

AUTROL®

HART
COMMUNICATION PROTOCOL



Smart Pressure Transmitter

for Differential / High Static / Gauge / Absolute Pressure Measurement



MODEL

APT3500

- ... Best performance 0.04%
- ... High Accuracy
- ... Five-year stability under Actual process conditions

Duon System Co.,Ltd.
www.autrol.com

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.

APT3500



Standard



SST Housing



High Static Pressure

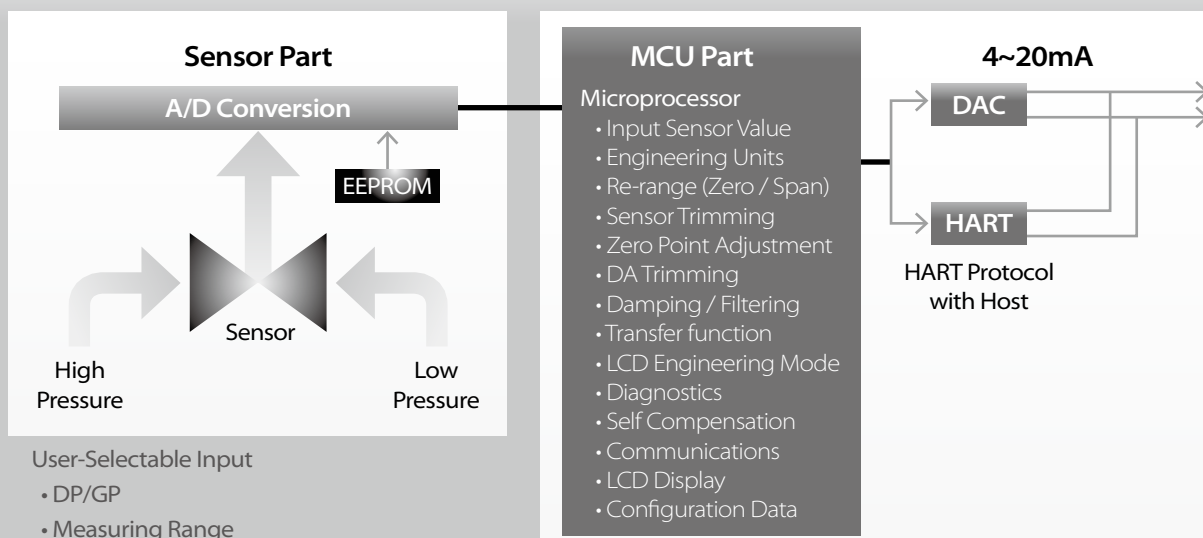
Description of Product

The APT3500 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 liquid, gas or steam flow as well as pressure and liquid level by application method. All data of sensor is to be input, modified and stored in EEPROM.

Function

- » Flexible Sensor Input : DP, HS, GP, AP
- » 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 & Intrinsic Safety Approval : ATEX, FM, FMCanada, KCs, etc.
- » Marine Certificate: ABS, LR, BR, DNV

Functional Block Diagram



* Subject to change without notice



Features

» Superior Performance

- High Reference Accuracy : $\pm 0.04\%$ of Calibrated Span
- for range 1 (DP & GP)
 $\pm 0.10\%$ of Span
 For spans less than 4:1,
 $\text{accuracy} = \pm [0.025 \times (\text{URL}/\text{span})] \% \text{ of span}$
- for range 2 (DP & GP)
 $\pm 0.10\%$ of Span
 For spans less than 10:1,
 $\text{accuracy} = \pm [0.05 + 0.005 \times (\text{URL}/\text{span})] \%$
- for ranges 3 ~ 5 (DP & GP & HS)
 $\pm 0.040\%$ of Span
 For spans less than 5:1,
 $\text{accuracy} = \pm [0.015 + 0.005 \times (\text{URL}/\text{span})] \%$
- for DP6 & GP6 & HS7 & AP 3~5
 $\pm 0.075\%$ of Span
 For spans less than 10:1,
 $\text{accuracy} = \pm [0.025 + 0.005 \times (\text{URL}/\text{span})] \%$
- Long-Term Stability (0.125% URL for 5year)
- High Rangeability (100 : 1)(for the range 3~6)

» 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
- CE EMC Conformity Standards
 (IEC 61000-4 Series)

Transmitter Description

ATP3500 Pressure transmitter can be easily configured from any host that support the HART protocol.

» Basic Setup

- 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

Function

» Range and Sensor Limits

- Refer to Table 1.

