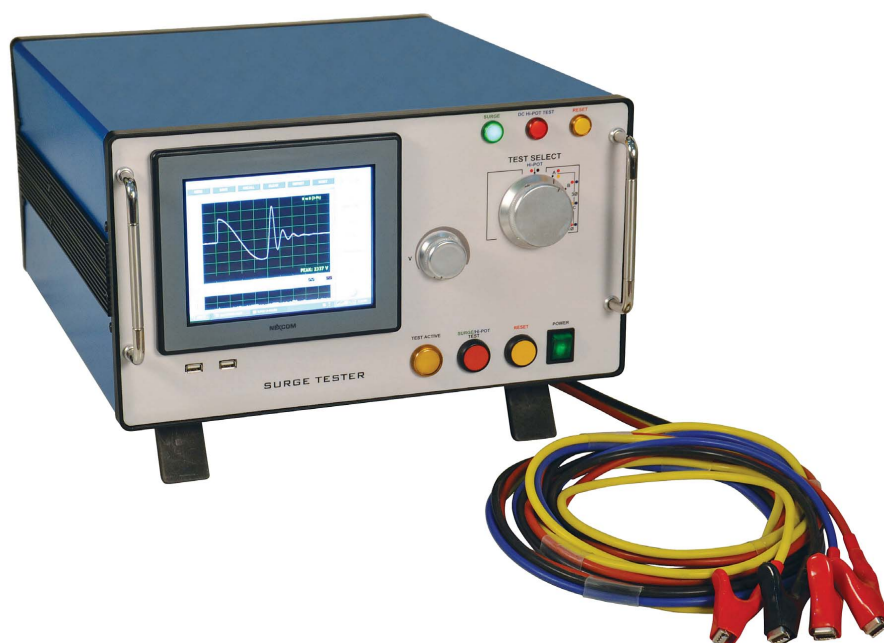


# Operating Manual

## Surge Tester Series ST6000

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## 1 General

### 1.1 Surge Tester Series ST6000

The surge tester of the series ST 6000 were developed to detect winding shorts and insulation faults within a winding, even before the fault is detected in the electrical specifications of the device under test. They are excellent for testing newly manufactured and rewound electric motors for example.

Apart from its flexibility, the latest generation of surge testers is impressive due to its high capacity. All devices are mobile so that they can be easily used in the manufacturing plant and in the motor repair shop as well as in the field for testing the windings. The integrated standard PC with Windows interface guides the user through the individual test steps and makes the handling simple and intuitive. For connection to a standard printer, the devices are equipped with a USB interface – all vibration curves and logs can thus easily be printed in colour. The virtually unlimited, internal memory also enables convenient storage.

#### **The Tester can be used for the following windings:**

- Single-phase and 3-phase motors and windings
- Low voltage coils
- AC motors
- DC motors
- Stators
- Transformer coils
- Magnet coils
- Choke coils
- HV motors and coils

#### **Technical Features:**

- Integrated Standard-PC with 8" TFT colour display
- Color coded waveforms for better analysis
- Graphical and numerical representation of error percentage between the waveforms
- Graphical and numerical error percentage display
- Test result (GOOD/FAIL) lamp indicator
- Dual feature to either compare against master waveform or compare two windings simultaneously
- Store, print and recall surge test waveforms and reports
- Surge test peak voltage indicator
- Motor data reference database
- Customisable test plan
- Fully electronic generator
- Calibration certificate according to ISO 9001

#### **User Interface and Controls:**

- Highly sensitive fault detection capability
- Test leads insulated up to 45 kV
- Single-phase and 3-phase test select switch
- Leads energised warning indicator
- Printer can be connected for direct printouts

**PC Specifications:**

- Industrial grade CPU (Intel Dual Core)
- 4 GB RAM / 500 GB hard disk
- Windows 7
- Dust proof, water resistant
- Temperature range 0 – 60 °C
- USB, RS 232 und Ethernet / LAN interface
- Wireless keyboard and mouse

**1.2 Scope of Delivery**

Included are below standard accessories for this device. If required these accessories can, of course, also be ordered separately.

- Mains cable
- 4 x high voltage test lines with spring clips
- 1 x 4-wire test line with kelvin clips (only devices with resistance measurement)
- Wireless keyboard and mouse, with USB adapter
- Operating manual of the device (i.e. this document)
- Data carrier with installation software

## 1.3 Requirements for the operation of this device

### 1.3.1 Regulations for application

The tester must be in an operational and reliable condition.

Only personnel having completely read and understood this operating manual and who are authorized skilled electricians or who have been instructed in electrical engineering are allowed to perform any operations with and at the testers.

The tester is not to be operated if or for:

- operations are performed which are not specified in this operating manual or which have not been recommended by *SPS electronic GmbH* concerning installation, operation, maintenance and service.
- unauthorized alterations and/or repairs
- dismantling and/or avoiding of safety devices
- use of components, tools, additional installations, supplements and working material which have not been approved or recommended by *SPS electronic GmbH*
- building in of spare parts which are not original *SPS electronic GmbH* spare parts or of spare parts from suppliers not recommended by *SPS electronic GmbH*

### 1.3.2 Product liability

The testers have been produced, adjusted and tested according to the state of the art and the approved safety requirements.

