

# User Guide

QL40 FWS-S – Full Waveform Sonic





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# 1 General Information

The ALT QL40 full waveform sonic tool (QL40 FWSS) is mainly dedicated for the water, mining and geo-technical industries. Its specification makes it ideal for cased-hole, open-hole applications and also to carry out fractures identification.

Sonic logs are widely used, often in combination with other logs, to provide porosity, permeability and geo-mechanical properties of the rocks. Under suitable borehole conditions and formations, Compressional (P), Shear (S), Stoneley and Tube wave arrivals can be detected.

The QL40 FWSS tool is optimized for such purpose. It implements a high energy source generated by a ceramic-piezoelectric transducer which excites the formations. Real time display and analysis of the full wave form are performed by the tool to enhance the picking of the different wave propagation modes.

The QL40 FWSS tool is supplied as a bottom sub of the Quick Link (QL) product line and can be combined with other QL40 tools to form a tool string or it can be run as a standalone tool.

The tool can only be operated in a fluid-filled hole. Logging speed depends on tool configuration and acquisition parameters.

## **Applications:**

- Cased-hole:
  - Cement bond logging (CBL)
- Open-hole:
  - Porosity and permeability
  - Lithology identification
  - Variation of rock strength
  - Elastic moduli
  - Indication of fractures and formation permeability in hard rocks

1.1 Dimensions

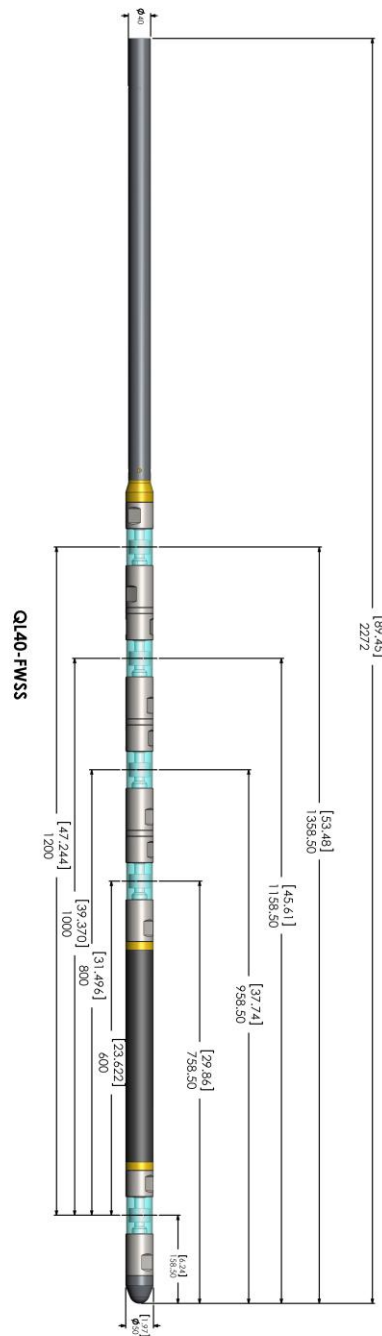


Figure 1-1 QL40 FWSSS dimensions

## 1.2 Technical Specification

### Tool

Diameter: Max 50mm  
Length: Standard configuration: 2.27m (89.45")  
1TX – 4RX @ 0.2m (7.87") RX separation

Measurement point: Transmitter location  
Max. Temp: 70°C  
Max.Pressure: 200bar  
Operating frequency: 15 KHz

### Cable:

Cable type: Mono, Coaxial, 4 or 7 conductor  
Digital data transmission: Up to 500 Kbits per second depending on wireline  
Compatibility: ALTLogger – BBOX – Matrix – SCOUT – SCOUT PRO -  
OPAL

### Sensors:

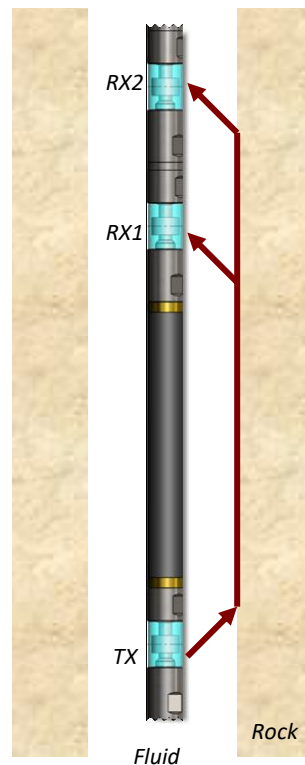
Transducers: Ceramic piezoelectric with 15 KHz resonant frequency  
Sonic Wave Sampling Rate: Normal Mode: 4  $\mu$ s  
Extended Mode: 20  $\mu$ s  
Sonic Wave Dynamic Range: 16 bits  
Sonic Wave Sample Length: Normal Mode: up to 4 ms  
Extended Mode: up to 16 ms



## 2 Measurement Principle

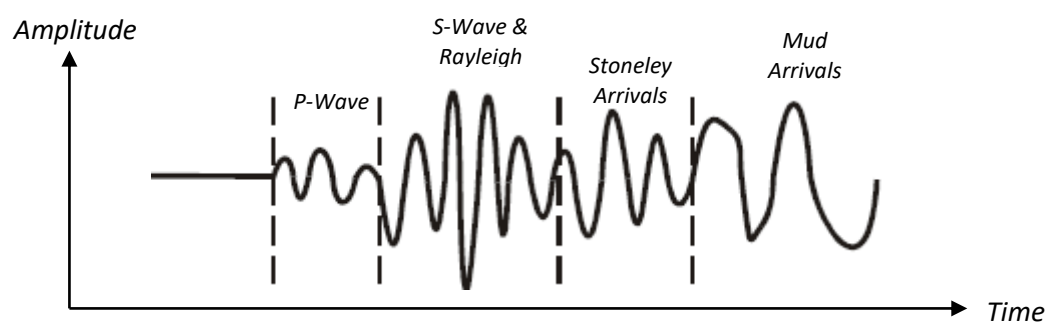
The QL40 FWSS tool measures the time it takes for a sound pulse to travel from a piezo electric transmitter to a receiver at a defined distance. Transmitter and receiver are mounted on the same tool. The acoustic pulse generated by the transducer travels through borehole fluid and rock in various different forms while undergoing dispersion and attenuation.

When part of the energy of the emitted sound pulse arrives at a receiver it does so at different times in form of different types of waves (**Figure 2-1**).



**Figure 2-1** Typical wave path for a 1 transmitter and 2 receiver tool

Usually it is the compressional wave (P-wave) that travelled through the rock (or pipe) that arrives first followed by shear waves (S-wave), Rayleigh, Stoneley and mud waves. **Figure 2-2** shows a typical sonic trace with received wave forms.



**Figure 2-2** Typical sonic trace with wave form arrivals

The P-wave is usually the fastest wave but has small amplitudes. The next wave to arrive is the S-wave, which is slower than the P-wave but usually has higher amplitudes. After them come Rayleigh and Stoneley waves, which are associated with energy moving along the borehole wall. The last arrival (mud wave) is a pressure wave that travels through the borehole fluid in the borehole. They can be of high amplitude but always arrive after the two main waves – P- and S-wave.

In cased wells, common application of the sonic tool is the measurement of the degree of cementation of steel casing. It is generally called “Cement Bond Logging”. It is often important to know how much cement is present in the annulus between casing and formation. The sonic tool is used to measure whether there is cement in contact with the outside of the casing and whether that cement is in contact with the formation. This can be achieved by measuring the amplitude of the first compressional arrival. Just one transmitter and one receiver is needed for this. The amplitude of the first arrival is linked to the amount of cement bonded to the casing. If there is no cement outside the casing, the sonic wave will travel almost entirely through the casing and return to the receiver with a high amplitude. If there is good, solid cement outside the casing, a large proportion of the sonic wave will be refracted into the cement and formation. The amount of energy returning to the receiver will be less and is corresponding to a low amplitude of the first compressional arrival.

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## 3 Operating Procedure

### 3.1 Tool setup and handling

**Note on centralisers : Tool centralization is mandatory for Cement Bond application. For open hole application, tool centralization is strongly recommended as it helps the detection of the different wave propagation modes.**

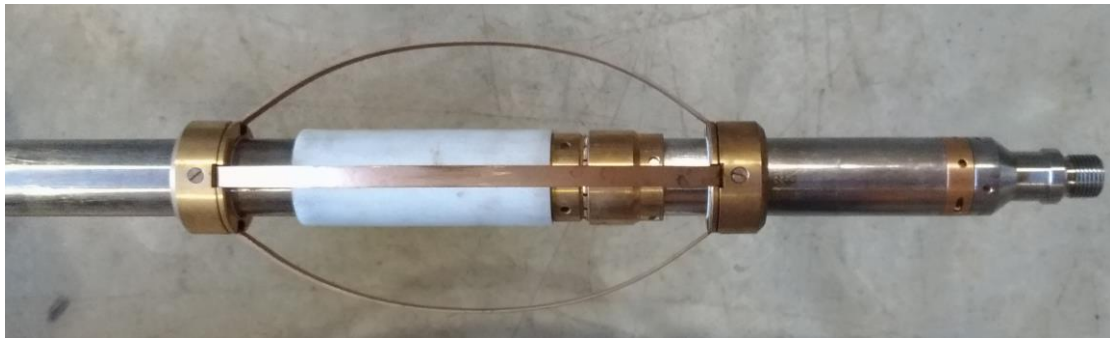
One set of slip over centralisers (ALT26705) is supplied with the tool.

