



TAF + Remote Control

4-20 mA and Contact Type Signals Radio Transmitter/Receiver

(Includes Pump Control and Meter Pulse Transmitter modes)



INSTALLATION AND CONFIGURATION MANUAL

Manual V1.8

For Firmware TAF+ E $\geq$ V3.0

For Firmware TAF+ R $\geq$ V2.7

(Free phone support)

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1- FUNCTION

The TAF+ system is usually composed of 2 units: A TAF+ E and a TAF+ R units. The system allows the transmission of contact signals and 4-20 mA signals between two locations, up to 10 Km away, employing licensed or unlicensed VHF or UHF radio bands.

Each unit has 12 preconfigured radio channels in the band, and can also be configured by the user to any frequency inside the band. Units integrate high sensitivity and high power professional radio modems.

Each TAF+ unit can be upgraded (increasing the number of digital (contact) and analog (4-20mA) signals in the field by means of a factory supplied code. All necessary hardware is standard.

Unit installation and configuration is very straightforward and do not require the use of special measurement equipment. Power supply voltages, input contact status, input 4-20 mA signal values, radio link quality, etc., are measured and displayed by the same units.

1.1 – Main characteristics

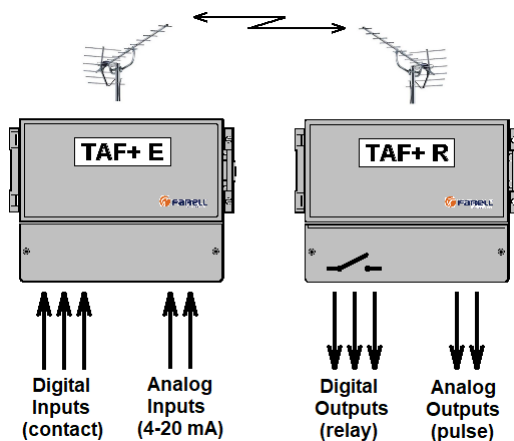
- For the transmission of digital (contact status) and analog (4-20 mA) signals
- Long range: Up to 10 Km. No direct sightseeing between points necessary. Unlicensed and licensed radio bands supported.
- 5 operating modes available: Transparent, 3 pumping control to fill tank modes (fixed and variable max/min levels); Meter pulse transmitter mode.
- TAF+ E (signal transmitter):
 - Power supply: 12 VDC or non rechargeable batteries: Alkaline (5 x LR20, more than 1.5 years duration) or Li (2 x LR20, more than 3 years duration). Analog inputs allow standard 4-20 mA sensors that can be powered by the same unit, even when battery powered (unit integrates a DC/DC to 20 VDC converter)
 - Up to 8 digital inputs and 2 analog inputs
- TAF+ R (signal receiver):
 - Up to 8 digital outputs (relay) + alarm output (relay)
 - Up to 2 isolated analog outputs (low cost)
 - One meter pulse output (static relay)
 - ModBus Com port (RS-232/RS-485 and RJ45 option). Master and Slave modes. To be linked to a PLC unit or a SCADA system.
- High security: Transmitted data is encrypted employing 64 bit key
- OLED display. High contrast and speed in all operating temperature range.
- Intuitive handling. Very user-friendly
- Units incorporate radio link quality measurements and test functions
- Easy unit installation, setting and startup
- Units can be upgraded by means of a supplied code. This allows the distributor or user to have lowest cost units in stock
- Units employ professional electronics to allow a very long service life
- KITs available, including antenna, antenna cables, contact level sensors, analog level sensors, etc.

2- OPERATING MODES

- (1) Transparent MODE

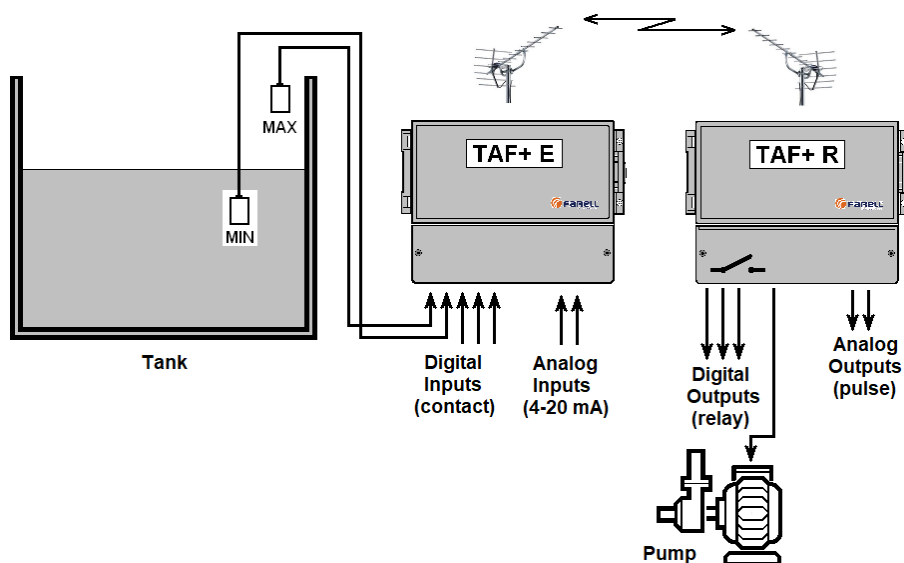
In this mode each digital input (contact status) on the TAF+ E is received by the TAF+ R and output on each corresponding relay

Also the TAF+ E analog inputs (4-20 mA)(if available) are output by the TAF+ R. See analog outputs paragraph.



- (2) Pump Control for Tank Filling Max/Min MODE

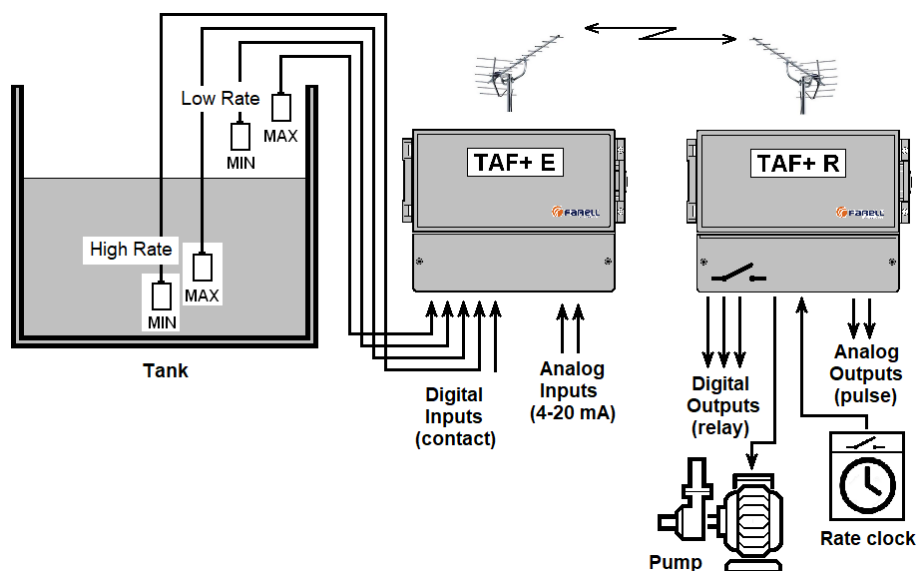
This mode is specific to control the ON/OFF state of a pump employed to fill a tank. Digital inputs 1 and 2 of the TAF+ E unit are associated to 2 contact level sensors (max and min levels respectively). On the TAF+ , outputs 1 to 7 repeat the status of 1 to 7 inputs on the TAF+ E unit, and output 8 corresponds to the ON/OFF state of the pump. Units incorporate the pump control logic.



- (3) Pump Control for Tank Filling 2 Max/Min MODE

This mode is similar to the previous one, except that pumping cost can be optimized when two or more energy rates are available at the pumping station. In this case 4 contact level sensors are employed, 2 for the Max/Min levels when the energy cost is low, and 2 other Max/Min levels for when the cost is high.

On the TAF+ R, outputs 1 to 7 repeat the status of 1 to 7 inputs on the TAF+ E unit, and output 8 corresponds to the ON/OFF state of the pump. The TAF+ R unit incorporates a digital input (by contact) to connect to an external rate clock. Pump control output is related to the current rate and the status of the Min/Max corresponding level sensors.



- (4) Pump Control when employing a Tank Analog Level Sensor

In this mode an analog level sensor, instead of some fixed ones, is employed on the tank. This allows the setting and modification of the Max/Min pumping levels from the pumping station (TAF+ R). Also the current tank level (in %) is displayed on both TAF+ units

In case of two or more energy tariff rates, 2 pairs of Max/Min levels can be defined, providing the optimization of the pumping cost.

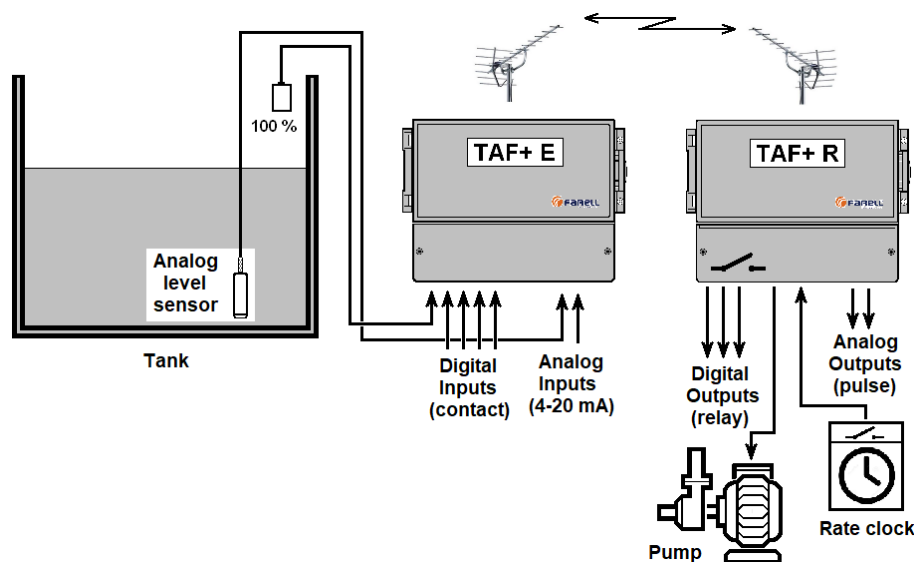
The TAF+ E unit includes a function to normalize tank level to % (0 to 100%), not depending of the level sensor range or the tank height.

Usually a standard submersible 4-20 mA, 2 wires level sensor is employed. In this case the sensor can be powered by the same TAF+ E unit, even when powered by batteries. Other mA active or passive level sensors can also be employed.

