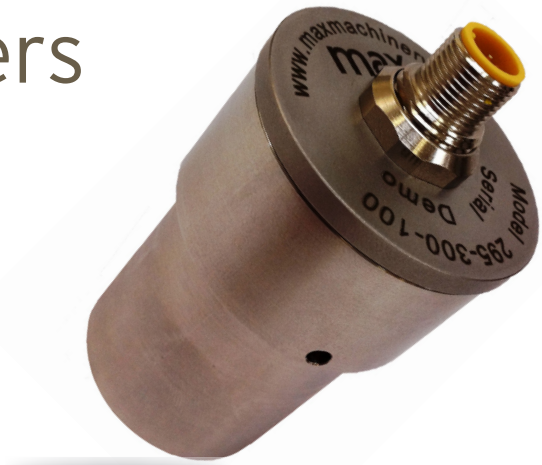
Max Machinery, Inc.
an ISO 9001:2008 certified company

High Resolution, Linearized Frequency Transmitters

Operational Manual



For Models
269, 294 and 295

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Additional technical documents regarding transmitter performance and advanced operation are available at www.maxmachinery.com. Max Machinery, Inc. reserves the right to make changes to the product in this instruction manual to improve performance, reliability, or manufacturability. Contact Max Machinery Inc. for the latest available specifications and performance data. Although every effort has been made to ensure accuracy of the information in this instruction manual, Max Machinery Inc. assumes no responsibility for inadvertent errors.

General Description

The Max frequency transmitters are designed to work with the entire family of Max Flow Meters to provide extremely precise flow measurement in a cost effective package. Different options for electrical connections and temperature ranges cover a wide range of application environments – from the laboratory to harsh industrial processes.

This latest generation of transmitters use modern sensor technology coupled with advanced signal processing to deliver new levels of performance and reliability. Hall sensors are used to detect the position of a driven magnet inside a Max Flow Meter. Changes in position are tracked by a microprocessor, which generates an output frequency proportional to the flow rate. Advanced signal processing provides both fine angular resolution (0.36 degrees rotation per pulse) and rapid response (output updated every one ms).

These transmitters are typically mated to a mechanical flow meter, configured, and calibrated at the factory as a matched set. This ensures accuracy and allows quick setup in the field. For field installations where the transmitter has not been setup with a meter at the factory, an optional serial interface kit provides full access to all configuration options and parameters.

Transmitter Features

High resolution measurement - Configured output resolution of 1 to 1000 pulses per revolution. Linearization of up to 16 points to fully describe the flow meter's output curve and achieve the highest system linearity over the meter's entire operating range.

Compensation Algorithm – Compensates for variations in Hall sensor and flow meter characteristics to provide a stable, undamped output frequency that accurately represents the instantaneous flow rate. This feature is factory set when the meter and transmitter are mated together. If the transmitter is changed, the compensation can be performed via the interface software (Models 269 and 294), or a button on the PCA (Models 295 and 296).

Anti-Dither Pulse Buffer - Prevents undesired reverse pulses which can occur at very low flow rates in the presence of vibration or hydraulic noise. If the meter reverses direction and then resumes forward rotation, the pulse count will represent only the total forward flow. Reverse flow exceeding the pulse buffer setting will result in an output frequency proportional to reverse flow rate. The buffer quantity can be set from 1% to 100% of a revolution.

Transmitter Specifications

Supply Voltage	5-26 Vdc	
Supply Current	25-30 mA typical	
Output (5.0 Volt Supply) (TTL and CMOS compatible)	No Load	0.00 / 4.80 Volts
	2.5K Load to Common	0.00 / 4.60 Volts
	2.5K Load to +5 Volts	0.25 / 4.80 Volts
Short Circuit Current (1)	45 mA	
Output Impedance	100 Ω	
Rise/Fall Time	0.2 µSec	
Output Update Rate(2)	1 ms	
Min/Max Frequency	0-60 kHz	
Resolution	1 - 1000 pulses/rev, Single Phase 1 - 500 pulses/rev, Quadrature	
Ambient Temperature Range	Transmitter (Storage)-40ºC to 85ºC (-40ºF to 185ºF) Transmitter (Operation)(3) -40ºC to 80ºC (-40ºF to 175ºF)	
Maximum Temperature, Process Fluid (20ºC Ambient, 5V supply)	295/294/269-x0x-xxx	Standard Model 105ºC (220ºF)
	294/269-x1x-xxx	High Temp Model 180ºC (355ºF)
	295-x1x-xxx	High Temp Model – 2 part model 155ºC (310ºF)
	294/269-x2x-xxx	Ultra High Temp Model 232ºC (450ºF)
	295-x2x-xxx	Ultra High Temp Model – 2 part model 225ºC (435ºF)
Anti-dither Range	Software selectable from 1-100% of 1 revolution. Default values: 50% Single Phase 2% Quadrature	
Signal Filtering	Software selectable from 1ms to 250ms time constant	

