



LTTpro V4 - User manual

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LTTpro V4

User Interface Software for LTT Devices

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*"Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is the most important." **

* Bill Gates

Part



1 Welcome to LTTpro, Version 4

LTTpro is a user interface software for LTT24 and LTT 18x devices. This user manual will guide you through all important functions of LTTpro and will make it more convenient for you to work with our software.

If LTTpro has not already been installed on your computer, please start with chapters [System Requirements](#)^[11] and [Installation](#)^[12].

Before using the program for the first time, you should study the chapter [First Application Start and Settings](#)^[14] as well.

Users of LTTpro Version 3.x may be interested in chapter [Changes to LTTpro V3.x](#)^[82]

If you have any questions or problems with LTTpro software, please contact us by email to info@tasler.de or visit our homepage on <http://www.tasler.de>.



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1.1 System Requirements

LTTpro in version 4 supports the following operating systems:

- Microsoft Windows™ Version XP (with SP3), Vista, 2003 and Windows 7,8 - 32-bit and 64-bit versions are supported.
- Linux, several distributions, kernel version 2.6 and above
- Mac-OS is not supported at the moment.

Hardware requirement of LTTpro depends on the installed operating system and user demands.

Minimum requirements:

- x86 compatible processor, at least 2.0 GHz
- 512 MB memory (RAM)
- 60 MB free hard disk space for program files
- graphic resolution: 1024x768
- USB 2.0 or (U-)SCSI interface for local connection to LTT24 and LTT-18x devices
- Fast-ethernet (100MBit) or gigabit (1GBit) ethernet interface for network connection to LTT-devices or *Netboxes*

Recommended:

- x86/x64 compatible processor, 2-4 cores, 2.0 GHz or higher
- 2 GB+ RAM
- enough free memory for program **and measurement** files
- graphic resolution: 1440x900 or better
- USB 3.0 interface for LTT24 devices

1.2 Installation

LTTpro is available on several operating systems but as installation varies on different Linux distributions, this chapter will only describe installation on Microsoft Windows™ operating system. For Linux installation, please see enclosed installation notes in `INSTALL` or `README` files.

For Microsoft Windows™ operating system, LTTpro is delivered as a single installation file `LTTpro_Setup.exe`. It is also possible that program version is part of the filename, e.g. `LTTpro-V4.0.0-Setup` for better distinction. With newer versions of LTTpro, a (smaller) update installation file is available. If any 4.x version of LTTpro is already installed on your system, this update can be used to have LTTpro on the most current version.

If your LTT device was delivered with a CD, installation will normally start automatically after insertion of compact disk.

If you have downloaded a newer version of LTTpro from internet, please start installation or update by double-clicking the downloaded file.

Depending on the installed version of Microsoft Windows™, please note:

- You may need **sufficient privileges** to install a new software package.
- For a complete installation, please uninstall previous versions of LTTpro before installing the new one.
- LTTpro setup file is not digital signed. Some versions of Microsoft Windows™ require additional confirmations for software that is not digital signed. If you have downloaded the installation file from the LTT website or if you have started installation directly from compact disk, you can confirm those dialogs without risk.

The setup programs allows to modify target directory and type of installation. A typical installation takes place in the `program` folder of you system and contains the following files:

- LTTpro executable (`lttpro4.exe`)
- LTTpro tools (`LTTRoad-Config.exe`)
- LTTpro ROA service installer (`LTTRoad-Service.exe`)
- LTTpro libraries (`*.dll`)
- LTTpro help file(s) (`lttpro_*.chm`)
- LTTpro user manual(s) (`lttpro_*.pdf`)

Wildcard (*) is for different names, languages or versions, e.g. `lttpro_de.pdf` or `lttpro_en.pdf`.

Important: Please **do not install** LTTpro to a network share even if a drive letter was assigned. Though LTTpro will start and most functions will work, newer versions of Microsoft Windows™ suppress more and more functions when running on a network share (e.g. launch of online help etc.).

The setup program will copy all necessary files to your system and creates shortcuts to your startmenu, desktop and quicklaunch bar.

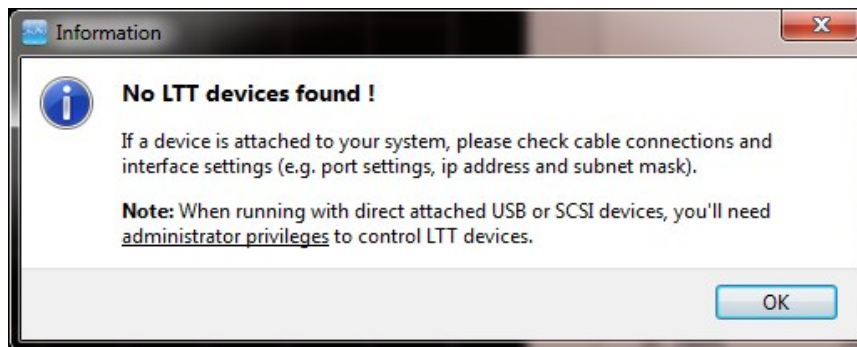
Important: If you intend to attach LTT devices with USB- or SCSI-interface to your computer, you will normally need **administrator privileges** while running LTTpro. Depending on your version of Microsoft Windows™, it might be necessary to modify program shortcuts with "Run as administrator" option.

An alternative on Microsoft Windows™ operating systems for the operation with local devices without administrator privileges is [LTTRoA Service](#)^[98]. This operation mode is a little slower (~75% transfer speed of *direct mode*) but runs totally without any privileges (normal Windows user privileges will suffice). Read the corresponding chapter [LTTRoA Service](#)^[98] to learn how to install and work with this Windows service.

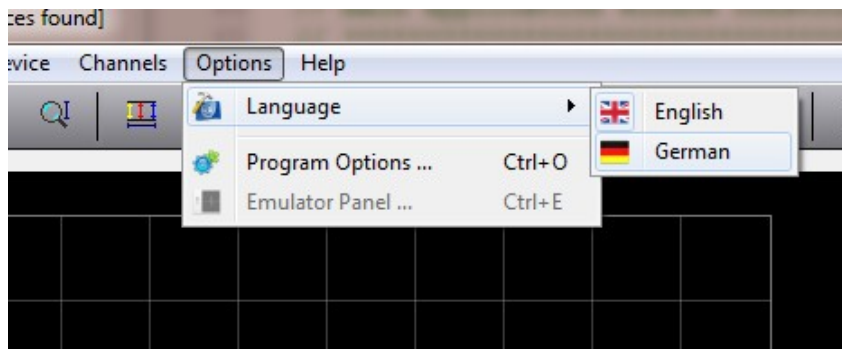
1.3 First Application Start and Settings

Application settings of LTTpro are stored individually for each user. When you start LTTpro for the first time, default settings for **language**, **display** and **hardware interface** are used. Please take a little time to configure **basic settings** to your needs before you start working with LTTpro.

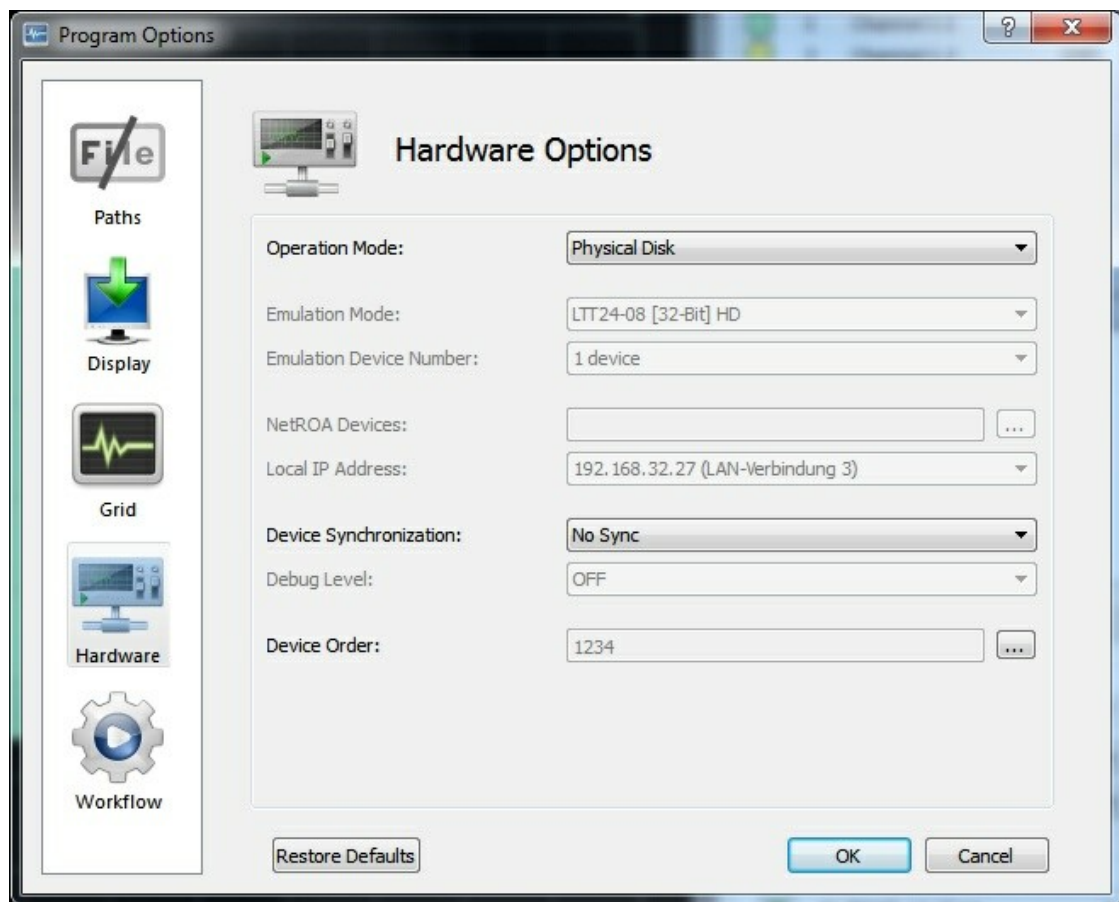
1. Please start LTTpro from Startmenu or with the desktop or quicklaunch shortcut. The program will start in English language with default hardware interface settings. If no LTT USB- or SCSI device is attached, the following message appears.



2. Confirm this dialog and go to *Options* menu. If you prefer another **language** (German/English/Spanish at version 4.0, further languages will follow), select it with *Language* menu item :



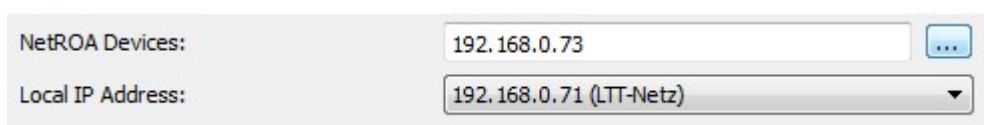
3. After changing the language you have to restart LTTpro in order to apply new language settings.
4. Please reopen *Options* menu and select *Program Options* this time. From the topics on the left, select *Hardware*:



Hardware Options

5. Select the correct *Operation Mode* for LTTpro, the following options are available:

- a) **Physical Disk**: Select this mode if you have one or more LTT devices with **USB-** or **SCSI-** interface attached to your computer. If only one device is attached, no further settings are required.
- b) **LTTroa Service**: Use this mode for locally attached devices if **no administrator privileges** are available. Please refer to [LTTroa Service](#)^[98] for more instructions.
- c) **Ethernet (NetROA)**: Select this mode with **ethernet devices** or devices that are attached to a LTT-**Netbox**. After changing the *Operation Mode* item, the controls for **NetROA Devices** and **Local IP Address** are enabled and have to be filled with correct settings. If your computer has multiple **IP Addresses**, please select the correct subnet first. If you know the correct **IP address** of your LTT ethernet device, you can enter that address directly to the **NetROA** field, multiple addresses can be separated by comma. If you don't know the LTT ethernet device address, click on the button right of the **NetROA** field to open a scan dialog.



- d) **Emulation**: Select this mode if you want to work with LTTpro without any attached LTT devices. This can be useful to exposure the software or to create or modify configuration setups for later measurement jobs.

All four *Operation Modes* can handle a **maximum of four devices** (up to 64 channels). While using multiple, synchronized devices (19 inch device or devices are connected with a sync-cable), please keep in mind to setup **Device Synchronization** and **Device Order**.

After leaving the dialog with "OK", changes take effect immediately. On **Physical Disk** and **Ethernet (NetRoa)** mode, a device rescan is done immediately, on **Emulation** mode the **Emulator Panel** is launched. If no signal appears on **Dataview** and no channels are listed in **Channel Control**, please check [FAQ](#)^[99] section .

No further configuration is required at that point. All other settings should work with defaults, if you want to change other settings at this time, please check section [Program Options](#)^[72] for further details.

Part



2 Controls and Panels

There are different demands for different measurement situations. For that reason, visibility and position of most panels and control elements can be configured within LTTpro. All important controls can be shown or hidden, their position can be docked on one side of LTTpro main window or free floating all over the desktop.

[Dataview](#)^[20], [Menu and Statusbar](#)^[19] however are **fixed elements** that cannot be hidden or repositioned.

The [Toolbar](#)^[21], [Controlbar](#)^[23] and the [Data Controls](#)^[51] as well as the widgets for [Device Control](#)^[25] and [Channel Control](#)^[26] can be positioned and shown/hidden individually.

Visibility toggling and (re-)positioning of the different controls can be done on different ways:

1. With **View** menu: Visibility of all major control elements can be toggled here. A check mark signals the the current status of each control. Collecting functions (e.g. *Show All* or *Hide All*) can toggle visibility of all controls and widgets with one step.
2. With **context menu**: With a right-click on the titlebar of each widget or on the free space of all panels, a context menu appears with menu-item to show/hide each major control.
3. With **hot keys**: Use these keyboard shortcuts for toggling visibility of the different controls. A summary of key combinations can be found at [Hotkeys](#)^[92].



View Menu

The positioning of control elements works as usually with window oriented systems. Panels can be picked with the mouse at the shaded corner, **dragged** to the desired location and then **dropped** to the target area. For the widgets [Device Control](#)^[25] and [Channel Control](#)^[26] the procedure is the same, use *titlebar* for **drag & drop** functionality.

As soon as one of the controls is **dragged** to a boundary of LTTpro main window, a target area in-between the main window (*dock-side*) is highlighted. If you **drop** the element in this situation, the control will **snap into the highlighted place** (*dock*). At any other position, the control element will act free *floating* as a standalone window.

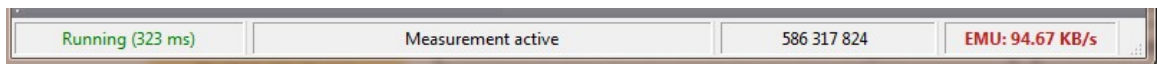
If you have unintentionally changed the position of control elements and want to restore the original position and visibility, use menu item *View | Reset View* (**Ctrl+0**) to reset default view settings.

2.1 Main Menu and Statusbar

It is assumed that **Main Menu** and **Statusbar** are known by other window based applications. **Main Menu** offers a structured access to all important functions and settings. Furthermore, **key combinations** ([Hotkeys](#))^[92] and **state of activatable items** is shown in **Main Menu**.

If you work for the first time with LTTpro, you will probably have some questions on practice with the program. You can invoke *Help | Help Contents (F1)* at any time from **Main Menu** to open that manual or *Help | Context Help (Ctrl+F1)* to toggle "What is this?" mode.

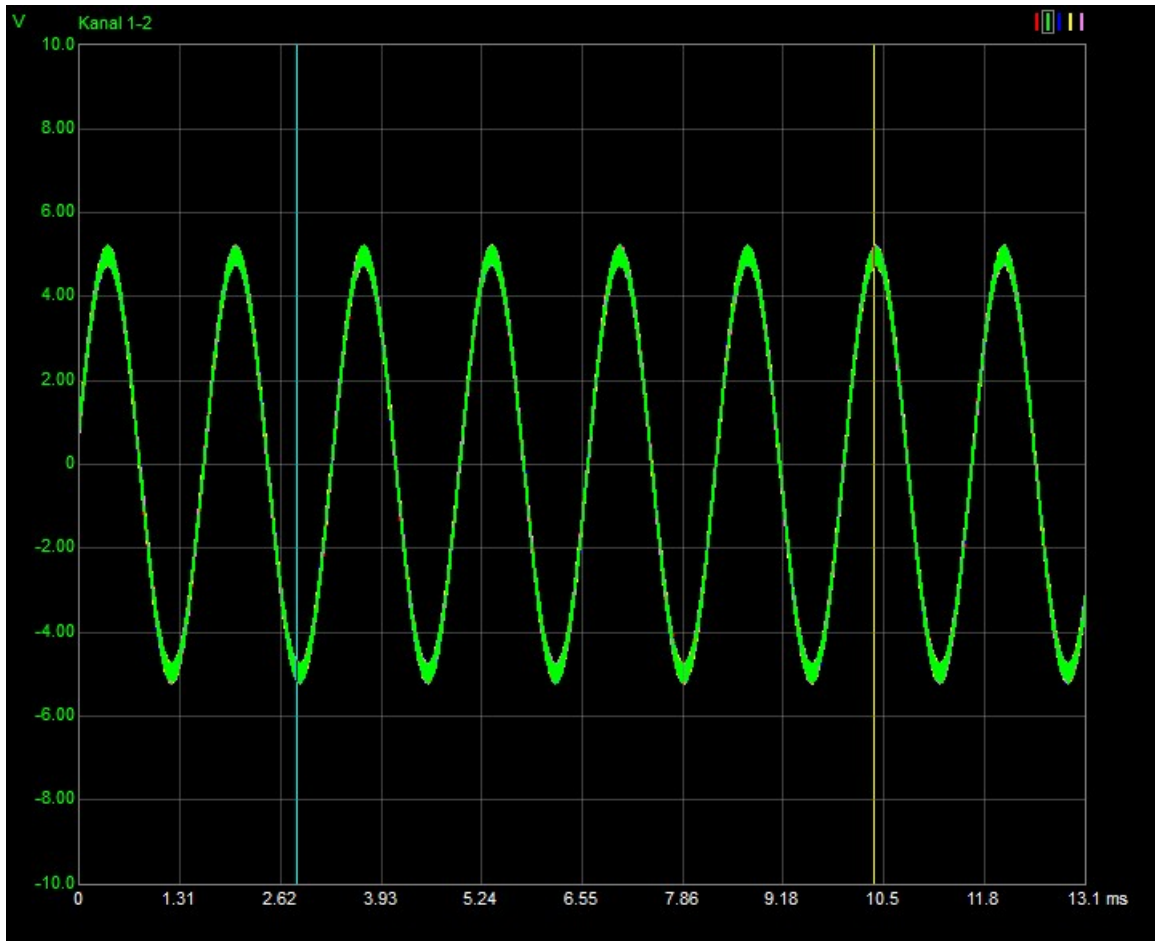
The Statusbar is divided into four (in some cases five) sections and permanently shows information on most important program states:



- **Left:** one of the states *Running*, *Stopped* or *Recording*, in **RAW Mode** additionally with prefix **RAW:**
- **Center left:** further information on recording etc.
- **Center** (optional, normally invisible): current progress and filename while recording
- **Center right:** total number of transferred bytes
- **Right:** effective transfer-rate in bytes per second, in **Emulation Mode** additionally with prefix **EMU:**

2.2 Dataview

The (Main-) **Dataview** of LTTpro is one of the fixed, non positionable controls. The default view is like an oscilloscope with additional controls and information items.



While the main (center) area of the **Dataview** is for signals and cursors, the boundaries show additional information and contain different context menus:

- **Top left:** name of selected **Top-channel**
- **Top center:** context menu with **Device Control** and **Recording** functions
- **Top right:** display and selection of **Top-channel**
- **Left:** graphical positioning of **Trigger**, unit and scaling of current **Top-channel**, more **Trigger** settings in context menu
- **Bottom:** x-axis with time or user defined unit, graphical setup of **PreTrigger**, context menu with **Display Settings**

2.3 Control Elements

2.3.1 Toolbar

The **Control Element Toolbar** is docked at the right side of LTTpro by default and provides access to commonly used functions. While moving the mouse cursor over an icon of a panel element, a short text is shown describing the corresponding function.



Sym bol	Function
	Load Configuration: Use this function to load (XML-) device configurations. Please note: The content of the device configuration that is loaded must be of same type and number as attached device(s).
	Save Configuration: A dialog opens to enter or select a valid path and filename. The current configuration will be saved in XML format.
	Print Configuration: The current device and channel configuration will be printed on a selectable printer.
	Save as Default: This function stores current configuration to the user's application path. Each time LTTpro is started, this configuration will be loaded. Use Clear Default to delete this configuration and to start LTTpro with a clean, safe setting.
	Clear Default: Deletes user default configuration. LTTpro will start the next time with a safe default setting.
	Add Operator: This function adds mathematical functions to a separate dataview
	Level Monitor: See the current signal level, their minima/maxima and clipping flag of all active channels.
	Channel Config Section: Use this Channel Control layout for the most important parameters: <i>Input-Type</i> , <i>Range</i> , <i>DMS-Power</i> and <i>State</i> . This is default for Channel Control widget.
	Channel Scale Section: Use this Channel Control layout for control of scaling and offset values of each channel.
	Channel View Section: Use this Channel Control layout for control of x- and y- grid division of each channel.
	Channel Cursor Section: Use this Channel Control layout to display cursor values with activated cursors.
	All Channel Sections: Use this Channel Control layout for the most informative display of Channel Control widget. This layout fits best with a wide, floating display of Channel

Sym bol	Function
------------	----------

Control.

Quit: LTTpro will terminate. Visibility and position of control elements and other application settings are stored automatically.

All functions of *Toolbar* are also accessible by **Main Menu** and by [Hotkeys](#)^[92].

2.3.2 Controlbar

The **Controlbar** is docked at the bottom of LTTpro application windows by default. Available buttons vary depending on current program state and/or running functions. During a normal measurement, the following functions are visible:



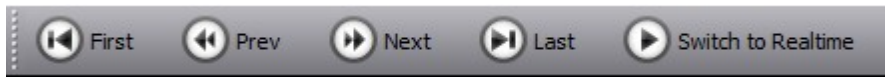
Symbol	Function
	<i>Start</i> : enabled when measurement is stopped or in <i>Single Shot Mode</i> , disabled else.
	<i>Stop</i> : terminates current measurement, interrupts data transfer to computer.
	<i>Record</i> : starts recording of measurement data, caption changes to <i>Stop Recording</i> while recording is active.
	<i>AutoZero</i> : if available, all signals are drawn to zero level. Only available with LTT-180/182 and LTT24 devices at the moment. If one or more signals are out of (correctable) range, a warning message will appear.
	<i>Quit Replay</i> : in normal measurement mode, this button is invisible . While replaying data from Stand-Alone Mode ^[60] , this button terminates replay or storing of replayed data.





If data was loaded from a stored measurement or replay file, **Controlbar** changes to:



Symbol	Function
	Switch to Realtime- or Devicemode (Ctrl+T)

If multiple files were recorded with the same setup (**Multiple Recording**) and those are loaded, the following controls are displayed in **Controlbar**:

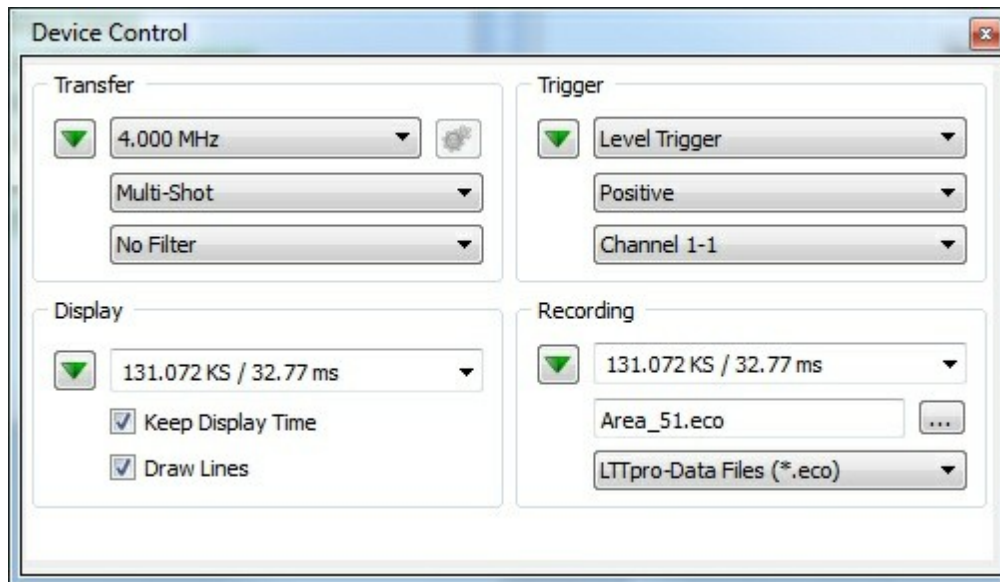


Symbol	Funktion
	First: Load first file of multiple recording.
	Prev: Load previous file of multiple recording
	Next: Load next file of multiple recording.
	Last: Load last file of multiple recording

These functions can also be invoked by *Device* menu or [Hotkeys](#)^[92].

