

ITZ FLEX ULTRASTAB

USER GUIDE

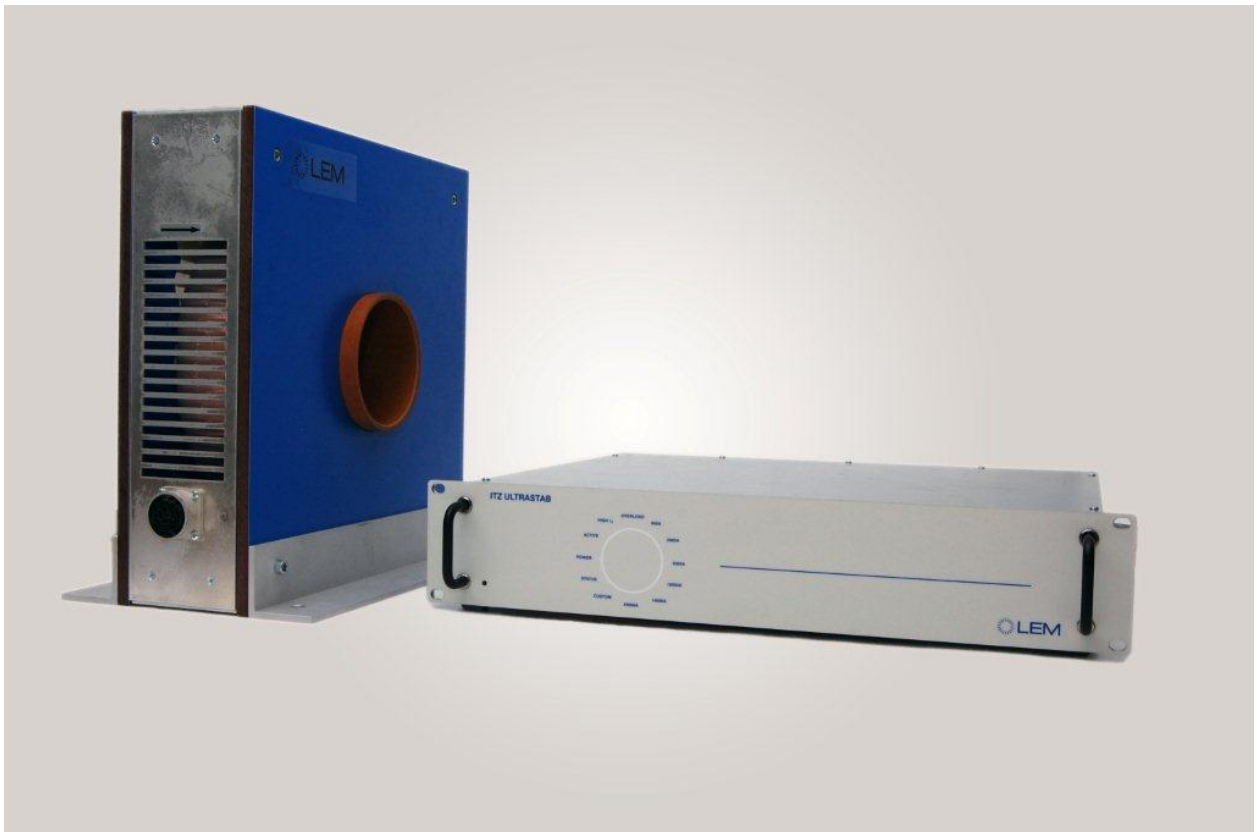


TABLE OF CONTENTS

TABLE OF CONTENTS	2
LIST OF FIGURES	3
LIST OF TABLES	3
DOCUMENT INFORMATION.....	3
INTRODUCTION.....	4
RECEIVING AND UNPACKING.....	6
GENERAL SPECIFICATIONS FOR RACK ELECTRONICS.....	7
1 Compliance with regulations.....	8
2 Usage precautions and recommendations.....	9
2.1 <i>Terms and symbols</i>	9
2.2 <i>General use and wear</i>	9
2.3 <i>Grounding considerations</i>	9
2.4 <i>Fuses</i>	9
2.5 <i>Precautions for use</i>	10
3 Quick start.....	11
3.1 <i>System overview</i>	11
3.2 <i>Setting up</i>	12
4 Introduction	14
4.1 <i>Main features</i>	14
4.2 <i>Standard transducer heads</i>	14
4.3 <i>Custom transducer heads</i>	15
4.4 <i>Voltage output module</i>	15
4.5 <i>Current conversion ratio and programmability</i>	15
4.6 <i>Front</i>	17
4.7 <i>Rear</i>	18
4.8 <i>Transducer head</i>	19
5 Installation.....	20
5.1 <i>Mounting requirements for the electronics unit</i>	20
5.2 <i>Mounting requirements for the transducer heads</i>	20
5.3 <i>Grounding the transducer head</i>	21
5.4 <i>Installation</i>	21
6 Offset adjustment	22
6.1 <i>Adjusting the current offset</i>	22
7. I/O-ports.....	23
7.1 <i>Analog Out connector</i>	23
7.2 <i>4 mm “Banana” Current Output terminals</i>	23
7.3 <i>Status/Interlock connector</i>	24
8 Absolute maximum ratings	26
9 Sweep function during overload status	26
10 Thermal protection.....	26
11 Over current protection - Electrical specifications	26
12 Transducer head connector.....	28
13 Operating instructions.....	28
13.1 <i>Switching on power</i>	28
13.2 <i>Using the ITZ FLEX ULTRASTAB in current mode</i>	28
13.3 <i>Connecting directly to a current measuring device</i>	29
13.4 <i>Connecting to an external burden resistor (current output)</i>	30
13.5 <i>Connecting the ITZ FLEX ULTRASTAB to a DMM or high impedance amplifier (voltage output)</i> 30	
14 Theory of operation	31
14.1 <i>Basic principle of ITZ FLEX ULTRASTAB current transducers</i>	31
15 Maintenance	32



LIST OF FIGURES

Figure 1: System overview for Current Output.....	11
Figure 2: System overview for Voltage Output.....	11
Figure 3: Front panel of electronics rack.....	17
Figure 4: Back panel of electronic rack.....	18
Figure 5: Analog out connector pinout.....	23
Figure 6: Wiring schematics to current measuring device.....	29
Figure 7: Wiring schematics to external burden resistor.....	30
Figure 8: Wiring schematics to high impedance load.....	30
Figure 9: Block diagram showing the zero flux detector principle.....	31

LIST OF TABLES

Table 1: General specifications for rack electronics.....	7
---	---

DOCUMENT INFORMATION

05.01.2012 Creation of user manual	Version: 0
06.02.2013 Replaced Manual title by user guide title (page 1) + Replaced LEM Danfisik by LEM Switzerland + Added picture page 11 Modified some pictures	Version: 1
28.05.2014 Updated completely according to the datasheets	Version: 2



INTRODUCTION

Congratulations with your purchase of LEM ITZ FLEX ULTRASTAB.

The ITZ FLEX ULTRASTAB system provides a flexible yet user-friendly platform for use in laboratory, test facility and industrial applications where the highest performance flux-gate current sensing is needed. The platform offers full-scale current sensing from 600 A and up to 24000 A by utilizing a broad range of compatible current measuring heads.

Please read this user guide carefully before use. It contains information on how to set up and use the ITZ FLEX ULTRASTAB and how to build an ultrahigh precision system. In case of unanswered questions do not hesitate to contact either LEM Switzerland S.A. or our local distributor directly.

IMPORTANT: LEM Switzerland S.A. will not be held responsible for use of the ITZ FLEX ULTRASTAB unit under conditions and/or in application setups not supported by the information in this user guide.

**5 Year Warranty
on LEM Transducers**

We design and manufacture high quality and highly reliable products for our customers all over the world.

