DAS240-BAT

Portable Multi-Channel Recorder

User Manual

Test Equipment Depot - 800.517.8431 - 99 Washington Street Melrose, MA 02176
TestEquipmentDepot.com

Safety Summary

The following safety precautions apply to both operating and maintenance personnel and must be followed during all phases of operation, service, and repair of this instrument.

⚠WARNING

Before applying power to this instrument:

- Read and understand the safety and operational information in this manual.
- Apply all the listed safety precautions.
- Verify that the voltage selector at the line power cord input is set to the correct line voltage. Operating the instrument at an incorrect line voltage will void the warranty.
- Make all connections to the instrument before applying power.
- Do not operate the instrument in ways not specified by this manual or by B&K Precision.

Failure to comply with these precautions or with warnings elsewhere in this manual violates the safety standards of design, manufacture, and intended use of the instrument. B&K Precision assumes no liability for a customer's failure to comply with these requirements.

Category rating

The IEC 61010 standard defines safety category ratings that specify the amount of electrical energy available and the voltage impulses that may occur on electrical conductors associated with these category ratings. The category rating is a Roman numeral of I, II, III, or IV. This rating is also accompanied by a maximum voltage of the circuit to be tested, which defines the voltage impulses expected and required insulation clearances. These categories are:

Category I (CAT I): Measurement instruments whose measurement inputs are not intended to be connected to the mains supply. The voltages in the environment are typically derived from a limited-energy transformer or a battery.

Category II (CAT II): Measurement instruments whose measurement inputs are meant to be connected to the mains supply at a standard wall outlet or similar sources. Example measurement environments are portable tools and household appliances.

Category III (CAT III): Measurement instruments whose measurement inputs are meant to be connected to the mains installation of a building. Examples are measurements inside a building's circuit breaker panel or the wiring of permanently-installed motors.

Category IV (CAT IV): Measurement instruments whose measurement inputs are meant to be connected to the primary power entering a building or other outdoor wiring.

⚠WARNING

Do not use this instrument in an electrical environment with a higher category rating than what is specified in this manual for this instrument.

⚠WARNING

You must ensure that each accessory you use with this instrument has a category rating equal to or higher than the instrument's category rating to maintain the instrument's category rating. Failure to do so will lower the category rating of the measuring system.

Electrical Power

This instrument is intended to be powered from a CATEGORY II mains power environment. The mains power should be 115 V RMS or 230 V RMS. Use only the power cord supplied with the instrument and ensure it is appropriate for your country of use.

Ground the Instrument

⚠WARNING

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical safety ground. This instrument is grounded through the ground conductor of the supplied, three-conductor AC line power cable. The power cable must be plugged into an approved three-conductor electrical outlet. The power jack and mating plug of the power cable meet IEC safety standards.

⚠WARNING

Do not alter or defeat the ground connection. Without the safety ground connection, all accessible conductive parts (including control knobs) may provide an electric shock. Failure to use a properly-grounded approved outlet and the recommended three-conductor AC line power cable may result in injury or death.

⚠WARNING

Unless otherwise stated, a ground connection on the instrument's front or rear panel is for a reference of potential only and is not to be used as a safety ground. Do not operate in an explosive or flammable atmosphere.

⚠WARNING

Do not operate the instrument in the presence of flammable gases or vapors, fumes, or finely-divided particulates.

⚠WARNING

The instrument is designed to be used in office-type indoor environments. Do not operate the instrument

- In the presence of noxious, corrosive, or flammable fumes, gases, vapors, chemicals, or finely-divided particulates.
- In relative humidity conditions outside the instrument's specifications.
- In environments where there is a danger of any liquid being spilled on the instrument or where any liquid can condense on the instrument.

- In air temperatures exceeding the specified operating temperatures.
- In atmospheric pressures outside the specified altitude limits or where the surrounding gas is not air.
- In environments with restricted cooling air flow, even if the air temperatures are within specifications.
- In direct sunlight.

This instrument is intended to be used in an indoor pollution degree 2 environment. The operating temperature range is 0°C to 40°C and 20% to 80% relative humidity, with no condensation allowed. Measurements made by this instrument may be outside specifications if the instrument is used in non-office-type environments. Such environments may include rapid temperature or humidity changes, sunlight, vibration and/or mechanical shocks, acoustic noise, electrical noise, strong electric fields, or strong magnetic fields.

Do not operate instrument if damaged

⚠WARNING

If the instrument is damaged, appears to be damaged, or if any liquid, chemical, or other material gets on or inside the instrument, remove the instrument's power cord, remove the instrument from service, label it as not to be operated, and return the instrument to B&K Precision for repair. Notify B&K Precision of the nature of any contamination of the instrument.

Clean the instrument only as instructed

⚠WARNING

Do not clean the instrument, its switches, or its terminals with contact cleaners, abrasives, lubricants, solvents, acids/bases, or other such chemicals. Clean the instrument only with a clean dry lint-free cloth or as instructed in this manual. Not for critical applications

⚠WARNING

This instrument is not authorized for use in contact with the human body or for use as a component in a life-support device or system.

Do not touch live circuits

⚠WARNING

Instrument covers must not be removed by operating personnel. Component replacement and internal adjustments must be made by qualified service-trained maintenance personnel who are aware of the hazards involved when the instrument's covers and shields are removed. Under certain conditions, even with the power cord removed, dangerous voltages may exist when the covers are removed. To avoid injuries, always disconnect the power cord from the instrument, disconnect all other connections (for example, test leads, computer interface cables, etc.), discharge all circuits, and verify there are no hazardous voltages present on any conductors by measurements with a properly-operating voltage-sensing device before touching any internal parts. Verify the voltage-sensing device is working properly before and after making the measurements by testing with

known-operating voltage sources and test for both DC and AC voltages. Do not attempt any service or adjustment unless another person capable of rendering first aid and resuscitation is present.

Do not insert any object into an instrument's ventilation openings or other openings.

⚠WARNING

Hazardous voltages may be present in unexpected locations in circuitry being tested when a fault condition in the circuit exists.

⚠WARNING

Fuse replacement must be done by qualified service-trained maintenance personnel who are aware of the instrument's fuse requirements and safe replacement procedures. Disconnect the instrument from the power line before replacing fuses. Replace fuses only with new fuses of the fuse types, voltage ratings, and current ratings specified in this manual or on the back of the instrument. Failure to do so may damage the instrument, lead to a safety hazard, or cause a fire. Failure to use the specified fuses will void the warranty.

Servicing

⚠WARNING

Do not substitute parts that are not approved by B&K Precision or modify this instrument. Return the instrument to B&K Precision for service and repair to ensure that safety and performance features are maintained.

For continued safe use of the instrument

- Do not place heavy objects on the instrument.
- Do not obstruct cooling air flow to the instrument.
- Do not place a hot soldering iron on the instrument.
- Do not pull the instrument with the power cord, connected probe, or connected test lead.
- Do not move the instrument when a probe is connected to a circuit being tested.

Safety Symbols

DANGER	**DANGER** indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	**WARNING** indicates a hazardous situation which, if not avoided, could result in death or serious injury
CAUTION	**CAUTION** indicates a hazardous situation which, if not avoided, will result in minor or moderate injury
	A **Caution**. Refer to the text near the symbol.
	Electric Shock hazard
	Alternating current (AC)
	Chassis ground
	Earth ground
	On (Power). This is the In position of the power switch when instrument is ON.
	Off (Power). This is the Out position of the power switch when instrument is OFF.
NOTICE	**NOTICE** is used to address practices not related to physical injury.

CE Declaration of Conformity

Safety testing has been performed on submitted samples and found in compliance with:

European Low Voltage directive 2014/35/UE:

- IEC 61010-1

European EMC directive 2014/30/UE:

Emission standard EN 61326-1, EN 31326-2-1

Immunity standard EN 61326-1, EN 61326-2-1

Installation category

- Measure 100V CAT I

Pollution degree

- 2

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Chapter 1

Introduction

Figure 1.1: Front View

The DAS 240 programmable recorder measures and records up to 200 channels. Measurement of voltages (from 1mV to 100V), currents, temperatures (thermocouple, Pt100, Pt1000), resistances, and as logic channels are possible. Each channel's units are configured using the previous measurement types.

The dialog between the user and the recorder is made easier thanks to an intuitive interface on a wide capacitive and color 10"1 touchscreen. The measurement parameters are easy to program.

The recording is made directly to the internal 32 GB memory card.

The DAS240 is composed with a main base frame and extension modules of 20 channels each.

The DAS240 is easy to program via Ethernet/Wi-Fi and uses the NTP, FTP and VNC protocols for a better use.

The DAS240 can be delivered with an internal battery (ref: 900240500)

1.1 Home screen

The home screen provides access to the various functions and settings of the unit. Access this menu via the "Home" button in the top right corner of the screen.

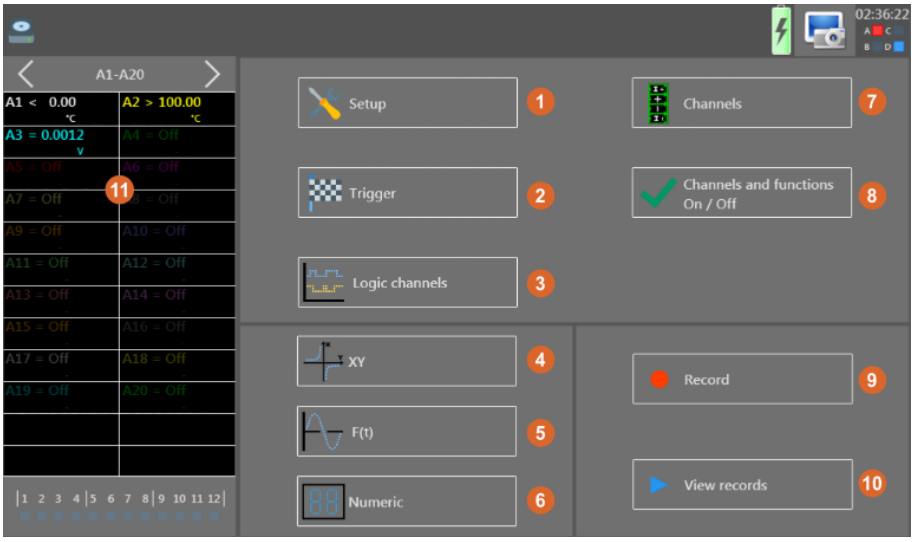


Figure 1.2: Home Screen

1. Setup Menu
2. Trigger Menu
3. Logic Channel Config Menu
4. XY Display
5. F(t) Display
6. Numeric Display
7. Channel Setup Menu
8. Channel and Function display configuration
9. Recording Display
10. Recording Replay Screen
11. Channel Configuration Screen

1.2 Electrical Connections

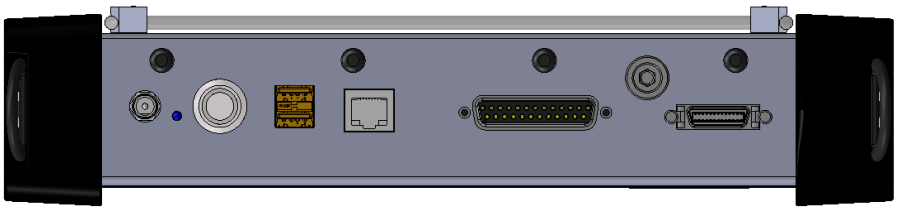


Figure 1.3: Electrical Connections

1. Battery supply/charger
2. Battery charging LED.
3. ON/OFF switch and switching on indicator.
4. 2 USB connectors.
5. RJ45 connector for the Ethernet 10/100 Base interface.
6. DB-25 connector for the 16 logic inputs and the alarm output.

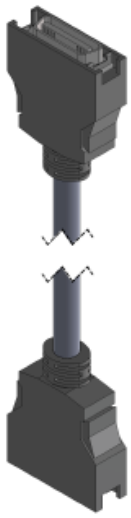


Figure 1.4: Extension cord (70cm)

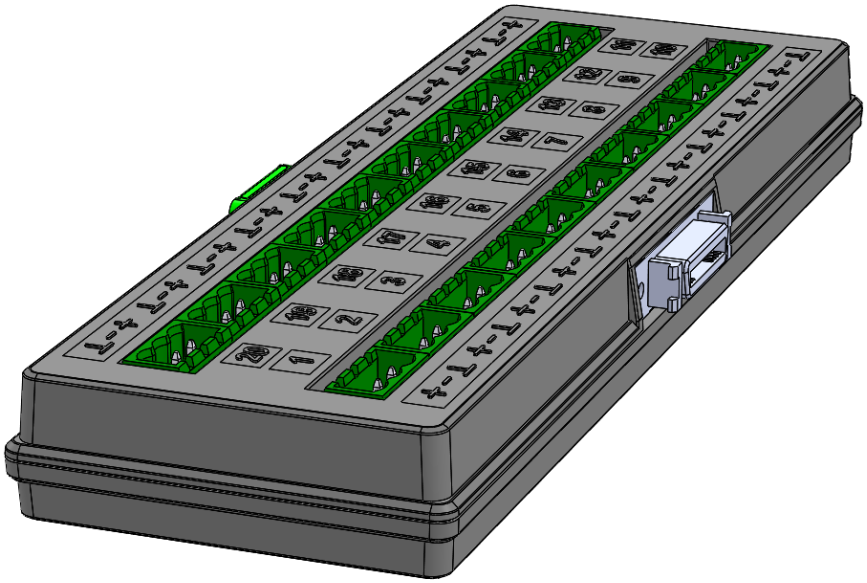


Figure 1.5: Terminal Block

7. Ground connection
8. 24 point connector for an access to the external module.

1.3 Extension Module

Signals are connected to the unit via terminal blocks, see Figure 1.5. These blocks accomodate 20 connections each, and may be chanined together to provide more channels.

Figure 1.6: 5.08 mm 3 contact step connectors

1.4 Recording Period

Acquisition sample rate is configureable. The sample period is set to one of the following settings: 1, 2, 5, 10, 20, 50 and 100ms. When 3-wire thermocouple measurements (PT100 and PT1000) are made, the time periods are doubled. The doubled time periods are highlighted in the channel setup dialog with a "(x2)" beside the period. Also, by using a configurable low-pass filter per channel, measurements can be made filtering out higher frequency components.

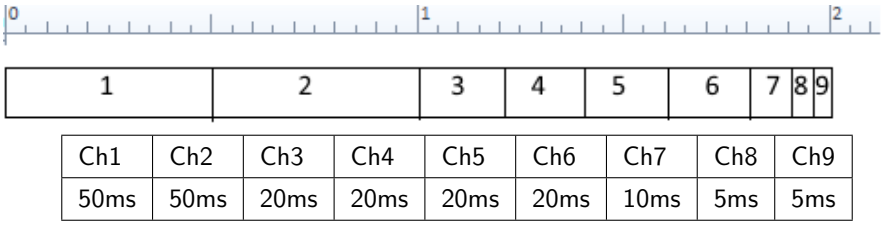
Measurements are taken in sequence. The sample period of each channel is cumulative.

Example: Main noise at 50Hz or engine noise at 1kHz.

For white noise or noise with lower frequency (lower than recording frequency) you can choose a software filter.

Example: Recording 9 Channels

The total time for an acquisition is 200ms, so the minimum period of recording is 200ms.



Ch1	Ch2	Ch3	Ch4	Ch5	Ch6	Ch7	Ch8	Ch9
50ms	50ms	20ms	20ms	20ms	20ms	10ms	5ms	5ms

Figure 1.7: Recording 9 Channels, timing

Chapter 2

Setup

2.1 Switching On

Prior to switching on the unit, connect the extension modules. If there are no modules connected or detected, the unit displays "Error:Ti" in the lower righthand corner of the startup screen.

Turn on the recorder by pressing the button at the top of the appliance. When the appliance is on, the ON/OFF button is lit in blue. The recorder displays a startup screen showing among other things, the hardware version. It then switches automatically to the oscilloscope "F(t)" mode. This display is accessible from the "Home" menu, Figure 2.1, by pressing the "F(t)" key.

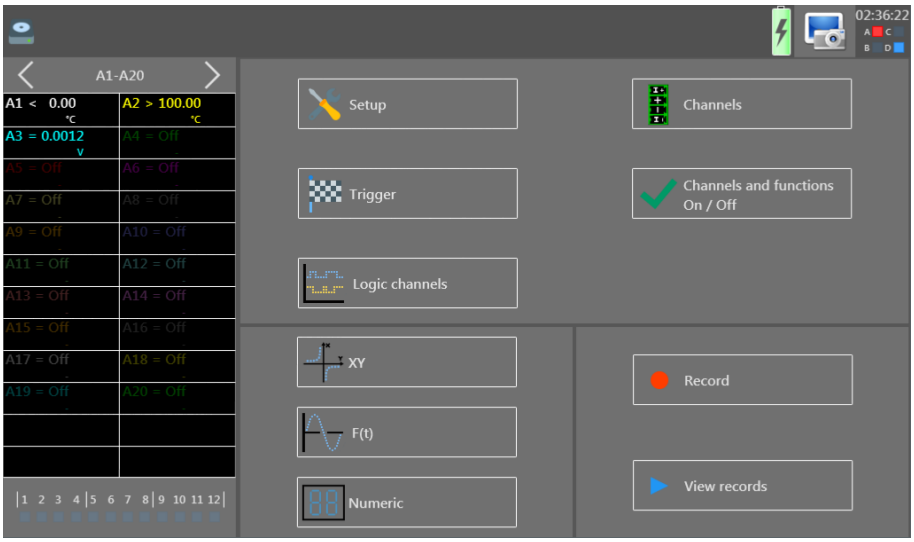


Figure 2.1: Home Screen

On powerup, the unit recalls the last settings and configuration used.

