Reference Manual

IMIB TECHNICIAN WORKSHOP GUIDE

Technical Training

Table of Contents

Integrated Measurement Interface Box

Subject **Page**

Integrated Measurement Interface Box 7
Operating modes 11
Stand Alone 11
Remote Operation 11

Standalone Mode 12
Start Screen 12
Oscilloscope 13
Additional commands 14
Display trace movement 14
Undo 14
Channel settings 14
ChX 14
Sensor 14
Measuring range 14
Coupling 14
Filter 14
Inverting 14
Time base settings 15
Time/Div 15
Trigger settings 15
Trigger 15
Line 15
Source 15
Side 15
Level in V 16
Timeout in ms 16
Pretrigger 16
Evaluations 16
Recorder / Player 17
Signal zoom 17
Cancel 17
Pause/Continue 17
Single Shot 17
Cursor On/Off 17

Subject	Page

Reference On/Off 18
Administration 18
Report 18
Stimuli 18
Multimeter 19
Preset measurement 19
Bluetooth test 20
WLAN test 20
USB test 21
Synchro test 21
Counter 21
Quiescent current 21
Quiescent current viewer 21

Measuring Devices 22
Multimeter 24
Display Range 25
Range 25
Source (measurement source) 25
Mode 26
Range 26
Using the Multimeter 27
Oscilloscope 28
Display Area 28
Graph Display 29
Measured Value Display 30
Range 30
Cursor and Display Settings 31
Channel 35
Trigger 36
Record Mode 38
Action Line 39
Signals 40
Using the Oscilloscope 42
Workshop Trolley 43

Basic Measurements 44
Wire Test 44
Wire Test - Standalone 46
Closed Circuit Current Monitoring 50
Closed Circuit Current Monitoring - Standalone 52
Recording and Analyzing Measurements 54
Alternator Test 55
Alternator Test - Standalone 56
Secondary Ignition Test 57

Subject	Page

Checking Injector Signal 58
Checking Injector Signal - Standalone 59
Checking the BSD Line 60
Checking K-CAN 61
Checking the BSD Line - Standalone 62
Checking PT-CAN 63
Checking FlexRay 64
Checking PT-CAN - Standalone 65
Checking FlexRay - Standalone 66

DME Signals 67
Activation Thrust Air Control Signal (Bypass Blow-off Valve) 67
BSD 68
Wastegate Control - Standalone 69
BSD - Standalone 70
Camshaft Signal 71
Crankshaft Signal 72
Camshaft Signal - Standalone 73
Crankshaft Signal - Standalone 74
DK Motor (Drosselklappe Motor – Throttle Valve Motor) 75
DK Motor - Standalone 77
EPDW - Turbocharged Engines 79
Ignition Primary Signal 81
Ion Current Combustion Monitoring (BMW M) 83
Injection Signal (High Impedance Coil) - Solenoid Type 85
Injection Signal (Low Impedance Coil) - Solenoid Type 87
Injection Signal (Low Impedance Coil) - HDEV Solenoid Type 88
Injection Signal - HPI Outward-opening Piezo-injectors 93
Oil Volume Control Valve (N18) 94
PT-CAN Low 95
PT-CAN High 96
PT-CAN Low - Standalone 97
PT-CAN High - Standalone 98
PT-CAN Shorted 99
PWG Signal 100
PWG Signal - Standalone 101
VANOS Signal 102
VALVETRONIC (Single Phase Motor) 103
VANOS Signal - Standalone 104
VALVETRONIC (3 Phase Motor) - Standalone 105
VALVETRONIC (3 Phase Motor) 106

Subject	Page

Body Signals **108**
Power Windows 108
Motor Hall Sensor (F25) 108
Window Motor End Travel 110
Automatic Tailgate Actuation - HKL 112
HKL Hall sensor 112
HKL Motor 114
HKL “Good” Shielded Ground 116
Single Wire Bus 118
LIN Bus 118
KL_30F (BN2020) 120
Blank Oscilloscope Screens 125
Blank Oscilloscope Screens 126
Blank Oscilloscope Screens 127
Blank Oscilloscope Screens 128
Blank Oscilloscope Screens 129
Blank Oscilloscope Screens 130

Subject **Page**

BLANK PAGE

Integrated Measurement Interface Box (IMIB)

Model: All

Production: All

OBJECTIVES

After completion of this module you will be able to:

- Identify the controls/interface of the IMIB.
- Demonstrate the use of the measuring devices.
- Perform measurements with the Multimeter and Oscilloscope.
- Know how to set up the basic measurements in the IMIB.

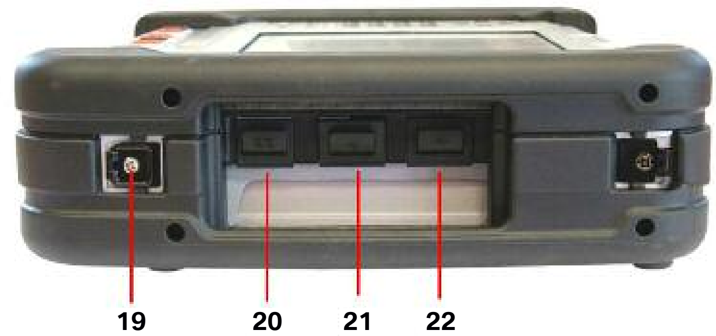
Integrated Measurement Interface Box

The Integrated Measurement Interface Box - Release 2 gives access to the measuring technology in the new workshop system. The compact shape of the Integrated Measurement Interface Box makes it a versatile tool for testing signal transmitters, data lines and electronic components of vehicles.

The Integrated Measurement Interface Box (IMIB R2) offers the following functions:

- Voltage measurement
- Current measurement with current clips up to 1,800 A
- Resistance measurement
- Pressure measurement
    - Low-pressure measurement up to 2 bar onboard
    - Up to 100 bar with external sensor
- Temperature measurement with external sensor
- Use of:
    - kV clip (kilovolt clip)
    - Trigger clamp
- Multi-channel oscilloscope
- Stimuli function
- Multimedia test
    - Bluetooth
    - USB (power and data transfer)
    - WLAN

Integrated Measurement Interface Box (IMIB R2)



Index	Explanation	Index	Explanation
1	Input 1 for voltage, current, resistance, and diode test	12	Stylus cord
2	Input 2 for voltage	13	Measurement input 3 Trigger sensor, 100A/1,800A current clamp, 100 bar pressure sensor, temp. sensor
3	Microphone	14	Measurement input 5 Video test pattern, SPI interface
4	Power On/Off button and LED display	15	Measurement input 4 100A/1,800A current clamp, 100 bar pressure sensor, temp. sensor, kV clip, SID cable
5	Control buttons	16	USB connector (Type B)
6	LED displays: WLAN, battery status and hard drive access	17	Connections for low-pressure hoses
7	Keypad: numeric keypad and special functions	18	Stimuli output
8	Rubber buffer	19	Hand strap fastening (strap not included)
9	Cursor keys for quick navigation for the input fields	20	Cover for RJ45 connector (LAN connection)
10	Speaker	21	Cover for USB connector (Type A)
11	Touchscreen	22	Cover for USB connector (Type A)

If a measurement is carried out during a diagnostic procedure, the result determined by the Integrated Measurement Interface Box is automatically evaluated in the diagnostics program and therefore influences the next diagnostics stage. In addition to its use in diagnostic procedures, the Integrated Measurement Interface Box can also double as a standalone, portable digital multimeter and oscilloscope.

The measured values are shown on the display screen. It is possible to measure voltage, current, pressure, resistance, temperature, frequency as well as test Bluetooth and USB functions. Measured values are not displayed on the display screen if the Integrated Measurement Interface Box is being controlled by ISTA.

The results are displayed in the Integrated Service Technical Application under "Measuring devices". Registration and configuration (e.g. of the display language) is carried out using the ISPI Next Admin client and IMIB operating software (OS) respectively. Software updates are managed using the IMIB OS and are implemented when necessary.

Shown below are the cables and sensors that are provided with the IMIB R2.

1

2

3

4

5

6

7

8

Index	Explanation
1	Two sets of multi-measurement leads
2	Stimuli leads
3	AUX cable for connecting the 100 bar pressure sensor
4	Pressure sensor
5	kV clip
6	100A Current clamp
7	Temperature sensor
8	Ignition trigger sensor

Note: The 1,800 A current clamp and set of low pressure hoses are optional accessories and must be purchased separately.

Operating modes

The IMIB R2 supports 2 modes of operation: **Stand Alone** and **Remote**.

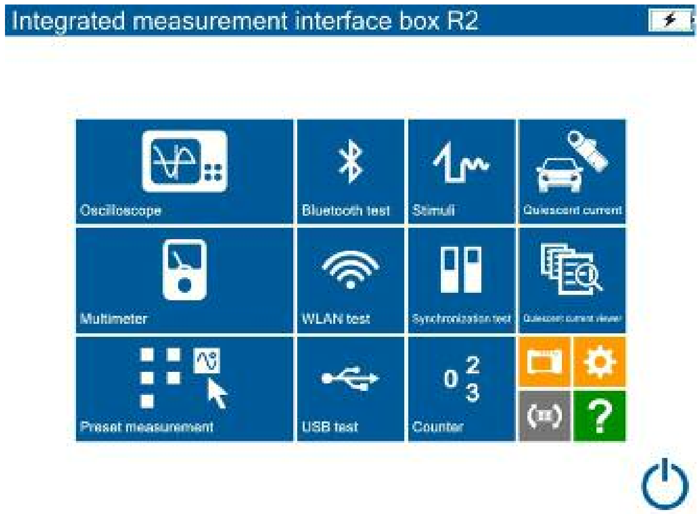
Stand Alone
In this mode the IMIB R2 will operate as a local instrument. All displays and user input are made at the IMIB R2.

Remote Operation
In this mode the IMIB R2 is remotely controlled by an ISID and supplies the measured data to the ISID. All visualizations and user interactions take place on the ISID. The IMIB R2 displays a message indicating the IMIB R2 is in the remote mode. The remote operation can be cancelled by tapping “unlock” and confirming with the security prompt.

Standalone Mode

Start Screen

In standalone mode, the start screen displays the menu selection.

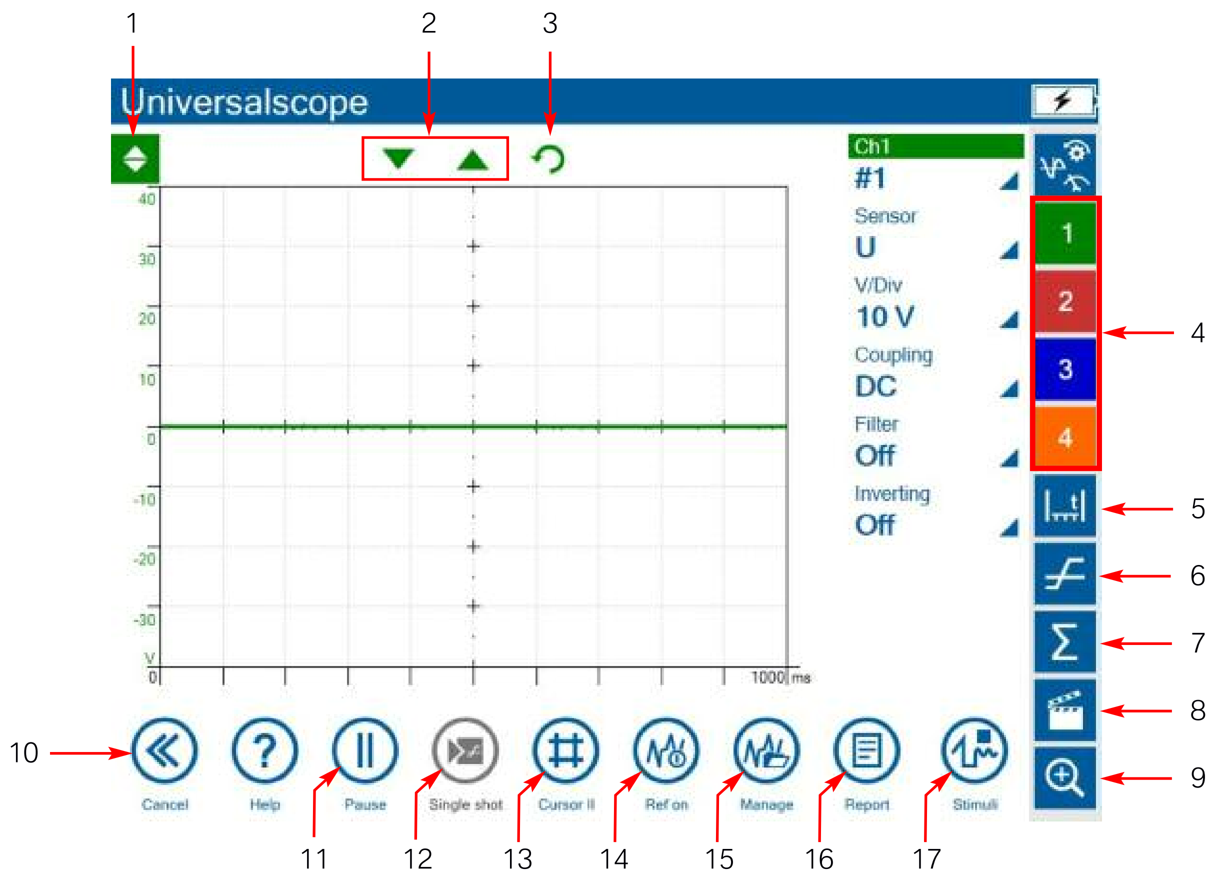


The following menus are available from the start screen:

- Oscilloscope
- Multimeter
- Preset measurements
- Bluetooth test
- WLAN test
- USB test
- Stimuli
- Synchro test
- Counter
- Quiescent current
- Quiescent current viewer
- System info
- Settings
- Software update
- Help

Oscilloscope

When selecting the Oscilloscope, the user is presented with the following screen.



Index	Explanation	Index	Explanation
1	Additional commands	10	Cancel
2	Display trace movement	11	Pause / Continue
3	Undo	12	Single shot
4	Channel settings	13	Cursor On/Off
5	Time base settings	14	Reference On/Off
6	Trigger settings	15	Administration
7	Evaluations	16	Report results
8	Recorder / Player	17	Stimuli
9	Signal zoom		

Additional commands
Clicking this button shows or hides additional buttons for moving the trace as well as the Undo button.

Display trace movement
Moves the associated trace up / down. These buttons will be turned on/off by the additional command button function. For each configured channel, a pair of buttons appears in the color of the channel (e.g., green, red, blue, or orange).

Undo
Undoes the adjustment.

Channel settings
Used to configure buttons for each channel. Unconfigured channels are displayed with “---”. The channel settings can be made or adjusted while making measurements. After selecting a channel, the configuration can be made on the area left of the channels button.

- **ChX**
Selection to assign a channel to one of the 8 physical measuring ports.

- **Sensor**
Selection field to select the hardware input to the measurement channel. Automatically detected sensors can be pre-set.

- **Measuring range**
Selects the measuring range per division in the display (e.g., 10V/division).

- **Coupling**
Selection of signal coupling: AC (alternating), DC (direct) or GND (ground).

- **Filter**
Sets the hardware-side smoothing filter. Available options are: Off, 100Hz, 1kHz, 10kHz, 450kHz.

- **Inverting**
Sets inverting of the graph. On or Off.

Time base settings

The time base settings allow for adjusting the resolution of the scope to match the signal being measured. They can be adjusted while making measurements. Configuration of time settings can be made after pressing the time base settings button, in the upper right area of the screen.

Time/Div

Time settings per division can be made here. Divisions per box can be set from 50 ns (nanoseconds) to 5 hours.

50 ns	1 ms	20 s
100 ns	2 ms	50 s
200 ns	5 ms	1 min
500 ns	10 ms	2 min
1 µsec	20 ms	5 min
2 µsec	50 ms	10 min
5 µsec	100 ms	20 min
10 µsec	200 ms	50 min
20 µsec	500 ms	1 h
50 µsec	1 s	2 h
100 µsec	2 s	5 h
200 µsec	5 s	
500 µsec	10 s	

Note: The other fields in the time base settings (Buffer size, Streaming mode, Min/Max, etc.) are information only. They are grayed out and cannot be changed.

Trigger settings

The trigger enables users to stabilize repetitive waveforms and make it appear as though it is static.

Trigger

Selection field for turning the signal trigger on or off.

Line

Graphical representation of the trigger threshold above or below which the signal value (graph) must be to meet a trigger condition.

- On: Trigger line is always displayed on all measurement screen displays.
- Off: Trigger line is always hidden.
- Auto: Trigger line in only displayed when selecting the trigger settings, otherwise it’s hidden.

Source

Selection field to set the trigger reference source (CH1, CH2, etc.). This setting determines which channel is used as a reference to evaluate whether the trigger condition is met.

Side

Selection field for setting the signal edge which is used for triggering.

- Rising: Rising edge from the lower value to the higher value (e.g., 1V rising to 12V).
- Falling: Falling edge from the higher value to the lower value (e.g., 12V falling to 0V).

Level in V
Input field for setting a value that must change for the trigger to start. Settings are made by either typing the value in the selection field or moving the on-screen line.

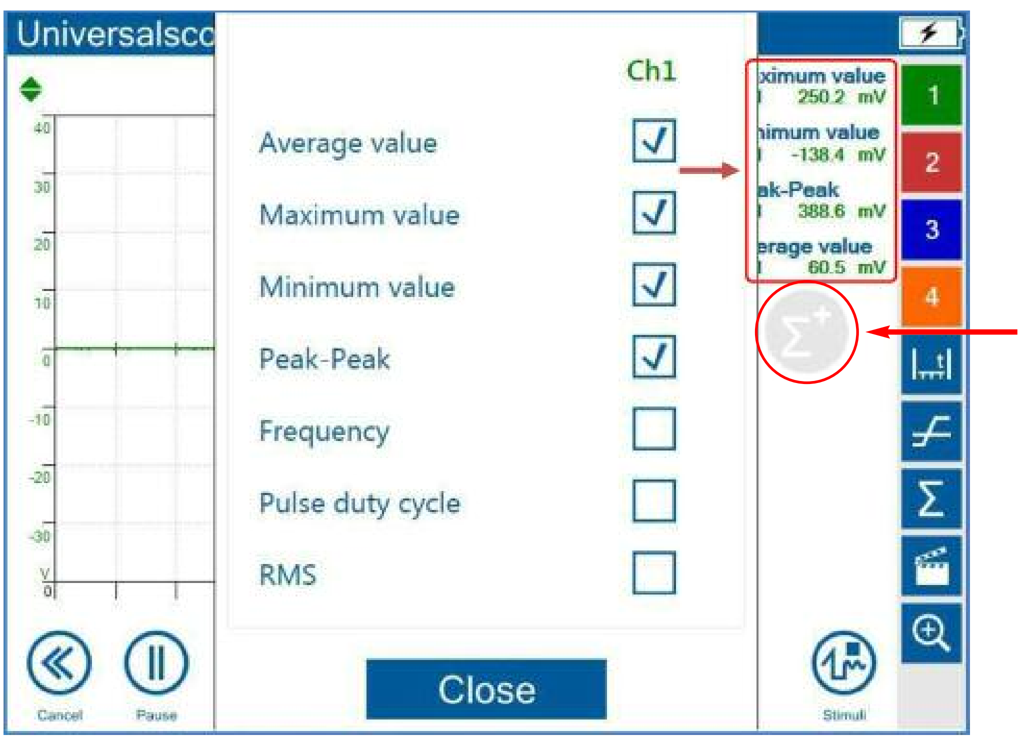
Timeout in ms
Selection field for setting the trigger timeout after which a new signal recording starts. Values range from Infinite (standard operation) to 10 seconds.

Infinite	100 ms
1 ms	200 ms
2 ms	500 ms
5 ms	1 s
10 ms	2 s
20 ms	5 s
50 ms	10 s

Pretrigger
Selection field for setting the pre-trigger condition. Values range from 0% to 100% in 5 percent increments. Once the trigger condition is met recording will start, the pre-trigger value corresponds to where on the display the recording starts. Value of 0 is the left most position on the display. Value of 100 is the right most position. Default value is 50% which correspond to the center of the display.

Evaluations

Nominal evaluations relating to the graphs are displayed on the right side of the screen in case they have been selected previously. If there are no evaluations on screen, tap the evaluations button followed by the watermark on the screen. Display selections can then be made.



Evaluations watermark.

Recorder / Player
When selected, operating elements for the recorder / player are displayed in the top right section of the screen. Once a recording has been completed, it can be saved on the IMIBs hard drive under a user specified name.

Signal zoom
The signal zoom function starts with no zoom level (x1). Zoom levels are adjusted either by using the selection field in the top right section of the screen or by using the two functional zoom keys +/-. Zoom ranges from x1 to x2048.

Cancel
Terminates the current measurement display and switches back to the previous screen.

Pause/Continue
The current measurement display can be "frozen"/ continued. While pausing, "frozen" measurement displays can be scrolled through using the directional buttons on the screen.

Single Shot
As soon as the trigger conditions are met the measured data is recorded. There is no further triggering. For "Single Shot", no trigger timeout can be set. Pressing the "Single Shot" button once more resets the previous result and re-activates the Single Shot mode.

Note: The Single Shot mode only works when the signal trigger is switched on!

Cursor On/Off
Once pressed, the cursor function is activated and relevant evaluations and their measurement units relating to the current position are displayed in the top right section of the screen. There are 4 modes of the cursor:

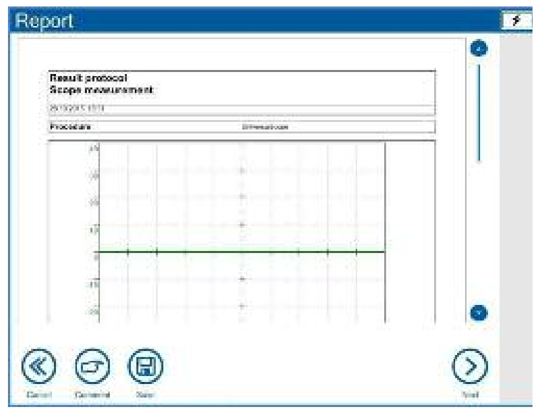
- Pressing the button once, Time cursor (Cursor II) is activated.
- Pressing the button twice, Amplitude cursor (Cursor =) is activated.
- Pressing the button three times, Time and Amplitude cursor (Cursor #) is activated.
- Pressing the button four times deactivates the cursor function.

The cursor lines can be moved by using either the hardware arrow keys or by dragging the lines on screen.

Reference On/Off
Activates the reference curve selection. A separate reference curve selection window appears. A predefined reference curve matching the current measurement selection is pre-displayed (if available). Once the curve has been selected, click "accept curve" to overlay it on the screen. Pressing the reference button again hides the curve.

Administration
Activates a new window where the technician can save, rename and delete their own curves and measurements. Saved curves can later be called up using the "Reference On/Off" function from the "Own" folder. Own measurements can be easily retrieved from the Start Screen under Preset measurements button.

Report
Opens the report preview with a copy of the last measurement data and a field for individual notes. It displays the date and time of the measurement as well the oscilloscope settings and any cursor conditions. The technician can add thier own comments using the "Comment" button. The report can be saved as a PDF file using the "Save" button. It can then be printed. The name of the report file consists of the name of the measurement and the date and time of the report file creation (e.g., Universalscope_20180621_105943.pdf).



Stimuli
Stimuli is a function generator to create signals. Stimuli settings can be made during ongoing measurements. Three general physical variables are available to create signals:

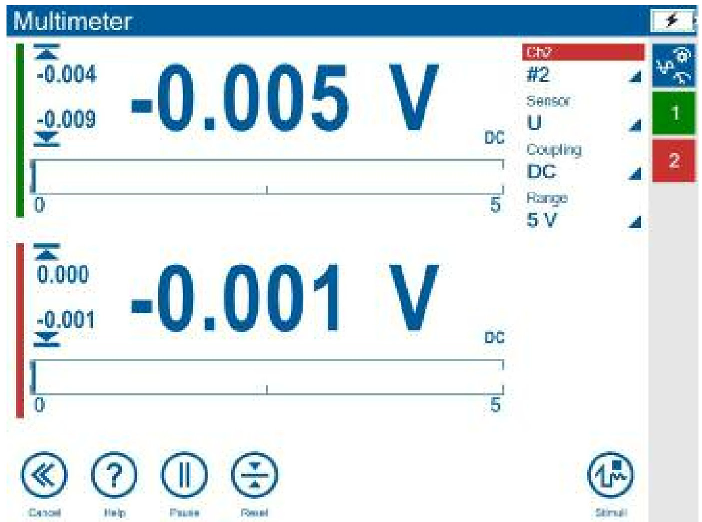
- Voltage from 0.1V to 40V (DC, Sine, Rectangle, Saw tooth)
- Amperage from 1mA to 120mA
- Resistance from 50Ω to 12.8kΩ

Once the settings have been made the function can be activated by pressing the "On" button in the lower right corner of the display. Pressing it again turns off the stimuli function.

Multimeter

Using the Digital Multimeter's measurement menu, the technician can simultaneously configure two channels entirely independent from one another in numbers and by means of a bar display. The following measurements can be taken:

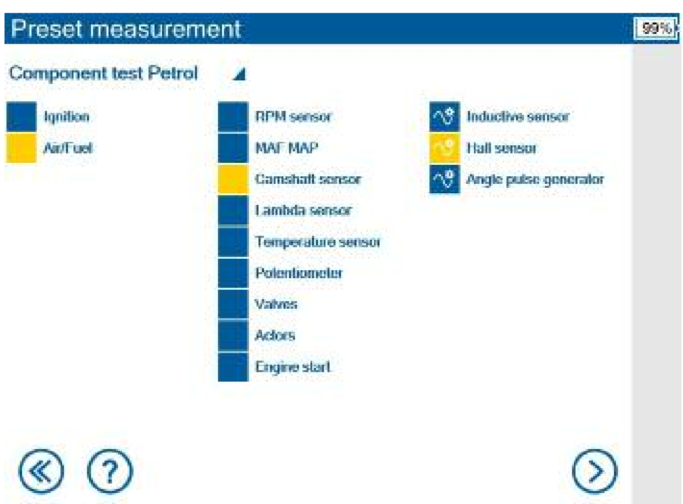
- Voltage (AC/DC)
- Current (AC/DC)
- Resistance
- Diode
- Pressure
- Temperature



Note: Channel settings are referenced in the oscilloscope section of this manual.

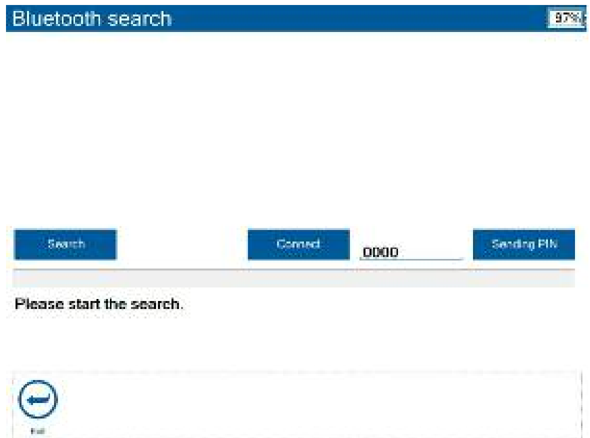
Preset measurement

This measurement menu offers default measurement settings for all motor vehicle-related measurements. Automatic default settings and a good reference curve for the oscilloscope are available for every default measurement.



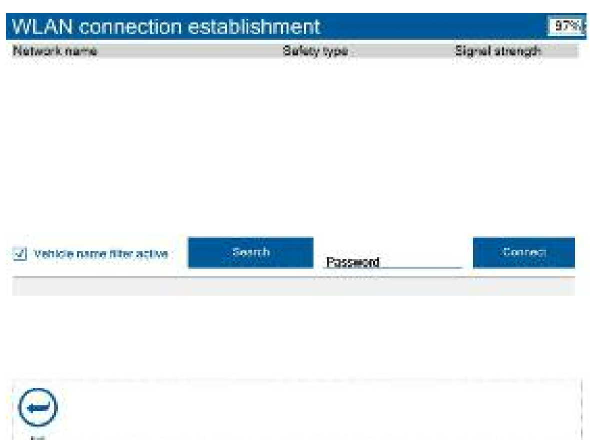
Bluetooth test

This measurement menu allows technicians to search and display vehicle-related bluetooth connections. After that, the technician can connect the IMIB with the vehicle's selected bluetooth device and test it for proper communication.



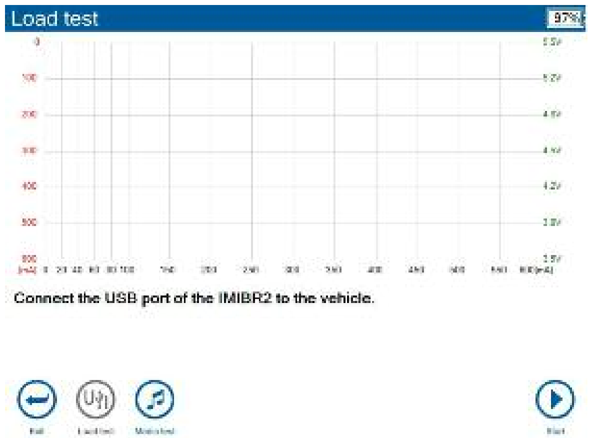
WLAN test

This menu allows technicians to search and display Wi-Fi connections. Names of connections and their signal strength are displayed. When selecting "vehicle filter active", only vehicle-related connections are displayed. Afterwards, the technician can connect the IMIB to the vehicle's selected Wi-Fi connection and test it for proper operation.



USB test

In this menu, tests can be performed on the vehicle's USB ports. The load test measures voltage and current supply of the USB port and the media test evaluates whether the list of media stored on the IMIB (MP3) is recognized by the vehicle.



Synchro test

This measurement menu allows the technician to measure and compare two pressure conditions using the IMIBs two low pressure ports (no. 7 & 8).

Counter

The technician can use this menu to record the frequency, duty cycle, duration period and the number of evaluated periods since the start of measurement of a clocked signal.

Quiescent current

This menu is used for recording current when performing a current draw test. The duration of the recording can be set from 30 minutes to 72 hours and later saved as a measurement file.

Quiescent current viewer

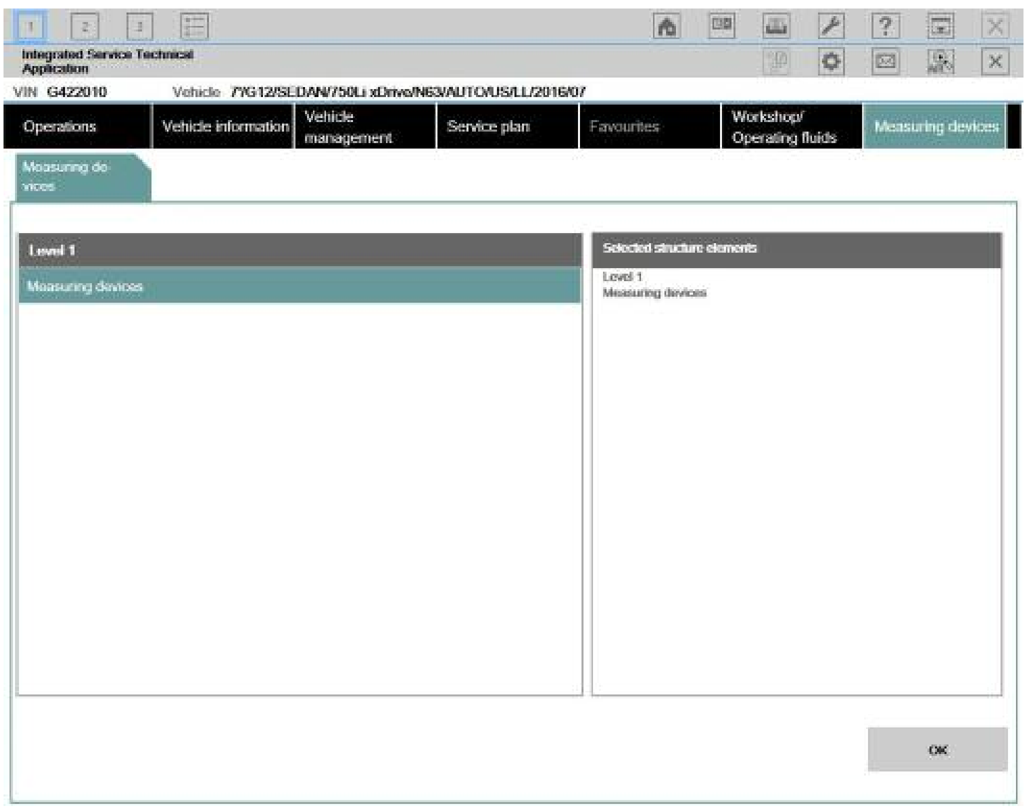
This function alows the technician to display and evaluate the saved measurement file created when performing a current draw test.

Measuring Devices

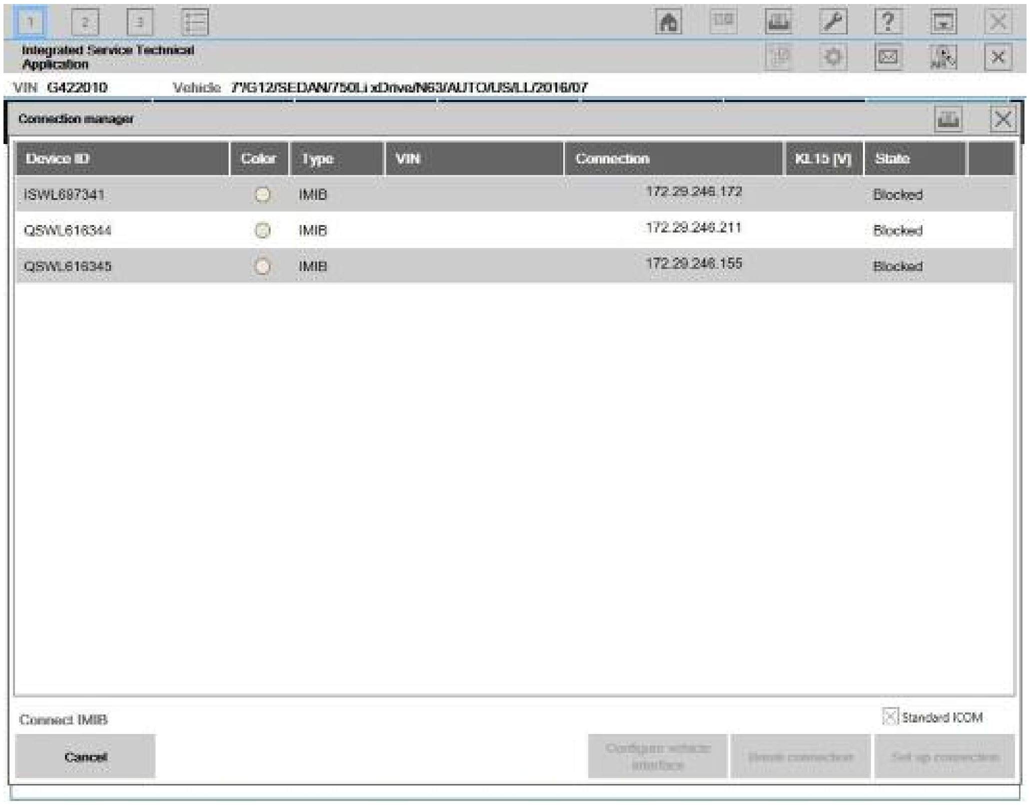
The measuring devices (Multimeter, Oscilloscope, Signals) are component parts of the ISTA workshop system. The corresponding measuring devices hardware, as well as the periodic measurement data logging, preparation of information, and provision of the results, are all performed by the IMIB connected via LAN.

How to start the measuring devices:

- Call up the measuring devices via the "Measuring devices" selection in the navigation area.
- Select the "OK" button. The "Connection manager" mask appears.
- Select the desired IMIB and click the "Set up connection" button. The "Measuring devices" tab will then appear with the preset "Multimeter" preset tab.



"Measuring devices" tab



"Connection manager" mask

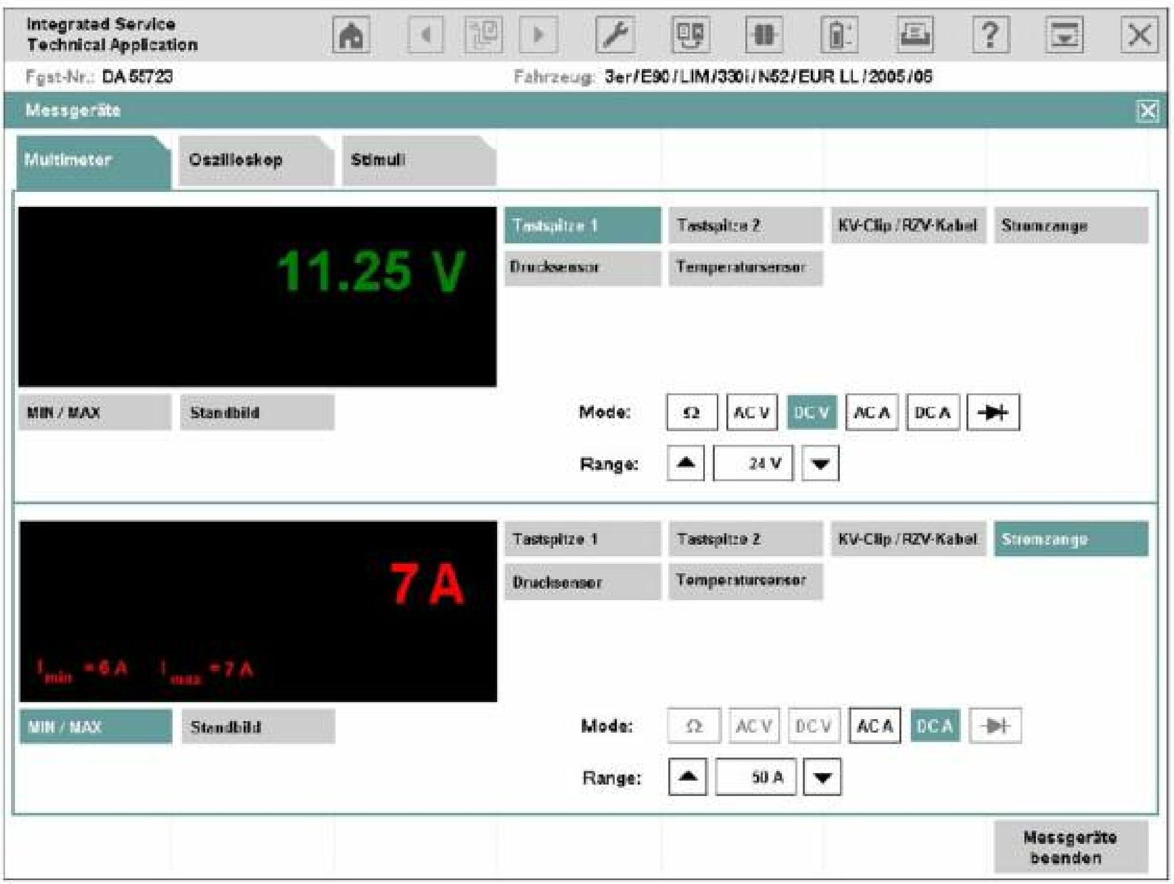
Switching to Another Tab

When switching between the measuring devices tabs, the most recently made setting will be retained.

Multimeter

The "Multimeter" tab contains display and control elements for two multimeters that are separately displayed in the content range, separated into two boxes. Besides individual measurements, the device also supports parallel measurement via Probe 1 and Probe 2 for resistance, direct/alternating voltage, direct/alternating current, as well as the diode test. Furthermore, parallel measurements with Probe 1 or 2, as well as a sensor (kV clip/RZV cable [resting voltage cable], clip-on ammeter, pressure sensor, or temperature sensor), are possible.

Each multimeter consists of a display area (left) and a settings area (right). With the "Quit measuring devices" button in the action line, you can return to the "Measuring devices" tab.



"Multimeter" mask

Display Range

The display area shows the measured value with its physical unit of measurement highlighted in color. The measured values of Multimeter 1 (connected with Probe 1 by default) are displayed in green; Multimeter 2 (connected with probe 2 by default) displays measured values in red.

Under the display area, there are two buttons with the following functions:

- ◇ MIN/MAX: If you click this button, the two limit values are shown at the bottom left of the display window. "MIN" corresponds to the lowest value in the period of measurement, e.g. "Imin = 6 A". "MAX" shows the highest value, e.g. "Imax = 7 A".
- ◇ Freeze-frame: This function "freezes" the measurement; the last measurement is thus retained. You can also trigger the freeze-frame function at the probe and then read the value at the tester. If you click the button a second time, the measured values continue to be displayed.

Range

The setting range is located at the bottom right of the mask, divided into an area for Multimeter 1 (top) and Multimeter 2 (bottom). At the top, there are six buttons for selecting a measurement source (probes and sensors). Under these are the "Mode" zones for setting the measurement type and "Range" for setting the measurement range.

Source (measurement source)

The following measurement sources are used:

- Probe 1: for resistors, direct/alternating voltage, direct/alternating current, diode tests.
- Probe 2: for resistors, direct/alternating voltage, direct/alternating current, diode tests.
- kV clip/RZV cable: for high voltage measurements in ignition systems.
- Clip-on ammeter: for direct and alternating current.
- Pressure sensor: for pressure measurements, e.g. cylinder 1 compression.
- Temperature sensor: for temperature measurements in liquids, e.g. oil temperature.

After the source has been selected, the button will be displayed in the color of the mask.

Mode

The possible settings change according to the selected source. After selection of a mode, e.g. "DC V", it is highlighted in the color of the mask.

The abbreviations are defined below:

- ΩΩ: Resistor measurement
- AC V: Alternating voltage measurement
- DC V: Direct voltage measurement
- AC A: Alternating current measurement
- DC A: Direct current measurement
- ▷| : Diode test

Range

The range changes according to the source. The measuring device will automatically be set to the highest measurement range by default; however, you can manually adjust it if required.

If the displayed measurement value lies outside the manually selected range, the display changes to "++++" or "----".

