DOC. NO. : 3700N-E01I

AUTROL®

Smart Pressure Transmitter For Nuclear Service

for Differential / Gauge / Absolute Pressure Measurement

MODEL

APT 3700N

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Smart Pressure Transmitter

APT3700N

Description of Product

The APT3700N Smart Pressure Transmitter is a micro processor-based high performance transmitter, which has flexible pressure calibration and output, automatic compensation of ambient temperature and process variable, configuration of various parameters, communication with HART protocol. The application is very various, as measuring pressure, flow and level by application method. All data of sensor is to be input, modified and stored in EEPROM.

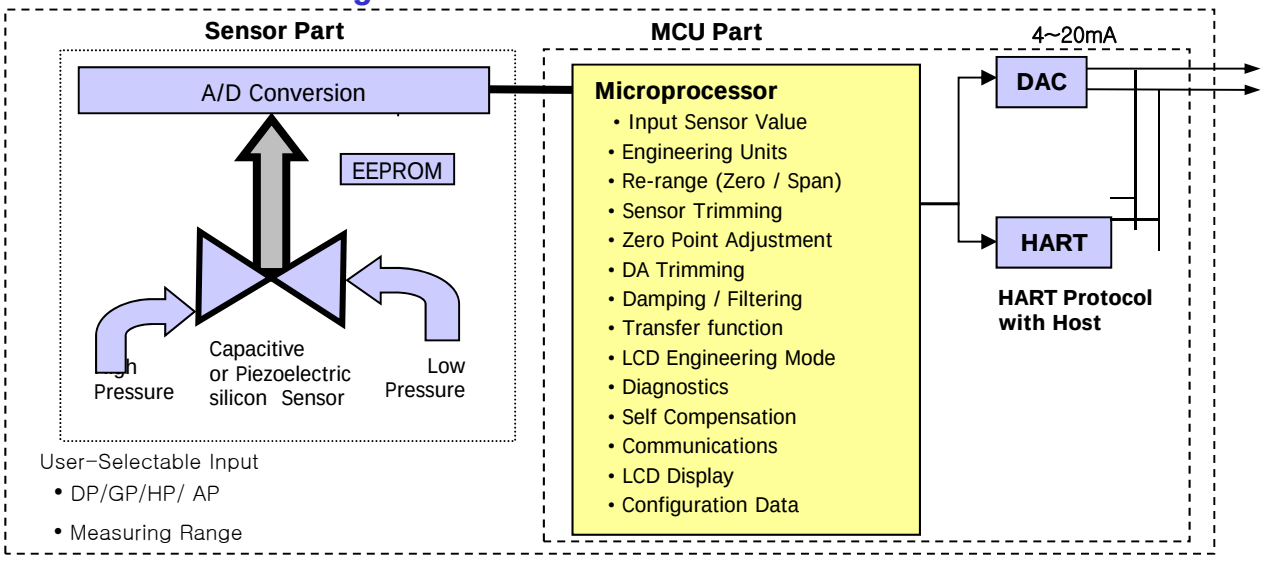
Function

- Flexible Sensor Input : DP, GP, AP, Vacuum
- Various Output : 4 ~20mA , Digital Signals
- Setting Various Parameters : Zero/Span, Trim, Unit, Fail-mode, etc.
- Self Diagnostic Function : Sensor, Memory A/D Converter, Power, etc
- Digital Communication with HART protocol
- Explosion-proof Approval KOSHA
- Qualified per IEEE Std 344-1987/2004 and IEEE Std 323-1983/2003, NRC Regulatory Guide 1.180 (Rev.1)

Features

- Superior Performance
  - High Reference Accuracy : ±0.075% of Calibrated Span
  - Long-Term Stability : ± 0.25% URL per 24 months
  - High Rangeability (100 : 1)
- Flexibility
  - Data Configuration with HART Configurator
  - Zero Point Adjustment
- Reliability
  - Continuous Self-Diagnostic Function
  - Automatic Ambient Temperature Compensation
  - Fail-mode Process Function
  - EEPROM Write Protection
  - Equipment Qualifications
    - Environmental Qualification
    - Seismic Qualification and EMI / RFI Test

Functional Block Diagram



APT3700N
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Transmitter Description

Electronics Module

The Electronics module consists of a circuit board sealed in an enclosure.
There are a MCU module, a power module, an analog module and a terminal module in a transmitter.
The MCU module acquires the digital value from the analog module and apply correction coefficients selected from EEPROM.
The output section of the power module converts the digital signal to a 4~20 mA output.

