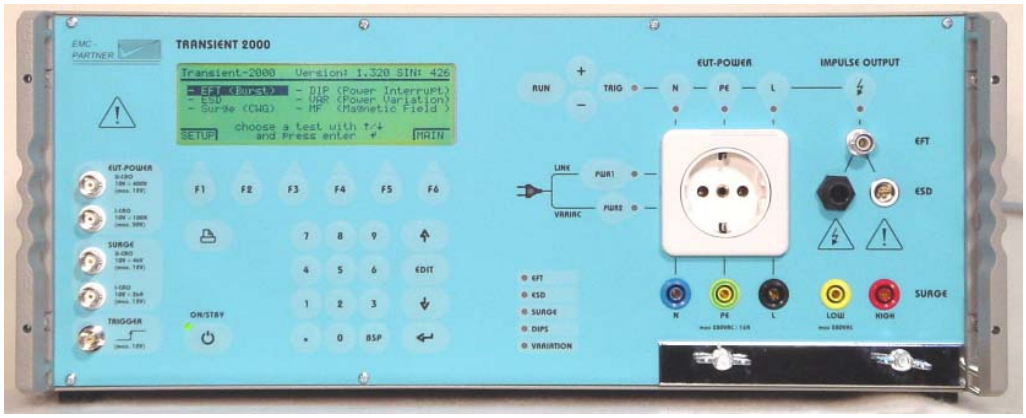
EMC - PARTNER

User Manual TRANSIENT-2000 and Versions



Title:	EMC Test System TRANSIENT-2000
Date:	22.10.99
Division Manager:	M. Lutz
Product Manager:	R. Casanova
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EMC TESTER
TRANSIENT-2000

ATTENTION

This user manual provides information necessary for operation of the test equipment.

Throughout the users manual, standard references are used as an aid to understanding only.

The relevant standard(s) **must** be obtained and used in conjunction with this users manual

Declaration of Conformity

See sheets attached at the end of this user manual:

- **Declaration of conformity to product standards**
- **Declaration of conformity to low voltage directive**
- **Declaration of conformity to EMC directive**

Contents:

1 Description

1.1 The interference sources of the transients

1.1.1 Switched inductance EFT (Burst)

*E*lectric *F*ast *T*ransient or Burst.

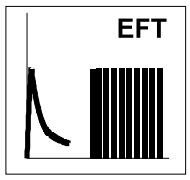


Figure: 1.0.1.1

Industrial measurement and control equipment practically always operates in conjunction with conventional control units (relays, contactors). Fluorescent lamp ballast units, insufficiently suppressed coffee grinders, vacuum cleaners, drilling machines, hair dryers, universal motors, etc. can be found everywhere in the power supply system. All these primarily inductive loads produce interference when switched on and off. A wide range of switching transients, also called bursts, are produced with the following waveform.

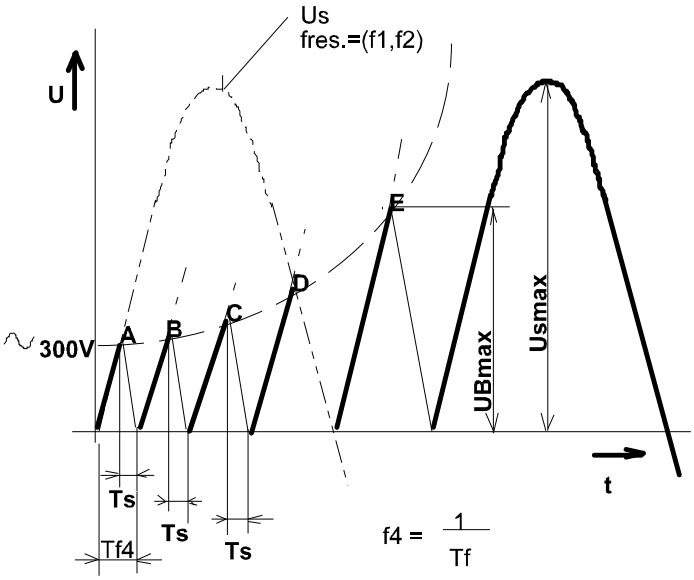


Figure: 1.0.1.2

The parameters which define the burst are:

Rise time of the spike Ts in ns
Repetition frequency f4 in the range of kHz up to MHz
Energy, some mJ
Voltage amplitude UBmax. up to some kV
Duration of a burst several milliseconds

The different EFT sources generate different bursts waveforms. A typical waveform of a burst is shown in the next figure:

The impedance of the EFT source is generally high, therefore the capacitance of connected cables influences the rise time.

1.1.2 Electrostatic discharge ESD

*E*lectro *S*tatic *D*ischarge

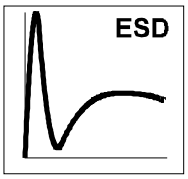


Figure: 1.0.2

What causes electrostatic discharges?

A person becomes electrostatically charged by walking over an insulating floor surface. The capacity of the body can be charged to several kilovolts (1000 V). This capacity is discharged when contact is made with an electronic unit or system. The discharge is visible as a spark in many cases and can be felt by person concerned, who gets a „shock“. The discharges are harmless to humans, but not to sensitive, modern electronic equipment. The resulting current causes interference in the units or makes entire systems „crash“.

For over 25 years it has been known to the electrical industry that electrostatic discharges as encountered every day can have a disastrous effect on electronic equipment.

The cost of damage caused by ESD is difficult to assess, but amounts to billions of dollars worldwide.

The areas most affected are:

- manufacturing of integrated circuits (chips).
- the chemical industry, e.g. by explosion, fires caused by the sparkes from electrostatic discharges.
- malfuntioning of process control with the secondary damage costs.

1.1.3 Indirect lightning SURGE

SURGE are transients with a high energy, relatively low frequency content up to some kV.

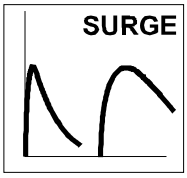


Figure: 1.0.3

Lightning is a daily event and occurs about 8 million times in approximately 44,000 storm centres throughout the world. That is in the order of 100 discharges per second. Measuring and recording equipment in aircraft registers one lightning strike for every 1,000 flying hours.

Product assembly and finishing in many industries depends on modern electronics. The most frequent cause of damage is overvoltage, caused either by switching action in the equipment itself or by atmospheric discharges such as lightning. In order that the overvoltages do not destroy the electronic equipment, protection elements and circuits are placed at the inputs and outputs of electronic equipment.

Consumer electronic devices, such as antenna ports on television sets, telephones, faxes, can also be influenced by atmospheric discharges. The disturbances are mostly tolerable because of their relatively low occurence. To protect such equipment from damage protection elements and circuits are installed. Tests must be carried out to determine whether these protective circuits are really effective.

Beside lightning, switching action can also generate high energy impulses. As shown in the parageaph 1.0.1 EFT.

1.1.4 Voltage interruptions, Dips

DIPS means a sudden reduction of the voltage at a point in electrical system, followed by voltage recovery after a short period of time from a few cycles to a few seconds.

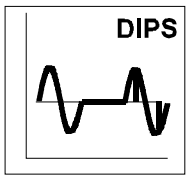
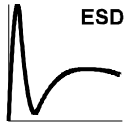
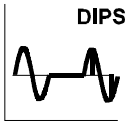


Figure: 1.0.4

Voltage failures occur following switching operations, short-circuits, fuses blowing and when running up heavy loads. These are man-made faults, produced unintentionally, and include operation of domestic appliances, electronically controlled machine tools, switching operations in the public lighting system, economy lamps, etc.
The quality of the electrical power supply is increasingly becoming a central topic of discussion. The interference sources in the mains, caused by electronic power control using non-linear components such as thyristors which are increasingly used in domestic appliances, such as hotplates, heating units, washing machines, television sets, economy lamps, PCs and industrial systems with speed-controlled drives. Simultaneously an increase in electronic systems sensitive to interference is apparent in all sectors of electrical power system.
In order to achieve electromagnetic compatibility, both the interaction of the electrical equipment connected to the supply and its noise immunity must be determined.
The electromagnetic compatibility of electronic equipment must be guaranteed e. g. Europe Union 31. December 1995.

1.1.5 How ESD, EFT, SURGE DIPS differ

Characteristics	**Static discharges**	**Switched inductance**	**Lightning. switching actions**	**Mains Interruptions**
Phenomenon	**"ESD"**	**"EFT Burst"**	**"Surge"**	**"DIPS"**
Voltage U	up to 15 kV	up to 4 kV	up to 4 kV	supply source voltage
Energy at maximum voltage	approx. 10 mJ	300 mJ	300 J	-
Repetition rate	Single event	Multiple event 5 kHz	Maximum 6 Impulse / minutes	supply source frequency
Application to the different ports	Touchable metallic part (enclosure ports)	AC/DC ports, Signal and data lines	AC/DC ports, Signal and data lines	AC/DC ports
upper limit frequency	approx.. 1 GHz	approx. 200 MHz	approx. 350 kHz	approx. 100 kHz
impulse waveform	 IEC 61000-4-2	 IEC 61000-4-4	 IEC 61000-4-5	 IEC 61000-4-11

The overview of „How ESD,EFT, SURGE,DIPS differ“ shows that all four test have to be carried out because the frequency content and energy of the four transient tests are different.

1.2 Overview of the TRANSIENT-2000 test system

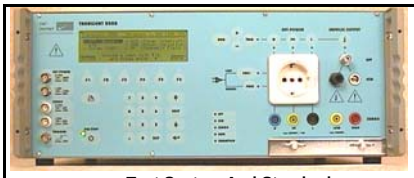
1.2.1 The TRANSIENT-2000 and its versions

The Tester TRANSIENT-2000 simulates transients of different interference sources. such as: indirect lightning in electronic systems, human body electrostatic discharges, switched inductance (Burst), power supply interruptions and variations. The test system TRANSIENT-2000 fulfils all requirements of the IEC basic standards IEC 61000-4-2 (ESD); 61000-4-4 (EFT); 61000-4-5 (SURGE) as option available 10/700 µs Impulse; 61000-4-11 (Interruption and Variations), and with accessories 61000-4-8 (Magnetic field 50/60Hz) and 61000-4-9 (Magnetic field SURGE) and 61000-4-29d dips and interruption on d.c.

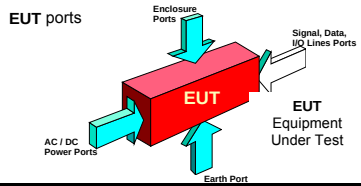
If not all transient test are needed, the TRANSIENT-2000 tester is also available in various versions, with the possibility to upgrade the tester later to a full TRANSIENT-2000 test system.
The upgrade must be carried out in Switzerland at EMC PARTNER AG. The upgrade includes a verification of the Tester TRANSIENT-2000. The best occasion for an upgrade is together with a annual inspection or verification.
The TRANSIENT-2000 contains a single-phase coupling / de-coupling network, which allows a controlled superposition of the transients onto a power supply line. All transients are generated at the same EUT power output, therefore a true single port test is possible. The TESTER 2000 allows the automated switching of the coupling paths and the programming of large range of test sequences.

The tester TRANSIENT-2000 is a stand-alone equipment for automated EMC test without a PC.

1.2.2 Which system configuration is needed for a particular test?



Test System And Standards



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In addition we offer for carrying out EMC test and measurements in your company:

IEC Standards	Max. Values of EMC-PARTNER Testers	Tester type	AC/DC	Signal Telecom	Signal	Earth	Enclosure	Calibration	Test set-up	Control via PC
1000-4-2 ESD	CD* 8kV; AD* 15kV	TRA-2000	-	-	-	-	1+2 (13)	9,19	20 (21)	14 (16, 23)
1000-4-4 EFT	4,4 kV; 1MHz	TRA-2000	1 (12)	1+3	1+3	1+3	-	10,19	20 (21)	14 (16, 23)
1000-4-5 SURGE	CWG 4,1 kV 2 kA	TRA-2000	1 (12)	1+18	1+4	1+5	1+5	19	-	14 (16, 23)
1000-4-8 a.c. MF	160A/m, 1050A/m	TRA-2000	-	-	-	-	1+7+8+15 (22)	-	22	14 (16, 23)
1000-4-9 Surge MF	1600 A/m	TRA-2000	-	-	-		1+7+8 (22)	-	22	14 (16, 23)
1000-4-10 Oscil. MF	120 A/m	MIGOS-OM	-	-	-		1+7+8 (22)	-	22	
1000-4-11 DIPS 1000-4-11 Variation	16 A different levels 5 A different levels	TRA-2000 TRA-2000	1 (6, 12)	-	-	-	-	11,19	-	14 (16, 23)
1000-4-12 Ring 1000-4-12 Oscillation	6 kV 3 kV, 1MHz, 100kHz	MIG0603IN4 MIGOS-OSI	1 (12, 24) 1 (24)	-	-	-	-	19	-	14 (16, 23)
1000-4-13 Harmonics	16 A, 230 V	HAR-1000	1	-	-	-	-	19	-	14 (16)
1000-4-14 V-variation	16 A, 230 V	HAR-1000	1 (6, 12)	-	-	-	-	19	-	14 (16)
1000-4-17 Ripple on d.c.	16 A, 200V d.c.	HAR-1000	1 (6, 12)	-	-	-	-	19	-	14 (16)
1000-4-16 Common Mode	300 V a.c., 300 V d.c.	TRA-2000	-	1+17	1+17	-	-	19	-	14 (16, 23)
1000-4-29 DIP on d.c.	16 A , 110V	TRA-2000	1	-	-	-	-	19	-	14 (16, 23)

N°	Description / Accessories	N°	Description / Accessories	N°	Description / Accessories
1	See colon "Tester type"	9	Measuring Target ESD 2 Ω	17	NW16S, CN16, CN16T
2	ESD discharge circuit, Relay, Finger	10	Measuring set EFT 50 Ω / 1 kΩ	18	Coupling Kit Telecom CDNKIT1000T
3	Coupling clamp CNEFT1000	11	Measuring-set DIPS (inrush current)	19	Certificate and Protocol
4	SURGE coupling kit CDNKIT1000	12	Three phase coupling CDN2000-06-32	20	Connection set
5	Test tip CN-TRA	13	ESD stand	21	Test set-up accessories
6	External Variac VAREXT-1000 (16/32A)	14	GENECS to TRA, HARCS-Immunity to HAR	22	Stand to MF1000-1 or MF1000-2
7	Antenna for magnetic field MF1000-1 1x1m	15	Antenna for magnetic field MF1000-1 1x1m, 3s	23	Fibre Optic link
8	Antenna for magnetic field MF1000-2 1x2.6m	16	EUT Monitor for EUT failed control	24	Three phase coupling CDN2000-06-25

***CD = Contact Discharge *AD = Air Discharge**

1.3 Technical data of the TRANSIENT-2000

1.3.1 Switched inductance EFT (IEC 61000-4-4)

Voltage waveform into 50 Ω:	Impulse Outpur		Chap 14.1.1 IEC 61000-4-4
Risetime	5 ns	± 30%	
Half time value	50 ns	± 30%	
Voltage waveform into 1000 Ω:			
Risetime	5 ns	± 30%	
Half time value	100 ns	- 50 ns	+ 100 ns
Adjustable voltage range	250 V to 4400 V		
Voltage amplitude into 50 Ω	125 V to 2000 V	± 10%	
Voltage amplitude into 1000 Ω	250 V to 4000 V	± 20%	
Source impedance	50 Ω	± 10%	
Spike frequency	1 kHz up to 1 MHz		
Maximum Spikes per seconds	8'000 at 1000 V		1000 at 4000 V
Burst duration	0,001 ms up to 20 ms		
Burst repetition	1 ms up to 1000 ms		
Polarity	positive / negative		
Ramps	-Voltage -Spike frequency -Synchronisation -Burst duration		
High voltage output	10 nF decoupled	max. 450 V ac	

1.3.2 Coupling / De-coupling Network EFT

Maximum EUT power supply voltage	260 V ac 50/60 Hz		
Maximum allowed continuous current	16 A		
Spike waveform superimposed onto the lines of the EUT power supply	within the tolerances as above		Chap 14.1.1 IEC 61000-4-4
damping between output and input of the CDN	better 30 dB		
Coupling paths:	L-GND; N-GND, PE-GND, L+N+PE - GND L+N - GND; L+PE - GND; N+PE - GND		

1.3.3 Electrostatic discharges ESD (IEC 61000-4-2)

Energy storage capacitance	150 pF	± 10%	
Discharge resistance	330 Ω	± 10%	
Charging resistance	54 MΩ		
holding time (drop to 95%)	better than 5 s		
Current rise time, 2 Ω load	0,7 to 1 ns		See 14.1.2 IEC 61000-4-2
Definition of current waveform:			
Current amplitude at 30 ns	4 to 16 A	± 30%	
Current amplitude at 60 ns	2 to 8 A	± 30%	
Voltage range „air discharge“	2 to 15 kV	± 10%	
Voltage range „contact discharge“	2 to 10 kV	± 10%	
First current amplitude into 2 Ω „contact discharge“	7,5 to 30 A	± 10%	
Polarity	positive / negative; automatic switchover		
Number of discharges Detection of the number of discharges	-preselectable -count „every pulse“ -count „discharge only“. Only the impulses whereas the voltage of the discharge capacitor tropes lower then 10% of the charging voltage are counted.		1 to 29’999
Ramps	voltage amplitude changes from shot to shot, alternate polarity		
Reporting	test sequence with the number of discharges -Voltage amplitude -Polarity		
Discharge modes:	-Air discharge -Contact discharge		
Repetition of the discharges	0.05 up to 30 s Single discharge „Man“		

1.3.4 Lightning and switching actions SURGE (IEC 61000-4-5)

Waveform at no load :	Impulse output		See 14.1.3
Front time	1.2 µs	± 30%	
Time to half value	50 µs	± 20%	
Waveform at short circuit:			
Front time	8 µs	± 20%	
Time to half value	20 µs	± 20%	
Preselectable voltage range	220V to 4100 V		
Open circuit output range	250 V to 4000 V	- 0%; +10%	-
Short circuit output current	125 A to 2000 A	- 0% + 10%	
Output impedance Umax / Imax	2 Ω	± 0.25 Ω	
Polarity	positive / negative / altn		
Ramps	-Voltage -Polarity -Synchronisation		
High voltage output "low"	maximum voltage between „low“ and earth 260 V ac		
Time between successive shots	3 s		5s at 4000 V

1.3.5 Coupling / De-coupling Network „CDN-SURGE“

Maximum allowed voltage phase neutral	260 V ac 50/60 Hz	16A	
Coupling path phase- earth	9 µF + 10 Ω	(L-PE)	
Coupling path neutral - earth	9 µF + 10 Ω	(N-PE)	
Coupling path phase - neutral	18 µF	(L-N)	
Coupling modes:	L-N; L-PE; N-PE, automatic coupling path switching		

Attention ! The CDN-SURGE 1,2 / 50; 8 / 20 µs is designed for maximum power consumption at 260V rms 50/60Hz and a coupling capacitance of 18 µF.
If using EMC PARTNER coupling de-coupling network other than, the maximum power dissipation of the TRANSIENT-2000 must be considered. Power Line voltages higher than specified can destroy the impulse

forming devices in the TRANSIENT-2000. Please contact EMC PARTNER AG or a representative before using a unknown coupling network.

1.3.6 Voltage interruption and Variation (IEC 61000-4-11) with internal Variac

Voltage range	0 to 260 V		EUT Power	See 4.2
Frequency range without variac	DC up to 400 Hz			external Source
Frequency range with variac involved	48 Hz to 60 Hz			external Source
Nominal current	16A			
Interruption with internal variac and linear load	maximum 12 A maximum 16 A			< 5s < 300 ms
Inrush current	500 A Peak		- 0%, +30%	See 14.1.4
Interruption time	50 µs to 30 s			phase angle selectable
Amplitude of the interruptions	continuously selectable from 0 to 100 %			IEC: 0 %, 40 %, 70 %
Phase angle for turn ON and OFF of the EUT selectable	0 to 360°		± 5°	
Voltage variation with the internal variac	0 to 110 % maximum. 5A		± 20%	2 s to 30000 s
Voltage variation with external variac	0 to 110 % maximum. 16 A		± 20%	2 s to 30000 s
Less than 1 period More than one period d.c. interruption	Interruption within one period. Input as angle Interruption longer then one period. Input in ms Input in ms			
Ramps	-Voltage -Synchronisation angle -Interruption time			
Interruption for all kind of loads UT= voltage at EUT Power 1	DIP 100 %	% UT 0 %	0 to 16 A	

For interruptions of 0 to 100% and 100% to 0% the internal Variac is not involved, therefore the test can be carried out up to 16 A. For interruption with UT =EUT Power 1 voltage not null, the internal variac limits the EUT power current. The maximum allowed current values are listed in the table on the next page. Please be aware that different types of loads influence the maximum current differently.

With internal Variac:

Types of loads: switching **from**	**to**	**Variable power** consumption maximum **2.6 kW at UT 230 V.** With reduction of the voltage the current is also reduced. Examples: Ohmic -, inductive -, capacitive -, mixed loads	**Constant power** consumption maximum **1,2 kW at UT = 220V.** With reduction of the voltage the current is increased. Example: switched power supply	**voltage change in % of UT** at current change 0 to 100 % UT= voltage at EUT Power 1
UT	% UT	current range r.m.s	current range r.m.s	% of UT
100 %	0 %	0 to 16A	0 to 16A	0.7 %
100%	80%	0 to 10 A	0 to 5A	4%
100%	70%	0 to 9 A	0 to 6 A	4%
100%	40%	0 to 5 A	0 to 10 A	5%

Note: all values apply for switching time at %UT< 5 s

1.3.7 Interruption and Voltage Variation IEC 61000-4-11 with external Variac

Types of loads: switching **from**	**to**	**Variable power** consumption maximum **3.7 kW at UT 230 V.** With reduction of the voltage the current is also reduced. Examples: Ohmic -, inductive -, capacitive -, mixed loads	**Constant power** consumption maximum **3,7 kW at UT = 220V.** With reduction of the voltage the current is increased. Example: switched power supply	**voltage change in % of UT** at current change 0 to 100 % UT= voltage at EUT Power 1
UT	% UT	current range r.m.s	current range r.m.s	% of UT
100 %	0 %	0 to 16A	0 to 16A	0.7 %
100%	80%	0 to 12.8 A	0 to 20A	4%
100%	70%	0 to 11.2 A	0 to 23 A	4%
100%	40%	0 to 6.5 A	0 to 40 A	5%

Note: all values apply for switching time at %UT< 5 s

1.3.8 DIPS circuit in accordance with IEC 61000-4-29 for d.c. power ports.

Voltage range d.c.	20 to 110 V	EUT Power	
Current range	0 up to 16A		
Inrush current capability at 110 V	220A Peak	- 0%, +30%	See 6.1.1
Interruption time	1ms up to 29999 ms		
Rise and fall time at 100 Ohm load	between 1 µs and 50 µs		See 6.1

IEC 61000-4-29 page 19:
The use of a generator with higher or lower voltage/current capability is allowed provided that the other specifications are preserved. The test generator steady state power/current capability shall be at least 20% greater than the EUT power/current ratings.

1.3.9 Measuring circuit, measuring outputs

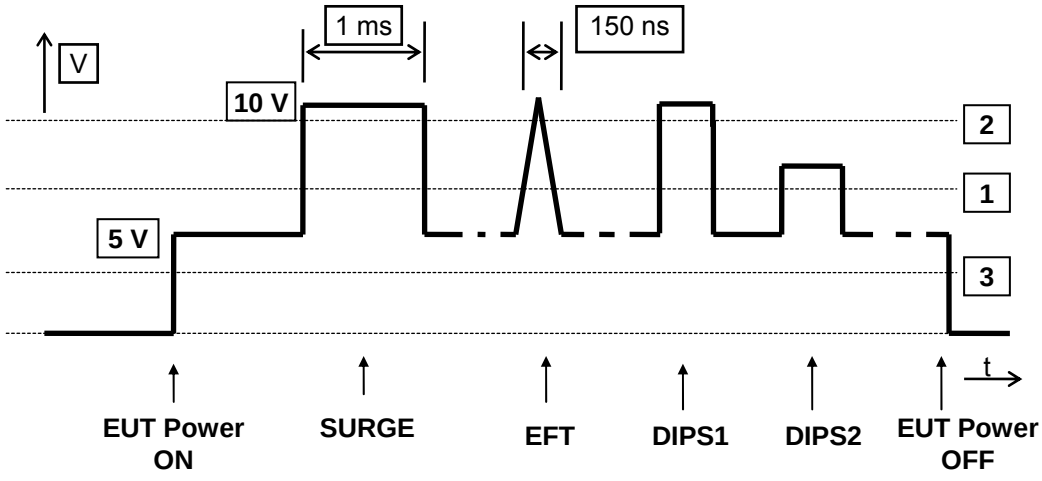
Monitor outputs for measuring equipment e. g. oscilloscope:

Outputs	Relations	Tolerances	Maximum values
SURGE Voltage	10 V equals 4000 V	5 %	4800 V
SURGE Current	10 V equals 2000 A	5 %	2400 A
EUT Power Voltage	10 V equals 400 V	3 %	480 V
EUT Power Current	10 V equals 100 A	5 %	500 A

Numeric measurements e.g. measuring values in the display and in the report.

Display	Range	Tolerances	
SURGE Voltage Peak value	0 to 5000 V	5 %	
SURGE Current Peak value	0 to 2500 A	5 %	
EUT Power Voltage (rms)	0 to 260 V	3 %	
EUT Power Current (rms)	0 to 18 A	3 %	

1.3.10 Trigger Output Levels



1 Trigger level 7 V interference

2 Trigger level 9 V for triggering only DIP1

3 Trigger level 3 V Power ON/OFF

1.3.11 Control

Set-up memory	Up to 15 memory places
Test sequences	the set-ups can be linked serially
Ramps	automatic linear variation of one parameter e.g. voltage, frequency etc.
Synchronisation on different power line frequencies	16,$^{2}/_{3}$;40; 50; 60, Hz
Impulse release	Manual or automatic
Failure detection on EUT	-External Input EUT failed -Manual detection -Selectable limit value for impulse voltage and current for SURGE
Safety switching	Emergency stop Switch off the EMC Test and the EUT power
Control of an external variac	separate remote-control output
Test report	RS232 port for printer, Centronics
Control of external CDN	via RS 485 port

1.4 Mechanical dimensions

Tester -Type	Dimensions [mm]	Weight [kg]	Versions
	width x depth x height		
TRA2000	550 x 600 x 190	33	19" 4 UH
TRA2000-DIPS	550 x 600 x 190	20	19" 4 UH
TRA2000-EFT-ESD	550 x 600 x 190	20	19" 4 UH
TRA2000-DIPS-SURGE	550 x 600 x 190	30	19" 4 UH
TRA2000-EFT-ESD-DIPS	550 x 600 x 190	32	19" 4 UH
TRA2000-EFT-ESD-SURGE	550 x 600 x 190	27	19" 4 UH
TRA2000-SURGE	550 x 600 x 190	22.5	19" 4 UH

1.5 Power Consumption

The power line input is located on the rear side of the TRANSIENT-2000.

Voltage between phase and neutral	230 V (50 Hz) 115 V (60 Hz)	± 10 % ± 10 %
Power consumption	Operation mode < 400 VA Standby < 50 VA Power OFF < 5 VA	(230 V, 50 Hz) (115 V, 60 Hz)

The tester TRANSIENT-2000 is shipped for a line voltage 230 or 115 V.
Following power cords can be ordered:
Europe (CEE-7/VII) UK (BS-1363) Switzerland (SEV Type 12) USA (NEMA5-15P)

1.6 Accessories delivered with the TRANSIENT-2000

ZUB = Standard accessory	Article No.	Component Stock No.	Short Description	Color	Dimensions	Weight kg	Photo No.	TRA2000
AA			S/N = SN or only LOGO = L		-/-	-/-	-/-	SN
AA			Unit height in HE		-/-	-/-	-/-	4
AA			Weight in KG		-/-	-/-	-/-	34
AD			Software GENECS		1 CD	-/-	-/-	1
AD			User manual D		A4	-/-	-/-	x
AD			User manual E		A4	-/-	-/-	x
AD			Verification protocol		A4	-/-	-/-	1
CA	ZUB039	95018	MC safety cable with protected banana plug	black	2m		03386	1
CA	ZUB040	95014	MC safety cable with protected banana plug	blue	2m		03385	1
CA	ZUB041	95015	MC safety cable with protected banana plug	yellow-green	2m		03387	1
CA	ZUB049		Power cord 3 pole CH (10A)	grey	2m		03483	x
CA	ZUB050		Power cord 3 pole D SCHUKO (16A)	grey	2m		03480	x
CA	ZUB051		Power cord 3 pole GB (10/13A)	grey	2m		03482	x
CA	ZUB052		Power cord 3 pole USA (16A)	grey	2m		03481	x
CA	ZUB054		Remote control cable 25/9 pole		3m		03479	1
DI	ZUB097	95057	MC bridge	black			03424	2
FU	ZUB105		Spare fuse 4AT		5 x 20mm		03448	1
FU	ZUB106		Spare fuse 5AT		5 x 20mm		03449	1
FU	ZUB110		Spare fuse 16AT		6.3 x 32mm		03455	2

2 Safety

The TRANSIENT-2000 belongs to Safety class 1

2.1 Safety standard

The TRANSIENT-2000 fulfils the requirements of the safety standards IEC 1010 for laboratory measurements equipment „Safety requirements for electrical measuring, control and laboratory equipment". Based on EN 61010 (IEC1010) the declaration of conformity to low voltage directive (LVD 73/23/EEC O.J.N° L77, 1973-03-26) is given.

