

## Regulator

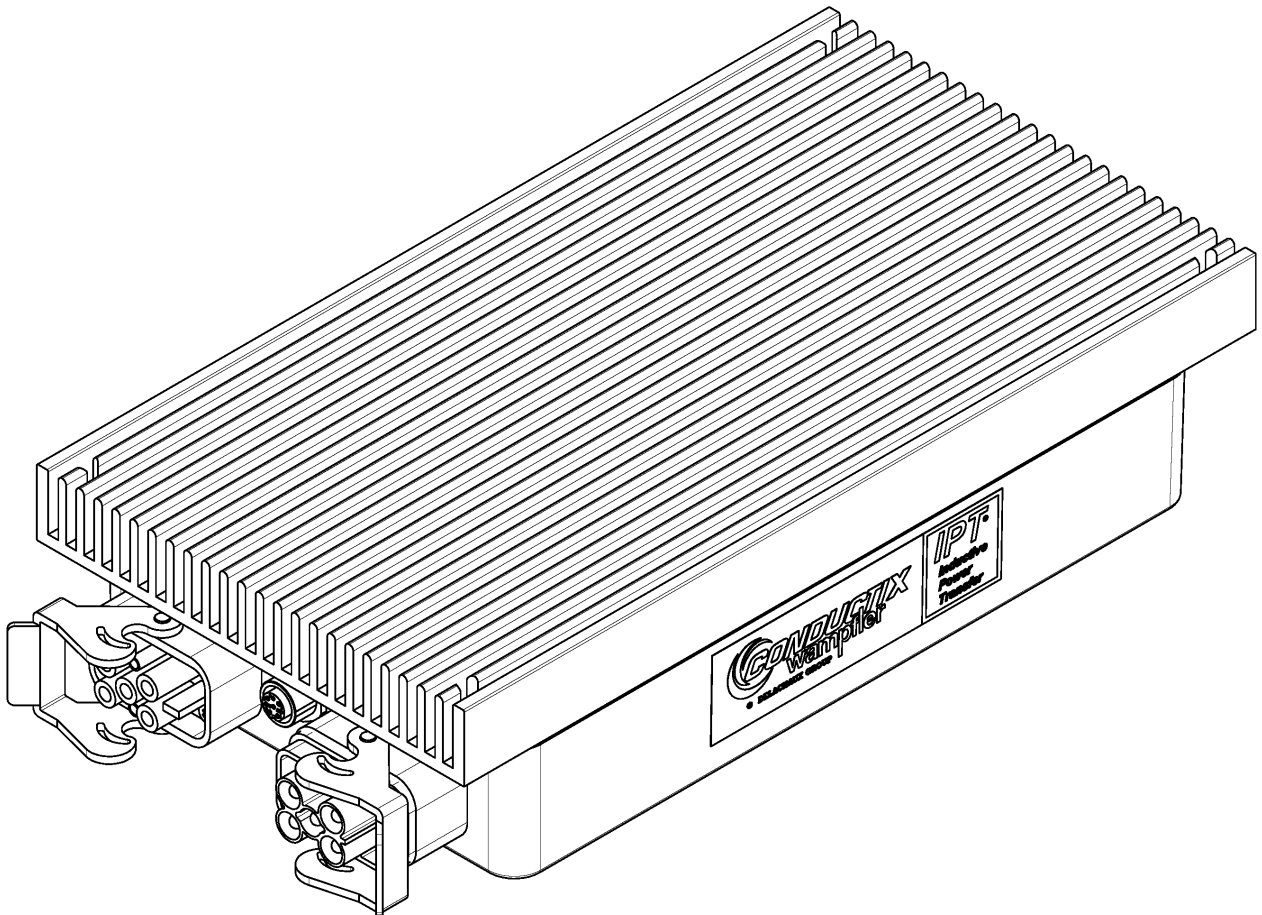
Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

### Part-Number

|                   |                        |
|-------------------|------------------------|
| 91008-411-3280288 | Regulator 48 V DC      |
| 91008-411-3188088 | Regulator 54 V DC      |
| 91008-411-3198704 | Regulator 65 V DC      |
| 91008-411-3093036 | (Configurable version) |

(Matching pickups must be ordered separately)



## Contents

|        |  |    |
|--------|--|----|
| 1      | General Advice .....                                 | 6  |
| 1.1.   | Information to these Operating Instructions.....     | 6  |
| 1.2.   | Limitation of Liability .....                        | 6  |
| 1.3.   | Copyright .....                                      | 7  |
| 1.4.   | Spare Parts.....                                     | 7  |
| 1.5.   | Material Defects.....                                | 7  |
| 1.6.   | Technical Support.....                               | 7  |
| 2      | Safety Advice.....                                   | 8  |
| 2.1.   | Definition of Symbols .....                          | 8  |
| 2.2.   | Requirements Regarding Personnel .....               | 9  |
| 2.2.1. | Qualification.....                                   | 9  |
| 2.2.2. | Unauthorized Persons .....                           | 9  |
| 2.3.   | Application in Accordance with the Regulations ..... | 10 |
| 3      | Intended Purpose .....                               | 10 |
| 4      | Technical Data.....                                  | 11 |
| 4.1.   | Electrical Data .....                                | 11 |
| 4.2.   | Environmental Data .....                             | 12 |
| 4.3.   | Protection Measures.....                             | 13 |
| 4.4.   | Design Standards Applied .....                       | 13 |
| 4.5.   | Mechanical Integration .....                         | 14 |
| 4.6.   | Electrical Connections .....                         | 15 |
| 4.6.1. | Connection of Power Input: X1.....                   | 15 |
| 4.6.2. | Connection of Power Output: X2.....                  | 16 |



## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

|        |  |    |
|--------|--|----|
| 4.6.3. | Connection of Interface: X3 .....                      | 16 |
| 4.6.4. | Ground Connection .....                                | 17 |
| 4.6.5. | ESD Protection .....                                   | 17 |
| 5      | Scope of Delivery .....                                | 17 |
| 6      | Transport, Packing and Storage .....                   | 17 |
| 6.1.   | Transport .....  | 17 |
| 6.1.1. | Safety Advice for Transport .....                      | 17 |
| 6.1.2. | Transport Inspection .....                             | 18 |
| 6.2.   | Packing .....  | 18 |
| 6.3.   | Storage .....  | 18 |
| 7      | Installation .....                                     | 19 |
| 7.1.   | Who is authorized to carry out the Installation? ..... | 19 |
| 7.2.   | General Advice for the Installation .....              | 19 |
| 7.3.   | Electrical Regulations .....                           | 20 |
| 7.4.   | Recommended Connection .....                           | 20 |
| 7.4.1. | Connection of Pilot Pins .....                         | 20 |
| 7.4.2. | Example: Using the Interface .....                     | 21 |
| 7.4.3. | Example: Interface is not used .....                   | 22 |
| 7.5.   | Place and Conditions of Installation .....             | 23 |
| 7.5.1. | Position .....   | 23 |
| 7.5.2. | Air Flow Required .....                                | 23 |
| 7.5.3. | Proximity to Iron/Steel .....                          | 24 |
| 7.5.4. | Attachment Points .....                                | 24 |

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

|       |  |    |
|-------|--|----|
| 8     | Operation.....   | 25 |
| 8.1.  | Powering Up.....   | 25 |
| 8.2.  | Powering Down.....                                       | 25 |
| 8.3.  | Positional Tolerances.....                               | 25 |
| 8.4.  | Parallel Operation of Regulators.....                    | 27 |
| 8.5.  | Maximum Number of Regulators on a Track.....             | 28 |
| 8.6.  | Information and Advice for Operation with Interface..... | 29 |
| 8.7.  | Precautions.....   | 29 |
| 9     | Warnings and Cautions.....                               | 30 |
| 10    | Fault and Diagnosis.....                                 | 31 |
| 10.1. | Basics.....  | 31 |
| 10.2. | Reset.....   | 32 |
| 11    | Maintenance.....   | 32 |
| 12    | Repair.....  | 32 |
| 13    | Disassembly and Disposal.....                            | 33 |
| 13.1. | Safety.....  | 33 |
| 13.2. | Disassembly.....   | 34 |
| 13.3. | Disposal.....  | 34 |
| 14    | Accessories.....   | 35 |
| 14.1. | Power Input X1.....                                      | 35 |
| 14.2. | Power Output X2.....                                     | 35 |
| 14.3. | Interface.....   | 36 |
| 15    | Tools.....   | 37 |

This operating instruction is based on the following IPT-Documentation-No.: OM9100-0127-EN!

### **Important:**

Company names and trademarks mentioned in this manual which are registered and protected trade names and marks by copyright remain the property of the companies themselves.

We reserve the right to carry out technical modifications of illustrations and statements in these operating instructions in order to improve the energy supply system and its function.

System related details please find in the system manuals. Refer always to the system documentation before starting any work on the system or components within the system or before operating the system.

