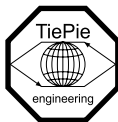


Handyscope HS6

User manual



TiePie engineering

ATTENTION!

Measuring directly on the **line voltage** can be very dangerous.

The **outside** of the **BNC connectors** at the Handyscope HS6 are connected with the **ground** of the computer. Use a good isolation transformer or a differential probe when measuring at the **line voltage** or at **grounded power supplies**! A short-circuit current will flow if the **ground** of the Handyscope HS6 is connected to a positive voltage. This short-circuit current can damage both the Handyscope HS6 and the computer.

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Revision 2.43, July 2023

Despite the care taken for the compilation of this user manual, TiePie engineering can not be held responsible for any damage resulting from errors that may appear in this manual.

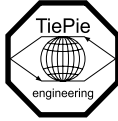
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When working with electricity, no instrument can guarantee complete safety. It is the responsibility of the person who works with the instrument to operate it in a safe way. Maximum security is achieved by selecting the proper instruments and following safe working procedures. Safe working tips are given below:

- Always work according (local) regulations.
- Work on installations with voltages higher than 25 V_{AC} or 60 V_{DC} should only be performed by qualified personnel.
- Avoid working alone.
- Observe all indications on the Handyscope HS6 before connecting any wiring
- Check the probes/test leads for damages. Do **not** use them if they are damaged
- Take care when measuring at voltages higher than 25 V_{AC} or 60 V_{DC}.
- Do not operate the equipment in an explosive atmosphere or in the presence of flammable gases or fumes.
- Do not use the equipment if it does not operate properly. Have the equipment inspected by qualified service personal. If necessary, return the equipment to TiePie engineering for service and repair to ensure that safety features are maintained.
- Measuring directly on the **line voltage** can be very dangerous. The **outside** of the **BNC connectors** at the Handyscope HS6 are connected with the **ground** of the computer. Use a good isolation transformer or a differential probe when measuring at the **line voltage** or at **grounded power supplies**! A short-circuit current will flow if the **ground** of the Handyscope HS6 is connected to a positive voltage. This short-circuit current can damage both the Handyscope HS6 and the computer.



TiePie engineering
Koperslagersstraat 37
8601 WL Sneek
The Netherlands

EC Declaration of conformity

We declare, on our own responsibility, that the product

Handyscope HS6-1000(XM/E/S)
Handyscope HS6-500(XM/E/S)
Handyscope HS6-200(XM/E/S)

for which this declaration is valid, is in compliance with

EC directive 2011/65/EU (the RoHS directive)
including up to amendment 2021/1980,

EC regulation 1907/2006 (REACH)
including up to amendment 2021/2045,

and with

EN 55011:2016/A1:2017
EN 55022:2011/C1:2011

IEC 61000-6-1:2019 EN
IEC 61000-6-3:2007/A1:2011/C11:2012 EN

according the conditions of the EMC standard 2004/108/EC,

also with

Canada: ICES-001:2004

Australia/New Zealand: AS/NZS CISPR 11:2011

and

IEC 61010-1:2010/A1:2019

USA: UL 61010-1, Edition 3

and is categorized as 30 Vrms, 42 Vpk, 60 Vdc

Sneek, 1-9-2022
ir. A.P.W.M. Poelsma

A handwritten signature in blue ink, appearing to read 'A.P.W.M. Poelsma', written over a blue horizontal line.

Environmental considerations

This section provides information about the environmental impact of the Handyscope HS6.

End-of-life handling

Production of the Handyscope HS6 required the extraction and use of natural resources. The equipment may contain substances that could be harmful to the environment or human health if improperly handled at the Handyscope HS6's end of life.



In order to avoid release of such substances into the environment and to reduce the use of natural resources, recycle the Handyscope HS6 in an appropriate system that will ensure that most of the materials are reused or recycled appropriately.

The shown symbol indicates that the Handyscope HS6 complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE).



Before using the Handyscope HS6 first read chapter 1 about safety.

Many technicians investigate electrical signals. Though the measurement may not be electrical, the physical variable is often converted to an electrical signal, with a special transducer. Common transducers are accelerometers, pressure probes, current clamps and temperature probes. The advantages of converting the physical parameters to electrical signals are large, since many instruments for examining electrical signals are available.

The Handyscope HS6 is a portable four channel measuring instrument with single ended inputs. It is available in several models with different maximum sampling rates. The native resolutions are 8, 12 and 14 bits and a user selectable resolution of 16 bits is available too, with adjusted maximum sampling rates:

| Measuring | | Model | | |
|------------|-----------|------------|-------------|------------|
| Resolution | Channels | HS6-1000 | HS6-500 | HS6-200 |
| 8 bit | 1 ch | 1 GSa/s | 500 MSa/s | 200 MSa/s |
| | 2 ch | 500 MSa/s | 200 MSa/s | 100 MSa/s |
| | 3 or 4 ch | 200 MSa/s | 100 MSa/s | 50 MSa/s |
| 12 bit | 1 ch | 500 MSa/s | 200 MSa/s | 100 MSa/s |
| | 2 ch | 200 MSa/s | 100 MSa/s | 50 MSa/s |
| | 3 or 4 ch | 100 MSa/s | 50 MSa/s | 20 MSa/s |
| 14 bit | | 100 MSa/s | 50 MSa/s | 20 MSa/s |
| 16 bit | | 6.25 MSa/s | 3.125 MSa/s | 1.25 MSa/s |

Table 3.1: Maximum sampling rates

The Handyscope HS6 is available with two memory configurations, these are:

| Measuring | | Model | |
|----------------|-----------|----------|----------------|
| Resolution | Channels | Standard | with XM option |
| 8 bit | 1 ch | 1 Mpts | 256 Mpts |
| | 2 ch | 512 Kpts | 128 Mpts |
| | 3 or 4 ch | 256 Kpts | 64 Mpts |
| 12, 14, 16 bit | 1 ch | 512 Kpts | 128 Mpts |
| | 2 ch | 256 Kpts | 64 Mpts |
| | 3 or 4 ch | 128 Kpts | 32 Mpts |