(1) Continuous Short Circuit is not recommended. The output current should not exceed 10 mA
(2) Events are seen as output transitions 1 ms after they occur
(3) Temperature of metered fluid will affect transmitter temperature, see graph

Installation - Model 269

Model 269 - Mechanical Installation

Transmitters are installed on the meter at the factory. If a transmitter needs to be replaced in the field, use the following procedure:

1. Disconnect the wiring and remove the two socket cap screws to remove the old transmitter.
2. Position the alignment key on the new transmitter with the corresponding notch on the flow meter and drop into place.
3. Tighten both socket cap screws until snug. Ensure that the transmitter is not crooked, then turn screws a 1/4 turn. Do not over tighten.

Electrical Connection

This model is wired at the factory. All that is required is to connect the transmitter's mating cable into the remainder of the system as follows:

Blue: Case Ground
Black: Common
Brown: Power (+5-26 Vdc)
White: Output Signal

Installation - Model 294

Model 294 - Mechanical Installation

1. Attach the transmitter to the threaded magnet shield on top of the flow meter. Hand tighten. (~ 3 ft-lb)[1]
2. If necessary, loosen set screws on the transmitter's cap and rotate to align cable as desired.
3. Ensure cap is firmly pushed down to seal O-ring. Tighten set screws.

[1] Transmitter may be wrench tightened up to 15 ft-lb if it will be subject to vibration or loads. This additional torque causes relative movement between transmitter and meter, so to ensure optimal performance, request that the factory apply the extra torque before calibration / compensation, or run the compensation program in the field after tightening.

Removal

1. Remove electrical connections
2. Unscrew transmitter, using a wrench if necessary.

Removal note: The transmitter does not need to be removed from the flow meter for any field servicing or adjustments. Normally, the flow meter and transmitter are shipped back to the factory for calibration or service as a unit. If the transmitter needs to be removed from the flow meter for installation, be sure to retighten the transmitter snugly in order to seal the O-ring and to ensure proper sensor alignment.

Installation - Model 295, 296

Model 295, 296 – Mechanical Installation

1. The transmitter is attached to the flow meter's threaded magnet shield. Hand tighten only. (~ 3 ft-lb)

2. The transmitter lid has four thread paths. To realign the cable, remove the lid and rotate up to 180° and retighten using an alternate starting point. Tighten to compress the O-ring seal.

Removal

1. Remove electrical connections

2. Unscrew transmitter, using a wrench if necessary.

Removal note: The transmitter does not need to be removed from the flow meter for any field servicing or adjustments. Normally, the flow meter and transmitter are shipped back to the factory for calibration or service as a unit. If the transmitter needs to be removed from the flow meter for installation, be sure to retighten the transmitter snugly in order to ensure proper sensor alignment.

Moisture Protection

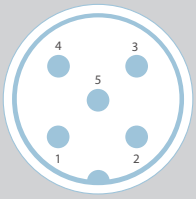
On all models, the housing is designed as a liquid and vapor-tight enclosure. There are O–ring seals at the lid and possibly also the base of the housing – these need to be fully seated. A properly sealed transmitter will prevent the formation of damaging moisture inside the housing.

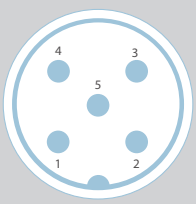
Turck connector Model: The connector is sealed to the lid at the factory and is ready for use.

NPT Model: To ensure a moisture-tight seal, apply appropriate sealant to the threads at installation.