» Zero and Span Adjustment Limits

- Zero and span values can be set anywhere within the range limits stated in Table 1.(Page 9)
 Span must be greater than or equal to the minimum span stated in Table 1.(Page 9)

» Output (Analog Current and Digital Data)

- LCD Display & ENG Mode
- 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.
 * 250 ohm load – 17.5 Vdc
 * up to a 550 ohm load – 24 Vdc
 $\text{Max. Loop Resistance} = (E - 12) / 0.022$
 (E = Power Supply Voltage)
- Voltage Range : 12 to 45 Vdc
- Voltage Rating : 24 Vdc $\pm 30\%$
- Loop Load
 0 ~ 1500 ohm – Operation
 250 ~ 550 ohm – HART Communications

» EMC Conformity Standards

- IEC 61000-4 Series

» Failure Mode

- Fail High : Current $\geq 21.1 \text{ mA}$
- Fail Low : Current $\leq 3.78 \text{ mA}$

» Storage Temperature

- -40°C to 85°C (without condensing)

» Process Temperature Limits

- (Range codes and approval codes may effect limits)
- -40°C to 120°C (-104 to 248°F)

Function

» Isolation

- Input/output isolated to 500Vrms (707 Vdc)

» Working Pressure Limits (*silicone oil*)

- Model D & G
 - 0 ~ 5 MPa - # 1
 - 0 ~ 13 MPa - # 2
 - 0 ~ 25 MPa - # 3~6
- Model HS
 - 0 ~ 32 MPa - # 3~5
 - 0 ~ 75 MPa - # 7
- Model AP
 - 0 ~ 0.25 MPa - # 3
 - 0 ~ 1.5 MPa - # 4
 - 0 ~ 2.5 MPa - # 5

» Hydrostatic Test Pressure

- Model D & G
 - 8 MPa - # 1
 - 20 MPa - # 2
 - 38 MPa - # 3~6
- Model HS
 - 48 MPa - # 3~5
 - 60 MPa - # 7
- Model AP
 - 0 ~ 0.38 MPa - # 3
 - 0 ~ 2.25 MPa - # 4
 - 0 ~ 3.75 MPa - # 5

» Burst Pressure

- Model D & G
 - 69 MPa - # 1 ~ 6
- Model HS
 - 132 MPa - # 3~5
 - 80 MPa - # 7
- Model AP
 - 1.05 MPa - # 3
 - 4 MPa - # 4
 - 7 MPa - # 5

» 5 Digit LCD

- Express all pressure unit and flow unit.
- Use 5 digit.
- Select decimal place (0 to 4)
- PV, % and mA value indicate on LCD rotationally & automatically.

» User define unit function



» Change main parameter by Button

- Change Unit
- Change Upper range value
- Change Lower range value
- Change the Damping Second
- Select the Decimal Place
- Zero Trim
- Zero Adjustment