The MCU module communicates with the HART-based Configurator or Maintenance System such as HTT 275 or 375 and AMS.
The Power module have a DC-to-DC Power conversion circuit and an Input/output isolation circuit.
An optional LCD module plugs into the MCU module and displays the digital output in user-configured unit.

Sensor Inputs

The model APT3700N-D,G,H is available in a differential pressure sensor of a capacitance type.
The capacitance pressure sensor measures differential and gauge pressure and is commonly used in flow and level applications. Both sides in the capacitance sensor transmit process pressure from the process isolators to the sensor.
The model APT3700N-A,G is available in a absolute pressure and high gage pressure sensor of a piezo-resistive type and measures absolute/high gage pressure.
The sensor module converts the capacitance or the resistance to the digital value.
The MCU module calculates the process pressure based on the digital value.

- The software of the transmitter compensates for the thermal effects, improving performance.
- Precise Input Compensation during operation is achieved with temperature and pressure correction coefficients that are characterized over the range the transmitter and stored in the sensor module EEPROM memory
- EEPROM stores sensor information and correction coefficients separately from MCU module, allowing for easy repair, reconfiguration and replacement

Class 1E safety related Applications

Seismic test : IEEE Std 344 at 5 OBE and 1 SSE response spectrum.
Environment test : IEEE Std 323 (Thermal, radiation , Functional Aging)
EMI/RFI test : MIL-STD-461D & 462D, RG 1.180, IEC61000-4-2(EMC, ESD, EFT/Burst Surge)

Basic Setup

ATP3700N Pressure transmitter can be easily configured from any host that support the HART protocol.

- Operational Parameters.
- 4~20mA Points (Zero/Span)
- Engineering Units
- Damping Time : 0.25 ~ 60 sec
- Tag : 8 alphanumeric characters
- Descriptor : 16 characters
- Message : 32 characters.
- Date : day/month/year

Calibration and Trimming

- Lower/Upper Range (zero/span)
- Sensor Zero Trimming
- Zero Point Adjustment
- DAC Output Trimming
- Transfer Function
- Self-Compensation

Self-Diagnosis and Others

- CPU & Analog Module Fault Detection
- Communication Error
- Fail-mode Handling
- LCD Indication
- Temperature Measurement of Sensor Module

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Performance Specifications

Range and Sensor Limits
• Refer to Table 1

Reference Accuracy of Calibrated Span
• for range 2
±0.25% of Span for 0.15URL ≤ Span ≤ URL
±[0.24 + (0.008 x (URL/span))]% of Span
for 0.05URL ≤ Span < 0.15URL

• for range 3
±0.25% of Span for 0.1URL ≤ Span ≤ URL
±[0.24 + (0.003 x (URL/span))]% of Span
for 0.02URL ≤ Span < 0.1URL

• for ranges 4 through 7, 9, 0
±0.075% of Span for 0.1URL ≤ Span ≤ URL
±[0.025+(0.005 x (URL/span))]% of Span
for 0.01URL ≤ Span ≤ 0.1URL

• for range 8
±0.2% of Span for 0.1URL ≤ Span ≤ URL
±[0.2+ (0.005 x (URL/span))]% of Span
for 0.01URL ≤ Span ≤ 0.1URL

Zero and Span Adjustment Limits
• Zero and span values can be set anywhere within the range limits stated in Table 1. Span must be greater than or equal to the minimum span stated in Table 1