The devices comply with the conditions agreed upon by contract of the confirmation of order concerning execution, single parts and accessories selection.

*SPS electronic GmbH* will be liable for errors or omissions to the extent of the guarantee liabilities of the confirmation of order.

Applicable are the general conditions of delivery of the Central Association of Electrical Engineering and the Electronics Industry, registered association (ZVEI).

The contents of this operating manual is in compliance with the condition of the tester on the date when same was drawn up.

Subject to change are technical alterations because of further developments and improvements of these products by *SPS electronic GmbH*.

Liability claims can therefore not be derived from the contents of this operating manual (data, descriptions, graphs, misprints, etc.).

Errors and omissions excepted!

***SPS electronic GmbH* will only be liable in case of application of the testers according to regulations (pl. see 1.3.1).  
If those regulations have not been applied the operator is solely responsible for risks of hazard to body and life of the user or a third party and impairments of the tester and other material assets!**



## 1.4 General safety regulations



**In addition to this operating manual the generally applicable legal regulations and other binding instructions concerning safety regulations, regulations for preventing accidents and regulations for the protection of the environment must be adhered to.**

The Surge-Testers ST6000 are designed as laboratory devices for manual testing of winding goods.

The devices have a big surge energy of up to 1.44 / 7.2 / 11.3 Joule (ST6000A/B / ST6000E/F / ST6000I/H). According to EN50191 only devices with an electrical discharge energy  $\leq 350$  mJ may be operated without additional safety measures.

Due to the high voltages and discharge energy, there may occur hazards if the devices are operated improperly or carelessly.

Be sure to observe the following safety precautions:



- **The device may only be operated by trained electricians or by persons with electrical training.**

- **Perform testing only in test stations that are set up acc. to EN50191. The access of other persons to the tester or the tested device is to be prevented while a test is running.**

- **Do only start a test when all measuring lines are connected to the test object.**

- **Never touch the test object when a test is running.**



- **The voltage surges cause short but strong electromagnetic fields. This can lead to interferences with sensitive electrical devices in the surrounding of the test station. Also, this is of particular concern to persons with active or passive medical devices, like e.g. cardiac pacemaker.**

### 1.4.1 Obligations of the operator

- The tester is only to be operated according to regulations and in operational condition (see chap. 1.3.1)
- Protective and safety devices, locking devices and couplings, etc. have to be inspected by an expert at least once a year.
- A protocol on the test results has to be drawn up in form of a **test report** same has to be retained.
- Instructions on operations with or at a machine or installation as to hazards to health and/or life of persons are obligatory.
- Persons who operate with or at an ST6000 have to confirm by their signature to have read and comprehended this operating manual especially in regard to the operating instructions.
- Dangerous zones resulting from the integration of the tester into a system or a device have to be located by the operator and safeguarded against.

When assembling or installing devices, systems or items of equipment of different manufacturers or suppliers and after modifications by company or service personnel where changes within the electric equipment were made the operator has, before putting into operation, to perform a precise inspection according to the accident prevention regulations VBG 4 in compliance with the individually applicable rules of electrical engineering.

### 1.4.2 Operating instructions for personnel

- Operating instructions, general instructions and regulations are part of the tester and have to be accessible, readable and complete for all those who operate with or at the ST6000.
- Before operating with or at the ST6000 questions have to be answered or uncertainties have to be explained by the personnel in charge.
- Any operations with or at the ST6000 may only be performed by workers skilled in electrical engineering or trained in electronic engineering and who have been given instructions for such operations and thus been authorized by the operator.
- Testing personnel may only operate the ST6000 when an authorized attendant is in charge.
- Adjustments, service and inspections have to be performed according to the instructions specified and according to schedule.

### 1.4.3 Note on possible disorder of USB devices

When testing with high-voltage, it is possible that failing testpieces may cause disorder of USB devices in close surrounding of the test field.

Please see annex A for a problem description, and measures to avoid.

### 1.4.4 Information on further publications

For the protection of persons the trade associations and unions have published below literature:

- DIN EN 50191 Installation and Operation of Electrical Installations
- DIN EN 50274 Protection against Electric Shock –  
Protection against unintended direct contact of dangerous active parts
- DIN 40 008 part 3 Safety Signs for Electrical Engineering;  
Warning Signs and Additional Signs
- DIN 40 050 IP-Protective System, Protection against Contact, Foreign Matter and Water  
for Production Equipment
- DIN 57100 Specifications for the Installation of Power Plants with Nominal Voltages of  
up to 1000 V
- BGI 891 Establishing and operation of electrical test plants