We have delivered several million current and voltage transducers since 1972 and most of them are still being used today for traction vehicles, industrial motor drives, UPS systems and many other applications requiring high quality standards.

The LEM 5-year warranty applies to all LEM transducers and is valid in addition to the legal warranty.

The warranty granted on LEM transducers is for a period of 5 years (60 months) from the date of their delivery.
(not applicable to EM4T & EM4TII & TEMA4T & LEMABOX & LZQJ products and automotive transducers where the warranty period is of 2 years).

During this period LEM shall replace or repair all defective parts at its' cost (provided the defect is due to defective material or workmanship).

Additional claims as well as claims for the compensation of damages, which do not occur on the delivered material itself, are not covered by this warranty.

All defects must be notified to LEM immediately and faulty material must be returned to the factory along with a description of the defect.

Warranty repairs and or replacements are carried out at LEM's discretion.

The customer bears the transport costs. An extension of the warranty period following repairs undertaken under warranty cannot be granted.

The warranty becomes invalid if the buyer has modified or repaired, or has had repaired by a third party the material without LEM's written consent.

The warranty does not cover any damage caused by incorrect conditions of use and cases of force majeure.

No responsibility will apply except legal requirements regarding product liability.

The warranty explicitly excludes all claims exceeding the above conditions.
LEM, warranty application date: April 1. 2008



François Gabella
President & CEO LEM



RECEIVING AND UNPACKING

The shipping material and the ITZ FLEX ULTRASTAB should be thoroughly inspected for signs of obvious physical damage immediately upon receipt.

All materials in the package should be checked against the enclosed packing list and the list of standard delivery below. LEM Switzerland S.A. will not be responsible for any shortages unless notified no later than 14 days after receiving.

The LEM ITZ FLEX ULTRASTAB package should contain:

- 19 inch rack-mount ITZ FLEX ULTRASTAB electronics
- Transducer head – depending on nominal current range
- European (Schuko) and US mains cable with three-pin IEC female connector
- Cable for connecting head and rack electronics
- Analog output cable
- Current short-plug and analog out short-plug
- Final manufacturing test check-list.

IN CASE OF DAMAGE

If the equipment is damaged in any way, a claim should be filed with the shipping agent, and a full report of the damage should be forwarded to LEM Switzerland S.A. or our local representative immediately upon receiving.

Upon receipt of this report, LEM Switzerland S.A. will forward instructions concerning the repair, replacement or return shipment.

Please include the Type No., Serial No., and Order No. for the ITZ FLEX ULTRASTAB on any communication with LEM Switzerland S.A. or our local representative.

GENERAL SPECIFICATIONS FOR RACK ELECTRONICS

Electrical Data – MAINS INPUT		
Mains Input	100-240 V AC, 50/60 Hz	IEC-type inlet socket
Fuses	2.5 AT / 240 V AC	Internal fuses, not user-replaceable
Electrical data – ANALOG OUTPUT PORT		
Full-scale output current	±1 A (± 2 or ± 3 A)	-S and –SB versions
Full-scale output voltage	± 10 V	-SB versions
Output impedance	< 1 Ohm	-SB versions
Electrical data – STATUS/INTERLOCK PORT		
Max collector-emitter voltage, off-state	60 V	
Max reverse collector-emitter voltage, off-state	5 V	
Max collector-emitter current, on-state	10 mA	
On-state saturation collector-emitter voltage	< 0.2 V	
Physical data – Electronics rack		
Dimensions	482x88x430 mm	WxHxD, including handles and connectors
Weight	8.4 kg (9.2-10.0kg)	Value for 600-5000 A systems (10 kA/16 kA–24 kA systems)
Operating conditions		
Temperature	10 .. 40 °C	
Relative humidity	20 .. 80 % RH	
Cooling	Internal fan	
Storage conditions		
Temperature	-20 .. 85 °C	
Relative humidity	20 .. 80 % RH	

Table 1: General specifications for rack electronics



1 Compliance with regulations

FCC statement

This equipment complies with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference in which case the user will be required to correct the interference at his own expense.

CE statement

This product has been tested and found to comply with the following standards.

Electrical safety: IEC/EN 61010-1

Electromagnetic Compatibility:

Emission: IEC/EN 61326-1:2006

FCC 47 CFR Part 15

Immunity: IEC/EN 61326-1:2006

A technical file is kept available at:





LEM Switzerland S.A.
Chemin des Aulx 8
P.O. Box 35
1228 PLAN-LES-OUATES
Geneva, Switzerland

2 Usage precautions and recommendations

The following precautions are recommended to insure your safety and to provide the best operating conditions of this instrument. If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

2.1 Terms and symbols

These terms and symbols may appear in this manual or on the product.

	WARNING: Warning statement identifying condition or practices that could result in human injury or loss of life.
	CAUTION: Caution statement identifying conditions or practices that could result in damage to the product.
	DANGER: High Voltages.
	Protective Ground Conductor Terminal.

2.2 General use and wear



CAUTION: Do not place any heavy objects on the instrument. Avoid severe impacts or rough handling that could damage the instrument. Use electrostatic discharge precautions while handling and making connections to the instrument. Do not place bare or unterminated wires into the connectors of the instrument, only mating connectors and adapters. Do not block or obstruct the ventilation openings on the side panels and over the heat sink.

2.3 Grounding considerations

To avoid the risk of electrical shock it is mandatory to observe proper grounding practices.



WARNING: To avoid electrical shock the power cord protective grounding conductor must be connected to earth ground. All transducer heads must be connected to earth ground as described in section 5.3.

Failure to establish a functional ground connection to earth may lead to hazardous errors and cause malfunction and/or measurement inaccuracies.

2.4 Fuses



WARNING: The unit has no user replaceable fuses. In the event that fuses need replacement please consult your local LEM Sales representative. Please include Type and Serial no. with all communication with LEM Switzerland or the local representative.

2.5 *Precautions for use*

Due to the nature of the zero-flux based transducer principle it is necessary to take the following precautions:



CAUTION: Do not subject the system to primary current without mains power applied.



CAUTION: Do not operate the system with a disconnected secondary when the system is subject to primary current.