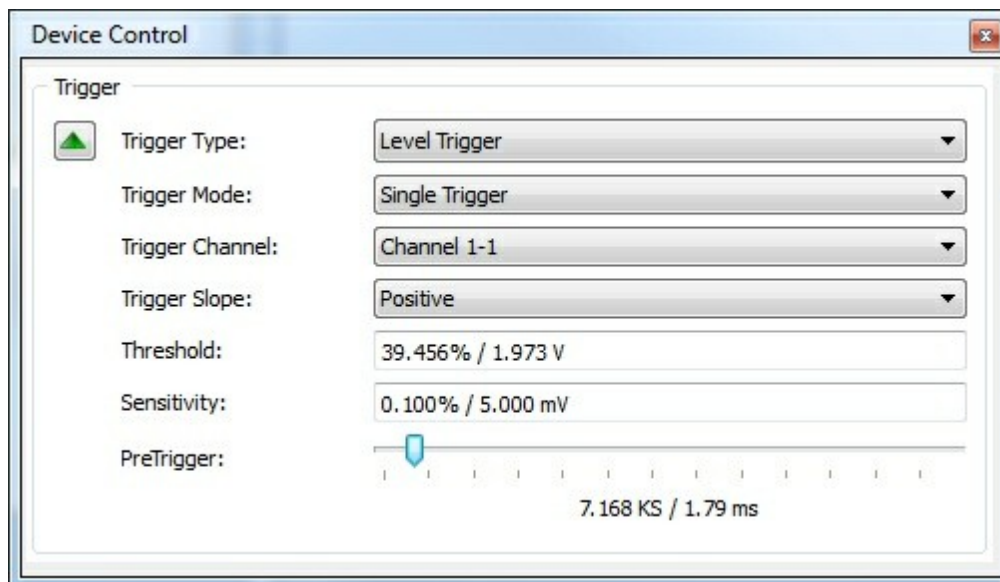
2.3.3 Device Control

The **Device Control** element contains all **global device settings** for measurement, e.g. sample clock, filter mode etc.



Device Control Widget

The most commonly used settings can be adjusted in the **Device Control Widget**. This widget is separated in four sections, a click on the down arrow will overlay more detailed settings of the particular section.


































Trigger Section

A detailed description of all sections can be found in [Working with LTTpro](#)^[30].

2.3.4 Channel Control

The channel behaviour of all attached devices is controlled by **Channel Control**. This control element can alter to different layouts and has a lot of direct and context-driven functions.

Channel Control

▼	Analog		Input-Type	Option	Range	Supply	State
	1	Channel 1-1	Volt DC	SE BNC	±5 V	OFF	
	2	Channel 1-2	Volt DC	SE BNC	±50 V	OFF	
	3	Channel 1-3	Volt DC	SE BNC	±50 V	OFF	
	4	Channel 1-4	Volt DC	SE BNC	±50 V	OFF	
	5	Channel 1-5	GND	None	±5 V	OFF	
	6	Channel 1-6	GND	None	±5 V	OFF	
	7	Channel 1-7	GND	None	±5 V	OFF	
	8	Channel 1-8	GND	None	±5 V	OFF	
▼	DAC-Output		Type	Signal	Freq	Amp	State
	O1:1	Chnl 1-1 Line A	OFF				
	O1:2	Chnl 1-1 Line B	OFF				
	O2:1	Chnl 1-2 Line A	OFF				
	O5:1	Chnl 1-5 Line A	OFF				
	O6:1	Chnl 1-6 Line A	OFF				
▼	Pulse Recog		Line A		Line B	Line Z	State
	P1	Chnl 1-1 Pulse	1000 10 1000		OFF	OFF	
	P5	Chnl 1-5 Pulse	OFF		OFF	OFF	
▼	Math		Math-Type	Option	Source	Result	State
	M15:1	FFT dB-Ref	FFT	Hamm dB	Chnl 1-1		
	M16:1	FFT dB-Ref	FFT	Hamm dB	Chnl 1-2		
	M17:1	FFT dB-Ref	FFT	Hamm dB	Chnl 1-3		
	M18:1	FFT dB-Ref	FFT	Hamm dB	Chnl 1-4		

Channel Control

To power on a channel (and to include its signals to the data stream), this channel has to be activated. Click on the **State** column of the desired channel(s) in order to toggle channel activity. Multiple channels can be selected with the mouse, all channels can be selected with *Channels | Select All Channels (Ctrl-A)* or unselected with *Channels | Clear Channel Selection (Ctrl-U)*.

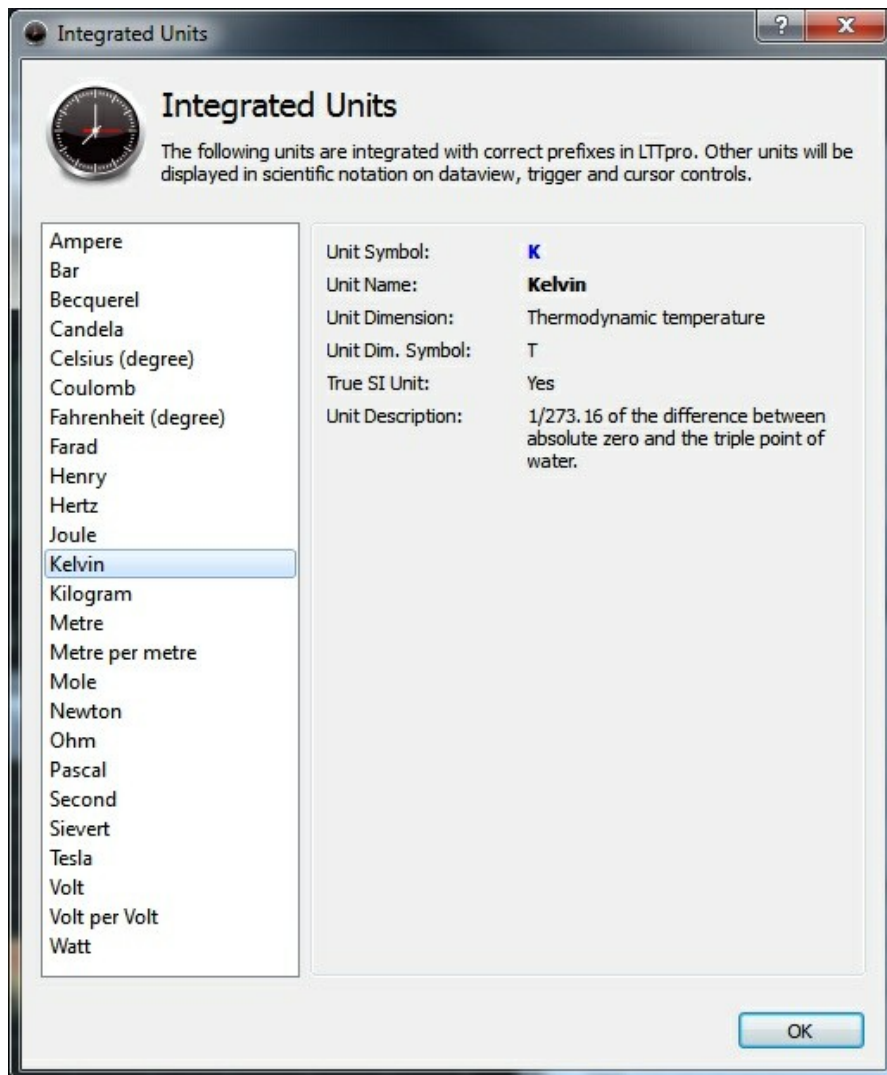
Further channel settings can be achieved directly with edit field or context menus (right-click). For detailed information on device and channel configuration, please work through chapter [Working with LTTpro](#)³⁰⁾.

2.4 Integrated Unit System

Default unit for **DataView** and **Control Elements** in LTTpro is (V)olt (with prefix, if necessary). If a new unit is assigned to a channel, display changes to this new unit.

LTTpro has a lot of units *integrated*, that means that those units are scaled with correct prefixes, like *mA* for $1e-3$ A or *t(ons)* for $1e3$ kg and so on.

Select **Help | Integrated Unit System** to open a dialog with all integrated units and additional information.



Units that are not specified in that list are indicated in scientific notation, e.g. " 5.6 e-3 at ".

Please note: Please enter units without prefix, e.g. *bar* instead of *kbar* in order to avoid ambiguousness. With some units the dialog shows *Unit Alias* as alternative input for units that are displayed with symbols that are hard to enter with keyboards, e.g. "cel" will result in °C and "ohm" will result in Ω.

Part



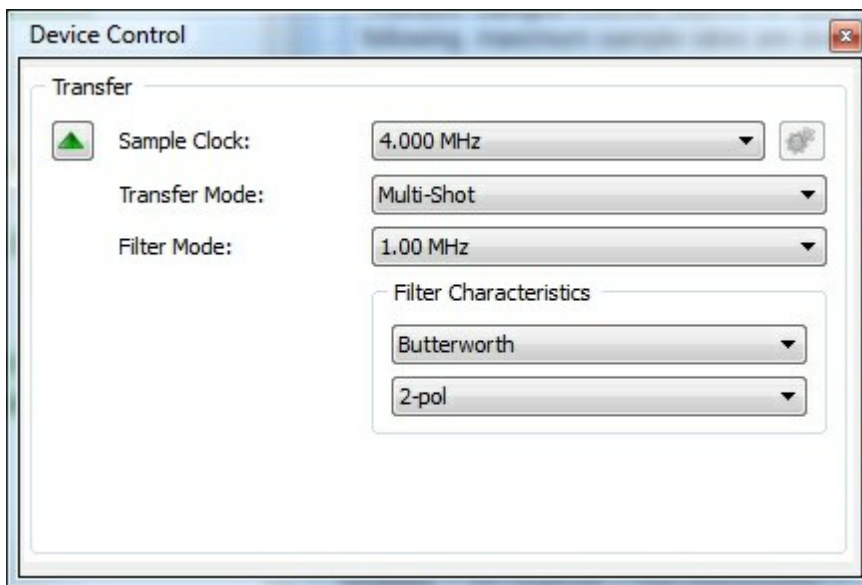
3 Working with LTTpro

All topics in this chapter will describe general functions of LTTpro that are available without special hardware features or additional software licenses. See separate documentation for specific hardware and software features such as **Pulse Recognition**, **DAC-out**, **Mathematics** and further more. Optional, additional functionality is integrated in the LTTpro user interface and will not affect the general functions of the application.

3.1 General Settings

3.1.1 Sample Clock, Transfer and Filters

The **Device Control** element has several sections that allow a structured access to the different parameters. Pressing the "down-arrow" next to **Transfer** you will find control elements for **Sample Clock**, **Transfer Mode** and **Filter Mode**. Every time one of these settings is changed, a new measurement starts.



Device Control - Transfer

Available **Sample Clocks** depend on type and number of attached devices. All channels are digitized with the same clock. Sample rates below 100KHz are oversampled with 100KHz (104KHz with LTT-184/186). The following, maximum sample rates are available for LTT devices:

- **LTT-184/186 Transientrecorders:** 1 KHz - **20 MHz** with single device, 1 KHz - **2.5 MHz** with multiple devices
- **LTT-180/182 SensorCorders:** 50 Hz - **500 kHz**, optional 50 Hz - **2.5 MHz** with *Fast-SensorCorder*
- **LTT24:** 5.0 kHz - **4.0 MHz**

With LTT-18x devices, the overall sampling rate **can not exceed 100MHz**, e.g. per device a

maximum of five channels can be active with 20MHz etc.

Transfer Mode defines start and duration of data acquisition. The following modes are available:

- **Single-Shot:** exactly **one measurement** is taken, length is defined with **Display Size** on the **Display tab**. After measurement data is transferred and displayed in **Dataview**, measurement stops and can be restarted with **Start** button.
- **Multi-Shot:** there will be a **permanent data acquisition with restart** after display length. Normally, a *buffer overflow* should not occur in this mode. This is the default setting for **Transfer Mode**.
- **Continuous:** there will be a **permanent data acquisition without restart**. As long as no device *buffer overflow* occurs, data is transferred to computer. A *buffer overflow* happens, if measurement data is recorded faster than transferred to computer and device buffer runs out of memory. In this case measurement aborts and an error message appears.

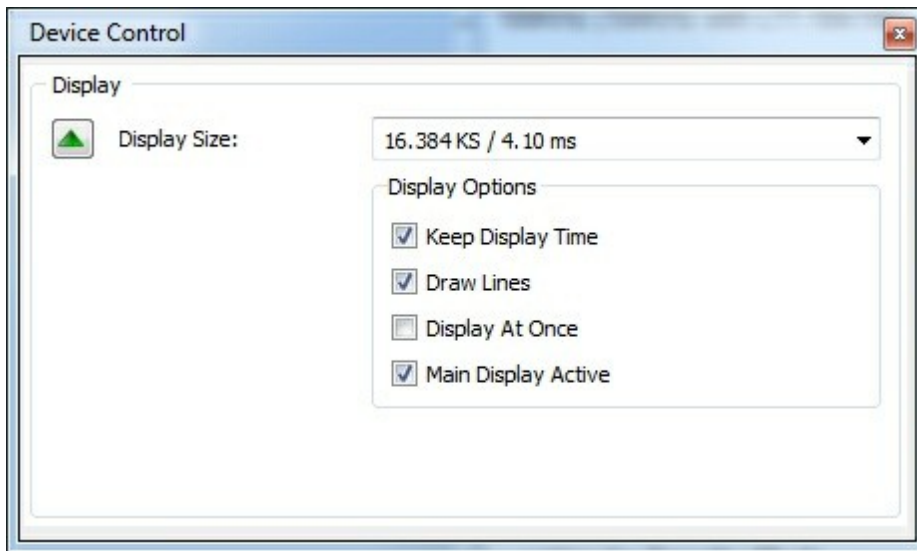
With **Filter Mode**, a digital low-pass filter can be enabled and **cutoff frequency** (ω_0) can be defined. After selecting ω_0 , **Filter Type** and number of **Poles** can be selected. The following **Filter Types** are available:

- **Butterworth Filter:** by way of example http://en.wikipedia.org/wiki/Butterworth_filter
- **Bessel Filter:** by way of example http://en.wikipedia.org/wiki/Bessel_filter
- **Tschebyscheff-Filter:** by way of example http://en.wikipedia.org/wiki/Tschebyscheff_filter

Please note: all numerated low-pass filters are calculated in LTTpro and not in LTT devices. Depending on your computer system there can be a performance lack with a lot of active channels with active filters and high sample clock.

3.1.2 Configure Display

Clicking the "down-arrow" near **Display** will open the extended display options. **Display Size** items are defined in size (samples per channel) and time (total time). The minimum **Display Size** is one Kilosample (1KS). Maximum **Display Size** depends on number of active channels and the amount of dedicated display memory for LTTpro that can be adjusted in *Options | Program Options* dialog in [Display](#)^[74] section. **Display Size** is always declared **per channel**.

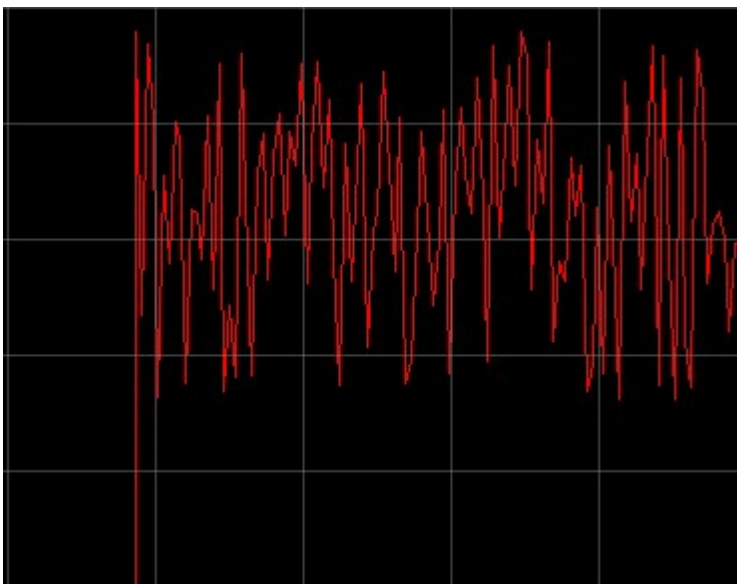


Device Control - Display

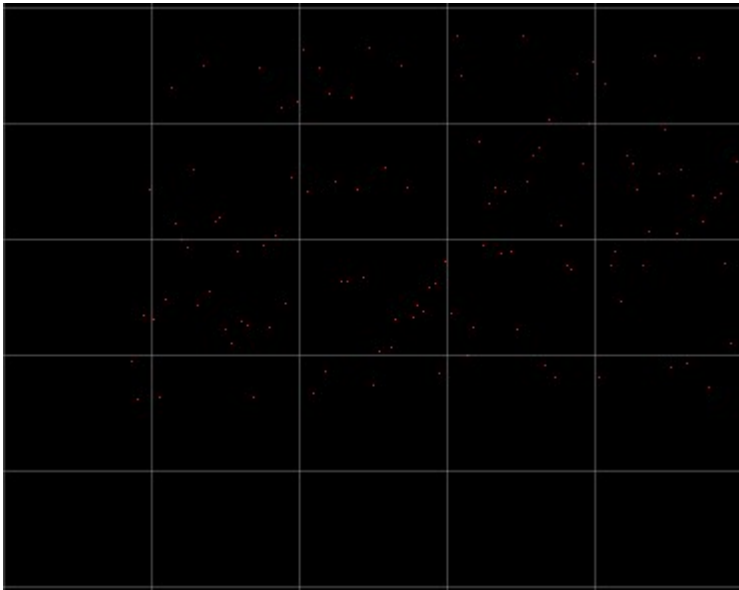
Besides, the following **Display Options** are available:

Use **Keep Display Time** to toggle if LTTpro should try to adjust **Display Size** when **Sample Clock** is changed in order to maintain signal form on display. Please note that this option will not work with all combinations of **Display Sizes** and **Sample Clocks**. This option is **on** by default.

Draw Lines defines, if single data dots are joined in **Dataview**. This option is **on** by default.



Display: Draw Lines



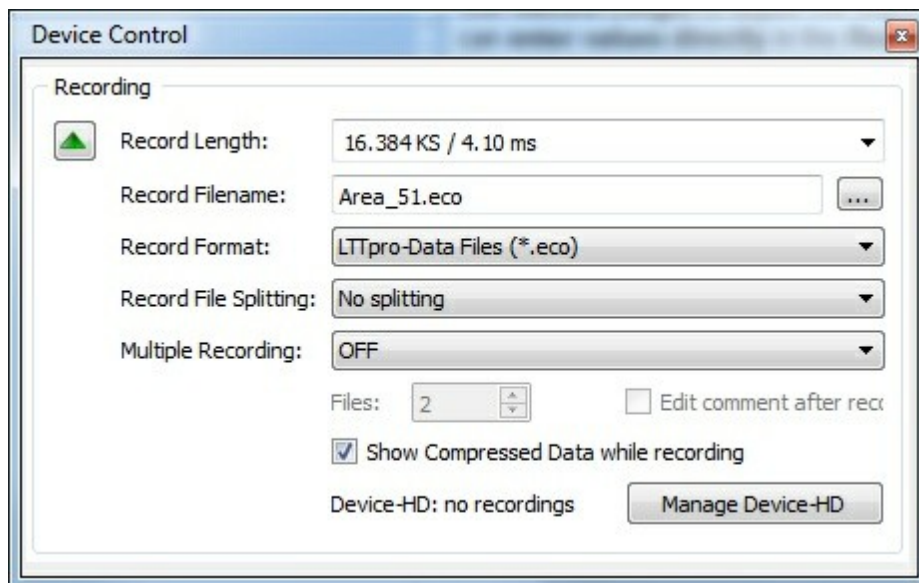
Display: Do not Draw Lines

With small display length it is possible that an annoying flickering occurs on high sample rates. To avoid this effect, enable **Display At Once** option. With this option enabled, display is painted completely instead of slices. The default for this option is **off**.

For testing purposes painting can be disabled at all. Uncheck option **Main Display Active** in order to maximize performance. Data will be transferred (and recorded) as normal but not painted in **Dataview**. Use this option to check if painting bulk 2D data means a bottleneck to your computer system or its graphical subsystem. By default, this option is **on**.

3.1.3 Recording

Parameters that belong to recording can be configured in the **Recording section** of **Device Control**.



Device Control - Recording

Use **Record Length** to adjust the required amount of data that should be recorded **per channel**. You can select the desired length from a list of pre-calculated values or you can **enter values directly** in the **Record Length** field. Accepted will be **time values** like 3_{min} for three minutes or 2.8_{s} for two seconds and 800 milliseconds. You can also enter an **amount of samples**, e.g. 500_{KS} for five hundred Kilo-samples or 2_{GS} for two Giga- samples. LTTpro will round values that are too small in order to get a multiple of 1024 Bytes. **Record Length** is not limited at all so please keep in mind to have enough free space on the target directory.

Record Filename defines directory and (major-) filename for recorded files. LTTpro automatically generates an five digit index that is appended to that filename. With **Multiple Recording** activated, an additional four digit number is appended. To setup a filename, click on the button (...) next to the edit field and select a directory, format and filename from the file open dialog.

Available **Recording Formats** at the moment:

- **LTTpro Data Files (*.eco)** : proprietary LTTpro file format, configuration in XML file, data in IO files.
- **LTTView Data Files (*.con)**: proprietary LTTView file format, configuration in CON file, data in IO files.
- **Diadem Files (*.dat)**: the Diadem format. Configuration in DAT file, data in I16 files.
- **Famos Files (*.dat)**: single Famos DAT file, configuration in header of file.
- **FTrans (*.bin)**: single FTrans BIN file, configuration in header of file.
- **MGraph Files (*.mdf)**: Multigraph (MDF) format.
- **CSV Files (*.csv)**: Comma Separated Values
- **DASYLab Files (*.ddf)**: single DASYLab file in standard format, version 1 with (4 Byte) float data values.

- **Device Internal Harddisk:** this option is only available on LTT24 devices with integrated SSD, see section [Device Internal Recording](#)^[67] for details.

Long recordings can cause huge recording files. **Record File Splitting** option can be used to split large files to smaller junks. If total recording size is larger than one Gigabyte (1GB = 1024MB = 2^{30} Bytes), **a splitting into junks of 1GB will be performed automatically** in order to avoid problems with some file-systems.

Edit comment after recording will open a small text editor directly after a (single) recording has finished. You can describe current measurement setup in your own words. These remarks will be saved with your recorded measurement file. This option is not available with **Multiple Recording** enabled.

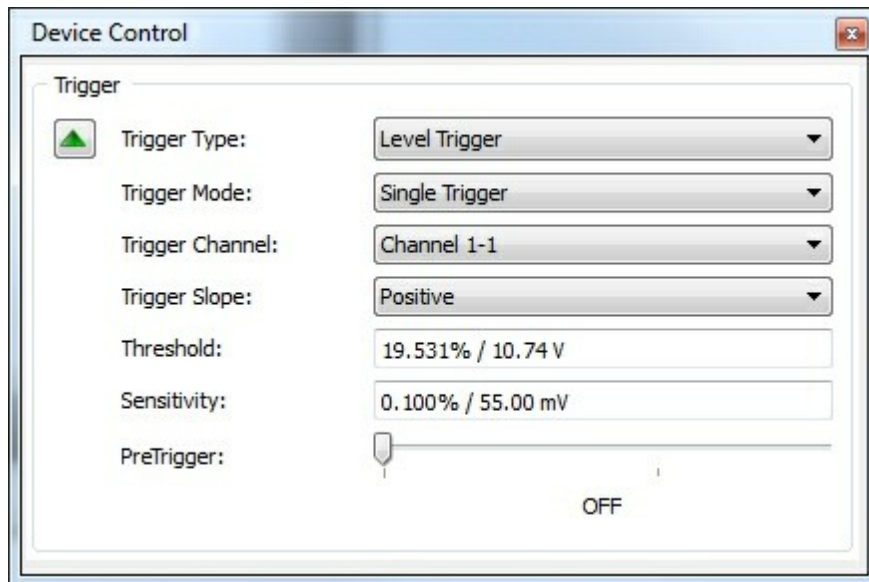
You can record up to 10000 files with the same setup with **Multiple Recording** enabled. Select **Number of Files** to get the file number editor field enabled. Enter the desired number of files or modify the number with the arrow controls. As described above, **Record Filename** becomes another suffix for file numbering. Another option for this mode is **Infinite**, meaning that recording will not stop before you quit recording manually or hard disk runs out of space.

