

START PRIMARY SWITCHING POWER SUPPLY

Technical and User Manual Revision 02

Described units:

All 2, 5 or 11kW START Power Supplies

Doc. N°: START_MA_02

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This manual describes the units as they are at the date of printing.

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This unit is not designed for any type of use which is not specifically described in this manual. Such use may be hazardous.

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Introduction

This manual applies to all 2, 5 or 11kW START Power Supplies

The built in electronic protection circuitry has been designed to protect against:

Thermal risks

Electrical hazards

Technical Chapter

1 SAFETY INSTRUCTIONS

The device has been developed in accordance with the standard IEC 61010-1 “Safety requirements for electrical equipment for measurement, control, and laboratory use”. For any maintenance operation, please refer to the chapter *Maintenance*. The different operations must be done by an authorized and qualified technician only. The user can also contact SIGMAPHI Electronics After-Sales Service

E-mail: elecsupport@sigmaphi.fr
Phone : +33 3 67 220 314

This device is an electric generator and must be used for its especially designed applications only. Please refer to the *OPERATION* chapter of this manual. These power units contain live parts. Running without protection panels or doors opened is strictly forbidden. Switch off imperatively the mains inputs before any intervention.

Electrocution risk!

In certain types of device and depending on the configuration, an electric potential can be generated between the analogue ground and the protective earth. Be sure of voltage absence before every intervention on the device or on the load.

The connection of the device to the user's grid must be done by an authorized and qualified technician only. Use only the provided cables. For specific devices, cables may not be provided. In that case, types and sections of cables must be in accordance with the running standards. A non-adapted section can lead to excessive heating or even fire. The type must be in accordance with the voltage of the equipment.

Risk of flash or electric shock!

Never touch, disconnect or short-circuit any cable during the use of the device. Flash, burning and electrocution risk!

Sprinkling or pouring liquids on the device is forbidden. Use a wet or alcohol soaked rag to clean the machine.

Warning concerning the pacemakers: the device emits EM waves that can disrupt the functioning of pacemakers.

The non-respect of all warnings, advices and instructions indicated in this manual can deteriorate the security of the device. Thus, the safe operation will no longer be guaranteed.

The power units described in this manual are intended to be used inside an IP 20 (minimum) cabinet and protected in accordance with the running standards. In case of non-respect of this normal use condition, safety is no longer guaranteed and the manufacturer declines any responsibility for damage or injury. A label, stuck on the device, reminds this rule to the user.

Information:



Figure 1-1 Electrical Shocks

DANGER! Risk of electrical shocks

Throughout this manual, this symbol indicates the possibility of severe personal injury, loss of life or equipment damage if the instructions are not followed.

On the equipment, the symbol also implies a danger and alerts the user.

This general danger sign warns about the different risks listed below:



Figure 1-2 Danger

- Electrical shock from power supply
- Contact burns from the module and heat sink
- Cutting
- Burning
- Electronic shocking
- Moving part (fan)

2 HANDLING

The unit weights less than 25kg and can be handled by one person.

3 GENERAL INSTALLATION

The installation of the device must be done only by an authorized and qualified technician, in total accordance with the running standards. Every breakdown due to a non-respect of the following instructions will not be attributable to SIGMAPHI Electronics and will not be covered by the guarantee clauses.

The non-respect of all warnings, advices and instructions indicated in this manual can deteriorate the security of the device. Thus, the safe operation will no longer be guaranteed. SIGMAPHI Electronics assumes no liability for the customer's failure to comply with these requirements and is therefore not responsible or liable for any injury or damage that occurs as a consequence of non-approved installation.

3.1 *Initial Inspection*

3.1.1 *Mechanical Check*

If damage of the shipping protection material, request the carrier's agent to be present when the instrument is unpacked. Check the equipment for damage and inspect the cabinet and panel surfaces for dents and scratches.

3.1.2 *Claim for Damage*

If the unit is mechanically damaged or fails to meet specifications upon receipt, notify SIGMAPHI Electronics Support immediately. Retain the shipping and packing material for the carriers inspection as well as for subsequent use in returning the unit if necessary.

3.1.3 *Reshipment and Repackaging Requirements*

Whenever possible, the original packing material should be used for reshipment. If the original packing material is not available, wrap the instrument in heavy paper or plastic. Use a strong shipping container.

Use shock absorbing material around all sides of the instrument to provide a firm cushion and to prevent movement from inside the container wall on each side. Protect the front panel by means of cardboard spacers inserted between the front panel and the shipping box. Make sure that the instrument cannot move in the container during shipping. Seal the box with a good grade of shipping tape and mark the container:

"FRAGILE ELECTRONIC INSTRUMENT"

3.2 Environmental Requirements

This model is built for inside use only on a maximum elevation of 2000m above sea level (6600 feet).

Be sure that the device has enough area around it so that the free air flow into and out of the device is not obstructed.

The storage temperature range is 5°C - 50°C (41°F - 122°F). For working conditions see specifications.

To offer optimum ventilation:

- Respect a 20 cm minimum distance between the device and the walls.
- Do not seal the different air admissions.
- Do not cover air extractions.
- The non-respect of these instructions can lead to an over-heating of the device and deteriorations can be a result.

Keep away any inflammable parts around and under the device.

3.3 Mains Input

Make sure that the available mains voltage corresponds to the need of the device.

3.4 Output Connection to the Load

Connect the unit's output to the load before applying power.

3.5 *Water Cooling (if device is concerned)*

3.5.1 *Used Materials*

The cooling circuits of SIGMAPHI Electronics power supplies are built with the following materials being in contact with cooling water:

- Copper
- Stainless Steel
- Plastic
- Rubber hoses

Not all materials of this list are used in all supplies.
Explicitly not used are:

- Brass
- Zinc
- Aluminum
- Black Iron
- Polyvinyl Chloride.

For any precision needed, please contact SIGMAPHI Electronics Support

3.5.2 *Definition of Water Quality:*

This power supply do not contains parts which are directly exposed to a voltage potential, the conductivity of the cooling water must be limited to not more than **40 mS/m**.

(Comment: This value corresponds to 400 $\mu\text{S/cm}$). This limit applies to switch-mode power supplies. The water must be free from oxygen; this implies the use of a closed-circuit cooling system with degassing, if necessary.

This limit is derived from values given by GSI Helmholtzzentrum für Schwerionenforschung GmbH, an internationally agreed research center for nuclear physics, operating since 1969 serious amounts of power supplies and magnets of all interesting technologies. Same values can be found throughout all international research centers; DESY at Hamburg and CERN at Geneva are only two of them.

The non-respect of values can severely damage the water circuit.

3.5.3 *Cooling Water Temperature*

Caution: Condensation can result from high difference between the ambient temperature and the cooling water temperature.

Table 3-1 Cooling Water Temperature

| | | Room temperature (°C) | | | | | | | | | | | | | | | |
|-----------------------|----|-----------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| Relative Humidity (%) | 10 | | | | | | | | | | | | | | | | |
| | 20 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 |
| | 30 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 |
| | 40 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 13,0 | 14,0 | 14,5 | 15,5 | 16,5 |
| | 50 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,0 | 12,5 | 13,5 | 14,5 | 15,0 | 16,0 | 17,0 | 18,0 | 19,0 | 20,0 |
| | 60 | 12,0 | 12,0 | 12,0 | 12,0 | 12,5 | 13,5 | 14,5 | 15,0 | 16,0 | 17,0 | 18,0 | 19,0 | 20,0 | 21,0 | 22,0 | 23,0 |
| | 70 | 12,0 | 12,0 | 13,0 | 14,0 | 15,0 | 16,0 | 17,0 | 18,0 | 19,0 | 20,0 | 21,0 | 22,0 | 22,5 | 23,5 | 24,5 | 25,5 |
| | 80 | 13,0 | 14,0 | 15,0 | 16,0 | 17,0 | 18,0 | 19,0 | 20,0 | 21,0 | 22,0 | 23,0 | 24,0 | 25,0 | 26,0 | | |
| | 90 | | | | | | | | | | | | | | | | |

Example: at 23°C room temperature and 60% humidity, the cooling water temperature must be above 16°C

4 CONNECTIONS

Most of the connections like mains input, DC output or optional cooling water are made on the rear side. The front panel is generally reserved for interface and local control.

