MAGTROL

Load Monitoring Unit

LMU 216

User's manual

First Edition, rev. D – May 2012

MAGTROL

Revisions To This Manual

The contents of this manual are subject to change without prior notice. Should revisions be necessary, updates to all Magtrol User's Manuals can be found at Magtrol's web site at www.magtrol.com/support/manuals.htm?tab=2#TabbedPanels1.

Please compare the date of this manual with the revision date on the web site, then refer to the manual's Table of Revisions for any changes/updates that have been made since this edition.

TABLE OF REVISIONS

DATE	EDITION	CHANGES	SECTION
05/22/2012	First Edition, rev. D	adding the inversion to the amplifier adjusts the X coefficent on MEM783 card	4. Fig.4-3, Fig 4-8, appendix A
03/26/2010	First Edition, rev. C	Section 4.2. USING B.I.T.E SIGNAL added.	4.2
12/09/2009	First Edition, rev. B	The micro switch SWB9 «must be ON» was changed to the micro switch SWA10 «must be OFF.»	3.2
07/01/2009	First Edition, rev. A	0% hysteresis changed to < 0.5%	2.4.4.1, 2.4.4.2, 2.4.4.3, and 2.4.4.4
05 2009	First Edition	-	-

Table of Contents

TABLE OF FIGURES

Preface

PURPOSE OF THIS MANUAL

This manual has all the necessary information regarding the installation, connection, calibration and use of Magtrol's LMU 216 load monitoring unit. To achieve maximum capability and ensure proper use of the system, please read this manual in its entirety before operating. Keep the manual in a safe place for quick reference whenever a question should arise.

WHO SHOULD USE THIS MANUAL

This manual is for users who want to install and use the load monitoring unit LMU 216 for processing data generated by load measuring pins. The user should have suitable technical training in mechanics and electronics so as to allow him to install and use this load monitoring unit without risk.

MANUAL ORGANIZATION

This section gives an overview of the structure of the manual and the information contained in it. Some information has been deliberately repeated in different sections of the document to minimize cross-referencing and to facilitate understanding through reiteration.

Summary of the different chapters :

Chapter 1 : INTRODUCTION – Contains the technical data sheet of the load monitoring units LMU 216 and gives its technical characteristics as well as a brief overview of the application fields.

Chapter 2 : INSTALLATION / CONFIGURATION – Contains the mounting and configuration explanations for the load monitoring unit LMU 216.

Chapter 3 : CALIBRATION – Describes the calibration procedures of the zero, sensitivity and relays detection level of the load monitoring unit LMU 216.

Chapter 4 : APPLICATIONS – Describes two examples of applications for one load monitoring unit LMU 216. In the first example only one transducer is used, in the second four of them are used.

Chapter 5 : REPAIR – Contains solutions to problems encountered with LMU series load monitoring units.

Appendix A : CONFIGURATION AND CALIBRATION REPORT – Contains the configuration and calibration report of the LMU 216 which must be filled in with great care when installing the load monitoring unit.

Appendix B : CE CONFORMITY DECLARATION – Contains the CE conformity declaration of the MAGTROL LMU series load monitoring units.

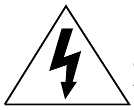
WARNING

WARNING : THE INSTALLATION AND CALIBRATION OF THE LMU UNIT MUST BE CARRIED OUT BY SUITABLY QUALIFIED AND TRAINED PERSONNEL. PLEASE READ THIS MANUAL BEFORE INSTALLING AND CALIBRATING THIS LMU UNIT AND FOLLOW CLOSELY THE OPERATING INSTRUCTIONS.

THE WIRING MUST ONLY BE CARRIED OUT WHEN THE MAINS ARE SWITCHED OFF.

THE CALIBRATION ASKS TO OBSERVE THE RELEVANT SAFETY WORKING METHODS.

PLEASE PAY ATTENTION TO THE SYMBOLS PLACED ON THE LOAD MONITORING UNIT.



The lightning inside of a triangle indicates the presence of dangerous non insulated components in the apparatus which may expose the user to electric shocks.

The exclamation mark inside of a triangle is used to inform the user, that some important instructions about how to operate and maintain the apparatus are to be found in the manual delivered with the unit.

SYMBOLS USED IN THIS MANUAL

The following symbols and type styles may be used in this manual to highlight certain parts of the text:

Note: This is intended to draw the operator's attention to complementary information or advice relating to the subject being treated. It introduces information enabling the correct and optimal function of the product.

CAUTION: THIS IS USED TO DRAW THE OPERATOR'S ATTENTION TO INFORMATION, DIRECTIVES, PROCEDURES, ETC. WHICH, IF IGNORED, MAY RESULT IN DAMAGE TO THE MATERIAL BEING USED. THE ASSOCIATED TEXT DESCRIBES THE NECESSARY PRECAUTIONS TO TAKE AND THE CONSEQUENCES THAT MAY ARISE IF THESE PRECAUTIONS ARE IGNORED.

WARNING! THIS INTRODUCES DIRECTIVES, PROCEDURES, PRECAUTIONARY MEASURES, ETC. WHICH MUST BE EXECUTED OR FOLLOWED WITH THE UTMOST CARE AND ATTENTION, OTHERWISE THE PERSONAL SAFETY OF THE OPERATOR OR A THIRD PARTY MAY BE AT RISK. THE READER MUST ABSOLUTELY TAKE NOTE OF THE ACCOMPANYING TEXT, AND ACT UPON IT , BEFORE PROCEEDING FURTHER.

1. Introduction

1.1 GENERAL INFORMATION

The LMU series load monitoring units have been specially designed for applications using load pins with strain gauge sensors. This range of monitoring units offer a large degree of flexibility for the implementation of load measuring systems.

Three models of load monitoring units are available :

- LMU 212 : basic model
- LMU 217 : model combining two LMU 212 placed side by side
- LMU 216 : model combining one LMU 212 and a control module.

☞ Note : Only the model LMU 216 will be described in this manual. The LMU 212 and LMU 217 are the subject of one manual entirely dedicated to them.

The specially robust design of these units allows monitoring load limits in the most challenging environments.

1.2 DATA SHEET

MAGTROL

LMU
Data Sheet

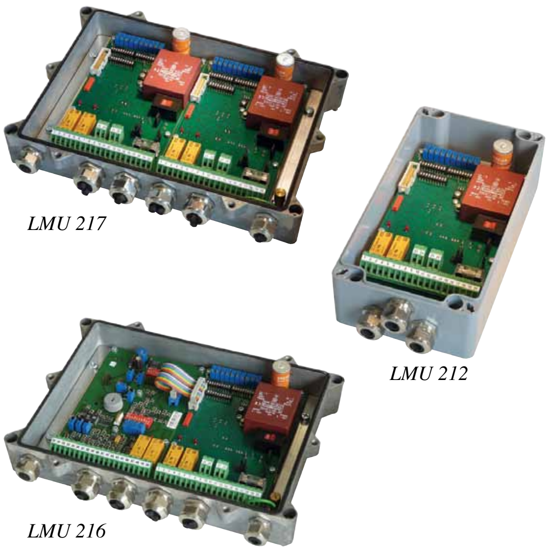
LMU Series
Load Monitoring Units

FEATURES

- For use with full-bridge strain gauge transducers (sensitivity 0.5 to 4 mV/V)
- Voltage input for load summation or for individual use (without sensor)
- 2 to 4 level detectors with relay output contacts
- 0–20 mA or 4–20 mA DC current output
- ±10 V voltage output(s)
- Provides continuous detection of signal line failure and short circuits («OK» signals)
- Includes integrated test equipment (B.I.T.E.) with continuous power supply monitoring
- Compatible to CE Standards
- IP 65 aluminum housing

Features of LMU 216 only:

- 4 level detectors with output contacts, 2 of them with programmable memory
- Summer with 4 inputs
- Tare function
- Optional balancing and comparator sub-module



LMU 217

LMU 212

LMU 216

DESCRIPTION

The Magtrol Load Monitoring Unit is specially designed for strain gauge transducer applications. Specifically developed for use with Magtrol load measuring pins and load-force-weight sensors, the LMU Series provides excitation current and amplifies the output signal of full-bridge strain gauges.

Load Monitoring Units are flexible and fully configurable due to DIP-switches and jumpers which allow the unit to be easily installed—no solder connections are required. The level detectors and the outputs can be dedicated either to the full-bridge input, to the voltage input, or to the sum of both (*see "Application Selection" at the top of page 3*). A built-in auto-diagnostic system detects any short circuits or signal line failures, **thus allowing the system to be used in applications where safety is important**. If a problem is detected, both relays are deactivated and the output voltage (respective current) changes to >10 VDC and >20 mA.

The LMU is fully compatible with European Community (CE) standards. Its IP 65 aluminum housing allows the system to be used in harsh environments. Using SMD (surface mounted device) technology, the LMU allows the maximum performance/price ratio for strain gauge transducer monitoring.

MODEL COMPARISON

	LMU 212	LMU 217	LMU 216
Description	1 transducer input	2 transducer inputs (2 × LMU 212)	1 transducer input
Voltage Output	1 × 0–10 V	2 × 0–10 V	3 × 0–10 V
Current Output	1 × 0–20 mA or 4–20 mA	2 × 0–20 mA or 4–20 mA	1 × 0–20 mA or 4–20 mA
Relays	2	4	4
Summation	2 signals	3 signals	4 signals

Specifications

LMU

INPUT CHARACTERISTICS		
Power Supply		
Voltage	• 115–230 VAC and 20–32 VDC jumper selectable • 48 VAC fixed	
Maximum Current	Current	Fuse rating
	70 mA for 230 VAC	80 mAT
	150 mA for 115 VAC	160 mAT
	250 mA for 20 VDC	400 mAT
	350 mA for 48 VAC	400 mAT
Bridge signal		
Supply Voltage	10 VDC	
Max. Possible Current	140 mA DC	
Sensitivity	0.5 to 4 mV/V	
Max. Dynamic Component of Bridge Signal	±45 mVDC	
Max. Common Mode Voltage on Input	±10 V	
Voltage Input for Summation of Another Load		
Input Impedance	70 kΩ	
Max. Input Signal (dynamic)	±10 V	
Signal Division by 2	DIP-switch selectable	
Use Without Transducer	Jumper selectable	
Input for Auto-diagnostic Feature (OK I/P)		
Type	Active if short circuited	

OUTPUT CHARACTERISTICS	
Relay Outputs	
Number of Relays	LMU 212: 2 LMU 217: 4 (2 per input) LMU 216: 4
Relay Behavior	Configurable with DIP-switch
Max. Current per Contact	4 A at 250 V AC 3 A at 30 V (0,5 A at 48 V DC)
Max. Voltage per Contact	AC : 250 V_{eff} DC : 48 VDC
Contact Rating	90 W or 1000 VA
Insulation Voltage	Contact-contact: 750 V_{eff} Contact-coil: 1.5 kV_{eff}
Lifetime	min. 10^5 (at 4 A, 250 V AC) 10^8 (unloaded)
Contact Resistance	< 20 mΩ
Current Output	
Output Type	Current generator
Nominal Current Range	0 to 20 mA DC
Max. Current Range	0 to 25 mA DC
Max. Load	< 500 Ω for I_{max} = 20 mA
Output Impedance	> 50 kΩ
Voltage Output	
Max. Dynamics	±10 V ≡ EM
Max. Load	≥10 kΩ (ε≤0.5%) [≥1 kΩ (ε≤5%)] *
Output Impedance	50 Ω (in series)
Output for Auto-diagnostic Feature (OK O/P)	
Type	Open collector

TRANSFER CHARACTERISTICS

Voltage Transfer Ranges ($\Delta U_{I/P}$ / $\Delta U_{O/P}$)

Range	1	2	3
Bridge Sensitivity [mV/V]	0.42 to 0.78 (0.6)	0.7 to 1.3 (1)	1.2 to 2.2 (1.7)
Voltage Transfer (gain)	2380 to 1280 (1670)	1428 to 769 (1000)	833 to 455 (588)
Adjustment Range	±30%	±30%	±30%

Range Selection	Selectable using DIP-switches
Signal Division by 2	DIP-switch selectable (the available sensitivities then moves from 0.84 to 4.4 mV/V according to the selected range)
Measuring Chain Zero Adjustment	Coarse adjustment using multi-turn potentiometer: equivalent to ±10 V/output for range 3 Fine adjustment using multi-turn potentiometer: 5% of the coarse adjustment
Temperature drift of the transfer function	≤ 200 ppm/°C
Temperature drift of the measuring chain zero value	≤ 200 ppm of FSD/°C for 0.5 mV/V at the input ≡ ≤1 µV/°C
Current transfer range	
Sensitivity Range with Multi-turn Potentiometer	± 20% of FSD on $U_{O/P}$
Nominal Current Range	0 to 20 mA DC
Max. Current Range	0 to 25 mA DC
Zero Adjustment Range	± 5 mA DC for $I_{O/P}$ ≥ 5 mA DC
Selectable low-pass filter	
Filter Type	Butterworth
Filter Order	2
-3 dB Cut-off Frequency	Selectable using DIP-switches (0.3 Hz, 1 Hz, 3 Hz, 10 Hz, 100 Hz)
Level detectors	
Number of Detectors	1 per relay
Level Adjustment Range	-10 to +10 VDC using multi-turn potentiometer (measured on voltage output)
Hysteresis	<0.5% or ≈ 5% (DIP-switch selectable)
Detection Indication	< or > (DIP-switch selectable)
Switching Delay	
Delay Adjustment Range	0.01 to 4.25 seconds (adjustment for every relay by multi-turn potentiometer)

** NOTE: To guarantee precise calibration, the impedance of the connected unit must be indicated at time of order. If this value is unknown, an impedance of 1 MΩ will be used for calibration. The resulting deviation will be ≤5% with an impedance of ≥2 kΩ or ≤1% with ≥10 kΩ.*

Specifications

LMU

TRANSFER CHARACTERISTICS (cont.)
Application selection
Output specific application:

REL1 det.	REL2 det.	$U_{O/P}$	$I_{O/P}$
A, B or A+B	A, B or A+B	A, B or A+B	A, B or A+B

A = bride signal; B = voltage input

MECHANICAL CHARACTERISTICS	
Housing	
Material	Aluminum
Stuffing glands	
Type and number	LMU 212: 3 × PG 11 LMU 216 and 217: 6 × PG 11
Material	Nickel-plated brass
Terminal strip	
Type	MK8 (screw and connection at 45°)
Max. Area of Connecting Wire	AWG 20 to 16 Cross section: 0.5 to 1.5 mm² (0.00077 to 0.0023 in²)

ENVIRONMENTAL CHARACTERISTICS	
Operating Temperature	-40° C to +80° C
Storage Temperature	-45° C to +85° C
Protection Class	IP 65
Vibration and Shock	According to IEC 68.2
EMC	According to EN 61326-1 and EN 61326-2-3

SAFETY CHARACTERISTICS	
B.I.T.E. test signal *(Built In Test Equipment)*	
Signal type	Load simulation on request (calibrated during the installation)
Control	Logic signal, active low, CMOS/TTL compatible
Reliability	
MTBF	> 1,500,000 hours

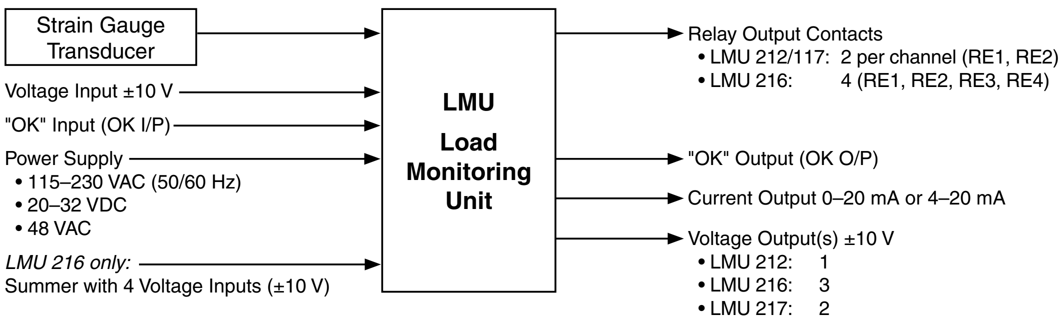
ADDITIONAL LMU 216 FUNCTIONS

SUMMER	
Number of Inputs	4 (UA, UB, UC and UD)
Input Voltage	±10 V
Output Voltage	UE1 = (UA + UB ± UC ± UD)X X adjustable between 0.25 and 10
LATCHING	
Control	Using DIP-switches
Reset Signal	RESET REL3, RESET REL4

CALIBRATION CIRCUIT	
Principle	Volatile* digital memory at 12 bits (memory reset at startup), the stored digital value is substracted from the input signal after D/A conversion * *Current interruptions lasting for less than 30 ms do not lead to the loss of the stored calibration value*
Resolution	1/4096 of the selected range
Storing Time	< 2 s
Output Impedence	< 200 Ω
Acceptable Load Resistance	≤ 20 kΩ

BASIC CONFIGURATION

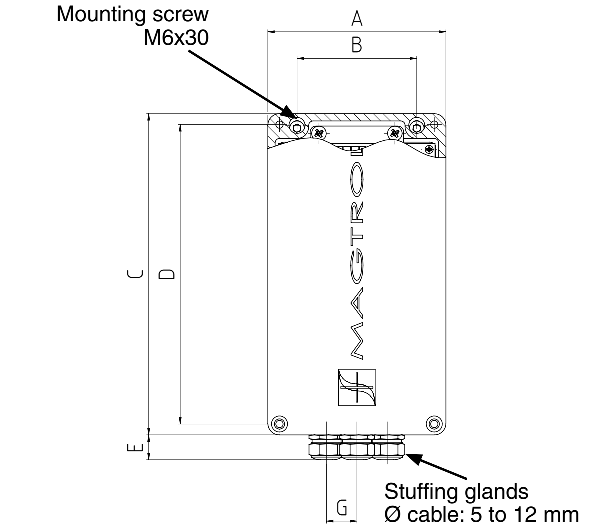
The LMU Load Monitoring Unit offers unlimited configuration possibilities. It is impossible to list them all in this data sheet. Please contact Magtrol or one of its subsidiaries or sales agents to discuss your specific applications.



