LAH 10x

SENT Signal Source

This integral version of this document, all the setup files can be found under

www.lahniss.com/_uLAH10x

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Introduction and Contents of Demo Kit

LAH10x is a SENT Signal source developed by Lahniss for LeCroy oscilloscopes. It is built to easily demonstrate the SENT Decoder, as well as some other feature of the oscilloscope when they are used on a SENT signal. The LAH10x is based on Melexis Pressure and Position MEMS (Micro Electro Mechanical System) Sensors.

There are 2 variations of the LAH10x, the LAH100 and the LAH101:

- The LAH100 has 2 Sensors ICs built in (1 MLX 90809 + 1 MLX 90367)
- The LAH101 has 4 Sensors built-in. (3 MLX 90809 + 1 MLX 90367). Each of the MLX 90809 is configured differently to reflect various industry needs.

The possibilities of both versions will be explained in this document. Both versions of the LAH10x require the presence on the unit of the ProtoBusMAG option key when Tracking and Trending measurements are needed.

The LAH10x lends itself to interesting demos for various purposes such as Sales Demos, Training, Tech Schools, Trade Shows, etc.

The demo kit consists of the following items	
1: LAH 100 or LAH 101 **2**: Syringue **3**: 40 cm section of plastic hose **4**: Mini-magnet inserted into a small piece of hose. **5**: Short Manual (not shown)	

Getting started, how to connect the hardware

SENT demos without probes (Standard Mode)

The LAH10x is designed to be a simple device that can be inserted into any of the channel connectors. **As soon as it is powered via the 12V line of the ProBus connector, it starts generating signal into the channel BNC**. The following images show the basic arrangement.

Figure 1 LAH 101 inserted on the oscilloscope

While the LAH10x can be inserted into any of the channels of the DSO, it is important to realize that the Panel files provided with the Demo kit always assume that the LAH10x is plugged into Channel 1.

In this mode, the output of the Melexis Pressure/Temperature sensor goes directly into C1 and no other connection is required. The following section shows arrangements using one or more probes.

SENT Demos with Probes (Advanced Mode)

While it is expected to use predominantly the demo without probes, several interesting additional demos are possible when using the side probing points. The image and diagram below show the arrangement and explain the code used in the Panel file names to indicate the arrangement necessary to probe.

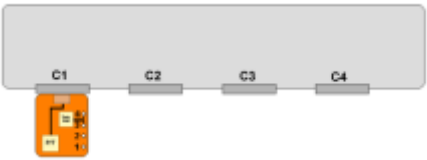
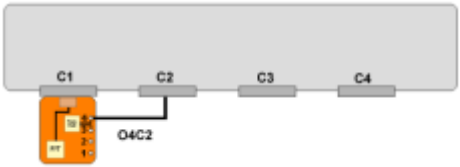
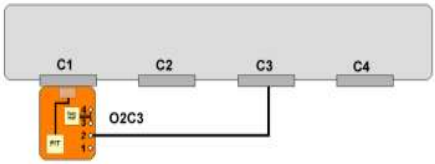
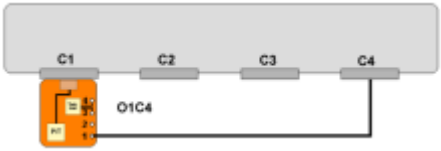
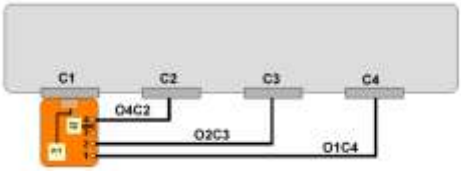
In order to explain the connection modes, it is necessary to document the outputs of the LAH10x located on the side of the device.

Figure 2 The Side Output Connectors of the LAH10x

Note that the MLX 90367 is present on all devices (LAH100 and LAH101) and hence there is always live signal on ports 3 and 4.

LAH 10x connection modes

Connections modes are exemplified here, with schematic and picture. The schematic will be repeated with every example, but not the picture.

Mode	Picture	Resulting schematic
LAH10x **C1 No probes**		
LAH10x **O4C2**		
LAH101 Only **O2C3**		
LAH101 Only **O1C4**		
LAH101 Only **O1C4 O2C3 O4C2**		

Getting started, how to stimulate the sensors

The LAH10x start emitting SENT messages as soon as they are powered. It is therefore possible to demonstrate the SENT Decoder and the Standard triggers without stimulating the sensors at all. However, demos using the Tracks and Trends require that the sensors are stimulated to vary their output and therefore obtain interesting Graphs.

The following sections explain the manual tricks to stimulate the sensors.

Stimulating the Pressure Sensors

The Melexis Relative Pressure Sensors (see also www.melexis.com/Pressure-Sensors/General/MLX90809-791.aspx) presents a small orifice leading to the sensitive membrane. This orifice is located directly below the round hole on top of the housing. This hole allows the insertion of the plastic house that will fit snuggly onto the upper MLX90809 mounted in both the LAH100 and the LAH 101.

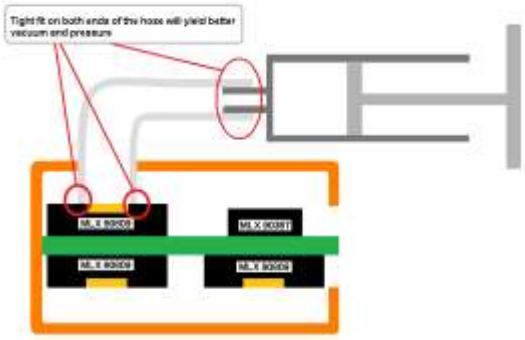


Figure 3 Cross Section Showing Fit of Hose to Pressure Sensor

In order to reach the vacuum or pressure build up, the hole is drilled exactly to fit the hose. To insert the hose, it is necessary to pinch it and start inserting it into the orifice. It helps if the hose is warmed up first by hand or with a heat source. It is normal that the hose is initially wrinkled.

