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User Manual

ST9410 / ST9411 Ground Bond Tester

Contents

1 Setup

This chapter describes the procedures from unpacking to installation to operation checking.

1.1 Precautions for Use

Be sure to observe the following precautions when using the tester:

- **Do not use the tester in a flammable atmosphere.**

  To prevent explosion or fire, do not use the tester near alcohol, thinner, or other combustible materials, or in an atmosphere containing such vapors.

- **Avoid locations where the tester is exposed to high temperatures or direct sunlight.**

  Do not locate the tester near a heater or in areas subject to drastic temperature changes.
  Operating temperature range: 5 °C to 35 °C
  Storage temperature range: -20 °C to 60 °C

- **Avoid humid environments.**

  Do not locate the tester in a high-humidity environment—near a boiler, humidifier or water supply.
  Operating humidity range: 20 % to 80 % RH (no dew condensation permitted)
  Storage humidity range: 90 % RH or less (no dew condensation permitted)

  Condensation may occur even within the operating humidity range. In that case, do not start using the tester until the location is completely dry.

- **Do not place the tester in a corrosive atmosphere.**

  Do not install the tester in a corrosive atmosphere or one containing sulfuric acid mist or the like. This may cause corrosion of various conductors and imperfect contact with connectors, leading to malfunction and failure, or in the worst case, a fire.

- **Do not locate the tester in a dusty environment.**

  Dirt and dust in the tester may cause electrical shock or fire.

- **Do not use the tester where ventilation is poor.**

  This tester features a forced-air cooling system. Provide sufficient space for the air inlet on the lateral side and the air outlet on the rear side to allow air to flow.

- **Do not place the tester on a tilted surface or in a location subject to vibrations.**

  If placed on a non-level surface or in a location subject to vibration, the tester may fall, resulting in damage and injury.

- **Do not use the tester in locations affected by strong magnetic or electric fields.**

  Operation in a location subject to magnetic or electric fields may lead the tester to malfunction, resulting in electrical shock or fire.

- **Do not use the tester in locations near a sensitive measuring instrument or receiver.**

  This may cause such equipment to be affected by noise generated by the tester.

- **At a test voltage exceeding 3 kV, corona discharge may be generated to produce substantial amounts of RF broadband emissions between grips on the test leadwire.**

  To minimize this effect, secure a sufficient distance between alligator clips.
  In addition, keep the alligator clips and test leadwire away from the surfaces of conductors (particularly sharp metal ends).

1.2 Precautions for Moving

When moving the tester to the installation site or otherwise transporting it, take the following precautions:

- Before moving the tester, turn off the power switch. Transporting the tester with its POWER switch on can lead to electric shock and damage.
- When moving the tester, disconnect all wires from it.
- Moving the tester without disconnecting the cables may result in wire breakage or injury due to the tester tipping over.

1.3 Connecting the AC Power Cord

The power cord that is provided varies depending on the destination for the product at the factory-shipment. **Do not** use AC power cords that are not standard with this instrument!

Connection procedure:

1) Make sure the power switch of the instrument is turned off.
2) Make sure the power supply is within the line power range of the instrument.
3) Confirm the nominal value of the instrument fuse, and the installation position of the fuse box is correct.
4) Toggle the power switch to match the input power.
5) Please use the supplied AC power cord, or an AC power cord selected by a sufficiently qualified professional.
6) Connect the AC power cord to the ACLINE terminal on the rear panel.
7) Plug the AC power cord into an AC outlet.

1.4 Grounding

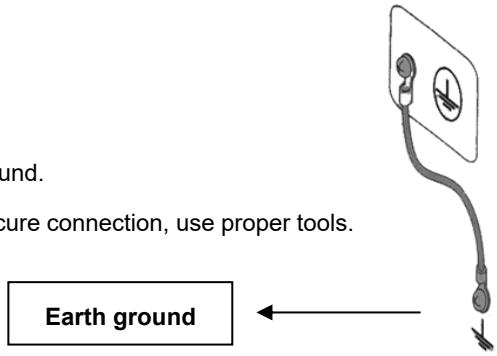
WARNING!	
⚠	This tester is designed as a Class II equipment (equipment protected against electric shock with protective grounding in addition to basic insulation). Therefore, electric shock may occur without proper grounding!

To ensure safety, be sure to ground the tester!

Choose either of the following two available methods of doing so:

1) Connect the AC power cord to a three-contact grounded electrical outlet.
2) Connect the protective conductor terminal on the rear panel to the earth ground.

Have specialized engineers select, manufacture, and install cables. To ensure secure connection, use proper tools.



1.5 Checking Operations

Checking procedure:

1) Confirm that the allowable voltage range indicated on the power supply is the same as the input voltage range set by the fuse holder.
2) Confirm that the AC power cord is properly connected to the AC LINE connector on the rear panel.
3) Plug in the AC power cord.
4) Turn on the POWER switch. Confirm that all LEDs on the front panel are lit.
5) Following the opening screen, display the ACW screen and confirm that the tester is kept in the READY status.

2 Precautions on Handling

This chapter describes the precautions to be followed in the handling of this tester. When using the tester, take utmost care to ensure safety.

WARNING!	
	This instrument can generate a current of up to 45 A (32 A for ST9411). If the contact resistance is too large, a high temperature will be generated at the contact point. When operating the instrument, extreme care must be taken and the cautions, warnings, and other instructions given in this chapter must be followed!

2.1 Prohibited Operations

- **Do not turn on/off the power repeatedly!**

  After turning OFF the power switch, be sure to allow several seconds or more before turning it ON again. Do not repeat turning ON/OFF the power switch rapidly. If you do this, the protectors of the tester may not be able to render their protective functions properly. Do not turn OFF the power switch when the tester is delivering its test voltage – you may do this only in case of emergency.

