

SA75-12

SWITCHING AMPLIFIER FOR PIEZOELECTRIC
ACTUATORS

Version : 1.2
Date: 15/02/2016



CAUTION: READ BEFORE OPENING

For safety purposes these instructions must be read before use of this product.

This power amplifier is dedicated to piezoelectric actuators.

Only qualified personnel should work on or around this equipment and only after becoming thoroughly familiar with all warnings, safety notices, and procedures contained herein.

The successful and safe operation of this equipment is dependent on proper handling, installation and operation.

A "qualified person" is one who is familiar with the installation, construction and operation of the equipment and the hazards involved. In addition, he/she has the following qualifications :
is trained and authorized to energize, de-energize, clean, and ground equipment in accordance with established practices, is trained in the proper care and use of protective equipment in accordance with established safety practices.

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1. DESCRIPTION

The SA75-12 consists in a powerful switching amplifier designed to piezoelectric actuators. The package follows the next dimensions:

RACK 84F-4U

Width : 470 mm

Length : 310 mm

Height : 200 mm

This electronic is a modular one; which means that a RACK84F, for instance, may receive two power supply units (SC75) and up to 4 amplification channels (SA75X_Y- X represents A, B, D version and Y represents 1 or 2 channels), as well as sensors conditioning units:

- Strain gauges sensors conditioner (SG75 unit),
- Eddy current sensors conditioner (ECS75 unit).

And servo controllers:

- UC45 on the SA75 board,
- UC65 on specific position.

Nota: "X" refers to the "A", "B" or "D" version of the driving electronics.

1.1. FRONT AND REAR PANEL

The rear panel includes the main power connection, the ON/OFF switch and the fuses. The front panel includes the connections with actuators, orders, the switches to close the loop (SERVO) and the led indications regarding faults (Cf. Figure 1). The rack can include other boards described in separate documentations.

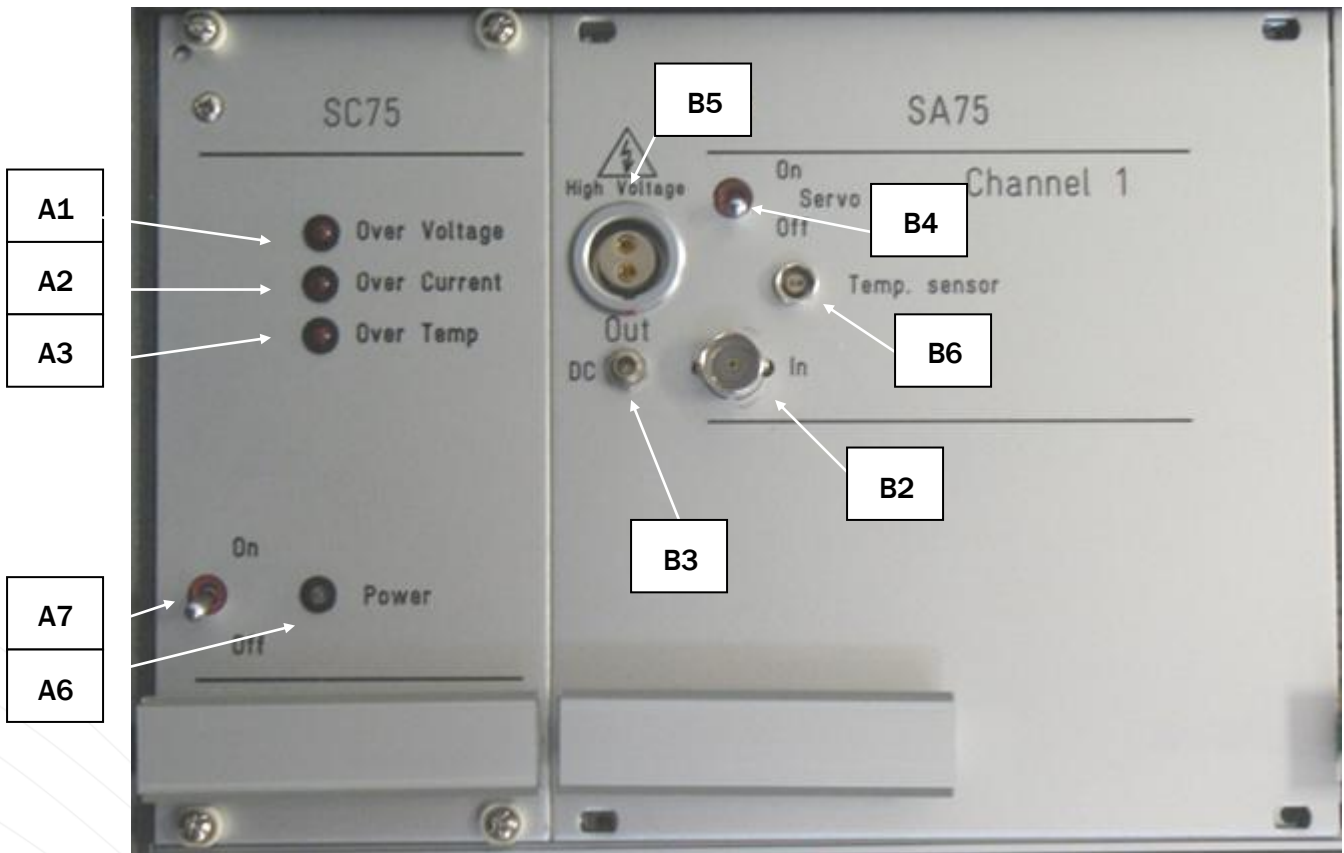


Figure 1 - Front panel of the SA75 power supply

Each item is described in the next table.

Reference	Designation
1st module	Main power supply unit - SC75
A1	Over Voltage - This diode lights when the amplifier detects an overvoltage on the actuator.
A2	Over Current - This diode lights when the amplifier detects an overcurrent.
A3	Over Temp - This diode lights when the actuator or the amplifier reaches the maximum temp
A6	Led power supply presence (green) - Led protect (red)
A7	Power On Switch
2nd module	Switching amplifier - SA75X
B2	Order BNC connector - channel 1
B3	DC offset order potentiometer (10 turn screw)- channel 1
B4	Closed loop selector (SERVO ON / OFF) - channel 1
B5	LEMO connector for piezo actuator - channel 1
B6	LEMO connector for over temperature protection of piezo actuator - channel 1

Nota: If overvoltage, overtemp or overcurrent appear on the SC75 board side, the A6 lights red but no flag appears on A1, A2, and A3.

2. MAIN FEATURES

SA75	Value
Output Voltage	150V -20V
Output Current	20A
Max Apparent Power	1252VA
Active Power	<100W
Efficiency typ.	94%
Switching frequency	200kHz

The product includes a power supply, namely SC75, compatible with 110/230Vac main lines and capable of an output voltage and power of 175V – 175W.

- Power Factor Correction.
- High apparent and active power output.
- Compact.
- High efficiency / Energy recovering.
- Fast rise and fall times.
- Large power bandwidth.
- Fully isolated from ground.

3. APPLICATIONS

- Large piezoelectric actuators driving (capacitance >10 μ F).
- Synthetic jet research.
- Vibration generation.

4 . ELECTRICAL SAFETY INFORMATION

The following safety symbols are used in this manual.



Danger

For you own safety and for your system security, be sure to carefully respect that information.