## 2 Hardware Description

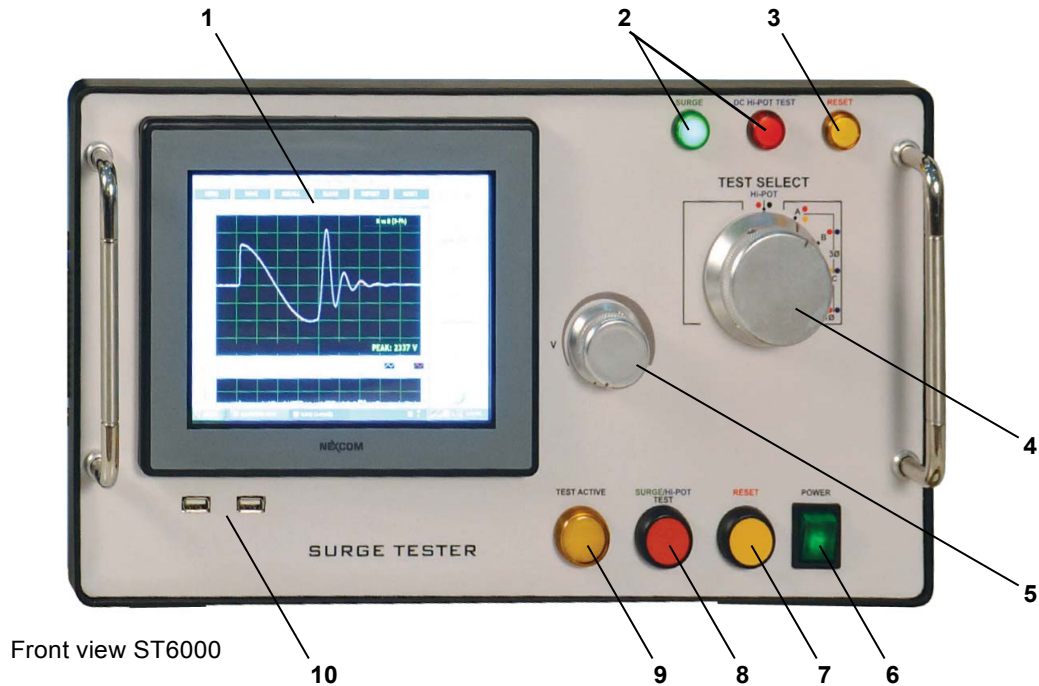
### 2.1 Technical Data

	<b>ST6000 A/B, ST6010 A/B</b>	<b>ST6000 E/F</b>	<b>ST6000 I/H</b>
<b>Measurements &amp; weights</b>			
Dimensions (HxWxD)	280 x 450 x 460 mm	250 x 435 x 540 mm	
Weight	25 kg	30 kg	
<b>Ambient</b>			
Temperature	operation: 15 °C – 40 °C storage: 5 °C – 60 °C		
Air humidity	max. 70% (uncondensing)		
<b>Connection data</b>			
Power supply	230 V ± 10% (50-60 Hz)		
Power input	240 W (max)	400 W (max)	
Display	8" Touch Screen		
<b>Surge voltage</b>			
Voltage range	6000 V	12000 V	15000 V
Impulse current	max. 400 A	max. 800 A	max. 1000 A
Surge energy	1.44 J	7.2 J	11.3 J
Surge capacity	0,04 µF	0,05 µF	0,05 µF
Surge repetition rate	1 pulse/sec		
Minimal DUT inductance	24 µH	24 µH	24 µH
Time base	variable 10µs -10ms		

	<b>ST6000 A, ST6010 A</b>	<b>ST6000 E</b>	<b>ST6000 H</b>
<b>High voltage test DC</b>			
Test voltage	6000 V	12000 V	15000 V
Current range	max. 2000 µA		
<b>Resistance measurement</b>	4-wire-technology		
Measurement range	0.001 Ω - 60 Ω		

## 2.2 Set-up of device

### 2.2.1 Operating elements



- 1 LCD touch display
- 2 Operating mode telltales "SURGE / HI-POT"
- 3 Telltale "RESET"
- 4 Selector switch for operating mode, or phase-selection
- 5 Control dial for regulation of test voltage
- 6 Mains switch
- 7 Reset-button
- 8 Start-button – *mut be held pressed all time while performing a test*
- 9 Telltale for indication of a running test
- 10 USB connectors for keyboard / mouse / printer

## 3 Putting into operation

### 3.1 Requirements



The tester *ST6000* as well as all of the electric connections and lines must be in operational and reliable condition.

The device may only be used by skilled electricians, or persons trained in electrical engineering, and under the presence of an authorized attendant in charge.

The General Safety Regulations (pl. see chapter 1.4) and the generally applicable legal rules as well as other binding directives for industrial safety, for accident prevention and for the protection of the environment have to be adhered to and persons staying in the area of operation must be informed respectively.



There is danger to life caused by electric current or voltage in case of handling electric installations inappropriately!

### 3.2 Connection of device

1. switch off, if necessary, power switch at tester
  2. plug power cable of tester into cold equipment socket at back of device
  3. connect power cable to power supply (230 V / 55 Hz)
  4. connect 4-wire measuring line to the 4-pole socket at the front or rear (depending on device variant)
  5. connect EMERGENCY-OFF switch to the socket "X1 Safety Contact" at the rear panel
- ▶ Place the EMERGENCY-OFF switch so that it can be reached fast and easily in case of emergency!
  - ▶ Caution: When the EMERGENCY-STOP switch is actuated during a high-voltage test, the high voltage generator is immediately switched off, but the discharge of the capacitors takes a few seconds.

### 3.3 Switching the device on

The *ST6000* is switched on with the green mains switch at the front of the device.

The device is then booting the operation system (Windows 7). When the boot process is finished, the surge tester application is started automatically, which is required for all testing operations.