This manual is a integral part of the TRANSIENT-2000 tester. The instructions contained in the manual regarding operation and the test set up are to be strictly observed.

2.2 Climatic Conditions

The TRANSIENT-2000 contains high voltage circuits in integrated form. EMC PARTNER only guarantees a correct functioning of the tester TRANSIENT-2000 and the associated accessories, if the TRANSIENT-2000 is operated in the climatic condition specified.

Temperature	15 °C to 35 °C	
Relative humidity	45 % to 75 %	
Atmospheric pressure	86 kPa to 106 kPa	(860 to 1060 mbar)
Not influenced by:	direct solar radiation, rain or condense water, dust or larger electro magnetic fields as specified in the EMC compatibility chapter.	

The TRANSIENT-2000 should be operated in a dry, clean room. If for any reason water condenses in the TRANSIENT-2000, then no TRANSIEENT-2000 operation should be started before the tester is dry.

It is strictly forbidden to operate the TRANSIENT-2000 in rooms with of gas explosion risk. The high voltage of the TRANSIENT-2000 can generate sparks, which can ignite the gas.

People with heart pacemakers should not be in the vicinity of the test set up during operation.

2.3 Precautionary measure during use

The TRANSIENT-2000 generate high voltage. The energy content of the SURGE impulse is high and can be dangerous with improper use. It is wise to observe the following rules:

• Never touch the EUT when a test is in operation.
• Touch no connectors of connection cable when a EMC test is in operation.
• The high voltage of the TRANSIENT-2000 and the power on the EUT must turned off before a manipulation on the EUT is carried out.
• For all services, e.g. check of the fuses, the power cord must first be unplugged.

The TRANSIENT-2000 must be connected to power line with a safety ground. If an isolation transformer is involved in TRANSIENT supply the secondary side of the isolating transformer must be grounded.

2.4 Electromagnetic Compatibility

The outputs of the TRANSIENT-2000 and the links between TRANSIENT-2000 and the EUT can emit disturbances. Please consider the national PTT rules.
The Test System TRANSIENT-2000 should not be operated near sensitive measuring and control systems.
The TRANSIENT-2000 fulfils the following immunity requirements:

• Electrostatic discharge	Level 4 (8 kV)	(IEC 1000-4-2)
• Burst EFT	Level 4 (4 kV)	(IEC 1000-4-4)
• SURGE	Level 3 (2 kV)	(IEC 1000-4-5)

2.5 The manual is an integral part of the equipment. Refer to the manual.

This manual is an integral part of the TRANSIENT-2000. The safety rules and precautions in the manual must be observed. EMC PARTNER and their representatives are not responsible for damage to persons and equipment by not observance the safety rules and precautions in the manual.

3 Mechanical structure

3.1 General

The TRANSIENT-2000 is ideal for running tests in development/test laboratory environments and for outdoor service on larger systems. For outdoor service, the TRANSIENT-2000 can be fitted into a military case.

For better understanding the TRANSIENT-2000 will be divided in two parts:

- The left hand part of the TRANSIENT-2000 contain the control and measurements. The left hand side of the front panel, is called the control panel.
- The right hand part contains all high voltage circuits, such us high voltage source, high voltage switches, the impulse-forming network and the coupling / de-coupling network. This part is called the operation panel.

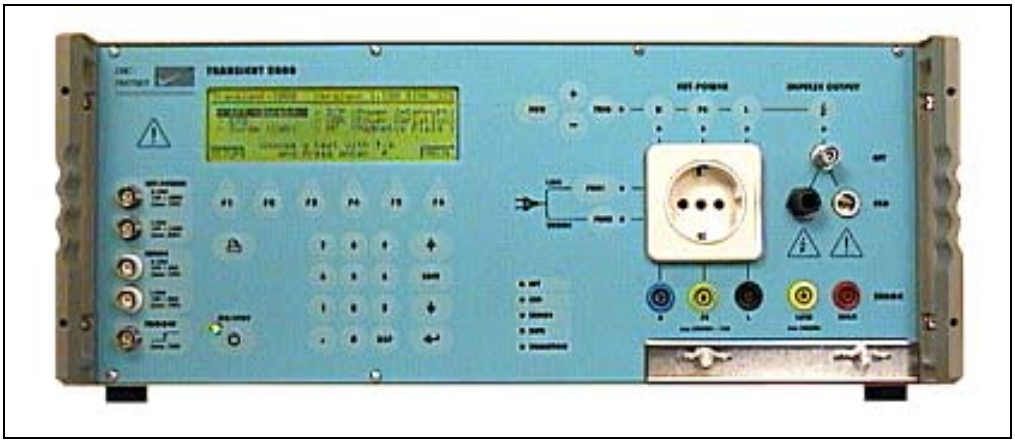


Fig.3.1

The power connections of the TRANSIENT-2000 and the EUT are located on the rear panel. With the power inputs on the rear side and the outputs on the front side an optimum de-coupling is guaranteed. This arrangement allows test set-up without parallel-running cables.

The TRANSIENT-2000 is available with different options:

Standard with handles on both side as showed in Figure 3.1. This version is recommended for use in development and EMC test laboratories.

19“ insert version. The handles are removed and angle brackees are fixed on both sides for fixing the TRANSIENT-2000 in a 19“ rack.

Standard with handle in a military case. This version is recommended for outdoor EMC testing.

3.2 Impulse-forming Network

Behind the operation panel, the high voltage source, the polarity change-over switch, the impulse capacitors, the semiconductor switch and the impulse forming networks are located.
The impulse capacitor Cs is charged by the high voltage source. The discharge of the high voltage capacitor is done via the semiconductor switches. The different impulses are formed by the different impulse forming networks.

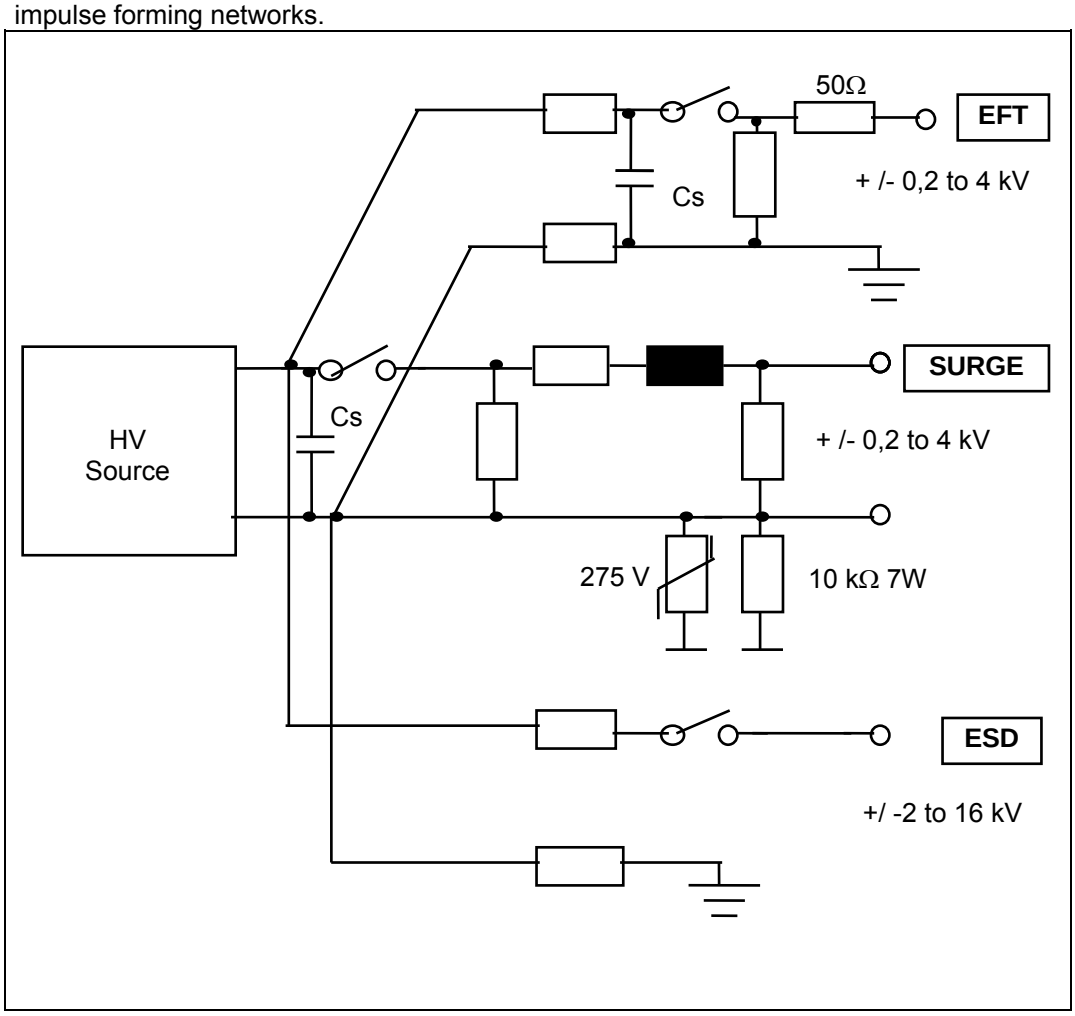


fig. 3.1

3.3 Measuring Circuit

The SURGE impulse voltage is measured differentially with two internally-located voltage dividers. The current is measured with a current monitor with differential amplifier. The peak values of voltage and current are memorised and shown in the display. With the two CRO outputs, the voltage and current waveform can be monitored on a oscilloscope.

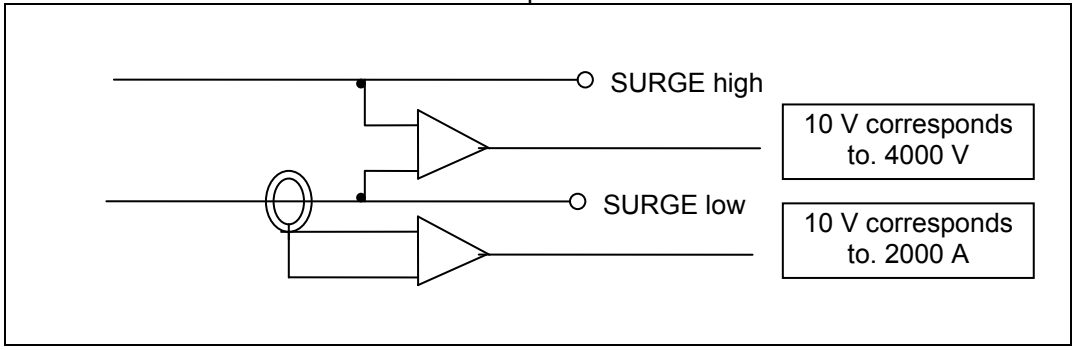


fig. 3.2

3.4 Coupling / De-coupling Network CDN

The coupling / de-coupling network (CDN) of the TRANSIENT-2000 allows the superimposition of the EFT or SURGE impulses onto the power line of the EUT. The switching of the different coupling paths can be programmed. For the voltage DIPS test, the de-coupling network is automatically bypassed.

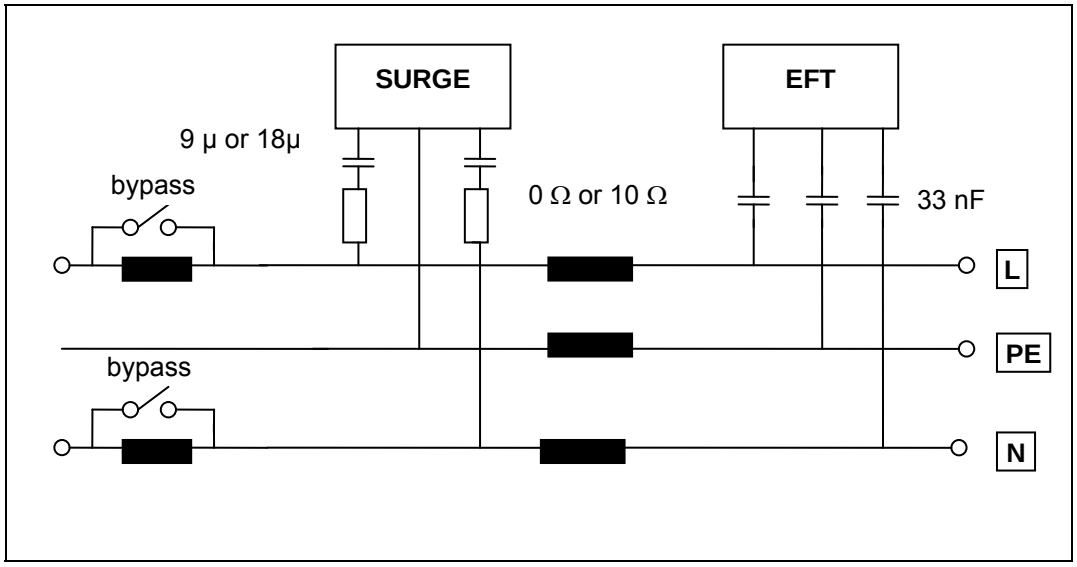


fig. 3.3

3.5 EUT power supply at DIPS

In the operation mode (DIPS voltage interruption), the switch S1 turns on the EUT Power 1 power source (undisturbed level). S2 turns on the power to EUT Power 2 (disturbed level). The internal variac can be replaced by an external variac and therefore the EUT Power 2 can be generated by the internal or external variac.

For DIP testing, the NEUTRAL must be close to earth potential (PE). If voltage is present on the Neutral an error will be shown on the TRA2000 display. If the Neutral is not close to earth potential, an isolation transformer must be used between the mains supply and TRA2000 input..

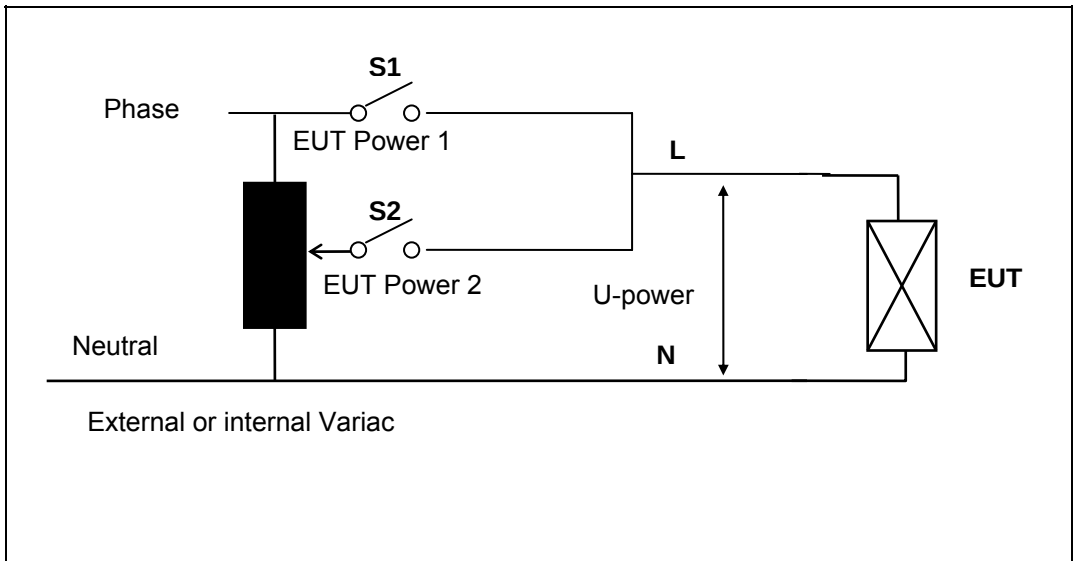


fig. 3.4

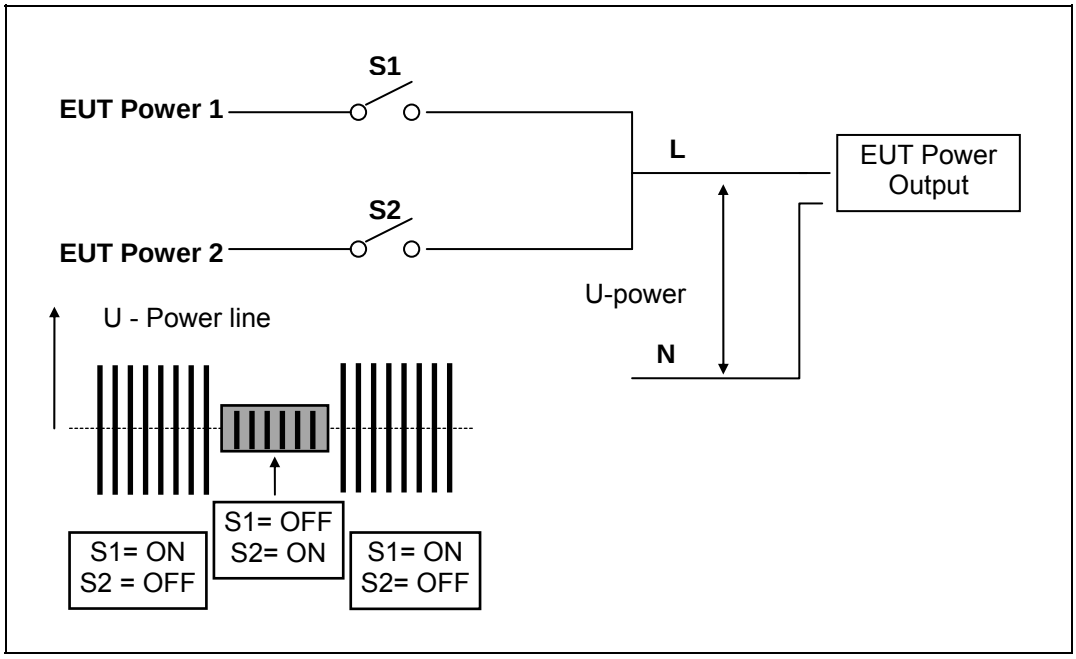


Fig. 3.4

At DIPS to 0 % of the power line voltage, two operating conditions can be differentiated:
A) Switch S1 is opened, the voltage of the power decreases at the EUT with the discharge constant of the EUT (High Z at 0% = ON)
B) Some µs after switch S1 has opened, switch S2 will be closed and the EUT will be discharged via the circuit EUT Power 2 (High Z at 0% = OFF).

AT High - Z Mode = OFF and large capacitive loads, the large capacitance will be discharged via the internal variac at the beginning of the interruption. A large current will result, if an interruption to 0% of the power line voltage is generated. To avoid reducing the life span of the carbon contact electrode of the variac, it is recommended to make a short circuit with an external bridge between L2 and N of EUT Power 2.

4 Control Panel

4.1 Front panel of the TRANSIENT-2000

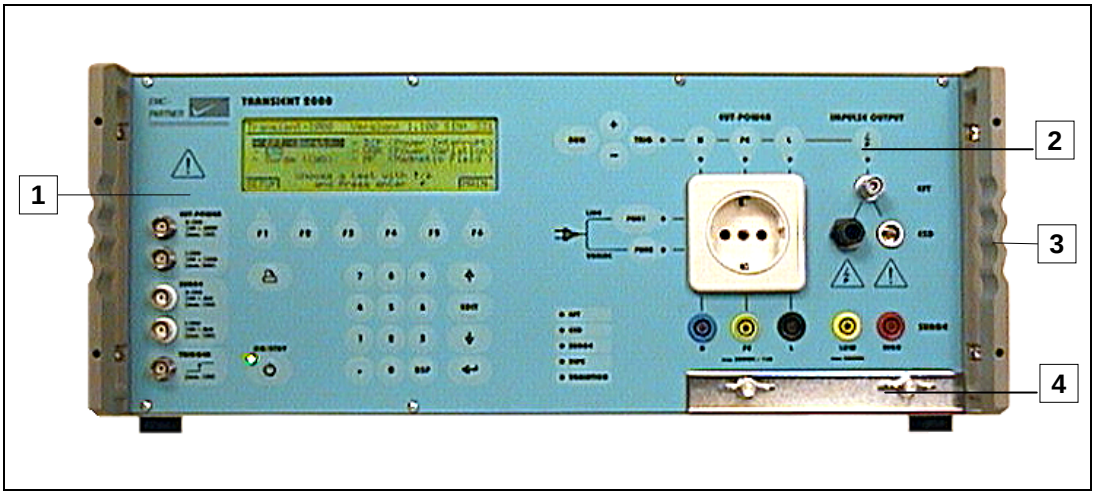


fig.4.1

The most important elements of the front panel are:

1. Control panel
2. Operation panel
3. Handles or angle bracket for the 19“ rack
4. Large surface earth connection

The controls on the front and rear panels are protected by the angle bracket (3).

For the signalisation, the follow colours are generally used:

green	Power on
read	EMV Tests active
yellow	General signals

4.1.1 Control part

The control of the TRANSIENT-2000 is carried out by a microprocessor. The microprocessor controls the EMC tests, stores the inputs of the numeric input terminal, updates the display, checks whether the inputs of the operators are allowed values or not, stores the program and prepares test reports. The operator communicates with the TRANSIENT-2000 via the numeric input terminal, the display and the soft keys.

For better understanding, the control panel elements will be explained separately from the connection panel.

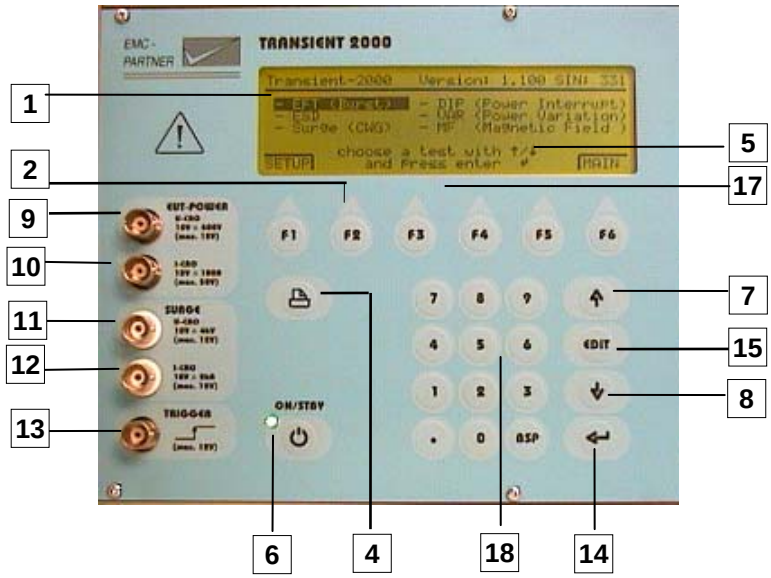


fig. 4.1.1

4.1.1.1 The Display (1)

All important information for the operator are permanently shown on the display during the EMC test. The large graphic display includes additionally 6 soft-keys and some hints or setting range information.

4.1.1.2 Soft-keys“ (2)

The program in the TRANSIENT-2000 is a large program, therefore six soft-keys are provided in order to be able to move and quickly change to different menus.
Example of "Main"

Test	Main	Ramp	Menu
Choice of tests	-pre-setting of nominal values -pre-set of coupling path	-definition of different ramps	-Power -EUT action if failed
EFT ESD SURGE DIP (Interruption) VAR. (Variation) MF (Magnetic field)	e.g. EFT EFT V-peak. Polarity Repetition Burst Spike frequency HV-Out	e.g. EFT EFT V-peak Synchronisation Burst duration Spike Frequency	e.g. Power "ON /OFF" in ° Current limits Synchronisation f Variac setting

4.1.1.3 Push button ON/STBY (6)

With this button, the TRANSIENT-2000 will be set into the power ON / OFF mode. In the turn off mode, the control and the signals are deactivated. In this status of the TRANSIENT-2000, the power consumption is at a minimum of 5 W.

4.1.1.4 Push button up and down (7,8)
These two buttons make it possible to moves the cursor forwards or backwards.

4.1.1.5 Measuring outputs EUT PowerVoltage (9) and Current (10)
A signal corresponding to the mains voltage is available at these two BNC outputs „EUT power“. Maximum 12 V for the voltage at the output (9) and maximum 12 V for the current at the output (10).
:

4.1.1.6 Measuring outputs SURGEVoltage (11) and Current (12)
During SURGE tests, voltage sequence of the SURGE waveform can be measured at the output socket 11 and the current sequence at output socket 12. The range and the accuracy of the measuring system is given in the Chapter 1.2 Technical data Section 1.2.8 measuring circuits, measuring outputs.
:

4.1.1.7 Trigger output for oscilloscope (13)
This output provides all the necessary trigger impulses for the different tests. The different trigger levels and the time delays are listed in Chapter 1.2 Technical data Section 1.2.9.

4.1.1.8 The Push-button ENTER (14)
Numeric read in will be quit with the ENTER button.

4.1.1.9 Push-button Edit (15)
This button has a multifunctional use:
- Activate the dialogue line
- Open pull down windows

4.1.1.10 Buttons F1 to F6 (17)
The buttons F1 to F6 are allocated to the showed function of the display. Depending on the menu, different functions are allocated to the six buttons.

4.1.1.11 Numeric control panel (18)
If the cursor is activated in one line of the display, then data can be input with the numeric key board. Each data input must be terminated with ENTER.
The button BSP (Backspace) enables correction of a wrong data input.

4.1.1.12 Dialogue line within the display (5)
Indicates what range can be selected or which next step must be done.

4.1.1.13 Print button (5)
At test end a summarised test report can be print out

4.1.2 Operation panel

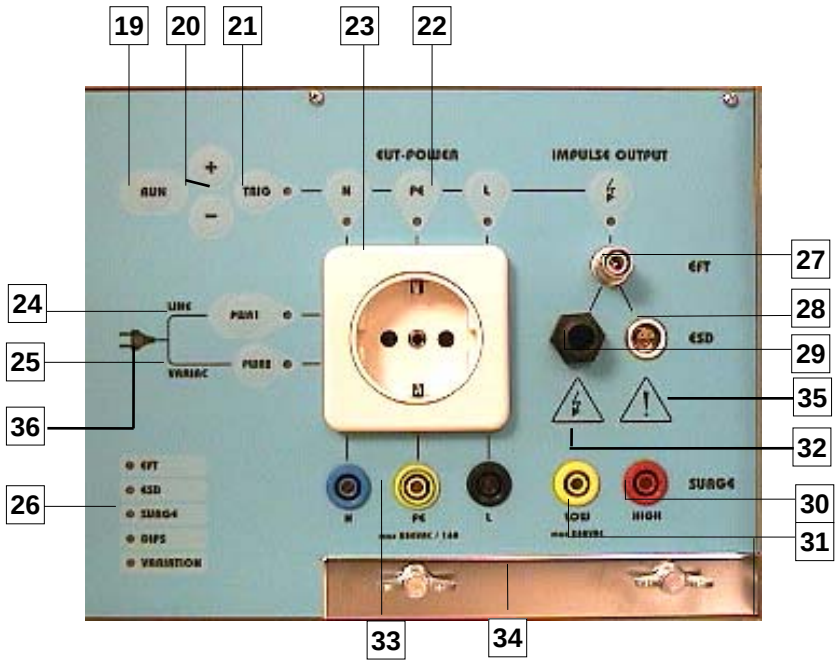


Fig. 4.1.2

4.1.2.1 Taste Run (19)

With the „Run“ button, a test can be started or interrupted.

4.1.2.2 Manual Trigger (21)

When manual trigger is programmed and the tester is ready for manual trigger, this will be signalled by the LED. As soon as the signal occurs the pulse can be released.