Reprint and duplication (as well as extracts) are only allowed with permission from Conductix-Wampfler GmbH.

© Conductix-Wampfler GmbH 2017

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

## 1 General Advice

---

### 1.1. Information to these Operating Instructions

These installation and operating instructions allow the safe and efficient handling of the equipment.

The installation and operating instructions are part of the equipment and must be stored close to the equipment and always available to the personnel. The personnel must have read carefully and understood these installation and operating instructions prior to starting work. The basic requirement for safe working is the observance of all safety advice and guidelines specified in these installation and operating instructions. Moreover you have to observe the local accident prevention guidelines and the general regulations for the application of the equipment.

Illustrations in this documentation are for basic comprehension and can deviate from the real design of the equipment.

All stated values are based on the metric system. If units of measurement have been omitted, millimeters (mm) apply.

Complementary instructions given in track installation manuals for specific applications, i.e. MV9100-0038 for EMS systems, must be observed at all times, if of relevance for the installation and operation of the equipment.

### 1.2. Limitation of Liability

All information and instructions of this operating instruction have been compiled with due regard to the standards and regulations in force, best engineering practice and the findings and experience we have accumulated over many years.

Conductix-Wampfler does not accept liability for damage due to:

- Non-observance of the operating instructions
- Improper use
- Use by untrained personnel
- Unauthorized modifications
- Technical modifications
- Use of unauthorized spare parts and accessories

The effective volume of delivery may deviate from these explanations and descriptions in case of special design, the utilization of additional order options or on account of the latest technical modifications.

The commitments of the supply contract, the general terms and conditions as well as Conductix-Wampfler's terms of delivery and the legal regulations at the time of the conclusion of contract have to be observed.

We reserve the right of technical modifications in the context of revision of useful properties and further developments.

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

### 1.3. Copyright

These installation and operating instructions are subject to copyright and intended for customer internal use only.

Providing third parties with the installation and operating instructions, duplications in any form - even in extracts - as well as reuse and/or disclosure of the contents are not permitted without written approval of Conductix-Wampfler, except for customer internal purposes.

Violations will be subject to damages. This will not exclude additional claims. Conductix-Wampfler is the holder of the copyright. We reserve the right for technical modifications of illustrations and specifications in these operating instructions that serve for the improvement of the systems and their functions.

### 1.4. Spare Parts



**WARNING!**

#### **Safety risk due to wrong spare parts!**

The utilization of wrong or faulty spare parts may cause danger to persons as well as damage, malfunctions or total failure.

- Use only original spare parts Conductix-Wampfler or spare parts approved by the Conductix-Wampfler!
- If uncertain always contact Conductix-Wampfler



**ADVICE!**

The product warranty expires with the use of unauthorized spare parts. Spare parts must be ordered from your licensed dealer or directly from Conductix-Wampfler. Address see last page of these operating instructions.

### 1.5. Material Defects

The regulations about material defects are listed in the general terms and conditions of business.

### 1.6. Technical Support

For technical support please contact our staff from the Customer Support Department. For contact data see last page of these instructions. Moreover, our staff is constantly interested in new information and experiences, which will arise from the application and which might be valuable for the improvement of our products. Please also contact our customer service in this context.

## 2 Safety Advice

### 2.1. Definition of Symbols

Safety and hazard information is identified in these installation and operating instructions by symbols. Signal words are used to indicate the degree of hazard. Always observe safety and hazard information and work carefully to avoid accidents, bodily harm or property damage!



**DANGER!**

... indicates an imminent danger, which might cause deathly or serious injuries if not avoided.



**WARNING!**

... indicates a possibly dangerous situation, which might cause deathly or serious injuries if not avoided.



**CAUTION!**

... indicates a possibly dangerous situation, which if not avoided, may result in moderate or minor injury and property damage.



**ADVICE!**

**Advice and recommendations:**

... gives advice and recommendations as well as information for efficient and trouble-free operation.

#### Special safety notes

The following symbols are used to point out special risks:



**DANGER!**

This combination of symbol and signal word indicates an imminent dangerous situation caused by electrical power and/or electrical voltage. If a labelled hint like this is not observed this may result in heavy or deadly injuries.



**WARNING!**

This sign draws the attention to parts of the operating instructions, where special care must be taken on account of heating of surfaces or on account of inductive heating of ferromagnetic material and where other special measures have to be taken.



**WARNING!**

This sign warns of the risks of electrostatic discharges (ESD)

- Comply with the respective ESD measures before and during work at the open device, e.g. by means of a grounding bracelet
- Connection to the ground must be assured at all times



## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

## 2.2. Requirements Regarding Personnel

### 2.2.1. Qualification



**WARNING!**

#### **Risk of injury due to insufficient qualification!**

Incorrect handling can cause serious injuries to persons and heavy damage to property.

→ All activities must be carried out by qualified staff!

The operating conditions indicate the following qualifications for the various fields of activity:

#### ■ **Electrician**

When the cables have been terminated correctly by authorized personnel having received instruction exclusively from Conductix-Wamplifier, further work may be performed by an electrician.

#### ■ **Instructed personnel/operators**

have been instructed by the operator about the tasks assigned to them and the possible dangers in case of improper behavior.

#### ■ **Specialized staff**

is able to carry out the work assigned to them and realize and avoid any dangers in this regard, based on their training, knowledge, experiences and knowledge of the respective regulations.

■ Only those persons are authorized for these works, who are expected to do their work properly. Persons with restricted responsiveness, e.g. due to drugs, alcohol or medication, are not permitted.

■ For the selection of personnel observe the age-specific and job-related prescriptions effective at the place of installation.

### 2.2.2. Unauthorized Persons



**WARNING!**

#### **Danger caused by unauthorized personnel!**

Unauthorized personnel, who do not meet the requirements described hereunder, are not familiar with the dangers that might occur within the working area.

→ Keep unauthorized personnel away from the working area

→ In case of doubt clarify authorization and qualification and dismiss unauthorized persons from the working area in case there are any doubts remaining regarding authorization and qualification

→ Interrupt the work as long as there are unauthorized persons within the working area

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

### 2.3. Application in Accordance with the Regulations

The equipment has been exclusively designed and constructed for the intended purpose.



#### **Danger caused by application not in accordance with regulations!**

Each application of the equipment not in accordance with and/or different from the regulations can result in dangerous situations.

Only use the equipment in accordance with the regulations.

- Any details of these operating instructions must be strictly observed
- The following applications of the equipment are prohibited. Applications not in accordance with regulations are as follows:
  - Application of the equipment with accessories not permitted or authorized by Conductix-Wampfler
  - Operation of the equipment by not instructed personnel
  - Operation of the equipment outdoors
  - Operation of the equipment with installation on an improper foundation/subsurface

Any claims due to improper application are excluded.

The operator is responsible for any damage due to improper application.

---

## 3 Intended Purpose

---

The intended purpose of this device is a use in conjunction with other IPT® components for the inductive transfer of electrical power. A Regulator produces DC voltage from the AC magnetic field generated by an IPT® track and captured by a Pickup.

The type of Pickup defines which version of a Regulator is suitable for order.

The device is not suitable for stand-alone operation and must be used in conjunction with the appropriate IPT® components.

The Regulator together with the Pickup have been designed with motor based loads in mind. The rate of change of such loads is limited by the dynamics of the motor. In the case of switched resistor loads, the internal protection measures may activate due to the high rate of current change. If such a load is intended please consult Conductix-Wampfler GmbH.

Only qualified personnel may operate this equipment.

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

### 4 Technical Data



**DANGER!**



**WARNING!**



**WARNING!**

The data specified in this section are valid only if the requirements regarding the environment of the device (nominal position, ambient temperature, etc.) are respected.

For instance, the layout of the IPT® Track, the variations with respect to nominal position of a Pickup, or the ambient temperature around a Regulator, may lead to a reduction of the peak and/or continuous power available.

Regulators and Pickups are not designed for independent operation. Refer to both operation manuals together.

