HT-LEF-200
Ignition Control Unit
User Manual

Doc.-No. :	HT-LEF-200-MN-EN-2017
Version :	1.1.4
Date of Issue :	17.11.2017

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1 Introduction

The HT-LEF-200 is an intelligent digital ignition control unit that delivers precisely timed ignition sparks to ensure optimal combustion engine performance.

The HT-LEF-200 can run as stand-alone (for engines up to 8 cylinders) or in a Master / Slave configuration with two units controlling engines up to 16 cylinders.

A simple configuration is required to make the HT-LEF-200 operate correctly with a given engine. This is done through the intuitive *Ignition System Configuration Software* (denoted “Ignition Software” in the rest of this manual). The same software can be used to monitor relevant data in relation to the operation of the HT-LEF-200.

2 Unit Interfaces

Below follows an overview of the interfaces (I/O and communication) of the HT-LEF-200.

Appendix IV – Pin Layout, lists the connector pins and their function.

2.1 Pickup Sensor Inputs

The unit has two pickup sensor inputs. One sensor is mandatory, the other is optional. Whether one or two sensors must be used depends on the specific installation (see *Chapter 10 Installation*).

2.2 Emergency Stop Input

This input, when pulled to ground, will cause the unit to stop firing.

2.3 Interpolation Input

This 0 - 5 V input can be optionally used, if there is a need to control the firing angle from an external source.

2.4 Digital Output

This configurable output can be optionally used to drive a relay or similar in order to alert that the HT-LEF-200 unit has gone into a certain state or that a certain event has occurred.

2.5 Communication Interfaces

The unit has three communication interfaces, USB, RS485, and CAN.

The *USB interface* is dedicated for communication with the *Ignition Software.*

The *RS485 interface* can also be used for communication with the Ignition Software. In addition this interface may be used by other units supporting the Modbus protocol to write configuration parameters to the HT-LEF-200 unit or to read operational and diagnostics parameters from it.

On the *CAN interface* selected operational and diagnostics parameters are sent out in the J1939 message format. These messages are specified in a separate document called “HT-LEF-200 CAN Message Specification”.

2.6 LEDs

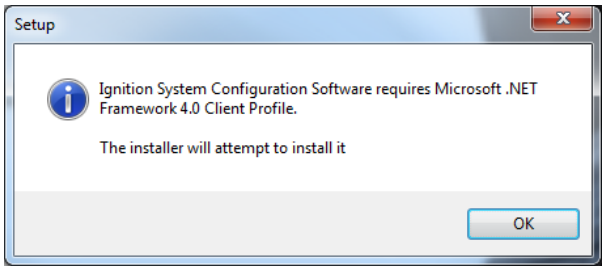
The HT-LEF-200 unit has a green power LED and 8 channel LEDs that can each light up in either green or red color. “Appendix I - Channel LED Indications” explains how to interpret the channel LED indications.

The unit also has 5 smaller, yellow event code LEDs. “Appendix II – HT-LEF-200 Event Codes” and “Appendix III – HT-LEF-100 Event Codes ” list the event codes and explains their meaning.

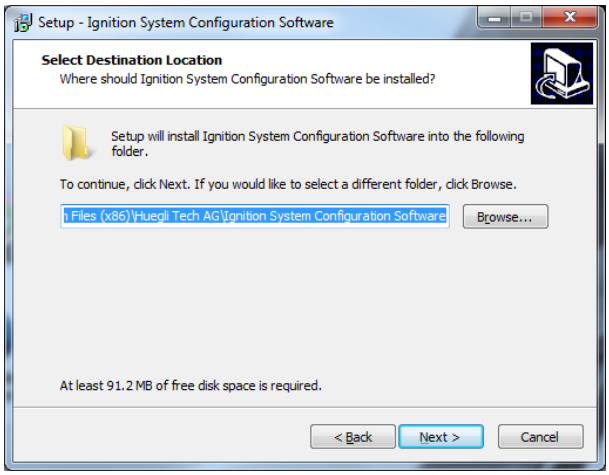
3 Getting Started

3.1 Software Installation

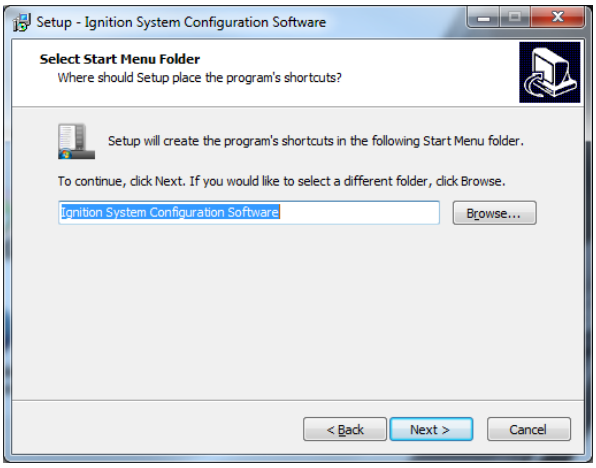
Double-click on the Ignition Configuration Software installation file to run it, then follow the instructions.



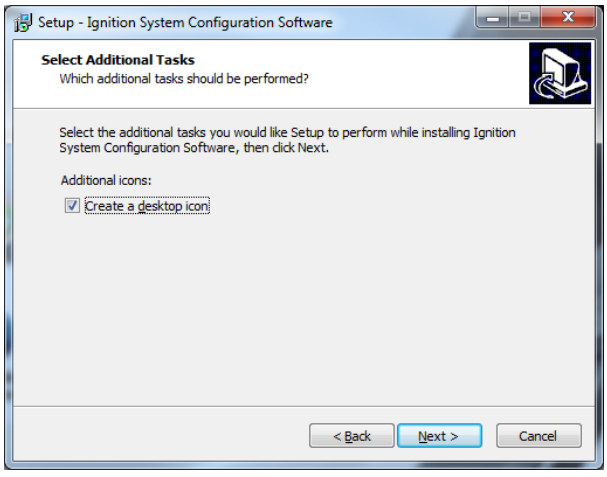
Step 1: Microsoft .NET is required by the ignition software and will be installed if not already present.



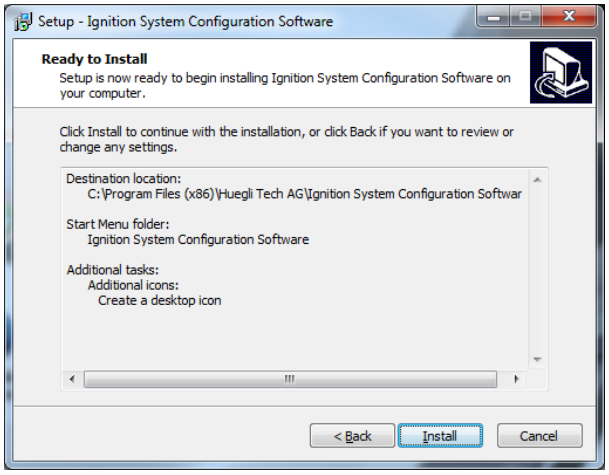
Step 2: Here the folder where the ignition software will be installed is shown. Optionally a different installation folder can be selected.



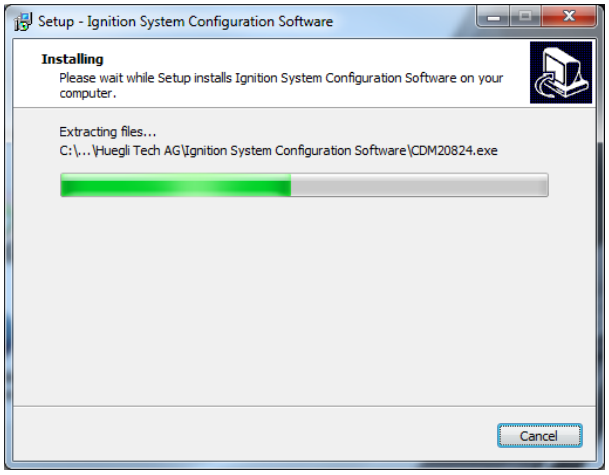
Step 3: The installer will create a folder with a shortcut to the ignition software in the Start Menu under All Programs. The location of this folder may be changed as desired.



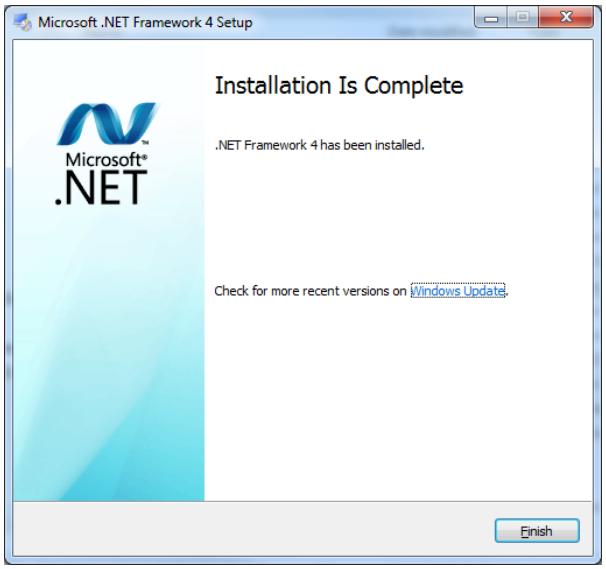
Step 4: Optionally let the installer create a shortcut to the ignition software on the desktop.



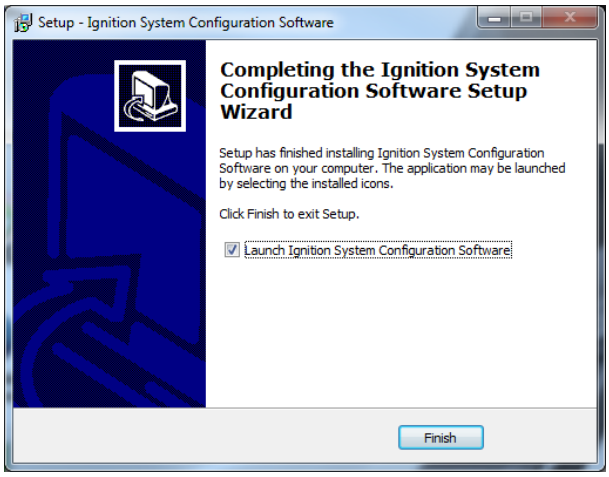
Step 5: Review the previous selections and click 'Install' to start the installation.



Step 6: Wait for the installation to complete.



Step 7: If Microsoft .NET was installed together with the ignition software, this window indicates that the Microsoft .NET installation was completed successfully.



Step 8: This window indicates that the installation of the ignition software was completed successfully.

3.2 First Connection

Now connect a USB cable to your PC, plug it into the HT-LEF-200 and power on the device (the green power LED will turn on). A new virtual COM port is now available on your PC.

Start the Ignition Configuration Software. Under the *Connection* menu at the top, click *Connect*, select the new COM port and finally click *OK*. Now all the parameters and values are retrieved from the HT-LEF-200 unit and displayed.

3.3 Basic Configuration

Various parameters can be configured in the ignition unit. Depending on the engine, and the simplicity of the configuration, most parameters' default values may be acceptable.

A few parameters are fundamental to the operation and cannot be left at their default values.

Table 1: Basic parameters

Parameter	Description
Number of cylinders	This is the number of cylinders on the engine.
Offset Angle	This is the angle from the trigger (i.e. tooth or notch) to the TDC of the associated cylinder.
Firing Angle	The number of degrees before TDC that the spark plugs must fire.
Firing Sequence	The sequence in which the output channels must fire their respective spark plugs in order to achieve the correct firing order for the particular engine.

Figure 1: Configuration & Monitoring (configuration example)

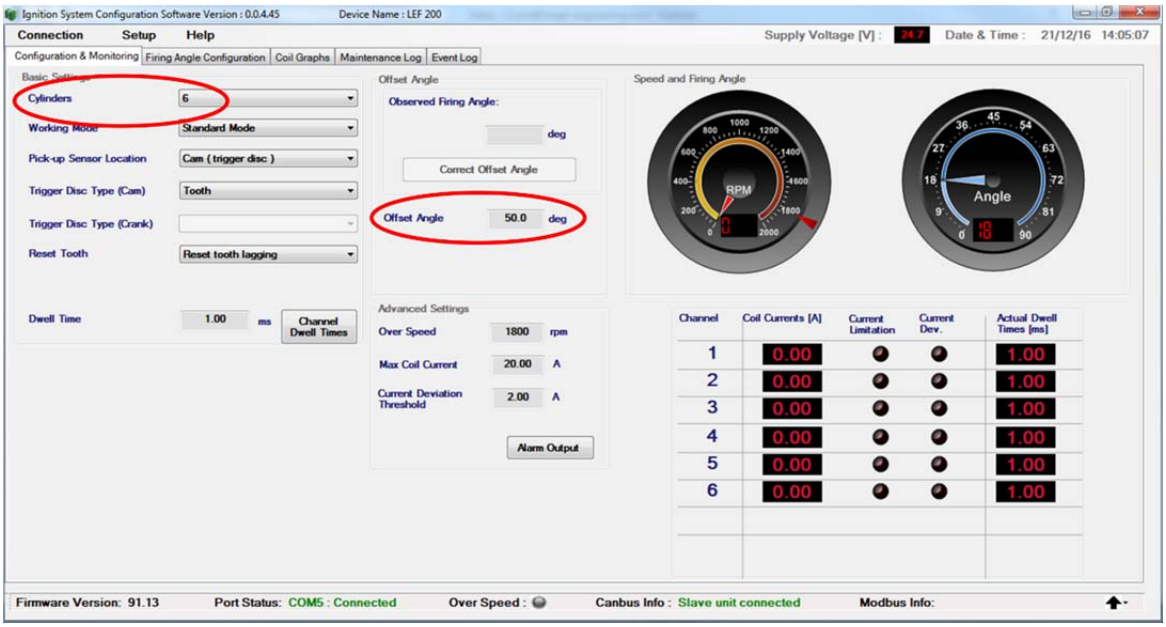
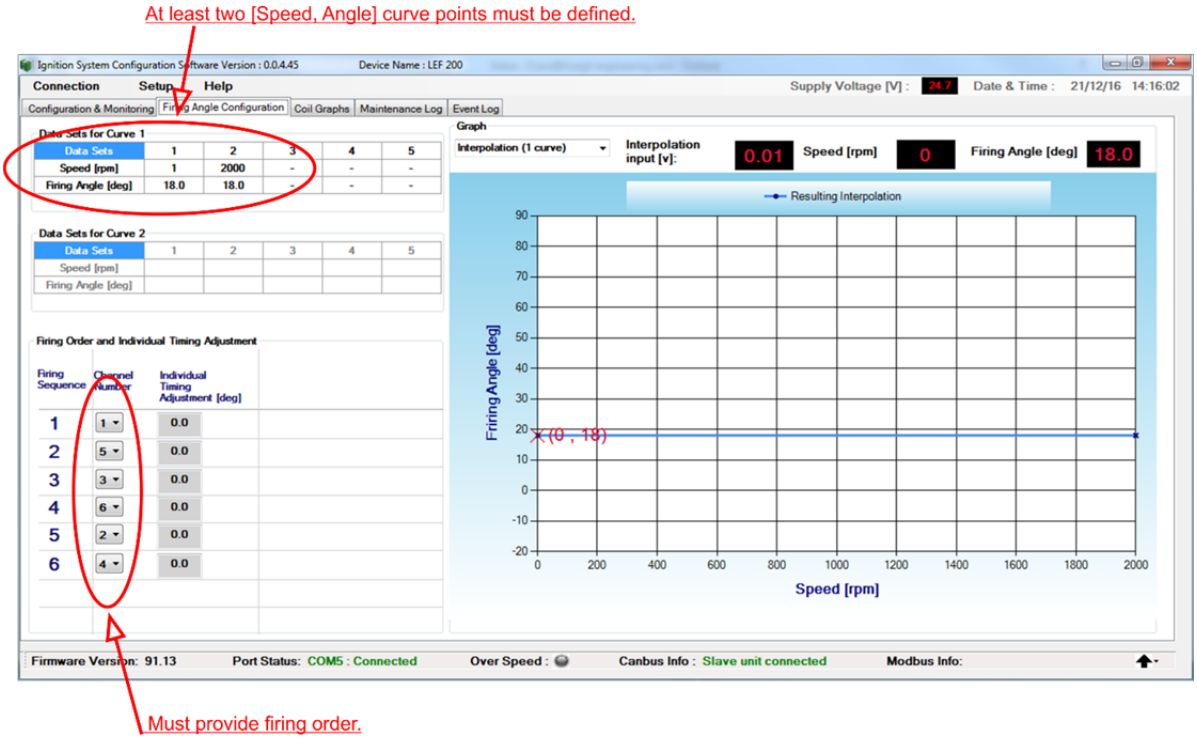


Figure 2: Firing Angle Configuration (configuration example)



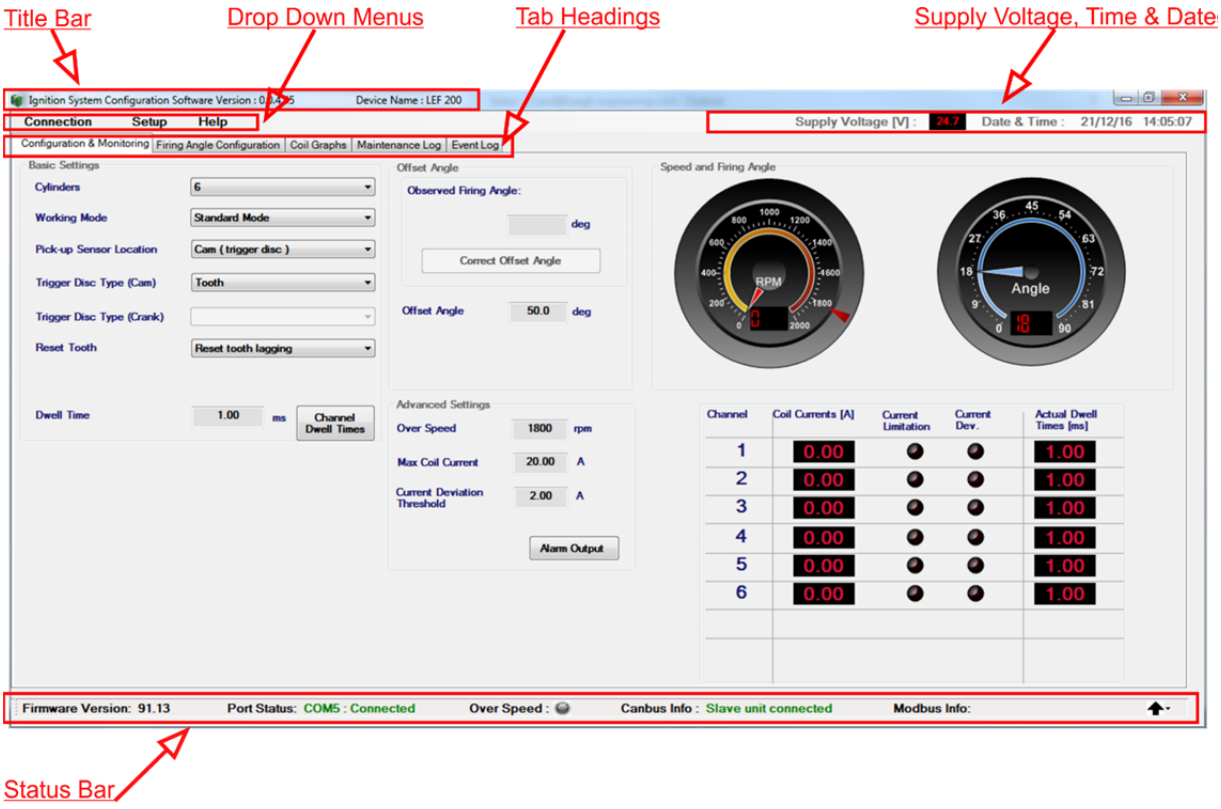
4 Software Overview

The Ignition System Configuration Software is organized in a number of separate tabs that group the supported configuration and monitoring features.

