SY3634 – SY3634T

Bipolar Power Supply
Heterogeneous System

CAENels
Gear For Science

Troubleshooting Guide

MAGNET POWER SUPPLY SYSTEMS

Rev. 2 – August 2024

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This product is CE certified.

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Document Revision	Date	Comment
1.0	July13th 2011	First Release
1.1	February 27th 2012	Some information added - e.g. ripple and regulation threshold
1.2	November 3rd 2014	Manual graphics changed
2	August 8th 2024	Updated address and revision numbering

Safety information - Warnings

CAENels will repair or replace any product within the guarantee period if the Guarantor declares that the product is defective due to workmanship or materials and has not been caused by mishandling, negligence on behalf of the User, accident or any abnormal conditions or operations.

Please read carefully the manual before operating any part of the instrument

WARNING

High voltage inside, do NOT open the boxes

CAENels declines all responsibility for damages or injuries caused by an improper use of the Modules due to negligence on behalf of the User. It is strongly recommended to read thoroughly this User's Manual before any kind of operation.

CAENels reserves the right to change partially or entirely the contents of this Manual at any time and without giving any notice.

Disposal of the Product

The product must never be dumped in the Municipal Waste. Please check your local regulations for disposal of electronics products.

Read over the instruction manual carefully before using the instrument.
The following precautions should be strictly observed before using the SY3634:

WARNING

- Do not use this product in any manner not specified by the manufacturer. The protective features of this product may be impaired if it is used in a manner not specified in this manual.
- Do not use the device if it is damaged. Before you use the device, inspect the instrument for possible cracks or breaks before each use.
- Do not operate the device around explosives gas, vapor or dust.
- Always use the device with the cables provided.
- Turn off the device before establishing any connection.
- Do not operate the device with the cover removed or loosened.
- Do not install substitute parts or perform any unauthorized modification to the product.
- Return the product to the manufacturer for service and repair to ensure that safety features are maintained

CAUTION

- This instrument is designed for indoor use and in area with low condensation.

The following table shows the general environmental requirements for a correct operation of the instrument:

Environmental Conditions	Requirements
Operating Temperature	5°C to 45°C
Operating Humidity	30% to 85% RH (non-condensing)
Storage Temperature	-10°C to 60°C
Storage Humidity	5% to 90% RH (non-condensing)

1. Faults

The aim of this troubleshooting guide is to give users information and hints on how to solve possible problems on the SY3634 system, the A3636 auxiliary power supply, the external bulk power supply unit, the Hardware Sentinel Key (HSK) and the A36xxBS modules – i.e. A3605BS, A3610BS, A3620BS, and A3630BS.

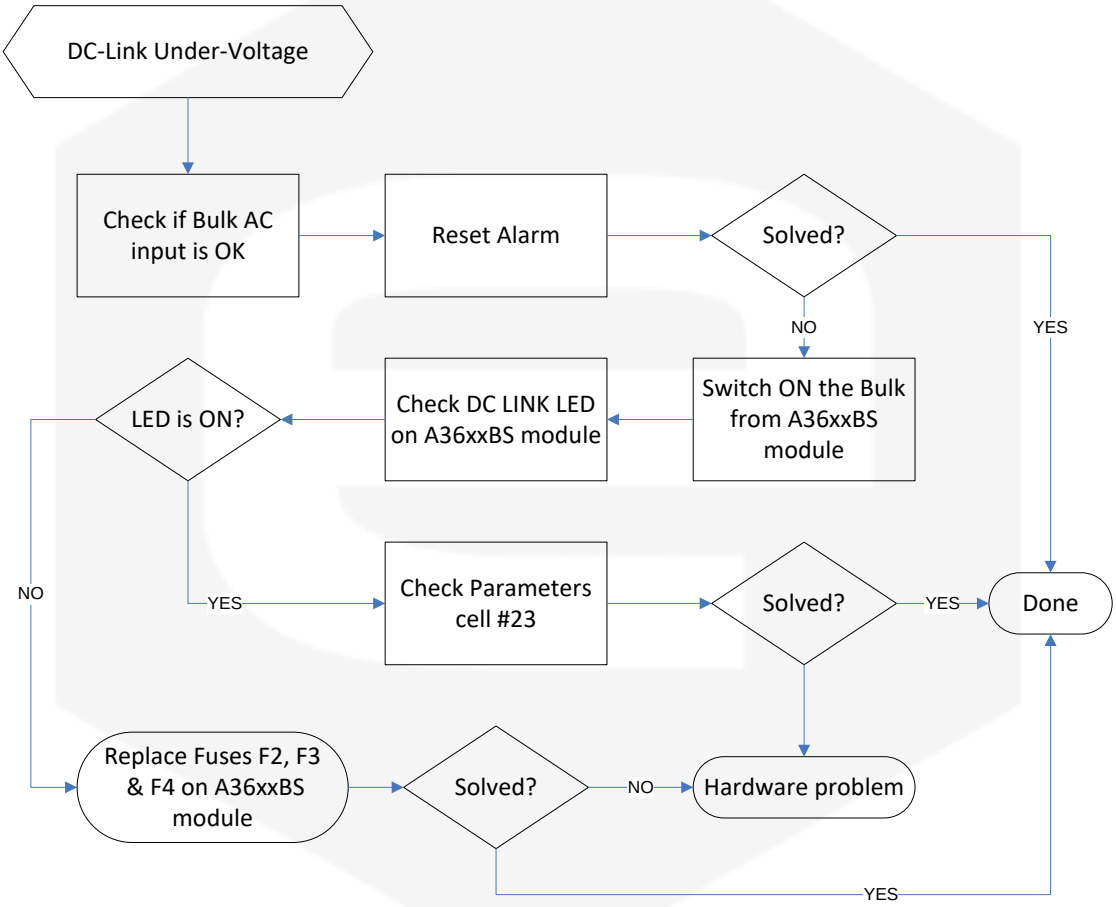
Some faults can be caused by hardware protection circuits and some other by software diagnostic routines. Please try to follow fault related flow-charts in order to solve arisen problems.

1.1 DC-Link Under-voltage

Each A36xxBS power supply module installed in the SY3634 system crate is capable of switching ON the external bulk power converter (with a 'BON' command, please refer to *SY3634 User's Guide* for further details).

When a switch ON command is sent to the bulk unit, it should imply the feeding of the 24V DC-Link to the SY3634 crate; if this does not happen, a DC-Link under-voltage fault is triggered.

Try to follow the **Flow Chart 1** to solve the problem.



Flow Chart 1: DC-Link Under-Voltage

- **Check DC LINK LED on the A36xxBS module**

  The DC LINK green light – see Figure 1 - is ON when at least 12V are present on the output stage circuit of the A36xxBS module. If this light is OFF and the DC-Link is present on the SY3634 crate – i.e. the DC_OK LED is ON in the external bulk power supply module – probably the fuses on the A36xxBS board are blown-up.
- **Check EEPROM "value" section cell #23**

The EEPROM “value” section cell #23 stores the voltage threshold limit value that is compared with the actual DC-Link voltage: if the measured voltage value drops below the threshold the module FPGA triggers the DC- Link under-voltage fault. Load a proper voltage threshold value to make the fault not being triggered again.