Table 3.2: Maximum record lengths per channel

The Handyscope HS6 supports high speed continuous streaming measurements. The maximum streaming rates when connected to a USB 3.0 port are:

| Measuring | | Model | | |
|------------|-----------|-------------------------|-------------------------|------------|
| Resolution | Channels | HS6-1000 | HS6-500 | HS6-200 |
| 8 bit | 1 ch | 200 MSa/s ¹ | 100 MSa/s ¹ | 40 MSa/s |
| | 2 ch | 100 MSa/s ² | 50 MSa/s ² | 20 MSa/s |
| | 3 or 4 ch | 50 MSa/s ³ | 25 MSa/s ³ | 10 MSa/s |
| 12 bit | 1 ch | 100 MSa/s ² | 50 MSa/s ² | 20 MSa/s |
| | 2 ch | 50 MSa/s ³ | 25 MSa/s ³ | 10 MSa/s |
| | 3 or 4 ch | 25 MSa/s ⁴ | 12.5 MSa/s ⁴ | 5 MSa/s |
| 14 bit | 1 ch | 100 MSa/s ² | 50 MSa/s ² | 20 MSa/s |
| | 2 ch | 50 MSa/s ³ | 25 MSa/s ³ | 10 MSa/s |
| | 3 or 4 ch | 25 MSa/s ⁴ | 12.5 MSa/s ⁴ | 5 MSa/s |
| 16 bit | | 6.25 MSa/s ⁵ | 3.125 MSa/s | 1.25 MSa/s |

Table 3.3: Maximum streaming rates


¹ ≤ 40 MSa/s when connected to USB 2.0


² ≤ 20 MSa/s when connected to USB 2.0

³ ≤ 10 MSa/s when connected to USB 2.0

⁴ ≤ 5 MSa/s when connected to USB 2.0

⁵ ≤ 3.125 MSa/s when connected to USB 2.0, measuring 3 or 4 channels

Optionally available for the Handyscope HS6 is **SureConnect** connection test. **SureConnect** connection test tells you immediately whether your test probe or clip actually makes electrical contact or not. No more doubt whether your probe doesn't make contact or there really is no signal. This is useful when surfaces are oxidized and your probe cannot get a good electrical contact. Simply activate the **SureConnect** and you know whether there is contact or not. Also when back probing connectors in confined places, **SureConnect** immediately shows whether the probes make contact or not. 

Models of the Handyscope HS6 with **SureConnect** come with resistance measurement on all channels. Resistances up to 2 MOhm can be measured directly. Resistance can be shown in meter displays and can also be plotted versus time in a graph, creating an Ohm scope. 

With the accompanying software the Handyscope HS6 can be used as an oscilloscope, a spectrum analyzer, a true RMS voltmeter or a transient recorder. All instruments measure by sampling the input signals, digitizing the values, process them, save them and display them.

3.1 Sampling

When sampling the input signal, samples are taken at fixed intervals. At these intervals, the size of the input signal is converted to a number. The accuracy of this number depends on the resolution of the instrument. The higher the resolution, the smaller the voltage steps in which the input range of the instrument is divided. The acquired numbers can be used for various purposes, e.g. to create a graph.

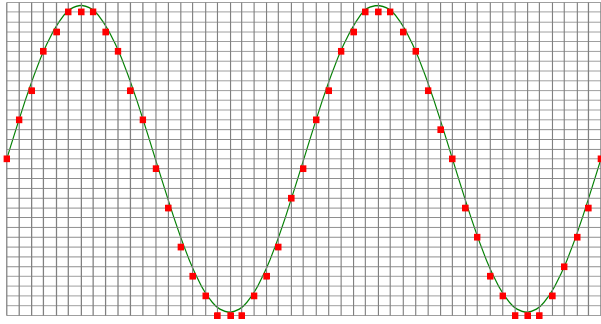


Figure 3.1: Sampling

The sine wave in figure 3.1 is sampled at the dot positions. By connecting the adjacent samples, the original signal can be reconstructed from the samples. You can see the result in figure 3.2.

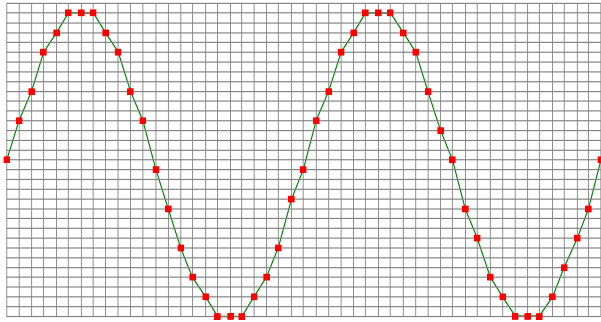


Figure 3.2: "connecting" the samples

3.2 Sampling rate

The rate at which the samples are taken is called the **sampling rate**, the number of samples per second. A higher sampling rate corresponds to a shorter interval between the samples. As is visible in figure 3.3, with a higher sampling rate, the original signal can be reconstructed much better from the measured samples.

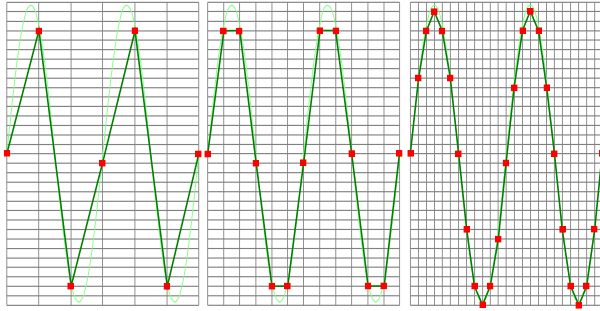


Figure 3.3: The effect of the sampling rate

The sampling rate must be higher than 2 times the highest frequency in the input signal. This is called the **Nyquist frequency**. Theoretically it is possible to reconstruct the input signal with more than 2 samples per period. In practice, 10 to 20 samples per period are recommended to be able to examine the signal thoroughly.