In addition to the analog level sensor, a contact level sensor is also employed on the TAF+ E unit to signal full tank (100%). This signal is employed to automatically re-calibrate analog level to 100% and is also used as security function.

On the TAF+ R, outputs 1 to 7 repeat the status of 1 to 7 inputs on the TAF+ E unit, and output 8 corresponds to the ON/OFF state of the pump. The TAF+ R unit incorporates a digital input (by contact) to connect an external rate clock when 2 energy rates are available. The units incorporate the pump control logic.

The analog output 1 of the TAF+ R corresponds to the tank level and outputs a 4-20 mA signal normalized to the normalized tank level (4 mA when 0 %, 20 mA when 100 %).



- (5) Pulse Transmitter (meter) MODE

Sometimes it is necessary to receive the information (flow rate, totalizer) of an isolated remote meter, where even there is no power supply available. In this case TAF+ units can be employed to retransmit the meter values.

The TAF+ E digital input 1 is connected to a meter, provided with a pulse emitter. A totalizer inside the TAF+ E unit increments on each received pulse. This totalizer is transmitted periodically to the TAF+ R unit. On each reception the TAF+ R unit subtracts the received totalizer value from the previous one and outputs the result as pulses on its pulse output 2. This method guarantees the complete correspondence between the pulses emitted by the meter with the pulses emitted by the TAF+ R unit.

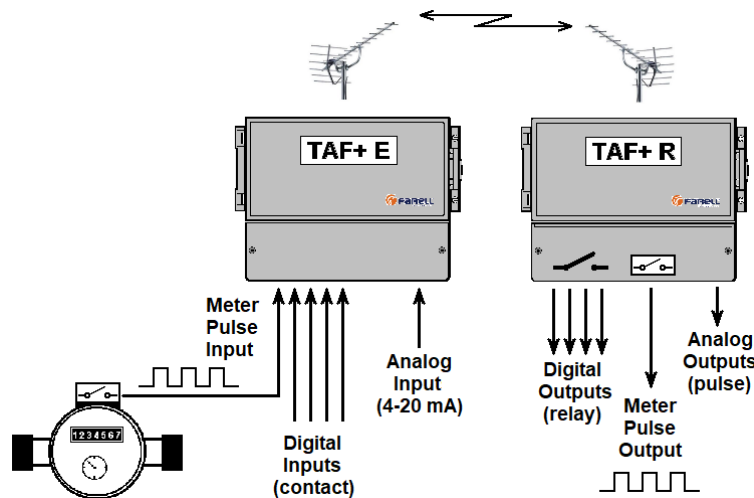
The totalizer value is displayed on both TAF+ units and can be reset. The totalizer is continuously saved in non-volatile memory to be kept during replacement of TAF+ E batteries.

Digital input 1 on the TAF+ E (meter input) incorporates a digital filter to reject meter pulse output contact rebounds, or noise. Minimum pulse ON or OFF time is 80 mS.

TAF+ R pulse output:

- Pulse output frequency (one or more pulses): 4,9 Hz (minimum ON state: 100 mS)
- Max current output: 100 mA
- Max voltage: 48 VDC or VAC

On the TAF+ R, outputs 2 to 8 repeat the status of 2 to 8 inputs on the TAF+ E unit, and analog output 1 (pulse) repeats the analog input 1 of the TAF+ E.



Security function (All Modes)

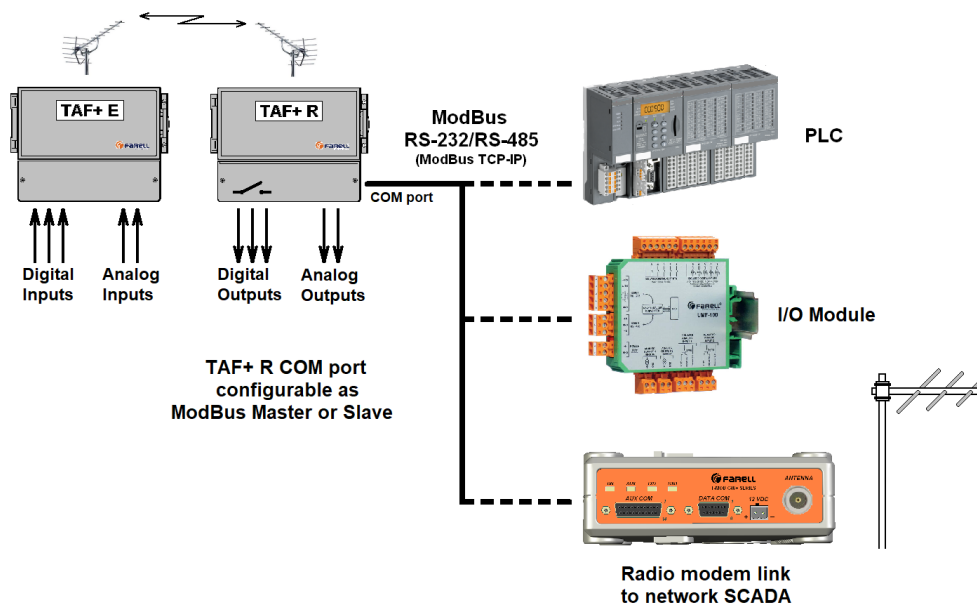
In case of failure (loss of radio link, level sensor failure, etc.) output relays are opened, pump stopped, analog signal outputs passed to 0 mA, the output alarm relay is activated and the corresponding alarm cause is displayed.

3 - ModBus OPTION

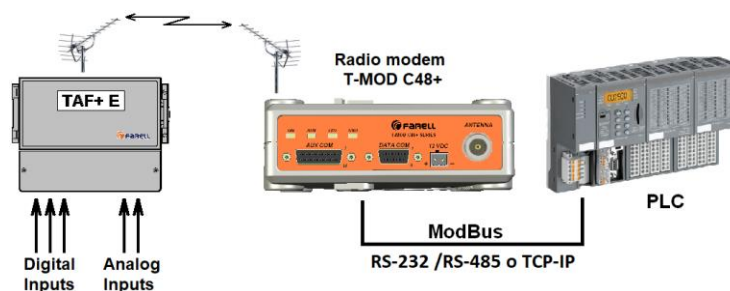
COM port on the TAF+ R unit

In any of the working modes, a ModBus RTU port is available on the TAF+ R unit. The unit can be configured as ModBus Master or Slave. Port type (RS-232/RS-485) can be selected by means of an internal jumper. Optionally a JR45 port can be provided (ModBus TCP-IP).

When in Slave mode an external Master can read all the system status, including digital and analog input/outputs, power supply values, radio link status, unit temperatures, alarms, etc. When in Master mode, the TAF+ R is configured with the Slave ModBus address, the first ModBus register to be written and the number of a pre-defined data frame to be sent. TAF+ R ModBus registers content and pre-defined data frames content are defined on a specific document.



Employing a T-MOD radio modem



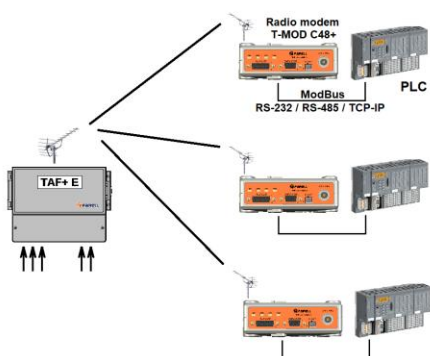
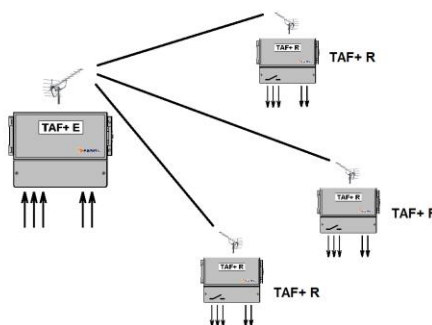
In this mode the TAF+ E acts as a ModBus Master and a PLC or SCADA as Slave. The TAF+ E is configured with the Slave ModBus address, the first ModBus register to be written and the number of a pre-defined data frame to be sent. Pre-defined data frames content are defined on a specific document.

A T-MOD C48+ radiomodem is employed as radio receiver. RS-232/RS-485 port is available as standard and RJ45 port is available as option.

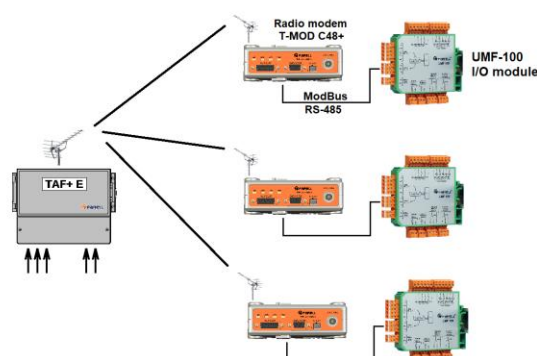
4 - MULTIPLE RECEIVERS

Three possible configurations when a same TAF+ E must be received in various sites:

a) TAF E + n x TAF R



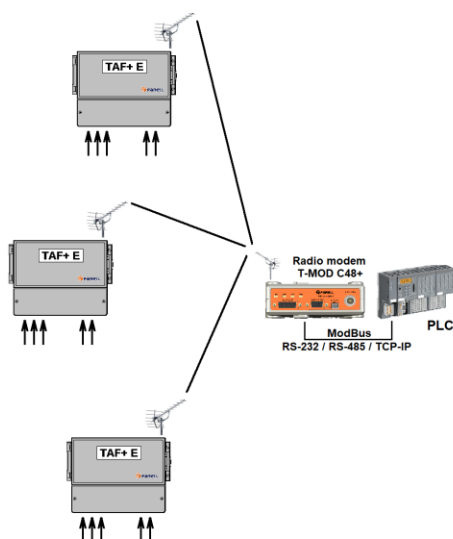
b) TAF E + n x (T-MOD + PLC)



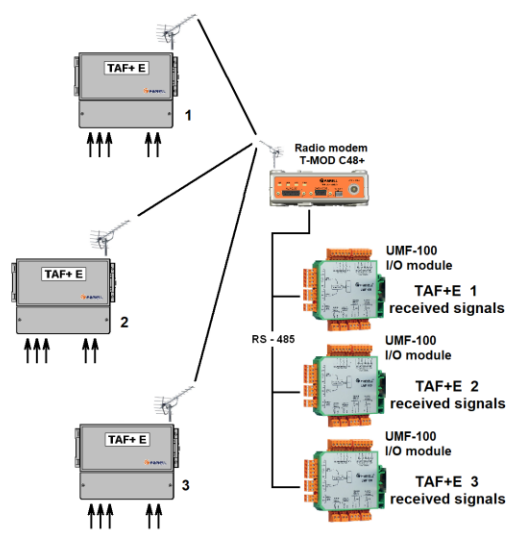
c) TAF E + n x (T-MOD + UMF-100)