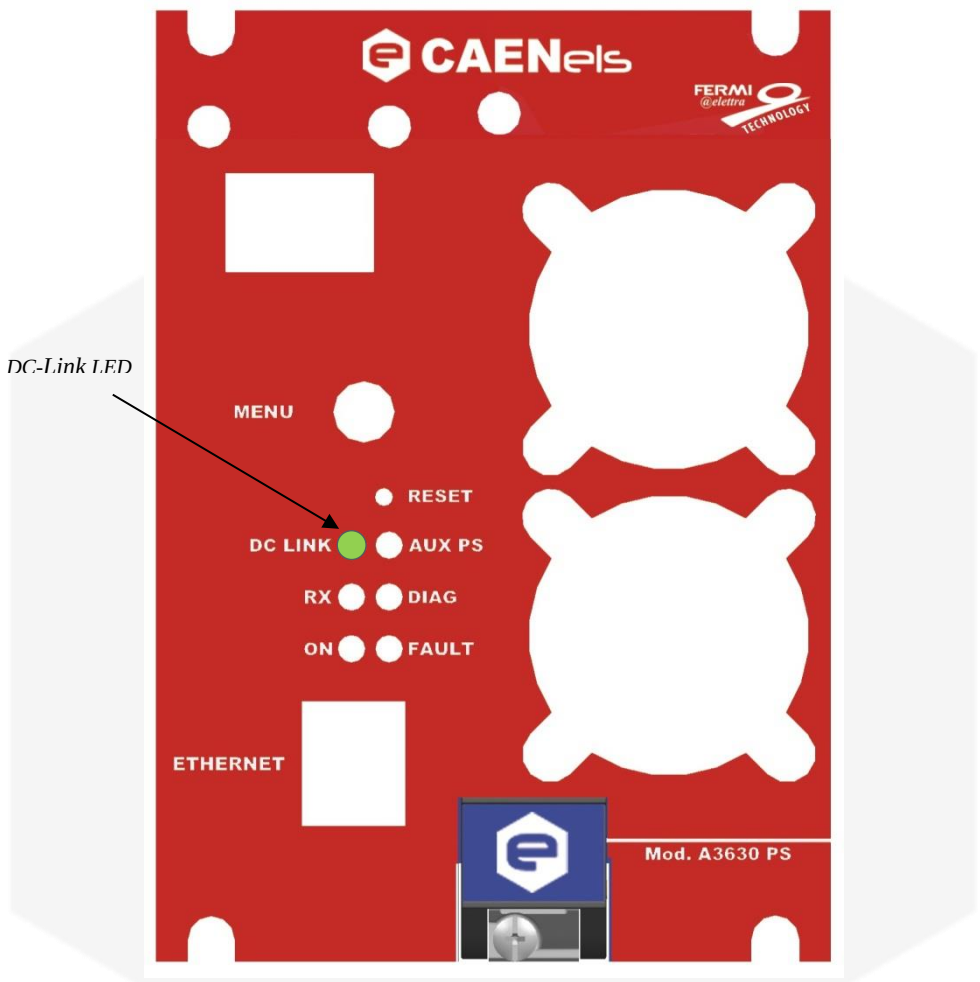


Figure 1: A36xxBS DC-Link LED

- **Replace fuses**

CAUTION: This operation can be done by expert personnel only.

WARNING: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.

Remove the three 10A surface-mounted fast fuses and mount equivalent new ones by a proper solder, avoiding damaging other close components.

- **Hardware problem**

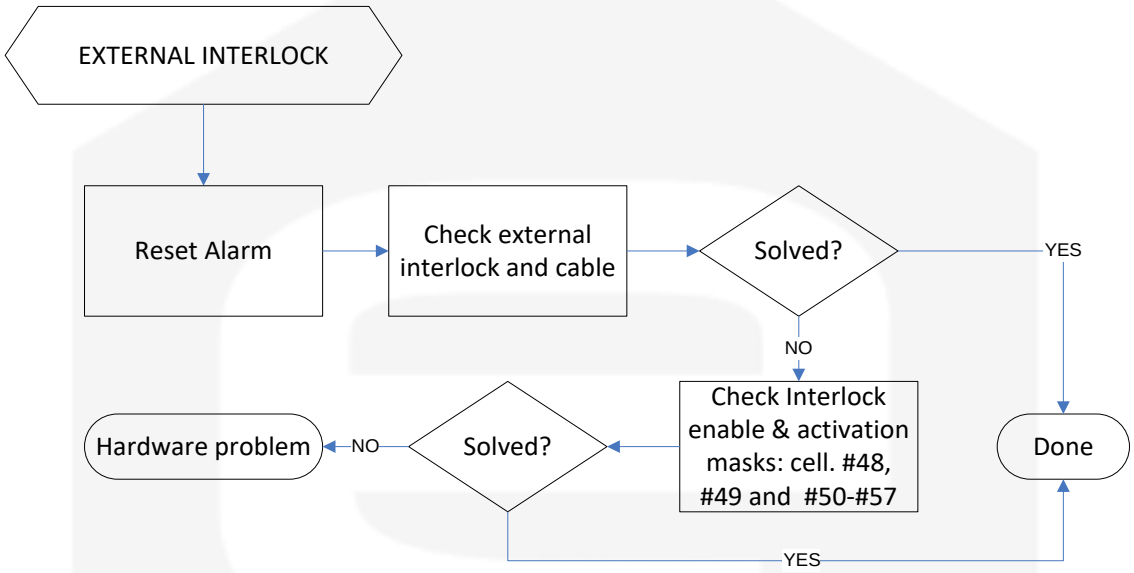
  A severe hardware problem has occurred and the module needs to be sent to assistance.

WARNING: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.

1.2 External Interlocks

Each channel/power supply is equipped with 8 external configurable faults; each external interlock name can be changed by storing the desired string in the respective EEPROM cell Fields (accessible with the commands “MRF:” and “MWF:”); cells from field #50 (for Interlock 1) to field #57 (for Interlock 8) are available. The stored strings are then shown on the local display when the respective interlock is triggered.

When no real interlock is sent but the A36xxBS triggers a fault, please follow **Flow Chart 2** to try solving the problem.



Flow Chart 2 : External Interlock

- **Check EEPROM “value” section cells #48, #49 and #50 to #57**

  The EEPROM “value” section cell #48 stores (in an ASCII hexadecimal notation) the interlock enabling/disabling mask.

  For example, a value of “05” means that only external interlock 1 and interlock 3 (note that interlocks are numbered from 0 to 7) are active and all the others are ignored.

  The EEPROM “value” section cell #49 stores (in an ASCII hexadecimal notation) which input logic level (LOW or HIGH) must trigger a fault.

