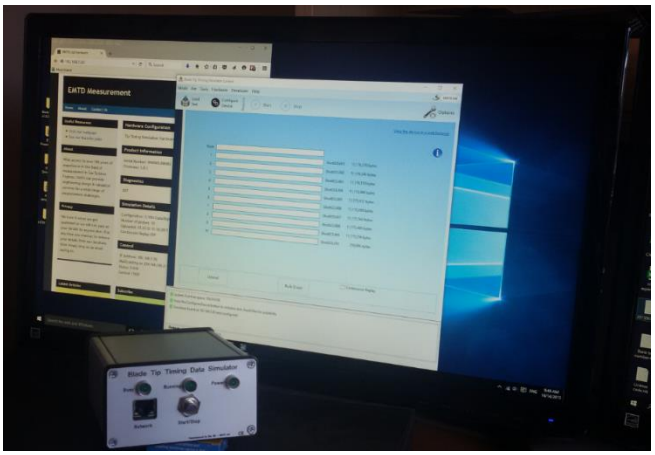
MultiTool Blade Tip Timing Acquisition, Analysis and Data Simulation Software

Data Simulator



Contents

Declaration of Conformity.

EMTD Ltd declare that:

Blade Tip Timing Data Simulator V1.0 serial No 003

Is in compliance with essential requirements of 2004/108/EC (EMC), 2006/95/EC (LVD), 2011/165/EU (RIHS). (EMC).

The following standards are applied.

EMC - Emission

EN55022, 2010 class A

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

EN61000-3-2 class D

EN61000-3-3

EMC Immunity

EN 61000-4-2, EN 61000-4-3, EN 61000-4-4, EN 61000-4-5, EN 61000-4-6, EN 61000-4-11

Restriction of Hazardous substances

EN50581: 2012

The TCF is located at EMTD Ltd

Nottingham, England

Email:enquiries@emtd-measurement.com

Person responsible for this declaration

Dr P Russhard FIET CEng

Engineering Director

Package content

1. Blade Tip Timing Data Simulator.
2. 12v 1A PSU.
3. CD containing MultiTool software and example data files
4. Carry case.
5. Electronic Operating manual accessible from the Simulator.

Description

The Blade Tip Timing (BTT) data simulator has been designed primarily as a tool to assist in the development and evaluation of BTT acquisition and analysis systems. It has also proven invaluable as a training aid allowing operators to gain experience of monitoring and identifying real time events often encountered during testing.

The simulator is capable of using existing data files, either real engine data or accurate simulations to produce analogue output pulses that represent blade passing and once-per-rev (OPR) signals that can be acquired by any BTT acquisition system. This allows a third party evaluation of existing configurations through to data analysis.

Future software upgrades will allow existing data to be resampled to vary both the maximum blade passing speed and the rate of speed change allowing systems to be evaluated at higher speeds than previously experienced prior to committing to a BTT experiment.

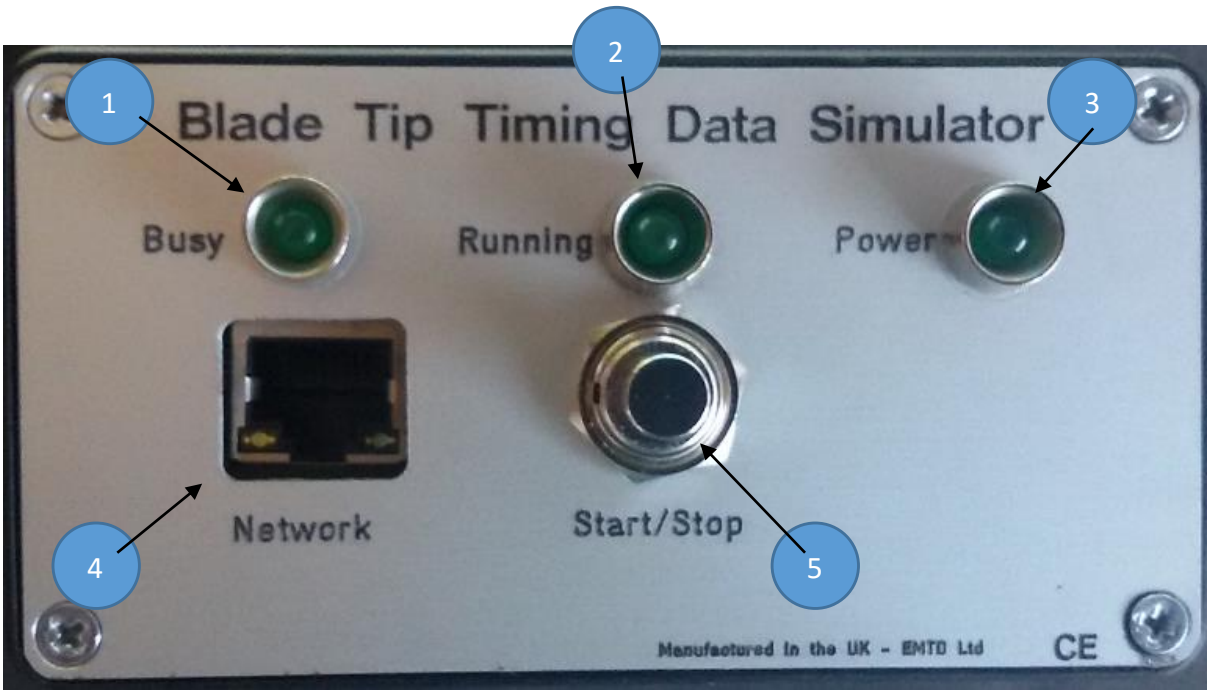
The current version produces a digital representation of the blade passing signal. Future variants will mimic output waveforms from a common range of probes such as capacitance, optical and eddy current, allowing triggering systems to be characterised.

Features

- 10 channel capability.
- High level differential output signals.
- 100MB per channel memory capability.
- Timing resolution 13nS.
- Maximum blade passing speed 100 KHz.
- Web page interface containing system information.
- Continuous replay of data.
- Simple operation.
- MultiTool BTT software (Simulation and configuration Editor enabled).

