



SIEMENS SINAMICS TESTER S1 INSTRUCTIONS FOR USE

1. Table of Contents

1.	TABLE OF CONTENTS.....	2
2.	LEGAL INFORMATION.....	3
3.	DESCRIPTION OF THE SINAMICS S1 TESTER.....	4
4.	CIRCUIT DESCRIPTION.....	5
4.1.	DISMANTLING THE CIM/CIB.....	5
4.2.	DESCRIPTION OF THE TESTER WIRING.....	8
5.	CONTROLLING THE TESTER.....	11
5.1.	IGBT SWITCH.....	12
5.2.	RECTIFIER.....	13
5.3.	FAN.....	13
5.4.	TEMPERATURES.....	14
5.5.	I SENSORS.....	15
6.	DESCRIPTION OF THE SATURATION VOLTAGE MEASUREMENT METHODOLOGY.....	16
7.	TROUBLESHOOTING ERRORS AND PROBLEMS.....	18
8.	LIST OF ABBREVIATIONS.....	19

2. Legal information

➤ Safety instructions

This manual contains instructions that you must follow to maintain your personal safety and to prevent property damage. Instructions for maintaining your personal safety are highlighted with a warning triangle; instructions for property damage only are shown without the triangle. The warning notices are displayed in descending order according to the degree of danger as follows.

DANGER

means that death or serious injury will occur if appropriate safety precautions are not taken.

WARNING

means that death or serious injury may result if appropriate safety precautions are not taken.

ATTENTION

with a warning triangle means that minor injuries can occur if the appropriate safety precautions are not taken.

ATTENTION

without a warning triangle means that material damage may occur if the appropriate safety measures are not taken.

NOTICE

means that an undesirable result or condition may occur if the relevant instruction is not followed.

In the event of several levels of threat, the warning with the highest level is always used. If a warning instruction with a warning triangle warns of injury to persons, a warning of damage to property may also be included in the same warning instruction.

➤ Qualified staff

The relevant equipment/system described in this documentation may be operated by qualified personnel authorised for the function and in accordance with the relevant documentation. In particular, the warnings and safety instructions must be observed. Qualified personnel are persons who, on the basis of training and personal experience, are able to define the risk factors and avoid possible hazards when working with these devices/systems.

➤ Using Siemens products as intended

Please observe the following:

Siemens products may only be used in the applications specified in the catalogue and technical description and only in conjunction with third party equipment and components recommended or approved by Siemens. Faultless and safe operation of this product requires proper transportation, storage, installation and assembly as well as careful operation and maintenance.

➤ Tags

All designations using the ® trademark are registered trademarks of Siemens AG. Other marks in this document may be marks whose use by a third party for its own purposes may infringe the rights of the mark holders.

➤ Disclaimer

We have revised the content of this publication to ensure that it is consistent with current hardware and software products. Changes to the publication are subject to change, complete conformity with the current state cannot be guaranteed. The information in this publication is periodically corrected and any corrections are inserted in subsequent editions.

3. Description of the SINAMICS S1 Tester

The tester is designed for service, diagnostics and maintenance of SIEMENS SINAMICS inverters series G130, G150, S120 Chassis, S120 Cabinet Modules, S150, MISCROMASTER Chassis.

The tester has the following features (tests):

- IGBT transistor switching test
- Inverter Current Sensor Test
- Temperature sensor test
- Fan switching test
- Rectifier switching test
- IGBT saturation voltage measurement (only using SINAMICS TESTER SW)
- 1000VDC source control option for IGBT tests

Control via touch screen with buttons and rotary controller and also via computer (USB or WiFi).

Dimensions 200 x 120 x 50 mm.

Power supply 24VDC, via the 230VAC adapter included in the delivery.

4. Circuit description

4.1. Dismantling the CIM/CIB

The Sinamics tester plugs in instead of the CIB/CIM card. The connectors used on the CIB/CIM card plug directly into the tester. See below for CIM/CIB disassembly. The connector from the current transformers must be removed from the IPD.

