Manual
for Operation

BS 200N

Electronic switch
for Voltage Transient testing

CA BS Load impedance for BS 200N

- ISO 7637 Part 2

The BS 200N is used to evaluate automotive electrical and electronic components for conducted emissions of transients along battery fed or switched supply lines of a Device Under Test (DUT). A device under test which is considered a potential source of conducted disturbances should be tested according to ISO 7637 part 2.

The BS 200N includes an electronic switch for repeatable switching of inductive loads as specified in ISO 7637-2:2004.

EM Test AG
Sternenhofstrasse 15
4153 Reinach BL1
Switzerland

Phone : +41 61 717 91 91
Fax : +41 61 717 91 99

URL : http://www.emtest.com

Contents

1. Standards covered by BS 200N

With the BS 200N the user covers the following standards for conducted emission transients:

- ISO 7637 Part 2	**Road vehicles; Electrical disturbances by conduction and coupling ;** **Part 2 : Electrical transients conduction along supply lines only**
- several standards	**In accordance with ISO 7637 Part 2**

The unit is the same as the BS 200B

2. Operating functions

2.1. Operating elements on the top side

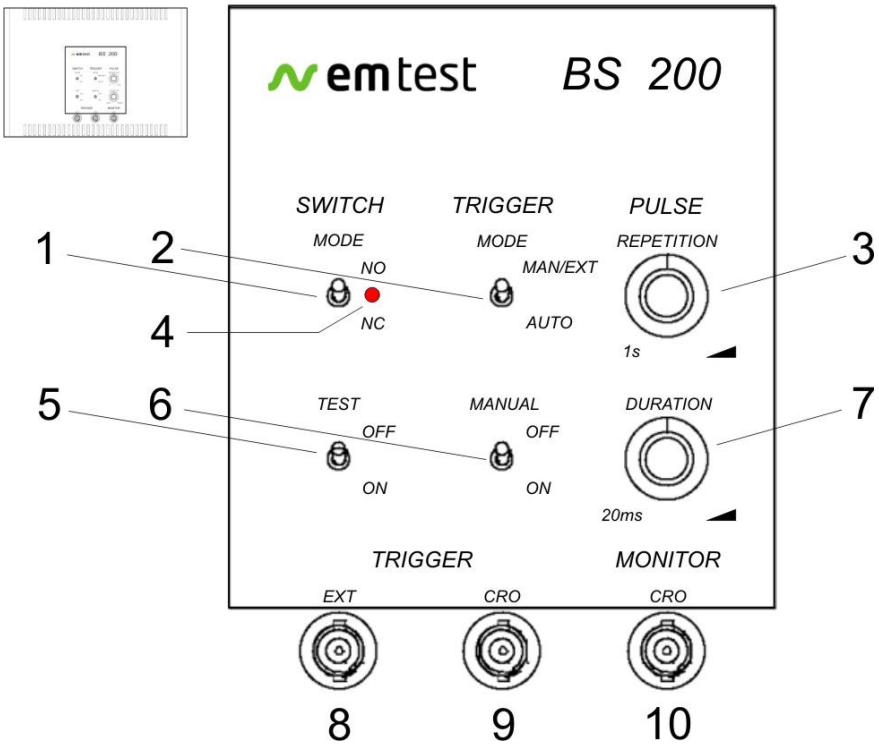


Figure 2.1 : BS 200N Top side

1	Switch operating mode (normal open / closed)	**6**	Button MANUAL Trigger
2	Switch Trigger mode :Manual or Ext. / Auto	**7**	Potentiometer Pulse duration 20ms ...>500ms
3	Potentiometer Pulse repetition 1s...>5s	**8**	Ext. Trigger input (Pull down)
4	LED Switch closed	**9**	CRO Trigger Output (15V neg. slope)
5	Switch TEST ON / OFF	**10**	CRO Measuring output 1:100, 5%

1 Switch Mode
Setting of the switch mode :
- **NO** : (Normally open) The switch is normally open and close at each event.
- **NC** : (normally closed) The switch is normally closed and opens at each event.

2 Trigger Mode
Trigger release selection of the BS 200N switch :
MAN / EXT : The trigger is released by manual operation with the button MANUAL, or via an external trigger signal at the BNC plug EXT.
AUTO : After switch TEST ON button, the BS 200N switch starts to work.

3 Pulse Repetition
Potentiometer to adjust the repetition time.
Range : 1s ... > 5s ... 10s.

4 LED Switch closed
The LED is lighted during the switch is closed.

5 TEST
On / Off switch for start the electronic switch:
- **OFF** **:** Switch out of service (switch status depends on setting NC or NO).
– **ON** **:** Switch in operation (open and closing time depends the time setting).