- **Do not apply an external voltage!**

  Do not apply a voltage from any external device to the output terminals of the tester. The analog voltmeter on the front panel cannot be used as stand-alone voltmeter. They may be damaged if their output terminals are subject to an external voltage.

2.2 To Ensure Long-Term Use Without Failures

Due to the volume, weight, and actual use of the instrument, the module heat dissipation requirements of the instrument are very high. The instrument is recommended to be used within the following ranges.

Prerequisites for Contact Resistance Testing:

Ambient Temperature	Current Limit	Output Time Limit
≤ 40°C	> 40 A	up to 5 minutes
	> 30 A	up to 15 minutes
	< 10 A	supports continuous output

Note: After a test with a current of 30 A or more, you must rest for an equal amount of time before the next test. Otherwise, overheat protection may be triggered. If the fan works continuously for 30 minutes, it is recommended to suspend the use of the instrument. If it is protected from overheating, the instrument must be stopped for 30 minutes.

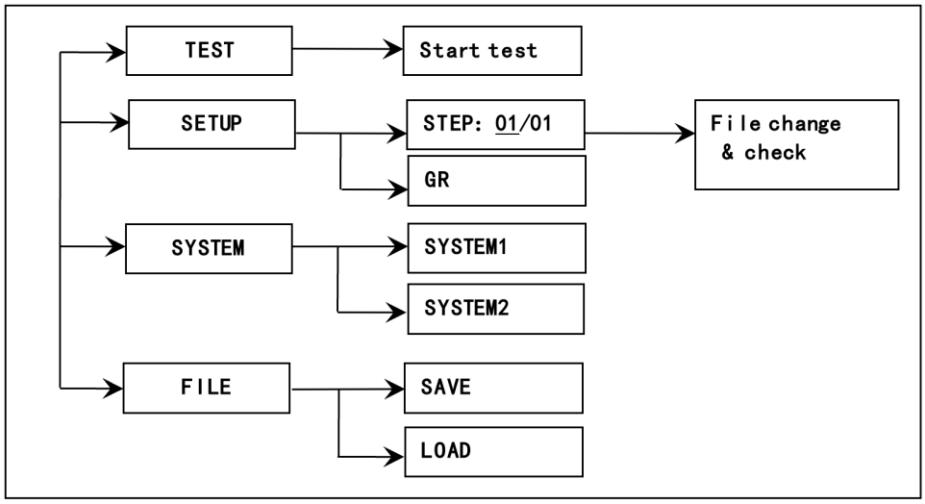
2.3 Daily Checking

1) To avoid accidents, confirm at least the following before starting operation:
2) The input source complies with the standard and the tester power configuration is correct.
3) The tester is connected to an earth ground.
4) The coating of the high-voltage test lead wire is free from cracks, fissures, and breakage.
5) Without connecting the test lines, the instrument can finish the test successfully when starting test by default.
6) When connecting the test line to start the test, make sure that the test interface is in reliable contact, and the instrument can generate an OVERFAIL (failure) signal when the low and high voltage ends of the test line are disconnected.

3 Basic Operation

3.1 Interface Structure Overview

This chapter describes the procedure for contact resistance testing. The interface structure of the instrument is shown as follows:



Operation Steps

Introduction to the Interface:

1) The first column in the interface structure shows the initial states corresponding to the function keys on the panel. The TEST interface cannot modify parameters.
2) The second column in the interface shows the parameter structures of the interface. For example, the SETUP interface defaults to STEP 01/01: program step 1, total number of steps 1, and GR parameters.
3) The third column of the interface structure is the multi-step function interface switching.

Note:

- Turn on the power while pressing F4 key, the instrument will restore factory defaults.
- Clear extent: SETUP (test condition) and SYSTEM (system setup).
- When the software is updated or display error caused by recalling archive of low fileversion is encountered, use this method to restore the normal work of the instrument.

3.2 Instruction of Panel Function Interface and Parameter

This section mainly describes the function interface and relevant parameter in accordance with the order of software process and interface relevance.

Initial State Introduction of the Instrument:

- After starting up, the system enters into the last used setup interface before shutdown last time.
- The default set of the instrument is single step, contact resistance and default parameters.
- The default cursor of the default interface is the interface switch. Other interfaces can be chosen directly.
- Four function keys can be directly used to realize the interface switch, namely TEST, SETUP, SYSTEM and FILE. The interface function will be introduced separately below.

Interface	Description
TEST	Put the instrument into the test waiting state, ready to start the contact resistance test.
SETUP	Change the previous interface of test program, test item, and test parameter. The modification of the test plan is completed in this interface. (This interface is entered by default at boot)
SYSTEM	The settings related to testing safety and the working mode of the instrument
FILE	Save and load the test program, relating to the data storage
▼▲◀▶	Cursor can move freely among each parameter.
F1 ~ F5	Change the selected data by coordinating with the contents in soft key function display zone.

3.2.1 SETUP

Test Program Modification Instructions:

STEP: 01/01 Test procedure: current setting No. / total items.

The maximum number of total test items is 5 steps, and the number of files that can be stored is 20 groups.

Item identification of the test program, current test program No./ total items

Key	Function	Instruction
F1	INS	Add a new test item. The current item and subsequent items will move one step backward.
F2	DEL	Delete the current test item. The subsequent item will move one step forward.
F3	NEW	Create a blank test program (PROG). The system will automatically create a default test item. Please remember to save the test program after finishing writing.
F4	+	Visit the parameter of the step after the current displayed step.
F5	–	Visit the parameter of the step before the current displayed step.