The standard assembly comprises upper and lower mounting rings with sets of bowsprings for different borehole diameters, a locking ring and sleeve. The mounting rings are equipped with a teflon ring in order to eliminate the road noise caused by the friction of the centralisers against the borehole wall.

Two C spanners are also provided for tightening the locking ring.

The following points relating to the use of centralisers should be considered:

The top centraliser should be fitted before mating the tool with the wireline cable head. One centraliser should be placed at the top of the tool. By the use of optional accessories (Aluminum Extension Bar - Q40BOT-0005 and Lower Adaptor for Extension Bar – Q40BOT-0009) a second centraliser could be placed at the bottom of the QL40-FWS-S to optimize the tool centralization.



*Top centraliser assembly*



*Bottom centraliser assembly*

Use the C spanner to fasten the locking ring but take care not to cross thread or over tighten them.

(The weak point of the bowsprings is the welded bearing pin. Take care during assembly as the weld can be broken by reverse bending.)

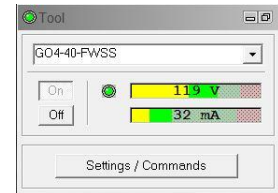
**Note on tool handling :** when the QL40-FWS is stacked with other subs, special care should be taken when handling the tool string. On the rig site, it is recommended to lift the tool string using the logging wireline. During this operation, care should be taken and operator must avoid to apply too much flexion on the spacer section of the QL40-FWS.

## 3.2 Quick Start

**Note:** Parts of the topics discussed in these sections below assume that the user is familiar with the LoggerSuite acquisition software. Refer to the corresponding operator manuals for more details. Information about assembly and configuration of tool stacks can be found in the same manuals.

1. Connect the QL40 FWSS to your wireline and start the data acquisition software.

2. Select the relevant QL40 FWSS tool from the drop down list (**Figure 3-1**) in the software's **Tool** panel (if your tool is not listed check that your tool configuration file is stored in the designated folder on your computer).



**Figure 3-1** Tool panel

3. In the **Tool** panel switch on the tool (click **On** button) and verify that the power indicator shows a valid (green) level. The system goes through a short initialization sequence which sets the default parameters and communication settings. The configuration returned by the tool is also checked during this procedure. Setup tool communication as explained in chapter **3.2** and **3.3** if error message is displayed)
4. On the **Tool** panel (**Figure 3-1**) click the **Settings / Commands** button to configure your tool. (see chapter **3.4** for details).

5. In the **Acquisition** panel (**Figure 3-2**) select the sampling mode (depth or time). Click on **Settings** and specify the corresponding sampling rate. Switch on the sampling (click the **ON** button).

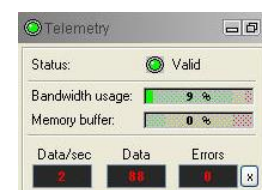


**Figure 3-2** Acquisition panel

6. Press the **Record** button in the **Acquisition** panel (**Figure 3-3**), specify a file name and start the logging.

7. During logging observe the controls in the **Telemetry** panel:

- Status must be valid (green light);
- Bandwidth usage in green range;
- Memory buffer should be 0%;
- Number of **Data** increases and number of **Errors** negligible.

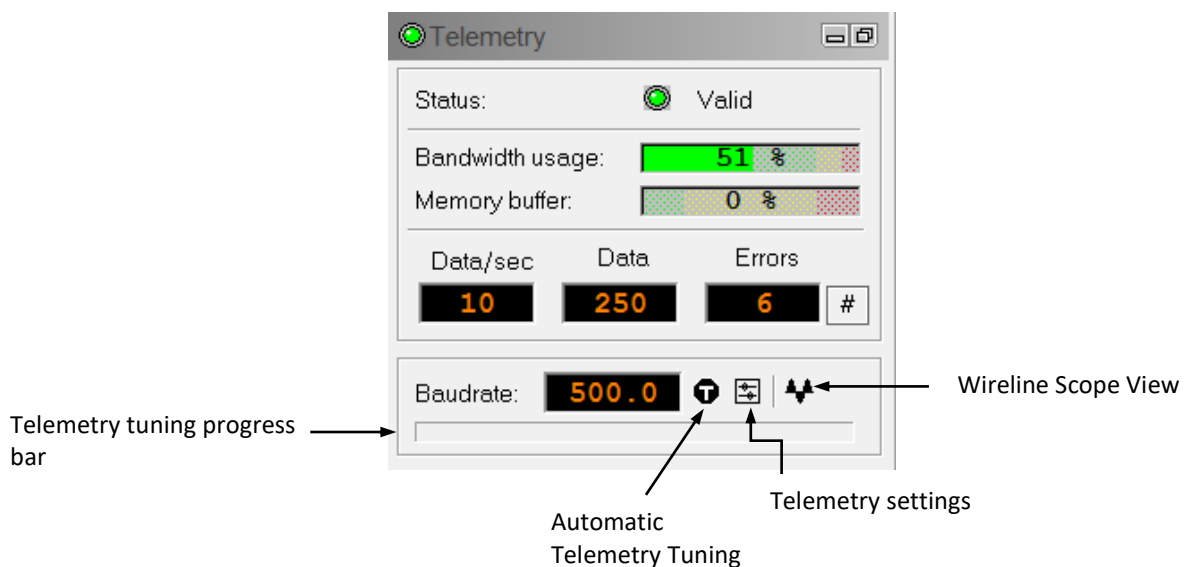


**Figure 3-3** Telemetry panel

8. To end the logging procedure press the **Stop** button in the **Acquisition** panel and turn off the sampling (click **OFF** button).
9. In the **Tool** panel power off the tool.

### 3.3 Tool Communication with OPAL/SCOUT (ALT MODEM)


The telemetry provided through the **OPAL-SCOUT** systems implementing the **ALT MODEM** controls and configures **AUTOMATICALLY** the telemetry settings for any wireline. In case communication status is not valid the user has different options to adjust manually the telemetry settings from the telemetry panel of the dashboard:



#### **Baud rate:**

Indicates the default baud rate or optimal baud rate in kbps found by the system for the selected winch/telemetry scheme

#### **Automatic Telemetry Tuning:**

The Tune button  resets the telemetry tuning automatically. This process defines:

- the optimum baud rate for the winch configuration selected
- a transfer function and a filter to re-construct at the surface the shape of the pulse trains distorted by the wireline.

A **progress bar** at the bottom of the telemetry window shows the progression of the telemetry tuning. At the end of the process the baud rate display is refreshed with the optimal baud rate value.

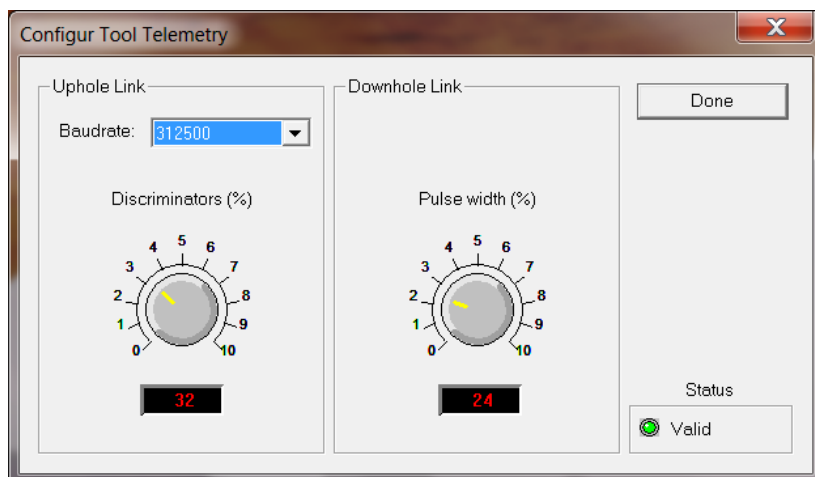
Refer to **Appendix** at the end of this manual for more information on the **advanced telemetry settings**.

### 3.4 Tool Communication with ALT Logger

The telemetry provided through the ALTLogger is self-tuning. In case communication status is not valid the user can manually adjust the settings. In the **Telemetry** panel of the dashboard click on **Settings** to display the **Configure Tool Telemetry** dialog box (**Figure 3-4**).

A procedure to achieve valid communication is given below:

- Change the **Baudrate** to 41666 kbps.
- Verify that the **Downhole Pulse width** knob is set on 20 (default value). This value is the preferred one and is suitable for a wide range of wirelines. For long wireline (over 2000m), increasing the pulse width could help to stabilize the communication. The reverse for short wireline (less than 500m).
- Set the **Uphole** discriminators in the middle of the range for which the communication status stays valid.
- Increase the **Baudrate**, check the communication status stays valid and the **Bandwidth usage** (in **Telemetry** panel of the dashboard) is below the critical level.
- When **Uphole** discriminators are properly set, store the new configuration as default. The tool should go through the initialization sequence the next time it is turned on.



