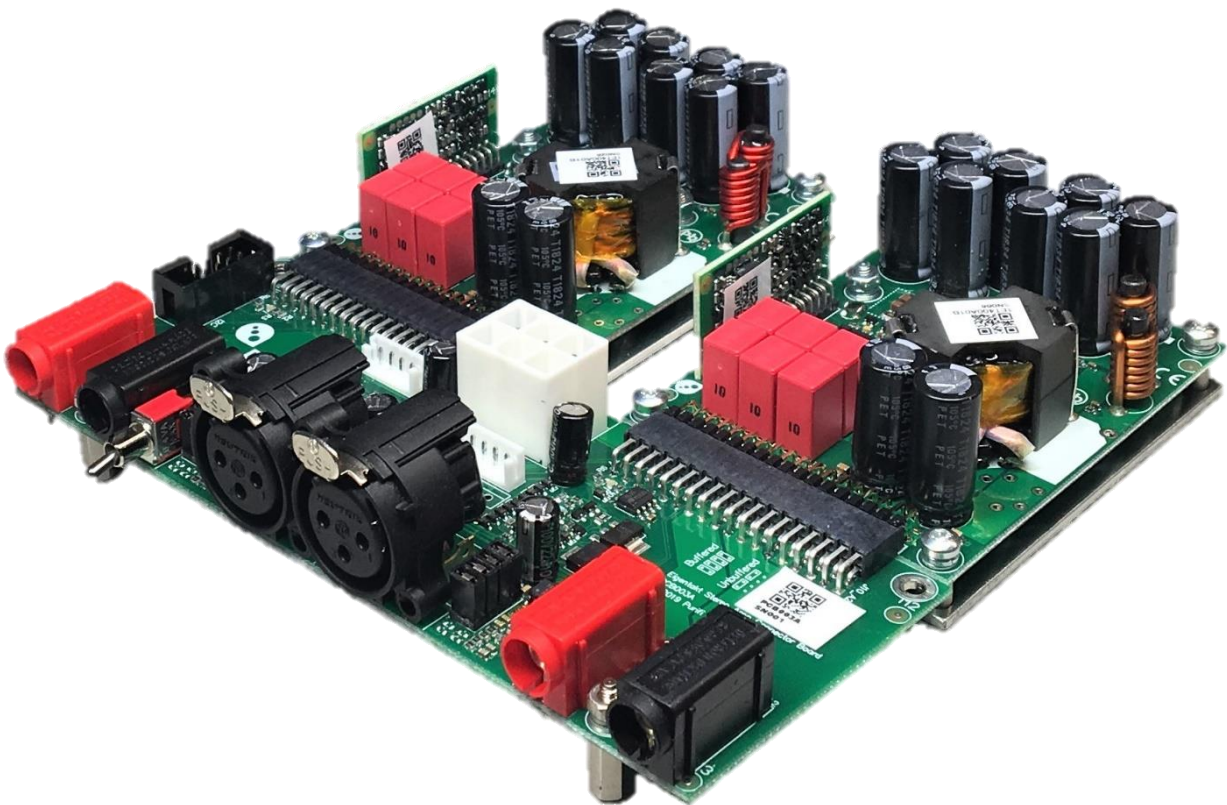




PURE SOUND

Building a Straight Wire
to the Soul of Music

EVAL1 USER'S GUIDE



1	Introduction.....	2
1.1	Usage and Purpose.....	2
1.1.1	Setup and operation	2
1.1.2	Power Testing.....	2
2	EVAL1 Overview	3
3	Interface.....	4
3.1	Standby switch, S1.....	4
3.2	Power connector, J1.....	4
3.3	I2C connector, J2 (for e.g., Aardvark).....	4
3.4	Aux connector, J3	5
3.5	Analog input XLR connectors, J4 & J9.....	5
3.6	Edge connectors, J10_A1 & J10_A2.....	6
3.7	Speaker output connectors, J11 & J13	7
3.8	I2C/Status connector, J16	7
3.9	Gain/Bypass jumpers, B1 & B2	8
4	Power Supplies.....	9
4.1	Linear Regulators.....	10
5	Operating Modes & Status Reporting	11
5.1	Mode Configuration.....	11
5.2	HW Mode.....	11
5.3	SW Model	11
6	Mechanical Specifications & System Considerations.....	12
6.1	EVAL1 Dimensions.....	12
6.2	Thermal Requirements.....	14
6.3	Mechanical Requirements	14
6.4	Compliance Testing.....	14
7	External Standby Switch.....	15
8	Revision History.....	15
	Figure 1 EVAL1 Overview.....	3
	Figure 2 Buffer Schematic	8
	Figure 3 Power Supplies.....	9
	Figure 4 Linear Regulator Schematic	10
	Figure 5 Mode Selection.....	11
	Figure 6 Dimensions.....	12
	Figure 7 Bottom-side mounting holes	13
	Figure 8 Back plate mounting holes	14
	Figure 9 External ON/OFF Switch	15
	Table 1 Standby switch, S1.....	4
	Table 2 Power connector, J1	4
	Table 3 I2C connector, J2 (for e.g., Aardvark).....	4
	Table 4 Aux connector, J3.....	5
	Table 5 Analog input XLR connectors, J4 & J9	5
	Table 6 Edge Connector, J10_A1 & J10_A2.....	6
	Table 7 Speaker output connectors, J11 & J13	7
	Table 8 I2C/Status connector, J16.....	7
	Table 9 Gain/Bypass jumpers, B1 & B2	8

Table 10 Gain/Bypass resistors, B1 & B2	8
Table 11 Recommended Supply Voltages	9
Table 12 Mode Selection	11
Table 13 Revision History.....	15

1 Introduction

This document describes the operation, function and usage of the EVAL1 evaluation kit (“EVM”) consisting of two 1ET400A amplifier modules and one FE02 stereo front-end module.

1.1 Usage and Purpose

The EVM is provided for engineering evaluation and laboratory test purposes only. Great care should be taken when handling the EVM, especially when connected to power supplies and loads. Observe the voltage and power ratings and apply suitable precautions to protect the operator from electrical hazards.

Also note that the EVM is provided as an unshielded PCB assembly and should be protected from ESD as well as mechanical stress.

