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Radio Tide Transmitter/Receiver Station

MTU821-W-VT (outdoor use version)

MTU821-D-VT (rackmount version)

Operation Manual Version 1.4

Introduction

MGB-Tech's Radio Tide Stations may be operated as Radio Tide Receiver and as Radio Tide Transmitter as well.
Switching between both functions is done via the menu – no modifications inside the units are necessary.

When operating as receiver, the Radio Tide Station waits for messages transmitted by one or more Radio Tide Transmitters. Up to ten transmitters may share the same radio channel: they are identified by their 'Radio Code' which is transmitted together with the tide message.
Our Radio Tide Station has the capability to simultaneously display the tide of four Transmitter Stations.

A Radio Tide Transmitter is connected to a Tide Gauge. This is mostly a pressure transducer with analog or digital output signal.

Our Radio Tide Stations are based on the MTU821 Telemetry Unit.
Two versions of the MTU821 are available:

1. MTU821-D: built in 19-inch case and designed for desktop or rack-mount use
2. MTU821-W: this version is built in a fiberglass-reinforced polyester enclosure and is intended for outdoor use (IP66 protection class)

The MTU821-W-VT and MTU821-D-VT are using Vyner's over-the-air protocol and will read messages transmitted by Vyner MK2 Radio Tide Gauge units or by CES' TGM Radio Tide Stations.
Also the reverse is true: MK2 and TGM units will read flawless the messages from our MTU821.

MTU821 Panel Operation

ON/OFF pushbutton with maintained action:

Push once to switch the instrument ON.
Push again to switch OFF.

ON status is indicated by the LED integrated in the pushbutton

Important:
This switch commands logic circuitry only. The AC power supply remains operational. Make sure to remove the AC Power Lead before opening the instrument case.

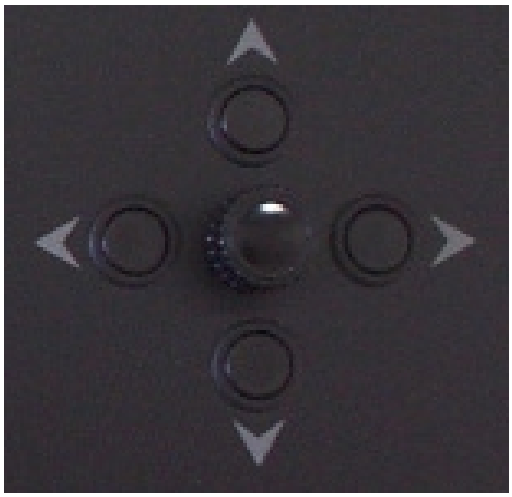
LCD display Intensity & Contrast Controls:

The 'Intensity' control adjusts the intensity of the LED backlight integrated in the LCD display. This potentiometer has no effect when the backlight is switched OFF.
Note:
Pushing any of the cursor or selection keys or rotating the digital panel control will make automatically the LCD backlight switch to ON

The 'Contrast' potentiometer adjust the readability of the LCD display.
The contrast is influenced by temperature variation but also varies with the 'viewing angle'.

Selection keys:

<ESC>	Push the ESCAPE button to step-up one level in the menu tree or to return to the operation screen
<MENU>	Pushing this key activates the menu
<ENTER>	Use this pushbutton to confirm your selection(s)
<ALPHA>	The MTU821 accepts alpha-numerical entries. Use this pushbutton to switch between letters or figures entry.
<Funct>	This is a function key.



Cursor keys:

 UP/DOWN cursor keys
Use these keys to scroll the menu or to jump to scroll to other selections fields above or below the current one

 LEFT/RIGHT cursor keys
The keys are used to scroll between horizontally spaced fields or to ease entry of large numbers

Digital Panel Control:

The Digital Panel Control may be used for UP/DOWN scrolling in addition to the cursor keys, but it also make entry of letters and figures possible:
press the ALPHA key to switch from letters to figures and vice versa and rotate the Digital Panel Control until the required letter or figure appears on the screen.

The Digital Panel Control is also used when entering operational parameters, like Baud Rate, Averaging Interval interval, etc. Every click of the Digital Panel Control will make the parameter value increase or decrease one step at the time.
When large variations are required, the Digital Panel Control may be used in combination with the LEFT/RIGHT cursor keys: pushing the RIGHT cursor key will increase the parameter value by a number of units, pushing the LEFT key will decrease it by a number of units at the time.