In order to achieve safe operation of the SA75-12 amplifier, some safety information must be given. This information is intended to protect the user and the product and allows safe operating of the product.



Danger

- This product contains components with lethal voltage, it is strictly forbidden for the user to remove the boards from the rack. It is also strictly forbidden to disconnect the load when electrically powered.
- The actuator may store lethal energy for an indefinite time, do not touch the actuator or its connections. The user can discharge the actuator thanks to the amplifier with a null order.



Warning

This symbol is intended to alert you about an important element concerning the product.



Warning

- Do not open the product during or after use, lethal voltages may be present even after the product has been turned off.
- This device produces hazardous potentials and should be used by suitably qualified personnel. Do not operate the device when there are exposed conductors. Parts of the circuit may store charge so precautions must also be taken when the device is not powered.
- A special care in the use of the LEMO connections should be taken in plugging and unplugging them: you have to pull onto the connector and not the cable.
- It is strictly forbidden to connect the electrical output channels of several SA75x in parallel.
- The switching amplifier must be connected to a piezo load before switch on the A7 switch (Power on). Otherwise the power amplifier may be unstable.

A qualified person is a person entitled to perform near electric endanger.

5. INFORMATION ON DISPOSAL FOR USERS OF WASTE ELECTRICAL & ELECTRONIC EQUIPMENT (PRIVATE HOUSEHOLDS)



This symbol on the product(s) and / or accompanying documents means that used electrical and electronic products should not be mixed with general household waste. For proper treatment, recovery and recycling, please take this product(s) to designated collection points where it will be accepted free of charge.

Alternatively, in some countries you may be able to return your products to your local retailer upon purchase of an equivalent new product.

Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

Please contact your local authority for further details of your nearest designated collection point.

Penalties may be applicable for incorrect disposal of this waste, in accordance with your national legislation.

For business users in the European Union:

If you wish to discard electrical and electronic equipment, please contact your dealer or supplier for further information.

Information on Disposal in other Countries outside the European Union

This symbol is only valid in the European Union. If you wish to discard this product please contact your local authorities or dealer and ask for the correct method of disposal.

6. GENERAL DESCRIPTION

The switching electronic SA75X is dedicated to the supply and control of piezoelectric actuators based on multi-layers piezoelectric ceramics such as APA or PPA from **Cedrat Technologies**. The SA75X consists in an amplifier with a maximal power given in the attached technical datasheet (see Appendix 2), including

- A switching power supply (SC75) providing a continuous voltage from the main power (1st module),
- A switching power amplifier (SA75X) dedicated to capacitive load allowing excitation of piezoelectric actuators between -20 and 150 V (2nd module),
- A strain gauge conditioner (SG75) allowing to measure the displacement of piezoelectric actuators equipped with gauges (optional module),
- A servo controller (UC45) allowing to close the loop and to insure a feedback control on the actuator (optional module)

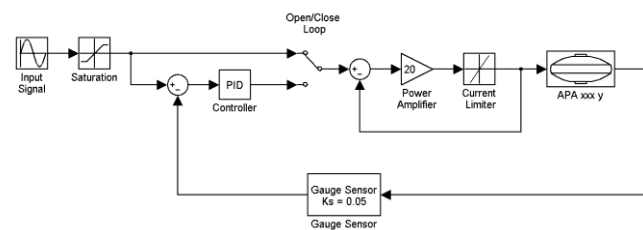


Figure 2 - Synoptic of the electronic control of a piezo actuator

A switching amplifier is built around PWM technology and a dedicated output filter including inductors and the piezo load. As the piezo load is capacitive, the output PWM is filtered and a continuous output signal is supplied to the piezo load (see below).

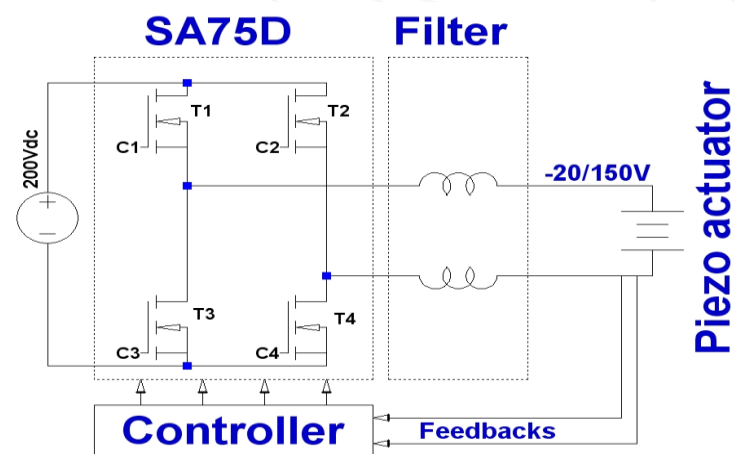


Figure 3 - Synoptic of a switching piezoelectric amplifier



Warning

- The output piezo connections are floating. If the operator wants to measure the output voltage on the load, a differential probe able to withstand more than 250V should be used. If the operator doesn't use a differential probe, damage on the switching amplifier may arise.
- The amplifier is only intended to perform on piezo actuator or on capacitive loads.



Warning

The switching amplifier must be connected to a piezo load before switch on the A7 switch (Power on). Otherwise the power amplifier may be instable.

6.1. VOLTAGE CONTROL LOOP

A specific controller is implemented to control the output voltage on the piezoelectric actuators. The controller is tuned with the output load to provide the best performances in regards of the control (speed and accuracy). For this reason, your switching amplifier is tuned with factory settings and the operator cannot change the load without a lack of performance. A range around the initial value is specified corresponding to -25%, +100%.

Ex: The switching piezo amplifier is tuned with initial piezo is 30 μ F, the switching amplifier is stable in the range [20-60] μ F.

6.2. BANDWIDTH

The power switching amplifier is characterized with two specific bandwidths.

- The power bandwidth,
- The signal bandwidth

The first one is due to the possibility to the SA75 to provide the necessary current to charge and discharge the piezo load (a capacitance): This is the current or power capability. Following the next formula:

$$I = C \frac{dV}{dt}$$

Equation 1. Electrodynamics fundamental equation.

The max current is function of your switching power amplifier current range (5A, 10A or 20A). If the commanded signal is high frequency and when the max output current is reached, the output voltage is limited like a slew rate (see Figure 4).