Show compressed data while recording is a performance option. Normally, the default dataview will show you a complete image of the recording progress. This is realized by continuously calculating and scaling "MinMax" data to the available dataview size. With large recording sizes this will consume a lot of cpu time and will slow down your computer. Uncheck this option to avoid this side-effect on large recording size or slow computers.

LTT24 devices with internal hard disk (SSD) enable the **Device-HD** label and **Manage Device-HD** button in LTTpro. See section [Device Internal Recording](#)^[67] for details.

3.1.4 Trigger

LTT-devices offer a number of different hardware triggers. **Trigger Type** and corresponding parameters can be configured in the **Trigger** section of **Device Control**.



Device Control - Trigger

The configurable parameters vary on selected **Trigger Type**. Controls and labels are enabled or disabled depending on necessary settings.

Trigger Mode can be **Single Trigger** (default) or **Missing Event**. With **Single Trigger**, a fulfilled trigger condition will start measurement. The other option, **Missing Event**, will enable a new edit field **Event Timer** that can hold a value between 1 and 4200000000 μ s. This option will start measurement if trigger condition **IS NOT FULFILLED** in between the indicated time.

A trigger is always fixed to exactly one analog **Trigger Channel** or one bit of a digital channel. **Threshold** or **Limit** values can be set graphically (see below) or entered in the corresponding edit fields. Values can be entered as percent of *full scale range* (% FSR) or as number values with corresponding unit, i.e. a value of 10% in a ± 10 V range means 1V, -17.38% in a ± 50 V range mean -8.69V etc.

Available **Trigger Types**:

- **Off**: no trigger is active. All further controls are disabled.
- **Level**: in addition to **Trigger Channel**, you have to select a *Positive* or *Negative Trigger Slope*. **Threshold** defines the value when the trigger is fired and **Sensitivity** defines a range, the signal has to under- or overrun before. Example: *Positive Slope*, *Threshold* 10% and *Sensitivity* 0.5%. Based on a range of ± 10 V for the *Trigger Channel* you will get **1V Threshold** and **50mV Sensitivity** so signal has to come from **below 950mV** with a **rising slope** in order to fire trigger at **1V**.
- **Comparison**: define a value in **Threshold** that has to be overrun (*Bigger*) or underrun (*Smaller*) by **Trigger Channel** in order to fire trigger.
- **Region**: define a region with **Upper Limit** and **Lower Limit** that has to be entered (*Enter*) or left (

Exit) by signal of **Trigger Channel** in order to fire trigger.

- **Level+Delta**: same as **Level** but **Delta** defines the maximum distance of the signal one sample before **Threshold** resulting in a specific gradient.

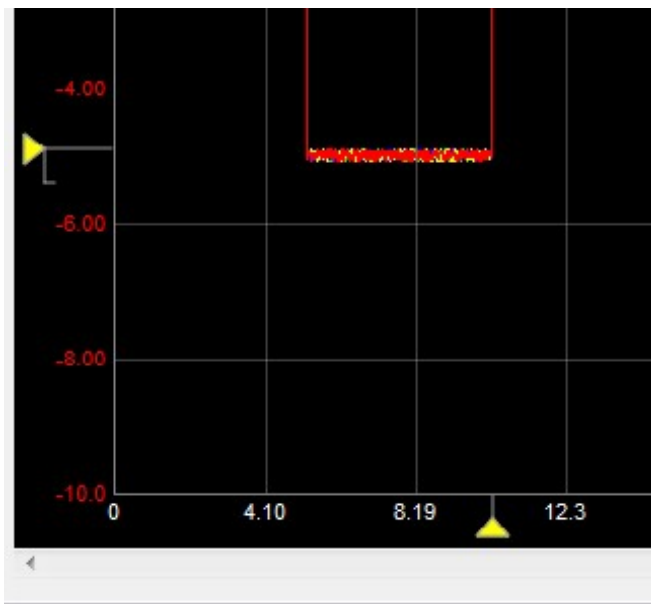
In addition to all active triggers you can define a **PreTrigger**. With the slider on the **Trigger tab**, a number of samples (minimum 1KS) or time span can be defined, that is measured **before the trigger condition is fulfilled**. Maximum **PreTrigger** size depends on **Display Size** and number of active channels.

Use **Trigger** and **PreTrigger**:

- to get a stable signal in **Multi-Shot** mode with monotone signals.
- to start a recording with the fulfillment of a condition.
- to analyze signals before a condition.

Graphical setup of **Trigger** and **PreTrigger**:

Use a mouse click left-facing the Y-axis to set or modify the trigger of the active **Trigger Channel**. An arrow in the color of the active **Trigger Channel** shows the position and additional information depending on **Trigger Type**. Use a right click to open a context menu where you can modify **Trigger Type** and **Trigger Channel**.



A **PreTrigger** can be graphically activated and modified with the mouse cursor underneath the X-axis.

Please note: **PreTrigger** values can not become arbitrary, normally the PreTrigger length must be a multiple of one Kilo-sample (1KS). With small display sizes you will have the feeling that **PreTrigger** marker will *jump* while moving the mouse cursor.

Please note: A change of **Trigger** or **PreTrigger** settings during an active measurement causes a restart of measurement.

3.2 Channel Settings

3.2.1 Channel Views

The individual setup of particular or all channels is realized in **Channel Control**. Depending on installed hardware and software options, the channel control is vertically divided into several blocks. Each block has a (blue) header line with column labels, followed by associated channels:

- **Analog**: The general setup of all analog channels is done here. This block is always available.
- **DAC-Output**: Type and settings of digital output signals can be setup here. Only available with devices that have **DAC-Out** option installed.
- **Digital**: Setup digital input lines. This block is available with devices that have a **Digital Input**.
- **Pulse Recognition**: This block controls hardware pulse detection and is available if **Pulse Recognition** option is installed.
- **Math**: All additional (mathematic) operators can be controlled in this block. Requires installed math-license.

Each block can be shown or hidden with the arrow symbol in the block header. The status of the blocks (shown/hidden) is stored in application settings and will remain even if you close and restart LTTpro.

Normally, not all channel controls and information elements are required at once. Hence there are different *views* or *sections* for this **Channel Control** that can be switched with **Channel** main menu or with [Hotkeys](#) ^[92] **F5** to **F8**. The following *views/sections* are available for **Channel Control**:

Channel Control						
▼	Analog	Input-Type	Option	Range	Supply	State
1	Channel 1-1	Volt DC	SE BNC	±50 V	OFF	●
2	Channel 1-2	Volt DC	SE BNC	±50 V	OFF	●
3	Channel 1-3	Volt DC	SE BNC	±50 V	OFF	●
4	Channel 1-4	Volt DC	SE BNC	±50 V	OFF	●
5	Channel 1-5	GND	None	±5 V	OFF	○
6	Channel 1-6	GND	None	±5 V	OFF	○
7	Channel 1-7	GND	None	±5 V	OFF	○
8	Channel 1-8	GND	None	±5 V	OFF	○
▼	DAC-Output	Type	Signal	Freq	Amp	State
O1:1	Chnl 1-1 Line A	OFF				○
O2:1	Chnl 1-2 Line A	OFF				○
O5:1	Chnl 1-5 Line A	OFF				○
O6:1	Chnl 1-6 Line A	OFF				○
▼	Pulse Recog	Line A	Line B	Line Z	State	
P1	Chnl 1-1 Pulse	OFF	OFF	OFF	○	
P5	Chnl 1-5 Pulse	OFF	OFF	OFF	○	
▼	Math	Math-Type	Option	Source	Result	State
M15:1	FFT dB-FS	FFT	Hamm dBFS	Chnl 1-1		●
M16:1	FFT dB-FS	FFT	Hamm dBFS	Chnl 1-2		●
M17:1	FFT dB-FS	FFT	Hamm dBFS	Chnl 1-3		●
M18:1	FFT dB-FS	FFT	Hamm dBFS	Chnl 1-4		●

Channel Control - Config Section

Use **Channel Config Section (F5)** to setup common channel settings as:

- ID, name and color of channel
- **Input-Type** (Coupling)
- **Option**(al) settings
- Input-**Range**
- **Supply** for sensors
- **State** on or off

This is the default view for **Channel Control**.

For a user defined scaling and offset of each channel, **Channel Scale Section (F6)** can be used:

	Analog	Scale	Offset	Unit
1	Channel 1-1	1	0	V
2	Channel 1-2	1	0	V
3	Channel 1-3	1	0	V
4	Channel 1-4	1	0	V
5	Channel 1-5	1	0	V
6	Channel 1-6	1	0	V
7	Channel 1-7	1	0	V
8	Channel 1-8	1	0	V

	DAC-Output	Offset	Phase
O1:1	Chnl 1-1 Line A		
O2:1	Chnl 1-2 Line A		
O5:1	Chnl 1-5 Line A		
O6:1	Chnl 1-6 Line A		

	Pulse Recog
P1	Chnl 1-1 Pulse
P5	Chnl 1-5 Pulse

	Math

Channel Scale Section

In addition to the permanent columns ID, name and color of channel five further columns are available for each channel:

- **Scale**: an individual scale factor can be entered for each channel, default is 1.0
- **Offset**: an individual offset can be entered, default is 0.0
- **Unit**: an user defined unit, default is V

Scale, **Offset** and **Unit** will be directly used while recording measurement data. By default a **Scaling** $m_k = 1.0$, an **Offset** $t_k = 0.0$ and an **Unit** $u_k = "V"$ is used. The resulting signal y_k is calculated: $y_k = m_k x_k + t_k$ in the **Unit** u_k .

Use **Channel View Section**, or **Channel Divider Section (F7)** to adjust scaling and offset in dataview. These values will always alter if a zoom-factor or a range has changed. You can also change these settings manually to fit a required view scaling.

Channel Control					
	Analog	X-Div	X-Off	Y-Div	Y-Off
1	Channel 1-1	409.600 μ s	0 s	11.0000 V	0 V
2	Channel 1-2	409.600 μ s	0 s	11.0000 V	0 V
3	Channel 1-3	409.600 μ s	0 s	11.0000 V	0 V
4	Channel 1-4	409.600 μ s	0 s	11.0000 V	0 V
5	Channel 1-5	409.600 μ s	0 s	1.00000 V	0 V
6	Channel 1-6	409.600 μ s	0 s	1.00000 V	0 V
7	Channel 1-7	409.600 μ s	0 s	1.00000 V	0 V
8	Channel 1-8	409.600 μ s	0 s	1.00000 V	0 V
DAC-Output					
O1:1	Chnl 1-1 Line A				
O2:1	Chnl 1-2 Line A				
O5:1	Chnl 1-5 Line A				
O6:1	Chnl 1-6 Line A				
Pulse Recog					
P1	Chnl 1-1 Pulse				
P5	Chnl 1-5 Pulse				
	Math	X-Div	X-Off	Y-Div	Y-Off
M15:1	FFT dB-FS	200.024 kHz	0 Hz	18 dBFS	-90 dBFS
M16:1	FFT dB-FS	200.024 kHz	0 Hz	18 dBFS	-90 dBFS
M17:1	FFT dB-FS	200.024 kHz	0 Hz	18 dBFS	-90 dBFS
M18:1	FFT dB-FS	200.024 kHz	0 Hz	18 dBFS	-90 dBFS

Channel Divider Section

Use **Channel Cursor Section (F8)** if one or both cursors are active and you want to see individual cursor values (and **Cursor Difference** if both cursors are set) for each channel:

Channel Control

	Analog	Cursor 1	Cursor 2	Cursor Diff
1	Channel 1-1	26.508546 V	28.446724 V	1.9381784 V
2	Channel 1-2	26.504118 V	28.449235 V	1.9451168 V
3	Channel 1-3	26.508682 V	28.449327 V	1.9406453 V
4	Channel 1-4	26.502540 V	28.446577 V	1.9440366 V
5	Channel 1-5			
6	Channel 1-6			
7	Channel 1-7			
8	Channel 1-8			
DAC-Output				
Pulse Recog				
	Math	Cursor 1	Cursor 2	Cursor Diff
M15:1	FFT dB-FS	-110.30222 dBFS	-114.2423 dBFS	3.9400787 dBFS
M16:1	FFT dB-FS	-111.06707 dBFS	-122.2571 dBFS	11.190033 dBFS
M17:1	FFT dB-FS	-111.18399 dBFS	-117.69593 dBFS	6.51194 dBFS
M18:1	FFT dB-FS	-112.33809 dBFS	-113.06863 dBFS	0.73053741 dBFS

Channel Cursor Section

This view is only informative, no parameters can be changed. Please note that cursor values are display with limited **significant digits** so rounding errors are possible in display of **Cursor**

Difference.

Use **All Channel Sections** to view to see all relevant channel parameters in one display. This layout is useful if LTTpro runs on multiple screens or on monitors with high resolution.

Channel Control																
▼	Analog	Input-Type	Option	Range	Supply	Scale	Offset	Unit	X-Div	X-Off	Y-Div	Y-Off	Cursor 1	Cursor 2	Cursor Diff	State
	1 Channel 1-1	Volt DC	SE BNC	±50 V	OFF	1	0	V	409.600 µs	0 s	11.0000 V	0 V	26.508819 V	28.451383 V	1.9425631 V	
	2 Channel 1-2	Volt DC	SE BNC	±50 V	OFF	1	0	V	409.600 µs	0 s	11.0000 V	0 V	26.511040 V	28.447570 V	1.9365294 V	
	3 Channel 1-3	Volt DC	SE BNC	±50 V	OFF	1	0	V	409.600 µs	0 s	11.0000 V	0 V	26.507521 V	28.453677 V	1.9461560 V	
	4 Channel 1-4	Volt DC	SE BNC	±50 V	OFF	1	0	V	409.600 µs	0 s	11.0000 V	0 V	26.508500 V	28.453202 V	1.9447021 V	
	5 Channel 1-5	GND	None	±5 V	OFF	1	0	V	409.600 µs	0 s	1.00000 V	0 V				
	6 Channel 1-6	GND	None	±5 V	OFF	1	0	V	409.600 µs	0 s	1.00000 V	0 V				
	7 Channel 1-7	GND	None	±5 V	OFF	1	0	V	409.600 µs	0 s	1.00000 V	0 V				
	8 Channel 1-8	GND	None	±5 V	OFF	1	0	V	409.600 µs	0 s	1.00000 V	0 V				
DAC-Output																
▼		Type	Signal	Freq	Amp	Offset	Phase									State
	O1:1	Chnl 1-1 Line A	OFF													
	O2:1	Chnl 1-2 Line A	OFF													
	O5:1	Chnl 1-5 Line A	OFF													
	O6:1	Chnl 1-6 Line A	OFF													
Pulse Recog																
▼		Line A	Line B	Line Z												State
	P1	Chnl 1-1 Pulse	OFF	OFF	OFF											
	P5	Chnl 1-5 Pulse	OFF	OFF	OFF											
Math																
▼	Math	Math-Type	Option	Source	Result				X-Div	X-Off	Y-Div	Y-Off	Cursor 1	Cursor 2	Cursor Diff	State
	M15:1 FFT dB-FS	FFT	Hamm(dBFS	Chnl 1-1		dBFS	200.024 kHz	0 Hz	18 dBFS	-90 dBFS	-109.47971 dBFS	-120.96651 dBFS	11.486801 dBFS			
	M16:1 FFT dB-FS	FFT	Hamm(dBFS	Chnl 1-2		dBFS	200.024 kHz	0 Hz	18 dBFS	-90 dBFS	-113.51218 dBFS	-117.95136 dBFS	4.4391861 dBFS			
	M17:1 FFT dB-FS	FFT	Hamm(dBFS	Chnl 1-3		dBFS	200.024 kHz	0 Hz	18 dBFS	-90 dBFS	-111.33103 dBFS	-116.47896 dBFS	5.1479263 dBFS			
	M18:1 FFT dB-FS	FFT	Hamm(dBFS	Chnl 1-4		dBFS	200.024 kHz	0 Hz	18 dBFS	-90 dBFS	-112.25121 dBFS	-122.89899 dBFS	10.647781 dBFS			

All Channel Sections

The different views/sections can be switched in *docked* as well as in *floating* state of **Channel Control**.

3.2.2 Setup Channel Parameters

Almost all channel specific parameters can be configured with the **Channel Control** element. Changing parameters normally takes two steps:

1. **Select** one or more channels.
2. **Change** required parameters.

Selecting channels happens as you know it from other list-based window elements. A selection of multiple continuous channels can be done with a hold down **Shift** key, multiple discontiguous channels can be selected with a hold down **Ctrl** key. To select all channels you can use *Channels | Select All Channels (Ctrl+A)*, to unselect all use *Channels | Clear Channel Selection (Ctrl+U)*.

Channels are **turned on** or **off** by clicking the circle in **State** column in **Channel Config Section (F5)**, a filled **orange circle** signals an active channel, an empty circle means channel is off.

The columns **Name**, **Scale**, **Offset** and **Unit** can be handled as normal edit fields. Select one or more channels, then click once to the desired field. A small editor opens and you can enter the values.

The screenshot shows the 'Channel Control' window with a table of channel parameters. The table is divided into several sections: Analog, DAC-Output, Pulse Recog, and Math. Each section has its own set of columns and rows.

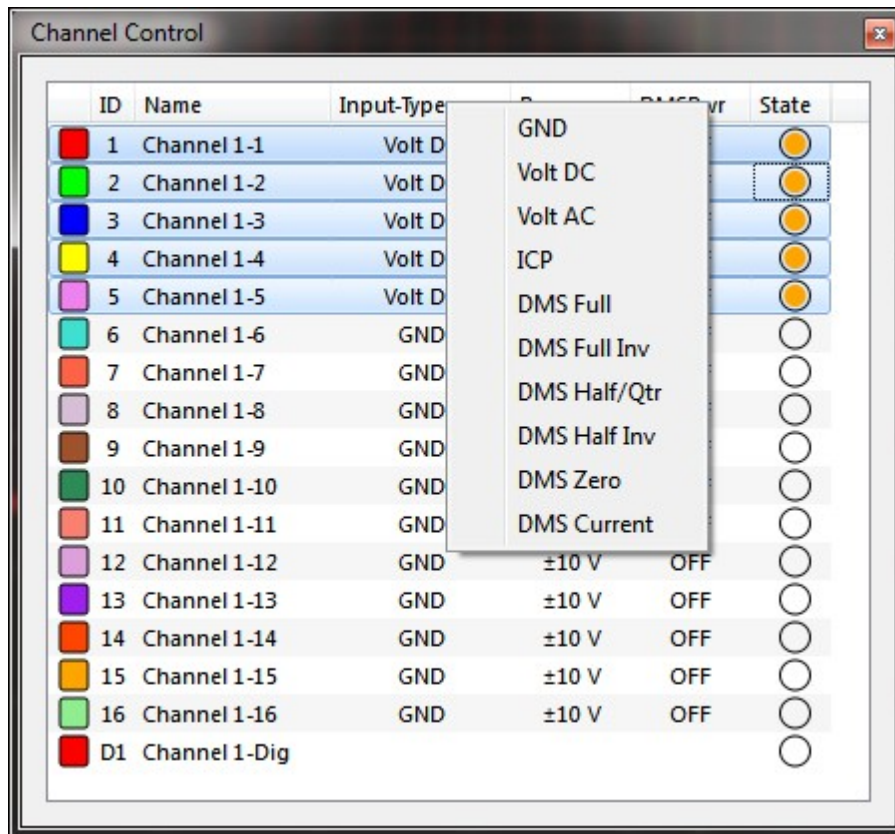
Channel Control						
Analog						
		Input-Type	Option	Range	Supply	State
1	Channel 1-1	Volt DC	SE BNC	±50 V	OFF	<input checked="" type="radio"/>
2	Channel 1-2	Volt DC	SE BNC	±50 V	OFF	<input checked="" type="radio"/>
3	Channel 1-3	Volt DC	SE BNC	±50 V	OFF	<input checked="" type="radio"/>
4	Channel 1-4	Volt DC	SE BNC	±50 V	OFF	<input checked="" type="radio"/>
5	Channel 1-5	GND	None	±5 V	OFF	<input type="radio"/>
6	Channel 1-6	GND	None	±5 V	OFF	<input type="radio"/>
7	Channel 1-7	GND	None	±5 V	OFF	<input type="radio"/>
8	Channel 1-8	GND	None	±5 V	OFF	<input type="radio"/>
DAC-Output						
	Type	Signal	Freq	Amp	State	
O1:1	Chnl 1-1 Line A	OFF			<input type="radio"/>	
O2:1	Chnl 1-2 Line A	OFF			<input type="radio"/>	
O5:1	Chnl 1-5 Line A	OFF			<input type="radio"/>	
O6:1	Chnl 1-6 Line A	OFF			<input type="radio"/>	
Pulse Recog						
	Line A	Line B	Line Z	State		
P1	Chnl 1-1 Pulse	OFF	OFF	OFF	<input type="radio"/>	
P5	Chnl 1-5 Pulse	OFF	OFF	OFF	<input type="radio"/>	
Math						
	Math-Type	Option	Source	Result	State	
M15:1	FFT dB-FS	FFT	Hamm dBFS	Chnl 1-1	<input checked="" type="radio"/>	
M16:1	FFT dB-FS	FFT	Hamm dBFS	Chnl 1-2	<input checked="" type="radio"/>	
M17:1	FFT dB-FS	FFT	Hamm dBFS	Chnl 1-3	<input checked="" type="radio"/>	
M18:1	FFT dB-FS	FFT	Hamm dBFS	Chnl 1-4	<input checked="" type="radio"/>	

Channel Control: change Channel Name

After you finished your input, confirm with **Enter** or dismiss your input with **ESC**. Invalid values will be dismissed automatically.

Please note: If you have selected multiple channels and change **Channel Name**, this property will change on all selected channels!

The property **Input-Type**, **Option**, **Range** and **Supply** (*DMSPwr*) can be modified with **context menus**. Select the desired channels and **right-click** in the corresponding column, i.e. **Input_Type**:



Change parameters with context menu

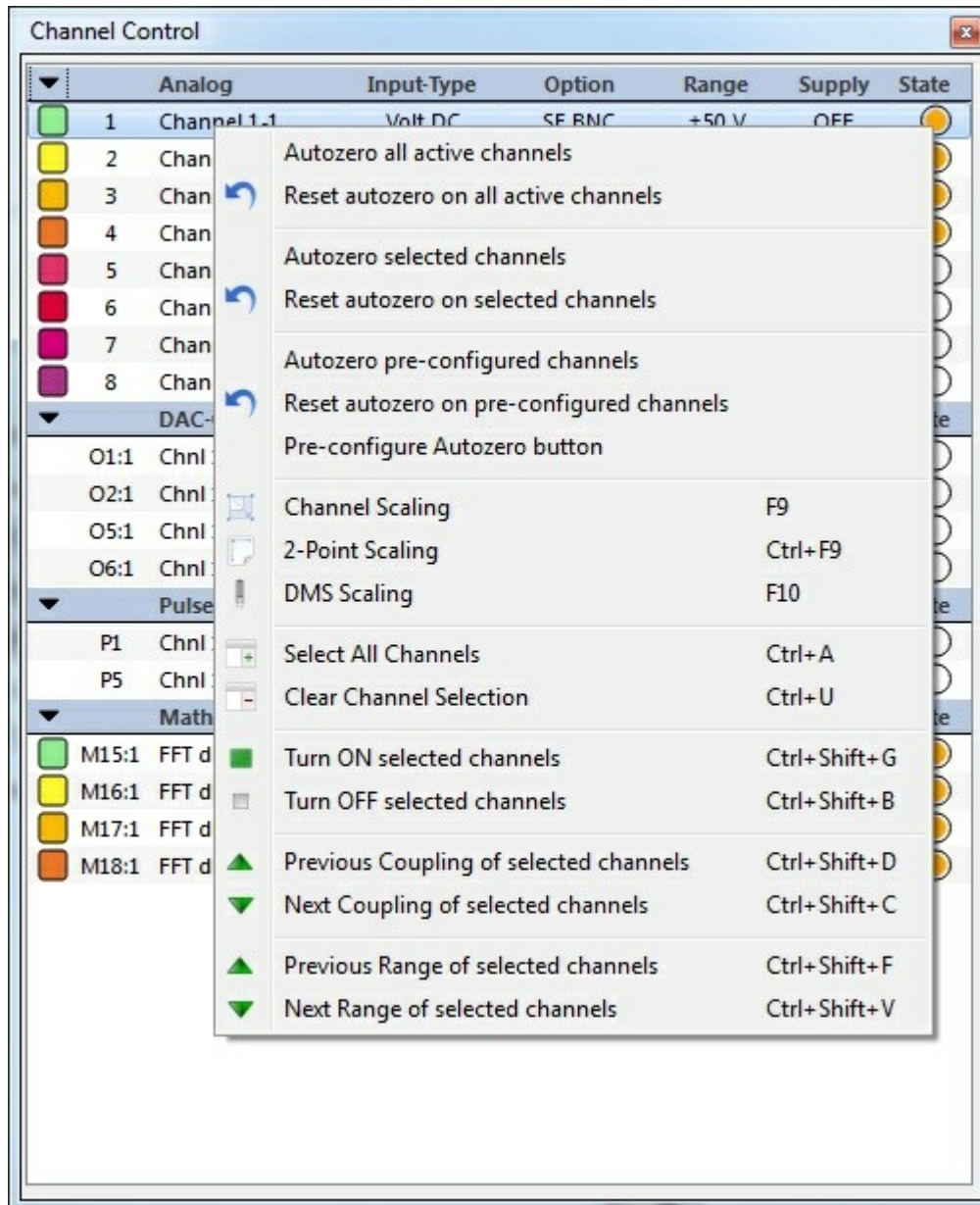
You can now select an Input-Type, i.e. *Volt DC*. Changes take effect immediately, measurement is restarted and you can perform further parameter changes. The column **DMSPwr** (Supply) is **None** or **OFF** with LTT-184/186 Transientrecorders because those devices cannot feed sensors. With LTT24 and LTT-180/182 SensorCorders, this column controls **current** in **mA** for **ICP** and **DMSCurrent** and **voltage** for other **Volt-** and **DMS** couplings.

