Honeywell

PM/APM Smartline Transmitter Integration Manual

PM12-410

Implementation
PM/APM Optional Devices

PM/APM Smartline Transmitter Integration Manual

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About This Publication

This publication describes how to integrate a Smartline Transmitter into a TDC 3000X UCN and LCN after the transmitter has been installed in the field.

This manual assumes knowledge of how to use the hand-held Smart Field Communicator. Section 6 assumes knowledge of point-building procedures and UCN node specific configuration procedures.

Change bars are used to indicate paragraphs, tables, or illustrations containing changes that have been made by Document Change Notices or an update. Pages revised only to correct minor typographical errors contain no change bars. All changes made by previous Document Change Notices have been incorporated in this update.

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INTRODUCTION
Section 1

This section describes the features of the TDC 3000^X PM/APM Smartline Transmitter subsystem.

1.1 OVERVIEW OF PM/APM SMARTLINE TRANSMITTER SUBSYSTEM

The **PM/APM Smartline Transmitter subsystem** is the digital integration of Smartline 3000 Transmitters into the TDC 3000^X System. The **Smart Transmitter Interface I/O Processor** in the PM/APM node provides a digital interface to the Smartline Transmitters, shown in Figure 1-1. There are two types of I/O processors (IOPs) that provide digital integration of Smartline Transmitters.

The STI IOP supports these single-PV Honeywell Smartline Transmitters:

- **ST 3000** for differential, gauge, and absolute pressure measurements,
- **STT 3000** for temperature, millivolt, and ohms measurements, and
- **MagneW 3000** for flow measurements (electromagnetic flowmeter).

The STIMV IOP supports all Honeywell Smartline Transmitters including multi-PV field devices such as

- **SCM 3000** for flow measurements (coriolis flowmeter).

The Smartline Transmitter can be set in analog or **Digital Enhanced (DE)** mode. DE mode offers bidirectional communication (read/write capability) between the system and the transmitter. In DE mode, it is possible to monitor and manipulate the transmitter from the Universal Station.

Each Smart Transmitter IOP (also referred to as the **STIM** on the Universal Station) can accommodate a maximum of 16 inputs from transmitters operating in the DE mode. The STI IOP accommodates sixteen single-PV transmitters. The STIMV IOP accommodates four multi-PV field devices with up to four PVs each, or some mix of single PV and multi-PV field devices that equals 16 inputs per IOP.

By combining the Smart Transmitter IOP and Smart Transmitters operating in the Digital Enhanced (DE) mode, the transmitter operation and database become part of the TDC 3000^X Control System. This **digital integration** provides the capabilities to:

- upload/download (save/restore) the transmitter database,
- alarm on transmitter loop failure,
- rerange the transmitter, and
- preconfigure the field system.

These capabilities are aimed at improving the overall efficiency of the process plant operation by combining the central control room equipment with field equipment performance.

A more complete list of digital integration features is outlined below.

1.1.1 Signal Noise Immunity

A conventional 4-20 mA field instrument signal is subject to distortion caused by electrical noise or radio frequency interference. With digital communication, transmitter data is sent as a 24-bit floating point number. **Noise immunity** is achieved by filtering the noise from the signal by clearly separating signal levels—20 mA for logical zero and 4 mA for logical one. The transmission of data is determined to be either good or corrupted when a severe interference is present. This feature ensures the certainty of data used in a control loop.

1.1.2 History Function (Database Collections)

You can historize up to 2,400 floating point or digital points per History Module. Transmitter data that can be configured and saved includes PV, PV Status and ranges.

1.1.3 Single Database

The Smart Transmitter database can be uploaded to the IOP, then saved to a checkpoint file on a History Module or removable media. In this way, the point database, resident in the PM or APM, is maintained with the transmitter database in one checkpoint file.

1.1.4 Journal

Operator changes such as reranging, upload, and download of transmitter database are journaled as part of the System Journal.

1.1.5 Bad Database Protection

Bad Database Protection and **Traffic Detection** refers to the ability of the system to detect receipt of a bad database by comparing the database elements sent by the transmitter with the IOP memory database. If a mismatch of the database occurs, the transmitter database is flagged—and gives a bad PV signal to the PM or APM to ensure that the control loop does not use a bad database.

The Smartline Transmitter broadcasts part of its database three times each second. The IOP compares the database received from the transmitter to the database in the IOP. If they do not match, the IOP flags the mismatched database and gives a bad PV signal to the PM or APM to ensure that the control loop does not use the bad database.

The Smart Transmitter IOP performs traffic detection — these are changes to the transmitter database from the hand held **Smart Field Communicator** (SFC). The Smart Field Communicator (SFC) is a battery powered unit that can be connected to the transmitter's output signal lines at any termination point, for communication directly with the transmitter's database. When the parameter being changed affects the PV, the IOP reports the bad PV to the PM or APM and the TDC 3000X System. This action prevents the control loop in the PM or APM from operating on a bad database. It also alerts the TDC 3000X operator of the change to the transmitter database, which could impact the process operation.

1.1.6 Alarming

Digital integration of Smartline Transmitters gives full support of TDC 3000X process and system alarm mechanisms. The user can also configure alarm limits for Secondary Variables through additional point configuration. For example, you can configure a high temperature alarm for the ST 3000 pressure transmitter's Secondary Variable to detect any abnormal sensor temperature condition.

1.1.7 Database Checkpointing

The Smartline transmitter database can be configured to be part of the periodic or demand checkpoint database through the checkpoint/history function.

1.1.8 Off-Line Configuration

Using a Universal Station, you can download the database from an LCN file to the transmitter. You can access the LCN engineering personality off-line to construct the transmitter database—communication with the transmitter is not needed at this time. Configuration tools such as WORKBOOK and transmitter configuration forms are available to build the transmitter database. This also eliminates the need to sort out, bench test, and calibrate a transmitter during installation. Using the database comparison feature, cross-checking of the transmitter's tags and serial numbers provides a mechanism to verify and track the location of any transmitter.

1.1.9 Reranging

The Smartline Transmitter can be reranged from the SFC, Universal Station, or a Control Language program in the Application Module (AM). Both the Upper Range Value (URV) and Lower Range Value (LRV) are accessible and modifiable.

1.1.10 Transmitter Diagnostics

Smartline transmitters perform self-diagnostic functions. The results of the diagnostics are reported to either the Smart Field Communicator (SFC), when queried, or to the PM or APM. The transmitter self-diagnostics information is displayed on the Point Detail display.

1.2 IOP FEATURES

The PM and APM are connected to the **Universal Control Network (UCN)** as shown in Figure 1-1. The UCN includes a **Network Interface Module (NIM)** which links to the **Local Control Network (LCN)**.

As shown in Figure 1-1, the PM or APM includes the **Process Manager Module** (PMM) or **Advanced Process Manager Module** (APMM) and the I/O Subsystem, to which the **Smart Transmitter Interface IOP** is connected.

The **Field Termination Assembly** (FTA) in the PM or APM is cabled to the IOP, providing a serial communication link for direct digital communications to the Smart Transmitter in the field. Maximum length of the FTA cable is 50 meters.

Physically connected to the PM or APM through the FTA, the Smart Transmitter sends digital information (changes in the loop current), which are sensed as voltage changes across the 250 ohm loop resistor in series with the transmitter and its power supply.

The Smart Transmitter IOP provides the following features:

- single window access to Smartline Transmitter data, including
  - — access to Smart Transmitter database using standard LCN parameter access mechanisms (point and parameter),
  - — access to both Process Variable (PV) and Secondary Variable (SV) and PV conversion to user selected engineering units,
  - — support for reranging transmitters from the Universal Station or a CL program,
- bad database protection to ensure the integrity of measurement data,
- transmitter status access and alarm support,
- range checking and PV filtering,
- off-line configuration of Smartline Transmitters, including transmitter tag ID,
- transmitter database upload, download, and checkpoint save,
- display of transmitter self-diagnostic messages, serial and revision numbers, and the scratch pad,
- PV source selection—PV can be from the transmitter, a manually entered PV, or a program substituted PV, and
- digital enhanced format makes the transmitter signal immune to noise.

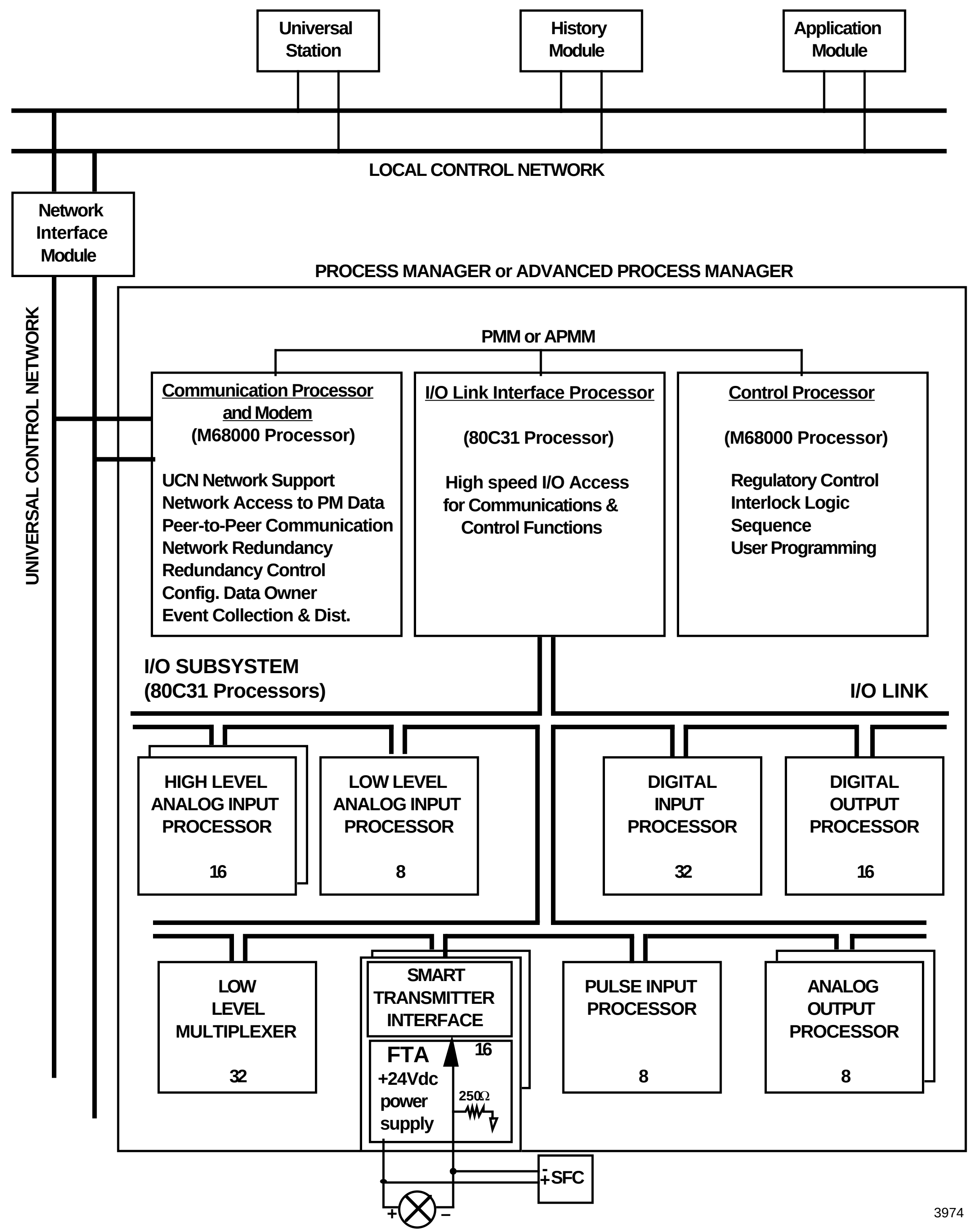


Figure 1-1 — System Signal Flow Diagram

1.3 REFERENCE DOCUMENTS AND TRAINING COURSES

Other Honeywell documents that apply to Smartline Transmitter Integration are listed below.

PM

PM12-400	Process Manager Implementation Guidelines

APM

AP12-400	Advanced Process Manager Implementation Guidelines

SFC

34-ST-11-10A	Smart Field Communicator, Model STS102 Operating Guide
34-ST-11-18	Smart Field Communicator, Model STS103 Operating Guide for SCM 3000

SCM 3000

34-CM-25-01	Smart Coriolis Flowmeter User Manual

SGC 3000

34-GC-25-01	Smart Gas Chromatograph User Manual

ST 3000

34-ST-32-02B	ST 3000 Smart Transmitter User Manual
34-ST-11-11	SFC Model STS102 Operating Card (ST 3000)

STT 3000

34-ST-33-19	STT 3000 Installation Guide
34-ST-25-06	STT 3000 Smart Temperature Transmitter User's Manual
34-44-29-01	A Guide to Temperature Sensors and Transmitters
34-ST-11-12	SFC Model STS102 Operating Card (STT 3000)

MagneW 3000

36-KI-25-01	MagneW 3000 Magnetic Flowmeter User's Guide
36-KI-29-01	MagneW 3000 Specifier Guide
34-ST-11-13	SFC Model STS102 Operating Card (MagneW 3000)

Smart Meter 3000

34-ST-25-08	SM 3000 Smart Meter User's Guide

Training courses that include Smartline Transmitter Integration are listed below.

PM Implementation	3350 and 3351
PM Maintenance	3610
APM Implementation	3750 and 3751
APM Maintenance	3710

Smart Transmitter training is available by calling the Honeywell Automation College at 1-800-852-3211 or by contacting your local Smartline Account Executive.

INTEGRATION CHECKLIST
Section 2

This section lists the steps to complete a PM or APM Smart Transmitter integration.

2.1 OVERVIEW

The following is a complete checklist of tasks that must be accomplished in order to integrate the PM or APM Smartline Transmitter subsystem into your TDC 3000^X System.

2.1.1 Hardware Considerations

The following hardware is required for PM or APM Smartline Transmitter subsystem integration:

- STI or STIMV IOP—the PM or APM's Smart Transmitter Interface I/O Processor.
- FTA—the Field Termination Assembly connecting the field wiring to the PM or APM.
- FTA cable—the cable connecting the IOP and the FTA.
- Smartline 3000 Transmitter—a transmitter that can transmit in DE mode.
- Smart Meter (optional)—provides local display of the Smartline Transmitter output and loop diagnostics.
- Smart Field Communicator (optional)—hand-held device for local checkout of transmitter.

The following is a list of tasks performed when bench checking, calibrating, and commissioning a Smartline 3000 Transmitter.

The optional bench check procedure consists of the following:

- Unpack the transmitter.
- Check the contents.
- Connect a power source to the transmitter (with a 250 Ω resistor).
- Connect Smart Meter to the loop (optional).
- Run a communications check with the SFC.
- Check the operating status with the SFC.
- Check the configuration database with the SFC.
- Write to the scratch pad with the SFC.
- Check to be sure you have a transmitter with an adequate range for your application.

2.1.2 Commission Loop

Communication check and commissioning the transmitter consist of the following:

- Test the communication loop to verify that the transmitter's configuration is consistent with the system's configuration.
- Check the operating status of the transmitter and loop.
- Check the output of the transmitter to be sure you are receiving the correct signal at its destination point.

Startup consists of the following:

- Calibrate zero on the transmitter to system conditions (except STT).
- Rerange the transmitter, if necessary.
- Verify the output with respect to the input.

TRANSMITTER THEORY OF OPERATION
Section 3

This section covers the theory of operation of three single PV Smartline Transmitters (ST 3000, STT 3000, and MagneW 3000), and provides an overview of DE communication protocol. For basic operation, specification, and ranges of multivariable field devices, refer to the user manual for the specific field device. Subsection 1.3 lists the user manuals for Honeywell multivariable field devices.

3.1 TRANSMITTER OPERATION

3.1.1 Differential Pressure Transmitter Basic Operation

The **ST 3000 Differential Pressure Transmitter** measures differential pressures and transmits an output signal proportional to the measured variable. The output signal is transmitted in either an analog 4-20 mA format or in digital enhanced (DE) format. The selection of the output mode is made through the Universal Station (R230 or later) or through the Smart Field Communicator (SFC).

This transmitter measures differential pressures from 0 to 1 inH_2O through 0 to 400 inH_2O. Both linear and square root output conformity are available from the same transmitter electronics module.

The measuring means is a micro-machined piezoresistive sensor, which actually contains three sensors in one:

- Differential pressure sensor
- Static pressure sensor
- Temperature sensor

Microprocessor-based electronics provide major improvements:

- Higher span-turndown ratio
- Improved temperature and pressure compensation
- Improved accuracy

The transmitter's meter body and electronics housing resist shock, vibration, corrosion, and moisture. The electronics housing contains a compartment for the single-board electronics, which is isolated from an integral junction box. The single-board electronics is replaceable.

The **ST 3000 Gauge Pressure Transmitter** measures pressure in reference to atmosphere, while the **ST 3000 Absolute Pressure Transmitter** measures pressure in reference to vacuum.

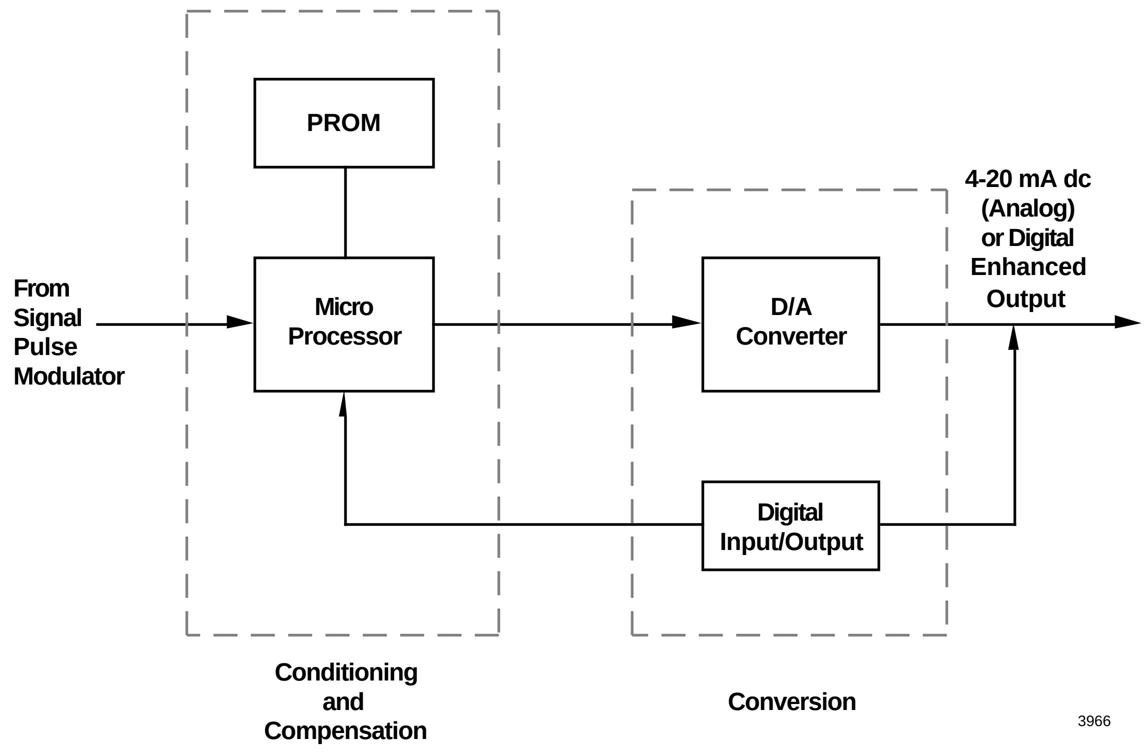


Figure 3-1 — ST 3000 Pressure Differential Transmitter Block Diagram

3.1.1.1 ST 3000 Condensed Specifications (for Series 100, for example)

Output

Linear or square root

Analog Mode: 4-20 mA dc

Digital Mode: DE protocol
Analog or digital mode selectable by SFC
Digital mode selectable by SFC or US (R230 and later)

Accuracy (Reference)

Analog Mode: ± 0.1% span

Digital Mode: ± 0.075% span or ± 0.15% reading, whichever is smaller.

Combined zero and span temperature effect per 28°C (50°F)

Analog Mode: ±0.175% span

Digital Mode: ±0.125% reading

Combined zero and span static pressure effect per 70 bar (1000 psi)—DP models only

Analog Mode: ±0.2% span

Digital Mode: ±0.2% reading

Ambient temperature limits

–40° to +93°C (–40° to +200°F)

Meter body temperature limits
–40° to +125°C (–40° to +257°F)

Damping
Adjustable from 0-32 seconds

Overpressure
210 bar (3000 psi) for DP models;
1.5 x upper range limit for GP models

Supply voltage
11 to 45 Vdc

Table 3-1 — ST 3000 Transmitter Ranges

Measurement	Model	Minimum-Maximum Span
Differential Pressure	STD 120	1-400 inH_2O
	STD 130	5-100 psi
	STD 170	100-3000 psi
	STD 624	25-400 inH_2O
Flange Mount	STF 128	10-400 inH_2O
	STF 132	5-100 psi
	STF 12F	1-400 inH_2O
	STF 13F	5-100 psi
	STF 62F	25-400 inH_2O
Remote Seal	STR 126	10-400 inH_2O
	STR 130	5-100 psi
Gage Pressure	STG 140	5-500 psi
	STG 170	100-3000 psi
	STG 180	100-6000 psi
	STG 644	5-500 psi
	STG 674	100-3000 psi
Absolute Pressure	STA 122	10-780 mmHg
	STA 140	5-500 psi

3.1.2 Temperature Transmitter Basic Operation

The **STT 3000 Temperature Transmitter** is a microprocessor-based Smart Transmitter that converts a primary sensor input into a proportional 4-20 mA output signal or a DE mode digital output. The STT 3000 accepts signals from

- Thermocouples
- RTDs
- Millivolt sources
- Ohm inputs

See Table A-2 in Appendix A (PV CHAR parameter) for a complete list of signal sources.

The STT 3000 provides a current output which is either linear with temperature or linear with input. Linearization, digital cold junction compensation, and communications functions are performed by the STT 3000. The transmitter provides full input-to-output isolation.

The STT database parameters can be reranged and diagnosed from the Universal Station or the SFC. The configuration data is stored in an internal EEPROM.

The transmitter electronics are enclosed in a sealed Noryl housing that can be mounted on a DIN rail using an optional clip, or in an optional NEMA Type 4 explosion-proof aluminum housing for surface or pipe mounting. There are no internal switches or jumpers. Burn out direction is controlled by an external shorting link.

As shown in the block diagram, Figure 3-2, the transmitter is powered by the two wire, 4-20 mA signal connected to terminals 7 and 8 on the output side of the unit. Input and output sides each have a microprocessor with associated memory. The memory of the input microprocessor memory contains ranging and communications data to enable customizing to the required application via the SFC or the Universal Station

Inputs are sampled at a rate of four times a second, digitized by the A/D converter, linearized, compensated for cold junction temperature or resistance lead length and transferred across the galvanic isolation interface. Both power and signal are galvanically isolated between input and output circuits to 500 Vac. On the output side of the isolation, the digital data is ranged to the lower and upper range values held in nonvolatile memory and converted back to an analog signal. Any changes to customer settings are held in nonvolatile memory so that they are secured against loss of power. When the transmitter is received from the factory, the data in nonvolatile memory is that data programmed into the unit at the manufacturing location.

Unless the transmitter has been "custom configured" (option TC), the preprogrammed data is:

Parameter	Configuration
Device Tag Name (ID)	Up to 8 characters
LRV	0 mV
URV	100 mV
Sensor Type	Millivolt
Fault Detect	On
Input Filter	60 Hz
Output	Linearized
CJ Compensation	Internal
Damping	0 Seconds

Reconfiguration to meet specific process requirements is easily accomplished by connecting an SFC (STS101 or the STS102) across the transmitter signal lines, or by entering data from the Universal Station.

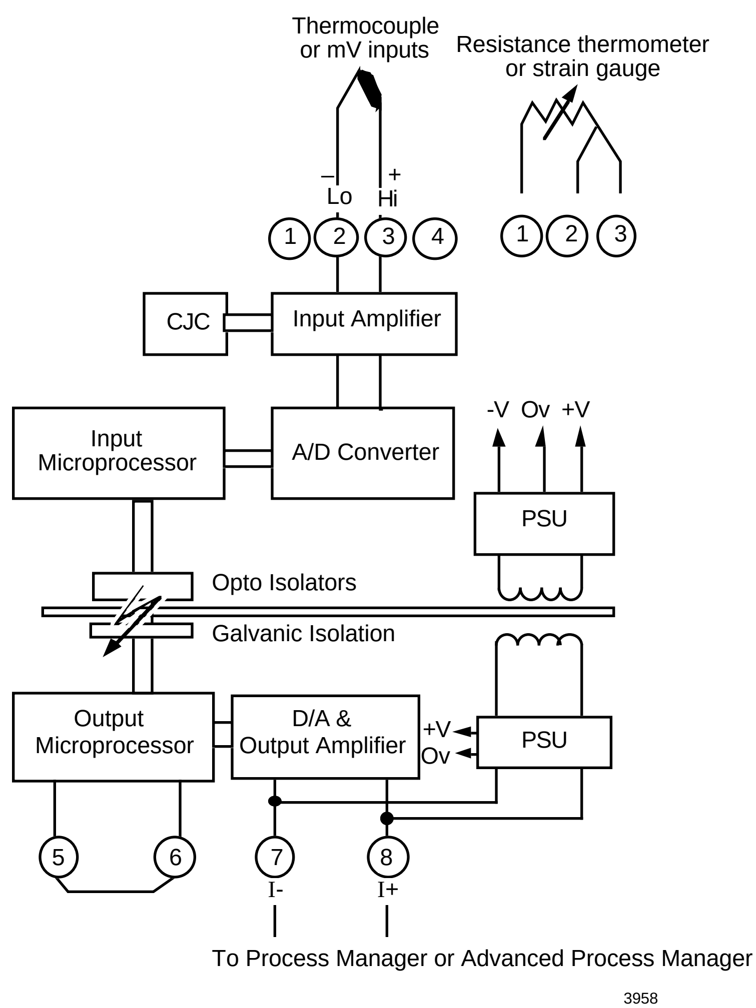


Figure 3-2 — STT 3000 Temperature Transmitter Block Diagram

3.1.2.1 STT 3000 Condensed Specifications

Ambient Temperature
Reference: °C25 ±1, Rated: –40 to 85, Operative: –40 to 85;
°F77 ±2, Rated: –40 to 185, Operative: –40 to 185

Accuracy
Total Accuracy = Digital Accuracy + Output D/A Accuracy
Output D/A Accuracy = ±0.025% span

Digital Ambient Temperature Effect (per 28°C/50°F change)
RTD: ±0.1% of input ohms value (±0.2 minimum)
T/C or mV: ±0.1% of input mV value (±0.005 mV minimum)
Cold junction rejection: 60:1 for measured temperatures >0°C; 40:1 for measured temperatures <0°C.

Output D/A Temperature Effect (per 28°C/50°F change)
±0.1% span

Total Temperature Effective
Total Temperature Effective = Digital Effect + Output D/A Effect + CJ Effect (T/C only)

Supply Voltage Effect
0.005% span per volt

Adjustment Range
No limit to zero or span adjustments within range limits

Output (2-Wire)
4 to 20 mA

Damping Time Constant
Adjustable from 0 to 102 seconds digital damping

Mounting/Wiring
DIN rail (top hat type to EN50022)
Explosion-proof housing with surface or 2-inch pipe mounting
Accepts up to 14 AWG

Displays
°F, °C, °R, or °K by SFC and Universal Station

Hazardous Condition Certification (Pending)
Mounted in a NEMA 4 housing, STT 3000 is designed to meet intrinsic safety requirements for North American Classifications: Class 1, Groups B, C, and D, Division 1.

3.1.3 MagneW 3000 Flow Transmitter Basic Operation

The **MagneW 3000 Magnetic Flowmeter** consists of a detector/converter combination which operates on the principles of Faraday's Law. The detector/converter combination comes in either a remote or an integrated configuration. With a remote configuration, cables connect the detector to the converter which can be located up to 900 feet away. A typical example of the Smartline 3000 MagneW electromagnetic flowmeter system is shown in Figure 3-3. The detector is connected to the converter with the signal cable and the excitation cable. The converter delivers a current output and a pulse output.

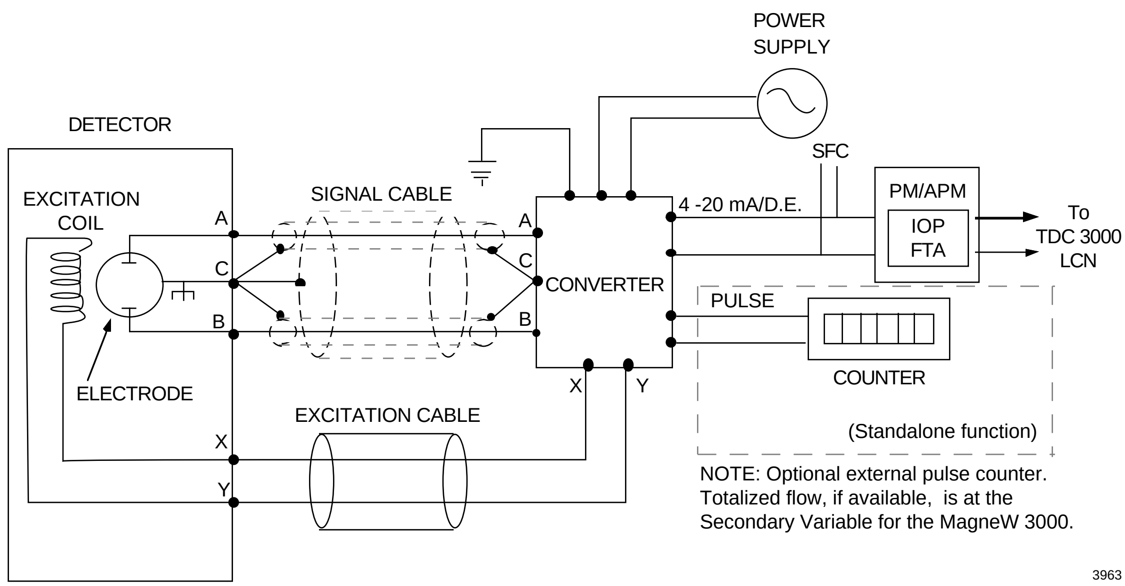


Figure 3-3 — MagneW 3000 Magnetic Flowmeter Block Diagram

3.1.3.1 MagneW 3000 Condensed Specifications

Accuracy (Reference)
±0.5% of rate

Turndown ratio
100:1

Flow span velocity range
0-0.1 m/s to 0-10 m/s; 0-0.3 ft/s to 0-30 ft/s

Liquid conductivity
3 μΩ /cm or greater

Built-in Totalizer for Batch Control
Dry contact output on total

Display Units
Gallons per minute or 20 other engineering units

Output
4-20 mA into 240-600 or resistance load, pulse output type, or DE

Damping time constant
0.0 to 100 seconds

Liquid temperature limits
–40 to +180°C (–40 to +365°F)

Liquid pressure limits
22 mmHG absolute to 430 psig

Self-diagnostics
STATUS OK, Empty pipe detection, Coil failure, Range exceeded.

Grounding rings
Standard: 316 SS; Optional: several materials including platinum

Liner
Standard: Teflon PFA molded around stainless steel punch plate. Alternate materials available for special applications.

Electrodes
Standard: Stainless steel with Teflon™ seats. Alternate materials available for special applications.

Detectors
0.1 to 24 inches

FM Approval Available

3.1.4 PV Processing

PV processing for the Smartline 3000 transmitter is dependent on the transmitter type. The following discussion covers these items:

- key transmitter parameters
- A/D Conversion
- an example of PV processing using the ST 3000 pressure transmitter.

PV processing digitizes the analog signal from the ST 3000 pressure transmitter using the A/D converter, and passes the digital signal through a series of algorithms in the transmitter to linearize, perform static pressure and temperature compensation, PV characterization, and damping before broadcasting the signal to the PM or APM's IOP. Figures 3-4, 3-5, and 3-6 show block diagrams of PV processing.

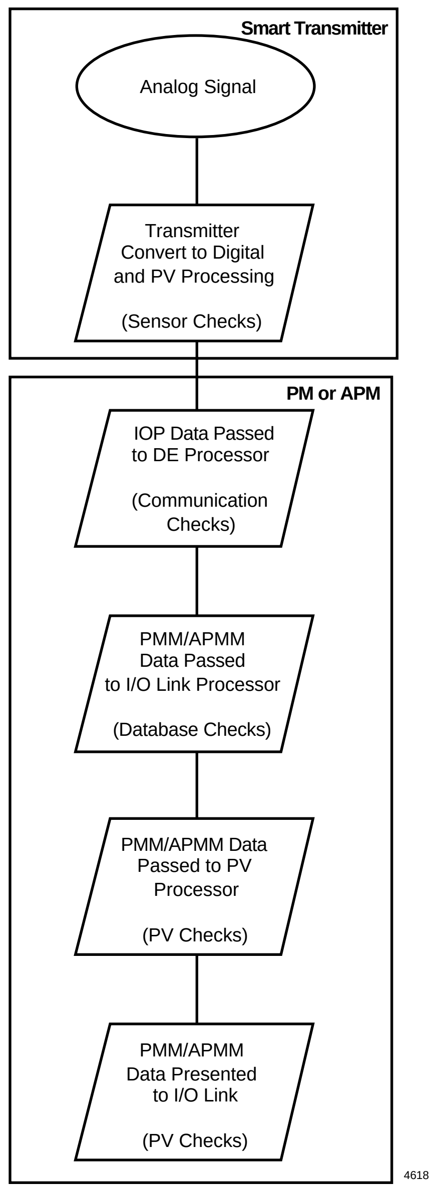


Figure 3-4 — PV Data Path

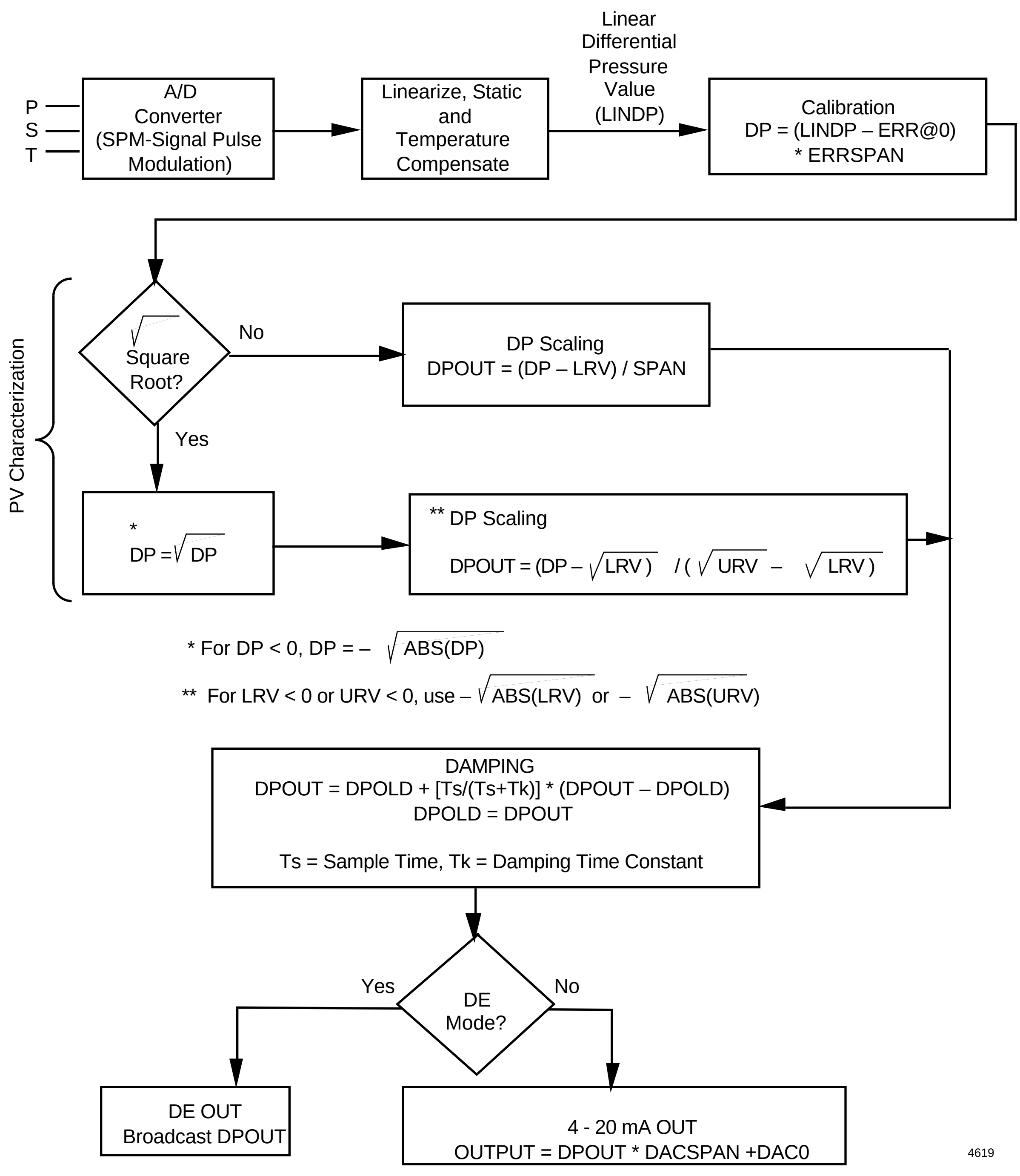


Figure 3-5 — ST 3000 PV Processing

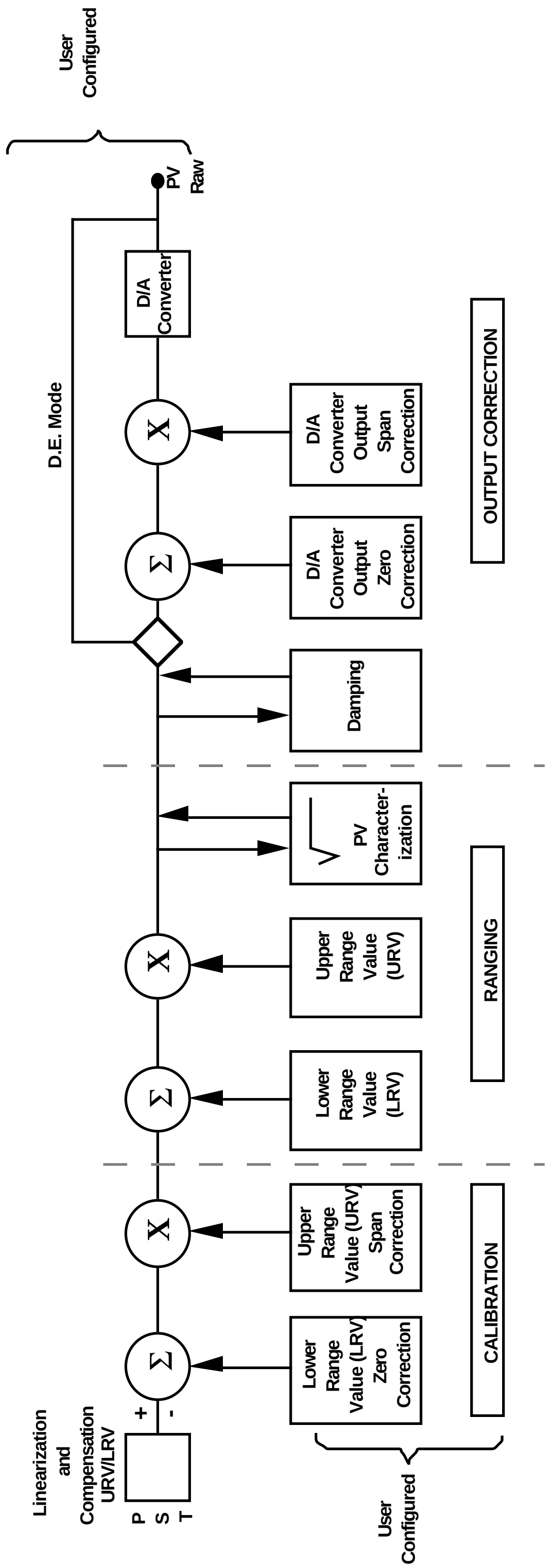


Figure 3-6 — ST 3000 User-Configured PV Processing Parameters 3972

Key Transmitter Parameters are

- URL, Upper Range Limit (real);
- URV, Upper Range Value (real), expressed as a fraction of URL;
- LRV, Lower Range Value (real), expressed as a fraction of URL;
- DPOUT, Differential Pressure Output, calculated output of transmitter (real), the number that is broadcast, expressed as a percent of span (DP – LRV)/(URV – LRV);
- ID, 8 ASCII characters;
- Damping Time: 0., 0.16, 0.32, 0.48, 1.0, 2.0, 4.0, 8.0, 16.0, 32.0 seconds;
- PROM ID, unique ten character BCD used to identify characterization—transmitter type and range is imbedded;
- LINEAR/SQRT, binary flag;
- DECONF, DE Mode Configuration (encoded).

3.1.4.1 A/D Conversion (SPM)

The microprocessor in the transmitter instructs the multiplexer to select one of the three input voltages (either P, S, or T). A **Sensor-to-Pulse Modulator (SPM)** converts the sensor’s analog signals to a pulse width modulated signal. Circuits in the SPM compare the selected voltage with a triangle wave.

A/D Conversion (SPM) includes the following:

- P Sensor—Differential Pressure (PV); One sample every 183 milliseconds,
- S Sensor—Static Pressure; Four samples averaged every 18.3 seconds,
- T Sensor—Meter Body Temperature; Four samples averaged every 1.83 seconds,
- SPM Zero Offset—Four samples at each gain averaged every 18.3 seconds,
- P,S, & T compensated by appropriate zero offset, and
- Duty cycle modulated output—50% at 0 Volts.
  —Normalized duty cycle used to preserve resolution around 0

Sampling schedule includes: P Sensor, S Sensor, T Sensor, and SPM Zero Offset.

Average values passed through digital filter with 54.9 second time constant include T Sensor and SPM Zero Offset. P,S, & T are compensated by appropriate zero offset.

The output of the pulse generator is on (5 Vdc) when the selected voltage is greater than the triangle wave, and off (0 Vdc) when it is less than the triangle wave. More circuitry measures the pulse duration and period. The on-time plus the total-time are the digital signal inputs to the microprocessor when the following occur:

1. The three input signals from the sensor and the meter body characterization data stored in the EPROM are used to calculate a static pressure and temperature-compensated process value, based on the Upper and Lower Range Limit values.

   Every meter body is characterized in the factory for the effects of changing combinations of differential pressure, static pressure, and temperature. This information is stored in a characterization PROM (programmable read only memory), which is located in the electronics housing of the transmitter. These compensation factors are accessed by the microprocessor to compensate the output signal of the transmitter; therefore, you get a very accurate output signal independent of changing conditions.

2. The output signal is scaled to a 4-20 mA signal based on the lower and upper range values or is sent out as a digital signal.

3.1.4.2 URL and LRL

The Smart Transmitter database includes the transmitter limits and the point's operating (working) range. The **upper and lower transmitter range limits** (**URL** and **LRL**) are set at the factory, according to the transmitter type, and cannot be changed from the US or SFC. (For the STT 3000 temperature transmitter, when any type of thermocouple is selected, the transmitter automatically selects the URL and LRL for that type of thermocouple.)

All transmitter range values (LRV, URV, LRL) are referenced to the URL. When configuring a point from the US, it is necessary to have a value of URL available to calculate properly scaled values of LRV and URV. If a value of URL is entered which differs from the connected transmitter, a database mismatch is detected.

When your process requires a different range on the transmitter, you rerange the transmitter from the Universal Station while it is in the loop. The URV, LRV, URL, and LRL values are displayed in Engineering Units with Release 300 software and later. Prior to Release 300, it is displayed in predefined units, for example inH_2O for ST 3000, °C for STT 3000, and m^3/hr for MagneW 3000. Refer to STI_EU parameter in Appendix A for details.