Figure 4 Beginning of insertion of hose; note the wrinkles on the hose.

Once the hose is inserted, it is enough to gently rotate it back and forth, while pushing it further into the orifice. The final position should look like the following image.

Figure 5 Final position of hose, without wrinkles

Once the hose is completely fitted on the LAH10x side, the Syringe can be attached to the other end.

Figure 6 Hose Connection on Syringe Side

Stimulating the Hall Effect Sensor

The Melexis Hall Effect sensor (http://www.melexis.com/Hall-Effect-Sensor-ICs/Triaxis®-Hall-ICs/MLX90324-707.aspx) is sensitive to the angular position of a magnetic field. It is designed for contactless rotary position sensors: the MLX90324 detects the absolute angular position of a small magnet that is positioned and rotates above the device surface.

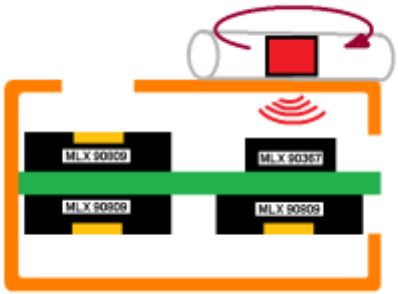


Figure 7 Stimulating the Hall Sensor with a Mini Magnet

Figure 8 Mini Magnet In Position on top of LAH10x

LAH 100 Demos (Basic Mode)

The Basic Demo set consists of the following Panel files (Extension LSS). These files completely configure the instrument for the desired experiment or demonstration. This manual has one page per experiment, detailing the necessary connections, stimuli and results. All the panels use the “Normal” trigger mode and the Smart Trigger in Interval Mode, 168 us ± 5 us

Files listed under:

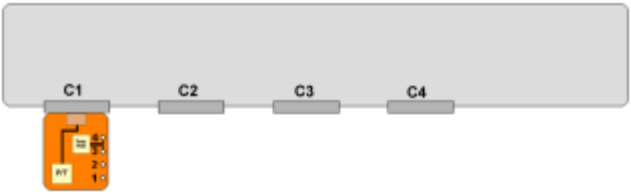
- **1x** are general purpose setups
- **2x** pertain to the Pressure/ Temperature Sensor
- **3x** to the Hall Angle Sensor.

The following files constitute the demo set:

- **10_ C1_Trigger_on_SYNC_with_Intervall_Trigger.lss**
- **11_ C1_AnyInput_BasicSignalTest.lss**
- **12_ C1_Measure_SYNC_Period_with_Trend.lss**
- **13_ C1_Persistence_3D_SENT_Edges.lss**
- **14_ C1_Persistence_TickTimeRaster_x3.lss**
- **20_ C1_PT_Decode_and_Zoom.lss**
- **21_ C1_PT_Decode_and_Trend.lss**
- **22_ C1_PT_Decode_and_Track.lss**
- **30_ C1_o4C2_Hall_Decode_and_Zoom.lss**
- **31_ C1_o4C2_Hall_Decode_and_Trend.lss**
- **32_ C1_o4C2_Hall_Decode_and_Track.lss**

The files can be either recalled via the Recall Setup dialog, or simply double-clicked in Windows Explorer.

Demo 10 for P/T sensor, Smart Trigger on SYNC Pulse

Schematic	
Panel File	**10_ C1_Trigger_on_SYNC_with_Intervall_Trigger.lss**
Comments	This is an easy way to have a stable trigger. Use the decoded value of the SYNC here 169.6 us to set the "**Nominal width**" of the Interval. Then allow a Delta to accommodate the fluctuations. The delta could be computed more tightly by using a Trend of the decode Sync value, or applying statistics on it.
Stimulation	None

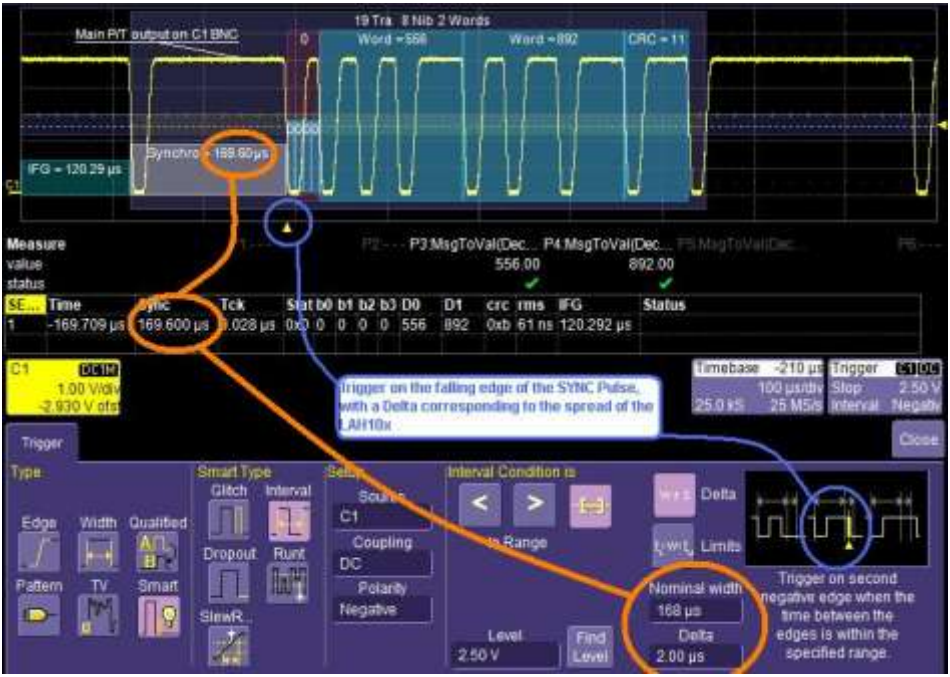
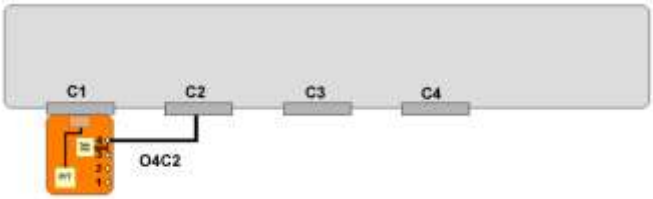


