

TPS II Single Channel Current Transducer System

Installation Manual



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1. Introduction

The TPS is a single channel power supply for the LEM IT- and IN-current transducers, mainly used for the range extension of power meters and other instruments. The current output terminals deliver the transducer output current on the back panel. Passive plug-on burden resistors and active plug-on voltage amplifiers are available as an option. The status-readout-interface delivers the transducer status (ok or overload/error) by means of internal galvanic isolated relay contacts.

Warning

Please be aware that an unsupplied transducer or a transducer used with open output can be destroyed. The same can happen if a transducer is heavily overloaded. Power and transducer status is visible on the front panel. The status-readout-interface on the back panel can be used to switch off the primary current in case the transducer is overloaded, the TPS power is off or the output loop is interrupted. All these events will change the transducer status to error on the front panel led and the status-readout-interface. There is more information about the status-readout-interface available in chapter 6.

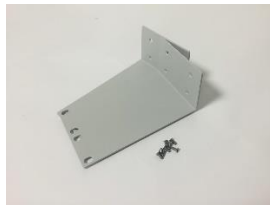
2. Receiving of goods

The TPS system is able to power one transducer of the LEM IT- and IN-series. A multi channel transducer system MCTS is available either. There are various transducer types available from 60 A up to 2000 A. Connection cables are available in different lengths. Passive plug-on shunts and active plug-on voltage modules are available as an option. A status-readout cable and different current and voltage output cables are available as options too.

Please compare your order papers with our packing list and the received goods.

3. Hardware Installation

The TPS is delivered as a desktop unit. 19" rack mounting brackets are available as an option. The mounting brackets can be installed easily with four screws on the left and the right side panel. The 19" rack mounting brackets including the screws have to be ordered separately.



3.1. Connection of the current sensor to the TPS rack



The current transducer will be connected to the TPS rack with the delivered D-SUB current transducer connection cable.

3.2. Connection of the current output to an instrument current input terminal



The transducer output current can be directly connected to the current input terminals of a current or a power meter.

3.3. Connection of the optional voltage output to an instrument voltage input terminal



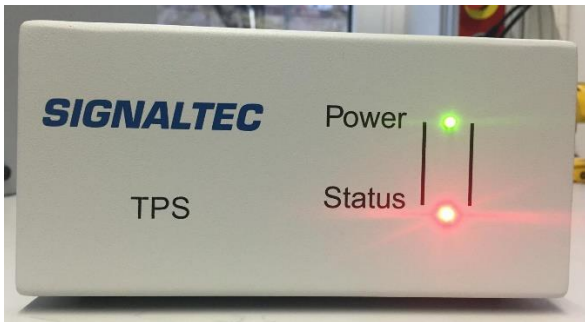
Before you connect the current output to the voltage input terminal of a voltage meter or the sensor input terminal of a power meter you have to transfer the output current to a voltage signal. For this purpose, passive plug-on burden resistors and active plug-on output voltage amplifiers are available.

4. Operating instructions

Before you switch on the primary current through the current transducer, be sure that the transducer is powered by the TPS rack and that the output current loop is closed. An unsupplied transducer can be damaged as well as a sensor with open current output loop. The power and transducer status (ok or error/overload) are visible on the front panel and available on the status-readout interface (see chapter 6).

Power-LED off:	TPS switched off or internal power supply defective
Power-LED green :	TPS on
Status-LED off:	TPS switched off or internal power supply defective
Status-LED green :	Transducer connected, normal operation
Status-LED red :	Transducer overloaded or interruption in output current loop, switch primary current off!

Example: Transducer powered but overloaded, damaged or current output loop open.



5. Scaling

Various transducer types are available for the TPS system. The older types of transducers (IT x0-S) are specified for a maximum DC- or peak-range. To calculate the AC rms-range of the sensor you have to divide the DC- or peak range by the square root of 2. The newer transducer types (IT x5-S and IN) are specified for a maximum rms- and DC-Range. You can find the detailed transducer specification in chapter 7.2.

