LANGER
EMV-Technik

User Manual

ICI L-EFT set
IC EM fault injection Langer Pulse

CE

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1 Safety

Read and follow the operating instructions carefully and keep them in a safe place for later consultation. The devices may only be used by personnel who are qualified in the field of electromagnetic compatibility (EMC) and who are fit to work under the influence of disturbance voltages and (electric and magnetic) ESD fields.

When using a product from Langer EMV Technik GmbH, please observe the following safety instructions to protect yourself from electric shocks or the risk of injuries and to protect the devices used and the test IC from destruction.

- Observe the operating and safety instructions for all devices used in the set-up.
- Never use any damaged or defective devices.
- Carry out a visual check before using a measurement set-up with a Langer EMV-Technik GmbH product. Replace any damaged connecting cables before starting the product.
- Never leave a product from Langer EMV-Technik GmbH unattended whilst this is in operation.
- The Langer EMV-Technik GmbH product may only be used for its intended purpose. Any other use is forbidden.
- People with a pace-maker are not allowed to work with these devices.
- The test set-up should always be operated via a filtered power supply.

Attention! Functional near fields and interference emissions may occur while the field source is operated. The user is responsible for taking measures to prevent any interference on the correct function of products outside the operational EMC environment (particularly through interference emissions).

This can be achieved by:

- observing an appropriate safety distance,
- using shielded or shielding rooms.

We cannot assume any liability for damage due to improper use.

The disturbances injected into the modules can destroy the device under test (latch-up) if their intensity is too high. Protect the device under test by:

- connecting a protective resistor in the IC's incoming power supply
- increasing the disturbance gradually and stopping when a functional fault occurs,
- interrupting the power supply to the device under test in the event of a latch-up.

Attention! Make sure that internal functional faults are visible from outside. The device under test may be destroyed due to an increase in injection intensity if the faults are not visible from outside. Take the following measures as necessary:

- monitoring of representative signals in the device under test,
- special test software,
- visible reaction of the device under test to inputs (reaction test of the device under test).

We cannot assume any liability for the destruction of devices under test!

2 System description

2.1 Intended Use

The ICI L-EFT set is used to couple fast transient pulses into devices under tests e.g. ICs. The pulses can be applied in well-defined areas due to the small probe tips. This allows for the immunity of individual areas of the IC to be tested. The ICI L-EFT set consists of up to three ICI probes emitting an electric field (**ICI E450**), a magnetic field (**ICI HH500-15**), and current pulses (**ICI I900**).
The probes are connected to the **BPS 202,** which provides the high voltage and the control signals. The **BPS 202** is connected to a PC[1] via USB and is controlled by the software **BPS 202-Client** or the included DLL functions.
Figure 1 / Table 1 shows a possible setup of the ICI L-EFT set using the ICI HH500-15 probe to inject a magnetic field into a Test IC (DUT). The controlling and timing of the DUT is done by the control unit. The ICI probe is placed above the DUT via a multiaxial positioning system. A camera is used for optical inspection. The probe tip current can be monitored by connecting the SSMB output to an oscilloscope.

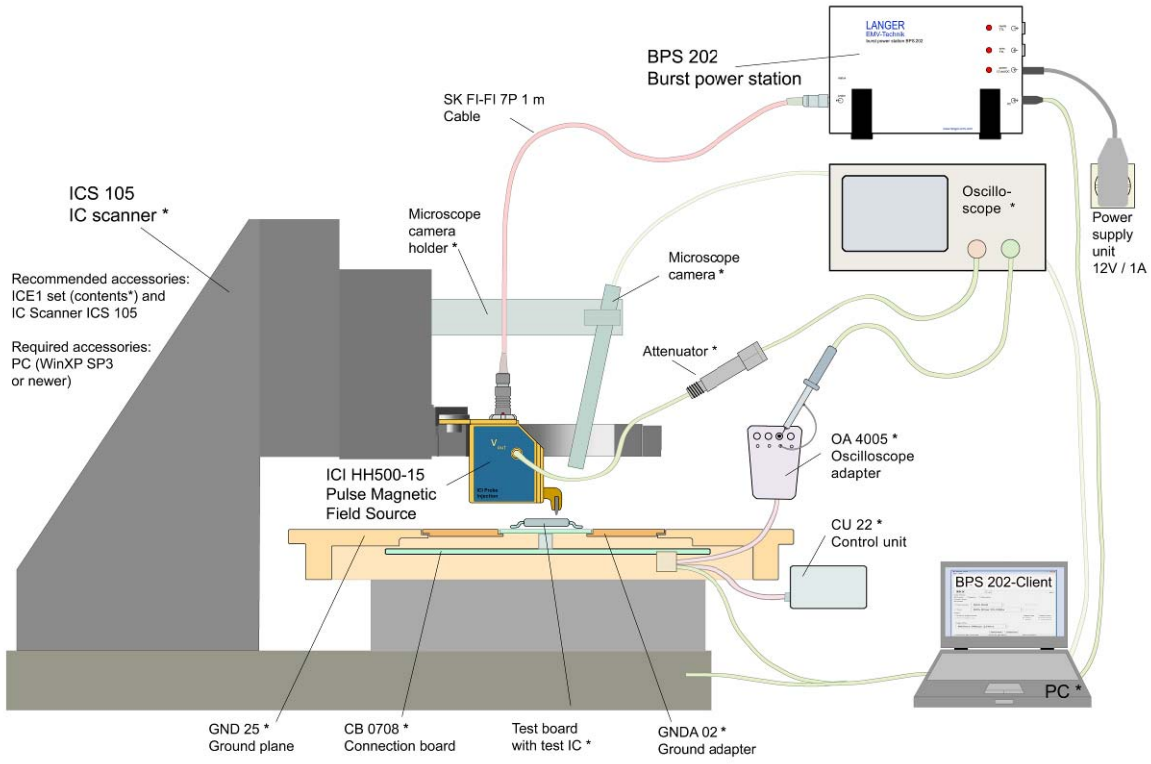


Figure 1: Setup of ICI L-EFT Set with **ICI HH500-15** probe. All devices which are not included in the scope of delivery are marked with an asterisk.

[1] Not included in the scope of delivery.

Table 1 ICI L-EFT set short description

No	Name	Description
①	ICI HH500-15 L-EFT	Generates the H-Field injected into the DUT
	ICI E450 L-EFT	Generates the E-Field injected into the DUT
	ICI I900 L-EFT	Generates the current pulse injected into the DUT
②	BPS 202	Supplies the high voltage and control signals to the ICI Probe
③	HV / Signal cable	Connects ICI probes with the **BPS 202**
④	Measurement cable	SSMB to SMA cable to connect measurement output with an oscilloscope
⑤	USB cable	Connects the **BPS 202** with a PC
⑥	Power supply unit	12V / 1A wall power supply, used to power the ICI L-EFT set
⑦	BPS 202-Client[2]	PC software / DLL to control ICIs

2.2 BPS 202

The **BPS 202** is used as power supply and control unit for the ICI probes. The control unit is connected to the user's PC via an USB interface. The provided software includes a standalone Client (**BPS 202-Client**) and a DLL for implementing automated systems.
The sync TTL input allows for the synchronization of the pulse generation to external events, e. g. operation sequences of ICs.

Features are:

- Adjustment of the pulse frequency and pulse voltage
- Single pulse or pulse sequence
- External triggering possible
- Adjustable trigger delay
- Synchronization output

[2] Minimum requirements: Win XP SP3 or above

Figure 2: **BPS 202** features

Table 2 **BPS 202** features

Socket	**Description**
HV / Signal Cable socket	High-voltage power supply and probe communication
Ready TTL Output	BNC, used for external trigger, high state indicates that the **BPS 202** has finished building up high voltage and is ready to start the pulse
Sync TTL Input	BNC, used for external trigger, the trigger impulse is sent from external to the **BPS 202** to start the disturbance pulse. The **BPS 202** reacts on the rising or falling edge (adjustable in software).
Power Supply	Power input for **BPS 202** and the attached probe
USB Port	USB-B port to connect **BPS 202** to a PC

Table 3 **BPS 202** states (Indicator LEDs)

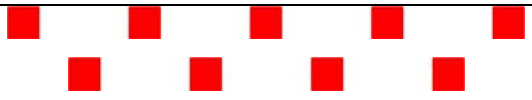
LED	**State**		**Description**
Status		10Hz	Fault: Probe is not connected or is incorrectly connected
		2Hz	Probe is ready
		2Hz	Pulse operation
Ready TTL Sync TTL		2Hz	Bootloader state (during firmware update)
Ready TTL		-	External trigger is ready to initiate (start pulse)
Sync TTL		-	External trigger pulse received
12V Power		-	**BPS 202** is powered

Figure 3 shows the block diagram of the **BPS 202**. The internal logic is controlled by the **BPS 202-Client** or the DLL.

