FH71 Preamplifier

User's Manual

For specific installation and maintenance advice, please contact FAURE HERMAN Service Department and if possible, indicate the serial number of the equipment.

Chapter 1: Introduction & General Description

This manual contains information to install and operate any type of FH71x preamplifier series in a safe and reliable manner. The meter application and operating parameters should be reviewed in order to select the best combination of pickup and preamplifiers for optimal performance.

Turbine meter pickup coils produce signals whose amplitude and frequency ranges are related to their flow range and type. The type of preamplifier must be selected to have its input sensitivity (or input detection level), match these signals: See Table 1

Electrical classification and distance of the electronics to the flow computer are important criteria to select the pickup and preamp combination to provide the best performance for the meter installation.

FH71x preamplifiers are robust electronic devices protected by potting. Preamplifiers are located inside the electronic enclosures most often attached to the meter body; in certain applications, the electronics containing the preamplifier can be located remotely from the meter.

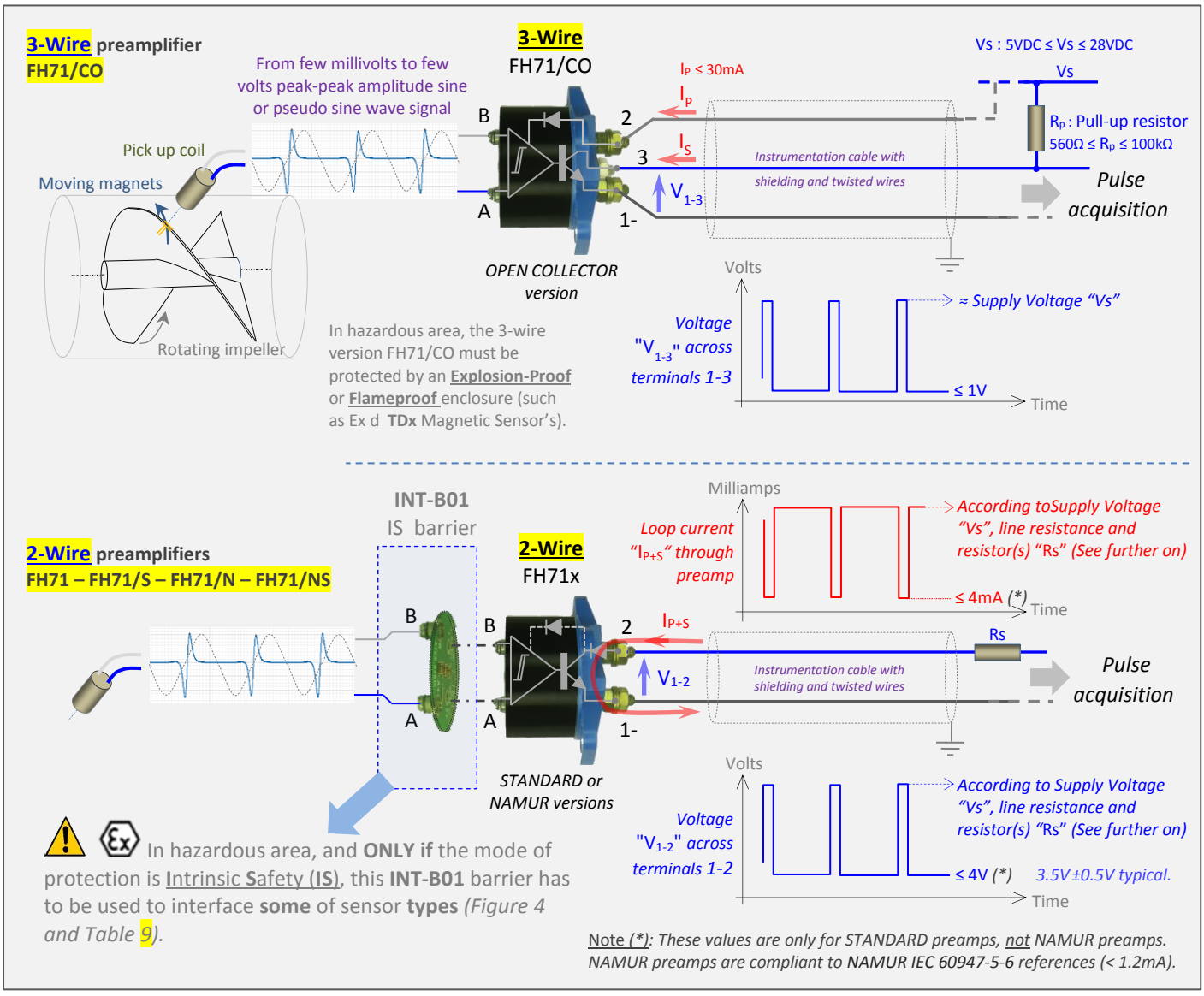


Figure 1: Functional principles of 2 and 3 wire preamplifiers

Functional Principle of Preamplifier

Magnetic pickup coils generate low power signals from the motion of the magnets fitted into the rotating impeller. When connected to the preamplifier, these signals are transformed into square wave signals. This output can then be securely transmitted to long distant pulse acquisition equipment (flow computer).
These principles are illustrated in **Figure 1** for both the 2-Wire and 3-Wire versions of the preamplifier.

Description

Faure Herman offers several different types of preamplifiers to allow clients to choose best preamplifier for their particular application based on meter type, electrical classification, and desired output. Specifics of each preamplifier type by detection level and hazardous classification are listed in Tables 1 & 2. Schematics and advices concerning the interconnection between preamplifier and flow computer are provided in this manual with recommended circuit parameters. Physical dimensions and terminal connections can be seen in Figure 2.

Table 1: Preamplifier Versions listed by detection voltage levels and output type

FH71x Type Name	Part Name	Part Number	Input Detection Level	Typical Input Signal Voltage Sensitivity	Connection Accessories *(Supplied with preamps)*
STANDARD	FH71	500090	Normal	10mVrms @ 10Hz Sine wave 100mVrms @ 400Hz Sine wave	Input: **300267** Ø 2mm round soldering terminal Output: **300288** **AWG 16-22** Wire Ø 4mm round crimp terminal
NAMUR	FH71/N	500092	Normal		
STANDARD SENSITIVE	FH71/S	500094	Sensitive	10mVrms @ 10Hz Sine wave 30mVrms @ 400Hz Sine wave	
NAMUR SENSITIVE	FH71/NS	500093	Sensitive		
OPEN COLLECTOR	FH71/CO	500091	Sensitive		

Table 2: Preamplifier Versions by Hazardous Area & Magnetic Sensor enclosures

FH71x Type Name	Part Name	Transmitter Output		Hazardous Area: Protection Mode	Magnetic Sensor Model type enclosures	Front Side Information Plate			
						PR	N	S	CO
STANDARD	FH71	FH BRAND STANDARD	2-Wire Current Loop	"Ex d" *or* "Ex ia"	TDx... or TDxSI... - PR	X			
STANDARD SENSITIVE	FH71/S			"Ex d" *or* "Ex ia"	TDx... or TDxSI... - PR/S	X		X	
NAMUR	FH71/N	NAMUR STANDARD		"Ex d" *or* "Ex ia"	TDx... or TDxSI... - PR/N	X	X		
NAMUR SENSITIVE	FH71/NS			"Ex d" *or* "Ex ia"	TDx... or TDxSI... - PR/NS	X	X	X	
OPEN COLLECTOR	FH71/CO	**3-Wire**		**"Ex d" only**	TDx...- PR/CO	X			X

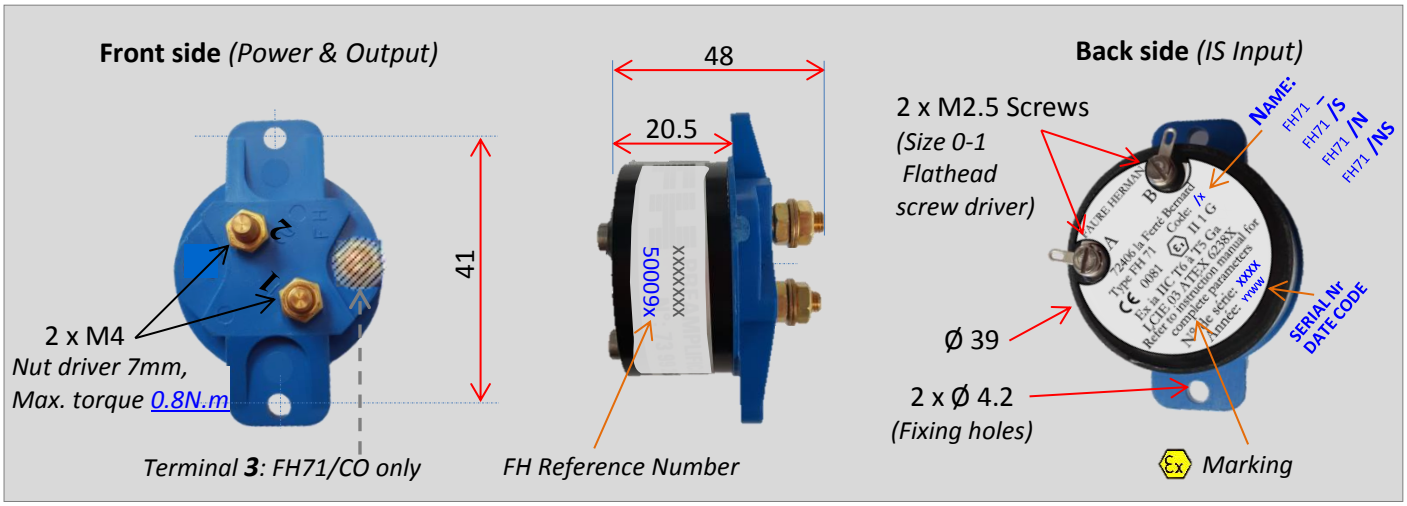


Figure 2: FH71x view and physical illustration, preamplifier identification and marking

Summary of selection criteria and main characteristics of FH71 preamplifiers

The information in Table 3 provides a brief overview of parameters to consider when selecting a type of preamplifier.