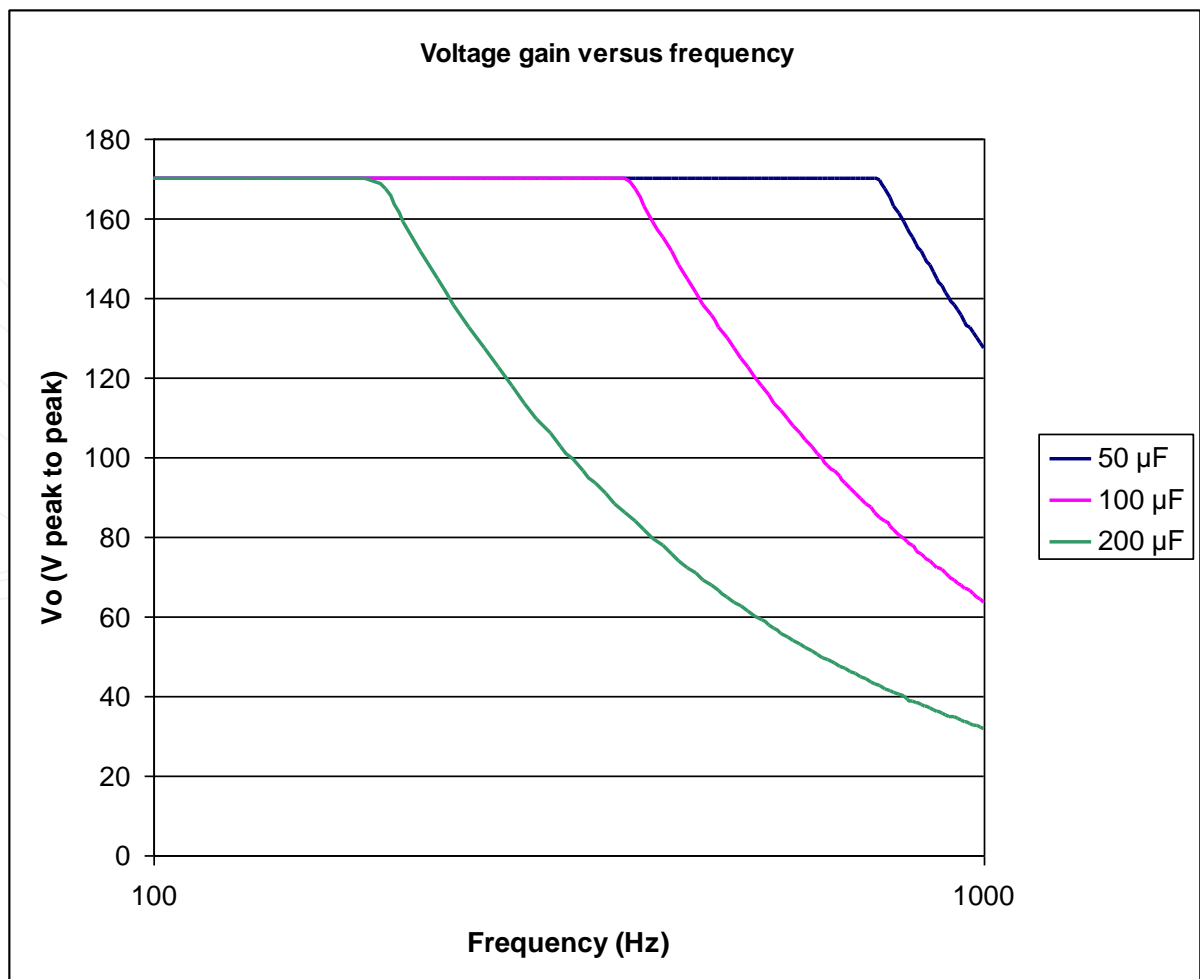


Figure 4. Power bandwidth description for different loads.

The second one is the possibility to drive a piezo when the power bandwidth is not reached (small signal). This parameter is directly linked to the voltage controller performance (see Figure 5).

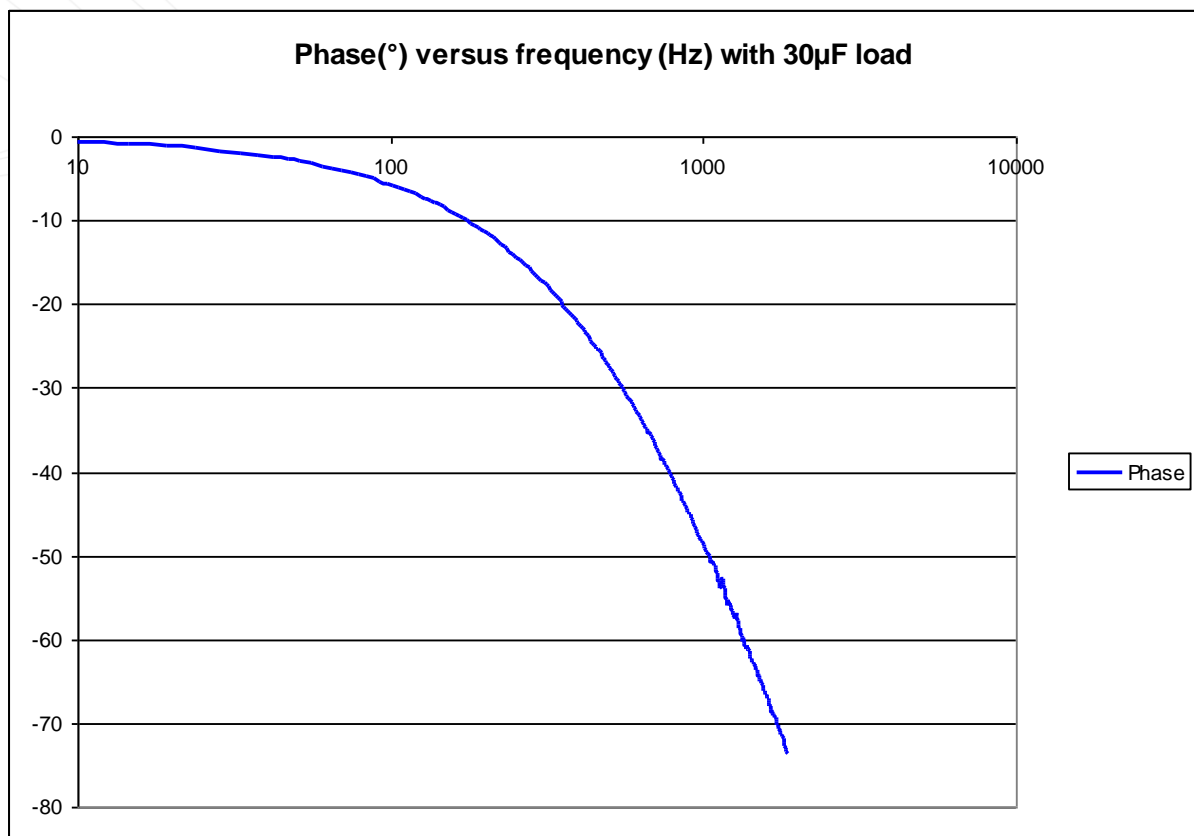
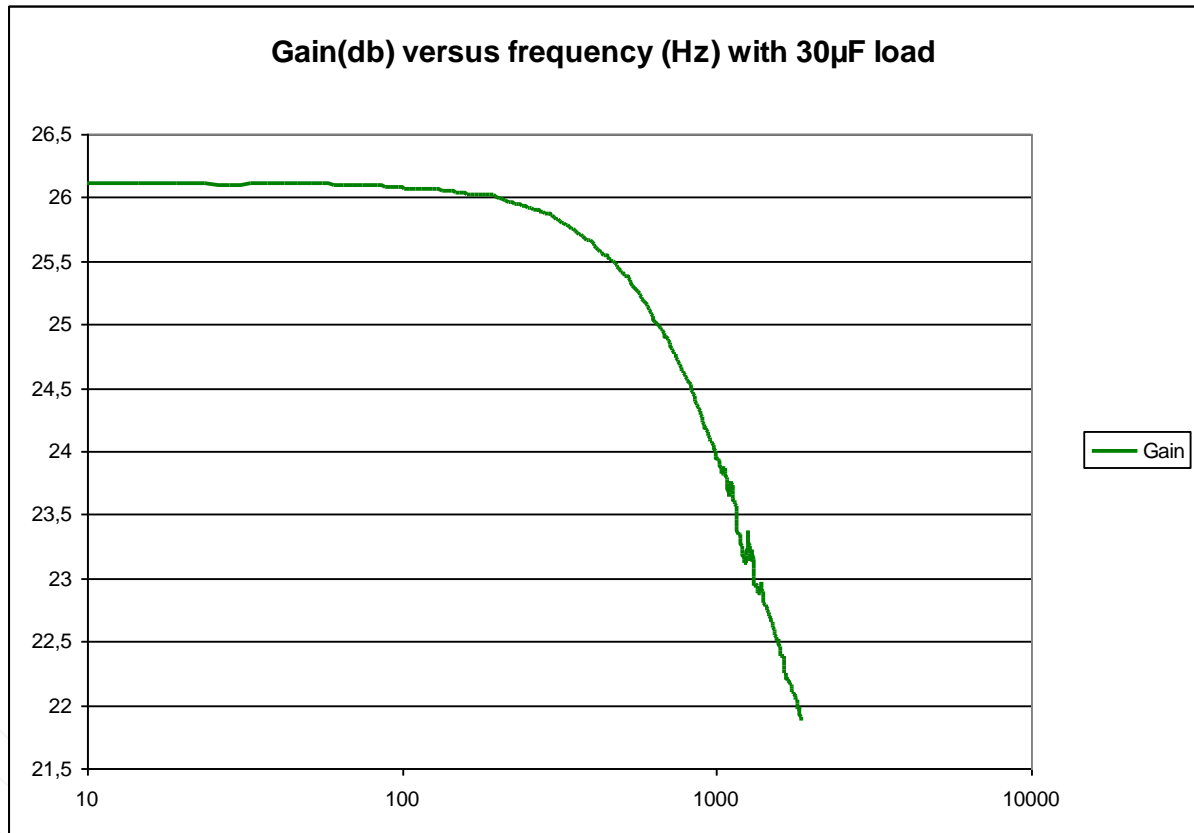