Test Parameter Modification Instructions:

Label	Instruction	Definition
CURR	1 A ~ 45 A (ST9410A)	Ground current value setting
	1 A ~ 32 A (ST9411A)	
UPPR	6 V / CURR	Ground resistance upper limit value
LOWR	Same as UPPR	The lower limit of grounding resistance must be less than the UPPR value.
	OFF	No lower limit required
TIME	0.2 s ~ 999.9 s	Test time, when time is up, end the test. RISE≠OFF
	OFF	Unlimited test time
OFFSET	OFF; ON	Base clear setting
	GET	Get the test base under the current test conditions
	<Data>	Directly input
FREQ	50 / 60	AC working frequency

3.2.2 GRTEST

1) Press ▼ to enter the SETUP interface.
2) The function key F5 can lock the keyboard. When the keyboard is locked, only three keys: START, STOP and F5 (unlock) are usable.
3) The three large font data in the middle of the front panel is the real time test data. After finishing testing, the last test result will be displayed on the panel before pressing the STOP key.
   - The one above is the output current, which is measured in amperes (A).
   - The one in the middle is the measured contact resistance at the low end of the test, measured in milliohms (mΩ).
   - The lower one is the remaining time of the corresponding step during the high voltage test. If the user closes the test time, the test time shows the time after entering the test state, and the count will not be accumulated after the count is greater than 999.9. If not "FAIL", the test state must be exited with "STOP". Users can intuitively analyze the test situation of the tested object. It is in seconds (S).

3.2.3 SYSTEM

System interface is to set the test program of the instrument, not the specific test component parameters.

3.2.3.1 SYSTEM 1 Interface

Instruction:

Label	Instruction	Definition
PASSHOLD	0.2 s ~ 99.9 s	Pass judge hold time.
	KEY	Pause, press the 'STOP' key to end.
FAILMODE	STOP	If FAIL, quit the testing directly.
	CONTINUE	If FAIL, continue to test, result in table form.
	RESTART	If FAIL, press start key to test from the current step.
	NEXT	If FAIL, press start key to test from the next step.
STEPHOLD	0.2 s ~ 99.9 s	Waiting time between steps.
	OFF	No waiting time between steps.
	KEY	Pause, press ‘START’ key to test the steps.
CTRLMODE	FILE	HANDLER interface output the test results after test file ends up.
	STEP	HANDLER interface output the current test result after each step ends up.
PASSBEEP	OFF	Turn off
	ONELONG	One long beep sound
	TWOSHORT	Two short beep sounds
FAILBEEP	OFF	Turn off
	LOWLONG	One low and long beep sound
	TWOSHORT	Two short beep sounds
KEYBEEP	OFF	Turn off
	ON	Turn on

STRTDLY	0.2 s ~ 99.9 s	Set the test delay time from starting test to the beginning of the test of step 1
	OFF	By default, the instrument starts testing after being ready

3.2.3.2 SYSTEM 2 Interface

Instruction:

Label	Instruction	Definition
BUSMODE	RS232C	Serial mode: Data Format: 8.n. 1
	USBTMC	Standard USB slave mode
	USBVCOM	USB analog serial mode: Data Format: 8.n. 1
BAUD	9600 ~ 115200	Baud rate of the serial bus.
BUSADDR	1 ~ 32	Bus address
DEFAULT	–	Restore factory defaults. Not valid on PASSWORD.
LANGUAGE	Chinese, ENGLISH	Interface language selection
PASSWORD	OFF	Turn off the key lock function. The default password is 9410.
	SYSTEM (lock system)	Need the password when entering the system.
	FILE (lock file)	Need the password when recalling the file.
	MODIFY	Change the original password for the new password.
ADJSET	SET	Adjustment interface.
	UPDATE	Instrument firmware upgrade entry.
CMD	SCPI	SCPI command set
	MODBUS	MODBUS command set

3.2.4 FILE

Press the FILE key to enter into the file manage interface.

Instruction:

No.	Category	Shortcut	Name	Description
1	Memory Selection	F1	Internal	Internal file interface.
		F2	External	External file interface.
2	File List	F1	Load	Load the current file as the internal use file.
		F2	Save	Save the internal use file to the current file.
		F3	Delect	Delete the current file.
		F4	Copy to E:	Copy the current file to the USB stick (internal file).
			Copy to I:	Copy the current file to the interior instrument (external file).

		F5	Select	Select the current file (to be used for batch processing)
3	Page Number		PgUp	PageUp the file list.
			PgDn	PageDown the file list.

3.2.4.1 Operation Interface of the Internal File

<INTERNAL FILE>							
1	FILE-N1.STA		2011/11/11	11:11		Load	F1
2	FILE-N2.STA		2012/05/20	13:14		Save	F2
3	FILE-N3.STA		2013/09/19	19:09		Delete	F3
4	FILE-N4.STA		2099/09/09	09:09		Copy to E:	F4
PAGE 1						Select	F5

3.2.4.2 Operation Interface of the External File

<EXTERNAL FILE>							
	STA		2011/11/11	11:11		Load	F1
	FILE-A1.STA		2012/05/20	13:14		Save	F2
	FILE-A2.STA		2013/09/19	19:09		Delete	F3
	FILE-A3.STA		2099/09/09	09:09		Copy to I:	F4
PAGE 1						Select	F5

3.3 Test Function Theory and Instruction

This section describes the test theory and instruction of ground connection, ground wire current detection and arc detection according to the order of the test procedure.

