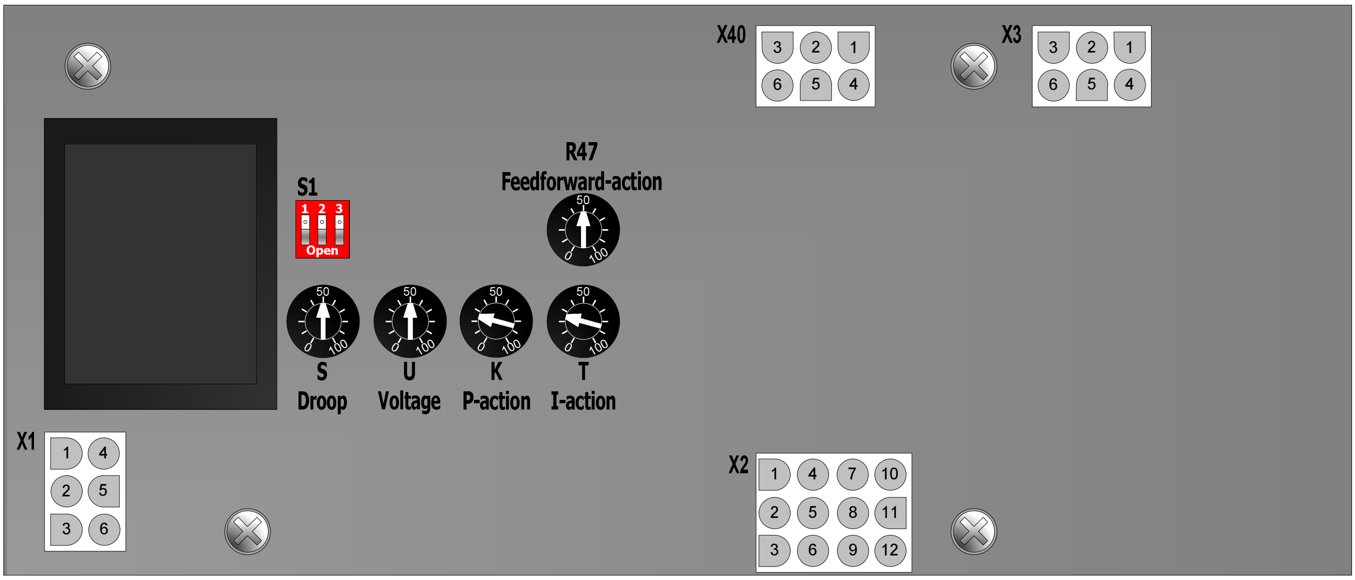
# EMRI2491/2 V1.38

***Voltage regulator for generators***




**December 2011 V1.38**

**Instruction Manual**

# WARNINGS

**WARNING**

The system should not be installed, operated, serviced or modified except by qualified personnel who understand the danger of electric shock hazards and have read and understood the user instructions
.

**WARNING**

Never work on a LIVE generator. Unless there is another person present who can switch off the power supply or stop the engine

**WARNING**

Dangerous voltages are present at the voltage regulator board. Accidental contact with live conductors could result in serious electrical shock or electrocution.
Disconnect the power source before making repairs, connecting test instruments, or removing or making connections to the voltage regulator or generator.

ELECTRICAL HAZARDOUS VOLTAGES. DANGEROUS, DO NOT OPERATE WHEN NOT FAMILIAR WITH GENERATORS.

Due to liability reasons, EMRI products may not be used, applied or commissioned in equipment residing under law of the United States of America or Canada. Neither may EMRI products be applied or commissioned by any person residing under law of the United States of America or Canada.

The manual does not cover all technical details of the product. Specifications may be modified by the manufacturer without notice. For further information, the manufacturer should be contacted.

# Table of contents

# 1. INTRODUCTION

## 1.0 General description

This manual contains instructions for installing, operating and maintaining the EMRI2491 and EMRI2492 automatic voltage regulators (AVR).

The information in this manual applies to the EMRI2491 AVR and the EMRI2492 AVR which in addition to the control card includes additional power electronics mounted on a heatsink.

Both incorporate analogue controller circuitry and are specifically designed for Siemens® and Siemens® licensed Hyundai®, Uljanik® and Fenxi® brushless synchronous machines. The EMRI2491 is suitable for controlling generator series 1FC6 18 to 28. The EMRI2492 is suitable for controlling generator series 1FC6 35 to 56.

The EMRI2491 and EMRI2492 are designed for use in generators with a compounding system. The AVR operates according to a subtractive principle meaning that any excess excitation current generated by the generator compounding is dissipated in a shunt resistance.

## 1.1 EMRI2491 Dimensions (control card)

The AVR is protected against harmful environmental impact by a protective coating.

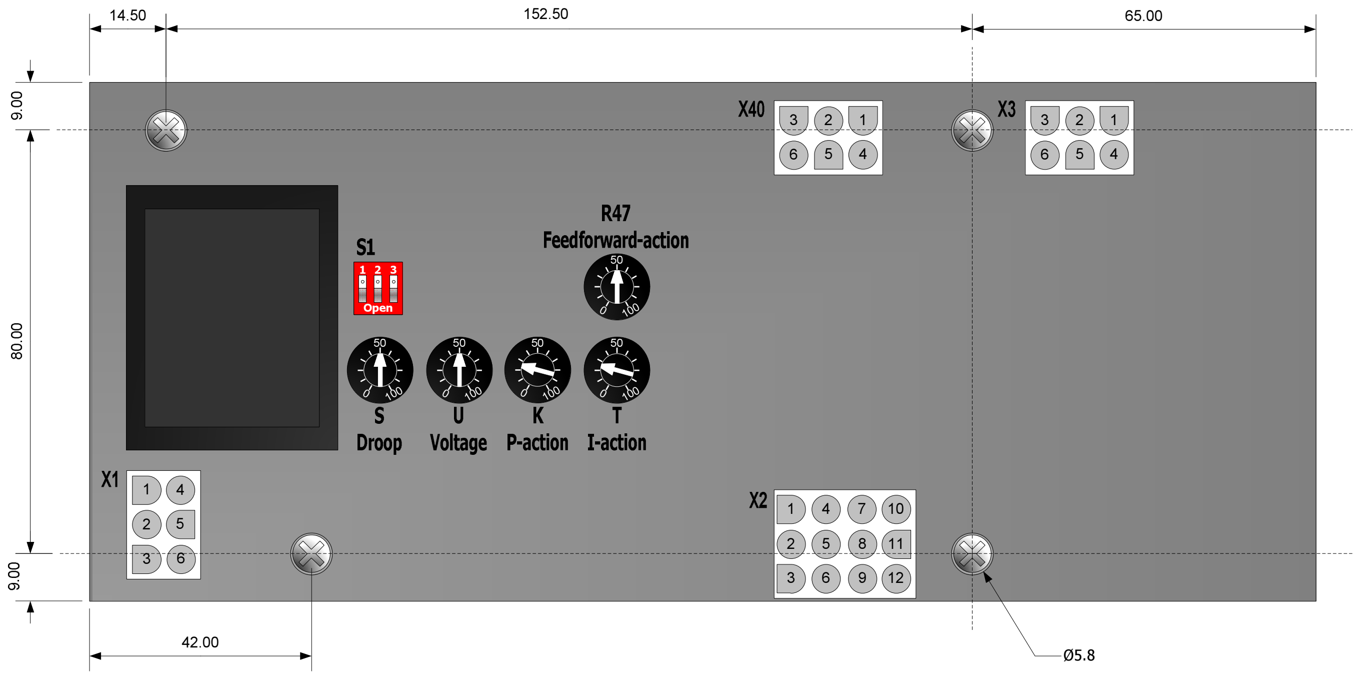



**Fig 1. EMRI2491 dimensions**

- Measurements in mm
- Height ± 40 mm

## 1.2 EMRI2492 Dimensions (control card with power module)

The AVR control card is protected against harmful environmental impact by a protective coating. In the figure below the EMRI2491 control card is seen from aside. The connector which connects the power electronics, mounted on the heat sink, to the control card header X3 is not drawn.