Figure 5 – Signal bandwidth description for a 30 μ F load.

6.3. ENERGY RECOVERY

The switching amplifier is well suited to drive reactive load. With the specific topology used, the energy stored in the capacitive load can be transferred into the internal buffer capacitors. In this case, the switching amplifier doesn't consume the reactive power but only the active power of the piezoelectric actuators and the losses in the power switching functions.

Ex: A switching power amplifier providing sine signal with 10A at 170p-p to the load (625VA) consumes less than 12.5W (from piezo dielectric losses) plus 30W due to the power components losses.

7. MAIN VOLTAGE CONNEXIONS

The switching amplifier is able to be connected on the **110VAC** or **230VAC** main voltage without any modifications but a fuse adaptation:

1 SA75 & SC75 :

SC75 (110Vac)	SC75 (230Vac)
fuse 1: 250V 4A T type	fuse 1: 250V 2A T type
fuse 2: 250V 4A T type	fuse 2: 250V 2A T type

2 SA75 & SC75 :

SC75 (110Vac)	SC75 (230Vac)
fuse 1: 250V 8A T type	fuse 1: 250V 4A T type
fuse 2: 250V 8A T type	fuse 2: 250V 4A T type

Note: The fuses are reachable in the main voltage plug on the rear face.

8. OPERATING INSTRUCTIONS FOR THE SWITCHING POWER SUPPLY, AC/DC CONVERTER, (SC75)

This module produces from the mains, the regulated DC voltage to the amplifier functioning needs:

+175Vdc regulated voltage with up to **175W** maximum output power.

The switch **A7** is used to power on and off the power supply and the amplifier. There is a delay of less than two seconds between the activation of the switch and the effective start up of the **SC75/SA75**.

It is possible to shut down the amplifier by using the switch A7. This switch is the easiest way to disable the piezoelectric actuator as soon as required. However, few seconds are necessary to come to a completely discharged actuator.

This module is protected against over temperature, over voltage and over current conditions.



Warning

It is recommended to keep free space all around the electronic rack while driving in order to make the ventilation easier and to obtain the nominal performance of the driving electronics.

Note: Do use the tilt feet for the SA75 rack versions.



Danger

Do not unplug the boards when the rack is powered on. This may cause large electrical damage and creates risk for the operator.

9. OPERATING INSTRUCTIONS FOR THE AMPLIFIER (SA75X)

9.1. GENERAL INSTRUCTIONS

The switching amplifier allows applying to the actuator a signal comparable to the order's one, with a gain of 20.

The order may be applied in two different and complementary manners:

- Static offset (potentiometer): B3 screw,
- Dynamic order: B2 connector.

These two signals are added and their sum should fall between $-1V$ and $7.5V$.

To connect the actuator to the voltage amplifier, the standard cable available is a coaxial LEMO connector in one end and 2 banana 4mm plugs in second end (see Annex 1).

A thermal protection of the piezo is implemented when B6 is connected with the temperature sensor embedded on the piezo actuator. When the surface temperature reaches 80°C, the output of the SA75 is switched OFF and only an OFF-ON sequence on A7 switch could rearm the protection to re-initialise the latch.

The operator should follow the next sequence to assure a proper use of the switching amplifier.

1. Connect the piezo load on the switching amplifier output. If the load is not connected, the voltage output could be unstable. For piezoelectric actuators with metallic shell, the operator could connect the shell to the earth.
2. Switch on the main selector on the rear panel. The A2, A3, A4 blinks red during few milliseconds and the A6 led should light green. If not, don't follow the sequence and call your vendor.
3. Verify that B4 is in correct position: Servo Off if the piezo is not coupled with position control loop or Servo On if the piezo is coupled with position control loop. If servo is in On position with no position control loop, a DC signal will be apply on the command corresponding to 5V output.
4. The operator should switch on the A7 switch to power on the switching amplifier with no order through B2 BNC (zero command). With this operation, the Bus voltage is applied on the H Bridge and the amplifier switches.
5. Apply through B2 BNC connector the order. We suggest before sending the final command to valid the voltage output by applying small signals. This suggestion limits some risks on the piezo actuator with a bad order.
6. To switch off the output voltage of the switching amplifier, the operator may only suppress it command (or applying 0V)
7. If maintenance on the piezo actuator or its harness is necessary, the operator should switch off the A7 switch to avoid electrical risk.

Nota: A specific sequence is applied on the switching amplifier when the operator switches on the A7 switch. Accordingly, when the SC75 is powered on, the SA75 waits few hundred milliseconds to be operational and able to send the command on the amplifier (See Figure 6). This sequence is necessary to well start the switching amplifier. If the sequence doesn't work well, the A6 led will light red. In this case, the operator re-initialises the process by switching off the A7 switch followed by switching on.

