Department of Electrical Power Engineering and Mechatronics

Safety instructions for
Industrial Robotics Laboratory NRG-201
Robotics Control Laboratory NRG-202
Mechatronics Systems Research Laboratory NRG-208
Mechatronics Laboratory NRG-211
Mechatronics Research Laboratory NRG-221
Unmanned Aerial Systems Research Laboratory NRG-235

General safety

- Any equipment that is located in laboratory may only be used by an individual who is familiar with these safety instructions, the technical data and operational guides of the equipment, and whom has been guided in the workplace and who have committed to complying with all general requirements present at TUT set of electrical and fire safety in the laboratory work safety regulations.

- Students (training course attendees) attending in the laboratory must carry out only the tasks assigned to them by the tutor. Arbitrary switching of equipment to the mains is prohibited.

- The use of laboratory equipment and furnishings should be prudent and sustainable. Work place has to be kept clean and in order, after the completion of the work restore the condition of the work place.

- Any defects noted in appliances and work place have to be informed about to their supervisor immediately. Continuation of the work with these non-functioning devices is prohibited.
BEFORE WORK

- Ensure that the equipment necessary for the work are available and in working order.
- Ensure that the function and proper use of the tools and the necessary safety equipment is known. Otherwise, ask for guidance from the supervisor.
- Ensure that electrical tools and equipment is unplugged and the trim of the equipment would be detected by external examination.
- **Safety of industrial robots in the labs (from the aspect of mechanics):**

Every person, working with (industrial) robots in the room, has to learn about the following:

- Robots workspace and space where moving parts of the robot may reach to must be marked clearly or restricted by barriers and clear from unnecessary unattached objects. If such area is not marked or mechanically restricted, it must be done before switching on the robot, according to the user's guide of the robot. Also, it must be taken into consideration that a robot with modified configuration or program might be able to penetrate some light barriers.

- Hatches and doors, which are designed to be equipped with sensors, connected to the emergency stop circuit, must be closed when robot is being used. It is not allowed to remove such sensors from the emergency stop circuit nor to fool such sensors.

- Hazardous tools, which are in use by a robot, must be completely disconnected from the control electronics and power supplies when being mounted or dismounted. Sharp edges of tools should have cover's when possible.

- At normal operation of the robot, the safety of nearby people must be ensured even in the case of possible failure of a tool or parts of tool attachment.

- People who start working with robots must be acquainted with the maximum values of motion parameters, power and input voltages of the robots beforehand. They also have to know, where emergency stop buttons and electric cabinet with circuitbraker's are located, allowing to disconnect robots from the mains.

- Person, who switches on the robot or runs a robot control program, must be sure, that people nearby are notified about it every time beforehand.

- Industrial robot's may not be dismounted from their original mount (except at the concert and presence of the supervisor).

- Robot's joints may not be manually forced to an alternate position (even unpowered), unless permitting this is clearly stated in the robot's user's guide.

- No drinks nor food are allowed to be brought into the room.
- Liquids (even cleaning agents) are not to be brought into the room.
- No cutting, grinding, welding nor painting works may be carried out in the room (dedicated workshop must be used for such works).

**TEKLAB electrical workbench safety:**

**SU1 Supply unit**

1 **Front panel layout**

The front panel of the SU1 supply unit is described in figure 1.

![Diagram of SU1 Supply unit](attachment:figure1.png)

Figure 1: The front panel of the SU1 supply unit.

1 Power indicator light  
2 Main switch  
3 Emergency switch  
4 Fault current protector (ReD)  
5 Thermal overload protector  
6 PE-connector
2 Back side of the supply unit

The back side connections of the SU1 supply unit are described in figure 2.

![Diagram of SU1 supply unit connections]

Figure 2: The back side of the SU1 supply unit.

1. Socket outlets: Sockets power instrument modules in the workstation.
2. Mains power connector: Power plug must be connected to an earthed outlet.
3. Output connector: This connector powers the sockets and lighting in the workstation.
4. PE-connector: The device panel of the workstation is safety earthed. See also workstation manual.

3 Operating instructions

3.1 Operational description
SUI is a one-phase supply unit for Teklab workstations. The supply unit feeds the whole workstation. The panel devices are connected to the sockets at the backside of the supply unit.

**Important!**
If You are going to open the module rack, always disconnect the workstation's power plug from the electric network. Make sure that the electricity cannot be turned on by accident.

3.2 Switching power

The power is switched on by turning the main switch 10 position 'S ', and then releasing it 10 position '1'. The green power indicator light shows that the power is switched on.
The power is switched off by pulling the main switch to position '0'.
The workstation is advised to be switched off when not used (e.g. night time).

**Warning!** A device that is going to be repaired or fixed must always be connected to an isolated outlet. (Isolated outlets can be ordered as additional equipment.)

3.3 Protection systems

SUI is a safety grounded device, and it must always be connected to an earthed power outlet. There is also a PE-connector at the front panel.
The supply unit is equipped with a thermal overload protector and a fault current protector for all module devices connected. The supply unit includes also an emergency switch.
3.3.1 Thermal overload protector
The thermal overload protector operates at a current of 16 A. When protector is launched, the button moves outwards. To reset, press the button.

3.3.2 Fault current protector
The fault current protector is launched at a leak current of 30 mA. Check the operation of the fault current protector once a month by pressing the TEST-button. The lever should switch to OFF position.

In a case of fault:
- If the lever is in OFF-position, switch it to ON-position.
- If the lever does not stay in the ON-position, there is a faulty device in the panel.
- Find and remove the faulty device or contact an electrician.

3.3.3 Emergency switch
The emergency switch is connected between the feeding network and the main switch. When the mushroom button is pressed, the power is cut from the workstation. If the button is pressed, the reason for the launch must be found out before connecting the electricity back to the workstation.

Resetting the launch: Turn the mushroom button clockwise and check that the button releases to upper position. Turn the main switch to position '5', and then release it to position 'l'.

Important! Never use the emergency switch as operating switch.
SU3 supply unit

1 Front panel layout

The front panel of the SU3 supply unit is described in figure 1.

Figure 1: The front panel of the SU3 supply unit.

1 Power indicator light
2 Emergency switch
3 Main switch
4 Fault current protector (ReD)
5 Thennal overload protectors
6 PE-connector

2 Back side of the supply unit

The back side connections of the SU3 supply unit are described in figure 2.

Figure 2: The back side of the SU3 supply unit.
1 Sockets: Sockets are used to power the I-phase equipment in the device panel.
2 I-phase connector: This connector has multiple uses:
   • To power lighting in high Concept workstation
   • To power extra sockets (ELPSL4, ELP SL3UK, ELP SL3US)
3 3-phase connector: This connector is used to power 3-phase equipment in the device panel.
4 Mains power: Must be connected to an earthed outlet.
5 PE-connector

3 Operating instructions
3.1 Operational description
SU3 is a three-phase supply unit for Teklab workstations. The supply unit feeds the whole workstation: One-phase panel devices are connected to the one-phase sockets at the backside of the supply unit, and three-phase supplies to the three-phase connection.

Important! If You are going to open the module rack, always disconnect the workstation's power plug from the electric network. Make sure that the electricity cannot be turned on by accident.

3.2 Switching power
The power is switched on by turning the main switch first to position 'S', and then releasing it to position '1'. The green power indicator lights show that the power is switched on. The power is switched off by turning the main switch to position '0'. The workstation is advised to be switched off when not used (e.g. night time).

Warning! A device that is going to be repaired or fixed must always be connected to an isolated outlet. (Isolated outlets can be ordered as additional equipment.)

3.3 Protection systems
SU3 is a safety grounded device and it must always be connected to an earthed power outlet. There is also a PE-connector at the front panel. The supply unit is equipped with thermal overload protectors and a fault current protector for all module devices connected. There is also a protection circuit for missing phase / wrong phase order, which cuts electricity in a case of a failure. The supply unit is equipped with an emergency switch.