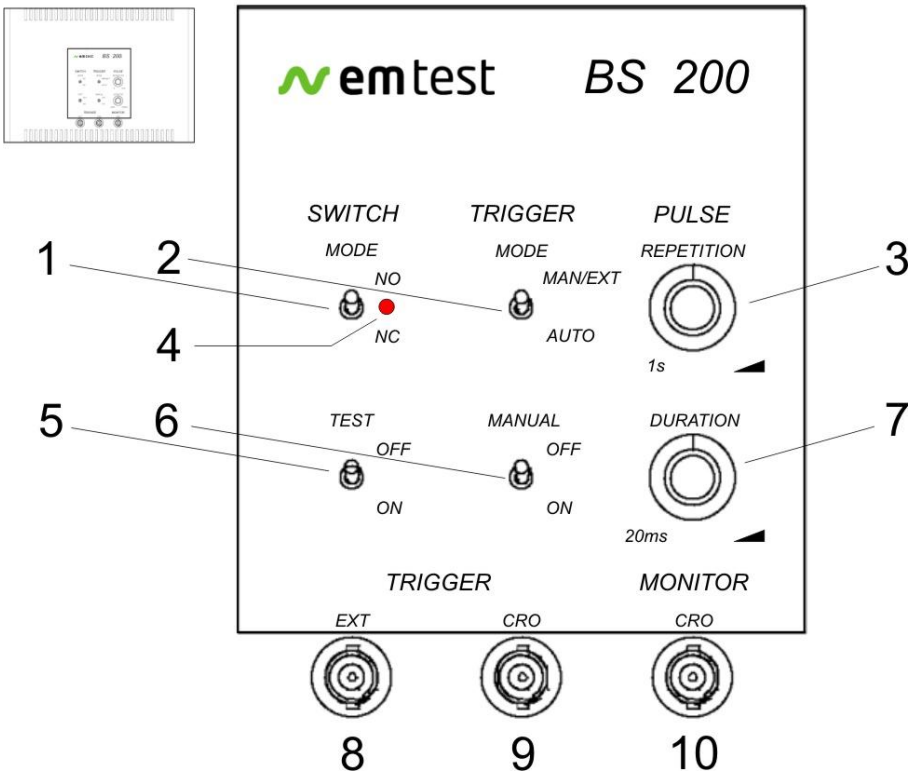


Figure 2.1. : BS 200N top side

1	Switch operating mode (normal open / closed)	**6**	Button MANUAL Trigger
2	Switch Trigger mode :Manual or Ext. / Auto	**7**	Potentiometer Pulse duration 20ms ...>500ms
3	Potentiometer Pulse repetition 1s...>5s	**8**	Ext. Trigger input (Pull down)
4	LED Switch closed	**9**	CRO Trigger Output (15V neg. slope)
5	Switch TEST ON / OFF	**10**	CRO Measuring output 1:100, 5%

6 Manual
Select “Manual trigger” mode of the switch. (open and closing time depends the time setting)
- **OFF** **:** Initial state
– **ON** **:** One switch event is released.

7 Pulse Duration
Potentiometer to adjust the switch duration.
Range : 20ms ... > 500ms ... 1000ms.

8 EXT Trigger
External trigger input for start a single switch event.
The trigger shall be a zero going signal (BNC to GND.

9 CRO Trigger
Trigger output for an oscilloscope trigger.
Trigger with a negative slope (+15V to 0V).

10 Monitor CRO
Measuring output for voltage measuring (divider 100:1 , 5%). The CRO output plug is isolated.

2.2. Side mounted components

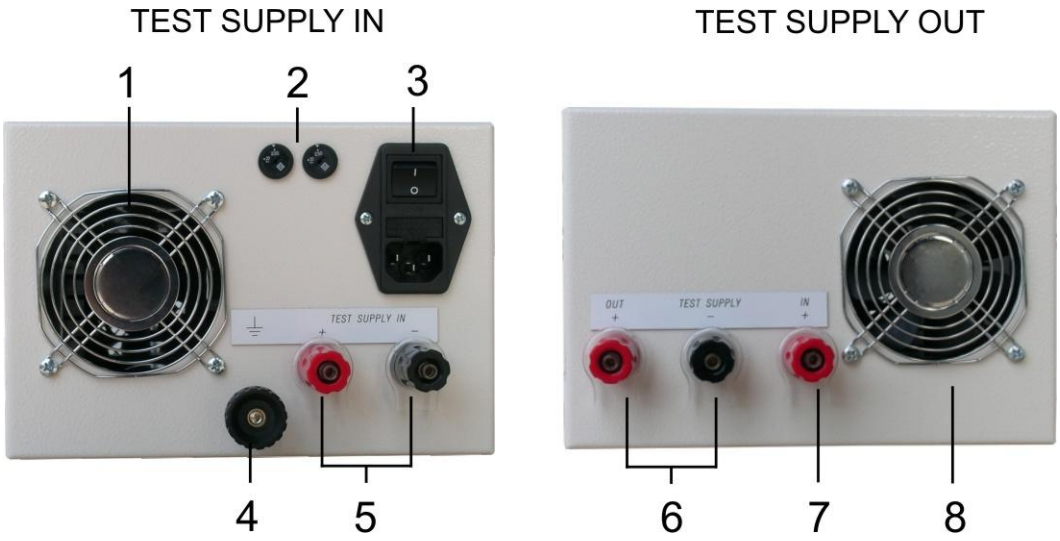


Figure 2.2. : BS 200N view left and right side

1 Ventilation grid
2 Voltage selector 115V / 230V
3 Power on switch
4 Reference earth connection
5 Input DUT supply **+**IN **-** IN
6 Output DUT supply **+**Out , **-** OUT
7 Input DUT supply **+**IN
8 Ventilation grid

1 Ventilation
Air ventilation for the battery supply switch. Ventilation grid and ventilator (blower) must be kept away from other devices in order to allow sufficient air flow through the battery supply switch.