Figure 9 Using Interval Smart Trigger, negative Pulse, to trigger on SYNC

Demo 11 for P/T Basic LAH 100 test, raw signal only

Schematic	 Or any number of inputs connected
Panel File	**11_ C1_AnyInput_BasicSignalTest.lss**
Comments	Both Pressure and Temperature values are emited using 12 bits. This simple demo verifies that the LAH100 is electrically functional and awake. The trace labels document the origin of the signal. Same Panel file can be used for testing the LAH101
Stimulation	None required

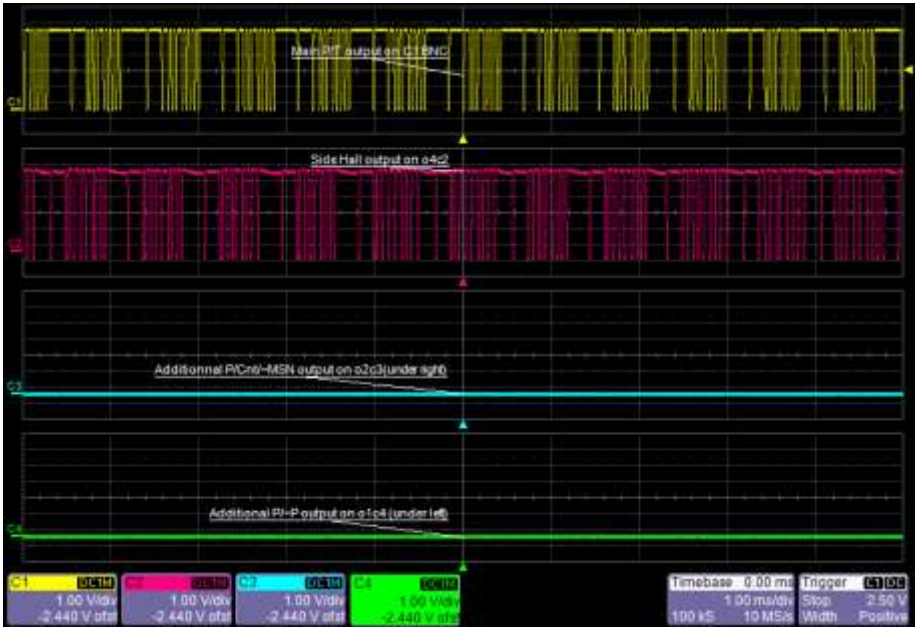


Figure 10 Basic Functionality Test of LAH100, showing the SENT activity

Demo 12 for P/T sensor, Basic Consistency test of SYNC Pulse

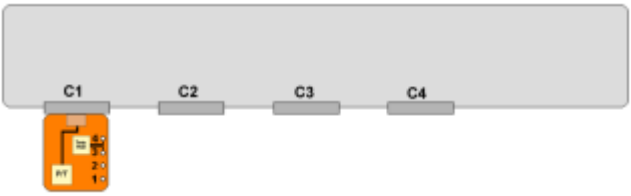
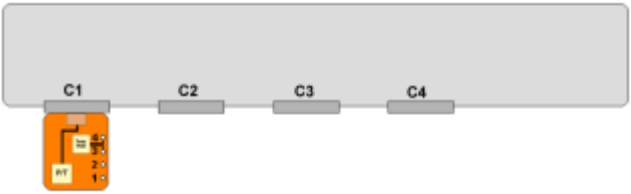
Schematic	
Panel File	**12_ C1_Measure_SYNC_Period_with_Trend.lss**
Comments	Observe the Gaussian distribution of P1=Period of (C1)
Stimulation	Use Syringe and verify that pumping has no effect on TickTime

Figure 11 Monitoring Stability of the TickTime, with a SYNC of 168.5 us

Demo 13 for Pressure Sensor 3D SENT Persistence

Schematic	
Panel File	**13_ C1_Persistence_3D_SENT_Edges.lss**
Comments	A glimpse of glamour for the Canne Film Festival!
Stimulation	Pump the **syringe** to get more edges. Use **Clear Sweeps** to reset. Use the **mouse** to change the 3D orientation of the perspective. The persistence time can also be modified for other effects.