1.1.1 Setup and operation

1. Plug 1ET400A modules into the Front-End Board (FE02)
2. Place EVM on a flat surface Note that the amplifier base plates are connected to GND and should be attached to an external heatsink, e.g., a larger aluminum plate, for extended high power testing.
3. Connect external laboratory supplies (or other suitable PSU’s) to FE02 (refer to section 4)
4. Connect audio inputs and speakers (or other suitable loads/test equipment)
5. Enable operation via toggle-switch on FE02
Two red LED’s will light up when all supply voltages are within operational range.
6. It is recommended to disable operation (toggle-switch) and turn off all power supplies when module is not in use

1.1.2 Power Testing

The amplifier modules are protected from overheat via individual thermal protection systems that monitor the temperature of the aluminium base plates. The aluminium plates provide limited cooling, likely adequate for full-power music as well as typical test sweeps etc., However, for continues high power delivery additional cooling is required.

2 EVAL1 Overview

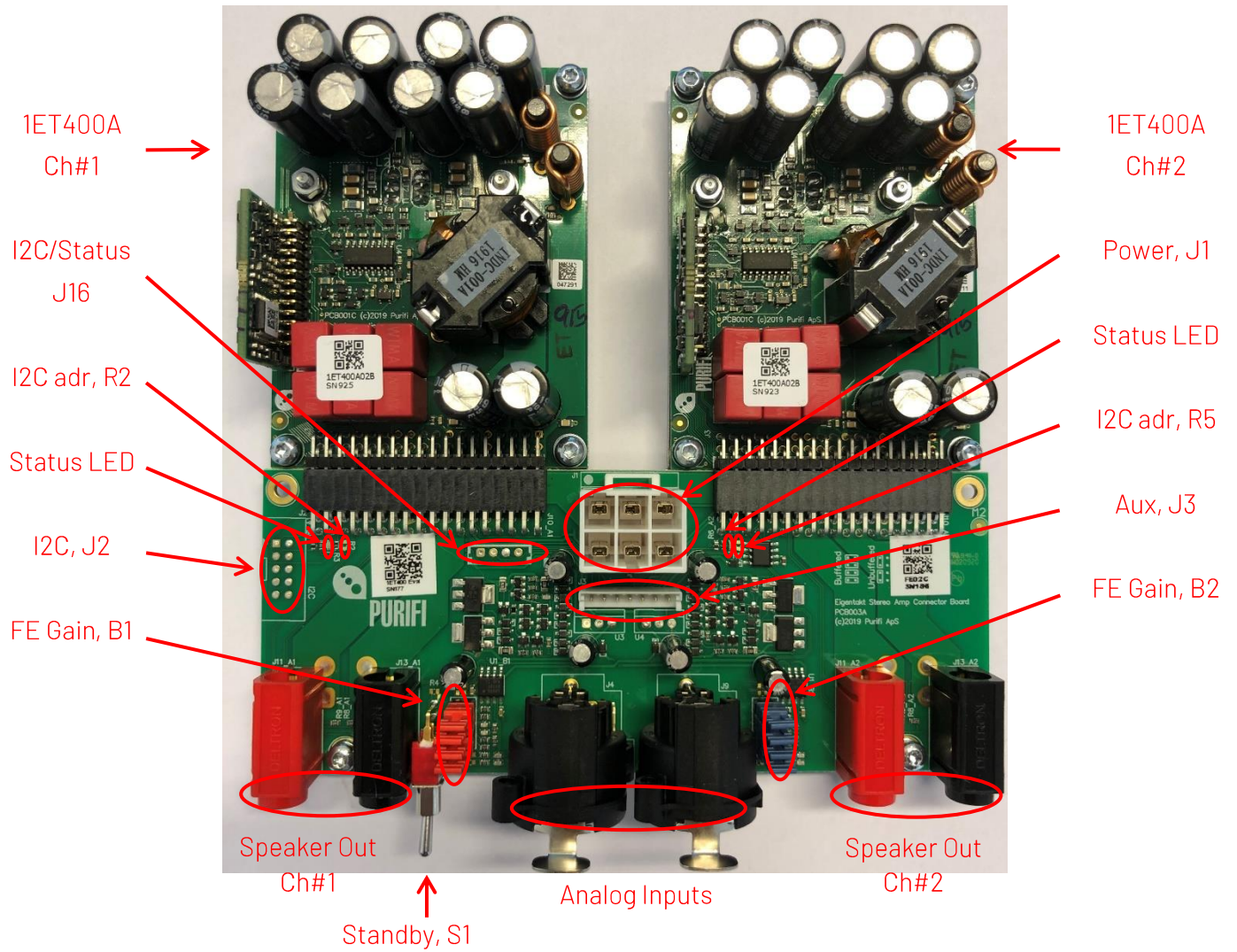


Figure 1 EVAL1 overview

3 Interface

3.1 Standby switch, S1

Position	Description
UP	Operational – Power stage is on
DOWN	Standby, Power stage is off

Table 1 Standby switch, S1

3.2 Power connector, J1



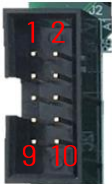
Pin	Signal	Rating	I/O	Description
1	VDR		P	Gate Drive Supply, referenced to -VP
2	+VP		P	Power Stage Supply, positive rail
3,6	GND		-	Ground
4,5	-VP		P	Power Stage Supply, negative rail

Table 2 Power connector, J1

Connector type equivalent: JST: B06P-VL.

Matching cable part: JST: VLP-06V.