Moving within Menu : Zero

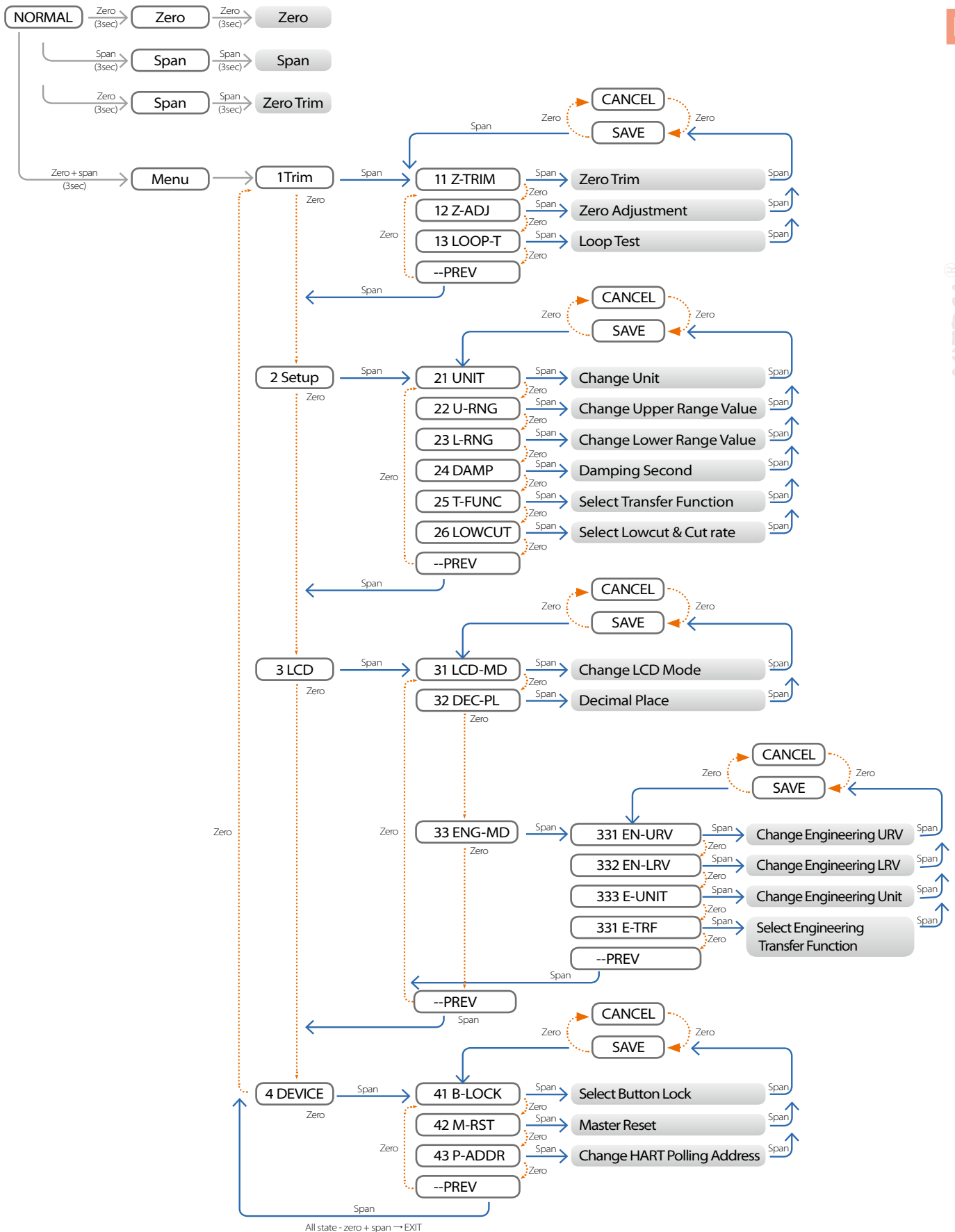
Moving to below Menu : Span

Moving Top Menu : Zero+Span



Button Menu tree

» Button Menu tree



Physical Specifications

» Wetted Materials

- Isolating Diaphragms 316L SST, Monel, Tantalum, HAST-C
- Drain/Vent Valves 316 SST, HAST-C
- Flanges and Adapters 316 SST (ASTMCF8M), HAST-C
- O-ring Viton, PTFE

» Non-wetted materials

- Fill Fluid Silicone oil or Inert fill
- Bolts 304 SST
- Electronics Housing Aluminum or 316L SST (Option)
Flameproof and Waterproof (IP67)
- Cover O-ring Buna-N
- Paint Epoxy-Polyester or Polyurethane
- Mounting Bracket 304SST with U-bolt (304SST)
for 2-inch pipe
- Nameplate 304 SST