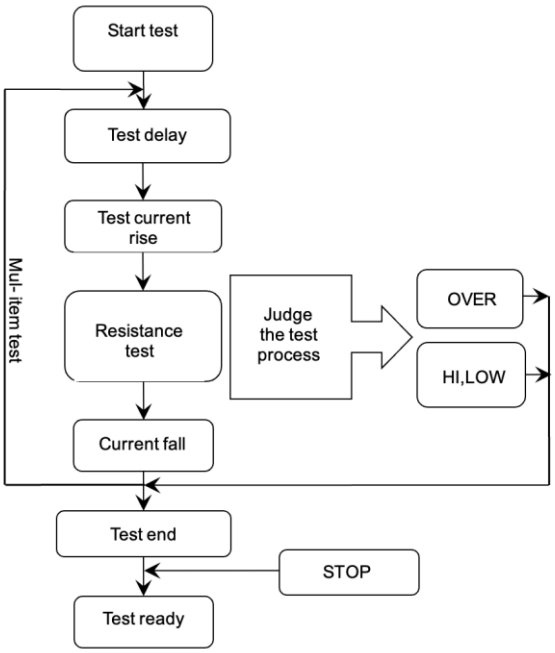


Figure 3-1 Block Flow Diagram of the Instrument

3.3.1 Start Up Test

In measurement mode, after the tester check the test conditions and the connection with DUT, press START to start up test.

3.3.2 Test Delay

After the delay set by STA DELY in SYSTEM, the tester will start measurement.

3.3.3 Test Current Rise

When the instrument starts to output, the output current is zero. When the current output starts, the instrument will control the output current to increase step by step in units of 5 A / 0.1 s.

3.3.4 Contact Resistance Test

Conduct a contact resistance test on the DUT. At this time, it should be ensured that the test circuit is correct, the test results will not be affected by some special incidental parameters, and the display content is the actual contact resistance required by the test.

3.3.5 Test Current Fall

When the current drops at the end of the test, the instrument will control the output current to drop within 0.1 s.

3.3.6 Contact Resistance Over Limit

Contact resistance classification: contact resistance lower limit, contact resistance upper limit, voltage overlimit.

- **Resiatance Low Limit Judge (LOW)**

  Generally used as a test low-end short circuit judgment. When the instrument tests the equipment, the equipment will definitely have a certain on-resistance. When the on-resistance tested by the instrument is less than the lower limit set

resistance value, the test is considered Fail. If the contact resistance of the tested element itself is very small, this function must be turned off. Judgment display (LOWFAIL) when the limit is exceeded, this judgment is only valid in test mode, timing sampling, and the rate is 100 ms each time.

- **Resistance High Limit Judge (HIGH)**

  The most commonly used test is the judgment of contact resistance overlimit. When the instrument tests the equipment, the equipment will definitely have a certain contact resistance. When the contact resistance tested by the instrument is greater than the contact resistance set by the upper limit, it is considered that the contact resistance of the equipment is insufficient and the test fails. Judgment display (HIFAIL) when the limit is exceeded, timing sampling, the rate is 100 ms each time.

- **Voltage Over Limit (OVER)**

  The voltage sampling judgment is slow, and the sampling circuit cannot respond in time when the contact point is disconnected. When the voltage peak exceeds the allowable output range of the instrument, this type of overrun judgment will be triggered, and the judgment will display (OVERFAIL) when the limit is exceeded. Data cannot be collected due to such voltage exceeding the limit. The result output by the system at this time is: the test result within 100 ms before the current exceeds the limit. The voltage limit is the allowable output voltage limit of the instrument. The fall time is invalid, and this judgment cannot be masked.

3.3.7 Test End

Display the test data of the test process, and display the test judgment result.

If the test process exceeds the limit, it is judged as (FAIL). If FAIL appears in the multi-step test, the final result is FAIL.

- There are many test items in the test file, and the FAIL judgment processing mode is controlled by the failure mode of the system. Otherwise, the instrument will display FAIL judgment and category waiting for the user to process.
- After the test, there is no unqualified mark, and the test result is judged as (PASS).
- The PASS judgment processing mode is controlled by PASSHOLD of SYSTEM, and then it is ready to start the next measurement or return to the test waiting state.
- The HANDLER signal output is controlled by the control mode. Select FILE mode, then the test result will be output only when the entire file test is over. In STEP mode, each step will control the interface to output the corresponding signal.

3.3.8 STOP

1) Press the 'STOP' key at any state during the entire test process, the instrument will automatically end the test and enter the test end state.
2) Press the 'STOP' key again, the instrument will return to the test waiting state. No test result judgment output is given when the test is stopped.

At the end of the test, the customer can use the software to query the last test data obtained before 'STOP'.

3.3.9 OFFSET

Before the test, due to the change of the working environment of the instrument and the placement of the test cable, there may be some base numbers during the short-circuit test of the instrument test line. For customers who require accurate measurement, it can be cleared. The offset value cannot be greater than 100 mΩ.

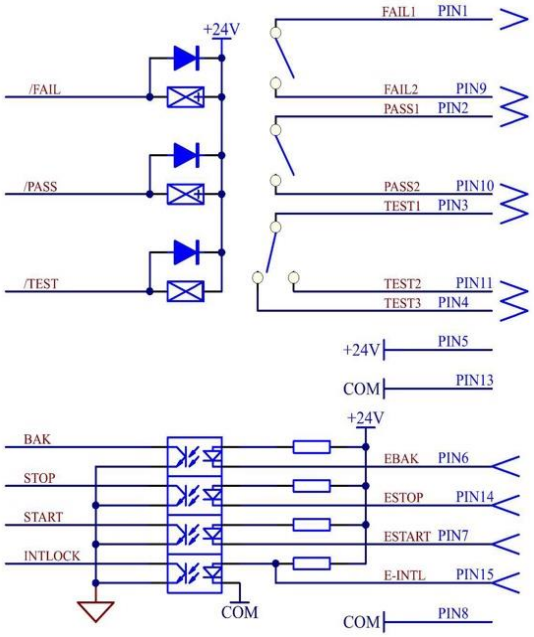
The specific operation steps are as follows:

1) Select the OFFSET item.
2) Press GET and the instrument will automatically start the contact resistance test and take the current test value as the zero value. You can also directly enter a contact resistance base.