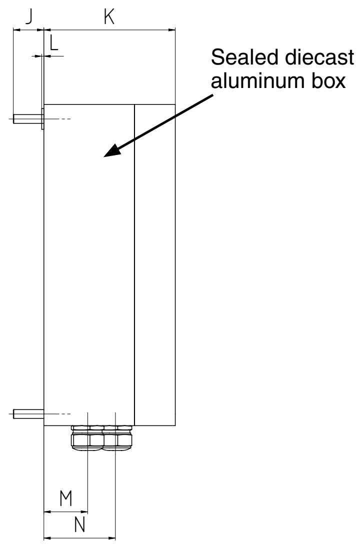
Dimensions

LMU

LMU 212



OVERHEAD VIEW

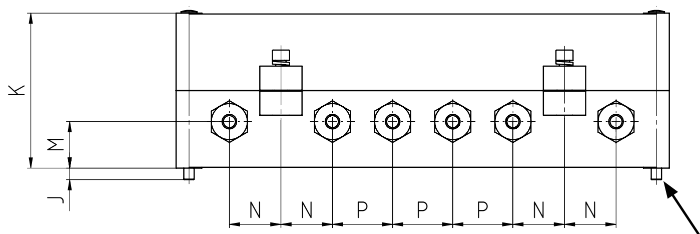


SIDE VIEW

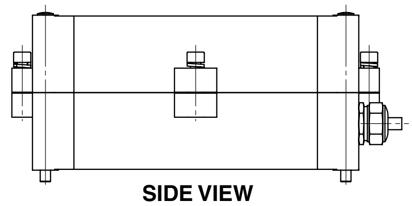
	mm
A	122
B	82
C	220
D	204
E	≈16
G	20.75
J	13.4
K	90
L	≈1.5
M	28
N	47

Model	**Weight**
LMU 212	2 kg

LMU 216 AND LMU 217

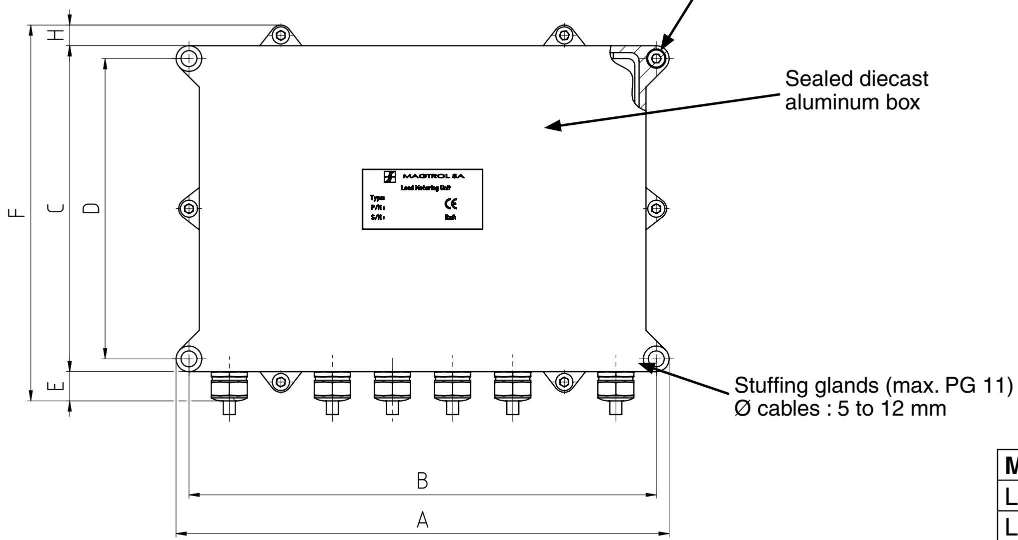


FRONT VIEW



SIDE VIEW

Mounting screw
M6x30



OVERHEAD VIEW

	mm
A	287
B	272
C	190
D	175
E	≈18
F	≈220
H	12
J	10
K	90
M	27
N	30
P	35

Model	**Weight**
LMU 216	4 kg
LMU 217	3.750 kg

Ordering Information

LMU

ORDERING INFORMATION

LOAD MONITORING UNIT P/N 224 - □□□-000-□□□□

Model
- LMU 212 (1 input) — 212
- LMU 216 (1 input) — 216
- LMU 217 (2 inputs) — 217

Supply
- 115–230 VAC (50/60 Hz) or 20–32 VDC — 0
- 48 VAC (50/60 Hz) — 4

Balancing comparator option *(only for LMU 216)*

LMU 216:
- No — 11
- Yes — 61

LMU 212:
- No (not available) — 11

LMU 217:
- No (not available) — 11

Configurated and calibrated?
- No (standard) — *(blank)*
- Yes (according to application and Magtrol Configuration and Calibration Protocol) — C

Due to the continual development of our products, we reserve the right to modify specifications without forewarning.

www.magtrol.com

MAGTROL INC
70 Gardenville Parkway
Buffalo, New York 14224 USA
Phone: +1 716 668 5555
Fax: +1 716 668 8705
E-mail: magtrol@magtrol.com

MAGTROL SA
Centre technologique Montena
1728 Rossens/Fribourg, Switzerland
Phone: +41 (0)26 407 3000
Fax: +41 (0)26 407 3001
E-mail: magtrol@magtrol.ch

Subsidiaries in:
Great Britain
Germany • France
China • India
Worldwide Network
of Sales Agents

ISO 9001 BUREAU VERITAS Certification

LMU-US 04/10

2. Installation / Configuration

2.1 GENERAL INFORMATION

It is essential to follow and apply the installation and configuration procedure described in this chapter to avoid any perturbation of the measuring signal processed by an incorrectly installed LMU 216.

☞ Note : The procedures described in this chapter do not cover all mounting and connection possibilities. However, they can be used as a guide for further customer specific applications. In case of doubt, the user should not hesitate to contact Magtrol's customer service to find a solution offering the best guaranty for optimal measuring accuracy.

2.2 INSTALLATION OF THE LMU 216 LOAD MONITORING UNIT

☞ Note : For optimal operation, the load monitoring unit should be run at temperatures between -40° C and +80° C.

Proceed as described in the following points to mount and connect a LMU 216 :

1. Select a suitable mounting place free of vibrations. An instrument support, for instance, offers excellent results.
2. Trace the location of the 4 screw taps on the mounting surface.
3. Drill and tap the 4 holes for the M6 mounting screws. The taps' depth must be approximately 15 mm.
4. Remove the cover of the load monitoring housing. The LMU 216 cover is fixed with 6 screws (see *figure 2-1*).
5. Position the housing on the mounting surface and fasten the 4 M6 x 30 mounting screws by applying a fastening torque corresponding to the type of screw used.
6. Configure and calibrate the load monitoring unit if not already done according to the procedure described in this chapter.
7. Carry out the necessary electrical connection and make sure that the housing stuffing glands are water-tight.
8. Insert a copy of the calibration protocol (see Appendix A) into the load monitoring unit housing before placing the cover back onto the housing and fastening its screws.

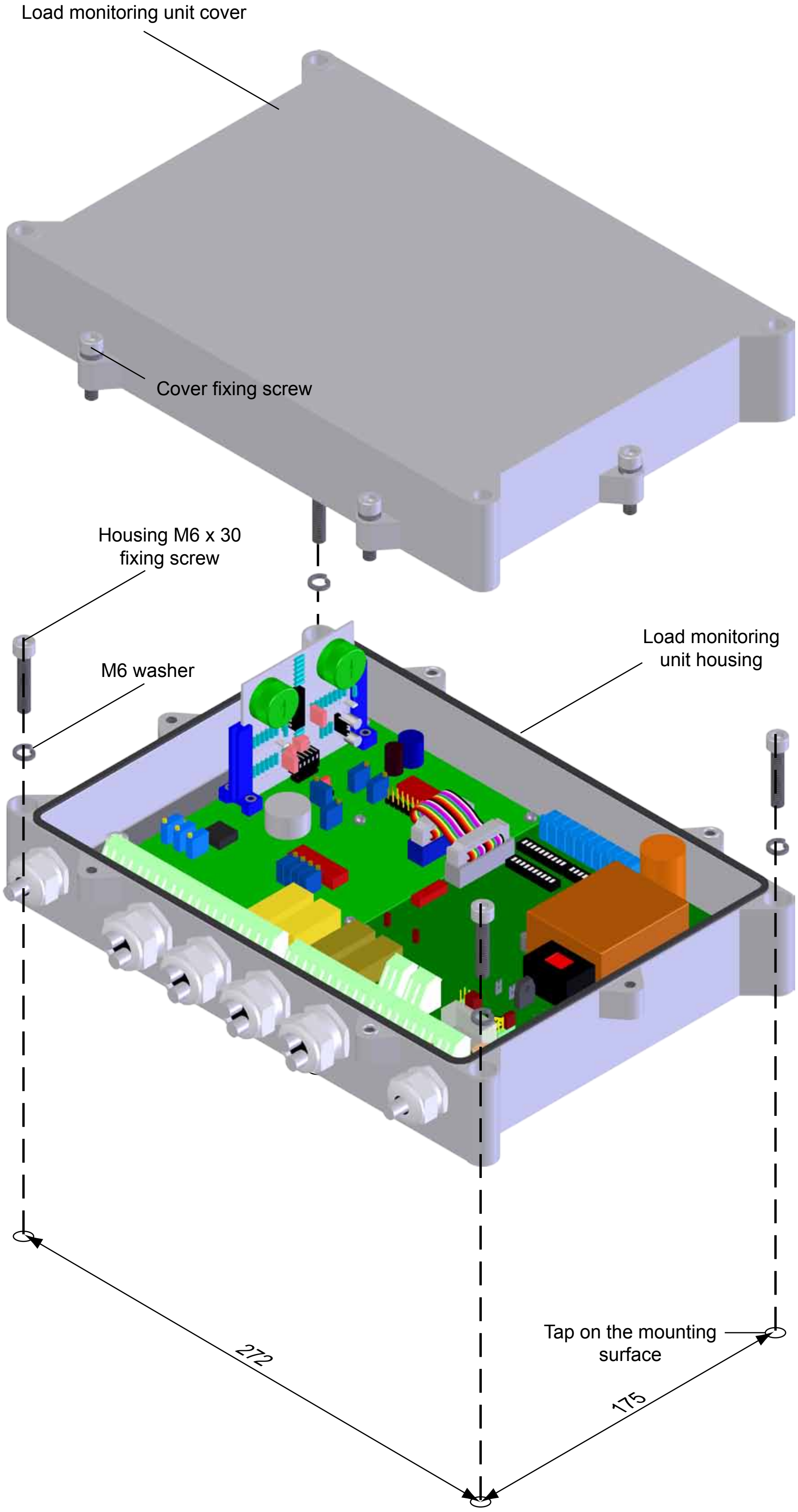


Fig. 2–1 Installation of the LMU 216 load monitoring unit

2.3 CONNECTION OF THE LMU 216 LOAD MONITORING UNIT

The LMU 216 load monitoring unit is fitted with stuffing glands maintaining the connection cables and securing the tightness of the unit's housing. To pass the cables through the stuffing glands simply apply the following procedure :

1. Uninsulate the conductors of the different cables.
2. Remove the housing cover after having unscrewed the fixing screws.
3. Pass the cables through the stuffing glands as shown on *figure 2–2* :
   a. Unscrew the hex nut ① by rotating it counterclockwise. The main body of the stuffing gland ⑤ should not be removed from the unit's housing.
   b. Extract the internal ② and external gasket ③ from the hex nut ①. Both gaskets are used to compensate for the different cable diameters. Push the internal gasket ② to extract it from the external gasket ③.
   c. Pass the cable through the hex nut ①, the internal gasket ② (when used), the external gasket ③, the sealing ring ④ and the main body ⑤.
   d. Reassemble the stuffing gland and coat the front part of the external gasket ③ with silicone (see *figure 2–3)* before screwing the hex nut ① onto the main body ⑤. Tighten the hex nut ① in such a way that the internal gasket ② and/or the external gasket ③ protrudes, so as to provide the degree of watertightness required.
   e. Ensure also that the cable is held firmly in the stuffing gland.

CAUTION : DO NOT DAMAGE THE GASKETS WITH CUTTING OBJECTS. CHECK THAT NO FOREIGN BODIES HAVE SLID BETWEEN THE ELEMENTS OF THE STUFFING GLAND. DEGREASE THE SURFACE OF THE CABLE WHICH WILL COME INTO CONTACT WITH THE GASKET. THE SEAL OF THE STUFFING GLAND CANNOT BE GUARANTIED IF THESE INSTRUCTIONS ARE NOT FOLLOWED.

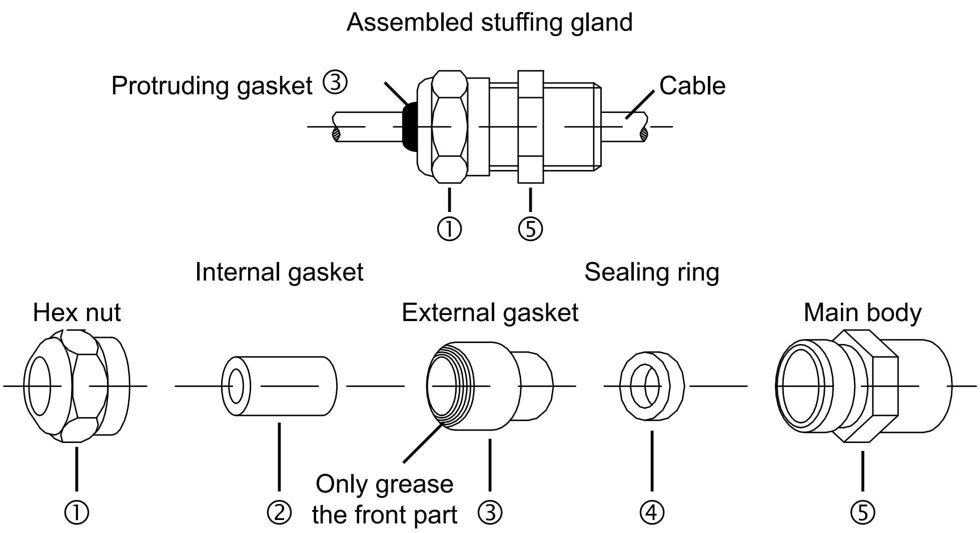


Fig. 2–2 Stuffing gland (overall and exploded view)

4. Connect the conductors of the various cables to the load monitoring unit terminals.
5. Put the cover back on the load monitoring unit and tighten up its six screws.

2.4 CONFIGURATION OF THE LOAD MONITORING UNIT

Note :	The asterisks (✫) correspond to the standard configuration of the LMU 216 version 02X, that is to say the basic uncalibrated modules.

The configuration of the LMU 216 load monitoring unit includes all start-up operations which are necessary to achieve a trouble free operation. This ranges from the supply voltage to the selection of the application, the sensor connection, the energising mode of the relays and their delay time, the selection of the pass-band and the sensor sensitivity and the use of the summer. As a reminder: the LMU 216 is composed of one LMU 212 and a control module.

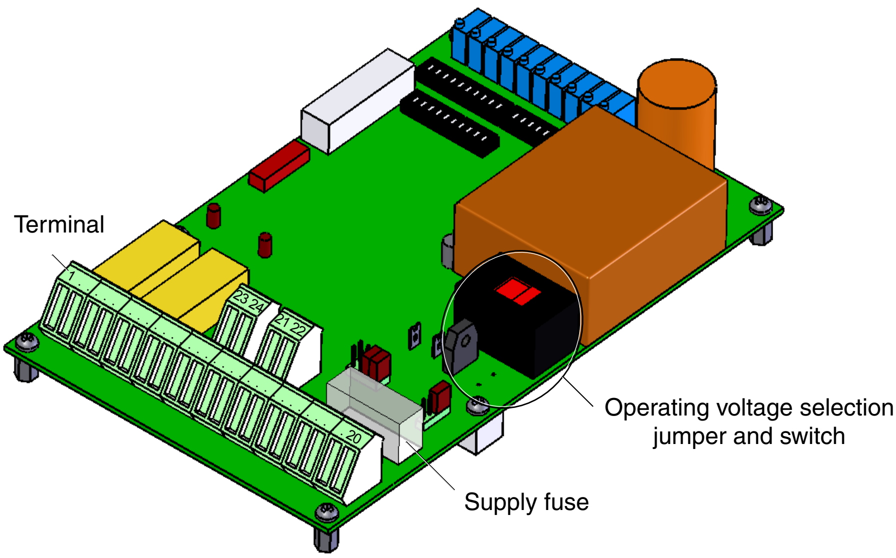
2.4.1 Adaptation of the monitor to the available supply unit

2.4.1.1 Supply voltage

Before connecting the LMU 216 load monitoring unit, select its operating voltage by correctly positioning the jumper (DC or AC voltage) and then, in case of an AC supply, choosing the correct voltage by means of the switch. Finally choose the supply fuse rating.

WARNING!	**THE MONITORING UNIT CAN BE SERIOUSLY DAMAGED IF NOT DESTROYED, IF THIS ADVICE IS NOT FOLLOWED.**

The information given in *figures 2–3* to *2–5* and in the table on the next page allows the user to select the operating voltage of the load monitoring unit, to choose the supply fuse and to assign the supply terminals.



1. Place the jumper according to the selected supply mode (see *figure 2–4*) :

   - 'DC' for a DC type supply with a voltage between 20 and 32 VDC

   - 'AC' for an AC type supply (230 VAC, 115 VAC or 48 VAC)

2. In case of an AC supply position the switch on (see *figure 2–4*) :

   - '230 V' for an AC voltage of 230 VAC

   - '115 V' for an AC voltage of 115 VAC

   for operating voltages of 48 VAC or 20 to 32 VDC the position of the switch is irrelevant.

