

AUTROL®

DOC. NO. : C3700N-E21B



Smart Pressure Transmitter For Nuclear Service

for Differential / Gauge / Absolute Pressure Measurement



MODEL : APT3700N
Manufacturer : DUON System Co., Ltd.
Brand : **AUTROL®**

MODEL APT3700N

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AUTROL®, AUTROL™ are trade mark of smart transmitter brand series to measure Pressure, Temperature and Level, which is manufactured & owned by DUON System Co., Ltd(hereafter DUON) since 1989. AUTROL®, AUTROL™ series also provide services of electric appliance installation, repair of electric, magnetic measuring instruments, electric appliance repair, repair of instruments and appliances for measuring and testing, repair of computer hardware, repair of electronic application machines and apparatus, repair of instruments and appliances for rotating, repair of electric power distribution machines and apparatus, repair of control machines and apparatus, computer hardware maintenance and administration, computer hardware installation. APT3500-Differential and high accuracy pressure Transmitter APT3100-Differential pressure Transmitter, APT3200-Gauge & Absolute pressure Transmitter, APT2100-Temperature Transmitter, AI100-Field Indicator.

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 sensor modules include the following features

- 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

Basic Setup

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

- HART Version
- 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
- Temperature Measurement of Sensor Module
- Fail-mode Handling
- LCD Indication

Nuclear Specification

- Qualification Code(STANDARD)
- Seismic-IEEE STD.323-2003(5 OBE&1 SSE response spectrum)
- Environment-IEEE STD.344-2004(Thermal, Radiation, Functional Aging)

- EMI/RFI

- USNRC R.G 1.180(Rev.1)
- IEC61000 series of EMI/RFI test methods
- Refer to Autrol Technical -> Documents "T 37sun-012-1"

- Software(Firmware) V&V(Verification & Validation)

- IEEE STD. 7-4.32

• Qualification Item - Environmental

• Qualified like 41years by Aging Analysis

• Temperature Humidity, -20 °C ~ +60 °C, Max 98% RH

• Test Audient Temperature is Atmospheric Pressure

- Radiation, 1.0x10² Gy(1.0x10⁴ rads),(Cobalt-60 gamma ounce)

- SEISMIC

EVENT	Damping
OBE(1/2 of SSE)	2%
SSE	3%

• SEISMIC is test according to required response spectra on[Fig.1]

- Cleaning

Wettied part cleaning according to "2.1 Quality Assurance requirements for cleaning of fluid system and associated components for Nuclear power plants" in KEPIC QAP-2

• Hydrostatic or pneumatic Test

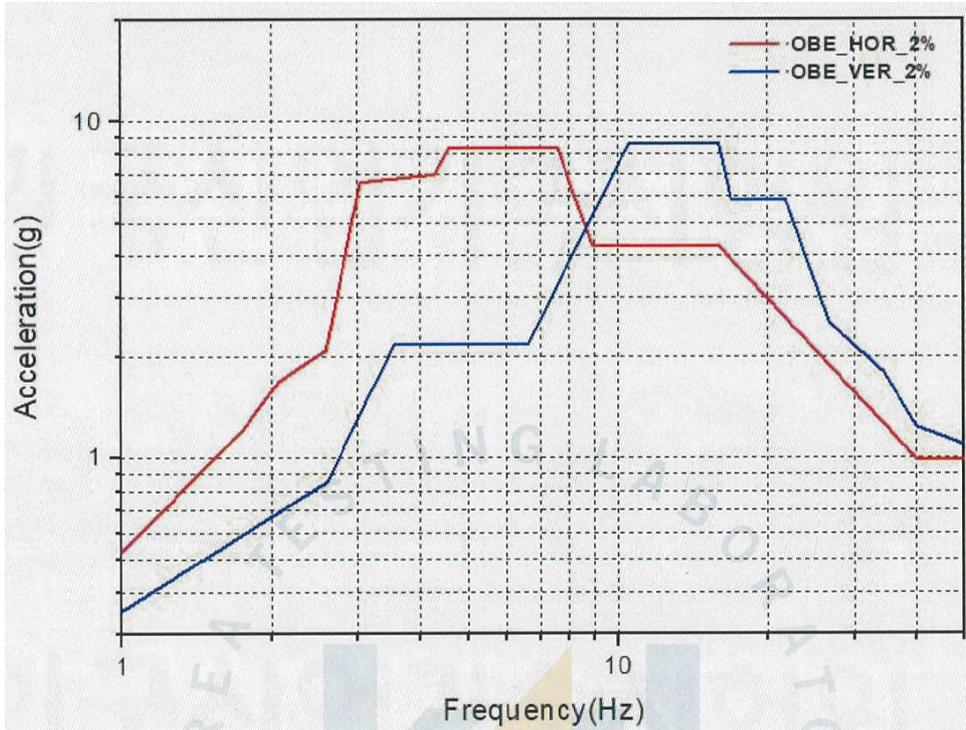
- If no requisite from customer, it will be tested by Hydrostatic test