✍ ***note***

The Smart Transmitter output is not in engineering units, and is always a representation of percent of span. With the ST 3000 transmitter, the LRV may be greater than the URV and the transmitter will continue to operate correctly. However, when the transmitter is operating on negative differential pressures, there is a degradation in accuracy. Whenever possible, the High side of the transmitter should be connected to the high pressure leg, and the Low side to the low pressure side in any level application to get the best performance.

3.1.4.3 PV Characterization

If square root is selected, this function is performed by the Smartline Transmitter in its computation of **PVRAW**. At the SFC, PV characterization is seen as **Output Form** or **Probe Type** (for temperature transmitter). Figure 3-7 shows PV characterization and PV filtering.

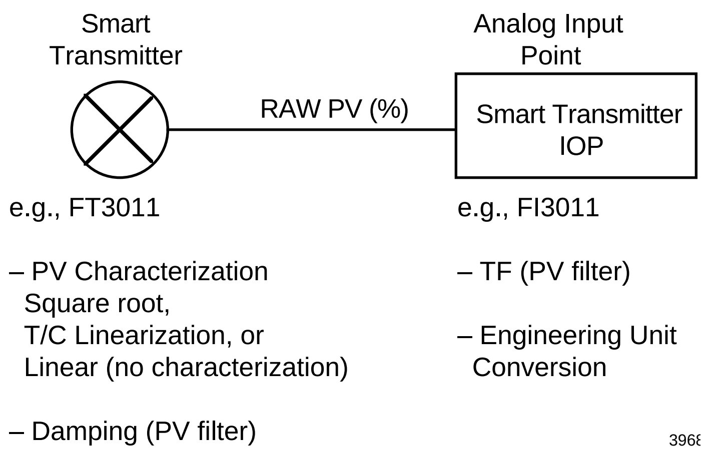


Figure 3-7 — PV Characterization and PV Filtering

Square root is calculated before scaling and allows for suppressed/elevated zero and reverse flow.

✍ ***note***

Square root is calculated in the transmitter, not in the PM or APM (as the Point Detail Display suggests, see Figure 4-2). The Smart Transmitter IOP does not perform square root extraction.

3.1.4.4 Thermal Conversion

For the Smartline Temperature Transmitter (STT 3000) thermal linearization is available for the thermocouple and RTD inputs. The following thermocouples are supported by the STT 3000:

Btherm	RhRad
Etherm	Rtherm
Jtherm	Stherm
Ktherm	Ttherm
NiNiMoTC	W5W26TC
Ntherm	W3W25TC

The STT 3000 calculates the reference junction compensation from the measured reference junction output level. This value is stored and then later converted back to millivolts, with respect to 0 degrees C, for each thermocouple that is to be compensated. The external cold-junction reference compensation parameter is expressed in millivolts for the specified thermocouple and is added to the millivolt value for PVRAW.

The following 3-wire RTDs are supported by the STT 3000:

PtDinRTD (Pt100D)
PtJisRTD (Pt100J)
NicklRTD (Ni500)
Pt200RTD
Pt500RTD
Cu10RTD
Cu25RTD

For an RTD, the transmitter calculates the lead-wire compensation and then subtracts the value from PVRAW.

3.1.4.5 Damping

Basically, the **damping time** sets the unit of time for the damping constant which establishes the upper limit of frequency response and the response time characteristics of the transmitter. Damping is used to reduce the process noise.

Damping can be implemented at the IOP or at the Smartline Transmitter. The IOP performs **first-order lag filtering**, as specified by the user through parameter **TF (filter lag time)**. The transmitter performs filtering on the PV as specified by the user through the DAMPING parameter. The user should decide the type of filtering required based on the following guidelines:

- The DAMPING parameter allows for better control accuracy because more PV samples are used in calculating the filtered PV value at the transmitter.
- To change the DAMPING value requires the point to be made inactive and requires the database to be down-line loaded to the transmitter after the change has been made.
- TF can be changed on-process from the Universal Station.

For better control accuracy, the use of the DAMPING value is preferred over the TF value. Some transmitters accept only certain DAMPING values from the IOP, and the value received is converted to one of the predefined DAMPING values that reside in the transmitter. This conversion is accomplished automatically by the IOP by finding the DAMPING value that is nearest to the desired DAMPING value.

✍ ***note***

Damping should be done in the transmitter, not in the Smart Transmitter IOP. For better time delay, damping should be kept as physically close to the process as possible.

DAMPING values differ between the Smartline Transmitters. The valid DAMPING values for each transmitter type are defined in Appendix A:

The Damping Calculation is based on a first order digital filtering.

> ✍ ***note***
>
> As the turn down ratio increases, the peak-to-peak noise on the output signal increases. Therefore, it's desirable to set the damping to the appropriate value consistent with expected control performance.

For the ST 3000, the Damping Time is set at the factory based on the following:

Turn Down Ratio	Damping Setting
0 through 8:1	0.32 seconds
8:1 and above	1.0 seconds

The Turn Down Ratio is found by dividing the Upper Range Limit of the transmitter by the configured range using the following equation:

$$\text{Turn Down Ratio} = \frac{\text{Upper Range Limit}}{\text{Upper Range Value} - \text{Lower Range Value}}$$

For the ST 3000, for example, a 400 inH_2O transmitter configured for a range of 0 to 50 inH_2O would have a turn down ratio of 8:1 (400/(50-0))

3.1.4.6 PV/SV Scaling and Conversion

The PV and SV values are scaled and converted within the transmitter. The URL value is always specified in the Base Engineering Units defined in Table 3-2.

Table 3-2 — Base Engineering Units

Transmitter Type	Base Engineering Units			
	Sensor	**Linear**	**Non-Linear**	**Secondary Variable**
STT 3000 (Temp.)	T/C	°C	mV[1, 2]	°C
	PYRO	°C	mV[1, 2]	
	RTD	°C	ohms[1]	
	mV	mV	mV	
	ohms	ohms	ohms	
ST 3000 (Pressure)	all	inH_2O	inH_2O	°C
MagneW 3000 (Flow)	all	m^3/hr	m^3/hr	counts
Multivariable Field Device	Refer to the user manual for the specific field device.			

Footnotes:
1 Output is not linearized but cold junction compensation is still performed.
2 Mode not supported by Smart Transmitter IOP.

When ranging/scaling or exchanging input/PV information of the primary process variable, it is always a ± percentage of the transmitter's URL. The actual ranging and scaling values (LRV, LRL, URV, SPAN, and RANGE) sent to the host device (SFC or US) from a transmitter are represented as a signed floating point fractional value (±0.nn) of the transmitter's Upper Range Limit (URL).

PVs are always represented as a signed floating point fractional value (±0.nn) of the transmitter's working range (URV–LRV). SVs are always represented directly in base Engineering Units. For example, the sensor temperature for the Smartline pressure Transmitter and the cold junction temperature for the temperature transmitter are in °C. For the MagneW flowmeter, the totalized value is in raw counts.

The following are examples of PV and SV output from the ST 3000, STT 3000, and MagneW 3000 Smartline Transmitters. For examples of multivariable field devices, refer to the user manual for the specific device.

Example—ST 3000 Pressure Transmitter

Given

Smart Transmitter type	= Pressure transmitter
base units	= inH_2O
transmitter range	= 500 psi
LRV	= 50 psi
URV	= 100 psi
process pressure	= 75 psi
sensor temperature	= 25°C

Since

500 psi = 13840 inH_2O

Then

URL = 13840 (inH_2O, implied units)

LRL = 0 (fixed)

LRV[1] = 50 psi/URL = 50/500 = 0.10

URV[1] = 100 psi/URL = 100/500 = 0.20

$$PVRAW = \frac{75\text{ psi} - LRV}{URV - LRV} = \frac{75 - 50}{100 - 50} = \frac{25}{50}$$

= 0.5 (50% of span, implied)

SV = 25.0 (°C, implied units)

Footnote:

[1] This is the normalized LRV and URV values used for communication.

Example—STT 3000 Temperature Transmitter

Given

Smart Transmitter type	= Temperature transmitter
base units	= °C
transmitter range	= –200°C to +1,000°C
LRV	= 200°C
URV	= 300°C
process pressure	= 250°C
CJT	= 25°C

Then

URL = 1000 (°C, implied units)

LRL = –200°C/URL = –200/1000 = –0.2

LRV[1] = +200°C/URL = +200/1000 = +0.2

URV[1] = +300°C/URL = +300/1000 = +0.3

$$\text{PVRAW} = \frac{250°\text{C} - \text{LRV}}{\text{URV} - \text{LRV}} = \frac{250 - 200}{300 - 200} = \frac{50}{100}$$

= +0.5 (50% of span, implied)

SV = 25.0 (°C, implied units)

Footnote:

[1] This is the normalized LRV and URV values used for communication.

Example—MagneW 3000 Flow Transmitter

Given

Smart Transmitter type	= Flow transmitter
detector type	= KID
detector diameter	= 100 mm
number dummies	= 2
base velocity	= 1 m/s
base units	= m^3/hr
pulse weight	= 10.0 1/p
LRV	= 0.0 m^3/hr (fixed)
URV	= 100.0 m^3/hr
flow rate	= 40.0 m^3/hr
total	= 2000 counts

Then

LRL = 0.0 (fixed)

URL = $(DIA)^2$ (2.8274E–3) (N+1)
= $(100)^2$ (2.8274E–3) (2+1)
= (1E4) (2.8274E–3) (3)
= 84.823 (m^3/hr, implied units)
(max flow rate Q, @ v=lm/sec)

LRV[1] = (0.0 m^3/hr)/URL
= 0.0/84.823
= 0.0

URV[1] = (100.0 m^3/hr)/URL
= 100.0/84.823
= 1.1789

$$\text{PVRAW} = \frac{(\text{flow rate}) - \text{LRV}}{\text{URV} - \text{LRV}}$$

$$= \frac{(40.0\ m^3/\text{hr}) - \text{LRV}}{\text{URV} - \text{LRV}} = \frac{40.0 - 0}{100.0 - 0} = \frac{40.0}{100.0}$$

= 0.400 (40% of span, implied)

SV = 2000.0 (counts, implied)

Footnote:

[1] This is the normalized LRV and URV values used for communication.

3.1.4.7 Ranging (Scaling) vs. Calibration Functions

Ranging (scaling) and calibration functions are not exactly the same. Separate constants are changed in calibration and scaling, giving you the versatility to rerange and maintain accuracy without recalibrating— some accuracy is lost but is still within an acceptable range. To achieve maximum accuracy, it is recommended that you calibrate the Smartline Transmitter in the range for which you will be using it. Then you can rerange the transmitter without recalibrating, and not lose accuracy.

3.1.4.8 Secondary Variable (SV)

The SV is a read-only parameter at the Universal Station. It is not used for control. Table 3-3 lists the secondary variables for the Honeywell Smartline Transmitters.

Table 3-3 — Secondary Variable

Transmitter	Secondary Variable
ST 3000	Meter Body Temperature of the Transmitter
STT 3000	Cold Junction Compensating Temperature
MagneW 3000	Totalized Value
Multivariable Field Device	Refer to the user manual for the specific device.

3.1.4.9 STT Exceptions

PIUOTDCF —Open Thermocouple Detection Configuration

Open thermocouple detection works by sending energy down the line. If the thermocouple is open, it senses a higher impedance at the input, signaling the open thermocouple condition. When a thermocouple opens, the transmitter goes into burnout and this is relayed back to the system as a Bad PV alarm. A detailed diagnostic message appears on page 2 of the Point Detail Display.

From the US or SFC, the parameter **PIUOTDCF** can be turned on or off:

ON — Transmitter performs open thermocouple detection
OFF — Transmitter does not perform open thermocouple detection

Open thermocouple sample and PV sample are taken every other cycle. Due to the Bad PV alarm generated at the US, the transmitter’s failsafe/burnout action is not significant.

CJTACT—Cold Junction Temperature Activation

For STT 3000, **Cold Junction Activation** is used to select either internal digital cold junction compensation (ON state) for thermocouple inputs or external cold junction temperature (OFF state). Note that cold junction compensation has no effect on RTD inputs. You must use an SFC to enter an external cold junction reference temperature if the external cold junction temperature option is selected.

3.1.5 Scratch Pads

All transmitters contain 32 characters of **scratch pad data** which can be read from the LCN system. The display of scratch pad data is typically organized as two lines of 16 characters each (SFC) or one line of 32 characters with a blank after 16 characters (IOP).

SFC	XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX	
IOP	XXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXX

Although the scratch pads can be used for storage of any alphanumeric data, it is recommended that they be used for greater system utility:

- Notification of calibration data
- Identify physical location of transmitter (for example, Boiler 4, ED fan 7)
- Record maintenance information, such as date of maintenance
- Notes related to process application

Scratch pad data can be entered only from the SFC and is a read only parameter to the Smart Transmitter IOP. The Universal Station Point Detail Display can read the 32-character scratch pad of a transmitter, but cannot write to it.

The transmitter scratch pad is a parameter that must remain unique to a transmitter. The scratch pad is often used as a unique way to identify the physical location of a transmitter, or to record specific calibration data that must remain resident in the transmitter — as such, a download is not allowed to overwrite this field.

3.1.6 Transmitter Tag ID

The Universal Station, the transmitter, and the Smart Transmitter IOP allow 8 characters to be entered as a transmitter tag identifier; if more than 8 characters are used, the Universal Station, IOP, and the transmitter will truncate them.

3.2 DE COMMUNICATION PROTOCOL

The Smartline Transmitters can be set in Digital Enhanced (DE) or analog communication format. Communications between an SFC or Universal Station and a transmitter communicating in analog format features a half-duplex, variable length message with a wake up pulse for on-demand requests and responses. While messages travel back and forth, the transmitter's output varies between 4 and 20 mA. For this reason, when in **analog format** your control loop must be in manual mode during SFC communications so the data exchange does not interfere with the control loop.

> ✍ ***note***
>
> In Digital Enhanced format, there is no need to put the control loop in manual mode when using SFC communication.

The Smartline Transmitters in DE format broadcast a new PV three times per second. When configured for Secondary Variable (SV) broadcast, the SV is transmitted every eighth broadcast, rather than the PV.

All communications between the Smart Transmitter IOP and the Smartline transmitters are in bit-serial form using the Honeywell DE (digital enhanced) protocol. The communication format for the transmitter is selectable through the **DECONF (DE configuration format) parameter**. The possible DECONF entries from the Universal Station are defined in Table 3-4.

Table 3-4 — DECONF Parameter

DECONF Entry from US	Definition
Analog	Not supported by Smart Transmitter IOP
Pv	Transmitter communicates only the PV (4-byte format)
Pv_Sv	Transmitter communicates the PV and the Secondary Variable (SV) (4-byte format)
Pv_Db*	Transmitter communicates the PV and the database (6-byte format)
Pv_Sv_Db*	Transmitter communicates the PV, SV, and the database (6-byte format)
* The use of these two formats is recommended for single PV and multivariable transmitters because they offer database mismatch detection and on-process mismatch recovery.	

Communication between an SFC or a Smart Transmitter IOP and a transmitter communicating in the digital enhanced format features one of the message formats in Table 3-4, depending on the operation being performed.

The DE message formats are selectable from the SFC using different designations: "single range," "dual range," and "single range with secondary variable." Select "Single Range with Secondary Variable" if the secondary variable is required. A second selection gives a choice of "w/DB (6- byte mode)" or w/oDB (4-byte mode)." Table 3-5 compares the DE message format and failsafe parameters as seen from the SFC and Universal Station.

Table 3-5 — Comparison of US and SFC DE Configuration

If PED entry is...	Then comparable SFC entry is...	
DECONF	**Multivariable Field Device**	**Single PV Transmitters** (see notes)
PV	Refer to Section 10	Single or Dual Range, 4-Byte
PV_SV		Single Range W/SV, 4-Byte
PV_DB		Single or Dual Range, 6-Byte
PV_SV_DB		Single Range W/SV, 6-Byte

NOTES:

1. 4-Byte – In R230, download is OK, but upload cannot be performed.
   In R300 and later, upload and download can be performed; the transmitter is automatically switched to 6-Byte mode.

   6-Byte – Upload and download can be performed.
2. FAILSAFE is not applicable from the Universal Station, but is user-configurable from the SFC:
   - upscale
   - downscale
   - freeze slot output

3.2.1 Broadcast 4-Byte Format (PV)

The 4-byte format is used for accessing the transmitter’s process variable without database. It features one byte for flags, which includes transmitter status and some configuration data, and three bytes for process variable data. Flags include: Status, Failsafe Mode, 4/6 Byte Format, Variable Type (PV only, or PV and SV).

3.2.2 Broadcast 6-Byte Format (PV, SV, and Database)

Figure 3-8 illustrates the 6-byte message format. The 6-byte format is normally used for accessing the transmitter’s PV, SV, and database. It is similar to the 4-byte mode format, but includes two additional bytes of transmitter database information to support both on-demand database upload requests from an SFC and passive database collection by the Smart Transmitter IOP. One of the two additional bytes is transmitter database so that a new database is received and compared with the database in IOP memory every few seconds, depending on the transmitter type. Table 3-6 lists the maximum broadcast database size and time for each transmitter type.

Flags include: Status, Failsafe Mode, 4/6 Byte Format, Variable Type (PV and Database, or PV, SV, and Database). The identification byte (fifth byte) contains the specific database location identifier. The database byte (sixth byte) contains one byte of database. SV is broadcast on every eighth broadcast in place of the PV.

Table 3-6 — Maximum Transmitter Broadcast Database Size and Time

Transmitter Type	Database (bytes)	Time (Seconds)
ST 3000 (Pressure)	80	31
STT 3000 (Temperature)	92	35
MagneW 3000 (Flowmeter)	125	47
Multivariable Field Device	up to 255	up to 93

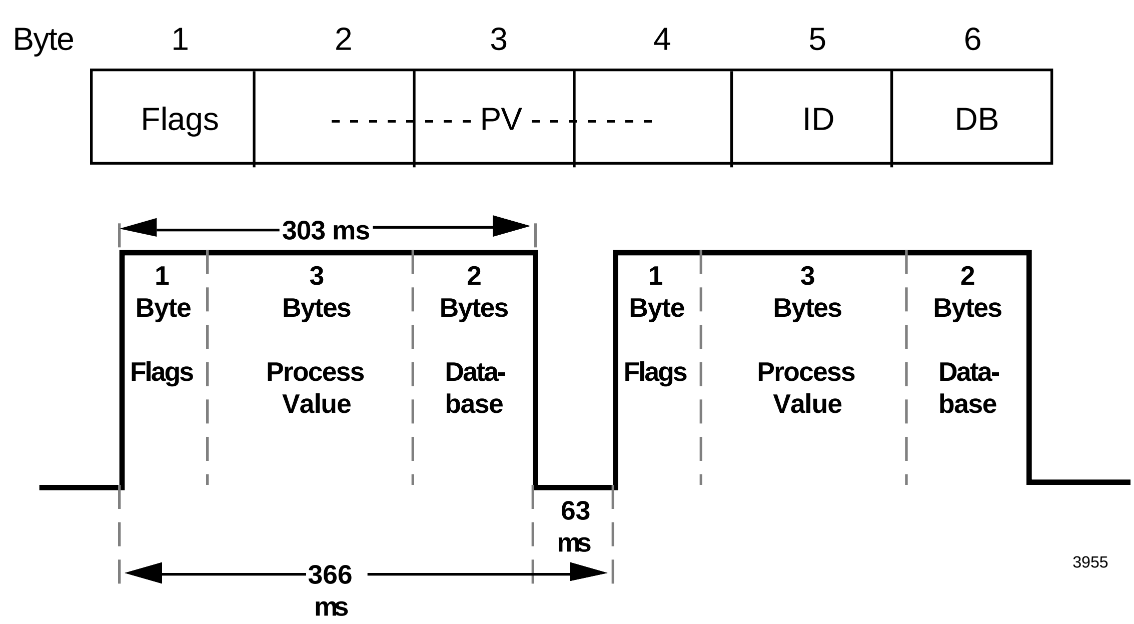


Figure 3-8 — Typical Timing for 6-Byte Message Format

note

For the PM or APM Smart Transmitter interface, select the 6-byte format with Secondary Variable (SV) and database (PV_SV_DB), to take full advantage of the benefits of bidirectional digital integration.

3.2.3 "Three Layer" Architecture

The Instrument Society of America Standard Practices Group # 50, commonly known as ISA SP50, was the committee that established the existing industrial analog 4-20 mA standard (ISA-S50.1) in December, 1975.

The new charter of ISA SP50 is to establish a standard for a digital, serial, bidirectional communication protocol for intelligent sensors and actuators mounted in an industrial process area.

The SP-50 Committee has adopted a "four layer" architecture: The Physical Layer, the Data Link Layer, the Application Layer, and the User Layer. Each layer has a formal subcommittee and a defined charter to pursue the definition of the architecture and contents of that layer.

The Physical Layer defines the characteristics of the physical connection among nodes that are required to transport data from one device to another. Key elements of the physical layer include: topology of the network and its limitations, modulation techniques, data rates, redundancy requirements, and physical media types.

The Data Link Layer defines the media access control and data movement and scheduling function. This layer also addresses mechanisms for error detection and retry policy.

The Application Layer defines the user interface message formats and services available with this communication protocol.

The User Layer defines the application oriented database, such as analog input and control functions.

The layers of the Honeywell DE Protocol are defined in the following paragraphs.

3.2.3.1 Physical Layer of DE Protocol

The **Physical Layer of DE Protocol** defines the mechanical and electrical characteristics of the DE Protocol physical interface.

The physical connection between the Smart Transmitter IOP FTA and the Smartline Transmitter is through a twisted pair wire. The field devices are typically powered from 24 Vdc.

Information is exchanged by **NRZ (Non-Return-to-Zero) modulation** of the loop current. Changes in loop current can be sensed at the field device or across a 250 ohm (load) resistor placed in series with the loop and physically located between the field device and supply return. Note that the signal will be inverted when sensed across any series device.

Active communicating host devices (SFC or PM/APM) must be electrically connected across the 4-20 mA wires feeding the field device (transmitter), with a minimum of 250 ohms resistance between it and the loop power supply.

The resistance inserted into the loop should be a minimum of 250 ohms. Larger resistance values can be used, provided they still meet the overall system requirements.

WARNING

Make sure you do not power starve the field device. A steady and reliable power source is recommended for all field instruments.

Signaling Levels

With the introduction of the DE Protocol, the traditional analog signal used to communicate the PVs from the transmitters to the controllers has been greatly altered. The continuous 4-20 mA analog PV has been replaced by a continuous digital PV signal.

logic 0 = 20 mA (5 V, typically across 250 ohm load resistor)
logic 1 = 4 mA (1 V, typically across 250 ohm load resistor)

The communication signal's rise and fall times are intentionally slow in order to reduce potential crosstalk problems within large wire bundles.

T(rise) = ~0.5 ms, ±20% (0-63.2%)
T(fall) = ~0.5 ms, ±20% (0-63.2%)

Performance Considerations

The signaling and data rate is 218.5 bps, ±1%. The ±1% tolerance is the sum of all error contributors on a communication link (slave and host, for example).

It is typically assumed that the field transmitters contain lower cost/performance resonators with worst case tolerances of ±.99% and that the host devices contain higher cost/performance crystals with worst case tolerances of ±0.005%. It also takes into consideration, performance with long cable lengths and a worst case timing jitter of 1/4 bit.

3.2.3.2 Data Link Layer of DE Protocol

The **Data Link Layer of DE Protocol** defines the data flow initialization, control, termination, and error recovery. The Data Link Layer protocol is half-duplex, bit-serial, byte oriented. For every request from a master, there must be a response from the slave. Allowances for up to three retries are incorporated for harsh or noisy environments. The following gross status responses result in a retry from the transmitter:

- Nack
- Busy
- Illegal response

The following communication error/faults result in a retry:

- Bad checksum
- Bad parity
- Incomplete message
- Framing error
- No transmitter response

3.2.3.3 Application Layer of DE Protocol

The **Application Layer of DE Protocol** functions include:

- Detailed Transmitter Status
- Digital PV/Transmitter Status
- Bad PV Protection
- Bad Database Protection
- Long PV Dropout
- Database Download
- Database Upload
- Initial Database Check — Power up
- Database Mismatch
- SFC Traffic Detect

3.2.4 Floating Point Format

The Honeywell **Floating Point Format** is 24 bits (3 bytes) in length for PV and SV representation and includes the following:

- One Sign bit (0 = positive, 1= negative)
- Seven bits of Exponent (excess 64)
- Sixteen bits of Mantissa
- Fixed implied binary point

The number is stored in three bytes as shown below.

Sign = 1 bit   Exponent = 7 bits   Mantissa = 16 bits

S	Exponent	Mantissa

The resolution of a number (worst case) is 1/32768 or 0.003% of any number.

The value of a number is:

$-1^{s} * 0.\text{Mantissa} * 2^{(\text{Exponent} - 64)}$

3.2.5 Error Checking

The DE protocol incorporates two means of enhancing **error detection** to ensure that the original information is correctly received by the system:

- **Field Device Status**—The DE protocol requires that an indication of the field device status be transmitted with every digital PV value. As a result, the system will never control on a PV from a known bad field device.

- **Information Redundancy**—Redundancy is the addition of noninformation carrying bits so that calculations can be made at the receive end to determine whether the group of bits, including the redundant bits, are the same as those transmitted.

3.2.6 Noise Immunity

In DE protocol, increased noise immunity is gained by using a digital communication baud rate that is low in frequency relative to its environmental noise. The DE protocol transmits at a rate of 218 baud. The advantages of this are

1. High frequency noise can be easily filtered out with simple RC filters (on the Smart Transmitter IOP board).

2. It is less likely that burst noise will last long enough or contain enough energy to interfere with the signal.

Noise immunity is also gained by selecting significantly large and different voltage/current levels to represent a logical 1 and 0. For the DE protocol, these levels are 4 mA/1 volt and 20 mA/5 volts.

SMART TRANSMITTER IOP OPERATION
Section 4

This section discusses the operation of the Smart Transmitter IOP, PV Processing, Engineering Units Conversion, PV Characterization, Linear Conversion, Square Root Conversion, Thermal Conversion, Range Checking, PV Filtering, PV Source Selection, Bad PV Processing and Alarming.

4.1 OVERVIEW OF IOP FUNCTIONS

The primary function of the **Smart Transmitter Interface I/O Processor (STI and STIMV IOPs)** is to provide up to sixteen independent bidirectional channels of communication between the PM or APM and the Smartline Transmitters in DE mode.

The Smart Transmitter IOP functions include

- Ground-referenced transmitter power for each input channel.
- Filtering input signals for high frequency noise suppression and surge limiting.
- Slew rate limiting for outputs to Smartline transmitters to minimize cross talk and interference with other system signals.
- Receiving and decoding serial input data on each channel.
- Sending configuration commands to Smartline transmitters.
- Converting digital input representation into Engineering Units (EUs).
- Making processed input data available to devices on the I/O Link in the form of EUs and/or percent of range.
- Maintaining local database of configuration and processing information.
- Checking received data against specified limits, maintaining alarm flags, and generating alarm events.
- Providing an orderly, initialized state of limited operation, and accepting downline loaded configuration data from higher-order devices on the I/O Link to establish full functionality.
- Interface to the I/O Link, with full support of the I/O Link protocol.
- PV Source selection.
- Optional IOP redundancy (R300 and later)
- Power-on database validity detection (R300 and later)

The two DE Processors on the IOP each provide communication with eight DE Smartline transmitters. As illustrated in Figure 4-1, each DE processor consists of

- A processing unit, comprised of a Motorola MC68HC11 single chip microcomputer, 32 K bytes of ROM, and 8 K of RAM.
- Eight data receivers, which provide input signal conditioning (noise filtering, surge limiting, and so on) for the serial data inputs on the processing unit.
- An output channel selector and driver, which allows the DE processor to talk (output) to any one of its eight connected devices.

The IOP's 8 K byte Shared Memory provides a mailbox through which the I/O Link Processor and the two DE Processors can communicate. Access to the shared memory is under the control of the I/O Link Processor.

The IOP's Field Termination Assembly (FTA) includes 250-ohm range resistors to convert the 4-20 mA current signals from Smartline Transmitters in DE mode, and the 4-20 mA output signals from the IOP itself, into 1-5 volt signaling levels.

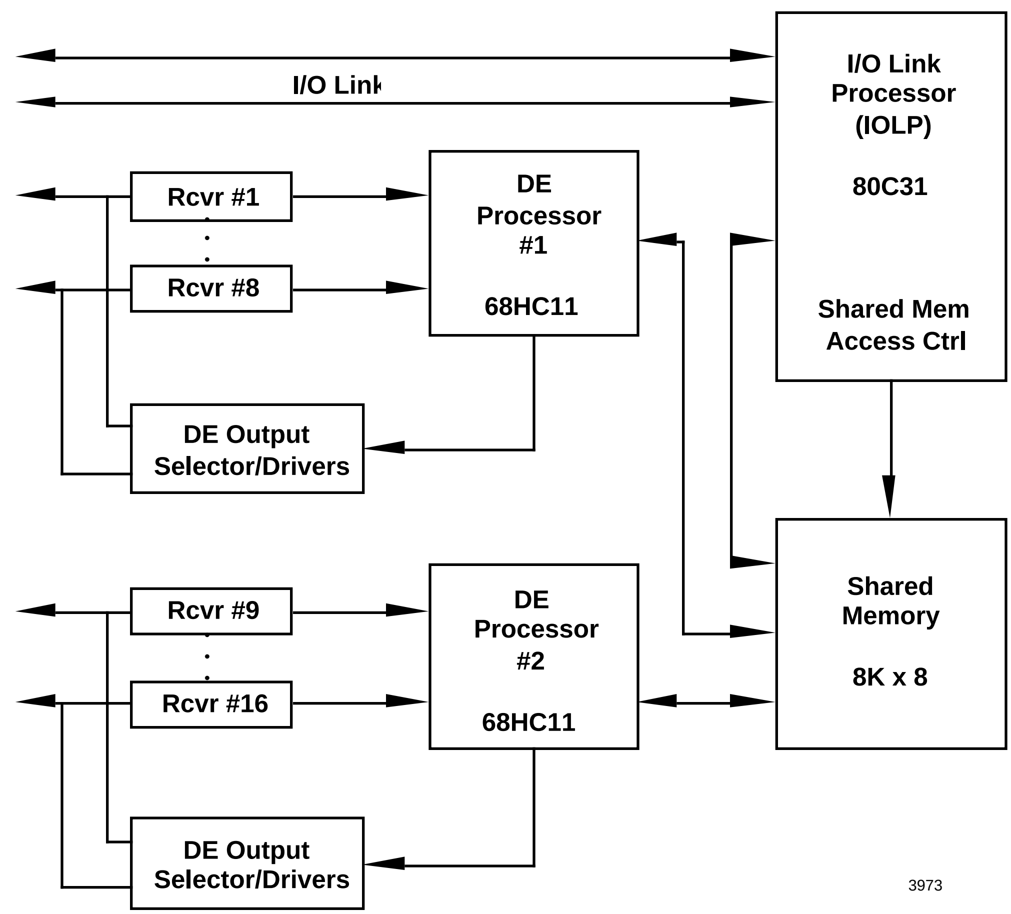


Figure 4-1 — Smart Transmitter IOP Functional Block Diagram

Input signals are stripped of high frequency noise by single pole 12 kHz RC filters on the IOP.

DE Processor functions include:

- Error detection
  — 5 time bit sample
  — 4 of 5 sample voting
  — Parity (odd)
  — Framing (1 stop req. >1.4 stop bad)
  — Data context checks
  — Checksum on database

- Database formatting
  — floating point to IEEE
  — Packed BCD to ASCII

- Two copies of PV, SV, and database for each slot
  — Last complete valid copy
  — Active copy (currently being received)

- Pass valid PV, SV, and database to I/O link processor via shared RAM

4.1.1 IOP and Transmitter Database

The transmitter database can be configured at the Universal Station and downloaded to the transmitter, or the transmitter database can be uploaded to the IOP, as required, when the Smart Transmitter point is in the inactive state. During normal operation (when the Smart Transmitter point is in the active state), each time that the transmitter broadcasts the PV value to the IOP, it also sends the one byte of its database (depending on the selected DECONF mode) to the IOP. This allows the IOP to compare the stored database to the newly received database to check for database discrepancies (mismatch). If a discrepancy is detected, the PV is set to NaN and the status is set to DBCHANGE. The user can easily correct the discrepancy by uploading or downloading the database.

All key transmitter parameters can be accessed from the Universal Station including

- Upper and Lower Range Values
- Damping
- PV type
- DE (Digital Enhanced communications) configuration variables
- Status of the Transmitter
- Transmitter’s serial number and software revision number
- Transmitter’s scratch pad

The user can access these variables through the point’s Detail Display or custom-built schematics.

The Smart Transmitter IOP maintains a copy of the transmitter's database. When a transmitter failure occurs, the database can be downloaded to the transmitter. This database download feature can significantly reduce the downtime of a control loop by reducing the time to get a replacement transmitter into operation. The transmitter database can also be saved to a History Module or removable media if a checkpoint request is initiated. This allows for centralized control of the transmitter database, significantly minimizing the effort required to establish the transmitter database during startup or normal operation.

The Smart Transmitter IOP also allows the user to access the detailed status of a transmitter. The Universal Station displays the transmitter status and the scratch pad information that has been entered, including any maintenance notes. This remote diagnostic feature greatly improves the safety of maintenance personnel, by reducing the need to physically access transmitters located in hazardous areas.

Calibration of the transmitter can also be accomplished from the Universal Station. This function allows on-line adjustment of the transmitter's working ranges so that the reference points for a measurement are accurate.

In addition, a Smart Field Communicator (SFC), which is a hand-held device, can also be physically connected to the appropriate FTA in the PM or APM cabinet to communicate with Smartline Transmitters without disrupting the process, as required (refer to the *Operating Guide for Smart Field Communicators*).

A Detail display of a typical Smart Transmitter point is shown in Figure 4-2. The Detail display shows the IOP's copy of the transmitter database parameters.

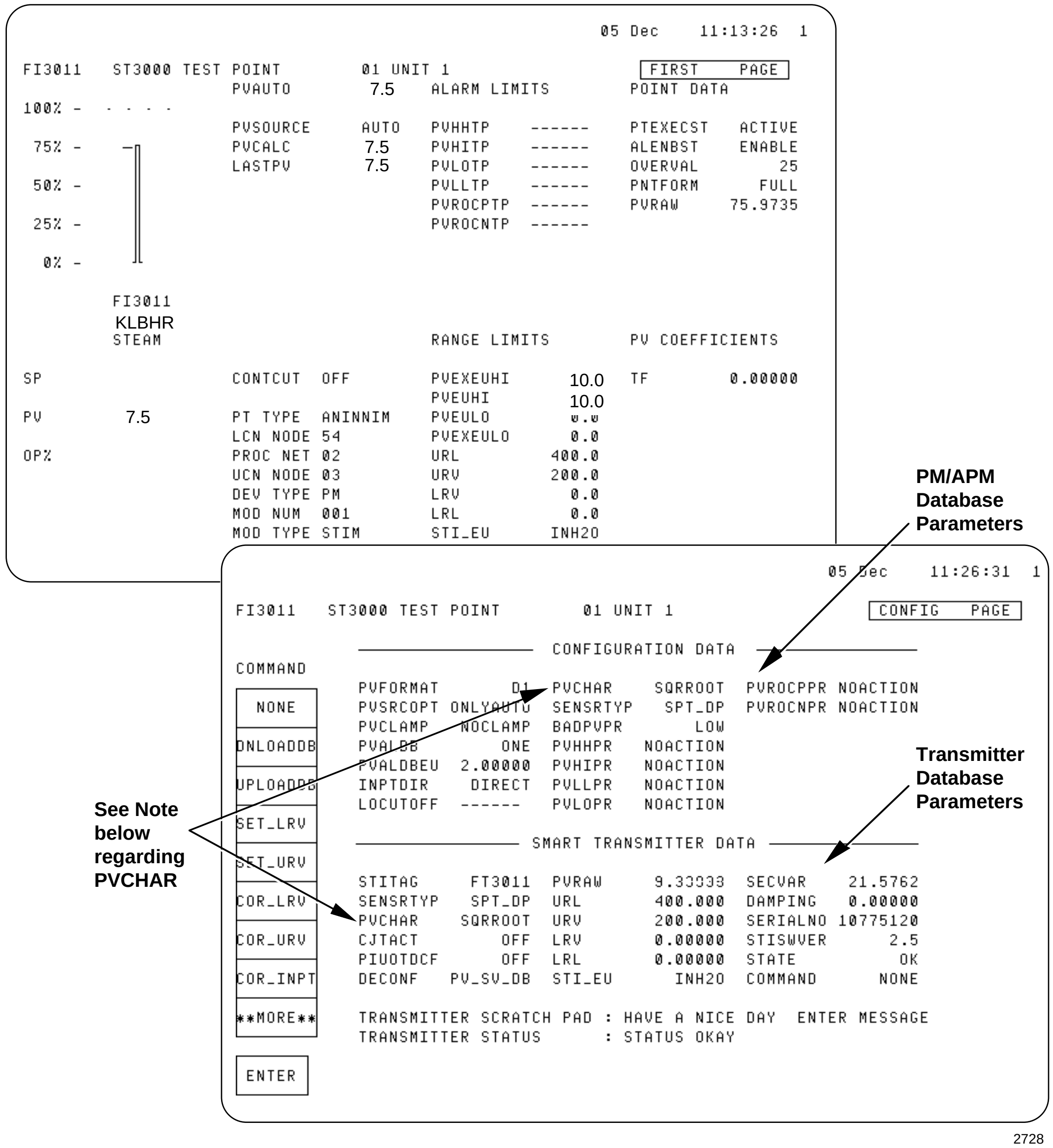


Figure 4-2 — Smart Transmitter Point Detail Display

✍ ***note***

PV Characterization (PVCHAR) is performed only in the transmitter, although it is displayed in both portions of the Smart Transmitter Point Detail Display.

4.2 PV PROCESSING

The PV processing functions of the transmitter and the IOP are illustrated in Figure 4-3. Each parameter illustrated is defined in Appendix A of this manual.

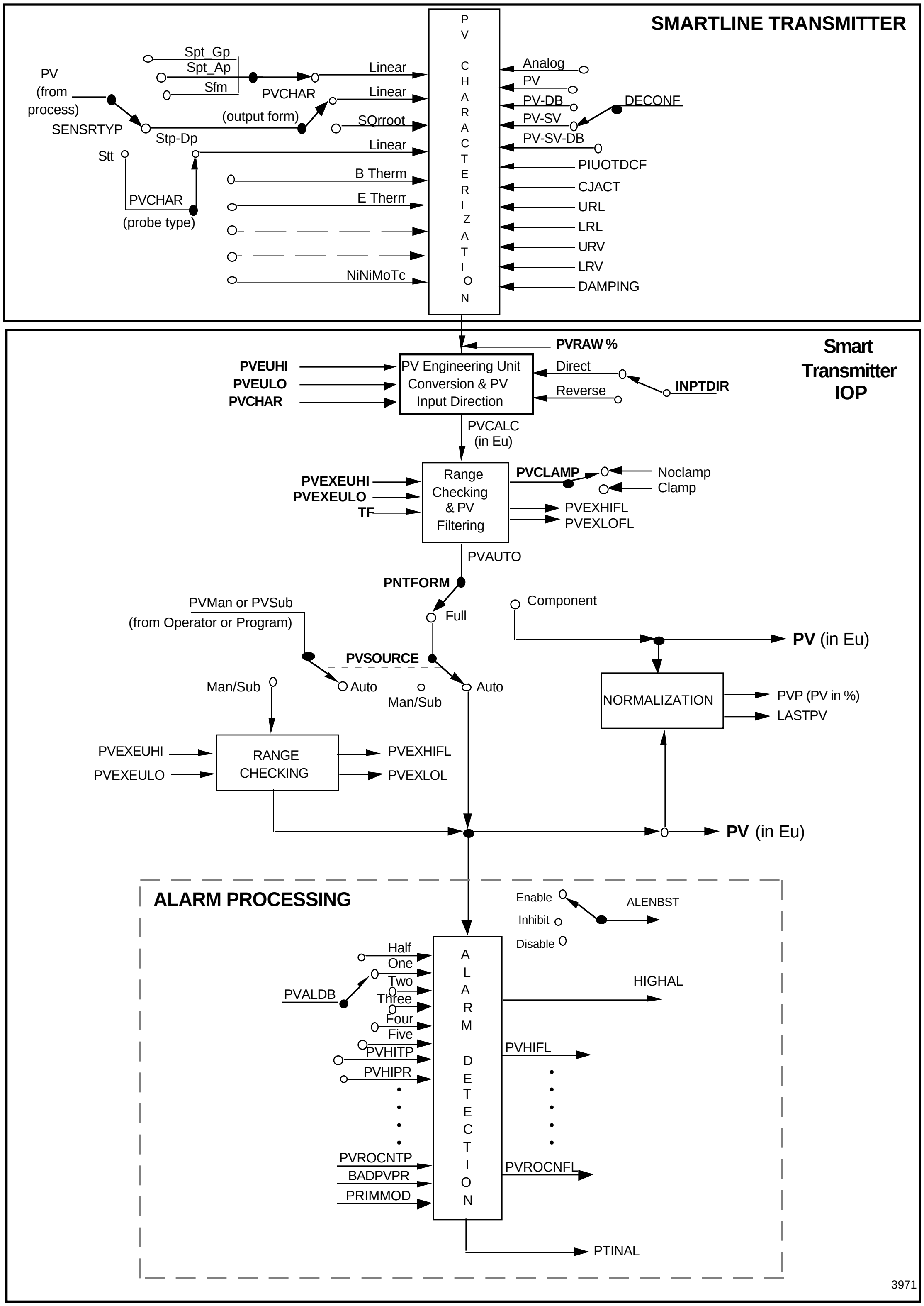


Figure 4-3 — PV Processing Block Diagram

4.2.1 Engineering Units Conversion

Smartline Transmitters do not transmit in engineering units but rather transmit a number between 0 and 1 that is proportional to percent of span. The SFC (Smart Field Communicator) units function allows the SFC to do engineering units conversion as selected by the user.

For ST 3000, STT 3000, and MagneW 3000 <u>**only**</u>, the Smart Transmitter IOP uses the STI_EU parameter to do engineering unit conversions on the displayed transmitter parameters, but not on the displayed PV. For all other transmitter types, including the SCM 3000, the setting of STI_EU is irrelevant since no conversions are performed, and the choice of settings for STI_EU is restricted to m^3/hr (CM_HR), or in release 400 and later, CM_HR or BLANK. Parameters for transmitters other than ST 3000, STT 3000, and MagneW 3000 are always displayed in the default base unit of the specific transmitter.

For all transmitters, the IOP relies on the values entered for PVEUHI and PVEULO in the point to calculate the displayed PV on the Universal Station. If the PV is to be displayed in units other than base engineering units (EUs), conversions can be made using the equation mx+b. The conversions between the various base EUs and the preferred EUs are defined below.

All Engineering Units Conversions are performed based on the following linear relationship:

Y = mX + B

Where:

X = URV value for PVEUHI or LRV value for PVEULO (in base EUs)
Y = new PVEUHI or PVEULO value in preferred EUs
m = conversion multiplier
B = conversion offset

Note that

1. For the MagneW 3000 ONLY, when the PVEUHI and PVEULO are in **MASS** EUs, the conversion multiplier **m** must first be corrected (multiplied) by the specific gravity value.

2. For the MagneW 3000 ONLY, when the PVEUHI and PVEULO are in **VELOCITY** EUs, the conversion multiplier **m** must first be corrected (divided) by the URL value in default units, m^3/hr.