Output (Analog Current and Digital Data)
• Two wire 4~20mA
user-configurable for linear or square root output, digital process value superimposed on 4~20mA signal, available to any host that conforms to the HART protocol

Power Supply & Load Requirement
• **External power supply required.**
Transmitters operate on 12.5 to 45 V dc.
* 250 ohm load-- 17.5 Vdc
* up to a 550 ohm load -- 24 Vdc
Max. Loop Resistance = (E - 11.9) / 0.022
(E = Power Supply Voltage)

• **Supply Voltage**
12.5 ~ 45 Vdc -- operation
17.5 ~ 45 Vdc -- HART Communications
* 0.9W @ 45Vdc

• **Loop Load**
0 ~ 1500 ohm -- Operation
250 ~ 550 ohm -- HART Communications

EMC Conformity Standards
• MIL-STD-461D & 462D, RG 1.180, IEC61000-4-2(EMC, ESD, EFT/Burst, Surge)

Update Time and Turn-On Time
• Update Time : 0.2 seconds
• Turn-On Time : 3 seconds

Failure Mode
• Fail High : Current ≥ 21.75 mA
• Fail Low : Current ≤ 3.75 mA

Operating Temperature
• -40℃ to 85℃ (without condensing)

Process Temperature Limits
(Range codes and approval codes may effect limits)
• -40℃ to 120℃ (-40 to 248 ℉)

Isolation
• Input/output isolated to 500Vrms (707 Vdc)

Working Pressure Limits (silicone oil)
• **Model DP & GP**	0 ~ 13.79 MPa --- # 3 ~ 8
• **Model GP**	0 ~ 31.02 MPa --- # 9
	0 ~ 51.71 MPa --- # 0
• **Model HP**	0 ~ 31.02 MPa --- # 4 ~ 7
• **Model AP**	0 ~ 400 KPa --- # 4
	0 ~ 1500 KPa --- # 5
	0 ~ 3000 KPa --- # 6

Hydrostatic Test Pressure
• **Model DP**	3000 psi (20.7 MPa)
• **Model HP**	6750 psi (46.5 MPa)
• **Model GP**	2000 psi (13.8 MPa) --- # 3 ~ 8
	4500 psi (31.0 MPa) --- # 9
	7500 psi (51.7 MPa) --- # 0
• **Model AP**	58 psi (400 KPa) --- # 4
	218 psi (1500 KPa) -- # 5
	435 psi (3000 KPa)--- # 6

Burst Pressure
• **Model DP,GP & HP** -------10000 psi (68.9MPa)
• **Model AP** ---------- 2 x URL

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Physical Specifications

Wetted Materials
- Isolating Diaphragms ---- 316L SST, Monel, Tantalum, HAST-C
- Drain/Vent Valves -------- 316 SST, HAST-C
- Flanges and Adapters ---- 316 SST, HAST-C
- O-ring ---------- Viton, PTFE, 316SST

Non-wetted materials
- Fill Fluid ---------- Silicone oil or Inert fill
- Bolts ---------- Stainless Steel
- Electronics Housing -- Aluminum, 316SST, Flameproof and Waterproof (IP67)
- Cover O-ring ---------- Buna-N
- Paint ---------- Epoxy-Polyester or Polyurethane
- Mounting Bracket ----- 2-inch Pipe, 304 SST, Painted Carbon Steel with 304 SST U-bolt
- Nameplate ---------- 304 SST

Electrical connections
- 1/2-14 NPT conduit with M4 Screw Terminals

Process Connections
- 1/4-18 NPT on 2.126 inch (54.0 mm) centers on flanges for Standard
- 1/2-14 NPT on Process Adapter (option)

*** Refer to drawing in the last page**

Weight
- 5.5 kg (excluding options)

QAP and Qualification Item

Quality Assurance Program
In accordance with KEPIC-QAP & KEPIC-EN

Qualification Item (Mild Environment)
- Radiation
- Relative Humidity
- Temperature
- Pressure (Thermal aging, Operational Cycling)
- Seismic

