

Operating Instructions
for
Smart Pressure Transmitter
Model: PAD



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2. Introduction

The PAD Smart Pressure Transmitter is correctly calibrated at the factory before shipment. To ensure correct and efficient use of the instrument, please read this manual thoroughly and fully understand how to operate the instrument before operating it

- (1) The contents of this manual are subject to change without prior notice.
- (2) All rights reserved. No part of this manual may be reproduced in any form without Kobold Messring's written permission.
- (3) If any question arises or errors are found, or if any information is missing from this manual, please inform the nearest sales office.
- (4) The specifications covered by this manual are limited to those for the standard type under the specified model number break-down and do not cover custom-made instrument.
- (5) Please note that changes in the specifications, construction, or component parts of the instrument may not immediately be reflected in this manual at the time of change, provided that postponement of revisions will not cause difficulty to the user from a functional or performance standpoint.

2.1 Using This Manual

The Chapters in this operating manual provide information on installing, operating, and maintaining devices from KOBOLD Model PAD Smart Pressure Transmitter. Chapters within this manual are organised as follows.

Chapter 3 Handling

Chapter 3 provides instructions on software functions, configuration parameters, and online variables.

Chapter 4 Transmitter Functions

Chapter 4 contains instructions for configuring and commissioning Model PAD Smart Pressure Transmitters.

Chapter 5 Installation

Chapter 5 contains mechanical, environment and electrical installation instructions for Model PAD Smart Pressure Transmitters.

Chapter 6 On-line Operation

Chapter 6 describes the configuration process and how to use basic and advanced Model PAD Smart Pressure Transmitter software functions during configuration.

Included in these sections are details on using:-

- (1) Sensor or Output Trim
- (2) Changing range configuration, Output Type, Damping, measurement units etc.
- (3) Change of general data such as Tag No. Date, Message etc.

Chapter 7 Maintenance

Chapter 7 contains hardware diagnostics, troubleshooting and maintenance tasks.

Appendix I : List of Error Codes available on LCD display

2.2 Overview of Transmitter

Kobold Smart Pressure Transmitter are microprocessor based “smart” pressure transmitters. It uses a piezoelectric/ capacitance pickup optimised & accurately characterised with a patented temperature compensation algorithm for high precision & long term stable gauge and absolute pressure measurements over a wide range of operating conditions. PAD is a two wire loop power transmitter and has a standard 4/20mA output scaled for desired output pressure range. In addition it also offers digital HART® (digital signal superimposed over the analogue output) communication that allows transmitting additional digital parameters/diagnostic information for advanced control systems like DCS, PLC. This transmitter can be configured remotely via HART® communication through a HHT (HART® Hand-Held Terminal using DDL or DOF technology) or any HART® enabled PC configurator. This allows critical variables to be changed, configured and tested remotely by users. Note: For HART® Communication a minimum 250~500 Ohm loop resistance is mandatory between power supply and transmitter.

2.3 Software Compatibility

KOBOLD Smart Pressure Transmitters are shipped from the factory with the most up to date firmware. However as product developments and new features are released a firmware update becomes necessary to incorporate these new changes. As such transmitters with older firmware may restrict certain functions when communicating with an external HHT(Model 275/375HART® Communicator). There may also be some differences on supported functions on the local push button menu based on the installed firmware revision of the transmitter. This manual is based on firmware Revision 6.3. Function deviations as to firmware Revision are same as in table below:

FUNCTION	Function Supports		
	ZERO / SPAN Button Version 6.3 or above	PC/UMPC	HART 275/375
ZERO/SPAN	●	●	●
ZERO TRIM	●	●	●
ZERO Adj	●	●	●
Units set	●	●	●
Range set	●	●	●
Damping set	●	●	●
LCD Decimal set	●	●	△
LCD Mode	●	●	△

- : Supported.
- △ : Supported but update required

2.4 Transmitter Components

The various components of PAD Series Smart Pressure Transmitter are shown below:

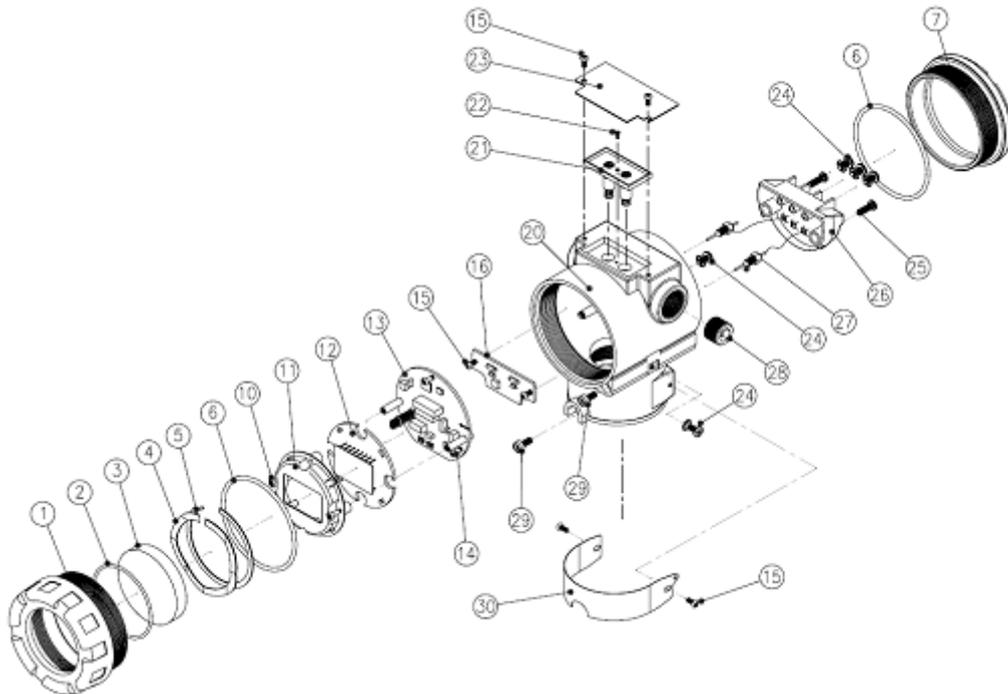


Figure 2-1. Model PAD Transmitter Exposed View (Housing)

P.N	PART NAME	P.N	PART NAME
1	FRONT COVER	20	HOUSING
2	O-RING/GLASS	21	ZERO/SPAN ADJUSTMENT SWITCH
3	GLASS	22	SCREW/ SWITCH COVER
4	WAVE WASHER	23	NAMEPLATE
5	C-SNAP RING	24	SCREW
6	O-RING/COVER	25	SCREW/TERMINAL BLOCK
7	REAR COVER	26	TERMINAL BLOCK
10	SCREW/LCD	27	EMI FILTER
11	LCD COVER	28	PIPE PLUG
12	LCD BOARD	29	SCREW
13	MAIN BOARD	30	TAGPLATE
14	SCREW/MAIN BOARD		
15	SCREW		
16	TERMINAL BOARD		

Figure 2-2. TRANSMITTER COMPONENTS (HOUSING)

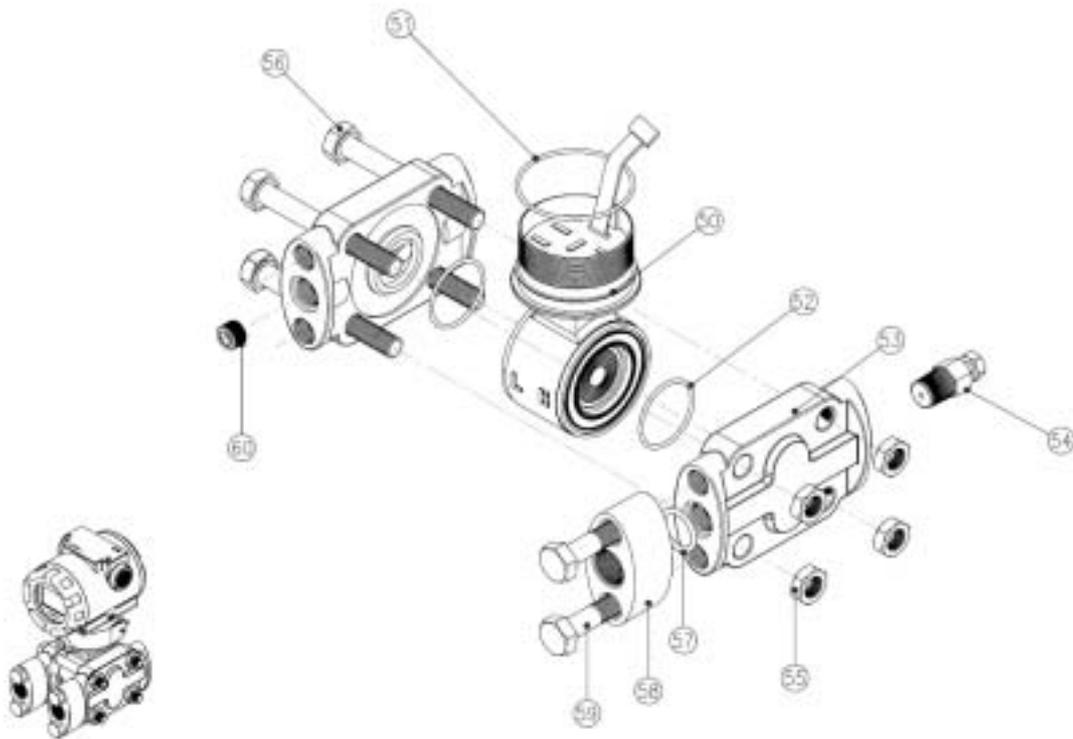


Figure 2-3. Model PAD Exploded View (Sensor Module-D,G)

P.N	PART NAME	P.N	PART NAME
50	SENSOR BODY	51	O-RING/SENSOR BODY
50-1	RANGE 2, 1.5 kPa	52	O-RING/ SENSOR
50-2	RANGE 3, 7.5 kPa	53	FLANGE/DP, GP, SIDE TYPE
50-3	RANGE 4, 37.3 kPa	54	DRAIN/VENT PLUG
50-4	RANGE 5, 186.5 kPa	55	NUT
50-5	RANGE 6, 690 kPa	56	BOLT
50-6	RANGE 7, 2068 kPa	57	O-RING/FLANGE ADAPER
50-7	RANGE 8, 6895 kPa	58	FLANGE ADAPTER
50-8	RANGE 9, 20680 kPa	59	BOLT/ FLANGE ADAPTER
50-9	RANGE 0, 41370 kPa	60	FLANGE PLUG

Figure 2-4. TRANSMITTER COMPONENTS (SENSOR MODULE -D, G)

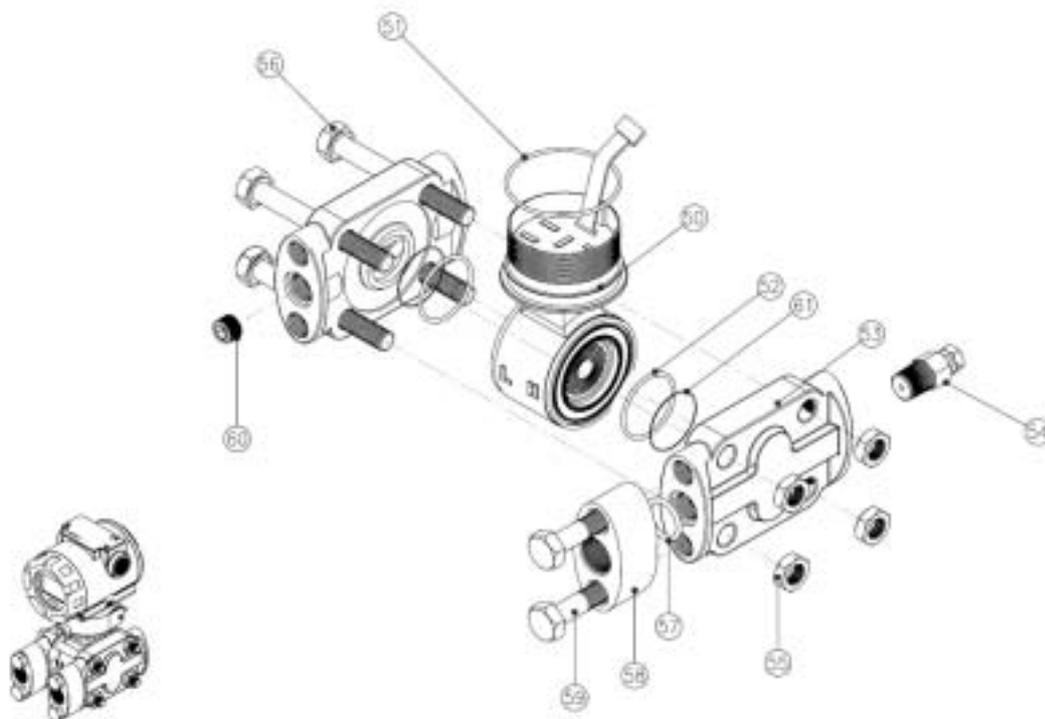


Figure 2-5. Model PAD Exploded View (Sensor Module-H)

P.N	PART NAME	P.N	PART NAME
50	SENSOR BODY (HIGH LINE PRESSURE)	51	O-RING/SENSOR BODY
50-H4	RANGE 4, 37.3 kPa	52	O-RING/ SENSOR
50-H5	RANGE 5, 186.5 kPa	53	FLANGE/DP, GP, SIDE TYPE
50-H6	RANGE 6, 690 kPa	54	DRAIN/VENT PLUG
50-H7	RANGE 7, 2068 kPa	55	NUT
		56	BOLT
		57	O-RING/FLANGE ADAPER
		58	FLANGE ADAPTER
		59	BOLT/ FLANGE ADAPTER
		60	FLANGE PLUG
		61	BACKUP RING

Figure 2-6. TRANSMITTER COMPONENTS (SENSOR MODULE -H)

3. Handling Cautions

This chapter consists of cautions for transmitter handling and storage, selection of installation locations, insulation structure, etc.

[Quick Reference Manual]

Step	Job	Job Details	Instrument
1	Unpacking	- Unpack transmitter packing	
2	Model and Specifications Check	- Make sure whether the delivered transmitter is same as options attached on its nameplate	Nameplate
3	Storage	- Places not exposed to water, non-vibration and non-impact area - Ambient temperature 25 deg C and relative humidity 65 % RH	
4	Calibration Bench	- Configuration of Range, Zero/Span, Unit, Tag, Damping Time, Transfer Function, DA Trim and other parameters	- HHT - Pressure Source - Galvanometer
5	Installation Locations	- Where ambient temperature is not fluctuated - Where no corrosion happens by chemical materials, etc. - Where vibration and impact is not severe - Where maintenance is very easy	(Engineering)
6	Mechanical Considerations	- Where transmitter can be handled easily - Be cautious of the pressure leaks	(Engineering)
7	Electrical Considerations	- Connect 24 V _{DC} (Recommended Power Supply is 11.9 V _{DC} – 45 V _{DC}) - For HART communication, total resistance on transmitter terminal loop should be 250 – 550 Ohm.	(Engineering)
8	Mounting and Installation	- For mounting transmitter, an appropriate bracket should be used. - Transmitter should be firmly to its bracket.	(Mounting and Installation)
9	Calibration on Spot	- Sensor Zero Trim is highly recommended during first installation and start-up. During a Zero trim the zero baseline of transmitter is established. - Before initiating zero trim make sure that PV value of transmitter is zero and current output is at 4 mA	HHT or Zero/Span button
10	Pressure	- Do not apply the differential and/or full line pressure suddenly. - Close equalizing valve of 3/5 valve manifold, then, open stop valve on high and low side slowly and simultaneously.	(Applying pressure)
11	Operation	- Make sure that transmitter operates within specs.	Visual or HHT

3.1 Unpacking

When moving the transmitter to the installation site, transfer it in its original packaging. Only unpack the transmitter on site of installation to avoid damage during transit.

3.2 Models and Specifications Check

The model name and specifications are indicated on the top name plate fixed to the transmitters. Please check your specification and model supplied for your installation.

3.3 Storage

The following precautions must be observed when storing the instrument, especially for a long period.

- (1) Select a storage area that meets the following conditions:
 - (a) It is not directly exposed to rain, water, snow or sun light.
 - (b) It is exposed to minimum vibration and shock.
 - (c) If possible, it is advisable to store at normal temperature and humidity (approx. 25 °C, 65 % RH).

However, it can also be stored under ambient temperature and relative humidity within the following published ranges.

- Ambient Temperature: -40 ~ 80 °C (with LCD module) *
- * General use only. For explosion proof versions follow product certification requirements.
- Relative Humidity: 5 % ~ 98 % RH (at 40 °C)

- (2) When storing the transmitter, repack with original (or similar) packaging that was shipped from the factory.
- (3) If storing a transmitter that has already been used, thoroughly clean all wetted parts including diaphragm seals (if installed), process connections/manifolds in contact with process fluid. In addition, make sure before storing the transmitter that remote seal (if supplied) assemblies are securely mounted.

3.4 Selecting the Installation Locations

The transmitter is designed to withstand severe environmental conditions. However, to ensure stable and accurate operation for many years, the following precautions must be observed when selecting an installation location.