» Electrical connections

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

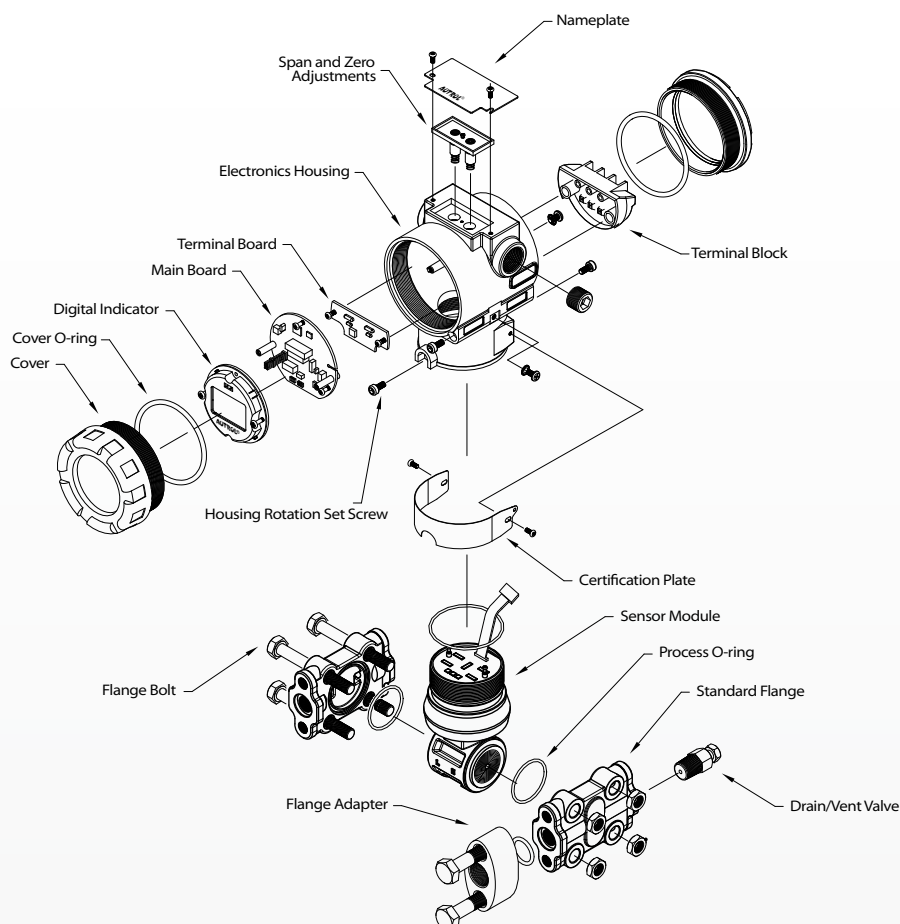
» Process Connections

- 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

- 3.51 kg (Standard - excluding options)
- 5kg (SST Housing- excluding options)

Exploded drawing of APT3500





Hazardous Location Certifications (option)

» Explosive-proof Certification :

KCs(Korea Certification)

Type : Flameproof (Ex d IIC T6, IP67 ($-200^{\circ}\text{C} \leq T_{\text{amb}} \leq +600^{\circ}\text{C}$))

Certificate No.: 12-AV2BO-0741

Power Supply : 12.5 ~ 45Vdc, 4 ~ 20mA, Process Temperature : +800°C

» ATEX Approvals E1 Code :

Type : ATEX Explosion-proof Certification

Certification No.: DNV 14 ATEX 5433X

Ex II 2 G Ex d II CT6...T4, IP66/67

 $V_{cd} = 12.5 \sim 45V_{dc}, 4 \sim 20mA$

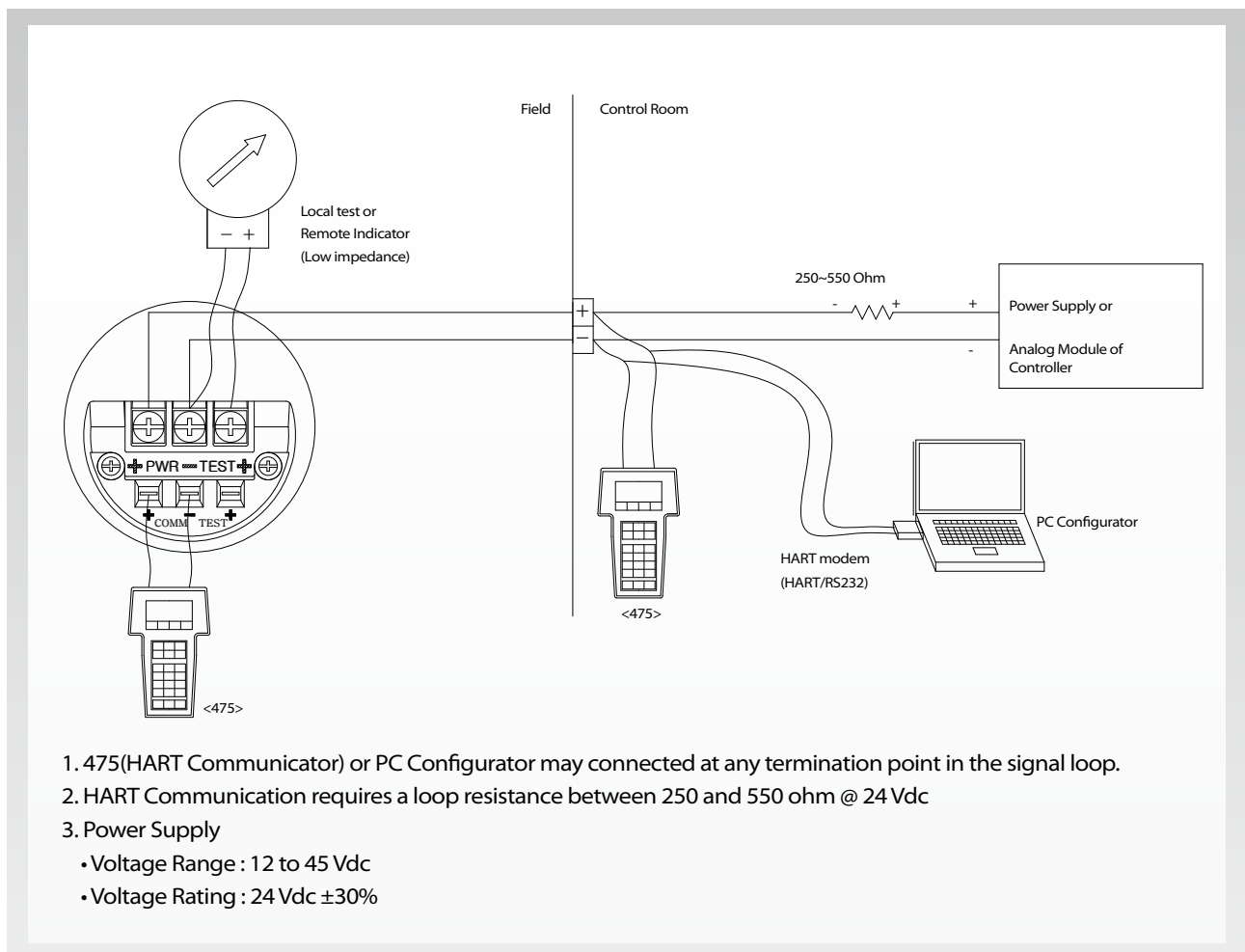
» KCs Intrinsic Safety Certification K2 Code :