5.1. Current output ratio

Transducer	DC-Range	rms-range	Ratio	Scaling Factor
IT 65-S	60 A	60 A	60A/100mA	600 : 1
IT 205-S	200 A	200 A	200A/200mA	1000 : 1
IT 405-S	400 A	400 A	400A/266.67mA	1500 : 1
IT 605-S	600 A	600 A	600A/400mA	1500 : 1
IN 1000-S	1000 A	1000 A	1000A/666.67mA	1500 : 1
IN 2000-S	2000 A	2000 A	2000A/1000mA	2000 : 1
IT 60-S	60 A	42 A	60A/100mA	600 : 1
IT 200-S	200 A	141 A	200A/200mA	1000 : 1
IT 400-S	400 A	282 A	400mA/200mA	2000 : 1
IT 700-S	700 A	495 A	700A/400mA	1750 : 1
IT 1000-S/SP1	1000 A	707 A	1000A/1000mA	1000 : 1

5.2. Sensor output ratio when using the passive plug-on resistors

Transducer	DC-Range	rms-range	Plug-on Burden Resistor	Ratio	Scaling Factor
IT 65-S	60 A	60 A	MCTS/BR25/0.01	60A/2.5V	41,667 mV/A
IT 205-S	200 A	200 A	MCTS/BR10/0.01	200A/2V	10.000 mV/A
IT 405-S	400 A	400 A	MCTS/BR10/0.01	400A/2.667V	6.667 mV/A
IT 605-S	600 A	600 A	MCTS/BR2.5/0.02	600A/1V	1.667 mV/A
IN 1000-S	1000 A	1000 A	MCTS/BR1.5/0.02	1000A/1V	1.000 mV/A
IN 2000-S	2000 A	2000 A	MCTS/BR1/0.02	2000A/1V	0.500 mV/A
IT 60-S	60 A	42 A	MCTS/BR25/0.01	60A/2.5V	41.667 mV/A
IT 200-S	200 A	141 A	MCTS/BR25/0.01	200A/5V	25.000 mV/A
IT 400-S	400 A	282 A	MCTS/BR2.5/0.02	400A/0.5V	1.250 mV/A
IT 700-S	700 A	495 A	MCTS/BR2.5/0.02	700A/1V	1.429 mV/A
IT 1000-S/SP1	1000 A	707 A	MCTS/BR1/0.02	1000A/1V	1.000 mV/A

5.3. Sensor output ratio when using the active plug-on voltage amplifiers

Transducer	DC-Range	rms-range	Plug-on Burden Resistor	Ratio	Scaling Factor
IT 65-S	60 A	60 A	MCTS/VM0.1/0.02	60A/7V	116,667 mV/A
IT 205-S	200 A	200 A	MCTS/VM0.2/0.02	200A/7V	35.000 mV/A
IT 405-S	400 A	400 A	MCTS/VM0.26/0.02	400A/7V	17.500 mV/A
IT 605-S	600 A	600 A	MCTS/VM0.4/0.02	600A/7V	11.667 mV/A
IN 1000-S	1000 A	1000 A	MCTS/VM0.66/0.02	1000A/7V	7.000 mV/A
IN 2000-S	2000 A	2000 A	MCTS/VM1/0.02	2000A/7V	3.500 mV/A
IT 60-S	60 A	42 A	MCTS/VM0.1/0.02	60A/7V	116.667 mV/A
IT 200-S	200 A	141 A	MCTS/VM0.2/0.02	200A/7V	35.000 mV/A
IT 400-S	400 A	282 A	MCTS/VM0.4/0.02	400A/3.5V	8.250 mV/A
IT 700-S	700 A	495 A	MCTS/VM0.4/0.02	700A/7V	10.000 mV/A
IT 1000-S/SP1	1000 A	707 A	MCTS/VM1/0.02	1000A/7V	7.000 mV/A

6. Status readout interface



Status-Readout-Interface

The transducer status is visible on the TPS front panel and can be read out via the Status-Readout Interface.

