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Flow Measurement and Calibration Service

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Electronic Linearization for Flowmeters With Viscosity Compensation TriLIN & TriLIN+T

Rev.005

Installation, Operation And Maintenance Manual

Thank you for selecting a TrigasFI GmbH product for your flow measurement application.

Virtually every major commercial, government, and scientific organization is making use of our services, products, expertise and extensive technical support. This is a culmination of years of refinement in our flowmeter and calibrator designs which has resulted in the technological leadership in the flow measurements field which we enjoy.

We are proud of our quality products, our courteous service and welcome you, as a valued customer, to our growing family.

WARRANTY

Limited Warranty. Seller warrants that goods delivered hereunder will at delivery be free from defects in materials and workmanship and will conform to seller's operating specifications. Seller makes no other warranties, express or implied, and specifically makes NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Limitation of Liability. Seller's obligation under the warranty shall be limited to replacing or repairing at Seller's option, the defective goods within twelve (12) months from the date of shipment, or eighteen (18) months from the date of shipment for destination outside of the United States, provided that Buyer gives Seller proper notice of any defect or failure and satisfactory proof thereof. Defective goods must be returned to Seller's plant or to a designated Seller's service center for inspection. Buyer will prepay all freight charges to return any products to Seller's plant, or other facility designated by Seller. Seller will deliver replacements for defective goods to Buyer freight prepaid. The warranty on said replacements shall be limited to the unexpired portion of the original warranty. Goods returned to Seller for which Seller provides replacement under the above warranty shall become the property of the Seller.

The limited warranty does not apply to failures caused by mishandling or misapplication. Seller's warranty obligations shall not apply to any goods which (a) are normally consumed in operation or (b) have a normal life inherently shorter than the warranty period stated herein.

In the event that goods are altered or repaired by the Buyer without prior written approval by the Seller, all warranties are void. Equipment and accessories not manufactured by Seller are warranted only to the extent of and by the original manufacturer's warranty. Repair or replacement goods furnished pursuant to the above warranty shall remain under warranty only for the unexpired portion of the original warranty period.

Should Seller fail to manufacture or deliver goods other than standard products appearing in Seller's catalog, Seller's exclusive liability and Buyer's exclusive remedy shall be release of the Buyer from the obligation to pay purchase price therefore.

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The total liability of Seller (including its subcontractors) on any claim whether in contract, tort (including negligence whether sole or concurrent) or otherwise, arising out of or connected with, or resulting from the manufacture, sales, delivery, resale, repair, replacement or use of any goods or the furnishing of any service hereunder shall not exceed the price allocable to the product or service or part thereof which gives rise to the claim.

1. Description of Function and Technical Data

a. Function

The TriLIN family of smart flowmeter signal conditioners amplifies, linearizes and scales the output signal of almost all commercially available flow meters.
Temperature and Pressure correction options allow compensation for the effects of fluid viscosity on the performance of turbine flowmeters.
In addition to scaling and linearization, signal conditioning circuits convert raw flowmeter outputs into analog 0-10V (optional 4-20mA) or frequency signal with a user selectable range of 0-4800 Hz. Update (recalculation) time is approximately 1.5 to 2.5 milliseconds.
The user friendly interface software is capable not only of programming, scaling and testing of the linearizer, but also allows visual review and printing of the linearization data.

b. Input Signals

Three standard flowmeter inputs are supported, which are user selectable by jumpers.

i. Carrier Frequency (RF) input
   Input frequency: 1 to 4000 Hz.
   Inductance: 1mH,
   Resistance: 10-13 ohms,
   Carrier frequency: 45 to 55 kHz

ii. Sinusoidal input
   From magnetic flowmeter sensors.
   Input voltage: 10mVss to 10Vss

iii. Pulse input
   Ulow < 1.5 V
   Uhigh > 3-30 V
   Range 0.4-32000 Hz (optionally even for lower frequencies).
   Input Impedance > 10 kOhm

c. Linearization

Up to 32 points (frequency/viscosity vs. pulses/liter),
Linear interpolation between points.

d. Temperature input

PT100 4-Wire or 0-10 V (scaleable)

e. Update Time (average value)