Using the Multimeter

How to perform a resistor measurement with Multimeter 1:

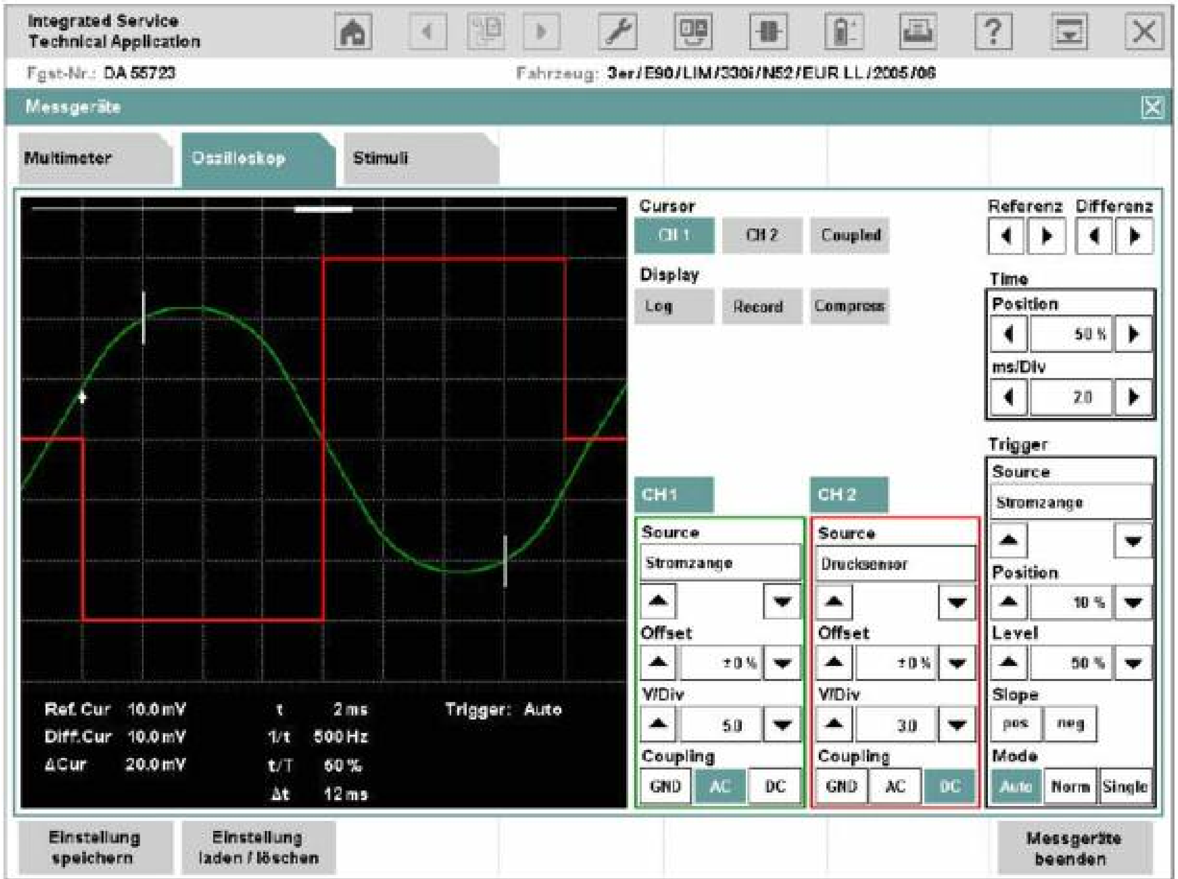
- Select the source "Probe 1".
- Select the "Ω" mode.
- Connect the DSO cable 1 to the IMIB.
- Connect the probes in parallel with the load/resistance while isolating that part of the circuit.
- Perform the measurement.

How to perform measurements on two signals simultaneously, so that you can measure battery voltage and current, for example:

- Select the source "Clip-on ammeter" on Multimeter 2.
- Select the "DC A" mode on Multimeter 2.
- Select the range matching the selected clip-on ammeter on Multimeter 2.
- Select the source "Probe 1" on Multimeter 1.
- Select the "DC V" mode at Multimeter 1.
- Connect the clip-on ammeter to the IMIB.
- Connect the clip-on ammeter lead around the vehicle's negative cable in the direction of current flow.
- Connect the DSO cable 1 to the IMIB.
- Connect the probes to the battery poles.
- Click the button on the probe to freeze the measurement.
- Evaluate the measurement.

Oscilloscope

Two time-dependent variables are measured with the dual channel oscilloscope. The screen displays measured and processed curves and results in the left (display) area. The IMIB settings can be adjusted in the right (setting) area.



"Oscilloscope" tab

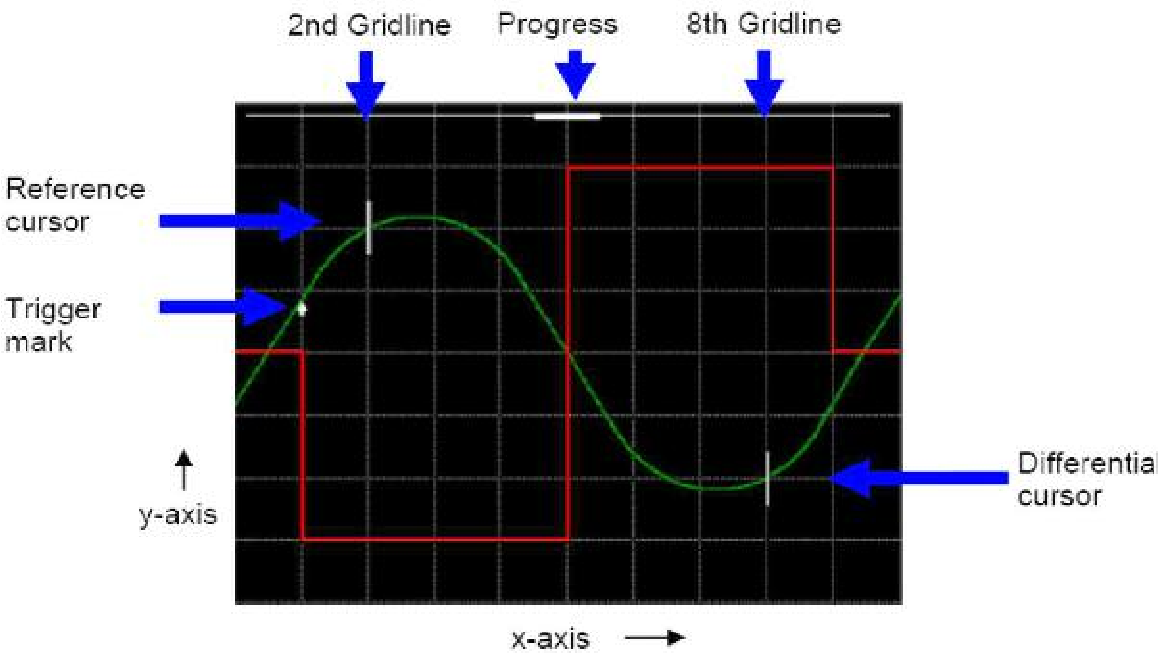
Display Area

The display area is divided into the following:

- Graph display: for graphical plots of curves.
- Measured value display: for numerical display of voltage and time values.

Graph Display

With linear scaling, the graph display is divided into a 10 x 8 grid. With logarithmic scaling, the y-axis is divided into 4 groups of 10; the x-axis remains unchanged.



Graph display

Depending on the application, a trigger mark, two cursors and a progress bar on the top edge will appear in the graph plot.

So that you can distinguish between curves and correctly assign their settings, the curve from Channel 1 (CH1) is green and the curve from Channel 2 (CH2) is red. Cursors, trigger marks and progress bars are white.

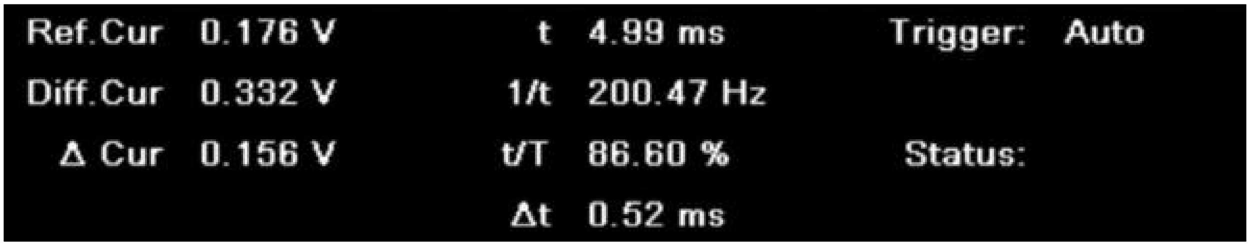
The frequency of graph updates depends on the sampling rate set on the oscilloscope.

The following presets apply for individual areas:

- Sampling rate < 100 s: Time interval 10 ms.
- 100 µs ≤ sampling rate < 1 s: Time interval 300 ms.
- Sampling rate ≥ 1 s: Record mode (Record). The curve progresses in linear steps of approx. 4 pixels from right to left and is recorded at the same time.

Measured Value Display

Below the graph display, there is a display consisting of 3 columns for numerical values and status messages.



Measured value display

The meaning of the displays is described in the following chapter.

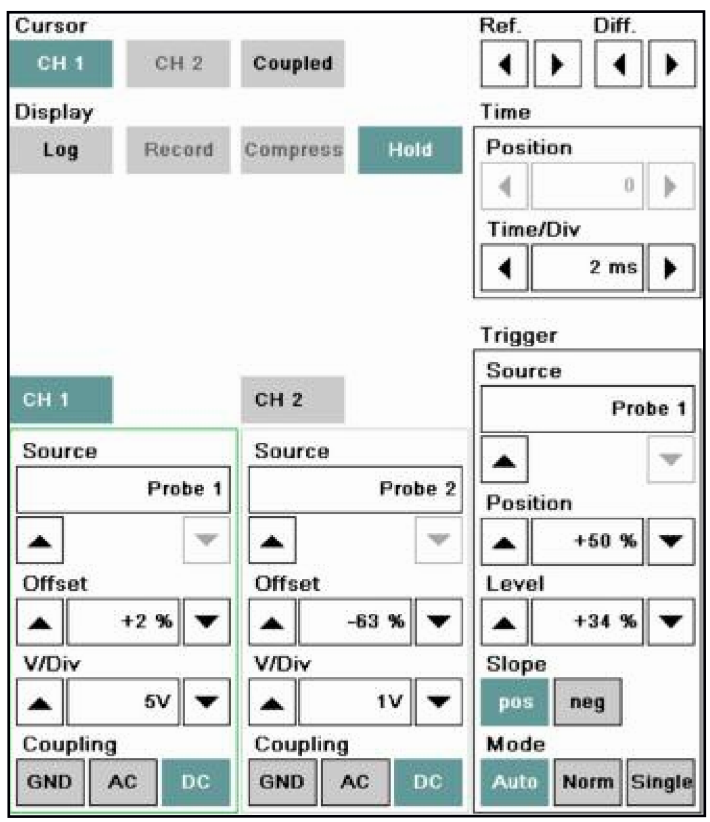
Range

The controls for setting the oscilloscope are located on the right-hand side of the mask.

The controls are arranged in five settings:

- Cursor (exclusively arrow keys for reference and difference)
- Display
- Time
- Channel
  (channels CH1 and CH2)
- Trigger

Range

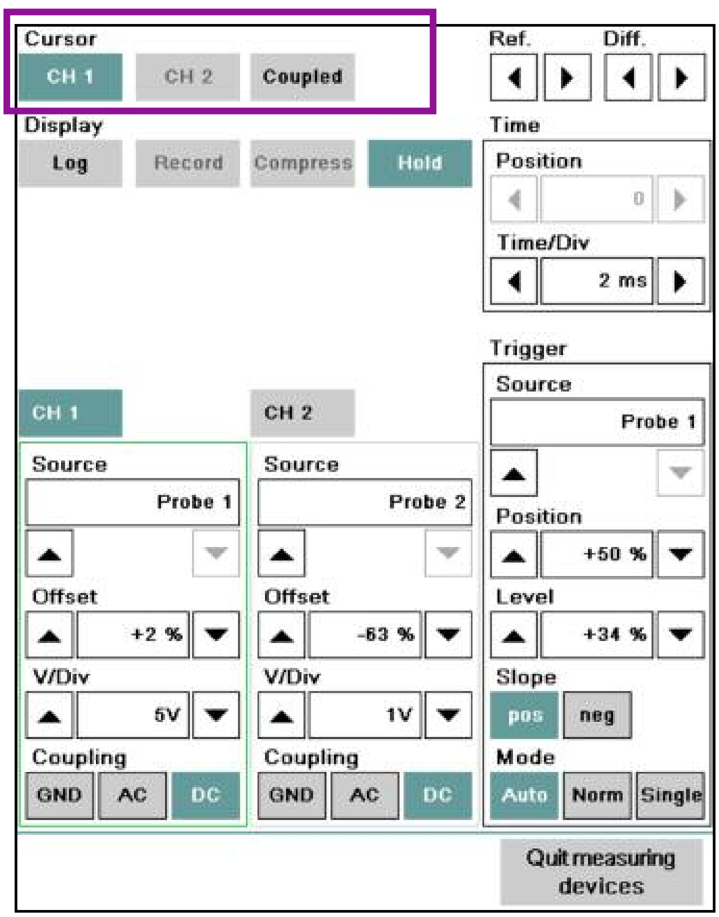


Cursor and Display Settings

The "Cursor" settings group contains the following buttons:

◇ CH1, CH2: When clicking and locking a button, the two cursors will appear in the second and eighth grid line of the graph display for the respective curve (reference and difference). The cursors can only be displayed for one channel respectively: For example, if you lock the "CH2" button, then the "CH1" button will be simultaneously unlocked. If you click the same button once more, the measuring cursors will be faded out again. You can move the reference cursor along the x-axis with the two reference arrow keys and the differential cursor by using the differential arrow keys. The cursors move pixel by pixel; their speed increases the longer you hold the arrow key down. As soon as a cursor reaches the edge of a measurement curve, the respective arrow key can no longer be operated.

◇ Coupled: is activated only if one of the "CH1" or "CH2" buttons, is active. If the "Coupled" button is locked, then the differential cursor moves when the differential cursor is displaced, maintaining constant spacing. With the differential arrow keys, you can continue to displace the differential cursor separately. If you hide the cursor for one channel and later show it again (cursor key locked), the "Coupled" button adopts the most recently displayed state.

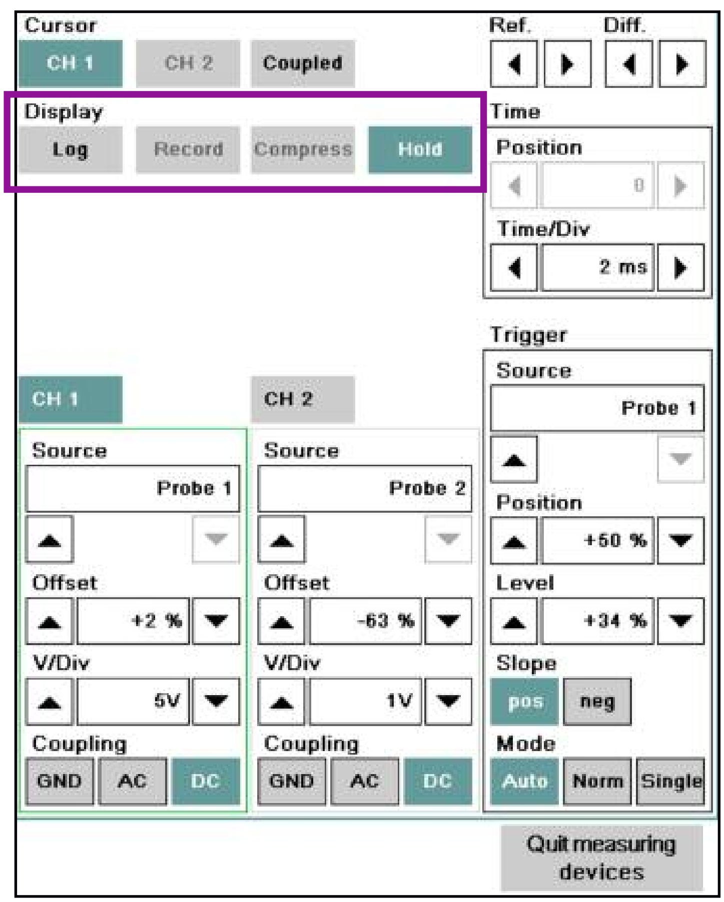


The following applications are linked with the cursor function:

- Measuring curves: The oscilloscope determines the following points and shows the values in the measured value display:
- Intersection of reference cursor with the curve ("Ref.Cur")
- Interface of differential cursor with the curve ("Diff.Cur")
- Voltage difference between the reference and differential cursor ("Cur")
- Output of Set values: When you select the "CH1" or "CH2" button in the cursor settings group

The following counter values are entered into the measured value display:

- Period ("t")
- Frequency ("1/t")
- Sample ratio of selected channel ("t/T")
- Time lag between reference and differential cursor ("t")
- Zooming compresses the curves. In compressed mode, you can select and zoom in on a curve section.

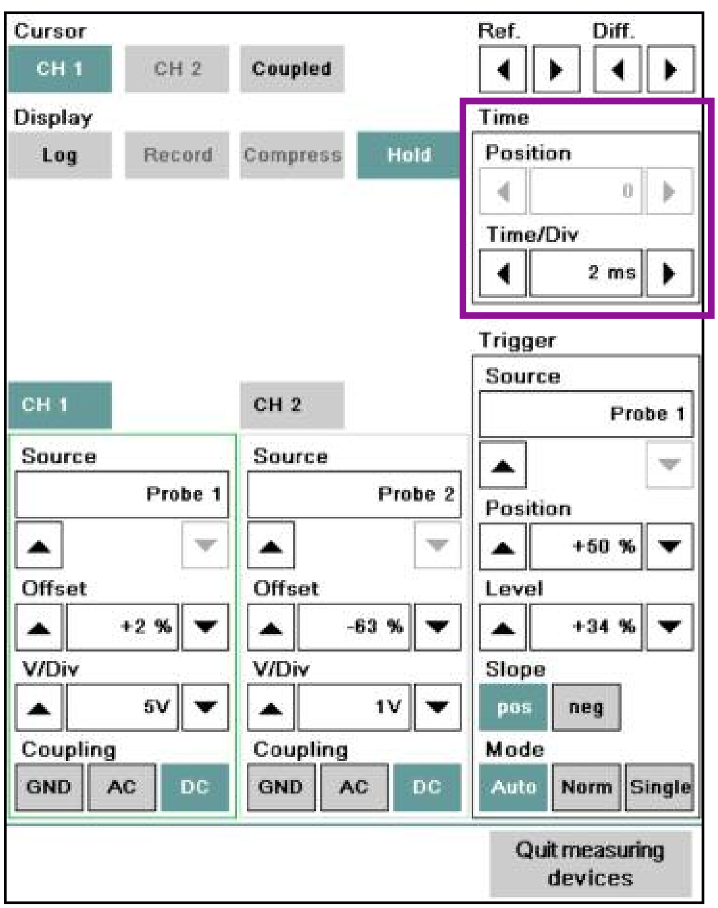


The "Display" settings group contains the following buttons:

◇ **Log:** logarithmic scaling on/off, as default y-values are presented in linear fashion. When clicking and locking the "Log" button , the y-axis switches to logarithmic scaling in value ranges up to 4 groups of 10. Negative measurements are zeroed in the logarithmic display. Clicking the button a second time switches back to linear scaling.

◇ **Record:** record mode on/off. When clicking and locking the "Record" button, the record mode will be started. The process can be interrupted by once again clicking on the "Record" button. The record mode is automatically stopped in the "Single" trigger mode if a trigger event occurs (trigger level, ramp). All settings for the "Channel", "Time" and "Trigger" groups are locked. The record mode is only accessible if the "Compress" button is not locked.

◇ **Compress:** scales the x-axis over the entire curve. When clicking and locking the "Compress" button, the x-axis is scaled so that the entire and most recently recorded curve can be shown in the measured graph display. The "Record" button and those for the trigger mode (Auto, Normal, Single) are deactivated. The "Compress" button can only be clicked after a curve has been recorded. Mark a section of the compressed curve (either Channel 1 or 2) with the reference and differential cursor. Click the "Compress" button. The oscilloscope zooms in on the marked curve section to the normal scaling of the x-axis.

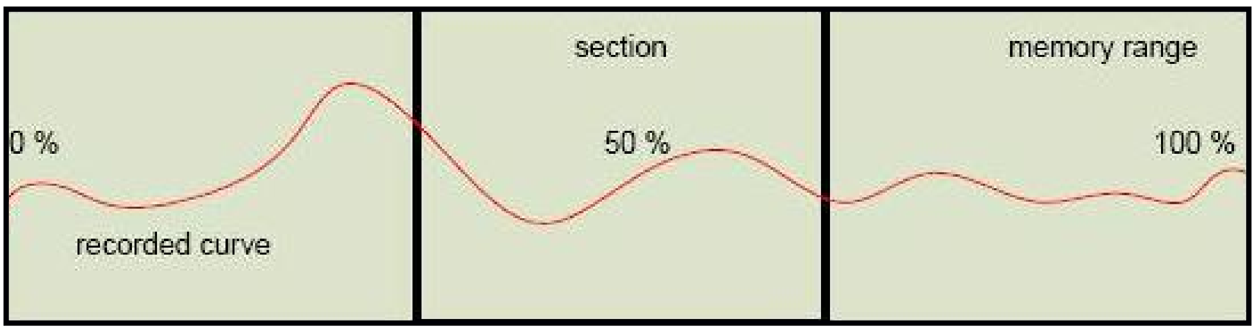


By increasing the sampling rate with the "<Time>/Div" arrow keys, you can zoom in further into a curve section until the curve is completely expanded.

With the "<Range>/Div" arrow keys, you can extend the curve in the vertical direction. This does not enhance the resolution, however.

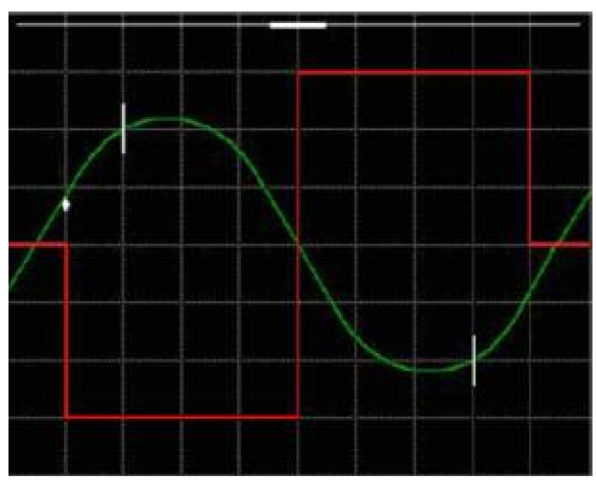
The settings group contains display ranges for the set values and two arrow keys which can be used to adjust the set values.

◇ Position: You can move the section along the x-axis if the recorded curve can no longer be completely displayed in the measurement value display. With the arrow keys, you can zoom in/out the section from 0 to 100% along the saved curve. The longer you hold the arrow key down, the faster the section moves. The percentage value indicates in which section of the saved area the section is located.



As long as the reference and differential cursors are displayed (with channel CH1 or CH2 in the "Cursor" settings group selected), the section can only be displaced between the two cursors. To scroll through the entire memory, you have to deselect both channels in the "Cursor" settings group.

The visible section is displayed in the graph display by the size and position of the status bar at the top of the display.



◇ <Time>/Div: This is where you define the sampling rate, in other words, it determines the horizontal scale of the graph which appears on the oscilloscope screen. The associated unit, e.g. "ms/Div", is displayed via the left arrow key.

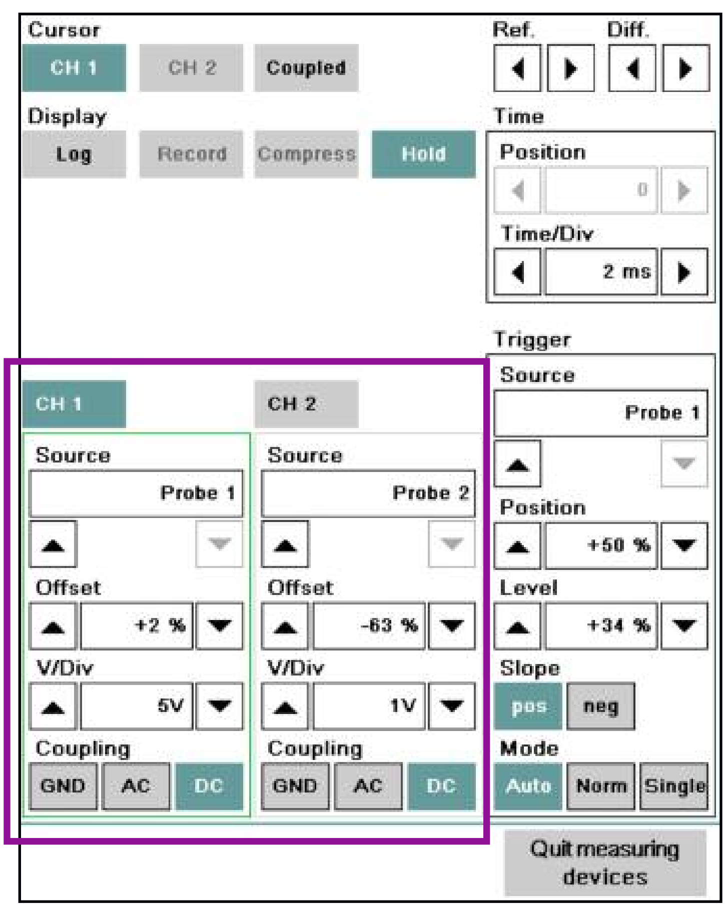
Channel

This channel settings group has two buttons, "CH1" and "CH2". Each channel has a Source, Offset, <Range>/Div (Range/Unit) and Coupling display range selection.

Source: The group of sensors. A signal is transmitted to the oscilloscope via a sensor.

Select from the possible sensors:

- Probe 1 and/or 2
- kV clip/RVZ cable
- 50 A or 1000 A clip-on ammeters
- 3.5 bar or 100 bar pressure sensors
- Trigger clamp
- Temperature sensor



Select a sensor with the arrow keys. If the sensor is not yet connected, a corresponding message appears.

◇ Offset: The signal displayed on Channel 1 or 2 can be respectively overlaid with a constant component or a DC voltage (offset). The offset value is preset to 0%; you can change the range ±100% of the y-axis.

◇ <Measurement range>/Div: This setting designates the group of measurement ranges and depends on the sensor selected. Set the range with the arrow keys; it will be displayed in the associated display range. The physical unit is above the left-hand arrow key.

The set range is transferred to the y-axis.

◇ Coupling: Signal coupling for the corresponding channel.

The following settings are possible:

◇ GND (Ground): The input is decoupled from the sensor and is grounded.

◇ AC (Alternating Current): Only alternating current components are represented in the curve.

◇ DC (Direct Current): Alternating and direct current components are represented in the curve.

The buttons for the non-available coupling types are gray.

Trigger

In the "Trigger" area, you can set the source, the (trigger) position, the trigger value (level), the slope and the mode. The current trigger position and trigger value are indicated by an arrow, with the arrow direction indicating slope.

◇ Source: The group of sensors. A trigger signal is transmitted to the oscilloscope via a sensor.

Select from the possible sensors:

- Probe 1 and/or 2
- kV clip/RVZ cable
- 50 A or 1000 A clip-on ammeters

Select a sensor using the arrow keys. If the sensor is not yet connected, a corresponding message will appear.

◇ Position: With the arrow keys, you can displace the trigger time along the x-axis between 10% and 90% along the graph display. The default setting is 50%; the signal in this case is triggered in the middle of the graph display.

◇ Level: With the arrow keys, you set the amplitude at which triggering should occur as a percentage of the y-axis.

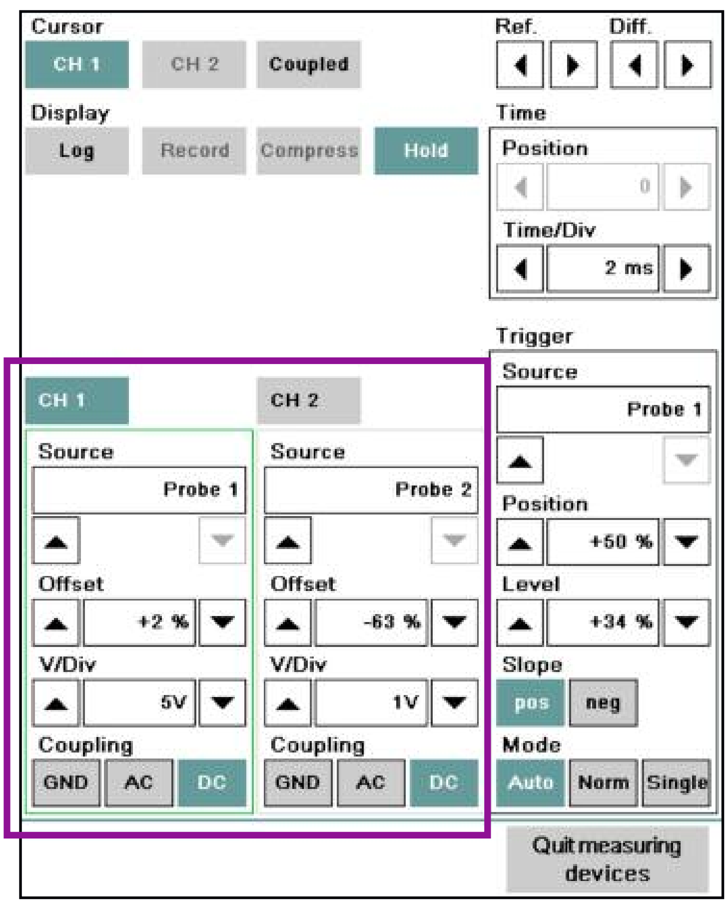
◇ Slope: Defines whether triggering should occur on the positive or negative slope, whereby only one switch ("pos" or "neg") can be activated at one time. If both buttons are inactive, the trigger is activated whenever the set trigger value is reached, regardless of whether this occurs on the rising or falling slope.

◇ Mode: Except in record mode, a trigger mode is always active. The default setting is "Auto".

◇ Auto: If no trigger is set, then an untriggered image will be shown.

◇ Norm: Prerequisite for a display is the availability of a trigger.

◇ Single: Stops the oscilloscope measurement after the first valid trigger signal. If you click the "Single" button again, the mode is reactivated and recording of another measuring signal can begin.



Record Mode

In record mode, the measurements are recorded without being triggered continuously and temporarily stored.

Recording begins when you click the "Record" button. During recording, the latest measurements are presented in the graph display. The remaining memory capacity is continuously displayed as a percentage in the measurement display.

The trigger mode cannot be reactivated until the record mode has been stopped by clicking the "Record" button.

Recording may be stopped by the following events:

- Repeated clicking of the Record button
- Reaching of the preset trigger level (depending on the trigger mode)
- Memory full

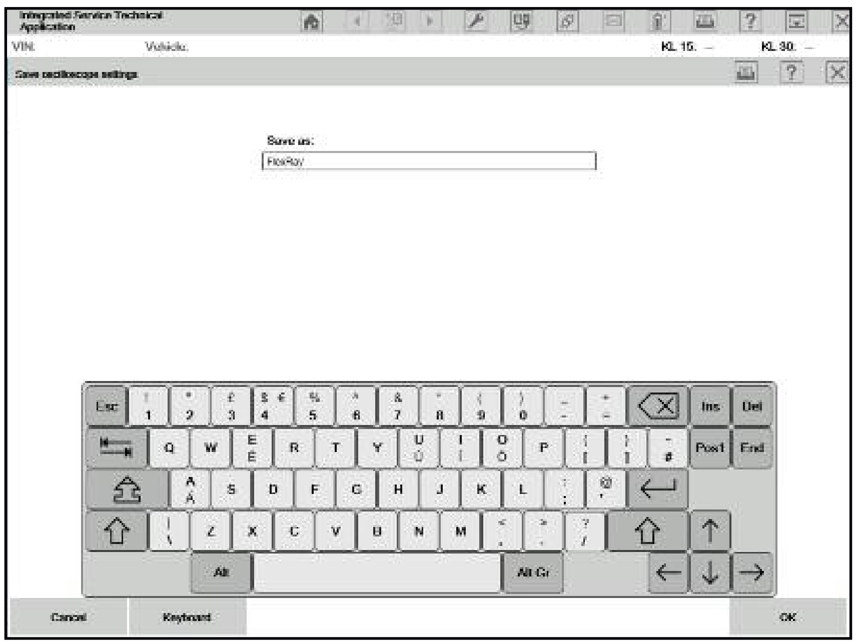
After completion (manual or automatic) of data recording, the "Compress" button is activated and the entire curve along the x-axis is compressed to the width of the graph. Various tools are available for closer examination of the curve, using cursor settings and the adjustment of values under "Time".

Action Line

The action line contains the following buttons:

◇ Save settings: You can save oscilloscope settings. Saved settings are stored on the ISIS workshop server and are thus available on every ISID that is linked to the respective ISIS in online mode. You start the operation by selecting the "Save settings" button in the action line. The "Save oscilloscope settings" mask appears. Enter a name in the "Save under" field under which the settings should be saved. The workshop system checks whether the name has already been assigned.

"Save oscilloscope settings" mask



"Save oscilloscope settings" mask (no current screenshot)

◇ Load/delete settings: The button is only active if oscilloscope settings have been saved. You can load or delete saved oscilloscope settings after you have clicked this button. The "Load oscilloscope settings" window opens with a list of saved oscilloscope settings.

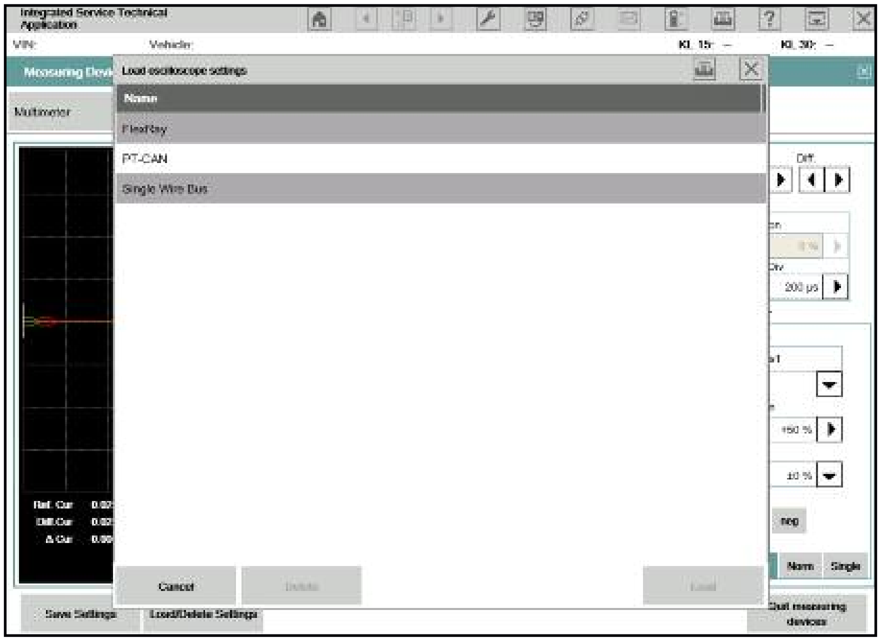
Select a line and click one of the following buttons:

◇ Load: The settings are loaded into the oscilloscope. The window closes.

◇ Delete: Deletes the selected settings. The window stays open.

◇ Cancel: Closes the window after opening.

"Load oscilloscope settings" mask



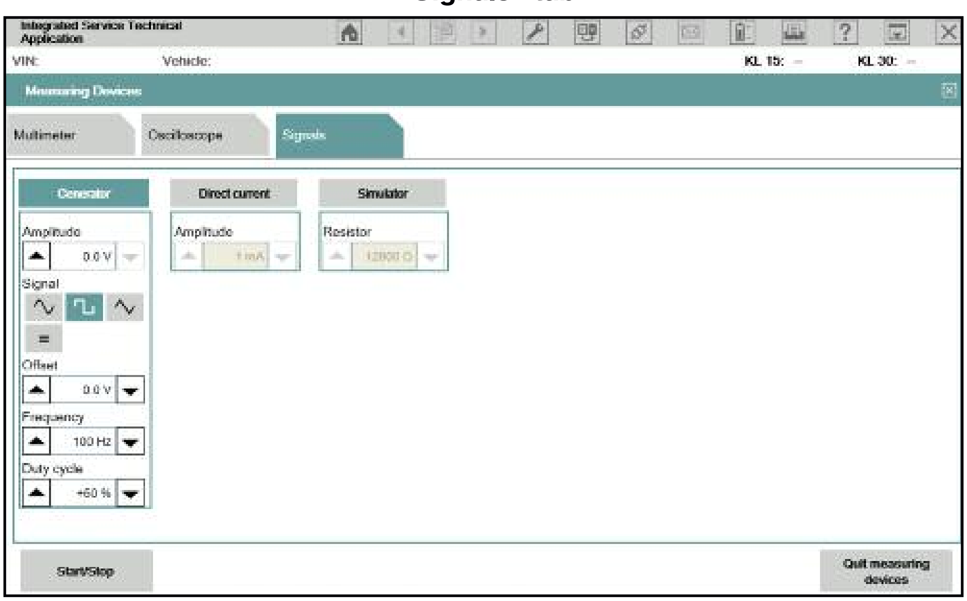
◇ **Quit measuring device:** The IMIB is reset, any activated signals are switched off, and the workshop system returns to the "Measuring devices" mask.

Signals

The signals feed defined direct currents as well as direct and alternating voltages to the sensors and leads or simulate resistances. You can observe the effects with measuring instruments.

With the "Signals" tab, you parameterize the signal functions of the IMIB.

“Signals” tab



The content range contains a settings group for each of the signal sources, i.e. direct voltage, generator, direct current and simulator.

The settings for "Amplitude", "Frequency", "Sample ratio" and "Resistor" consist respectively of a display range for the set value and two arrow keys left and right, with which you can adjust the signal. The longer you hold the arrow key down, the faster the signal value changes.

The setting "Signal" provides a separate button for the "Rectangular" and "Sinusoidal" signal types.

Select a signal by clicking its heading. It is not possible to make multiple selections.

If you switch to Multimeter or Oscilloscope and then return to Signals, then the most recent setting is retained. However, if you quit the Measuring instruments and then call up Signals again, then the settings will be reset to the default values.

The buttons in the action line have the following functions:

- Start/Stop: Transmits the set signals to the IMIB. In the message line, a message appears, indicating that the signals are active. When you click the button a second time, you switch the signals off again.
- Exit measuring devices: Switches active signals off, sets the measuring instruments back to the IMIB, and returns to the "Measuring instruments" tab.

Using the Oscilloscope

How to set direct voltage or direct current:

- Click the name of the signal source: "Direct voltage" or "Direct current".
- Select a value in the appropriate signal source with the arrow keys.
- Click the "Start/Stop" button.
- Click the "Start/Stop" again when you wish to terminate the signal feed.

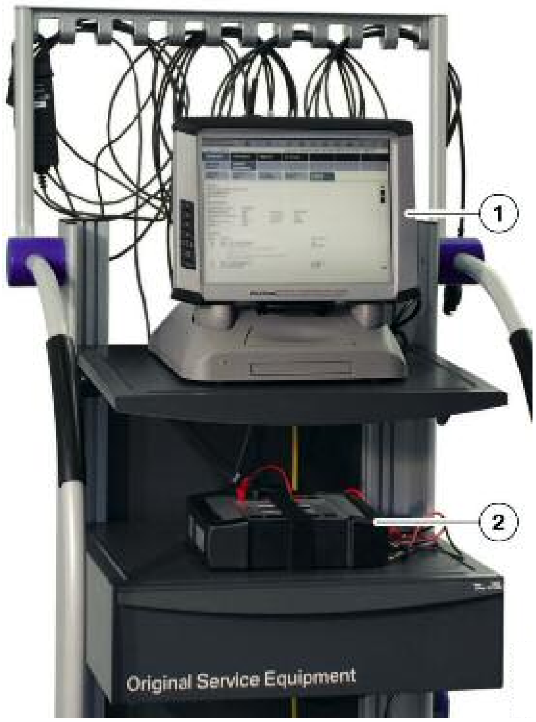
How to adjust the alternating current generator:

- Click the name of the signal source: "Generator".
- Select the signal form: "Rectangular" or "Sinusoidal".
- Set the amplitude and frequency with the respective arrow keys.
- If you have selected the "Rectangular" signal form: Set the sampling rate with the corresponding arrow keys.
- Click the "Start/Stop" button.
- Click the "Start/Stop" again when you wish to terminate the signal feed.

How to simulate a resistance:

- Click the name of the signal source: "Simulator".
- Set the desired resistance with the corresponding arrow keys.
  The permissible resistance values are displayed in the window.
- Click the "Start/Stop" button.
- Click the "Start/Stop" again when you wish to terminate the signal feed.

Workshop Trolley



Workshop trolley with Integrated Service Information Display and Integrated Measurement Interface Box

Index	Explanation
1	Integrated Service Information Display (ISID)
2	Integrated Measurement Interface Box (IMIB)

The workshop trolley used for Group Tester One, or GT1, can continue to be used for the new workshop system. It is simply a case of having to exchange the brackets for GT1 with the brackets for the Integrated Service Information Display. The brackets were delivered with the Integrated Service Information Display (ISID).

Top view of ISID mounting brackets

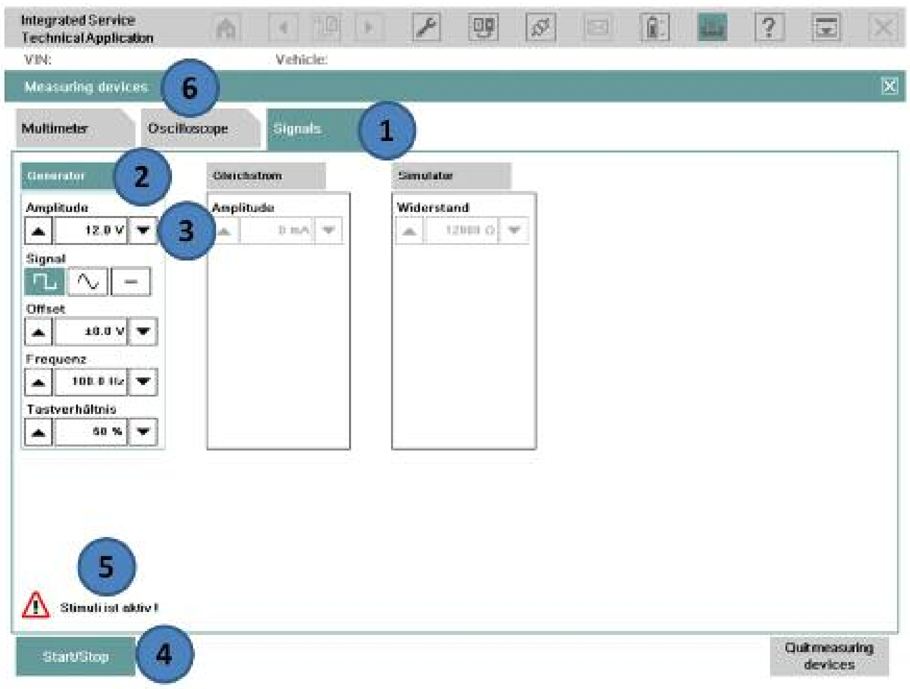
Bottom view of ISID mounting brackets

Basic Measurements

Wire Test

Cables needed:

- *Stimulus Cables*
- *Measurement Input 1 Cables*



Procedure:

Connect B- from Stimulus Cable to B- of Measurement Input 1.

Connect B- from Measurement Input 1 to a ground on the vehicle.

Connect B+ from Stimulus Cable to one end of wire being tested.

Connect B+ from Measurement Input 1 to other end of wire being tested.

(1) Select the "Signals" tab.

(2) Select the "Generator" column.