The interface gives out the transducer status by means of potential free relay contacts.

Switching voltage: 200 V
Switching current: 2 A

A status readout cable is available as an option.

Transducer status ok: TPS on and transducer in normal range
Transducer status error: TPS off, transducer in over range or current output loop open

6.1. Pin-out of the 25-pole D-SUB

Status	Pin-Connection	Wire Color*
ok	14 - 2	green - brown
power off, error, overload	14 - 1	green - white

* Status-Readout-Interface cable TPS/ROC is available as an option

7. Specifications

7.1. Rack specifications



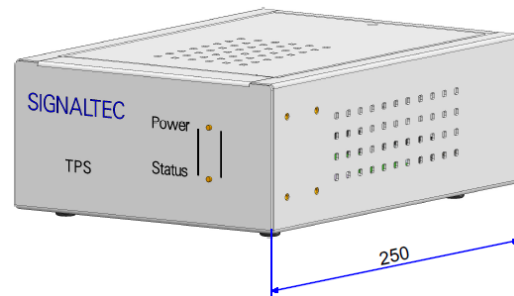
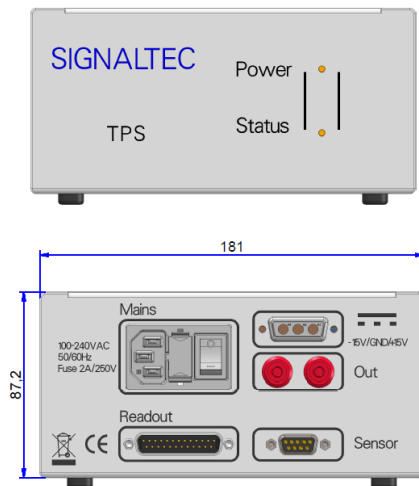
Front



Rear

Dimensions

Cabinet Width: 181 mm
Cabinet Height: 87,2 mm (2 HU)
Cabinet Depth: 250 mm
Mass: 2.7 kg



General Data

Operation Temperature: -10 ... 60 °C
Operation Humidity: 20 ... 90 % RH, noncondensing
Warranty period: 36 Months







Electrical Data

Supply voltage: 100-240 VAC, 50/60 Hz, fused with 2 A slow blow
Output voltages: + 15 V_{DC}, 2.4 A_{max} / -15 V_{DC}, 1.6 A_{max}
Max. Power Consumption: The maximum power consumption depends on the current consumption of the connected current sensor. The maximum power consumption of the largest transducer IN 2000-A is around 30 W.

7.2. Transducer specifications

7.2.1. Transducers with rms-range






Newer LEM transducer types of the IT xx5-S series and the IN series are specified for a maximum rms-range.