### 3.4 Switching the device off

Before switching the device off, first the operating system Windows 7 must be shut down. When the shut down process has finished, the device can be switched off with the mains switch at the front panel.

## 4 Operation

After starting the software, the main menu of the application, the "motor management" opens. All orders or inspection projects are managed in this list:

MOTORENVERWALTUNG					
SSS electronic SAFETY MEETS COMPETENCE		HINZUFÜGEN	BEARBEITEN	LÖSCHEN	
TESTMENÜ	Motor ID	KundenName	Modell	Serien-Nr	Datum
3-PHASIG	1000	1	1	1	4/15/2015
	S1	FFG Werke	ST1	9001	11/25/2015
	S2	FFG Werke	S5	8003	11/25/2015
	test01	SPS	Stator-003	4711	1/18/2016
1-PHASIG					
HVDC					
WIDERSTAND					
ENDE					

For each order, a large number of information can be stored, which will also be listed in the test reports.

**Note:**

You must make entries in this motor database. All tests of this device are always directly associated to the selected motor data set. With an "empty" motor database no tests can be carried out.

**Creation of a new data record**

To create the data record for a new order, press the "Add" button:

Job Work Entry Screen

**Typenschild-Daten Motor**

Motor ID  \* Serien-Nr.  \*

Kundename  \* Reparaturauftrag Nr.  \*

Modell  \* Standort

Nennspannung  Nennstro

U/min  Leistung kW

Hersteller  Standort

Getestet von  Fehler-Grenzwert %

\* markiert Pflichtfelder Sonderzeichen / !: " ? < > \*

CANCEL OK

The frame data for a new test object is entered in this dialog. The fields marked with an asterisk "\*" are mandatory fields. Data must be entered here. The other fields are optional, they can be used if desired, but they can also be left blank.

The mandatory fields are:

<b>Motor ID</b>	The motor ID is the most important field, after this designation all orders are managed. No special characters can be used for this designation (folders with this label are created on the hard disk - the characters not allowed are listed in the lower right corner.) The motor ID can not be changed after the record has been saved.
<b>Serial Number</b>	Entry of the serial no. of the motor
<b>Client name</b>	Entry of the name of the client
<b>Repair Job No.</b>	Entry of the number of the repair job
<b>Model</b>	Entry of the model or type of the motor
<b>% Error Pass Limit</b>	Chooses the percentage for the error area, which will later during surge testing be used for the pass/fail evaluation.

When all entries have been made, the dialog can be closed with "OK". The record is saved and appears as a new entry in the motor database.

### **Changing an existing data record**

You can make changes to an existing data set by marking the record in the list and then pressing the "Edit" button.

The field "Motor ID" can not be edited any more, all other fields can be freely edited.

### **Deleting a data record**

The "Delete" button can be used to delete an existing record. An additional safety query is made if the data record really should be deleted.

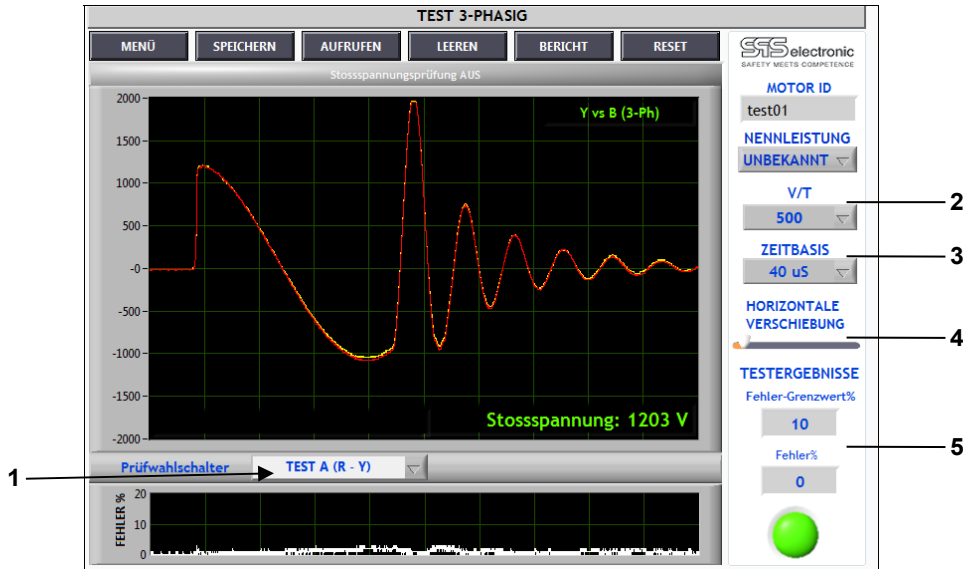
### **Attention:**

**All measurement results, master curves, test reports, etc. of the respective motor data record are also deleted!**



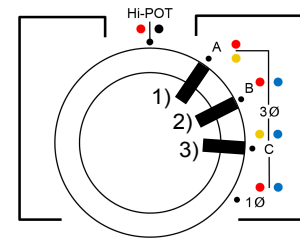
## 4.2 3-Phase Test

After selecting the 3-phase test, the following window opens:



In the 3-phase test, the oscillations of the 3 phases are compared against each other. For this, three measurements have to be carried out in succession:

- 1) Red against Yellow (switch position "A")
- 2) Red against Blue (switch position "B")
- 3) Yellow against Blue (switch position "C")



### Important:

Ensure that the "selector switch" (1) in the test window is always set to the same position as the selector switch at the tester!