For display purposes, the first column of **Channel Control** configures visibility and color of each channel. Click to the colored rectangle of each channel to toggle if this channel is visible or not in **Dataview**. Right-click on the rectangle to open a color dialog in order to change **Channel Color**.

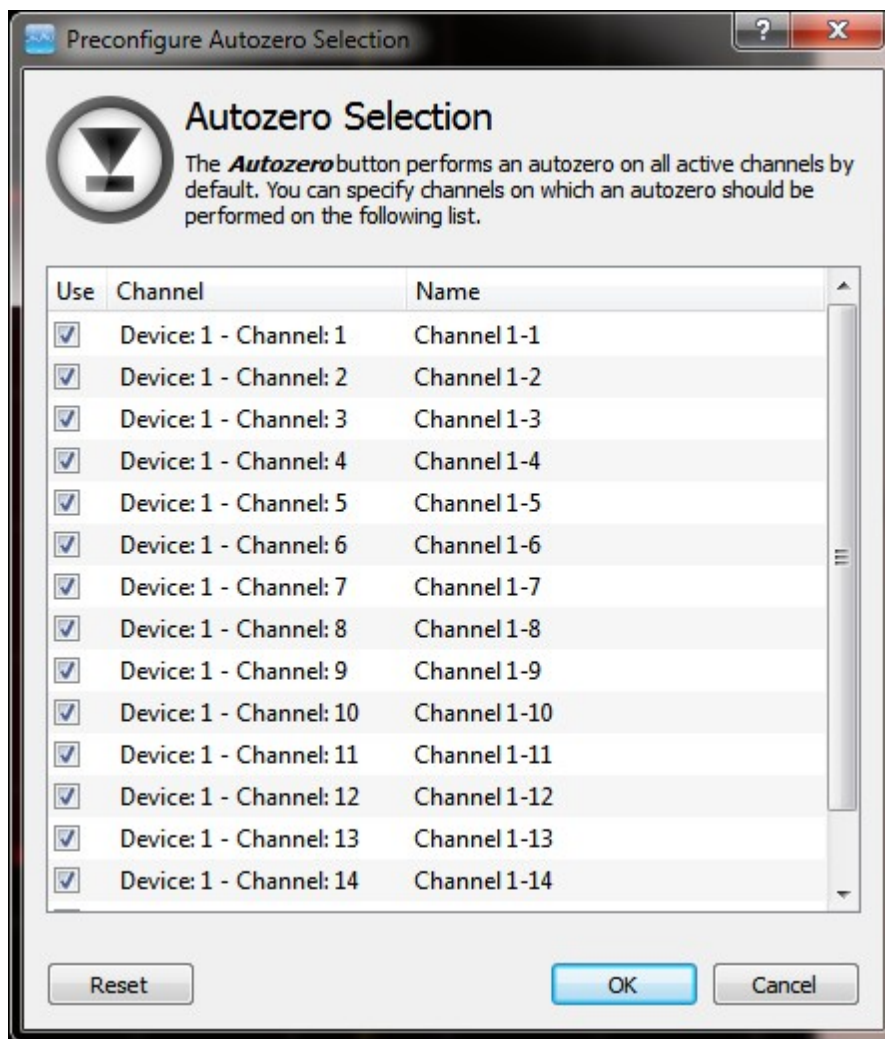
Please note: With multiple channels selected, color changes only apply to the channel where the right-click took place.

3.2.3 Multichannel Functions

Some functions are single channel driven but apply normally to multiple or all channels. For that reason, LTTpro offers some **Multichannel Functions**, that affect **all**, **all selected** or **all active** channels. You will find these functions in the *Channels* menu within **Channel Activity**, **Channel AutoZero**, **Channel Coupling** and **Channel Range** submenus or with a right-click above *ID* or *Name* in **Channel Control**.



Multichannel Functions for AutoZero are only available with **LTT24** and **LTT-180/182** devices. Use this functions to execute or reset an zero adjustment to **all**, **all selected** or **all configured** channels. Configuring channels for **AutoZero** can be done with *Channels* | *Channels AutoZero* | *Pre-configure AutoZero button*. Channels that are configured with this method (default: all channels) will be included when **AutoZero** button is pressed on **Controlbar**.



Configure Channel AutoZero

Check or uncheck all channels depending on your requirements. All checked channels will be included if **AutoZero** button is pressed, all others will not. Press **Reset** button to check all channels which is default for this setting.

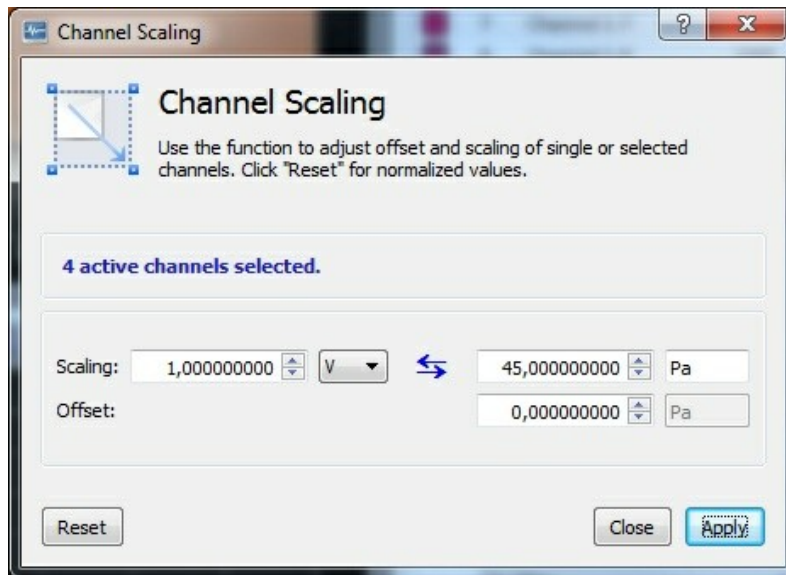
Further **Multichannel Functions** for selected channels:

- **Turn ON/OFF selected channels:** With this *main-menu* or context menu item, selected channels are turned **ON** or **OFF**. Turned off channels alter their **Input-Type (Coupling)** to **GND**, the behaviour on turning on a channel can be configured in [Program Options](#)^[72] on [Workflow](#)^[79] tab (last setting or *safe* setting with 10V DC can be configured).
- **Previous/Next Coupling of selected channels:** Changes to previous or next **Input-Type** (order from context-menu is taken) on **selected channels**.
- **Previous/Next Range of selected channels:** Changes to previous or next **Range** (order from context-menu is taken) on **selected channels**.

All **Multichannel Functions** apply immediately. If multiple channels have different **Input-Types**, only channels with valid and reasonable Input-Types are affected.

3.2.4 Channel Scaling

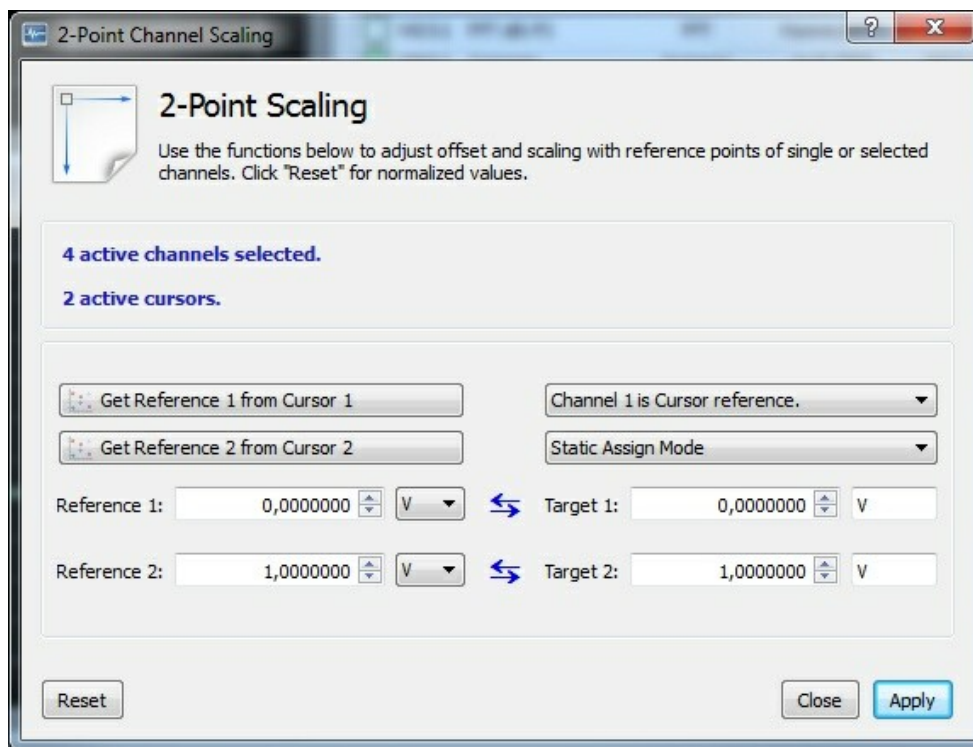
Individual setup of *Scaling* and *Offset* values was already discussed in [Setup Channel Parameters](#) [42]. **Channel Scale Section (F6)** can be used to type in individual values for scale, offset and channel unit. For extended scaling functions, e.g. *2-point scaling*, use *Channel Scaling* dialog from *Channels* or context menu or use hotkey **F9**.



Channel Scaling Dialog

This dialog stays on top even if control elements of main window are clicked, so all functions of LTTpro are available while *Channel Scaling* dialog is open. Proceed the following steps in order to change scale and offset:

1. At first, **select** one or more channels in *Channel Control*. You will now see "*n active channels selected*" in Channel Scaling dialog. **Only active channels** can be changed!
2. Enter now the desired *Reference* and *Target Points* and the *Target Unit* (optional).
3. Click on **Apply** button, changes will be assigned to selected, active channels.



2-Point Scaling Dialog

1. Apply both cursors in LTTpro *DataView* on two *Reference Points*, e.g. *Minimum* and *Maximum* or *Zero Level* and *Standard Value*.
2. Click on both buttons "Get Reference *n* from Cursor *n*" to assign cursor values to reference value fields.
3. Enter the *Target Value(s)* (only Target 2 if first was *Zero Level*). and *Target Unit* (optional).
4. Click on **Apply** button, changes will be assigned to selected, active channels.

Modes for cursor assignment:

While working with cursors and multiple selected channels, two modes for scaling and offset assignment are available:

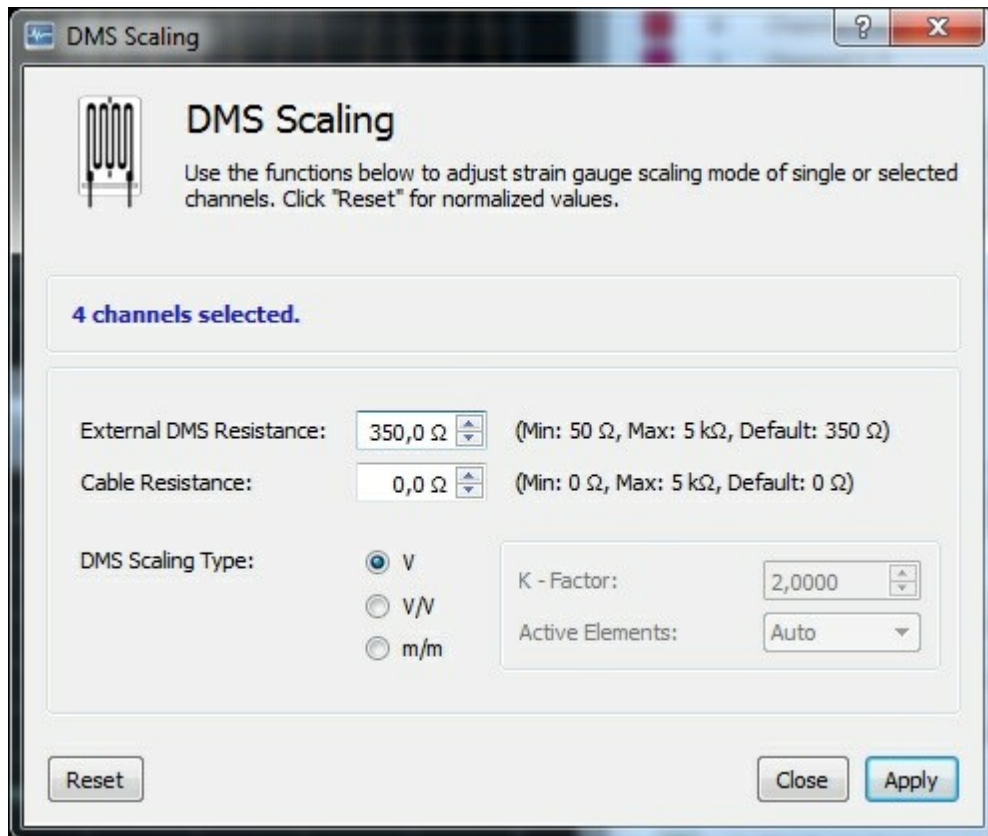
- **Static Assign Mode:** values for scaling and offset are calculated **once for a selectable reference channel** and are assigned to all selected channels.
- **Dynamic Cursor Mode:** values are calculated **for each selected channel** with the corresponding values from cursor points.

With the "Reset" button, default setting 1.0 for scaling and 0.0 for offset is restored.

Please note: After all changes in this dialog (even on *Reset*), a click on the *Apply* button is required to assign calculated values to selected channels!

3.2.5 DMS Scaling

For LTT devices of type LTT24, LTT-180 and LTT-182, a *DMS Scaling* is available additionally to [Channel Scaling](#)^[46] for *strain gauge* parameters.



When using one of the strain gauge input types DMS-Half or DMS-Quarter, you might have to adjust values for *External DMS Resistance*. *Cable Resistance* has to be adjusted if a significant one exists.

There are three modes for strain gauge scaling:

- **V**: there will be no additional scaling to the measured values.
- **V/V**: measured values are scaled in relation to supply voltage (1V, 2V, 5V or 10V). This scaling **will only be valid with active supply!**
- **m/m**: scaling is calculated by type of bridge (full-, half- or quarter) and *k - factor* (*gauge factor*).

Please note: All settings in this dialog are applied only to channels that are set to a *strain gauge input type* (DMS). Scaling types **V/V** and **m/m** are applied only to channels **with active supply**.

Use "Reset" button to restore default settings (350 ?, 0.0 ? and V scaling).

Please note: After all changes in this dialog (even on *Reset*), a click on the *Apply* button is required to assign calculated values to selected channels!

3.2.6 Level Monitor

With multiple active channels it can be complicated to survey *signal level* of individual channels. For that, a *Level Monitor* can be invoked with *Channel* menu or hotkey **F4**.



Level Monitor

This dialog indicates the current signal level of each active channel, history indicators for minima and maxima and a clipping indicator. Values remain until a manual *Reset* or a parameter change.

Values range from -100% to +100% of each channel's input range, a division is made in 20% steps. Colors indicate three different ranges:

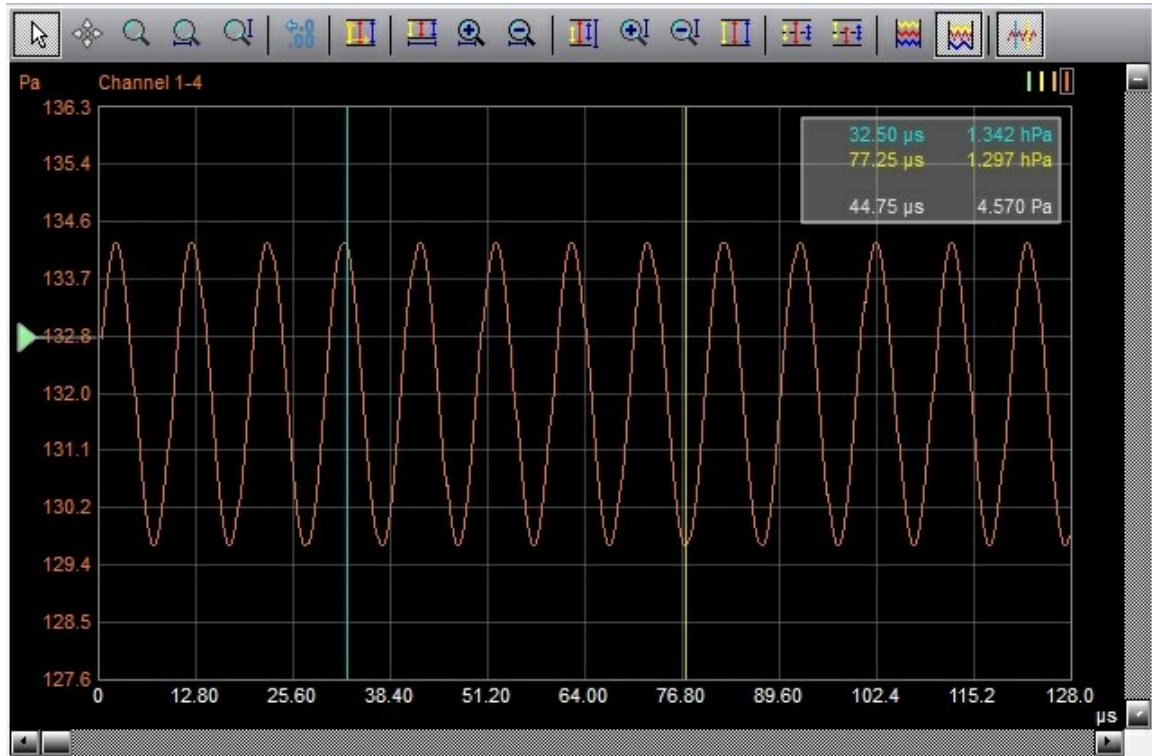
- **±80% to ±100%** of possible range (**Full Scale Range**)
- **±60% to 79%** of possible range
- **0% to ±59%** of possible range

The symbol on the right indicates, if signal level has reached $\pm 100\%$ FSR (=clipped) (**clp**) or not (**ok**). The light-gray arrow symbols keep history of *minimum* and *maximum* until next parameter change or manual *Reset*. You can move mouse cursor over each channels bar to get a popup window with all information of that channel.

Please note: *Level Monitor* is only available for **Online-** and **Replaymode** at the moment and will not work with loaded data.

3.3 Dataview

The main window of LTTpro consists of at least one *dataview* showing the incoming analog data of all or selected active channels.



Main Dataview with active trigger and cursor markers

Depending on active mathematic operators or loaded data files, multiple dataviews can be visible at a time.
















Each dataview consists of:




- [Data Controls](#)^[51] at the top of the dataview and the
- [Draw Area](#)^[53]

3.3.1 Data Controls

The panel **Data Controls** is connected directly with the **Dataview**. Some of the buttons toggle a specific behaviour of the mouse (e.g. single/all channel mode), others invoke direct functions (e.g. zoom).



Symbol	Function
	<i>Cursor Mode</i> : a mouse click above Dataview will set or move the currently selected cursor.
	<i>Shift Mode</i> : use mouse to move single or all signals to any possible direction in Dataview
	<i>Rectangle Zoom Mode</i> : click and span a rectangle over Dataview . The selected area will then be zoomed.
	<i>X-Rectangle Zoom Mode</i> : use mouse to span an area in Dataview . The X-axis of the selected area will be zoomed to complete Dataview width.
	<i>Y-Rectangle Zoom Mode</i> : use mouse to span an area in Dataview . The Y-axis of the selected area will be zoomed to complete Dataview height.
	<i>Reset all Zoom</i> : reset all previous zooms of all directions
	<i>X-Zoom Reset</i> : reset all previous X-axis zoom. The length is reset to Display Length .
	<i>X-Zoom In</i> : X-axis (Time) is zoomed in by 2 if possible.
	<i>X-Zoom Out</i> : X-axis (Time) is zoomed out by 2 if possible.
	<i>Y-Zoom Reset</i> : reset all previous Y-axis zoom. The complete range of channels is displayed again.
	<i>Y-Zoom In</i> : Y-axis range of Topchannel is zoomed in by 2 if possible.
	<i>Y-Zoom Out</i> : Y-axis range of Topchannel is zoomed out by 2 if possible.
	<i>Y-Zoom All</i> : Y-axis range is zoomed to 120% of <i>signal amplitude</i> , if possible.
	<i>Y-Zoom Center</i> : Dataview is centered to current signal.
	<i>Y-Zoom Offset Reset</i> : a manual set Y-axis offset will be reset.

Symbol	Function
	<i>Split Mode</i> : click on this button toggle Split Mode . All signals are displayed among each other in this mode, instead of being displayed in a row.
	<i>All/Single Channel Mode</i> : toggles <i>function scope</i> . In Single Channel Mode functions apply to Topchannel only, in All Channel Mode however all channels are affected by functions.
	<i>Toggle Cursor Display</i> : activates or deactivates display of cursor values in dataview.

Most of the above functions depend on additional **mouse interaction**, this is why no menu items or key combinations are available for that functions.

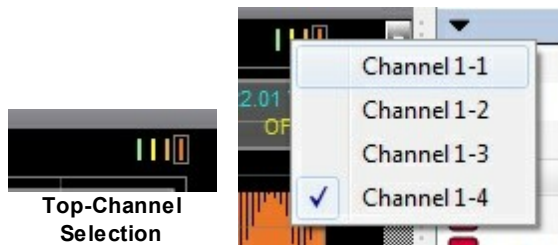
If a wheel mouse is available, the scroll wheel can be used to zoom the desired section.

- Without additional keys: the section below the mouse pointer is zoomed in (wheel up) or zoomed out (wheel down).
- With **ALT**-key: the X-axis (time) below the mouse pointer is zoomed in (wheel up) or zoomed out (wheel down).
- With **CTRL**-key: the Y-axis (range) below the mouse pointer is zoomed in (wheel up) or zoomed out (wheel down).

Using **Reset Dataview (Ctrl+Z)** all previous zoom is undone and the timescale and range will be displayed fitting to selected **Channel Ranges** and **Display Length**.