» FM and FMc Certification F1 & F2 Code :

» ATEX Intrinsic Safety Approvals E2 Code :

* Some certificates are on pending for approval. Please ask us before order.

Connection Diagram of Signal, Power, HHT for Transmitter



APT3500

Bottom Connection for Vertical Process Line



*Easy Installation,
Vertical Process line.
Industrial standard connection.
Not require additional
retrofitted Flanges or Adapters.*

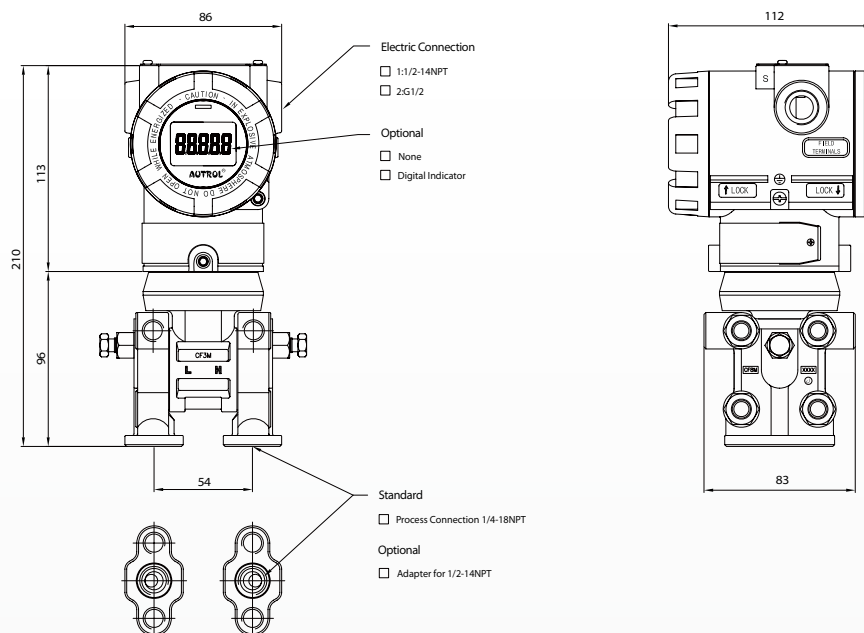
Background

Traditionally, some of applications require vertical installation such as flow application, orifice assemble line, special location and etc. The traditional connections may require additional flanges or adapters, which is inconvenience and additional charge. (Except changing size of process connection).

Advantage

Direct connection from vertical process line with manifold. And it is not required additional retrofitted flanged or adapter to connect vertical process line or assemble manifold because it has industrial standard size 54 mm between L & H process connection in the transmitter. Moreover, Manifold can be connected directly.

Dimension





General Specifications

(Rangeability : #1=20:1 / #2=50:1 / 4~6=100:1)

1. APT3500 Pressure Sensor Range

<Table 1>

Range Code	DP		GP		AP		HS	
	Calibrated Span(KPa)	Lower Range(KPa)	Calibrated Span(KPa)	Lower Range(KPa)	Calibrated Span(KPa)	Lower Range(KPa)	Calibrated Span(KPa)	Lower Range(KPa)
1	0.0625 ~ 1.25	-1.25	0.0625 ~ 1.25	-1.25				
2	0.15 ~ 7.5	-7.5	0.15 ~ 7.5	-7.5				
3	0.65 ~ 65	-65	0.65 ~ 65	-65	2.5 ~ 250	0	0.65 ~ 65	-65
4	2.5 ~ 250	-250	2.5 ~ 250	-100	15 ~ 1500	0	2.5 ~ 250	-250
5	21 ~ 2100	-2100	21 ~ 2100	-100	25 ~ 2500	0	21 ~ 2100	-2100
6	140 ~ 14000	-14000	140 ~ 14000	-100				
7							400 ~ 40000 (Gauge Only)	0