Electrical Installation – Wiring

The electrical connector versions are pre-wired inside the transmitter and ready to accept a mating cable (available from the factory). The liquid-tight, NPT models need to be wired during installation as shown in the tables below:

Frequency Single Phase	294 NPT model	295/296 NPT Model	Turck Connector		
			Mating Cable Wire Color	Pin #	
Case Ground	In-lid	Case	Blue	3	
Common	1	Com	Black	4	
Power 5-26 Vdc	2	V+	Brown	1	
Pulse Output	3	Ph A	White	2	
N/A		NC	Grey	5	

Frequency Quadrature	294 NPT model	295/296 NPT Model	Turck Connector		
			Mating Cable Wire Color	Pin #	
Case Ground	In-lid	Case	Blue	3	
Common	1	Com	Black	4	
Power 5-26 Vdc	2	V+	Brown	1	
Output Phase A	3	Ph A	White	2	
Output Phase B	4	Ph B	Grey	5	

Rotation/Output Indicators

All of the microprocessor based transmitters incorporate a LED to indicate that they are producing a pulse output and/or detecting magnet rotation in the meter.

An alternating red/green or blue/green LED indicates that the circuit is detecting a rotating magnet and should provide an output. Additional LED's are present for setup, programming and troubleshooting and are not intended for general use.

Note: There are no selections or adjustments to be made on the circuit board. The only method of altering the setup parameters is through the serial interface program. Contact the factory regarding P/N 294-100-050, user interface software.

Field Compensation of transmitter

When a new transmitter is attached to a flow meter, the compensation routine should be performed to optimize the performance of the system. This routine requires a steady flow rate which turns the meter at between 15 and 1000 RPM. If you are using the interface software, please consult the "software Interface" manual for instructions. For the Model 295 and 296, the sequence is as follows:

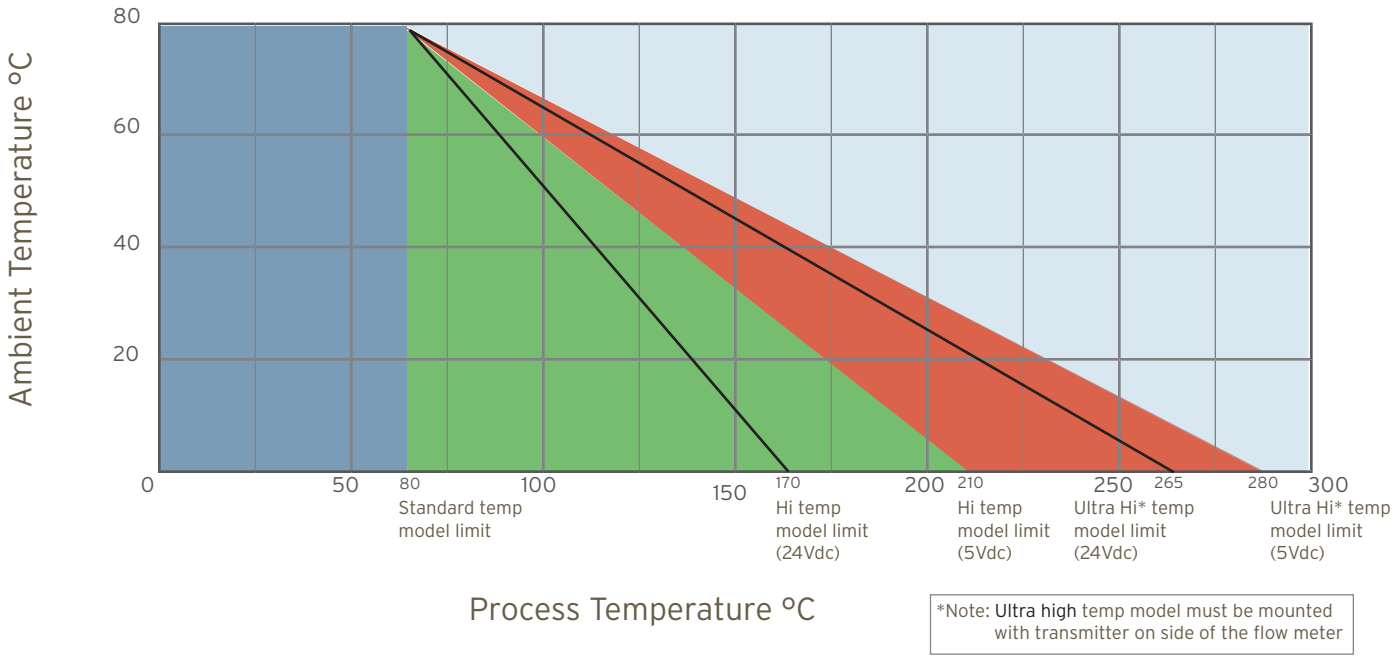
1. Stabilize the flow rate
2. Push the compensation button on the PCA
3. The blue/green LED will change to solid blue for 6 to 8 revolutions of the meter
4. A green indicator light indicates a successful update of the compensation, a red indicator light indicates that the previous compensation has been retained.