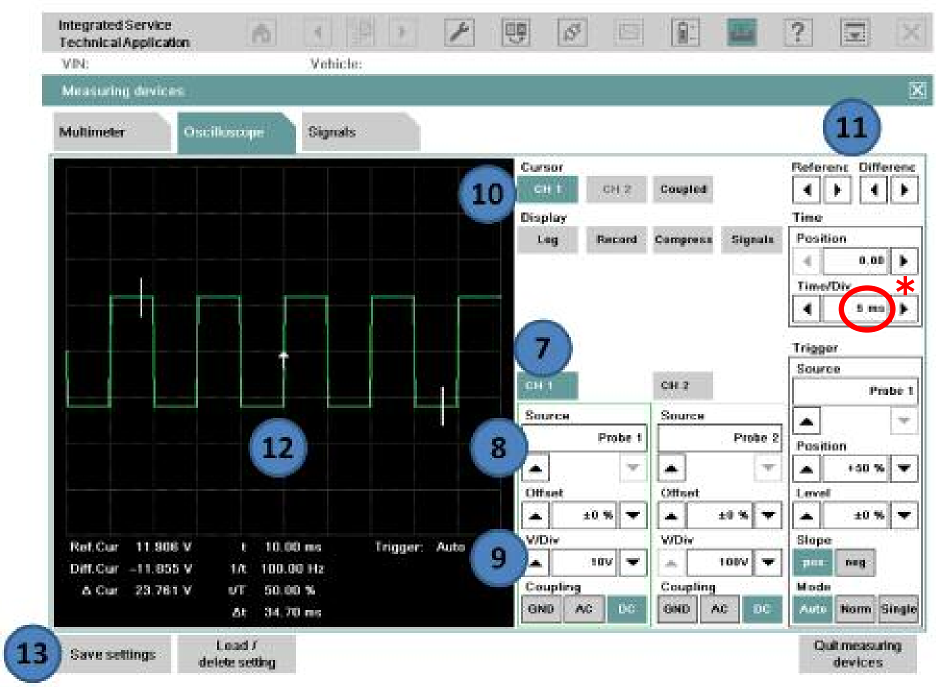
(3) Set the voltage for the "Amplitude" setting using the 2 arrows, to the voltage of the circuit tested (for example 5V or 12V).

(4) Select the "Start/Stop" button to start generating the voltage signal.

(5) A warning message is shown indicating "Stimuli ist Aktiv!"

(6) Switch to the "Oscilloscope" tab.

Wire Test (continued)



(7) Select one of the 2 channels (in this example, channel 1 is selected).

(8) Select “Probe 1”(Measurement Input 1) from the “Source” setting under channel 1.

(9) Select “10V” from the “V/Div” setting under channel 1.

(10) Select the channel 1 cursor “CH 1”.

(11) The cursors can be moved to a different part of the signal with the “Referenc/Differenc” arrows.

(12) The signal above indicates a good wire. Any other signal indicates an open or shorted wire.

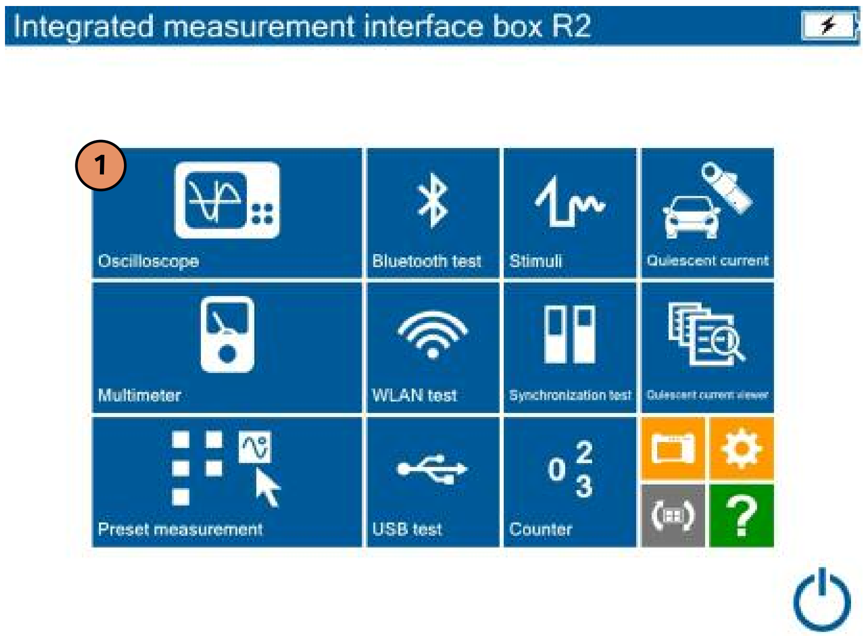
(13) Select “Save settings” to save the configuration setup (can be loaded back up at a later time).

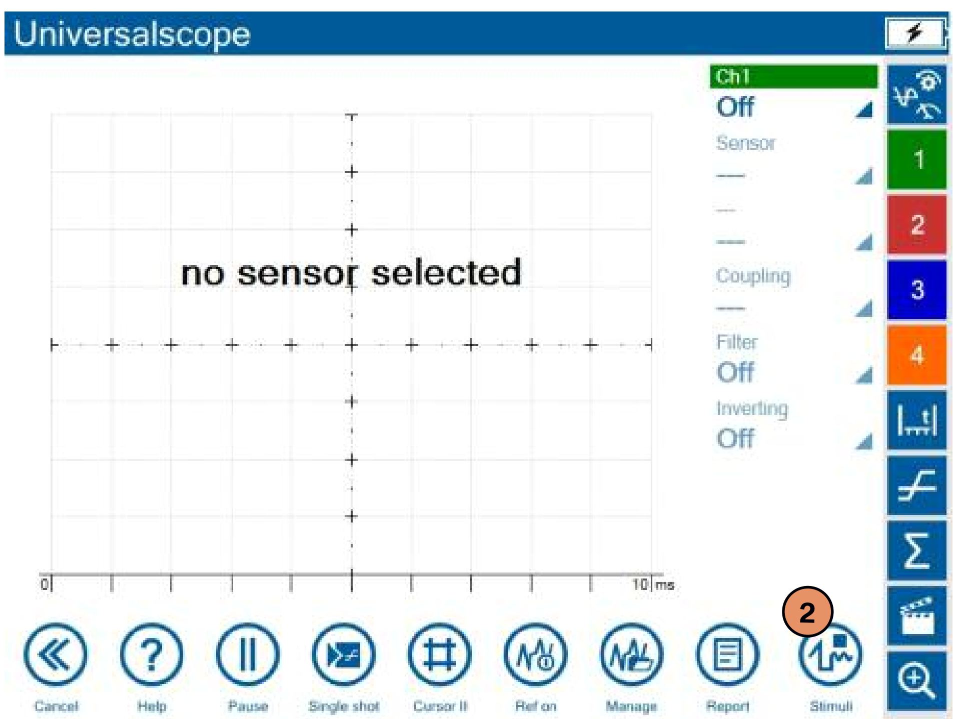
** Also try setting the Time/Div to 200 ms.*

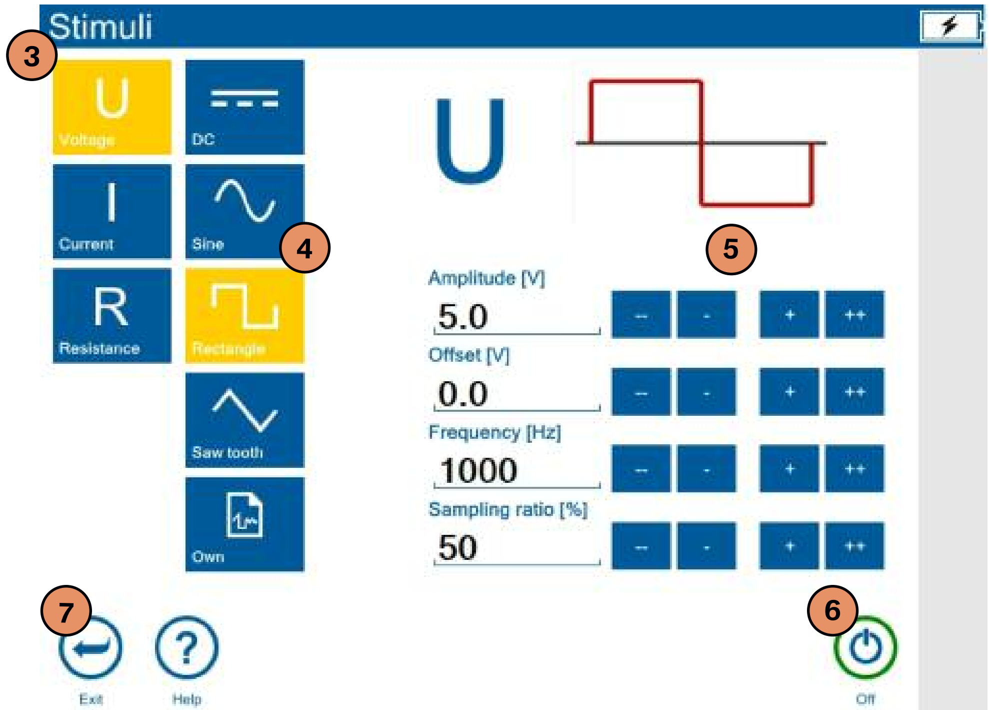
Wire Test - Standalone

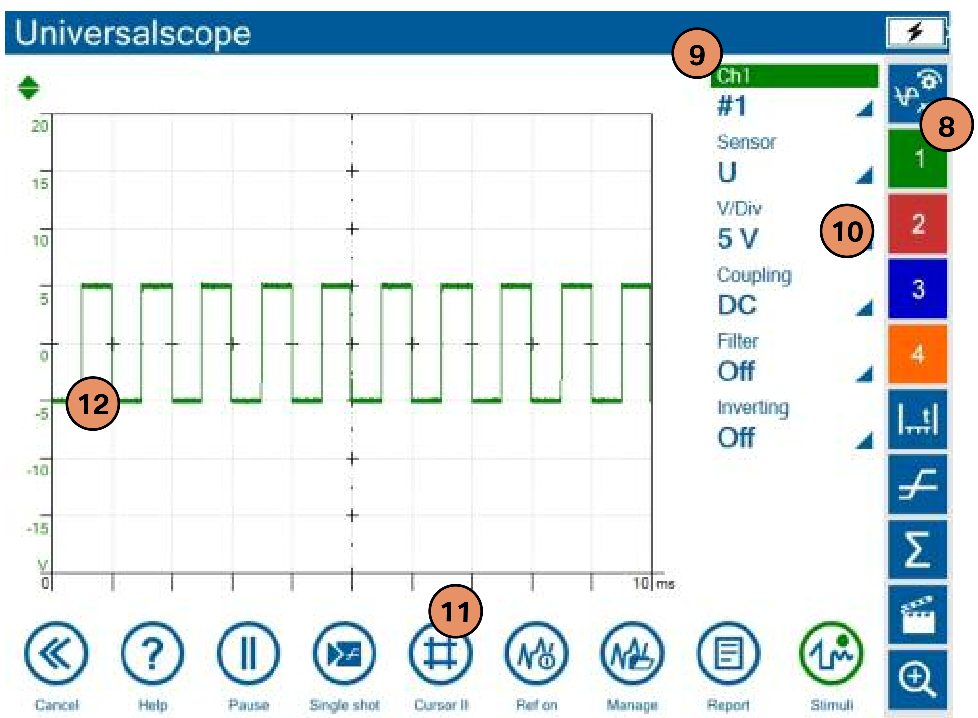
Cables needed:

- *Stimulus Cables*
- *Measurement Input 1 Cables*






Stimuli
3
U
Voltage
DC
I
Current
Sine
4
R
Resistance
Rectangle
Saw tooth
Own
U
5
Amplitude [V]
5.0
Offset [V]
0.0
Frequency [Hz]
1000
Sampling ratio [%]
50
7
6
Exit
Help
Off


Universalscope
9
Ch1
#1
8
Sensor
U
V/Div
5 V
10
Coupling
DC
Filter
Off
Inverting
Off
12
11
Cancel
Help
Pause
Single shot
Cursor II
Ref on
Manage
Report
Stimuli

Wire Test (continued)

Procedure:

Connect B- from Stimulus Cable to B- of Measurement Input 1.

Connect B- from Measurement Input 1 to a ground on the vehicle.

Connect B+ from Stimulus Cable to one end of wire being tested.

Connect B+ from Measurement Input 1 to other end of wire being tested.

(1) Select the "Oscilloscope" from the main screen.

(2) Select the "Stimuli" button.

(3) Select "Voltage".

(4) Select "Rectangle" from the wave form selection column.

(5) Set the voltage for the "Amplitude" setting using the plus or minus buttons, to the voltage of the circuit tested (for example 5V or 12V).

(6) Press the "On" button to start generating the voltage signal.

(7) Press the "Exit" button to switch back to the "Oscilloscope" screen.

(8) Select one of the 4 channels (in this example, channel 1 is selected).

(9) Select "# 1"(Measurement Input 1) from the "Source" setting under channel 1.

(10) Select "5V" from the "V/Div" setting under channel 1.

(11) Select the cursor using the "Cursor II" button.

(11) The cursors can be moved to a different part of the signal with the hardware keys or by dragging them using the stylus.

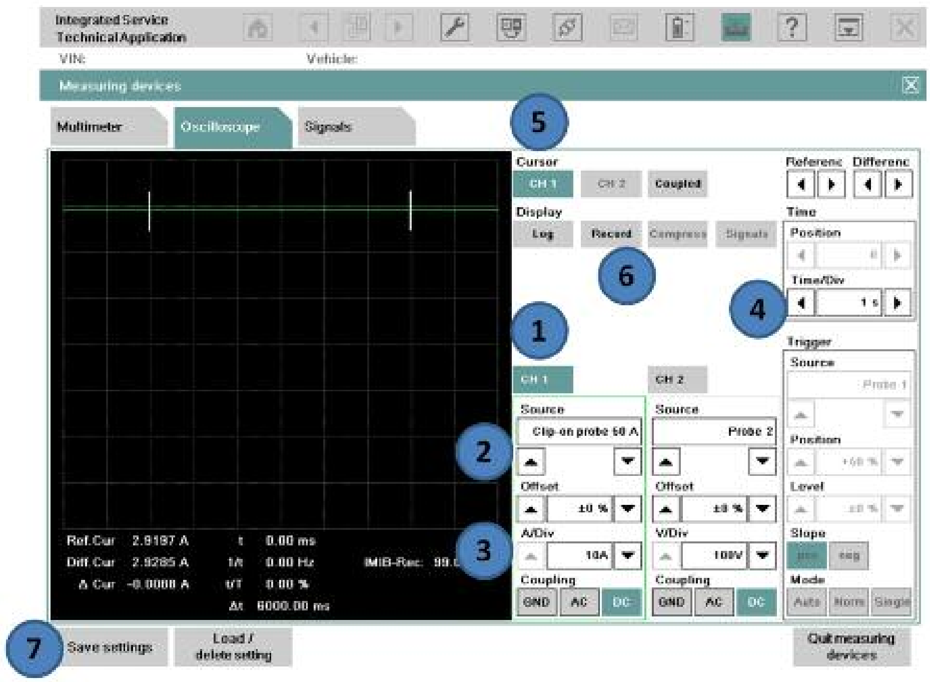
(12) The signal above indicates a good wire. Any other signal indicates an open or shorted wire.

NOTES PAGE

Closed Circuit Current Monitoring

Cables needed:

- *IMIB and the "Clip-on probe 50A or 100A"*



Procedure:

(1) *Select channel 1 or 2.*

(2) *Change the "Source" to "Clip-on probe 50A or 100A" (confirm calibration prompt).*

(3) *Set "A/DIV" to "10A".*

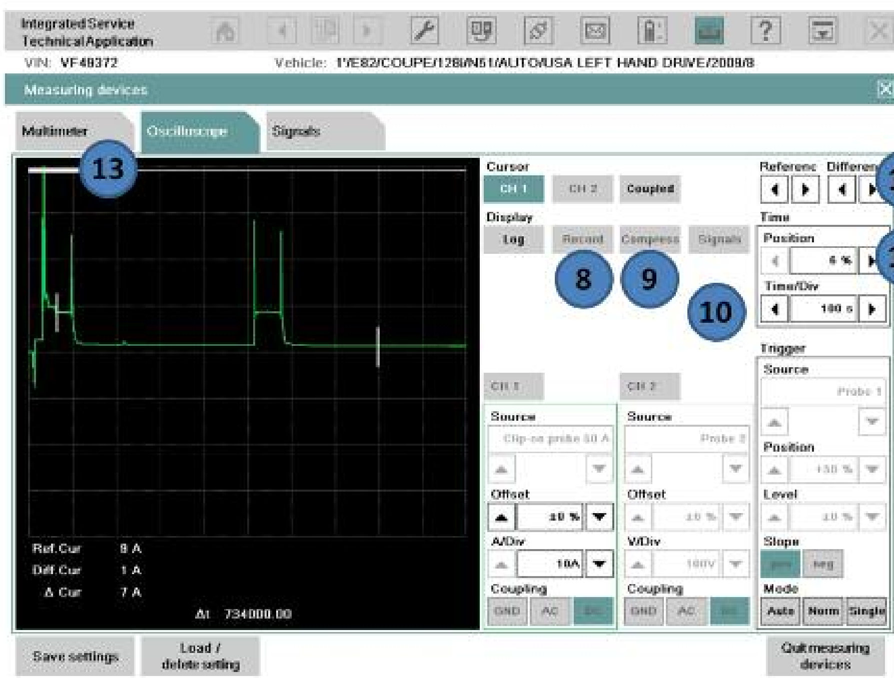
(4) *Change the "Time/DIV" in the "Time" box to "1 s" to start the value can be changed if longer recording time is needed).*

(5) *Select the "Cursor" for the channel selected, 1 or 2.*

(6) *Once the measurement is started, press the "Record" button to start monitoring.*

(7) *Select "Save settings" to save the configuration setup (can be loaded back up at a later time).*

Closed Circuit Current Monitoring (continued)



(8) Select the "Record" button to stop recording.

(9) Select the "Compress" button to start analyzing the recorded signal.

(10) Change the "Time/DIV" in the "Time" box to the value which makes the signal easier to view glitches.

(11) Change the "Position" in the "Time" box to scroll through the signal.

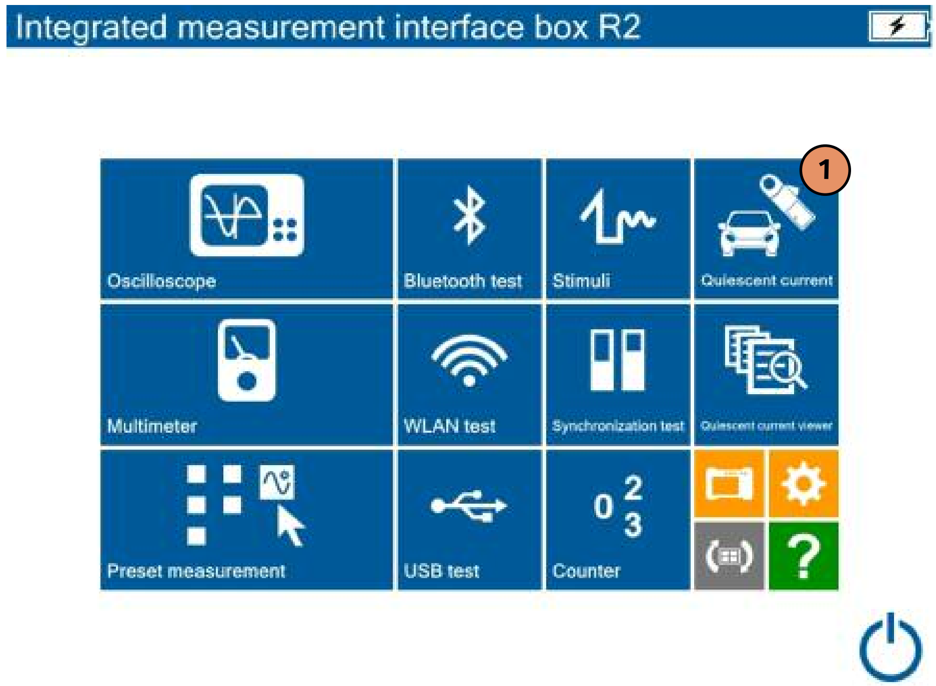
(12) The white bar along the top of the display indicates the part of the entire signal being viewed.

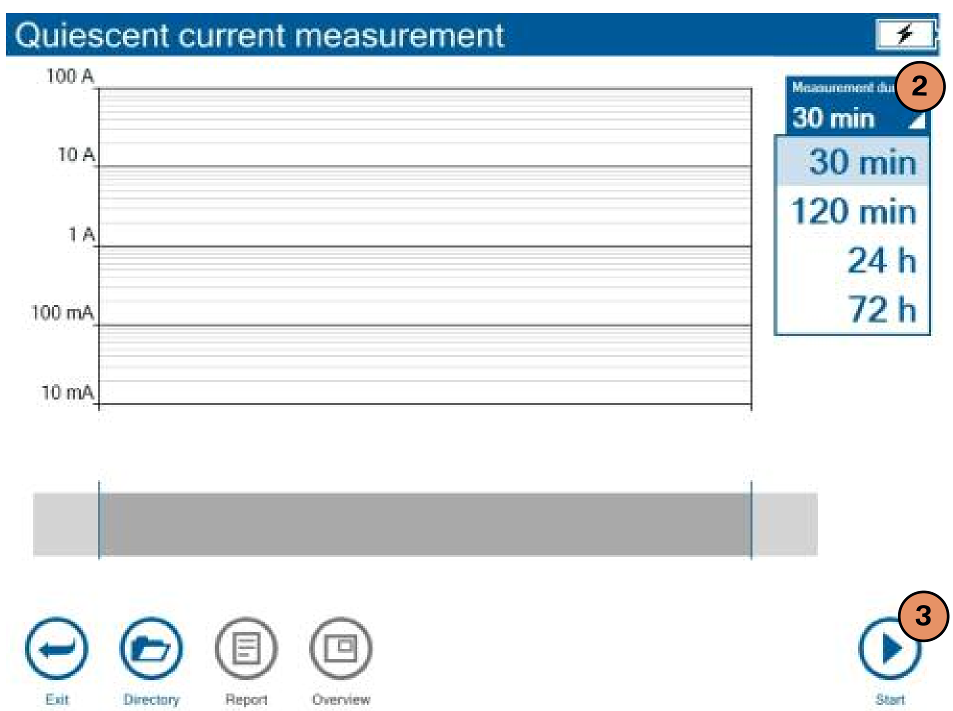
(13) The cursor(s) may be moved to display the value of different parts of the display.

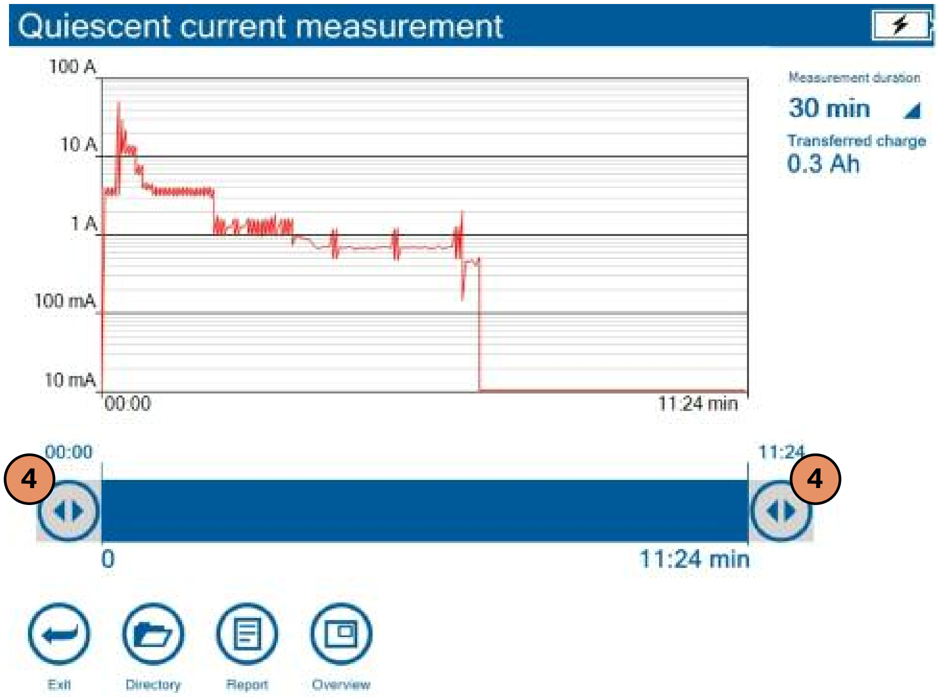
Closed Circuit Current Monitoring - Standalone

Cables needed:

- *IMIB and the “Clip-on probe 100A”*







Procedure:

(1) Select “Quiescent current” from the main screen.

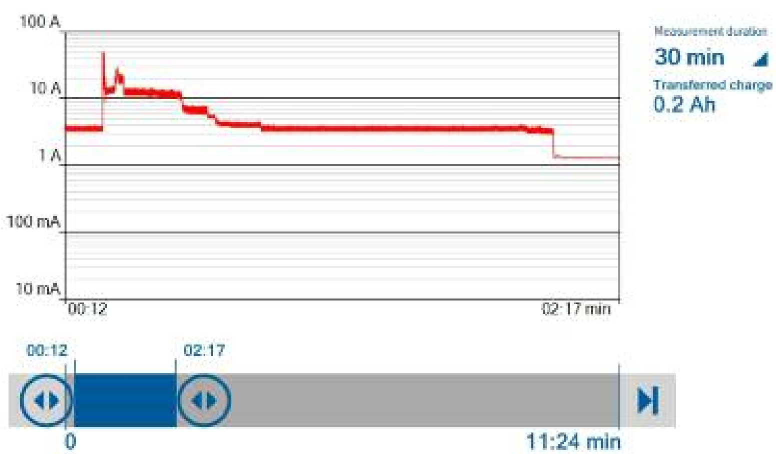
Plug in “Clip-on probe 100A” into measurement port 3 or 4 (confirm calibration prompt).

(2) Set the desired “Measurement duration” from the dropdown menu.

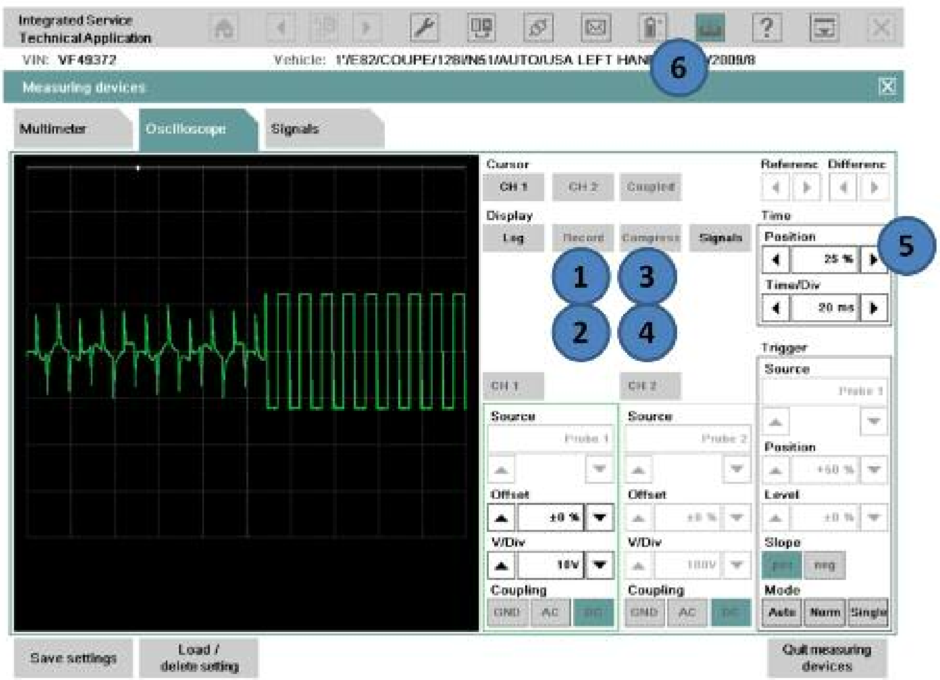
(3) Press “Start” button to begin recording.

Press “Stop” button to stop recording, otherwise recording will stop when “Measurement duration” has elapsed.

(4) Using “Start point” and “End point” buttons, narrow the recording to a specific time (if desired).



Recording and Analyzing Measurements



Procedure:

(1) Start recording the signal by pressing the “Record” button.

(2) Stop recording the signal by pressing the “Record” button again.

(3) The “Compress” button is then highlighted and the entire signal is compressed on the display.

(4) Press the “Compress” button to enter the analysis mode.

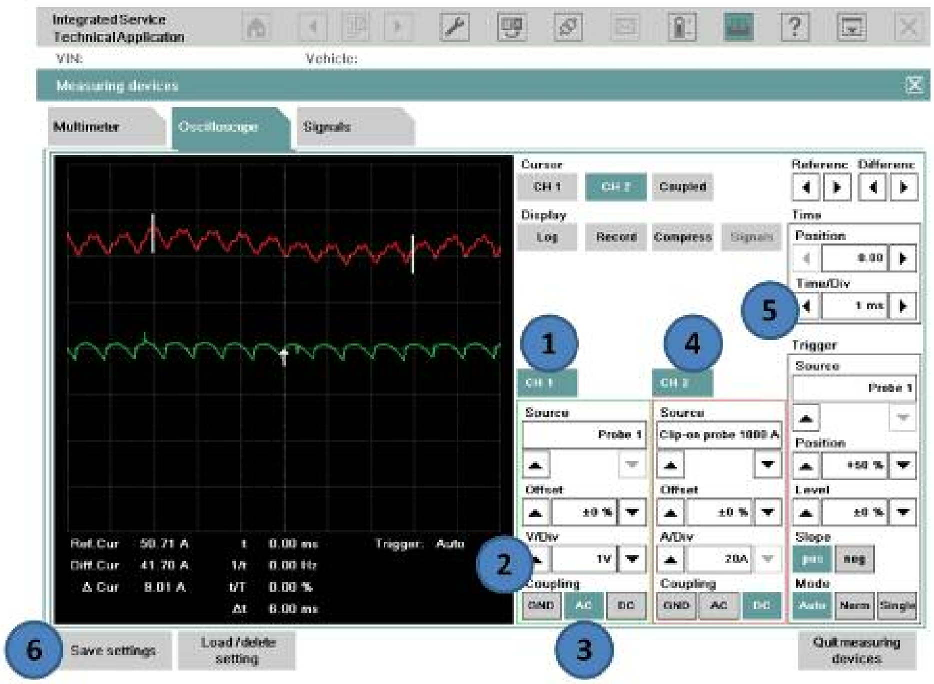
(5) In the “Time” box, scroll backward or forward to scan the recorded signal (a white status bar is displayed at the top of the display, which shows the part of the signal being analyzed).

(6) The screen may be printed at any time using the print button.

Alternator Test

Cables needed:

- *Probe 1 (Measurement Input 1)*
- *1800 A Clip-on probe*



Procedure:

Connect B+ of Probe 1 to the engine compartment battery post.

Connect B- of Probe 1 to the engine compartment ground post.

Connect the 1800 A Clip-on probe to the B+ cable at the engine compartment jump point.

(1) Select channel 1 and set the "Source" as "Probe 1".

(2) Set the "V/DIV" to "1V".

(3) Set the "Coupling" to "AC".

(4) Select channel 2 and set the "Source" as "Clip-on probe 1800 A". A pop-up message prompts to calibrate the clamp first before connecting to the B+ cable.

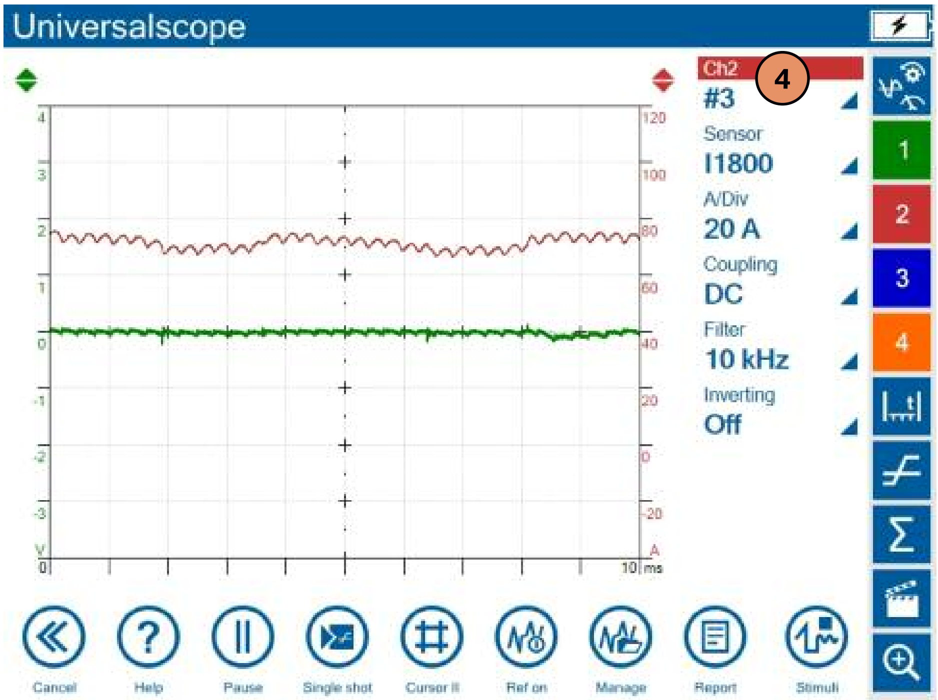
(5) Set the "Time/DIV" under the "Time" box to "1 ms".

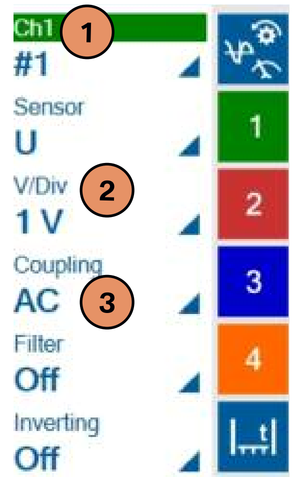
(6) Select "Save settings" to save the configuration setup (can be loaded back up at a later time).

Alternator Test - Standalone

Cables needed:

- *Probe 1 (Measurement Input 1)*
- *1800 A Clip-on probe*





Procedure:

Connect B+ of Probe 1 to the engine compartment battery post.

Connect B- of Probe 1 to the engine compartment ground post.

Connect the 1800 A Clip-on probe to the B+ cable at the engine compartment jump point.

(1) Select channel 1 and set the "Source" as "#1".

(2) Set the "V/DIV" to "1V".

(3) Set the "Coupling" to "AC".

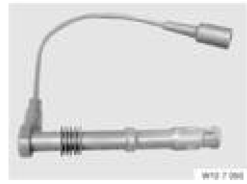
(4) Select channel 2 and set the "Source" as "#3 or #4".

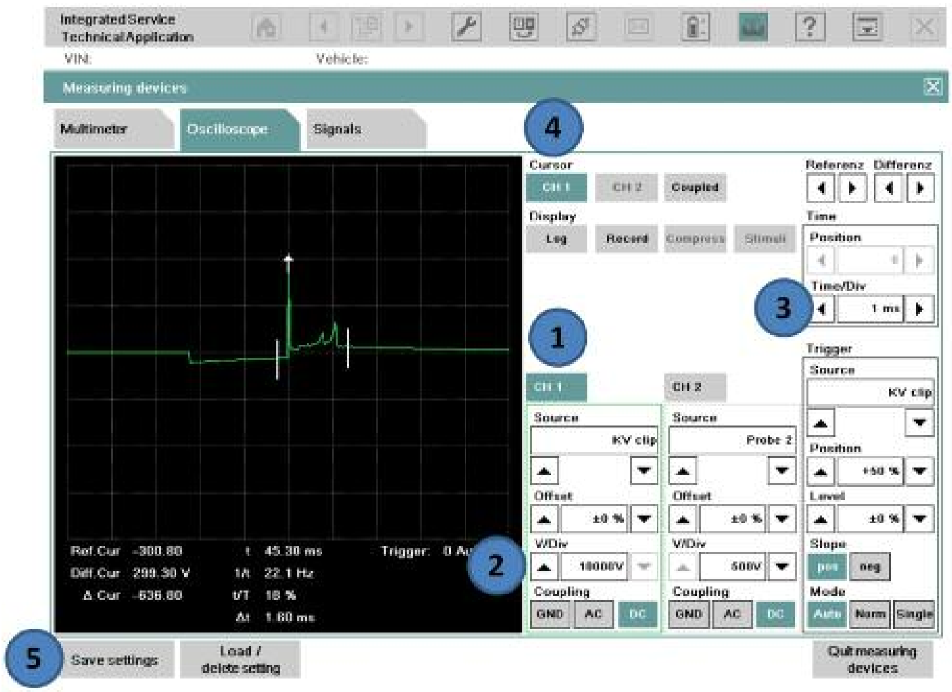
(5) Set the "Time/DIV" under the "Time" box to "1 ms".

Secondary Ignition Test

Cables needed:

- *KV Trigger Clip*
- *Adapter Cable 12 7 050*





Procedure:

Remove the coil to test, and install the adapter lead between the coil and spark plug.

Clip the KV trigger onto the adapter lead.

(1) Select channel 1 and set the "Source" as "KV clip".

(2) Set the "V/DIV" to "10,000V".

(3) Set the "Time/DIV" under the "Time" box to "1 ms".

(4) Set the "Cursor" to "CH 1".

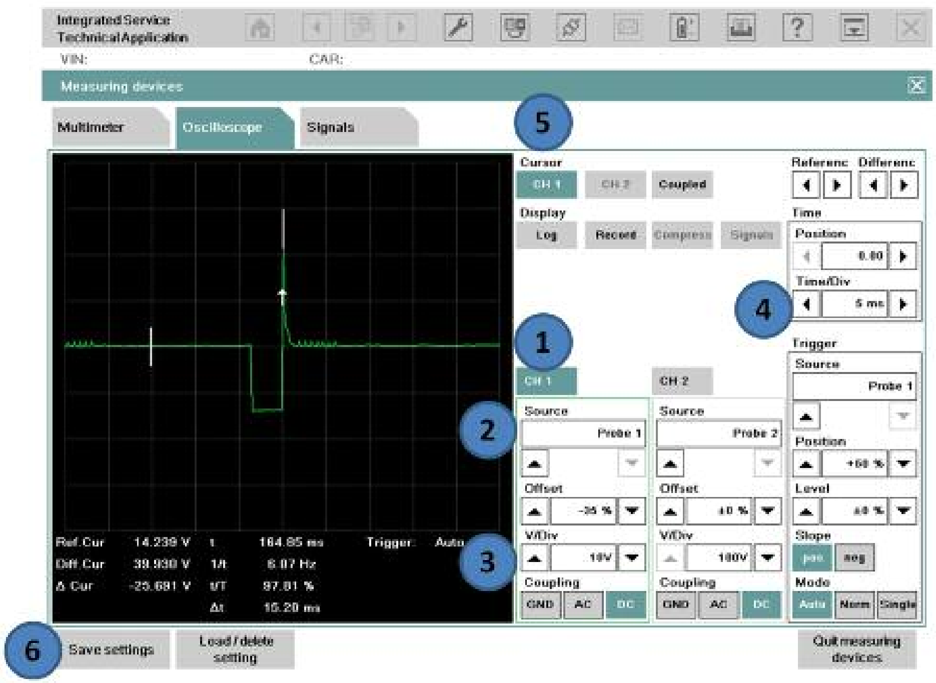
(5) Select "Save settings" to save the configuration setup (can be loaded back up at a later time).

(6) Repeat the test for all the cylinders.

Checking Injector Signal

Cables needed:

- *Probe 1 (Measurement Input 1) or*
- *Probe 2 (Measurement Input 2)*



Procedure:

Connect B+ of Probe 1 or Probe 2 to the P_EVZ signal line at the DME.

Connect B- of Probe 1 or Probe 2 to the vehicle ground point.

(1) Select either channel 1 or channel 2.

(2) This is the "Source" for the channel to Probe 1 and Probe 2 (depending on the channel selected).

(3) Set the "V/DIV" for each channel to "10V".

(4) Set the "Time/DIV" in the "Time" box to "5ms".

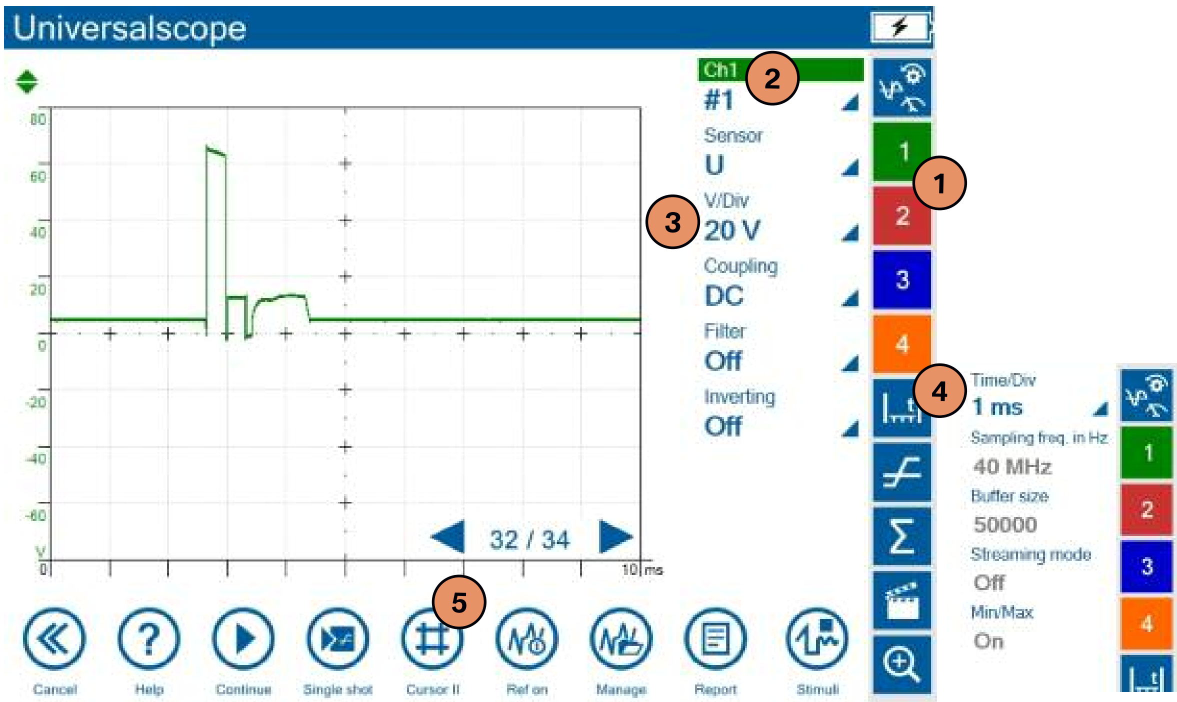
(5) Select the cursor for channel 1 or 2 (depending on the channel selected).

(6) Select "Save settings" to save the configuration setup (can be loaded back up at a later time).