Table 3: Quick choice and main characteristics of FH71 preamplifier versions

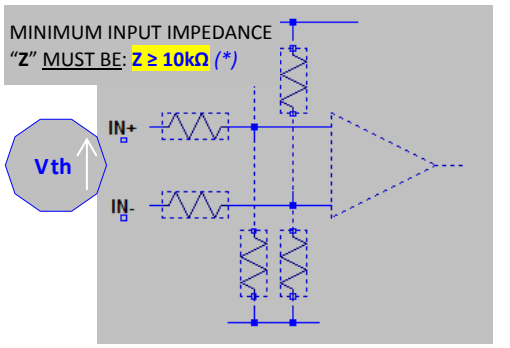
QUICK CHOICE & CHARACTERISTICS	PULSE ACQUISITON SYSTEM SIDE	SCHEMATICS	ADVICE ON SAFETY & RELIABILITY	HAZARDOUS AREA PROTECTION MODE
3-WIRE OC	Open Collector **FH71/CO** preamp just needs to use the simple Open Collector output and power supply to be delivered separately	#SCH1xx	Never apply reverse voltage on output terminal 3. Limit signal current. Input sensitivity may need pickup coils with resistors for some turbine types.	Only "**Ex d**" Flameproof / Explosion-proof.
2-WIRE STANDARD	Using **FH71/S** standard Sensitive or **FH71** standard preamp implies that: In-circuit resistors must be adjusted to match both ideal operating conditions for preamp and electrical characteristics of pulse acquisition input (i.e. thresholds & type) Cable resistance matters when defining resistors	#SCH3xx #SCH42x #SCH43x	**Check power rating of resistors.** Adjust operating currents at supply voltage with correct resistors. Adjust resistor values to match input detection thresholds,	Can be used in "**Ex d**" Flameproof / Explosion-proof, or in "**Ex i**" Intrinsic Safety
2-WIRE NAMUR	Namur **FH71/N** and Namur Sensitive **FH71/NS** preamp are mostly dedicated to NAMUR standard pulse input types	#SCH2xx #SCH411	Relies on own pulse input standard of acquisition system or interface. Pulse currents are only few milliamps and considerations are needed concerning electromagnetic noise.	

Chapter 3: Matching the pulse input to varied acquisition types and conditions

It is necessary to review the types of pulse inputs of flow computers, interfaces (barriers or isolators) or other acquisition systems before bringing the FH71x signal into the flow computer. The voltage and current threshold types are seen in Figure 3.

Please note that FAURE HERMAN provides and regularly adds interconnection wirings dedicated to various flow computers, acquisition systems or interfaces at the following Web address: https://faureherman.zendesk.com.
Do not hesitate to contact technical support via support@faureherman.zendesk.com for technical support for wiring, signal acquisition, etc….

Voltage Threshold detection input, V th



Current Threshold detection input, Ith

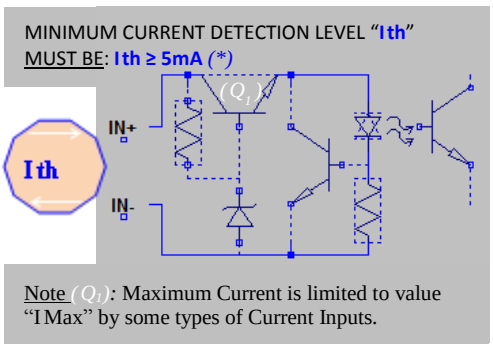


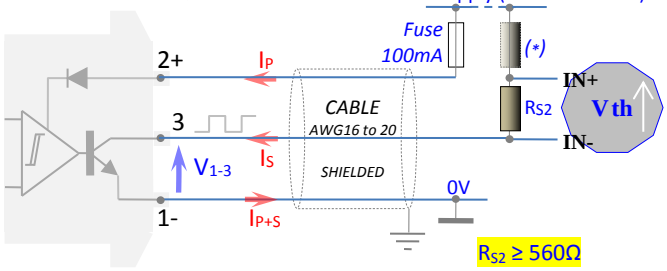
Figure 3: Main Pulse Acquisition Input Types

Chapter 4: 3-Wire preamplifier, FH71/CO, External Wiring

The FH71/CO preamplifier version has a simple Open Collector output and can use any VDC power supply from 5 - 28 VDC. It is not "Intrinsically Safe" and requires "Ex d" enclosures to be used in Hazardous Areas.

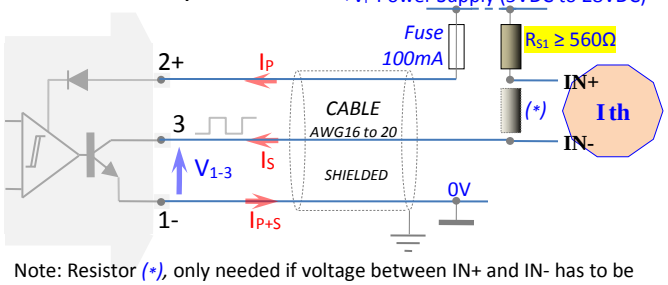
Table 4: Main Functional Parameters and Wiring Diagrams for 3-Wire FH71/CO Preamps

SPEC #SCH111: FH71/CO



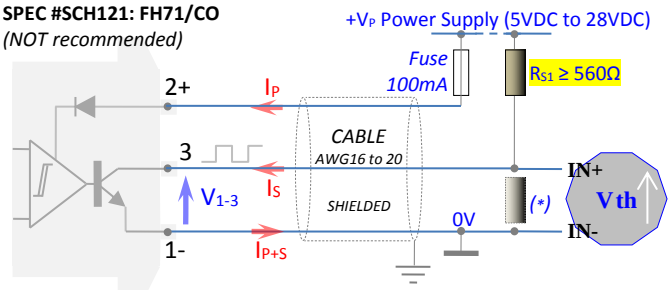
Note: Resistor *(*)*, only needed if Vth max needs to be limited on acquisition input (*following recommendation from manufacturer of acquisition system).*

SPEC #SCH112: FH71/CO



Note: Resistor *(*)*, only needed if voltage between IN+ and IN- has to be limited on acquisition input. *Also check that the resistors values comply with Max current and threshold current Ith on input following recommendation from manufacturer of acquisition system.*

SPEC #SCH121: FH71/CO
(NOT recommended)



NOTICE: The minimum value of V_{1-3} can be as high as 1.9V.
Note: Resistor *(*)*, only if Vth max needs to be limited on acquisition input.

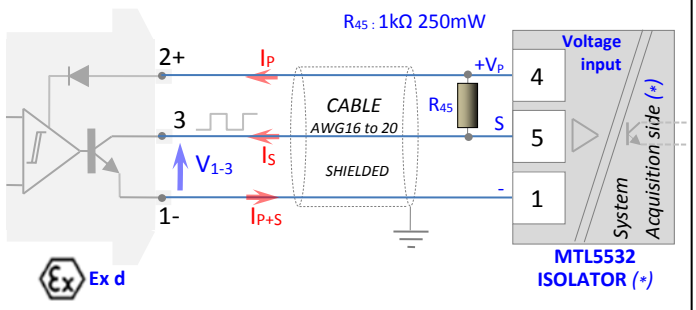
SPEC #SCH122: Other characteristics

Safety recommended Power Rating P_R for resistors $R_{S\_}$:	
P_R : Watt $R_{S\_}$: Ohm V_P : Volt	$P_R \geq 1.5 \times V_P^2 / R_{S\_}$ *(Worst case and 1.5 safety factor)*
$R_{S\_}$ minimum safe value is meant to limit the maximum peak current I_{S_MAX} preferably below ≈50mA in the preamplifier output circuit *(worst case gives V_P = 28V => ≈1.2kΩ 1W minimum always sufficient)*	
$R_{S\_}$: Ohm V_P : Volt I_S : Ampere	$R_{S\_} \geq V_P / 0.050$
Maximum value 1kΩ for resistors $R_{S\_}$ is compliant with most situations.	