High Temperature Operation Above 65°C (150°F)

The operating limit of the meter/transmitter is a function of both the ambient and the metered fluid temperature, as shown in the following graphs. Although the electronic components are rated to 80°C (175°F), additional heat can be conducted from the flow meter into the transmitter housing requiring a lower ambient temperature limit for high fluid temperatures.

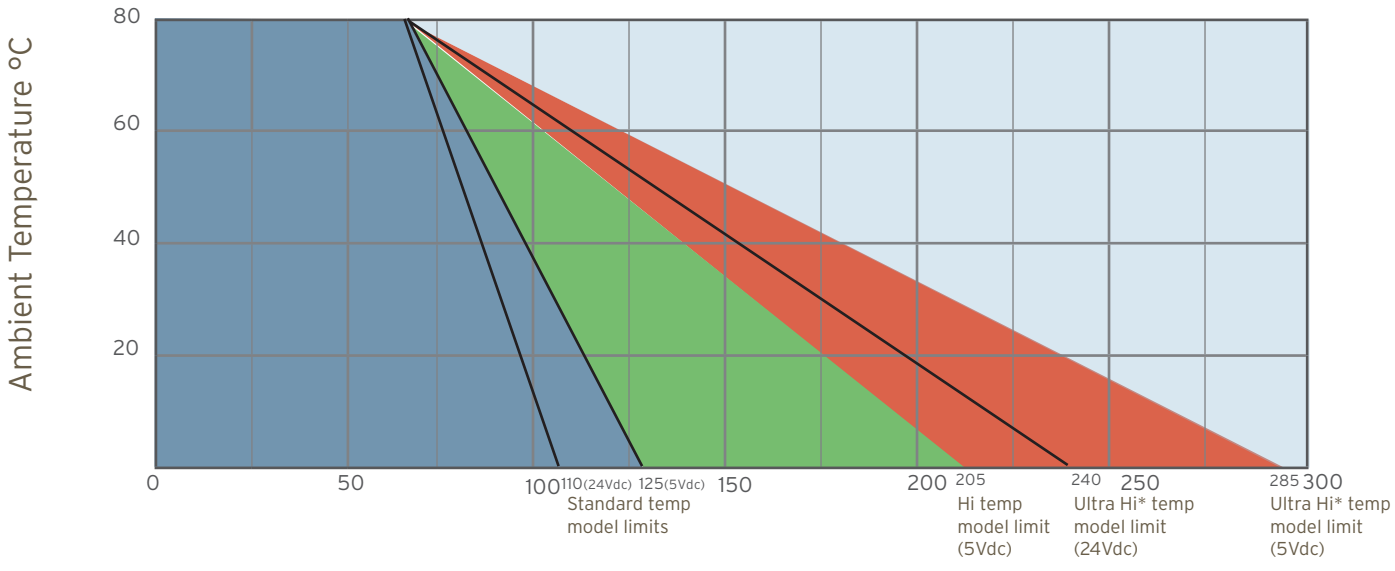
To prolong the life of the transmitter and reduce the risk of component related failures over time, high ambient temperatures >65°C (150°F) should be avoided if possible. It is a good idea to locate the transmitter away from hot spots such as steam pipes, ovens and heaters. When working with elevated fluid temperatures >65°C (150°F), insulating the flow meter is recommended to reduce the risk of burns, and to reduce the heating of the electronics by convection of hot air off of the meter (especially for larger meters). The upper temperature limits shown in the curves rely on ambient convection to remove heat from the transmitter housing, cooling the electronics. For this reason, if operating near the upper temperature limit, the transmitter should not be insulated. At these elevated temperatures, the transmitter will be very hot — exercise appropriate caution.