Checking Injector Signal - Standalone

Cables needed:

- *Probe 1 (Measurement Input 1) or*
- *Probe 2 (Measurement Input 2)*



Procedure:

Connect B+ of Probe 1 or Probe 2 to the P_EVZ signal line at the DME.

Connect B- of Probe 1 or Probe 2 to the vehicle ground point.

(1) Select either channel 1 or channel 2.

(2) Set the "Source" for the channel to "#1" or "#2" (depending on the channel selected).

(3) Set the "V/DIV" for each channel to "20V".

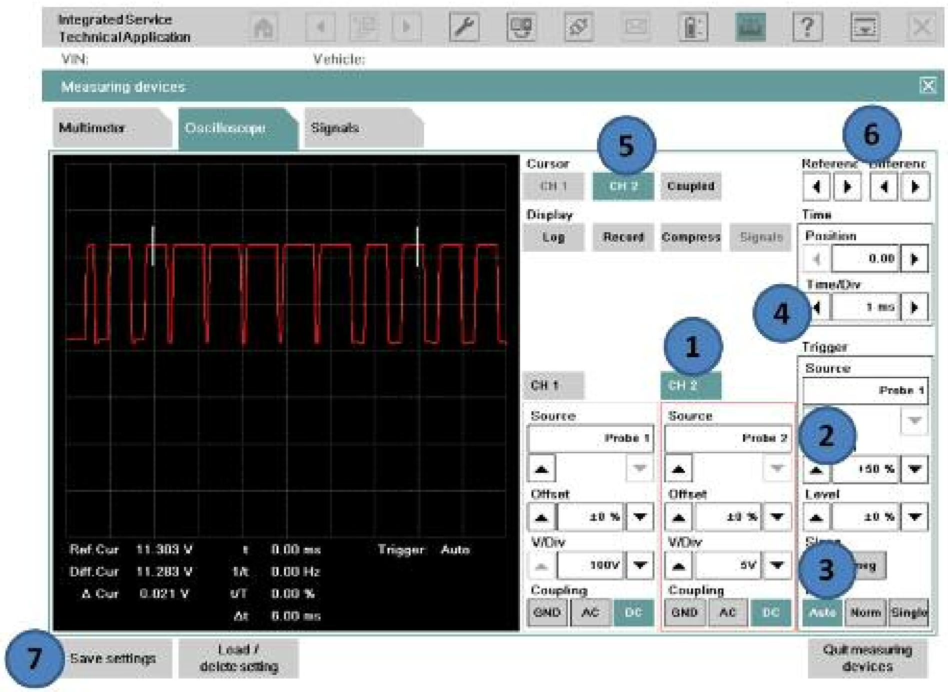
(4) Set the "Time/DIV" in the "Time" box to "1ms".

(5) Select the cursor for channel 1 or 2 (depending on the channel selected).

Checking the BSD Line

Cables needed:

- *Probe 1 (Measurement Input 1) or*
- *Probe 2 (Measurement Input 2)*



Procedure:

Connect B+ of Probe 1 or Probe 2 to the BSD Line at the vehicle harness.

Connect B- of Probe 1 or Probe 2 to the vehicle ground point.

(1) Select one of the 2 channels (in this example, channel 2 is selected).

(2) Select "Probe 2"(Measurement Input 2) from the "Source" setting under channel 2.

(3) Select "5V" from the "V/Div" setting under channel 2.

(4) Set the "Time/DIV" under the "Time" box to "1 ms".

(5) Select the channel 2 cursor "CH 2".

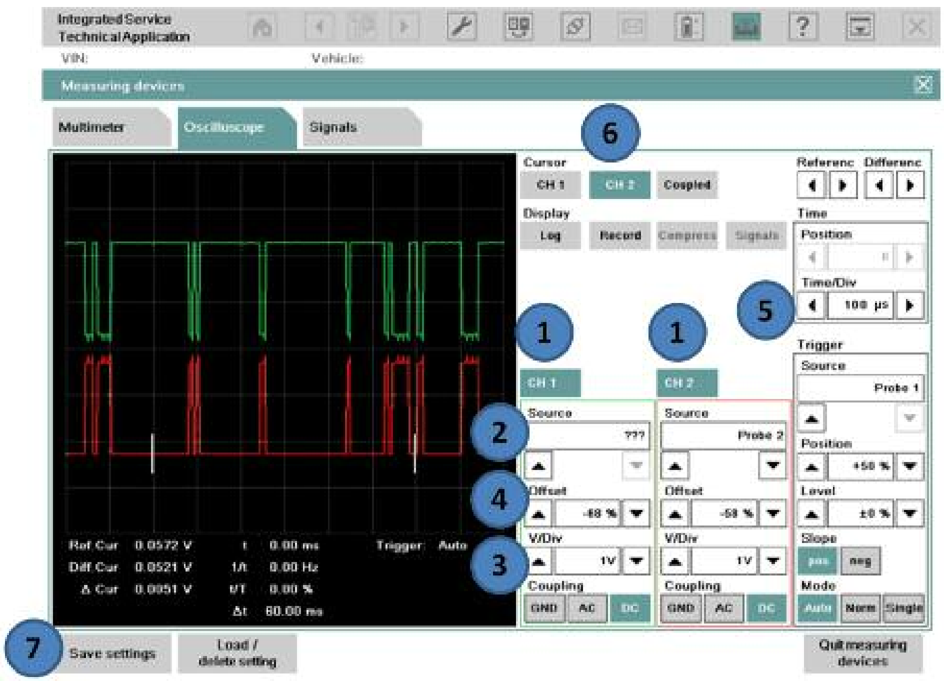
(6) The cursors can be moved to a different part of the signal with the "Referenc/Differenc" arrows.

(7) Select "Save settings" to save the configuration setup (can be loaded back up at a later time).

Checking K-CAN

Cables needed:

- *Probe 1 (Measurement Input 1)*
- *Probe 2 (Measurement Input 2)*



Procedure:

Connect B+ of Probe 1 and Probe 2 to K-CAN_L and K-CAN_H at vehicle harness.

Connect B- of Probe 1 and Probe 2 to vehicle ground point.

(1) Select both channels in order to view both the K-CAN_H and K-CAN_L.

(2) The "Source" under each channel should be set to Probe 1 and Probe 2.

(3) Set the "V/DIV" for each channel to "1V".

(4) Once the scope signals are displayed, use the "Offset" arrows to move the signals apart on the display (this makes it easier for viewing).

(5) Set the "Time/DIV" in the "Time" box to "100 µs".

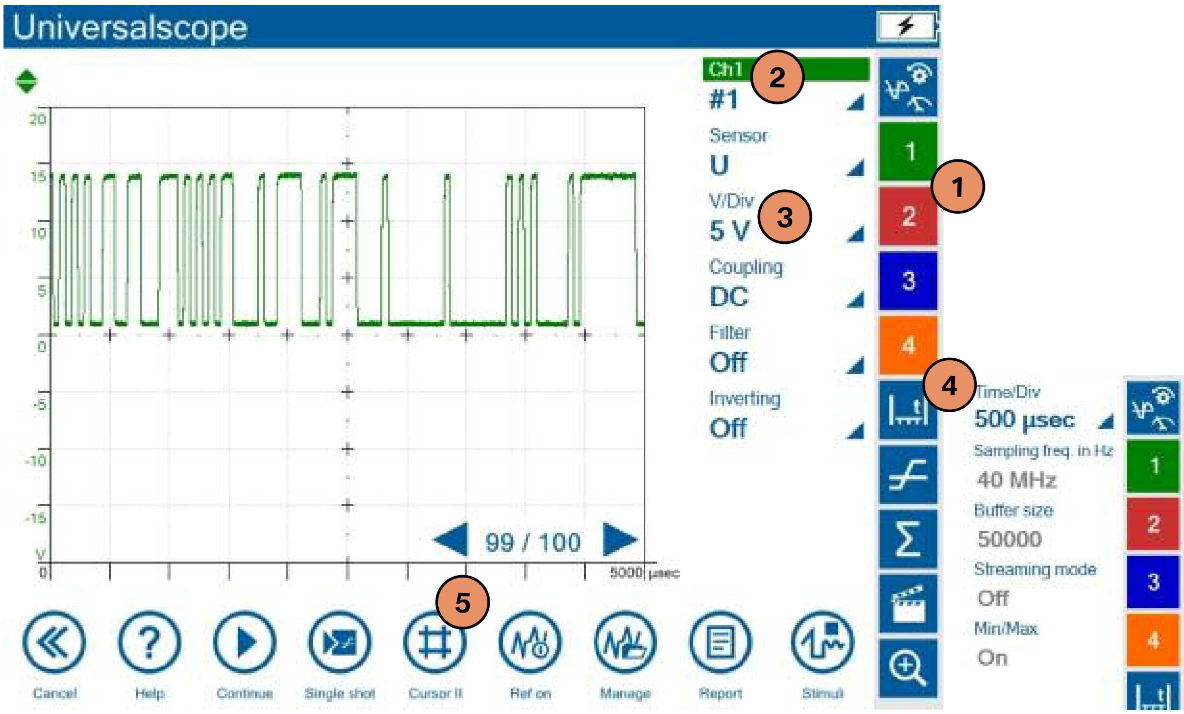
(6) Select the cursor for channel 1 or 2 (only 1 channel can display cursors at a time).

(7) Select "Save settings" to save the configuration setup (can be loaded back up at a later time).

Checking the BSD Line - Standalone

Cables needed:

- *Probe 1 (Measurement Input 1) or*
- *Probe 2 (Measurement Input 2)*



Procedure:

Connect B+ of Probe 1 or Probe 2 to the BSD Line at the vehicle harness.

Connect B- of Probe 1 or Probe 2 to the vehicle ground point.

(1) Select one of the 4 channels (in this example, channel 1 is selected).

(2) Select "#1"(Measurement Input 1) from the "Source" setting under channel 1.

(3) Select "5V" from the "V/Div" setting under channel 1.

(4) Set the "Time/DIV" under the "Time" box to "500 µsec".

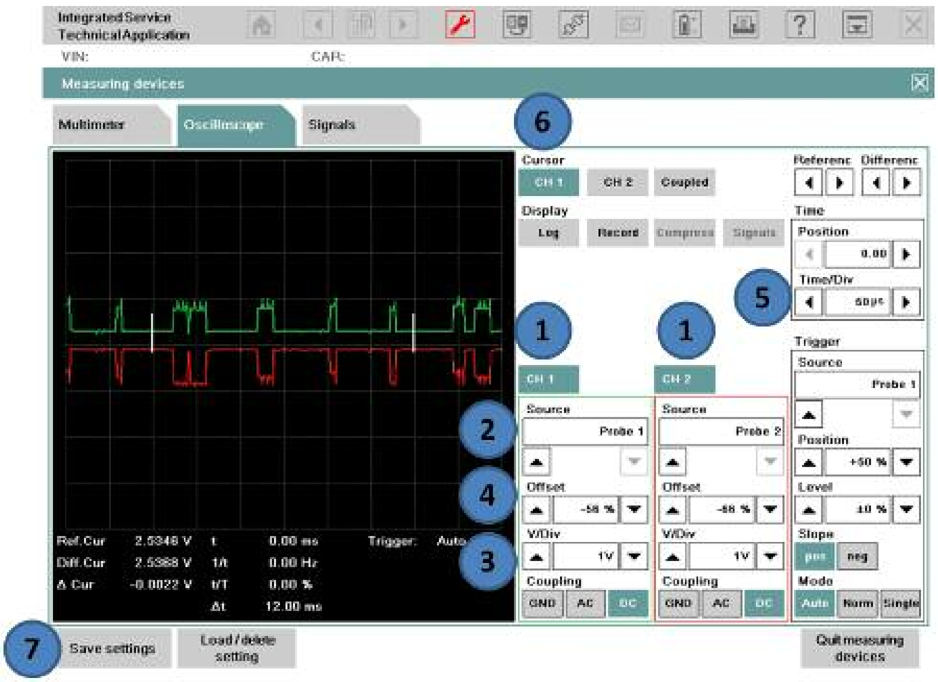
(5) Select the cursor using the "Cursor II" button.

The cursors can be moved to a different part of the signal with the hardware keys or by dragging them on screen using the stylus.

Checking PT-CAN

Cables needed:

- *Probe 1 (Measurement Input 1)*
- *Probe 2 (Measurement Input 2)*



Procedure:

Connect B+ of Probe 1 and Probe 2 to PT-CAN_L and PT-CAN_H at the vehicle harness.

Connect B- of Probe 1 and Probe 2 to the vehicle ground point.

(1) Select both channels in order to view both the PT-CAN_H and PT-CAN_L.

(2) The “Source” under each channel should be set to Probe 1 and Probe 2.

(3) Set the “V/DIV” for each channel to “1V”. If 0.5V is selected, this may cause a flat line of the signal.

(4) Once the scope signals are displayed, use the “Offset” arrows to move the signals apart on the display (this makes it easier for viewing).

(5) Set the “Time/DIV” in the “Time” box to less than “50 µs”.

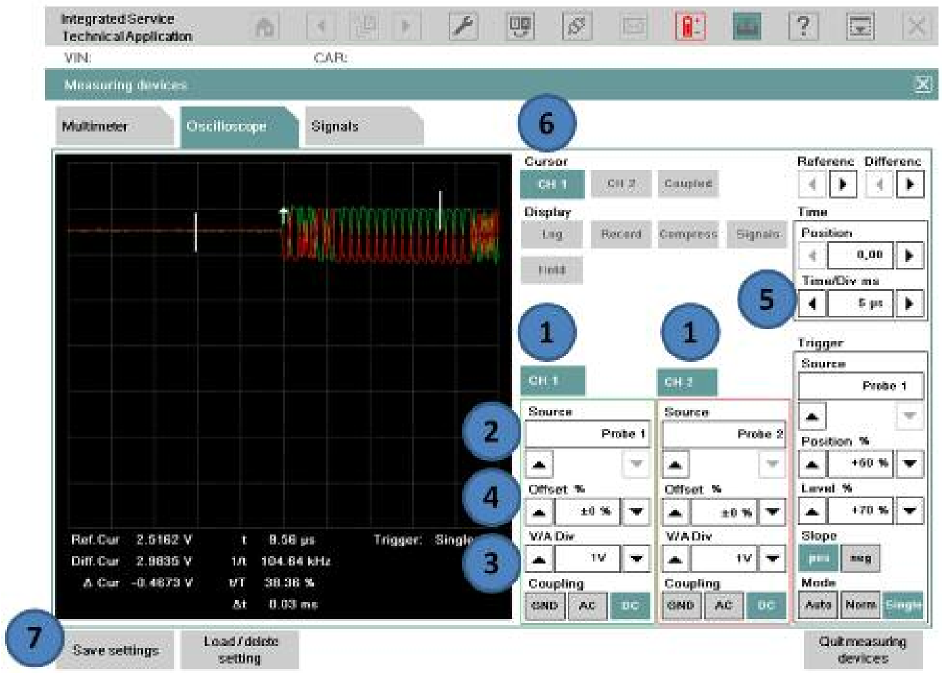
(6) Select the cursor for channel 1 or 2 (only 1 channel can display cursors at a time).

(7) Select “Save settings” to save the configuration setup (can be loaded back up at a later time).

Checking FlexRay

Cables needed:

- *Probe 1 (Measurement Input 1)*
- *Probe 2 (Measurement Input 2)*



Procedure:

Connect B+ of Probe 1 and Probe 2 to FlexRay_H and FlexRay_L at vehicle harness.

Connect B- of Probe 1 and Probe 2 to vehicle ground point.

(1) Select both channels in order to view both the FlexRay_H and FlexRay_L.

(2) The "Source" under each channel should be set to Probe 1 and Probe 2.

(3) Set the "V/DIV" for each channel to "1V".

(4) Once the scope signals are displayed, use the "Offset" arrows to move the signals apart on the display (this makes it easier for viewing).

(5) Set the "Time/DIV" in the "Time" box to "5 µs".

(6) Select the cursor for channel 1 or 2 (only 1 channel can display cursors at a time).

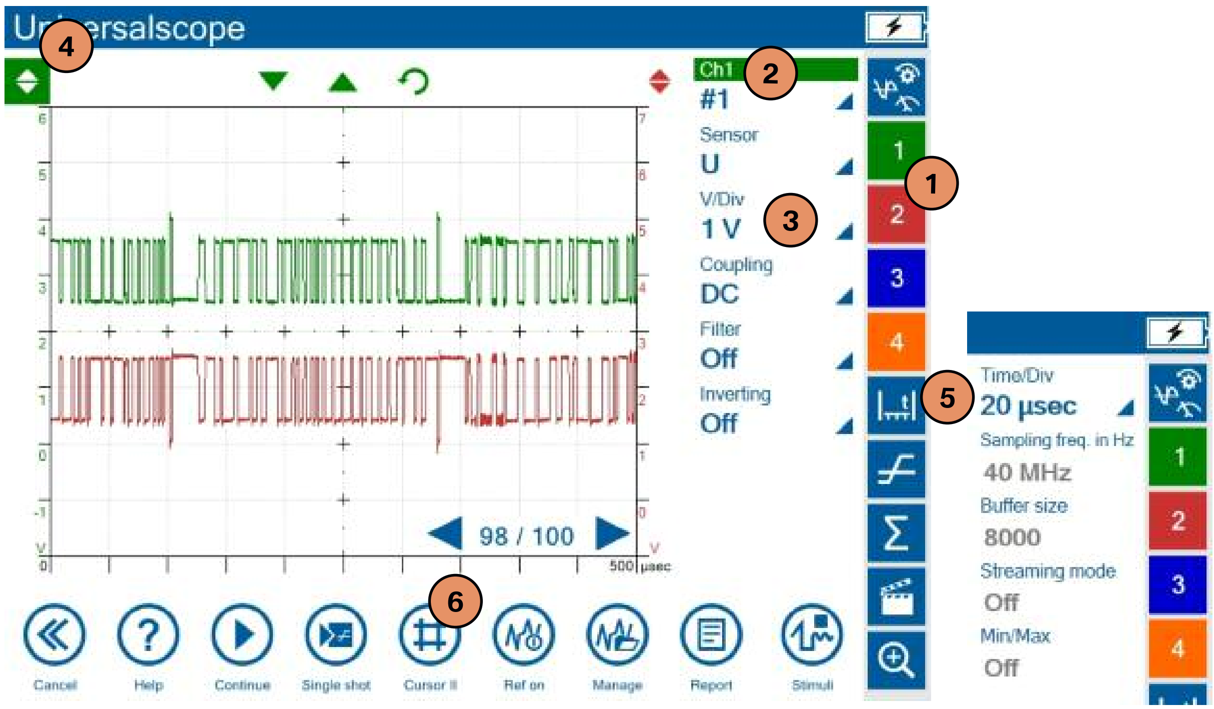
(7) Select "Save settings" to save the configuration setup (can be loaded back up at a later time).

Workshop Hint
As of ISTA v2.24.2 the RECORD button becomes unavailable if the Time/Div is < 2ms, however if you press the HOLD button and then press it again, the RECORD button becomes available for a short period of time.

Checking PT-CAN - Standalone

Cables needed:

- *Probe 1 (Measurement Input 1)*
- *Probe 2 (Measurement Input 2)*



Procedure:

Connect B+ of Probe 1 and Probe 2 to PT-CAN_L and PT-CAN_H at the vehicle harness.

Connect B- of Probe 1 and Probe 2 to the vehicle ground point.

(1) Select both channels in order to view both the PT-CAN_H and PT-CAN_L.

(2) The “Source” under each channel should be set to “#1” and “#2”.

(3) Set the “V/DIV” for each channel to “1V”. If 0.5V is selected, this may cause a flat line of the signal.

(4) Once the scope signals are displayed, use the “Offset” arrows to move the signals apart on the display (this makes it easier for viewing).

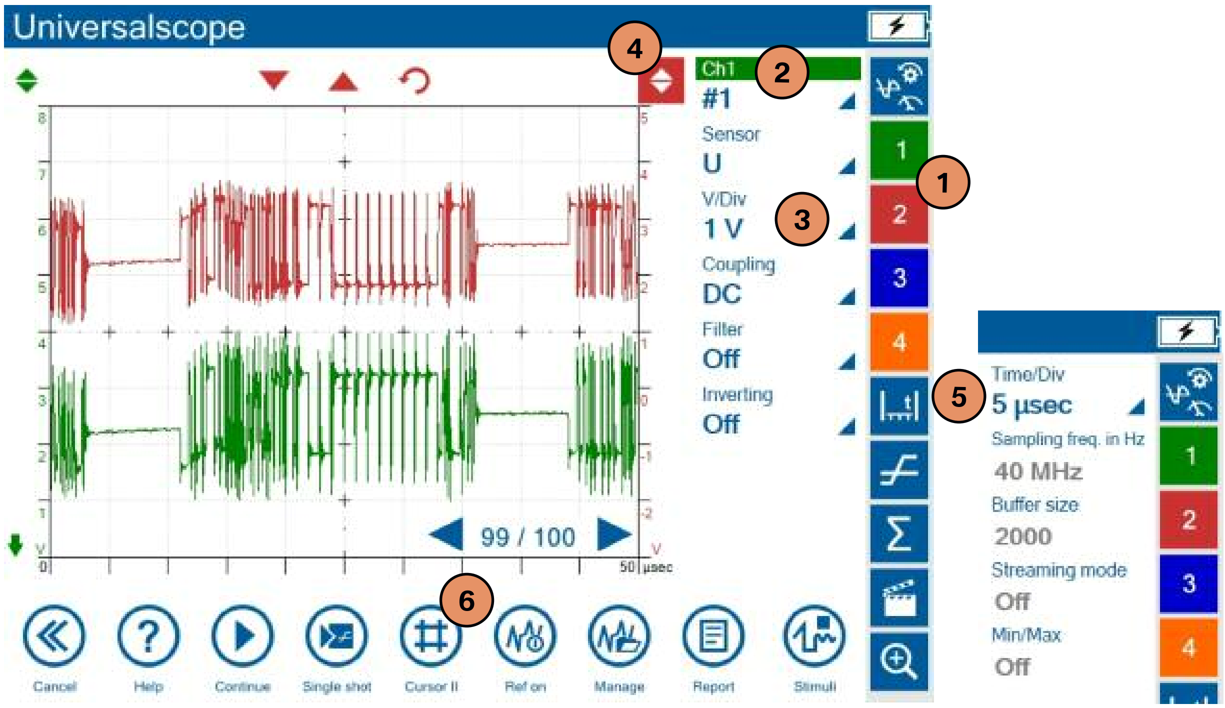
(5) Set the “Time/DIV” in the “Time” box to less than “50 µsec”.

(6) Select the cursor for channel 1 or 2 (only 1 channel can display cursors at a time).

Checking FlexRay - Standalone

Cables needed:

- *Probe 1 (Measurement Input 1)*
- *Probe 2 (Measurement Input 2)*



Procedure:

Connect B+ of Probe 1 and Probe 2 to FlexRay_H and FlexRay_L at vehicle harness.

Connect B- of Probe 1 and Probe 2 to vehicle ground point.

(1) Select both channels in order to view both the FlexRay_H and FlexRay_L.

(2) The "Source" under each channel should be set to "#1" and "#2".

(3) Set the "V/DIV" for each channel to "1V".

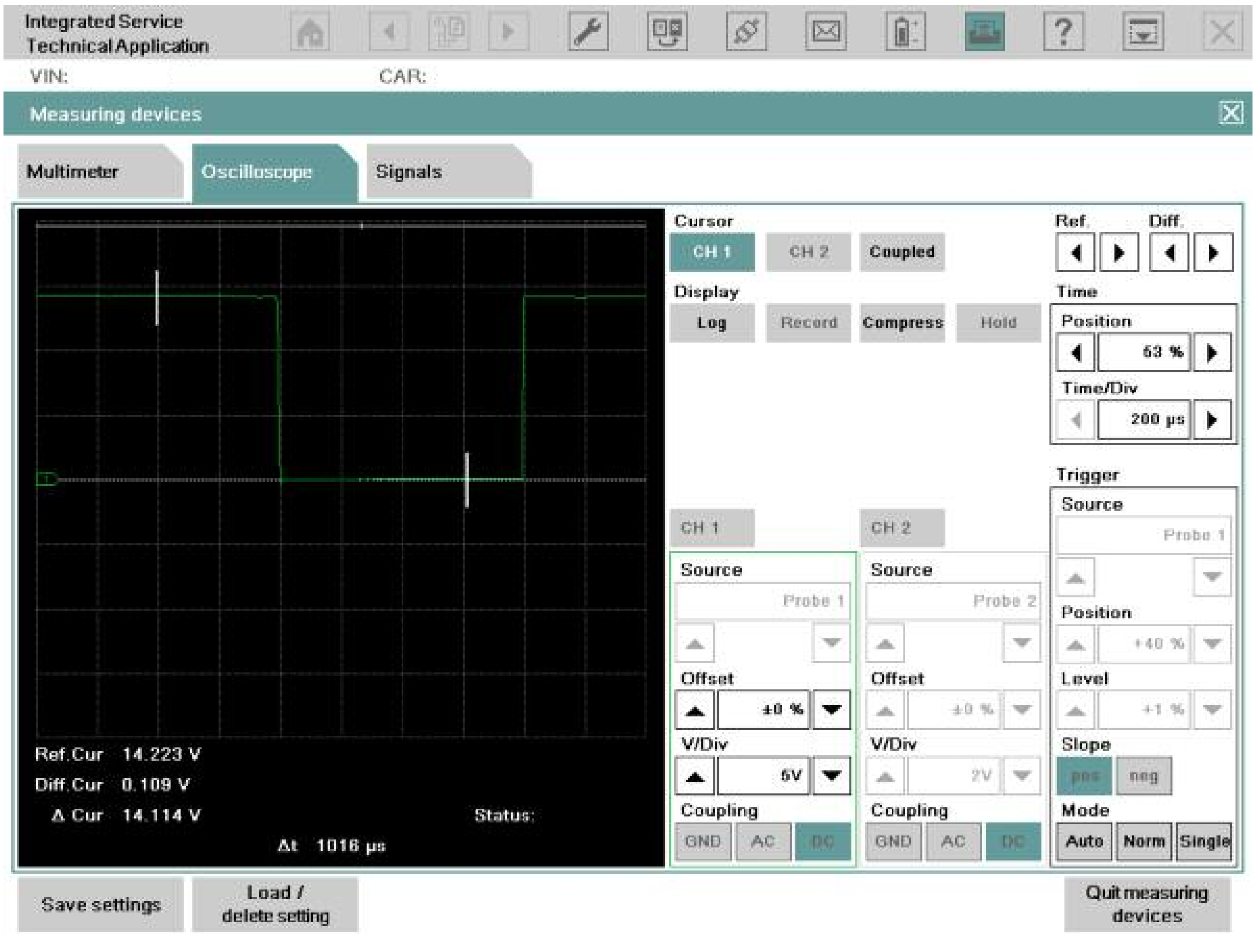
(4) Once the scope signals are displayed, use the "Offset" arrows to move the signals apart on the display (this makes it easier for viewing).

(5) Set the "Time/DIV" in the "Time" box to "5 µsec".

(6) Select the cursor for channel 1 or 2 (only 1 channel can display cursors at a time).

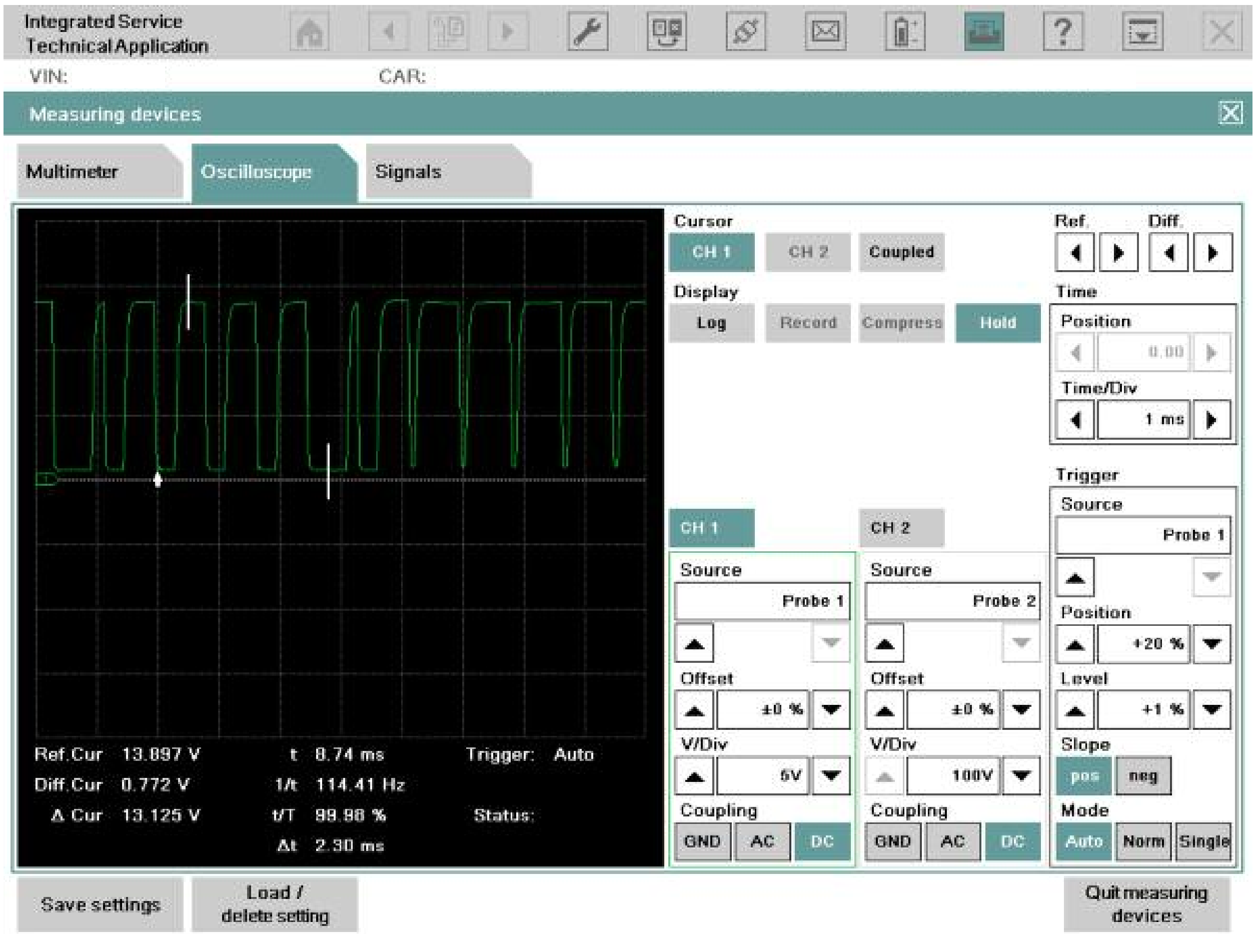
DME Signals

Activation Thrust Air Control Signal (Bypass Blow-off Valve)



Workshop Hint
Please blip throttle to actuate the thrust air control valve (Blow-Off Valve – BOV). *Note that during valve actuation, the voltage @ the DME is pulled low and is approx. ~100 mV. This reading validates that:* *1) The actuator is grounded by the DME's final stage transistor;* *2) That the ground is credible (no voltage drop), and also;* *3) That the voltage applied to the valve is good @ 14.2V.*

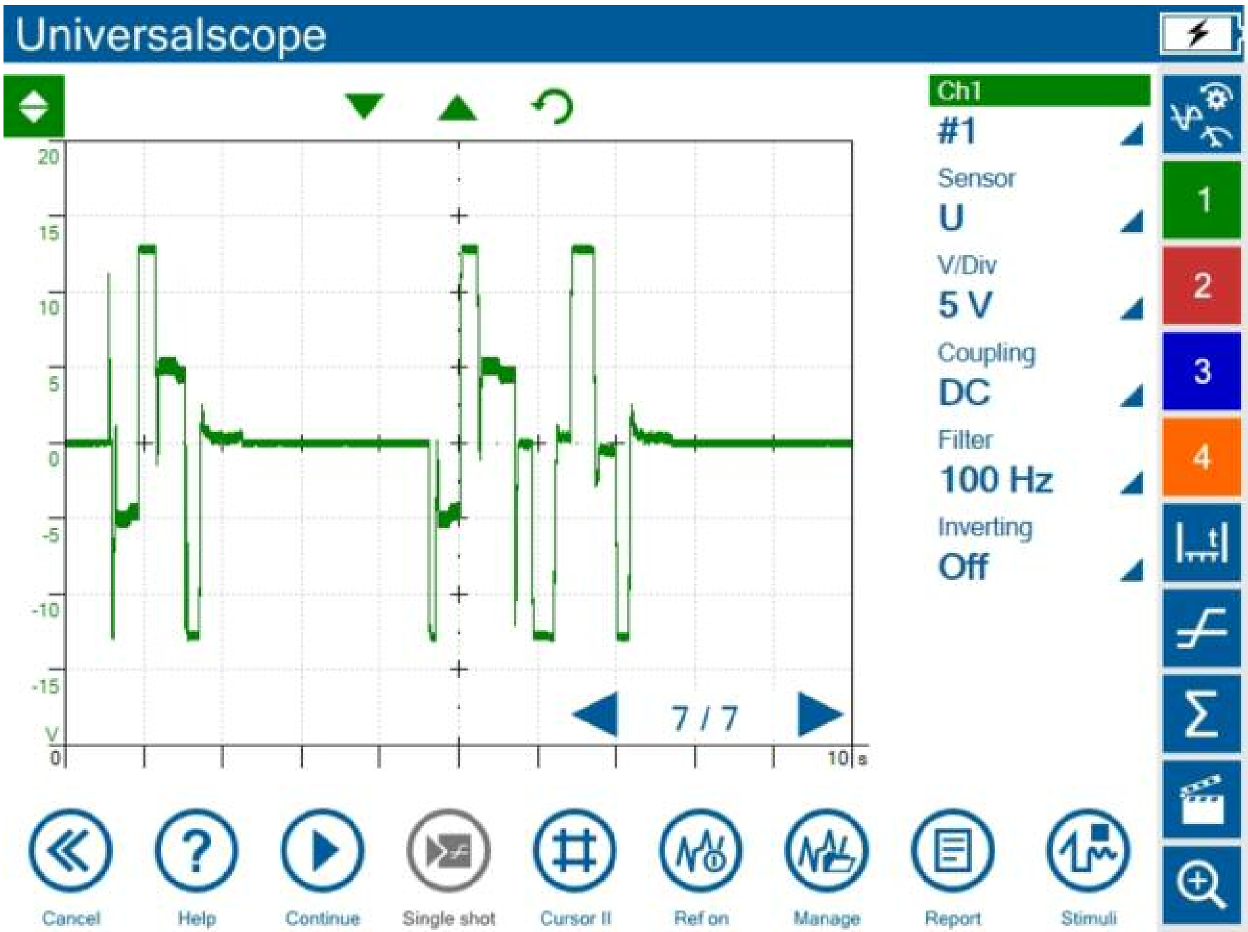
BSD



Workshop Hint
This is a compliant BSD bus signal regarding voltage that will equate to digital high and low – binary 1 and 0 respectively. This signal is shared with other components such as the Alternator and Intelligent Battery Sensor (IBS) if equipped.
In this example, "binary 0" is the voltage @ 13.897V and the "binary 1" is the voltage @ 772 mV or 0.772V.

For more information on single wire bus specifications, please review the Bus Specification Overview table.

Wastegate Control - Standalone

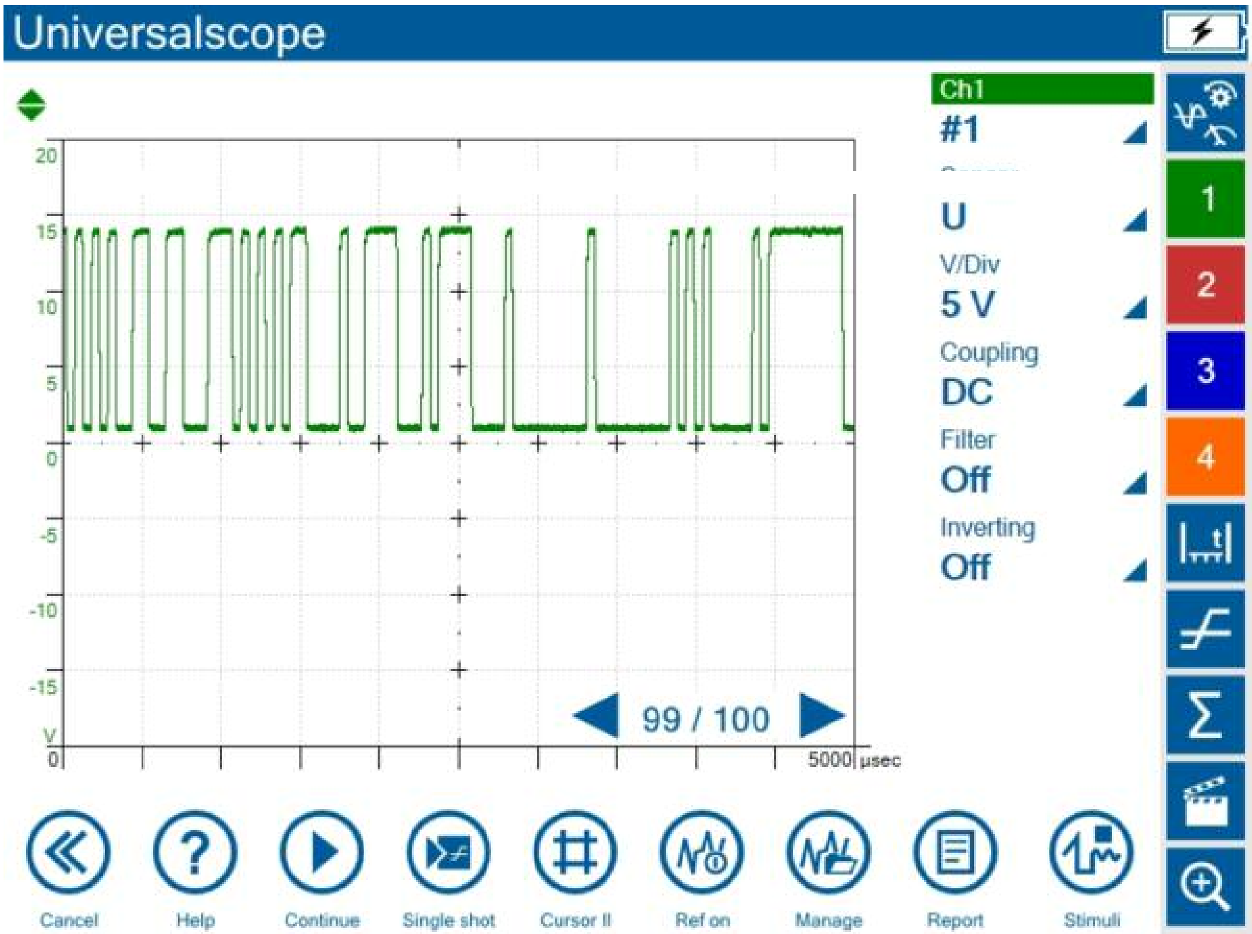


Workshop Hint

Use the functional test in the "Wastegate valve" ABL to actuate the motor.

Note that during motor actuation, the voltage @ the DME is pulled high in the positive and low in the negative direction signifying motor operation in both directions (e.g. opening and closing).

BSD - Standalone



Workshop Hint
This is a compliant BSD bus signal regarding voltage that will equate to digital high and low – binary 1 and 0 respectively. This signal is shared with other components such as the Alternator and Intelligent Battery Sensor (IBS) if equipped. *In this example, "binary 0" is the voltage @ 14.217V and the "binary 1" is the voltage @ 687 mV or 0.687V.*

For more information on single wire bus specifications, please review the Bus Specification Overview table.

Camshaft Signal

Workshop Hint

Intake or exhaust camshaft signal. Note that signal amplitude is approximately 5V, reinforcing that:

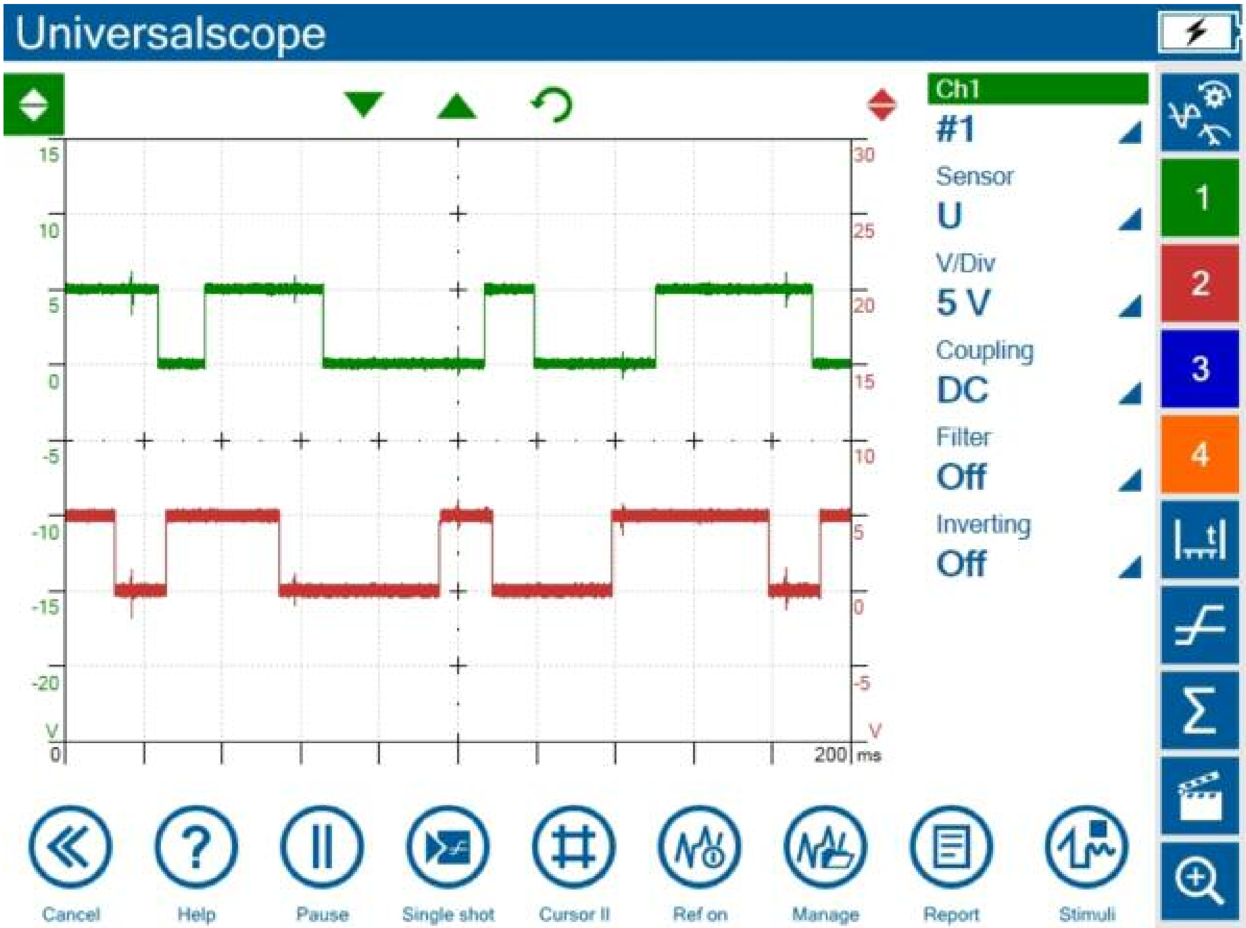
1) The reference voltage is good, and;

2) The signal is being grounded by the hall element to less that 100 mV. This is indicating that the circuit board has a credible ground at the DME.