2 Voltage selector
The voltage selector is used for change the mains supply voltage (115V / 230V)

3 Power on switch
The switch is part of the mains. Mains fuses are part of the filter.
230V / 1A and 115V / 2A

4 Reference earth connection
This plug is for connecting the BS 200N to the ground reference plane.

5 Input DUT supply
The battery supply + IN and **-** IN for the DUT is connected to this input. The nominal dc supply parameters are 60V / 25A .The switch is located between +IN and + OUT plug.

6 Connection for device under test (DUT)
The DUT is connected at the banana output sockets **+**Out , **-** OUT.

7 Input DUT supply +IN
Input for testing pulses in the us and ns range. The distance AN to BS 200N output shall be 100 ±25mm (figure 11).

8 Ventilation
Air ventilation for the battery supply switch. Ventilation grid and ventilator (blower) must be kept away from other devices in order to allow sufficient air flow through the battery supply switch.

3. Equipment description

The Switch BS 200N is designed with the following main components:

- Electronic switch
- Load 220Ω
- Voltage divider 100:1

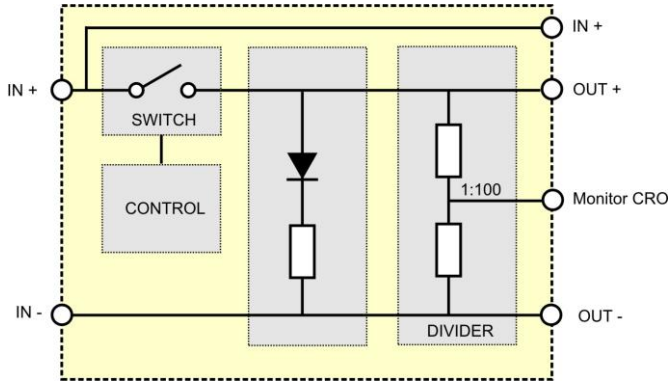


Figure 3.1. : General diagram BS 200N

3.1. Electronic switch

The electronic Switch has 2 operating modes:
NC : Normally Closed
NO : Normally Open

Figure 3.2 shows the both operating modes with the variable parameters “Repetition“ and “Duration“

The electronic switch disconnects the DUT from battery supply voltage for a specified time in a well specified and reproducible manner.

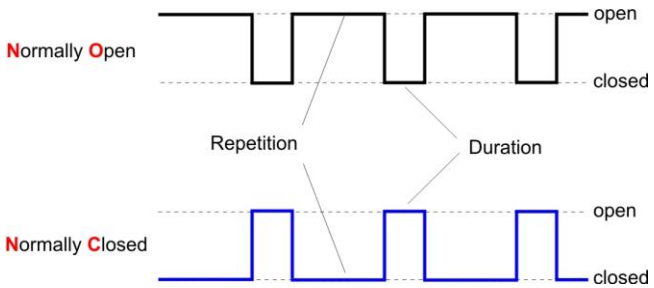


Figure 3.2. : Operating modes Switch BS 200N

The electronic switch is activated by pushing the button ***TEST***. The red LED indicate the closed status.

In ***AUTO*** mode the electronic switch is triggered internally with the preselected repetition rate. In MANUAL mode a single switching event is triggered either by pushing the ***MANUAL*** button or by remote trigger.

The electronic switch can switch currents up to 50A and is able to withstand voltages up to 1000V.
The electronic switch is protected against overload and can withstand short-circuit conditions.
Specific protection requirements of the EUT must be separately assured by the user.

Inrush currents
Inrush currents up to 500A are permitted.

Overvoltage
The switch is protected against over voltages higher than 1000V by internal varistors.

3.2. Load resistor

The internal load makes sure, that the voltage will drop down even with a DUT of high impedance. The built in resistor value is 220Ω and is designed for a constant operating voltage of 24V dc. Two diodes will decouple the resistor.

3.3. Divider 1:100

The built in divider is designed to measure transient Overvoltage. The measuring signal is available over an isolated BNC plug.

The divider is an resistive-capacitive divider with a 50Ω terminating resistor to the BNC plug.