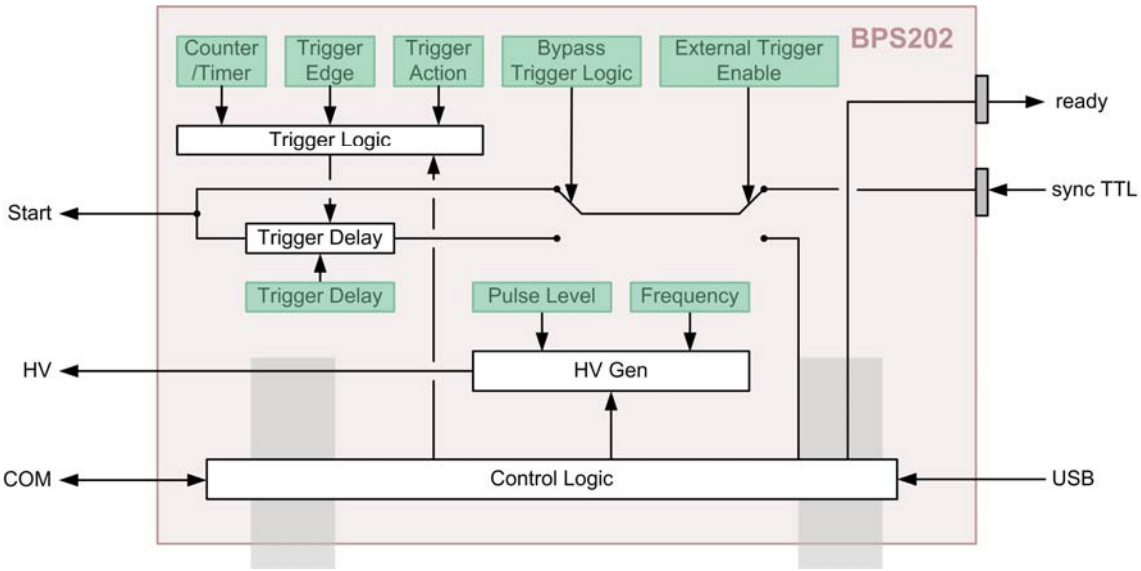


Figure 3: block diagram of the **BPS 202**

2.3 ICI Probes

2.3.1 Overview

Figure 4: ICI probes for generating a magnetic field (left), an electric field (middle) and current pulses (right)

The ICI probes emit an electric field, a magnetic field or current pulses. Each probe is connected with the HV / signal cable to the **BPS 202**. The internal probe current (*Figure 6*) can be monitored by connecting the SSMB output to an oscilloscope with the provided cable (see *Chapter 4*).

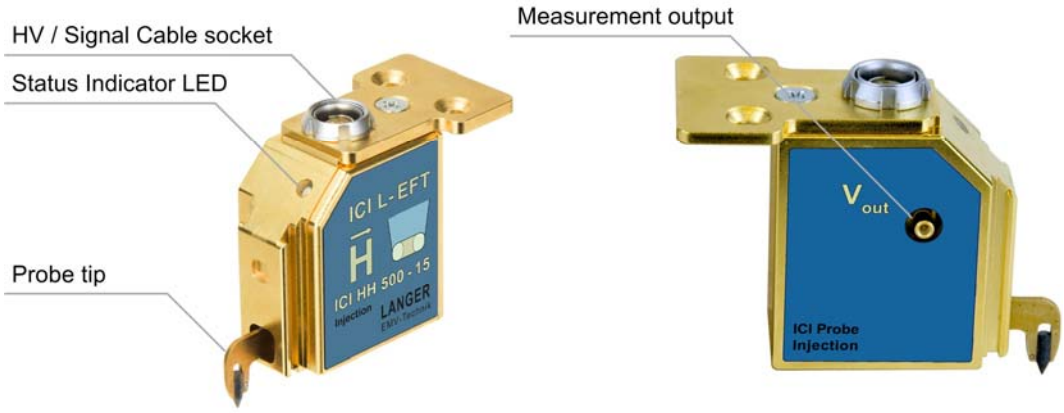


Figure 5: ICI features (ICI HH500-15 as example)

Table 4: ICI features

Socket	Description
HV / signal connector	high-voltage power supply/ control signals
Measurement output	50Ω (5Ω shunt)

The current operational state of the ICI probes is indicated by the multicolour status LED. The possible states are listed in *Table 5.*

Table 5 Operational states of the ICI probes.

State		Description
	Strobe	System start
	-	Probe is ready
	2Hz	Pulse operation
	2Hz	Delay Line Error
	2Hz	Bootloader state (during firmware update)

All ICI probes are equipped with an additional pulse delay with a low trigger to pulse jitter (see *Chapter 6.8*). This feature allows the device under test to be disturbed with the same signal-triggered pulse at well-defined points of time. The delay can be defined within the **BPS 202-Client** or by the corresponding DLL function call.

Figure 6 shows the block diagram of the ICI probes. The internal logic is controlled by the **BPS 202-Client** or the DLL. The current I_{pulse} can be measured by the integrated shunt. The measured voltage V_{out} is positive independent of the pulse polarity settings.

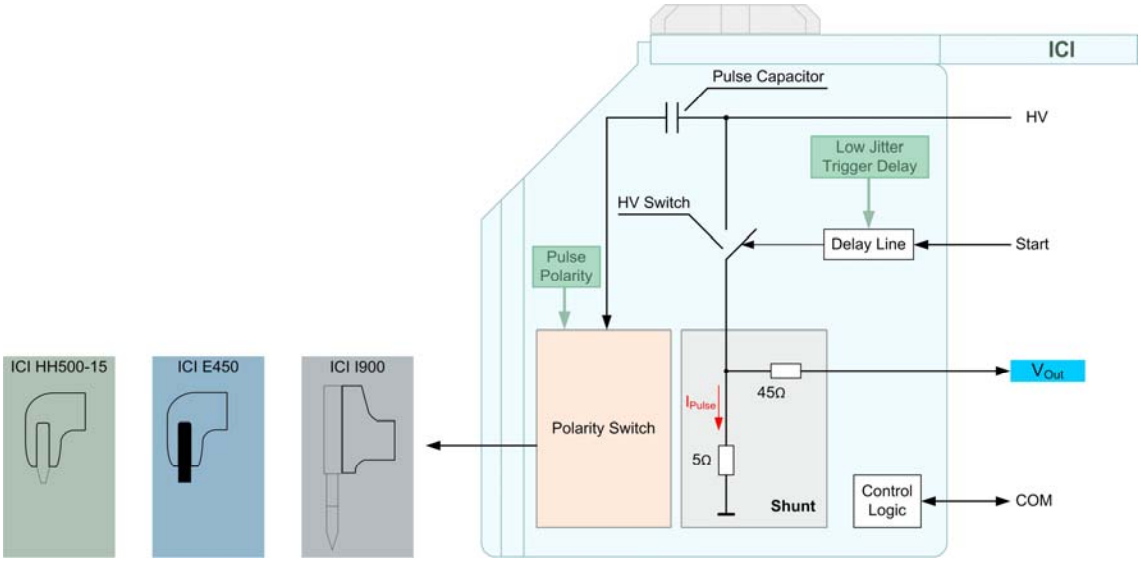


Figure 6: block diagram of the probes

2.3.2 ICI HH500-15 Magnetic-Field Pulse Source

The ICI HH500-15 L-EFT pulse magnetic-field source couples fast transient pulses into an IC (open die) via a magnetic field. This allows for the immunity of individual areas of the IC to be tested. Side-channel attacks can be simulated to test security-critical circuits. Special features include a very high-resolution 500 µm probe tip (allowing for the testing of extremely small areas) and a very low trigger-pulse jitter (allowing for the disruption of very specific points in the program sequence). Figure 5 shows the front view and the back view of the ICI HH500-15.

2.3.3 ICI E450 Electric-Field Pulse Source

The ICI E450 L-EFT pulse electric-field source couples fast transient pulses into an IC (open die) via an electric field. This allows for the immunity of individual areas of the IC to be tested. Side-channel attacks can be simulated to test security-critical circuits. Special features include a very high-resolution 450 µm electrode diameter (allowing for the testing of extremely small areas) and a very low trigger-pulse jitter (allowing for the disruption of very specific points in the program sequence).

2.3.4 ICI I900 Current Pulse Source

The ICI I900 L-EFT is a current pulse source with a spring loaded tip. This allows for contacting the substrate without damaging the probe tip or the test device.

3 Quick start

1. Check all components for damage
2. Install **BPS 202-Client** onto your PC
3. Connect the ICI with the **BPS 202** via the provided Fischer cable
4. Connect the measurement output to an oscilloscope

⚠ Make sure you do not exceed the limits of your oscilloscope (Table 7). If required use an external attenuator[3].

5. Connect the wall power supply to the **BPS 202**
   - the status indicator LED of the ICI lights up green
   - the status indicator LED of the **BPS 202** flashes with 2 Hz
6. Connect the **BPS 202-Client** to the PC (USB)
7. Start the **BPS 202-Client** Software

[3] Not in scope of delivery

4 Pulse-Current Measurement

You can use the measurement output of the ICI probe to view the internally generated pulse current. The oscilloscope input has to be set to 50 Ω. Otherwise an external termination should be used.

⚠ Make sure not to exceed the limits of your oscilloscope (Table 7). If required use an external attenuator[4].

The appropriate attenuator settings for the oscilloscope (resulting from the shunt / external attenuator and 50Ω termination) are found in Table 6. To get a proper pulse-current reading, the damping factor in the oscilloscope must be set according to the individual attenuator used. The transfer function is listed below.

$$I_{Pulse} = \left(\frac{50\Omega \cdot (5\Omega // 95\Omega)}{95\Omega} \cdot 10^{\frac{1}{20} \cdot \frac{a}{dB}} \right)^{-1} \cdot V_{Out} = \left(2{,}5\Omega \cdot 10^{\frac{1}{20} \cdot \frac{a}{dB}} \right)^{-1} \cdot V_{Out}$$ Eq. 1

Example: using an 30 dB attenuator (a = -30 dB)

$$I_{Pulse} = \left(2{,}5\Omega \cdot 10^{-\frac{30}{20} \cdot} \right)^{-1} \cdot V_{Out} = 12{,}6 \frac{1}{\Omega} \cdot V_{Out}$$

$$\frac{I_{Pulse}}{dBA} = \frac{V_{Out}}{dBV} + 22$$ Eq. 2

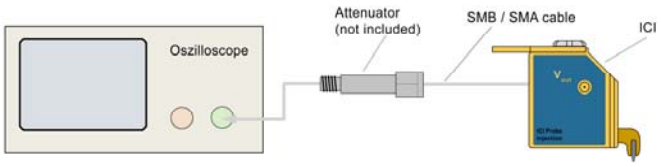


Figure 7: Setup for pulse-current measurement with an oscilloscope.