- (1) Ambient Temperature
Avoid locations subject to wide temperature variations or a significant temperature gradient. If the location is exposed to radiant heat from plant equipment, provide adequate insulation or ventilation.
- (2) Ambient Atmosphere
Avoid installing the transmitter in a corrosive atmosphere. If the transmitter must be installed in a corrosive atmosphere, there must be adequate ventilation as well as measures to prevent intrusion or stagnation of rainwater in conduits. Moreover, there should be appropriate ventilation preventing corrosion by rain gathered on conduit.
- (3) Shock and Vibration
Select an installation site suffering minimum shock and vibration (although the transmitter is designed to be relatively resistant to shock and vibration)
- (4) Accessibility
Select location that provides easy access for maintenance & calibration.
- (5) Installation of Explosion Protected Transmitters.
Explosion – protected transmitters can be installed in hazardous areas according to gas types for which they are certified.

3.5 Performing Sensor Zero Trim after Installation

- (1) Sensor Zero Trim should be done after transmitter is installed because zero point can shift due to mounting status of the sensor pick up.
- (2) For Sensor Zero Trim, make input pressure of transmitter zero prior to initiating zero trim calibration. Any Sensor Trim done in field must be carried out after installation is finalized and with transmitter position fixed. Also if applying external pressure ensure the display is sufficiently stabilized (after approximately 10 to 15 seconds) before initiating any Trim function.
- (3) There are two recommendations for making input pressure “zero”. One is to apply a “zero” pressure source (mandatory for absolute pressure models). The second option is to open equalizing valve of manifolds and venting to atmospheric pressure (allowed only for Gauge type models).
- (4) Sensor Zero Trim can be performed using an external HHC (Hand held calibrator), PC or PDA configurator, and/ or using Zero/Span local push buttons provided on the transmitter.
- (5) When using local push buttons please refer to Chapter 4.7 of this manuals for detailed instructions. If using an external HHT or HART® PC configurator please refer to the user manuals supplied by the third party supplier.

3.6 Pressure Connections

▲ Warning

- Instrument installed in the process is under pressure. Never loosen or tighten the flange bolts as it may cause dangerous spouting of process fluid.
- If the accumulated process fluid may be toxic or otherwise harmful, take appropriate care to avoid contact with the body or inhalation of vapours even after dismantling the instrument from process line for maintenance.

The following precautions must be observed in order to safely operate the transmitter under pressure.

- (1) Never apply a pressure higher than the maximum working pressure specified on the nameplate.
- (2) Use adequate seals for leak tight process connections and use only quality and standardized parts.
- (3) Regularly inspect for signs of leakage and apply corrective actions when necessary.

3.7 Waterproofing of Cable Conduit Connections

Apply a non-hardening sealant (silicone or tape, etc.) to the threads to waterproof the transmitter cable conduit connections.

3.8 Restrictions on Use of Radio Transceivers

▲ Warning

- Although the transmitter has been designed to resist high frequency electrical noise, if a radio transceiver is used near the transmitter or its external wiring, the transmitter may be affected by high frequency noise pickup. To test for such effects, bring the transceiver in use slowly from a distance of several meters from the transmitter, and observe the measurement loop for noise effects. Thereafter, always use the transceiver outside the area affected by noise.

3.9 Insulation Resistance Test and Dielectric Strength Test

Since the transmitter has undergone insulation resistance and dielectric strength tests at the factory before shipment, normally these tests are not required. However, if required, observe the following precautions in the test procedures.

- (1) Do not perform such tests more frequently than is absolutely necessary. Even test voltages that do not cause visible damage to the insulation may degrade the insulation and reduce safety margins.
- (2) Never apply a voltage exceeding 500 V_{DC} (100 V_{DC} with an internal lightning protector) for the insulation resistance test, nor a voltage exceeding 500 V_{AC} (100 V_{AC} with an internal lightning protector) for the dielectric strength test.
- (3) Before conducting these tests, disconnect all signal lines from the transmitter terminals. Perform the tests in the following procedure.
- (4) Insulation Resistance test
 - (a) Short-circuit the + and - SUPPLY terminals in the terminal box.
 - (b) Turn OFF the insulation tester. Then connect the insulation tester plus (+) lead wire to the shorted SUPPLY terminals and the minus (-) lead wire to the grounding terminal.
 - (c) Turn ON the insulation tester power and measure the insulation resistance. The voltage should be applied as short as possible to verify that insulation resistance is at least 20 MΩ.
 - (d) After completing the test and being very careful not to touch exposed conductors disconnect the insulation tester and connect a 100KΩ resistor between the grounding terminal and the short-circuiting SUPPLY terminals. Leave this resistor connected at least three second to discharge any static potential. Do not touch the terminal while it is discharging.
- (5) Dielectric Strength Test
 - (a) Short-circuit the + and - SUPPLY terminals in the terminal box.
 - (b) Turn OFF the dielectric strength tester. Then connect the tester between th shorted SUPPLY terminal and the grounding terminal. Be sure to connect the grounding lead of the dielectric strength tester to the ground terminal.
 - (c) Set the current limit on the dielectric strength tester to 10mA, then turn ON the power and gradually increase the tester voltage from '0' to the specified voltage.
 - (d) When the specified voltage is reached, hold it for one minute.
 - (e) After completing this test, slowly decrease the voltage to avoid any voltage surges.

3.10 Installation of Explosion Protected Type Transmitters

3.10.1 ATEX Certification

ATEX Certification number : **KEMA 10ATEX0141 X**
CE 0158  II 2 G

Note 1. Model PAD for potentially explosive atmosphere

- Ex d IIC T6 or T5
- Operating Temperature : $-20^{\circ}\text{C} \leq T_{\text{amb}} \leq +60^{\circ}\text{C}$
- T6 for process $\leq 85^{\circ}\text{C}$;
- T5 for process $\leq 100^{\circ}\text{C}$;

Note 2. Electrical Data

- Supply Voltage : 11.9...42 V_{DC}
- Output Signal : 4 to 20 mA + HART

Note 3. Electrical Connection: see ordering table

Note 4. PAD ATEX Certification is according to the below standards

EN 60079-0 : 2006
EN 60079-1 : 2004

Note 5. Installation

- All wiring shall comply with local installation requirement.
- The cable glands and blanking elements shall be of a certified flameproof type, suitable for the condition of use and correctly installed. Also those devices should be endured at the 130°C.
- Housing Ground must be followed to “local electrical codes”. The most efficient ground procedure is to connect directly to the earth as least impedance.
- How to Housing Ground:
 - * Internal Ground Connection: Internal ground connection screw is located in terminal in housing, the screw can be identified as ground sign.
 - * External Ground Assembly: This is located in the right side of housing and identified as ground sign. (For grounding use a cable lug)
- When use tubing, Stopping boxes must be connected with the wall of housing directly.
- Tubing is installed a minimum of 5 threads.
- Sensor is to be threaded a minimum of 7 threads and prevented from turning by tightening the housing rotation set screw.
- Do not disassemble flameproof Joints but in an unavoidable case to disassemble it or need the specification of flameproof Joints, contact the manufacturer before doing.

Note 6. Operation

- WARNING-DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT
- Take care not to generate mechanical spark when access to the instrument and peripheral devices in hazardous location.

Note 7. Maintenance and Repair

- The instrument modification or parts replacement by other than authorized representative of KOBOLD Messring GmbH is prohibited and will void KEMA/ATEX Explosion-proof / Flame-proof.

3.11 EMC Conformity Standards

EMI (Emission): EN55011
EMS (Immunity): EN50082-2

Kobold Messring GmbH recommends customer to apply the Metal Conduit Wiring or to use the twisted pair Shield Cable for signal wiring to conform the requirement of EMC Regulation, when customer installs Kobold Series Transmitters to the plant.

4. Transmitter Functions

4.1 Overview

This Chapter contains information on operating Model PAD. Tasks that should be performed on the bench prior to installation are explained in this chapter.

4.2 Safety Message

Procedures and instructions in this chapter may require special precautions to ensure the safety of the personal performing the operations. Information that raises potential safety issues is indicated by warning symbol (▲). Refer to the following safety messages before performing an operation preceded by this symbol.

4.3 Warning

▲ Warning
Electrical can result in death serious injury: ❖ Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

▲ Warning
Electrical can result in death serious injury: ❖ Only qualified & trained personnel should be allowed to operate these transmitters.

4.4 Fail Mode Alarm

Kobold Smart Pressure Transmitter automatically and continuously performs self-diagnostic routines. If the self-diagnostic routines detect a failure, the transmitter drives its output outside of the normal saturation values. The transmitter will drive its output low (down) or high (up) based on the position of the failure mode alarm jumper . See Table 4.1 for Output values.

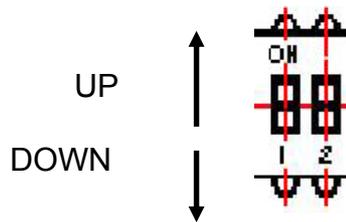
[Table 4-1 Standard Alarm and Saturation Value]

Level	4~20 mA Saturation	4~20 mA Alarm
Low/Down	3.9 mA	≤ 3.75 mA
High/Up	20.8 mA	≥ 21.75 mA

Fail Mode Selection (Fail High/UP or Low/DOWN) can be configured using the appropriate jumper switch provided on the LCD Module or DIP switches included on the Main CPU Module. For units provided with a LCD module one can select desired fail safe mode directly from the jumper switch included in the front display and this setting overrides the DIP settings on the back-end Main CPU module, provided the DIP switch “2” on CPU module is DOWN. If DIP switch “2” on CPU module is UP, this setting overrides the jumper setting on LCD module. Default setting from the factory is “Fail Down” (DIP Switch “2” on CPU Module is DOWN). However in case of blind units please select your required DIP switch settings from the DIP switch labelled (2) marked on the Main CPU board. Recommended jumper & DIP settings are listed in the table below for ready reference.

Select Fail Mode	Both LCD Module and CPU Module		Only CPU Module
	CPU Module	LCD Module	CPU Module
Fail Down	Down	D	D
Fail Up	Down	U	U
	Up	U or D	

< Fail Mode Selection DIP Switch of CPU Module >



1. WR_EN (EEPROM Write Enable)
 DOWN : ENABLE CONFIGURATION CHANGES
 UP : DISABLE/ LOCK CONFIGURATION CHANGES
2. Fail Mode(Alarm)
 DOWN : LOW
 UP : HIGH



Note: DIP Switch (1) shown on Left in Fig 4-1 is for Write Enable/ Disable selection. DIP switch (2) shown on right in Fig 4-1 is for Fail Mode.

(Figure 4-1. Fail Mode and EEPROM-Write Selection DIP Switch)

< Fail Mode Selection Jumper Switch of LCD Module >

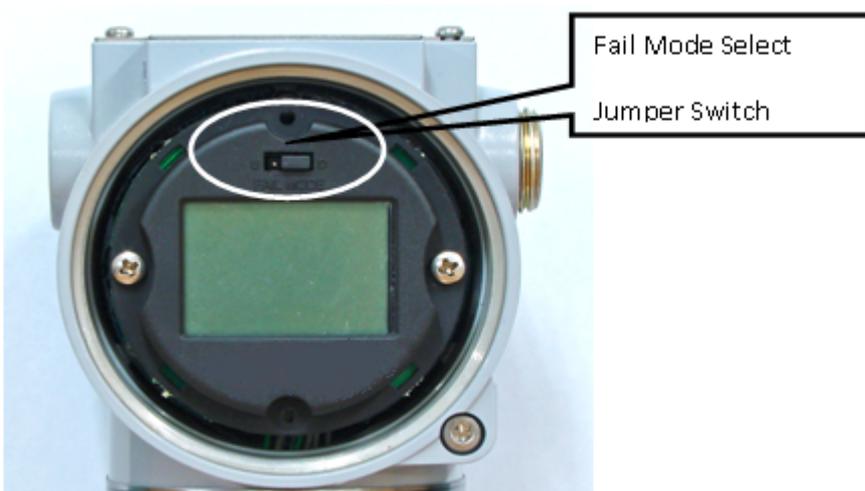
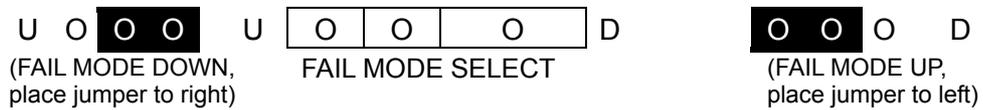


Figure 4-2 Fail Mode Selection Jumper Switch of LCD Module

4.5 EEPROM-Write Enable / Disable Mode Switch

PAD includes an EEPROM (Electrically Erasable Programmable Read Only Memory) that allows saving and restoring various configuration data within the transmitter on power failure. To lock configuration and protect changes to stored configuration data, one can use a HHC and or external HART® enabled PC device to enable a software lock feature under Status menu. Optionally for security lock on hardware side there is a Write-Protect Mode DIP Switch (1) on the Main CPU Module placed right next to the Fail Safe Mode switch (2). If you push DIP switch to UP you can lock out users from making any changes to configuration data through push buttons and/ or remote HHC already saved in the EEPROM. Alternatively when you push DIP Switch (1) to DOWN you can allow changes made to configuration data in EEPROM. Default state from factory (including with NO Jumpers) installed is EN (enable configuration changes).

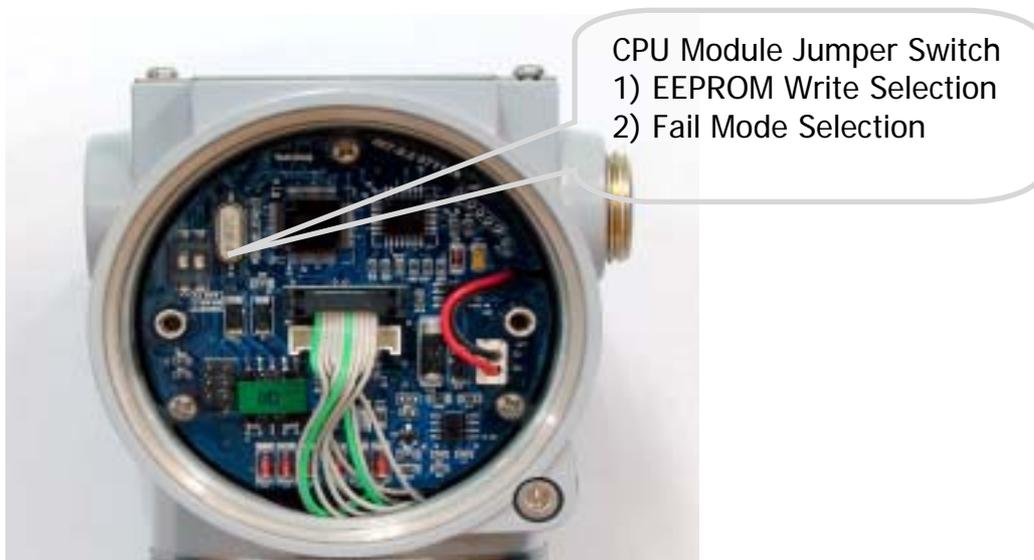
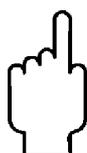


Figure 4-3. CPU Module Fail Mode, EEPROM-Write Selection Jumper Switch



**Note: DIP Switch (1) shown on Left in Fig 4-1 is for Write Enable/ Disable selection.
DIP switch (2) shown on right in Fig 4-1 is for Fail Mode.**

4.5.1 Security

To quickly summarize there are three options available to implement configuration security

lock out within the PAD. These include:

- (1) DIP settings on CPU Board
- (2) Software enable/ disable on Write function using HHT or HART® PC.
- (3) Physically removing Zero and Span Magnetic Buttons from Transmitter thereby restricting local access to push button menus. This option will still allow changes via a remote HHT or HART® enabled configurator.

4.5.2 Zero and Span Magnetic Push Buttons

To access push buttons please remove top name plate to expose the magnetic style push buttons labelled zero/ span. To disable please unscrew and remove these push buttons.

4.6 Configuration of Alarm and Security Jumper Procedures

To change Jumper/ DIP switch position in field:

- (1) If transmitter is already wired and installed, cut off power.
- (2) Open the housing front side covers.

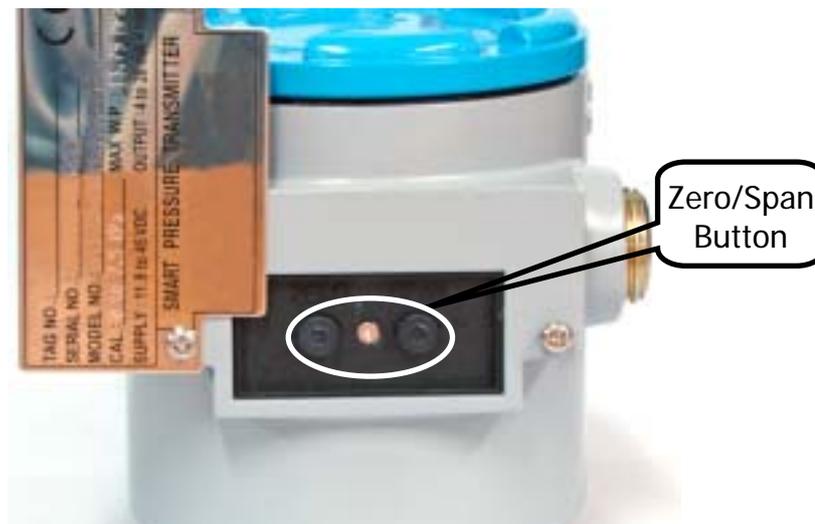


Warning: In hazardous areas DO NOT open the covers of Transmitter when power is energized as this can create a potential dangerous situation. Always kill power and de-energize the transmitter prior to opening front OR back covers in a hazardous location.