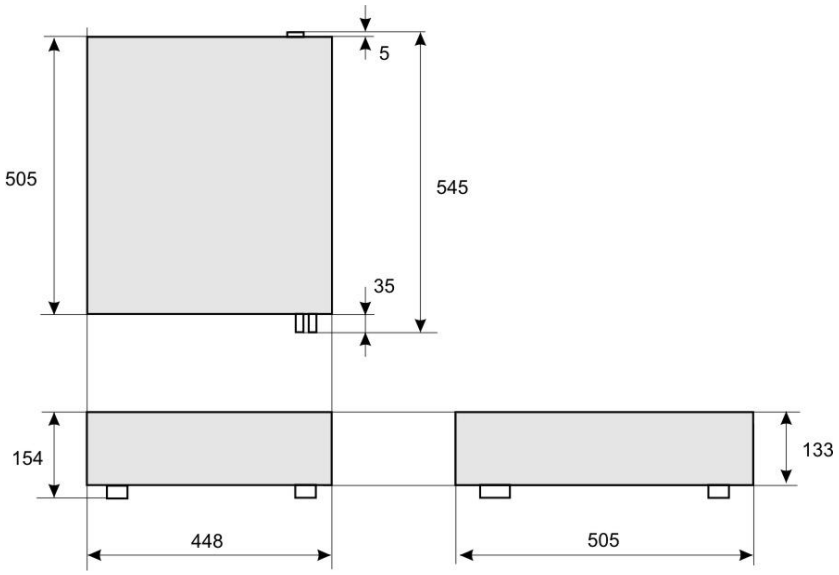
4. Technical Data

4.1. Technical data BS 200N

Test voltage	
Max DUT supply	60V / 50A nominal
Output	50mm above GND plane
over current protection	50 -55A switch off after 0.5 – 1ms electronic protection
Inrush current	170 -190A switch off after 10-15µs electronic protection
Peak voltage	Max. 1000V
Overvoltage protection	By varistor
Electronic switch	
Switching time	300ns ±20%300ns ±20% (240ns – 360ns) into test load 50µH/0.6Ω
On/Off time	Min. 10ms to max. ~ 500ms continuously selectable by potentiometer
Operation	Indicated by LED
Trigger	
Manual	Manual trigger of a single event
Auto	Automatic trigger with min. ~ 0.1Hz to max. 1Hz repetition, continuously selectable by potentiometer
Extern	External trigger ↓0V, BNC input
Measurement	
Voltage monitor	BNC output; divider 1:100, ± 5%
CRO trigger	BNC output, ↓ 0V
General data	
Dimensions	350mm x 212mm x 174mm (LxWxH);
Weight	5.7kg
Supply voltage	115/230V +10/-15%
Fuses	1A slow

4.2. Technical data CA BS

Test voltage		
Battery supply voltage	28Vdc max.	
Load current	50A max.	
Operating time	13.5V supply	approx.1 hour
	28.0V supply	approx. 10 minutes
Overheat indication	LED	
Protection	Switch Off by overtemperature sensor	
Cooling	Forced air temperature controlled	
Impedance		
Load	0.6 Ω in series with 50µH	selectable with bridge
Parallel load resistor	10Ω, 20Ω, 40Ω, 120Ω	selectable with bridge
General data		
Dimensions	19“ / 3HU 154 x 448 x 505mm	
Weight	18.1 kg	
Mains supply	80V to 230V ac	50/60Hz
Fuse	1A slow blow	



5. Calibration / Measuring procedure

5.1. Test load CABS

The test impedance CABS, a test load with 0,6 Ω in series with 50 µH inductor, is designed for verification the BS 200N acc. ISO 7637-2 standard.

Test load => R (total) = 0,6 Ω in series with
L (total) = 50 µH (1 kHz)

Both R and L also include the variations of the cable and the structure. The parallel capacity which cannot be avoided is approx. 50pF.

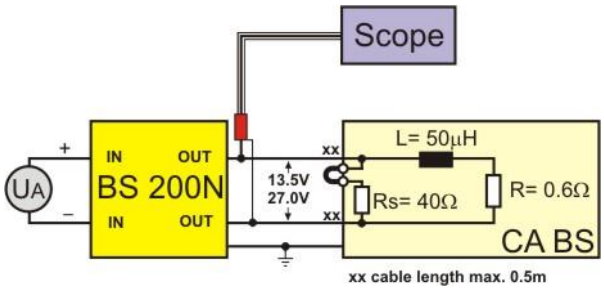


Figure 5.1. : Verification setup

Figure 5.2.: Verification setup

5.2. Test voltage

According to the standard the switch-Off time should be determined under varying test voltages, such as

Va : U1 = 13.5V and U2 = 27V

Consequently constant currents of 22.5A or 45A must be considered. The resulting energy consumption at the test load is:

DC Supply	Power 0.6Ω
13.5 V	304 W
27.0 V	1215 W

5.3. Switch-Off fall time

The switch-Off fall time is specified as follows (90% to 10%) :

ISO 7637 (old version ≤ 1992) tf = 200 ... 400ns
ISO 7637 new and DIN 40839 part 1 tf = 300ns ± 20%

The resulting transients of the BS 200N are measured with a 1:100 voltage probe under loaded condition according the standard. The voltage probe is directly connected to the + and – output of the generator.