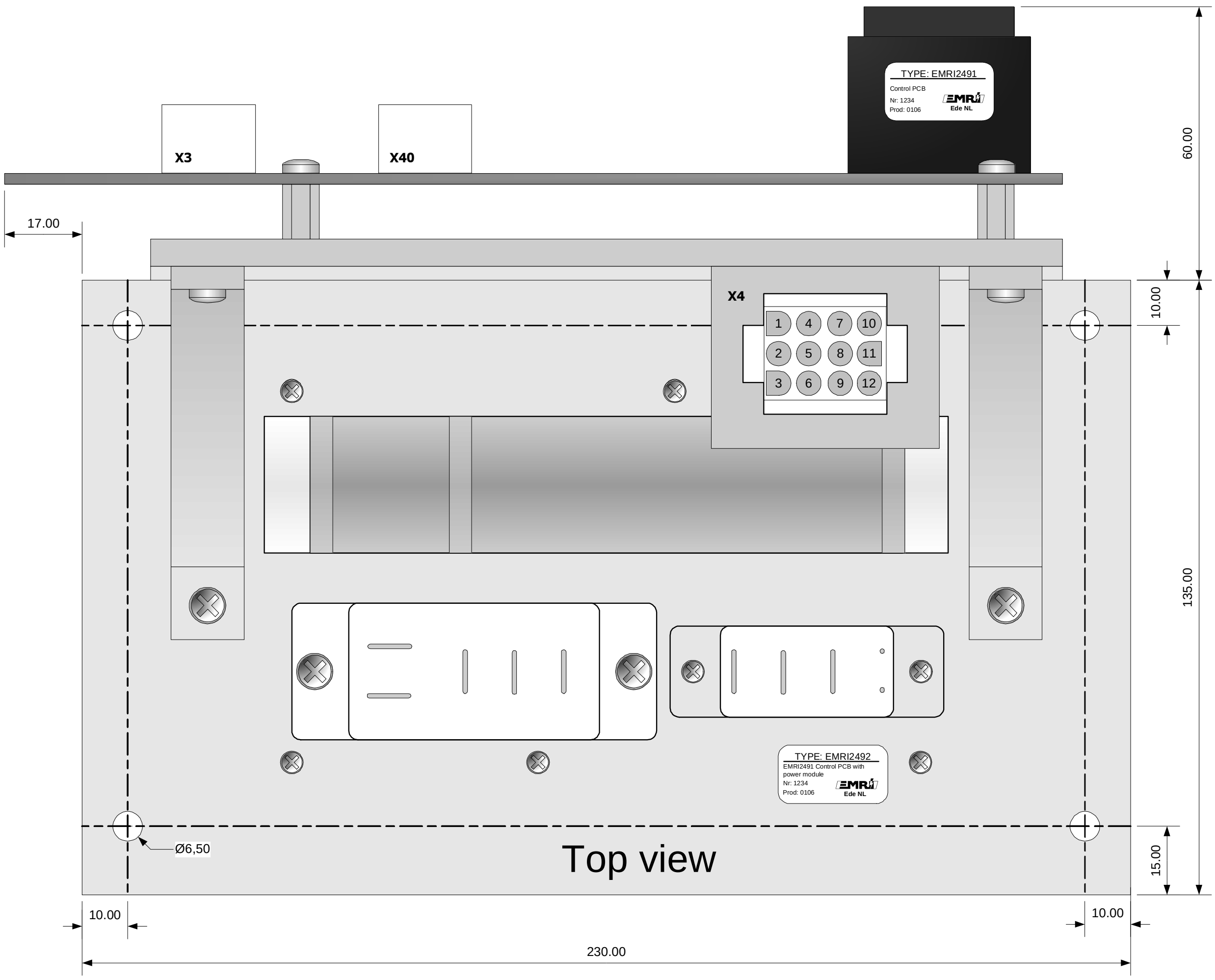



**Fig 2. EMRI2492 dimensions**

- Measurements in mm
- Height ± 130 mm

## 1.3 Electrical characteristics

| Symbol | Parameter | Condition | Min | Max. | Unit |
|---|---|---|---|---|---|
| X1 – 3/1 | Voltage sensing input 400 $V_{AC}$ | @ 50Hz<br>@ 60Hz | -<br>- | 450<br>480 | $V_{AC}$<br>$V_{AC}$ |
| X1 – 3/5 | Voltage sensing input 230 $V_{AC}$ | @ 50Hz<br>@ 60Hz | -<br>- | 260<br>275 | $V_{AC}$<br>$V_{AC}$ |
| X2 – 7/10/11 | Total compounding current | EMRI2491 (per phase) | - | 1.8 | $A_{AC}$ |
| X4 – 1 to 6 | Total compounding current | EMRI2492 (per phase) | - | 15 | $A_{AC}$ |
| $I_{SHUNT}$ | AVR Shunt current | EMRI2491 | - | 3 | $A_{DC}$ |
| $I_{SHUNT}$ | AVR Shunt current | EMRI2492 | - | 9.5 | $A_{DC}$ |
| $T_{AMB}$ | Operating temperature | 95 % RHD non condensing | 0 | +70 | ℃ |
| $T_{STG}$ | Storage temperature | 95 % RHD non condensing | -45 | +85 | ℃ |
| X40 – 2/3 | External setpoint adjust | | -5 | +5 | $V_{DC}$ |
| X2 – 5/9 | Droop | Isolated CT | - | 0.5 | $A_{AC}$ |
| X2 – 1/3 | External voltage potentiometer | 4k7Ω / 1W potentiometer | - | 4k7 | kΩ |

**Table 1. Electrical characteristics**

## 1.4 Absolute maximum ratings

| Symbol | Parameter | Condition | Min. | Max. | Unit |
|---|---|---|---|---|---|
| X1 – 3/1 | Voltage sensing input 400 $V_{AC}$ | @ 50Hz<br>@ 60Hz | -<br>- | 470<br>500 | $V_{AC}$<br>$V_{AC}$ |
| X1 – 3/5 | Voltage sensing input 230 $V_{AC}$ | @ 50Hz<br>@ 60Hz | -<br>- | 270<br>285 | $V_{AC}$<br>$V_{AC}$ |
| X2 – 7/10/11 | Total compounding current | EMRI2491 (per phase) | - | 3.3 | $A_{AC}$ |
| X4 – 1 to 6 | Total compounding current | EMRI2492 (per phase) | - | 22.5 | $A_{AC}$ |
| $I_{SHUNT}$ | AVR Shunt current | EMRI2491 | - | 3 | $A_{DC}$ |
| $I_{SHUNT}$ | AVR Shunt current | EMRI2492 | - | 13.5 | $A_{DC}$ |
| $T_{AMB}$ | Operating temperature | 95 % RHD non condensing | 0 | +70 | ℃ |
| $T_{STG}$ | Storage temperature | 95 % RHD non condensing | -45 | +85 | ℃ |
| X40 – 2/3 | External setpoint adjust | | -7 | +7 | $V_{DC}$ |
| X2 – 5/9 | Droop | Isolated CT < 30 s | - | 0,6 | $A_{AC}$ |
| X2 – 1/3 | External voltage potentiometer | >=1 Watt | - | 4,7 | kΩ |

**Table 2. Absolute maximum ratings**

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability and lifetime.

## 1.5 Commissioning information

The system should not be installed, operated, serviced or modified except by qualified personnel who understand the danger of electric shock hazards and have read and understood the user instructions.

Defects in the generator or AVR may cause consequential loss. Precautions must be taken to prevent this from occurring.

Never work on a LIVE generator. Unless there is another person present who can switch off the power supply or stop the prime mover.

Dangerous voltages are present at the voltage regulator board. Accidental contact with live conductors could result in serious electrical shock or electrocution.
Disconnect the power source before making repairs, connecting test instruments, or removing or making connections to the voltage regulator.

The unit should be installed with respect to the environmental specifications as well as the rules mentioned in the General installation information.
For safety reasons the voltage LEVEL potentiometers are best turned completely counter clockwise in order to start at the lowest possible voltage.

## 1.6 Replacement instructions

Before replacing an existing AVR is it strongly advised to copy and verify potentiometer, dipswitch and wire bridge settings. In case a EMRI2492 AVR is replaced the power resistor, mounted on the heatsink, must also be checked. If the resistance is not equal adjust the wiper position accordingly.
Do not adjust the compounding transformer tapping from the factory settings.