0 to 3.5 seconds

f. Low Flow Suppression

0.6 to 3.5 seconds per pulse, maximum waiting period

g. Outputs

i. Frequency
Linearized and scaled frequency 5V NPN referred to analog ground
Scaleable top frequency 50-4800 Hz
Output Impedance < 2,2 kOhm
Accuracy 0.1% of reading
Resolution 0.018 Hz
Computing time 1.5-2.5 ms for the linearization + 1 measuring period

ii. Analog
0-10 V linearized and scaled
Zero point offset <= 10mV to analog ground
Accuracy 0.1% full scale
Resolution 16 bits (~0.16 mVs)
Option: 4-20 mA

h. Data Communication

Over serial interface with standard Win96, 98, XP system and Country Setup English/USA
Programming cables are available with standard USB interface or with 9 Pin SubD connector.

i. Data Input

Manual entry or data import

j. Data Processing

All data are permanently stored inside the TriLIN as well an on the programming computer.

k. Environmental Conditions

Operating temperature: -40…+85°C
Storage temperature: -55… +125°C
Humidity: 0-85% relative, non-condensing

l. CE

EN50081-1, EN50082-1, EN61010

2. Pin Allocation / Wiring Diagram

a. Power Supply

M12 standard industry socket
Pin 1 = 9-30 VDC. approx. 900mW
Pin 2 = 0 V

b. Voltage and Frequency Output

BNC standard socket, isolated from the housing
Central contact = signal +
External contact = signal –

c. Flowmeter Input (Carrier frequency)

M12 standard industry plug
Pin 2 = cable shield
Pin 3 = carrier frequency +
Pin 4 = carrier frequency –

d. Flowmeter Input (Magnetic)

M12 standard industry plug
Pin 2 = cable shield
Pin 3 = sine +
Pin 4 = sine -

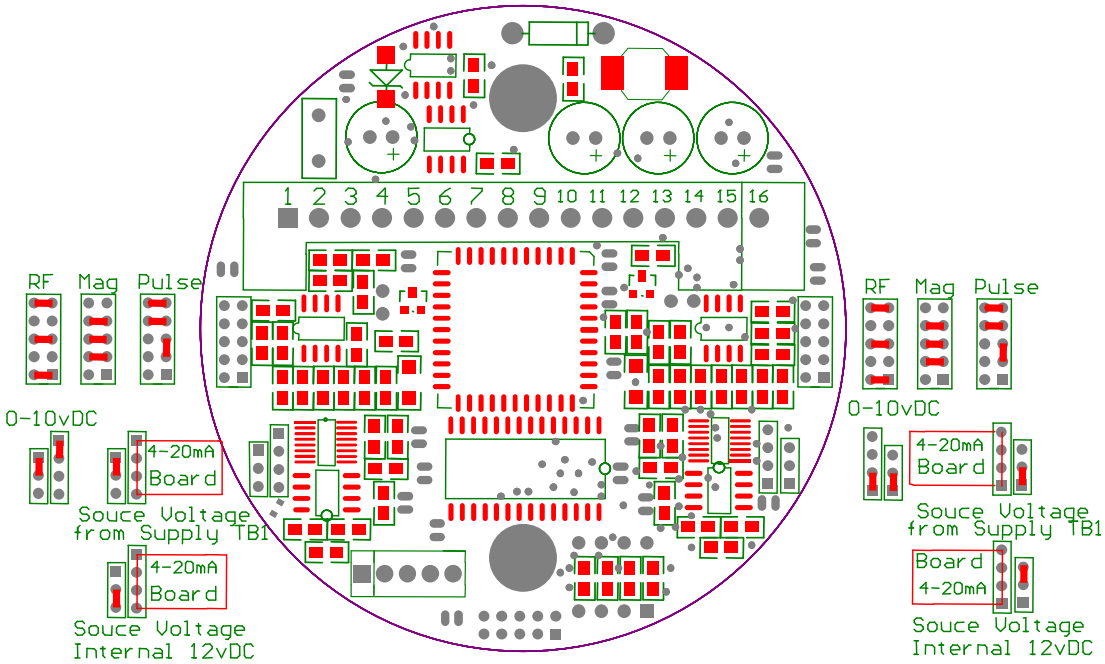
e. Flowmeter Input (PNP Pulse)