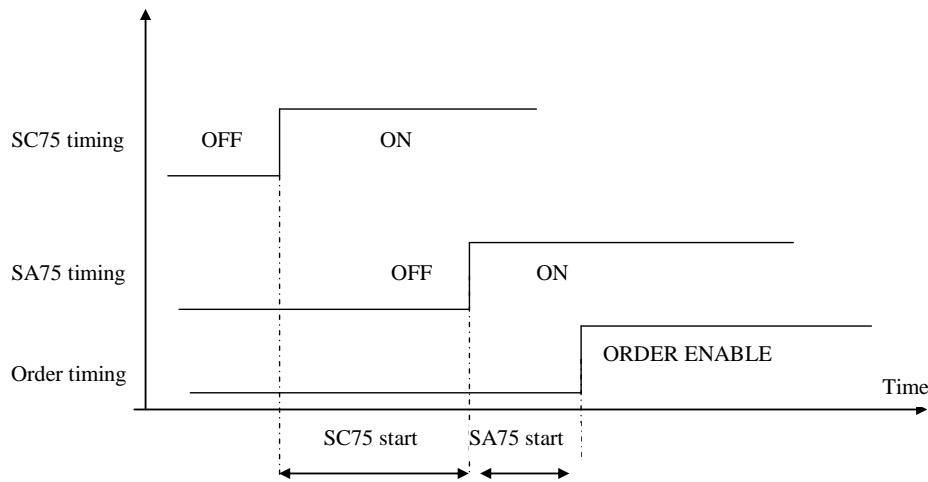


Figure 6 – Automatic Timing during ON switching



Warning

When the switching amplifier is commanded to supply the piezo with large current, the operator should valid that the small rise and fall time don't excite the mechanical resonant frequency of the piezo mechanism. If no protection is taken into account, damages on the MLA can occur with electric and mechanical damages on each part.



Warning

If the operator wants to increase the length of the harness, the wire section should be above 1.5mm² to be compatible with the large current flow.

9.2.LIMITATIONS AND PROTECTIONS

9.2.1.Voltage limitation

An onboard input voltage limitation is implemented to not reach the voltage limits of the piezoelectric actuator.

Note 1: This limitation can be tuned to specific values in the range: $\pm 175V$ upon request.

Note 2: This limitation doesn't limit the output voltage if ringing appears due to an electric or mechanic resonance. However, the Output voltage protection does.

If the order signal is below $-1V$ or above $7.5V$, the power amplifier saturation will clamp the signal so that the voltage applied to the actuator stays roughly between $-20V$ and $150V$. (See Appendix 3)

9.2.2. Current limitation

The maximum output current is limited to respectively $5A$, $10A$ or $20A$ depending on the version of the SA75 (resp. A, B and D).

9.2.3. Slew rate limitation

The latter limitation will affect the voltage slew rate according to the Equation 1.

9.2.4. Output voltage protection

The output voltage is protected to $+170V$ and $-30V$. If the output voltage reaches those values, the amplifier shuts down and the OverVoltage Led on the SC75 lights.

9.2.5. Output current protection

The output current is protected to $\pm 25A$. If the output current reaches those values, the amplifier shuts down and the OverCurrent Led on the SC75 lights.

Note 1: The amplifier is protected against load short circuit.

Note 2: The amplifier is also protected against transistor short circuit.

9.2.6. Temperature protection

The temperatures of the actuator and of the amplifier are protected. If the temperature of the amplifier or of the actuator reaches $80^{\circ}C$, the amplifier shuts down and the OverTemp Led on the SC75 lights.

9.2.7. Reset protection

For each fault, the power supply and the amplifier are shut down and only an OFF-ON sequence on A7 switch can reset the latch.

10 . OPEN/CLOSED LOOP

By default, the open/closed loop selector should be set on the mode open loop (SERVO OFF): in that mode, the amplifier applies a voltage gain of 20 to the input.

A displacement sensor, its conditioner and a servo controller will be necessary to use the closed loop (SERVO ON); otherwise the order will be set to zero.

11. OPERATING INSTRUCTIONS FOR THE OPTIONAL SG75 STRAIN GAUGES CONDITIONER

11.1. GENERAL INSTRUCTIONS

This module allows reading up to three strain gauges bridges. For each one of them, you can:

- Read the signal emitted by the conditioner (C2),
- Adjust the offset (C3).

The gain and the offset of the conditioner are adjusted at the factory on a gauge bridge set on the piezoelectric actuator, but only the offset is accessible to the user (C3). If you wish to use the conditioner with another actuator, it may be necessary to modify the gain at the factory.

11.2. THERMAL EFFECT

The strain gauges solution is the easiest way to operate a piezoelectric actuator in a closed loop. The best accuracy that can be achieved with this sensor is around 0.025%.

However, the strain gauges sensor is temperature dependent, so that the offset may vary with temperature.

12. OPERATING INSTRUCTIONS FOR THE OPTIONAL ECS75 EDDY CURRENT SENSOR CONDITIONER

12.1. GENERAL INSTRUCTIONS

The ECS75 card includes up to 2 channels of Eddy Current sensors, which have been calibrated at the factory. Only the offset can externally corrected (F2, F5 trimmers).

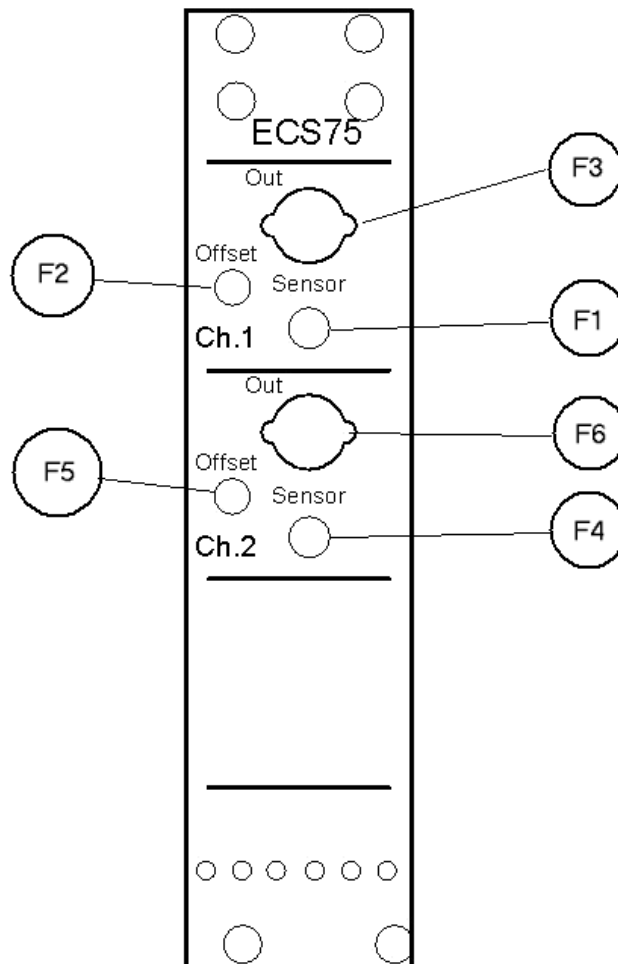


Figure 7 : - Front panel of the ECS75-2 board

12.2. EDDY CURRENT DISPLACEMENT SENSORS

The Eddy Current displacement sensor is a non contact proximity sensor using the eddy current effect generated by the probe in a (preferably) nonferrous material target. The eddy current changes the impedance of the probe, which is read by the conditioner.

Although the probe is calibrated with the target, the gain is somewhat dependent on the angle between the probe and the target, the target's thickness.

13. OPERATING INSTRUCTIONS FOR THE OPTIONAL UC45 DIGITAL CONTROLLER (OPTION)

13.1. INTRODUCTION

This mezzanine (optional) board UC45 is stackable on the amplifier board and allows the support of two channels. Only one controller is available on the UC45 board, except in the case of the control of XY stage with Eddy Current Sensors. Only the input and output channel selection is configurable on a single board. Two boards with appropriate input/output selection are necessary for a two channel application.