Hazardous Location Certifications (default)

KOSHA Approvals (KOSHA: Korea Occupational Safety & Health Agency) **K1 Code :**
Flameproof for Class I, Zone 1 : Ex d ⅡC T6, IP67
Ambient Temperature : -20 to 60 °C
Max. Process Temperature : 80 °C
Power Supply : Max. 45 Vdc
Output : 4 to 20 mA + HART, Max. 22 mA

KTL TEST REPORT (No. 14-023955-04)
Test for degree of protection provided by enclosures (IP Code) : IP 66

Pressure Limits & Hydrostatic Test Conditions

Model	Range Code	Static Pressure (Overpressure Limits)	Hydrostatic Test Pressure
APT3700N-Dx	Range 2-8	13.79 Mpa (2,000 psig)	23.7 Mpa (3,000 psi)
APT3700N-Hx	All range	13.02 Mpa (4,500 psig)	46.5 Mpa (6,750 psi)
APT3700N-Gx	Range 2-8	13.79 Mpa (2,000 psig)	13.8 Mpa (2,000 psi)
	Range 9	31.02 Mpa (4,500 psig)	31.0 Mpa (4,500 psi)
	Range 0	31.02 Mpa (4,500 psig)	51.7 Mpa (7,500 psi)
APT3700N -Ax	Range 4	400 kpa (58 psig)	400 kpa (58 psig)
	Range 5	1,500 kpa (218 psig)	1,500 kpa (218 psig)
	Range 6	3,000 kpa (435 psig)	3,000 kpa (435 psig)

- APT3700N-Dx Differential Pressure Transmitter
- APT3700N-Gx Gauge Pressure Transmitter
- APT3700N Hx Differential High Line Pressure Transmitter
- APT3700N Ax Absolute Pressure Transmitter

General Specifications

(Rangeability : #2=20:1 / #3=50:1 / 4~0=100:1)

1. APT3700N Pressure Sensor Range & URL

< Table 1 >

Range Code	DP/GP/HP					AP	
	Calibrated Span (KPa)	Upper Range (URL) (KPa)	Lower Range (LRL) (KPa)			Calibrated Span (KPa)	Range (KPa)
			D.P	G.P	H.P		
2	0.075 ~ 1.5	1.5	-1.5	-1.5	NA	NA	NA
3	0.25 ~ 7.5	7.5	-7.5	-7.5	NA	NA	NA
4	0.373 ~ 37.3	37.3	-37.3	-37.3	-37.3	2 ~ 200	0 ~ 200
5	1.865 ~ 186.5	186.5	-186.5	-100	-186.5	10 ~ 1000	0 ~ 1000
6	6.9 ~ 690	690	-690	-100	-690	21 ~ 2100	0 ~ 2100
7	20.68 ~ 2068	2068	-2068	-100	-2068	NA	NA
8	68.95 ~ 6895	6895	-6895	-100	NA	NA	NA
9	206.8 ~ 20680	20680	NA	-100	NA	NA	NA
0	413.7 ~ 41370	41370	NA	-100	NA	NA	NA

Range Code	KPa	Kg/c㎡	bar	psi	inH_2O@4℃	mmH_2O@4℃	inHg@0℃
2	1.5	0.015	0.015	0.217	6	152	0.442
3	7.5	0.076	0.075	1.087	30	765	2.215
4	37.3	0.38	0.373	5.410	149	3804	11.014
5	186.5	1.902	1.865	27.049	749	19018	55.072
6	690	7.036	6.900	100.073	2773	70361	203.750
7	2068	21.088	20.680	299.930	8310	210878	610.660
8	6895	70.309	68.950	1000.009	27708	703097	2036.025
9	20680	210.876	206.800	2999.303	83105	2108781	6106.597
0	41370	421.856	413.700	6000.211	166085	4218566	12216.550

2. Electrical Specifications

Power Supply	12.5 ~ 45 Vdc	Output Signal	4 ~ 20 mA dc / HART
HART loop resistance	250 ~ 550 ohm	Isolation	500 Vrms (707 Vdc)