Temperature Limits
Model 269 Transmitter Series



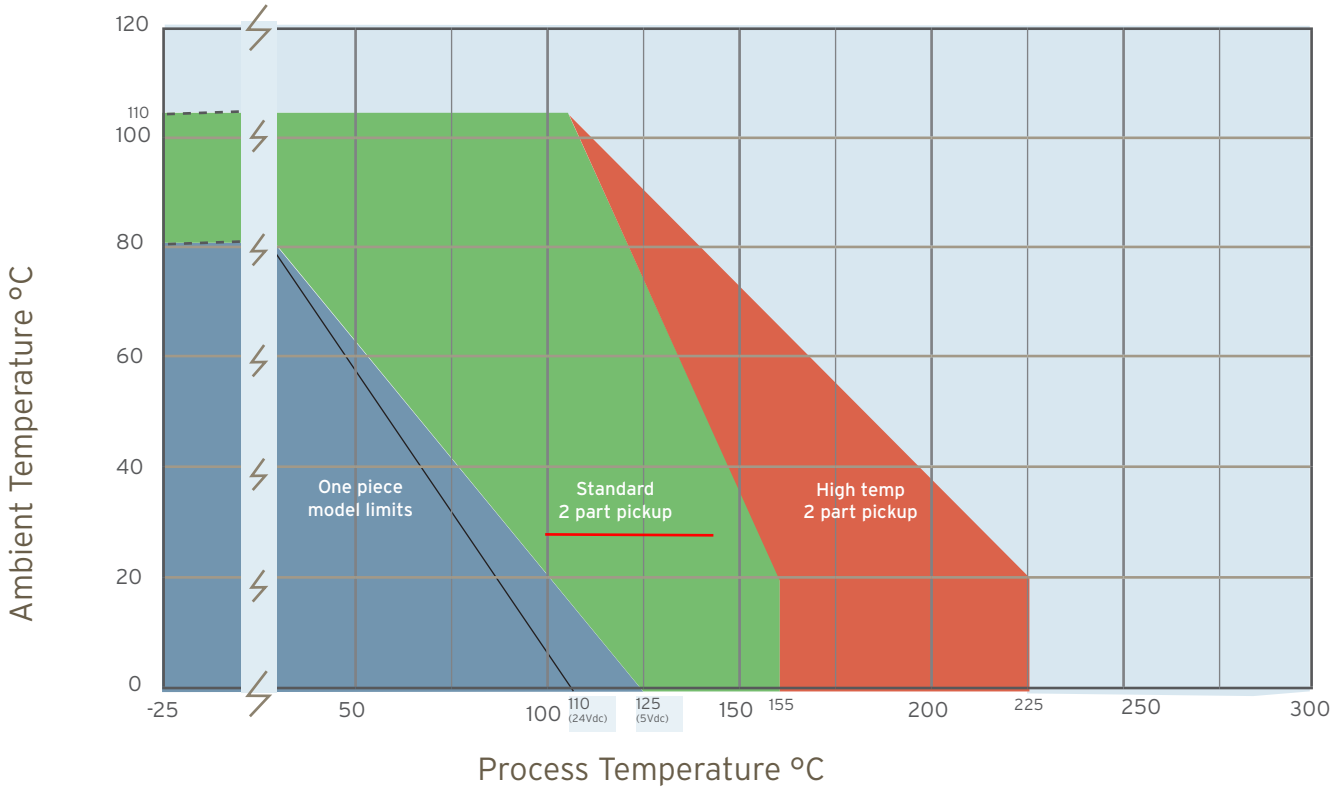
*Note: Ultra high temp model must be mounted with transmitter on side of the flow meter