The optional board UC45 is available for the boards SA75A-x, SA75B-x and SA75D-x. It performs digital closed loop control with a PID and output filter configuration. The output filter can be either of type notch or lowpass. The optional board UC45 is delivered with a free standard version (latest version downloadable on the web site) of a (Graphical User Interface) GUI software HPDM45. This GUI is a Labview® executable software (the Labview® from National Instruments is not transferred) and provides the following functionalities:

- Remote control of the drive electronic,
- Change of the parameters of the controller PID and filter,
- Order selection between internal (e.g. generated by the GUI), external (analogue order),
- Reading of the calibration parameters of the sensor using the TEDS functionality.

For further details, see the user's manual for the UC45 controller.

Additionally, UC65 controller board can be integrated to improve the sampling rate.

13.2. TERMS AND DEFINITION

13.2.1. Resolution

The resolution is the smallest displacement that the sensor (and its conditioning electronic) is able to measure. The resolution is preferably given with a relative value (a percentage of the total range of measurement).

13.2.2. Precision error in closed loop

The precision error is the difference between the command and the effective value of the displacement. Several contributors play a role in the precision error (resolution of the sensor, sensitivity to external parameters – ageing, temperature ...), corrector error. The precision error is preferably given with a relative value (a percentage of the total displacement).

The following table gives the performances of the position sensor

Sensor type	Resolution	Precision error	Most contributing factors
Strain Gauge (SG)	10^{-4}	10^{-3}	Temperature
Eddy Current Sensor (ECS)	10^{-5}	10^{-4}	Temperature ; material of the target
Capacitive sensor (CS)	10^{-5}	5.10^{-5}	Tilt effect between the target and the probe Humidity

Table 1 : Performances of the sensors

13.3. SYNOPTIC

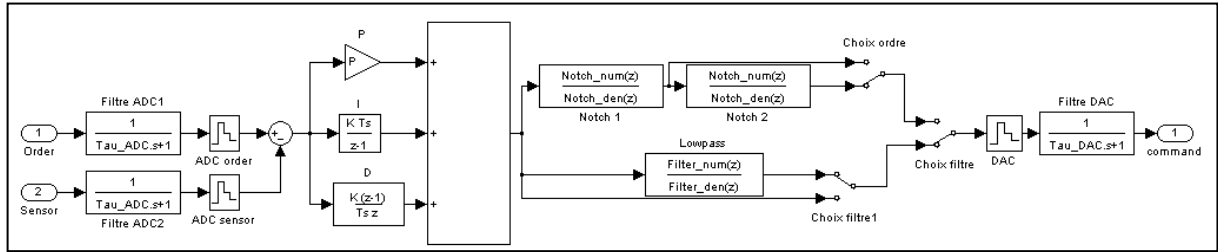


Figure 8: Synoptic of the UC45 controller

TROUBLE SHOOTING

Problem: The plugged piezo actuator does not move while the rear connection and the A7 is switched on.

Action	Possible Causes
<p>Check the led A6 :</p> <p>a) If A6 is off</p> <ul style="list-style-type: none"> - Check the main cable and the fuses at the rear panel <p>b) If A6 is red</p> <ul style="list-style-type: none"> - Check the connection lines to the piezo actuator / disconnect every LEMO cable. Test the electronics with the unplugged and plugged piezo actuator, as follows - switch A7 off <p>If A6 is green</p> <ul style="list-style-type: none"> - switch A7 on <p>if the electronics works,</p> <p>if the electronics doesn't work,</p> <p>If A6 is red</p> <ul style="list-style-type: none"> - Wait for 10 minutes and switch A7 on 	<ul style="list-style-type: none"> - misconnection with main cable or burnt fuses - The electronics is in protection - May be a short circuit through the cable connection or through the piezo actuator occurred - an external parasitic noise might have disturbed it - a breakdown is certain - The electronics was in thermal protection and needed to cool itself down

if the electronics works, if the electronics doesn't work,	a breakdown is certain
---	------------------------

Problem: incoherent response from the actuator in open loop

Action	Possible Causes
Check the output signal (B5) If the DC offset is wrong, turn (B3) to settle it*	The DC offset may be wrong

Problem: incoherent response from the actuator in closed loop

Action	Possible Causes
Go back in mode SERVO OFF (B4) and check the sensor's response (C2)**	The strain gauges offset (C3) may be wrong

* 10 turns potentiometers are used: do not hesitate to rotate the potentiometers and keep attention to the 'clik' noise arising at the end of the trimmer range.

** Adjusting the Strain Gauge offset

- Apply a command of 0V (by a 50 Ohms BNC connector on B2 for instance),
- Check that the voltage output on B5 is nearly zero,
- Adjust the potentiometer B3 to get the output B5 near zero,
- Measure the output of the Strain Gauge conditioner C2,
- Adjust the potentiometer C3, so that the output C2 is 0.38 V

One has :

$$V_{sg} = (\text{SetPointLA} + 1) / \text{MaxAmplitudeLA} * \text{MaxAmplitudeSG} - 0,5$$

With :

$$\text{MaxAmplitudeLA} = 8.5$$

$$\text{MaxAmplitudeSG} = 7.5$$

The customer is not entitled to modify the power supply or the switching amplifier. The only manipulations allowed to him are described in the set here above, including the replacement of (the) external fuse(s.). For any other matter or breakdown suspicion, we suggest the customer to contact your local vendor.

WARRANTY CONDITIONS AND EXCEPTIONS

The equipment is warranted for one year, including parts and labour, and only under standard technical conditions as outlined above and expressly mentioned in the technical data sheet. Repairs will be carried out at CEDRAT TECHNOLOGIES or through your vendor. Shipping, handling and insurance costs to return a part for repair must be paid by the customer.

Interventions or attempts to service or repair the SA75 by any unauthorized persons will invalidate this warranty.

INSPECTION UPON RECEIPT

This product has been inspected and shown to operate correctly at the time of shipment, as verified by the Factory Verification Form that accompanies the power supply

Immediately upon receipt of the product, it should be inspected carefully for any signs of damage that may have occurred during shipment. If any damage is found, a claim should be filed with the carrier.

The package should also be inspected for completeness according to the enclosed packing list. If an order is incorrect or incomplete, contact your distributor.

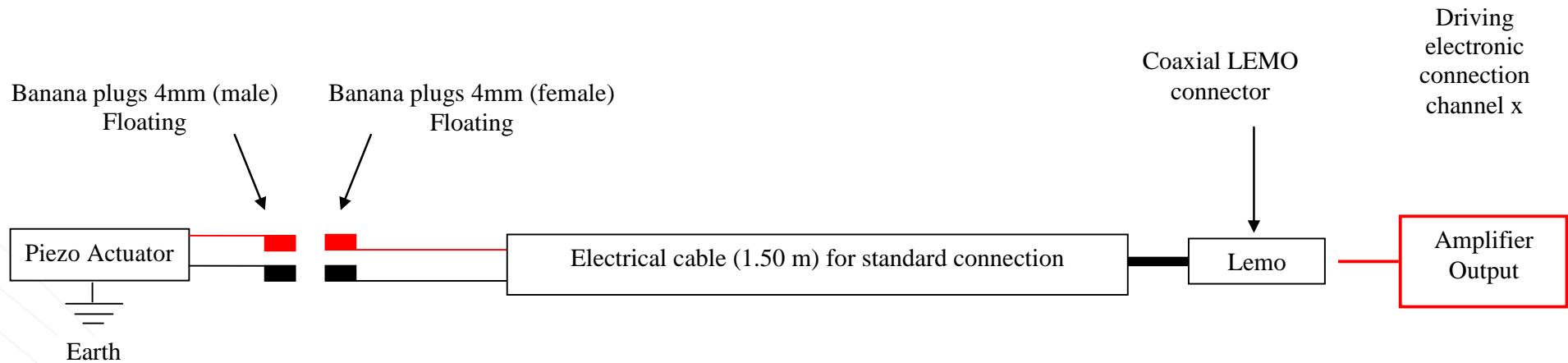
CEDRAT TECHNOLOGIES recommends the customer to keep the original package for any further carriage of the electronic product.