5 – MULTIPLE TRANSMITTERS

Two possible configurations when various TAF+ E must be received in one site:



a) n x TAF E + (T-MOD + PLC)



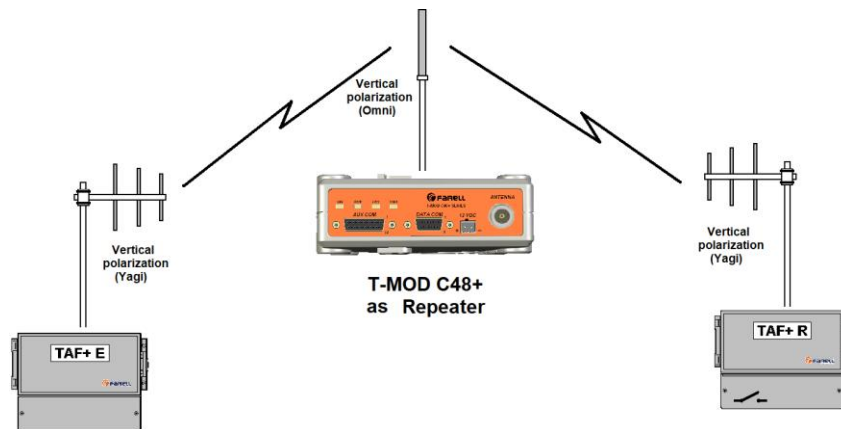
b) n x TAF E + (T-MOD + n x UMF-100)

6 – EMPLOYING A RADIO REPEATER

If necessary, a radio repeater can be employed. A T-MOD C48+ radio modem will be employed as repeater. The T-MOD will be configured in S&F repeater mode. This repeater mode employs the same radio frequency (channel) for the down-link as for the up-link links.

TAF+ E unit will be configured as level 0, the T-MOD as level 1 and the TAF+ R as level 2. If necessary, up to 2 repeaters can be employed.

Data encryption is also supported.

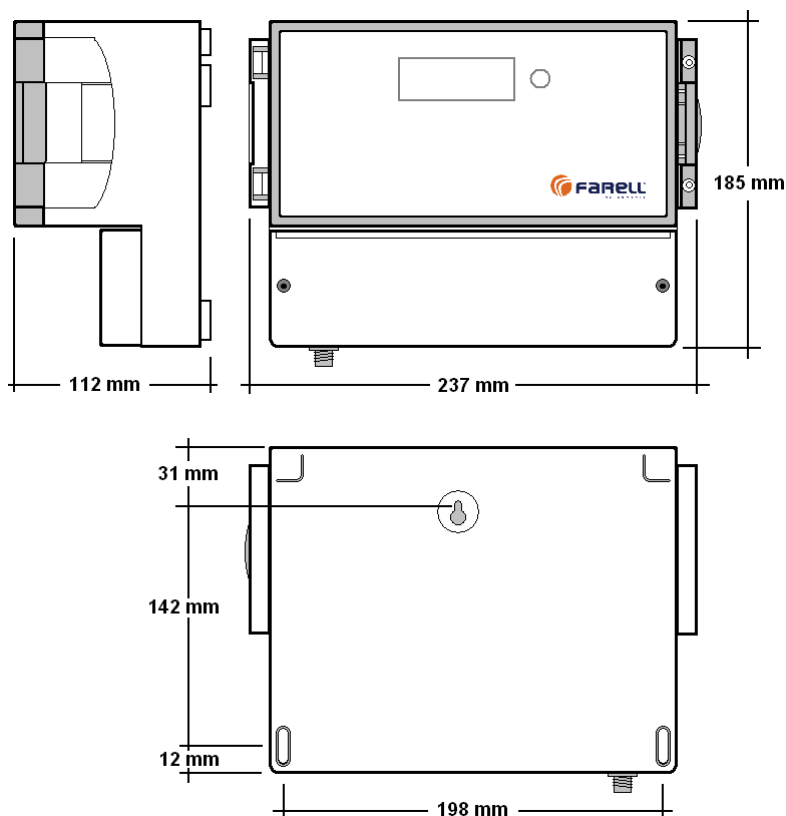


7 – UNIT INSTALLATION

WARNING

- *TAF units must be installed protected from the rain and from direct sunshine*
- *Do not vibrate the units during installation*
- *Avoid places where corrosive gases can be present*
- *Tighten the cable glands to avoid dust and insect entering the unit*
- *Avoid installing the unit near power cables specially the ones coming from electronic motor starters or frequency converters*
- *Signal input cables must be installed far from power cables. Never employ the same cable duct. If not possible, pass the signal cables inside a metallic tube.*

7.1 - Dimensions



7.2 – Wall mounting

Units provide a rear hanger and two fixing bores (see figure)

Some empty space must be left at the left side to allow the opening of the front door.

7.3 – Antenna installation and connection

Antenna placement, orientation and connection is of the main importance in order to establish a reliable link.

Antenna must be of the 50 ohm type and adapted to the working frequency. Many different antenna types are available, but we will talk about two main types: Omnidirectional (can communicate in all directions) and directive (one main direction). The directive ones (YAGI) have gain, so in many cases its use are preferable.

Yagi type antenna

Are of the same type as the ones employed in terrestrial TV reception. Its gain depends on the number of elements. The antenna size also depends on the frequency. For a same gain, a VHF (lower frequency) antenna is bigger than a UHF (higher frequency) antenna. Also lower frequencies have better propagation in mountainous areas or when are obstacles near the units.

Yagi antennas can be installed in horizontal or vertical polarization (see figures). Antennas must employ the same polarization in boths ends.

Omnidiretional type antenna

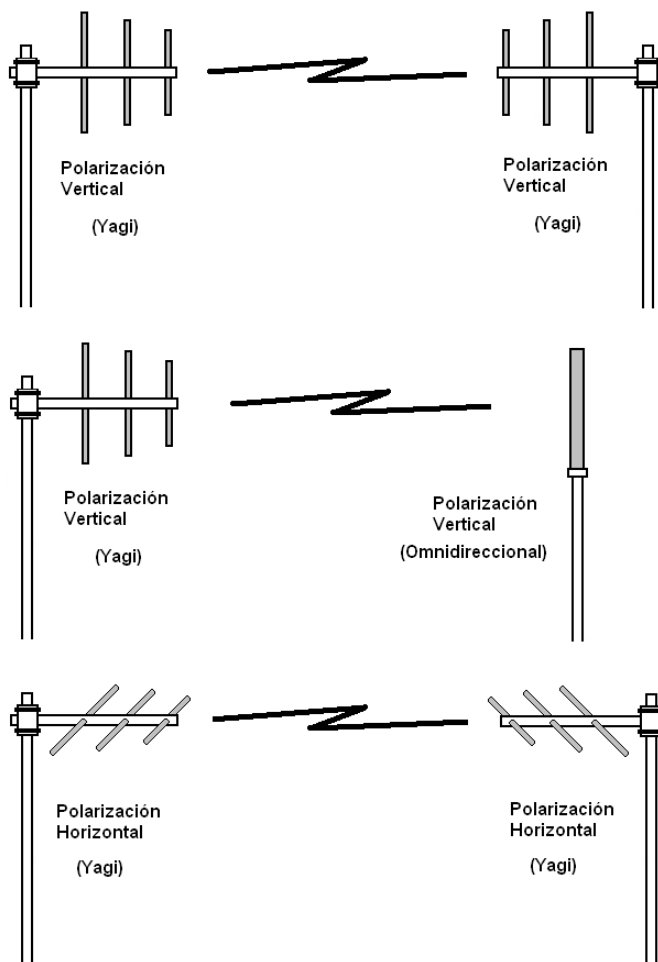
Consists of a vertical element. Its polarization is vertical and has no gain.

Antenna location

Antenna must be mounted far from walls, trees, etc. and with no nearby elements in the communication direction. Employ a wall holder for the mast.

Antenna height is very important. Differences of only some meters can greatly improve the signal level.

If more than one YAGI antenna on the same mast, antennas must be separated at least at the distance of the longest antenna element. Omni directional antennas must be mounted at the top of the mast.



Antenna cables

Antenna cables are special for the transmission of high frequency signals. If necessary, cable to cable connections must be done employing special RF connectors. Avoid tight curves when installing the cable. Excess cable can be kept wrapped with long radius (do not cut).

Antenna cable is provided with connectors mounted at both sides. Connector types depend on the radio band. See table:

Band	TAF+	Antenna cable	Antenna
VHF (138 a 175 MHz)	N female	N male - PL259	SO239
UHF (406 a 470 MHz)	N female	N male - N male	N female
870 / 915 MHz	N female	N male - N male	N female

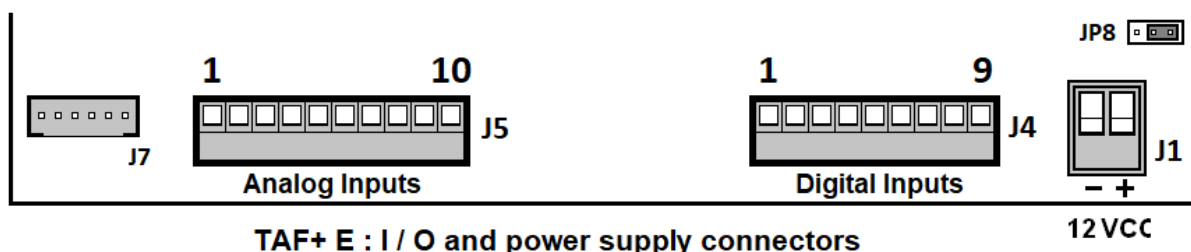
It is important to select the appropriate antenna cable length and type. Cable length increases the signal loss. It is recommended to install the TAF+ unit near the antenna in order to avoid long antenna cables, specially if high frequency bands are employed or in locations where weak signal reception is expected .

Different antenna cable types are available. See table:

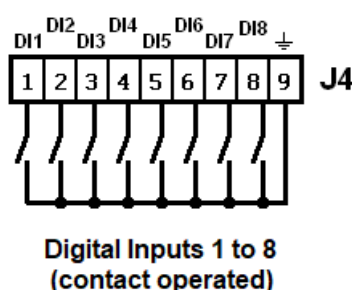
Antenna cable type	Operating Frequency (MHz)	Atenuation (dB / 100m)
RG-58	100	16,10
	200	24,3
	450	40,1
	870	55
RG-213	100	6,8
	200	10,2
	450	15,5
LMR - 200	870	32,0
	915	32,6

Each 6 dB of signal attenuation halves the radio range

7.4 – TAF+ E Input/Output



DIGITAL INPUTS: Contact operated. Each input includes a digital filter and protections. Employ contact type suitable for low currents (mA).



