FINERO *The Quality Control Company*

User Manual

Leakage Current Tester FST-140

Generalvertretung Deutschland:

TESTEC

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Dear Customer,

Thank you for purchasing Finero test and measurement equipment. Finero is obliged to provide you with the best on the market available test and measurement equipment. The 30 years of Finero experience in most demanding production applications is made available to you in this piece of equipment.

We are confident that this equipment will support your endeavors to keep up the good quality of your production.

If you have any comments about Finero products, software or services I would like to hear of them.

Yours truly,

Risto Vuolle
Chief Executive Officer

Finero Inc.
Kausala, Finland

All information is subject to changes without prior notice.

DELIVERY SCOPE LIST

Although Finero packages the equipment with utmost care you should check the package regarding any delivery damages. If the equipment is damaged you should contact your insurance company directly and inform Finero as well about the matter. Please include photos if possible.

The package should include in minimum following documents and materials:

FST-140	1pc
Mains cable	1pc
User Manual	1pc
Calibration Certificate	1pc

1 TECHNICAL INFORMATION

Type:	FST-140
Serial number:	See the back of device
Size:	483x148x410 (width, height, depth) Designed to 19”-eurorack, height 3U 133mm without legs
Weight:	20 kg
Operation voltage:	230VAC (±10%) 50Hz 1~phase
Operation power:	700VA
Connection:	Cable plug , equipment earth
Main fuses:	3,15A T in mains connector unit External power supply 14A manual resettable fuse inside tester
Environment temperature:	+5°C...+35°C
Environment conditions:	Dry and clean
Output voltage:	0-260V 3A (230-260V 2,5A) from internal power supply External voltage max 300V External voltage max current 14A
Measurement range:	2 range 0...1mA and 0...10mA (standard) Analogy meter reading 0,01mA and 0,1mA Alternatively possible other scaled ranges (change only in factory setting)
Output connections :	In back panel 4mm laboratory sockets
Remote control :	Start, stop, test, fail and safety circuit 24VDC D25-female -connector in back panel
Computer connection (option):	LAN, USB(B), GPIB or RS-232 connector in the back panel
RS485 Interface	To be used for device to device communication between FST-line equipment

2 GENERAL

2.1 FST-140

The protective earth conductor tester or also called ground bond tester is intended for measuring of protective earth conductor resistance or other low resistances of the device under test (D.U.T.). The test can be carried out either by 10A or 25A current.

ANY UNAUTHORIZED OPEING OF THE EQUIPMENT WILL VOID THE WARRANTY.

2.2 FST-140 control modes

The FST-140 can be controlled either locally by means of the front panel buttons, indicators and analogue meter or in automatic test systems by a computer. Other remote control possibilities exist by using the D25 connector in the back panel.

2.3 Calibration

The FST-140 is factory tested and calibrated to meet the accuracy requirements. We recommend to calibrate FST-140 regularly once a year. The equipment may be calibrated in our factory or by other means agreed separately. In the back of the equipment is a replaceable measurement module, which can be sent to calibration.

3 SAFETY PRECAUTIONS

3.1 General

The operator should study carefully the instruction manuals and operation of the FST-140 as well as testing instructions for the product to be tested before starting any tests. As a further safety precaution the operator should be aware of emergency first aid actions. The FST-140 shall only be used strictly according to this user manual. All modifications are not allowed.

3.2 High Current WARNING

The rear panel test connectors have low voltage during the test but due to high current there may occur some sparking in the test connectors. Also care must be taken of heating of the test leads caused by high currents. Therefore use sufficient cable cross section size for test leads. They can be ordered also as an option from Finero.

The FST-140 measures the current in the circuit and shall switch the voltage off if the current exceeds the set current limit, THIS FEATURE CANNOT BE USED AS A SAFETY MEASURE!

NEVER TOUCH THE CONNECTORS OR TEST LEADS IF THE FST-140 IS SWITCHED ON!