Type						
Current Range						
DC	60 A	200 A	400 A	600 A	1000 A	2000 A
AC Sinus	60 A	200 A	400 A	600 A	1000 A	2000 A
Peak	85 A	283 A	566 A	845 A	1414 A	2828 A
100 ms Overload	300 A _{pk}	1000 A _{pk}	2000 A _{pk}	3000 A _{pk}	5000 A _{pk}	10000 A _{pk}
Ratio	600 : 1	1000 : 1	1500 : 1	1500 : 1	1500 : 1	2000 : 1
Output Range	0 ... 100 mA _{rms}	0 ... 200 mA _{rms}	0 ... 266.67 mA _{rms}	0 ... 400 mA _{rms}	0 ... 666.67	0 ... 1 A _{rms}
Max. Measuring Resistance (Full Range)	50 Ω	20 Ω	15 Ω	5 Ω	4 Ω	3.5 Ω
Bandwidth (-3 dB, Small Signal 0,5 %)	DC ... 800 kHz	DC ... 1 MHz	DC ... 300 kHz	DC ... 300 kHz	DC ... 440 kHz	DC ... 140 kHz
Step Response (0 ... 90 %)	1 μs	1 μs	1 μs	1 μs	1 μs	1 μs
Error (of Full Scale)	< 0.033 %	< 0.0103 %	< 0.0059 %	< 0.0039 %	< 0.0012 %	< 0.0012 %
Temp.-Coefficient (of Full Scale)	< 2.5 ppm/K	< 1 ppm/K	< 1 ppm/K	< 1 ppm/K	< 0.3 ppm/K	< 0.1 ppm/K
Frequency Influence* (of Measured Value)	< 0.025 %/kHz	< 0.1 %/kHz	< 0.175 %/kHz	< 0.3 %/kHz	< 0.1 %/kHz	< 0.1 %/kHz
Angular Accuracy*	< 0.01 ° + 0.02 °/kHz	< 0.01 ° + 0.075 °/kHz	< 0.01 ° + 0.08 °/kHz	< 0.01 ° + 0.175 °/kHz	< 0.01 ° + 0.05 °/kHz	< 0.01 ° + 0.075 °/kHz
Temperature Range	-40 ... 85 °C	-40 ... 85 °C	-40 ... 85 °C	-40 ... 85 °C	-40 ... 85 °C	-40 ... 85 °C
Test Voltage 50 Hz	5.4 kV	5.4 kV	4.6 kV	4.6 kV	4.2 kV	6 kV
Inner Diameter	26 mm	26 mm	30 mm	30 mm	38 mm	70 mm
Mass	0.33 kg	0.35 kg	1.08 kg	1.08 kg	1.3 kg	4.2 kg
Link to LEM Data Sheet for detailed Specifications	IT 65-S	IT 205-S	IT 405-S	IT 605-S	IN 1000-S	IN 2000-S

* Verified with 50 Arms, DC ... 10 kHz


7.2.2. Transducers with peak-range

Older LEM transducer types of the IT xx0-S series are specified for a maximum DC-range. They can be used up to the equal AC-rms-range by using a limited burden resistor.

Type					
Current Range					
DC	60 A	200 A	400 A	700 A	1000 A
AC Sinus	42 A	141 A	282 A	495 A	707 A
Peak	60 A	200 A	400 A	700 A	1000 A
100 ms Overload	300 A _{pk}	1000 A _{pk}	2000 A _{pk}	3500 A _{pk}	4000 A _{pk}
Ratio	600 : 1	1000 : 1	2000 : 1	1750 : 1	1000 : 1
Output Range	0 ... 100 mA _{pk}	0 ... 200 mA _{pk}	0 ... 200 mA _{pk}	0 ... 400 mA _{pk}	0 ... 1000 mA _{pk}
Max. Measuring Resistance (Full Range)	60 Ω	30 Ω	2.5 Ω	2.5 Ω	3 Ω
Bandwidth (-3 dB, Small Signal 0,5 %)	DC ... 800 kHz	DC ... 500 kHz	DC ... 500 kHz	DC ... 100 kHz	DC ... 500 kHz
Step Response (0 ... 90 %)	1 μs	1 μs	1 μs	1 μs	1 μs
Error (of Full Scale)	< 0.027 %	< 0.0083 %	< 0.0043 %	< 0.0053 %	< 0.0053 %
Temp.-Coefficient (of Full Scale)	< 2.5 ppm/K	< 2 ppm/K	< 1 ppm/K	< 0.5 ppm/K	< 0.5 ppm/K
Frequency Influence* (of Measured Value)	< 0.025 %/kHz	< 0.075 %/kHz	< 0.05 %/kHz	< 0.1 %/kHz	< 0.3 %/kHz
Angular Accuracy (DC ... 10 kHz)	< 0.01 ° + 0.05 °/kHz	< 0.01 ° + 0.075 °/kHz	< 0.01 ° + 0.075 °/kHz	< 0.01 ° + 0.12 °/kHz	< 0.015 ° + 0.15 °/kHz
Temperature Range	10 ... 50 °C	10 ... 50 °C	10 ... 50 °C	10 ... 50 °C	10 ... 50 °C
Test Voltage 50 Hz	5.4 kV	5.4 kV	5.4 kV	4.6 kV	3.1 kV
Inner Diameter	26 mm	26 mm	26 mm	30 mm	30 mm
Mass	0.3 kg	0.3 kg	0.3 kg	0.8 kg	1 kg
Link to LEM Data Sheet for detailed Specifications	IT 60-S	IT 200-S	IT 400-S	IT 700-S	IT 1000-S/SP1