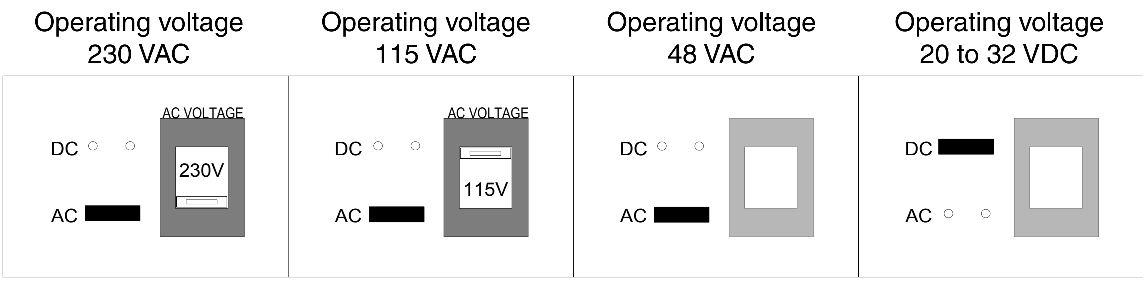


Fig. 2–4 Jumper and switch configuration

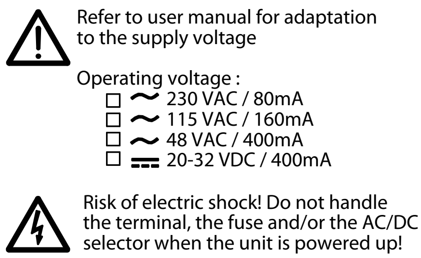
3. Check the rating of the fuse inserted in its support according to the following table:

Operating voltage	Supply terminals			Fuse	Switch
	0 V (18)	N (19)	P (20)		
☆ 230 VAC	earth	neutral	phase	80 mAT	230 V
115 VAC	earth	neutral	phase	160 mAT	115 V
48 VAC	earth	neutral	phase	400 mAT	irrelevant
20-32 VDC	0 V	—	20-32 V	400 mAT	irrelevant

A fuse of each rating is supplied with each load monitoring unit.

WARNING! **SWITCH OFF THE SUPPLY BEFORE WIRING THE LMU. FOR SAFETY REASONS IT IS IMPORTANT TO SECURE THE STABILITY OF THE SUPPLY UNIT USED AND RESPECT THE OPERATING VOLTAGE SELECTED ON THE LMU.**

Note : Do not forget to report the designation of the collected external signals connected to the supply terminal on the configuration and calibration form (see *Appendix A*). Also check off the sticker placed inside of the cover to specify the voltage to which the unit is configured.



4. When using a 230 VAC, 115 VAC or 48 VAC supply always connect the LMU to the ground as shown on *figure 2–5* :

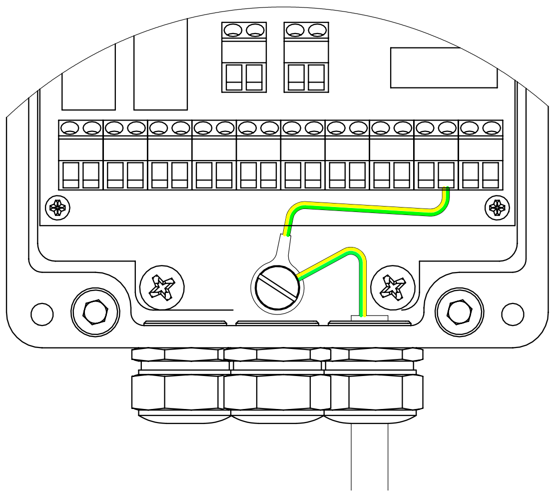


Fig. 2–5 LMU grounding when using a 230, 115 or 48 VAC supply

Connect the earth wire to the ground screw and the LMU terminal no. 18 to the ground screw.

WARNING! WHEN USING A 48 / 115 / 230 VAC SUPPLY ALWAYS MAKE SURE THAT THE LMU HOUSING IS ADEQUATELY CONNECTED TO THE GROUND!

2.4.2 Selection of the type of wiring to the strain gauge

The choice of the type of wiring depends on the length of the cable between the LMU and the strain gauge transducer, on the impedance of the transducer and the linear resistance of the cable.

If the linear resistance of the cable is ≤0,1 Ω/m, the impedance of the strain gauge transducer is ≥200 Ω and the length of the cable is ≤100 m, the wiring of type 1 can be selected (see *figure 2–6*).

The wiring of the type 2 of *figure 2–6* applies to cable lengths of more then 100 m or when the cable length has been changed after the calibration of the load monitoring unit.

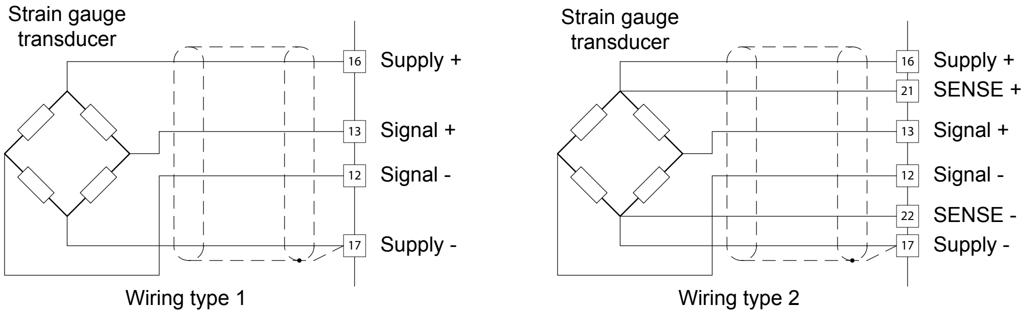


Fig. 2–6 Types of wiring

For applications in conformity with the TÜV standard detecting short-circuits and/or failure of a conductor in the connecting cable is compulsory. In this case no signal must be sent on terminals 21 (SENSE+) and 22 (SENSE-).

Note :	Record the length of the cable between the transducer and the LMU as well as its type on the configuration and calibration form (see *Appendix A*).

2.4.3 Designation of the voltage and current inputs/outputs

The LMU 216 load monitoring unit is fitted with one voltage input ($U_{I/P}$) on the LMU 212 module and also for voltage inputs $U_{AI/P}$, $U_{BI/P}$, $U_{CI/P}$ and $U_{DI/P}$ on the summer of the control module.

The main voltage input for instance allows to collect the voltage generated by another LMU type load monitoring unit.

The summer voltage input is used to directly add voltages generated by up to four load monitoring units. In this case, it is important no to saturate the LMU 216 having a dynamic range of ±10 V. For this reason the summer output is fitted with an amplifier damping the summing result.

The LMU 216 also owns four outputs, two of which are main outputs, one voltage and one current output on the LMU 212 module ($U_{O/P}$ and $I_{O/P}$), as well as two voltage outputs on the control module ($TARING_{O/P}$ and $U_{EO/P}$).

The main voltage output ($U_{O/P}$) delivers the conditioned signal supplied by the load measuring pin connected to the load monitoring unit. According to the jumper position, the current output ($I_{O/P}$) delivers either the conditioned and current-converted signal supplied by the load measuring pin, or the current-converted signal corresponding to the net or the gross load.

The signals on the control module voltage outputs correspond to the net load ($TARING_{O/P}$) and to the sum of the gross loads ($U_{EO/P}$).

☞ Note : Record the designation of the external signals linked with $U_{I/P}$, $U_{AI/P}$, $U_{BI/P}$, $U_{CI/P}$ and $U_{DI/P}$, as well as $U_{O/P}$, $I_{O/P}$, $TARING_{O/P}$ and $U_{EO/P}$ on the configuration and calibration form (see *Appendix A*).

2.4.4 Configuration of the detection chains

The load monitoring unit relays are used to detect under- and overloads. In case of an overload, the relay is de-energised when the output voltage $U_{O/P}$ is lower than the threshold voltage U_{level}. In case of an underload the output voltage must be higher than the threshold voltage to de-energise the relay. We shall come back to the adjustment of the threshold voltage when calibrating the load monitoring unit.

2.4.4.1 Detection chain for relay 1 (REL1)

Figure 2–7 indicates the location of the SWA micro-switches on the load monitoring unit board.

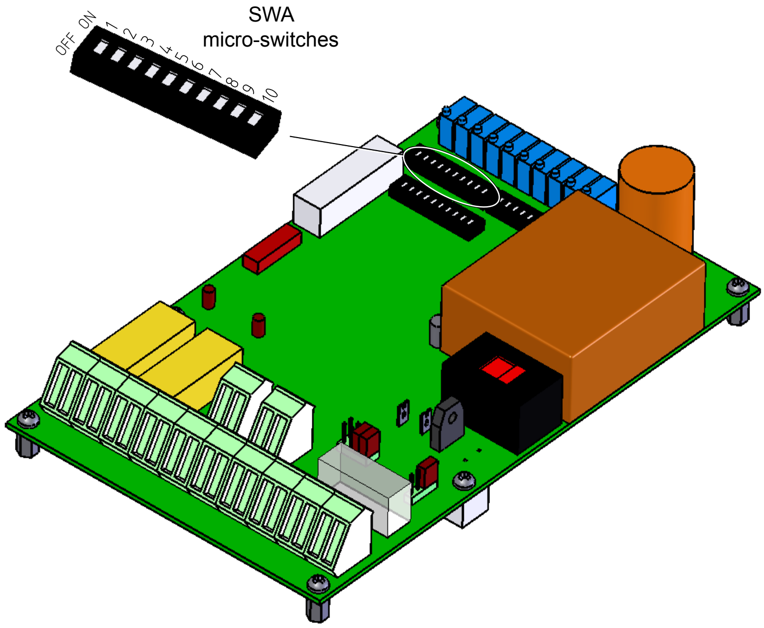


Fig. 2–7 Location of the SWA micro-switches

The following table allows the user to select the energising mode and the hysteresis value for the relay REL1.

	Condition	Configuration			Effect
		SWA4	SWA5	SWA6	
	REL1 de-energised for $F < F_{level1}$	ON	OFF	—	Detection for $U_{O/P} < U_{level1}$
☆	REL1 de-energised for $F > F_{level1}$	OFF	ON	—	Detection for $U_{O/P} > U_{level1}$
☆	Hysteresis < 0.5%	—	—	OFF	Hysteresis < 50 mV measured on $U_{O/P}$
	Hysteresis ≈ 5% (FSD)	—	—	ON	Hysteresis ≈ 500 mV measured on $U_{O/P}$

☞ Note : Record the value F_{level1} and the configuration of the micro-switches SWA4, SWA5 and SWA6 on the configuration and calibration form (see *Appendix A*).

This table allows the user to select the configuration of the micro-switches according to the state of the relay REL1.

State of relay REL1	Contact REL1A - REL1C	Contact REL1A - REL1B
REL1 energised	Closed	Open
REL1 de-energised	Open	Closed

The relay REL1 also operates as a line check relay and is de-energised in case of short-circuit or line failure.

☞ Note : Record the designation of the external signals linked to REL1A, REL1B and REL1C on the configuration and calibration form (see *Appendix A*).

2.4.4.2 Detection chain for relay 2 (REL2)

Figure 2–7 on the previous page indicates the location of the SWA micro-switches on the load monitoring unit board. The following table allows the user to select the energising mode and the hysteresis value for the relay REL2.

	Condition	Configuration			Effect
		SWA7	SWA8	SWA9	
☆	REL2 de-energised for $F < F_{level2}$	ON	OFF	—	Detection for $U_{O/P} < U_{level2}$
	REL2 de-energised for $F > F_{level2}$	OFF	ON	—	Detection for $U_{O/P} > U_{level2}$
☆	Hysteresis < 0.5%	—	—	OFF	Hysteresis < 50 mV measured on $U_{O/P}$
	Hysteresis ≈ 5% (FSD)	—	—	ON	Hysteresis ≈ 500 mV measured on $U_{O/P}$

☞ Note : Record the value F_{level2} and the configuration of the micro-switches SWA7, SWA8 and SWA9 on the configuration and calibration form (see *Appendix A*).

This table allows the user to select the configuration of the micro-switches according to the state of the relay REL2.

State of relay REL2	**Contact REL2A – REL2C**	**Contact REL2A – REL2B**
REL2 energised	Closed	Open
REL2 de-energised	Open	Closed

The relay REL2 also operates as a line check relay and is de-energised in case of short-circuit or line failure.

☞ Note : Record the designation of the external signals linked to REL2A, REL2B and REL2C on the configuration and calibration form (see *Appendix A*).

2.4.4.3 Detection chain for relay 3 (REL3)

Figure 2–8 indicates the location of the SWE micro-switches on the load monitoring unit board.

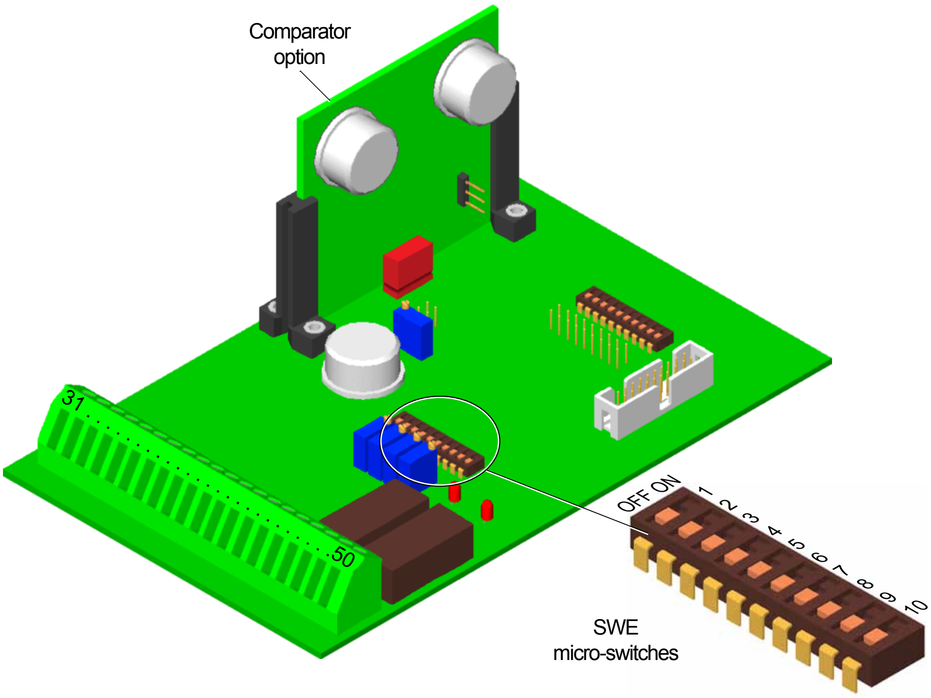


Fig. 2–8 Location of the SWE micro-switches

The following table allows the user to select the energising mode and the hysteresis value for the relay REL3.

	Condition	Configuration				Effect
		SWE7	SWE8	SWE9	SWE10	
☆	REL3 de-energised for $F < F_{level3}$	—	OFF	ON	—	Detection for $U_{O/P} < U_{level3}$
	REL3 de-energised for $F > F_{level3}$	—	ON	OFF	—	Detection for $U_{O/P} > U_{level3}$
☆	Hysteresis < 0.5%	—	—	—	OFF	Hysteresis < 50 mV measured on $U_{O/P}$
	Hysteresis ≈ 5% (FSD)	—	—	—	ON	Hysteresis ≈ 500 mV measured on $U_{O/P}$
☆	No latching	OFF	—	—	—	Relay switching after the alarm has gone off
	Latching	ON	—	—	—	No relay switching after the alarm has gone off

☞ Note : Record the value F_{level3} and the configuration of the micro-switches SWE7, SWE8, SWE9 and SWE10 on the configuration and calibration form (see *Appendix A*).

This table allows the user to select the configuration of the micro-switches according to the state of the relay REL3.

State of relay REL3	Contact REL3A – REL3C	Contact REL3A – REL3B
REL3 energised	Closed	Open
REL3 de-energised	Open	Closed

☞ Note : Record the designation of the external signals linked to REL3A, REL3B and REL3C on the configuration and calibration form (see *Appendix A*).

☆

2.4.4.4 Detection chain for relay 3 (REL4)

Figure 2–8 indicates the location of the SWE micro-switches on the load monitoring unit board. The following table allows the user to select the energising mode and the hysteresis value for the relay REL4.

	Condition	Configuration				Effect
		SWE3	SWE4	SWE5	SWE6	
☆	REL4 de-energised for $F < F_{level4}$	—	OFF	ON	—	Detection for $U_{O/P} < U_{level4}$
	REL4 de-energised for $F > F_{level4}$	—	ON	OFF	—	Detection for $U_{O/P} > U_{level4}$
☆	Hysteresis < 0.5%	—	—	—	OFF	Hysteresis < 50 mV measured on $U_{O/P}$
	Hysteresis ≈ 5% (FSD)	—	—	—	ON	Hysteresis ≈ 500 mV measured on $U_{O/P}$
☆	No latching	OFF	—	—	—	Relay switching after the alarm has gone off
	Latching	ON	—	—	—	No relay switching after the alarm has gone off

☞ Note : Record the value F_{level4} and the configuration of the micro-switches SWE3, SWE4 and SWE5, SWE6 on the configuration and calibration form (see *Appendix A*).

This table allows the user to select the configuration of the micro-switches according to the state of the relay REL4.

State of relay REL4	Contact REL4A – REL4C	Contact REL4A – REL4B
REL4 energised	Closed	Open
REL4 de-energised	Open	Closed

☞ Note : Record the designation of the external signals linked to REL4A, REL4B et REL4C on the configuration and calibration form (see *Appendix A*).

2.4.4.5 Adjusting the switching delay

The switching delay corresponds to the time passing between the moment when the detection level is reached at the voltage output of the LMU ($U_{O/P}$) and the moment when the relay is de-energized (see *figure 2–9*). On the other hand, the switching delay on tripping of the relay is instantaneous.