Above the tab headings a number of drop-down menus can be found. Next to these the supply voltage is displayed alongside the time and the date.

At the very bottom a Status Bar is showing various kinds of status information.

Figure 3: User interface overview

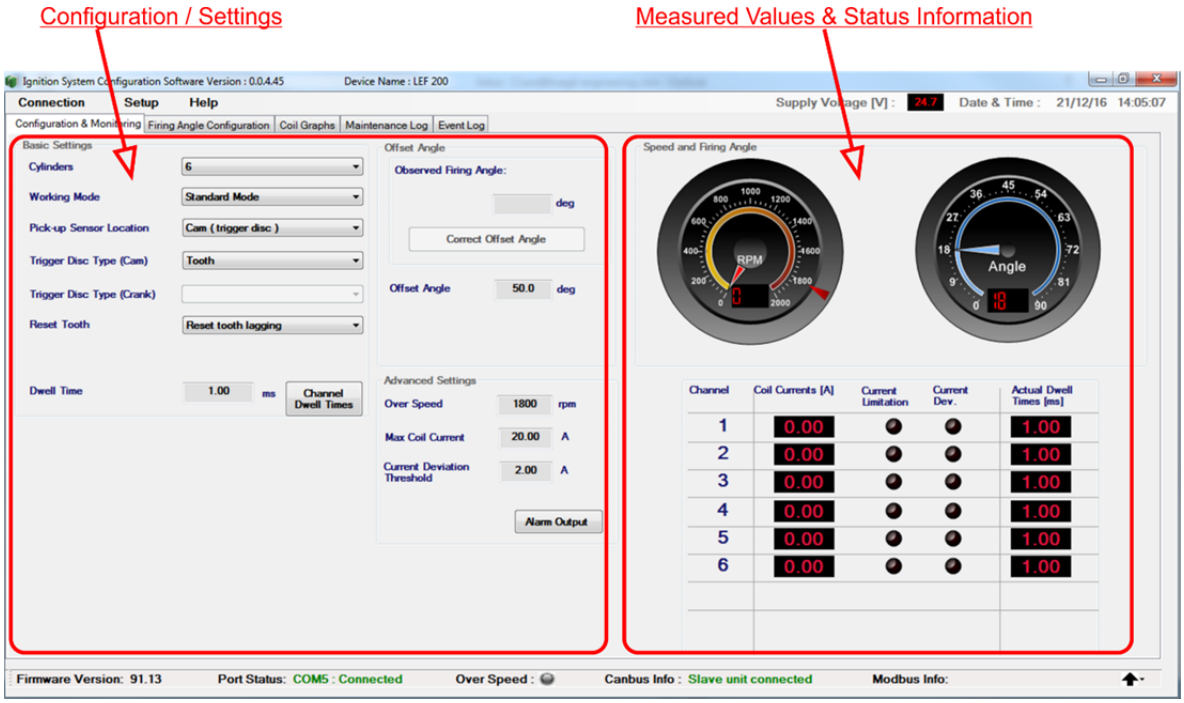


5 Software Tabs

5.1 Configuration & Monitoring Tab

The left side of this tab is where most of the configuring of the HT-LEF-200 is done. The right side is where measured operating values and status information are shown.

Figure 4: Configuration & Monitoring Tab



5.1.1 Configuration

5.1.1.1 Cylinders

Configure the number of cylinders here.

5.1.1.2 Working Mode

Table 2: Working Mode

Setting	Description
Standard Mode	When running in Standard Mode one HT-LEF-200 unit it is controlling the ignition of an engine with up to 8 cylinders. In this Working Mode the HT-LEF-200 operates as a stand-alone unit.
Master Mode	In a Master / Slave setup two HT-LEF-200 units are working together to control the ignition of an engine with up to 16 cylinders. In this mode the two units take turns in creating the sparks. The two units are connected with each other using a wiring harness dedicated for this type of operation.
Slave Mode	See above.

In Master Mode only the Master unit needs to be configured. The Slave unit will receive its configuration from the Master unit.

It is possible still to connect the PC software to the Slave unit and view the configuration and measured operating values, but most of the settings cannot be changed, as they are dictated by the Master.

5.1.1.3 Pickup Sensor Location

Table 3: Pickup Sensor Location

Setting	Description
Cam (trigger disc)	One pickup sensor is used. It is mounted next to a trigger disc/device that rotates with the cam shaft. The trigger disc has a trigger for each engine cylinder. It also has a reset trigger that's located right before or right after the trigger associated with the last cylinder in firing order [also see 5.1.1.5 Reset Tooth (Single Pickup Configuration), and, 10.1.2.1 Trigger Disc]. For one cylinder engines the trigger disc has only one trigger and no reset.
Cam (trigger disc - wasted spark) See: Note 1	One pickup sensor is used. It is mounted next to a trigger disc/device that rotates with the crank shaft. The trigger disc has a trigger for each engine cylinder. It also has a reset trigger that's located right before or right after the trigger associated with the last cylinder in firing order. In this configuration, which only supports 3-cylinder engines, the HT-LEF-200 is not only creating a spark in the combustion stroke of each cylinder but also one in the exhaust stroke.
Crank (triggers) & Cam (reset) See: Note 1	Two pickup sensors are used. One is mounted next to triggers fitted on the crank shaft. There must be exactly half as many triggers as the engine has cylinders. In a Master / Slave setup, there must be exactly half as many triggers as the Master bank has cylinders. The other pickup sensor is mounted next to a reset trigger fitted on the cam shaft.
Crank (timing wheel) & Cam (reset) See: Note 1	Two pickup sensors are used. One is mounted next to triggers fitted on the crank shaft. There must be at least half as many triggers as the engine has cylinders. The highest supported number of triggers is 60. In a Master / Slave setup, there must be at least half as many triggers as the Master bank has cylinders. The other pickup sensor is mounted next to a reset trigger fitted on the cam shaft.

Notes

1. These configurations can be used in setups, where space constraints make it difficult or impossible to mount a trigger disc on the cam shaft.

5.1.1.4 Trigger Type

There is a trigger type configuration for the cam sensor and, if applicable, one for the crank sensor as well.

Table 4: Trigger Disc Type

Setting	Description
Tooth	The trigger passing the sensor is a tooth, a screw or similar protruding metal.
Notch	The trigger passing the sensor is a notch, a hole or similar void / absence of material.

5.1.1.4.1 HT-LEF-100

For the older HT-LEF-100 unit, the Trigger Disc Type configuration is not available / required. Instead the sensor type must be configured.

This configuration option is only visible when the Ignition Software is connected to an HT-LEF-100 unit.

5.1.1.5 Reset Tooth (Single Pickup Configuration)

Table 5: Reset Tooth

Setting	Description
Lagging	In direction of rotation the *Reset Tooth* (or *Reset Trigger*) appears after the tooth associated with the last channel in firing order.
Leading	In direction of rotation the *Reset Tooth* (or *Reset Trigger*) appears before the tooth associated with the last channel in

	firing order.

5.1.1.6 Dwell Time

The dwell time expresses how long time the coils are charged before the spark is created. The amount of energy released from the coil to the spark plug is approximately proportional to the configured *Dwell Time*.

When this common Dwell Time is set, the dwell times of all channels become identical to that value. This is what's normally needed, as usually the required spark energy is the same for all cylinders.

If desired the Dwell Time can be configured individually for each channel by clicking the 'Channel Dwell Times' button.

The highest Dwell Time that can be configured depends on the configured Over-Speed limit. If the configured Over-Speed limit is more than 2500 rpm, the highest configurable Dwell Time is 2.50 ms.

If the configured Over-Speed limit is 2500 rpm or less, the highest configurable Dwell Time is 5.00 ms.

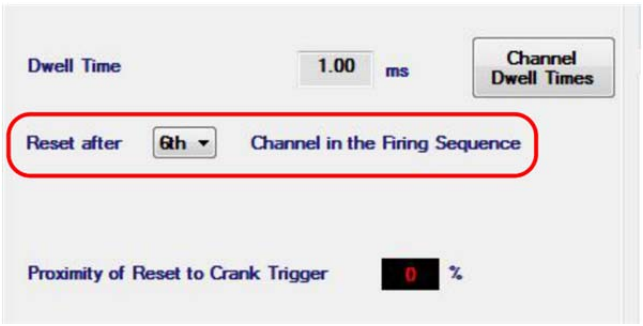
Warning: Caution must be taken when configuring the Dwell Time. Different coil types have different maximum Dwell Time specifications. If the charging time exceeds specifications, the charging current may increase rapidly and damage the coils.

5.1.1.7 Reset After Xth Channel in the Firing Sequence (Dual Pickup Configuration)

This configuration only applies to setups where the *Pickup Sensor Location* is configured to *"Crank (triggers) & Cam (reset)".*

Here the position of the *Reset Trigger* is configured.

Figure 5: Reset Trigger Position



The configuration tells the HT-LEF-200 where the *Reset Trigger* appears, seen in relation to the *Timing Triggers* on the crank shaft.

For example, if the engine has 6 cylinders and the *Reset Trigger* appears somewhere between the *Timing Trigger* of the 6th channel that fires and the *Timing Trigger* of the 1st channel that fires, then the correct configuration is "Reset after **6th** Channel in the Firing Sequence".

5.1.1.8 Number of Triggers on Timing Wheel (Dual Pickup Configuration)

This configuration only applies to setups where the *Pickup Sensor Location* is configured to *"Crank (timing wheel) & Cam (reset)".*

Here the number of *Triggers* on the *Timing Wheel* is configured.

Figure 6: Number of Triggers on Timing Wheel

5.1.1.9 Angle Zero Point defined by Trigger Number X after the Reset (Dual Pickup Configuration)

This configuration only applies to setups where the *Pickup Sensor Location* is configured to *"Crank (timing wheel) & Cam (reset)".*

Here the position of the *Reset Trigger* is configured.

Figure 7: Reset Trigger Position

The configuration tells the HT-LEF-200 where the *Reset Trigger* appears, seen in relation to the *Triggers* on the *Timing Wheel*.

For example, if the *Trigger* on the *Timing Wheel* that must indicate the angle zero point appears as the 5th *Trigger* after the *Reset Trigger*, then the correct configuration is *"Angle Zero Point defined by Trigger Number **5** after the Reset"*.

5.1.1.10 Proximity of Reset to Crank Trigger (Dual Pickup Configuration)

This configuration only applies to setups where the *Pickup Sensor Location* is configured to either *"Crank (triggers) & Cam (reset)"* or to *"Crank (timing wheel) & Cam (reset)".*

While the engine is running, this parameter shows how close the *Reset Trigger* is located to its neighboring *Timing Triggers*.

Figure 8: Proximity of Reset to Crank Trigger

The *Timing Wheel* (crank shaft) and the *Reset Trigger* (cam shaft) must be mounted in such a way that the *Reset Trigger* does not coincide with any of the *Timing Triggers*.

In other words, at the moment when the *Reset Trigger* is right at the cam pickup sensor, the closest *Timing Trigger* must be some distance away from the crank pickup sensor.

If this parameter is in the lower percentage range (near 0 %), it means the *Reset Trigger* appears closely after a *Timing Trigger*.

If the parameter is in the upper percentage range (near 100 %), it means the *Reset Trigger* appears closely before a *Timing Trigger*.

To have sufficient margin the *Timing Wheel* (crank shaft) and the *Reset Trigger* (cam shaft) must be mounted in such a way that this parameter stays above 30 % and below 70 % at all times.

For installations where speeds of 3000 rpm or more are required and where the *Timing Wheel* has more than 30 *Timing Triggers*, the *Timing Wheel* and the *Reset Trigger* must be mounted in such a way that this parameter stays above 40 % and below 60 %.

5.1.1.11 Offset Angle

This configuration does not apply to setups where the *Pickup Sensor Location* is configured to *"Crank (timing wheel) & Cam (reset)".*

The *Offset Angle* is the angle from a *Timing Trigger* to the TDC of the cylinder timed by that trigger.

For one cylinder engines the trigger disc must be mounted in such a way that the *Timing Trigger* appears at the pickup sensor at least 30 degrees before the firing point. Note: The trigger disc for a one cylinder engine has one *Timing Trigger* and no *Reset Trigger*.

5.1.1.12 'Correct Offset Angle' button

This configuration does not apply to setups where the *Pickup Sensor Location* is configured to *"Crank (timing wheel) & Cam (reset)".*

During installation and commissioning a common scenario is that the actual firing angle being observed by the use of a timing light while the engine is being cranked or is running deviates from the configured firing angle by a small amount.

Various mechanical and electrical factors can cause this. One way to get the HT-LEF-200 to fire exactly at the configured firing angle, is to adjust the Offset Angle to compensate for the observed deviation. This adjustment can be done automatically by keying in the observed firing angle in the dedicated field and then clicking the 'Correct Offset Angle' button. The *Offset Angle* will then be adjusted, after which the firing angle observed by using the timing light will match the configured firing angle.

5.1.1.13 V-Angle

This configuration is only relevant in Master / Slave setups on V-engines, where the Master unit creates the sparks for one bank and the Slave unit creates the sparks for the other. In such a setup, the two units take turns in creating a spark and the V-angle is the number of degrees by which the Slave must fire after the Master.

5.1.1.14 Over-Speed

This configuration defines the speed at which the HT-LEF-200 will stop firing the spark plugs. The firing will be disabled until the engine comes to a halt.

The highest Over-Speed limit that can be configured depends on the configured Dwell Time. If the configured Dwell Time is more than 2.50 ms, the highest configurable Over-Speed limit is 2500 rpm.

For lower Dwell Times the Over-Speed limit can be configured freely.

5.1.1.15 Maximum Coil Current

This configuration is the highest current the HT-LEF-200 will allow when charging the ignition coils.

During the charging time of an ignition coil (i.e. during the Dwell Time), the charging current rises linearly over time until the point when the coil is discharged and the spark is created.

In the unlikely event that a short somewhere in the wiring causes the current to increase uncontrollably, the HT-LEF-200 will interrupt charging the coil to prevent damage to the unit, the coils etc. At the same time the Dwell Time of the associated channel is reduced to a value, where charging can be completed without reaching a potentially damaging current. The dwell time will stay at this reduced value until the engine has stopped and is being started again.

The Maximum Coil Current configuration is the threshold at which charging is interrupted and the Dwell Time is reduced.

5.1.1.16 Current Deviation Threshold

The Current Deviation Threshold is used to configure the current deviation detection functionality, which must be done while the engine is running. Observe the coil currents in the Configuration & Monitoring tab and roughly estimate the different between the highest and the lowest value. Configure the Current Deviation Threshold to at least 1 Amp more than this estimated difference.

Any current deviation detected after the engine was last started is indicated by the LEDs in the Configuration & Monitoring tab. It is also indicated by the channel LEDs on the physical unit. They will be constantly lit in red color for the channels where the current has deviated.

To disable the current deviation detection functionality, set the Current Deviation Threshold to the highest possible value (9.99 Amps).