## 1.7 Functional block diagram EMRI2491

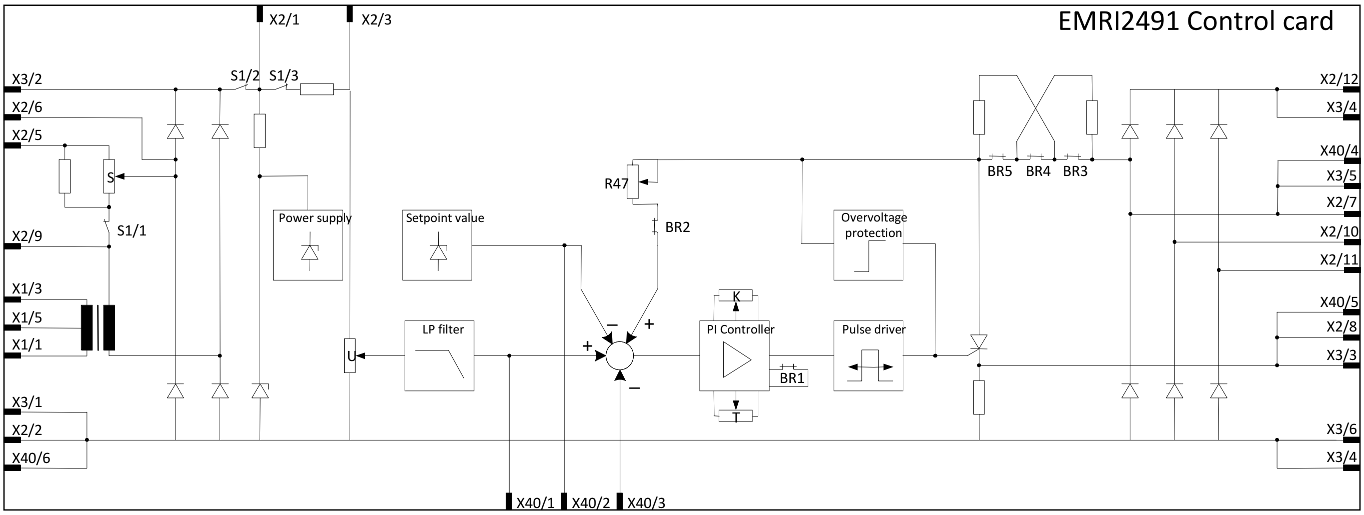



**Diagram 1. EMRI2491 Functional diagram**

## 1.8 Functional block diagram EMRI2492

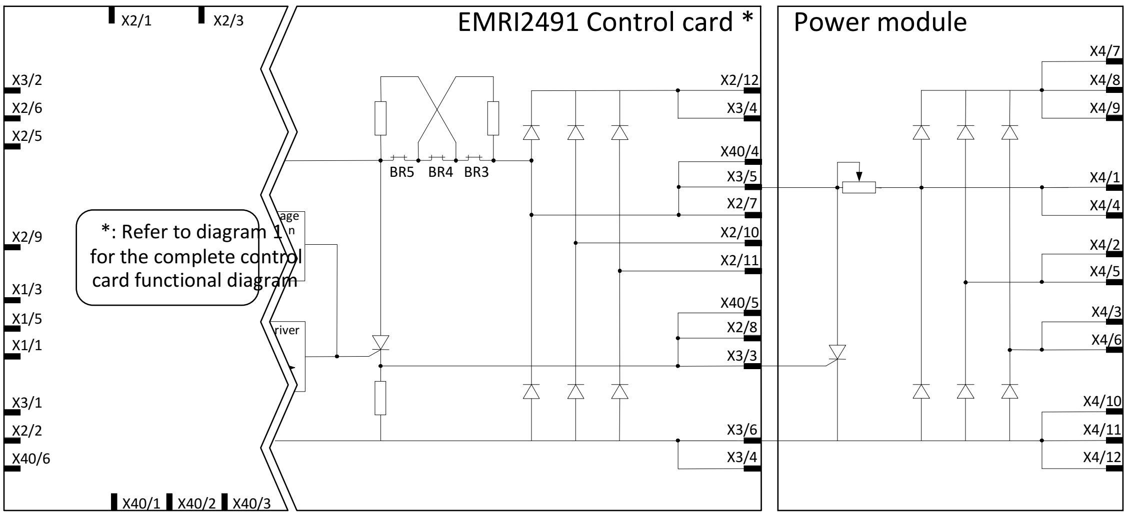



**Diagram 2. EMRI2492 Functional diagram**

# 2. INSTALLATION

For a complete wiring diagram see page 21.

## 2.0 Adjustments overview

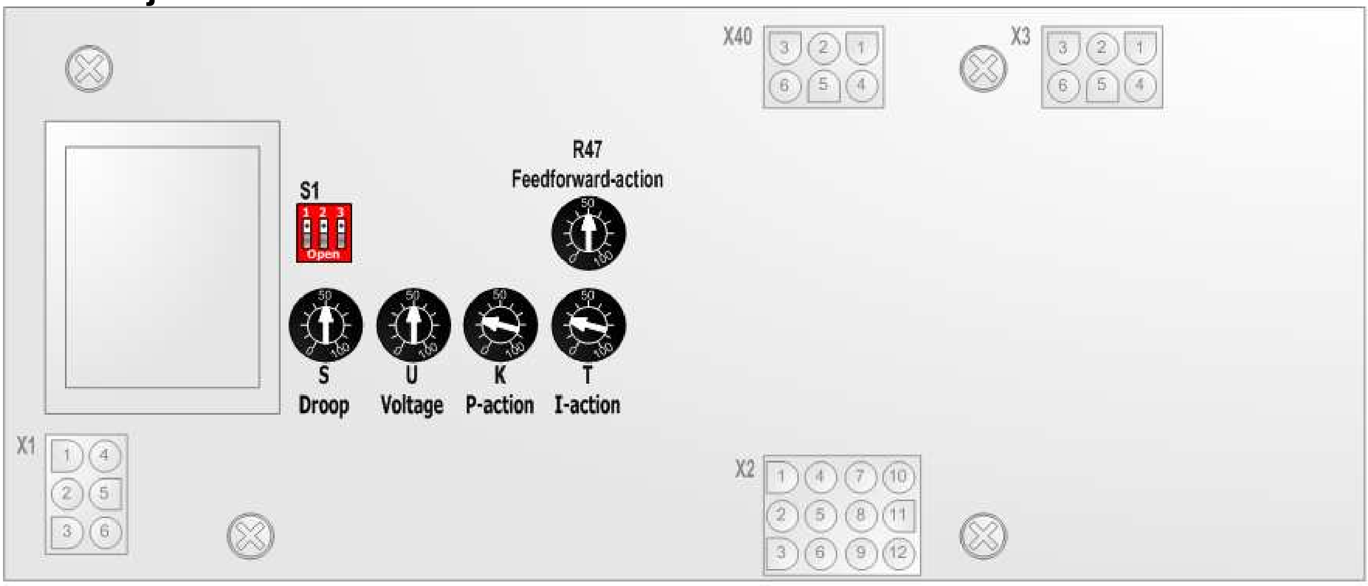



**Fig 3. Adjustments overview**

| Symbol | Description | Notes |
|---|---|---|
| S | Voltage droop setpoint | For parallel operation |
| U | Generator voltage setpoint | |
| K | Control loop proportional action | |
| T | Control loop integral action | |
| R47 | Control loop feedforward action | |
| S1/1 | Selection 1 phase or 3 phase sensing | Closed: 1 phase sensing<br>Open: 3 phase sensing |
| S1/2 | Selection 1 phase or 3 phase sensing | Closed: 1 phase sensing<br>Open: 3 phase sensing |
| S1/3 | External voltage adjustment potentiometer | Closed: Ext. potentiometer disabled<br>Open: Ext. potentiometer enabled |

**Table 3. Adjustments**

## 2.1 Terminals overview EMRI2491

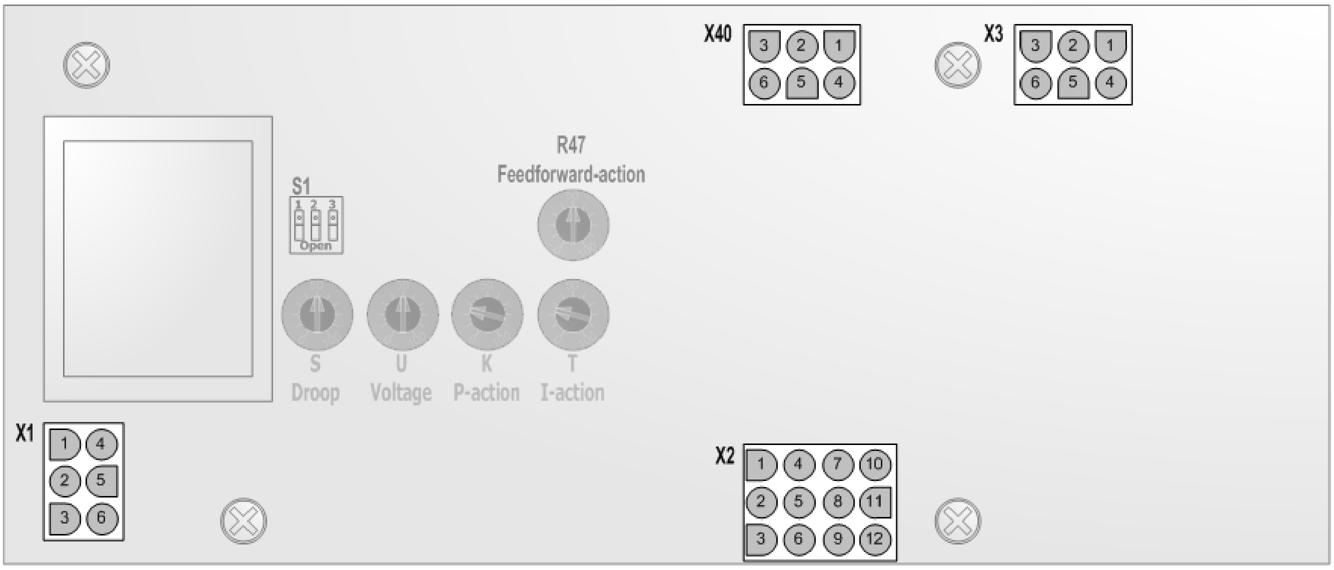



**Fig 4. Terminals overview**

| Header | Terminal | Description | Notes |
|---|---|---|---|
| X1 | 1 | 400 $V_{ac}$ voltage sensing | |
| | 2 | Not connected | |
| | 3 | 0 $V_{ac}$ voltage sensing | |
| | 4 | Not connected | |
| | 5 | 230 $V_{ac}$ voltage sensing | |
| | 6 | Not connected | |
| X2 | 1 | External voltage adjustment potentiometer | |
| | 2 | EMRI2491 circuit ground | |
| | 3 | External voltage adjustment potentiometer | |
| | 4 | Field excitation - | For EMRI2491 |
| | 5 | CT input for voltage droop | |
| | 6 | External sensing influence | |
| | 7 | Compound transformer input AC1 | |
| | 8 | EMRI2492 gate drive | Link with X2.4 for EMRI2491 |
| | 9 | CT input for voltage droop | |
| | 10 | Compound transformer input AC2 | |
| | 11 | Compound transformer input AC3 | |
| | 12 | Field excitation + | For EMRI2491 |
| X3 | 1 | Voltage sensing rectifier - | |
| | 2 | Voltage sensing rectifier + | |
| | 3 | EMRI2492 gate drive | |
| | 4 | Field Excitation + | |
| | 5 | Compound transformer input AC1 | |
| | 6 | Field excitation - | EMRI2491 circuit ground |
| X40 | 1 | Controller actual value | |
| | 2 | External setpoint input - | |
| | 3 | External setpoint input + | |
| | 4 | Compound transformer input AC1 | |
| | 5 | EMRI2492 gate drive | |
| | 6 | EMRI2491 PCB ground / Field excitation - | |