- Hydrostatic test : up to 150% of design pressure

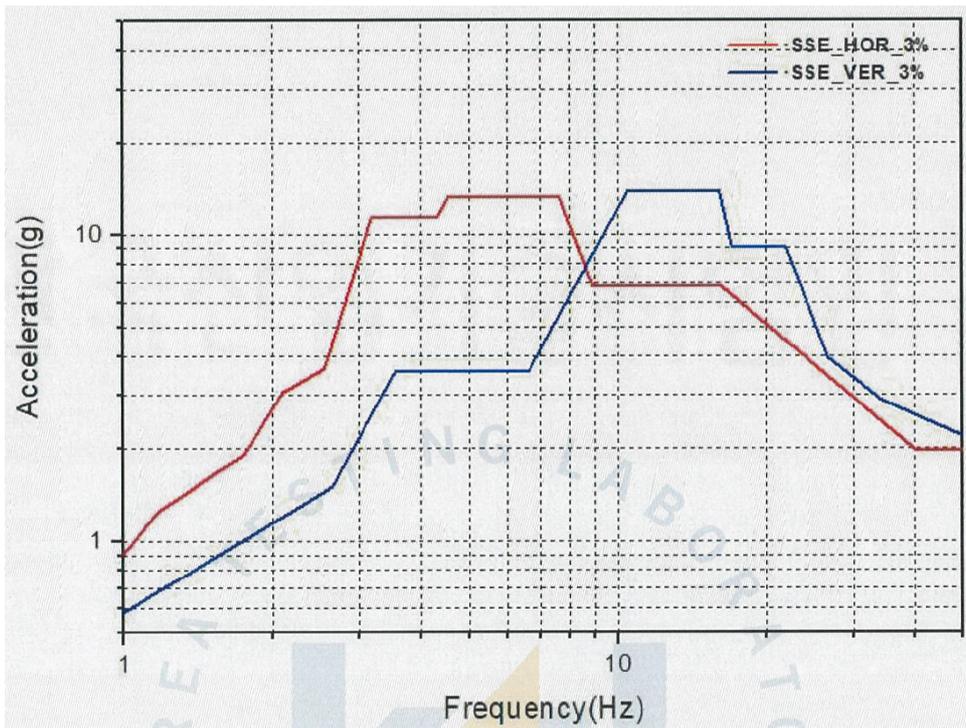
- Pneumatic test : up to 120% of design pressure

SEISMIC Qualification

- RRS (Requirement Response Spectra)
- OBE (Operating Basis Earthquake) 2%



- RRS (Requirement Response Spectra)
- SSE (Safe Shutdown Earthquake) 3%



Performance Specifications**Range and Sensor Limits**

- Refer to Table 1

Reference Accuracy of Calibrated Span

±0.25% Standard, ±0.075% is available for special application
(To be discussed with MFR)

- for range 2
±0.25% of Span for $0.15URL \leq Span \leq URL$
 $\pm[0.24 + (0.008 \times (URL/span))]\%$ of Span
for $0.05URL \leq Span < 0.15URL$
- for range 3
±0.25% of Span for $0.1URL \leq Span \leq URL$
 $\pm[0.24 + (0.003 \times (URL/span))]\%$ of Span
for $0.02URL \leq Span < 0.1URL$
- for ranges 4 through 7, 9, 0
±0.25% of Span for $0.1URL \leq Span \leq URL$
 $\pm[0.24 + (0.003 \times (URL/span))]\%$ of Span
for $0.01URL \leq Span \leq 0.1URL$
- for range 8
±0.25% of Span for $0.1URL \leq Span \leq URL$
 $\pm[0.2 + (0.005 \times (URL/span))]\%$ of Span
for $0.01URL \leq Span \leq 0.1URL$