4.1 Mains Connections

Connect the mains input cables to the *Mains* connectors and terminals. Never modify the internal wiring of the apparatus.

The protective earth cable must be connected to the foreseen terminal marked \oplus .
Connect the protective earth cable before any others.

Use the provided cables. The cables may not be provided for specific devices. In that case, types and sections of cables must be in accordance with the running standards and the power requirements given in the *Specifications* chapter. To narrow a section can lead to an excessive heating or even fire. The type must be in accordance with the voltage of the equipment.

Flash or electrocution risk!!!

The upstream cable protection must also be in accordance with its section. Refer to the *Specifications* chapter.

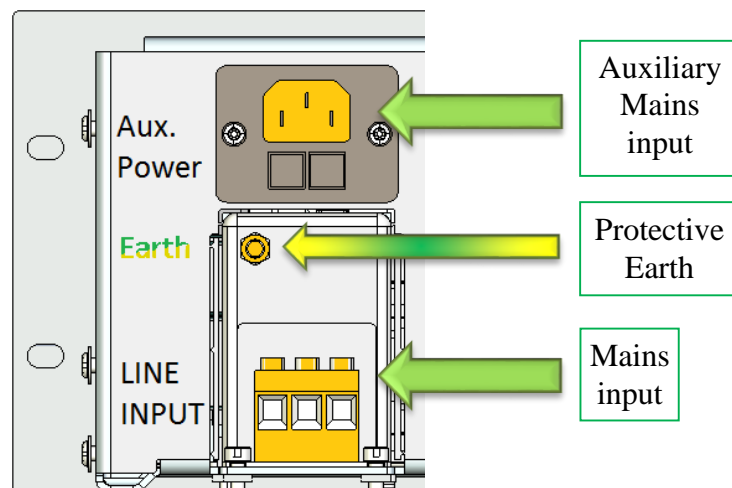


Figure 4-1 Power Input Connections

Mains Switch:

The main switch is located at the front side of the cabinet.

Position 0: Unit is disconnected from the mains.

Position 1: Unit is connected to the mains.

The line filters remain under voltage even if the mains switch (and MCB1 on rear side of START 11) is in position 0.

4.2 Cooling Water Connection

Only for concerned devices. See the Device Identification table.

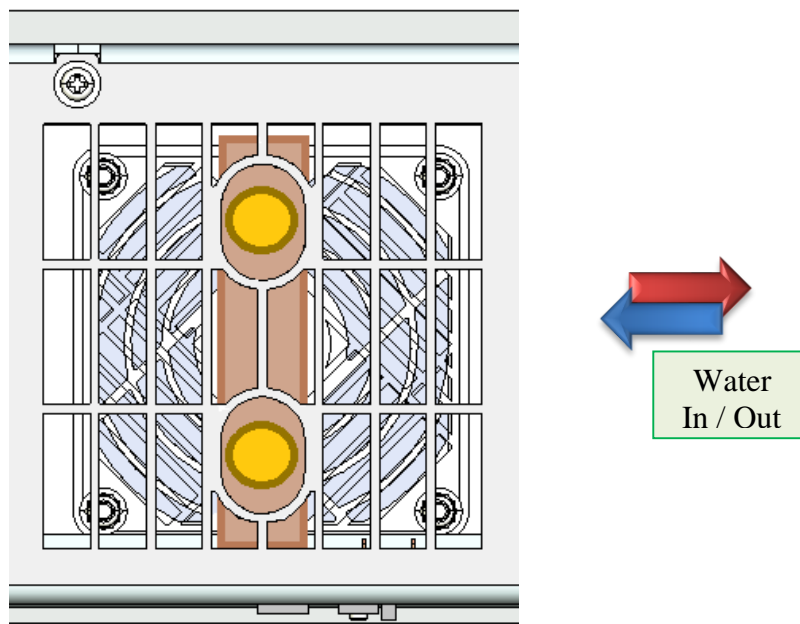


Figure 4-2 Cooling Water Connection

Each connector can be either an inlet or an outlet. There is no sense to respect

4.3 Power Supply Output Connection to the Load

The load cables must be connected to the respective terminal on the rear side. Please respect the instructions of the mains connection paragraph.

Never short circuit the output, verify that both wires of the load are floating.

Don't connect the outputs to earth. Risk of flash or burning or electric shocks!

Non-respect of this instructions can caused damage at the control and power circuits.

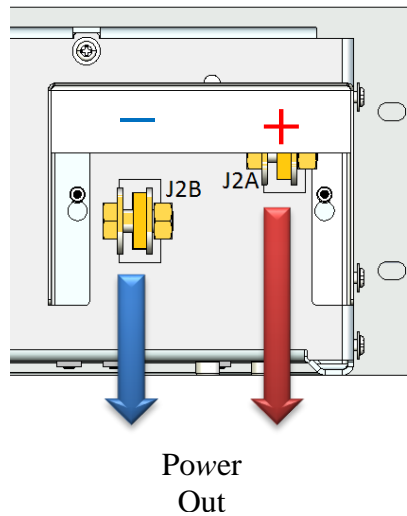


Figure 4-3 Load Output Connection

The screws of the power circuit must be checked for tightness during installation and two weeks after start up SIGMAPHI Electronics recommends according the torques to the values indicated in the Tightening Torques Tables.

4.4 External Control and Interlock Signals

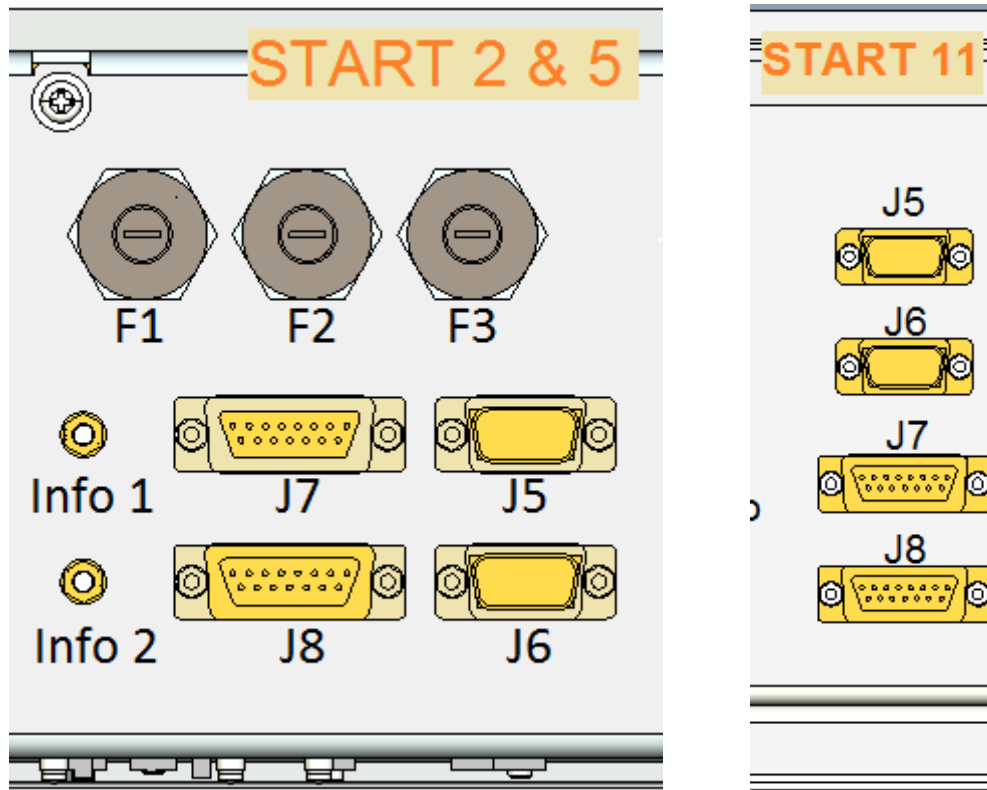


Figure 4-4 External Control and Interlock Signals

Table 4-1 External Control and Interlock Signals Assignment Table

| Conn N° | Name | IN OUT | Notes |
|---------|-------------------|--------|---------------------------------------------------------------|
| Info 1 | Info 1 | OUT | Only used for test purpose |
| Info 2 | Info 2 | OUT | Only used for test purpose |
| J5 | CAN | IN/OUT | Optional CAN port |
| J6 | CAN | IN/OUT | Optional CAN port |
| J7 | External Security | IN | Allows the PS to monitor two external safety relevant states. |
| J8 | Hardware Control | IN/OUT | Optional hardware control interface |