**Table 4. Terminals EMRI2491**

## 2.2 Terminals overview EMRI2492

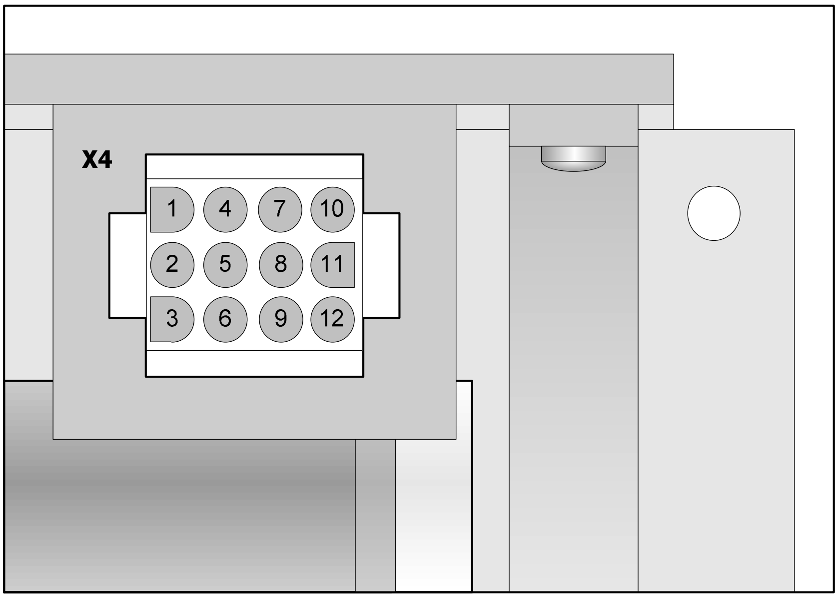



**Fig 5. Terminals overview**

Since the EMRI2492 consists of the EMRI2491 control board with an additional power module, only the additional power module terminals are defined here. The control board terminals can be found in paragraph 2.1.

A separate, 6 pin wired connector originates from the power module. The connector is not drawn but is connected to the control board connector X3. Refer to the X3 terminal overview in table 4 for pin definitions.

| Header | Terminal | Description | Notes |
|---|---|---|---|
| X4 | 1 | Compound transformer input AC3 | |
| | 2 | Compound transformer input AC2 | |
| | 3 | Compound transformer input AC1 | |
| | 4 | Compound transformer input AC3 | |
| | 5 | Compound transformer input AC2 | |
| | 6 | Compound transformer input AC1 | |
| | 7 | Field excitation + | |
| | 8 | Field excitation + | |
| | 9 | Field excitation + | |
| | 10 | Field excitation - | |
| | 11 | Field excitation - | |
| | 12 | Field excitation - | |

**Table 5. Terminals EMRI2492**

## 2.3 Wire bridges overview EMRI2491

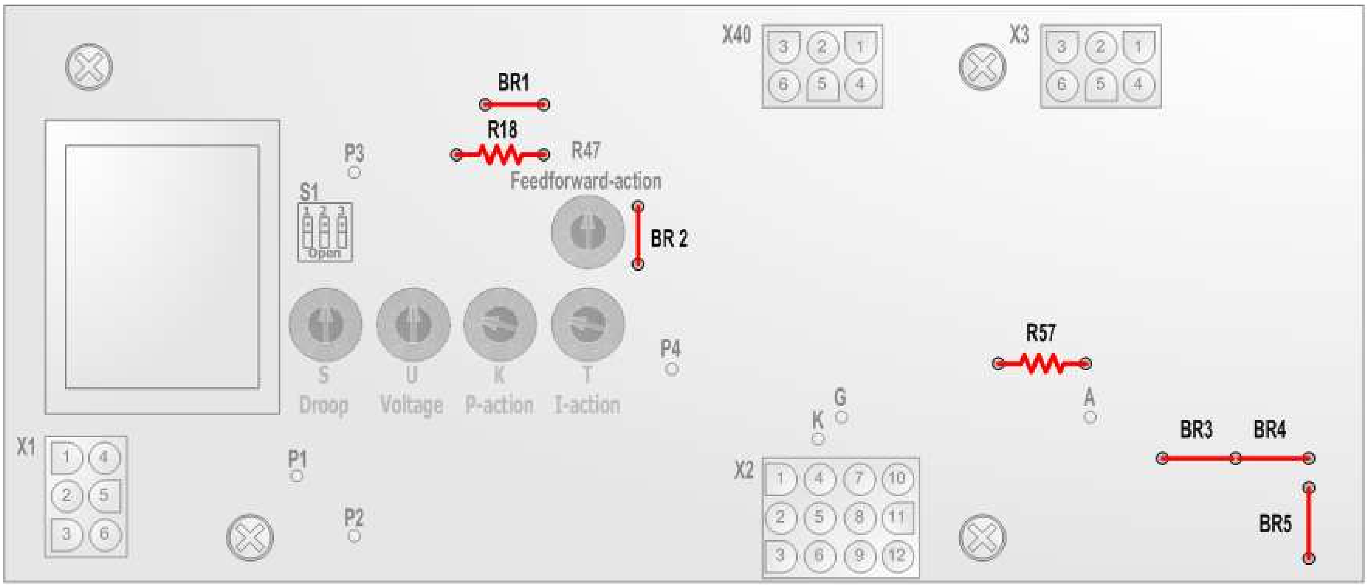



**Fig 6. Wire bridges overview**

| Symbol | Description | Notes |
|---|---|---|
| BR1 | Controller proportional gain adjust | Opening reduces P-action by 4 |
| BR2 | Controller feedforward link | Opening disables feedforward action |
| BR3 | Shunt resistor selection | See paragraph 5.3 |
| BR4 | Shunt resistor selection | See paragraph 5.3 |
| BR5 | Shunt resistor selection | See paragraph 5.3 |
| R18 | External setpoint range resistor | Adjusts external setpoint range |
| R57 | Excitation bridge resistor | Normally not fitted |

**Table 6. Wire bridges**

## 2.4 Test points overview EMRI2491

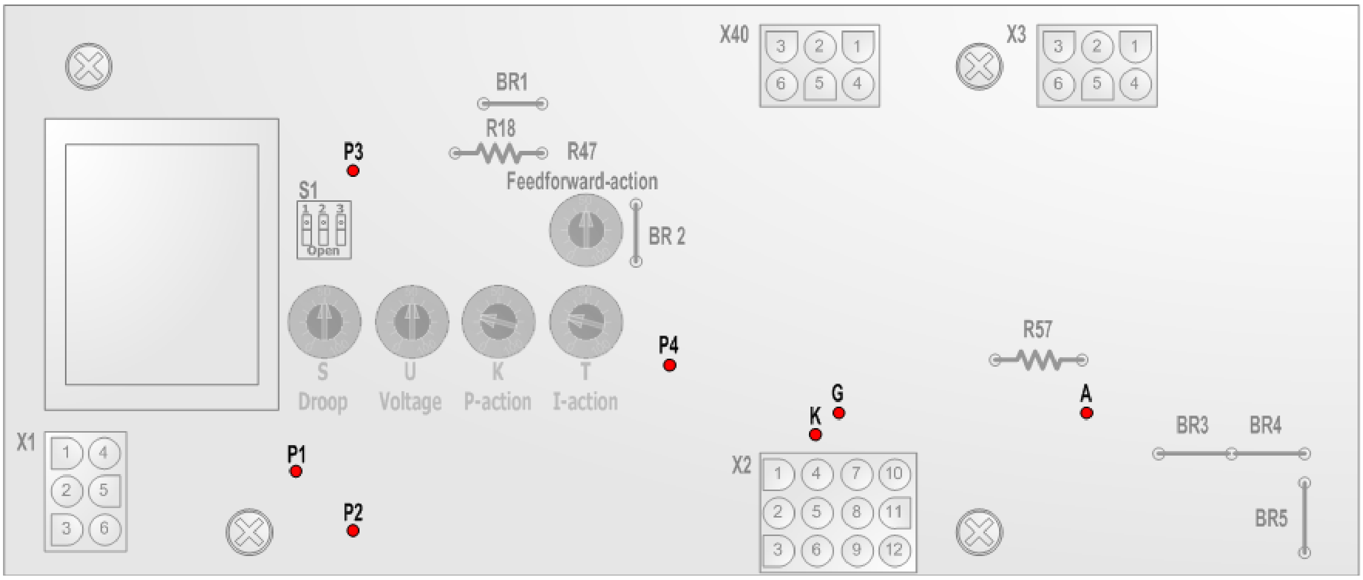



Fig 7. Test points overview

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| Symbol | Description | Notes |
|---|---|---|
| P1 | EMRI2491 circuit ground | |
| P2 | CT input for voltage droop | Connected to X2.9 |
| P3 | External setpoint input - | Connected to X40.2 |
| P4 | Controller output | |
| K | Thyristor cathode | |
| A | Thyristor anode | |
| G | Thyrisor gate | |

Table 7. Test points

# 3. OPERATION

## 3.1 Basic operation

The EMRI2491 and EMRI2492 are designed for use in generators with a compounding system. The AVR operates according to a subtractive principle meaning that any excess excitation current generated by the generator compounding is dissipated in a shunt resistance.

In basic operation, when no-protections are triggered and no voltage droop is set, the AVR controls the generator voltage according a constant voltage characteristic irrespective of load and frequency.

