

DOCTOR

*Doctor DK-200
On-Line Surveillance
System
Operating Guide*

*Revision 1.2
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Chapter 1 – Overview of the DK-200

1.1 Using This Manual

This manual describes the setup and operation of the DK-200 on-line surveillance system. It assumes that all sensor and communication connections have been made and that the unit has been powered up.

Note that the DK-200 requires a safety earth as described in the installation instructions. Ensure that the unit is correctly installed before proceeding.

Chapter 2 describes how to operate the DK-200 in diagnostic mode which is used for setup, installation and commissioning. In this mode the system, including sensor and pickup connections, can be checked without having a network connection to a host computer.

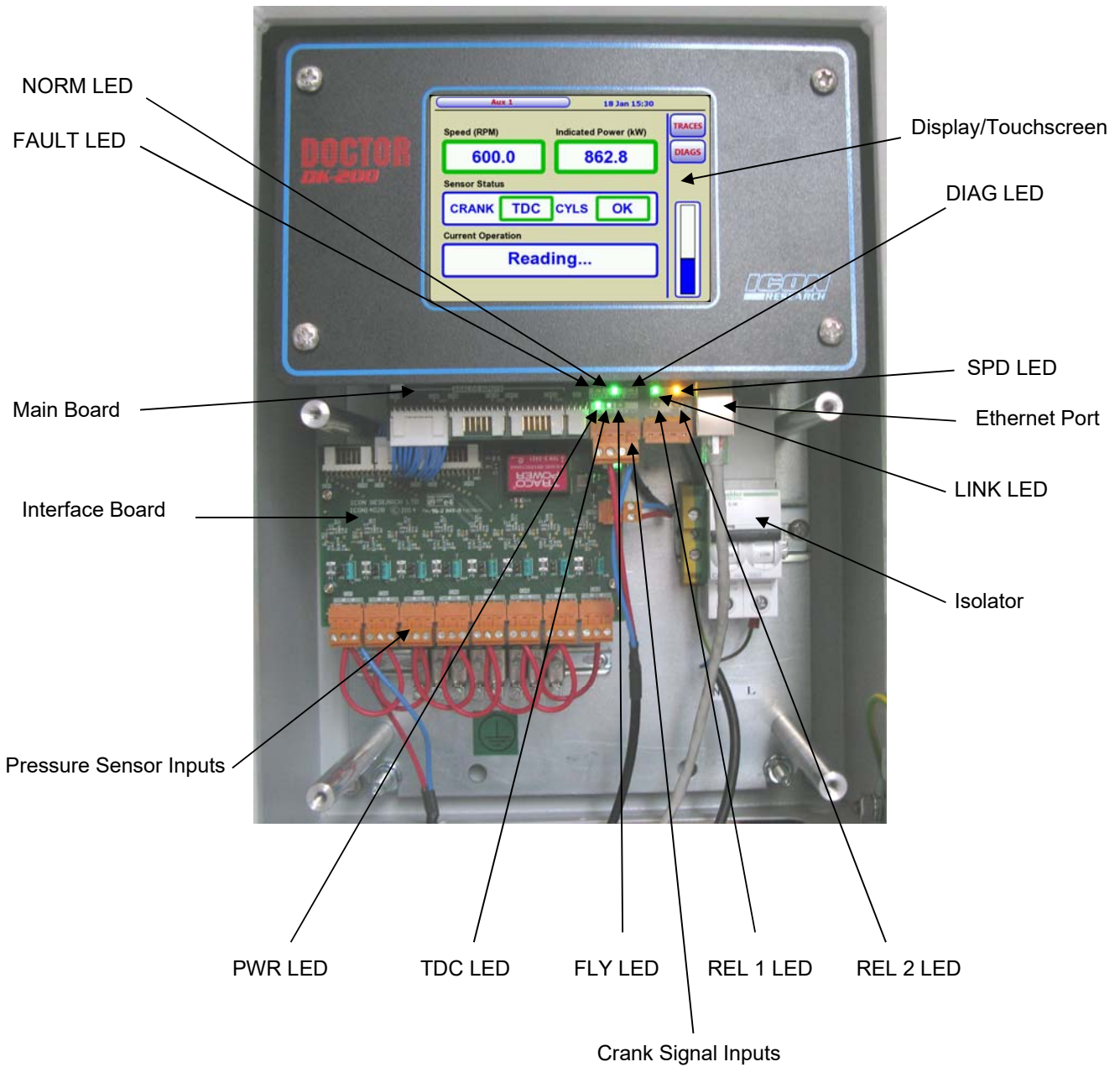
Chapter 3 describes operation in normal mode ie. when connected to a host computer via a network.