3.4 Structure and Use of HANDLER Interface Circuit

3.4.1 Control Interface Theory

The HANDLER interface is a DB15 interface, the internal principle of the instrument is as follows:



HANDLER Interface Signal Function Description:

- **Function Description of Output Signal**: The signal constitutes the remote output control. It is valid in closing the relay switch output.
  - **TEST:** the normally open switch is closed when the instrument starts the test, and is disconnected when the test is stopped.
  - **PASS:** After one test of the instrument, if the test is qualified (PASS), the normally open switch is closed, and the next test starts to restore the normally open state.
  - **FAIL:** once the test of the instrument is over, if the test is FAIL, the normally open switch will be closed, and the next test will resume the normally open state.
  - The system interface (SYSTEM) control mode (CTRL) can control the above signal output state when the test file (FILE) is multi-step mode, and output control signals in steps (STEP) according to a single test item; or the entire test file (FILE) as a whole, output control signals.
- **Function Description of Input Signal**: Remote input control, switch input closure is valid.
  - **START:** Start the test of the current test file, or restart a subsequent test if the test is paused.
  - **STOP:** stop this test, or return to the test waiting interface on the test end interface.
  - **INTLOCK:** when this signal is open circuit, it is forbidden to start the output of the instrument, and the default is short circuit when single-unit use.
  - **COM:** signal ground or signal common terminal.
- **Description of the Backup Power Supply Interface**: The instrument interface provides about 24 V DC power supply.
  - This power supply is a pull-up power supply for input signals and is not connected to the ground of the instrument.
  - The external output current is less than 0.2 A, which can be used to drive indicator lights and photoelectric switches with a current less than 50 mA.

3.4.2 Control Interface Instruction

Control interface is generally used as remote control and test synchronization or indication.

The external connection of the interface is as follows:

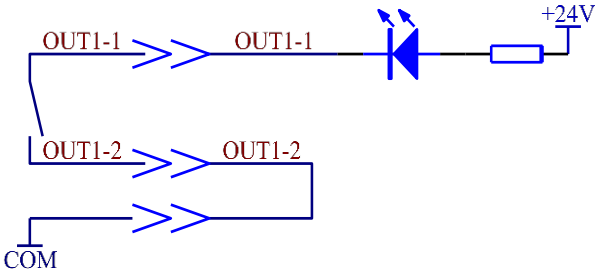


Figure 3-2 Output: The Internal Power Connected with Indicator Light

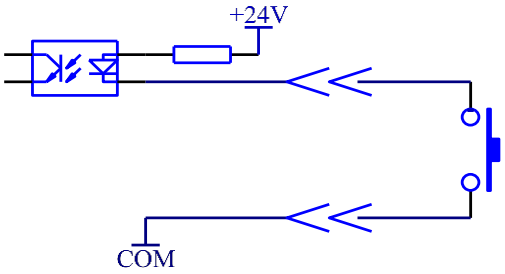


Figure 3-3 Input: External Switch Connection Diagram

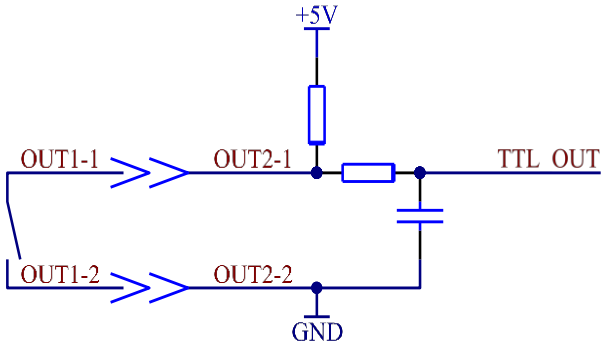


Figure 3-4 Output: External 5V Power Supply to Level

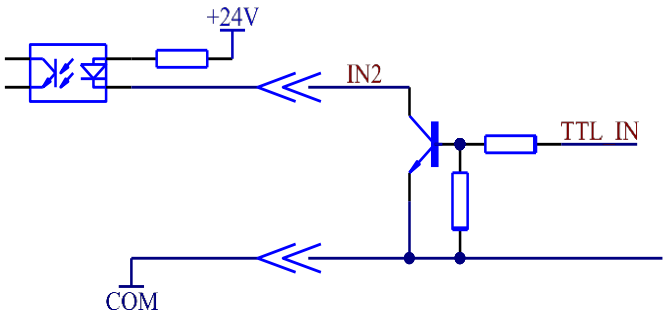


Figure 3-5 Input: External Logic Level Connection Diagram

Instructions:

The switch can be replaced with secondary optical coupling and other isolated form switch element. For the current direction, refer to the principle of above diagram (COM terminal is LOW end).

The indicator light can be replaced with other drive control components. The current direction is subject to the power.

Internal Power Supply Performance:

- The unregulated output is about 24 V, please confirm before use.
- The maximum transient output current of the internal power shall not be larger than 0.5 A and the current of long working hours shall be less than 0.2 A. Self-contained power is necessary if larger current is needed.
- If the external control signal needs to be larger than 2 A or 220 V, the internal relay of the instrument can not bear it. Please transfer it by yourself.

3.5 Other Interfaces and Functions

- **USB DEV:** On the front panel, is used for connecting the USB stick, exporting and importing the setting files and upgrading the software.
- **USB HOST:** On the rear panel, is used for the communication with the computer. There are two working modes.
- **USBTMC:** Standard USB slave mode. Compatible software format IEE488.
- **USBVCOM:** USB simulated serial port, data format: 8.n.1. Compatible software format IEE485.
- **RS232:** Is used for the communication with the computer. See the baud rate in SYSTEM SETUP, data format: 8.n.1. Compatible software format IEE485.