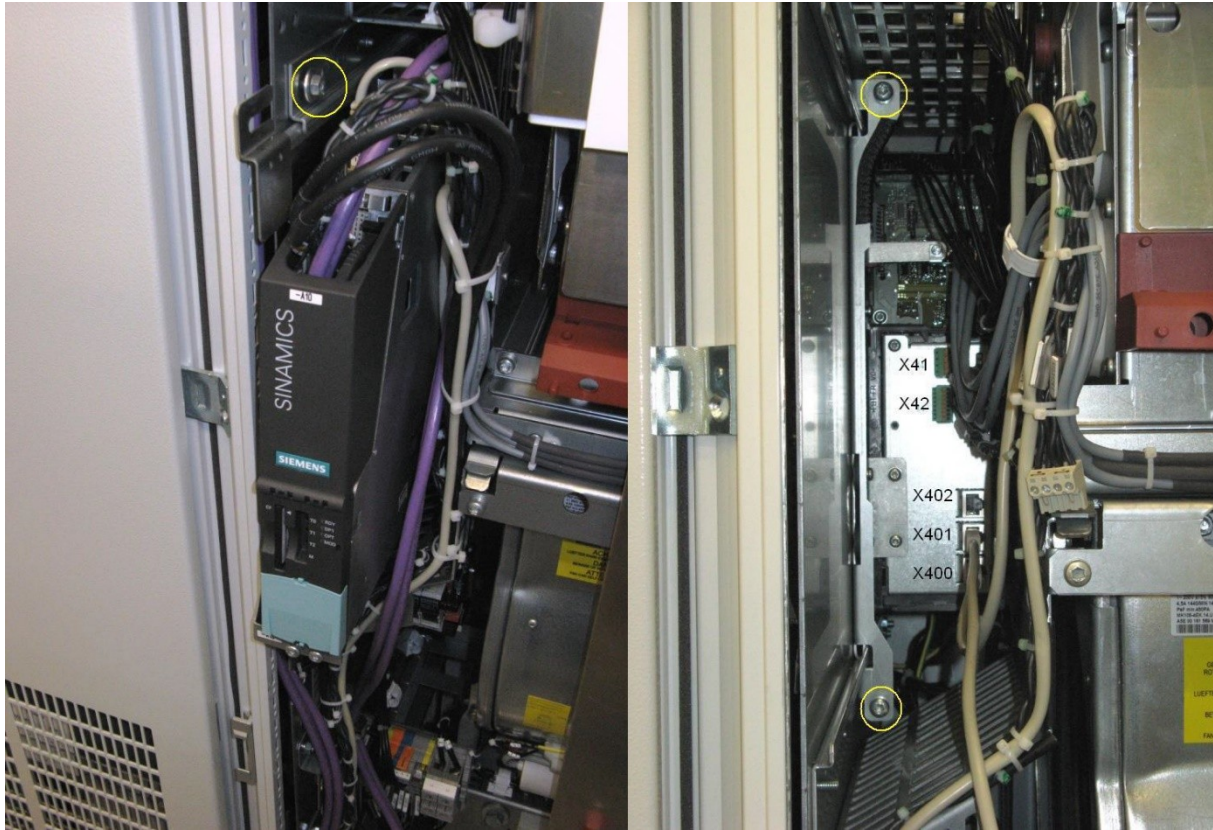


Figure1 - CIM/CIB disassembly procedure

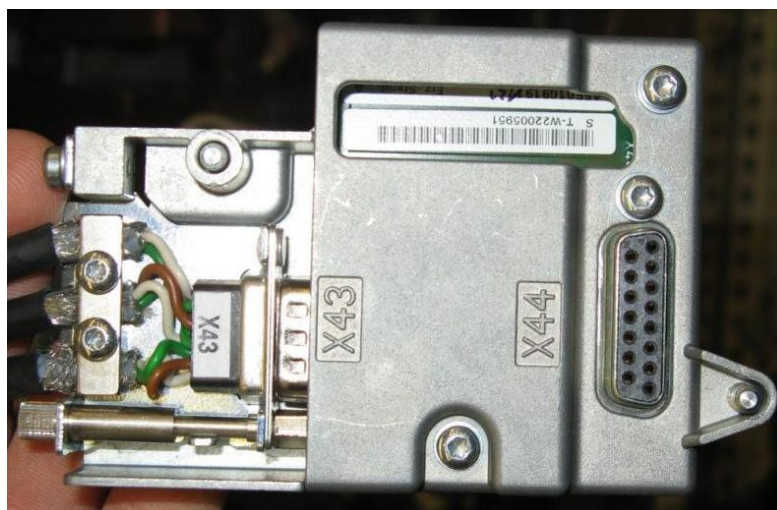


Figure2 - Connecting current transformers to IPDs

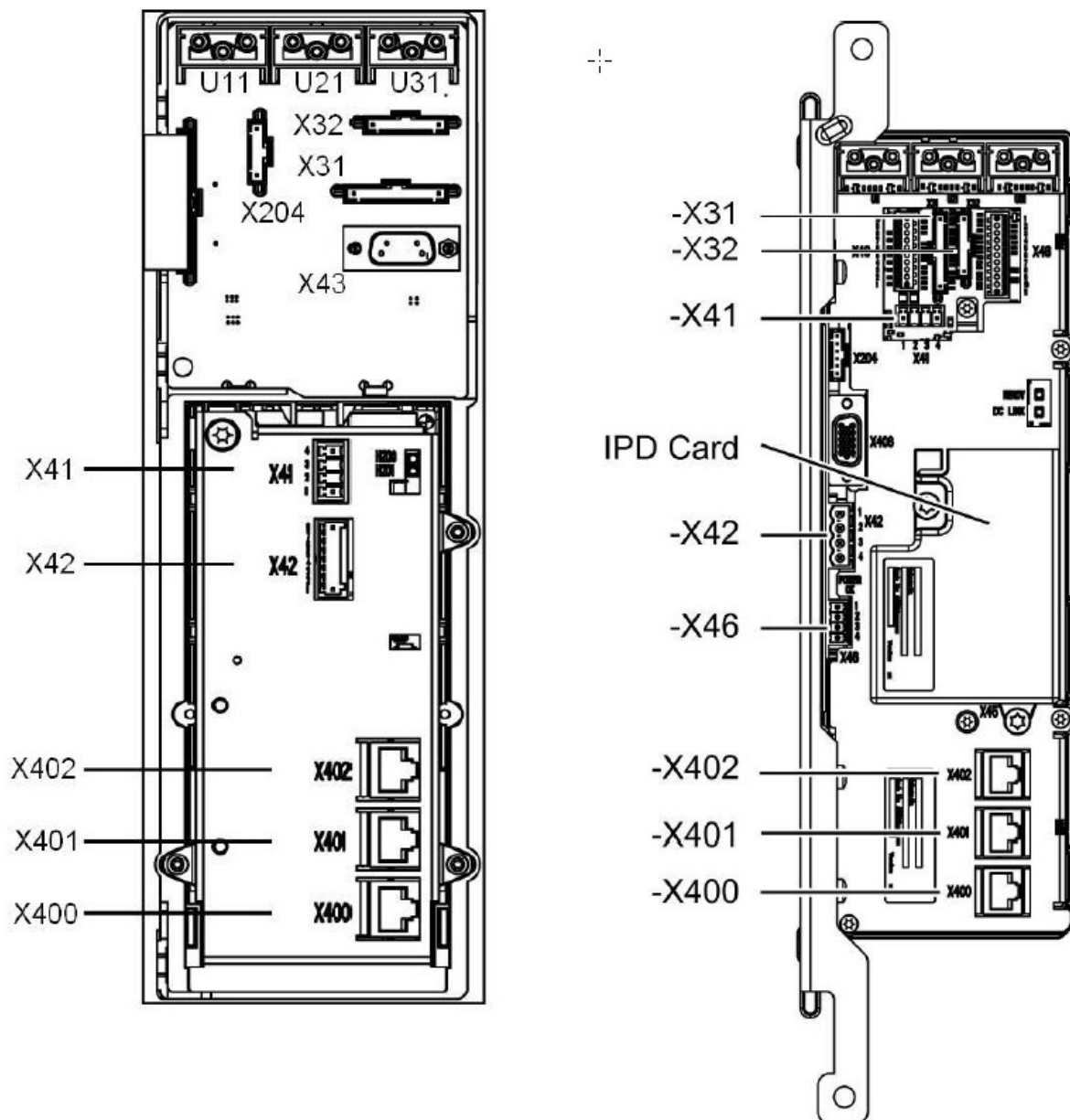


Figure3 - Description of the AIBO connectors on the CIB card (left) CIM (right)

- It is recommended to disconnect all connectors from the CIM/CIB card especially X60 (DC line measurement) and X9 of the 24VDC power supply of the CIM/CIB card. This would unnecessarily power the card and consume current from the VDC power supply of the tester.
- When testing S120, S150, G150 parallels, it is recommended to disconnect all power to other untested arrays/blocks. In the G150 inverter, for example, disconnect terminal X9 (bottom left orange terminal). For large S120 inverters, the DC link decoupling of other fields should also be considered. This is not a requirement, but it is necessary to remember that the tester or VDC source must always charge the DC link of the untested blocks/fields.

