

# Materials Manufacture & Supply

## Power Supplies

### Transformer Rectifier

#### Perfection in transformer rectifier production

Perfection - an innovative process which starts the dialogue with the users. It assists our staff to think of our customers as partners and to act accordingly.

These dialogues provide requirements, concepts, products with high claim to quality - quality of the materials, quality of the customer benefit, quality of manufacture.

We achieve perfection and quality by dedicated research, competent development and design, followed by particularly stringent quality control and test methods. Only transformer rectifiers which pass with distinction, are ready for shipment and ready for "switch on".



The continuous development of user-orientated complete solutions for manufacturing of transformer rectifiers is one of the core tasks of the company.

This development work is reflected in our transformer rectifier manufacture program. It provides all options and variations an endless number of solutions.

The company's specially developed computer software and AUTO CAD program resolve problems concerning design, selection of components, climate conditions etc. and provides a composite solution in one process. A plan quickly becomes the complete answer with ultimate benefit for the user.

A DC power equipment such as transformer rectifier supplies current that is applied for cathodic protection of buried or immersed metal structure. The transformer rectifiers are normally used when AC power from the mains is available.

■ **Air-cooled**

for normal climatic and ambient conditions

■ **Oil-cooled**

for special climatic conditions such as high humidity and high ambient temperature

■ **Explosion proof**

for classified hazardous area in explosion proof enclosure



PSE cathodic protection rectifiers are designed for areas where high content of dust, saline conditions, corrosive, abrasive, excess moisture or high electrical discharge environments that could reduce the normal life span of the units.

Depending on ambient conditions and locations, air-cooled, oil-cooled, explosion proof is generally used in CP systems.

The transformer rectifiers are designed to meet the German Standards (DIN/VDE) and the Standards of the International Electro Technical Commission (IEC), but can also be designed to meet the requirements of other Standards.

All transformer rectifiers can be used in indoor and outdoor locations and are capable of supplying continuous full rated output at an ambient temperature up to +60° C.

**Type: TR-AC-01**

**Microprocessor controlled units**

*For technical details note Chapter 18 Document PSE-18-118-R622*

**CORROCONTROL OUTPUT REGULATOR (CCOR)**

The variable output controller units are equipped with a specially designed microprocessor which can be set to operate the transformer rectifiers in any one of the following three automatic output control modes:

■ **Constant voltage**

automatic control to maintain the **DC output voltage** at the set value continuously from zero to maximum rated voltage

■ **Constant current**

automatic control to maintain the **DC output current** at the set value continuously from zero to maximum rated current

■ **Potential control** automatic control to maintain the **structure-to- electrolyte potential** at the set level

**Other features**

- the mode of above mentioned operations is selectable by four programmed buttons on the front panel
- modern 1 MHz switcher with efficiency up to 90% at 24 V - 10 A
- protection against inrush current in operation mode
- all data input and measuring values are displayed on a 2- line alphabetical numbering LCD display
- failure indication by LED
- built-in current interrupter for on/off measurements
- possibility of programming the "MENU"-settings and readings in different languages
- on network power failure, the unit automatically returns to the latest programmed operation mode with all previous given values

The transformer rectifier is mounted on a 19" rack convenient for indoor and outdoor installations dependent of enclosure construction.

All transformer rectifier control modules are provided on printed circuit boards.

**Parallel operation**

The transformer rectifiers can be connected in parallel to increase the DC output power if required.



**Master-slave parallel operation**

One master can drive 4 slaves. However, a slave can again drive 4 other slaves. The slaves parallel will share the output current equally. The master-slave combination functions can be adjusted or programmed via the master.

**Technical Data**

AC input	single or three phase 230 V ± 10 %, 50 or 60 Hz single or three phase 400 V ± 10 %, 50 or 60 Hz other voltages or frequencies on request
DC output	up to 50 A, up to 50 V, max. 2.5 kW
Control method	Standard: Constant voltage, step less adjustment
Protection class	depending on enclosure
Temperature	ambient temperature: max 50° C, min. -20° C
Current limit	protection against current overloading
Thermalprotection	a thermostat disconnects the output in case of insufficient cooling

**Options**

- Manual controlled output regulation devices
- **REMOTE MONITORING AND CONTROL SYSTEMS (RMCS)**

## TRANSFORMER RECTIFIER

### TYPE: TR-OC-01

Document No.: PSE-622-01-BRT

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### Type: TR-OC-01

Oil-cooled transformer rectifiers are specially designed for safe and long term operations in environments such as desert and tropical locations.