3.3 I2C connector, J2 (for e.g., Aardvark)



Pin	Signal	Rating	I/O	Description
1	SCL		I	I2C clock (SW Mode)
2	GND		-	Ground
3	SDA		I	I2C Data (SW Mode)
10	GND		-	Ground
4,5,6, 7,8,9	NC		-	Not connected

Table 3 I2C connector, J2 (for e.g., Aardvark)

Note: J2 is per default not mounted

Connector: 2x5pin IDC header: T821110A1S100CEU Amphenol

3.4 Aux connector, J3



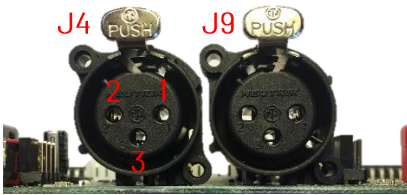
Pin	Signal	Rating	I/O	Description
1	PSUDIS /AMPON		0 I	PSU off control signal (SW Mode), or Amplifier Disable (HW Mode) – <i>pull low to enable Amp</i>
2	SDA READY		I 0	I2C Data (SW Mode), or Amplifier Ready (HW Mode) – “all good for operation” when high
3	SCL /FATAL		I 0	I2C clock (SW Mode), or Amplifier “error/fail” (HW Mode) – <i>signal goes low on error</i>
4	+5V		P	5V output (from onboard regulator), 20mA max load. Requires R1 mounted
5	+VUNREG		P	Voltage regulator input, positive rail
6	GND		-	Ground
7	-VUNREG		P	Voltage regulator input, negative rail

Table 4 Aux connector, J3

Connector type: JST: B7B-EH-A(LF)(SN).

Matching cable part: JST: EHR-7.

3.5 Analog input XLR connectors, J4 & J9



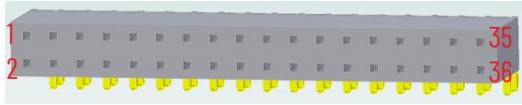
Pin	Signal	Rating	I/O	Description
1	GND		-	Ground
2	IN+		I	Analog input, positive
3	IN-		I	Analog input, negative

Table 5 Analog input XLR connectors, J4 & J9

Connector type: Neutrik NC3FAH2

If a single ended input is need then connect GND and IN- to the negative analog input.

3.6 Edge connectors, J10_A1 & J10_A2

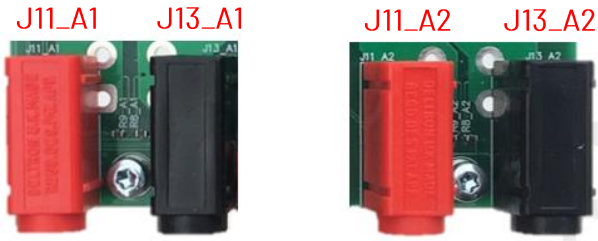


Pin	Signal	Rating	I/O	Description
Power Supplies				
1, 2	+VP		P	Power Stage Supply, positive rail
3, 4, 5 6, 7, 8	GND		-	Ground
9, 10	-VP		P	Power Stage Supply, negative rail
11	VDR		P	Gate Drive Supply, referenced to -VP
12	VD		P	(option use) External Voltage supply to on-board 3.3V regulator
26	+VOP		P	OPAMPs, positive rail
25	-VOP		P	OPAMPs, negative rail
27	GND		-	Ground
I/O's				
13, 14, 15, 16, 18	OUT-		O	Speaker Output, negative (internally connected to GND)
17	VFBLF-		I	Feedback sense input, negative
19	VFBLF+		I	Feedback sense input, positive
20, 21, 22, 23, 24	OUT+		O	Speaker Output, positive
28, 33, 34	NC		-	Not connected
29	IN+		I	Analog Input, positive
30	IN-		I	Analog Input, negative
31	HS/ADDR		I	Mode/I2C Address Selection; set by one 1% resistor.
32	PSUDIS /AMPON		O I	PSU off control signal (SW Mode), or Amplifier Disable (HW Mode) – <i>pull low to enable Amp</i>
35	SDA READY		I O	I2C Data (SW Mode), or Amplifier Ready (HW Mode) – “all good for operation” when high
36	SCL /FATAL		I O	I2C clock (SW Mode), or Amplifier “error/fail” (HW Mode) – <i>signal goes low on error</i>

Table 6 Edge Connector, J10_A1 & J10_A2

Connector type: Samtec: SSW-118-02-T-D-RA

3.7 Speaker output connectors, J11 & J13



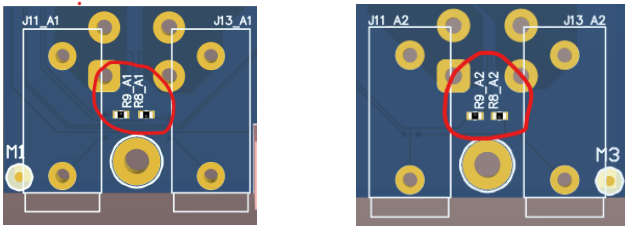
Pin	Signal	Rating	I/O	Description
J11_A1	OUT+		0	Speaker output, positive - Channel 1
J13_A1	OUT-		0	Speaker output, negative - Channel 1
J11_A2	OUT+		0	Speaker output, positive - Channel 2
J13_A2	OUT-		0	Speaker output, negative - Channel 2

Table 7 Speaker output connectors, J11 & J13

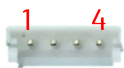
Connector: 4mm banana socket: Deltron: 571-0100(Black), 571-0500(Red)

Note:

The 1ET400A module senses directly at the speaker connector (VFBLF-, VFBLF+) to get lowest possible output impedance, so if the connectors J11 & J13 are removed there is a 1R 0603 resistor at position R8_A1, R9_A1 & R8_A2, R9_A2 to sense the output signal.



3.8 I2C/Status connector, J16



Pin	Signal	Rating	I/O	Description
1	+5V		P	5V output (from onboard regulator), 20mA max load. Requires R1 mounted
2	SCL /FATAL	0 – 3,3V	I 0	I2C clock (SW Mode), or Amplifier “error/fail” (HW Mode) – signal goes low on error
3	SDA READY	0 – 3,3V	I 0	I2C Data (SW Mode), or Amplifier Ready (HW Mode) – “all good for operation” when high
4	GND		-	Ground

Table 8 I2C/Status connector, J16

Note: J16 is per default not mounted.

Connector type: JST: B4B-EH-A(LF)(SN).

Matching cable part: JST: EHR-4.