3 Quick start

3.1 System overview

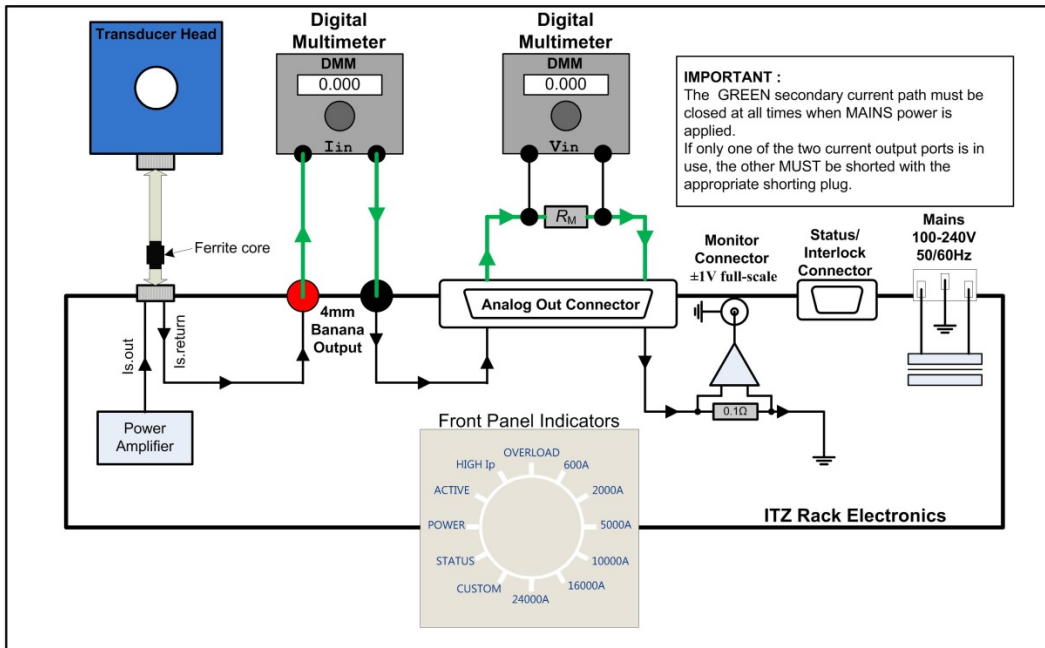


Figure 1: System overview for Current Output

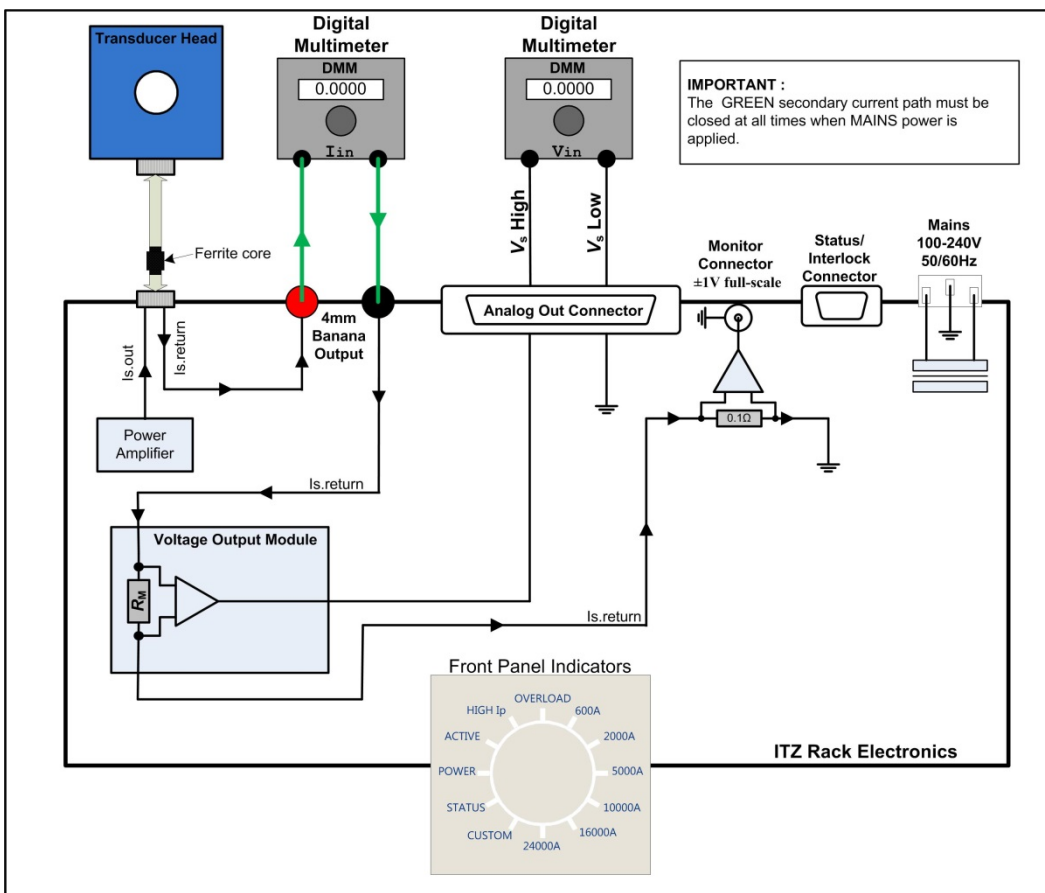


Figure 2: System overview for Voltage Output

3.2 Setting up

To quickly get your new ITZ FLEX ULTRASTAB system operational, follow the instructions given below.

1. Connect the transducer head to the unit using the supplied transducer head cable and mount the programming plug in the connector on the transducer head if your system has the programming feature – please note that not all transducer heads are programmable.
2. Connect a Digital Multimeter (DMM) to the unit.

If your unit has current output (-S or -SPR versions):

The primary access is through the Analog Output Port, using the Current Output Adaptor supplied with the ITZ system.

The unit also has a secondary output through the 4 mm banana terminals on the back panel of the ITZ unit. Since the primary and secondary current outputs are connected electrically in series internal to the electronics **the 4 mm banana terminals should be left shorted** (using the supplied shorting plug) for this exercise.



CAUTION: It is **MANDATORY** that the secondary current path remains **CLOSED** whenever the system is powered – if not, there is a risk of permanently damaging the system. Furthermore, if there is no closed secondary current path the system will not be able to produce measurable output. The secondary current path is closed either by shorting the 4mm banana terminals or by connecting a series (measuring) resistor at these outputs.

Using standard 4 mm banana test leads, connect the **red** wire on the Current Output Adaptor to the current input terminal on the DMM and the **black** wire of the adaptor to the common terminal on the DMM. Set the DMM to measure DC current in a range greater than:

- ± 1 A for ITZ 600-SPR (-SBPR) and ITZ 2000-SPR (-SBPR)
- ± 2 A for ITZ 2000-S (-SB), ITZ 5000-S (-SB), ITZ 10000-S (-SB) and ITZ 16000-S (-SB)
- ± 3 A for ITZ 24000-S (-SB).

IMPORTANT: Refer to page 23 for EMC precautions for the 4 mm banana terminal port.

If your unit has a voltage output (-SB or -SBPR versions):

Connect the Analog Output Cable to the Analog Output Port. Using standard 4 mm banana test leads, connect the **red** wire of the cable to the positive terminal on the DMM and the **black** wire to the common terminal. Set the DMM to measure DC/AC voltage in a range greater than ± 10 V.

The **blue** wire of the cable is connected to the cable shield and to chassis ground.

Make sure the supplied shorting plug is installed on the 4 mm banana terminals as described in the previous section.



CAUTION: It is **MANDATORY** that the secondary current path remains **CLOSED** whenever the system is powered – if not, there is a risk of permanently damaging the system. Furthermore, if there is no closed secondary current path the system will not be able to produce measurable output. For voltage output versions this is ensured either by shorting the 4 mm banana terminals using the supplied shorting plug, by connecting a DMM in low-impedance current measuring mode or by connecting a measuring resistor to the 4 mm banana terminals.

3. Connect the mains cord.



CAUTION: Since the ITZ system has no mains switch the unit will be powered immediately by inserting the mains cord.

4. The ITZ FLEX ULTRASTAB will now measure the current running through the transducer head. On the front plate the status of the unit can be monitored using the status LED panel.

4 Introduction

4.1 Main features

The ITZ FLEX ULTRASTAB is a high precision current measuring device based on the Flux-gate principle. It can measure current in both the DC and AC domain. The instrument can be configured in a variety of ways to suit the user's demands. Amongst the ITZ FLEX ULTRASTAB main features are:

- Current or voltage output
- Input range from 0 to ± 24000 A
- Status signals for interfacing with other equipment

The current measuring range is configurable depending on the transducer head.

4.2 Standard transducer heads

ITZ FLEX ULTRASTAB can be delivered with the following transducer heads.