**Figure 3-4** Tool communication settings

### 3.5 Tool Communication with MATRIX

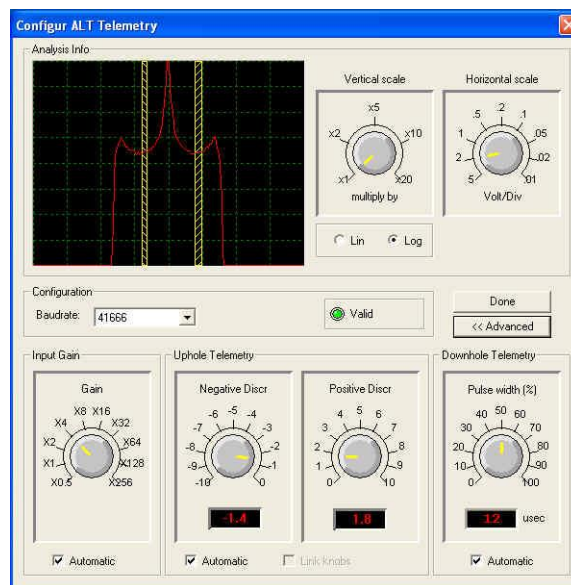
The tool telemetry can be configured through the **Telemetry** panel of the Matrix dashboard. By clicking on **Settings**, the operator has access to the **Configure ALT Telemetry** dialog box (**Figure 3-5**) providing various controls to adjust the telemetry settings and monitor its current status.

The **Analysis View** displays the current discriminator levels (vertical yellow lines) and a histogram of the up-hole data signal. The scales of the **Analysis View** can be adjusted using the **Vertical Scale** and **Horizontal Scale** knobs and the **linear / logarithmic** scale buttons. The status of the configuration should be flagged as Valid (indicated by the LED being green). In any other case (LED red) the telemetry should be adjusted (we assume a pulse signal

is displayed in the analysis view). Click on the **Advanced** button to display additional controls to tune the telemetry.

The Automatic settings option is the preferred mode and should allow the telemetry to be configured for a wide range of wirelines without operator input. For wirelines with a more limited bandwidth, the operator might need to turn off the automatic mode and adjust the telemetry settings manually.

For each wireline configuration, the discriminators (vertical yellow lines) for the **positive** and **negative** pulses must be adjusted in order to obtain a valid communication status (see **Figure 3-5** for an example of a suitable discriminator position). There is also the option to alter the **baudrate** in order to optimize the logging speed. The input **gain** can be increased (long wirelines) or decreased (short wirelines) in order to set up the discriminator levels correctly.



**Figure 3-5** Matrix telemetry settings

Once the telemetry is correctly set, store the new settings as default. The tool should go through the initialization sequence in “Valid” status the next time the power is turned on.

## 3.6 Configuring Tool Parameters

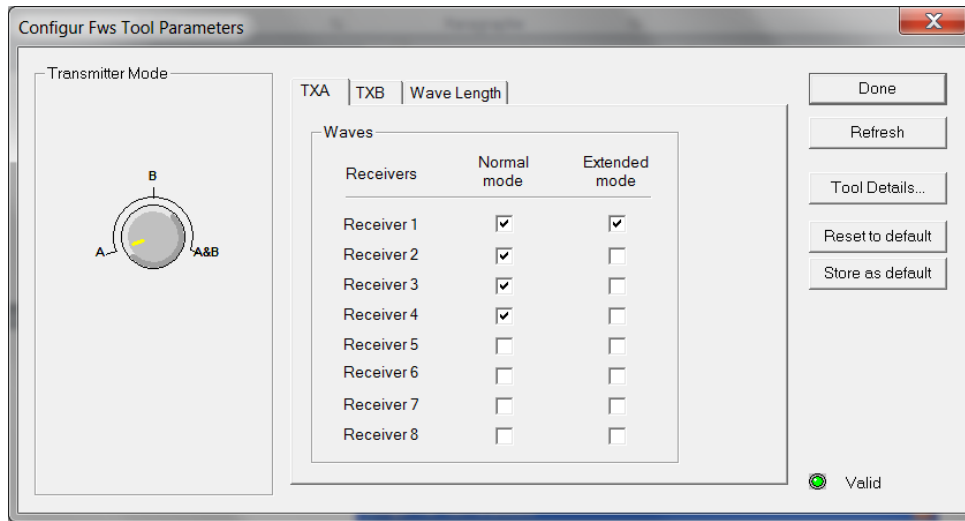
The **Configure FWS Tool Parameters** dialog box (**Figure 3-6**) can be accessed by clicking on the **Settings / Command** button on the dashboard’s **Tool** panel (**Figure 3-1**).

### 3.6.1 Transmitter Selection

If your FWS tool is fitted with two transmitters you can choose to operate only one transmitter or both by turning the Transmitter Mode knob (**Figure 3-6**). Turn it to position A or B to operate only a single transmitter or set it to A & B to fire both transmitters in alternance. Transmitter A is the one located closest to the bottom of the tool.

### 3.6.2 Receiver Selection

The Configure FWS Tool dialog box provides two tabs – TXA and TXB - to choose the receivers to be used with each transmitter. With each transmitter the maximum number of receivers available on the tool can be used.



**Figure 3-6** Receiver Selection per transmitter

Receivers can be operated in different modes:

**Normal Mode:** A receiver in **Normal** mode samples the received sonic signal in 4  $\mu$ s steps up to the maximum recording time specified in the Wave Length tab (see section 3.4.3).

**Extended Mode:** One receiver can be chosen to operate in **Extended** mode. The selected receiver will sample the sonic trace in 20  $\mu$ s steps up to the maximum recording length. This might be useful when looking for reflected tube waves.

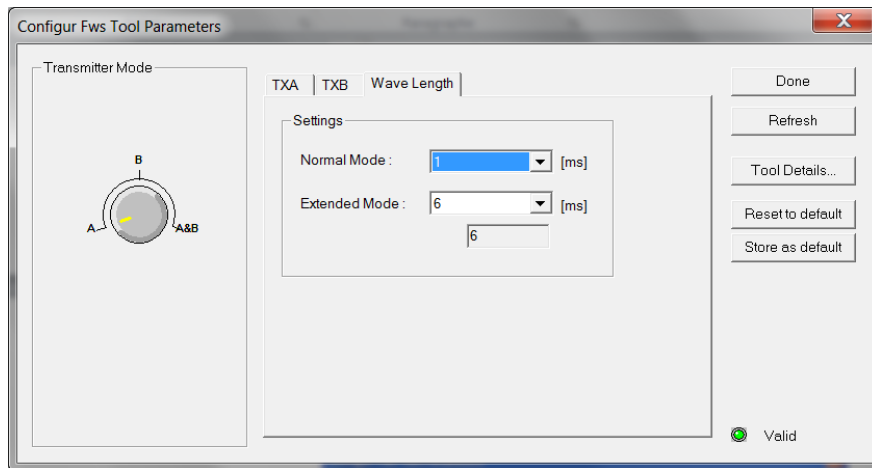
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**Note:** Only one receiver can be chosen for transmitter A and B to operate in **Extended** mode.

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### 3.6.3 Selecting the recording time

The third tab in the Configure FWS Tool dialog box – Wave Length (**Figure 3-7**) – allows the user to set the maximum recording time and hence the length of the recorded full waveform trace in Normal and Extended mode. A maximum length of 16 ms is possible in Extended mode.

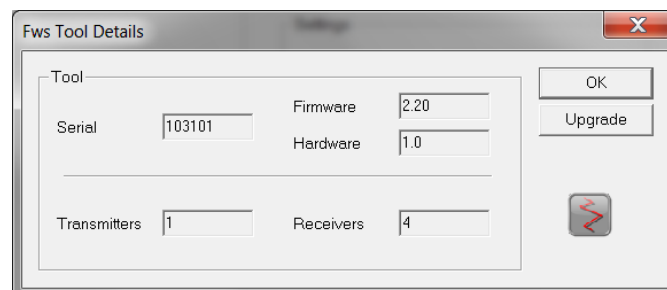


**Figure 3-7** Definition of recording time

Click on the **Store as default** button to save the new settings into the internal memory of the tool and make the default for future measurements.

### 3.6.4 Tool Details

Click the **Tool Details** button in the **Configure FWS Tool** dialog box to display a dialog box showing the tool's serial number, firmware and hardware versions, and the transmitter-receiver configuration (**Figure 3-8**). None of the items shown is editable.



**Figure 3-8** Tool Details displayed

## 3.7 Recorded Parameters, Processors and Browsers

The QL40 FWSS in combination with the **FwsProc** processor displays the fullwave form recorded on each receiver. It allows also to perform Dt picking of the first compressional wave arrival and cement bond analysis in real time.

### 3.7.1 Recorded parameters

The following data channels are recorded by the tool. Depending on the number of transmitters and receivers used the number and naming of the recorded data channels may vary.

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**Note:** None of the data channels recorded has been shifted in depth. The transmitter location is considered as measurement point.

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RX1-1A	Amplitudes of the sonic trace recorded at transmitter A and recorded at receiver 1 (Normal mode)
RX2-1A	Amplitudes of the sonic trace recorded at transmitter A and recorded at receiver 2 (Normal mode)
RX1-1B	Amplitudes of the sonic trace recorded at transmitter B and recorded at receiver 1 (Normal mode)
RX1-2A	Amplitudes of the sonic trace recorded at transmitter A and recorded at receiver 1 (Extended mode)
...	

The naming convention for the data channels is:

#### ***RXn-mT***

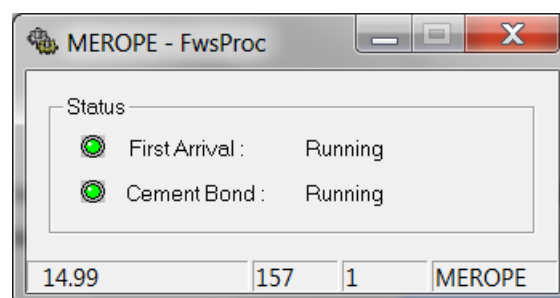
where *n* is the receiver number, *m* defines the receiver mode (1 : normal, 2 : extended) and *T* defines the transmitter which generated the wave (A or B).