1.2 DK-200 Hardware Overview

Setting up and viewing of data is carried out entirely by use of the touchscreen display. This is accessed by opening the door of the unit. The door is sealed to prevent ingress of moisture. If it is required to power the unit down locally, this can be done by operating the circuit-breaker inside the unit. Remove the plastic safety barrier to access this breaker.

The circuitry of the DK-200 comprises two boards and a LCD display. The display is full VGA size with a capacitive touchscreen. The display incorporates an integral LED backlight to ensure long life. The main board carries out data acquisition and processing tasks while the lower interface board conditions the incoming signals for compatibility with the main board. Both boards are powered from an internal 24Vdc supply

There are a number of indicator LED's on the boards. Refer to the picture below for an explanation of these.



Main Board LED Functions

LED	COLOUR	FUNCTION
FAULT	Red	A fault has occurred on the unit. Investigation is required.
NORM	Green	The DK-200 is operating in NORMAL display mode.
DIAG	Green	The DK-200 is operating in DIAGNOSTIC setup mode.
LINK	Green	A suitable ethernet network has been detected. The LED flashes off to indicate data communication.
SPD	Orange	Illuminates orange when network speed is 100Base-T. Remains off when operating at 10Base-T.
PWR	Green	Power is applied to the main board.
TDC	Green	Flashes when TDC pulse is detected.
FLY	Green	Flashes when FLY pulse is detected. May appear solid at high pulse rates.
REL 1	Green	Relay 1 is set.
REL 2	Green	Relay 2 is set.

Interface Board LED Functions

LED	COLOUR	FUNCTION
PWR	Green	Power is applied to the interface board.

1.3 Operating the DK-200 with the Touchscreen

The touchscreen on the DK-200 enables quick and easy navigation of its features. All control of the unit is carried out via the touchscreen. The touchscreen is a capacitive type with Xensation™ glass for extreme ruggedness. The touchscreen should be operated without wearing gloves.

Note that any button that has red text indicates that it is valid for a key tap and will take you to that screen or function. If the text on a button is grey, the function is not available or not valid at that time. If a button has a yellow background, this indicates that the button function is selected at this time.

1.4 DK-200 Modes

The DK-200 has two modes of operation namely NORMAL and DIAGNOSTIC.

In normal mode, the device is under the control of a host computer and is typically acquiring measurement data and returning data to the host over the ethernet network. Diagnostic mode is used for setting up the DK-200 and checking operation, including all connected sensors, without the unit having to be connected to a host PC. Diagnostic mode is very useful when installing and commissioning on an engine.

It is possible to move between normal and diagnostic mode while the system and engine are running. However, the system must be in normal mode for data to be transferred to the host. If the system is left in diagnostic mode, it will revert back to normal mode after 10 minutes if a key is not tapped. The *NORM* and *DIAG* LED's at the bottom of the main board indicate which mode is active.

The two modes of operation are detailed in the next two chapters.

1.5 Sensor Interfacing

The DK-200 can support up to 24 pressure sensor inputs. These are connected to up to three signal interface boards, each of which can accommodate eight channels. Refer to the *Installation Wiring Schedule* in the *DK-200 Installation Manual* for the input configuration specific to your installation.

1.6 Crank Inputs

The TDC and FLY crank inputs are usually driven by a 24V signal from three-wire PNP-type output sensors. These pickup sensors are supplied from the 24V on-board supply via an appropriate junction box as detailed in the *Installation Wiring Schedule* for the installation.

For test purposes, it can be desirable to trigger the crank inputs from a signal generator or other device with a TTL output signal range (typically 3.3V to 5V). This can be achieved by removing the jumpers fitted in positions TDC and FLY.



Signal Range	Jumpers
24V	Fitted
5V	Not Fitted

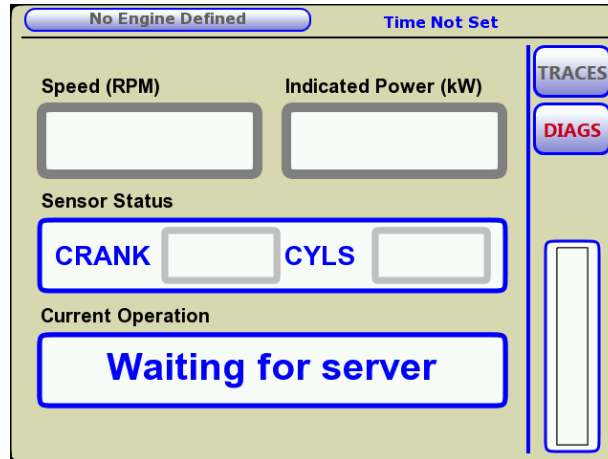
Default position is fitted as above for 24V operation. Note that this feature only applies to revision D main boards onwards.