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.
* min. 17.5V 250 ohm load
* Load resistance Max. 545 ohm@24 Vdc
Loop Resistance = $(E - 12.5) / 0.0211$
(E = Power Supply Voltage)
- **Supply Voltage**
12.5 ~ 45 Vdc -- operation
17.5 ~ 45 Vdc -- HART Communications
* Input power : 0.5W @24Vdc
0.9W @45Vdc
- **Loop Load**
0 ~ 1500 ohm -- Operation
250 ~ 550 ohm -- HART Communications

EMC Conformity Standards

- US NRC, RG 1.180(Rev.1),
IEC61000 series of EMI/RFI test methods

Dielectric withstand Test

- -500VAC, 60SEC. leakage less than 4mA
- insulation Resistance test
- 500VDC, 60SEC. greater than 50M ohm

Update Time and Turn-On Time

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

Failure Mode

- Fail High : Current ≥ 21.1 mA
- Fail Low : Current ≤ 3.78 mA

Operating Temperature

- -40°C to 85°C (without condensing)
- (Range codes and approval codes may effect limits)
-40°C to 120°C

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 ~ 350 KPa --- # 4
0 ~ 2000 KPa --- # 5
0 ~ 3500 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** 77 psi (525 KPa) --- # 4
436 psi (3000 KPa) --- # 5
762 psi (5250 KPa) --- # 6

Burst Pressure

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

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

Non-wetted materials

- Fill Fluid ----- Silicone oil or Inert fill
- Bolts ----- Stainless Steel
- Electronics Housing -- Aluminum, 316SST, Flameproof
and Waterproof (IP67/IP66)
NEMA4X
- Cover O-ring ----- Viton
- Paint ----- Epoxy-Polyester or Polyurethane
- Mounting Bracket ---- - Wall Mount Type(SEISMIC)
- Flat Mount Type
- 304SST bolts & Nuts
- Nameplate ----- 304 SST

Electrical connections

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

Process Connections

- 1/4-18 NPT on flanges for Standard
- 1/2-14 NPT on Process Adapter (option)

Weight

- 5.5 kg (excluding options)

QAP**Quality Assurance Program**

In accordance with KEPIC-QAP & KEPIC-EN

Hazardous Location Certifications**KCs Approvals**

(Korea Occupational Safety and Health Agency)
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

APT3700N

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	2.5 ~ 250	0 ~ 250
5	1.865 ~ 186.5	186.5	-186.5	-100	-186.5	15 ~ 1500	0 ~ 1500
6	6.9 ~ 690	690	-690	-100	-690	25 ~ 2500	0 ~ 2500
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/cm ²	bar	psi	inH ₂ O@4°C	mmH ₂ O@4°C	inHg@0°C
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	Dielectrical Withstand	500 Vrms (707 Vdc)≤4mA

3. Performance Specifications

Reference Accuracy	± 0.25% of Span (0.1URL≤Span≤URL) ±[0.025+0.005x(URL/Span)]% of Span (0.01URL≤Span<0.1URL)	Ambient Temperature	-40 ~ +85 °C
		LCD Meter Ambient Temp.	-30 ~ +80 °C
		Humidity Limits	5% ~ 100% RH
Ambient Temp. Effect	±[0.019%URL+0.125% Span] / 28 °C	Process Temperature Limits	-40°C ~ +120 °C
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	Default Mounting Bracket	5.5Kg
Electronic Housing	Aluminum, SUS316	2" Pipe Stanchion Type bracket	Wall(Siesmic) or Flat Mount type
Bolts & Bolting Flange	304 SST	Enclosure Protect	IP66/67 / NEMA 4X

5. Hazardous Location Certifications (Option)

KCs Safety Certificate & KTL Test Report
Flameproof Approval : Ex d IIC T6 (IP66/IP67)