Simulator Hardware

Front panel controls and connections



1	Busy – Indicates when the network and simulator are communicating and no other operation is permissible.
2	The data simulation is running and the outputs are active.
3	Flashes on power up and illuminates when the simulator is ready for use.
4	Network connection to a PC running MultiTool software. Not required after downloading data.
5	Initiates the simulation either as a single event or continuous operation depending upon simulator option settings.

Rear panel controls and connections

6	Press and hold for 5 seconds to reset to factory settings
7	Analogue outputs channels 1 - 6
8	Analogue outputs channels 7 - 10
9	On/OFF switch
10	External power 9 -18V maximum 1A

Output connections

Channels 1 – 6

Pin	Function
A	CH1+
B	CH1-
C	CH2+
D	CH2-
E	CH3+
F	CH3-
G	CH4+
H	CH4-
J	CH5+
K	CH5-
L	CH6+
M	CH6-
Z	Ground (0V)

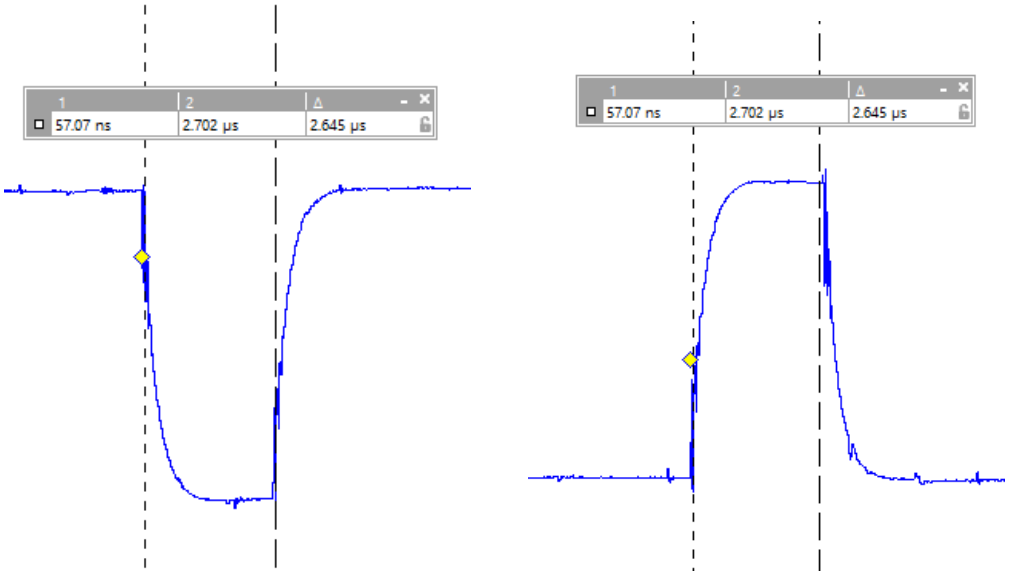
Channels 7 – 10

Pin	Function
A	CH7+
B	CH7-
C	CH8+
D	CH8-
E	CH9+
F	CH9-
G	CH10+
H	CH10-
J	n/c
K	n/c
L	n/c
M	n/c
Z	Ground (0V)

Output levels and waveforms

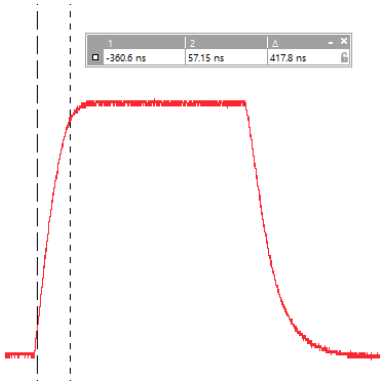
All outputs are driven through a 390Ω resistor. This allows twisted pair connection to be terminated in their characteristic impedance (typically 220 Ω) minimising rise time skew due to cable capacitance. Further attenuation of the signal can be achieved simply by reducing the termination value.

Typical waveforms are shown for one of channel outputs. (CH1+ and CH1-)



Pulse width is approximately 2.6µS and the rise time approximately 400nS when driving 2m of twisted pair overall screened cable (approx. 200pF cable capacitance). Typical output amplitude when driving 220 Ω. All outputs are AC coupled.

Typical waveform after the differential line receiver (of the BTT acquisition unit) should resemble the following waveform



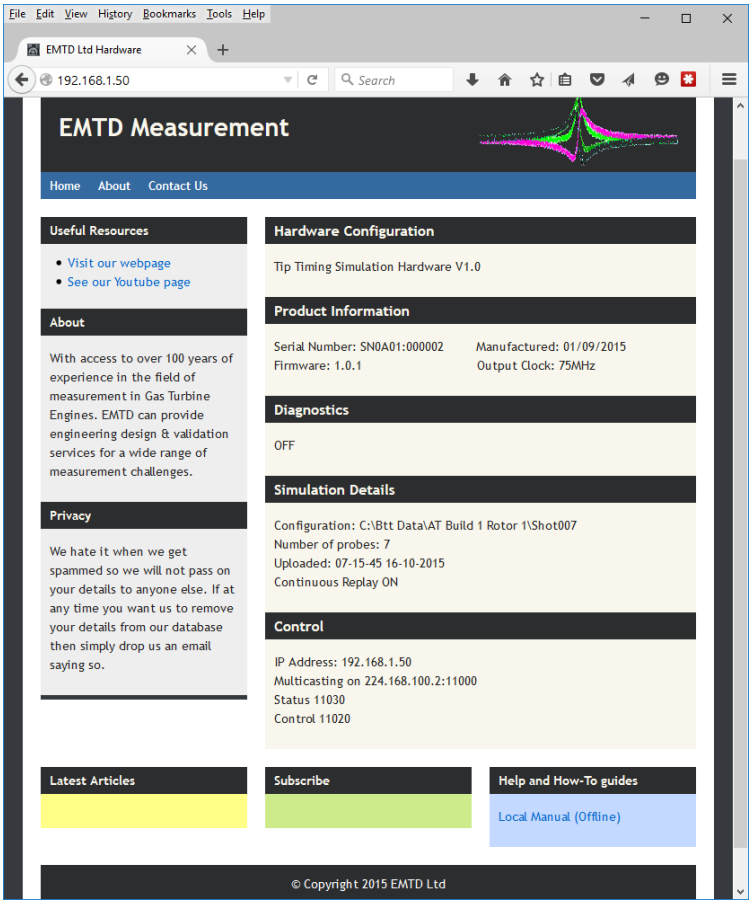
Simulator Network Settings

The simulator is accessed via Ethernet and is configured from the factory with the following IP address

192.168.1.50

Ensure that the host PC can access the device before continuing. Connect the Simulator to the network and apply power to it.