5.4. Measuring results

5.4.1. Voltage drop in dependence of the test load

DUT current	Nominal voltage drop	Tolerances	voltage drop (typical value)
1 A	0.75 V	+200mV / -400mV	0.73 V
5 A	1.0 V	+200mV / -400mV	1.03 V
10 A	1.3 V	+200mV / -400mV	1.24 V
25 A	1.8 V	+200mV / -400mV	1.71 V
50 A	2.5 V	+500mV / -1.00V	2.41 V

➔ manufacturer values (measured between Test supply in and Test supply out)

5.4.2. Measuring results

All measuring values indicated as well as the curve illustrated have been recorded with a serial model.

Reference values measured with BS 200N

Input Voltage: **15.5 V**

Output Voltage: **13.50 V**

Upeak: **- 626 V**

tf (90% - 10%): **314.5 ns**

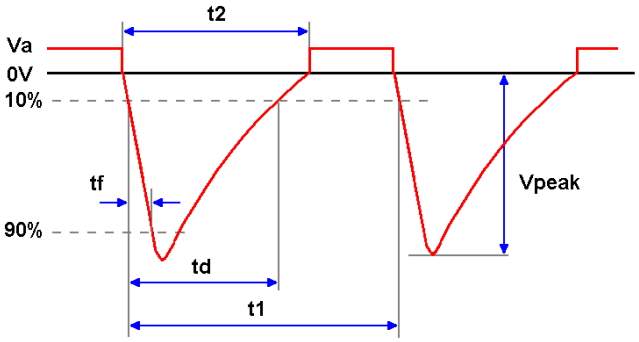


Figure 5.3. : Pulse parameter

Verification with CABS 0.6Ω in series with 50µH ; Rshunt 10Ω	**Va** output voltage	**Vpeak**	**tf** 90% - 10% fall time
With standard load	+13.5V ±10%	-600V ±30%	300ns ±20%
With standard load	+27.0V ±10%	-800V ±30%	300ns ±20%

Example for the switch off impulse

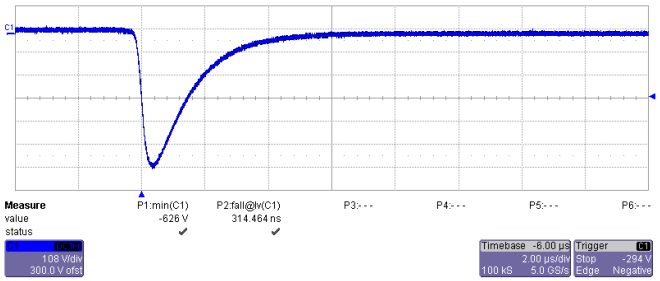


Figure 5.4. : Test load at 13.5V

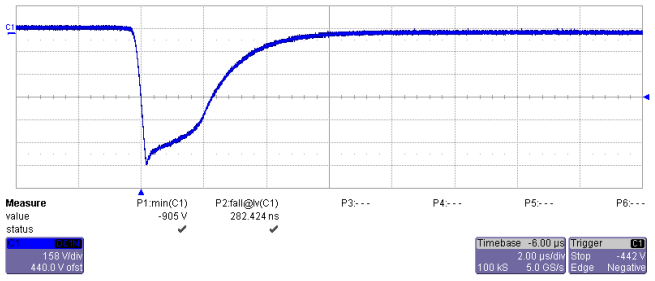


Figure 5.5. : Test load at 27V (BS 200N)

6. Maintenance

6.1. General

The internal semiconductor switch does not need any maintenance.

6.2. Calibration and Verification

6.2.1. Factory calibration

Every EM TEST generator is entirely checked and calibrated as per international standard regulations before delivery. A calibration certificate is issued and delivered along with a list of the equipment used for the calibration proving the traceability of the measuring equipment. All auxiliary equipment and accessories are checked to our internal manufacturer guidelines.

The calibration certificate and the certificate of compliance (if available) show the date of calibration.

The EM Test product is calibrated in the factory and marked with a calibration mark. The used measuring instruments are traceable to the Swiss Federal Office of Metrology.
The calibration interval is to the responsibility of the user's quality system. Neither the certificate of calibration nor the corresponding label mark any due date for re-calibration.

Example: Calibration mark

6.2.2. Guideline to determine the calibration period of EM Test instrumentation

Our International Service Departments and our QA Manager are frequently asked about the calibration interval of EM TEST equipment.

EM TEST doesn't know each customer's Quality Assurance Policy nor do we know how often the equipment is used and what kind of tests are performed during the life cycle of a test equipment. Only the customer knows all the details and therefore the customer needs to specify the calibration interval for his test equipment.

In reply to all these questions we like to approach this issue as follows :
EM TEST make use of a solid state semiconductor switch technique to generate high voltage transients. A precious advantage of this technique is the absolute lack of periodical maintenance effort. In consequence thereof a useful calibration period has to be defined based on two criteria :

- The first one is the customer's Quality Assurance Policy. Any existent internal regulation has to be applied at highest priority. In the absence of such internal regulation the utilization rate of the test equipment has to be taken into consideration.

- Based on the experience and observation collected over the years **EM TEST recommend a calibration interval of 1 year** for frequently used equipment. A 2-years calibration interval is considered sufficient for rarely used test generators in order to assure proper performance and compliance to the standard specifications.