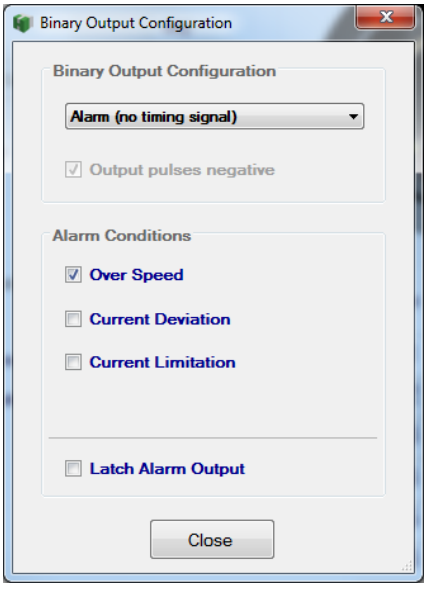
5.1.1.17 Binary Output Configuration

The Binary Output can be used for two different purposes:

- An Alarm Output, which is pulled to ground when an alarm condition is present.
- A Timing Output, which can be configured to generate pulses to time an external device.

When clicking the ‘Binary Output Configuration’ button, the configuration window appears.

Figure 9: Binary Output Configuration Window



5.1.1.17.1 Binary Output Configured as an Alarm Output

When the Binary Output is configured as an Alarm Output, the alarm will go off when one or more of the checked alarm conditions are present.

If the 'Latch Alarm Output' checkmark is not checked, the alarm condition is cleared when the engine comes to a halt.

If the 'Latch Alarm Output' checkmark is checked, the alarm condition is not cleared until the HT-LEF-200 unit is repowered.

5.1.1.17.2 Binary Output Configured as a Timing Output

Important!
When the Binary Output is configured as a Timing Output, a pull-up resistor must be connected between the Binary Output and V_{bat}. The suggested resistor value is 2.7K ohm, but the value is not critical.

The timing signal can be configured to one of the following two behaviors:

- A pulse is generated right at the firing point of the first cylinder in firing order.
- A pulse is generated every time a trigger disc signal is detected (i.e. every time a tooth or a notch is detected by the trigger disc pickup sensor).

The checkmark decides if the pulses are positive (signal goes high to generate the pulse) or negative (signal goes low to generate the pulse).

Figure 10: Positive Pulses at the Firing Point of the 1st Cylinder

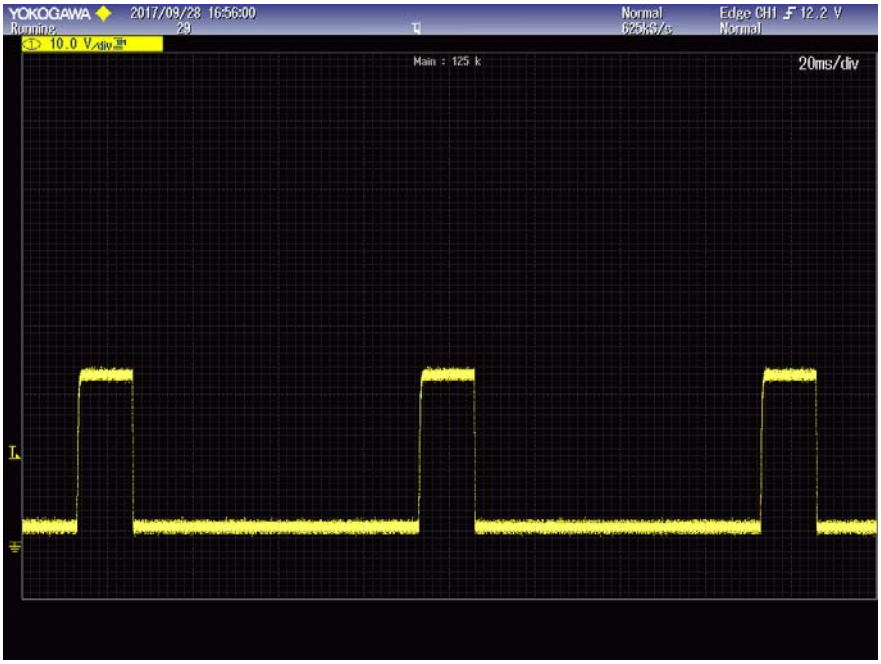
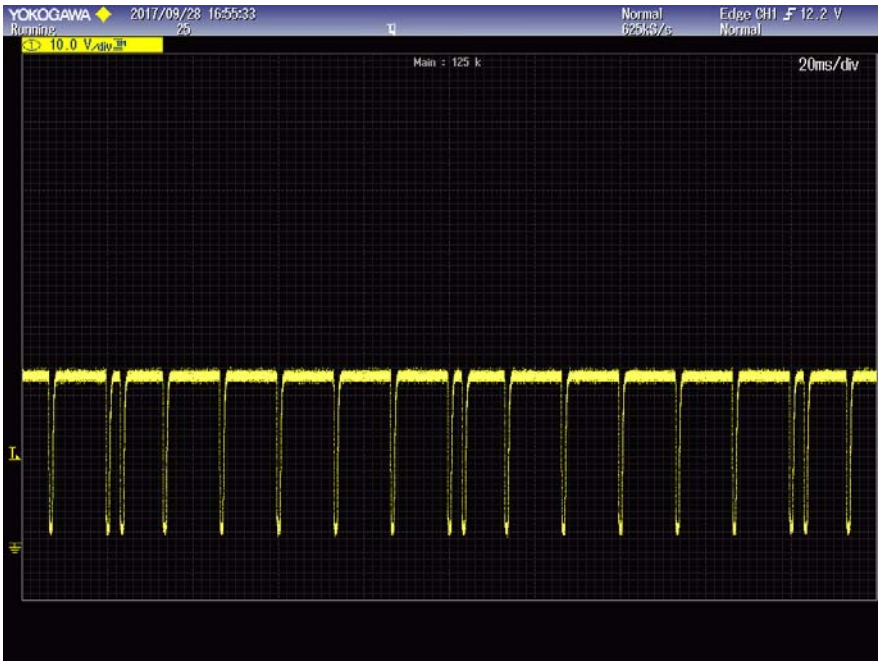


Figure 11: Negative Pulses Following the Trigger Disc



5.1.2 Measured Values & Status Information

At the right side of the tab, two gauges show the engine speed and the firing angle.

Below the two gauges the charging currents of each channel and the individual Channel Dwell Times are shown.

If dwell times have not been configured individually and if there has been no automatic dwell time reduction due to high charging currents, the Channel Dwell Times will all be identical to the common Dwell Time that has been configured.

5.1.2.1 Current Limitation

If at any point in time the charging current of one or more channels exceeds the configured *Maximum Coil Current*, the *Dwell Times* of those channels will be automatically reduced to bring the current down below this configured threshold. Such a current limitation does not happen during normal operation and is done to protect the HT-LEF-200 unit as well as coils and cabling against unrealistically high currents caused by shorts or faulty coils or wiring.

The red LEDs in the Current Limitation LED column indicate for which channels a current limitation has occurred since the engine was started.

5.1.2.2 Current Deviation

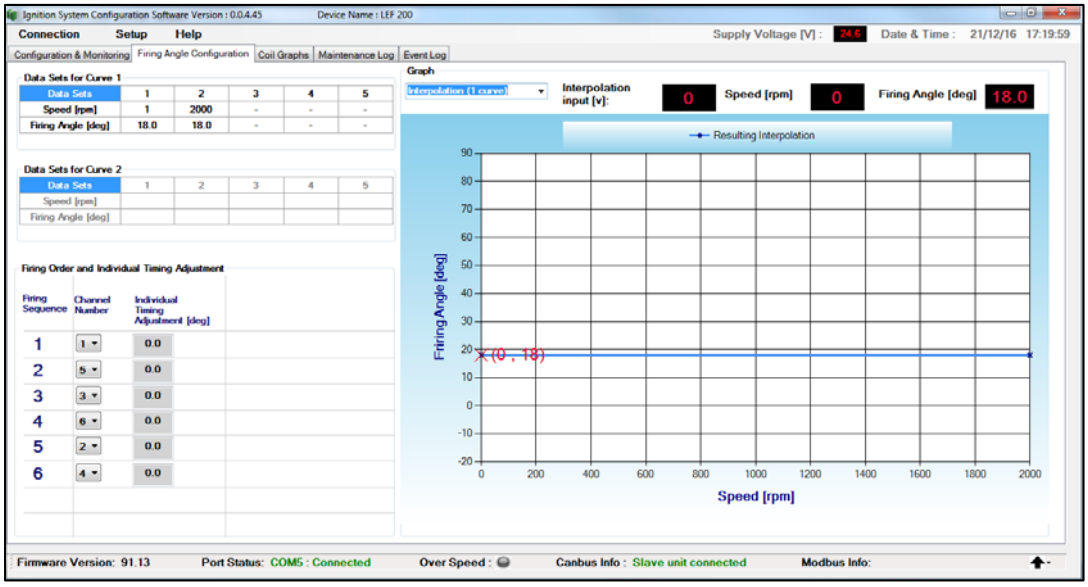
If at any point in time the configured threshold for charging current deviation is exceeded, this is considered an unintended current deviation.

The red LEDs in the Current Deviation LED column indicate for which channels a current deviation has occurred since the engine was started.

5.2 Firing Angle & Firing Sequence tab

The left side of this tab is where configuration related to firing angle and firing order is done. The right side shows a graphical representation of the firing angle as a function of the speed.

Figure 12: Firing Angle & Firing Sequence tab



Two different interpolation configurations are available.

5.2.1 Interpolation (1 curve)

The firing angle is configured as a set of [Speed, Angle] curve points defining a curve that expresses the firing angle as a function of the engine speed. This is the common way to configure the firing angle.

5.2.2 Interpolation (2 curves)

Optionally a second curve may be defined. This curve also expresses the firing angle as a function of engine speed. In between these two curves a third resulting curve appears. This third curve, which is an interpolation between the two configured curves, is defining the firing angle in this configuration.

The interpolation is controlled by the 0 - 5 V interpolation input of the HT-LEF-200. With 0 V on the input the resulting firing angle curve overlaps with Curve 1. With 5 V on the input the second curve overlaps with Curve 2. With any voltage between 0 V and 5 V on the input, the resulting firing angle curve appears in between curves 1 and 2, and the vertical distance to each curve is scaled in accordance with the voltage on the interpolation input.

5.2.3 Curve Definition

The firing angle curves are defined in the two tables at the left side of the tab as sets of [Speed, Angle] curve points. A maximum of 5 curve points can be defined for each curve. At least one curve point is required for each curve.

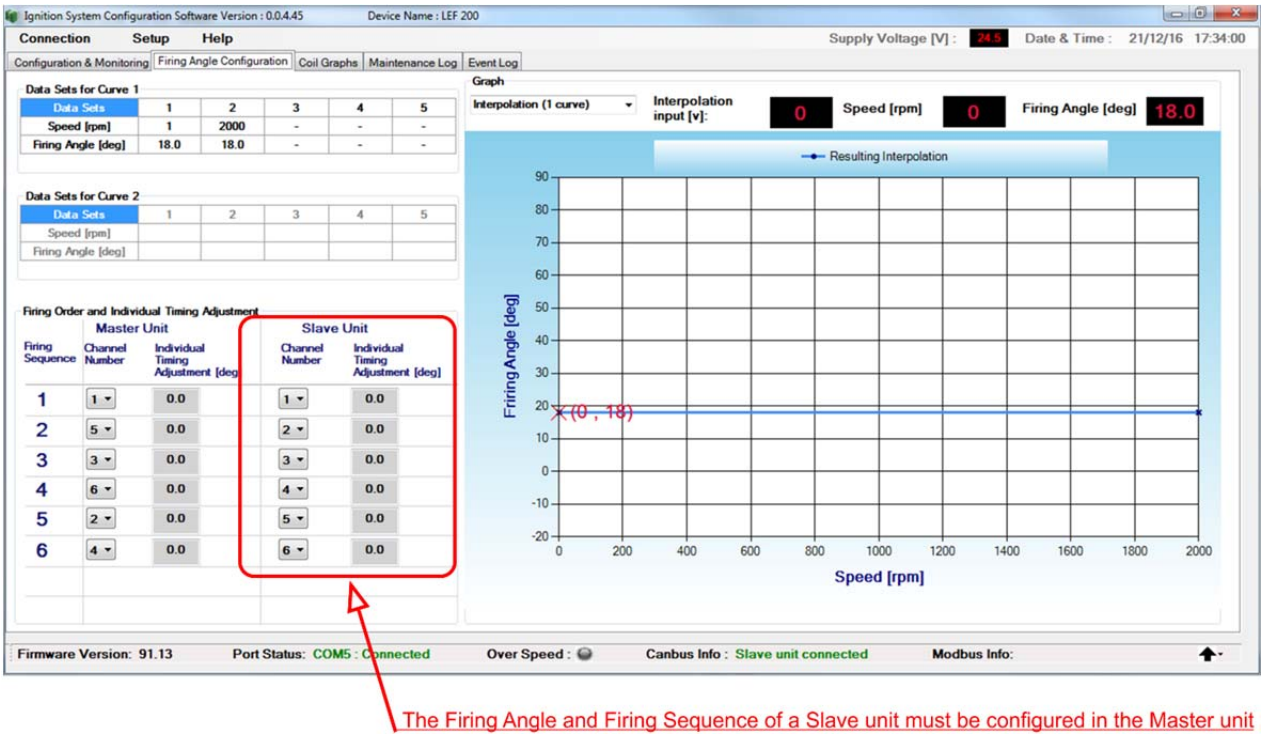
Curve points where the speed is configured to 0 are ignored. It is not possible to define more than one curve point with the same speed.

5.2.4 Firing Sequence

At the lower left side of the tab, the firing sequence must be defined. In one cycle as many channels are fired as there are engine cylinders. The configured firing sequence tells the HT-LEF-200 in which order the channels must fire. In the screen shot they fire in this sequence: 1 -> 5 -> 3 -> 6 -> 2 -> 4.

Note: In a Master / Slave setup the Firing Sequence of the Slave unit must be configured in the Master unit (see below):

Figure 13: Firing Angle & Firing Sequence tab (Master unit)



5.2.5 Individual Timing Adjustment

Small mechanical imbalances can be compensated for by configuring the Individual Timing Adjustment settings to values different from zero. These settings are signed values that are added to the common firing angle defined.

Note: In a Master / Slave setup the Individual Timing Adjustment of the Slave unit must be configured in the Master (see At the lower left side of the tab, the firing sequence must be defined. In one cycle as many channels are fired as there are engine cylinders. The configured firing sequence tells the HT-LEF-200 in which order the channels must fire. In the screen shot they fire in this sequence: 1 -> 5 -> 3 -> 6 -> 2 -> 4.

Note: In a Master / Slave setup the Firing Sequence of the Slave unit must be configured in the Master unit (see below):

Figure 13: Firing Angle & Firing Sequence tab (Master unit).

5.3 Coil Graphs tab

In this tab the coil charging currents and the coil voltages can be viewed in graphical form.

5.3.1 Coil Charging Currents

The charging currents rise linearly over the charging time (Dwell Time). This graphical representation allows easy comparison of the charging currents to see if the graphs all look similar, like they are expected to. If a graph is deviating, it is likely that the coil or coil connection associated with it is faulty.

The peak values of the current graphs (i.e. the current right before the coil is discharged and the spark is created) are identical to the coil currents shown in the Configuration & Monitoring tab. These peak values are the basis of the current deviation detection functionality (see chapter 5.1.1.16, “Current Deviation Threshold” and chapter 5.1.2.2, “Current Deviation”). If a current deviation is detected for a channel, the coil graph associated with that channel can be observed in order to get some idea about the nature of the charging current problem.

Figure 14: Coil Graphs Tab

5.3.2 Coil Voltages

These graphs show the coil voltages measured on the primary side of the coil for some milliseconds, starting from the point in time where the coil is discharged. The measure period can be configured at the top of the tab. This affects the graph view but does not affect any functionality.

The voltage measured on the primary side of the coil is much lower than the voltages measured on the secondary side, but the characteristics of the two voltage waveforms are very similar. As with the coil currents, these voltage waveforms are also expected to look similar. If they don't, it is likely that the coil, the sparkplug or the cabling associated with the channel of the deviating graph is faulty.

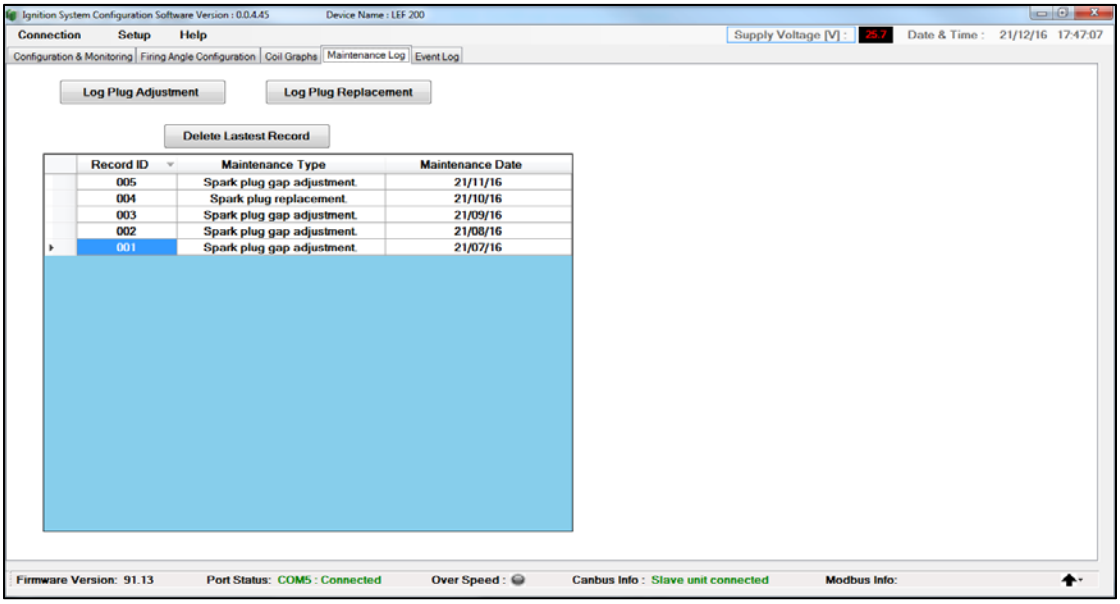
5.4 Maintenance Log Tab

This tab allows for keeping a record of the spark plug maintenance on the engine.

