ITZ ULTRASTAB

USER GUIDE

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DOCUMENT INFORMATION

History	Version
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**
18.01.2022: Added some data according to the external laboratory	**Version 2**
28.10.2022: Modified picture (page 1); added maximum power consumption for all ITZ products + ITZ 6100-S (page 7) + replaced LEM Switzerland by LEM International (all pages) + changed warranty statement picture (page 3) + added “Packaging” paragraph (page 9) + added 2.6 paragraph (page 10) + modified front panel picture (page 17) + modified back panel picture (page 18)	**Version 3**
06.11.2025: Removed page 5 about 5 year warranty. Added Important Notice on the last page.	**Version 3**

INTRODUCTION

Congratulations with your purchase of LEM ITZ Ultrastab.

The ITZ Ultrastab system provides a flexible yet user-friendly platform for use in laboratory, test facility and industrial applications where the highest performance fluxgate current sensing is needed. The platform offers full-scale current sensing from 2000 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 Ultrastab and how to build an ultrahigh precision system. In case of unanswered questions do not hesitate to contact either LEM International S.A. or our local distributor directly.

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

RECEIVING AND UNPACKING

The shipping material and the ITZ 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 delivery note. LEM International S.A. will not be responsible for any shortages unless notified no later than 14 days after receiving.

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 International S.A. or our local representative immediately upon receiving.

Upon receipt of this report, LEM International 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 Ultrastab on any communication with LEM International S.A. or our local representative.

GENERAL SPECIFICATIONS FOR RACK ELECTRONICS

Electrical Data – MAINS INPUT		
Mains input voltage	100-240 V AC (±10 %)	IEC-type inlet socket OVCII and PD2
Mains input frequency	50-60 Hz	
Fuses	2.5 At / 240 V AC	Internal fuses, not user-replaceable
Maximum power	76 W	ITZ 2000-S; ITZ 2000-SB; ITZ 2000-SPR; ITZ 2000-SBPR; ITZ 5000-S; ITZ 5000-SB
Maximum power	163 W	ITZ 6100-S
Maximum power	137 W	ITZ 10000-S; ITZ 10000-SB
Maximum power	202 W	ITZ 16000-S; ITZ 16000-SB
Maximum power	300 W	ITZ 24000-S
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	< 1 V	
Physical data – Electronics rack		
Dimensions	480 x 88 x 430 mm	W x H x D, incl. handles/connectors
Weight	8.4 kg (9.2-10 kg)	Value for 2000-5000 A systems (10 kA/16 kA–24 kA systems)
Operating conditions		
Temperature	10 … +40 °C	For rack
Temperature	0 … +55 °C	For head
Maximum primary conductor temperature	100 °C	
Humidity	20 … 80 % RH	Non-condensing
Altitude	2000 m [1)]	
Environmental conditions		Indoor
Cooling conditions	Internal fan	
Storage conditions		
Temperature	-20 … 85 °C	Head and electronic
Humidity	20 … 80 % RH	

Note: [1)] Insulation coordination at 2000 m.

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 61010-1: 2010 + A1 (2016)

Electromagnetic Compatibility:
Emission: EN 61326-1: 2013
Immunity: EN 61326-1: 2013

A technical file is kept available at:

LEM International S.A.
Route du Nant-d'Avril, 152
CH-1217 Meyrin

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 International 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.

2.6 *Danger*

Caution, risk of electrical shock

Use caution during installation and use of this product; certain parts of the module can carry hazardous voltages and high currents (e.g., primary conductor).
Ignoring this warning can lead to injury and or/or cause serious damage.
De-energize all circuits and hazardous live parts before installing the product.
All installations, servicing operations and use must be carried out by trained and qualified personnel practicing applicable safety precautions.

