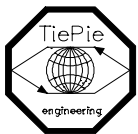


User manual

Handyscope 3

a multifunctional
PC measuring instrument



TiePie engineering

ATTENTION!

Measuring directly on the LINE VOLTAGE can be very dangerous. The OUTSIDE of the BNC CONNECTORS at the Handyscope 3 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 GROUND-ED POWER SUPPLIES!

In case this has not been considered and the GROUND of the Handyscope 3 is connected to a positive voltage, a short-circuit current will be flowing. Because of this short-circuit current both the Handyscope 3 and the computer can be damaged.

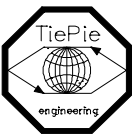
Despite the care taken for the compilation of this user manual, **TiePie engineering** can not be held responsible for any damages resulting from errors that may appear in this book.

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Safety

Before you start working with the **Handyscope 3**, first read these safety rules.

- C Avoid working **alone**.
- C Check the probes / test leads for damages. Do **NOT** use them if they are damaged.
- C Take care when measuring at voltages higher than 25V AC or 60 V DC.
- C Measuring directly on the LINE VOLTAGE can be very dangerous. The **OUTSIDE** of the BNC CONNECTORS at the **Handyscope 3** 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!
In case this has not been considered and the GROUND of the **Handyscope 3** is connected to a positive voltage, a short-circuit current will be flowing. Because of this short-circuit current both the **Handyscope 3** and the computer can be damaged.

Declaration of conformity

TiePie engineering
Kopeslagersstraat 37
8601 WL Sneek
The Netherlands

EC declaration of Conformity

We declare, on our own responsibility, that the product

Handyscope 3

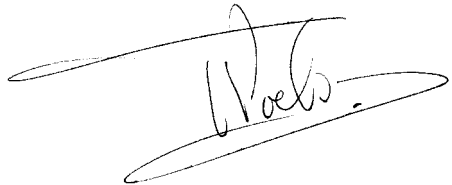
for which this declaration is valid, is in compliance with

EN55011, EN55022, EN50081-1 and EN50082-1

according the conditions of the EMC standard 89/336/EEG, and the amendments 92/31/EEC and 93/68/EEC

Sneek, 1-12-2002

ir. A.P.W.M. Poelsma





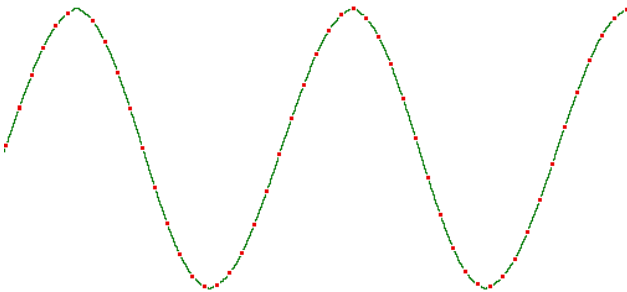
Note before using the Handyscope 3, first read the chapter about Safety

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 several instruments for examining electrical signals are available.

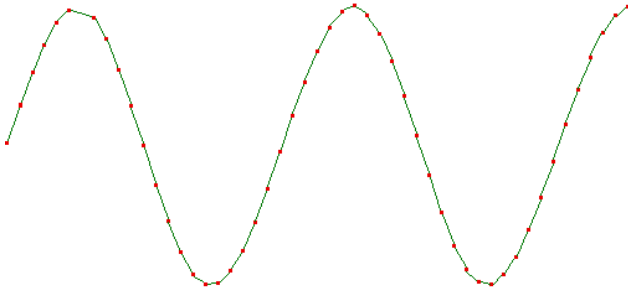
The **Handyscope 3** is a two channel, 12 bits, 5, 10, 25 or 50 Msamples/sec measuring instrument. With the accompanying software the **Handyscope 3** can be used as an oscilloscope, a storage oscilloscope, a spectrum analyzer, a true RMS voltmeter or a transient recorder. All instruments measure by sampling the input signals, digitizing the values, process them, save them and display them.