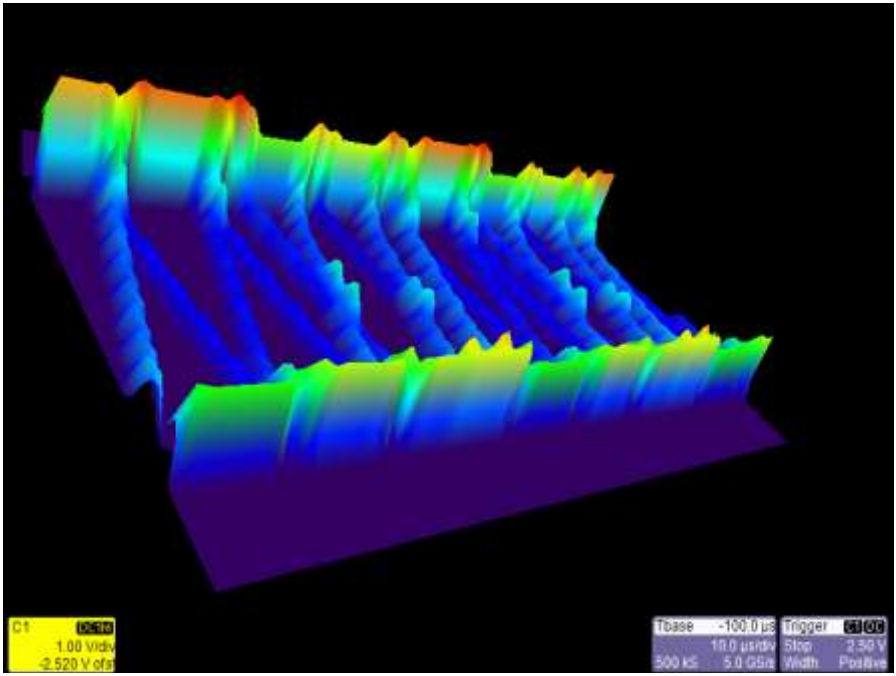
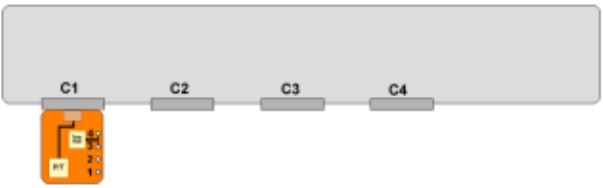


Figure 12 3D Persistence of SENT signal, with evenly spaced r/f edges.

Demo 14 for Pressure Sensor Triple Staggered Persistence

Schematic	
Panel File	**14_ C1_Persistence_TickTimeRaster_x3.lss**
Comments	The 3 zooms show 3 portions of the single SENT message, with the evenly spaced 3us Rising and Falling Edges.
Stimulation	Pump the **syringe** to get more edges. Use **Clear Sweeps** to reset. The concept is that the idle sensor always emits the same values, therefore the same edges. As soon as the sensor is stimulated, other values will be transmitted, therefore other nible length.

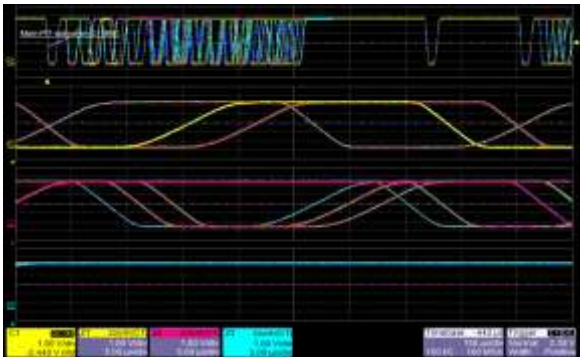


Figure 13 Initial Infinite Persistence, steady P and T values

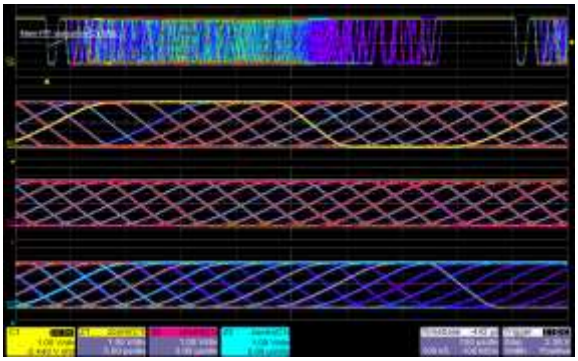


Figure 14 Final Persistence; all nibble values have been hit

Demo 20 for Pressure Sensor, Decode and Zoom

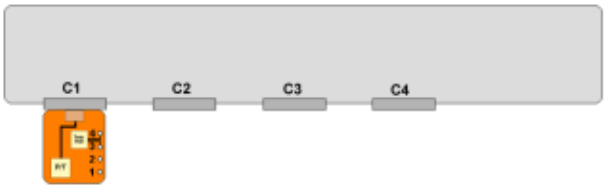
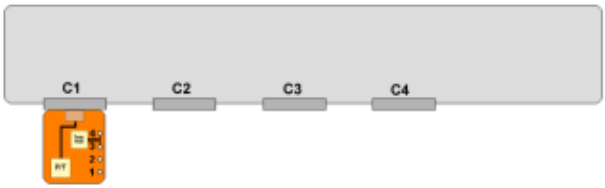
Schematic	
Panel File	**20_ C1_PT_Decode_and_Zoom.lss**
Comments	This shows the SENT stream decoded in C1 and one SENT message in Z3. The first 12 bit word (555) is the pressure while the second 12 bit word is the temperature (902) Observe the satbility of both outputs in columns **D0 and D1**
Sensor Stimulation	Use the syringe to increse/decrease the pressure. Observe how the nibble length in the Zoom changes. Observe D0 and D1.

Figure 15 Decode and Zoom of main SENT output on C1

Demo 21 for Pressure Sensor, Decode and Trend

Schematic	
Panel File	**21_ C1_PT_Decode_and_Trend.lss**
Comments	This experiment shows the Trendline of the Pressure and the Temperature applied to the sensor.
Sensor Stimulation	Use the syringe to increase/decrease the pressure. Observe the reaction on the Trend in real Time. Is is also possible to observe the temperature, by tuning the sensitivity of F4, and heating the LAH10x