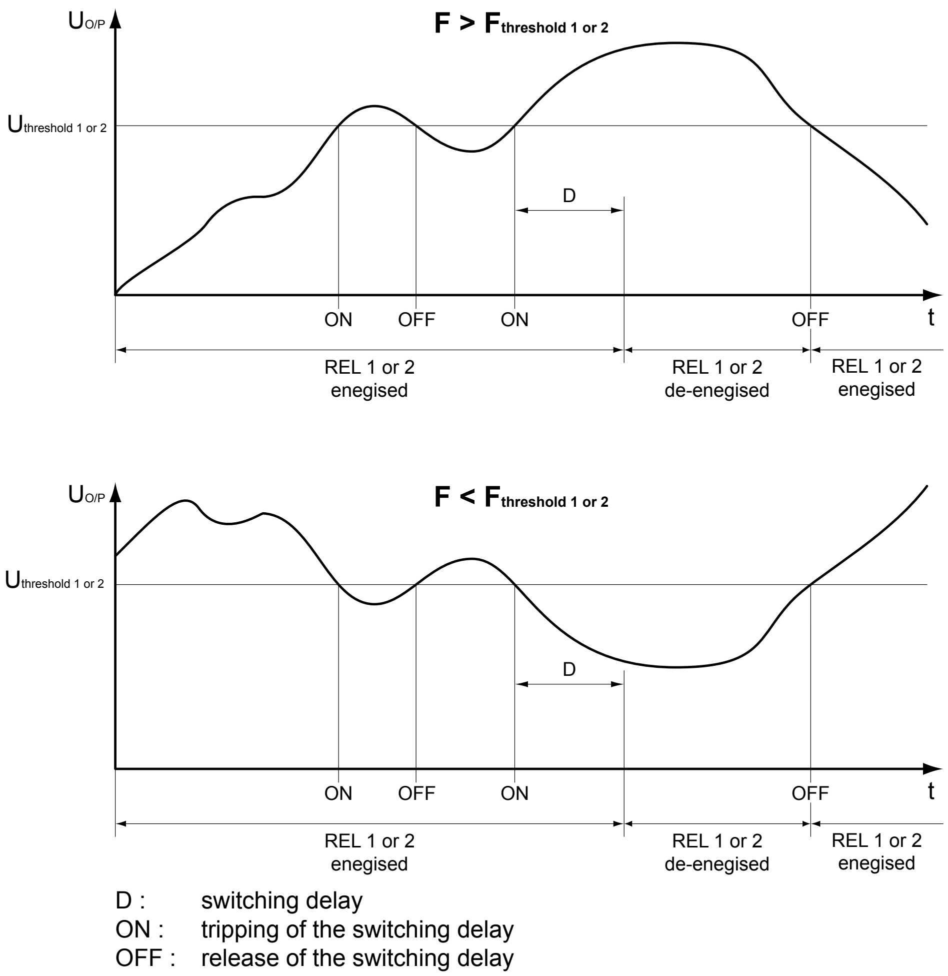


Fig. 2–9 Examples of switching delays

To set the switching delay to be applied on relays REL1, REL2, REL3 and REL4, adjust potentiometer P1, P2, P13 and P15. *Figure 2–10 and 2–11* show the user where the potentiometers are located on the LMU 216 load monitoring unit board.

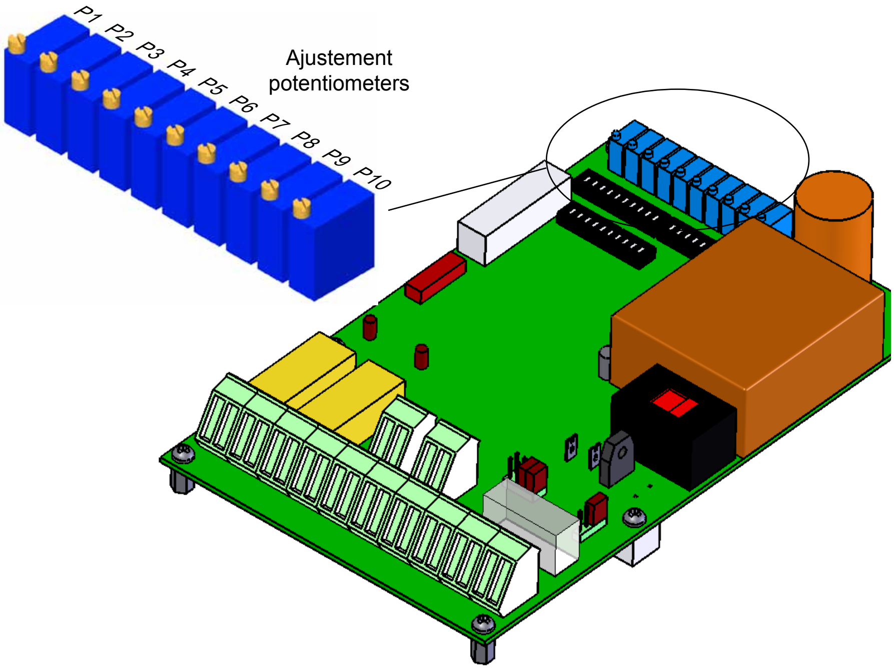


Fig. 2–10 Potentiometer location on the load monitoring unit board (P1 to P10)

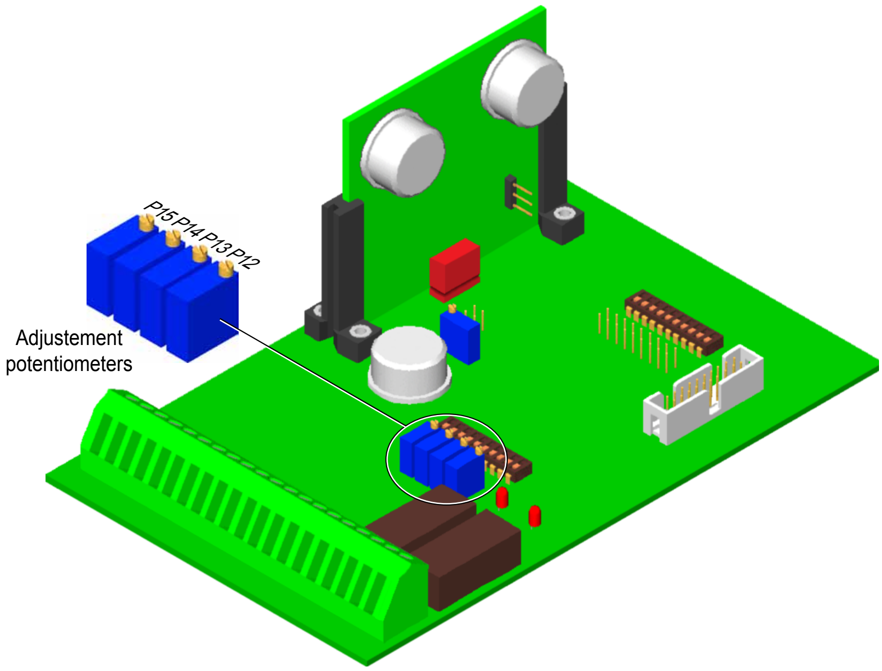


Fig. 2–11 Potentiometer location on the load monitoring unit board (P12 to P15)

The switching delays D1, D2, D3 and D4 are applied to the relays REL1, REL2, REL3 and REL4. The method of adjustment is as follows :

To determine the switching delay value, calculate the number of turns to be applied to the potentiometers using the following formula :

$$N = \frac{D - 0{,}01}{0{,}170}$$

Avec N = number of turns to be applied to the potentiometer.

D = switching delay required for the relay in seconds.

D_{min} = 0,01 s

D_{max} = 4,25 s

Apply the calculated number of turns (N) by counting them starting at 0 (the potentiometer at its limit stop in the anti-clockwise sense) and by turning the potentiometer clockwise.

To reach the limit stop, make more than 30 turns anti-clockwise.

Note : Record the switching values of D1, D2, D3 and D4 on the configuration and calibration form (see *Appendix A*).

2.4.5 Selection of the pass band

Figure 2–12 indicates the location of the SWB micro-switches on the LMU 212 load monitoring unit board.

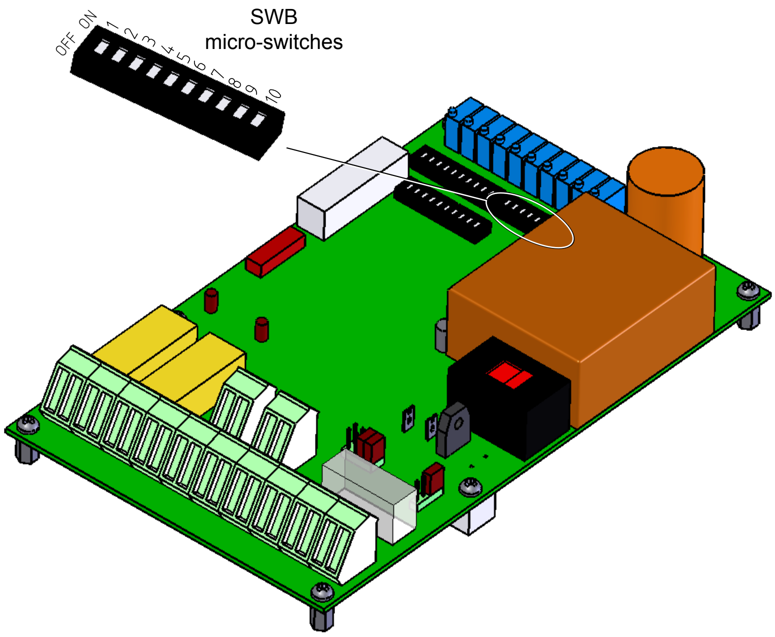


Fig. 2–12 Location of the SWB micro-switches on the load monitoring unit board

The following table allows the user to select the pass band of the output signal.

	f_C frequency range	SWB1	SWB2	SWB3	SWB4	SWB5	SWB6	SWB7	SWB8
	DC – 100 Hz	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
☆	DC – 10 Hz	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF
	DC – 3 Hz	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF
	DC – 1 Hz	ON	ON	OFF	OFF	OFF	OFF	OFF	OFF
	DC – 0,3 Hz	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

☞ Note : Record the value of the cut-off frequency f_c and the configuration of the micro-switches SWB1, SWB2, SWB3, SWB4, SWB5, SWB6, SWB7 and SWB8 on the configuration and calibration form (see *Appendix A*).

The SWB7 is used only to calibrate the LMU load monitoring unit.

2.4.6 Selection of the sensitivity range

Figure 2–7 indicates the location of the SWA micro-switches on the load monitoring unit board.

The following table allows the user to select the sensitivity range of the strain gauge transducer.

	Strain gauge sensitivity [mV/V]	SWA1	SWA2	SWB10
	0,42 à 0,78	OFF	OFF	ON
☆	0,7 à 1,3	ON	OFF	ON
	1,2 à 2.2	ON	ON	ON

For strain gauge transducers featuring a higher sensitivity than 2,2 mV/V see chapter 2.4.8

☞ Note : Record the selected strain gauge sensitivity as well as the configuration of the micro-switches SWA1, SWA2 and SWB10 on the configuration and calibration form (see *Appendix A*).

2.4.7 Signal combination on the summer

The LMU 216 can be run on its own or connected to up to three other load monitoring units according to the selected application. In fact, the LMU 216 is fitted with a signal summer issuing the summing result on terminal 32 (U_{E1}). The following table allows the user to select the signals to be added/ subtracted on the summer.

$U_{E1} = (U_A + U_B \pm U_C \pm U_D) \cdot X$			
SWD4	**SWD5**	**SWE1**	**Summation**
OFF	OFF	OFF	U_A+U_B
OFF	OFF	ON	$U_A+U_B-U_D$
OFF	ON	ON	$U_A+U_B-U_C-U_D$
ON	OFF	OFF	$U_A+U_B+U_C$
☆ ON	OFF	ON	$U_A+U_B+U_C-U_D$
ON	ON	OFF	$U_A+U_B+U_C+U_D$

☞ Note : With this option installed, only the last summation configuration is available ($U_A+U_B+U_C+U_D$).

The voltages U_A (terminal 36) and U_B (terminal 35) are added in any case, whereas it is possible to subtract the voltages U_C (terminal 34) and U_D (terminal 33). The result of the summation is sent on the output U_{E1} (terminal 32). *Figure 2–13* shows the location of the SWD micro-switches on the load monitoring control module board. *Figure 2–8* shows the location of the SWE micro-switches.

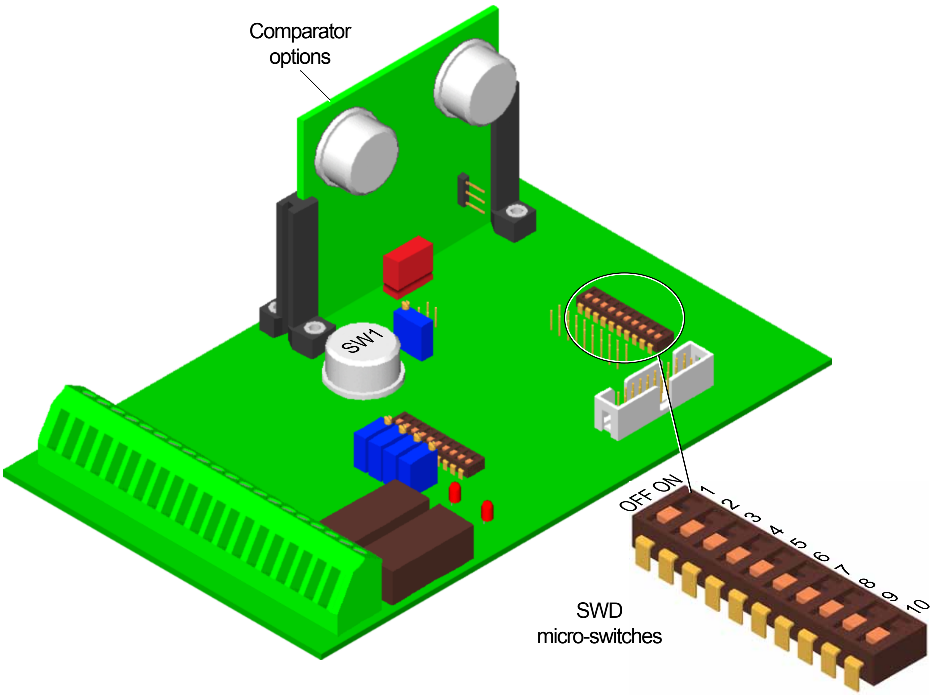


Fig. 2–13 Location of the SWD micro-switches

☞ Note : Record the configuration of the micro-switches SWE1, SWD4 and SWD5 on the configuration and calibration form (see *Appendix A*).

☞ Note : Record the configuration of the micro-switch SW1 on the configuration and calibration form (see *Appendix A*).

2.4.8 DIVISION OF THE TRANSDUCER SIGNAL OR THE INPUT VOLTAGE $U_{I/P}$ BY TWO

The LMU load monitoring unit allows the user to divide the transducer signal or/and the voltage input $U_{I/P}$, by two.

This can for instance happen:

- in the case of an application A + B (with A as the transducer signal and B as the voltage $U_{I/P}$), with the signal at its maximum, the sum will generate an output voltage $U_{O/P}$ exceeding 10 VDC.
- when the transducer signal is too big (between 2 and 4 mV/V), the load monitoring unit gain can be divided by two.

Figure 2–12 indicates the location of the SWB micro-switches on the load monitoring unit board. *Figure 3–2* in chapter 3 indicates the location of the SWC micro-switches.

	Transducer signal (A)	SWB10
	Divided by 2 (:2)	OFF
☆	Full (:1)	ON

	Voltage input $U_{I/P}$ (B)	SWC10
	Divided by 2 (:2)	ON
☆	Full (:1)	OFF

As a reminder: the input signal $U_{I/P}$ must remain within -10 VDC and +10 VDC.

☞ Note : Record the SWB and SWC micro-switch configuration on the configuration and calibration form (see *Appendix A*).

2.4.9 SELECTION OF THE X COEFFICIENT RANGE

The following table allows the user to select the X coefficient range used in the following formula :

$$U_{E1} = (U_A + U_B \pm U_C \pm U_D) \cdot X$$

The load monitoring unit voltage output features a maximum range of ±10 V and 4 voltage signals with a range of ±10 V can be connected to the summer inputs. The X coefficient prevents the saturation of the load monitoring unit by damping the summer output signal.

The fine adjustment of this coefficient will be discussed in the chapter handling the load monitoring unit calibration.

Figure 2–13 on the previous page indicates the location of the SW1 micro-switch on the load monitoring unit board.

SW1	X Coefficient	
Position	Minimum	Maximum

1	4,99	10,5
2	2,49	5,32
3	1,21	2,84
4	0,57	1,31
5	0,24	0,61

☞ Note : Record the SW1 micro-switch configuration on the configuration and calibration form (see *Appendix A*).

3. Calibration

CAUTION : CHAPTER 3.1 AND 3.5 DESCRIBE THE PARAMETRISATION OF THE TRANSDUCER CONNECTED TO THE LMU 212 AS WELL AS THE RELAYS LATCHING LEVELS. ACCORDING TO THE CONFIGURATION, THE EXTERNAL INPUTS (U1I/P, UAI/P, UBI/P, UCI/P , UDI/P) CAN HAVE AN INFLUENCE ON THE OUTPUTS. THEREFORE IT IS NECESSARY TO CHECK THAT THEY ARE DE-ACTIVATED (SEE DIAGRAM IN APPENDIX A) BEFORE POWERING UP AND WIRING THE LMU.

3.1 ZERO ADJUSTMENT ON THE VOLTAGE OUTPUT $U_{O/P}$

The following conditions are required for the zero adjustment on the voltage output :

- No load must be applied on the transducer.
- The micro-switch SWB9 (see *figure 3–3*) must be OFF.
- The micro-switch SWC2 (see *figure 3–2*) must be ON.
- The jumper JP33 must have been removed.

Proceed as follows to carry out the zero adjustment :

1. Connect a digital millivoltmeter between terminals 15 ($U_{O/P}$) and 9 (0 V) of the load monitoring unit.
2. Adjust the potentiometers P6 and P7 to get a reading of 0 V ±10 mV on the millivoltmeter. *Figure 3–1* indicates the location of the potentiometers P1 to P10.