Table 6: Measurement output – oscilloscope settings

V_{Out} (linear / log)	Attenuator (linear / log)	Termination Oscilloscope (termination / att.)	Total attenuation (linear / log)
5 / 14dB	3,2 / -10dB	50Ω (-6dB)	1,3 / -2dB
5 / 14dB	10 / -20dB	50Ω (-6dB)	4 / -12dB
5 / 14dB	31,6 / -30dB	50Ω (-6dB)	12,6 / -22dB
5 / 14dB	100 / -40dB	50Ω (-6dB)	40 / -32dB

[4] not in scope of delivery

Table 7: Input voltage present at oscilloscope using different attenuators

Pulse level (HV)	**Pulse current (I_{Pulse})**	**Input voltage oscilloscope (50 Ω) using different attenuators**			
[V]	**[A]**	**10dB [V]**	**20dB [V]**	**30dB [V]**	**40dB [V]**
50V	1	0,76	0,26	0,08	0,025
100V	2	1,54	0,50	0,16	0,050
150V	3	2,30	0,75	0,24	0,075
200V	4	3,08	1,00	0,32	0,100
260V	5	3,84	1,26	0,40	0,125
330V	6	4,62	1,50	0,48	0,150
400V	7	5,38	1,76	0,56	0,175
500V	8	6,16	2,00	0,64	0,200

5 Operating modes overview

The ICI L-EFT set can generate the following types of pulses:

- Single pulse (Figure 8)
- Continuous pulse
- Burst packets with a defined number of pulses and burst period (Figure 9)
- Defined number of pulses or burst packets

The type of pulse sequence is set by the control software **BPS 202-Client** or the included DLL.

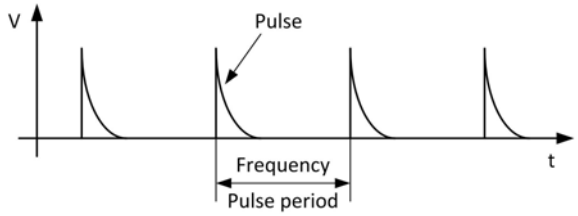


Figure 8: Pulse mode

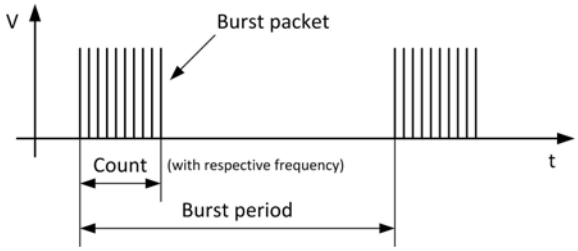


Figure 9: Burst mode

Furthermore, it is possible to synchronize the generated pulses to an external event by using the external trigger function.

5.1 Free-running mode (pulses not synchronized)

In free-running mode, the pulse generation is controlled by the **BPS 202-Client** (see *Chapter 6*). The pulse generation in this mode cannot be synchronized to external trigger signals.

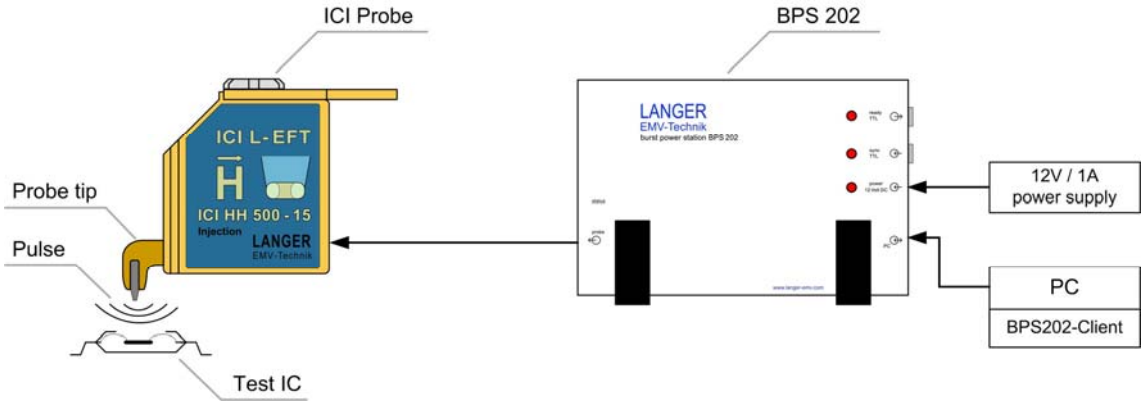


Figure 10: System setup for free running mode

5.2 Synchronized mode (pulses synchronized to external event)

In the synchronized mode, the pulse can be triggered by an external signal source (Start Logic) e. g. a signal from the test IC (TTL max. 5V).

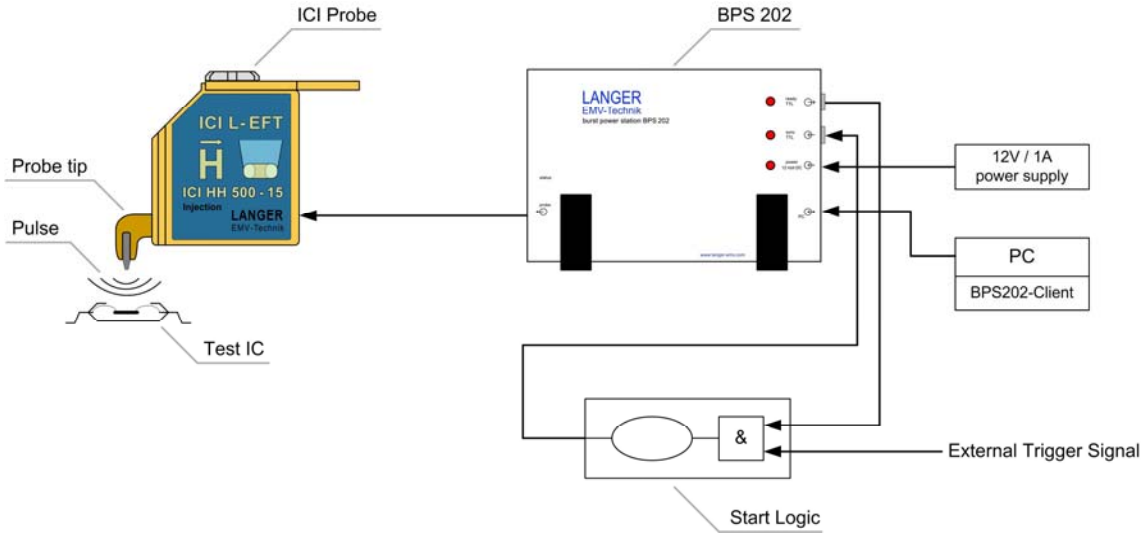


Figure 11 System setup external trigger via **BPS 202** ***sync TTL*** input

The trigger to pulse delay can be set in the **BPS 202-Client** (see *Figure 3 / Figure 6*) by using either the delay timer in the **BPS 202** or the low-jitter trigger delay line in the ICI probes (see *Chapter 6.7 / 6.8*).
The ready TTL output of the **BPS 202** signals when the **BPS 202** is ready to start a pulse. The control signals can be found on Figure 12 and Figure 13.

Figure 12 and Figure 13 show the sequence of control signals when the external trigger mode is used.

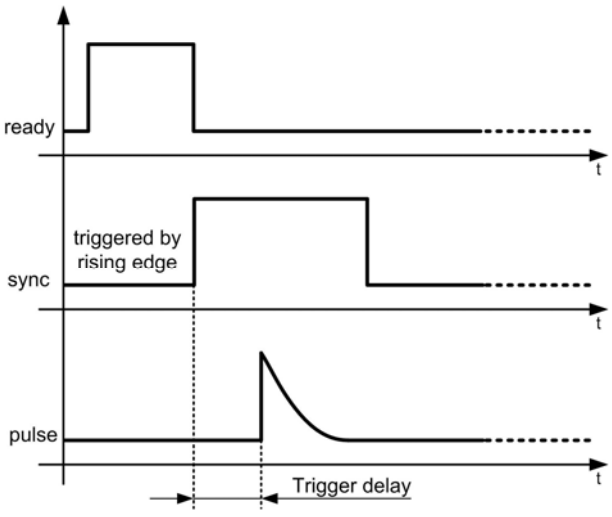


Figure 12: Signal sequence of external trigger mode, trigger on rising edge

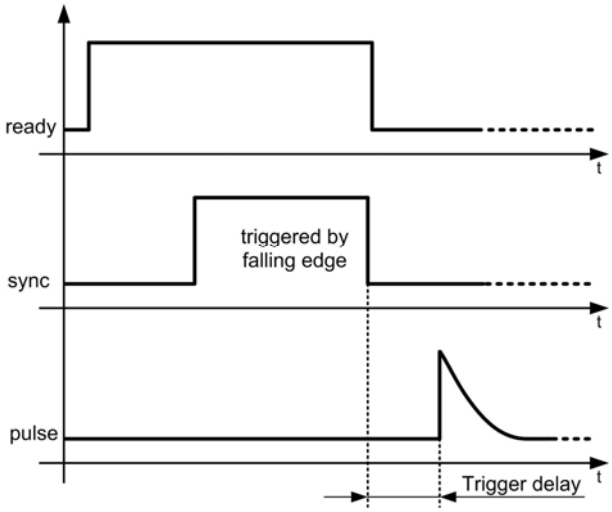


Figure 13: Signal sequence of external trigger mode, trigger on falling edge

Control signals:

Ready:
When the ready signal is driven high by the **BPS 202**, it accepts trigger signals to start pulses.