1. ITZ 600-25-PR – programmable in steps of 20 A from 40 A to 620 A. Conversion ratio (default) of 1:600. Nominal secondary current 1 A. Aperture \varnothing 25 mm
2. ITZ 2000-50-PR – programmable in steps of 125 A from 125 A to 2000 A. Conversion ratio (default) of 1:2000. Nominal secondary current of 1 A. Aperture \varnothing 50 mm
3. ITZ 2000-50 – non-programmable, wide-bandwidth. Conversion ratio of 1:1000. Nominal secondary current of 2 A. Aperture \varnothing 50 mm
4. ITZ 5000-140 – non-programmable. Conversion ratio of 1:2500. Nominal secondary current of 2 A. Aperture \varnothing 140 mm
5. ITZ 10000-100 – non-programmable. Conversion ratio of 1:5000. Nominal secondary current of 2 A. Aperture \varnothing 100 mm
6. ITZ 16000-150 – non-programmable. Conversion ratio of 1:8000. Nominal secondary current of 2 A. Aperture \varnothing 150 mm
7. ITZ 24000-150 – non-programmable. Conversion ratio of 1:8000. Nominal secondary current of 3 A. Aperture \varnothing 150 mm

Please note that systems are always **downwards** compatible in the sense that a smaller transducer head can be used with the rack electronics from a larger system. ie., if you have purchased an ITZ 10000-S system you will be able to use a 600 A transducer head with your rack electronics without any limitations. The system will adapt itself to this.



However, the system is **not** generally **upwards** compatible. ie., you will not generally be able to use a larger head with the rack electronics from a smaller system. If you want to expand the measuring range of your system by using a larger transducer head, please consult your local LEM SA Sales representative to obtain information on existing options and cost.

4.3 Custom transducer heads

For current measurement of 10 kA and beyond certain customizing may be required. Your local LEM SA Sales representative will be able to assist you with custom requirements for conversion ratio, programmability options etc.

4.4 Voltage output module

In addition to the different transducer heads a system can also be equipped with a VOM (Voltage Output Module). This module will convert the output current to an output voltage of ± 10 V (nominal full-scale).

Two types VOMs are available, one for each nominal output current range (1 or 2 A). In all cases, the output current is also available for monitoring either by the 4 mm banana jacks on the back panel or with the Analog Output Cable.

If you have ordered your system with the “B” option (eg. ITZ 5000-SB), it already has a VOM installed. If your system was ordered as a standard current output system you can have a VOM retrofitted. Please contact your local LEM SA Sales representative to obtain information on existing options and cost.

4.5 Current conversion ratio and programmability

The system can generally be considered as a “*current transformer also working at DC*”. The primary winding is the wire through the center hole of the head, and the secondary winding is the compensation winding of the transducer head. The ratio between these two windings defines the current conversion ratio (K_N) of the system.

The smaller transducer heads come with a programming option.

As the nominal output current (1, 2 or 3 A) is fixed (defined by the transducer head) and the maximum input current I_{PM} can be changed using a programming plug, the current conversion ratio can be changed enabling the user to program the system to many different maximum input currents.



Example:

A system with an ITZ 2000-50 PR transducer head programmed to 1500 A will produce 1 A when the primary current is 1500 A. The current conversion ratio of the system is then:

$$K_N = \frac{1A}{1500A} = \frac{1}{1500}$$

When a system is equipped with a VOM, the output current will be converted to a voltage. The maximum nominal output voltage (V_S) is fixed at 10 V. Thus the sensitivity (G) from the example above can be found as:

$$G = \frac{10V}{1500A} = \frac{1}{150} V/A$$

4.6 Front

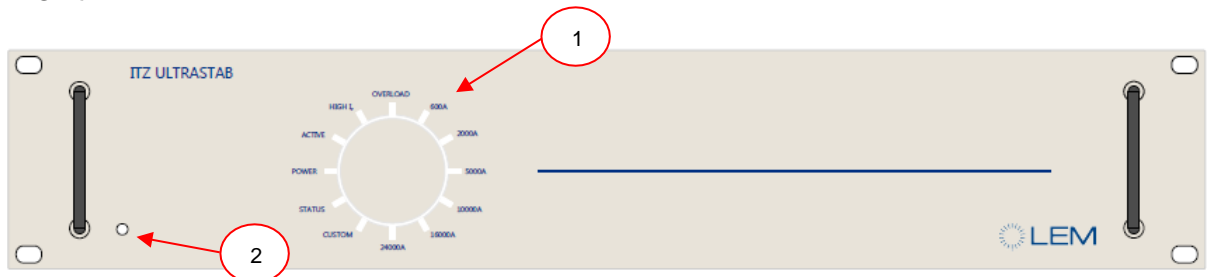


Figure 3: Front panel of electronics rack

On the front of the ITZ FLEX ULTRASTAB there is an LED indicator panel:

1 POWER:
This LED is lit (Blue) when the unit is on.

ACTIVE:
This LED is lit (Yellow) when the transducer output is active, with I_P higher than approximately 1% of nominal full-scale output.

HIGH I_P :
This LED is lit (Yellow) when the transducer output is active with an I_P higher than 105% of nominal full-scale output.

OVERLOAD:
This LED is lit (red) when the transducer head saturates due to excessive primary current.

600 A .. 24000 A:
These LEDs are lit (Yellow) when a transducer head with the corresponding full-scale range is connected to the ITZ FLEX ULTRASTAB.

CUSTOM:
This LED is lit (Yellow) when the system setup has detected a custom head configuration.

STATUS:
This LED is lit (Green) when the status of the unit is OK.

2 Output current offset adjustment
An offset adjustment is positioned next to the left-most handle. The adjustment is accessible using a miniature slotted screwdriver.



CAUTION: Please refer to section 6 for instructions on how to adjust offset correctly.

4.7 Rear

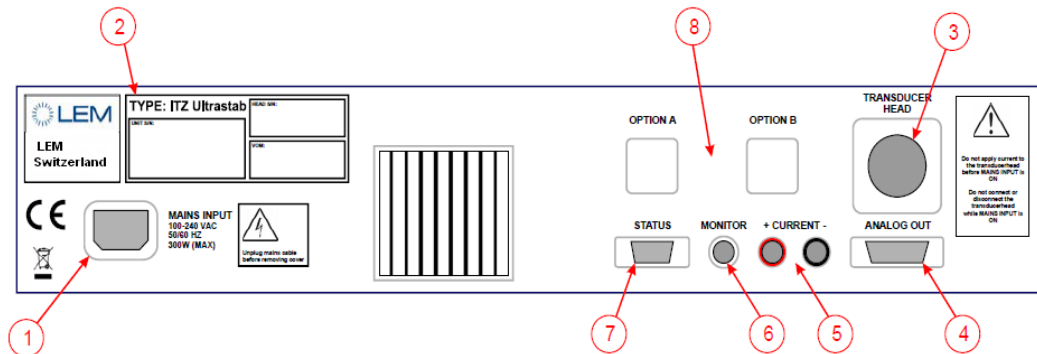


Figure 4: Back panel of electronic rack

All connections on the ITZ FLEX ULTRASTAB are located on the rear of the unit.

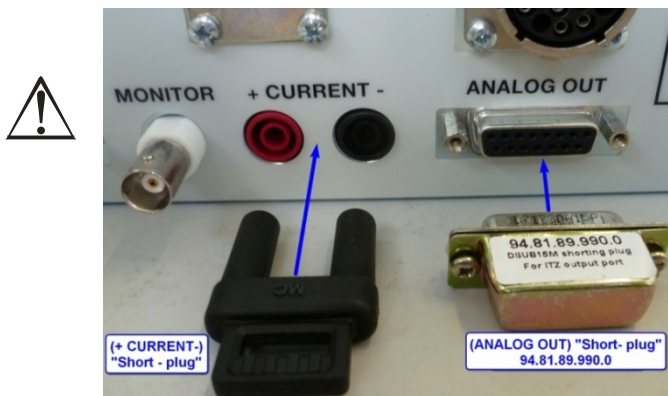
1. IEC power inlet: This connector accepts a standard IEC power cord.

IMPORTANT: The power inlet also serves as mains switch.

IMPORTANT: The unit operates with a universal mains input. This means that the unit does not require any switching between mains voltages as long as the supplied mains voltage is within 100-240 V AC (50/60 Hz).

IMPORTANT: The unit has no externally accessible user-serviceable fuses. If the unit requires replacement of fuses please contact your local LEM Switzerland S.A. sales representative.