2.1.1 Switching Off

To switch off the recorder, press the ON/OFF key. A dialog appears prompting the user to confirm the power off. Select the Green check mark to proceed. The dialog dissapears if either the red "X" is pressed or the 10s countdown expired. The setup will be saved, the current file will be closed and the appliance will be turned off.

If the appliance does not switched off correctly, then press the ON /OFF button for 5 seconds. The setup will not be saved.

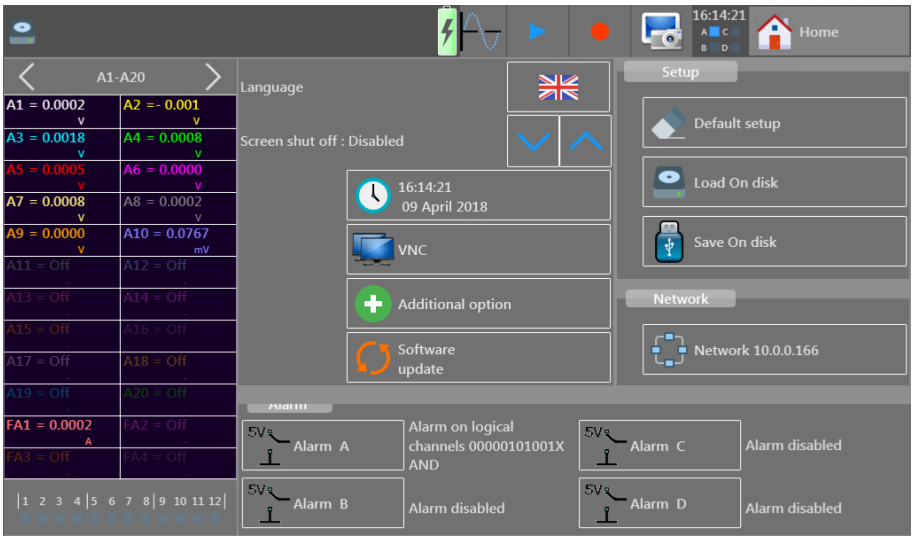


Figure 2.2: Setup Screen

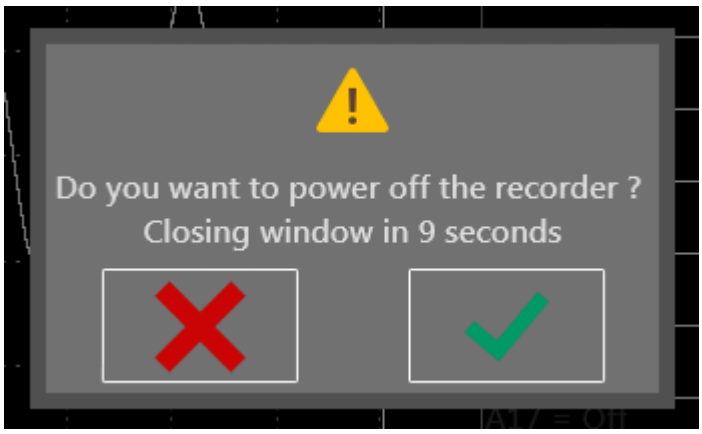


Figure 2.3: On Off dialog

If the unit stops without pressing the ON/OFF button (abrupt stop of the power supply), the current setup will not be saved. The unit setup at next start will be the last one saved.

2.1.2 In Case of Error

- If the unit still starts normally: reinitialize to the default settings. From the main menu open the "Setup" menu, then click on the "Default setup " key. See Figure 2.2.
- Alternatively, a reset to original defaults is possible.
  - With the power off, press the power button to turn the unit on.
  - While the unit is starting, quickly and repeatedly press power button until the display shows the white startup screen. A setup_error.cnf file will be created in the base folder of the internal SD.
  - The unit resets to defaults and reverts to French.
  - To change the language back to English, press "Menu Principal", then "Configuration", then press the French flag and select the British flag for English.

Note: If errors persist, please contact B&K for further assistance.

2.2 Extension Modules

Up to 10 extension modules may be connected at a time.

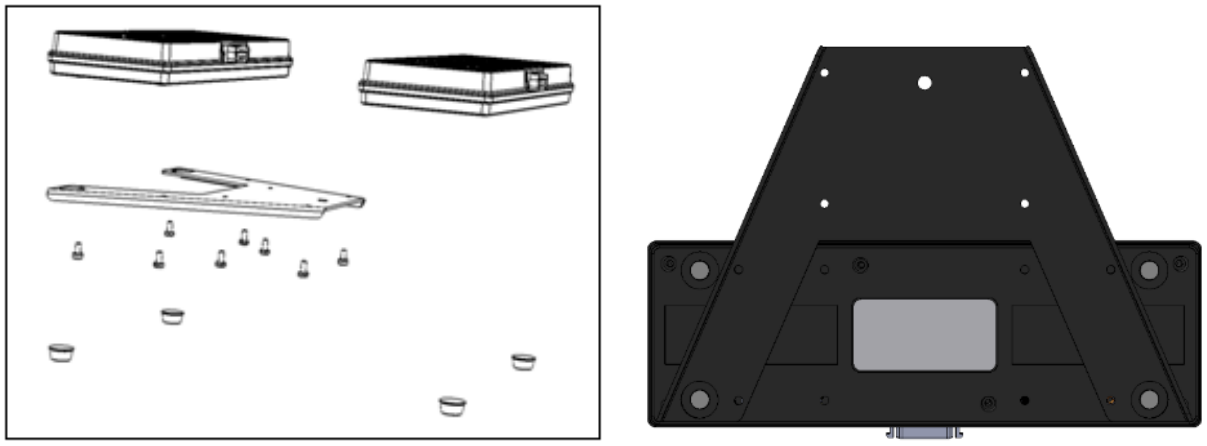


Figure 2.4: Extension Module

To assemble multiple terminal block modules:

- Screw the electrical connectors' plate to each additional extension
- Assemble the extension modules together
- Screw the plates with the adjacent modules
- Stick the additional adhesive buttress
- Connect the cable using unlocking levers
- Connect the cable on the DAS240 (must be powered off first)
- Switch on the unit.

Note: The unit is delivered with a 70cm cable.

2.3 Making Measurement Connections

Using the terminal blocks provided with the unit. Figure 2.6.

(Phoenix Contacts: SMSTB 2,5/3-ST5,08 - 1826296)

2.3.1 Voltage Measurement

Voltage measurement is performed between the + and - terminals of the relevant input. The "GND" terminal is not used.

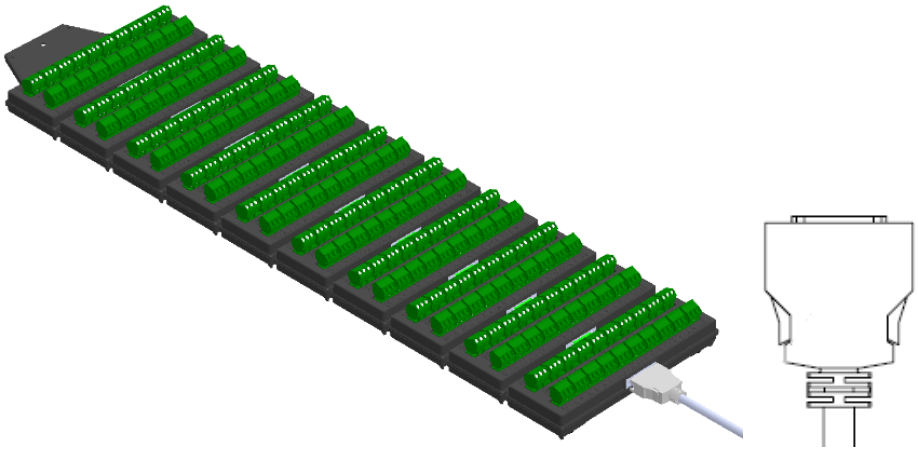


Figure 2.5: Extension Module

Figure 2.6: Terminal Block

2.3.2 Temperature Measurement With a Thermocouple

The voltage resulting from thermocouple effect must be measured between the + and - terminals of the relevant input. The "GND" terminal is not used.

2.3.3 Temperature Measurement With Pt100/Pt1000

The Pt100/Pt1000 probe must be connected to the + and - terminals. The current is injected through the "GND" terminal. For a 4 wire Pt100/Pt1000, the mounting will be in 3 wires, the 4th wire will not be connected.

> **Note:** the "gnd" current injection is shared by all channels.

Figure 2.7 shows 2 ways to wire the temperature sensors. Using the 2-wire method, the "-" and "GND" terminals are connected together at the terminal block. In 3-wire, the ground is run to the point of measurement and connected there.

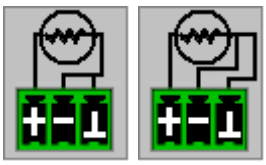


Figure 2.7: 2 and 3 wire measurement connections

2.3.4 Resistance Measurement

Connect the resistance source between the "+" and "-" terminals and connec the "-" and "GND" terminals together. A current is sourced into the "+" terminal. For greatest resolution and accuracy, configure the resistance range appropriately. For example, measuring a sensor with a range of 10-50 ohms is best done using the 100 Ohm range. The resistance ranges are 1kOhms and 10kOhms.

2.3.5 Current Measurement

The DAS240 includes the option to convert sensed voltage across a shunt or sense resistor into a current value. From the "Home" screen, open the "Channels" menu. The "Type" row shows the current function per channel. Press the square in the "channel" column and "Type" row to open the configuration dialog for the function type. See Figure 2.8. Select the "Current" menu option. The window will change to show a button listing the current shunt value. To change the value, press the button and a dialog for setting the shunt value opens. See Figure 2.9. Select the numeric value and units and press the green check mark to confirm the setting and return to the previous menu.

To wire the circuit for current measurement, connect the "+" and "-" terminals to the current shunt. Also, set the current range in the "Channels" window appropriately.

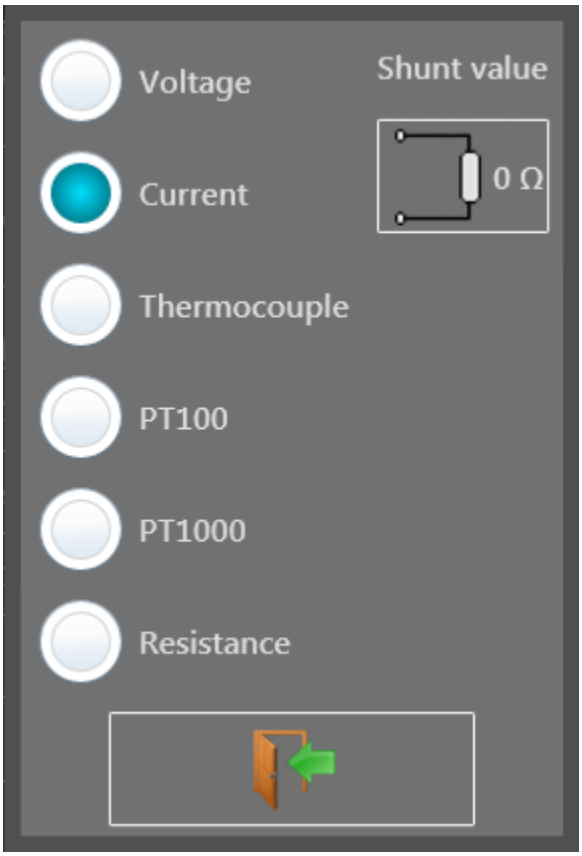


Figure 2.8: Channel Function Type

You will use either an external resistance or a shunt (ref 902406500: 50Ω).

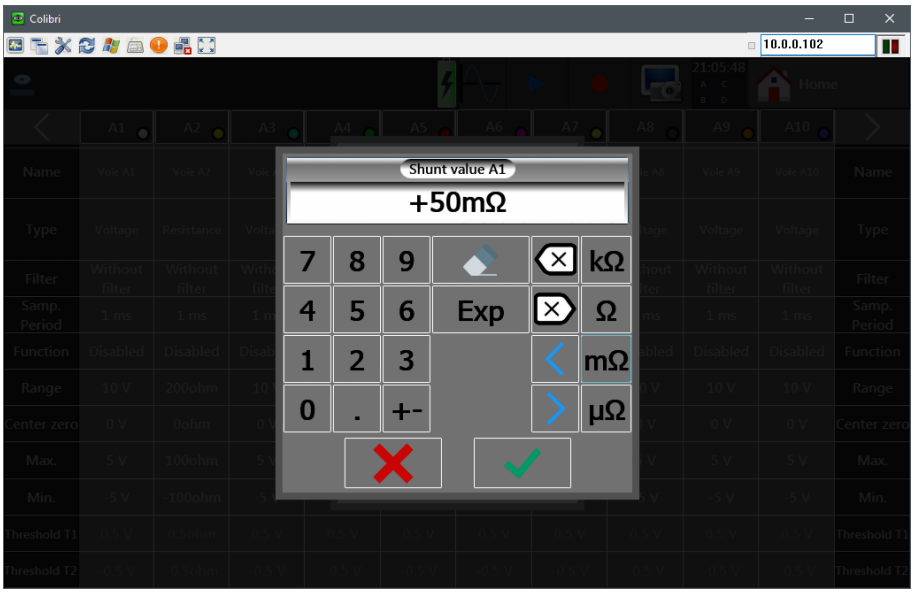


Figure 2.9: Current Shunt Value Setup

2.4 External Power

The DAS240 is powered and charged using a 15V DC, 5A power supply.

Warning: To minimize the risk of shock, the instrument chassis and cabinet must be connected to an electrical safety ground. This instrument is grounded through the ground conductor of the supplied, three-conductor AC line power cable. The power cable must be plugged into a three-conductor electrical outlet.

Warning: When the charger is connected to the unit, the chassis is connected to the power supply earth ground.

2.5 Battery

The unit s equipped with a lithium-ion battery. If the unit has remained unused for more than one month, check its charge status and recharge it if necessary.

> **Note:** Battery replacement and service is to be performed by B&K or Sefram staff. Contact your local service center for details. Only use batteries provided by B&K or SEFRAM.

For continued safe use:

- Never heat up or expose the battery pack to fire
- Never shunt parts of the battery: there is a risk of explosion!
- Do not puncture the battery.
- Do not dismantle the battery pack.
- Do not reverse the polarities of the battery.
- This battery pack includes protection that should not be damaged or removed.
- Do not store the pack in a place exposed to excessive heat.
- Do not damage the protective sheath of the pack.
- Do not store the in a vehicle exposed to the sun.

The battery should last at least 200 full charge-discharge cycles or 2 years.

To ensure long battery life:

- Do not store for a long time without use.
- Store the battery at around 40% charge.
- Do not fully charge or discharge the battery before storage.

When the battery is nearly discharged, the unit closes all open files, stops the software, and will shut itself off.

2.5.1 To Charge the Battery

- Connect the provided external power supply on the jack plug of the unit.
- Connect AC power to the power supply.
- The green LED will light when the battery is charging and extinguish when charging is complete.
- Charging can be done with the unit turned on or off.

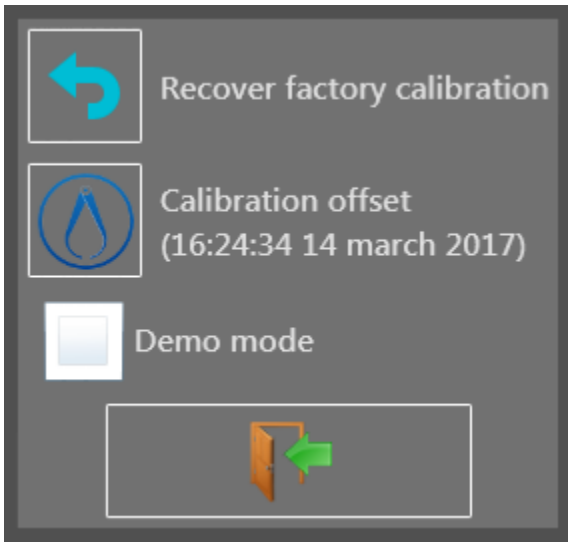


Figure 2.10: Offset Calibration Screen

2.6 Calibration

You can easily calibrate the recorder inputs for the voltage and thermocouple offsets. This will remove any offset present on different channels.

To do so:

1. Let the unit work for 20 minutes (ambient temperature 68-77F (20-25C))
2. Enter the recorder main page and then press the "Setup" key
3. Select the "Additional Option" menu
4. Select the "Electric Calibration" menu
5. Press the "Calibration offset" to start calibration. This takes approximatly 5 minutes
6. Restart the unit

2.6.1 Factory Default Calibration

You can restore the default factory calibration to correct any possible mistake in the calibration coefficients. This restores calibration values configured at the factory. This is performed as follows:

1. Let the unit work for 20 minutes (ambient temperature 68-77F (20-25C))
2. Enter the recorder main page and then press the "Setup" key
3. Select the "Additional Option" menu
4. Select the "Electric Calibration" menu
5. Press the "Recover factory calibration"
6. Restart the unit.

2.7 Keypad Lock

You can also lock the recorder completely, no key will be accessible.

- Press the “Setup” key
- Press the “Additional Option” key
- Press the “Locking the recorder” key
- Press the green check mark to confirm and lock the unit.

The keypad lock will occur 10 seconds after confirmation.

All the keys of the unit will be locked.

A yellow padlock appears in the upper right corner of the display when locked. To unlock the recorder press the lock icon in the upper right corner repeatedly.