Sampling

When sampling the input signal, samples are taken at certain moments. The frequency at which the samples are taken is called the sampling frequency. By taking a (large) number of samples, the input signal can be reconstructed.



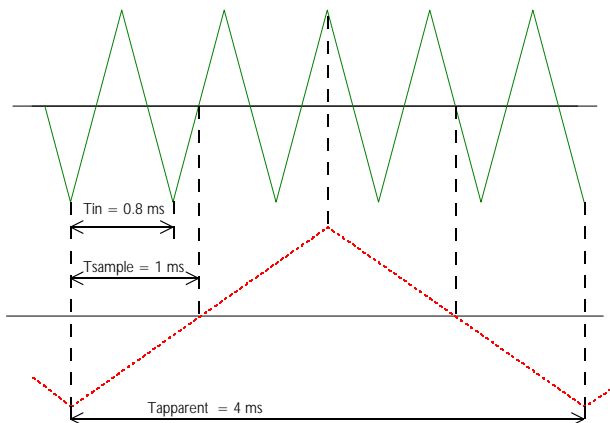
In the latter illustration a sine wave signal is sampled with 50 samples. By connecting the adjacent samples, the original signal can be reconstructed. See also the next illustration.



The more samples are taken, the better the signal can be reconstructed. The sampling frequency 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. In practice, 10 to 20 samples are necessary to be able to examine the signal thoroughly.

Aliasing

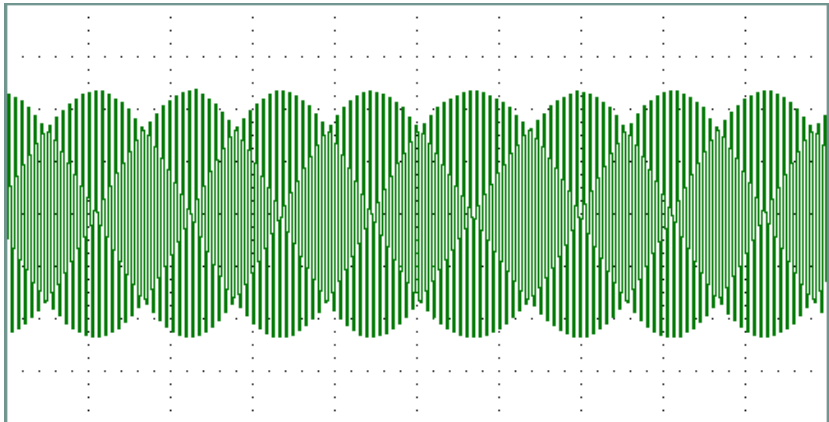
If the sampling frequency is lower than 2 times the frequency of the input signal, 'aliasing' will occur. The following illustration shows how aliasing occurs.



The input signal is a triangular signal with a frequency of 1.25 kHz (upper most in the illustration). The signal is sampled at a frequency of 1 kHz. The dotted signal is the result of the reconstruction. From that triangular signal the periodical time is 4 ms, which corresponds with an apparent frequency (alias) of 250 Hz ($1.25 \text{ kHz} - 1 \text{ kHz}$).

To avoid aliasing, the sample frequency must be higher than 2 times the maximum frequency of the input signal.

Aliasing is not always visible on an oscilloscope. In the latter illustration, it gives a 'good looking' picture. It is not apparent that aliasing occurs. The next illustration gives an example of visible aliasing.



This time it is a sine wave signal with a frequency of 25.7 kHz, which is sampled at a frequency of 5 kHz. The minimal sampling frequency should have been 51.4 kHz. For proper analysis, the sampling frequency should have been 500 kHz.

Digitizing

After taking a sample of the input signal, it is digitised. This is done with an Analog to Digital Converter, ADC. The ADC converts the size of the signal to a digital number. This is called quantifying.

The first condition for accurate measurement is to have as many as possible quantifying steps. This can be realised by using an ADC with a resolu-

tion as high as possible.