3.9 Gain/Bypass jumpers, B1 & B2

FE02 includes a ~13dB pre-gain stage for a total EVM gain of ~26dB. The pre-gain stage can be bypassed by location of two sets of jumpers:



Description	Pre-gain enabled	Pre-gain bypassed
Front-End gain	~14dB	0dB
Total EVM gain	~27dB	~13dB
Jumper setting		

Table 9 Gain/Bypass jumpers, B1 & B2

The pre-gain stage is made with a dual OPA1612 configured as Balanced/single-ended to balanced gain stage as shown below:

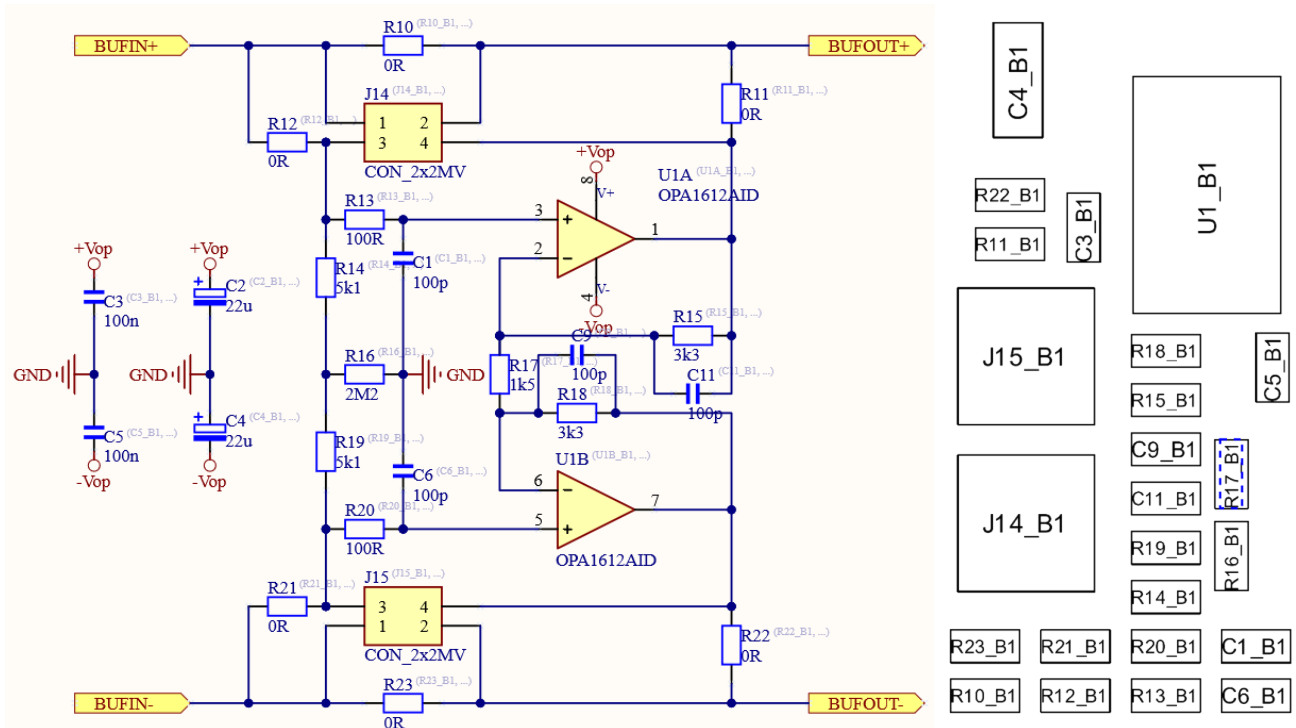


Figure 2 Buffer Schematic

Differential input impedance is 10.2kohm

The 0R resistors: R10, R11, R12, R21, R22, R23 are not mounted per default

The gain stage can be enabled/by-passed with the help of pin headed J14/J15 and jumpers as shown in Table 9.

If a fixed setting is needed the 0R resistors can be used as follows:

Description	Pre-gain enabled	Pre-gain bypassed
Front-End gain	~14dB	0dB
Total EVM gain	~27dB	~13dB
Resistors mounted	R11, R12, R21, R22	R10, R23
Resistors NOT mounted	R10, R23	R11, R12, R21, R22

Table 10 Gain/Bypass resistors, B1 & B2

If a different gain is needed resistor R17 can be modified.

$$\text{Gain} = 1 + (R15 + R18) / R17 = 1 + (3.3K + 3.3k) / 1.5K = 5.4 = 14.6\text{dB}$$

4 Power Supplies

Refer to below figure showing required power supplies and how to connect these to FE02:

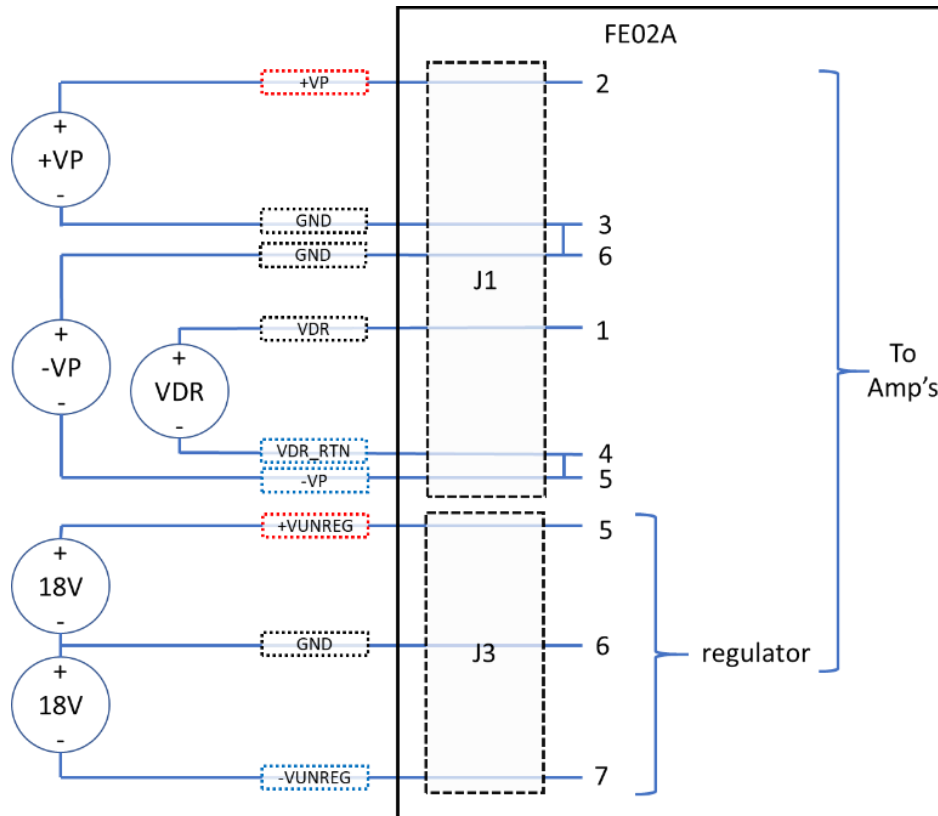


Figure 3 Power Supplies

All supplies levels should be crosschecked with the Recommended Operation Conditions as specified in the respective amplifier module data sheet.