4 Technical Specifications

4.1 General Specifications

<table>
<tr><th colspan="3">Model</th><th colspan="3">ST9410A</th><th colspan="2">ST9411A</th></tr>
<tr><td rowspan="11">Output</td><td rowspan="5">Current</td><td>Scope</td><td colspan="3">1 A ~ 45 A</td><td colspan="2">1 A ~ 32 A</td></tr>
<tr><td>Range</td><td>1.00 A ~ 5.00 A</td><td>5.01 A ~ 30 A</td><td>30.01 A ~ 45 A</td><td>1.00 A ~ 5.00 A</td><td>5.01 A ~ 32 A</td></tr>
<tr><td>Accuracy</td><td colspan="5">± (2 % Reading + 3 Digits)</td></tr>
<tr><td>Setting Resolution</td><td colspan="5">0.01 A</td></tr>
<tr><td>Readback Resolution</td><td colspan="5">0.01 A</td></tr>
<tr><td colspan="2">Output Voltage</td><td colspan="2">8 V max</td><td>6 V max</td><td colspan="2">8 V max</td></tr>
<tr><td colspan="2">Frequency</td><td colspan="5">50 / 60 Hz: ± 0.1 %SET</td></tr>
<tr><td rowspan="9">Resistance</td><td colspan="2">Test Range</td><td colspan="5">0 mΩ ~ 600 mΩ (R_{max} <= 6 / I_{set} (I_{set}: Setting Current));
The max. resistance could be 600 mΩ when the current is less than 10 A.</td></tr>
<tr><td colspan="2">Accuracy</td><td colspan="5">± (2% Reading + 2 Digits)</td></tr>
<tr><td colspan="2">Resolution</td><td>1 mΩ</td><td>0.1 mΩ</td><td>0.1 mΩ</td><td>1 mΩ</td><td>0.1 mΩ</td></tr>
<tr><td rowspan="3">Setting</td><td>Upper Limit</td><td colspan="5">0 mΩ ~ 600 mΩ</td></tr>
<tr><td>Lower Limit</td><td colspan="5">0 mΩ ~ 600 mΩ (must be < upper limit)</td></tr>
<tr><td>Resolution</td><td colspan="5">1 mΩ</td></tr>
<tr><td rowspan="3">Bias</td><td>Range</td><td colspan="5">0 mΩ ~ 100 mΩ</td></tr>
<tr><td>Resolution</td><td colspan="5">0.1 mΩ</td></tr>
<tr><td>Accuracy</td><td colspan="5">± (2 % Setting + 2 Digits)</td></tr>
<tr><td colspan="2" rowspan="3">Test Time</td><td>Range</td><td colspan="5">0 s; 0.5 s ~ 999.9 s (0 = Continuous)</td></tr>
<tr><td>Resolution</td><td colspan="5">0.1 s</td></tr>
<tr><td>Accuracy</td><td colspan="5">± (0.1 % + 0.05 s)</td></tr>
<tr><td colspan="2" rowspan="3">Input Power</td><td>Voltage</td><td colspan="5">110 V; 220 V</td></tr>
<tr><td>Frequency</td><td colspan="5">47.5 Hz ~ 63 Hz</td></tr>
<tr><td>Power Consumption</td><td colspan="3"><= 900 VA</td><td colspan="2"><= 800 VA</td></tr>
</table>

4.2 Other Specifications

- **Power:**
  < 900 VA (ST9410A)
  < 800 VA (ST9411A)
- **Dimensions (W × H × D):** 280 mm × 88 mm × 420 mm
- **Weight:** approx. 15 kg

Input Voltage	Frequency Range	Fuse	Model	Rated Power
110 V	47 Hz ~ 63 Hz	10 A	ST9410A	900 VA
			ST9411A	800 VA
220 V		5 A	ST9410A	900 VA
			ST9411A	800 VA

5 Serial Port Command Description

This instrument can use RS232C serial interface (standard) or GPIB parallel interface (optional) for data communication and remote control without instrument panel, but the two cannot be used at the same time; they have the same program control commands, but use different hardware configuration and communication protocols. This chapter introduces how to use the interface.

5.1 Brief Description of Command Format

The instrument command set describes only the actual characters that the instrument receives or sends.

The command characters are all ASCII characters.

- The data "<???>" of the instruction are all ASCII strings. The default format of the system is integer or floating-point number, and the unit of data is the default value which does not appear in the instruction.
- There must be an instruction end marker at the end of the instruction: an identifier for the end of an instruction, and the instrument will not parse the instruction without this symbol.
    - The default closing tags are: carriage return (NL), print control character (\n), decimal number (10), hexadecimal number (0x0A).
    - End marker of IEEE-488 bus: keyword (^END), signal (EOI).

Multiple instructions can simplify sending examples as follows:

- FUNC:SOUR:STEP1:CURR10;UPPC100;TTIM9.9(NL^END)
- FUNC:SOUR:STEPINS(NL^END)
- FUNC:SOUR:STEP2:CURR20;UPPC200;TTIM9.9(NL^END)
- FUNC:START(NL^END)

Note: In the example, "" is the (space) mark, and (NL^END) is the end mark.

5.2 SCPI Commands

Subsystem Commands for ST9410A/9411A:

- DISPlay
- FUNCtion
- SYSTem
- MMEMory
- FETCh

5.2.1 DISPlay Subsystem Commands

The DISPlay subsystem command set is mainly used to set the display page of the instrument.

The :DISPlay? query returns the current page.

5.2.1.1 DISPlay:PAGE

Syntax:

Command: DISP:PAGE<pagename>

Options for <pagename>:

MEASurement Set the display page to measurement display.

MSETup	Set the display page to measurement setup.
SYST1	Set the display page to system setup.
SYST2	Set the display page to system setup.
FLISt	Set the display page to (internal) file list.

Use the character? to query the current page.

Example:

Set the display page to measurement display.