Chapter 3

System Setup

General configuration of the appliance, monitoring of the alarm outputs, network address TCP/IP, calibration of the channels, update of the internal software.

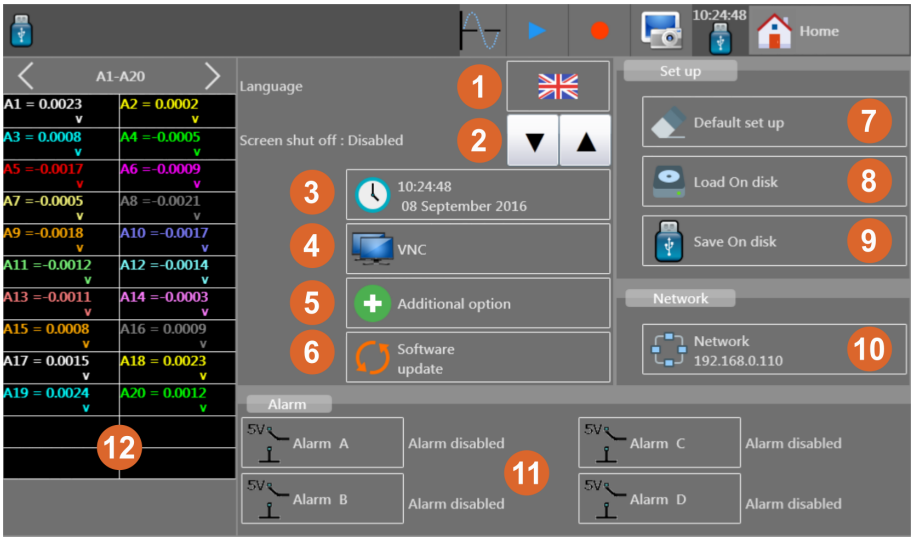


Figure 3.1: Setup Menu

1. Language
2. Screen dimming time
3. Date and time setup
4. VNC setup
5. Additional settings (Beep, Screen Brightness, Lock, Calibration, Startup screen, and Modbus)
6. Update
7. Load default settings
8. Load configuration from disk
9. Save configuration to disk
10. Network status and setup
11. Alarms
12. Channels

3.0.1 Language

The system language may be set to one of 6, French, Spanish, English, Italian, German, and Sweedish. Open the language dialog by pressing the flag icon on the setup screen (Home>Setup). Then select the desired language from the flag icons, Figure 3.2.

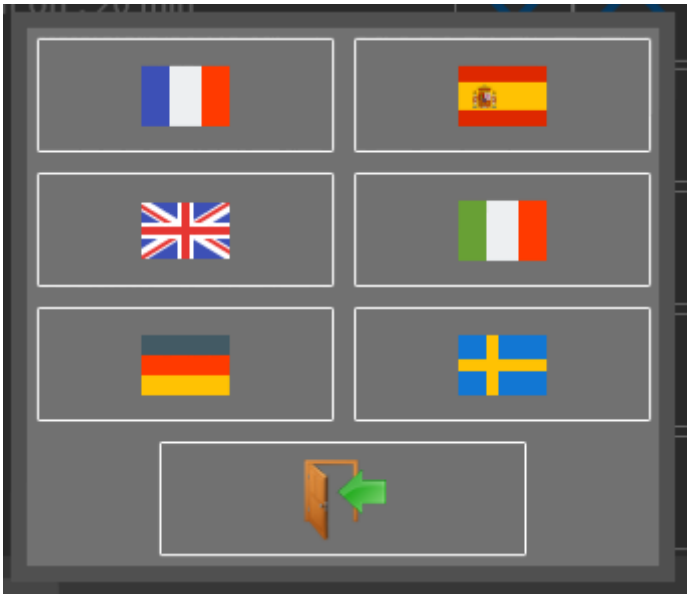


Figure 3.2: System languages

3.0.2 Screen shut off (dimming)

The amount of time the screen backlight stays at full brightness may be set from 1-30 mins or kept on (disabled). Use the arrow keys to change the screen shut off timeout.

3.0.3 VNC

VNC (Virtual Network Computing) allows the user to mirror the front panel using a viewer on a networked computer. This button is for setting the password. See Section 13.2 for more details.

3.0.4 Additional options

Setting the screen brightness, locking the touchscreen, calibrating the machine, setting the startup screen image and settings for the Modbus server are available in this menu. See Section 2.6 for calibration information, and see Section 2.7 for screen lock information.

3.0.5 Software update

See Chapter 14 for details about updating the internal software.

3.0.6 Instrument Configuration loading and saving

Settings like the F(t) time/division and channels to display may be saved and recalled by the instrument. Also, a default set of settings may also be loaded. This is all done with the 3 buttons in the “Setup” box of the setup display window (home>setup).

Figure 3.3: Network configuration dialog

3.0.7 Network

The current IP addresses of the network is shown within the network button. If there is no network connection, 0.0.0.0 is shown. If more than one network connection is made (wired/wireless), both addresses are shown.

Pressing the button opens the network configuration dialog. Available options are shown in this window depending on the hardware connected (wifi adapter). Set the networking settings necessary here, such as whether to use DHCP, or the specific ethernet settings necessary (IP Address, Mask and Gateway). If using WiFi (experimental), currently only an open wireless network is working reliably.

3.0.8 Alarms

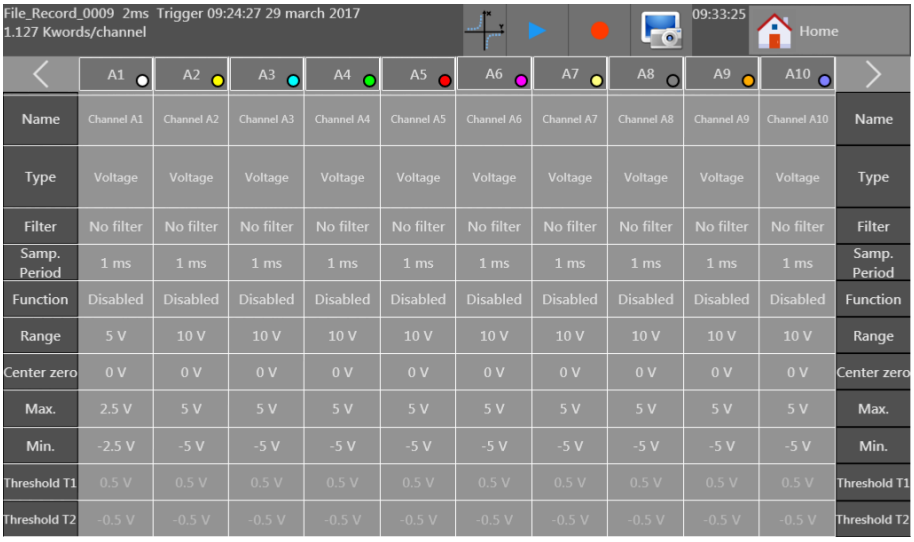
See Chapter 10 for details.

Chapter 4

Channel Setup

4.1 All Channels Screen

Access the channel setup menu from the Home screen and press the "Channels" button. The screen shown in Figure 4.1 appears.



	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	
Name	Channel A1	Channel A2	Channel A3	Channel A4	Channel A5	Channel A6	Channel A7	Channel A8	Channel A9	Channel A10	Name
Type	Voltage	Voltage	Voltage	Voltage	Voltage	Voltage	Voltage	Voltage	Voltage	Voltage	Type
Filter	No filter	No filter	No filter	No filter	No filter	No filter	No filter	No filter	No filter	No filter	Filter
Samp. Period	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms	Samp. Period
Function	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Disabled	Function
Range	5 V	10 V	10 V	10 V	10 V	10 V	10 V	10 V	10 V	10 V	Range
Center zero	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	0 V	Center zero
Max.	2.5 V	5 V	5 V	5 V	5 V	5 V	5 V	5 V	5 V	5 V	Max.
Min.	-2.5 V	-5 V	-5 V	-5 V	-5 V	-5 V	-5 V	-5 V	-5 V	-5 V	Min.
Threshold T1	0.5 V	0.5 V	0.5 V	0.5 V	0.5 V	0.5 V	0.5 V	0.5 V	0.5 V	0.5 V	Threshold T1
Threshold T2	-0.5 V	-0.5 V	-0.5 V	-0.5 V	-0.5 V	-0.5 V	-0.5 V	-0.5 V	-0.5 V	-0.5 V	Threshold T2

Figure 4.1: Channels Menu

The channel configuration screen provides quick access to individual channel settings. Each column lists a set of values for each channel. The parameter available is listed in the left and right most columns. Pressing the box corresponding to the channel and parameter opens a dialog box with options for configuring that parameter. The contents of the dialog change depending on the selected parameter value. For example, when the channel type parameter is opened, selecting the Thermocouple value modifies the box to give further options for thermocouples (type, temperature units, etc...). Back on the main channel table, the value in the box shows a summary version of the parameter's configured value.

In the upper right and left corners of the table are navigation arrows for showing more sets of channels. 10 channels may be shown on screen at a time.

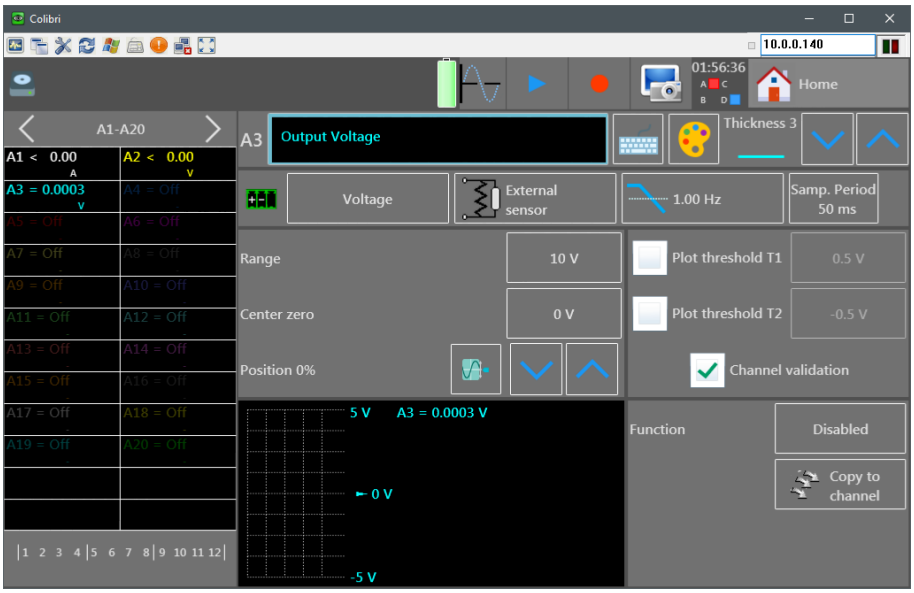


Figure 4.2: Channel Configuration Screen

4.1.1 Individual Channel Screen

The complete set of parameters, values and options are also viewable for a single channel on a single screen. To open this screen, press the box displaying the Channel ID (A1 for example). This opens a window for setting a greater number of values than available from the channels table. The plot color and thickness are available here for example. See Figure 4.2.

Chapter 5

XY Plot

The XY mode is accessible via the main menu by pressing the **XY** key. In this mode, one of the channel drives the horizontal axis, and the other channels give points on the vertical axis. For example, if the channel driving the horizontal axis is 1V and the channel for the vertical axis is at 95F, the recorder plots a point at (1,95).

A custom background/grid may also be shown on the display. From the "Screen Setup" menu accessed by pressing the button on the XY plot screen, select the "custom grid" check-box, select the folder containing the bitmap to be used (middle button), and select the bitmap using the right most button on the line.

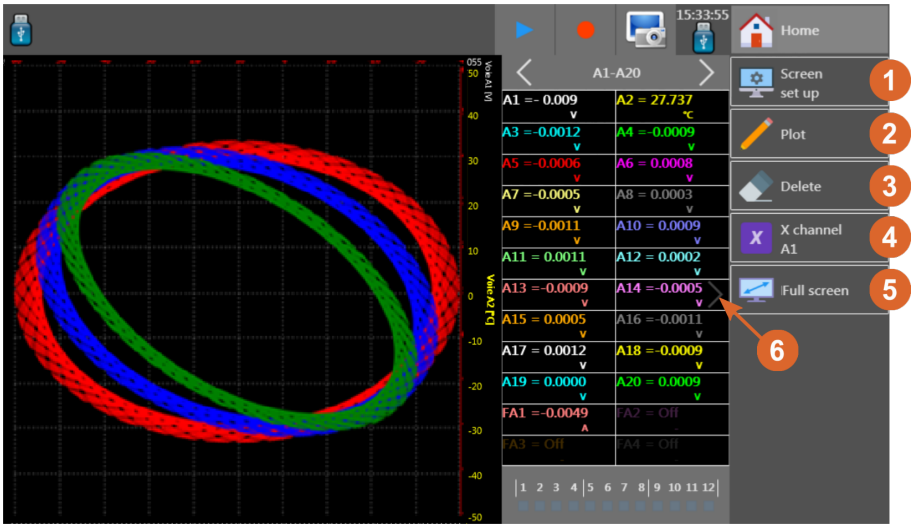


Figure 5.1: XY Display Screen

1. Screen configuration: Setting the measurement display on screen
2. Traced: allows to start or stop the outline
3. Delete: allows to delete the screen
4. X channel: Choice of the channel on the horizontal axis
5. Full screen: Allows to view on the full screen, press on the reticule to come back to the normal mode
6. Arrow: key shows or hides the numerical window

Options available from the screen setup dialog:

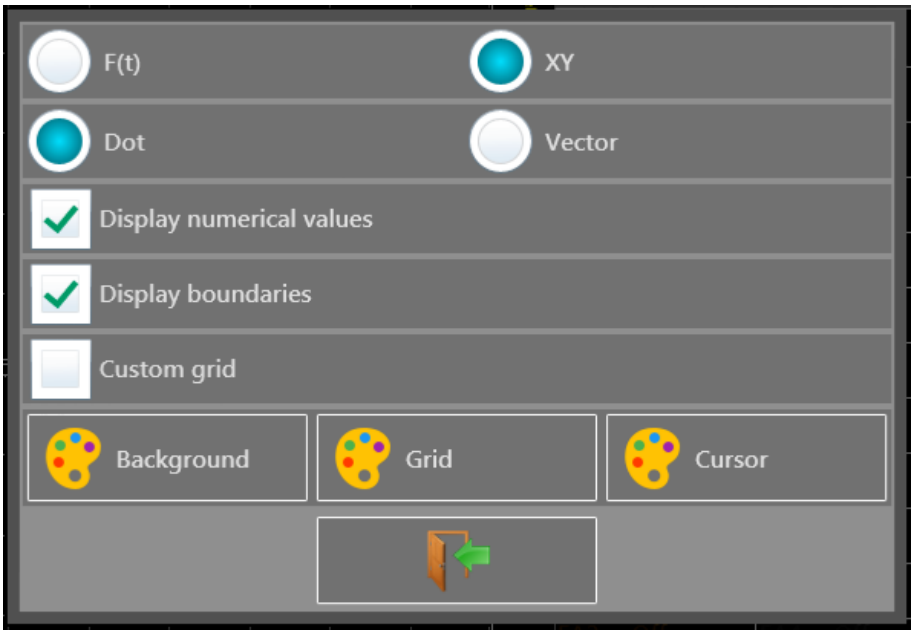
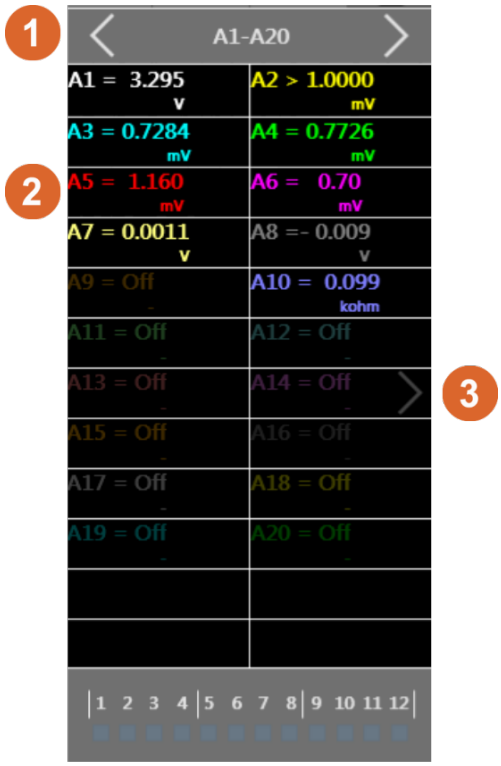


Figure 5.2: XY Screen Setup Dialog

- Plot type - F(t) or XY
- Point display - Dots or vectors
- Display Numerical Values - show the numerical panel showing values in a table
- Display Boundaries - show or hide the axes
- Custom Grid - configure the grid and possible background image
- Colors - set the color of the Background, grid and cursor using a color picker

Along with the XY plot, a numeric representation of the current signal values is show.



1. The < or > keys : allow to choose the group to view
2. By pressing a specific channel :
   - The graph terminals are bound to this channel.
   - In real time acquisition, the instant value will show up.
   - By visualizing the cursors; then the difference value between cursors as well as T1 and T2 values corresponding to cursors T1 and T20 will be displayed.
3. Right to hide this window, when hidden, the icon points left.

Figure 5.3: Numerical window

Chapter 6

F(t) Plot

This mode displays the channel signals versus time, much like an oscilloscope. The time per division is called the "Timebase" on this unit. The display is normally in a scrolling mode displaying real time data. This changes somewhat when recording data. In that case, the display shows the full record and resises to accomodate all of the data taken. See Chapter 8 for more information about recording data.