3.3.1 Thermal overload protector
The thermal overload protectors operate at a current of 16 A. When protector is launched, the button moves outwards. To reset, press the button.

3.3.2 Fault current protector
Fault current protector launches at a leak current of 30 mA. Check the operation of the fault current protector once a month by pressing the TEST-button. The lever should switch to OFF-position. In a case of fault: If the lever is in OFF-position, switch it to ON-position. If the lever does not stay in the ON-position, there is a faulty device in the panel. Find and remove the faulty device, or contact an electrician.
3.3.3 Emergency switch
The emergency switch is connected between the feeding network and the main switch. When the mushroom button is pressed, the power is cut from the workstation. If the button is pressed, the reason for the launch must be found out before connecting the electricity back to the workstation. Resetting the launch: Turn the mushroom button clockwise, and check that the button releases to upper position. After that, turn the operating switch to 'Sf-position, and release it to '1 '-position.

**Important! Never use the emergency switch as operating switch.**

3.3.4 Protection against wrong phase order / missing phase
If there is a faulty connection in the mains voltage, the supply unit will not switch on. Both wrong phase order and missing phase voltage will cause the supply unit not to start. Also when the supply unit is on, it will switch off if the mains voltage turns faulty.

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**TL303 / TL3035 DC supplies**

**1 Front panel layout**

Figure 1 shows the front panel of the TL3035 power supply.

![Figure 1: The front panel of the TL3035 supply. The TL303 model is equal except the fixed 5 V output.](image)

1 Thermal overload protector
2 Operating switch
2 Operational instructions

2.1 Operational description
TL303 is an adjustable DC voltage supply for Teklab workstations. TL3035 model has also a fixed DC output. The power supplies are modular and they can be replaced or repositioned, see the workstation manual for replacing instructions.
TL303(5) is connected to the workstation's supply unit with a standard earthed power plug.

2.2 Switching power
Switch the voltage supply on from the operating switch (2). The indicator light in the switch turns on ( in TL3035 model also the indicator light (8) turns on). After turning the device on, connect the load to the output terminals (9, 10).
Before turning off the device, disconnect the load from the output.

2.3 Adjusting output voltage and current limit
The output voltage can be adjusted by turning the voltage knob (5), and current limit by turning the current knob (6). The output voltage and current can be read from the displays (3, 4).
When the output current is under the set current limit, the output follows the voltage setting. When the current limit is reached, the output voltage goes under the set value and the current stays constant. This is showed by an indicator light (7).
In TL3035 model there is also a constant 5 V/3 A output. The output current is limited to 3 A.
When the output current is under 3 A, the green indicator light (8) is on. When 3 A is exceeded, the current limiter turns on and the indicator light goes out. If the limiter is activated, the load must be disconnected.

2.4 Series and parallel connections
Floating power supplies can be connected in parallel or series to get higher voltage or current.
When using series connection, the output current is limited to the lower current value of the supplies.
When using parallel connection, adjust other supply's current limit to desired value, and voltage a little over desired value. With the other supply, adjust voltage to desired level, and set the current limit a little higher than the other supply's current limit.

2.5 Protection systems
TL303(5) is equipped with a thermal overload protector (1). When the protector is activated, the button moves outwards. To reset, push the button.

The outputs are floating.
TLMB12 DC supply
1 Front panel layout

Figure 1 shows the front panel of the TLMB12

![Diagram of TLMB12 DC supply](image)

Figure 1: The front panel of the TLMB12 supply.

1 Thermal overload protector
2 Operating switch
3 Voltage selector
4 Connection example
5 Toggle switches
6 Indicator lights
7 Output terminals
2 Operational instructions

2.1 Operational description
TLMB12 is a constant DC power supply for Teklab workstations. The device is modular and it can be replaced or repositioned; see the workstation manual for replacing instructions. TLMB 12 is connected to the workstation's supply unit with a standard earthed power plug.

2.2 Switching power
Switch the constant voltage supply on from the operating switch (2). The indicator light in the switch and all the indicator lights (6) should switch on. After turning the device on, connect the load to the output terminals. Before turning off the device, disconnect the load from the outputs.

2.3 Selecting output voltage
Based on knowledge about needed voltage, choose the output using the voltage selector (3) and the toggle switches (5). The outputs are floating with respect to each other, and they can be connected in series or in parallel. An example of possible connections is showed on the front panel (4). When using parallel connection, the outputs must have same voltage. In series connection, the current is limited to the lower value of the outputs. In series connection it is also possible to make a three point system with ± voltages and a zero point. Note! The outputs are equipped with a current limiter. When the maximum current of the output is reached, the limiter activates and the indicator light (6) goes down. If the limiter is activated, the load must be disconnected.

2.4 Protection systems
TLMB12 is equipped with a thermal overload protector (1). When the protector is activated, the button moves outwards. To reset, push the button.

The outputs are floating.
ACP40 Programmable AC supply

1 Front panel layout
Figure 1 shows the front panel of the ACP40.

1 Thennal overload protector for the secondary circuit
2 Operating switch + thermal overload protector for the primary circuit
3 LCD -display
4 MENU -button
5 Adjustment wheel
6 SELECTION -button for the isolated socket
7 Socket indicator light
8 SELECTION -button for the isolated terminal screws
9 Terminal screws indicator light
10 Isolated terminal screws
11 Isolated socket

2 Operating instructions

2.1 Operational description
ACP40 is a programmable AC power supply for Teklab workstations. The device is modular and it can be replaced or repositioned; see the workstation manual for replacing instructions. ACP40 is connected to the workstation's supply unit with a standard earthed power plug. ACP40 has inner electronic protection systems and it can be controlled by TeklabNet -software.

2.2 Switching power
Before turning on the device, check that there is no load connected to the outputs.
Switch the variable AC supply on from the operating switch (2). The device performs a self-test after which it is ready to use. While self-testing, the device also shows the measured mains voltage on the display.
Connect load to the output before turning the output on.
The supply can be turned off by switching the operating switch to position '0'.

2.3 Menus
There are five menus available that can be accessed by pressing the MENU -button (4).

2.3.1 Main menu
The first menu (nonnal view) allows the user to adjust the output voltage by turning the adjustment wheel. By pressing the wheel at the same time the voltage is adjusted 3 V / step.
Notice! This adjustment controls the voltage setting beforehand; the voltage is available from the outputs when they are turned on.

In the main mode the display (3) shows output voltage, output current, voltage setting and current limitation setting, figure 2.

2.3.2 I limit menu
This menu allows the user to adjust the current limit from 0.1 A to 4.1 A or OFF. OFF allows ammornentary maximum current of ~ 6-7 A. The Inaximum continuous current is 4 A. Turn the adjustment wheel to set the desired limitation. If the output current exceeds the current limitation, the output is turned off.

2.3.3 OVP menu
The over voltage protection ( OVP ) can be adjusted from 1 V to 250 V. Turn the adjustment wheel to set the OVP. When OVP is set, the output voltage setting cannot exceed the OVP -value.

2.3.4 Mode menu
The mode menu allows the user to select between normal, U-stabil. or Static mode. Turn the adjustment wheel to make the selection.

Normal mode
The power supply operates as a variac, which means that the output voltage varies due to changes in input voltage. The output voltage also drops if load is increased due to internal impedance.

U-stabil. mode
The voltage supply will keep the output voltage as stable as possible. In other words, the supply adjusts the output to compensate the changes in input voltage or load.

Static mode
The output voltage is "locked" (not adjustable) and the device will not automatically try to adjust the output voltage to selected value. This means that output voltage will change if input voltage changes. The output voltage will also drop if load is increased ( due to internal impedance ).
2.3.5 OC-time menu
This menu allows to set the OC time+ (Over Current time). This gives the user a possibility to adjust the time before shut down in a case of short circuit or over current. The value is adjustable from 0 to 1330 μs.