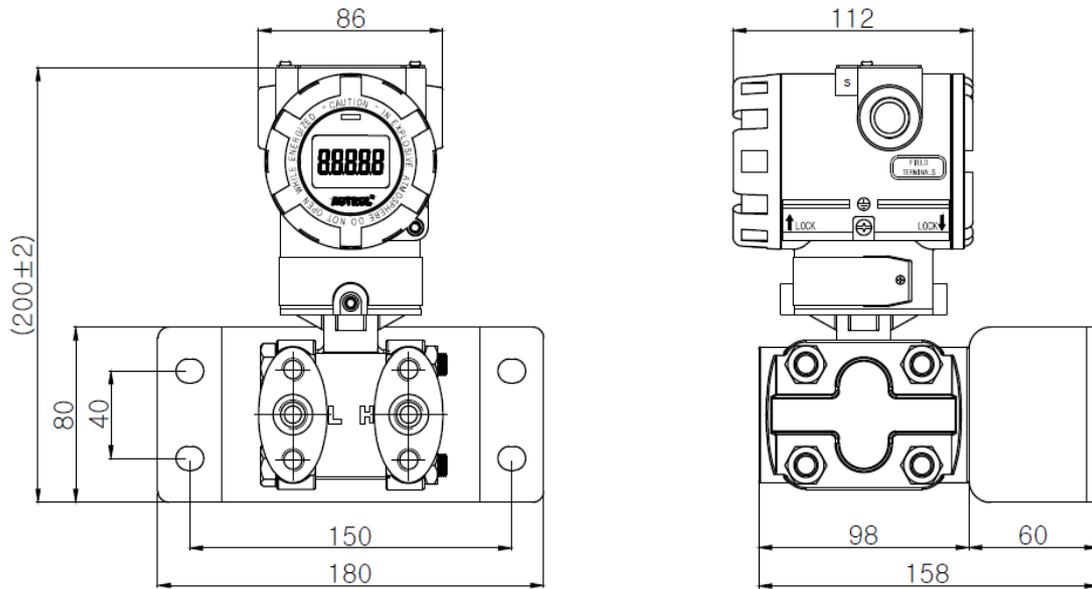
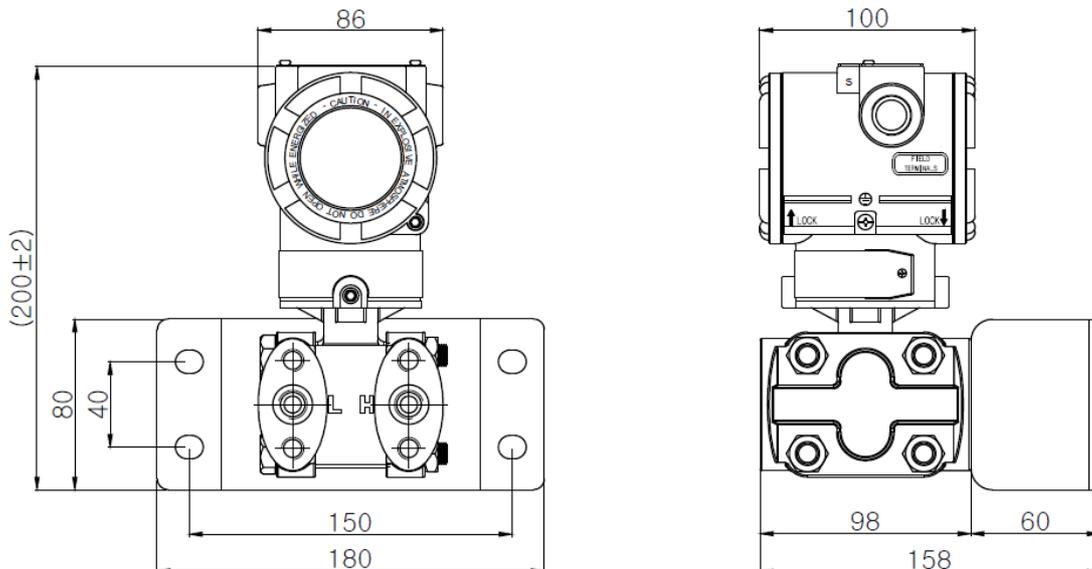
Ordering Information