Recommended supply voltages for EVAL1 (please also refer to the 1ET400A Data Sheet):

Parameter		Min	Typ	Max	Unit
Power Supplies					
+VP	Power Stage, positive rail voltage	25	65	70	V
-VP	Power Stage, negative rail voltage	-70	-65	-25	V
VDR	Gate Drive, voltage (must be referenced to -VP)	13.6	15	16.5	V
+VUNREG	OPAMPs, positive rail voltage	16.4	18	25	V
-VUNREG	OPAMPs, negative rail voltage	-25	-18	-16.4	V

Table 11 Recommended Supply Voltages

4.1 Linear Regulators

FE02 includes two low noise discrete voltage regulators for the OPAMP’s negative and positive supply voltages, +Vop & -Vop and a 5V regulator for the standby regulator, +VSBY. Schematic is shown here below:

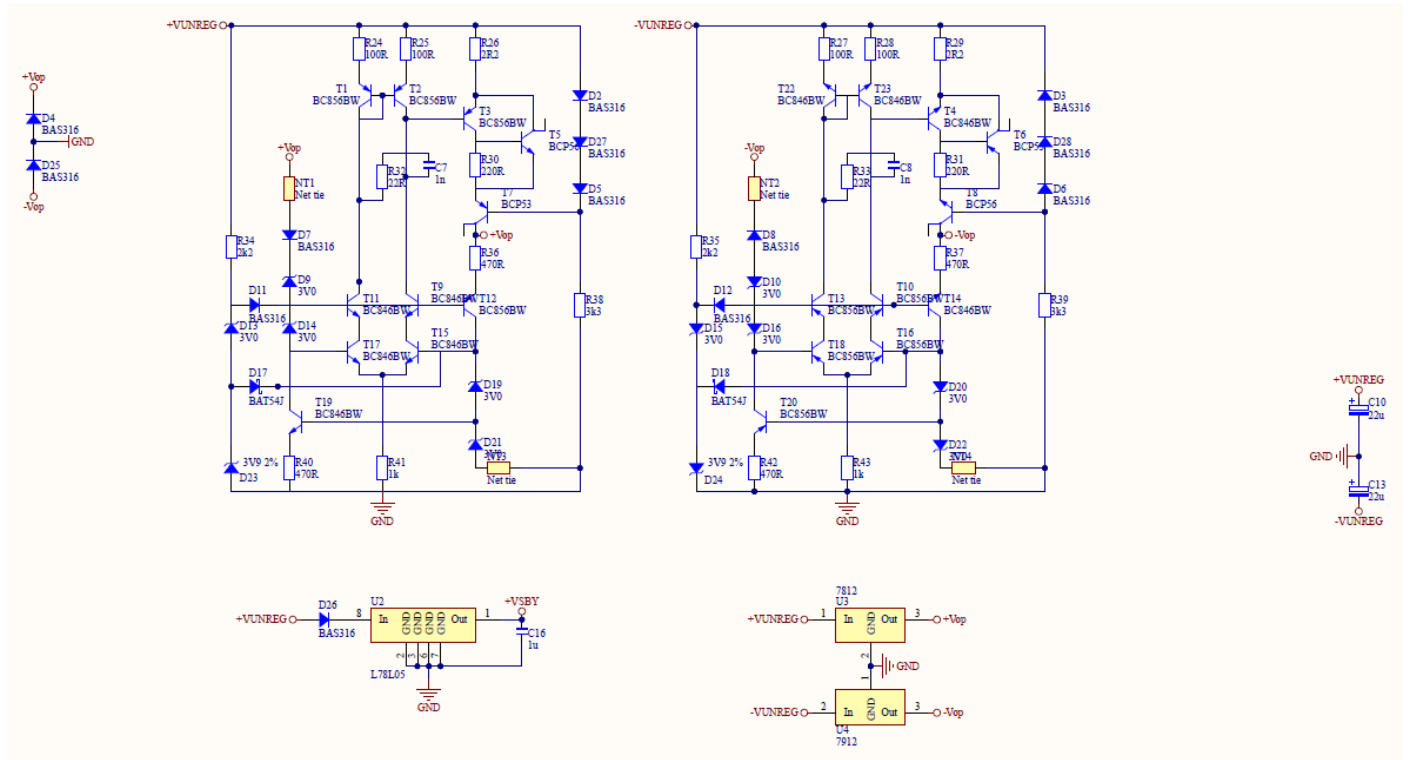


Figure 4 Linear Regulator Schematic

Note: U3 & U4 are not mounted

5 Operating Modes & Status Reporting

5.1 Mode Configuration

The EVAL1 can operate in two modes:

1. HW Mode: all control and status via pins (HW interface)– DEFAULT CONFIGUTATION
2. SW Mode: enables control and status via I2C interface

FE02 is configured for HW Mode by default. To reconfigure for SW Mode, at bit of soldering is required, see Table 12 and Figure 5:

FP	Channel	Description	HW Mode	SW Mode
R6_A1	1	Mode Selection	Diode	0Ω shunt
R6_A2	2			
R2	1	I2C Address Selection	open	Refer to data sheet
R5	2			