Chapter 2 – DIAGNOSTIC Mode

2.1 DK-200 DIAGNOSTIC Mode

Diagnostic mode enables the DK-200 to be run independently of a host computer and is used for setup, during installation and commissioning, and for debugging in the event of a problem.

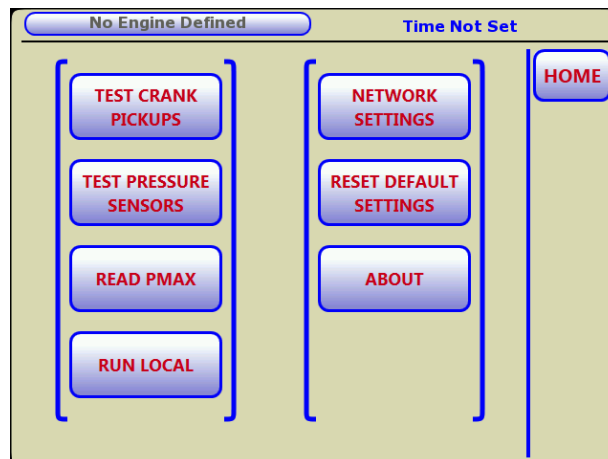
When the DK-200 is first turned on, the screen below will appear.



Note that the time is set automatically when the unit is connected to the server on the host computer. When first turned on the screen will show *Time Not Set*.

To enter Diagnostic Mode, tap **DIAGS** on the top right corner of the first screen as shown above. The main diagnostic test selection screen will now be displayed as shown below. If you wish to return to normal mode, tap the **HOME** button.

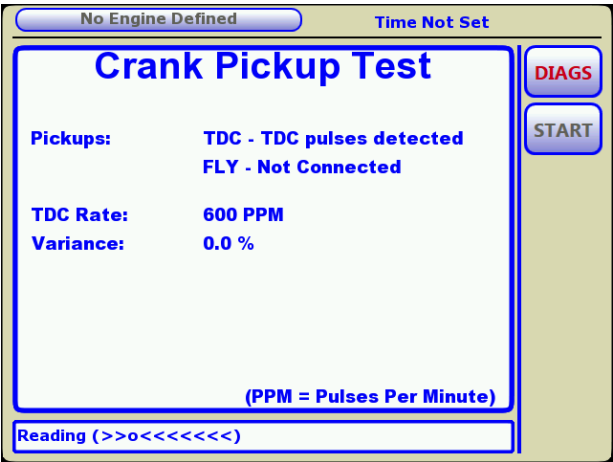
When you are in any of the diagnostic tests, tapping the **DIAGS** button will bring you back to the main diagnostic test selection screen. When there are more channels than can be displayed on a particular screen, you can scroll vertically through the channels using the up/down arrows labelled **CHAN**.



When installing and commissioning a system, it is suggested that the checks are carried out in the order of the buttons on the screen.

2.2 Test Crank Pickups

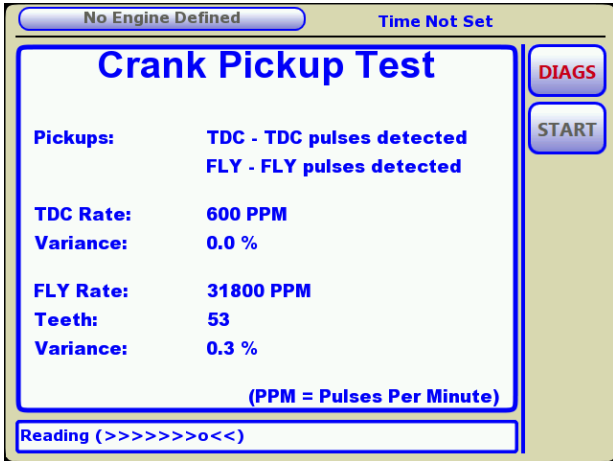
Tapping TEST CRANK PICKUPS takes you to the following screen. Note that the engine must be running to carry out this test.



The test checks the pulses coming in from the TDC and FLY pickups and displays them as PPM (pulses per minute). Note that the TDC rate in PPM will be the RPM of the engine. A report is given on the screen, an example of which is shown above. The *Variance* figure is a measure of the jitter on the sequence of pulses being detected. The allowable *Variance* can be set in the system software.

If no pulses are detected, this is displayed on the screen and the **START** button is enabled. Issues with the crank pickups and wiring should be rectified and the **START** button tapped to restart the test.