2.4 Outputs
ACP40 has two isolated outputs; the terminal screws (10) and the socket (11). The outputs are turned on or off by pressing the SELECTION -buttons (6, 8). The indicator lights (7, 9) show which output is active. At the same time the set-section from the display disappears and the <adj> is showed. Now the adjustment wheel and the menus can be used as previously described to control the selected output.
Turn off the output before disconnecting load. After disconnecting the load turn off the device.

NOTICE! Only one output can be active at a time.

2.5 Protection systems
ACP40 has both electronic and thermal protection systems. The electronic protection system cuts the circuit in a case of over current. This is done quickly enough to prevent a hazard.
The thermal protection system is also used to increase safety. There are two 4 A overload protectors; one for the primary circuit (2), and one for the secondary circuit (1). These activate if the electronic system doesn't operate.
When the protector for the secondary circuit is activated, the button (1) moves outwards. To reset, push the button.
When the protector for the primary circuit is activated, the operating switch switches to position '0'. To reset, switch it to position '1'.
The supply unit is short-circuit protected.

2.6 Software
ACP40 can be controlled by TeklabNet software. The same operations described here can be done using a PC. Measured data can also be saved. Read more about PC controlling from the software manual.

Users Guide
ACP Client Software

IMPORTANT INFORMATION:
Remote controlling of any device should be performed with extreme caution so that there will not be any material damage or human injury. The operator of the remote controlling software is always himself 100% responsible for the actions carried out by the remote controlling software.
Quick start guide (MS Windows)
1: Install the ACP Client application
Run Setup.exe found in the „w32_installer“ folder on the install-media.
2: Turn on the ACP device
3: Program IP-address to ACP
By using the Digi Device Discovery program found on the install-media in the „support_sw“ folder, the network settings for the ACP can easily be altered to suit the network. If not pre-programmed at the factory, the ACP gets its IP-address and network settings from a DHCP-server (if there is one present).
The MAC-address of the ACP can be found printed on the front panel of the device.
4: Start the ACP Client application
Start the application and from the Settings-menu select Network settings (or press Ctrl+N). Enter the correct IP-address and make sure the Remote port is set to 2101.
5: Save, Exit and Connect
Click Save end then Exit. From the File-menu select Connect (or press Ctrl+C) The ACP Client application is now ready to use.

Figure 1: Main view, connected
Figure 1.1: Main view, disconnected

Controls for Main view (figure 1):

1: Menu structure
File
Connect
Disconnect
Exit
Settings
Network settings
Program settings
Data logging settings
Help
About

Establish connection to the device.
Disconnect from the device.
Exit this program.

See page 4 of this manual.
See page 5 of this manual.
See page 6 of this manual.

Shows version information about this program.

2: Identifier
Identifies the device connected (ACP40 or ACPIOO), in this case the additional identifier is set to "TAI".

3: Status indicators
Link
Off
Flashing
yellow steady
Not connected.
Establishing connection.
Connection established.
Remote

   Off                  Program runs as normal stand alone application.
   yellow steady       The device is remotely controlled by Teklab GroupControl
                        application. Control of the device from this application is not
                        possible when in remote-mode.

4: Exit button
Exits this program.

5: Mode indicator and control
This indicator indicates the operation mode in the device. It is possible to set the value in the device
by selecting a new value from the control field drop-down menu.

6: Uset control and indicator
This indicator indicates the variable Uset in the device. It is possible to set the value in the device by
entering a new value in the control field.

7: OVP control and indicator
This indicator indicates the variable OVP in the device. It is possible to set the value in the device by
entering a new value in the control field.

8: Ilim controls and indicator
This indicator indicates the variable Ilim in the device. It is possible to set the value in the device by
entering a new value in the control field. The button "Disabled" will put the device to Ilim=OFF state
and the button "Enabled" will take the device back to normal Ilim-operation.

9: OCtime control and indicator
This indicator indicates the variable OCtime in the device. It is possible to set the value in the device
by entering a new value in the control field. OCtime is indicated in percent [%] as opposite to
milliseconds in the device.

10: U voltage indicator
This indicator shows the U-value (voltage) in the device.

11: I current indicator
This indicator shows the I-value (current) in the device.

12: overcurrent / currentlimit indicators
The indicators will flash if the overcurrent or currentlimit circuit is triggered in the device.

13: Output ON/OFF controls and indicator
These controls enables and disables the outputs of the device. The green indicator shows the current
state of the outputs (off = output off, bright green = output on).

14: Output select controls and indicators
These controls selects the output in use. The selected output will carry the text "SELECTED".
When a output is selected and enabled, a green indicator will show this.
Only one output can be enabled at a time.

15: Allowed indicators
The indicators show the highest settable values for voltage (on the two different outputs) and current
in the device. Note that these values are present in the device and are only programmable through the
Teklab GroupControl (GC) management software.

16: Error indicator
off No error.
red steady Connection or framing error. By holding the mouse pointer over the
indicator, the active Labview error-message will show up.

17: Navilock indicator
Off Control wheel on the device is not locked.
green steady Control wheel on the device is locked. The status can only be changed
through the Teklab GroupControl (GC) management software.

18: Log control and indicators
LOG-control Enables or disables data logging. Also activates snapshots.
Timed start/end
Off No Automatic start/end is scheduled.
green steady Automatic start/end is scheduled.
Snapshot
Off Snapshot mode is disabled.
green steady Snapshot mode (one row log per LOG-click) is enabled.
Logging
Off No file-output is being generated.
green steady Output file is being written.

Controls for Network settings (figure 2):
1: TCP/IP, SERIAL and Postfix
TCP/IP Select if the device is connected to Ethernet
SERIAL Select if the device is connected to the computer with a RS232 port.
Postfix A local additional identifier that is displayed in the main view.
2: IP address
IP address The IP address of the device to be controlled. (When connected to Ethernet)
3: Port
TCP/IP: The port to be used on the device. Normally this is 2101. Do not change the port to something else if you are not sure what you are doing.
SERIAL: The serial port to be used. Enter the number for the COM-port, for example "1" means COM1.
4: Client listen port
The port that this program listens for incoming connection from the Teklab GroupControl (GC) application. Default value is 2109.
5: Timeout
The connection timeout in ms. Default value is 5000 ms.
6: Write interval and read delay
The write and read delays in ms. Default value for write delay is 200 ms. Default value for read delay is 200 ms. These delays will be activated after every read/write operation to the device.
7: Error indicator
Off No error.
red steady Syntax error in IP-address field, port-field or system error writing the configuration file that holds the network settings information.
8: Save and Exit buttons
Save Saves the network settings to the configuration file.
Exit Exit from this part of the program.

Controls for Program settings (figure 3):
1: Change administrative password
Some components in this program can be protected by a administrative password. The password is by default admin and can be changed to something else here. Characters accepted are in the range [a-z], [A-Z] and [0-9]. The password can be reset to admin by re-installing this application.

2: Password protected components
Select the components that are to be protected by the administrative password. If a component is protected by password, the program will prompt for the password if that component is accessed by the user.

3: Program settings
Connect on startup
Automatically try to establish a connection to the device when the program is started.

4: Error indicator
Off
No error.
red steady
Error writing the configuration file that holds the program settings information.

5: Save and Exit buttons
Save
Saves the program settings to the configuration file.
Exit Exit from this part of the program.
Controls for Data logging settings (figure 4):

1: **Header options**
The options that are checked will be added to the header of the log file.

2: **Data to record**
The different variables that can be logged to the log file.

3: **Data separator**
Select the data separator to be inserted between logged variables.

4: **Logging options**
   - **Snapshotmode**
     Instead of logging periodically, snapshot-mode can be used. In snapshotmode one line of data will be written to the log file every time the user clicks the "LOG" control button (see page 3 part 18 of this manual).
   
   - **Write interval**
     The interval in ms the data is being written to the log file. Not in use if snapshotmode is selected.
   
   - **Timed start and end**
     The logging of data can be programmed to start and or stop any time by enabling the feature here.

5: **File location**
The full path and name of the file that is to be generated when the logging data.