Command Message:	DISP:PAGE MEAS
Query Message:	DISP:PAGE?
Return Value:	MEAS

5.2.2 FUNCtion Subsystem Commands

Command Tree:

Base Command	Command 2	Command 3	Command 4	Command 5	Description
FUNC	:SOUR	:STEP	NEW	—	Create a new test file
			INS		Insert test step after current position
	:STAR		DEL		Delete the test step of current position
	:STOP		<n>	:CURR	GR test current
				:UPPC	GR resistance upper limit
				:LOWC	GR resistance lower limit
				:TTIM	GR test time
				:OFFSET	GR resistance bias
				:FREQ	GR working frequency

5.2.2.1 PROG Function Commands

- **FUNCtion:STARt**

  Start the test while the instrument is in test interface.

- **FUNCtion:STOP**

  Stop the test while the instrument is in test interface.

- **FUNCtion:SOURce:STEPINS**

  Add a new test item in existing test program (STEP).

- **FUNCtion:SOURce:STEPDEL**

  Delete the current test item in existing test program (STEP).

- **FUNCtion:SOURce:STEPNEW**

  Create an empty test program to write a brand-new test program.

- **FUNCtion:SOURce:STEP<sn>**

  Edit the <sn> step of the current test program (<sn> = 1 ~ 20)

5.2.2.2 FUNCtion:SOURce:STEP:CURRent

Set/query the current of GR.

Syntax:

Command: FUNC:SOUR:STEP<sn>:CURR<current value>

Query: FUNC:SOUR:STEP<sn>:CURR?

Data<sn>:

Data Format: Integer

Data Range: 1 ~ 5

Data Accuracy: 1

Data<current value>:

Data Format: Float

Data Range: 1 ~ 45

Data Accuracy: 1

Data Unit: A

Example:

Set the current of GR in STEP 1 to 20 A.

Command Message: FUNC:SOUR:STEP1:CURR20

Query Message: FUNC:SOUR:STEP1:CURR?

Return Value: 20

5.2.2.3 FUNCtion:SOURce:STEP:UPPC

Set/query the upper limit resistance of GR.

Syntax:

Command: FUNC:SOUR:STEP<sn>:UPPC<resistance value>

Query: FUNC:SOUR:STEP<sn>:UPPC?

Data<resistance value>:

Data Format: Integer

Data Range: 1 ~ 6000

Data Accuracy: 1

Data Unit: mΩ

Example:

Set the upper limit of the resistance of GR in STEP 1 to 200 mΩ.

Command Message: FUNC:SOUR:STEP1:UPPC200

Query Message: FUNC:SOUR:STEP1:UPPC?

Return Value: 200

5.2.2.4 FUNCtion:SOURce:STEP:LOWC

Set/query the lower limit resistance of GR.

Syntax:

Command: FUNC:SOUR:STEP<sn>:LOWC<resistance value>

Query: FUNC:SOUR:STEP<sn>:LOWC?

Data<resistance value>

Data Format: Integer

Data Range: 0 ~ 6000 (where 0 is OFF)

Data Accuracy: 1

Data Unit: mΩ

Example:

Set the resistance lower limit of GR in STEP1 to 100 mΩ.

Command Message: FUNC:SOUR:STEP1:LOWC100

Query Message: FUNC:SOUR:STEP1:LOWC?

Return Value: 100

5.2.2.5 FUNCtion:SOURce:STEP:TTIMe

Set/query the test time of GR.

Syntax:

Command: FUNC:SOUR:STEP<sn>:TTIM<time value>

Query: FUNC:SOUR:STEP<sn>:TTIM?

Data<time value>:

Data Format: Float

Data Range: 0 (OFF)
0.2 ~ 999.9

Data Accuracy: 0.1

Data Unit: s

Example:

Set the test time of GR in STEP 1 to 1 s.

Command Message: FUNC:SOUR:STEP1:TTIM1

Query Message: FUNC:SOUR:STEP1:TTIM?

Return Value: 1

5.2.2.6 FUNCtion:SOURce:STEP:OFFSet

Set/query GR zero offset value.

Syntax:

Command: FUNC:SOUR:STEP<sn>:OFFS<resistance value>

Query: FUNC:SOUR:STEP<sn>:OFFS?

Data<resistance value>

Data Format: Integer

Data Range: 0 ~ 100 (where 0 is OFF)

Data Accuracy: 1

Data Unit: mΩ

Example:

Command Message: FUNC:SOUR:STEP1:OFFSGET
//The instrument automatically obtains the offset base

Set the resistance lower limit of GR in STEP 1 to100 mΩ.

Command Message: FUNC:SOUR:STEP1:OFFS100

Query Message: FUNC:SOUR:STEP1:OFFS?

Return Value: 100

5.2.2.7 FUNCtion:SOURce:STEP:FREQuency

Set/query the test frequency of GR.

Syntax:

Command: FUNC:SOUR:STEP1:FREQ<frequency value>

Query: FUNC:SOUR:STEP1:FREQ?

Data<frequency value>:

Data Format: Character

Data Range: 50 / 60

Data Unit: Hz

Example:

Set the test frequency of GR in STEP 1 to 50 Hz.

Command Message: FUNC:SOUR:STEP1:FREQ50

Query Message: FUNC:SOUR:STEP1:FREQ?

Return Value: 50

5.2.3 SYSTem Subsystem Commands

Command Tree:

Base Command	Command 2	Function/Range
SYST	:PASS	0.3 s ~ 99.9 s
	:STEP	0.3 s ~ 99.9 s
	:FAIL	0 (STOP) 1 (CONT) 2 (REST) 3 (NEXT)
	:BEEP	0 (OFF) 1 (SHORT) 2 (LONG)
	:DELA	0 s ~ 99.9 s
	:CTRL	0 (STEP) 1 (FAIL)
	:LANG	0 (Chinese) 1 (English)
	:RES	—
	:ON	
	:CMD	0 (SCPI) 1 (MODBUS)

5.2.3.1 SYSTem:PASS

Set/query the time of the PASS beep response.