Mode: Pump Control Tank Filling Max/Min:

- Max. level switch to input 1
- Min. level switch to input 2

Mode: Pump Control for Tank Filling 2 Max/Min

- Max. level low cost rate switch to input 1
- Min. level low cost rate switch to input 2
- Max. level high cost rate switch to input 3
- Min. level high cost rate switch to input 4

Mode: Pump Control for Tank Filling. Analog level

- 100 % level switch to input 1

Mode: Pulse Repeater (meter)

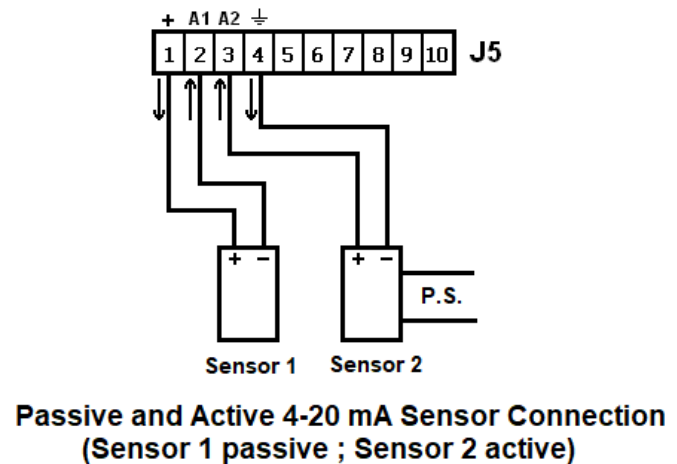
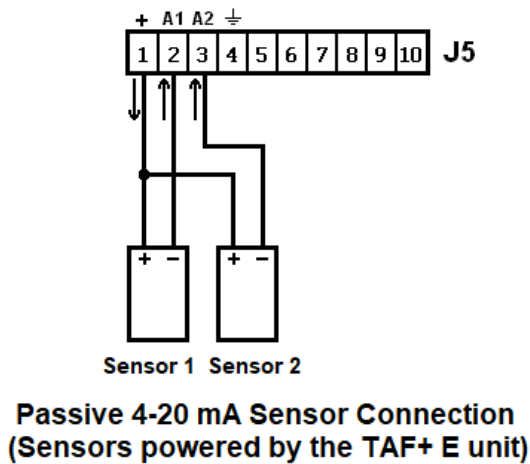
- Meter pulse output to input 1

Note: Level switches must **open the contact when covered**.



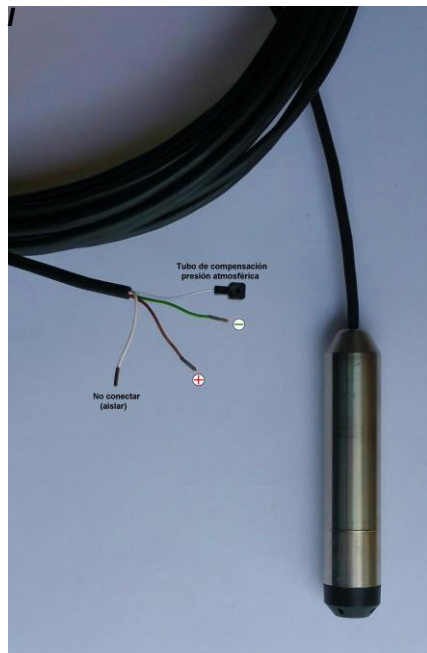
FARELL level switch. Employs an internal float that incorporates a magnet to operate a reed type contact. Can be configured, inverting the float position, to open or close the contact when covered (verify when installing). Inox. body. Cable length: 5 m. Suitable for drinking water and other liquids.

ANALOG INPUTS: Accept 4-20 mA signals and sensors (2 wires passive type or active type). 2 wires passive sensors type can be powered by the TAF+.



Pump Control for Tank Filling. Analog level MODE

- Analog level sensor must be connected to analog input 1



Submersible level sensor, 4-20 mA 2 wires passive type, model FARELL HUBA 712.

Brown: Positive (power supply)(To terminal 1 of J5)

Greene: Negative (4-20 mA output)(To terminal 2 of J5)

White (do not connect. **Isolate**)

Remove the black protective cap from the small compensation tube. This tube end must be in a moisture free zone.

Sensor range is 1 Bar, so is adequate for tanks up to 9 m height (cable is 10 m long). TAF+ E unit allows normalizing the tank level in % values (0 to 100 %). This is done very easily when configuring the unit.

Other level sensor can also be employed: Radar type, ultrasonic type, etc.

SENSOR STABILIZATION TIME

When an analog 4-20 mA type sensor is powered by the TAF+ unit, and the unit is powered by alkaline or Li non rechargeable batteries, the sensor stabilization time is important in order to minimize unit consumption (at each analog measurement the unit powers-up the sensor, waits the stabilization time, does the measurement and removes power to the sensor). The stabilization time of the FARELL HUBA level sensor is 20 mS. If different sensors are employed, the stabilization time, if not known, can be empirically measured. Configure an initial long stabilization time and repeat measures decreasing it until measures start being wrong. Configure the stabilization time some 20 to 40 % higher than the last value tried.

POWER SUPPLY:

TAF+ E (3 power supply options)

- **Alkaline Batteries Model:** Employs 5 standard alkaline batteries type D (LR20). Unit can also be powered at 12 VDC. The JUMPER JP8 selects the type of power supply employed.
 - Use new good quality batteries
 - Never mix batteries of different brands or types
 - Pay attention to the battery polarity when installing (positive up)
 - Alkaline batteries provide more than 1.5 years of operation between replacement (*)
- **Lithium Battery Pack Model:** Employs a Li non rechargeable battery pack. Unit can also be powered at 12 VDC. The JUMPER JP8 selects the type of P.S. employed.
 - Battery pack (2 serially connected D size Li cells: 3,6V x 2, 13 AH)
 - Pay attention to the battery pack connector polarity.
 - Li pack battery provide more than 3 years of operation between replacement (*)
 - Specially indicated when unit is installed in sites where operating temperatures can be under -5 °C (23 °F)
 - New battery packs can be in stock during long periods without sensible capacity loss (less than 5 % / year, at 25 °C)
- **12VCC / 110/230VCA Model:** Allows the unit to be powered at 12 VDC or 110/230 VAC 50/60 Hz (external 110/230 VAC 50/60 Hz /12VDC converter supplied).

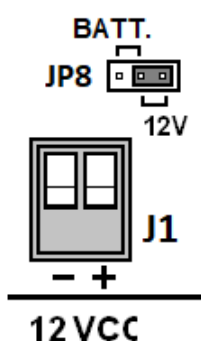
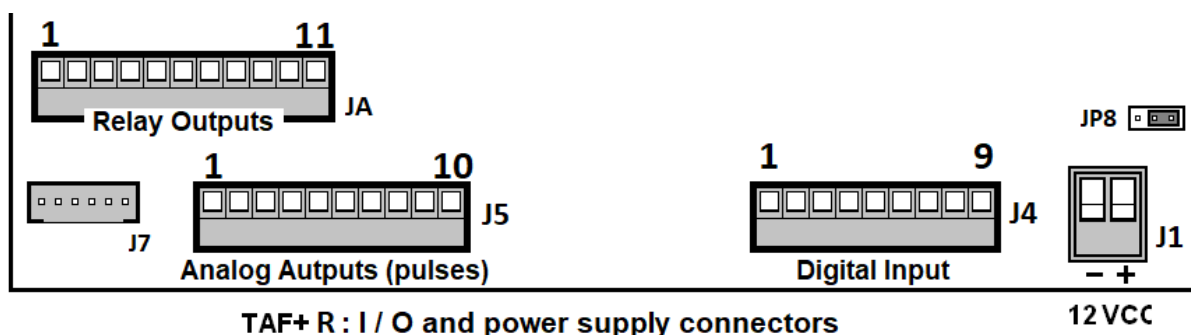


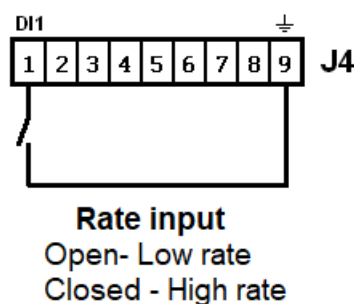
Fig.: JP8 jumper must be placed according to the power supply employed

(*) Conditions: Use of any of the operating modes. Two minutes mean time between consecutive transmissions. Two 4-20 mA analog sensors powered by the unit, making measurements each minute. Analog sensor stabilization time: 100 mS. Radio transmitting power: 500 mW. Unit temperature: 25 °C. Extreme temperatures effect battery operation and consequently decrease the operation time. If no analog sensor, more than 2 years operation between replacement.

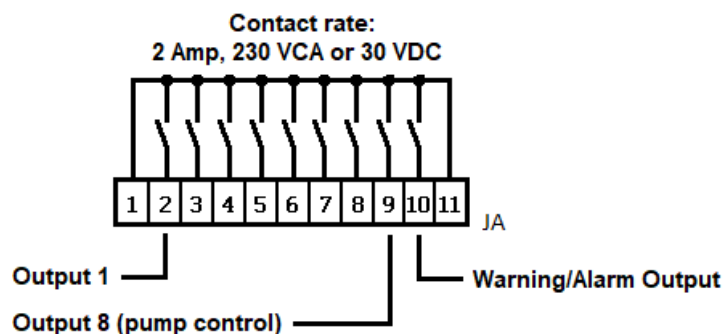
7.5 – TAF+ R Input/Output



DIGITAL INPUT: Contact operated. Input includes digital filter and protections. Employ contact type suitable for low currents (mA). This input is employed as current rate indication when operating in one of the two rate pumping control modes.



DIGITAL OUTPUTS (relay):



Outputs 1 to 8: Correspond to the 1 to 8 inputs state on the TAF+ E unit, except output 8 when operating in one of the pumping control modes. In this case, output 8 corresponds to the pump control output. Pump output is always available when units operate in any of the pump control modes, even when unit has less than 8 outputs. Warning/Alarm output is also always available.