- (3) Adjust required jumper/ DIP position as detailed in section 4.4 & 4.5 above.
- (4) Close the housing covers. You must fully engage all cover threads to ensure compliance to explosion proof requirements

4.7 Configuration Using Zero and Span Push Buttons

There are ZERO and SPAN Buttons to be seen when the nameplate is opened (Figure 4-4). You may reconfigure the function settings of ZERO, SPAN, ZERO TRIM, ZERO ADJ, Units, Range, Damping, LCD and Decimal place, using ZERO / SPAN buttons.



[Figure 4-4 Transmitter Zero/Span configuration Buttons]

- (a) Unscrew both name plate screws on upper part of transmitter.
- (b) Flip the name plate to access Zero and Span Buttons. (Figure 4-4)



Caution: Do not fully unscrew all screws in order not to lose them.

4.7.1 Advance Configuration via Push Buttons

The advanced “smart” functions which can be initiated using ZERO / SPAN Buttons are shown below. This includes re-ranging of transmitters (Set URV/LRV) without an external pressure source.

To access advanced configuration and enter programming menu press both (Zero + Span) buttons simultaneously for 3 seconds. When display reads “MENU” release both push buttons immediately. This will put user into top of main programming menu indicated by message “1-TRIM” on display. To navigate through Main Menus and/ or Sub-Menus:

- (1) Use (Zero) button to scroll down a menu (or sub-menu if active).
Example: Press/ Release (Zero) to scroll down from Main Menu 1-Trim> 2-Setup > 3-LCD>1-Trim > 2-Setup etc. Or from an active sub-menu press/ release (Zero) to scroll down within a sub menu Example 21-Units> 22-URL > 23-LRL > 24-Damping > 21-Units > 22-URL etc.
- (2) Use (Span) button to enter into a specific Sub Menu or data input function.
Example: Pressing (Span) button from Main Menu <1-TRIM> will put user into Sub menu “11 ZERO TRIM”. Releasing and Pressing (Span) button again will initiate Zero Trim configuration OR Releasing and Pressing (Zero) button instead will increment user down to submenu “12 Z- ADJ”
- (3) Within an active sub-menu use of (Span) button also acts as an <enter> key to allow user to save changes and exit programming mode.
- (4) For moving back to previous menu press (Zero + Span) button together. During numeric value entry mode use (Zero + Span) button together to save numeric data inputted and exit from programming menu. See 4.7.3.3 below

Caution:



After 30 seconds inactivity the automatic time out feature will default user back to normal measurement mode with a “BT-Err” message on display.

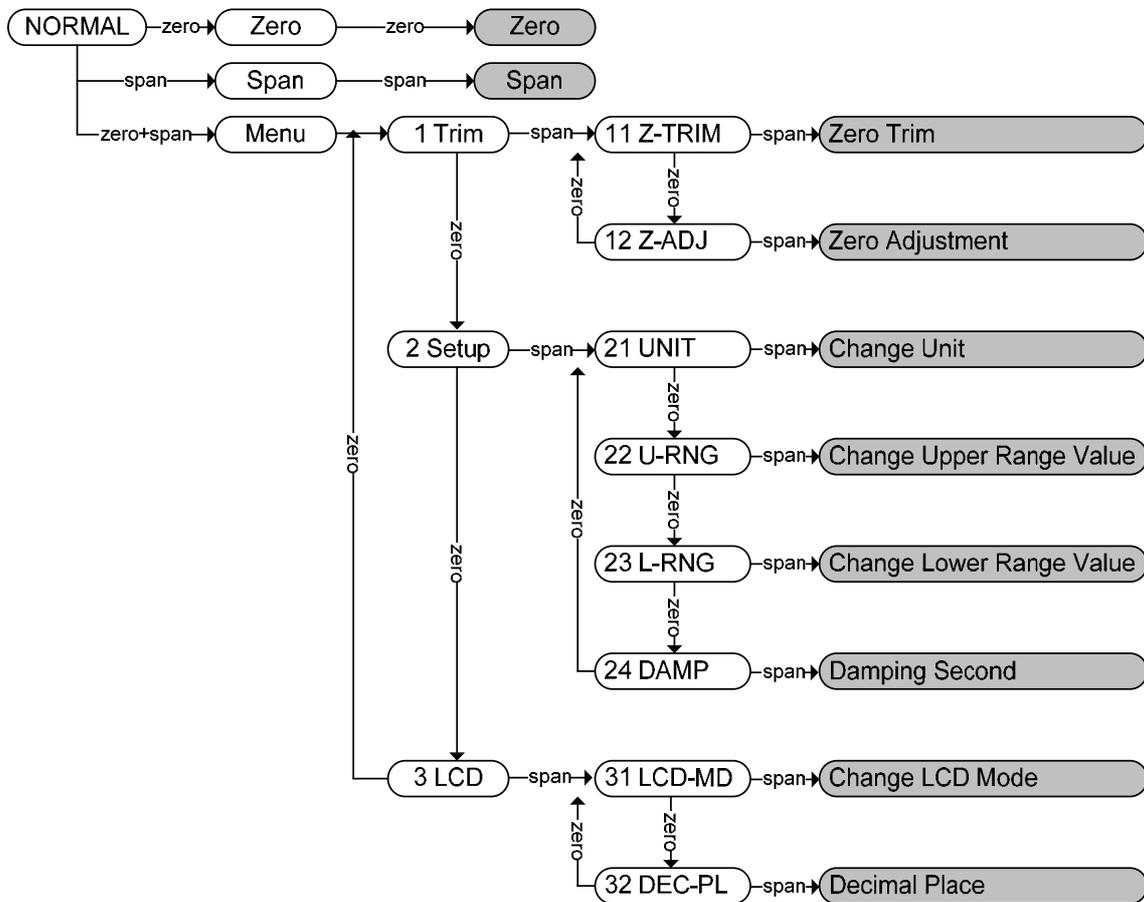
Please refer to Appendix 1 for LCD display messages and the button errors.

4.7.2 Button functions and Purpose

Grey colour parts in the following menu tree in section 4.7.3

Function	Purpose	Remark
Zero	Sets the current process value for Lower Range Value (4 mA)	
Span	Sets the current process value for Upper Range Value (20 mA)	
Zero Trim	To modify exact "zero shift" to compensate for the mounting position	
Zero Adjustment	allows user to add a pre-defined offset (other than zero) to measured PV	
Change Unit	To modify units as user desires	
Change Upper Range Value	To modify upper range value as user desires	
Change Lower Range Value	To modify lower range value as user desires	
Damping Second	Modifies damping setting based on the required response time, signal stability, and other requirements of the loop dynamics of your system	
Change LCD Mode	To modify LCD Mode as user desires	
Decimal Place	To modify decimal place as user desires	

4.7.3 Menu Tree of ZERO/ SPAN Button Functions



4.7.3.1 Zero Configuration

- Sets the current process value for Lower Range Value (4 mA).
- Apply zero value pressure for 10 seconds and press ZERO button over 3 seconds. The LCD should display “ZERO”. After checking this message, remove finger from the button.
- After 1 second, push the Zero button for 3 seconds. The LCD should display “-ZR-“. This message means that the Zero configuration is completed and saved.
- If Zero Configuration was incorrectly performed the LCD will display error code “ZR-ERR” indicating failure and possible LRV setting out of sensor range capabilities. Try repeating the Zero configuration steps.

4.7.3.2 Span Configuration

- Sets the current process value for Upper Range Value (20 mA).
- Apply the desired pressure for 10 seconds and press SPAN button over 3 seconds. The LCD should display "SPAN". After checking this message, remove finger from the button.
- After 1 second, push the Span button for 3 seconds. The LCD should display "-SP-". This message means that the Span configuration is completed and saved.
- If the Span configuration was incorrectly performed the LCD will display error code "SP-ERR" indicating failure and possible URV setting out of sensor range capabilities. Try repeating the Span configuration steps.

4.7.3.3 STEPS TO INPUT NUMERIC DATA VALUE:

Specific functions that need users to input a numerical value are found in following sub-menus:

- 12 Zero Adjustment,
- 22 Change Upper Range Value,
- 23 Change Lower Range Value,
- 24 Damping Second

First time users should familiarize themselves with numeric value input sequence prior to accessing above sub menus. Due to limited flexibility with only 2 push buttons

available for configuration, it is not possible to directly input numeric values within these sub-menus. Instead, the correct sequence requires user to first set an increment (10x) rate e.g. 0.01, 0.1, 1.0, 10. 100, 1000 etc and then proceed with changing numeric value by the set rate increment.

For example, to input a numeric value as "3810" from existing displayed value of "0000":

- >First Set increment rate as "1000"
- >Increase display "0000" value 3 times in steps of 1000 till it reads "3000"
- >Then set increment rate again as "100"
- >Increase 8 times in steps of 100 till display reads "3800"
- >Set increment rate again as 10
- >Increase 1 time for a step change of 10 till display reads 3810.

This section outlines the push button sequence for facilitating direct numeric value input from following sub-menus :

"12 Zero Adjustment", " 22 Change Upper Range Value",
"23 Change Lower Range Value" and "24 Damping".

When activating these sub-menus (by pushing down & releasing (span) button from within its active menu) the display will automatically prompt for "SEL INC" message.

From here:

- (a) To select an increment rate push down on (Zero) button when “SEL INC” Message is displayed on LCD sub-menu. Release (Zero) button when display value changes.
Each subsequent (Zero) push-release key stroke will shift display decimal point to left. Example when display shows “SEL INC” 1000. Subsequently for every push release keystroke of (Zero) button the display will cycle from >100>10>1>0.1>0.01>100>10 etc
- (b) Once desired “SEL INC” (0.1, 1, 10, 100 etc) increment rate is set push the (Span) button to accept and enable set numeric “VALUE” mode.



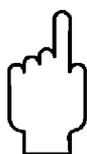
Note: When executing (Span) button from “SEL INC” menu the LCD display will typically show the last saved numerical value along with a “VALUE” message on second line indicating that user can now initiate changes by incrementing or decrementing numeric value.

- (c) From within “VALUE” menu pushing down on either (Zero) OR (Span) button (not both) will allow the numeric value to increment (Zero) or decrement (Span) by the “SEL INC” value selected by user in the previous step (b).
- (d) After desired numeric value is displayed, push down on (Zero + Span) buttons together to accept new data inputted and this will bring user back to <SEL INC> menu. Step (a) screen above.
- (e) Repeat steps (a) through (c) detailed above until the final numeric value required is displayed in “VALUE” Menu.
- (f) To store final numeric value to EEPROM push (Zero + Span) button twice to save and exit. Note pressing Zero + Span once from “VALUE” menu will bring user back to “SEL INC” menu step (a). However pressing (Zero + Span) buttons together second time (from “SEL INC” menu) and releasing these buttons, when screen shows “INC OK” message, will save the last numeric value inputted and brings the user back to Measurement Mode.
- (g) If the programming sequence is successful, the display will read –DONE- else “BR-ERR” to indicate failure. If display shows “RANGOVR” it indicates numerical value inputted is out of specs.

4.7.4 Push Button sequence for each Programming Sub-Menu

4.7.4.1 ZERO TRIM (Sub Menu 11)

- Enter programming menu by pushing both (ZERO+SPAN) buttons together for 3 seconds. Release buttons when LCD displays MENU and display will automatically change to “1 TRIM” confirming access into programming menu.
- Access “Zero Trim” Function by pressing the SPAN button until “11 Z-TRIM” message appears.
- To save the settings, press SPAN button again until “-TR-“ message appears.



(Important Note: make sure process input to transmitter is at true zero else this may create an incorrect Zero Offset. If a wrong zero is suspected please execute Zero Trim again ensuring the proper steps & correct Zero PV input is applied to transmitter)

4.7.4.2 ZERO ADJUSTMENT (Sub Menu 12)

- Example used to show changing the PV value as 14

- Enter programming menu by pushing both (ZERO + SPAN) buttons together for 3 seconds. Release buttons when LCD displays MENU and display will automatically change to "1 TRIM" confirming access into programming menu.
- Access Zero Trim Function by pressing the SPAN button until "11 Z-TRIM" message appears.
- Press ZERO button until the "12 Z-ADJ" message appears.
- Press SPAN button to access the "Zero Adjustment" function.
- When the "SEL INC" message appears, press ZERO button repetitively until LCD value changes to 10.0. Select it as increment rate by pressing SPAN button.
- When "VALUE" message appears on display, increment forward (Zero) or decrement backward (Span) to set the LCD value to "10.0". You will note the LCD display will increment or decrement by factor of 10 which is the "SEL INC" value selected in previous menu. Once desired base value of "10" is displayed push (Zero + Span) button to accept new value and "SEL INC" message appears upon which release buttons.
- From menu where "SEL INC" message appears again, change the LCD value to 1.0 by pushing (Zero) button once and then push (Span) button to enter input "VALUE" menu.
- Here push (Zero) or (Span) to increment or decrement by SEL INC (1) until display reads "14". Push (Zero + Span) button after LCD value is changed to 14.0 and release both buttons when display reads "SEL INC".
- To save the numeric value of 14 set from previous steps push ZERO + SPAN buttons until the "IN_OK" message appears.
- Release ZERO + SPAN buttons. Message "ZA" confirms that Zero Adjustment is finished.
- If display shows "BT-ERR" instead of -ZA- please repeat all steps once again.
- If display shows "ADJ-U" or "ADJ-L" the inputted numerical value is out of specs for zero adjustment range for the supplied range codes.

4.7.4.3 CHANGE UNITS (Sub-Menu 21)

- Enter programming menu by pushing both (ZERO+SPAN) buttons together for 3 seconds. Release buttons when LCD displays MENU and display will automatically change to "1 TRIM" confirming access into programming menu.
- Move to the next menu by pressing ZERO button until the "2 SETUP" message appears.
- Press SPAN button to access 21 UNIT, press SPAN button to access function of "Change Unit". To execute this function push SPAN button. Release button when display changes to 211 (xxx) where "xxx" are the last units (e.g. bar, kpa, "H2O etc) saved previously.
- Press ZERO button repetitively until the desired unit is displayed on the bottom of the LCD. Save and exit by pressing (Span) button.

4.7.4.4 CHANGE Upper Range Value (Sub-Menu 22)

- Enter programming menu by pushing both (ZERO + SPAN) buttons together for 3 seconds. Release buttons when LCD displays MENU and display will automatically change to "1 TRIM" confirming access into programming menu.
- Move to the next menu by pressing ZERO button until the "2 SETUP" message appears.
- Press SPAN button until the "21 Unit" message appears.
- Press ZERO button until the 22 U-RNG message appears.
- Press SPAN button to access function "Change Upper Range Value".
- Follow Set numeric value procedure explained under section 4.7.3.3 to
- input desired URV numeric value.

4.7.4.5 CHANGE Lower Range Value (Sub-Menu 23)

- Enter programming menu by pushing both (ZERO + SPAN) buttons together for 3 seconds. Release buttons when LCD displays MENU and display will automatically change to "1 TRIM" confirming access into programming menu.
- Move to the next menu by pressing the Zero button until the "2 SETUP" message appears.
- Press SPAN button until the "21 Unit" message appears.
- Press ZERO button until the "23 L-RNG" message appears.
- Press SPAN button to access function "Change Lower Range Value".
- Follow Set numeric value procedure explained under section 4.7.3.3 to input desired LRV numeric value.



Note: When setting URV/ LRV numeric data please ensure values being inputted fall within the allowed minimum/maximum specifications published for the installed sensor range code. Only if display shows -DONE- will the transmitter update its stored configuration & accept the new values. If out of limits the transmitter will reject values entered and default to previous saved values after displaying a "RNGOVR" error message.

4.7.4.6 CHANGE Damping Value (Sub-Menu 24)

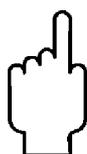
- Enter programming menu by pushing both (ZERO + SPAN) button together for 3 seconds. Release buttons when LCD displays Menu and display will automatically change to "1 TRIM" confirming access into programming menu.
- Push (Zero) button when "1 TRIM" message appears on LCD. Release button when display changes to "2 SETUP".
- To move into sub directory push (Span) button when "2 SETUP" message appears on display. Release button when 21 UNIT message is displayed.
- Push (Zero) button to move down to sub-menu 22. When display shows "22 U-RNG" release button.
- Push (Zero) button to move down to sub-menu 23. When display shows "23 L-RNG" release button.
- Push (Zero) button to move down to sub-menu 24. When display shows "24 DAMP" release button.
- You are now in Change Damping sub menu. To execute this function push (Span) button when "24-Damping" message appears on display. Release button when display changes to 241 (xxxx) when xxxx is last configured damping value saved.
- Follow Set numeric value procedure explained under section 4.7.3.3 to input desired URV numeric value.