3 Quick start

3.1 System overview

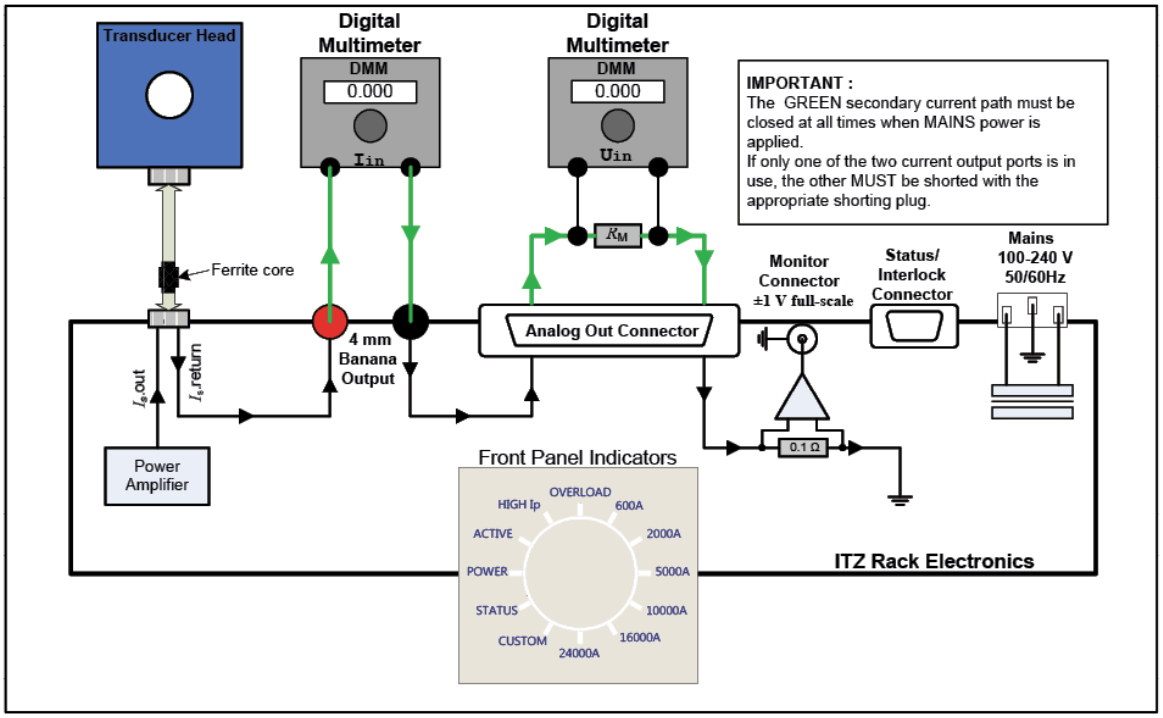


Figure 1: System overview for Current Output

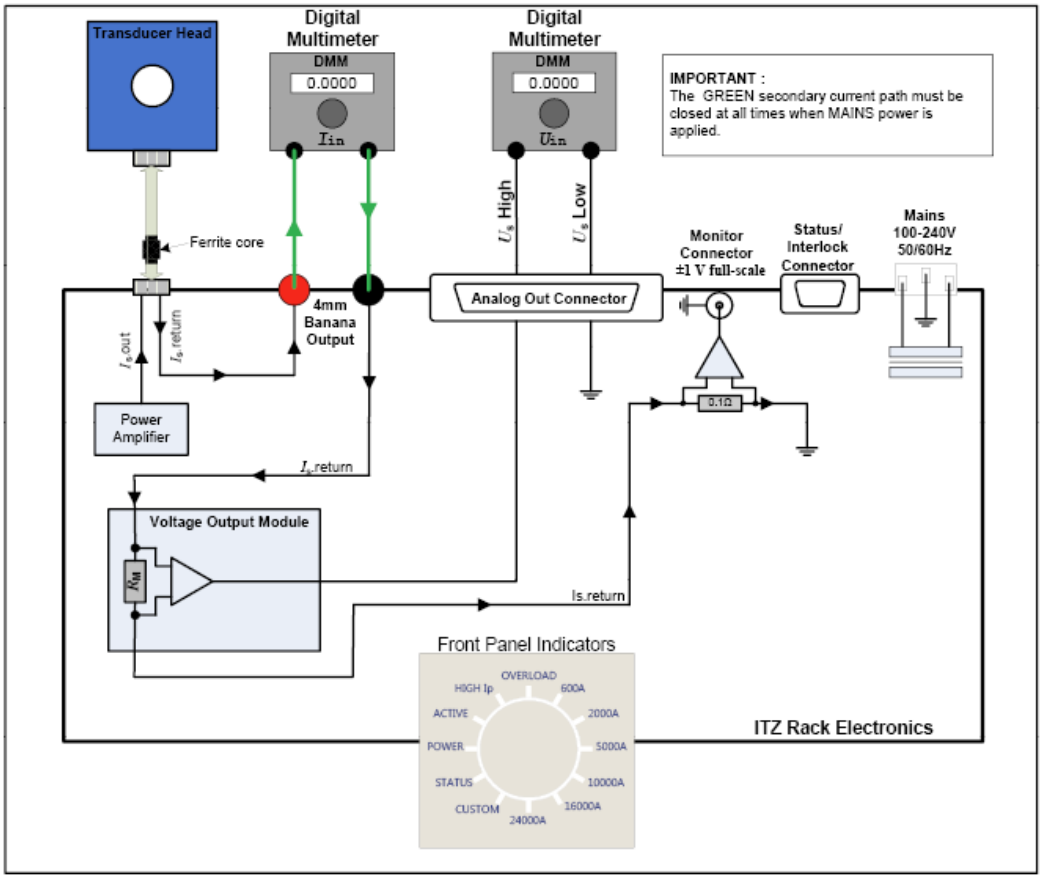


Figure 2: System overview for Voltage Output

3.2 Setting up

To quickly get your new ITZ 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 2000-SPR (-SBPR)
   - ±2 A for ITZ 2000-S (-SB), ITZ 5000-S (-SB), ITZ 10000-S (-SB) and ITZ 16000-S (-SB)
   - ±2.44 A for ITZ 6100-S
   - ±3 A for ITZ 24000-S.

IMPORTANT: Refer to page 22 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 then ± 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.

240 V AC main	Power Cable, C13, IEC to CEE 7/4, Schuko, 16 A, 250 V
110 V AC main	Power Cable, C13, IEC to NEMA 5-15, 10 A, 125 V

4. The ITZ 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 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 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 ULTRASTAB can be delivered with the following transducer heads.

1. ITZ 2000-50-PR – programmable in steps of 125 A from 125 A to 2000 A. Turns ratio (default) of 2000 :1;
   Nominal secondary current of 1 A; Aperture Ø 50 mm

2. ITZ 2000-50 – non-programmable, wide-bandwidth;
   Turns ratio of 1000 :1; Nominal secondary current of 2 A;
   Aperture Ø 50 mm

3. ITZ 5000-140 – non-programmable. Turns ratio of 2500 :1
   Nominal secondary current of 2 A; Aperture Ø 140 mm

4. ITZ 6100-140 – non-programmable. Turns ratio of 2500 :1
   Nominal secondary current of 2.44 A; Aperture Ø 140 mm

5. ITZ 10000-100 – non-programmable. Turns ratio of 5000 :1;
   Nominal secondary current of 2 A; Aperture Ø 100 mm