Warning/Alarm Output: Always available. When contact closed indicates:

Warning:

- TAF+ E weak battery (only if battery powered)
- Low radio link signal

Alarm:

- No radio link with the TAF+ E
- TAF+ E analog level sensor error (only possible when operating in Pump Control for Tank Filling. Analog level MODE)
- TAF+ E low battery. Needs replacement (only if battery powered)

The warning or alarm cause is showed on the unit display

ANALOG OUTPUTS (pulse):

TAF+ R unit allows different modes to output analog signal values.

ANALOG OUTPUT BY PULSES (PLC, etc.)

TAF+ R unit includes 2 specific pulse output relays. Pulses are generated by the closing/opening of isolated static relays.

The number of pulses in a 30 seconds period is proportional to the analog value output. Its range is from 0 to 1023 (corresponds to a 10 bit resolution).

This output can be connected to a PLC digital input to pass the analog value. PLC program only needs to periodically count the number of received input pulses in 30 seconds time.

This is a very low cost solution, that also provides isolation.

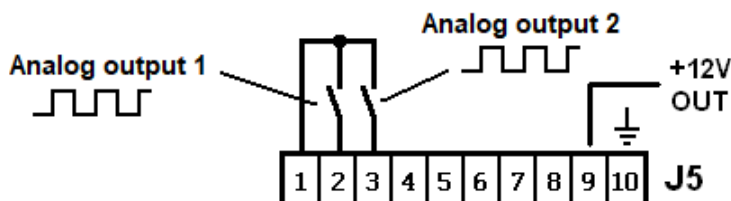
Analog value (mA) = (Number received pulses in 30 seconds / 1023) x 20

Thus:

- 0 pulses / 30 seconds → 0.00mA
- 204 pulses / 30 seconds → 3.99 mA
- 1023 pulses / 30 seconds → 20.00 mA

Pulse characteristics:

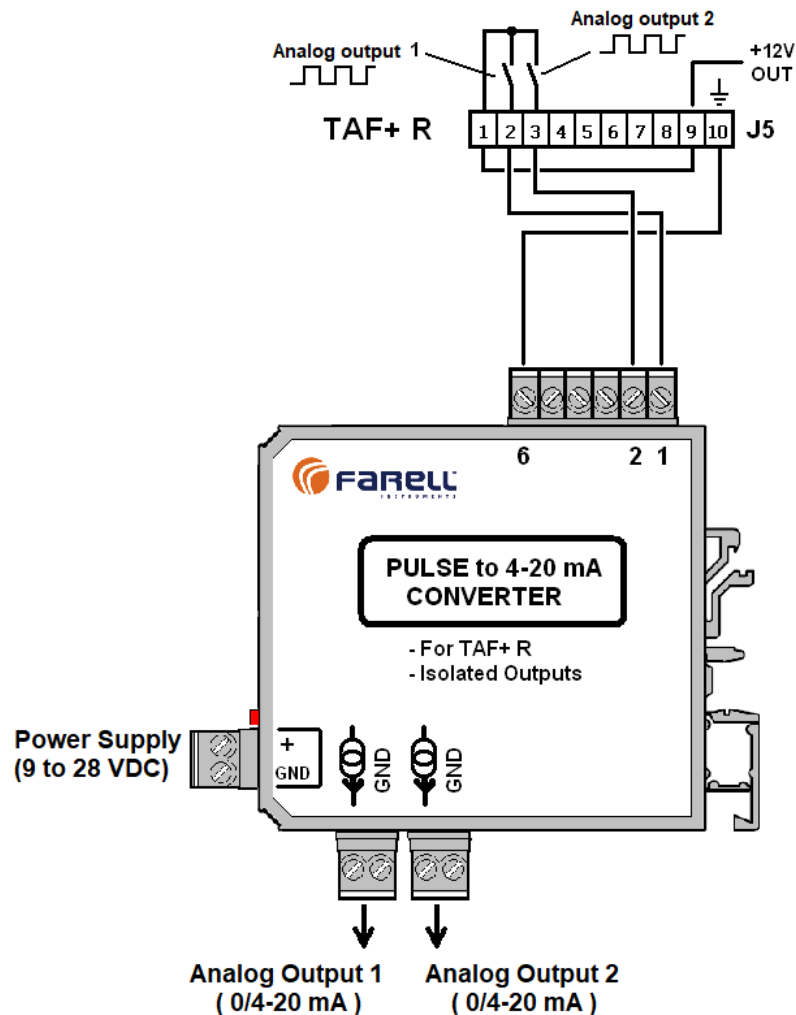
- ON time = OFF time ≥ 10 mS
- Pulse frequency: 43 Hz
- Max. contact current: 100 mA
- Max. open contact voltage: 48 VDC or VAC



ANALOG OUTPUT USING Pulse/mA CONVERTER MODULE

The Pulse to 4-20 mA Converter module does the direct conversion to mA. The module converts two pulse outputs to two active 0/4-20 mA outputs. The module is factory configured. Only showed connections must be done.

If the module is powered by a power supply, other than the one employed to power the TAF+ R unit, the analog outputs are isolated from the TAF+ unit.



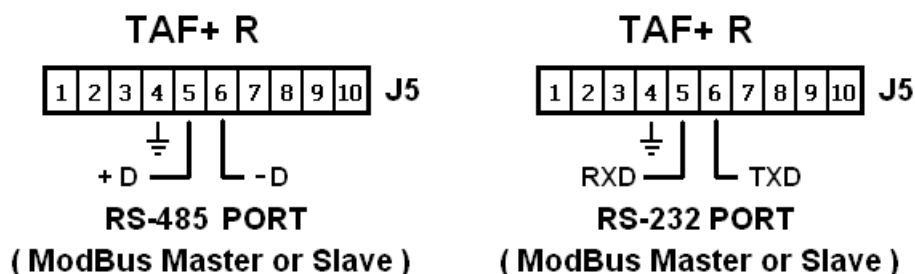
ANALOG OUTPUTS THROUGH MODBUS MASTER SERIAL PORT

- The TAF+ R unit includes an RS-232/RS-485 ModBus port that can be configured as Master or Slave. In Master mode can provide internal data (analog outputs, digital outputs, etc.) to an external I/O UMF-100 Slave module. The module will provide the digital outputs 1 to 4 and the warning/alarm output (relay) and the 2 analog outputs (0/4-20 mA active type, 12 bits resolution)
- The ModBus port can also be employed to connect to a ModBus Slave PLC unit to provide the data

ANALOG OUTPUTS THROUGH MODBUS SLAVE SERIAL PORT

The TAF+ R unit includes an RS-232/RS-485 ModBus port that can be configured as Master or Slave. In Slave mode can be connected to a ModBus Master PLC unit or SCADA to provide the data (digital outputs, analog outputs, warning/alarms, power supply values, temperature values, counter values, link status, link strength, etc.)

The document *ModBus_Variables_TAF+_V1.0_eng* defines the internal ModBus registers content (when Slave mode employed) and the register content of the ModBus pre-defined master data frames.



Choice of RS-485 or RS-232 is made by means of an internal jumper. RS-485 by default.

METER PULSE OUTPUT (Pulse Transmitter (meter) MODE):

Read paragraph *Pulse Transmitter (meter) MODE* in section 2

In this mode the digital input 1 of the TAF+ E unit acts as a meter pulse input. The meter pulses are output at the pulse output 2 of the TAF+ R unit (terminals 1 and 3 of J5) (In this mode analog output 2 is not available).

TAF+ E sends periodically the counter value to the TAF+ R unit. At each reception the TAF+ R unit calculates the difference between the last two received counter values and generates the corresponding pulses. Counter value can also be viewed on the display.

TAF+ R pulse output:

- Pulse duration: ON state = 100 mS ; OFF state $\geq$ 100 mS (4.9 Hz max)
- Max current output: 100 mA
- Max voltage: 48 VDC or VAC

Analog output 2 is not available in this operation mode

POWER SUPPLY:

TAF+ R

- **12VCC / 110/230VCA Model:** Allows the unit to be powered at 12 VDC or 110/230 VAC 50/60 Hz (110/230 VAC 50/60 Hz /12VDC pluggable power supply supplied).

8 – UNIT CONFIGURATION

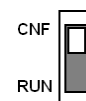
The 4 x 20 characters OLED display and the single push/selector button is employed to configure the unit.

8.1 – Display operation

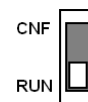
- Usually the display is OFF. A short button push turns it ON
- Many different screens are available. Each screen is numbered on the up left corner (except the first one (0)).
- Rotating the button changes the number of screen displayed. The rotation sense of the button moves screens ahead or back. The first screen comes after the last one (presentation is cyclic)
- There are screens that allow data display and configuration. Others are only for data or status display.
- Once on a configurable screen, to start a configuration it is necessary to maintain the button pushed until the first configurable parameter starts to blink (some 5 seconds).
- Button rotation modifies the parameter value up or down to the required value. A short push ends the parameter configuration and the next one (if any) starts to blink. When the last parameter is configured, the configured values are saved to non volatile memory.
- Display turns OFF after one minute without actuating the button.

8.2 – TAF+ E configuration

1. Switch the dip-switch CNF/RUN to the **CNF** position (up) located on the down left side of the display.
2. Push the button to turn ON the display. Screen 0 displays the number of digital inputs (DI), and analog inputs (AI) available on the unit. If necessary can be increased up to 8DI and 2AI by means of a provided on demand code.
3. Go to screen 4
4. Select a radio channel **Chan1** (any preconfigured channel from 1 to 12). If necessary, channel 0 allows programming a specific radio frequency inside the band by means of 3 numbers that will be provided by the distributor. When employing non licensed channels, it is recommended to check channel availability to be sure that the channel is not occupied for some big percentage of the time. Channel occupation can be tested employing the RX Test. If the channel is heavily occupied it is recommended to switch to another one.
5. Configure **Cod**: (network code) Any value from 0 to 255 (choose any random value)
6. Configure **Dst** (unit destination address). Any value from 1 to 255
7. Configure **Lv** (radio network level). Configure to **0**
8. Configure **Reg** (first ModBus register address to be written at destination unit). Configure to **17,128**
9. Configure **Frame = 1**
10. Go to screen 7
11. Select the **Operating Mode** (read paragraph 2 to view the characteristics of each one):
 - a. Transparent
 - b. Pumping/Tank Mx/Mn
 - c. Pumping/Tank 2 Mx/Mn
 - d. Pump/Tank Sensor mA
 - e. Meter (pulses)
12. Configure **TX no change** = 255. Corresponds to time (in seconds) between two consecutive radio transmissions when no changes occur at the inputs. Value range: 15 to 255. Lower values increase unit power consumption
13. Configure **TX if change** = 30. Corresponds to the minimum time (in seconds) between two consecutive radio transmissions when changes occur at the inputs. Value range: 2 to TX no change – 1 (max: 60). Lower values increase unit power consumption
14. Go to screen 14
15. Employ data frame encryption to enhance transmitted data security if needed. (Yes or No). If **Yes**, enter the 8 figures encryption code. Figure range: 0 to 255. If **No** the encryption code is not employed.
16. Go to configuration paragraph 32 if analog inputs are not employed.
17. Go to screen 6
18. Configure **PM1 = 60** (time in seconds between two consecutive analog input 1 measurements). Range: 30 to 990
19. Configure **PM2 = 5 x PM1** (time in multiples of PM1 between two consecutive analog input 2 measurements). *Example: If PM1=60 and PM2=5, analog input 1 will be measured each 60 seconds and analog input 2 each 300 seconds)*
20. Configure **M1 = 60**. Stabilization time in mS of the analog 1 sensor. Is the time from powering analog sensor to making the measurement. Set stabilization time according to the sensor employed. If the sensor is not powered by de unit, set to 60. Range: 20 mS to 20 Seconds. (See paragraph *SENSOR STABILIZATION TIME* on page 14)
21. Configure **M2 = 60**. Stabilization time in mS of the analog 2 sensor. Range: 20 mS to 20 Seconds