4.1.2.3 Signalling the EMC test type(26)

The LED (26) signals which of the five possible EMC test is chosen: ESD, EFT, SURGE, DIPS, Variation. A continuous signal indicates which test has been selected in set-up, while a blinking signal indicates that the test is running.

4.1.2.4 Indication of the coupling path (22)

The four LED indicate on which path the disturbance is: on the three lines of the EUT power, or at the direct high voltage outputs. The signals appear as soon as a test is active. With the buttons manually the coupling path can be activated also during operation.

4.1.2.5 Single phase power output power plug Schuko(23) or banana plug (33) type.

When superposing the disturbance onto the EUT power line, the power cord of the EUT must be connected with the Socket (23). EMC PARTNER offers adapters for the different types of power cord connectors for different countries.

4.1.2.6 Button Power LINE PWR1 (24)

With this button the EUT power is turned on or off at the phase angle defined.

4.1.2.7 Button Variac (25)
With this button the EUT power is turned on from varic. When the power of the EUT is feed from input (48) (see Figure 4.2) e.g. internal or external variac, this status will be indicated by the LED (25) .

4.1.2.8 Synchro ON EUT Power (36)
When a voltage higher than 10 V is applied at the EUT power 1 input on the rear side of the TRANSIENT-2000, the synchronisation will be referred to the sypply voltage. The LED (26) indicates whether the synchronisation is based on the EUT power voltage or not. At voltages lower than 10 V the synchronisation is based on the power line of the TRANSIENT-2000 (41). If the phase and the neutral are interchanged, no indication will occur.

4.1.2.9 High voltage pulse output EFT (27)
This output is needed to run EMC tests with the external capacitive coupling clamp or an additional coupling/de-coupling network.

4.1.2.10 High voltage- (29) and control plugs ESD (28)
These two connectors are for connecting the ESD discharge circuit accessory (ESD Mouse), see TRANSIENT-2000 accessories.

4.1.2.11 Impulse output SURGE (30,31)
These two connectors are for connecting the SURGE coupling kit accessory or three phase coupling/de-coupling network, see TRANSIENT-2000 accessories.
The output are marked with „high“ and „low“. The „low“ output is not earthen, and a maximum external voltage of 280 V ac can be connected, as described on the front panel.

4.1.2.12 High voltage (32)
Attention high voltage at the ESD (AMP plug) and SURGE (MC plugs)

4.1.2.13 Earth connection (34)
Particularly for interference tests with high frequency components, such as EFT, a large surface earth connection is necessary. The earth terminal of the TRANSIENT-2000 allows a low inductance earth connection between test equipment and the reference ground plane to be made.

4.1.2.14 Attention, refer to manual (35)
This sign tells the operator to study the manual in detail. Only instructed personal is allowed to operate the TRANSIENT-2000.

4.2 Rear Panel of the TRANSIENT-2000

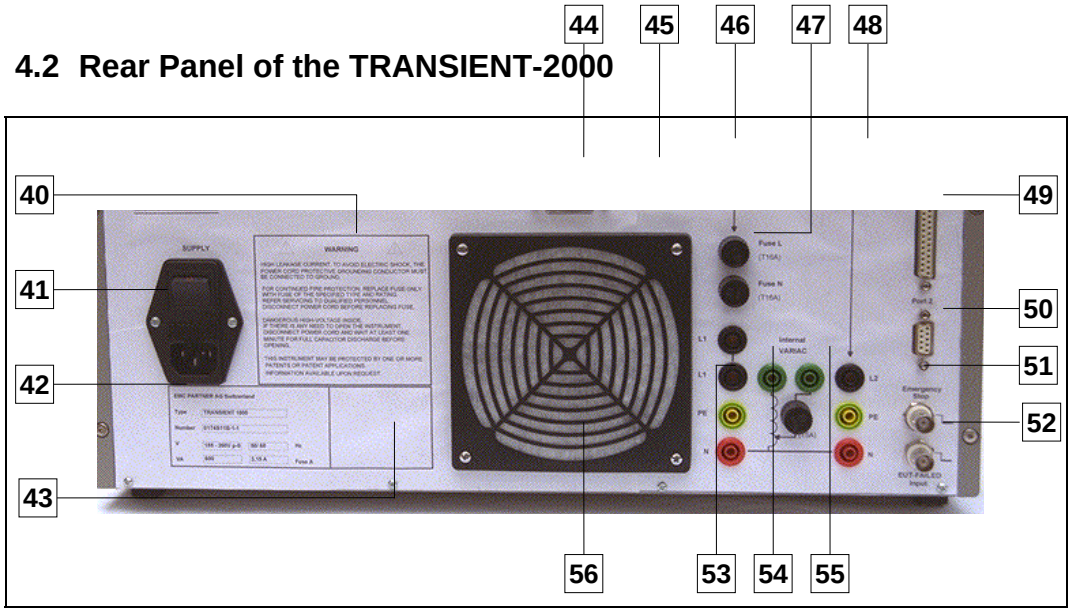


Fig. 4.2

4.2.1.1 Warnings (40)

High leakage currents. To avoid electric shock the power cord protective grounding conductor must be connected to ground.

For continued fire protection, replace fuse only with fuse of the specified type and rating. Refer servicing to qualified personnel. Disconnect power cord before replacing fuse.

Dangerous high-voltage inside. If there is any need to open the instrument, disconnect power cord and wait at least one minute for full capacitor discharge before opening.

This instrument may be protected by one or more patents or patent applications. Information available upon request.

4.2.1.2 Power supply of the TRANSIENT-2000 (41)

The TRANSIENT-2000 receives ist power via power connection (41). A power switch, a fuse and a filter are build in directly at the plug. As ordered the TRANSIENT-2000 will be shipped with power selected to either 230 V 50 Hz or 115 V 60 Hz.
Power consumption: turned on minimum < 50 W; maximum power consumption < 400 W, standby < 5 W
The fuse is rated with T 3.15 A / 250 V.

4.2.1.3 Type plate (42)

All important supply information is written on the type plate. Please quote the serial number and type of the equipment when requesting service or repair.
Type plate

4.2.1.4 CE mark (43)

This plate is reserved for the CE mark. The CE -mark is needed for the free movment of the goods into and within European community.

4.2.1.5 External Variac Control (44)

Via this special interface, the external variac can be controlled by the TRANSIENT-2000. The external variac is needed for EUT (>12 A) and mains voltage variation (>5A).
External

4.2.1.6 Attention, refer to manual (45)

This expression requests the operator to consult the manual in detail. Only instructed personnel are allowed to operate the TRANSIENT-2000.

4.2.1.7 EUT Power 1; Inputs (46,47,53)

All inputs plugs and fuses for EUT power 1 are located in row (46). The two 16 A fuses for phase and neutral (47) located above. Below the fuses are the three power line connections for the EUT power supply (53). For the phase, two plugs are available for connecting the internal variac to the power. At external variac operation, the bridge (53) and (54) must be removed, see Chapter 6 „Testing with the TRANSIENT-2000“.

Supply data: 0 to 260 V ac; 0 to 110 V dc; 16 A.

4.2.1.8 Internal Variac (54,55)

For the interruption and variation mode tests different voltages are needed. As standard the TRANSIENT-2000 has a internal variac with a continuous current rating of 6 A. At shipment, two bridges are inserted between (53) and (54) and between (48) and (55). The variac is protected with its own fuses. For external variac operation, the two bridges must be removed, see Chapter 6 „Testing with the TRANSIENT-2000“.

4.2.1.9 EUT Power 2 Inputs (48)

Input for the disturbance level during interruption. When an external source, e.g. external variac or an external dc source, is used, the external sources must be connected to thes inputs (48).

Supply data: 0 to 260 V ac; 0 to 110 V dc; 16 A.

4.2.1.10 Interface „Port 1“ RS232 for printer and controller PC (49)

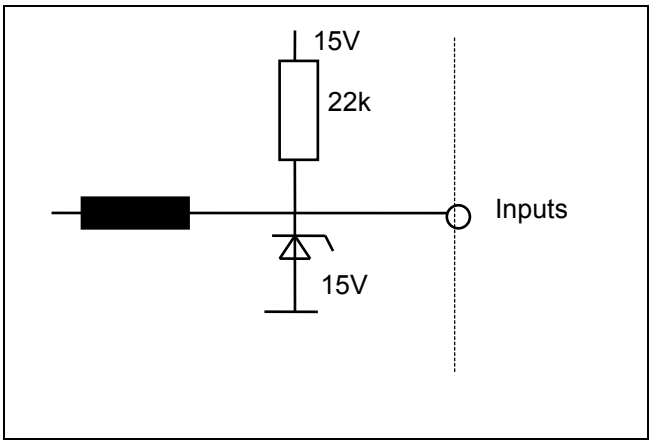
Via this interface a test report can be printed out on a external printer. Using the same interface port, the TRANSIENT-2000 can be also controlled by an external PC. To configure the interface, see Chapter 13 „Remote Control“.

4.2.1.11 Interface „Port 2“ RS 485 for controlling external coupling networks or checking the EUT failed status (50)

Via this interface, the coupling path of external CD-networks can be controlled.
For further information, see the CD-networks manual.
With an additional EMC PARTNER module, a multiple channel EUT-failed control can be built. The control system operates during the EMC tests.

4.2.1.12 Emergency stop, (EMERGENCY STOP) (51)

When the „emergency stop“ input is activated, the EMC test and the EUT power supply will be immediately interrupted. The power supply of the TRANSIENT-2000 will not be turned off. The status „emergency stop“- will be signalled on the front panel. Emergency stop corresponds to 0V at the input.



The trigger value at the intput is approximately 3V
Low: active
High: inactive
Driving with an open-collector output is recommended.

4.2.12 Definition of the inputs „Emergency stop and EUT failed“

4.2.1.13 EUT Failed input (52)

This input can be used fo a single channel the EUT during the EMC test. EUT failed is equal to 0V.

4.2.1.14 Forced cooling of the TRANSIENT-2000 (56)

A ventilator cools the TRANSIENT-2000 internally. Forced cooling is necessary for the impulse forming network devices and the electronic high-voltage switch. A distance of about 20 cm must be maintained between the rear panel of the TRANSIENT 100 and any wall, and about 3 cm between the sides of the TRANSIENT-2000 and any equipment or wall. The TRANSIENT-2000 can be built into a 19“ rack, with 3 cm side separation.

5 Preparation for Operation

5.1 Attention, Refer to Manual

This manual is an integral part of the TRANSIENT-2000. The safety rules and precautions in the manual must be observed. EMC PARTNER and their representatives accept no responsibility not responsible for damages to persons and equipment as a results of non-observation of the safety rules and precautions in this manual.

Before connecting the TRANSIENT-2000 to a public power line, Chapter 3 „Safety must be carefully studied.

5.2 Operators and Service Personnel

Only trained personnel should carry out EMC tests. For small groups of maximum 10 persons EMC PARTNER AG offers the following in-house seminars in English or German at the customer's location:

1. EMV Introduction
2. EMV Standardisation
3. EMC „ESD" immunity test
4. EMC „EFT" immunity test
5. EMC „SURGE" immunity test
6. EMC „DIPS" immunity test
7. EMC „HARMONICS" immunity test
8. EMC „MAGNETIC FIELD" immunity test
9. EMC „CW CURRENT INJECTION" immunity test
10. EMC „CE-MARK" transient immunity tests
11. „NEMP" immunity test
12. „AC, DC, IMPULSE" insulation test

5.3 Checks before operation

5.3.1 Optical verification of the TRANSIENT-2000

Before you unpack the TRANSIENT-2000, please check whether the packing is deformed or damaged. When the TRANSIENT is unpacked, also check whether the tester is damaged. If you detect a damage, please inform EMC PARTNER and the shipping organisation immediately.

5.3.2 Power source check

On the rear panel, you will find a type plate. Please check whether the Tester has been prepared for the correct power line voltage of your public power. If the power supply voltage is different please inform EMC PARTNER AG in Switzerland, or your EMC PARTNER AG representatives.

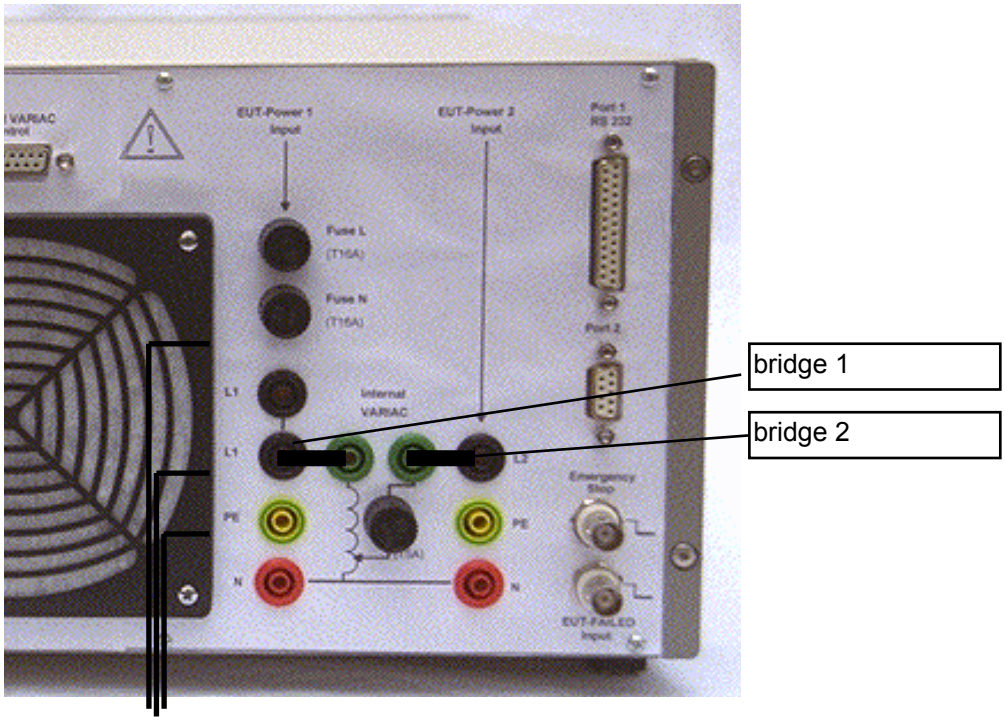
5.3.3 Connecting the TRANSIENT-2000 to the power line

Please use the supplied power cord for connecting the TRANSIENT-2000 to your public power supply. As stated on the rear panel, the power supply must have an earth safety wire. Please check the earth connection on your power outlet before you connect and turn on the TRANSIENT-2000. The high inrush current during the DIPS test can only be reached, when the public power supply can deliver 500 A peak current. The public power supply must be protected by 16 A fuse.

5.3.4 EUT Power, Power source for the EUT

To connect the EUT Power 1 Input with the public power supply please cut the three black, blue and green/yellow cables supplied into two halves of the same length. One half used for the EUT Power 1 connection on the rear side of the TRANSIENT-2000, and the other half for supplying the EUT from the front panel.

Connection of the internal Variac:



Public power line

The Bridge 1 connects the internal variac with the public power supply on the primary side.

The Bridge 2 connects the secondary side of the variac to the EUT power 2 input.

Attention: Phase and neutral must be connected correctly. When the phase and the neutral are connected correctly, this is indicated on the front panel by a green LED.

Attention!
If your power supply is equipped with fault current protective switch it will maybe release when connecting the TRANSIENT-2000. The TRANSIENT-2000 contains filters with a leakage current to earth. In addition a high current will flow to earth when Surges are superimposed between phase and earth. The impedance of 2 Ohm in series with 10 Ohm and 9 µF is a load on the power supply.

Solutions:
1. For testing with TRANSIENT-2000 use a power supply without a fault current protective switch.
2. Connect a insulation transformer between power supply and TRANSIENT-2000. One secondary output terminal of the transformer must be grounded.

As a results of the leakage current always connect two earth lead to the TRANSIENT-2000. The TRANSIENT-2000 have four earth terminal.

5.3.5 EUT Power, supply of the EUT with voltages differ from the public power line (Variac)

Internal Variac

bridges

Both bridges must be placed as shown on the picture beside. EUT Power 1 must be connected to the 230 V public power supply.

Figure 5.3.5.1

Connection external Variac:

EUT
Power 1

EUT
Power 2

The external Variac replaces the internal Variac.

Remove the two bridges.
EUT Power 1 (L1) of the TRANSIENT-2000 must be connected with L1 of the external Variac.
EUT Power 2 L, N, PE must be connected as shown on the picture.

In addition connect the control cable between „External Variac Control“

Figure 5.3.5.2

Accessories delivered with the external Variac

- See VAREXT1000 user manual

5.3.6 Correct selection of voltage range for the VARIAC voltage regulation.

1. **First check the voltage between the N and PE of the EUT power supply on the rear side of the TRA2000 DIPS.**

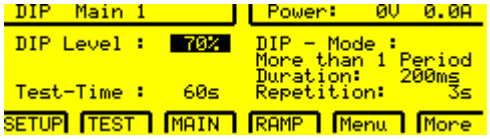
The Voltage must be 0V

When the voltage is not 0V connect with 4 mm banana plugs the neutral and PE together. The voltage measurement for the variac is made between L and PE

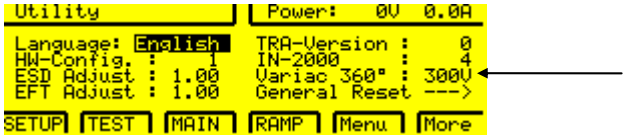
2. The correct voltage setting for the regulation range of the VARIAC

Select DIP and press Main

Press two times the Menu button and „UTIL“



Press two times the Menu button



For the optimum variac regulation select the following setting for different EUT power supply voltages:

EUT power supply	Variac 360° : ????V
230 V	300 V
115 V	150 V
100 V	130 V

3. **Measurement at the output without load**

When no load is connected at the output of the TRA2000 a capacitive voltage can be measured. Especially when the measurement equipment has a high impedance like a multimeter. Connect a load of approximate 1 k Ohm onto the output of the TRA2000 and repeat the measurement.

5.3.7 EUT Power, supply of the EUT with dc

bridges

Caution!

Before a dc supply for the EUT can be used the two bridges must be removed.

If the bridges are not removed when the EUT is powered with dc the internal Variac will be heated and destroyed.
Dc voltage range 110 V
Maximum dc current 16 A

Figure 5.3.6

Preparations:
1. Remove the two bridges on the rear side of the TRANSIENT-2000.
2. Connect the DC power supply with EUT - Power 1. When ever possible connect the positive pin of the dc source with L and the negative pin with PE. Only when a grounding of the EUT is no allowed connect the negative pin with the neutral N of the TRANSIENT-2000.
3. When a dc-dips to x% of Udc is required a second dc source must be connected to EUT power 2 of the TRANSIENT. When a interruption of the dc-source to 0% of the Udc must be applied, connect L2 with N of EUT power 2.

Preparations:
Activate "Main" DIPS test and select the d.c. interruption mode.

Remarks:
- The green LED „Synchro on EUT Power“ has no indication.
- The voltage and current measurement EUT Power is out of order. The measurement circuit is designed for ac.

SURGE superimposing on dc
For this kind of test the dc voltage should be, if possible connected to L and PE on EUT-Power 1. Only for this coupling path the coupling impedance is 10 Ω and 9 µF.
This is an advice from EMCP based on experience of customers, that protection devices has been destroyed when SURGE test has been carried out with coupling impedance 18 µF and 2 Ohm between L and N. In the real installation environment they never had a damage of the equal protection devices. In the IEC 61000-4-5 no specific chapter is dealing with different d.c. sources. The only hints for Surge tests on d.c. supply can be found in the single phase test set up examples.

5.4 Hints for the test set up according to IEC standards

We list below those experiences of EMC PARTNER which are important for the success of the various tests. This information is only partly given in the standards.
Before a test is started, it is important to define which ports (inputs, outputs) must be tested. For the most important transient tests the ports are given as follow in the European generic standard:

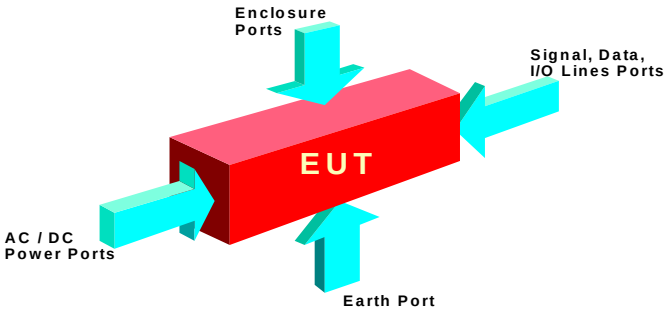


figure 5.4

5.4.1 Test set up EFT

Ports which must be tested:
AC/DC power supply, signal, data and I/O lines;

Coupling path:
For EFT pulses, the capacitive coupling is the dominant coupling path. The reasons why the capacitance coupling path plays the dominate roll are explained in the book „EMV Störfestigkeitsprüfungen“, published by FranzisVerlag Munich, or in the report „Schmalbandige Störfestigkeitsprüfungen im n-Sekungen Bereich“ by M. Lutz.
An example will show, that the impedance of EFT spikes at a capacitance of 100 pF (e.g. stray capacitance can be as high as 100 pF) is very low. As an approximation, the rise time of 5 ns can be converted into a frequency of 100 MHz, and the impedance can be calculated as:

$Z=1/ 2\pi f C = 1/ 6{,}28 \times 100\ 10^{6} \times 100\ 10^{-9}$ **= 15 mΩ**

Test set-up:
As showed in the mathematical example, stray capacitance between coupling plate, tester, cables, laboratory wall and reference ground plates can have a large influence on the test results. Here some hints for the set.up of an EFT test:

- The tester must remain on the reference ground plane, and be connected to the reference ground plane by a low inductive connection.
- On table-top equipment tests, it is not clear from the existing IEC basic documents 61000-4-4 that the reference ground plane must be on the table, and not on the floor under the table. The EUT must be lifted 10 cm from the reference ground
- All cable must be reproducibly placed. (We recommend a photo of the test set-up)

Safety:
The burst impulses described in the IEC standard 61000-4-4 are not dangerous to persons, because the energy and the pulse duration are too low. Testers are available on the market with higher spike frequencies and longer test duration, where the energy is much higher, and therefore more dangerous to persons.

As mentioned in Chapter 2, EFT disturbances can affect heart pacemakers or hearing aids.

5.4.2 ESD test set up

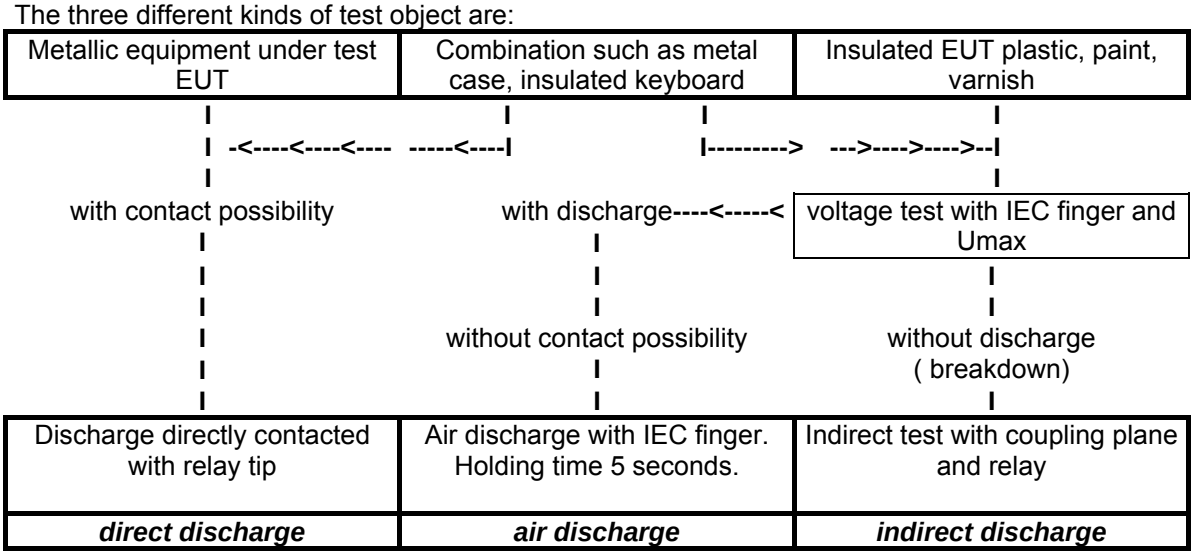
Ports which must be tested:
Enclosure Ports include operational keys, displays, ground and earth points, metallic parts such as connector etc.

Coupling path:
Basically all types of coupling exists during static discharges. Practical experience shows that, for the most electronic equipment, the current is the dominant parameter.
In practice the current path of the discharge current plays a important role e.g. if secondary sparks or breakdown in the UET occur the test is no longer reproducible.
The frequencies contained in the ESD discharge current are higher than in the EFT spike impulse. As a consequences, reproducibility of the ESD test is more difficult than the reproducibility of the EFT test results. The ESD test is most complex transient test.

Test set-up:
As shown by the example in the IEC document 61000-4-2 the same test set up can be used for all different discharge mode (contact-, air- and indirect-discharge). Under the table lays the reference ground plan and on the table is the horizontal coupling plane placed.

The test mode used depends on the test object.

The three different kinds of test object are:



The ESD transient test is a single event test. The susceptibility of an EUT is strongly influenced by the clock frequency. With the clock frequency, the information will be transmitted in the EUT or to the auxiliary equipment within a system. The ESD pulse enters the EUT when no information is being transmitted, the EUT has a very good immunity to EMC test, whereas the equipment will fail in operation. The existing ESD testers on the market the discharge cannot be synchronised with the clock frequency. Therefore the number of shots must be increased up to 100 discharges.

Safety:

ESD discharges are not dangerous for humans.

5.4.3 Test set up SURGE

Ports which must be tested:
AC/DC power supply, signal, data and I/O lines; earth connections
Hints to the test set-up

Coupling path:
Unlike the EFT and ESD tests stray capacitance are not important here. The frequencies contained in the SURGE impulses are low frequencies. The galvanic and mutual coupling are dominant. The cable lay-out and the test set-up is therefore uncritical. The test results are easily reproduced.

Test set-up:
What must be tested?
Protection circuit for inputs, and outputs as shown in the figure below.

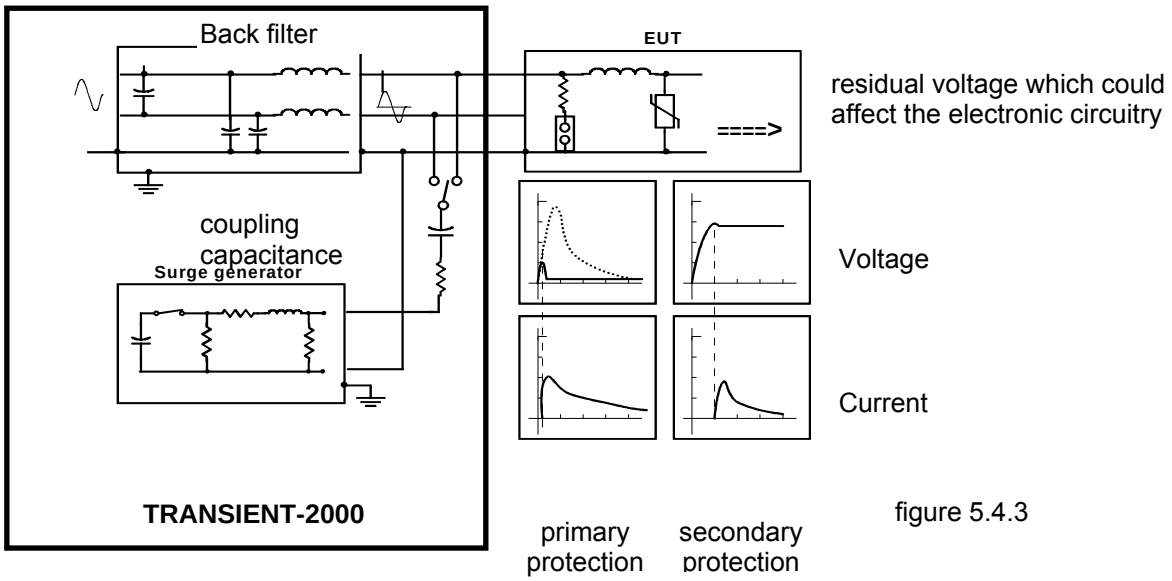


figure 5.4.3

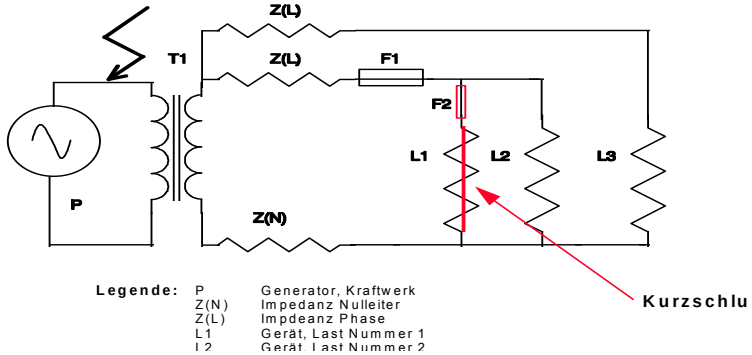
Superimposing SURGE pulses onto power lines is carried out using a capacitance between the tester and the power line. With the SURGE test, the effectiveness of the protection circuit will be tested. The residual voltage after the protection circuit could affect the electronic parts of the EUT.
The SURGE test is a single discharge, as in the ESD. The considerations regarding single discharge which were made for the ESD discharge also apply here. Synchronisation with the power line frequency is important, and must be considered.