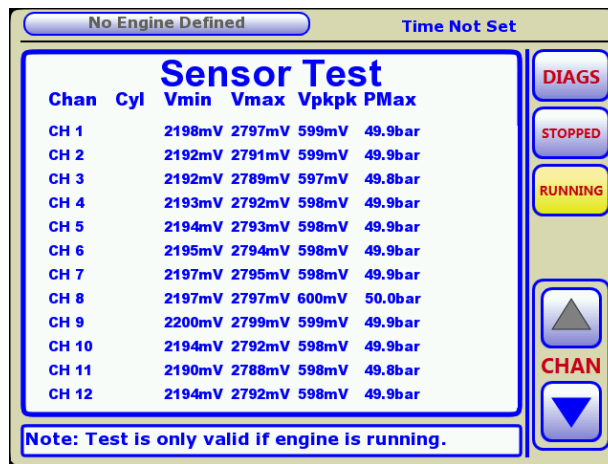
The screen below shows an example of the *Crank Pickup Test* with both TDC and FLY pickups fitted to the engine.



2.3 Test Pressure Sensors

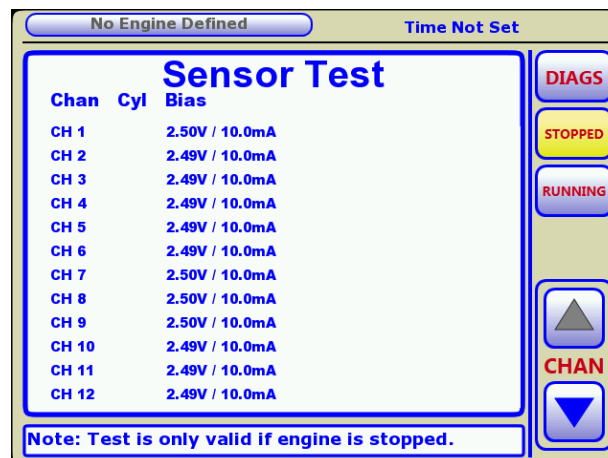
The pressure sensors connected to the DK-200 can be checked by tapping the **TEST PRESSURE SENSORS** button. Sensors can be checked with the engine running or stopped.

When the engine is running, tap the **RUNNING** button. The minimum voltage, maximum voltage and Vpk-pk from the sensor on each channel are displayed, together with a value of Pmax based on a nominal sensitivity of 50uA/bar and a PScav of 2.0 bar. (The resulting voltage is based on a load resistor of 250 ohms giving 12.5mV/bar). On channel 8 in the screen below, for example, Vpk-pk of 600mV gives 48.0 bar plus PScav of 2.0, resulting in 50.0 bar. Note that diagnostic mode assumes a PScav of 2.0 bar.



The main purpose of this test is to ensure that the voltage range from each sensor lies comfortably within the 0V to 5V input range of the DK-200. On any channel, if the minimum voltage is tending towards zero or the maximum voltage is tending towards 5V, then this should be investigated.

If the engine is stopped, the bias voltage from the sensors can be viewed. Only the bias voltage is available as there is no dynamic pressure signal present. Tapping the **STOPPED** button will display the screen below.



The *Bias* is displayed as a voltage and a current, the relationship being based on a load resistor of 250R as fitted to each channel on the DK-200. The bias voltage/current on each channel should be checked against the sensor manufacturer's data sheet to ensure that the bias (or sometimes called quiescent voltage/current) is within the expected range.

2.4 Read Pmax

With the engine running, it is useful to measure the Pmax being returned from the sensors. Tapping **READ PMAX** brings up the screen below.

Chan	Cyl	PMax	Min	Max	Avg
CH 1		49.9bar	49.9	49.9	49.9
CH 2		49.9bar	49.9	49.9	49.9
CH 3		49.8bar	49.8	49.8	49.8
CH 4		49.9bar	49.9	49.9	49.9
CH 5		49.9bar	49.9	49.9	49.9
CH 6		49.9bar	49.9	49.9	49.9
CH 7		49.8bar	49.8	49.9	49.9
CH 8		49.9bar	49.9	50.0	50.0
CH 9		49.9bar	49.9	49.9	49.9
CH 10		49.9bar	49.9	49.9	49.9
CH 11		49.8bar	49.8	49.8	49.8
CH 12		49.9bar	49.9	49.9	49.9