AFTER-SALES SERVICE

If a device requires service, please contact **CEDRAT TECHNOLOGIES** or your local vendor. Please include the device model and serial number in all correspondence with **CEDRAT TECHNOLOGIES** or your vendor.

APPENDIX 1 : CONNECTIONS

Scheme of the cable connection for standard electrical configuration



Note: the piezo connections are floating. Only mechanical shell could be connected to earth.

APPENDIX 2 : SA75-12 TECHNICAL DATA
SHEET ¹

Table of standard properties of use and measurement

The properties defined in the table below, are set up according to the technical conditions of use and measurement. These properties are warranted within their variation range and in compliance with the standard technical conditions of use.

Properties standard technical conditions of use and measurement:

Quasistatic excitation : AC voltage between -20 and 150 V at 1 Hz

Environment : Ambient temperature (15-25° C) and dry air (Humidity < 50 % rH)

Standard main supply : Main according to directive HD472.

Noise measurement : Excitation 0.5 Vrms ; reading bandwidth 1 Hz to 1 kHz

Any technical conditions of use, different from those defined above, can lead to temporary or definitive alterations of properties. Thank you to contact CEDRAT TECHNOLOGIES before using actuators under non standard technical conditions.

Factory tests carried out

- Test 1: Load and discharge time
- Test 2: Linearity output voltage vs. input voltage

Extra factory tests

- Test 3: Gain and linearity in closed loop
- Test 4: Step response in closed loop (sensor output voltage versus command voltage)
- Test 5: Thermal test at full load

¹ In all CEDRAT TECHNOLOGIES SA documents, the decimal sign is a comma on the line (ISO 31 -0:1992).

Properties SA75-12	Min.	Typ.	Max.	Unit	
Notes					
Function	Switching Power Amplifier				
Max. number of channels	2				
Protections	Thermal				
	Current				
	Voltage				
Main Voltage	110-230			Vac	
Output Voltage	-23		153	V	
Gain	20			V/V	
Peak Current Limitation	5 (SA75A)	10 (SA75B)	20 (SA75D)	A	
Output Apparent Power (Sine)	313 (SA75A)	626 (SA75B)	1252 (SA75D)	VA	
Peak Output Instantaneous Power	750 (SA75A)	1500 (SA75B)	3000 (SA75D)	VA	
Max. Output Active Power	150			175	W
Control Input Voltage (Single Ended)	-1		7.5	V	
Effective Switching Frequency	200			kHz	
Small signal bandwidth (-3dB)	1250			Hz	
Current noise (BW = 25MHz)	150			mArms	
Total Harmonic Distortion (C = 30µF)	0.7			%	
Signal to Noise Ratio	70			dB	
Input Impedance	10			kΩ	
Dimensions	470x310x200			mm ³	
Weight				kg	
Ambient temperature	0		40	°C	
Misc.	Actuator temp. sensor LEMO EPG-00-302-NLN card				

Available options:
 [UC] Servo Controller

APPENDIX 3 : SA75-12 TYPICAL WAVEFORMS

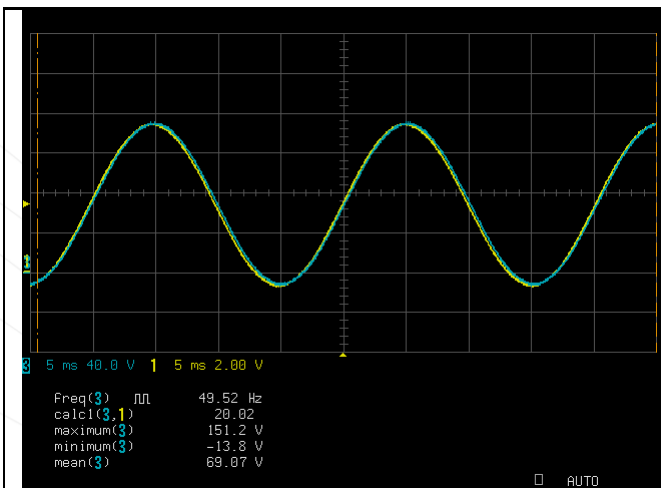
The next screenshots have been taken with these instruments:

Oscilloscope: Lecroy LT224 with a limited bandwidth of 25MHz

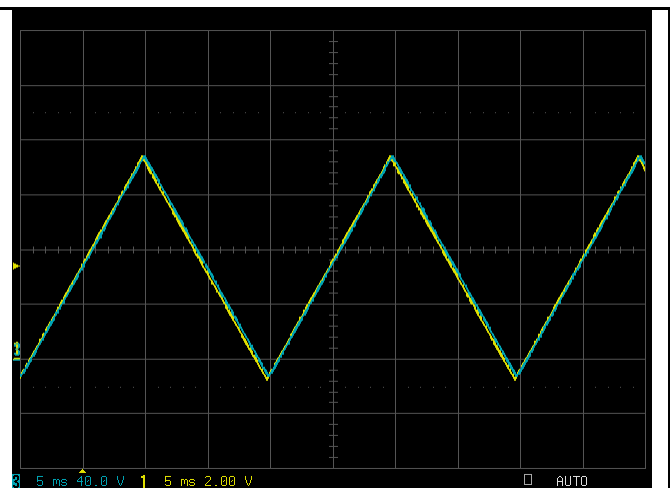
Voltage probe: GE8100 (200x attenuation unless otherwise stated)

The blue waveform is the output voltage measured with the mentioned probe on the load.

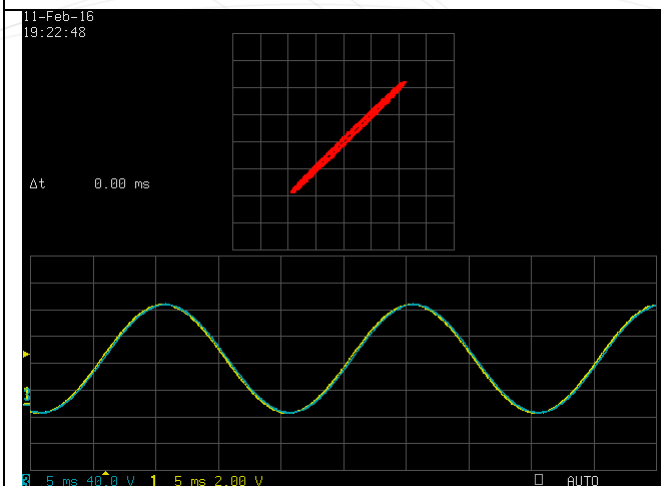
The yellow waveform is the order.