4.7.4.7 CHANGE LCD Mode (Cyclic or Fixed Display) (Sub-Menu 31)

- Enter programming menu by pushing both (ZERO + SPAN) button together for 3 seconds. Release buttons when LCD displays Menu and display will automatically change to "1 TRIM" confirming access into programming menu.
- Move to the next menu by pressing ZERO button until the "2 SETUP" message appears.
- Move to the next menu by pressing ZERO button until the "3 LCD" message appears
- Press SPAN button until "31 LCD-MD" message appears. Press SPAN button again to access function "LCD Multi-display".
- Press ZERO button repetitively until the desired display form is displayed on the bottom of the LCD (see table below for different options).

Message on LCD	Definition	Description	Remark
NOR_RO	Normal Rotation Mode	Indicating the value with PV, %, mA units as continually on LCD	
NOR_PV	Normal PV Mode	Indicating measured PV value only on LCD	
NOR_%	Normal Percent Mode	Indicating percentage of Cal. Range of measuring PV value on LCD	
NOR_mA	Normal mA Mode	Indicating 4 ~ 20 mA value depending on measured PV value on LCD	
ENG_RO	Engineering Rotation Mode	Indicating the value with Engineering PV, Engineering %, Engineering mA units as continually on LCD	
ENG_PV	Engineering PV Mode	Indicating changed PV value with modified Engineering range	

- To save the settings, press SPAN button. And indicating "DONE" message.



Important Note: Always select only one of NOR (normal) modes. Though it is possible to set ENG (engineering) modes also from this menu it is not recommended unless specific Engineering mode parameters such as engineering units, High/Low values, Linear/Sq-Root functions etc have been pre-configured either from factory (if specified on your order) or using an external HHC based configurator when available. With engineering mode enabled users have the added flexibility of configuring LCD display to emulate custom preferences separate from the transmitter current output functions. As such with engineering mode enabled users can program custom units, engineering units for flow, volume totals and level, scale different URV/LRV, linear mode etc independent of those explained in previous sections.

4.7.4.8 CHANGE LCD Resolution (Decimal Place) (Sub-Menu 32)

- Enter programming menu by pushing both (ZERO + SPAN) button together for 3 seconds. Release buttons when LCD displays MENU and display will automatically change to "1 TRIM" confirming access into programming menu.
- Move to the next menu by pressing ZERO button until the "2 SETUP" message appears.
- Move to the next menu by pressing the Zero button until the "3 LCD" message appears.
- Press the Span button until the "31 LCD-MD" message appears.
- Push (Zero) button to move down one sub menu and release button when "32- DEC-PL" message is displayed.
- Press the Span button to access function "Decimal Place". All available resolution modes are listed in table below.
- Push Zero button to cycle through display options i.e. AUTO, 5-0, 4-1, 3-2, 2-3 and 1-4 and once desired resolution is displayed push SPAN to save and exit.

Display	Description	Max. Value
AUTO	Auto ranging of display	99999
5 - 0	No decimal place	99999
4 - 1	Display one decimal place	9999.9
*3 - 2	Display two decimal place	999.99
2 - 3	Display three decimal place	99.999
1 - 4	Display four decimal place	9.9999

*3-2 format will be displayed for mA and % regardless of any other setting.

- The set value will be applicable for displaying PV value and Engineering value.
 - The LCD will display "LCD_OV" and current setting unit when the pressure exceeds the limit of the setting value.
- Please refer to Appendix 1 for LCD display message and the button errors.

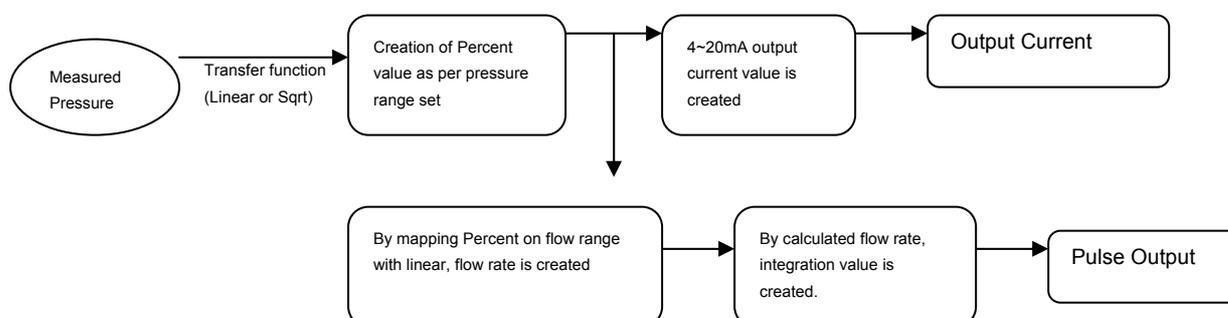
4.8 Additional Functions (valid for PAD-F only)

4.8.1 Summary

The functioning of Flow Meter “Totaliser”:

- The measured differential pressure corresponds to a specific flow range (programmed as “Flow rate LRV” and “Flow rate URV” in the programming menu). Example: 0...1200 mmH2O = 4...20 mA = 0...+100% = -30...+50 l/h (to be confirmed by the user while ordering)
- The percentage of delta P thus determines the actual flow rate as the relationship between percentage delta P and flow rate is linear, e.g. +50%=+10 l/h.
- By integrating the flow rate function with respect to time over a specific time span, flow totalisation value is determined.
- By knowing the flow rate URV and choosing a pre-defined pulse scale (unit volume per pulse e.g. m³/pulse), the pulse duty cycle (pulses/sec) is calculated (see section 4.8.2.3 for an example).

	LRV	to	URV	Unit	Remark
Cal. Range	0	600	1200	mmH2O	Measuring Pressure
Percentage	0	50	100	%	% of Cal. Range
Flow Range	-30	10	50	l/h	Indicating value on LCD
Current Output	4	12	20	mA	Output signal value depending on Cal. Range



Note: PAD-F measures the flow rate by using differential pressure. It cannot compensate the changes in operating temperature and static pressure.

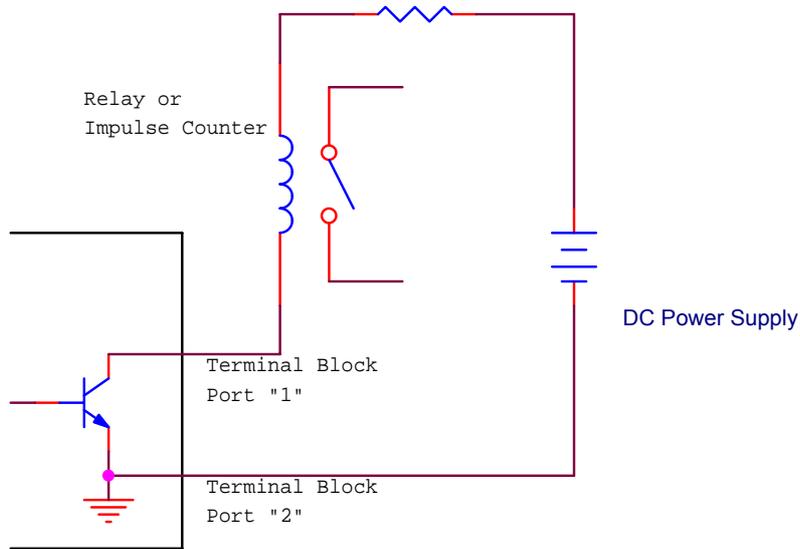
4.8.2 Pulse Output

4.8.2.1 The appearance and definition of port.



1 : Pulse Output+ , 2 : Pulse Output-

4.8.2.2 Wiring Structure



[In case of operating external Relay or Counter]

4.8.2.3 Spec.

- Scaled Pulse : A Single pulse is output for a specified flow amount.
- Pulse Width : 10 ms, 50 ms, 100 ms selectable (Negative going pulse)
- Duty Cycle : 49 Pulse/sec. Max.
- Output Type : Open Collector, 30 V, 500 mA Max.

- $Duty_cycle = Flow_rate / (Pulse_Scale * Unit_Time[s])$

Unit_Time = MIN:60, HOUR:3600,

Ex) Flow_rate : 17,640

Flow_rate_unit : normal cubic meter per hour

In case of Pulse_Scale : 0.1

Pulse Duty Cycle = $17,640 / (0.1 * 3600) = 49$ [Pulse/sec]

- $Flow_rate = Duty_cycle * Pulse_Scale * Unit_Time[s]$

Unit_Time = MIN:60, HOUR:3600,

Ex) Duty_cycle : 10

Flow_rate_unit : kilograms per minute

In case of Pulse_Scale : 1 ...

Flow_rate = $10 * 1 * 60 = 600$ kg/min

When pulse output is used, the most important thing is to check the above Duty_cycle, Flow_rate and Pulse_scale. The specification check of the system in which PAD-F pulse output will be input is also important. For examples, if the system to which PAD-F will be applied is used to measure the flow rate 0~20,000/h and the Pulse_Scale is set to 0.1, Pulse Duty Cycle will be shown as follows.

$$Pulse\ Duty\ Cycle = 20,000 / (0.1 * 3600) = 55.55 \text{ [Pulse/sec].}$$

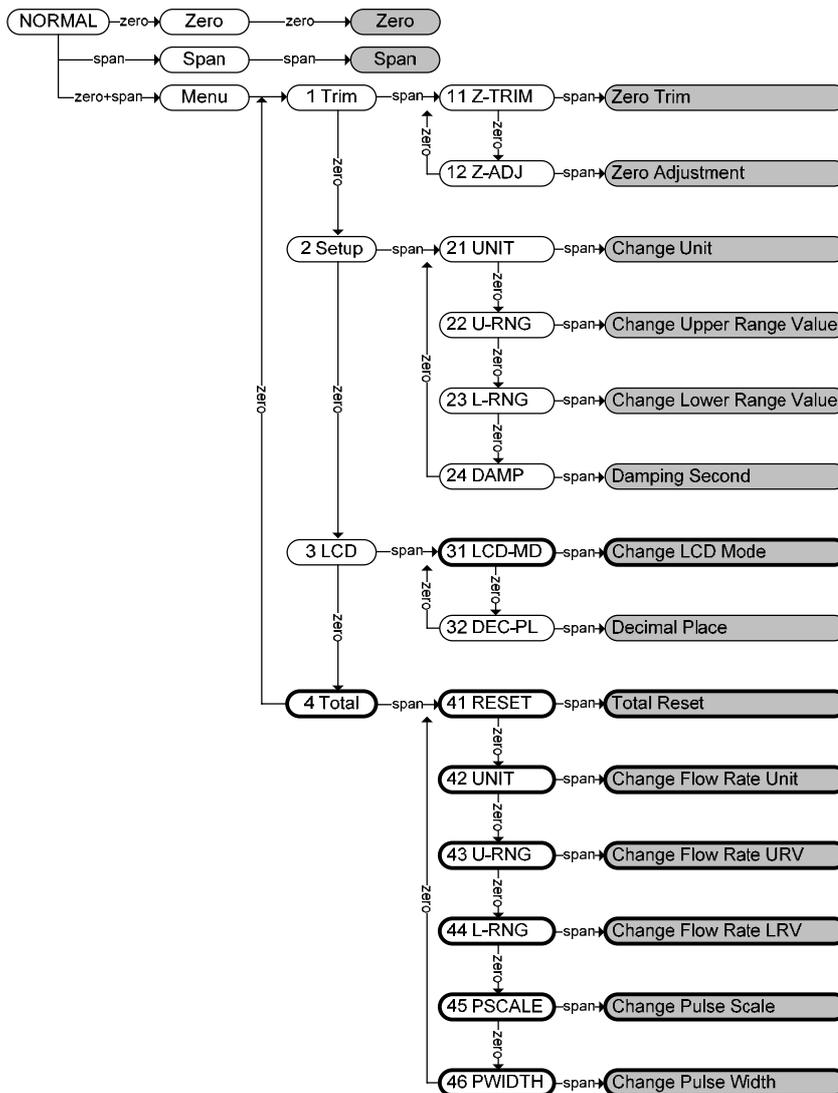
On the above result, the value exceeds the maximum Duty cycle (49Pulse/sec) PAD-F can output. In this case, Pulse_Scale must be set to 1 or more. If the system requires Pulse_Scale to be set to 0.1 or less, you can not use PAD-F. On the contrary, in case of the system that Duty_cycle is primarily decided, you need to calculate the Flow_rate and check it matches the value of system design.

- If the pulse is beyond maximum Duty Cycle like the above case, the output pulse will be set to 49 Pulse/sec and “PLS-OV” mark will be shown on the LCD.

4.8.3 Button Input method

4.8.3.1 Changed function.

- Zero or Span function is executed in the same way it is done on the existing model.
- In case you push Zero+ Span button, Menu function is executed.



[Button input structure]

- (1) Item movement between menus : Zero
- (2) Movement to lower menus or function execution: Span
- (3) Movement to Top menu: Zero+ Span

4.8.3.2 STEPS TO INPUT NUMERIC DATA VALUE:

Specific functions that need users to input a numerical value are found in following sub-menus:

- 12 Zero Adjustment
- 22 Change Upper Range Value
- 23 Change Lower Range Value
- 24 Damping Second
- 43 Change Flow Rate URV
- 44 Change Flow Rate LRV

First time users should familiarize themselves with numeric value input sequence prior to accessing above sub menus. For an example to demonstrate push button sequence for facilitating direct numeric value input, refer to section 4.7.3.3.

4.8.3.3 Push Button Sequence for each Programming Sub-Menu

4.8.3.3.1 ZERO TRIM (Sub Menu 11)

Refer to section 4.7.4.1

4.8.3.3.2 ZERO ADJUSTMENT (Sub Menu 12)

Refer to section 4.7.4.2

4.8.3.3.3 CHANGE UNITS (Sub-Menu 21)

Refer to section 4.7.4.3

4.8.3.3.4 CHANGE Upper Range Value (Sub-Menu 22)

Refer to section 4.7.4.4

4.8.3.3.5 CHANGE Lower Range Value (Sub-Menu 23)

Refer to section 4.7.4.5

4.8.3.3.6 CHANGE Damping Value (Sub-Menu 24)

Refer to section 4.7.4.6

4.8.3.3.7 CHANGE LCD Mode (Cyclic or Fixed Display) (Sub-Menu 31)

Refer to section 4.7.4.7. Following LCD Modes are available in addition to those described in section 4.7.4.7:

Message on LCD	Definition	Description	Remark
FL_RO	Flow Rotation Mode	Shows Flow Rate/ Totaliser/ PV values in rotation on LCD	
F_RATE	Flow Rate	Shows Flow Rate value on LCD	
FTOTAL	Flow Totaliser	Shows Flow Totaliser value on LCD	

4.8.3.3.8 CHANGE LCD Resolution (Decimal Place) (Sub-Menu 32)

Refer to section 4.7.4.8

4.8.3.3.9 Total Reset (Sub-Menu 41)

- Enter programming menu by pushing both (ZERO + SPAN) button together for 3 seconds. Release buttons when LCD displays MENU and display will automatically change to "1 TRIM" confirming access into programming menu.
- Move to the next menu by pressing ZERO button until the "2 SETUP" message appears.
- Move to the next menu by pressing the ZERO button until the "3 LCD" message appears.
- Move to the next menu by pressing the ZERO button until the "4 TOTAL" message appears.
- Press the Span button until the "41 RESET" message appears.
- Press the Span button reset the accumulated total value to "0".

4.8.3.3.10 Change Flow Rate Unit (Sub-Menu 42)

- Enter programming menu by pushing both (ZERO + SPAN) button together for 3 seconds.
- Release buttons when LCD displays MENU and display will automatically change to "1 TRIM" confirming access into programming menu.
- Move to the next menu by pressing ZERO button until the "2 SETUP" message appears.
- Move to the next menu by pressing the ZERO button until the "3 LCD" message appears.
- Move to the next menu by pressing the ZERO button until the "4 TOTAL" message appears.
- Press the Span button until the "41 RESET" message appears.
- Push (Zero) button to move down one sub menu and release button when "42 UNIT" message is displayed.
- Press SPAN button to access function of "Change Flow Rate Unit". To execute this function push SPAN button. Release button when display changes to "xxx" where "xxx" are the last flow units saved previously.
- Press ZERO button repetitively until the desired Flow Rate Unit is displayed on the bottom of the LCD.
- Save and exit by pressing (Span) button.

4.8.3.3.11 Change Flow Rate URV (Sub-Menu 43)

- Enter programming menu by pushing both (ZERO + SPAN) button together for 3 seconds.
- Release buttons when LCD displays MENU and display will automatically change to "1 TRIM" confirming access into programming menu.
- Move to the next menu by pressing ZERO button until the "2 SETUP" message appears.
- Move to the next menu by pressing the ZERO button until the "3 LCD" message appears.
- Move to the next menu by pressing the ZERO button until the "4 TOTAL" message appears.
- Press the Span button until the "41 RESET" message appears.
- Push (Zero) button to move down one sub menu and release button when "42 UNIT" message is displayed.
- Push (Zero) button to move down one sub menu and release button when "43 U-RNG" message is displayed.
- Press SPAN button to access function "Change Upper Range Value".
- Follow Set numeric value procedure explained in section 4.7.3.3 to input desired Flow Rate URV numeric value equivalent to 100% of pressure (20mA).