M12 standard industry plug
Pin 1 = supply + (1: 1 connected with electronics supply)
Pin 2 = supply - (1: 1 connected with electronics supply)
Pin 5 = pulse input

f. Temperature Input

Pin 1-4 Pt100 input
Pin 5 = + temperature input (0-10V, optional)
Pin 6 = - temperature input (0-10V, optional)

Tri-LIN Wiring Diagram



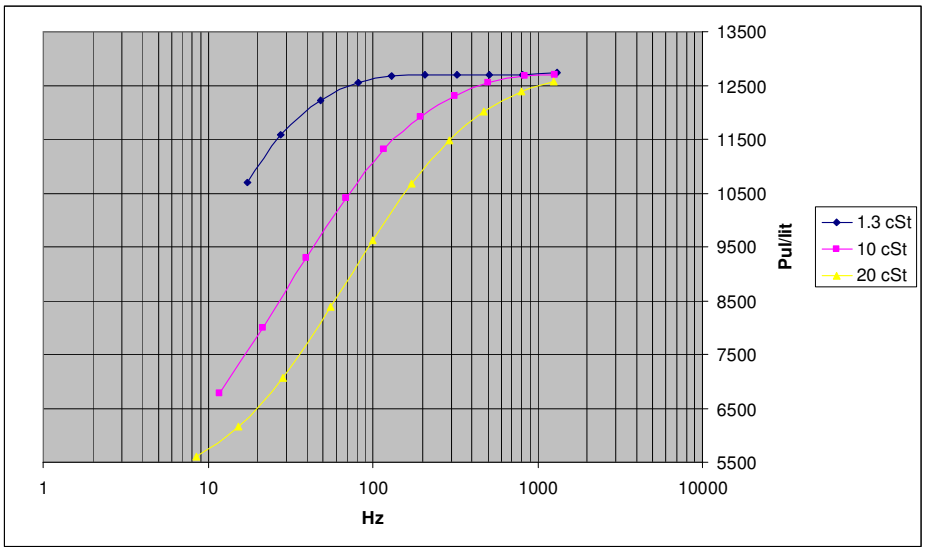
Terminal Block assignments:

Terminal	Description	Tri-LIN	Tri-LIN+
1.	+9-32vDC Supply Input	*	*
2.	0v	*	*
3.	Sensor Input +	*	*
4.	Sensor Input -	*	*
5.	0-10vDC Flow Output	*	*
6.	0v	*	*
7.	0-10vDC Temperature Output		*
8.	RTD PT100 + Supply		*
9.	RTD PT100 + Sense		*
10.	RTD PT100 - Sense		*
11.	RTD PT100 - Supply		*
12.	0-10vDC Temperature Input		*
13.	5v (TTL Pulse) Frequency Output	*	*
14.	0v	*	*
15.	Sensor Input +	*	*
16.	Sensor Input -	*	*