Table 4-2 External Security Assignment Table

| Pin N° | Name | IN OUT | Notes |
|---------|--------|--------|----------------------------------------------------------------------------------------|
| 1 | +24VDC | IN | Connect a dry NC contact between these two points to enter EXTERNAL security 1 signal. |
| 2 | EXT 1 | | |
| 3 | +24VDC | IN | Connect a dry NC contact between these two points to enter EXTERNAL security 2 signal. |
| 4 | EXT 2 | | |
| 5 To 15 | n/u | | |

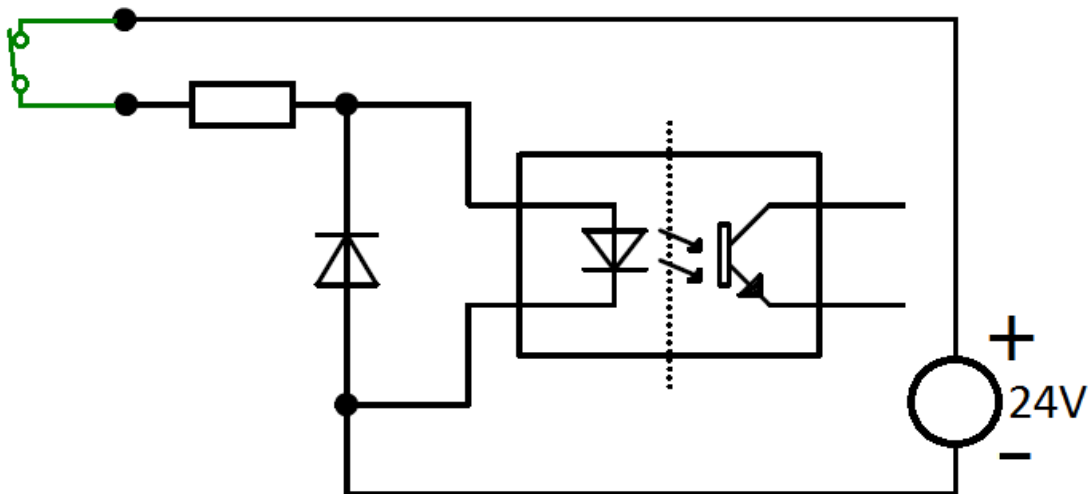


Figure 4-5 External Security Inputs Configuration

When validated, EXT 1 and EXT 2 circuits must be closed to allow starting the equipment. As a consequence, if unused each input must be shorted.
When masked by software the inputs are ignored by the device, their state is not relevant.
Do not apply any voltage between both terminals of an input pair. The contact must be floating and have to withstand a voltage of 24VDC.
Loop current: $I_{Loop} \leq 20\text{mA}$.