Assume the actual Averaging Interval =1.
Every clockwise click on the Digital Panel Control will increase the Averaging Interval by one while every counter-clockwise click will decrease the Averaging Interval by one.
On the contrary, every push on the RIGHT cursor key steps makes the Averaging Interval increase by 100. The LEFT cursor key will behave the same way, but to lower the Averaging Interval by 100 at the time.

Context sensitive help

The LCD display informs the operator what to do when entering operation parameters. E.g., following message is put on the LCD screen when entering the Averaging Interval:

```
Scroll between 1 and 900 seconds.
Use Left & Right arrow keys to scroll
with stepsize 100.
```

Other examples:

When changing from Radio Tide Receiver to Radio Tide Transmitter:

```
When changing the radio function to
transmitting, be sure to set the
transmission settings first!
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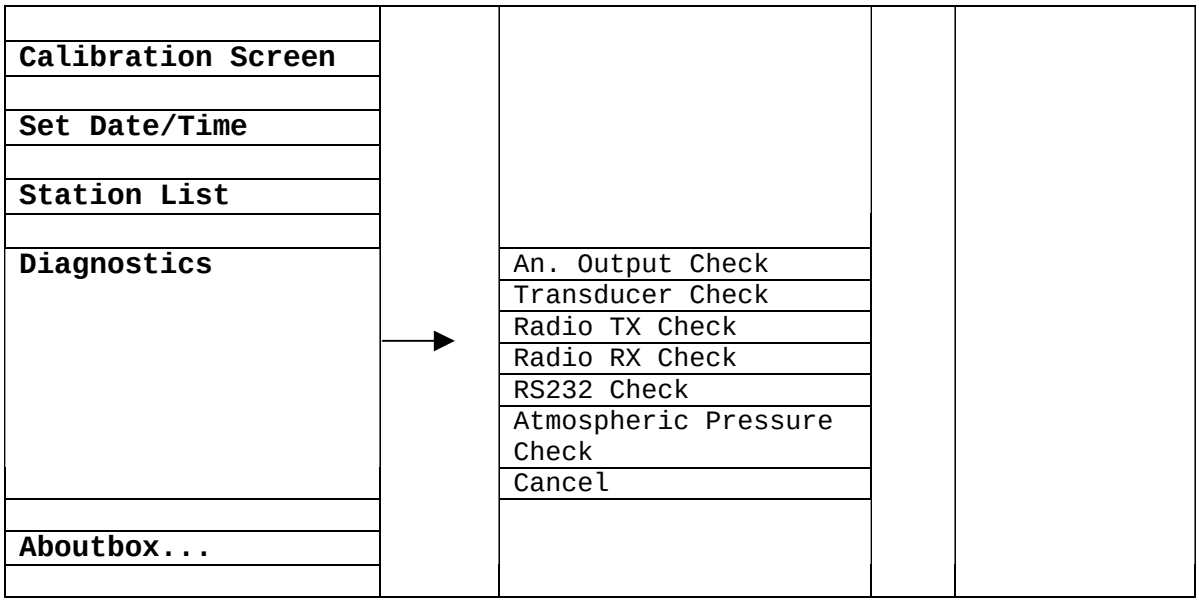
When modifying the serial communication speed:

```
Select the serial line baudrate. You
can use a log dump to test the serial
line if this value is changed.
```

Menu tree

Tide View Page	(Return to main screen)	
View Logged Data	LogMenu	Mark Begin
		Mark End
		Dump Range
		Reset Index
		Goto Home
		Goto #0
	Scroll	
	Step	
Select Radio Channel	Select Radio Channel: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 <OK> <CANCEL>	
Select Station	Select Primary Sation/Transmission Station A B C D E F G H I J <OK> <CANCEL>	
General Config	Radio Function	(Transmit/Receive)
	Logging Interval	(1 to 900)
	Averaging Interval	(1 to 900)
	Baud rate	(1200 to 115200 bps)
	Serial Format	(A/B/C)
	Auto Backlighting	(Enabled/Disabled)
Transmitter Config	Sensor Type	Analog 0-20mA Analog 4-20mA Digital Serial
	Atmospheric Compensation	(Y/N/Value)
	Offset To Tide	(-9.99 to +9.99m)
	Pressure Range	(0 to 25m)
	Transmit Voltage	(Yes/No)



Very important:

Leave a submenu by pressing the <ENTER> key, otherwise all selection changes will be discarded.

What after powering ON? - Common Settings

Do not forget to connect the antenna before switching on the Radio Tide Station!

The equipment becomes alive by pushing the Power ON switch. The red LED indicator starts glowing and the LCD display shows the welcome screen.
Adjust contrast and backlight intensity until you feel comfortable with the readability.
Meanwhile, the LCD display has jumped to the 'Main Operation Screen'.
Depending on the active operation mode when the equipment was switched OFF, this will be

Radio Tide Station Transmitter

(the active mode was 'Transmit' before switching OFF)
or

Radio Tide Station Receiver

(the active mode was 'Receive' before switching OFF)

Now set the parameters which are **common to both Receive and Transmit operation** mode:

- Push the MENU button
- Select ***'Set Date/Time'*** and adjust the real time clock if necessary
- Scroll now to the menu item ***'Select Radio Channel'*** and choose the radio channel in use on the site: our Tide Stations use the same frequency for transmission and for reception, so if channel 2 is used by the Radio Tide Transmitter Station, the same channel must selected at each Radio Tide Receiver station that needs tide information from that particular transmitting station.
- Do not forget that up to ten Radio Tide Transmitter Stations and an unlimited number of Radio Tide Receiver Stations may share the same channel.
  The ***'Select Station'*** permits to select a radio code (A,B, C, …, or J) for a particular transmitter.
  The 'Radio Code' parameter makes it possible to distinguish between the Radio Tide Transmitter Stations active on the same radio channel. At the receiver side, the ***'Select Station'*** menu is used to select the radio code of the 'Primary Station': this must be the radio code used by the most important Radio Tide Transmitter Station on your site.
  It is also possible to receive other Radio Tide Transmitter Station active on the same radio channel. See the receiver section for more information on this subject.

- Next step is to select the ***'General Config'*** menu:

Radio Function:
Select 'TRANSMIT' when to get the 'Radio Tide Transmitting Station' operation mode.
Select 'RECEIVE' when the 'Radio Tide Receiving Station' mode is required.

Logging Interval:
Sets the interval between two successive writing operations to the internal memory.
The logged information is date, time, radio code of the transmitting station or radio code of the primary received station and last measured tide (in case of a transmitting station) or last received tide (in case of a receiving station)
The shortest interval is one second, the longest is 900s.

Averaging Interval:
Defines how many samples are used to calculate an average.
The minimum is one, the maximum 900

Baud rate:
A serial port is available at the back panel of the MTU821-D-VT or at the left side of the MTU821-W-VT. The label is 'RS232 Serial Port'. This port may be used to send received tide information to an external device in format A, B or C (see below).
The same port is used to dump the logged data. The MTU supports high data rates, so dump time can be shortened dramatically.
Supported baud rates are 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200 baud.

Serial Format:
The serial format is A, B, or C:
When the active mode is 'Radio Tide Transmitter Station' then the MTU821 will sent information about the last measured tide through the serial port.

When the active mode is 'Radio Tide Receiver Station', the MTU821 sends tide information about the primary station to the serial port (format A and B) and tide information about both primary and secondary stations when format C is selected.

Output format A:

The MTU821 'Radio Tide Receiving Station' serial output consists of the radio code and tide.

A+05.43<CR><LF>

Output format B:

The MTU receiver serial output is data& time, followed by radio code and tide.

08/01/98 17:40:12 A+05.43<CR><LF>

Output format C:

The last received tide of primary and secondary stations is sent to the serial port. This mode is only available in 'Radio Tide Receiver Station'.

Auto Backlighting Enabled/Disabled

When Enabled, the LCD backlight is automatically shut-off when no panel operation was detected during some time. Rotating the panel control or pushing one of the panel keys will immediately result in backlight ON again.

Note that Auto Backlighting always is enabled in ‘Radio Tide Transmitter Station’ mode.

Radio Tide Transmitter Station Mode – Measuring the Tide.

The MTU821-x-VT Radio Tide Station offers the choice out of four transducers:

1. Analog 0-20 mA
2. Analog 4-20 mA
3. Digital
4. Serial

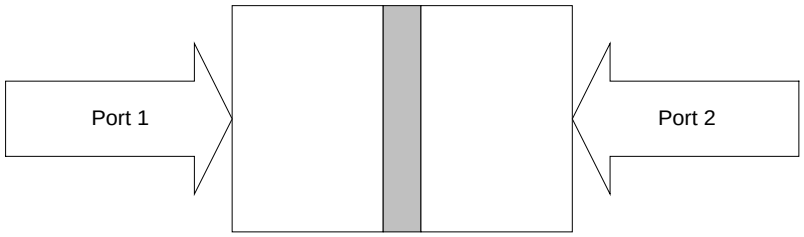
Selection 4, 'Serial', will not be discussed here, because it's not supported in the standard version of the Radio Tide Station.

The MTU821 is configured to calculate the tide out of a pressure transducer output signal. The pressure transducers may offer an analog output signal or may output the pressure value as a digital data stream.
Anyhow, a pressure transducer is required.

Besides the output signal, pressure transducers may distinguish as 'absolute pressure transducer' or 'gauge pressure transducer'.
The MTU821 offers a selection parameter 'Atmospheric Compensation' to deal with both transducer types.

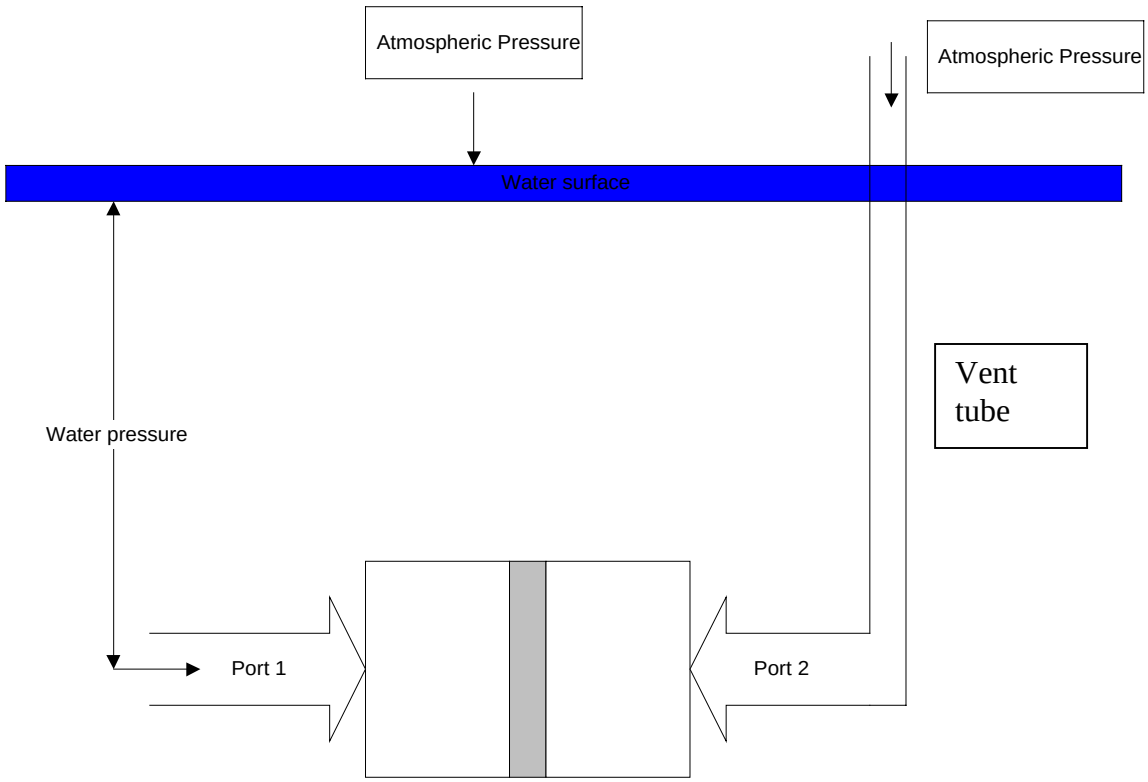
How do pressure transducers work?

All pressure transducers provide two measuring ports: port 1 and port 2



The deflection of the separation wall between both ports is proportional to the pressure difference (P1 – P2) and is transformed into an electrical signal, which then also is proportional to the pressure difference (P1-P2).

Gauge pressure transducers have a vent tube connected to Port 2. This vent tube raised above the water surface, making the pressure at port 2 equal to the atmospheric pressure (local barometric pressure) above the water surface.
Port 1 is connected to the water.



P1 = water column pressure + atmospheric pressure

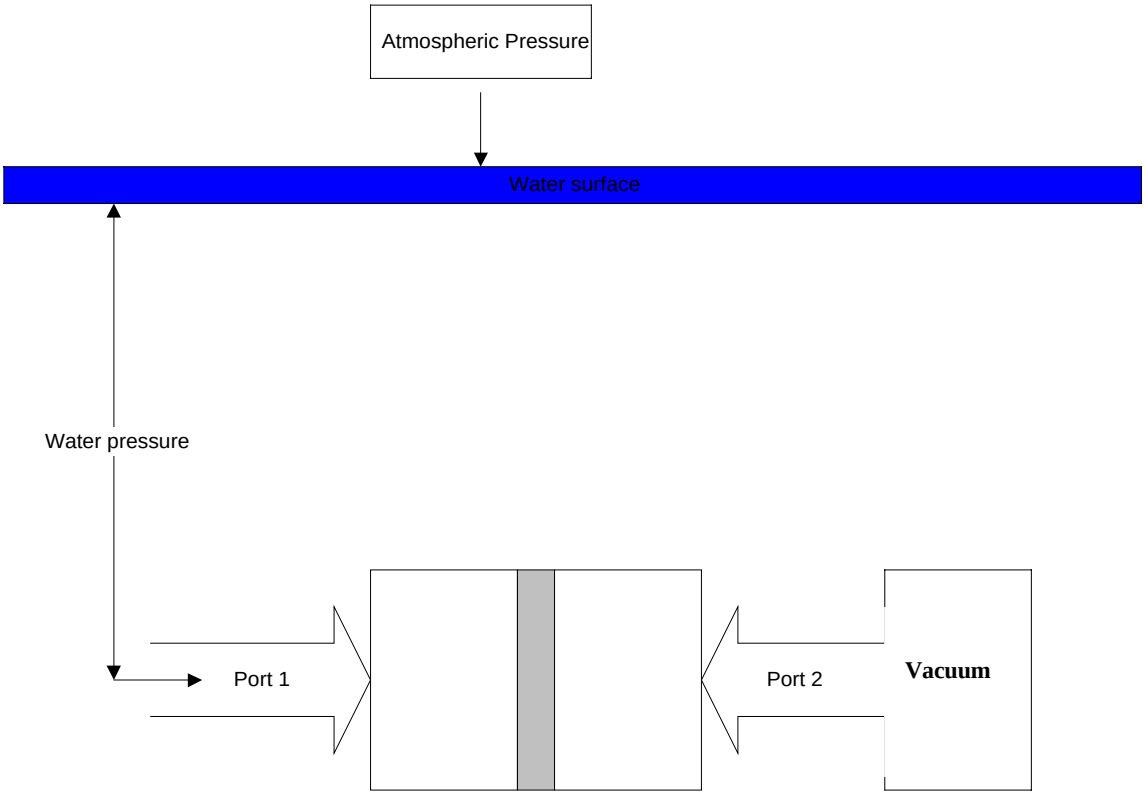
P2 = atmospheric pressure sensed at port 2 via the vent tube

Pressure measure by the gauge pressure transducer P = P1 – P2
= water column pressure

Pressure P is proportional to the height of the water surface above the pressure transducer's port 2.

Set 'Atmospheric Pressure Compensation' selector to NO when using a vented gauge pressure transducer.