To record a maintenance activity where the spark plug gaps were adjusted, click the button 'Log Plug Adjustment'.

To record a maintenance activity where the spark plug gaps were replaced, click the button 'Log Plug Replacement'.

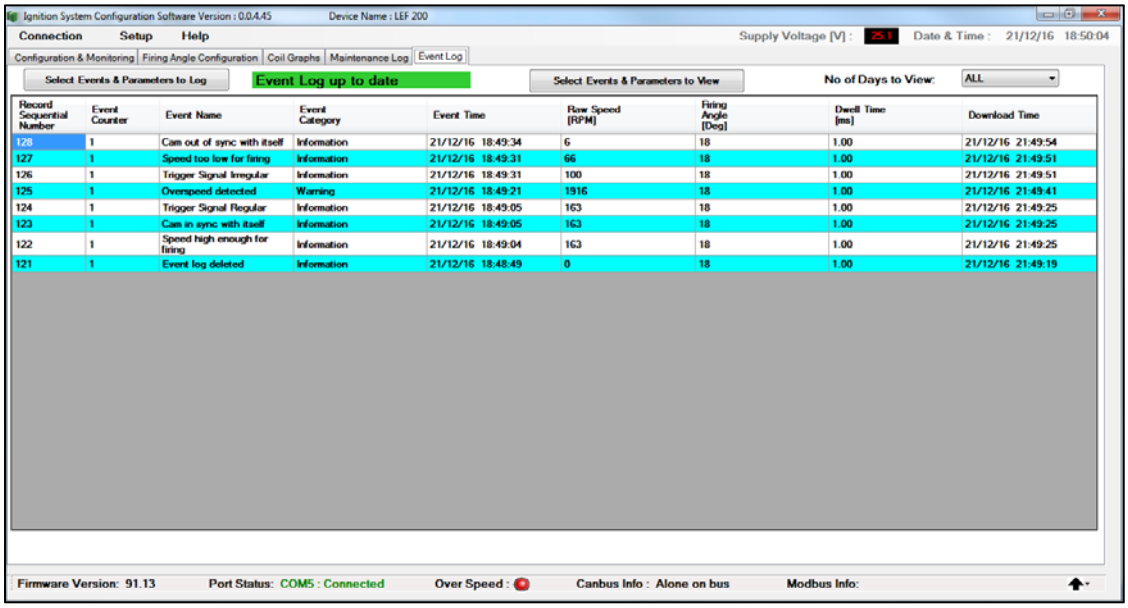
Figure 15: Maintenance Log tab



5.5 Event Log Tab

In this tab events logged by the HT-LEF-200 are displayed. Events are logged automatically as they happen and are stored in the unit. The log has the capacity to store up to 200 events, after which the oldest events will begin to get overwritten. Whenever the Ignition Software is connected to the HT-LEF-200 and the Event Log tab is being shown, new events that were logged since the last time the Ignition Software was connected to the unit are uploaded and stored in a database on the PC. This helps preserve events before they are overwritten.

Figure 16: Event Log Tab



5.5.1 Event Types

The events are divided in three categories:

Information events are logged when something happens as part of the normal operation routine. A number of information events occur every time the engine is started and stopped.

Warning events are logged if something happens which is not necessarily critical but not part of the normal operation routine (emergency stop pressed, over-speed detected, misfiring detected, current deviation detected, current limitation detected etc.).

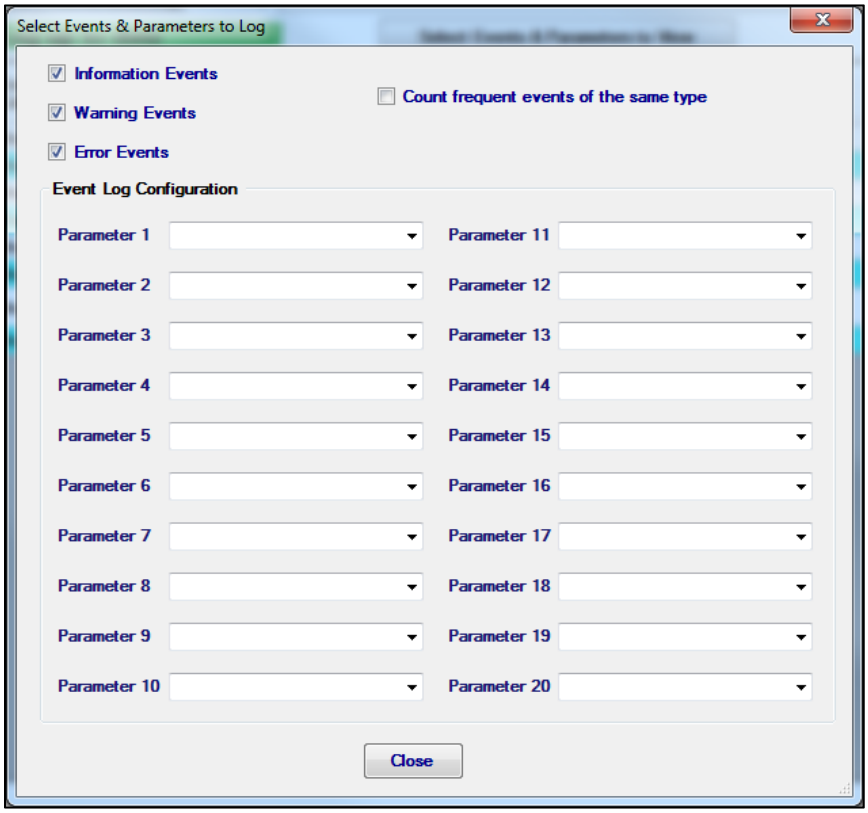
Error events are logged if an internal unit failure should happen.

Together with each event up to 20 parameters may be logged. Which parameters are logged with each event can be configured by clicking the button 'Select Events & Parameters to Log'.

5.5.2 Events and Parameters to Log

When clicking the button 'Select Events & Parameters to Log', a window opens where the event categories to be logged can be selected. The parameters to be logged with each event can also be selected here.

Figure 17: Events & Parameters to Log



The Information Events provide an opportunity to monitor what happens internally in the HT-LEF-200 when starting and stopping the engine etc. In some situations these events can be useful, but they also contribute to filling up the Event Log. Un-checking the 'Information Events' checkmark will result in an Event Log that's easier to read and does not fill up for many months or even years.

Note: Only the event categories and parameters selected here can be viewed in the Event Log.

5.5.2.1 Count Frequent Events of the Same Type

When the checkmark 'Count frequent events of the same type' is set, events that happen frequently do not create a new record in the Event Log. Instead the latest record holding an event of the same type is updated as follows:

- The time stamp is updated to the time of the newest event.
- The values of the parameters in the record are updated to the values measured at the time of the newest event.

- The Event Counter is incremented by one.

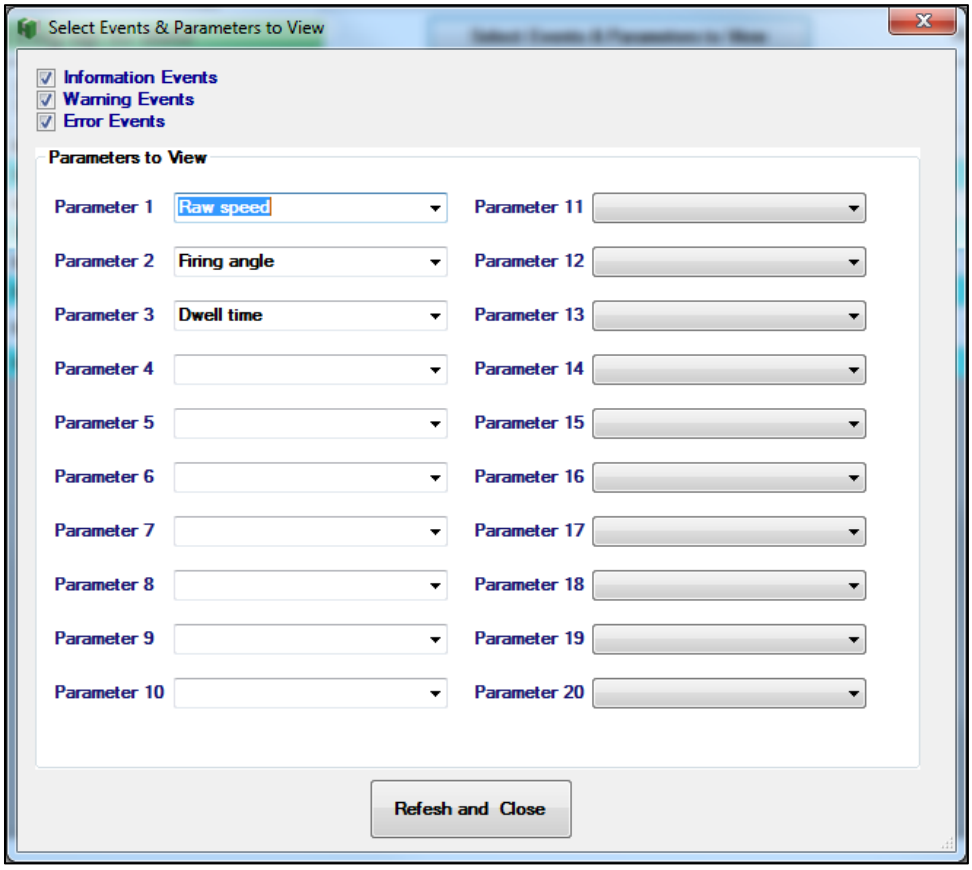
With the checkmark set, if an event occurs and an identical event was logged less than one hour earlier, then the record of the existing event is updated as described above.

Setting this checkmark is another way to obtain a simpler Event Log, which does not fill up fast.

5.5.3 Events and Parameters to View

When clicking the button 'Select Events & Parameters to View', a window opens where the event categories to be viewed can be selected. The parameters to be viewed with each event can also be selected here.

Figure 18: Events & parameters to View



Note: Regardless of which event categories and parameters have been selected for viewing, only event categories and parameters that were previously selected in the "Select Events & Parameters to Log" window will appear in the Event Log.

5.5.4 Number of Days to View

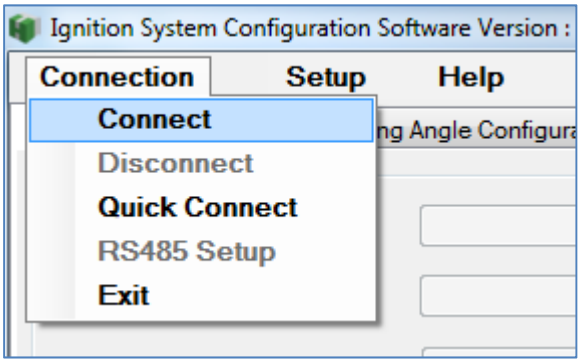
This selection makes it possible to only view more recent events and filter out the older ones.

6 Drop-Down Menus

At the top of the PC software there are three drop-down menus, which will now be explained.

6.1 Connection

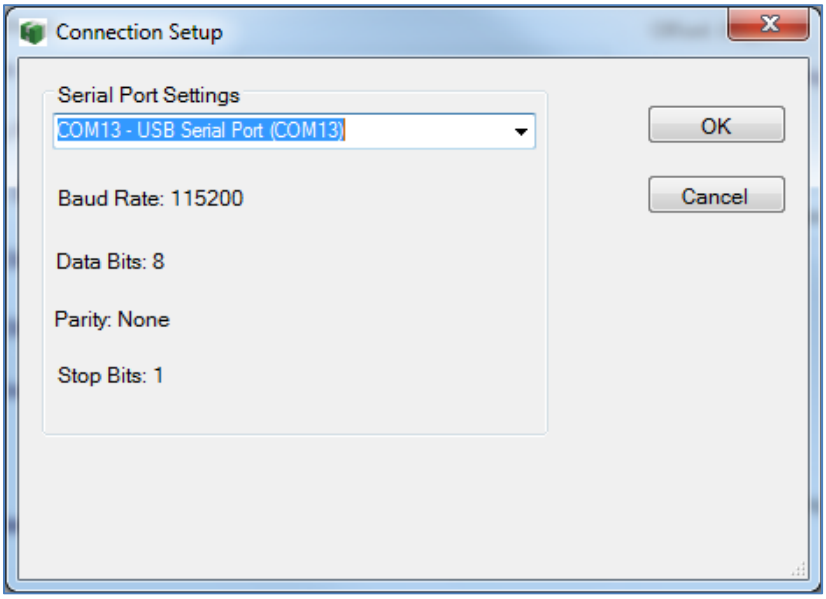
Figure 19: Connection drop-down menu



6.1.1 Connect

Here the COM port of the HT-LEF-200 must be selected before connecting to the unit.

Figure 20: Connection Setup

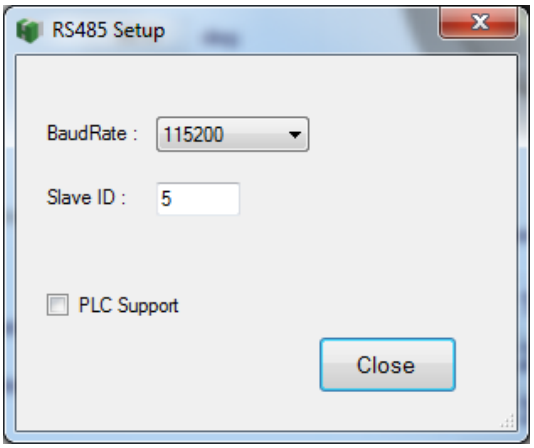


6.1.2 RS485 Setup

In this window the RS485 communication interface can be configured to operate differently from the standard configuration. All configuration here relates to the Modbus protocol that runs on this interface. Changing any of the settings will prevent the Ignition Software from communicating with the HT-LEF-200 and is therefore only relevant, if another device is going to communicate with the HT-LEF-200 unit.

The RS485 Setup window can only be accessed when connected to the unit via the USB interface.

Figure 21: RS485 Setup

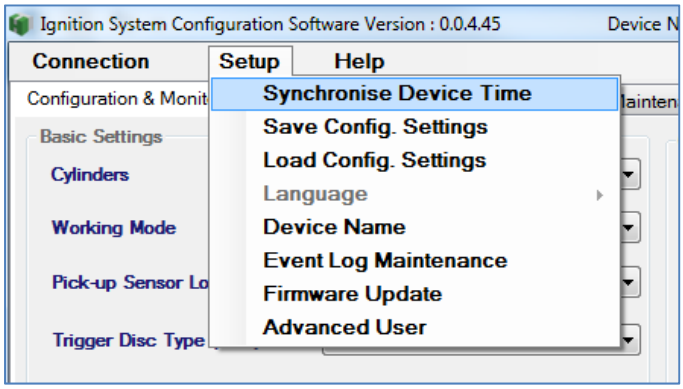


The ‘Baud Rate’ and the ‘Modbus Slave ID’ can be changed.

By checking the ‘PLC Support’ checkmark, the unit will support a Modbus register address set that complies with the standard Modbus protocol.

6.2 Setup

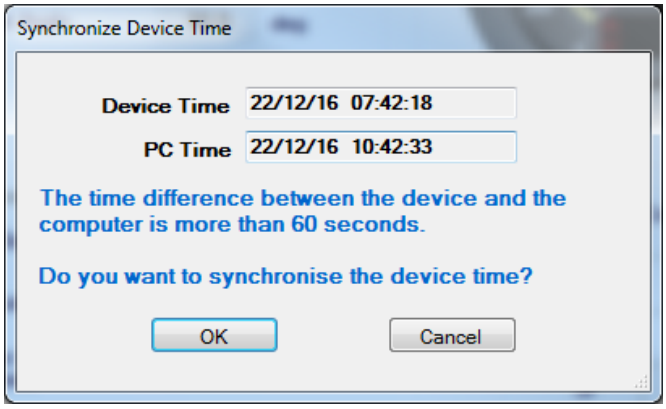
Figure 22: Setup drop-down menu



6.2.1 Synchronize Device Time

This window shows the date and time held by the HT-LEF-200 and the date and time held by the PC. Clicking OK will synchronize the date and time of the unit with that of the PC.