The simplest method of obtaining information about the simulator is to browse its web page interface.



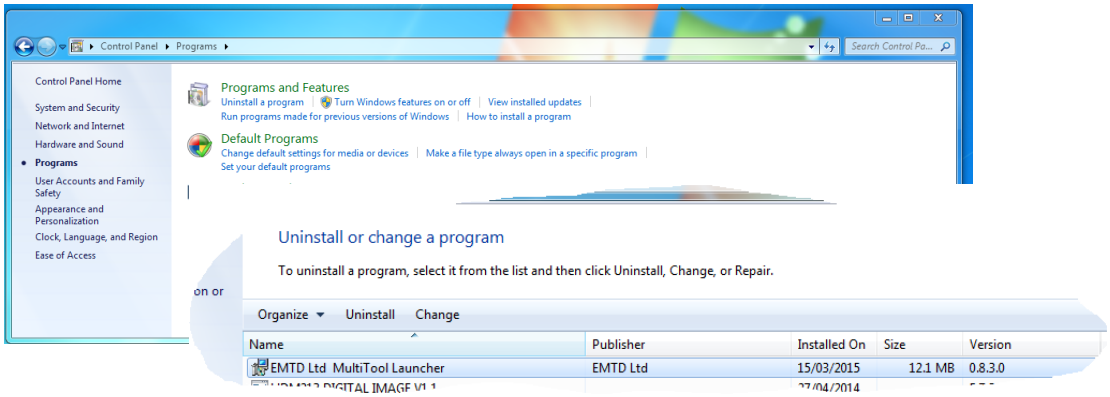
Software Installation

Removal of previous versions

There is one software packages associated with BTT MultiTool. All setup files are contained in the folder *<MultiTool x.x.x Installer>*

Installation of these programs follows that for many windows applications. The following instructions show this process.

Prior to any installation any previous versions should be removed using control panel and the add/remove programs feature. All programs are compatible with Windows 7 and 10

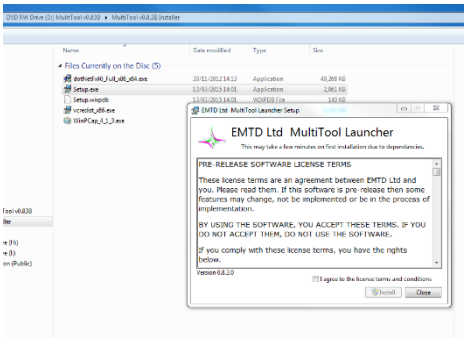


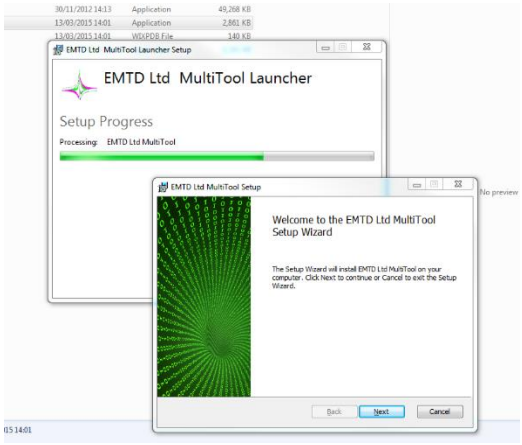
Please note that latest file sizes may differ from that shown.

Installation of latest version

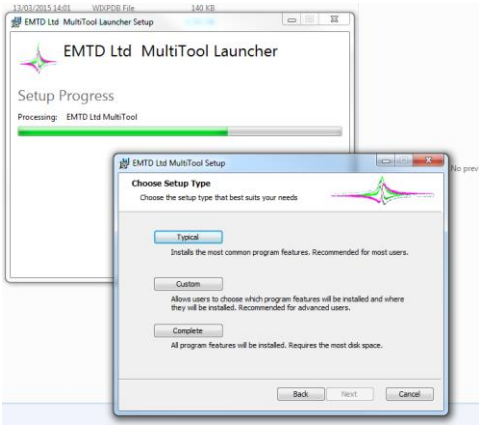
Locate the file *<Setup.exe>* on the MultiTool CD and double click the Icon to start the installer.

Agree to the terms and conditions and click Install

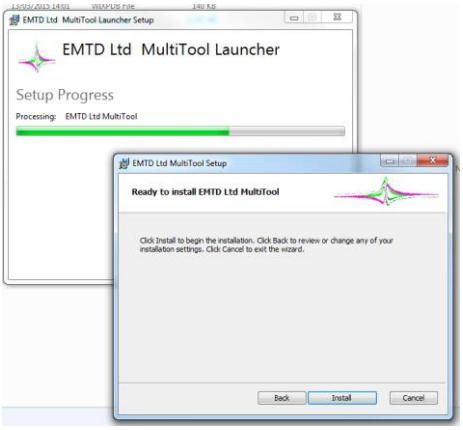


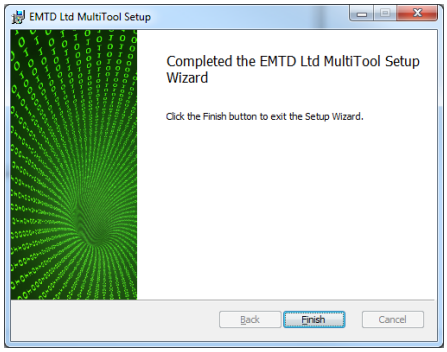


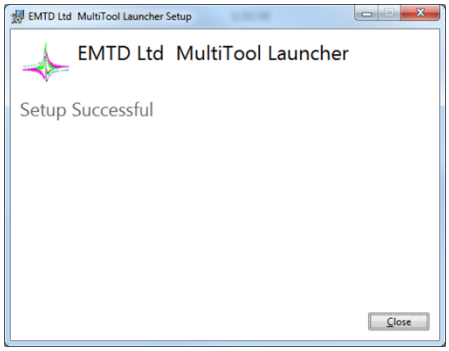
When the setup panel appears click Next



Select Typical. As more features are added to the software it will be possible to perform custom installations for advanced users.