4 INSTALLATION

4.1 General

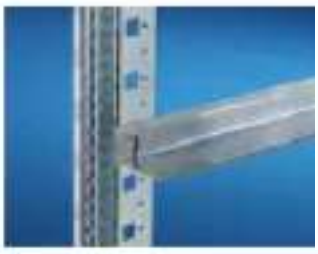
FST-140's depth is about 370mm and connectors need about 150mm space from rear. The handles mounted on the front panel are elevated about 40mm from the panel. The FST-140 is not allowed to be carried from the front panel handles. For carrying FST-140 the handles on the side of the equipment should be used.

The FST-140 can be used in its own case only in dry and clean environment. The ventilation, however, should not be prevented.

4.2 Mounting into 19" Module –Rack or Case

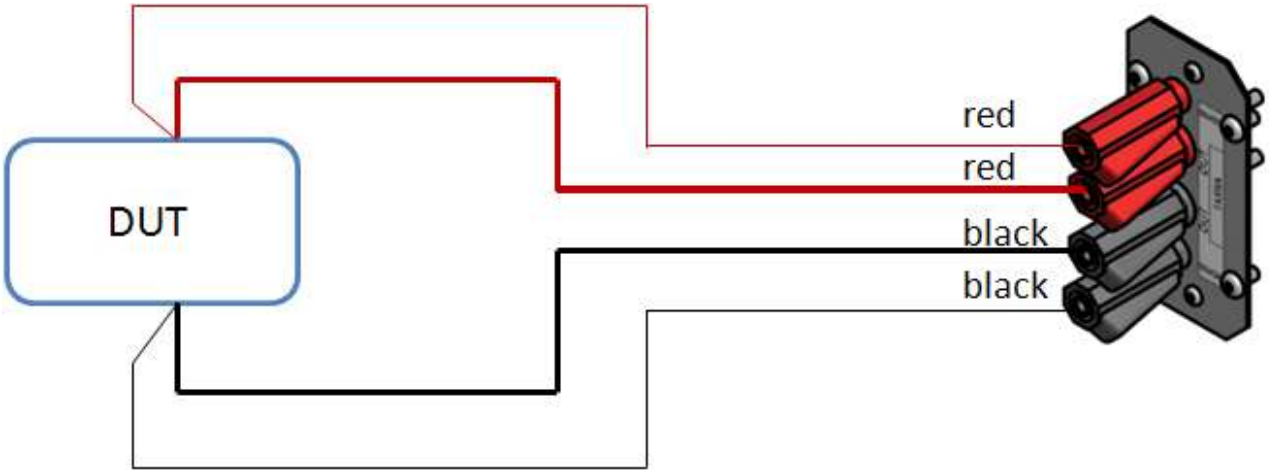
When installed into a rack or a similar case it is mandatory to use mounting rails due to the weight of the device. The holes in the front panel are intended for locking the device in its place not for backing the whole device. If there are legs below of FST-140, they must take off before installation to 19" rack. Care must be taken of the air circulation in the rack in order to avoid temperature rise above +35 °C.

Here are some examples of how build the support for rack installation.



4.3 Connecting to the D.U.T.

There are 4pcs of 4mm sockets are in the back panel. The connections to the D.U.T. are made according to the below figure.



It is possible to use only 2 wires by compromising on measurement accuracy. So Finero recommends to use only 4-wire measurement method.

4.5 Mains supply and Switching On the FST-140

Connect the FST-140 to the mains supply in following order:

- Check that the position of the front panel POWER switch is 0.
- Connect the control and high voltage cables to the FST-140.
- Plug the mains cord to the FST-140.
- Plug the mains cord to a mains outlet
- Switch ON the FST-140

5 MANUAL OPERATION

5.1 General

The manual operation means the use of the FST-140 by the front panel buttons, indicators and display panel. At the end of the manual there is a list of malfunctions with possible causes. Caution, there are high voltage in connectors behind FST-140 while test is ON.

5.2 Buttons and indicators

There are indicators "Test", which blinking when test is switched ON and "Fail" indicator for limit values exceeds. Test voltage switched ON with "Start" –button and switched OFF with "Stop" –button. Also there are selector wheel and "Enter" –button for control menu uses.