### Performing a surge test:

- ▶ Turn the voltage regulator on the front panel all the way to the left to the zero position
- ▶ Press & hold the red "Surge" key on the front panel
  - ▷ *The device now generates voltage pulses in a 1-second cycle. The oscillations of the two tested phases are displayed, and are updated with each pulse.*
- ▶ Adjust the voltage with the voltage regulator until the desired test voltage is reached
- ▶ When the "Surge" button is released, the last recorded curve is frozen, and the test result is displayed at the bottom right (5)
- ▶ At the top of the screen, press "Save" to accept the displayed result for the result log
- ▶▶ Repeat the procedure with the other two switch positions

### Other functions & controls

- (1) "Test selector switch" - this field must always be set to the same position as the selector switch at the tester. Otherwise the assignment in the results report is not correct, and / or already recorded curves are overwritten.
- (2) "V/T" – This is used to set the vertical display range for the test voltage, depending on the required test voltage. Smallest range 500 Volt/div (max 2000V displayed), largest range 4000 Volt/div (max 16000 Volt displayed).
- (3) "Time base" – Sets the display range of the x-axis, from 10  $\mu$ s to 100 ms.
- (4) "Horizontal shift" – Moves the oscillation curve horizontally on the screen
- (5) The result field, here the specified error tolerance, the currently measured error, and the pass/fail result are displayed.

### Function of buttons at the window's top border:

**Menu** – Leave the testing module, goes back to the main menu

**Save** – Saves the data of the actually recorded oscillation curve.

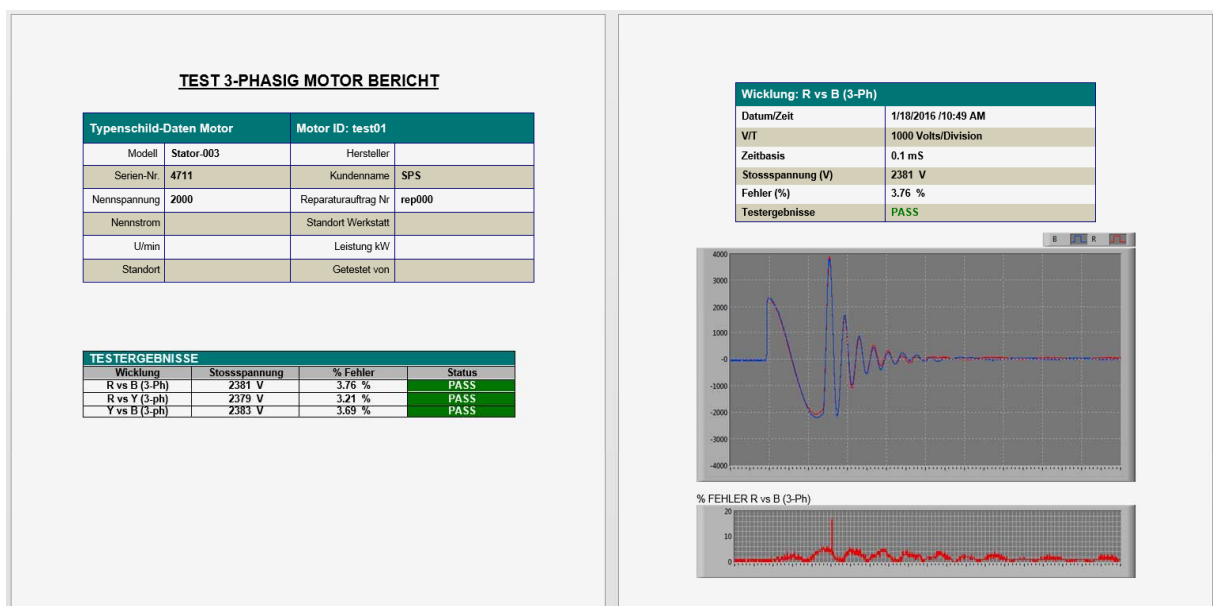
This function must be carried out if the data of the current curve are to be included in the test report!

**Recall** – This allows previously recorded data & curves to be loaded and displayed on the screen.

**Clear** – Deletes all data and graphs on the screen

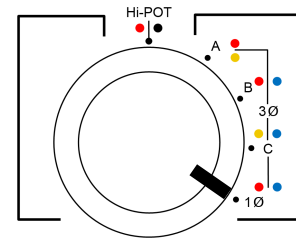
**Report** – Once all necessary measurements have been carried out and stored, this function can be used to generate the test report for the 3-phase test. The report is stored as a \*.doc file on the hard drive, or can be output directly on the standard Windows printer.