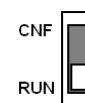
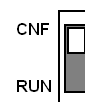


22. Go to configuration paragraph 32 if the selected operating mode is not *Pump/Tank Sensor mA*.
23. Calibration of tank level in % (corresponds to analog input 1). Connect the submersible level sensor to analog input 1 and the 100% switch level sensor to digital input 1. 100% switch level sensor must be uncovered (contact closed)
24. Go to screen 1
25. Extract the submersible analog level sensor from the tank. Keep at free air
26. Make a short button push to force a measurement (an asterisk will appear on the upper right side of the screen)
27. Configure **Level** to **0** value (corresponds to the level 0%) (First tank level calibration step done)
28. Immerse the analog level sensor to the position corresponding to 0 % of the tank.
29. Calculate, approximately, the current water level in the tank, in %
30. Make a short button push to force a measurement (an asterisk will appear on the upper right side of the screen)
31. Configure **Level** to the calculated **current % value** (Last tank level calibration step done). Level will be automatically recalibrated at 100 % each time 100% level switch covered.
32. Switch the dip-switch CNF/RUN to **RUN** position (down). Unit power consumption lowers in RUN position. In RUN mode only USER screens are displayed.
33. End of configuration



8.3 – TAF+ R configuration

1. Switch the dip-switch CNF/RUN to the **CNF** position (up) located on the down left side of the display.
2. Push the button to turn ON the display. Screen 0 displays the number of digital outputs (relays) (DO), analog outputs (AO) and COM port. If necessary can be increased up to 8DO, 2AO and 1 COM port by means of a provided on demand code. Two pulse outputs are always available if unit has AO. Warning/alarm output is always available.
3. Go to screen 4
4. Select a radio channel **Chan1**. Must be the same channel as TAF+ E
5. Configure **Cod**. Must be the same code as TAF+ E
6. Configure **Dst**. Must be the same destination as TAF+ E
7. Configure **Ni**. Configure to **1** if direct radio link to the TAF+ E unit (no repeater employed). Configure to **2** if a repeater (T-MOD C-48+ in S&F mode) is employed.
8. Go to screen 5
9. Configure the **Link Timeout** = 800. Maximum elapsed time from last received frame before entering to the *no link status* (security function). Must be configured to a time greater than 3 times the *TX no change* (screen 7 in TAF+ E).
10. Go to configuration paragraph 12 if the selected operating mode is not *Pump/Tank Sensor mA*
11. Go to screen 7: Set the **Max/Min tank levels** that control the pump (ON/OFF). Two Max/Min level pairs are available if 2 energy rates are employed. Max/Min levels can be modified any time during unit operation. If the Max level of LOW rate is 100 %, the pump will stop (OFF) when the 100 % level switch will be covered (and 100 % level recalibrated). If HIGH rate is not employed, the Max/Min HIGH rate levels are no used.
12. If no COM port available, go to configuration paragraph 15
13. Go to screen 6
14. Configure the operating mode of the unit COM port (ModBus Master or ModBus Slave), the port baud rate (1200 to 115200 bps) and the character format (8N1 ; 8O1 ; 8E1)
15. Go to screen 14
16. Frame data encryption. Must be configured the same as screen 14 on the TAF+ E unit.
17. Switch the dip-switch CNF/RUN to **RUN** position (down). In RUN mode only USER screens are displayed.
18. End of configuration



Notes:

- *TAF+ E in Pump/Tank Sensor mA mode*
 - *Manual tank level calibration (configuration paragraphs 23 to 31) is only possible if current tank level is 10 % or higher*
 - *For tanks with less than 1.5 meters between 0 % and 100 % levels, it is recommended to employ a low F.S. level sensor (for example, 0.5 bar)*
- *The reconfiguration of the TAF+ R unit (modification of Max/Min levels on screen 7 excluded) causes a RESET of the unit. Output relays (pump output included) will be open and warning/alarm relay closed (signaling a no reception status) until new reception from TAF+ E unit.*

9 - SCREENS

9.1 – TAF+ E unit: Configuration screens

***** FARELL Instruments TAF+E 8DI+2AI *****	First screen (0). Number of digital inputs (DI) and analog inputs (AI) available. Allows language selection (Spanish, English, French). Warning or alarm messages appear at line 4 LOW BATTERY! - Warning ! REPLACE BATTERY ! - Alarm
01- Transparent Inp:1 2 3 4 5 6 7 8 A1= 14.8 A2= 7.3 mA	Transparent mode Digital inputs status: ON status is presented with a mark on the right side of the input number Analog input values (mA)
01- Pumping to Tank Inp:1 2 3 4 5 6 7 8 A1= 14.8 A2= 7.3 mA	Pumping/Tank Mx/Mn mode: Digital input status. Input 1 corresponds to the Max level switch and digital input 2 to the Min level switch (open contacts when covered) Analog input values (mA)
01- Pumping/Tank 2 Inp:1 2 3 4 5 6 7 8 A1= 14.8 A2= 7.3 mA	Pumping/Tank 2 Mx/Mn mode. Digital input status. Input 1 and 2 correspond to the Max/Min level switches when Low rate, and inputs 3 and 4 to the Max/Min level switches when High rate (open contacts when covered) Analog input values (mA)
01- Pumping/Tank % Inp:1 2 3 4 5 6 7 8 Level = 67 % A1= 10.4 A2= 7.3 mA	Pump/Tank Sensor mA mode: Digital input status: Input 1 corresponds to the 100% level switch (open contact when covered). Normalized tank level (%). Analog input values (analog input 1 corresponds to the level sensor)
01- Meter (pulses) Ent:1 2 3 4 5 6 7 8 Meter (pulses):1234 A1= 14.8 mA	Meter (pulses) mode Digital input status. Input 1 corresponds to the pulse input. Analog 1 input value (mA)
02 - POWER SUPPLY Batt.: 7.1 V Temperatura= +25 °C	Battery voltage (when battery powered) Low and Replace messages can appear Unit temperature
02- POWER SUPPLY 12V P.S.: 12.1 V Temperatura= +25 °C	Power supply (when 12V powered) High (> 15.6 V) and Low (< 10.0V) messages can appear Unit temperature
03- UNIT Serial N: 00000000 Firmware:V 2.1 10137 Loader :V 1.0 30239	Unit serial number and firmware versions
04- RADIO Band: 5 Chanl= 1 Cod= 0 Dst= 2 Lv=0 Reg= 17,128 Frame=1	Radio band (depends on the unit RF hardware installed) Chanl: radio channel ; Cod: Network code ; Dst: ModBus address of the slave unit ; Lv: Network level ; Reg: ModBus address of the first register to write ; Frame: Type of predefined data frame sent

04- RADIO Band: 5 Chan1= 0 xxx,xxx,xxx Cod= 0 Dst= 2 Lv=0 Reg= 17,128 Frame=1	Same as previous, but employing the channel 0 that allows to define an specific radio frequency. The frequency is defined by 3 numbers (xxx,xxx,xxx) that will be supplied on demand by the distributor.
05- RADIO LINK Level RX: - 76 dBm Time next TX: 178 S	Radio signal level (dBm) received from de TAF+ R. Recommended to be higher than -95 dBm (Remember: -80 dBm represents a higher signal tan -95 dBm). If not, increase antenna height, employ a higher gain antenna, try repositioning the antenna for better reception, etc.) Time to next TX (seconds) if no input changes
05- RADIO LINK Level RX: - ? dBm Retries: 2 Time next TX: 178 S	Not receiving signal from the TAF+ R The TAF+ E has done 1 TX + 2 TX (retries) on the last attempt
06- ANALOG CONFIG. PM1= 60 S PM2= 5xPM1 M1= 60 M2= 60 mS A1 in STANDARD mode	PM1: Time between two analog 1 measurements (Sconds) PM2: Time between two analog 2 measurements in PM1 multiples M1 and M2: Stabilization time (from power-up) of analog sensor 1 and 2 (mS) Analog 1 mode: Standard or Tank Level mode (when unit in Pump/Tank Sensor mA mode)
07- OPERATION MODE xxxxxxxxxxxxxxxxxxxx TX no change = 255 S TX if change = 30 S	Operation Mode: <i>Transparent ; Pumping/Tank Mx/Mn ; Pumping/Tank 2M/m ; Pump/Tank Sensor mA ; Meter (pulses)</i> TX no change: Time between consecutive transmissions when no input changes occur TX if change: Time between consecutive transmissions when input changes (*) occur (*) Change conditions according to operation mode: Mode 1 <i>Transparent</i> : - Digital input change - Analog input variation: 1 mA Mode 2 <i>Tank Mx/Mn</i> : - Digital input change on inputs 3 to 8 or on 1 & 2 that imply pump ON/OFF change - Analog inputs variation: 1 mA Mode 3 <i>Tank 2M/m</i> : - Digital input change on inputs 5 to 8 or on 1 to 4 that imply pump ON/OFF change - Analog input variation: 1 mA Mode 4 <i>Pump/Tank Sensor</i> : - Digital input change on inputs 1 to 8 - Analog input variation: 1 mA on Analn 2 or 3 % tank level on Analn 1 Mode 5 <i>Meter Pulse Transmitter</i> : - Digital input change on inputs 2 to 8 - Totalizer increment - Analog input 1 variation: 1 mA
13- RADIO TESTS -----	To start radio reception (RX) or transmission (TX) tests
13-Test RX ON (dBm) Ins=- 83 Max=- 72 #0_1_2_3_4_5_6_7_8# #*****#	RX test ON. <i>Ins</i> : Instantaneous signal level (-dBm). <i>Max</i> : Maximum signal level received during the test (-dBm). Lines 3 and 4 correspond to an instantaneous analog signal level display. Corresponding dB levels on paragraph 12.3. Test to verify channel occupation. A button push ends the test