5 TECHNICAL DESCRIPTION

5.1 Mechanical Drawing

5.1.1 Front Panels

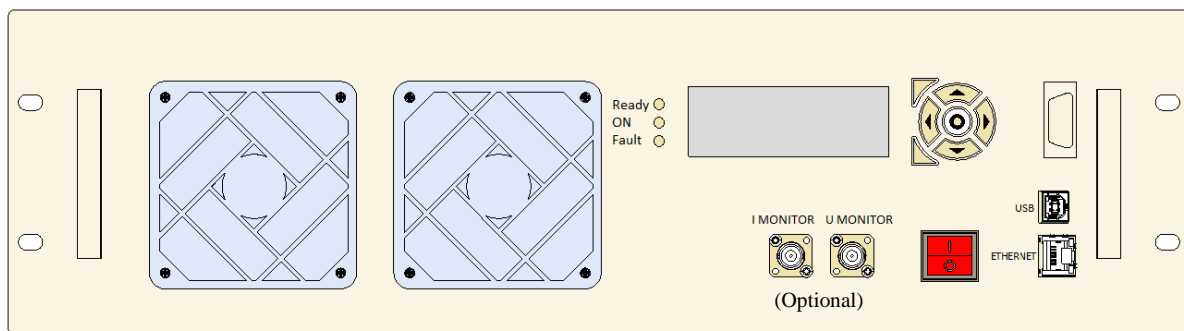


Figure 5-1 Front Panel START 2 & 5

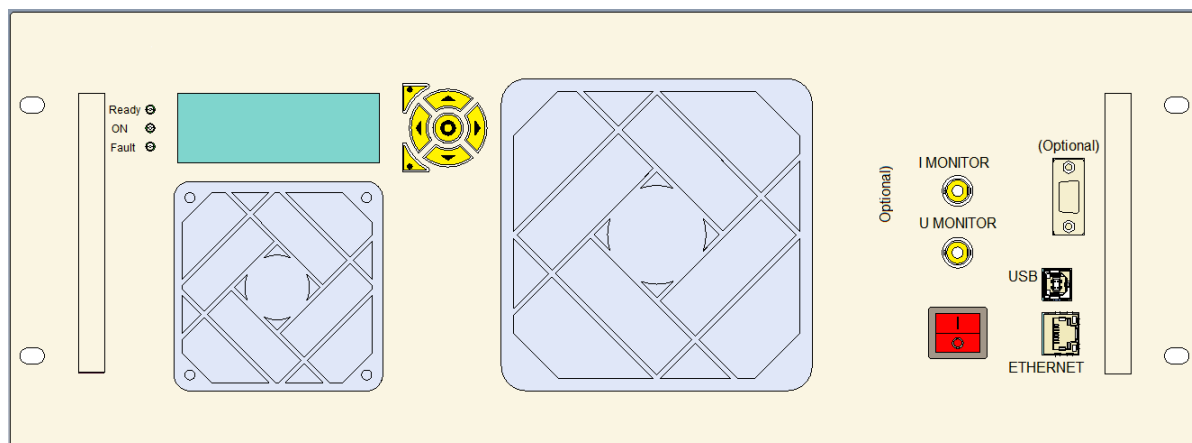


Figure 5-2 Front Panel START 11

5.1.2 *Rear Panels*

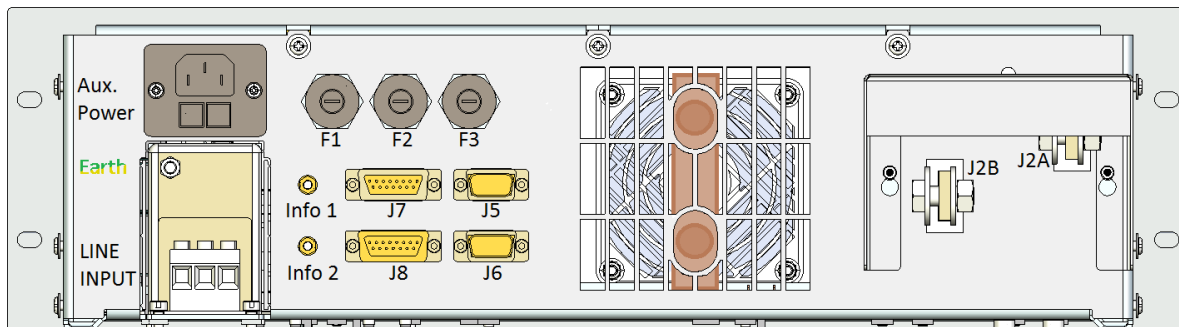


Figure 5-3 Rear Panel START 2 & 5

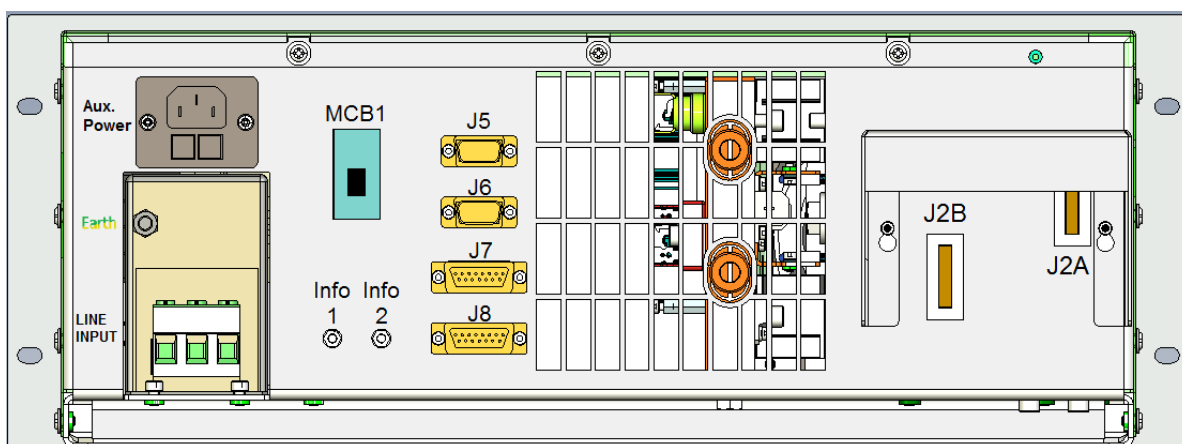


Figure 5-4 Rear Panel START 11

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5.2 Functional Overview

The following Block Diagram shows the completest version. Some features are optional.
See the Device Identification table.

For detailed information refer to the Wiring Diagram of the device.

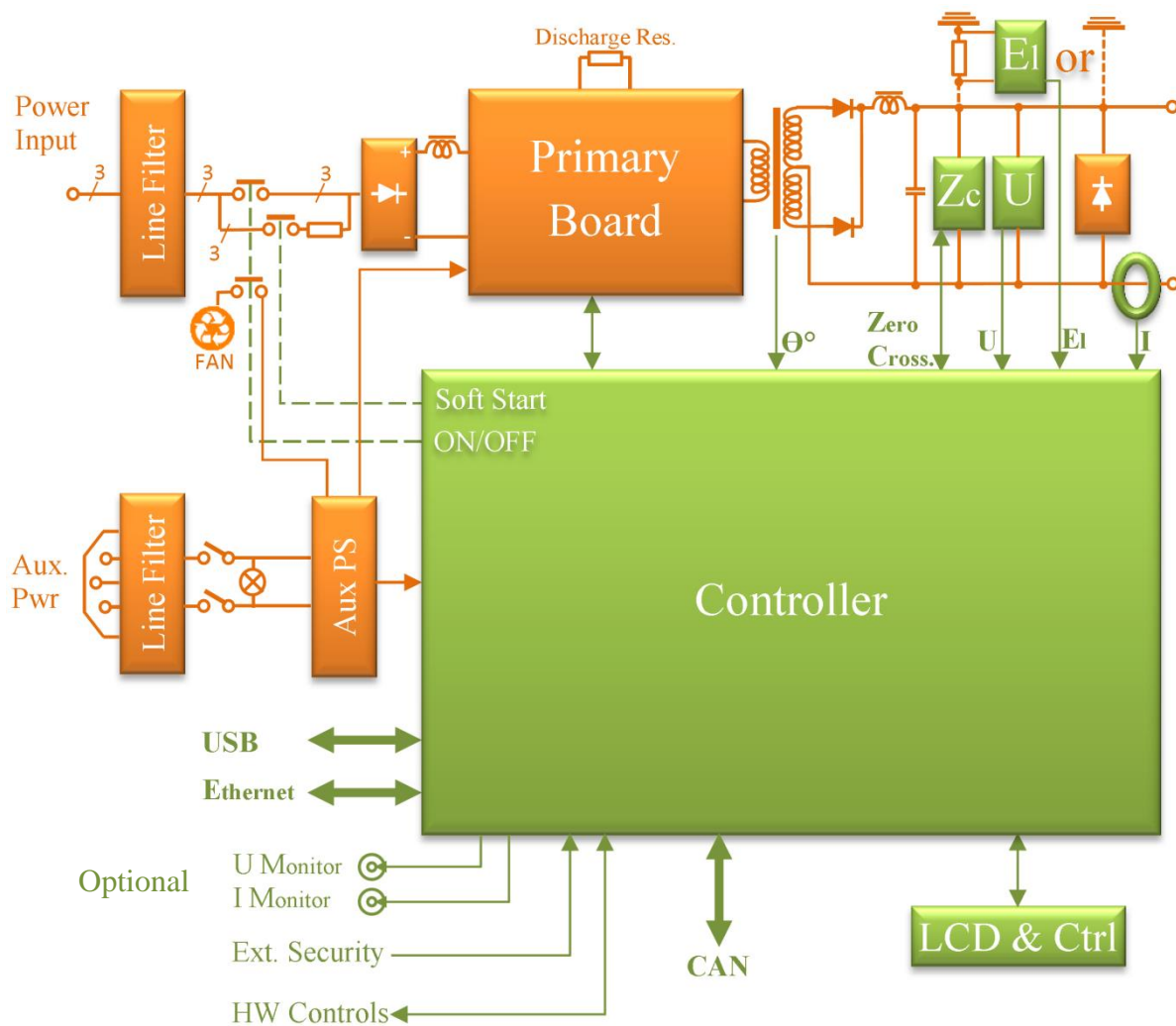


Figure 5-5 START Block Diagram

6 SERVICE INFORMATION AND MAINTENANCE

Every intervention on the device must be carried out by an authorized and qualified person. Any failure due to a non-respect of the following instructions will not be attributable to SIGMAPHI ELECTRONICS and will not be covered by the guarantee clauses.

6.1 *Points to Check at the Startup*

The screws of the power circuit must be checked for tightness during installation and two weeks after startup according the indicated in the followings tables.

- Mechanical Parts

| Screw | Tightening torque (Nm) |
|-------|------------------------|
| M8 | 16 |
| M10 | 32 |
| M12 | 56 |
| M16 | 135 |

- Semiconductors

| Screw | Tightening torque (Nm) | | |
|-------------|------------------------|------------------|------|
| | Electrical contact | | Case |
| | Strip line mounted | Terminal mounted | |
| M4 (ISOTOP) | 1,5 | 1,5 | 1,5 |
| M4 | 3 | 2,5 | 4,8 |
| M5 | 4,5 | 4 | / |
| M6 | 7 | 6 | 6 |
| M8 | 10,8 | 7,5 | / |

6.2 Points to Check Every Three Months

| Point to check | Procedure |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Visual checking | Proceed to visual inspection of the device |
| Water tightness of the cooling system | Check the absence of leak or drops at the connections level. Replace any defective tubing or connector |
| Functionality of the water flow sensor | Stop the water inlet and check that Water error is displayed. If the default is not detected, check or replace the flow meter |
| Functionality of the fans | Check the fans for easily and silently operating. Replace if necessary |
| Functionality of the interlock systems | Check the different circuits and the corresponding error messages. Be sure of their efficiency |

6.3 Complementary Checks to Carry out Every Six Months

| Point to check | Procedure |
|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cleaning out the components and the filters | Any dust or mess must be removed by vacuum extraction or with a soft bristle brush. Clean the dust filters (only on certain types of devices) or replace if necessary. For any cleaning of components, please use a 90° alcohol impregnate rag. Do not use water |
| Checking hoses and cooling plates | Replace any defective, porous or harden component |
| Power circuit | Check the tightness of screws and connections of the power circuit and semiconductors (according tables chapter 4.1). Replace components or cables which are altered by time or by over-heating due to a misconnection |

After important on-site repairing or return from factory, be sure to read and respect the SAFETY INSTRUCTIONS listed at the head of this manual.

