



Instruction manual 877 Field Display & Interface

Instruction manual 877 FDI Field Display & Interface

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Preface

This manual is intended for technicians involved with the commissioning and service of the Honeywell Enraf Series 877 Field Display & Interface.

For mechanical and electrical installation of the 877 FDI, refer to the Installation guide 877 Field Display & Interface. Refer also to the list of related documents in Appendix D.

A description preceding the technical procedures gives the technical information necessary to understand its functioning. It is recommended to read this description prior to performing any of the procedures.

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- Neglect of the general safety precautions for handling tools, use of electricity and microwave radiation.

EC declaration of conformity

This instrument is in conformity with the protection requirements of EC Council Directive 89/336/EEC.
The CE conformity marking fulfills the provisions of

EN 50081-2 Generic Emission Standard
EN 50082-2 Generic Immunity Standard
73/23EEC Low Voltage Directive

when installed, maintained and applied according to requirements as specified in this manual.

Additional information

Please do not hesitate to contact Honeywell Enraf or its representative if you require additional information.

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1 Introduction

The Honeywell Enraf 877 Field Display & Interface (FDI) is a field indicator, which can be used to indicate the measured level and, if selected, the temperature from its related level gauge. This level gauge can be one of the Honeywell Enraf series servo gauges (model 854 ATG or 854 XTG) or one of the Honeywell Enraf series radar gauges.

Optionally, the indicator can be provided with an RPU board (Relay Processor Unit), which provides the indicator with two hard alarm SPDT output contacts for level alarms.

A transmission line relay on the RPU board provides for the fall back mode. Then the indicator automatically polls the level gauge when the host is out of service.

In addition to the RPU board the 877 FDI has one more optional slot available for the following functions:

- Analog 4 - 20 mA level output for control applications or analog recorders can be obtained with the optional MPU board.
- Spot temperature can be measured with the optional TPU-2 board (Temperature Processor Unit) or the optional HSU board (HART™ and Spot temperature processor Unit).
- Average product temperature as well as average gas temperature measurement can be performed with the optional MPU, HPU or OPU board and a 862 MIR or 862 MIT box.
- Honeywell ST3000 series pressure transmitters can be connected via the optional OPU board. Via the optional HPU or HSU board, HART pressure transmitters and/or a HART compatible external water bottom probe can be connected.

The 877 FDI can also become a gauge when used as HTG (Hydrostatic Tank Gauge) or can be used as stand alone temperature gauge.

Note:

For water bottom measurement by external HART probe and when used as stand alone temperature gauge, the XPU-2 board is required in stead of the standard XPU board.

1.1 Principle of operation

In indicator mode and indicator and fall back mode, the 877 FDI copies the level and temperature information from the Enraf field bus at the moment the related level gauge answers to the host interrogating request. The level data is copied from B-records, L-records or D records. The temperature data is only copied from C-records.

If the temperature is measured internally by the 877 FDI, then the host can request the temperature data at the same transmission address as the level gauge. This concept is only valid for the level gauge types 854 ATG and 854 XTG when equipped with XPU board. Please note that separate requests must be made for level (B-record) and temperature (C-record).

In master mode and master display scan mode, there is no host connected and the 877 FDI request for level and temperature information from the connected level gauge.

In HTG mode and stand alone temperature gauge mode, the 877 FDI is a gauge. In HTG mode, the gauge performs level, observed density and optionally temperature measurements. In stand alone temperature gauge mode, only temperature is measured, without the need for a level value.

1.2 Operating modes

There are six different operating modes possible:

- indicator mode
- indicator and fall back mode
- master mode
- master display scan mode
- HTG level gauge mode
- stand alone temperature gauge mode

Refer to figure 1.1 for an overview of the configuration with the different operation modes.

Indicator mode

The host is the master on the Enraf field bus line and request for level and temperature from the connected level gauges. Each 877 FDI copies the level data from its related level gauge when the level gauge answers to the host request.

Temperature data can be retrieved either externally from the related level gauge (same as with level data) or internally via the optional temperature board in the 877 FDI.

If the temperature is measured by the 877 FDI internally, then the host can request for the temperature data at the same transmission address as the related level gauge, or at the transmission address from the 877 FDI.

If the host has not requested for data longer than the specified time-out, the display of the 877 FDI will show a status message and the level dimension, level type and temperature dimension is changed into exclamation marks.

Indicator and fall back mode

This mode requires the optional RPU board. The working is the same as with the indicator mode, except for the situation as the host is not requesting data anymore.

After the specified fall back time-out is passed, the transmission relay disconnects the Enraf field bus lines to the host and the 877 FDI request for level and eventually temperature. Then the transmission relay briefly switches back to monitor for communication from the host. If there is still no communication activity, the fall back time out is reset. Meanwhile, the level and temperature data is requested from the related level gauge approximately once per 2 seconds.

The time-out from the indicator mode watches over the display refresh from the level and temperature data requested by the 877 FDI. If the gauge is not responding on the 877 FDI request, the message: "No gauge answer" appears on the display. For a correct functioning of this mechanism this time-out must be set shorter than the fall back time-out.

If the host is polling again the level gauges, the transmission relay is closed and the indicator functions as described in the indicator mode.

Master mode

In master mode is no host system connected and the 877 FDI request for level data and eventually for temperature data from the connected level gauge. The refresh time of the data is approximately 0.5 seconds.

Master display scan mode

In master display scan mode is no host system connected and the 877 FDI request for one of the other display data than level and temperature from the connected level gauge. The data which can be requested in this mode is from one of the available display formats of the connected level gauge and must be specified in the 877 FDI.

HTG level gauge mode

In this mode the 877 FDI is a Hydrostatic Tank Gauge. The level, observed density (and optional) temperature can be measured by pressure transmitters (and optionally) a temperature probe. One of the following option boards should be installed in the 877 FDI: HPU, HSU or OPU.

Stand alone temperature gauge mode

When the 877 FDI is equipped with an optional TPU-2 board **and** the XPU-2 board then this mode can be selected. The 877 FDI measures the spot temperature without the need for a level value and transmits it to the host as product temperature.

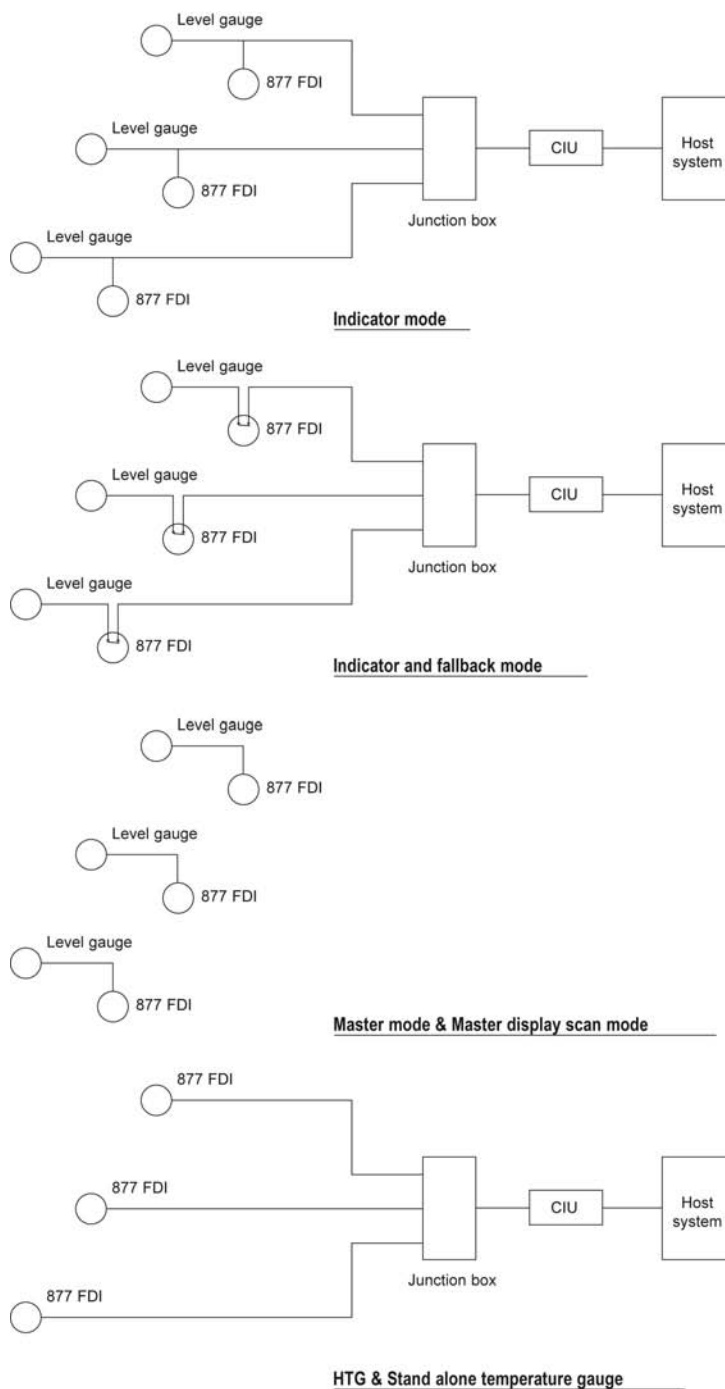


Figure 1.1 877 FDI configurations with different operating modes

1.3 Optional functions

Optional functions can be added in the 877 FDI when using one of the following optional boards of the 854 family: TPU-2, MPU, HPU, OPU or HSU board.

Alarm relay outputs and transmission relay for fall back option is optional available with the RPU board.

An XPU-2 board (in stead of the standard XPU board) is required with the following options: external HART water bottom probe (e.g. Honeywell Enraf 964 WaterScout) or RS-232C / RS-485 communication. In HTG level gauge mode it is possible to connect a 977 TSI (Tank Side Indicator) when the XPU-2 with i.s. channel is installed.

The table below gives an overview of all options and related manuals.

Option	Board	Refer to
Level alarm output relays (or digital outputs)	RPU	Instruction manual RPU alarm output contacts (4416258)
Analog level output (4 - 20 mA)	MPU	Instruction manual MPU analog 4 - 20 mA (4416222)
Spot temperature measurement	TPU-2 <i>or</i> HSU	Instruction manual TPU-2 / HSU option board (4416253)
Average temperature measurement via 864 MTT and 862 MIT	MPU <i>or</i> HPU <i>or</i> OPU	Instruction manual 862 MIT (4416231)
Average temperature measurement via 863 MRT and 862 MIR	MPU <i>or</i> HPU <i>or</i> OPU	Instruction manual 862 MIR (4416230)
Pressure measurement for mass, density and/or vapour pressure via HART protocol	HPU <i>or</i> HSU	Instruction manual HIMS (4416241) Instruction manual HTG (4416242)
Pressure measurement for mass, density and/or vapour pressure via Honeywell DE protocol	OPU	Instruction manual HIMS (4416241) Instruction manual HTG (4416242)
Water bottom measurement via external HART probe	HPU <i>or</i> HSU and XPU-2	Instruction manual Water bottom measurement via capacitive probe (4416595)
RS-232C / RS-485 communication (only possible in HTG and stand alone temperature gauge mode)	XPU-2	Instruction manual XPU-2 option RS-232C / RS-485 (4416237)
Tank Side Indicator connection (only possible in HTG mode)	XPU-2 i.s.	Instruction manual 977 TSI Tank Side Indicator (4416266)
Listening mode for Modbus with 854 XPU-2 up from version H2.6	XPU-2 (up from version I2.5)	Instruction manual Modbus protocol Honeywell Enraf gauges (4416513)

1.4 Approvals (FM, ATEX)

The Honeywell Enraf Field Display & Interface is certified explosion proof by official testing institutes as Factory Mutual and PTB (ATEX). The indicator is also approved and certified by Weights and Measures (W&M) or Custom and Excise authorities for legal use and custody transfer.