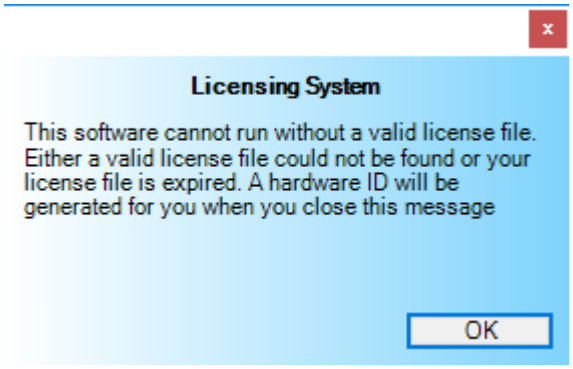


When the setup is complete click Finish. If the installation fails then repeat all steps including the removal of any existing MultiTool version. If the installation fails repeatedly then contact

Enquiries@EMTD-measurement.com

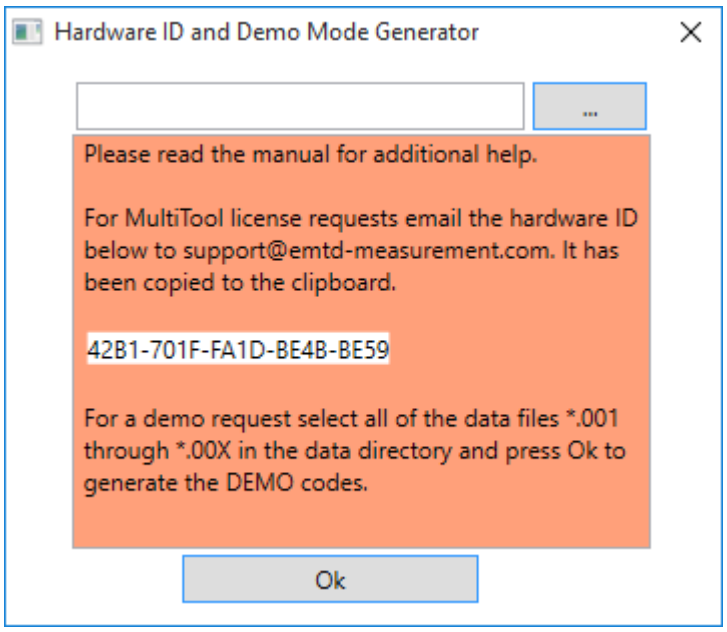
A desktop Icon will be created

Attempting to run the software without a valid license will result in the following message.



Obtaining a License

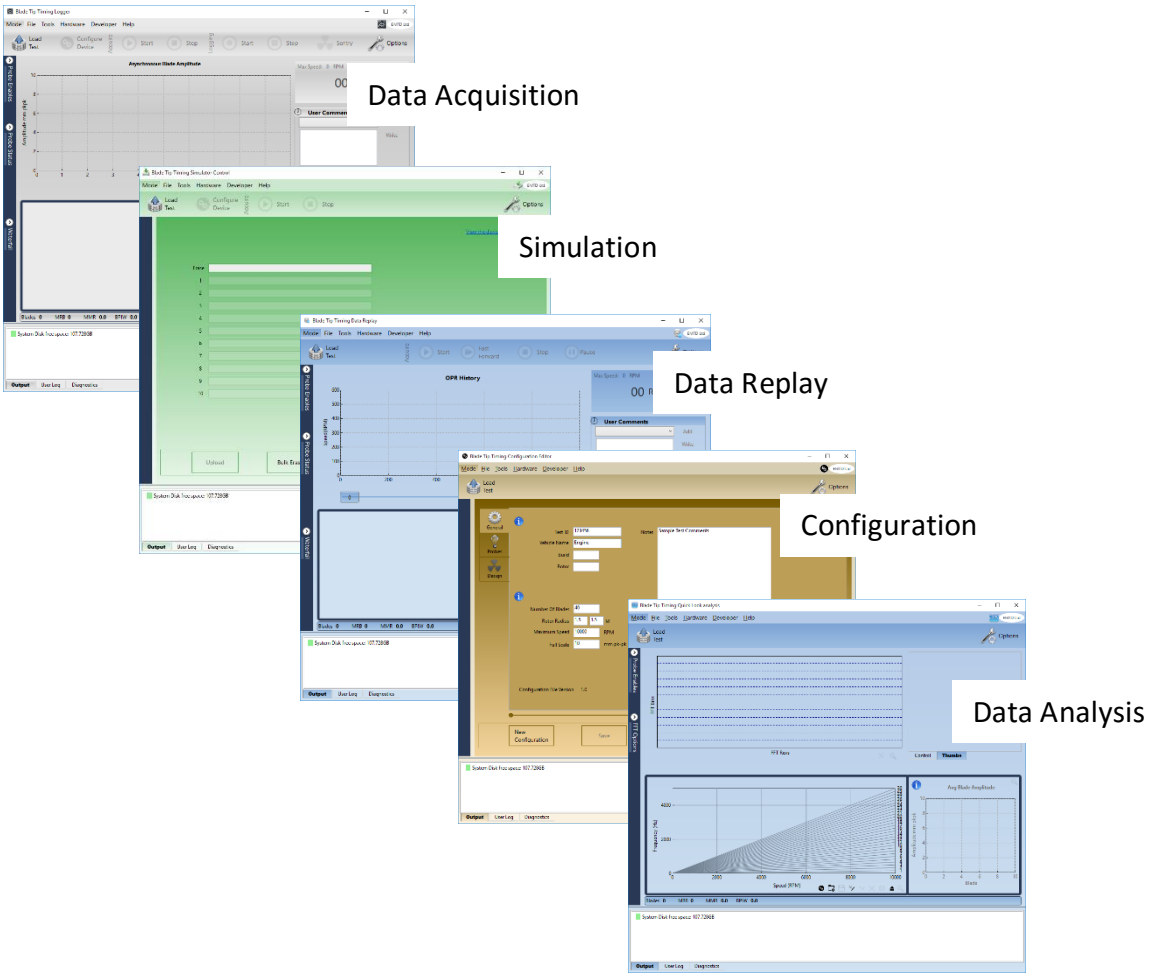
When closed the following dialogue box gives instruction on obtaining a license.