  For example, a value of “01” means that interlock 1 is triggered as a fault when input is open – and the voltage level is HIGH – and Interlocks from 2 to 8 are triggered when input are closed (assuming that all inputs are activated by a “FF” stored in cell #48).
  The EEPROM “value” section cells from #50 to #57 store the time of intervention for each interlock in milliseconds (ms).
- **Hardware problem**

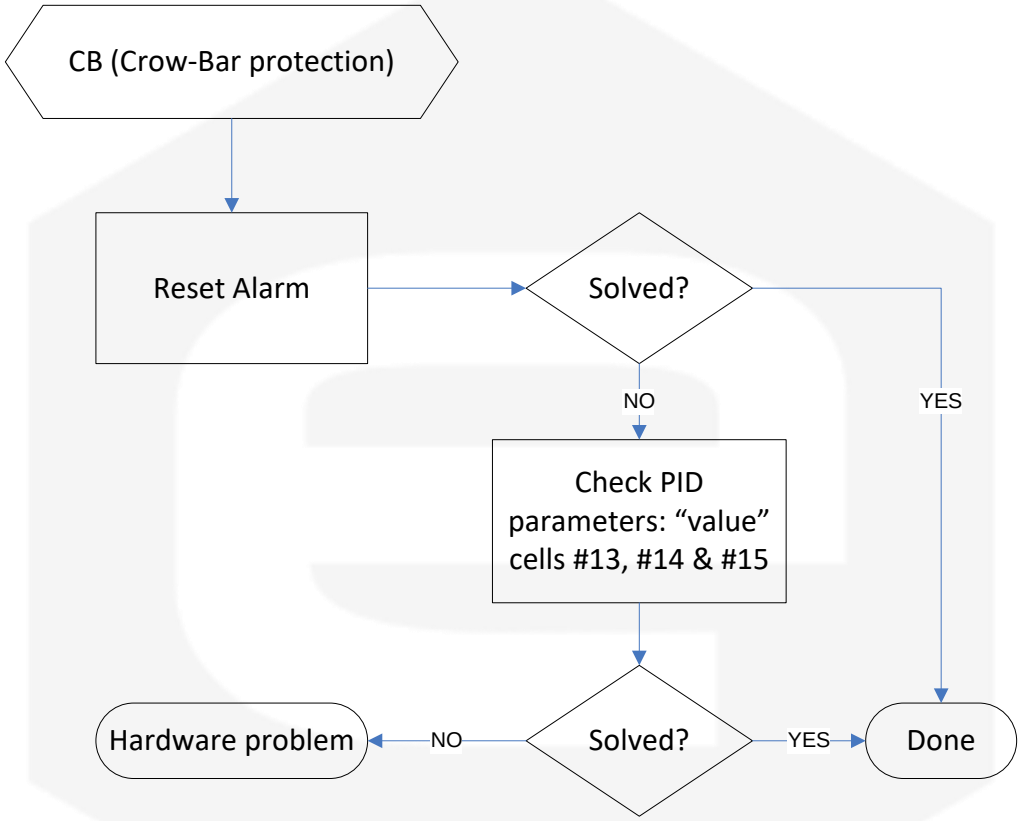
A severe hardware problem has occurred and the module needs to be sent to assistance.

WARNING: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.

1.3 Crow-Bar Protection

The Crow-Bar circuit shorts the A36xxBS output terminals by switching on a TRIAC if the output voltage exceeds a fixed threshold, thus triggering the respective fault that consequently switches off the A36xxBS power supply module.

An unwanted-high output voltage can be caused either by an uncontrolled sudden turning off of the H-Bridge when an inductive load is used or by a wrong selection of the digital PID compensator parameters.



Flow Chart 3: Crow-Bar protection

Please follow **Flow Chart 3** to solve the problem.

- **Check EEPROM “value” section cells #13, #14 and #15**

  The EEPROM “value” section cells #13, #14 and #15 store the compensator parameters, i.e. K_P, K_I and K_D respectively. If these gain parameters are not well matched to work on the actual load conditions, the output voltage can oscillate during current set changes and subsequently can trigger the crow-bar circuit to operate.

- **Hardware problem**

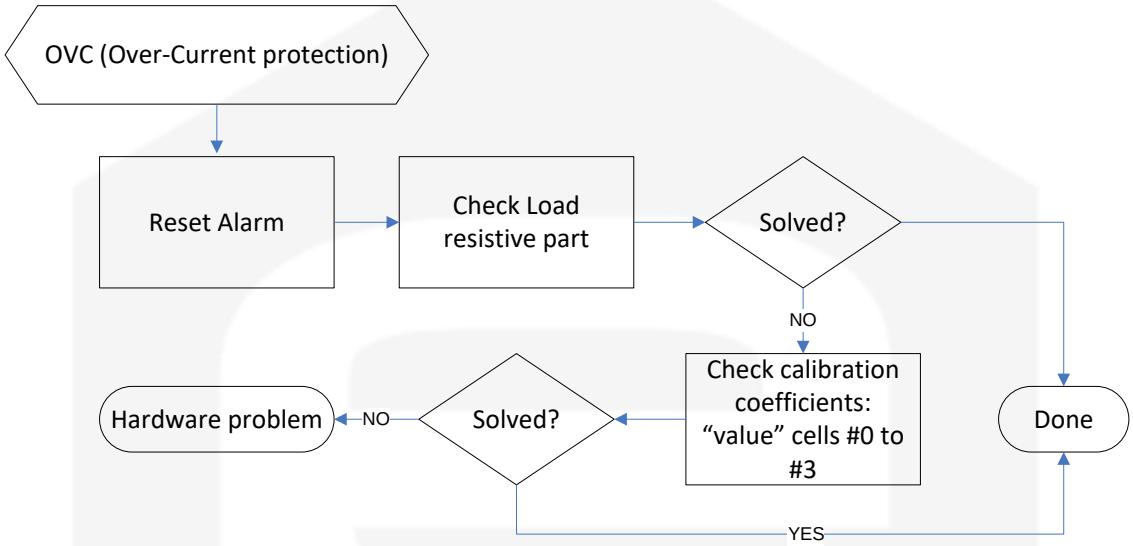
  A severe hardware problem has occurred and the module needs to be sent to assistance.

WARNING: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.

1.4 Over-Current Protection

The Over-Current protection circuit measures the module input DC-Link current by means of a surface-mounted Hall-effect sensor that switches OFF the output MOSFET drivers when the current exceeds a fixed threshold (note that this threshold is lower than input fuses rating – i.e. 30A).

An excessive input current can be caused either by an excessive output power request or by a hardware failure on the MOSFET H-Bridge. The Over-Current fault can be also rarely caused by a wrong EEPROM parameterization setup.



Flow Chart 4: Over-Current protection

Follow **Flow Chart 4**: **Over-Current protection** to solve the problem.

- **Check connected load resistive part**

  If the connected load resistive part is too high the output power can exceed the capabilities of the A36xxBS module at high current sets.

- **Check calibration coefficients – EEPROM “value” section cells #0 to #3**

  The EEPROM “value” section cells #0 to #3 store the coefficient for the cubic calibration curve. If, for some reason, these coefficients are corrupted, the output current set will not correspond to the actual output current and may correspond to a high output power.