2 Safety

2.1 Safety aspects of the 877 Field Display & Interface

Warning

The 877 FDI is designed to copy the level, temperature and other data from Honeywell Enraf level gauges or can be used as an HTG gauge or stand alone temperature gauge. The instrument can be used in hazardous areas (refer to explosion proof certification data below). Do not apply the instrument in another operational area than mentioned above with the classifications mentioned below. For other applications, contact Honeywell Enraf.

The housing of the 877 FDI is made of aluminium and certified as explosion proof:

- EEx d [ja/ib] IIB T6 according to ATEX (KEMA: 03ATEX1098 X)
- Class I, Division 1, Groups B, C and D in accordance to NFPA, certified by FM (FM no.: 2Q1A6.AE)
- Class I, Groups C and D, CSA Encl 4, certified by CSA (Certificate Number: LR 46612-11)

The environmental conditions for the 877 FDI are:

ambient temperature : -40 °C to +85 °C (-40 °F to +185 °F)
 relative humidity : 0 - 100 %
 ingress protection : IP67 (NEMA Type 6P), suitable for outdoor installation
 over voltage category : II
 pollution degree : I

One of the three cable entries is available for wiring of the intrinsically safe options, such as temperature and pressure measurement.

The cover can optionally be provided with blocking facilities which prevents unauthorized opening.

Programming (configuration) of the 877 FDI can be done by the 847 PET (Portable Enraf Terminal), which is an intrinsically safe device and is connected to the 877 FDI via an infra-red coupling.

Caution

The 877 FDI is an explosion proof instrument with intrinsically safe output/input circuits. Modification to the instrument may only be carried out by trained personnel which is authorized by Honeywell Enraf. Failure to adhere to this will invalidate the approval certificate.

The safety approval can become invalid when the instrument housing is damaged. Directly inform Honeywell Enraf in this case to verify if the instrument can still be used.

2.2 Personal safety

Safe execution of the procedures in this manual requires technical experience in handling tools, and knowledge of safety regulations in handling electrical installation in hazardous environments.

The sequence of steps in a procedure may also be important from the point of view of personal safety and prevention of damage; it is therefore advised not to change the sequence of procedure steps or modify any procedure in any other way.

Warning

*In hazardous areas it is compulsory to use personal protection and safety gear such as:
hard hat, fire resistive overall, safety shoes, safety glasses and working gloves.*

*Avoid possible generation of static electricity. Use non-sparking tools and explosion proof testers.
Do not open the instrument cover while power is still connected.*

Never start working before the work permit is signed by all parties.

2.3 Safety conventions

"**Warnings**", "**Cautions**", and "**Notes**" have been used throughout this manual to bring special matters to the immediate attention of the reader.

- A **Warning** concerns danger to the safety of the technician or user;
- A **Caution** draws attention to an action which may damage the equipment;
- A **Note** points out a statement deserving more emphasis than the general text, but not requiring a "Warning" or a "Caution".

3 Commissioning

Caution

*Keep screw threads from the cover free from dirt.
Grease them lightly with an acid-free grease before closing the instrument.
When closing, turn the cover counter-clockwise until the tread clicks in place, then turn clockwise.*

3.1 Checks before starting the commissioning

- Check that the mains voltage selector of the 877 FDI is set for the correct mains supply
- Check the connections of all electrical cabling
- Check that the ground connection is made
- Check that non-used cable inlets are sealed with appropriate stopping plugs
- Close the cover carefully (mind the O-ring) before any electrical power is applied

3.2 Introduction into programming the 877 FDI

The 877 FDI is a field configurable instrument with one (or more) microprocessors boards. The instrument can be totally programmed in the field, or remotely, without opening the instrument.

It is recommended to use an 847 PET (Portable Enraf Terminal) to load the different parameters. It is coupled to the 877 FDI via an infra-red coupling. The 847 PET is intrinsically safe and waterproof (IP65) and consists of a full ASCII membrane keyboard and an LCD display.

Alternatively, the Honeywell Enraf service tool Ensight can be used to configure the instrument. The Ensight program runs under MS- or PC-DOS 3.0 or higher. It is recommended to use the service tool to make a log file of the instrument. A log file contains all important settings and the information is stored on the hard disk (or diskette).

For more information, refer to the Instruction manual Ensight service tool.

The item concept

All parameters, settings, etc. are accessible via so-called items. These items all have unique 2-letter abbreviations which allow easy access and programming. In this manual, items are printed **bold**. There are three different type of items:

Type of item	Description
Commands	These will force the instrument to execute a special task or function. For example: EX (exit). After the EX command the instrument starts initializing and modified NOVRAM settings become active.
Data requests	Items for request of setup or measured data from the instrument. For example: JS (jumper setting). Item JS returns the jumper setting on the XPU(-2) board. Some of the data items are read only.
NOVRAM settings	All parameters which can be programmed and should not be lost after a power break down, are stored in NOVRAM. The NOVRAM is a non-volatile RAM memory which does not require battery back-up.

Data stored in NOVRAM can be protected by a password and by the Weights & Measures (W&M) jumper on the XPU(-2) board (refer to figure 3.1).

Protection levels are provided for all NOVRAM items, depending on the importance of an item. Protection level 1 is protected by password 1 (**W1**) and protection level 2 is protected by password 2 (**W2**).

If the NOVRAM is protected by the W&M jumper J(A)3, level 2 NOVRAM items cannot be changed without opening the instrument, thereby breaking off the sealing.

Most data requests and commands are not password protected.

Protection level 1

Access to items which are not directly measurement related, such as the master mode display format (item **RV**), tank identifier (item **TI**), etc. is protected by password 1 (**W1**). It is possible to modify these data only after entering the correct level 1 password W1=XXXXXX, where XXXXX is the level 1 password.

Password **W1** itself can be read protected by means of jumper J(A)1 on the XPU(-2) board.

Protection level 2

All NOVRAM items which affects the remote level reading, such as level time-out (item **TO**), gauge address (item **GA**), etc. are protected by password 2 (**W2**). It is possible to modify these data only after entering the correct level 2 password W2=XXXXXX, where XXXXX is the level 2 password. Additional measurement related items, such as temperature items, can also be protected by password 2.

Password **W2** itself can be read protected by means of jumper J(A)2 on the XPU(-2) board.

In protection level 2, the items which resides under protection level 1 can also be modified.

Weights & Measures protection

Items under protection level 2 can also be protected by jumper J(A)3 on the XPU(-2) board. If this jumper is placed in position 1, the write access is completely disabled. Also issuing the correct level 2 password will not work.

The table below gives an overview of the XPU(-2) jumper functions (refer also to figure 3.1).

Jumper (XPU / XPU-2)	Function	Position "0"	Position "1"
JA1 / J1	read password 1	not protected	protected
JA2 / J2	read password 2	not protected	protected
JA3 / J3	W&M protection	not protected	protected
JA4	NOVRAM initialising	active	not active
JA5 - JA7 / J4 - J6	spare		

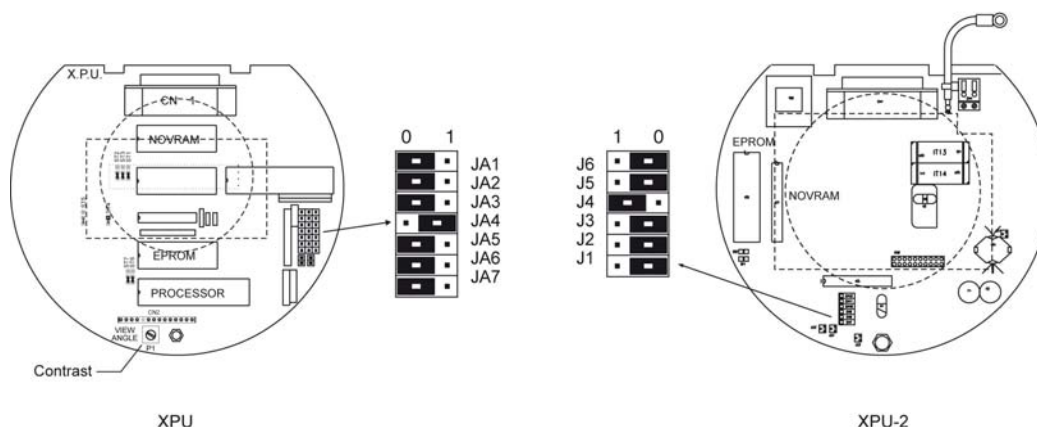


Figure 3.1 Jumpers on XPU and XPU-2 board

How to program?

When the 847 PET is connected to the 877 FDI (via the infra red connector) and the instrument is powered, the PET can be switched on. By operating the keyboard, items can be requested and settings can be changed. For example:

Item (+ setting) (typing in on PET keyboard)		Description
TO	<enter>	Request for the current value of item TO (level time-out). Reply on PET display will be: TO03 This means: the level time-out is 3 minutes.
W2=ENRAF2	<enter>	Enter protection level 2 (default level 2 password is: ENRAF2).
TO=01	<enter>	Give the required setting for the level time-out (here, as an example: 1 minute).
EX	<enter>	Exit protection level 2. The 877 FDI will now initialise and the new entered value for the level time-out will become active after the re-start.

Recommended programming sequence

The 877 FDI is already pre-programmed at the factory. However, several parameters, application depended, must be programmed at commissioning.

- Step 1** Start with programming / checking of the format depended items (refer to section 3.3)
- Step 2** Proceed with programming / checking of the items for the standard indicator function, without optional functions (refer to sections 3.4, 3.5)
- Step 3** Check with the identification code on the label of your 877 FDI whether the instrument is equipped with one or more optional functions, and program the items for that options (refer to section 3.6 and to the appropriate option manuals)

Apply power to the 877 FDI

To program the instrument, power must be switched on. That should be done in this stage.

3.3 Selecting dimension and decimal separator

When the 877 FDI is used as indicator, the level and temperature dimension **must** be set to the same unit as from the related level gauge. When used as HTG level gauge or stand alone temperature gauge, the level and temperature dimension can be freely selected.

When one of the dimension items are changed, all items with related formats have to be changed and the values must be converted to the new dimension. The same applies for the decimal separator.