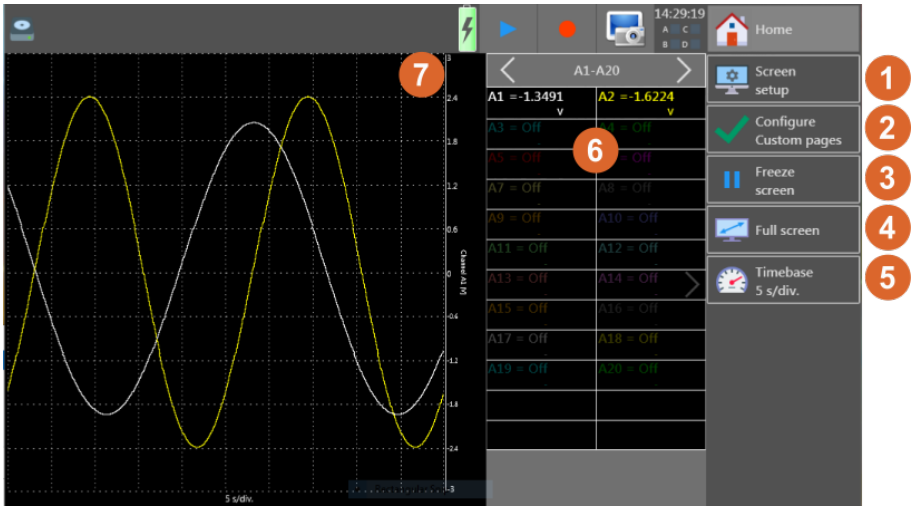


Figure 6.1: F(t) Screen

6.1 F(t) Menu keys

1. Screen Setup, Section 6.2.
2. Configure custom pages, Section 6.2.1
3. Freeze Screen, Section 6.3
4. Full Screen - change the view to full screen, touch the screen anywhere to exit.
5. Timebase, Section 6.4
6. Numerical display - display the current signal value and control which channel page is displayed.
7. F(t) plot

6.2 Screen Setup

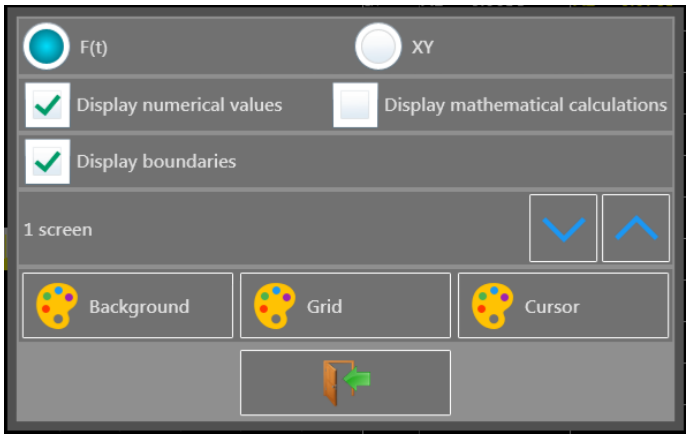


Figure 6.2: Screen Setup Dialog

From this dialog, the type of plot, numerical values, math, grid scales, number of plots, and colors are set here. The number of plots is available when in F(t) mode, and is limited to the number of signals measured. The maximum number is 10. When in XY mode, the number of plots is replaced by the option to enable a custom grid (background image). When a custom grid is enabled, the options of directory and file are added to the dialog as in Figure 6.3. Lastly, the choice of displaying points as dots or vectors is available for the XY display mode.

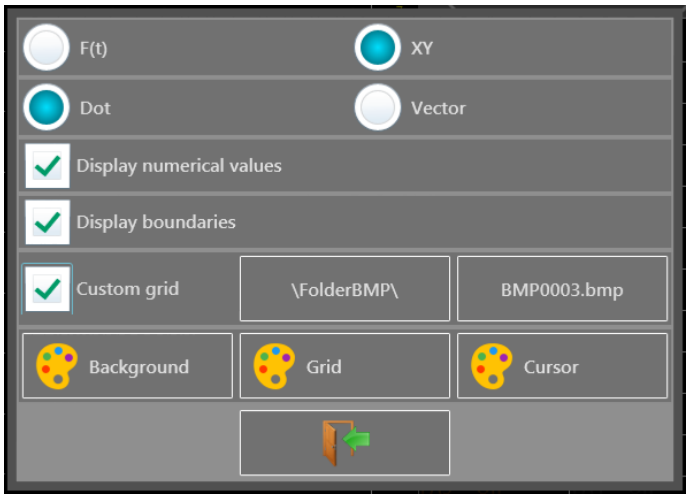
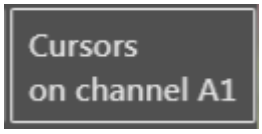


Figure 6.3: Screen Setup Dialog - XY mode

6.2.1 Custom Pages

Using this menu, a set of 20 channels per page can be shown. This allows selecting from different banks of channels. For example, this allows channels 1 and 101 to be shown on the screen. This is not possible on the normal display pages.

	Undo the last cursor action completed
	Opens a dialog box for setting the signal to measure with the cursors.
	Zoom the selected channel to fit within the current cursor settings.
	Set the vertical axis parameters for the selected channel. The range is the vertical span of the channel. The center value defines what value is the middle of the axis. The "Position" defines the vertical location of the horizontal axis (time) in percentage. The range is from -100 to 100 %. For example, -50 will place the horizontal axis at 2.5 divisions above the bottom of the display. All together, the range sets how many volts tall the vertical axis is, center sets the

6.3 Freeze Screen and Cursor Measurements

Freezes the graph at the screen to perform measurements through cursors, calculations, save or print the measurements at screen, in the F(t) mode.

When frozen, horizontal and vertical cursor icons are added to the right-hand panel. Selecting the vertical cursor icon enables time based cursors. Move the individual cursors by the touchscreen or other mouse interface to set the cursor positions. selecting the horizontal cursor icon changes the available buttons in the right hand panel, See Figure 6.4.

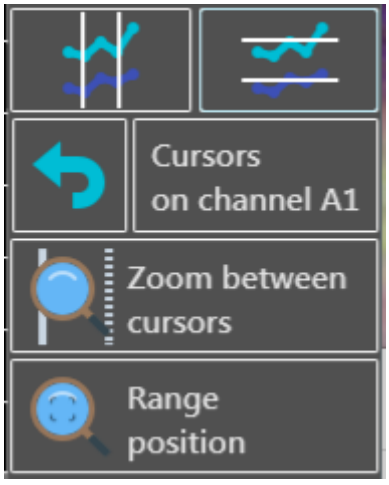


Figure 6.4: Horizontal cursor options

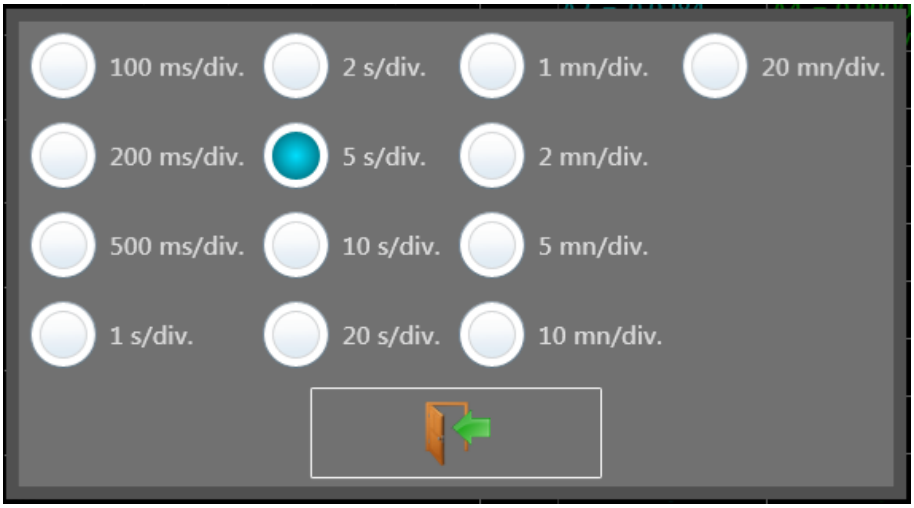
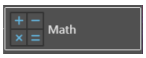


Figure 6.5: Time Base Setting (Time/Division)

6.4 Time base

The trace time scale may be set to a number of values. Pressing the Timebase button on the right of the F(t) plot screen brings up the dialog as shown in Figure 6.5.

6.5 Math

Math functions may be applied to multiple channels. To enable math functions, enable the check-box for "Math" in the "Screen Setup" window. When enabled, the 

icon is added to the right hand button panel. Pressing the button brings up the configuration dialog shown in Figure 6.6. Use the arrow buttons at the top to increase of decrease the number of math functions. Use the arrows at the bottom to change the channel on which the math is done, or press the channel named for each row to set the desired channel. See Figure 6.7 for the set of functions available.

The values calculated for each function configured are shown on the main plot screen, colored the same as the channel they do math on. See Table 6.1 for more details.

Calculated values are displayed in the plot window showing the following:

- channel number (with its color)
- function name
- value

Math function values may be moved around on the screen. To move the math values, click and drag them to a desired position on screen.

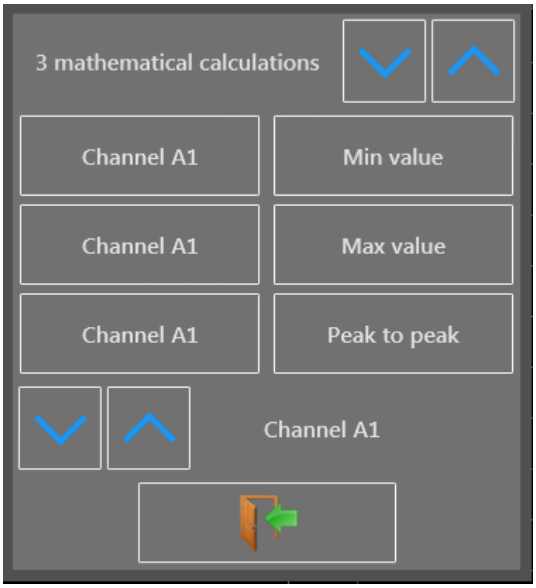
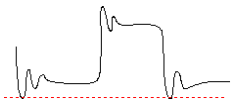
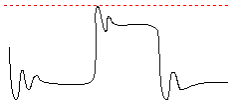
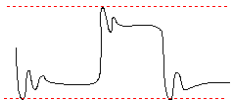
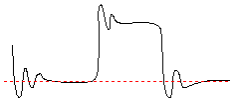
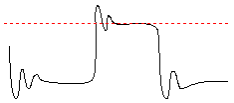
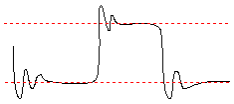
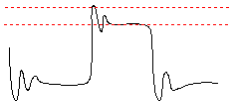
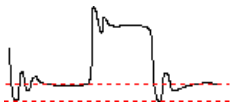
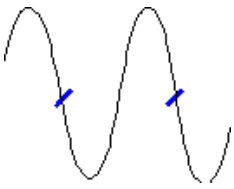
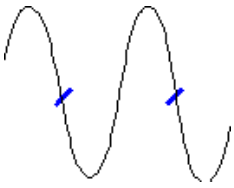
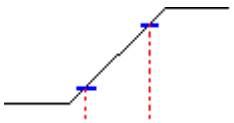
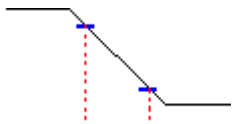


Figure 6.6: F(t) Channel math settings dialog

Figure 6.7: F(t) Channel math functions dialog

Drawing	Math function	Calculation	Notes
	Minimum		The lowest negative voltage bottom
	Maximum		The highest positive voltage peak

Drawing	Math function	Calculation	Notes
	Peak to Peak	Max-Min	
	Low		The most frequent value below the median
	High		The most frequent value above the median
	Amplitude	High - Low	
	On positive oscillation	$\frac{Max-High}{Amplitude} * 100$	
	On negative oscillation	$\frac{Low-Min}{Amplitude} * 100$	
	Frequency	$\frac{1}{Period}$	Average frequency
	Period	$\frac{\text{Duration of N complete periods}}{N}$	Average duration of a complete cycle calculated on as many periods as possible
	Rising edge	T1 = 10% Amplitude T2 = 90% Amplitude Trise = T2 - T1	
	Falling edge	T1 = 90% Amplitude T2 = 10% Amplitude Tfall = T2 - T1	

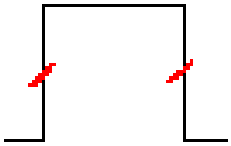
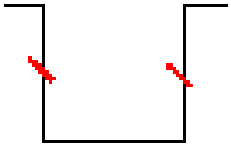
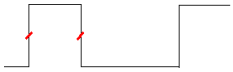
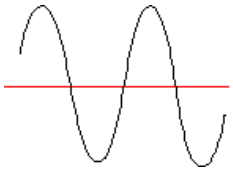
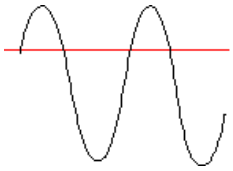
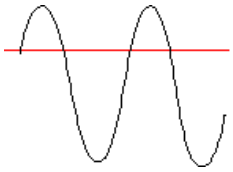
Drawing	Math function	Calculation	Notes
	Width of positive impulsion	Measurement of the time of 1st positive pulse. It is measured at 50% of amplitude	
	Width of negative impulsion	Measurement of the time of 1st negative pulse. It is measured at 50% of amplitude	
	Positive cyclic ratio	$\frac{\text{positive pulse duration}}{period}$	
	Negative cyclic ratio	$\frac{\text{negative pulse duration}}{period}$	
	Average	$\frac{1}{N}\sum_{i=1}^{N} V_i$ N : total number of dots	Calculation on the whole graphic range
	RMS	$\sqrt{\frac{1}{N}\sum_{i=1}^{N}(V_i)^2}$	Calculation on the whole graphic range
	Standard deviation	$\sqrt{\frac{1}{N}\sum_{i=1}^{N}(V_i-\overline{V})^2}$	Calculation on the whole graphic range

Table 6.1: Waveform math functions

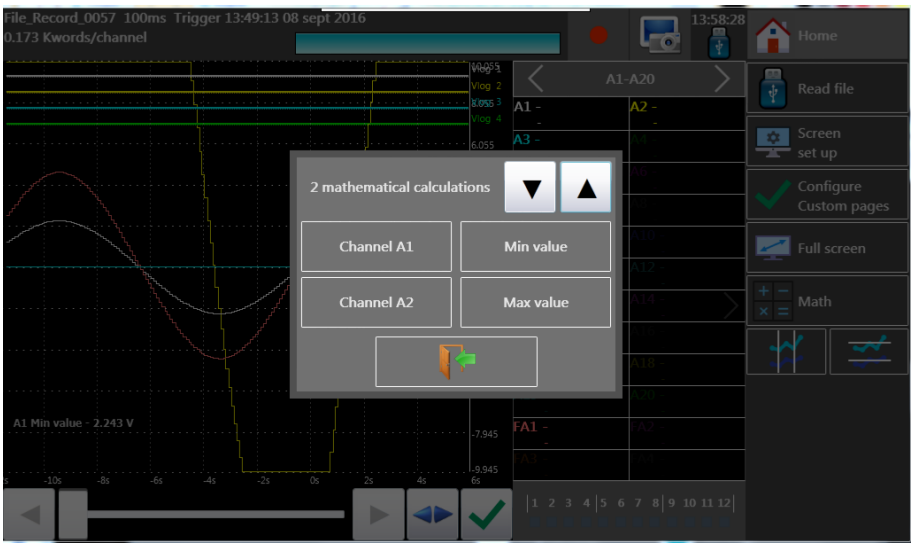


Figure 6.8: Math Menu

Chapter 7

Numeric Display

The numerical window allows to visualize in real time the values of each channel. See Figure 7.1. The number of channels shown per screen depends on the number of channels selected. Each display page is accessed by pressing the right and left arrows.

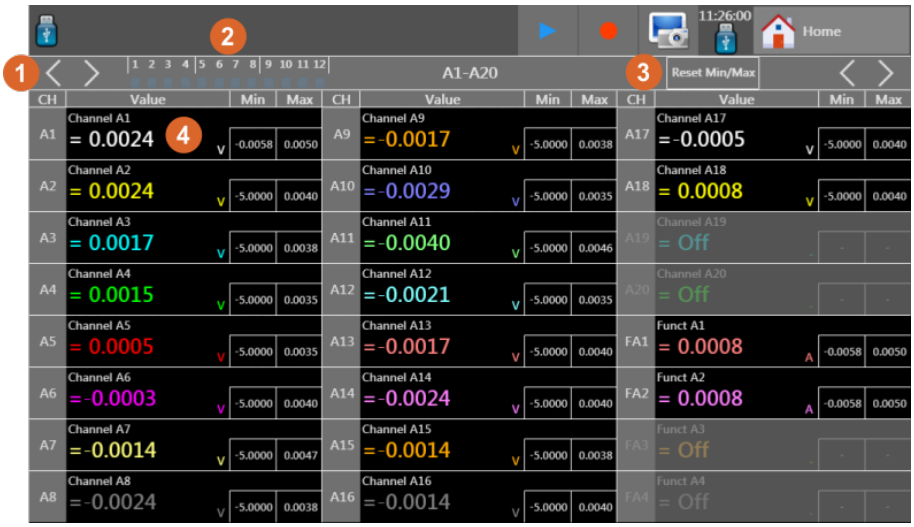


Figure 7.1: Numeric Display Screen

1. Cycle display screens (channels, custom sets, logic functions, etc...)
2. Digital channel state (shown when "Logic Channels" option is set in the "Channels and Functions" menu.
3. Reset minimum and maximum recorded values
4. Individual channels, click within each channel to open the configuration menu for that channel

Chapter 8

Recording

The DAS240 can save data to internal storage. The user can then retrieve the data and review it on the unit, save it to a USB drive, and retrieve it via the Ethernet interface or from USB drives.