Syntax:

Command: SYST:PASS<time value>

Query: SYST:PASS?

Data<time value>:

Data Format: Float

Data Range: 0 (OFF)
0.2 ~ 99.9

Data Accuracy: 0.1

Data Unit: s

Example:

Set PASS to 1.0 s.

Command Message: SYST:PASS1

Query Message: SYST:PASS?

Return Value: 1.0

5.2.3.2 SYSTem:FAIL

Set/query the status of (AFTR)FAIL.

Syntax:

Command:	SYST:FAIL<0/1/2/3>
Query:	SYST:FAIL?

Data<0/1/2/3>:

Data Format:	Character
Data Range:	0 (STOP) 1 (CONT) 2 (REST) 3 (NEXT)

Example:

Set (AFTR)FAIL to STOP.

Command Message:	SYST:FAIL0
Query Message:	SYST:FAIL?
Return Value:	0

5.2.3.3 SYSTem:STEP

Set/query the interval time of the STEP.

Syntax:

Command:	SYST:STEP<time value>
Query:	SYST:STEP?

Data<time value>:

Data Format:	Float
Data Range:	0 (OFF) 0.2 ~ 99.9
Data Accuracy:	0.1
Data Unit:	s

Example:

Set STEP to 1.0 s.

Command Message:	SYST:STEP1
Query Message:	SYST:STEP?
Return Value:	1.0

5.2.3.4 SYSTem:BEEP

Set/query the buzzer setting.

Syntax:

Command:	SYST:BEEP<0/1/2>
Query:	SYST:BEEP?

Data<0/1/2>:

Data Format:	Character
Data Range:	0 (OFF) 1 (SHORT) 2 (LONG)

Example:

Set BEEP to one short beep.

Command Message:	SYST:BEEP1
Query Message:	SYST:BEEP?
Return Value:	1

5.2.3.5 SYSTem:DELAy

Set/query the delay time of DELAy test.

Syntax:

Command:	SYST:DELA<time value>
Query:	SYST:DELA?

Data<time value>:

Data Format:	Float
Data Range:	0 (OFF) 0.2 ~ 99.9
Data Accuracy:	0.1
Data Unit:	s

Example:

Set DELA to 1.0 s.

Command Message:	SYST:DELA1
Query Message:	SYST:DELA?
Return Value:	1.0

5.2.3.6 SYSTem:LANGuage

Set/query the state of the language.

Syntax:

Command:	SYST:LANG<0/1>
Query:	SYST:GFI?

Data<0/1>:

Data Format:	Character
Data Range:	0 (Chinese) 1 (English)

Example:

Set LANG to English.

Command Message:	SYST:LANG1
Query Message:	SYST:LANG?
Return Value:	1

5.2.3.7 SYSTem:RESet

Restore all settings to their default state.

Syntax:

Command:	SYST:RES

5.2.3.8 SYSTem:ON

Instrument firmware upgrade.

Syntax:

Command:	SYST:ON

5.2.3.9 SYSTem:CMD

Set the current command format

Syntax:

Command:	SYST:CMD<0/1>
Query:	SYST:CMD?

Data<0/1>:

Data Format:	Character
Data Range:	0 (SCPI) 1 (MODBUS)

Example:

Set the command Syntax to MODBUS.

Command Message:	SYST:CMD1
Query Message:	SYST:CMD?
Return Value:	1

5.2.4 MMEMory Subsystem Commands

5.2.4.1 MMEMory:STORe

Save the current file to file number.

Syntax:

Command: MMEM:STOR:STAT<file number>[,<file name>]

Data<file number>:

Data Format: Integer

Data Range: 1 ~ 20

Data Accuracy: 1

Data<file name> (optional):

Data Format: Character String

Data Range: 1 ~ 15

5.2.4.2 MMEMory:LOAD

Load the file specified by the file number to the current one.

Syntax:

Command: MMEM:LOAD:STAT<file number>

Data<file number>:

Data Format: Integer

Data Range: 1 ~ 20

Data Accuracy: 1

5.2.5 FETCh Subsystem Commands

5.2.5.1 FETCh:AUTO

Set/query the status of the AUTOmatic FETCh function to obtain measurement results.

Syntax:

Command: FETCh:AUTO<ON/OFF> or <0/1>

Data<ON/OFF> or <0/1>

Data Format: Character

Data Range: 0 (OFF)
1 (ON)

Example:

Set test data automatic return to ON.

Command Message: FETCh:AUTO ON or
FETCh:AUTO 1

5.2.5.2 FETCh?

After the instrument receives this command, the instrument will automatically send out the test result until the end of the test.

Return Format:

- Test current (A)
- Test resistance (mΩ)
- Sorting results

Format is: (1): (2), (2), (3);

- : Step, the separator is (:).
- The separator between test data is (,).
- The separator between steps is (; + space). Data terminator defaults to (newline: 0x0A)

Note:

- All data are integers or float syntax, ASCII character strings.
- By default, the data unit is the same as the FUNC setting instruction set. Units are not returned when character strings are returned.

Example:

The test results are…

- STEP1: The test current is 10 A, the test resistance is 100 mΩ, and the result is PASS.
- STEP2: The test current is 20 A, the test resistance is 200 mΩ, and the result is FAIL.

Return Value: 10, 10, PASS ; 20, 200, FAIL

5.2.6 Other Control Commands

5.2.6.1 *IDN

Query instrument model and version information

Example:

Command Message: WrtCmd("*IDN?");

Return Message: <manufacturer>,<model>,<firmware><NL^END>

Where…

- <manufacturer> Get the manufacturer name (i.e. Sourcetronic)
- <model> Get the machine model (e.g. ST9410A/9411A)
- <firmware> Get the software version number (e.g. Version 1.0.0)

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