FH71/CO 3-Wire Preamplifier can also be connected through a galvanic isolator (practical example below)

Table 4 Continued from previous page *(Wiring diagrams for 3-Wire FH71/CO Preamps)*

SPEC #SCH131: FH71/CO



Note *(*)*: *See MTL recommendations to connect on System Acquisition side.*
All configuration switches in ***OFF*** *position*

Chapter 5: 2-Wire preamplifier, External Wiring

All FH71x versions other than the 3-Wire version have the benefit of using the same pair of wires for both pulse transmission and power supply. In the case of the 2-wire preamplifier, the current in the loop alternates between two values (~ few tens of milliamps and ~3.5mA for FH STANDARD, or ~ 3mA and ~ 0.5mA for NAMUR); this variation creates the pulse. The number of pulses per second is the frequency of the pulses.

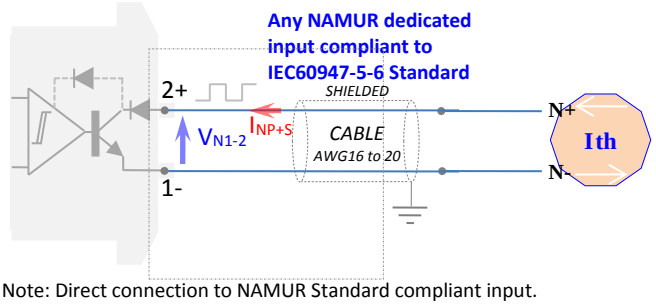
FH Standard operates like NAMUR Standard, but with higher currents which are less sensitive to electromagnetic interferences than NAMUR standard.

These devices are Intrinsically Safe and can be connected to intrinsically safe equipment in Hazardous Areas as far as these connections have been justified by an *Intrinsically Safe Circuit Verification Calculation, as per IEC 60079-14 standard*. *See* Chapter 7*, Intrinsic Safety.*

NAMUR preamplifiers FH71/N and FH71/NS:
These versions are the easiest to install as they comply with NAMUR IEC 60947-5-6 international standard.

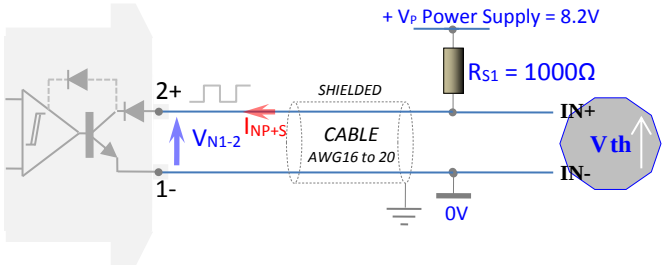
Table 5: Main Functional Parameters and Wiring Diagrams for 2-Wire NAMUR Preamps

SPEC #SCH211: FH71/N or FH71/NS = NAMUR preamplifiers



Note: Direct connection to NAMUR Standard compliant input.
Note: Signal variation of I_{NP+S} NAMUR pulse current:
I_{NP+S} Min < Ith Min = 1.2mA and I_{NP+S} Max > Ith Max = 2.1mA
Note: *Maximum resistance of cable wire for NAMUR configuration ≈ 50Ω*

SPEC #SCH212: FH71/N or FH71/NS = NAMUR preamplifiers
(NOT recommended)



Note: V th must be able to detect the following signal variations of V_{N1-2} pulse voltage: V_{N1-2} Min < 6.2V and V_{N1-2} Max > 7.2V

Note: MAXIMUM CABLE LENGTH RECOMMENDED FOR NAMUR VERSIONS = 100m (330ft)

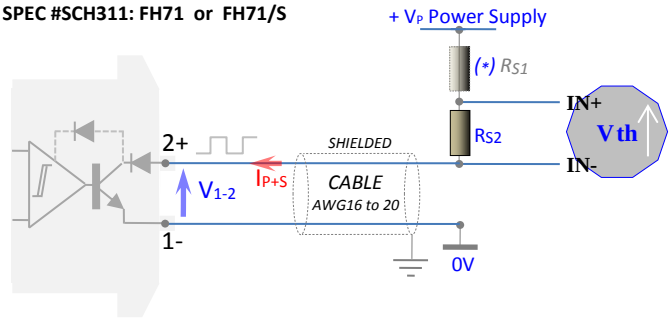
Non NAMUR FH71x preamplifiers, 2-Wire Standard FH71 & Standard Sensitive FH71/S

For an acquisition system such as a flow computer to acquire pulses from 2-Wire STANDARD preamplifiers, the current needs to be considered first when wiring the device. The current signal should alternate between a minimum value ≈3.5mA and a maximum value ≈32mA.

Table 6: Main Functional Parameters and Wiring Diagrams for 2-Wire STANDARD Preamps

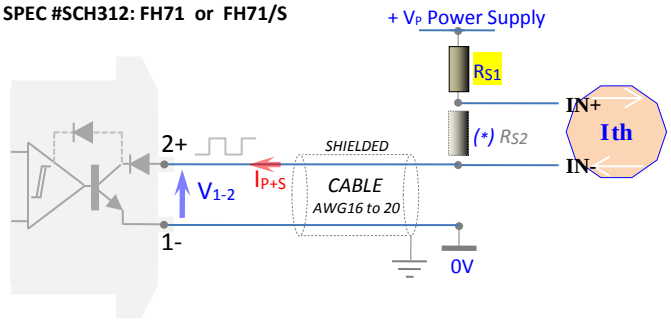
MAIN FUNCTIONAL PARAMETERS OF 2-WIRE STANDARD PREAMPS	
Loop current when it is commuted = ON: ..... *Depends on loop circuit resistance and supply voltage*	I_{P+S} = Recommended ≈ 32mA
Consumption current when not-commuted = OFF:	V_{1-2} = 3.5mA±0.5mA
Voltage across terminals 1-2 when it is commuted = ON: ...	V_{1-2} = 3.5V ±0.5V - ***Notice that it is not 0V***
Voltage across terminals 1-2 when not-commuted = OFF: ...	Almost the same as supply voltage V_P

SPEC #SCH311: FH71 or FH71/S



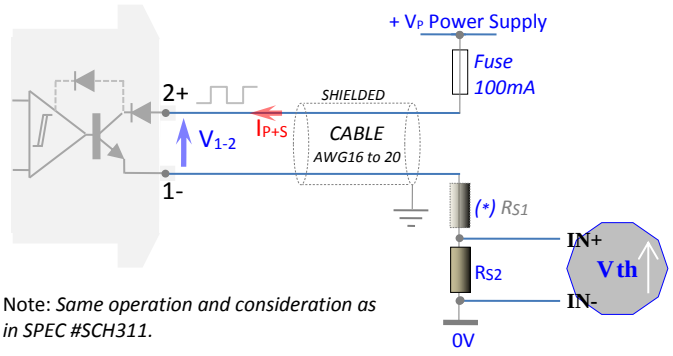
Note: Resistor *(*)*, only needed if the maximum allowed voltage at the input between IN+ and IN- is below +VP (*following specification data from manufacturer of acquisition system)* **OR** if the threshold voltage level V th is lower than $V_{LTH} = R_{S2} \times 0.005$

SPEC #SCH312: FH71 or FH71/S



Note: Resistor *(*)*, only needed if the current is limited by the input type below 30mA, **OR** if current detection level I th is below 5mA (*following specification data from manufacturer of acquisition system).*

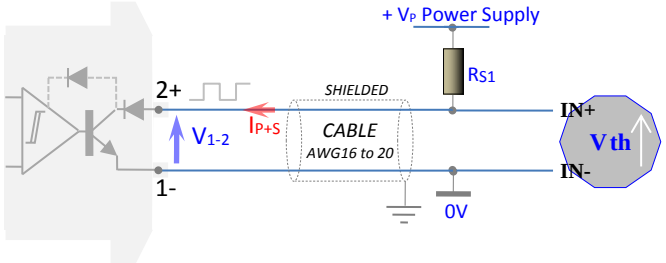
SPEC #SCH321: FH71 or FH71/S



Note: *Same operation and consideration as in SPEC #SCH311.*

SPEC #SCH322: FH71 or FH71/S

(NOT recommended, easy wiring though for rapid testing)



Note: V th level must be able to detect the following signal variations of V_{N1-2} pulse voltage: $4V > V_{N1-2}\_Min > 2.5V$ and $V_{N1-2}\_Max < V_P$
Note: V_{N1-2}_Min value is related to preamplifier temperature.

SPEC #SCH331: BEST OPERATING CONDITIONS for FH71 & FH71/S

Safety recommended Power Rating P_R for resistors R_S_ :
Refer to SPEC #SCH122 page 5 for calculation

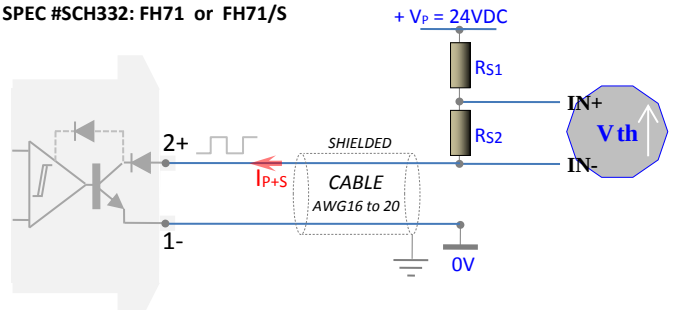
R_S_ minimum value 560Ω always safe up to V_P=28V, but see here below:

For most reliable operating conditions, FAURE HERMAN STANDARD for 2-Wire preamplifiers should consist in pulse current I_{P+S} varying from "OFF State" ~3.5mA±0.5mA to "ON State" ~32mA±2mA.