Button	**Used for…**
SELECT fly wheel knob	Turn to browse between parameters or select parameter value
ENTER button	Used to confirm
TEST indication	Indicates the TEST is running
Button	**Used for…**
START button	Start the test sequence
STOP button	Stop the test
FAIL indication	Indicates failed test (not passed) and loud buzzer noise will go off simultaneously

5.3 Start-Up

Power is switched on by the "Power" –switch (see 4.5). After switching the unit on calibration information is shown for a few seconds in the panel display.

→ FST-140 set values -- Ready-display

5.4 Setting Parameters

The unit has a set value memory, last time saved values are stored in flash memory (no power needed).

Setting paremeter with FST-line equipment is very easy.

After the READY display, like above please follow the instructions as below.

Setting Parameters with FST

Action	**Result**	**Display**
press ENTER for a few seconds in READY display mode	Parameter setting display	
Turn Flywheel knob to the desired parameter position and press ENTER	Ready to set parameter	
Turn flywheel knob in order to set the desired parameter value	Parameter value selected	
Press ENTER	Set parameter value confirmed	
Move cursor with flywheel knob to the EXIT and press ENTER	Exiting from parameter setting mode	

5.5 Preparation for Service Call

To check program version (for service only): press “Enter” –button when calibration information is shown.

All software version and printed circuit board versions can be seen on the display. This is important information before you contact Finero Service.

5.6 Control menu and commands

During the measurement the measured values as well as after test the last measured values are shown on front panel display.

Menu commands

Parameter	Function and setting range
I-set	Test current (10A or 25A)
R-min	Resistance low limit value (0mΩ… high limit value)
R-max	Resistance high limit value (low limit value…500mΩ)
U-set	Output maximum voltage value (6V or 12V)
Timer	Test time (OFF or 0,3s…60s)
Timer	Test timer clock (OFF or 0,3s…60s)
Save	Setting value stored to memory (Yes or No)
Remote	Manual or Computer operation (Yes or No) (only in computer oper.)
EXIT	Back to “Ready-display” or Parameter setting mode

5.6.1 Selection of current and voltage values

The below table shows the recommended settings for various Ohmic ranges. If the test leads resistance is over 50mOhm it can limit the maximum measurable protective earth conductor resistance. In this case the user should switch to a lower measurement current and higher measurement voltage or replace the test leads with larger cross section leads.

Recommended current and voltage settings:

Measurement range	Test current I-set	Test voltage U-set
0…350mΩ	10A	6V
180…500mΩ	10A	12V
0…100mΩ	25A	6V
0…350mΩ	25A	12V

5.6.4 Use of timer (Timer)

FST-140 has a programmable timer for semiautomatic testing. Timer stops testing automatically when preset time is elapsed. It is still possible to interrupt the test by pressing "stop"-button. This will however result in a "fail"-alarm and "interrupted" text in display. In Timer off –mode test is ON until "Stop"-button is pressed (however never exceeding 120s).

5.7 Testing

The test voltage is switched on by pressing the "Start" -button. The minimum measurement time is recommended at least 1 second.

Test voltage switched off by pressing "Stop" –button (if timer used, then according to timer setting)

After that the measurement can start again with the "Start"-button or return to "Ready" –display by pressing "Stop" –button.

6 ERROR MESSAGES

FST-140 makes alarms if measurements values are not inside set limits.

Errors:

HIGH RES	Resistance value higher than limit value (R-max).
LOW RES	Resistance value lower than limit value (R-min).
INTERRUPTED	Test is stopped by user.
LOW CURRENT	Test current is low. Resistance value is too high or some cables are broken. Test current must be in 10A range 10,5A and 25A range 25,5A. Check I-set and U-set value tables “Recommend current and voltage settings”

7 OPERATION WITH COMPUTER

7.1 General

The FST-140 can be incorporated in an automatic test system providing automatic control and recording of the test results and other applications. Almost all operations are controlled by the computer or easier by using a Finero's specific proprietary application program Safetest. The command list for computer operation mode is appendix of this manual. The control interface, like USB, GPIB, RS232 or Ethernet, is optional and it must be ordered separately factory installed.