2. Type / Serial number plate. Three individual S/Ns may be listed here: One for the ITZ electronics, one for the matching head and one (optional) for the installed VOM.
3. Transducer head: Connection to the transducer head.



CAUTION: The secondary current path **must** be closed with the system powered. This includes both the current output in the Analog Out connector and the 4 mm banana terminals – if one of them is used, the other must be shorted with the supplied “Short-plug”.

4. Analog out: Output connection to a DMM or other equipment, 15 pin D-Sub female UNC 4-40 screw lock.
5. Current +/-: Secondary current output.
6. Monitor: Voltage output with a low-precision voltage output derived from the secondary current. Output is ± 1 V full-scale.
7. Status/Interlock signal outputs, 9 pin D-Sub male UNC 4-40 screw lock.
8. Option A+B: These positions are for future expansion or customization.



Ventilation exit

The main heat sink has an airflow exit centered on the back panel. Inlet holes are on the side panel of the chassis.



CAUTION: Do **not** block the airflow to/from the unit.

4.8 Transducer head

The transducer head is connected to the electronics rack using a dedicated cable with a multi-pin bayonet-style connector. Various cable lengths are available.

If the transducer head is programmable it also has a 25-pin D-Sub male UNC 4-40 screw lock connector. This connector is used with suitable programming plugs (accessory) – for further information, please refer to section 4.5 for further information on programmability.



CAUTION: A programming plug **must** be connected to the programming port of a programmable head when the system is powered.

5 Installation

5.1 Mounting requirements for the electronics unit

The ITZ FLEX ULTRASTAB can be mounted in either a rack based system or as a stand-alone unit using the supplied rubber feet.



CAUTION: The unit must be mounted horizontally. To ensure proper cooling, keep ventilated sides on side and back panel free. Failure to do this may result in improper cooling of the system which may lead to malfunction of the unit.

5.2 Mounting requirements for the transducer heads

ITZ 600-25-PR: Use the mounting bracket (part no.: 7100088284) to mount the 600 A transducer head. It may be installed in any orientation.

ITZ 2000-50 (-PR): The 2000 A transducer head must be installed using two M8 screws. The head may be mounted in any orientation. Please observe that the length of the screws may not exceed the length D shown in figure 5. To calculate the maximum length of the mounting screw, measure the thickness of the mounting substrate C and add the length A + B which is 10 mm + 15 mm.

Max. Screw length:
 $D = 10 + 15 + C$ [mm]

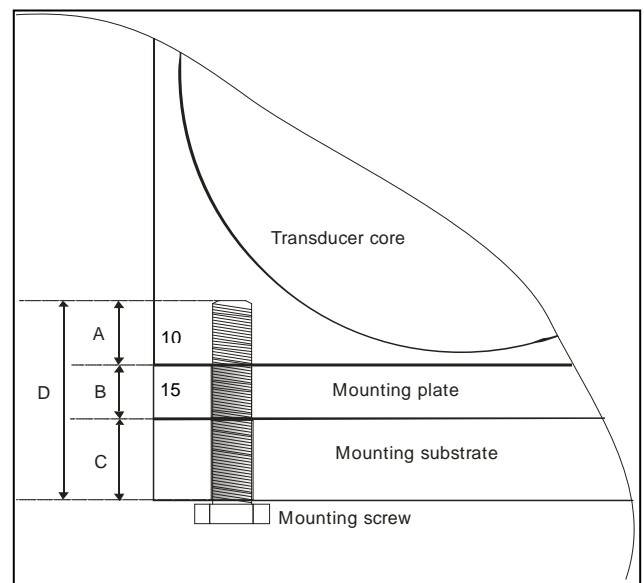


Figure 5

CAUTION: Using too long screws may cause damage to the inner parts of the transducer head and lead to malfunction.

ITZ 5000-140 and ITZ 10000-100: These transducer heads are mounted using four M10 screws inserted into the holes on the brackets. These heads may be installed in any orientation.

5.3 *Grounding the transducer head*

For safety reasons all types of transducer heads must be properly grounded. Follow the description below for the appropriate transducer head in order to establish a good grounding connection.

ITZ 600-25-PR: A Ground wire (min 1.5 mm²) with an Ø 4.3 mm ring tongue must be connected to the transducer head. The ring tongue is fastened to the M4 stud in the lower rightmost corner of the STH600 using a M4 nut.

ITZ 2000-50 (-PR): A ground wire (min 1.5 mm²) with an Ø 8.3 mm ring tongue must be connected to the transducer head. The ring tongue is placed on one of the 4 mounting screws before mounting the head.

ITZ 5000-140 and ITZ 10000-100: A Ground wire (min 1.5 mm²) with an Ø 10.8 mm ring tongue must be mounted to the transducer head. The ring tongue is placed on one of the 4 mounting screws before mounting the head.

ITZ 16000-150 and ITZ 24000-150: A Ground wire (min 1.5 mm²) with an Ø 12.3 mm ring tongue must be mounted to the transducer head. The ring tongue is placed on one of the 2 mounting screws before mounting the head.

5.4 *Installation*

1. Establish the ground connection (see section 5.3).
2. Mount the provided connection cable between the ITZ FLEX ULTRASTAB electronics and transducer head.
3. Connect the Analog Output Cable as described in section 13.4 and 13.5.
4. Check that all cables terminated in a plug are correctly installed and that the lock screws are tightened firmly.
5. Connect the supplied power cord to the IEC inlet on the unit to turn it on.

The transducer head and electronics can be installed with a transducer head connecting cable of 30 meters maximum.



6 Offset adjustment

The ITZ FLEX ULTRASTAB should occasionally have a current offset adjustment made to ensure the highest accuracy.

All ITZ FLEX ULTRASTAB are offset adjusted with the accompanying transducer head prior to shipment from the factory. In case the ITZ FLEX ULTRASTAB system has been recalibrated or serviced, and as a minimum after half a year of operation, it is advisable to perform an offset adjustment with the selected transducer head connected prior to any measurement in order to achieve the highest accuracy.

6.1 Adjusting the current offset

To adjust the ITZ FLEX ULTRASTAB please follow these steps.

1. Connect a DMM capable of measuring micro amps (μA) to the Analog output port using the current output adaptor cable.
2. Connect the mains cord to the IEC inlet.
3. Wait for approx. 15 minutes after powering up the system for the unit to stabilize thermally.
4. Locate the offset trim hole on the front of the electronics unit (lower left corner).
5. Use a trim screwdriver to adjust the offset until the current is as close to zero as possible.

7. I/O-ports

7.1 Analog Out connector

Normally an appropriate output cable should be used, depending on whether your system has current or voltage output. It is also possible to configure your own output cable, bearing the following description in mind.

The female 15-pin D-Sub Analog out connector contains the following signals:

1. Current return
2. Current return
3. Current return
4. V_S High Sense
5. V_S High Out
6. Ground
7. V_S Low Sense
8. V_S Low Out
9. Current out
10. Current out
11. Current out
12. V_S High Sense
13. V_S High Out
14. V_S Low Sense
15. V_S Low Out

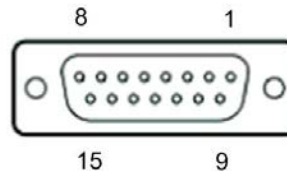


Figure 5: Analog out connector pinout

When using the ITZ FLEX ULTRASTAB in current out mode (no VOM installed) only pin 1, 2, 3 and 9, 10, 11 should be used.

- Pin 9, 10, 11: Is the current output from the ITZ FLEX ULTRASTAB.
- Pin 1, 2, 3: Current return path.

When using the ITZ FLEX ULTRASTAB in voltage out mode (VOM installed) pin 1–9, pin 2–10 and pin 3-11 must be shorted. This will loop the current output to the VOM. The output signal V_S High is then present at pins 4 and 5 and the output signal V_S Low is then present at pins 7 and 8.