Crankshaft Signal

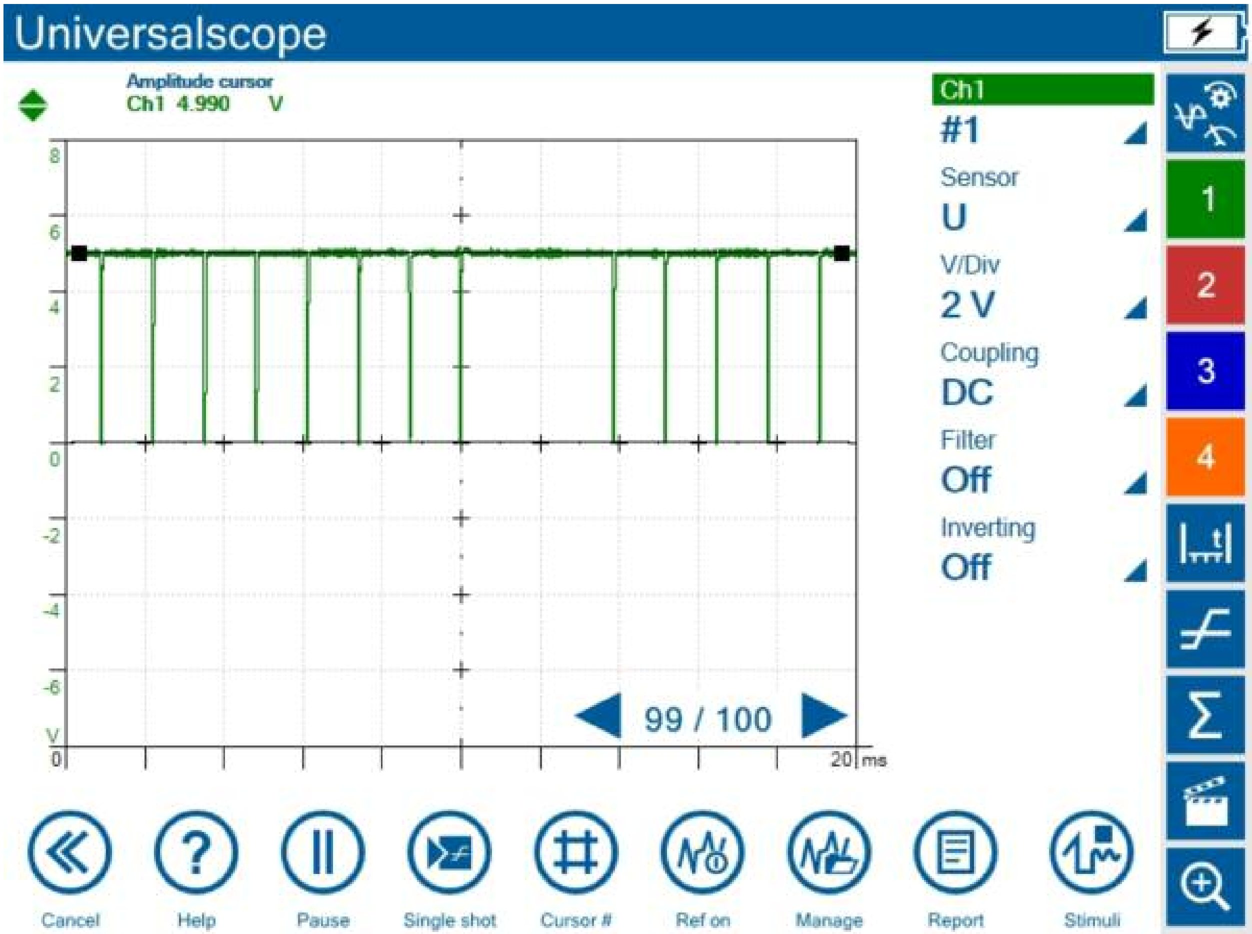
Workshop Hint
This is a compliant crankshaft signal @ the DME and is from a 3 wire hall sensor that receives 12 volts yet the digital signal has an amplitude of 5 volts.   *The large tooth that is captured at 7ms is the indicator of TDC. The frequency of the sensor indicates RPM (rate at which the trigger wheel accelerates or decelerates past the hall element.) and the duration of each cycle assists with engine misfire detection.*

Camshaft Signal - Standalone



Workshop Hint
Intake and exhaust camshaft signal. Note that signal amplitude is approximately 5V, reinforcing that: *1) The reference voltage is good, and;* *2) The signal is being grounded by the hall element to less that 100 mV. This is indicating that the circuit board has a credible ground at the DME.*

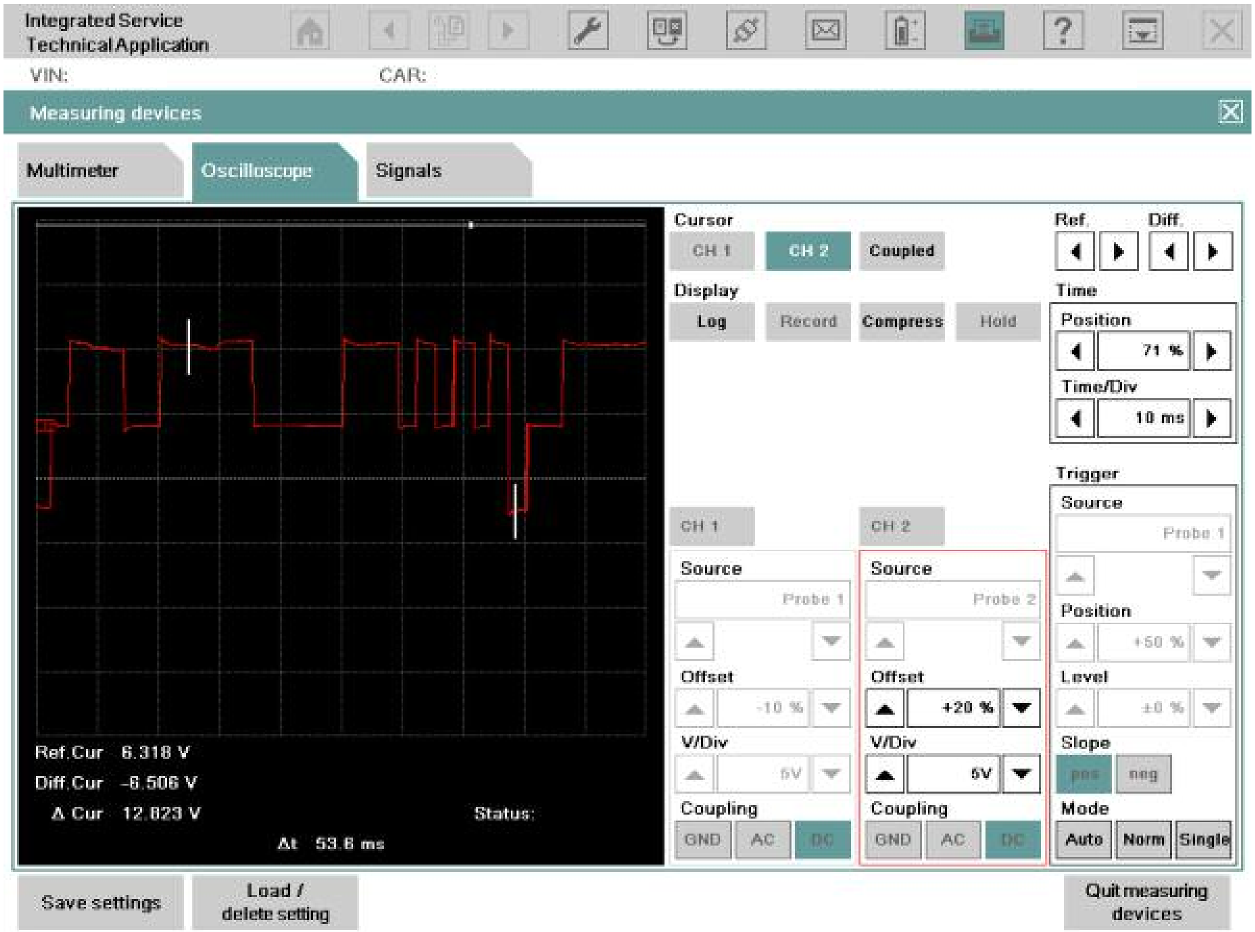
Crankshaft Signal - Standalone



Workshop Hint
This is a compliant crankshaft signal @ the DME and is from a 3 wire hall sensor that receives a 5 volt reference.   *The large tooth that is captured is the indicator of TDC. The frequency of the sensor indicates RPM (rate at which the trigger wheel accelerates or decelerates past the hall element.) and the duration of each cycle assists with engine misfire detection.*

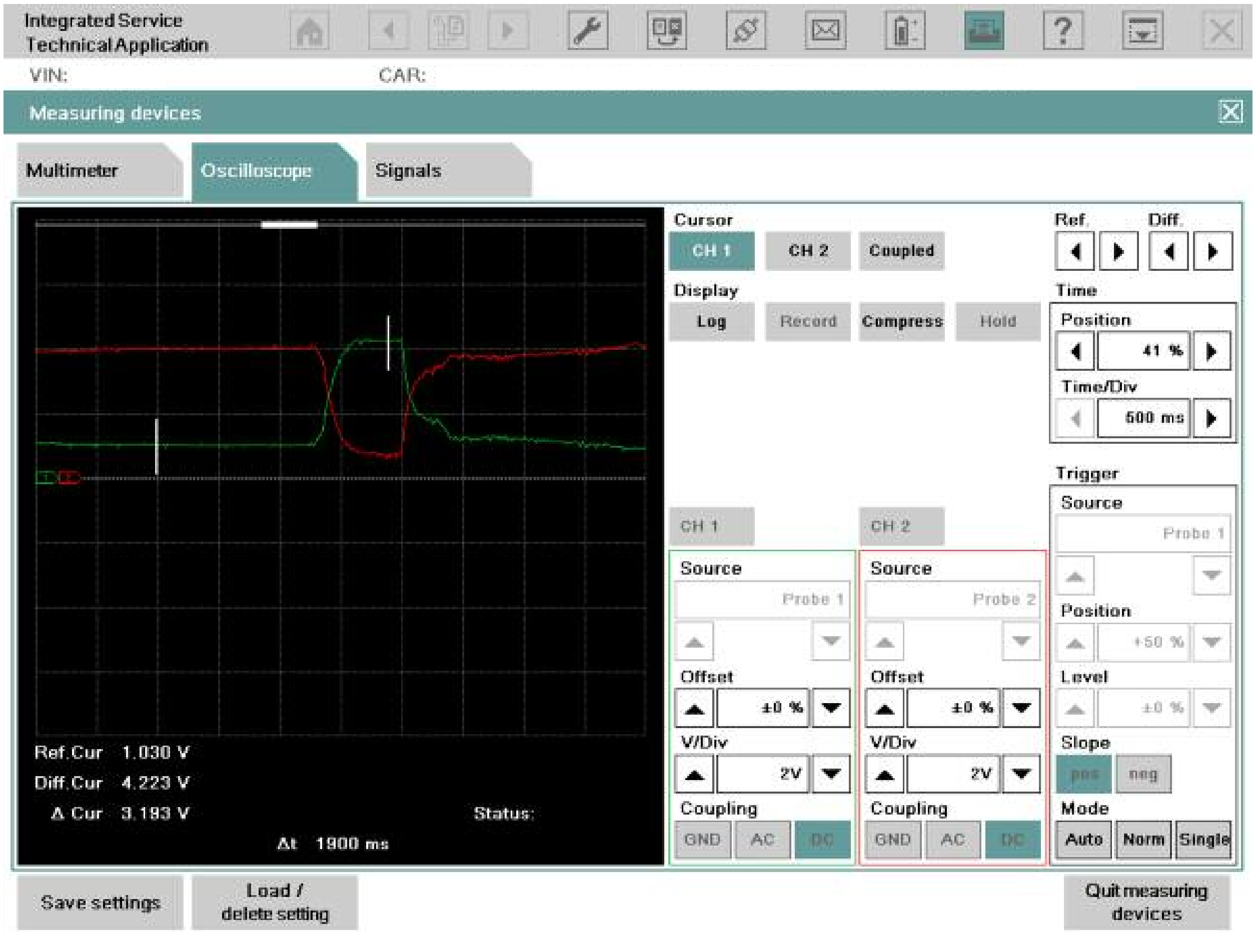
DK Motor (*Drosselklappe* Motor – Throttle Valve Motor)

B+ => B-



Workshop Hint
B+ => B- *This is a scope pattern from a DK motor with CH 2 leads in BOB terminals that feed the 2 wire DC motor allowing you to see the transition of polarity.*

Amplitude is 12 volts peak to peak with a 6 volt positive and 6 volt negative signal.



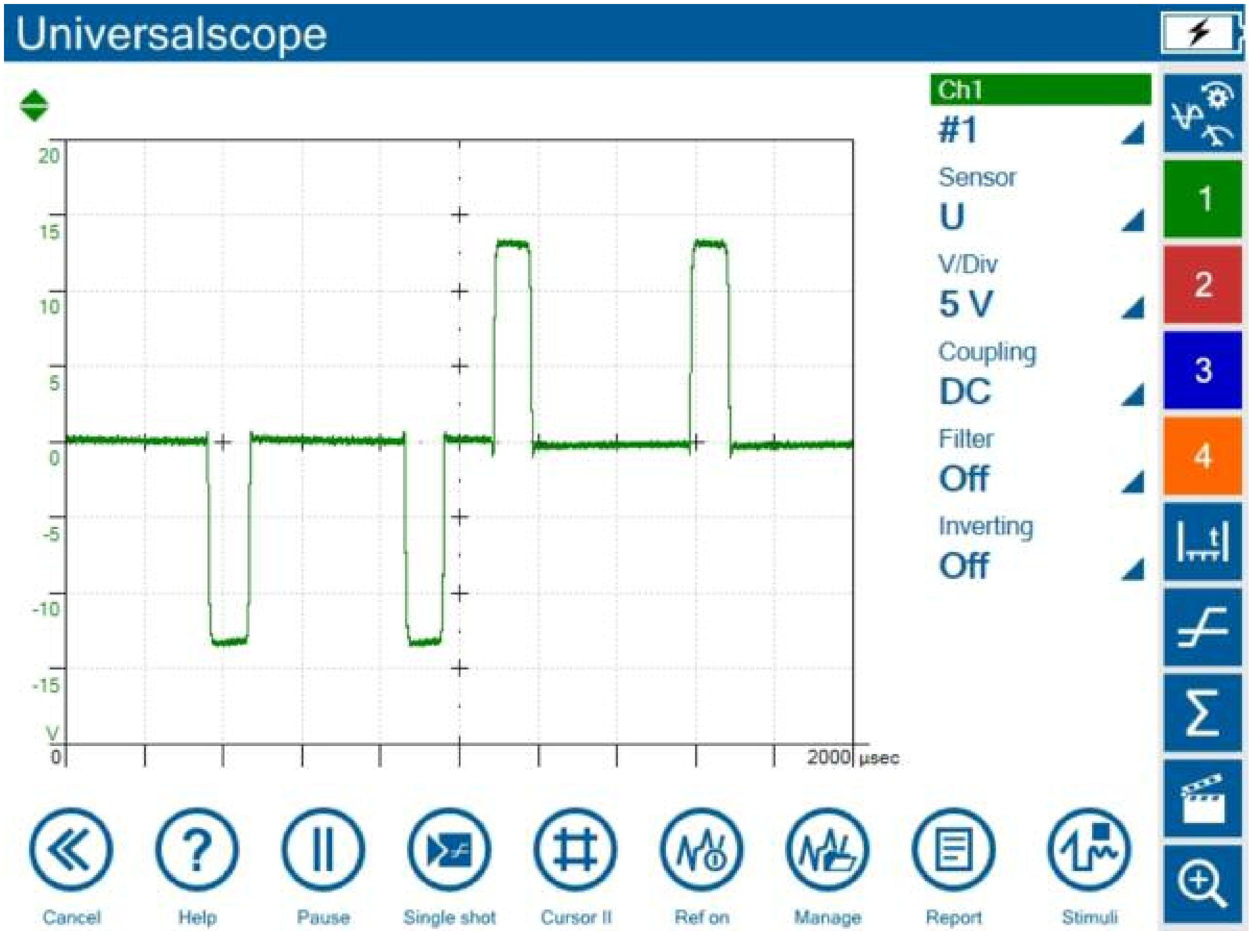
Workshop Hint

Potentiometers

This is a scope pattern from the DK potentiometers (Hall) from a “throttle sweep” done during a KL_15 cycle. Note the symmetry that reinforces that the position is identical at both sensors. Also, the sum check of the sensors is displayed as mirror images.

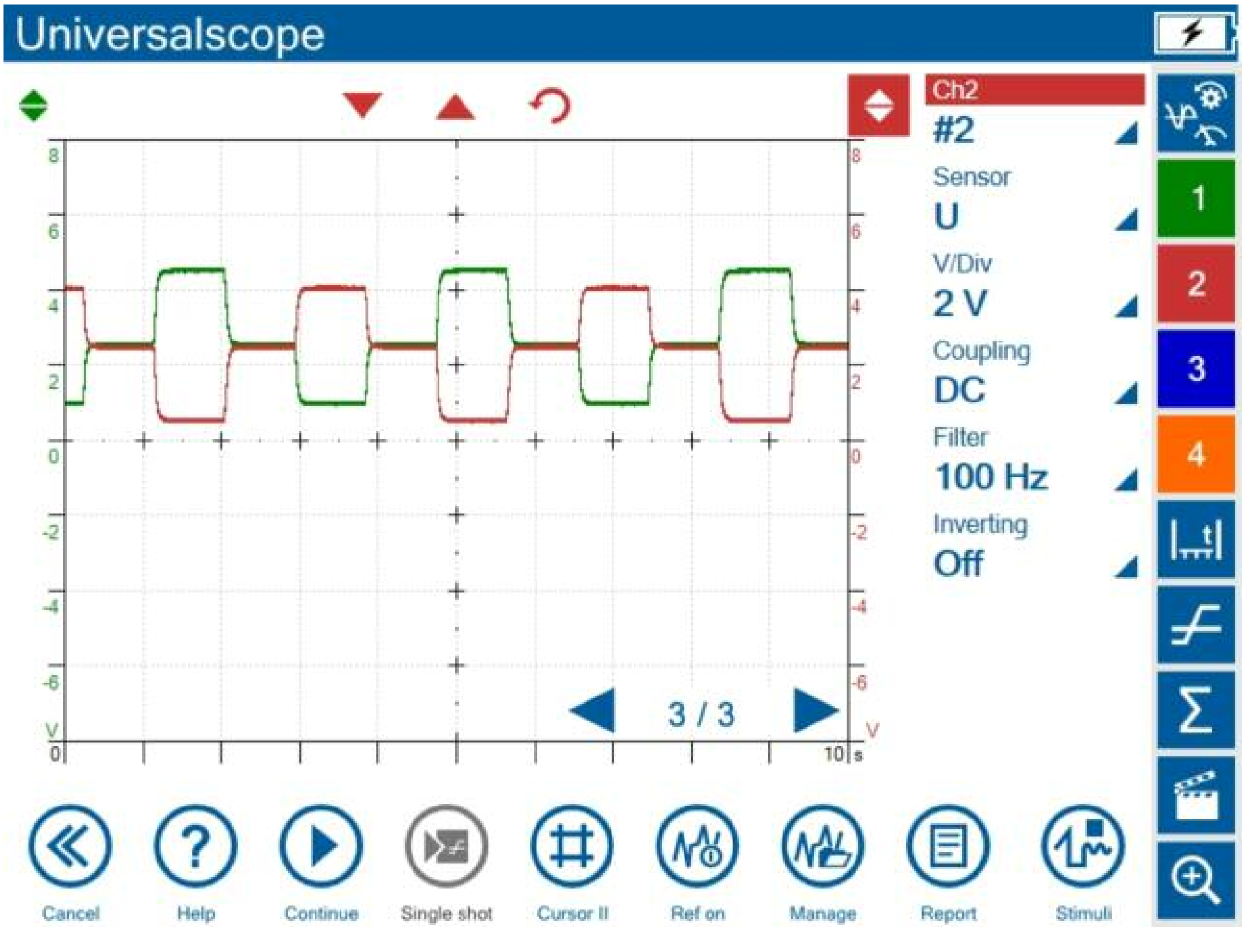
DK Motor - Standalone

B+ => B-



Workshop Hint
B+ => B-   *This is a scope pattern from a DK motor with CH 1 leads in BOB terminals that feed the 2 wire DC motor allowing you to see the transition of polarity.*

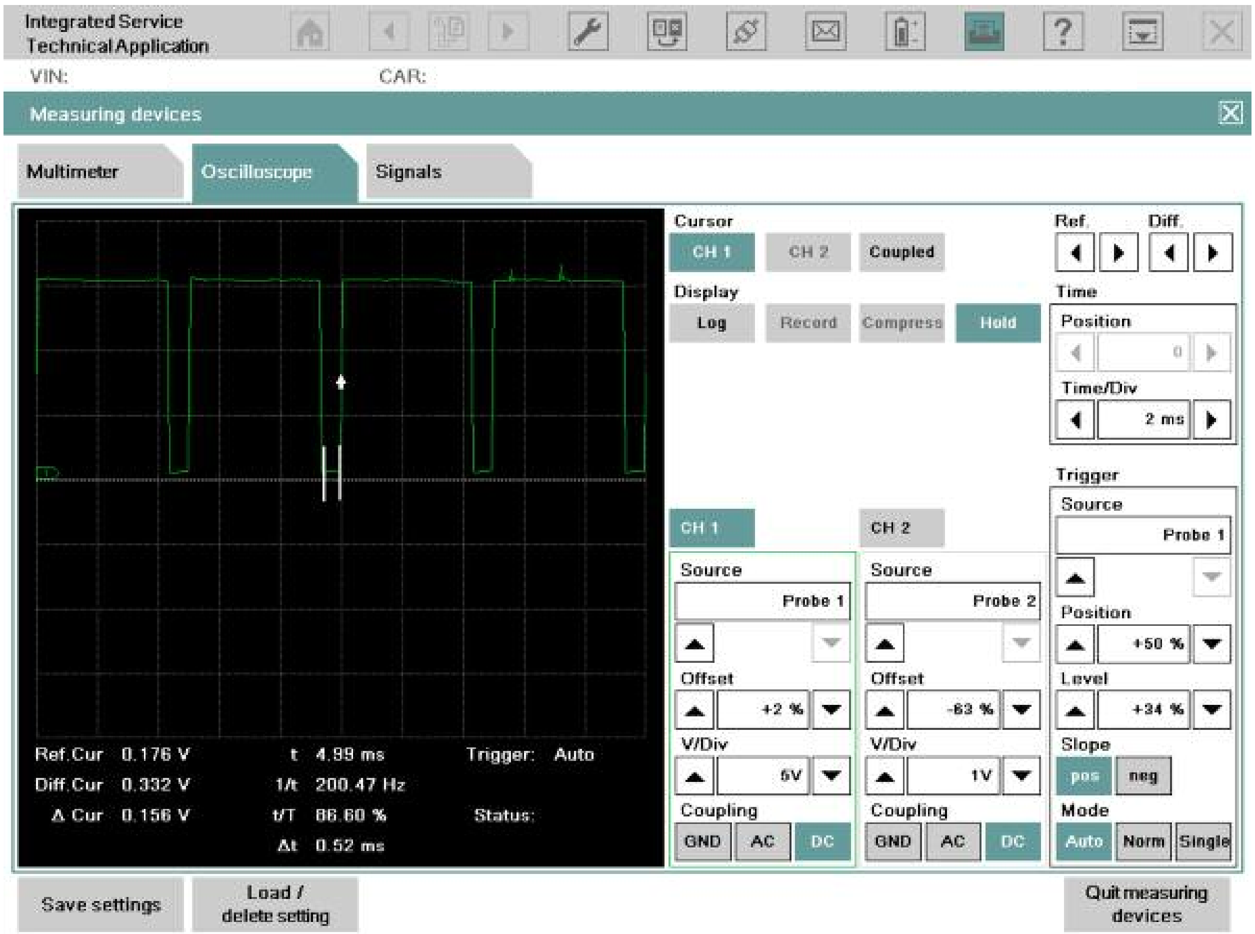
Amplitude is roughly 24 volts peak to peak with a 12 volt positive and 12 volt negative signal.



Workshop Hint
Potentiometers   *This is a scope pattern from the DK potentiometers (Hall) from a functional test. Note the symmetry that reinforces that the position is identical at both sensors. Also, the sum check of the sensors is displayed as mirror images. The 100Hz filter has been applied for a clearer view.*

EPDW - Turbocharged Engines

Pic 1



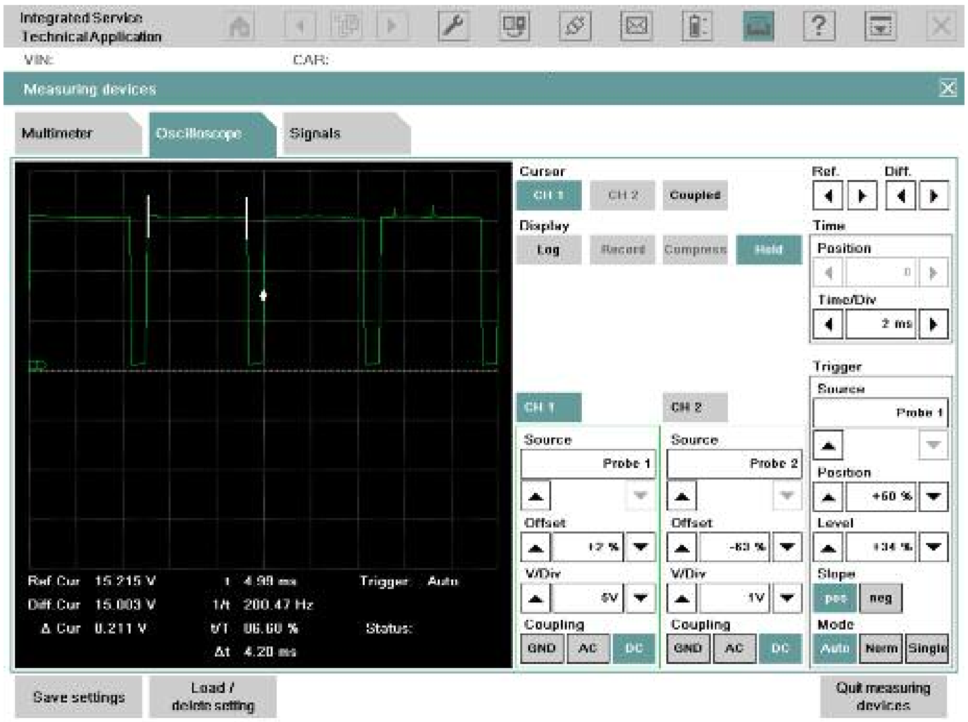
Workshop Hint

Pic 1
*This is the EPDW ground signal provided by the DME. You'll note that the time for this signal is shown @ 0.52 ms and the voltage here is below 340 mV reinforcing a good ground under load. The percentage or duty cycle is shown to be 86.6%, remember that this value is the time that the EPDW coil is **NOT** being grounded.*

Pic 2
The cursors are plotted on the EPDW signal when it is not being grounded by the DME. This would represent the 86.6% of duty cycle and the time that this signal remained high is shown as 4.20ms. Also, you can validate that the voltage to this device is sufficient @ 15.215 volts DC.

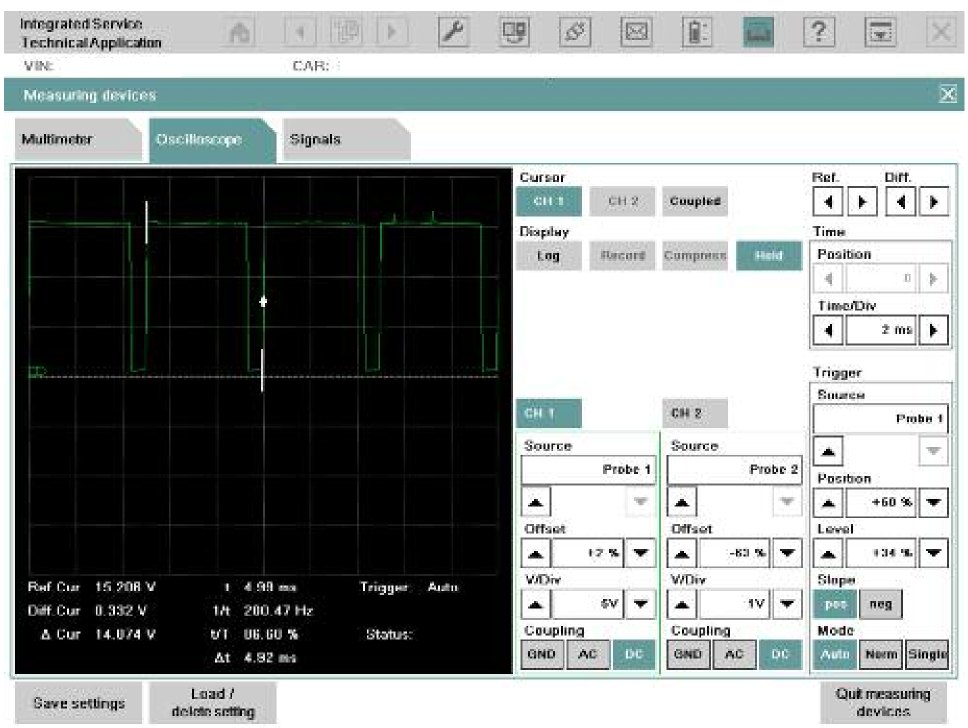
Pic 3
Screenshot of EPDW but the cursors are denoting a cycle.

Pic 2



Integrated Service Technical Application
VIN:
CAR:
Measuring devices
Multimeter
Oscilloscope
Signals
Cursor
CH 1
CH 2
Coupled
Display
Log
Record
Compress
Hold
Ref.
Diff.
Time
Position
Time/Div
2 ms
Trigger
Source
Probe 1
Position
+60 %
Level
Slope
pos
neg
Mode
Auto
Norm
Single
CH 1
CH 2
Source
Probe 1
Probe 2
Offset
V/Div
5V
1V
Coupling
GND
AC
DC
Ref.Cur 15.215 V
Diff.Cur 15.003 V
Δ Cur 0.211 V
1/t 200.47 Hz
Δt 4.20 ms
Trigger: Auto
Status:
Save settings
Load / delete setting
Quit measuring devices

Pic 3

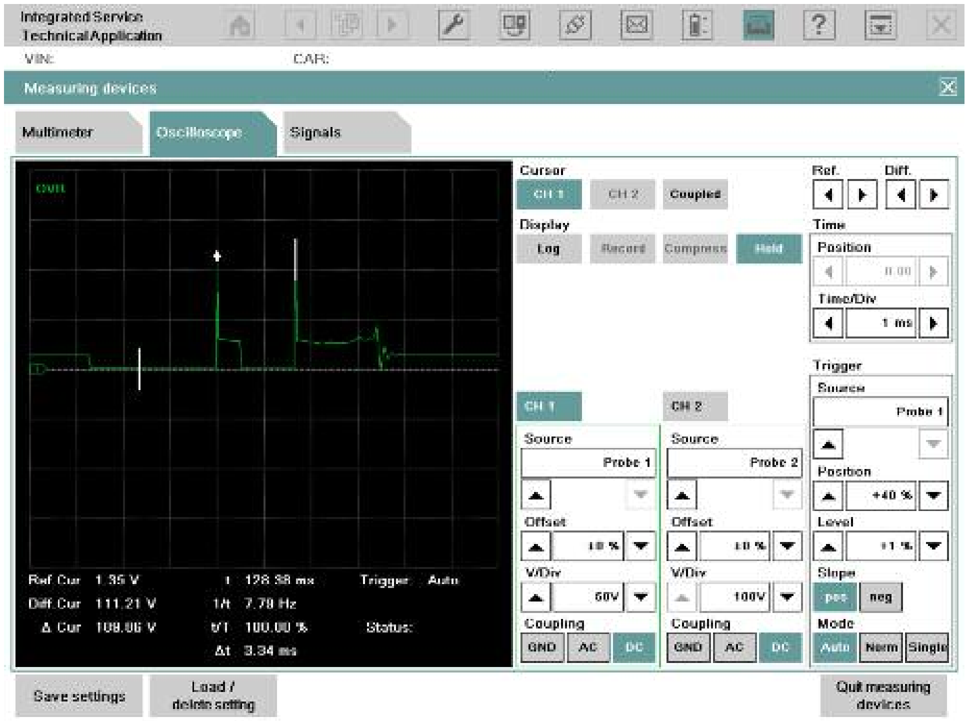


Integrated Service Technical Application
VIN:
CAR:
Measuring devices
Multimeter
Oscilloscope
Signals
Cursor
CH 1
CH 2
Coupled
Display
Log
Record
Compress
Hold
Ref.
Diff.
Time
Position
Time/Div
2 ms
Trigger
Source
Probe 1
Position
+60 %
Level
Slope
pos
neg
Mode
Auto
Norm
Single
CH 1
CH 2
Source
Probe 1
Probe 2
Offset
V/Div
5V
1V
Coupling
GND
AC
DC
Ref.Cur 15.208 V
Diff.Cur 0.332 V
Δ Cur 14.874 V
1/t 200.47 Hz
Δt 4.92 ms
Trigger: Auto
Status:
Save settings
Load / delete setting
Quit measuring devices

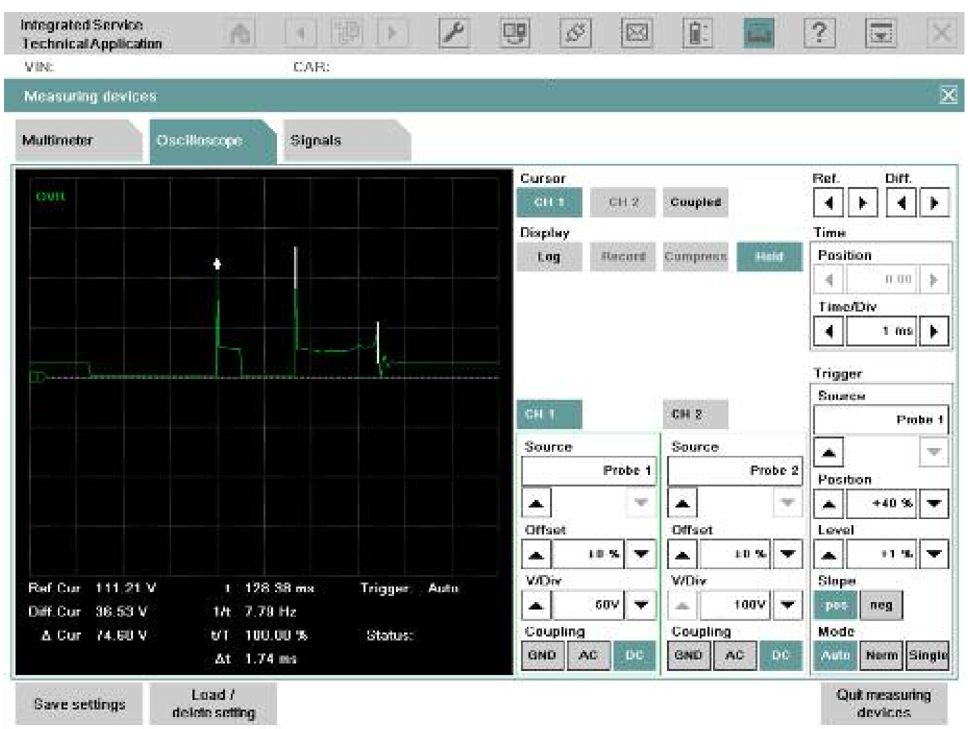
Ignition Primary Signal

Workshop Hint
This primary ignition event is at an idle and shows multiple events. The system will switch to a single event if the idle is raised above 1,300 RPM.   *The key is analyzing the spark event for amplitude (coil inductance), burn time and coil oscillations to determine winding condition.*   *Primary B+ voltage and ground credibility can be determined at the DME rather than accessing the coil connector.*

Ignition Primary Signal - 2

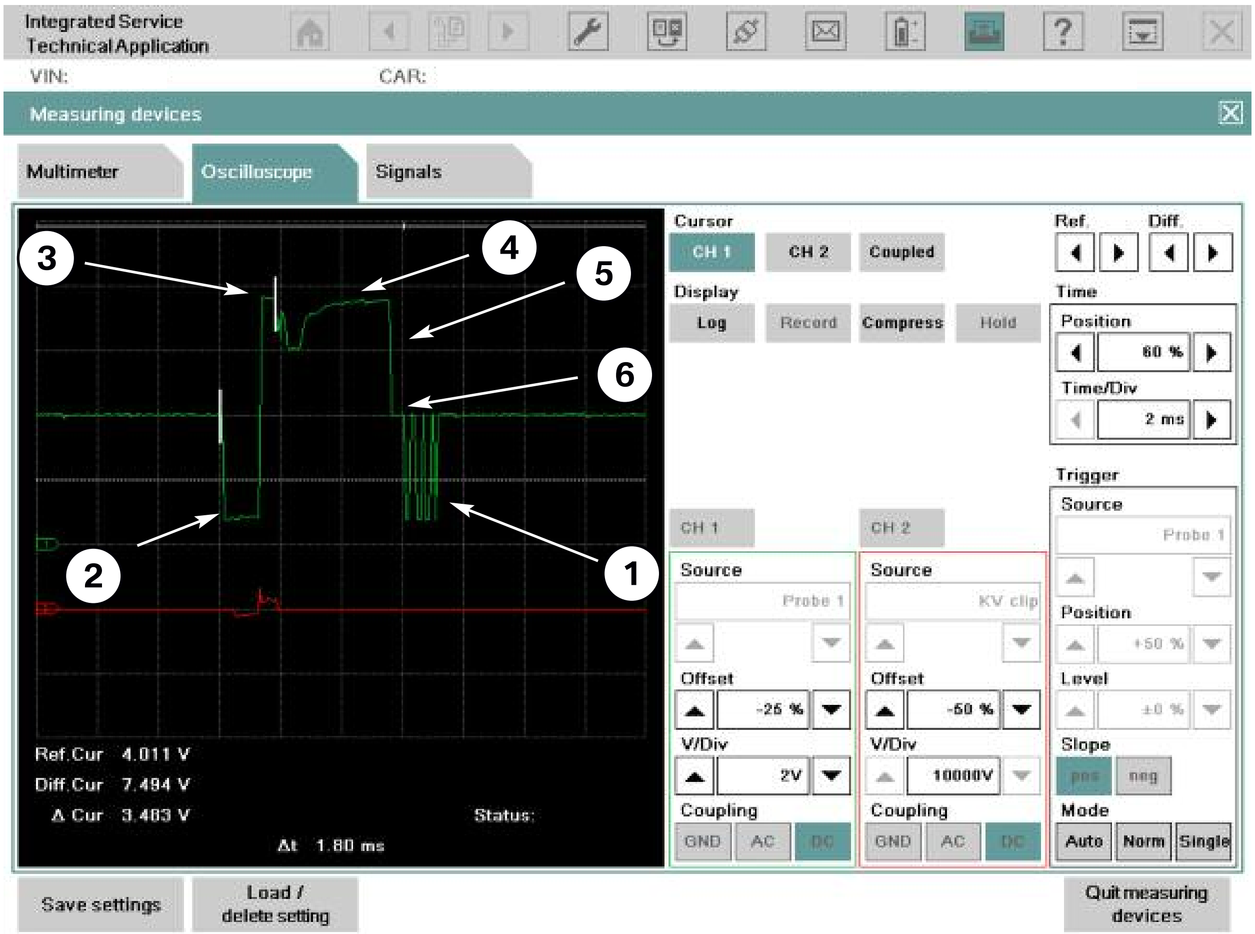


Ignition Primary Signal - 3



Ion Current Combustion Monitoring (BMW M)

S65B40



Index	Explanation	Index	Explanation
Channel 1 (Green)	Primary Ignition Signal	3	Coil is set into current measurement mode (DME => Coil)
Channel 2 (Red)	Secondary Ignition Signal	4	The ionic current is measured and sent from Coil => DME
1	Signal from DME => Coil. Ion current amplification and offset.	5	Coil sets line voltage to a Weak 4V (Idle line)
2	Loading coil (DME => Coil). Spark is released at the end of this phase.	6	DME performs calculations and prepares for next combustion.

If the ignition suppression capacitor is defective, this can lead to faults in the communications and/or audio electronics when the engine is running.

Workshop Hint

The ion current combustion monitoring is used for knock identification and misfiring identification on some Motorsport Engines (S65 and S85).

The ionic current is measured after ignition occurs. A low voltage is applied between the electrodes of the spark plug immediately after the end of the ignition spark and the resulting current (ionic current) is measured.

For the purposes of smoothing the voltage and electromagnetic compatibility, an "ignition suppression capacitor" is installed in the wiring harness of each cylinder bank (in the S85 this is in the ion current control device). This is electrically connected using terminal 87 and vehicle earth.

The interface between DME and Coil is a bidirectional communication with different modes:

- ***Weak 4V*** *= idle, no communication.*
- ***Strong 0V*** *= digital Signal from DME to coil for primary coil drive and adjusting amplification of ion current measurement.*
- ***>5V*** *= ion current signal from coil to DME.*

A typical sequence for one combustion is as follows (The numbers match those in the graphic):

1. *Setting ion current amplification and offset (DME => Coil) seen in the graph as a burst of low-pulses (100-200 µs, low voltage signal).*
2. *Loading coil by a long low voltage signal (1-1,5 ms) (DME => Coil). At the end of this phase ignition is started, that is, the spark is released at the sparkplug (note how the Secondary Ignition Signal spikes).*
3. *Setting line level to about 8V to set coil into ion current measurement mode (DME => Coil).*
4. *Driving amplified ion current + offset on the line as a current signal (1-20mA, Coil => DME).*
5. *DME release line to indicate idle line; coil sets line voltage to a Weak 4V level.*
6. *DME calculates misfire, knock detection, diagnostic info and amplification for next combustion.*

For more information on Ionic Current Combustion Monitoring please reference:

- **ST505 E60 M5**
- **ST609 Motorsport Technology**
- **ST709 E9x M3**

Injection Signal (High Impedance Coil) - Solenoid Type

Pic 1

Workshop Hint
Pic 1   *High impedance injector waveform (manifold injection). Note injection "on time" of 3.12 ms and voltage during activation @ 500 mV, indicating a good transistor ground and a crisp activation. Also voltage to injector is @ 14.07V indication of acceptable power supply.*

Pic 2

Workshop Hint

Pic 2

This scope pattern has the cursor on the supply to the injector informing the Tech that the feed and windings are capable of carrying the potential (voltage)to the DME and the winding resistance state of health (impedance) is acceptable since the inductive spike is around 55 volts.