Sync:
The trigger signal for the pulse is fed into this port. The **BPS 202** accepts rising or falling edges depending on the setting in the **BPS 202-Client** software.

Pulse:
The generated pulse can be emitted with a variable trigger to pulse delay. For the minimum delay refer to the parameter sheet.

Sequence:

a) external trigger of the **BPS 202** is set in the **BPS 202-Client** software (see *Chapter 6.7 / 6.8*)

b) **BPS 202** sets the ***ready TTL*** output to high, when the high voltage is built up and a pulse can be triggered

c) the pulse is bemitted on a rising or falling edge at the ***sync TTL*** input (Figure 13). This depends on the settings in the **BPS 202-Client** software (see *Chapter 6.7*).

d) The trigger to pulse delay between the trigger signal at the ***sync TTL*** input and pulse can be set in the **BPS202-Client** software

6 BPS 202-Client Software

6.1 Installation

The enclosed CD contains:

- **BPS 202-Client** software and DLL
- operational manual
- device driver

Important: You need administrator rights to install the device driver on the PC.

- Double click the installer file BPS 202-Client-*.exe on the installation media.
- Follow the instructions during the installation.
- Proceed with the device driver installation which follows automatically.

After installing the client software and the device driver, connect the ICI set as described in *Chapter 3*.

6.2 Software Client – General Notes

The **BPS 202-Client** software contains all control elements needed to operate the **BPS 202** and its probes in all its operating modes.

The Graphical User Interface (GUI) consists of:

- Pulse configuration
- Burst configuration *(Burst Mode only)*
- Trigger Control
- Start / Stop
- Status bar

Settings are only possible if a valid **BPS 202** and a valid probe is detected by the software. This is displayed in the status bar (see *Chapter 6.10*).

After launching the software, the main dialog of the application always displays the ***Pulse Mode***, see Figure 14.

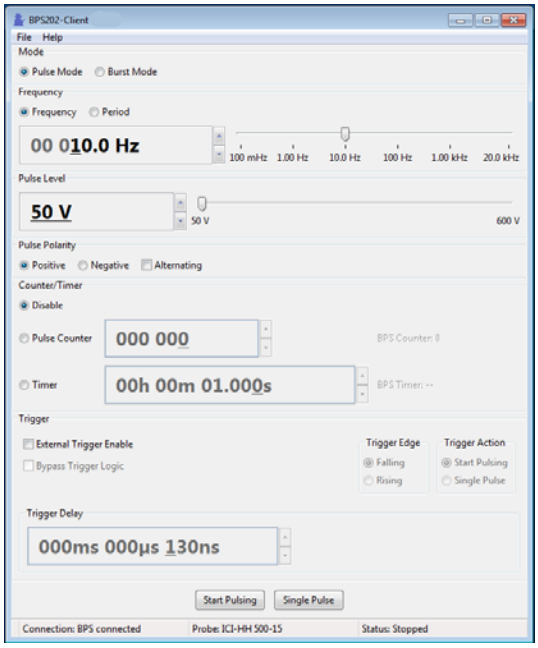


Figure 14: Main Dialog Pulse Mode

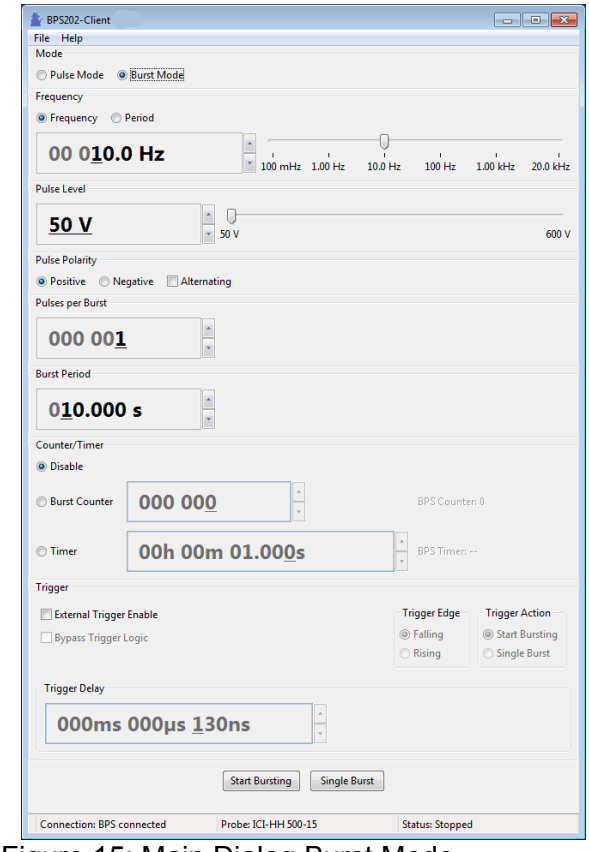


Figure 15: Main Dialog Burst Mode

6.3 Setup of the Operating Mode

The operating modes ***Pulse Mode*** and ***Burst Mode*** can be chosen within the operating mode section by clicking one of both radio buttons. The application's main menu changes respectively, see Figure 14 and Figure 15.

a. ***Pulse Mode***: creates several pulses that are equidistant in time
b. ***Burst Mode***: creates packets of pulses that are equidistant in time

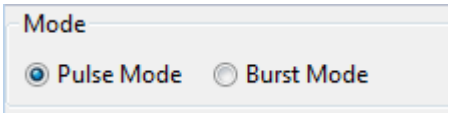


Figure 16: Radio buttons for operating mode selection

6.4 Pulse Configuration

The pulse parameters, e.g. frequency, amplitude etc., were set in the pulse configuration section.

6.4.1 Setup of the Pulse Frequency or the Pulse Period

The frequency of the pulses can be setup in the GUI section ***Frequency*** (Figure 16) in the range from 0.1 Hz to 20 kHz (probe dependant). Only probe-specific values will be displayed. Alternatively, the ***Pulse Period*** can be setup in a range from 50 µs to 10 s (probe dependant). Pulse frequency or pulse period can be selected by activating the corresponding radio button.

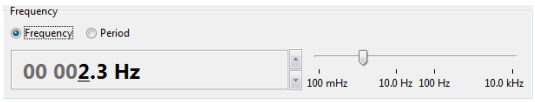


Figure 17: Setup of the pulse frequency

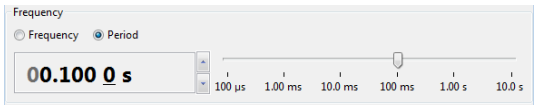


Figure 18: Setup of the pulse period

6.4.2 Setup of the Pulse Level

The voltage amplitude of the pulses can be set up in the GUI section **Pulse Level** (Figure 17). The displayed values are dependent on the which probe is connected. The pulse level slider allows a rough setup and the spin buttons allow a fine grain setup. The setup of the pulse voltage level is possible if the **BPS 202** has not been started as well as in the operation modes ***Pulse Mode*** and ***Burst Mode***.

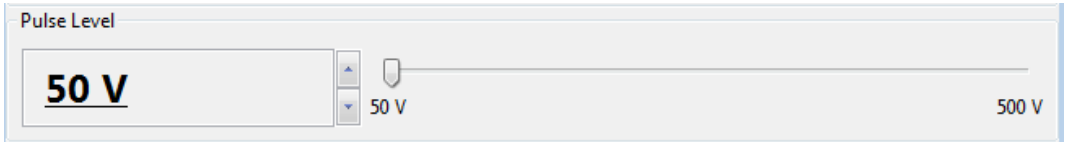


Figure 19: Setup of the pulse level

6.4.3 Setup of the Pulse Polarity

The polarity of the created pulses can be set up in the GUI section **Pulse Polarity**. Available options are:

- Positive (+)
- Negative (-)
- Alternating (+/-)

Alternating the polarity of the created pulses with the option ***Alternating*** takes effect in all operating modes of the **BPS 202**. The first pulse will have the selected polarity.

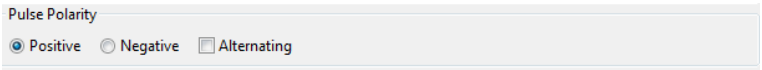


Figure 20: Setup of the pulse polarity

6.5 Burst Configuration

When the ***Burst Mode*** is chosen, the burst configuration section is displayed. In this operating mode, the **Burst Period** and the number of **Pulses per Burst** are additional parameters which must be defined.

6.5.1 Setting up the number of pulses per burst

In this section, the number of pulses per burst packet are defined, see Figure 21.

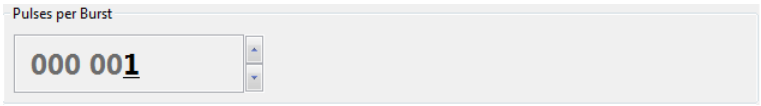


Figure 21: Setting the number of pulses per burst packet.

6.5.2 Set up the burst period

In this section, the ***Burst Period*** is regulated, which defines the time between two consecutive burst packets. The minimal value of the burst period is derived from the pulses in each burst and the pulse frequency.