To get these conditions, for instance at V_P = 24VDC, the total circuit resistance should be ≈ *Cable Wire Resistance + R_{S1} + R_{S2}* ≈ **650Ω**.

The total Cable Wire Resistance should be taken into account when exceeding ≈ 10Ω *(See **Table 7**)*

SPEC #SCH332: FH71 or FH71/S



Note: See **Table 7** for resistors R_{S1} and R_{S2} values.

Table 7: Typical circuit parameters for FH71 & FH71/S preamplifiers

Refer to previous page SPEC #SCH332 & #SCH321	Using **24VDC** Power Supply Voltage, **RS2 = 180Ω 0.5W 1%**		
	RS1 RESISTOR VALUE *(*):*		
SHIELDED CABLE	**470Ω ≥ 1W**	**450Ω ≥ 1W**	**430Ω ≥ 1W**
1,3 mm² AWG 16	**0 → 455 m 0 → 1493 ft**	**→ 715 m → 2346 ft**	**→ 1525 m → 5003 ft**
1,0 mm² AWG 18	**0 → 325 m 0 → 1066 ft**	**→ 500 m → 1640 ft**	
0,6 mm² AWG 20	**0 → 100 m 0 → 330 ft**	*Please consult FAURE HERMAN for longer distances*	

Note *(*)*: Recommended tolerance = **±1%**

Chapter 6: Hazardous locations

FH71x preamplifiers are generally enclosed into FAURE HERMAN flameproof/explosion-proof "TDx" or intrinsically safe "TDxSIx" types of enclosures called "Magnetic Sensors", directly mounted on turbine flowmeters.

The pickup coil is also enclosed in the Magnetic Sensors, right below the preamplifier to reduce electromagnetic interferences hazards.

The next tables help to define the internal composition of Magnetic Sensors from their marking.

Table 8: Flameproof/Explosion-proof Magnetic Sensors

FH71x Type	Part Designation	**Magnetic Sensor Model Types / Enclosures TDx … *Explosion Proof***				
		FH Coil type				Other Coil type
		FH 101510	FH 101510-1	FH 101510-2	FH 100055	PC45-25
Open Collector	FH71/CO	…-PR/CO	…-1-PR/CO	…-2-PR/CO	…-55- HT-PR/CO	…- PC45-PR/CO
Standard	FH71	…-PR	…-1-PR	…-2-PR	…-55-HT-PR	- PC45-PR
Namur	FH71/N	…-PR/N	…-1-PR/N	…-2-PR/N	…-55- HT-PR/N	- PC45-PR/N
Standard Sensitive	FH71/S	…-PR/S	…-1-PR/S	…-2-PR/S	…-55- HT-PR/S	…- PC45PR/S
Namur Sensitive	FH71/NS	…-PR/NS	…-1-PR/NS	…-2-PR/NS	…-55- HT-PR/NS	…- PC45-PR/NS

Table 9: Intrinsically Safe Magnetic Sensors

FH71x Type	Part Name	**Magnetic Sensor Model Types / Enclosures TDxSI … *Intrinsically Safe***				
		FAURE HERMAN Coil types				Other Coil type
		FH 101510 **+ INT-B01**	FH 101510-1 **+ INT-B01**	FH 101510-2 **+ INT-B01**	FH 100055	PC45-22
Standard	FH71	…-PR	…-1-PR	…-2-PR	…-55-HT-PR	…- PC45-PR
Namur	FH71/N	…-PR/N	…-1-PR/N	…-2-PR/N	…-55- HT-PR/N	…- PC45-PR/N
Standard Sensitive	FH71/S	…-PR/S	…-1-PR/S	…-2-PR/S	…-55- HT-PR/S	…- PC45PR/S
Namur Sensitive	FH71/NS	…-PR/NS	…-1-PR/NS	…-2-PR/NS	…-55- HT-PR/NS	…- PC45-PR/NS
REMINDER: FH71/CO is NOT intrinsically Safe !						

INT-B01: (see Table 10 and Figure 4 next page) is sometimes needed in order to preserve intrinsic safety.

FH71x can also be installed inside enclosures which are located remotely from the pickup coil, provided the connection is reasonably short and protected from electromagnetic interferences (Contact FAURE HERMAN concerning these configurations and if the distance is greater than 5m).

Chapter 7: Intrinsic safety

Details of proper use of Faure Herman preamps in hazardous areas are available in Table 8. All 2-Wire preamplifiers, both FH STANDARD versions and both NAMUR versions, can be used in intrinsically safe areas. Wiring diagrams incorporating intrinsically safe isolators (MTL5532 & MTLx787 Zener barriers) can be seen in APPENDICES A & B.
Other brands can also be used; please do not hesitate to contact FAURE HERMAN.

IMPORTANT NOTE:

When located in hazardous areas requiring intrinsic safety as a mode of protection, the FH71x is fully compatible with intrinsic safety standards only in the following conditions:

- FH71x must only be connected to certified intrinsically safe equipment,
- The parameters of the connected equipment must be compatible with those of the preamplifier given in Table 10, and the parameters of the cable must be taken into account in a Safety System Analysis.
- If the preamplifier is part of an intrinsically safe certified subassembly, the connection parameters and the operating conditions must meet those of the subassembly.
- When incorporated into a subassembly, safety conditions of use of the preamplifier rely on the information written on identification plate of the subassembly, such as the plate for instance which is riveted on the top cover of TDxSIx Magnetic Sensors enclosures.

IMPORTANT NOTE: When connecting the preamplifier input to some types of pickup coils in Intrinsic Safety mode of protection, **INT-B01** interface is compulsory (See Figure 4 below and Tables 9 and 10).

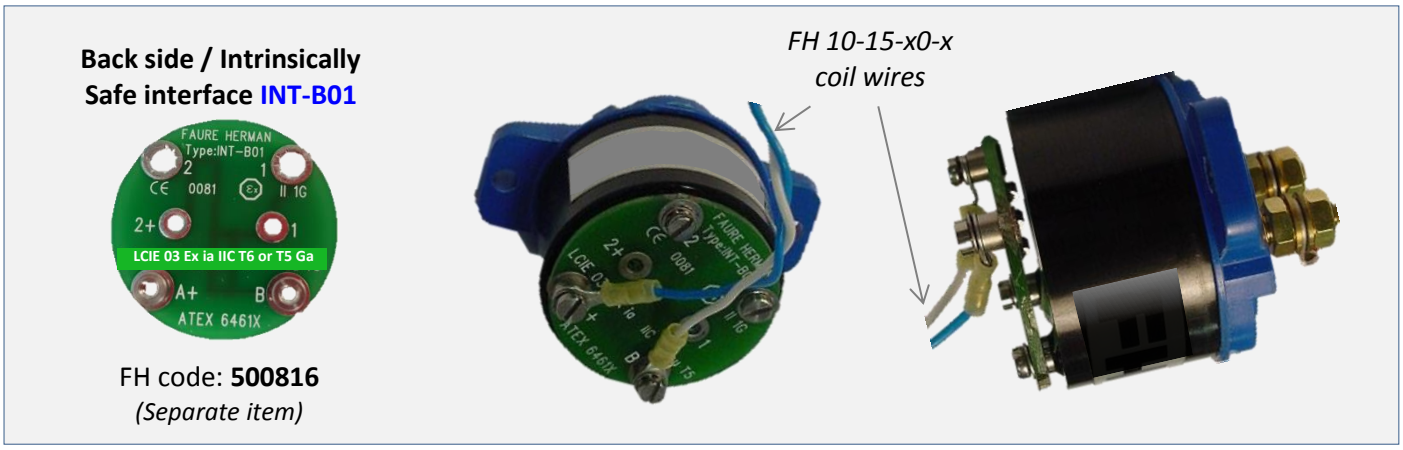


Figure 4: INT-B01 interface, FH71x intrinsically safe input side barrier

Table 10: Intrinsic Safety Parameters

Code Name	Ordering Ref	Nr. 1-2 Signal Output & Power Terminals						Nr. A-B Input Terminals								Condition of use in Hazardous Area
		Ui	Ii	Li	Ri	Ci	Pi	Uo	Io	Lo	Ro	Co	Po	Lo/Ro	Ri	Ui
		V	mA	mH	Ω	nF	W	V	mA	mH	Ω	nF	mW	H/ Ω	Ω	V
FH71	500090	28	150	0	_	0	1	28	6.5	700	_	23	_	_	4275	28	**IIC** T5 at T_{amb} Max 80°C Or T6 at T_{amb} Max 60°C
FH71/N	500092	28	150	0	_	0	1	28	6.5	700	_	23	_	_	4275	28	
FH71/S	500094	28	150	0	_	0	1	28	6.5	700	_	80	_	_	4275	28	
FH71/NS	500093	28	150	0	_	0	1	28	6.5	700	_	80	_	_	4275	28	
FH71/CO	*500091*	**WARNING:** FH71/CO 3-Wire Open Collector preamplifier is NOT intrinsically safe														*FH71/CO are Inside "Ex d" Enclosure only*

Note: Tamb = Ambient Temperature.