Absolute pressure transducers have port 2 connected to a vacuum chamber.
Port 2 is connected to the water.



P1 = water column pressure + atmospheric pressure

P2 = zero pressure (vacuum)

Pressure measure by the gauge pressure transducer P = P1 – P2
= water column press.+ atm. press.

The pressure transducers outputs a signal which is proportional to the height of the water surface above port 1 plus the atmospheric pressure.
A second absolute pressure transducer measures the atmospheric pressure (local barometric pressure). This pressure transducer is integrated in the MTU-821 electronics. The firmware calculates the difference between both pressure transducer signals and the result is a value proportional to the height of the water column.

Set ‘Atmospheric Pressure Compensation’ selector to YES when using absolute pressure transducers.

Pressure Range

What is called in the MTU821 menu the ***'Pressure Range'*** is the measurement range of the pressure transducer.

Pressure is expressed in Bar, in kg/cm2, in PSI, in mWC (meter Water Column), etc. Pressure transducer manufacturers use often PSI, Bar of kg/cm2 to indicate the pressure range of their products.
In our application, we are interested in the height of the water surface above the pressure sensor, so we use the unit mWC (meter Water Column)

To convert kg/cm2 into Bar → multiply by 0.9804
To convert PSI into Bar → multiply by 0.06893

In pure water, following statement is valid: **1 kg/cm2 = 10.0 mWC**

With reasonable accuracy we can say that 1 bar = 1 kg/cm2 = 15 PSI

Keep also in mind that 1 bar = 1000 mBar = 1000 hPa.

Now again the *'vented gauge pressure transducer'* and *absolute pressure transducer* :

Vented gauge pressure transducer:

- Assume the pressure transducer has a measurement range of 1.5 kg/cm2: this means the transducer will measure pressures ranging from zero to 1.5 kg/cm2 or 0 to 15 mWC (meter Water Column).
- The output of the pressure transducer is (as explained above) proportional to the height of the water column above the sensor. No barometric compensation is required, since a vent tube is used.
- The transmitter configuration menu must be set as follows:
  - Pressure range: 15.00 meter
  - Atmospheric compensation: NO

Absolute pressure transducer:

- Assume a pressure transducer with a measurement range of 2.5 kg/cm2: the transducer will be capable to measure pressures between zero and 2.5 kg/cm2.
  Since 1 kg/cm2 = 10 mWC, the working range of this transducer is zero to 25 mWC **absolute pressure** (compared to vacuum!)
- The output of an absolute pressure transducer is proportional to the height of the water surface above the sensor + the atmospheric pressure.
  The atmospheric pressure varies between 960 and 1060 mBar (or hecto-Pascal). This corresponds to 9.60 to 10.60 mWC!
  This means that the maximum height of the water surface this absolute

pressure transducer is capable to measure varies with the atmospheric pressure (15.4 to 14.4 m)!

- The transmitter configuration must be set as follows:
  - Pressure range: 20.00 meter
  - Atmospheric compensation: YES

Adjusting the Atmospheric Compensation

The MTU821's internal pressure transducer is a stable barometric sensor.
A difference may exist between the atmospheric pressure as measured by the MTU821 and the local barometric pressure.

Proceed as follows to adjust this difference:

- Press MENU → Diagnostics → Atmospheric Pressure Check
- The LCD display will show the message 'Press <ENTER> to read the Atmospheric Pressure'.
- After pressing the <ENTER> key, the atmospheric pressure as measured by the MTU821 will be displayed, e.g.:
  `Transducer value:  1015 mBar`