6. ITZ 16000-150 – non-programmable. Turns ratio of 8000 :1;
   Nominal secondary of 2 A; Aperture Ø 150 mm

7. ITZ 24000-150 – non-programmable. Turns ratio of 8000 :1;
   Nominal secondary of 3 A; Aperture Ø 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. i.e., if you have purchased an ITZ 10000-S system you will be able to use a 2000 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. i.e., 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 turns 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 (**V**oltage **O**utput **M**odule). This module will convert the output current to an output voltage of ±10 V (nominal full-scale).

Three types VOMs are available, one for each nominal output current range (1, 2 or 3 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 (e.g. ITZ 5000-S**B**), 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 transfer 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 transfer ratio (N) of the system.

The smaller transducer heads come with a programming option.

As the nominal output current ($I_{S\,N}$) is fixed (defined by the transducer head) and the maximum input current (I_P) can be changed using a programming plug, the current transfer 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 transfer ratio of the system is then:

$$N = \frac{I_P}{I_{S\,N}} = \frac{1500\ \text{A}}{1\ \text{A}} = 1500$$

When a system is equipped with a VOM, the output current will be converted to a voltage. The maximum nominal output voltage (U_{out}) is fixed at 10 V. Thus the ratio (S) from the example above can be found as:

$$S = \frac{I_P}{U_{out}} = \frac{1500\ \text{A}}{10\ \text{V}} = 150\ \text{A/V}$$