$BurstPeriod_{Min} = \frac{1}{Frequency} * Pulse\_per\_Burst$	Eq. 3

$BurstPeriod_{Min} = Period * Pulse\_per\_Burst$	Eq. 4

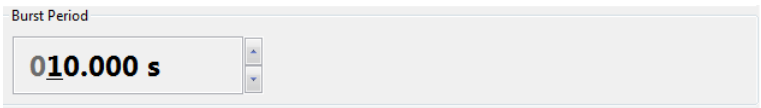


Figure 22: Time between two consecutive burst packets

6.6 Setup of a defined pulse counter or time

In the GUI section **Counter/Timer** a defined pulse- / burst counter or a timer can be setup. The following three modes can be selected:

Disable:
No pulse counter or timer is set → **Start** leads to continuous pulses

Pulse Counter (Pulse Mode):
Pulse counter active → **Start** generates the selected number of pulses

Burst Counter (Burst Mode):
Burst counter active → **Start** generates the selected number of pulses

Timer:
Timer active → **Start** will run selected function for the length of the timer

Figure 23: Setup of a defined pulse/ burst counter or timer

6.7 Setup of the external trigger

The control of the external trigger is done in the GUI section **Trigger**. By enabling the box ***External Trigger Enable***, the following options will be enabled.

• Trigger edge: **Trigger Edge**

1. ***Falling***: Trigger activated at HIGH – LOW transition
2. ***Rising***: Trigger activated at LOW – HIGH transition

• Trigger action for operating mode ***Pulse Mode:***

1. ***Start Pulsing***: generates test pulses with the setup pulse parameters
2. ***Single Pulse:*** generates one test pulse with the setup pulse parameters

• Trigger action for operating mode ***Burst Mode:***

1. ***Start Bursting***: generates burst packets with the setup burst parameters
2. ***Single Burst***: generates one burst packet with the setup burst parameters

• The trigger delay can be setup in 10ns steps (see *Chapter 5.2*).

Figure 24: GUI section ***Trigger*** for operating mode pulse mode

6.8 Setup of the low jitter trigger

In order to enable the **Low-Jitter Trigger Delay** the **Bypass Trigger Logic** box must be selected. The low-jitter trigger feature directly connects the pulse start signal and the signal applied to the sync input of the **BPS 202**. Since the external start signal is no longer processed by the **BPS 202** the BPS delay option is no longer available. The **Trigger Delay** section changes to **Low Jitter Trigger Delay**.
In this mode only rising edge and single pulse / single burst operation modes are available.

This programmable delay is generated by the probe (if available). The ICI probe features a programmable delay line (see *Figure 6*). The programmable delay adds to the minimum propagation delay of the whole system (see parameter sheet).

Figure 25: External trigger with bypass enabled

6.9 Operating modes

6.9.1 Pulse Mode

Single Pulse

By pressing the ***Single Pulse*** button (*Figure 26*) the **BPS 202** will generate a single pulse with the defined **Pulse Level** and **Polarity**. The **Status LED** of the **BPS 202** and the **Probe LED** of the connected probe will blink one time, as described in *Chapter 1*. The pulse polarity will alternate every time the ***Single Pulse*** button is pressed, if the pulse polarity option ***Alternating*** is selected.

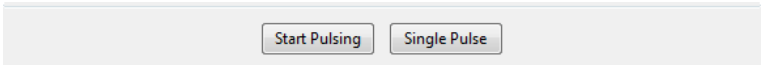


Figure 26: Active buttons: **Start Pulsing** and **Single Pulse**

Continuous Pulses

When the ***Start Pulsing*** button (*Figure 26*) is pressed, the **BPS 202** will generate continuous pulses with the defined pulse parameters. Additionally the LED on the probe and the **Status LED** on the BPS 202 will blink continuously, the software's status will display ***Status: running*** (see *Chapter 6.10*), and the **Start Pulsing** button is renamed **Stop Pulsing**. The pulse frequency and voltage can be changed at any time. The pulse polarity can be set to alternate after each pulse by activating the pulse polarity option **Alternating** (which must be set before ***Start Pulsing*** button is pressed). The continuous pulses can be stopped at any time by pressing the **Stop Pulsing** button.

Depending on the **Counter / Timer** settings, the pulses generated by the **BPS 202** can be defined by time (also unlimited) or number.
The pulses or the time remaining is displayed next to the set value and is updated continuously.

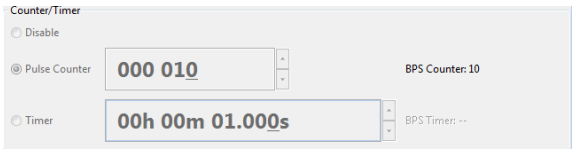


Figure 27: Pulse option counter

Figure 28: Pulse option timer

6.9.2 Burst Mode

Single Burst

By pressing the button ***Single Burst*** (Figure 27) the **BPS 202** will generate a single burst packet with the defined burst parameters. Additionally, the **Status LED** and the probe's **LED** will blink as described in *Chapter 1*. The pulse polarity will alternate every time the ***Single Burst*** button is pressed, if the pulse polarity option ***Alternating*** is selected.

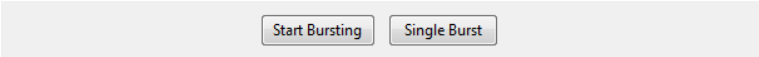


Figure 29: Active buttons: **Start Bursting** and **Single Burst**

Continuous Burst

When the ***Start Bursting*** button (*Figure 26*) is pressed, the **BPS 202** will generate continuous bursts with the defined burst parameters. Additionally the LED on the probe and the **Status LED** on the BPS 202 will blink continuously, the software's status will display ***Status: running*** (see *Chapter 6.10*), and the **Start Bursting** button is renamed **Stop Bursting**. The burst frequency and voltage can be changed at any time. The pulse polarity can be set to alternate after each burst by activating the pulse polarity option **Alternating** (which must be set before ***Start Bursting*** button is pressed). The continuously generated bursts can be stopped at any time by pressing the **Stop Bursting** button.

Depending on the **Counter / Timer** settings, the bursts generated by the **BPS 202** can be defined by time (also unlimited) or number.
The bursts or the time remaining is displayed next to the set value and is updated continuously.

6.9.3 Externally triggered Pulses or Bursts

The generated pulses or bursts can be synchronized with an external event by activating the ***External Trigger Enable*** option. When the ***Start Pulsing/ Start Bursting*** button is pressed,

- the button ***Start Pulsing/ Start Bursting*** changes to ***Stop Pulsing/ Stop Bursting*** and will stop the generation of pulses/ bursts when pressed
- the LED **ready TTL** of the **BPS 202** lights up
- the **BPS 202** waits for a trigger event at its input **sync TTL**
- the status bar of the **BPS202-Client** displays the status message ***Status: Waiting for Trigger***

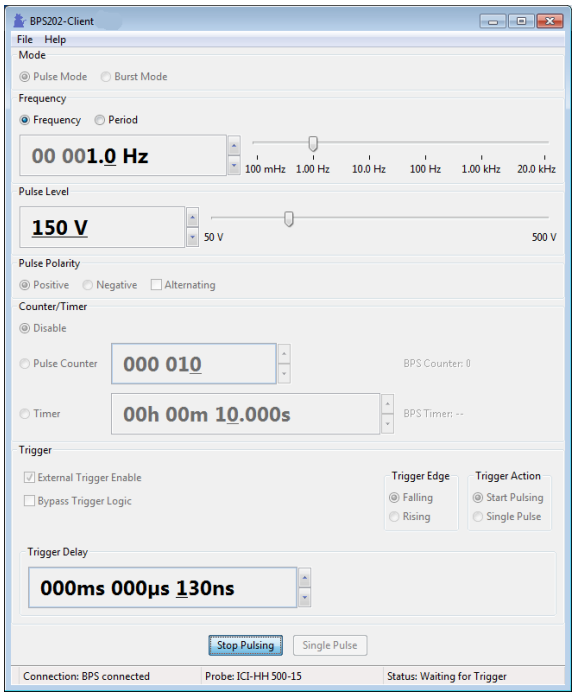


Figure 30: Trigger for **Pulse Mode**

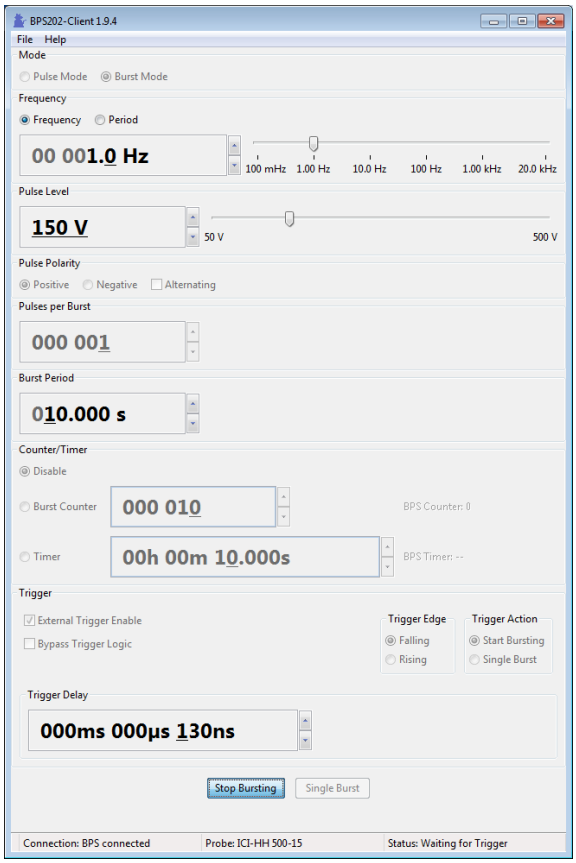


Figure 31: Trigger for **Burst Mode**

The trigger edge and the reaction of the **BPS 202** to a trigger event can be set up in the **Trigger** section. A trigger event recognized at the input **sync TTL** of the **BPS 202** executes the defined ***Trigger Action***, which is indicated by the blinking **Status LED** and **Probe LED**.