- **Hardware problem**

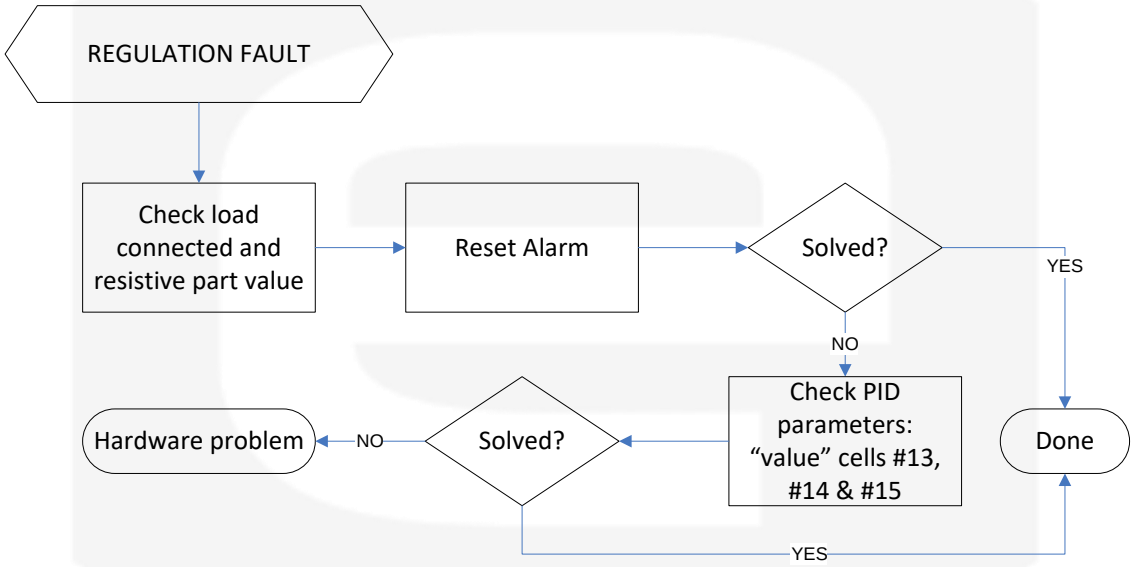
  A severe hardware problem has occurred and the module needs to be sent to assistance.

WARNING: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.

1.5 Regulation Fault

The regulation fault diagnostics continuously compares the actual output current value with the current set and triggers a fault condition whenever their absolute difference exceeds by a user-defined fixed limit; this trigger switches off the A36xxBS power supply module.

A regulation fault generally arises when the load is not correctly connected (or not connected at all) to the output terminals of the power supply or the resistive part of the load is higher than the A36xxBS module ratings in terms of maximum output voltage. This fault can be caused by a wrong choice of the PID compensator parameters as well. The regulation fault current threshold is defined as the maximum steady-state difference between the output desired setpoint value and the regulated actual output current readback value. Factory default (EEPROM cell #37) is 0.2 [A] for any A36xxBS modules.



Flow Chart 5: Regulation Fault

Follow **Flow Chart 5** to solve the problem.

- **Check EEPROM "value" section cells #13, #14 and #15**

  The EEPROM "value" section cells #13, #14 and #15 store the A36xxBS digital regulator parameters, i.e. K_P, K_I and K_D. If these values are not well matched to work on the actual load conditions, the output current can reach, after current set changes, the set value too slowly (e.g. tens of seconds) and the difference between the set current and the actual output current can be too high for an excessive time interval.

- **Hardware problem**

A severe hardware problem has occurred and the module needs to be sent to assistance.

As the last check, you may try to read to content of the EEPROM "value" field cell #37; this value should be factory default 0.2 [A].

WARNING: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.

1.6 Auxiliary Earth Fault

When any output terminal of any of the A36xxBS power supply modules installed in a SY3634 system crate has a path to Earth, an undesired current entity flows through this path.

If this current is relatively small – i.e. less 1A – the earth current DCCT detector installed on the corresponding A36xxBS module directly switches off the output H-Bridge, thus avoiding possible system damages.

If the A36xxBS module, for any reason, does not correctly detect the leakage current to earth or it does not switch OFF the output driver, the earth fuse, placed on the A3636 auxiliary power converter module, will blow-up

A detection circuit directly feeds an opto-coupler placed on the inputs of the A36xxBS power supply modules installed in the SY3634 crate, thus resulting in a fault and switching ON the red light, marked as “E F” on the A3636 auxiliary front panel, as shown in Figure 2.

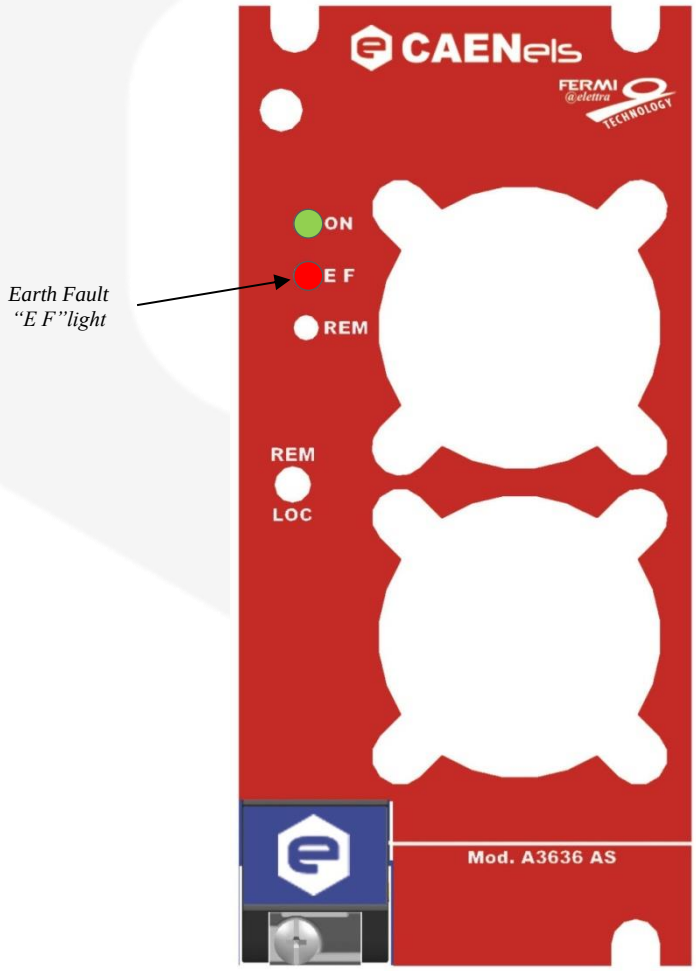
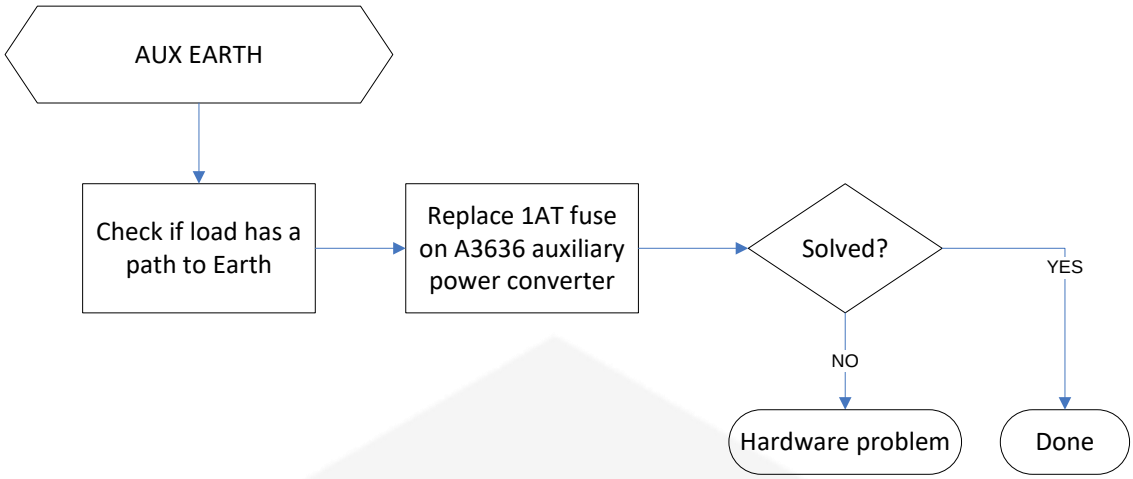


Figure 2: A3636 “E F” light on auxiliary power supply

Follow **Flow Chart 6** to solve the problem.