It's important to note that as resistance decreases, the amplitude of the inductive spike will decrease. Also, always remember to compare to the other cylinders.

Injection Signal (Low Impedance Coil) - Solenoid Type

Workshop Hint

The Injection signal is sent from the DME and is amplified in order to drive the "peak and hold" low impedance injector. The current is initially high, however, once opened it decreases to keep the injector open.

Remember that if you have uncertainties regarding this signal, you could compare them to those in the other cylinders!

Injection Signal (Low Impedance Coil) - HDEV Solenoid Type

HDEV

Workshop Hint
HDEV   *This scope pattern is from an N55.*   *For more information on HDEV injector scope patterns please reference the following pages and the ST055 Reference Manual.*

Workshop Hint

HDEV Injectors Basic Information

The following electrical interface specification is valid for the HDEV 5.2 and for a system pressure of 20 MPa. A 65V output stage is required for driving the HDEV 5.2. Driving with constant voltage is not allowed.

The maximum permissible coil temperature of HDEV5.2 injectors is 140°C (284°F).

Driving Phases

HDEV5.2 driving occurs in 4 phases (see diagram on the right).

1. Booster phase

Opening of the HDEV5.2 is initiated in the booster phase (No. 1 in the diagram) by a high booster voltage U_{Boost} *from the DME, through commuting the booster capacitor on the HDEV5.2. The booster phase ends upon reaching the booster current* I_{Boost} *(approx. 10A). The high current is achieved by a voltage of up to approx. 65 Volt. The maximum booster time* $t_{Boost\ max}$ *must not be exceeded.*

2. Energization phase (Pickup phase)

In the energization phase (or pickup phase, No. 2 in the diagram), the HDEV5.2 is completely opened by controlling the current to approx. 6.2A, the so called pickup current I_A*. The effective pickup current* $I_{A\ eff}$ *must be provided. Time* t_1 *comprehends the booster phase and the pickup phase, i.e. from the beginning of the booster phase till the commuting of pickup current unto holding current.*

At the end of this phase, the current is reduced from the energization to the holding current level of approx. 2.5A. Time t_2 *must not be exceeded while switching over.*

3. Hold phase

The energized HDEV5.2 is kept open by controlling the current at approx. 2.5A (holding current $I_{hold\ eff}$*) in the hold phase (No. 3 in the diagram). The low current level yields a fast closing and low heat dissipation at the HDEV5.2 and the output stage.*

4. Switch off phase

The current is switched off at the end of the injection time t_i *in the switch off phase (No. 4 in the diagram). In this phase the voltage* $U_{discharge}$ **(or** $-U_{Boost}$ **)** *must have at least the level of* U_{Boost}*. At least 2 milliseconds elapse between two injection cycles.*

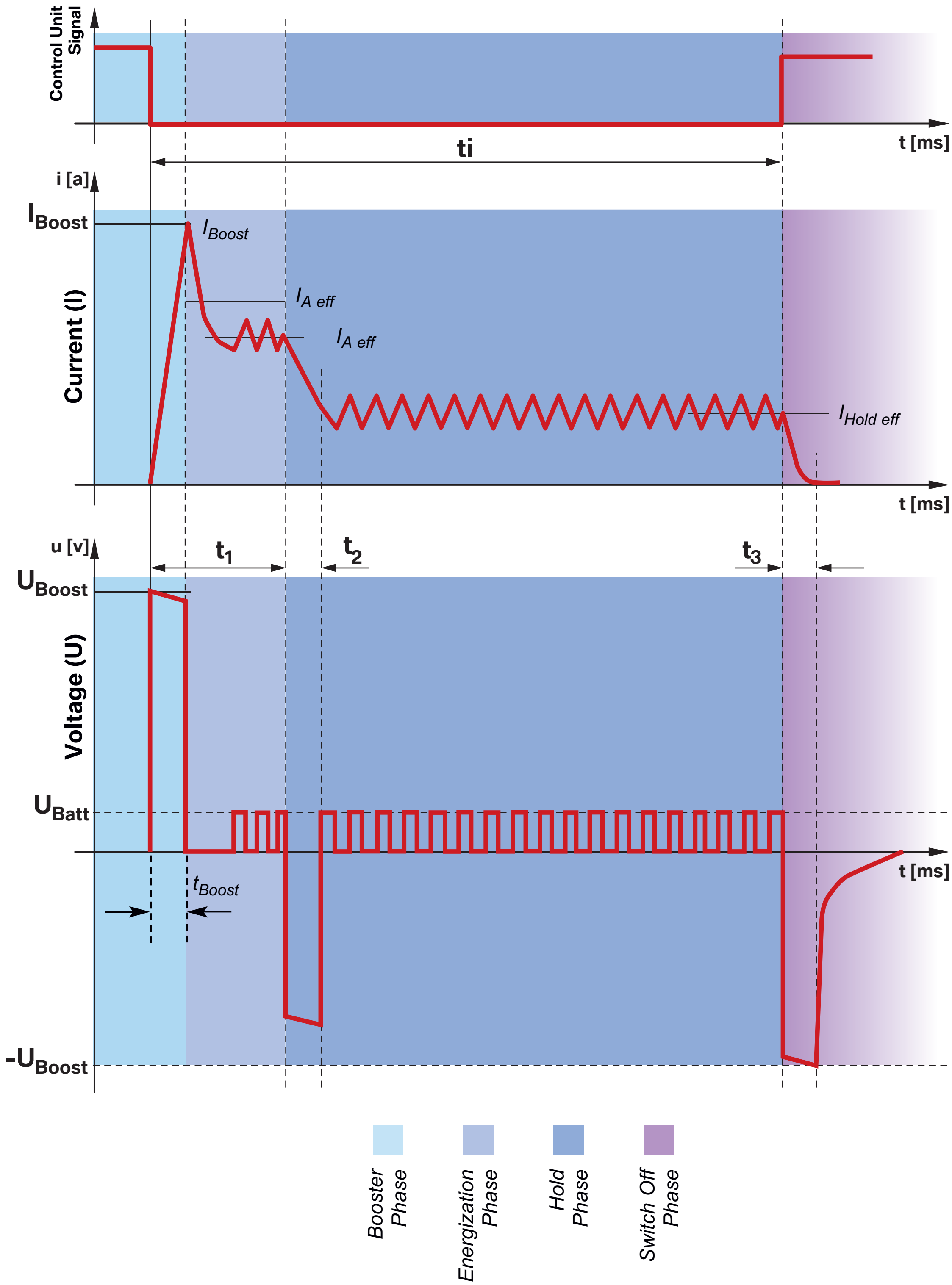
Current Profiles for HDEV5.2 driving

A target current profile must be provided for opening and holding the HDEV5.2 open. Depending on the fuel system, the system pressure may vary. The current profiles are defined for several system pressures in order to keep the power dissipation low.

General injector data

- *Ohmic resistance of HDEV 5.2 at 23°C (73°F): 1.5Ω ± 5%.*
- *Inductance: L = 2.1mH (typical value, not specified with tolerances) at 1 KHz measurement frequency.*

Actuation phases of the HDEV5.2 injector



Tolerances HDEV5.2		
Index	**Description**	**Tolerances**
t_i	Injection time	-
U_{Boost}	Booster voltage at the beginning of an injection	+/- 3V
$t_{Boost\ max}$	Maximum booster time; should not be exceeded even at high temperatures and low booster voltage	-
I_{Boost}	Booster current	+/- 10%
t_1	Duration of Booster phase together with pickup (energization) phase	+/-2µs
$I_{A\ eff}$	Effective pickup (energization) current	-10% / + 20%
t_2	Transition time between pickup (energization) current and holding current	-
$I_{Hold\ eff}$	Effective holding current	+/- 10%
$I_{hys\ max}$	Maximum hysteresis at current control	-
$U_{discharge}$	Voltage needed for discharging holding current to zero	-2V

NOTES

Pressure	Index	Static Flow Rate (Qstat) [cm³/s]		
		13.5	**17.5**	**22.5**
	ti	**According to operating point**		
for P_{max} = 22MPa (e.g. normal operation mode)	U_{Boost}	65V	65V	65V
	$t_{Boost\ max*}$	410µs	430µs	430µs
	I_{Boost}	10.5A	11.5A	11.5A
	t_1	640µs	640µs	640µs
	$I_{A\ eff}$	5.8A	6.2A	6.2A
	t_2	<50µs	<50µs	<50µs
	$I_{Hold\ eff}$	2.8A	2.8A	3.1A
	$I_{hys\ max}$	1.2A	1.2A	1.2A
	$U_{discharge}$	U_{Boost}	U_{Boost}	U_{Boost}
for P_{max} = 27MPa (e.g. at opening pressure of pressure relieve valve)	U_{Boost}	65V	65V	65V
	$t_{Boost\ max*}$	**430µs**	430µs	**440µs**
	I_{Boost}	**11.5A**	11.5A	**12A**
	t_1	**704µs**	**704µs**	**704µs**
	$I_{A\ eff}$	**6.1A**	**6.1A**	**6.8A**
	t_2	<50µs	<50µs	<50µs
	$I_{Hold\ eff}$	**3.1A**	**3.1A**	3.1A
	$I_{hys\ max}$	1.2A	1.2A	1.2A
	$U_{discharge}$	U_{Boost}	U_{Boost}	U_{Boost}
for P_{max} = 29.5MPa (e.g. at limp home mode full delivery)	U_{Boost}	65V	65V	65V
	$t_{Boost\ max*}$	430µs	**440µs**	**460µs**
	I_{Boost}	11.5A	**12A**	**13A**
	t_1	704µs	704µs	704µs
	$I_{A\ eff}$	**6.6A**	**6.8A**	**7.1A**
	t_2	<50µs	<50µs	<50µs
	$I_{Hold\ eff}$	3.1A	3.1A	**3.4A**
	$I_{hys\ max}$	1.2A	1.2A	1.2A
	$U_{discharge}$	U_{Boost}	U_{Boost}	U_{Boost}

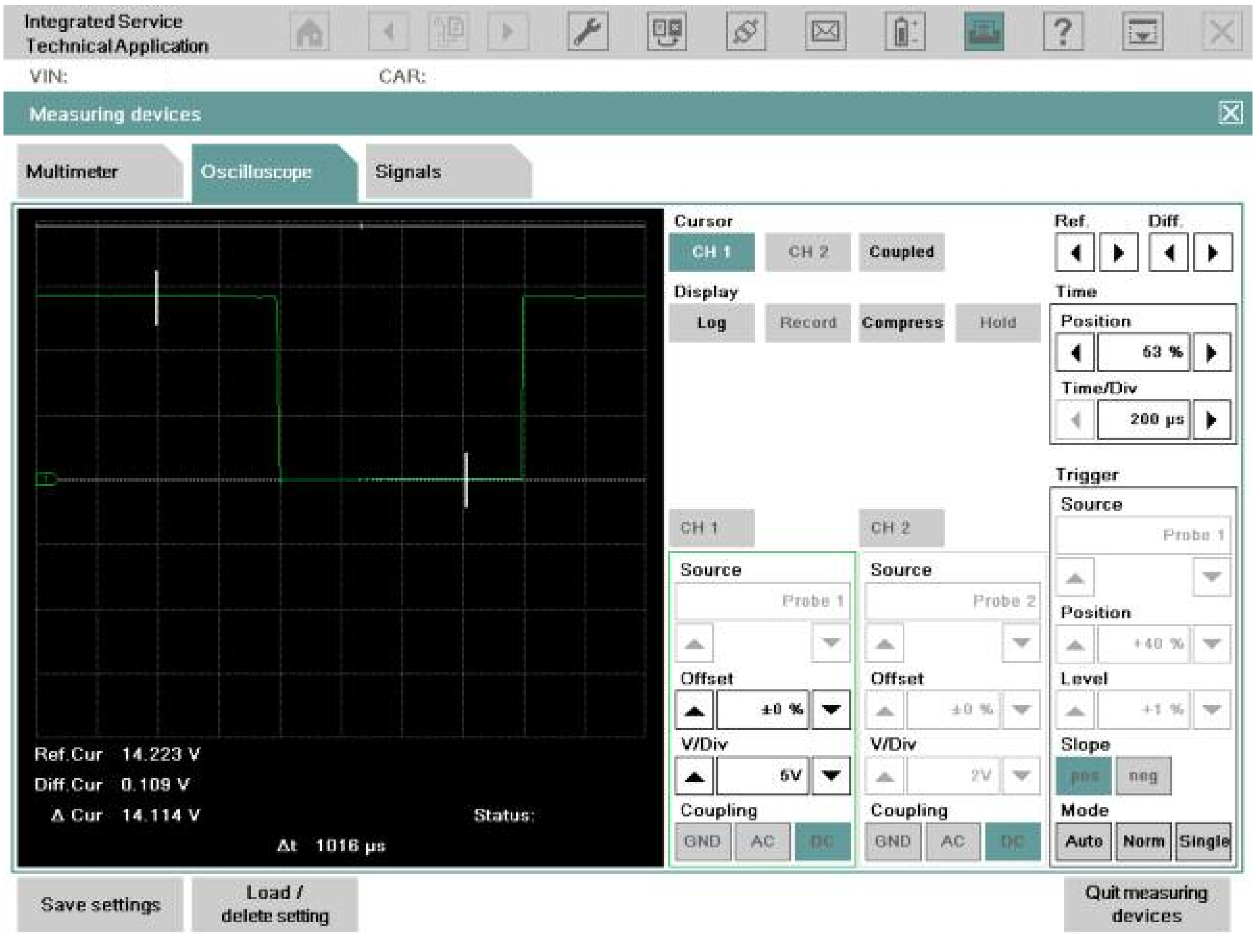
Bolded data = **data change from previous operating pressure.**

$t_{Boost\ max*}$ = **should not be exceeded even at high temperatures and low boost voltage (for typical injector and I_{Boost} given above).**

Injection Signal - HPI Outward-opening Piezo-injectors

Workshop Hint
The shown scope image illustrates the voltage across an HPI injector. This is the main injection signal and you can see that it is activated by more than 100V. *Measuring voltage across the injector is a good way to determine whether an injector is actually being activated.*

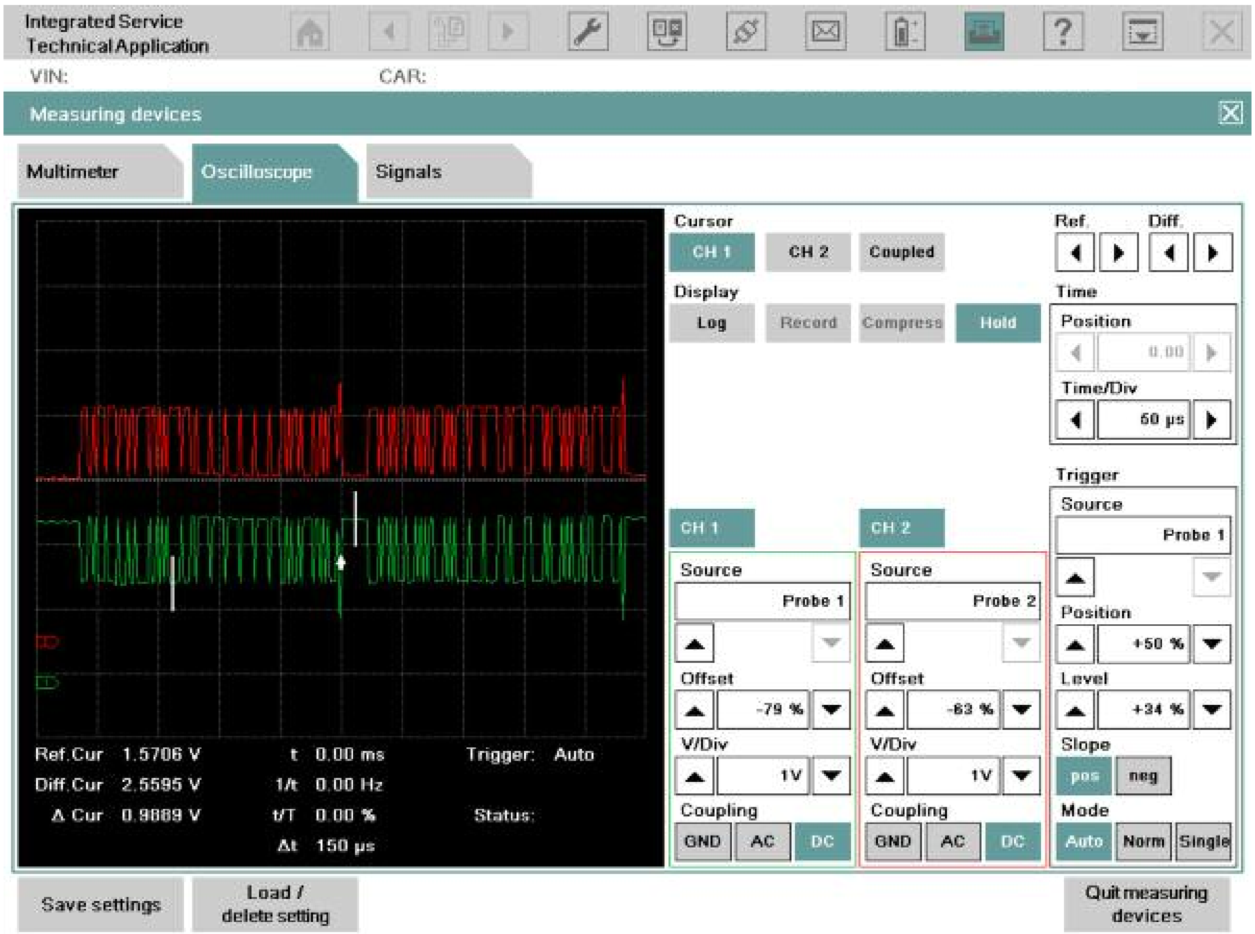
Oil Volume Control Valve (N18)



Workshop Hint
This pattern was captured at the DME utilizing a 200 microseconds snapshot.   *Once again, the added value of scoping this signal is that we can look at the power supply to the control valve noted at 14.223 volts before the solenoid is activated. We can also confirm that the final stage and ground at the DME are working accordingly since the actuated value is around 100 mV.*

The actuation of this control valve is dependent on many parameters and we can't determine that the ON time meets the engines demands. We would need to compare that to another known good vehicle if that was needed.

PT-CAN Low



Workshop Hint
This is a sample of PT-CAN Low.
Base voltage starting @ 2.559V (binary 0) and pulling down to 1.571V (binary 1). The amplitude of this bus, as far as the IMIB, is dependent on the time base you use. Anything greater than 50 microseconds, as seen here, may display a voltage value that would be inaccurate. Utilizing smaller values, i.e. 100 or 200 microseconds, would allow you to look at more details and less bits. That is acceptable and sometimes recommended. You'll note the anomaly in the center and end of the screen. This is quite normal and doesn't always represent a problem.
Also note that images are mirrors of each other. Differences in voltage and bits of data as compared to each other are considered to be a problem. Always use the basic bus diagnosis troubleshooting techniques for any CAN or single wire bus faults or errors.

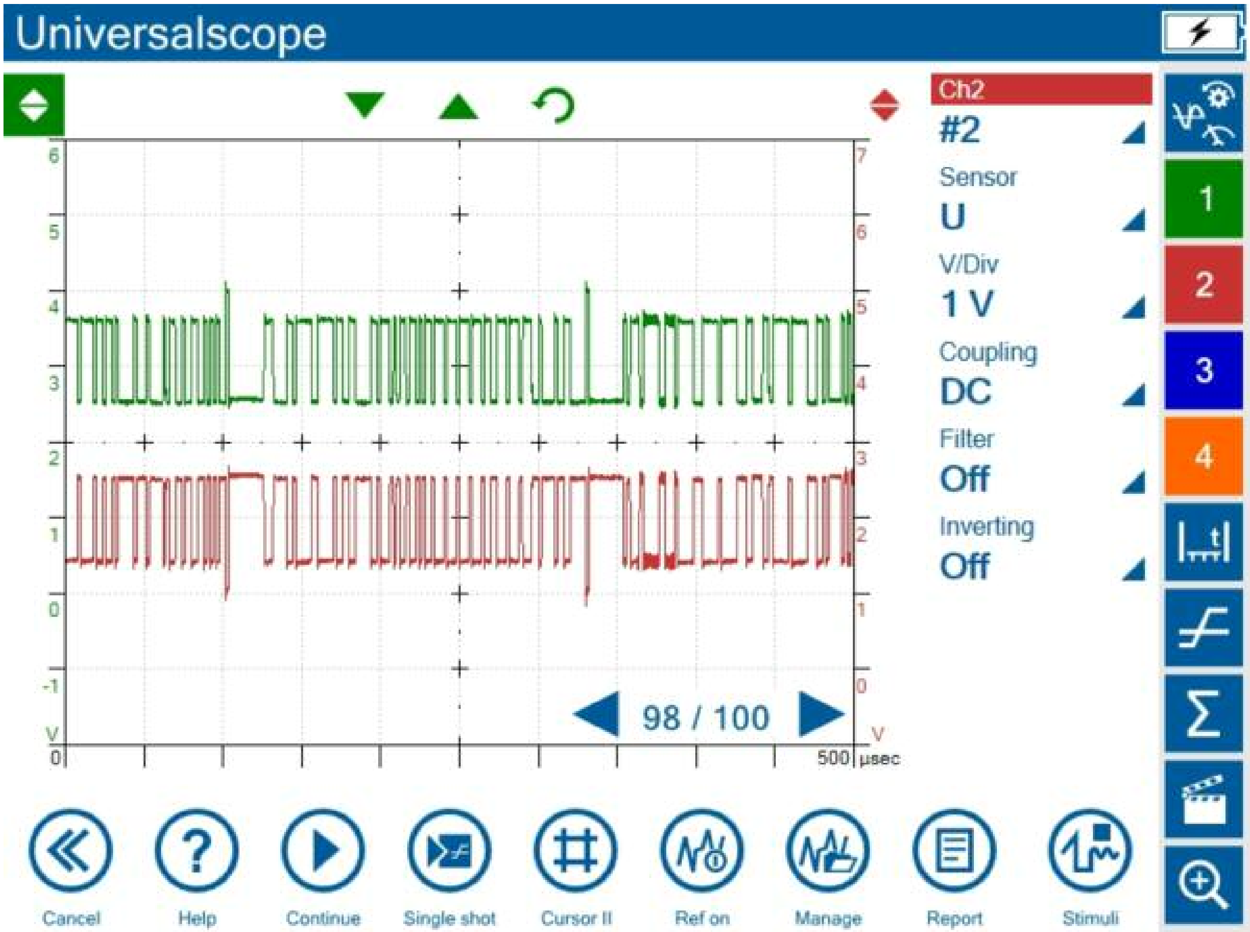
TIME SETTINGS ARE PARAMOUNT!

PT-CAN High

Workshop Hint
This is a sample of PT-CAN High. Please read PT-CAN Low for more details.   *This sample was taken @ 20 microseconds. The bus voltage will be accurate at this time base. The default time base will not give the same details and may give inaccurate voltage amplitude.*

TIME SETTINGS ARE PARAMOUNT!

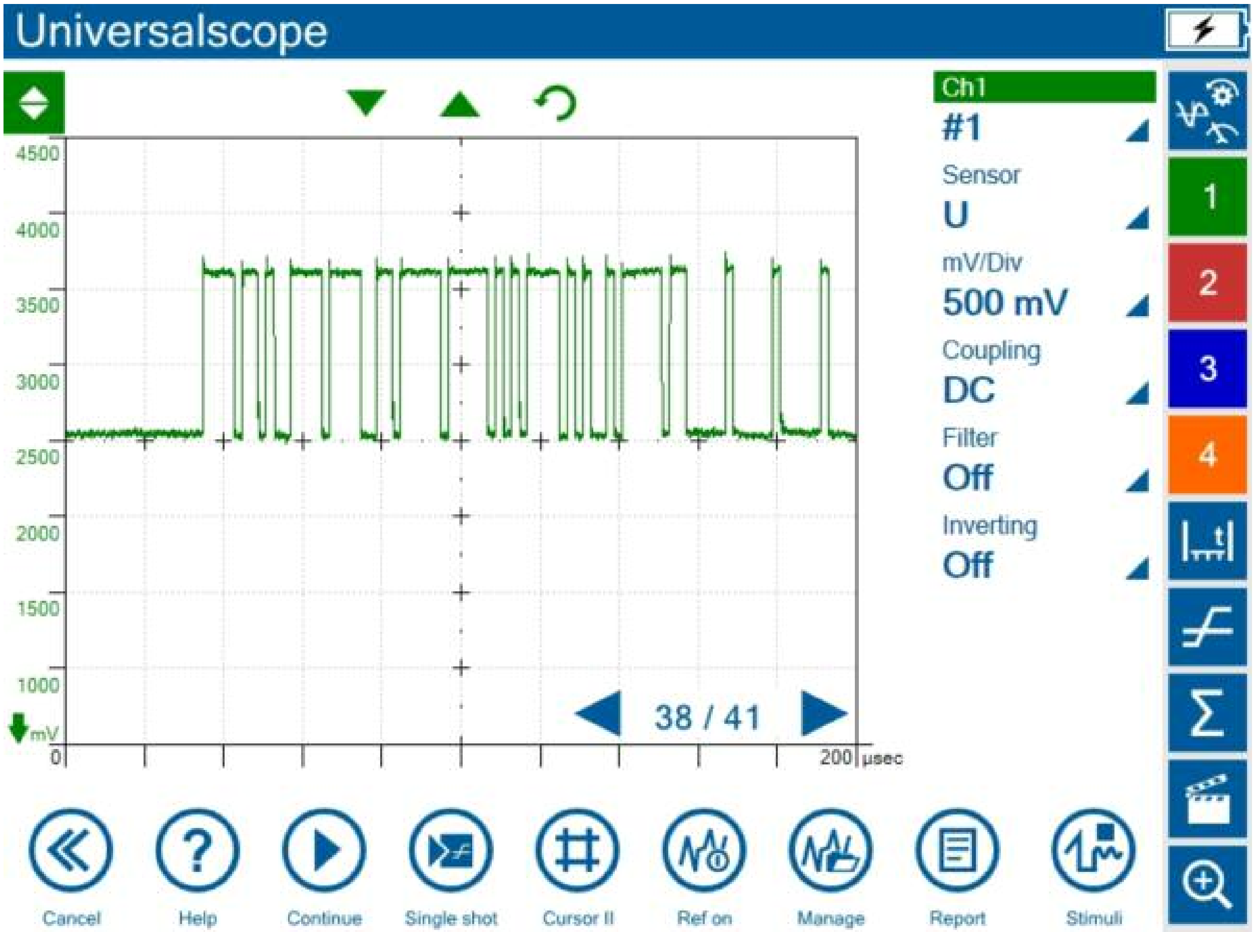
PT-CAN Low - Standalone



Workshop Hint
This is a sample of PT-CAN Low. *Base voltage starting @ 2.559V (binary 0) and pulling down to 1.571V (binary 1). The amplitude of this bus, as far as the IMIB, is dependent on the time base you use. Anything greater than 50 microseconds, as seen here, may display a voltage value that would be inaccurate. Utilizing smaller values, i.e. 100 or 200 microseconds, would allow you to look at more details and less bits. That is acceptable and sometimes recommended. You'll note the anomaly in the center and end of the screen. This is quite normal and doesn't always represent a problem.* *Also note that images are mirrors of each other. Differences in voltage and bits of data as compared to each other are considered to be a problem. Always use the basic bus diagnosis troubleshooting techniques for any CAN or single wire bus faults or errors.*

TIME SETTINGS ARE PARAMOUNT!

PT-CAN High - Standalone



Workshop Hint
This is a sample of PT-CAN High. Please read PT-CAN Low for more details. *This sample was taken @ 20 microseconds. The bus voltage will be accurate at this time base. The default time base will not give the same details and may give inaccurate voltage amplitude.*

TIME SETTINGS ARE PARAMOUNT!

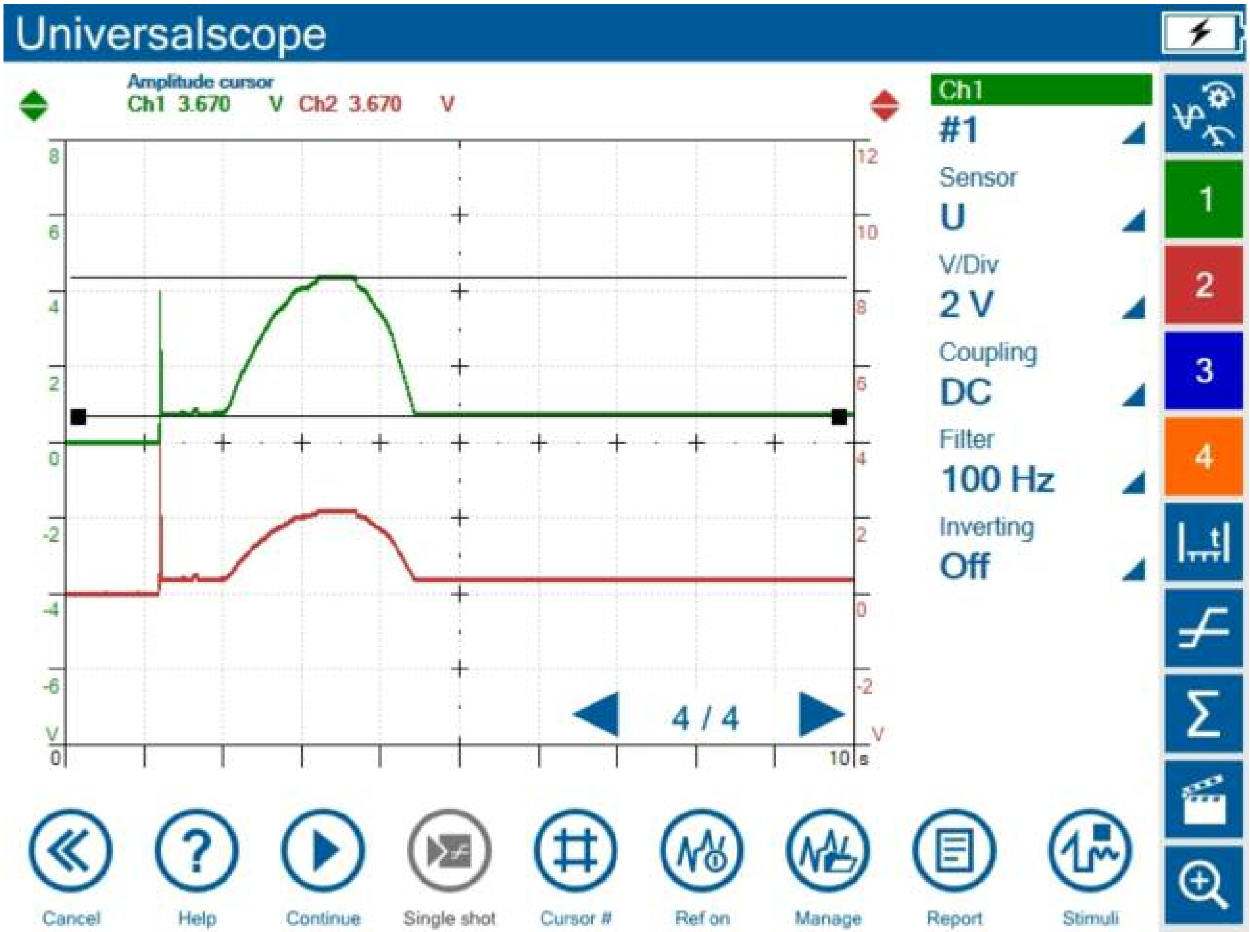
PT-CAN Shorted

Workshop Hint
PT-CAN lines shorted together. *Note that the voltage is around 2 volts and the attempt to communicate is repetitive. Also important is the fact that the binary voltage thresholds are not being met.*

PWG Signal

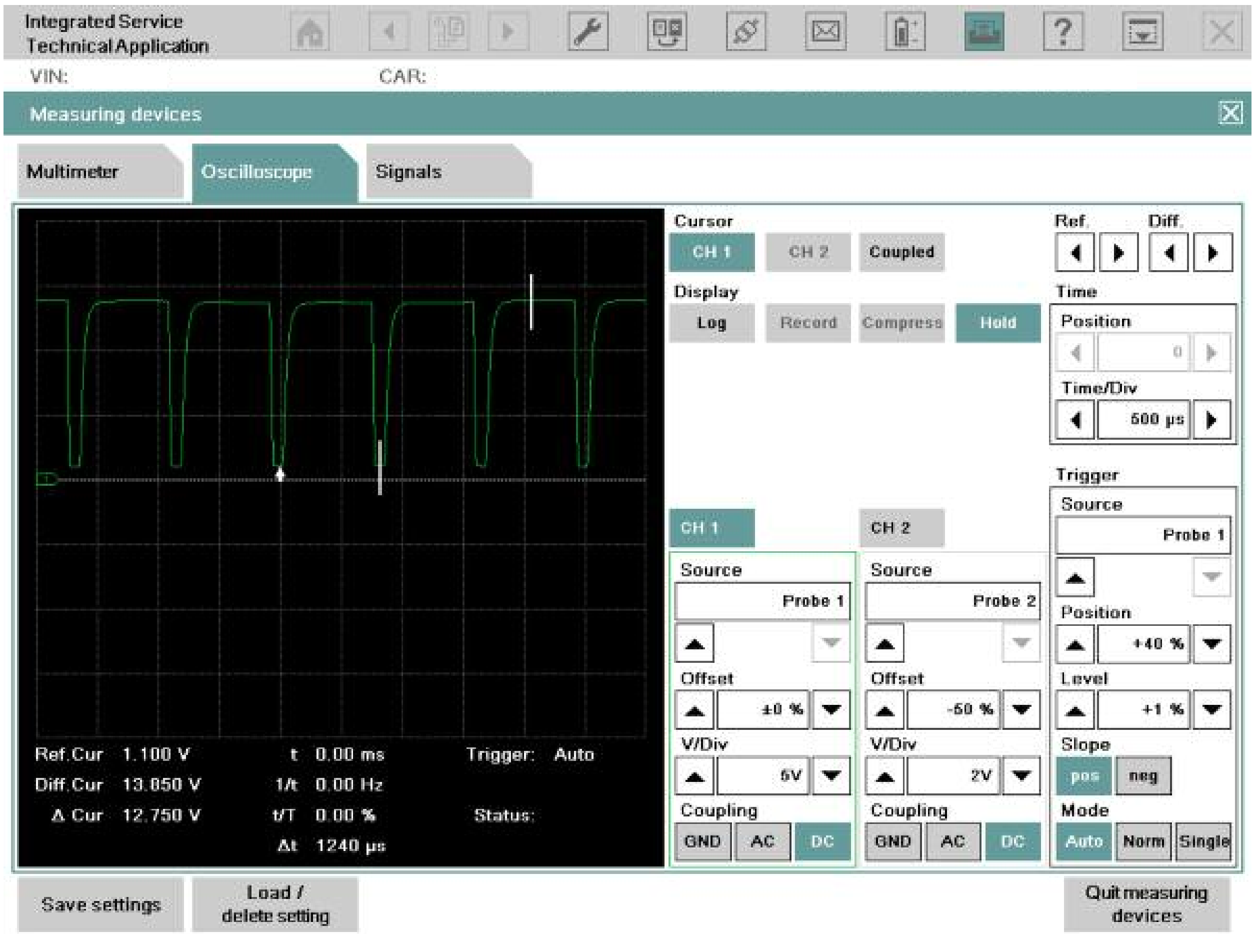
Workshop Hint
Here is an example of an analog input from the PWG (Pedalwertgeber or Pedal Position Sensor) to the DME.   *The advantage of scoping this signal (Hall elements in this case) is that you can check it for irregularities. The scope pattern should mirror each other (although one of the signals is ½ the voltage) and any glitches from unsteady actuation would be present on the other sensor. Otherwise these momentary faults would be overlooked unless you scope them.*   *The time base should be slow so the recorded signal can be analyzed.*

PWG Signal - Standalone



Workshop Hint
Here is an example of an analog input from the PWG (Pedalwertgeber or Pedal Position Sensor) to the DME.   *The advantage of scoping this signal (Hall elements in this case) is that you can check it for irregularities. The scope pattern should mirror each other (although one of the signals is ½ the voltage) and any glitches from unsteady actuation would be present on the other sensor. Otherwise these momentary faults would be overlooked unless you scope them.*   *The time base should be slow so the recorded signal can be analyzed.*

VANOS Signal

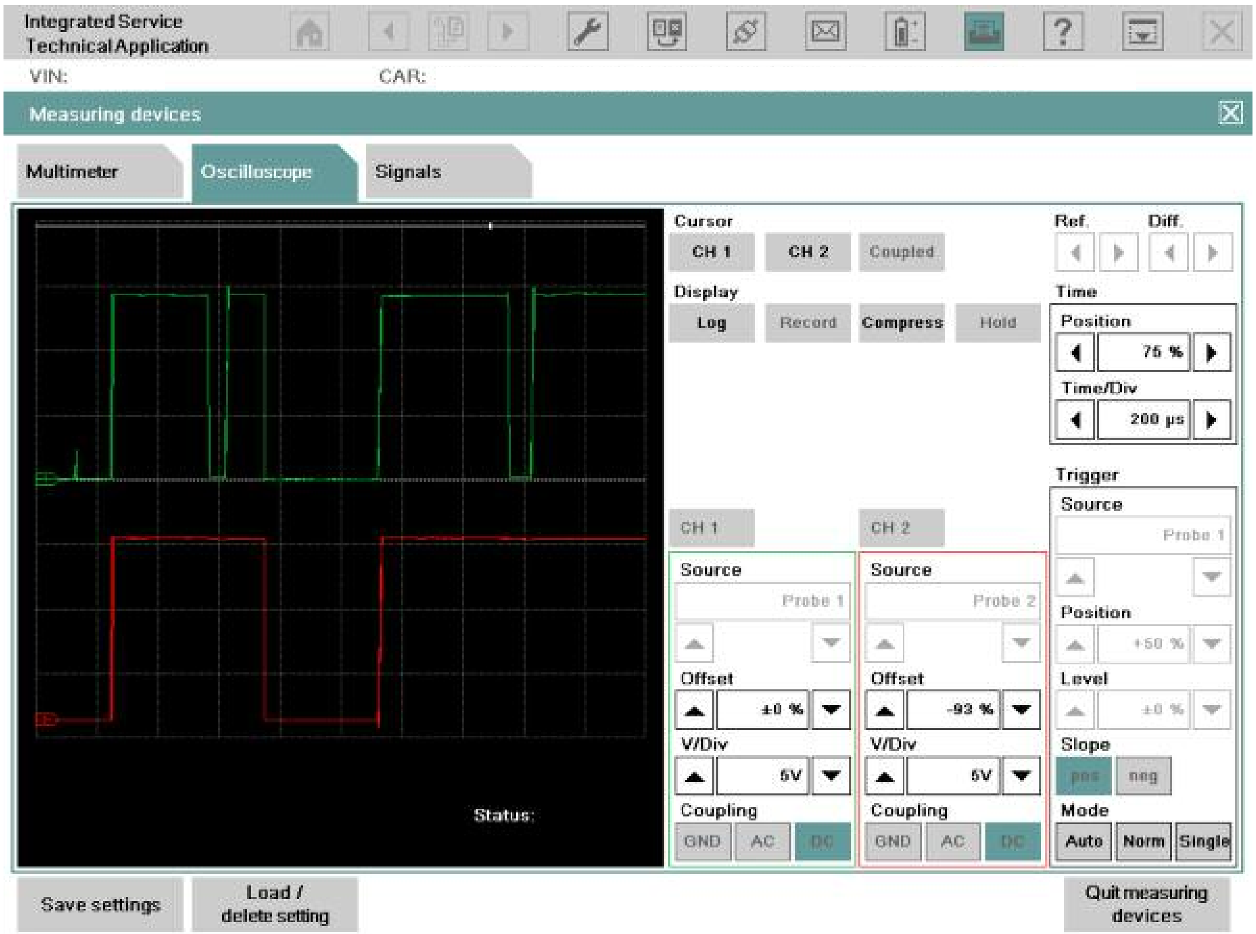


Workshop Hint

Here is an example of a VANOS solenoid that is fed 12 volts and is awaiting a ground from the DME's transistor in order to actuate the valve to open. The pattern shows a credible voltage awaiting @ the DME and a circuit to ground assuring the solenoid windings are good and the circuit is complete.

The ground is acceptable since the voltage when actuated is @ 167 mV.