#### 4.1. Electrical Data

- Input Power 1.6 kW, 20 kHz (see chapter 14.1)
- Output voltage configurable  
48 V DC ± 2%  
54 V DC ± 2%  
60 V DC ± 2%  
65 V DC ± 2%  
70 V DC ± 2%
- Nominal Peak output power at 65 V DC 1.5 kW (see chapter 7.5 and 8.3).
- Total overall output power according to EN60034-1 S3 Mode at 20 °C 1.1 kW @ 48 V DC / 1.2 kW @ 54 V DC / 1.4 kW @ 60 V DC<sup>1</sup>  
/ 1.5 kW @ 65 V DC / 1.5 kW @ 70 V DC<sup>1</sup>  
at 20°C ambient with 1m/s air flow - max. load over 10 minute period (math. integral)
- Continuous overall output power according to EN60034-1 S1 Mode at 40 °C 440 W @ 48 V DC / 500 W @ 54 V DC / 560 W @ 60 V DC<sup>1</sup>  
/ 600 W @ 65 V DC / 600 W @ 70 V DC<sup>1</sup>  
at 40°C ambient with 1m/s air flow
- Maximum dc output current 23 A
- Heat loss ~ 100 W at full load
- No Load Power Consumption 8.7 W (enabled) or 4.25 W (disabled)
- Maximum rate of load application 1 A / msec
- Electrical protection Class II (reinforced internal insulation).  
Functional Extra Low Voltage (FELV) output voltage.
- Insulation Output to Ground or Interface: production tested at 2.5 kV DC / 1 sec.  
Interface to Ground tested at 500 V DC / 1 sec.
- Auxiliary 24 Vdc maximum current 150 mA DC

<sup>1</sup> available upon request, minimum order quantity: 100 pieces

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

### 4.2. Environmental Data

- Storage temperature - 20°C to + 60°C<sup>1</sup>
- Transport temperature - 40°C to + 80°C<sup>1</sup>
- Ambient temperature (operation) 0°C to + 40°C<sup>1</sup>  
Air temperature as measured in immediate vicinity of working device. Please note that the heat loss of the Regulator will raise the ambient temperature, especially in enclosed mounting spaces.
- Operation For indoor operation only.
- Humidity < 95%, non-condensing.
- Chemical resistance For industrial use without special conditions.  
Any specific influences of chemicals must be checked.
- Protection rating IP54 when plugs are in place.
- EMC environment The device is designed for use in industrial environments (EN60001-6-2, EN55011 Class A).
- Installation altitude Up to 1000 m; continuous output power must be de-rated for higher altitudes.

The use in explosion-proof areas or in areas where the device is exposed to harmful oils, acids, vapors, dust, gases, radiation, humidity, etc. is explicitly forbidden.

<sup>1</sup> If the storage temperature or ambient temperature is lower than the specified operating temperature, proceed as described below prior to commissioning the device:

- Store the device unloaded and switched-off for at least 12 hours at operating temperature.

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

### 4.3. Protection Measures

The Regulator is protected against the following events:

- Output over voltage Automatic shutdown if the voltage supplied by the Regulator is > 85 V. Output protected up to 100 V (no reverse polarization).
- Disconnected DC output Automatic shutdown when output unplugged/disconnected: Protection against DC contact arcing; output voltage is removed. Unplugging under load is not recommended (proper wiring of the pilot pins: see chapter 7.4).
- Over current Output is current limited. Automatic shutdown on strong overload or short circuit of output 1 - i.e. voltage < 12 V.
- Reverse current Output is protected against typical reverse inrush current flow from a battery. However, reverse battery connection should be avoided.
- Over temperature Automatic shutdown on internal over temperature measured at three independent points in the regulator.
- Repetitive shutdowns Shutdown procedures (i.e. turning off the Regulator through the interface plug) discharge internally the energy stored inside the Regulator. To avoid overheating, the number of shutdown procedures is limited to 3 within 30 seconds. This number exceeded, the Regulator will remain in disable mode and respond only passed a delay of 30 seconds.

### 4.4. Design Standards Applied

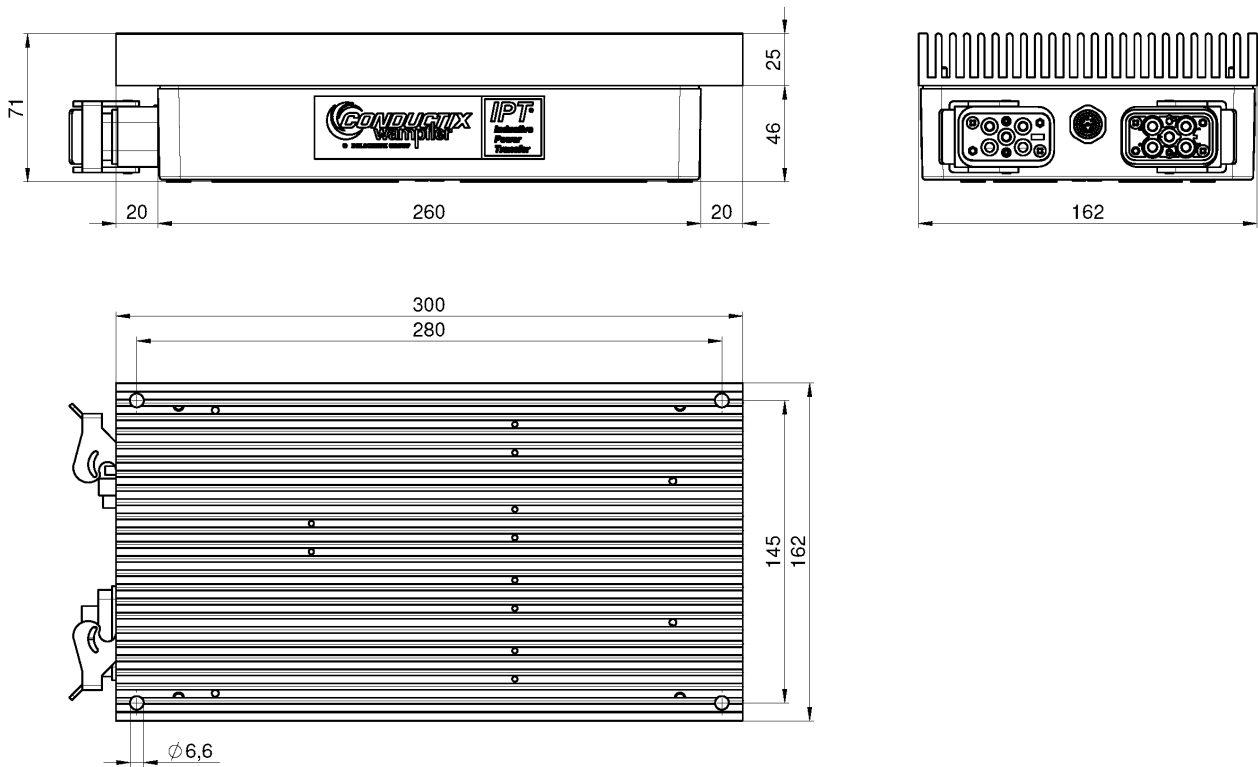
- EN50178 Electronic equipment for use in power installations
- EN55011 Industrial, scientific and medical equipment - Radio-frequency disturbance characteristics - Limits and methods of measurement
- EN61000-6-2 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
- UL508 Industrial Control Equipment

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

### 4.5. Mechanical Integration

- Dimensions See drawing
- Weight ~ 4 kg (without cables or pickup)
- Surface temperatures Heatsink surface temperature may reach up to 70°C depending on operating conditions. To a lesser extent the housing may also get hot.
- Positioning of Heatsink Heatsink should be mounted with fins vertically and aligned to direction of airflow.



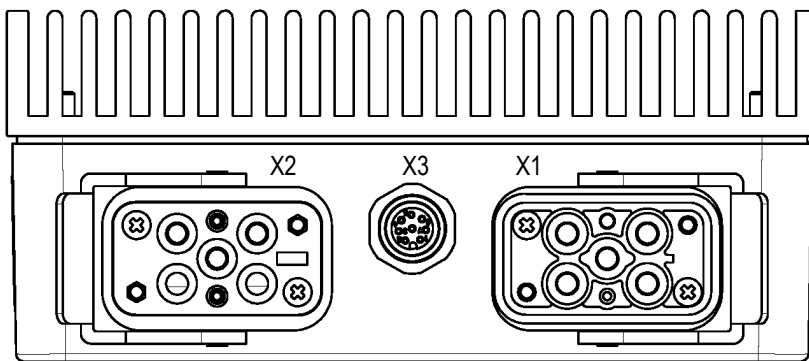
Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

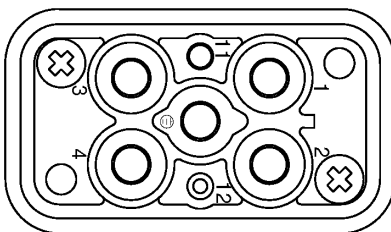
**4.6. Electrical Connections**

- X1 - AC Input Refer to chapter 14 for information on Pickups
- X2 - DC Power output HAN Q4/2 (Harting) or CQM04/2 (Ilme)
- X3 - Interface SACC-E-M12FS-8CON (Phoenix) or series 763/8-pole (Binder)

Connection cables can be ordered separately (refer to chapter 14).



**4.6.1. Connection of Power Input: X1**



(view: contact side)

- PIN 1 400 V AC
- PIN 2 400 V AC
- PIN 3 0 V AC
- PIN 4 0 V AC

PIN 12 Polarizing Pin



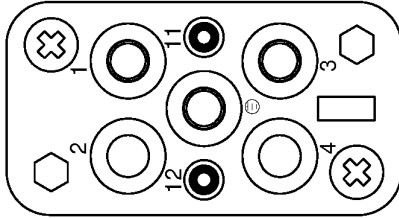
PIN Ground

The power input of the Regulator must be connected to a suitable Pickup. The use of an extension cable between the Regulator and the Pickup is generally not allowed. Refer to chapter 14 for information on Pickups.