With the proposed current injection method, the bonding of screen and earth connections can be tested.

Safety:
The SURGE pulses can be dangerous for persons. The EUT and its cables should not be touched during SURGE EMC tests.
In case of a breakdown in the EUT, it must be remembered that high currents can flow from power supply.

Test set up DIPS, Interruption
Ports which must be tested:
AC / DC power supply
Hints for the test set-up

Coupling path:
This disturbances appear on the power lines. Disturbance sources are short circuits between power lines, power line switching actions and heavy load changes etc.



Legend:

P	Power generator
Z(N)	Impedance neutral
Z(L)	Impedance Phase
L1	Load 1
L2	Load 2
L3	Load 3
F1	Power line fuse
F2	Equipment fuse

Short circuit at load 1 ure 5.4.4.1

Test set-up:
- During DI h current are possible during the turn on phase of the DIPS.
- With switc an increase linearly with the voltage reduction e.g. I= 1A at U 230V, and with reduced voltage of U = 40%, the current increase to 2,5 A.
- For a realistic DIPS and interruption test, the test object must be discharged using the power line impedance, see Chapter 3.4.
-

Test levels, Voltage interruption

Test Level % U_T	Voltage Dip/int % U_T	Duration (in period)
0	100	0.5* 5 10
40	60	25 50 x
70	30	

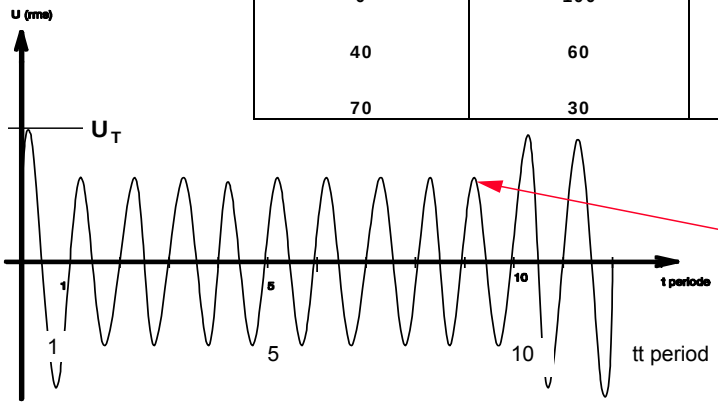
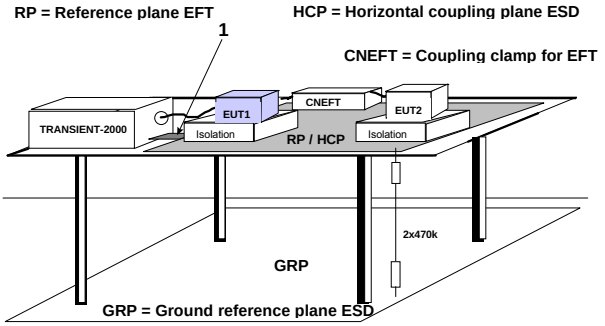


figure 5.4.4.2

Safety:
The safety regulation of high voltage technology must be complied with.

5.4.4 Test set-up for table top equipment

Test set up	Test sequence
Single Phase EUT	**I. EFT** 1. Connect the earth bar of the TRANSIENT-2000



with the flat multiwire cable (1) to the reference ground plate
2. Put 10 cm insulation between EUT and the reference ground plate
3. Carry out the tests!

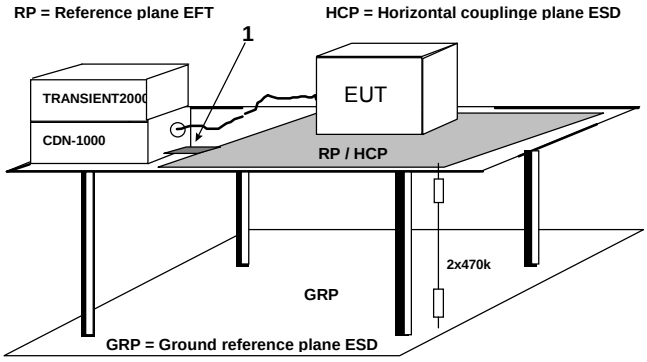
II. ESD

1. Remove the flat multiwire cable (1) between the earth bar of the TRANSIENT-2000 and the reference ground plate
2. Put 0,5 mm insulation between EUT and the reference ground plate
3. Carry out the tests!

III. SURGE, DIPS, VARIATION

1. Reinstall the flat multiwire cable 1
2. Carry out the tests!

Three Phase EUT



I. EFT

1. As for single phase EUT
2. As for single phase EUT
3. Connect the Impulse out of the TRANSIENT with EFT coupling on the Threephase Coupling/De-coupling network CDN-2000-06-25
4. Carry out the tests!

II. ESD

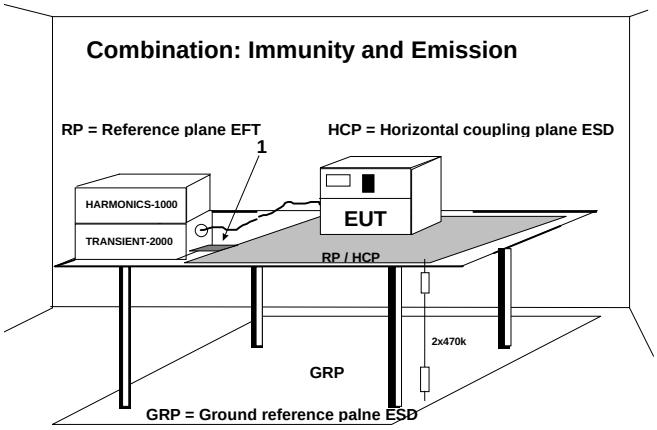
1. As for single phase EUT
2. As for single phase EUT
3. Carry out the tests!

III. SURGE,

1. Make connection 1
2. Connect the surged phase for synchronisation with EUT Power 1
3. Carry out the tests!

IV. DIPS Interruption

1. Loop the phase for dips and interruption through the TRANSIENT-2000 (EUT Power 1)
2. Carry out the tests!



I. TRANSIENT-2000 Tests:

1. Carry out the tests as explained for single and three phase EUT

II. HARMONICS-1000-Measurements

1. Harmonics in accordance with IEC 61000-3-2
2. Flicker in accordance with IEC 61000-3-3
3. Immunity Harmonics IEC 61000-4-13 d

For brochures and further information about HARMONICS-1000 contact EMC PARTNER AG or your nearest representative. See overleaf for address detail.

5.5 Practical testing sequence

In practice, the following test procedure has been shown to be reliable:

1. Burst-Testing:

- **Burst-testing** on mains inputs with a test voltage of 4kV
- **Burst-testing** of signal and data lines up to 4kV

The energy contained in the burst pulses is relatively small, thereby minimising damage to the test object. The higher the repetition frequency, the more likely it that weak points become evident in the test object.

2. ESD-Testing:

With this test, effects induced through the keys and the housing of electronic equipment can be simulated.

Metallic parts, contacted method up to 8 kV

- Insulated parts, air discharge up to 15 kV

In practice, an item that has undergone burst testing shows a better immunity to ESD, than one which has not. Likewise, an item that has undergone burst testing shows a better immunity to current injection or cw field tests.

3. Surge-testing:

- **Surge testing** mains up to 2 kV

This should be used to test input protection elements and protection circuits installed in electronic equipment. The energy content is very high in the surge test, and can destroy elements in the EUT.

- **Surge testing** signal and data lines up to 1 kV

4. Mains simulation:

As a consequence of the increasing number of non-linear loads, the quality of the mains gets worse and worse. To be sure that electronic equipment can withstand the mains interference, test are such as:

Mains interruption, Mains under and over voltage variation, harmonics simulation etc. are required.

5. Further testing:

For most EUT, the described transient tests are sufficient. Further testing of the product to determine differences, e.g. with regards to the effects of magnetic field on monitors or on protection elements, may be needed.

Conclusion:

The product determines which kind of EMC test must be applied. It is also important, that EMC testing should only be carried out by trained personnel, with a knowledge of how the test object should function, and some knowledge of transients and EMC. The four tests, with their range of impulse types, simulate only single signals, and do not cover the compete range of EMP phenomena. However, if no more failures were registered, after a period of EMC testing with electronic equipment and systems in practical operation, it would not be justified to impose additional EMC tests.
Further EMC test information can be obtained from EMC Partner or from our representatives.

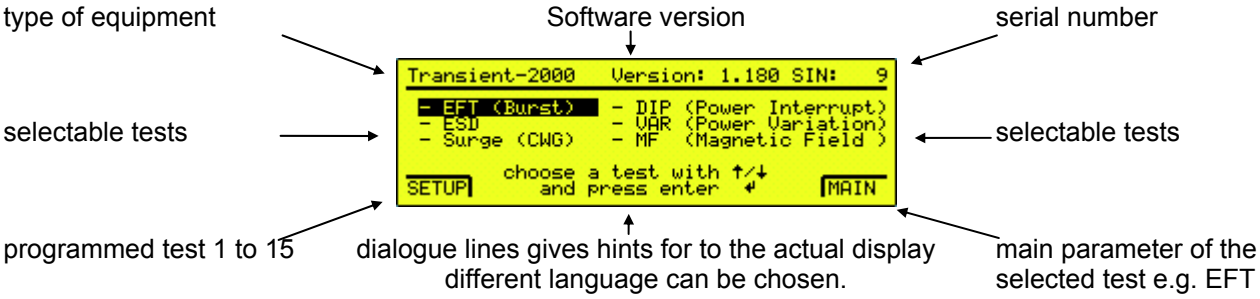
6 Testing with the TRANSIENT-2000

6.1 Quick start of the TRANSIENT-2000

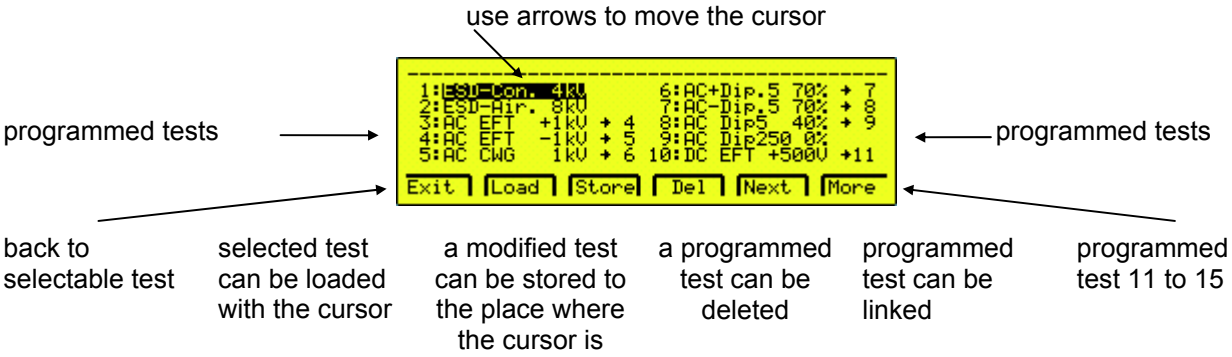
When you have studied Chapter 2 „Safety“ and Chapter 5 „Preparation for operation“ and all instructions have been followed you have green light for a quick start. The quick start includes the most important tests using the TRANSIENT-2000.
EMC PARTNER store the needed tests specified in the generic standard "domestic" in the TRANSIENT 2000 before shipping.

To start a set-up, the follow steps must carried out:

- Turn the power switch on the rear side to position I
- Operate the ON/STBY button on the front panel the display turns to:

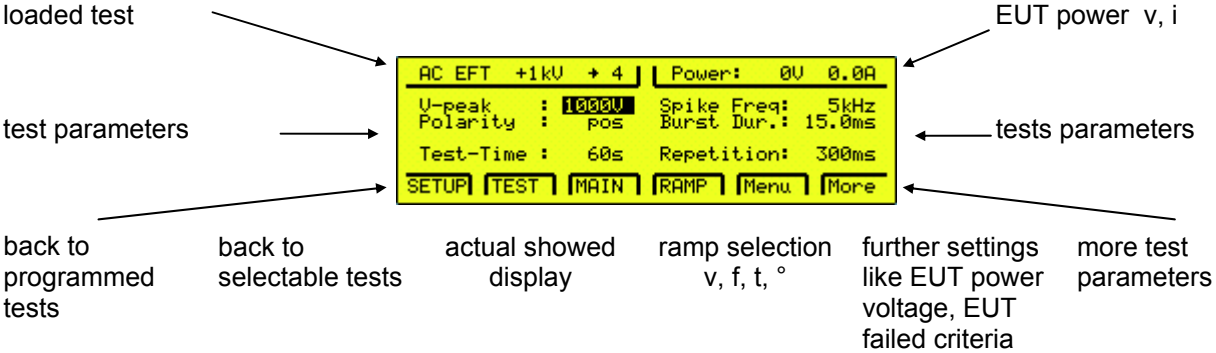


Press "SETUP"

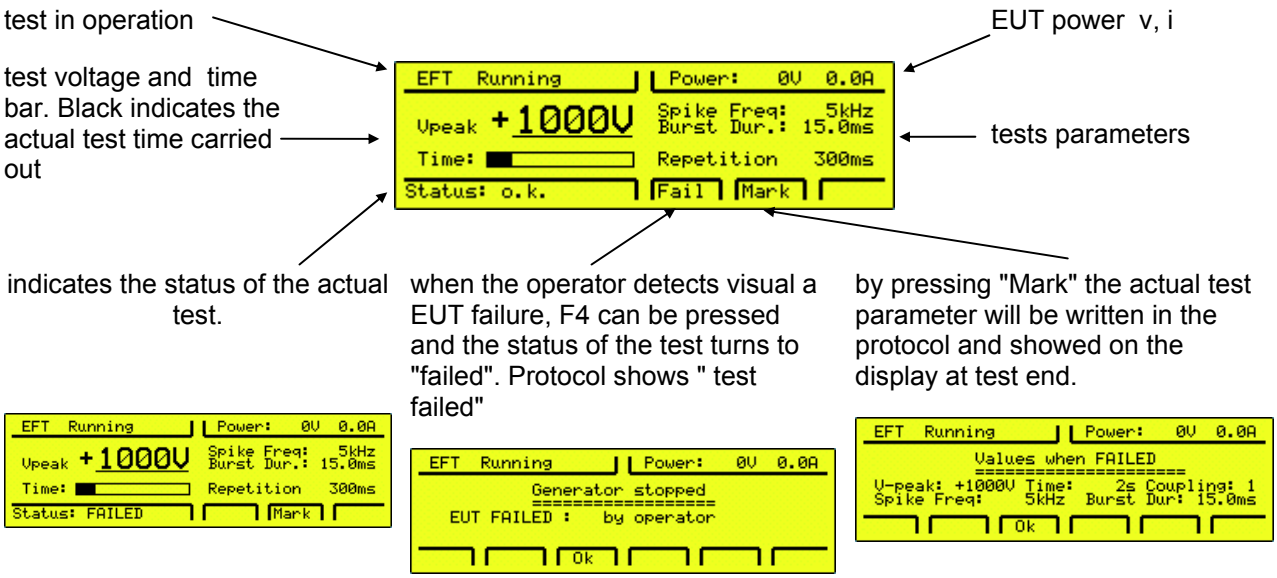


Quick test example AC EFT +1kV:

- move the cursor with the arrow to number 3
- press F2 Load



- press "RUN" button



When a printer is connected to the TRANSIENT-2000 or the TRANSIENT-2000 is controlled from a PC with GENECS the following protocol will be printed or showed on the monitor:

```
EMC Partner AG

--------------------------------------------------------------------------------
TRANSIENT-2000-  9   Version: 1.10     Test :  AC EFT  +1kV
                                       Date :  10.12.1999  Time :  08:28:39
Test Kind:  EFT (Burst)
EUT :                                  Operator :

--------------------------------------------------------------------------------
  PowerON Syncro:    0Deg   PowerOFF Syncro:    0Deg   Current Limiter: 20A
--------------------------------------------------------------------------------

  EFT V-peak       :  1000V          Polarity       : pos      Trigger : auto
  Spike Frequency  :     5kHz        Random Spikes  : off
  Burst Duration   :  15.0ms         Burst Syncro   : off
  Repetition       :   300ms

--------------------------------------------------------------------------------


       Test-Time per path:                60s
       ================================================================================


       1. Coupling EFT to: L+N+PE              Result:   Test aborted

          Test End ......................   12s


       Test Result :  Test aborted
```

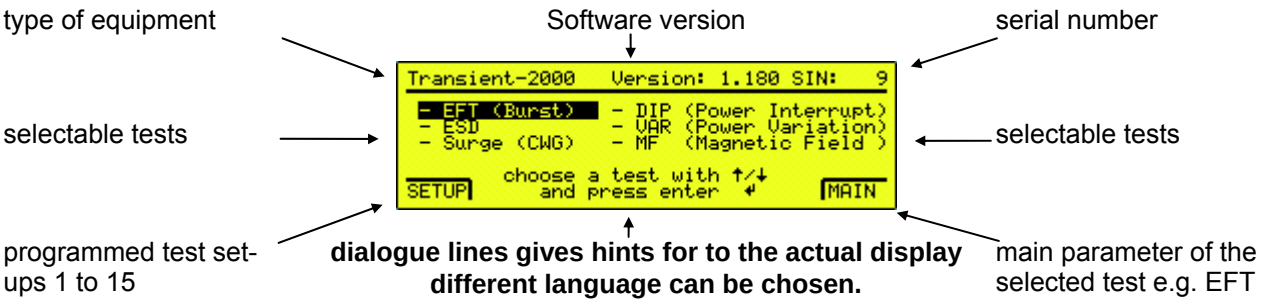
Well that's easy isn't it ?

All other 14 programmed tests can be started and carried out on the same way. All test can be stared or stopped with the "RUN" button.

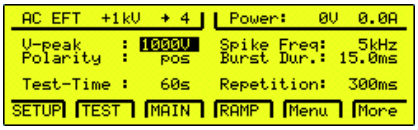
The quickstart tests contain only a small part of the testing possibilities of the TRANSIENT-2000. In the next two sections, the additional possibilities of the TRANSIENT-2000 will be explained in detail.

6.1.1 Selection of a language: Deutsch, Français, Italiano, Espagnol

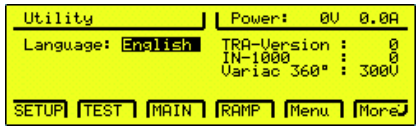
One of the great advantages of the TRANSIENT-2000 is the language selection. The equipment are shipped with English language selected. To change the language follow the instruction below.



Press "Main" - and twice "Menu" - "UTIL" - -EDIT button



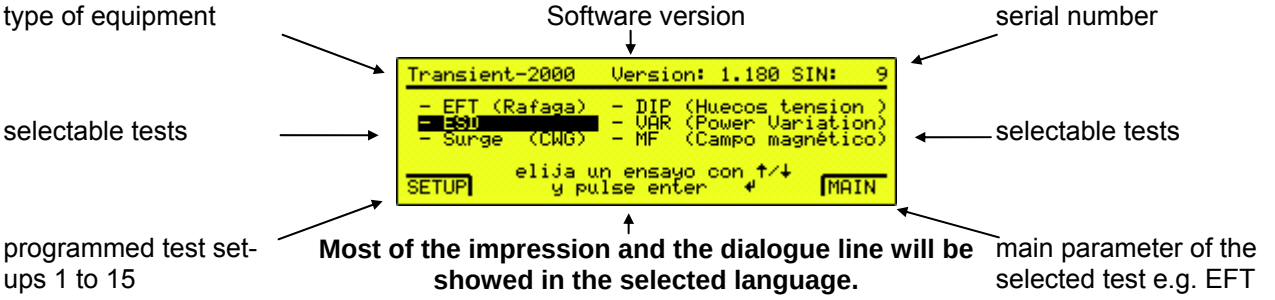
display when "Main" has been pressed



display after pressing twice Menu and UTIL

after pressing "EDIT" button

Chose the desired language (e.g. Spanish) with the arrows and quit with the ENTER button and press soft key F2 "TEST". The display "TEST" has know changed to

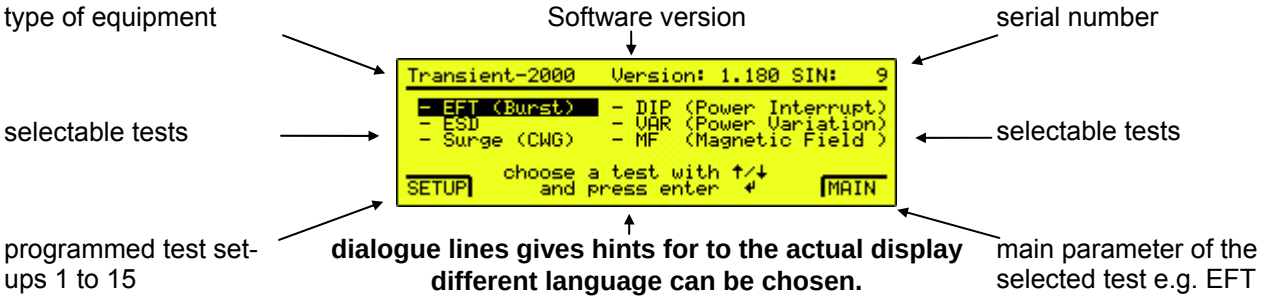


Further languages are possible on the GENECS software but not on the TRANSIENT-2000 level.

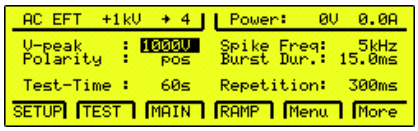
Advantage:
Automatically all expression and remarks on the display and the **protocol** will be written in Spanish or in the selected language.

6.1.2 Protocol and beeper possibilities

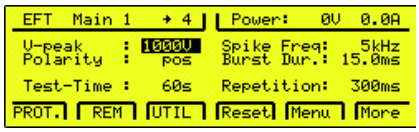
The TRANSIENT-2000 can be adapted to printer with serial or Centronics ports. The TRANSIENT-2000 default value are set at shipment: Autoprint ON, Port Centronics, Beep on Trig ON, Beep on Fail ON. The default values can be changed as follow:



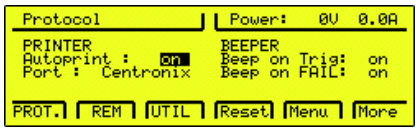
Press "Main" - and twice "Menu" - "PROT"



display when "Main" has been pressed



display after pressing twice Menu

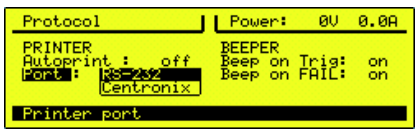


after pressing "PROT." soft key

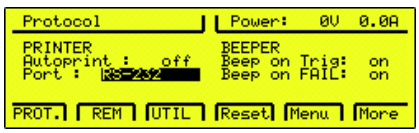
Autoprint:
When Autoprint is set to OFF no protocol will be printed or send to the GENECS soft on the PC.

Port:
When a printer with Centronics port is used on the Port 1 of the TRANSIENT-2000 (rear side) the "Centronics Adapter" must be plugged. The printer can know be connected with a standard printer connection cable to the TRANSIENT-2000.

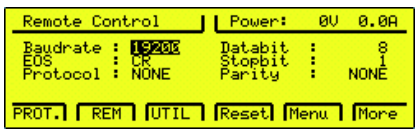
When a printer with RS232 port is used remove the Centronics adapter and change the remote control of the TRANSIENT-2000 to serial port set-up of the printer.



display when "EDIT" has been pressed



press "ENTER" and REM soft key



after pressing "REM" soft key

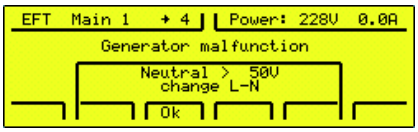
When the serial port is used to control the TRANSIENT-2000 from a PC select the "Remote Control parameter" as showed above corresponding to the PC serial port.

Beeper:
Turn the beep function "ON" or "OFF" as personally preferred.

6.1.3 EUT - Power and EUT - Control

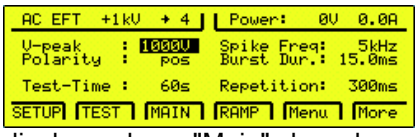
For running the interruption, voltage variation and DIPS, the EUT Power 1 Input on the rear side of the TRANSIENT-2000 must be connected to the mains. The mains is correctly connected if the green LED in the symbolic power plug on the front panel of the TRANSIENT-20000 is glowing. The green indication will only be visible when the phase and the neutral are connected in the right sequence. If the power main is connected and the green light is not on, the mains cable phase and neutral must be interchanged. This ensures that L and N inscribed on the front panel correspond with the phase and neutral of the mains.

The following information will be displayed when the phase and the neutral are not connected in the right sequence and PWR1 button on the front plate has been pressed.

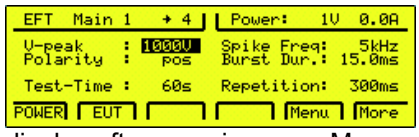


Different parameter of the EUT power can be selected:

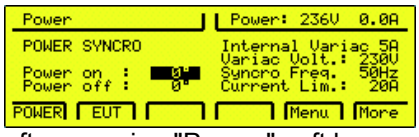
Press "Main" - and once "Menu" - "PROT"



display when "Main" has been pressed



display after pressing once Menu



after pressing "Power." soft key

Power on: The angle turning "on" the EUT power synchronised to the EUT power input of the TRANSIENT-2000 in degrees. With this feature inrush current of EUT can be checked. The measurement of the current can be made via EUT-Power I-CRO on the front plate on an oscilloscope.

Power off: The angle turning "off" the EUT power synchronised to the EUT power input of the TRANSIENT-2000 in degrees. With this feature overvoltages can be checked when EUT current is unequal 0A. The measurement of the voltages can be made via the EUT-Power U-CRO on the front plate and an oscilloscope.

Variac voltage: When the variac with button PWR2 is activated the output voltage can be changed directly by editing the variac voltage. Online the power voltage is measured and indicated on top of the display.

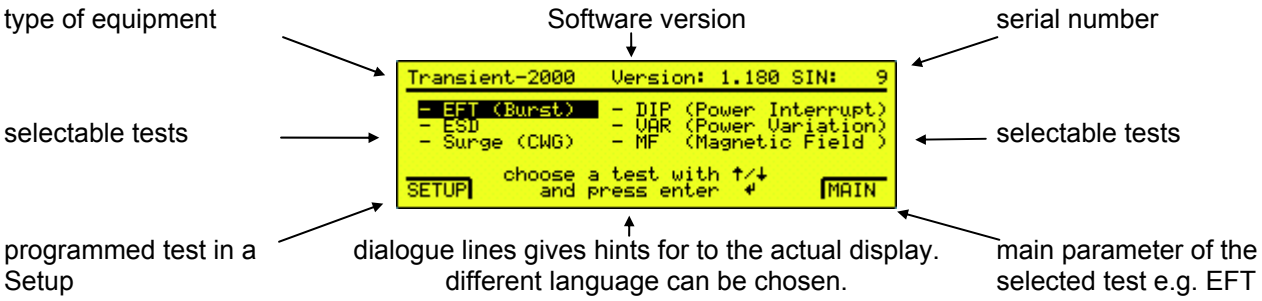
Synchro Freq.: The EUT-power frequency must be selected corresponding to the actual power line frequency 16, 40, 50, 60 or 400 Hz. The synchronisation angle for superposing SURGE or "Power ON" or Power OFF" is base on the selected frequency.