3. Performance Specifications

Reference Accuracy	± 0.075% of Span (0.1URL≤Span ≤URL) ±[0.025+0.005x(URL/Span)]% of Span (0.01URL≤Span<0.1URL)	Ambient Temperature	-40 ~ +85 ℃
		LCD Meter Ambient Temp.	-30 ~ +80 ℃
		Humidity Limits	5% ~ 100% RH
Ambient Temp. Effect	±[0.019%URL+0.125% Span] / 28 ℃	Process Temperature Limits	-40℃ ~ +120 ℃
Stability	±0.125% URL for 12 Months	Power Supply Effects	±0.005% of Span per Volt
Static Pressure Effects	±0.1% of URL per 7MPa (Zero Error) ±0.2% of Reading per 7Mpa (Span Error)	Mounting Position Effects	Zero Shift up to 350Pa No Span Effect

* LCD : User Requirements

4. Physical Specifications

Isolating Diaphragm	316L SST	Process Connection Size	1/4 - 18 NPT
Drain & Vent Valve	316 SST	(Adapter – Option)	1/2 – 14 NPT
Flange & Adapter	316 SST	Electrical Connections	1/2 – 14 NPT with M4
O-ring	Viton, PTFE	Weight (excluding Option Items)	5.5Kg
Electronic Housing	Aluminum	2” Pipe Stanchion Type bracket	Angle or Flat type
Bolts & Bolting Flange	304 SST	Housing Class	Waterproof (IP66/67) / NEMA 4x compatibility

5. Hazardous Location Certifications (option)

Korea Standards Approval & KTL Test Report
Flameproof Approval : Ex d IIC T6 (IP 66/67)

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Ordering Information

MODEL	Code	Description					
Type	D	Differential Pressure Transmitter (Static Pressure 13.79 MPa / 2000psi)					
	G	Gauge Pressure Transmitter					
	H	Differential Pressure Transmitter for High Line Pressure (Static Pressure 31.02MPa / 4500psi)					
	A	Absolute Pressure Transmitter					
Ranges		DP/GP/HP					AP
		Calibrated Span Min. to Max	Lower Range Limit			Upper Range Limit	Range
			APT3700N-D	APT3700N-G	APT3700N-H		APT3700N-A
	2	0.075 ~ 1.5 KPa (0.302~6.022 inH_2O)	-1.5 KPa (-6.022 inH_2O)	-1.5 KPa (-6.022 inH_2O)	NA	1.5 KPa (6.022 inH_2O)	NA
	3	0.15 ~ 7.5 KPa (0.6~30 inH_2O)	-7.5 KPa (-30 inH_2O)	-7.5 KPa (-30 inH_2O)	-7.5 KPa (-30 inH_2O)	7.5 KPa (30 inH_2O)	NA
	4	0.373 ~ 37.3 KPa (1.5~150 inH_2O)	-37.3 KPa (-150 inH_2O)	-37.3 KPa (-150 inH_2O)	-37.3 KPa (-150 inH_2O)	37.3 KPa (150 inH_2O)	0~200 KPa
	5	1.865 ~ 186.5 KPa (7.5~750 inH_2O)	-186.5 KPa (-750 inH_2O)	-98KPa (-14.7 psi)	-186.5 KPa (-750 inH_2O)	186.5 KPa (750 inH_2O)	0~1000 KPa
	6	6.9 ~ 690 KPa (1~100 psi)	-690 KPa (-100 psi)	-98KPa (-14.7 psi)	-690 KPa (-100 psi)	690 KPa (100 psi)	0~2100 KPa
	7	20.68 ~ 2068 KPa (3~300 psi)	-2068 KPa (-300 psi)	-98KPa (-14.7 psi)	-2068 KPa (-300 psi)	2068 KPa (300 psi)	NA
	8	68.95 ~ 6895 KPa (10~1000 psi)	-6895 KPa (-1000 psi)	-98KPa (-14.7 psi)	NA	6895 KPa (1000 psi)	NA
	9	206.8 ~ 20680 KPa (3~3000 psi)	NA	-98KPa (-14.7 psi)	NA	20680 KPa (3000 psi)	NA
	0	413.7 ~ 41370 KPa (60~6000 psi)	NA	-98KPa (-14.7 psi)	NA	41370 KPa (6000 psi)	NA
Mounting Flange /Material		Flange / Adapters		Vent Plug		Diaphragm	
	M11	316 SST		316 SST		316L SST	
	M12	316 SST		316 SST		HAST - C	
	M13	316 SST		316 SST		MONEL	
	M14	316 SST		316 SST		Tantalum	
	M22	HAST – C		HAST – C		HAST – C	
	M23	MONEL		MONEL		MONEL	
	M24	Tantalum		Tantalum		Tantalum	
	M31	CS		CS		316L SST	
Electronic Housing	S	316 SST					
	A	Aluminum					
Fill Fluid	1(L)	Silicone					
	2(H)	Inter Fill					
Process Connection	4N	1/4 - 18 NPT (Standard)					
	3N	3/8 – 18 NPT Female (Adapter)					
	2N	1/2 - 14 NPT Female (Adapter)					
Electrical Connection	1	1/2-14NPT					
	2	G 1/2					
	X	Special					
Nuclear Data *1		Safety Class	Seismic Category	Quality Class	Environmental Zone	Electric Class	
		S (Safety)	1	Q*2	O	1 E*2	
		NS(Non – Safety)	2	T		NE (Non – 1E)	
			3	R			
				S			
Option	M1	LCD Indicator					
	W	SUS 304 Bolts and Nuts					
	C6	Engineering Unit					
	C7	Custom Calibration					
	K	Oil Free Finish					
	BA	Stainless Steel Bracket (Angle type) with SST Bolts					
	BF	Stainless Steel Bracket (Flat type) with SST Bolts					
	CA	Painted Steel Mounting Bracket (Angle Type) with SST Bolts					
	CF	Painted Steel Mounting Bracket (Flat Type) with SST Bolts					