4.8.3.3.12 Change Flow Rate LRV (Sub-Menu 44)

- Enter programming menu by pushing both (ZERO + SPAN) button together for 3 seconds.
- Release buttons when LCD displays MENU and display will automatically change to "1 TRIM" confirming access into programming menu.
- Move to the next menu by pressing ZERO button until the "2 SETUP" message appears.
- Move to the next menu by pressing the ZERO button until the "3 LCD" message appears.
- Move to the next menu by pressing the ZERO button until the "4 TOTAL" message appears.
- Press the Span button until the "41 RESET" message appears.
- Push (Zero) button to move down one sub menu and release button when "42 UNIT" message is displayed.
- Push (Zero) button to move down one sub menu and release button when "43 U-RNG" message is displayed.
- Push (Zero) button to move down one sub menu and release button when "44 L-RNG" message is displayed.
- Press SPAN button to access function "Change Lower Range Value".
- Follow Set numeric value procedure explained in section 4.7.3.3 to input desired Flow Rate LRV numeric value equivalent to 0% of pressure (4mA).

4.8.3.3.13 Change Pulse Scale (Sub-Menu 45)

- Enter programming menu by pushing both (ZERO + SPAN) button together for 3 seconds.
- Release buttons when LCD displays MENU and display will automatically change to "1 TRIM" confirming access into programming menu.
- Move to the next menu by pressing ZERO button until the "2 SETUP" message appears.
- Move to the next menu by pressing the ZERO button until the "3 LCD" message appears.
- Move to the next menu by pressing the ZERO button until the "4 TOTAL" message appears.
- Press the Span button until the "41 RESET" message appears.
- Push (Zero) button to move down one sub menu and release button when "42 UNIT" message is displayed.
- Push (Zero) button to move down one sub menu and release button when "43 U-RNG" message is displayed.
- Push (Zero) button to move down one sub menu and release button when "44 L-RNG" message is displayed.
- Push (Zero) button to move down one sub menu and release button when "45 PSCALE" message is displayed.
- Press SPAN button to access function "Change Pulse Scale".
- You could set numerical value for 1 pulse output (available options: 0.001, 0.01, 0.1, 1, 10, 100, 1000, 10000). The set numerical value has same "Units" as programmed for flow rate.
- Push Zero button to cycle through display options and once desired value is displayed, push SPAN to save and exit.

4.8.3.3.14 Change Pulse Width (Sub-Menu 46)

- Enter programming menu by pushing both (ZERO + SPAN) button together for 3 seconds.
- Release buttons when LCD displays MENU and display will automatically change to "1 TRIM" confirming access into programming menu.
- Move to the next menu by pressing ZERO button until the "2 SETUP" message appears.
- Move to the next menu by pressing the ZERO button until the "3 LCD" message appears.
- Move to the next menu by pressing the ZERO button until the "4 TOTAL" message appears.
- Press the Span button until the "41 RESET" message appears.
- Push (Zero) button to move down one sub menu and release button when "42 UNIT" message is displayed.
- Push (Zero) button to move down one sub menu and release button when "43 U-RNG" message is displayed.
- Push (Zero) button to move down one sub menu and release button when "44 L-RNG" message is displayed.
- Push (Zero) button to move down one sub menu and release button when "45 PSCALE" message is displayed.
- Push (Zero) button to move down one sub menu and release button when "46 PWIDTH" message is displayed.

- Press SPAN button to access function "Change Pulse Width".
- Choose one Output Pulse Width from among 10ms, 50ms, 100ms. Push Zero button to cycle through display options and once desired value is displayed, push SPAN to save and exit.

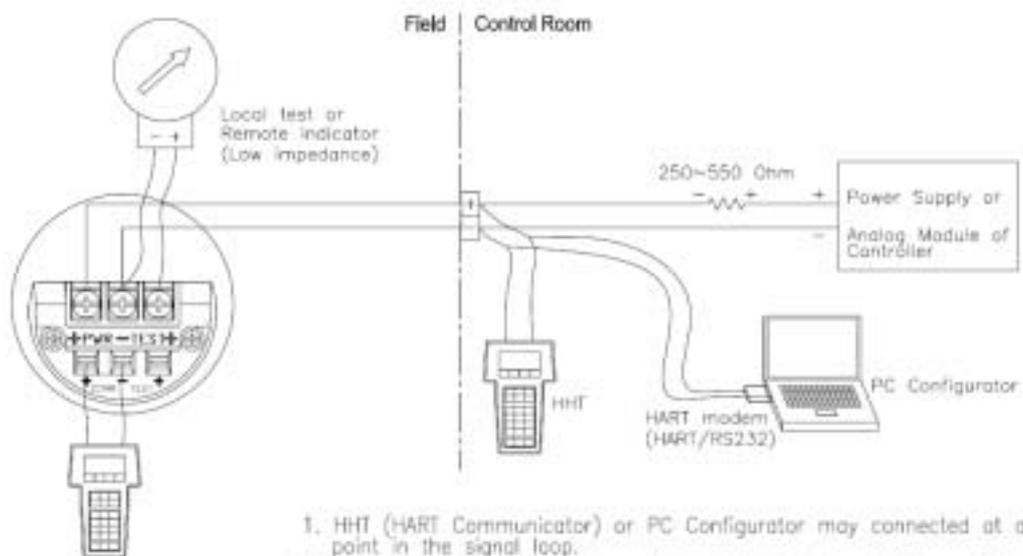
4.9 Wiring Connections for External HHT/ Ammeter

PAD Pressure Transmitter can also be commissioned using a HART® enable HHT Or PC configurator either before or after installation. A complete commissioning consists of configuring and/ or verifying transmitter configuration data, testing the transmitter, testing the loop and zero trimming.

For hazardous area installation to avoid exposure of "live" electronic circuits in field it is recommended that all Jumper settings of transmitter (Fail safe, Write disable etc) be done in the shop prior to moving the transmitter on to field installation.



Note: Test pins can be used to connect an Ampere meter for measuring output current without disconnecting loop connections or for connecting a remote indicator. You cannot initiate HART® digital communication if connecting a HHT directly across "TEST" pins. Use terminals marked communication for connecting an external HART® MASTER. You must ensure a minimum of 250~550 ohm resistance in Current Loop for any HART® Communication or PC configurator to work. If needed connect a 250 ohm resistor in loop to enable digital communications. Also for correct operation of a 4~20 mA loop, required power supply (11.9 V ~ 45 Vdc) must be provided at supply inputs marked (+) and (-).



1. HHT (HART Communicator) or PC Configurator may connected at any termination point in the signal loop.
2. HART Communication requires a loop resistance between 250 ~ 550 ohm @ 24Vdc.
3. Transmitter operates on 11.9 to 45.0 Vdc transmitter terminal voltage. [Applied Power]
 - * 11.9 ~ 45.0 Vdc for General Operation
 - * 17.4 ~ 45.0 Vdc for HART Communication

[Figure 4-5 Connection the transmitter to HHT]

5. Installation

5.1 Overview

The information in this chapter 5 covers installation considerations. Dimensional drawings for Model PAD variation and mounting configuration are included in this chapter.

5.2 Safety Message

Procedures and instructions in this chapter may require special precautions ensure the safety of the personnel performing the operation. Information that raises potential safety issues is indicated by a warning symbol (▲). Refer to the following safety messages before performing an operation proceeded by this symbol.

5.3 Warning

▲ Warning
Explosion can result in death or serious injury: <ul style="list-style-type: none">❖ Do not remove the transmitter covers in hazardous locations when the circuit is live.❖ Transmitter covers must be fully engaged to meet explosion proof approval requirements.

▲ Warning
Electrical shock can result in death or serious injury. If you install transmitter around a high voltage environment e.g. power lines there may be a very high likelihood of high voltages induced on to the signal lines. <ul style="list-style-type: none">❖ Avoid direct contact with the signal leads and terminals to avoid potential electrocution.

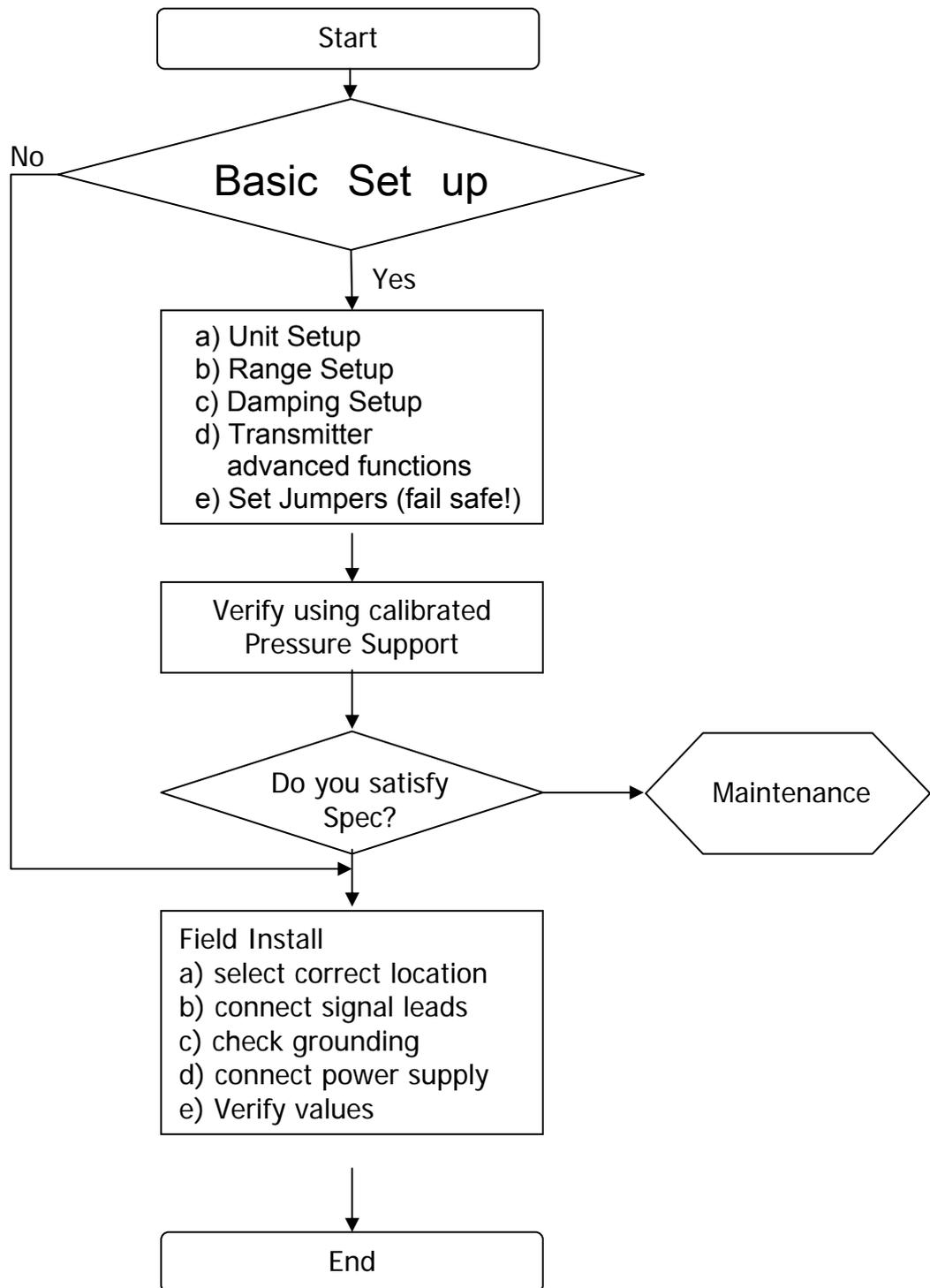
▲ Warning
Process leaks can cause death or serious injury: <ul style="list-style-type: none">❖ Install and tighten before applying pressure. Inspect regularly for process leaks.

▲ Warning
Electrical can result in death serious injury: <ul style="list-style-type: none">❖ Only qualified & trained personnel should be allowed to operate these transmitters.

▲ Warning
<ul style="list-style-type: none">❖ Instrument installed in the process is under pressure. Never loosen or tighten the flange bolts as it may cause leakage of process fluid.❖ If the process fluid may be toxic or otherwise harmful, take appropriate care to avoid contact and/ or exposure to direct vapours even after dismantling the instrument from process line for maintenance.

5.4 Commissioning on the bench with Hand-Held Terminal

Use of a HHT is possible before or after field installation. However, as a good engineering practice it is recommended to first familiarise with available functions before installation so that you have pre-commissioning done on the bench before installing the transmitters in field. In line with good engineering practice please follow the flow chart outlined below:



[Figure 5-1 Commissioning Flow Chart]

5.5 General Considerations

The PAD transmitter uses a capacitance or piezoresistive pick up. As changes in pressure are accurately detected, any zero shift or installation offsets will be transmitted as a pressure change on the 4~20mA analogue current output. Hence it is recommended that the transmitter be mounted as close to the process as possible and use short impulse piping, when possible, to achieve best accuracy. However it is equally important to be mindful of basic requirements including ease of access, safety of personnel, practical field calibration accessibility and a suitable transmitter environment when selecting a mounting location. In general, install the transmitter so as to minimize vibration, shock, and temperature fluctuations.

5.6 Electrical Considerations

The internal of the transmitter housing comprises of two sections. The front section is for the electronics module, and Rear side is for the terminal block. On backplane of the Rear Cover "Field Wiring Diagram" is included for easy identification. This can be accessed by opening the rear housing cover and exposing the terminal block inside. Terminal blocks have polarity cleared marked for supply, TEST and communication connections. Please connect transmitter power to supply connections with proper polarity. Hand held configurators connect directly to "COMM" pin provided below the Supply connections. Similarly a remote field Indicator or current ammeter can connect to "TEST" pins provided. Though transmitter is protected from reverse polarity protection it is recommended not to apply incorrect polarity across TEST pins as it may damage the protection diodes included.

5.6.1 Power Supply

For powering transmitter an external DC voltage between 11.9V~ 45 Volts DC is recommended. The external power supply ripple noise should not be higher than 2 %. When calculating loop resistances please include resistance of all devices added in the loop.

$$\text{Max. Loop Resistance } [\Omega] = (E-11.9) [\text{Vdc}] / 0.022 [\text{mA}]$$

Here, loop resistance of minimum 250 ~ 550 Ω (@24 V_{DC}) is recommended for HART® communication.

5.7 Wiring

5.7.1 Cautions during Wiring

- (1) Install signal cables away from electrical noise resources like capacitive transformers, motors, power supplies where possible.
- (2) Before wiring pull out the electrical lead connection cap included and replace with appropriate cable glands.
- (3) Please use waterproof sealants on conduit screws. Use of silicon based sealants is recommended when possible.
- (4) Do not run signal lines & power lines in same cable duct to reduce noise on signal lines.
- (5) For explosion-proof transmitters in order to maintain explosion-proof requirements please follow additional local electrical codes and practices where applicable.

5.7.2 Selecting the Wiring Materials

- (1) Use PVC shielded wire or standard lead line of same class or cable rated for 600 V or higher. In order to ensure proper communication use 24 AWG or larger wire specs, and do not exceed 1500 meters.
- (2) Use twisted pair double shielded wires in high electrical noise affected areas.
- (3) For high or lower ambient temperature areas ensure wires or cables installed also meet the operating temperature specs.
- (4) Similar use appropriate insulation in environment with high likelihood of oil, solvent, toxic gas or liquid spills.
- (5) Wiring leads must NOT be soldered to terminal lug. Use the mounting screws included instead to ensure a tight rigid hook up to the terminals.

5.7.3 Connections of External Wiring to Transmitter Terminal Box

Wiring method is as follows:

- (1) Open the housing cover indicated "FIELD TERMINAL". NOTE: For hazardous environments do not open the covers when transmitter is powered and circuits are live.
- (2) Connect the power supply in the terminal indicated "+PWR" (left terminal) and "-" power supply in the central terminal. Do NOT connect "+" power supply in "+" terminal of the point indicated "TEST". It will damage the test diode used for connecting TEST terminal.
- (3) Seal and close unused conduit connections to protect transmitters from severe humidity and explosive gases from entering into the terminal box compartment.
- (4) Avoid running signal wiring near AC or high power lines. In case of ground signal, ground the signal loop's on one side making sure other side is not grounded.
- (5) Ensure loose contacts are eliminated and proper wiring connections are maintained.

- (6) After wiring replace transmitter cover. In case of explosion proof areas, you must satisfy all requirements to maintain certification requirements.
- (7) Do not supply high voltage AC power into transmitter leads as it can cause permanent damage to transmitter.
- (8) Use surge protectors to protect transmitter from external power surges.
- (9) Ensure you have a 250~600 W Loop Resistor in current loop (between power supply and transmitter) for proper HART® Communication. Follow Figure 5-2 below for wiring instructions.