3.2.1 Aliasing

When sampling an analog signal with a certain sampling rate, signals appear in the output with frequencies equal to the sum and difference of the signal frequency and multiples of the sampling rate. For example, when the sampling rate is 1000 Sa/s and the signal frequency is 1250 Hz, the following signal frequencies will be present in the output data:

| Multiple of sampling rate | 1250 Hz signal | -1250 Hz signal |
|---------------------------|-------------------------------|------------------------|
| ... | | |
| -1000 | $-1000 + 1250 = \mathbf{250}$ | $-1000 - 1250 = -2250$ |
| 0 | $0 + 1250 = 1250$ | $0 - 1250 = -1250$ |
| 1000 | $1000 + 1250 = 2250$ | $1000 - 1250 = -250$ |
| 2000 | $2000 + 1250 = 3250$ | $2000 - 1250 = 750$ |
| ... | | |

Table 3.4: Aliasing

As stated before, when sampling a signal, only frequencies lower than half the sampling rate can be reconstructed. In this case the sampling rate is 1000 Sa/s, so we can only observe signals with a frequency ranging from 0 to 500 Hz. This means that from the resulting frequencies in the table, we can only see the 250 Hz signal in the sampled data. This signal is called an **alias** of the original signal.

If the sampling rate is lower than twice the frequency of the input signal, **aliasing** will occur. The following illustration shows what happens.

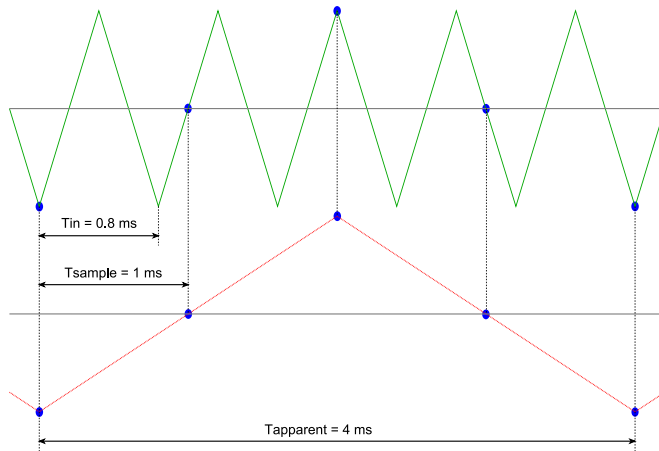


Figure 3.4: Aliasing

In figure 3.4, the green input signal (top) is a triangular signal with a frequency of 1.25 kHz. The signal is sampled with a rate of 1 kSa/s. The corresponding sampling interval is $1/1000\text{Hz} = 1 \text{ ms}$. The positions at which the signal is sampled are depicted with the blue dots. The red dotted signal (bottom) is the result of the reconstruction. The period time of this triangular signal appears to be 4 ms, which corresponds to an apparent frequency (alias) of 250 Hz ($1.25 \text{ kHz} - 1 \text{ kHz}$).



To avoid aliasing, always start measuring at the highest sampling rate and lower the sampling rate if required.

3.3 Digitizing

When digitizing the samples, the voltage at each sample time is converted to a number. This is done by comparing the voltage with a number of levels. The resulting number is the number corresponding to the level that is closest to the voltage. The number of levels is determined by the resolution, according to the following relation: $LevelCount = 2^{Resolution}$.

The higher the **resolution**, the more levels are available and the more accurate the input signal can be reconstructed. In figure 3.5, the same signal is digitized, using two different amounts of levels: 16 (4-bit) and 64 (6-bit).

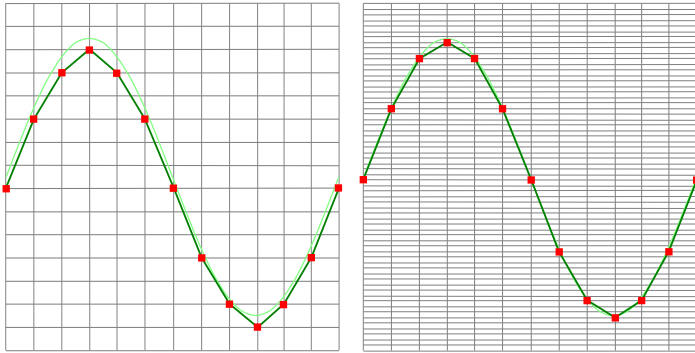


Figure 3.5: The effect of the resolution

The Handscope HS6 measures at e.g. 14 bit resolution ($2^{14}=16384$ levels). The smallest detectable voltage step depends on the input range. This voltage can be calculated as:

$$\text{VoltageStep} = \text{FullInputRange} / \text{LevelCount}$$

For example, the 200 mV range ranges from -200 mV to +200 mV, therefore the full range is 400 mV. This results in a smallest detectable voltage step of $0.400 \text{ V} / 16384 = 24.41 \mu\text{V}$.

3.4 Signal coupling

The Handscope HS6 has two different settings for the signal coupling: AC and DC. In the setting DC, the signal is directly coupled to the input circuit. All signal components available in the input signal will arrive at the input circuit and will be measured.

In the setting AC, a capacitor will be placed between the input connector and the input circuit. This capacitor will block all DC components of the input signal and let all AC components pass through. This can be used to remove a large DC component of the input signal, to be able to measure a small AC component at high resolution.



When measuring DC signals, make sure to set the signal coupling of the input to DC.

3.5 Probe compensation

The Handscope HS6 is shipped with a probe for each input channel. These are 1x/10x selectable passive probes. This means that the input signal is passed through directly or 10 times attenuated.