IMPORTANT: The sense pins (V_S High Sense on pin 4 and 12, and V_S Low Sense on pin 7 and 14) must be connected to V_S High Out and V_S Low Out respectively.

7.2 4 mm “Banana” Current Output terminals

Two standard 4mm banana jacks are available for easy connection to a low impedance current measuring DMM.



CAUTION: These terminals should be shorted when not in use by use of the supplied shorter plug.

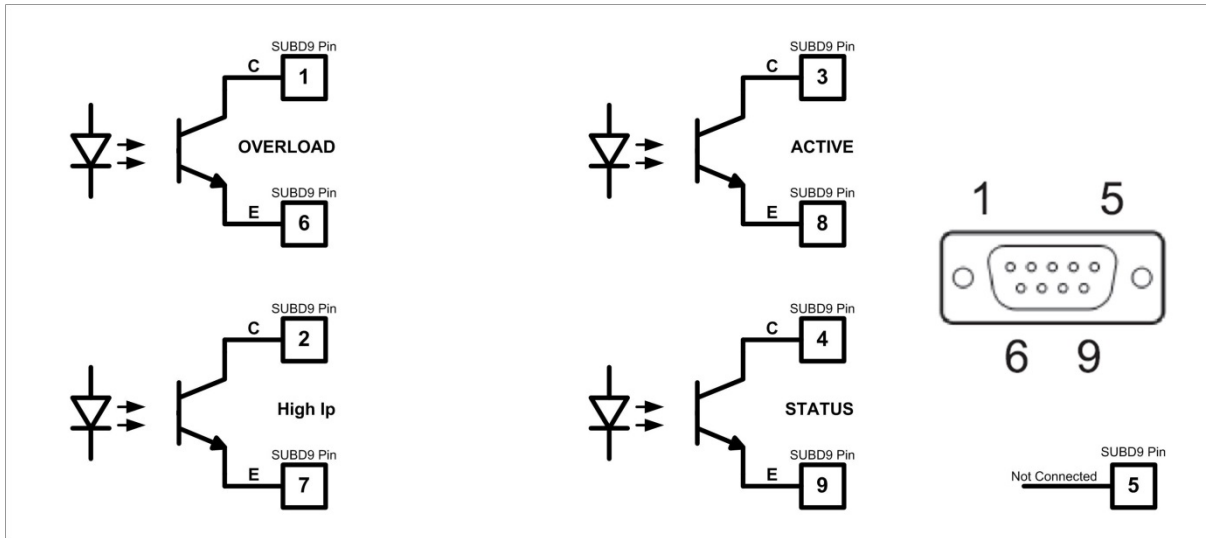
IMPORTANT: The ITZ system is tested for EMI conformance against industrial standards. Use of the unshielded 4mm banana current output port can be critical under circumstances with a high level of external disturbance.

7.3 Status/Interlock connector

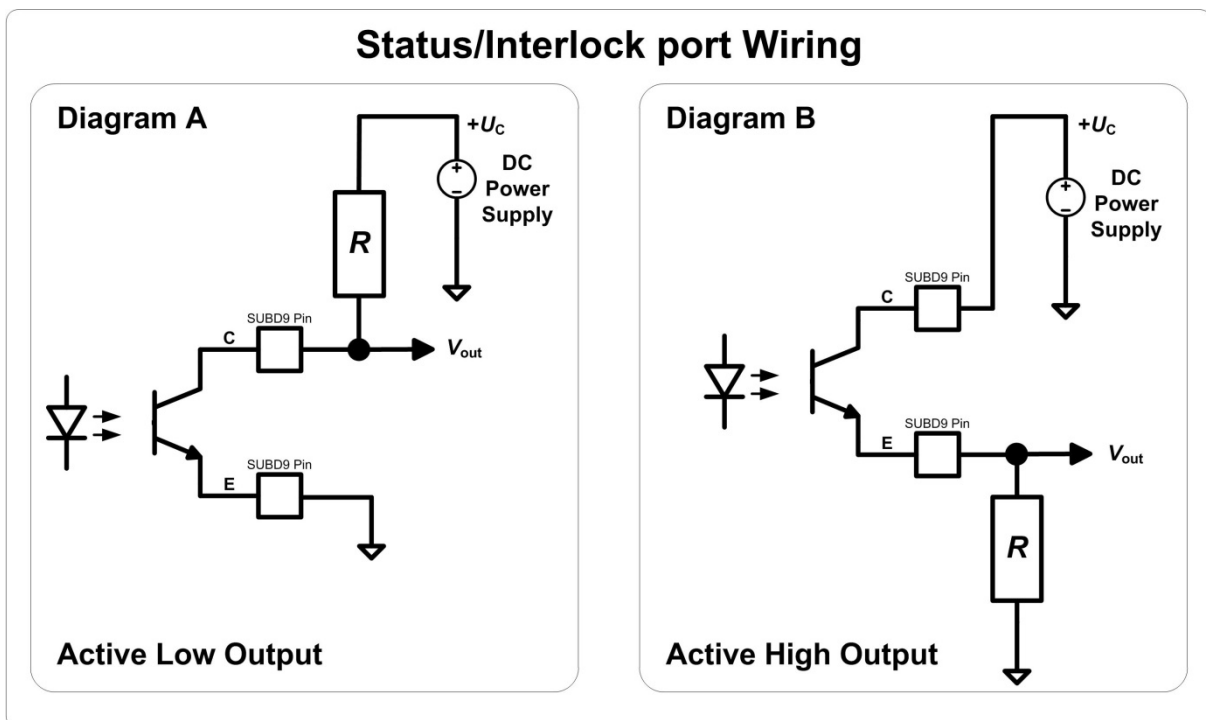
All signals on the Status/Interlock port are optically isolated, Photo couplers type, floating Collector and Emitter.

Four signals are present on the port, each having two dedicated floating pins in the SUBD9 Male connector:

- . Collector (C)
- and
- . Emitter (E)



Depending on how each signal is wired, It can be “Active Low” or “Active High” as shown below:



In the Diagram A Active Low Output, the output signal V_{out} switches to GND when the corresponding LED is ON.

In the Diagram B Active High Output, the output signal V_{out} switches to $+U_C$ when the corresponding LED is ON.

When the output signal V_{out} is switched to GND, its value is lower than 0.2 V.

When the output signal V_{out} is switched to $+U_C$, its value is equal to $+U_C$

output signal	Diagram	V_{out}	Description
OVERLOAD	A	< 0.2 V	The transducer head is saturated due to excessive primary current.
		$+U_C$	The transducer head is not saturated.
	B	$+U_C$	The transducer head is saturated due to excessive primary current.
		< 0.2 V	The transducer head is not saturated.
High I_p	A	< 0.2 V	The primary current is higher than 105% of nominal full-scale output.
		$+U_C$	The primary current is lower than 105% of nominal full-scale output.
	B	$+U_C$	The primary current is higher than 105% of nominal full-scale output.
		< 0.2 V	The primary current is lower than 105% of nominal full-scale output.
ACTIVE	A	< 0.2 V	The primary current is higher than approximately 1% of nominal full-scale output.
		$+U_C$	The primary current is lower than approximately 1% of nominal full-scale output.
	B	$+U_C$	The primary current is higher than approximately 1% of nominal full-scale output.
		< 0.2 V	The primary current is lower than approximately 1% of nominal full-scale output.
STATUS	A	< 0.2 V	When the unit status is OK (Normal operation).
		$+U_C$	When the unit status is not OK (Supply fault, over-temperature conditions and Current overloads or No detected head).
	B	$+U_C$	When the unit status is OK (Normal operation).
		< 0.2 V	When the unit status is not OK (Supply fault, over-temperature conditions, Current overloads or Transducer head not detected).