6.2.3. Calibration of Accessories made by passive components only:

Passive components do not change their technical specification during storage. Consequently the measured values and the plots stay valid throughout the storage time. The date of shipment shall be considered as the date of calibration.

6.2.4. Periodically In-house verification

Please refer to the corresponding standard before carrying out a calibration or verification. The standard describes the procedure, the tolerances and the necessary auxiliary means. Suitable calibration adapters are needed. To compare the verification results, EM Test suggests to refer to the waveshape and values of the original calibration certificate.

7. Application

7.1. Test setup

Important
- The artificial network AN shall be connected directly to the ground reference plane.
- All wires between AN and the DUT shall be isolated from the ground plane by 50mm.
- The DUT will be placed on the ground plane as in real installation.
  - directly grounded to the ground plane or
  - 50mm isolated from the ground plane
- The position of the instruments shall be as specified in the standard.

Switch as per ISO 7637-2 :2004

For the measurement of the emission the ISO 7637-2: 2004 standard defines two different switches and switch positions. These are pending from the rise time of the voltage impulse. The switch position for slow impulses in the ms range is before the electrical switch see figure 7.1. For fast impulses, in µs and ns range, the switch is on the DUT side figure 7.2. During the examination only one switch may be operated.

For the emission measurement ISO 7637-2 :2004 defines the test setup below. Cause the dimension of the BS200N EM Test propose the test setup illustrated in figure 7.1 and 7.2.

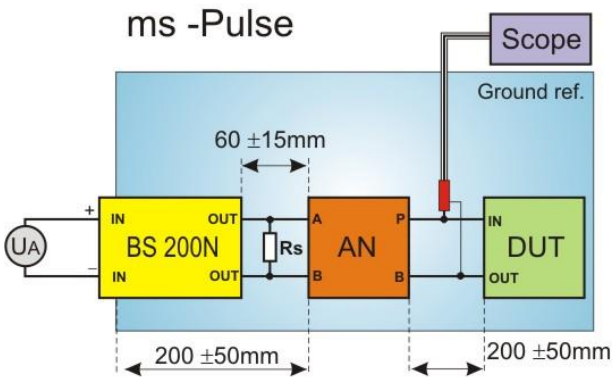


Figure 7.1. : Setup for pulses in the ms range

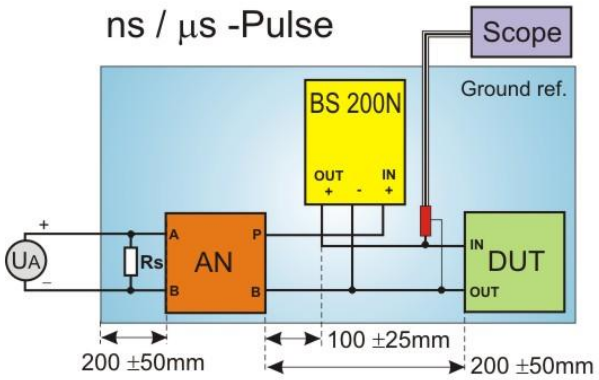


Figure 7.2. : Setup for pulses in the µs / ns range

Electronic Switch for pulses below 400V

Inside the BS 200N the electronic switch is built in. A clear determination of a disturbance is possible only if an electronic switch with reproducible characteristics is used. For the measurement of the pulses under 400V an electronic switch is recommended.

In order to determine the amplitude and waveshape of a transient , first use the test set-up shown in figure 7.1 for determine the maximum amplitude of the slower impulses (ms range). In the next procedure use test setup as shown in figure 7.2 for measure the maximum amplitude of the fast transients.

Switch for voltage impulses higher than 400V special in µs / ns range

The switch affects in particular the characteristics of the fast transient ones substantially. Besides gladly high amplitudes arise with fast pulses, which can be limited by the protection device of the electrical switch. Therefore the standard recommends to use the **original switch** how it is used in the vehicle as switching device for pulses in µs / ns range. If such a device is not available, an automotive relay with the following characteristics shall be used:

- contact rating, $I = 30$ A, continuous, resistive load;
- high purity silver contact material;
- no suppression across relay contact;
- single/double position contact electrically insulated from the coil circuit;
- coil with transient suppression.

The switching relay shall be replaced if significant contact degradation occurs.

Resistor Rs

A shunt resistor of 40Ω shall simulate the dc impedance of other connected consumers in the cable tree. According to ISO/DIN 7637 when measuring transient overvoltage a shunt resistor of 40Ω is required, whereas when measuring transient overcurrent a shunt resistor of 2Ω is required. For this purpose an external resistor of 2.5 Ω / 400 W (at 30 V DC) respective 40Ω must be connected in the test circuit. (figure 7.1. and 7.2.)

The external shunt resistor shall be a non-inductive one. The external resistor is not part of the delivery and the user is responsible to design this resistor to the behaviour of the applied voltage range.