4.6 *Front*

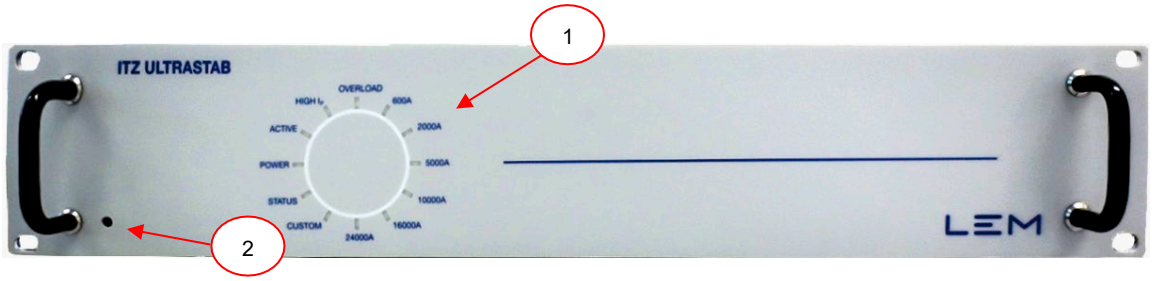


Figure 3: Front panel of electronics rack

On the front of the ITZ 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.

2000 A to 24000 A:
These LEDs are lit (Yellow) when a transducer head with the corresponding full-scale range is connected to the ITZ 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

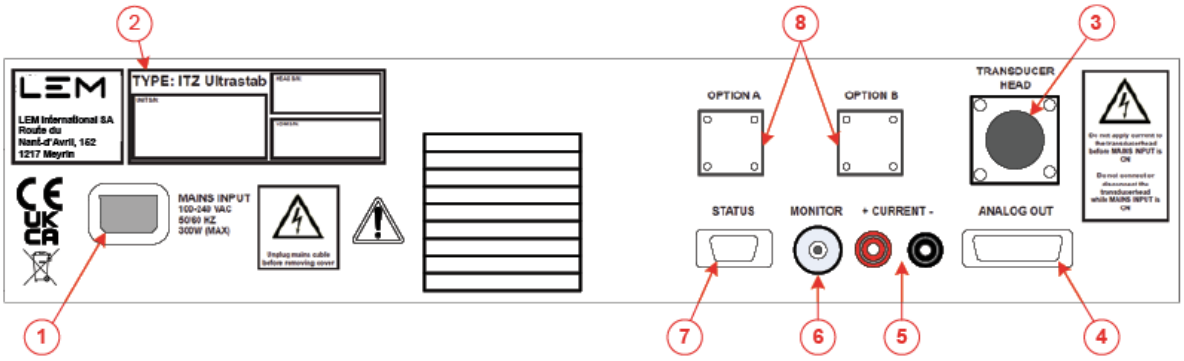


Figure 4: Back panel of electronic rack

All connections on the ITZ 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 International 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.
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.
8. Option A+B: These positions are for future expansion or customization.

Ventilation exit

The main heat sink has an airflow exit centred 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 D-sub 25-pin male 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 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 ides 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 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]

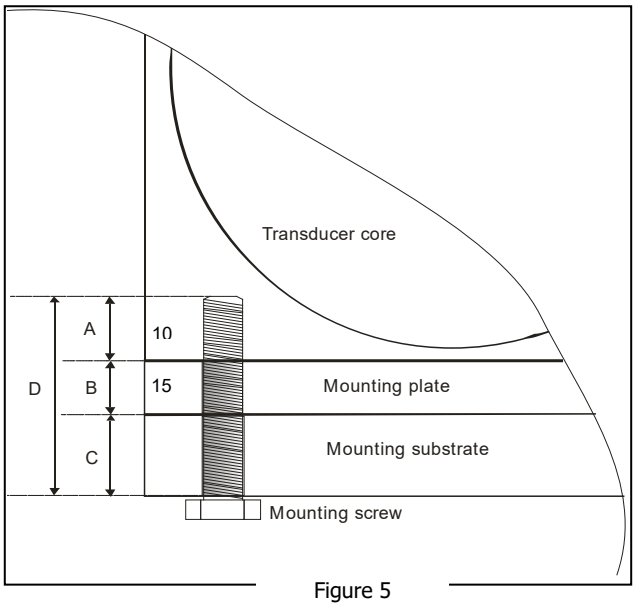


Figure 5

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

ITZ 5000-140, ITZ 6100-140, 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.