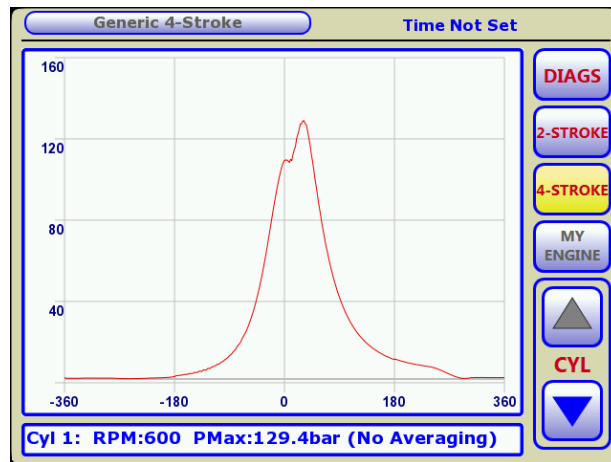
No engine: PScav=2.0bar Sens=50uA/bar

The test provides an analysis of the Pmax values returned from the sensors during the test. The *Pmax* column shows the latest (or instantaneous) value for each channel while the other three columns provide the minimum, maximum and average values recorded during the test. To clear the values and start another test, tap **RESET**.

Note that the values in bar are based on a nominal sensor sensitivity of 50uA/bar or 12.5mV/bar, and a PScav of 2.0 bar.

2.5 Taking Local Measurements

It is possible to measure and display real-time traces from all cylinders in diagnostic mode. Tapping **RUN LOCAL** brings up the screen below.



Note that there are three types of engine that can be measured, namely a generic 2-stroke, a generic 4-stroke and *My Engine* where the engine parameters have been loaded into the DK-200. Tap the appropriate selection for the way that the measurements are interpreted and displayed.

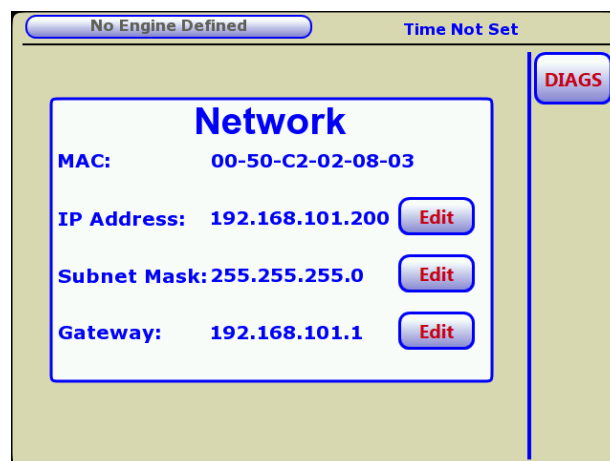
Tapping **2-STROKE** selects a generic two-stroke engine. Make this selection if the DK-200 is mounted on a two-stroke engine and you have not yet uploaded any engine details to the DK-200. The display will show an angular range of -180° to $+180^{\circ}$. Tapping **4-STROKE** will select a generic four-stroke engine with an angular range of -360° to $+360^{\circ}$. The generic engines assume a sensitivity of 50uA/bar or 12.5mV/bar, and a PScav of 2.0 bar.

If you have already loaded an engine into the DK-200 via the network, you can select **MY ENGINE** which will apply the engine parameters. The test now shows cylinders as it is known which cylinder is connected to which channel.

The red trace shows the cylinder currently selected – use the **CYL** up/down arrows to select different cylinders.

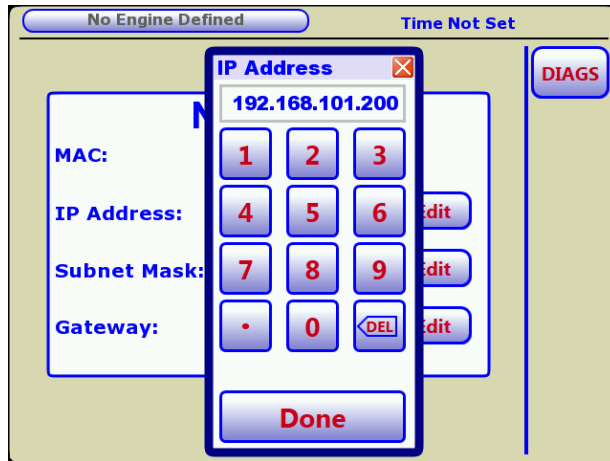
2.6 Defining Network Settings

The network settings for the DK-200 are set by tapping the **NETWORK SETTINGS** button. The screen below will be displayed.



The MAC address of the DK-200 unit is displayed. The IP Address, Subnet mask and Gateway for the ethernet network are changed by tapping the appropriate **EDIT** button. An example of the IP Address edit screen is shown below. Simply enter the desired IP address with the dot separator in the correct places and tap **DONE**. If you enter an incorrect syntax, the **DONE** button will be greyed out.