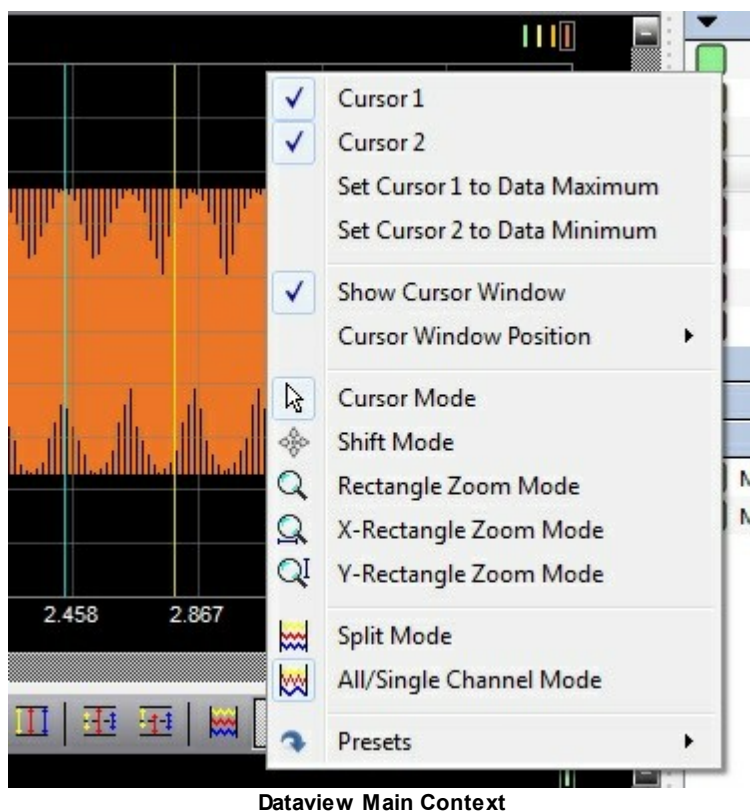
3.3.2 Draw Area

The **Draw Area** is primarily used to display measured signals or calculated analytic data in an user definable grid. The x-/y- axis of the grid are labeled with values that depend on unit, range and zoom-factor of the current **Top-Channel**. That can be selected by clicking the ID column (2nd) in [Channel Control](#)^[26] or by the **Top-Channel** selection in the dataview.



You can click the mouse cursor to the color line of the desired channel or you can right-click in the **Top-Channel** area to popup a context menu.

Right-clicking in the main dataview area will show a context menu with all cursor functionality and the most important functions of the [Data Controls](#)^[51] toolbar.



Cursor markers can be activated by clicking the mouse in the data area of the dataview (Cursor 1) and by pressing **Alt** key + click in the data area of the dataview (Cursor 2). If cursors are active they can be dragged to another position by clicking near to their current position (in between 10 pixels) and drag them to the desired position. Cursors can always be re-positioned to any position by pressing **Ctrl**-key for cursor 1 and **Alt**-key for cursor 2. Deactivating (hiding) of cursors is done within the dataview main context menu.

Other functions of the main context menu:

- **Set Cursor 1 to Data Maximum:** cursor 1 is always positioned to the maximum (first maximum if multiple) value of a screen
- **Set Cursor 2 to Data Minimum:** cursor 2 is always positioned to the minimum (first minimum if multiple) value of a screen
- **Show Cursor Window:** toggle cursor value visibility in the corner of main dataview area.
- **Cursor Window Position:** if cursor window is visible, the corner of this window is selectable in this submenu
- **Mouse Cursor Modes:** select one of the mouse modes (described in [Data Controls](#)^[51])
- **Split Mode:** toggle all signals stacked or each in an area of dataview (described in [Data Controls](#)^[51])
- **All/Single Channel Mode:** toggle what channels are affected by a zoom- or shift operation (described in [Data Controls](#)^[51])
- **Presets:** this submenu offers four preset buttons to allow a fast switch between multiple zoom-states or individual positions in dataview (see [Presets](#)^[56] for details)

The free space between the dataview grid and border will raise specific context menus:

- Left border: **Trigger Context** - depending on an active trigger, the most important trigger functions can be invoked
- Bottom border: **Transfer and Display Context** - sample clock, display size and some other commonly used function can be invoked
- Right border: **File Context** - functions affecting setup and loading data can be found in this context menu

Note that these context menus can be disabled in [Program Options](#)^[72] if you are bothered by their appearance. Besides, they are only available in main dataview and not in math dataview or file dataview.

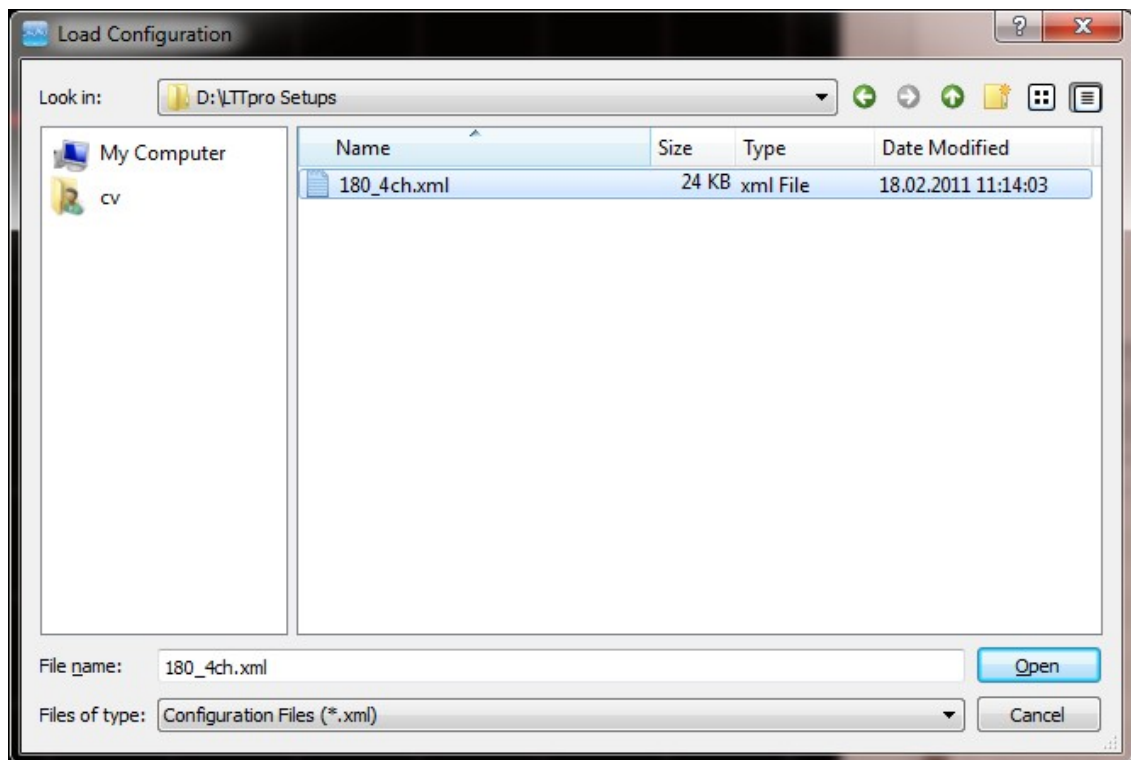
3.4 Setup and Recording

3.4.1 Load and Save Configurations

A configuration (or setup) integrates all important parameters of hardware and software. Configurations can be saved as a file in XML format in order to reload it later and to have same conditions as when it was saved.

In order to save a configuration, setup all device and channel parameters as required and select *File | Save Configuration (Ctrl+S)* or the corresponding button on the toolbar. A **File Save** dialog appears and you can assign a meaningful filename.

Loading a configuration is just as simple as saving a configuration. Use *File | Load Configuration (Ctrl+L)* or the corresponding button on the [Toolbar](#)^[21] to get a **File Open** dialog:



Load Configuration

Select a configuration file in this dialog. Depending on the option *Apply Directories on Load and Save* in [Program Options](#)^[72] | [Paths \(Files and Directories\)](#)^[73] the standard path is applied when a file is loaded or saved. After a file is selected, LTTpro checks for the following:

1. Configuration file must have been created with a **valid version of LTTpro**, other configuration files **will not be loaded**.
2. The **device type** in configuration file must be the same or compatible with currently attached device(s), else the file **will not be loaded**.
3. **Number of devices** in configuration file must match the number of attached devices, failing this the file **will not be loaded**.

After these checks have passed, configuration parameters are passed to attached device(s). You can define if *Local Settings will overwrite Configuration Settings* with the correspondent option in [Program Options](#)^[72] | [Workflow](#)^[79]. If one of the above checks has failed, configuration file is not

loaded and a corresponding error message will appear.

3.4.2 Reset Configuration

In some situations it might be useful to start a configuration with **safe defaults**. For that reason, the function *File | Reset Configuration* is available in main menu or with the corresponding button on the toolbar. The following defaults apply:

- medium sample rate, depending on device type
- multi-shot
- no filter
- 16 Kilosamples display size
- no trigger
- no cursor
- channel 1 is turned on, coupling, option and range depends on device type
- channel 2 - n turned off (GND)

Use this function as well if applied signals are not displayed as expected and you cannot find the problem or wrong setting.

3.4.3 Default Setup

If you run LTTpro always or often with the **same or very similar setups**, this function will simplify your work.

First, configure your device and channel settings as required. Then select *File | Save as Default* (**Ctrl+Shift+S**) or the corresponding button on [Toolbar](#)^[21] to save the current setup as default configuration.

On startup, LTTpro scans for a default setup file and will load it if one exists. Loading a default setup involves the same checks as manually loading a configuration - it means that another device type or different number of devices **will cause an error message on startup** as default setup cannot be applied.

Naturally, any other configuration can be loaded after LTTpro has started with a default setup.

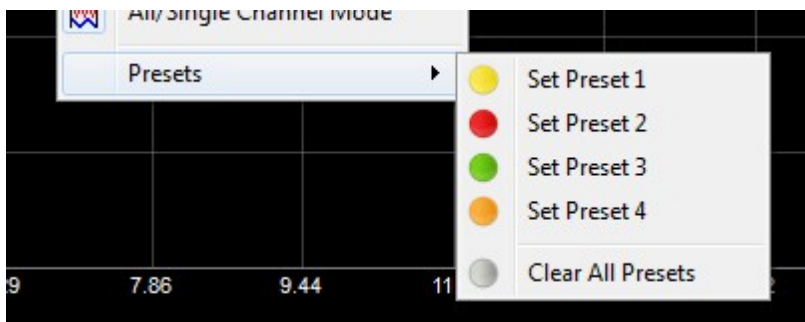
Use *File | Clear Default* (**Ctrl+Shift+X**) or the corresponding button on [Toolbar](#)^[21] to delete the default configuration file and to start LTTpro with safe settings (same as [Reset Configuration](#)^[56]) the next time.

You can find the default configuration file in your **user** or **home directory** in the `.ltp` subdirectory. The name is `ltp_default.xml`.

3.4.4 Presets

Sometimes it can be useful to toggle between two or more sections of one measurement. With *View | Presets* or *Presets* in **DataView's** context-menu you can store **up to four presets** in LTTpro. Those **presets** keep all **DataView** parameters such as scale and position of each channel, *splitmode* and other. A **preset** is stored until:

- a new configuration is loaded
- reset configuration is called
- **Clear All Presets** was called from mainmenu or contextmenu



Presets submenu

After setting a **preset**, a symbol with the corresponding color appears on the right (bottom) of the [Data Controls](#)^[51] bar. You can use those symbol(s) or *View | Presets | Preset <1-4>* to toggle between a pre-set view and another (pre-set) view.

3.4.5 Printing and Screenshots

The following **printing methods** are available in LTTpro:

- **Print Configuration:** a text page (multi-paged if necessary) will be printed with current device and channel settings.
- **Print Screen:** the current **Dataview** and major device and channel settings are printed.

A **printer setup dialog** goes ahead every printing method to select the favored printer and to configure individual settings. By default, printout is configured for **A4 portrait** paper format on **Print Configuration**, **A4 landscape** on **Print Screen**. Paper format can be changed but if paper size is too small, a loss of information is possible as well as unreadable fonts or symbols.

Important: **Print Screen** method uses most current data so if this function is invoked during a long measurement and data is not transferred complete, **only the available data will be plotted in printout!**

If you need the current **Dataview** as image for proceeding in own documents, use *File | Screenshot (F11)* to save the current display to a file. Assign a filename and select graphic format in the **File Save** dialog. The following graphic formats are available:

- Windows Bitmap (*.bmp)
- Joint Photographic Experts Group (*.jpg and *.jpeg)
- Portable Network Graphics (*.png)
- Portable Pixmap (*.ppm)
- Tagged Image File Format (*.tif)
- X11 Bitmap (*.xbm)

The default image size is 1024x768 pixel but can be changed in [Program Options](#)^[72] | [Display](#)^[74] up to a QSXGA (2560 x 2048 pixel) resolution in several steps.

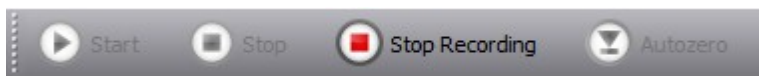
3.4.6 Recording Data

LTTpro allows you to record measurement data in **several file formats** in **almost any length**. In chapter [Recording](#)^[34], the necessary parameters for data recording on the [Device Control](#)^[25] tab have already been explained.

In order to start data recording, select *Device | Record (Ctrl+Shift+R)* or use the **Record** button on the [Controlbar](#)^[23].



Controlbar in normal mode



Controlbar while recording

During recording of measurement data you will see signals in compressed form in **Dataview**. The display is compressed because the complete record length will be rendered to one display. If you want to abort recording before the end of specified recording length, click on the **Stop Recording** button in [Controlbar](#)^[23] or select *Device | Stop Recording (Ctrl+Shift+R same as record!)* from main menu.

Analyzing signals during recording is possible with all available **Dataview** functions. However, please keep in mind that **signals are plotted in a compressed mode while recording** so multiple use of zoom-in function will not result in exact signals.

All available foreign file recording formats can be loaded with LTTpro at a later date **only if they were created with LTTpro**. When using other file formats than proprietary LTTpro format on recording, LTTpro will create an **additional XML configuration file**. If this file is available, (data) files of other formats (i.e *Famos* or *Diadem*) can be opened. Foreign files that are recorded with native applications such as Famos do not have such a XML configuration file and thus **can not be loaded or analyzed with LTTpro**.

3.4.7 Loading Measurement Data

As mentioned above, all files that have been recorded with LTTpro can be **loaded and analyzed**. This is because LTTpro creates an (XML-based) configuration file in **eco-format** every time data is recorded, saved (save screen method) or replayed from a standalone device. The only exception to this is **csv fileformat**: **data that is recorded in this format cannot be loaded in LTTpro later** because no additional XML or binary data is recorded with csv format.

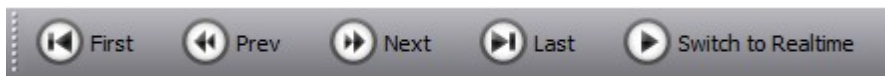
Please note: If you move or copy recorded data to another memory medium or place in file-system, please **don't forget to copy also the eco-file** in addition to the binary files.

Loading of recorded measurement files is done with *File | Load Data (F3)* or by the corresponding button on the [Toolbar](#)^[21]. A *File Open* dialog raises and a **eco-file** can be selected. If you want to open files from a **Multiple Recording**, please select first file of series, you can navigate through files with additional navigation buttons (see below) on the [Controlbar](#)^[23].



Controlbar with loaded file (no Multiple Recording)

After loading and analyzing a recorded file you can load another file with **Load Data (F3)** or **Switch to Realtime mode (Ctrl+T)**



Controlbar with loaded Multiple Recording file

With **Multiple Recording** files you can use navigation buttons on [Controlbar](#)^[23] for a comfortable loading of sequential files.

3.5 Stand-Alone Mode

LTT-18x Transientrecorders and SensorCorders are available optionally with **integrated hard disk**. Those models (*LTT-182* and *LTT-186*) are capable of the so called **Stand-Alone Mode**, i.e. devices can record up to 16 different recordings without been attached to a personal computer. **Stand-Alone Mode** will work with up to four synchronized devices and up to 64 channels. This chapter will describe the **Stand-Alone Mode** in interaction with LTTpro. **Stand-Alone Mode is not available with LTT24 devices!**

On startup, LTTpro scans for internal hard disks on LTT-devices. If any is found, the following additional menu items are enabled:

- [Stand-Alone Setup](#)^[61]
- [Stand-Alone Informationen](#)^[64]
- [Stand-Alone Replay](#)^[66]

Depending on state and content of device internal hard disk, some of the menu items are disabled, e.g. if no stored configuration exists.

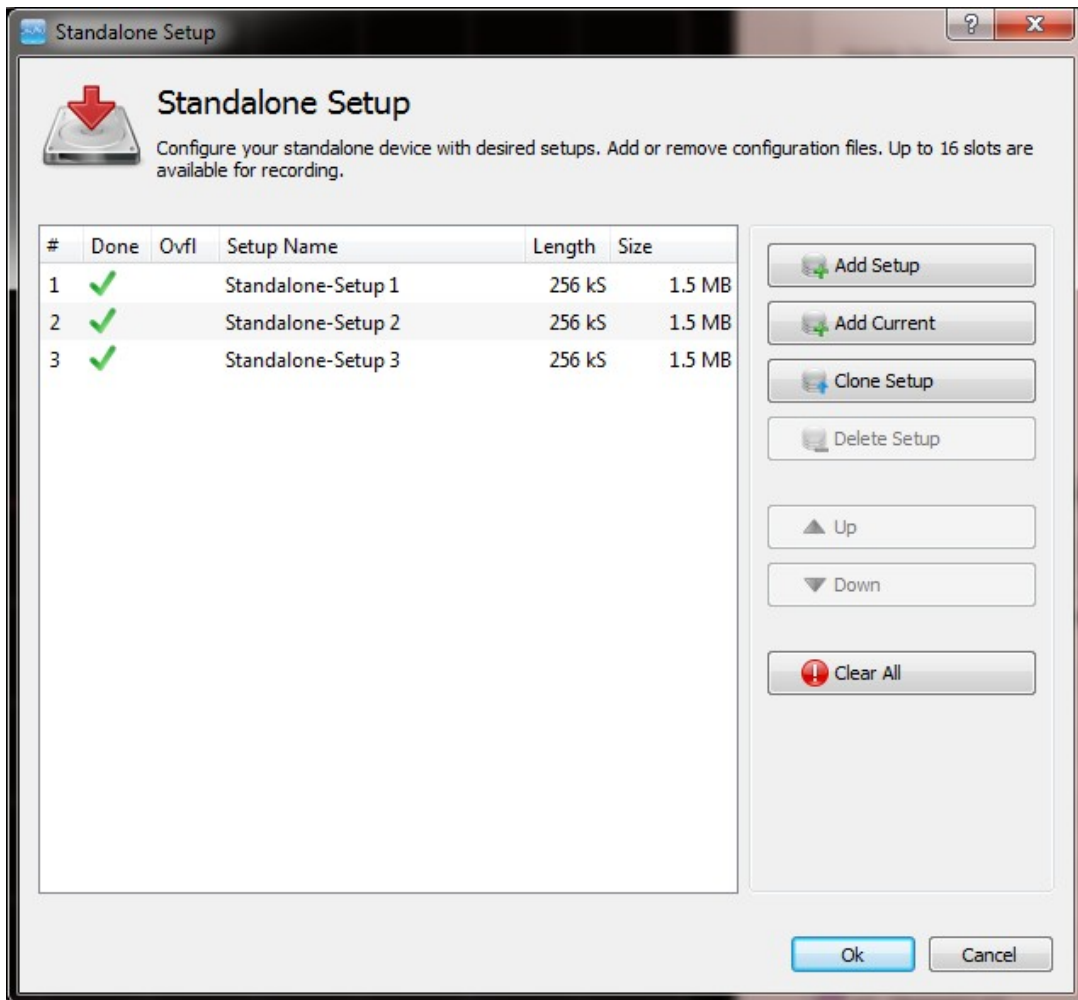
Stand-Alone recordings will proceed in the following steps:

1. Create a configuration as usual with the required device and channel settings.
2. Transfer up to 16 configurations with [Stand-Alone Configuration](#)^[61] dialog to LTT device(s).
3. Quit LTTpro, disconnect LTT-device(s) from your computer and perform your measurement (on arbitrary places).
4. Re-attach LTT-device(s) to your computer, start LTTpro.
5. Use [Stand-Alone Replay](#)^[66] dialog to show recorded data on display and to transfer data to computer hard disk.,

Please note with Multi Device Setup: While running in Stand-Alone Mode devices must have the **same order** and assembly of sync-cables while **creating a setup, running the measurement and replaying data!**

3.5.1 Stand-Alone Setup

Use *Device | Stand-Alone Setup* to transfer one or more configurations to a LTT device with internal hard disk.



Stand-Alone Setup dialog

The list shows the following information:

- **#** continuous configuration number.
- **Done** shows if measurement has already happened.
- **Ovfl** shows if a buffer overflow occurred during measurement.
- **Setup Name** an arbitrary configuration name (without further meaning).
- **Length** number of samples **per channel**.
- **Size** the total recording size in bytes.
- **Button** optional: Start-button on device has to be pushed for next configuration (depends on firmware).

Up to 16 configurations can be transferred to a device with internal hard disk. If fewer entries are stored, additional configurations can be added later. Single configurations can be deleted, if

measurement has not already happened. If so, the complete list has to be deleted with **Clear All** button.

There are three ways to add a configuration:

1. **Add Setup**: add (XML-) configuration from a **File Open** dialog.
2. **Add Current**: the current LTTpro setup is added.
3. **Clone Setup**: a selected list entry is duplicated at the end of the list.

A configuration can be deleted with the **Delete Setup** button **if no measurement has already happened**. Selected list entries can be **moved up** or **down** to a valid position with the corresponding buttons. Configurations that are already done cannot be moved.

Every change to the **Stand-Alone Setup** has to be applied with the **Ok** button (button changes to **Apply** or **Delete** depending on performed functions). In some cases, an additional message dialog has to be confirmed, e.g. if all items were deleted with **Clear All** button **because all recorded data on device internal hard disk is also deleted in this case**.

After confirmation the new setup list is transferred to device and the next Stand-Alone measurement can be started.

3.5.2 Devices in Stand-Alone Mode

Once a LTT device with internal hard disk has at least one valid configuration, you can perform a **Stand-Alone** measurement. Follow these steps for **Stand-Alone** operation:

1. Quit LTTpro, power off LTT device and disconnect USB- or SCSI- cabling from your computer.
2. Build up your measurement setup, connect signal cables to LTT device. Keep in mind to regard **device order** and synchronizing cables with **Multi Device Setup**.
3. Power on LTT device with power supply. Press **Start**-button at the front of the device and **Reset**-button at the rear of the device simultaneously.
4. Release **Reset**-button, keep **Start**-button pressed. Now also release **Start**-button.
5. The first (respectively next) configuration is loaded, depending on the firmware and **Press Start Button** option the measurement starts immediately or after a new push on **Start**-button.



Start button at the front



Reset button at the rear

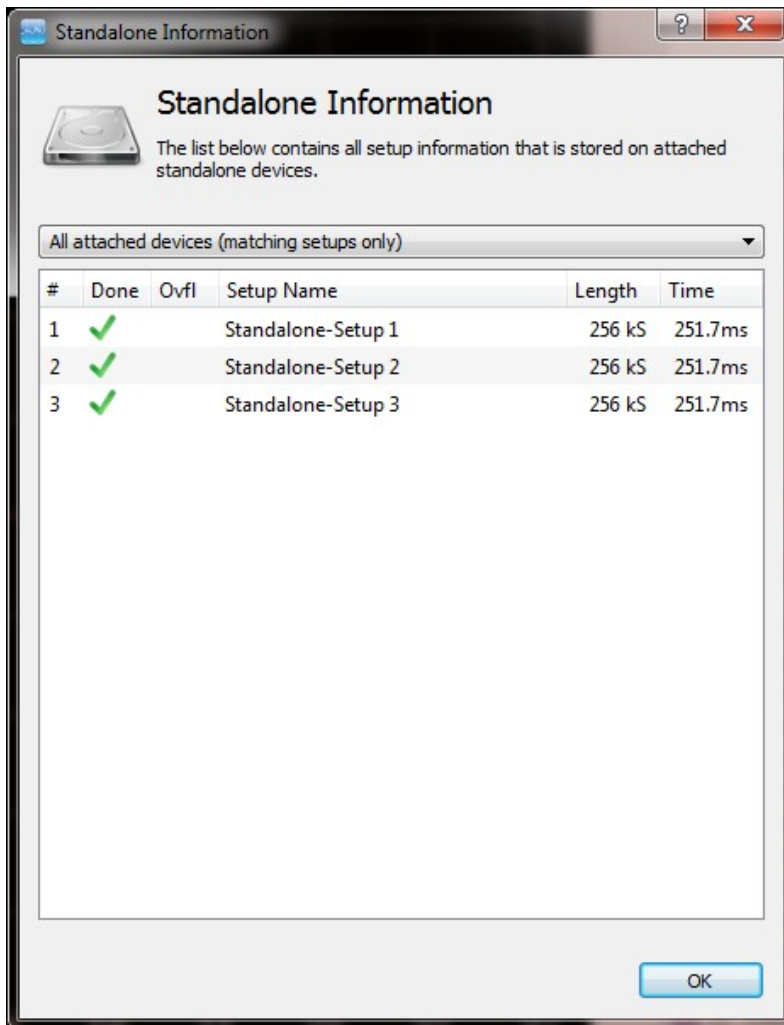
If LTT device was turned off before the last measurement in device-stored list has happened, the next configuration in list will be loaded the next time the device is started in **Stand-Alone** mode. After all measurements are done, the green control led turns off and red led turns on.