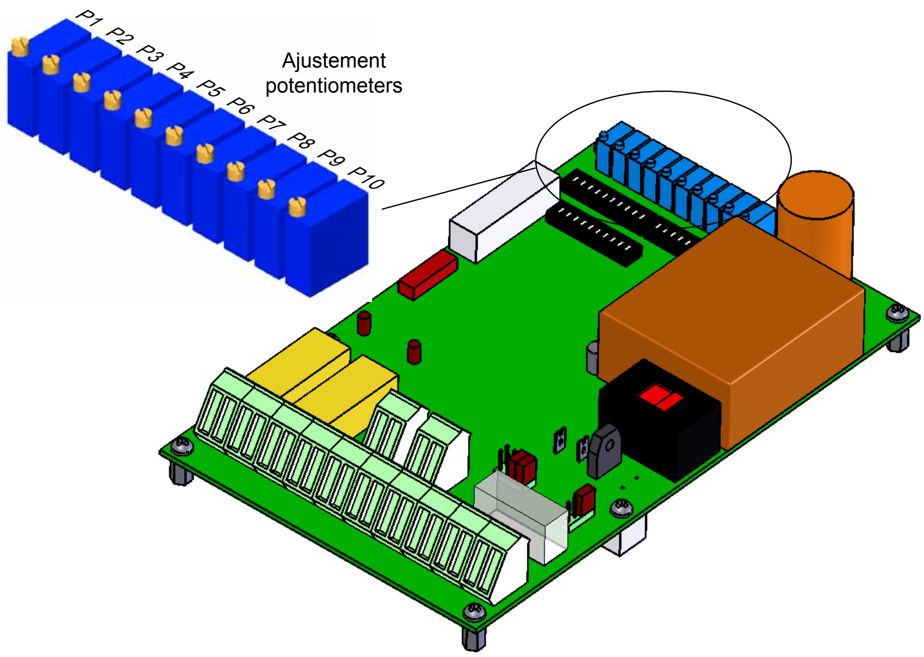


Fig. 3–1 Location of the potentiometers on the load monitoring unit board

3.2 ZERO ADJUSTMENT ON THE CURRENT OUTPUT $I_{O/P}$

The following condition is required to adjust the zero on the current output :

- No load must be applied on the transducer.
- The micro-switch SWC1 (see *figure 3–2*) must be ON.
- The micro-switch SWA10 (see chap 2, *figure 2–7*) must be OFF.
- Make sure that the jumper JP33 has been removed.

In this configuration the current output does not depend on the applied load. This allows the user to carry out an accurate adjustment on the current output.

Proceed as follows to carry out the zero adjustment :

1. Connect a digital milliampermeter between terminals 10 ($I_{O/P}$) and 9 (0 V) of the load monitoring unit.
2. Adjust the potentiometer P8 to get the initial value with an accuracy of ±50 µA, for instance 4 mA ±50 µA, on the milliampermeter. *Figure 3–1* indicates where the potentiometer P8 is located.

3.3 SENSITIVITY ADJUSTMENT ON THE VOLTAGE OUTPUT $U_{O/P}$

To adjust the sensitivity on the voltage output ($U_{O/P}$, terminal 15), carry out the following operations :

1. Apply a known load $F_{known} > ½ \cdot F_{nominal}$ on the transducer :
   $F_{nominal} \sim U_{O/P\ nominal} = 10$ V DC
   $U_{O/P\ known} \sim F_{known}$
2. To determine the rating of the voltage output, carry out the following calculation :

$$U_{O/P\ known} = \frac{10\ V \times F_{known}}{F_{nominal}}$$

3. Make sure that the jumper JP33 has been removed.
4. Connect a numerical milliampermeter between terminals 15 ($U_{O/P}$) and 9 (0 V) of the load monitoring unit.
5. Adjust the potentiometer P4 to get a reading of $U_{O/P\ known}$ with an accuracy of ±10 mV. *Figure 3–1* indicates where the potentiometer P4 is located.

3.4 SENSITIVITY ADJUSTMENT ON THE CURRENT OUTPUT $I_{O/P}$

To adjust the sensitivity on the current output ($I_{O/P}$, terminal 10) maintain the load F_{known} on the transducer. First carry out the procedures described in the *chapters 3.1 and 3.3* and then proceed as follows :

1. To determine the rating of the current output make the following calculation :

$$I_{O/P\ known} = \frac{16\ mA \times F_{known}}{F_{nominal}} + 4\ mA$$

2. Connect a numerical milliampermeter between terminals 10 ($I_{O/P}$) and 9 (0 V) of the load monitoring unit.
3. Position the micro-switch SWA10 and ON so as the current output depends on the applied load.
4. Adjust the potentiometer P10 to get a reading of $I_{O/P\ know}$ with an accuracy of de ±50 µA. *Figure 3–1* indicates where the potentiometer P10 is located.

CAUTION : THE LOAD MONITORING UNIT WILL ONLY BE OPERATIONAL WHEN THE MICRO-SWITCH SWA10 IS ON.

3.5 ADJUSTMENT OF THE DETECTION THRESHOLDS

The following conditions are required to adjust the detection thresholds :

- No load must be applied to the transducer.
- The micro-switch SWB9 (see *figure 3–3*) must be ON to activate the test signal.
- To adjust the detection thresholds U_{level1} and U_{level2} place the micro-switches SWC3 and SWC4 (see *figure 3–2*) on ON.
- Make sure that the jumper JP33 has been removed.
- To adjust the detection thresholds U_{level3} and U_{level4}, connect $U_{O/P\ level3}$ and $U_{O/P\ level4}$ to $U_{O/P}$ and check that the test signal transits through C1 (see Appendix *A*) after having pluged in the jumpers JP37 and JP38. *Figure 3–4* indicates the location of these jumpers.

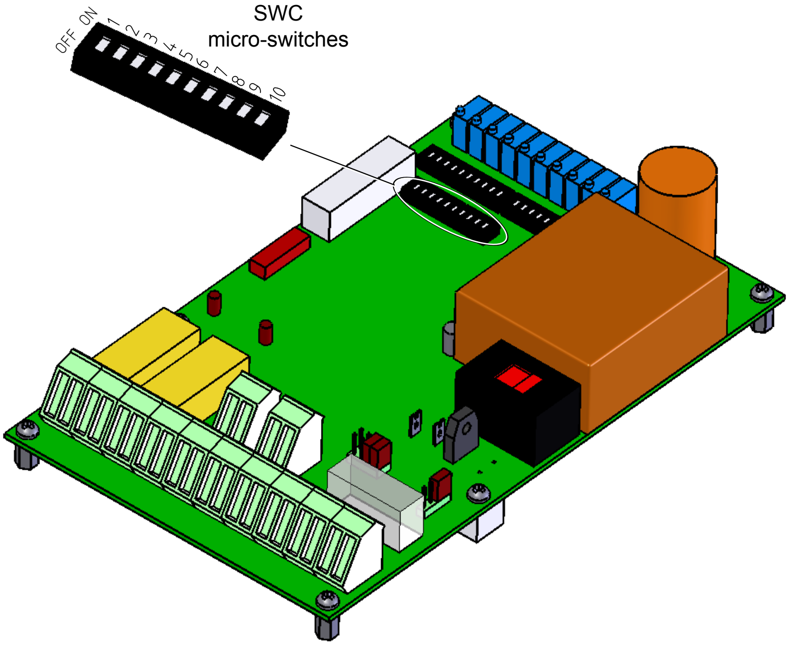


Fig. 3–2 Location of the micro-switches SWC on the load monitoring unit board

Calculate the threshold voltages in relation to the voltage output $U_{O/P}$:

$$U_{O/P\ level} = \frac{10\ V \times F_{level}}{F_{nominal}}$$

3.5.1 Adjustment of the detection threshold U_{level1}

1. Connect a digital millivoltmeter between terminals 15 ($U_{O/P}$) and 9 (0 V) of the load monitoring unit.
2. Adjust the potentiometer P9 to obtain a reading of $U_{O/P\ level1}$ with an accuracy of ±20 mV. *Figure 3–1* indicates where the potentiometers P1 to P10 are located.
3. Turn the potentiometer P3 slowly until the LED of REL1 goes on: the detection level will then be switched off. *Figure 3–3* indicates where this LED is located.
4. Turn the potentiometer P3 slowly until the LED of REL1 goes off: the detection level will then be switched off : the detection threshold is now reached.

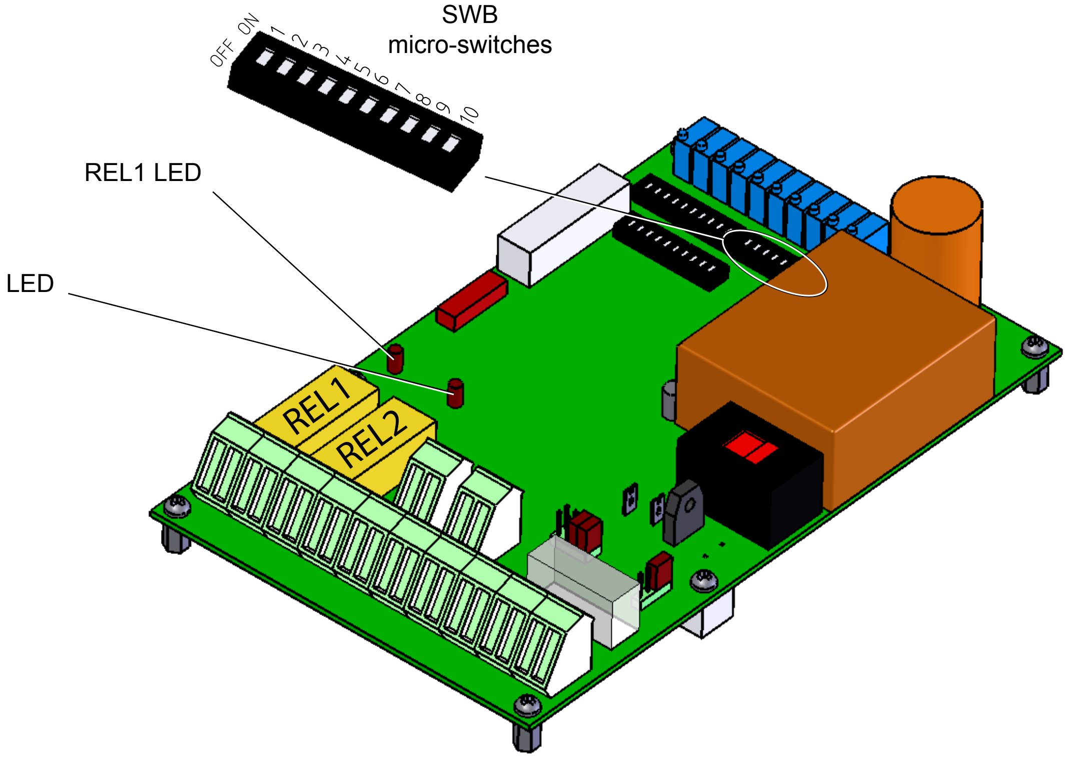


Fig. 3–3 Location of the relays REL1 and REL2 and of the micro-switches SWB of the load monitoring unit board

Note :	Record the values $U_{O/P\ level1}$ and F_{level1} on the configuration and calibration form (see *Appendix A*).

3.5.2 Adjustment of the detection threshold U_{LEVEL2}

1. Connect a digital millivoltmeter between terminals 15 ($U_{O/P}$) and 9 (0 V) of the load monitoring unit.
2. Adjust the potentiometer P9 to obtain a reading of $U_{O/P\ level2}$ with an accuracy of ±20 mV. *Figure 3–1* indicates where the potentiometers P1 to P10 are located.
3. Turn the potentiometer P5 slowly until the LED of REL2 goes on: the detection level will then be switched off. *Figure 3–3* indicates where this LED is located.
4. Turn the potentiometer P5 slowly until the LED of REL2 goes off: the detection level will then be switched off : the detection threshold is now reached.

Note : Record the values $U_{O/P\ level2}$ and F_{level2} on the configuration and calibration form (see *Appendix A*).

3.5.3 Adjustment of the detection threshold U_{LEVEL3}

1. Connect a digital millivoltmeter between terminals 15 ($U_{O/P}$) and 9 (0 V) of the load monitoring unit.
2. Adjust the potentiometer P9 to obtain a reading of $U_{O/P\ level3}$ with an accuracy of ±20 mV. *Figure 3–1* indicates where the potentiometers P1 to P10 are located.
3. Turn the potentiometer P12 slowly until the LED of REL3 goes on: the detection level will then be switched off. *Figure 3–4* indicates where the potentiometers P12 to P15 and this LED are located.
4. Turn the potentiometer P12 slowly until the LED of REL3 goes off: the detection threshold is now reached.

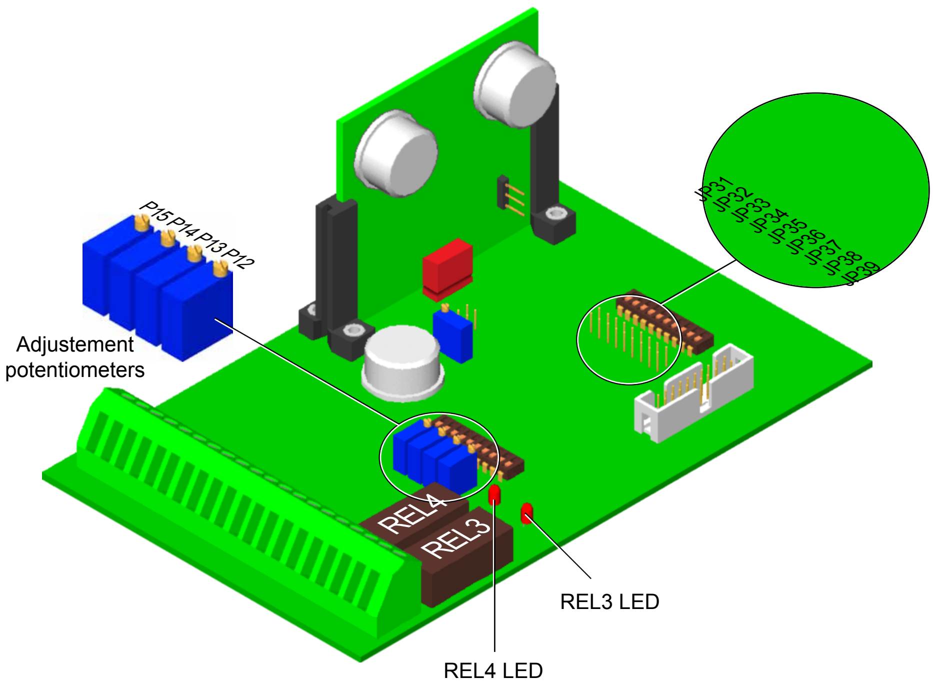


Fig. 3–4 Location of the relays REL3 and REL4 and of the adjustment potentiometers

Note : Record the values $U_{O/P\ level3}$ and F_{level3} on the configuration and calibration form (see *Appendix A*).

3.5.4 Adjustment of the detection threshold U_{LEVEL4}

1. Connect a digital millivoltmeter between terminals 15 ($U_{O/P}$) and 9 (0 V) of the load monitoring unit.

2. Adjust the potentiometer P9 to obtain a reading of $U_{O/P\ level4}$ with an accuracy of ±20 mV.
3. Turn the potentiometer P14 slowly until the LED of REL4 goes on: the detection level will then be switched off. *Figure 3–4* indicates where the potentiometers P12 to P15 and this LED are located.
4. Turn the potentiometer P14 slowly until the LED of REL4 goes off: the detection threshold is now reached.

☞ Note : Record the values $U_{O/P\ level4}$ and F_{level4} on the configuration and calibration form (see *Appendix A*).

3.6 ADJUSTMENT OF THE SUMMER COEFFICIENT X

The following conditions are required to adjust the X coefficient :

- Place the micro-switch SWB9 (see *figure 3–3*) on ON to activate the test signal.
- Check that the terminal 36 ($U_{A\ I/P}$) is free.
- Make sure that all other inputs (terminals 33, 34 and 35) are on zero.
- Plug in the jumper JP41 and remove the jumpers JP33 and JP42 (see *figure 3–5*).

Proceed as follows to carry out the coefficient adjustment :

1. Connect a digital millivoltmeter between terminals 15 ($U_{O/P}$) and 9 (0 V) of the load monitoring unit.
2. Adjust the potentiometer P9 to obtain a reading of $U_{O/P}$ = 1 V.
3. Connect a digital millivoltmeter between terminals 32 ($U_{E\ O/P}$) and 9 (0 V).
4. The micro-switch is already positioned. Now adjust the potentiometer P11 to obtain an output voltage $U_{E\ O/P}$ equal to the input voltage $U_{O/P}$, set at 1 V and multiplied by the coefficient X, this with an accuracy of ±20 mV. All adjustment components are shown on *figure 3–5*.

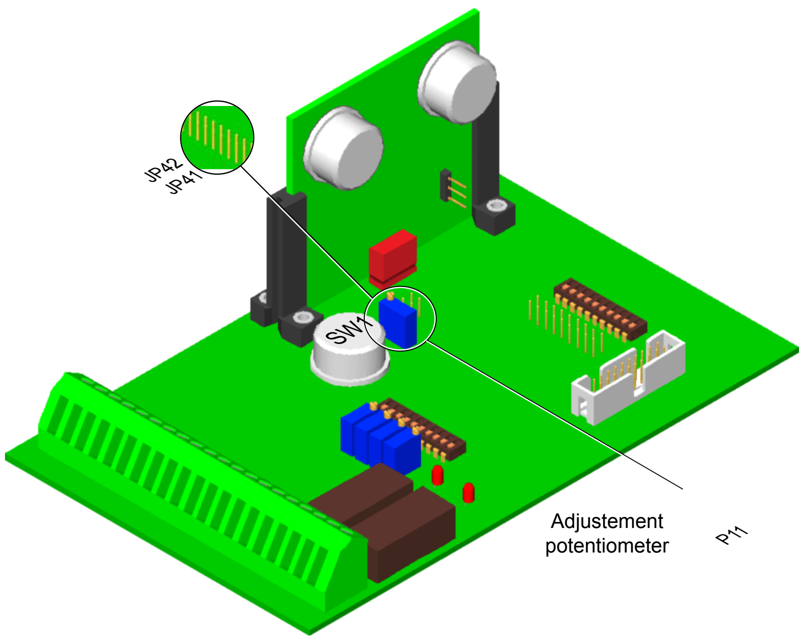


Fig. 3–5 Location of the X coefficient adjustment components

Example : The user want to get a coefficient of 0,5. He first places the micro-switch on position 5. He then turns the potentiometer P11 to get an output voltage $U_{E\ O/P}$ of 0.5 V wit an input voltage $U_{O/P}$ set on 1 V.