Chapter 8: General Specifications

Table 11: General Specifications

Signal input			
Impedance: > 30kΩ @10Hz			
Report to Table 1 concerning amplitude sensitivity			
Input Power / Voltage Supply			
Reverse polarity protection: Supply voltage terminals 1-2 on all versions			*(1)*
FH71 & FH71/S:	12VDC to 28VDC	4mA to 50mA	*(2)*
FH71/N & FH71/NS:	8.2VDC	1mA to 5mA *(1000Ω pull-up resistor from NAMUR Std)*	
FH71/CO:	5VDC to 28VDC	1mA to 30mA, + Output Signal Sink Current ≤ 50mA	*(2)*
Maximum Power Dissipation:	FH71/CO < 1W	FH71, FH71/S, FH71/N, FH71/NS < 0.3W	*(3)*
Output Signal			
FH Standard Current Pulses - FH71 & FH71/S:		FH Standard using higher currents than NAMUR	*(4)*
NAMUR Current Pulses - FH71/N & FH71/NS:		NAMUR Following IEC 60947-5-6 Standard	
Open Collector - FH71/CO:		NPN Open Collector – Max. Sink Current = 50mA	*(2)*
Environmental:			
Operating:	-40°C ≤ Tamb ≤ +80°C		*(5)*
Storage:	-50°C to + 90°C		
Compliance / EU conformity – CE marking			
EMC Directive (2014/30/UE)			
IEC/EN 61326 (heavy industrial) and IEC/EN 61000 (included in MID inspection)			
Intrinsically safe ATEX, Hazardous area, (EN/IEC 60079-0 & EN/IEC 60079-11):			
II 1 G, Ex ia IIC T5 or T6 Ga		-40°C ≤ Tamb ≤ +60°C (T6) or +80°C (T5)	
ATEX :	LCIE 03 ATEX 6238 X	*See parameters **Table 10***	
OIML (Weights & Measures): MID (2004/22/CE), OIML R117-1 (ed. 2007). Evaluation Certificate TC7466			
-25°C ≤ Tamb ≤ +55°C			
Enclosures and Assemblies (IP66 - IEC 60529 / 4X - NEMA 250)			
Intrinsically Safe ATEX, Hazardous area, (EN/IEC 60079-0 & IEC/EN 60079-11):			*See **Table 9***
FAURE HERMAN "TD xx SI xx " series of Magnetic Sensors assemblies			
II 1 G, Ex ia IIC T5 or T6 Ga		-40°C ≤ Tamb ≤ +60°C (T6) or +80°C (T5)	
ATEX :	LCIE 03 ATEX 6230 X		
Flameproof ATEX & IECEx, Hazardous area, (EN/IEC 60079-0 & IEC/EN 60079-1):			*See **Table 8***
FAURE HERMAN "TD xx" series of Magnetic Sensors assemblies			
II 2 G, Ex d IIC T6 Gb or IIB+H2 T6 Gb		-50°C ≤ Tamb ≤ +80°C,	
ATEX :	LCIE 03 ATEX 6230 X		
IECEx :	LCI 12.0013 X		
Explosion-proof Hazardous location, (Std No. CAN/CSA C22.2 No. 30-M1986 and Standard No. UL1203, Explosion-Proof and Dust-Ignition-Proof)			*See **Table 8***
FAURE HERMAN "TDF xx Sn xx" series of Magnetic Sensors assemblies,			
Class I, Division 1, Groups C, D Hazardous Locations		-50°C ≤ Tamb ≤ +80°C,	
Certificate Nr. 20150928-E470977			
Class I, Zone 1, Group IIA or IIB			

Note (1): Open Collector terminal 3 of the 3-Wire version can be damaged in case of reverse voltage
Note (2): Maximum current is depending on both pull-up resistor value and supply voltage value
Note (3): Another fraction of the power is dissipated externally in "pull-up" or "pull-down" circuit resistor(s),
(See "Pull-up Resistors" R_P and R_S in Figure 1, "Pull-down Resistors" R(*) and R_{S2} in drawing SPEC #SCH321 page7).
Note (4): Higher currents allow to increase transmission distance & can be adapted to any usual pulse input types
Note (5): Negative temperatures may affect frequency and sensitivity ranges of preamplifier; this could be detrimental to signals in some types of flowmeters below -10°C if precautions are not taken

Chapter 9: Troubleshooting & Quick Checks to Determine Potential Sources of Problems

Determining the likely source of an issue can be challenging. Many factors such as age of meter, length of operation and physical factors can contribute to issues. If at least one channel is operating correctly, having a problem with the impeller can probably be excluded. Conversely, having the same problem on two transmitter channels does not mean that the cause necessarily involves the impeller, especially at first start up or commissioning.
See Table 12 below for a summary of general troubleshooting information.

When troubleshooting measurement issues with turbine meters, the electronics are often incorrectly suspected. Each electronic assembly goes through factory testing throughout the entire measuring range of the meter prior to shipment.
Prior to changing any electronics, please take the time to assess the situation. This will avoid complications that can be introduced to due improper reassembly or wiring issues in the field.
Please review this material to help guide troubleshooting of measurement issues.

Table 12: Troubleshooting Guide

Things to verify	
Is voltage supply correct?	Check with a voltmeter and refer to Table 14
Are pulses present in the signal circuit loop but not detected by flow computer?	Check signal with an oscilloscope, Check that given threshold levels of pulse input (flow computer or acquisition system) are matching the actual pulses (can the pulse input detect the actual pulses)
Are some pulses “decaying” in some circumstances?	Check signal with oscilloscope, find in what circumstances
Is the power rating of resistors correct?	Check that resistor temperature is not too high to degrade the resistor.
Is the resistance of cable wire or line being used correct? *(See Table 18)*	Measure line resistance: If not as expected, then find the reason (loose connections or other reasons). The value of the resistors R_{Sx} may have to be reassessed
Timing Onset of Problem	
At commissioning (first start up)	Check that wiring conforms with schematics, input matching with flow computer or interface input thresholds (total circuit resistance, resistors value non correctly adjusted) Check control wiring to flow computer, electrical parameters
After a short period of operation	Check electrical parameters, no loose connections, environmental conditions, power rating of resistors
After long time or about one year of operation	Check electrical parameters; check for moisture in interconnections and possibly in electronics enclosure
After maintenance or repair to electronics or mechanics	Check to make sure the proper part was installed, all screws are in place, and all connections, grounding, etc. are tight.
Bad weather: Heavy storms, temperature extremes	Lightning strikes and extreme temperatures can affect or damage electronics
After long storage period	Check that there was no risk of water ingress
Frequency of Problem	
Progressive or recurrent failure	Check voltage and power rating of resistors, flow computer or interface input not operating in nominal conditions
Spontaneous occurrence	Check interconnection, fuse, configuration change, flow computer or interface input damaged, preamplifier or coil damaged

Table 12 continued from previous page *(Frequency of Problem)*

Sporadic and apparently random malfunctions	Check for EMI, interconnection, grounds, shielding, loose connections
Pulse Issues (dropped pulses, many bad pulses)	Electronics on meter does not operate in appropriate conditions (), or the preamplifier output signal does not match the detection threshold of the flow computer.
Reproducible Issues in a specific area of the flow range *(every time in the same part of the flow range: low, Intermediate or High flow rate)*	Check sensitivity issues, matching of impeller (cartridge) and coils, correct preamplifier version, check matching of flow computer or interface input, adaptation of resistors and total line resistance
Source of Problem: Electrical or mechanical	
Electronics / Wiring Source of Issue *(*)*	**Mechanical or Fluid Source of Issue**
Other transmitter channel(s) giving better results	Other transmitter channel(s) giving same results
Reproducible instances of flow meter over counting or undercounting in particular parts of the flow range	Flow meter over counting or undercounting in its entire measuring range is not likely to be caused by electronics if the flow computer does not detect bad pulses.
If only one channel is used but has operated correctly over a long time: • Check voltages on electronic parts, both meter and flow computer sides, integrity of connections, then presence of coil signal, absence of moisture, …	If only one channel is used but operating correctly over a long time, check that impeller is rotating
Electromagnetic interferences can generally give sporadic over counted pulses	Sporadic over counting pulses are not likely to result from mechanical issue

Not *(*)*: Cable link, preamplifier type and sensitivity, coil and coil signal, electromagnetic interferences, matching of Flow computer input circuit, environmental and electrical operating parameters of preamplifier