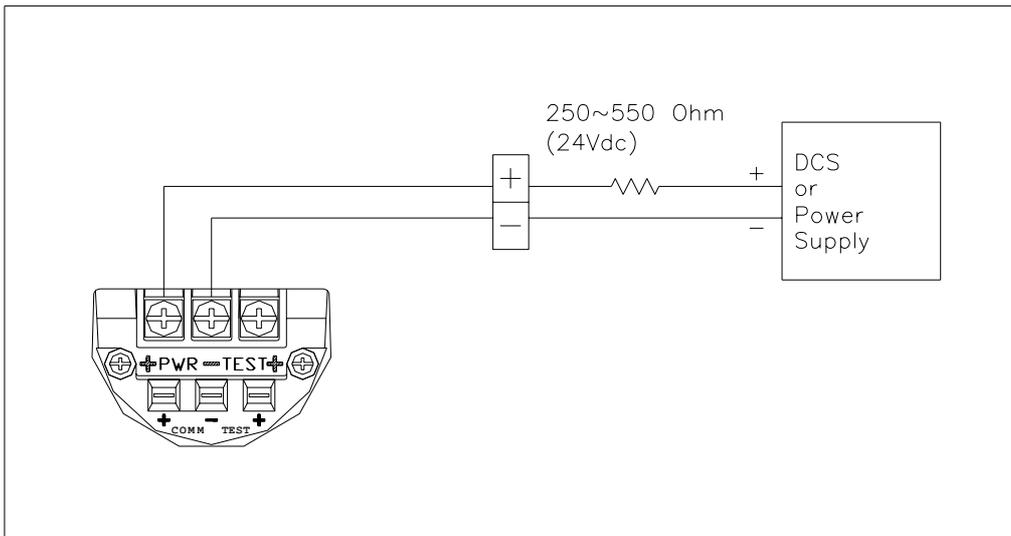


Figure 5-2 Connection with Terminal Board of Transmitter

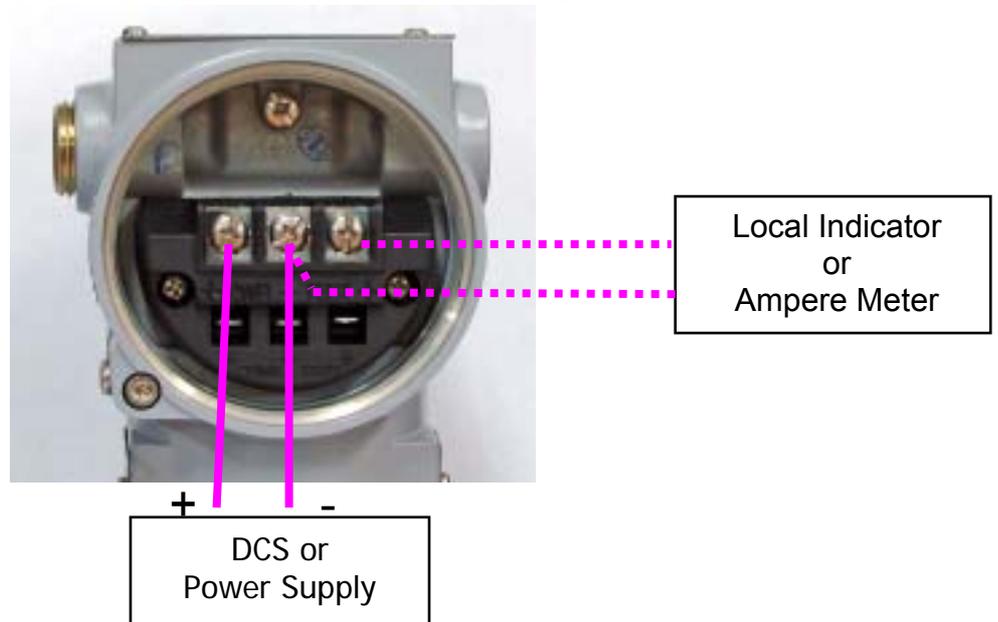


Figure 5-3 Picture of Terminal Board of Transmitter

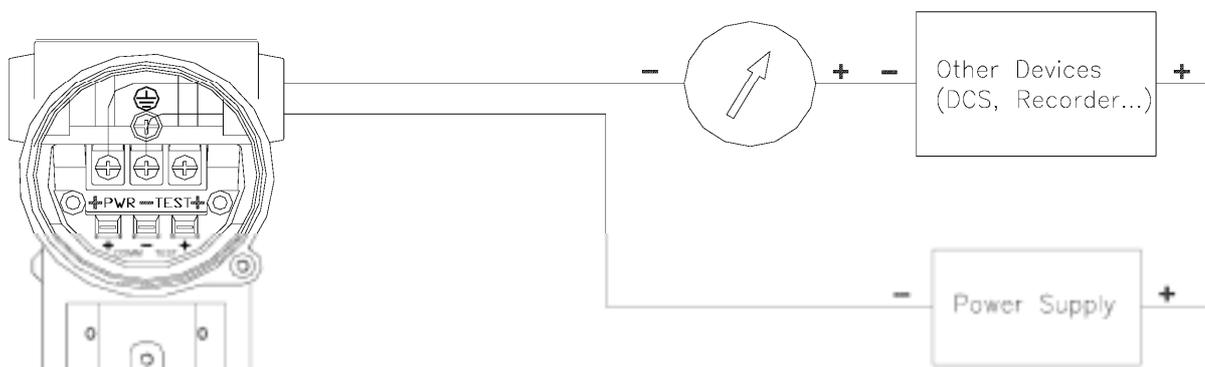
5.7.4 Wiring

A. Loop Configuration

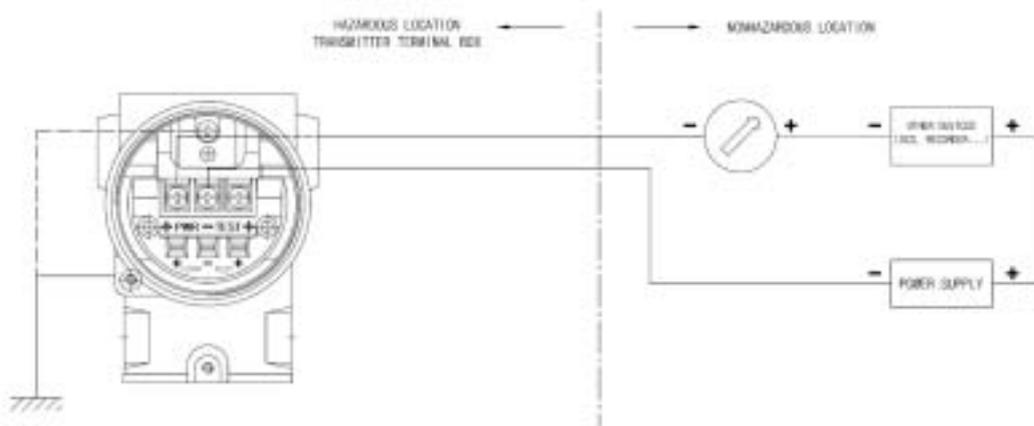
Kobold Series Transmitters use a two-wire system for power supply, 4~20mA analogue signal transmission and HART digital transmission. DC Power Supply is required for the transmitter loop. The Transmitter and distributor are connected as shown below.

(1) Non-Explosionproof / Non-Flameproof Type

Transmitter terminal box



(2) Explosionproof Type

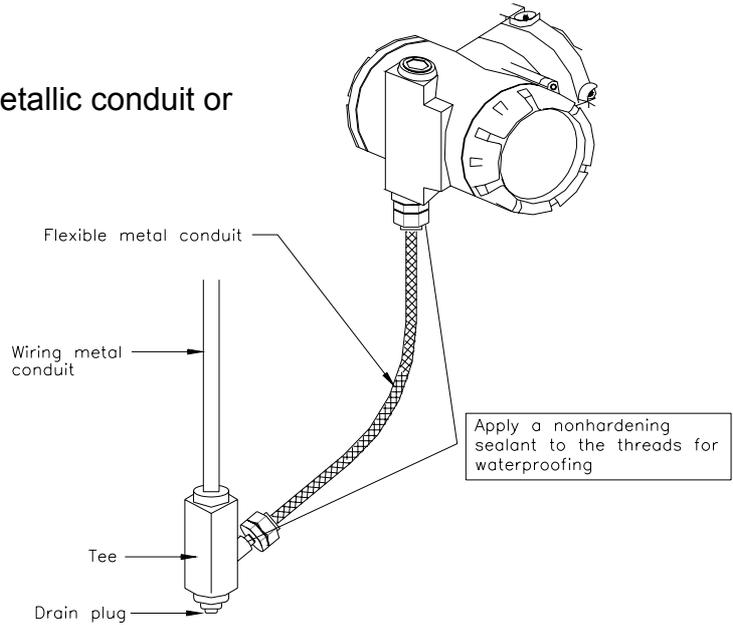


B. Wiring Installation

(1) General-use Type

Make cable wiring using metallic conduit or Waterproof cable glands.

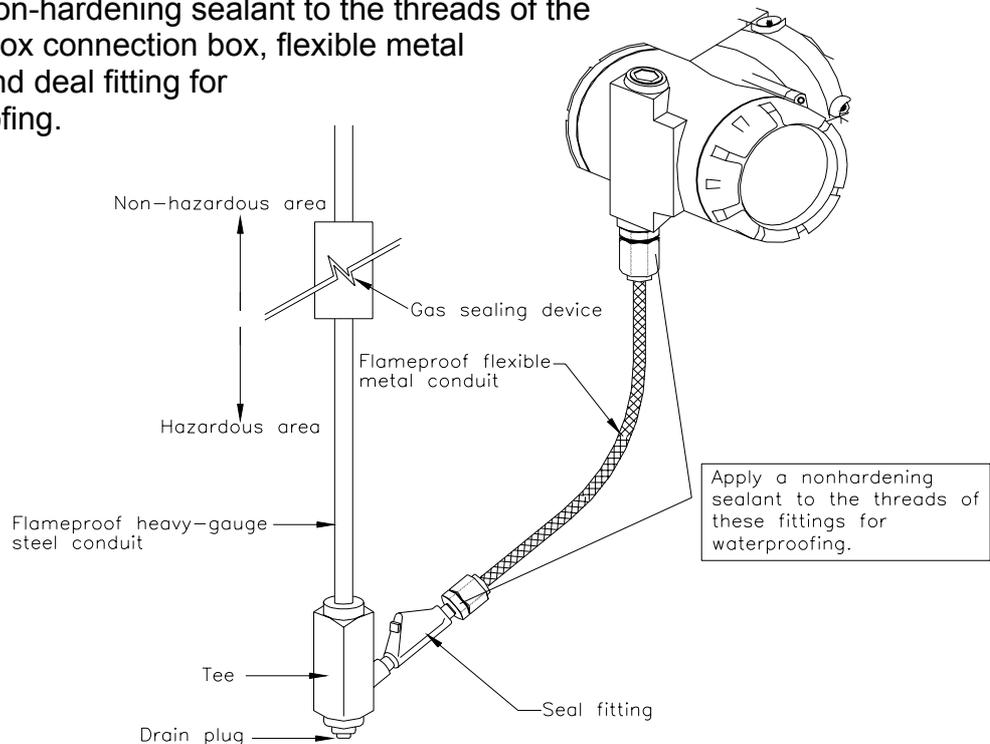
Apply a non-hardening sealant to the terminal box connection port and the threads on the flexible metal conduit for the waterproofing.



[Figure 5-4a
Typical Wiring using
Flexible Metal Conduit]

(2) Flameproof metal conduit wiring (Figure 5-4b)

- A seal fitting must be installed near the terminal box connections port for a sealed construction.
- Apply a non-hardening sealant to the threads of the terminal box connection box, flexible metal conduit and deal fitting for waterproofing.



[Figure 5-4b
Typical Wiring using Flameproof Metal Conduit]

After wiring, impregnate the fitting with a compound to seal tubing.

5.7.5 Grounding

- (a) Grounding should satisfy typical requirements (grounding resistance 10 Ohm or less). Grounding is required below 10 Ohm for explosion proof requirements.



[Note] In case of with Built-in Lightning Protector, grounding should satisfy special requirements of 1 Ohm or less.

- (b) There are ground terminal provided on the inside and outside of the terminal box. Either one of these terminals may be used for grounding the transmitters.
- (c) Use PVC insulated wire (600V min rated) for grounding.

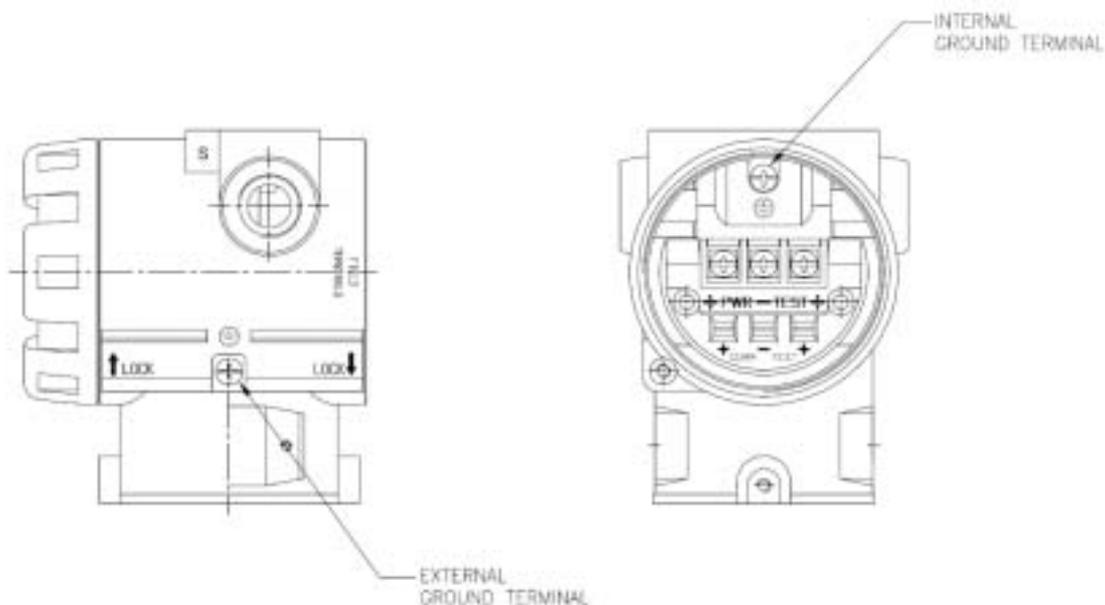


Figure 5-5 Internal and external grounding terminals

5.7.6 Power Supply Voltage and Load Resistance

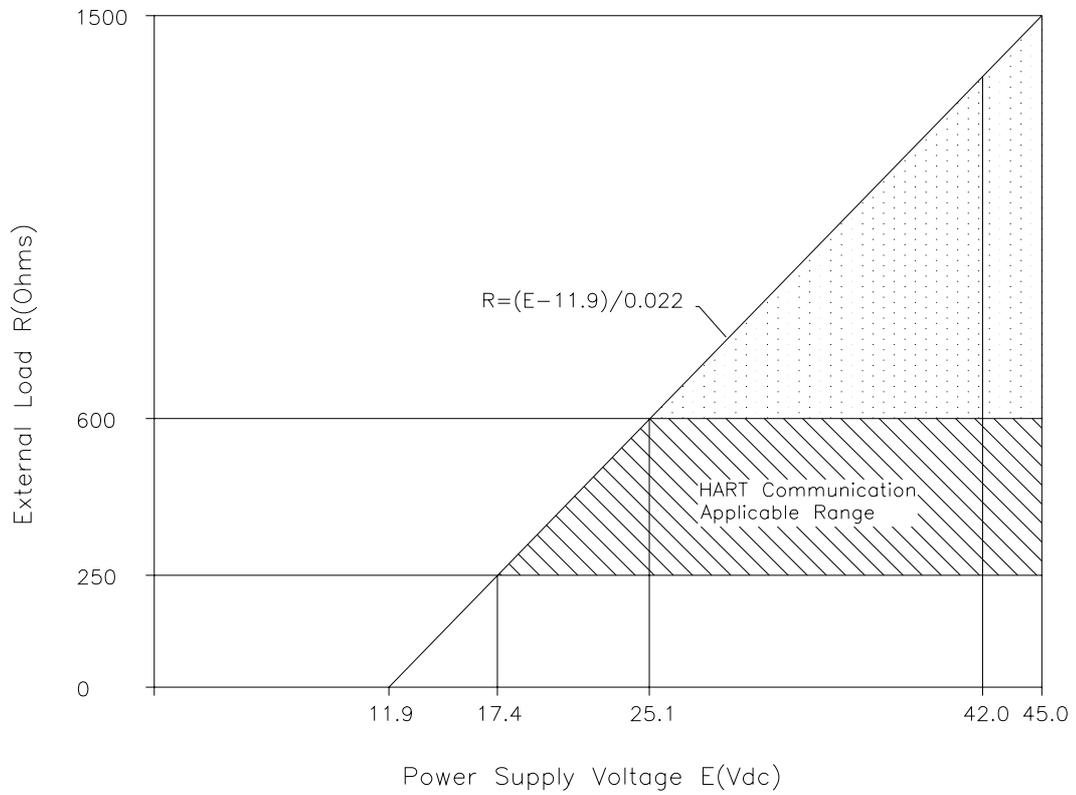
When configuring the loop, make sure that the external load resistance is within the range in the figure below. Since the voltage of transmitter terminal input is same as follows.

- General Standard : 11.9 to 45 V_{DC}
- Hart Communication : 17.4 to 45 V_{DC}

And maximum loop current is 24mA, Load resistance R:

$$R = (E - 11.9) / 0.022 \quad (E = \text{Power Supply Voltage})$$

[Note] In case of an intrinsically safe transmitter, external load resistance includes safety barrier resistance.