Flow Chart 6: Auxiliary Earth Fault

- **Replace the fuses on A3636 auxiliary power converter**

  WARNING: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate. Replace the 1AT fuse present in the inner-side of the board, as shown in Figure 3.

- **Hardware problem**

  A severe hardware problem has occurred and the module needs to be sent to assistance.

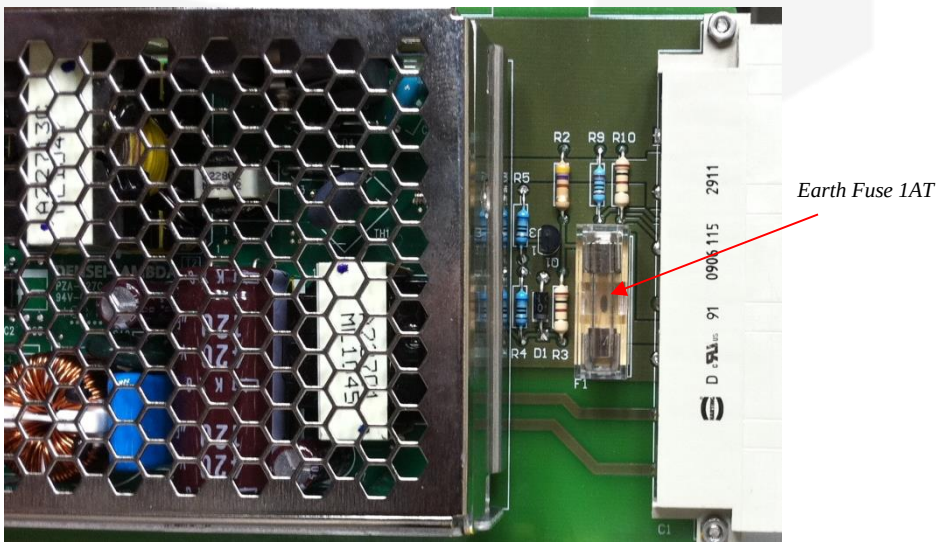
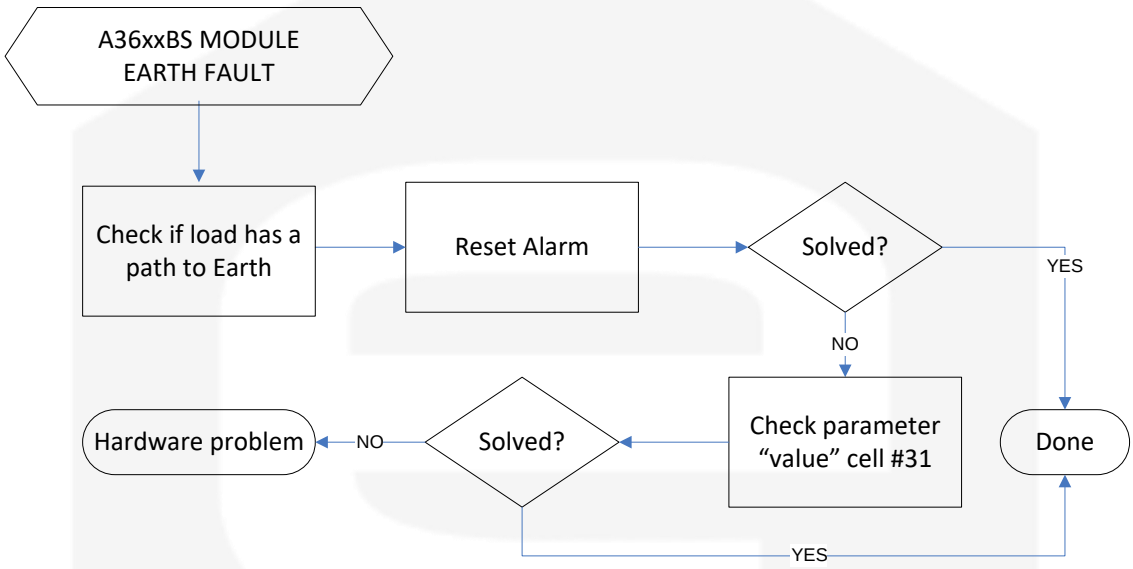


Figure 3: A3636 auxiliary power supply earth fuse

1.7 Earth Fault

When any output terminal (either positive or negative) of the A36xxBS module has a direct path to earth, an undesired current flows through this path. The earth DCCT mounted on the module measures this current and compares its value to a configurable threshold: if the measured value its higher than the threshold a fault triggering condition takes place.

If the A36xxBS module, for any reason, does not correctly detect the leakage current to earth or it does not switch OFF the output driver, the earth fuse, placed on the A3636 auxiliary power converter module, will blow-up



Flow Chart 7: Earth module fault

Follow **Flow Chart 7** to solve the problem.

- **Check "value" section cell #31**

  The EEPROM "value" section cell #31 stores the threshold current value that is compared to the earth leakage current detected by the earth DCCT placed on each A36xxBS module.
  Values for this parameter should be included between 50mA to 1000mA.

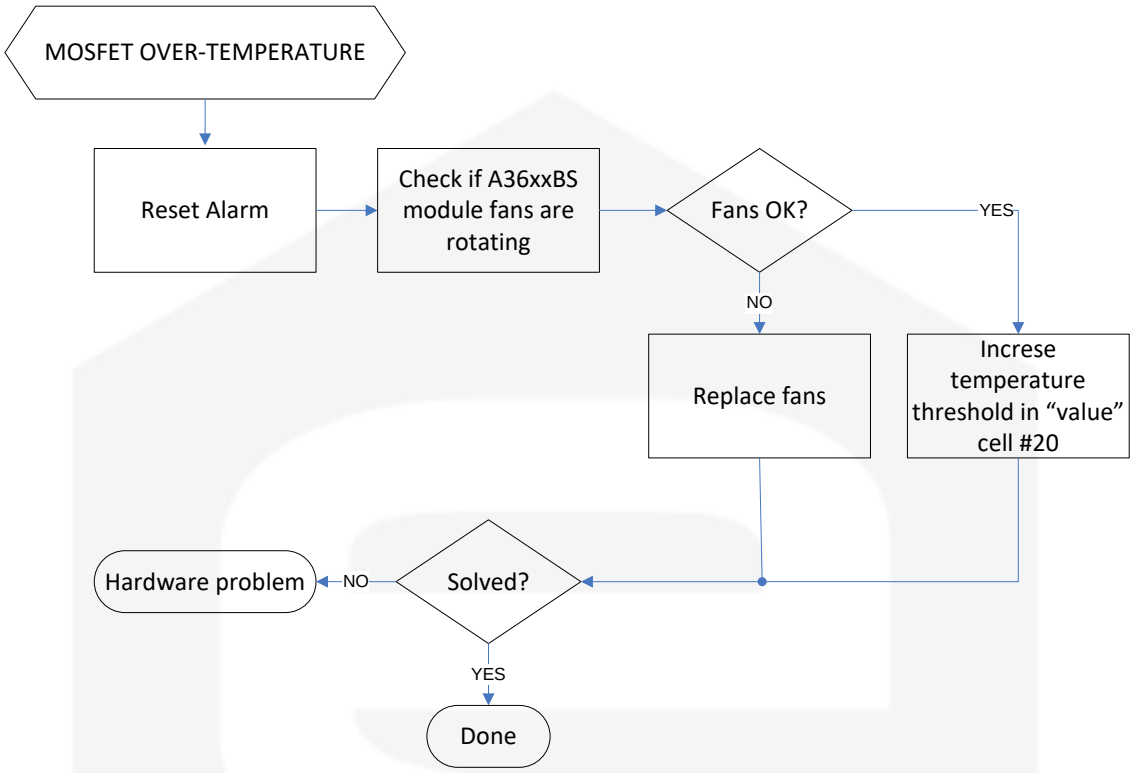
- **Hardware problem**

  A severe hardware problem has occurred and the module needs to be sent to assistance.