The STT 3000 works in the same way as the ST 3000. It transmits a PV as percent of span. As such, conversion from degrees C to degrees F can be done by setting the PVEUHI and PVEULO to do this mX + B conversion. For example, to get degrees F, set the URV to 100 degrees C, the LRV to 0 degrees C; set the PVEUHI to 212 and the PVEULO to 32. The IOP then converts the PV from degrees C to degrees F (see Figure 4-4).

The following pages show examples of engineering unit conversions and PVEUHI/PVEULO calculations pertaining to **ST 3000, STT 3000, and MagneW 3000**.

For the multiplier (m) and conversion offset (B) pertaining to multivariable field devices, refer to the user manual of the specific device.

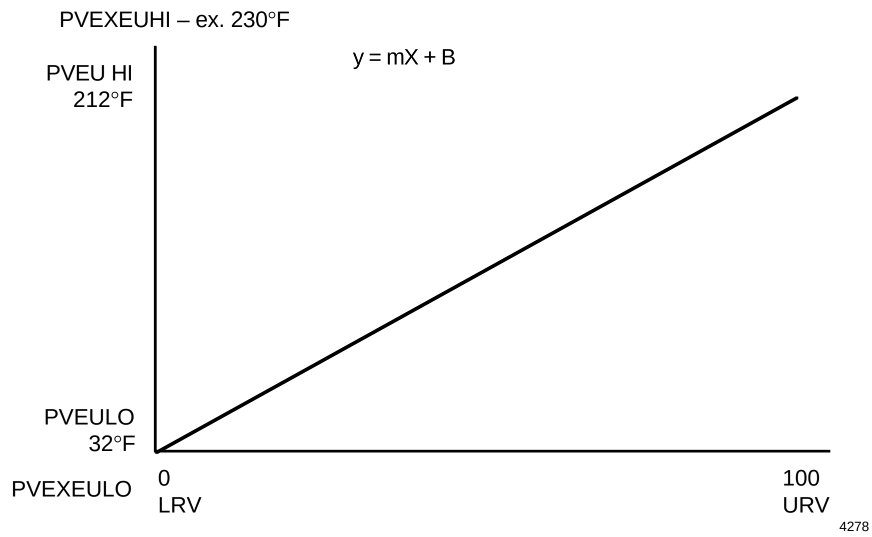


Figure 4-4 — Engineering Units Conversion, Temperature (Example)

Example 1 — ST 3000 (Pressure)

Base Units = inH_20 (default for pressure transmitter)
Desired PV Range: 0 to 400 in H_20 (LRV, URV)
Preferred Display Units = PSI

Y = mX + B

PVEULO
= 0.03612629 (0) + 0
= 0 PSI

PVEUHI
= 0.03612629 (400) + 0
= 14.44 PSI

Therefore:
PVEULO = 0
PVEUHI = 14.44 PSI

Conversion Multiplier (m) and Conversion Offset (B) Values for ST 3000

Base (default) Units = inH_2O @ 39.2°F (4° C)

Units	m	B
inH2O @ 39.2 F	1.0	0.0
mmHg @ 0C	1.8682681	0.0
PSI	0.03612629	0.0
KPa	0.249082	0.0
MPa	0.000249082	0.0
mbar	2.49082	0.0
bar	0.00249082	0.0
G/cm2	2.5399294	0.0
KG/cm2	0.002539929	0.0
mmH2O @ 39.2 C	25.4	0.0
inHg @ 32 F	0.07355387	0.0
mH2O @ 4 C	0.0254	0.0

Where:

PSI = lb/in^2
KPa = Kilopascals
MPa = Megapascals
G/cm^2 = grams/cm^2
KG/cm^2 = kilograms/cm^2

1 inch = 25.4 mm
1 lbf = 4.448222 N
1 lbm = 0.4535924 Kg
1 bar = 100,000.0 N/m^2
1 inH_2O @ 39.2°F (4° C) = 249.082. N/m^2
1 inH_2O @ 68°F (20° C) = 248.638. N/m^2
1 inHg @ 32°F (0° C) = 3,386.389 N/m^2

Example 2 — STT 3000 (Temperature)

Base Units = °C (default for STT, thermocouple)
Desired PV Range: 0 to 100°C (LRV and URV)
Preferred Display Units = °F

Y = mX + B

PVEULO
= 1.8 (0) + 32
= 32°F

PVEUHI
= 1.8 (100) + 32
= 212°F

Therefore:
PVEULO= 32°F
PVEUHI = 212°F

Conversion Multiplier (m) and Conversion Offset (B) Values for STT 3000

Base (default) Units = °C, mV, or ohms

Units	m	B
°C	1.0	0.0
°F	1.8	32.0
°K	1.0	273.15
°R	1.8	491.67
mV	1.0	0.0
V	0.001	0.0
ohms	1.0	0.0

Base Units depend on the active sensor and linear/nonlinear selection.

Base Engineering Units		
Sensor	**Linear**	**NonLinear**
T/C	°C	mV[1, 2]
PYRO	°C	mV[1, 2]
RTD	°C	ohms[1]
mV	mV	mV
ohms	ohms	ohms

Footnotes:

1 Output is not linearized but cold junction compensation is still performed.
2 Mode is not supported by Smart Transmitter IOP.

Example 3 — MagneW 3000 (Volumetric Flow Rate)

BaseUnits = m^3/hr (default for MagneW)
Desired PV Range: 0 to 100 m^3/hr (LRV and URV)
Preferred Display Units = GPM

Y = mX + B

PVEULO	PVEUHI
= (4.402867) (0) + 0	= (4.402867) (100) + 0
= 0 GPM	= 440.2867 GPM

Therefore:
PVEULO = 0
PVEUHI = 440.2867

Example 4 — MagneW 3000 (Mass Flow Rate)

Base Units = m^3/hr (default for MagneW)
Desired PV Range: 0 to 100 m^3/hr (LRV and URV)
Preferred Display Units = lb/min
Specific Gravity = 1.02

Y = (m*SG)X + B

PVEULO	PVEUHI
= (36.74371*1.02) (0) + 0	= (36.74371*1.02) (100) + 0
= 1b/min	= 3747.8584 1b/min

Therefore:
PVEULO = 0
PVEUHI = 3747.8584

Example 5 — MagneW 3000 (Velocity Flow Rate)

Base Units = m^3/hr (default for MagneW)
Desired PV Range: 0 to 100 m^3/hr (LRV and URV)
Preferred Display Units = ft/s
URL = 84.823 m^3/hr (NNK, 100mm dia, N=2)

Y = mX + B

PVEULO	PVEUHI
= (3.280840/84.823) (0) + 0	= (3.280840/84.823) (100) + 0
= 0 ft/s	= 3.868 ft/s

Therefore,
PVEULO = 0
PVEUHI = 3.868

Conversion Multiplier (m) and Conversion Offset (B) Values for MagneW 3000

Base (default) Units = m^3/hr

Units	m	B	
m3/hr	1.0	0.0	volume
GPH	264.1720	0.0	"
l/hr	1,000.0	0.0	"
cc/hr	1.0E+6	0.0	"
m3/min	1.666667E-2	0.0	"
GPM	4.402867	0.0	"
l/min	16.66667	0.0	"
cc/min	16,666.67	0.0	"
m3/day	24.0	0.0	"
GPD	6340.129	0.0	"
kGPD	6.340129	0.0	"
BPD	150.9554	0.0	"
m3/sec	2.777778E-4	0.0	volume
kg/hr	1,000.0 kg/m3	0.0	mass[1]
kg/min	16.66667 kg/m3	0.0	mass[1]
kg/s	0.2777778 kg/m3	0.0	mass[1]
PPH	2,204.62 lb/m3	0.0	mass[1]
lb/min	36.74371 lb/m3	0.0	mass[1]
lb/s	0.6123951 lb/m3	0.0	mass[1]
ft/s[3]	3.280840	0.0	velocity[2]
m/s[3]	1.0	0.0	velocity[2]

Footnotes:

[1] Value must also be corrected (multiplied) by the specific gravity value.
[2] Value must also be corrected (divided) by the URL.
[3] These two units are not supported by the Universal Station.

Where:

GPM	=	gal/min
GPH	=	gal/hr
GPD	=	gal/day
BPD	=	barrels/day
kGPD	=	1,000 * GPD
PPH	=	lb/hr
1 Gallon	=	0.003785412 m^3
1 Barrel	=	42 gal
1,000 l	=	1 m^3
1 ft	=	0.3048 m
1 lb	=	0.4535924 kg
density H_2O	=	1 gram/cc @ 4°C

4.2.2 PV Characterization

The PV signal (PVRAW) received from the transmitter has been characterized by the transmitter in terms of linear or square-root characterization and damping.

> ✍ **note**
>
> PV Characterization (PVCHAR) is performed only in the transmitter, although it is displayed in both portions of the Smart Transmitter Point Detail Display.

4.2.3 Linear Conversion

If the entry for PVCHAR is **Linear**, the PVRAW input from the FTA is calculated as a proportion of the input span in percent, as determined from upper and lower range values URV and LRV. This proportion is then used in generating an identical proportion of the output span, as determined from PVEULO and PVEUHI shown in Figure 4-5. The URV and LRV values are the 100% and 0% values that correspond to the PVEUHI and PVEULO values, respectively.

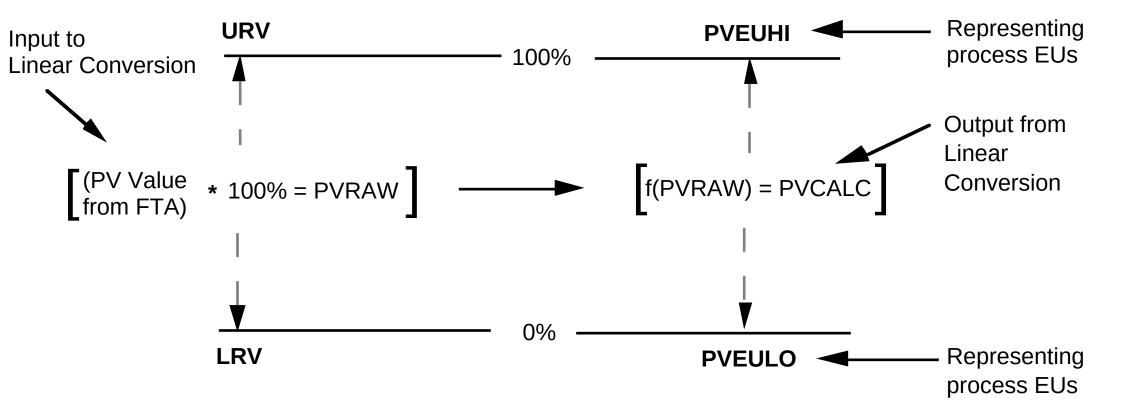


Figure 4-5 — Linear Conversion, Smart Transmitter IOP 2726

Table 4-1 — PV Characterization Options

Transmitter (Sensor) Type (SENSRTYP)	PVCHAR Options	PV RAW[1, 3]	PV CALC	PV Detection[2]
Spt_Dp (Differential Pressure)	Linear Square Root	% inH_2O % flow	EU	Range check on PVCALC Range check on PVCALC
Spt_Gp (Gauge Pressure)	Linear	% inH_2O	EU	Range check on PVCALC
Spt_Ap (Absolute Pressure)	Linear	% inH_2O	EU	Range check on PVCALC
Stt (Temperature)[4]	Linear Thermocouple	% mV % °C	EU EU	Range check on PVCALC Open thermocouple detection, and range check on PVCALC
	RTD	% °C	EU	Range check on PVCALC
	RTD Ohms	% Ohms	EU	Range check on PVCALC
Sfm (Flow) (all multivariable transmitters are of this type)	Linear	% m^3/Hr	EU	Range check on PVCALC

LEGEND:
EU = Engineering Units
PVCALC = Calculated PV
PVCHAR = PV Characterization
PVRAW = PV received from transmitter and multiplied by 100 by the IOP

Notes:

1. PVRAW is a percentage of the configured range for the sensor type. For multivariable field devices, the PVRAW EUs are different for each PV slot.
2. If the transmitter gross status indicates Bad, PVRAW of the Smart Transmitter point is set to NaN, and PVSTS is set to Bad. With STIMV and R230 and later STI IOP F/W, Output Mode also sets PVRAW to NaN.
3. The normal operating range for PVRAW (0% = PVRAWLO, 100% = PVRAWHI) is configured by the user.
4. For the supported temperature ranges, refer to the definition of the PVCHAR parameter in Appendix A of this manual.

4.2.4 Square-Root Conversion

If **square root** is selected, this function is performed by the smart transmitter in its computation of PVRAW. The value for PVCALC is then determined in the same manner as linear conversion. These conversion equations are provided below.

If INPTDIR = Direct:

$$\text{PVCALC} = \frac{\text{PVRAW}}{100}(\text{PVEUHI} - \text{PVEULO}) + \text{PVEULO}$$

If INPTDIR = Reverse:

$$\text{PVCALC} = \frac{\text{PVRAW}}{100}(\text{PVEULO} - \text{PVEUHI}) + \text{PVEUHI}$$

4.2.5 Thermal Conversion

Thermal linearization is available for the thermocouple and RTD inputs of the STT 3000 (temperature) transmitter. Thermal linearization is selectable by parameter PVCHAR (see Appendix A). Thermal linearization and cold junction compensation are performed by the STT 3000 instead of the Smart Transmitter IOP.

For an RTD, the Smart Transmitter point calculates the lead-wire compensation and then subtracts the value from PVRAW.

4.2.6 Range Checking

PV range checking by the IOP ensures that the PVCALC output of PV characterization is within the limits defined by parameters PVEXEULO and PVEXEUHI. If either of the limits is violated, the output of the range check is set to BadPV if clamping has not been specified. If clamping has been specified, the output of the range check is clamped at either PVEXEUHI or PVEXEULO, accordingly.

If the range-checked and filtered value is less than the value specified by the user-configured LOCUTOFF parameter, the final output called PVAUTO is forced to PVEULO.

4.2.7 PV Filtering

PV filtering can be implemented at the IOP, or at the Smartline Transmitter. At the IOP, first-order filtering is performed on PVCALC, as specified by the user through parameter TF (filter lag time).

For more information, see the Damping heading in this manual, under the Transmitter Operation, PV Processing subsection.

4.2.8 PV Source Selection

The **PVSOURCE parameter** allows the user to select the source of the PV for this data point. As shown in Figure 4-3, the PV can be provided by the Range Checking and Filtering circuit (when PVSOURCE is Auto), or it can be the manually entered PV (when PVSOURCE is Man or Sub).

In addition, the PV source option parameter (PVSRCOPT) determines whether it is permissible to change the PV source to a source other than Auto. PVSRCOPT has two states: OnlyAuto and All. The All state allows the PV to be manually entered for this data point.

4.2.9 Bad PV Processing

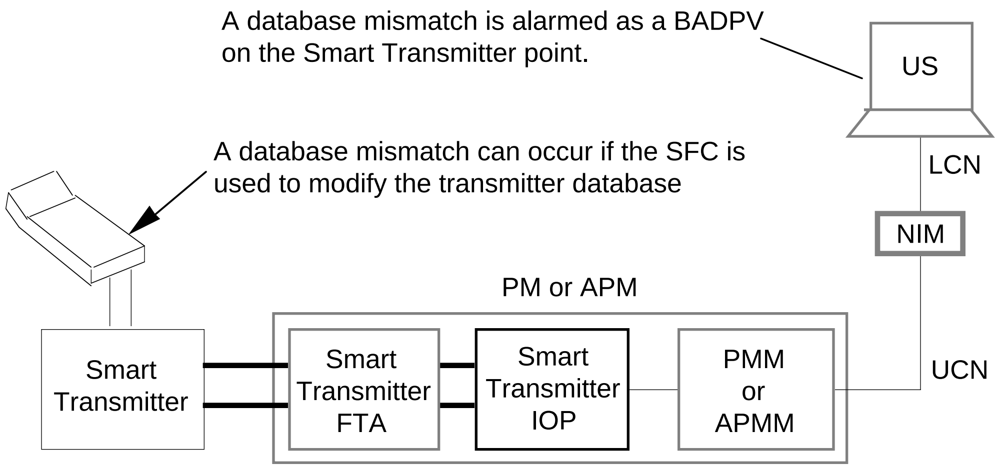
Bad PV Processing handled in the Smart Transmitter IOP can occur as the result of the following:

- Out of range PV input
- Transmitter failure
- Inconsistency in the database parameters

There are three ways that a database mismatch can occur:

- A write to the transmitter from an Smart Field Communicator (SFC)
- A parameter write to the IOP from the Universal Station (during checkpoint restore, point build, or Point Detail display change)
- Replaced the transmitter with one that has a different database.

Parameters listed in Figure 4-6 affect the PV and are compared for database discrepancies (mismatch).



The Smart Transmitter IOP checks the following parameters for database mismatches IF 6-BYTE MODE IS SELECTED:

	Parameter at US	
Communication Mode (4 or 6 byte format)	DE_CONF	
Transmitter ID	STITAG	
Transmitter/Sensor type (pressure, temperature, or flow)	SENSRTYP	
Upper Range Limit of Transmitter	URL	
Upper/Lower Range Values	URV and LRV	
Damping Time	DAMPING	
PV Characterization (specifies square root conversion or thermal linearization, depending on input type)	PVCHAR	
Power Filter (50 or 60 Hz)	FREQ6050	
Open Thermocouple Detection (on or off)	PIUOTDCF	STT3000 only
Cold Junction Temperature (on [internal] or off [external])	CJTACT	STT3000 only
Number of PVs	NUM PVS	Multivariable Field Devices only
PV Number	PV NUM	Multivariable Field Devices only

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Figure 4-6 — Parameters That Are Checked for Mismatches

The following parameters are not compared for mismatch:

PV	SV	STATUS	XMTR SERIAL NUMBER
SCRATCH PADS		XMTR SOFTWARE VERSION	

Bad Database Protection is handled in the IOP.

4.2.10 Alarming

The Smart Transmitter point compares the PV to threshold values and records the alarms in the database of the point. The alarms are then reported by the PMM or APMM. The parameters that are associated with alarming in the Smart Transmitter point are as follows:

ALENBST	PVHHPR	PVLOPR
BADPVFL	PVHHTP	PVLOTP
BADPVPR	PVHIFL	PVROCNFL
PRIMMOD	PVHIPR	PVROCNPR
PTINAL	PVHITP	PVROCNTP
PVALDB	PVLLFL	PVROCPFL
PVALDBEU	PVLLPR	PVROCPPR
PVEXHIFL	PVLLTP	PVROCPTP
PVEXLOFL	PVLOFL	
PVHHFL		

Refer to Appendix A of this manual for the definition of these parameters.

4.2.10.1 Alarm Trip Points

Alarm trip points are user-configured alarm limit values. When a monitored variable exceeds the trip point, an alarm is generated.

In PMs, you can configure the trip point as NaN—not a number. When an alarm trip point is defined as NaN, the trip-point test is not performed.

The following types of trip points are available for Smart Transmitter points. Each trip point is described in Appendix A of this manual:

PV High High Alarm (PVHHTP)
PV High Alarm (PVHITP)
PV Low Alarm (PVLOTP)
PV Low Low Alarm (PVLLTP)
PV Increasing Rate of Change (PVROCPTP)
PV Decreasing Rate of Change (PVROCNTP)

4.2.10.2 Alarm Deadband

A deadband affects the return-to-normal to eliminate the nuisance alarm. Alarms are generated when the PV increases through the trip point and the return-to-normal indication occurs when the PV returns through the trip point and the deadband. Refer to the PVALDB parameter in Appendix A of this manual.

4.2.10.3 Alarm Priorities

Alarms with different priority levels cause different types of annunciation at the Universal Stations, or none at all. You configure priorities for each alarm Trip point, plus Bad PV:

BADPVPR
PVHHPR
PVHIPR
PVLLPR
PVLOPR
PVROCPPR
PVROCNPR

The following are the five priorities and the annunciation and reporting for each:

Priority	Action
Emergency	Display message, print message, store in journal
High	Display message, print message, store in journal
Low	Display message, print message, store in journal
Journal	Store in journal
None	No action

Alarms in the top three priorities can be set up to sound a user-supplied audible alarm device.

The “journal” referred to here is an alarm journal (file) in a History Module.

4.2.10.4 Alarm Levels

The Smart Transmitter point can be configured to detect appropriate alarm types. Each of the alarm types is assigned a relative (fixed, nonconfigurable) alarm level. If more than one alarm occurs for a data point at the same time, only the alarm at the highest level appears on the point's Group and Detail displays. The levels are as follows:

Highest
Bad PV
PVHH or PVLL Alarm
PV High or PV Low Alarm
PV Rate-of-Change Positive or Negative
Lowest

4.3 R230 VS R300 SERIES CAPABILITIES AND LIMITATIONS

The following is a list of features available R300 and later Smartline Transmitters. The features were not fully available for R230.

- Smart Transmitter IOP Redundancy
- Switching the transmitter from Analog to DE mode from the Universal Station through a download or upload
- STI_EU supported for these parameters (does not apply to multi-PV transmitters)
  — URL
  — URV
  — LRV
  — LRL
- Output Mode permitted (PVRAW shows the SFC entered PV value in percentage)
- More Status messages (for example, Transmitter Write Protect)
- Transmitter Status updated with point inactive
- I/O processor database validity check (cold starting an I/O processor requires its checkpoint database be restored prior to start up)

Table 4-2 summarizes the Smart Transmitter functions provided by the R300 series and later.

Table 4-2 — Smart Transmitter Point Functions – R230 vs. R300 and Later

Function	LCN S/W	PM or APM
DE Mode switching on upload/download	R230 and later	STIMV, or R300 STI IOP F/W and H/W
Selectable EUs for LRL, URL, URV, and LRV	R300 and later	STIMV, or R300 STI IOP F/W, and R230 or R300 STI IOP H/W
Output Mode	R230 and later	STIMV, or R300 STI IOP F/W, and R230 or R300 STI IOP H/W
Smart Transmitter IOP Redundancy	R300 and later	STIMV, or R300 STI IOP F/W and H/W, (including redundancy FTA)
Transmitter Write Protect (ST 3000 and MagneW 3000 only)	R230 and later	STIMV, or R300 STI IOP F/W and R230 or R300 STI IOP H/W (Also: Transmitter H/W jumper needs to be set.)

4.3.1 Smartline Transmitter Operational Limits

Listed below are operational limits for each transmitter type.

4.3.1.1 MagneW 3000 Transmitter Parameter Limitations

MagneW 3000 Flowmeter parameter support on the Universal Station is limited to the common parameters that are shared with ST 3000 or STT 3000. Several parameters are not supported by the Smart Transmitter IOP:

- Excitation Current
- Detector Sizes
- Direct/Reverse Flow
- Dual Ranges

The SFC is needed at this point to configure the MagneW 3000. Refer to the SFC manual for the specific transmitter type for the configuration instructions.

4.3.1.2 STT 3000 Temperature Transmitter Parameter Limitations

The Smart Transmitter IOP does not support the STT 3000 on the following items:

- Entry for external Cold Junction Temperature (refer to CJTACT parameter in Appendix A.

CONNECTION TO THE PROCESS
Section 5

This section covers IOP cabling and FTA wiring considerations to connect the Smart Transmitters to the TDC 3000X System.

5.1 OVERVIEW OF CABLING

The TDC 3000X Smart Transmitter is connected to a **Field Termination Assembly (FTA)** in the PM or APM through twisted pair wires on a point-to-point basis. The FTA is cabled to the **Smart Transmitter Interface I/O Processor** board **(STI or STIMV IOP)**.

Selection of cable lengths should follow Honeywell's guidelines. The FTA cable is not to exceed 50 meters. See the following subsections on redundant, intrinsically safe, and nonredundant Smart Transmitter IOPs, for Honeywell recommended cabling.

5.2 FTA TO TRANSMITTER WIRING

The field termination assembly (FTA) for the smart transmitter is the same as that used for high level analog inputs. There are two types of FTA: one supports redundant IOPs, and the other does not. The redundant and the nonredundant versions of the FTA can use screw-type or Weidmuller compression type termination. Figures 5-1 through 5-4 illustrate the FTA for the nonredundant Smart Transmitter IOP. Figures 5-6 through 5-10 illustrate the FTA for the redundant Smart Transmitter IOP.

Notice the SFC connection points on the FTA in Figure 5-1.

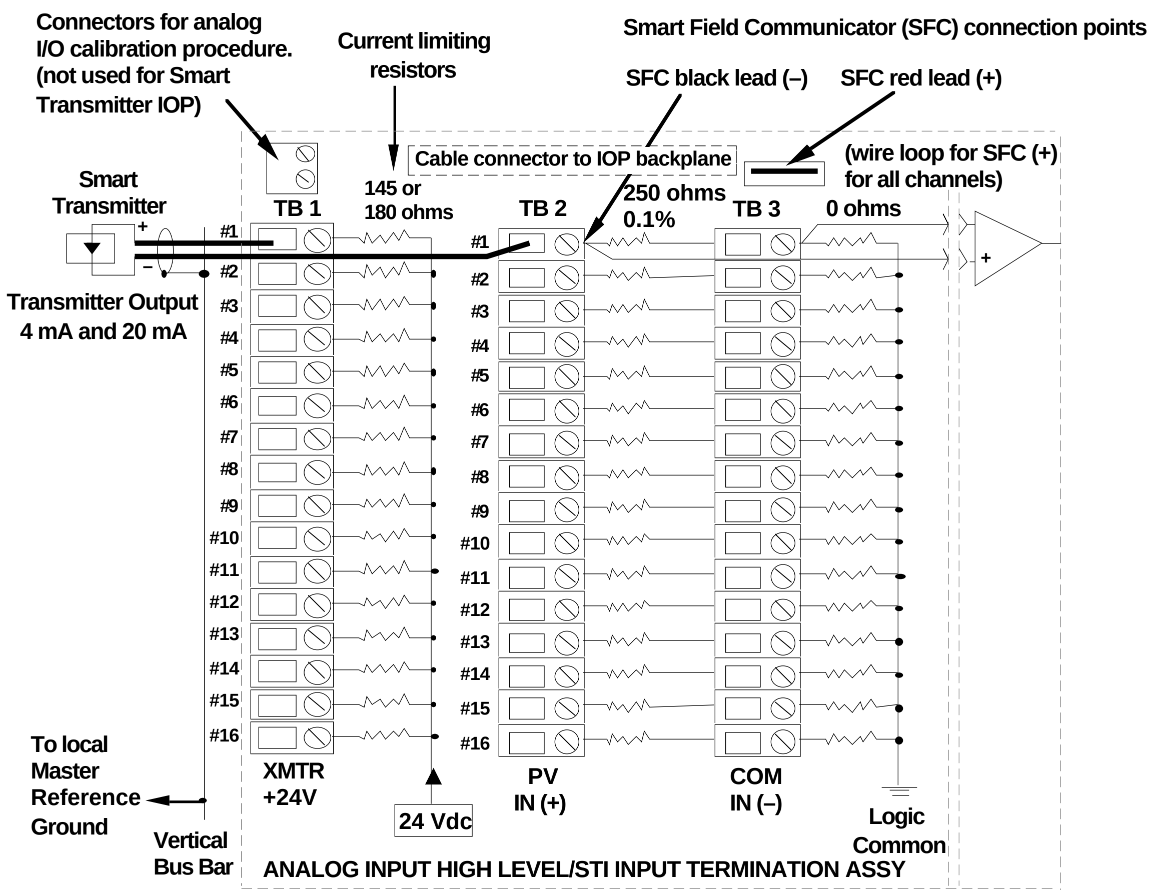

Figure 5-1 — FTA Schematic (MU-TAH02) – Nonredundant IOP

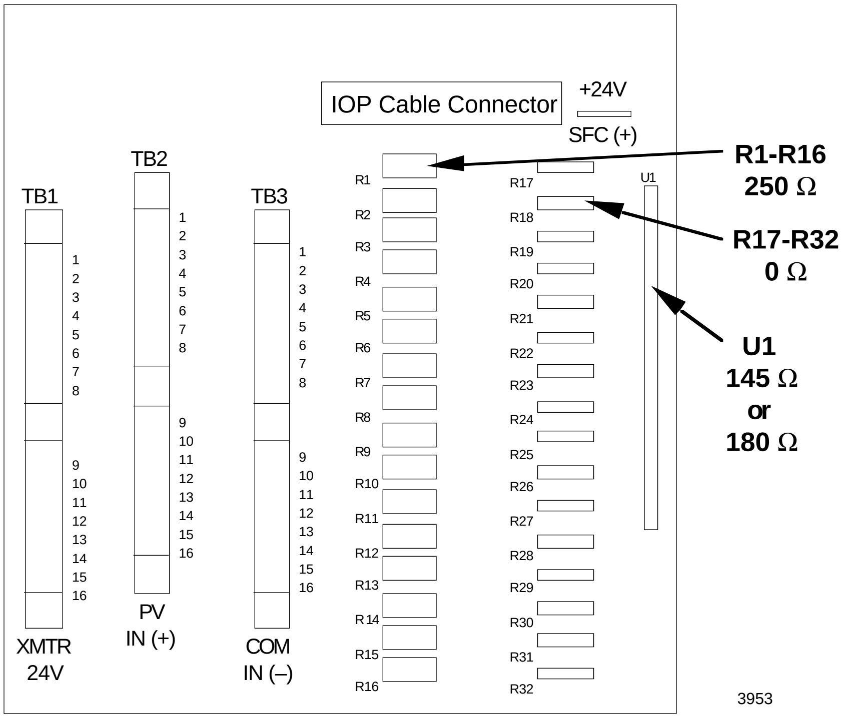

Figure 5-2 — FTA Physical Layout (MU-TAH02) – Nonredundant IOP

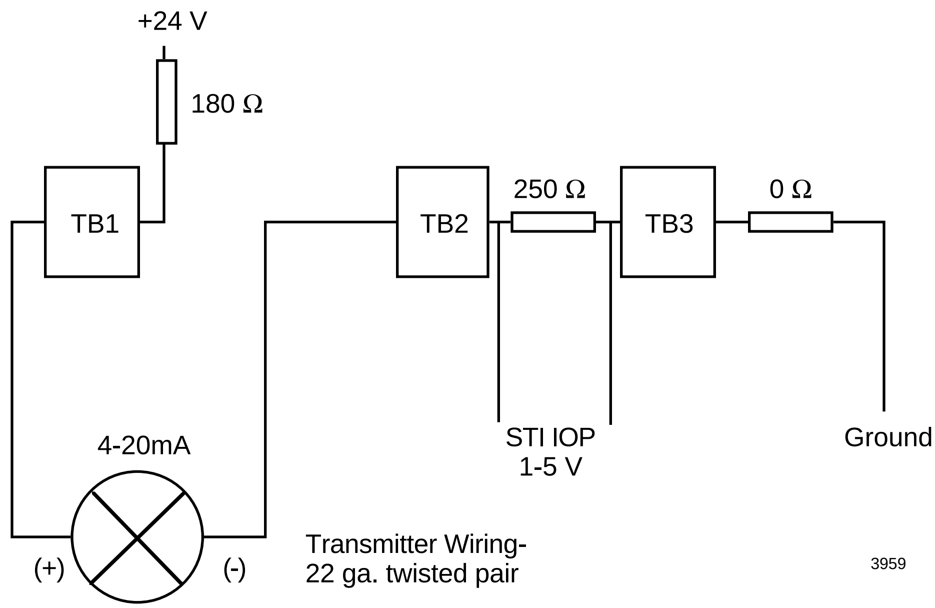

Figure 5-3 — Nonredundant IOP Circuit for Smart Transmitter (Non-I.S. Environment)

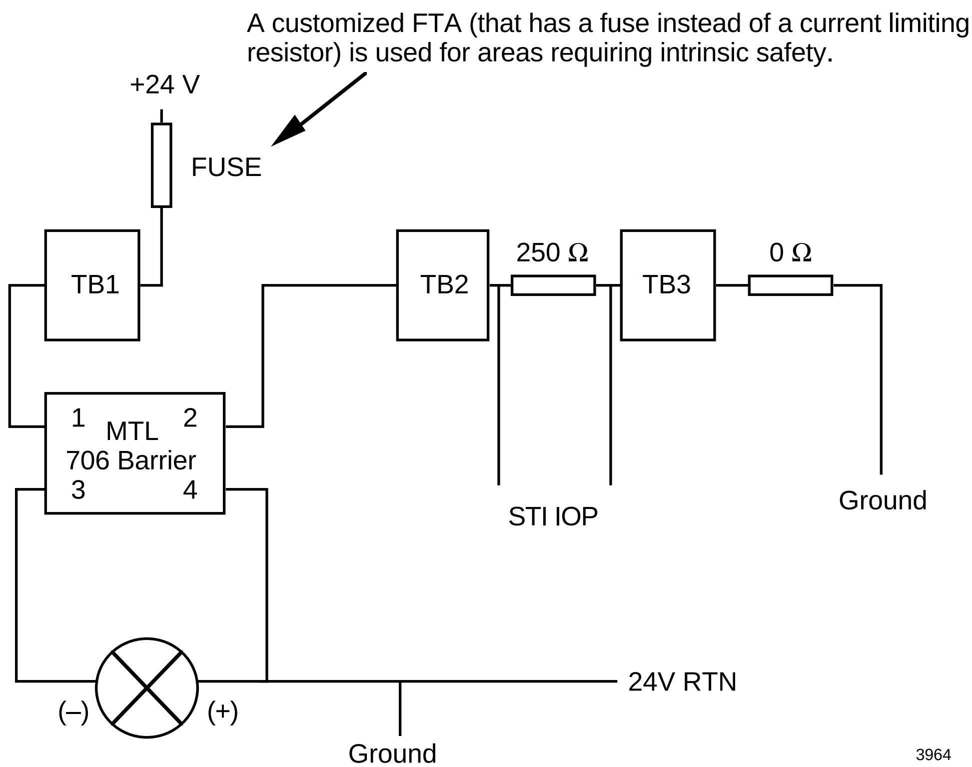

Figure 5-4 — Nonredundant IOP Circuit for Smart Transmitter (I.S. Environment)

5.2.1 Redundant Smart Transmitter IOPs

The Smart Transmitter IOPs are available as redundant partners. Either one of the partner IOPs operates as the primary and the other backs up the primary. Each of the partners connects to the process through a single Field Termination Assembly (FTA).

Both the primary and backup IOPs receive all data from the UCN or from the process simultaneously, and should the primary IOP fail, the backup IOP takes over automatically, becoming the new primary IOP. Such a failover is transparent to the remainder of the system, except for Universal Station displays that show IOP status information. A failover is completed in 100 milliseconds or less.

At the PM or APM Detail Status display, you can request that the primary and backup roles for the partner IOPs be exchanged. To do this, select the IOP, then select `RUN STATES`, `SWAP PRIMARY`, and `ENTER`.

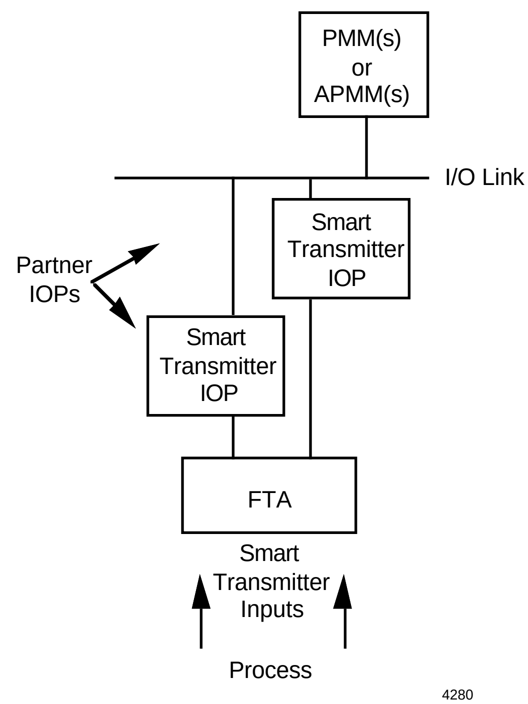

Figure 5-5 — Redundant Smart Transmitter IOP Signal Flow

Synchronization of the database in the partner IOPs is verified as the backup IOP checks that the primary IOP received and responded to each data item sent on the I/O Link, and by periodic comparisons of the databases in both IOPs.

Smart Transmitter IOPs monitor the inputs from the FTA. A diagnostic routine verifies that the physical interconnection between the partner IOPs is functional.

In a redundant configuration where a STIMV IOP is used, both IOPs must be STIMV IOPs. Refer to subsection 10.1 for more information.

Figures 5-6 and 5-7 show the screw type FTA for redundant Smart Transmitter IOPs.

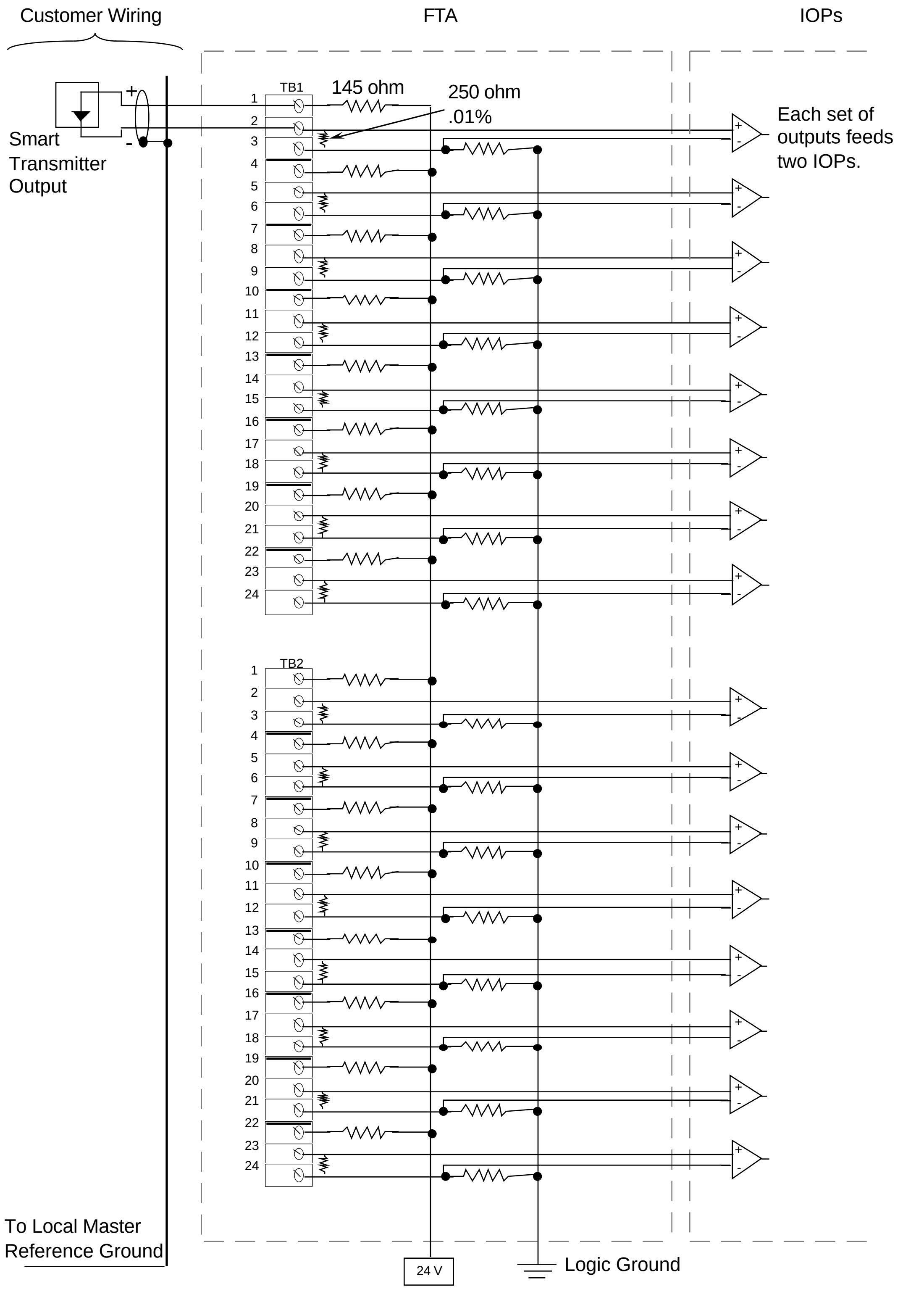

Figure 5-6 — Screw Type FTA Schematic (MU-TAIH52) – Redundant IOP

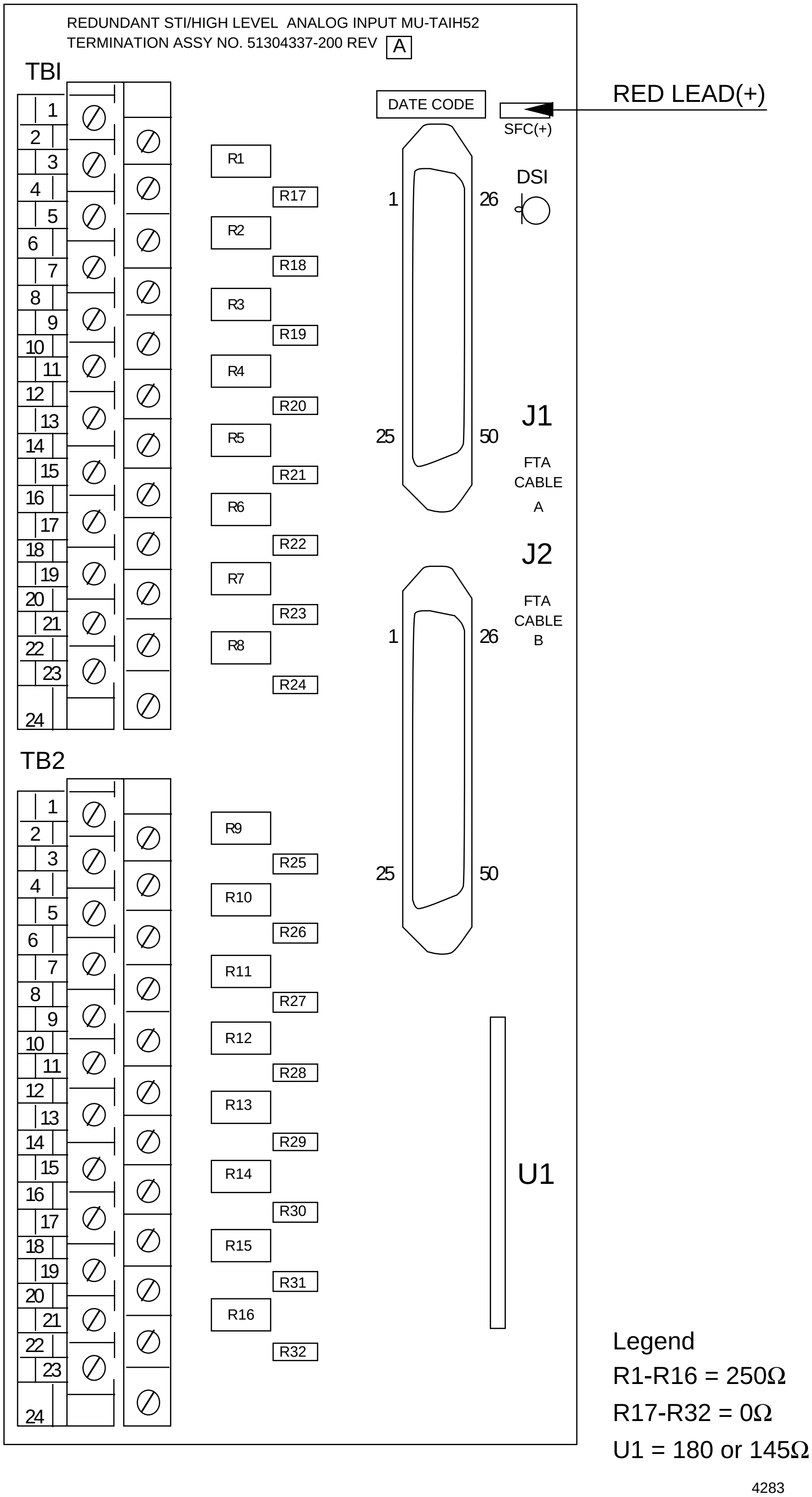

Figure 5-7 — Screw Type FTA (MU-TAIH52) – Redundant IOP

Figure 5-8 shows the Weidmuller type FTA for redundant Smart Transmitter IOPs.