Table 12 Mode Selection

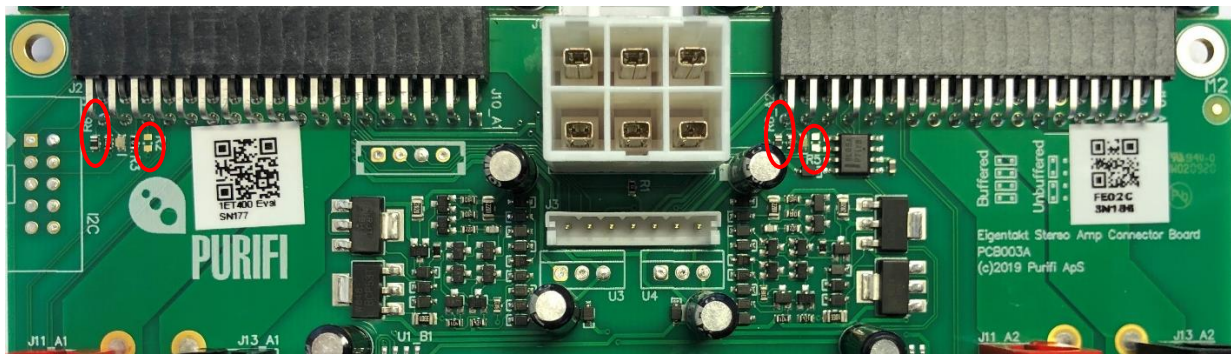


Figure 5 Mode Selection

5.2 HW Mode

The amplifier modules are controlled via toggle switch S1 connected to amplifier control signal /AMPON. /AMPON is also made available on connectors J3 and can be controlled via external source once shunt R3 has been removed.

Amplifier status is signaled via READY and /FATAL:

READY signals are connected to individual LED’s on FE02. LED’s are located close to pin 1 of the amplifier edge connectors.

/FATAL signals are wire or’ed together on FE02 and pinned out on connectors: J2, J3 and J16.

5.3 SW Model

The main feature of the SW Mode is access via I2C to status and control information. The I2C register map can be found in the amplifier data sheet.

I2C is accessed via SCL, SDA on connectors J2, J3 and J16.

The I2C address can be programmed via value of resistors R2 and R5 on FE02. Refer to the **Mode Selection via HS/ADR** table in the amplifier data sheet for information on resistor value vs. I2C address.