5.8 Mechanical Considerations

Figure 5-6 is transmitter dimensional drawings of PAD. A mounting example and dimensional drawings are shown in Figure 5-7.

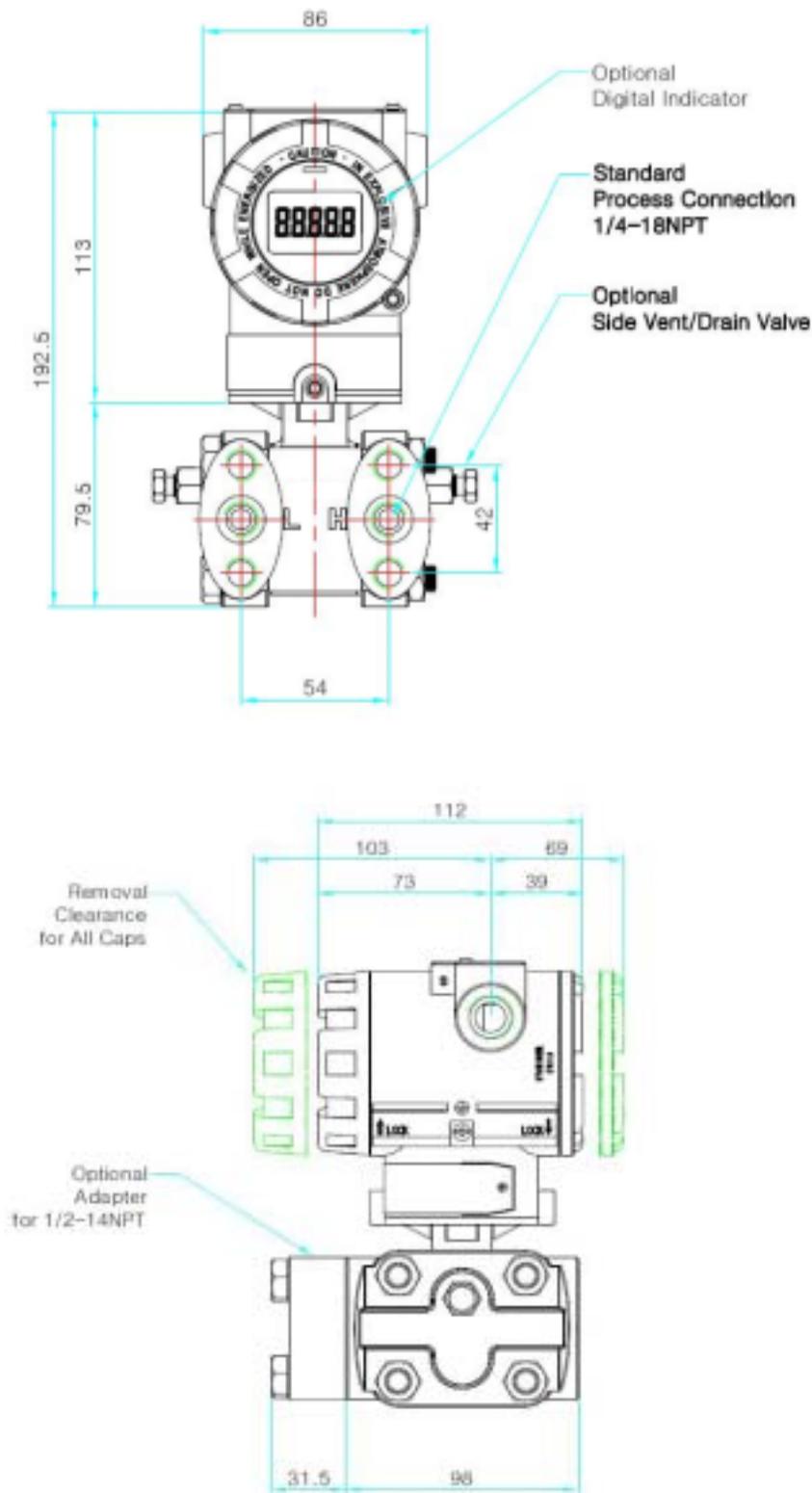
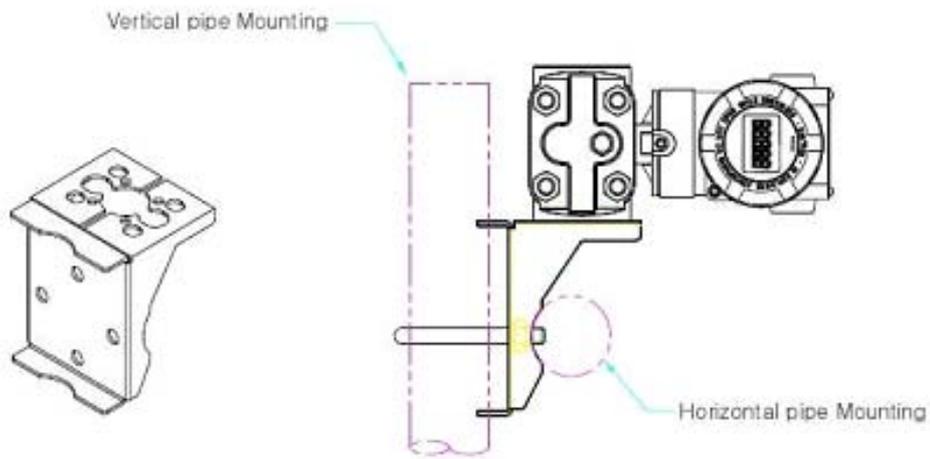
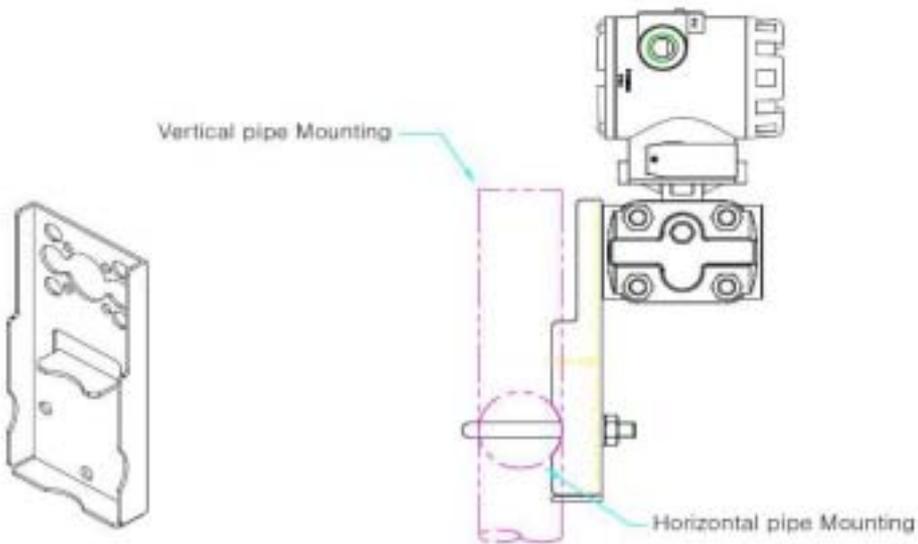


Figure 5-6. Model PAD Outline Dimension Drawing



Vertical Mounting Type
2" Pipe Mounting Bracket
Model: ZUB-PAD/PAS-K



Horizontal Mounting Type
2" Pipe Mounting Bracket
Model: ZUB-PAD/PAS-L

Figure 5-7. Typical Bracket Mounting

5.8.1 Mounting

During installation provide transmitters with adequate support. In the case of severe vibration, we recommend mounting to a 2" pipe using appropriate mounting bracket available as option. Kobold offers two styles of mounting brackets in SS. These include an "Angle type" and a "Flat type".

5.8.2 Transmitter Accessibility

When selecting a suitable location to install the transmitter it may be convenient to also consider following options.

- (1) Ensure adequate clearance is provided for rear cover access and wiring terminals.
- (2) If LCD option is installed provide adequate access for front.
- (3) Housing can be rotated up to 180° clockwise or 90° anticlockwise to provide easy access to front (or rear) of the transmitter. When rotating housing loosen lock nut placed above neck tag and ensure that sensor cable connectors are not damaged.
- (4) LCD Module can also be rotated 90° clockwise or anticlockwise, if required.

5.9 Environmental Considerations

5.9.1 Effect of Ambient Temperature

Transmitter is recommended for use within -40C to 80C operating ambient temperature range. Recommended installation for continuous operation is -20C to 60C with appropriate heat tracing or insulation provided if installing outside of these limits for extended periods.

5.9.2 Toxic/ High Humidity considerations

Housing of PAD Smart transmitters is protected from direct exposure to moisture or toxic materials provided front and rear covers are engaged fully with appropriate O-rings included. Electronic circuits are separated from terminal side; however it must be protected from moisture ingress entering housing through conduit lines. To avoid moisture build up, use appropriate water tight sealants on conduits entries and ensure correct positioning of conduit pipes to avoid condensation build up from occurring inside the terminal housing.

5.9.3 Installation in Hazardous locations

Transmitter Housing is designed to meet explosion proof protection requirements, if marked accordingly. When installing transmitter inside a hazardous classified area please ensure all required explosion proof installation & wiring requirements outside of the transmitter as stated by relevant regulatory bodies are also complied with.

6. On-line Operation

6.1 Overview

This chapter describes configuration functions of PAD smart pressure Transmitter. Transmitter can be configured in either On-Line or Off-Line mode. In On-Line configuration mode, you must connect through an external HHT (Hand Held Terminal) supporting HART® DDL technologies. When connecting in Multi-drop mode ensure each device on the HART® bus is provided with a unique HART® device ID for identification.

6.2 Safety Message

For safety of operator please pay specific attention to safety note identified under Warning symbol (▲).

6.2.1 Warning

▲ Warning

Explosion can result in death or serious injury:



- Do not remove the transmitter covers in hazardous areas when the circuit is live.

-Before connecting HHT in a classified zone, check that the configuration device connecting to transmitter also complies to required safety regulations.

-Both transmitter covers must be fully engaged to meet explosion proof certification requirements

6.2.2 Multidrop Mode

In the case of multidrop mode where current loop is set at 4 mA the current loop must be set to passive mode. This is set automatically when changing the HART® device ID to a numeric value 1 to 15 (except 0).

6.3 Configuration Data Review

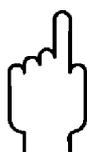
In case transmitter is already installed on site, review configuration data to reconfirm it meets the application requirements.

6.4 Check Output

Transmitter is provided with a Loop Test function (accessible only via an HHT) under service/ maintenance menu which can be used to output desired values 4, 8, 12, 16, 20 mA for testing current outputs.

6.4.1 Process Variable

The PAD Smart pressure transmitter measures two variables. Primary Variable is always the process pressure measured and SV (Secondary Variable) is the temperature.



Note: Temperature measured is used strictly for internal compensation . Only PV value can be assigned to current output on a 4~20mA loop. However in digital mode both PV and SV can be read through a compatible HART® communicating device.

6.5 Basic Setup

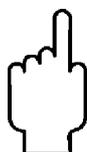
This involves configuring minimal settings required to operate transmitter correctly.

6.5.1 Select Sensor Range

This value is automatically set from factory based on the sensor Range code installed on the transmitter. This Range defines the minimum/ maximum range limits and span settings for installed sensor which should not be exceeded for normal operation or during re-ranging or Zero/ Span configuration.

6.5.2 Set Output Units

Select required measurement units e.g. kPa, kg/cm², bar, psi, mmH₂O etc.



Note: This is different to Engineering mode unit as settings configured under this menu affect only the transmitter current 4/20 mA output configuration. In normal LCD mode these units are indicated on LCD module.

6.5.3 Rerange

Set the Zero and Span for the 4~20mA analogue output.

6.6 Detailed Setup

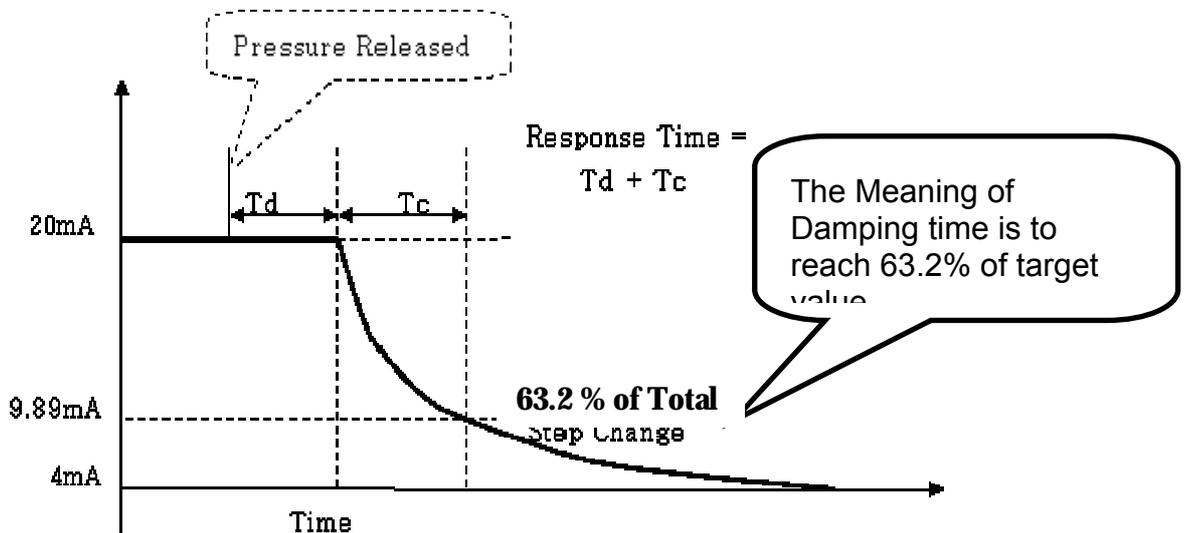
6.6.1 Set Fail Safe Mode

Sets failure mode (fail down or fail up) for 4/20mA outputs in case of an error or malfunction detected automatically during self diagnostic routine included within the transmitter.

6.6.2 Set Damping Time

Determine the appropriate damping setting based on the required response time, signal stability and other requirements of the loop dynamics of your system. The default damping value is 1.0 seconds, and can be reset to damping values between 0 and 60 seconds.

[Graph illustrating Damping/ Response time features]



6.7 Tag Information set up

6.7.1 Set Tag

Set tag information to uniquely classify transmitter. Tag information is limited to max of 8 alpha-numeric characters. For additional description use Set Message option under 6.7.2.

6.7.2 Set Messages

When using several transmitter, user may classify each transmitter by using 32 alpha-numeric characters. This message is saved in EEPROM of transmitter.

6.8 Diagnostics and Services

6.8.1 Loop Test

The Loop Test verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed loop. Perform the following procedure for a loop test.

- (1) Connect a reference meter to the transmitter.
- (2) Select the Loop Test of HHT and operate the Loop Test.
- (3) Select output current (4 mA/20 mA/etc.)
- (4) If the readings match, then the transmitter and the loop are configured and functioning properly. If the readings do not match, then you may have the current meter attached to the wrong loop, there maybe a fault in the wiring, the transmitter may require an output trim, or the electrical current meter may be malfunctioning.

6.9 Calibration

Re-Ranging scales the upper and lower ranges of transmitter outputs and does not affect the stored calibration data of the transmitter. On the other hand a Sensor Trim function can be used to tune/modify the stored calibration.

It is important to keep in mind that Smart transmitters operate differently from conventional analogue transmitters. A Smart transmitter uses a microprocessor that contains information about the sensor's specific characteristics in response to pressure and temperature inputs which is what is used for calculating final PV (Process Variable). These calibration curves are performed under traceable laboratory standards and stringent quality control parameters. Changing factory calibration data is advisable only if it is necessary to correct transmitter offsets and only when checking against a traceable calibration source which is at least five time more accurate than the transmitter under test.

As such a Sensor trim and Output Re-range function differ. Re-ranging sets the transmitter analogue output to the selected upper and lower range points and can be done with or without an applied pressure. Re-ranging does not change the factory characterization curve stored in the microprocessor. Sensor trimming requires an accurate pressure input and adds additional compensation that adjusts the position of the factory characterization curve to optimize transmitter performance over a specific pressure range.

6.9.1 Sensor Trim

The Sensor trim function adjusts the A/D signal conversion within the transmitter sensor electronics and determines how it digitally interprets any pressure changes applied to the sensor inputs. It is highly recommended to perform a sensor trim when first commissioning the transmitter on site. There are three ways to trim the sensor: Sensor zero trim, full trim and zero adjustment.

Sensor zero trim is a one-point adjustment typically used to compensate for the mounting position.

Two point trim is a full sensor trim, in which two accurate pressures with difference within the published sensor span specifications for the specific range codes are applied (equal to or greater than the range values), and the output is set to linear. You should always adjust the low trim value first to establish the correct offset.

Zero adjustment allows user to add a pre-defined offset (other than zero) to measured PV that may be required on certain applications such as Level measurements to compensate for nozzle placements.