## 3.2 Parallel operation

If the generator operates in parallel operation with one or more generators, reactive load sharing can be accomplished by means of Quadrature Droop Compensation (QDC). Parallel operation requires an EMRI droopkit. The droopkit must be rated to match the generator nominal current. In order to obtain a proper load distribution the no-load voltages and the amount of voltage droop during load must be set equal for all generators. The adjustments must be made very precise and under equal conditions for each generator (frequency, current, power factor)

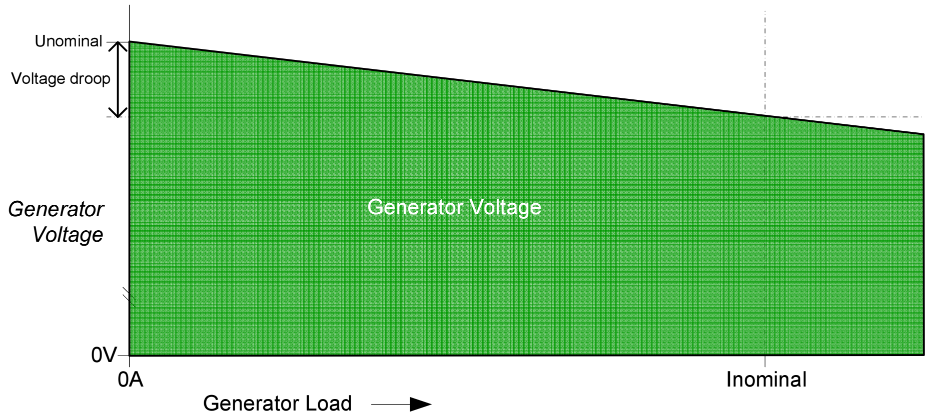



**Diagram 3. Voltage droop**

# 4. PROTECTIONS

## 4.1 Protections

### 4.1.0 Excitation overvoltage protection

The overvoltage protection validates the excitation voltage generated by the compounding system. If the overvoltage limit of $600V_{dc}$ is exceeded the AVR shunts excess excitation current cycle by cycle. This will limit the output voltage of the compounding transformers and prevent damage to the compounding transformers as well as the AVR excitation circuitry.
An overvoltage above $600V_{dc}$ is likely to be caused by an interruption in the excitation circuit, as this will cause the current transformers in the compounding system to raise voltage level up to the compliance voltage.

Diagram 4 shows a sequence of events for diagnosis purposes in case of an excitation over-voltage error.

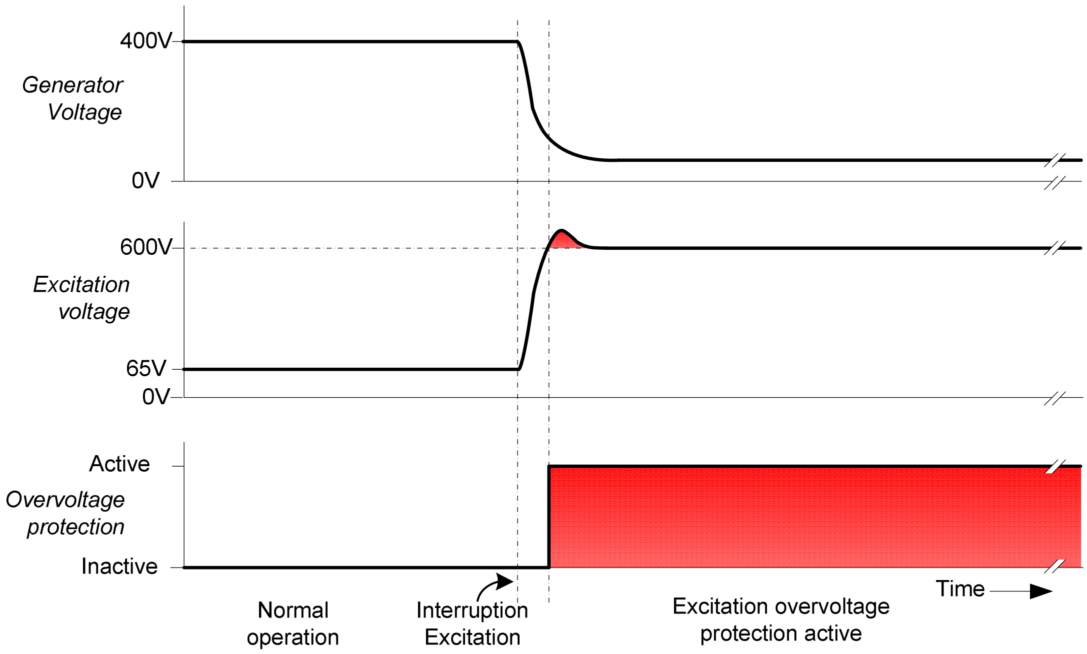



**Diagram 4. Excitation overvoltage protection**

# 5. SETTINGS

## 5.1 Generator Voltage

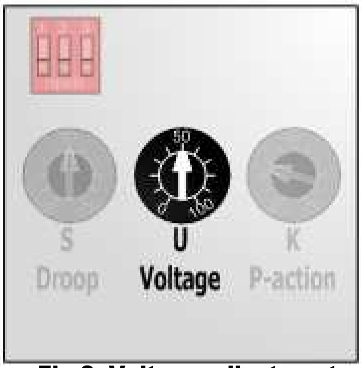



Fig 8. Voltage adjustment

The generator voltage setpoint is user adjustable by a voltage potentiometer. The voltage potentiometer range is $U_{nom}$ +30% and -15%. Turning the potentiometer clockwise increases the generator voltage, turning counter clockwise decreases the generator voltage.
Note that increasing the shunt resistance can increase the minimum settable voltage setpoint. This is due to the fact that the shunt resistance limits the amount of excitation current that can be subtracted.

## 5.2 Stability

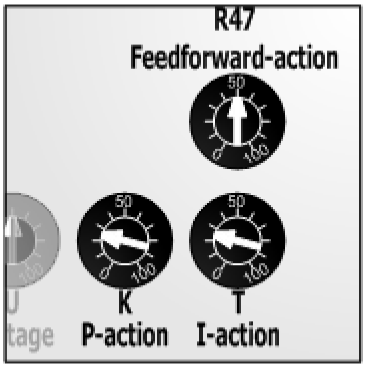



Fig 9. Stability adjustments

The generator stability and control response are adjustable by means of the proportional-, integral- and feedforward-action potentiometers.
Turning the proportional action potentiometer (K) clockwise increases the proportional gain, turning counter clockwise decreases the proportional gain.
Turning the integral action potentiometer (T) clockwise increases integral time, turning counter clockwise decreases the integral time.
Turning the feedforward action potentiometer (R47) clockwise increases feedforward action, turning counter clockwise decreases feedforward action. The feedforward action can be completely eliminated by interrupting wire bridge BR2 (See paragraph 2.3).

When the control rate must be reduced beyond the range adjustable with the potentiometers, the proportional action potentiometer range can be reduced by a factor 4 by interrupting wire bridge BR1 (See paragraph 2.3). Another possibility to reduce control rate is to increase the shunt resistance. A trade-off in this case is that an increase in shunt resistance can increase the minimum settable voltage setpoint.
Tuning the PI-controller must be performed by a control specialist to prevent damage to the AVR and generator.

## 5.3 Droop

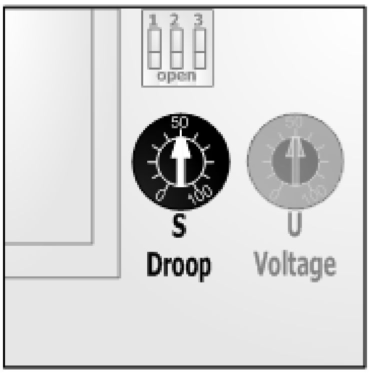



Fig 10. Droop adjustment

When the generator is in parallel operation with one or more generators, Quadrature Droop Compensation is used to enable load sharing. The amount of voltage droop can be adjusted by means of the droop potentiometer.
The droop potentiometer range is $U_{nom}$ ±20% at power factor 0. Turning the potentiometer clockwise increases the voltage droop, turning counter clockwise decreases the voltage droop. If the generator is not operating in parallel, turn the droop potentiometer completely counter clockwise to disable voltage droop. For a more detailed description of voltage droop see paragraph 3.2.

## 5.3 Dipswitches

Before any dipswitch settings are altered the generator must be stopped. A description of each individual dipswitch is drawn up in table 8. Please note that incorrect dipswitch settings can cause overvoltage situations and AVR damage.

**Note:** Dipswitch is closed when the switch is level with the topside of the dipswitch. The dot is on the topside.
Dipswitch is opened when the switch is level with the bottom side of the dipswitch. The dot is on the bottom side.


**Fig 11. Dipswitch settings**

| Dipswitch | Description | Notes | Default |
|---|---|---|---|
| S1/1 | 1 phase / 3 phase sensing | Closed = 1 phase sensing<br>Open = 3 phase sensing | Closed |
| S1/2 | 1 phase / 3 phase sensing | Closed = 1 phase sensing<br>Open = 3 phase sensing | Closed |
| S1/3 | External voltage potentiometer | Closed = disabled<br>Open = enabled | Closed |

**Table 8. Dipswitch settings**

## 5.4 Shunt resistor adjustment

The excitation current that is subtracted by the AVR is current limited by a series connected shunt resistor. For the EMRI2491 AVR the resistance can be adjusted by means of wire bridges BR3, BR4 and BR5. Table 9 shows the resistance for the different wire bridge combinations.

For the EMRI2492 AVR the resistance can be adjusted by adjustment of the wiper position on the power resistor, mounted on the heat sink.