All FST-line equipments are delivered standard with RS485 interface. By using this interface all FST-line equipments can communicate with each other.

7.2 Connections

The RS485 connection to other FST-140 must be done by a shielded Cat5 cable (STP) RJ45 (8 pin connector).

Other computer interfaces like USB, GPIB, RS232 and Ethernet, are connected with commercially available and compatible cables. The cables are not part of the delivery scope.

8 REMOTE CONTROL AND LOGIC OPERATION

8.1 General

This means a possibility to incorporate the FST-140 in less sophisticated automatic test systems. The FST-140 operates as in the manual mode but has a provision for extra output contacts for indicators and logic inputs for the control buttons.

8.2 Start-up

Basically the FST-140 will be put into operation as in manual mode. In addition the wiring of the operator connector at the rear is to be done. The connector is a 25-pin D-type female connector. In the main circuit diagram connections of the D25 connector are explained. Maximum output from +25V are 300mA (7,5W).

8.3 Logic Connections

Contacts are available to show state of test and test result. Also there are two additional user programmable outputs.

“Test On” output are on, when voltage is on.

“Fail” output are on, when test current is higher than limit value. At the same time the test is interrupted.

The connector has logic inputs like the start and stop buttons. Also there are two extra inputs, which are possible programmed.

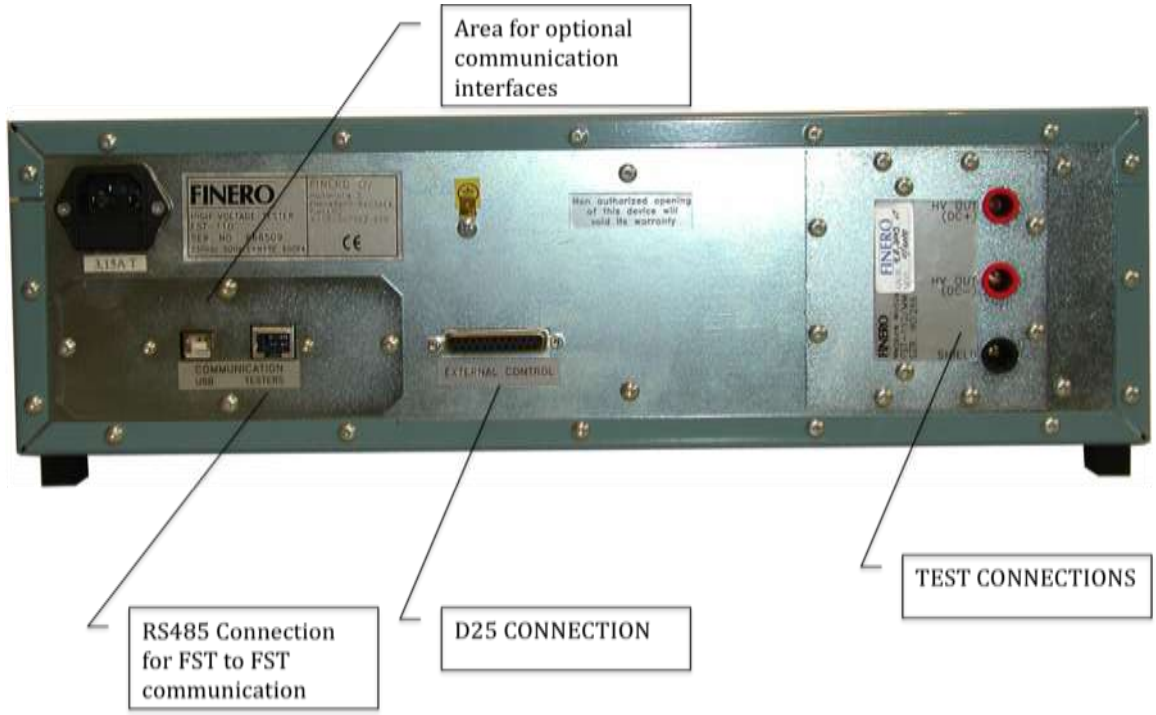
“Start” signal switches the test voltage on.