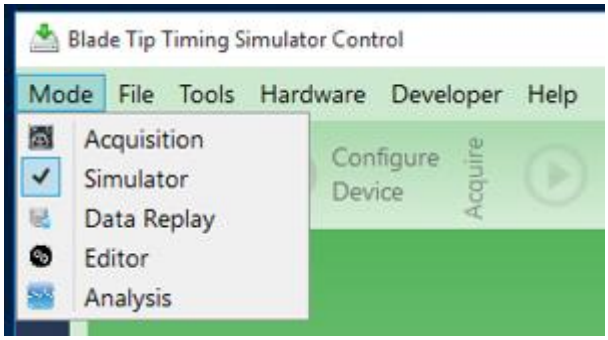
Help on generating a demonstration license is available for MultiTool analysis users.

Running MultiTool Software

Double click the MultiTool icon to launch the program. Depending upon your license options and previous use of the software one of the following launch screens will appear



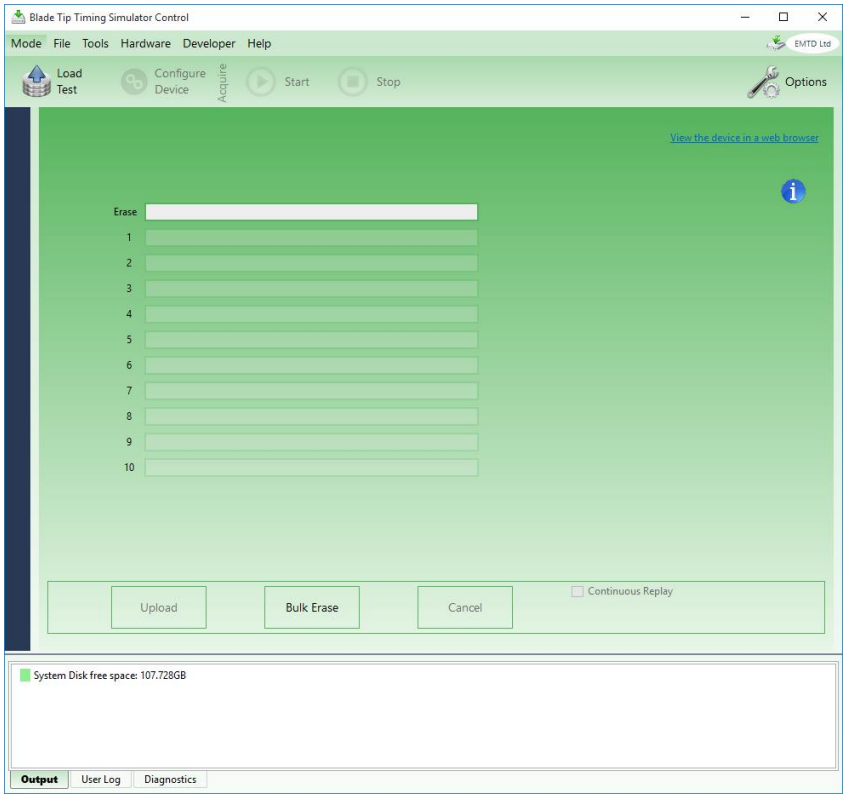
The Simulator function can be selected using the drop down lists accessed via the <mode> menu.



Tool Tips are available for most functions and can be accessed by hovering the mouse over the required function.

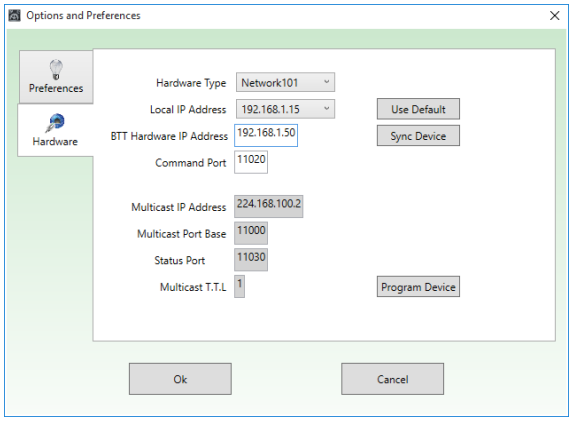
Simulator Main Screen

The simulator main screen is shown below.

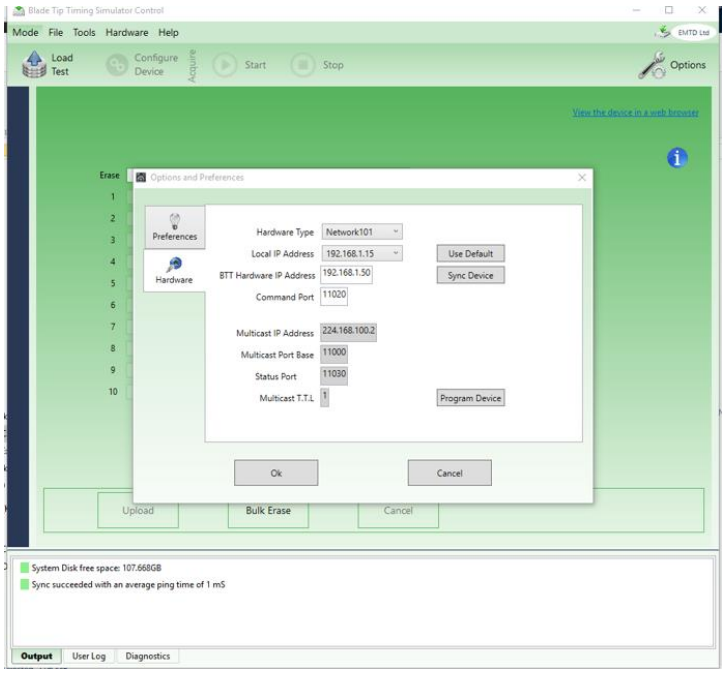


Ensure the Simulator hardware is attached and powered. Browse the web page to view its current settings.