Example of a test report (excerpt):



### 4.3 1-Phase Test

**For the 1-phase test, the test selector must be set to the "1-Ø" position!**

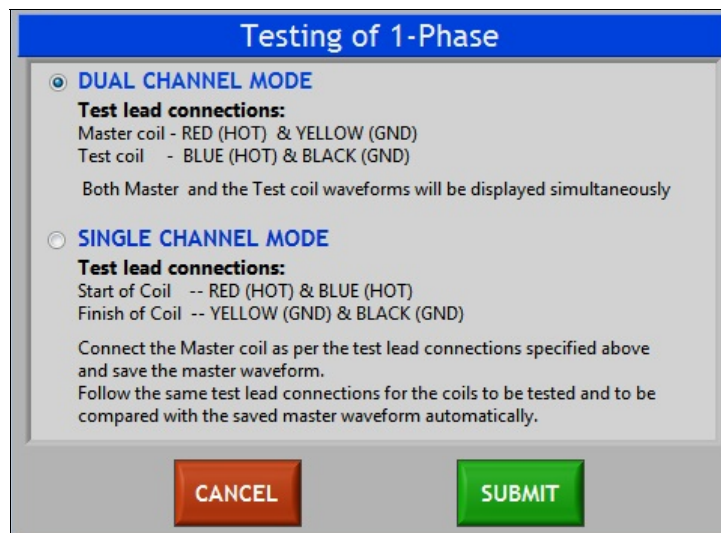


Two different test modes are available:

Dual channel mode: Test samples are compared "live" against a simultaneously connected reference test piece

Single channel mode: Test specimens are compared with a master curve that was previously recorded from the reference specimen

After selecting the 1-phase test, a selection window opens to choose the desired test mode:



#### Voltage application

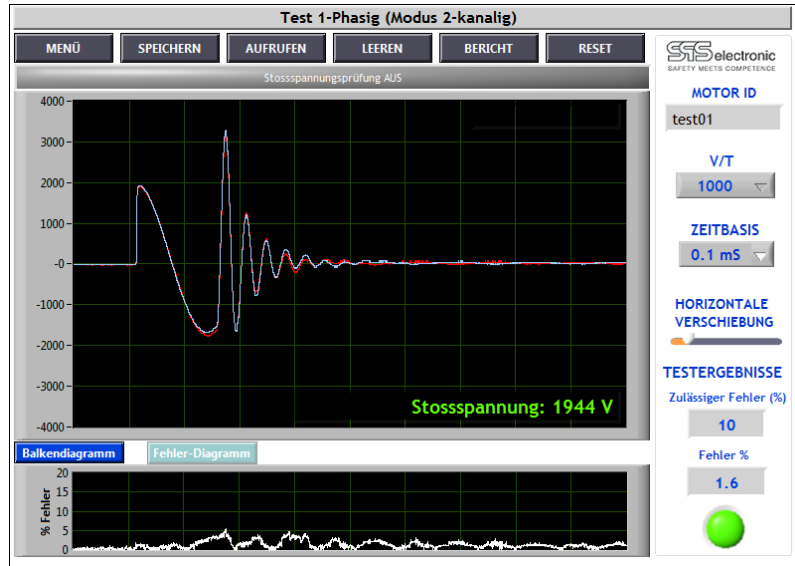
For the 1-phase test, the positive voltage potential is applied to RED and BLUE, and the negative potential (ground) to YELLOW and BLACK.

The connection and evaluation is carried out between RED ↔ YELLOW, and between BLUE ↔ BLACK.

### 4.3.1 Dual channel mode

In the 2-channel mode, the reference coil and the test specimen are simultaneously connected, their oscillation curves are recorded and compared with one another.

When this mode is selected, the following window opens:

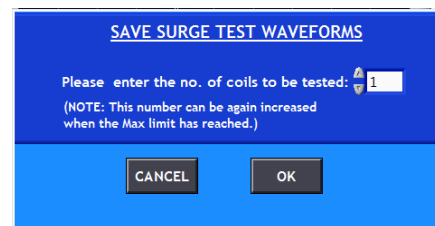


#### Performing the surge tests:

The reference coil must be connected to RED and YELLOW, the tested coil to BLUE and BLACK.

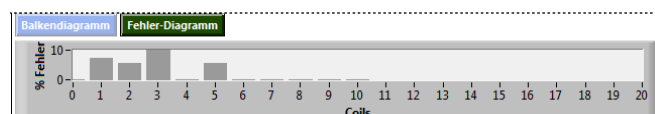
- ▶ Turn the voltage regulator on the front panel all the way to the left to the zero position
- ▶ Press & hold the red "Surge" key on the front panel
- ▶ Adjust the voltage with the voltage regulator until the desired test voltage is reached
- ▶ When the "Surge" button is released, the last recorded curve is frozen, and the test result is displayed at the bottom right
- ▶ At the top of the screen, press "Save" to accept the displayed result for the result log

When storing a curve for the first time, it is asked how many coils are to be tested in this batch. An approximate specification is sufficient, the number can be increased later, or the test series can also be terminated before reaching the number..



- ▶ Connect the next test item and repeat the process on the remaining test items.
- ▶▶ As soon as all the test pieces of the batch have been checked, the report can be created with "Report".