To create recordings, press the "record" button on either the "setup" screen or from the top ribbon when in any of the 3 data display modes (F(t), XY, or Numeric) to start a recording. See Figure **??**. Recording starts when the trigger condition is met. If the trigger function is not running, stop is selected on the trigger setup page, then recording starts immediately.

8.1 Recording playback

View and analysis of stored recordings is accessed from the "View Records" button on the "Home" screen. See Section **??**.

- current sampling speed
- status of data acquisition (waiting for trigger, sampling rate xx%, ...)

Figure 8.1: Record Keys

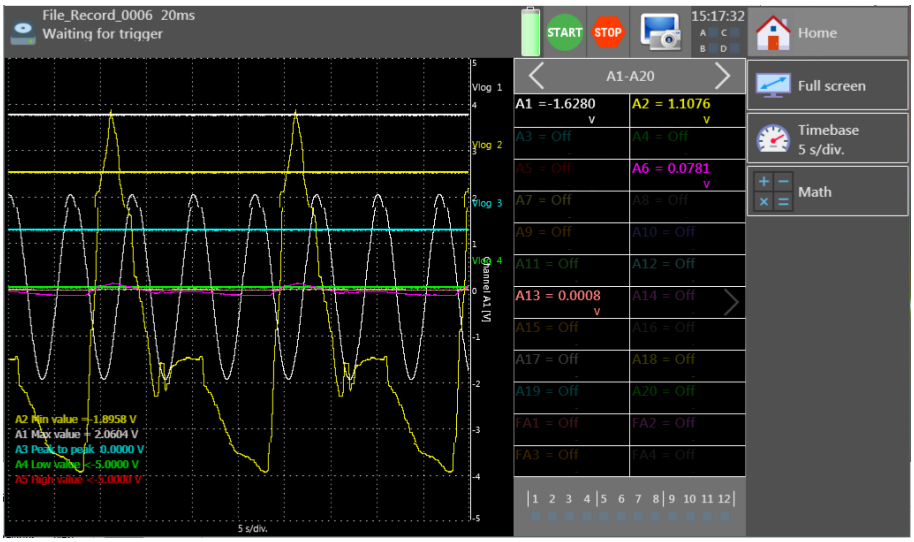


Figure 8.2: Record screen

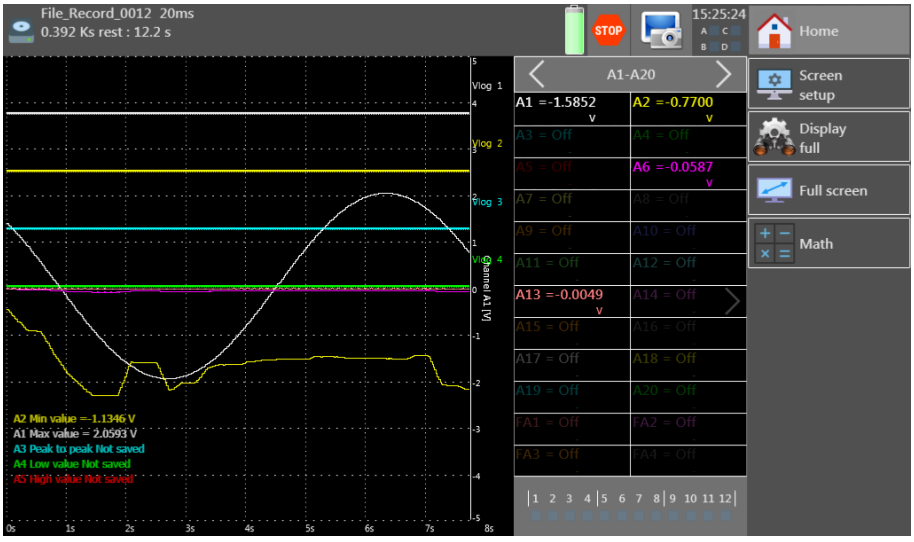


Figure 8.3: Recording started

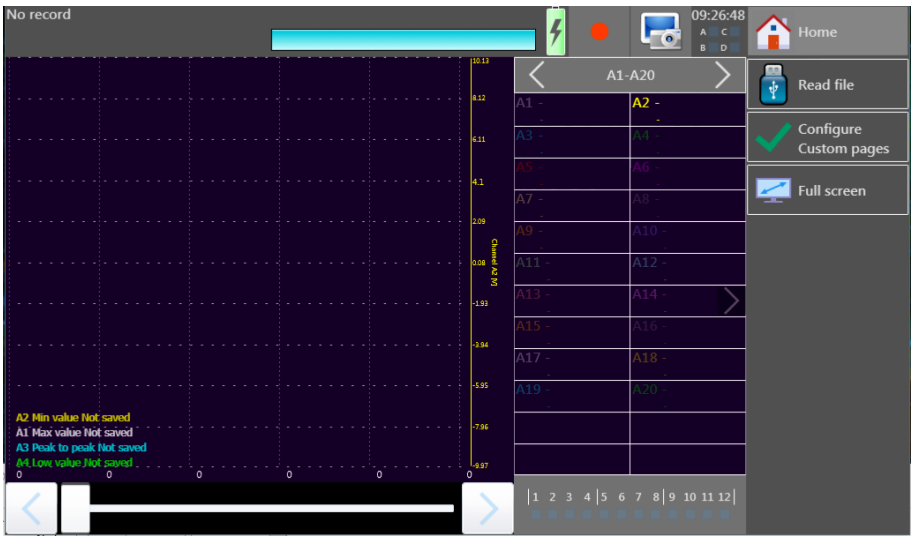


Figure 8.4: Recording playback

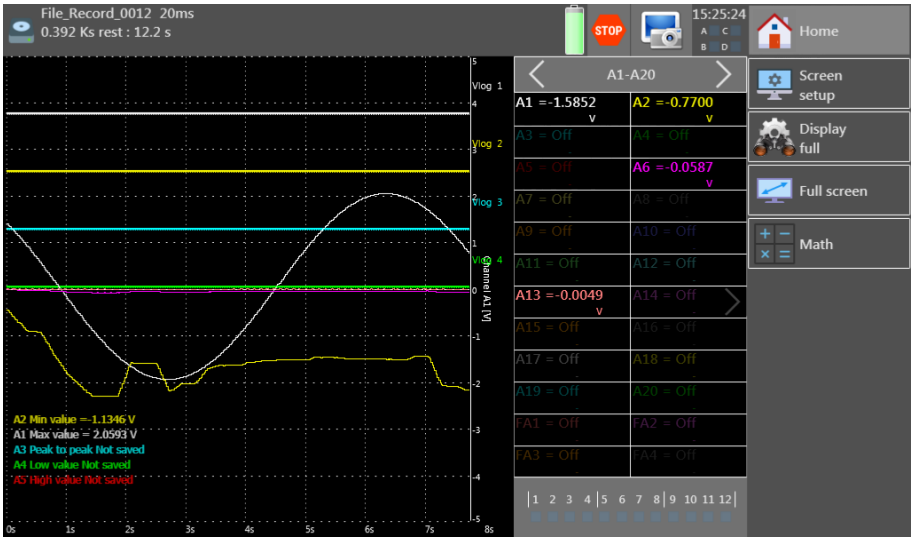


Figure 8.5: Load saved recording file dialog

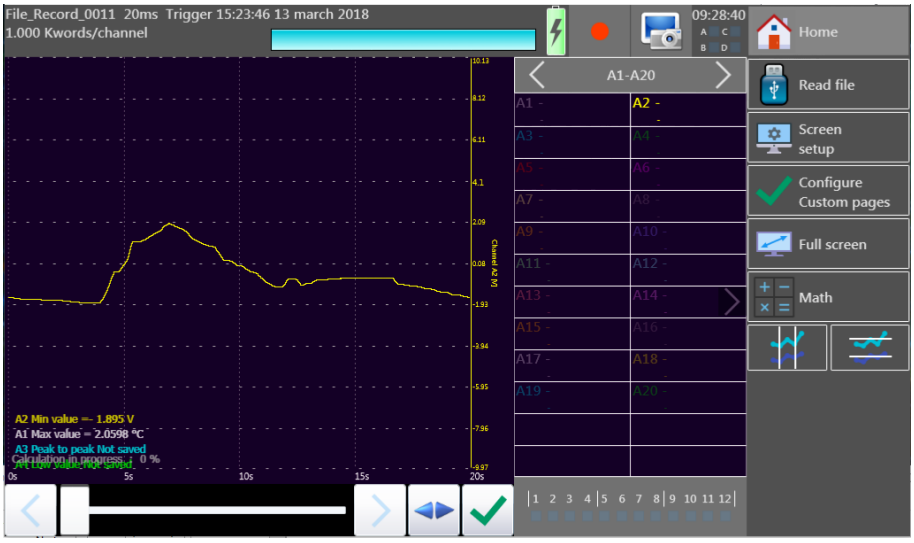
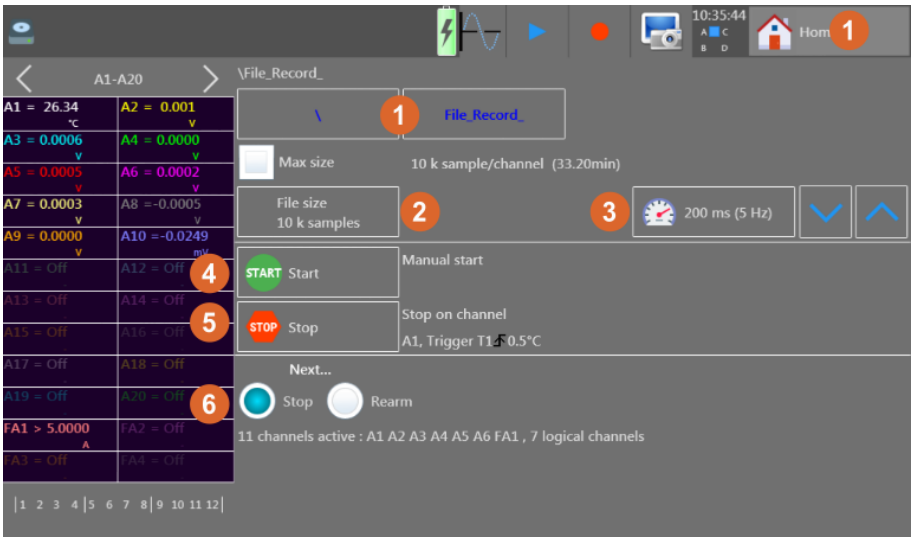


Figure 8.6: Saved recording loaded

Chapter 9

Triggering recordings



1. Record file path
2. Recording size
3. Reading storage rate (reading period)
4. Start condition
5. Stop condition
6. Trigger arm state

Figure 9.1: Trigger Menu

The start and stop functions control the conditions that initiate data recording to disk. Opening the "Start", or "Stop" trigger menus open the start condition dialogs with the following recording start options:

Manual pressing a key

Trigger based on Analog, or Digital signal conditions. See 9.3 for details.

Waiting after a delay or at a specified date and hour. See 9.1 for details.

Automatic occurs immediately, and automatically stops when the file is full

Pre-Trigger Quantity of samples to record preceeding the trigger

9.1 Waiting start condition

Starting a recording at a prescribed later time or date. Figure 9.2 shows the 2 dialogs for configuring each condition. Waiting on a delay, will wait for the prescribed time and proceed with a recording. Waiting for date delays recording until a specific time and date. For each, configure the time in hours, mins and seconds, and for the date, the day, month and year is also set.

Figure 9.2: Wait to start on time and date dialogs

9.2 Recordings

- Recording setup:
  - Selection the folder
  - Selection the file name (beginning of the file name, the end is an incremented numerically)
  - Length of the file (maximum or selection of the number of samples per channel)
  - Measurement data prior to a trigger event may be included in the data recording. The amount of data is defined as the "Pre-trigger" samples. The amount of data is set and determines the amount of time before the trigger event to include in the recording.
- Speed:

  The maximum speed is determined by the number of channels for acquisition.
- Start: Start condition of the data acquisition
- Stop: Stop condition of the data acquisition
  - Automatic: when the file is full
  - Trigger: on a channel or a combination of analog or logic channels
- After acquisition: action after the end of the data acquisition (only available if the Start and Stop triggers are not set to Manual)

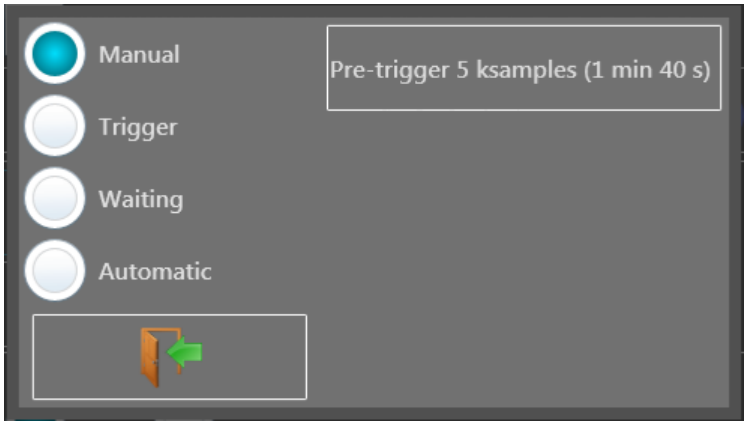


Figure 9.3: Start condition dialog

  - Stop: no action
  - Rearm: a new file is launched waiting for the Start trigger

- View of the active channels, of the recording time, of the pre-launch

Note: A message "Impossible" shows up when the saving possibilities are exceeded. Fix this by reducing the sampling speed or the number of channels.

Various conditions are available for starting and stopping acquisition recording. Analog signals, time delays, and logic inputs are trigger sources. Also, the amount of data prior to a trigger event is configurable. Access the trigger menu from the "Home" screen and the "Trigger" button. Figure 9.1 is representative of the trigger configuration window.

9.3 Triggering

Triggering is based either on a single channel edges and thresholds, combinations of analog channels, or set digital signal states.

9.3.1 Single analog channel trigger

To use a single analog channel as a trigger source, the general procedure is as follows:

1. Select trigger, and "Analog Channel" from the trigger dialog.
2. Set the amount of Pre-trigger samples to record.
3. Choose the trigger source channel.
4. Select the trigger condition (Threshold, level (higher/lower), or edge)
5. Set the trigger analog signal level.

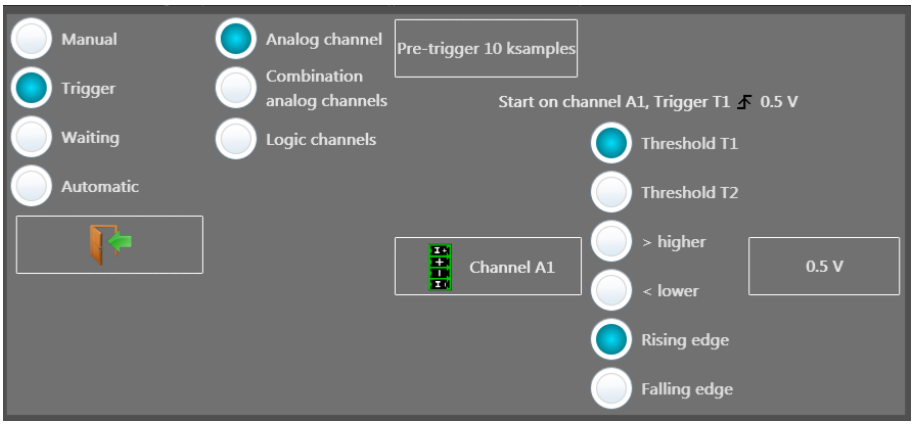


Figure 9.4: Trigger Threshold Setup

9.3.2 Single threshold

Channel: selection of the channel, on which the trigger threshold is applied

Threshold 1 / Threshold 2: selection of the threshold to settle; each channel is tested with reference with 2 thresholds, i.e. you can program a start condition on the channel A1 and the threshold 1, and a stop condition on this same channel A1 and the threshold 2

Higher / Lower: trigger when the channel value is more or less than the set threshold

Threshold value: threshold value selected in real value (taking the current unit and scale of the configuration of the selected channel into account)

Edge: Selection of the active edge of the channel in reference to the threshold

Pre-triggering (only for start): gives the acquisition time before the trigger appears.

9.3.3 Multiple thresholds

After selection of a trigger on a set of logic channels, the window allows you to set the trigger under several conditions. Then, by pressing the various thresholds in front of their respective channels, you open the threshold parameter window.