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6.4 Long-time storage

Caution: if the device is to be stored for a long period of time without being powered on, it is necessary to power it on at least one hour twice a year. This is necessary to prevent the chemical capacitors from accelerated aging.

6.5 Shipping Precaution

In order to avoid damage due to cooling water freezing.

In case of shipping the whole cooling circuit must be empty.

Make sure that all the cooling water is removed.

Preventive maintenance of the module

Fan have a high reliability and manufacturer gives an expected live time of 70000 hours (8 years) at 40°C and 35000 hours (4 years) at 70°C.

Replacement of the fan could be done in the field when a malfunction of fan is detected and displayed by the system.

To prevent such a malfunction, a preventive maintenance could be done every 5 years.

This maintenance can only be done by a qualified technician.

6.6 Post-Intervention Start

After important on-site repairing or return from factory, be sure to read and respect the SAFETY INSTRUCTIONS listed at the head of this manual.

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6.7 Fuses

Table 6-1 Line Input Fuses

| Fuse label | Dimension | Voltage | Value |
|------------|------------|---------|-------|
| F1 | 6.3 x 32mm | 500V | 10AT |
| F2 | 6.3 x 32mm | 500V | 10AT |
| F3 | 6.3 x 32mm | 500V | 10AT |

Table 6-2 Auxiliary Line Input Fuses

| Fuse label | Dimension | Voltage | Value |
|------------|-----------|---------|-------|
| F4 | 5 x 20mm | 250 V | 1AF |
| F5 | 5 x 20mm | 250 V | 1AF |

6.8 Defective Parts (filters, fans, water pipes)

These parts must be replaced by original parts. Please contact SIGMAPHI Electronics After-Sale Service:

E-mail: elecsupport@sigmaphi.fr

Phone : +33 3 67 220 314

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7 SPECIFICATIONS

7.1 Device Identification

Table 7-1 Device Identification

| UNIT / TYPE | Options |
|--------------------|-------------------------------------------|
| PS START 2 vv/iii | N; W; I, D; C; E; F; V; Z; B1;R; S; M; P. |
| PS START 5 vv/iii | N; W; I, D; C; E; F; V; Z; B1;R; S; M; P. |
| PS START 11 vv/iii | N; W; I, D; C; E; F; V; Z; B1;R; S; M; P. |

vv = value of output voltage
iii = value of output current

| Short | Definition |
|-------|--------------------------------|
| N | Non standard |
| W | Water cooled |
| I | High precision current control |
| D | Diode output protection |
| C | CAN bus |
| E | Earth leakage measurement |
| F | Air filters |
| V | High precision voltage control |
| Z | Zero crossing |
| B1 | Profibus |
| R | Relay board |
| S | External Security interface |
| M | U and I Monitor |
| P | Handles |

7.2 Ratings

Table 7-2 Ratings

| Parameter | | Value |
|----------------------|--------------|--------------------------------------|
| Mains input voltage | | 400V ($\pm 10\%$) 3 phases + PE |
| Auxiliary line input | | 230V ($\pm 10\%$) 1 phase + N + PE |
| Input frequency | | 50/60Hz ($\pm 5\%$) |
| | | |
| Efficiency | @ 30% P | > 80% |
| | @ full power | > 90% |

| | | |
|---------------|-------------------------|--------|
| Water Cooling | START 11 when occurring | 3l/min |
|---------------|-------------------------|--------|

Caution:

- 1) This equipment is designed for mains category II. If the mains at the user site do not comply, over voltage absorbers have to be installed. Serious damage can result following spikes exceeding 2500V.
- 2) The acceptable voltage between each phase and earth is at maximum 250V.

7.3 Dimensions

Dimensions

- Height
 - 3U for SMART 2 & 5
 - 4U or 5U for SMART 11
- Width 19"
- Depth 800 mm

Weight: 25kg

7.4 General Specifications

Table 7-3 General Specifications

| Parameter | | Value |
|-------------------------------------------------------------|------------------|---------------|
| PERFORMANCE | | |
| Operation mode | | DC constant |
| Output voltage ripple | 40KHz | < 60 Vpp |
| | 0,1 Hz → 1 kHz | < 50 mVpp. |
| Output current ripple | 1 Hz → 1 kHz | < 20 ppm |
| Output current resolution | | 5 ppm |
| Output stability at Nom current | 100s → 8h | +/- 100 ppm |
| Reproducibility | | +/- 50 ppm |
| Dynamic response to load variation 100% → 50% or 50% → 100% | 1% of full scale | 1ms |
| Acoustic noise | UNE-EN ISO 3744 | < 50 dBA @ 1m |
| Cos Φ | for P > 50% Pmax | >0.9 |
| MTBF | | 150 000 h |

| | | |
|-----------------------------------|--|---------------------------------------------|
| ENVIRONMENT | | |
| Utilization | | Inside |
| Operating ambient air temperature | | + 10°C to +40°C |
| Storage temperature | | -10 to 50°C (max 12 months) free from water |
| Humidity | | 30 to 90% non-condensing |
| Altitude | | 0 to 2000 meters |
| Pollution degree | | 2 |
| Protection rating | | IP20 |
| Installation category | | II |

| | | |
|-----------------------|--|----------------------------------------------------|
| ISOLATION TEST | | |
| Input to output | | 2* input voltage + 1000Vac during 1min |
| Input to earth | | 2* input voltage + 1000Vac during 1min |
| Output to earth | | 500Vdc during 1min, earth strap or circuit removed |

| HOMOLOGATIONS | |
|---------------|-----------------------------------------------------------------------------------|
| IEC 61204 | Power supply stabilized low voltage at continuous output |
| IEC 61204-3 | Power supply stabilized low voltage at continuous output (emission) |
| IEC 61204-4 | Power supply stabilized low voltage at continuous output (immunity) |
| IEC 61010-1 | Safety rules for electric appliances of measurement, regulation and of laboratory |
| Compliance | CE marking |

| CABINET | |
|----------------------|----------------------|
| Material | Steel |
| Color of front panel | RAL7035 (light grey) |

8 TECHNICAL CONTACT

SIGMAPHI Electronics

Technical Support

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67500 Haguenau France

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FAX: +33 (0) 3 67 220 319

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9 CONFORMITY



Direction Générale

SIGMAPHI ELECTRONICS

**DECLARATION DE CONFORMITE
AUX DIRECTIVES EUROPEENNES (CE)**
Declaration of conformity to European Directives (CE)

| | |
|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Déclare que le(s) produit(s): | PS START 2 vv/iii ; PS START 5 vv/iii et PS START 11 vv/iii |
| Code article: | Document générique |
| <i>Part number:</i> | |
| Satisfait aux directives Européennes: <i>Meets the protection requirements of the following directives:</i> | |
| Directive Basse tension: <i>Low Voltage Directive:</i> | 2006/95/CE |
| Suivant les normes de sécurité: <i>In accordance with the safety standards:</i> | IEC 61010-1: 10 |
| Directive CEM: <i>EMC Directive:</i> | 2004/108/CE |
| Suivant les normes CEM: <i>In accordance with the EMC standards:</i> | EN 61326-1 : 10: EMC Generic standard - Emission CISPR 16 Class B EN 61000-3-2: 10 EN 61000-3-3: 09 |
| Déclaration authentifiée par: <i>Certified by:</i> | C. JODEZYK Responsable Méthodes/Production  |
| Wissembourg, le 25 novembre 2013 | |
| N° de document: START_CE_00 | |

SIGMAPHI ELECTRONICS
Siège Social: 34, rue de l'Industrie – BP 10002 – 67166 Wissembourg Cedex – Tél. +33 (0)3 88 73 68 00 – Fax +33 (0)3 88 73 68 86

Figure 9-1 Declaration of Conformity

10 WARRANTY

Clause 1 - General Terms.

Unless otherwise stipulated in the contract, the guarantee applies in the following manner:

Clause 2 - Enacting Clause.

Included in the Guarantee:

The spare parts required for repairs on site or at the factory,
The labor on site or at the factory,

Not included in the Guarantee:

The handling and shipping costs in case of return of sub-units for repairs at the factory,
Travel expenses such as round trip air fare,
Hotel expenses,
Taxi or rental car expenses.
The travel expenses in case of repairs for the customer on site.