The resolution of ADC's is often given in bits. The number of bits determines the number of quantifying steps according the formula:

$$\text{number of quantifying steps} = 2^{\text{number of bits}}$$

A 2 bits ADC has 4 quantifying steps. With an input range of 10 Volt, this ADC can divide the input range in 4 parts of each 2.5 Volt.

By increasing the number of bits, the resolution increases, the number of quantifying steps increases and the sub-divisions get smaller.

The probes

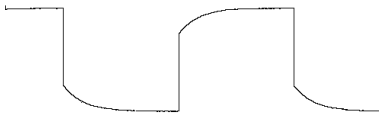
The **Handyscope 3** is shipped with two probes. These are 1x/10x selectable passive probes. This means that the input signal is passed through directly or 10 times attenuated.

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.

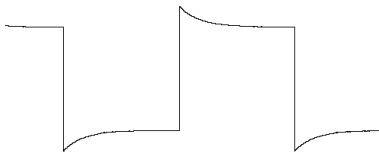
Therefore the probe is equipped with a setscrew, with which the parallel capacity of the attenuation network can be altered. To adjust the probe, switch the probe to the x10 and attach the probe to a 1 kHz square wave signal. Then adjust the probe for a square front corner on the square wave displayed. See also the following illustration.



correct



undercompensated



overcompensated

Chapter 2

Hardware installation

The **Handyscope 3** is an external measuring instrument which can be connected to a PC.

The **Handyscope 3** is connected to a USB port of the PC using the attached cable.

The **Handyscope 3** does not need an external power supply, but is powered by the computer, through the USB.

The USB can deliver only a limited amount of power. In case the USB can not supply enough power, an extra cable is supplied which can be connected to the **Handyscope 3** and between the computer and the keyboard cable. In that case the **Handyscope 3** will be powered by the keyboard connection.



Note The outside of the external power connector is connected to +5 Volt. In order to avoid shortage, first connect the cable to the **Handyscope 3** and then to the keyboard connector.

Chapter 3

Driver installation

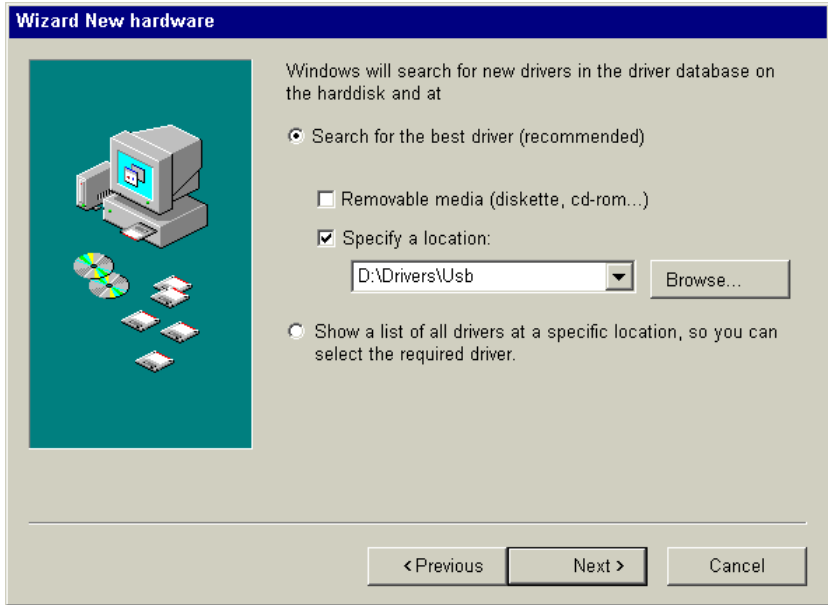
When the **Handyscope 3** is connected to an USB port of the computer of the first time, Windows will report new hardware.

Windows will request for the location where the drivers can be found. The exact appearance of the dialogs will differ for each windows version and they might be somewhat different on the computer where the **Handyscope 3** is installed.