- Assuming the local weather office reports a barometric pressure of 1017 mBar, then input 1015 in the 'Corrected Value' window:
  `Corrected value:  1017 mBar`

The MTU821 will offset now the measured atmospheric pressure by 2 mBar to obtain the correct local barometric pressure.

Sensor type:

Pressure transducers may be analog or digital.
The MTU821 was designed to deal with current output analog pressure transducers with an output range of either 0 to 20 or 4 to 20 mA.

a. With the first type of analog transducer, measured pressure = zero corresponds to an output of zero mA while measured pressure = pressure range corresponds to 20 mA output current
b. The second type of analog transducers uses a 'live zero': measured pressure = 0 corresponds with 4 mA output current while measured pressure = pressure range corresponds with 20 mA.
   Zero output current means the transducer wires are broken.

A digital pressure transducer transmits a data stream to the MTU821 after each information request. Connect only MGB-Tech approved transducer to the MTU821.

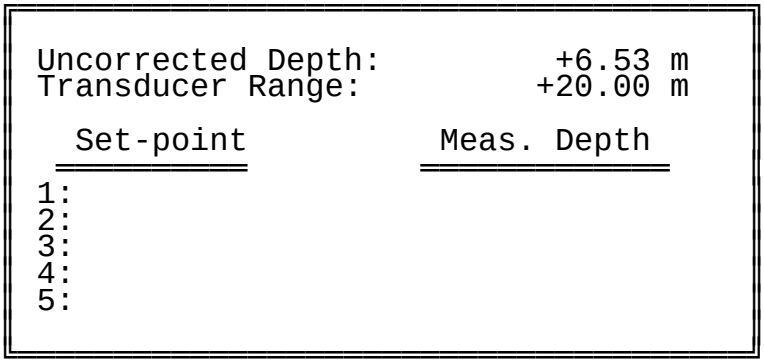
The serial transducer selection is only available with some firmware versions.

Both analog and digital transducers may be of the 'vented gauge pressure' or 'absolute pressure' type.

Calibration:

The relation 1kg/cm2 = 10.00 mWC is only valid for pure water at a temperature of about 20°C.
Salt water and water pollution have a serious impact on the water density and hence on the relation between water height and measured pressure.

The MTU821 allows on-site calibration. Press <MENU> → Calibration Screen to get access to the calibration menu.
The MTU821 will display the calibration screen:



Uncorrected Depth:

- Vented gauge pressure transducers: this is the output value of the pressure transducer converter to mWC
- Absolute pressure transducers: this is the output value of the pressure transducer minus the local barometric pressure (parameter 'Atmospheric Compensation' = YES) and the result converted to mWC
- To ease calibration, this 'Uncorrected Depth' value is heavily filtered. It will take about 20 seconds to stabilize.

Transducer Range:

- This is the 'Sensor Range' from the 'Transmitter Configuration' menu

Set-point:

- This is the distance between pressure transducer and water surface as measured with a mechanical gauge.

Measured Depth:

- This becomes the 'Uncorrected Depth' at that particular set-point

Hang down the transducer at depths ranging from close to surface (but no less than 0.5m) up to maximum expected tide span. Allow the time to stabilize (see Uncorrected Depth) and note Set-point and Measured Value in the appropriate row and column.

Interpolation Zones

The table provides sic interpolation zones: 0m to set-point 1, set-point 1 to set-point2, etc., with the sixth zone from set-point 5 to Transducer Range.
A correction factor is calculated for each of the interpolation zones, and this correction factor is used by the firmware to calculate the correct transducer depth.

Incomplete Table

The table may remain empty. In that case no correction calculation will be performed.
Also, it is not necessary to fill the calibration table completely: 3 correction zones instead of 6 will be generated when only 2 fields with set-point and measured depth are available.

Incorrect entries

- A zero entry is not accepted
- Set-point values must be entered in increasing order
- Set-point must be lower than the 'Pressure Range' of the transducer
- Measured Depth values must also be entered in increasing order (which corresponds to normal behaviour of the pressure transducer).
- The Measured Depth value must be lower then the 'Pressure Range' of the transducer.