The power supply voltage $+U_C$ must be between 4 V and 60 V DC and the resistor value must be chosen between a minimum value R_{min} and a maximum value R_{max} calculated by using the following equations:

$$R_{min} (k\Omega) = \frac{+U_C}{3.4} \text{ and } R_{max} (k\Omega) = \frac{+U_C}{1.7}$$

Some recommended standard values are given in the following table:

Power supply Voltage $+U_C$	R_{min} (k Ω)	R_{max} (k Ω)	R Standard Values $\pm 5\%$
5 V $\pm 5\%$	1.5	3	1.8 k Ω or 2.2 k Ω
12 V $\pm 5\%$	3.5	7	4.7 k Ω or 6.8 k Ω
24 V $\pm 5\%$	7	14	10 k Ω or 12 k Ω

8 Absolute maximum ratings

Symbol	Description	Specification	Unit
$+U_C$	Power supply Voltage	60	V
$V_{CE\ off}$	Maximum Off-state Collector-Emitter Voltage	60	V
$V_{CE\ off}$	Maximum reverse Off-state Collector-Emitter Voltage	5	V
I_{CE}	Maximum ON-state Collector-Emitter Current	10	mA

Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the status/interlock signal outputs.

9 Sweep function during overload status

The overload occurs when the primary current I_P exceeds a trip level such that the fluxgate detector becomes completely saturated and, consequently, the transducer will switch from normal operation to overload mode.

This trip level is guaranteed to be greater than 110 % of $I_{PN\ DC}$ and its actual value depends on operation conditions such as temperature and measuring resistance.

When this happens, the ITZ rack electronics will automatically begin to sweep in order to lock on to the primary current again and the measuring can resume when the primary current returns in the nominal range between $- I_{PN\ DC}$ and $+ I_{PN\ DC}$.

In sweep mode, the output current signal will be a slope between $\pm 1\ A$, $\pm 2\ A$ or $\pm 3\ A$ depending on the transducer head.

10 Thermal protection

The ITZ FLEX ULTRASTAB series has thermal shutdown circuitry that protects the electronics from damage.

The thermal protection circuitry disables the measuring circuit when the rack electronics temperature reaches approximately 65 °C and allows the transducer to cool.

When the rack electronics temperature cools to approximately 60 °C, the measuring circuit is automatically re-enabled and the status LED is again lit.

11 Over current protection - Electrical specifications

The Over current occurs when the primary current exceeds 120 % of $I_{PN\ DC}$. To detect the over current with primary AC, the secondary current is full-wave rectified and is time-averaged by a low-pass filter.

Depending on the frequency range of the primary current, two cases appear:

- Low frequency range: DC .. 1.6 Hz (over current slow)

In this case, the over current trip level is set to 120 % of $I_{PN\ DC}$.



The secondary current is tracked until the primary AC peak exceeds this trip level. Then, the rack electronics shut down the measuring circuit and wait until the primary AC peak becomes lower than the set trip level.

- High frequency range: 1.6 Hz .. 1.6 KHz (over current fast)

In this case, the over current trip level is set to 160 % of $I_{PN DC}$.

The secondary current is tracked until the primary AC peak exceeds this trip level. Then, the rack electronics shut down the measuring circuit and wait until the primary AC peak becomes lower than the set trip level.

The DC .. 1.6 KHz characteristics of the over current trip level with a sine-wave primary AC is shown in the following table:

Primary current frequency (Hz)	Typical over current trip level to detect over current state
DC (0Hz)	120 % of $I_{PN DC}$
0.2	122 % of $I_{PN DC}$
0.5	126 % of $I_{PN DC}$
1	130 % of $I_{PN DC}$
1.5	140 % of $I_{PN DC}$
2	147 % of $I_{PN DC}$
5	157 % of $I_{PN DC}$
50	160 % of $I_{PN DC}$
800	170 % of $I_{PN DC}$
1600	186 % of $I_{PN DC}$

Under these conditions:

- The signal Status (contact between Pin 4:C and Pin 9:E) switches off, this signal becomes open (no current from collector to emitter) to indicate that the unit is not OK.
- The green Led located on the front panel switches off (fault state)
- The transducer is protected against damage that the over current primary AC may cause to the electronics.

The transducer will automatically starts again to work when the primary AC peak becomes lower than the trip level value indicated in the table above.

12 Transducer head connector

The circular multi-pin bayonet-style connector is used to connect the transducer head to the electronics.

It is critical to ensure the signal integrity in this I/O interface in order to maintain the very high performance level this system can achieve. As a consequence, pins in this I/O interface are not available for the user.

13 Operating instructions

13.1 Switching on power



CAUTION: Before switching on the power make sure that there is no current running through the transducer head.

IMPORTANT: The ITZ rack electronics has no MAINS switch. To power off the unit disconnect the mains plug at the power inlet.

Before powering up the ITZ FLEX ULTRASTAB be sure to check the following:

1. Check that all cables terminated in a plug are correctly installed and that the lock screws are tightened firmly
2. Check that the system is properly grounded through the mains connection and that the transducer head is grounded according to the directions given in section 5.3.
3. Connect the power cord to the mains inlet
4. The ITZ FLEX ULTRASTAB will now run through its power up sequence. After a few second the unit is ready and the status of the unit can be seen on the front panel LEDs
5. Switch primary current on. The ACTIVE LED will turn on.

13.2 Using the ITZ FLEX ULTRASTAB in current mode

When using the ITZ FLEX ULTRASTAB without a VOM installed there are essentially two ways to measure the output. It can either be connected to a current measuring device or to an external burden resistor.

13.3 Connecting directly to a current measuring device

Connecting the ITZ FLEX ULTRASTAB directly to a current measuring device like a DMM or a power analyser, can easily be done from the current output port with two standard 4 mm banana plugs. Take care that both terminals are floating relative to ground. The red wire carries the output current while the black is the current return path. Simply connect these two wires to your current measuring device using standard laboratory test leads with 4 mm banana terminals.

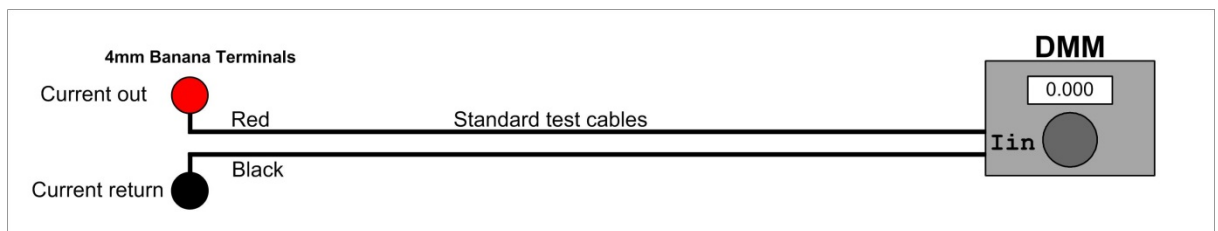


Figure 6: Wiring schematics to current measuring device

13.4 Connecting to an external burden resistor (current output)

If an external burden resistor is to be connected to the ITZ FLEX ULTRASTAB the connection shown below should be used.