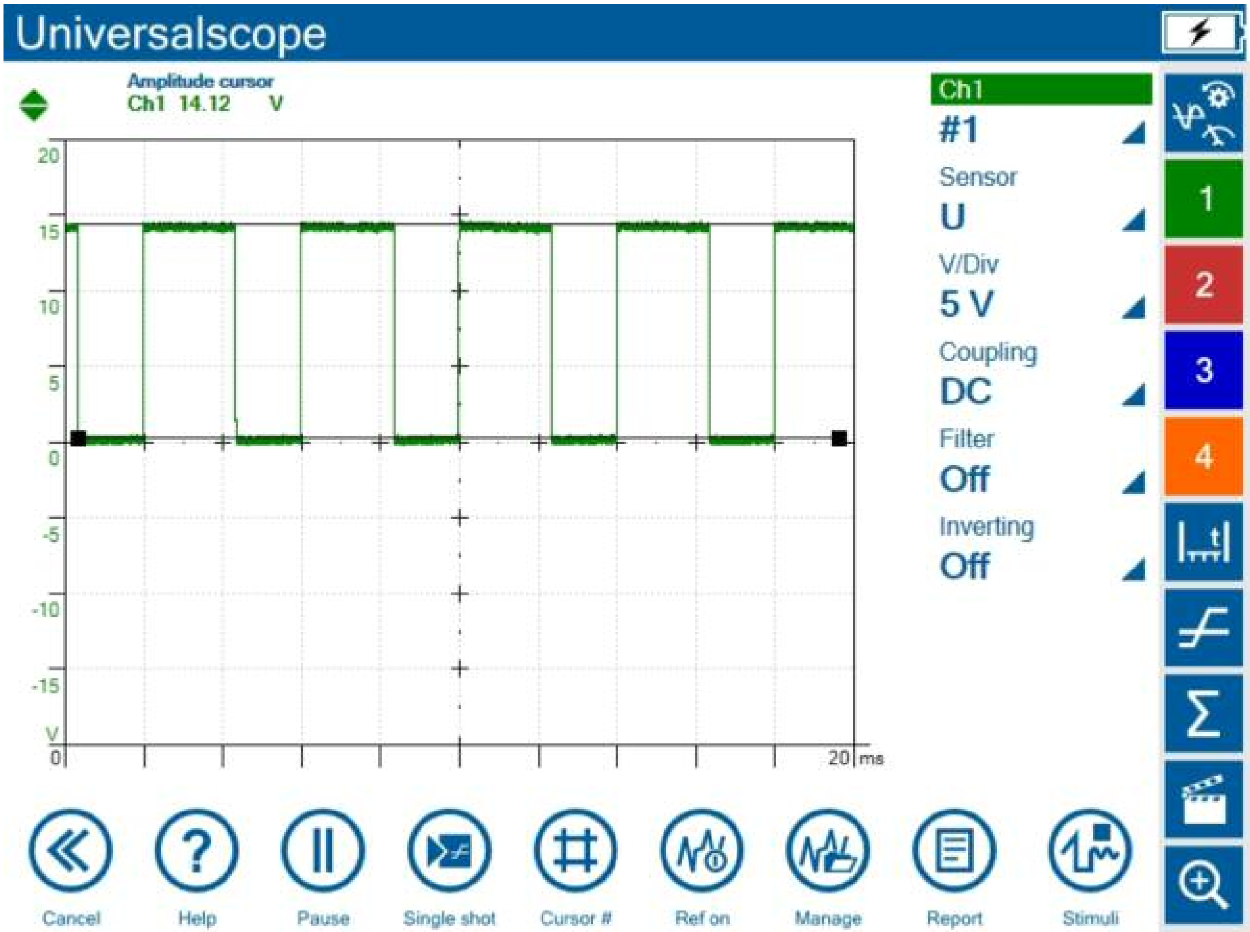
VALVETRONIC (Single Phase Motor)



Workshop Hint
This is a snapshot of the VVT motor with IMIB B+ leads in the leads to the 2 wires feeding the motor from DME and the B- wires on the chassis ground.   *Note that there is activity on both lines for VVT control and position.*

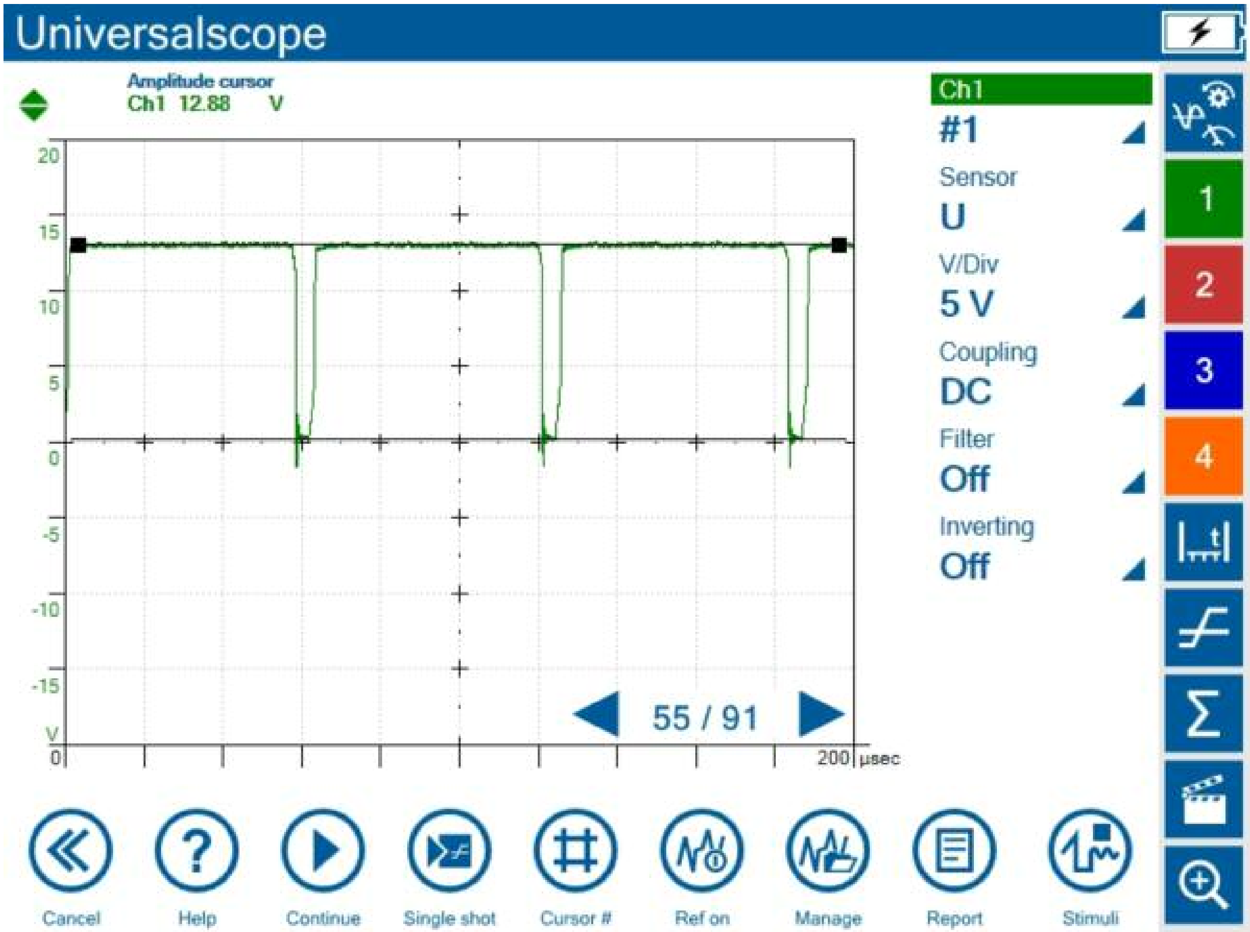
Single Phase VVT Motors are utilized in VALVETRONIC I and II.

VANOS Signal - Standalone



Workshop Hint
Here is an example of a VANOS solenoid that is fed 12 volts and is awaiting a ground from the DME's transistor in order to actuate the valve to open. The pattern shows a credible voltage awaiting @ the DME and a circuit to ground assuring the solenoid windings are good and the circuit is complete.

VALVETRONIC (3 Phase Motor) - Standalone



Workshop Hint
This screen shot is from one phase (BLDC_V) of the VVT motor with reference to ground at KL_31 @ the DME. Each of the 3 field windings in the VVT motor (U, V and W) have a current applied to them in a synchronous fashion. This will create a magnetic field at that winding and the VVT motor armature which has permanent magnets in it and in turn repel or attract the magnets in order to rotate.

VALVETRONIC (3 Phase Motor)

Workshop Hint

This screen shot is from one phase (BLDC_V) of the VVT motor with reference to ground at KL_31 @ the DME. Each of the 3 field windings in the VVT motor (U, V and W) have a current applied to them in a synchronous fashion. This will create a magnetic field at that winding and the VVT motor armature which has permanent magnets in it and in turn repel or attract the magnets in order to rotate.

If one phase were to have an open wire, winding or lack of voltage, the magnetic field in that phase (120 degrees) would not be created and the motor, in theory, would only be able to cover the other 240 degrees. The reality is it would be faulted and cease to move.

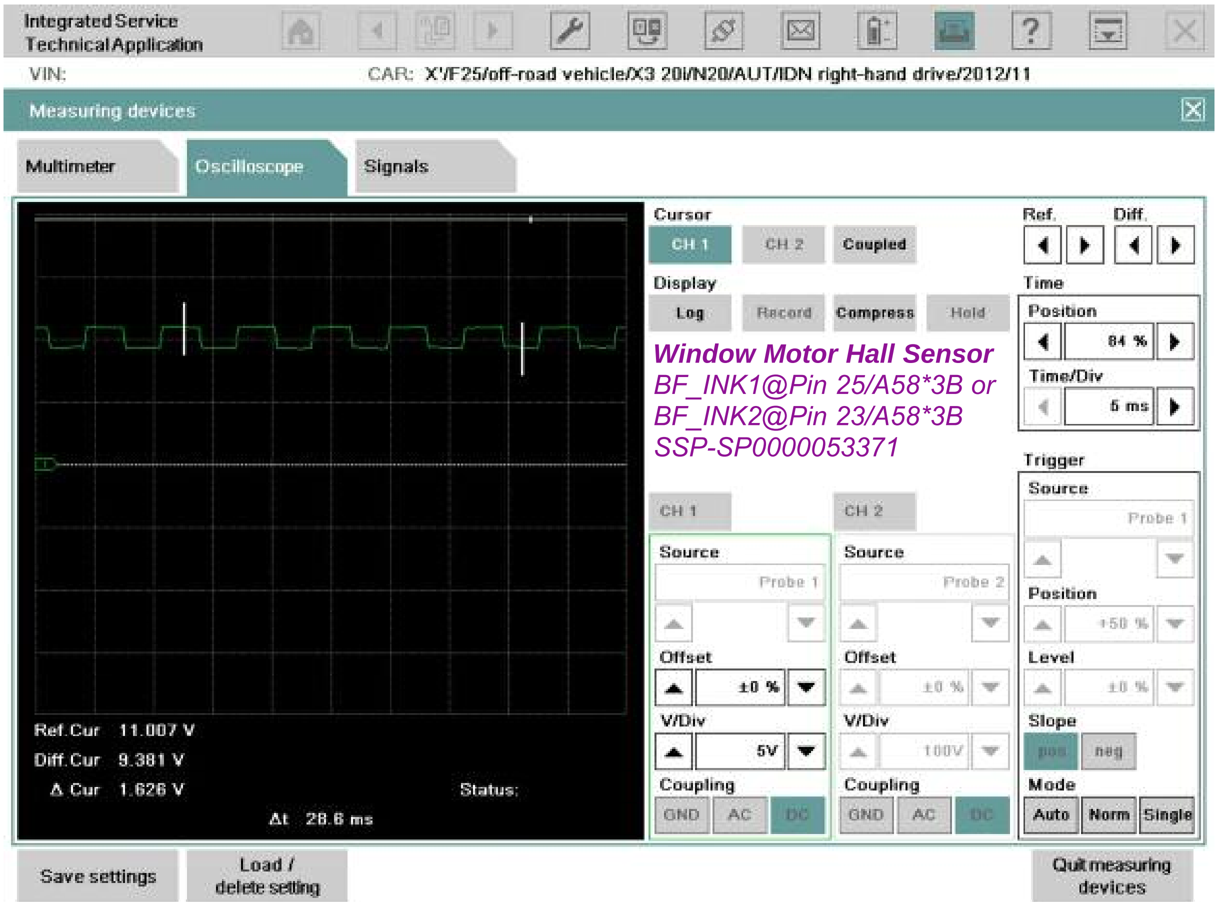
The voltage amplitude created at these windings is approximately between 7 and 14 volts as displayed in the example.

NOTES PAGE

Body Signals

Power Windows

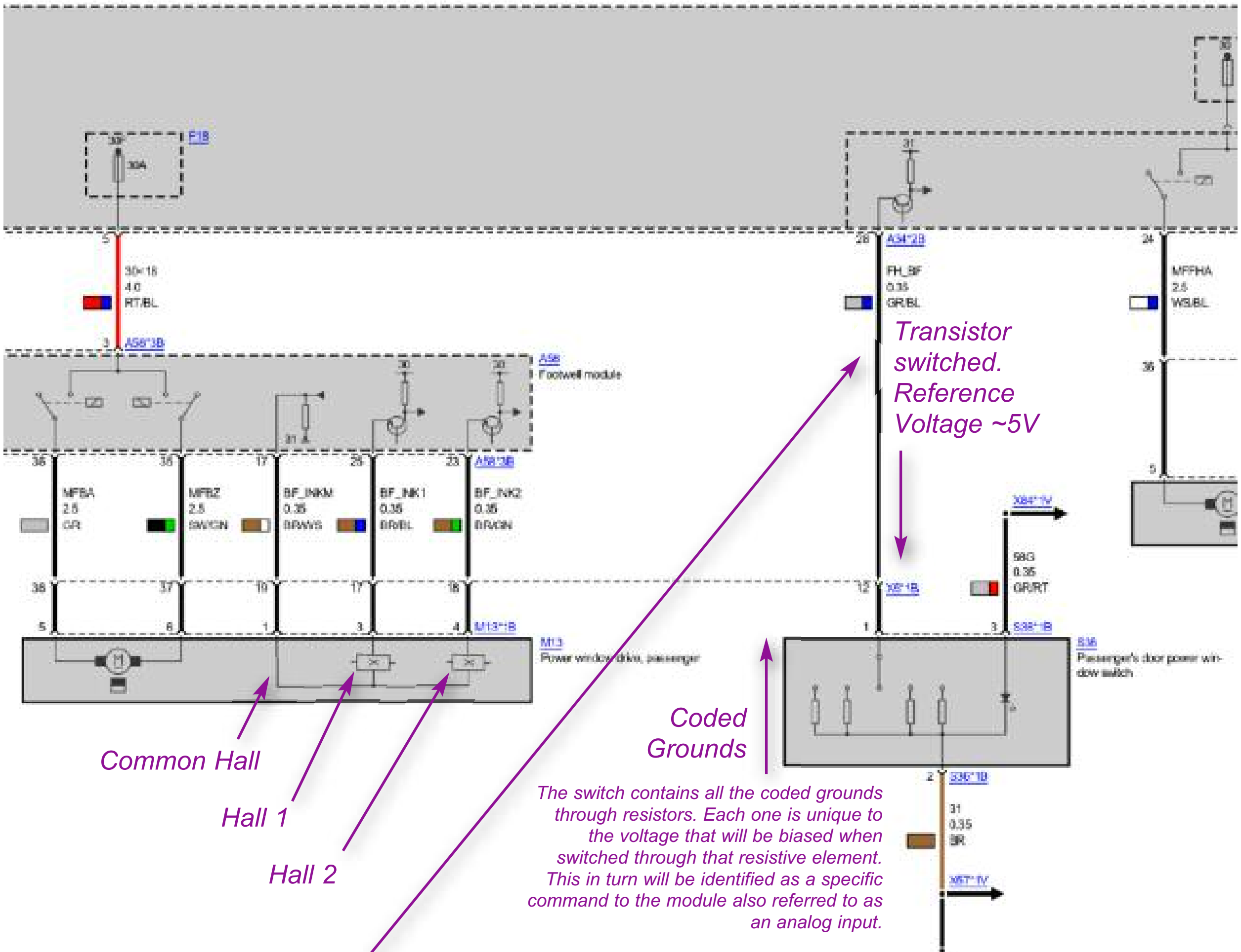
Motor Hall Sensor (F25)



Workshop Hint
*This oscilloscope pattern is showing a **Window Motor Hall Element**, used to monitor speed and uniformity. This particular graphic describes a good motor as it shows a synchronous pattern. If you were to scope one that showed changes that are NOT synchronous, it would indicate a change of speed due to a mechanical issue e.g. something trapped between the glass etc.* *Binary values for this signal are reported to the Master Controller, in this case the FRM. Binary 1 and 0 are ~11007 mV and ~9381 mV.* *Remember, when in doubt always compare the value to another "good" window motor so you have a reference!*

The measurement was done @ BF_INK1 or BF_INK2 to KL_31, SSP-SP0000053371 – Power Window (F25). See the SSP with some notes on the next page.

SSP-SP0000053371 - Power Window (F25)



FRM input signal FH_BF@Pin28/A34*2B:

Momentary up = ~4100 mV
This analog value on the DVOM is a request for momentary up or movement of the glass window as long as the switch is held to the first detent position. Once released, the glass will stop moving. Here the bias voltage is skewed by the switch through a resistor network to 4100 mV.

The DVOM is a perfect tool for this analog data!

Toll up = ~3256 mV
This analog value created by the coded ground (resistive device in the switch) biases the reference voltage to a specific value, is a request for toll up to the control module.

Momentary down = ~2092 mV
This coded value is an analog signal requesting the control module to actuate the window to move as long as the switch is held. It's a request for momentary down.

Toll down = ~927 mV
This analog value created by the coded ground (resistive device in the switch) biases the reference voltage to a specific value, is a request for toll down to the control module.

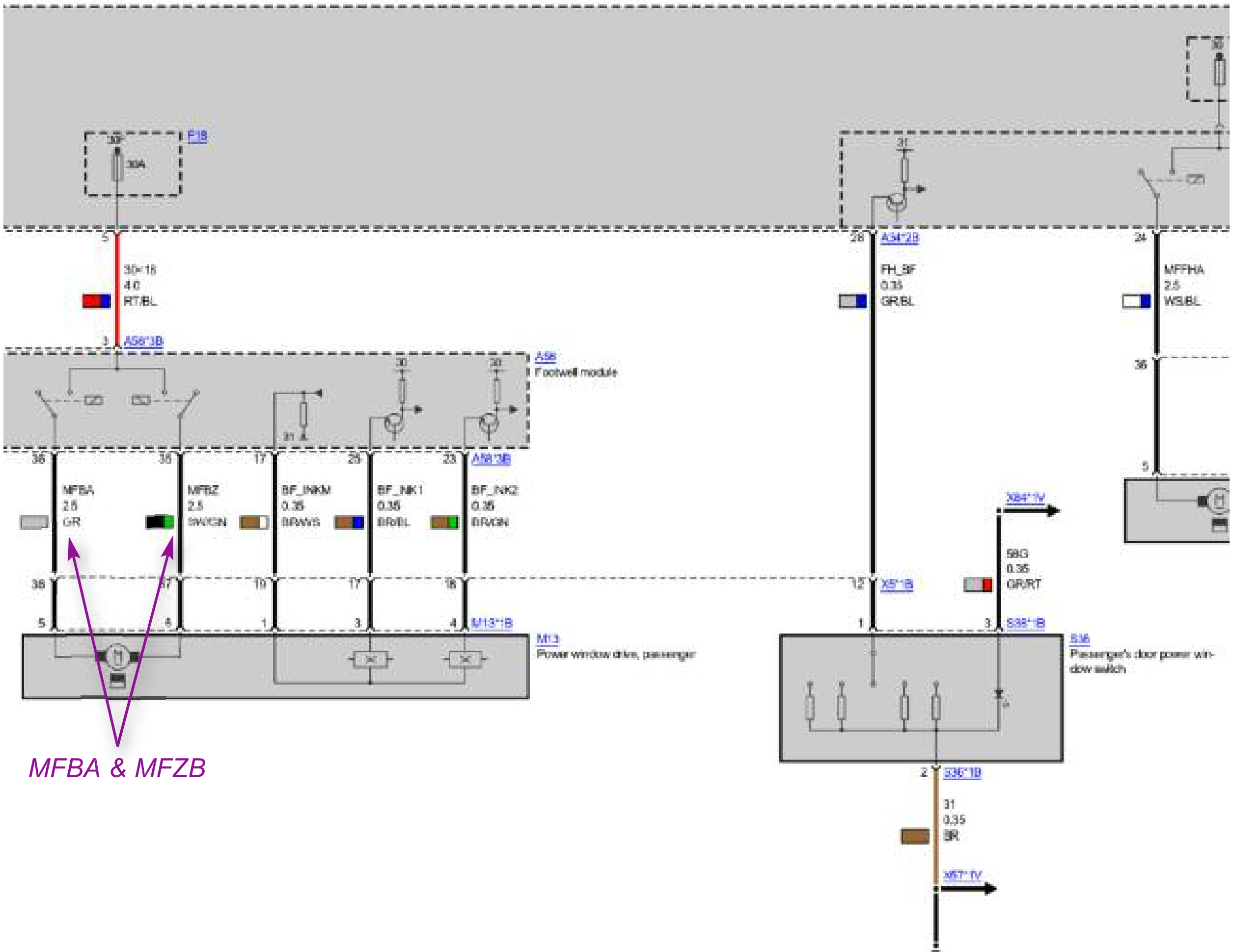
Static "N" = ~4969 mV
Static Neutral position. Here is the bias voltage coming from the FRM and not influenced by the switch. This is verification that the FRM is providing the reference voltage to the coded ground/switch. If we had no voltage or too much potential at this pin, we would never be able to create the analog signal to request the commands required.

Window Motor End Travel

Workshop Hint
*This oscilloscope pattern shows the "erratic" signal voltage applied to the **window motor near its end travel**. The Control Unit does this to "soft stop" the motor and prevents it from "banging". If you take a closer look at the scope pattern you can see that it is showing battery voltage and credible ground applied from the master controller. The cursors could be moved to these points to establish that there are no voltage drops (Vd) under operation conditions on both B+ and B- coming from the control unit. This avoids unnecessary Vd tests. A picture speaks a million words!*
Please note that the peak voltage denoted on the reference cursor (left) is a spike due to the internal driver shutting ON and OFF.

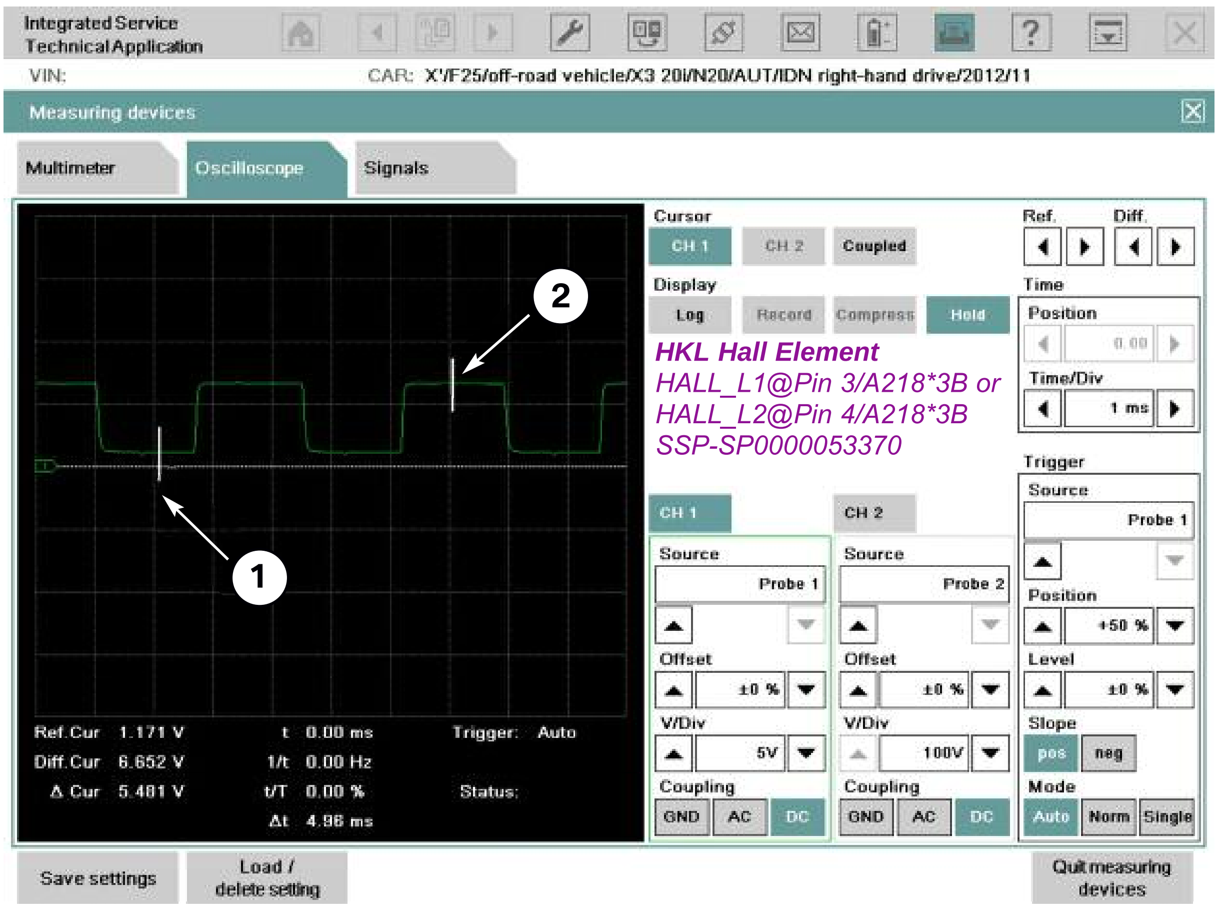
The measurement was done @ MFBA or MFBZ to KL_31, SSP-SP0000053371 – Power Window (F25).
See the SSP with some notes on the next page.

SSP-SP0000053371 - Power Window (F25)



Automatic Tailgate Actuation - HKL

HKL Hall sensor



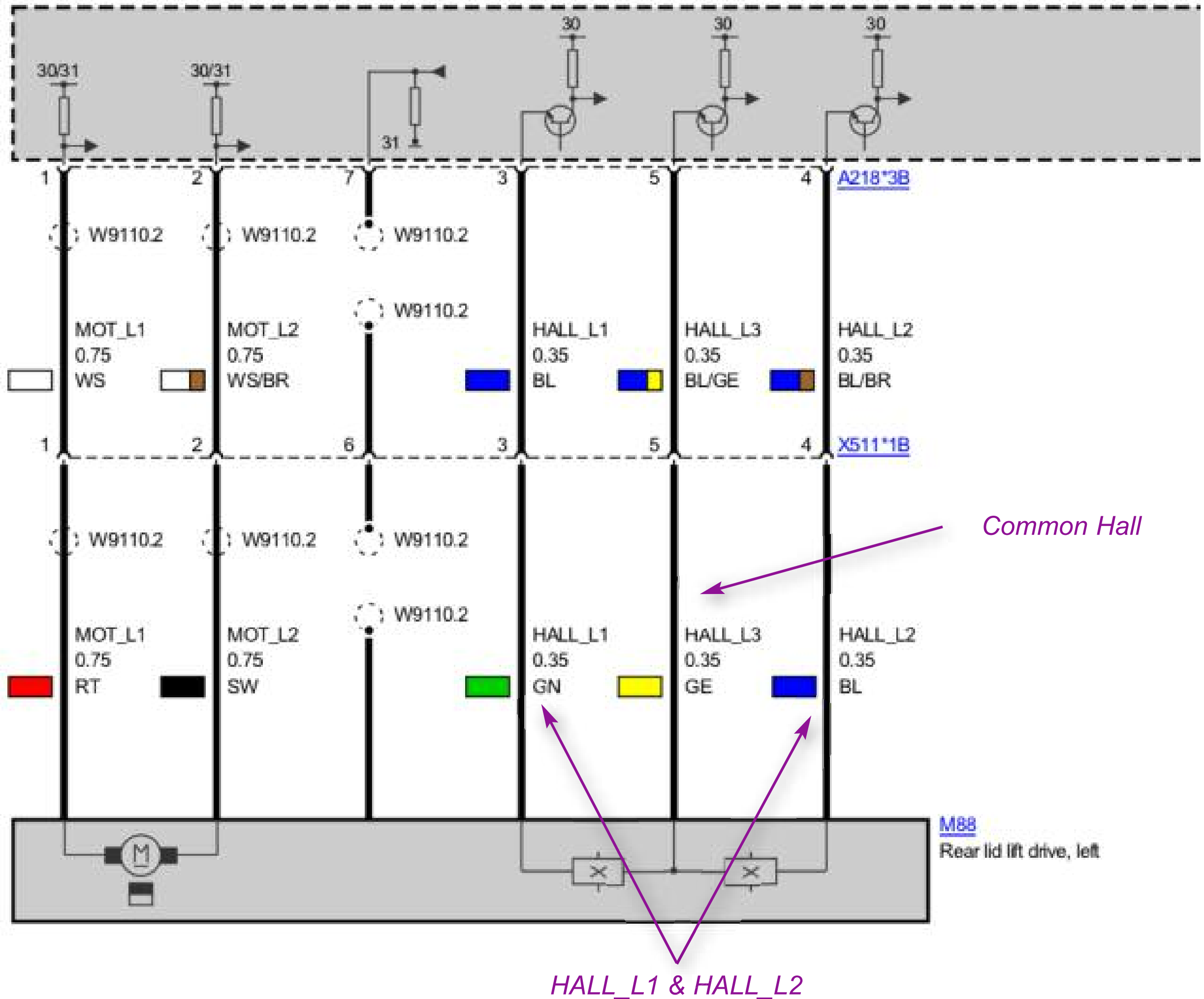
Workshop Hint

(1) *The hall element digital signal low for this application is ~1171 mV. The consistency of this signal can be compared to the other signals on this screen (all of them go to ~1171 mV). You can also view more cycles by changing the time base to 5 or 10 ms.*
Remember, the digital "handshake" requires a voltage level to be established, not just a signal that "looks good".

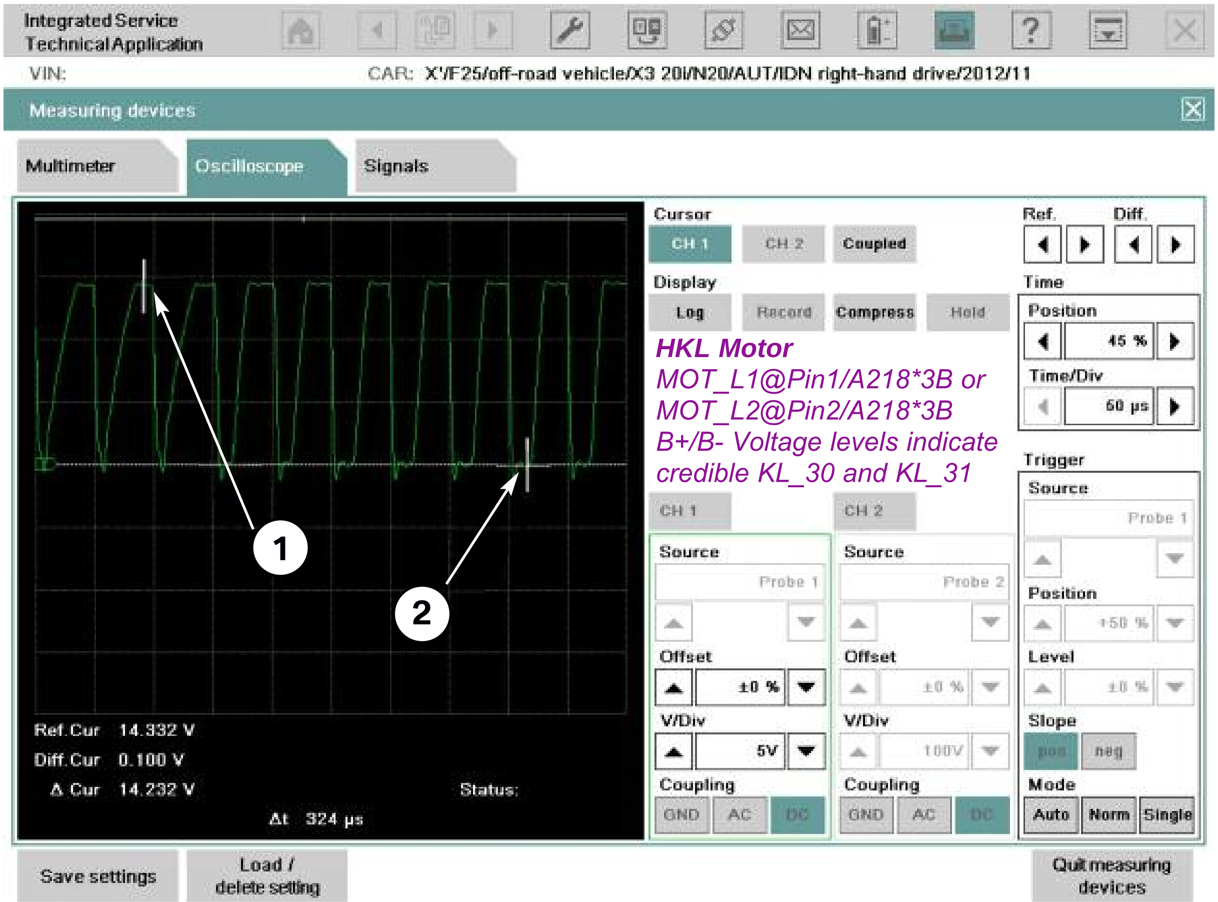
(2) *The hall element digital signal high is ~6600 mV. See (1) for hints.*

The measurement was done @ HALL_L1 or HALL_L2 to KL_31
SSP-SP0000053370 – Boot lid lift (F25).
See the SSP with some notes on the next page.

SSP-SP0000053370 - Boot lid lift (F25)



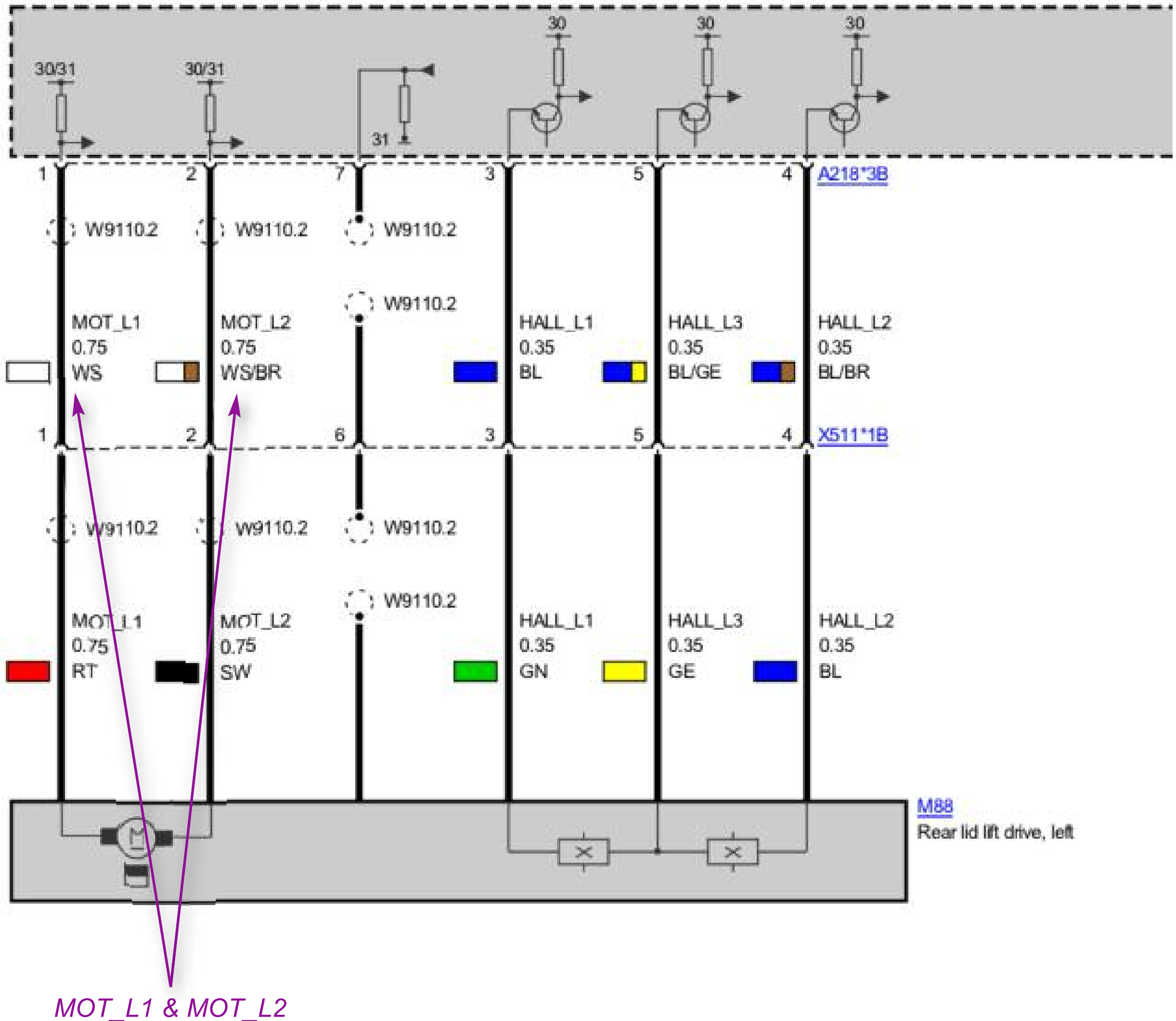
HKL Motor



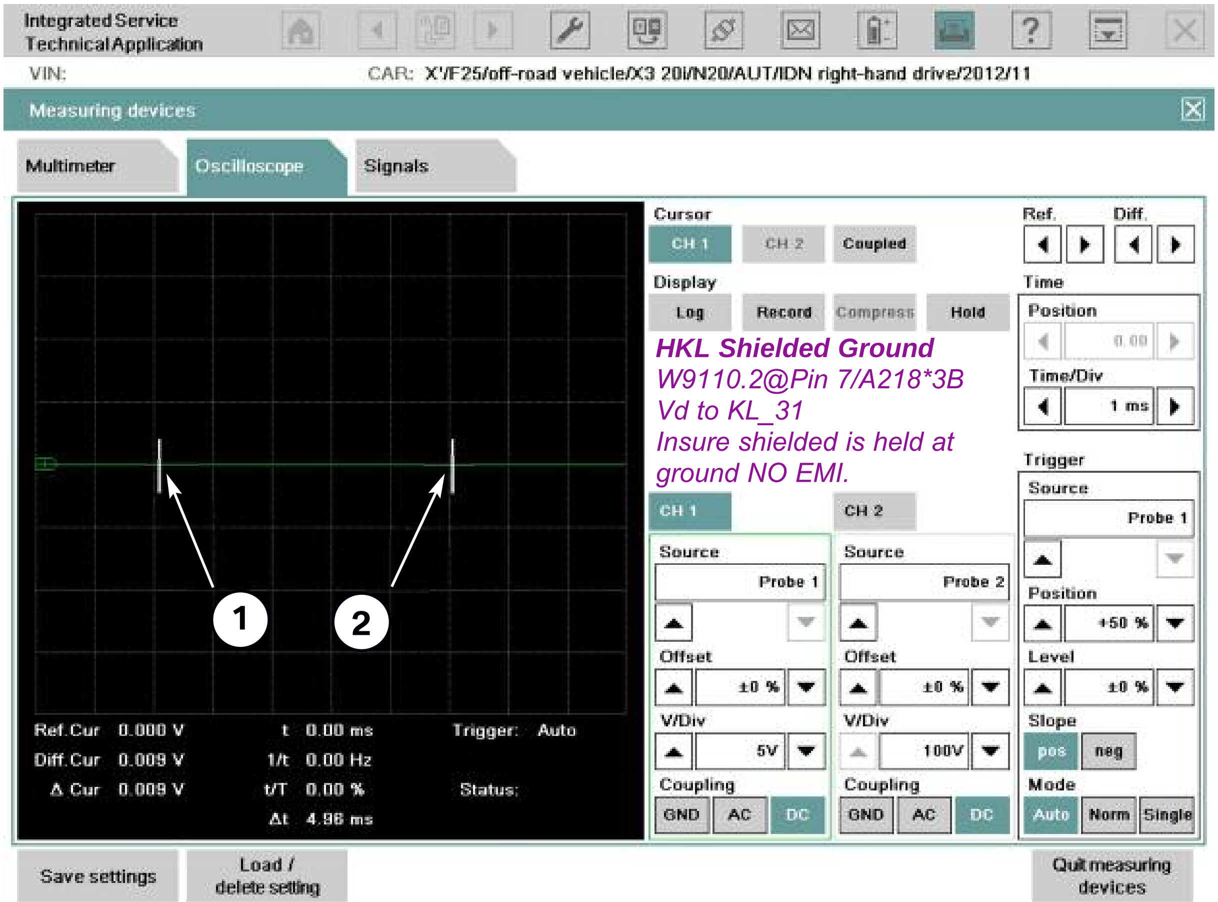
Workshop Hint
(1) *This pattern shows the positive voltage applied to the DC motor. The Reference Cursor shows 14.33 V which would conform that the B+ side of the circuit has no concerns. A voltage drop test at that wire or the driver itself (M88) would not be required.*
(2) *The Difference Cursor shows the "B- driven value" which is 100 mV. This would validate that the ground credibility is within specs and no voltage drop on the module or wire is needed. Remember, the HKL module is capable of driving both B+ and B-. When this motor voltage is looked at with a DVOM, the value is a calculated average of approximately 14.3 V at 50% duty cycle or 7 V. Also, we vary the speed of the lid so the DVOM is a bad choice of tool!*

The measurement was done MOT_L1 or MOT_L2 to KL_31, SSP-SP0000053370 – Boot lid lift (F25). See the SSP with some notes on the next page.