Important hints on Stand-Alone mode:

- Before you reconnect devices to your computer after a **Stand-Alone** operation, please power off devices once to reset device for normal operation mode.
- In **Stand-Alone** mode with **Multi Device Setup**, measurements can have different points in time when recording ends. This is a normal attitude and belongs to different block-sizes and other factors.

3.5.3 Stand-Alone Informationen

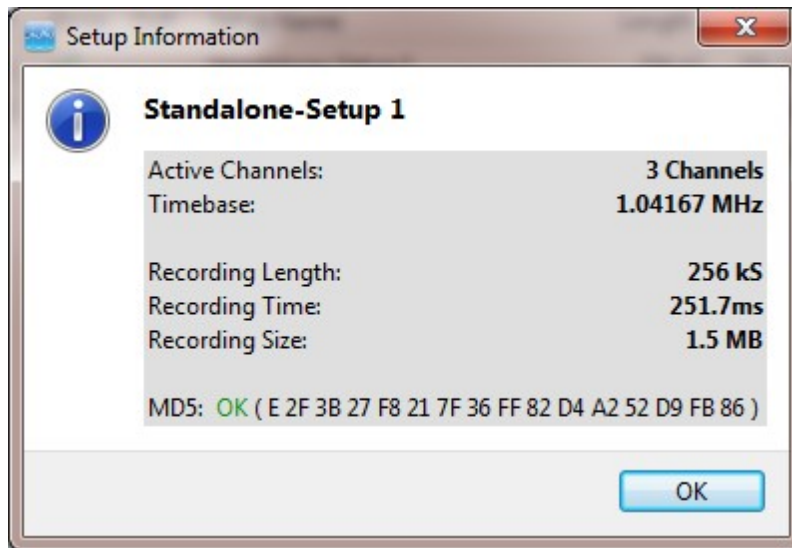
If at least **one valid configuration** is found on a LTT device with internal hard disk, you can invoke *Device | Stand-Alone Information* to get a dialog with detailed configuration specs.



Stand-Alone Information

In addition to a list of stored configuration items, this dialog enables you to see individual device settings with **Multi Device Setup**. The selection list (combo box) on top of the configuration list allows you to filter for matching configurations of all attached devices or single configurations on each device. If errors occur on recording or replaying data with multiple devices, this function can be useful to check if configurations have been transferred correctly to each device.

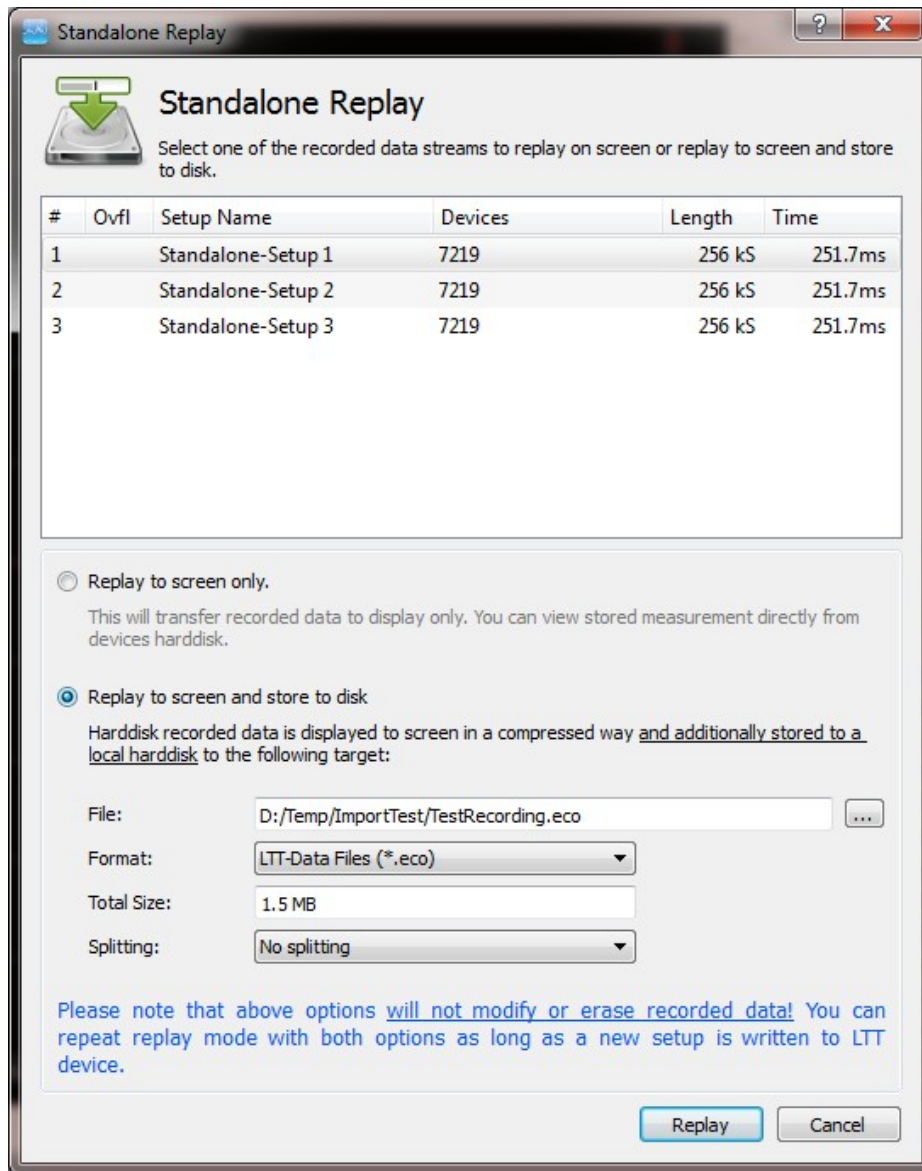
With a **double-click** on each configuration item you will get extended information on important parameters:



The lowermost entry in this extended information dialog shows a (MD5) hash. If this entry is not headed with **OK** but with **error**, configuration transfer to device **has failed and must be repeated**.

3.5.4 Stand-Alone Replay

For a replay of recorded data, attach your LTT **Stand-Alone** device to your computer and start LTTpro. Select *Device | Stand-Alone Replay* to open the corresponding dialog. If at least one valid recording exists, a list with further recording information is shown.



Stand-Alone Replay

You can now select an entry from the list for replay. There are two possibilities for replaying data:

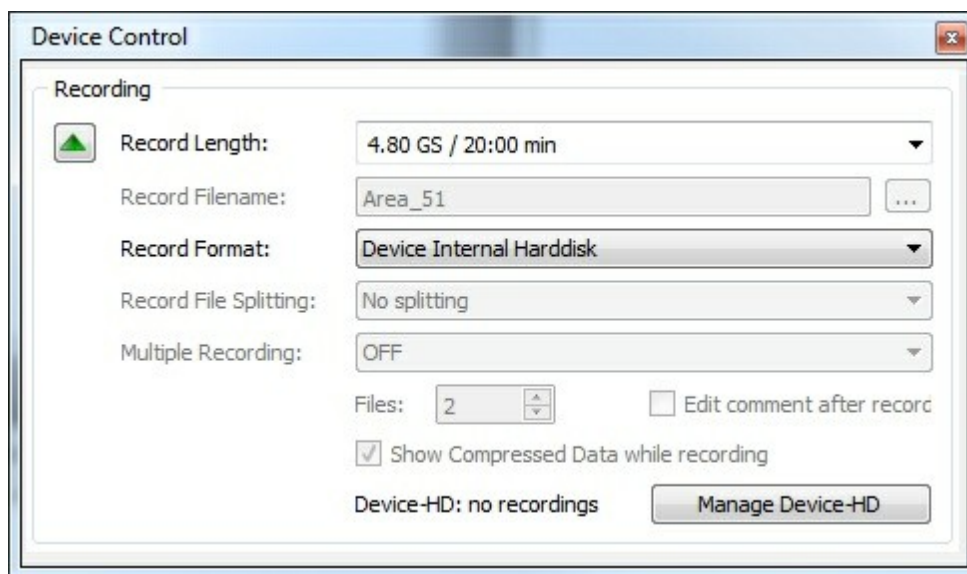
- **Replay to screen only:** recorded data is rendered to Dataview and can be analyzed on screen.
- **Replay to screen and store to disk:** in addition to screen rendering, data is stored to a file. Configure path and filename, file format and splitting in this dialog and click on **Replay** to transfer data to screen and disk.

3.6 Device Internal Recording

The new LTT24 device generation comes with optional integrated Solid State Disk (SSD). Unlike Stand-Alone Mode with LTT-18x devices, this integrated hard disk is not used for recording without an attached personal computer but for the following benefits:

- allows maximum data rate with all channels over long time recording (only limited by size of SSD)
- keep recorded data on device for later replay, replay and store or (optional) DAC-out replay
- recording will not abort even if connection to personal computer is disrupted (e.g. blasting tests)

LTT24 devices with integrated SSD option offer a new **Record Format** in [Recording](#)^[34] Section of [Device Control](#)^[25].



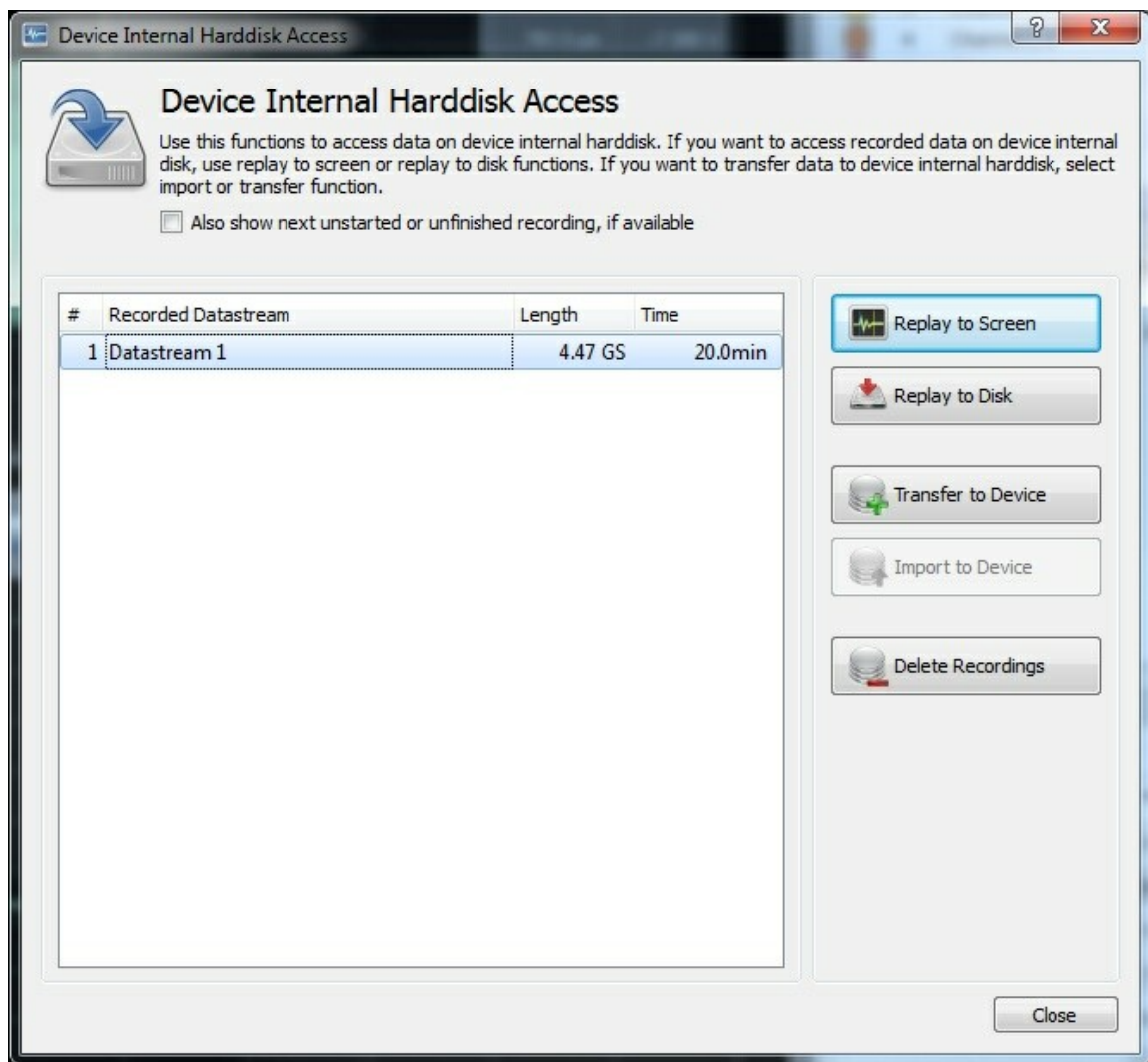
Recording - Device Internal Harddisk

Using this **Record Format** will work as normal recording to computer hard disk but will store data on LTT24 device internal SSD. Recording is started as usual by pressing the **Record** button in [Controlbar](#)^[23] but will not show any data in dataview and will not store any data to local (computer) hard disk. Instead you will see a recording progress bar and the data rate that is achieved inside the LTT24.

After a complete (or interrupted) **Device Internal Recording**, the counter of Device-HD recordings is increased and you can invoke the [Device Internal Harddisk Access](#)^[67] dialog from main menu or by the **Manage Device-HD** button on **Device Control**.

3.6.1 Device Internal Harddisk Access

Optional Solid State Disks (SSD) in LTT24 can be used to store device internal recordings and to hold user defined signals for **DAC-out** operation. Use the **Device Internal Harddisk Access** dialog to manage these functions.



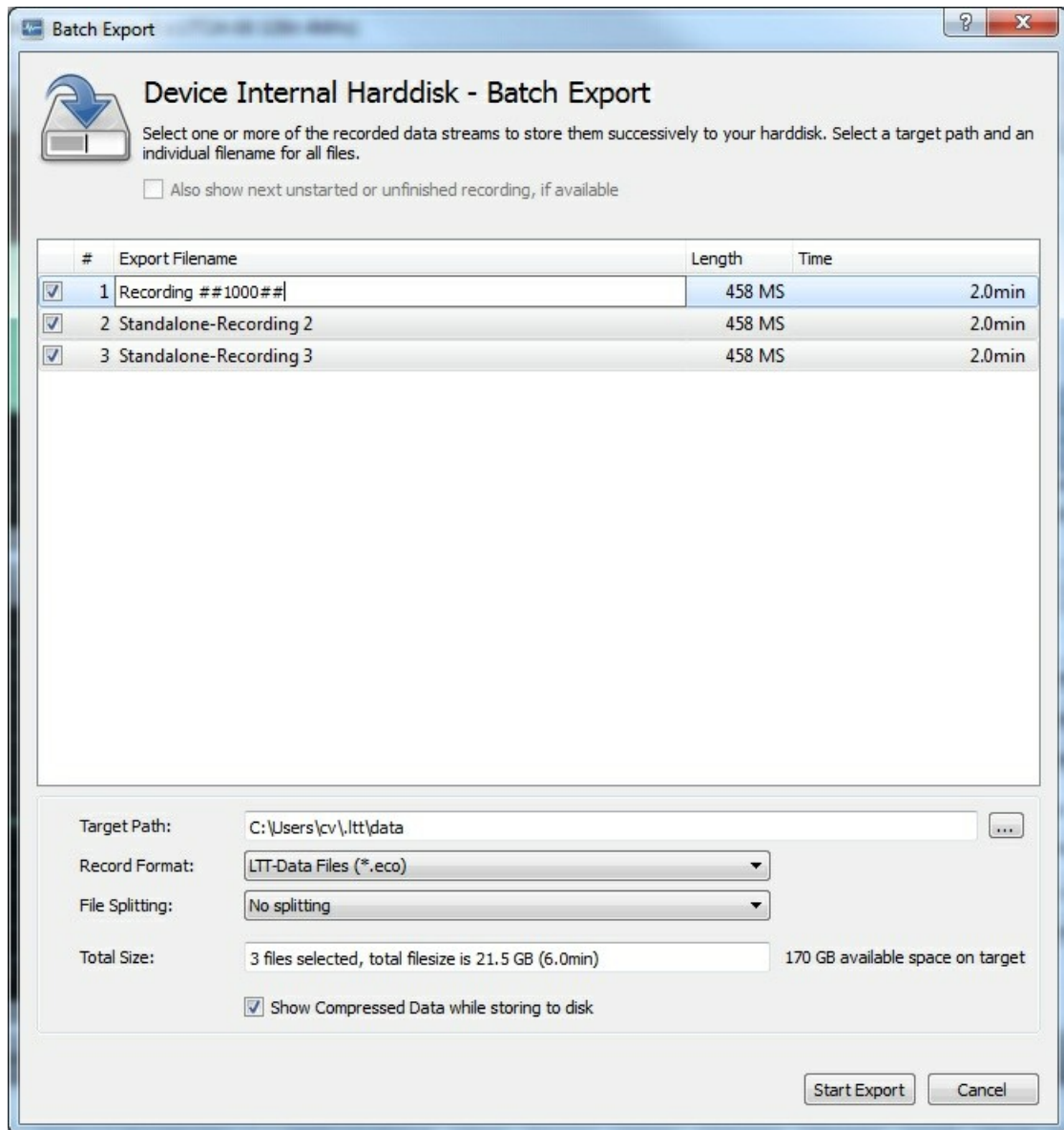
Device Internal Harddisk Access

The main area contains a list of all recordings with length and duration that are stored on the device internal SSD. Click one or more entries to enable functions that will affect the selected recording(s):

- **Replay to Screen:** the dialog will close and the recording will be replayed to LTTpro as if analog data comes directly from LTT24 channels.
- **Replay to Disk:** another dialog will ask for the recording parameters, then stored data is transferred to your computer hard disk.
- **Transfer to Device:** pre-recorded data files can be transferred to device internal SSD and can be used for optional **DAC-out** replay.
- **Import to Device:** for future versions - not implemented in this version of LTTpro.
- **Delete Recordings:** selected recordings (sequentially from end of list) can be erased from device internal SSD.

3.6.2 Device Internal Batch Export

Device Internal SSD can optionally have capacities up to 512GB (as in 04/2014). Replay to a (computer) hard disk can take up to several hours and manual replay of each file could mean hours of work. For that, a **Batch Export** of **Device Internal Recordings** is implemented in LTTpro. This dialog is available in main menu if at least one recording was stored on device internal SSD.



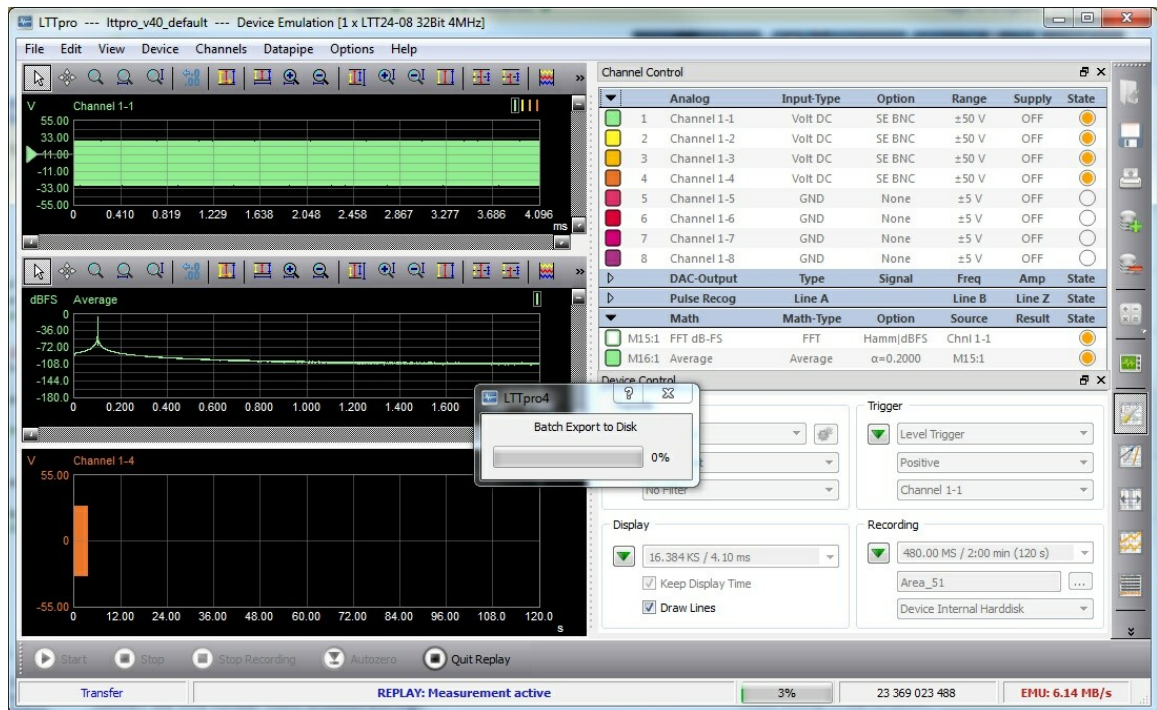
Device Internal Harddisk - Batch Export

Follow the next steps for an unattended replay and store of all (or selected) device internal SSD recordings to your computer hard disk:

1. Select all recordings in list that should be replayed and stored to your hard disk.
2. Click on the checkbox in first column to indicate recording.
3. Select **Target Path**: All recordings are transferred to that directory.
4. Select **Record Format** and **File Splitting** option.
5. Every recorded file can have its individual filename (default is "Standalone-Recording x"). You can edit each line in recording list or select multiple lines and give a common name to all entries.

Recording files are indexed automatically on replay but you can also add specific numbers to your recording name. In the above picture three items are selected, item one is edited as *Recording ###n###*. Pressing <Enter> will generate the following filenames: Recording 1000, Recording 1001 and Recording 1002.

Click on **Start Export** to begin replay and store. The dialog is closed and you will see main LTTpro window with progressing data from SSD.



Batch Export

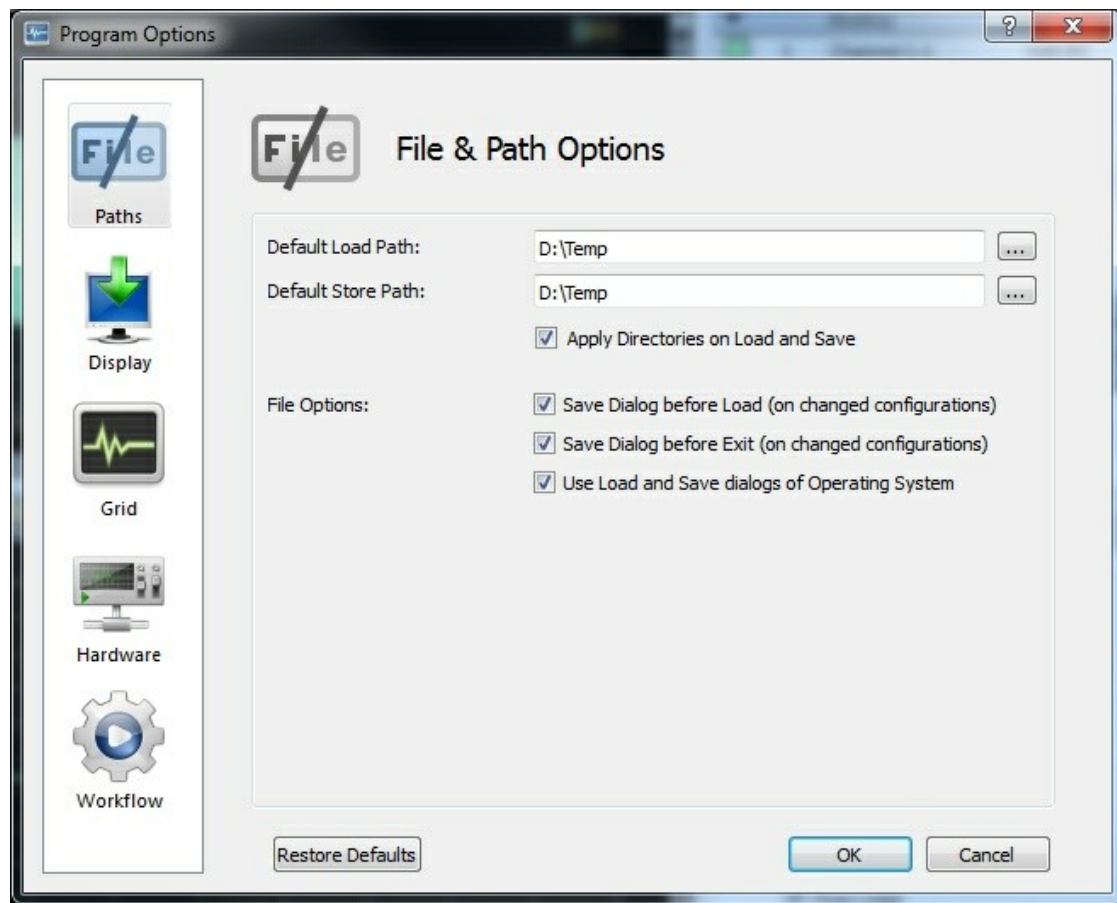
While Batch Export is running, most functions in LTTpro are disabled. Even if some functions like dataview zoom/shift are available, **you should not use LTTpro while a batch export is running**. Additional tasks will slow down transfer speed or data replay, others will probably interfere with replay and store!