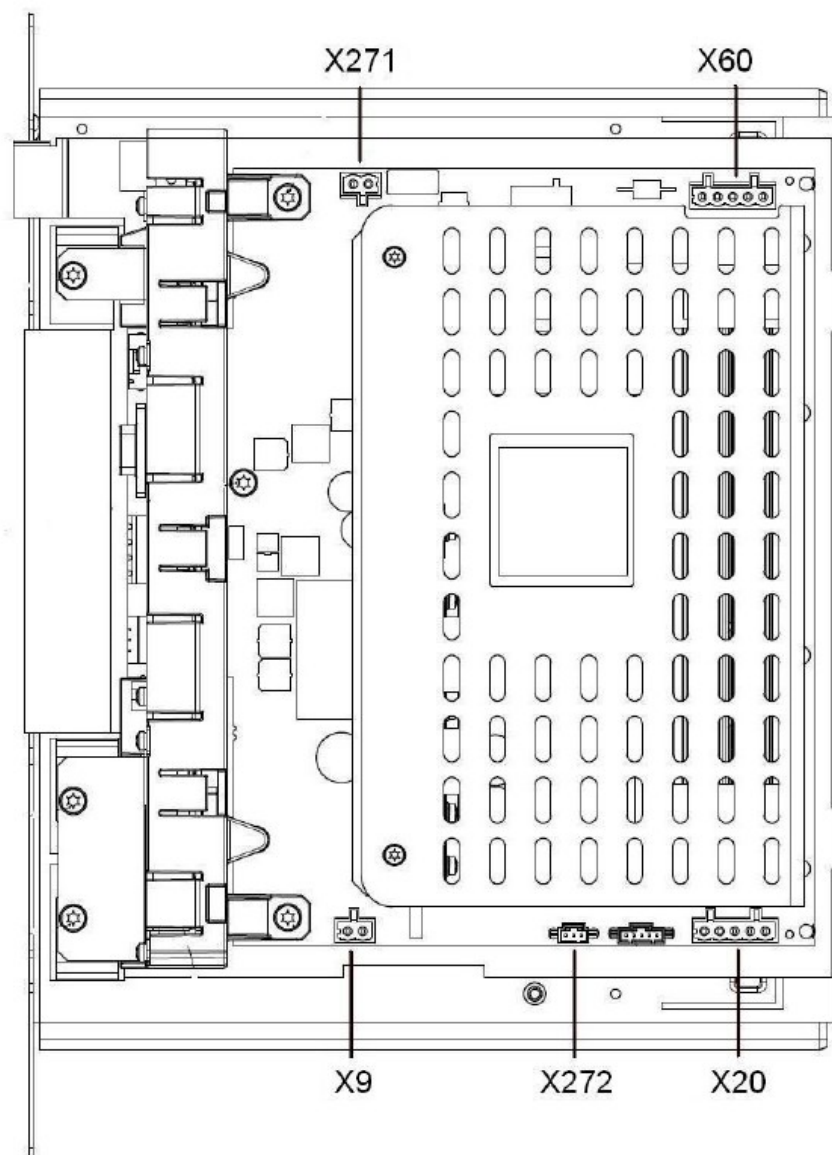


Figure4 - Description of the PSB connectors on the CIM/CIB card

4.2. Description of the tester wiring

Clamp on tester	Description
X272	Connector for fan control
X204	Connector for controlling the Rectifier, BLM
X31	Temperature sensor connector
X32	Temperature sensor connector is not used in some inverters
X43	Connector for IGD exciter power supply
U11	L1 phase optical cable connector
U21	L2 phase optical cable connector
U31	L3 phase optical cable connector
UIN1	Connects to the output terminals of the L1 phase shifter
UIN2	Connects to the output terminals of the L2 phase shifter
UIN3	Connects to the output terminals of the L3 phase shifter
UDC +	Connects to the "+" potential of the DC line
UDC -	Connects to the "-" potential of the DC line
I OUT +	Connects upstream of the power block current transformer
I OUT -	Connects behind the power block current transformer
USB	μUSB connector for communication with PC
RS485	RJ45 connector for communication with VDC source