Current Lim.: When the EUT supply current will reach the selected limit the test will be stopped and the EUT power will be turned OFF. The current limiter can be used for automated test during night etc. The reaction time of the limiter is several 100 ms. During a variac regulation, or while printing a report the current limiter is inactive.

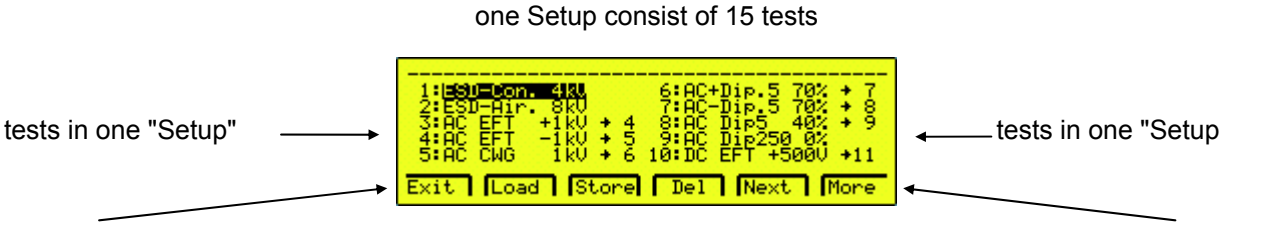
6.2 Editing test parameters

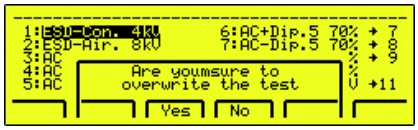
In addition to the installed test 1 to 15 of EMC PARTNER AG, you can also write your own test. In the following sections, the menu which you need to define your own test will be described.
The sequence of the menu presentation corresponds with the soft key button:
Test, Main, Ramp, Menu.
The installed tests can be edited or deleted.

6.2.1 Overview of programmable test with the TRANSIENT-2000



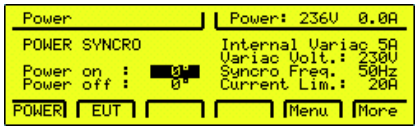
Press F1 SETUP the display changes as follow:





display when "Store" has been pressed.

display when "Del" has been pressed.

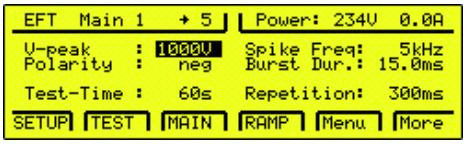


after pressing "Next" a small black cursor ask for link to 1 to 15

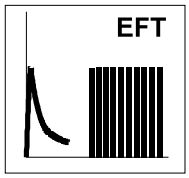
Test name should be written with the GENES software. The keyboard of the PC can be used. See chapter GENECS software.

On the next few pages the possible tests of the TRANSIENT-2000 are summarised. Some of the EMC test can only be carried out when the accessories are available.

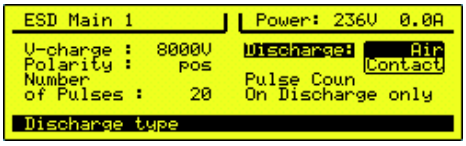
6.2.1.1 EFT



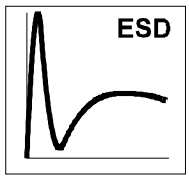
IEC 61000-4-4



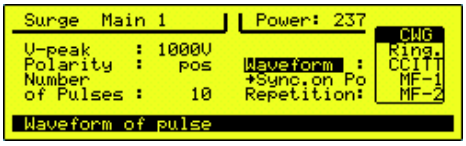
6.2.1.2 ESD



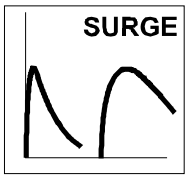
IEC 61000-4-2



6.2.1.3 SURGE

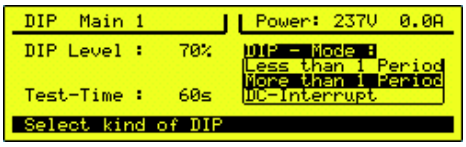


IEC 61000-4-5

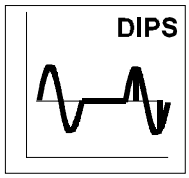


In addition to CWG the TRANSIENT-2000 can be equipped with 100 kHz Ring wave or the 10/700 telecom wave. In the standard TRANSIENT-2000 only the CWG circuit is included.

6.2.1.4 Interruption

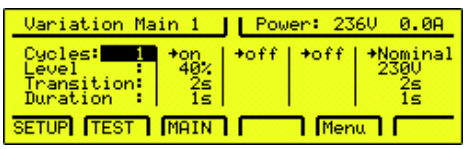


IEC 61000-4-11

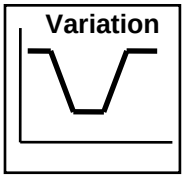


Three dips test modes exists. Parameter inputting is for each mode different.

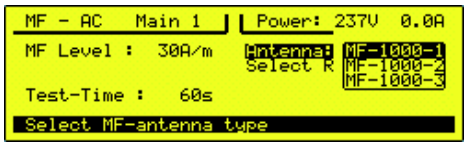
6.2.1.5 Variation



IEC 61000-4-11



6.2.1.6 Magnetic Field "a.c"

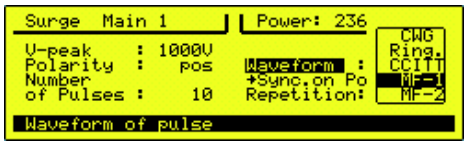


IEC 61000-4-8

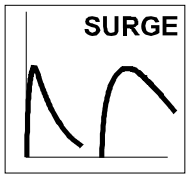
either 50 or 60 Hz
as supplied at EUT power input1
on the rear side of the TRA

The magnetic field can be selected in A/m. It can be differed between three antenna types.

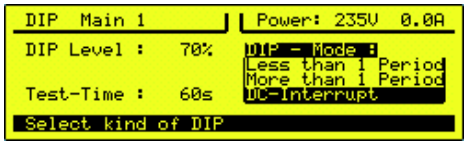
6.2.1.7 Magnetic Field "SURGE"



IEC 61000-4-9

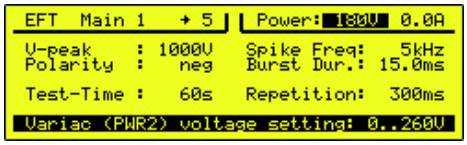


6.2.1.8 Interruption on d.c.

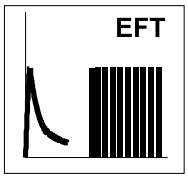


IEC 61000-4-29

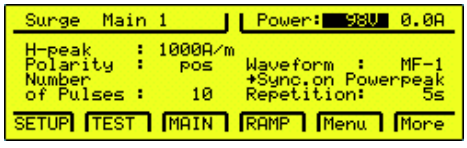
6.2.1.9 EFT and SURGE, EUT power from Variac



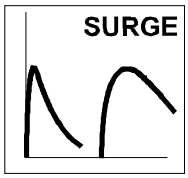
IEC 61000-4-4



When the cursor is place as showed the EUT power voltage can be selected and the EFT or SURGE superimposed at the chosen supply voltage.



IEC 61000-4-5

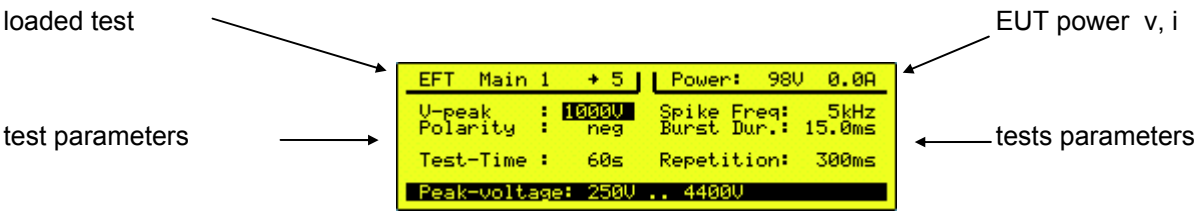


6.2.2 Nominal values setting

When in the display „TEST“ e. g. the EFT test has been chosen and the „Main“ button has been pressed, the different parameters of the „Electric Fast Transient test“ can be edited.

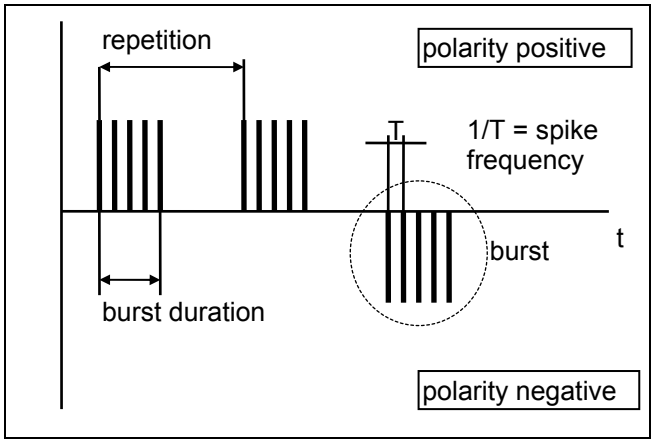
The parameter values can only be selected within the range given. If values are chosen that are above or below the given range the maximum or minimum value will be input automatically.

6.2.2.1 Editing EFT test parameters



When the EDIT button has been pressed the dialogue line indicates the possible range like v, f, time, etc.

The values can be varied as follows within the given ranges:
1. Set the cursor to the parameter to editing
2. Edit the values as required using the numerical keys
3. Confirm that the values entered are correct by pressing the ENTER - button.



6.2.2.1.1 definition of EFT parameters

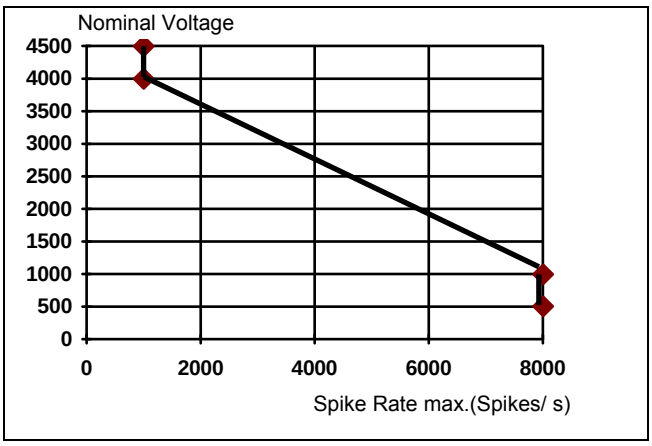
The *Repetition*, *Burst Duration* and *Spike Frequency* are combined in the number of spikes / seconds value (Spike Rate):

Spike rate [Spikes/s] = (Burst duration [ms] / repetition [ms]) x spike frequency [kHz] x 1000

This formula is only valid if the „*Burst Duration*“ is lower than the „*Repetition*“. If the „*Burst Duration*“ is equal the „*Repetition*“, the „Spike Rate“ will be equal to the „*Spike Frequency*“ (continuous burst).

Spikes per Burst = Burst duration [ms] x Spike frequency [kHz]

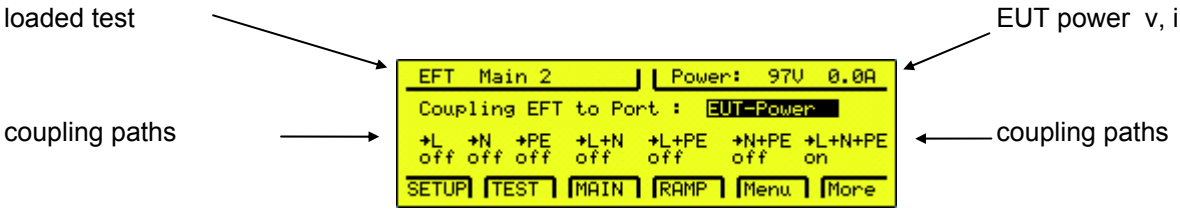
The following Spike Rate Limits are valid for the TRANSIENT-2000:



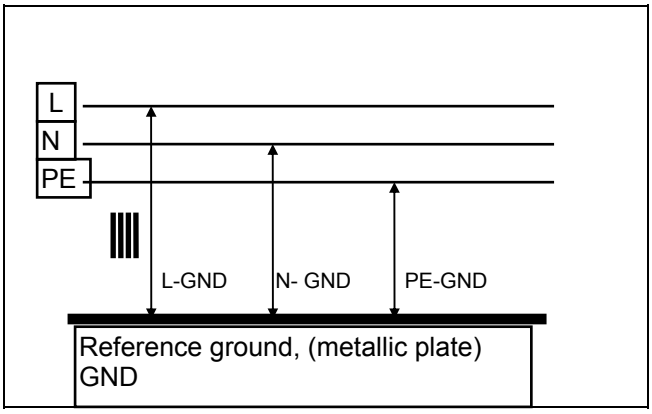
6.2.2.1.2 Spike Rate = number of spikes/ seconds

Selection of coupling path

When pressing "More" the display below will be showed



The coupling paths can be selected as follows:
1. Set the cursor to the coupling path to editing
2. select ON or OFF
3. Confirm that the values entered are correct by pressing the ENTER - button.

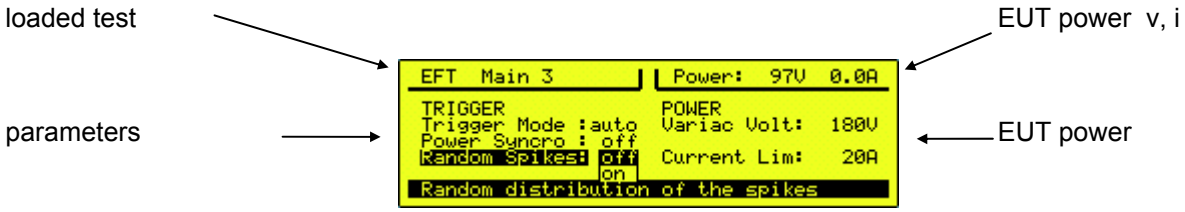


6.2.2.1.3 Definition coupling path

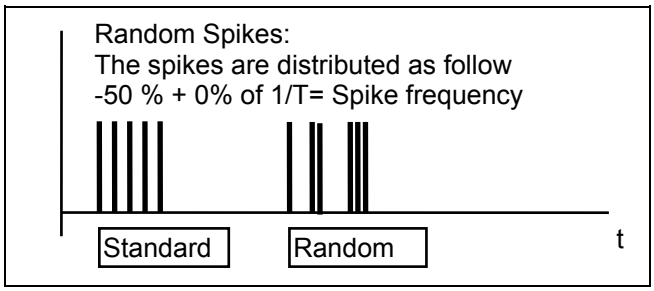
When several coupling paths are activated „ON“, they will be chosen step by step. The sequence corresponds with the sequence listed in the „Main“ menu. When Impulse -Out = On, the burst impulses stay at the high voltage. The capacitive coupling clamp can be connected on the high voltage EFT output (superimposing EFT on data line).

Random Spikes

When pressing "More" the display below will be showed



Randomly distributed spikes can drastically reduce the test time, especially for digital circuits. Weak points of EUT are found very rapidly.



Standard = Random Mode OFF

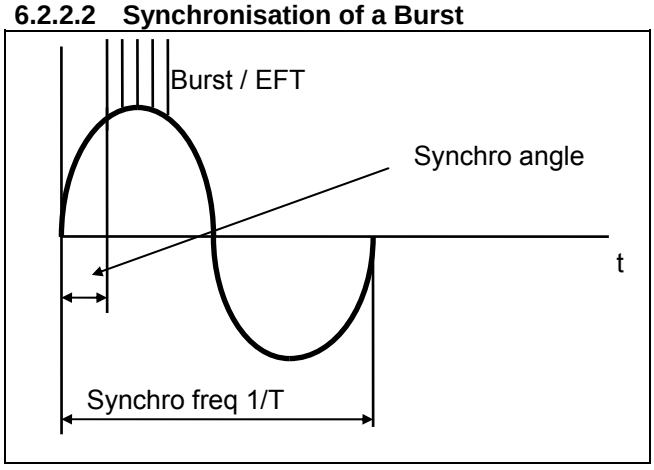
Random = Random Mode ON

6.2.2.1.4 Definition Random Spikes

Synchronisation of a Burst

When the synchronisation „Burst Synchro“ is „ON“, the synchronisation angle and the synchronisation frequency will be displayed.

6.2.2.2 Synchronisation of a Burst

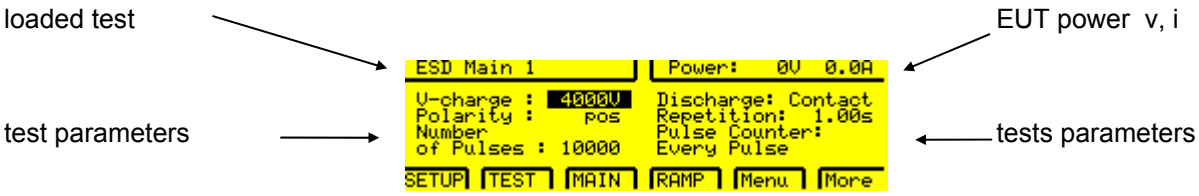


By pressing „Manual“ trigger one burst will be released.

6.2.2.1.5Definition synchronisation

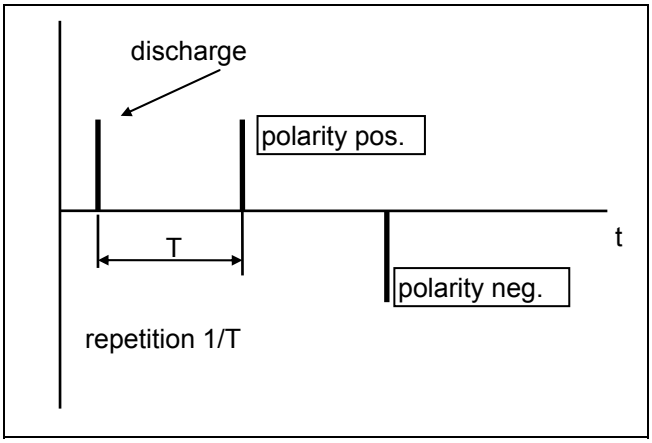
6.2.2.3 Editing ESD test set-up

Editing ESD test set-up



6.2.2.4 When the EDIT button has been pressed the dialogue line indicates the possible range like v, time, etc.

The values can be varied as follows within the given ranges:
1. Set the cursor to the parameter to editing
2. Edit the values as required using the numerical keys
3. Confirm that the values entered are correct by pressing the ENTER - button.



6.2.2.2.1 Definition of ESD parameters

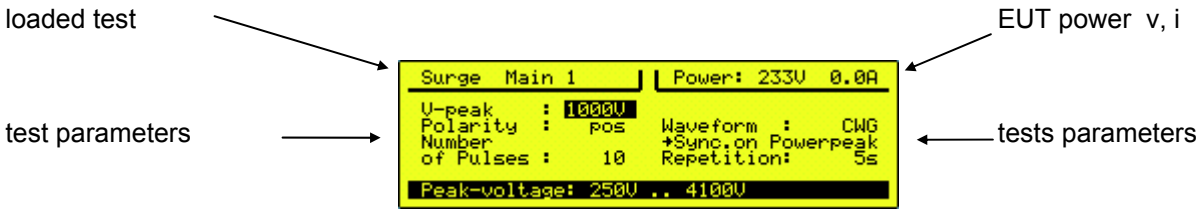
Contact Discharge = Discharge via the „ESD Relay“ tip. The relay tip must be on top of the ESD discharge network. The relay tip must contact the EUT.

Air Discharge = Discharge via the adapter „finger“. The discharge occurs as a spark between the finger and the EUT.

Pulse Counter = On discharge only
Only the impulses whereas the voltage of the discharge capacitor (150 pF) tropes lower than 10 % of the charging voltage are counted.

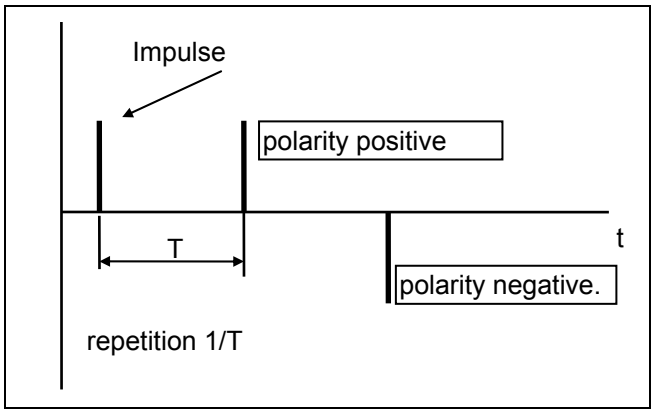
Which discharge method must be used? See Chapter 5.4.2.

6.2.2.5 Editing of SURGE parameters



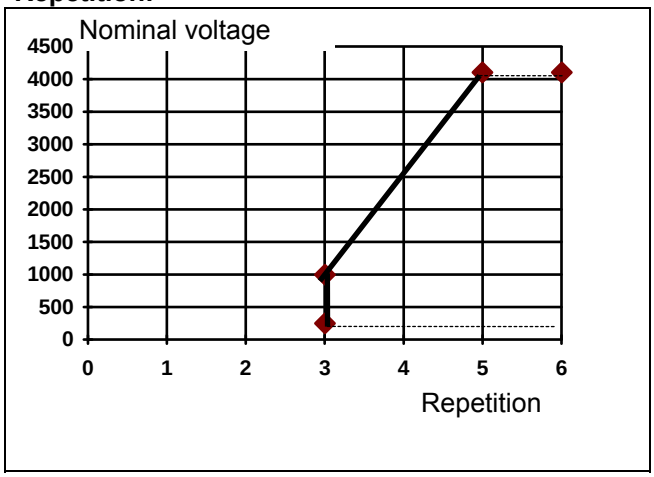
When the EDIT button has been pressed the dialogue line indicates the possible range like v, time, etc.

The values can be varied as follows within the given ranges:
1. Set the cursor to the parameter to editing
2. Edit the values as required using the numerical keys
3. Confirm that the values entered are correct by pressing the ENTER - button.



6.2.2.3.1 Definition of SURGE parameters

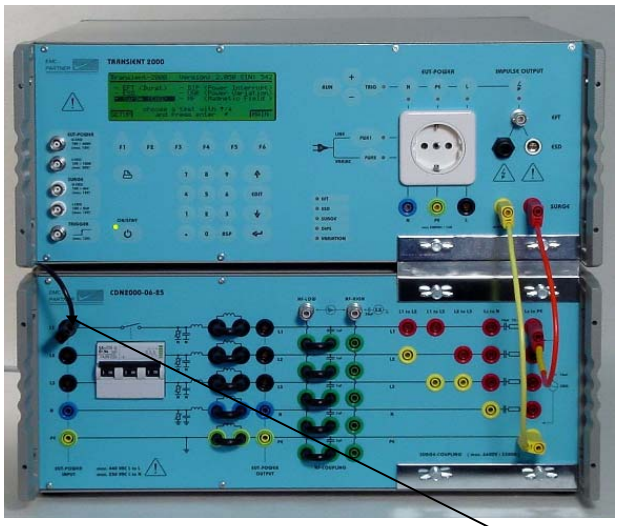
Repetition:



Repetition is defined as the time between two successive impulses. For each discharge the capacitor in the TRANSIENT-2000 must be charged. The stored energy is a function of the charging voltage, therefore the repetition rate is a function of the voltage.

6.2.2.3.2 Minimum time (Repetition) between two successive impulses as a function of the voltage.

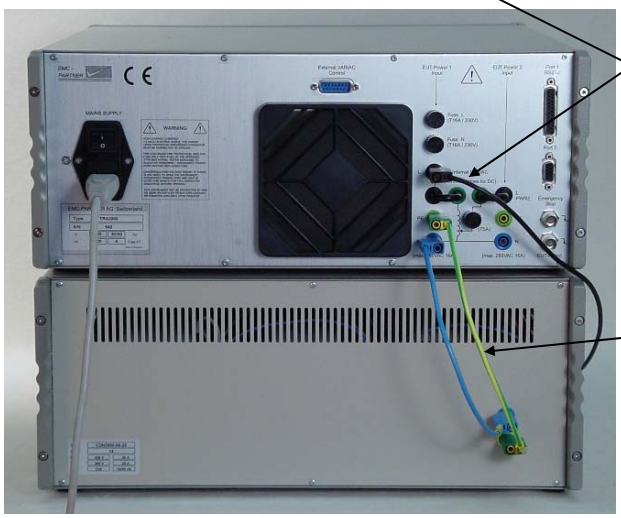
6.2.2.6 TRA2000 with CDN2000 SURGE Synchronisation



Different possibilities exist to Synchronize the TRA-generator with a three phase coupling filter.

Example: The SURGE impulse must be synchronized with the phase L1 to PE.

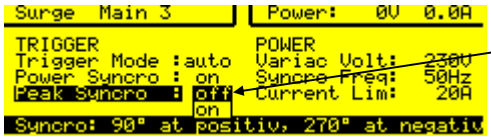
Set the black banana plugged cable for Synchronization and the yellow and red cable for the surge pulse as showed in the pictures beside.



Cable for the synchronisation. Please use the 1 m black cable delivered with the CDN2000 to synchronize the TRA2000 with the desired phase of the CDN2000.

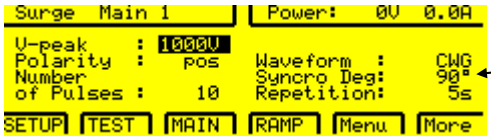
In the pictures the synchronisation is made for the Phase L1.

Additionally the neutral and the protective earth must be connected on the rear side of between the TRA2000 and the CDN2000



First the Peak Synchro must be turned „OFF“

When the Peak Synchro is turned „OFF“ in the Display SURGE Main 1 the synchronisation angle can be selected.



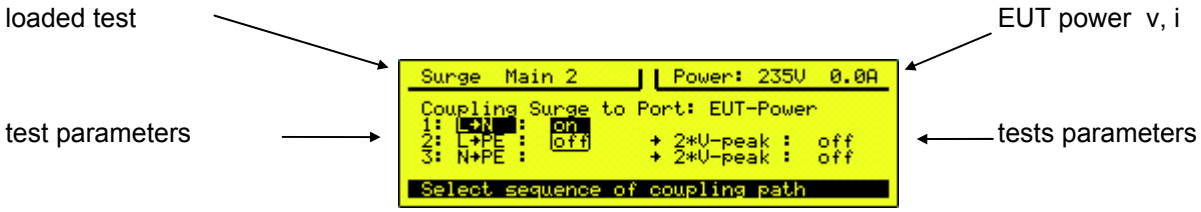
Depending on the SURGE coupling (cable yellow and red) the synchronisation angle must be set as defined below:

Coupling: **Phases to PE or N** and Synchronisation (black cable on L1)
SURGE L1: 0° equal 0°
SURGE L2: 0° equal 120°
SURGE L3: 0° equal 240°

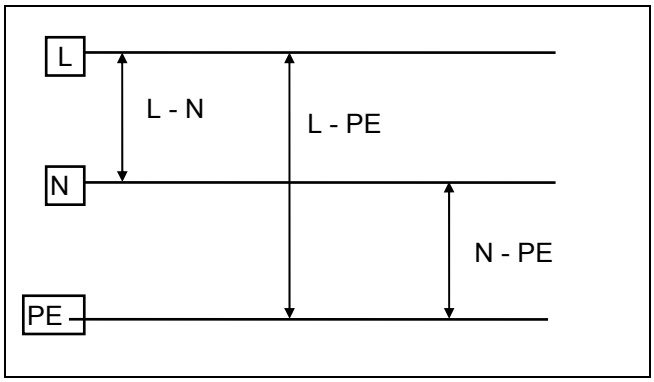
Coupling: **Phases to Phases** and Synchronisation (black cable on L1)
SURGE L1 to L2: 0° equal 330°
SURGE L2 to L3: 0° equal 90°
SURGE L1 to L3: 0° equal 30°

Note: The 0° is defined as the angle at which the Surge is superimposed on the power supply depending of the manually selected red yellow connections.