The network information can be viewed by selecting the <options> menu and clicking on the Hardware tab.



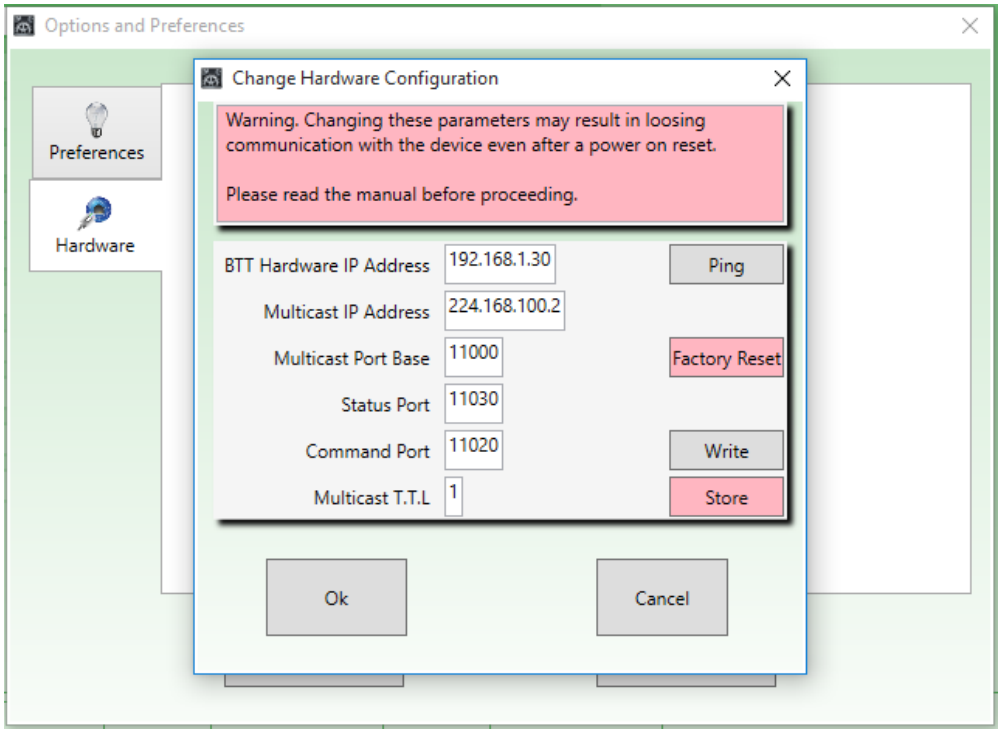
Ensure that the local IP address is correct as the PC may contain multiple LAN connections. Select <sync device> to check the communications with the Simulator.



The sync succeeded message should appear in the output window.

Changing the Hardware Configuration

If the IP address requires changing select click on the <Program Device> button.



Care should be taken before changing any of these setting as loss of communication may occur. An option to reset to factory settings is available if this problem is encountered.

Make changes to the required fields and select write. This applies the settings but they remain temporary within the device. Select store to make the settings permanent.

Monitor the output window for messages

Close the Change hardware Configuration window and enter the new values into the hardware tab. **Turn off the power to the simulator and then back on again.**

Sync the device to test the new settings. The web browser settings should also be changed to access the device web page.

Factory Reset

Factory reset can be achieved by two methods.

Hardware reset

Using a blunt tool to prevent damage to the button gently press and hold the reset button for approximately 5 seconds. On releasing the button the three front panel indicators will flash indicating that a power cycle is required to complete the reset.

After the power cycle the device will return to the factory settings and the web page information accessible on IP address **192.168.1.50**

Software reset

The software reset can only be used if the device is connected and functioning correctly on its current network settings.

From the <options> menu click on the hardware tab and select program device.

Press the <Factory Reset> button.

A dialog box will appear asking for confirmation.

Select Yes

Check the output window for confirmation of the reset. The Simulator hardware should have the three front panel indicators flashing. Cycle the power to complete the process.

Programming the simulator

Time of arrival data is downloaded to the Hardware and this data is used to recreate signals that would be encountered during a real test. The time of arrival data must conform to the following format.

File properties

The files must reside in a single directory and each probe have its own file with the extension indicating which probe it is;

For example

Datafile.001

Datafile.002

Datafile.003 etc.

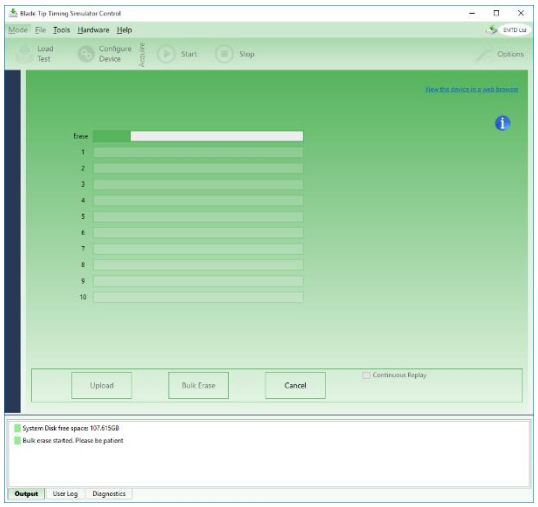
The OPR file must be the last file in the sequence and no more than 10 files of this type should be in the directory.

The file format requires that each arrival time is the time in seconds and is stored as a double. The files do not need to be time aligned and can be the raw data files from a compatible BTT acquisition system.