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

### 4.6.2. Connection of Power Output: X2



(view: contact side)

PIN 1 + 48 / 60 / 65 / 70 V DC  
 PIN 3 0 V DC

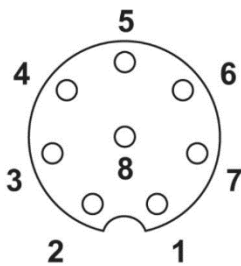
PIN 11 Pilot 1  
 PIN 12 Pilot 2

*(Pilot 1 and 2 must be shorted for the device to power up - see chapter 7.4 and 8.1)*



PIN Ground

### 4.6.3. Connection of Interface: X3



(view: contact side)

PIN 1 Isolated 24 V DC  
 PIN 2 Isolated 0 V DC  
*(150 mA maximum. Do not distribute externally: see chapter 8.1).*

PIN 3 COM  
*(common to the 3 output relays "Warning", "Error" and "Status")*

PIN 4 Enable  
*(must be connected to allow the Regulator to power up - see chapter 8.1.)*

PIN 5 Warning  
 PIN 6 Error  
 PIN 7 Status  
*(relays have potential free contacts, rated for 30 V DC / 5 A max.)*

PIN 8 Ground

All pins are isolated from the main power output.



## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

### 4.6.4. Ground Connection

All electrical equipment must be connected together to the vehicle frame to ensure an equipotential bonding. The ground output of each plug must therefore be connected. In the same way, make sure to connect the housing of the device to the vehicle frame (GND) and not rely only on the connection to ground provided by the power connector. The reason is that if the connection to the load is removed while the IPT® primary is active, then the device is still internally energized though the ground connection is broken.

### 4.6.5. ESD Protection

Because the IPT® system is isolated, some electrical charges may accumulate on the vehicle depending on the surrounding conditions and the vehicle design. An adequate solution must be foreseen using a conductive floor coating together with for example conductive brushes, sliders, track rollers, wheels or similar methods for a connection to Earth, in order to reduce the likelihood of static charge build up and therefore ensure protection against electrostatic discharge (ESD).

---

## 5 Scope of Delivery

---

Cables and plugs, as well as material for mounting the device to a supporting structure (i.e. screws, etc.) are not included in the scope of supply. Refer to chapter 14 for more information.

---

## 6 Transport, Packing and Storage

---

### 6.1. Transport

#### 6.1.1. Safety Advice for Transport



**CAUTION!**

#### **Damage from improper transport!**

Improper transport can result in substantial property damage.

- Act with care when unloading the packaged unit as well as during internal transport and observe the symbols and the hazard information on the packaging
- Remove packaging only shortly before installation
- Pay attention to product specifications

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

### 6.1.2. Transport Inspection

Delivered goods must be checked immediately after arrival for completeness and transport damage.

If any transport damage is recognizable from the outside, proceed as follows:

- Do not accept the delivery or only with reservation
- Note extent of damage on the transport documents or on the delivery note of the carrier
- Initiate complaint



#### ADVICE!

Complain about each fault, as soon as you have noted it. Claims for damages can only be raised within the respective terms.

### 6.2. Packing

The individual packages have been packed and labelled according to the expected transport conditions for a (closed) truck transport. If special conditions are to be taken into account, please notify us in advance.

The packing shall protect the individual components up to the assembly from transport damage, corrosion and other kind of damage. This is the reason why the packing material should not be destroyed and only be removed immediately before starting with the assembly. For further transportation or return it must be ensured that at least equivalent packaging is used and the packing is labelled as required.

#### Handling of packing material:

Dispose of packing material according to the respective legal regulations and local prescriptions.



#### CAUTION!

Damage caused to the environment by faulty disposal!

### 6.3. Storage

Store packages under the following conditions:

- Do not store in the open air
- Keep in a dry and dust-free atmosphere
- Do not expose to aggressive media
- Protect from solar radiation
- Avoid mechanical vibration
- Before use, make sure the device is still in perfect condition



#### ADVICE!

In case goods are delivered with specific storage instructions or specific hints on the package, those must be observed. They may overrule the above requirements if they are more demanding than the above requirements.

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

## 7 Installation

---

### 7.1. Who is authorized to carry out the Installation?



**DANGER!**

All installation and commissioning work as well as maintenance work and disassembly have to be carried out by qualified staff (IEC 364 respectively CENELEC HD 384 or DIN VDE 0100 and IEC 664 or DIN VDE 0110 and national safety rules).



**WARNING!**

Qualified staff according to the safety regulations are persons who are familiar with the assembly and installation of the energy supply system and who have the appropriate qualifications.

### 7.2. General Advice for the Installation



**WARNING!**

After receipt of the components and prior to starting the installation work:

- Unpack the components and check carefully for damage that may have occurred during transport or storage (damage to housings and insulation, missing parts etc.)
- Check data on the identification plate to make sure that the components meet the requirements with regard to nominal power and voltage and that they are matching parts to the regulator used
- Check completeness of the documents and conformity with the delivered components
- If the storage temperature or ambient temperature is lower than the specified operating temperature, proceed as described below prior to commissioning the device:  
Store the device unloaded and switched-off for at least 12 hours at operating temperature.

Regulators have to be installed on an even surface and in a permanently safe position. An improper installation of the energy supply system has a negative impact on the function, the efficiency and the lifetime of the device. It is therefore important to observe the specification for the choice and place of installation. The warranty will expire if this is not observed!

Follow the instructions of chapter 7.5 for attaching a regulator to a supporting structure. See also chapter 4.6.4 for making the connection to ground.

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

### 7.3. Electrical Regulations



#### WARNING!

The general electrical operating conditions according to VDE 0100 (installation and operation of electrical equipment up to 1000 V) have to be observed. If necessary apply the local regulations when they go beyond or differ from these requirements.

### 7.4. Recommended Connection

#### 7.4.1. Connection of Pilot Pins

Shorter pilot pins are used in the power connector (regulator side/X2) to provide a signal to the regulator when the load is connected. Breaking the pilot connection while unplugging will signal to the regulator to shut down before the main contacts are disconnected, thus preventing DC arcing in the connectors (protection measure presented in chapter 4.3).

If the pilot signal is shorted in the plug on the regulator side, the regulator will not be able to detect when the cable is disconnected at the load side. No protection against DC contact arcing can be expected in this case, nor would the output voltage be disabled once the cable disconnected. This could result in an unsafe situation.

In order to fully use the benefits of the pilot pins in case the power output cable is disconnected, we recommend shorting the pilot pins on the load side. Only this way is it assured that the regulator switches off when the cable is disconnected, be it on the regulator side as well as on the load side. Refer to following examples for more details.

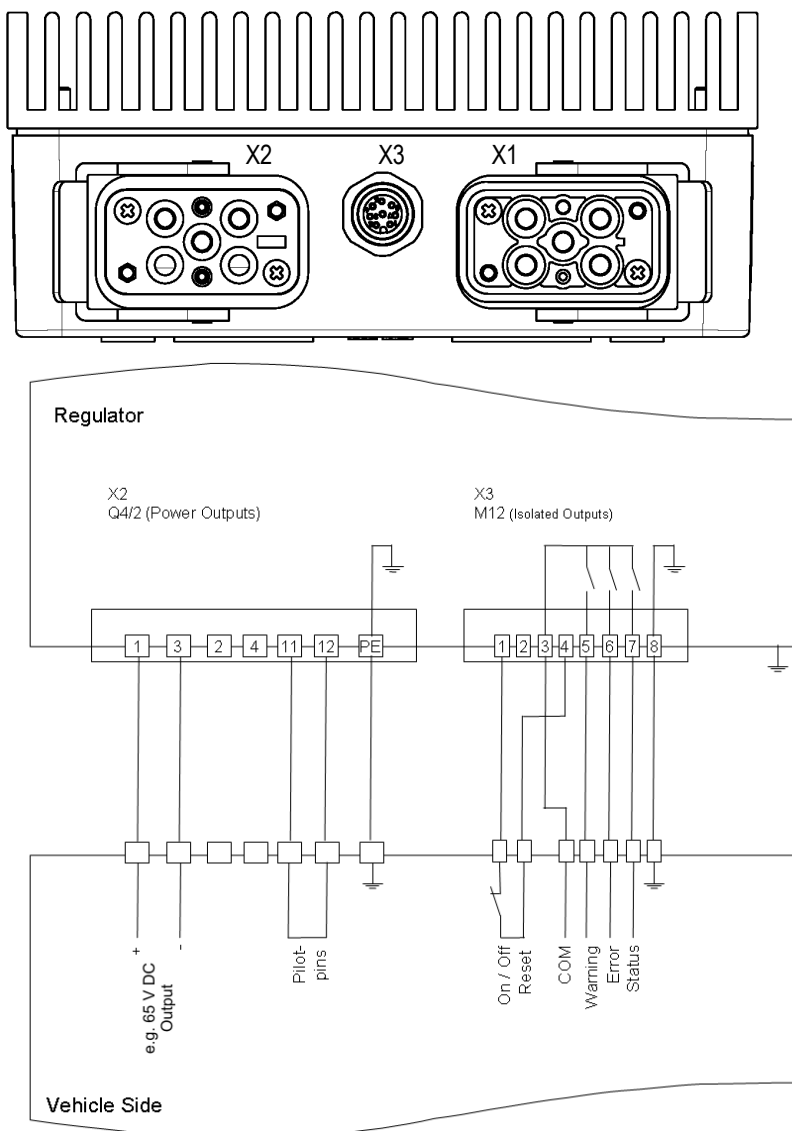
## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

### 7.4.2. Example: Using the Interface

Below is an example of connection when both the power output and the interface connection are used.