ITZ 16000-150, and ITZ 24000-150:
These transducer heads are mounted using two M12 screws inserted into the holes under the head.
This head must be installed in vertical position.

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 2000-50 (-PR): A ground wire (min 1.5 mm^2) 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, ITZ 6100-140, ITZ 10000-100: A Ground wire (min 1.5 mm^2) with an Ø 10.3 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 mm^2) with an Ø 12.3 mm ring tongue must be mounted to the transducer head. The ring tongue is placed on one mounting screw 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 ULTRASTAB electronics and transducer head.
3. Connect the Analog Output Cable as described in section 8.3-8.6.
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 ULTRASTAB should occasionally have a current offset adjustment made to ensure the highest accuracy.

All ITZ ULTRASTAB are offset adjusted with the accompanying transducer head prior to shipment from the factory. In case the ITZ 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 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/0-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 Analog out connector (Dsub15-F) contains the following signals:

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

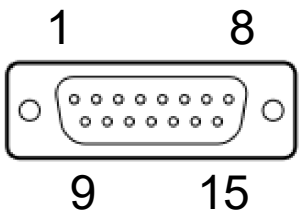


Figure 5: Analog out connector pinout

When using the ITZ 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 ULTRASTAB.
- Pin 1, 2, 3: Current return path.

When using the ITZ 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 voltage output is then present at pin 4 - 8 and 12 - 15.

IMPORTANT: The sense pins (U_o High Sense on pin 4 and 12, and U_o Low Sense on pin 8 and 14) must be connected to U_o High Out and U_o Low Out respectively.

7.2 4 mm "Banana" Current Output terminals

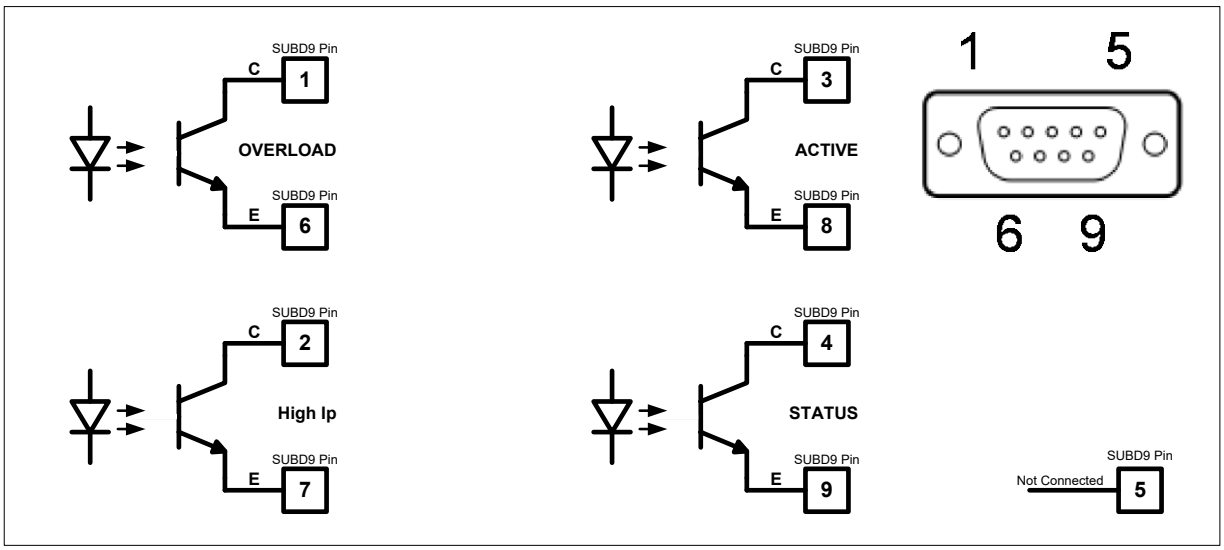
Two standard 4 mm banana jacks are available for easy connection to a low impedance current measuring DMM.