IMPORTANT: Note that, once editing is completed, the unit must be power-cycled for updated network settings to take effect.



The same applies to the Subnet mask and Gateway entries.

IMPORTANT: Note that, once editing is completed, the unit must be power-cycled for updated network settings to take effect.

All units on leaving the factory have settings as in the table below. Note that all units on a network must have a unique IP address. It is essential, therefore, that appropriate IP addresses are set.

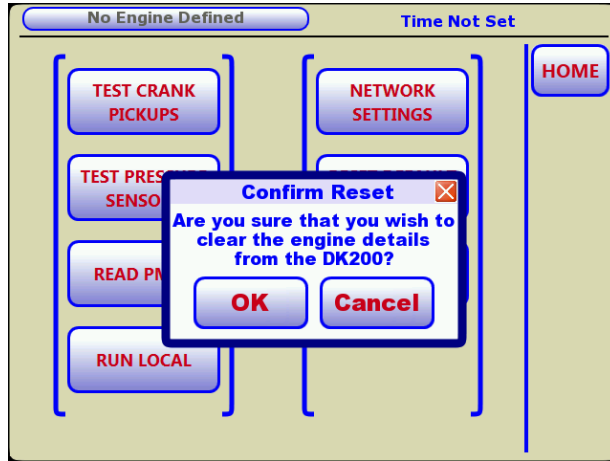
Factory Network Settings

IP Address	192.168.101.101
Subnet Mask	255.255.255.000
Gateway	192.168.101.1

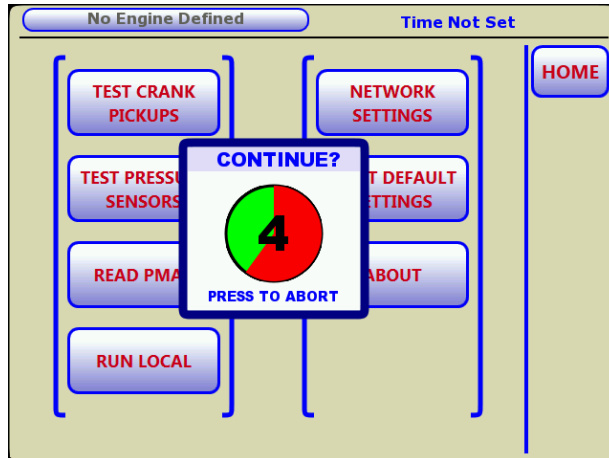
2.7 Reset Default Settings

The default settings can be applied to the DK-200 by tapping the **RESET DEFAULT SETTINGS** button. This erases all engine details held by the DK-200.

Note that this operation does NOT modify network settings. The screen is shown below.

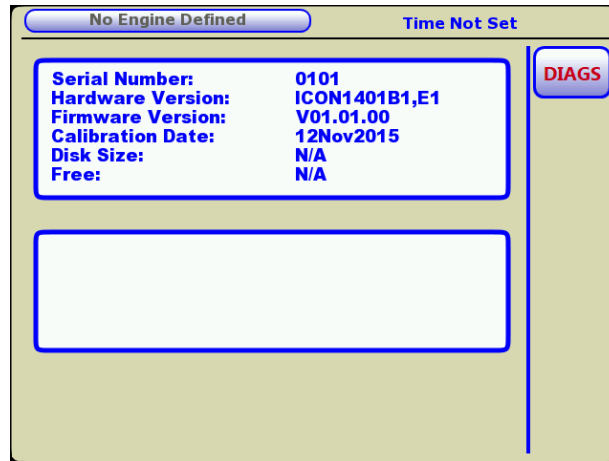


Clicking **OK** brings up the countdown screen shown below. You have 10 seconds to abort the default setting process if you wish by tapping the centre of the countdown counter.



2.8 System Information

Tapping the **ABOUT** button provides information about the DK-200 unit, including hardware and software versions and date of last calibration. The size of the internal memory and free space is also shown. The screen is shown below.



The lower display area on the *ABOUT* screen is used for testing the touchscreen. Tapping on the touchscreen shows the X-Y co-ordinates in a range of 640 x 480 of where the tap was detected.