* Verified with 50 Arms, DC ... 10 kHz

7.3. Connection cable specifications



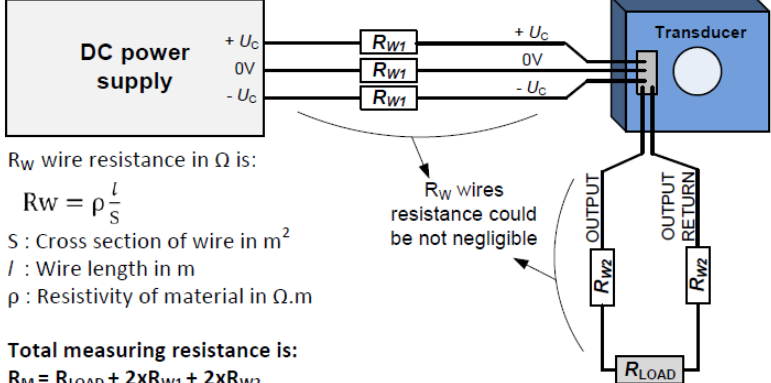
Connection cables from the MCTS rack to the transducers are available in various cable lengths. Special cable lengths can be manufactured according demand. Be aware that the cable resistance is part of the maximum burden resistance mentioned in the transducer data sheets. The cables are available with two different wire cross sections, 0.34 mm² and 0.75 mm².

Power supply and load

In order to reach the measuring range according to the maximum measuring resistor, be careful with the setup measurement when wires length are high. It means that:

- the wires resistance could be not negligible
- the voltage at the output of the DC power supply and the voltage at the transducer could be significantly different.

Minimum ± U_C-5% must be seen by the transducer



R_W wire resistance in Ω is:

$$R_W = \rho \frac{l}{S}$$

S : Cross section of wire in m²
 l : Wire length in m
 ρ : Resistivity of material in $\Omega \cdot m$

Total measuring resistance is:
 $R_M = R_{LOAD} + 2xR_{W1} + 2xR_{W2}$

If $R_{W1} = R_{W2} = R_{WIRE}$ then $R_M = R_{LOAD} + 4xR_{WIRE}$

7.3.1 Standard Connection Cables

Order Number	Cable Length	Wire Cross Section	Single Wire Resistance	Loop Resistance (4 x R _{WIRE})	Mass
MCTS/TPS/1.5	1.5 m	0.34 mm ²	0.08 Ω	0.31 Ω	0.21 kg
MCTS/TPS/2.5	2.5 m	0.34 mm ²	0.13 Ω	0.52 Ω	0.28 kg
MCTS/TPS/3	3 m	0.34 mm ²	0.16 Ω	0.63 Ω	0.32 kg
MCTS/TPS/5	5 m	0.34 mm ²	0.26 Ω	1.05 Ω	0.47 kg
MCTS/TPS/10	10 m	0.34 mm ²	0.52 Ω	2.09 Ω	0.84 kg
MCTS/TPS/15	15 m	0.34 mm ²	0.79 Ω	3.14 Ω	1.21 kg
MCTS/TPS/20	20 m	0.34 mm ²	1.05 Ω	4.19 Ω	1.58 kg
MCTS/TPS/25	25 m	0.34 mm ²	1.31 Ω	5.24 Ω	1.95 kg
MCTS/TPS/30	30 m	0.34 mm ²	1.57 Ω	6.28 Ω	2.32 kg
MCTS/TPS/5/0.75	5 m	0.75 mm ²	0.12 Ω	0.47 Ω	0.65 kg
MCTS/TPS/10/0.75	10 m	0.75 mm ²	0.24 Ω	0.95 Ω	1.15 kg
MCTS/TPS/15/0.75	15 m	0.75 mm ²	0.36 Ω	1.42 Ω	1.70 kg
MCTS/TPS/20/0.75	20 m	0.75 mm ²	0.47 Ω	1.90 Ω	2.30 kg
MCTS/TPS/30/0.75	30 m	0.75 mm ²	0.71 Ω	2.85 Ω	3.30 kg