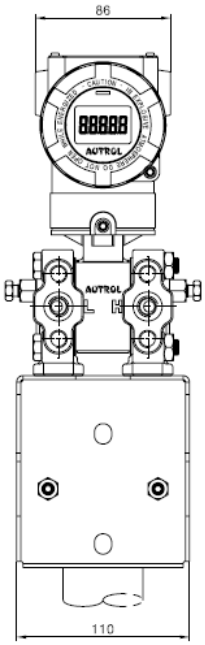
Example : APT3700N-D5-M11A1L3N1-NS3TONE-M1WBA

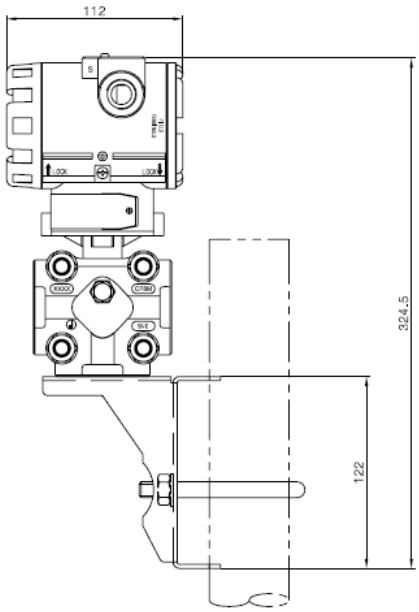
*1 : KHNP, Spec. NO. 9-183-J230C " Intelligent Type Field Instrument"