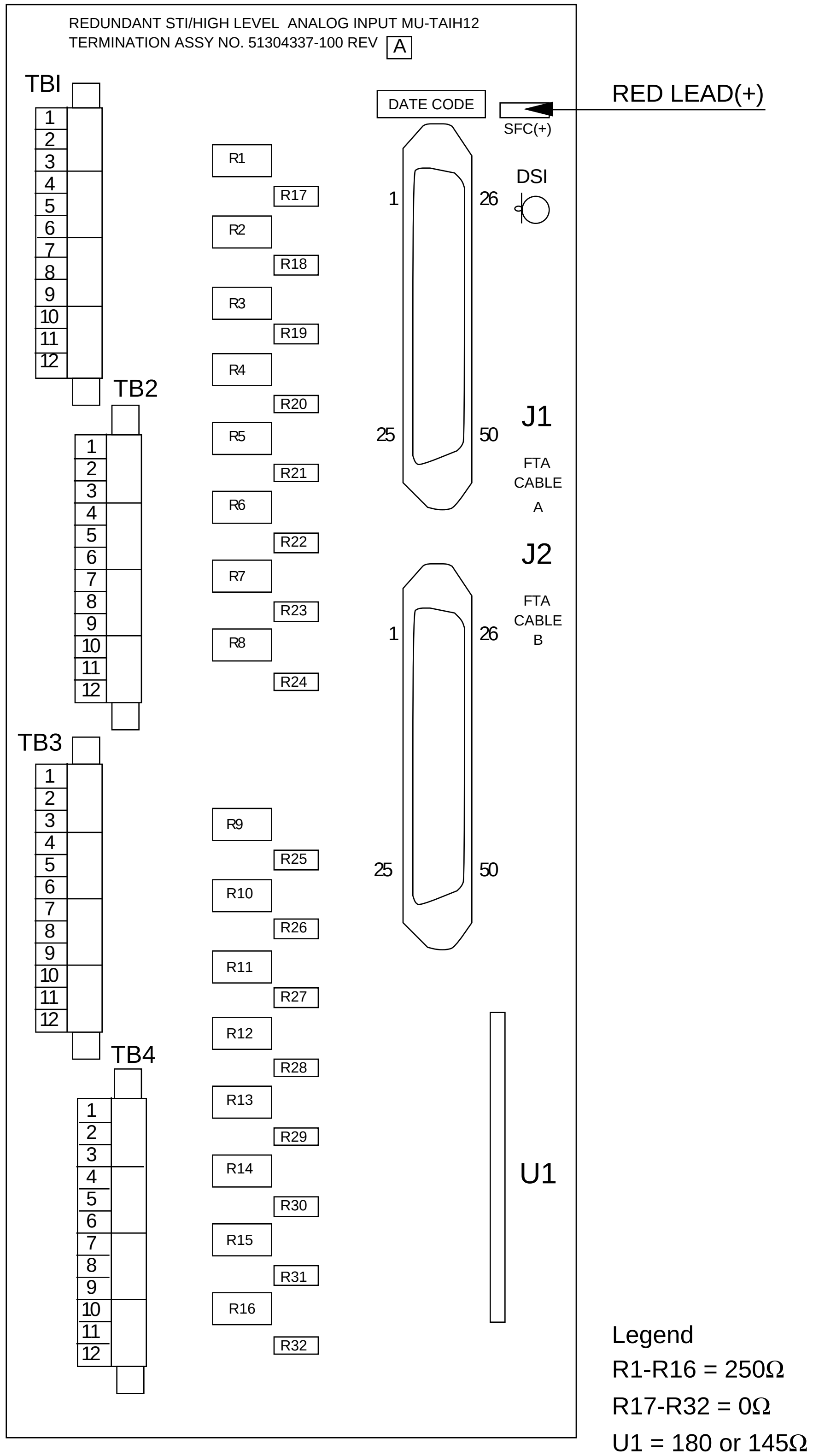

Figure 5-8 — Compression Type FTA (MU-TAIH12) – Redundant IOP

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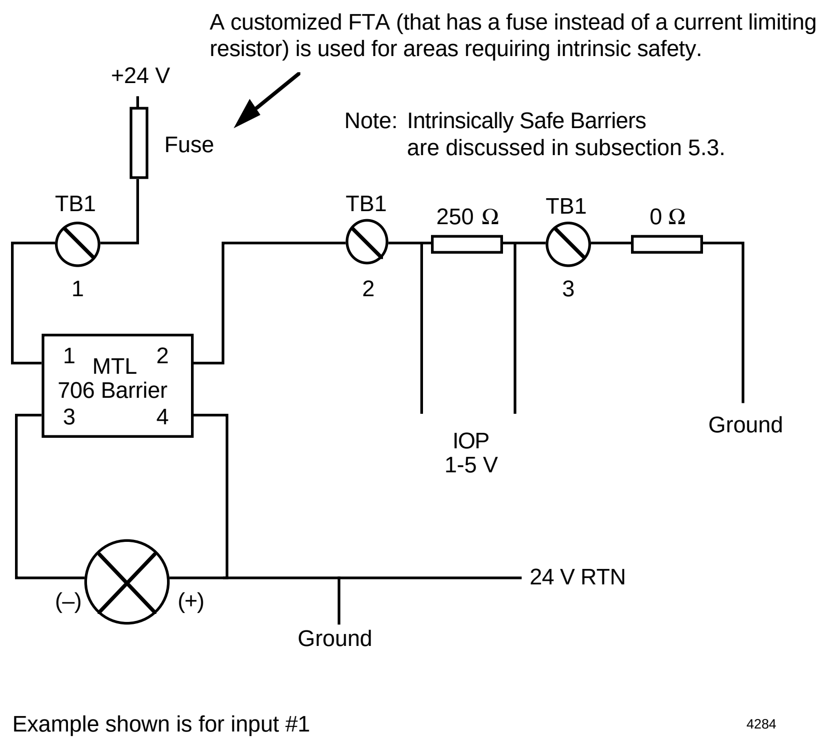

Figure 5-9 — Redundant Smart Transmitter IOP Circuit (I.S.) – Screw Type FTA

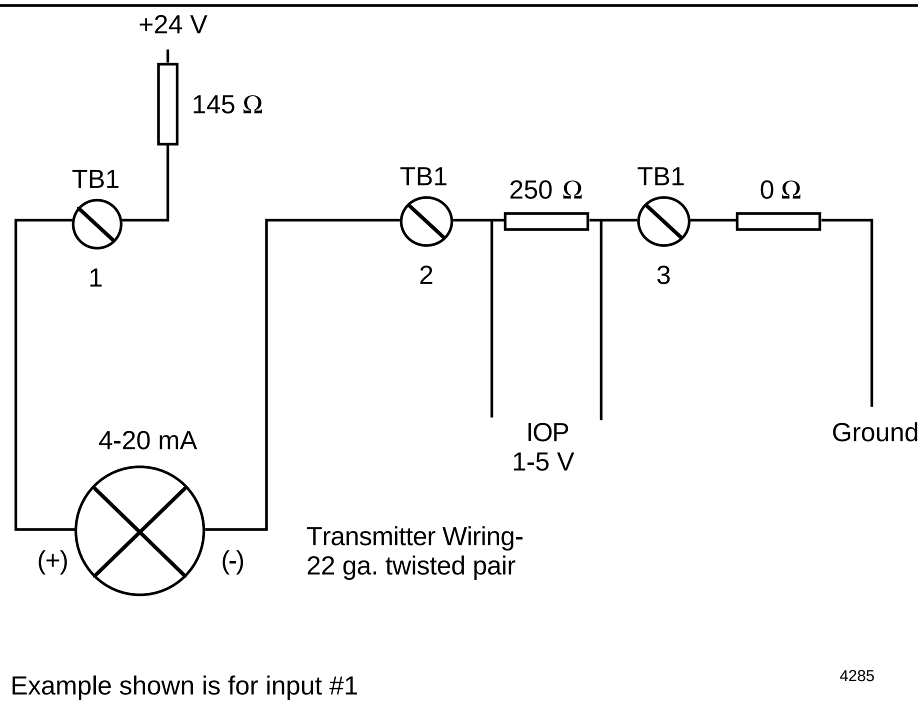

Figure 5-10 — Redundant Smart Transmitter IOP Circuit (Non-I.S.) – Screw Type FTA

5.3 Intrinsically Safe Barriers

Intrinsic safety barriers can be implemented using traditional Zener barriers or using Galvanic Isolation/Intrinsic Safety Field Termination Assemblies (GI/IS FTAs) that are imbedded within the PM or APM.

On the GI/IS FTAs, plug-in modules, called isolators, incorporate galvanic isolation and intrinsic safety functions. The GI/IS FTAs are always fully populated with isolators to provide a one-to-one correspondence with the respective IOP. The Smart Transmitter GI/IS FTA has 16 isolators. The PM and APM Installation manuals (PM20-400 and AP20-400) provide complete drawings and wiring details for the GI/IS FTAs (model numbers: GAIH13-compression type and GAIH83-crimp type). The GI/IS FTA Specification and Technical Data provides additional information (document number GA03-100).

The following pages of this manual discuss traditional Zener barriers.

Honeywell has tested five intrinsically safe barriers to handle bidirectional (two-way) communications for Smartline Transmitters interfaced with a Smart Transmitter IOP to provide a few safe operations.

The current mirror barriers approved by Honeywell include:

MTL 706 and 3046
Elcon CS-I-7042
Pepperl & Fuchs KHD3-IST/EX 1 or KHD3-ISV/EX 1
Stahl 9001/51-280-091-00

The galvanic isolation barrier approved by Honeywell, is not as wide ranging as the current mirror barriers and is used primarily in Europe:

Stahl 9603/712213 C854

It is the user's responsibility to verify that any part used has the appropriate safety rating.

When installing Honeywell suggested I.S. barriers with bidirectional mode you must make the following power accommodations:

1. Barrier leads must get 24 volts directly. There must be no resistance in the 24 volt lead.

2. Barriers themselves draw power. You may have to allocate as much as 100 mA per transmitter to compensate for this power draw.

✍ ***note***

For Division 1 applications requiring the use of Intrinsic Safety Barriers, a special FTA (without a 180 Ω current limiting resistor) is required. Also, the particular model of barrier must be selected carefully so that it will not filter out the digital communication. Consult your Honeywell representative for further information and recommended barrier models. Refer to Figures 5-4 and 5-9, the MTL 706 Barrier.

MTL 706 and 3046 IS

The MTL 706 barrier is recommended for use with Smart Transmitter IOP. The barrier passes communication bidirectionally and works properly with the SFC or DE meter in any location. It provides a regulated voltage of 23.6 Vdc out to the field for any power supply voltage between 22.3 Vdc and 35 Vdc. The barrier will handle at least 200 ohms of line resistance. A sample barrier demonstrated a maximum dc current mirror error of 0.0007%. Like most barriers, the bias current required to operate the barrier is roughly twice the signal current.

The MTL 3046 IS barrier is also acceptable. It will pass communications bidirectionally and has plenty of voltage and resistance margins to handle most applications.

Elcon CS-I-7022/IIS/ST

This barrier operates properly with any loop resistance between 0 to 170 ohms. The power supply considerations is not an issue with this barrier because it operates from an 120 Vac line. It generates internally a 24 Vdc transmitter supply.

Pepperl & Fuchs KHD3-IST/EX or KHD3-ISV/EX 1

The two barriers are twins. The ISV version has a voltage (as opposed to a current) output; otherwise, they are identical. Both barriers were tested over a power supply range of 18.5 volts to 35 volts and loop resistance of 0 to 220 ohms. They both performed acceptably under all conditions.

Stahl 9001/51-280-091-00

This current mirror barrier is an acceptable barrier. Check the manufacturers catalog to verify the exact model number for your application.

Stahl 9603/712213 C854

The Stahl 9603/712213 C854 galvanic isolation barrier is acceptable for service with Smartline Transmitters, the Smart Transmitter IOP, and the PM or APM, with certain limitations. These limitations include the following:

1. The Smartline Transmitters cannot be located more than 1,000 to 1,500 feet of wiring from the I.S. barrier. The voltage available to the field device is only 12.4 volts during communications. This limits the resistance of field wiring to 70 ohms for the ST 3000 Pressure Transmitter and 20 ohms for the STT 3000 Temperature Transmitter. These are quite low values, but 20 ohms is equivalent to 1,000 double feet of 20 AWG or 1,500 double feet of 18 AWG.

2. Since the barrier can draw over 200 mA, it cannot be powered from the FTA. The Stahl I.S. Barrier card file must be powered directly from the 24 volt power supply. The 24 V power to the card file requires separate fusing. In addition, the amount of power required for the barriers must be considered in the overall power budget for the system.

3. Using the SFC on the safe (control room) side of the barrier will require that the power return and the signal ground be tied together somewhere in the system. This is required because the SFC signals with a current and needs a current return path. There is no such limitation when using the SFC on the hazardous side of the barrier.

Check the manufacturer’s catalog to verify the exact model number for your application.

5.4 TRANSMITTER TO PROCESS WIRING

5.4.1 Multivariable Field Devices

For fieldwiring of multivariable devices, refer to the user manual of the specific field device.

5.4.2 ST 3000 Pressure Transmitter

To wire the ST 3000 to the PM or APM FTA, connect the transmitter as shown in Figure 5-11.

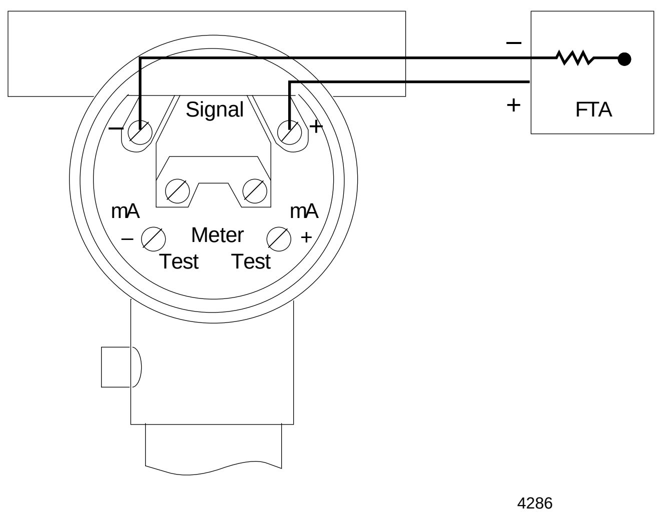

Figure 5-11 — ST 3000 Connection to FTA

5.4.3 STT 3000 Temperature Transmitter

To wire the STT 3000 to the PM or APM FTA, connect the transmitter as shown in Figure 5-12. The sensor input connections are indicated on the top label adjacent to the terminals.

Millivolts and thermocouples are connected to terminals 3 (positive) and 2 (negative).

Resistance temperature detector (RTD) measurement uses the three-wire approach with the resistance sensor connected to terminals 1 and 2 and the compensating connection to terminal 3. If a two-wire RTD is used, then terminals 2 and 3 must be linked. If a four-wire RTD is used, connect the fourth wire to spare terminal 4 (a dummy termination point). Ensure that the compensating wire on terminal 3 is from the same side of the RTD as the connection to terminal 2.

For more details, refer to the STT Installation Guide, 34-ST-33-19.

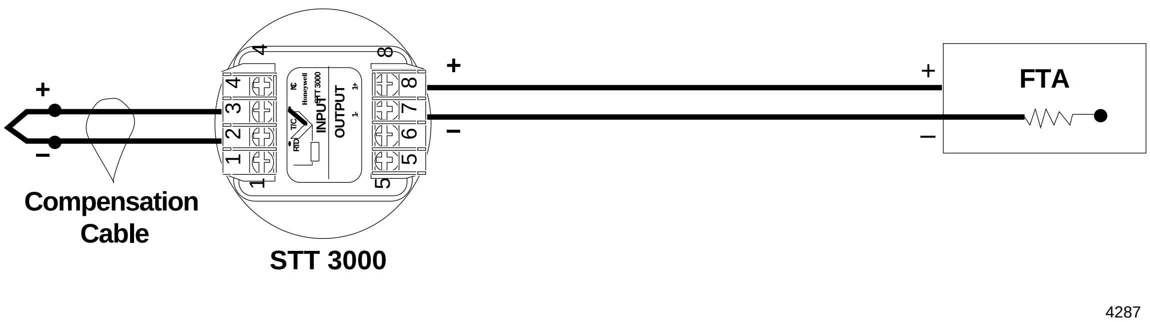

Figure 5-12 — STT 3000 Connection to FTA

5.4.4 MagneW 3000 Flowmeter Transmitter

To wire the MagneW 3000 to the PM or APM FTA, connect the transmitter as shown in Figure 5-13.

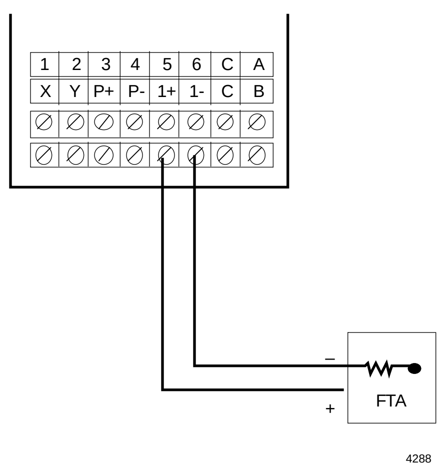

Figure 5-13 — MagneW 3000 Connection to FTA

5.5 SMART METER TO TRANSMITTER WIRING

Since the Smart Meter can be integrally mounted in an ST 3000 or STT 3000 transmitter and remotely mounted in a separate housing, the following wiring and mounting procedures cover both integrally mounted and separate housing installation requirements. See Section 9, Smart Meter, for more information.

5.5.1 Smart Meter Connection to ST 3000 Pressure Transmitter

To wire the Smart Meter to the ST 3000, connect the meter to the transmitter as shown in Figure 5-14.

Prerequisites:

–Transmitter has a meter end cap
–Power is removed from transmitter
–Meter end cap is removed
–Screwdriver (medium blade)

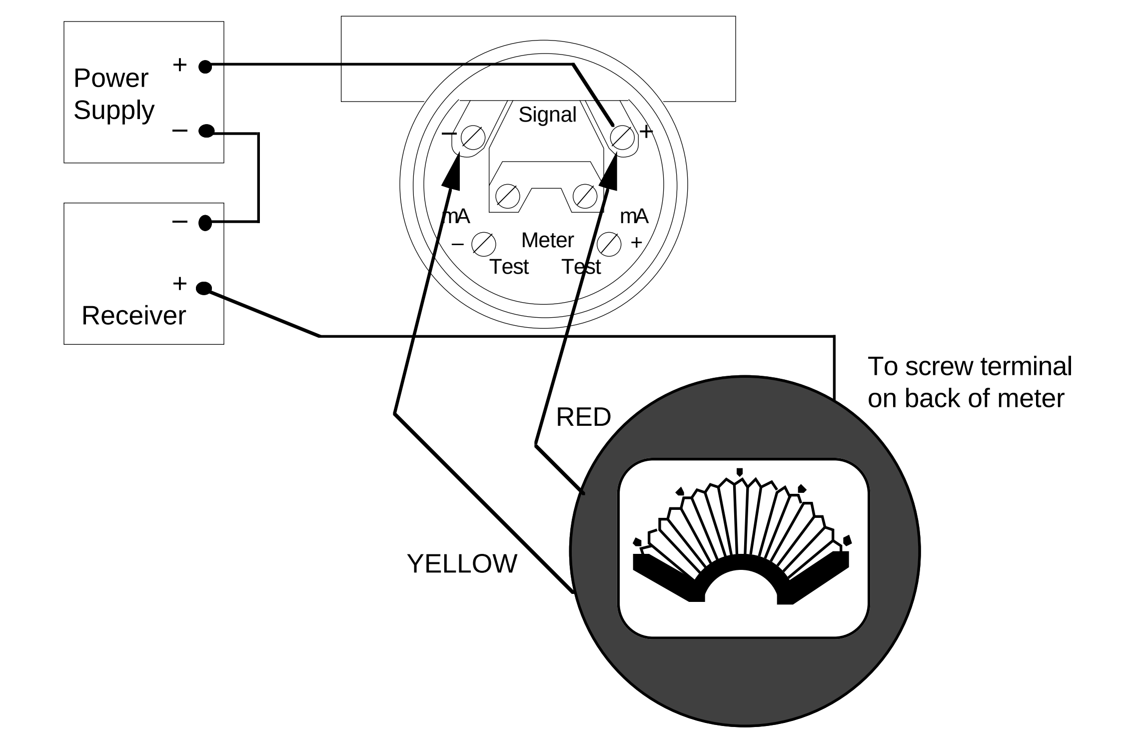

Figure 5-14 — Smart Meter Connection to ST 3000 Transmitter

The procedure to wire the Smart Meter to the ST 3000 follows.

✍ *note*

If the Smart Meter is already installed, remove it by pulling the meter toward you so that you can make field wiring connections and check the meter connections to the transmitter.

1. Connect Yellow lead from Smart Meter to the –Signal terminal and Red lead to the +Signal terminal on the transmitter's terminal block.

WARNING

Never connect the Smart Meter leads to the terminals marked METER on the transmitter's terminal block.

2. Connect a lead from +node of receiver (typically a 250 ohm resistor) to screw terminal on the back of the meter. Note that this connection is the negative side of the current loop. With previous meter designs, this connection was made to the –Signal terminal.
3. Consult transmitter's instruction to make other field wiring connections.
4. Orient Smart Meter for proper viewing through the end cap window, align the feet on the meter with the holes in the terminal block, and press the meter in place.
5. Lubricate the end cap O-ring with silicon grease (recommend Dow Corning #33 or equivalent).
6. Go to "Preparing Smart Meter for Operation" before replacing end cap, discussed in the *SM 3000 Smart Meter User's Manual*, 34-ST-25-08.
7. Replace end cap and tighten end cap lock.

5.5.2 Smart Meter Connection to STT 3000 Temperature Transmitter

To wire the Smart Meter to the STT 3000, connect the meter to the transmitter as shown in Figure 5-15.

Prerequisites:

–Transmitter has a tall cap housing with a glass window
–Power is removed from transmitter

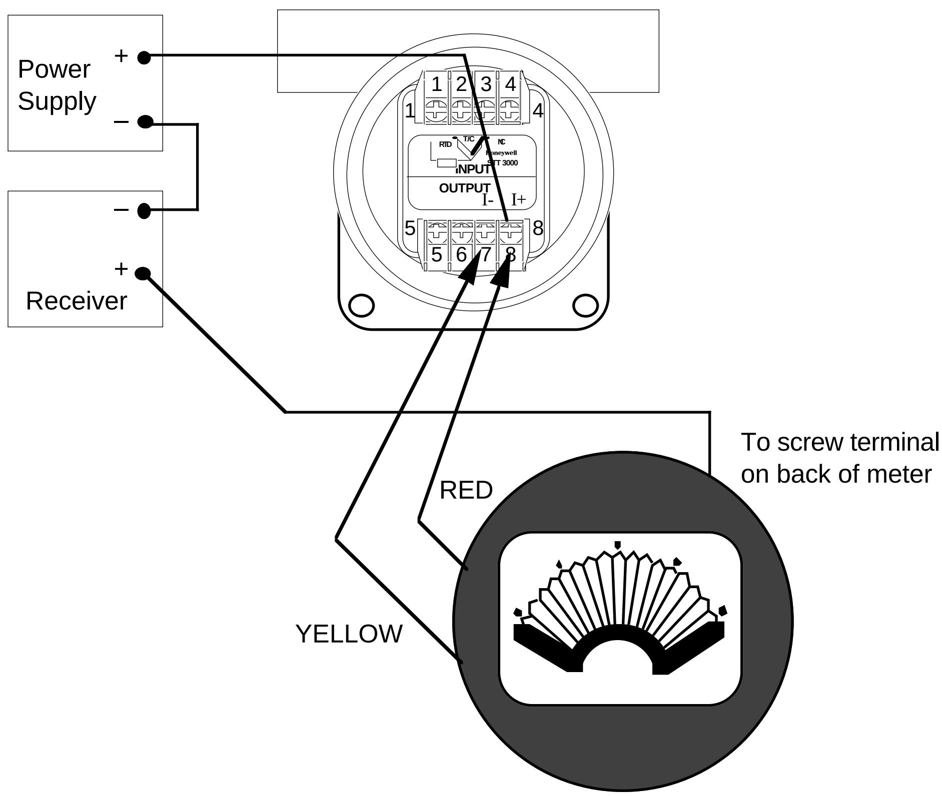

Figure 5-15 — Smart Meter Connection to STT 3000

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The procedure to wire the Smart Meter to the STT 3000 is shown in the following steps.

> ✍ ***note***
>
> If the Smart Meter is already installed, remove it by pulling the meter toward you so that you can make field wiring connections and check the meter connections to the transmitter.

1. Connect Yellow lead from Smart Meter to the I – (7) terminal and Red lead to the I + (8) terminal on the transmitter.
2. Connect a lead from +node of receiver (typically a 250 ohm resistor) to screw terminal on the back of the meter. Note that this connection is the negative side of the current loop. With previous meter designs, this connection was made to the –Signal terminal.
3. Consult transmitter's instruction to make other field wiring connections.
4. Orient Smart Meter for proper viewing through the cover window, align the feet on the meter with the holes in the spacer assembly and press the meter in place.
5. Go to "Preparing Smart Meter for Operation" before replacing end cap, discussed in the *SM 3000 Smart Meter User's Manual*, 34-ST-25-08.
6. Replace cover.

CONFIGURATION AND IMPLEMENTATION
Section 6

This section discusses how to configure the Smartline Transmitters from the Universal Station, starting from the Main Menu, implementing the Smart Transmitter IOP, building and loading the STIM point to the PM or APM, and loading the database to or from the transmitter.

6.1 BUILD PM BOX DATA POINT

A **Box Data Point** is built for each PM or APM. The point is used to allocate the number and scan rate of the control functions; it is used to map the physical file and card number of each I/O processor (IOP) to a logical module number (1-40). (These are used to reference the IOP in the various UCN status displays.) The box data point needs to be modified if an Smart Transmitter IOP is added.

Configuration of the Box Data Point begins at the Engineering Personality Main Menu, shown in Figure 6-1.

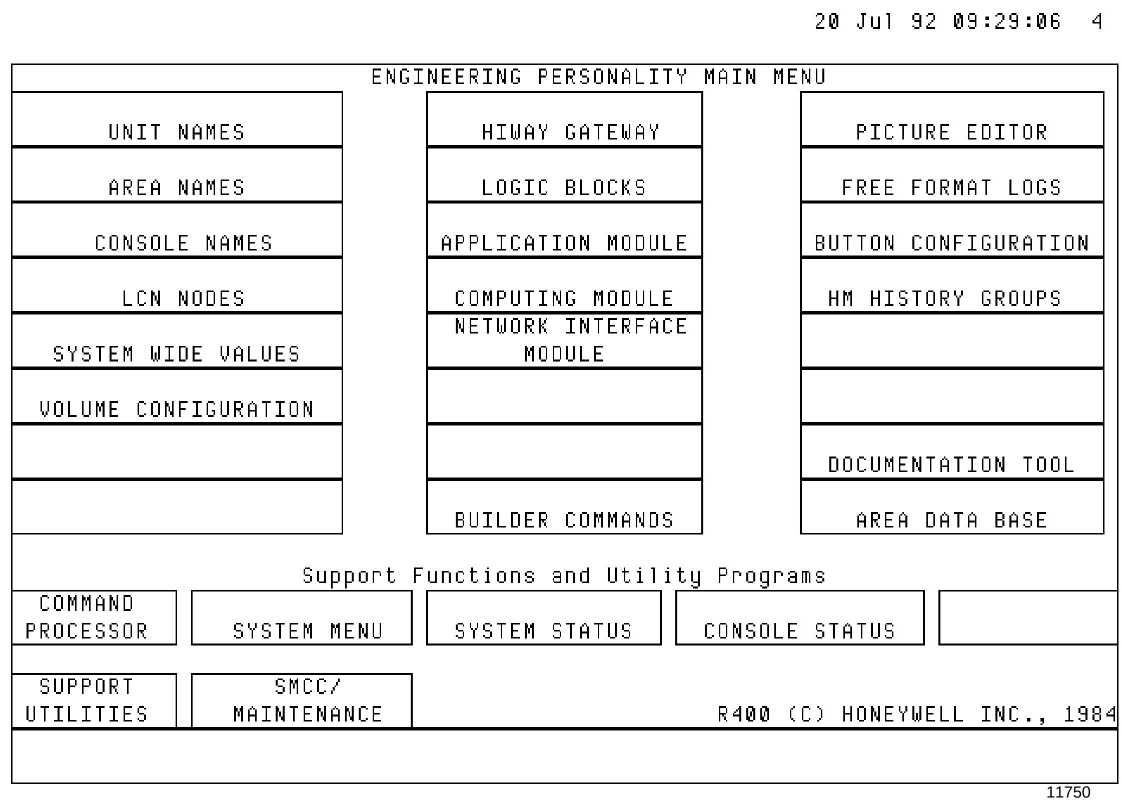

Figure 6-1 — Engineering Personality Main Menu

A variety of Parameter Entry Displays (PEDs) exist under the **NETWORK INTERFACE MODULE** target for configuration of UCN network data points, box data points, and process data points. When this target is selected, the menu shown in Figure 6-2 is produced.

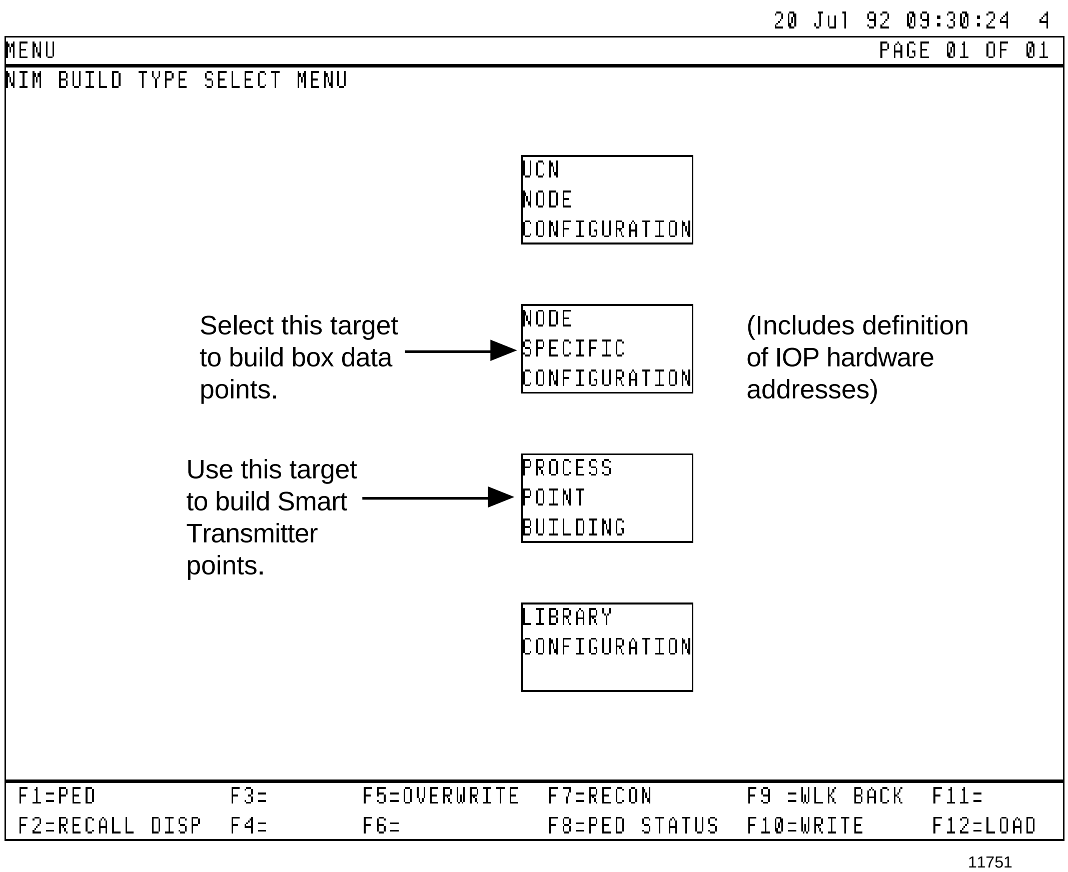

Figure 6-2 — Build Type Selection Menu

6.1.1 Node Specific Configuration (Build and Load Box Data Point)

When the **NODE SPECIFIC CONFIGURATION** target is selected, the Box Data Point PED, shown in Figure 6-3, appears.

When adding a Smart Transmitter IOP to the PM or APM, reconstitute the PM or APM's Node Specific Configuration(box data point). Figure 6-3 shows the first page of the PED used to modify the box data point. Notice the point name at the top of the display: `$NM04B03`. Pages 2 through 4 of the PED are used to define the control partition, and are not included in this manual.

```
                                                                20 Jul 92 09:33:13  4
PED >>>>>>> POINT:$NM04B03                UNIT:SY        UNENTERED   PAGE 01 OF 03
NODE-SPECIFIC CONFIGURATION

*****************************************
*                                       *
* WARNING: IF THE POINT MIX OR THE SCAN *
* RATE IS CHANGED, THEN THE NODE'S FULL *
* DATA BASE WILL BE SET TO ITS DEFAULT. *
* THE DISPLAY LINES WHICH CAN CAUSE THE *
* DATA BASE TO BE DEFAULTED ARE STARRED *
* AND HAVE AN ASTERISK (*) IN COLUMN 80 *
*                                       *
*****************************************

NETWORK NUMBER              (NTWKNUM)  04

NODE NUMBER                 (NODENUM)  03

NODE TYPE                   (NODETYP)  PM         APM        LM

 F1=PED           F3=        F5=OVERWRITE  F7=RECON        F9 =WLK BACK   F11=
 F2=RECALL DISP   F4=        F6=           F8=PED STATUS   F10=WRITE      F12=LOAD
```

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Figure 6-3 — Box Data Point PED, Page 1

6.1.2 I/O Module Configuration

The remaining pages of the PED are used to do the following configuration:

- list the I/O Link addresses (logical module numbers) from 1 to 40,
- specify the card file number (1-8) and the card number (card slot 1-15) of the IOP to be associated with each logical module number, and
- specify the IOP type.

A Smart Transmitter IOP is type **STIM (Smart Transmitter Interface Module).** Configure the STI IOP and the STIMV IOP as the STIM module type.

I/O Module (IOM), as shown in Figure 6-4, refers to a single IOP or a redundant pair of IOPs. For a redundant pair of IOPs, the IOM number is the logical I/O link address for the pair of IOPs.

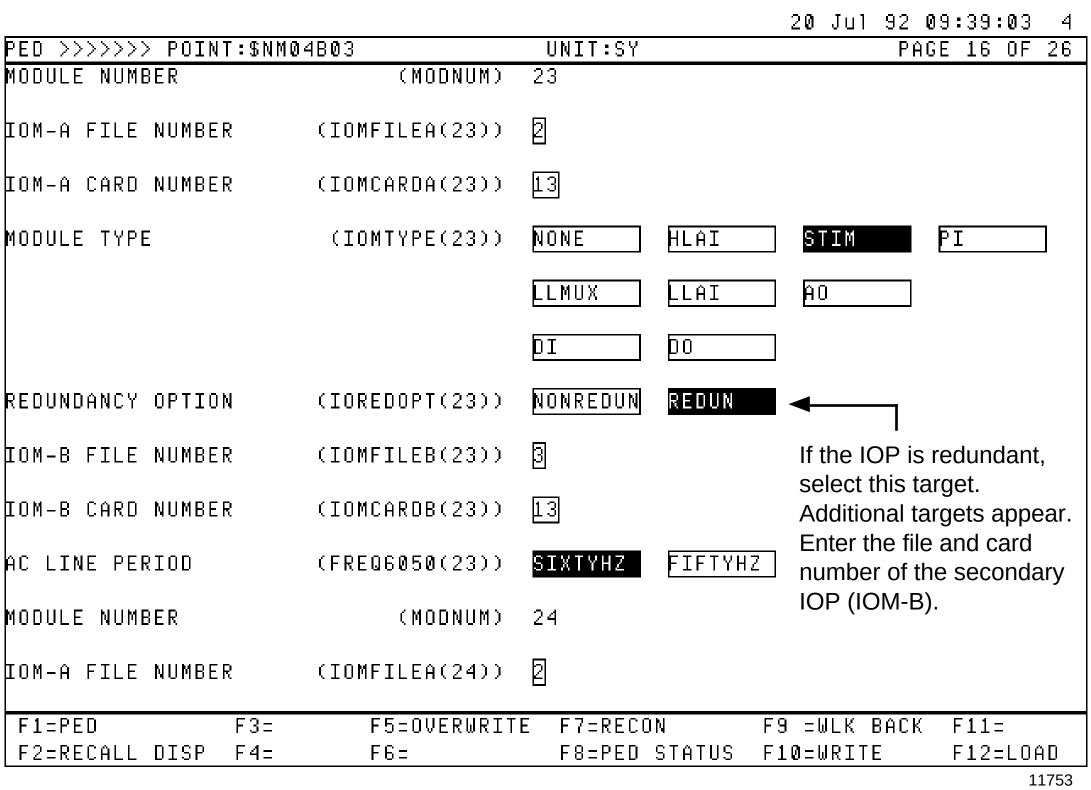


Figure 6-4 — Box Data Point PED, Page 4

6.1.2.1 AC Line Period

The **AC Line Period** parameter is applicable only to the Smart Transmitter IOP (STIM) and the Low Level Multiplexer IOP (LLMUX). The parameter is a line frequency phase reference for noise rejection. It specifies the frequency of the input filter as either 50 or 60 Hz (refer to the FREQ6050 parameter in Appendix A).

6.2 VERIFY IOP OPERATING STATE AND LOAD POINTS

The following steps summarize the remaining configuration process:

1. After loading the box data point, check the operating status of the Smart Transmitter IOP by displaying the IOP Detail Status Display (see procedure in Figure 6-5). Figure 6-6 shows the Smart Transmitter IOP Detail Status display.

2. The Smart Transmitter IOP (STIM) should be in the IDLE state. If the Smart Transmitter IOP has a failure condition, troubleshoot the failure.

1. Press the Universal Station key

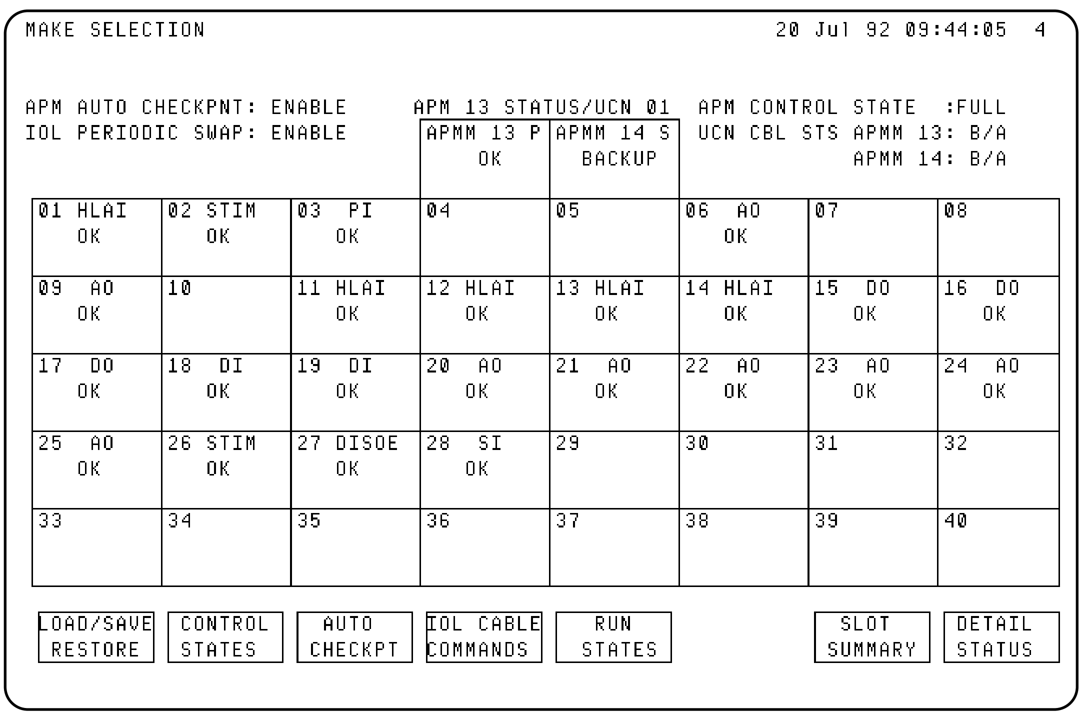
   SYST STATS

   The System Status Display appears

2. Select Process Network (UCN) target. The UCN Status Display appears.

3. Select PM or APM, then select DETAIL STATUS. The PM or APM Status Display below appears.

4. Select the Smart Transmitter IOP (STIM), then select DETAIL STATUS target. The IOP Status Display appears (Figure 6-6).



11754

Figure 6-5 — Procedure to Call Up PM or APM Status Display

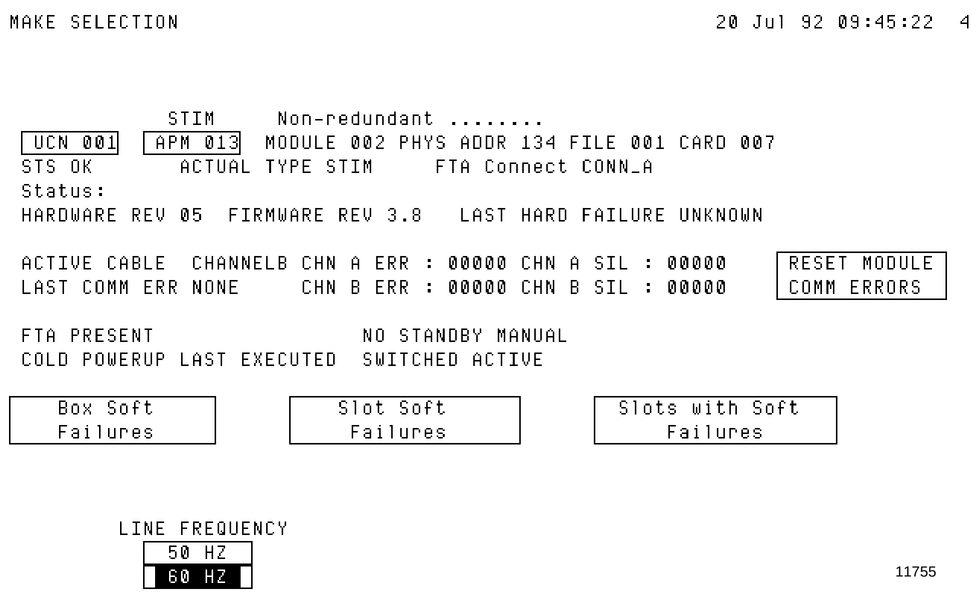


Figure 6-6 — Smart Transmitter IOP Detail Status Display

3. After verifying the status of the IOP, build the Smart Transmitter data points (described later in subsection 6.3).

4. After the Smart Transmitter data points are built, use the SAVE target (under the LOAD/SAVE RESTORE target) to save the IOP database to the checkpoint file.

ATTENTION

For LCN systems operating with R300 software and later, you cannot save an IOP database or startup an IOP until it contains a database that has been restored from a checkpoint file. A database that has been restored from a checkpoint file is considered a “valid” database. Since a checkpoint file for a new IOP does not exist during the initial configuration, you must use the VALIDATE IOP DB target (under the RUN STATES target) to validate the initial database, allowing it to be saved.