These costs are at the expense of the customer and can be charged to the customer or covered directly by him.

Clause 3 - Corrective Action.

During the guarantee period, any corrective action taken to restore proper functioning of the installation may be done either through repairs or by standard replacement of modules or sub-units.

Clause 4 - Period of Guarantee.

In the case of facilities installed by a SIGMAPHI Electronics engineer, the date of reception of the facilities is the date that is taken into account for the beginning of the period of guarantee. In the case of facilities installed by the customer, the date that is taken into account is the date of delivery plus a period determined in agreement with the customer.

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Clause 5 - Repairs and Standard Replacement.

In no way can the repairs or standard replacements provide one or more extensions of the period of guarantee of the facilities.

Exchanged parts are covered by the initial guarantee of the facilities and at the most 3 months after the expiration of the guarantee.

Clause 6 - Terms for On-site Service and Repairs.

In the case of breakdowns or malfunctions of the facilities, the customer must contact the SIGMAPHI ELECTRONICS after sales service by telephone, mail or e-mail.

A precise description of the breakdown, along with the item number and the serial number of the equipment must be given in order to evaluate the corrective measures required to restore proper functioning of the facilities.

The SIGMAPHI ELECTRONICS after sales service is at the following address:

1, rue Branly
67500 Haguenau France
Mail: elecsupport@sigmaphi.fr
Phone : +33 3 67 220 314

Clause 7 - Contractual Limits.

Any unjustified on-site servicing or repairs can be charged to the customer.

The guarantee does not apply in the following cases:

- Use non-compliant with SIGMAPHI Electronics recommendations,
- Modification of the operating instructions,
- Moving of all or part of the facilities,
- Use of unsuitable fluids,
- Accidents,
- Fire,
- Water damage,
- Mains not protected against overvoltage,
- Servicing or repairs by persons not accredited by SIGMAPHI Electronics,
- Modification of all or part of the facilities,
- Use of supplies not approved by SIGMAPHI Electronics,
- Exposure to environment exceeding the limits defined in the SIGMAPHI Electronics manuals.

Clause 8 - Contractual Obligations.

Under the contract, the customer promises to:


- Comply with and ensure compliance with the user instructions defined in the SIGMAPHI Electronics manuals or prescribed during training sessions or during reception at the factory or on site.

User Chapter

11 OPERATION

11.1 System Check

Before applying mains and turning ON for the first time:

- Check that the feeding mains voltage and the upstream protection are compatible with the equipment.
- Check that the protective earth cable is connected to the foreseen and adequate terminal labeled 
- Check that the types and sections of all cables are in accordance with the running standards. Too narrow sections can lead to an excessive heating or even fire. The types must be in accordance with the voltages of the equipment. The upstream protection must be in accordance with the cross section. Refer to the *Specifications* table.
- Check that the device is connected to the load and to its external interlocks.
- Check that the temperature and the flow of the cooling water will fit with the requirements. See: Connections

The equipment can be energized after checking the mentioned points above.

Connect an oscilloscope using either two probes in differential mode or one differential probe on the DC output of the device. The conventional probe has to be avoided because one of output poles of the device is grounded in most cases.

Select AC mode, a few kilohertz and a sensitivity of a few volts per division. Ensure that there are no significant oscillations during startup. In case of, switch the unit immediately OFF because they can lead to deterioration of the power circuit. The oscillations may occur when the control loop of the device is not adapted to the load. In that case, contact the After-Sales Service.

Set the Main Switch in ON position and follow the instructions here after for running.



11.2 CONTROL-COMMAND DESCRIPTION

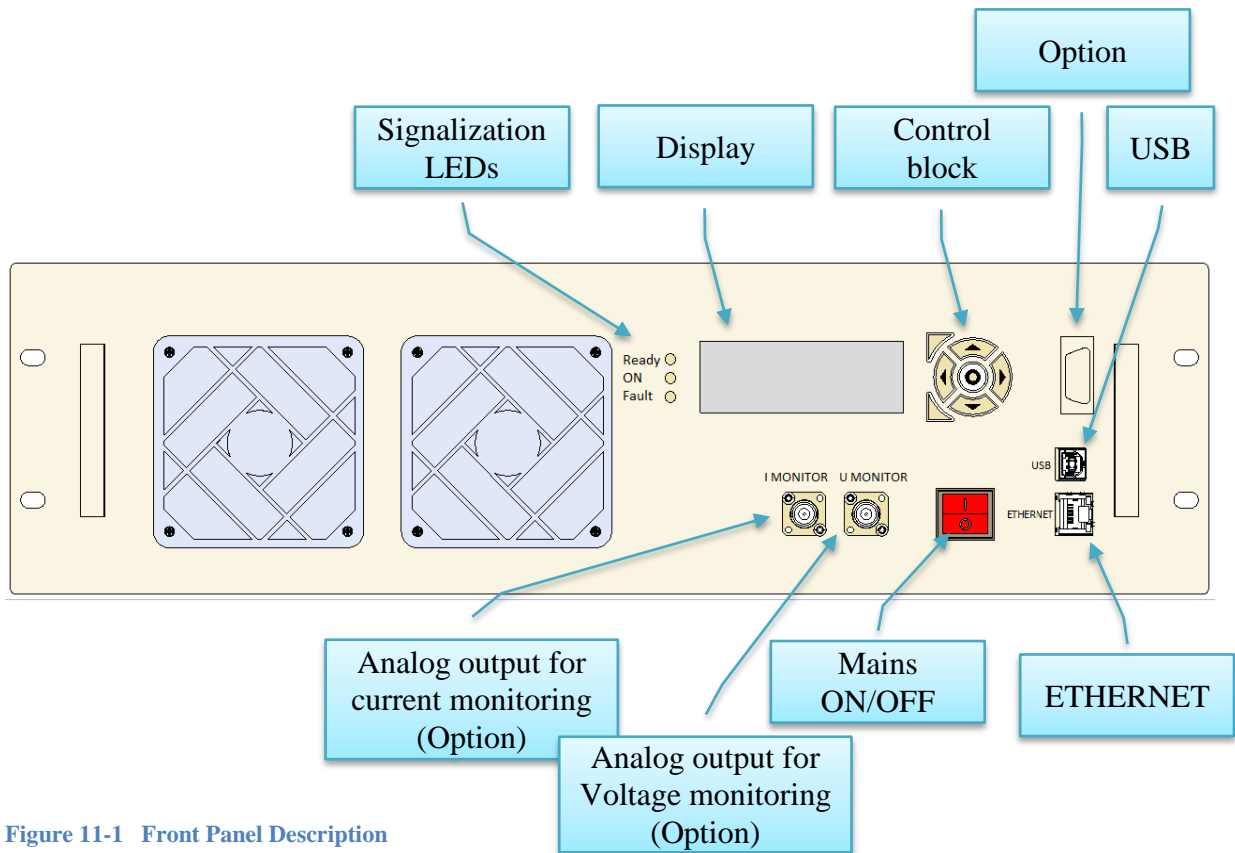


Figure 11-1 Front Panel Description

| Front Panel Element | Type | Short Name | Designation |
|---------------------|------|-------------|-------------------------------------------------------|
| LEDs | -- | Signal LEDs | Indicate the basic state of the power supply |
| Display | -- | Display | Shows the data in case of read back or local control. |
| Control block | -- | | Allows selecting functions / entering data |
| | USB | USB | Optional control or configuration port |
| | RJ45 | ETHERNET | Optional control port of the device |
| | BNC | I MONITOR | Analog output for current monitoring (option) |
| | BNC | U MONITOR | Analog output for Voltage monitoring (option) |
| Mains ON/OFF | | | Power ON/OFF switch |
| Option | | | Optional interface |

11.3 Overview

11.3.1 Power Supply Structure

See “Functional Overview”

11.3.2 Control-Command

Control board is a BCS B-RC Prim G2(P/N W138882). Firmware depends on device.
For firmware upgrade, refer to: W138882_MA01_00_BRC_G2_Firmware_upgrade.pdf

11.4 Power Supply General Information

11.4.1 Power Supply State

The power supply state machine can take several values. A variable (UNSIGNED8), which can be read via Ethernet, gives the current position of the state machine.