Please note that additional data channels can be produced by the FwsProc processor. Please refer to the following chapter.

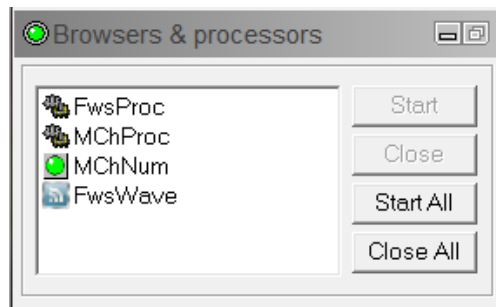
### **3.7.2 FwsProc Processor**

Processors perform real time operations on the recorded data. For the QL40 FWSS tool two processes are supported: picking of the First Arrival and Cement Bond log processing. The FwsProc window (**Figure 3-9**) informs about the running status of the processes.

If the processor window is not started automatically choose the **FwsProc** entry from the **Browser & processors** panel (**Figure 3-10**) and click on the **Start** button.



**Figure 3-9** FwsProc window



**Figure 3-10** Start the processor from the Browser & processors panel

To start or stop a process right click on the title bar of the FwsProc window and select the **Parameters** option from the context menu.

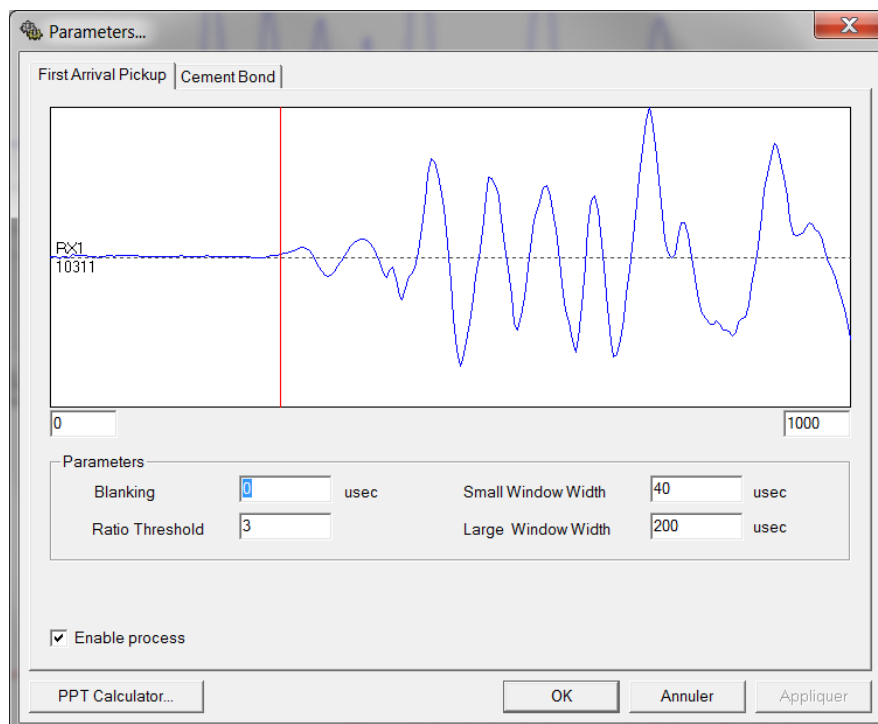
The **Parameters** dialog box will open providing a tab to adjust the processing parameters for each process (**Figure 3-11** and **Figure 3-13**).

### **First Arrival Pickup**

To start the **First Arrival Pickup** process, check the corresponding box in the lower left edge of the dialog box.

The preview window shows the recorded trace at the first receiver and the determined first arrival pick (red vertical line). The number displayed at the beginning of the trace is the maximum amplitude span found in the actual trace.

The first arrival time will be picked for each selected receiver and output as a data channel. The resulting data channels can be used in formulas to compute P-wave slowness and velocities.



**Figure 3-11** First Arrival Pickup process options

The process iterates through each trace in the time dimension. For each data point the average of the data values in a time window centered on the actual data point (Small Window = signal window) will be calculated. Another average value will be calculated from

RX1-1A - dt	First arrival pick (in $\mu\text{s}$ ) at receiver 1	the data
RX2-1A - dt	First arrival pick (in $\mu\text{s}$ ) at receiver 2	points
RX3-1A - dt	First arrival pick (in $\mu\text{s}$ ) at receiver 3	falling into
RX4-1A - dt	First arrival pick (in $\mu\text{s}$ ) at receiver 4	a time
Slowness	Difference of the dt (in $\mu\text{sec}$ ) of the first arrival picked on Rx2 and Rx1 divided by the receiver spacing (in m). The slowness derived is expressed in ( $\mu\text{sec}/\text{m}$ ).	window preceding the actual data

sample (Large Window = noise window). The ratio of small window average and large window average (signal to noise) will be compared against a user specified threshold value. The first time sample for which the computed signal to noise ratio exceeds the threshold will be considered as first arrival intercept.

$$\frac{\textit{Small Window Average}}{\textit{Large Window Average}} > \textit{Ratio Threshold}$$

### Blanking

In the edit box, enter the time period in micro-seconds for which the first arrival detection will be skipped. Using this option, you can blank out noise occurring in the beginning of the traces.

### Small Window Width

In the edit box, enter the Small Window time width in micro-seconds.

### Large Window Width

In the edit box, enter the Large Window time width in micro-seconds.

### Ratio Threshold

In the edit box, enter the Ratio Threshold value.

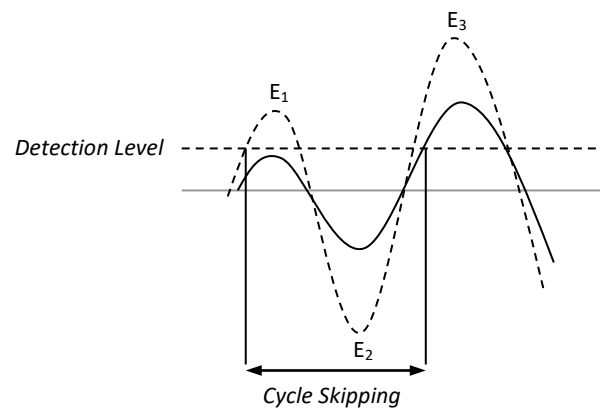
The following additional data channels will be created by the first arrival pickup process:

### Cement Bond

To start the Cement Bond process, check the corresponding box in the lower left edge of the dialog box.

If a FWS tool is run in borehole with cemented casing, the quality of the bond from casing to cement can be evaluated. The emitted acoustic signal travels through the casing, cement and formation before it reaches the receivers. The sonic waves travelling along the casing are attenuated when energy is lost to the environment behind the casing due to conversion of P- to S-waves, i.e. when the bond is good. As the compressional wave travelling through the casing is generally the first one to reach the near receiver, the Cement Bond Log is the recording of the amplitude of the first arrival of energy on the near receiver.

The first three peaks of the signal at the receiver are traditionally labeled  $E_1$ ,  $E_2$  and  $E_3$  (**Figure 3-12**).



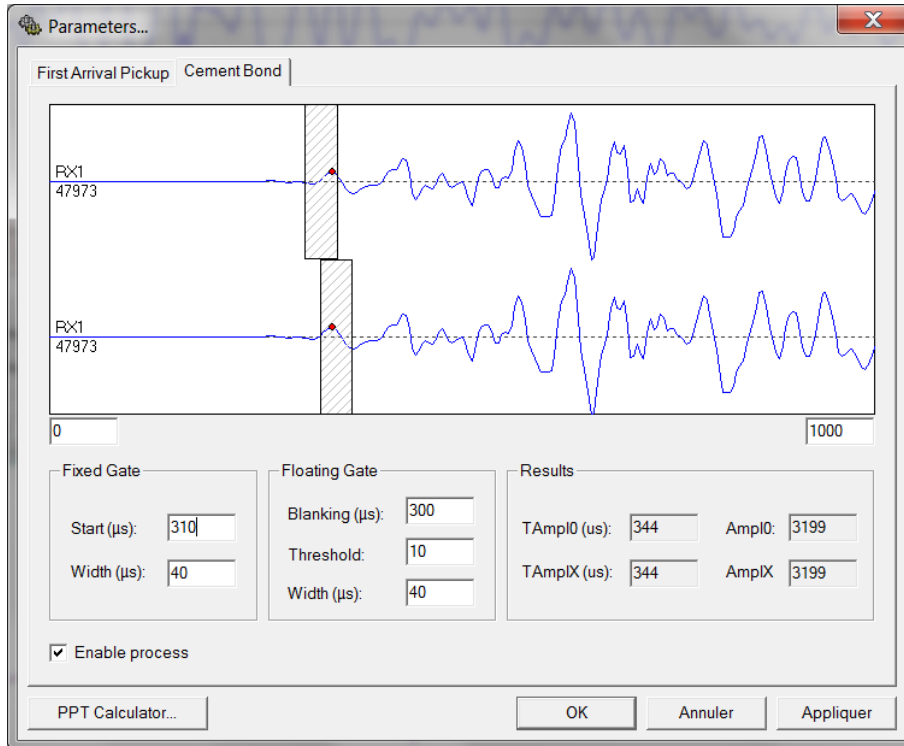
**Figure 3-12** Naming of signal peaks and principle of cycle skipping

It is the goal of the Cement Bond processing to extract the amplitude of the E1 peak, which leads to judgment of the cement bond quality (low amplitude = good bond, high amplitude = bad bond).

In the case when the bond leads to amplitudes of E<sub>1</sub> so low that they are below the detection level, the first arrival pick would be triggered by E<sub>3</sub> instead of E<sub>1</sub>. This is referred to as cycle skipping (**Figure 3-12**).