6: **Error indicator**
   - **Off**
     No error.
   
   - **red steady**
     Error writing the configuration file that holds the data logging settings information or error generating the file entered in "File location".

7: **Save and Exit buttons**
   - **Save**
     Saves the data logging settings to the configuration file.
   
   - **Exit**
     Exit from this part of the program.
TLP305 / 603 / 305D / 603D
Programmable DC power supplies

1 Front panel layout
Figure 1 shows the front panel of the TLP power supplies.

![Figure 1: The front panel of the TLP voltage supply.](image)

1 Thermal overload protector
2 Operating switch
3 LCD display
4 U-knob
5 DISPLAY-button
6 I-knob
7 Output terminal
8 OUTPUT-button

2 Operating instructions
2.1 Operational description
TLPx is a programmable DC power supply for Teklab workstations. The device is modular and it can be replaced or repositioned; see the workstation manual for replacing instructions. The power supply is connected to workstation’s supply unit with a standard earthed power plug. TLPx has inner electronic protection systems and it can be controlled by Teklab software.

2.2 Switching power
Before turning on the device, check that there are no leads connected to the terminals. Switch the DC supply on from the operating switch (2), the indicator light will turn on inside the switch. Information about the power supply is displayed on the LCD screen. Wait for the device to perform a self-test. After this the device is ready to use.

The output is turned on or off by pressing the OUTPUT-button (8). Turn off the output before you disconnect a load. Disconnect the leads from the terminals before turning off the device.
2.3 Display
The TLP voltage source is equipped with a multi-purpose LCD display (3). Figure 2 shows the display in main mode.

![Image of display with various settings]

2.4 Adjusting voltage, current limit and adjustment resolution

**Voltage:**
The output voltage can be adjusted by turning the U-knob (4).

**Current limit:**
The current limit can be adjusted by turning the I-knob (6).

**Resolution:**
By pressing the U-knob the adjustment resolution can be toggled between 1 V and 0.1 V / 0.01 V. The resolution setting between 0.1 V and 0.01 V can be chosen in the SETUP menu described later.

By pressing the I-knob the adjustment resolution can be toggled between 0.1 A and 0.01 A / 0.001 A. The resolution setting between 0.01 A and 0.001 A can be chosen in the SETUP menu described later.

2.5 SETUP menu
The SETUP menu can be accessed by pressing the DISPLAY button (5). Figure 3 shows the menu structure.

![Image of SETUP menu]

Use the U-knob to navigate in the menu: Turn the knob clockwise to move down and counter clockwise to move up in the menu.

When the desired menu is selected, turn the I-knob to change the settings.
2.5.1 Tracking (only 0 models)
If there is no slave device connected to the master device, then passive option should be chosen. If there is a slave device connected, then master option should be chosen. When a master-slave connection is made, the master device controls the voltage and current settings of the slave device. The output is also turned on and off simultaneously. The backside of connected supplies is described in figure 4.

![Figure 4](image)

**Figure 4:** Backside of connected supplies. The devices are connected to each other by a signal cable. The devices can also be connected to computer via RS -cable (in figure) or Ethernet -cable.

2.5.2 OVP
The over voltage protection is the limit of how high the U-set value can be adjusted during use.

2.5.3 U min div
Choose either 0.1 V or 0.01 V as the most accurate voltage adjustment resolution.

2.5.4 I min div
Choose either 0.01 A or 0.001 A as the most accurate current limit adjustment resolution.

2.5.5 Voltage Compensation
The voltage compensation menu can be accessed by pressing the U-knob. Voltage compensation is used for compensating the voltage loss, when using for instance long output cables. Connect load as described and follow the instructions on the screen. Finally the resistance of the shorted leads is displayed and the voltage compensation is done. U-comp displays the voltage loss. If the resistance is larger than 0.5 [Ω], the test fails and the feature is not usable. The current used in this test is 1.5 A and the voltage for a open circuit is 5.0 V. Return to main mode by pressing the DISPLAY -button.

![Figure 5](image)

**Figure 5:** The voltage compensation can be used to compensate the voltage loss in long cables.
2.5.6 System settings
By pressing the U -knob, the system settings menu can be accessed.

![System settings menu](image)

Figure 6: The system setting menu allows the user to change for example the language used.

- Show max-min makes it possible to view Inaximum and minimum voltage and current values during use. These are shown above the actual measured voltage and current values. The values can be reset by pressing and holding either the U or I -knob for two seconds.
- Contrast can be adjusted between 1-100 %.
- Language option can be used to change the system language. Available are Finnish, Swedish and English.
- TCP/IP: Set IP-address from Device Discovery Utility.
- Device Discovery Utility can be found on the software installation CD or at [http://www.digi.com](http://www.digi.com). Ports UDP 161 (SNMP) and UDP 2362 (ADDP) must be open in network.
- RS232: Show RS232-settings. The settings are not changeable. (19200 bps, 8N1)

By pressing the DISPLAY -button the previous menu is accessed. By pressing the DISPLAY button once Inore the adjustment screen is accessed.

2.6 Protection systems
TLP power supplies have both thermal and electronic protection systems.
The electronic protection system restricts the output current e.g. in a case of a short circuit. This is done quickly enough to prevent a hazard.
Also a thermal overload protector (1) is used. When the protector is activated, the button moves outwards. To reset, push the button.
The supply unit is short circuit protected and the output is floating.

2.7 Software
TLP voltage sources can be controlled by TeklabNet software. Read more about PC – controlling from the software manual.

3 Technical information
Operating voltage: 230 V AC, 50 Hz
Operating environment:
- Temperature: 10 - 40°C
- Altitude: < 2000 m
- Humidity: < 80 %
Ventilation: No special needs for ventilation under operating circumstances
Protection systems: 1.5 A thermal overload protector, electronic controlled output
Ripple: < 8 In Vpp
Resolution: 0.01 V /0.001 A
Measurement accuracy: ± 0.03 V / ± 0.006 A
Dimensions: TLPx: Yz -I1odule, 125(W) x 200(H) mm, TLPxD: full module, 250(W) x 200(R) mm

FLOATING OUTPUTS:

TLP305
Output voltage: 0-31 V, maximum current 5.05 A, max 150 W

TLP305D
Output voltage: 2 x 0-31 V, maximum current 5.05 A from both outputs, max 300 W.

TLP603
Output voltage: 0-31 V: maximum current 5.05 A, 31-61 V: maximum current 3.05 A, max 180 W

TLP603D
Output voltage: 2 x 0-31 V: maximum current 5.05 A from both outputs, 2 x 31-61 V: maximum current 3.05 A from both outputs, max.360 W.

Users manual
DYM6101 Digital multimeter

1 DYM6101 digital multimeter
1.1 Safety rules and precautions
• Check that there is no damage in the test leads before using the instrument
• The input voltage and current cannot exceed the range stipulation
• The common mode voltage between COM (public end of meter measurement) and the voltage to earth cannot exceed 1000 V
• The fuse should be replaced only with the same type of fuse
• Sound alarm will be automatically heard if the test leads are connected to the wrong terminals compared to the selected measuring function.
1.2 Measurements

DC voltage

1. Select the DC voltage range
2. Connect the test leads to the terminals as shown
3. Connect the test leads to the circuit

AC voltage

1. Select the AC voltage range
2. Connect the test leads to the terminals as shown
3. Connect the test lead to the circuit
**DC current**

1. Turn off power from the measurement circuit
2. Select the DC 10 A current range and connect the test leads to the terminals as shown
3. Open the circuit and connect the meter in series with the load
4. Turn on power to the measurement circuit and read the values

*Note! When using other ranges than 10 A, change the range and test lead connection accordingly. Be sure that the current isn't higher than the used range. Too high current will blow the fuse (5). If the fuse is blown, replace it with same type of fuse. WARNING! Never connect the meter in parallel with a voltage source!*

**AC current**

1. Turn off power from the measurement circuit
2. Select AC current 10 A range and connect the test lead to the terminals as shown
3. Open the circuit, and connect the meter in series with the load
4. Turn on power to the measurement circuit and read the values

*Note! When using other ranges than 10 A, change the range and test lead connection accordingly. Be sure that the current isn't higher than the used range. Too high current will*
blow the fuse (5). If the fuse is blown, replace it with same type of fuse. WARNING! Never connect the meter in parallel with a voltage source!