Selection of coupling path

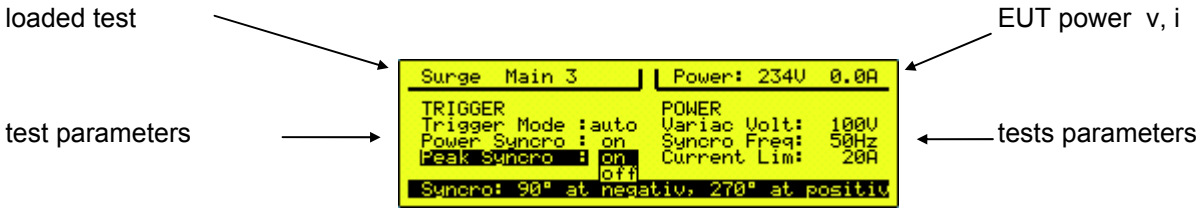


When the 2 x V-peak are selected "on" the voltage of the L→N voltage will be doubled as specified in the standard for common and differential tests.

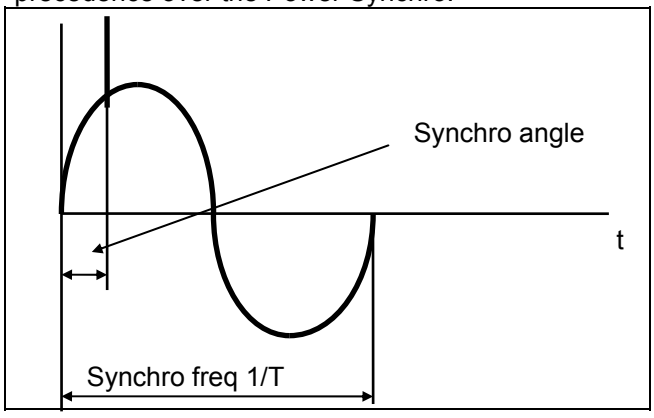


6.2.2.3.3 Coupling path definition SURGE

When several coupling paths are activated „ON“, they will be chosen step by step. The sequence corresponds with the sequence listed in the „Main“ menu. When Impulse -Out = On, the impulses stay at the high voltage (banana plugs). The coupling kit or the three phase filter can be connected on the high voltage SURGE output.
At peak synchro ON: automatically the SURGE are superimposed at 90° with positive SURGE and at 270 ° with negative SURGE.



At Power Synchro =ON, the surges are released sychononous to the main frequency. The Peak Synchro must be switched „Off“ to activate „Power Synchro“. When the Peak Synchro is switched „ON“ it has precedence over the Power Synchro.

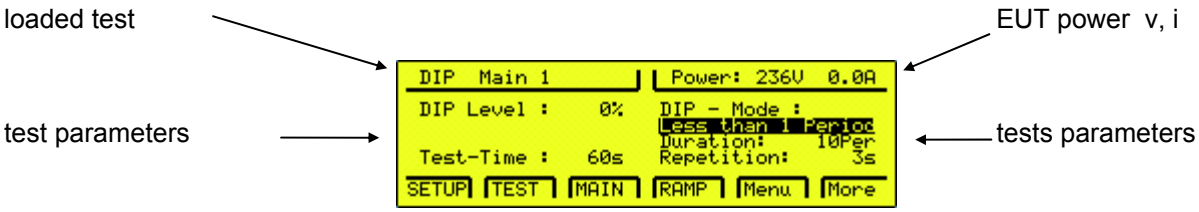


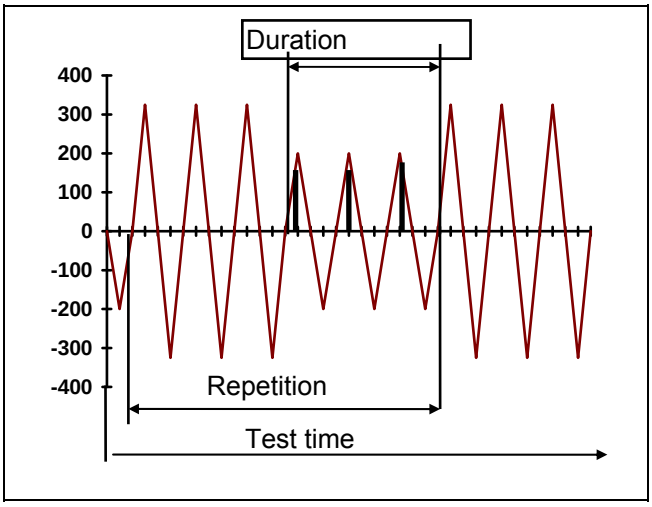
At SURGE Trigger = Manual, the surge is not automatically released after the repetition time, but operation of the Man-Trigger button.

6.2.2.3.3 Definition synchronisation

6.2.2.7 Editing DIPS less than 1 period

Short Dips are interruptions shorter than one period of the EUT power supply. The duration of a dip is entered as an angle in degrees (°). A maximum of two different dips can be defined per period. Periods with equal dips can be multiplied.

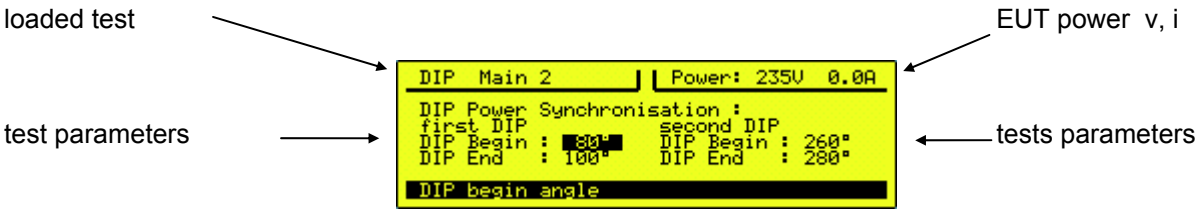




Nbr. of periods is equal the number of disturbed periods. Repetition defines how often the disturbance occurs.

6.2.2.4.1 Definition number of periods, repetition, test time

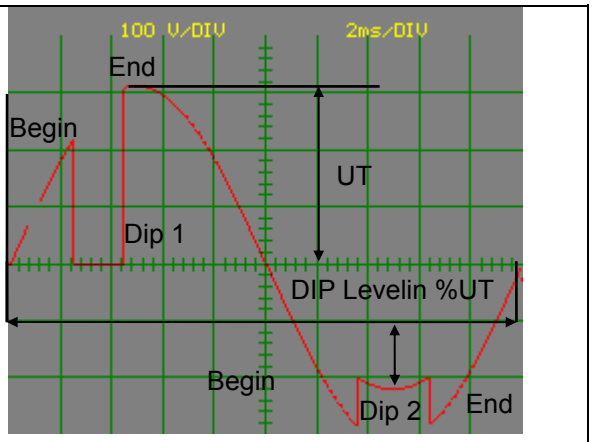
When the soft key F6 has been pressed:



When the EDIT button has been pressed the dialogue line indicates the possible range like v, time, etc.

The values can be varied as follows within the given ranges:

1. Set the cursor to the parameter to editing
2. Edit the values as required using the numerical keys
3. Confirm that the values entered are correct by pressing the ENTER - button.



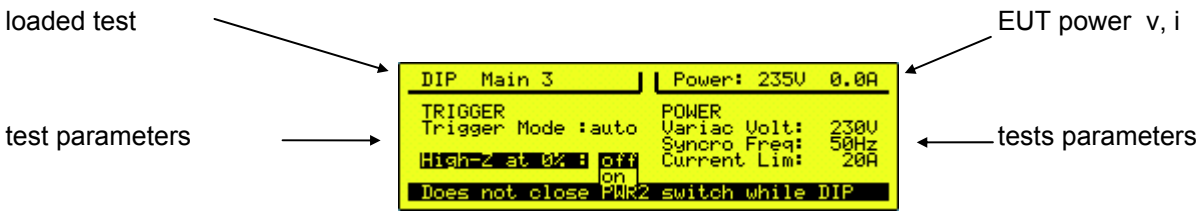
Conditions which must be fulfilled:

DIP End >= DIP Begin
DIP2 Begin > = DIP 1 Begin

When only one DIP is required, then the DIP 2 can be placed on DIP 1, or DIP2 Begin is equal DIP2 End.

6.2.2.4.2 Definition synchronisation

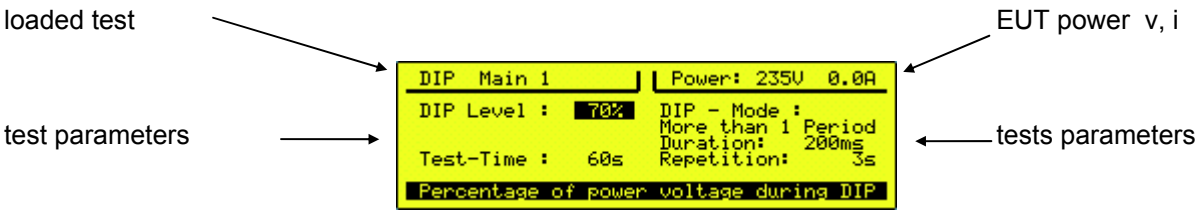
When the soft key F6 has been pressed:

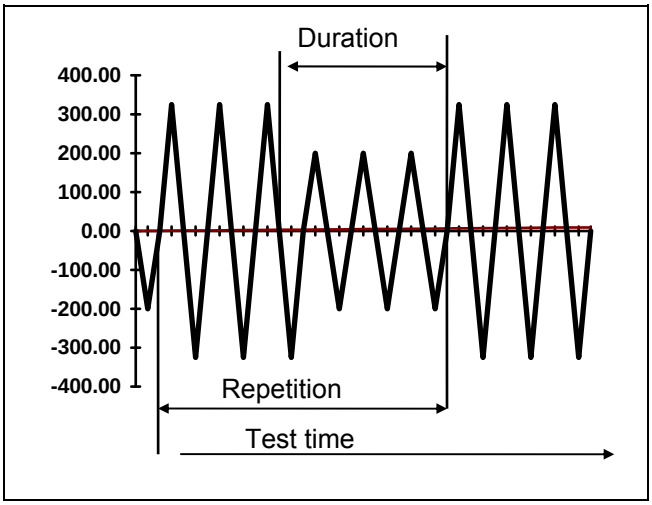


At an interruption to 0%, two power supply impedance can be differentiated: supply impedance high Z and low Z. At high-Z and 0% = OFF, the EUT will be discharged at DIP begin via a low impedance as in reality happen. Further explanation about high Z, see Chapter 3.4

6.2.2.8 Editing DIPS longer than one period

Long DIPS are interruptions with a duration longer than one period. The duration is specified in ms. The turn ON and OFF angles can be selected.

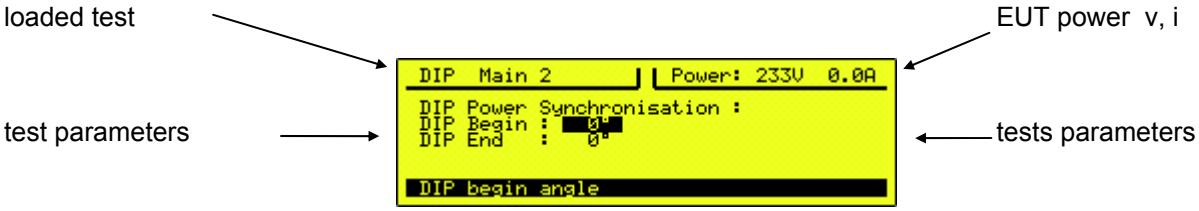


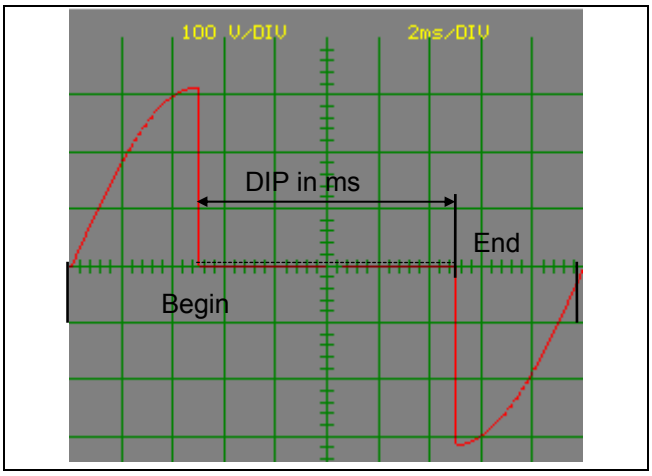


Duration is the length of time of the lowered voltage. Repetition defines how often the disturbance occurs.

6.2.2.5.1 Definition duration, repetition, test time

When the soft key F6 has been pressed:





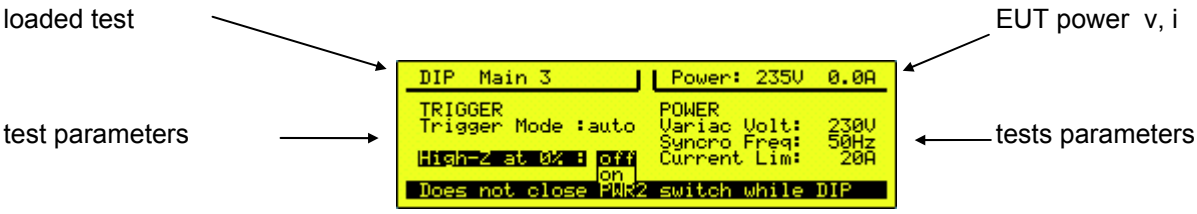
6.2.2.5.2 DIP Begin, DIP End

The TRANSIENT-2000 processor calculates the number of disturbed periods as in function of the chosen duration. The condition for a correct test is the correctly selected power frequency, in the range of ($16^2/_3$ to

400 Hz). If the angle of DIP Begin and DIP End are different, the DIP duration will be adapted e.g. for End > Begin longer or for Begin > End shorter.

Interruption to 0% with and without EUT discharge

6.2.2.9 When the soft key F6 has been pressed:



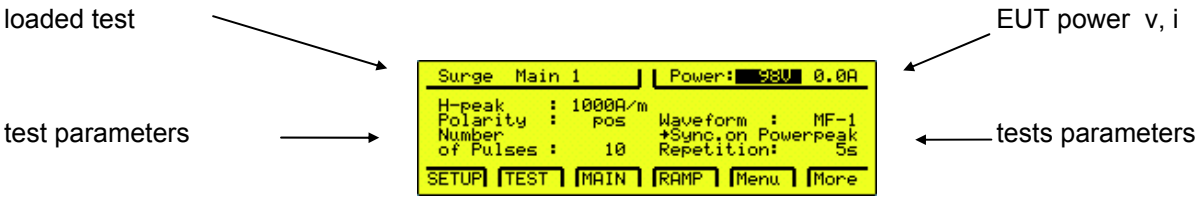
At an interruption to 0 %, two modes can be differentiated:

A) High Z at 0% = ON
In this mode, the voltage across the EUT decreases with the time constant of the EUT during an interruption.

B) High Z at 0% = OFF
Some µs after the DIP begin, the EUT input will be discharged via the EUT Power 2 circuit.

For more information see Chapter 3.4

6.2.2.10 Editing the EUT power voltage "internal variac"

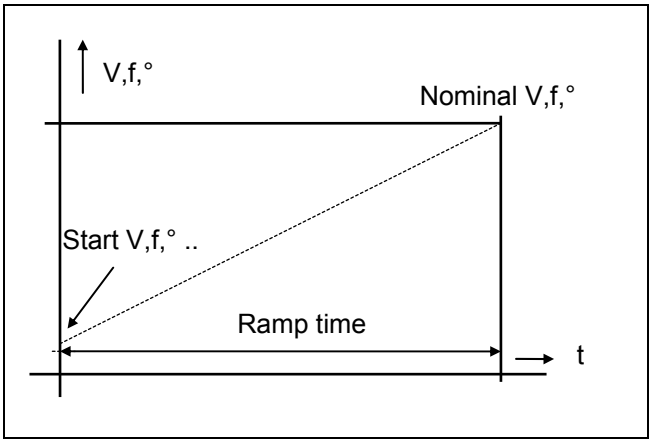


With „PWR2 bottom“ the EUT power supply is switched between the variac or the public power supply. No voltage interruption occur at switching.

If a new value is chosen and the new value is acknowledged with the ENTER button the variac will be immediately set to the chosen voltage.

6.2.3 Editing „Ramp“

A „Ramp“ is defined as a linear change of either voltage, angle, frequency, etc. as a function of time.



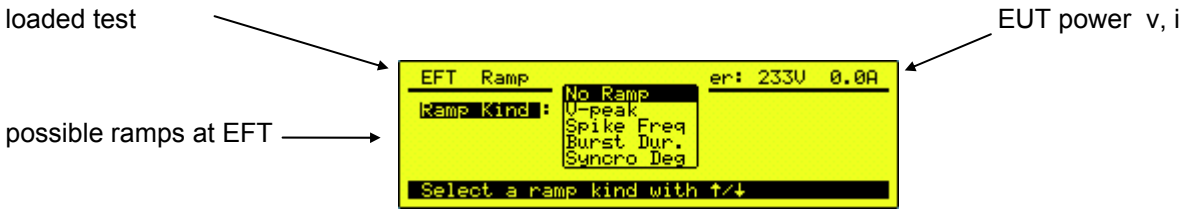
6.2.3.1 Definition of a ramp

Remarks:

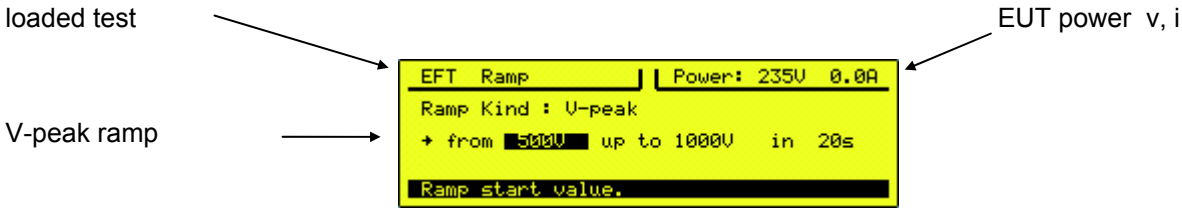
If several coupling paths are selected at SURGE or EFT, the ramp will be performed for each coupling path.
e.g.
L-GND; N-GND; PE-GND

The steps of a „Ramp“ depend on the ramp time and the difference between the nominal and start- values.

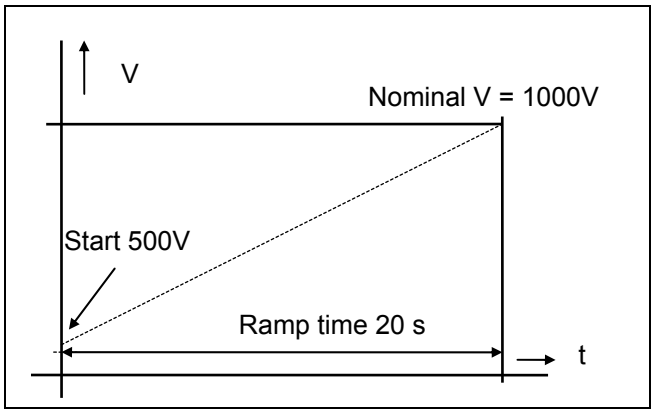
6.2.3.1 EFT Ramps



When V-peak is selected:



Ramp: Spike amplitude (voltage)



6.2.3.1 Example ramp definition

In the example in picture 6.2.3.1, the voltage will be increased from 500V to 1000 V in 20 seconds. The steps or resolution of the ramp depend on the ramp time and on the voltage difference between V Nominal and V-peak start.

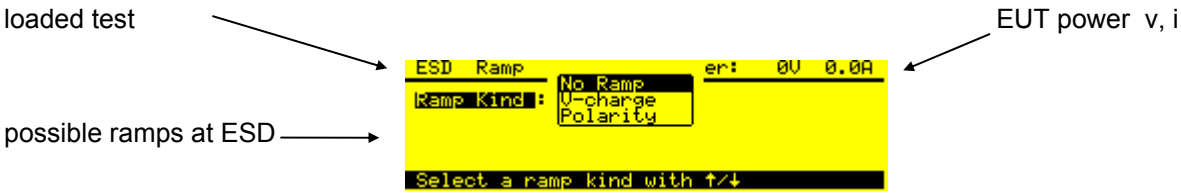
Ramp: Spike frequency
The steps or resolution of the ramp depend on the ramp time and on the frequency difference between f nominal and start frequency. The chosen number of spikes (=10) per Burst is constant. As a consequence the burst duration decreases with increasing spike frequency. The energy content of one burst is constant. The constant energy per burst simplifies the failure analysis. When a failure occurs at higher frequency the failure relates to the frequency and not to the energy The burst duration in the is no longer applicable.

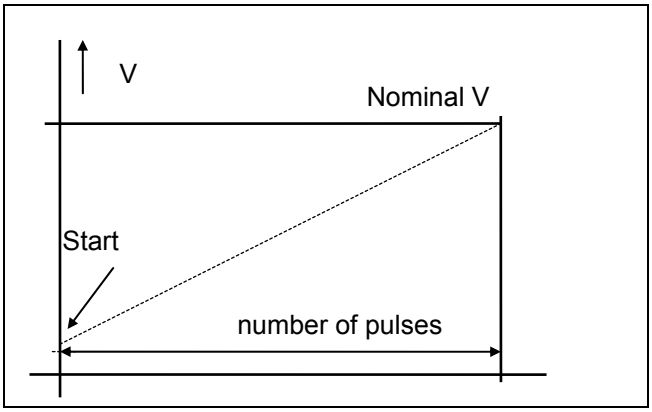
Ramp: Burst duration ramp
When analogue circuit are tested, the energy per burst is very important. With the burst duration ramp, the number of spikes will be continuously increased and therefore also the energy. If RC networks e.g. filters, are integrated into a circuit, the disturbance energy can be defined with this mode.

Ramp: Synchronisation angle

With this setting the synchronisation angle of synchro start is continuously adjusted from start angle to stop angle.

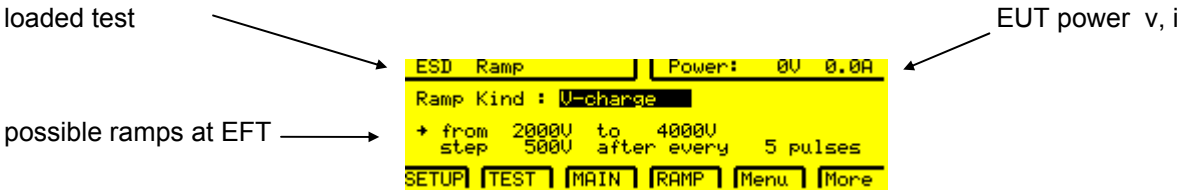
6.2.3.2 ESD Ramp

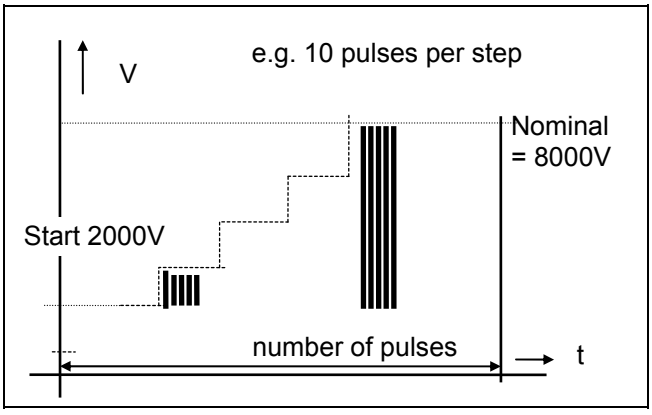




6.2.3.2.1 Definition ramp

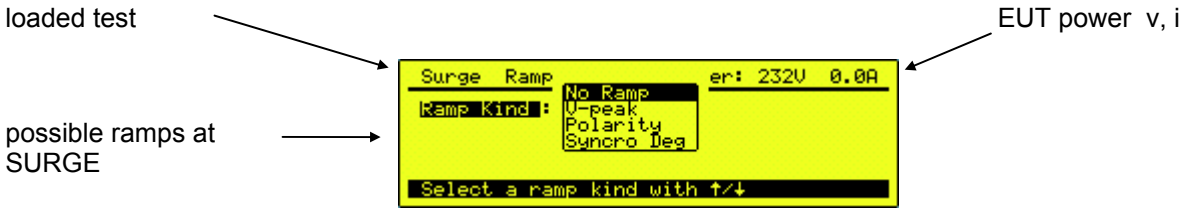
Example Voltage
The voltage will be increased from 2000 V to 8000 V with a 500 V step voltage after every 10 discharges.

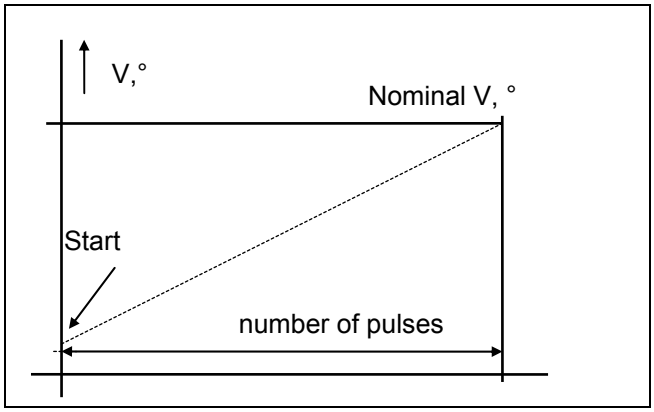




6.2.3.2.2 Definition ramp ESD

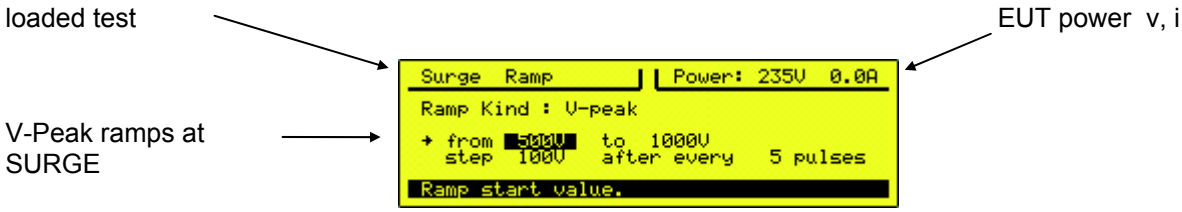
6.2.3.3 SURGE Ramp

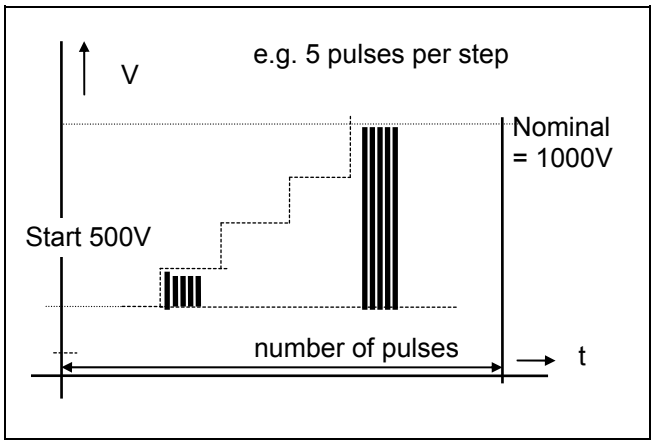




6.2.3.3.1 Definition SURGE ramp

Example Voltage

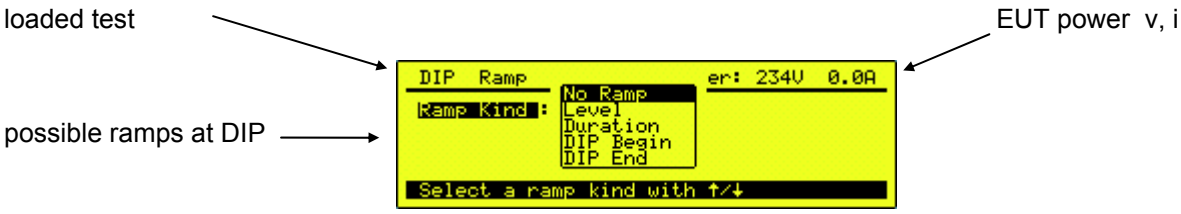




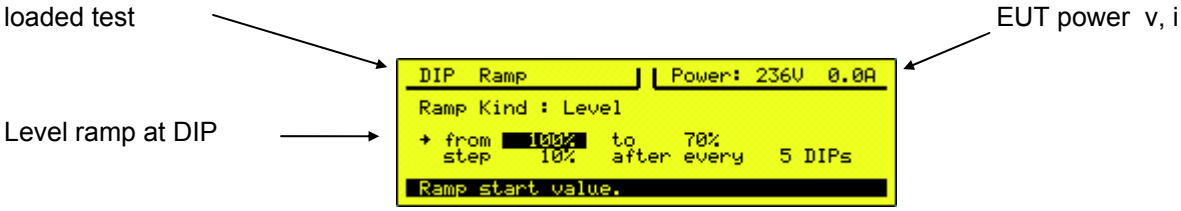
The nominal voltage can also be selected in „Main“ menu.