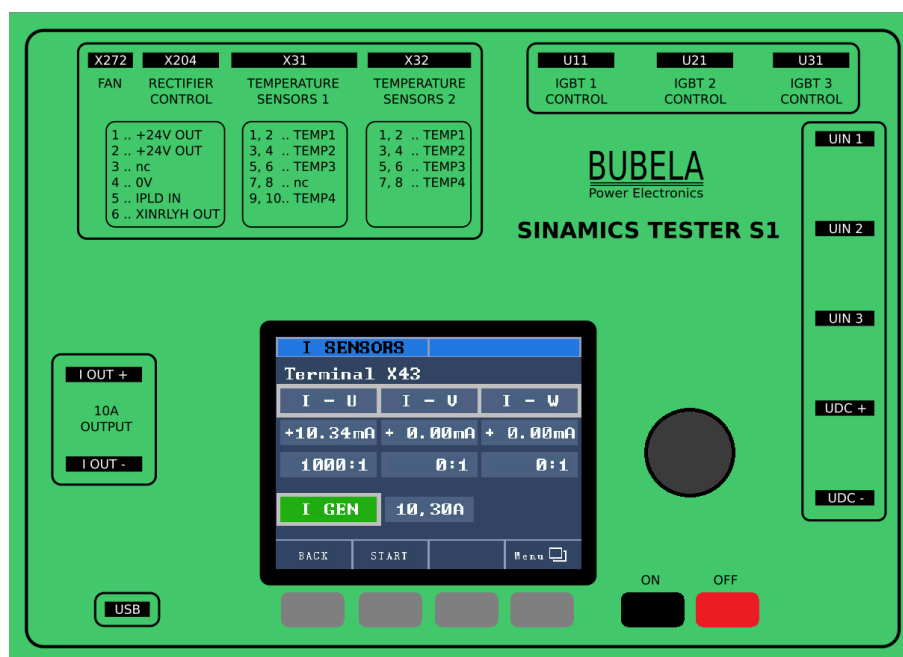


Figure5 - Front view of the tester with description of terminals



Image6 - Top view of the tester

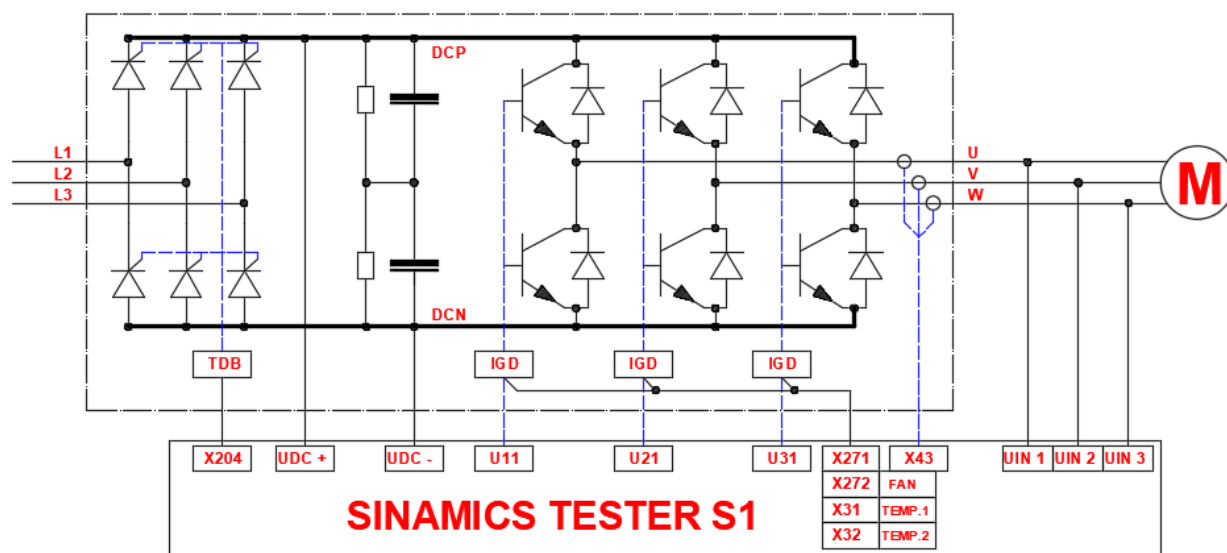


Figure7 - Block diagram of the Tester

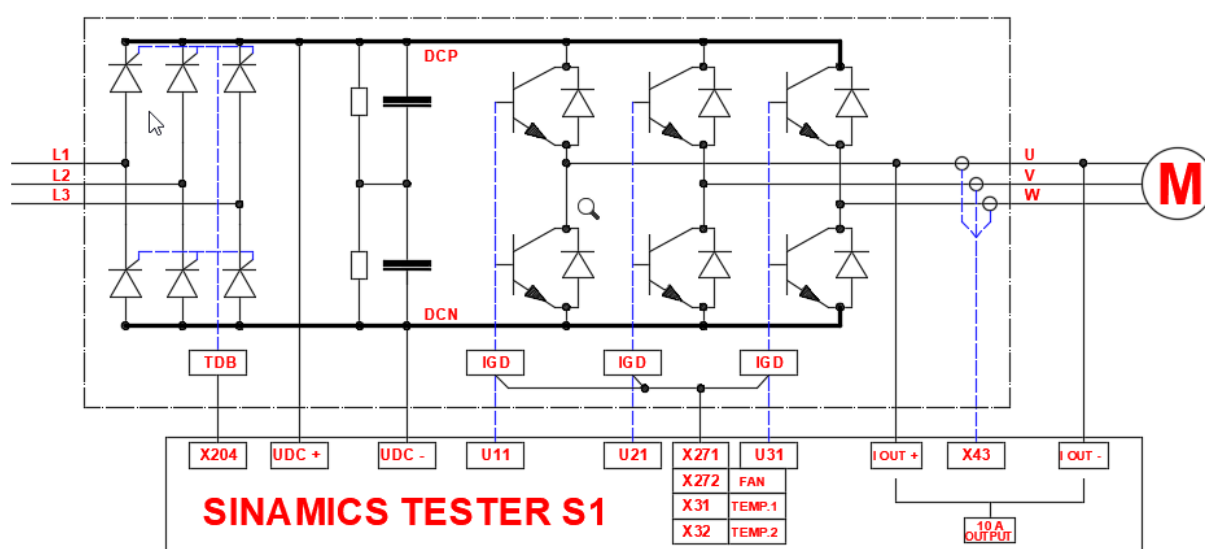


Figure8 - Block diagram of the Tester in current transformer test mode

The wiring diagram in Figure 7 is based on the standard inverter wiring. In this circuit, the tester is able to fully test the entire power block.

The wiring diagram in Figure 8 is the wiring in the case of the current transformer test. This test is necessary to determine the exact conversion of the current transformers and is recommended to be performed in at least one phase (the tester will then remember the conversion for all three phases). Figure 8 is illustrative and represents a measurement in phase U. For measurements in the remaining phases from the wiring must reconnect. The current source can only generate current for one phase.

- **WARNING** After performing the current transformer test, the cables must be disconnected from the current source, there is a risk of damage to the current source.

4.3. Connecting to a computer

The tester can also be controlled from a Windows PC program on a PC. Advanced tests, such as measuring saturation voltage, can only be performed via PC. The tester connects to the PC either via USB interface or wirelessly via WiFi.

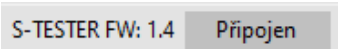
Connection via USB

1. Connect the tester and the computer with a cable with a micro USB connector on the side of the tester.
2. When the power is connected to the tester, the COM port should be automatically installed on the computer.

WiFi connectivity

1. Select a WiFi network connection on your computer named TESTER-S-xxx, where xxx is the serial number of the tester.
2. Enter the authorization password "password".
3. After a successful connection, the computer will report that the connection is without internet, which is a normal condition.

S-TESTER application

1. Start the PC program S-TESTER.
2. Select the connection method, USB COM port or WiFi (default IP address is 192.168.4.1).
Note: The connection labeled Simulation is used to allow you to familiarize yourself with the operation of the application without the tester and the inverter under test connected.
3. Select Connect.
4. The connection status is indicated in the lower left corner: .

Connecting the capacitor forming source

The tester can be connected to a PSVD-1K-1000V type capacitor forming source. It connects with a standard patch cable to the RJ45 connectors on the tester and the source marked RS485.

The tester automatically detects the connected power supply and allows you to control it via the PC application. The use of the power supply is especially important when testing the saturation voltage, where the tester automatically sets the voltage of the power supply and controls its output.

5. Control of the Tester

The tester is equipped with a fully graphical touch screen. It can be operated by touching the screen or alternatively by a black rotary control wheel. The rotary dial also serves as a confirmation button.

The four grey buttons below the display change their properties according to the description on the display above the button.