7.3.2 Total Measuring Resistance at Full Scale

Transducer	Measuring Resistance
IT 60-S	60 Ω
IT 200-S	30 Ω
IT 400-S	2.5 Ω
IT 700-S	2.5 Ω
IT 1000-S/SP1	3 Ω
IT 65-S	50 Ω
IT 205-S	20 Ω
IT 405-S	15 Ω
IT 605-S	5 Ω
IN 1000-S	4 Ω
IN 2000-S	3.5 Ω

7.3.3. Maximum Burden Resistor depending on Transducer and Connection Cable

The remaining burden resistance can be calculated by the subtraction of the connection cable loop resistance from the transducer total measuring resistance.

Example IN 1000-S with 15 meters cable 0.34 mm² and 0.75 mm²:

IN 1000-S total measuring resistance: 4 Ω at 1000 A_{rms}

MCTS/TPS/15 loop resistance: 3.14 Ω → Maximum allowed burden resistor = 4 Ω - 3.14 Ω = 0.86 Ω

MCTS/TPS/15/0.75 loop resistance: 1.42 Ω → Maximum allowed burden resistor = 4 Ω - 1.42 Ω = 2.58 Ω

7.4. Burden module specifications



TPS with passiv plug-on burden resistor



TPS with active plug-on voltage module

The transducer system delivers the transducer output current at the 4 mm output terminals on the back panel of the rack. For those instruments which don't have current input terminals, optional high precision passive and active plug-on burden modules with very low phase angle error are available. The active voltage output modules are supplied by the TPS rack with a 3-pole D-SUB connector.

7.4.1. Passive plug-on burden resistor specifications



Passive plug-on burden resistors are available from 1 Ω to 50 Ω. The burden resistor is limited by the transducer and the length of the connection cable. For higher output voltages active plug-on burden amplifiers are available.

Order Number	Resistance Value	Accuracy [% of V]	Max. Output Voltage	Bandwidth	Phase Error	Load Influence
MCTS/BR1/0.02	1 Ω	0.02 %	1.00 V _{rms} @ 1000 mA _{rms}	> 1 MHz	< 1° @ 100 kHz	< 0.1 ppm/mW
MCTS/BR1.5/0.02	1.5 Ω	0.02 % of MV	1.00 V _{rms} @ 667 mA _{rms}	> 1 MHz	< 1° @ 100 kHz	< 0.1 ppm/mW
MCTS/BR2.5/0.02	2.5 Ω	0.02 %	1.58 V _{rms} @ 632 mA _{rms}	> 1 MHz	< 1° @ 100 kHz	< 0.1 ppm/mW
MCTS/BR3.75/0.02	3.75 Ω	0.02 %	1.94 V _{rms} @ 516 mA _{rms}	> 1 MHz	< 1° @ 100 kHz	< 0.1 ppm/mW
MCTS/BR5/0.02	5 Ω	0.02 %	2.24 V _{rms} @ 447 mA _{rms}	> 1 MHz	< 1° @ 100 kHz	< 0.1 ppm/mW
MCTS/BR10/0.01	10 Ω	0.01 %	3.16 V _{rms} @ 316 mA _{rms}	> 1 MHz	< 1° @ 100 kHz	< 0.1 ppm/mW
MCTS/BR25/0.01	25 Ω	0.01 %	5.00 V _{rms} @ 200 mA _{rms}	> 1 MHz	< 1° @ 100 kHz	< 0.1 ppm/mW
MCTS/BR50/0.01	50 Ω	0.01 %	7.07 V _{rms} @ 141 mA _{rms}	> 1 MHz	< 1° @ 100 kHz	< 0.1 ppm/mW