3. Operating Principle

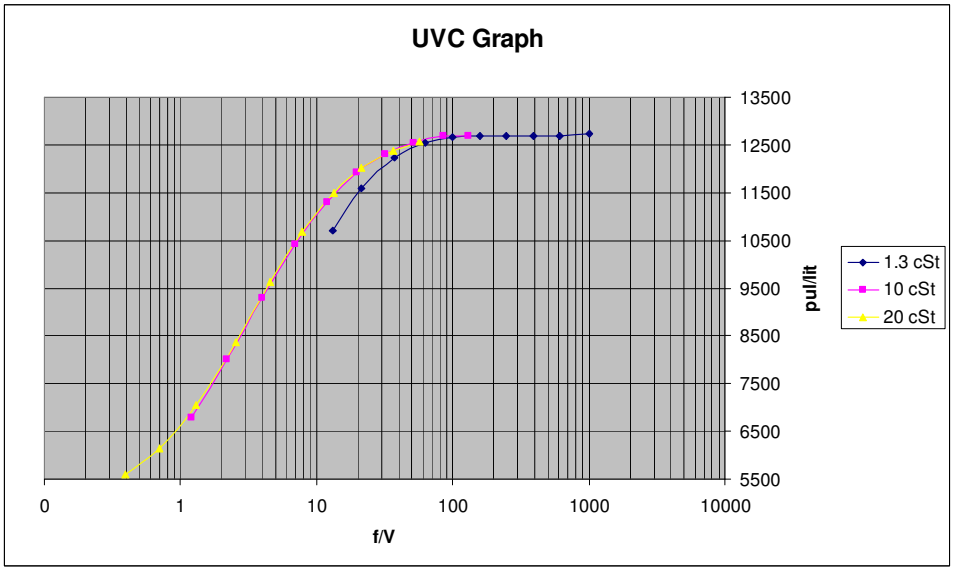
a. Influence of Viscosity

Turbine flow meter performance is affected by changes in the viscosity of the fluid being measured. As a general rule, the higher the viscosity of the measured fluid, the lower the output frequency for the same flow rate. A good presentation of a flowmeters performance is the relationship between frequency to meter K-factor in pulses per liter (pul/lit). Curves for a flowmeter calibrated at different viscosities are shown below.



b. Compensation for Viscosity Change (UVC Method)

The same turbine flow meter data as shown here compensated for viscosity (see UVC method details below). This method works well over the standard 10:1 measurement range of turbine flowmeters and can under certain circumstances be extended up to 100:1 range.



The blue line (=1,3cSt or mm²/s) shows the limitations of the UVC method. It can be seen that at least 3 points deviate significantly from the ideal UVC line. These outlying calibration points will not be used for linearization and temperature compensation.

c. Computation Method

The TriLIN+T includes a table where the viscosity vs. temperature characteristics of the fluid being measured can be programmed.
This table must correspond to the actual operating medium otherwise calculation errors may result.
The TriLIN uses the temperature input to look up the corresponding viscosity and perform the UVC compensation accordingly. The calculation steps are as follows:

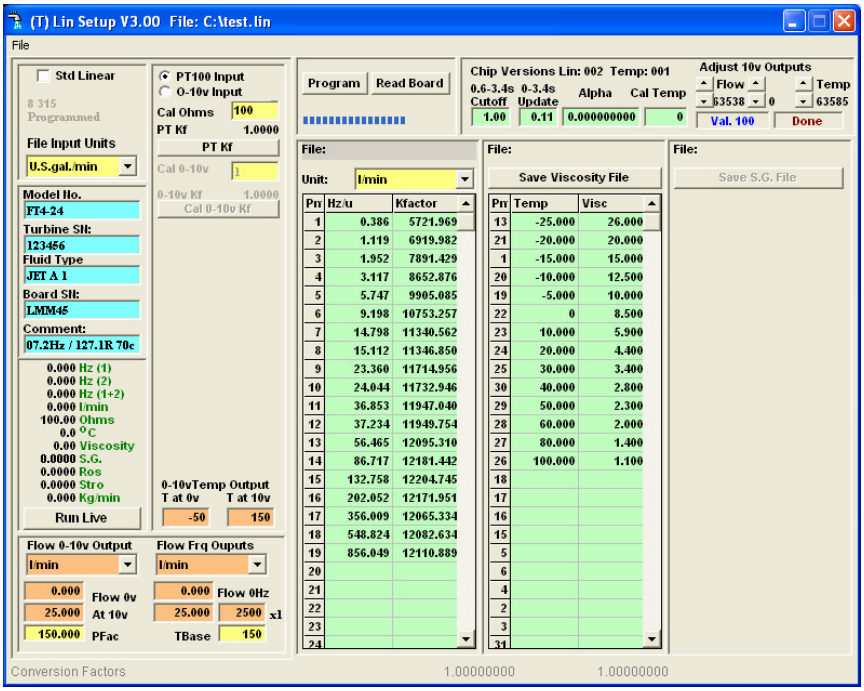
i. Determination of the viscosity (lookup from the cSt vs. °C table)
ii. Measurement of the actual incoming frequency and calculation of the current factor (f/V = frequency to viscosity)
iii. Determination of the current K-factor (pul/lit) corresponding to the f/V calculated in step ii. Above (lookup from the K vs. f/V table)
iv. Calculation of actual flowrate: Q = f/K and conversion to the required units (for example lit/min)
v. Optional: Conversion of the volumetric flowrate Q by means of a programmed temperature/density table into mass flow (for example kg/min)
vi. Scaling and output of the current temperature (for example -50 to +150 °C = 0 to 10 V)
vii. Scaling and output of the current flow to analog and to the frequency output. (for example. 0-10 l/min. = 0-10V = 0-2000 Hz)