Note : Record the value of the coefficient X on the configuration and calibration form (see *Appendix A*)

CAUTION : AFTER HAVING ADJUSTED THE COEFFICIENT X PLACE THE MICRO-SWITCH ON OFF.

CAUTION : TO MAKE THE LOAD MONITORING UNIT OPERATIONAL PUT THE MICRO-SWITCH SWA10 ON ON.

3.7 TARING CIRCUIT CONFIGURATION

The LMU 216 is fitted with a taring circuit. By using the external controls AUTO-ZERO (terminal 42) and COM-TAR (terminal 40) the measured signal can be brought back to zero. This new value, called NET, is available on the output TARING O/P (terminal 38).

The output TARING O/P follows the rule : NET = BRUT – TARE.

3.7.1 ENTER A TARE

To add a tare to the measured signal short-circuit the input COM-TAR (terminal 40) with the input 0 V (terminal 41) for at least 1 s.

3.7.2 REMOVE THE TARE

To remove the tare from the measured signal short circuit the input AUTO-ZERO (terminal 42) with the input 0 V (terminal 41) for at least 1 s.

3.7.3 TARE SIGNAL SELECTION

The following table lists the various signals which can be selected on the taring circuit input.

Taring circuit input signal	SWD6	SWD7	JP41
Amplified transducer signal (C1)	ON	OFF	—
Summer output signal (E2)	OFF	ON	ON
Comparator output signal (optional)	OFF	ON	OFF
Taring system decommissioning	OFF	OFF	—

The signal at the taring circuit input can be selected by using the micro-switches SWD6 and SWD7 as well as the jumper JP41. The signal corresponds to the TARE value which will be subtracted from the measured signal to obtain the NET signal on the output TARING O/P (terminal 38) (see *figure 3–6*).

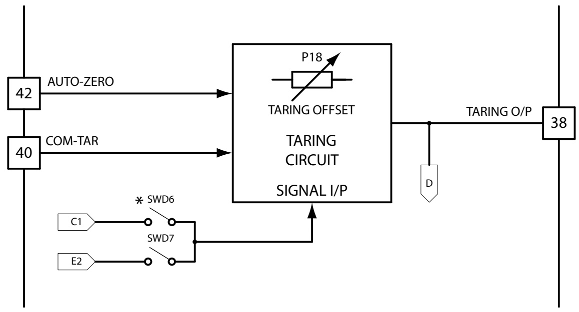


Fig. 3–6 Internal connection taring circuit diagram

3.7.4 Taring control circuit connection diagram

Figure 3–7 shows the external taring circuit connections. Two push-buttons can for instance be fixed on the side of the weight display unit, one being used for taring (TARE), the other for resetting the tare (RESET). The signal NET is made available on the output TARING O/P (terminal 38).

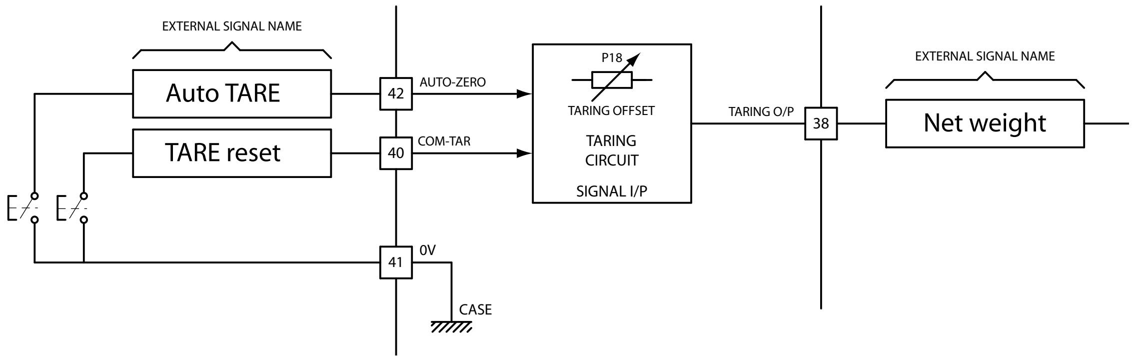


Fig. 3–7 External connection taring circuit diagram

With this equipment, taring can be carried out by pushing the TARE button for at least 1 s or until the display unit shows a 0. To reset the tare push the RESET button for at least 1 s or until the display unit shows the gross weight.

3.8 CALIBRATION OF THE BUILT-IN TEST EQUIPMENT (B.I.T.E.)

The built-in test equipment (B.I.T.E.) is based on a signal simulating a fictitious load passing through the complete signal amplification chain. At each call of the B.I.T.E. function (see signal C, Appendix A) the user will be able to check on the various outputs (voltage $U_{O/P}$ and current $I_{O/P}$) as well as on certain relays according to the selected configuration that the load monitoring unit reacts to this fictitious load as if it would be a real load.

The calibration requires the following conditions :

- The load monitoring unit calibration according *paragraph 3.1* or *paragraph 3.2* must already have been carried out.
- No load must be applied to the transducer.
- The micro-switch SWB9 (see *figure 3–3*) must be on ON.

The calibration is carried out as follows :

1. Connect a digital millivoltmeter between terminals 15 ($U_{O/P}$) and 9 (0 V) of the load monitoring unit (for the voltage calibration) or the milliampermeter between terminals 10 ($I_{O/P}$) and 9 (0V) (for the current calibration).

2. Adjust the potentiometer P9 to obtain a reading of $U_{O/P}$ with an accuracy of ±20 mV for the voltage calibration or a reading of $I_{O/P}$ with an accuracy of ±50 µA.

   CAUTION : ADJUST THE B.I.T.E. TO GET $U_{O/P}$ BETWEEN -10 VDC AND +10 VDC. IF THIS OUTPUT IS NOT WITHIN THESE LIMITS TURN THE POTENTIOMETER P9 BACK TO ITS HALF-WAY POSITION AND CARRY OUT A FINE ADJUSTMENT.

   Figure 3–1 shows where the potentiometers P1 to P10 are located.

3. Put the micro-switch SWB9 back on OFF.

4. Applications

4.1 USING ONE OR SEVERAL LOAD MONITORING UNITS

A load monitoring unit can be used as a stand-alone or combined with other load monitoring units. In the second case the different measuring signals are cascaded and their sum appears on the output of the load monitoring unit at the end of the chain. It is however possible to pick up the measuring signal at the level of each element of this chain.

4.1.1 SIMPLE WEIGHING FOR CRANES WITH TARE ADJUSTMENT

Figure 4–1 shows an application with a load measuring pin connected a load monitoring unit LMU 216 monitoring surcharges of a crane hook. The LMU 216 taring function is used to monitor the gross as well as the net load.

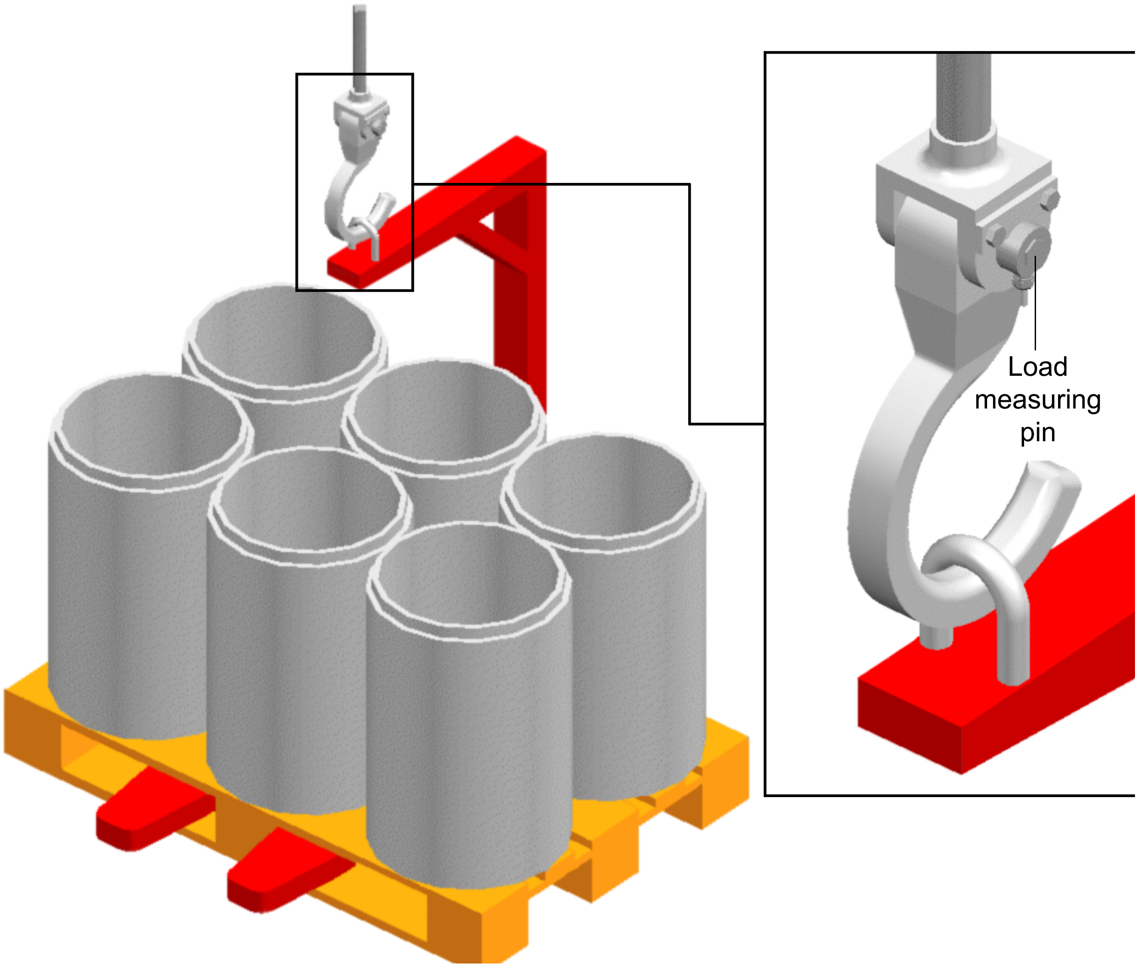


Fig. 4–1 Simple weighing application

Following functions and signals are available on the LMU 216:

- Input signal: load measuring pin signal.
- Output signals: "gross load" signal
"net load" signal
"net load" current.
- Relay output thresholds: ① "gross load"
② "gross overload"
③ "net load"
④ "net overload".

Figure 4–2 offers a synthesis of this information in a diagram.

① Maximum gross load threshold
② Maximum gross overload threshold
③ Maximum net load threshold
④ Maximum net overload threshold

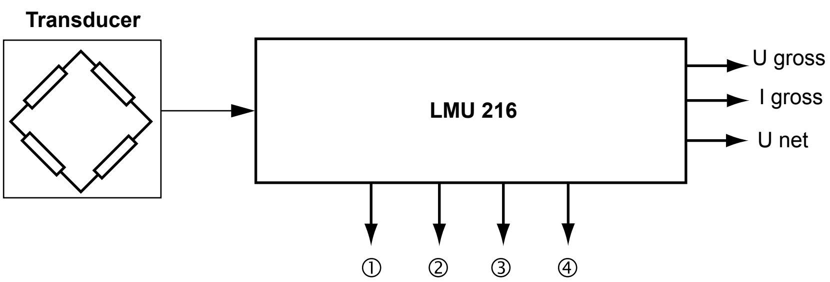


Fig. 4–2 Simple weighing system

The configuration and calibration protocol illustrated on *figures 4-3* and *4-4* indicate the various signals made available on the load monitoring unit for this application.

Fig. 4–3 Configuration and calibration protocol for a simple weighing application (part 1 of 2)

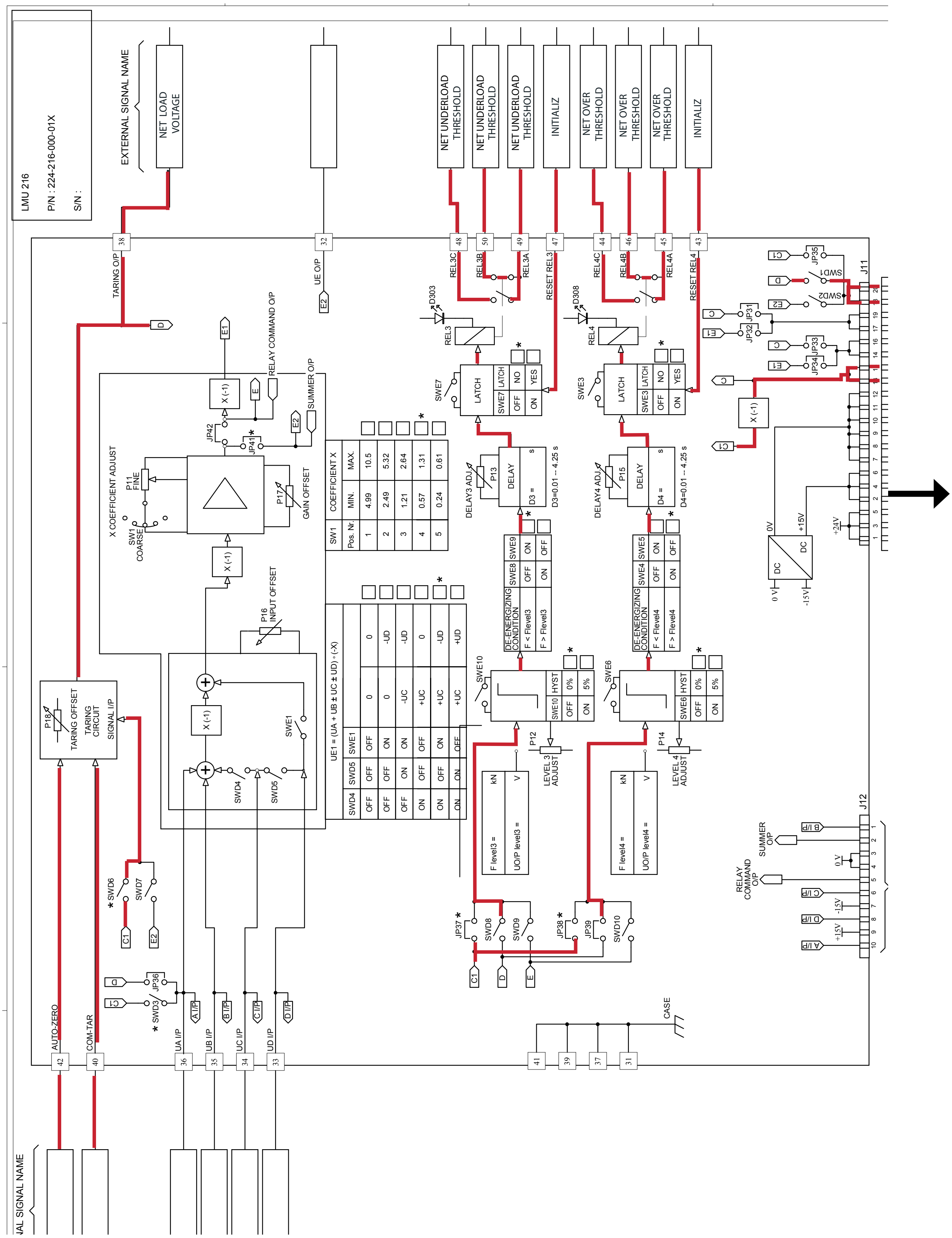
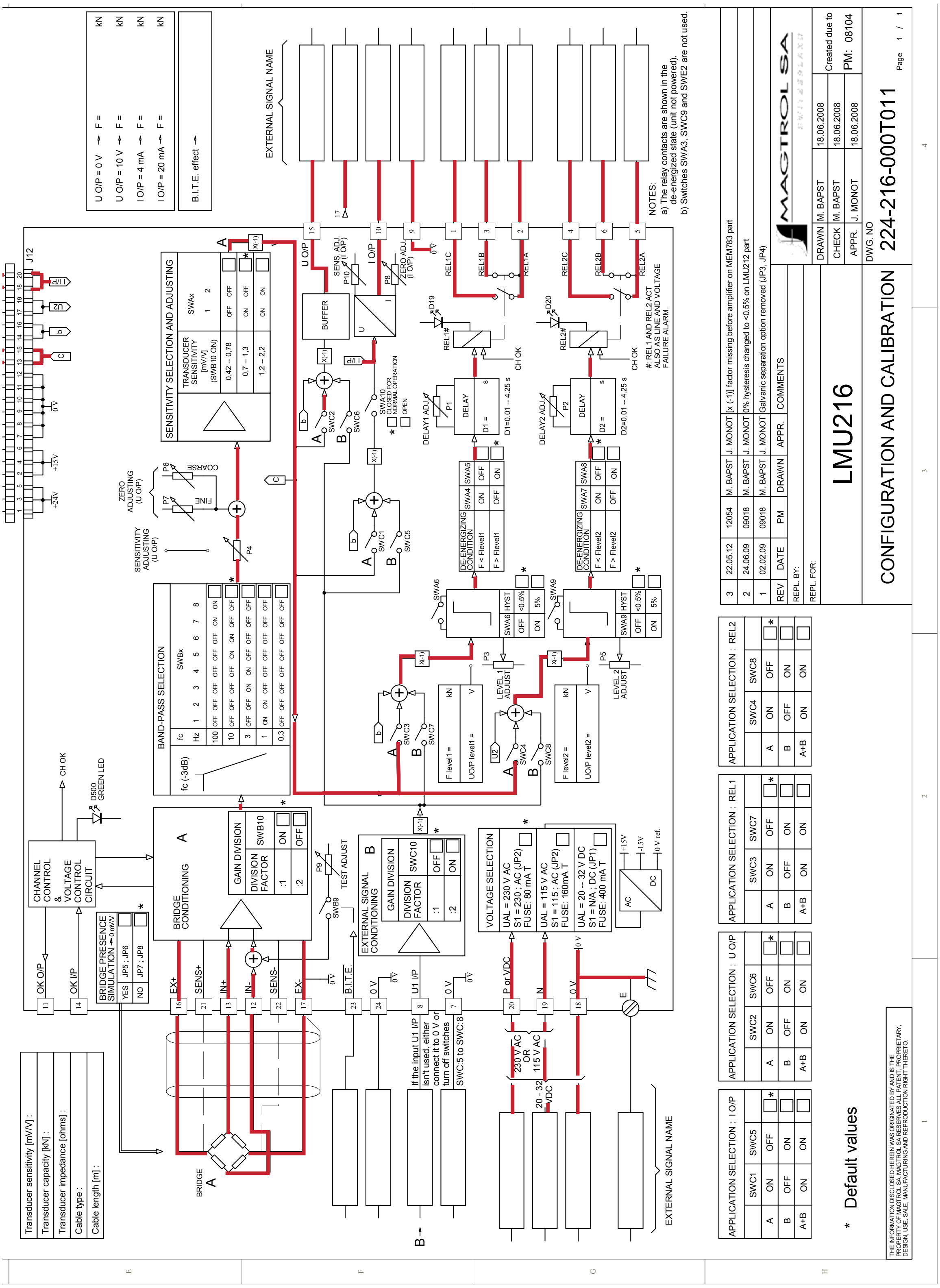


Fig. 4–4 Configuration and calibration protocol for a simple weighing application (part 1 of 2)



4.1.2 Multi-transducer weighing for container gantry cranes

F*igure 4–4* illustrates an application of multi-transducer weighing used for overloads monitoring on container gantry cranes. Four load pins are connected to different load monitoring units: pins A and B are connected to a LMU 217, pin C to a LMU 212 and pin D to a LMU 216. The four pins are equally loaded. The total load is obtained by adding the four signals delivered by the load pins.