Part

IV

4 Program Options

Some basic settings define hardware communication of LTTpro with attached devices. Other settings have an impact on display, control elements and workflow. You can configure all of these settings in *Options | Program Options (Ctrl+O)*.



Program Options

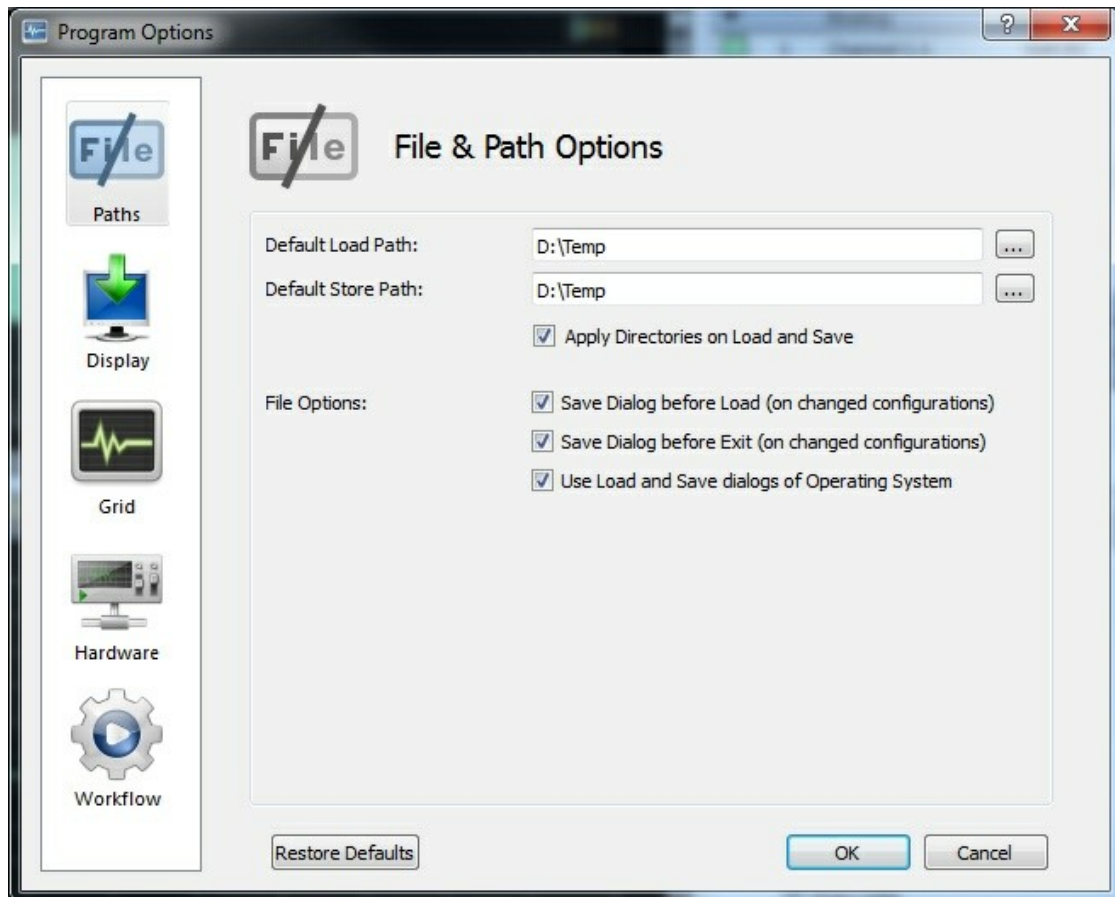
On the left side of the **Program Options** dialog all sections are listed with icons and after you have selecting one, the main area of the dialog shows the corresponding parameters. The following sections are available at the moment:

- [Paths \(Files and Directories\)](#)^[73]
- [Display](#)^[74]
- [Grid](#)^[76]
- [Hardware](#)^[77]
- [Workflow](#)^[79]

Work through the following chapters to learn how different settings affect your daily work with LTTpro.

4.1 Paths (Files and Directories)

Use this section to setup default locations for loading and saving configurations and recording data.



File and Path Options

Default Load Path and **Default Store Path** define the locations where a **File Open** and **File Save** dialog will initialize their start directory.

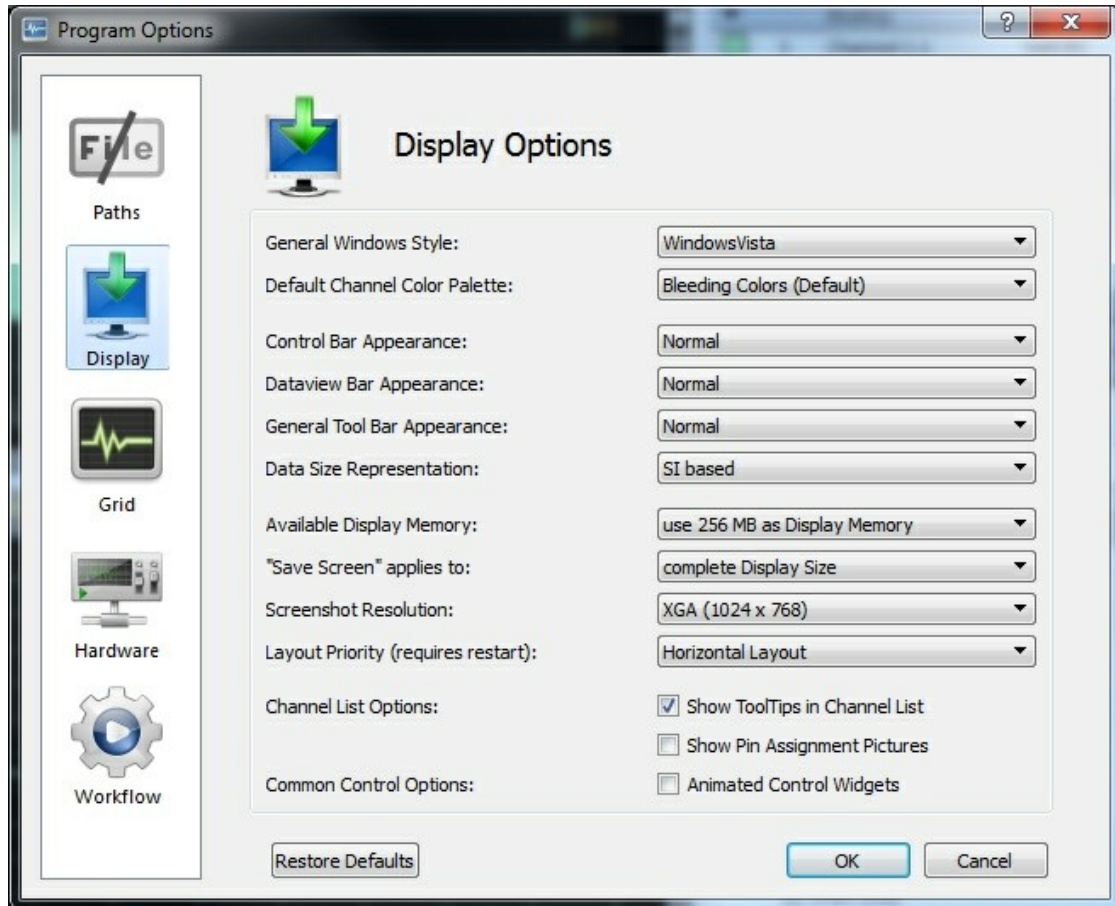
The option **Apply Directories on Load and Save** states if loading files from or saving files to another directory than default will change the current load and save path or if default paths always stay untouched.

Default setting for **Load Path** and **Store Path** is `.ltd` subdirectory in the *user/home directory* (depends on operating system).

File Options will affect the behaviour of LTTpro in some situations like loading a new configuration or terminating without saving the current situation. LTTpro comes with own dialogs for loading and saving files. If you prefer the system dialogs of your operation system, enable this option.

4.2 Display

The **Display Options** section define settings for general application appearance and some display regarding parameters.



Display Section

A selection of "*Themes for Color and Windows*" can be found in the **General Windows Style** list. Available items in this list depend on type and version of operation system, every item configures general window appearance and the **look and feel** of control elements. Please note that themes are no graphical gimmick but a feature for better usability, e.g. contrast and visibility of control elements can be improved on low-end displays etc.

Default Channel Color Palette defines the standard palette of channel colors if you do not change them manually. Default value for LTTpro 4 is **Bleeding Colors**, if you prefer channel colors of previous versions select **LTTpro V3 style** and if you come from LTTView, you may prefer **LTTView Style**.

Control Bar Appearance, **Dataview Bar Appearance** and **General Toolbar Appearance** define width, height and font size of the most important panels. Each bar can be defined **Normal**, **Large** or **Huge**.

The option **Available Display Memory** allocates a fix memory size from available RAM for LTTpro's internal display buffer handling. Possible values are 64MB, 128MB, 256MB and 512MB. Please keep in mind to have enough free memory when selecting large values. This option has a direct impact on available **Display Sizes**.

"Save Screen" applies to belongs to the homonymous menu item *File | Save Screen (F2)*. This option defines if the complete **Display Size** is saved or only the currently selected area.

While creating a **Screenshot** from the current **Dataview**, a default resolution for the target image is used. Define this image size with **Screenshot Resolution**. Eight resolutions are available from XGA (1024x768) up to QSXGA (2560x2048). The resolution is also used for *Edit | Copy Dataview to Clipboard (Ctrl+C)* function.

Layout Priority will affect the way how the widgets are arranged in main window. Changing this setting will need a restart of LTTpro.

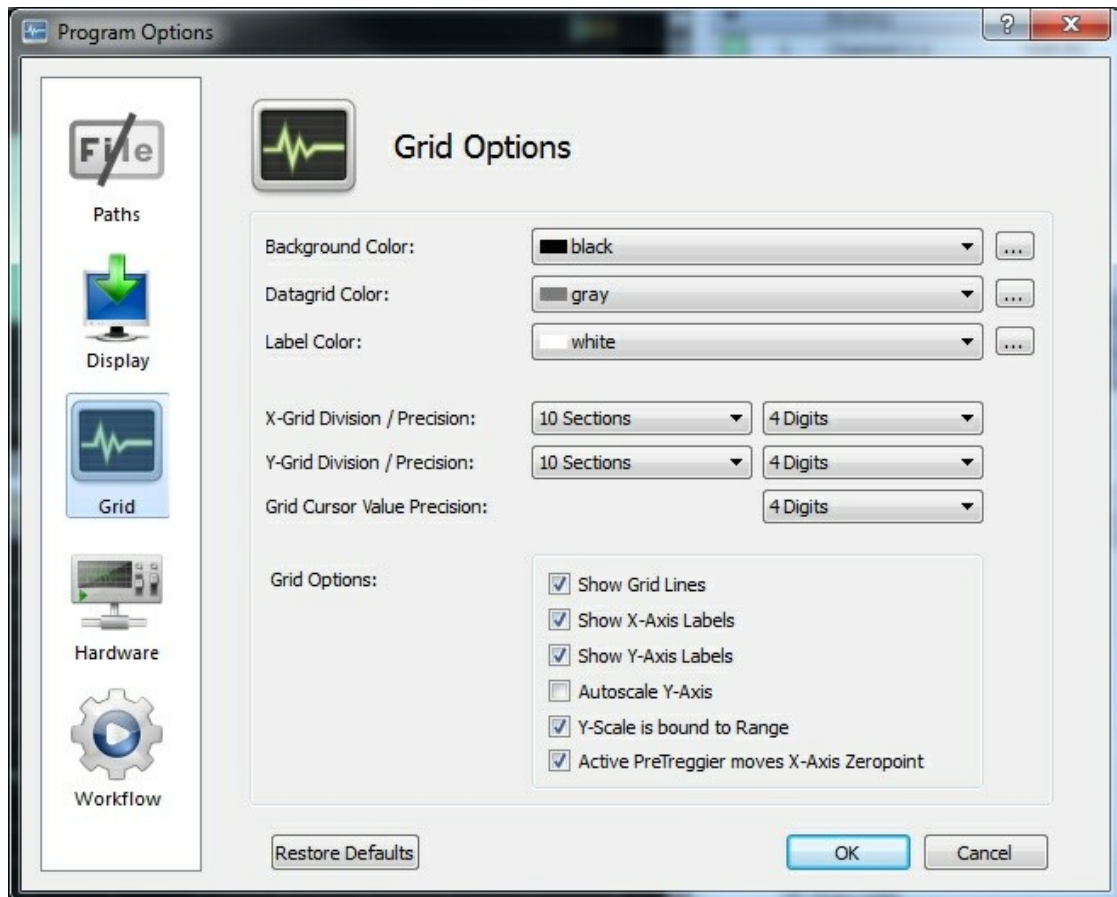
Show ToolTips in Channel List option enables automatic popup windows with channel information if you leave the mouse cursor above a channel in the [Channel Control](#)^[26].

Show Pin Assignment Pictures option includes small pictures with information on pin assignment in the ToolTips of a channel.

Animated Control Widgets option causes some fade-in and fade-out effects in [Device Control](#)^[25]. Besides, the view in [Device Control](#)^[25] is restored to common view if no control of a section is used and mouse focus has left the area.

4.3 Grid

Grid Options define parameters for the **Dataview** appearance.



Grid Section

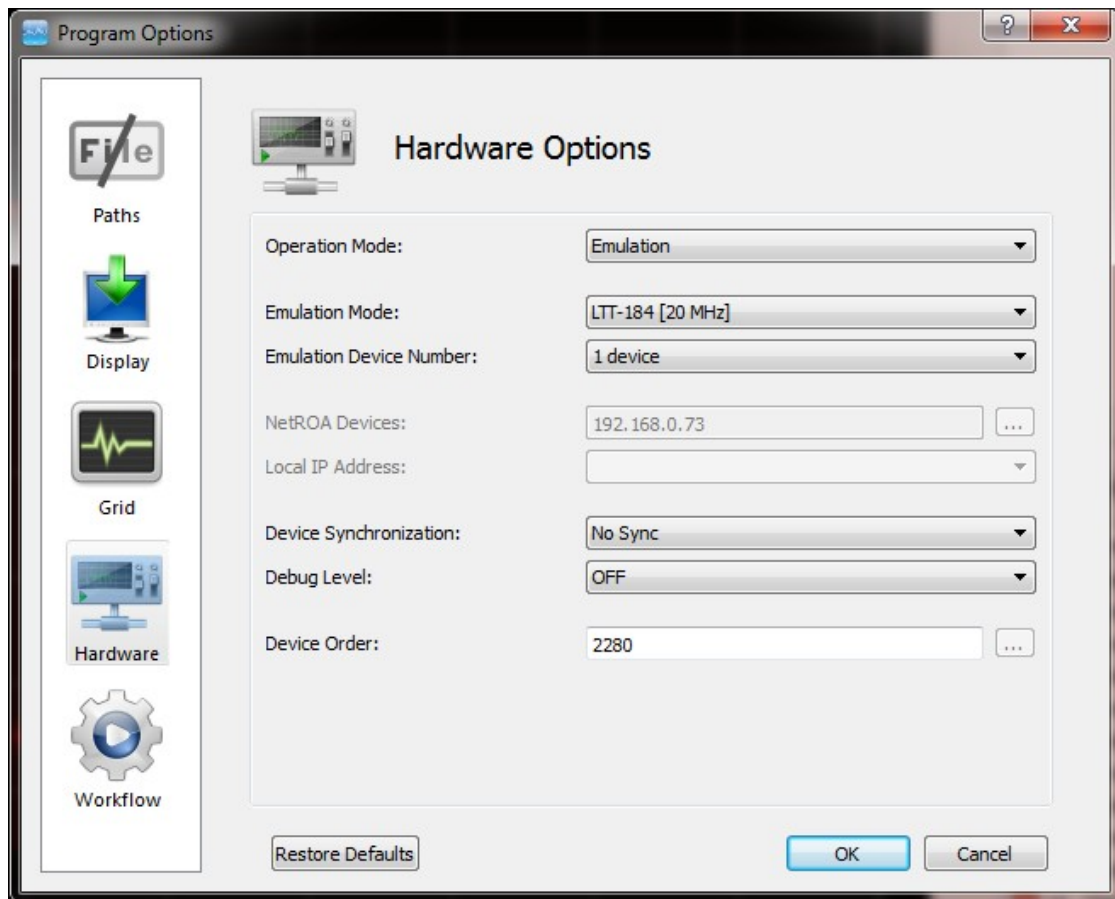
Define **Background Color**, **Datagrid Color** and **Label Color** for the **Dataview** element. If the desired color is not available in the list, you can open a **Color Dialog** with the (...) button next to each color and select an individual color.

X-Grid Division and **Y-Grid Division** define the number of **zones** in each direction. Default setting is 10 section for each direction. A range from one to twenty-two sections is possible. Additionally you can enter a default precision for x-/y-axis and cursor values.

With **Grid Options**, you can toggle visibility of **Grid Lines**, **X-Axis Labels** and **Y-Axis Labels**. In addition, **Autoscale Y-Axis** option toggles an automatic scaling of y-axis to the current signal amplitude.

4.4 Hardware

This section defines generally the **Operation Mode** of LTTpro. Four modes are available: **Physical Disk**, **LTTRoA Service**, **Net-ROA** and **Emulation**.



Hardware Section

Depending on selected **Operation Mode**, further settings are necessary. All modes in detail:

- **Physical Disk (USB/SCSI):** Up to four devices (64 channels) can be attached locally on USB- or SCSI-interface. No further parameters are required (despite of **Device Synchronization**, see below).
- **LTTRoA Service:** Use this mode for locally attached devices if **no administrator privileges** are available. Please refer to [LTTRoA Service](#)^[98] for more instructions.
- **Net-ROA:** With proprietary *NetROA* network protocol up to four devices can be controlled in local area networks (LAN). Select desired subnet with **Local IP Address** (select an existing entry that is in the subnet of the LTT devices). You can now enter IP addresses of attached network devices (if you know them) or invoke a scan dialog with the (...) button next to the **NetROA Devices** edit field. **Please note:** the computer with LTTpro running and the network devices must be in the **same subnet**, else LTTpro will not find these devices.
- **Emulation:** Use this **Operation Mode** for two reasons: First, you can learn how to work with

LTTpro without a running device. Second, you can create and save configurations for later measurement jobs without the necessity of an attached device.

As soon as **multiple devices** are attached, **Device Synchronization** must be configured. The following options are available:

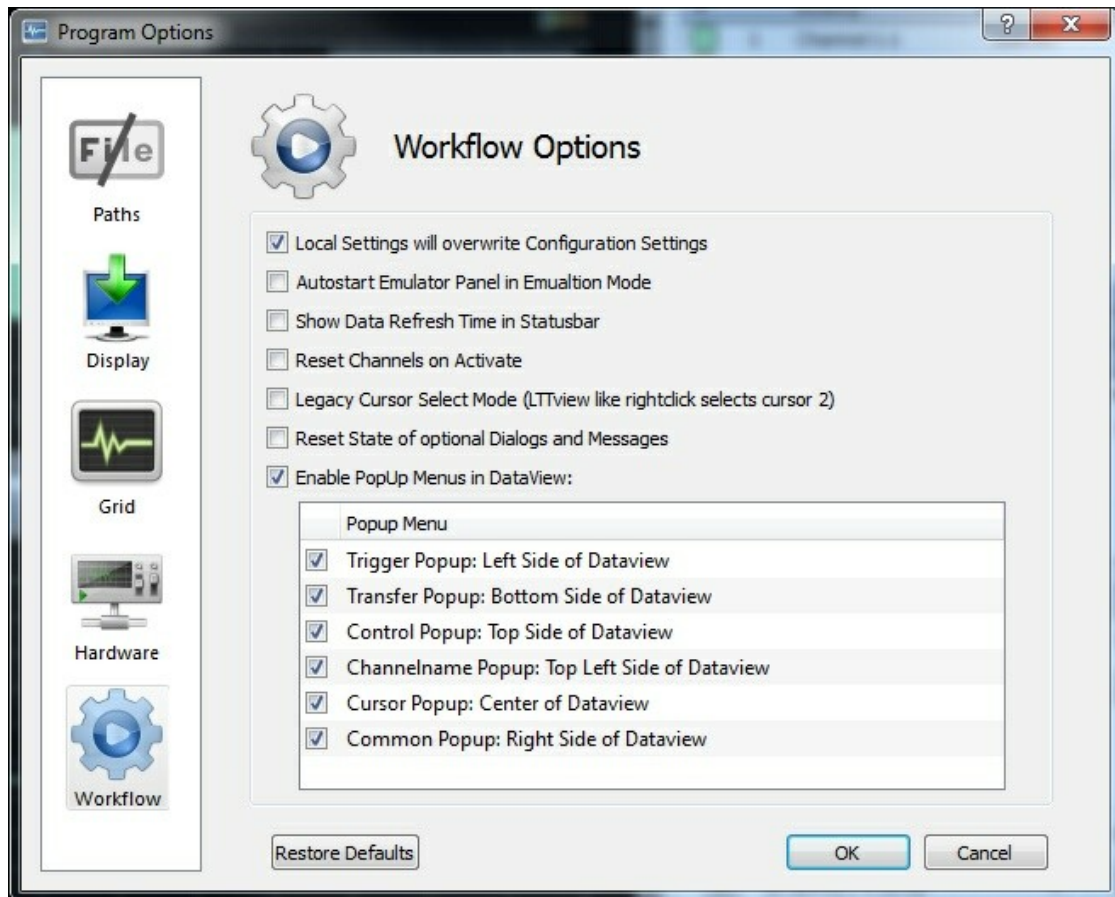
- **No Sync:** Each device runs independent with own clock. This is default for single device operation.
- **Sync MEAS Start:** Multiple devices are connected with a trigger-cable and synchronize measurement start.
- **Sync Start and Clock:** Multiple devices are connected with a synchronization cable, use same clock and start simultaneously.

In addition **Device Order** can be configured with **multiple devices**. This is important if you want a dedicated channel assignment each time a configuration is loaded. As a LTTpro device scan can vary with its result, e.g. USB has no deterministic device order, define a fix order of devices in this field to ensure a predictable behaviour of your setup.

The last option within **Hardware Options** is **Debug Level** that can be configured from **Off** to **4**. This option determines the details that are logged to `~\.ltt\log\lttpro.log` if debugging is enabled.

4.5 Workflow

Workflow Options define the behaviour of LTTpro in typical processes.



Workflow Section

- **Local Settings will overwrite Configuration Settings:** A saved configuration primarily stores device and channel settings but in addition, some application and display settings (e.g. grid division) are also saved. This option determines if those stored values are used when loading a configuration or if local program settings are kept.
- **Autostart Emulator Panel in Emulation mode:** If **Emulation** is selected as **Operation Mode** in [Hardware Options](#)^[77], a synthetic signal is generated. You can control the parameters of this signal with a special control, the [Emulator Panel](#)^[89]. This option states if this control is shown automatically when LTTpro starts and **Emulation** is active.
- **Show Data Refresh Time in Statusbar:** This option toggles an additional time indicator (in ms) in the left statusbar panel. This indicator shows the duration of the last data transfer from device layer to display. The value can vary from 15ms up to several seconds depending on **Display Size** and number of active channels. Use this option as a "still alive" indicator and for performance issues.
- **Reset Channels on Activate:** If a channel is turned on (activated), it can restore the last settings of input-type and range or it can always use a safe default. This option toggles if a channel is always activated with a default input-type and range (normally $\pm 10V$ DC) or with last settings (not checked).

- **Legacy Cursor Select Mode:** Users of LTTView where used to select or reposition cursors with left and right mouse button. Enable this behaviour with this option.
- **Reset State of optional Dialogs and Messages:** Some dialogs and messages can be closed with a "*Don's show again*" button in order to suppress this messages in the future. Use this option (check once and apply) to reset the state of these dialogs and messages and show them again in the future.
- **Enable Popup Menus in Dataview:** The **Dataview** contains six position-sensitive context menus (popups). Use this option and the list below to enable or disable each of those popup-menus.