APT3700N 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 ₂ O)	-1.5 KPa (-6.022 inH ₂ O)	-1.5 KPa (-6.022 inH ₂ O)	NA	1.5 KPa (6.022 inH ₂ O)	NA
	3	0.15 ~ 7.5 KPa (0.6~30 inH ₂ O)	-7.5 KPa (-30 inH ₂ O)	-7.5 KPa (-30 inH ₂ O)	NA	7.5 KPa (30 inH ₂ O)	NA
	4	0.373 ~ 37.3 KPa (1.5~150 inH ₂ O)	-37.3 KPa (-150 inH ₂ O)	-37.3 KPa (-150 inH ₂ O)	-37.3 KPa (-150 inH ₂ O)	37.3 KPa (150 inH ₂ O)	0~250 KPa
	5	1.865 ~ 186.5 KPa (7.5~750 inH ₂ O)	-186.5 KPa (-750 inH ₂ O)	-98KPa (-14.7 psi)	-186.5 KPa (-750 inH ₂ O)	186.5 KPa (750 inH ₂ O)	0~1500 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)	0~2500 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	
Wetted Parts Material		Flange		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	Silicone					
	2	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	A (T,R)			NE (Non - 1E)	
	3	S					
Option	M1	LCD Indicator					
	K	Oil Free Finish					
	BW	Stainless Steel Bracket (for Wall Mount) with SST Bolts					
	BF	Stainless Steel Bracket (Flat type) with SST Bolts					
	X	Special					

Example : **APT3700N-D5M11A13N1-NS3SONE-M1BF**

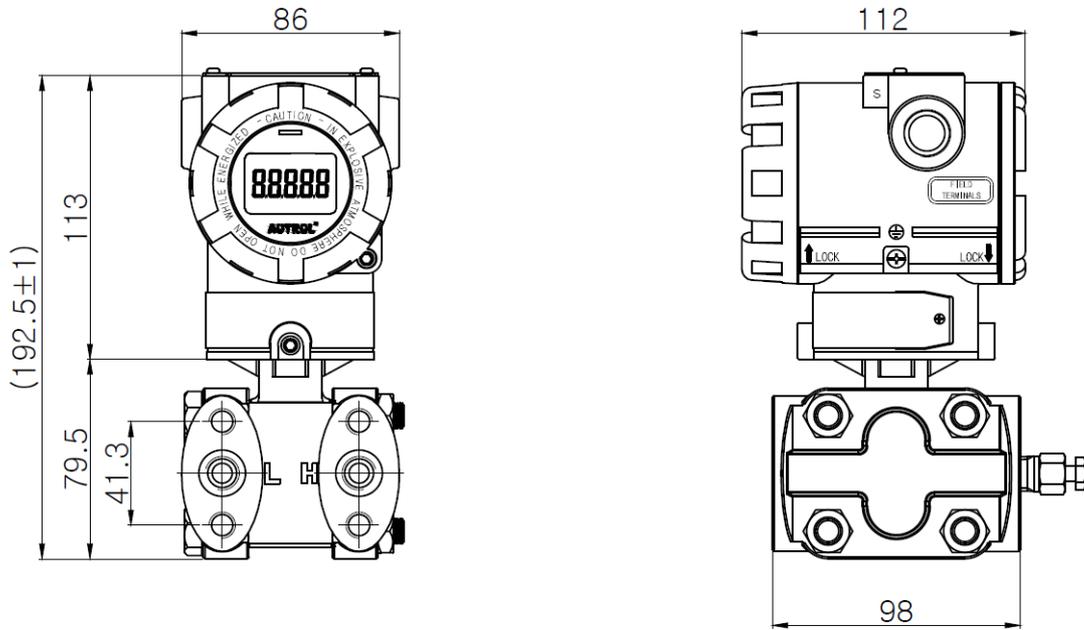
*1 : KHNP, Spec. NO. 9-183-J230C " Intelligent Type Field Instrument"