- One of the thresholds, or the first achieved condition activates the trigger
- All thresholds, and all conditions must be simultaneously achieved to validate the trigger
- A table makes it possible to select all channels and the validity of the channels

Selecting the channel allows the selection of the thresholds:

- S1 and S2
- Value of the thresholds
- Rising / Falling edge, or

Low / High value

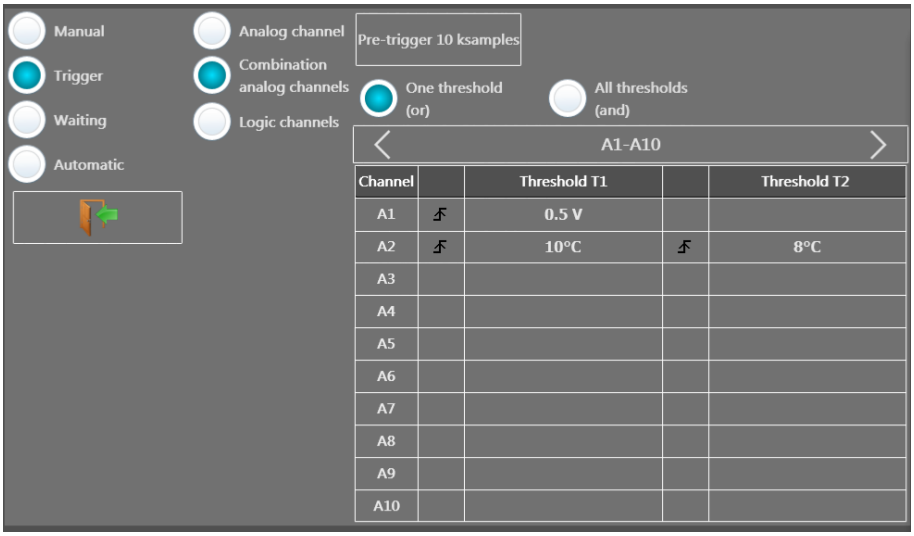


Figure 9.5: Multiple Threshold Trigger Screen

Trigger examples:

- Edge trigger: you need a change of status
  Example: Channel A1, rising edge, threshold = 0V: triggers only if the signal status changes from negative to positive
- Level trigger: no need to pass the threshold
  Example: Channel A1, high level, threshold = 0V: triggers only if the signal is positive
- Alarms only have level triggers

9.4 Trigger on Logic Channels

Selecting "Logic Channels" as the trigger source changes the window to show conditions for logic channel triggering. Each of the logic channels is configured as a 1, 0 or X (don't care). Use the arrow keys to move through the logic input bits. Triggering may be configured as either an AND condition or an OR condition. This is applied to each channel. Lastly, the trigger event is generated on either a Level or Edge condition.

Logic 1 Greater than 4.0 Volts

Logic 0 Less than 1.6 Volts

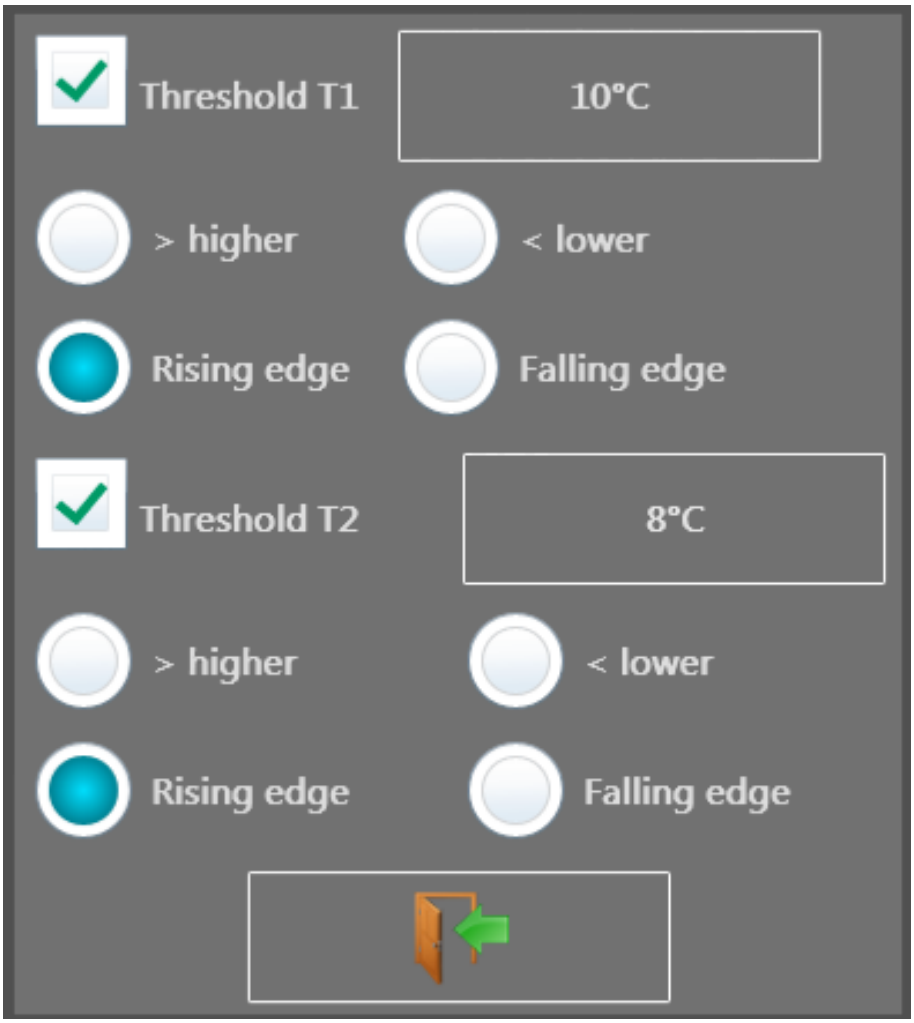


Figure 9.6: Trigger type setup screen

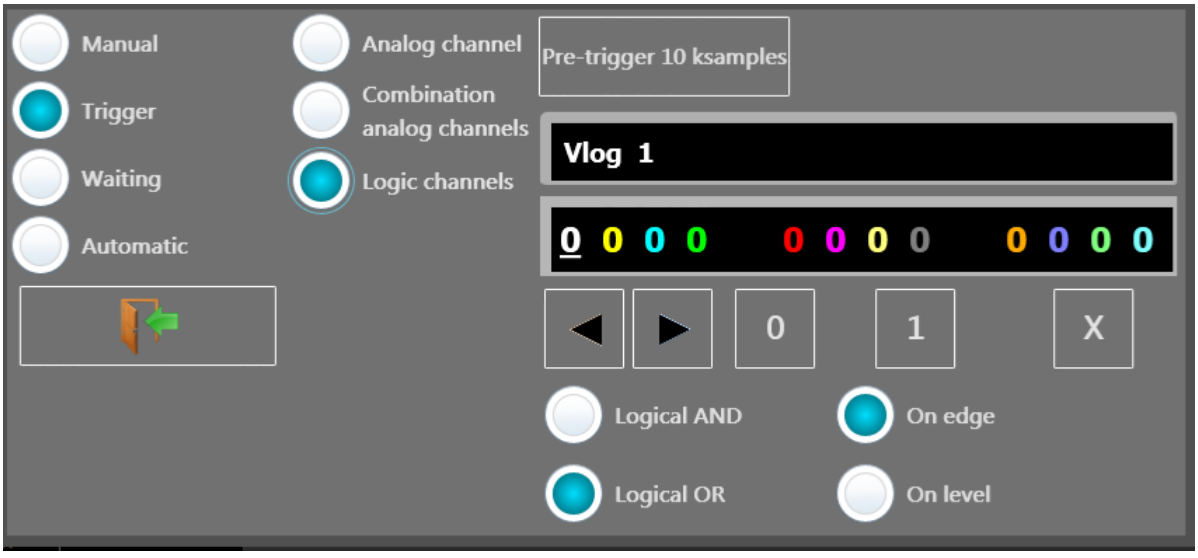


Figure 9.7: Logic Trigger Setup Screen

Chapter 10

Alarms

4 configurable alarm signals allow signaling from the recorder through the digital port. The alarm signals are high (5V) when the alarm condition is detected. The main display's alarm status section indicates the status of the alarms. The main display alarm status is "sticky" in that when alarm triggers, the field is set to active (red). See Figure 10.3. The condition may clear, and the alarm status will continue to show an alarm happened. The digital port clears the alarm when the programmed condition is not met any longer and returns to 0V.

To configure the alarms, open the "setup" menu from the "home" screen. See Figure 10.1. At the bottom of the screen are the 4 alarms. Each button opens the configuration dialog for that alarm. See Figure 10.2

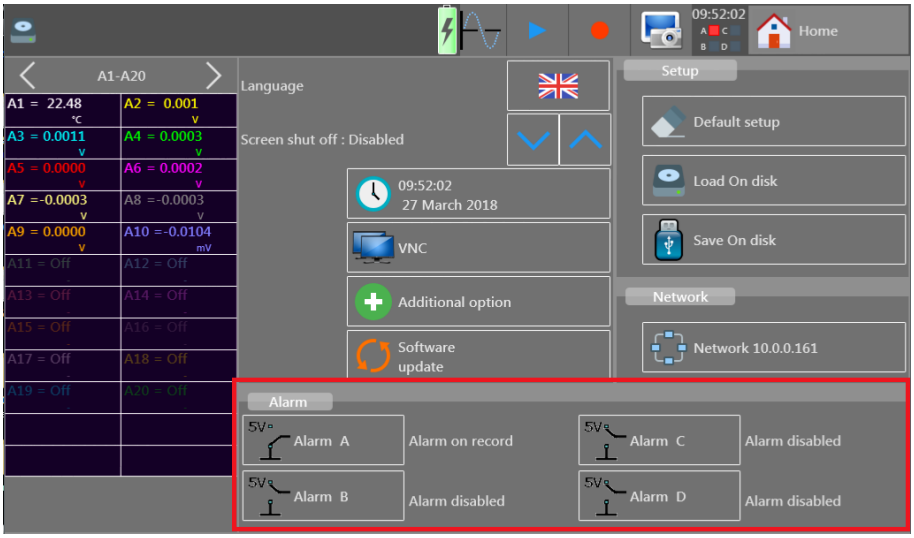


Figure 10.1: Alarms on Setup screen

10.1 Alarm status

The status of all 4 alarms is always visible in the top ribbon, each with its own small square. The status of each alarm is indicated 3 colors:

Transparent alarm disabled

Blue alarm enabled, not triggered

Red alarm enabled and triggered

Figure 10.2: Alarm dialog

Figure 10.3: Alarm Status

To clear an alarm, press the on screen box containing the alarm statuses.

10.2 Analog/Math/Timing signal alarm

An alarm based on analog signal levels, a math function, or a "logical function" is set by selecting the "trigger" function on the Alarm dialog (Figure 10.2). Signals available for Alarms must be active signals configured in the "Channels" menus on the "Home" screen.

When selected, the dialog changes contents to show something similar to Figure 10.4.

Select the desired signal by pressing the button listing a channel at the center of the dialog box. Depending on the signal type, 1 thresholds may be set. The selected threshold is show at the top of the dialog. To set the trigger as a window, the "channels combination" configuration must be used. See Section 10.3.

10.3 Analog signal combination alarm

More complex triggering based on windows, and combinations of signals is available. The signals are limited to the analog channels and do not include math and timing as in the single channel alarm. The signals may have 2 thresholds.

The set of signals configured will trigger the alarm if 1 threshold is true, or all thresholds are true. This is set by the AND/OR condition at the top of the dialog.

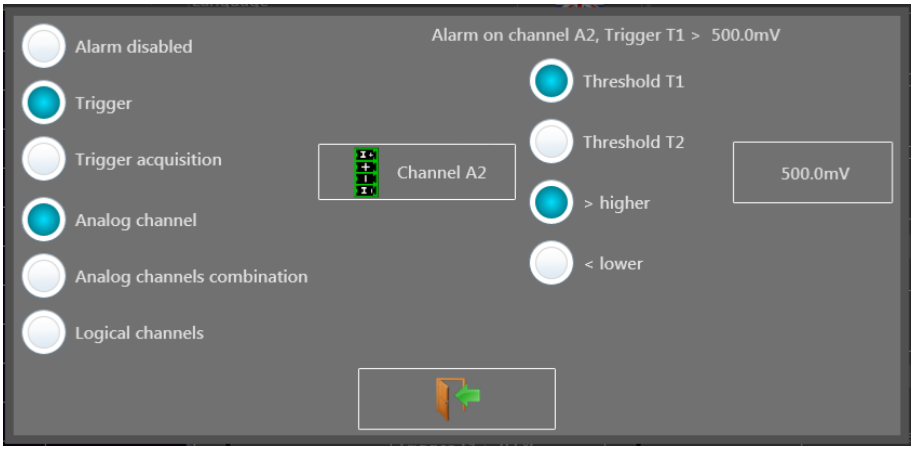


Figure 10.4

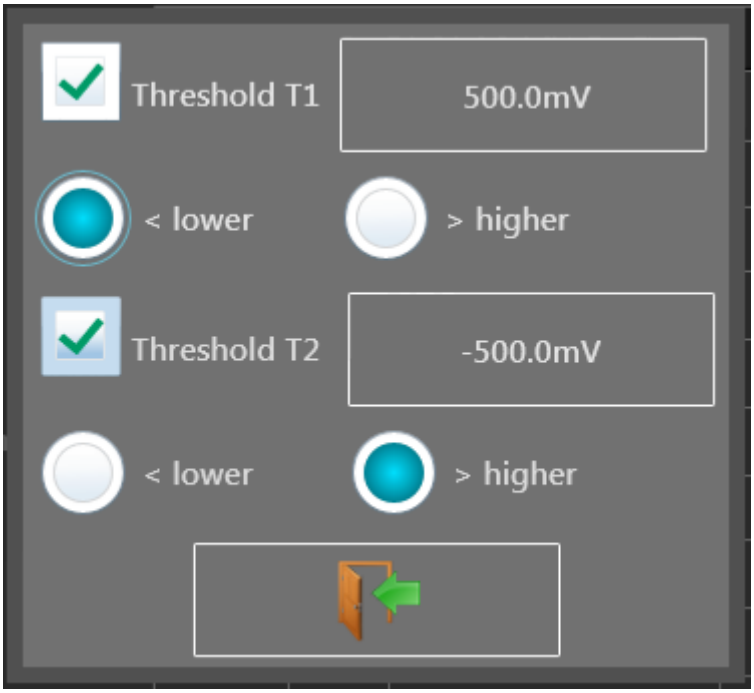


Figure 10.5

10.4 Logic (Digital) signal alarm trigger

An alarm based on the logic state of the digital input is configured by selecting the "Logical Channels" option. Following the typical convention of a 1, 0 and X to denote true, false and "dont't care" respectively, is used to set the digital patter to trigger on. Also, using the "AND" or "OR" conditions select when the trigger occurs. With the "AND" condition, all signals defined must be true for the Alarm to trigger. In the "OR" case, any valid signal, excluding the "X" signals will trigger an alarm.

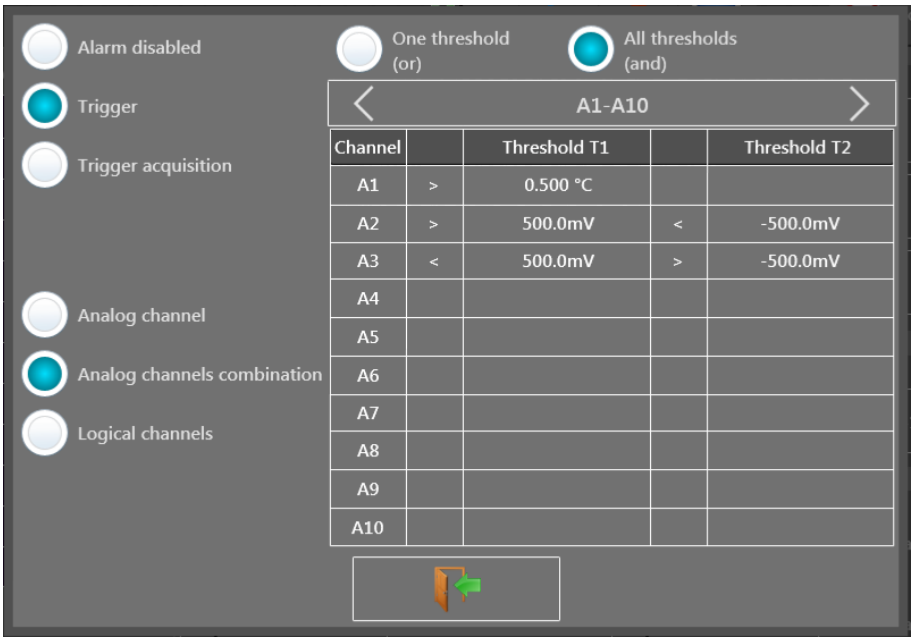


Figure 10.6: Analog combination trigger

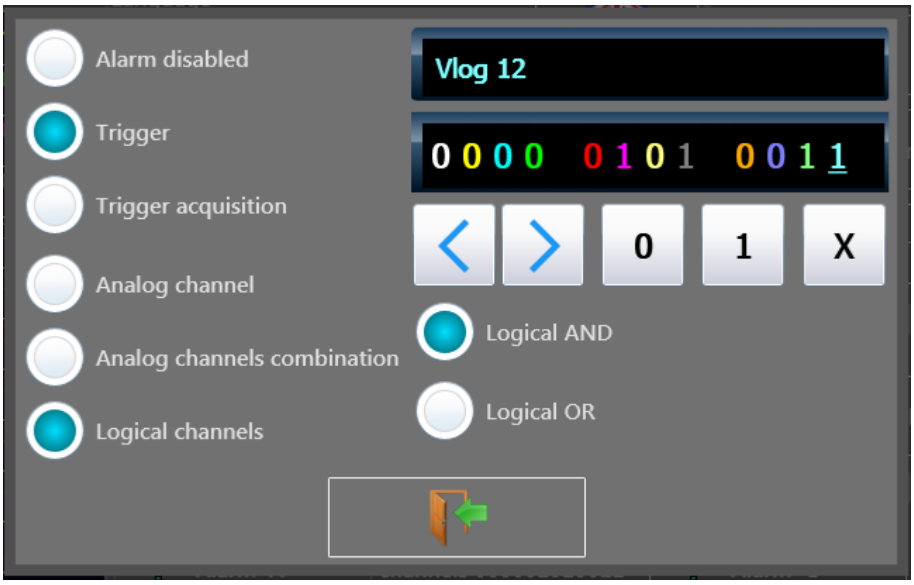


Figure 10.7: Digital trigger

10.5 Alarm on recording start (Trigger Acquisition)

An alarm is also available for signaling the start of a recording. Select the "Trigger Acquisition" option to enable this type of alarm.