When using an oscilloscope probe in 1:1 the setting, the bandwidth of the probe is only 6 MHz. The full bandwidth of the probe is only obtained in the 1:10 setting

The x10 attenuation is achieved by means of an attenuation network. This attenuation network has to be adjusted to the oscilloscope input circuitry, to guarantee frequency independency. This is called the low frequency compensation. Each time a probe is used on an other channel or an other oscilloscope, the probe must be adjusted.

Therefore the probe is equipped with a setscrew, with which the parallel capacity of the attenuation network can be altered. To adjust the probe, switch the probe to the x10 and attach the probe to a 1 kHz square wave signal. This signal is available at pin 3 of the 9 pin extension connector at the rear of the Handyscope HS6. Then adjust the probe for a square front corner on the square wave displayed. See also the following illustrations.

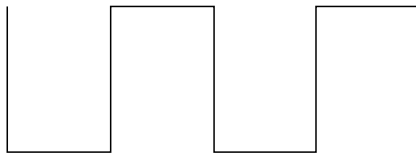


Figure 3.6: correct

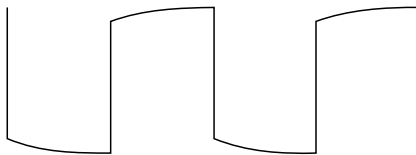


Figure 3.7: under compensated

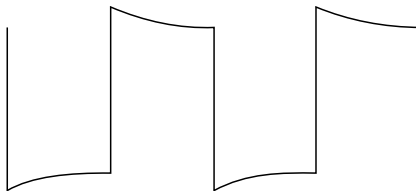


Figure 3.8: over compensated



Before connecting the Handyscope HS6 to the computer, the drivers need to be installed.

4.1 Introduction

To operate a Handyscope HS6, a driver is required to interface between the measurement software and the instrument. This driver takes care of the low level communication between the computer and the instrument, through USB. When the driver is not installed, or an old, no longer compatible version of the driver is installed, the software will not be able to operate the Handyscope HS6 properly or even detect it at all.

4.2 Computers running Windows 10

When the Handyscope HS6 is plugged in into a USB port of the computer, Windows will detect the instrument and will download the required driver from Windows Update. When the download is finished, the driver will be installed automatically.

4.3 Computers running Windows 8 or older

The installation of the USB driver is done in a few steps. Firstly, the driver has to be pre-installed by the driver setup program. This makes sure that all required files are located where Windows can find them. When the instrument is plugged in, Windows will detect new hardware and install the required drivers.

4.3.1 Where to find the driver setup

The driver setup program and measurement software can be found in the download section on TiePie engineering's website. It is recommended to install the latest version of the software and USB driver from the website. This will guarantee the latest features are included.

4.3.2 Executing the installation utility

To start the driver installation, execute the downloaded driver setup program. The driver install utility can be used for a first time installation of a driver on a system and also to update an existing driver.

The screen shots in this description may differ from the ones displayed on your computer, depending on the Windows version.

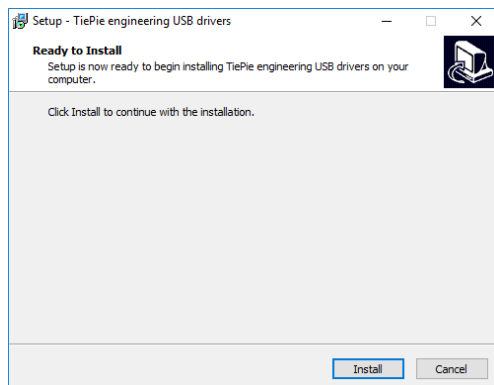


Figure 4.1: Driver install: step 1

When drivers were already installed, the install utility will remove them before installing the new driver. To remove the old driver successfully, **it is essential** that the Handyscope HS6 is disconnected from the computer prior to starting the driver install utility. When the Handyscope HS6 is used with an external power supply, this must be disconnected too.

Clicking ***“Install”*** will remove existing drivers and install the new driver. A *remove entry* for the new driver is added to the software applet in the Windows control panel.

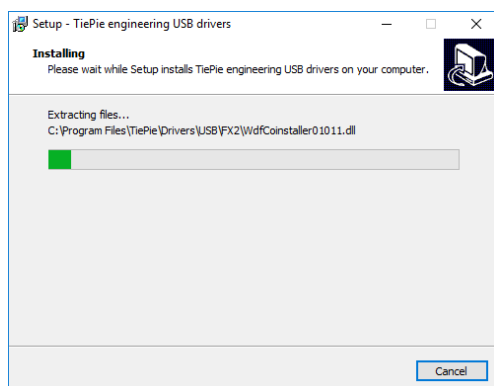


Figure 4.2: Driver install: Copying files

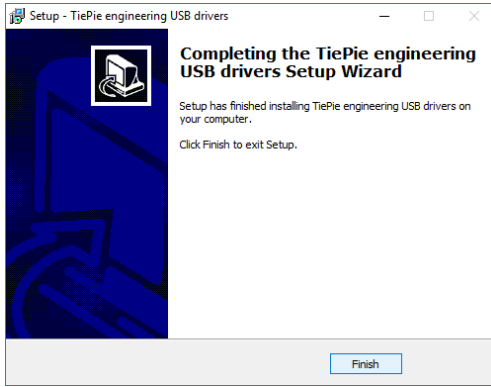


Figure 4.3: Driver install: Finished



Drivers have to be installed before the Handyscope HS6 is connected to the computer for the first time. See chapter 4 for more information.

5.1 Power the instrument

The Handyscope HS6 is powered by the USB, no external power supply is required. Only connect the Handyscope HS6 to a bus powered USB port, otherwise it may not get enough power to operate properly.