Table 13: Examples of output pulse signals

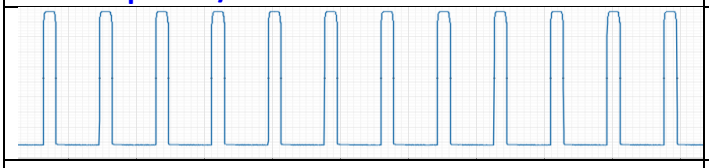
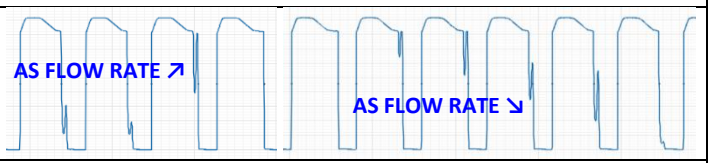
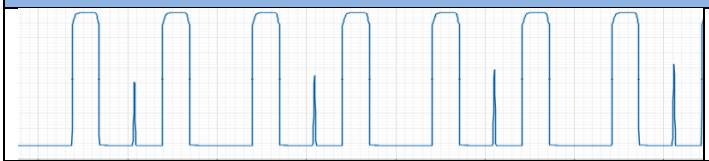
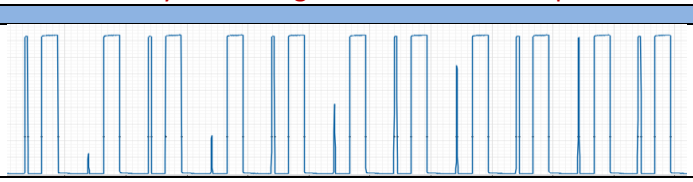
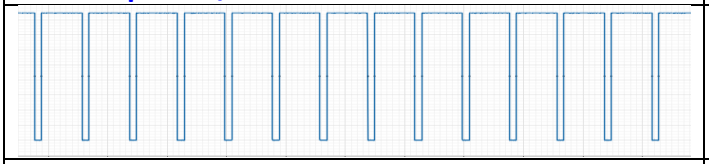
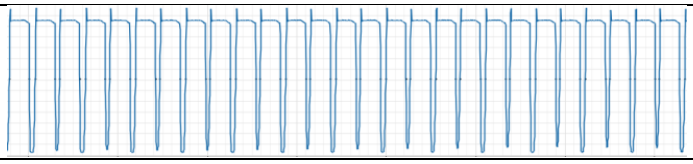
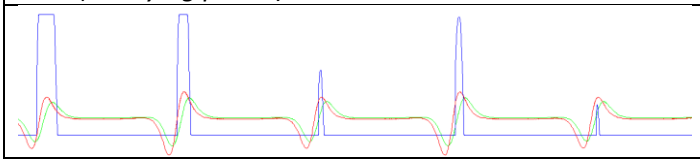
Current pulses / CO	
	
Correct pulses	Sensitivity set too high can cause “double pulses”
	
Sensitivity set too high can cause “double pulses”	Sensitivity set too high can cause “double pulses”
Current pulses / STD	
	
Correct pulses	Sensitivity set too low can cause lost pulses
Display Output voltage pulses & irregular coil signal / STD *(Decaying pulses)*	
	

Table 14: Test to check preamplifier parameters in operation

Preamplifier Type	Related Schematics	Terminals	Typical DC voltage across terminals as indicated					
			Non rotating impeller				Rotating impeller	
			ON STATE (V DC) (*) Power up state		OFF STATE (V DC) (*) Power up state		AVERAGE (V DC)	
			MIN	MAX	MIN	MAX	MIN	MAX
2-Wire STD & STD SENSITIVE	24.0V V_P Power *#SCH3xx*	1-2	3.0V(*)	4.0V(*)	21.3V	22.7V	~4.5V	~13.5V
	MTL5532 *#SCH422*	1-2	3.0V(*)	4.0V(*)	~23.0V	~23.5V	~5.0V	~14.0V
2-Wire NAMUR & NAMUR SENSITIVE	8.2V V_P Power *#SCH21x*	1-2	4.7V(*)	_	7.8V	_	~5.0V	~6.5V
	MTL5532 *#SCH411*	1-2	4.9V(*)	_	7.8V	_	~5.0V	~6.5V
3-Wire OPEN COLLECTOR	Power V_S 5V to 24V #SCH1xx	1-2	V_S	_	V_S	_	V_S	_
		1-3	0V	1.0V	VS(*)	_	~0.5 x VS to ~0.9 x VS ~12V to ~22V @ VS=24V	
	MTL5532 1kΩ *#SCH131*	1-2	0V	1.0V	~19.0V(*)	_	~9.5V	~17.5V
		1-3	~10.9V(*)	_	~20.7V	_	~15.0V	~20.0V

Table 15: Simple test for FH71/CO using a multimeter "Diode Test" Function

(Note: Terminals 1-2 should not be connected to any other circuit than the multimeter leads during the test)

Connection to FH71/CO terminals		
Insure correct Polarity		**Result on multimeter display**
+	-	Preamplifier Output:
1	3	If no forward voltage drop is displayed, this indicates the preamplifier is damaged
2	3	
3	1	If a forward voltage drop is displayed, this indicates the preamplifier is damaged
3	2	

Table 16: Coil polarity for connection to preamplifier input terminals A-B

Coil type	Right polarity connection to FH71x input
FH10-15-x0-x	Blue wire connected to terminal A
FH10-00-55/x	Tagged #1 wire connected to terminal A
PC45-25	White wire connected to terminal A

Table 17: Quick method to check resistance of coils using an ohm-meter

This test looks for cut internal or connection wires. The test can be done without disconnecting the wires from A-B terminals as that will not significantly change the outcome.

FH Coil Type	Ωmin At 20°C	Ωmax At 20°C
10-15-x0	3420Ω	4200Ω
10-15-x0-1	6555Ω	8020Ω

FH Coil Type	Ωmin At 20°C	Ωmax At 20°C
10-15-x0-2	8740Ω	10700Ω
10-00-55/x	900Ω	1300Ω

Table 18: How to measure RW1 and RW2 line resistance of cable wires and connections

This test looks for loose connections or abnormal resistance in junction boxes, and helps to determine the value of resistors to install in series.

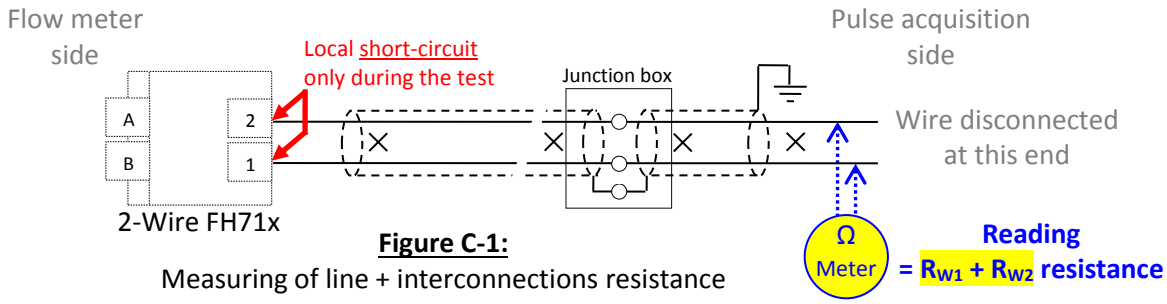
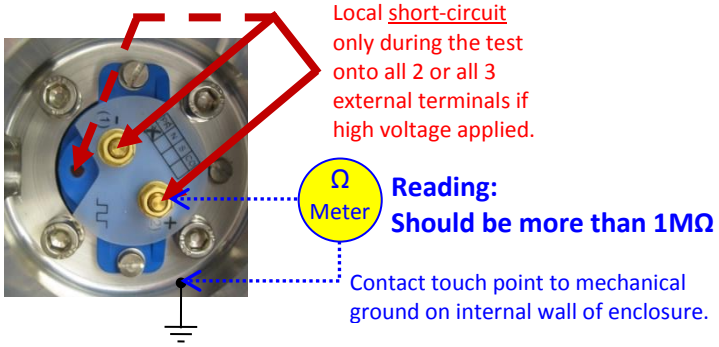


Figure C-1:
Measuring of line + interconnections resistance

Table 19: Checking insulation inside TDx Magnetic Sensor enclosure

This test checks for problems with internal insulation of coils inside enclosures after replacement of a preamplifier or pickup coil.



The insulation of the coil wires inside TDx enclosures can be tested with an ohm-meter between terminal 1 and mechanical ground: There is a problem if the reading indicates a resistance value less than 1MΩ when the external wires are disconnected.

The measurement can also be done with a high- voltage 50-500VDC insulation tester, providing that all output side terminals #1-2 for 2-Wire versions, or #1-2-3 for 3-Wire versions are connected together during the test.

Table 20: Details regarding coil wires during installation of the preamplifiers

Be careful not to damage the insulation of the coil wires connected at the back of the preamplifier to terminals A-B. The wires can be pinched when the mechanical parts are reassembled. Also check that the round soldering terminals are orientated inward when their fixing screws are tightened.