Bulk erase

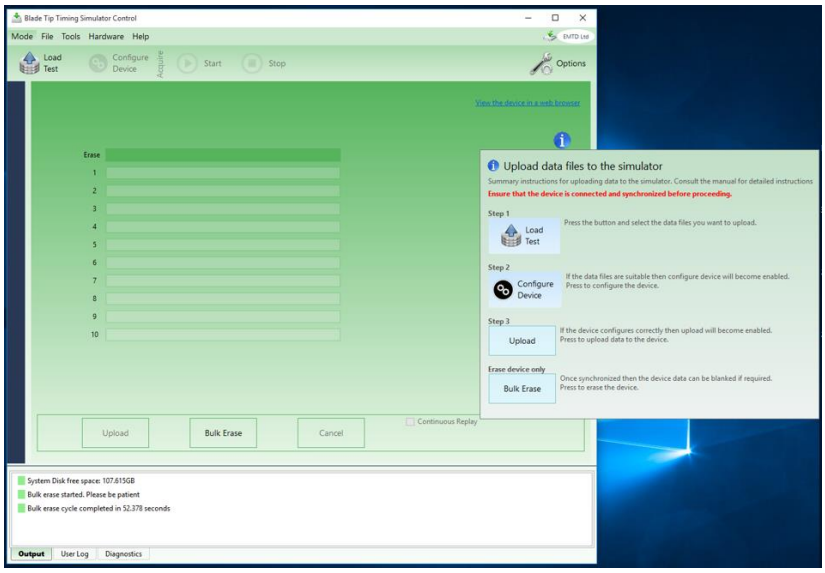
The Hardware contains 128MB of flash memory for each probe and this requires erasing prior to any new data being uploaded.

From the Simulator main screen select Bulk Erase



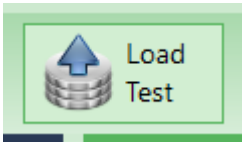
The progress bar indicates how long the process will take and upon completion message appears in the output widow with the time to complete. This is typically around 50 seconds. As the device ages this may take longer. If the message fails to appear press the cancel button, recycle the power and repeat the process. Continued failure should be reported back to enquiries@emtd-measurement.com

An overview of the erase and upload process is available by hovering the cursor over the information icon

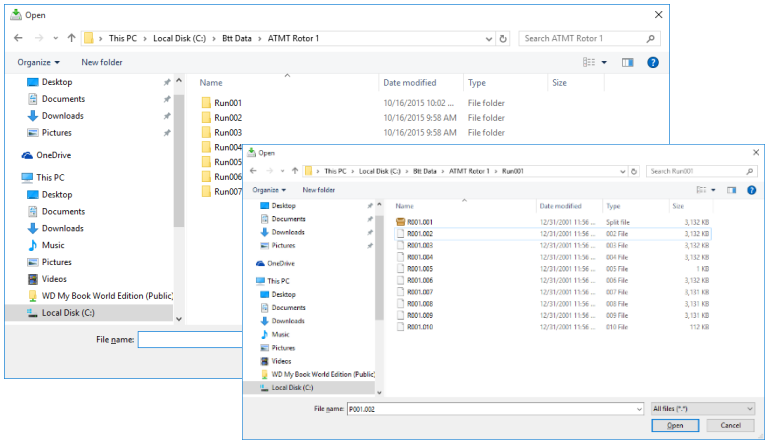


Data Upload

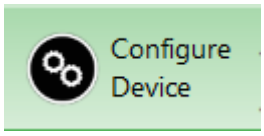
Select the Lo ad test I con and a file browser will open.



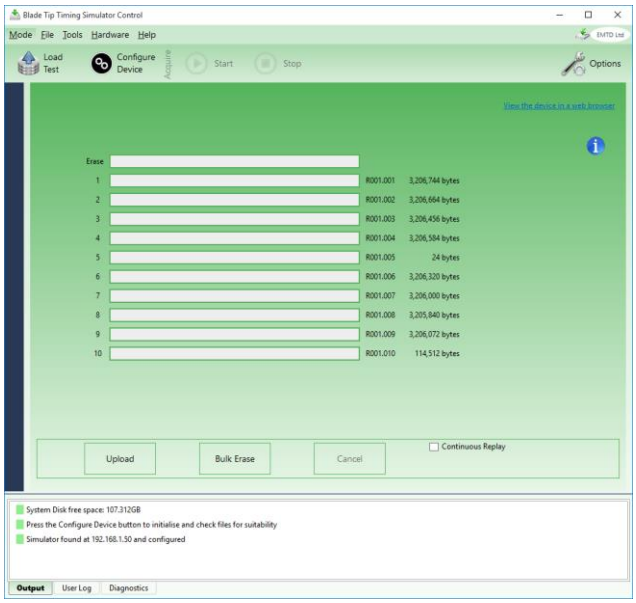
Browse to the location of the files to upload and select any one of the data files and click on open.



The output window will prompt the user to configure the device to initialise the data files and check for their suitability. Errors in data files may cause them to be rejected from the upload process. If this happens contact Enquiries@emtd-measurement.com for further advice and help.

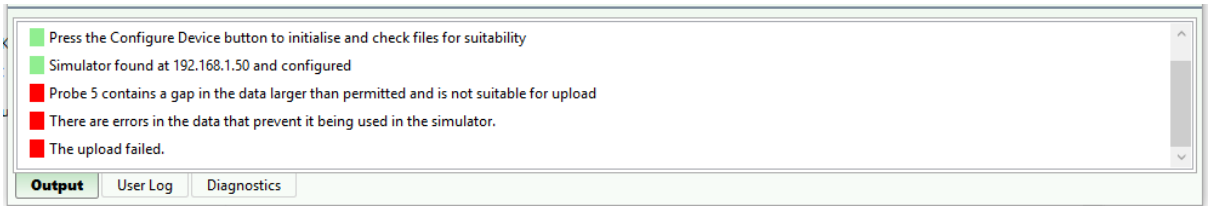


If the data files are suitable the download screen and output window will update.