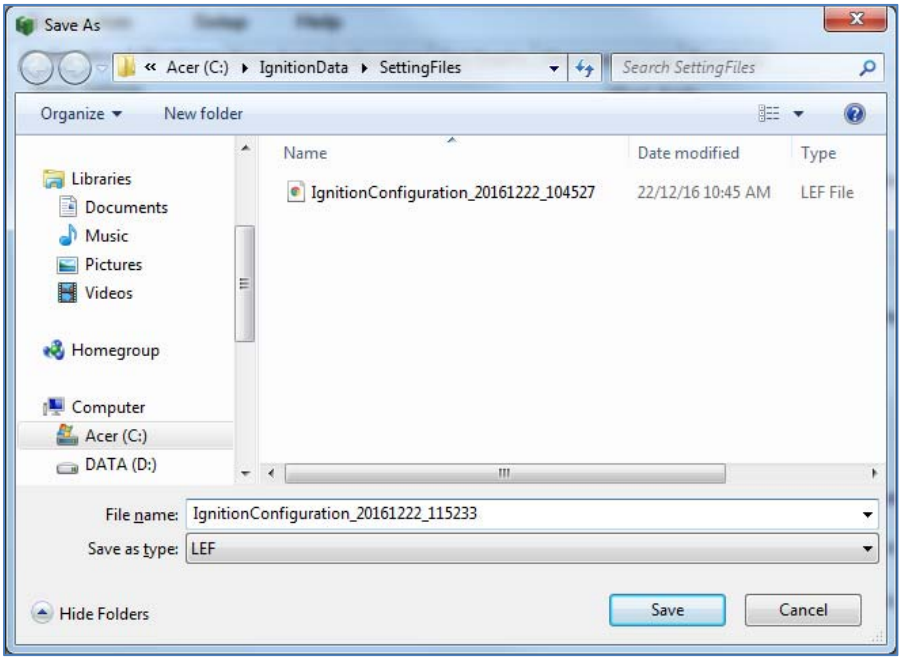
Figure 23: Setup drop-down menu



6.2.2 Save Configuration Settings

Selecting this option will prompt the user to select a folder and a file name to which the entire unit configuration will be saved.

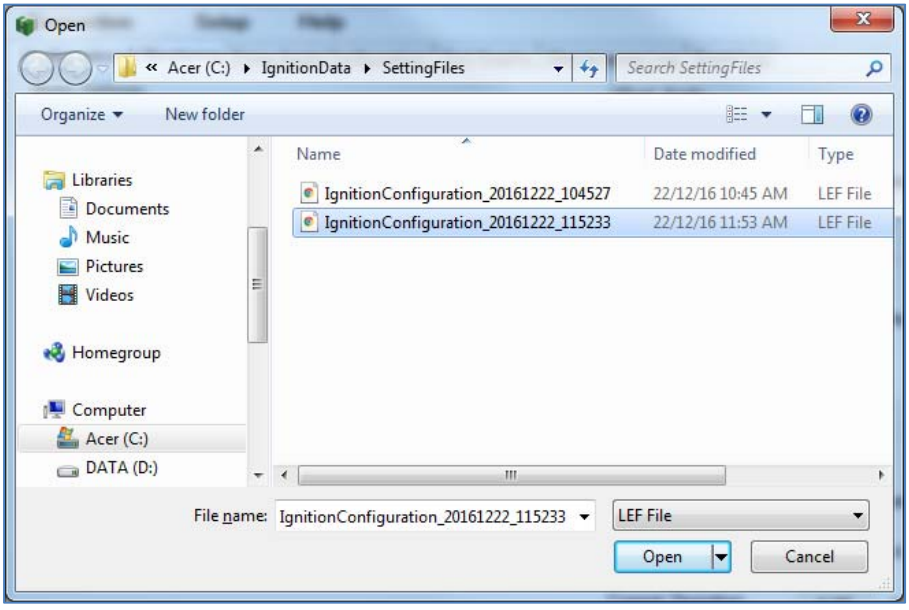
Figure 24: Save Configuration Settings



6.2.3 Load Configuration Settings

Selecting this option will prompt the user to select a configuration file containing settings to be loaded to (saved in) the unit.

Figure 25: Load Configuration Settings

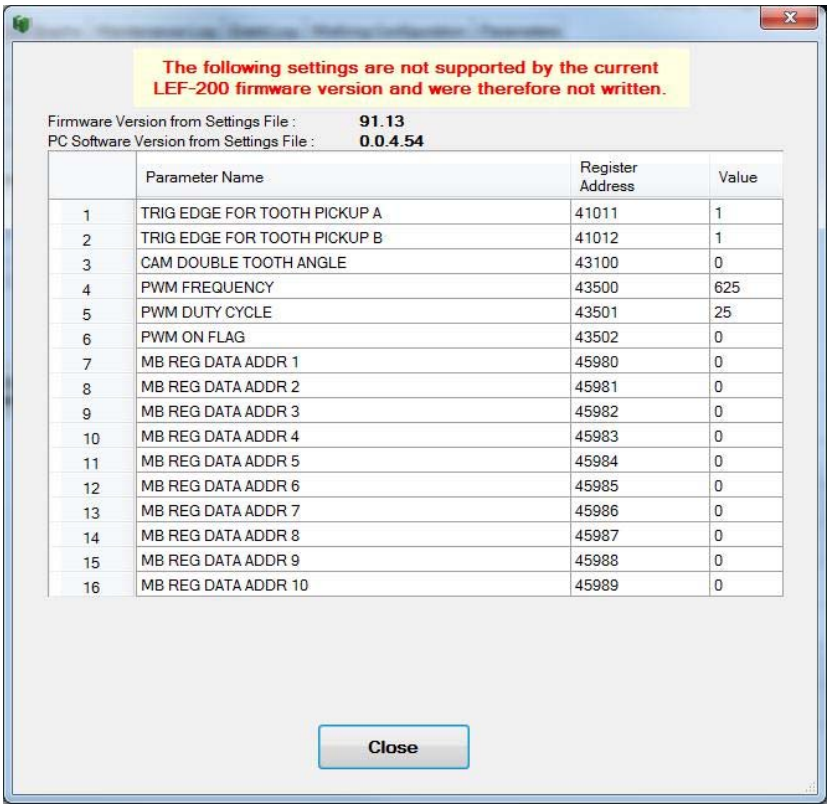


Note: This option is only available when the engine is not running.

The firmware version decides which parameters are supported. To have a complete update of all configuration parameters, it is recommended to load configuration settings from a file that was saved from a unit running the same firmware version as the target unit.

If the firmware version of the source unit and the target unit differs, a window similar to the one below may be shown.

Figure 26: List of Parameters That Were Not Written



This is not an error but indicates, that the listed parameters are not known to the firmware in the target unit and were therefore not written.

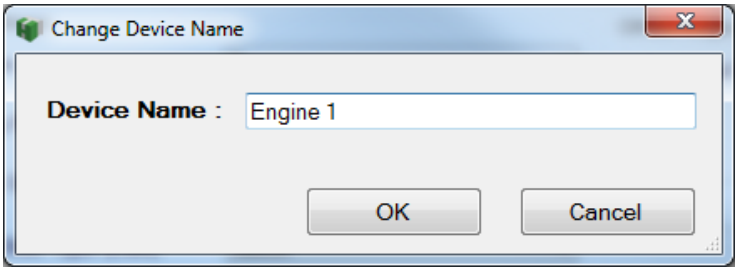
6.2.4 Language

Supported languages can be selected from here *(Note: At the time of writing only English language is supported)*

6.2.5 Device Name

Here the unit can be assigned a device name. This name is shown in the title bar of the PC software. It is also used to identify and distinguish units in the Event Log Maintenance window.

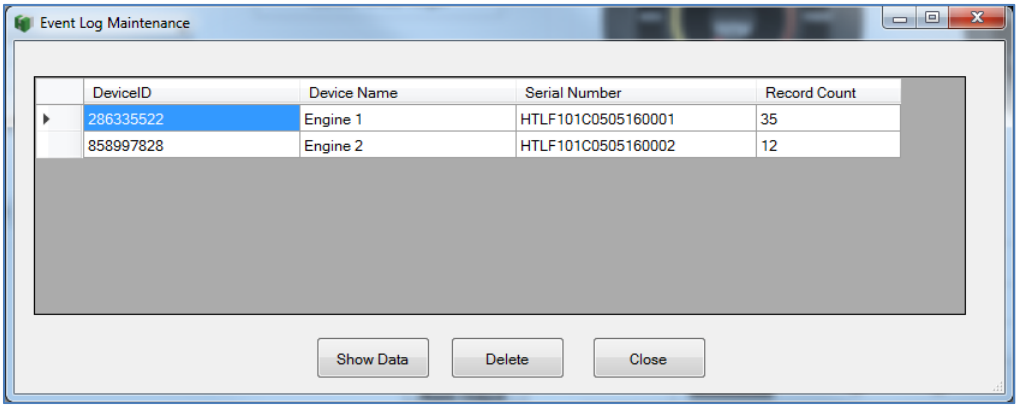
Figure 27: Change Device Name



6.2.6 Event Log Maintenance

This window allows for viewing the Event Log of the HT-LEF-200 units that have ever been connected with the PC.

Figure 28: Event Log Maintenance



To view the Event Log of a specific unit, double-click the line corresponding to it. The units can be identified by their name and serial number.

There is an option to clean up an Event Log by deleting the event database on the PC for a particular unit. To do this, select the unit and click ‘Delete’.

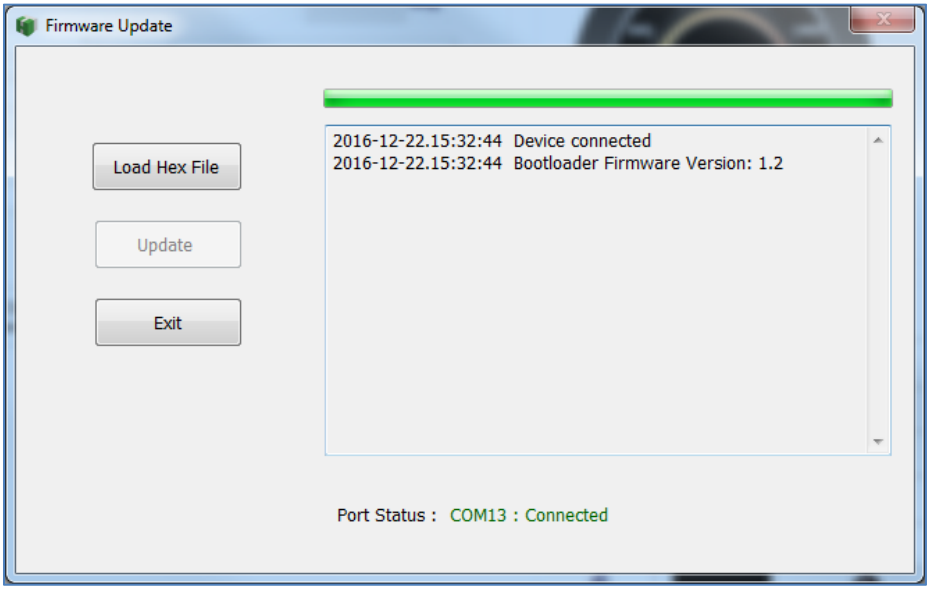
Note: When the event database of a unit is deleted, the events in the physical unit still remain and will be uploaded to the database next time the Ignition Software is connected to the unit and the Event Log tab is shown.

6.2.7 Firmware Update

A firmware is only possible when connected to the HT-LEF-200 via the USB interface.

To access the Firmware Update window, key in the password when prompted. Note: The password must be obtained via the Huegli-Tech support line or through your local dealer.

Figure 29: Firmware Update



To update the firmware, load / select the file with the desired firmware and click ‘Update’.

Do not unplug the USB cable during the firmware update.

During the firmware update process the yellow Error Code LEDs on the physical unit will move in a characteristic pattern, indicating that the unit is in Firmware Update mode.

After the firmware update is completed, it will take around 5 seconds for the unit to initialize itself and start communicating again.

6.2.8 Advanced User

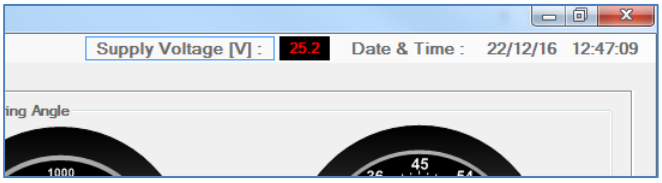
Certain functionality is only available in Advanced User mode, which is password-protected. This functionality is only relevant to technicians with in-depth knowledge of the product and in connection with production.

7 Top Info Line

At the top of the PC software window, to the right of the drop-down menus, two basic pieces of information are shown:

- The supply voltage measured by the unit.
- The date and time held by the unit. This date and time are used to time-stamp events at the moment when they occur.

Figure 30: Top Bar



8 Status Bar

At the bottom of the PC software window there is a Status Bar. In the Status Bar the following information is shown:

Figure 31: Status Bar

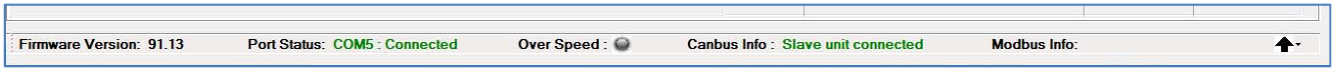


Table 6: Status Bar Definitions

Firmware version	91.13 (or whatever the current version is)
Port Status	Connected / Connection closed.
CAN bus Info	Alone on bus / Slave unit connected / Master unit connected.
Modbus info	Timeout error / Checksum error / Unknown register address.
Over-speed indication	The LED turns red color if the engine speed at any point has exceeded the configured Over-speed threshold.

The Modbus info relates to either the USB communication or the RS485 communication, depending on which of the communication interfaces of the HT-LEF-200 the PC is connected to. Usually nothing is shown here, but info may appear during communication in an electrically noisy environment.

8.1.1 Firing Conditions

A small arrow at the rightmost end of the Status Bar gives access to a window listing the conditions that must be fulfilled in order for the unit to fire. Each condition has a LED associated with it, which is red when the condition is blocking the unit form firing and green otherwise.

Different configurations have different Firing Conditions (see the figures below).

Figure 32: Standard Mode

Figure 33: Master / Slave Mode

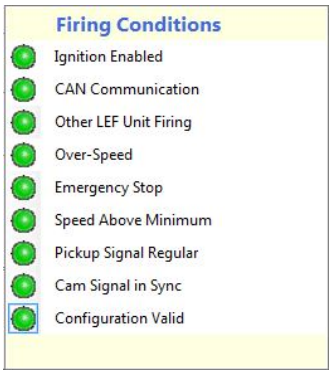


Figure 34: Dual Sensor Mode

9 Troubleshooting

9.1 Firing Conditions

If the engine is being cranked but the unit is not firing, or if the unit stops firing while the engine is running, the most likely reason is that one or more firing conditions are not fulfilled and are therefore blocking the firing (see chapter 8.1.1, "Firing Conditions"). The table below describes each blocking condition and what can be done to remove the block.

Table 7: Troubleshooting Firing Conditions

Firing Condition In the *Firing Conditions* window, the corresponding indicator lamp is red.	**What Is Occurring / What Has Occurred?**	**Possible Causes**	**Suggested Action**
Ignition Enabled	The ignition has been disabled.	An external device is connected to the unit, either via the CAN bus or via the RS485 interface, and this device has disabled the ignition. (See: Note 1)	Operate the external device in such a way that the ignition is re-enabled.
Over-Speed	The speed measured by the unit has exceeded the configured Over-speed threshold.	The engine speed went higher than allowed.	Identify the cause of the over-speed condition, rectify it and re-crank the engine.
		The Over-speed threshold is configured too low.	Increase the Over-speed threshold setting.
		The *Number of Cylinders* is configured incorrectly, causing the speed to be measured incorrectly.	Rectify the configuration.
		Electrical noise has corrupted the pickup sensor signal, causing the speed to be measured incorrectly.	Ensure that the unit is grounded properly.
Emergency Stop	The unit has detected that the 'Emergency Stop' button was pressed.	The 'Emergency Stop' button was pressed.	Eliminate the cause for the button being pressed, and re-crank the engine.
		The 'Emergency Stop' button or the wiring is faulty.	Rectify the button and the wiring.
Speed Above Mini-	The unit is measuring a speed	The gap between the pickup	Reduce the gap.

Firing Condition In the *Firing Conditions* window, the corresponding indicator lamp is red.	**What Is Occurring / What Has Occurred?**	**Possible Causes**	**Suggested Action**
mum (See: Note 2)	of 0 rpm.	sensor and the triggers (teeth or notches) is too big.	
		The pickup sensor is defective, or the sensor wiring is incorrect.	Check the sensor wiring and replace the pickup sensor if necessary.
	The unit is measuring a speed below 100 rpm.	The cranking speed actually is below 100 rpm, which is too low for firing.	Find a way to crank the engine at more than 100 rpm.
		The *Number of Cylinders* is configured incorrectly, causing the speed to be measured incorrectly.	Rectify the configuration.
Pickup Signal Regular	The rate of the pickup sensor pulses being generated by the triggers (e.g. by the trigger disc) is irregular. The signal may even be erratic.	The *Reset Tooth Lead/Lag* setting is configured wrongly.	Rectify the configuration.
		One or more spark plug cables are not connected. (See Note 3)	Connect all spark plug cables.
		The unit is not properly grounded.	Ground the unit properly.
		The pickup sensor is defective.	Replace the pickup sensor.
Cam Signal in Sync	The unit expects to "see" a pickup sensor pulse pattern that reflects the configured *Number of Cylinders* and the configured *Reset Tooth Lead/Lag* setting. However, the unit sees a pulse pattern that does not match the configuration.	The *Number of Cylinders* is configured incorrectly.	Rectify the configuration.
		The *Reset Tooth Lead/Lag* setting is configured wrongly.	Rectify the configuration.
		One or more spark plug cables are not connected. (See Note 3)	Connect all spark plug cables.
		The unit is not properly grounded.	Ground the unit properly.
		The pickup sensor is defective.	Replace the pickup sensor.
Configuration Valid	Some configuration is invalid / not meaningful.	Two or more channels have been assigned the same firing sequence.	Rectify the configuration.
		The parameter *Angle Zero Point defined by Trigger Number X after the Reset* has been configured to more than twice the configured number of triggers on the timing wheel.	
		The parameter *Number of Triggers on Timing Wheel* has been configured to less than half of the configured number of cylinders.	
Two Pickup Sensors (Cam and Crank)			
Crank and Cam Signals in Sync	The unit expects to "see" a combined pickup sensor pulse pattern from the two pickup sensors that reflects the configured *Number of Cylinders*. However, the unit "sees" a pulse pattern that does not match the configuration.	The *Number of Cylinders* is configured incorrectly.	Rectify the configuration.
Two Units (Master / Slave)			
CAN Communication	The CAN communication between the Master unit and the Slave unit is down.	The "other LEF unit" (i.e. the unit the Ignition Software is currently not communicating with) is not connected to the wiring harness, or it is powered down.	Connect the other LEF unit and power it up.
		The physical CAN bus connection	Rectify the CAN bus wiring.