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V

5 Changes to LTTpro V3.x

LTTpro in version 4 adopts most user interface elements of version 3. However some functionality has changed or was relocated to another interface section.

One of the most serious innovations of version 4 is the **License** model. While basic functionality comes free with all versions of LTTpro, additional features or customization can be added by means of license files. See section [License Handling](#)^[83] for details.

Device Control has been revised completely for better clearness. Cursor marker handling has moved to dataview area, former **Quickbar** is no longer necessary as new **Device Control** widget integrates most important parameters all at once. See section [Device Control](#)^[25] for details.

Channel Control has also been revised for more flexibility and integration of new functions. Display of all kind of channels (analog, digital, math, ...) can be adapted to your individual needs. The introduction of blocks and sections improves usability many times over. See [Channel Control](#)^[26] for details.

The new LTT24 device generation extends the hitherto existing **Stand-Alone Mode** of LTT-18x devices with the new **Device Internal Recording** mode. See [Device Internal Recording](#)^[67] section to understand the differences and benefits of this new feature.

All data handling in LTTpro is represented in a model called **Datapipe**. This model allows not only the mere processing of data but also the linkage of multiple signals or operators. See [Datapipe](#)^[84] to get to know this new feature.

5.1 License Handling

Some additional features and customizations in LTTpro can be unlocked with **license files**. You can order that license when buying a LTT device or you can add licenses at any time to an existing installation of LTTpro 4. Normally, you will obtain a license file by Email or by a memory medium, such as a usb-stick or similar. The license consist of a single file in the form `licNNNNNNNNN.xlic` that is readable in a normal text editor. **Do not modify a license file on your own! Modifying a single bit in a license file will destruct the license!**

A new license has to be registered once for every LTTpro installation. Select **Register License** from **Options** menu and select a valid *.xlic file. A dialog confirm the import of a new license and **you should always restart LTTpro in order to get new features work**.

Select **License Information** in **Help** menu to show all registered license information.



License Information

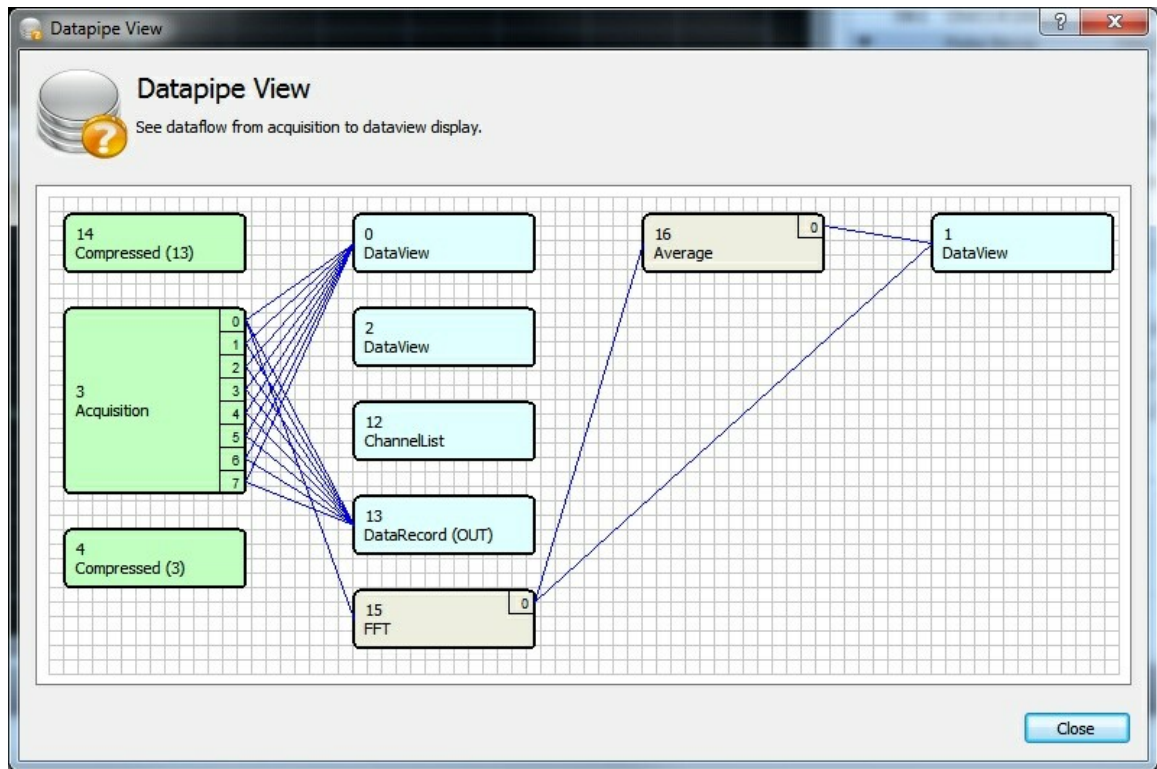
The License Information dialog will show you some information on license holder and acquired features (possibly temporary).

A license will remain on a computer system until LTTpro is uninstalled or a new (other) license is registered. Licenses are normally for a single computer system. Do not install the same **license file** on multiple systems, if not mentioned otherwise.

5.2 Datapipe

The LTTpro internal data representation and handling is realized with a mechanism called **Datapipe**. Though you will never have to work directly with the **Datapipe**, it could be helpful to know some further details.

A visualization of current Datapipe connections can be opened with **Open Datapipe View** in **Options** menu.



Datapipe View

The **Datapipe View** visualizes the current state of LTTpro and will alter with every parameter change. Objects in **Datapipe View** can be categorized in three types:

- **Data Source** (green): a data generator, normally an LTT device (Acquisition) but also a pre-handled set of data (Compressed) from a file or other source
- **Data Sink** (blue): a data recipient, this is normally a display (DataView) or a control element (ChannelList), can also be a file for recording (DataRecord)
- **Operator** (khaki): a data modifying function (e.g. FFT, Average) between a **Data Source** and a **Data Sink**

The numbers top left in between an object represent the unique ID of the object, numbers in parentheses indicate the related object. Lines between objects will show their connections and thereby represent the current data flow.

In the above example data is generated by an 8-channel device (3, *Acquisition*) and is displayed in LTTpro main display (0, *DataView*). A data source object is connected in order to record data to a file (13, *DataRecord*). The first analog channel is connected to a mathematic operator (15, *FFT*) that is connected itself to another mathematic operator (16, *Average*), the FFT and the smoothed FFT are

displayed in an additional math dataview (1, *DataView*).

If you have any doubt on the plausibility of displayed data, have a look at ***Datapipe View*** first and check out if data is handled in the way you want.

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6 Emulator

Running LTTpro with **Emulation** as **Operation Mode**, USB- SCSI- and network interfaces are ignored completely, **up to four arbitrary LTT devices** are emulated.

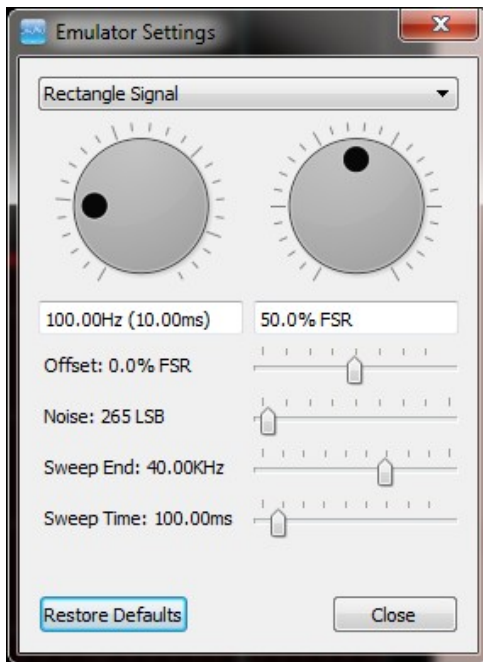
You will see no difference in LTTpro to real hardware, control and information elements are filled with the corresponding parameters, channels are generated and listed in **Channel Control** and a synthetical signal is painted in **Dataview**. However, in order to see a running emulation mode, the rightmost statusbar panel has a "**EMU: xx,x MB/s**" format instead of normal transfer-rate display.

The synthetical signal can be controlled with [Emulator Panel](#)^[89]. With the help of different signal forms and functions, real conditions can be simulated and working with LTTpro can be learned without attached devices.

Furthermore you can use **Emulation Mode** in order to create configurations for later measurements. Select type and number of devices to use in [Program Options](#)^[72] | [Hardware](#)^[77]. Now setup the desired device- and channel configuration and save it with **File | Save Configuration (Ctrl+S)**. This configuration can now be used with real devices of the preset type.

6.1 Emulator Panel

Virtual signals in **Emulation Mode** are generated synthetically by device layer of LTTpro. A signal is assigned to every active channel so all channels will get the same signal (noise differs with every channel if noise is not zero). The characteristic parameters of the signal can be configured in Emulator Panel which can be invoked with *Options | Emulator Panel (Ctrl+E)*.



Emulation Panel

The main parameter is signal form. While a **DC Signal** is characterized solely by an **Offset**, the other signal forms **Sinus**, **Rectangle** and **Triangle** can be manipulated in their **Frequency** and their **Amplitude**. In addition, some **Sweep functions** with adjustable **Sweep Time** and **Sweep End** frequency are available.

Offset and **Amplitude** are adjusted in percent of full-scale range because emulation generates signed 16 bit shortint values, independent of the current range or input-type, i.e. an **Amplitude** of 50% will remain 50% in 1V range as in 10V range.

Emulation Mode can synthesize most signals of real world, however there are a few limitations of this mode:

- Signals are **always** generated and painted in **Emulation Mode**, even if a trigger was configured and trigger condition was not met.
- Transfer-rate (in byte per second) and refresh-rate (in ms) are a little vague in **Emulation Mode**. With a lot of active channels, large **Display Size** and a high **Sample Clock**, the simulated transfer-rate will differ from realistic values.

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7 Appendix

Appendix contains an [alphabetically](#)^[92] and [thematically](#)^[95] list of key combinations and a [FAQ](#)^[99] section for troubleshooting.

7.1 Hotkeys

Hotkeys are **key combinations** or **function keys** that activate frequently used functions. In addition to some commonly used and well known hotkeys (e.g. **F1** for **Help**) LTTpro uses a lot of key combinations and function keys in order to offer the possibility of keyboard operation .

You will find a [alphabetically](#)^[92] and [thematically](#)^[95] list of key combinations and hotkeys below.

7.1.1 Alphabetically

Alphabetically order of hotkeys:

hotkey/key combination	meaning/function	siehe auch
F1	Online Help: open online help/manual	
F2	Save Screen: save current display to data file	
F3	Load data: load a recorded data file	
F4	Level Monitor: open signal level window	
F5	Channel Config Section	
F6	Channel Scale Section	
F7	Channel View Section	
F8	Channel Cursor Section	
F9	Channel Scaling Dialog	
F10	DMS Scaling Dialog (strain gauge, only with LTT-180 and LTT-182)	
F11	Screenshot: save current display to image file	
F12	All Channel Sections	
Ctrl+F1	Help context ("What's this" - Mode): changes cursor to question mark for <i>point and click help</i>	
Ctrl+A	Select All Channels: select all channels in Channel Control	Ctrl+U
Ctrl+B	Stop: abort data transfer from device	Ctrl+R
Ctrl+C	Copy Dataview to Clipboard	
Ctrl+D	Digital Line Setup: show dialog for optional digital input	

hotkey/key combination	meaning/function	siehe auch
	parameters	
Ctrl+E	Emulator Panel: opens Emulator Panel ^[89]	
Ctrl+H	Device Internal Harddisk Access: show dialog for optional device internal SSD	
Ctrl+I	Device Information: a dialog with extended device information is launched	
Ctrl+L	Load Configuration: a saved configuration is loaded and applied	Ctrl+S
Ctrl+O	Program Options: opens Program Options ^[72] dialog	
Ctrl+P	Print Screen: the current display and configuration is printed	
Ctrl+R	Start: start data transfer from device, get next screen with <i>Single-Shot</i> mode	Ctrl+B
Ctrl+S	Save Configuration: current setup is saved to a (XML-) file	Ctrl+L
Ctrl+T	Realtime Mode: return to online or realtime device mode after a file was loaded or data was replayed	
Ctrl+U	Clear Channel Selection: selection in Channel Control is cleared, no channel is selected	Ctrl+A
Ctrl+Z	Reset Dataview: all previous zoom in <i>Dataview</i> is undone	
Ctrl+1	Device Control: toggle visibility of control	
Ctrl+2	Channel Control: toggle visibility of control	
Ctrl+3	Toolbar: toggle visibility of control	
Ctrl+4	Controlbar: toggle visibility of control	
Ctrl+5	Data Controls: toggle visibility of control	
Ctrl+0	Reset View: all controls are reset to standard size and position	
Ctrl+ + (Plus)	Show Used: a user defined setup of control size and position is restored	Ctrl+ - (Minus)
Ctrl+ *	Show All: all controls are shown	
Ctrl+ - (Minus)	Hide All: all controls are hidden	Ctrl+ + (Plus)
Ctrl+Shift+A	AutoZero: if possible autozero function is invoked	
Ctrl+Shift+B	Turn OFF selected channels: deactivate selected channels in <i>Channel Control</i>	Ctrl+Shift+G
Ctrl+Shift+C	Next coupling of selected channels: the next input-type of selected channels is used	Ctrl+Shift+D
Ctrl+Shift+D	Previous coupling of selected channels: the previous input-	Ctrl+Shift+C

hotkey/key combination	meaning/function	siehe auch
	type of selected channels is used	
Ctrl+Shift+F	Previous range of selected channels: the previous range of selected channels is used	Ctrl+Shift+V
Ctrl+Shift+G	Turn ON selected channels: activate selected channels in <i>Channel Control</i>	Ctrl+Shift+B
Ctrl+Shift+R	Record/Stop Recording: starts <u>or aborts</u> a recording	
Ctrl+Shift+S	Save as Default: current configuration will become the default configuration	Ctrl+Shift+X
Ctrl+Shift+V	Next range of selected channels: the next range of selected channels is used	Ctrl+Shift+F
Ctrl+Shift+X	Clear Default: default setup is cleared, LTTpro will start with clean setup next time	Ctrl+Shift+S

7.1.2 Thematically

Thematically (menu based) order of hotkeys:

Hotkey/ Funktionstaste	Bedeutung/Funktion	siehe auch
Ctrl+L	Load Configuration: a saved configuration is loaded and applied	Ctrl+S
Ctrl+S	Save Configuration: current setup is saved to a (XML-) file	Ctrl+L
Ctrl+Shift+S	Save as Default: current configuration will become the default configuration	Ctrl+Shift+X
Ctrl+Shift+X	Clear Default: default setup is cleared, LTTpro will start with clean setup next time	Ctrl+Shift+S
F2	Save Screen: save current display to data file	
F3	Load data: load a recorded data file	
Ctrl+T	Realtime Mode: return to online or realtime device mode after a file was loaded or data was replayed	
Ctrl+P	Print Screen: the current display and configuration is printed	
F11	Screenshot: save current display to image file	
Ctrl+C	Copy Dataview to Clipboard	
Ctrl+Z	Reset Dataview: all previous zoom in Dataview is undone	
Ctrl+1	Device Control: toggle visibility of control	
Ctrl+2	Channel Control: toggle visibility of control	
Ctrl+3	Toolbar: toggle visibility of control	
Ctrl+4	Controlbar: toggle visibility of control	
Ctrl+5	Data Controls: toggle visibility of control	
Ctrl+0	Reset View: all controls are reset to standard size and position	
Ctrl+ + (Plus)	Show Used: a user defined setup of control size and position is restored	Ctrl+ - (Minus)
Ctrl+ - (Minus)	Hide All: all controls are hidden	Ctrl+ + (Plus)
Ctrl+ *	Show All: all controls are shown	
Ctrl+R	Start: start data transfer from device, get next screen with Single-Shot mode	Ctrl+B
Ctrl+B	Stop: abort data transfer from device	Ctrl+R

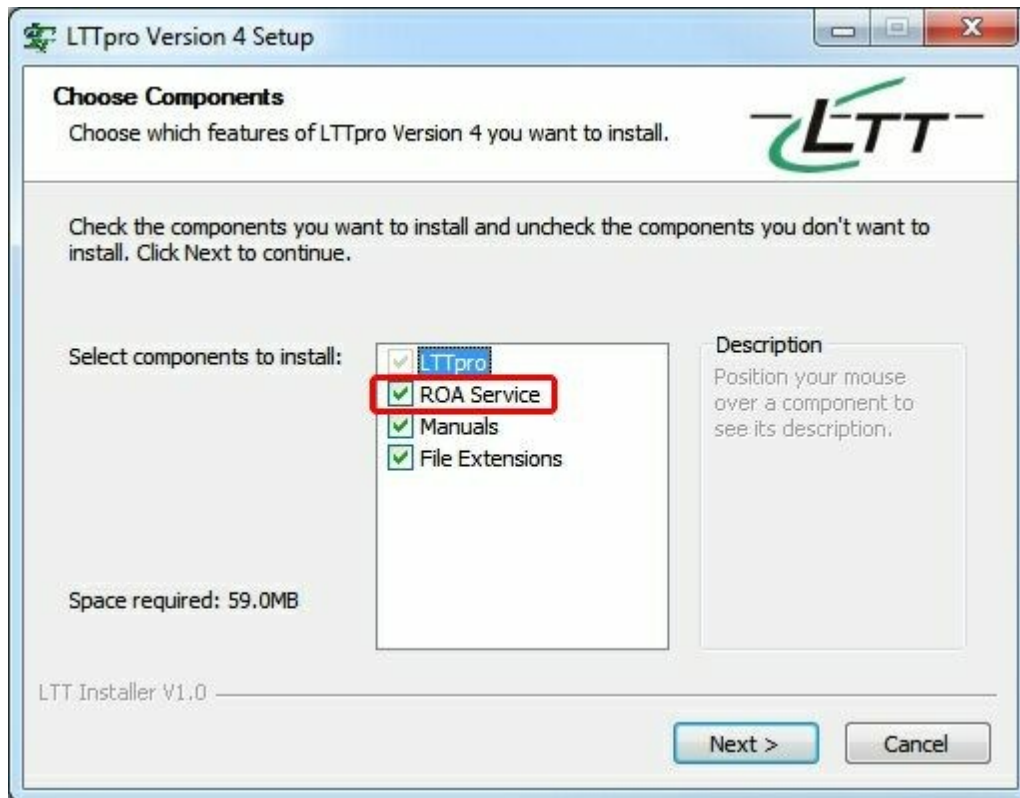
Hotkey/ Funktionstaste	Bedeutung/Funktion	siehe auch
Ctrl+Shift+R	Record/Stop Recording: starts <u>or aborts</u> a recording	
Ctrl+Shift+A	AutoZero: if possible autozero function is invoked	
F4	Level Monitor: open signal level window	
F5	Channel Config Section	
F6	Channel Scale Section	
F7	Channel View Section	
F8	Channel Cursor Section	
F12	All Channel Sections	
F9	Channel Scaling Dialog	
F10	DMS Scaling Dialog (strain gauge, only with LTT-180 and LTT-182)	
Ctrl+Shift+G	Turn ON selected channels: activate selected channels in <i>Channel Control</i>	Ctrl+Shift+B
Ctrl+Shift+B	Turn OFF selected channels: deactivate selected channels in <i>Channel Control</i>	Ctrl+Shift+G
Ctrl+Shift+D	Previous coupling of selected channels: the previous input-type of selected channels is used	Ctrl+Shift+C
Ctrl+Shift+C	Next coupling of selected channels: the next input-type of selected channels is used	Ctrl+Shift+D
Ctrl+Shift+F	Previous range of selected channels: the previous range of selected channels is used	Ctrl+Shift+V
Ctrl+Shift+V	Next range of selected channels: the next range of selected channels is used	Ctrl+Shift+F
Ctrl+A	Select All Channels: select all channels in <i>Channel Control</i>	Ctrl+U
Ctrl+U	Clear Channel Selection: selection in Channel Control is cleared, no channel is selected	Ctrl+A
Ctrl+O	Program Options: opens Program Options ^[72] dialog	
Ctrl+E	Emulator Panel: opens Emulator Panel ^[89]	
F1	Online Help: open online help/manual	
Ctrl+F1	Help context ("What's this" - Mode): changes cursor to question mark for <i>point and click help</i>	
Ctrl+I	Device Information: a dialog with extended device information	

Hotkey/ Funktionstaste	Bedeutung/Funktion	siehe auch
	is launched	

7.2 LTTRoA Service

With version 3.2.14 and newer, LTTpro comes with an additional operation mode: *LTTRoA Service*. This operation mode is based on a Microsoft™ Windows *service* and separates LTTpro from direct hardware access. LTTpro can be used **without administrator privileges** by installing this service. You will **once** need administrator privileges for installation of the service in the following steps:

1. While installation of LTTpro, keep the "ROA Service" option checked.



LTTpro Installer

2. After installation has finished, please open Windows Explorer and change to LTTpro 4 program path (normally C:\Program\LTTpro Version 4).
3. Check for `LTTROAD-Service.exe` and launch this installer application. Service will be installed and started automatically.
4. Start LTTpro and open [Program Options](#)^[72] with *Options | Program Options*, select *Hardware*.
5. Select *LTTRoA Service* from *Operation Mode* and click on OK. Local attached devices will be found now.

Please note: As LTTpro is an additional communication layer between hard- and software, data transfer speed is a little slower than normal with local devices that are directly attached. Depending on the performance of the controlling computer, maximum transfer speed is limited to **~35MB/s**.

7.3 FAQ

This chapter should help you in case of problems or errors. With frequently asked questions (FAQ) that are answered common problems are solved or explained.

LTT-device is connected to computer but LTTpro does not find any device.

With locally attached devices (USB/SCSI), LTTpro has to be started with sufficient privileges. With Microsoft Windows™, the user should have administrator privileges (WinXP) or LTTpro should be started with "Run as administrator ..." (Windows Vista/Windows 2003/Windows 7). Running Linux, the user must be member of a group that has read-/write permissions to disc devices, e.g. member of *disc* group with Ubuntu/Kubuntu distributions.

Plotted signals do not fit with connected signals. and Attached device(s) do not respond to LTTpro even though channels and signals are displayed.

Check [Hardware](#)^[77] section in [Program Options](#)^[72] if **Operation Mode** is **Emulation**. In this case LTTpro ignores local- and network attached devices and works exclusively with [Emulator](#)^[88].

Data transfer-rate from device is significant below estimated range.

Transfer-rate to computer depends on several criteria:

- selected interface: *USB*, *SCSI* or *Ethernet*
- selected sample clock and number of active channels
- selected display size

Benchmarks for single device with higher sample rate (**500KHz+**) and long display size (**1MS+**) :

- **Ethernet** with *NetROA*: **6 MB/s**
- **USB 2.0** with *Ratoc U2SCX*: **13 MB/s**
- **SCSI** with *Adaptec 2940U/AU*: **19 MB/s**
- **LTT24 with USB 2.0**: **30 MB/s**
- **LTT24 with USB 3.0**: **up to 180 MB/s** (depends on computer and active math operators)

If real transfer-rates differ extremely from these values, please check for the following:

- **Ethernet**: Is there a stable link between computer and network switch/hub respectively between LTT network device and network switch/hub. With a hub: are there a lot of collisions on the network (indicated on most hubs)? Is there a lot of other network traffic that slows down your network performance?
- **USB 2.0**: Does the USB to SCSI converter run in the correct mode (mass storage) or in a slow compatibility mode. Please check with Firmware utility etc.
- **SCSI**: Is SCSI host-adapter configured correct (*AUTO* or *20MB/s* or *ULTRA*) for the *ID* of LTT device or is *ASync* used?

I used LTTView until now with my LTT Stand-Alone device. With LTTpro I do not see device internal hard disk any longer.

LTTView, the former standard software for LTT devices used to store data on a FAT32 partition on Stand-Alone devices. Since Microsoft Windows™ Vista, an application can access a formatted device in a sector based mode, what is necessary with LTT devices. For that, LTTpro does not use any formatting for device internal hard disk. Data is stored and replayed with LTTpro without the necessity of a file-system.

Please note: If your device internal hard disk was formatted with LTTView, please delete this partition with disk-manager in windows, else the device will not be usable with LTTpro!

I have not used my LTT Stand-Alone device with LTTView. However LTTpro does not offer Stand-Alone functionality

Some USB to SCSI converters (e.g. *Ratoc U2SCX* with firmware older than 1.17) do not allow multiple devices (LTT device + hard disk) on one controller or fallback to a slow compatibility mode. In this case, update firmware of your adapter or get a newer version of the product.

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LTT24 with 8 channels