6 Mechanical Specifications & System Considerations

6.1 EVAL1 Dimensions

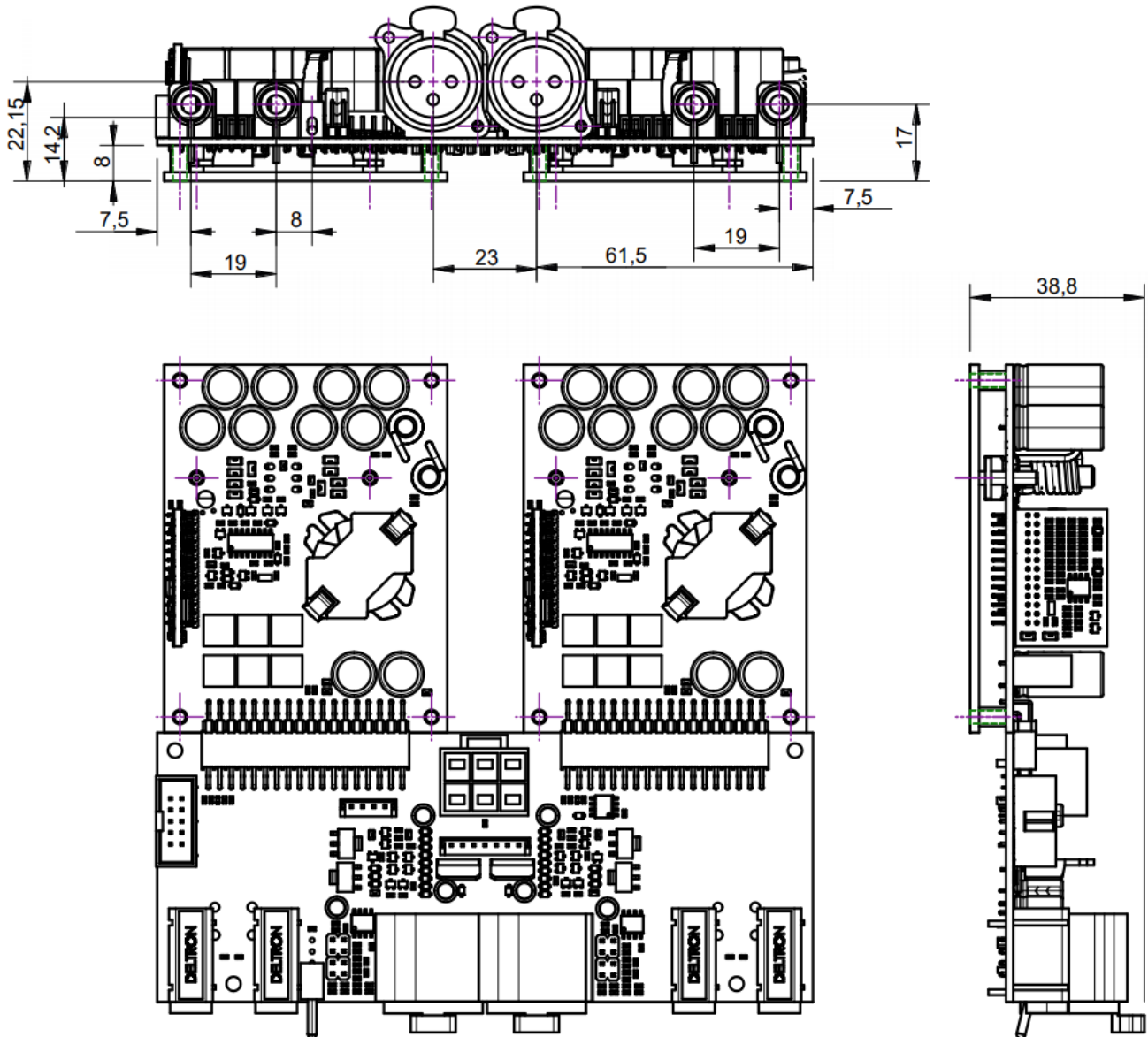


Figure 6 Dimensions

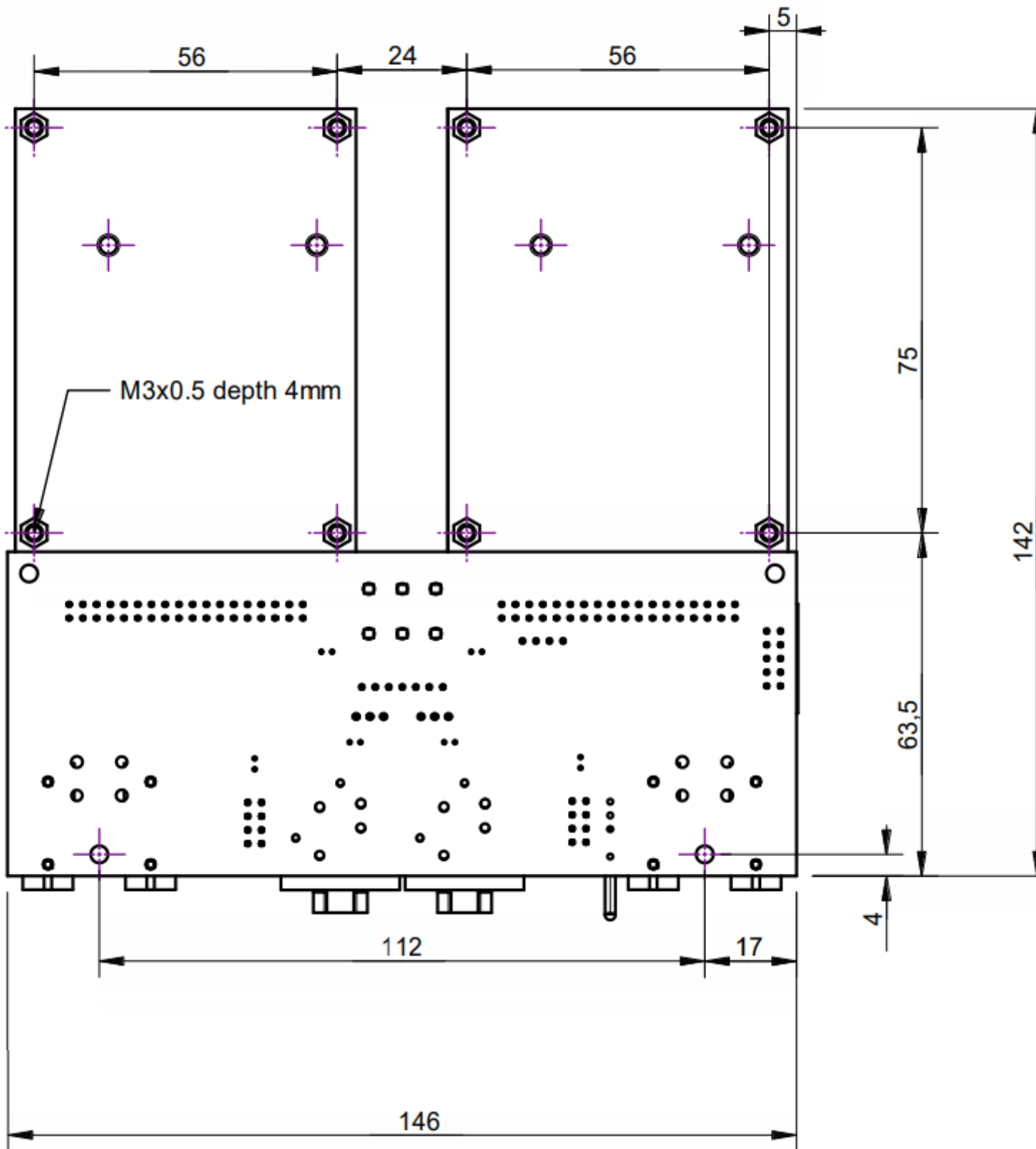


Figure 7 Bottom-side mounting holes (scale 1:1 if printed on A4)

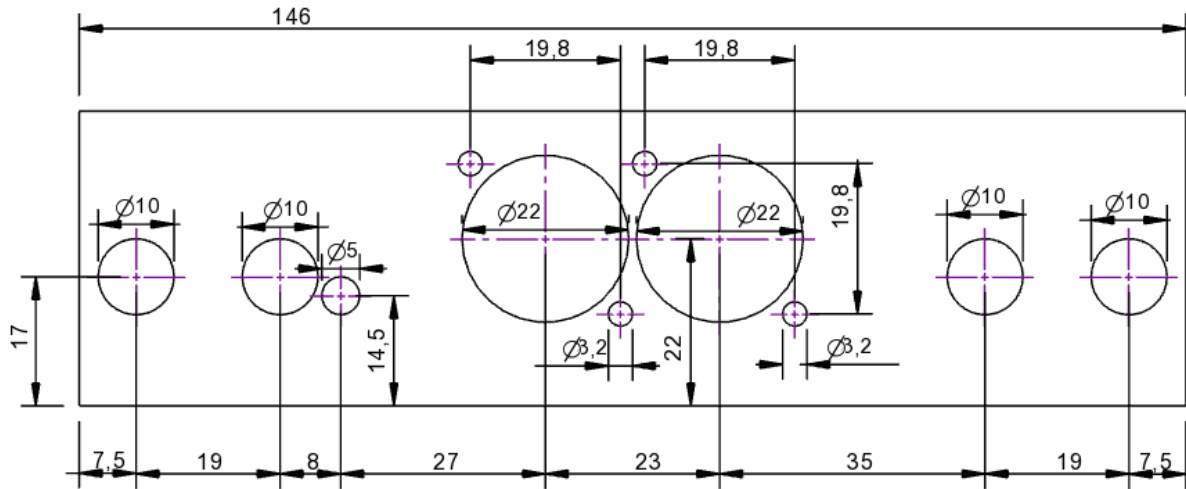


Figure 8 Back plate mounting holes (Scale 1:1 if printed on A4)

Note: Dimensions from bottom mounting plate including the 8mm standoff.

6.2 Thermal Requirements

While 1ET400A has very low idle losses and high overall efficiency, adequate cooling is essential for sustained power delivery. Careful considerations must be given to design of the thermal system in order to achieve desired output power specifications.

It is recommended to mount the module on a heatsink, e.g., an adequately design aluminum chassis.