Two processes (**Fixed** and **Floating Gate**) will be run in parallel to extract the desired amplitude. In general the maximum amplitude within a time window (also referred to as gate) will be determined. The gate can be opened always at the same fixed time for all traces (**Fixed Gate**) or it can be opened at the time provided by a first arrival pick log (**Floating Gate**) – in the last case the starting time varies from trace to trace. If cycle skipping occurs the Fixed Gate method would return small amplitudes and the Floating Gate method high amplitudes, altogether indicating a very good bond (the E<sub>1</sub> amplitude was so low that the higher E<sub>3</sub> amplitude was detected by the Floating Gate method; **Figure 3-12**).

The Cement Bond options dialog box shows a preview of the sonic trace seen by the first receiver (**Figure 3-13**). The upper part of the preview shows the first receiver trace with the fixed gate start position and width as defined in the corresponding edit boxes. The lower part of the preview shows the trace with the Floating Gate configuration.



**Figure 3-13** Cement Bond processing option

**For the Fixed Gate configuration you can enter:**

**Start( $\mu$ s):** Starting point of the detection gate.

**Width( $\mu$ s):** Width of the gate.

**Threshold:** Amplitude of detection level.

Only signal amplitudes within the gate limits and above the defined detection level will be extracted and recorded.

**For the Floating Gate configuration you can adjust the following parameters:**

**Blanking( $\mu$ s):** Only first arrival times beyond the blanking period are considered as valid starting point for the gate.

**Width( $\mu$ s):** Width of the gate.

**Threshold:** Amplitude of detection level.

For each gate the gate starting time (**TT( $\mu$ s)**), extracted amplitude (**Ampl**) and intercept time of the amplitude (**TAmpl( $\mu$ s)**) are displayed.

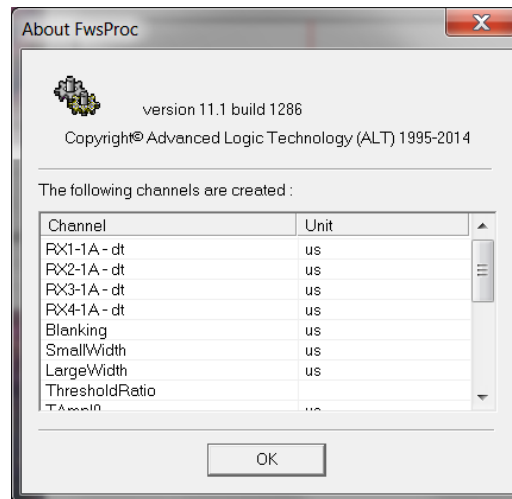
The following additional data channels will be created by the cement bond process:

TT0	Start time of fixed gate (in $\mu$ s)
TAmpl0	Time at which fixed gate amplitude was derived (in $\mu$ s)
Ampl0	Amplitude from fixed gate
TTX	Start time of floating gate (in $\mu$ s)
TAmplX	Time at which floating gate amplitude was derived (in $\mu$ s)
AmplX	Amplitude from floating gate

### About FwsProc

When right clicking on the FwsProc window title bar the **About FwsProc** dialog box can be opened.

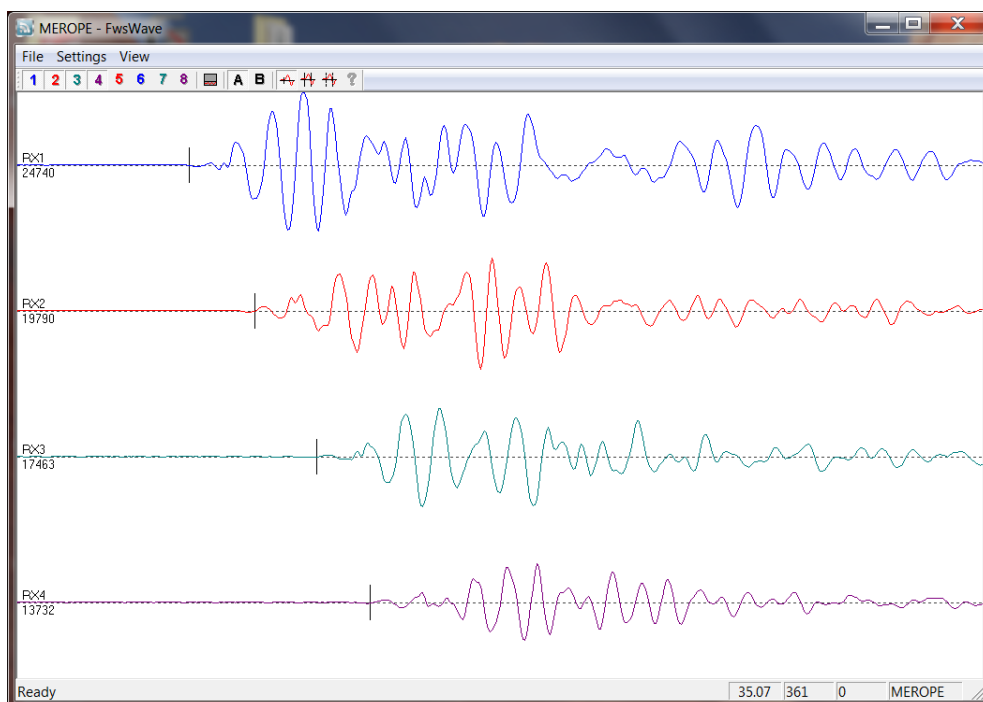
The dialog box provides information about the software version and the names of the recorded data channels.



**Figure 3-14** FwsProc version and channels produced


### 3.7.3 FwsWave Browser


The FwsWave browser displays the waves acquired on each receiver in real time.






**Figure 3-15** FwsWave browser - Receivers 1 to 4 from Transmitter A – Dt picking display activated

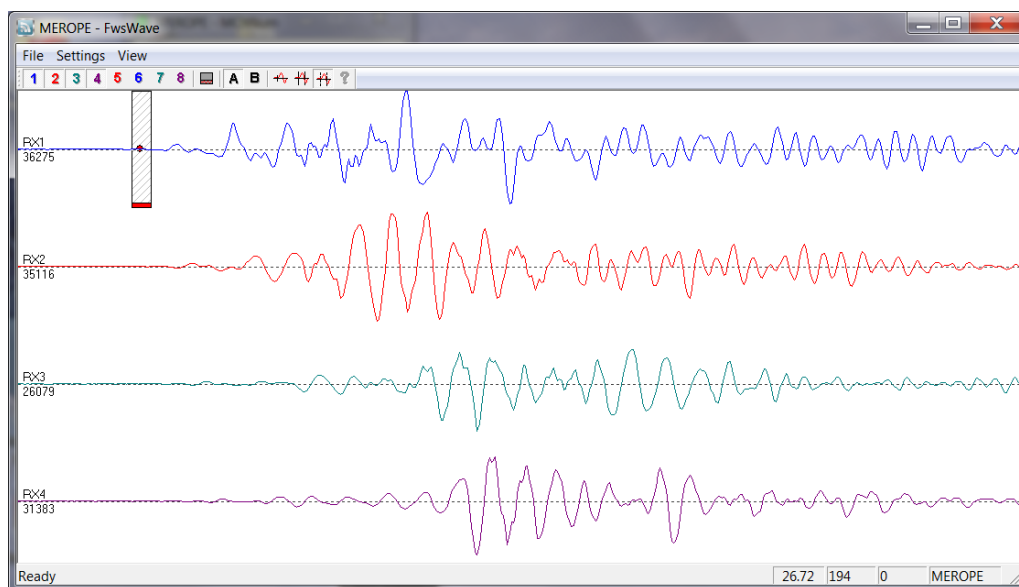
The 1, 2, ... 8 toolbar buttons  allow selection of the waves detected by the different receivers to be displayed.

The A and B toolbar buttons  allow display of the received waves fired by the transmitter A or B respectively.

The Extended Wave  is displayed in the bottom part of the window.

User can also choose to display the results of the real time processing of the Dt picking  and Cement Bond (Fixed Gate  method - Floating Gate  method).

All these options are either available from the toolbar or from the menu.



**Figure 3-16** FwsWave browser - Receivers 1 to 4 from Transmitter A – Cement Bond display activated – Floating Gate method

### 3.7.4 MChNum Browser

**Figure 3-17** show a typical example of the numerical values displayed in the MChNum browser window during logging. The display can be modified by right-clicking on the browser window and selecting the **Display options** entry.

From the **Display options properties** dialog box add or remove the channels to display. It is also possible to change the format of decimal digits displayed for a channel. Select the channel and click on "Settings" to configure the number of digits after the period.

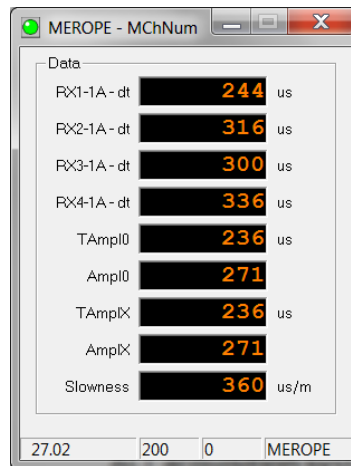


Figure 3-17 MChNum browser

### 3.7.5 WellCad Browser

The **WellCAD Browser** is an add-on module allowing WellCAD software to be connected to ALT acquisition systems. While logging, WellCAD borehole documents will receive the data stream in real time offering the operator all WellCAD data edition capabilities for preprocess or quality check operations. Data can be saved, additional data loaded and templates can be applied.