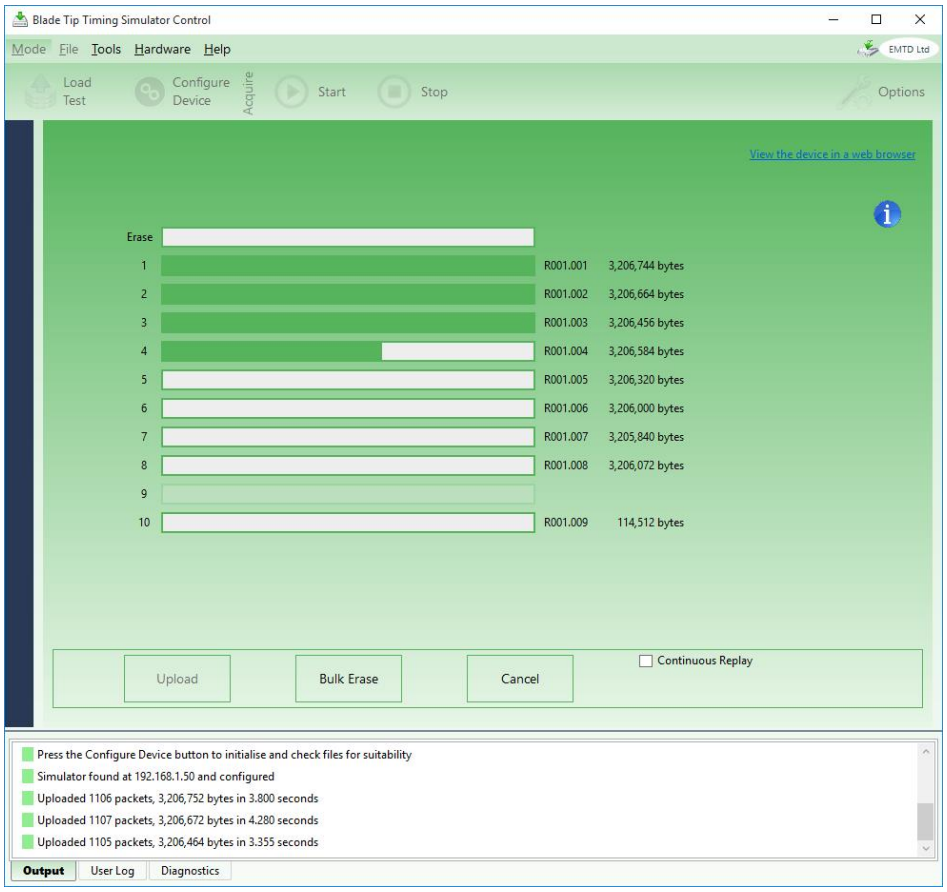


The continuous replay check box is now accessible. Selecting this configures the hardware to automatically restart the simulation after it has completed. Select the Upload button to start the process of transferring data from the PC to the Hardware.

In this example probe 5 has a large number of errors and causes the file to be rejected. These errors need to be rectified if this file is to be used.



Once rectified, the transfer process is displayed on the progress bars and in the output window.



The hardware is now configured programmed with data and ready to use.

Using the Simulator

Power the Simulator using the power unit supplied. The Power light will flash for a short period whilst the simulator configures. When ready the light will remain on

The simulator can be disconnected from the PC and operated as a stand-alone unit if required.

Connect the Simulator to the fully configured BTT acquisition system.

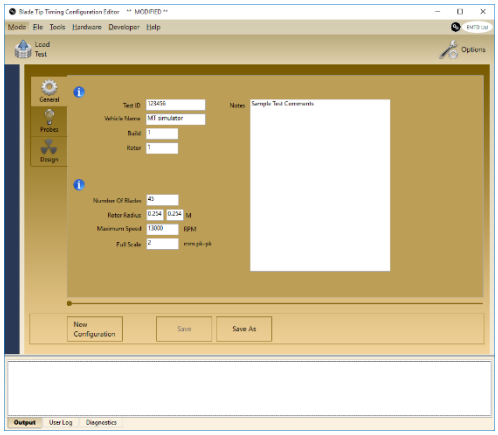
Start and stop the simulation with the push button on the front panel. The Running light will illuminate when data is being output and will extinguish at the end of the data file. If the continuous function has been selected then it will automatically restart after a few seconds.

The Simulation can be stopped and restarted at any time by depressing the start/stop button.

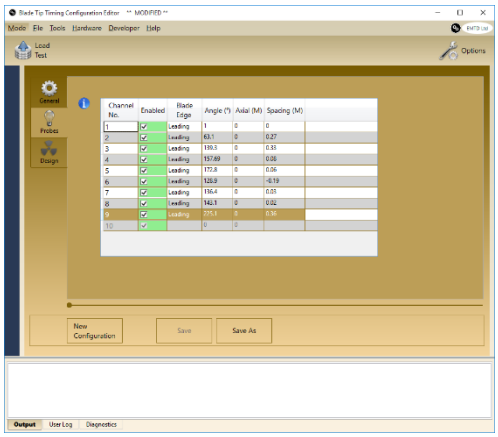
Example data

A number of numerical simulation files have been created to allow checks to be made on any BTT system.

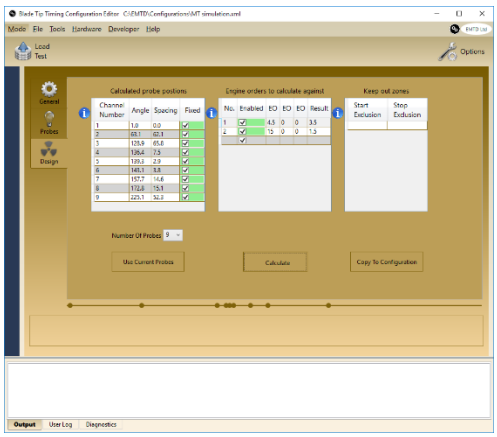
The configuration for each file is identical but the components of vibration vary in each. These files have not been validated against any other standards but are believed to be correct.



General information



Probe Angles



Condition number calculation

All response amplitudes are 1mm peak to peak for all blades.

Probe angles are

1.00˚, 63.1˚, 139.3˚, 157.7˚, 172.8˚, 128.9˚, 136.4˚, 143.1˚, 225.1˚,

Rotor tip radius: 0.254m

Number of blades: 45

Data file R001

15EO ND4 integral response at 5000rpm.

Data file R002

650 Hz ND-2 response at 12,500rpm passing close to an integral.

Data file R003

965 Hz ND 5 non-integral response at 12500 rpm.

Data file R004

15EO ND4 integral response at 12300 rpm

965 Hz ND 5 non-integral response at 12500 rpm.