The "ON" and "OFF" buttons are used to activate or deactivate the respective test selected on the display.

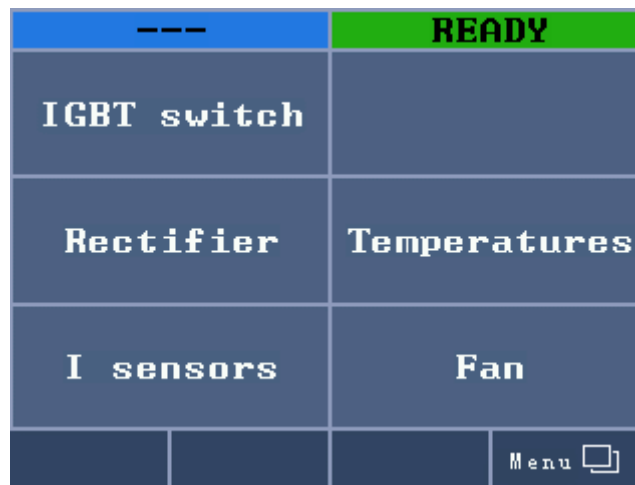


Figure10 - Default screen for selecting individual tests

The upper blue square shows the current test being performed, the upper green square shows the status of the tester. The box changes color to red in case of tester failure or failure to meet certain conditions.

Test	Description
IGBT switch	Ignition test of individual IGBT transistors
Rectifier	Rectifier functionality test, the test is almost useless as the rectifier has no diagnostics. This test only makes sure that the rectifier board is properly powered.
Temperatures	Verification of inverter temperature sensors
I sensor	Current transformer test, the tester must be connected according to figure 8
FAN	Cooling fan relay function test

5.1. IGBT switch

IGBT AUTO		READY	
		Udc	0V
FAULT 1	FAULT 2	FAULT 3	
U11 H	U21 H	U31 H	
OFF ?	OFF ?	OFF ?	
U11 L	U21 L	U31 L	
OFF ?	OFF ?	OFF ?	
BACK	AUTO	MANUAL	Menu 

IGBT AUTO		READY	
		Udc	8V
FAULT 1	FAULT 2	FAULT 3	
U11 H	U21 H	U31 H	
OFF OK	OFF OK	OFF OK	
U11 L	U21 L	U31 L	
OFF OK	OFF OK	OFF OK	
BACK	AUTO	MANUAL	Menu 

Figure11 - IGBT transistor ignition test

The IGBT test can be switched between "AUTO" and "MANUAL" modes. In the "AUTO" mode, all IGBT transistors are switched on sequentially. In manual mode, the user selects the switching of the respective IGBT transistor. Manual switching is done via the touch screen by touching the corresponding element.

FAULT 1,2,3 symbolizes the feedback of the exciter protection. If an error is displayed the exciter is not working properly, the fiber optic cable is not connected, or the 24VDC power supply for the exciter is not connected.

In manual mode, it is possible to perform tests of individual blocks outside the inverter, or to perform diagnostics of damaged blocks.

- **ATTENTION** For large inverters with large DC link capacity, the DC link must be powered by an external power supply up to 24VDC. The tester's internal power supply is not powerful enough for such large capacitances and takes a long time to charge, in some cases it cannot be charged at all.
- The IGBT test must be performed before running the Usat IGBT test (via PC program only)

5.2. Rectifier



Image12 - Rectifier Test

The rectifier in G130, G150 and Basic Line in S120(G150) has no diagnostics. The controller has a life of its own and cannot be tested thoroughly. There is only a run signal and a feedback signal. However, this signalling is only indicative and is nowhere introduced into the control signalling.

5.3. Fan

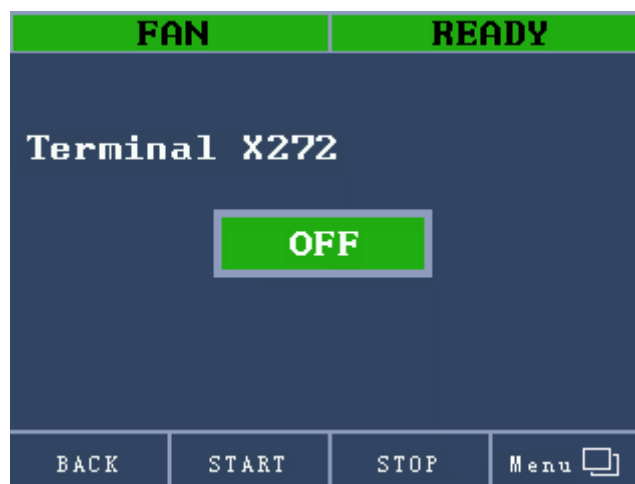


Image13 - Fan switching test

Performing this test will test the fan switching relay. When the test is activated, the relay must close.

5.4. Temperatures



Image14 - Temperature Sensor Test

Temperatures are measured continuously using PT100 sensors.