The interface connection allows turning on and off the regulator even under load and provides as well an easy way to reset the device in case a fault has been detected. These basic functions are fulfilled by the switch connected between pins 1 and 4 on the vehicle side. Due to the low voltages involved and the isolated characteristics of the interface connections, the switch requires very basic isolation and ratings (24 V DC/150 mA).



Initial status of relays - Please see chapter 10.

## Regulator

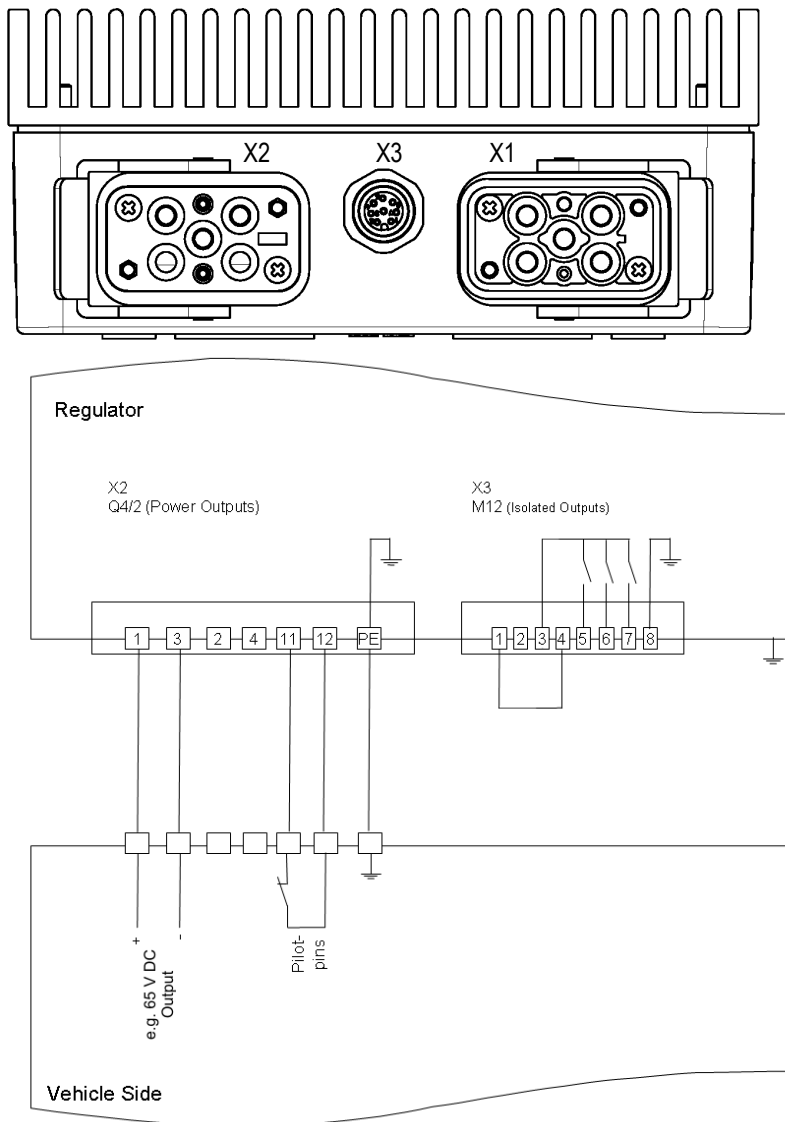
Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

### 7.4.3. Example: Interface is not used

Even if signals available through the interface plug are not being used, it is still **necessary to connect pin 1 to pin 4 for the Regulator to start**. See also chapter 8.1 for more information on this subject.

Pilot pins are not designed to be used as an ON/OFF switch and it is thus recommended not to open the pilot connection under load. However, disconnecting the pilot pins will reset the regulator. Therefore, this procedure can be used to reset a fault in case of automatic shutdown. This is the purpose of the switch shown in the following illustration, connecting pins 11 and 12 on the load side. Refer to chapter 10 for more information.

Voltage present on the pilot pins is not isolated from the main output power. Make sure to use a switch with suitable isolation to ground. Rating between contacts is 24 V DC/150 mA.



Initial status of relays, please see chapter 10.

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

### 7.5. Place and Conditions of Installation



**WARNING!**

Install the regulator in an environment and under conditions as specified in this document only. The regulator is to be attached to a solid base, mounted with the heatsink fins in a vertical position.

Ensure free space around the regulator to provide sufficient cooling air circulation.

The available output power as specified in this document strongly depends on the ambient conditions of the device. Refer to chapter 4.1 for more information.

#### 7.5.1. Position



**WARNING!**

A position exposing the heatsink cooling fins to an air flow  $> 1$  m/s is required to enable the efficiency of convection cooling. If the regulator is positioned differently, the maximum continuous power available may be reduced.



#### 7.5.2. Air Flow Required

The heat power of the regulator is dissipated by forced convection cooling only. Ensure that 1 m/s free flow of air is guaranteed around the device at all times while under load. It is essential to make sure that the air flow is not hindered in any way by objects and that the device is protected from additional heating, i.e. exposure to sun light or hot air flow from inverters, proximity to brake resistors.



**WARNING!**

Confined areas should be adequately ventilated, allowing also for the heat generated by the regulator which can reach about 100 W under full load conditions.

Positions where free air flow around the device and more specifically around the heatsink is not sufficiently provided, i.e. close or directly against an obstacle, will lead to higher local temperature and therefore cannot be allowed generally.



**WARNING!**

Failure to satisfy these requirements may result in reduced performance, damage and/or reduction in lifetime.

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

### 7.5.3. Proximity to Iron/Steel

There are no special requirements regarding the proximity of the regulator itself to ferromagnetic material.

However, special care should be taken regarding the presence of ferromagnetic material near the pickup (refer to chapter 14.1 for more information) and near the IPT® track itself (refer to the entire documentation related to the installation of your IPT® system).

We strongly recommend to respect the specifications for areas free of ferromagnetic material as specified in the document mentioned above, and even to go beyond these requirements whenever possible.

### 7.5.4. Attachment Points

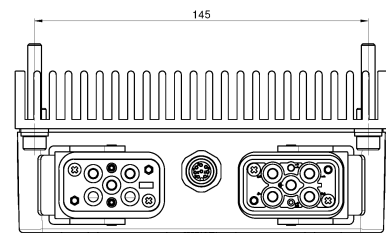
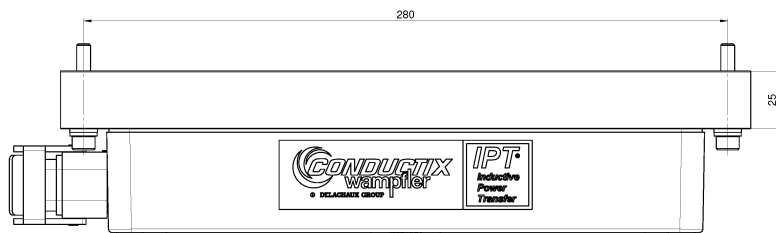
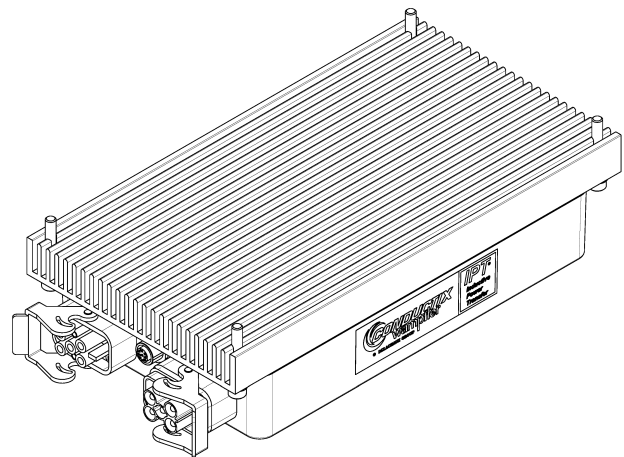
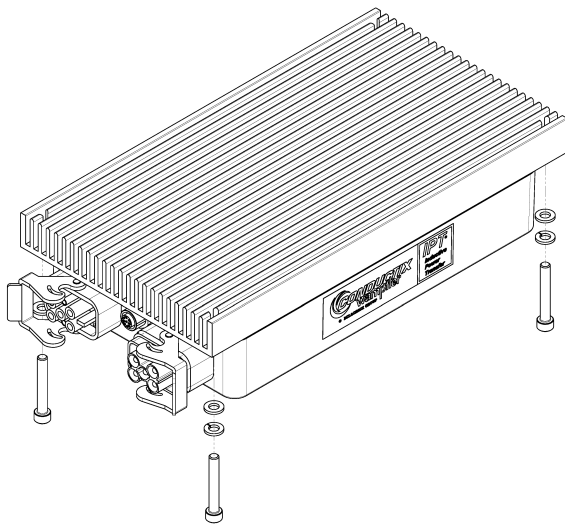


**WARNING!**

Ensure free space around the regulator to provide sufficient cooling air circulation. The heatsink cooling fins must not be covered.