5. After validating the database, use the START target (under the RUN STATES target) to start the IOP. The IOP should go to the OK state. If it does not, call up the DETAIL STATUS display for the IOP and troubleshoot the failure.

6. When the IOP goes to the OK state, each transmitter database can be uploaded or downloaded from the Detail Display of each Smart Transmitter data point (described later in subsection 7.1.2 and Section 10 for special considerations when uploading and downloading the database of multivariable transmitters, such as the SCM 3000).

7. If you upload the transmitter database to the IOP, be sure to perform another save of the IOP database to the checkpoint file.

6.3 BUILD SMART TRANSMITTER DATA POINTS

To build Smart Transmitter (STIM) data points, perform the following procedures:

1. Select PROCESS POINT BUILDING from the NIM menu (see Figure 6-2). The point type menu appears.

2. Select the ANALOG INPUT point type. The first page of the analog input **Parameter Entry Display** (PED) appears.

The following figures show the PED entries for a STIM point. Refer to Appendix A of this manual for definitions of each parameter. Refer to Section 10 if you are configuring multivariable field devices, such as the SCM 3000.

If the Smart Transmitter database has been configured previously using the Smart Field Communicator or configured in the factory per user specifications, then you do not have to configure these parameters from the PED:

STITAG
SENSRTYP
PVCHAR
CJTACT
PIUOTDCF
DECONF
URL
URV
LRV
STI_EU
DAMPING

After loading the STIM point, you will upload these parameters from the transmitter database.

After entering all of the desired parameters, load the point to the IOP. Loading from the PED (or from IDF or EB file) downloads the parameters to the IOP, but does not download the transmitter database. Each transmitter database must be downloaded or uploaded using the Universal Station Point Detail Display.

```
                                                                20 Jul 92 09:48:51  4
PED >>>>>>> POINT:FI3011                  UNIT:01                   PAGE 01 OF 05
NIM-POINT ASSIGNMENT
    ANALOG INPUT

TAG NAME                           (NAME)  FI3011

NODE TYPE                       (NODETYP)  PM        APM       LM        ALM

POINT FORM                      (PNTFORM)  FULL      COMPONNT


POINT DESCRIPTOR                 (PTDESC)  STEAM FLOW INDICATOR

E.U. DESCRIPTOR                  (EUDESC)  KLB/HR

POINT KEYWORD                   (KEYWORD)  STEAM


UNIT ID                            (UNIT)  01

NETWORK NUMBER                  (NTWKNUM)  03

NODE NUMBER                     (NODENUM)  03

MODULE NUMBER                    (MODNUM)  23
 F1=PED           F3=       F5=OVERWRITE  F7=RECON       F9 =WLK BACK  F11=
 F2=RECALL DISP   F4=       F6=           F8=PED STATUS  F10=WRITE     F12=LOAD
```

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Figure 6-7 — STIM Point PED, Page 1

```
                                                                20 Jul 92 09:52:12  4
PED >>>>>>> POINT:FI3011                  UNIT:01  ERRS             PAGE 02 OF 05

SLOT NUMBER                     (SLOTNUM)  001

PM MODULE TYPE                 (PNTMODTY)  HLAI      STIM      PI        LLMUX

                                           LLAI

 F1=PED           F3=       F5=OVERWRITE  F7=RECON       F9 =WLK BACK  F11=
 F2=RECALL DISP   F4=       F6=           F8=PED STATUS  F10=WRITE     F12=LOAD
```

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Figure 6-8 — STIM Point PED, Page 2

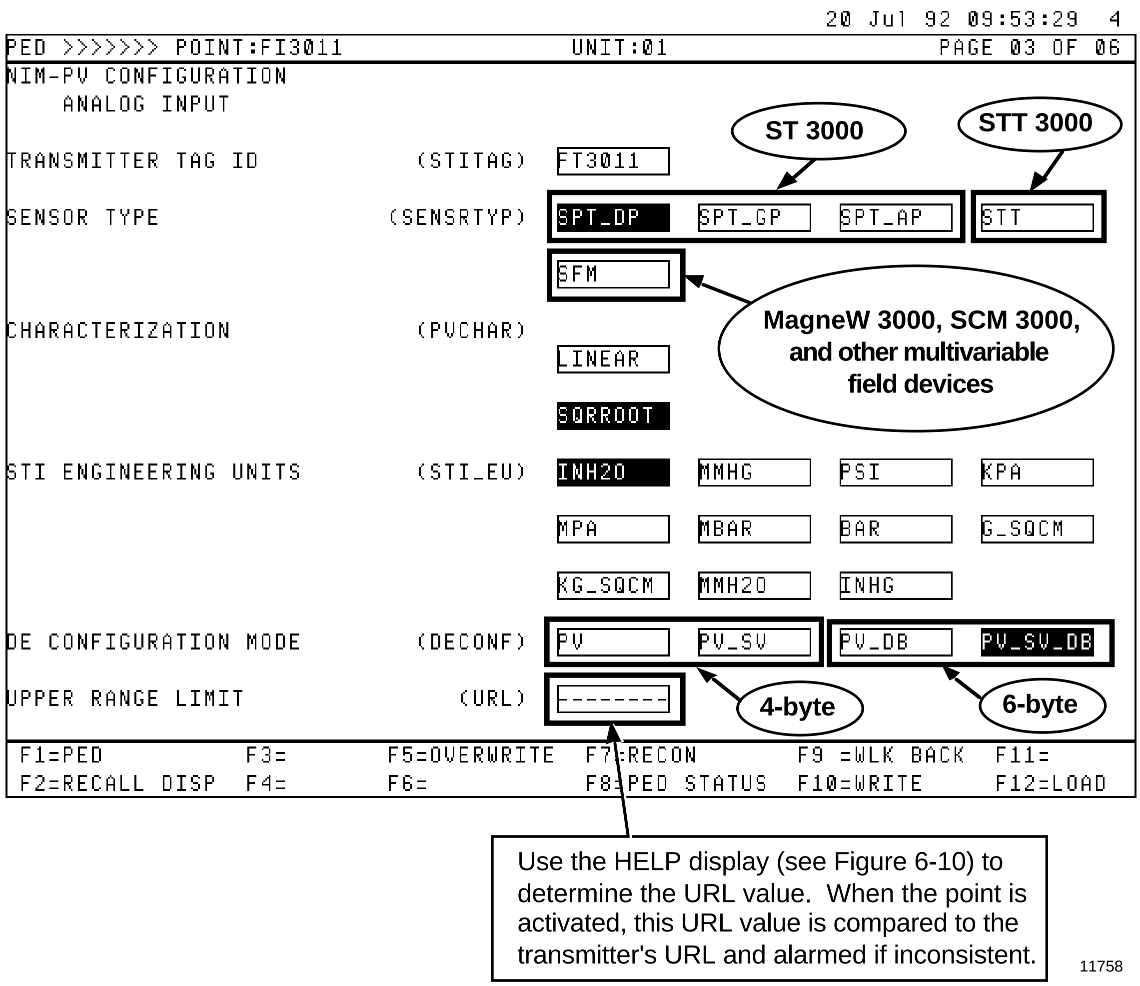

Figure 6-9 — STIM Point PED, Page 3

```
                                                   19 Aug 92 15:32:32  4
PARAMETER ENTRY DISPLAY HELP                                PAGE 01 OF 01
           SPT             |            STT                        STT
 XMTR RANGE   URL(inH2O)   | XMTR RANGE   URL(Deg C)   XMTR RANGE   URL(Deg C)
 ----------   ----------   | ----------   ----------   ----------   ----------
  400 inH2O     400.0      |     J          1,200.0      PT100J        640.0
  780 mmHga     400.0      |     K          1,370.0      PT100D        850.0
  600 inH2O     600.0      |     T            400.0      PT200         850.0
  100 PSI     2,768.07     |     S          1,760.0      PT500         850.0
  200 PSI     5,536.13     |     R          1,760.0      Ni500         150.0
  500 PSI/A  13,840.34     |     E          1,000.0       Cu10         250.0
 1500 PSI    41,521.01     |     B          1,820.0       Cu25         250.0
 2000 PSI    55,361.35     |     N          1,300.0     W5W26("C")   2,300.0
 3000 PSI    83,042.02     | mV(Linear)     1,000.0     W3W25("D")   2,300.0
 6000 PSI   166,084.0      | Ohms(RTD)      4,000.0       NiNiMo     1,300.0
                           |  RH Rad        1,800.0
SFM:
---              URL(m**3/hr) = [PI*(DIA**2)/4E6]*3600*(N+1)
DIA = mm : 2.5,5,10,15,25,40,50,80,100,150,200,250,300,350,400,500,600,700
  N = # dummies (integer) : 0-9

 F1=PED           F3=        F5=OVERWRITE  F7=RECON       F9 =WLK BACK  F11=
 F2=RECALL DISP   F4=        F6=           F8=PED STATUS  F10=WRITE     F12=LOAD
```

11759

Figure 6-10 — URL Help Display

```
                                                              20 Jul 92 09:55:39  4
PED >>>>>>> POINT:FI3011                 UNIT:01                     PAGE 04 OF 06
UPPER RANGE VALUE                (URV)   --------
LOWER RANGE VALUE                (LRV)   --------
XMTR FILTER LAG TIME         (DAMPING)   0.0
INPUT DIRECTION              (INPTDIR)   DIRECT     REVERSE
PV RANGE HIGH                 (PVEUHI)   200.0
PV RANGE LOW                  (PVEULO)   0.0
PV DECIMAL FORMAT            (PVFORMAT)  D0         D1         D2         D3
PV RANGE EXTENSION HIGH      (PVEXEUHI)  210.0
PV RANGE EXTENSION LOW       (PVEXEULO)  -5.0
PV CLAMPING OPTION            (PVCLAMP)  CLAMP      NOCLAMP
LOW SIGNAL CUTOFF            (LOCUTOFF)  --------
PV SOURCE OPTION             (PVSRCOPT)  ONLYAUTO   ALL

 F1=PED          F3=        F5=OVERWRITE  F7=RECON       F9 =WLK BACK  F11=
 F2=RECALL DISP  F4=        F6=           F8=PED STATUS  F10=WRITE     F12=LOAD
```

11760

Figure 6-11 — STIM Point PED, Page 4

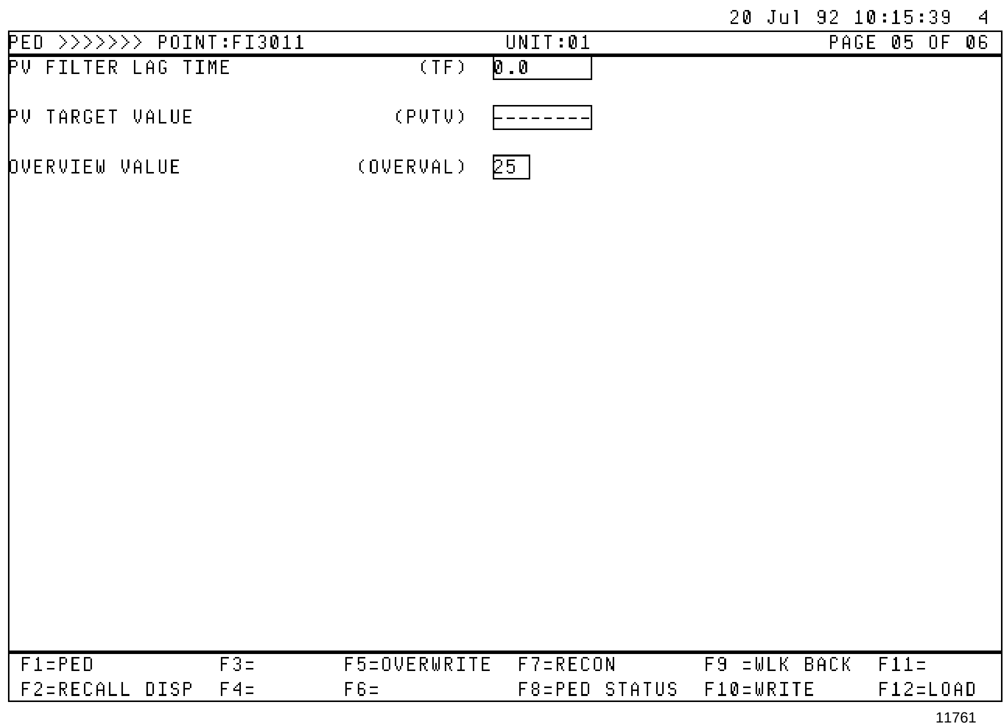

Figure 6-12 — STIM Point PED, Page 5

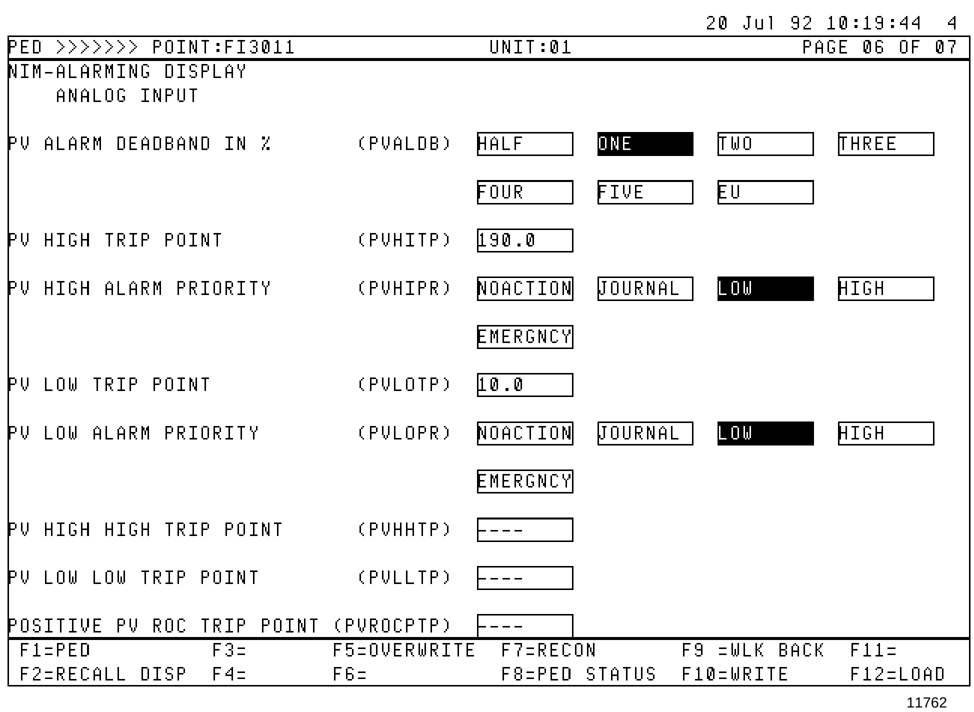

Figure 6-13 — STIM Point PED, Page 6

```
                                                    20 Jul 92 10:20:50  4
PED >>>>>>> POINT:FI3011                UNIT:01              PAGE 07 OF 07

NEGATIVE PV ROC TRIP POINT (PVROCNTP) [----   ]

BAD PV ALARM PRIORITY       (BADPVPR) [NOACTION] [JOURNAL ] [LOW     ] [HIGH    ]

                                      [EMERGNCY]

ALARM ENABLE STATE          (ALENBST) [ENABLE  ] [DISABLE ] [INHIBIT ]

PRIMARY MODULE POINT ID     (PRIMMOD) [--------        ]

 F1=PED          F3=        F5=OVERWRITE  F7=RECON       F9 =WLK BACK  F11=
 F2=RECALL DISP  F4=        F6=           F8=PED STATUS  F10=WRITE     F12=LOAD
                                                                        11763
```

Figure 6-14 — STIM Point PED, Page 7

For the STT 3000 temperature transmitter, pages 3 and 4 of the PED differ slightly (see Figures 6-15 and 6-16).

```
                                                    20 Jul 92 10:22:46  4
PED >>>>>>> POINT:FI3011                UNIT:01  ERRS        PAGE 03 OF 07
NIM-PV CONFIGURATION
    ANALOG INPUT

TRANSMITTER TAG ID           (STITAG) [TT3011  ]

SENSOR TYPE                (SENSRTYP) [SPT_DP  ] [SPT_GP  ] [SPT_AP  ] [STT     ]

                                      [SFM     ]

CHARACTERIZATION             (PVCHAR)
                                      [LINEAR  ]

                                      [BTHERM  ] [ETHERM  ] [JTHERM  ] [KTHERM  ]

                                      [NTHERM  ] [RTHERM  ] [STHERM  ] [TTHERM  ]

                                      [DINRTD  ] [JISRTD  ] [NICKLRTD]

                                      [PT200RTD] [PT500RTD] [CU10RTD ] [CU25RTD ]

                                      [RTD_OHMS]

                                      [RHRAD   ] [W5W26TC ] [W3W25TC ] [NINIMOTC]
 F1=PED          F3=        F5=OVERWRITE  F7=RECON       F9 =WLK BACK  F11=
 F2=RECALL DISP  F4=        F6=           F8=PED STATUS  F10=WRITE     F12=LOAD
                                                                        11764
```

Figure 6-15 — STT 3000 PED, Page 3

```
                                                     20 Jul 92 10:24:15  4
PED >>>>>>> POINT:FI3011               UNIT:01                PAGE 04 OF 07
STI ENGINEERING UNITS        (STI_EU)  DEG_C     DEG_F     DEG_K     DEG_R

DE CONFIGURATION MODE        (DECONF)  PV        PV_SV     PV_DB     PV_SV_DB

UPPER RANGE LIMIT               (URL)  --------

UPPER RANGE VALUE               (URV)  --------

LOWER RANGE VALUE               (LRV)  --------

XMTR FILTER LAG TIME        (DAMPING)  0.0

OTD ENABLE OPTION          (PIUOTDCF)  OFF       ON

INT COLD JCT COMPENSATION    (CJTACT)  OFF       ON

PV RANGE HIGH                (PVEUHI)  200.0

PV RANGE LOW                 (PVEULO)  0.0

PV DECIMAL FORMAT          (PVFORMAT)  D0        D1        D2        D3

PV RANGE EXTENSION HIGH    (PVEXEUHI)  210.0

 F1=PED         F3=       F5=OVERWRITE  F7=RECON       F9 =WLK BACK  F11=
 F2=RECALL DISP F4=       F6=           F8=PED STATUS  F10=WRITE     F12=LOAD
                                                                      11765
```

Figure 6-16 — STT 3000 PED, Page 4

6.3.1 Smart Transmitter Database

Because a Smartline Transmitter maintains its own configurable database, you must either upload its database to the IOP or download its database from the IOP to the transmitter, after the STIM point is built. If the transmitter had been configured previously (using the Smart Field Communicator (SFC) or in the factory per your specifications), you would *upload* its database to the IOP. If the transmitter database is not already configured, you should download the database to the transmitter.

To **upload** the transmitter database (if transmitter was preconfigured in factory or with SFC):

1. Call up the Detail display of the point and make sure the point is Inactive.
2. Go to page 2 of the Detail display and select the COMMAND target.
3. From the list of commands, select the UPLOADDB target, then select ENTER.

RESULT: The bottom half of the Detail display should now reflect the parameters from the transmitter database that were uploaded to the IOP.

To **download** the transmitter database (if transmitter has not been previously configured for this operation):

1. Call up the Detail display of the point and make sure the point is Inactive.
2. Go to page 2 of the Detail display and select the COMMAND target.
3. From the list of commands, select the DOWNLOADDB target, then select ENTER.

RESULT: The transmitter should now contain the same parameter values that are in the IOP, indicated at the bottom of page 2 of the Detail display.

6.4 CHECK CONFIGURATION

After uploading or downloading the transmitter database, activate the point to determine if there are any database discrepancies that need to be resolved.

After activating the point, call up page 2 of the Detail display and check the bottom of the display.

If there are any database discrepancies, the names of the parameters that have discrepancies will appear in a field labeled DATABASE DISCREPANCY. Section 7 discusses how to resolve database discrepancies.

In addition, configuration errors related to multivariable transmitter slots appear as one or two asterisks (*) in the `x of n` display at the bottom right corner of Detail display. Section 10 discusses how to resolve multivariable transmitter configuration errors.

6.5 CHECKPOINT PROCEDURE

After the Smart Transmitter data points are built and loaded to the IOP, and the transmitter database is uploaded from, or downloaded to, the transmitter, the IOP database should be saved to the checkpoint file (on removable media or on a network History Module). The `LOAD/SAVE/RESTORE` target on the PM or APM Status Display can be used to perform a manual save operation (see Figure 6-5, PM or APM Status Display).

ATTENTION

For LCN systems operating with R300 software and later, you cannot save an IOP database or startup an IOP until it contains a database that has been restored from a checkpoint file. A database that has been restored from a checkpoint file is considered a “valid” database. Since a checkpoint file for a new IOP does not exist during the initial configuration, you must use the VALIDATE IOP DB target (under the RUN STATES target) to validate the initial database, allowing it to be saved.

6.6 COMMISSIONING CONTROL

When implementing digital communication between the PM or APM and the Smartline Transmitter, there is no need to take extra steps to verify loop connection and configuration. This is due to the Bad PV Protection/Database Comparison feature of the Smart Transmitter IOP. A mismatch of between a transmitter database parameter and the configured IOP database triggers an alarm condition (database discrepancy).

With this built-in capability, the system will automatically notify the user of a bad loop connection or configuration errors.

OPERATING THE TRANSMITTER FROM THE UNIVERSAL STATION
Section 7

This section discusses the various functions of the Smartline Transmitter that can be operated from the Universal Station.

7.1 DATABASE CONSIDERATIONS

During normal operation, the Smart Transmitter point database in the IOP and the corresponding transmitter database contain the same information. If under special conditions, the databases are not the same, a status message appears on the point's Detail display to indicate a database mismatch: `DATABASE DISCREPANCY.` Three possible ways that a database mismatch can occur between the IOP database and the transmitter database are as follows:

- The Smart Field Communicator (SFC) is used to change PV-related values in the transmitter.
- A write operation is performed from the Universal Station to the IOP (during a checkpoint restore, point building, or Detail display changes).
- The same transmitter has been reinstalled after bench calibration, or after the transmitter electronic module has been replaced and the LRV/URV values have been modified.

The following parameters of the IOP database and the transmitter database are compared when the IOP checks for database mismatches:

```
CJTACT
DAMPING
DE_CONF
FREQ60/50
PIUOTDEN
PVCHAR
SENSRTYP
STITAG
URL
URV, LRV
```

If a database mismatch is detected, the first four parameter mismatches are displayed in the DATABASE DISCREPANCY field of the Smart Transmitter point's Detail display at the Universal Station.

7.1.1 Database Discrepancies

All Smartline transmitters can be configured to operate with database broadcasts (6-byte mode) or without database broadcasts (4-byte mode). If the 6-byte communication mode has been selected, then the IOP and transmitter database parameters are compared and those that have mismatches are displayed. Page 2 of the Detail display (Figure 7-1) shows any existing mismatches (database discrepancies). If the databases do not match, a BADPV alarm occurs to ensure that the control loop will not use an erroneous database.

If the 4-byte communication mode has been selected, no database checks are performed.

It is strongly suggested that you use the 6-byte DE mode (adding the database byte to the signal) to more fully utilize the transmitter's capabilities. In the Detail display, the DECONF parameter should be PV_SV_DB or PV_DB to signify 6-byte mode.

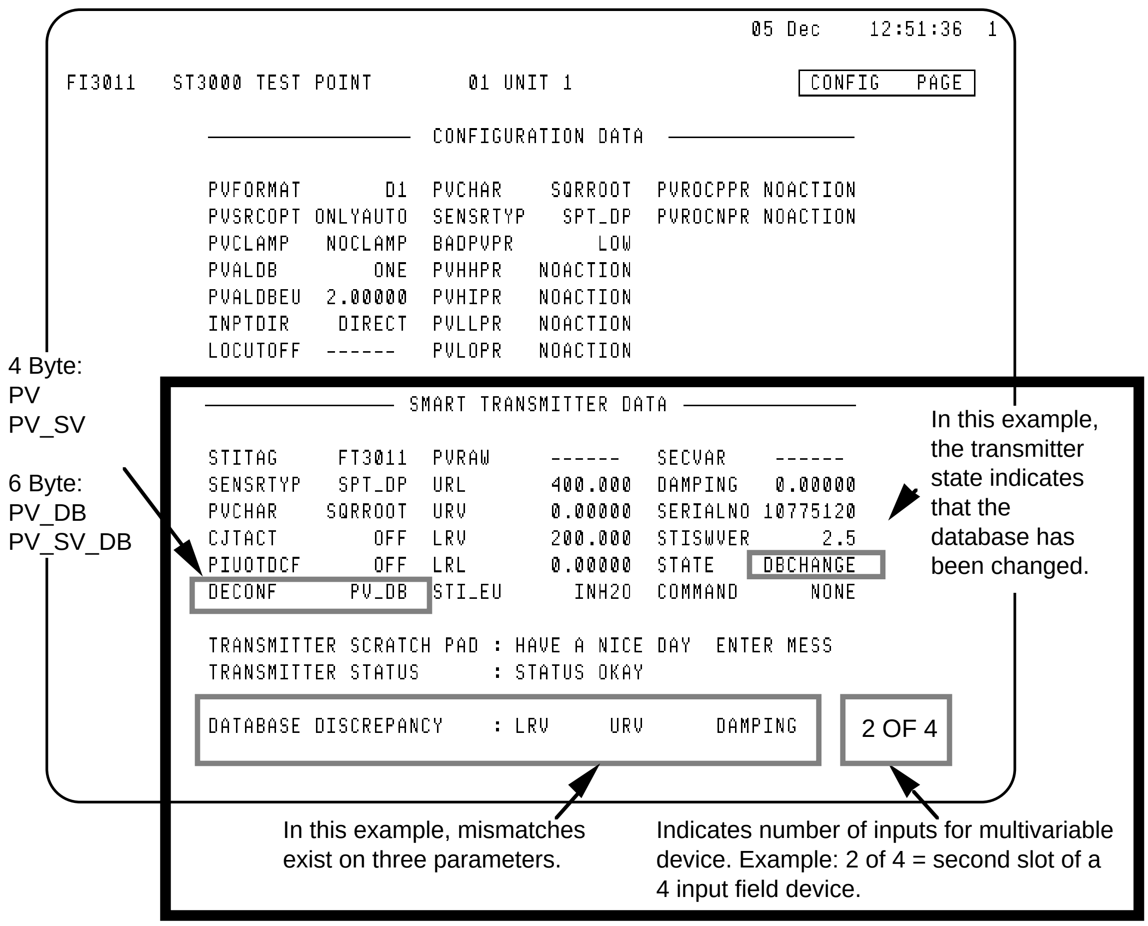

Figure 7-1 — Database Discrepancy Display

7.1.2 Upload/Download

If a mismatch occurred because the Smart Field Communicator (SFC) was used to change a parameter in the transmitter database, the data in the transmitter database may be correct. In this case, the IOP does not know which value to use and issues an `SFC CORRUPTED DB` transmitter status message, which appears on the Point Detail display. The user should wait until the next database transfer occurs from the transmitter before taking action; at that time, the specific change is displayed.

You can correct the mismatch by one of the following methods:

- You can download the IOP database to the transmitter by issuing a `DNLOADDB` command through the `COMMAND` parameter (see Figure 7-2) when the point execution state (PTEXECST) is in an Inactive state. If the loading is successful, the point `STATE` changes to `LOAD COMPLETE`, then `OK` when the point is made active.

  A download from the IOP loads the database into the transmitter's working memory. 30 seconds later, the ST 3000 automatically loads the database from working memory into nonvolatile memory. With the STT 3000, a download goes directly into nonvolatile memory. Release 300 implements a force-write to nonvolatile memory.

- You can upload the transmitter database to the IOP by issuing an `UPLOADDB` command through the `COMMAND` parameter when the point is in an Inactive state. If the loading is successful, the point `STATE` changes to `LOAD COMPLETE`, then `OK` when the point is made active.

- You can correct mismatched parameters using the SFC. If the parameter or parameters are updated by the SFC to the same value as in the IOP database, the STATE changes from DBCHANGE to OK when the next database transfer from the transmitter occurs.

> ✍ ***note***
>
> Refer to Section 10 for special considerations when uploading or downloading multivariable transmitters.

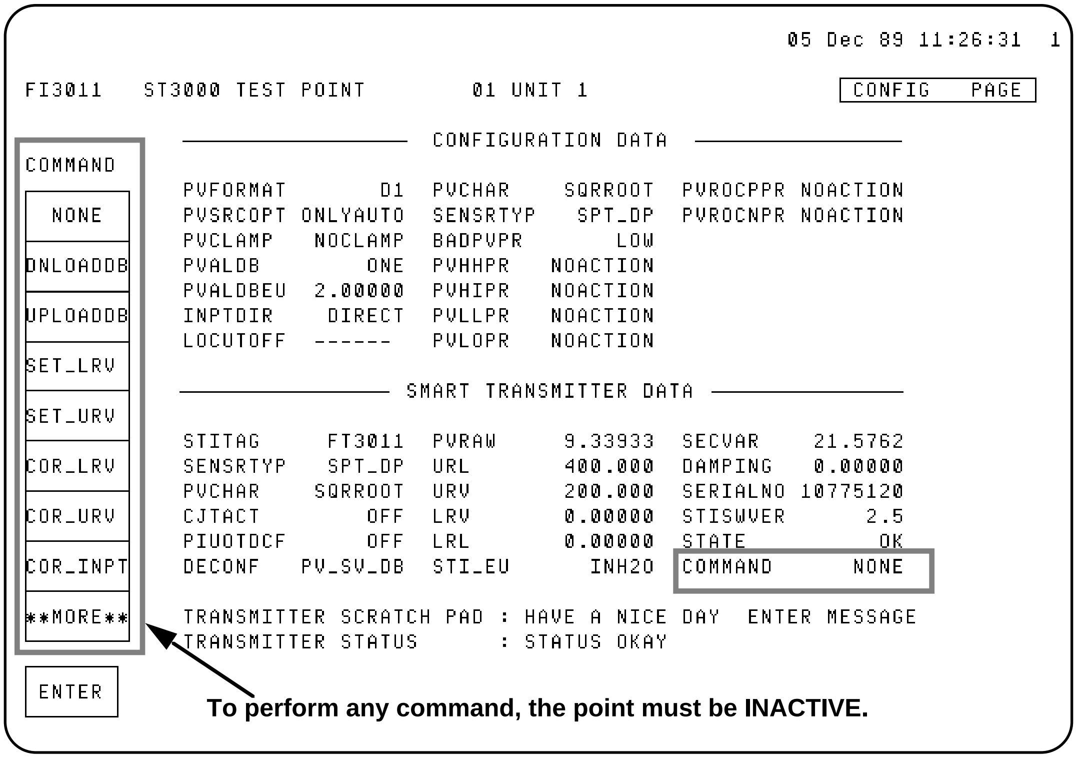

Figure 7-2 — Smart Transmitter Command Display

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A database mismatch can also occur because the transmitter was miswired during installation. This can be fixed by correcting the transmitter wiring.

Troubleshooting tip:
Check the **STITAG** parameter of the transmitter (first transmitter parameter of the detail display, see Figure 7-1). If there is a mismatch of database information for a configured IOP and separately configured transmitter, check the wiring connection to see if it is correct. For multivariable transmitters, the STITAG parameter is used to determine the numbers of PVs being transmitted. Refer to Section 10 for additional information.

The following rules apply to upload and download procedures:

- To upload or download transmitter database information from the Universal Station, the point execution state must be set Inactive.
- Any SFC write that modifies a transmitter database parameter, is indicated at the Universal Station by the DBCHANGE transmitter state.
- In R300 systems and later, upload from a Smartline Transmitter set in analog mode to the Smart Transmitter IOP automatically switches the transmitter to DE mode. Download from the Smart Transmitter IOP to a Smartline Transmitter set in analog mode automatically switches the transmitter to DE mode.

Table 7-1 Smart Transmitter IOP/SFC Upload/Download Parameters

Transmitter Parameters	SFC	IOP	Upload to IOP	Download from IOP
Software Rev. No.	R	R	√ STISWVER	
PROM ID	R	R	√ SERIALNO	
Diagnostics	R	R	√	
URL and LRL	R	R	√ URL and LRL	
Sensor Type	R	R	√ SENSRTYP	
Engineering Units	R	Note 4	√ STI_EU	
Scratch Pad	R/W	R	√	
Output Mode[1]	R/W	R	N/A	N/A
Transmitter ID	R/W	R/W	√ STITAG	√ STITAG
DE Configuration	R/W	R/W	√ DECONF	√ DECONF
URV and LRV	R/W	R/W	√ URV and LRV	√ URV and LRV
Output Form	R/W	R/W	√ PVCHAR	√ PVCHAR
Probe Type	R/W	R/W	√ PVCHAR	√ PVCHAR
Damping	R/W	R/W	√ DAMPING	√ DAMPING
Open T/C Detect	R/W	R/W	√ PIUOTDCF	√ PIUOTDCF
Power Filter	R/W	R/W	√ FREQ6050[2]	√ FREQ6050[2]
Failsafe Mode	R/W	The IOP has built-in failsafe capabilities (Bad PV Alarm) and ignores this parameter.		
External CJT	R/W	R/W	√ CJTACT[3]	√ CJTACT[3]

Legend:

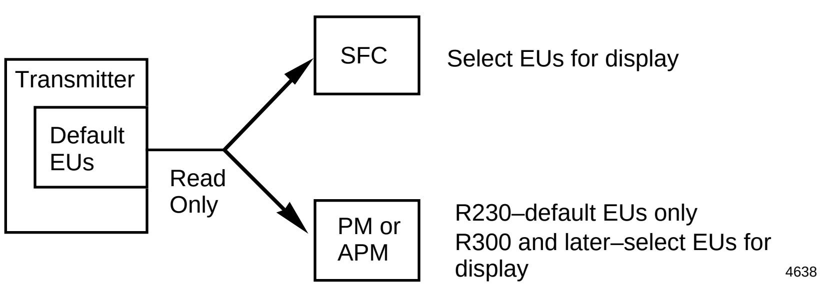
R = Read Only

R/W = Read and Write

√ = Item is uploaded or downloaded

Notes:

1. Output Mode allows you to use the transmitter to generate a constant value for the PV to verify the hardwire connection. The PV value is set bad in the PM or APM. In Release 300 and later, the PVRAW value (% of output) remains as a valid signal from the transmitter.
2. AC Line Period (FREQ6050) is specified from the Universal Station during “Node Specific Configuration.” The resulting selection for the AC Line Period appears on the IOP Detail Status Display.
3. External CJT source can be selected, but you must use the SFC to tell the transmitter what the CJT is.
4. EU options vary between the SFC and the PM or APM as shown in the figure below:



The procedures described in Figure 7-3 are performed from the following displays:

UCN Status display (see Section 5)
PM or APM (IOP) database SAVE - (SAVE target)
PM or APM (IOP) database RESTORE- (RESTORE target)

Detail display of STIM point:
Transmitter database SAVE - (UPLOADDB target)
Transmitter database RESTORE- (DNLOADDB target)

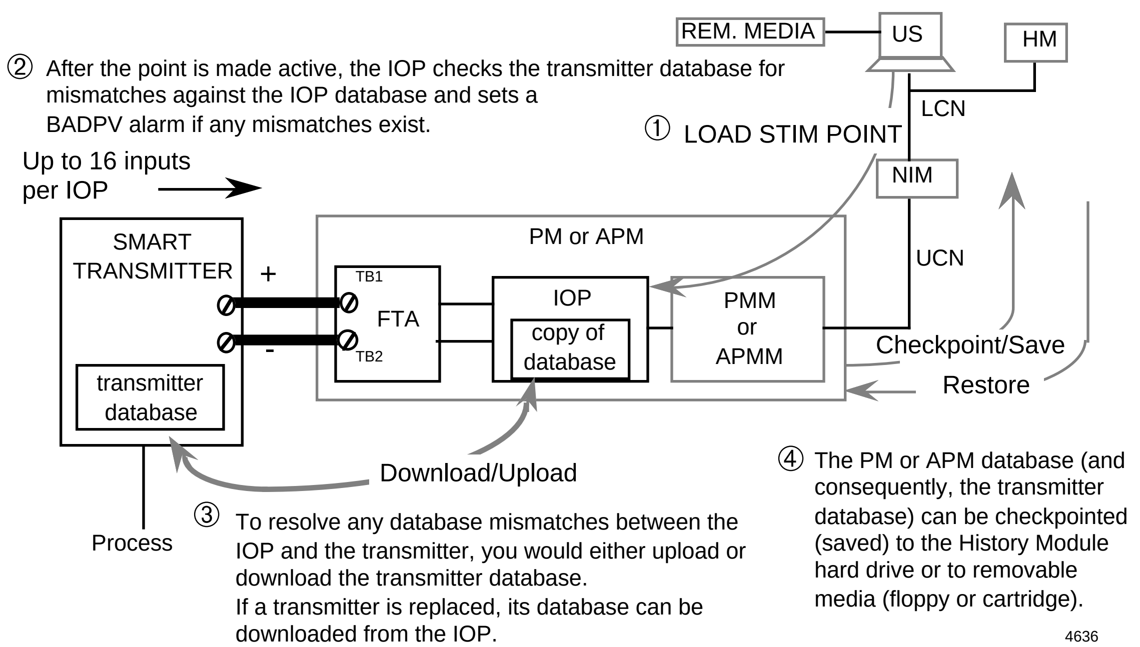


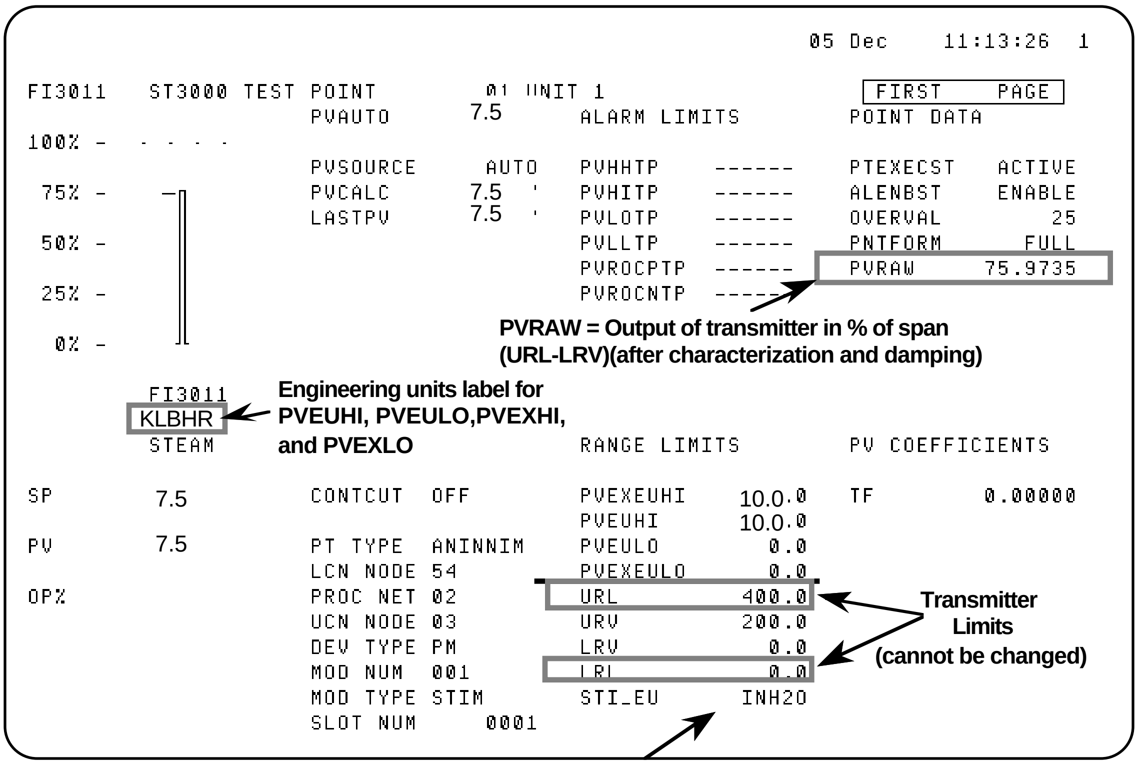
Figure 7-3 — Database Overview

7.2 TRANSMITTER LIMITS AND OPERATING RANGE

The smart transmitter database includes the **transmitter limits** and the point's operating ("working") range. The **upper and lower transmitter range limits** (URL and LRL) are set at the factory, according to the transmitter type, and cannot be changed from the Universal Station or SFC.

For the STT 3000 transmitter, if type J is selected for the PV characterization, then the transmitter automatically selects the URL and LRL for that type of thermocouple.

In the Detail display example shown in Figure 7-4, the transmitter range (factory set) is 0 to 400 inH_2O, and the point's working range (entered by user) is 0 to 200 inH_2O.



ST 3000, STT 3000, and MagneW 3000:
STI_EU = Engineering units for URL, LRL, URV, and LRV (point must be inactive to change).
Multivariable Field Devices:
STI_EU is not used. Limits are in transmitter default base units.

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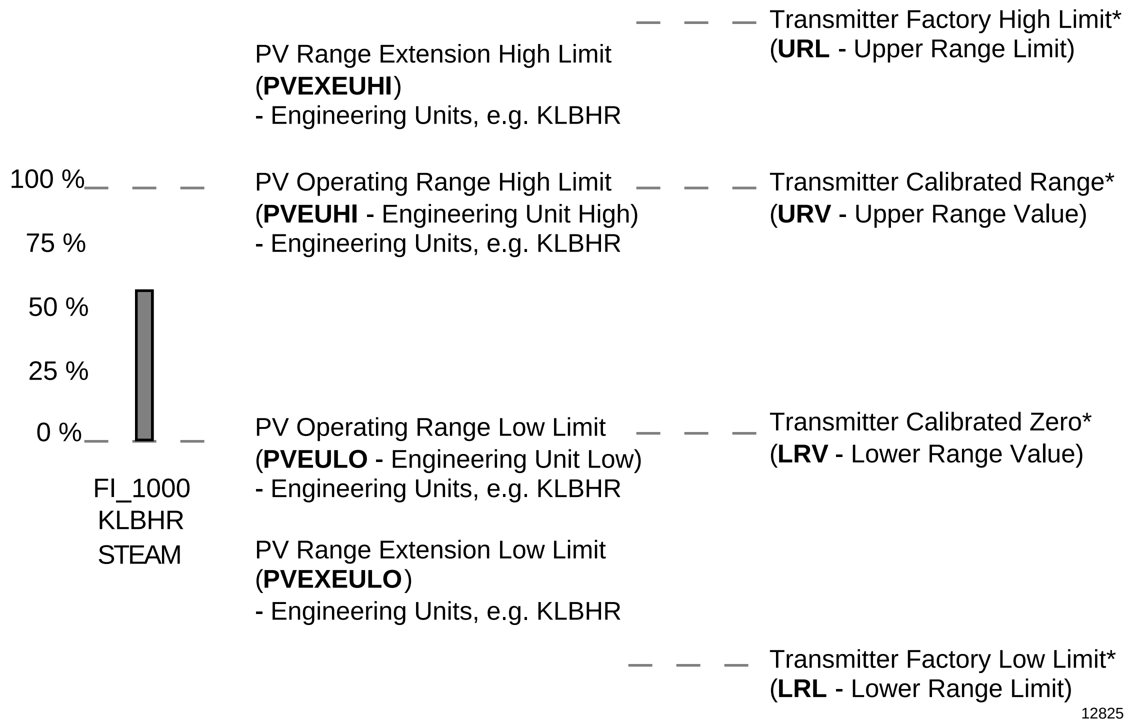
Figure 7-4 — Smart Transmitter Point Range and Engineering Units

✍ ***note***

For the MagneW 3000, the URL value displayed on the SFC is a factor of 10 higher than the actual value displayed at the Universal Station. The value displayed at the SFC is the scaled limit while the value displayed at the Universal Station represents raw data. Also, the IOP does not respond to changes made in the MagneW 3000 database parameters for up to 3 minutes when the database changes are made using the Local Setting Card. This card is an option that is available with the MagneW 3000.