Note:

*When the 877 FDI is equipped with an XPU-2 board (can be recognised by requesting the software version item **SV** read: XPU ... Ix.x), then all dimension depended items will be automatically changed and the values will be automatically converted.*

Item	Name	Description
W2=	Protection level 2	Enter protection level 2 (default password: ENRAF2).
LD=	Level dimension	<p>Selects the level dimension. This item contains one character, which can be:</p> <p>M : metres; format: sign X X X separator X X X X</p> <p>F : feet; format: sign X X X X separator X X X</p> <p>I : inches; format: sign X X X X X separator X X</p> <p>P : fractions; format: sign X X “ X X “ X X</p>
TD=	Temperature dimension	<p>Selects the temperature dimension. This item contains one character, which can be:</p> <p>C : degrees Celsius</p> <p>F : degrees Fahrenheit</p>
DP=	Decimal separator	<p>The decimal separator character can be:</p> <p>. : point, or</p> <p>, : comma</p>
.. =	<i>format depended items</i>	<p>Not required with XPU-2 board.</p> <p>Program all level dimension and/or decimal separator depended items to the new dimension format and/or separator. Refer to the table below for an overview of these items.</p>

EX Exit Exit protection level.

Items from which the format depends on the level dimension and decimal separator			Additional items from which the format depends on the decimal separator	
AH	LM*)	MP*)	28*)	M1*)
AM*)	LN*)	RP*)	29*)	M2*)
AN*)	LP*)	UR	DL*)	M3*)
HA	LS*)		DU*)	O1*)
HH	MG*)		H1*)	O2*)
IL*)	MI*)		H2*)	O3*)
LA	MK*)		H3*)	PH*)
LL	MO*)		HD*)	RO*)

*) The presence of these items depends on the installed option board(s).

Standard floating point format

Some items are expressed in a floating point format. The floating point format is a fixed format;

Standard floating point format: sign point M M M M M M M M E sign P P

where: M = Mantissa
 P = Exponent

3.4 Indicator settings

For the standard indicator functions, the following items are to be programmed / checked:

Item	Name	Description										
W2=	Protection level 2	Enter protection level 2 (default password: ENRAF2).										
IM=	Indicator mode	<p>This item contains one character, which selects the indicator mode. The selections can be:</p> <p>I : Indicator mode; Copies the level (and temperature) from the Enraf field bus. (Only XPU-1 GPU or XPU-2 up from version I2.5 in Modbus mode)</p> <p>F : Indicator and fall back mode; As with indicator mode, but with fall back option (requires optional RPU board).</p> <p>M : Master mode; Request for level (and temperature) form the connected level gauge. In this mode no host connection is possible.</p> <p>D : Master display scan mode; As with master mode, but now one of the available display formats (A - J) from the connected level gauge is displayed.</p> <p>H : HTG level gauge mode; The 877 FDI is now set up as HTG level gauge (optional HPU, OPU or HSU board is required).</p> <p>T : Stand alone temperature gauge; The 877 FDI is now set up for temperature measurement without the need for a level value (XPU-2 board and optional TPU-2 board are required).</p>										
TF=	Temperature source selection	<p>This item contains one character which determines whether the temperature is measured internally or externally;</p> <p>I : Internal; optional temperature board required.</p> <p>E : External; temperature fetched from Enraf field bus.</p>										
RV=	Master mode display format request	<p>This item contains one character which selects the required display format.</p> <p>Only used when item IM is set to: "D".</p> <table><tr><td>A : Display format A</td><td>F : Display format F</td></tr><tr><td>B : Display format B</td><td>H : Display format H</td></tr><tr><td>C : Display format C</td><td>I : Display format I</td></tr><tr><td>D : Display format D</td><td>J : Display format J</td></tr><tr><td>E : Display format E</td><td></td></tr></table>	A : Display format A	F : Display format F	B : Display format B	H : Display format H	C : Display format C	I : Display format I	D : Display format D	J : Display format J	E : Display format E	
A : Display format A	F : Display format F											
B : Display format B	H : Display format H											
C : Display format C	I : Display format I											
D : Display format D	J : Display format J											
E : Display format E												
TO=	Level time-out	<p>Two digits; units: minutes. Gives a time-out on the received level and temperature data. When this time expires, a status message is displayed and the level dimension, level type and temperature dimension changes into exclamation marks. The last valid values for level and temperature remains on the display.</p>										
GA=	Gauge address	<p>Two digits; default value: 99.</p> <p>In this item is programmed the transmission address of the related level gauge. From the related level gauge the level and temperature, if required, are copied.</p> <p>Do not program this item when the indicator mode (item IM) is set to "H" (HTG level gauge) or "T" (stand alone temperature gauge).</p>										

Continue:

Item	Name	Description								
TA=	Transmission address	<p>Two digits; default value: 00.</p> <p>The transmission address identifies the instrument on the Enraf field bus. Each instrument (level gauge <i>and</i> indicator) must have a unique address and hence TA must be programmed differently.</p> <p>Note: <i>Item TA must differ from item GA.</i></p> <p>When connected to an 858 CIU, please note that the 858 CIU has three highways, containing the following transmission addresses:</p> <table><tr><th>CIU highway</th><th>Transmission address (TA)</th></tr><tr><td>TL 1</td><td>00 - 29</td></tr><tr><td>TL 2</td><td>30 - 59</td></tr><tr><td>TL 3</td><td>60 - 99</td></tr></table>	CIU highway	Transmission address (TA)	TL 1	00 - 29	TL 2	30 - 59	TL 3	60 - 99
CIU highway	Transmission address (TA)									
TL 1	00 - 29									
TL 2	30 - 59									
TL 3	60 - 99									
TI=	Tank identifier	Six characters. Used as a label; the tank name can be programmed in the tank identifier item (spaces are not allowed!).								
TS=	Transmission speed	Four digits; either 1200 (default) or 2400. Units: baud. Item TS must correspond with item TS from the related level gauge.								
GT=	Gauge type	One character. Represents the gauge type. For most applications, GT=B (item GT must correspond with item GT from the related level gauge).								
EX	Exit protection level 2.	The instrument will now initialise and after start-up, the modified settings become active.								

Example:

The indicator from tank 812 is programmed. Level gauge address is 12; indicator address becomes 13.
The 877 FDI will be used in indicator mode with a level time-out of 2 minutes. Temperature is copied from the level gauge.

Item +(setting)		Description
W2=ENRAF2	<enter>	Enter protection level 2 (ENRAF2 is the default level 2 password).
IM=I	<enter>	Sets 877 FDI in indicator mode.
TF=E	<enter>	Temperature is copied from related level gauge.
TO=02	<enter>	Sets level time-out on 2 minutes.
GA=12	<enter>	Sets gauge address to transmission address of related level gauge.
TA=13	<enter>	Program the transmission address of indicator as 13.
TI=LI-812	<enter>	Tank identifier programmed as: "LI-812".
TS	<enter>	Check whether the transmission speed is correct; if not, change it.
GT	<enter>	Check whether the gauge type is set correct; if not, change it.
EX	<enter>	Exit protection level.

3.5 Display control and password protection

Item	Name	Description										
W2=	Protection level 2	Enter protection level 2 (default password: ENRAF2).										
DF=	Display format	<p>One character. Selects the data which will be shown on the display (refer to appendix B for a detailed overview).</p> <p>A : level and temperature B : level C : average gas temperature D : average product temperature E : HIMS or HTG density F : pressure P1 G : pressure P2 H : pressure P3 J : analog output K : water level from external HART probe (only with XPU-2)</p> <p>In indicator mode, indicator and fall back mode, and master mode, select display format A or B.</p> <p>In HTG level gauge mode, one of the display formats A, B, E, F, G, or H can be selected.</p> <p>In stand alone temperature gauge mode, select display format D.</p>										
DE=	Level type	<p>One character; either C, I, or U.</p> <p>Must be set to the contents of item DE of the related level gauge.</p> <p>C : innage, compensated for hydrostatic level deformation I : innage (default) U : ullage</p>										
DJ=	Zero format	<p>One character which selects how the number zero is displayed:</p> <p>0 : as a “0” with “slash” O : as a capital letter “O”</p>										
W1=	Password 1	<p>Six characters, default password is: ENRAF1. You can define your own level 1 password by entering six characters.</p> <p>Password 1 is read protected if strap J(A)1 on the XPU(-2) board is set in position “1”.</p>										
W2=	Password 2	<p>Six characters, default password is: ENRAF2. You can define your own level 2 password by entering six characters.</p> <p>Password 2 is read protected if strap J(A)2 on the XPU(-2) board is set in position “1”.</p>										
WM=	Weights & Measures protection	<p>Four characters; either “A” (feature W&M approved) or “N” (feature not W&M approved). If the N is selected for a feature, the level dimension and level type on the display will be replaced by hashes: “### ##”.</p> <table><tr><th>Position</th><th>Feature</th></tr><tr><td>1</td><td>product level</td></tr><tr><td>2</td><td>interface 1 / Interface 2 (with 854 only)</td></tr><tr><td>3</td><td>water level from I3 or external water probe</td></tr><tr><td>4</td><td>dip mode on product level (with 854 only)</td></tr></table>	Position	Feature	1	product level	2	interface 1 / Interface 2 (with 854 only)	3	water level from I3 or external water probe	4	dip mode on product level (with 854 only)
Position	Feature											
1	product level											
2	interface 1 / Interface 2 (with 854 only)											
3	water level from I3 or external water probe											
4	dip mode on product level (with 854 only)											
EX	Exit	Exit protection level.										

3.6 Additional items for optional board

When the 877 FDI is equipped with an optional board (TPU-2, MPU, HPU, OPU or HSU board), the optional board must be declared present by means of item **OB** (optional board).

If temperature is measured by this optional board, mind the setting of item **TF** (temperature source selection) and item **EG** (enable temperature transmission).

Note:

The settings described below are not required when a XPU-2 is installed (877 FDI used as HTG level gauge or stand alone temperature gauge).

Item	Name	Description
W2=	Protection level 2	Enter protection level 2.
OB=	Optional board	<p>This item contains three character, which determines the installed option board. This can be:</p> <p>TPU : TPU optional board installed</p> <p>MPU : MPU optional board installed</p> <p>HPU : HPU, OPU, HSU or TPU-2 optional board installed</p> <p>- - - : no optional board installed</p>
TF=	Temperature source selection	<p>This item contains one character which determines whether the temperature is measured internally or externally;</p> <p>I : Internal; optional temperature board required.</p> <p>E : External; temperature fetched from Enraf field bus.</p>
EG=	Enable temperature transmission	<p>This item contains one character which enables/disables the transmission of the temperature data on a host request at the address of the related level gauge.</p> <p>Only used when item TF is set to: "I".</p> <p>E : Enables temperature transmission addressed at (GA)</p> <p>D : Disables temperature transmission addressed at (GA).</p>
EX	Exit protection level	

Hereafter, program the items of the optional function(s). Reference is made to the applicable option manual(s).

4 Operation display 877 FDI

The 877 FDI has an LCD display consisting of 2 rows of 16 characters each.

On the display, one of several formats will appear, depending on the status of the XPU(-2). Immediately after power on the display is blank. Once the power is stable for 20 seconds, the display will show its initialization message.

If the initialization of all processors is successful, the display will switch to its default display format, which is programmed in item **DF**.

The possible display formats are:

A level and temperature	F pressure P1
B level	G pressure P2
C average gas temperature	H pressure P3
D average product temperature	J analog level output
E HIMS / HTG density	K water level from external HART probe (only with XPU-2)

Refer to appendix B for an overview of the different display formats.