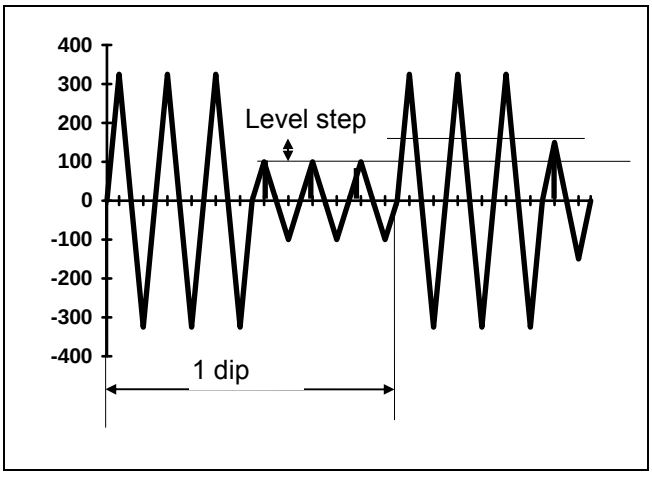
6.2.3.3.2 Definition SURGE ramp

6.2.3.4 DIPS



Example Level Ramp: Amplitude as % of EUT voltage

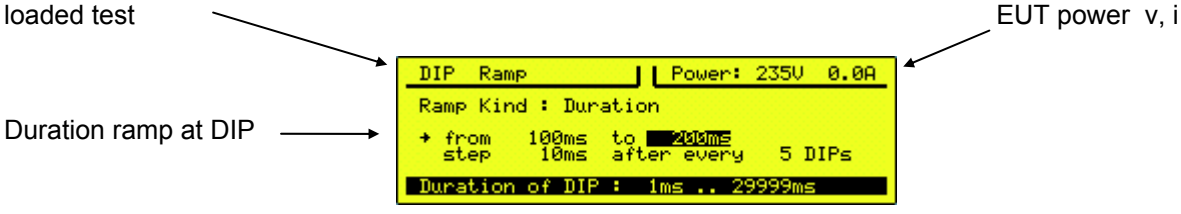


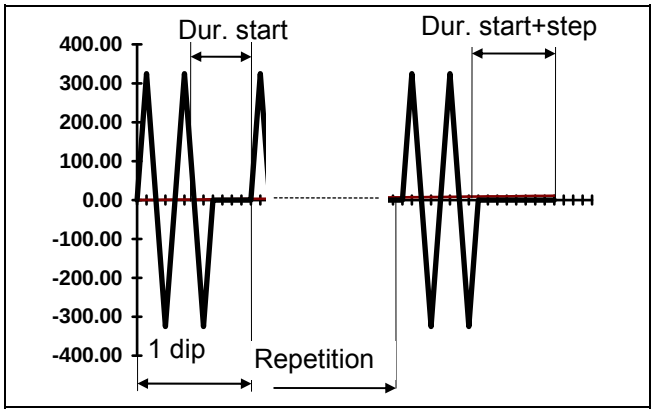


6.2.3.4.1 Definition DIP level ramp

The start of the ramp begins at 100% and changes with „Level step“ (10%) to the DIP voltage. If the test time has been selected to be long enough, the voltage UT will be reached.

Ramp: Length of interruption in ms:



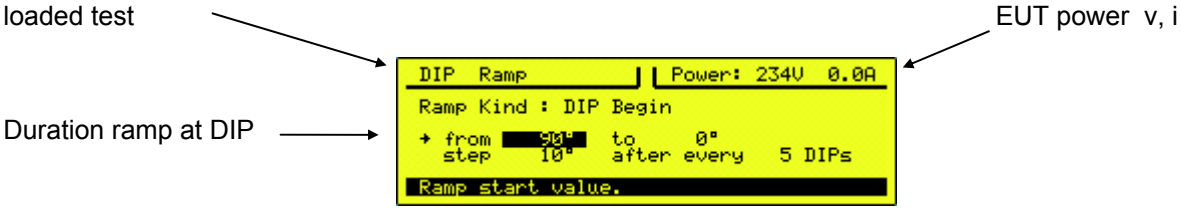


Smallest step is 1/f. (f=Mains Power frequency EUT)
The Begin and End angles remain constant as selected in „Main menu“.

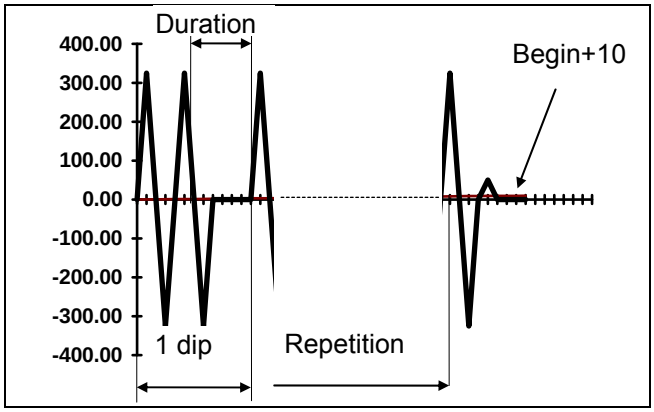
6.2.3.5.2 Definition duration ramp

The chosen DIP Begin and DIP End angles remain constant during a duration ramp. As a consequence, the duration does not change continuously, but over one period.

Ramp: Ramp angle at DIP Begin:



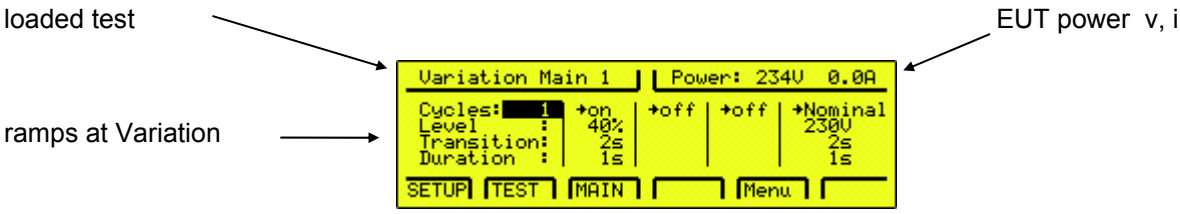
At DIP Begin, the angle changes within the range specified.

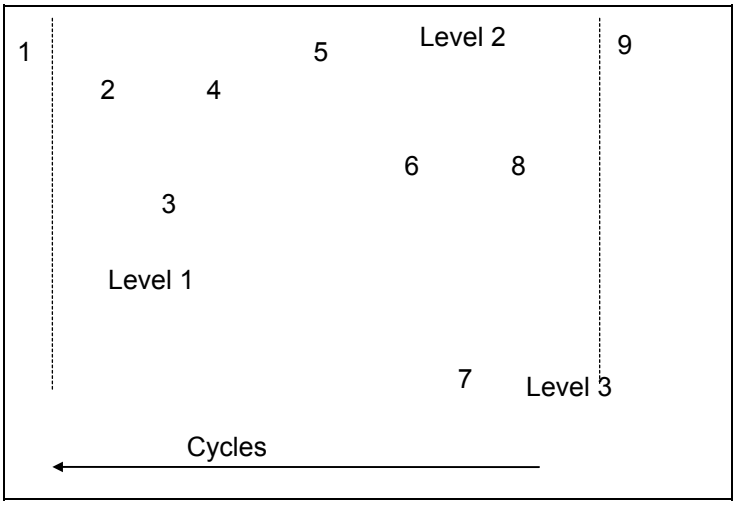


6.2.3.5.3 Definition ramp

Ramp: Ramp angle at DIP End:
At End Ramp, the angle will be changed in steps of 5° from 90° to 0° when the EUT power is turned on. With this mode the inrush current after a interruption can be investigated.

6.2.3.5 Variation Ramp





6.2.2.6.1 Definition variation

Legend:

1	Nominal, approx. 5 seconds	5	Level 2 duration
2	Transition to Level 1	6	Transition to Level 3
3	Level 1 duration	7	Level 3 duration
4	Transition to Level 2	8	Transition to nominal
		9	Duration nominal

At Nbr of Cycles >1, the voltage sequence will be repeated.

6.2.3.6 EUT Error control

EUT error information can come from three different sources:

1. From EUT failed input on the rear side of the TRANSIENT-2000,
2. From the SURGE limiter and
3. From the current limiter

The error can initiate different actions:

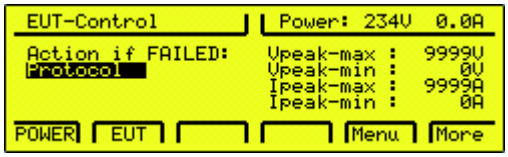
	Acoustic signal	Remark in the report	Message on display	Abort the test
Protocol	**x**	**x**		
Next Setup	**x**	**x**	**x**	
Stop Run	**x**	**x**	**x**	**x**

SURGE peak limits

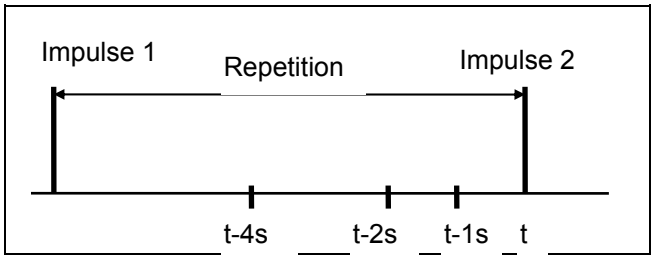
loaded test

ramps at Variation

EUT power v, i



Limits for SURGE peak measurements:
If selected limits are exceeded a message appears on the display. An error will be registered within a limited time. (See diagram on next page).



6.2.4.3 Time window for error message SURGE

At t-4 seconds, the charging of the SURGE capacitor for the next impulse number 2 starts.
t-2 seconds is the last possible opportunity to give an error message from impulse number 1 via the EUT failed input on the rear side of the TRANSIENT-2000.
At t-1second, the data of impulse 1 will be printed out and the error message will possibly be reset.

6.3 EMC test operation „RUN Mode“

Before you start an EMC test, you should be familiar with the following:

„Run Mode“ is defined as an EMC test operation such us EFT, ESD etc. The „Run Mode“ is indicated by the blinking LED on the operation panel of the front. Pressing the RUN-button sets the TRANSIENT-2000 into the RUN mode. During RUN Mode, the corresponding test-LED on the operation part blinks and the corresponding coupling path is illuminated.
Renewed pressing of the RUN-button stops the generator (Reset to the standby mode).

In **„Standby Mode**“ the power to the TRANSIENT is switched on. The control is activated. No high voltage source is switched on.

Depending on local safety standards, an emergency stop must be installed. All operators and laboratory personnel must be able to reach the emergency stop. On the rear side of the TRANSIENT-2000 there is an **EMERGENCY STOP** input. See Chapter 5 „Preparation for Operation“.

Trigger.
After the RUN button has been pressed, the tester is started, but not the EMC test. As soon the generator is ready (e. g., the impulse capacitor is charged), the LED on the trigger button is illuminated. As soon as the LED is illuminated a single EMC test can be initiated (Burst, ESD, DIP, Variation). The next trigger can take place when the LED is illuminated again.
During ESD, the trigger button has the same function as the button on the ESD discharge network.

6.3.1.1 Changing values during operation

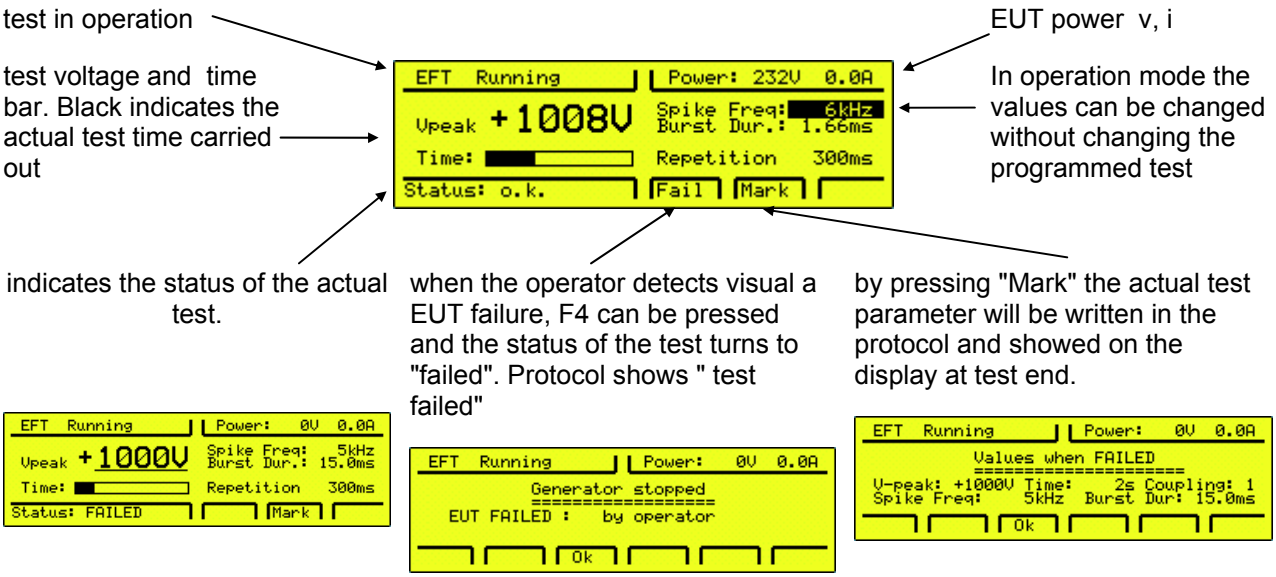
In RUN-mode, most of the parameters can be continuously varied using the „+“ and „- “ buttons. This is very helpful for exactly determining of the immunity level of the EUT. The manual change of the nominal voltage will be noted in the report with a warning.

If ramp has been chosen, the different values will change as follows:

Voltage ramp	V-peak	V
Frequency ramp	Freq.	kHz
Burst duration	Burst	Dur
Synchronisation	Synchro	°

For very fast investigation the coupling paths can also be changed during operation by pressing the N, PE, L buttons.

6.3.1.2 EFT operation



The values can be varied as follows within the given ranges:

1. Set the cursor to the parameter to changing
2. With the + or - buttons the values can be changed during operation
3. The protocol will extended with a remark

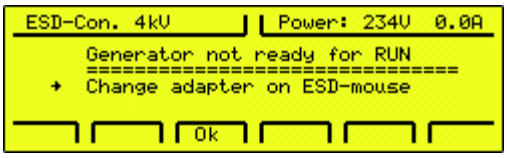
```
--------------------------------------------------------------------------------
TRANSIENT-2000-  9   Version: 1.10     Test :   AC EFT  +1kV
                                       Date :   12.12.1999  Time :   20:51:15
Test Kind:   EFT (Burst)
EUT :                                  Operator :

--------------------------------------------------------------------------------
  PowerON Syncro:    0Deg   PowerOFF Syncro:    0Deg   Current Limiter: 20A
--------------------------------------------------------------------------------

  EFT V-peak       :   1000V          Polarity       : pos       Trigger : auto
  Spike Frequency  :      5kHz        Random Spikes  : off
  Burst Duration   :   15.0ms         Burst Syncro   : off
  Repetition       :    300ms

--------------------------------------------------------------------------------


       Test-Time per path:                 60s
       ==========================================================================


       1. Coupling EFT to: L+N+PE              Result:   Test aborted

          Test End ......................   17s  Warning !   Manual up/down      <----------


       Test Result :  Test aborted
```

6.3.1.3 ESD operation

In the RUN-mode the nominal voltage (V-peak) can be continuously varied using the „+“ and „-“ buttons. This is very helpful for exactly determining the immunity level of the EUT. The manual change of the nominal voltage will be noted in the report with a warning see example EFT.
The ESD discharge network must be connected to the outputs HV and Control.

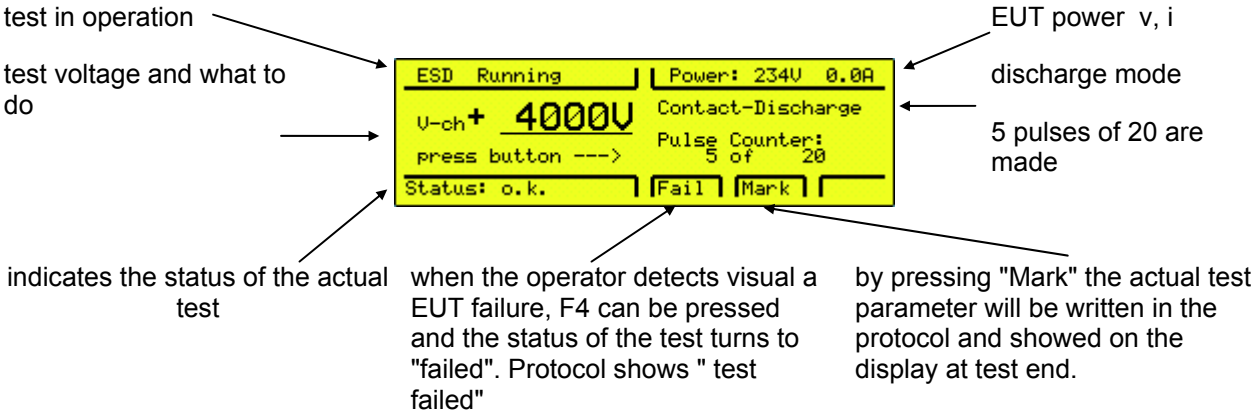
6.3.1.4 Contact Discharge

The „ESD Relay“ adapter must be on top of the discharge network. When the air discharge adapter is on top of the discharge network the following message will be displayed:



Change the adapter.

Press "RUN" and contact EUT with the relay tip.



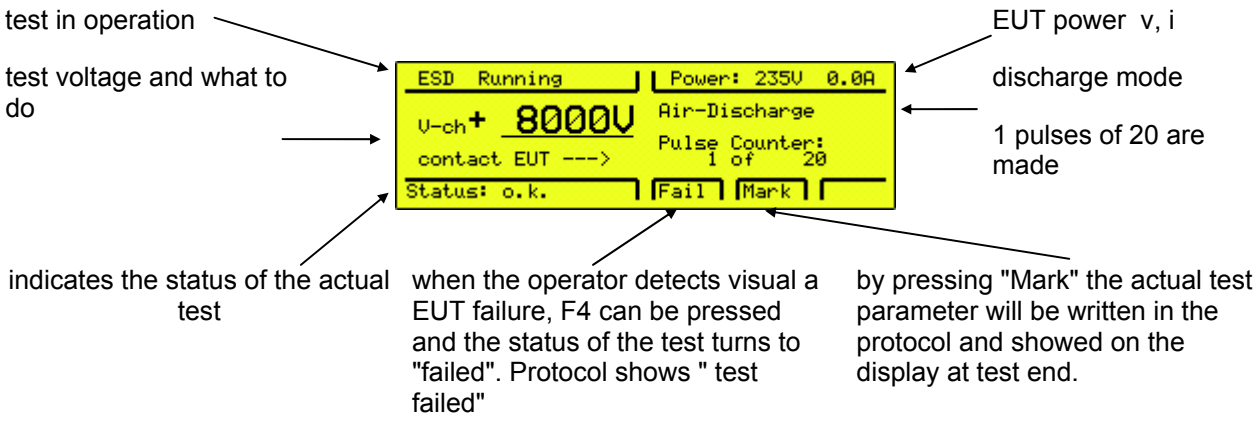
The values can be varied as follows within the given ranges:
1. Set the cursor to the parameter to changing
2. Change with the + or - buttons the values during operation

```
ESD V-charge     :     4000V        Polarity    :  pos

Contact Discharge                  Repetition  :    1/s        Trigger : man

Alternating Polarity          :    starting positive

Change Ramp value after       :     10 pulse(s)

-------------------------------------------------------------------------------
          1       + 4000V
          2       + 4000V
          3       + 4000V
          4       + 4000V
          5       + 4145V
          6       + 4230V
```

To stop the running test, press the red RUN button.

6.3.1.5 Air Discharge

The „ESD Finger“ Adapter must be on top of the ESD discharge network. After pressing the RUN-button:



Air discharge Sequence

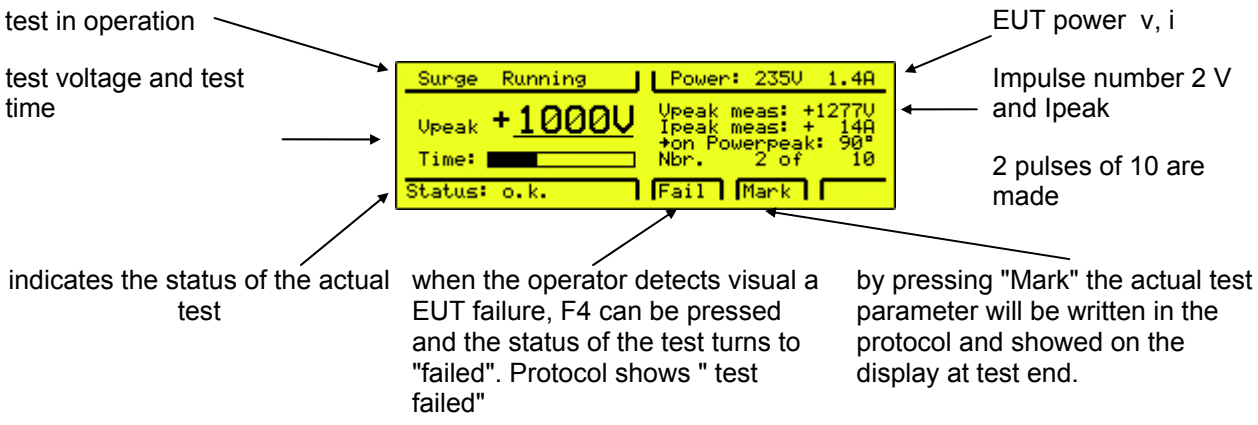
1.Press the button on the ESD discharge network as soon as the request „press button“ appears on the display. The capacitor in the ESD discharge network will be charged to the preselected voltage.

2. As soon as a „Beep“ sounds, the finger can be moved against the EUT. The display shows „contact EUT“. For the movement against the EUT a maximum of 5 Seconds are reserved, corresponding to the holding time in the standard.

3. When the discharge onto the EUT has occurred, you need not wait 5 seconds. By pressing the button a second time, either two or three „Beeps“ will be heard. Two beeps means no full discharge has occurred, and the discharge will not be reported. Three beeps means the discharge occurred, and the discharge will be counted and reported..

For the next discharge, steps 1 to 3 must be repeated.

6.3.1.6 SURGE

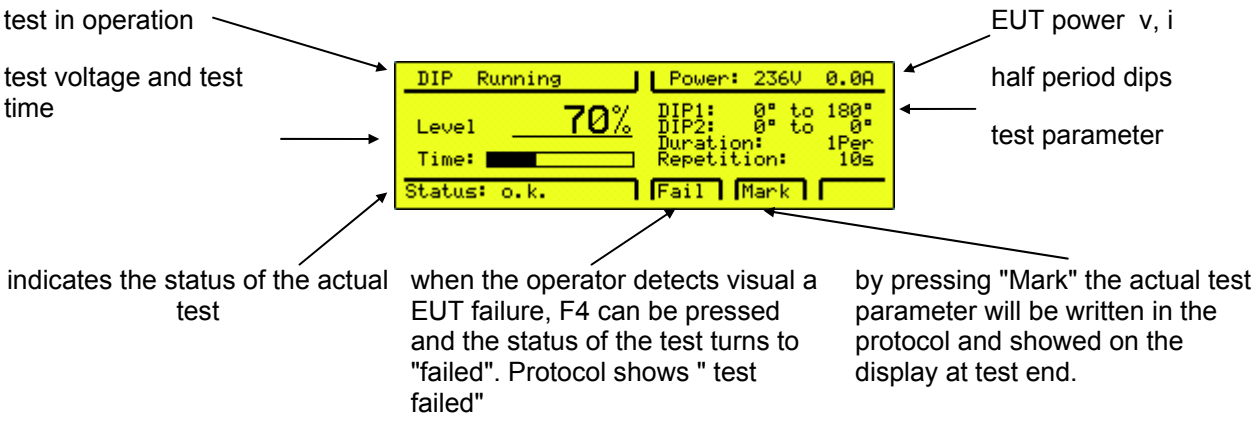


Example protocol:

```
Nbr.  Nominal     Syn
=====================================================================


1. Coupling SURGE to: L-N

  1   +1000V      90      +1265V    +   14A
  2   +1000V      90      +1261V    +   14A
  3   +1000V      90      +1262V    +   14A
  4   +1000V      90      +1263V    +   14A
  5   +1000V      90      +1264V    +   14A
  6   -1000V     270      -1263V    -   13A
  7   -1000V     270      -1262V    -   13A
  8   -1000V     270      -1261V    -   13A
  9   -1000V     270      -1261V    -   13A     Test aborted

2. Coupling SURGE to: L-PE                      Test not run

  0   +1000V     270
```

Synchro on Power peak automatically the SURGE polarity will be changed and the superimposed angle will be set to 270 °.

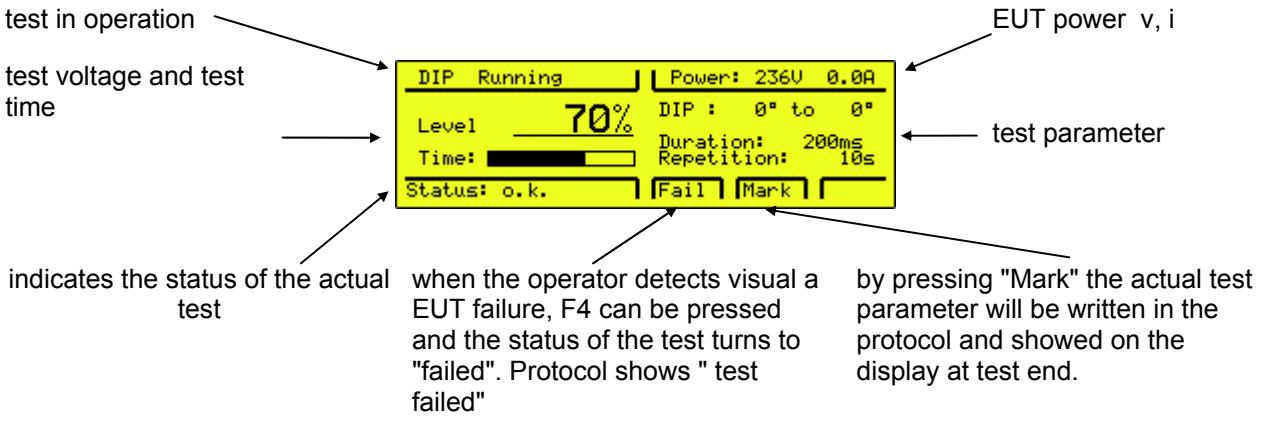
6.3.1.7 DIP less than 1 period



For the interruption and Variation test the EUT Power 1 input on the rear side of the TRANSIENT-2000 must be connected to the public power mains. Connecting the TRANSIENT to the public power mains is explained in Chapter 5.

To stop the running test, press the red RUN button.