Temperature Limits
Model 294 Transmitter Series

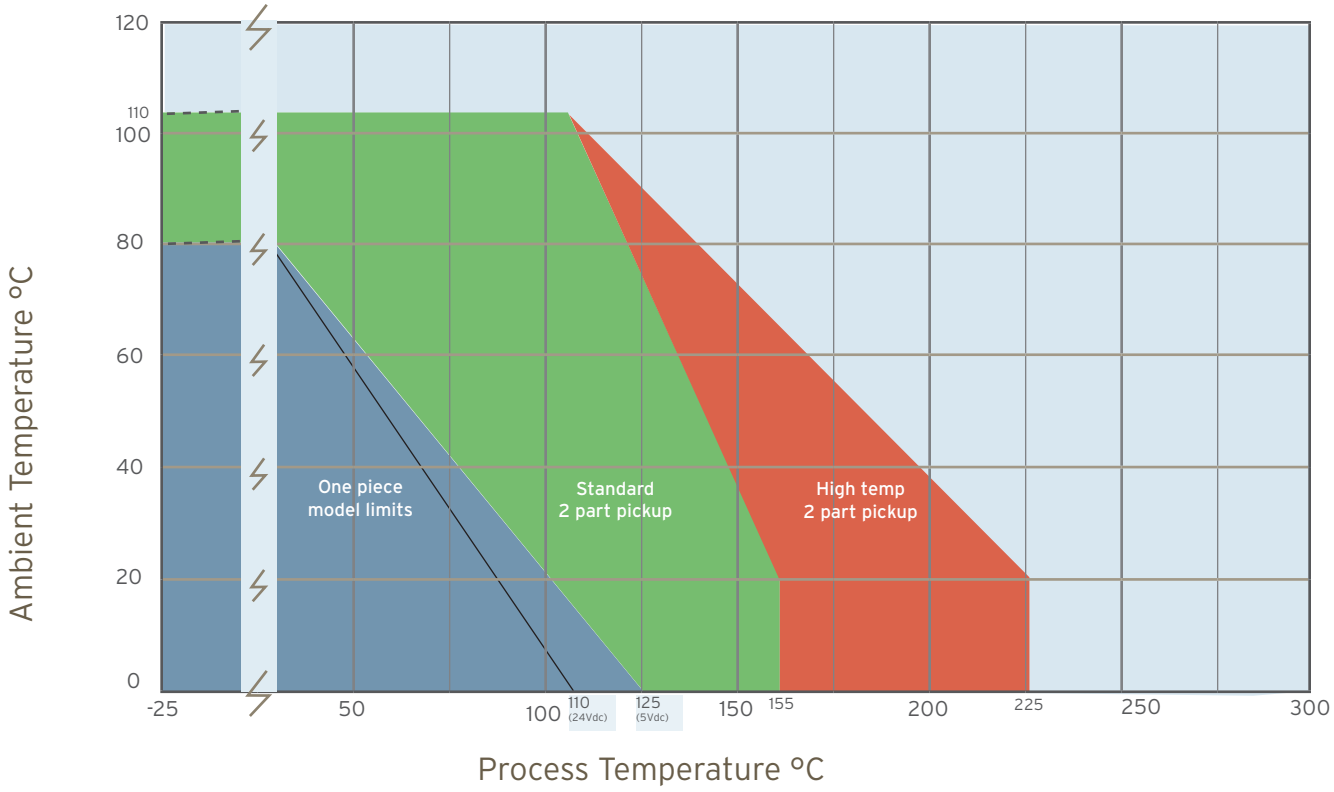


*Note: Ultra high temp model must be mounted with transmitter on side of the flow meter

Temperature Limits
Model 295 Transmitter Series



Temperature Limits
Model 296 Transmitter Series



Installation - Hazardous Locations

Applies only to Max Model EX295 and EX296 Transmitters with explosion proof certification.

These transmitters provide protection via a flame proof housing and through current limiting to the circuit board: Must wire with a class 2 power supply (See table for loads).

Meets US and Canadian Haz-Loc classifications, Class I, Div 1, Groups C and D, Tx

As well as ATEX/IECEx II 2 G Ex d IIB Tx Gb

Certification numbers Demko 11 ATEX 1013058X and IECEx UL 10.0048X

Mechanical Installation

The outer housing freely rotates to align the conduit hole with your electrical connection point. If the transmitter is already attached to the meter skip to step 5:

1. To attach the transmitter to the flow meter, apply a small amount of low strength thread adhesive, such as Loctite™, on the threads and screw the transmitter into the threaded recess on top of the flow meter.

2. Locate the locking set screw below the conduit hole and remove it. Rotate the outer housing clockwise until the screw hole lines up with a hole in the inner housing. Inserting an Allen key into the threaded hole while rotating the housing can help in finding the point of alignment. Now re-insert the set screw and hand-tighten it to lock the inner and outer housing together.