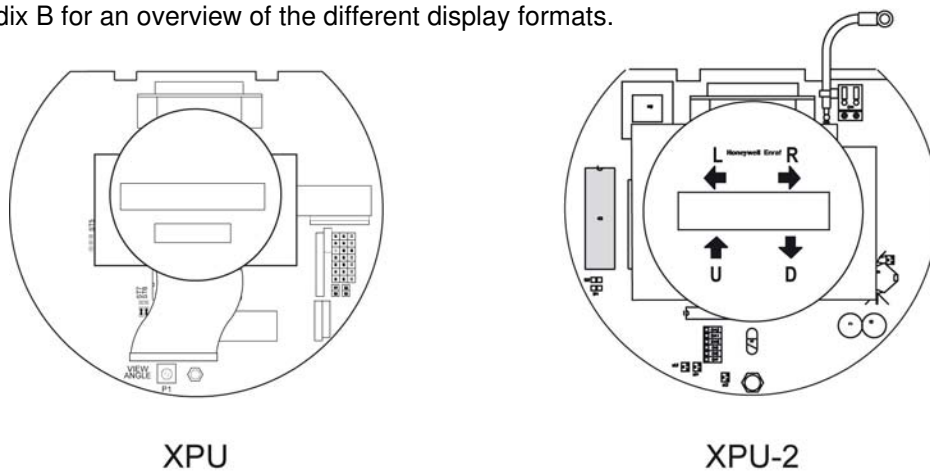


Figure 4.1 Display of XPU and XPU-2

4.1 XPU display

Display contrast

For best readability the viewing angle can be adjusted, using a small potentiometer on the XPU board, located on the bottom left (refer to figure 4.1). Normally, it is adjusted in the factory for viewing horizontally.

Display test using a test magnet

A magnetic reed switch is located below the display of the 877 FDI. When the reed switch is closed by means of a magnet, the XPU will perform a 4 second display test.

This test consists of:

- dark test - every dot on the display will be activated causing black squares (2 seconds)
- blank test - the display will be empty (2 seconds)

After releasing the read switch the display will switch to the default display format (programmed in item **DF**).

Display scroll with a test magnet

If the magnet is hold longer than 4 seconds in front of the reed switch, the display scrolls through all display formats. Each display format is visible for approximately 4 seconds.

After releasing the read switch the display stops scrolling and switches to the default display format.

4.2 XPU-2 display

Display contrast

Item **CD** allows the user to adjust the display contrast for maximum readability. **CD** can be set between 01 (minimum contrast) and 16 (maximum contrast). The display contrast can also be adjusted by means of the hall switches.

Additional displays

There are four hall switches located on the XPU-2 display, marked: “**L**”, “**R**”, “**U**” and “**D**” (refer to figure 4.1). These switches can be operated by holding a magnet in front of them.

Switch “**L**” allows scrolling through several additional displays. When an additional display is selected, further information can be requested by operating other switches. After 3 seconds the display switches back to the standard display format (programmed by item **DF**).

The additional display gives information on:

- Display configuration
- Display scroll
- NOVRAM item view
- XPU-2 error list
- System configuration
- Diagnostic view

The table below gives an overview of the additional display selections.

Function switch L	Additional display and function of other switches
1 st	Display configuration R display test (blank test / dark test) U display contrast up D display contrast down
2 nd	Display format toggle (formats A - K) U previous display format D next display format
3 rd	NOVRAM item view (all items) R fast forward U previous item D next item
4 th	Error list view (item EP) R fast forward U previous error D next error
5 th	System configuration (items: GA, GT, TA, TC, TH, TI, TS, WM) U previous item D next item
6 th	Diagnostic view (items: 00, 03, EI, OS, OT, EJ, EP, FH, FL, FM, FT, FX, PF, XS) U previous item D next item

The steps of switch **L** can only be followed in the sequence as given in the table above.

Display scroll

The XPU-2 display can be configured to scroll automatically through all display formats. This is done by setting item **3Z** to enable.

Item	Name	Description
W2=	Protection level 2	Enter protection level 2 password.
3Z=	Toggle display format	<p>One character; either "D" or "E". With this item the toggle display format function (display scroll) can be enabled or disabled. When enabled, all display formats are shown for approximately 2 seconds.</p> <p>E : enable toggle display format D : disable toggle display format</p>
EX Exit	Exit protection level	

5 Service and trouble shooting

The 877 FDI does not require preventive maintenance.

For mechanical and electrical installation, refer to the installation guide of the 877 FDI.

In case of an error, refer to section 5.3 (error codes) for an explanation of the error and a suggestion to solve it.

5.1 Layout 877 FDI

When the cover of the indicator is removed, the printed circuit boards and terminal row can be reached.

Figure 5.1 gives the cross section of the 877 FDI.

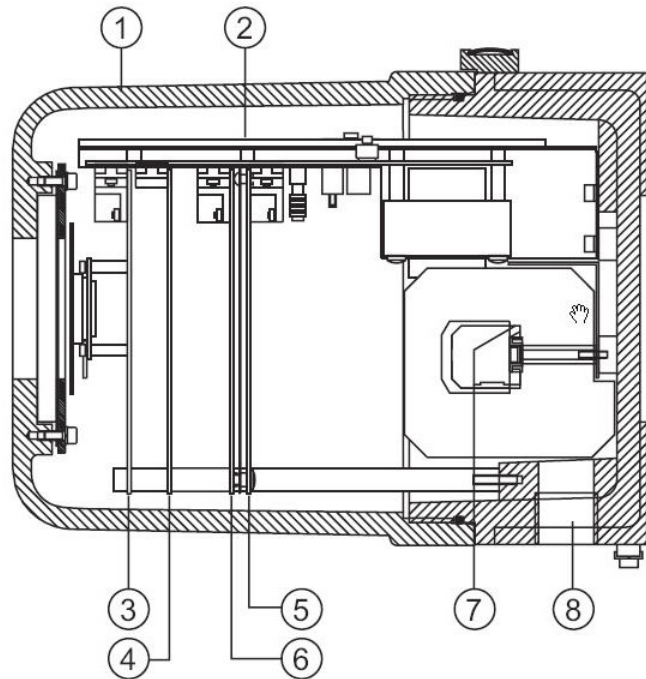


Figure 5.1 Cross section 877 FDI

Item	Description	Item	Description
1	Instrument cover	5	GPS board (supply board)
2	Backplane with mains transformer and mains selector	6	Optional board (one of the following: TPU-2, MPU, HPU, OPU or HSU)
3	XPU(-2) board	7	Terminals
4	RPU board (optional)	8	Cable entries (3 x ¾" NPT)

Caution

*Never remove the electronic boards when the mains power is connected to the indicator.
It may damage the electronic circuits.*

5.2 Instrument cover

The housing of the 877 FDI is classified as IP67. For this purpose, the cover is fitted with an O-ring.

Check the O-ring before closing the indicator.

Caution

Keep screw thread free from dirt. Grease it lightly with an acid-free grease before closing the instrument. When closing, turn the cover counter-clockwise until the tread clicks in place, then turn clockwise.

Warning

Never open the instrument while mains power is still connected.

5.3 Error codes

The 877 FDI is an instrument with self diagnostics. Detected errors will be shown as status information on the display (refer to Appendix B), or can be requested as an item by the PET (Portable Enraf Terminal).

Item **EP** contains the XPU(-2) error code. The XPU(-2) error code is a three digit number. When the XPU(-2) detects an error about a certain item, that item follows the error code, separated by a space.

For example: 067 LL : invalid level format in item **LL**.

Some XPU error codes of item **EP** are listed below, with suggestions for solving the problem. For a complete overview, refer to: "Item documentation for Honeywell Enraf series 877 FDI" and in the item help of the service program Ensité.

000	No error	
011	NOVRAM version error	New software is installed; requires NOVRAM initializing.
014	NOVRAM operation error	Set item 03 to "@"; check all settings, there may be an error.
017	NOVRAM init failed	NOVRAM seize too small. Use XPU-1 board with larger NOVRAM seize.
028	RPU start-up failure	RPU board not well connected in backplane, or defective.
029	Optional board start-up failure	Optional board not well connected in backplane, or defective.
036	Jumper setting changed	Jumper setting changed while power was on. Give reset (RS) command.
043	Missing RPU board	Missing RPU board or board not well connected in backplane, or defective.
051	Unknown item	Item not known to 877 FDI, check for correct item.
053	Invalid item length	Wrong data field, check for correct item setting.
056	Wrong protection level	First enter protection level 1 or 2.
067	Invalid level format	Check item LD , then give the setting in the correct level format.
071	Invalid decimal separator	Check item DP , then give the setting with the correct decimal separator.
082	Invalid password	Give the correct password for W1 and W2 .
086	Error: TA equal to GA	Change the address in item TA .
096	Password read not allowed	Sorry, no access to this data.
101	Watchdog error	The watchdog reset is a sign that there is a serious fault, caused by interference, or a faulty XPU(-2) board.
133	Fall back operation error	RPU board not installed or faulty RPU board; replace RPU board or select indicator mode.
134	No transmission relay mounted	Faulty RPU board; replace RPU board or select indicator mode.
135	Wrong indicator mode	Conflict in settings of items IM and HT , check the setting of these items.
136	RPU board not responding	Missing RPU board, or board not well connected in backplane, or RPU board defective.
137	Optional board not responding	Missing optional board, or optional board not well connected in backplane, or optional board defective.
999	Fatal XPU error	Serious internal XPU software error; check contents of item 00 and report to Honeywell Enraf Delft.

Item **FX** is a two digit fatal XPU error counter.

5.4 Update software

The actual version of the installed software can be checked with item **SV** (software version). Compare the combination of the software versions of the XPU, RPU and optional board with the value of **SV** in the “set-up and maintenance form” sent with every instrument.

If a software update is required, it is advised to make a log file with the service program Ensight, before changing the software. Later, the logged data can be loaded into the 877 FDI.

Changing software starts with removing the printed circuit boards. Proceed as follows:

- Switch off the mains power and remove the cover.
- Remove PCB retaining screw (B), slide the locking latch (A) on the XPU(-2) board to the right (refer to figure 5.2).
- Remove XPU(-2) board
- Disconnect the wiring from the RPU board and remove the RPU board (if present).
- Disconnect non i.s. wiring from the optional board (if present), and put the board temporary on the backplane (still connected via ground wire and blue i.s. wires).
- Change the EPROM's. Refer to Appendix C for the layout of the different processor boards.
- Install the processor boards in reverse order as they have been removed (mind the wiring!).
- Close the cover and apply mains power.

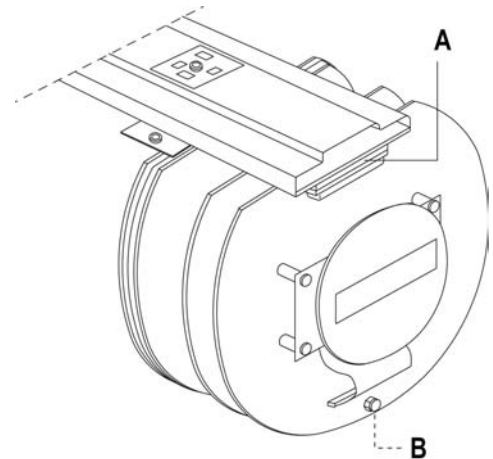


Figure 5.2 Locking latch

After updating the software, it may be required to initialize the NOVRAM (refer to section 5.5).