By activating the ***Counter*** and ***Start Pulsing*** options, each trigger event will prompt the defined number of pulses or bursts.

Caution: The minimum delay relates only to the signal propagation delay in the BPS 202. The total delay varies dependent on the attached probe, pulse voltage, and polarity. (see parameter sheet)

6.10 Status bar messages

The status bar of the **BPS202-Client** consists of:

1. The status of the **BPS 202** USB connection
   - ***Connection: BPS disconnected***
   - ***Connection: BPS connected***

2. Status of the automatic probe recognition
   - ***No Probe detected***
   - ***P***xyz ***detected***

3. Operating mode of the **BPS 202**
   - ***Status: stopped*** – no generation of pulses or bursts
   - ***Status: running*** – generating pulses or bursts
   - ***Status: Waiting for Trigger*** – **BPS 202** waits for an external trigger event

Figure 32: No USB connection to a **BPS 202**

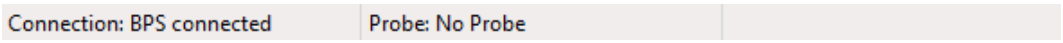


Figure 33: **BPS 202** connected but no valid probe detected

Figure 34: **BPS 202** connected and the ICI probe is detected

6.11 Menus

File:

- EXIT: Shuts down the **BPS202-Client**

Figure 35: File menu

Help:

- Hardware Info: Display hardware information about the **BPS 202** and its connected probe.
- About: Software information / link: www.langer-emv.de
- Manual: Display Operation Manual
- Update BPS Firmware: Open the **BPS 202** firmware update dialog
- Update Probe Firmware: Open the probe firmware update dialog

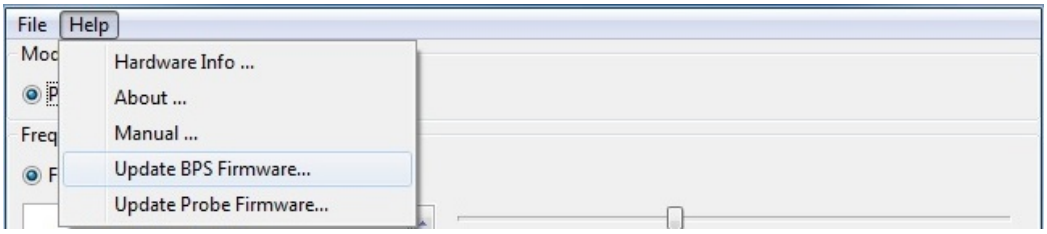


Figure 36: Help menu

7 DLL

The **BPS 202-Client** contains a dll to control the **BPS 202** by function calls. Depending on your system (32bit or 64bit), the dll file and the corresponding header file are stored at:

<installation path>\BPS202-Client_*Version*\dll_Win32 or
<installation path>\BPS202-Client_*Version*\dll_x64

The BPS 202 remote control commands are explained in either the header file or the programming manual "Langer EMV-Technik GmbH – BPS 202 remote control commands.pdf".

8 Warranty

Langer EMV-Technik GmbH will remedy any fault due to defective material or defective manufacture during the statutory warranty period.

Warranty is only granted on condition that:
- the operating instructions are observed,
- only original spare parts are used.
- external components such as power supply units, etc. have separate warranty terms and conditions which are applicable for the respective manufacturer.

The warranty will be forfeited if:
- unauthorized repairs have been made to the Langer EMV-Technik GmbH product,
- the product from Langer EMV-Technik GmbH has been modified,
- the product from Langer EMV-Technik GmbH has not been used correctly.

9 Characteristics

9.1 General

Parameter	
Voltage range	50V – 500V
min delay (Bypass mode)	approx. 98ns[5]
max delay (Bypass mode + Delayline)	approx. 400ns[5]
min delay (Timer mode)	approx. 190ns (13ns Jitter)[5]
Software	BPS 202-Client / DLL (32Bit / 64Bit) Win XP SP3 or higher

9.1 BPS 202 – Burst Power Station

Parameter	
Power supply	12V / 1A
Pulse repetition frequency	0.1Hz – 20kHz[5]
Pulse voltage range	Probe dependent
Voltage polarity	+ / - / alternating
External trigger	TTL (5V), max. 20kHz – BNC
Synchronization output	TTL (5V) – BNC
Trigger delay (programmable)	approx. min 130ns – 100ms
Control interface	USB – B
Software	BPS 202-Client / DLL (32Bit / 64Bit)
Size (L x W x H)	175 / 122 / 61 (mm)
Weight	300g

[5] The actual value is probe dependent (see parameter sheet)

9.2 ICI HH500-15

Parameter	
Supply / control	BPS 202
Diameter probe tip	500µm
Max. flux density	ca. 50mT[6]
Max. pulse repetition frequency	20kHz
Pulse rise time	approx. 2ns
Pulse polarity (programmable)	+ / - / alternating
Measurement output	50Ω
Pulse level voltage range	50V – 500V
Trigger pulse delay	see parameter sheet
Trigger pulse jitter	see parameter sheet
Weight	70g