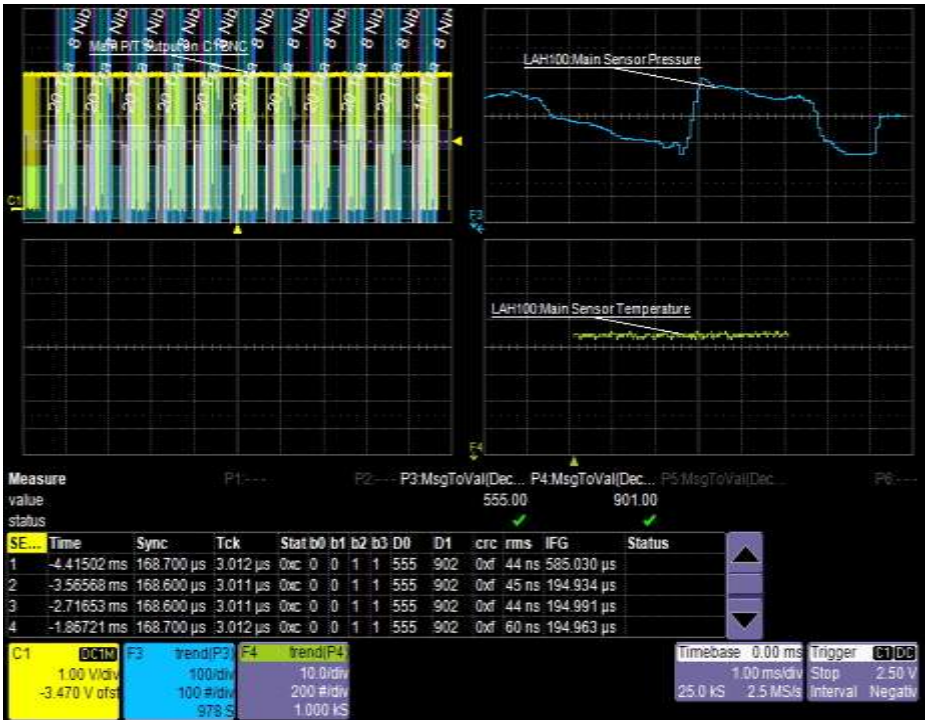


Figure 16 Trend Reacting in Real Time to Pressure/Temperature changes

Demo 22 for Pressure Sensor, Decode and Track

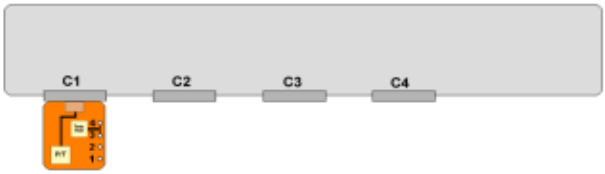
Schematic	
Panel File	**22_ C1_PT_Decode_and_Track.lss**
Comments	This experiment shows the Track of the Pressure and Temperature applied to the sensor.
Sensor Stimulation	Use the syringe to increse/decrease the pressure. Observe the reaction on the Track after the acquisition has stopped. Is is also possible to observe the temperature, by tuning the sensitivity of F4, and heating or cooling the LAH10x

Figure 17 Track of P and T on the sensor over a time span of 5 seconds

Demo 30 for Hall Angle Sensor, Decode and Zoom

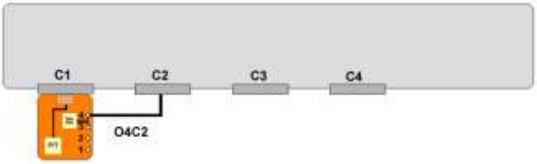
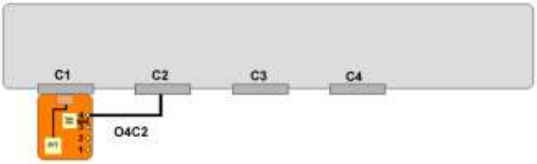
Schematic	
Panel File	**30_ C1_o4C2_Hall_Decode_and_Zoom.lss**
Comments	This shows the SENT stream decoded in C2 and one SENT message in Z3. The first 12 bit word (3916) is the angle while the second 8 bit word is the running counter (21). The third word of 4 bits is the inverse of the MSN of the angle.
Sensor Stimulation	Put the mini-magnet on the housing and rotate it. Observe how the D0 column changes. Observe (Stopped mode) how the running counter evolves between 0 and 255

Figure 18 Hall Effect Sensor output when rotating mini-magnet

Demo 31 for Hall Angle Sensor, Decode and Trend

Schematic	
Panel File	**31_ C1_o4C2_Hall_Decode_and_Trend.lss**
Comments	Experiment shows the reaction of the sensor to the magnet motion. By the same token we can monitor the Running counter.
Sensor Stimulation	Put the mini-magnet on the housing and rotate it. Observe how the Track of the Magnetic Deflection changes Observe the jagged line of the Running Counter, due to the cumulative effect of the Trend, with gaps between acqusitions. This counter is easier to monitor using Tracks as in nexte experiment.