More specifically when operating the QL40 FWSS tool, WellCad browser offers the possibility to display in real time the full wave forms recorded by each receiver as “**Variable Density Logs**” – **Figure 3-18**.

In addition, when combined with **WellCad Full wave sonic module**, User can access to various Full wave sonic process options.

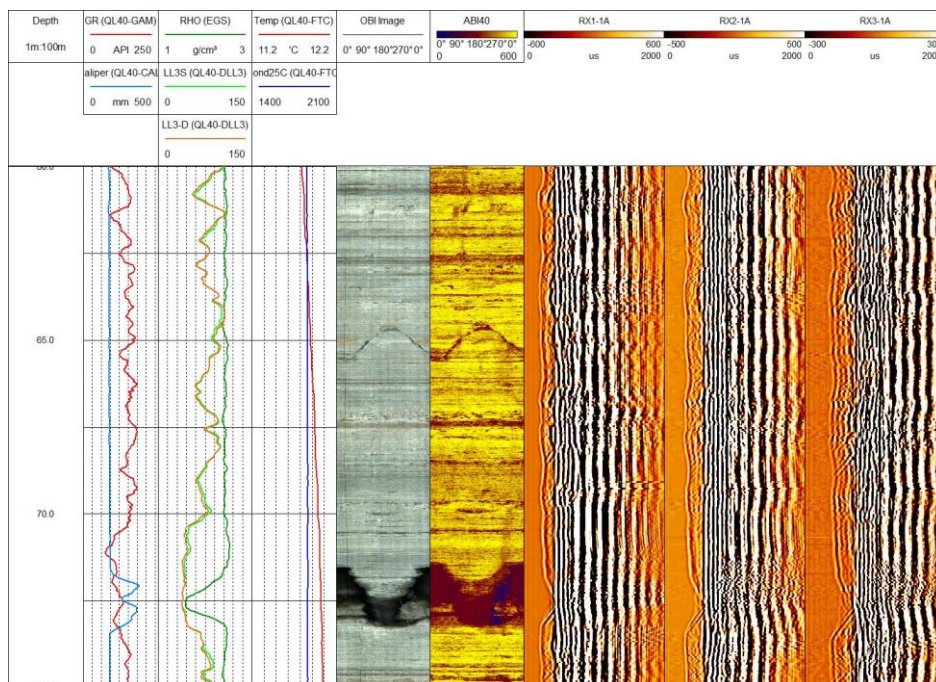


Figure 3-18 Example of WellCad browser display

---

## 4 Performance Check & Calibration

There is no specific performance check or calibration procedure recommended by ALT. When starting the sampling after powering on the tool the firing of the transmitter pulse should be heard even in air. A test borehole or water filled pipe could be used to check the correct operation of the tool over time. Reported slowness when the tool is centered in water-filled steel pipe is 183 – 190 uS/m or 56 – 58 uSec/ft.





## 5 Maintenance

**Warning: Removing the electronic chassis from pressure housing without prior consultation with ALT will void the tool warranty.**

### 5.1 Upgrading QL40 FWSS firmware

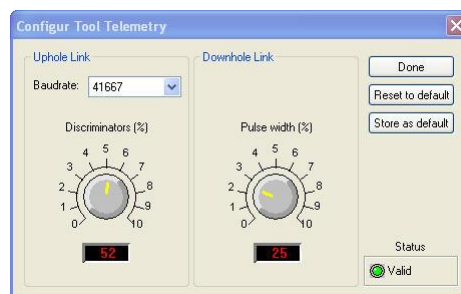
In accordance with the ALT policy of continuous development the QL40 FWSS has been designed to allow firmware upgrades. The current version of firmware installed in a tool may be verified in the **Tool Details** window opened from the **Tool Settings** dialogue box.

*Firmware upgrade procedure is as follows:*

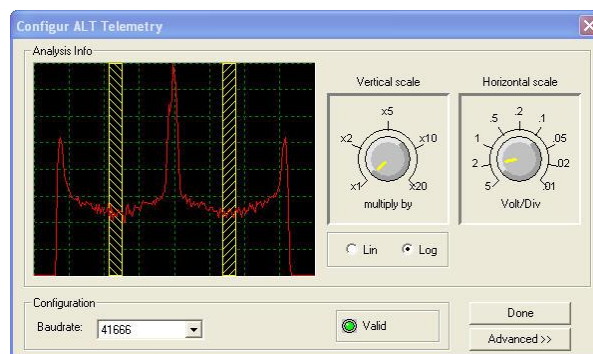
1. **Checking the communication is valid.**
2. **Upgrading firmware**

#### 5.1.1 Checking the communication

1. Connect the QL40 FWSS tool to your acquisition system.
2. Start LoggerSuite software.
3. In the **Tool** panel select the appropriate tool and turn on the power.
4. In the Communication panel, select Settings. Check baud rate is set to 41666 and communication status is valid.



**Figure 5-1** Tool communication settings - ALLog



**Figure 5-2** Tool communication settings - Matrix

**Warning: Telemetry must be tuned properly. Bad communication may abort the upgrade of the firmware!**

### 5.1.2 Upgrading the firmware

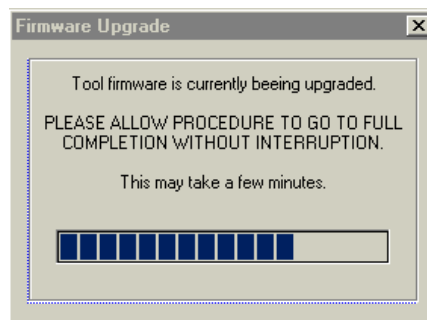
In the **Tool** panel, select **Tool settings/commands**. Check that the communication status is valid.

1. Click on **Tool Details**. Note that the firmware version currently in use is displayed in the firmware box. Click on the **Upgrade** button.
2. The following message will appear. Click **Yes** to validate your choice.



*Figure 5-3 Warning Message during firmware upload*

3. Select and open the appropriate **.hex** file provided. The upgrade will start.
4. During the upgrade procedure, the following message is displayed:



*Figure 5-4 Firmware upgrade progress window*

5. Once the upgrade has been successfully completed, click on **OK** to turn off the tool.



*Figure 5-5 Successful upgrade*

6. Power on the tool to initialize the upgraded firmware. Check in **Tool settings/commands** and **Tool details** that the firmware version has been changed with the new one.

Note that the following error message will appear at the end of the procedure when the tool firmware upgrade has failed or has been aborted. Verify the tool communication settings in this case.



**Figure 5-6** Error message



## 6 Troubleshooting

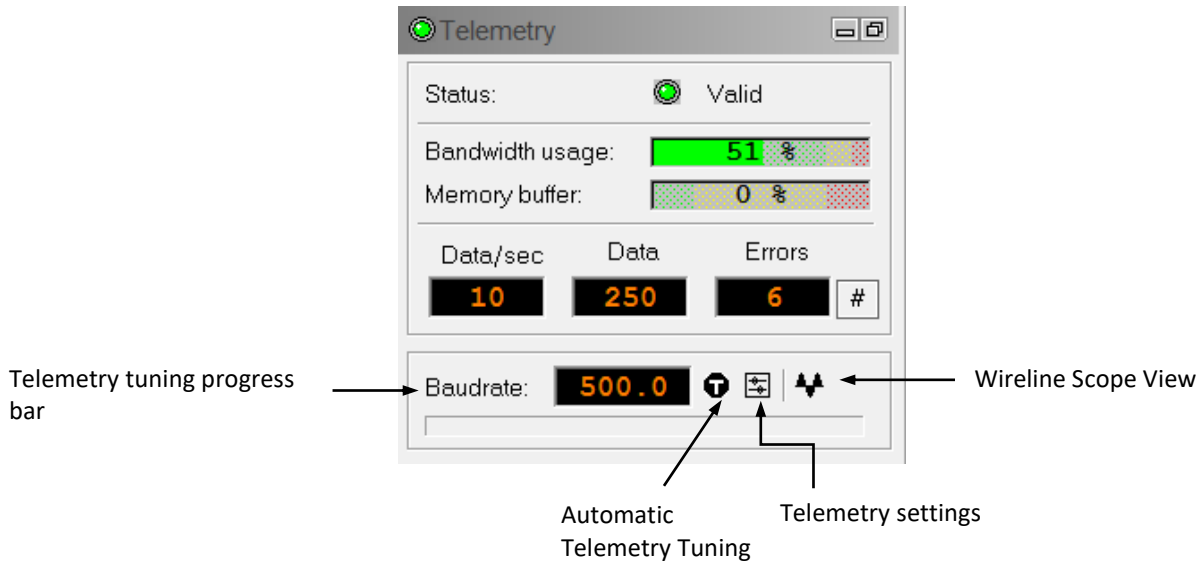
Observation	To Do
<i>Tool not listed in Tool panel drop down list.</i>	<ul style="list-style-type: none"> <li>- Do you have a tool configuration file?</li> <li>- Has the tool configuration file been copied into the correct folder? Refer to LoggerSuite manual about details of the directory structure.</li> </ul>
<i>Tool configuration error message when powering on the tool.</i>	<ul style="list-style-type: none"> <li>- Check all connections.</li> <li>- Adjust the telemetry settings for your wireline configuration (see chapter 3.2 or 3.3) and store the new settings as default. Apply the appropriate tool settings for your logging run (see chapter 3.4).</li> </ul>
<i>Tool panel - No current.</i>	<ul style="list-style-type: none"> <li>- Verify that the wireline armour is connected to the logging system. Test your interface cable between winch and data acquisition system.</li> <li>- Verify cable head integrity.</li> <li>- Verify voltage output at the cable head (it should be 120V for ALT tools).</li> </ul>
<i>Tool panel - Too much current (red area).</i>	<p><b>! Immediately switch off the tool !</b></p> <ul style="list-style-type: none"> <li>-Possible shortcut (voltage down, current up): Check for water ingress and cable head integrity - wireline continuity.</li> <li>- Verify the interface cable between winch slip ring and data acquisition system is not loose at the connectors. Check for possible source of a shortcut.</li> <li>- If the above shows no issues, use the test cable provided by ALT to verify the tool functionality.</li> <li>- If the problem still occurs, please contact service centre.</li> </ul>
<i>Telemetry panel - status shows red.</i>	<ul style="list-style-type: none"> <li>- Verify the telemetry settings for your wireline configuration (see chapter 3.2 or 3.3).</li> <li>- If problem cannot be resolved contact <a href="mailto:support@alt.lu">support@alt.lu</a> or <a href="mailto:tech.support@mountsopris.com">tech.support@mountsopris.com</a></li> </ul>
<i>Telemetry panel - memory buffer shows 100%.</i>	<ul style="list-style-type: none"> <li>- Indicates that the systems internal memory buffer is full. PC can't receive incoming data streams fast enough. Ensure your PC has enough resources available.</li> </ul>
<i>Telemetry panel – bandwidth usage shows 100%. (Overrun error message.)</i>	<ul style="list-style-type: none"> <li>- Set the baudrate to highest value allowed by your wireline configuration.</li> <li>- Reduce logging speed, decrease tool resolution, adjust tool parameters and/or increase vertical sample step.</li> </ul>
<i>Telemetry panel - large number of errors.</i>	<ul style="list-style-type: none"> <li>- Verify the telemetry settings for your wireline configuration (see chapter 3.2 or 3.3).</li> <li>- Check bandwidth usage and telemetry error status.</li> </ul>