5.1.1 External power

In certain cases, the Handyscope HS6 cannot get enough power from the USB port. When a Handyscope HS6 is connected to a USB port, powering the hardware will result in an inrush current higher than the nominal current. After the inrush current, the current will stabilize at the nominal current.

USB ports have a maximum limit for both the inrush current peak and the nominal current. When either of them is exceeded, the USB port will be switched off. As a result, the connection to the Handyscope HS6 will be lost.

Most USB ports can supply enough current for the Handyscope HS6 to work without an external power supply, but this is not always the case. Some (battery operated) portable computers or (bus powered) USB hubs do not supply enough current. The exact value at which the power is switched off, varies per USB controller, so it is possible that the Handyscope HS6 functions properly on one computer, but does not on another.

The Handyscope HS6 comes with a universal power supply, that can be connected to a power outlet using the appropriate adapter. The 3.5 mm connector attached to the power supply must be plugged into the power connector at the rear of the Handyscope HS6. Refer to paragraph 8.1 for specifications of the external power input.

5.2 Connect the instrument to the computer

After the new driver has been pre-installed (see chapter 4), the Handyscope HS6 can be connected to the computer. When the Handyscope HS6 is connected to a USB port of the computer, Windows will detect new hardware.

Depending on the Windows version, a notification can be shown that new hardware is found and that drivers will be installed. Once ready, Windows will report that the driver is installed.

When the driver is installed, the measurement software can be installed and the Handyscope HS6 can be used.

5.3 Plug into a different USB port

When the Handyscope HS6 is plugged into a different USB port, some Windows versions will treat the Handyscope HS6 as different hardware and will install the

drivers again for that port. This is controlled by Microsoft Windows and is not caused by TiePie engineering.

5.4 Operating conditions

The Handyscope HS6 is ready for use as soon as the software is started. However, to achieve rated accuracy, allow the instrument to settle for 20 minutes. If the instrument has been subjected to extreme temperatures, allow additional time for internal temperatures to stabilize. Because of temperature compensated calibration, the Handyscope HS6 will settle within specified accuracy regardless of the surrounding temperature.

Combining instruments

When more channels are required than one instrument can offer, multiple instruments can be combined into a larger combined instrument. To combine two or more instruments, the instruments need to be connected to each other using special cables.

The CMI (Combine Multiple Instruments) interface that is available by default on the Handyscope HS6 provides an easy way to couple multiple oscilloscopes to one combined oscilloscope.

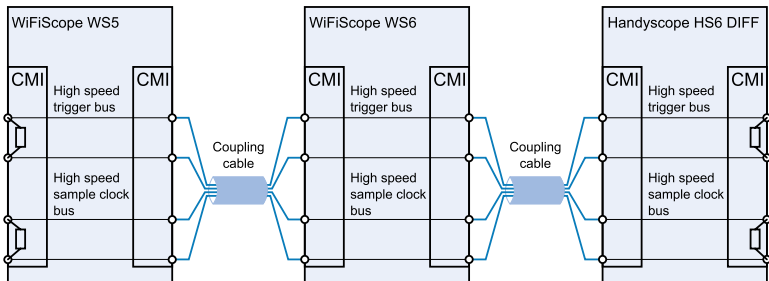


Figure 6.1: CMI diagram

The CMI interface supports automatic recognition of the instrument. The high speed trigger bus is automatically terminated with the correct impedance and the high speed sampling bus is automatically configured and terminated at the beginning and end of the bus. The high speed sampling bus takes care that each Handyscope is fully synchronized to ensure that even at the highest sampling rate the instruments operate at the same sample clock (0 ppm clock error!). The connection order when combining multiple instruments is not important. The CMI interface has built-in intelligence to detect the connections and terminate all buses properly at both ends of the bus. So instruments can be connected to each other in random order. Placing terminators and determining the proper connection order is not required!

Advantages of the CMI (Combine Multiple Instruments) interface are:

- automatic instrument recognition,
- automatic creation and termination of the high speed trigger bus,
- automatic creation and termination of the high speed sampling bus,
- automatic master/slave setting of the sampling clock bus.

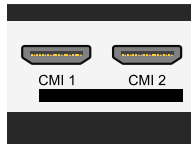


Figure 6.2: CMI connectors

Connecting is done by daisy chaining the CMI connectors of the instruments prior to starting the software, using special coupling cables (order number TP-C50H). The software will detect how the instruments are connected to each other and will automatically terminate the connection bus. The software will combine the connected instruments to one large instrument. The combined instruments will sample using the same clock, with a deviation of 0 ppm.



Figure 6.3: Multiple Handyscope HS6s combined

A 20 channel instrument is easily made by connecting five Handyscope HS6s to each other.

When combining one or more Handyscope HS6s with other instruments including Handyscope HS5s and/or WiFiScope WS5s, the daisy chained CMI bus must begin or end with a Handyscope HS6, Handyscope HS6 DIFF, WiFiScope WS6, WiFiScope WS6 DIFF, Automotive Test Scope ATS610004D-XMSG, Automotive Test Scope ATS605004D-XMS, Automotive Test Scope ATS610004DW-XMSG or Automotive Test Scope ATS605004DW-XMS. Additionally, the maximum sampling rate is limited to 100 MSa/s at 14 bit resolution.

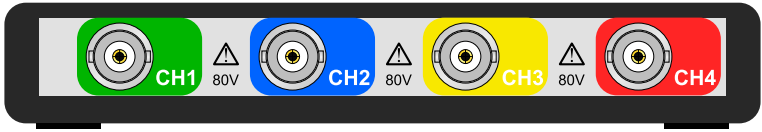


Figure 7.1: Front panel

7.1 Channel input connectors

The CH1 – CH4 BNC connectors are the main inputs of the acquisition system. The outside of all four BNC connectors is connected to the ground of the HandyScope HS6. Connecting the outside of the BNC connector to a potential other than ground will result in a short circuit that may damage the device under test, the HandyScope HS6 and the computer.