SSP-SP0000053370 - Boot lid lift (F25)



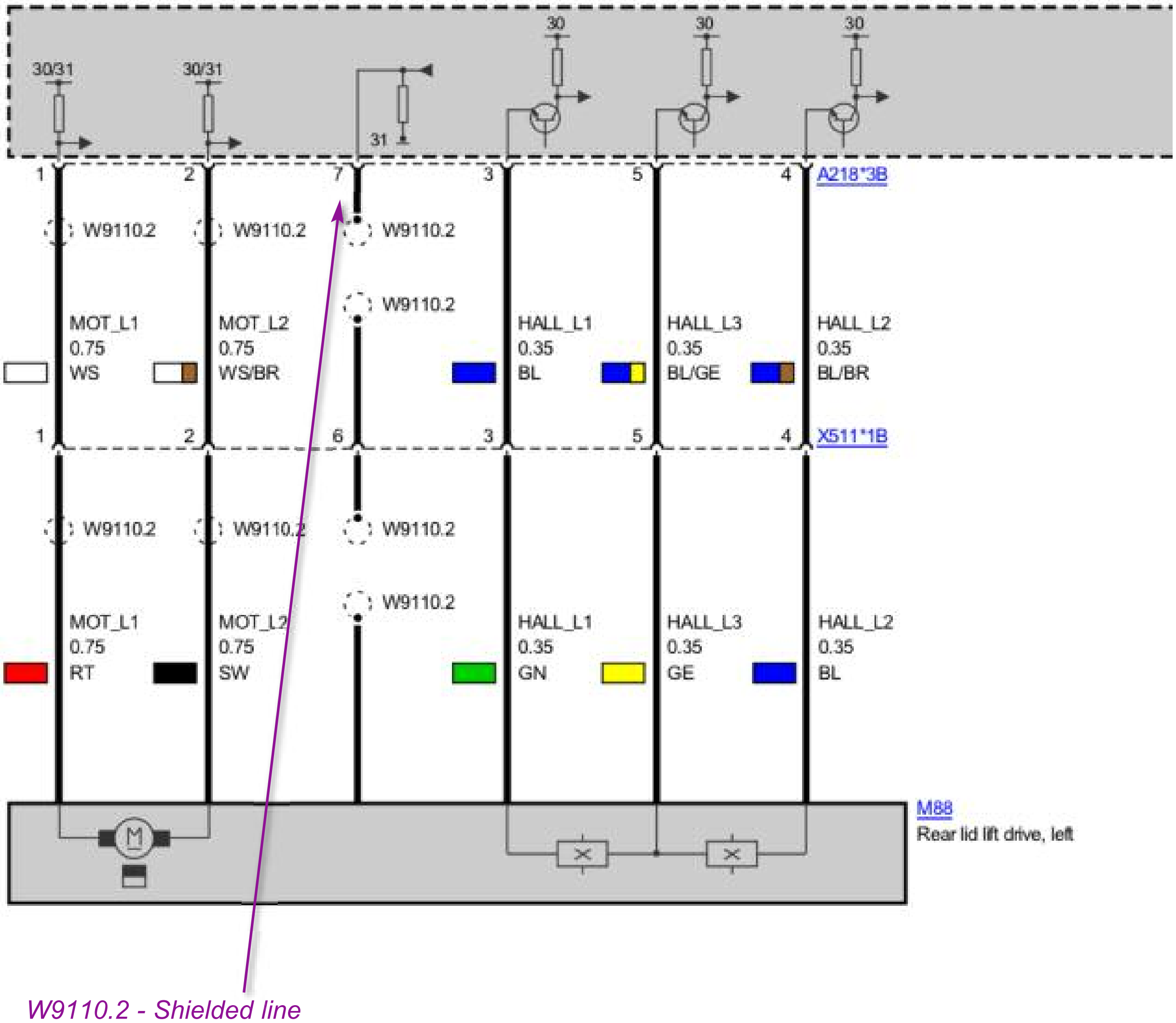
HKL “Good” Shielded Ground



Workshop Hint
The line we're looking at is one of the shielded lines coming from the HKL module to the HKL motor (M88 or M43). This line is shielded to prevent any Electromagnetic Interference (EMI) created by the drives to be induced into delicate circuits i.e hall or audio antennas. *The fault caused by an open shield line may not always be evident or cause a fault code. We could check continuity to ground, but by monitoring this line while using the HKL motor, we can watch for induced noise such as voltage spikes. The scope is hooked to the shielded terminal on HKL@Pin 7/A218*2B and KL_31. This voltage drop (Vd) test with the scope is the most precise way to eliminate any concerns with a credible shield wire to KL_31.* *(1) & (2) show the Reference and Difference Cursors at 0 V, with no noise at all during operation. Hence we can conclude it is a “good shielded line”!*

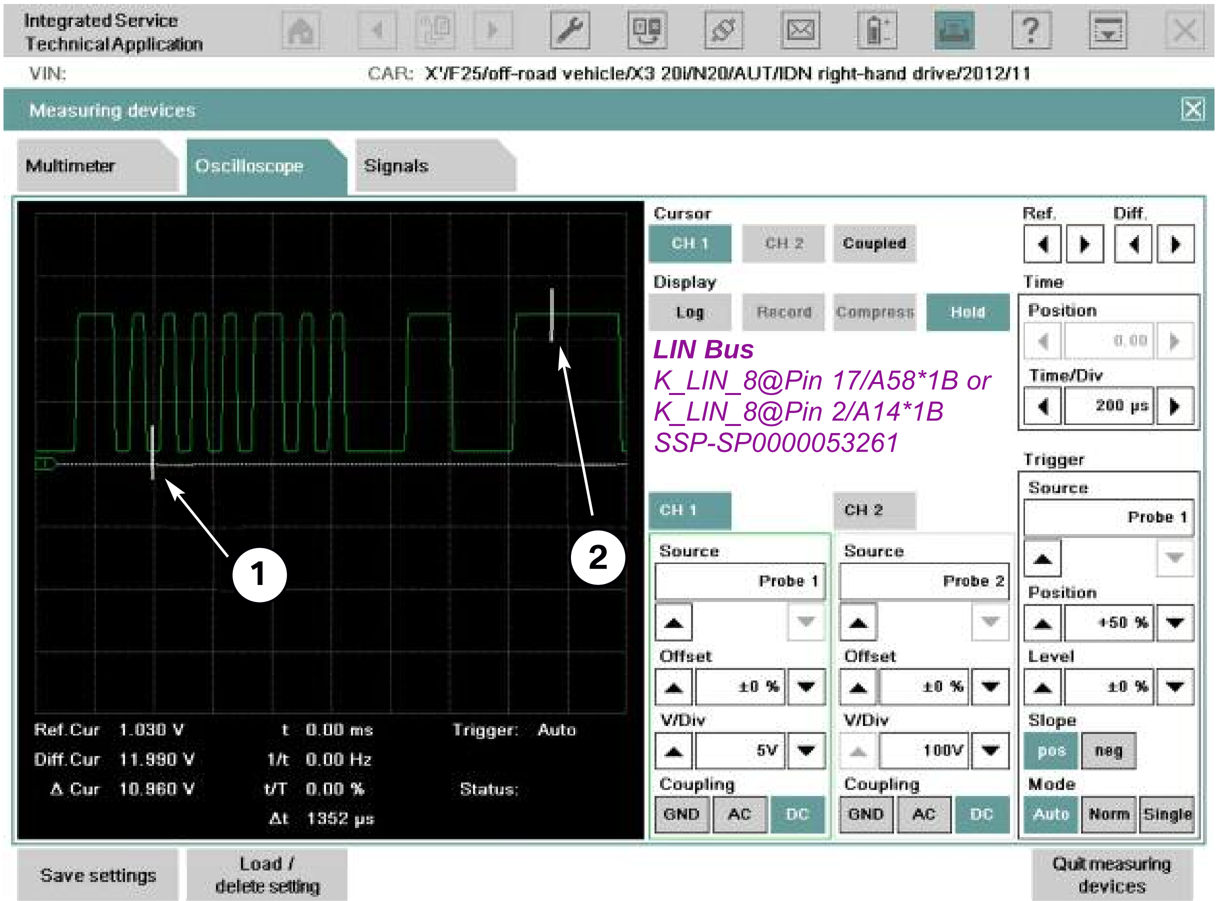
The measurement was done W9110.2 to KL_31, SSP-SP0000053370 – Boot lid lift (F25). See the SSP with some notes on the next page.

SSP-SP0000053370 - Boot lid lift (F25)



Single Wire Bus

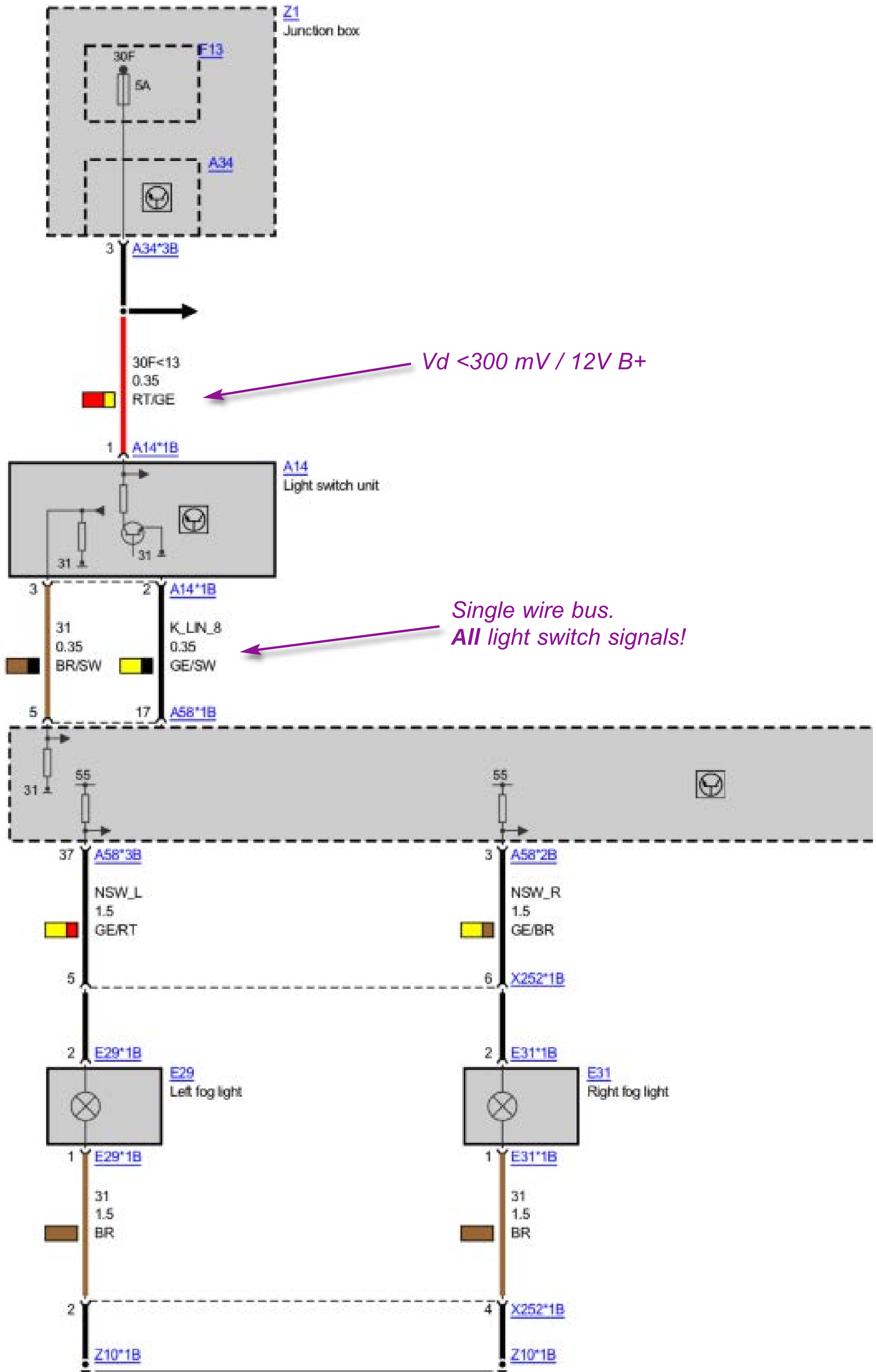
LIN Bus



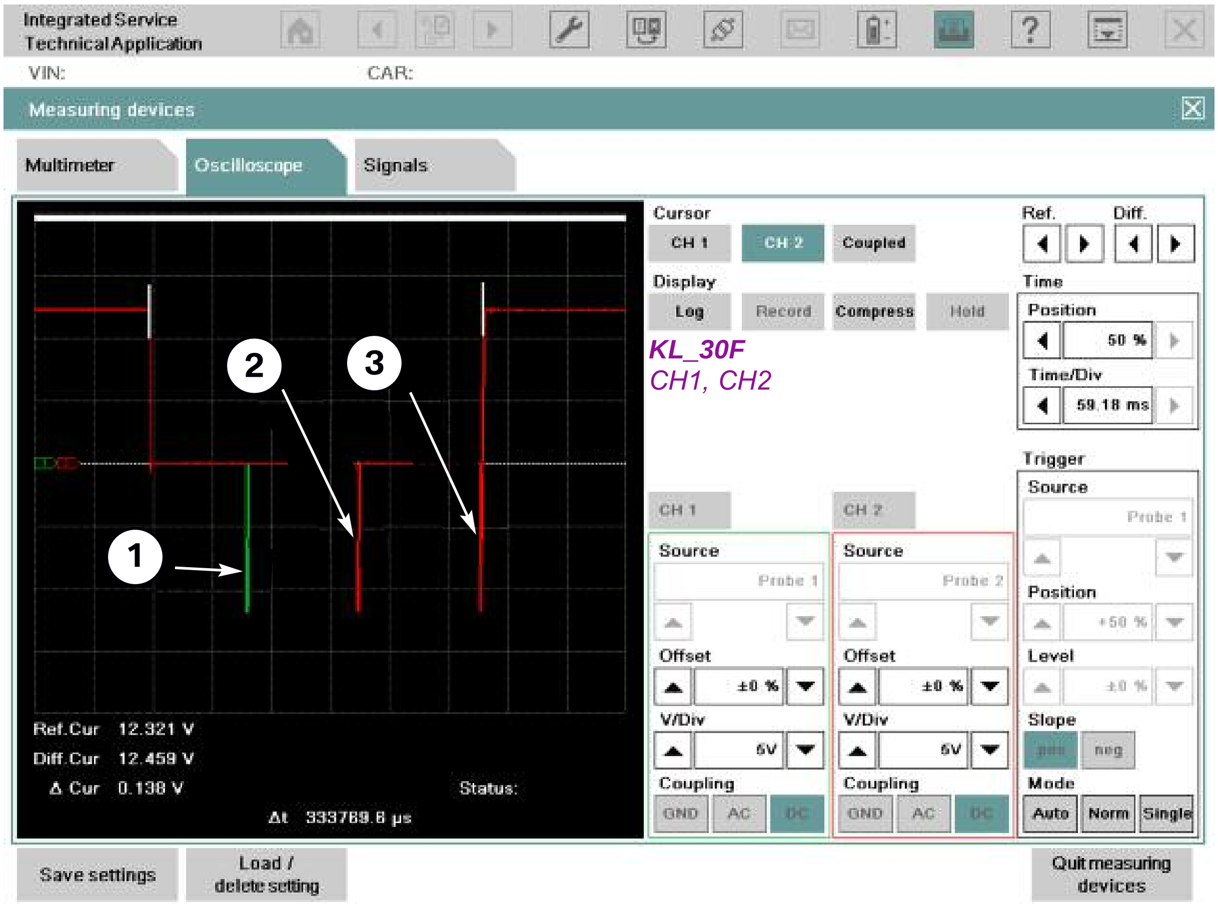
Workshop Hint
(1) Single wire bus binary 1 and 0 require a threshold voltage for that data to be transmitted. The ***Reference Cursor*** *shows* ***binary 1*** *voltage at around 1 V (1030 mV to be exact). Once the voltage fails to pull down to approximately ~1200-1300 mV, we start to see communication faults. In other words, if the voltage were to fail to pull below that threshold, we would need to diagnose accordingly, find the culprit and fix the bus communication fault.* *(2) The* ***Difference Cursor*** *shows the value for* ***binary 0****. The threshold for this voltage is generally greater than 9 V and is usually around 12 V on all single wire bus systems. The Footwell Module (FRM) is the Master of the bus and is also responsible for the voltage to establish communication. The switch participates as a "secondary control unit" and cannot work without the FRM.*

The measurement was done @ K_LIN_8 to KL_31, SSP-SP0000053261 – Front fog lights and rear fog lights. See the SSP with some notes on the next page.

SSP-SP0000053261 - Front fog lights and rear fog lights (F25)



KL_30F (BN2020)

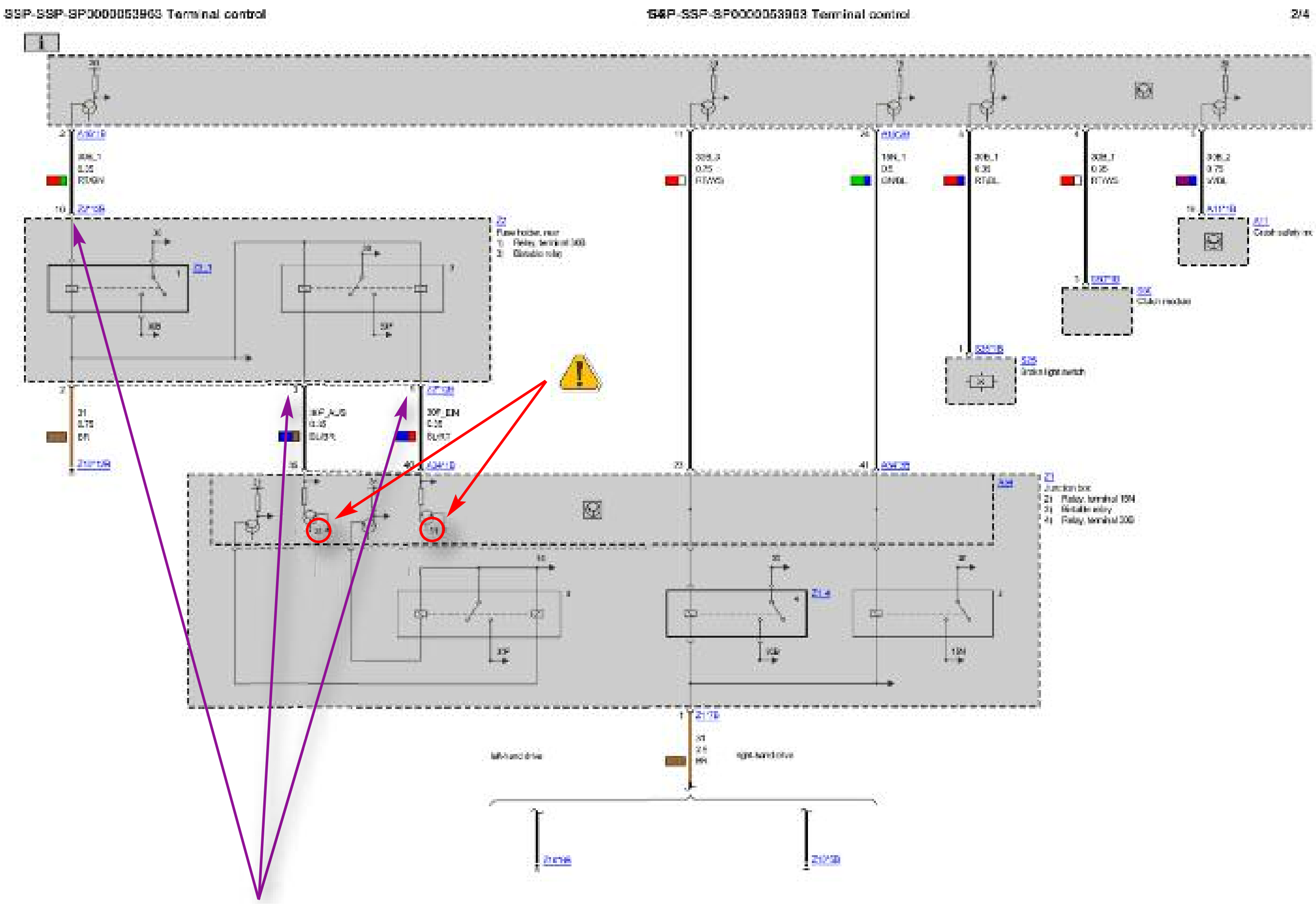


Workshop Hint
(1) *Channel 1 (green line) is the KL_30F OFF signal (Pin 3 @ Z2*12B).*
(2) *Channel 2 (red line) is the KL_30F ON signal, first red "blip" starting from left side (Pin 5 @ Z2*12B).*
(3) *Channel 2 (red line), the second red blip is KL_15N and KL_30B being powered back up (Pin 10 @ Z2*12B).*

These measurements were done on:
"KL_30F_AUS" Pin 3 @ connector Z2*12B to Pin 10 @ Z2*12B.
"KL_30F_EIN" Pin 5 @ connector Z2*12B to Pin 10 @ Z2*12B.
SSP-SP0000053963 - Terminal Control (F25).

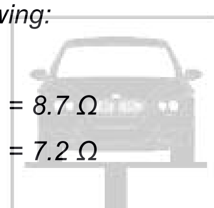
For more information, reference FUB-FB-610003-K10 - Vehicle system voltage supply

SSP-SP0000053963 - Terminal Control (F25)

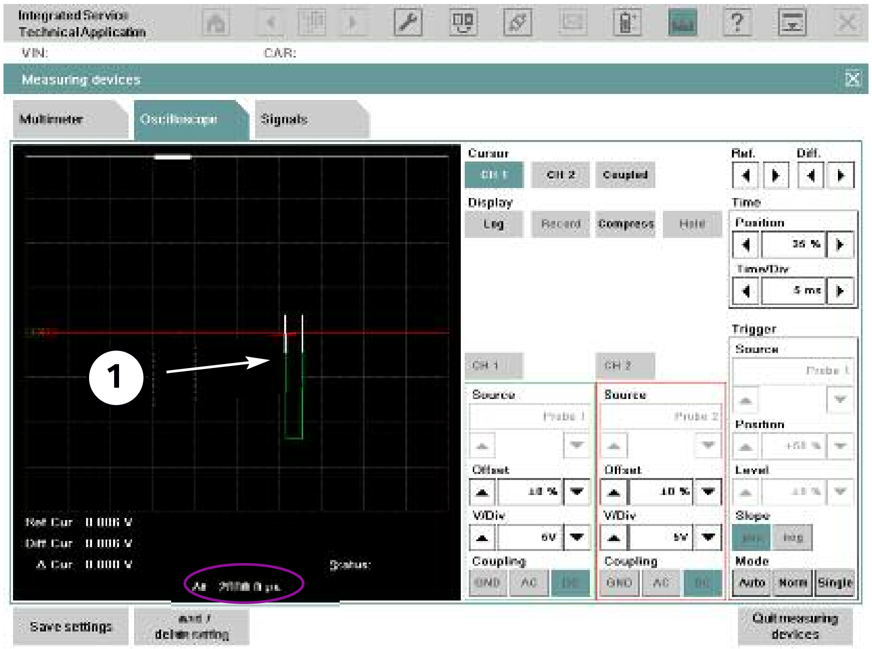


The leads should be connected to:
***KL_30F_AUS** Pin3 @ connector Z2*12B to Pin 10 @ Z2*12B.*
***KL_30F_EIN** Pin 5 @ connector Z2*12B to Pin 10 @ Z2*12B..*

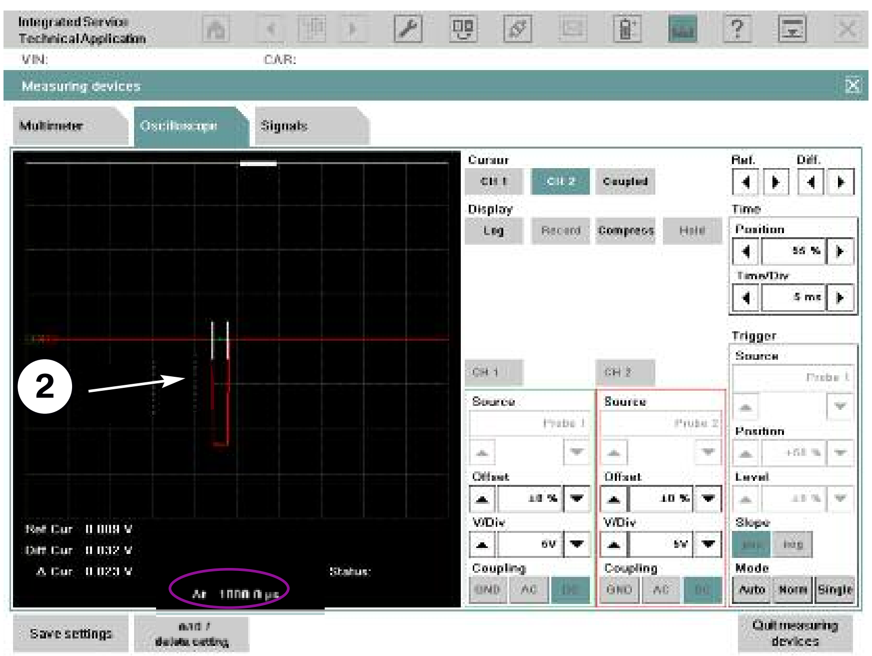
Workshop Hint
After verifying that the signal is OK, you can check the resistance of the bi-stable relay to confirm it is also OK. Both ends should be roughly the same. As an example see the following: *A known "Good Relay":* *Pin 3 to Pin 2 @ Z2*12B = 8.7 Ω* *Pin 5 to Pin 2 @ Z2*12B = 7.2 Ω* *A known "Bad Relay":* *Pin 3 to Pin 2 @ Z2*12B = 75.4 Ω* *Pin 5 to Pin 2 @ Z2*12B = 75.3 Ω*



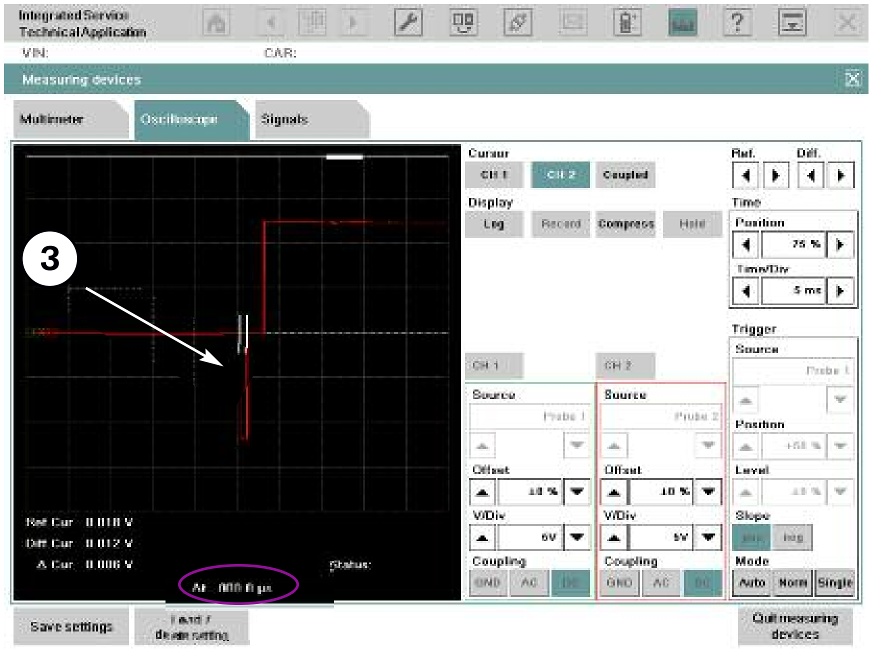
SSP-SP0000053963 - Terminal Control (F25), pins 35 & 40 on A34*1B on component A43 should list KL_30 instead of KL_31.



04/06/2013



04/06/2013



04/06/2013

Workshop Hint

KL_30F signal times:

(1) Channel 1 (green line) is the KL_30F OFF signal time: 2000 µs = 2 ms = 0.002 s

(2) Channel 2 (red line) is the KL_30F ON signal time (first red "blip" starting from left side): 1800 µs = 1.8 ms = 0.0018 s

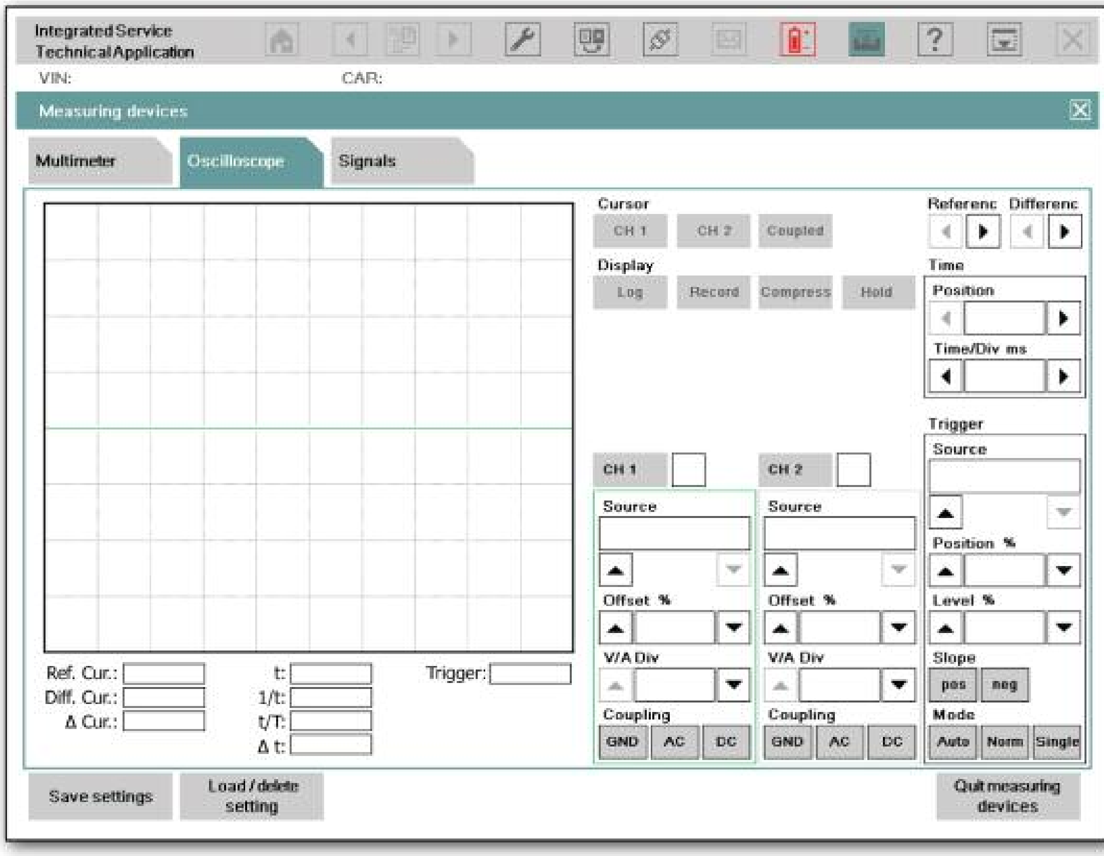
(3) Channel 2 (red line), the second red blip is KL_15N and KL_30B being powered back up: 800 µs = 0.8 ms = 0.0008 s

So, pretty fast indeed!

NOTES PAGE

Blank Oscilloscope Screens

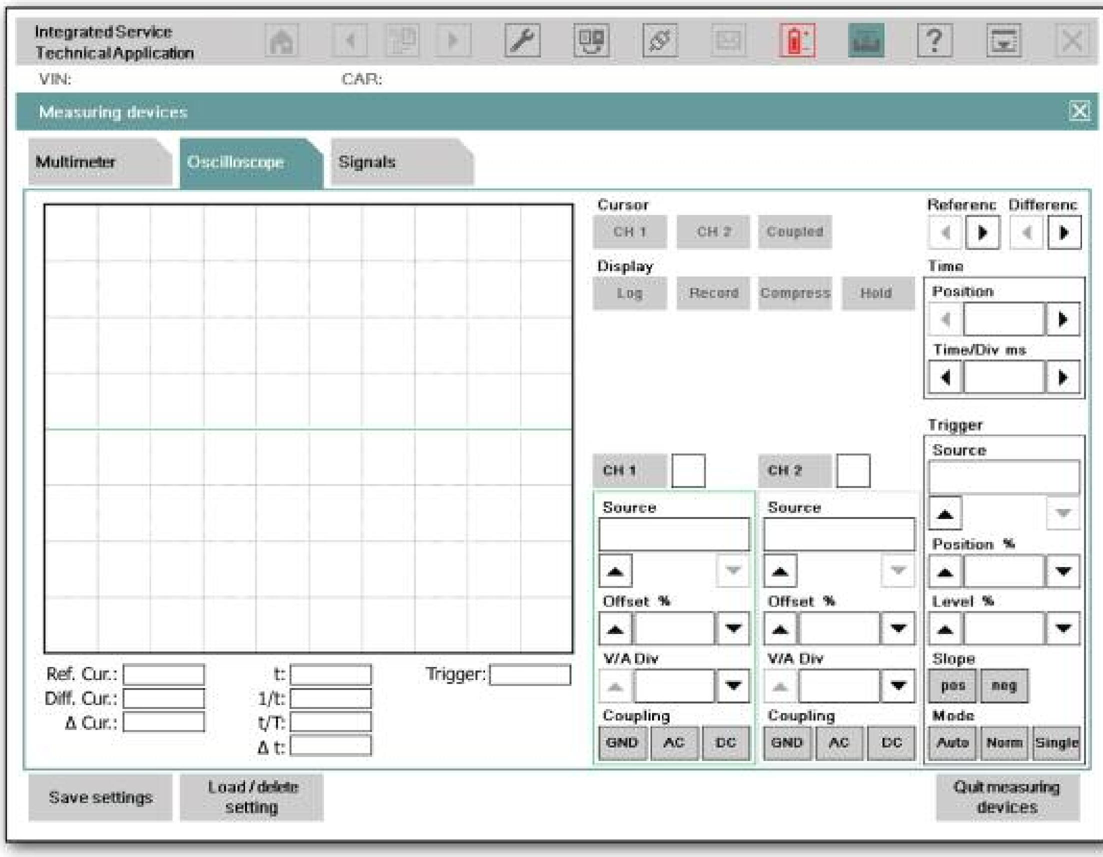
Use for additional scope measurements.



NOTES

Blank Oscilloscope Screens

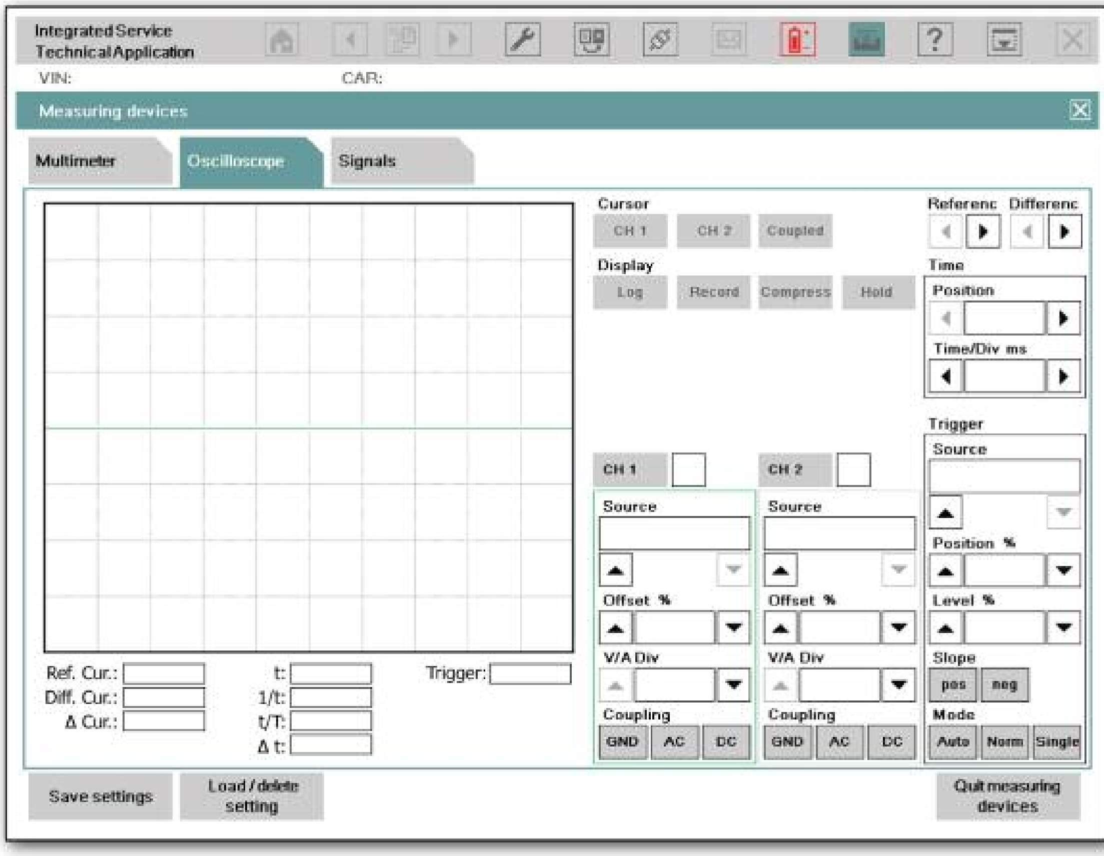
Use for additional scope measurements.



NOTES

Blank Oscilloscope Screens

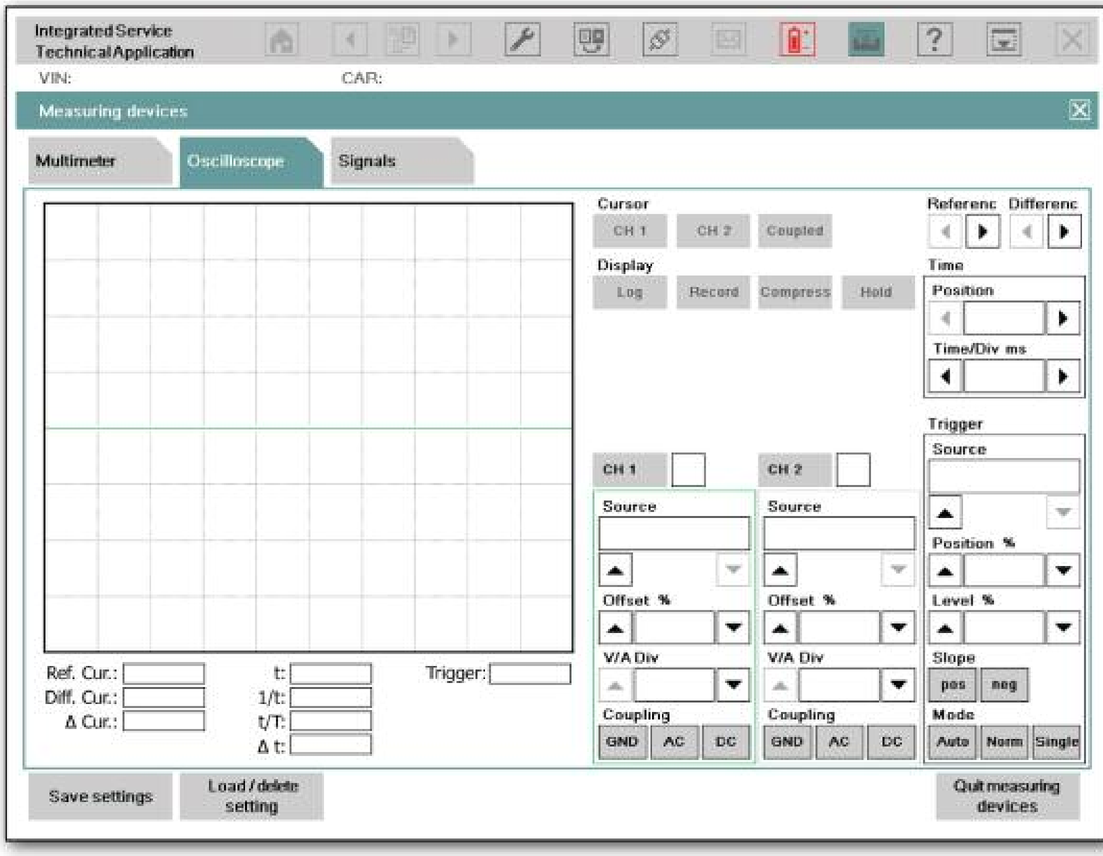
Use for additional scope measurements.



NOTES

Blank Oscilloscope Screens

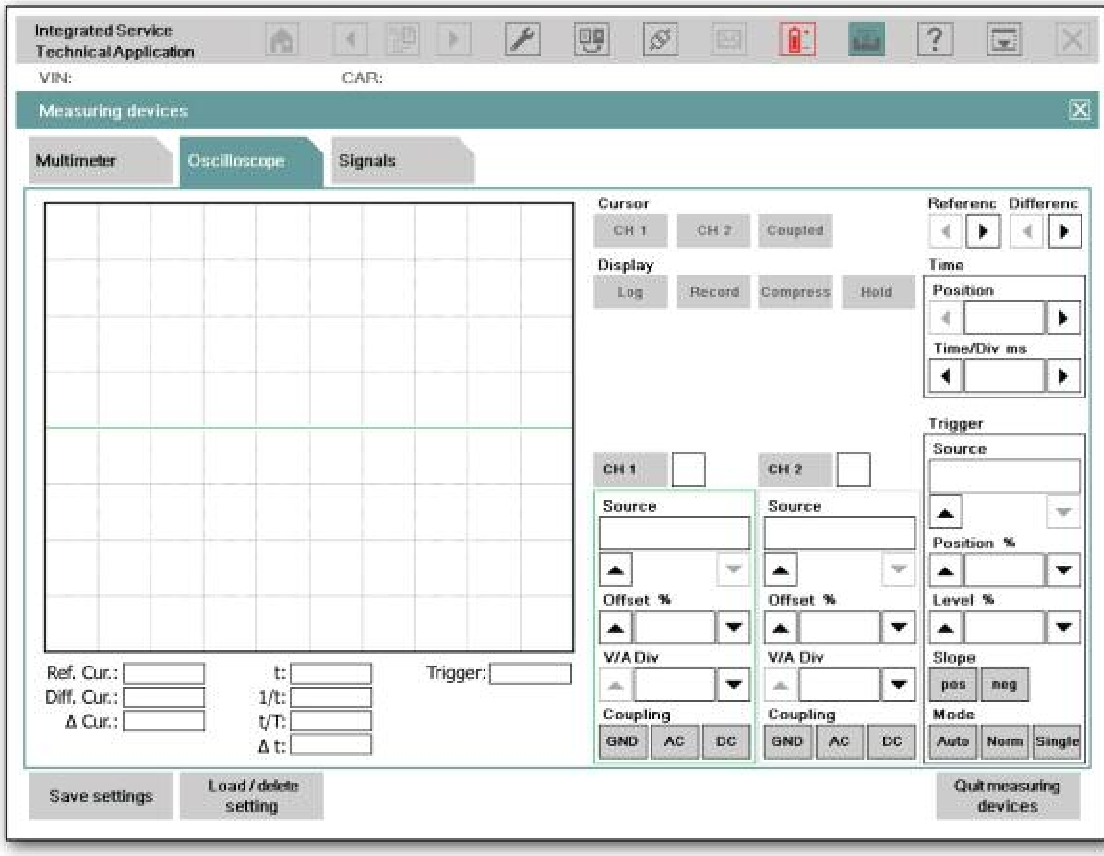
Use for additional scope measurements.



NOTES

Blank Oscilloscope Screens

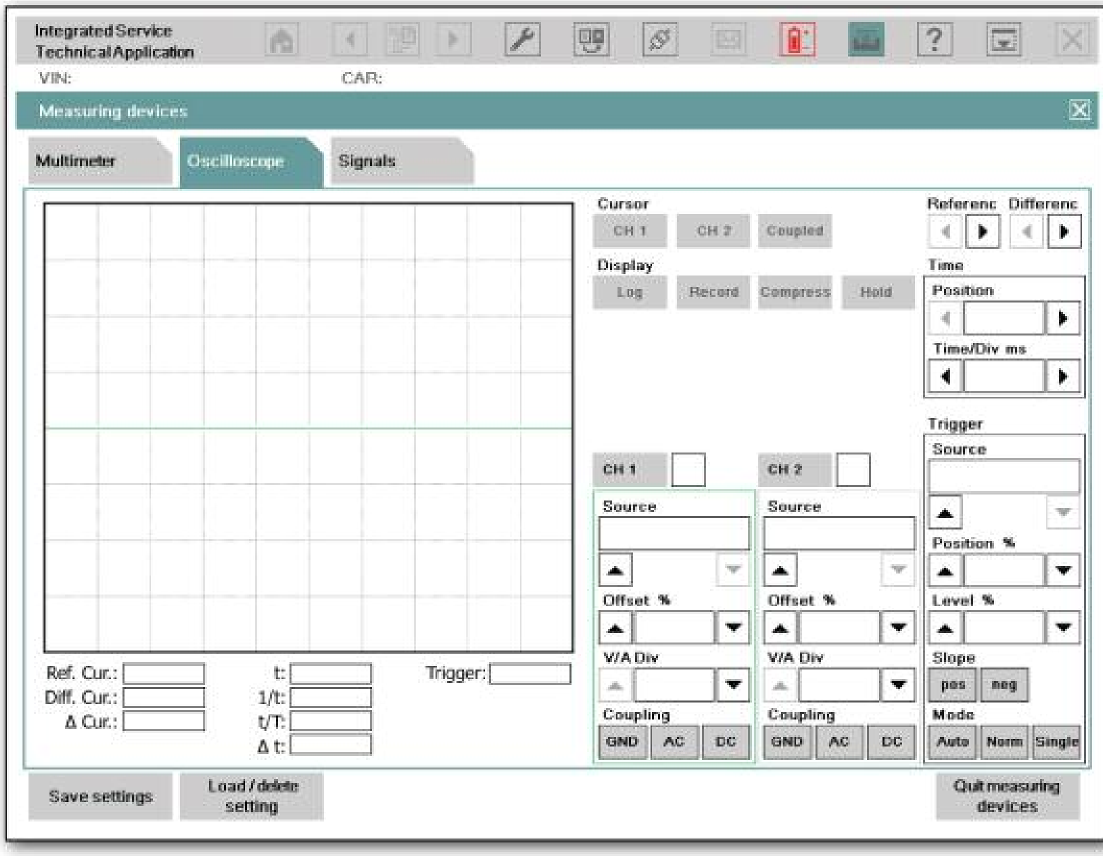
Use for additional scope measurements.



NOTES

Blank Oscilloscope Screens

Use for additional scope measurements.



NOTES