6.9.2 DA (Digital to Analogue) Trim

The Sensor Trim functions adjust the calibration values of the PV applied to sensor (on input side only), however a D/A trim adjusts sensor input to match the 4~20mA current output. When executing a D/A trim the current output can be adjusted minutely to match desired current values outputted from the transmitter. To perform a D/A Trim a precise and traceable reference current meter is required to be connected on the output loop. When performing a D/A trim avoid using TEST pin and try to install reference meter directly in series in output loop to eliminate any undesirable offsets. Here again make sure that reference meter used for D/A trim is 5 times more accurate than published accuracy specs. of the transmitter. When performing a D/A trim it is recommended to do a minimum of two points i.e. trim at (4mA) and (20mA). It may however be necessary to perform repeated trims at both 4/20 mA to achieve optimum results.

6.10 Advance Set Up:

(Needs a HART® enabled HHT and/ or PC configurators)

6.10.1 Output Mode

The transmitters can be set to output its 4/20 mA signal in linear or Square Root. Square Root mode may be desirable configuration when installing a PAD-D or PAD-F for flow measurement.

In Engineering mode (when enabled) users have added flexibility of enabling square root mode only for local display purpose on LCD and retain a linear 4/20 mA current output for a remote totaliser or DCS /PLC control system.

7. Maintenance

7.1 Overview

This chapter describes breakdown diagnostic and maintenance.

7.2 Safety Message

When operation, it requires specially notice for the safety of operator. Information that raises potential safety issues is indicated by a warning symbol (▲). Refer to the following safety messages before performing an operation proceeded by this symbol.

7.2.1 Warning

▲ Warning
<p>Explosion can result in death or serious injury:</p> <ul style="list-style-type: none"> ❖ Do not remove the transmitter covers in hazardous locations when the circuit is live. ❖ Transmitter covers must be fully engaged to meet explosion proof approval requirements.

▲ Warning
<p>Electrical shock can result in death or serious injury. If you install transmitter around a high voltage environment e.g. power lines there may be a very high likelihood of high voltages induced on to the signal lines.</p> <ul style="list-style-type: none"> ❖ Avoid direct contact with the signal leads and terminals to avoid potential electrocution.

▲ Warning
<p>Process leaks can cause death or serious injury:</p> <ul style="list-style-type: none"> ❖ Install and tighten before applying pressure. Inspect regularly for process leaks.

▲ Warning
<p>Electrical can result in death serious injury:</p> <ul style="list-style-type: none"> ❖ Only qualified and trained personnel should be allowed to operate these transmitters.

▲ Warning
<ul style="list-style-type: none"> ❖ Instrument installed in the process is under pressure. Never loosen or tighten the flange bolts as it may cause leakage of process fluid. ❖ f the process fluid may be toxic or otherwise harmful, take appropriate care to avoid contact and/ or exposure to direct vapours even after dismounting the instrument from process line for maintenance.

7.3 Hardware Diagnostics

If you suspect a malfunction despite the absence of any diagnostic messages on the HHT follow Table 6-1 described here to verify that transmitter hardware and process connections are in good working order.

[Table 6-1 Troubleshooting]

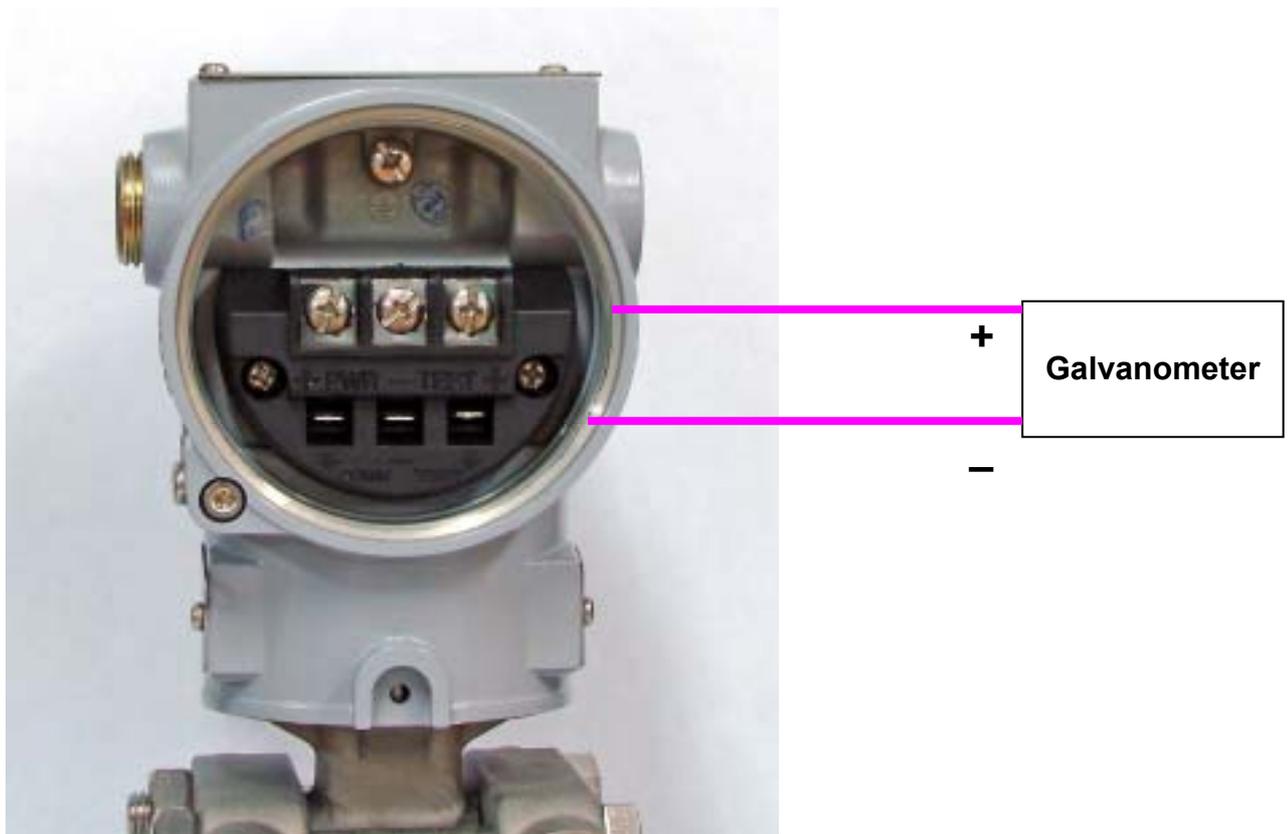
Symptom	Potential Source	Corrective Action
Transmitter Does not Communicate With HART Communicator	Loop Wiring	<ul style="list-style-type: none"> Check for a minimum of 250 ohms resistance between the power supply and HHT. Check for adequate voltage to the transmitter. The transmitter always requires 11.9 ~ 45 V_{DC}. Check for intermittent shorts, open circuits, and multiple grounds.
High Output	Sensor Input Failure	<ul style="list-style-type: none"> Connect HHT and enter the Transmitter test mode to isolate a sensor failure.
	Loop Wiring	<ul style="list-style-type: none"> Check for dirty or defective terminals, interconnecting pins, or receptacles.
	Power Supply	<ul style="list-style-type: none"> Check the output voltage of the power supply at the transmitter terminals. It should be 11.9 to 45 V_{DC} in spite of loop scale.
	Electronics Module	<ul style="list-style-type: none"> Connect HHT and enter the Transmitter test mode to isolate module failure. Check the sensor limits to ensure calibration adjustments are within the sensor range.
Erratic Output	Loop Wiring	<ul style="list-style-type: none"> Check the output voltage of the power supply at the transmitter terminals. It should be 11.9 to 45 V_{DC}. Check for intermittent shorts, open circuits, and multiple grounds. Check for proper polarity at the signal terminals. In case of measuring electric current while digital communication, output current should be appear around +0.013mA
	Electronics Module	<ul style="list-style-type: none"> Connect HHT and enter the Transmitter test mode to isolate an electronics mode failure.
Low Output or No Output	Sensor Element	<ul style="list-style-type: none"> Connect HHT and enter the Transmitter test mode to isolate a sensor failure. Check the PV to see if it is out of range.
	Loop Wiring	<ul style="list-style-type: none"> Check for adequate voltage to the transmitter. The transmitter always requires 11.9 ~ 45 V_{DC}. Check for intermittent shorts, open circuits, and multiple grounds. Check polarity of signal terminal Check the loop impedance.
	Electronics Module	<ul style="list-style-type: none"> Connect HHT and check the sensor limits to ensure calibration adjustments are within the sensor range.

7.4 Hardware Maintenance

Kobold PAD Smart Transmitters have no moving parts and require a minimum of scheduled maintenance. Both transmitters feature modular design for easy maintenance. If you suspect a malfunction, check for an external cause before performing the diagnostics as discussed later in this section. If you must return failed transmitters or parts, send them to Kobold Messring GmbH for inspection, repair, or replacement.

7.4.1 Test Terminals

The test terminal is clearly marked as TEST on the terminal block behind the rear cover. The test and negative terminals are connected internally via a diode. As long as the voltage across these terminals is kept below the diode threshold voltage, no current passes through the diode. To ensure that there is no leakage current through the diode while making a test reading, or while an indicating meter is connected, the resistance of the test connection or meter should not exceed 10 ohms. A resistance value of 30 ohms will cause an error of approximately 10 percent of reading.



[Figure 7.1 Test Terminals]

7.4.2 Disassembling the Electronics Housing

The transmitter is designed with dual-compartment housing; one contains the electronics module, and the other contains all wiring terminals and the communication receptacles.



Figure 7.3 Structure of Housing

7.4.2.1 Disassembling Electronics Module

Use the following procedure to remove the electronics module.



[Note1]:-The electronics module Board comes standard with conformal coating for added protection in tropicalised environments. These modules are designed as non-repairable units. If a malfunction does occur the entire unit must be replaced.

1. Disconnect the power to the transmitter. Remove the cover from the electronics side of the transmitter housing (Figure 7.2).
2. Do not remove the instrument cover in explosive atmospheres when the circuit is alive.
3. Remove the LCD meter by first disconnecting the screws and then pulling out the LCD module from the plug in connector located behind the module.
4. Remove the two screws that anchor the electronics module to the transmitter housing.
5. Remove the analogue sensor cable & power cables from their plug in connectors.
6. Firmly grasp the electronics module and pull it straight out of the housing, taking care not to damage the interconnecting pins.



[Note2]:The transmitter EEP-Write Enable and failure mode DIP-Switches are located on the front of the electronics module. When replacing with a new one make sure to duplicate the same DIP-Switches settings on the replacement board.



Figure 7.3 Structure of Electronics Module inner Transmitter

7.4.2.2 Fail Mode and Jumper Switch of EEPROM-write

Fail-mode and jumper switch of EEPROM-write are located front of electronics module (Refer to Figure 4-3)

7.4.3 Assembling the Electronics Housing

Re-assembling procedure is as follows:-

1. Make sure that Fail-mode and Jumper Switch are set exactly as the electronics board being replaced.
2. Insert electronics module into housing Connect back the cable connectors of analogue sensor board and power.



Note: An improper connection on either connector can cause wrong outputs and/ or effect power to the transmitter. Also make sure neither of the connector cables are pinched or twisted between the electronics board and transmitter housing.

3. Anchor electronics module with the 3 screws.
4. Attach LCD module making sure plug in connectors are installed correctly on appropriate mating connectors on the electronics board.
5. Secure LCD module with the screws provided.
6. Close the front cover of housing. For explosion proof rated transmitters ensure covers are fully engaged and O-Ring seal is securely in place.
7. Power on the transmitter and note the start up screen/ boot sequence.
8. If all self checks are completed and found OK, the transmitter will enter measurement mode automatically.
9. If any errors are found, same will be displayed on LCD. Follow the troubleshooting guide included in this manual to help identify and correct any fault conditions.

8. Appendix I

PAD SMART PRESSURE TRANSMITTER
LCD DISPLAY CODE

Message	Description	Remarks
ADJ-U	Out of Zero setting value when Zero Adj function using button(Upper side)	
ADJ-L	Out of Zero setting value when Zero Adj function using button(Lower side)	
ZERO	Initial message in using Zero button	
SPAN	Initial message in using Span button	
BT-ERR	Button input Sequence error	
P-LOCK	Button input error when Protect Locked	
ZT-ERR	Setting Limit (10 %) Error when Zero Trim	
-TR-	Zero Trim Done	
ZR-ERR	Setting Limit error when executing Zero button function	
SP-ERR	Setting Limit error when executing Span button function	
-ZR-	Zero button function done	
-SP-	Span button function done	
-ZA-	Zero Adjustment done	
-DONE-	Setting Done using button	
RNGOVR	Setting Limit error when executing other setting function	
LCD_OV	Over figure values for LCD	
SCD-ER	Sensor Code Error	
F-RST	Flash Setting Data Reset	
F-LOCK	While Flash Setting Data Reset, Protect Locked	
F-FAIL	Flash Setting Data Reset Failure	
-FR-	Flash Reset Done	
A-RST	Analogue EEPROM Initialising Start	
A-STOR	Analogue EEPROM Whole Write	
A-FAIL	Analogue EEPROM Whole Write Failure	

Message	Description	Remarks
-AC-	Analogue EEPROM Whole Write Done	
S-FL	Sensor Fail	
S-OP	Sensor Overpressure	
AEP-RF	Analogue EEPROM read checksum error	
TS-FL	Temperature Sensor Error	
AEP-WF	Analogue EEPROM write fail	
EOSC	Crystal Element Defect Alarm	
FAVE	Flash Access Violation	
NOR_RO	Indicating the value with PV, %, mA units as continually on LCD	
NOR_PV	Indicating measured PV value only on LCD	
NOR_%	Indicating percentage of Cal. Range of measuring PV value on LCD	
NOR_mA	Indicating 4 ~ 20 mA value depending on measured PV value on LCD	
ENG_RO	Indicating the value with Engineering PV, Engineering %, Engineering mA units as continually on LCD	
ENG_PV	Indicating changed PV value with modified Engineering range	

9. Declaration of Conformance

We, KOBOLD Messring GmbH, Hofheim-Ts, Germany, declare under our sole responsibility that the product:

Smart Pressure Transmitter Model: PAD

to which this declaration relates is in conformity with the standards noted below:

EMI (Emission): EN 55011
EMS (Immunity): EN 50082-2

Kobold Messring GmbH recommends customer to apply the Metal Conduit Wiring or to upset he twisted pair Shield Cable for signal wiring to conform the requirement of EMC Regulation, when customer installs Kobold Series Transmitters to the plant.

Hofheim, 22. Sept. 2009



H. Peters
General Manager



M. Wenzel
Proxy Holder

(1) EC-TYPE EXAMINATION CERTIFICATE

(2) **Equipment and protective systems intended for use in potentially explosive atmospheres - Directive 94/9/EC**

(3) EC-Type Examination Certificate Number: **KEMA 10ATEX0141 X** Issue Number: **1**

(4) Equipment: **Pressure Transmitter Series PAD and PAS**

(5) Manufacturer: **Kobold Messring GmbH**

(6) Address: **Nordring 22-24, 65719 Hofheim, Germany**

(7) This equipment and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

(8) KEMA Quality B.V., notified body number 0344 in accordance with Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres given in Annex II to the directive.

The examination and test results are recorded in confidential test report number 213610600.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0 : 2006

EN 60079-1 : 2004

EN 60079-1 : 2007

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-Type Examination Certificate relates only to the design, examination and tests of the specified equipment according to the Directive 94/9/EC. Further requirements of the directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(12) The marking of the equipment shall include the following:



II 2 G Ex d IIC T6 or T5 (Series PAD)

II 2 G Ex d IIC T6...T4 (Series PAS)

This certificate is issued on July 12, 2010 and, as far as applicable, shall be revised before the date of cessation of presumption of conformity of (one of) the standards mentioned above as communicated in the Official Journal of the European Union.

KEMA Quality B.V.

T. Pijpker
Certification Manager

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(13) **SCHEDULE**

(14) **to EC-Type Examination Certificate KEMA 10ATEX0141 X** Issue No. 1

(15) **Description**

The Pressure Transmitter Series PAD and PAS measures the pressure of a process and converts it into an electrical 4 - 20 mA analog current signal with digital communication (HART protocol).

Ambient temperature range: -20 °C to +60 °C
Process temperature: max. 85 °C for T6
max. 100 °C for T5
max. 130 °C for T4

Electrical data

Supply: 11,9 to 42 Vdc
Output: 4 - 20 mA

Installation instructions

The instructions as provided by the manufacturer shall be followed in detail to assure safe operation of the equipment.

The cable glands and blanking elements shall be of a certified flameproof type, suitable for the conditions of use and correctly installed.

Routine tests

Each welded sensor of the Series PAD transmitters shall be subjected to the routine test of EN 60079-1 : 2004, clause 16 using a test pressure of 1 MPa during at least 10 seconds.

Each welded sensor of the Series PAS transmitters shall be subjected to the routine test of EN 60079-1 : 2007, clause 16 using a test pressure of 840 kPa during at least 10 seconds.

(16) **Test Report**

KEMA No. 213610600.

(17) **Special conditions for safe use**

For information regarding the dimensions of the flameproof joints the manufacturer shall be contacted.

(18) **Essential Health and Safety Requirements**

For Series PAD, covered by the standards EN 60079-0 : 2006 and EN 60079-1 : 2004
For Series PAS, covered by the standards EN 60079-0 : 2006 and EN 60079-1 : 2007

(19) **Test documentation**

As listed in Test Report No. 213610600.