7.2 Power indicator

A power indicator is situated at the top cover of the instrument. It is lit when the HandyScope HS6 is powered.

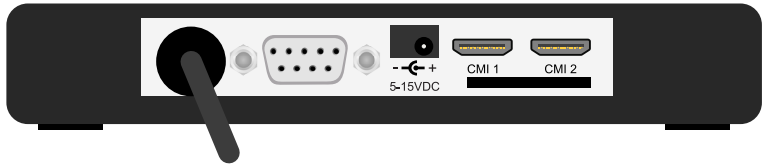


Figure 8.1: Rear panel

8.1 Power

The Handyscope HS6 is powered through the USB. If the USB cannot supply enough power, it is possible to power the instrument externally. The Handyscope HS6 has two external power inputs located at the rear of the instrument: the dedicated power connector and a pin of the 9 pin D-sub extension connector. The specifications of the dedicated power connector are:



| Pin | Dimension | Description |
|-----------------|-----------|-------------|
| Center pin | Ø1.3 mm | positive |
| Outside bushing | Ø3.5 mm | ground |

Figure 8.2: Power connector

To power the instrument through the extension connector, the power has to be applied to pin 7 of the extension connector. Pin 6 can be used as ground. The following minimum and maximum voltages apply to the power inputs:

| | |
|---------|--------------------------------|
| Minimum | 4.5 V _{DC} / 2 A max. |
| Maximum | 15 V _{DC} / 1 A max. |

Table 8.1: Maximum voltages

Note that the externally applied voltage should be higher than the USB voltage to relieve the USB port.

8.1.1 Power adapter

The Handyscope HS6 comes with an external power adapter that can be connected to any mains power net that supplies 100 – 240 V_{AC}, 50 – 60 Hz. The external power adapter can be connected to the dedicated power connector.



Figure 8.3: Power adapter

8.1.2 USB power cable

A special USB external power cable is supplied with the Handyscope HS6 that can be used instead of a power adapter. One end of this cable can be connected to a second USB port on the computer, the other end can be plugged in the dedicated power connector at the rear of the instrument. The power for the instrument will then be taken from two USB ports.



Figure 8.4: USB power cable

8.2 USB

The Handyscope HS6 is equipped with a USB 3.0 Super speed (5 Gbit/s) interface with a fixed cable with type A plug. It will also work on a computer with a USB 2.0 interface, but will then operate at 480 Mbit/s.

8.3 Extension Connector



Figure 8.5: Extension connector

A 9 pin female D-sub connector is available at the back of the Handyscope HS6 containing the following signals:

| Pin | Description | Pin | Description | Pin | Description |
|-----|----------------|-----|-------------|-----|-------------------|
| 1 | EXT 1 (LVTTTL) | 4 | reserved | 7 | Power IN |
| 2 | EXT 2 (LVTTTL) | 5 | reserved | 8 | Power OUT |
| 3 | Probe Cal | 6 | GND | 9 | External Clock in |

Table 8.2: Pin description Extension connector

Pins EXT 1 and EXT 2 are equipped with internal 1 kOhm pull-up resistors to 2.5 V. These pins can simultaneously be used as inputs and outputs. Each pin can be configured as external digital trigger input for the acquisition system of the Handyscope HS6.

Pin 3, Probe Cal, has a 1 kHz, -1 V to 1 V square wave signal that can be used to perform probe frequency compensations.

Pin 8, Power OUT, has the same potential as the Handyscope HS6 power supply. When the Handyscope HS6 is USB powered, it is at USB power level. When the Handyscope HS6 is externally powered, it is at the same level as the external power input.

The External Clock In signal must be a 10 MHz \pm 1% or a 16.369 MHz \pm 1% 2.5 V TTL signal.

8.4 CMI

The Handyscope HS6 has two Combine Multiple Instruments interface (CMI) connectors at the rear of the instrument. These are used to combine multiple instruments to a single combined instrument to perform fully synchronized measurements. This requires one TP-C50H coupling cable per two instruments.

They can also be used to get an external sampling clock OUT.



Figure 8.6: CMI connector

| Pin | Description |
|-----|----------------------|
| 1 | GND |
| 2 | EXT CLK OUT P (LVDS) |
| 3 | EXT CLK OUT N (LVDS) |

Table 8.3: Pin description CMI connector



The CMI connectors use HDMI type C sockets, but are not HDMI compliant. They can not be used to connect an HDMI device to the Handyscope HS6.

8.5 Ventilation slot

Below the two CMI connectors a ventilation slot is located, with a fan behind it.

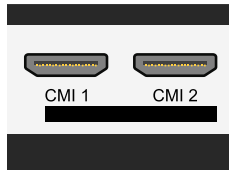


Figure 8.7: Ventilation slot



Do not block the ventilation slot as this may cause the Handyscope HS6 becoming too hot.
Do not insert objects in the ventilation slot as this may damage the fan.

To achieve rated accuracy, allow the instrument to settle for 20 minutes. When subjected to extreme temperatures, allow additional time for internal temperatures to stabilize. Because of temperature compensated calibration, the Handy-scope HS6 will settle within specified accuracy regardless of the surrounding temperature.