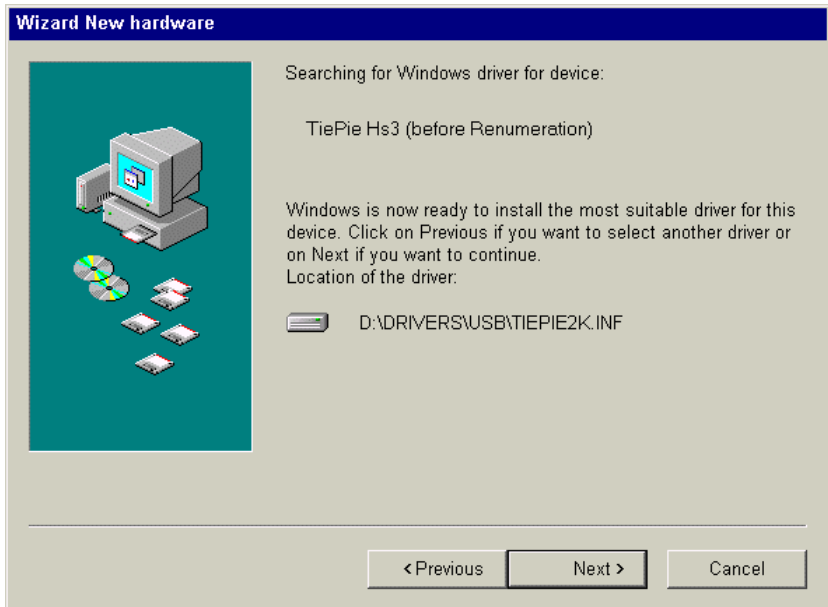
Insert the TiePie software CD in the CDROM drive of your computer. Select **Specify the location of the drivers** and click **Next >**.

Now a location for the drivers has to be specified:



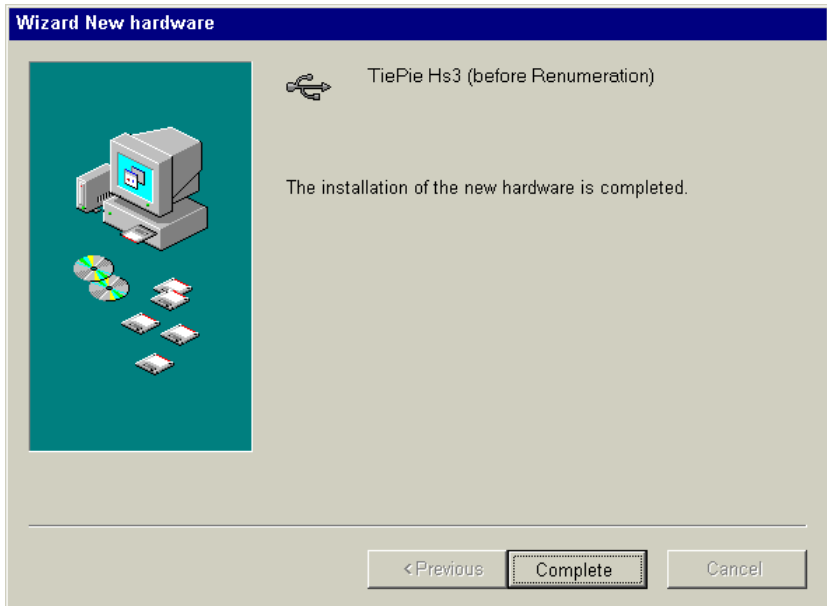
Select **Search for the best driver** and check **Specify a location**. Use the **Browse** button to browse to the folder `Drivers\Usb` on the TiePie software CD. Then click **Next >**.

Windows will now report that it has found the **Handyscope 3**:



Click **Next >** to install this driver.

Windows will now install the drivers for the **Handyscope 3**. When the installation is complete, Windows will report:



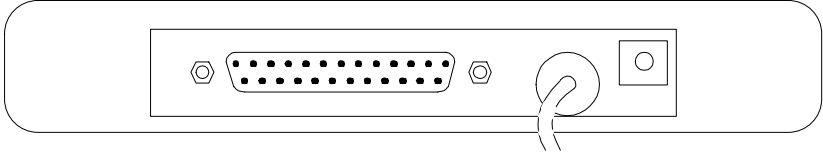
The **Handyscope 3** is now known in Windows. After installing the measurement software, it will be ready to use.