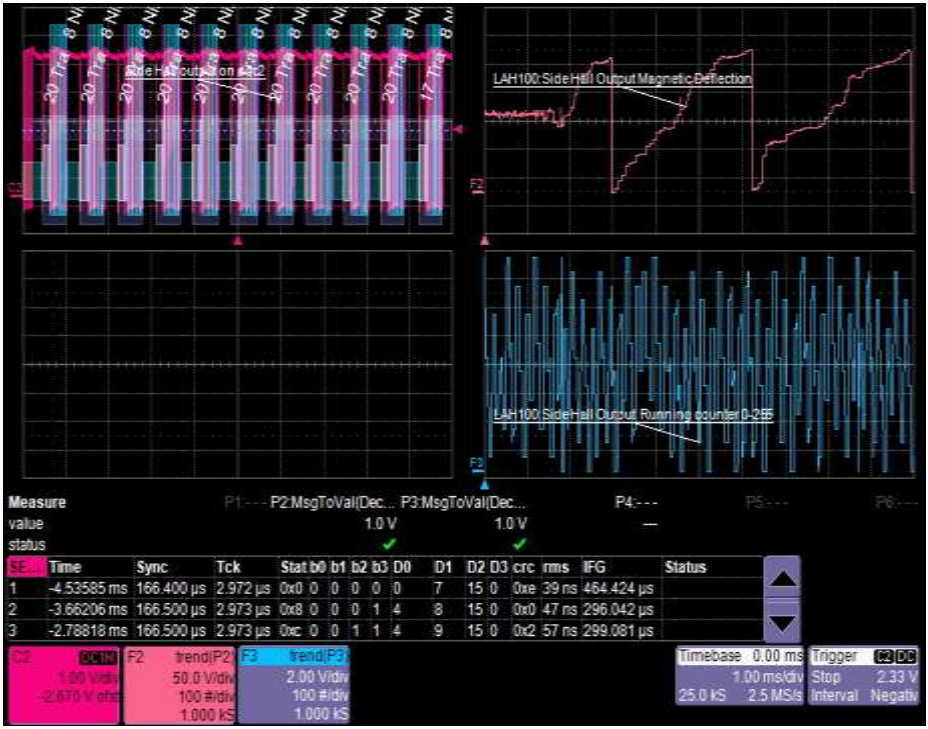
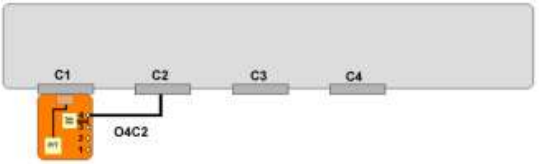


Figure 19 Monitoring the Angle measured by the MLX90367 and its counter

Demo 32 for Hall Angle Sensor, Decode and Track

Schematic	
Panel File	**32_ C1_o4C2_Hall_Decode_and_Track.lss**
Comments	Experiment shows the reaction of the sensor to the **magnet motion**. By the same token we can monitor the Running counter, over several seconds in a better way then using the Trends.
Sensor Stimulation	Put the mini-magnet on the housing and rotate it for 5 seconds

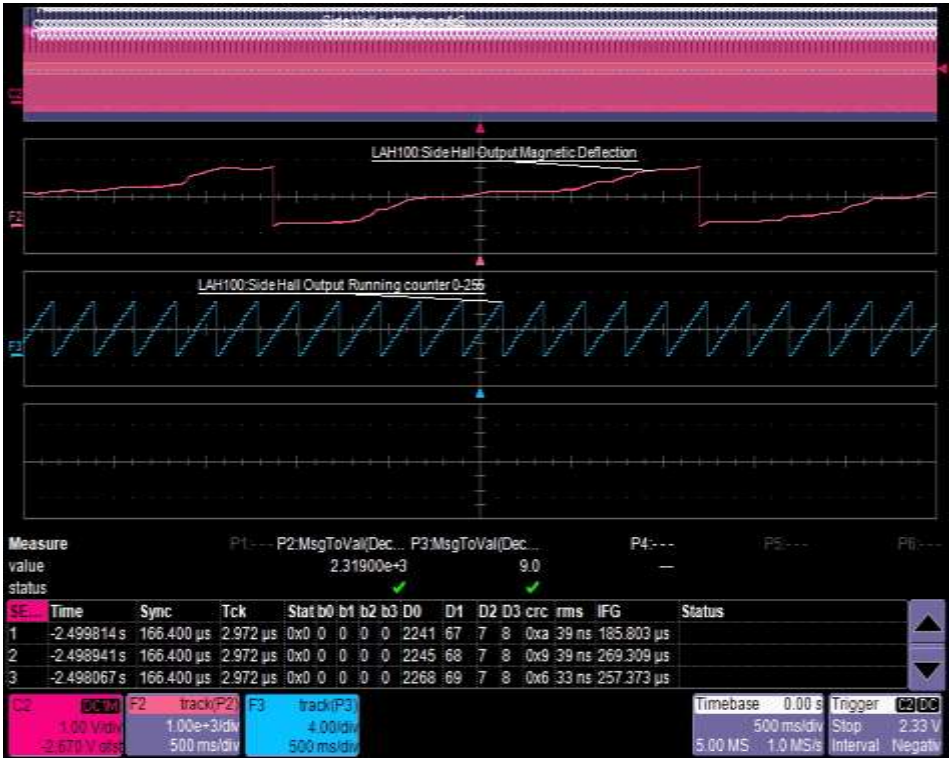


Figure 20 Monitoring Evolution of Angle and Counter over 5 seconds

Demos for the LAH 101 (advanced Mode)

The Advanced Demo set consists of the following Panel files (Extension LSS). These experiments pertain to the additional SENT Secure sensors mounted on the bottom of the LAH101 PCB.

These files completely configure the instrument for the desired experiment or demonstration. This manual has one page per experiment, detailing the necessary connections, stimuli and results.

Files listed under:

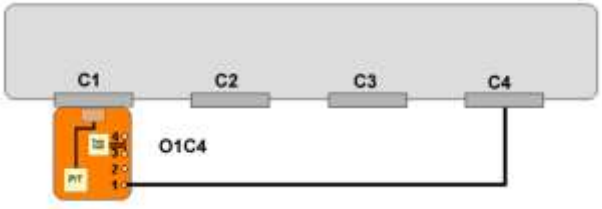
- **4x** are Setups for the Pressure/Inverted pressure Sensor
- **5x** are Setups for the Pressure/Counter/Inverse of Most Significant Nibble

The following files constitute the demo set:

- **40_ C1_o1C4_PmP_Decode_and_Trend.lss**
- **41_ C1_o1C4_PmP_Decode_and_Track.lss**
- **50_ C1_o2C3_P_Cnt_Decode_and_Trend.lss**
- **51_ C1_o2C3_P_Cnt_Decode_and_Track.lss**

The files can be either recalled via the Recall Setup dialog, or simply double-clicked in Windows Explorer.