9.1 Acquisition system

| | | | |
|----------------------------------|---|---|---|
| Number of input channels | 4 analog | | |
| CH1, CH2, CH3, CH4 | BNC, female | | |
| Type | Single ended input | | |
| Resolution | 8, 12, 14, 16 bit user selectable | | |
| Accuracy | 0.25% of full scale \pm 1 LSB | | |
| Ranges (full scale) | \pm 200 mV \pm 2 V \pm 20 V | \pm 400 mV \pm 4 V \pm 40 V | \pm 800 mV \pm 8 V \pm 80 V |
| Ranges (full scale) | \pm 200 mV \pm 2 V \pm 20 V | \pm 400 mV \pm 4 V \pm 40 V | \pm 800 mV \pm 8 V \pm 80 V |
| Coupling | AC/DC | | |
| Impedance | 1 M Ω / 20 pF \pm 1 % | | |
| Noise | 240 μ V _{RMS} (200 mV range, 12 bit, 50 MSa/s) 90 μ V _{RMS} (200 mV range, 16 bit, 6.25 MSa/s) | | |
| Maximum voltage | 200 V (DC + AC peak <10 kHz) | | |
| Bandwidth | HS6-1000 | HS6-500 | HS6-200 |
| -3 dB, at 75 % of full scale | 250 MHz | 250 MHz | 250 MHz |
| Limit, selectable per channel | Off (250 MHz) 150 MHz 100 MHz 50 MHz | Off (250 MHz) 150 MHz 100 MHz 50 MHz | Off (250 MHz) 150 MHz 100 MHz 50 MHz |
| AC coupling cut off freq. (-3dB) | \pm 1.5 Hz | | |
| SureConnect | Optionally available (option S) | | |
| Maximum voltage on connection | 200 V (DC + AC peak <10 kHz) | | |
| Resistance measurement | Optionally available (option S) | | |
| Ranges | 100 Ohm to 2 MOhm full scale | | |
| Accuracy | 1% | | |
| Response time (to 95%) | <10 μ s | | |

9.2 Acquisition system (continued)

| | | | |
|-------------------------------------|---|-------------------------|------------|
| Maximum sampling rate | HS6-1000 | HS6-500 | HS6-200 |
| 8 bit | | | |
| Measuring 1 channel | 1 GSa/s | 500 MSa/s | 200 MSa/s |
| Measuring 2 channels | 500 MSa/s | 200 MSa/s | 100 MSa/s |
| Measuring 3 or 4 channels | 200 MSa/s | 100 MSa/s | 50 MSa/s |
| 12 bit | | | |
| Measuring 1 channel | 500 MSa/s | 200 MSa/s | 100 MSa/s |
| Measuring 2 channels | 200 MSa/s | 100 MSa/s | 50 MSa/s |
| Measuring 3 or 4 channels | 100 MSa/s | 50 MSa/s | 20 MSa/s |
| 14 bit | 100 MSa/s | 50 MSa/s | 20 MSa/s |
| 16 bit | 6.25 MSa/s | 3.125 MSa/s | 1.25 MSa/s |
| Maximum streaming rate ⁶ | HS6-1000 | HS6-500 | HS6-200 |
| 8 bit | | | |
| Measuring 1 channel | 200 MSa/s ¹ | 100 MSa/s ¹ | 40 MSa/s |
| Measuring 2 channels | 100 MSa/s ² | 50 MSa/s ² | 20 MSa/s |
| Measuring 3 or 4 channels | 50 MSa/s ³ | 25 MSa/s ³ | 10 MSa/s |
| 12 bit | | | |
| Measuring 1 channel | 100 MSa/s ² | 50 MSa/s ² | 20 MSa/s |
| Measuring 2 channels | 50 MSa/s ³ | 25 MSa/s ³ | 10 MSa/s |
| Measuring 3 or 4 channels | 25 MSa/s ⁴ | 12.5 MSa/s ⁴ | 5 MSa/s |
| 14 bit | | | |
| Measuring 1 channel | 100 MSa/s ² | 50 MSa/s ² | 20 MSa/s |
| Measuring 2 channels | 50 MSa/s ³ | 25 MSa/s ³ | 10 MSa/s |
| Measuring 3 or 4 channels | 25 MSa/s ⁴ | 12.5 MSa/s ⁴ | 5 MSa/s |
| 16 bit | 6.25 MSa/s ⁵ | 3.125 MSa/s | 1.25 MSa/s |
| | ¹ ≤ 40 MSa/s when connected to USB 2 | | |
| | ² ≤ 20 MSa/s when connected to USB 2 | | |
| | ³ ≤ 10 MSa/s when connected to USB 2 | | |
| | ⁴ ≤ 5 MSa/s when connected to USB 2 | | |
| | ⁵ ≤ 3.125 MSa/s when connected to USB 2, measuring 2 or more channels | | |
| | ⁶ On some computers, the highest streaming rates may not be available, due to computer restrictions. | | |
| Sampling source | | | |
| Internal | TCXO | | |
| Accuracy | ±0.0001% | | |
| Stability | ±1 ppm over 0 °C to +55 °C | | |
| Time base aging | ±1 ppm per year time base aging | | |
| External | LVDS, on CMI connectors | | |
| Input range | 10 MHz ±1 % 16.369 MHz ±1 % | | |
| Memory | Standard model | XM option | |
| 8 bit | | | |
| Measuring 1 channel | 1 Mpts | 256 Mpts | |
| Measuring 2 channels | 512 Kpts | 128 Mpts | |
| Measuring 3 or 4 channels | 256 Kpts | 64 Mpts | |
| 12, 14, 16 bit | | | |
| Measuring 1 channel | 512 Kpts | 128 Mpts | |
| Measuring 2 channels | 256 Kpts | 64 Mpts | |
| Measuring 3 or 4 channels | 128 Kpts | 32 Mpts | |

9.3 Trigger system

| | |
|--------------------------|--|
| System | Digital, 2 levels |
| Source | CH1, CH2, CH3, CH4, digital external, OR |
| Trigger modes | Rising edge, falling edge, any edge, inside window, outside window, enter window, exit window, pulse width |
| Level adjustment | 0 to 100% of full scale |
| Hysteresis adjustment | 0 to 100% of full scale |
| Resolution | 0.024 % (12 bits)/0.006 % (14/16 bits) |
| Pre trigger | 0 to selected record length, 1 sample resolution |
| Post trigger | 0 to selected record length, 1 sample resolution |
| Trigger hold-off | 0 to 64 MSamples, 1 sample resolution |
| Trigger delay | 0 to 16 GSamples, 1 sample resolution |
| Digital external trigger | |
| Input | Extension connector pins 1 and 2 |
| Range | 0 to 2.5 V (TTL) |
| Coupling | DC |
| Jitter | ≤ 1 sample |