5.5 NOVRAM initialization

After updating software, or adding an optional function, it may be (or is) required to initialize the NOVRAM (NOVRAM init). With this procedure all items are declared in the NOVRAM and filled with their default value. After the initialization, reprogramming of all items is necessary.

The NOVRAM init procedure with an XPU board can be done as follows:

- Switch off mains and open cover.
- Switch over strap JA4 on the XPU board to position 0.
- Close cover and apply mains power.
- Wait till the NOVRAM initializing message is shown on the display.
- Hold the test magnet in front of the display.
- When the message “NOVRAM init completed” appears, switch off mains supply.
- Open cover and switch over strap JA4 to position 1.
- Close cover and apply mains power.

Alternatively, and for the XPU-2 **the only**, the following procedure can be used:

When the 877 FDI is powered, issue the **IN** command by the PET 3 times in sequence. After the first command, use twice the “_” key and “enter” key. No other command may interfere in this sequence.

Note:

To prevent other commands in the initialization sequence, the Enraf field bus lines may, temporary, be disconnected.

6 Remote Display via 877FDI - RS485 Modbus mode (XPU-2 up from I2.5)

The 877 Field Display & Interface (FDI) has a mode (indicator mode) that listens on the field line to capture data that is queried by the host system and replied by the level gauge. It is configured to listen to one specific level gauge and display its displacer position, temperature and status. This way the 877FDI becomes an XD safe secondary display that can be installed at a more accessible location than the level gauge itself.

*The host request must contain registers for displacer position and displacer position status (Modicon address 40040 thru 40042) in order for the indicator to be updated with data from the connected level gauge.

6.1 Configuration

Item	Name	Description
W2=	Protection level 2	Enter password 2.
BC=	Address byte CIU emulation	One ASCII character (default: -). For the Modbus RTU mode, it is required that there is no CIU address emulation. Therefore, this item must be set to ' - '.
TA=	Transmission address	Two ASCII numbers, ranging from 00 till 99 (default: 00). Read the transmission address and note it for use in the Modbus RTU addressing.
GA=	Gauge address	Two ASCII numbers, ranging from 00 till 99 (default: 00). Corresponds to transmission address (item TA of the connected level gauge) for which the 877 is an indicator for.
GM=	GPU / Modbus mode switch	One ASCII character (default: G) Selects the communication mode of the RS-232C / RS-485 communication channel {See 1)* section 5.2.4} G = Enraf GPU protocol M = Modbus RTU protocol
BI=	Baud rate	Four ASCII digits (default: 19K2) Selects the baudrate for the RS channel 1200 = 1200 baud 2400 = 2400 baud 4800 = 4800 baud 9600 = 9600 baud 19K2 = 19200 baud
TH=	Turn around host delay	Two ASCII digits (default: 01) Selects the turn around delay for the request/reply communication with the following delays supported: 01 = 10ms 10 = 100ms 02 = 20ms 20 = 200ms 03 = 30ms 30 = 300ms 04 = 40ms 40 = 400ms 05 = 50ms 50 = 500ms 06 = 60ms 60 = 600ms 07 = 70ms 70 = 700ms 08 = 80ms 80 = 800ms 09 = 90ms 90 = 900ms
TO=	Level timeout delay	Two ASCII numbers, ranging from 00 till 99 (default: 03). Number of minutes the 877FDI captures no level request/response between host and level gauge before an error is displayed. {See 2)* section 5.2.4}
EX Exit	Exit protection level.	

6.2 Display properties

The 877 FDI shall display the following data and their related statuses according to the level gauge for which it is an indicator for. Items LD and TD must have the same values as the gauge it is an indicator for.

The data display representation shall support the following dimensions for level.

Level dimension item LD	Modbus data representation
M	0.1 mm
F	0.001 ft
I	0.01 inch
P	$\frac{1}{16}$ inch

The data display representation shall support the following dimensions for temperature:

Temperature dimension item TD	Modbus data representation
C	0.01 °C
F	0.01 °F

Display will indicate '!!' for relay status as this is not supported.

6.2.1 Displacer position

The 877FDI shall only capture the displacer level from a Modbus message when the same message also contains the displacer level status.

The following level types, dimensions and statuses are displayed under given conditions:

Value	Dimension
m	Level in Meters
ft	Level in Feet
in	Level in Inches
/ ₁₆	Level in fractions
!!	Level never received / Level timeout

Value	Status
!!	Level never received
TO	Time-out. No level data captured for TO minutes
FL	Level failure
ML	Motor limit switch hit
BL	Gauge blocked
LT	Gauge in lock test
TE	Gauge in test
DW	Dipping for water
WL	Water level found
SD	Density scan active
??	Reduced accuracy
--	Valid level

6.2.2 Product Temperature

The 877FDI shall only capture the product temperature from a Modbus message when the same message contains the product temperature status.

The following level dimensions and statuses are displayed under given conditions:

Value	Dimension
°C	Valid temperature in Celcius
°F	Valid temperature in Fahrenheit

Value	Status
TO	Time-out. No temperature data captured for TO minutes
RA	Reduced accuracy
FL	Temperature failure
!!	Invalid temperature/Never received/Level time-out

6.2.3 Alarm Status

The 877FDI shall capture the alarm status from a Modbus message whenever this appears in a gauge reply to the host.

The following alarm statuses are displayed under given conditions:

Value	Status
!!	Never received
TO	Time-out. No alarm data captured for TO minutes
FF	Gauge Fail
LL	Gauge in Low Low Alarm
LA	Gauge in Low Alarm
HH	Gauge in High High Alarm
HA	Gauge in High Alarm
??	Unknown alarm status
--	No alarm

6.2.4 Error Messages

1)* The 877FDI will only support indicator mode (item IM = 'I') when in Modbus mode (item GM = 'M'). When not in Modbus mode the display will show message:

IM = 'I' only when GM = 'M'

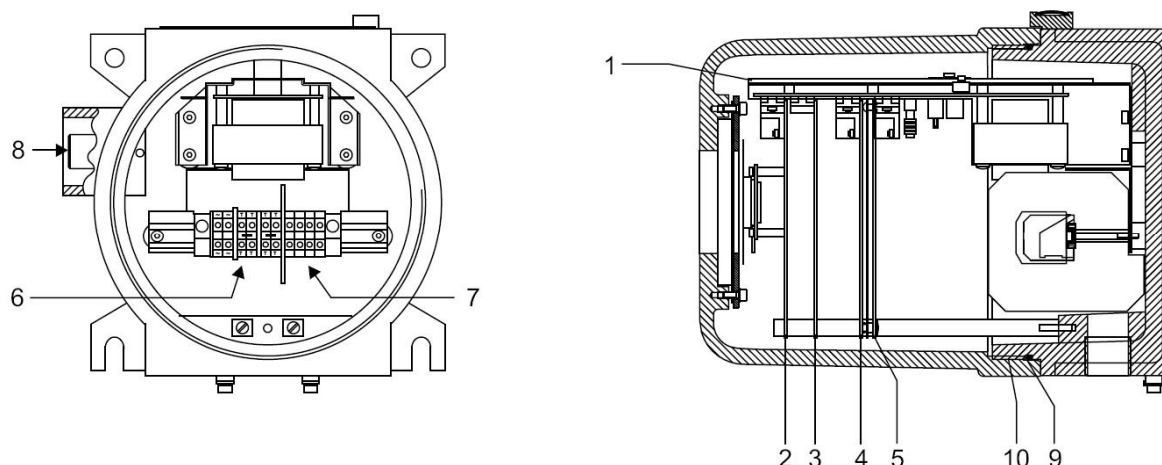
2)* Based on setting for item TO, to indicate a fault in the request/response communications between host and level gauge the 877FDI display will show the following:

99999999!! !!!
9999999 TO !! TO

Appendix A Article and part numbers

It is recommended to keep one set of printed circuit boards on stock for spare. This includes the backplane as the mains transformer is mounted on the backplane and the eventually installed optional boards.

No.	Description	Part no.
1	Backplane (with mains transformer 110 - 240 V) (with mains transformer 65 V)	0854.951 0854.964
2	XPU board without display (XPU board) (XPU-2 board) (XPU-2 board with RS-232C channel) (XPU-2 board with RS-485 channel) (XPU-2 board with i.s. output to 977 TSI)	0854.635 0873.620 0873.623 0873.624 0873.621
3	RPU board	0877.680
4	Optional board: TPU-2 board MPU board MPU board MPU board HPU board OPU board HSU board HSU board (Pt900)	0854.651 0854.658 0854.657 0854.656 0854.644 0854.665 0854.649 0854.652
5	GPS board Fuse 250 mA, 250 V Fuse 1 A, 250 V	0854.615 2655.169 2655.175
6	Terminals (grey)	2635.308
7	Terminals (blue)	2635.309
8	IR connector	0854.380
9	O-ring	2132.970
10	Grease, Anti seize	4000.015
	Test magnet for XPU board	0854.400
	Magnet for XPU-2 hall switches	0186.236

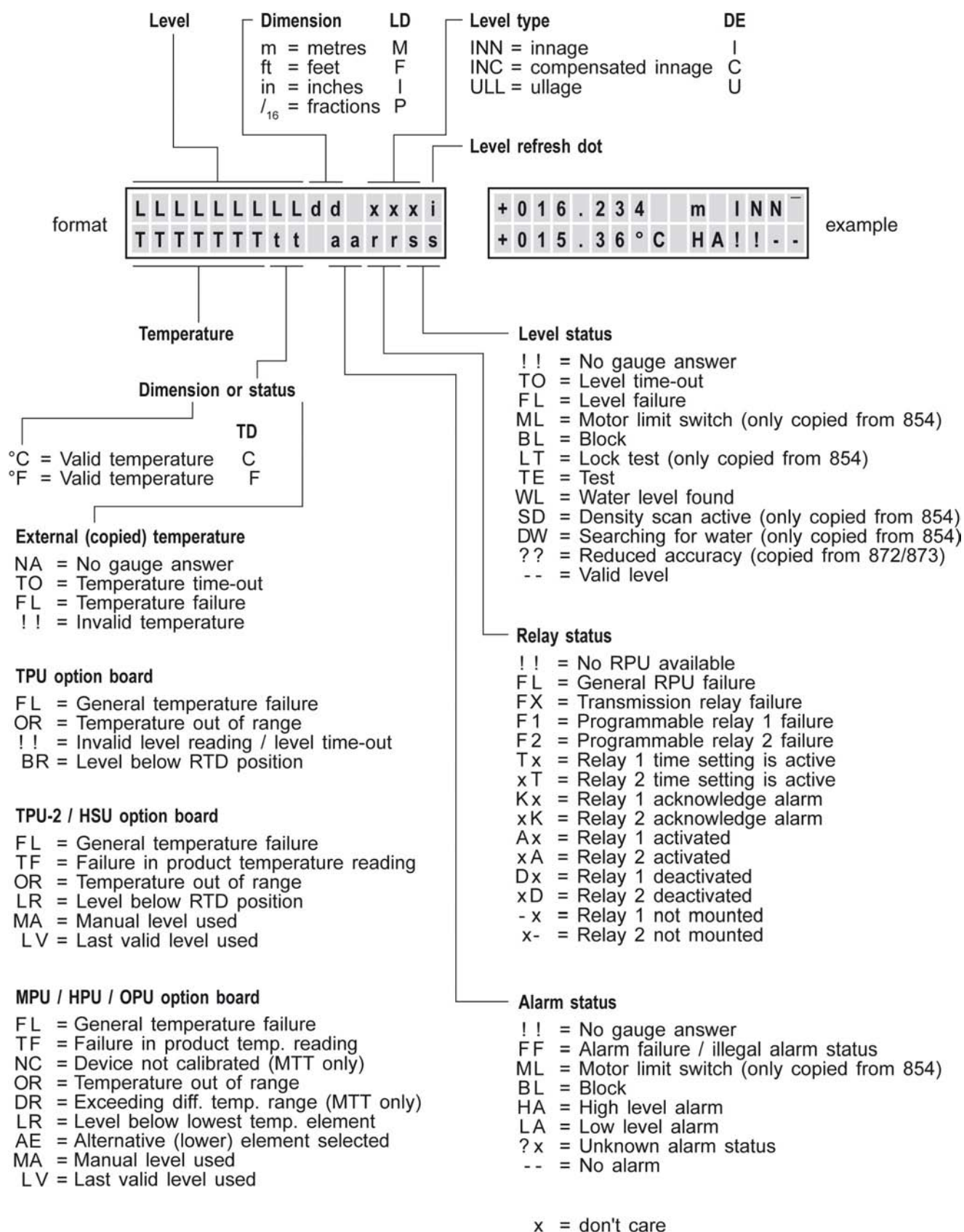


The printed circuit boards are delivered without EPROM's and on the XPU(-2) board the NOVRAM is not installed. These should be ordered separately; the part numbers are:

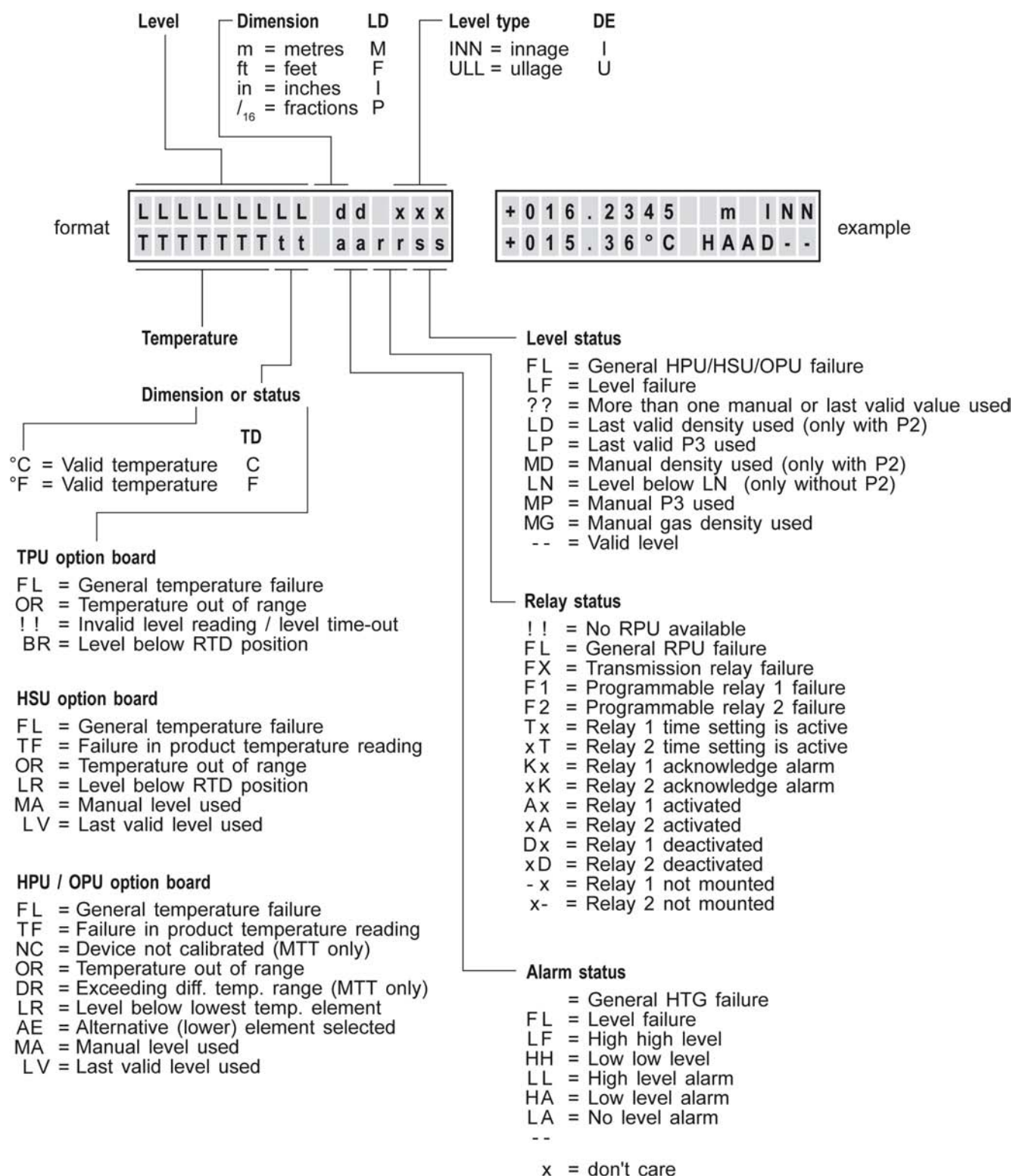
EPROM	Part no.	EPROM	Part no.	NOVRAM	Part no.
XPU	0181.192	HPU (MIR)	0181.143	XPU *)	2518.877
XPU-2	0181.193	HPU (MIT)	0181.144	XPU-1 *)	2518.936
RPU	0181.142	OPU (MIR)	0181.145	XPU-2	2518.929
MPU (MIR)	0181.154	OPU (MIT)	0181.146		
MPU (MIT)	0181.155	HSU / TPU-2	0181.147		

*) The XPU board is recently replaced by the XPU-1 board and is fully compatible with the XPU board. The only difference is a larger NOVRAM, which is (can be) installed on the XPU-1 board.

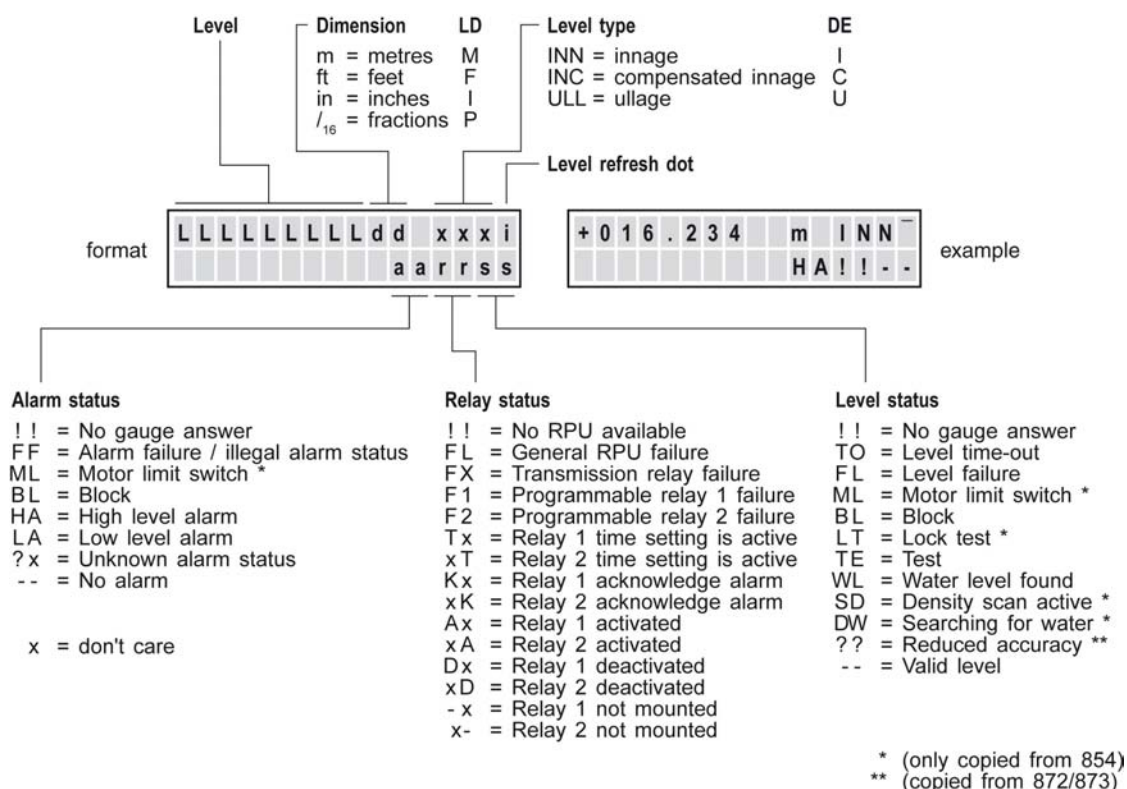
Appendix B Display formats



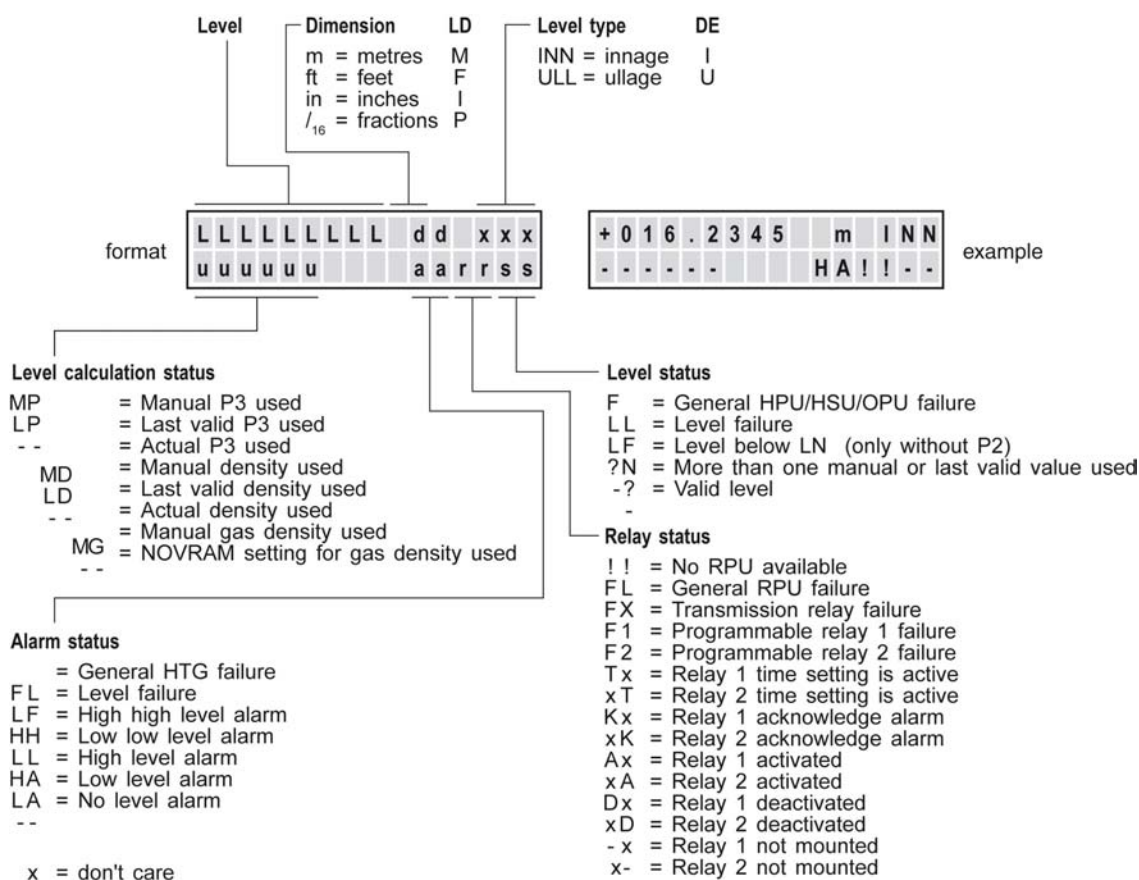
Copied level and temperature display (format A)