Demo 40 for P/-P sensor, using 2 Trends

Schematic	
Panel File	**40_ C1_o1C4_PmP_Decode_and_Trend.lss**
Comments	Only available on LAH 101. In order to stimulated the sensor, the housing needs to be removed. Both Pressure values are emited using 12 bits. Correctness can be verified using the sum of both trends, that should be zero. C1 is not used.
Stimulation	Use the syringe to increse decrease the pressure. Observe how both curves evolve in opposite direction in real time.

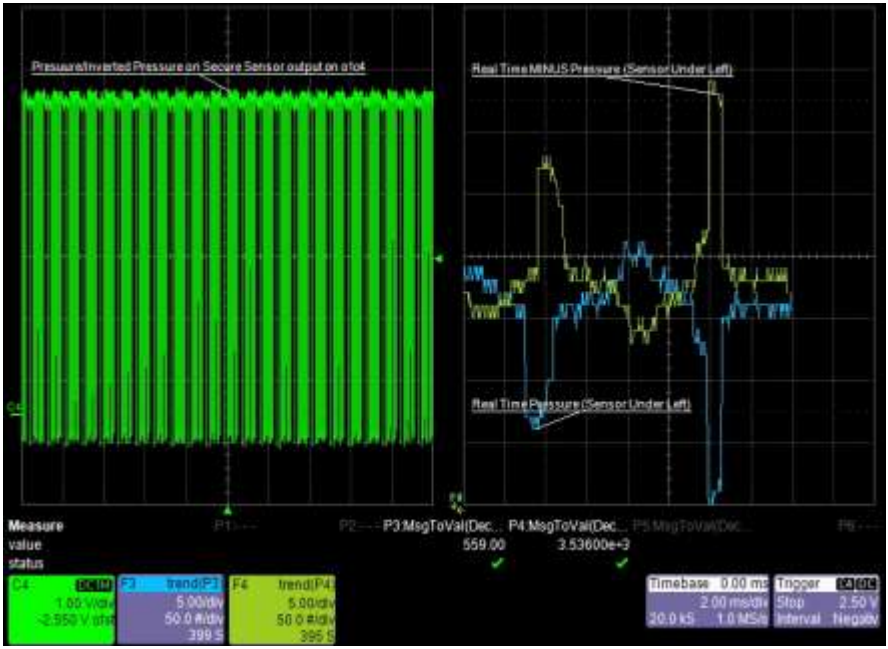
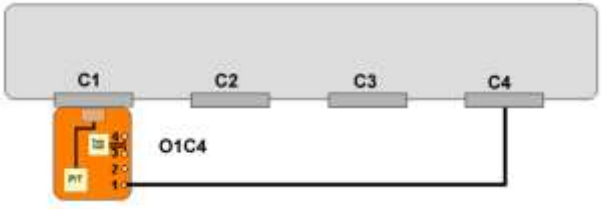


Figure 21 Opposite Trends on P/-P Sensor (Located under LAH101, left)

Demo 41 for P/-P sensor using 2 Tracks

Schematic	
Panel File	**41_ C1_o1C4_PmP_Decode_and_Track.lss**
Comments	Only available on LAH 101. In order to stimulated the sensor, the housing needs to be removed. Both Pressure values are emited using 12 bits. Correctness can be verified using the sum of both tracks, that should be zero. C1 is not used.
Stimulation	Use the syringe to increse decrease the pressure. Observe how both curves evolve in opposite direction over the measuring interval

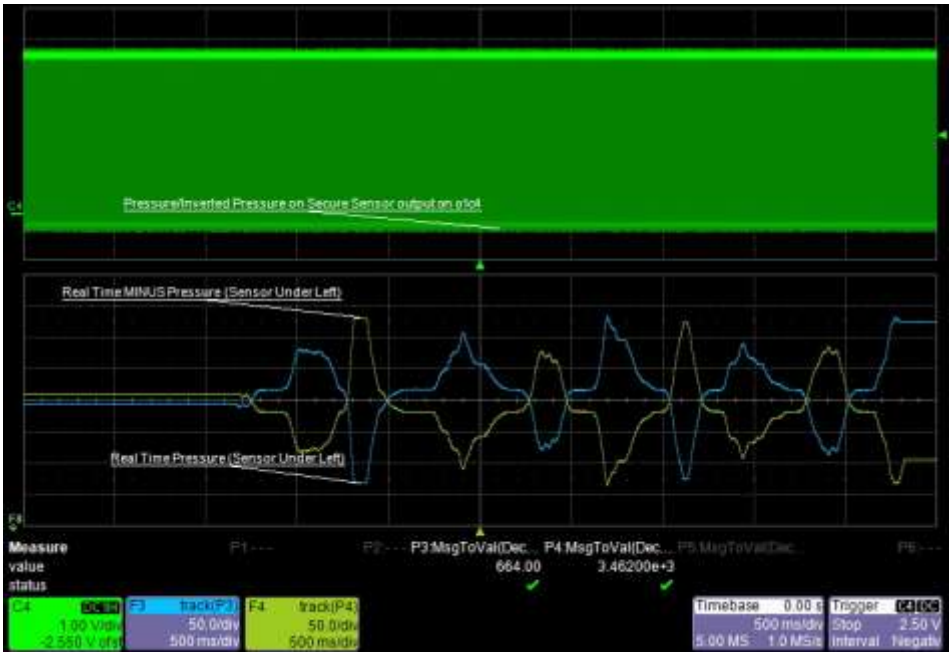
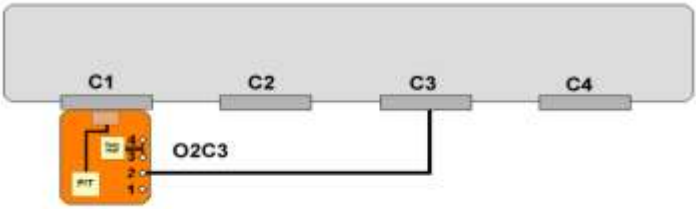


Figure 22 Pressure and its inverse monitored using 2 Tracks

Demo 50 for P/Cnt/Inv MSN sensor using 2 Trends

Schematic	
Panel File	**50_ C1_o2C3_P_Cnt_Decode_and_Trend.lss**
Comments	Only available on LAH 101. In order to stimulated the sensor, the housing needs to be removed. Pressure values is emited using 12 bits, running comuter using 8 bits and Inverse of Most Significant Nibble of Pressure using 4 bits. Note how the MSN Trend stays flat because the stimulation is too weak to induce an MSN change.
Stimulation	Use the syringe to increse decrease the pressure.