9.4 Multi-instrument synchronization

| | | |
|---------------------------------|---|--------------------------|
| Using CMI | Combining instruments is only available when all instruments are connected via USB. When connected via LAN or WiFi, combining is not available. | |
| Maximum number of instruments | Limited by available number of USB ports | |
| Synchronization accuracy | 0 ppm | |
| CMI interface | 2x, CMI 1, CMI 2 | |
| Required coupling cable | TP-C50H Coupling cable CMI | |
| Maximum coupling cable length | 50 cm | |
| Using WCMI | | |
| Maximum number of instruments | No limitation | |
| Required coupling module | WCMI-8 | |
| Clock synchronization accuracy | ≤ 1 ppm, typical ≤ 0.2 ppm | |
| Trigger jitter at sample rate * | ≤ 1 MSa/s | > 1 MSa/s |
| 2 x "5" | $\leq \pm 2$ samples | $\leq \pm 2 \mu\text{s}$ |
| "5" and "6" | | |
| Trigger source = "5" | $\leq \pm 2$ samples | $\leq \pm 2 \mu\text{s}$ |
| Trigger source = "6" | $\leq \pm 8$ samples | $\leq \pm 8 \mu\text{s}$ |
| 2 x "6" | $\leq \pm 8$ samples | $\leq \pm 8 \mu\text{s}$ |

* "5" = WiFiScope WS5 or Handyscope HS5

"6" = WiFiScope WS6 (DIFF) or Handyscope HS6 (DIFF)

9.5 Probe calibration

| | |
|-----------|--|
| Output | Extension connector pins 3 (signal) and 6 (ground) |
| Signal | Square wave |
| Level | -1 V to 1 V |
| Frequency | 1 kHz |

9.6 Power

| | |
|-----------------------------|--|
| Power | From USB or external input |
| Consumption | 5 V _{DC} , 1200 mA max |
| Power adapter | External |
| Input | 110 to 240 V _{AC} , 50 to 60 Hz, 500 mA |
| Output | 12 V _{DC} , 2 A |
| Dimension | |
| Height | 57 mm / 2.2" |
| Width | 30 mm / 1.2" |
| Length | 88 mm / 3.4" |
| Cable length | 1.8 m / 70" |
| Order number | TP-UES24LCP-120200SPA |
| Replaceable mains plugs for | EU, US, AU, UK |

9.7 Physical

| | |
|-----------------|------------------|
| Height | 25 mm / 1.0" |
| Length | 170 mm / 6.7" |
| Width | 140 mm / 5.2" |
| Weight | 500 g / 17 ounce |
| USB cord length | 1.8 m / 70" |

9.8 I/O connectors

| | |
|---------------------|---|
| CH1, CH2, CH3, CH4 | BNC, female |
| USB | Fixed cable with USB 3.0 type A plug, 1.8 m |
| Extension connector | D-sub 9 pins female |
| Power | 3.5 mm power socket |
| CMI connectors 1–2 | HDMI type C socket |

9.9 Interface

| | |
|-----------|--|
| Interface | USB 3.0 SuperSpeed (5 Gbit/s) (USB 2.0 HighSpeed (480 Mbit/s) compatible) |
|-----------|--|

9.10 System requirements

| | |
|-------------------|-----------------------------|
| PC I/O connection | USB 2.0, USB 3.0 or USB 3.1 |
| Operating System | Windows 10, 32 and 64 bits |

9.11 Environmental conditions

| | |
|---------------------|--|
| Operating | |
| Ambient temperature | 20 °C to 25 °C (10 °C to 40 °C without specifications) |
| Relative humidity | 10 to 90% non condensing |
| Storage | |
| Ambient temperature | -20 °C to 70 °C |
| Relative humidity | 5 to 95% non condensing |

9.12 Probes

| | | |
|--------------------------------|--|--|
| Model | HP-3250I | |
| | X1 | X10 |
| Bandwidth | 6 MHz | 250 MHz |
| Rise time | 58 ns | 1.4 ns |
| Input impedance | 1 M Ω oscilloscope impedance | 10 M Ω incl. 1 M Ω oscilloscope impedance |
| Input capacitance | 56 pF + oscilloscope capacitance | 13 pF |
| Compensation range | - | 10 to 30 pF |
| Working voltage (DC + AC peak) | 300 V 150 V CAT II | 600 V 300 V CAT II |

9.13 Certifications and Compliances

| | |
|-------------------------------------|-----|
| CE mark compliance | Yes |
| RoHS | Yes |
| REACH | Yes |
| EN 55011:2016/A1:2017 | Yes |
| EN 55022:2011/C1:2011 | Yes |
| IEC 61000-6-1:2019 EN | Yes |
| IEC 61000-6-3:2007/A1:2011/C11:2012 | Yes |
| ICES-001:2004 | Yes |
| AS/NZS CISPR 11:2011 | Yes |
| IEC 61010-1:2010/A1:2019 | Yes |
| UL 61010-1, Edition 3 | Yes |

9.14 Package contents

| | |
|--------------------------|---|
| Instrument | Handyscope HS6 |
| Probes | 4 x HP-3250I, x1 / x10 switchable oscilloscope probes, 250 MHz |
| Accessories | External power adapter USB power cable TP-DB9-BNC-30 Probe compensation cable |
| Software | Windows 10, 32 and 64 bits, via website |
| Drivers | Windows 10, 32 and 64 bits, via website |
| Software Development Kit | Windows 10 and Linux, via website |
| Manual | Instrument manual and software manual |

If you have any suggestions and/or remarks regarding this manual, please contact:

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