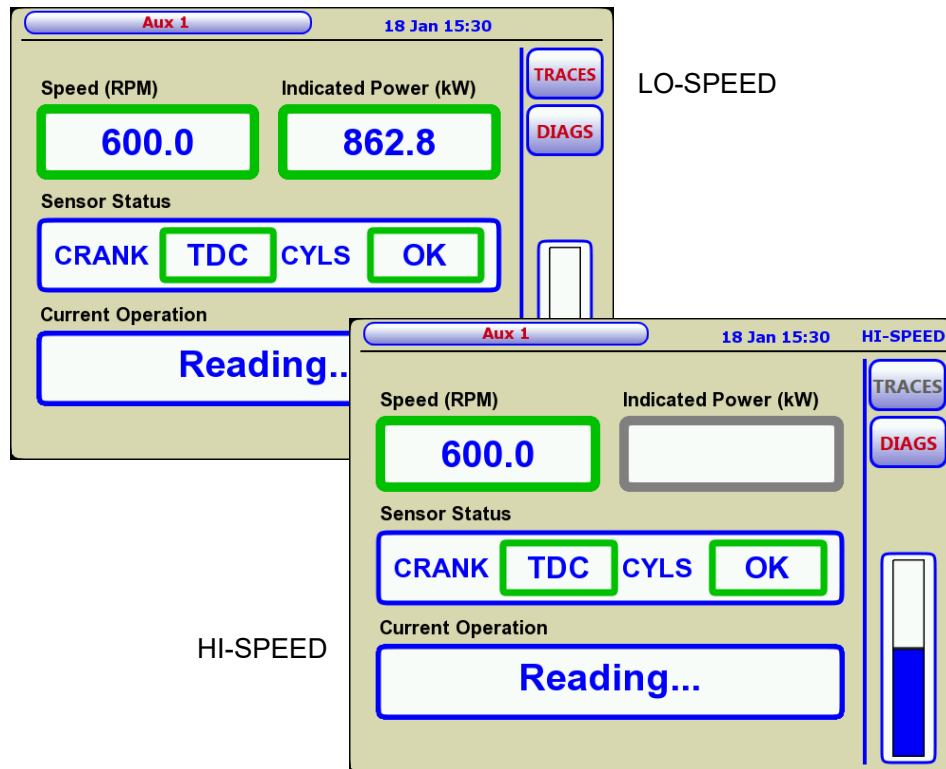
Chapter 3 – NORMAL Mode

3.1 DK-200 NORMAL Mode

In normal mode, the DK-200 operates under the control of a host computer via an ethernet network. The DK-200 receives commands from a server running on a PC and responds to these. The usual sequence is the acquiring of data, averaging the measurements and transferring the results over the network.

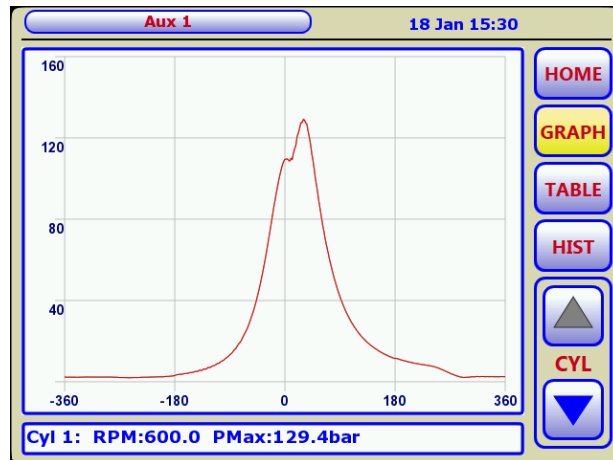
The DK-200 can operate in one of two sampling modes, namely *Lo-Speed* and *Hi-Speed*. The sampling mode is set in the *System Preferences* menu in the PC software. In *Lo-Speed* mode, the Indicated Power is displayed for each measurement. Measurement update rates to the PC screen are a few seconds for a typical medium speed engine. In *Hi-Speed* mode, screen data (power, traces and tables) are not displayed in order to speed up the acquisition time between measurements. In *Hi-Speed* mode on a typical four-stroke engine with no measurement averaging, update rates to the PC screen can approach once per second. Note that the acquisition time, including any averages specified, will largely dictate the update rate to the PC screen.

The main view screen in *Lo-Speed* and *Hi-Speed* modes is shown below. Note the message *HI-SPEED* in the top right corner when in this mode. The main view screen can be displayed by tapping the **HOME** button in the menu structure. If the system is left in diagnostic mode, it will revert back to normal mode after 10 minutes if a key is not tapped (as if the **HOME** button had been tapped).



The screen gives a summary of the overall status of the system, namely indicated power from the engine (*Lo-Speed* mode only), the current RPM, status of the pressure and crank sensors, and the operation currently being carried out. If the green border around a parameter turns yellow or red, this means that the corresponding function is out of limits and should be investigated using diagnostic mode. A yellow border indicates that alert limits have been reached as specified in the host application, and a red border indicates that fail limits have been reached. The sensors are tested before every set of cylinder measurements to ensure the integrity of the data.