“Stop” signal disconnects the test voltage.

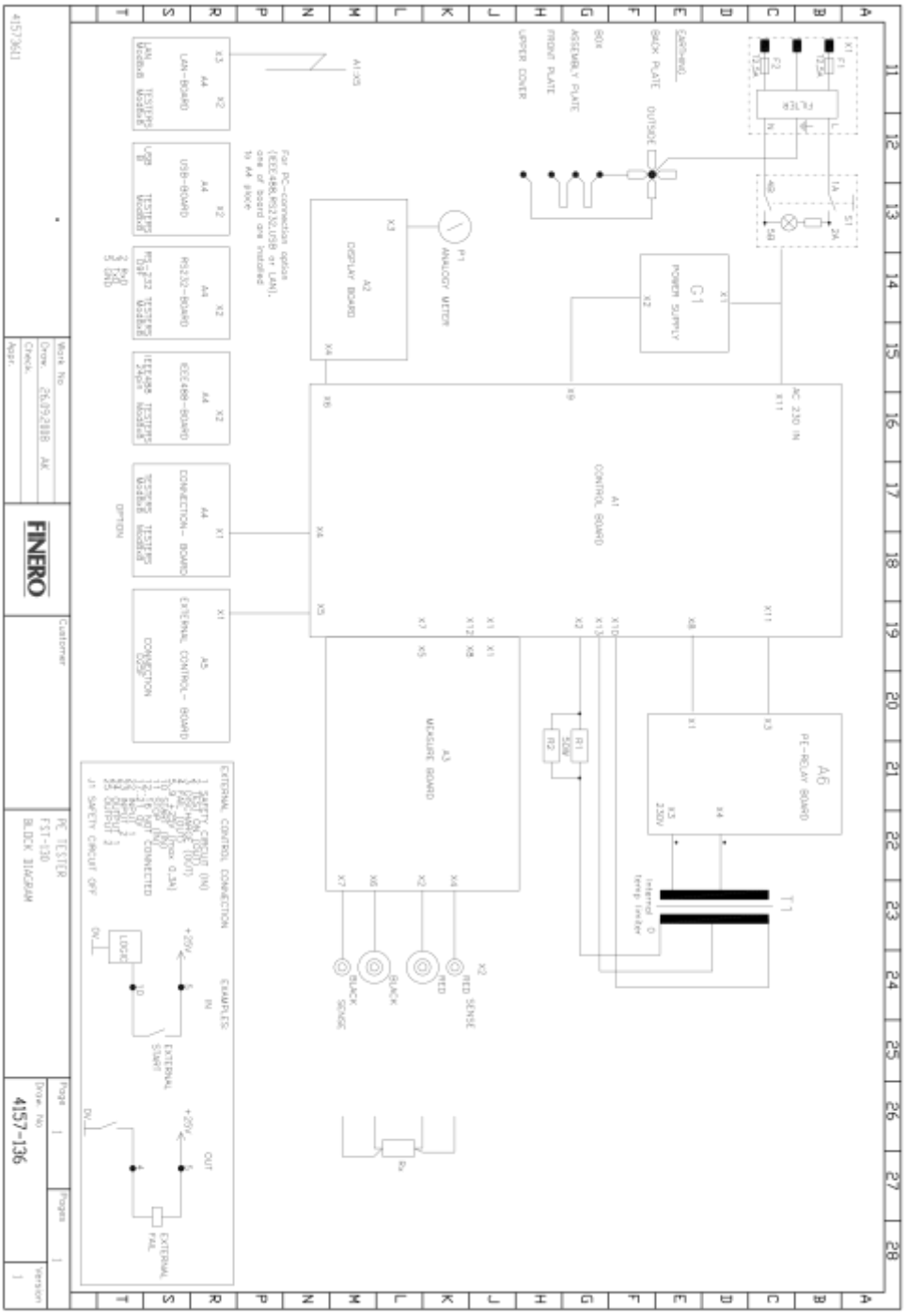
The connector has inputs for the safety circuit, if circuit is open high voltage are not connected. Please see the main circuit diagram for these connections.