Code	KPa	Kgf/cm ²	bar	psi	inH ₂ O@4°C	mmH ₂ O@4°C	inHg@0°C
1	1.25	0.012	0.0125	0.181	5.018	127.464	0.369
2	7.5	0.076	0.075	1.087	30.11	764.787	2.214
3	65	0.662	0.65	9.427	260.958	6628.154	19.194
4	250	2.549	2.5	36.259	1003.685	25492.9	73.825
5	2100	21.414	21	304.579	8430.958	214140.359	620.129
6	14000	142.76	140	2030.527	56206.38	1427602	4134.197

2. Electrical Specifications

Power Supply	12 to 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		± 0.04% of Span *See the specification feature on 3pgae	Ambient Temperature	-40 ~ +85°C
			LCD Meter Ambient Temp	-30 ~ +80°C
			Humidity Limits	5% ~ 100% RH
Ambient Temp. Effect	Range 1(DP&GP)	±[0.2% URL+0.08% Span] / 28°C	Process Temperature Limits	-40°C ~ +120°C
	Range 2(DP&GP)	±[0.13% URL+0.12% Span] / 28°C		
	Range 3~6(DP,GP,HS)	±[0.024% URL+0.045% Span] / 28°C		
	HS7, AP3~5	±[0.019% URL+0.125% Span]		
Stability		±0.125% URL for 60 Months	Power Supply Effects	±0.005% of Span per Volt
Static Pressure Effects	Zero	Range 1	Position Effect (90degree)	Zero Shift up to ± 0.4 KPa
		Range 2		
		Range 3~6		
	Span	Range 1	Mounting Position Effects	Zero Shift up to 400Pa No Span Effect
		Range 2		
		Range 3~6		

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)	3.51 Kg (Standard) 5 Kg(SST Housing)
Electronic Housing	Aluminum (Option:316L SST)	2" Pipe Stanchion Type bracket	Angle or Flat type
Bolts & Bolting Flange	304 SST	Housing Class	Waterproof (IP67), 4X

Ordering Information

MODEL	Code	Description								
APT3500 /APT3500N (Nuclear)	-D	Differential Pressure Transmitter (Static Pressure 25MPa)								
	-HS	Differential Pressure Transmitter for High Line Pressure (Static Pressure 32MPa)								
	-G	Gauge Pressure Transmitter								
	-A	Absolute Pressure Transmitter								
Ranges		DP		GP		AP		HS		
		Calibrated Span(KPa)	Lower Range(KPa)	Calibrated Span(KPa)	Lower Range(KPa)	Calibrated Span(KPa)	Lower Range(KPa)	Calibrated Span(KPa)	Lower Range(KPa)	
	1	0.0625 ~ 1.25	-1.25	0.0625 ~ 1.25	-1.25					
	2	0.15 ~ 7.5	-7.5	0.15 ~ 7.5	-7.5					
	3	0.65 ~ 65	-65	0.65 ~ 65	-65	2.5 ~ 250	0	0.65 ~ 65	-65	
	4	2.5 ~ 250	-250	2.5 ~ 250	-100	15 ~ 1500	0	2.5 ~ 250	-250	
	5	21 ~ 2100	-2100	21 ~ 2100	-100	25 ~ 2500	0	21 ~ 2100	-2100	
	6	140 ~ 14000	-14000	140 ~ 14000	-100					
	7							400 ~ 40000 (Gauge Only)	0	
	X	Special								
Mounting Flange /Material		Body		Flange & Adapter		Vent Plug		Diaphragm		
	M11	316 SST		316 SST		316 SST		316L SST		
	M12	316 SST		316 SST		316 SST		HAST - C		
	M13	316 SST		316 SST		316 SST		Monel		
	M14	316 SST		316 SST		316 SST		Tantalum		
	*M21	316 SST		HAST - C		HAST - C		HAST - C		
	*M22	316 SST		HAST - C		HAST - C		Monel		
	*M23	316 SST		HAST - C		HAST - C		Tantalum		
Hazardous Location Certifications	K0	Maker Standard (Waterproof:IP67)								
	K1	KCS Flameproof Approval				*K2	KCS Intrinsic Safety Approval			
	E1	ATEX(KEMA) Flameproof				*E2	ATEX(KEMA) Intrinsic Safety			
	*I1	IECEx Flameproof				*I2	IECEx Intrinsic safety			
	*F1	FM&FM Canada Explosion proof				*F2	FM&FM Canada Intrinsic Safety			
Fill Fluid	1	Silicone (DC200)				2	Inert fill fluid (Halocarbon oil)			
Process Connection	S	1/4 - 18 NPT (Standard)				O	1/2-14 NPT Female(Adapter)		X	Special
Electrical Connection	1	1/2-14NPT Epoxy-Polyester Painted Aluminum				2	G1/2-14 Epoxy- Polyester Painted Aluminum(Adapter)		X	Special
Option	M1	LCD Indicator(5digit)								
	BC	Bottom Process Connection								
	LPI	Lightning Protector (Internal)				LPE	Lightning Protector (External)			
	K	Oil Free Finish								
	F1	Side Vent / Drain Top								
	F2	Side Vent / Drain Bottom								
	2W	2 Way Manifold (SST) : Remote type				2WF	Flange type			
	3W	3 Way Manifold (SST) : Remote type				3WF	Flange type			
	5W	5 Way Manifold (SST) : Remote type				5WF	Flange type			
	BA	Stainless Steel Bracket (Angle type) with SST Bolts								
	BF	Stainless Steel Bracket (Flat type) with SST Bolts								
	ST	Stainless Steel Housing								
	T	Teflon O-Ring (Wetted Part)								
	X	Special								