*2 : Request to manufacturer for Safety Class Items

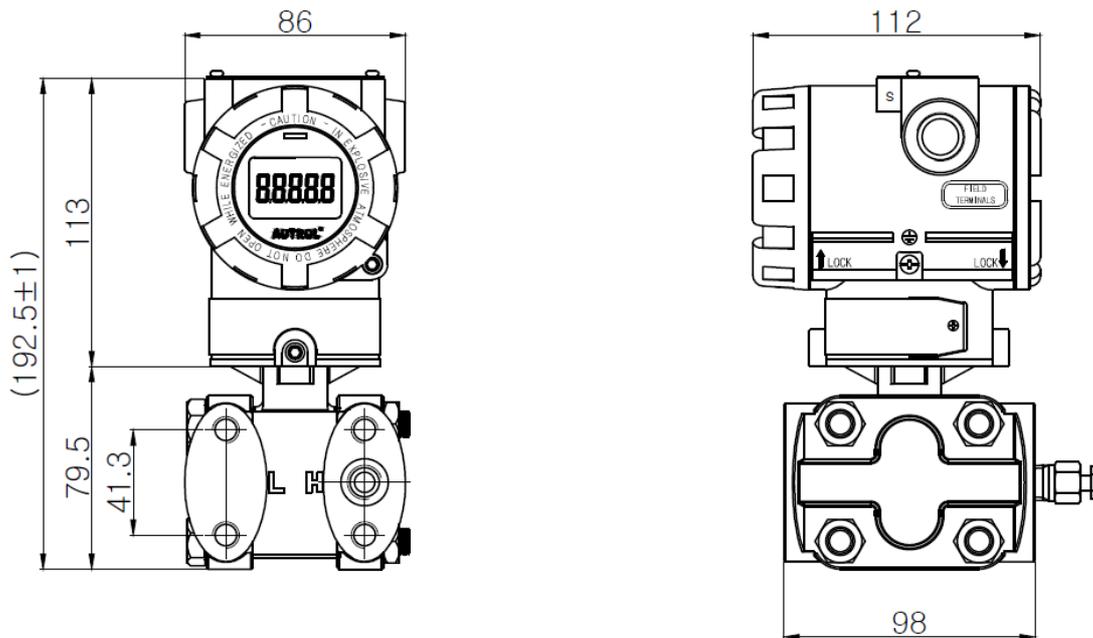
Installation with Mounting Bracket**With Stainless Steel Bracket for Wall Mounting (with LCD)****With Stainless Steel Bracket for Wall Mounting (without LCD)**

Dimensions of Transmitter (mm)

Differential Pressure Type (with LCD)

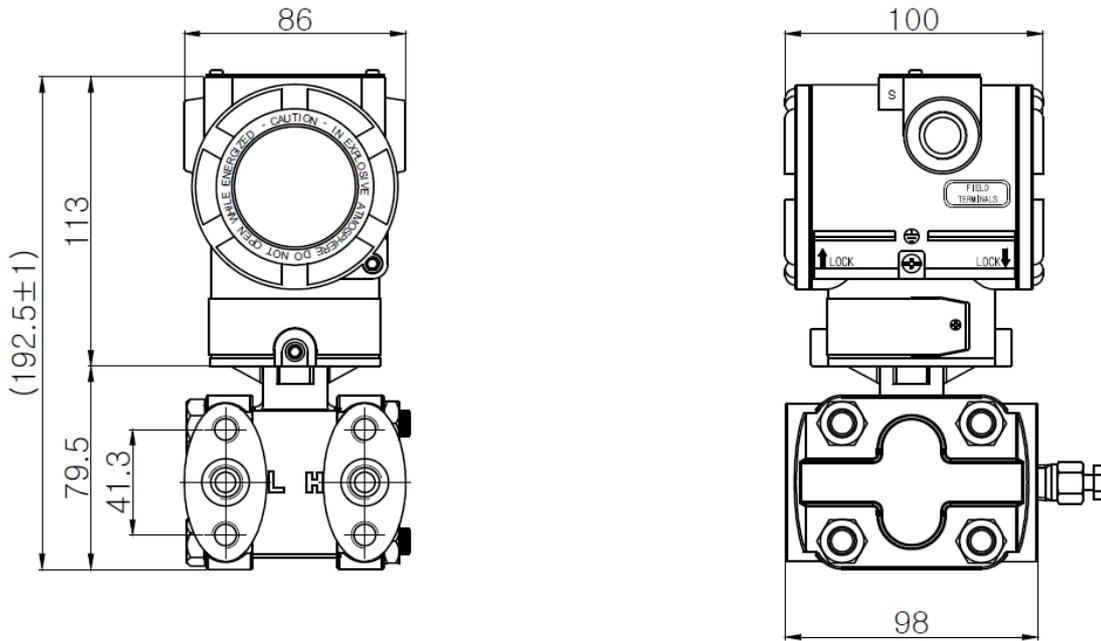


Gauge Pressure Type (with LCD)