Table 11-1 Power Supply State

| | | | | |
|-------------|----------------------------------------------------------------------------------------|--|----------------------------------------------|--|
| | Name : coState | | UNSIGNED8 | |
| Description | This object gives the current position of the general state machine. Read only. | | | |
| Value | State | | Corresponding values | |
| | • START sequence | | 0xFF or 0x01 | |
| | • FAULT | | 0x80 | |
| | • ACK sequence | | 0x81 or 0x82 or 0x83 | |
| | • IDLE | | 0x22 | |
| | • INRUSH sequence | | 0x24 or 0x25 or 0x26 or 0x31 or 0x32 or 0x33 | |
| | • ON | | 0x27 | |
| | • STOPPING | | 0x29 | |

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11.4.2 State Machine

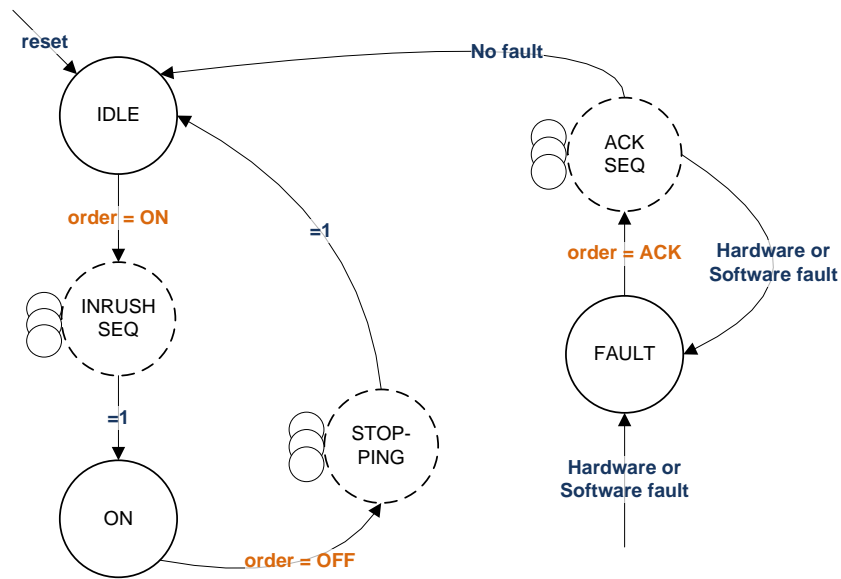


Figure 11-2 State Machine

When **Stop and Reset** contact is opened, the control board is reset. If this happen when in **ON** state, the control board first goes through **STOPPING** sequence (to switch the power supply properly off).

11.4.3 Local Control

11.4.4 Local LCD Display and Keyboard

A backlight 7-key keyboard allows navigating in the menu and carrying out the different actions.

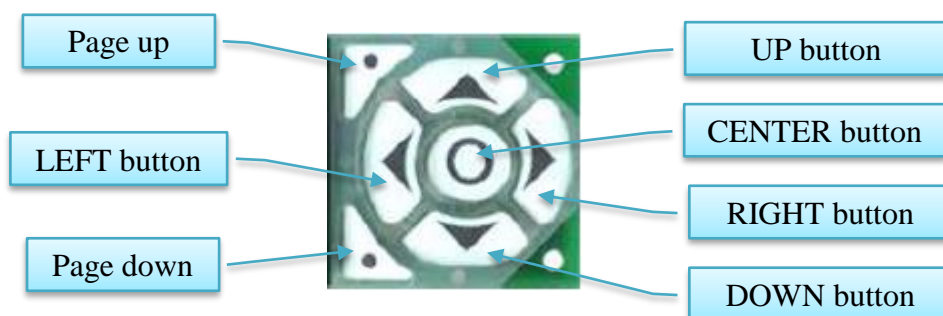


Figure 11-3 Keyboard Description

| Key | Action | Key | Action |
|--------|-----------------|------|-------------|
| CENTER | Validate | UP | Cursor up |
| LEFT | Cursor to left | DOWN | Cursor down |
| RIGHT | Cursor to right | | |

General remark: after 90s of inactivity the display goes in energy saving mode. Push any key to wake it up.

11.4.5 *How to Use the Different Pages*

At start up, after a few seconds, the display shows the "MAIN" page as follows:
The "Ready" LED is ON

| MAIN page | Converter state | REMOTE/ LOCAL |
|--------------|--------------------|------------------|
| ↓ | ↓ | ↓ |
| [M] | I d l e | R E M |
| r e f = + | 0 . 0 0 0 | A |
| I o u t = + | 0 . 0 0 0 | A |
| U o u t = + | 0 . 0 0 0 | V |

Push "Page Down" to reach the second page: "CMD"

| | |
|-----------|-----------|
| [C M D] | R E M |
| → O N | L O C A L |
| O F F | |
| A C K | |

Press "RIGHT" to bring the selection arrow next to "LOCAL".

| | |
|-----------|-------------|
| [C M D] | R E M |
| O N | → L O C A L |
| O F F | |
| A C K | |

Validate with "CENTER", you will automatically come back to "M" page.

| | | |
|-------------|-----------|-------|
| [M] | I d l e | L O C |
| r e f = + | 0 . 0 0 0 | A |
| I o u t = + | 0 . 0 0 0 | A |
| U o u t = + | 0 . 0 0 0 | V |

Before turning ON for the first time Connect an oscilloscope using either two probes in differential mode or one differential probe on the DC output of the device. The conventional probe has to be avoided because one of output poles of the device is grounded in most cases. Select AC mode, a few kilohertz and a sensitivity of a few volts per division. Ensure that there are no significant oscillations during startup. In case of, switch the unit immediately OFF because they can lead to deterioration of the power circuit. The oscillations may occur when the control loop of the device is not adapted to the load. In that case, contact the After-Sales Service.

Push twice “Page Down” to return to “CMD” page.

```
[ C M D ]                R E M  ␣
→ O N                L O C A L
O F F
A C K                ␣
```

The selection arrow is in front of “ON”, press “CENTER” to turn the Power Supply ON. The device is ready for entering parameters.

Press “Page Down” to go to the “REF” page where you can choose the sign and value of the output current you need.

```
[ R E F ]                L O C  ␣
I r e f = +          0 . 0 0 0  A
[ -      1 0 . 0 ; +      1 0 . 0 ]
→ S e t                ␣
```

(Values are only for example)

The cursor is on the sign, “UP” and “DOWN” buttons toggle between + and -. Choose the desired sign and define the value digit by digit. Use “LEFT” and “RIGHT” to reach the digits and “UP” and “DOWN” to adjust the values. The third line gives the limits of the available range.

Push “CENTER” key to validate the chosen value.

Following screen is displayed and the device generates the selected output current.

```
[ M ]      O N                L O C  ␣
r e f      = +          0 . 0 9 9  A
I o u t    = +          0 . 1 0 0  A
U o u t    = +          0 . 1 2 5  V  ␣
```

(Values are only for example)

Next page is “F”, the Fault page. It shows the list of occurring faults

For example when AC power is missing:

```
[ F ]      1 / 1      L O C      「  
S - U b u s      t o o      l o w
```

Or if “EMERGENCY” loop is open:

```
[ F ]      1 / 1      L O C      「  
h = E m e r g e n c y
```

Or in case of External Security alert:

```
[ F ]      1 / 1      L O C      「  
h = E x t e r n a l      1
```

If a fault appears fix the problem and go to “CMD” page

```
[ C M D ]      L O C      「  
O N      L O C A L  
O F F  
→ A C K      」
```

Press ACKnowledge to leave the fault state.