WARNING: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.

1.8 MOSFET Over-Temperature

When the output stage MOSFETs common heat-sink temperature on the A36xxBS module exceeds the threshold value stored in the EEPROM, the module on-board FPGA triggers a fault.



Flow Chart 8: MOSFET over-temperature

Follow **Flow Chart 8** to solve the problem.

- **Check MOSFET temperature threshold: EEPROM "value" cell #20**

  The EEPROM "value" section cell #20 stores the threshold value that is compared to the MOSFET common heat-sink temperature.
  Values for this parameter should be between 40°C to 80°C.

- **Replace fans:**

  Unscrew the screws that lock the fans to the front panel, unplug the cables connected to FAN_1 and FAN_2 connectors and replace fans with spare ones.

  WARNING: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a

shock hazard. Switch OFF the general mains before extracting the board from the crate.

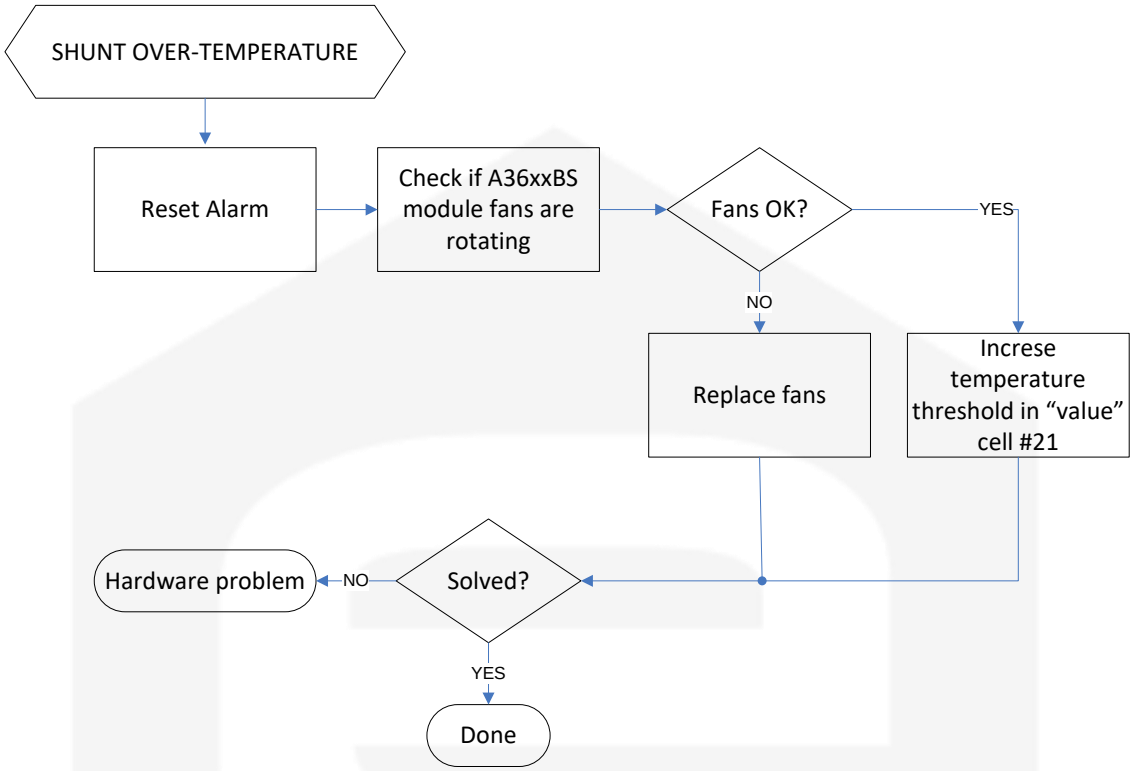
- **Hardware problem**

  A severe hardware problem has occurred and the module needs to be sent to assistance.

   *WARNING*: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.

1.9 Shunt Over-Temperature

When the shunt temperature on the A36xxBS power supply module exceeds the user-defined threshold value stored in the EEPROM, the module triggers a fault.



Flow Chart 9: Shunt Over-Temperature

Follow **Flow Chart 9** to solve the problem.

- **Check shunt temperature threshold: EEPROM "value" cell #21**

  The EEPROM "value" section cell #21 stores the temperature threshold that is compare with the shunt case temperature.
  Values for this parameter should be between 40°C to 80°C.

- **Replace fans:**

  Unscrew the screws that lock the fans to the front panel, unplug the cables connected to FAN_1 and FAN_2 connectors and replace fans with spare ones.

  WARNING: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.

- **Hardware problem**

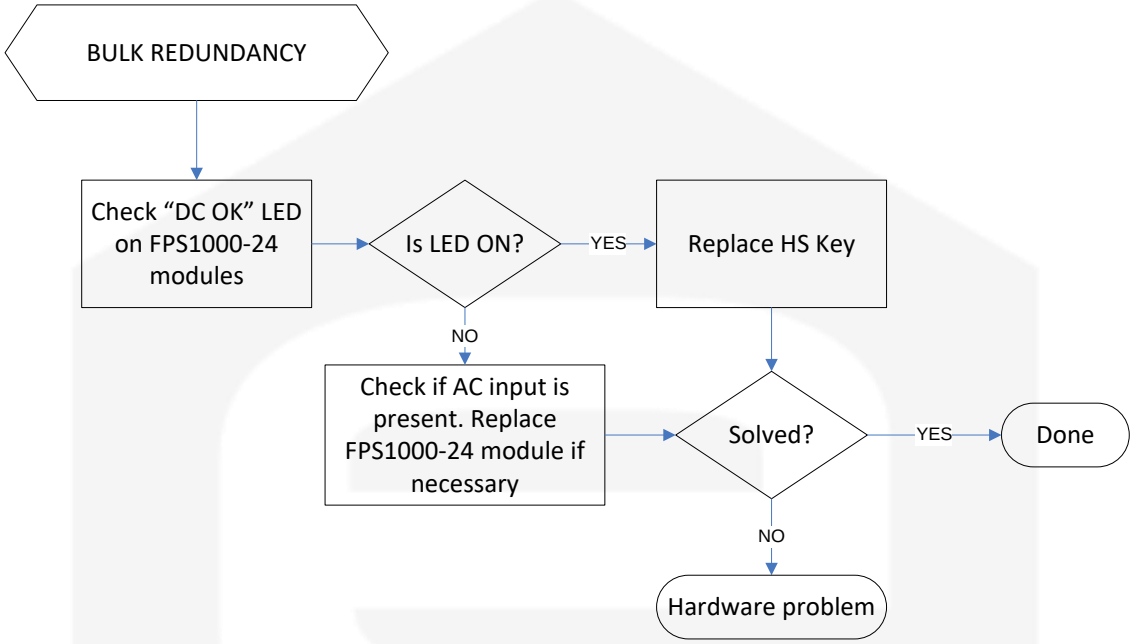
  A severe hardware problem has occurred and the module needs to be sent to assistance.