Resistance

1. Turn off the power from the measurement circuit. Never measure across voltage circuit.
2. Select Ohm-range and connect the test leads to the terminals as shown.
3. Connect the test leads across the resistance to be measured.

1.3 Specifications
Display: 3 ½ digits, max. reading 1999

<table>
<thead>
<tr>
<th>DC voltage</th>
<th>Accuracy ± (% of reading + digits)</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 mV</td>
<td>± (0.5 % + 2)</td>
<td>100 μV</td>
</tr>
<tr>
<td>2 V</td>
<td>± (0.5 % + 2)</td>
<td>1 mV</td>
</tr>
<tr>
<td>20 V</td>
<td>± (0.5 % + 2)</td>
<td>10 mV</td>
</tr>
<tr>
<td>200 V</td>
<td>± (0.5 % + 2)</td>
<td>100 mV</td>
</tr>
<tr>
<td>1000 V</td>
<td>± (1 % + 2)</td>
<td>1 V</td>
</tr>
</tbody>
</table>

Input impedance: All ranges 10 MΩ

Over-load protection: the ranges of 200 mV are DC 300 V, other ranges are DC 1000V

<table>
<thead>
<tr>
<th>AC voltage</th>
<th>Accuracy ± (% of reading + digits)</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 mV</td>
<td>± (1 % + 2)</td>
<td>100 μV</td>
</tr>
<tr>
<td>2 V</td>
<td>± (1 % + 2)</td>
<td>1 mV</td>
</tr>
<tr>
<td>20 V</td>
<td>± (1 % + 2)</td>
<td>10 mV</td>
</tr>
<tr>
<td>200 V</td>
<td>± (1 % + 2)</td>
<td>100 mV</td>
</tr>
<tr>
<td>750 V</td>
<td>± (1.5 % + 5)</td>
<td>1 V</td>
</tr>
</tbody>
</table>

Input impedance: All ranges 10 MΩ

Over-load protection: the ranges of 200 mV are AC 220 V, other ranges are AC 750V

Frequency range: 40 Hz-400 Hz (the ranges of 750 V are 40 Hz-100 Hz)

Display: average value response (effective value calibration for sine wave)
DC current

<table>
<thead>
<tr>
<th>Range</th>
<th>Accuracy ± ( % of reading + digits)</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 μA</td>
<td>± (1 % + 2)</td>
<td>0.1 μA</td>
</tr>
<tr>
<td>2 mA</td>
<td>± (1 % + 2)</td>
<td>1 μA</td>
</tr>
<tr>
<td>20 mA</td>
<td>± (1 % + 2)</td>
<td>10 μA</td>
</tr>
<tr>
<td>200 mA</td>
<td>± (1.5 % + 2)</td>
<td>0.1 mA</td>
</tr>
<tr>
<td>10 A</td>
<td>± (2 % + 5)</td>
<td>10 mA</td>
</tr>
</tbody>
</table>

AC current

<table>
<thead>
<tr>
<th>Range</th>
<th>Accuracy ± ( % of reading + digits)</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 μA</td>
<td>± (1.5 % + 2)</td>
<td>0.1 μA</td>
</tr>
<tr>
<td>2 mA</td>
<td>± (1.5 % + 2)</td>
<td>1 μA</td>
</tr>
<tr>
<td>20 mA</td>
<td>± (1.5 % + 2)</td>
<td>10 μA</td>
</tr>
<tr>
<td>200 mA</td>
<td>± (2 % + 2)</td>
<td>0.1 mA</td>
</tr>
<tr>
<td>10 A</td>
<td>± (2 % + 5)</td>
<td>10 mA</td>
</tr>
</tbody>
</table>

Protection: 250 mA fuse for other current range

Frequency range: 40 Hz-400 Hz

Display: average value response (effective value calibration for sine wave)

Resistance

<table>
<thead>
<tr>
<th>Range</th>
<th>Accuracy ± ( % of reading + digits)</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 Ω</td>
<td>± (1 % + 4)</td>
<td>0.1 Ω</td>
</tr>
<tr>
<td>2 kΩ</td>
<td>± (1 % + 2)</td>
<td>1 Ω</td>
</tr>
<tr>
<td>20 kΩ</td>
<td>± (1 % + 2)</td>
<td>10 Ω</td>
</tr>
<tr>
<td>200 kΩ</td>
<td>± (1 % + 2)</td>
<td>100 Ω</td>
</tr>
<tr>
<td>2 MΩ</td>
<td>± (1 % + 2)</td>
<td>1 kΩ</td>
</tr>
<tr>
<td>20 MΩ</td>
<td>± (1 % + 8)</td>
<td>10 kΩ</td>
</tr>
<tr>
<td>200 MΩ</td>
<td>± (2 % + 10)</td>
<td>100 kΩ</td>
</tr>
</tbody>
</table>

Limitation: protection capability when voltage input wrongly: AC 220 V

Diode measurement

<table>
<thead>
<tr>
<th>Reverse voltage</th>
<th>Display</th>
<th>Forward current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approx 3 V</td>
<td>Forward voltage drop of diode</td>
<td>Approx 1 mA</td>
</tr>
</tbody>
</table>

Limitation: protection capability when voltage input wrongly: AC 220 V

Break-make measurement

<table>
<thead>
<tr>
<th>Open circuit voltage</th>
<th>Threshold value of alarm sound</th>
<th>Output current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approx 3 V</td>
<td>Approx 50 Ω</td>
<td>Approx 1.0 mA</td>
</tr>
</tbody>
</table>

Limitation: protection capability when voltage input wrongly: AC 220 V
**Battery voltage measurement**

<table>
<thead>
<tr>
<th>Range</th>
<th>Load current</th>
<th>Input end protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 V battery</td>
<td>Approx 150 mA</td>
<td>MA fuse</td>
</tr>
<tr>
<td>9 V battery</td>
<td>Approx 8 mA</td>
<td>PTC thermistor</td>
</tr>
</tbody>
</table>

1. The difference of battery voltage measurement and general voltage measurement is that, the general voltage measurement has high input impedance; and it's only used to measure the open circuit voltage of battery and check the battery and electricity connections, it must be measured under load state.

2. mA jack input is employed for 1.5 V battery has low voltage but high load current. mA fuse shall be blown if the voltage is input wrongly.

3. 9 V battery employs voltage jack input, limit protection capability: AC 220 V.

---

**LF-8000 Soldering/Desoldering Station**

**KEY FEATURES**

EXTERNAL CALIBRATION PORT: The LF-8000 has two calibration ports on the front panel for both soldering/desoldering for quick and convenient precision temperature adjustments.

DELAYED SUCTION: To eliminate the problem of solder clogging up the tip, a delayed switch feature has been incorporated for the unit that allows the pump to continue sucking for 1.5 seconds after the actuator switch is released.

*LIGHTWEIGHT SOLDERING IRON: Ergonomic mini handle that stays cool and prevents operator fatigue.

*OPTIONAL TWEETERS: This additional feature is specially designed for SMD chips, SOT, Flat pack ICs’ etc. rework. Tweezers TWZ100 is equipped with 32V/50W x 2 conventional nichrome heater, which can be interchangeable with soldering iron 210ESD as an option.

*ENERGY SAVER: After the station has been idle for more than 15 minutes, this new feature will automatically kick in. When the “Pause” LED is lit, the energy saver feature has engaged, decreasing tip temperature by 1/3 which cuts power consumption and extends tip life.

* CELSIUS/FAHRENHEIT SWITCH: To address the global market place, a convenient switch has been incorporated to easily convert from one common measure to another.