8. Delivery Groups

8.1. Basic equipment

- Switch BS 200N
- Mains cable
- Manual on CD
- Calibration certificate
- 4 connection clamps

Figure 8.1. : BS 200N

Identische Zubehörteile werden nur einmal geliefert, bei Lieferung mehrere Geräte. Der mitgelieferte Packzettel ist in jedem Fall für die Lieferung verbindlich.

8.2. Options

- CA BS calibration load 50uH 0.6Ω

  Delivery : Mains cable
  2x connection cable (32cm)
  2x Short circuit bridges

Figure 8.2. CA BS

- NNBM8125 Artificial Network for Automotive (Schwarzbeck)

  LISN Impedance : As per ISO 7637-2 and CISPR 16/25
  Impedance : 5µH - 50Ω
  Current: 70A continuous, 100A short-time

Figure 8.3. : NNBM 8125

9. Appendix

9.1. Declaration of CE-Conformity

Manufacturer :	**EM TEST AG**
Address:	Sternenhofstr. 15 CH 4153 Reinach Switzerland

declares, that under is sole responsibility, the product's listed below, including all their options, are conformity with the applicable CE directives listed below using the relevant section of the following EC standards and other normative documents.

Product's name:	Switch
Model Number(s)	BS 200N

Low Voltage Directive 2006/95/EC

Standard to which conformity is declared:

EN 61010-1 : 2006	Safety requirements for electrical equipment for measurement, control, and laboratory use.

EMC Directive 2004/108/EG

Standard(s) to which conformity is declared:

EN 61326-1 : 2006	Electrical equipment for measurement, control and laboratory use Class A
EN 61000-3-2 : 2007	Limits for harmonic current emissions
EN 61000-3-3 : 2005	Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems.

	European representative	Manufacturer
	EM TEST GmbH	EM TEST AG
	Lünenerstr. 211	Sternenhofstr. 15
	D 59174 Kamen	CH 4153 Reinach
	Tel: +49 (0) 2307 / 26070-0	Tel: +41 61-7179191
	Fax: +49 (0)2307 / 17050	Fax: +41 61-7179199
By	U. Flor General manager	A. Burger Design and Research
Place	Kamen, Germany	Reinach BL , Switzerland
Date	27. July 2010	27. July 2010