   *WARNING*: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.

1.10 Bulk Redundancy

When one of the external FPS1000-24 AC/DC power converters composing the bulk power unit is faulty, a dry-contact signal is fed to all the A36xxBS modules connected to the SY3634.

This dry-contact signal is generated by the Hardware Sentinel Key (HSK) mounted on the 25-pin connector placed on the back side of the external bulk FPS1000 1U crate.



Flow Chart 10: Bulk redundancy

Follow **Flow Chart 10** to solve the problem.

- **Replace HS Key**

  CAUTION: switch OFF the GENERAL Mains before unplug the bulk cable from the HS Key and the FPS1000 case.

- **Hardware problem**

  A severe hardware problem has occurred in the A2630BS DC/DC module that is reporting the fault and the module needs to be sent to assistance.

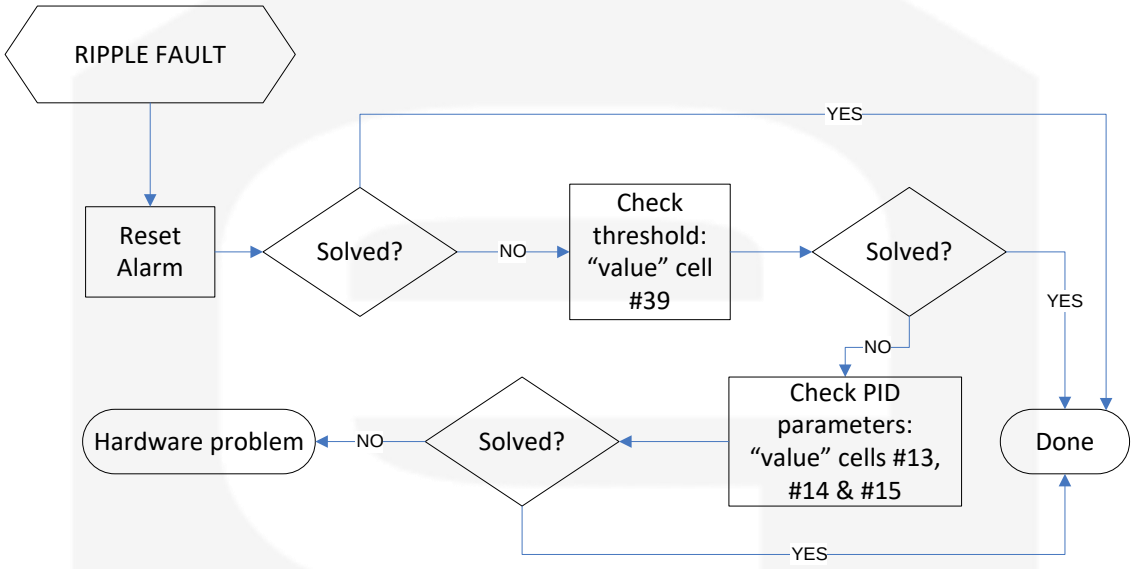
  WARNING: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.

1.11 Ripple Fault

The output current ripple fault diagnostics continuously compares if the actual output current value is within a pre-defined current threshold interval and triggers a fault condition; this trigger switches off the A36xxBS power supply module.

A ripple fault generally arises when the internal digital PID parameters are not well matched/tuned to the connected load. This fault can be caused by a wrong choice of the PID compensator parameters as well by a too small threshold value.

This threshold value can be found in EEPROM cell #39 (see **SY3634 User's Manual** for further details) and the default value is 1% of full scale - e.g. 50 mA for a A3605BS module.



Flow Chart 11: Ripple Fault

Follow **Flow Chart 11** to solve the problem.

- **Check EEPROM "value" section cell #39**

  The EEPROM "value" section cells #39 stores the A36xxBS current ripple threshold parameter. This threshold has to be interpreted as the maximum ripple *amplitude* value - i.e. half of the *peak-to-peak* allowable ripple.

- **Check EEPROM "value" section cells #13, #14 and #15**

  The EEPROM "value" section cells #13, #14 and #15 store the A36xxBS digital regulator parameters, i.e. K_P, K_I and K_D. If these values are not well matched to work on the actual load conditions, the output current can tend to oscillate and these oscillations can be greater than a pre-defined threshold. An

example of this behavior can be represented by a worse case of trace M3 in Figure 4 - e.g. it is closer to instability than trace M2 response.

- **Hardware problem**

  A severe hardware problem has occurred and the module needs to be sent to assistance.