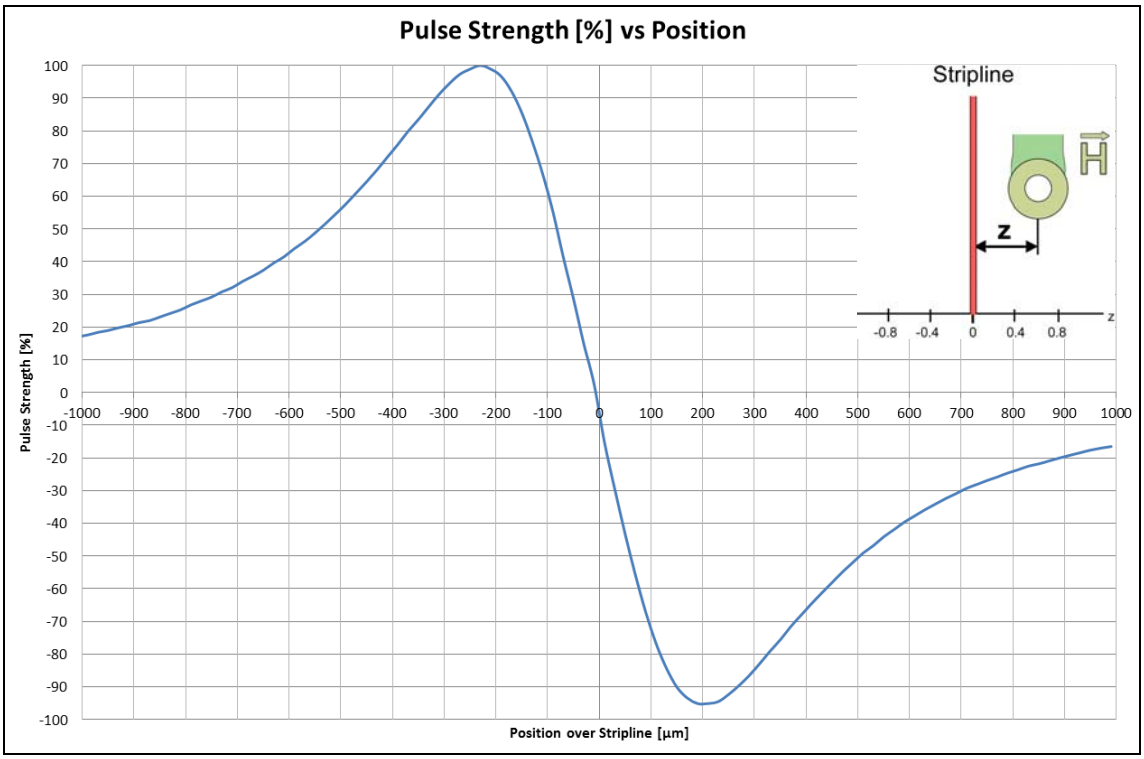


Figure 37: Relative pulse strength, scan across 100µm stripline

[6] Approximate value; for specific value refer to parameter sheet of the probe

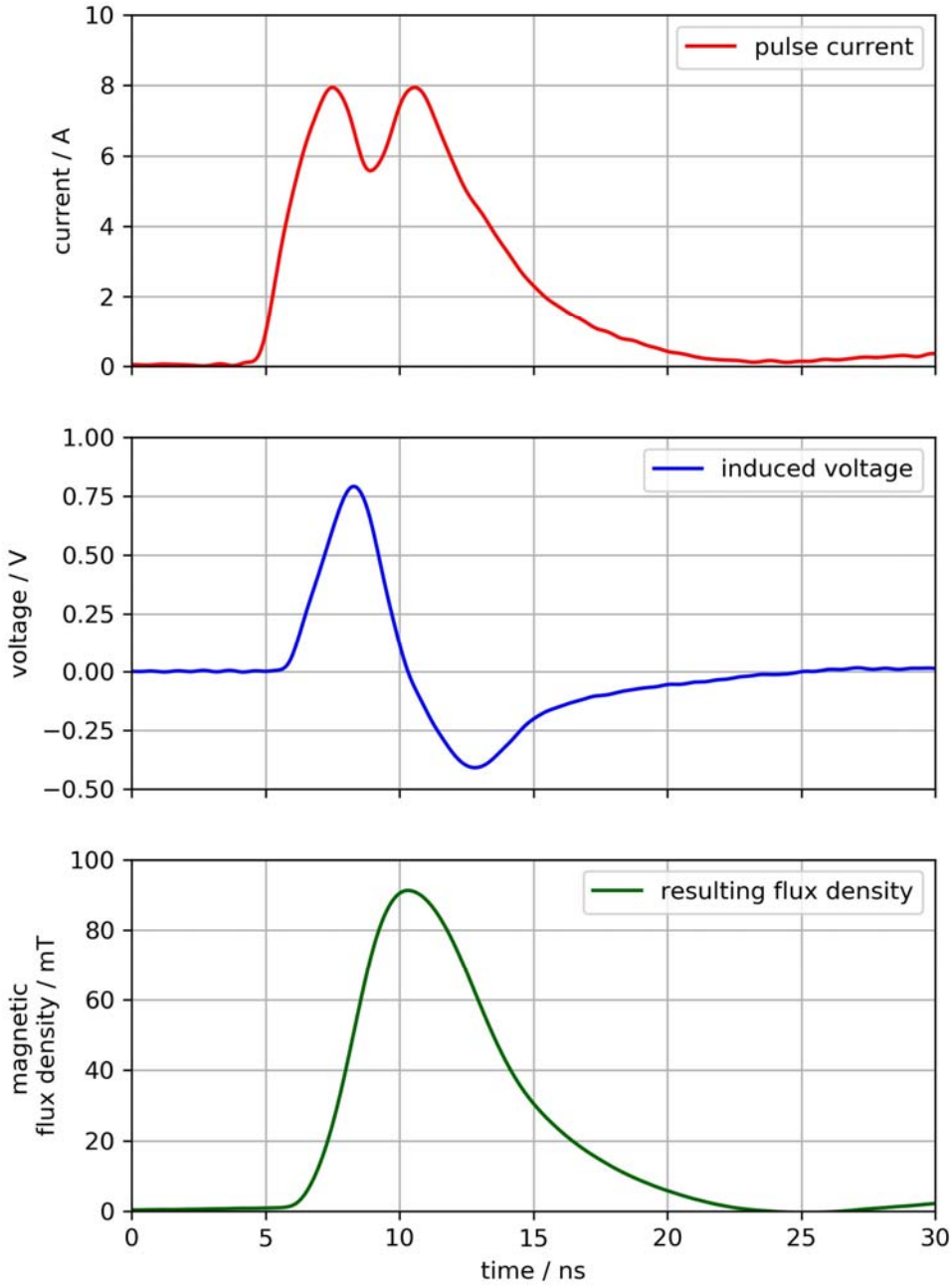


Figure 38: ICI HH500-15 typical waveform (reference setup, 500µm coil, 50Ω)

9.3 ICI E450

Parameter	
Supply / control	BPS 202
Diameter probe tip	400µm
Max displacement current (100µm stripline)	7mA[7]
Max. pulse repetition frequency	20kHz
Pulse rise time	approx. 2ns
Pulse polarity (programmable)	+ / - / alternating
Measurement output	50Ω
Pulse level voltage range	50V – 500V
Trigger pulse delay	see parameter sheet
Trigger pulse jitter	see parameter sheet
Weight	70g

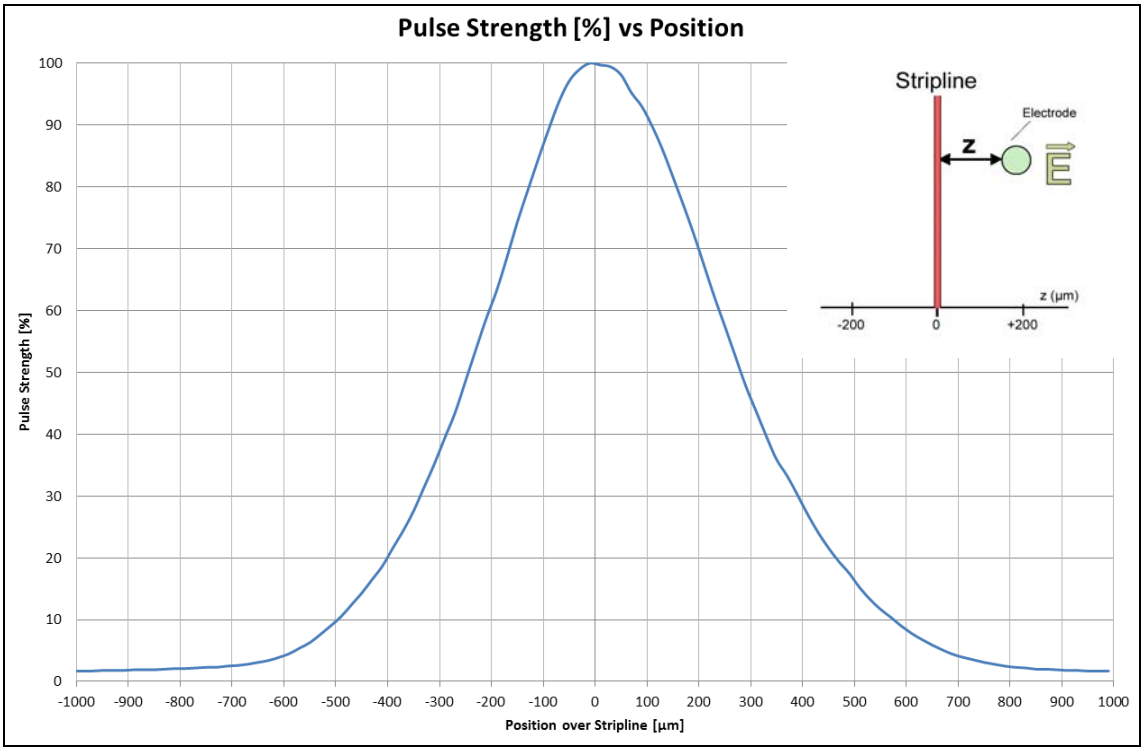


Figure 39: Relative pulse strength, scan across 100µm stripline

[7] Approximate value; for specific value refer to parameter sheet of the probe

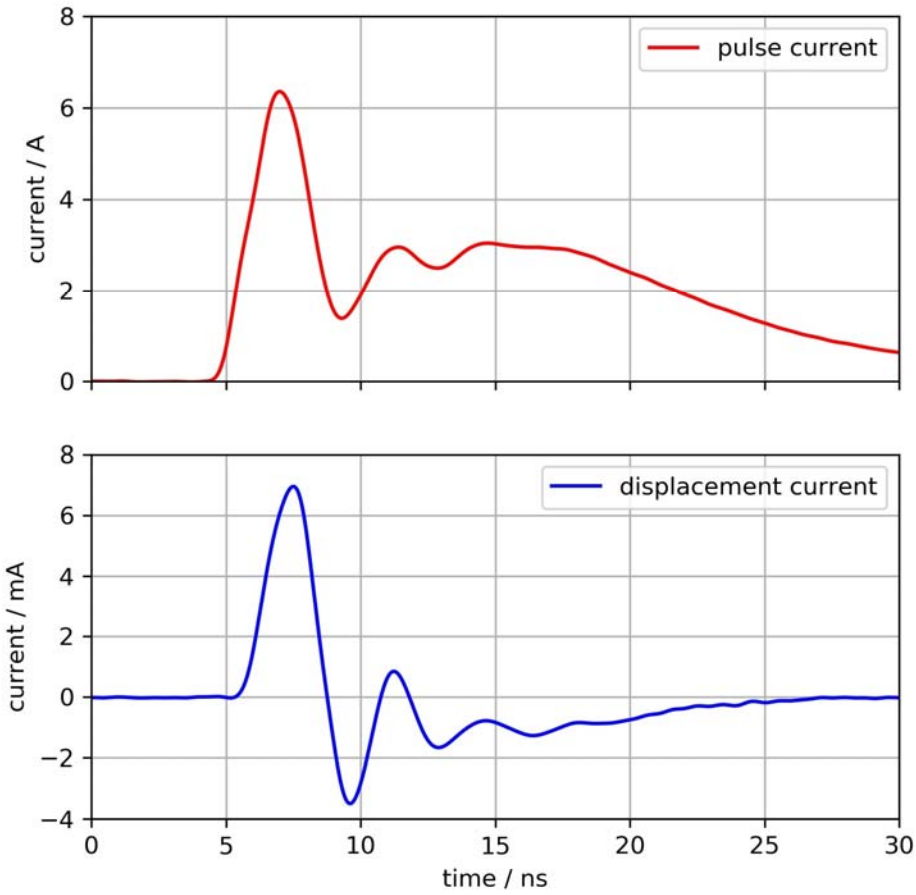


Figure 40: ICI E450 typical waveform (reference setup, 100µm stripline, 50Ω)

9.4 ICI I900

Parameter	
Supply / control	BPS 202
Probe tip	Spring Pin
Max displacement current (1Ω load)	approx. 4A[8]
Max. pulse repetition frequency	20kHz
Pulse rise time	approx. 2ns
Pulse polarity (programmable)	+ / - / alternating
Measurement output	50Ω
Pulse level voltage range	50V – 500V
Trigger pulse delay	see parameter sheet
Trigger pulse jitter	see parameter sheet
Weight	70g