Figure 7-5 shows the relationship between the transmitter range values and limits resident in the transmitter and those resident in the Smart Transmitter Point.



* Engineering Units are user selectable for ST 3000, STT 3000, and MagneW 3000 (see parameter STI_EU in Appendix A).
The CONFIG MISMATCH error message appears if an EU is selected that does not apply to that transmitter type.

Figure 7-5 — Point and Transmitter Range Values

note

URL and LRL values can be entered, but they cannot be downloaded to the transmitter, because they are fixed values. If values are entered, the next upload will overwrite them with the fixed values.

If you set the URV/LRV range outside of the URL/LRL limits, the transmitter accuracy may not be .075%.

7.3 POINT STATES

The STATE parameter indicates the current status of the Smart Transmitter IOP point and the transmitter. The various states are listed in Table 7-2. See subsection 8.2, Smart Transmitter Error Codes, for more information.

Table 7-2 — Smart Transmitter Point STATE

States	Description
OK	Normal state; indicates that the point and the transmitter are OK. Transmitter is updating the PV value at the point. STATE remains OK when the point is made inactive.
DBCHANGE	Indicates that a database mismatch between the point and the transmitter has been detected. Transmitter is not updating the PV value at the point. STATE remains DBCHANGE when the point is made inactive.
LOADING	Indicates that database loading between the point and the transmitter is occurring.
LOADCOMP	Indicates that the database transfer between the point and the transmitter has been successfully completed.
LOADFAIL	Indicates that the parameter transfer between the point and the transmitter has not been successfully completed.
CALIB	Indicates that certain parameters are being calibrated at the transmitter by the point.
CALCOMP	Indicates that the calibration has been successfully completed.
CALFAIL	Indicates that the calibration has not been successfully completed.

7.4 POINT COMMANDS

The COMMAND parameter allows the engineer to load configuration parameters to the smart transmitter and to calibrate the transmitter. The point must first be placed in the Inactive state through the PTEXECST parameter.

When the COMMAND parameter is selected, the Command targets appear (see Figure 7-6).

The enumerations of the COMMAND parameter are shown in Table 7-3.

Table 7-3 — Smart Transmitter Point COMMANDs

Command	Description
DNLOADDB	Downloads the IOP database into the transmitter.
UPLOADDB	Uploads the transmitter database into the IOP.
SET_LRV	Sets the Lower Range Value to current value of input.
SET_URV	Sets the Upper Range Value to current value of input.
COR_LRV	Corrects the Lower Range Value.
COR_URV	Corrects the Upper Range Value.
COR_INPT	Corrects the zero point.
RST_COR	Sets all input calibration parameters to their factory default values.
NONE	A command has not been issued by the IOP.

The result of issuing a command is reflected in the STATE parameter for the point, shown in Figure 7-6.

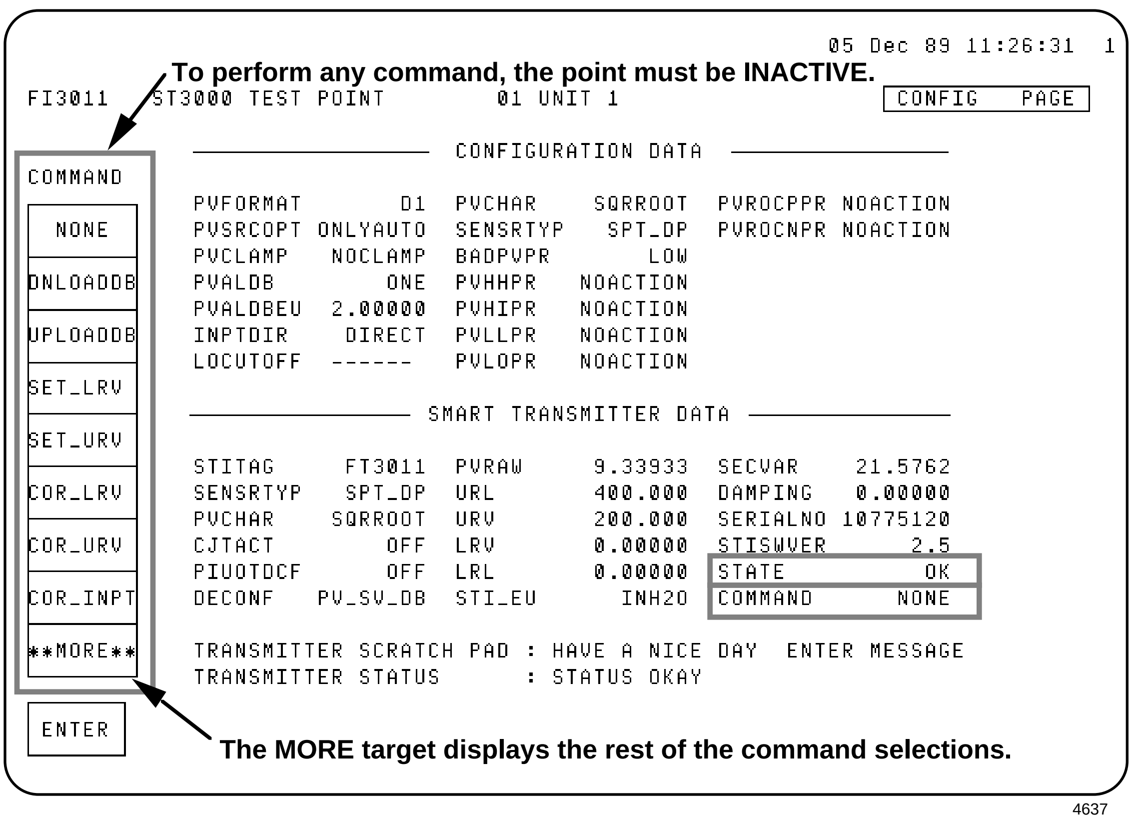


Figure 7-6 — Command Selections Display

7.4.1 Reranging the Smartline Transmitter

Procedure:

1. Make the point inactive (PTEXECST parameter).
2. Enter new values for LRV and URV.
3. Download the database to the transmitter (DNLOADDB command).
4. Calculate and enter the corresponding values for PVEUHI and PVEULO. Modify PVEXEUHI and PVEXEULO as needed.
5. Make the point active (PTEXECST parameter).

> ✍ ***note***
>
> The transmitter does not have to be recalibrated after reranging.

7.4.2 Reranging the Transmitter Using Process Inputs

To set the URV and LRV values if the process operating range is not known, use the SET_URV and SET_LRV commands (after the transmitter is installed) and the actual process input, which determines the range values.

Procedure:

1. Make the point inactive.
2. Change the process to cause the process input to be equal to the desired 0% signal value applied to the transmitter.
3. Select the SET_LRV command (see Figure 7-6). The LRV value should now equal the process input.
4. Change the process to cause the process input to be equal to the desired 100% signal value applied to the transmitter.
5. Select the SET_URV command (see Figure 7-6). The URV value should now equal the process input.
6. Make the point active.

The Smart Transmitter IOP supports both set and correct LRV/URV in the 6-byte DE mode. The set LRV/URV should be used instead of the correct LRV/URV because it will not degrade accuracy.

The **set functions** perform a reranging operation—they change the values of LRV and URV without affecting the calibration.

The **correct functions** change the calibration of the transmitter with potential loss of accuracy. It is acceptable to rezero a transmitter using the input correct (or LRV correct if LRV = 0), since an accurate zero is generally available. The URV correct should not be used unless a highly accurate (0.03% or better) pressure source is available. The only exception to this rule is when it is essential that a common reference be used for all transmitters in a plant.

7.4.3 Zero Correction

Input correction is supported in the DE mode and should be used to correct for zero. This does not affect the span accuracy of the transmitter.

The procedure to create zero correction:

Adjust the process input to the transmitter to equal zero, then select `COR_INPUT`.

7.4.4 Calibrating the Transmitter from the US

The **`COR_URV`** and **`COR_LRV`** commands provide a means to calibrate the transmitter using a calibration standard. The Smartline Transmitter is calibrated prior to being shipped and **should not be recalibrated,** except by someone who is experienced and has very accurate equipment.

The transmitter does not have to be recalibrated unless you change the meter body and EPROM or the electronics board of the transmitter. Every meter body has its own EPROM that was blown for that specific meter body. The EPROM stores the “compensation data” that was calculated in the factory by analyzing data over a wide range of ambient temperature ranges (“characterization process”).

The calibrate commands give you the means to recalibrate, but most lab standards are not as accurate as the Smart Transmitter. If you do not have highly accurate lab equipment, it is best to send the transmitter back to the factory to be recalibrated.

> ✍ ***note***
>
> If you change the transmitter electronics, **move the EPROM** from the old to the new electronics.

7.4.4.1 Calibration Procedure

> **Caution**
>
> You should NOT perform this procedure without a very accurate lab standard.

The procedure to calibrate the transmitter from the Universal Station (this procedure can also be done from the SFC):

1. Make point inactive.

2. Enter the desired LRV and URV operating range values. On the `CONFIG PAGE` of the Detail display all of the smart transmitter database parameters are shown (see Figure 7-6), including the transmitter limits (URL/LRL) and the operating range (URV/LRV).

3. To download the new LRV and URV to the transmitter, select the `COMMAND` target, then select the `DNLOADDB` target. (The point must be inactive to download database information to the transmitter.)

4. Adjust the calibration standard to equal the LRV value.

5. Select the `COR_LRV` command (see Figure 7-6), which calibrates the transmitter with the input equal to the LRV. Always calibrate LRV first!

6. Adjust the calibration standard to equal the URV value.

7. Select the `COR_URV` command (see Figure 7-6), which calibrates the transmitter with the input equal to the URV.

You can look at PVRAW to verify that calibration at LRV and URV point has occurred and is within the specified level of accuracy—.75% in DE mode.

> ✍ **note**
>
> If you use COR_URV incorrectly, you can recover to factory settings on calibration by selecting the RST_COR command discussed in the following subsection. Calibrating to zero for ST 3000 will yield an accuracy of better than .2% span.

Caution

Attention: Instrument personnel

AVOID MAKING THE MISTAKE OF CALIBRATING THE ST 3000 UPPER RANGE WITHOUT A VERY ACCURATE LABORATORY STANDARD PRESSURE APPLIED!

Do not send an upper range value calibration command (COR_URV) to the transmitter with no laboratory standard pressure applied for the upper value. (The pressure transmitters can be vented to atmosphere and a correction of the lower value applied, if needed.) If the pressure applied is grossly inaccurate (greater than twice the URV or less than one half of the URV) the command will fail (CALIBFAIL).

7.4.5 Resetting the Calibration Values to Factory Defaults

The RST_COR command restores the transmitter calibration to default values and requires that you recalibrate the transmitter and perform zero correction, if applicable. Default calibration values provide .2% accuracy.

7.5 CHANGING TRANSMITTER FROM ANALOG TO DIGITAL MODE

In R300 and later, an upload from an analog transmitter or a download to an analog transmitter switches it to 6-byte DE mode, and uploads or downloads the transmitter database.

If the transmitter has a default database (analog), a download database command changes the transmitter mode from analog to DE. A download command overwrites any transmitter database parameter that is different from the database contained in the IOP.

If a database has been installed in the transmitter prior to integration, the transmitter database must be configured for 6-byte DE mode.

> ✍ ***note***
>
> The download operation from the IOP to the transmitter synchronizes the transmitter and IOP databases. Under this condition, the TDC system does not verify the correct wiring connection between the FTA and transmitter.

In R230, if the transmitter is set for analog mode, the Smart Transmitter IOP cannot upload the database. Use the SFC to change the transmitter to the digital mode, then perform the following procedure:

1. From the Universal Station, set the the DECONF parameter to 6-byte mode. Activate the point and wait until one full database has been broadcast. In the 6-byte mode, one byte of transmitter database is included with each broadcast frame, so that a new database is received every few seconds (see Table 3-6 for database broadcast times).

2. From the Point Detail Display, upload the transmitter database to the IOP.

SYSTEM MAINTENANCE
Section 8

This section discusses transmitter error and diagnostic messages sent to the Universal Station or SFC and suggested corrective actions.

8.1 PROCESS VARIABLE RELIABILITY

The replacement of an analog PV signal with a digital PV signal can represent an increase in process value security if all the proper measures discussed below are implemented. The DE protocol provides the means necessary for accurate secured communication of process signals between field devices and their controllers. When used in conjunction with a Smart Transmitter IOP board, increased knowledge of the field device is provided along with the signal processing required for the digital PV to attain its high level of performance.

The analog version of the PV contains no checks and balances of any form to indicate to the control system the instantaneous validity of the PV signal. Also, the analog PV signal is not impervious to noise and the control system has no means of recovering lost or corrupted analog PV signals.

It should be noted that the control system, in a DE protocol environment, functions as a passive listener only and is incapable of polling field sensors. As a result, lost or corrupted digital PV data cannot be retransmitted by request. In fact, if that were possible, more PVs would be lost due to the increased communication activity.

Since the DE protocol requires that the field device continuously broadcast PVs, loss of one sample is immediately followed by another sample. As a result, the control system (Smart Transmitter IOP) need only determine whether a given sample is good or bad. This analysis serves to establish the rate at which the controller can be expected to miss PVs due to a corrupted digital communication channel, and also to establish a rate at which the Smart Transmitter IOP can be expected to detect that corruption.

The analysis falls into three categories:

- Error detection
- Noise immunity
- Noise rejection

8.1.1 Error Detection

The Digital Enhanced (DE) protocol incorporates two means of enhancing error detection:

- Field Device Status
- Information Redundancy

8.1.2 Field Device Status

The original analog version of the PV has no way of indicating field device failures to the control system, instantly. Many field devices use a **burnout** technique to indicate device failures—this is usually not instantaneous, and the controller may have already begun control on a signal being driven towards burnout. Consequently, there is no effective means to indicate to the control system the validity of an analog PV signal.

The DE protocol, however, requires that an indication of the field device status be transmitted with every digital PV value. As a result, a controller is never controlling a PV from a known bad field device.

8.1.3 Information Redundancy

Redundancy is the addition of noninformation carrying bits so that particular mathematical calculations can be made at the receive end to determine whether the group of bits, including the redundant bits, are the same as those transmitted. This process ensures that the original information was correctly received while allowing the capability to detect bad message blocks and have them rejected by the system. The DE protocol contains **Byte parity (VRC)** redundant bits in the message block.

The digital PV value is contained in bytes 2 through 4 of the message block. As a further means of screening potentially bad PV data, all consecutive byte parities (for bytes 1 through 4) must be good before a new digital PV value is accepted by the Smart Transmitter IOP.

8.1.4 Standardized Tests

The following tests were performed on the actual hardware with the results focused on the PV validity. Test reports are available from Honeywell by special request.

- Temperature
- Voltage Margin
- Power Cycling
- ANSI Surge
- RFI
- ESD
- Fault Insertion

8.1.5 Noise Immunity

See subsection 3.2.6 Noise Immunity, for more information.

8.1.6 Noise Rejection

The term **noise rejection** indicates that the digital PV signal is communicating through twisted pair wire in floating point numbers.

Since noise rejection assumes that noise has already corrupted the signal, all noise rejection techniques, in DE protocol, are only applicable to the Smart Transmitter IOP. The Smart Transmitter IOP has the capability of rejecting noise using four techniques:

1. **Digital Input Filtering—**the IOP contains a simple RC input filter to eliminate high frequency noise. The –3db point is set at 482 Hz.

2. **Samples per Bit—**The IOP software UART will take five samples per bit and use a voting technique before declaring a given logic level. Four of the five bit samples must agree for data to be considered good.

3. **Floating Point Value Check—**The IOP software verifies that the received floating point value is of a valid form. All floating point values that do not conform are rejected.

4. **Digital Noise Filtering—**The IOP software treats the received good digital PV as a real signal by not allowing unusually large instantaneous transitions to occur. This is accomplished by comparing the received digital PV sample with the previous sample. If the new sample differs by greater than 30% of the working range, the new value is discarded and the old value is used for control. The next digital PV value is always used. This technique allows the IOP to reject multibit errors which might pass undetected and corrupt the digital PV. Its limitations are that it can only reject one noise sample and it causes a temporary lag in the process.

8.2 SMART TRANSMITTER ERROR CODES ON UNIVERSAL STATION

Tables 8-1, 8-2, and 8-3 are error codes that appear on the STIM point Detail display at the Universal Station as IOP diagnostics for ST 3000, STT 3000, and MagneW 3000 Smartline Transmitters.

Error codes for multivariable field devices are described in the user manual for the specific field device.

Table 8-1 — ST 3000 Pressure Transmitter Error Codes

Critical Error Codes	Noncritical Error Codes
Char PROM Fault	Sensor Over Temp.
Suspect Input	Excess Zero Corr.
Electronic Fault	Excess Span Corr.
	In Output Mode
	Meter Body Overload or Meter Body Fault
	Corrects Reset[1]

Table 8-2 — STT 3000 Temperature Transmitter Error Codes

Critical Error Codes	Noncritical Error Codes
Self-Test Fail	Amb. Temp HI/LO
ISO Comm Fail	Uncertain Reading
Input Open	I/P out of Spec.
Inval. Cal Data	Uncertain CJC
Inval User Data	Excess Zero Corr.
NVM Write Fail	In Output Mode
	User Corr. Active

Table 8-3 — MagneW 3000 Flowmeter Transmitter Error Codes

Critical Error Codes	Noncritical Error Codes	Noncritical Error Codes
Excit. Coil Fail.	Bad Config. Data	Empty Pipe
A.C. Power Loss	Local Mode	Ext. Zero Active
NVM Fault	DO Output Mode	Type/Dia Error
RAM Fault	Fixed Pulse Mode	Hi<Lo Alarm Error
A/D Fault	Output Mode	Span>Range
	In Cal. Mode	Pulse Weight Error
	Corrects Reset[1]	Pulse>70%
	Excit. Check Mode	Hysteresis Error

[1] Corrects Reset — This error message on an Smartline 3000 Pressure or MagneW transmitter means that someone has sent a **Reset Correct (Rst Cor)** command to the transmitter from the SFC or the US. This command sets the calibration values to those set into the transmitter's nonvolatile memory during the characterization phase of the transmitter's manufacture.

To remove the Corrects Reset message, calibrate the transmitter using a lab standard. If you do not want to recalibrate, make sure that LRV is zero, vent the transmitter to zero inches, send a **Correct LRV** command, then switch transmitter power off and on.

8.3 SFC MESSAGES

The Smartline Transmitter and SFC run self-diagnostic tests during normal operation and communication, and will display a message on the SFC if a condition is detected. The SFC status key can be pressed at any time during operation to check the diagnostic status of the unit.

> ✍ ***note***
>
> If a value entered by an operator does not show a message, the only action the operator can take is to reenter the value. If there is no operator entry and the Status is bad, no action can be taken from the Universal Station—the operator must call Maintenance.

Tables 8-4, 8-5, and 8-6 give diagnostic messages for ST 3000, STT 3000, and MagneW 3000 Smartline Transmitters. Additional messages for multivariable field devices are included in the user manual for the specific field device.

Table 8-4 — ST 3000 Pressure Transmitter Diagnostic Messages

Message	Problem	Corrective Action
`CHAR PROM FAULT`	The characterization PROM is not functioning correctly.	Replace the characterization PROM with an identical PROM, or if needed, replace the entire meter body and PROM with a matching spare unit. Press CONF to display the PROM serial number on SFC model 103. On earlier versions, press SHIFT and 1.
`CORRECTS RESET`	Recalibration is necessary to attain the required accuracy.	Calibrate the LRV and URV.
`ELECTRONIC FAULT`	A component of the transmitter's electronics module is not functioning properly.	Replace the electronics module in the transmitter. Do not SAVE the data in the transmitter memory since it may not be correct.
`ENTRY>SENS RING` `(SFC ONLY)`	The number entered is beyond 1.5 times the upper range limit of the sensor.	Press the CLR key, check parameter, and start again.
`EXCESS ZERO CORR`	The ZERO correction factor is outside the acceptable limits for accurate operation.	Check the input and be sure it matches the calibrated range value. Check the meter body on pressure transmitters.
`EXCESS SPAN CORR`	The SPAN correction factor is outside the acceptable limits for accurate operation.	Check the input and be sure it matches the calibrated range value. Check the meter body on pressure transmitters.

(Continued)

Table 8-4 — ST 3000 Pressure Transmitter Diagnostic Messages (Continued)

Message	Problem	Corrective Action
FAILED COMM CHK **(SFC ONLY)**	The SFC failed a communication Diagnostic Check. This could be a SFC electronics problem or a faulty or dead communication loop.	1. Try communicating again. 2. Press STATUS. If a loop fault message appears, do the corrective action and try again. 3. If the COMM ERROR continues replace the SFC.
HI RES/LOW VOLT **(SFC ONLY)**	Either there is too much resistance in the loop (open circuit), the voltage is too low, or both.	Check the wiring, connections and the power supply. There must be 11 volts minimum at the transmitter to permit operation.
INVALID COMM **(SFC ONLY)**	The transmitter is not receiving the SFC message. SFC is not sending a correct message. OR The transmitter is sending an incorrect response; it's either not working correctly and/or there is too much noise on the communication loop.	1. Try communicating again. 2. Press STATUS and do any corrective action required. 3. Check the communication loop. 4. Replace the SFC.
INVALID DATA BASE **(SFC ONLY)**	The database of the transmitter was not correct at power-up.	1. Try communicating again. 2. Verify the database, recalibrate the transmitter, and then manually update the nonvolatile memory.
INVALID REQUEST **(SFC ONLY)**	1. The transmitter is being asked to correct or set its URV to a value which results in too small a span, or being asked to correct its LRV or URV while in the output mode. 2. The given key function is not valid for the associated transmitter.	1. Check that the proper calibrated URV input is being applied to the transmitter, or that the transmitter is not in the output mode. 2. Check that the key function is applicable for the associated transmitter (Pressure or Temperature).
IN OUTPUT MODE	The transmitter is operating as a current or constant digital PV source.	Press OUTPUT and CLR keys, if you want to EXIT the output mode.
LOW LOOP RES **(SFC ONLY)**	Not enough resistance in series with the communication loop.	Check the sensing resistor, and verify at least 250 Ω resistance in the loop.

(Continued)

Table 8-4 — ST 3000 Pressure Transmitter Diagnostic Messages (Continued)

Message	Problem	Corrective Action
NO XMTR RESPONSE	No response from the transmitter. It may be a transmitter or loop problem.	1. Try communicating again. 2. Press STATUS and do any corrective action required. 3. Check and be sure the transmitter's loop integrity has been maintained, and that the SFC is connected.
> RANGE **(SFC ONLY)**	The value to be displayed is over the range of the display.	Press the CLR key and start again.
SENSOR OVER TEMP	The meterbody temperature is too high. Accuracy and lifespan may decrease if it remains too high.	See the Pressure Transmitter Installation section of the Product Manual for temperature limits and suggested protections against over-temperature.
SFC FAULT **(SFC ONLY)**	A component of the SFC is not operating properly.	Try communicating again, if the condition still exists, replace the SFC.
SUSPECT INPUT	The input process data seems wrong. This could be a process problem, but it could also be a meterbody, on pressure transmitters, or electronics problem.	This message is most likely the result of transmitter failure. It cannot be determined if it is meterbody or electronics. The entire unit should be replaced.
XMTR FAULT SFCs with 2.7 or 2.9 software version **(SFC ONLY)** OR **STATUS UNKNOWN** SFCs with 3.0 or greater software version	Your SFC has an "older" version of software that cannot decode a "new" diagnostic message from a more recent transmitter.	1. Use the troubleshooting procedure in the smart transmitter pocket guide to diagnose the condition. 2. Have the software in your SFC updated.

Table 8-5 — STT 3000 Temperature Transmitter Diagnostic Messages

Message	Problem	Corrective Action
(Any Comm Error) SFC FAULT (SFC ONLY)	SFC communication is not possible due to detected SFC problem.	1. Press STATUS to obtain any other messages. 2. Replace the SFC.
AMB TEMP HI/LO	Transmitter internal temperature is beyond specified limits of -40 to +85°C.	Possible process of transmitter mounting problem. Condition will cause inaccuracies or potential failure if not corrected.
CORRECTS RESET	Recalibration is necessary to attain the required accuracy.	Calibrate the LRV and URV.
ENTRY>SENS RING (SFC ONLY)	The number entered is beyond 2 times the upper range limit of the sensor.	Press the CLR key, check parameter, and start again.
EXCESS ZERO CORR	The ZERO correction factor is outside the acceptable limits for accurate operation.	Check the input and be sure it matches the calibrated range value. Check the meter body on pressure transmitters.
EXCESS SPAN CORR (SFC ONLY)	The SPAN correction factor is outside the acceptable limits for accurate operation.	Check the input and be sure it matches the calibrated range value. Check the meter body on pressure transmitters.
EXCESSIVE OUTPUT (SFC ONLY)	The requested output percent in the output mode is too high or too low. The limits are –1.25% to +105%.	Press the CLR key, check parameter, and start again.
FAILED COMM CHK (SFC ONLY)	The SFC failed a communication Diagnostic Check. This could be a SFC electronics problem or a faulty or dead communication loop.	1. Try communicating again. 2. Press STATUS. If a loop fault message appears, do the corrective action and try again. 3. If the COMM ERROR continues replace the SFC.
HI RES/LOW VOLT (SFC ONLY)	Either there is too much resistance in the loop (open circuit), the voltage is too low, or both.	Check the wiring, connections and the power supply. There must be 11 volts minimum at the transmitter to permit operation.
INVAL CAL DATA	Factory calibration database is corrupted.	Data not user accessible. Return to factory for recalibration.
INVALID COMM (SFC ONLY)	The transmitter is not receiving the SFC message. SFC is not sending a correct message. OR The transmitter is sending an incorrect response, it's either not working correctly and/or there is too much noise on the communication loop.	1. Try communicating again. 2. Press STATUS and do any corrective action required. 3. Check the communication loop. 4. Replace the SFC.

(Continued)

Table 8-5 — STT 3000 Temperature Transmitter Diagnostic Messages (Continued)

Message	Problem	Corrective Action
INVAL USER DATA	User database is corrupted.	Reconfigure and recalibrate transmitter. If unit does not require user-calibration, press shift/correct to restore factory calibration.
IN OUTPUT MODE	The transmitter is operating as a current-source.	Press OUTPUT and CLR keys, if you want to EXIT the output mode.
ISO µC COMM FAIL	Electronic component failure on isolated (input) side of electronics module.	Replace transmitter.
ISO µC WR FAIL (SFC ONLY)	Last configuration/calibration item written to nonvolatile memory was not correctly stored.	Repeat previous command sequence. Replace transmitter.
I/P OUT OF SPEC	Input is lower that LRL or higher than URL.	Check input sensor, T/C type, etc. If process requires broader limits, change sensor type and reconfigure.
LOW LOOP RES (SFC ONLY)	Not enough resistance in series with the communication loop.	Check the sensing resistor, and verify at least 250 Ω resistance in the loop.
NO XMTR RESPONSE (SFC ONLY)	No response from the transmitter. It may be a transmitter or loop problem.	1. Try communicating again. 2. Press STATUS and do any corrective action required. 3. Check and be sure the transmitter's loop integrity has been maintained, and that the SFC is connected.
NVM WRITE FAIL	Last configuration/calibration item written to nonvolatile memory was not correctly stored.	Repeat last configuration/calibration command. Press SHIFT/ENTER (NON-VOL). Replace transmitter.
> RANGE (SFC ONLY)	The value to be displayed is over the range of the display.	Press the CLR key and start again.
SFC FAULT (SFC ONLY)	A component of the SFC is not operating properly.	Try communicating again, if the condition still exists, replace the SFC.
T/C BREAK (SFC ONLY)	Open input or high input impedance.	Check input terminals. Remove one input lead and check sensor for continuity.
UNCERTAIN CJC	Low quality reading of CJ inconsistent input. Possible internal communications failure.	Check input for noise, intermittent connection.
USER CORR ACTIVE	Inconsistent or step input. Possible internal communications failure.	Check input for noise, intermittent connection, etc. Ignore if unit recovers quickly and message does not repeat.

(Continued)

Table 8-5 — STT 3000 Temperature Transmitter Diagnostic Messages (Continued)

Message	Problem	Corrective Action
XMTR FAULT SFCs with 2.7 or 2.9 software version **(SFC ONLY)** OR **STATUS UNKNOWN** SFCs with 3.0 or greater software version	Your SFC has an "older" version of software that cannot decode a "new" diagnostic message from a more recent transmitter.	1. Use the troubleshooting procedure to diagnose the condition. 2. Have the software in your SFC updated.

Table 8-6 — MagneW 3000 Magnetic Flowmeter Diagnostic Messages

Message	Problem	Corrective Action
(Any Comm Error) SFC FAULT (SFC ONLY)	SFC communication is not possible due to detected SFC problem.	1. Press STATUS to obtain any other messages. 2. Replace the SFC.
A/D FAULT	Analog/digital converter of converter is abnormal.	1. Turn the converter power OFF then ON. 2. Replace the main printed circuit board if required.
BAD CONFIG DATA	Configuration data is incorrect.	Check for wrong setting-step through SFM configuration and Pulse configuration.
CORRECTS RESET	Recalibration is necessary to attain the required accuracy.	Calibrate the LRV and URV.
DI/DO STATUS (SFC ONLY)	Checking the contact input/output status.	Not applicable
EMPTY PIPE?	Detector is empty.	Not applicable
ENTRY>SENS RING (SFC ONLY)	The number entered is beyond 1.125 times the upper range limit of the sensor.	Press the CLR key, check parameter, and start again.
EXCESS ZERO CORR (SFC ONLY)	The ZERO correction factor is outside the acceptable limits for accurate operation.	Check the input and be sure it matches the calibrated range value. Check the meter body on pressure transmitters.
EXCESS SPAN CORR (SFC ONLY)	The SPAN correction factor is outside the acceptable limits for accurate operation.	Check the input and be sure it matches the calibrated range value. Check the meter body on pressure transmitters.
EXCESSIVE OUTPUT (SFC ONLY)	The requested output percent in the output mode is too high or too low. The limits are –1.25% to +105%.	Press the CLR key, check parameter, and start again.
EXCIT CHECK MODE	Excitation current is being checked.	Not applicable
EXCIT COIL FAULT	Electrical discontinuity of Detector Coil Circuit.	1. Check the connections. 2. Measure the CAL resistance. 3. Check the converter.

(Continued)

Table 8-6 — MagneW 3000 Magnetic Flowmeter Diagnostic Messages (Continued)

Message	Problem	Corrective Action
EXT. ZERO ACTIVE	In "External Zero Percent Lock" mode.	Not applicable
FIXED PULSE MODE	In "Pulse Output Check" mode.	Not applicable
HIGH<LOW ERROR	High setting is less than low setting.	Change setting to High greater than Low.
HI RES/LOW VOLT **(SFC ONLY)**	Either there is too much resistance in the loop (open circuit), the voltage is too low, or both.	Check the wiring, connections and the power supply. There must be 11 volts minimum at the transmitter to permit operation.
HYSTERESIS ERROR	Hysteresis is too large.	Reset to lower value of Hysteresis.
ILLEGAL RESPONSE **(SFC ONLY)**	Failure of communication between SFC and transmitter.	Check the wiring, load resistance, etc.
INVALID COMM **(SFC ONLY)**	The transmitter is not receiving the SFC message. SFC is not sending a correct message. OR The transmitter is sending an incorrect response; it's either not working correctly and/or there is too much noise on the communication loop.	1. Try communicating again. 2. Press STATUS and do any corrective action required. 3. Check the communication loop. 4. Replace the SFC.
INVALID DATABASE **(SFC ONLY)**	The database of the flowmeter was not correct at power up.	Try communicating again. Verify the database, recalibrate the transmitter, and then manually update the nonvolatile memory.
INVALID REQUEST **(SFC ONLY)**	1. The transmitter is being asked to correct or set its URV to a value which results in too small a span, or being asked to correct its LRV or URV while in the output mode. 2. The given key function is not valid for the associated transmitter.	1. Check that the proper calibrated URV input is being applied to the transmitter, or that the transmitter is not in the output mode. 2. Check that the key function is applicable for the associated transmitter (Pressure or Temperature).
IN OUTPUT MODE	The transmitter is operating as a current-source.	Press OUTPUT and CLR keys, if you want to EXIT the output mode.

(Continued)

Table 8-6 — MagneW 3000 Magnetic Flowmeter Diagnostic Messages (Continued)

Message	Problem	Corrective Action
LOCAL MODE	Converter (model KIX) is operating in the local mode.	Not applicable
LOW LOOP RES **(SFC ONLY)**	Not enough resistance in series with the communication loop.	Check the sensing resistor, and verify at least 250 Ω resistance in the loop.
NVM FAULT	The nonvolatile memory of converter is corrupted.	1. Turn the converter OFF, then ON. 2. Replace the main printed circuit board.
PLS WEIGHT ERROR	Pulse frequency is too high or low.	Check the pulse weight, span, and type of pulse.
PLS WIDTH ERROR	Pulse width is too large. Duty ratio is 70% or more.	Check the pulse weight, pulse width, and span.
> RANGE	The value to be displayed is over the range of the display.	Press the CLR key and start again.
RAM FAULT	RAM of converter is abnormal.	1. Turn the converter power OFF, then ON. 2. Replace the main printed circuit board, if required.
ROM FAULT **(SFC ONLY)**	ROM of converter is abnormal.	1. Turn the converter power OFF, then ON. 2. Replace the main printed circuit board, if required.
SFC FAULT **(SFC ONLY)**	A component of the SFC is not operating properly.	Try communicating again, if the condition still exists, replace the SFC.
SPAN OVER ERROR **(SFC ONLY)**	Span setting is 12 m/s or more.	Check the span, size, and type of detector.
TYPE-DIA ERROR	Mismatching between size and type of detector.	Check the size, and type of detector.
XMTR FAULT SFCs with 2.7 or 2.9 software version **(SFC ONLY)** OR **STATUS UNKNOWN** SFCs with 3.0 or greater software version	Your SFC has an “older” version of software that cannot decode a “new” diagnostic message from a more recent transmitter.	1. Use the troubleshooting procedure to diagnose the condition. 2. Have the software in your SFC updated.

8.4 SMART TRANSMITTER IOP MESSAGES ON UNIVERSAL STATION

The following messages appear on the Universal Station in the Transmitter Status field of the Detail display.

Table 8-7 — Smart Transmitter IOP Status Messages on US

Message	Problem	Corrective Action
XMTR DATABASE IS NOT YET AVAIL SYSTEM ACQUIRING DATABASE ...WAIT (R230 or later)	Power-up.	No action required. Wait for system to acquire database.
XMTR DATABASE NOT AVAILABLE XMTR FAILED OR IN ANALOG MODE (R230 or later)	No DE data on a slot.	Attempt to switch transmitter to 6-byte DE mode. If you cannot do this, replace the transmitter.
XMTR DATABASE NOT AVAILABLE XMTR IN PV MODE W/O DB ACCESS (R230 or later)	STI IOP is in 4-byte DE mode.	No action required. If you want database, switch to PV_DB or PV_SV_DB, 6-byte mode.
SFC MODIFIED XMTR DATABASE SYSTEM ACQUIRING DATABASE ...WAIT (R230 or later)	SFC activity has modified the transmitter database.	6-byte mode column: upload or download if required; or wait for message to disappear. 4-byte mode column: R230, download; R300 or later, upload or download.
COMMAND FAILURE UNSUCCESSFUL COMMUNICATIONS (R300 or later)	Failed download or calibrate command from transmitter.	Try again; if command fails, investigate for problem in the transmitter or diagnostic procedure on the communication link.
COMMAND FAILURE INVALID REQUEST (R300 or later)	Failed download or calibrate command from transmitter.	Verify that the correct function has been requested.
COMMAND FAILURE LOCAL MODE (R300 or later, MagneW only)	Failed download or calibrate command from transmitter.	Refer to MagneW 3000 Magnetic Flowmeter User's Guide, 36-KI-25-01.
COMMAND FAILURE FIELD DEVICE IS WRITE PROTECTED (R300 or later, MagneW or ST only)	Failed download or calibrate command from transmitter.	Remove the write protect from the transmitter. Refer to MagneW 3000 Magnetic Flowmeter User's Guide, 36-KI-25-01 or ST 3000 Smart Transmitter User's Manual, 34-ST-32-02B.
COMMAND FAILURE NVM BAD (R300 or later)	Failed download or calibrate command from transmitter.	Replace transmitter.

SMART METER
Section 9

This section discusses the Smart Meter used for Smartline Transmitter and loop diagnostics.

9.1 OVERVIEW

The Honeywell **Smart Meter** is a digital meter that can display Smartline 3000 Transmitter output in Engineering Units in either analog or digital mode. Only the ST 3000, STT 3000, and MagneW 3000 can use the Smart Meter. It handles analog (4-20 mA) and digital (Digital Enhanced) signals. The display can be read in percentage or preconfigured Engineering Units, shown in Figure 9-1. The Smart Meter is currently available for nonintrinsically safe environments.

Refer to subsection 5.5, Smart Meter to Transmitter Wiring, and the *SM 3000 Smart Meter User's Guide*, 34-ST-25-08, for additional information. See also, the subsection of the Smart Meter User's Guide that deals with Smart Meter indications and what they mean.

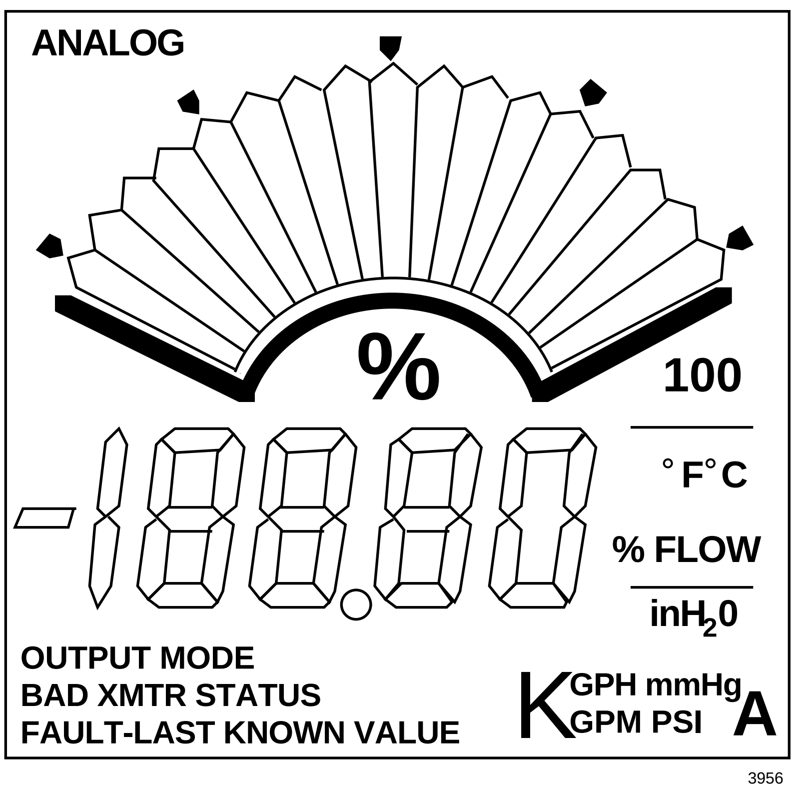


Figure 9-1 — Smart Meter Display

9.1.1 Smart Meter Features

The Smart Meter's liquid crystal display (LCD) features a seventeen segment bargraph, a digital readout in Engineering Units, and diagnostic status messages.

- Bargraph gives a gross indication of the transmitter PV from 0 to 100% that can be read from up to 30 feet away.
- Digital Readout provides a precise indication of transmitter output from –19990 to +19990 in user selected Engineering Units.
- Status messages serve as on-line diagnostics and operational flags for various detectable loop conditions and transmitter functions. Both the bargraph and the digital display flash if a diagnostic message is present.
- Engineering Unit Indicators on the LCD show what the digital readout represents in any of the commonly used Engineering Units, shown in Table 9-1.

Table 9-1 — Engineering Units by Transmitter Type

ST 3000	STT 3000	MagneW 3000
inH_2O	°F	GPH
PSI	°C	GPM
mmHg	%	%
%		

- Additional Engineering Units are supported with the use of stick-on labels supplied as part of the *Smart Meter User Manual*. 34-ST-25-08. The additional Engineering Units are shown in Table 9-2.

Table 9-2 — Additional Engineering Units by Transmitter Type

ST 3000	STT 3000	MagneW 3000
	°K	Liters/Hr.
KPa	°R	cc/Hr.
MPa	mVolts	Cubic Meters/min.
mBar	Ohms	Liters/min.
bar	Volts	Cubic Meters/hr.
g/cm^2		cc/min.
kg/cm^2		Cubic Meters/day
mmH_2O		GPD
inches HG		KGPD
mH_2O		BPD
		Cubic Meters/sec.

The Smart Meter supports the display of Engineering Units in analog mode (4-20 mA) or the Digital Enhanced mode. When operating in the analog mode, the Smart Meter reads the transmitter database when the SFC is connected and an ID is performed.

The Smart Meter supports the display of the following critical diagnostic messages:

- **Output Mode—**Indicates that the transmitter is in the output mode of operation (DE only).
- **Bad XMTR Status—**Indicates transmitter failure or open input for STT 3000.
- **Fault-Last Known Value—**Indicates a fault in the loop or meter, and displays the last known good value of PV.
- **Analog—**Transmitter is operating in the analog mode.
- **A—**Smart Meter is connected to an absolute pressure transmitter.
- **K—**Value displayed is in terms of 1000. Turns on automatically when reading exceeds 19990.
- **FLOW—**The Smart Meter is connected to a differential pressure transmitter that is configured for a square root output. The default Engineering Unit is percent and cannot be changed.

Section 10 – Integrating Multivariable Field Devices

10.0 Overview

Description

There are two types of field devices that can be digitally integrated into the TDC 3000X system: single PV field devices and multivariable field devices.

This section describes the integration of the multivariable devices using the STIMV IOP.

Section contents

These are the topics covered in this section:

10.1 Upgrading STI IOP to STIMV IOP

Types of IOPs

Table 10-1 compares the two available types of IOP (I/O processor) that support digital integration of smart transmitters. The multivariable type of IOP (STIMV) provides the PM and APM with a digital interface to single PV *and* multivariable field devices.

Table 10-1 Types of Smart Transmitter Interface IOPs

IOP	Description
STI	Supports these Smartline Transmitters: ST 3000, STT 3000, and MagneW 3000
STIMV	Supports *all* Honeywell Smartline field devices, including the new multivariable devices, such as the smart coriolis flow meter (SCM 3000).

IOP identification

These indicators identify the STIMV IOP:

- IOP Detail Status Display—FIRMWARE REV 4.0 or later, and
- IOP Firmware label—REV F or higher.

“Smart Transmitter Interface” is the descriptor on the card edge of the STI IOP.
“Smart MV Transmitter Interface” is the descriptor on the card edge of the STIMV IOP.

Upgrading

The STIMV IOP is a direct replacement for the STI IOP. No checkpoint translation is required.