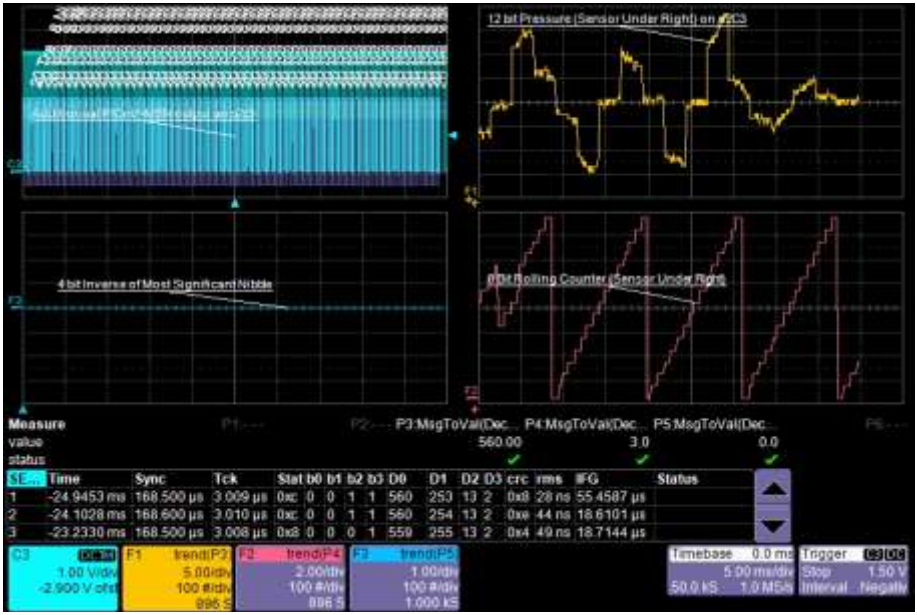
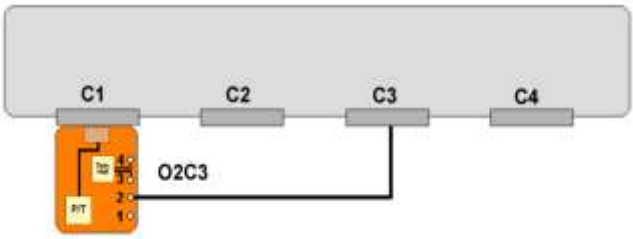


Figure 23 Pressure and Running counter monitored using Trends

Demo 51 for P/Cnt/Inv MSN sensor using 2 Tracks

Schematic	
Panel File	**51_ C1_o2C3_P_Cnt_Decode_and_Track.lss**
Comments	Only available on LAH 101. In order to stimulated the sensor, the housing needs to be removed. Pressure values is emited using 12 bits, running comuter using 8 bits and Inverse of Most Significant Nibble of Pressure using 4 bits Note the Tracks dedicated to the MSN and its inverse. Note how theyr are inverse of one another. Note how the MSN does not move under a certain pressure threshold.
Stimulation	Use the syringe to increse decrease the pressure on the sensor underneath and right on LAH101

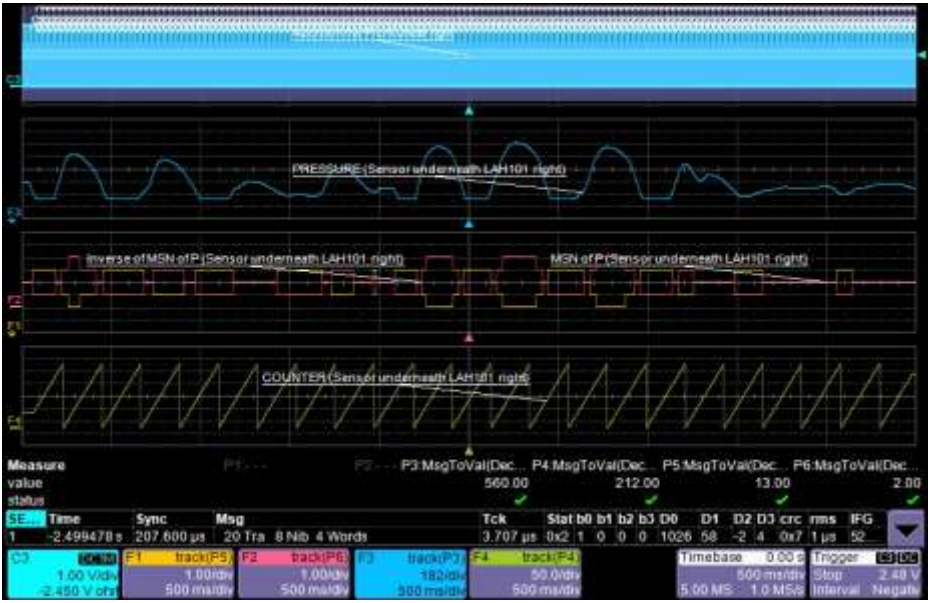


Figure 24 Pressure, Running counter and more monitored using Tracks