[8] Approximate value; for specific value refer to parameter sheet of the probe

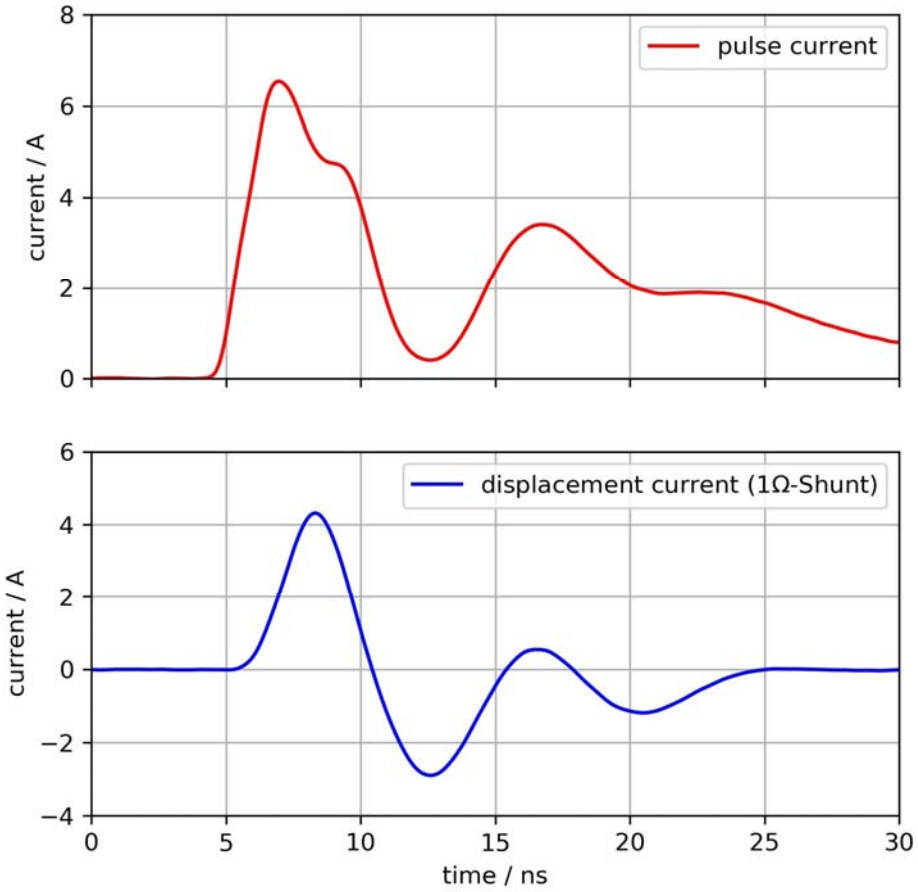


Figure 41: ICI I900 typical waveform (1Ω load, low-impedance ground connection)

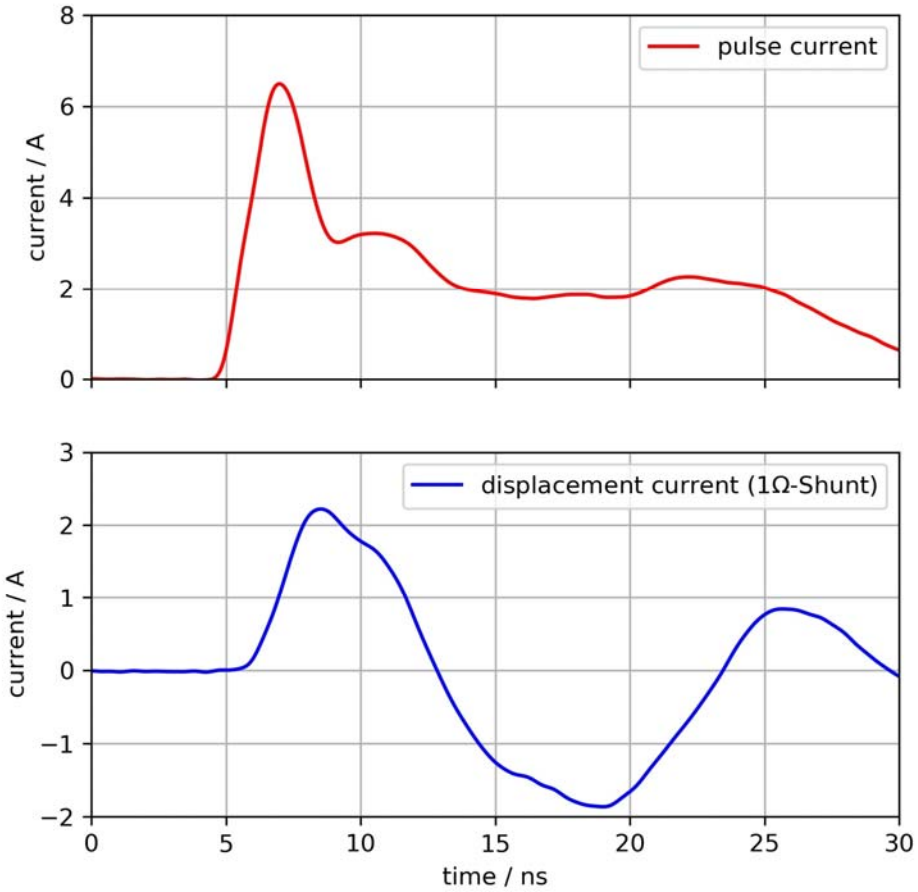
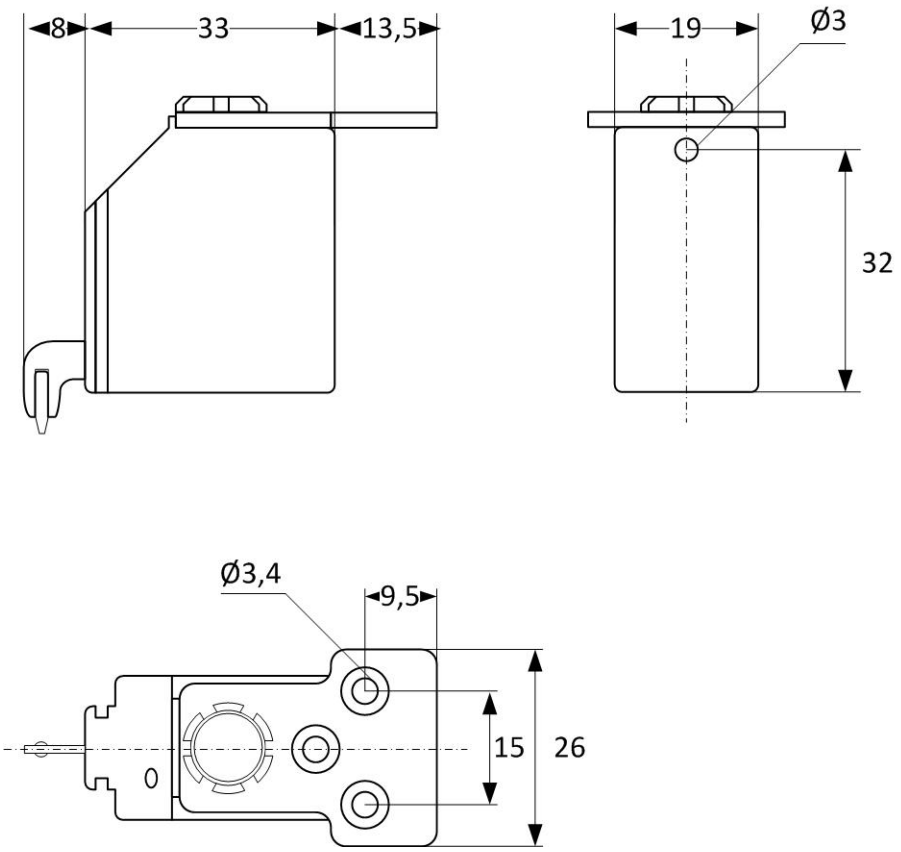


Figure 42: ICI I900 typical waveform (1Ω load, high-impedance ground connection)

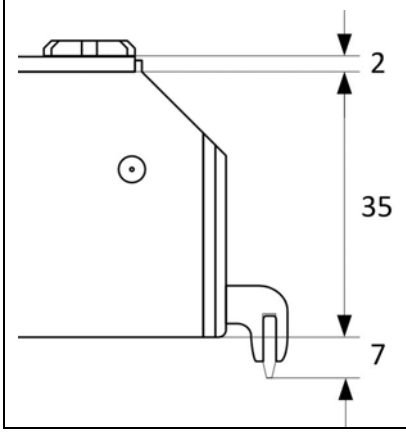
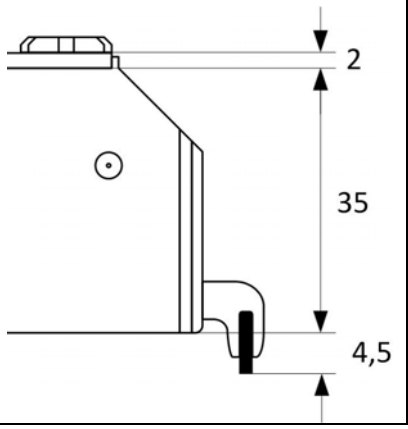
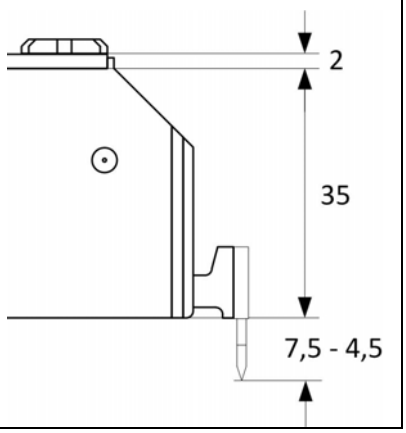
9.5 Dimensions

9.5.1 All ICI Probes



*all dimensions in [mm]

9.5.2 ICI Probe Tips

ICI HH500-15	ICI E450	ICI I900
		

10 Contents

Item	Designation	Type	Qty.
	ICI HH500-15	magnetic-field probe	1
01	ICI E450	electric-field probe	1
	ICI I900	current injection probe	1
02	Burst power station	BPS 202	1
03	HV / signal cable	1m / 7Pol Fischer	1
04	Measurement cable	1m / SSMB - SMA	1
05	USB cable	USB-A / USB-B	1
06	Power supply	12V / 1A	1
07	CD with BPS202-Client		1
08	User manual		1
09	Case		1