Firing Condition In the *Firing Conditions* window, the corresponding indicator lamp is red.	**What Is Occurring / What Has Occurred?**	**Possible Causes**	**Suggested Action**
		between the Master unit and the Slave unit is broken.	
Other LEF Unit Firing	The "other LEF unit" (i.e. the unit the PC is currently not communicating with) is not firing.	The physical Timing Output signal connection between the Master unit and the Slave unit is broken.	Rectify the Timing Output signal wiring.
		The cause may be any of the conditions listed in this table.	Connect the Ignition Software to the other LEF unit, and see what firing conditions are blocking the firing (use this table).

Notes

This is a rare state that can only occur in special setups where an external device has been integrated into the ignition system and is communicating with the ignition unit.

2. When the engine is standing still, this firing condition is always indicated as blocking (i.e. the corresponding red lamp in the Firing Conditions window is on).

3. A disconnected spark plug cable creates noise that may disturb the pickup signal.

9.2 Failure States

Table 8: Failure states

Observation	Suggested Action
Power is connected, but the green power LED (and all other LEDs) are off.	Check that the device is really powered.
One or more of the yellow event LEDs are blinking at a fast rate of around 10 blinks per second.	Repower the device. If the condition remains, hand the unit in for service.

10 Installation

10.1 Components

10.1.1 Sensors

It is highly recommended to use one of the pickup sensors that have been approved for the HT-LEF-200. They are:

- MSP-LEF-75-VR (passive sensor)
- MSP-LEF-L85 (active sensor)

10.1.2 Triggers

10.1.2.1 Trigger Disc

In installations where the HT-LEF-200 is installed, most commonly just one pickup sensor is used, and the signal is picked up from a trigger disc mounted on the cam shaft.

For the notch disc type the outer edge surface must be completely smooth to avoid that an invalid signal is generated by the pickup sensor.

If the trigger disc is not an integrated part of the engine, it is highly recommended to use a quality trigger disc sold for use with the HT-LEF-200.

The disc will have a *Timing Trigger* (i.e. a tooth or a notch) for each cylinder that the unit is controlling. These *Timing Triggers* are distributed evenly around the circumference of the disc, and the signal they generate is used for timing the ignition.

In addition to the *Timing Triggers* the trigger disc will have a *Reset Trigger*, which is located “close” (less than half the space between two *Timing Triggers*) to the *Timing Trigger* associated with the last cylinder in firing order.

10.1.2.2 Other Types of Triggers

In some installations space constraints make it difficult or impossible to mount a trigger disc on the cam shaft. For such installations an alternative approach is possible, whereby the *timing triggers* are installed on the crank shaft (half as many triggers as the number of cylinders the unit will control) and a *reset trigger* on the cam shaft.

For this type of installation, two pickup sensors are required - one for the *timing triggers* on the crank shaft and one for the *reset trigger* on the cam shaft.

10.1.3 Coil Rail

Standard coil rails are available for the HT-LEF-200. They come in different variants and dimensions to match the engine they are going to be installed on. Approach your nearest Huegli Tech technical consultant for more information.

In standard installations one coil rail is required. In master / Slave installations two coil rails are required - one for each engine bank.

10.1.4 Wiring Harness

Standard wiring harnesses are available for the HT-LEF-200.

The wiring harness connecting with the black connector (communication and I/O) comes in three variants:

- A harness for units operating as stand-alone (Standard Mode, engines up to 8 cylinders).
- A harness for units operating as the Master in a Master / Slave installation.
- A harness for units operating as the Slave in a Master / Slave installation.

The wiring harness connection to the blue connector (coils) also comes in three variants:

- A harness for 4 cylinder engines.
- A harness for 6 cylinder engines.
- A harness for 8 cylinder engines.

In Master / Slave installations each unit requires a coil harness matching the number of cylinders it controls. For more detail, see 13.5 Appendix V – Wiring Harnesses, which contains wiring diagrams for the different variants of wiring harnesses.

10.1.5 Sample System Diagrams

Figure 35: Sample Inline Engine Using Trigger Disc

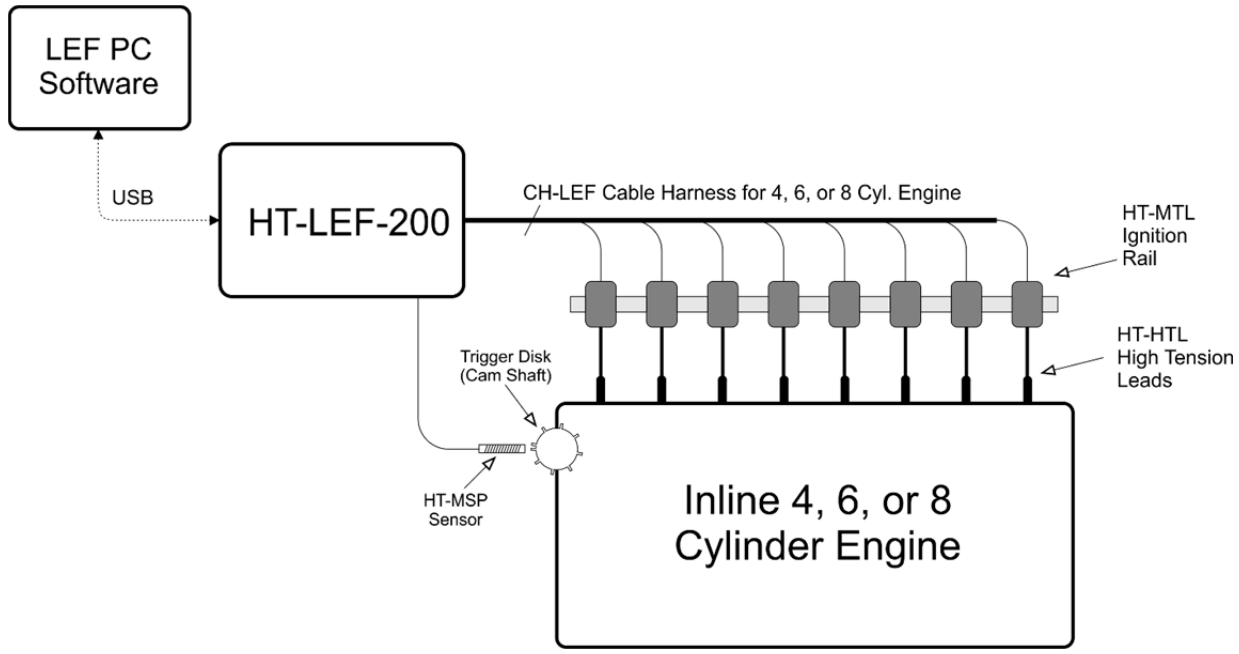


Figure 36: Sample V Engine Using Trigger Disc

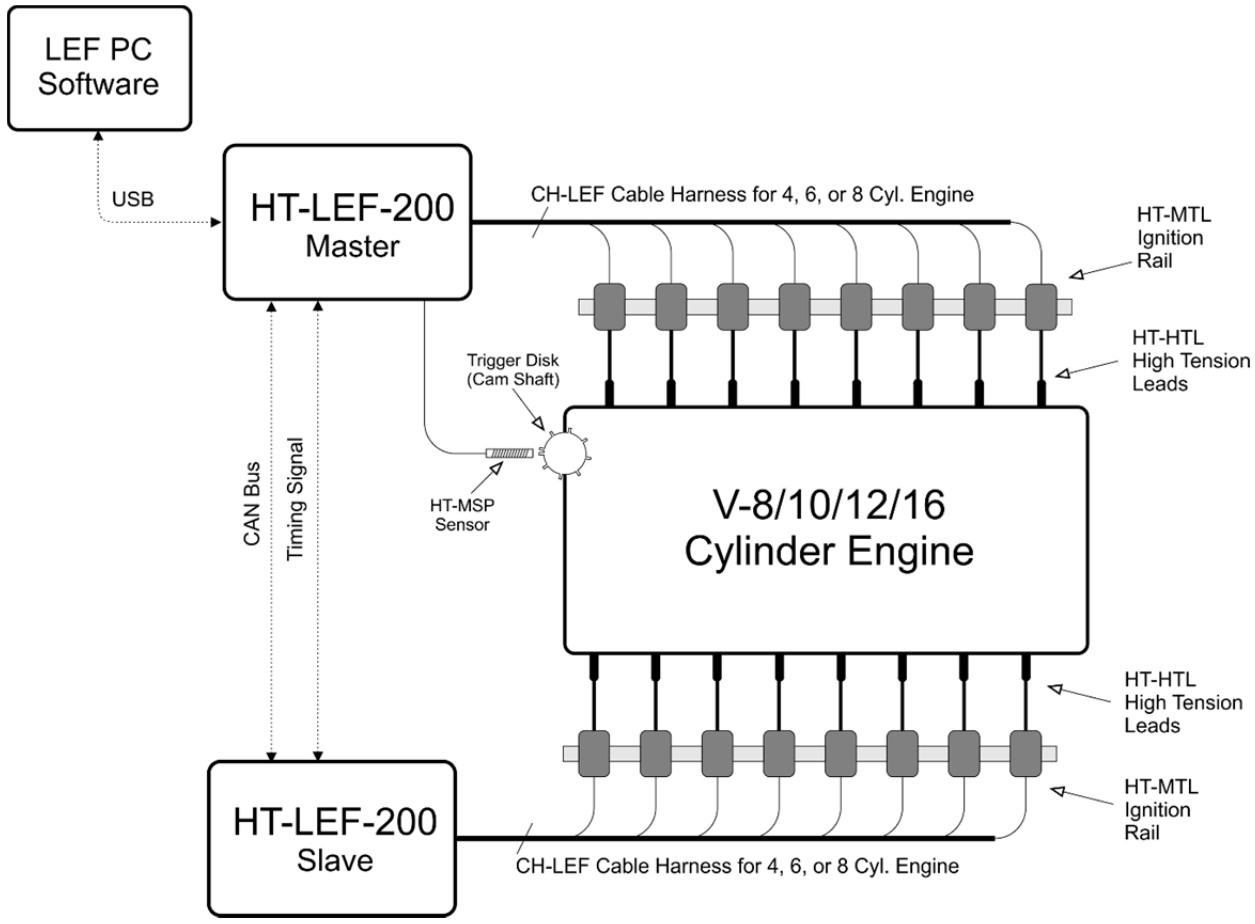


Figure 37: Sample Inline Engine Using Timing Disc with Reset

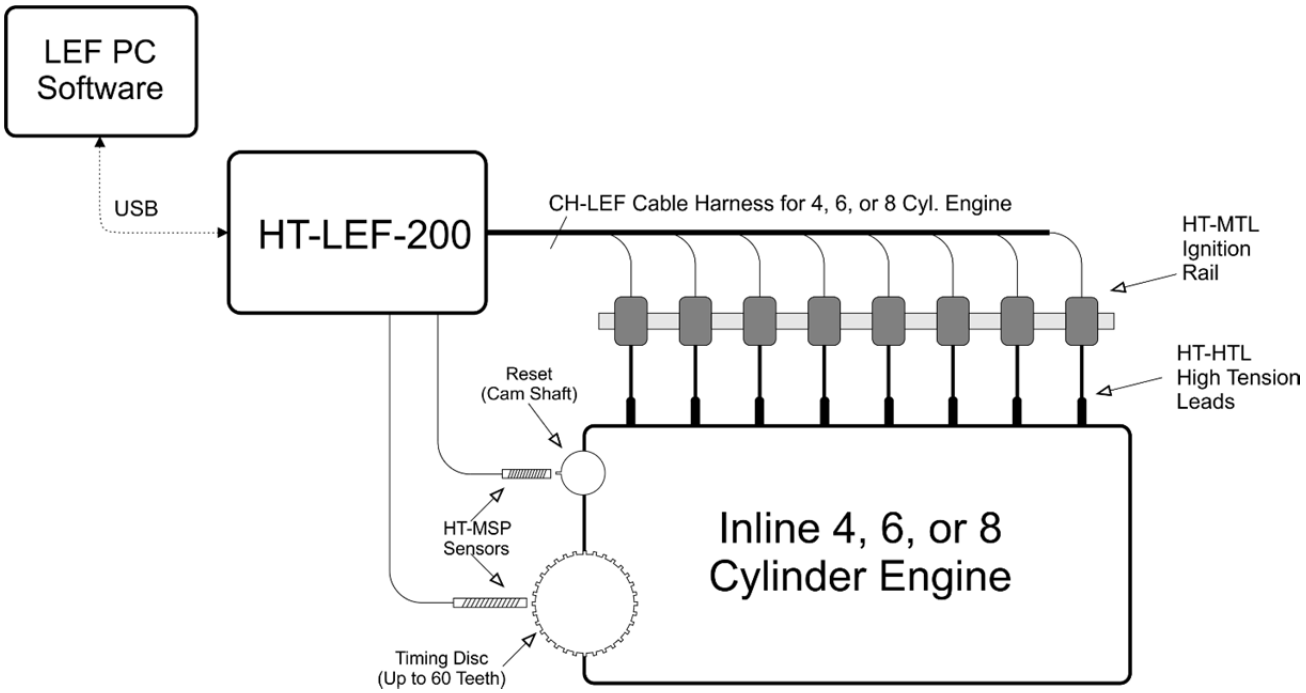
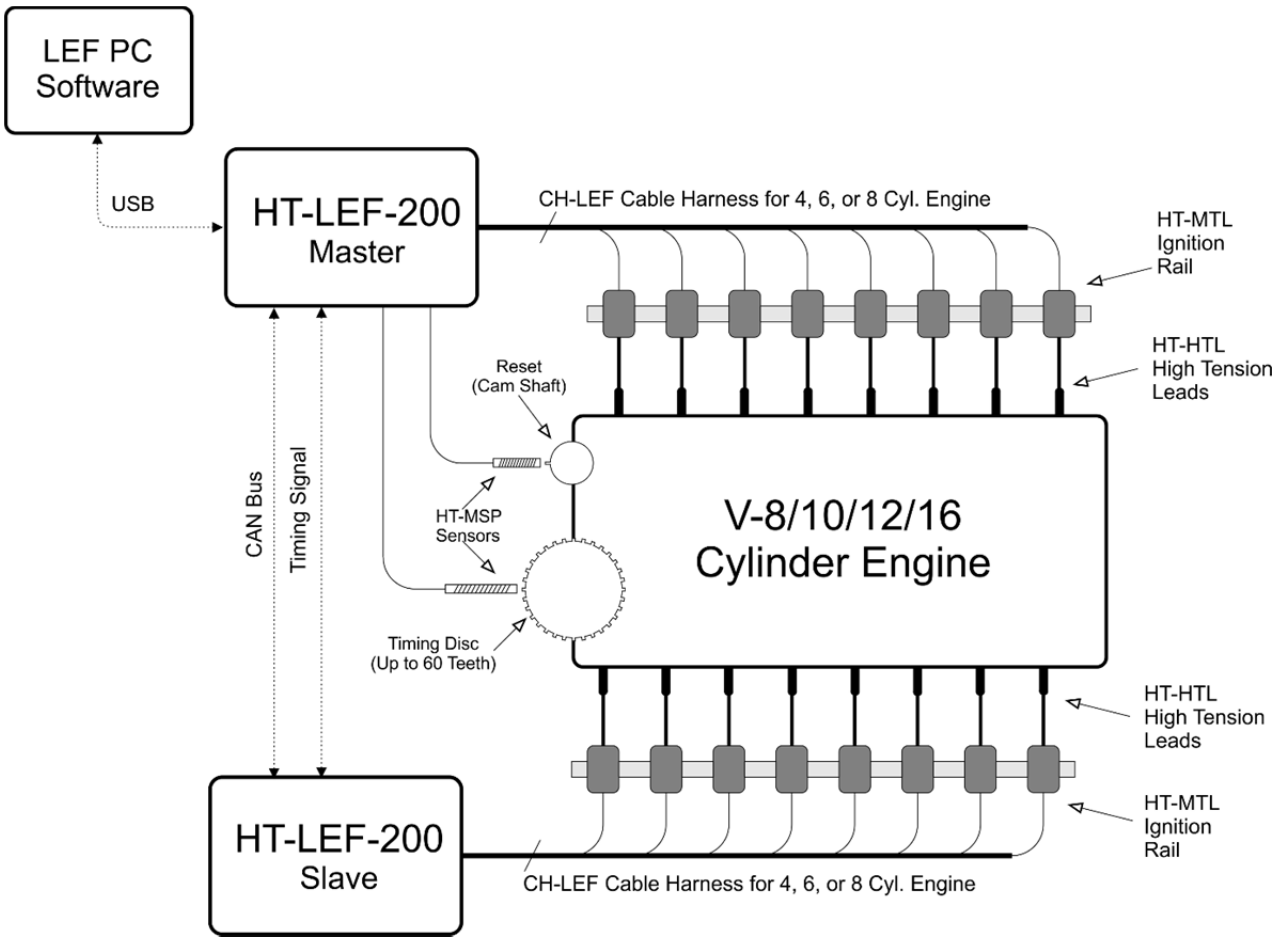