The use of temperature sensors always depends on the inverter design

NC - the sensor is not used in the given inverter design

ERR - sensor is out of tolerance, probably damaged

Description of individual sensors, terminal block **X31**

Clamps	Description
1-2	Temperature in the cabinets
3-4	Inverter cooler temperature (L1,L2,L3), L1 phase cooler temperature (upper)
5-6	Inverter cooler temperature (L2,L3), phase cooler temperature L1 (bottom)
9-10	Rectifier temperature

Description of individual sensors, terminal block **X32**

Clamps	Description
1-2	Cooler temperature of L2 phase (upper)
3-4	Cooler temperature of L2 phase (bottom)
5-6	Cooler temperature of L3 phase (upper)
7-8	Cooler temperature of L3 phase (bottom)

5.5. I Sensors



Image15 - Current Sensor Test

The display shows all three phases. However, it is recommended to always measure one phase and then move on to the next.

The measurement can be done by running the cable through the measuring transformer or by connecting directly to the power bus before and after the measuring transformer. At least one phase measurement must be made to determine the current transformer conversion.

- The wiring for current transformer measurements is as shown in Figure 8.
- After this test, the power current cables must be disconnected, there is a risk of damage to the tester.
- It is recommended to perform this test in at least one phase to determine the current transformation by measurement. At the same time, the conversion must be determined for later execution of the IGBT Usat test.
- If the tester restarts during the test, it is necessary to use a stronger power supply or disconnect all connectors from the tester and leave only the current trace measurement.

6. Description of the saturation voltage measurement methodology

The tester can only perform this test via a PC program. At the same time, a suitable DC power supply connected to the DC intermediate circuit of the inverter is required to perform this test successfully. It is also necessary that a motor or other inductive load, e.g. an inductor, is connected to the inverter.

As a DC source, the most suitable formation capacitor source is the PSVD-1K-1000V type, which can directly control the tester.

The principle of measuring the saturation voltage of an IGBT is to shortly switch the IGBT to an inductive load, e.g. a motor. In the switched state, the current increases from zero to the maximum set value depending on the voltage and time U_{DC} - see Fig. 16. The result is the measured voltage across the collector-emitter U_{CE} depending on the current I_C - see Fig. 17.

For a three-phase load it is similar, it depends only on the appropriate switching of the IGBT elements, as can be seen in Figure 18.

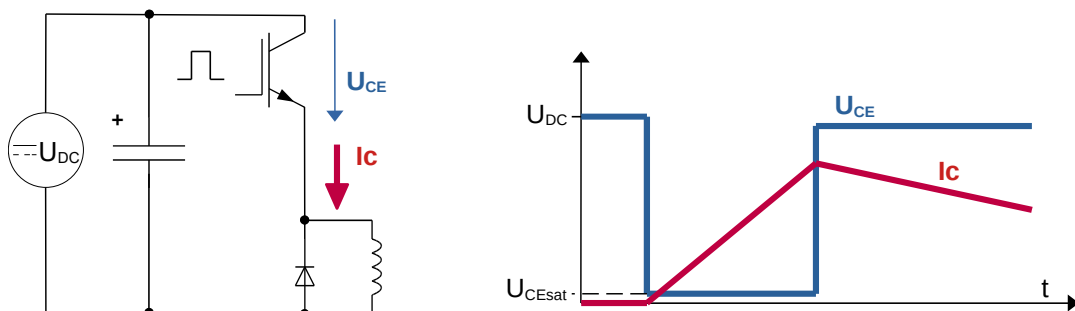


Figure16 - Basic principle and flow of saturation voltage measurement

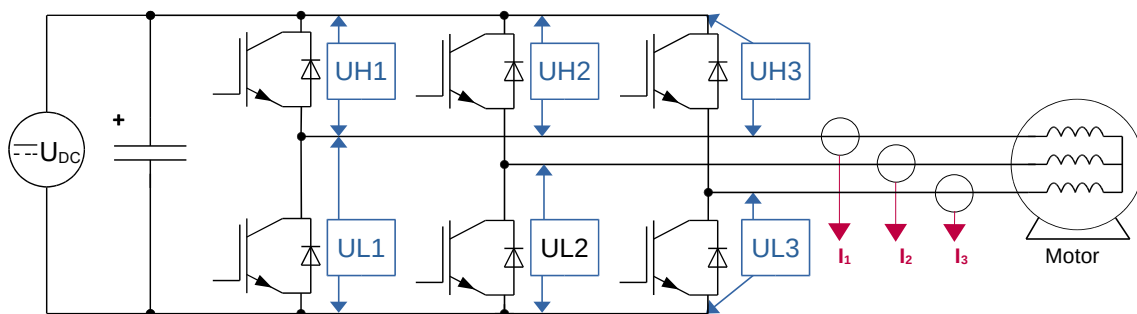


Figure17 - Topology of three-phase inverter with motor connected and voltage saturation measurement

This measurement is only informative and only useful in the long term. During the next preventive inspection, it is ideal to measure the inverter again (with the same input parameters) and compare the values. In the long term, this measurement can be used to determine the gradual ageing of power block components.