Attaching a regulator to a supporting structure must be done without opening the housing.

Warranty seals are placed on the housing in order to forbid the opening of the lid and therefore preventing accidental soiling or insertion of foreign parts. Breaking a seal will terminate the warranty.





## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

## 8 Operation

---

### 8.1. Powering Up

The primary track being turned on, once a suitable magnetic field is detected, and if the pilot pins (pins 11 and 12 of the power output connector) are shorted, the regulator will be ready to be turned on. The output voltage will however appear at the power output of the shrouded pin connector only if the Regulator is enabled at the interface plug. Enabling the Regulator can be done in two different ways:

- by making a connection between pin 1 (internal isolated 24 V) and pin 4 (enable)
- by connecting an external 24 V supply. 0 V to pin 2 and 24 V to pin 4

Note that when the regulator is in the disable mode (pin 1 and 4 disconnected), the internal isolated 24 V supply is only suitable to supply a starting signal to the regulator itself; do not distribute externally! When the regulator is enabled and the “status” relay is closed (between pins 3 and 7), the maximum current allowed is 150 mA.

⇒ **When the interface is not used:**

Even if signals available through the interface plug are not being used, it is still **necessary to connect pin 1 to pin 4 for the Regulator to start.**

### 8.2. Powering Down

Turning off the primary track will immediately turn off all regulators present on the track. If a regulator is in an enable mode, the output voltage will decrease according to the load connected to it. This behavior allows continued function (the length in time depends on the load needed at that point) even in the case where the IPT® power is temporarily interrupted (i.e. the Track Supply was briefly turned off, a Pickup runs over an area where the magnetic field from the track is shielded etc.).

Turning off a Regulator resets the error mode. It may therefore be required in the event of a fault to turn off a single regulator, instead of turning the track supply which would turn off all vehicles. Please, refer to chapter 10.2 to find out more on how to reset regulators.

If the need of turning on and off a regulator exists even under load, using the interface plug is the best way to proceed; simply break the contact with pin 4. It is not recommended to use the pilot pins to turn off a Regulator under load.

When a regulator is turned off, the FELV output is disconnected electronically from the internal higher voltage supply. For this reason, the number of times a regulator can be turned off (number of shutdown procedures) is limited to 3 within 30 seconds. Exceeding this limit causes the regulator not to respond and it will remain disabled (off) for the next 30 seconds.

### 8.3. Positional Tolerances

The data concerning regulators specified in this documentation strongly depends on the interaction with the attached pickup. The validity of these specifications depends on the respect of nominal positions as defined for the pickup itself. Always refer together to the operating instructions of a regulator and of its designated pickup.

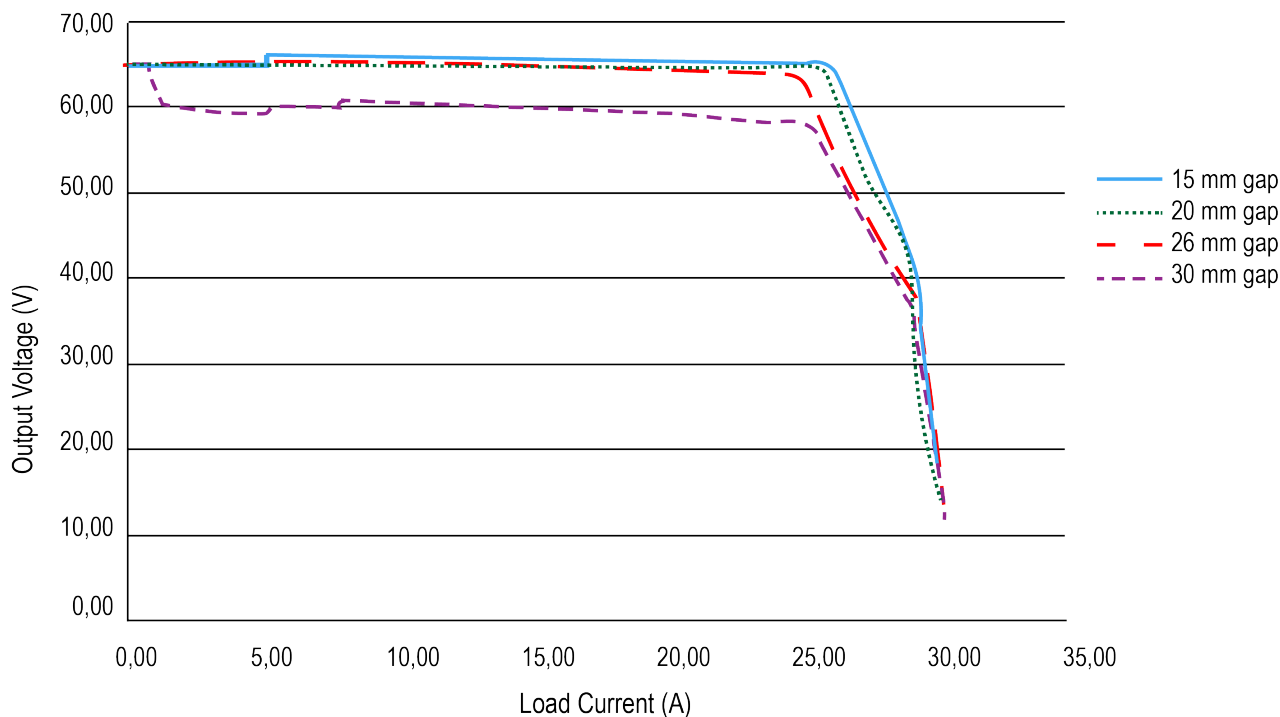
The power ratings - peak power as well as continuous power - of the combination pickup and regulator will be affected by the relative position of the pickup to the IPT® Track and therefore the layout of the track, i.e. bifurcations, curves, influence of ferromagnetic material, etc. (see also chapter 7.5).

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

As the pickup is increasingly moved away from the track cable, for instance due to chording on curves, the regulator may not be able to maintain the desired DC output voltage. The Regulator will automatically reduce the output voltage to a lower value. This is clearly seen for the 30 mm air gap in the traces below.

### Voltage vs Current



Typical Output Voltage vs. Load Current for a 65 V DC Power Regulator with a centered Pickup and different cable clearances.

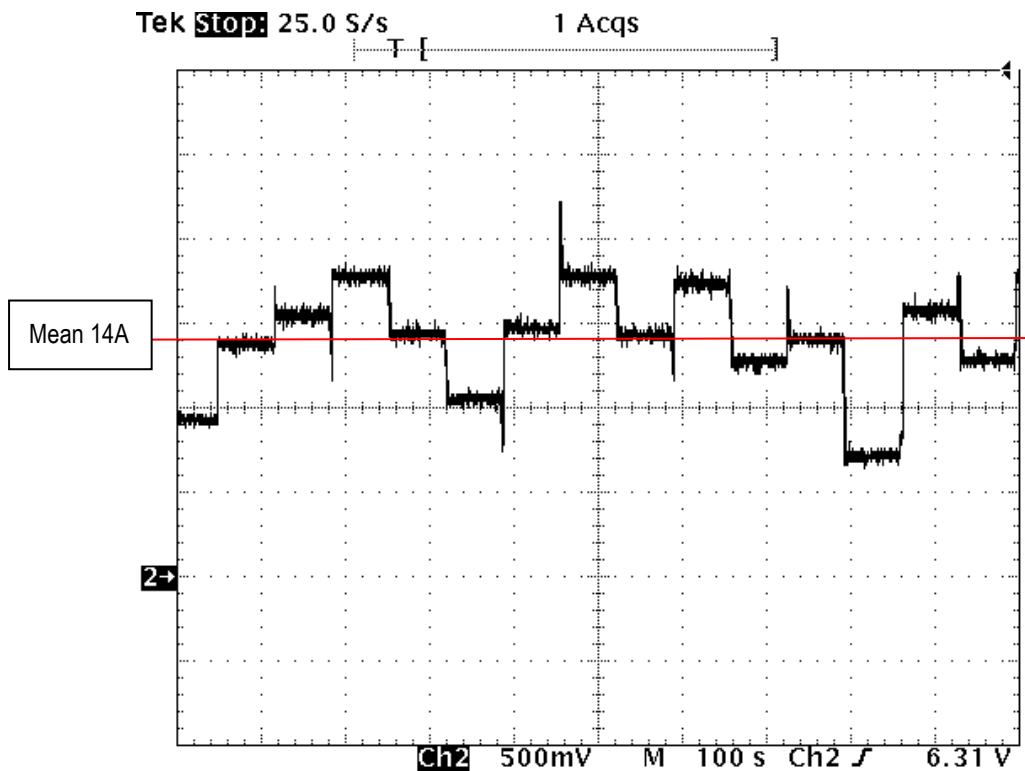
Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