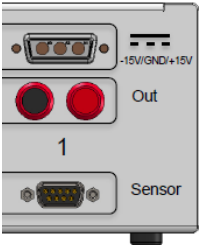
Mechanical Data

Width:	51 mm
Height:	51 mm
Depth:	62 mm (Connectors included)
Mass:	85 g

7.4.2. Active plug-on voltage amplifier specifications



The output voltage level the transducer can drive is limited. The active plug-on burden modules combine a very precise burden resistor with a highly accurate voltage amplifier. The plug-on burden voltage modules deliver up to 7 V_{rms} (9.9 V_{pk}) at transducer nominal value.



The active plug-on voltage output modules are powered by the 3-pole D-SUB on the back panel of the system.

Order Number	Input Resistance	Accuracy [% of V + % of R]	Max. Output Voltage	Bandwidth	Phase Error	Load Influence
MCTS/VM1/0.02	1 Ω	0.01 % + 0.01 %	7 V _{rms} @ 1000 mA _{rms}	> 300 kHz	< 1° @ 100 kHz	< 0.1 ppm/mW
MCTS/VM0.66/0.02	1.5 Ω	0.01 % + 0.01 %	7 V _{rms} @ 667 mA _{rms}	> 300 kHz	< 1° @ 100 kHz	< 0.1 ppm/mW
MCTS/VM0.4/0.02	2.5 Ω	0.01 % + 0.01 %	7 V _{rms} @ 400 mA _{rms}	> 300 kHz	< 1° @ 100 kHz	< 0.1 ppm/mW
MCTS/VM0.26/0.02	3.75 Ω	0.01 % + 0.01 %	7 V _{rms} @ 267 mA _{rms}	> 300 kHz	< 1° @ 100 kHz	< 0.1 ppm/mW
MCTS/VM0.2/0.02	5 Ω	0.01 % + 0.01 %	7 V _{rms} @ 200 mA _{rms}	> 300 kHz	< 1° @ 100 kHz	< 0.1 ppm/mW
MCTS/VM0.1/0.02	10 Ω	0.01 % + 0.01 %	7 V _{rms} @ 100 mA _{rms}	> 300 kHz	< 1° @ 100 kHz	< 0.1 ppm/mW

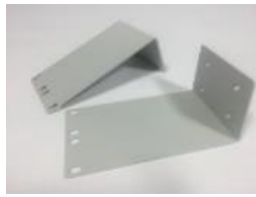
Mechanical Data

Width: 51 mm
 Height: 51 mm
 Depth: 62 mm (Connectors included)
 Mass: 105 g

8. Switching off and deinstallation

Before you switch off the TPS rack or open the output current loop or remove any cable between rack and sensor, make sure that the primary current is switched off. An unpowered transducer can be damaged.

9. Accessories



TPS/RMB
Rack mounting brackets for installation into a 19" cabinet



TPS/CB
Carrying bag for rack, transducers, cables and burden modules



TSC
Transducer soft case for use with carrying bag
TSC1 for IT 60-S, 65-S, 200-S, 205-S, 400-S
TSC2 for IT 405-S, 605-S, 700-S, IN 1000-S
TSC3 for IT 1000-S/SP1
TSC4 for IN 2000-S



TPS/ROC
18-pole D-SUB-cable for status-readout-interface, length 3 m



BNC4A
BNC to 4 mm banana-plug adapter



BPL0.5
4 mm banana-plug test lead set, length 0.5 m



BPL01
4 mm banana-plug test lead set, length 1 m



BNCL1
BNC to BNC test lead, length 1 m



BNC4L1
BNC to 4 mm banana-plug test lead, length 1 m