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

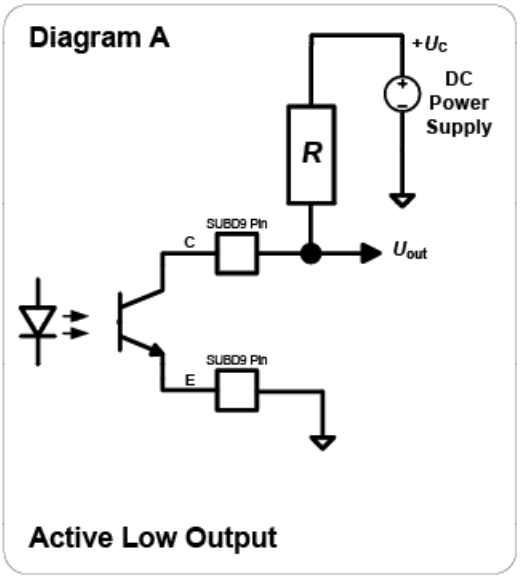
IMPORTANT: The ITZ system is tested for EMI conformance against industrial standards. Use of the unshielded 4mm banana current output port can be critical under circumstances with a high level of external disturbance.

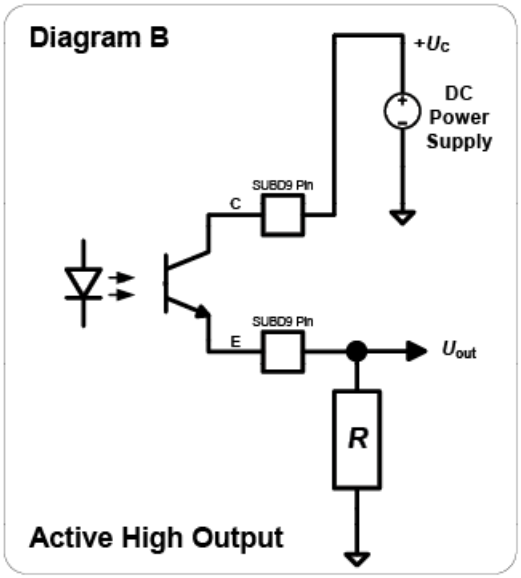
7.3 Status/Interlock connector

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 U_{out} switches to GND when the corresponding Led is ON.
In the Diagram B Active High Output, the output signal U_{out} switches to $+U$ when the corresponding Led is ON.

When the output signal U_{out} is switched to GND, its value is lower than 0.2V.
When the output signal U_{out} is switched to $+U$, its value is equal to $+U$

output signal	Diagram	U_{out}	Description
OVERLOAD	A	< 0.2 V	The transducer head is saturated due to excessive primary current
		$+U$	The transducer head is not saturated
	B	$+U$	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
		$+U$	The primary current is lower than 105 % of nominal full-scale output
	B	$+U$	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
		$+U$	The primary current is lower than approximately 1 % of nominal full-scale output
	B	$+U$	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)
		$+U$	When the unit status is not OK (Supply fault, over-temperature conditions, Current overloads or Transducer head not detected)
	B	$+U$	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 $+U$ 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} (KΩ) = $\frac{+U}{3.4}$ and R_{max} (KΩ) = $\frac{+U}{1.7}$

Some recommended standard values are given in the following table:

Power supply Voltage $+U$	R_{min} (KΩ)	R_{max} (KΩ)	R Standard Values
5 V ±5%	1.5	3	1.8 KΩ ±5 % or 2.2 KΩ ±5 %
12 V ±5%	3.5	7	4.7 KΩ ±5 % or 6.8 KΩ ±5 %
24 V ±5%	7	14	10 KΩ ±5 % or 12 KΩ ±5 %

8 Absolute maximum ratings

Symbol	Description	Specification	Unit
$+U$	Power supply Voltage	60	V
$U_{C\ E\ off\ max}$	Maximum Off-state Collector-Emitter Voltage	60	V
$U_{C\ E\ off\ max}$	Maximum reverse Off-state Collector-Emitter Voltage	5	V
$I_{C\ E\ on\ max}$	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 Packaging

See datasheets of the products.

10 Sweep function during overload status

The Overload occurs when the primary current I_P exceeds a threshold value outside the measuring range and, consequently, the fluxgate detector becomes completely saturated.
This threshold value is beyond 110 % of $I_{P\ N}$ and the precise threshold value is related to the transducer head and to the measuring resistor.