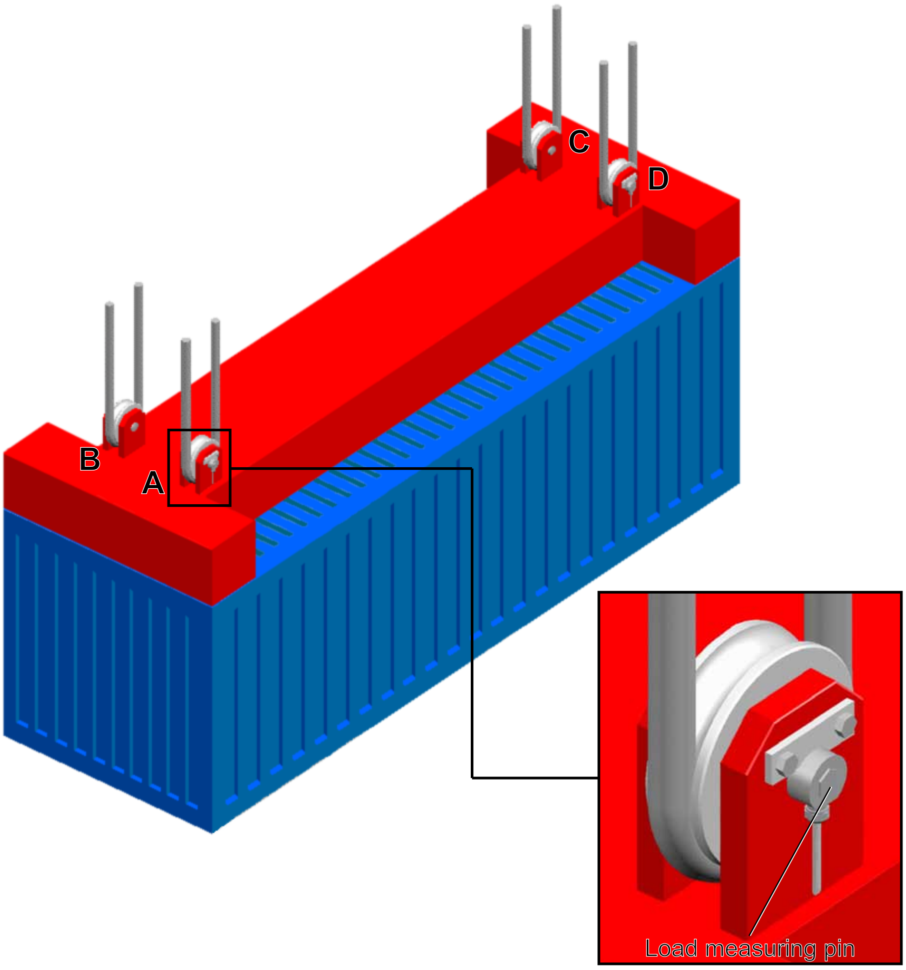


Fig. 4–5 Multi-transducer weighing application

Following functions and signals are available on the LMU 216:

- Input signals: signal of load measuring pin D
  "gross load A" voltage on summer
  "gross load B" voltage on summer
  "gross load C" voltage on summer
  "gross load D" voltage on summer
- Output signals: "gross load D" voltage
  "total net load" voltage
  "total gross load" voltage
  "total gross load" current

- Relays output threshold: ① "gross load on pin D"
  ② "maximum gross overload"
  ③ "maximum gross underload (slack of cable)"
  ④ "maximum net overload".

Figure 4–6 offers a synthesis of this information in a diagram and *figures 4-6* and *4-8* indicate the different signals available on the load monitoring unit terminals for this application.

① Maximum gross surcharge threshold for each pin
② Maximum gross surcharge threshold for all four pins
③ Maximum gross undercharge threshold for all four pins
④ Maximum net surcharge threshold for all four pins

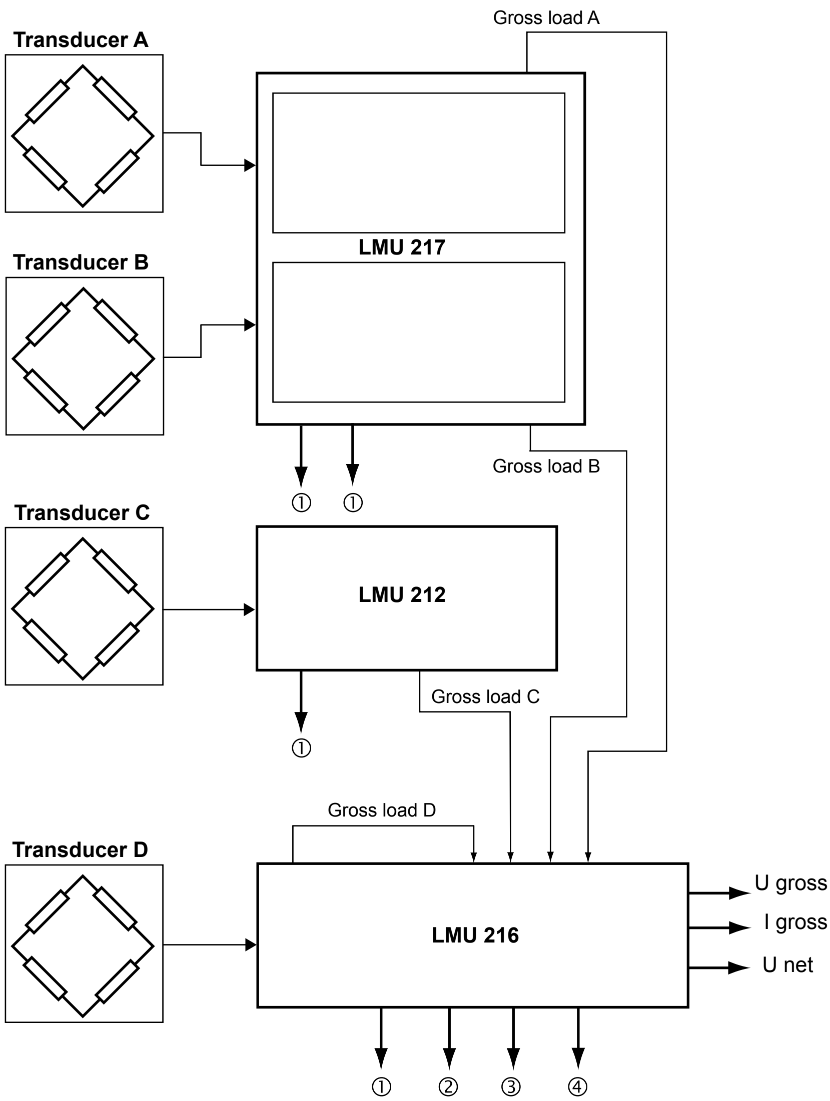


Fig. 4–6 Multi-transducer weighing system

4.2 USING B.I.T.E. SIGNAL

The LMU Load Monitoring Unit is fitted with a system to test the amplification chain of the signal generated by the transducer. The B.I.T.E. test signal simulating a load must be calibrated when installing the LMU (see *chapter 3, section 3.8*).

There are two ways to activate the function:

- connect the B.I.T.E. control input (terminal 23) to the ground (terminal 24), see *figure 4–7.*
- send a "low active" CMOS/TTL compatible control signal (see following table) on the B.I.T.E. (signal on terminal 23, ground on terminal 24):

B.I.T.E. function	Necessary logic state	B.I.T.E. input terminals condition (23-24)
Activated	Low	"Low" level input voltage (VIL) : 0 to +0,5 VDC
Deactivated	High	"High" level input voltage (VIH) : +0,7 to +25 VDC

WARNING! **HAVING ACTIVATED THE B.I.T.E. FUNCTION, THE VARIOUS OUTPUTS ($U_{O/P}$, $I_{O/P}$ AND RELAYS) WILL NO LONGER BE REPRESENTATIVE OF THE REAL LOAD APPLIED TO THE TRANSDUCER. NO SAFETY CHECKS WILL BE CARRIED OUT!**

TO PREVENT ANY RISK, ONLY ACTIVATE THE B.I.T.E. WHEN THE APPLIED LOAD IS ZERO AND WHEN THE SYSTEM REPRESENTS NO RISK.

THE B.I.T.E. FUNCTION MUST ONLY BE USED AS A PERIODICAL CHECK. DO NOT HAVE IT ACTIVATED DURING NORMAL USE OF THE LOAD MONITORING UNIT.

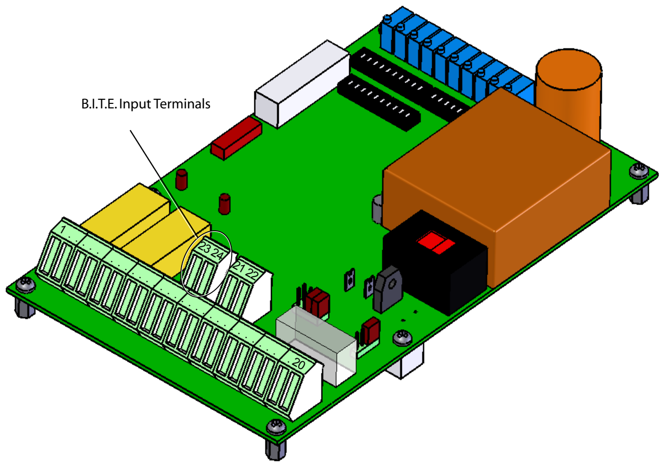


Fig. 4–7 B.I.T.E. control input terminals

Procedure:

1. Make sure that no load is applied on the transducer and that the activation of the B.I.T.E. function does not endanger the application.

2. Activate the B.I.T.E. function.

3. Wait until the final voltage has settled (up to approximately 7 s if the LMU has been configured with a 0,3 Hz filter).

3. Check the correct operation of the relays REL1 and/or REL2 (depending on the setting). Measure the voltage $U_{O/P}$ and the current $I_{O/P}$ (by means of a measuring instrument connected to the corresponding outputs).

4. Compare the measured signal to the calibrated signal (see installation).

5. Deactivate the B.I.T.E. function.

The signal obtained on the load monitoring outputs when the B.I.T.E. function is activated must correspond to the signal after calibration.

Fig. 4–8 Configuration and calibration protocol for a multi-transducer weighing system (part 1 of 2)

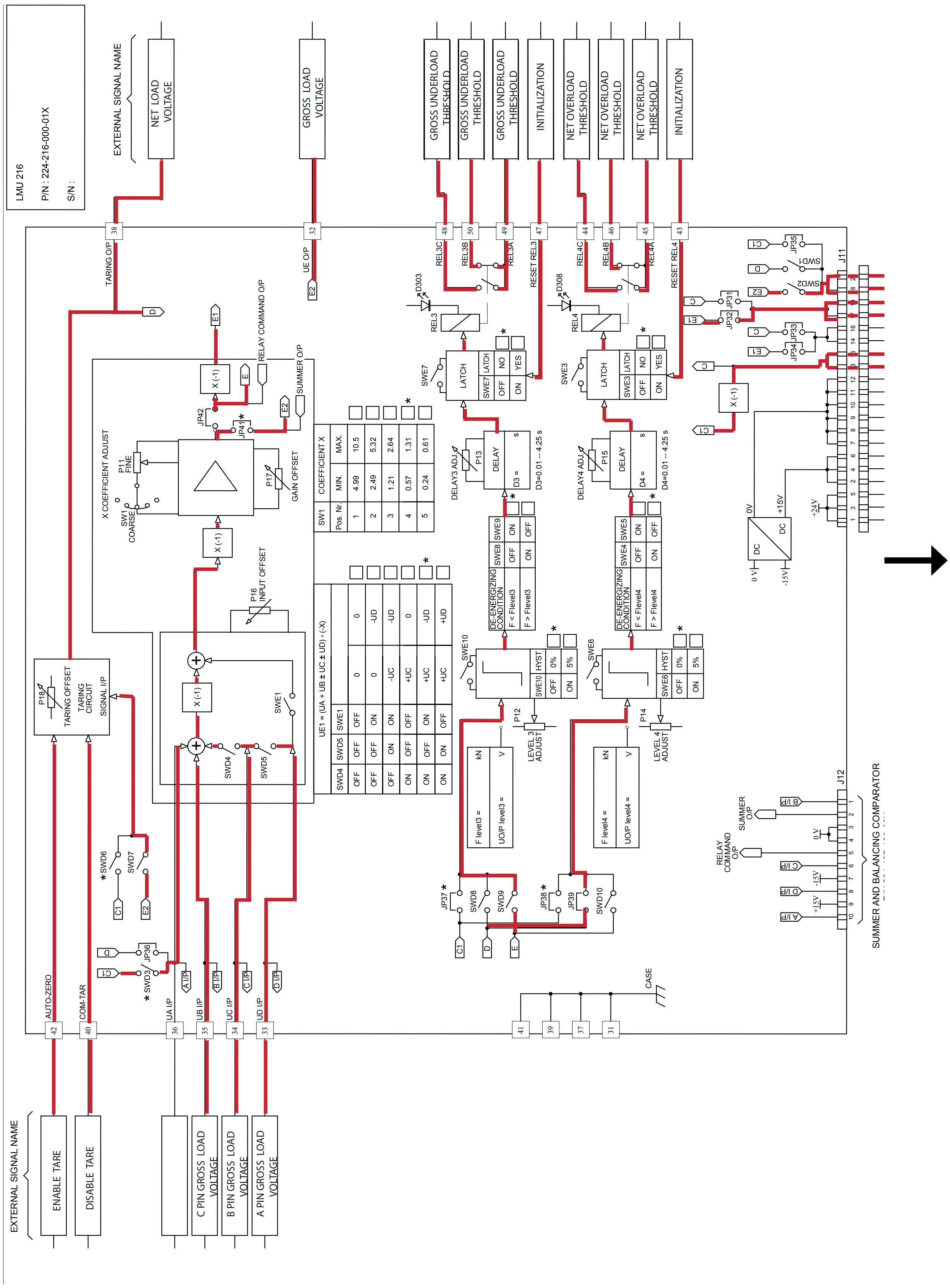
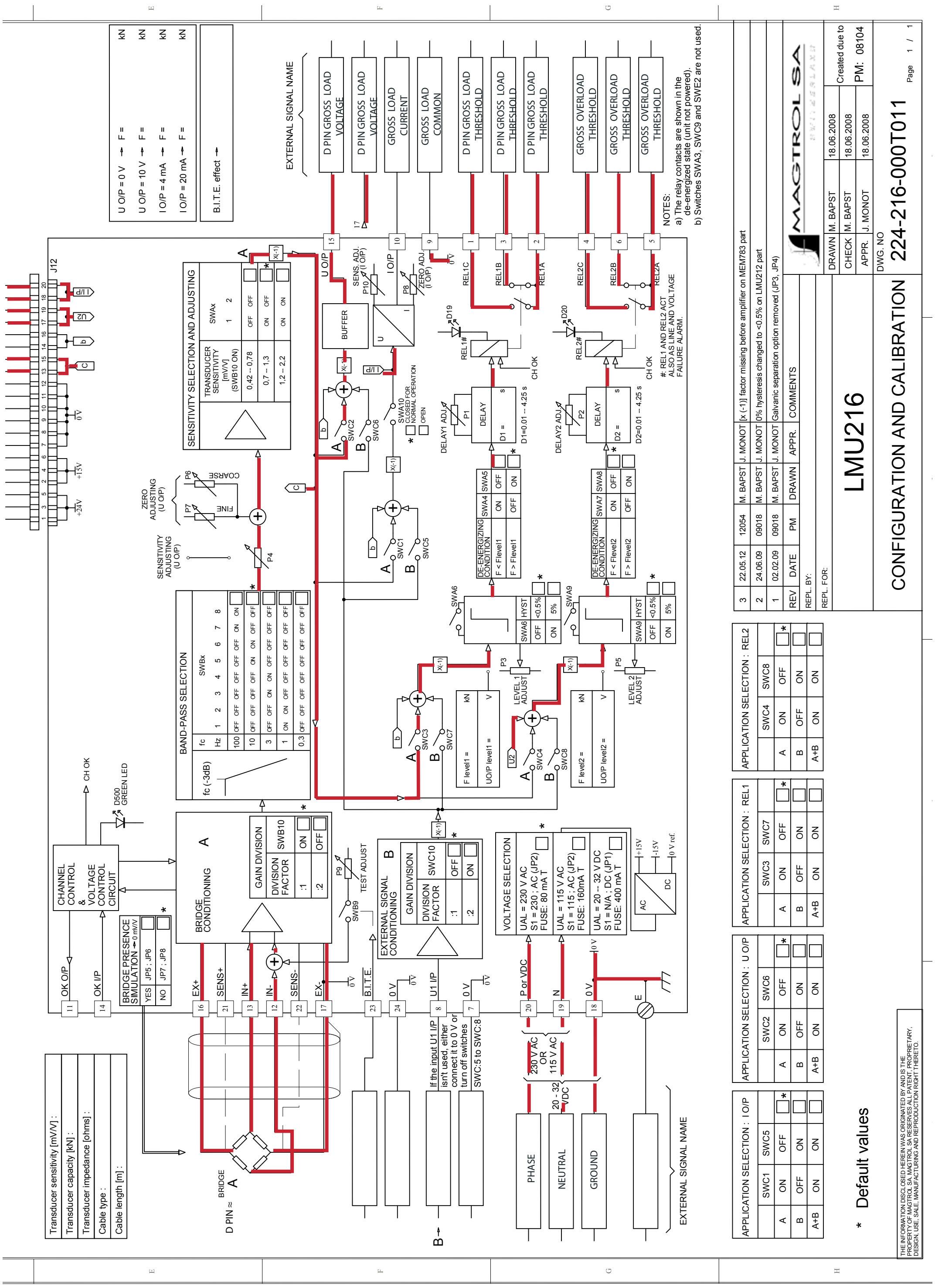


Fig. 4–9 Configuration and calibration protocol for a multi-transducer weighing system (part 2 of 2)



5. Repair

5.1 TROUBLE-SHOOTING

In case of a defect requiring repair it is very important to include the product defect report and the following information:

- Model number, part number, serial number, order number and date of purchase.
- Description of the defect and the conditions in which it appeared.
- Configuration and calibration report.
- Description of the test bench (drawing, photographs, sketches, etc.).
- Description of the tested object (drawing, photographs, sketches, etc.).
- Description of the test cycle.