Accuracy

Handle as follows to obtain optimal accuracy:

- Set-point 1 about 0.5 m below water surface
- Set-point 5 as close as possible to the maximum expected tide variation (this implies that calibration is done at high tide)
- Set-points 2,3, and 4 evenly spread over the span covered by (set-point 5 – set-point 1)
- Allow sufficient time to stabilize the reading after moving the transducer to next set-point

Offset To Tide

This parameter in the 'Transmitter Configuration' menu allows to link the local depth reading to some reference depth in use at or close to your site.

Tide = Local **Measured Depth** (corrected conf. calibration table) + **Offset To Tide**

Radio Tide Receiver Station Mode – Receiving Tide Information from Radio Tide Transmitting Stations.

Several 'Radio Tide Transmitter Stations' may be active on the same channel (frequency) on condition each of them is allocated a different 'Radio Code'.
The 'Radio Tide Receiver Station' uses this 'Radio Code' to distinguish between the received transmitter stations.

Primary Station
Not all information of the 'Radio Tide Transmitting Station' sharing the same frequency is of equal importance. The most important station will be selected as *'Primary Station'*.
This is doen in the 'Select Station' Menu.
The primary station's tide information is displayed in large font on the LCD display.

Secundary Stations
Information of other Radio Tide Transmitting Stations may be useful, and it is handy for a navigating vessel to check if a particular transmitter station comes in range.
Up to four Radio Tide Transmitting Stations can be selected as 'Secundary Stations'.
The information received from secondary stations is displayed in small font on the LCD.

Go to the 'Station List' menu to get the list of transmitter stations. Set the parameter 'Show' to YES for those stations selected as secondary station.

Same transmitter station as primary as well as secondary station
It is allowed to select the same Radio Tide Transmitter Station (same 'Radio Code') as primary station as well as secondary station. This may be useful, because more stringent tests are performed on information received from a primary station. In fringe areas, the secondary station information may be quicker available on the display than information received from the same station but handled as primary station.

Age of data
An 'Age of Data' check is performed on messages received from ***ALL*** Radio Tide Transmitter Stations (either primary, secondary, or not selected).
Tide information will be erased when no fresh information is received from a particular transmitter station within the 'Age of Date' time span.

Go to the 'Station List' menu to get the list of transmitter stations. Select the required 'Age of Data' in the 'Life' column.
Available selections are 1 to 90 seconds and 2 to 60 minutes.
The default value is 60 s.

Note that the 'Age of Date' parameter selected in this menu applies to both the primary and secondary station with the same 'Radio Code'.

Averaging Interval
Normally, average calculation will be performed by the 'Radio Tide Transmitter Station'. This is always the case with our MTU821 Radio Tide Stations.
If the transmitter station doesn't provide this facility, then average calculation may be done at the receiver side.

Go to the 'Station List' menu to get the list of transmitter stations. Go to the 'Average' column and set the selection box to 'YES' for those stations needing average calculation at the receiver side.

The default setting for all stations is NO.

Voltage information