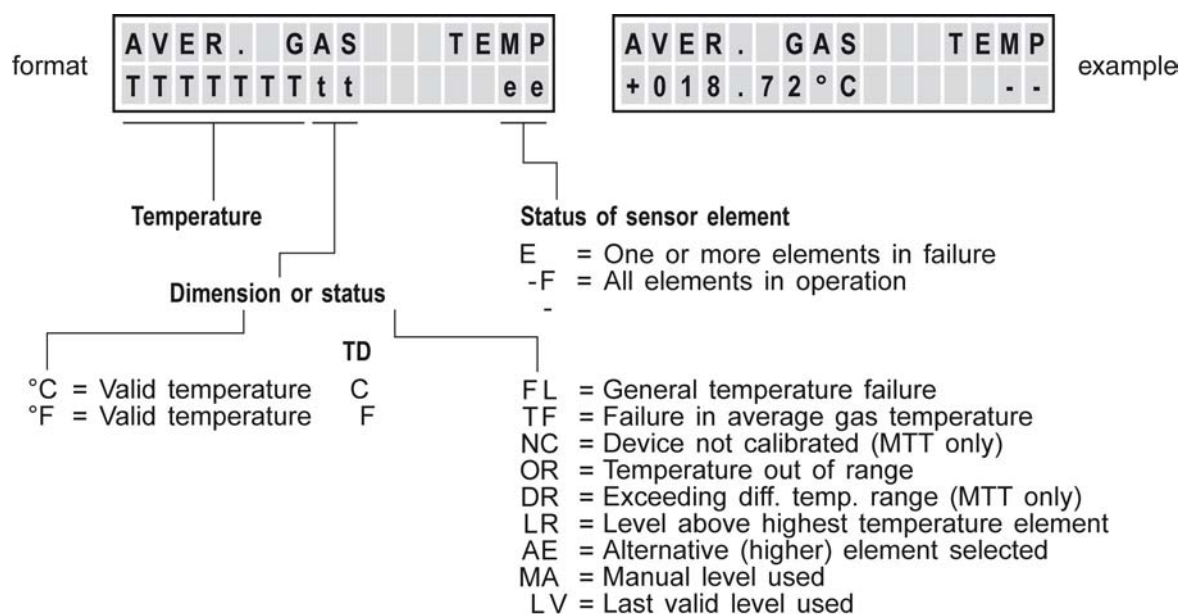
HTG level and temperature display (format A)



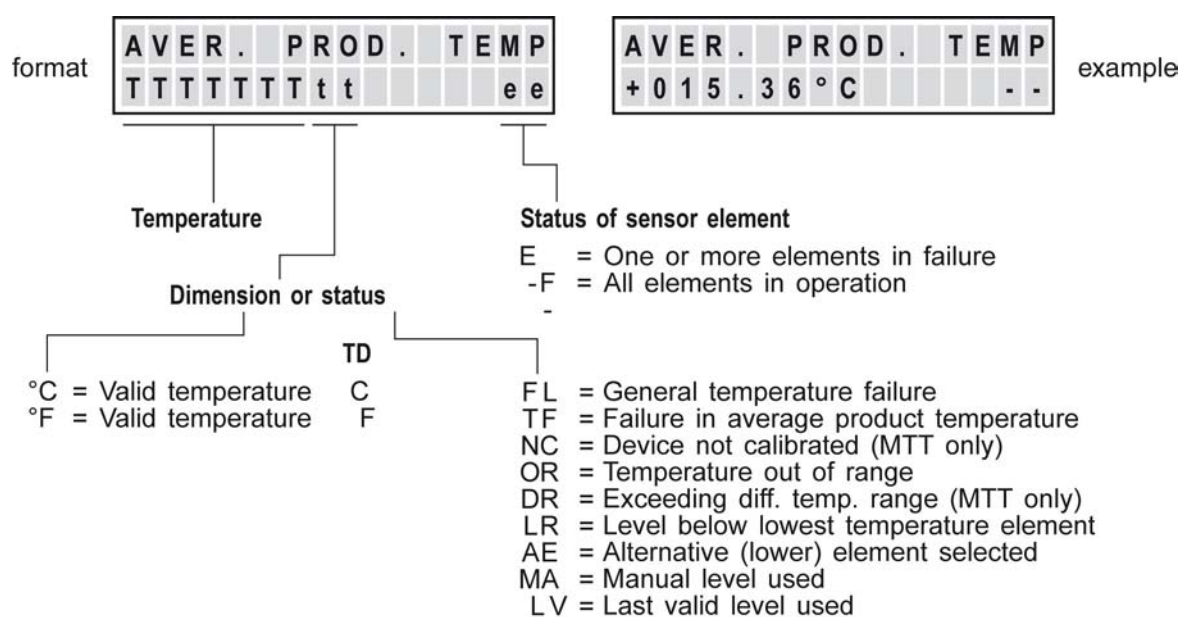
Copied level display (format B)



HTG level display (format B)



Average gas temperature display (format C)



Average product temperature display (format

Received level status

MA = Manual level used
 LV = Last valid level used
 LF = Level failure / invalid level
 LN = Level below minimum
 required level for HIMS
 -- = Valid level used

P3 status

MP = Manual P3 used
 LP = Last valid P3 used
 -- = Valid P3 used

Gas density / pressure status

FL = General HPU/HSU/OPU failure
 PF = Failure of P1 or P3
 OR = P1 or P3 out of range
 TR = P1 or P3 exceeds trip pressure
 MG = Manual gas density used
 -- = Valid density

General density status

FL = General HPU/HSU/OPU failure
 MD = Manual density
 LD = Last valid density
 OF = °API under/overflow or negative density
 DH = Density high alarm
 DL = Density low alarm
 -- = Valid density

format

O	b	.	D	E	N	S	.	a	a	b	b	c	c	d	d
D	D	D	D	D	D	D	D	e	e	e	e	e	e	e	e

O	b	.	D	E	N	S	.	-	-	-	-	-	-	-	-
0	0	8	1	1	.	5		k	g	/	m	³			

example

Observed density

Dimension

DI

kg/m³

°API

lbs/cuft

K

A

L

*HIMS density display (format E)***Density status 1 (HTG with P2)**

FL = General HPU/HSU/OPU failure
 PF = One or more transmitter(s) failure
 OR = One or more transmitter(s) out of range
 TR = One or more transmitter(s) exceeds trip
 pressure
 LN = Level below LN
 -- = Valid density

Density status 1 (HTG without P2)

FL = General HPU/HSU/OPU failure
 OF = °API under/overflow or negative density
 DH = Density high alarm
 DL = Density low alarm
 -- = Valid density

Density status 2 (with P2)

FL = General HPU/HSU/OPU failure
 MD = Manual density
 LD = Last valid density
 OF = °API under/overflow or negative density
 DH = Density high alarm
 DL = Density low alarm
 -- = Valid density

Density status 2 (without P2)

FL = General HPU/HSU/OPU failure
 MD = Manual density
 LD = Last valid density
 -- = Valid density