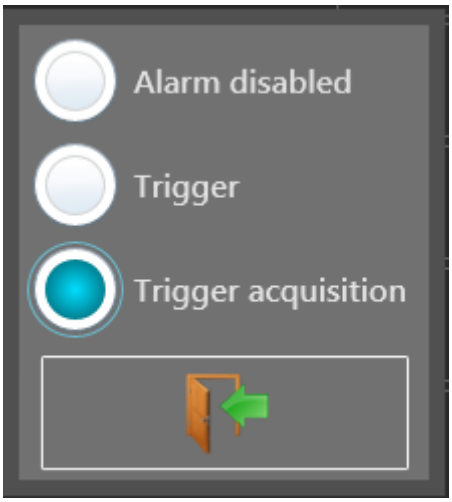


Figure 10.8: Trigger on alarm

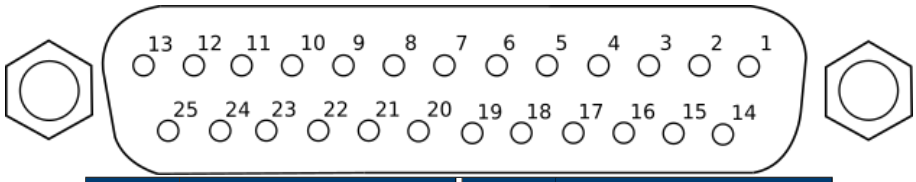
Chapter 11

Logic Channels

Up to 12 logic channels can be recorded simultaneously with the analog channels. In addition, 4 timing channels are also available for measuring duty cycle, RPM and pulse count.

11.1 Logic Input Connector

This is a DB-25 connector located on the top of the unit.



#pin	Name of the signals	#pin	Name of the signals
13	Logic channel 1	19	Function K2
25	Logic channel 2	6	Function K3
12	Logic channel 3	18	Function K4
24	Logic channel 4	5	Ground
11	Logic channel 5	17	Ground
23	Logic channel 6	4	Ground
10	Logic channel 7	16	9-15V 0.2A power
22	Logic channel 8	3	Ground
9	Logic channel 9	15	Alarm C
21	Logic channel 10	2	Alarm D
8	Logic channel 11	14	Alarm A
20	Logic channel 12	1	Alarm B
7	Function K1		

Figure 11.1: Logic Connector

Warning: The DB-25 connector shell is connected internally to power supply ground.

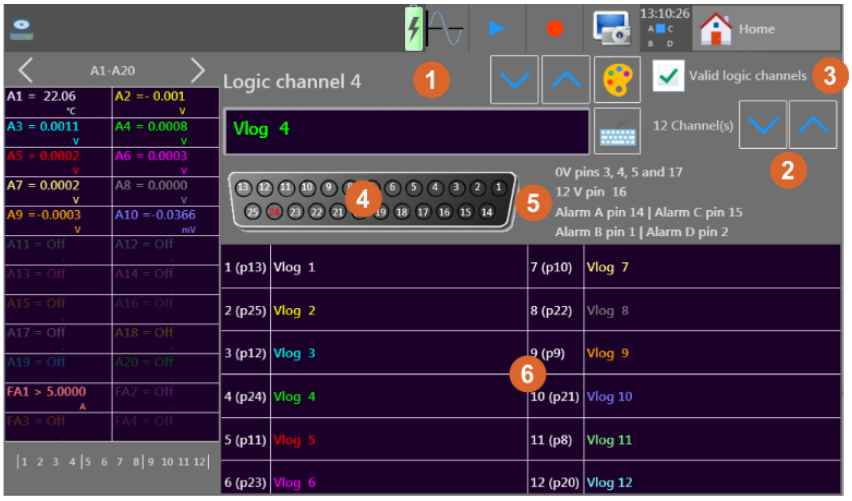
11.2 Logic channel setup

To set the logic channels, press the "logic channels" button on the "Home" screen, or from the "F(t)" screen, click within the logic signal portion of the screen when present, See figure 11.2. The configuration screen will open and resemble Figure 11.3.

The set of channels depends on the number of channels chosen. For a given number of channels, the signals enabled on the connector is fixed. For example, if 4 channels are enabled by the up/down arrows beside the text listing the number of channels, then pins 13, 25, 12, and 24, will be active. They become channels 1-4 respectively.

Note: Logic inputs are 3.3V TTL level and 24V tolerant.

Figure 11.2: Logic channels on the F(t) screen



1. Channel number, color and arrows to change channel
2. Channel count
3. Enable logic channels
4. Connector (red - selected channel)
5. Additional pin information
6. Channel #, pin, and state (dim - disabled)

Figure 11.3: Logic channel configuration screen

11.3 Timing

Function channels K1-4 are used for measuring the PWM duty cycle, count, or frequency of up to 4 digital signals. They are also 3.3V level signals and tolerant of 24V.

Access the setup for these functions from the "Home" screen and pressing the

. Then navigate to the channels K1-4. See Figure 11.4. To configure each channel, either change the parameters on this screen by opening the menus per field in the table, or open the configuration screen for a single channel by pressing the channel ID (i.e. K1). Configuration of a single channel is done via screens similar to Figure 11.5.

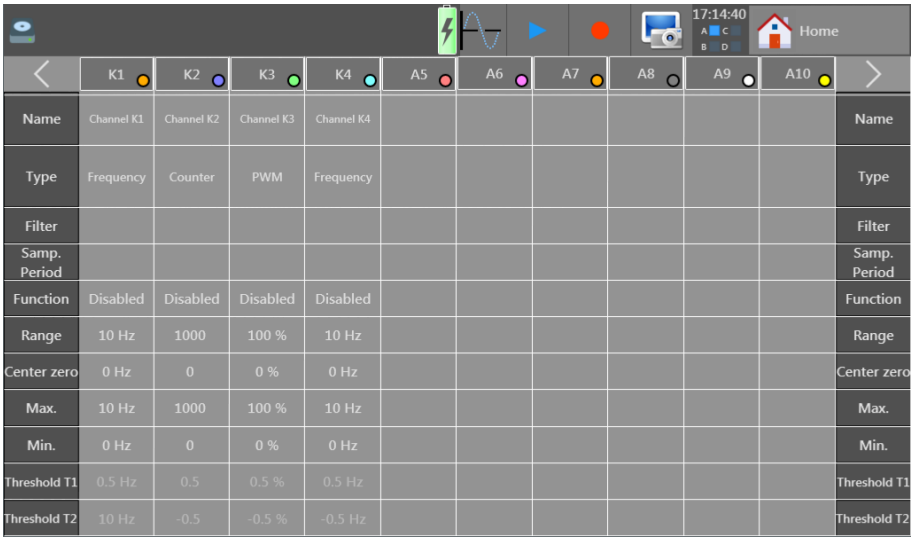


Figure 11.4: Timing function channels

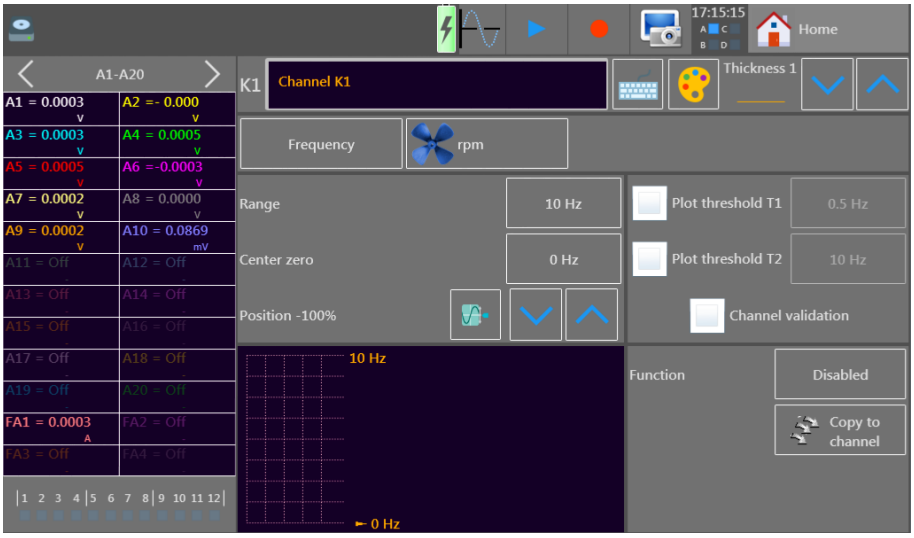


Figure 11.5: Single Timing function setup screen

11.4 Alarm outputs

Finally, the "Alarm" signals are also present on the Logic connector (A, B, C and D. Pins 14, 1, 15 and 2 respectively). Their setup and use is described in Section 10. All outputs are TTL 5V. When the unit is powered off, outputs have a 5kΩ resistance.

Chapter 12

File Management

The recorder is capable of creating recordings, screenshots, and saving device setup configurations. All of these are stored as files, "*.rec" for recordings, "*.bmp" for screenshots, and "*.cfg" files for configurations. The file view dialog Figure 12.1 is accessible from the "Home>Setup", "(Waveform)>Screen Setup>Background", "Home>View Records", "Home>Setup>Load/Save on Disk" screens for example. Each instance of the file dialog allow interaction between internal and external (USB) storage. Finally, folder navigation and creation is also available.

Note: It is highly advisable to work in a folder and not at the root of the flash disk. When erasing a folder, all files in this directory will be erased too.

12.1 Setup Files

Setup configurations are loaded and saved from the "Home>Setup" menu. The configuration may be changed via the 3 buttons in the upper righthand corner of the screen:

Default sets up the appliance in standard configuration

Load from disk loads a configuration from a file in the internal flash disk or an USB stick

Save to disk saves a configuration into a file in the internal flash disk or an USB stick

These commands are only available when the data recording is stopped.

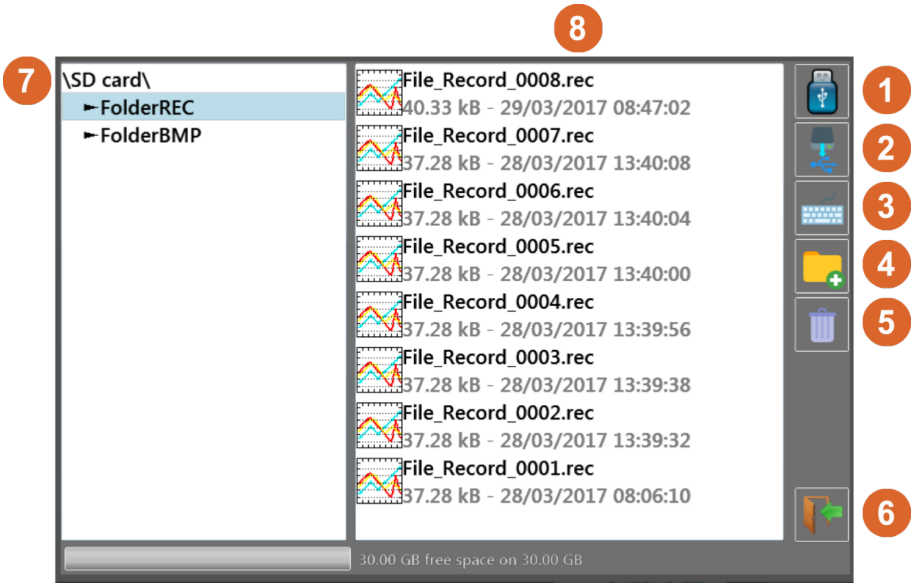
12.1.1 Default

This action loads the system defaults as programmed into the unit during manufacturing.

12.1.2 Save Setup files

To save a configuration, press the

. The name of the file with the alphanumerical keyboard displayed on screen, or, if attached, a USB keyboard.



1. Read/write to internal flash disk or USB stick (if it was connected during unit startup)
2. Copy the selected file or folder to a USB drive
3. Create and name a new file
4. Create a new folder
5. Delete the selected folder or file
6. Close the window
7. Folder navigation and location window
8. File view and selection window

Figure 12.1: File View Screen

12.1.3 Load setup files

To load a configuration, press the

. Select the directory and then the file to load, and click "Load".

12.2 Recordings files

Saved recordings are transferable between internal storage and USB. Recordings are saved to internal storage. See Chapter 8 for details.

Chapter 13

Remote Interfaces

13.1 LAN Interface

The LAN connection to the DAS240 supports ModBus, VNC, Sefram Viewer and DAS Lab. Sefram Viewer and DAS Lab are tools provided by B&K/Sefram, and are available as a single download from `http://www.sefram.com/en/`. The LAN connection supports 10mBit and 100mBit networks. In the case where a network is not available, using a crossover cable is also possible.

13.1.1 LAN setup

Setup of the LAN interface is available by clicking the "Network" button on the "Home" screen. (See Figure **??**). Clicking the "Network" button opens the network setup dialog (See Figure **??**). The LAN interface supports static and dynamic (DHCP) configuration. For DHCP, the DHCP checkbox is marked, and the network address will be shown on the "Network" button shown on the "Home" screen. For static IP configuration, using parameters defined for the network (see your local network administrator for details) are set in the dialog.

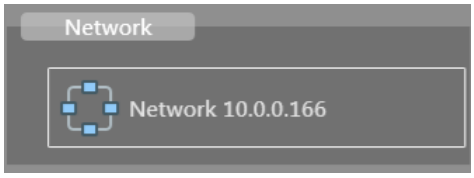


Figure 13.1: LAN configuration button

13.2 VNC

Use of the unit from another computer is available using VNC (Virtual Network Computing). This presents an interactive view of the front panel allowing nearly all functions to be used remotely. Numerous software tools are available for using VNC (ex. UltraVNC).

To open a connection, the IP address of the unit is required. This is found on the "Network" button on the "Setup" screen.

13.2.1 Changing the password

Open the "Setup" screen and press the "VNC" button. The resulting dialog box shows the current password. Press the keyboard icon in order to change the password.

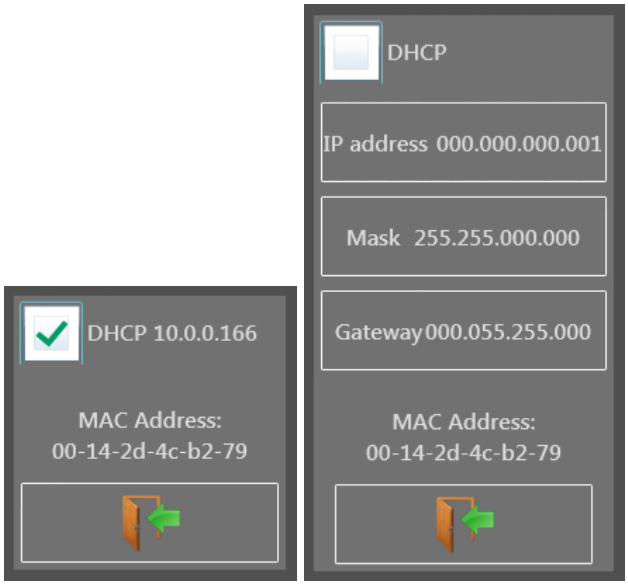


Figure 13.2: LAN configuration dialog windows

13.3 Network file transfer

Transfer your files to your computer to save them or view them with the SeframViewer software.

- Using of the Windows file explorer
- Filezilla: freeware (https://filezilla-project.org/)
- Using an external browser (Internet Explorer, Mozilla, Opera, Chrome, etc.)

13.4 Viewing with SeframViewer

You can transfer the data acquisition files to a PC computer for viewing.

The SeframViewer software is provided on a CD-ROM with the appliance. You can use it to view the recorded files or convert it into xls or txt files.

It works under WINDOWS with Framework 2.0.

Transfer of the files from the appliance to the PC computer:

- USB peripheral device
- with the FTP protocol

Launch the SeframViewer software (or double-click on a file)

Open a data acquisition file (suffix .rec)

You can select:

- the channels to display
- the display mode f(t) or xy

- the self-calibration of the channels.

Your data acquisition file shows up on screen. The functions of SeframViewer are available.