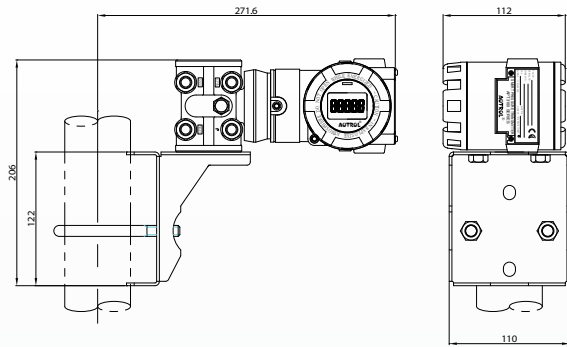
Example : APT3500-D5-M11-E1-1-S-1-M1-BA

Note 1 : Request to manufacturer for Draft Range, Absolute (small pressure and vacuum) and Items marked " * " before order.

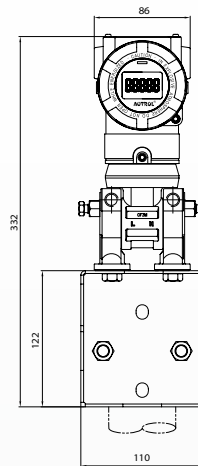


Installation With Mounting Bracket

2" Pipe Mounting Bracket Model Angle Type

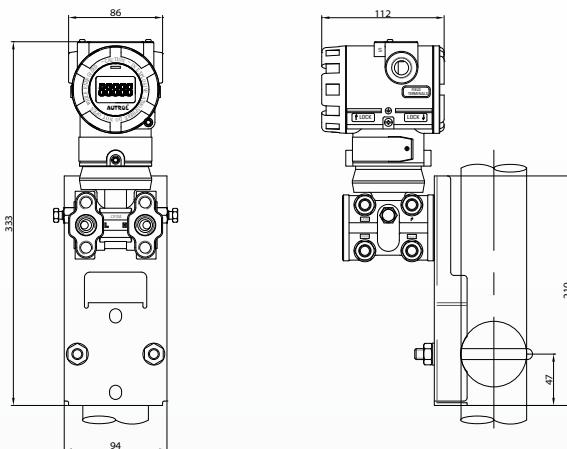


Standard Model

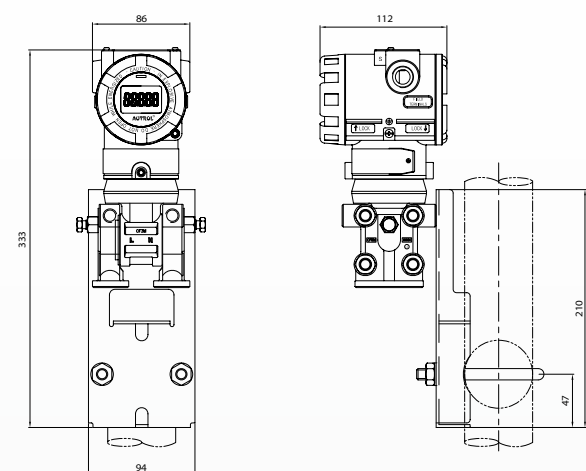


MP Model