The transformer rectifier components are housed in steel enclosures divided into two main sections, namely oil tank and control cabinet.

The oil tank is a heavy duty welded steel enclosure. The side walls are specially corrugated steel sheets in order to increase the cooling surface area. A top steel cover is bolted and sealed to the tank.

The oil tank is equipped with the following standard fittings:

- Oil filling cap and drain plug
- Thermometer integrated with oil level gauge
- Silica gel breather
- Earthing terminal
- Lifting lugs and rating plate

The main transformer, auto-transformer or thyristor module, rectifier and all components producing heat loss during operation are fixed on a fabricated steel rack, welded to the tank top cover and immersed in oil.

The control cabinet on the top of the oil tank has a front and a back part, each has a hinged lockable door. Both the front and the back doors are also lockable in the completely open position. Control and metering devices are provided in the front part of the cabinet which has a viewing window of toughened glass to facilitate readings of the meters without opening the door. Test sockets are provided underneath each meter to allow readings to be taken independently of the instruments installed, by using portable meters.

For the entry and securing of cables, hot dip galvanized steel conduits are installed on the rear side of the transformer rectifier. The back part of the cabinet is used for mounting of all cable terminations, surge diverters, circuit breakers, shunts, etc.

The transformer rectifier is supplied complete with bolted type base frame and fixing bolts for plinth mounting. The control cabinets are provided with sunshades.

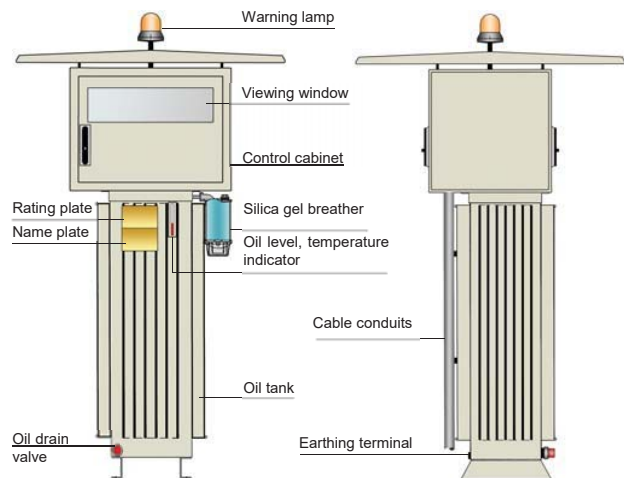
A transformer rectifier mainly comprises a main transformer, an auto-transformer or thyristor modules, a stack of selenium or silicon rectifiers and other auxiliaries/accessories such as protection devices, meters, switches, fuses, indicating lamps, enclosure, etc.

The transformer rectifiers are designed to meet the German Standards (DIN/VDE) and the Standards of the International Electro Technical Commission (IEC), but can also be designed to meet the requirements of other Standards.

The transformer rectifiers are built for years of rugged service.

### Technical data

AC input	single or three phase 230 V $\pm$ 10 %, 50 or 60 Hz single or three phase 400 V $\pm$ 10 %, 50 or 60 Hz other voltages or frequencies on request
DC output	up to 1000 A, up to 100 V, max. 10 kW
Control method	Standard: Constant voltage, stepless adjustment
Protection class	IP 55 acc. to IEC 529
Temperature	ambient temperature: max 55° C, min. -10° C
Transformer oil	acc. to DIN 57370, VDE 0370
Painting	galvanizing of inner and outer surface finished in several coats of colour RAL 9010