**PRODUCT DESCRIPTION**

LF-8000 operates basically the same as the standard digital readout 988D but with the high power 32V/100W soldering and desoldering irons which are specially designed for lead-free soldering works to meet RoHS requirement.

This unit built in a self-contained, oil free, maintenance free, and quiet running vacuum pump which is electronically controlled and will not overload with continuous use, eliminating the need for additional shop air. The vacuum pump provides up to 50cm/Hg (20in/Hg) suction power, activated by a push button switching circuit located on the desoldering iron housing. Internal solder collector in handpiece is quickly and easily removed for cleaning. The inside mesh aluminum cooling strip has better solder chip adherence. Also the ventilation slots makes for a cooler handle, improving operator comfort.

LF-8000 incorporates electronic circuitry which enables the user to fine tune soldering tip temperature from 200°C (392°F) through 450°C (842°F) and desoldering tip temperature from 300°C (572°F) through 450°C (842°F) without changing tips or heating elements. Both soldering and
desoldering irons are equipped with a precision would nichrome heating elements, both offer 32V/100W output. Also there is an optional fume extraction kit can be equipped easily on the soldering iron.

The temperature is maintained within +/-3°C (+/-6°F) of its operating temperature by a thermocouple sensor to ensure maximum temperature as close to the working surface of the tip as possible. This results in both a rapid heat up, fast recovery and exacting temperature control with minimal overshoot. The ergonomic and slender soldering iron design with a comfortable silicone rubber grip prevents operator fatigue.

The revolutionary “Zero Voltage” electronic switching design also protects voltage and current sensitive components (CMOS devices etc.) against damaging current and transient voltage spikes commonly produced by less efficient, mechanically switched stations. The power unit is isolated from the A.C. line by a transformer and allows 32Vac for soldering and desoldering to drive the heating elements. Both soldering and desoldering are constructed with an individual calibration port locating under the digital display on the face of the unit for quick and convenient precision temperature adjustments.

The new LF-8000 has been developed to meet the present and future needs of the electronic production industry and is ideal for use at any AC outlet. Engineered to meet the demanding needs of the hobbyist, service & repair technician as well as production people alike.

**WORKING TEMPERATURE**

To meet RoHS requirements, the common 60/40 lead solder alloys are not allowed in the production process. Lead free solder alloys require a working temperature of 30°C (54°F) higher than previous generation electrical soldering. The working temperature of solder is detailed below and can vary from manufacture to manufacture.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Melting point</td>
<td>220°C (428°F)</td>
</tr>
<tr>
<td>Normal operation</td>
<td>300-360°C (572-680°F)</td>
</tr>
<tr>
<td>Production line operation</td>
<td>360-410°C (680-770°F)</td>
</tr>
</tbody>
</table>

When the soldering iron’s working temperature is set within the parameters suitable for the type of soldering being used, a good joint assured. Too low of a temperature will slow the rate of solder flow while a high temperature setting might burn the flux in the solder and emit a heavy, white smoke resulting in a dry joint or permanent damage to the printed circuit board (P.C.B) and may also shorten tip life.

**IMPORTANT**: The temperature above 410°C (770°F) is not recommended for normal soldering functions, but can be used for short periods of time when high temperatures are required.

**OPERATING INSTRUCTIONS**

**OPERATING PROCEDURES FOR LF-8000:**

1. Ensure that the working voltage matches your power supply before beginning use.
2. Check carefully for any damage during transportation.
3. This unit contains:
   A: DIA80: Desoldering iron assembly with tip.
   B: 210ESD: Soldering iron assembly with tip.
   C: Two iron holders with tip cleaners for both soldering and desoldering.
   D: AC Power cord with plug.

Accessories included:
   a. One cleaning brush
   b. One cooling strip
3. One 0.7φ probe
4. Optional parts:
   A) TWZ100: 32V/100W Tweezers can be interchangeable with 210ESD soldering iron.
   B) Fume extraction kit: For soldering iron only
   C) HAP80: 32V/100W Hot air blow pencil can be interchangeable with DIA80.

OPERATING PROCEDURES
1. Ensure that the base unit’s power switch is in the ‘OFF” position.
2. Plug in “Solder and Desolder” wands, connect “Vacuum tube” to “VAC”.
3. Connect AC power cord to mains “In-Let”.
4. Set “Temperature control knobs” to “MIN”.
5. Switch “Mains power switch” to “ON” position, then switch both “SOLDER & DESOLDER” switches to “ON” position, both pilot lamps will be “ON”.
6. Tin the surface of both soldering and desoldering tips by applying a new covering of solder to protect it.
7. Set both “Temperature control knobs” to the desired temperature about 3 minutes after being warmed. The unit will be ready for use once it reaches preset temperature – indicated by the pilot light going off.
8. A slide switch below the digital display allows the operator to toggle between Fahrenheit and Celsius temperature readout.
9. You can preset the temperature setting by pushing the slide switch to “SET”position. Use the temperature controlled knob to set the desired temperature.
   Then slide the switch to “READ”. The temperature will then maintain a +/-3°C (+/-5°F) with the display showing actual tip temperature.

PLEASE NOTE:
1. Both soldering, desoldering irons can be used at same time.
2. If LF-8000 is idle for more than 15 minutes, an energy saving feature will automatically engage (evident by the green “PUASE” indicator light), reducing idle temperature by 1/3 and extending your tip life. Activating the red suction button on the desolder handle will disengage the power saving feature and the unit will immediately ramp up to the preset temperature.

CAUTION: Do not touch any of the irons at any time while the unit is on or while it’s cooling as they will still be hot.

NEW FEATURE FOR LF-8000
There is a calibration port on the front panel for both soldering and desoldering under the digital readout. This calibration is to be used in conjunction with an external thermometer. Place the tip on the thermometer, if the actual tip temperature reads higher or lower than the display on the thermometer temperature, then using a 2mm precision screwdriver to calibrate the temperature. Both soldering and desoldering sides if turning clockwise that the actual tip temperature will be up (+). Counter clockwise will let the tip temperature down (-).

SOLDERING
1. Temperature above 410°C (770°F) should not be used for normal soldering purposes. However, iron can be used for short periods of time when occasion demands, but should be used with caution.
2. See the OPERATING PROCEDURES section of this manual for tip replacement.
COMMON CAUSES FOR TIP FAILURES
1. Tip temperatures higher than 410°C (770°F).
2. The tip working surfaces are not tinned while the iron idling.
3. Lack of flux in soldering, wicking, repair, and touch-up operations.
4. Wiping the tip on a high sulfur content, dirty or dry sponge.
5. Contact with organic substances such as plastic, resin, silicone, grease and other chemicals.
6. Impurities in the solder and/or low tin content.

CARE OF TIPS
CAUTION: The soldering, desoldering irons can reach very high temperature. Be sure to turn the unit off prior to carrying out any maintenance or trouble shooting steps listed below!

IMPORTANT:
Remove the tip and clean after each moderate to heavy use or daily for light usage.
Remove any loose build up in the tip retaining assembly to prevent tip freezing.
Both solder, desolder tips supplied are iron clad copper and if used properly should maintain optimum life.
1. Always tin the tip before returning it to the holder, turning off the station, or storing it for long periods of time. Wipe the tip on a wet sponge or our tip cleaner 460 prior to use.
2. Keeping the iron set at high temperatures (more than 400°C or 750°F) will shorten tip life.
3. Do not use excessive pressure on the tip or rub the joint with the tip while soldering and/or desoldering, it does not improve the heat transfer and may damage the tip.
4. Never clean the tip with a file or abrasive materials.
5. Do not use fluxes which contain chloride or acid. Use only rosin or resin activated fluxes.
6. If an oxide film forms, it can be removed by careful buffing with 600-800 grit emery cloth, isopropyl alcohol or equivalent and then the tinned areas with rosin-core solder after the resin-core has melted.