9. BACK PANEL OF AN FST- LINE EQUIPMENT

The below picture shows a typical back panel of an FST-line product.



10. MAIN CIRCUIT DIAGRAM



11 FAULT FINDING

No indicator is lit	• Check the power cord connectors are properly plugged at both ends • Check the voltage in the mains socket. • Check the main fuses (F1 and F2) of the FST-140. The fuses are located in the fuse box below the power cord connector. Check the fuse by a multimeter for conductivity and replace with the similar one if necessary.
Indicators are lit but buttons don't function	• Check the safety circuit • Check set values in "Setting" menu.
FST-140 functions but high voltage is missing or voltage output is wrong	• Possibly the temperature switch inside the unit transformer has caused the equipment to stop • Wait for a moment and try again • If the occurs several times please contact Finero Service

If the above remedies do not remove the problem, please contact the Finero Service or Finero authorized service point.

Finero Service

For Service and Support please contact one of our representantives or

Tel. +358 5 752 2200
e-mail: fineroservice@qacontrol.com

12 LIMITED WARRANTY

All of our products and test systems are covered by a standard 12-month warranty period. The warranty period starts on the original shipment date of the product or test system. Our product and test system warranties guarantee that our products will be free from defects in material and workmanship and we will repair or replace any such Finero product or test system we find to be defective.

All new Finero products and test systems are calibrated prior to shipment. Finero products and test systems require annual calibration, if Finero has not given any other written instruction, and Finero accepts only calibrations made by an approved Finero partner or by Finero factory.

If your product during the 12-month warranty period fails to perform as Finero has specified please return the product to the below address or to one of our approved partners.

Warranty work includes parts and labour at Finero's cost, but excludes shipping costs. Finero products returned for warranty repair and found to be in proper working order may be subject to a shipping and handling fee.

Any non-authorized modification, repair, tampering or physical damage or if the product has been subject to gross misuse will void this warranty. Elimination of any connections in the earth grounding system or bypassing any safety systems will void this warranty. Parts subject to wear, such as test probes and leads, are not covered by this product warranty, except where they are deemed to have a manufacturing defect within 60 days of the original shipment of the Finero product.

Except as provided herein, Finero makes no warranties to the purchaser of Finero products and test systems and all other warranties, expressed or implied (including, without limitation, merchantability or fitness for a particular purpose) are hereby excluded, disclaimed and waived.

FINERO SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT CONSEQUENTIAL, INCIDENTAL OR OTHER SIMILAR DAMAGES SUFFERED BY THE PURCHASER OR ANY THIRD PARTY, INCLUDING WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS OR BUSINESS OR DAMAGES RESULTING FROM USE OR PERFORMANCE OF THE PRODUCT OR TEST SYSTEM, WHETHER IN CONTRACT OR IN TORT, EVEN IF FINERO OR ITS AUTHORIZED REPRESENTATIVE HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, AND FINERO SHALL NOT BE LIABLE FOR ANY EXPENSES, CLAIMS, OR SUITS ARISING OUT OF OR RELATING TO ANY OF THE FOREGOING.

Due to continuous development of the products warranty does not include updating of features

When the warranty repair is booked the customer is requested to inform type and serial number of the equipment and description of the malfunction as detailed as possible. The repair shall be carried out in reasonable time during normal working hours. If immediate repair is demanded or done outside of normal working hours the extra costs may be born to the customer account. The warranty repair is done primarily at the manufactures premises.

Return address: Finero Oy, Service and Calibration, Haltonintie 5, FIN-47400 Kausala, FINLAND

ANNEX A

FST-140 ISOLATION RESISTANCE TESTER

COMMAND LIST

NOTICE!