8.4. Parallel Operation of Regulators

As many regulators as desired can be connected together in parallel. By parallel operation it is understood that only the main voltage output X2 of several regulators are connected together (exception made of the ground connection see chapter 4.6.4). In other words, connections with pins 11 and 12 of X2, as well as all connections with X3 must remain separate for each regulator.

The current sharing between regulators depends on the output voltage of each regulator. The Regulator with the highest voltage will overtake most of the load until its current limit is reached. This may result in overheating of one or other regulator. As the temperature in the most loaded Regulator rises the Regulator will reduce its output voltage to off load some of its load. To ensure a time averaged sharing of the load the Regulator output voltage is randomly dithered (typically  $\pm 1$  V). This ensures that at least some of the time the Regulator has the highest output voltage and so will take on average its share of the load. In the picture below the total load on two Regulators connected in parallel is a constant 23 A and the trace is the current for one Regulator. It is seen that the load current on the Regulator varies depending the instantaneous output voltage of the Regulator. Sometimes the current out of one regulator will be higher than for the other, while some of the time it will be lower. On average however they will approximately share.



Current out of one Power Regulator at 5 A/div, 100 sec/div time base.

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---



**DANGER!**

When several Regulators are directly connected to a common bus, voltage will be present if a plug is disconnected on the regulator side. Please note that the interface makes it possible to detect when a power plug is disconnected while other Regulators are still powered up, see below.

⇒ **When the interface is used:**

Due to their isolated properties, it is possible to interconnect the X3 M12 interfaces together. However, we recommend to wire each signal separately to determine precisely which signal comes from which Regulator and therefore to be able to take corresponding action independently (i.e. if a Regulator entered an error mode, it can be reset without having to completely stop the vehicle).

As mentioned above, the detection of a disconnected power plug is possible. A closed "Warning" relay and open "Status" relay, while the controls of the vehicle still provide an "enable" (or ON) signal, is characteristic of such a case and therefore of a possibly unsafe situation if other Regulators are still powered up.

### 8.5. Maximum Number of Regulators on a Track



**WARNING!**

When the primary track is first turned on, Regulators shortly draw a certain amount of energy, energy which is proportional to the number of Regulators (enabled) present on the track during start-up. In the same way, the peak power and continuous power required during operation are determining factors of the maximum number of Regulators allowed on a track. Make sure that the track supply specifications and the maximum number of regulators possibly present on this primary track are compatible. The ramp up rate of the track current can be slowed down in the track supply to allow more regulators at startup. This parameter is defined during project planning by Conductix-Wampfler and may be critical for the reliability of the whole IPT® system. Therefore, the extension or the modification of an existing system is only allowed upon acceptance of the new parameters by Conductix-Wampfler.

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

### 8.6. Information and Advice for Operation with Interface

The signals that are available through the M12 interface plug are described hereafter, including their initial state (open or closed). For more details on available information and diagnosis, see chapter 10.

- Error relay (pins 3 - 6)  
Closes when a magnetic field acceptable to ensure the minimum function is detected, and that no error is present. This is however no guaranty for the deliverable output power (refer to chapter 7.5). Opens when an error is detected.
- Warning relay (pins 3 - 5)  
Is normally open. Closes when approaching limits of operations (i.e. temperature) to give the user the opportunity to take the signal into account and prevent an automatic shutdown which could cause the vehicle to stop in a critical zone and/or at a critical moment. Provides also some information on the pilot pin function. See also chapter 8.4.
- Status relay (pins 3 - 7)  
Is normally open. Closes when the main output has been enabled and the regulation functions are fully ready for operation with load. The state of this relay is no guarantee for the accuracy of the voltage output i.e. in case of overload the voltage will be lower than the nominal value specified.

### 8.7. Precautions



**DANGER!**

Regulators are not designed for independent operation. They have to be operated in conjunction with corresponding IPT® Rail components.

Never operate a device showing damage or that is in a non-touch proof state. Do not perform any work on the device while in operation. Life threatening danger of electrical shock!



**WARNING!**

During or after operation surfaces of the regulator may be hot. Use caution! Prevent access to hot surfaces if necessary. Refer to chapter 4.5 for more information.

Do not disconnect the pickup from the power regulator while under load. Severe arcing can result.



**WARNING!**

Do not connect or switch a charged or powered Regulator directly on to any batteries. Connection should only take place when the Regulator is in a powered down state. Never connect a battery load in reverse polarity, damage will occur. Regulators will draw a small amount of power from batteries even if switched off; batteries will discharge.

Ensure adequate ventilation (refer to chapter 7.5).

## 9 Warnings and Cautions

---



**DANGER!**

All electric work has to be carried out by qualified staff (IEC 364 respectively ENELEC HD 384 or DIN VDE 0100 and IEC 664 or DIN VDE 0110 and national safety rules).

Qualified staff, according to safety regulations, are persons that are familiar with the installation, commissioning and operation of the energy supply systems and that have the appropriate qualifications.



**WARNING!**

The devices are designated to be operated in conjunction with matching IPT® components only. If you are not sure whether components match, contact Conductix-Wamplifier. Do not put into operation before.



**WARNING!**

Do not use the output of the pickup for any other reason than to connect it to a corresponding regulator. Connecting the pickup to a regulator should only take place when the IPT® Track is not under power.

Route power and control cables separately so that no interference can occur.

Do not install an obviously damaged device. Do not take damaged devices into operation. Severe damage may result. Ensure that protection device and other preventive measures taken comply with the applicable regulations. Make sure that all connected circuits fulfill at least the same safety standards as the Pickup and fulfill requirements for safe operation.

During or after operation, surfaces of Power Regulators may be hot. Use caution! Prevent access to hot surfaces if necessary. Refer to chapter 4.5 for more information.

Ensure adequate ventilation. Refer to chapter 7.5.

Do not open Regulators, do not insert any objects inside, and do not touch connection terminals. The only safe means of working on circuits connected to the device is to ensure that the primary Track is switched off and then to disconnect physically the plug. Make sure that connections are not removed under dangerous conditions, i.e. under load. Improper handling can result in electric shocks or burns as well as damage to the devices!

Do not perform any work on or around the device while in operation. **Life threatening danger of electrical shock!**

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

## 10 Fault and Diagnosis

### 10.1. Basics

The X3 interface plug provides 3 potential free relays with a common pin (pin 3).  
For more information on relays (see also chapter 8.6).

- “Error” relay (pins 3 - 6)  
Open when primary power absent or in error state. Closed under normal conditions.
- “Warning” relay (pins 3 - 5)  
Initially open. Closed only to signal a warning.
- “Status” relay (pins 3 - 7)  
Initially open. Closed once the regulator is enabled and ready for operation with load.

The state of operation of a regulator can be determined precisely using the X3 interface plug shown above.

**As a general rule, never operate a Regulator when it is out of order.**

| Status                                   | Possible cause  |
|--|---|
| <b>Error</b>                             | Rate of load current exceeds 1 A/msec                 |
|  | Too much bus capacitance to charge up                 |
|  | Output is short circuited                             |
|  | Internal circuit failure                              |
|  | Pickup is too far out of position                     |
|  | Transient discharge current peaks in excess of 80 A   |
|  | Overload to the point the output voltage < 12 V       |
|  | Over Temperature due to exceeding duty cycle limits   |
|  | Over Temperature due to excessive ambient temperature |
|  | Over Temperature due to inadequate air flow           |
| Over Temperature due to poor positioning |   |
| <b>Error</b>                             | High Temperature due to exceeding duty cycle limits   |
|  | High Temperature due to excessive ambient temperature |
|  | High Temperature due to inadequate air flow           |
|  | High Temperature due to poor positioning              |
|  | Pilot pins open                                       |

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

### 10.2. Reset

#### When the interface is used:

If a connection with the interface plug is available, resetting a Regulator after a fault simply requires to disable it (open contact pin 1 - 4) then to enable it again (close contact pin 1 - 4).