NEW TIPS
Applying the following steps give the tip optimum life.
1. Set both temperature to min. then turn the main power switch to the “ON” position.
2. Set soldering tip temperature to 250°C (500°F approx.) and desoldering tip temperature to min. Coat the tinned surfaces with rosin-core solder after reaching 250°C.
3. Set to the desired temperature about 3 minutes after being warmed that the station will be ready for use once it reaches preset temperature.

IMPORTANT: Remove and clean the tip daily. If a new tip is installed, remove any loose build up ion the tip and barrel assembly, otherwise the tip may fuse to the heating element or retaining barrel.

10 MHz Function Generator
HM8030-6
Frequency range 50 mHz . . . 10 MHz, 
Output voltage up to 10 Vpp (into 50Ω) 
Waveforms: sine, trinagle, square wave, puls, DC 
Distortion factor <0.5% up to 1 MHz, rise and fall time typ. 15 ns 
Internal and external sweep, FM (with HO801) 
Surge- and short-circuit-proof output 
Mainframe HM8001-2 required for operation 

Safety 
This instrument has been designed and tested in accordance with IEC Publication 1010-1, Safety requirements for electrical equipment for measurement, control, and laboratory use. It corresponds as well to the the CENELEC regulations EN 61010-1. All case and chassis parts are connected to the safety earth conductor. Corresponding to Safety Class 1 regulations (three-conductor AC power cable). Without an isolating transformer, the instrument's power cable must be plugged into an approved three-contact electrical outlet, which meets International Electrotechnical Commission (IEC) safety standards. 

Warning! 
Any interruption of the protective conductor inside or outside the instrument or disconnection of the protective earth terminal is likely to render the instrument dangerous. Intentional interruption is prohibited. 

The instrument must be disconnected and secured against unintentional operation if there is any suggestion that safe operation is not possible. 

This may occur: 
– if the instrument shows visible damage, 
– if the instrument has loose parts. 
– if the instrument does not function, 
– after long storage under unfavourable circumstances (e.g. outdoors or in moist environments), 
– after excessive transportation stress (e.g. in poor packaging). 

When removing or replacing the metal case, the instrument must be completely disconnected from the mains supply. If any measurement or calibration procedures are necessary on the opened-up instrument, these must only be carried out by qualified personnel acquainted with the danger involved. 

Operating conditions 
The ambient temperature range during operation should be between +5°C and +40 °C and should not exceed −20 °C or +70 °C during transport or storage. The operational position is optional, however, the ventilation holes on the HM8001-2 and on the plug-in modules must not be obstructed.

TBS1000B-EDU Series Digital Storage Oscilloscope 
The instrument includes a 7-inch WVGA TFT color display, up to 2 GS/s sampling rate, bandwidths from 50 MHz to 200 MHz, dual channel frequency counters and a 5 year standard warranty, just a few of the features that make the TBS1000B-EDU the industry's best-value entry level oscilloscope for educational activities.
Key performance specifications

- 200MHz, 150 MHz, 100 MHz, 70 MHz and 50 MHz bandwidth models
- 2-channel models
- Up to 2 GS/s sample rate on all channels
- 2.5k point record length on all channels
- Advanced triggers including pulse and line-selectable video triggers

Key features

- 7 inch WVGA (800X480) Active TFT Color Display
- 34 automated measurements
- Dual window FFT, simultaneously monitors both the time and frequency domains
- Integrated Courseware feature
- Dual channel frequency counter
- Zoom Function
- Autoset and signal auto-ranging
- New affordable 50 MHz TPP0051 passive probes
- Multiple-language user interface
- Small footprint and lightweight - Only 4.9 in. (124 mm) deep and 4.4 lb. (2 kg)

Connectivity

- USB 2.0 host port on the front panel for quick and easy data storage
- USB 2.0 device port on rear panel for easy connection to a PC

Seeing signal details

To properly analyze signals you need to make sure that you can see them in enough detail. The TBS1000B-EDU comes standard with a 7-inch high resolution TFT display for a clear view of all of your signals and critical on screen information. The instrument is further enhanced by a user interface inspired by the award winning Tektronix MSO/DPO series of instruments. The interface is easy to use, provides quick access to all of the oscilloscope functions and includes a high resolution "Pan & Zoom" feature enabling you to see even more signal details of up to 10 times normal resolution.

The zoom function shows details in an event of up to 10X the normal view.
**Digital precision for accurate measurements**

With up to 200 MHz bandwidth, 2 GS/s maximum sample rate and 3% vertical measurement accuracy the oscilloscope allows you to see all of your signals details. With the Tektronix proprietary sampling technology there are no compromises, you will get the stated real-time sampling rate on all channels, all the time with at least 10X oversampling. The sampling performance is not reduced when changing horizontal settings or when using multiple channels, enabling you to see the true characteristics of your signals.

See all the details other oscilloscopes might miss with Tektronix proprietary digital real-time sampling.

**Critical tools for troubleshooting your device**

The TBS1000B-EDU oscilloscope enables students to learn about the advanced triggers used to debug today's complex circuitry. Standard rising or falling edge, pulse width and video trigger set-ups will allow students to quickly isolate signals of interest and investigate alternative triggering options using the flexible trigger set-up menus.

The pulse trigger function can easily capture critical events. Once signals are captured, the TBS1000B-EDU offers advanced math and measurement capabilities making it easy to evaluate signal quality. Users can quickly add, subtract and multiply waveforms or use any one of 34 automated measurements to quickly and reliably calculate important signal characteristics such as frequency, rise time or overshoot.
Quickly analyze signals with the standard 34 automated measurements. For advanced frequency analysis, a dedicated front panel button provides quick access to the FFT function that can show both frequency and time domain waveforms simultaneously, providing the student with a convenient way to understand the relationship between their signals and the FFT results.

Quickly perform an FFT with a dedicated front panel button.

To further enhance the teaching process, the oscilloscopes "Autoset" function can be disabled. For those beginning labs where it is important for a student to learn the basic operation of the oscilloscope, disabling Autoset will help them apply their knowledge of an oscilloscope's operation instead of taking shortcuts with the Autoset button. This feature is password controlled so Autoset can be disabled or enabled by accessing the Autoset screen in the Utility menu.

The "Autoset" function can be disabled or enabled by entering a password in the Utility menu.

The TBS1000B-EDU also comes with built-in dual channel frequency counters. Independent control of each counter's trigger level provides an easy way to monitor two different signal frequencies simultaneously.
Dual channel - 6 digit frequency counters come standard with all TBS1000B-EDU models.

Current safety guidelines have been compiled using materials from TEKLAB. [http://www.teklab.fi/download/manuals.aspx](http://www.teklab.fi/download/manuals.aspx)

**DURING THE LABORATORY WORK**

- Use all the tools and equipment in the manner prescribed for them.
- Working with electrical equipment power supply circuit make sure that the circuit is disconnected from power.
- During working under specialized lighting appropriate protective goggles must be worn.
- When working near camera system setup, beware of protruding parts of the structure in order to avoid injury. Dangerously protruding structures must be visibly marked.
- Be careful when working with sharp work equipment. Cutting equipment should be used only for purposes that are prescribed for them.

**After completion of work**

**After completion of work make sure to:**

- Disconnect equipment from electrical power supply.
- Clean up the work place and put the tools used back in their places.
- All dangers and deficiencies have to be reported to the management of the structural unit immediately.
**Ergonomics**

Work associated with a lot of movement and stretching of muscles shall be usually performed in a standing position. Avoid bending your back if working in standing position. If a person leans forward or to one side, his or her leg, back and shoulder muscles are under constant tension.

When the person straightens himself or herself again, he or she feels pain in his or her back as if his or her back has stiffened in the bent position. It is impossible to stand in a relaxed position, if the height selected is not correct.

Work height is a very important factor. If the selected height is incorrect, the body will get tired very quickly. Work height should be such that work could be carried out without bending the back and by keeping the shoulders in the right and relaxed position.

Work should be carried out by holding your hands in their natural position, as close to the body as possible.