6.3 Mechanical Requirements

Related to mechanical robustness of the end application: it is the responsibility of the system integrator to specify process, materials, locations, etc. for e.g., gluing of critical components which may be required and to prove/document short- and long-term performance and reliability. The system integrator must ensure integrity of mounting method and materials used related to fixation of the module. It is recommended to thoroughly test the final product for robustness against, e.g., shock and vibration.

6.4 Compliance Testing

1ET400A is designed with considerations for compliance of the end application. However, it is the responsibility of the system integrator to ensure any form of design-for-compliance and associated testing/certification which may be required. EVAL1 mounted in an adequate metal box has been tested to pass the EMI requirements.

7 External Standby Switch

Standby is controlled by the /AMPON signal, that is present on J3 pin-1. J3 also have a GND pin, so an external standby switch can be implemented by wiring a switch on J3 from Pin-1 to pin-6.

The revision C of the FE02 board in HW-mode comes with two diodes that OR the READY signal from Ch1 and C2, so a ON/OFF indication can be implemented by connecting a LED+330ohm resistor from J3 pin-2 to J3 pin-6.

The wiring diagram for this can look like shown below:

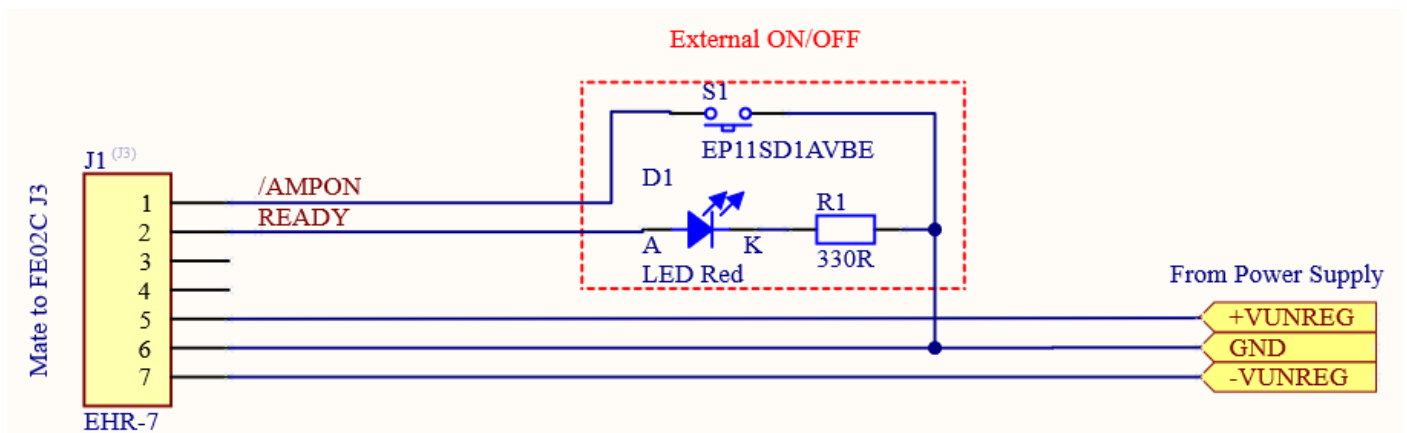


Figure 9 External ON/OFF Switch

8 Revision History

Rev	Date	Description	ID
(0.92)	2019-05	Pre-release version (preliminary)	CNN
(1.00)	2019-10	Release version	CNN
(1.10)	2020-01	Added J10 pinout & schematic details	KNM
(1.20)	2020-01	Corrected gain equation in section 3.9, set +/-Vunreg max to 25V	KNM
(1.22)	2020-01	Added edge connector type & backplate mounting holes	KNM
(1.24)	2020-07	Updates to revC	KNM
(1.25)	2020-09	Corrected typo's	KNM

Table 13 Revision History

1 EVM Use Restrictions and Warnings:

1.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS. 1.2 User must read and apply the user guide and other available documentation provided by PURIFI ApS regarding the EVM prior to handling or using the EVM. 1.3 Safety-Related Warnings and Restrictions: 1.3.1 User shall operate the EVM within PURIFI ApS's recommended specifications and environmental considerations stated in the specification or other available documentation provided by PURIFI APS, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM documentation prior to connecting any load to the EVM output. During normal operation, even with the inputs and outputs are kept within the specified allowable ranges, some circuit components may have elevated case temperatures. When working with the EVM, please be aware that the EVM may become very warm. If there is uncertainty as to the ratings and specifications, please contact PURIFI ApS prior to connecting interface electronics including input power and intended loads. 1.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees. 1.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

2. Accuracy of Information: To the extent PURIFI ApS provides information on function of EVMs, PURIFI ApS attempts to be as accurate as possible. However, PURIFI ApS does not warrant the accuracy of EVM descriptions or other information on its websites as accurate, complete, reliable, current, or error-free.

3. Disclaimers: 3.1 EXCEPT AS SET FORTH ABOVE, EVMs AND ANY WRITTEN EVM MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS". PURIFI APS DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, REGARDING TO E.G. BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY INTELLECTUAL PROPERTY RIGHTS. 3.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS AND CONDITIONS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF PURIFI APS, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.

4. USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS. USER WILL DEFEND, INDEMNIFY AND HOLD PURIFI APS, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS AND CONDITIONS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR LAW OF TORT, CONTRACT OR ANY OTHER LAW, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

5. Limitations on Damages and Liability: 5.1 General Limitations. IN NO EVENT SHALL PURIFI APS BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS AND CONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER PURIFI APS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST PURIFI APS MORE THAN ONE YEAR AFTER THE RELATED INCIDENCE HAS OCCURRED.

5.2 Specific Limitations. IN NO EVENT SHALL PURIFI APS'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY PURIFI APS EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO PURIFI APS FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

6. Governing Law: These terms and conditions shall be governed by and interpreted in accordance with the laws of Denmark, excluding Denmark's conflict-of-law rules, leading to the use of other law than the laws of Denmark. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within the courts of Denmark and consents to venue in Copenhagen, Denmark. Notwithstanding the foregoing, any judgment may be enforced in Danish court, and PURIFI ApS may seek injunctive relief in Denmark or foreign countries.