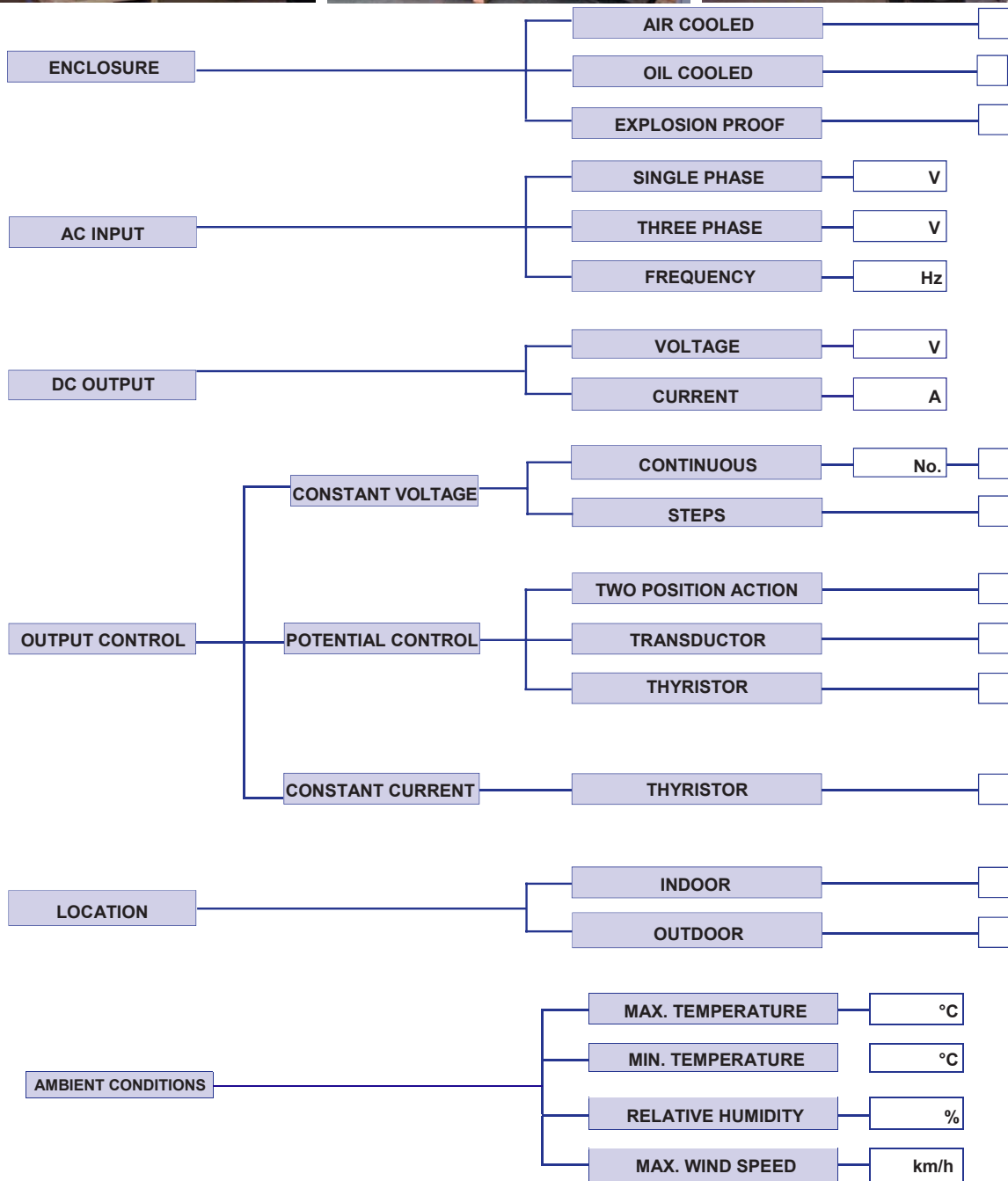


### Options

- CORROCONTROL OUTPUT REGULATOR (CCOR)  
*For technical details note Chapter 18 Document PSE-18-118-R622*  
The computerised output controller unit is equipped with a programmable micro-processor, which controls the functions of the transformer rectifier.  
  
The following output control modes are selectable by the on screen guided menu shown on the LCD-display:
  - Constant voltage mode  
Automatic control to maintain the DC output voltage at the set value continuously from zero to maximum rated voltage.
  - Constant current mode  
Automatic control to maintain the DC output current at the set value continuously from zero to maximum rated current.
  - Potential control mode  
Automatic control to maintain the structure to electrolyte potential at the set level.
  - Current Interrupter mode
- REMOTE MONITORING AND CONTROL SYSTEMS (RMCS)