3. Finish tightening the transmitter onto the meter by applying a torque of 2 to 5 ft.-lb. (2.7 to 6.78 N-m).

4. Now back out the locking screw until it is flush with the surface of the transmitter.

5. The housing can now be rotated to align the conduit port in the desired direction.

6. To open the housing for wiring, remove the locking screw at the edge of the lid and then remove the cap using a 3/8" socket drive.

7. Install conduit. Within 18" of the housing install a conduit stop and fully seal with potting compound.

8. Connect wires to terminal block as shown below.

9. A case ground terminal is provided internally, but if grounded metallic conduit is not used, then one of the external grounds below the conduit fitting must be used. For metric- use either a 6 or 8 mm long stainless steel M5 x 8.0 bolt. For inch measurement – use either a 1/4" or 5/16" long stainless steel #10-32 bolt.

10. Reattach cap and tighten to 40in-lbs to seal enclosure. Install safety lock screw at the edge of the lid and hand tighten.

Removal from Flow Meter

Note: the transmitter does not need to be removed from the flow meter for any field servicing or adjustments. Normally, the flow meter and transmitter are shipped back to the factory for calibration as a unit.

1. Remove the locking screw at the edge of the lid and then remove the cap using a 3/8" socket drive.

2. Disconnect wires at the terminal block and remove wiring conduit from transmitter.

3. Locate the locking set screw below the conduit hole and remove it. Rotate the outer housing clockwise until the screw hole lines up with a hole in the inner housing. Inserting an Allen key into the threaded hole while rotating the housing can help in finding the point of alignment. Now re-insert the set screw and hand-tighten it. This will lock the inner and outer housing together.

4. Unscrew the transmitter, using a strap wrench if necessary.

Moisture Protection

The housing is a liquid and vapor-tight enclosure certified to IP66. There is an O-ring seal at the lid of the housing – the seal needs to be fully seated to provide moisture protection and achieve flameproof specifications.

About Explosion proof installations

For the Model 295 and 296 to fully adhere to the HazLoc certifications, the wiring must meet the appropriate codes. (Use of a wire conduit does not make the installation explosion proof – read below.) The transmitters which are certified for use in hazardous locations require the use of a 1/2" NPT conduit fitting. The wiring conduit must be sealed with a conduit stop within 18" of the device. If you choose to use exposed cables, cable seals must be used with sealing fittings and the wiring must be an approved armored cable. (For detailed information on the joint constructions used to achieve a flame proof housing, please contact Max Machinery.)

Electrical Installation

Use wiring that is between 20 and 28 gauge and rated to at least 5°C above the maximum ambient temperature, and rated to at least 80% of the maximum fluid temperature.

Pulse Output Wiring	Circuit Board Label	Mating Cable Wire Color**	Analog Output Wiring	Two Part Transmitter	
				End Labels	Wire Color
Case ground	Case	Blue	Case	Com	Brown
Common	Com	Black	Com	Rb	Grey
Power*	V+	Brown	V+	Ra	White
Signal Output (+)	PHA	White	RET	5V	Black
(Quad only)	PHB	Grey	SIG	Case	Blue

* Consult Table
** (Color codes are typical for Max Machinery wired devices)

Electrical Requirements

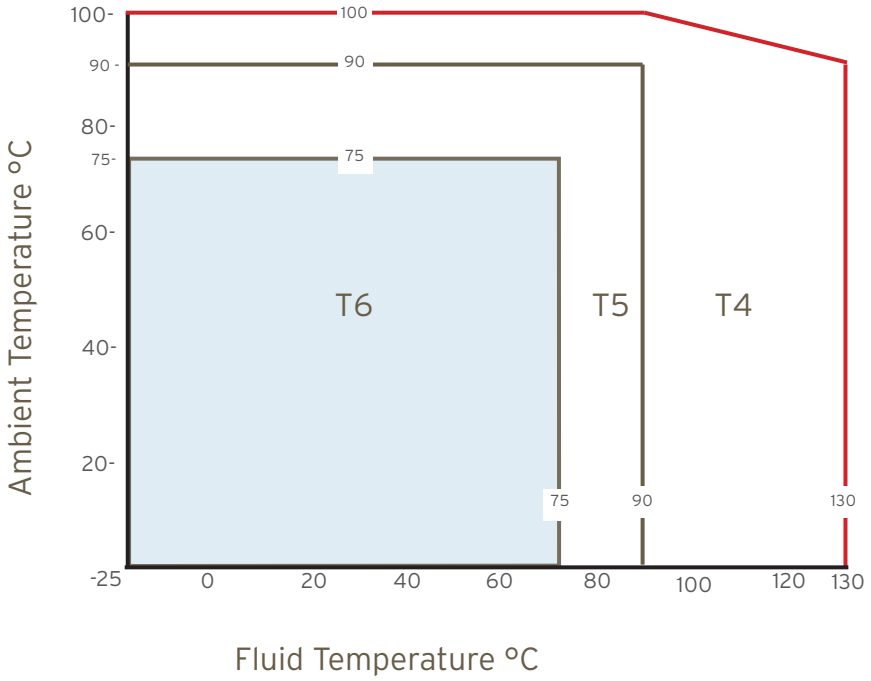
The device must be powered with a Class 2 power supply. Electrical loads are specific to model number's:

Part #'s	Transmitter Type	Electrical Input Requirements	Output Electrical Requirements
29x-0xx-0xx	Pulse Output Transmitter	5-28Vdc 40mA	Single Line 0-5V 10mA (500 ohm pulldown or greater)
29x-1xx-0xx	Quadrature Output Transmitter	5-28Vdc 50mA	2 Lines 0-5V 10mA each (500 ohm pulldown or greater)
29x-2xx-0xx	mA Output Transmitter (24Vdc)	24-28Vdc 50mA	Isolated current loop, max 500 ohms in line, 12Vdc max
29x-2xx-1xx	mA Output Transmitter (12Vdc)	12-15Vdc 100mA	Isolated current loop, max 500 ohms in line, 12Vdc max
29x-3xx-0xx	V Output Transmitter (24Vdc)	24-28Vdc 50mA	Isolated voltage loop, max 500 ohms in line, 12Vdc max
29x-3xx-1xx	V Output Transmitter (12Vdc)	12-15Vdc 100mA	Isolated voltage loop, max 500 ohms in line, 12Vdc max
29x-6xx-0xx	Level Shifter Pulse Output Transmitter	5-28Vdc 30mA	Single line, current sinking, max 28Vdc, max 25mA

Temperature Classification

Temperature class is a function of fluid temperature used in the meter and ambient temperature. For hot fluids, meter must be insulated and transmitter must be left exposed. All transmitters are rated to operate within the BLUE region, but only the remote sender unit variants (295-x5x-xxx) can operate up to the maximum temperatures shown in the chart. Consult factory for installation details when operating near temperature limits.

Temperature class chart for all explosion proof variants:



Note: Consult factory to determine the functional temperature limit of your transmitter variant. Temperature class ratings do not correspond with the continuous duty area for the electronics within the transmitter. A complete description of your transmitter may be found on the Max Machinery web site (www.maxmachinery.com). Individual specification sheets and product family manuals are also available for viewing or downloading.

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EC Declaration of Conformity

We, Max Machinery Inc. declare as manufacturer under our sole responsibility that the product series 295/296 Explosion Proof Flow Transmitter is in conformity with the provisions of the European Community Directives as shown below.

Applicable Series: Part numbers of the format 295-xx1-x00 and 296-xx1-x00 where 'x' does not affect conformity to the standards.

Low Voltage Directive 2006/95/EC

EMC Directive 2004/108/EC
EN 61000-6-2:2005 Electromagnetic Immunity
EN 61000-6-4:2007 Electromagnetic Emission

ATEX Directive 94/9/EC designed and manufactured in accordance with Annex II of the Atex Directive
EN 60079-0:2009 Explosive atmospheres general requirements
(Note: no routine verification and tests are required by clause 27)
EN 60079-1:2007 Protection by flameproof enclosures type d"

Designation: CE 0539 Ex II 2 G Ex d IIB Tx Gb

EC Type examination certificate DEMKO 11 ATEX 1013058X provided by
UL International DEMKO A/S NB Number: 0539
P.O. Box 514, Lyskaer 8, DK-2730 Herlev, Denmark

Product quality assurance notification #11 ATEX Q1116140 provided by UL Demko

Production control done to ISO 9001:2008, certificate #C2010-01864

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