2" Pipe Mounting Bracket Model Flat Type



Standard Model

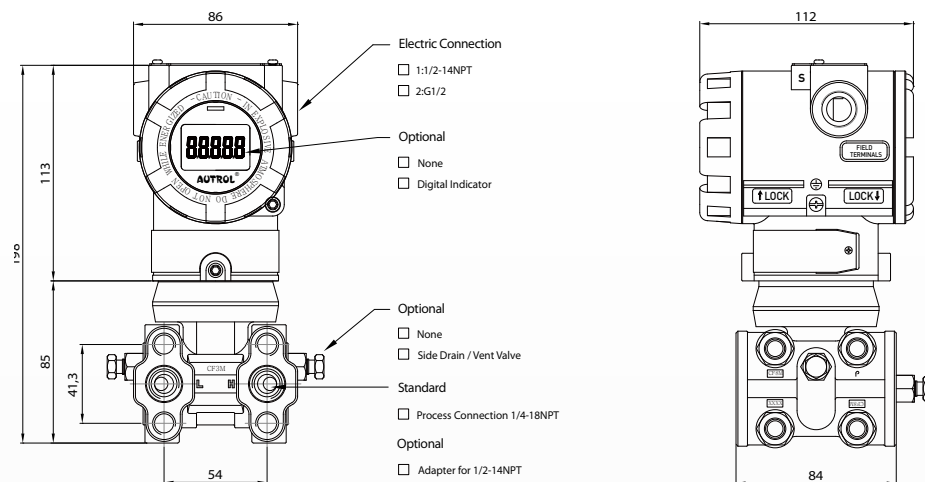


MP Model

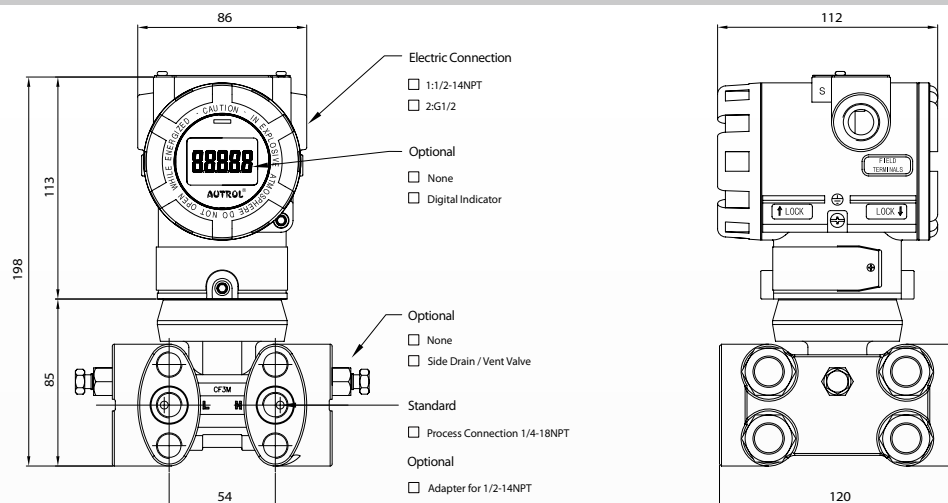
Dimensions of Transmitter (mm)

AUTROL®

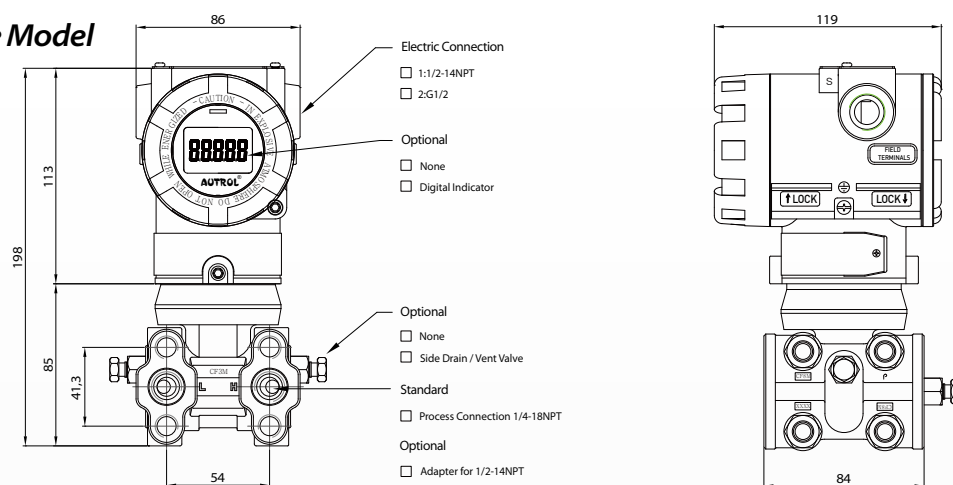
Standard Model



High Static Pressure Model



Intrinsically safe Model



Duon System Co.,Ltd.

298-29, GONDAN-RO, GUNPO-SI, GYEONGGI-DO, KOREA 15809
Tel: +82-31-389-6100 Fax: +82-31-429-7200 Web: www.autrol.com