentation for download.

For additional technical support, please contact your Lee Sales Engineer.

10.CERTIFICATE OF CONFORMITY

LEE Ventus Limited
Melbourn Science Park
Melbourn
Hertfordshire SG8 6EE
United Kingdom

THE LEE COMPANY

EC and UKCA Declaration of Conformity

CE UKCA

Products:	Piezoelectric disc pumps and related modules, drive electronics and accessories
Models:	
Piezoelectric disc pumps	UBLB5xxxxxxx (BL Series Disc Pumps) , UXPB5xxxxxxx (XP Series Disc Pumps), UHPB5xxxxxxx (HP Series Disc Pumps) , UHPB5xxxxxxx (US Series Disc Pumps)
Piezoelectric disc pump modules	UxxC5xxxxxxx (Smart Pump Modules incorporating any of the XP, BP, LT or HP Pump Series)
Drive electronics and accessories	UEKA0300000A (General Purpose Disc Pump Driver), UEKA0300050A (Evaluation Kit Motherboard), UACX0500100E (Breakout Board), UACX0500400E (SPM Communication Cable)
Serial numbers:	See label on product
Manufacturer:	LEE Ventus Ltd, Melbourn Science Park, Royston, Herts, SG8 6EE, UK
EU Authorised Representative:	The Lee Company Scandinavia AB, Stormbyvägen 2-4, 163 55 Spånga, Sweden

We hereby declare that the products above comply with all relevant provisions of the following directives:

- Restriction of Hazardous Substances Directive 2011/65/EU
- The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 No. 3032

The products have been evaluated in accordance with the following harmonised standards:

- EN IEC 63000:2018

A technical file for each product is retained at the manufacturer's address.

Signed .....

Name: Tom Harrison

Position: Managing Director

P-2-058 Declaration of Conformity v01

11.REVISION HISTORY

Revision	Date	Details
v01	June 2023	Branding changes, inclusion of accessories and certificate of conformity.
220513	13 May 2022	Initial release.