IF YOU HAVE ORDERED A COMPUTER INTERFACE WITH YOUR FST-EQUIPMENT THIS ANNEX IS RELEVANT FOR THE PROGRAMMING

Summary of Tester Commands

RS-parameter : Communication rate 19200, 8 data bits, 1 stop bit, no parity

Tester commands:

LCT	Commands are use to FST-140 leakage current tester
TEST 1	Test option, 1…7
VOLTage 2300	Voltage set value 0…3000 (=0,0…300,0V)
CURRent:RANGe 10	Leakage current range 1 or 10 mA (Analogy meter range)
CURRent:MAXimum 90	Leakage current high limit 1…999 (=0,01…9,99mA)
CURRent:MINimum 50	Leakage current low limit 0…999 (=0…9,99mA, 0=Not use)
TIM 10	Timer 1/10 seconds 0…600 (0=off, 600=60seconds)
ON	Test voltage on
OFF	Test voltage off
ALARm:ON	Tester alarm (software)
ALARm:OFF	Tester alarm off (software)
OUT1:ON	External control OUT1 ON or OFF
OUT2:OFF	External control OUT2 ON or OFF
IDN""	Tester identify code, maximum 20 characters
RES? 1	Results of test A1/1: Leakage current, current, status 1 and voltage
STAT? 2	Tester status of test A1/2
TIM?	Test time and all test time 0…1200 (=0…120sec(safety limit))
OUT?	External controls output status
IN?	External control input status
CAL?	Tester calibration date
VER?	Tester version
IDN?	Tester identify code

Tester commands, specification and examples:

LCT All next commands are use to FST-140 tester (leakage current tester (LCT)).

Example:

LCT;VOLT2300;ON Command to LCT-tester and test voltage are 230V and test on.

TEST m
m=1…7 Select test type (connection), check connections in user manual.

1	A1
2	A2
3	A1+A2
4	B
5	A1+B
6	A2+B
7	A1+A2+B

Example:

LCT;TEST 3 Select test A1 and A2

VOLTage mmmm
mmmm= test voltage Setting test voltage 0…3000 (0V…300V)

Examples:

VOLT 500 Test voltage 50V
VOLT 2300 Test voltage 230V

CURRent:RANGe m Setting leakage current range 1mA or 10mA (Analogy meter display)

m= measuring range

Examples:

CURR:RANG 1 Leakage current range 1mA

CURR:RANG 10 Leakage current range 10mA

CURRent:MAXimum mmm Setting leakage current high limit value 1…999 (=0,01…9,99mA).
mmm=leakage high limit If measurement value exceed high limit, test goes off, tester makes alarm and status 1 bit 1 (FAIL) and status 2 bit 0 (high limit) settings up.

Examples:

CURR:MAX 100 Leakage current high limit 1,00mA
CURR:MAX 999 Leakage current high limit 9,99mA

CURRent:MINimum mmm Setting leakage current low limit value 0…999 (=0…9,99mA) 0=
mmm=leakage low limit not use. If measurement value are under low limit test goes off, tester makes alarm and status 1 bit 1 (FAIL) and status 2 bit 1 (low limit) setting up.

Examples:

CURR:MIN 100 Leakage current low limit 1,00mA
CURR:MIN 900 Leakage current low limit 9,00mA
CURR:MIN 0 Leakage current low limit not use

TIMer mmm Test time in 1/10 seconds (1…600 or 0=off). Test are automatically
mmm=test time off (and status 1 bit 0 (OK) setting up), when setting time are go end. Test time starts, when voltage are in setting value.

Example:

TIM 20 Test time 2 seconds

ON Test voltage on. (same like Start-button). Remove same time ALAR:ON command effect. Reset some status bits (see STAT?).

Example:

LCT;VOLT 230 Commands to LCT-tester,

	TEST 1;CURR:MAX 300 ON	test voltage 230V, test A1, current high limit 3mA, test on

OFF Test voltage off. (same like Stop-button). If test voltage are on before command, then voltage goes off (test ok –display). If test are off before command, tester display setting values (ready –display). Reset some status bits.