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 - $I_{P\ N}$ and + $I_{P\ N}$.

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

11 Thermal protection

The ITZ 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.

12 Over current protection - Electrical specifications

The Over current occurs when the primary current exceeds 120 % of $I_{P\ N}$ 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 (Note 1).

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 $I_{P\,N}$ 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 $I_{P\,N}$ 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 with a sine-wave primary AC is shown in the following table:

Primary current frequency (Hz)	Typical value of primary peak current to detect over current state
DC (0Hz)	120 % of $I_{P\,N}$ DC
0.2	122 % of $I_{P\,N}$ DC
0.5	126 % of $I_{P\,N}$ DC
1	130 % of $I_{P\,N}$ DC
1.5	140 % of $I_{P\,N}$ DC
2	147 % of $I_{P\,N}$ DC
5	157 % of $I_{P\,N}$ DC
50	160 % of $I_{P\,N}$ DC
800	170 % of $I_{P\,N}$ DC
1600	186 % of $I_{P\,N}$ 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 start again to work when the primary AC peak becomes lower than the threshold value indicated in the table above.

Note 1:
This full-wave rectification creates a ripple voltage with an average DC component and an AC component whose frequency is twice the primary current frequency .The magnitude of the ripple voltage varies with the primary current frequency. This magnitude will be decreased if the frequency is increased.

13 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.

14 Operating instructions

14.1 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 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 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.

14.2 Using the ITZ ULTRASTAB in current mode

When using the ITZ 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.

14.3 Connecting directly to a current measuring device

Connecting the ITZ 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.

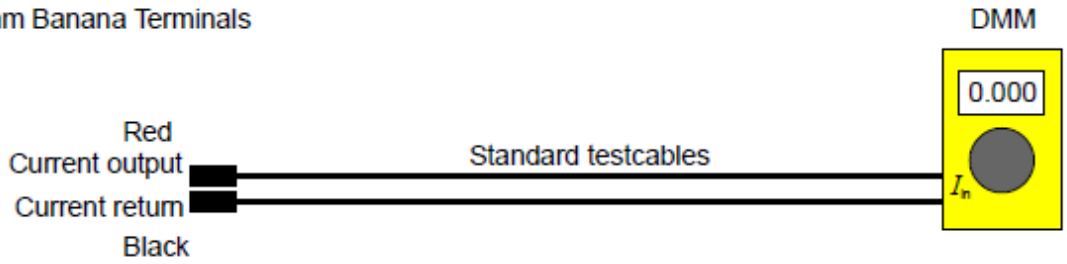


Figure 6: Wiring schematics to current measuring device

14.4 *Connecting to an external burden resistor (current output)*

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

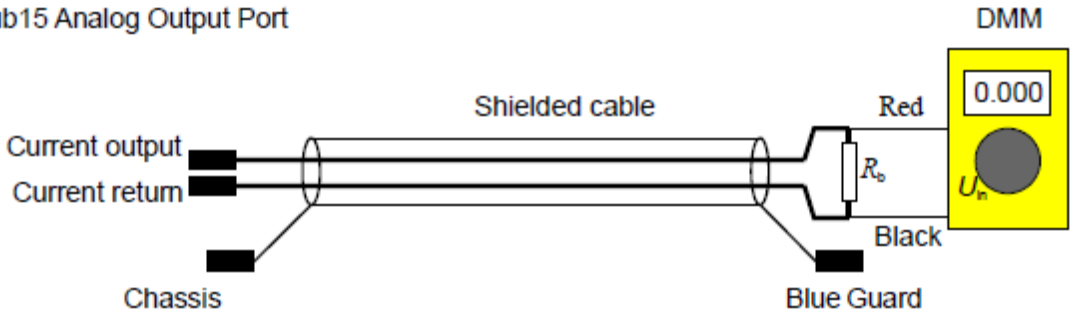


Figure 7: Wiring schematics to external burden resistor

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.

14.5 *Connecting the ITZ ULTRASTAB to a DMM or high impedance amplifier (voltage output)*

When connecting the ITZ 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.