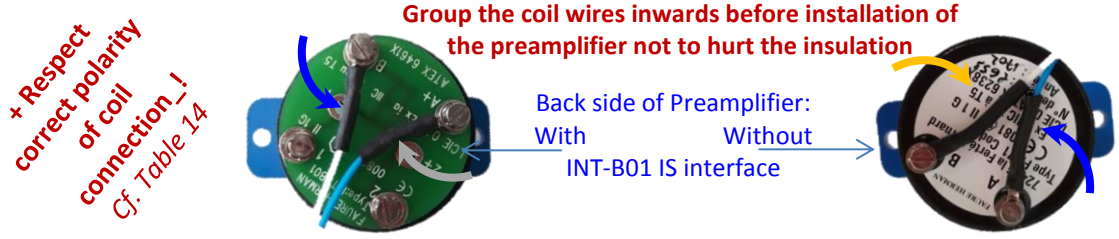
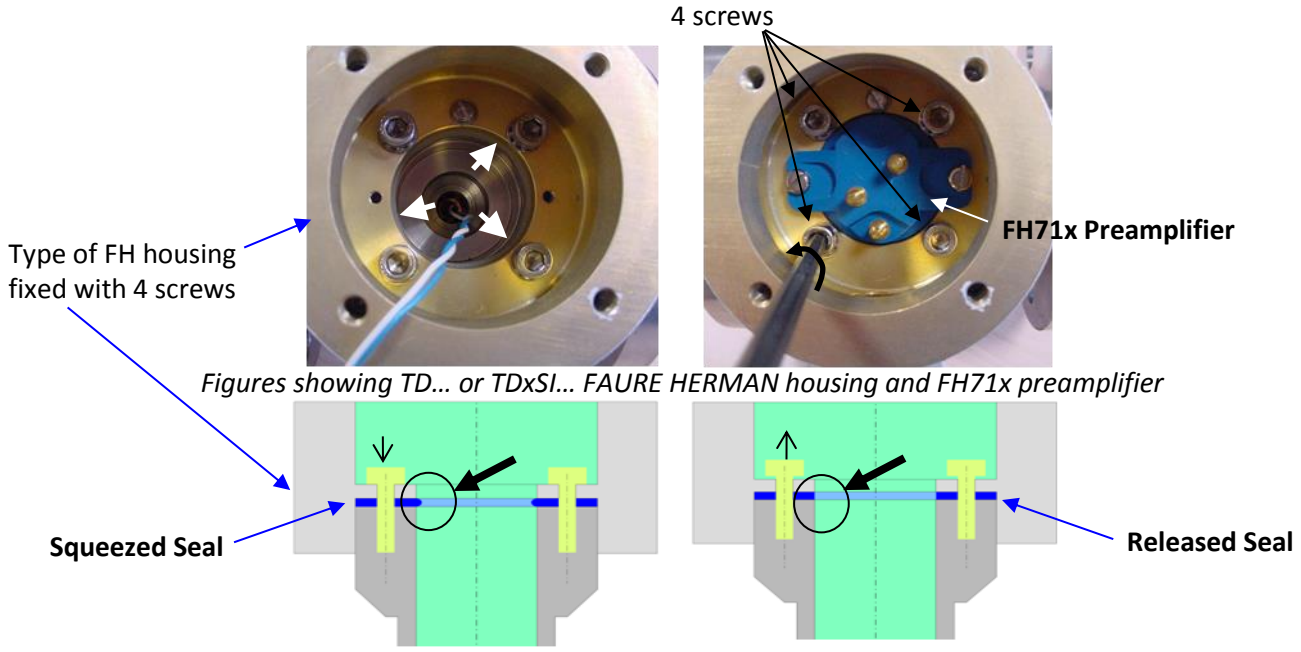


Table 21: Details regarding installation of the preamplifier inside TDx housing type fixed with 4 screws

Detail specific only to the TDx housing type which is attached with 4 screws:



Figures showing TD… or TDxSI… FAURE HERMAN housing and FH71x preamplifier

When the four screws are tightened, this squeezes the seal and holds it in place.
=> To remove the preamplifier, the screws may have to be loosened.
=> Do not forget to tighten the 4 screws after inspecting the connections;
Otherwise, this will cause the enclosure to leak.

Chapter 10: Answers to frequent questions

1. What can damage a preamplifier?
   - Voltage higher than 28VDC
   - Signal loop continuous current higher than 50mA for too long a period; high ambient temperature can also contribute to this. Check Current $I_S = V_P / R_S$
   - Reverse voltage applied on Open Collector output (3-Wire version only, Terminals 1-2 of 3-Wire and 2-Wire versions are protected)
   - Indirect or direct lightning strikes

2. What conditions can cause the preamplifier to malfunction?
   - Bad electrical parameters:
     - Supply voltage and pulsed current not correctly adapted by total circuit resistance
     - Resistors not adapted to flow computer or interface input thresholds
   - Moisture on terminals A-B can stop input signal
   - Corrosion of preamplifier output connections or other intermediate terminals in junction boxes used by external links
   - Electromagnetic interference (EMI)
     - Sources of EMI can be from cables running close to electromagnetic noise generators, power equipment, or because of poor shielding and grounding.
     - The flow computer cabinet can also be a source of EMI
   - 2-Wire Standard versions can be affected by negative temperatures (if pickup signal not adapted)

- Coil signal not properly adapted to preamplifier sensitivity:
  - Too strong: It can generate double pulses in a reproducible area of the flow rate range
  - Too weak: It can lose pulses at low flow rates. At high flow rates, the pulses may be too narrow to be properly integrated
  - Wrong pickup coil in meter, (FH10-15-10-1 or -2 coils can be used when signal is too strong)
  - Coil spacer removed: A plastic spacer can have been placed down in the bottom of the well to put the coil at more distance from the magnets (old meters)
  - If using a different cartridge than the cartridge originally supplied with the meter, the new cartridge and impeller may be slightly different than the original

- Bad pickup coil signal, potential causes:
  - Incorrect connection polarity to preamplifier (See Table 16)
  - Coil not correctly positioned and fixed in the bottom of the well (Magnetic Sensors orientated downward on flowmeters are more subject this to incorrect fitting of the coil)
  - Coil having corroded core; can happened after water ingress and if protection resin on coil tip is scratched
  - Excessive fluid temperature, (higher than 180°C for FH10-15-x0-x)
  - Loose terminals screws
  - Loss of insulation due to coil wire pinched, insulation damage, improper grounding or other electrical faults

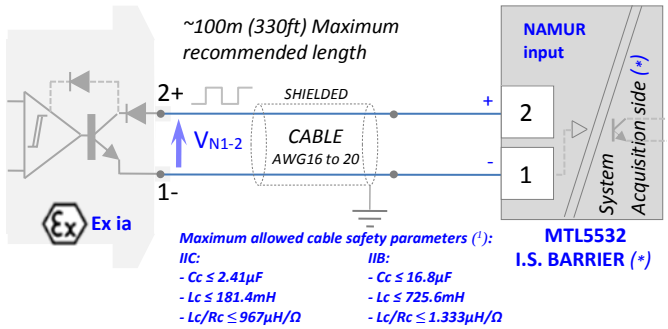
3. Why pulses can be missed by flow computer or input interface:
   - Resistors in circuit not appropriate to the detection thresholds of the input (Check FAURE HERMAN recommended schematics for the same flow computer or contact FAURE HERMAN),
   - Resistors in circuit and voltage supply not appropriate to best operating conditions of the preamplifier

4. For system implementing Dual Pulse integrity, why does the flow computer generate pulse alarms?
   Dual pulse integrity checking is available in some flow computers; this mode continuously compares two channels, namely A and B, coming from the same flow meter.
   - The pulse trains from the two channels of FAURE HERMAN turbines always have their rising or falling edges shifted 90 degrees (= 1/4th of period shift), conforming to Reference Standards (ISO6551, API MPMS §5.5, PMM Part XIII Section 1)
     Errors are produced when the pulses of two pulse trains are not phase shifted.
     However, pulse width can have an effect on some integrity checking systems requiring more than 25% or less than 75% duty cycle for pulses to overlap each other, false error detection may then happen:
     - Depending on turbine type it can be only at low flow rates: In such a case some configuration parameters in the pulse alarm processing of the flow computer, may be available to inhibit the detection at low flow rate or for some delay after the fluid starts to flow in the meter.
     - Some turbines produce signals whose pulse width is too small for these flow computers in the whole flow rate range. A dedicated interface is then needed in between the preamplifiers and the pulse acquisition, or the integrity checking has to be deactivated.
   - Dual pulse integrity checks allow some flow computers to distinguish which one of the channels is faulty.

APPENDIX A

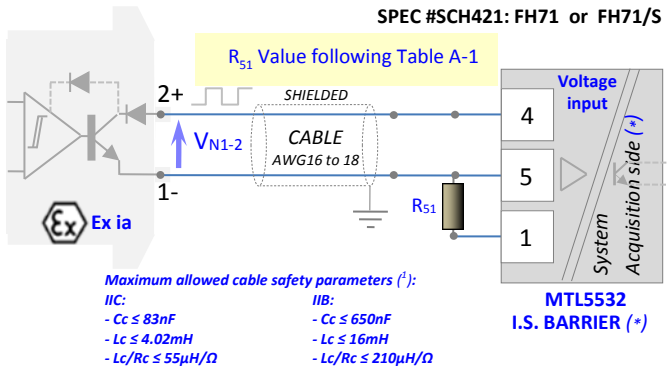
FH71x INTRINSICALLY SAFE WIRING, USING MTL5532 ISOLATOR *(1)*

SPEC #SCH411: FH71/N or FH71/NS = NAMUR preamplifiers



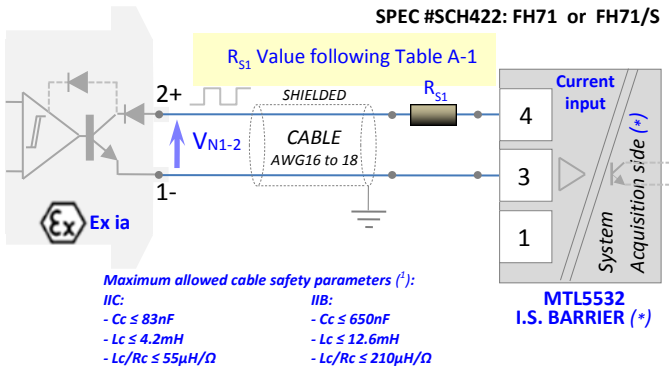
Note *(*)*: *See MTL recommendations to connect on System Acquisition side.*
*All configuration switches in **OFF** position*