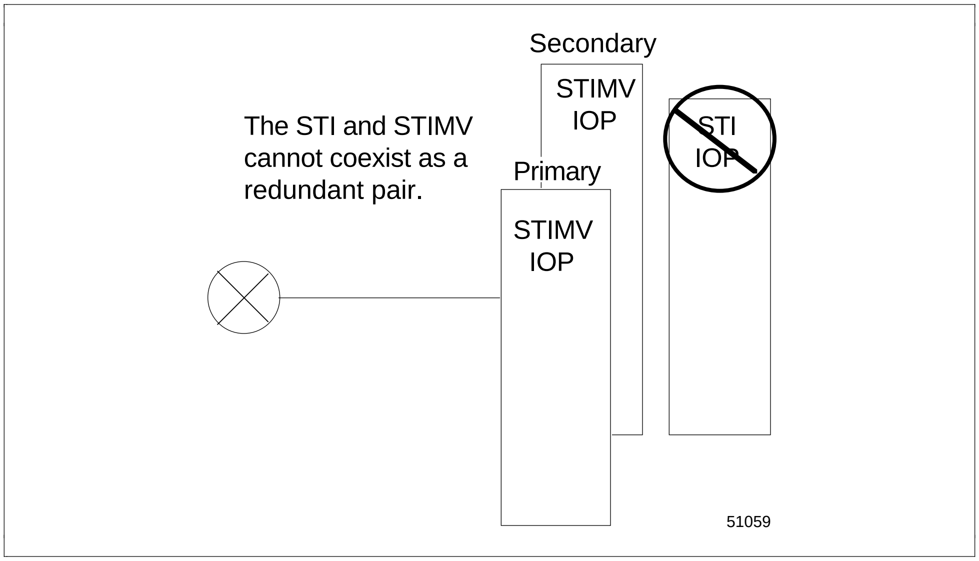
Due to differences between the two types of IOP, certain precautions must be taken when upgrading the STI IOP to the STIMV IOP.

Continued on next page

CAUTION

CAUTION—**In a redundant configuration where a STIMV IOP is used, both IOPs must be STIMV IOPs.** A hot failover upgrade of a STI IOP to the new STIMV IOP is allowed; however, the upgrade procedure should be used to **replace both primary and secondary** STI IOPs with STIMV IOPs. Failover from a primary STIMV IOP to a secondary STI IOP is not permitted.

Figure 10-1 STIMV Redundancy Restriction

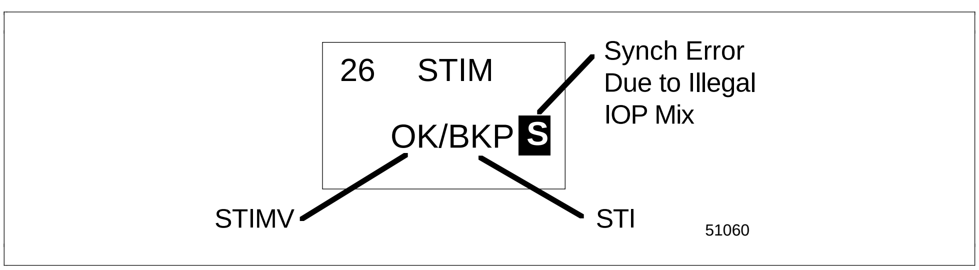


Synch error due to illegal IOP mix

The IOP box on the UCN Status Display indicates an illegal redundant IOP configuration with a red S and red BKP (see Figure 10-2). The S indicates a database synchronization error.

When a STIMV is the primary and an STI IOP is the secondary, the secondary database will not synch to the primary database, preventing redundant STI and STIMV operation. Replacing the secondary with a STIMV IOP clears the synch error.

Figure 10-2 Synch Error—Illegal IOP Configuration



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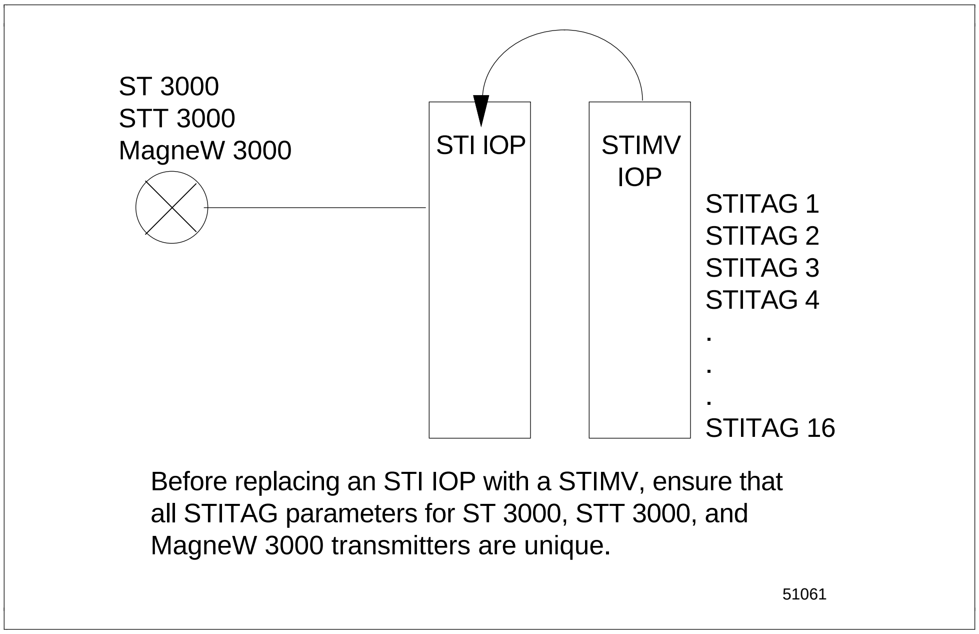
ATTENTION

ATTENTION—**Before replacing an STI IOP with a STIMV IOP, ensure that all STITAG parameters for ST 3000, STT 3000, or MagneW 3000 transmitters associated with the IOP are unique.** Performing this step prevents certain database discrepancies from occurring following the upgrade.

If you allow adjacent slots to have identical STITAG parameters, the STIMV IOP interprets the PVs as being from a single multivariable transmitter and a slot configuration overlap occurs.

A slot configuration overlap occurs because the PV data sent by the transmitters overlaps the database of what the IOP believes is a single transmitter database. To resolve slot configuration overlaps, the user should change the STITAG parameters to reflect the IDs of the transmitters connected to the IOP.

Figure 10-3 Check STITAG Before Upgrading STI with STIMV

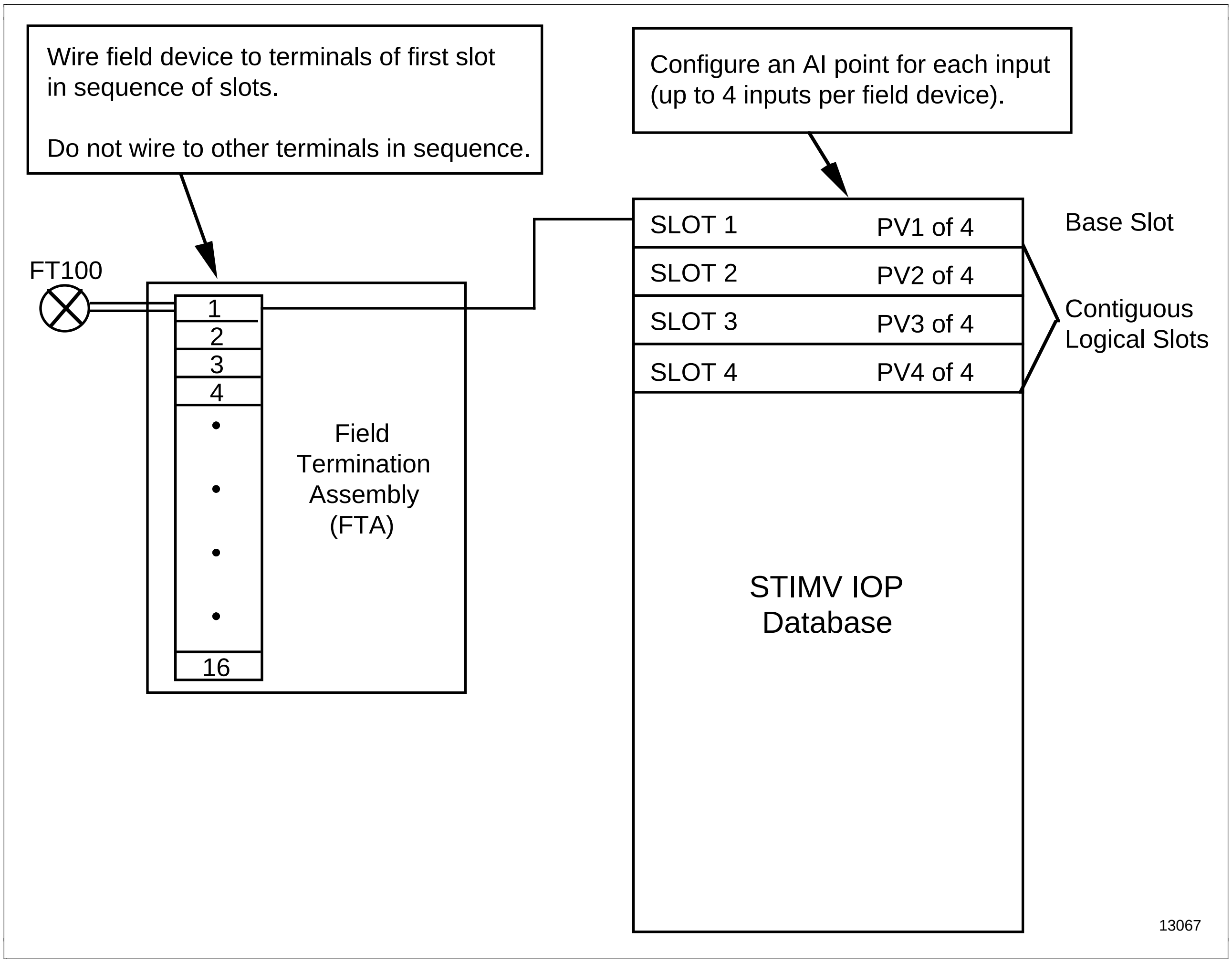


10.2 Slot Requirements for Multivariable Field Devices

Basic slot requirement

A multivariable field device physically connects to one STIMV slot (the base slot). The user allocates up to three additional contiguous slots, depending on the number of inputs (PVs) desired from the field device. Figure 10-4 illustrates the configuration of a 4-input multivariable field device.

Figure 10-4 Multivariable Field Device Slot Requirements



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STITAG

Configure the STITAG parameter identical and nonblank across all logical slots used by a single multivariable field device.

The STIMV IOP determines the number of PVs being sent by a transmitter based on the number of consecutive, identical STITAG parameters.

If the STIMV IOP detects consecutive slots with the same STITAG parameters, it recognizes the first slot in the sequence as the base slot for the field device. On page 2 of the Point Detail display, the base slot is referred to as PV 1 of n, where n is the total number of consecutive slots with identical STITAG parameters. The base slot should have the hardwired connection to the transmitter. The remaining slots allocated should not have a hardwired connection.

If you use the SFC to configure the number of PVs to be sent by the field device, the configuration must match the number of slots allocated in the IOP (slots with identical STITAG parameters).

`x of n` display

An `x of n` display indicates the number of consecutive slots with the same STITAG parameter as detected by the IOP. The `x of n` display helps the user locate:

- overlapping IOP slot configuration, and
- mismatches between the number of PVs configured in the transmitter and the number of identical STITAG parameters in the IOP.

The `x of n` display appears at the bottom of page 2 of the Point Detail display.

Display Example:

`2 of 4` indicates that this slot is the second slot in a sequence of four consecutive slots that have identical STITAG parameters.

`2` = PV Number (PV NUM)
`4` = Number of PVs (NUM PVS)

Continued on next page

`x of n` error indications

After a STIMV point is made ACTIVE asterisks may appear in the `x of n` display on the Point Detail display, indicating slot configuration errors.

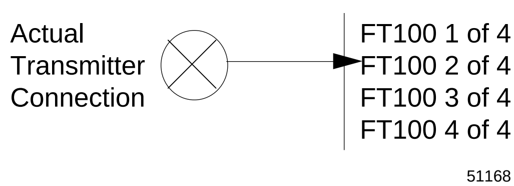
Asterisks in the `x of n` display indicate mismatches between the number of PVs allocated in the IOP and the number of PVs being sent by the transmitter.

Error Examples:

`2 of*3`	Three slots are allocated in the IOP through identical STITAG parameters, but the transmitter is sending four PVs.
`2* of 4`	Four contiguous slots have the same STITAG parameter, and you are viewing the second of these, but the PV being directed to this slot is not the second PV being generated by the actual transmitter.

Example:

STITAG parameters



`2* of*4`	Both of the above errors are present.

Configuration example

Figures 10-5 and 10-6 illustrate how the `x of n` display and the NUM PVS and PV NUM database discrepancy errors help locate mistakes in configuration or wiring.

Continued on next page

Figure 10-5 STIMV Slot Misconfiguration—Before Corrective Action

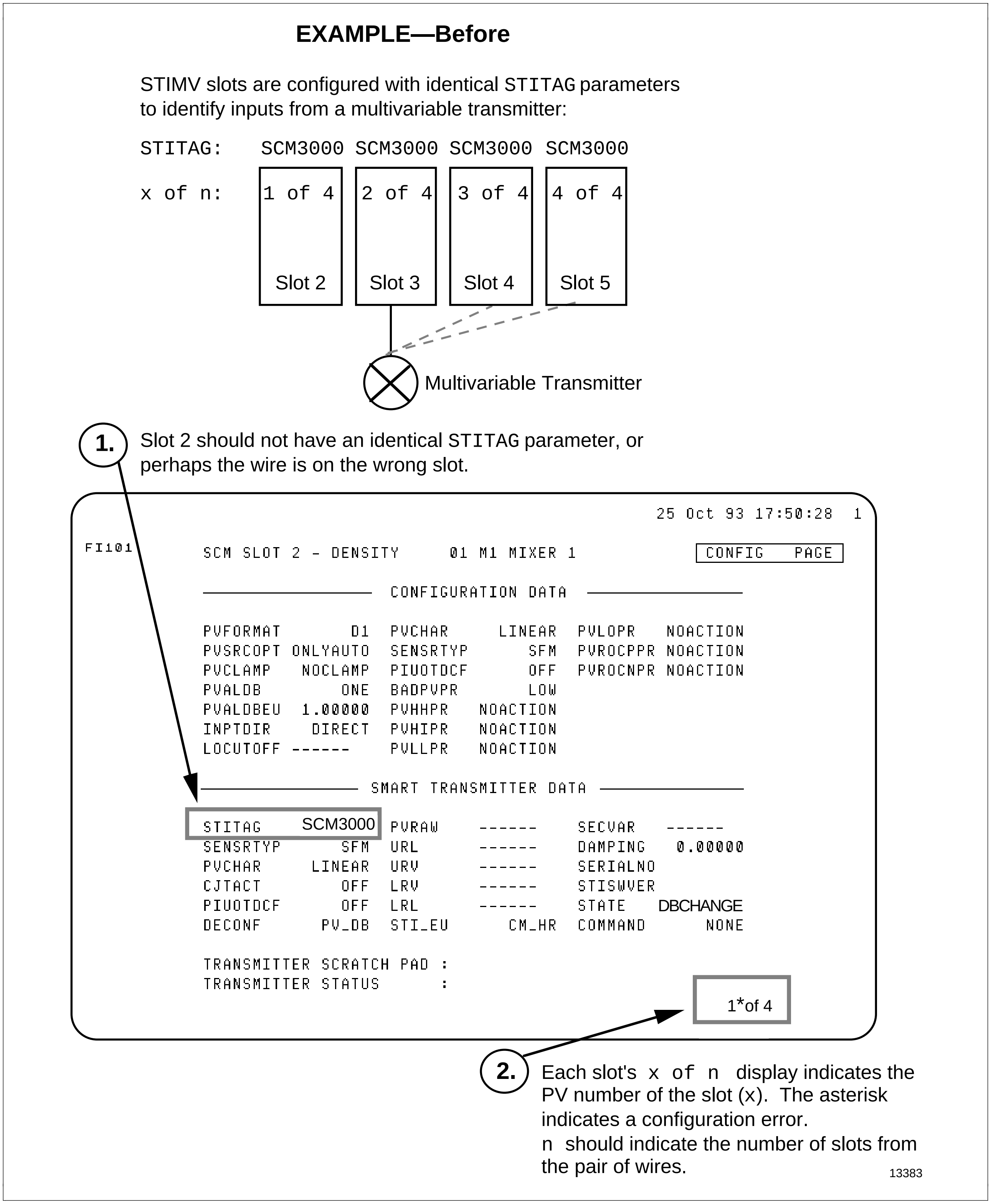


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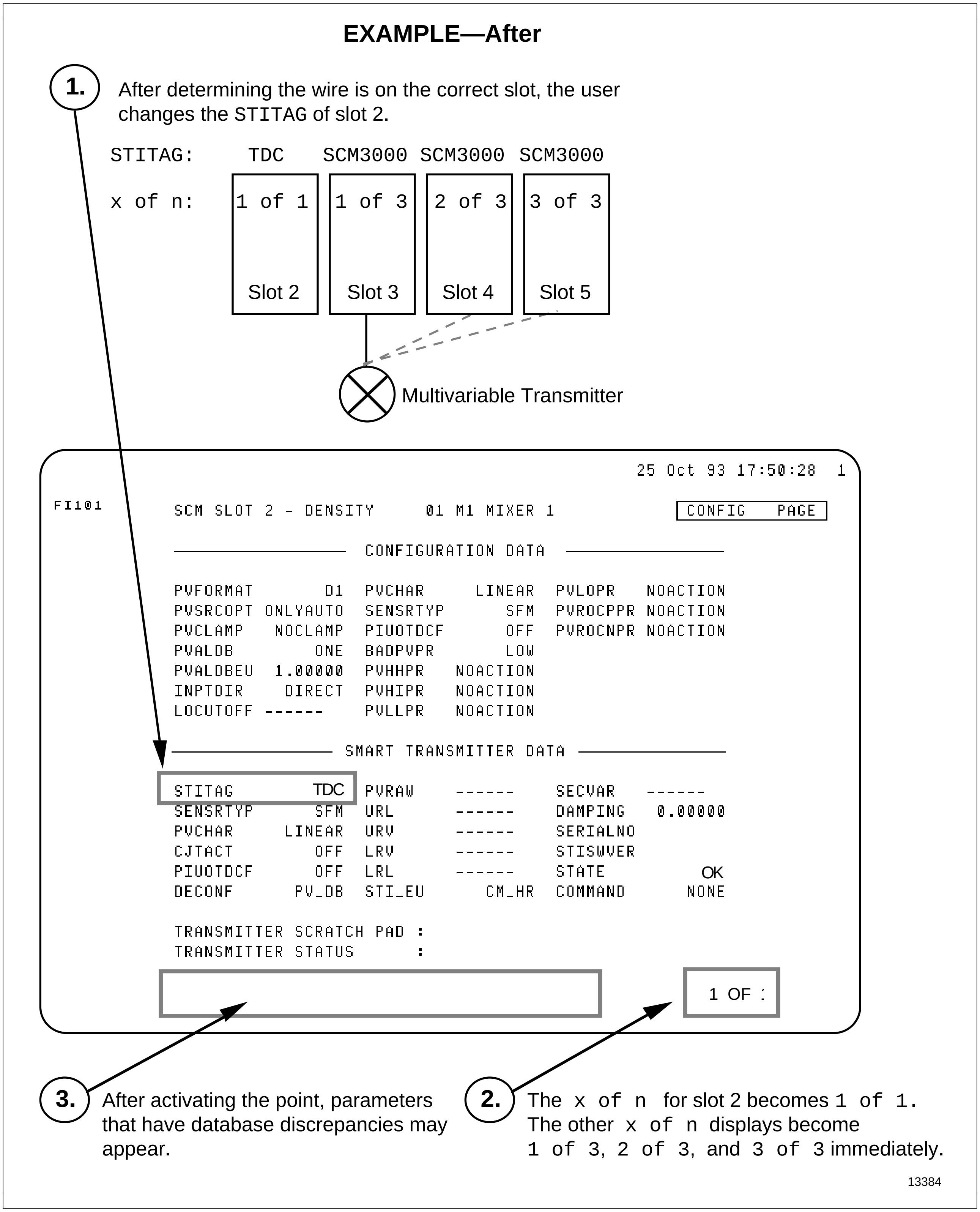
Figure 10-6 STIMV Slot Misconfiguration—After Corrective Actions



10.3 Configuration of Multivariable Field Devices

Configuration rules

Follow these rules when integrating multivariable field devices:

- No field device should be physically wired to the FTA screw terminals belonging to any slot other than the first slot in a logical sequence of slots.
- When assigning contiguous slots for a field device, you must adhere to the STIMV IOP's DE processor slot boundaries, that is, the contiguous logical slots must fall in the range of 1-8 or 9-16. *The contiguous slots cannot overlap boundaries (from slot 8 to 9) or wrap around (from 8 to 1 or 16 to 9).*
- *The STITAG parameter must be identical and nonblank across all logical slots configured for use by a multivariable field device.* If the STITAG parameter is null or all blanks, the IOP assumes it is a single variable field device.
- FTA communications are through the base slot, however, only the slot being implemented needs to be set active. For example, if you want the percent solids for the SCM 3000, you must allocate three slots, but only the slot for PV 4 needs to be active.
- After adding or deleting logical slots, you must download from the base slot that is physically connected to the field device in order to change the number of PVs being transmitted (DECONF).
- In order to download configuration of any slot in a multivariable field device, you must make all of the associated slots INACTIVE.
- Upload of a multivariable transmitter that is in analog or 4-byte mode must be performed from PV 1.

DECONF

Configure DECONF according to the definition in Table 10-2.

PVCHAR

PV characterization is assumed to be Liner for all multivariable field device PVs associated with inputs without recognized base units.

PVEUHI/PVEULO

Use the mx+b equation to convert the PV to engineering units other than the base engineering units. Subsection 4.2.1 provides details on the mx+b equation.

Continued on next page

SENSRTYP

For each slot of a multivariable device, select the SENSRTYP specified in the user manual for the transmitter.

Note that many slots of multivariable transmitters have a real SENSRTYP other than the configuration choices (SPT_DP, SPT_AP, SPT_GP, STT or SFM). For these slots, choose SFM for the SENSRTYP. When the transmitter is connected, the TRANSMITTER STATUS field on the point detail display will indicate the actual SENSRTYP.

STI_EU

For multivariable transmitter slots with SENSRTYP of SPT_DP, SPT_AP, SPT_GP, or STT, choose the preferred STI_EU (engineering units). For slots with SENSRTYP of SFM, select BLANK or CM/HR if BLANK is not available. When BLANK (or CM/HR) is selected, the limit values URL, LRL, URV, and LRV are always displayed in the base engineering units specified in the transmitter user manual.

The 8-character EUDESC parameter can be used to indicate the correct units of the PV to the operator.

CAUTION

CAUTION—All points of a multipoint transmitter should be made INACTIVE when altering the database of any or all points in the transmitter.

Continued on next page

Download

Each logical slot associated with a field device controls its own configuration parameters. On a per-slot basis, the user can change parameters in the transmitter database and download them from the slot's Detail display (DNLOADDB command) with the exception of DECONF.

Upload and download of DECONF can only be performed from the base slot (PV1 of x).

In order to perform a download to a multivariable transmitter, you must make all of the slots INACTIVE that are associated with the multivariable transmitter. If you attempt to download before all of the multivariable transmitter's associated slots are INACTIVE, the following error message appears:

```
COMMAND ALLOWED ONLY IF ALL
PVS INACTIVE ON THIS MULTI-PV TRANSMITTER
```

Database discrepancies

Each slot indicates database discrepancies associated with that slot's parameters. To resolve smart transmitter database discrepancies, do the following:

1. Perform an upload.
2. If an upload does not resolve the discrepancies, perform a download.

Continued on next page

DECONF parameter

The DECONF parameter of the base slot and each contiguous logical slot for a multivariable transmitter must agree as defined in Table 10-2. If they do not agree, a DECONF database discrepancy results.

Table 10-2 DECONF Parameter Entry Rules

US DECONF Entry		Comparable SFC Entry	
If PV1 is...	**Then PVx* must be...**	**If PV1 is...**	**Then PVx* must be...**
PV	PV	PV1 ON and w/o DB (4 byte)	PVx ON and w/o DB (4 byte)
PV_SV	PV	PV1 ON W/SV and w/o DB (4 byte)	PVx ON and w/o DB (4 byte)
PV_DB	PV_DB	PV1 ON and W/DB (6 byte)	PVx ON and W/DB (6 byte)
PV_SV_DB	PV_DB	PV1 ON W/SV and W/DB (6 byte)	PVx ON and W/DB (6 byte)
* where x = 2, 3, or 4			

ATTENTION

ATTENTION—SV is only available for PV1.

Analog or 4-byte mode

Attempting to upload a multivariable transmitter that is in analog or 4-byte mode from a slot other than PV 1, causes a Transmitter Status error message to appear:

```
COMMAND ALLOWED ONLY ON FIRST
SLOT OF MULTIPLE PV XMTRS
```

The error message appears because the STIMV point, before performing the upload, attempts to download the DECONF configuration to establish the 6-byte digital mode, but DECONF changes can only be made from PV 1.

In response to the above error message, the user should do the following:

Step	Action
1	Perform an upload or download from PV1, changing DECONF to 6-byte digital mode.
2	Perform an upload from PVx.

Continued on next page

DECONF configuration rules

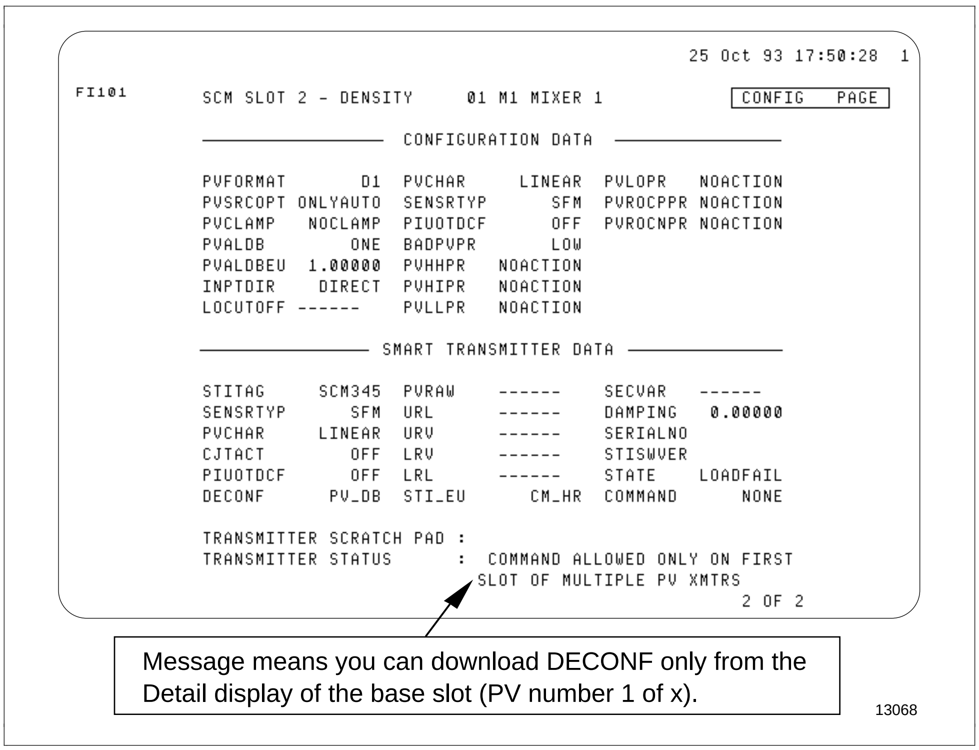
The following rules apply to the DECONF parameter for multivariable transmitters:

- Perform upload or download of DECONF from the base slot of a multislot configuration (PV 1 of x).
- Download a change in the DECONF parameter of any slot in a multislot configuration from the Detail display of PV 1 of x.

Example:

A DECONF parameter change to turn PV 2, 3, or 4 ON (which is equivalent to building a point for the given transmitter PV) can only be downloaded from PV 1. If you try to download a DECONF change from the Detail display of PV 2, 3, or 4, you will get an error message as shown in Figure 10-7.

Figure 10-7 Example of DECONF Download Error Message



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DECONF database discrepancy

If a transmitter sends PV data that overlaps another transmitter's data, the following error indications appear:

- DECONF appears in the DATABASE DISCREPANCY area of the Detail display, indicating a database mismatch,
- DBCHANGE appears as the transmitter STATE on the Detail display,
- this Transmitter Status message appears on the Detail display:

```
CONFIGURATION MISMATCH
MULTIPLE DEVICES ASSIGNED TO SLOT
```

- one or two asterisks appear in the `x of n` display for all logical slots associated with the conflicting devices.

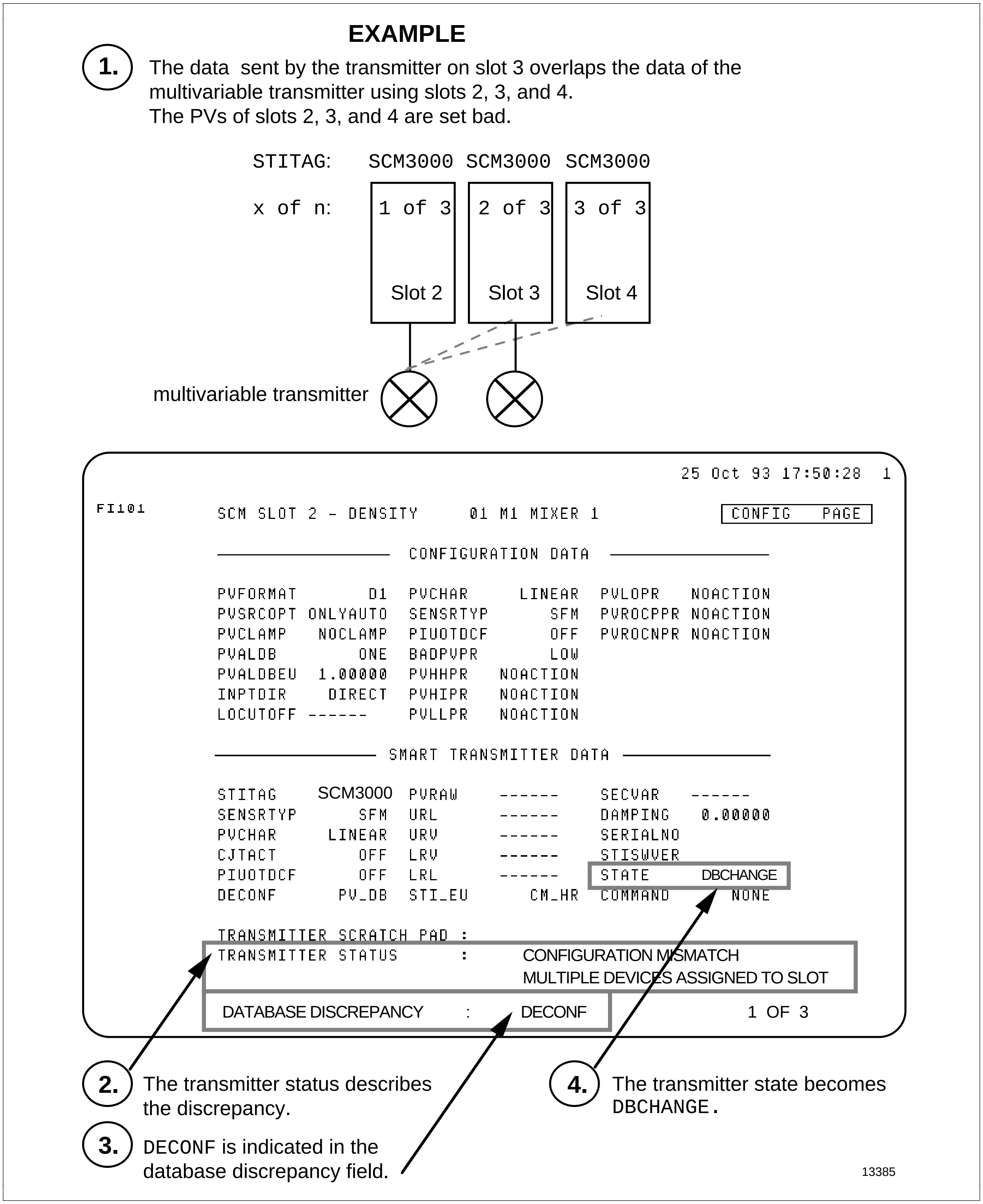
Operator intervention is required to clear the discrepancy by disconnecting the offending device or reconfiguring the number of PVs to eliminate the slot overlap (see Table 10-2 for how to configure DECONF to specify the number of PVs).

Overlap example

Figure 10-8 shows an example of an overlap error and the related display indications.

Continued on next page

Figure 10-8 DECONF Database Discrepancy Example



PARAMETER DICTIONARY
Appendix A

The parameters of Smart Transmitter points are listed below in alphabetical order. (F) indicates that the parameter is applicable when the PNTFORM = Full.

ALENBST (F)	MODNUM	PVALDB (F)	PVHIPR (F)	PVSRCOPT (F)
BADPVFL (F)	NAME	PVAUTO	PVHITP (F)	PVSTS
BADPVPR (F)	NODENUM	PVAUTOST	PVLLFL	PVTV (F)
CJTACT	NODETYP	PVCALC	PVLLPR	PVTVP (F)
COMMAND	NTWKNUM	PVCHAR	PVLLTP (F)	S1
CONTCUT (F)	OVERVAL (F)	PVCLAMP	PVLOFL	SECVAR
DAMPING	PIUOTDCF	PVEUHI	PVLOPR (F)	SENSRTYP
DECONF	PNTFORM	PVEULO	PVLOTP (F)	SERIALNO
EUDESC (F)	PNTMODTY	PVEXEUHI	PVP	SLOTNUM
FREQ5060	PNTNODTY	PVEXEULO	PVRAW	STI_EU
HIGHAL (F)	PNTSTATE	PVEXHIFL	PVROCNFL	STISWVER
HIGHALPR (F)	PNTTYPE	PVEXLOFL	PVROCNPR (F)	STITAG
INPTDIR	PRIMMOD (F)	PVFORMAT	PVROCNTP (F)	TF
KEYWORD (F)	PTDESC (F)	PVHHFL	PVROCPFL	UNIT
LASTPV	PTEXECST	PVHHPR (F)	PVROCPPR (F)	URL
LOCUTOFF	PTINAL	PVHHTP (F)	PVROCPTP (F)	URV
LRL	PV	PVHIFL	PVSOURCE (F)	
LRV				

ALENBST

Type: **e(ALENBST)**
Lock: **Oper***
Default: **Enable**
PtRes: **NIM**
Range:

Alarm Enable Status — Defines the alarm reporting function that is to be used when an alarm condition is detected in this data point. Note that even when alarms are disabled, the alarm indicators still appear on the Group and Detail displays.

	Displayed	Logged	Reported to EIP**
Enable	Yes	Yes	Yes
Disable	No	Yes	Yes
Inhibit	No	No	No

* The access lock for ALENBST is configurable through system-wide values.
** Event-Initiated Processing

Helpful Hint:	ALENBST should not be set to Disable or Inhibit for points critical to safe operations.

BADPVFL

Type: **Logical**
Lock: **View**
Default: **Off**
PtRes: **PM or APM**
Range: **Off** (PV is not bad)
On (PV is bad)

Bad PV Flag — Indicates that a bad PV value has been detected at this data point. For an analog input, a bad PV is defined as a PV whose value is NaN (Not a Number).

BADPVPR

Type:	**e(ALPRIOR)**	**Bad PV Alarm Priority —** Defines the priority of the bad PV alarm.
Lock:	**Eng/PB**	
Default:	**Low**	
PtRes:	**NIM**	
Range:	**Emergency** (Reported to all alarm summary displays, historized) **High** (Reported to Area and Unit Alarm Summary Display, historized) **Low** (Reported to Unit Alarm Summary Display, historized) **Journal** (Historized, but not reported to Universal Stations) **NoAction** (Alarm is not reported to the system)	

CJTACT

Type:	**Logical**	**Internal Cold Junction Temperature —** Defines whether the Smart Temperature Transmitter's internal cold-junction reference (CJR) is to be used, or an externally-provided cold-junction reference is to be used.
Lock:	**Eng/PtBld**	
Default:	**On**	
PtRes:	**PM or APM**	
Range:	**On** (Transmitter's internal cold-junction temperature is active) **Off** (External cold-junction temperature is active)	

> **NOTE**
>
> Honeywell recommends that you select the Internal Cold Junction Temperature Compensation. Consequently, there is no need to enter the CJR temperature. If you choose the External CJR, then the SFC must be used to enter the cold junction temperature value. Refer to the SFC manual for the specific transmitter type for configuration instructions.

COMMAND

Type:	**e(COMMAND)**	**Command —** Allows the user to do database transfers between the Smart Transmitter point and the Smart Transmitter, and to calibrate the transmitter.
Lock:	**Oper**	
Default:	**None**	
PtRes:	**PM or APM**	
Range:	0-**NONE** (A command has not been issued by the Smart Transmitter point) 1-**DNLOADDB** (Loads the transmitter parameters from the Smart Transmitter point database into the transmitter) 2-**UPLOADDB** (Loads the transmitter database from the transmitter into the Smart Transmitter point) 3-**SET_LRV** (Sets the Lower Range Value) 4-**SET_URV** (Sets the Upper Range Value) 5-**COR_LRV** (Corrects the Lower Range Value) 6-**COR_URV** (Corrects the Upper Range Value) 7-**COR_INPT** (Corrects the zero point for the PV value) 8-**RST_COR** (Sets all input calibration parameters to their default values)	

> **NOTE**
>
> An upload command reads previously unseen data from the transmitter and stores it in the IOP. If desired, restore the original data using the checkpoint restore or point build functions.

Helpful Hint:	If PV or PV_SV has been entered for the DECONF parameter, the only command supported is DNLOADDB.

DAMPING

Type: **Real** *Lock:* **Supr/View** *Default:* **0.0** *PtRes:* **PM or APM**	**Damping** — Defines the first-order digital filtering option for the Smart Transmitter PV. User can implement PV filtering by using this parameter on the TF parameter; however, DAMPING is the preferred parameter. For certain smart transmitters, if DAMPING has been configured at the transmitter using the Universal Station, the IOP adjusts the entered value to one of the values in the range shown below for the appropriate type. For multivariable transmitters with SENSRTYP of SFM, the IOP will not adjust the damping value. Any real number in the range of damping specified by the transmitter user manual can be used. The DAMPING parameter can be changed from the Universal Station only when the Smart Transmitter point execution state PTEXECST is Inactive.

Range: The values listed are the first-order filter time constants in seconds.

Sensor Type (SENSRTYP)

Spt	Stt	Sfm
0.0	**0.0**	**0.0**
0.16	**0.30**	**0.5**
0.32	**0.70**	**1.0**
0.48	**1.5**	**2.0**
1.00	**3.10**	**3.0**
2.0	**6.3**	**4.0**
4.0	**12.7**	**5.0**
8.00	**25.5**	**10.0**
16.0	**51.1**	**50.0**
32.0	**102.3**	**100**
NaN	**NaN**	**NaN**

DECONF

Type: **e($DECONF)** *Lock:* **Eng/View** *Default:* **Pv_Sv_Db** *PtRes:* **PM or APM**	**Digitally Enhanced Configuration Mode —** Defines the contents of the data that will be sent by the Smart Transmitter to the Smart Transmitter point. For all transmitters single and multivariable, the use of PV_Db and Pv_Sv_Db is recommended because they offer database mismatch detection and on-process mismatch recovery. This parameter can be changed only when the point execution state PTEXECST is Inactive.

Range:
0-**Analog** (Not Supported)
1-**Pv** (Transmits only the PV; 4-byte format)
2-**Pv_Sv** (Transmits the PV and the secondary variable (SV); 4-byte format)
3-**PV_Db** (Transmits the PV and the transmitter database; 6-byte format)
4-**Pv_Sv_Db** (Transmits the PV, SV, and the transmitter database; 6-byte format)

Helpful Hint:	For the PV_Db and Pv_Sv_Db selections, one byte of the transmitter database is transmitted each time the PV is transmitted to the Smart Transmitter IOP.

EUDESC

Type: **String_8**
Lock: **PtBld**
Default: **Blank**
PtRes: **NIM**

Engineering Units Descriptor — An eight-character descriptor that defines the name of the engineering units (EU) that are displayed on the Group and Detail displays for this point. In Figure 7-4, KLBHR is the engineering unit descriptor. Enter EUDESC to indicate the correct units of the PV to the operator.

Range: Permissible character set consists of all characters on the Engineer's Keyboard. Basically this set consists of alphabetics A-Z, numerics 0-9, and the following special characters: space ! " % & ' ( ) * + - / : ; > < = ? _ , . $

FREQ5060 (1) - (168)

Type: **e(FRQ6050)**
Lock: **Eng/PB**
Default: **60Hz**
PtRes **PM or APM**
Range: **60 Hz**
50 Hz

Frequency 60/50 Hz—This parameter is a line frequency phase reference for noise rejection. It specifies the frequency of the input filter as either 50 or 60 Hz. The parameter defines the 60/50 Hz frequency configuration needed for a Smart Transmitter IOP (STIM). Select the value that matches the power line frequency. This parameter is resident in the IOP and in the Smart Transmitter. If a mismatch occurs between the IOP parameter and the transmitter’s internal 60/50 Hz Hz frequency parameter, a database discrepancy is alarmed at the Universal Station. A database download from the IOP to the transmitter clears the mismatch. The transmitter uses the parameter to provide optimum rejection of power line noise. The parameter is changeable from the IOP Detail Status display of the Universal Station (see Figure 6-6).

HIGHAL

Type: **e(ALMTYPE)**
Lock: **View**
Default: **NoAlarm**
PtRes: **NIM**

Highest Alarm Detected — This parameter is used by the system to ensure that when two or more different types of alarms occur on an Smart Transmitter point at the same time, the most important or highest level alarm appears on the point's Group, Detail, and Alarm Summary displays.

Range: **NoAlarm** (No alarm exists—lowest level alarm)
PVRocN (PV Rate-Of-Negative)
PVRocP (PV Rate-Of-Change Positive)
PVHi (PV High)
PVHH (PV High High)
PVLo (PV Low)
PVLL (PV Low Low)
BadPV (Bad PV—highest level alarm)

HIGHALPR

Type: **e(ALPRIOR)**
Lock: **View**
Default: **Low**
PtRes: **NIM**

Highest Level Alarm's Priority — Defines the priority of the highest alarm currently detected at the data point.

Range: **Emergency** (Reported to all alarm summary displays)
High (Reported to Area and Unit Alarm Summary display)
Low (Reported to Unit Alarm Summary display)
Journal (Logged, but not reported to Universal Stations)
NoAction (Alarm is not reported to the system)

INPTDIR

Type:	**e(POLARITY)**	**Analog Input Direction —** Specifies direct or reverse indication for the PV input at this data point. Direct means PVCALC increases as PVRAW increases. Reverse means PVCALC decreases as PVRAW increases.
Lock:	**Eng/PB**	
Default:	**Direct**	
PtRes:	**PM or APM**	
Range:	0-**Direct** (Highest energy from sensor = 100% PV) 1-**Reverse** (Highest energy from sensor = 0% PV)	

Helpful Hint:	INPTDIR configuration applies only if PVCHAR = Linear or Sqrroot.

KEYWORD

Type:	**String_8**	**Keyword Descriptor —** An eight-character descriptor that is used to describe an important aspect of this particular data point. For example, in Figure 7-4 the keyword for the data point is STEAM.
Lock:	**PtBld**	
Default:	**Blank**	
PtRes:	**NIM**	
Range:	Alphabetics A-Z (uppercase only). Numerics 0-9 (an all numeric keyword is not allowed). Underscore (_) cannot be used as the first character or the last character in a keyword. Consecutive underscores are not allowed.	

LASTPV

Type:	**Real**	**Last PV Value —** Indicates the value of the PV before the value became bad (BADPVFL).
Lock:	**View**	
Default:	**NaN**	
PtRes:	**PM or APM**	
Range:	**N/A**	

LOCUTOFF

Type:	**Real**	**Low Signal Cut Off For Flow Inputs —** Defines the low cut-off point for flow inputs. If the range-checked and filtered PV value is less than the user configured LOCUTOFF value, PVCALC is forced to PVEULO.
Lock:	**Eng/PB**	
Default:	**NaN**	
PtRes:	**PM or APM**	
Range:	**PVEULO to PVEUHI;** $\geq$ **0** **NaN**	

Helpful Hint:	LOCUTOFF configuration applies only if PVCHAR = Linear or Sqrroot.