The possible faults or interlocks are listed in both tables below:

Table 11-2 Software Interlock Table

| Name | Description |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| EEPROM | Board configuration is stored in an EEPROM. An error rises at startup if data read from EEPROM are not valid or if EEPROM in uninitialized. |
| State machine | Internal software error (timeout or unexpected case). |
| Regulation parameter set | A wrong regulation parameter set was asked. |
| MEAS1 | Output current out of range |
| MEAS2 | Output voltage out of range |
| MEAS3 | Bus overvoltage |
| Earth leakage | An earth leakage occurred. |
| Ubus too low | Bus voltage too low (check power line, fuses and AC/DC converter) |

Table 11-3 Hardware Interlock Table

| Name | Description |
|----------------------|-------------------------------------------------------------------------|
| Temperature heatsink | Heatsink temperature is to high |
| EMERGENCY | Emergency button is activated |
| DOOR | Cabinet door is open. Can be used when the unit is hosted in a cabinet. |
| SEC. EXT | Customer security input |
| Overcurrent (MEAS1) | Output current out of range |
| Overvoltage (MEAS2) | Output voltage out of range |

“INFO” page reveals information about the firmware implemented in the device.

```
[ I N F O ] L O C 「
F i r m : B R C 1 _ A C C _ U L 2
2 0 1 4 0 6 0 4 」
```

Further U_{OUT} , I_{OUT} , part number and serial number:

```
[ I N F O ] L O C 「
4 0 V / 1 2 A
F I 0 0 0 2 5 1 / 9 」
```

“ETH” (Ethernet) page:

```
[ E T H ] L O C 「
I P : 1 9 2 . 1 6 8 . 1 . 1
M S K : 2 5 5 . 2 5 5 . 2 5 5 . 0
G T W : 0 . 0 . 0 . 0 」
```

11.4.6 States of the LEDs

| LED | STATE | | | | | |
|-------|-------|------------|----|-------|---------|---|
| | IDLE | INRUSH_SEQ | ON | FAULT | ACK_SEQ | |
| | Ready | ■ | ■ | ■ | ■ | ■ |
| | On | ■ | ■ | ■ | ■ | ■ |
| Fault | ■ | ■ | ■ | ■ | ■ | ■ |

11.5 Remote Control via Modbus/TCP

11.5.1 Modbus Overview

The Modbus/TCP connections constitute the main means of controlling power supply units. To use them effectively, it is necessary to use supervision software on the user side. The port to which the supervisor connects is port 502. The following Modbus/TCP functions are supported:

- Function 3, ReadMultipleRegisters
- Function 4, ReadInputRegisters
- Function 6, WriteSingleRegister
- Function 16, WriteMultipleRegisters
-

The registers are all defined in a single table in the Modbus/TCP sense. Bit-type objects are not supported.

11.5.2 Mapping

Table 11-4 Mapping Table

| Register | Description | Details |
|----------|--------------------------|-----------------------------------------------------|
| 00 - W | Command | UNSIGNED16. See details under "Commands". |
| 01 - R | Output current LSB | FLOAT32 Output current [A]. |
| 02 - R | Output current MSB | |
| 03 - R | Output voltage LSB | FLOAT32 Output voltage [V]. |
| 04 - R | Output voltage MSB | |
| 05 - RW | Current reference LSB | FLOAT32 Current reference [A]. |
| 06 - RW | Current reference MSB | |
| 07 - R | Output current error LSB | FLOAT32 Output current error [A]. |
| 08 - R | Output current error MSB | |
| 09 - R | Local/Remote | UNSIGNED16. 1: Remote - 0: Local |
| 10 - R | Power supply state | UNSIGNED16. See details under "Power supply state". |
| 11 - R | Software interlocks | BITFIELD See details under "Interlocks". |
| 12 - R | Hardware interlocks LSB. | |
| 13 - R | Hardware interlocks MSB. | |

11.5.3 *Commands*

Controlling the power supply remotely can be done by writing a variable. The value written defines the order.

Once taken into account, the variable is cleared by software.

For instance:

| | | | |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--|
| | Name : coOrder | UNSIGNED16 | |
| Description | This object is used to remotely drive the power supply. Commands are relative to the current state of the power supply. Write only. | | |
| Value | <ul style="list-style-type: none">• ACK 0x0003 Fault acknowledgement When in FAULT state, resets interlocks (if possible).• ON 0x0011 ON Starts INRUSH sequence.• OFF 0x0012 OFF Stops power supply. | | |

11.5.4 *Interlocks*

Interlocks are divided into two groups: hardware interlocks and software interlocks.

Software interlocks are generated by software (like a communication watchdog). In this case the firmware opens the main relays and stops the PWM.

On the control unit, a dedicated hardware circuitry with several inputs (normally closed mechanical contacts or analog windowing of measures) is also present. If a hardware interlock occurs (if the mechanical contact linked to heatsink temperature is open for instance), main relays are opened and PWM is stopped by hardware. The software reads the status of hardware interlocks.

Depending on control unit type and on the power supplies, up to 17 hardware interlocks and up to 16 software interlocks are present.

Table 11-5 Software Interlock Table

| | Name : coSoftFault | UNSIGNED16 | |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--|
| Description | This object gathers all software interlocks. A fault is memorized until acknowledgement. Bit high means interlock pending. Read only. | | |
| Value | <p>Each bit corresponds to an interlock. High for interlock pending.</p> <ul style="list-style-type: none"> • Bit 0 : EEPROM Board configuration is stored in an EEPROM. An error rises at startup if data read from EEPROM are not valid or if EEPROM is uninitialized. • Bit 1 : State machine Internal software error (timeout or unexpected case). • Bit 2 : PS Part number (Wrong PS code) • Bit 3 : Regulation parameter set A wrong regulation parameter set was asked. • Bit 4: n/a • Bit 6..5: n/a • Bit 7: MEAS1 (current) out of range (software) • Bit 8: MEAS2 (voltage) out of range (software) • Bit 9: MEAS3 Bus overvoltage (software) • Bit 10: MEAS4 out of range (software) • Bit 11: MEAS5 • Bit 12: n/a • Bit 13: Ubus too low Bus voltage too low (check power line, fuses and AC/DC converter) • Bit 14: MEAS_IPRIM • Bit 15: n/a | | |

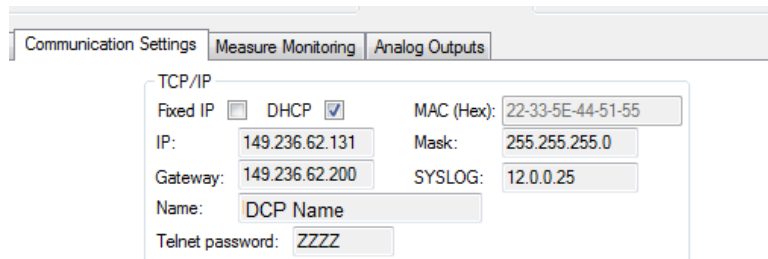
Table 11-6 Hardware Interlock Table

| | Name : coHardFault | UNSIGNED32 | |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--|
| Description | This object gathers all hardware interlocks. A fault is memorized until acknowledgement. Bit high means interlock pending. Read only. | | |
| Value | <p>Each bit corresponds to an interlock. High for interlock pending.</p> <ul style="list-style-type: none"> • Bit 0: Temperature heatsink 1 • Bit 1: DCCT • Bit 5-2: n/a • Bit 6: SEC. EXT. 1 see "External Control and Interlock Signals" • Bit 7: SEC. EXT. 2 see "External Control and Interlock Signals" • Bit 9-8: n/a • Bit 10: >I (MEAS1) • Bit 11: >U (MEAS2) • Bit 12: Primary current • Bit 13: Oscillation • Bit 14: n/a • Bit 15: n/a • Bit 31-16: unused | | |

11.5.5 Ethernet Configuration

USB interface can be used to change Ethernet configuration (IP address, DHCP or not...).

Provided interface for Windows XP/Vista/Seven must be used: **BRC G1 MMI**.



Communication Settings Measure Monitoring Analog Outputs

TCP/IP

Fixed IP ☐ DHCP ☒ MAC (Hex): 22-33-5E-44-51-55

IP: 149.236.62.131 Mask: 255.255.255.0

Gateway: 149.236.62.200 SYSLOG: 12.0.0.25

Name: DCP Name

Telnet password: ZZZZ

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