**TRANSFORMER RECTIFIERS**

**Selection guide**



**TRANSFORMER RECTIFIERS**

**Selection guide**

AC - VOLTMETER	_____	<input type="checkbox"/>
AC - AMMETER	_____	<input type="checkbox"/>
DC - VOLTMETER	_____	<input type="checkbox"/>
DC - AMMETER	_____	<input type="checkbox"/>
POTENTIAL METER	_____	<input type="checkbox"/>
WORKING HOUR METER	_____	<input type="checkbox"/>
CURRENT INTERRUPTER	_____	<input type="checkbox"/>
	SYNCHRONIZABLE	<input type="checkbox"/>
POTENTIAL CONVERTER	_____	<input type="checkbox"/>
	NOT SYNCHRONIZABLE	<input type="checkbox"/>
	Zn > Cu/CuSO <sub>4</sub>	<input type="checkbox"/>
	Ag/AgCl > Cu/CuSO <sub>4</sub>	<input type="checkbox"/>
POTENTIAL CONVERTER	_____	<input type="checkbox"/>
	MnO <sub>2</sub> > Cu/CuSO <sub>4</sub>	<input type="checkbox"/>
LIGHTNING ARRESTER	_____	<input type="checkbox"/>
WITHSTAND H.V. UP TO 3 kV AC	_____	<input type="checkbox"/>
REMOTE MONITORING	_____	<input type="checkbox"/>
	FAILURE ALARM	<input type="checkbox"/>
	DC - OUTPUT	<input type="checkbox"/>
CURRENT LIMITATION	_____	<input type="checkbox"/>
	POTENTIAL	<input type="checkbox"/>
BASE CURRENT SETTING	_____	<input type="checkbox"/>

**Other Requirements**

_____
_____
_____
_____
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## TRANSFORMER RECTIFIER

### TYPE: ACP-01

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### Type: TR-ACP-01

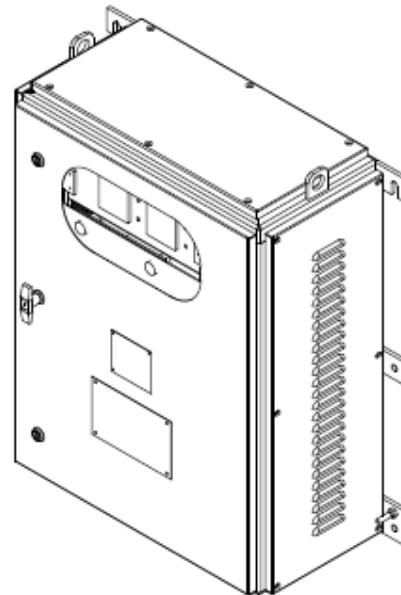
Portable transformer rectifiers are used for carrying out current drain tests to determine the resistance of corrosion protective coating on pipelines and the current density required for producing the desired swing in the existing potential of the object to be provided with cathodic protection.

The portable transformer rectifiers are designed for easy handling and transportation and for use in rough environmental conditions. The enclosure can be made of sheet steel, stainless steel, aluminium or glass-fibre polyester with weather proof protection up to IP 65.

The portable transformer rectifiers consist of a variable ratio-transformer to facilitate continuous adjustment of output voltage from zero to maximum rated voltage and built-in meters for measurement of output voltage and current. Test sockets are provided underneath each meter for more accurate measurements/calibration of meters by using portable instruments.

For ON/OFF potential measurements the units are equipped with a built-in quartz controlled current interrupter.

Colour coded (+) red and (-) blue, DC output terminals are provided on the front panel. The cable lead for connection of AC mains supply is provided with earthing facility.



<b>AC Input:</b>	single phase 230 V $\pm$ 10%, 50 or 60 Hz
<b>DC output current:</b>	0 - 20 A
<b>DC output voltage:</b>	0 - 50 V
<b>Max. DC power output:</b>	1 kW
<b>Protection class:</b>	depending on enclosure

other voltages, frequencies or output rates on request

## TRANSFORMER RECTIFIER

### TYPE: CCLU-01

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### Type: CCLU-01

On long distance pipeline routes several pipelines are often running parallel in one pipeline corridor which are Cathodically protected by one common CP-unit having individual cathode cable connections for every pipeline.

Depending on the age and quality of pipeline coating the current demand of the various pipelines differs in a wide range, which can result in an extremely high potential difference at the drain point.

This can not only lead to "UNDER PROTECTION" for poor coated pipelines and "OVER PROTECTION" for well coated pipelines but also result in the circulation of uncontrolled currents between the pipelines and thereby make the cathodic protection system insufficient and can cause corrosion.

The compensating current limitation unit which facilitates the adjustment of current in each pipeline circuit, prevents the flow of uncontrolled circulating currents between pipelines and uniform potential levels, can be provided in the transformer rectifier or supplied separately depending on site conditions and purchaser's specification.