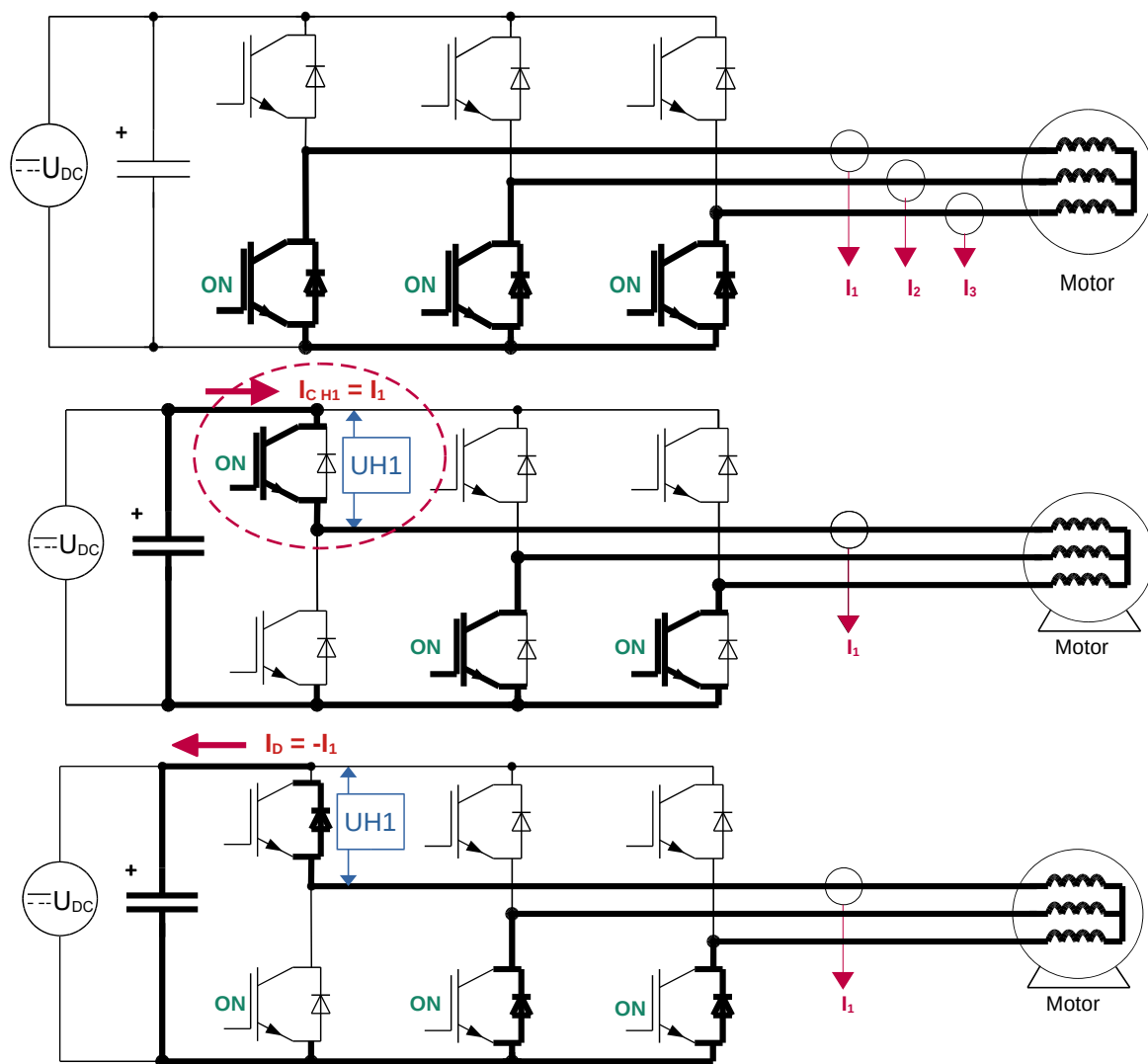


Figure18 - switching procedure of IGBT element during test

7. Troubleshooting errors and problems

Error/problem	Solution
Cannot make IGBT switch	The capacity of the DC line is very large, the tester is not able to supply such a large capacity. A sufficient external 5-24 VDC power supply needs to be connected to the DC link
Cannot perform IGBT switch - one of the elements prints FAULT	IGBT exciter power supply not connected correctly The appropriate fibre optic cable is not connected Exciter or IGBT is damaged
Cannot perform IGBT switch - one of the elements prints FAULT during the test	Probably the exciter or IGBT element is damaged, due to damaged saturation protection. This fault is manifested by the extinction of the feedback during the ignition of the corresponding IGBT
The tester restarts during any test	The tester power supply is not capable of supplying sufficient current to the tester. Use another power supply, disconnect unnecessary cables from the tester
Cannot make current transformer measurements	Check the correct wiring of the current transformer measurement. Connect the cable from the current transformers correctly.
Unable to perform IGBT Usat test, only the bottom line is displayed	Check the wiring with a tester. Connect the current transformer cable and repeat the current transformer test (for all transformers). By trial and error, set the Voltage to Current ratio in the PC program.
DC power supply is not able to charge the DC link fast enough and the program prints a DC link charge not reached error	Set a lower voltage. Perform a test when the power supply is not controlled by the tester and charge/power the DC link with a fixed value set directly on the power supply. This must be the same as the voltage setpoint in the program

8. List of abbreviations

Shortcut	Description
AIBO	Adaptation Interface Board
CU	Control Unit
PSB	Power Supply Board
TDB	Thyristor Drive Board
IGD	IGBT Drive Board
IPD	
BLM	Basic line module

9. Contact information

BUBELA Power Electronics, s.r.o.

email: info@bubela.cz

web: www.bubela-power.cz

Date of revision of the document

July 2024 PRELIMINARY English version

Document number

D230021-12