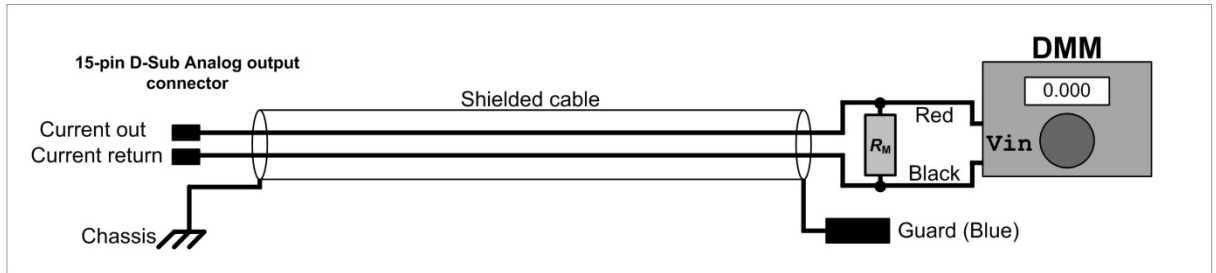


Figure 7: Wiring schematics to external burden resistor

In addition to the standard current output cable of 1.5 m length a 5 m long current output cable is also available. Both cables use two twisted pairs in order to reduce the resistance, and are terminated in three 4 mm female banana sockets for easy connection to other equipment.

13.5 Connecting the ITZ FLEX ULTRASTAB to a DMM or high impedance amplifier (voltage output)

When connecting the ITZ FLEX ULTRASTAB to a DMM or high impedance load in voltage mode (VOM installed) use the connection shown below. This diagram is equal to the standard voltage output cable. This cable uses a single twisted pair, and is terminated in three female banana sockets for easy connection to other equipment.

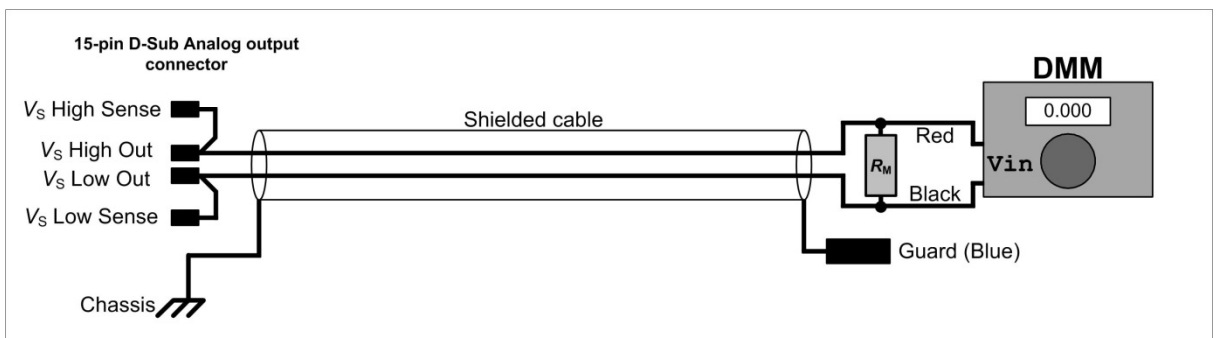


Figure 8: Wiring schematics to high impedance load

14 Theory of operation

14.1 Basic principle of ITZ FLEX ULTRASTAB current transducers

The ITZ FLEX ULTRASTAB current transducers are delivered in a series covering galvanic isolated measurements of currents from DC to 500 kHz ranging from 40 A to 24 kA.

These precision current transducers use a zero flux detector principle controlling a compensation current which counterbalances the ampere-turns generated by the primary current. Due to a balanced zero flux detector principle the output noise level is extremely low by nature and a resolution on the order of 2×10^{-8} is achieved.

Below is shown a block diagram of the zero flux detector principle.

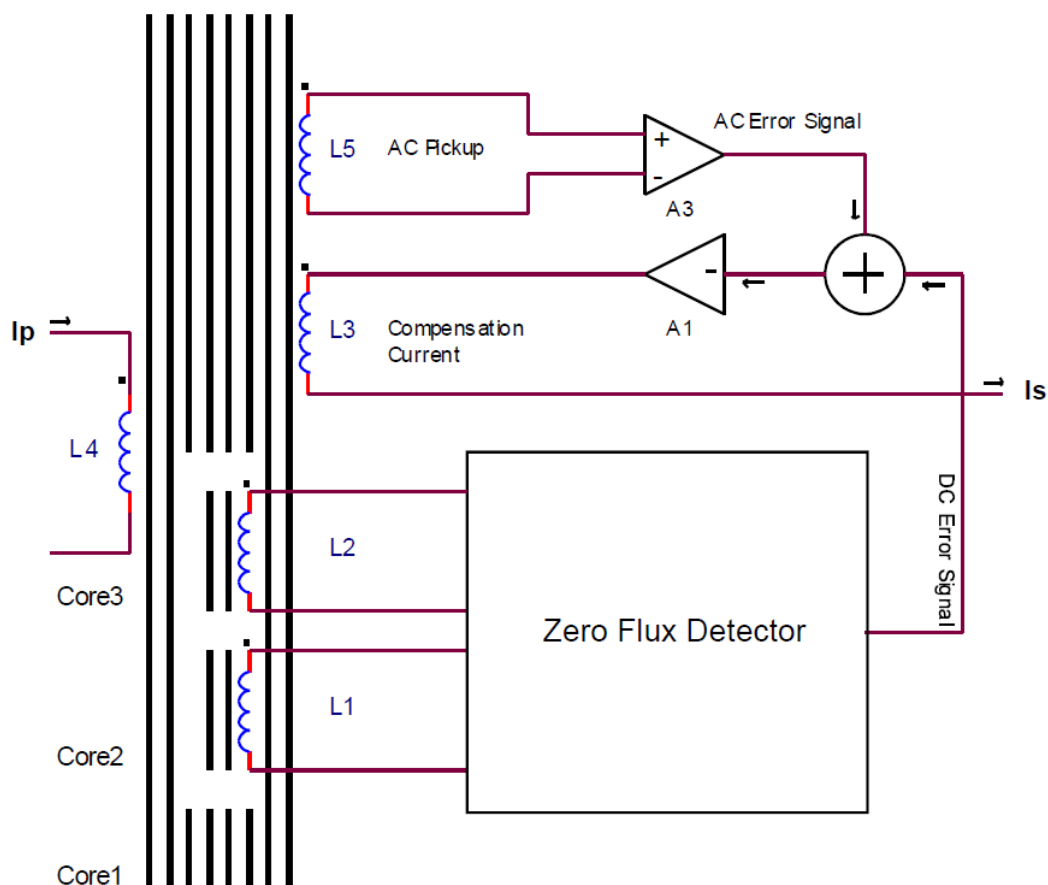


Figure 9: Block diagram showing the zero flux detector principle

The transducer head core1 is the basic body structure. The core2 and core3 are the flux detectors coupled to the zero-flux detector circuitry by means of the coils L1 and L2.

Coils L1 and L2 are coupled in parallel or series depending on the model, with opposite phase to reduce any unwanted flux generated in core 1.



With primary current (I_P) flowing through primary winding L4, a magnetic flux will be generated in the body structure and detected by the detector cores. An error signal will be generated, controlling the amplifier A1 to drive a current through the compensation, winding L3. When counterbalance is obtained, i.e. zero flux is re-established, the compensation current, multiplied by the number of turns in winding L3, is a true representation of the instantaneous primary current (I_P).

The zero flux detector circuitry operates from true DC to about 1 Hz. For higher frequencies the “AC pick up” winding L5 performs as a feedback error signal via the amplifier A3 which widens the active bandwidth of the transducer to more than 1 kHz.

Above 1 KHz the transducer operates as a passive current transformer with its -3 dB limit varying from 2 kHz to 500 kHz depending on the size and construction of the head.

15 Maintenance

The ITZ FLEX ULTRASTAB with current output does not require any maintenance under normal operation except for the offset adjustment explained in section 6.

The ITZ FLEX ULTRASTAB with voltage output requires offset adjustment as described in section 6.

The system is a calibrated entity that should be recalibrated every 2 years to ensure the calibration level of the system. To get your ITZ FLEX ULTRASTAB recalibrated we recommend shipping it to LEM Switzerland S.A.

If the unit needs service please contact LEM Switzerland S.A. our local sales representative.