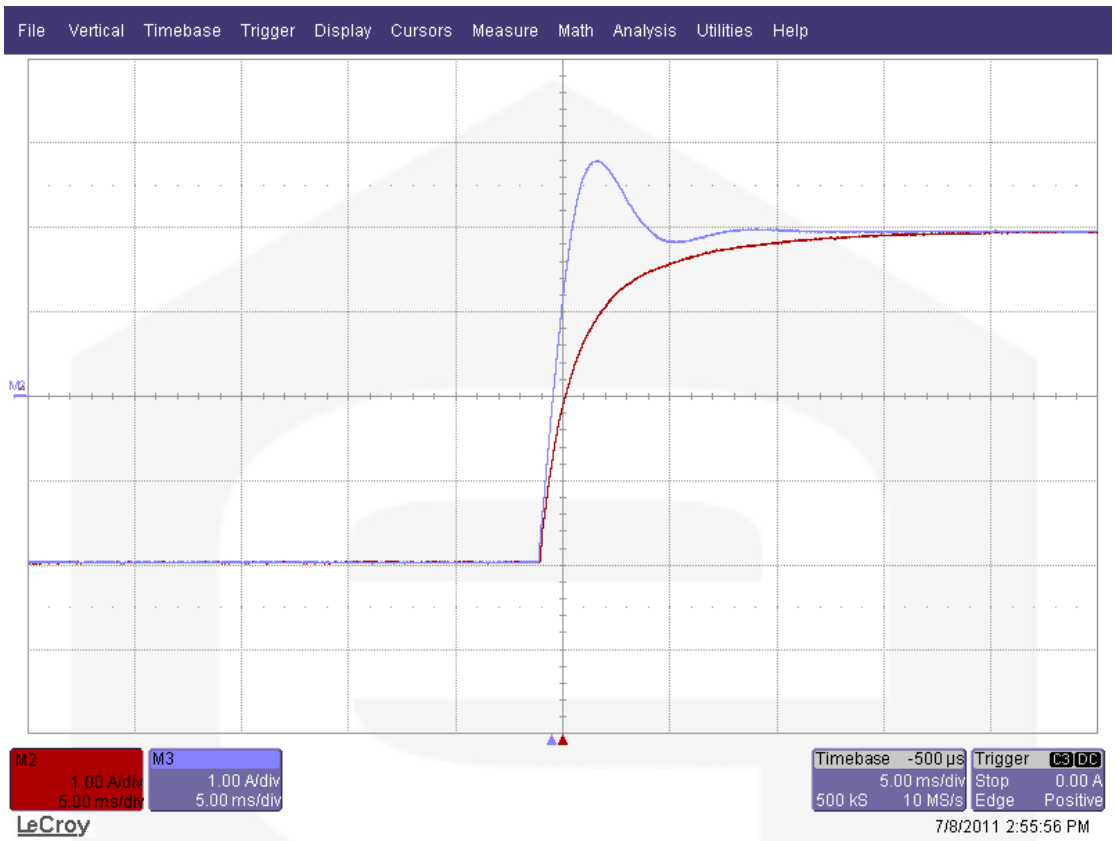
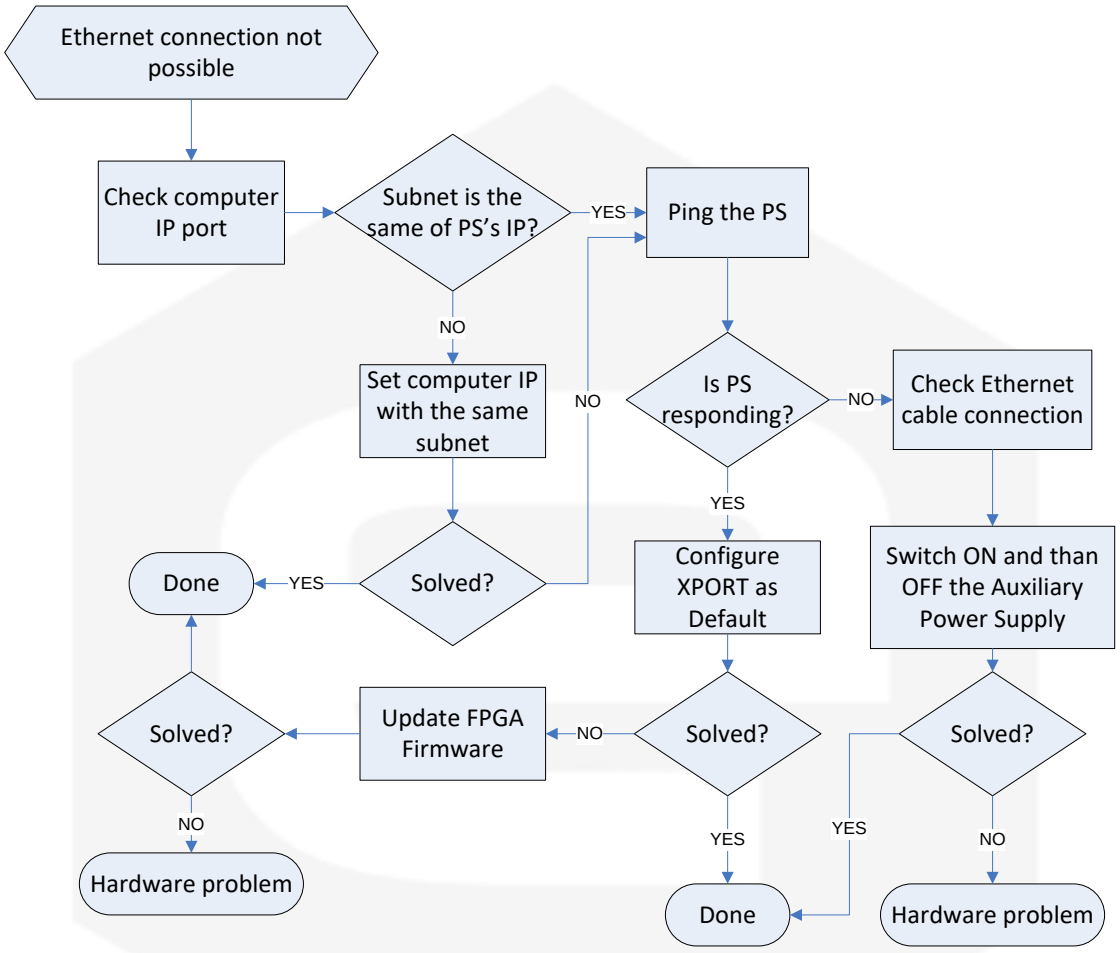


Figure 4: step responses for different PID parameters

WARNING: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.

1.12 Ethernet Connection

Flow Chart 12 may be used whenever a user is unable to remotely connect to an A36xxBS power supply module – neither by TCP/IP nor UDP.



Flow Chart 12: Ethernet connection problem solving

- **Set the computer subnet to the same one of the A36xxBS power supply**

  If the A36xxBS power supply IP address is in the form **10.2.2.xxx** (where 'xxx' is a number included from 0 to 255), try to configure the computer IP address on the same subnet: for instance as **10.2.2.1**.

- **Configure XPort™ as default**

  Use a web browser and connect to the A36xxBS power supply IP address, as shown in Figure 5. Referring to Figure 6, click on "Apply Default" link and confirm.

Figure 5: XPort™ web-server interface

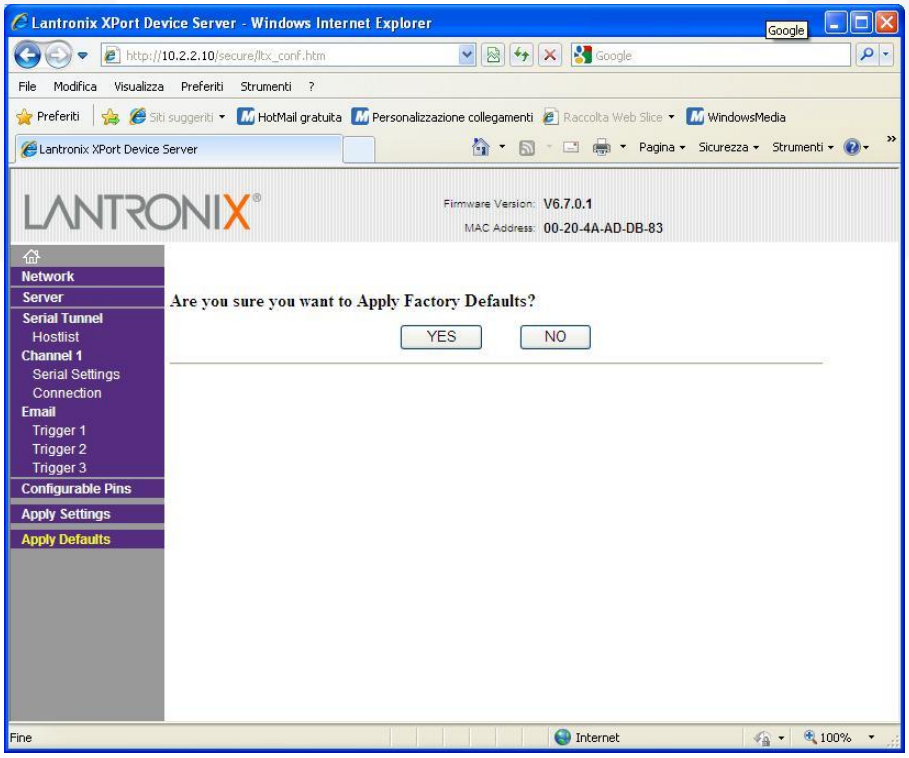


Figure 6: Apply default Ethernet settings

- **Update the FPGA firmware**

  Check for firmware updates on the CAENels website (www.caenels.com) and load/reload the FPGA firmware.

- **Hardware problem**

  A severe hardware problem has occurred in the A36xxBS power supply module that is reporting the fault and the module needs to be sent to assistance.

   *WARNING*: removing the first A36xxBS module installed in the SY3634 crate, next to the A3636 auxiliary power converter, can cause a shock hazard. Switch OFF the general mains before extracting the board from the crate.