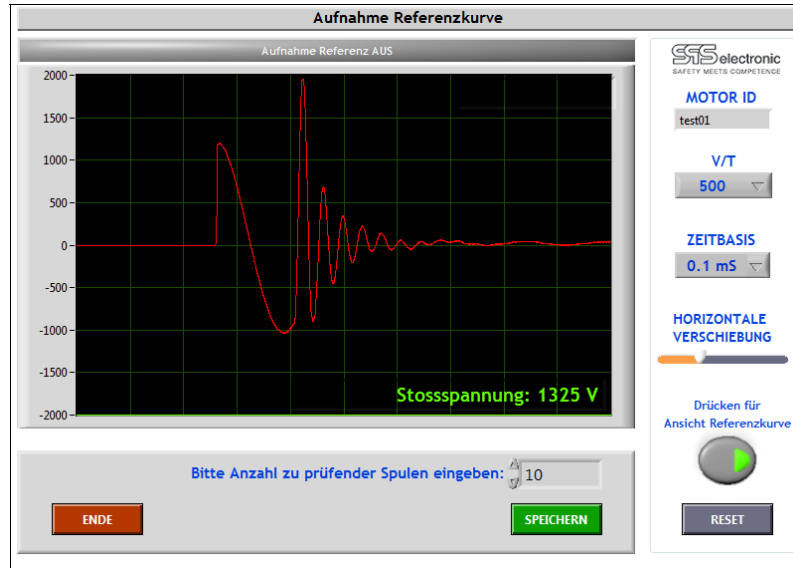
In the lower part of the test window, the view can be changed to "Bar Graph", which gives an overview of the error distribution of the coils tested so far:



### 4.3.2 Single channel mode

In the 1-channel mode, the oscillating curve is first determined from a reference coil and stored as a "master curve". The test operation takes place without the reference coil, the test pieces are compared with the stored master curve.

When this test is run for the first time to a motor set, the window for recording the master curve opens:

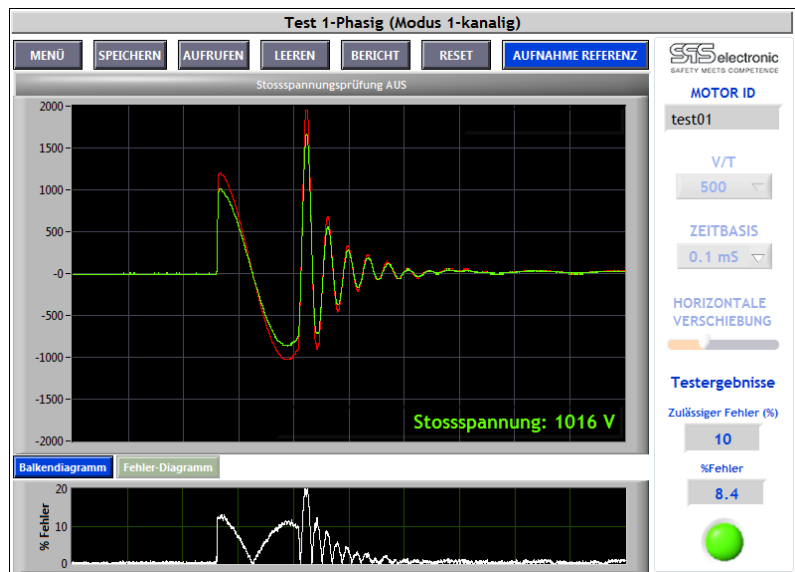


In this test, RED + BLUE must be connected to one coil end, and YELLOW + BLACK to the other end of the coil.

#### Recording of the master curve:

When the master DUT is connected as required, the master curve is taken as in the other surge tests: zero the voltage regulator, press and hold the "Surge" button, then set the desired test voltage. If the recorded master curve is correct, it can be stored with the green "Save" button for the later test series. In addition, the number of test pieces of this batch can also be specified here.

After the master curve has been recorded and saved, it is automatically continued with the normal test window:

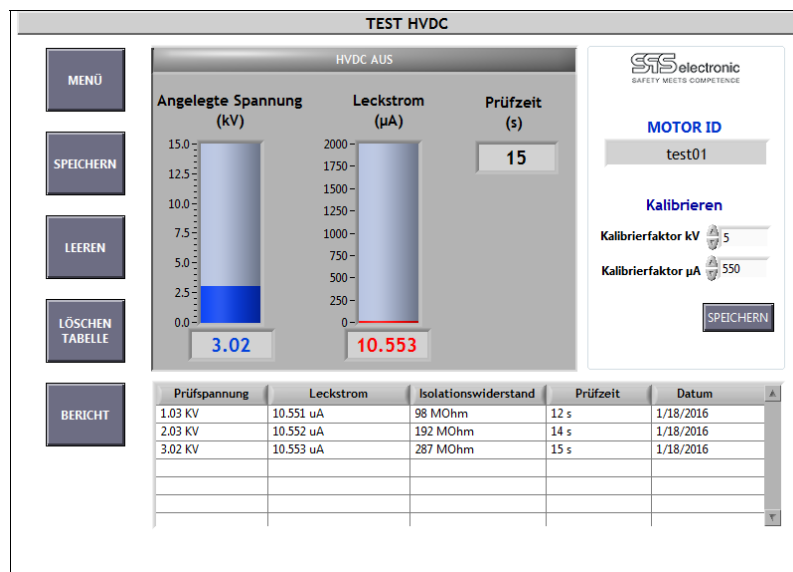
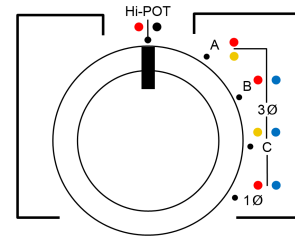


On the right, the controls for V/T, Timebase and Horizontal Shift are deactivated: These values are defined by the recorded master curve and can not be changed.