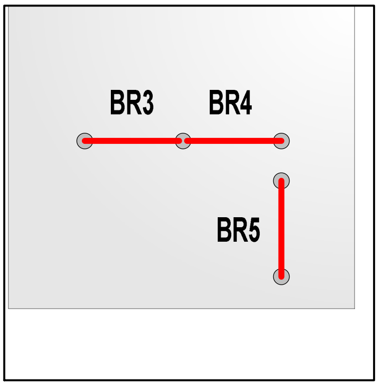



**Fig 12. Dipswitch settings**

Note that an increase in shunt resistance will result in a slower control characteristic and can increase the minimum settable voltage setpoint. The opposite is valid for a decrease in shunt resistance.

| BR3 | BR4 | BR5 | Resistance (Ohm) | Notes |
|---|---|---|---|---|
| Open | Open | Open | ∞ | Do not use |
| Open | Open | Closed | 10 | |
| Open | Closed | Open | 25 | |
| Open | Closed | Closed | 10 | |
| Closed | Open | Open | 15 | |
| Closed | Open | Closed | 6 | Default |
| Closed | Closed | Open | 15 | |
| Closed | Closed | Closed | 0 | Do not use |

**Table 9 Shunt resistor**

## 5.5 External voltage potentiometer

If the generator voltage setpoint is to be adjusted externally, a 4.7kΩ/1W potentiometer can be fitted between terminals X2/1 and X2/3. In this case dipswitch S1/3 must be opened. It is recommended to set potentiometer U (Voltage) to 50% when an external voltage potentiometer is fitted.

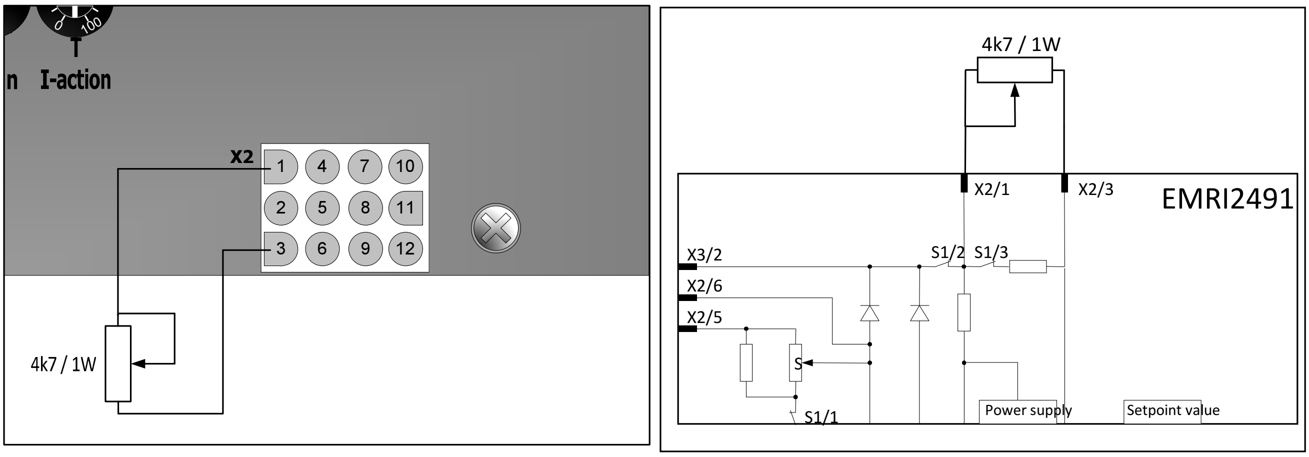



**Fig. 13 External voltage potentiometer**

## 5.6 External setpoint adjust

The generator voltage setpoint can be influenced by external control equipement by means of a potential free ±5V$_{dc}$ signal. The voltage is connected to terminals X40/2 (-) and X40/3 (+).
The influence of the applied setpoint adjust voltage on the nominal generator voltage can be calculated with the following formula:

$$\Delta U_{GEN} = -1.4 \times ( U_{NOM} / R18 ) \times U_{SET}$$

$\Delta U_{GEN}$ = Change in generator voltage
$U_{SET}$ = Input voltage at terminals X40/2 and X40/3
$U_{NOM}$ = Nominal generator voltage setpoint
R18 = Resistance (in kΩ)

Resistor R18 is default fitted with a 10kΩ resistor but can be adjusted to fit the external setpoint adjustment range to a specific application. Refer to paragraph 2.3 for locating R18 on the EMRI2491 controller board.

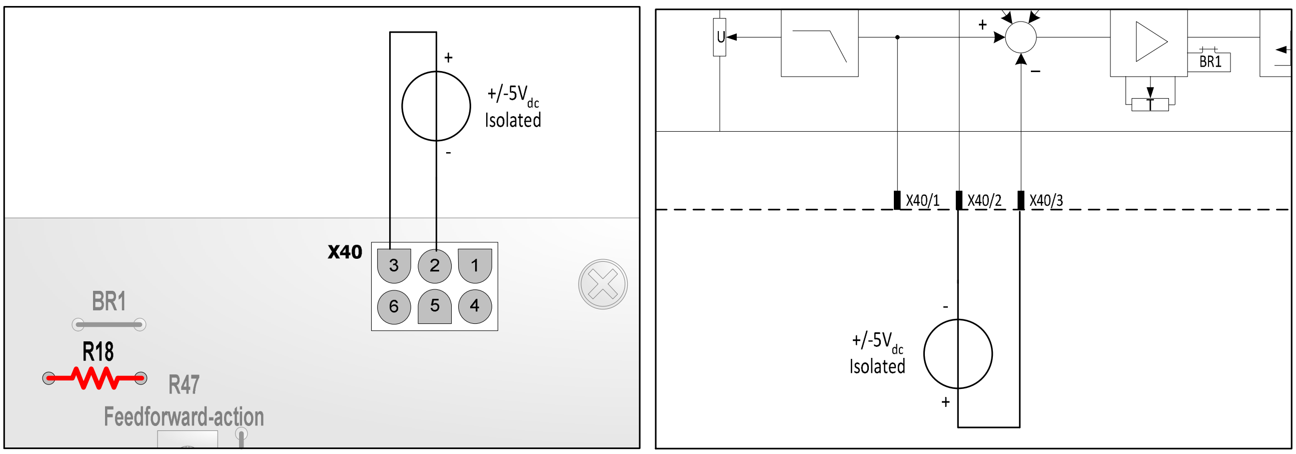



**Fig. 14 External setpoint adjust**

## 5.4 Factory settings

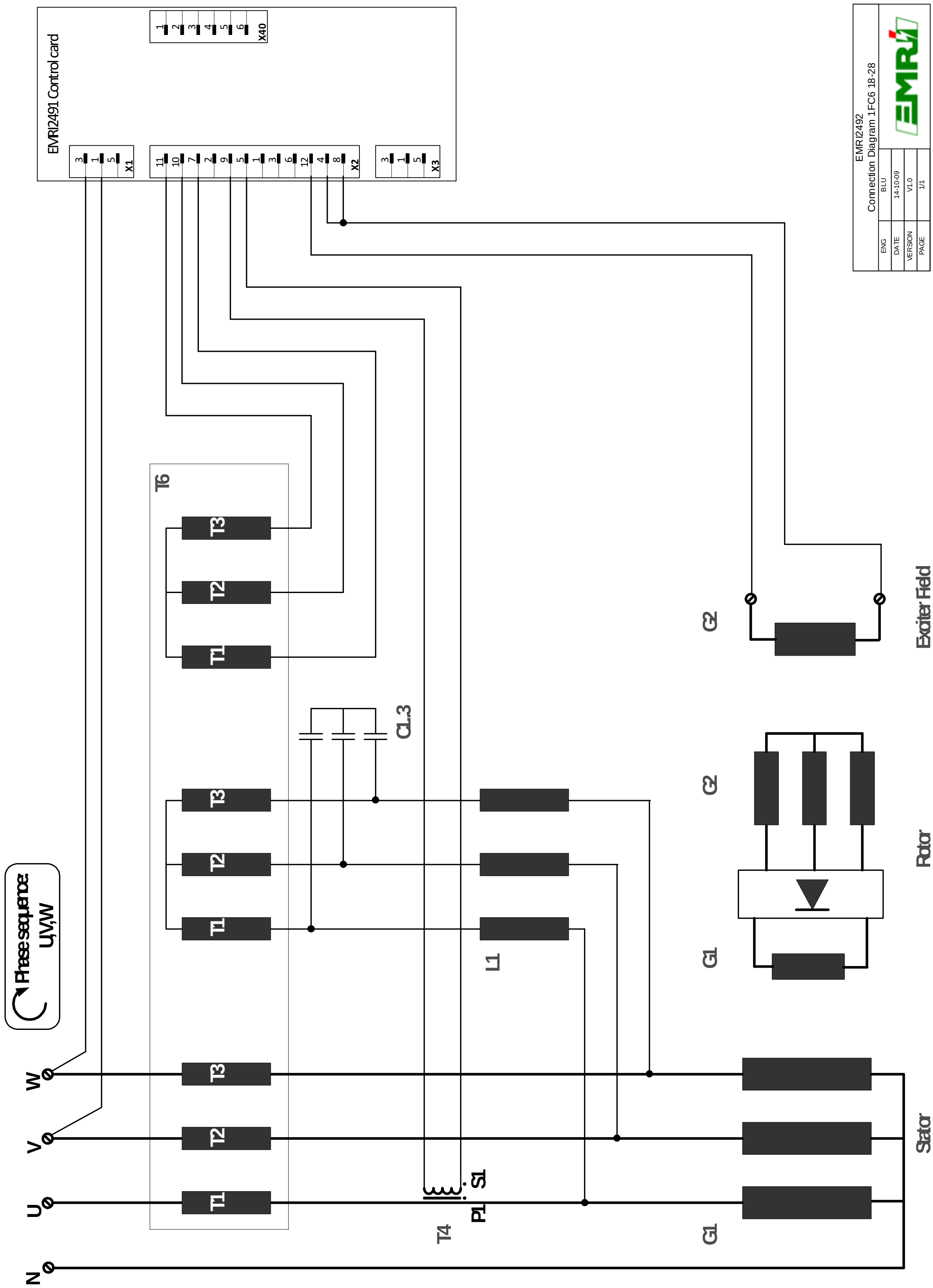
All new AVR's and AVR's returned from service are supplied with factory settings as described in table 10. Adjusting the factory settings must only be performed by qualified personnel who understand the danger of electric shock hazards and have read and understood the user instructions