When the **Handyscope 3** is disconnected, the required drivers will be removed from the memory of the computer.

The next time the **Handyscope 3** is connected, the required drivers will be loaded again. The CD is no longer required for that.

Chapter 4

Connections



Extension connector

To connect to the Handyscope 3, a 25 pin female Sub-D connector is available, containing the following signals:

1	Ground	14	Ground
2	not connected	15	Ground
3	External power in 5V DC / 500 mA	16	Ground
4	Ground	17	Ground
5	5 V out, 10 mA max.	18	Ground
6	External sampling clock in	19	Ground
7	Ground	20	not connected
8	External trigger in (TTL)	21	not connected
9	Data OK out (TTL)	22	Ground
10	Ground	23	I ² C SDA
11	Trigger out (TTL)	24	I ² C SCL
12	Square wave generator out (TTL)	25	Ground
13	External sampling clock out		

External power

The Handyscope 3 is powered through the USB. If the USB can not deliver enough power, an external power cable, to the keyboard connector, can be connected.



Note The outside of the external power connector is connected to +5 Volt. In order to avoid shortage, first connect the cable to the Handyscope 3 and then to the keyboard connector.

Center pin	Ø 1.3 mm	Ground
Outside bushing	Ø 3.5 mm	+ 5 V DC

Chapter 5

Specifications

Hardware

Channels

input	2 analog, BNC
output	1 analog, BNC

Analog input

input sensitivity	200 mV - 80 V full scale, in 2, 4, 8 sequence
resolution	12 bits 0.025 %, 14 bits and 16 bits selectable
maximum voltage	200 volt DC + AC peak, < 10 kHz
maximum voltage 1:10 probe	600 volt DC + AC peak, < 10 kHz
input impedance	1 Mohm / 30 pF
coupling	AC / DC
accuracy	0.2 % \pm 1 LSB
bandwidth	DC to 50 MHz

Analog output

resolution	14 bits
amplitude	- 12 V .. 12 V
amplitude step	0 .. 0.1 V 8192 steps 0 .. 0.9 V 8192 steps 0 .. 12 V 8192 steps
DC level	0 .. 12 V 8192 steps
coupling	DC
impedance	50 ohm
bandwidth	DC .. 2 MHz
sample rate	0 - 50 MHz
record length	1024 / 131060 points
waveforms	sine, triangle, square, DC, noise, user defined
symmetry	1 - 99%, in 1% steps

Trigger system

system		digital, 2 levels
source	Ch1, Ch2, Ch1 AND Ch2, Ch1 OR Ch2,	digital external
modes		rising/falling slope, inside/outside window
level adjustment		0 .. 100% of full scale, 12 bit resolution
hysteresis adjustment		0 .. 100% of full scale, 12 bit resolution

Acquisition system

memory depth		128 K samples per channel
sampling frequency	12 bit	5 MHz, 10 MHz, 25 MHz or 50 MHz
	14 bit	3 MHz
	16 bit	200 kHz
pre/post trigger		0 .. 131060 samples (0 .. 100%)

General

interface		USB 2.0 and USB 1.1
power		from USB, 500 mA @ 5 V
operation temperature		0EC .. +50 EC
storage temperature		-10EC .. +70 EC
relative humidity		5 % .. 90 %
dimensions h x l x b		1.0" x 6.7" x 5.2" / 25 x 170 x 140 mm
weight		approx. 17 ounce / 480 gram
cable length		approx. 70 " / 1.8 m

Accessories

probes		2, 1:1 - 1:10 switchable
external power cable to keyboard connector		
Connector types		PS2 male, PS2 female
length		70 " / 1.8 m

PC requirements

Windows version		Windows 98 / ME / 2000 / XP
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notes

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If you have any suggestions and/or remarks regarding the **Handyscope 3** or the manual, please contact:

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