## 7 Appendix

### 7.1 Tool Communication with OPAL/SCOUT


The telemetry provided through the OPAL-SCOUT systems implementing the ALT MODEM adapter is self-tuning. In case communication status is not valid the user has different options to adjust manually the telemetry settings from the telemetry panel of the dashboard:



#### **Baud rate:**

Indicates the default baud rate or optimal baud rate in kbps found by the system for the selected winch/telemetry scheme

#### **Automatic Telemetry Tuning:**

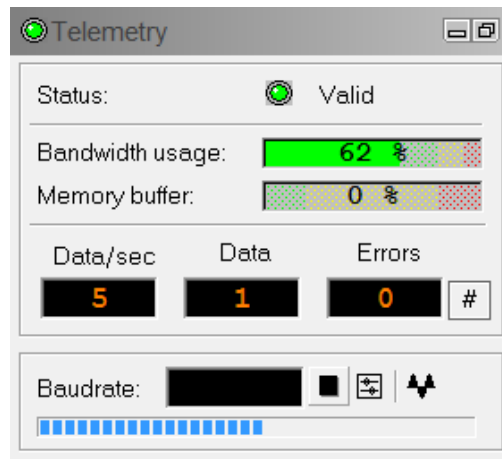
The Tune button  resets the telemetry tuning automatically. This process defines:

- the optimum baud rate for the winch configuration selected
- a transfer function and a filter to re-construct at the surface the shape of the pulse trains distorted by the wireline.<sup>1</sup> Refer to the **Equalizer** paragraph for more details.


The Automatic Tuning is very useful on wireline over 1000m length to optimize the telemetry performance and logging speed.

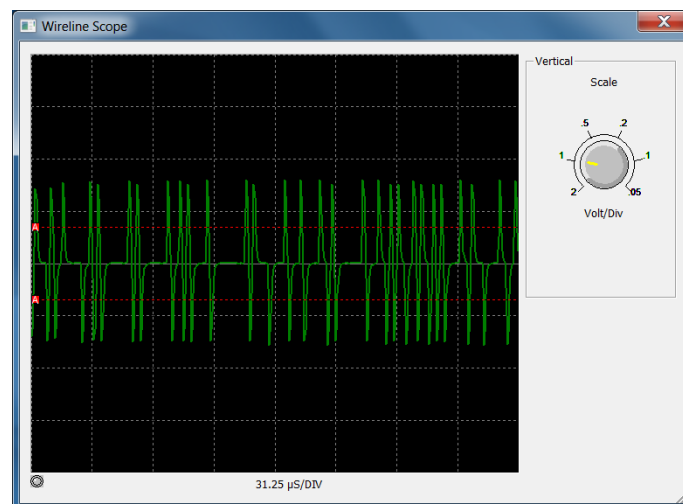
A **progress bar** at the bottom of the telemetry window shows the progression of the telemetry tuning. At the end of the process the baud rate display is refreshed with the optimal baud rate value.

<sup>1</sup> The transfer function and filter concept are only valid for tools implementing the latest generation of ALT MODEM telemetry board (i.e. QL40-ABI2G, ABI-GR-2G, QL40-OBI2G, OBI-GR-2G, QL43-ABI2G,...)



### Scope:

Pressing the scope button  on the **Telemetry Panel** brings up a **Wireline Scope** view (Figure x), which displays the pulse strings transmitted through the wireline and received by the system at the surface.



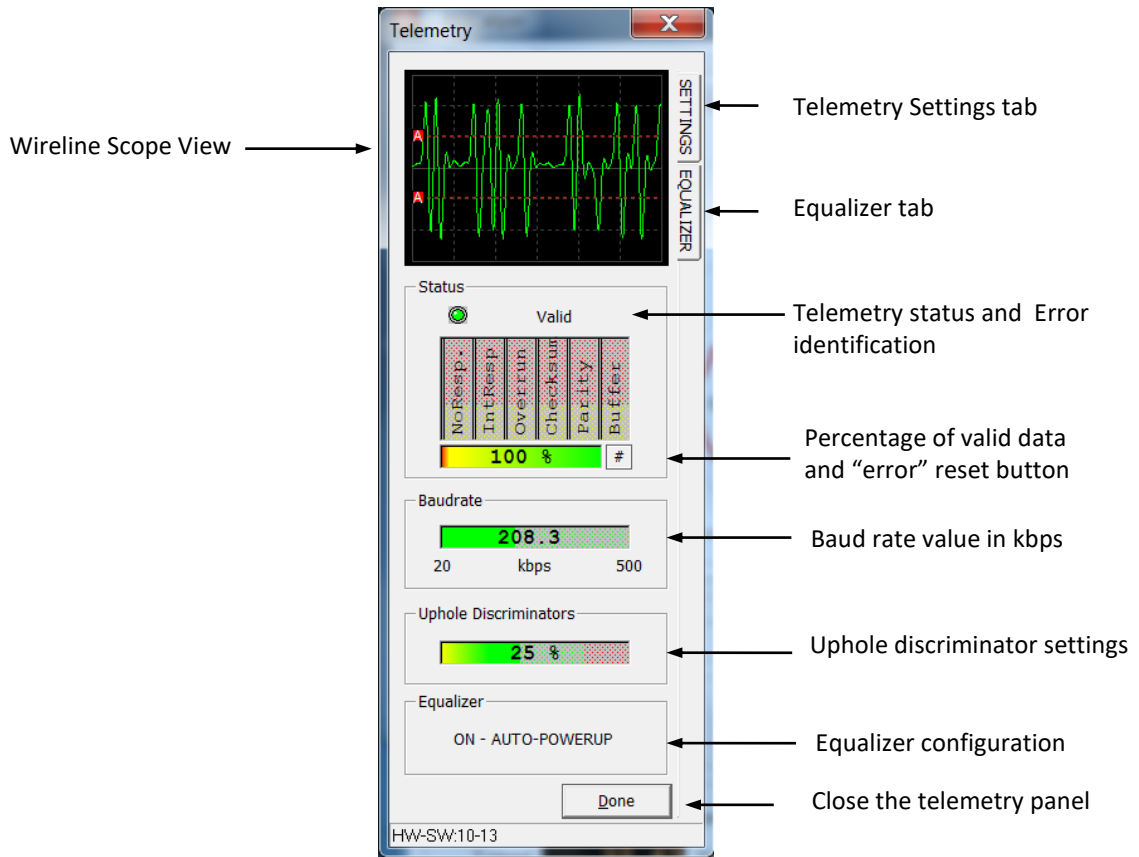
The two red-dashed horizontal lines help to visualize the position of the discriminator levels set for detecting the pulses at the surface. Discriminator levels can be tuned in the **Telemetry Settings** dialog – refer to section 3.6.1 for more information.

The Scale knob can be adjusted to show more or less vertical details. This view has no effect on the communications and is a visual aid only.

### Telemetry Settings:

The Telemetry Settings button  opens a **Telemetry** control panel summarizing the telemetry status and configuration.