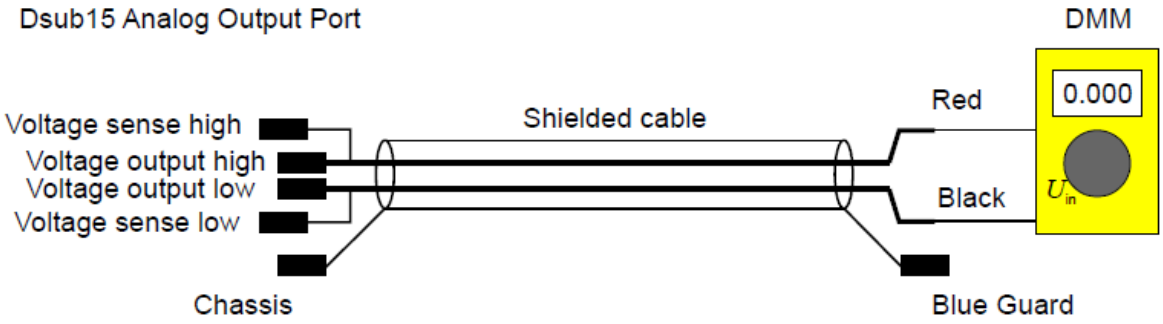


Figure 8: Wiring schematics to high impedance load

15 Theory of operation

15.1 Basic principle of ITZ ULTRASTAB current transducers

The ITZ ULTRASTAB current transducers are delivered in a series covering galvanic insulated 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 x 10^{-8} is achieved.

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

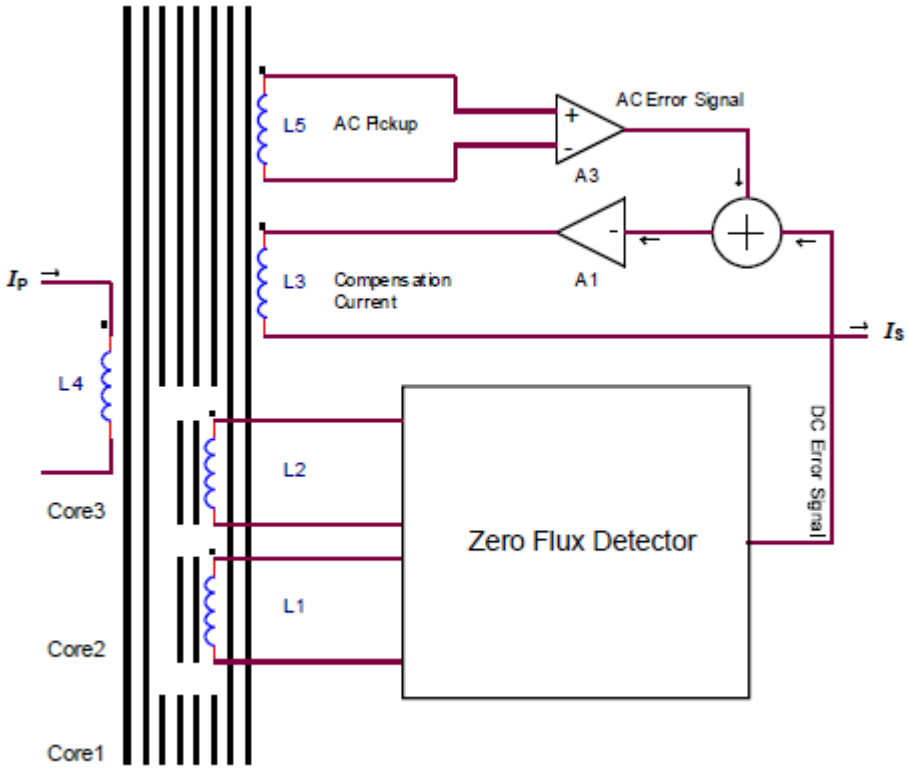


Figure 9: Block diagram showing the zero flux detector principle
T

The transducer head core (1) is the basic body structure. The cores (2) and (3) 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 10 kHz.

Above 10 KHz the Define CCT the transducer operates as a passive current transformer with its -3 dB limit varying from 300 KHz to 1 MHz depending on the size and construction of the head.

16 Maintenance

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

The ITZ 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 ULTRASTAB recalibrated we recommend shipping it to LEM International S.A.

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

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