*2 : Request to manufacturer for Safety Class Items

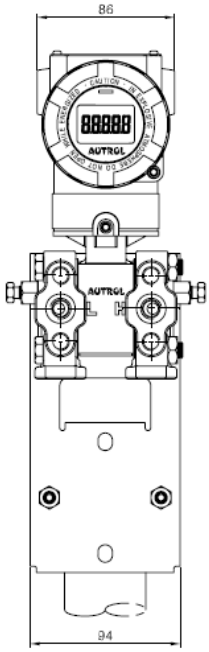
Installation with mounting bracket

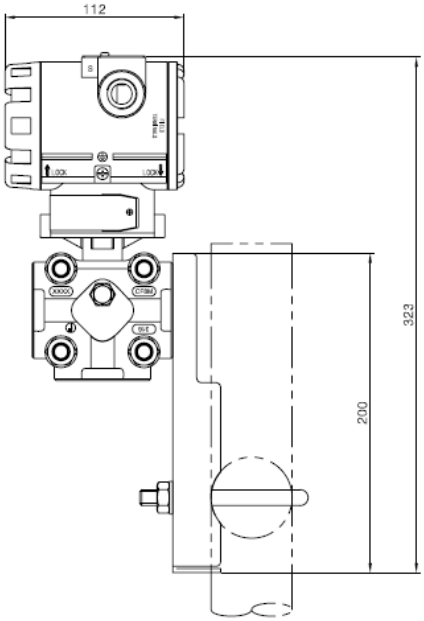
2” Pipe Mounting Bracket
Model Angle Type



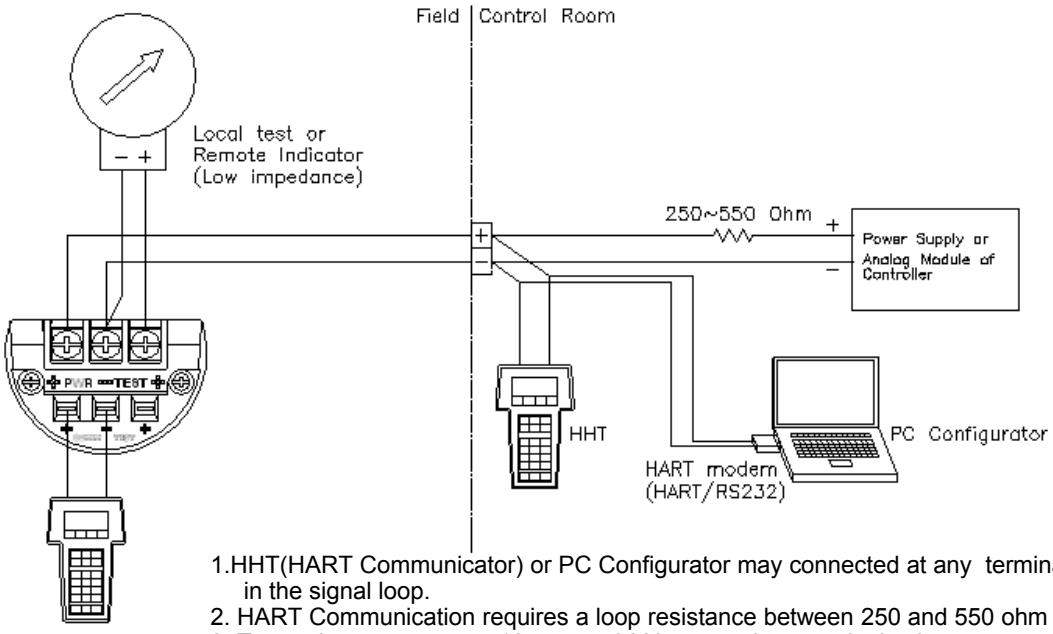


2” Pipe Mounting Bracket
Model Flat Type





Connection Diagram of Signal, Power, HHT for Transmitter



1.HHT(HART Communicator) or PC Configurator may connected at any termination point in the signal loop.
2. HART Communication requires a loop resistance between 250 and 550 ohm @ 24 Vdc
3. Transmitter operates on 12.5 to 45.0 Vdc transmitter terminal voltage.
[Applied Power]
* 12.5 ~ 45.0 Vdc for General Operation
* 17.5 ~ 45.0 Vdc for HART Communication

Dimensions of Transmitter (mm)