| Parameter | Value | Unit |
|---|---|---|
| U (Voltage) | 400 | Vac |
| S (Droop) | 0 | V |
| K (P - action) | 25 | % |
| T (I action) | 25 | % |
| R47 (Feedforward - action) | 50 | % |
| BR1 | Closed | |
| BR2 | Closed | |
| BR3 | Closed | |
| BR4 | Open | |
| BR5 | Closed | |
| R18 | 10 | kΩ |
| Dipswitch S1/1 | Closed | |
| Dipswitch S1/2 | Closed | |
| Dipswitch S1/3 | Closed | |

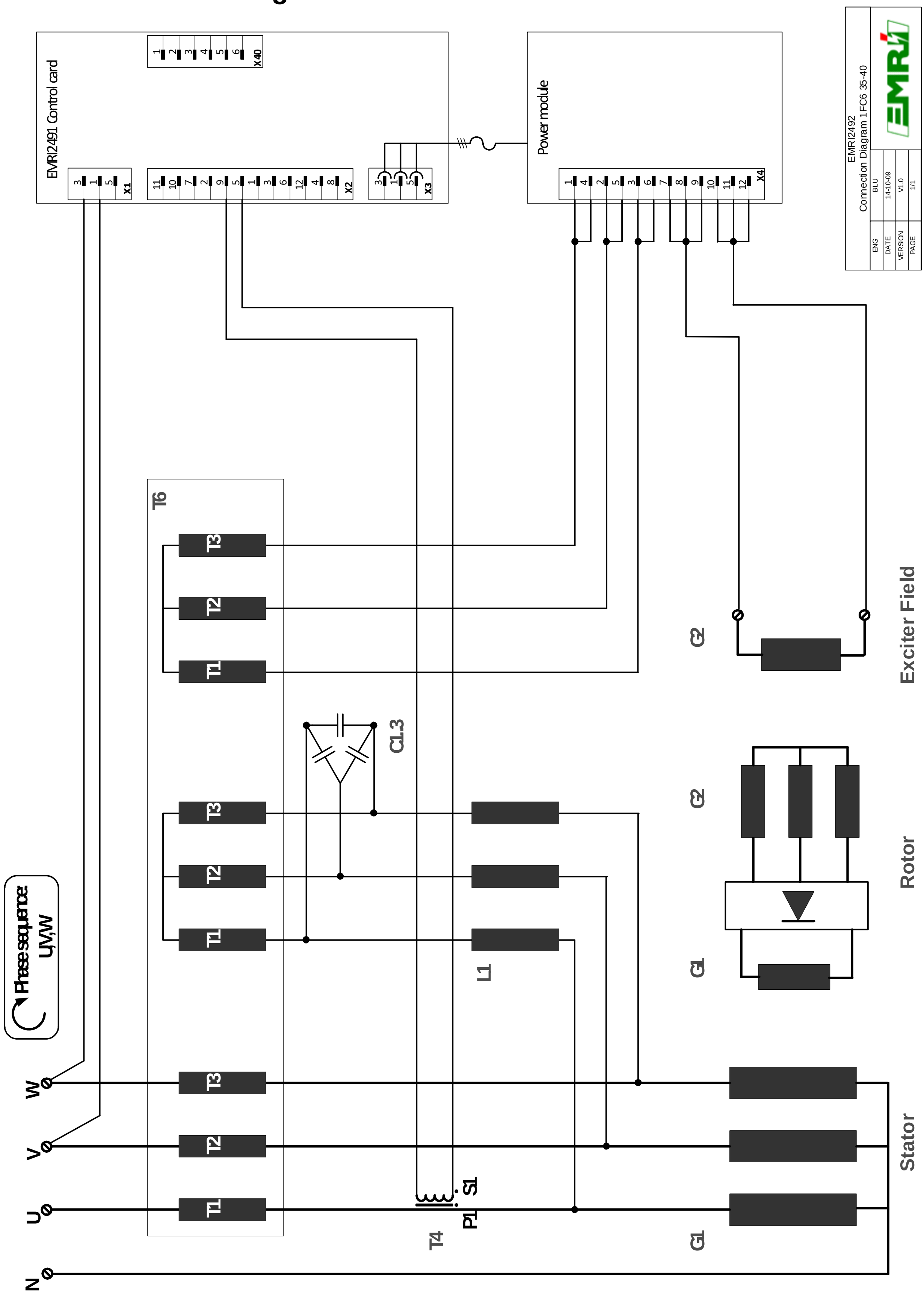
**Table 10. Factory settings**

# 6. WIRING DIAGRAMS

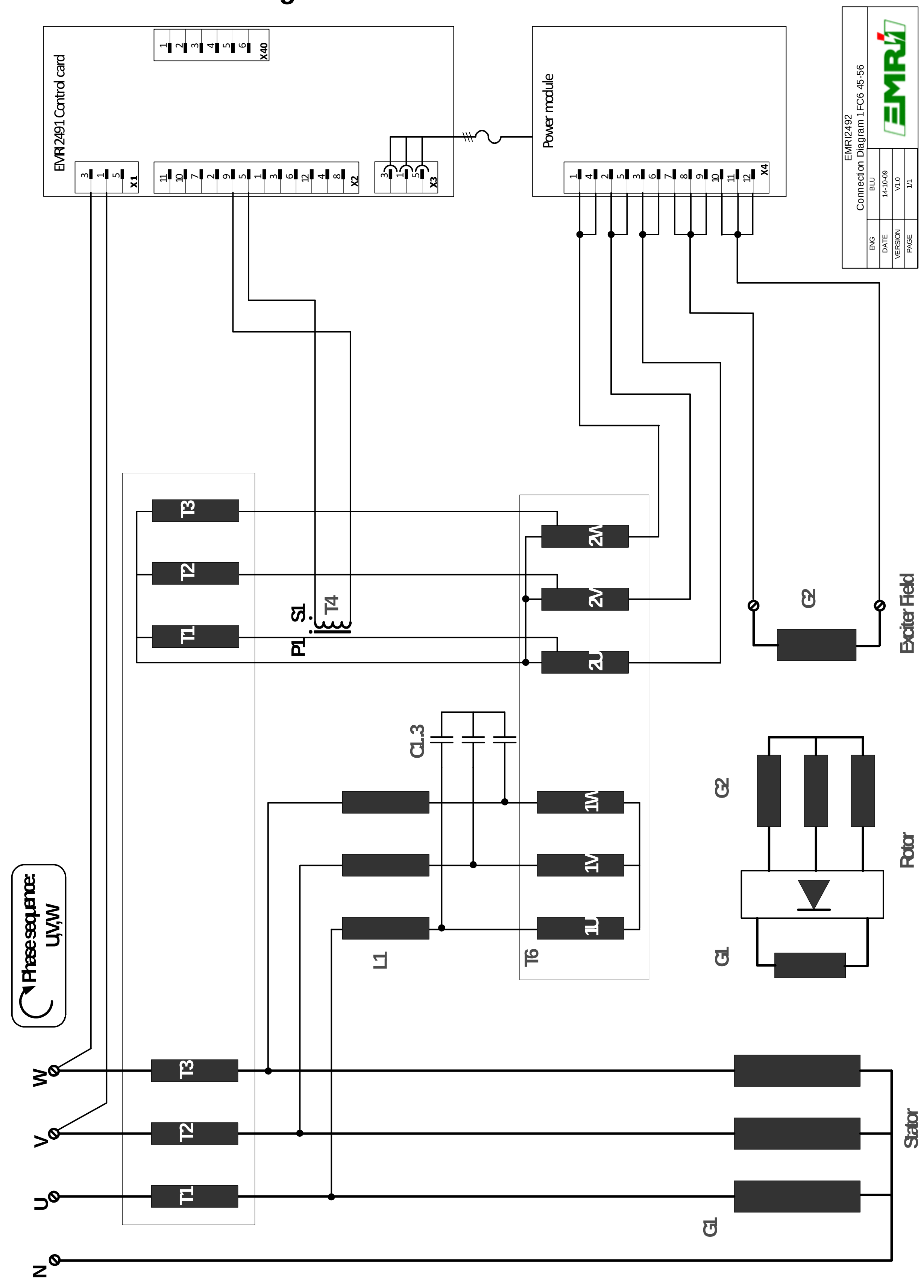
## 6.1 Connection diagram 1FC6 18-28



## 6.2 Connection diagram 1FC6 35-40



## 6.3 Connection diagram 1FC6 45-56

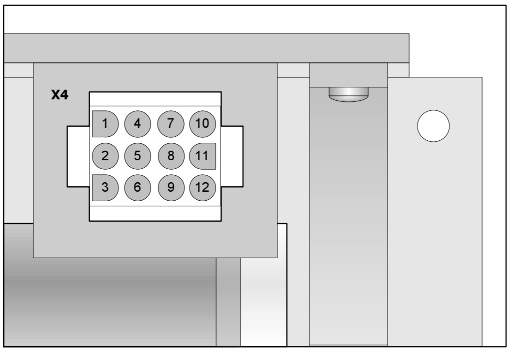


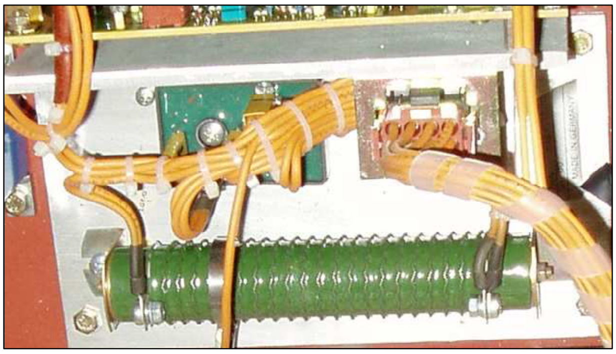
# 7. HYUNDAI/SIEMENS

## 7.1 X4 connector

| Header | Terminal | Description | Notes |
|---|---|---|---|
| X4 | 1 | Compound transformer input AC3 | |
| | 2 | Compound transformer input AC2 | |
| | 3 | Compound transformer input AC1 | |
| | 4 | Compound transformer input AC3 | |
| | 5 | Compound transformer input AC2 | |
| | 6 | Compound transformer input AC1 | |
| | 7 | Field excitation + | |
| | 8 | Field excitation + | |
| | 9 | Field excitation + | |
| | 10 | Field excitation - | |
| | 11 | Field excitation - | |
| | 12 | Field excitation - | |

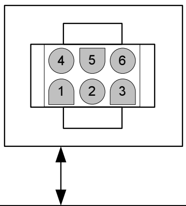
**Siemens/ EMRI connector**



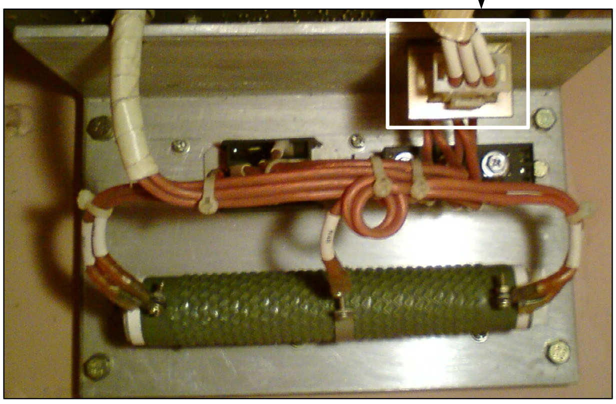



| Header | Terminal | Description | Notes |
|---|---|---|---|
| X4 | 1 | Compound transformer input AC3 | These pins only if a 6 pin connector is used |
| | 2 | Compound transformer input AC2 | |
| | 3 | Compound transformer input AC1 | |
| | 4 | Field excitation + | |
| | 5 | Field excitation - | |
| | 6 | Not connected | |
| | 7 | Not connected | |
| | 8 | Not connected | |
| | 9 | Not connected | |
| | 10 | Not connected | |
| | 11 | Not connected | |
| | 12 | Not connected | |

**Hyundai connector**







| Connectors EMRI2492/Hyundai | |
|---|---|
| ENG | ing. E.Bloemendal |
| DATE | 09-12-11 |
| VERSION | V1.0 |
| PAGE | 1/1 |

Diagrams manual 6GA249x.vsd

Contact EMRI for Siemens/ Hyundai convertor connector if required.

# APPENDIX

## A.1 General installation information

### Absolute Maximum Ratings

- The Absolute Maximum Ratings are those limits for the device that, if exceeded, will likely damage the device. Exceeding the absolute maximum ratings voids any warranty and/or guarantee.

### Mounting

- Mounting of the product should be done in such a way that the absolute maximum ambient temperature rating of the product will never be exceeded.
- Mounting of the product should be done in such a way that maximum cooling (direction of cooling ribs and direction of airflow) is achieved.
- Mounting of the product should be done in such a way that no humid air can flow through the product or condensation occurs.
- Mounting of the product should be done in such a way that dust or other materials or residue will not remain in or on the product.
- Mounting of the product should be done in such a way that the maximum vibration is not exceeded.
- Mounting of the product should be done in such a way that personal contact with persons is impossible.

### Wiring

- Diameter size of the wiring should be enough to carry the expected current. Wire insulation should be enough to withstand the expected operating voltages and temperatures.
- To improve EMC emission and immunity, care should be taken for the lay out of the wiring. This in respect to all wiring in the installation.