### Description

The unit mainly consists of several current paths depending on the number of pipelines to be connected.

Each current path consists of:

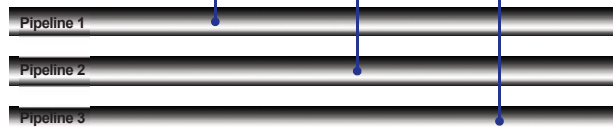
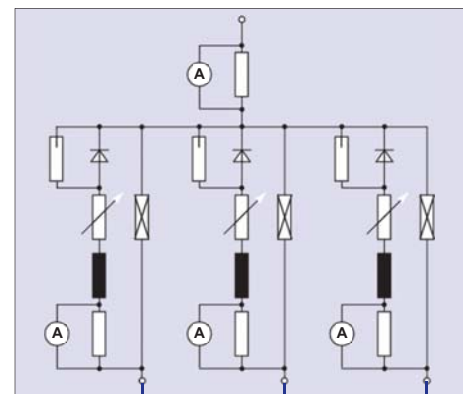
- BLOCKING DIODE to prevent the flow of current between pipelines
- VARIABLE RESISTOR to adjust the magnitude of current for each pipeline
- SURGE PROTECTION CASCADE to protect the components against overvoltage
- SHUNTS AND METERS for the total and individual current measurements
- TERMINALS for cable connections

The size of components (diodes, variable resistors, surge protection cascades, meters, shunts etc.) depends on total output current of the CP-unit and the single current of each individual pipeline.

The enclosure for the unit can be made of sheet steel, stainless steel, aluminum or non-metallic such as glass-fibre reinforced polyester with weather proof protection up to IP 65 and suitable for pole, wall or plinth mounting.



TO (-) TERMINAL OF CP-UNIT



**Residual voltage compensating unit for insulating flanges**

**Type: RVCU-01**

The problem of corrosion inside insulating flanges is known since many years. The main reason for that is the potential difference between the two flange sides; for example, at oil-, gas- and water wells, where the wells and connected flow lines are Cathodically protected by two individual systems because of their extremely different current density.

In order to eliminate the potential difference at these insulating flanges without losing the efficiency of the cathodic protection system the RESIDUAL VOLTAGE COMPENSATION UNIT was developed.

**Function**

The compensation unit receives as input parameter the residual voltage from the insulating flange and tuned via a variable load an output parameter which controls the current output of one transformer rectifier so that the residual voltage is brought to almost zero.

**Specification**

	RVCU-01 (Residual Voltage)	RVCU-01 (Potential)
Input resistance $R_i$ / Output resistance $R_o$	25 kOhm 1 kOhm	650 kOhm 1 kOhm
Input voltage $U_i$	$\pm 10$ mV... $\pm 5$ V	0...-5 V
Output voltage $U_o$	$U_{min}^{1)}$ ...10 V	$U_{min}^{1)}$ ...10 V
AC input	230 V, 50 Hz	230 V, 50 Hz
Operating temp. range	-25 °C / +85 °C	-25 °C / +85 °C
Permanent input protection	240 V rms	240 V rms
Permanent separation voltage	1 500 V rms	1 500 V rms
Transient protection	acc. to IEEE-472	acc. to IEEE-472
Interference rejection	160 dB	160 dB
Amplifier mode :		
Input voltage $U_i$	$\pm 10$ mV... $\pm 5$ V	$\pm 5$ V
Output voltage $U_o$	$\pm 5$ V	$\pm 5$ V
Gain	max. 500	max. 1
Accuracy	$\pm 0.05$ %	$\pm 0.05$ %
Linearity	$\pm 10$ $\mu$ V RTI	$\pm 0.2$ mV RTI
Drift	$\pm 0.02$ %	$\pm 0.02$ %
	$\pm 1$ $\mu$ V (Offset $U_i$ )	$\pm 20$ $\mu$ V (Offset $U_i$ )
	$\pm 20$ $\mu$ V (Offset $U_o$ )	$\pm 20$ $\mu$ V (Offset $U_o$ )

<sup>1)</sup> is determined through basic current setting



**Characteristic**

- automatic control without system deviation
- insulating flange compensation to zero
- accuracy potential control by potential
- grading non-oscillating control characteristic
- negligible electromagnetic interference
- high input protection
- galvanic separation between input and output