If the system cannot establish a stable communication with the tool, the **Settings and Equalizer tabs** allow the user to modify the telemetry settings and to apply a telemetry filter (Equalizer option)



**Adjusting the Telemetry Settings:**

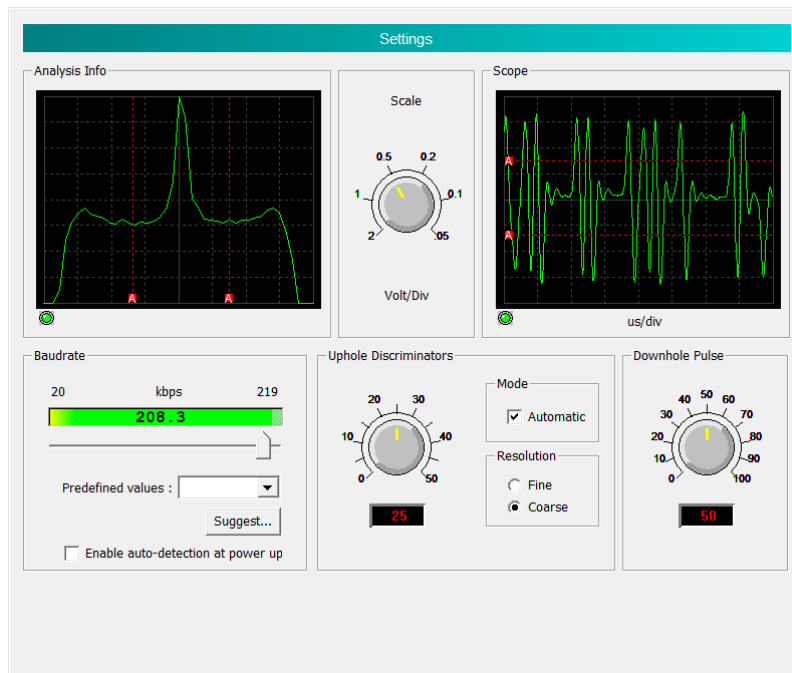
By default the telemetry settings are set to Automatic mode and should stay in this configuration. When more advanced tuning is required (i.e. long wirelines having a limited bandwidth) the manual mode can be activated.

In Automatic mode the uphole discriminators are set automatically to detect the pulse strings.

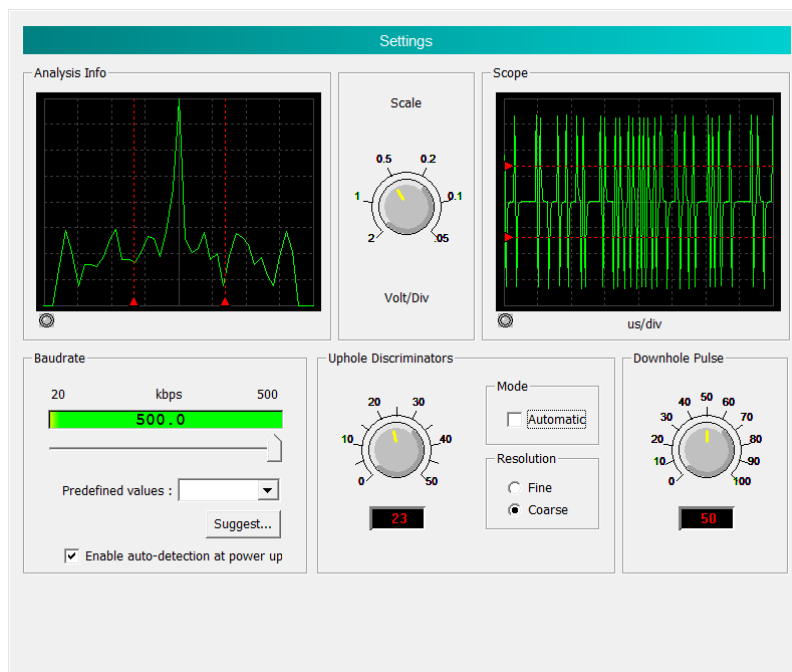
The position of the discriminator levels are visible on the Scope and Analysis views and are represented by two red dashed lines – one for the positive pulses and the other for the negative pulses.

The “A” letter on the red square means that the discriminators are set in automatic mode. The **Scale knob** controls the scale for the Analysis and Scope displays.

Position of the discriminator lines should be set as illustrated below.



When the automatic mode is unchecked user has the option to adjust manually the uphole discriminators using either the discriminator knob or by moving interactively the red dashed lines in the Analysis and Scope displays. The red triangles located at the extremities of the red dashed lines refer to manual mode. For fine tuning of the discriminators the **Fine resolution** can be chosen.



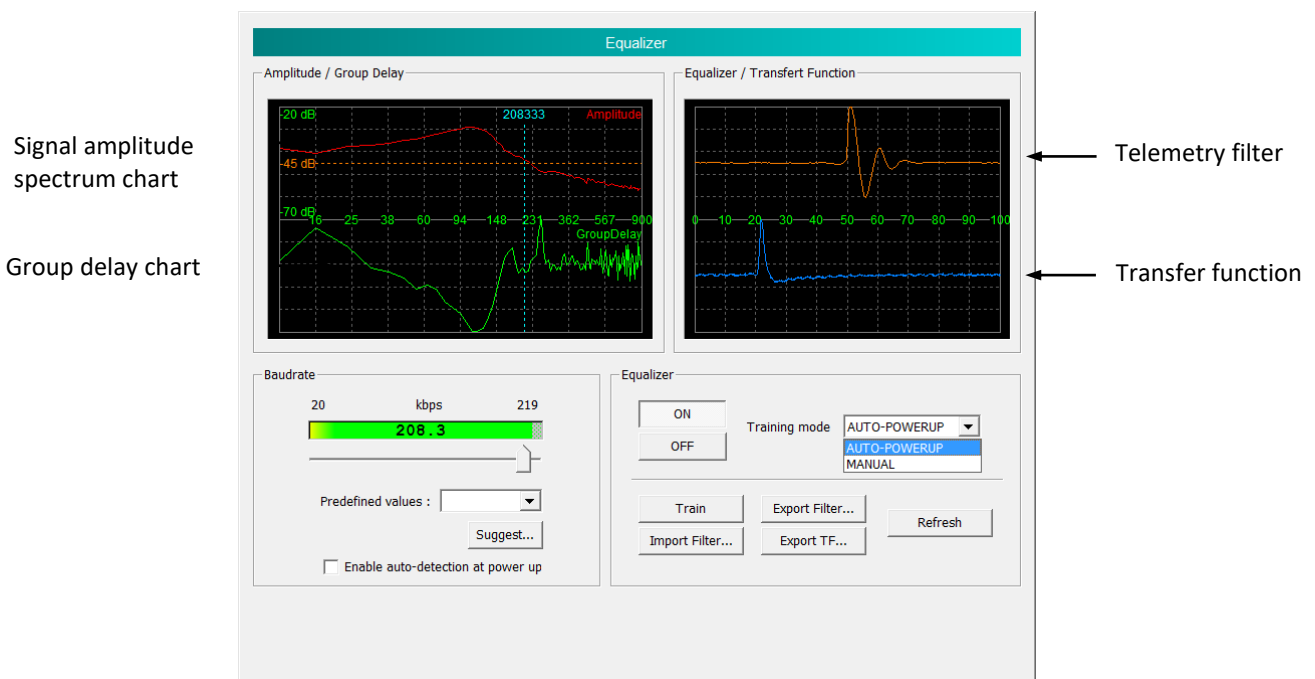
The **Downhole Pulse knob** controls the width of the pulse commands sent to the tool. It is set on 50 as a default value. This value is the preferred one and is suitable for a wide range of wirelines. For long wireline increasing the pulse width could help to stabilize the communication. The reverse for short wireline.

The **Baudrate** is generally set to the maximum value for which the communication status stays valid in order to optimize the logging speed for the wireline configuration. The baudrate can be adjusted by moving the cursor below the baudrate bar meter or by selecting a predefined baudrate value from the select box.

When clicking the **Suggest** button the system is searching for the optimum baudrate value and keeps this value for the data transmission.

The **Enable auto-detection at power-up** configures the system such a way that the baudrate is reset to its optimum value each time a tool is powered up.

### Applying the Equalizer



The **Equalizer** dialog provides some advanced telemetry settings described hereafter.

- The **Train** button computes the transfer function of a wireline - refer to the blue signal. When clicking on Train the tool sends a pilot pulse frame to the surface. The received signal at the surface is compared with the original pilot pulse frame to measure the distortion of the signal through the wireline. The result of this process is the definition of a transfer function specific to the wireline used.

A filter is then derived from the transfer function - refer to the orange signal. The filter will be applied on the telemetry signal to counteract the distortion of the pulse strings through the wireline.

**Applying the filter will thus improve the telemetry performance of the system and logging speed on wirelines with unfavorable band width.**

- The **Equalizer ON/OFF** buttons enables or disables the filter. The activation of the equalizer can be configured to **MANUAL** mode or to **AUTO-POWERUP**.

The AUTO-POWERUP feature applies the telemetry filter upon tool power-up.

- The **Export TF** option exports the **Transfer Function** defined by the wireline training process in a ASCII file format
- The **Export Filter** option exports the **Filter** derived from the transfer function in a ASCII format
- The **Import Filter** option loads a saved filter configuration
- The **refresh** button is refreshing the Equalizer/transfer function display

The **Amplitude/Group Delay** charts are mostly used by ALT developers for telemetry signal and performance analysis.

The Equalizer dialog repeats the **Baudrate** settings already discussed in the previous paragraph "Adjusting telemetry settings".

## 7.2 Parts list

### 7.2.1 Tool delivery kit QL40-xxx (ref. 209-016)

Item No.	Qty	Part No.	Description
1	1	210-002	Silicone grease Molykote111
2	2	211-004	C-spanner 40-42 (QL40-43)
3	6	AS215-V-75°	Oring-V 26.57 x 3.53 75°
4	1	210-003	Grease Lubriplate L0034-086

## 7.3 Technical drawings

The following technical drawings are available on request:

- Acquisition system wiring diagram.
- QL40 FWSS Wiring Diagram.

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