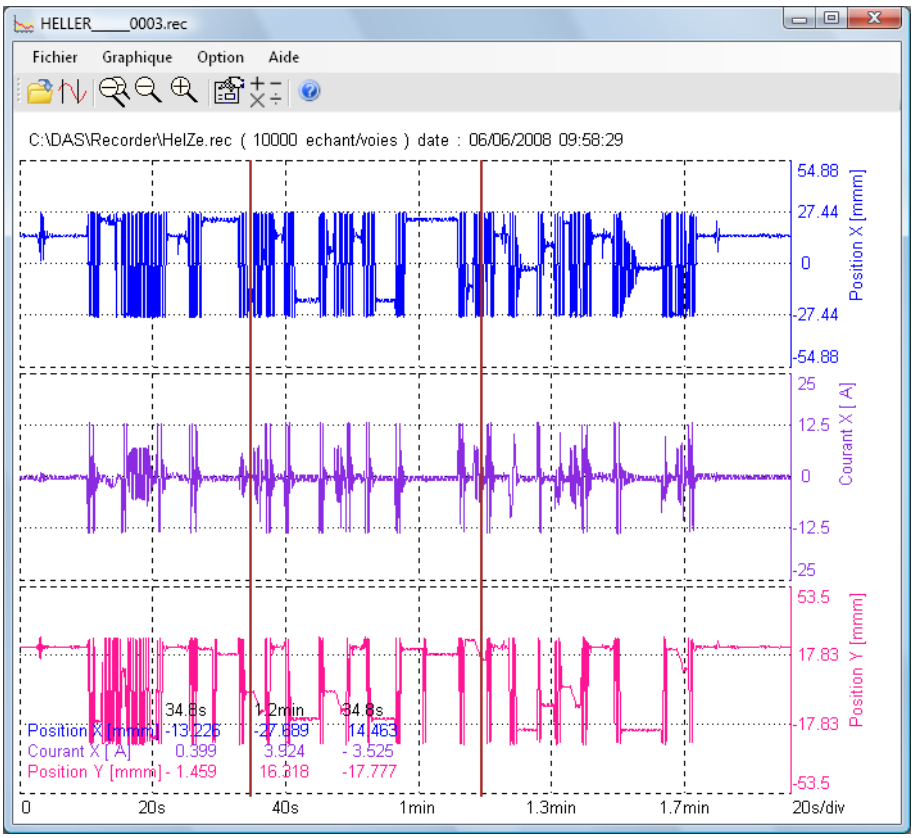


Figure 13.3: Sefram Viewer

Refer to the instruction manual included in the software to discover all available functions in SeframViewer by clicking on the last icon < Help >.

You can also directly create a file (.txt or .xls) by launching the command mode of Windows with the following line (see the Options sub-menu of the help):

Example: C:\Program Files (x86)\SeframViewer\seframviewer.exe myfile.rec /x

will create a .xls file

C:\Program Files (x86)\SeframViewer\seframviewer.exe myfile.rec /t

will create a .txt file

Excel@export will directly launch Excel in the browser.

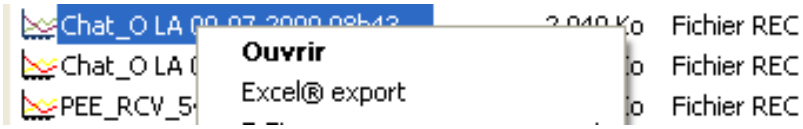


Figure 13.4: Excel Export

13.5 Control your device with DASLab

The DASLaB software manages configurations of your DAS240 device.

It helps you to :

- Open, modify and save your configurations
- Manage configurations remotly using network via Ethernet or WiFi
- Download your record files using network via Ethernet or WiFi

DASLaB is available on the sefram website:
http://www.sefram.com/en/products/recorders-dataloggers/DAS240-multi-channel-handheld-recorder.html

According to your needs, click on the right button. If you want manage your DAS240 using network, please enter the IP address to establish the connection.

For every action, including opening, saving, sending or refreshing configurations, the left sliding menu makes you able to apply it.

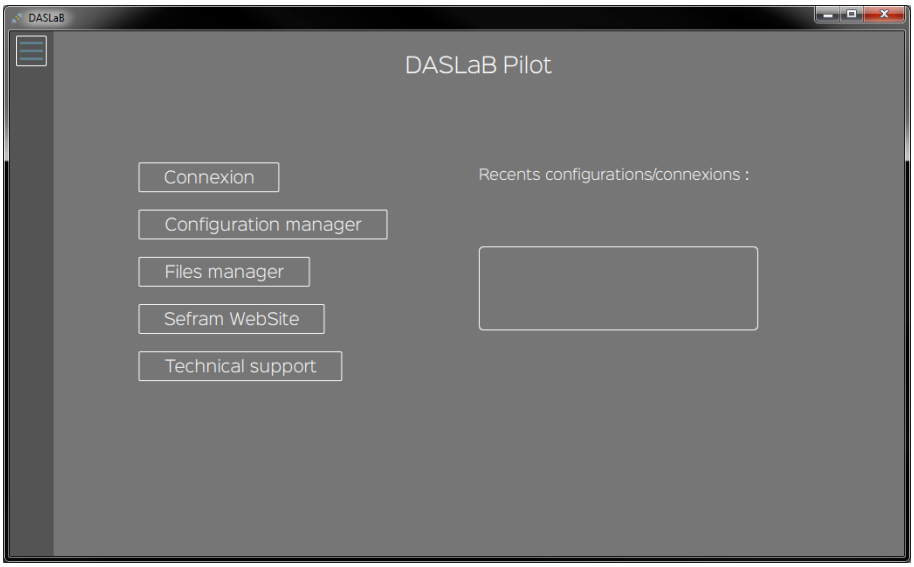


Figure 13.5: DASLab

13.6 Modbus (slave)

Modbus is a non-proprietary communication protocol. All Modbus frames are encapsulated into Ethernet frames: it is called Modbus over TCP/IP.

That protocol is dialog based (question-answer) : the client (master) send a command, and then the server (slave), send back wanted data.

Your instrument Sefram DAS240 includes a Modbus TCP Slave service.

For more explanations about Modbus protocol, please read the following link:

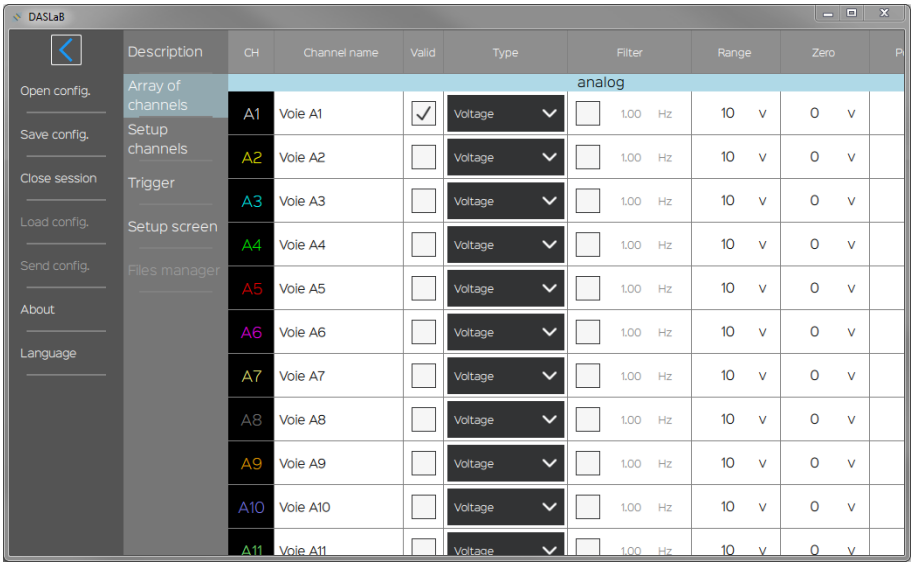


Figure 13.6: DASLab

13.6.1 Setup DAS240

The Modbus protocol uses ethernet network. So you have to choose the port used for that feature, and then enable the Modbus TCP server.

Default port for Modbus TCP is 502.

Your Sefram DAS240 includes a WiFi interface: for performance reasons, you should always use the wired ethernet interface when you perform Modbus communication.

In the Setup page of your instrument, then Additional option, select the “Modbus TCP Server” button.

The setup window for configuring the Modbus TCP server should be the following picture:

Pic. 2: Setup window to configure the Modbus TCP Server on DAS240

You could enable or disable the server: click on the radio button < Modbus server state >.

According to your preferences, you are able to change the network port dedicated to the Modbus server. To carry out that change to a successful conclusion, you must disable the Modbus server, change the port (502 by default), and then restart the Modbus server.

13.6.2 Mapping Modbus TCP

Your Sefram DAS240 instrument share acquisition data in input registers (0x04) and discrete inputs (0x02).

Analog data :

Acquisition data for the 200 analogs channels, and 4 logicial functions channels (K1 to K4) are located in inputs registers from the following address : 0x08.

An input register contains 16 bits, and each channel value is represented as a float (32 bits).

So, to read one channel, you should read two input registers.

Example : Input A1 from address 0x08 to 0x09

At address 0x08 : -16460 (16 bits)

Input	Registers
0x08	A1 High word
0x09	A1 Low word
0x0A	A2 High word
0x0B	A2 Low word
...	...
0x19F	K4 High word (channel n* 204)
0x1A0	K4 Low word

Table 13.1: Modbus register map

Discrete	Inputs
0x08	DI1
...	...
0x14	DI12

Table 13.2: Register Mapping

At address 0x09 : 28160 (16 bits)

Value in float : -1.40961 (32 bits)

Logical data :

Logical values about the 12 logical channels are located in the discrete inputs from the address 0x08.

Chapter 14

Maintenance

Unplug the unit before any cleaning or maintenance.

Periodically clean the recorder while unplugged, in the following ways:

- Use water and soap to clean the front and rear surfaces.
- Never use any product that contains petroleum by-products, benzene or alcohol: damage the screen printings may occur
- Wipe with a soft lint-free cloth.
- Use an antistatic product to clean the screen.

14.1 Updating the Internal Software

The internal software is updated regularly with the latest evolutions. These updates are available on our website. http://www.sefram.com/en/software-updates.html

- To update the software, copy the file that will be provided on an USB stick. Place it on the USB connector on the rear side of the unit.
- Press the "Setup" key.
- Then press the "Software update" key to enter the update.
- Finally, to run the update, press the "Sofware update" key.
- Then, the internal software automatically copies the necessary files to the new version.
- Turn the unit off and on after the end of the updating process.

Chapter 15

Specifications

Note: All specifications apply to the unit after:

1. A temperature stabilization time of 15 minutes over an ambient temperature range of 23 °C ± 5 °C.
2. Short correction operation performed before making measurement.

Specifications are subject to change without notice.

Specifications

Analog Channels		
Number of Analog Input Channels		
20 channels standard, expandable to 200 with optional 20-channel modules		
DC Voltage		
Ranges	± (0.5, 1, 2.5, 5, 10, 25, 50, 100) mV ± (0.5, 1, 2.5, 5, 10, 25, 50, 100) V	
Maximum input Voltage	100 V DC	
Accuracy	0.1% of the full scale ±10 µV	
Temperature with Thermocouples		
Sensors Range by Type (Cold junction compensation: ±0.5 °C)	J	-210 °C to 1200 °C
	K	-250 °C to 1370 °C
	T	-200 °C to 400 °C
	S	-50 °C to 1760 °C
	B	200 °C to 1820 °C
	E	-250 °C to 1000 °C
	N	-250 °C to 1300 °C
	C	0 °C to 2320 °C
	L	-200 °C to 900 °C
Temperature with Pt100 and Pt1000		
Current	1 mA (Pt100), 100 µA (Pt1000)	
Range	-200 °C to 850 °C	
Measurements	2 and 3 wires	
Accuracy (at 20 °C)	0.3 °C ±0.1% of reading	
Compensated Resistance	2 wires	30 Ω max.
	3 wires	50 Ω max.
Resistance		
Ranges	1 kΩ and 10 kΩ	
Accuracy	1 Ω (range 1 kΩ) and 10 Ω (range 10 kΩ)	

Logic Channels	
Logic Input/Output	
Number of Channels	12
Maximum Permitted Voltage	24 V Cat I
Input Impedance	4.7 kΩ
Sampling Rate	1 ms max.
Timing Input	
Number of Channels	4 (K1 to K4)
Maximum Permitted Voltage	24 V Cat I
Input impedance	4.7 kΩ
Sampling Rate	1 ms max.
Pulse Counter	0 to 10000000, accuracy 0.1%
Frequency Measurement	1 Hz to 10 kHz, accuracy 0.1%
PWM Measurement	100 Hz to 2 kHz, accuracy 0.1%
Alarm Output	
Number of Channels	4 Alarms (A, B, C, D)
Output Level	0 to 5 V

General		
Acquisition System		
Resolution	16 bit	
Acquisition System	Scan, one sample per channel	
Sampling Rate	V >50 mV	1 ms to 20 min
	V ≤50 mV, thermocouples and Pt100 / Pt1000	2 ms
Trigger	Date, delay, threshold, combination of thresholds (and/or), word on logic channels (and, or, slope, level)	
Pre-trigger	Variable from 0 to 100k samples	
Internal Storage		
Internal Flash Drive Size	32 GB	
Maximum File Size	2 GB	
Environmental		
Operating Temperature	0 °C to 40 °C, 80% RH (no condensation)	
Storage Temperature	-20 °C to 60 °C	
Auxiliary		
Display	10" TFT touchscreen LCD, backlit, 1024 x 600 dots	
Power Supply	15 V / 4 A max with main adapter (100 / 240 VAC)	
Interfaces	2 x USB host, LAN (10/100 base-T with RJ45 socket)	
Battery	Non removable, Lithium-ion	
Typical Battery Life	15 hours with standby mode, 10 hours without stand-by mode	
Safety	Cat I 100 V, according to IEC61010-1	
Weight	3.3 lbs (1.5 kg)	
Dimensions (W x H x D)	2.6" x 11.7" x 6.9" (66 x 298 x 176 mm)	
Warranty	Two Years	
Supplied Accessories	Main adapter 100 / 240 V, manual (CD-ROM), 1 male connector with 25 pins male and cover, 1 cable (70 cm) for measurement module connection, 1 measurement module (20 channels) with input terminals, a stylus, a soft wipe, a screwdriver	

Order Information for Optional Accessories	
902401000	20-channel module
902401050	Input terminal blocks 20 pack
902408000	Rugged carrying case
902407000	Logic channels patch cord
902406500	4 to 20 mA / 50 Ω shunt
902409000	19" rack-mount kit

Appendix A

Measurement accuracy for thermocouple

The thermocouple measurements are treated as voltage measurements.

For a given range of temperature measurement, the software calculates the voltage caliber the following way:

- Let $<$ T $>$ the absolute value of the max. measurable value, in °C
- Add 40°C to take the max. cold welding temperature into account
- Search the corresponding voltage value U in the table of thermocouples
- Program the caliber with U included in the range.

Example: You want to program a measurement range between -50 and + 50°C with a J thermocouple:

- Max. absolute value T = 50°C
- Add 40°C T + 40 = 90°C
- Corresponding U voltage according to the tables ThJ U = 4.726 mV
- Programmed caliber: 10 mV (measurement range: -5mV to +5mV)

The measurement inaccuracies below are max. values: the typical values are half to thrice as much.

The temperature measurement accuracy is the sum of several possible uncertainty causes:

- Pl: linearization accuracy
- Ps: weld welding accuracy
- Pm: measurement accuracy of the equivalent voltage

The total accuracy Pt is then: $Pt = Pl + Ps + Pm$

For the recorder:

- Pl = + 0.25°C for all thermocouples
- Ps = + 0.5°C for all thermocouples
- Pm = 0.1% of the voltage caliber + 10μV) divided by the slope of the thermocouple in μV/°C

A.1 Measurement accuracy: Pm

The measurement accuracy Pm depends on the voltage caliber of the appliance (see the previous paragraph) and on the slope of the thermocouple. You shall take the slope at 0°C while knowing that it will vary as a function of the temperature, but this variation is generally of the second order for the accuracy calculation.

A.2 Voltage of thermocouple (mV)

Slope of the thermocouples (μV)

Example:

- At 100 °C the slope of thermocouple J is 55μV
- At -100 °C slope is 30μV .
- So the error is 2 time greater then 100°C to -100°C.

A.2.1 Example Of Accuracy Calculation

You make a welding between -50°C and +50°C with a J thermocouple with compensation of cold welding.

$$Pt = Pl + Ps + Pm \tag{A.1}$$

Linearization accuracy $Pl = +0.25°C$ (A.2)

Compensation of cold welding $Ps = +0.5°C$ (A.3)

Used caliber $10mV$(see previous example) (A.4)

Accuracy for voltage measurement $0.1\% * 10mV + 10\mu V = 20\mu V$ (A.5)

Slope of J thermocouple $50\mu V/°C$ (A.6)

AccuracyPm $Pm = 20/50 = 0.4°C$ (A.7)

Total accuracy $Pt = 0.25 + 0.5 + 0.4 = 1.15°C$ (A.8)

A.3 Accuracy class - class index

This is one of the most important concepts of the CEI recommendation; it tends to shorten the list of specifications. To do so, it introduces the concept of PREDICTIVE CLASS that depends on the C CLASS INDEX.

The normalized values of the class index are: C = 0.1, 0.25, 0.5 and 1.

The intrinsic error (in the reference conditions) does not exceed + C% (the manufacturer may also specify this limit of the intrinsic error as an absolute value (ex. + 5 μV) for the first calibers).

The variations (of the measured value) with the variations of one of the influential variables in the nominal range of use do not exceed:

- C % for the position for the magnetic induction with external source and parasite voltages
- 0.5 C% for the power supply source
- 0.3 C% according to the class index at ambient temperature (0.15% for the 0.25 class).

In addition, the insensitivity range should not exceed:

- C% in the reference conditions
- 1.5C% for the maximal resistance of the external measurement circuit
- 2C% for parasite voltages

And the excess should not be more than 2C% (4C% within the limits of the power supply source). %

Appendix B

Grounding

- If the source of the signal you have to record has low internal impedance, you shall use twisted wires. In case of high impedance, you shall use shielded wires.
- When gathering grounds from the various items on the measurement line, it is good to check that there is no voltage difference between them, in order to prevent any shortcut. If any doubt, make a measurement with a voltmeter on a low resistance (i.e. 1kΩ) between the terminals.
- If any important noise,
  - When using the battery , connect the GND connection to the ground
  - use the sampling period for each channel $>$20ms
  - an appropriate capacity can be placed between the ground and the - wire of the signal.