The further test process is now the same as described in 4.3.1 Dual channel mode.

## 4.4 High Voltage Test

For the high-voltage test, the test selector must be set to the "Hi-POT" position!



### Performing a high-voltage test:

The plus potential (hot) is RED and must be connected to the phase to be tested. The zero potential is connected to BLACK and must be connected to the ground block of the test object.

- ▶ Turn the voltage regulator on the front panel all the way to the left to the zero position
- ▶ Press & hold the green "Hi-POT" key on the front panel
- ▶ Adjust the voltage with the voltage regulator until the desired test voltage is reached.  
The current test voltage and the measured current flow are displayed simultaneously in the middle field.
- ▶ When the "Hi-POT" button is released, the last recorded values are frozen.
- ▶ Mit Loslassen des "Hi-POT"-Tasters werden die zuletzt aufgenommenen Werte eingefroren
- ▶ Press "Save" on the left-hand side of the screen to accept the displayed result for the result log. At the same time, the result of the measurement is inserted into the result table below.
- ▶▶ As soon as all phases of the DUT have been checked, the test report can be created with "Report".

## Annex

### A USB devices, and "Testing with High Voltage"

- When testing with high voltage, a failing testpiece can be the cause for electromagnetic radiation. (Because of voltage arc-over at the weak point in the testpiece, and the resulting sparkling can cause EM radiation of high frequencies. This radiation gets emitted by the test lines – antenna principle – , and may get received again by USB lines in the closer surrounding.
- USB controllers are generally vulnerable to stray fields of high frequencies, and thus the communication with USB can get interrupted. In particular, it is possible that short occurrences of stray fields put the USB-controller into a persistent inoperable state, so that USB communication keeps being interrupted.
- If such an USB malfunction occurs, often it is already sufficient to just unplug the USB cable, and plug it in again after a few seconds. If the malfunction still persists, it is needed to switch the affected devices off, and on again.

#### Concerned Situations and devices:

- generally every kind of PC or similar device that is using a USB connection, and is located in very close neighborhood to a test with high voltage.
- in particular such PCs that are using DAT3800 or DAT1800 software to control a testing device, and are using an USB connection to the test device.
- also test devices of series 3800 or 1800, when they are themselves using external USB devices, like e.g. USB keyboard, USB barcode scanner, or USB sticks for data exchange.

#### Measures to avoid failures

- as far as possible, it is recommended to keep a sufficiently large distance between USB cables/devices, and testpiece / testing lines. (Recommended are at least 30cm, the practical rule is "the more, the better".)
- it is recommended to use well-shielded USB cables with ferrite-core coil.  
(On its own this won't eliminate the possibility of errors, but it generally reduces sensitivity against stray fields, and makes occurrence of errors less likely.)

## Your Notes

# EG-Konformitätserklärung

## EC Declaration of Conformity

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Wir / we :

**SPS electronic GmbH**  
**Steuerungs- und Prüfsysteme**  
**Blätteräcker 18**  
**D-74523 Schwäbisch Hall**

erklären hiermit, dass das nachfolgend genannte Gerät den einschlägigen grundlegenden Sicherheitsforderungen der EG-Richtlinie entspricht.

*declare, that the following unit complies with all essential safety requirements of the EC Directive.*

Geräteart: Stoßspannungsprüfgerät  
*Description of device: Surge Tester*

Typ / Type : ST6000 A/B/E/F/I/H

### EG Richtlinien / EC Directives:

- EG Maschinenrichtlinie 98/392/EWG mit Änderungen  
*EC Directive for machinery 98/392/EEC with amendments*
- EG Niederspannungsrichtlinie 2006/95/EC  
*EC Directive for low voltage 2006/95/EC*
- EG Richtlinie Elektromagnetische Verträglichkeit 2004/108/EC mit Änderungen  
*EC Directive electromagnetic compatibility 2004/108/EC with amendments*

Angewandte harmonisierte Normen:  
*Applicable harmonized standards:*

- EN 61 000-3-2; EN 61 000-3-3; EN 55 014-1; EN 55 014-2; EN 50 191

Angewandte nationale Normen und technische Spezifikationen:  
*Applicable national standards and technical specifications:*

18.09.2015

Datum / date:

**SPS** electronic  
**SPS electronic GmbH**  
Blätteräcker 18 • 74523 Schwäbisch Hall-Sulzdorf  
Telefon 0 714 07 / 878-0 • Fax 0 714 07 / 878-99

Unterschrift / Sign:

Dieser Konformitätserklärung unterliegt grundsätzlich nur das von uns gelieferte oder in Betrieb genommene Gerät. Für Änderungen und Erweiterungen ist der Betreiber verantwortlich und damit für die Sicherstellung der Übereinstimmung der veränderten Anlage mit der betreffenden EG-Richtlinie.

*Subject to this declaration of conformity is the device as supplied or placed into operation by us. The operator is responsible for subsequent alterations and extensions, and therefore has to ensure the altered unit complies with the corresponding EC directives.*