#### When the interface is not used:

When it is not possible to proceed as described above because the interface is not used, resetting a Regulator can be done using the pilot pins; disconnecting then reconnecting the pilot pins together will reset the regulator. Attention: Pilot pins are not designed to be used as an ON/OFF switch and it is thus recommended not to open the pilot connection under load.

#### In all cases:

Maximum number of shutdown or disable procedures: 3 times over 30 seconds. The regulator will then automatically restart after this delay if enabled (i.e. if pin 1 and 4 are connected together).

**Moving Regulators away from the IPT® track, or turning off and back on the primary track supply will also reset regulators.**

---

## 11 Maintenance

---



**WARNING!**

There is no specific maintenance required other than checking regularly that a free air flow for cooling is given and that there is no damage visible from the outside. Strong soiling or obstacles on the heatsink that would prevent sufficient cooling conditions should be avoided.

Any repair work is only possible at Conductix-Wampfler (see chapter 12).

---

## 12 Repair

---



**WARNING!**

If a fault cannot be attributed to external conditions of operation the device needs to be repaired by a specialist.

Warranty seals are placed on the housing in order to forbid the opening of the lid and therefore preventing accidental soiling or insertion of foreign parts. Breaking a seal will terminate the warranty.

Unless otherwise arranged return parts to Conductix-Wampfler for repair. Before returning any parts, contact Conductix-Wampfler for specific instructions.

#### Be sure to include the following information when returning parts to Conductix-Wampfler:

- Product name
- Material number and serial number, including software and bootloader versions
- Application/Installation, in case with a brief description
- Wiring schematic of overall system, if at hand
- Fault description
- Circumstances the fault occurred at, especially if any unusual events preceded the fault
- Presumption what could have caused the fault



## 13 Disassembly and Disposal

---

### 13.1. Safety



**WARNING!**

**All electric work has to be carried out by qualified staff (IEC 364 respectively, CENELEC HD 384 or DIN VDE 0100 and IEC 664 or DIN VDE 0110 and national safety rules)!**

Qualified staff, according to the safety regulations, are persons that are familiar with the installation, assembly, commissioning and operation of the energy supply system and that have the appropriate qualifications.



**ATTENTION!**

If it is necessary to exchange a device due to damage or to install it in another place, verify that no damage will occur during disassembly.

For installation in another place observe the described mounting and commissioning instructions. Improper application, installation or operation involve the danger of severe injuries to persons and damage to objects.



**WARNING!**

#### **Risk of injury due to improper disassembly!**

Stored residual energy, angular components, tips or corners at or in the device or at the required tools may cause injuries.

- Make sure the system does not carry any current anymore!
- It needs at least an electrician to switch off the system!
- Make sure there is enough room prior to starting work
- Be careful with open, sharp-edged components
- Ensure that the workplace is clean and tidy! Loose components or tools lying around may cause accidents
- Dismount components properly
- Secure components, so that they cannot fall down or turn over
- In case of questions, consult Conductix-Wamplier

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

### 13.2. Disassembly

When the device has reached the end of its useful life, disassemble it and dispose of it in an environmentally compatible way. If in doubt, contact Conductix-Wampfler or your supplier.

Clean assemblies and components properly and dispose of them with regard to the valid local instructions for operational safety and environmental protection.



**WARNING!**

- Disconnect the IPT® system from the mains voltage
- Make sure the system cannot be powered up again accidentally
- After disconnecting the Track Supply from the supply voltage wait at least 5 minutes for internally stored energy to discharge



**ATTENTION!**

- Dismount the device
- Dispose of components in a specific way

### 13.3. Disposal

If return or disposal arrangements have not been made, use decomposed components for recycling:

- Scrap metals
- Provide plastic elements for recycling
- Dispose of remaining components separately according to the material composition



**CAUTION!**

**Environmental damage due to incorrect disposal!**

Electronic scrap, electronic components, lubricants and other auxiliary material are considered as hazardous waste and may only be disposed of by authorized specialized service centers!

The local authority or specialized service centers for disposal give advice as to environmentally compatible disposal.

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

## 14 Accessories

### 14.1. Power Input X1

The power input of the regulator must be connected to a suitable pickup. The use of an extension cable between the regulator and the pickup is generally not allowed.

Both regulator and pickup strongly depend on each other. Please refer to both operating manuals together. Limiting conditions for one device limit the operation of the other, i.e. if the ambient temperature around a regulator is higher than what is allowed in the specifications, the maximum continuous power available will be decreased even if the pickup itself is sufficiently cooled.



The corresponding pickup for the regulator versions described in this documentation must be ordered separately through Conductix-Wampfler.

For further information please refer to the IPT documentation OM9100-0128 E-Pickup 1.5 kW.

Only a suitable pickup can be used on the power input X1.

### 14.2. Power Output X2

A connecting cable for the regulator is not included in the scope of delivery. The following components must be used for connection to the regulator (see chapter 15).

| Description   | Quantity needed       | Material Number Ilme          | Material Number Harting                            |
|---|-----------------------|-------------------------------|--|
| Hood (thermoplastic)  | 1                     | CQ08VK                        | 19 12 008 0429                                     |
| Cable gland (thermoplastic)   | 1                     | CRQ16                         | 19 12 005 5157                                     |
| Male contact Receptacle   | 1                     | CQM04/2                       | 09 12 006 3041                                     |
| Power crimp contact, male<br>4.0 mm <sup>2</sup>                          | 2                     | CXMA1.5<br>CXMA2.5<br>CXMA4.0 | 09 32 000 6104<br>09 32 000 6105<br>09 32 000 6107 |
| Control crimp contact, male<br>1.5 mm <sup>2</sup><br>2.5 mm <sup>2</sup> | 2<br>(One type only!) | CDMA1.5<br>CDMA1.5            | 09 15 000 6101<br>09 15 000 6106                   |

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

### 14.3. Interface



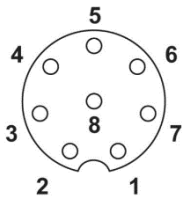
A 5 meter long cable, preassembled with one male connector on one side, can be ordered separately through Conductix-Wampfler under material number:  
91212-339-3047358

A compact enable plug allowing an automatic start-up of a regulator is also available for order through Conductix-Wampfler under material number:  
91000-400-3089971

Note: This plug does not allow any remote ON/OFF function nor any of the diagnosis possibilities. Refer to the product documentation for more information.

Otherwise you can find in the table below a choice of possible solutions for the connection to the interface:

| Description   | Material number<br>Phoenix Contact | Material number<br>Binder |
|---|------------------------------------|---------------------------|
| <b>5 m shielded cable</b><br>preassembled with 1 male connector   | 1543113                            | 79 3579 3508              |
| <b>5 m unshielded cable</b><br>preassembled with 1 male connector | ---                                | 79 3479 3508              |
| <b>Male connector</b><br>preassembled with wires                  | 1523492                            | 09 3481 700 08            |
| <b>Male connector</b><br>with solder terminals only               | 1542758                            | ---                       |



The information below is for reference only. It relies on the 2007 specifications of Conductix-Wampfler for the material mentioned in this paragraph only. In case of any doubt, or when using different material than those mentioned above, it will be necessary to check the correspondence between the pin number and the color of each wire in order to avoid possible damage to connected devices.

- PIN 1 > white
- PIN 2 > brown
- PIN 3 > green
- PIN 4 > yellow
- PIN 5 > grey
- PIN 6 > pink
- PIN 7 > blue
- PIN 8 > red or shield

## Regulator

Configurable Regulator 1.5 kW\* 48 to 70 V DC \*at 65 V

---

## 15 Tools

---

There are no special tools required other than for the assembly and/or disassembly of the separate parts listed in chapter 14.

| Description  | Manufacturer | Material number |
|--|--------------|-----------------|
| <b>Crimping tool</b><br>Han C and HAN D type contacts              | Harting      | 09 99 000 0021  |
| <b>Removal tool for Han C contacts</b><br>(Power crimp contacts)   | Harting      | 09 99 000 0305  |
| <b>Removal tool for Han D contacts</b><br>(Control crimp contacts) | Harting      | 09 99 000 0052  |
| <b>M12 plug</b>  |              |                 |

**Conductix-Wampfler GmbH**  
Rheinstraße 27 + 33  
79576 Weil am Rhein - Markt  
Germany

Phone: +49 (0) 7621 662-0  
Fax: +49 (0) 7621 662-144  
[info.de@conductix.com](mailto:info.de@conductix.com)  
[www.conductix.com](http://www.conductix.com)



Importer for the United Kingdom:  
**Conductix-Wampfler Ltd.**  
1, Michigan Avenue  
Salford  
M50 2GY  
United Kingdom

Phone: +44 161 8480161  
Fax: +44 161 8737017  
[info.uk@conductix.com](mailto:info.uk@conductix.com)  
[www.conductix.com](http://www.conductix.com)