9.2. BS 200N - Overview

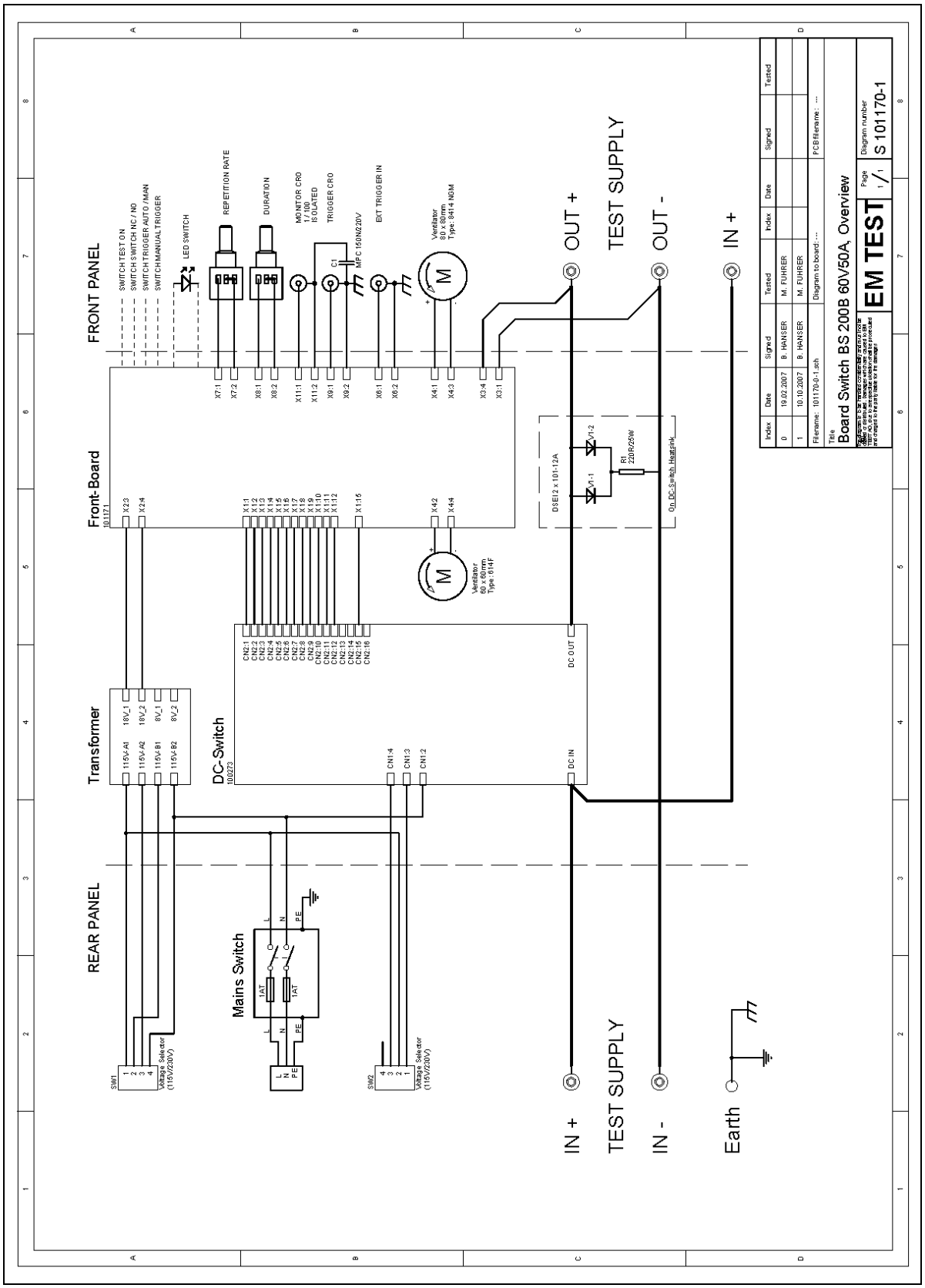


Figure 9.1. : Overview BS 200N

9.3. CA BS - Overview

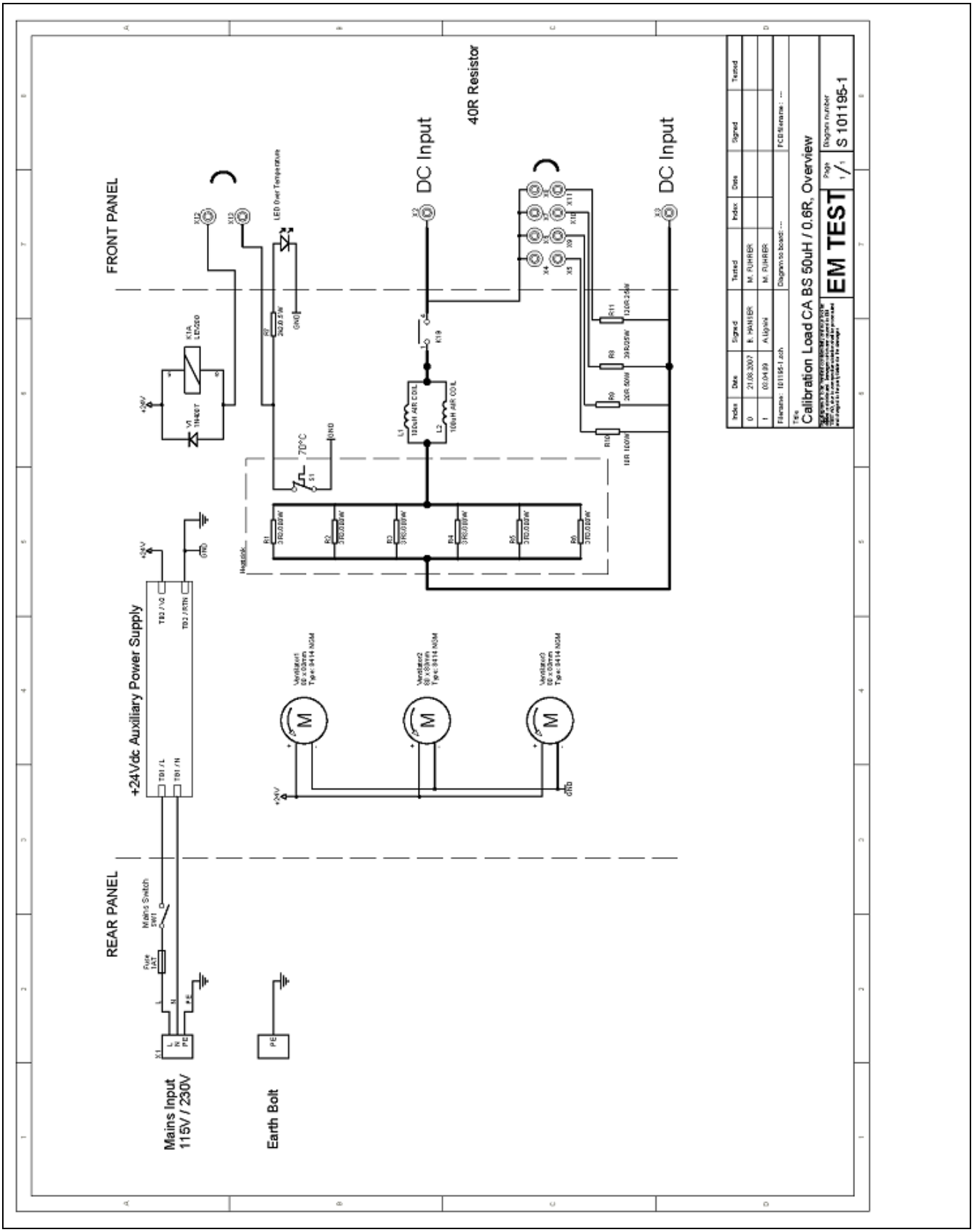


Bild 9.2.: Overview CABS