When in *Lo-Speed* mode, tapping the **TRACES** button brings up the screen below. Here the measurements from the engine can be viewed as graphs, in a table or in histogram format. The screen below will appear.



3.2 Graph View

When the **TRACES** button is tapped, graph view as above is shown first. You can select the three different views (graph, table and histogram) by tapping the corresponding button on the right panel. Tapping the **CYL** up/down arrows in graph view scrolls through the cylinders. Pmax for the selected cylinder and engine RPM are shown in the banner at the bottom of the screen.

3.3 Table View

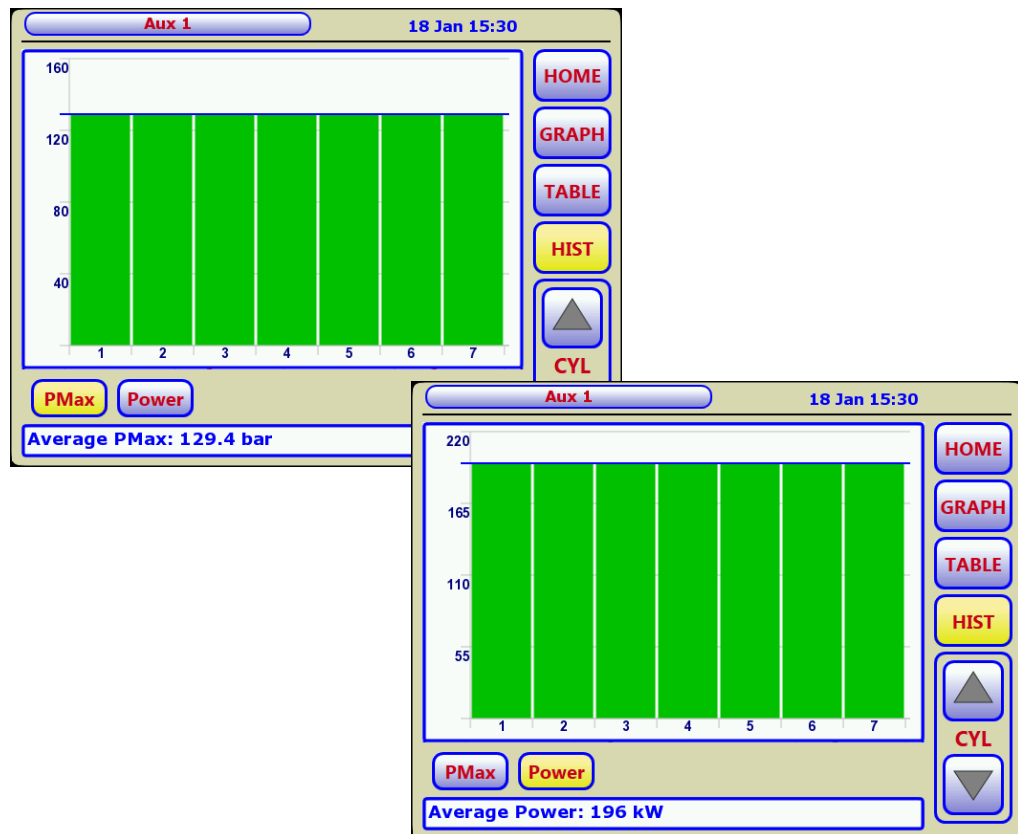
Tapping the **TABLE** button brings up table view as shown below.

Aux 1		18 Jan 15:30							
Cylinder	1	2	3	4	5	6	7	Avg	
PMax (bar)	129.4	129.1	129.8	129.5	129.6	129.2	129.4	129.4	HOME
Ang PMax	30.8	30.8	30.8	30.8	30.8	30.8	30.8	30.8	GRAPH
RPM	600.0	600.0	600.0	600.0	600.0	600.0	600.0	600.0	TABLE
MIP	33.0	32.9	33.0	33.0	33.0	32.9	33.0	33.0	HIST
Power (kW)	196.7	196.4	197.0	197.0	197.1	196.5	196.7	196.8	▲
Ign Ang	6.8	6.7	6.7	6.8	6.7	6.7	6.7	6.7	▼
									CYL

Key parameters for each cylinder are shown together with, where appropriate, the average value for all the cylinders. It is possible to see cylinder values which are deviating from the average.

3.4 Histogram View

Histograms of Pmax and indicated power can be shown by tapping the **HIST** button, as per the screens below. Tapping the **Pmax** and **Power** buttons toggles between the histograms.



3.5 Viewing Engine Parameters

The parameters of the engine can be viewed by tapping on the engine name at the top left side of the screen. An example screen is shown below. The left/right arrows toggle through the *Cylinder* parameters.