MTU821-D-VT and MTY821-W-VT Radio Tide Transmitter Stations offer the possibility to transmit the supply voltage of the data-acquisition board inside the MTU, together with the tide information:

- Received voltage between 14.6 and 15.2 VDC: the transmitter station is operation on the AC mains supply.
- Received voltage between 12.8 and 14.5 VDC: the transmitter station operates on battery power and is charged by solar energy.
- Received voltage below 12.8 VDC: the transmitter station operates on battery power. No charging from solar power when the received voltage remains decreasing. When the received voltage increases slowly, then the battery is charged by solar power but the battery has been deeply discharged.

Notes:
A watchdog circuit will shut-off the Radio Tide Station when battery voltage becomes too low.
It is not possible to check the battery status at the receiver side when for transmitter stations operating on AC power.

Diagnostics Menu.

Analog Output Check

Left column -→
Shows the tide.
This is also an indication of the volage available at the analog output connector, since a tide range of –10.00 to +20.00 corresponds to an analog output voltage of –1.00 to +2.00 V.
Right column -→
Shows the analog voltage available at the output of the D/A converter.
The relation between DAC voltage and analog output voltage is:
Analog Output Voltage = (DAC Output Voltage *2) –2.5

Rotate the panel control or pushing left/right arrow keys to change this analog output.
Return to the tide proportional analog output by pushing <ENTER>

Transducer Check

Left column -→
Shows the current output of the analog pressure transducer.
Discard this value when the digital or serial transducer is selected
Right column -→
Uncorrected pressure transducer output converter to mWC

Radio TX Check

Permits to switch the transmitter 'ON' for a 30 seconds time period.

Radio RX Check

Not yet implemented

RS232 Check

Shows the messages sent by the MTU821 to the RS232 serial port.

Hardware.

Hardware set-up

The MTU821-D-VT and MTU821-W-VT Radio Tide Stations consist of 6 units:

1. AM61AD Acquisition board AM61AD
2. Communication module with LDC display, processor board and communication interface
3. Charge controller unit and power source selector board
4. Synthesized UHF Radio (tranmitter/receiver)
5. Switched-mode power supply unit, 176-264 VAC/47-63 Hz
6. Sealed Lead-Acid battery 12V/7.5Ah

Connectors

The connectors on the MTU821-D-VT are located at the back panel of the 19-inch case.
The connectors on the MTU821-W-VT are located at the left side of the instrument.

Label	Pin	Function	Mating Connector or lead color
MAINS 176-264VAC	L	AC (hot)	Schuko AC Mains Plug
	N	ACC (cold or neutral)	
	E	Earth	
SOLAR PANEL	+	Positive terminal	Brown (+)
	-	Negative terminal	Blue (-)
RS232 SERIAL PORT			9-pos. female sub-D. cable connector (**DCE** configuration) Connects 1/1 to male serial port connector on PC (**PC=DTE**)
	1	Signal Ground	Pin 5
	2	Data Out	Pin 2 (RxD)
	3	Data In (to MTU)	Pin 3 (TxD)
	4	Handshake Input	Pin 4 (DTR)
	5	Handshake Output	Pin 8 (CTS)
	6	N.C.	--
ANALOG OUTPUT	1	Live terminal	Brown (+)
	2	Analog ground	Blue (-)

Label	Pin	Function	Mating Connector or lead color
EF1	1	Data In	9-pos. female sub-D. cable connector (**DCE** configuration) Connects 1/1 to male serial port connector on PC (**PC= DTE**) Pin 3 (TxD)
	2	Data Out	Pin 2 (RxD)
	3	Handshake Input	Pin 4 (DTR)
	4	Handshake Output	Pin 8 (CTS)
	5	Signal Ground	Pin 5
	6	N.C.	--
EF2	-	Not used	---
TIDE GAUGE	1	Analog Transducer Positive Output Terminal	See pressure transducer information
	2	Analog Transducer Return Terminal (connected to analog ground in MTU)	
	3	Trigger -	
	4	Trigger +	
	5	Data -	
	6	Data +	
	7	Ground	
	8	Positive Transducer Supply	
	9	N.C.	