Figure 38: Sample V Engine Using Timing Disc with Reset



11 Mechanical Dimensions

Figure 39: Mechanical Dimensions Front View

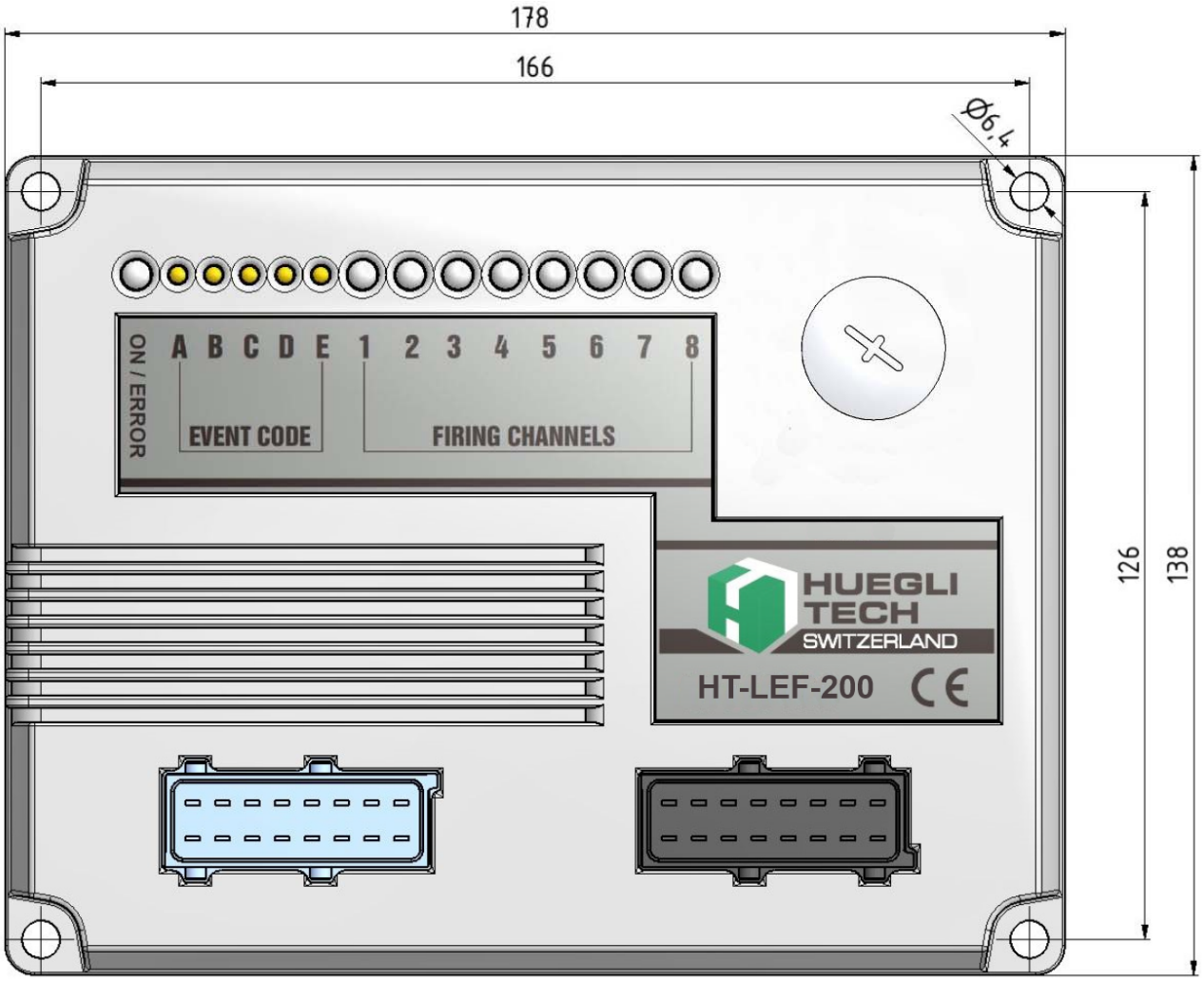
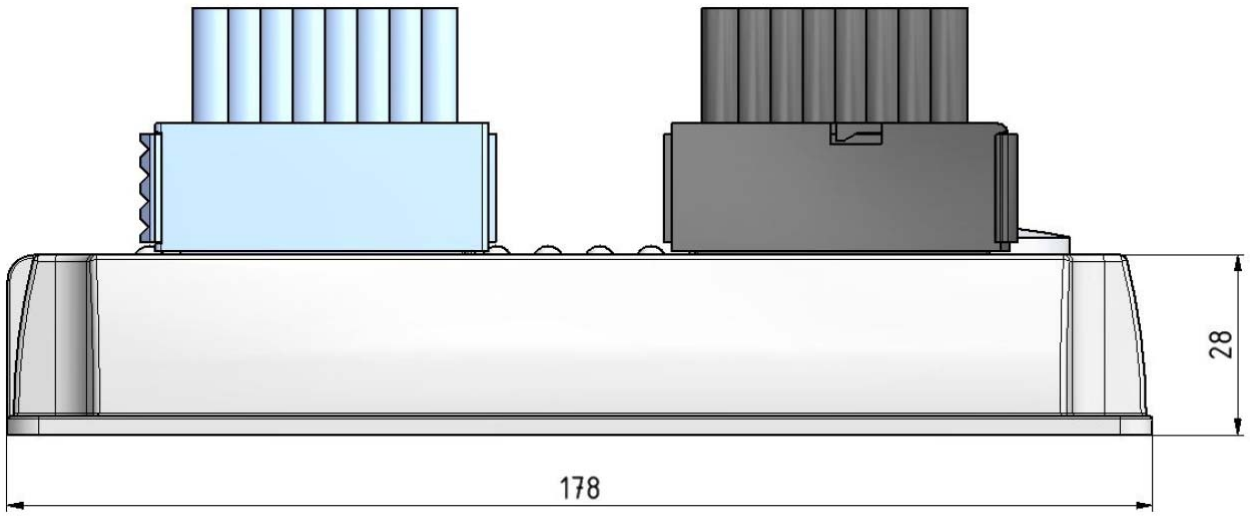


Figure 40: Mechanical Dimensions Side View



12 Specifications

12.1 Engine and Setup

Number of Channels	8
Max. Number of Supported Cylinders	16 (8 + 8)
Supported Pickup Sensor Types	Variable Reluctance, Active (square wave output)

12.2 Ignition Timing

Firing Precision	+/- 0.5˚ Crankshaft Angle
Firing Angle	-15˚ to +90˚
Asymmetrical Firing (V-engine)	Yes
Firing Angle as a Function of Speed	Yes
Analogue Input for Firing Angle Control	0 - 5 V

12.3 Electrical

Supply Voltage	12 or 24 VDC Battery, (10 VDC to 30 VDC)
Power Consumption, Control Electronics Only	3 W max. (Continuous)
Ignition Coil Peak Current	20 Amps (max.)
Reverse Polarity Protection	Yes

12.4 Communication

Product Configuration	USB, RS485 / Modbus
External ECU Interface	RS485 / Modbus, CAN Bus

12.5 Standards

Authorizing Office	CE and RoHS Requirements
CE Certifications	EN55011, EN61326-1

12.6 Dimensions and weight

Dimensions	178 x 138 x 28 mm
Weight	0.8 kg

12.7 Environmental

Temperature Range	-40° to 85°C (-40 to +180°F)
Relative Humidity	Up to 95%
Surface Finish	Fungus Proof and Corrosion Resistant

13 Appendixes

13.1 Appendix I - Channel LED Indications

Each individual channel LED can give different indications by changing color or by blinking (see table).

Generally speaking, either no channels are firing or all used channels are firing, regardless of the LED indication for the individual channel.

Table 9: Channel LED Indications

LED behavior	Meaning	LED state cleared when…	Is ignition firing?
Off (See: Note1)	The ignition is not firing.	-	No
Constant on, Green	The ignition is firing.	… the ignition is no longer firing.	Yes
Constant on, Red	A current deviation was detected for this channel.	… the engine is cranked after having been stopped.	Possibly

Notes

1. Either all active channels are firing or no channels are firing. Consequently having a state where some channels LEDs are off while others are constantly on/green is not possible.

13.2 Appendix II – HT-LEF-200 Event Codes

When an events occurs, the 5 yellow LEDs on the HT-LEF-200 indicate a binary code which identifies the event. The event code LEDs may be constantly on or blink. When they are constantly on, it's a Warning Event. When they blink, it's an Error Event.

Table 10: HT-LEF-200 LED Event Codes

Event Name	Event Code Yellow LEDs On										Description
	A	B	C	D	E						
Over-speed detected					X						
Emergency stop activated				X							
Charging current deviation	X	X		X	X						Current deviation on one or more channels.
High charging current	X	X	X								High current on one or more channels.
						Event Code Yellow LEDs Blinking					
Event Name						**A**	**B**	**C**	**D**	**E**	**Description**
Unresponsive tasks										X	Internally in the unit there is an ongoing surveillance of the various software functionalities. This event occurs if a functionality has malfunctioned. It should never occur.
Could not write to flash memory									X		Internal error writing to non-volatile memory. It should never occur.
Could not write to EEPROM									X	X	Internal error writing to non-volatile memory. It should never occur.

13.3 Appendix III – HT-LEF-100 Event Codes

When an events occurs, the 5 yellow LEDs on the HT-LEF-200 indicate a binary code which identifies the event. The event code LEDs may be constantly on or blink. When they are constantly on, it's a Warning Event. When they blink, it's an Error Event.

Table 11: HT-LEF-100 LED Event Codes

Event Name	Event Code Yellow LEDs On					Description
	A	B	C	D	E	
Over-speed detected					X	
Emergency stop activated				X		
Noise on CAM sensor signal			X			
Active sensor detection failed			X		X	When cranking begins, the firmware automatically detects which pulse edge comes first (rising or falling). Whichever comes first will be used as the trigger. If the detection fails, the unit will not fire. It should never occur.
Passive sensor detection failed			X	X		When cranking begins, the firmware automatically detects the polarity of the VR signal in order to use the edge corresponding to the zero crossing of the sinus as the trigger. If the detection fails, the unit will not fire. It should never occur.
Charging current deviation detected		X				The threshold for this event is configurable in the PC software.
High charging current	X					The threshold for this event is configurable in the PC software.

Event Name	Event Code Yellow LEDs Blinking					Description
	A	B	C	D	E	
Interrupt overload					X	A burst of pickup interrupts were detected due to electrical noise. It should never occur under normal operating conditions.
Could not write to flash memory				X		Internal error writing to non-volatile memory. It should never occur.
Could not write to EEPROM				X	X	Internal error writing to non-volatile memory. It should never occur.

13.4 Appendix IV – Pin Layout

Table 12: Pin layout

Black Connector		Blue Connector	
Pin No.	**Function**	**Pin No.**	**Function**
1	Reset Pickup Sensor (input). VR+.	1	Coil Output, Channel 1
2	Reset Pickup Sensor (input). VR- / Active Pickup.	2	Coil Output, Channel 2
3	Emergency Stop (input)	3	Coil Output, Channel 3
4	Firing Angle Interpolation (0 - 5 V input)	4	Coil Output, Channel 4
5	Slave Timing (output)	5	Coil Output, Channel 5
6	RS485 B-	6	Coil Output, Channel 6
7	RS485 A+	7	Coil Output, Channel 7
8	U_{bat} out (100 mA output for active pickups)	8	Coil Output, Channel 8
9	Timing Pickup Sensor (input). VR+.	9	Power in (10 – 30 V)
10	Timing Pickup Sensor (input). VR- / Active Pickup.	10	Power in (10 – 30 V)
11	GND (for active pickups)	11	Power in (10 – 30 V)
12	Binary Out (0 V / 5 V output)	12	GND
13	CAN Low	13	GND
14	CAN High	14	GND
15	GND	15	GND
16	Power in (10 – 30 V)	16	GND

13.5 Appendix V – Wiring Harnesses

Figure 41: Wiring harness for black connector (I/O and communication). Stand-alone unit.

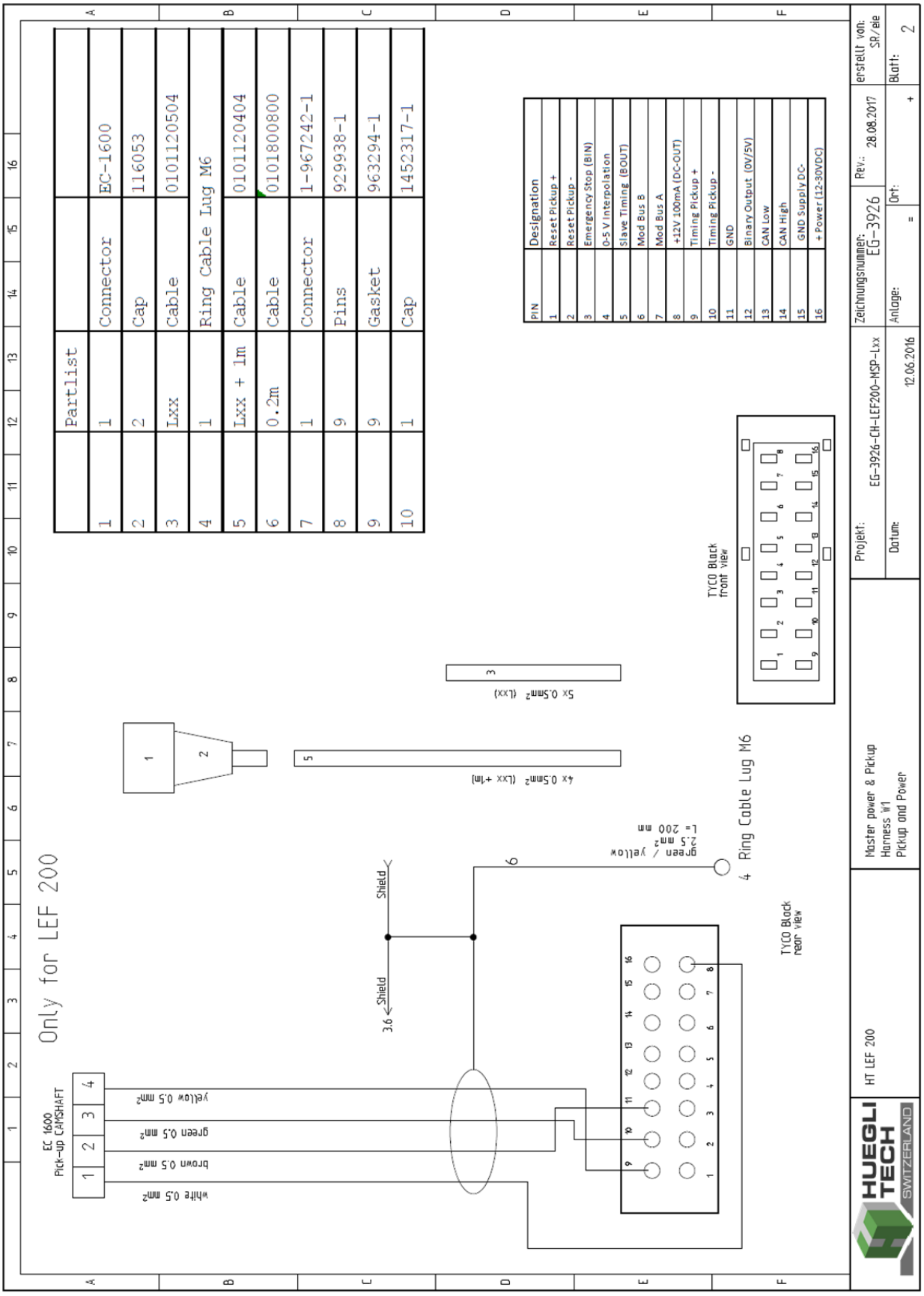


Figure 42: Wiring Harness for Black Connector (I/O and Communication), Standalone & Master Unit