To allow Magtrol to complete the work in the best possible time, follow the procedure outlined below:

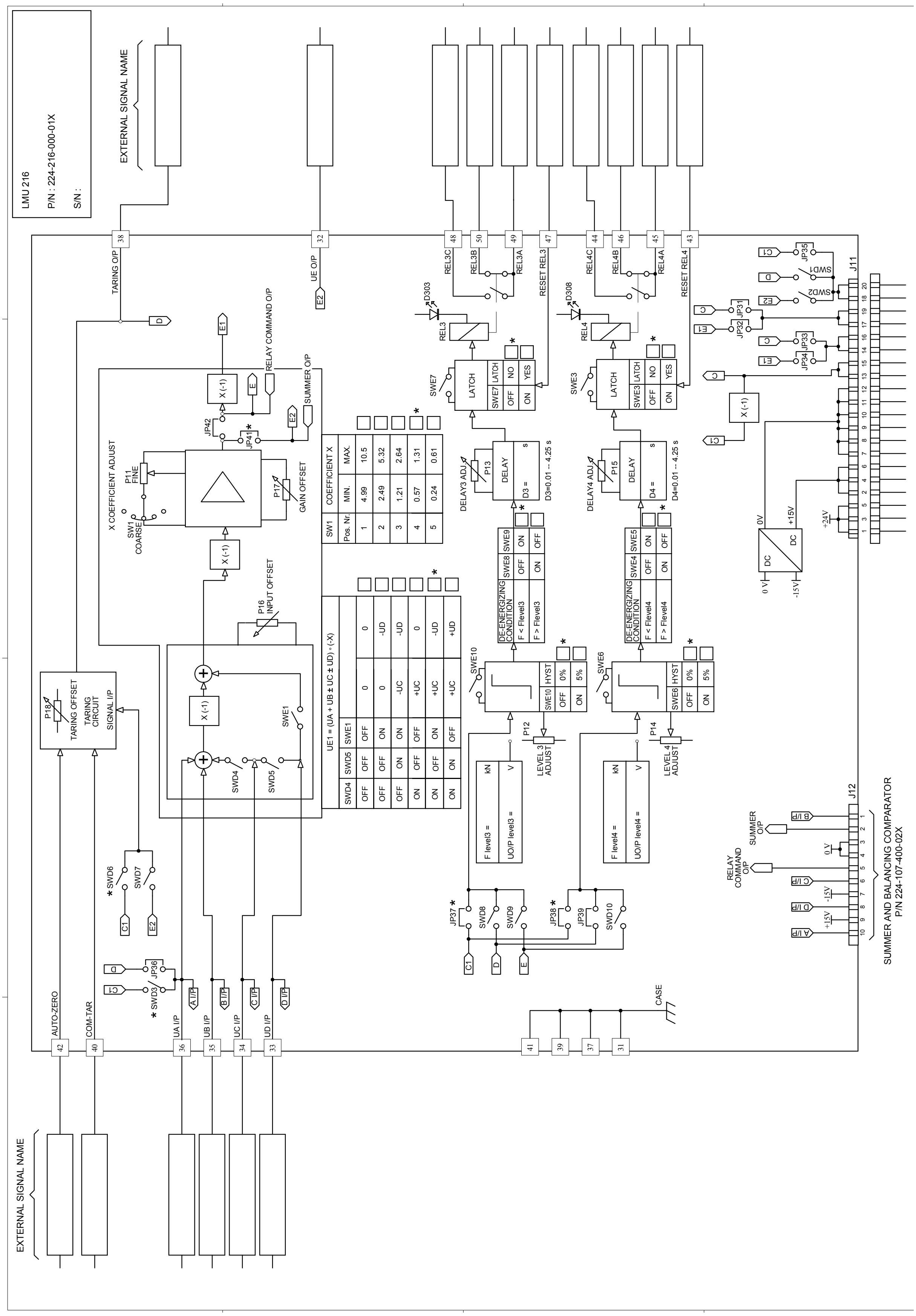
- Carefully pack the load monitoring unit.
- Attach the product defect report indicating the problems encountered.

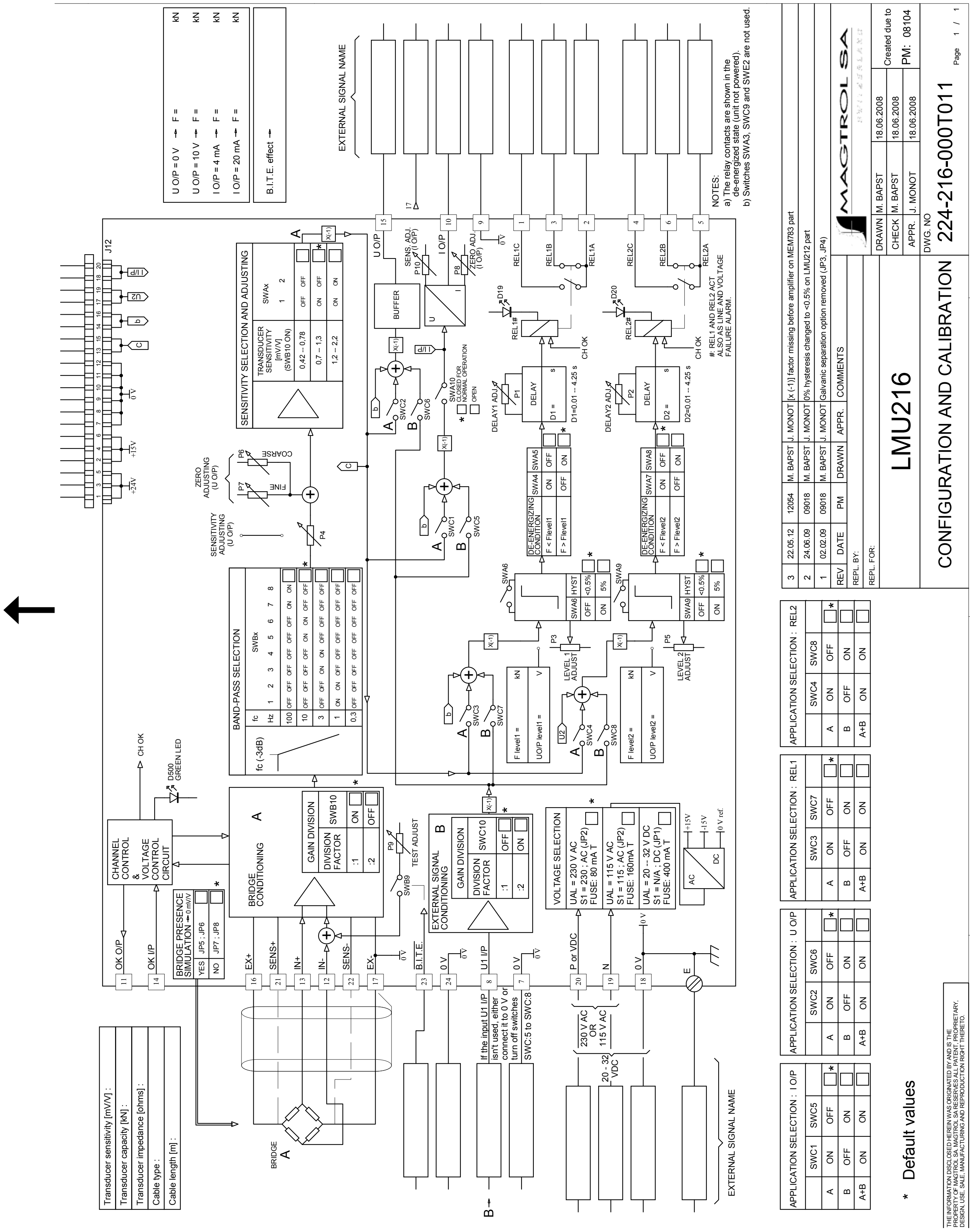
Note : Do not hesitate to contact Magtrol's after-sales service for additional information.

Appendix A : Configuration and calibration report

The configuration and calibration report for the LMU 216 (224-216-000T011) load monitoring units joined in this appendix have to be filled-in with the utmost care and placed in the load monitoring unit housing under its cover.

When the unit needs repairing, attach a copy of this report. This will allow the engineers to carry out the work in the shortest possible time.


LMU 216
P/N : 224-216-000-01X
S/N :
EXTERNAL SIGNAL NAME
TARING O/P
UE O/P
RELAY COMMAND O/P
SUMMER O/P
X COEFFICIENT ADJUST
GAIN OFFSET
INPUT OFFSET
TARING OFFSET
TARING CIRCUIT
SIGNAL I/P
AUTO-ZERO
COM-TAR
UA I/P
UB I/P
UC I/P
UD I/P
CASE
RESET REL3
RESET REL4
DELAY3 ADJ
DELAY4 ADJ
D3=0.01 .. 4.25 s
D4=0.01 .. 4.25 s
DE-ENERGIZING CONDITION
F < Flevel3
F > Flevel3
F < Flevel4
F > Flevel4
LEVEL 3 ADJUST
LEVEL 4 ADJUST
F level3 = kN
UO/P level3 = V
F level4 = kN
UO/P level4 = V
UE1 = (UA + UB ± UC ± UD) · (-X)
SUMMER AND BALANCING COMPARATOR
P/N 224-107-400-02X


LMU216
CONFIGURATION AND CALIBRATION
224-216-000T011
MAGTROL SA
* Default values
EXTERNAL SIGNAL NAME
BAND-PASS SELECTION
SENSITIVITY SELECTION AND ADJUSTING
BRIDGE CONDITIONING
EXTERNAL SIGNAL CONDITIONING
VOLTAGE SELECTION
DRAWN M. BAPST 18.06.2008
CHECK M. BAPST 18.06.2008
APPR. J. MONOT 18.06.2008
Created due to PM: 08104

Appendix B : CE Conformity declaration

MAGTROL SA SWITZERLAND	Formulaire - Q **Declaration of conformity CE**	*Document No :* **Do033E** *Date :* 16.03.2009 *Visa :* nbur

DEC No : **026**

We,

MAGTROL SA
Centre technologique Montena
CH – 1728 ROSSENS / Fribourg (SWITZERLAND)

Herewith declare that the following products :

Load monitoring unit

family types

LMU 212, 216 and 217

which are mentioned in this declaration, meet all requirements defined in :

2004/108/CE Electromagnetic compatibility (EMC)

Those products have been developed and manufactured according to the processes described in Magtrol's Manual conformity with the ISO 9001 norm.

For the evaluation of these products, following norms have been taken into account :

IEC ou EN 61326-1
Electrical equipment for measurement, control and laboratory use
– EMC requirements – Part 1: General requirements

IEC ou EN 61326-2-3
Electrical equipment for measurement, control and laboratory use
– EMC requirements – Part 2-3: Particular requirements

Rossens, may 5th 2009

J. Cattin
General Manager

N.Buri
QES System Manager

Page : 1 de 1

Magtrol Limited Warranty

Magtrol, Inc. warrants its products to be free from defects in material and workmanship under normal use and service for a period of twenty-four (24) months from the date of shipment. Software is warranted to operate in accordance with its programmed instructions on appropriate Magtrol instruments. This warranty extends only to the original purchaser and shall not apply to fuses, computer media, or any other product which, in Magtrol's sole opinion, has been subject to misuse, alteration, abuse or abnormal conditions of operation or shipping.

Magtrol's obligation under this warranty is limited to repair or replacement of a product which is returned to the factory within the warranty period and is determined, upon examination by Magtrol, to be defective. If Magtrol determines that the defect or malfunction has been caused by misuse, alteration, abuse or abnormal conditions of operation or shipping, Magtrol will repair the product and bill the purchaser for the reasonable cost of repair. If the product is not covered by this warranty, Magtrol will, if requested by purchaser, submit an estimate of the repair costs before work is started.

To obtain repair service under this warranty, purchaser must forward the product (transportation prepaid) and a description of the malfunction to the factory. The instrument shall be repaired at the factory and returned to purchaser, transportation prepaid. **MAGTROL ASSUMES NO RISK FOR IN-TRANSIT DAMAGE.**

THE FOREGOING WARRANTY IS PURCHASER'S SOLE AND EXCLUSIVE REMEDY AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTY OF MERCHANTABILITY, OR FITNESS FOR ANY PARTICULAR PURPOSE OR USE. MAGTROL SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES OR LOSS WHETHER IN CONTRACT, TORT, OR OTHERWISE.

CLAIMS

Immediately upon arrival, purchaser shall check the packing container against the enclosed packing list and shall, within thirty (30) days of arrival, give Magtrol notice of shortages or any nonconformity with the terms of the order. If purchaser fails to give notice, the delivery shall be deemed to conform with the terms of the order.

The purchaser assumes all risk of loss or damage to products upon delivery by Magtrol to the carrier. If a product is damaged in transit, PURCHASER MUST FILE ALL CLAIMS FOR DAMAGE WITH THE CARRIER to obtain compensation. Upon request by purchaser, Magtrol will submit an estimate of the cost to repair shipment damage.

Service Information

RETURNING MAGTROL EQUIPMENT FOR REPAIR AND/OR CALIBRATION

Before returning equipment to Magtrol for repair and/or calibration, please visit Magtrol's Web site at http://www.magtrol.com/support/rma.htm to begin the Return Material Authorization (RMA) process. Depending on where the equipment is located and which unit(s) will be returned, you will be directed to either ship your equipment back to Magtrol, Inc. in the United States or Magtrol SA in Switzerland.

Returning Equipment to Magtrol, Inc. (United States)

When returning equipment to Magtrol, Inc.'s factory in the United States for repair and/or calibration, a completed Return Material Authorization (RMA) form is required.

1. Visit Magtrol's Web site at http://www.magtrol.com/support/rma.htm to begin the RMA process.
2. Complete the RMA form online and submit.
3. An RMA number will be issued to you via e-mail. Include this number on all return documentation.
4. Ship your equipment to: MAGTROL, INC.
70 Gardenville Parkway
Buffalo, NY 14224
Attn: Repair Department
5. After Magtrol's Repair Department receives and analyzes your equipment, a quotation listing all the necessary parts and labor costs, if any, will be faxed or e-mailed to you.
6. After receiving your repair estimate, provide Magtrol with a P.O. number as soon as possible. A purchase order confirming the cost quoted is required before your equipment can be returned.

Returning Equipment to Magtrol SA (Switzerland)

If you are directed to ship your equipment to Switzerland, no RMA form/number is required. Just send your equipment directly to Magtrol SA in Switzerland and follow these shipment instructions:

1. Ship your equipment to: MAGTROL SA
After Sales Service
Route de Montena 77
1728 Rossens / Fribourg
Switzerland
VAT No: 485 572
2. Please use our forwarder : TNT • 1-800-558-5555 • Account No 154033
Only ship ECONOMIC way (3 days max. within Europe)
3. Include the following documents with your equipment:
   - Delivery note with Magtrol SA's address (as listed above)
   - Three pro forma invoices with:
     - Your VAT number
     - Description of returned goods
     - Noticed failures
     - Value - for customs purposes only
     - Origin of the goods (in general, Switzerland)
4. A cost estimate for repair will be sent to you as soon as the goods have been analyzed. If the repair charges do not exceed 25% the price of a new unit, the repair or calibration will be completed without requiring prior customer authorization.

MAGTROL INC
70 Gardenville Parkway
Buffalo, New York 14224 USA
Phone: +1 716 668 5555
Fax: +1 716 668 8705
E-mail: magtrol@magtrol.com

MAGTROL SA
Route de Montena 77
1728 Rossens/Fribourg, Switzerland
Phone: +41 (0)26 407 3000
Fax: +41 (0)26 407 3001
E-mail: magtrol@magtrol.ch

Subsidiaries in:
Germany • France
China • India

Worldwide Network
of Sales Agents