13- Test TX ON Warning ! This test can do interferences End in 38 seconds	TX test ON. Employed to measure TX power and SWR (antenna adaptation). RF wattmeter an SWR meter needed. Maximum test duration time is 60 seconds. A button push ends the test
14- ENCRYPTION Activated: Yes xxx,xxx,xxx,xxx xxx,xxx,xxx,xxx	To activate frame encryption and to enter the encryption key (8 numbers)
15- ADDING OPTIONS 1 2 3 4 5 xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx	To increase the number of Digital Inputs (max. 8) and/or the number of Analog Inputs (max. 2) supported by the unit. A 10 number code, related to the unit serial number, will be supplied on demand by the distributor

9.2 – TAF+ E unit: RUN screens

↔ 00 ↔ 01 ↔ 02 ↔ 05 ↔

9.3 – TAF+ R unit: Configuration screens

***** FARELL Instruments TAF+R 8DO+2AO+COM *****	First screen (0). Number of digital outputs (DO), analog outputs (pulse) (AO) and COM port available. Allows language selection (Spanish, English, French). Warning or alarm messages appear at line 4 !! NO RADIO LINK !! - No radio link (or lost radio link) !! LOW BATTERY !! – TAF+E unit low battery ! REPLACE BATTERY ! – Replace TAF+E unit battery ! ERROR LEVEL SENSOR! – Error in TAF+E unit submersible sensor ! LOW RECEP. LEVEL ! – Radio link level too low (< -100 dBm)
01- Transparent Out:1 2 3 4 5 6 7 8 A1= 14.8 A2= 7.3 mA	Operation mode when in Transparent mode (indicates NO RADIO LINK ! if no link) Out: Output relays status Analog output values (mA)
01- Pumping to Tank Out:1 2 3 4 5 6 7 8 Pump:OFF A1= 14.8 A2= 7.3 mA	Operation mode when in Pumping/Tank Mx/Mn mode (indicates NO RADIO LINK ! if no link) Out: Output relays status 1 to 7. Status of Pump output (relay 8) Analog output values (mA)
01- Pumping/Tank 2T Out:1 2 3 4 5 6 7 8 Low Rate Pump:OFF A1= 14.8 A2= 7.3 mA	Operation mode when in Pumping/Tank 2 Mx/Mn mode (indicates NO RADIO LINK ! if no link) Out: Output relays status 1 to 7. Status of Pump output (relay 8) Current Rate (Low or High) Analog output values (mA)
01- Tank Level= 67 % Out:1 2 3 4 5 6 7 8 Low Rate Pump:OFF An= 14.7 A2= 7.3 mA	Operation mode when in Pump/Tank Sensor mA mode Current tank level in %. 0 (indicates NO RADIO LINK ! if no link, o Tank Level = (i) if level sensor error). Out: Output relays status 1 to 7. Status of Pump output (relay 8). Analog output values (mA). Analog output 1 (An) is normalized to % level: 0% → 4mA ; 100% → 20 mA.
01- Meter (pulses) Out:1 2 3 4 5 6 7 8 Meter: 1234 A1= 14.7 mA	Operation mode when in Meter (pulses) mode Out: Output relays status 1 to 8. Last value of received meter totalizer Analog output 1 (mA)
02- POWER SUPPLY P.S.= 12.1 V Temperature= +25 °C	Power supply, High (> 15.6 V) and Low (< 10.0V) messages can appear Unit temperature
03- UNIT Serial N: 00000000 Firmware:V 2.1 48163 Loader :V 1.0 30239	Unit serial number and firmware versions
04- RADIO Band: 5 Chan1= 1 Cod= 0 Dst= 2 Lv=1	Radio band (depends on the unit RF hardware installed) Chan1: radio channel ; Cod: Network code ; Dst: ModBus address of the slave unit ; Lv: Network level. Same values as TAF+ E unit, except Lv that must be 1 if no repeater, or 2 if repeater employed.
04- RADIO Band: 5 Chan1= 0 xxx,xxx,xxx Cod= 0 Dst= 2 Lv=0	Same as previous, but employing the channel 0 that allows to define an specific radio frequency. The frequency is defined by 3 numbers (xxx,xxx,xxx) that will be supplied on demand by the distributor.

05- RADIO LINK RX Lev1 (dBm) :- 82 Last RX frame: 192 S Link Timeout: 800 S	<i>RX Lev1</i> : Radio signal level (dBm) received from de TAF+ E. Recommended to be higher than -95 dBm (Remember: -80 dBm represents a higher signal than -95 dBm). If not, increase antenna height, employ a higher gain antenna, try repositioning the antenna for better reception, etc.) <i>Last RX frame</i> : Elapsed time (seconds) from last received frame <i>Link Timeout</i> : Maximum elapsed time from last received frame before entering the <i>no link status</i> (security function). In <i>no link status</i> , outputs 1 to 8 are open, analog outputs pass to 0 mA and the alarm relay closes. Must be configured to a time greater than 3 times the <i>TX no change</i> (screen 7 in TAF+ E)
06-ModBus RS-485/232 Mode: Slave Baudrate: 9600 bps Format: 8N1	ModBus RTU port configuration Slave or master Mode Baudrate: 1200 bps to 115200 bps Character format: 8N1, 8E1, 8O1
07- T.Level/E.Rate LOW Rate HIGH Rate Max:100 % Max: 40 % Min: 90 % Max: 30 %	To set the maximum and minimum tank levels when in Pump/Tank Sensor mA mode. If the maximum level for LOW rate is 100%, the pumping will stop when level switch 100% covers (and automatically recalibrates 100% level). Values can be modified any time
13- RADIO TESTS -----	To start radio reception (RX) or transmission (TX) tests. Same as TAF+ E unit
14- ENCRYPTION Activated: Yes xxx,xxx,xxx,xxx xxx,xxx,xxx,xxx	To activate frame encryption and to enter the encryption key (8 numbers). Must be configured the same as the TAF+ E unit.
15- ADDING OPTIONS 1 2 3 4 5 xxx xxx xxx xxx xxx xxx xxx xxx xxx xxx	To increase the number of Digital Outputs (max. 8), the number of Analog Outputs (max. 2) and COM port supported by the unit. A 10 number code, related to the unit serial number, will be supplied on demand by the distributor

9.4 – TAF+ R unit: RUN screens

↔ 00 ↔ 01 ↔ 07(*) ↔

(*): Only if unit operating in *Pump Control for Tank Filling Analog Level* mode

10 – FINAL VERIFICATIONS

Once the units have been Installed, the electrical connections made, powered and configured, it is necessary to verify the quality of the radio link in both senses. Link signal strength visible on screen 5 at both units.

Radio signal level received en each unit (in dBm units) is displayed on screen 5. (As values are negative -80 dBm represents a higher signal tan -95 dBm). Receiving level must be at least 20 or 25 dB higher than the noise level of the channel (See RECEPTION TEST paragraph)

If not, increase antenna height, employ a higher gain antenna, try repositioning the antenna for better reception, etc.). In some bands, a 2W output power radio (instead of 500 mW) is available, giving a 6 dBm increase in power reception.

FORCING AN ANALOG INPUT MEASUREMENT IN TAF+ E UNIT

- A short push of the button while in screen 1, forces the execution of an analog measurement (an asterisk appears momentarily on the upper-right corner of the screen)

FORCING A POWER SUPPLY VOLTAGE MEASUREMENT

- A short push of the button while in screen 2, forces the execution of the power supply voltage of the unit (an asterisk appears momentarily on the upper-right corner of the screen)

FORCING A RADIO TRANSMISSION IN TAF+ E UNIT

- A short push of the button while in screen 5, forces a data radio transmission and waits for the reception of TAF+ R answer (an asterisk appears momentarily on the upper-right corner of the screen). Link signal strength is updated.

RECEPTION TEST

- This test allows to know if the selected channel is free or has a noise. To start the test in CNF mode go to screen 13. Push the button until the test text appears. Select the RX test and start the test.
- The screen shows:
 - **Ins**: Instantaneous RX signal level in numeric values (- dBm)
 - Graphic instantaneous RX level (refreshed at a higher speed) than Ins
 - **Max**: Maximum received signal level during the test (- dBm)

Scale	0	-	1	-	2	-	3	-	4	-	5	-	6	-	7	-	8
-dBm	120	115	111	107	103	99	95	91	87	83	79	75	71	67	63	59	55
Weak Strong																	

- This test must be done at both unit locations to be sure that no interfering signals are present (ideally Max signal must be lower than – 100 dBm). If interfering signals (or noise) are higher, try a different channel. If all available channels have noise choose the lower one and assure that link levels (RX Levl on screen 5) between units are at least 20 to 25 dBm higher. If necessary employ higher gain antennas, increase the antenna height or employ the 2 W power option that increases 6 dBm the link level

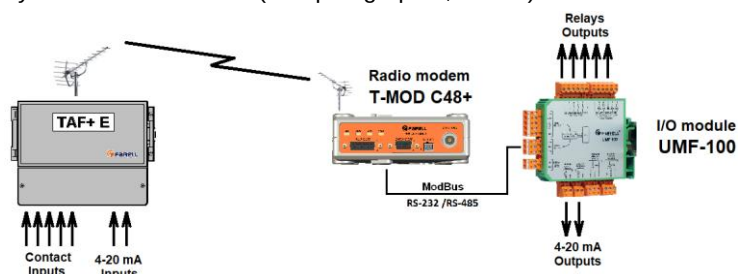
TRANSMISSION TEST

- This test allows to verify the output power of the unit and/or the antenna adaptation (a radio wattmeter adapted to the radio band is necessary)

Switch the dip-switch CNF/RUN to **RUN** position (down). In RUN mode only USER screens are displayed

11 – CONFIG. WHEN (T-MOD + UMF-100) BASED RECEIVER

This receiver type can be employed when many TAF+ E must be received in one same location (See paragraph 5, case b). Also can be employed in other situations (See paragraph 4, case c)



TAF+ E configuration: The one defined in paragraph 8.2, with the next modifications:

- (8.2.9): Configure *Frame* = 2 or 3 (See Tables of Signal Correspondence)
- (8.2.12): Configure *Tx no change* = Value range 15 to 200

T-MOD C48+ configuration:

- *Operation Mode* = M/S Slave
- *TX Frequency y RX Frequency*: The frequency must be the same corresponding to the configured radio Channel number on the TAF+ E unit (8.2.4). The correspondence between Channel number and frequency, in each Radio Band, can be seen on paragraph 13.3 tables. TAF+ E Radio Band is displayed on screen 4.
- *Data Bitrate*: 4800 bps
- *Data Format*: 8N1
- *Framming Mode*: Standard
- *Network Level*: 1 (o 2 si el enlace es a través de repetidor T-MOD C48+ S&F)
- *Network Code*: The same as configured on *Cod* (8.2.5) in TAF+ E

UMF-100 configuration:

- *Module Address*: Same as *Dst* (8.2.6) on associated TAF+ E
- *Network Role*: Slave
- *Com 1 / 2 Baudrate*: 4800
- *Com 1 / 2 Character Format*: 8N1
- *Com 1 / 2 EOF Chars*: 3
- *No Com Watch-Dog Time*: The value must be 1.2 times the value *Tx no change* (8.2.12) on TAF+ E (Example: If *Tx no change* = 200, configurar *No Com Watch-Dog Time* = 240).