SPEC #SCH421: FH71 or FH71/S



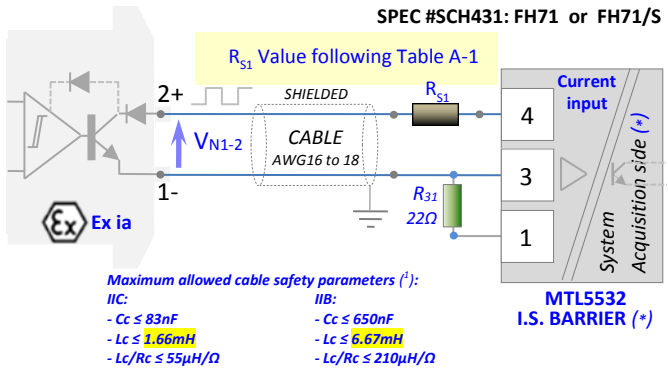
Note *(*)*: *See MTL recommendations to connect on System Acquisition side.*
*Configuration switch **SW1 = ON**, all others in **OFF** position*

SPEC #SCH422: FH71 or FH71/S



Note *(*)*: *See MTL recommendations to connect on System Acquisition side.*
*All configuration switches in **OFF** position*

SPEC #SCH431: FH71 or FH71/S



Note *(*)*: *See MTL recommendations to connect on System Acquisition side.*
*All configuration switches in **OFF** position*

Table A-1 :

Recommended R_{S1} resistor 5% 1W value vs. cable length

CABLE	1,3²	1,0²	0,6²
L_{max} (m/ft)	AWG 16	AWG 18	AWG 20
0	430	430	430
250/820			
400/1310			
570/1870			390
860/2820	390	390	
1320/4330			
1350/4430			
1770/5800			
1880/6150			

Please consult FAURE HERMAN for longer distances

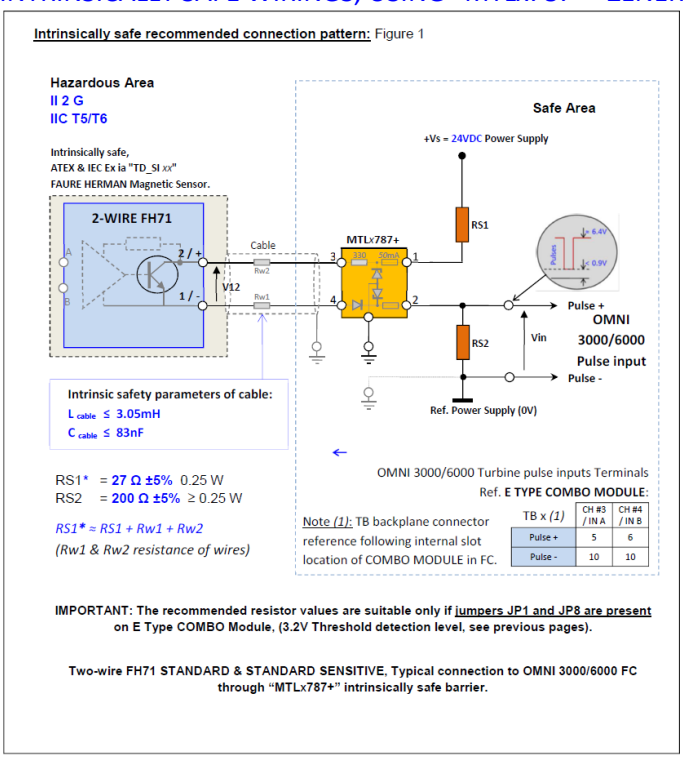
Note *(1)*: Isolators can also be used in non-intrinsically safe protection mode.

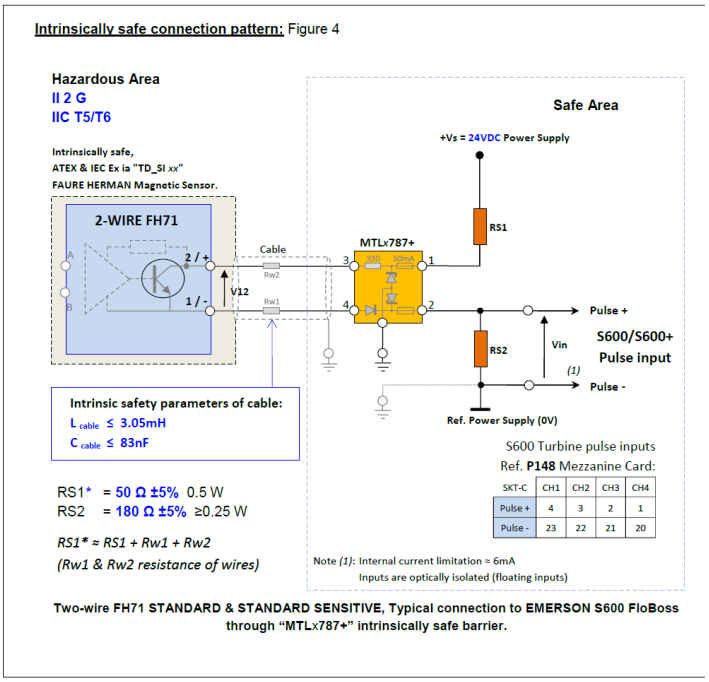
Note: The resistance value in the loop of the 2-Wire standard preamplifiers is an important parameter when using MTL5532 isolator: The high duty cycle of current pulse signal on large meters can increase the risk of losing pulses as the current limitation in the MTL is more likely to be activated.

APPENDIX B

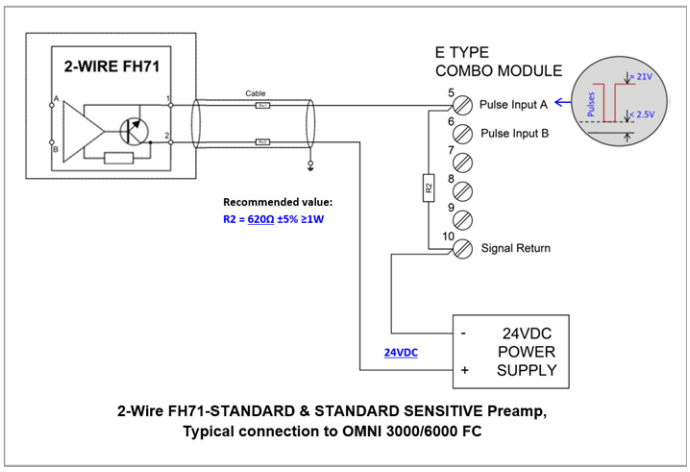
MISCELLANEOUS WIRINGS – *EXAMPLES - ([3])*

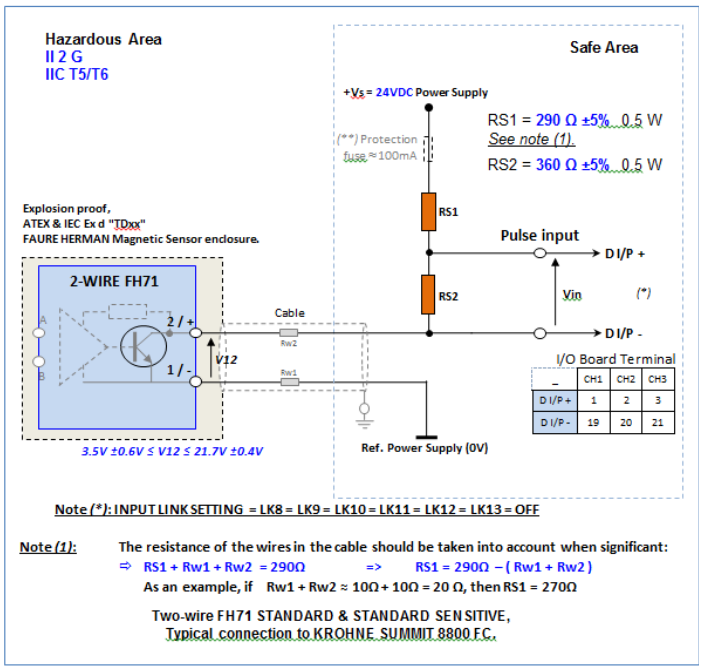
INTRINSICALLY SAFE WIRINGS, USING "MTLx787+" ZENER BARRIER





WIRINGS FOR FLAMEPROOF / EXPLOSION-PROOF MODE OF PROTECTION





Note *([3])*: FAURE HERMAN provides and regularly adds or updates interconnection wirings dedicated to various flow computers, acquisition systems or interfaces at the following Web address: https://faureherman.zendesk.com.

Note: For any request or configuration different from the available ones, do not hesitate to contact technical support: support@faureherman.zendesk.com. Please provide if possible the serial number of the related meter and information on the type and characteristics of the pulse acquisition system.

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