LRL

Type:	**Real**	**Lower Range Limit —** Indicates the lower range limit of the PV at the smart transmitter. This limit is fixed and cannot be changed. Refer to description of the STI_EU parameter for the LRL engineering units.
Lock:	**View**	
Default:	**NaN**	
PtRes:	**PM or APM**	
Range:	**N/A, NaN**	

LRV

Type:	**Real**	**Lower Range Value —** Defines the lower end of the operating range for the PVRAW value. User entry for PVEULO is the user-entered engineering-unit value that corresponds to LRV. Refer to description of the STI_EU parameter for the LRV engineering units.
Lock:	**Supr/View**	
Default:	**NaN**	
PtRes:	**PM or APM**	This parameter can be changed only when the Smart Transmitter point execution state PTEXECST is Inactive.
Range:	**N/A, NaN**	

MODNUM

Type:	**Integer**	**PMM/APMM or IOP Module Number —** Defines the module number in the PM or APM. The PMM or APMM is module number 0; the IOP Cards are module numbers 1–127.
Lock:	**PtBld**	
Default:	**N/A**	
PtRes:	**NIM**	
Range:	**0** to **127** (0 is reserved for the PMM/APMM)	

NAME

Type:	**String**	**Tag Name —** Identifies this point to the system and on displays, reports, and logs. For example, in Figure 7-4, the tag name is FI3011.
Lock:	**Eng/PB**	
Default:	**N/A**	
PtRes:	**NIM**	STI data points have to be configured by using the DEB and require that a tag name be specified during the point build process.

Range: Tag name can be up to 16 characters, and the permissible character set is as follows:
Alphabetics A-Z (uppercase only)
Numerics 0-9 (an all numeric tag name is not allowed)
Underscore (_) cannot be used as the first character or the last character, and consecutive underscores are not allowed.
Embedded space characters are not allowed.

NODENUM

Type:	**Integer**	**Node Number —** Defines the address of the NIM and the devices on the UCN. NODENUM assigned for any device on the UCN <u>must be odd</u> whether the device is nonredundant or redundant. Because of this restriction and because the NIM takes up one odd address and the next even address, the maximum number of devices that can be on the UCN is 31. The primary device is assigned an odd address, the associated secondary (redundant) device is assigned the next (even) address.
Lock:	**PtBld**	
Default:	**N/A**	
PtRes:	**PM or APM**	
Range:	**0**, **1** to **64**	

> ✍ ***note***
>
> The node number assigned to the NIM must be the lowest node number on the UCN.

NTWKNUM

Type: **Integer**
Lock: **PtBld**
Default: **N/A**
PtRes: **NIM**
Range: **1** to **20**

Network Number — Defines on which UCN the NIM and process connected devices reside.

OVERVAL

Type: **Integer**
Lock: **Eng/PB**
Default: **25**
PtRes: **NIM**
Range: **0** to **100** (Entering a 0 suppresses the value; value is not shown on the display.)

Overview Value In Percent — Defines the amount of deviation (PV - SP, in percent) that causes the PV to reach the overview limit. As shown in Figure A-1, the baseline on the overview display shows the normal operating value (SP) for this PV.

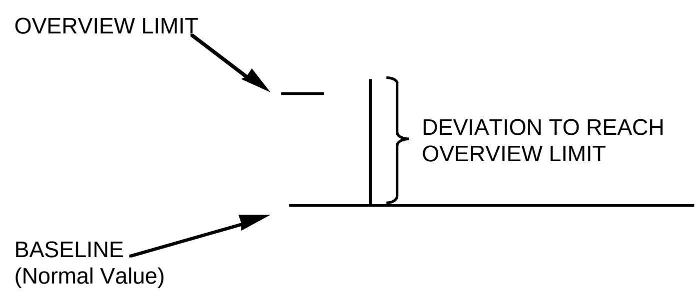


Figure A-1 — Overview Limit

PIUOTDCF

Type: **Logical**
Lock: **Eng/View**
Default: **On**
PtRes: **PM or APM**
Range: **On** (Detect an open thermocouple condition)
Off (Do not detect an open thermocouple)

Open Thermocouple Detection Enable — Defines whether the point is to detect an open thermocouple condition. This parameter is configurable for each Smart Transmitter point that is connected to a smart temperature transmitter.

This parameter is a view-only parameter when the point execution state PTEXECST is Active.

PNTFORM

Type: **e($PNTFORM)**
Lock: **View/PB**
Default: **Full**
PtRes: **PM or APM**
Range: 0-**Full** (Point is fully displayed and alarmed)
1-**Component** (Point is partially displayed, but not alarmed)

Point Form — Defines the form of the data point that is implemented. Points with “Full” point form include descriptor data and alarm-related parameters (primary operator interface point). Descriptor data and alarm-related parameters are suppressed for “Component” points. This form is used for points that provide inputs to the “Full” point.

PNTMODTY

Type: **e($PMMDTY)**
Lock: **View**
Default: **NotConfg**
PtRes: **NIM**
Range: **AO** (Analog Output)
DI (Digital Input)
DO (Digital Output)
HLAI (High-Level Analog Input)
LLAI (Low-Level Analog Input)
STI (Smart Transmitter Interface Module)
NotConfg (Not Configured)
PI (Pulse Input)
PMM (Process Manager Module) or **APMM** (Advanced Process Manager Module)
LLMUX (Low-Level Analog Input Multiplexer)
DISOE (Sequence of Events)
SI (Serial Interface)

Point’s Processor Module Type — Defines where the data point resides.

PNTNODTY

Type: **e($UCNNDTY)**
Lock: **View**
Default: **N/A**
PtRes: **NIM**
Range: **NIM** (Network Interface Module)
PM (Process Manager)
APM (Advanced Process Manager)
LM (Logic Manager)
NotConfg (Node not configured)

Point's Node Type—Defines the type of node on the UCN.

PNTSTATE

Type: **e(PNTSTATE)**
Lock: **View**
Default: **N/A**
PtRes: **NIM**
Range: **Confg** (Configuration problem, i.e., mismatch, etc.)
Fail (NIM cannot communicate with point's PMM/APMM or IOP)
Idle (Point's PMM/APMM or IOP is in the Idle State)
OK (Point's PMM/APMM or IOP is the Run State and is OK)

Point's Overall State — Defines the state of the data point, which is based on the state of the PMM or APMM and the IOP Card in which it resides.

PNTTYPE

Type: **e(PNTTYPE)** **Point Types —** Defines the type of point in the PM or APM.
Lock: **PtBld**
Default: **Null**
PtRes: **PM or APM**
Range: 0-**Null** (Not configured)
1-**AnalgIn** (Analog Input including HLAI, LLAI, LLMUX, Pulse Input, SDI, and STIM)
2-**AnalgOut** (Analog Output)
4-**DigIn** (Digital Input)
5-**DigOut** (Digital Output)
6-**DigComp** (Digital Composite)
8-**RegPV** (Regulatory PV)
9-**RegCtl** (Regulatory Control)
10-**Logic**
11-**Array**
12-**Flag**
13-**Numeric**
14-**ProcMod** (Process Module)
22-**Timer**
28-**DEVCTL** (Device Control)

PRIMMOD

Type: **Ent_Id**
Lock: **PtBld**
Default: **Blanks**
PtRes: **NIM**

Primary Module Identifier — This parameter contains the tag name of the process module point to which this data point is assigned. For collecting batch history for this data point, the name of the Batch History Data Point that is used by the AM for collecting batch histories is specified by this tag name.

Range: Tag name of the process module point can be up to 16 characters, and the permissible character set is as follows:
Alphabetics A-Z (uppercase only)
Numerics 0-9 (an all numeric tag name is not allowed)
Underscore (_) cannot be used as the first character or the last character, and consecutive underscores are not allowed.
Embedded space characters are not allowed.

PTDESC

Type: **String_24**
Lock: **PtBld**
Default: **Blank**
PtRes: **NIM**

Point Descriptor — A 24-character descriptor which is used to describe the point and appears on the Group and Detail displays for the point. Refer to Figure 7-4.

Range: Permissible character set consists of all characters on the Engineer's Keyboard. Basically this set consists of alphabetics A-Z, numerics 0-9, and the following special characters:
space ! " % & ' ( ) * + - / : ; > < = ? _ , . $

PTEXECST

Type: **e(PTEXECST)**
Lock: **Supr**
Default: **Inactive**
PtRes: **PM or APM**
Range: 0-**Inactive** (Point is not scanned or processed)
1-**Active** (Point is scanned and processed)

Point Execution State — Defines the current execution state of the point.

PTINAL

Type: **Logical**
Lock: **View**
Default: **Off**
PtRes: **PM or APM**
Range: **Off** (Point is not in alarm)
On (Point is in alarm)

Point In Alarm Indicator — Indicates when an alarm condition has been detected at this point.

PV

Type: **Real**
Lock: **Oper**
Default: **NaN**
PtRes: **PM or APM**
Range: **PVEXEUHI** to **PVEXEULO,**
NaN

Process Variable — PV is the PV's current value after the PV is selected from one of the following possible sources: a field device, an operator, or a program. See PVSRCOPT and PVSOURCE.

Helpful Hint:	PV change by a program requires PVSRCOPT = All and PVSOURCE = Sub. PV change by an operator requires PVSRCOPT = All and PVSOURCE = Man.

PVALDB

Type: **e(PVALDB)**
Lock: **Eng/PB**
Default: **One**
PtRes: **PM or APM**

PV Alarm Deadband — Alarm deadband is used to prevent excessive recurrence of alarms by adjusting the percent of Engineering Unit range at which the alarm "returns to normal." An increase in the deadband percent of PV range (PVEULO to PVEUHI) causes PV alarms to return to normal less frequently.

Range: 0-**Half** (1/2 of 1% of Engineering Unit range)
1-**One** (1% of Engineering Unit range)
2-**Two** (2% of Engineering Unit range)
3-**Three** (3% of Engineering Unit range)
4-**Four** (4% of Engineering Unit range)
5-**Five** (5% of Engineering Unit range)
6-**EU**   Specify deadband in Engineering Units

PVAUTO

Type: **Real**
Lock: **View**
Default: **NaN**
PtRes: **PM or APM**
Range: **N/A**

PV Auto Value — Value of the PV after PVCALC is range checked, filtered, and clamped.

PVAUTOST

Type: **e(PVVALST)**
Lock: **View**
Default: **Bad**
PtRes: **PM or APM**
Range: 0-**Bad** (All inputs, or result in PVCALC is bad)
1-**Uncertn** (Final result in PVCALC is an uncertain value)
2-**Normal** (Final result in PVCALC is a normal value)

PV Auto Value Status — Indicates the current status of the PVAUTO value.

PVCALC

Type: **Real**
Lock: **View**
Default: **NaN**
PtRes: **PM or APM**
Range: **PVEXEUHI** to **PVEXEULO, NaN**

Calculated PV — PVCALC is the PV value in Engineering Units after the raw PV (PVRAW) input to this data point has been characterized. The value of PVRAW is the PV value provided by the Field Termination Assembly (FTA).

PVCHAR

Type: **e(VALCHAR)**
Lock: **PtBld**
Default: **Linear**
PtRes: **PM or APM**

PV Characterization Option — Defines the display characterization to be used for characterizing the input PV value. Characterization is based on the field sensor type, as shown in Tables A-1 and A-2, and is performed by the Smart Transmitter and the Smart Transmitter IOP. The Smart Transmitter IOP does not perform square root PV characterization.

Table A-1 — PV Characterization (Pressure and Flow Transmitters)

Range	Spt_Dp	Spt_Gp	Spt_Ap	Sfm
Linear	X	X	X	X
Sqrroot	X	- -	- -	- -

X = Allowable Sensor Type

Table A-2 — PV Characterization (Temperature Transmitters)

Range	Normal Range (PVEULO to PVEUHI) in Degrees C (except where noted)	Maximum Range (PVEXEULO to PVEXEUHI) in Degrees C (except where noted)
Linear	-50 to 220 mV	-1000 to 1000 mV
Thermocouples:		
Btherm	400 to 1820	200 to 1820
Etherm	-100 to 1000	-200 to 1000
Jtherm	-180 to 1200	-200 to 1200
Ktherm	-170 to 1250	-200 to 1370
NiNiMoTC	600 to 1300	600 to 1300
Ntherm	-100 to 1300	-200 to 1300
Rtherm	0 to 1760	-50 to 1760
Stherm	0 to 1760	-50 to 1760
Ttherm	-120 to 400	-250 to 400
W3W25TC	0 to 2300	0 to 2300
W5W26TC	0 to 2300	0 to 2300
RTDs		
Cu10RTD	-20 to 250	-20 to 250
Cu25RTD	-20 to 250	-20 to 250
Pt100 DinRtd	-200 to 450	-200 to 850
Pt100 JisRtd	-200 to 450	-200 to 640
Pt200 RTD	-200 to 450	-200 to 850
Pt500 RTD	-200 to 450	-200 to 850
RH Rad	420 to 1800	700 to 1800
RTD Ohms	0 to 4 KΩ	0 to 4 KΩ

PVCLAMP

Type: **e(PVCLAMP)**
Lock: **Eng/PB**
Default: **NoClamp**
PtRes: **PM or APM**
Range: 0-**NoClamp** (No clamping of the PV value)
1-**Clamp** (Clamp PV value at range extension limit)

PV Clamping Option — Defines whether PV clamping is to be used for this data point. If PVCLAMP = Clamp and the PV extended range is exceeded, PV value status PVSTS is marked Uncertain and the PV is set equal to the extended limit that was violated.

PVEUHI

Type:	**Real**	**PV High Range In Engineering Units**
Lock:	**Eng/PB**	Note that PVEUHI cannot be written with NaN. NaN is the default value only.
Default:	**NaN**	
PtRes:	**PM or APM**	
Range:	**PVEULO** to **PVEXEUHI, NaN**	

PVEULO

Type:	**Real**	**PV Low Range In Engineering Units**
Lock:	**Eng/PB**	Note that PVEULO cannot be written with NaN. NaN is the default value only.
Default:	**NaN**	
PtRes:	**PM or APM**	
Range:	**PVEXEULO** to **PVEUHI, NaN**	

NOTE

PVEULO and PVEUHI— Smartline transmitters transmit output as a fraction (0 to 1.0) corresponding to percent of span. For all transmitters, the Smart Transmitter IOP relies on the values entered for PVEULO and PVEUHI in the STIM point to calculate the displayed PV. Table A-3 describes how to determine PVEULO and PVEUHI values. STI_EU does not affect the displayed PV. Enter EUDESC to indicate the correct units of the PV to the operator.

Table A-3 — Determining PVEULO and PVEUHI

Transmitter	PV Engineering Units	
ST 3000 STT 3000 MagneW 3000	**For these units…**	**Do this…**
	units defined by STI_EU	Set PVEULO equal to LRV, and PVEUHI equal to URV.
	any user-defined units	Calculate PVEULO and PVEUHI by converting LRV and URV using the basic equation mx+b: x = LRV (to calculate PVEULO) x = URV (to calculate PVEUHI)
Multivariable Transmitters	*Always* calculate PVEULO and PVEUHI by converting LRV and URV using the basic equation mx+b: x = LRV (to calculate PVEULO) x = URV (to calculate PVEUHI)	

Helpful Hint: Section 4.2.1 provides details on the mx+b equation. It shows examples of engineering unit conversions and PVEULO/PVEUHI calculations, along with charts of typical preferred units and corresponding "m" and "b" values.

PVEXEUHI

Type:	**Real**	**PV Extended Engineering Unit Range High —** Both PVEXEUHI and PVEXEULO are used to clamp or detect a bad PV value. Refer to parameter PVEXEULO. Note that PVEXEUHI cannot be written with NaN. NaN is the default value only.
Lock:	**Eng/PB**	
Default:	**NaN**	
PtRes:	**PM or APM**	
Range:	**≥ PVEUHI, NaN**	

PVEXEULO

Type:	**Real**	**PV Extended Engineering Unit Low Range —** Note that PVEXEULO cannot be written with NaN. NaN is the default value only.
Lock:	**Eng/PB**	
Default:	**NaN**	
PtRes:	**PM or APM**	
Range:	**≤ PVEULO, NaN**	

PVEXHIFL

Type:	**Logical**	**PV Extended High Range Violation —** Indicates that the PV has exceeded the extended-high range alarm trip point.
Lock:	**View**	
Default:	**Off**	
PtRes:	**PM or APM**	
Range:	**Off** (Extended high range not exceeded) **On** (Extended high range exceeded)	

PVEXLOFL

Type:	**Logical**	**PV Extended Low Range Violation —** Indicates that the PV has exceeded the extended-low range alarm trip point.
Lock:	**View**	
Default:	**Off**	
PtRes:	**PM or APM**	
Range:	**Off** (Extended low range not exceeded) **On** (Extended low range exceeded)	

PVFORMAT

Type:	**e(VALFORMT)**	**PV Decimal Point Format —** Defines the decimal format that is to be used to display the PV and SP values. It contains up to eight characters including the minus sign and decimal point.
Lock:	**Eng/PB**	
Default:	**D1**	
PtRes:	**PM or APM**	
Range:	0-**D0** (XXXXXX.) 1-**D1** (XXXXX.X) 2-**D2** (XXXX.XX) 3-**D3** (XXX.XXX)	

PVHHFL

Type:	**Logical**	**PV High High Alarm Flag —** Indicates whether the PV has exceeded the alarm trip point established by the PVHHTP parameter.
Lock:	**View**	
Default:	**Off**	
PtRes:	**PM or APM**	
Range:	**Off** (High High limit not exceeded) **On** (High High limit exceeded)	

PVHHPR

Type:	**e(ALPRIOR)**	**PV High High Alarm Priority —** Defines the priority of the PV high high alarm.
Lock:	**Eng/PB**	
Default:	**Low**	
PtRes:	**NIM**	
Range:	**Emergency** (Reported to all Alarm Summary displays) **High** (Reported to Area Alarm Summary display and Unit Alarm Summary display) **Low** (Reported to Unit Alarm Summary display) **Journal** (Logged but not reported to Universal Stations) **NoAction** (Alarm is not reported to the system)	

Helpful Hint:	PVHHPR configuration requires PVHHTP ≠ NaN.

PVHHTP

Type:	**Real**	**PV High High Alarm Trip Point —** Defines the trip point for the PV high high alarm for this point.
Lock:	**Supr**	
Default:	**NaN**	
PtRes:	**PM or APM**	A PV high high alarm is generated when the PV exceeds the PV high high alarm trip point. The PV high high trip point must be equal to or greater than the PV high trip point, but less than or equal to the PV high range plus overrange. A configuration error (mismatch) is detected if a user tries to enter a PV high high trip point value while the PV high trip point value is NaN. A return-to-normal is generated when PV falls below the PV high high alarm trip point, minus the deadband value. No crossover of the PV high high and PV high trip points is allowed.
Range:	**PVHITP** to **PVEXEUHI, NaN**	

Helpful Hint:	PVHHTP configuration requires PVHITP ≠ NaN.

PVHIFL

Type:	**Logical**	**PV High Alarm Flag —** Indicates that the PV has exceeded the alarm trip point established by parameter PVHITP.
Lock:	**View**	
Default:	**Off**	
PtRes:	**PM or APM**	
Range:	**Off** (No PV High alarm) **On** (High PV alarm)	

PVHIPR

Type: **e(ALPRIOR)**
Lock: **Eng/PB**
Default: **Low**
PtRes: **NIM**
Range: **Emergncy** (Reported to all Alarm Summary displays)
High (Reported to Area Alarm Summary display and Unit Alarm Summary display)
Low (Reported to Unit Alarm Summary display)
Journal (Logged but not reported to Universal Stations)
NoAction (Alarm is not reported to the system)

PV High Alarm Priority — Defines the priority of the PV high alarm for this point.

Helpful Hint:	PVHIPR configuration requires PVHITP ≠ NaN.

PVHITP

Type: **Real**
Lock: **Supr**
Default: **NaN**
PtRes: **PM or APM**
Range: **PVLOTP** to **PVHHTP, NaN**

PV High Alarm Trip Point — Defines the trip point for the PV high alarm for this point.

A PV high alarm is generated when the PV exceeds the PV high alarm trip point. The PV high trip point must be equal to or greater than the PV low trip point, and less than or equal to the PV high range plus overrange.

A return-to-normal is generated when the PV falls below the PV high trip point, minus the deadband value.

PVLLFL

Type: **Logical**
Lock: **View**
Default: **Off**
PtRes: **PM or APM**
Range: **Off** (PV ≥ Low Low alarm trip point)
On (PV ≤ Low Low alarm trip point)

PV Low Low Alarm Flag — Indicates that the PV has exceeded the alarm trip point established by the PVLLTP parameter.

PVLLPR

Type: **e(ALPRIOR)**
Lock: **Eng/PB**
Default: **Low**
PtRes: **NIM**
Range: **Emergncy** (Reported to all Alarm Summary displays)
High (Reported to Area Alarm Summary display and Unit Alarm Summary display)
Low (Reported to Unit Alarm Summary display)
Journal (Logged but not reported to Universal Stations)
NoAction (Alarm not reported to the system)

PV Low Low Alarm Priority — Determines the priority of the PV low low alarm for this data point.

Helpful Hint:	PVLLPR configuration requires PVLLTP ≠ NaN.

PVLLTP

Type:	**Real**	**PV Low Low Alarm Trip Point —** Defines the trip point for the PV low low alarm for this point.
Lock:	**Supr**	
Default:	**NaN**	
PtRes:	**PM or APM**	
Range:	**PVEXEULO** to **PVLOTP, NaN**	

Helpful Hint:	PVLLTP configuration requires PVLOTP ≠ NaN.

PVLOFL

Type:	**Logical**	**PV Low Alarm Flag —** Indicates that the PV has exceeded the alarm trip point established by parameter PVLOTP.
Lock:	**View**	
Default:	**Off**	
PtRes:	**PM or APM**	
Range:	**Off** (PV ≥ Low alarm trip point) **On** (PV ≤ Low alarm trip point)	

PVLOPR

Type:	**e(ALPRIOR)**	**PV Low Alarm Priority —** Defines the priority of the PV low alarm for this point.
Lock:	**Eng/PB**	
Default:	**Low**	
PtRes:	**NIM**	
Range:	**Emergncy** (Reported to all Alarm Summary displays) **High** (Reported to Area Alarm Summary display and Unit Alarm Summary display) **Low** (Reported to Unit Alarm Summary display) **Journal** (Logged but not reported to Universal Stations) **NoAction** (Alarm is not reported to the system)	

Helpful Hint:	PVLOPR configuration requires PVLOTP ≠ NaN.

PVLOTP

Type:	**Real**	**PV Low Alarm Trip Point—**Defines the trip point for the PV low alarm for this point.
Lock:	**Supr**	
Default:	**NaN**	
PtRes:	**PM or APM**	A PV low alarm is generated when the PV is less than the PV low trip point. The trip point must be less than or equal to the PV high trip point, and greater than or equal to the PV low range minus overrange. A return-to-normal is generated when PV exceeds the PV low trip point plus the deadband value.
Range:	**PVLLTP** to **PVHITP,** **NaN**	

PVP

Type:	**Real**	**PV In Percent —** Defines the PV as a percentage.
Lock:	**View**	
Default:	**NaN**	
PtRes:	**PM or APM**	
Range:	**N/A**	

PVRAW

Type:	**Real**	**PV Raw Value —** Indicates the raw input value of the PV in % of span based on the transmitter PV after PV characterization (PVCHAR) and DAMPING have been performed. The span of the PV is determined by using LRV as a 0%-point and URV as a 100%-point.
Lock:	**View**	
Default:	**NaN**	
PtRes:	**PM or APM**	
Range:	**N/A**	

PVROCNFL

Type:	**Logical**	**PV Negative Rate-Of-Change Alarm Flag —** Indicates that the PV negative rate-of-change has exceeded the value established by the PVROCNTP parameter.
Lock:	**View**	
Default:	**Off**	
PtRes:	**PM or APM**	
Range:	**Off** (No PV negative rate-of-change alarm) **On** (PV negative rate-of-change alarm)	

PVROCNPR

Type:	**e(ALPRIOR)**	**PV Negative Rate-Of-Change Alarm Priority —** Defines the priority of the PV negative rate-of-change alarm for this point.
Lock:	**Eng/PB**	
Default:	**Low**	
PtRes:	**NIM**	
Range:	**Emergency** (Reported to all Alarm Summary displays) **High** (Reported to Area Alarm Summary display and Unit Alarm Summary display) **Low** (Reported to Unit Alarm Summary display) **Journal** (Logged but not reported to Universal Stations) **NoAction** (Alarm is not reported to the system)	

Helpful Hint:	PVROCNPR configuration requires PVROCNTP ≠ NaN.

PVROCNTP

Type: **Real**
Lock: **Supr**
Default: **NaN**
PtRes: **PM or APM**
Range: **≥ 0.0, NaN**

PV Negative Rate-Of-Change Trip Point — Defines the trip point for the PV negative rate-of-change alarm for this point.

A PV decreasing rate-of-change alarm trip point is specified in parameter PVROCNTP as a decreasing rate per minute, in engineering units. There is no deadband provided for this alarm, but to protect from alarms caused by noise on the PV value, the following mechanism is used:

For the alarm to occur, the change in the PV value (present PV minus previous PV) must exceed the PVROCNTP divided by TS (the processing interval in minutes) for two consecutive processing passes. Similarly, for a return-to-normal, the change in the PV value must be less than PVROCNTP divided by TS, for two consecutive processing passes.

PVROCPFL

Type: **Logical**
Lock: **View**
Default: **Off**
PtRes: **PM or APM**
Range: **Off** (No PV Positive Rate-Of-Change alarm)
On (PV Positive Rate-Of-Change alarm)

PV Positive Rate-Of-Change Alarm Flag — Indicates that the positive rate-of-change of the PV has exceeded the value established by the PVROCPTP parameter.

PVROCPPR

Type: **e(ALPRIOR)**
Lock: **Eng**
Default: **Low**
PtRes: **NIM**
Range: **Emergncy** (Reported to all Alarm Summary displays)
High (Reported to Area Alarm Summary display and Unit Alarm Summary display)
Low (Reported to Unit Alarm Summary display)
Journal (Logged but not reported to Universal Stations)
NoAction (Alarm is not reported to the system)

PV Positive Rate-Of-Change Alarm Priority — Defines the priority of the positive rate-of-change PV alarm for this point.

Helpful Hint:	PVROCPPR configuration requires PVROCPTP ≠ NaN.

PVROCPTP

Type: **Real**
Lock: **Supr**
Default: **NaN**
PtRes: **PM or APM**
Range: **≥ 0.0, NaN**

PV Positive Rate-Of-Change Trip Point—Defines the trip point for the PV positive rate-of-change alarm for this point.

A PV increasing rate-of-change alarm trip point is specified in parameter PVROCPTP as an increasing rate per minute, in engineering units. There is no deadband provided for this alarm, but to protect from alarms caused by noise on the PV value, the following mechanism is used:

For the alarm to occur, the change in the PV value (present PV minus previous PV) must exceed the PVROCPTP divided by TS (the processing interval in minutes) for two consecutive processing passes. Similarly, for a return-to-normal, the change in the PV value must be less than PVROCPTP divided by TS, for two consecutive processing passes.

PVSOURCE

Type: **e(PVSOURCE)** **PV Source —** Defines the source of the PV input to this data point.
Lock: **Oper**
Default: **Auto**
PtRes: **PM or APM**
Range: 0-**Sub** (Value is provided by a control language (CL))
1-**Man** (PV is supplied by operator or program)
2-**Auto** (Field wiring or memory fetch supplies PV)
3-**Track** (PV tracks OP (DigComp points only))

Helpful Hint:	PVSOURCE change by an operator requires PVSRCOPT = All

PVSRCOPT

Type: **e(PVSRCOPT)** **PV Source Option —** Defines the PV source options available in this data point.
Lock: **Eng**
Default: **OnlyAuto**
PtRes: **PM or APM**
Range: 0-**OnlyAuto** (PV source selection is not available and field wiring or memory fetch supplies PV)
1-**All** (PV is provided by an operator, by a sequence program, or by field wiring)

PVSTS

Type: **e(PVVALST)** **Status Of PV Input Value —** Defines the current status of the PV value.
Lock: **View**
Default: **Bad**
PtRes: **PM or APM**
Range: 0-**Bad** (Value is bad and replaced with NaN. For an STI point, value can be set to Bad based on transmitter gross status.)
1-**Uncertn** (Status of the value is uncertain)
2-**Normal** (Value is good)

PVTV

Type: **Real** **PV Target Value In Engineering Units —** Defines the target value of the PV in engineering units.
Lock: **Oper**
Default: **NaN**
PtRes: **PM or APM**
Range: **PVEXEULO** to **PVEXEUHI,**
NaN

PVTVP

Type: **Real** **PV Target Value In Percent —** Indicates the target value of the PV in percent.
Lock: **View**
Default: **NaN**
PtRes: **PM or APM**
Range: $\geq$ **0.0%, NaN**

S1

Type: **String_127**
Lock: **View**
Default: **Blank**
PtRes: **PM or APM**
Range: **N/A, Blank**

Transmitter Status — Indicates the current status of the Smart Transmitter associated with this Smart Transmitter point. Transmitter status consists of
- Transmitter scratch pads 1, 2, 3 and 4
- Detailed transmitter status
- List of parameters whose values are not the same in both the IOP database and the transmitter's database. (Parameters are mismatched.)

SECVAR

Type: **Real**
Lock: **View**
Default: **NaN**
PtRes: **PM or APM**

Secondary Variable—Displays the value of the secondary variable of the Smart Transmitter as follows:
ST 3000—temperature of the transmitter
STT 3000—cold junction temperature
MagneW 3000—totalized value.
For multivariable field devices, refer to the user manual for the specific device.

Range: **N/A, NaN**

SENSRTYP

Type: **e($SENSRTY)**
Lock: **PtBld**
Default: **Spt_Dp***
PtRes: **PM or APM**

Sensor Type — Defines the Smart Transmitter type. The point status is set to SOFTFAIL if a mismatch occurs. Refer to PVCHAR for more information.

* For multivariable field devices, refer to the user manual for the default value of the specific device.

Range:
0-1_5_V (1 to 5 volts)
1-0_5_V (0 to 5 volts)
2-0_100_mV (0 to 100 millivolts)
3-THERMCPL (Thermocouple)
4-RTD (Resistance Temperature Device)
5-P4_2_V (0.4 to 2 volts)
6-SLDWIRE (Slidewire Resistance Device)
7-SLDWSRCE (Slidewire source)
8-**Spt_Dp** (ST 3000—differential pressure)
9-**Spt_Gp** (ST 3000—gauge pressure)
10-**Spt_Ap** (ST 3000—absolute pressure)
11-**Stt** (STT 3000—temperature)
12-**Sfm** (MagneW 3000—magnetic flow, and most multivariable field devices)

SERIALNO

Type: **String_8**
Lock: **View**
Default: **Blank**
PtRes: **PM or APM**
Range: **N/A**

Serial Number of a temperature or MagneW or PROM Number of a pressure transmitter

SLOTNUM

Type: **Integer**
Lock: **PtBld**
Default: **N/A**
PtRes: **NIM**
Range: **AnalgIn** (1–16)

Slot Number—Defines the slot number where this point resides. For IOP point types, it defines the hardware subslot on the module (IOP card) in which the point resides; refer to description of MODNUM parameter. While a multivariable field device is physically connected to only one slot, the user allocates adjacent slots for the other PVs.

STATE

Type:
Lock:
Default:
PtRes:
Range: OK
Db Change
Loading
Load Complete
Load Fail
Calibration
Calibration Complete
Calibration Fail

Transmitter Interface State—

STI_EU

Type: **e(STI_EU)**
Lock: **PTBLD**
Default: **N/A**
PtRes: **PM or APM**

Smart Transmitter Engineering Units — Does not apply to multi-PV transmitters. Specifies units of measurement for parameters LRL, LRV, URL, and URV of ST 3000, STT 3000, and MagneW 3000 transmitters (in R230 and later, the value is defaulted based on transmitter type).

Range:
0-**InH2O** (Pressure transmitter—Inches of water)
1-**MMHG** (Pressure transmitter—Millimeters of mercury)
2-**PSI** (Pressure transmitter—Pounds per square inch)
3-**KPA** (Pressure flow transmitter—Kilopascals)
4-**MPA** (Pressure transmitter—Millipascals)
5-**MBar** (Pressure transmitter—Millibars)
6-**Bar** (Pressure transmitter—Bars)
7-**G_SQCM** (Pressure transmitter—Grams per square centimeter)
8-**KG_SQCM** (Pressure flow transmitter—Kilograms per square centimeter)
9-**MMH2O** (Pressure transmitter—Millimeters of water)
10-**INHG** (Pressure transmitter—inches of mercury)
11-**Deg_C** (Temperature transmitter—Degrees Centigrade)
12-**Deg_F** (Temperature transmitter—Degrees Fahrenheit)
13-**Deg_K** (Temperature transmitter—Degrees Kelvin)
14-**Deg_R** (Temperature transmitter—Degrees Rankine)
15-**MV** (Temperature transmitter—Millivolts)
16-**V** (Temperature transmitter—Volts)
17-**Ohms** (Temperature transmitter—RTD Ohms)
18-**CM_HR** (Magnetic flow transmitter (volume)—Cubic Meters Per Hour)
19-**Gal_HR** (Magnetic flow transmitter (volume)—Gallons per hour)
20-**LIT_HR** (Magnetic flow transmitter (volume)—Liters per hour)
21-**CC_HR** (Magnetic flow transmitter (volume)—Cubic Centimeters per hour)
22-**CM_Min** (Magnetic flow transmitter (volume)—Cubic Meters Per Hour)
23-**Gal_Min** (Magnetic flow transmitter (volume)—Gallons per minute)
24-**Lit_Min** (Magnetic flow transmitter (volume)—Liters per minute)
25-**CC_Min** (Magnetic flow transmitter (volume)—Cubic centimeters per minute)
26-**CM_Day** (Magnetic flow transmitter (volume)—Cubic meters per day)
27-**Gal_Day** (Magnetic flow transmitter (volume)—Gallons per day)
28-**KGal_Day** (Magnetic flow transmitter (volume)—Thousands of gallons per day)
29-**BRL_Day** (Magnetic flow transmitter (volume)—Barrels per day)
30-**CM_Sec** (Magnetic flow transmitter (volume)—Centimeters per second)
31-**KG_HR*** (Magnetic flow transmitter (mass)—Kilograms Per Hour)
32-**LBS_HR*** (Magnetic flow transmitter (mass)—Pounds Per Hour)
33-**Ft_Sec*** (Magnetic flow transmitter (velocity)—Feet per second)
34-**M_Sec*** (Magnetic flow transmitter (velocity)—Meters per second)
35-**KG_Min*** (Magnetic flow transmitter (mass)—Kilograms per minute)
36-**KG_Sec*** (Magnetic flow transmitter (mass)—Kilograms per second)
37-**LBS_Min*** (Magnetic flow transmitter (mass)—Pounds per minute)
38-**LBS_Sec*** (Magnetic flow transmitter (mass)—Pounds per second)
39-**PRCNT***(Percent)
40-**BLANK** (Blank)—(Multi-PV Transmitter with SFM SENSRTYP)
41-**LBS***(Pounds)
42-**KG***(Kilograms)
43-**TONS***(Tons)
44-**GRAMS***(Grams)
45-**OZ***(Ounces)
46-**GAL***(Gallons)
47-**BRL***(Barrels)
48-**CUB_M***(Cubic Meters)
49-**LITERS***(Liters)
50-**MLITRES***(Milliliters)
51-**FL_OZ***(Fluid Ounce)
52-**FEET***(Feet)
53-**METER***(Meters)
54-**MM***(Millimeters)
55-**INCHES***(Inches)
56-**KG_CUM***(Kilograms per cubic meter)
57-**G_CUM***(Grams per cubic meter)
58-**LBS_CUFT***(Pounds per cubic foot)
59-**LBS_CUIN***(Pounds per cubic inches)

---

* Not implemented. When any of the “Not Implemented” units are loaded at point build time, a FUNCTION NOT IMPLEMENTED error results.

STI_EU, continued

> **NOTE**
>
> **Valid STI_EU Selections—**In the PED, the selections displayed for STI_EU are the same for all transmitters, although they are not all applicable or valid.
>
> The operation of the STI_EU parameter is different based on whether the transmitter is a traditional single variable type transmitter or a multivariable transmitter. Table A-4 describes the valid STI_EU selections and how STI_EU affects the display of range values.

Table A-4 — STI_EU for Transmitter Types

Transmitter	STI_EU
ST 3000 STT 3000 MagneW 3000	All relevant engineering unit selections are available. The STI_EU choices for MagneW are the same as those available using the SFC. Display of range values: URL, LRL, URV, and LRV are converted to the selected STI_EU units for display only (Detail display).
Multivariable Transmitters	For slots with a SENSRTYP of SFM, the STI_EU parameter is not used. Select CM_HR (before R400) or BLANK (R400 and later). BLANK is preferred. For slots with SENSRTYP of SPT_DP, SPT_AP, SPT_GP, or STT, choose the preferred STI_EU (engineering units). Display of range values: When BLANK (or CM/HR) is selected, the limit values URL, LRL, URV, and LRV are always displayed in the base engineering units specified in the transmitter user manual.

> **NOTE**
>
> **STI_EU database discrepancy—**The PED does not perform error checking on the selected STI_EU; therefore it is possible to enter and load a point configuration containing an invalid STI_EU. When the point is made ACTIVE, a database discrepancy occurs on STI_EU (STATE = DBCHANGE). For a multivariable transmitter, any STI_EU configuration other than CM_HR or BLANK results in an STI_EU database discrepancy. If the user attempts to correct the STI_EU from the Detail display, any selection is rejected as "CONFIG MISMATCH."

Helpful Hint:	To correct an STI_EU database discrepancy, do one of the following: • load the correct STI_EU parameter from the PED, or • perform a transmitter UPLOAD from the point Detail display.

STISWVER

Type: **String_8** — **Software Revision Level of the Smart Transmitter**
Lock: **View**
Default: **Blank**
PtRes: **PM or APM**
Range: **N/A**

STITAG

Type: **String_8**
Lock: **Eng/PB**
Default: **All Spaces**
PtRes: **PM or APM**

Transmitter Tag Name — Identifies the name of the Smart Transmitter to the system and on displays, reports, and logs. Besides serving as a transmitter identification name, the IOP uses the number of identical STITAG names to calculate the number of PVs associated with a given field device. An STITAG name must be entered for all multivariable field devices. A blank or null entry assumes a single PV transmitter.

Range: Tag name can be up to 16 characters, and the permissible character set is as follows:
Alphabetics A-Z (uppercase or lower case)
Numerics 0-9
Embedded space characters are allowed.

TF

Type: **Real**
Lock: **Supr**
Default: **0.0 minutes**
PtRes: **PM or APM**
Range: **0.0** to **60.0 minutes**

PV Filter Lag Time In Minutes — Defines the filtering time lag to be used after the PV range has been checked. A value of 0.0 specifies that the PV is not delayed.

UNIT

Type: **String_2**
Lock: **PtBld**
Default: **N/A**
PtRes: **NIM**

Unit Identifier — Defines the process unit to which this point is assigned. The unit identifier is originally assigned during network configuration, and it appears in displays and listings throughout the system.

Restriction: Two characters are required; blanks are not allowed. For example, unit 3 must be entered as 03.

CL and Picture Editor — An integer is returned. This number is equivalent to the unit position in the Unit Name configuration list.

Range: **A-Z, 0-9** (up to 100 unit IDs can be configured)

Helpful Hint:	UNIT is the external parameter name. UNITNUM is the internal name.

URL

Type: **Real**
Lock: **Eng/View**
Default: **NaN**
PtRes: **PM or APM**
Range: **N/A, NaN**

Upper Range Limit — Indicates the upper range limit of the PV at the Smart Transmitter. This limit is a fixed limit and cannot be changed in the transmitter. Refer to the description of the STI_EU parameter for the URL engineering units. During configuration, the value entered for this parameter must agree with the URL value of the transmitter. Although any value can be entered during configuration, a database mismatch will occur when the point is made active because the transmitter's URL value and the IOP's URL value are not the same. If the values are not the same, the STATE parameter value becomes DBCHANGE and the PV status (PVSTS) becomes Bad (see NOTE under PVCHAR parameter). The user should perform the UPLOADDB command to resolve the discrepancy.

The corresponding LRL parameter is not a configurable parameter at the Universal Station.

The upper range limits for the ST, STT, and MagneW 3000 Smart Transmitters are shown in Tables A-3 to A-5. For multivariable field devices, refer to the user manual for the specific device.

NOTE

URL and PVCHAR—The user should be aware that most changes in PVCHAR cause an automatic change in URL. For example, if the PVCHAR for STT is changed from J to K thermocouple, URL automatically changes from 1200 to 1370 degrees C. Therefore, both PVCHAR *and* URL must be changed in the point configuration before the point is made active.

To make URL changes easier, a HELP screen is available from the PED, providing a chart of sensor types, characterizations, and corresponding URL values. To access the Help screen, press the [HELP] key while the cursor is on URL (see Figure 6-10).

Only URL may be corrected in the Detail display.

Table A-3 — ST 3000 Range Limits

For the ST 3000 Smart Pressure Transmitters (SPT__DP, SPT__GP and SPT__AP):

Xmtr Range	URL (InH_2O)
400 inH_2O	400.0
600 inH_2O	600.0
780 mmHga	400.0
100 PSI	2768.0
200 PSI	5536.13
500 PSI/A	13840.34
1500 PSI	41521.0
2000 PSI	55361.35
3000 PSI	83042.02
6000 PSI	166084.0
10000 PSI	276806.7

Table A-4 STT 3000 Range Limits

For the STT 3000 Smart Temperature Transmitter:

Sensor Type (PVCHAR)	URL (In Degrees C except where noted)
Linear (mV)	1000 mV
Thermocouples:	
B	1820
E	1000
J	1200
K	1370
NiNiMoTC	1300
N	1300
R	1760
S	1760
T	400
W5W26TC	2300
W3W25TC	2300
RTDs:	
Cu10RTD	250
Cu25RTD	250
DINRTD	850
JISRTD	640
NicklRTD	150
Pt200	850
Pt500	850
RHRad	1800
RTD (ohms)	4000 Ω

Table A-5 — MagneW 3000 Range Limits

For the MagneW 3000 Magnetic Flowmeter (Sfm):

URL (in meters^3/hour) = $\frac{\pi D^2}{4x10^6}$ x 3600 x (N + 1)

where:
- D = the detector diameter in millimeters as follows: 2.5, 5, 10, 15, 25, 40, 50, 80, 100, 150, 200, 300, 350, 400, 500, 600, or 700
- N = the number of dummy submerged detectors, from 0 to 9

URV

Type:	**Real**	**Upper Range Value —** Defines the upper end of the operating range for the PVRAW value. Refer to the description of the STI_EU parameter for the URV engineering units.
Lock:	**Supr/View**	
Default:	**NaN**	
PtRes:	**PM or APM**	
Range:	**N/A, NaN**	

This parameter is a view-only parameter when the Smart Transmitter point execution state PTEXECST is Active (indicating that changes cannot be made in this parameter value from the Universal Station).

Although the following maximum values can be entered, values above the URL are not recommended and accuracy is not guaranteed in such cases:

For a pressure transmitter (Spt): URV_{max} = 2.0 x URL
For a temperature transmitter (Stt): URV_{max} = 2.0 x URL
For a magnetic flow transmitter (Sfm): URV_{max} = 12.0 x URL

USERID

Type:	**String_16**	**User ID Reservation —** The user ID that currently has reserved this point. The user can be changed by either a point, program, or operator. The operator can overwrite the USERID parameter at anytime. A program can store a nonblank string in this para meter only if it is blank. Blanks can be stored by a program unless the USERID starts with three dashes (---).
Lock:	**Oper**	
Default:	**Dashes**	
PtRes:	**APM**	
Range:	**16 Character String**	

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