When different T-MOD+ E units must be received on one same point, an UMF-100 module will be employed to receive each one. All the UMF-100 modules will be connected to the T-MOD by RS-485 bus. Each TAF+ E unit must employ a different *Dst* value, and this value must be the *Module Address* of its corresponding UMF-100 module.

Mode	Digital Outputs					Analog Outputs	
	1	2	3	4	5	1	2
Transparent	Dig.1 Input	Dig.2 Input	Dig.3 Input	Dig.4 Input	Dig.5 Input	Ana. Input 1	Ana. Input 2
Pmp/Tnk Mx/Mn	Dig.3 Input	Dig.4 Input	Dig.5 Input	Dig.6 Input	Pump Out	Ana. Input 1	Ana. Input 2
Pmp/Tnk 2 Mx/n	Dig.5 Input	Dig.6 Input	Dig.7 Input	Pump L.R.	Pump H.R.	Ana. Input 1	Ana. Input 2
Pmp/Tnk mA	Dig.1 Input	Dig.2 Input	Dig.3 Input	Dig.4 Input	Dig.5 Input	Tnk Level (*)	Ana. Input 2

Table of Signal Correspondence when **Frame = 2**

Mode	Digital Outputs					Analog Outputs	
	1	2	3	4	5	1	2
Transparent	Dig.1 Input	Dig.2 Input	Dig.3 Input	Dig.4 Input	Alarm	Ana. Input 1	Ana. Input 2
Pmp/Tnk Mx/Mn	Dig.3 Input	Dig.4 Input	Dig.5 Input	Alarm	Pump Out	Ana. Input 1	Ana. Input 2
Pmp/Tnk 2 Mx/n	Dig.5 Input	Dig.6 Input	Alarm	Pump L.R.	Pump H.R.	Ana. Input 1	Ana. Input 2
Pmp/Tnk mA	Dig.1 Input	Dig.2 Input	Dig.3 Input	Dig.4 Input	Alarm	Tnk Level (*)	Ana. Input 2

Table of Signal Correspondence when **Frame = 3**

(*) Tnk Level: Normalized tank level: 0 % to 100 % (4-20 mA). 0 mA if level sensor failure

- If lost radio link, digital output open and analog outputs at 0 mA.

- **Alarm**: Normally closed. Opens if alarm: Low battery on TAF+E (only if battery powered) or Radio link lost

12 – UNIT UPDATE

If necessary TAF+ units can be updated in the field (new functions added, etc.). A TAF Bluetooth dongle connected to the unit J7 connector is employed to link the TAF+ unit to an Android mobile set. A loader application '**FirmLoad App**' is available.



13 – TECHNICAL DATA

13.1 - TAF+ R

Relay outputs (mechanical relays)

- Max. contact current: 2 Amp. at 230 VAC or 30 VDC

Digital input electrical rate:

- Closed contact intensity: 3.8 mA
- Applied open contact voltage: 3 V

Analog outputs (pulse)(static relays)

- Measurement period: 30 Sec.
- Pulse frequency: 42.6 Hz (Symmetrical pulse: Ton = Toff > 10 mS)
- Max. contact current: 100 mA
- Max, contact voltage: 48 VDC or VAC
- 0 to 1023 pulses/30 sec. : $0 \text{ pulses}/30 \text{ seconds} = 0 \text{ mA}$; $204 \text{ pulses}/30 \text{ seconds} = 4 \text{ mA}$; $1023 \text{ pulses}/30 \text{ seconds} = 20 \text{ mA}$

Meter pulse output (static relay)

- Pulse frequency: 4.9 Hz (Symmetrical pulse: Ton = Toff >= 100 mS)
- Max. contact current: 100 mA
- Max, contact voltage: 48 VDC or VAC

COM ModBus port

- Configurable as Master or Slave. RS-232 or RS-485
- From 1200 bps to 115200 bps. Character format: 8N1, 8E1, 8O1

Power supply 12 VDC input: 12 VDC (10.0 VDC to 15.5 VDC)

Radio output power: 0.5 W (2W option)

Current consumption at 12VDC

- Average (screen OFF): 50 mA + (10 mA x N active output relays)
- Peak (screen ON): 650 mA (1.7 A if TX 2W)

Front LED: 1 flash/second or 5 flashes/second when alarm

Operating temperature range: - 20 °C to + 60 °C (-4 °F to 140 °F)

Protection grade: IP-67

13.2 - TAF+ E

Digital inputs

- Contact operated
- Closed contact intensity: 1.8 mA
- Applied open contact voltage: 3 V
- Digital filter times
 - Transparent mode – 1 second, all inputs
 - Pumping/Tank Mx/Mn mode – 4 seconds for inputs 1 and 2 ; 1 second for 3 to 8
 - Pumping/Tank 2 Mx/Mn mode – 4 seconds for inputs 1 to 4 ; 1 second for 5 to 8
 - Pump/Tank Sensor mA mode – 4 seconds for inputs 1 ; 1 second for 2 to 8
 - Meter (pulses) mode – 80 mS for input 1 (pulses), max. 5 pulses/sec ; 1 second for inputs 2 to 8
- Inputs protected against pulse voltage peaks by specific fast protection diodes

Analog inputs 0/4-20 mA

- Input impedance: 89 ohm +/- 4 ohm
- Output voltage to power two wires 4-20 mA type analog sensor: 15.5 VDC. Short circuit protected
- Inputs are isolated from the unit between successive measurements, by static relays.
- Inputs protected against pulse voltage peaks by specific fast protection diodes

TX period when no input changes: Configurable from 15 to 255 sec.

Minimum TX period when input changes: Configurable from 2 to 60 sec.

Input changes that force TX:

- Transparent mode – Change in any digital input state and/or 1 mA change in any analog input
- Pumping/Tank X Mx/Mn modes – Change in any of the switch level inputs that need a change of the pump status, and/or change in any other digital inputs (3 to 8 or 5 to 8) state and/or 1 mA change in any analog input
- Pump/Tank Sensor mA mode – 100 % level switch been covered and/or tank level variation $\geq 3\%$, and/or change in any other digital input, and/or 1 mA change in analog input 2
- Meter (pulses) mode – Change in any digital input 2 to 8, and/or 1 mA change in any analog input

Radio output power: 0.5 W (2W option)

Power supply 12 VDC input: 12 VDC (10.0 VDC to 15.5 VDC)

Current consumption at 12VDC

- Average current (TX each 60 Sec. ; Analog input measurements each 60 Sec. ; Analog sensors powered by the unit ; Stabilization time of analog sensors 100 mS ; Screen OFF: Transmitter power 500 mW: **2 mA** (4 mA if TX 2W)
- Peak current consumption (screen ON): **400 mA** (1.5 A if TX 2W)

Non rechargeable battery operation time between replacement (*) (Alkaline and Li options)

- TX 0,5W: Alkaline: > 1.5 years ; Li: > 3 years
- TX 2W: Alkaline: > 3 months ; Li: > 1.5 years

Operating temperature range:

- Power at 12VDC: - 20 °C to + 60 °C (-4 °F to 140 °F)
- Power by alkaline batteries: - 7 °C to + 45 °C (-3 °F to 113 °F)
- Power by Li battery module: - 20 °C to + 60 °C (-4 °F to 140 °F)

Front LED: 1 flash/second or 5 flashes/second when alarm

Protection grade: IP-67

(*) Conditions: Use of any of the operating modes. Two minutes mean time between consecutive transmissions. Two 4-20 mA analog sensors powered by the unit, madding measurements each minute. Analog sensor stabilization time: 100 mS. Radio transmitting power: 500 mW. Unit temperature: 25 °C. Extreme temperatures effect battery operation and consequently decrease the operation time.

13.3 - TAF+ : Channel to Frequency correspondence per Band

- **Band 1 : 915 - 928 MHz.**

1	2	3	4	5	6
915.0125	915.0375	915.0625	915.0875	915.1125	915.1375
7	8	9	10	11	12
915.1625	915.1875	915.2125	915.2375	915.2625	915.2875

- **Band 2 : 869 - 870 MHz**

1	2	3	4	5	6
869.400	869.425	869.450	869.475	869.500	869.525
7	8	9	10	11	12
869.550	869.575	869.600	869.625	869.650	869.650

- **Band 4 : 450 - 470 MHz**

1	2	3	4	5	6
458.1125	458.1250	458.1375	458.1500	458.1500	458.1500
7	8	9	10	11	12
458.1500	458.1500	458.1500	458.1500	458.1500	458.1500

- **Band 5 : 430 - 450 MHz**

1	2	3	4	5	6
433.0750	433.1000	433.1250	433.1500	433.1750	433.2000
7	8	9	10	11	12
433.2250	433.2500	433.2750	433.3000	433.3250	433.3500

- **Band 6 : 406.1 - 430 MHz**

1	2	3	4	5	6
407.0125	407.025	407.0375	407.0500	407.0625	407.0750
7	8	9	10	11	12
407.0875	407.1000	407.1125	407.1250	407.1375	407.1500

- **Band 8 : 160 - 175 MHz**

1	2	3	4	5	6
169,618750	169,643750	169,668750	169,693750	169,718750	169,743750
7	8	9	10	11	12
169,768750	169,793750	169,793750	169,793750	169,793750	169,793750

- **Band A : 146 - 162 MHz**

1	2	3	4	5	6
146,3750	146,8000	150,6750	150,937	150,0950	151,900
7	8	9	10	11	12
155,5375	155,550	159,1125	159,1250	159,1275	159,1375

14 - 110/230VCA 50/60 Hz - 12 VCC EXTERNAL P.S.

- Input: 110 to 230 VAC ; 50-60 Hz
- Output: 12 VDC, 1A