format

O	b	.	D	E	N	S	.							c	c	d	d
D	D	D	D	D	D	D	D	e	e	e	e	e	e	e	e	e	e

O	b	.	D	E	N	S	.							-	-	-	-
0	0	8	1	1	.	5		k	g	/	m	³					

example

Observed density

Dimension

DI

kg/m³

°API

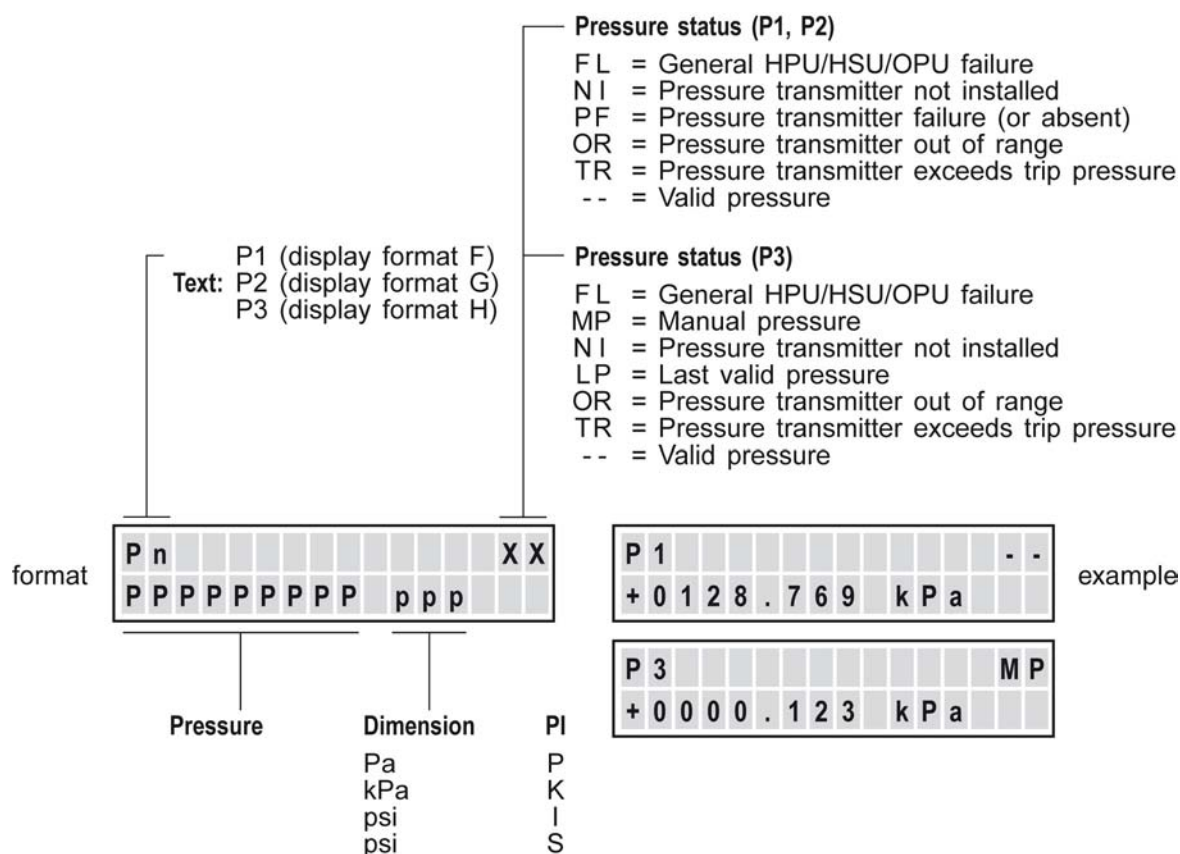
lbs/cuft

K

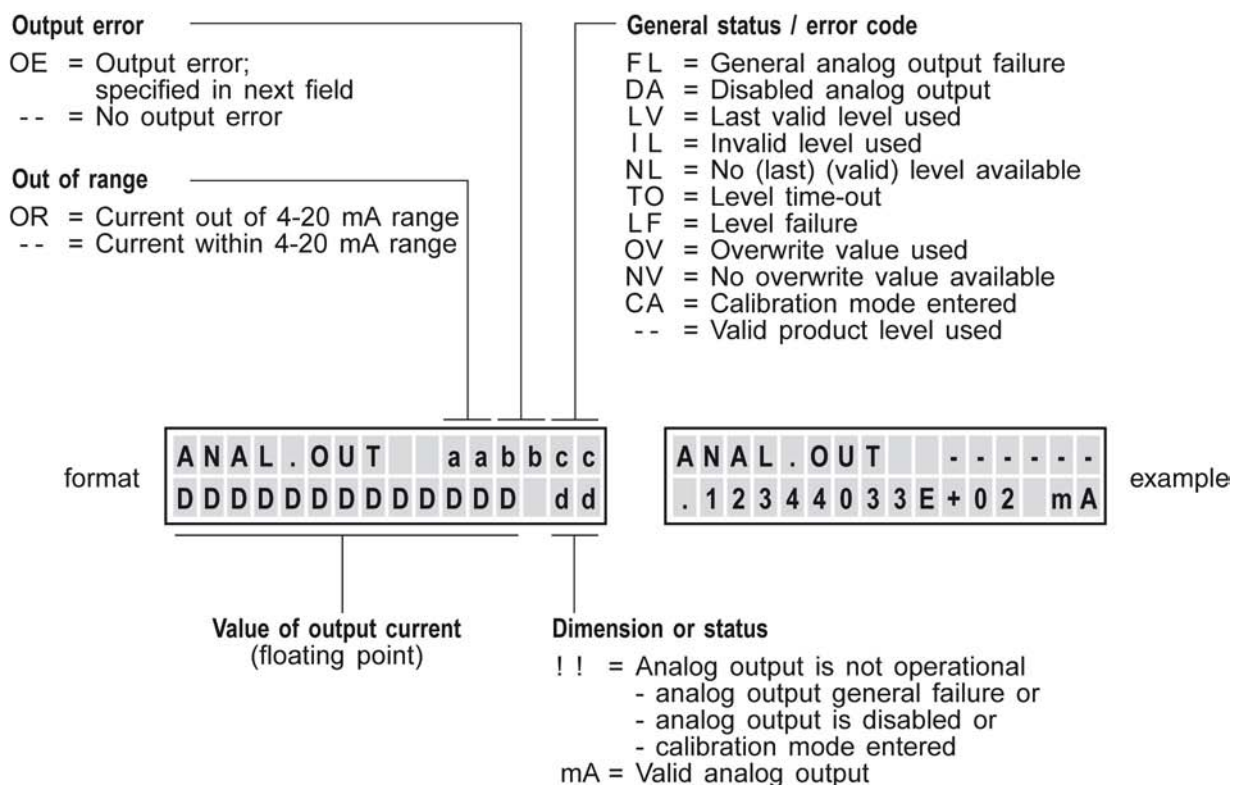
A

L

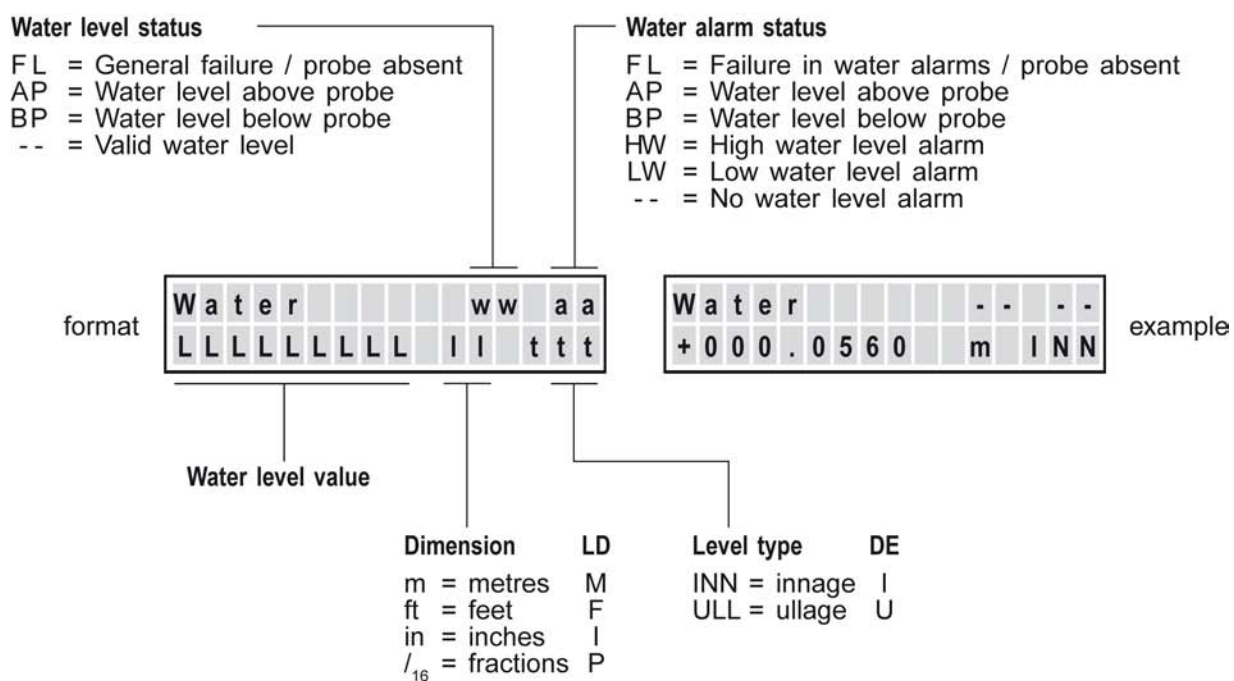
HTG density display (format E)



Pressure sensor P1, P2, P3 display (format F, G, H)



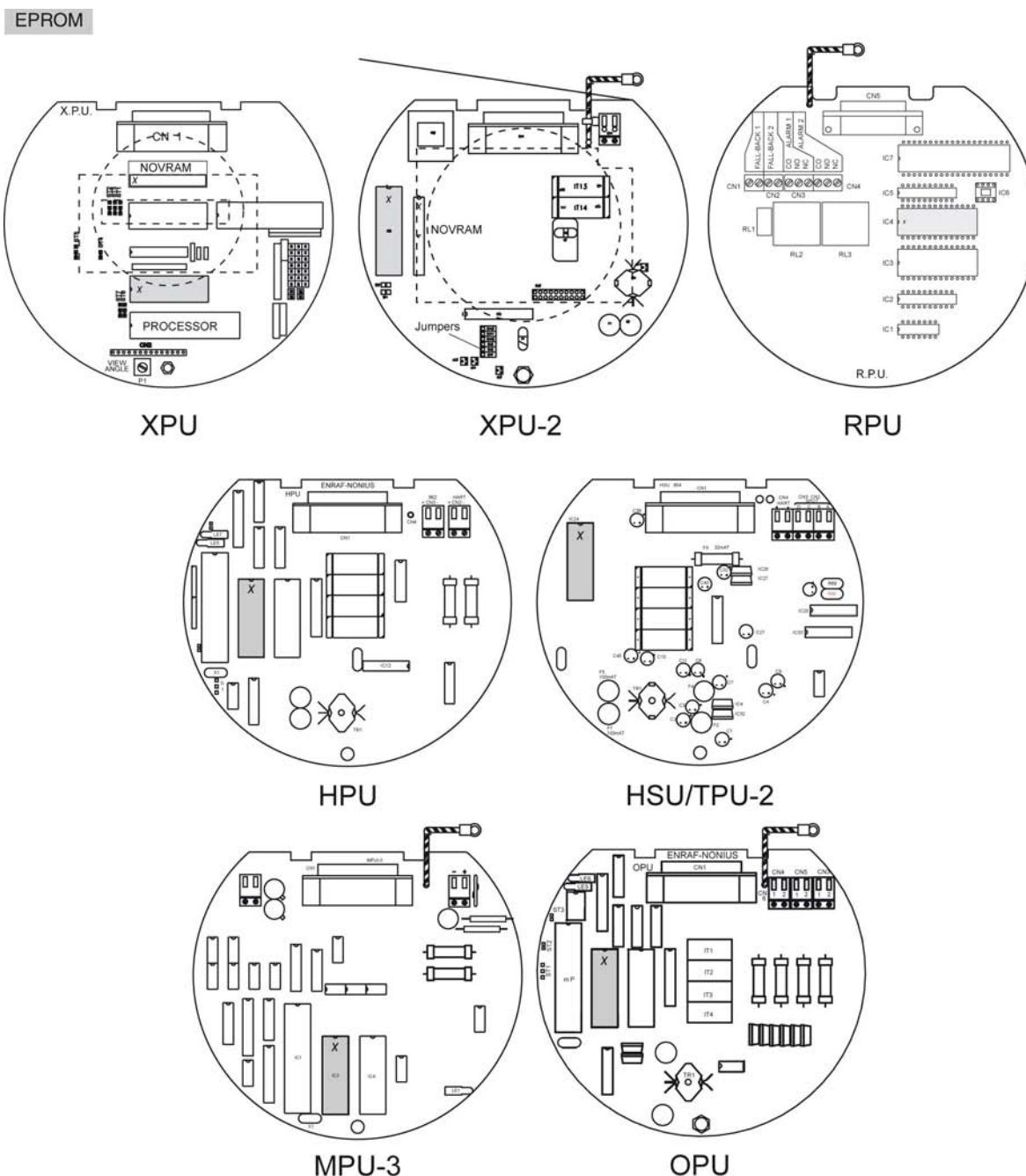
Analog level output display (format J)



Water level display (format K)

Appendix C PCB layout

The **x** inside the EPROM in the figure above notes the notch on the EPROM. The notch of the EPROM **must** fit with the notch of the EPROM socket on the processor board.



Layout of different processor boards

Appendix D Related documents

Title	Part no.
Installation guide 877 FDI Field Display & Interface	4416264
Instruction manual 977 TSI Tank Side Indicator	4416266
Instruction manual 847 Portable Enraf Terminal	4416210
Instruction manual RPU Hard alarm output contacts	4416258
Instruction manual MPU analog output 4 - 20 mA	4416222
Instruction manual TPU-2 and HSU option board	4416253
Instruction manual XPU-2 option RS-232C / RS-485	4416237
Instruction manual 862 MIR Multiple temperature selector	4416230
Instruction manual 862 MIT Multiple thermosensor selector	4416231
Instruction manual Water bottom measurement by capacitive probe	4416595
Instruction manual HIMS	4416241
Instruction manual HTG	4416242
Instruction manual Modbus protocol Honeywell Enraf gauges	4416513

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