For a detailed explanation of the Universal Viscosity Calibration (UVC) principles and Compensation methods, please visit the Technical Library at the TrigasFI web site: http://www.trigasfi.de/pdf/UVCPrinciples.pdf

4. Programming

a. Required Tools

i. Power supply 12-24V DC
ii. Computer with appropriate USB interface and a Windows operating system (e.g. Win98, WinXP) [NOT VISTA!].
Country Setup English/USA
iii. TriLIN programming Software
iv. Multimeter for rescaling of the analog outputs and function test



b. Electronics Readout

i. Supply TriLIN with power, connect the programming cable and start the programming software
ii. Assign the correct COM port (1-4) to the software
Click on the menu option “file” and “COMM x” (see above left)
iii. Read the TriLINs output by pressing the button “READ board “.
iv. Should the data not be read out correctly, repeat the procedure

c. Delete the old Flowmeter Calibration Curve

From the menu section “file” select “reset import”. The flow meter data table is erased.
The viscosity and density tables are however not affected.

d. Import the New Calibration Curve

i. From the “file” menu select the option “import Cal file “.
ii. Open the file and select “file type 1”.
iii. Repeat the procedure flow meter calibration curves (different viscosities) are imported.

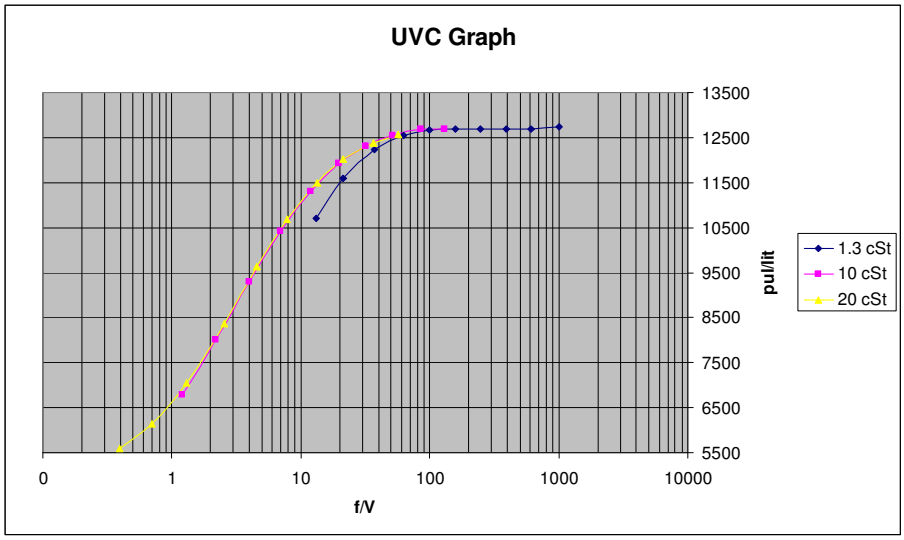
e. Optional: Manual Entry of Calibration Curve Data

Manual entry is necessary only if the data are not to you available in an appropriate electronic format.
IMPORTANT: Enter all values using point (not coma) as decimally separators. The first column is intended for the values "frequency/viscosity". The second column is for the K-factor.