- Keep current carrying wires as short as possible.
- Keep wires carrying a total sum of zero Ampere close to each other, or in one single cable. E.g. U, V, W or F1 and F2, or AC1, AC2 and AC3.
- Avoid current carrying conductors next to sensing or control wiring. Especially current controlled by SCR’s or PWM controlled transistors.
- If sensitive sensing signal cables need to be laid across distance along other cabling, shielded cable is preferred. Keep the shield as long as possible and the wiring outside the shield as short as possible. Do not solder or shrink the shield to a regular wire. Connect the original shield to ground at one side with an as large as possible contact surface.

## Additional installation information

- When the product is supplied by means of a transformer, it should never be an auto-transformer. Auto-transformers react as voltage sweep up coil and may cause high voltage peaks.
- Standard fit capacitors or over-voltage suppressers across F+ and F- or exciter field terminals inside the generator should be removed.
- When the product is supplied by means of a transformer, it should be able to carry at least the maximum expected current. Advisable is, to have a transformer which can carry twice the maximum expected current. Inductive loads make voltage sacks and peeks into the secondary voltage of a transformer, from which the device may malfunction.
- It is not recommended to apply switches in dc outputs. It is preferred to use switches in the ac supply inputs of devices. In case it is unavoidable to have switches in the dc output of a device, action must be taken to avoid over voltage damage to the device due to contact arcing. Use a voltage suppressor across the output.
- It is not recommended to apply switches or fuses in the sensing lines. Defects can cause high voltage situations due to over-excitation.
- When using a step down transformer in medium or high voltage generators, the transformer should be three phase (if three phase sensing), and the transformer should be suitable for acting as a sensing transformer. If the transformer is unloaded, connect a resistor to avoid voltage waveform distortion.
- The phase relation from the generator to the AVR is important. Also when voltage transformers and/ or current transformers are installed.
- When using a step down or insulation transformer in the droop circuit, phase relation from the generator to the AVR is important.
- CT's wiring, connected to the AVR should never be grounded.
- Always disconnect electronic products, circuits and people before checking the insulation resistance (Megger check).
- Due to differences in generators impedance's, EMC behavior is not predictable. Therefore the commissioner / installer should be aware of proper and correct installation.
- Large, highly inductive, exciter stator windings can cause destructive high voltage peaks. Adding a resistor from 10 to 20 times the exciter stator field resistance reduces voltage spikes. If necessary filter can be fitted additionally. (e.g. snubber, RC-network)
- Upon problems during commissioning, faulty behavior or defects in the generator, consult the fault finding manual at our web site
- Some advises may be overdone or seem extraordinary, but since the electrical rules are the same everywhere, these advises are given.

## A.2 Contact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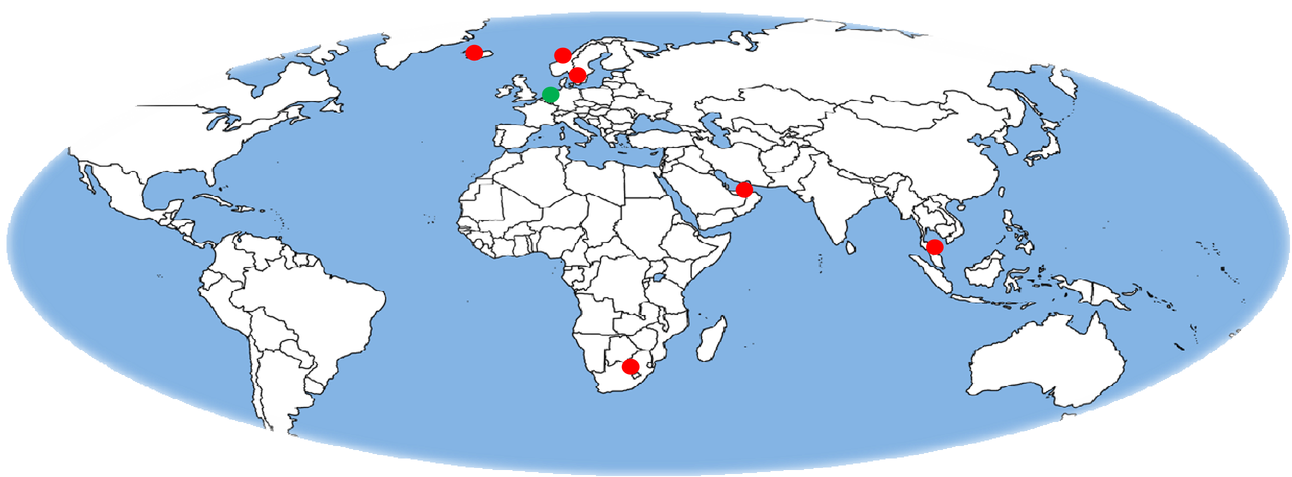

See our website www.emri.nl for local suppliers