Sine Full Scale 50Hz



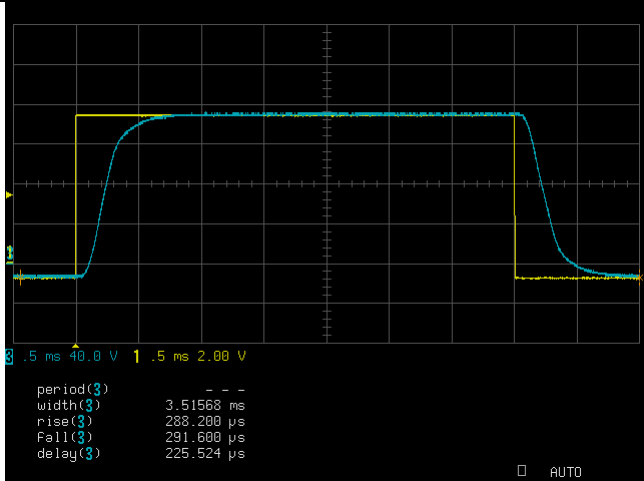
Triangle Full Scale 50Hz



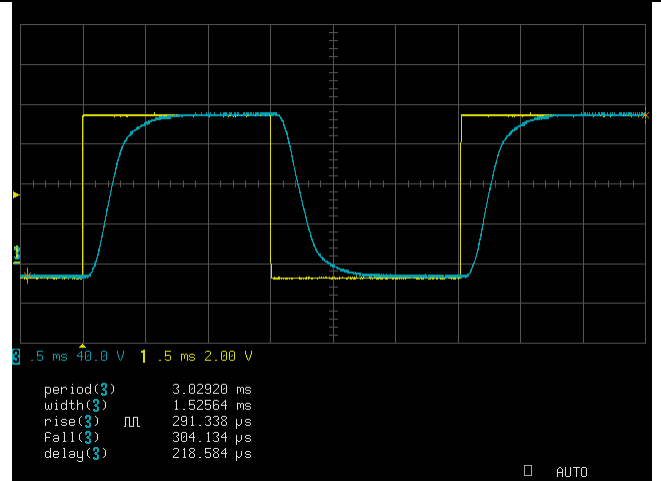
Sine Full Scale 50Hz (with XY)



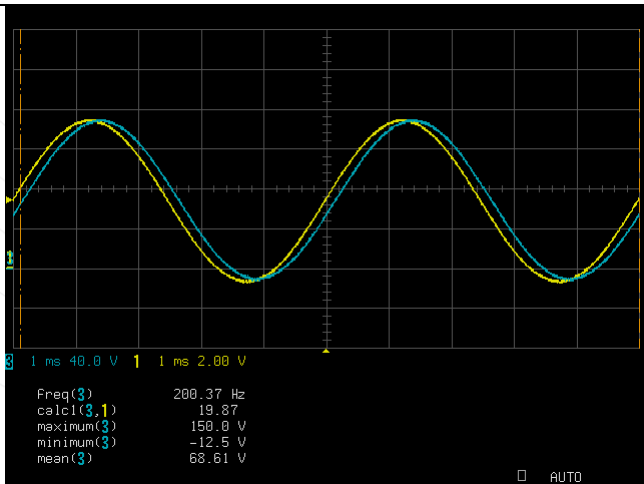
Triangle Full Scale 50Hz (with XY)



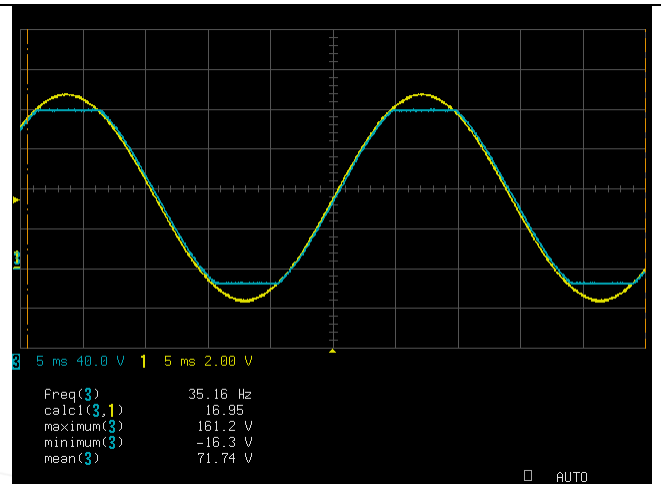
Square FS 140Hz



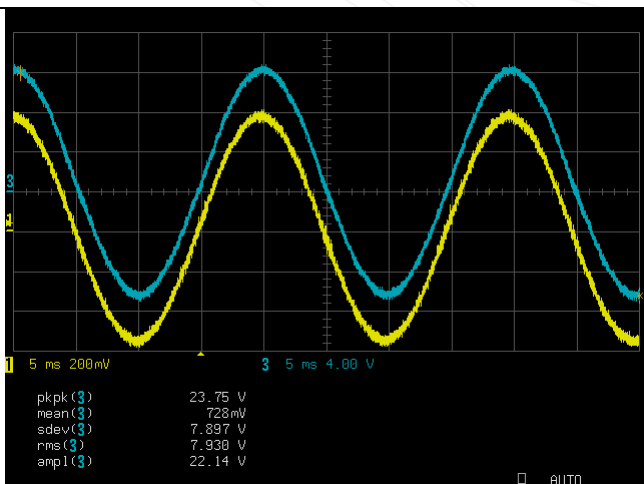
Square FS 330Hz



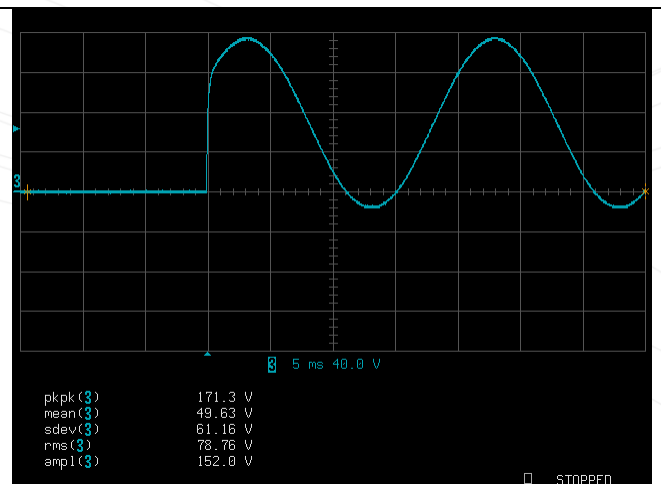
Sine 200Hz



Saturation behavior



Low voltage



Startup behavior

APPENDIX 4 : TROUBLE SHOOTING FORM

In case of trouble or breakdown with the electronic device, this form must be completed by the customer in order to:

- Allow Cedrat Technologies to authorise the product return back to the factory,
- Help Cedrat Technologies in repairing it.

Product: Please give mention here the references and delivery date,

History: Please summarise here every action which has been performed with the device since the delivery,

Problem description: Please describe here the problems faced with the electronics and which are not described in the paragraph 7,

Notations: Please define here the short term used for external devices plugged in the electronics in order to make the writing of “problem identification” easier,

Problem identification: Please summarise and describe here, using the “notations”, the operation that could lead to problem identification,

Action: Please mention and update here every action undertaken by yourself, by Cedrat Technologies or by your local vendor,

Please note that you need to get the authorization from CEDRAT TECHNOLOGIES before sending back the hardware.