**Acting in case of risk of accident or fire**

Accidents/injuries and fires that have occurred during laboratory work must be immediately reported to the supervisor. Appropriate measures must be taken in accordance with the type of the accident.

In the event of an accident where there is a victim, the victim must be removed from the danger area, if necessary, call first aid assistants or ambulance (call 112), arrange first aid to be given to the victim.

In the event of a serious accident, the workplace and equipment shall be kept untouched until the work environment specialist, representative of the labor inspection or the police arrives, and gives permission to continue work.

If the equipment or workplace cannot be kept untouched, their condition must be captured at the time of the accident.

In case of a serious and imminent risk of an accident, employees shall take steps according to their knowledge and the technical means at their disposal to avoid possible consequences even if their immediate superior cannot be contacted at once.

In case of a serious and unavoidable risk of an accident, the employees must leave their workplace quickly and safely. An employee who leaves his or her workplace or the danger area in case of a serious or unavoidable risk of an accident without permission shall not be punished or placed at any disadvantage.

Accident at work is classified according to the severity of the accident: a mild, severe or fatal accident at work. The victim must inform the head of the structural unit and the chief specialist of the work environment of the accident at work as soon as possible. If the victim turns to a health care facility for help, the healthcare worker should be told that the accident happened at work.

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In case of fire, safety of people and their quick evacuation or rescue form the hazardous area must be ensured.
A person who discovers fire is obliged:

- to immediately call the Emergency Response Centre (phone number 112) to inform where the fire has broken out, what is burning, tell his or her surname and the phone number used to provide information and to answer the questions asked by the rescue official;
- to warn the people in danger;
- to close the doors and windows and switch off the ventilation to prevent spreading of fire;
- to start extinguishing the fire as far as possible.

When the fire fighting and rescue team arrives at the scene, the person who discovered the fire or the representative of the possessor of the site shall inform the team leader of the following:
- the source and extent of the fire;
- the potential hazard to people;
- other potential hazards arising from the fire (explosions, hazardous chemicals, electrical equipment, etc.).

Fire in the building can be discovered by:
- employee or student who notices signs of fire;
- ATS, which responds to emerging smoke or temperature, which results in fire alarms going off, i.e., order to evacuate.

In the event of fire, it is important that the location and extent of the fire are identified before the emergency call. This is necessary because fire detected at the initial stage can be extinguished with manual fire extinguishers.

If a fire is detected which cannot be extinguished or the access to the place where fire is burning is life-threatening due to thick smoke or heat, emergency call 112 must be urgently activated if the ATS has not started. Then launch the ATS manually.

Operating instructions for employees in case of fire
The main tasks of the employee in detecting a fire is to quickly locate location of fire, make an emergency call, launch evacuation message, extinguish the fire.

1. Stop immediately any current activities.
2. Take the nearest fire extinguisher and move to the area where you notice smoke or flame and find out the exact location and extent of fire.
3. Point people away from the danger area.
4. Extinguish the fire (is possible if can be done with one fire extinguisher).
5. Avoid inhalation of smoke gases as they are toxic.

If the fire could not be extinguished or is dangerous:

1. Get immediately out of the burning room.
2. The teacher directs the students to the nearest safe exit and leaves the room last.
3. Close the doors and windows (but do not lock them).
4. Call 112 (do not be afraid of duplication) and say:
   - WHAT happened (FIRE)
   - WHERE it happened (Tallinn, Ehitajate tee 5, Tallinn University of Technology, building, floor, room)
   - Are there any victims?
   - Your name and phone number
   - Stay calm, answer briefly and accurately
• Follow the instructions
• If the situation changes significantly before the arrival of the rescuers, report this to number 112

5. When the ATS starts up, the Rescue Service will get the call and the Security Service gets information, after which the security vehicle will arrive at the scene and takes over the command.
6. If the ATS and the alarm signal are not automatically triggered, turn on the alarm by pressing the fire alarm button located in the corridor.
7. Help people who are in danger from a dangerous place without endangering yourself.
8. Inform people nearby of the fire.
9. Move around as safely as possible.
10. Give the emergency team responders necessary information
11. Notify your direct superior
12. If you had called the Rescue Service, but ATS did not launch (no automatic triggering), forward this information to TTÜ Security Service tel. 6202112

Evacuation procedure

Evacuation of the building is mandatory immediately after seeing signs of fire, ATS alarm going off, or after receiving an evacuation order.

Employee orders

Employee orders after getting evacuation notice
1. Stop immediately whatever you’re doing.
2. Close the doors and windows.
3. The teacher directs the students to the nearest safe exit and leaves the room last.
4. Help people with special needs get out safely.
5. Exit the building;
6. Give the emergency team information.

Tips in case you find yourself in a critical situation (you are in need of a rescue):

• try to maintain self-control and be calm;
• open the windows, announce yourself, shout for help;
• If the fire has cut off the exit path, do not try to break through the fire (the same applies to thick smoke);
• When moving in a smoke-filled room or in the corridor, do not stand upright, but move along the wall either down on hands and legs or crawl, because the smoke is less thick near the floor and
• If you do not know where the fire is located, remember to carefully touch the door handle and surface of the door before opening the door to check their temperature;
• If you open the door, always stay behind the door or stay next to the wall.

FIRST AID

All over the university there are marked first aid kits (white cross on green background).
The University has first aid assistants (those who have completed the relevant medical training) who are responsible for providing first aid in their work post. The list of first-aiders is on the stands and on the university’s in-house web site.
Health injuries requiring medical intervention at the university are usually occupational accidents (falls, slipping, incisions, crusts, traumatic trauma, burns, etc.) and various individual health problems (blood pressure and heart disease, hereditary diseases, asthma, etc.).

First aid must be given to those who need it. If you do not have the first-aid skills and sufficient courage to apply them yourself, call the first-aid provider, make emergency call 112 or take the victim to your nearest health care facility (Emergency Medicine Department, EMO).

We will solve the simplest health problems, we do not always have to call an emergency medical aid. Definitely call 112 if the victim is unconscious and does not breathe normally; at the same time, you must also start with a heart massage and revitalization, make sure you do the heart massage without stops (for a stranger, generally, no artificial respiration is performed).

**If a person has appropriate training 30 times the cardiac massage is given + 2 times of artificial respiration.**

**If the AED (defibrillator) is nearby, use it!**

AED (automated external defibrillator; automatic external cardiac pacemaker). This is a widespread technology in the world that allows you to perform an electrical shock, or to restart your heart, in the event of a sudden cardiac death. The use of the device does not require medical education, but is part of the first aid, the device is equipped with voice commands, so it can also be used by someone who has not previously completed first aid course. Turn on the AED and attach the electrodes to the victim. Follow the voice commands.

At TalTech, there are currently two AEDs, one in the lobby of U01 study building and the other in the fitness center.

When stopping bleeding, use disposable gloves, sterilize and cover the wound.

In case of burns, quickly remove clothing from the burning area (but do not remove close that have stuck to the skin). Cool the area with cold water for at least 10 minutes or in case of major burns until the ambulance arrives. Water should not be icy.

For dislocations, nicks, stretches and fractures, use a cold (single use freezing pad in a first aid kit) and then transfer victim to the emergency department. In the case of open bone fracture, you must immediately stop bleeding, placed sterile wrapping on the wound, and then deliver the victim to the emergency department.

**References and current legislation**

Töötervishoiu ja tööohutuse seadus RT I 28.04.2017, 9;
Tuleohutuse seadus RT I 30.12.2015, 52;

**COMPILED BY**

Merle Kutsar
Assistant to manager

An inseparable part of the guide is a signature page
Kinnitan allkirjaga, et olen tutvunud ohutustehnika ja elektriohutuse alaste eeskirjadega laboris NRG201, ja aru saanud täiendavatest instrueerija ................................................ poolt esitatud nõuetest.

Signature will confirm that I am familiar with safety and electrical safety rules in the laboratory NRG201, and understand the additional Instructor ................................................ the claims.

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