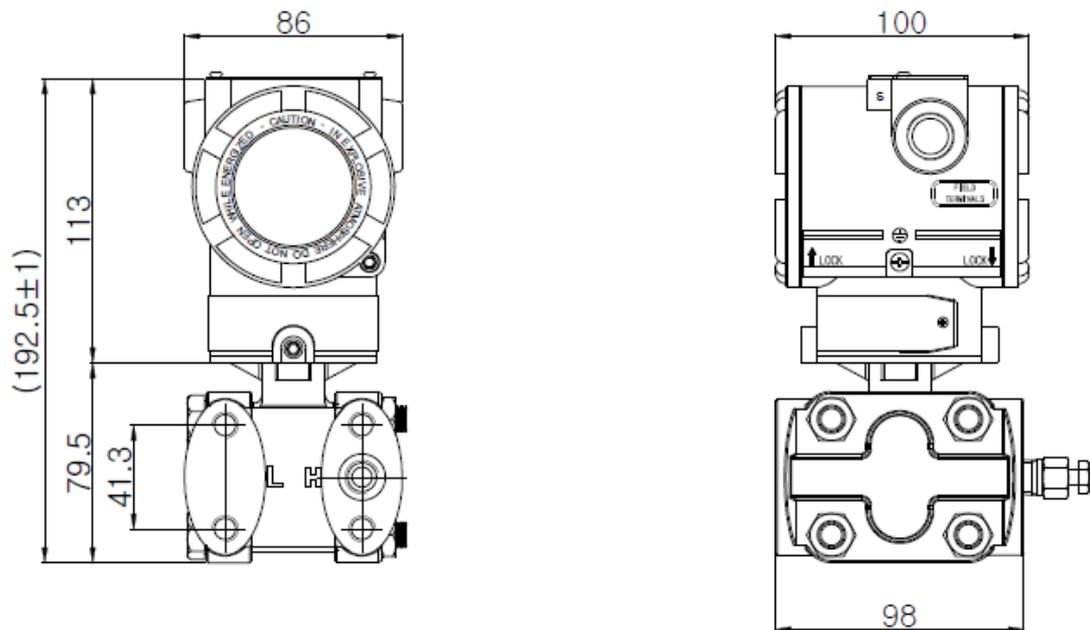


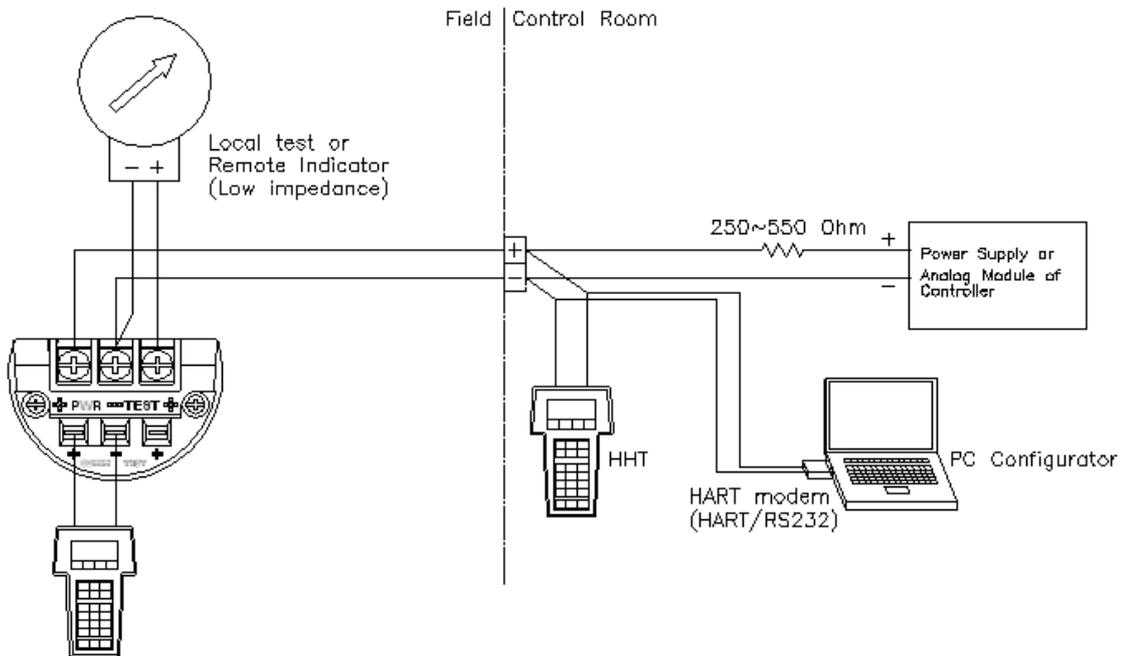
Dimensions of Transmitter (mm)

Differential Pressure Type (without LCD)



Gauge Pressure Type (without LCD)



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

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