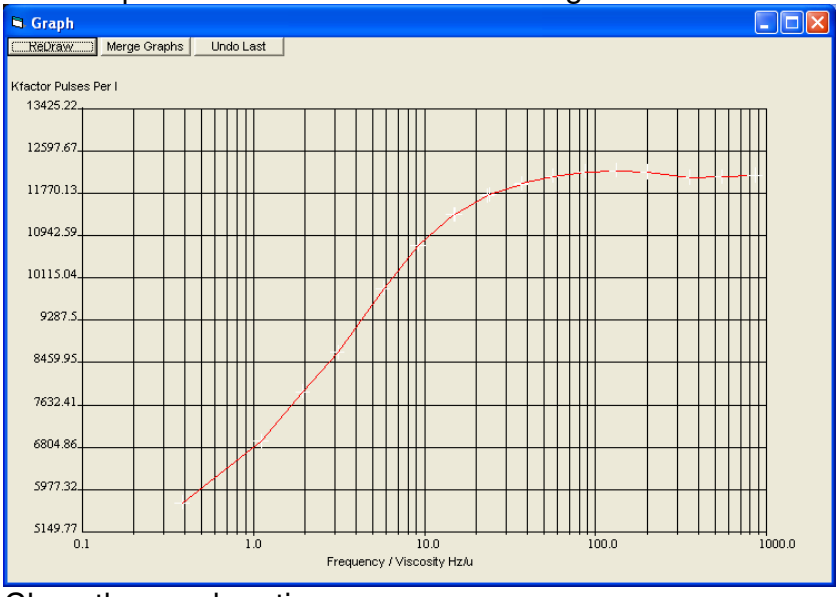
f. Sorting of Data and Graphical Presentation

This procedure is required after EACH change of data in order to ensure that data are sorted in ascending order.

i. Move mouse pointer over the data table of the flow meter.
ii. Press the right mouse button.
iii. A graph similar to the one below will appear on the screen.



iv. Delete all points that deviate from the optimal curve (here the lower points of the blue 1.3cSt curve)
Move the mouse pointer on the point which is to be deleted, press the right mouse button and confirm the deletion.
v. After all non-conforming points are deleted, press the button "Merge graph"
The Graph should now be a smooth single line as shown below.



vi. Close the graph option

g. Cut off und Update time

Change now, if necessary, the cut off and update time. Explanation of these features follows:

i. Cut off = the maximum waiting period for the completion of one signal period. If this time exceeded, no input will be recognized and all outputs will be set to zero.

ii. Update time = the time period between consecutive measurement updates (recalculations).

h. Data Fields

The data which appear in the left green fields are the data which will be programmed into the TriLIN and will also appear in the print out.

i. Scaling of Analog Outputs

At the bottom left hand corner in the orange fields, the desired scaling of the analog outputs are defined. Enter here the zero and span values as well as the desired units.
DO NOT CHANGE THE YELLOW FIELDS

j. Printing of Data

Press “print” from “file" menu.

k. Save

Press “Save Lin project" from “file" menu.

l. Programming the new Settings

Press "Program" and wait until the procedure is completed.

5. Kalibration of Analog Outputs

a. Connect TriLIN with data cable and power supply in the same way as when programming

b. Connect the voltmeter to the analog output which is to be calibrated

c. Read out the electronics by pressing “READ board “

d. On the top right portion of the screen there are arrow keys with which the bit values of the analog outputs can be changed as required
The bit value can be incremented by clicking on the field “100”

e. To complete the calibration routine click on the field “DONE “.

f. Program the entire electronics with one mouse-click on the button “Program”

6. Service Contacts

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www.trigasfi.com

7. Part Numbering (including Accessories)

Example: TL-E-01-R-W-U

TL- E 01 R W U

E = Without Temperature Compensation
T = With Temperature Compensation

01 = Standard housing, M12 industrial connector
ZZ = Special Housing

R = RF Input (Standard)
M = Mag Input
P = PNP Pulse Input
N = NPN Pulse Input (Special)

0 = Without mounting hardware (Standard)
W = Wall Mounting

U = Voltage Output (Standard)
I = Current Output

Standard Scope of Supply - TriLIN:

Connector for Power Supply
5m connecting cable, shielded with mating connector for RF pickoff:
MS3106-10SL-4S to flowmeter.

Standard Scope of Supply – TriLIN+T:
As for TriLIN above and in addition:
Mating Connector for Temperature Input for 4,5mm cable diameter

PT100 sensor option and non standard cable lengths are available upon request

Please contact us for details.