Example:

LCT;VOLT 230	Commands to LCT-tester,
TEST 1;CURR:MAX 300	test voltage 230V, test A1,
ON	current high limit 3mA, test on
….	Test time loop
OFF	test stop

ALARm:ON Stops testing and set Fail indicator on and buzzer ringing about 1 seconds. Used for software fail- alarm.

Example: ALAR:ON

ALARm:OFF Tester Fail indicator off

Example: ALAR:OFF

OUT1:ON External control output 1 on

OUT2:ON External control output 2 on

OUT1:OFF External control output 1 off

OUT2:OFF External control output 2 off

IDN ” ” Tester identify code (free setting), maximum 20 characters (not ”-marks). Normal there are tester type and serial number.

Example: IDN "FST-140 sno 556101"

RES? m

m=test result option

Gives test results: leakage current, current, status 1, test time voltage.

Return answer five numbers : aaaa bbbb ccc ddd eeee

aaaa	Leakage current 0…1100 (=0,00…11,00mA). Higher than measure range =16383
bbbb	Test output current 0…2000 (=0…20,00A)
ccc	Status byte 1 (see STAT?)
ddd	Test time from measurement starting 0…600(=0...60s)
eeee	Test voltage 0…3000 (=0,0…300,0V)

Option "m" select which test result are given.

0	Last test (or inquiry time results if test are on)
1	Test A1/1
2	Test A1/2
3	Test A2/1
4	Test A2/2
5	Test B/1
6	Test B/2

Example:

LCT;VOLT 230;TIM 10 TEST 1;CURR:MAX 300 ON RES? 0 Test loop… STAT?.	Commands to LCT-tester, test voltage 230V, test time 1s, test A1, current high limit 3mA, test on, inquiry between example 0,1s until test time are end. See

STAT? m

m=test result option

Tester status. Return answer two status bytes mmm nnn. Reset some bits.

mmm Status byte 1

Bit	Value	Meaning	Resetting
0	1	Test end OK	ON/OFF
1	2	Test end FAIL	ON/OFF
2	4	Tester are in local-operation	
3	8	Safety circuit open	
4	16	Communication error	STAT?
5	32	Tester function error	STAT?
6	64		
7	128		

nnn Status byte 2

Bit	Value	Meaning	Resetting
0	1	High limit fail	ON/OFF
1	2	Low limit fail	ON/OFF
2	4	Low test voltage	ON/OFF
3	8	High test voltage	ON/OFF
4	16	Communication error MM-LC	STAT?
5	32	Communication error RS-LC	STAT?
6	64	Communication error DNN-LC	STAT?
7	128	Communication error PC-RS	STAT?

Option “m” select which test status are given.

0	Last test (or inquiry time status if test are on)
1	Test A1/1
2	Test A1/2
3	Test A2/1
4	Test A2/2
5	Test B/1
6	Test B/2

Example:

LCT;TIM 10;VOLT 230;TEST 1;CURR:MAX 450 Settings

ON	Test start
STAT? 0	Asking status. If end of test status byte 1 value are 1 test are ok, but if value are 2, test are fail. Status byte 2 send reason of failing.

RES? 0 Asking resistance value

TIM? Testing time in 1/10 seconds.

Return answer two numbers : aaaa bbb
aaaa test time from measurement start-ing(0..1200=0..120s)
bbb setting test time 1/10 seconds (0..600, 0=timer off)

OUT? External control outputs status. Return answer two numbers : aa bb
aa Output 1 status (0=off, 1=on)
bb Output 2 status (0=off, 1=on)

IN? External control inputs status. Return answer two numbers : aa bb
aa Input 1 status (0=off, 1=on)
bb Input 2 status (0=off, 1=on)

CAL? Tester calibration date. Return answer dd.mm.yyyy (=29.08.2001)

VER? Tester inside circuits (pcb) and software versions.

Example:

RS-4122v1/v1.1 MM-4200v0/v1.0 LC-4199v0/v1.1DNN-4074v4/v1.0

IDN? Tester identify code. Return answer from tester free setting code.

Example: FST-140 sno: 556101