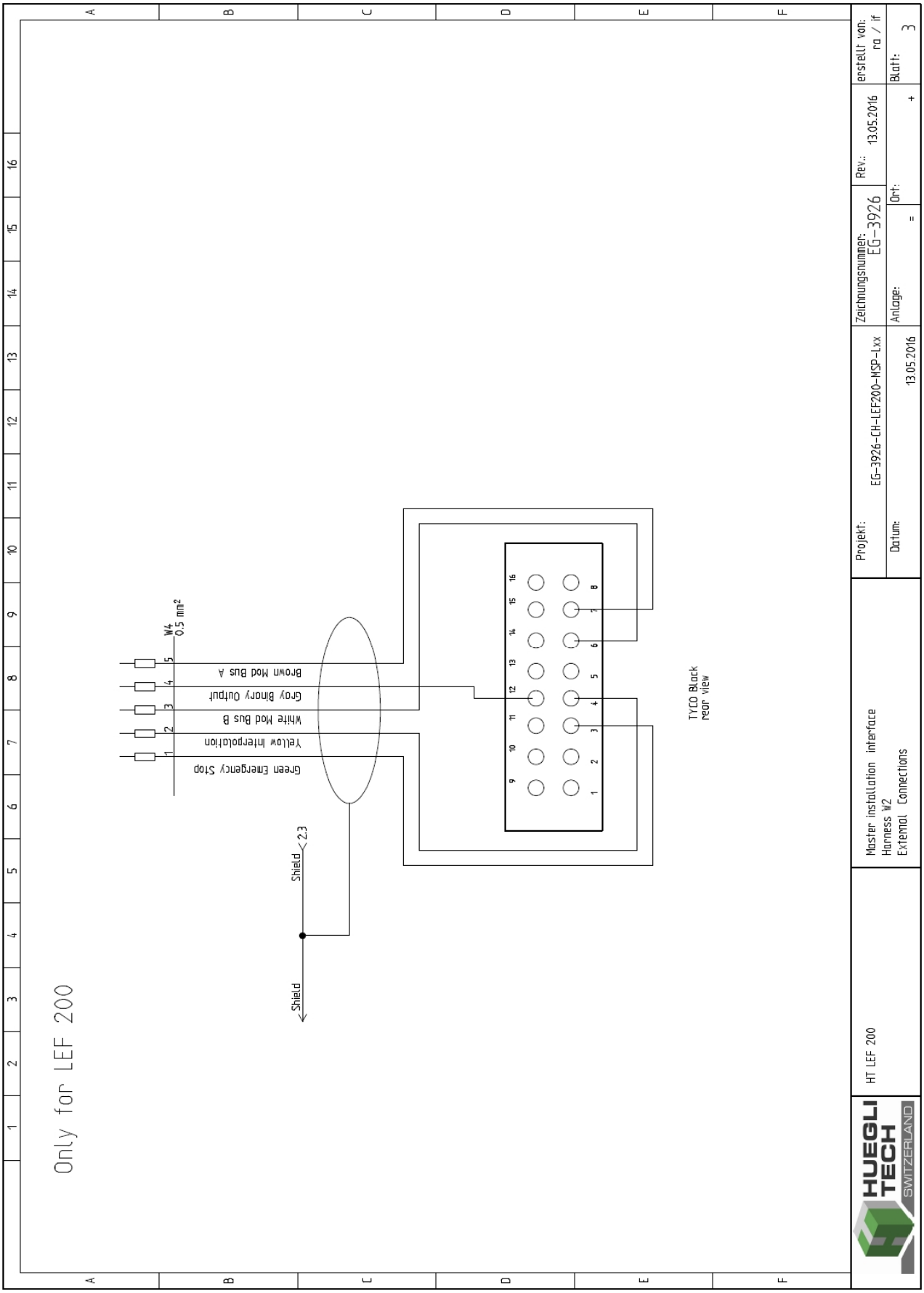


Figure 43: Wiring Harness for Black Connector (I/O and Communications), Master Unit

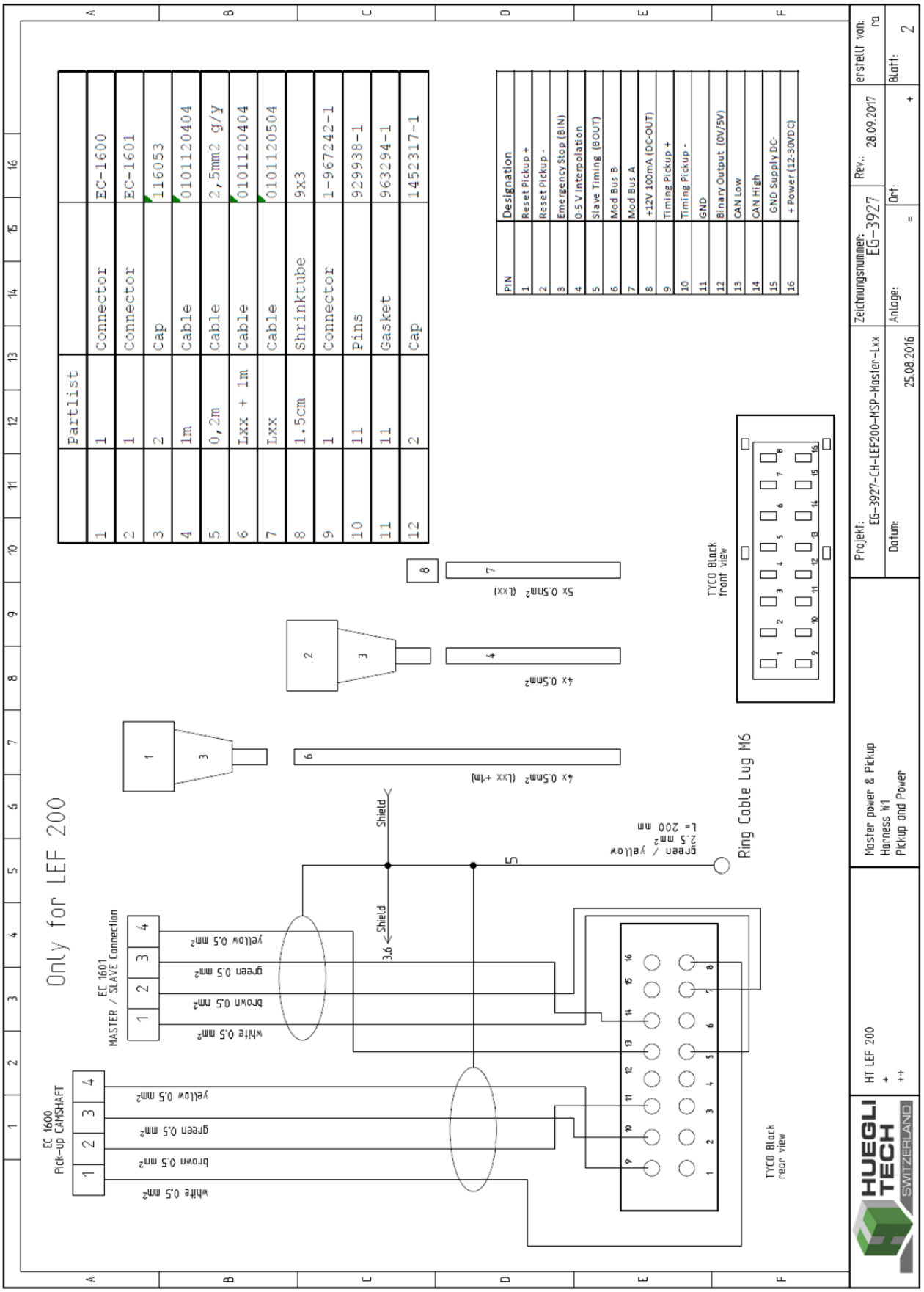


Figure 44: Wiring Harness for Black Connector (I/O and Communications), Slave Unit

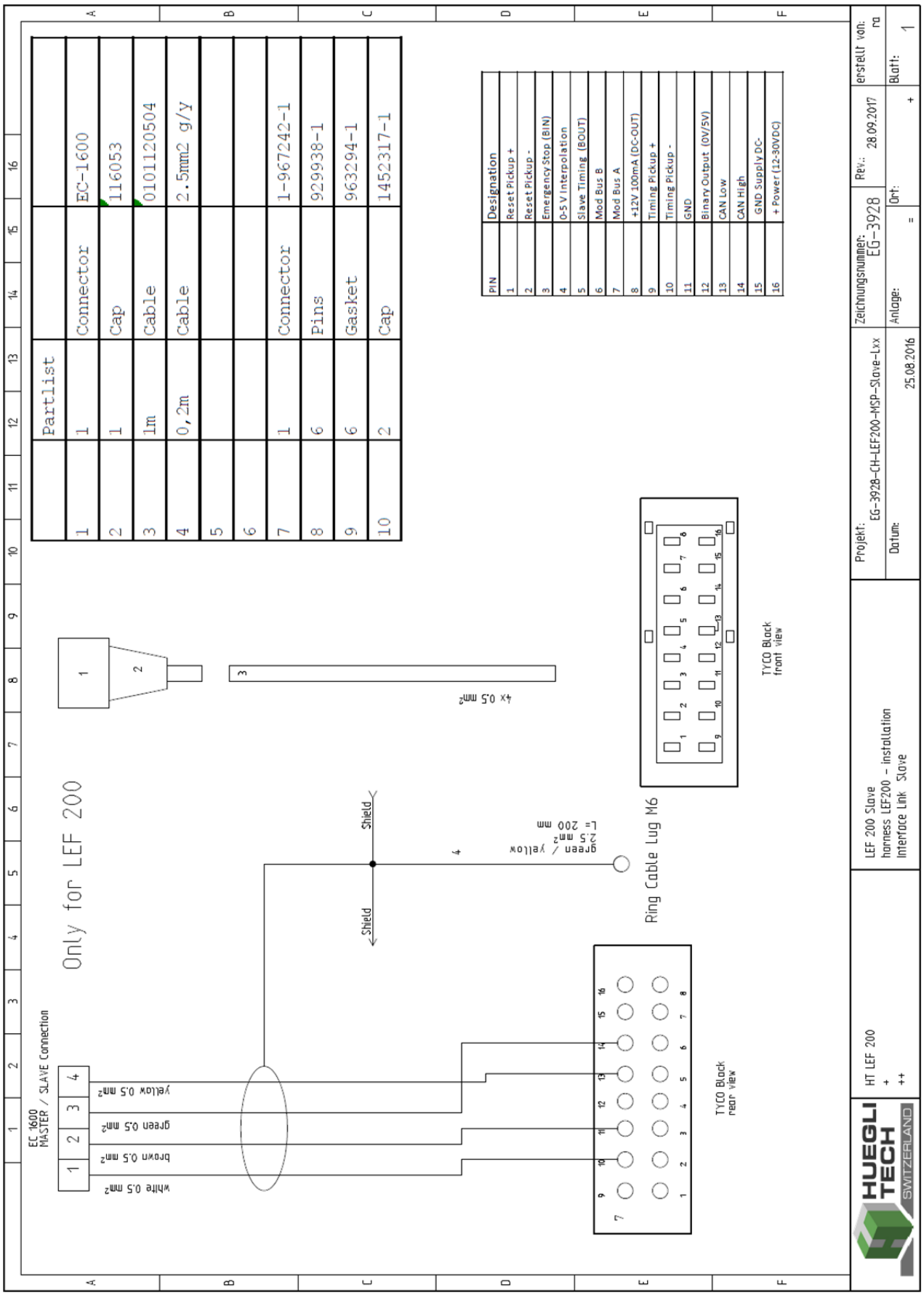


Figure 45: Wiring Harness for Blue Connector (4 Cylinder Engine)

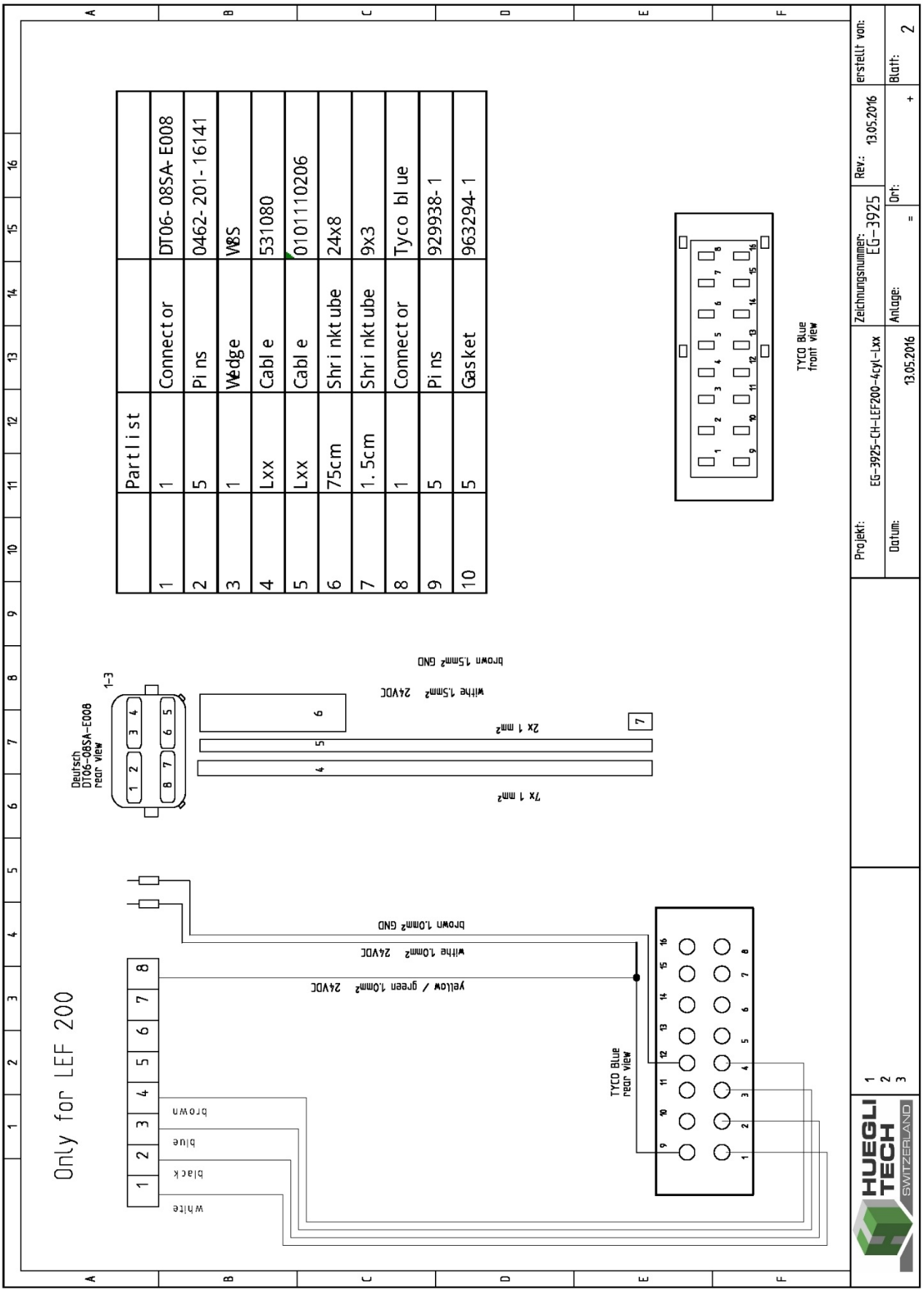


Figure 46: Wiring Harness for Blue Connector (6 Cylinder Engine)

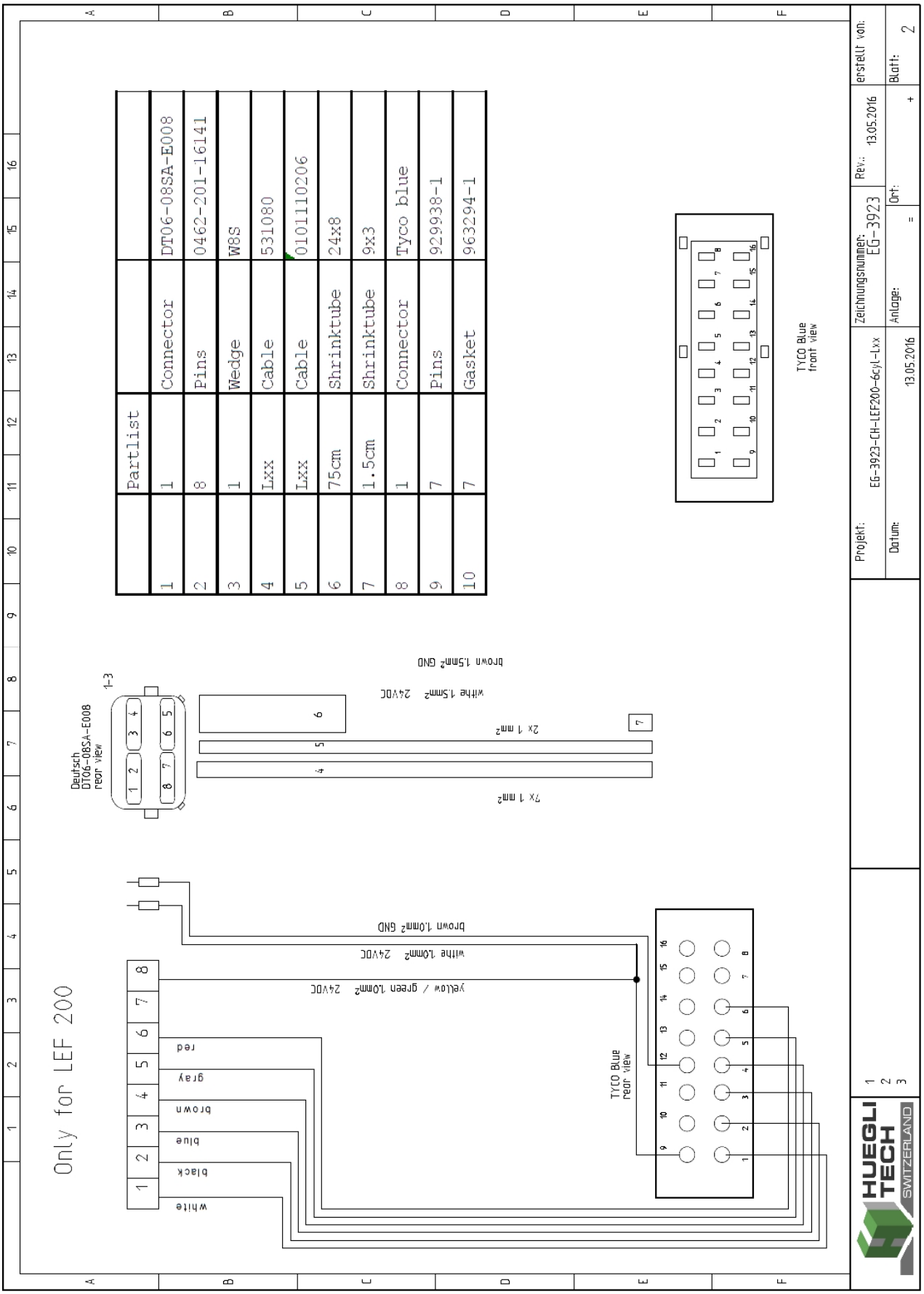


Figure 47: Wiring Harness for Blue Connector (8 Cylinder Engine)