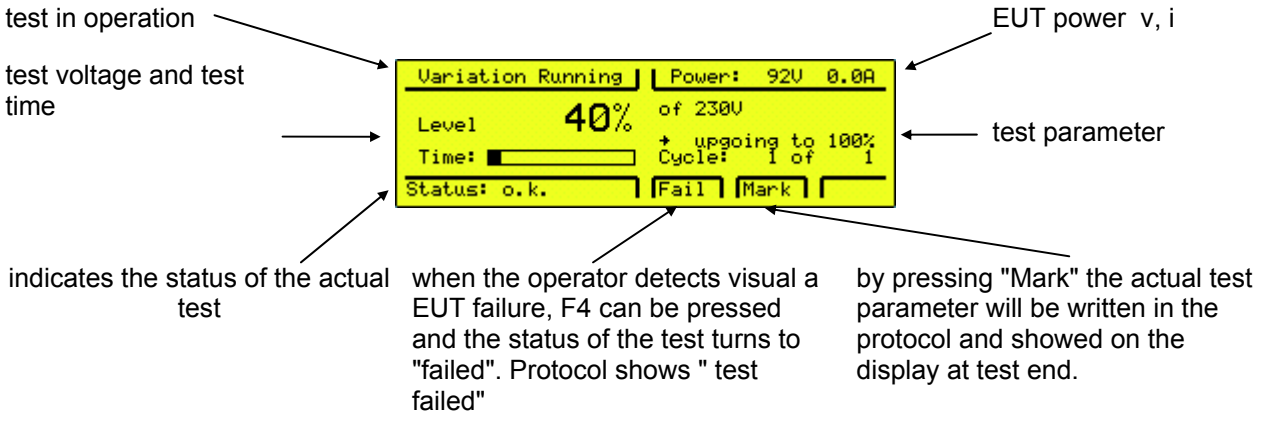
6.3.1.8 DIP



For the interruption and Variation test the EUT Power 1 input on the rear side of the TRANSIENT-2000 must be connected to the public power mains. Connecting the TRANSIENT to the public power mains is explained in Chapter 5.

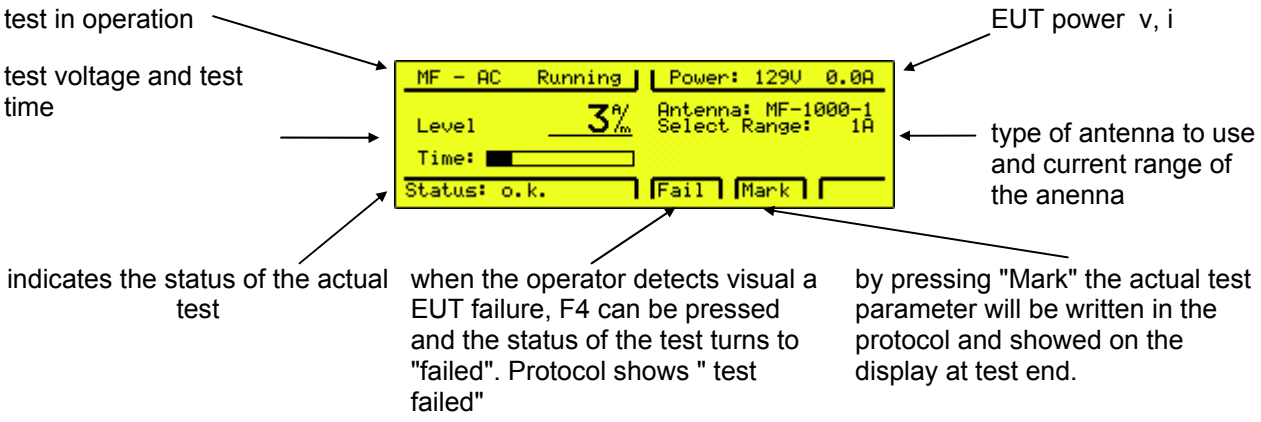
To stop the running test, press the red RUN button.

6.3.1.9 Variation



For the interruption and Variation test the EUT Power 1 input on the rear side of the TRANSIENT-2000 must be connected to the public power mains. Connecting the TRANSIENT to the public power mains is explained in Chapter 5.

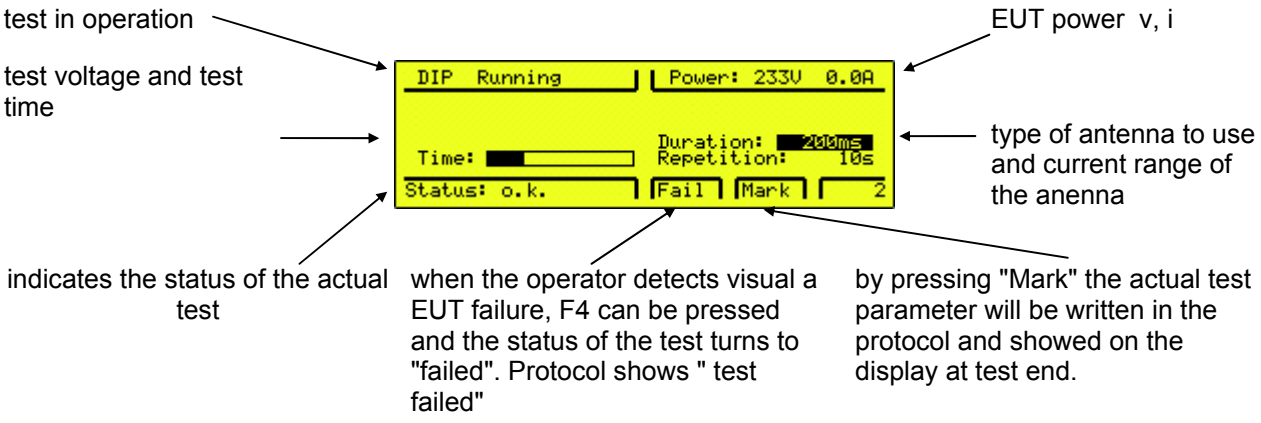
6.3.1.10 Magnetic Field



Test report example:

```
------------------------------------------------------------------------------
TRANSIENT-2000-  9   Version: 1.18     Test :  AC MF   3A/m
                                       Date :  12.12.1999  Time :  21:45:14
Test Kind:  MF   (Magnetic Field )
EUT :                                  Operator :
------------------------------------------------------------------------------
  PowerON Syncro:    0Deg   PowerOFF Syncro:    0Deg   Current Limiter: 20A
------------------------------------------------------------------------------

  MF Level        :     3A/m           Antenna :  MF-1000-1
------------------------------------------------------------------------------


       Test-Time :                        60s
       ==========================================================================


          MF   (Power Magnetic Field)           Result :  Test completed

          Test End ......................   60s
```

6.3.1.11 Interruption on d.c.



7 Maintenance and Servicing

7.1 Maintenance

To avoid electrical shock, be sure that the power cord is disconnected before starting maintenance work. EMC PARTNER recommends to that the air filter of the ventilator from time to time be cleaned. The cleaning cycle depends on the environmental conditions. Place the air filter of the ventilator in soapy water for 15 minutes . After 15 minutes, the air filter must be dried before being reinstalled.

If the DIPS and Variation circuit is used very often with high current, the VARIAC brushes must be changed.

No further maintenance is necessary on the TRANSIENT-2000.

7.2 Verification of the TRANSIENT-2000 by the user

A full verification in accordance with the IEC standards can only be carried out with very expensive measuring equipment. A simple verification whether high voltage pulses occur at the tester outputs can be carried out using an oscilloscope of a bandwidth of 20 MHz.

7.2.1 EFT

1. **Setting EFT Test „Main Menu“**
   V = 500 V; f = 100 kHz; Burst duration 10ms; Coupling path N-PE

2. **Measuring points:**
   With 10x probe at banana plug output marked N, connect ground to the earth terminal rail

3. **Settings at the oscilloscope**
   Time base 10 to 50 ms,
   Vertical deflection 5 V / division
   On the CRO screen, the Burst must be visible. The single spike is not visible because the bandwidth is insufficient.

7.2.2 ESD

1. Install the relay, select 8 kV charging voltage and repetitions frequency 1Hz

2. Discharge to a ground plate. A spark of approximately 3 mm length must be visible.

7.2.3 SURGE

Verification as specified in the Basic Standard 1000-4-5.

- Measurement of output voltage at no load
- Measurement of short circuit current with short circuit output
- Check that voltage and current waveforms are within the tolerances.
- Calculate the source impedance from the peak voltage divided by the peak current.

1. **Setting SURGE Test „Main Menü“**
   V = 1000 V; repetition 5s; coupling path L-N,
   Attention!! The power cord must be removed from the inputs EUT Power 1 and 2 of the rear side.

2. **Measuring points:**
   SURGE U-CRO for the voltage measurement at no load
   SURGE I-CRO for current measurement at short circuit (make a short circuit on the front panel of the TRANSIENT-2000 using a banana plug type cable 1000 between L-N)

3. **Setting measuring equipment**
   Time base 5 µs,
   Vertical deflection 0.5 V / division
   Definition of the wave-forms and their tolerances, see Chapter 14.1

7.2.4 Interruption

Verification as specified in the Basic Standard 61000-4-11.
Trigger the measuring equipment via the external trigger input. Different trigger level, see Chapter 1.2.7

7.2.5 Variation

1. **Setting TRANSIENT-2000 Setup Var 2s1s2s**

2. **Measuring point:**
   BNC output EUT Power U.

3. **Setting measuring equipment**
   Time base 10 to 50 ms,
   Vertical deflection 2 V / division
   The voltage variation can be measured with the oscilloscope.

Verification of the TRANSIENT-2000 by EMC PARTNER AG
EMC PARTNER verify the TRANSIENT-2000 in accordance with the verification chapter in the Basic Standards.

EFT	61000-4-4
ESD	61000-4-2
SURGE	61000-4-5
DIPS und VARIATION	61000-4-11

EMC PARTNER recommend a full verification of the TRANSIENT-2000 once a year. A test report with all oscillograms is included in the verification price. A full verification without a repair takes approximately 3 days.

Before a TRANSIENT-2000 is delivered, all verifications are carried out in accordance with the basic documents.

All data are within the tolerable tolerances.

See verification report TRANSIENT-2000 at the end of the Manual binder.

8 What must be done following failed operation

The TRANSIENT generators have many of different messages to assist the operator to solve possible problems, give information regarding incorrect operation of the TRANSIENT-generator, or to correct an incorrect system configuration. Basically, three different messages can be differentiated:

- Error message based on incorrect inputs
- Error based on incorrect operation of the generator
- Warning messages

8.1.1 Error caused by incorrect inputs „Generator not ready for run“

Error code. E?	Message	Description
ECAS10E	Emergency stop active	An emergency stop has been operated via the BNC outlet „Emergency Stop“ on the rear of the TRANSIENT-2000.
ECAS11E	no nominal defined	voltage or current
ECAS12E	V-start > V-nominal	At EFT : The test was selected with a voltage at „Voltage Ramp“ V-Start set lower than V-nominal. The start voltage in the „ Ramp“ menu must be decreased.
ECAS13E	Spike rate > xxxxx pulses/rep. reduce spacing, length or repetition	AT EFT: The spike rate is too high. For information about spike repetition limits of the TRANSIENT-2000, see Chapter 6.2.2.1 EFT. „Main“ Menu
ECAS14E	No coupling path defined	In the „Main“ menu no coupling path for superimposing SURGE and EFT onto the power line has been defined.
ECAS15E	Contact discharge max. 10’000	During ESD contact-discharge mode, a maximum voltage of 10000 V is allowed. Set the equal or lower than 10 kV voltage in the „ Main“ menu.
ECAS16E	Repetition < 100ms	At EFT: When synch mode = On, the Burst repetition must be greater than 100 ms.
ECAS17E	to high nominal	Reduce nominal value
ECAS18E	Repetition too low (<xxsec)	During SURGE test, the minimum repetition depends on the charging voltage. See Chapter 6.2.2.3 for repetition limits. Increase the repetition rate in „Main“ menu .
ECAS19E	DIP-end < DIP-begin	At DIPS: The End-angle of a DIPS must always be greater than the Begin-angle of a ramp. Chose the correct angle in „ RAMP“ menu.

ECAS25E	High-Z mode at level 0% only	The high-Z mode is only practical for an interruption to 0%. Turn off the High-Z Mode in „Main“ menu.
ECAS26E	Duration < 1 period	During Long Dip mode, the interruption cannot be shorter than one period. Increase the

		duration in „Main“ menu Long Dip, or choose short Dip .
ECAS27E	No ESD-Relay circuit found	Connect the ESD2000 to TRA2000
ECAS28E	DIP2 begin < DIP1 begin	AT DIPS: The start of the DIP2 must always be greater than the start of the DIP1. Choose the correct angle in „ RAMP“ menu.
ECAS29E	No DIP test while PWR2 is on	Turn off the PWR2 (power supply form variac
ECAS50E	Switch on power first	Press PWR1

8.1.2 Failure based on error at the generator „Generator malfunction“

ERR5L3E	Generator malfunctioning	Tittle of the message followed by the information below
ERR5L31E	no high-voltage	The voltage of the high voltage source of the TRANSIENT-2000 cannot be increased. Press any of the front panel buttons. Repeat the test. If there is no change contact EMC PARTNER.
ERR5L33E	High-voltage overshoot	The high voltage has exceeded a voltage limit. Press any of the front panel buttons. Repeat the test. If there is no change contact EMC PARTNER.
ERR5L34E	self firing	The pulse release has been before the trigger released. Press any of the front panel buttons. Repeat the test. If there is no change contact EMC PARTNER
ERR5L35E	no firing	The pulse release has not functioned. Press any of the front panel buttons. Repeat the test. If there is no change contact EMC PARTNER
ERR5L37E	Variac fault	The variac could not be set to the correct value. Please check: -Is voltage on EUT Power 1? -variac bracket inserted on the rear panel? -variac fuse o.k.?
ERR5L38E	earth switch fault	The earth switch worked not correctly. Press any of the front panel buttons. Repeat the test. If there is no change contact EMC PARTNER.
ERR5L398E	High voltage regulation fault	The high voltage regulation of the source is not functioning correctly. Press any of the front panel buttons. Repeat the test If there is no change contact EMC PARTNER

8.2 Service; Repairs

The TRANSIENT-2000 is a compact equipment and servicing or repairing the testercan only be carried out by EMC PARTNER authorised service companies.

8.3 Spare parts list

No spare parts are necessary for the TRANSIENT-2000.

8.4 Check before you contact the service of EMCP

8.4.1 Fuses

Always check first the fuses of the unit before you contact EMCP service. A set of fuses has been delivered with the tester.

8.4.2 System Reset (Software)

On three different ways a system reset can be done:

1. **Reset without deleting the stored 1 to 15 programs**
- Press the following softkey
- Main - Menu - Menu - Reset - quit with Yes

2. **Reset via the display**
- Press the following softkey:
- Main - Menu - Menu - Util - General Reset

3. **Reset with keyboard buttons**
- Press „Power ON“ and „1“ buttons simultaneously
- Wait until beep sounds
- Press button „2“ immediately

8.5 Service department of EMC PARTNER AG

EMC PARTNER AG	☎	++41 61 763 01 11
Baselstrasse 160	🖷	++41 61 763 01 15
CH - 4242 Laufen	✉	m.lutz@emc-partner.com
Switzerland	💻	www.emc-partner.com

Putting out of operation
Whenever the TRANSIENT-2000 is not needed remove the power cord.

Reasons for putting the TRANSIENT out of operation:

Maintenance work
Service, repair
Verification by EMC PARTNER
Shipment for outdoor tests

The TRANSIENT-2000 is a laboratory test equipment. When the tester is not used, store it in a dry, clean dark place.

9 Packaging and Transport

9.1 Packaging

If you transport the TRANSIENT-2000, pack it in the original shipping box and packing material.

9.2 Transport

If you transport the TRANSIENT-2000 for outdoor EMC tests, the military box from EMC PARTNER is recommended.

If you are transporting the TRANSIENT-2000 to an EMC PARTNER field office for repair, attach a tag to the equipment showing the instrument owner and address, the name of the person to contact about the instrument, the instrument type and the serial number.

10 Recycling / Disposal

10.1 RoHS directive 2002/95/EG

The TRA2000 generator complies with the directive 2002/95/EG (RoHS - Restriction of certain Hazardous Substances).

From December 2005, all EMC Partner products either hand soldered or by machine are produced using lead-free solder.

10.2 WEEE directive 2002/96/EG

The EMC Partner TRA2000 generator, is exempted from the directive 2002/96/EG (WEEE) under category 9.

The product should be recycled through a professional organisation with appropriate experience for the disposal and recycling of electronic products. EMC Partner are also available to help with questions relating to the recycling of this product.

10.3 Information for dismantling

 Remove always power cord fist.

There is no special danger involved in dismantling the TRA2000.

10.4 Parts which can be recycled

The TRA2000 contains parts made from steel, aluminium, PVC, two-component sealing compound. The impulse capacitors are filled with non-poisonous mineral oil. The various parts can be separated and recycled.

10.5 Parts which can not be recycled

All parts in the TRA2000 can be recycled.

11 Accessories

11.1 TRANSIENT-2000 Options

Verification, (Calibration) ask for a quote
All Verifications include detailed verification report.

Magnetic field tests

Pos.	Product No.	Type	Short Description
13	TRA1Z44B	MF1000-1	Test coil 1m x 1m for magnetic field test 50/60 Hz and SURGE in accordance with IEC 1000-4-8 and IEC 1000-4-9
14	TRA1Z07B	MF1STAND	Stand for MF1000-1, moveable in all three directions, max height 1,8m
15	TRA1Z47B	MF1000-2	Test coil 1m x 2.6m for magnetic field test in accordance with IEC 1000-4-8 for big control racks
16	TRA1Z64B	MF1000-3	Test coil 1m x 1m for magnetic field test in accordance with IEC 1000-4-8 for short time 3s 1000 A/m
17	TRA1Z13B	MF3STAND	Stand for MF1000-3, moveable in all three directions, max. height 1,8m

Software

Pos.	Product No.	Type	Short Description
27	TRA1Z225N	TEMA	Test Manager (TEMA). Comfortable control of TRA2000, MIG2000 or ESD3000 systems: EUT control, test report, test library. Each serial number requires one "ENTRY CODE". Incl. connection cable 25/9 pole to PC.
28	TRA1Z252A	TEMA OPTION DSO CONTROL	Option to TEMA Software: module for DSO (digital storage oscilloscope) control. "Extended" and "Option" codes neccessary.

Test place accessories

Pos.	Product No.	Type	Short Description
29	TRA1Z09A	Test-Setup	Test Package consisting of: - ESD-VCP50: vertical coupling plate 0.5 x 0.5m, incl. connection cable (1x 2m) and 2x 470 kOhm resistors - EFT-INSULATION: Insulation 2x 10cm
30	TRA1Z46A	TRA-Setup	Flexible connection TRANSIENT System to EFT reference plate, 1m cable, 2 x 470kOhm banana socket.
31	TRA1Z38B	CDN2000-06-32	Three phase CDN with line voltages L to N=280V and L to L=415V, line current 32A per phase, manual coupling path selection for EFT and SURGE.
32	TRA1A338	CDN2000A-06-32	Three phase CDN with line voltages L to N=280V and L to L=415V, line current 32A per phase, automatic coupling path selection for EFT and SURGE controlled by TRA2000, TRA2000INx and MIG0603INx with S/N > 199.
33	TRA1A339	CDN2000A-06-32 OPTION 480V	Three phase CDN with line voltages L to N=280V and L to L=480V, line current 32A per phase, automatic coupling path selection for EFT and SURGE controlled by TRA2000, TRA2000INx and

MIG0603INx with S/N > 199.

34	TRA1A340	CDN2000A-06-32 OPTION 480V / CMC	Three phase CDN with line voltages L to N=280V and L to L=480V, line current 32A per phase, automatic coupling path selection for EFT, SURGE and RING controlled by TRA2000, TRA2000INx and MIG0603INx with S/N > 199. Special coupling path mode L1 + L2 + L3 + N to PE.
35	TRA1Z211N	CN2000TT MC	Two test pistols for direct current injection of SURGE and 10/700µs according to IEC 61000-4-5. Cable length 1.5m with MC plugs. The test pistols can be used together with MIG system equipped with MC plug outputs on front panel or networks (NW).
36	TRA1A341B	CN16-450C	Single phase coupling decoupling filter for 115V, 400Hz to TRA2000 SURGE and EFT.

11.1.1.1 EFT Accessories

Options for data line tests

Pos.	Product No.	Type	Short Description
39	TRA1Z03B	CN-EFT1000	Capacitive coupling clamp 100 Ohm according to IEC 61000-4-4.
40	TRA1Z04B	VERI50	High voltage BNC with 50 Ohm termination and integrated divider for EFT calibration / verification.
41	TRA1Z05B	VERI1K	High voltage BNC with 1kOhm termination and integrated divider for EFT calibration / verification.
42	TRA1Z342A	CN-BALUN	Balanced / unbalanced transmission line transformer for EFT and 1MHz Damped Sine according to ANSI / IEEE C.37.90. Incl. - coaxial cable with HV-BNC plugs (3x 0.5m) - test tip + HV-BNC adapter (1 red, 1 black) - HV-BNC connector (2x).
43	TRA1Z383N	TRA OPTION TEST 3.2	TRA2000 modification for Burst and Interruption. Burst 3 bursts 1s within 10mn only for EN61036 necessary, Interruptions in accordance with IEC appendix B, EN appendix C.
44	TRA1Z419	ADAPTER EFT-CDN	Adapter for EFT calibration / verification at single or three phase CDN-EFT outputs. Remark: EFT measurement without power supply connected to CDN.

The capacitive coupling clamp make it possible to inject the burst into data and signal lines. The coupling clamp must be connected to the TRANSIENT-2000 using the TRA1Z25A cable.

11.1.1.2 ESD Accessories

Pos.	Product No.	Type	Short Description
37	TRA1Z321	ESD2000	ESD discharge network 150pF - 330 Ohm. contact discharge up to 10kV, air discharge up to 16kV according to IEC 61000-4-2. Stand available under ESD3000 System, product no. ESD1A291N, type ESD-STAND3.
38	TRA1Z48A	ESD-Mouse-Stand	Tripod and support for ESD-Mouse or ESD3000DM together with the ESD3000DM-EXT. Not suitable for ESD2000.

11.1.1.3 SURGE Accessories

Options for data line tests

Pos.	Product No.	Type	Short Description
45	MIG1A380C	CDN-UTP	Coupling-decoupling network for 1.2/50 and 10/700µs SURGE coupling 6.6kV on up to 2 pair (4 wires) balanced communication lines in accordance with IEC61000-4-5 (fig. 12) and ITU-K.20.
46	MIG1A418C	CDN-UTP8	Coupling-decoupling network for 1.2/50 and 10/700µs SURGE coupling 6.6kV on up to 4 pair (8 wires) balanced communication lines in accordance with IEC61000-4-5 (fig. 12) and ITU-K.20.
47	TRA1Z10B	CDN-KIT1000	SURGE coupling-decoupling network for data lines according to IEC 61000-4-5.
48	TRA1Z50A	IN1000	Impulse network 10/700 4kV and ring wave 0.5/100 kHz 6kV, other impulse shapes on demand. Only for TRA1000.
49	TRA1Z384N	NW-TRA-RAIL	Discharge network to TRA or MIG with surge circuit for waveform 5/50µs generation in accordance with IEC 60571, EN50155, RIA Spec 12 (1984). Maximum voltage approx. 3kV.
50	TRA1Z385N	DN2000-22-5	One Decoupling Module for IEC 60255-22-5 application. Inductance 20mH, varistor at the auxiliary side 275V, Imax continuous 3A, intermittant use 10mn 5A.

11.1.1.4 DIPS Accessories

Pos.	Product No.	Type	Short Description
51	TRA1Z17B	VAR-EXT1000	16A external variac for DIPS and variation, complies fully with IEC 61000-4-11.
52	TRA1Z19B	VERI-DIPS	Measuring set for calibration / verification of the inrush current TRA1000, TRA2000xx, PFS32 and PFS63.
53	TRA1Z27A	NW16S	Voltage source d.c./50/60Hz for IEC 61000-4-16 tests.
54	TRA1Z28A	CN16	Coupling network for common mode coupling dc, 50/60Hz and sinusoidal up to 150kHz according to IEC 61000-4-16.
55	TRA1Z29A	CN16T	T-coupling network for telecom lines coupling dc, 50/60Hz and sinusoidal up to 150kHz according to IEC 61000-4-16.
56	TRA1Z409	PFS32	Extension of TRA2000 DIPS. The PFS32 can generate interruptions on three phase power supply up to 480V/ 32A. For DIPS and supply configuration the PFS32 can be inserted in the SRC32 rack.
57	TRA1Z410	SRC32	18 Unit High rack with three phase transformer for three phase dips. The rack has enough space for inserting TRA2000 DIPS and PFS32 or PFS63. Minimum configuration TRA2000 DIPS and PFS32 or PFS63.
58	TRA1Z420	PFS63	Extension of TRA2000 DIPS. The PFS63 can generate interruptions on three phase power supply up to 480V/ 63A. For DIPS and supply configuration the PFS63 can be inserted in the SRC32 rack.
59	TRA1Z421	DIPS100E	100 Ohm resistor for switching time calibration / verification. Can be used with TRA1000, TRA2000xx, PFS32, PFS63. 100 Ohm +/- 5%, 1kW.

12 Serial Remote Port

12.1 General

The MIG remote-control option enables remote control of the MIG0603IN1 IEC-ANSI via the RS-232 serial port.

.

12.1.1 Technical Data of the RS 232C serial port

The V.24 serial port uses the data lines TxD and RxD for the information transfer.

Baudrate:	1200, 2400, 4800, 9600, **19200**
Databits:	7, **8**
Parity:	**None**, Even, Odd
Stop:	**1**, 2
Protocol:	**None**, RTS/CTS, XON/XOFF
End of sequence:	**CR**, LF, CR+LF

With the pinning below the remote control of a TRA2000 or MIG2000 generator is guaranteed.

Pinning	Signal	9 pol SubD		Signal	25 pol SubD
	TxD	Pin 3		TxD	Pin 2
	RxD	Pin 2		RxD	Pin 3
	RTS	Pin 7		RTS	Pin 4
	CTS	Pin 8		CTS	Pin 5
	DCD	Pin 1		DCD	Pin 8
	DSR	Pin 6		DSR	Pin 6
	DTR	Pin 4		DTR	Pin 20
	GND	Pin 5		GND	Pin 7
	RI	Pin 9		RI	Pin 22
Standard Nullmodem	**TxD**	**3**	**>>>>>>>**	**RxD**	**3**
	RxD	**2**	**>>>>>>>**	**TxD**	**2**
	RTS + CTS	**7 + 8**	**>>>>>>>**	**DCD**	**8**
	DCD	**1**	**>>>>>>>**	**RTS + CTS**	**4 + 5**
	DSR + DTR	**6 + 4**	**>>>>>>>**	**DSR + DTR**	**6 + 20**
	GND	**5**	**>>>>>>>**	**GND**	**7**
3-Wire Nullmodem	**TxD**	**3**	**>>>>>>>**	**RxD**	**3**
	RxD	**2**	**>>>>>>>**	**TxD**	**2**
	RTS+CTS+DCD	**7 + 8 + 1**		**RTS+CTS+DCD**	**4 + 5 + 8**
	DSR + DTR	**6 + 4**		**DSR + DTR**	**6 + 20**
	GND	**5**	**>>>>>>>**	**GND**	**7**
EMCP 25/9 pole cable	**TxD**	**3**	**>>>>>>>**	**RxD**	**3**
	RxD	**2**	**>>>>>>>**	**TxD**	**2**
	RTS	**7**	**>>>>>>>**	**DCD**	**8**
	CTS + DSR	**8 + 6**	**>>>>>>>**	**DTR**	**20**
	DCD	**1**	**>>>>>>>**	**RTS**	**4**
	DTR	**4**	**>>>>>>>**	**CTS + DSR**	**5 + 6**
	GND	**5**	**>>>>>>>**	**GND**	**7**
Min. wiring for remote control cable	**TxD**	**3**	**>>>>>>>**	**RxD**	**3**
	RxD	**2**	**>>>>>>>**	**TxD**	**2**
	RTS + CTS	**7 + 8**			
	GND	**5**	**>>>>>>>**	**GND**	**7**

Modification of the configuration values can carried out using the keyboard in the menu Remote Control Set-up. The remote-control-set-up menu is in the general menu.

12.1.2 Local or Remote Control

The function local or remote can be selected with the external system controller. Two conditions can be selected:

- Local (process is controlled by the MIG controller)
- Remote (process is controlled by the external controller e.g. PC)

After turning on the MIG0603IN1 IEC-ANSI the status of the generator is „local“. Only commands selected by the operator using the keyboard are accepted. The system controller commands are blocked.

The generator changes from the condition "local" to "remote" when the Command "REN" (Remote Enable) has been received from the system controller e.g. PC.

12.1.3 Remote Control

In this operation mode, the MIG0603IN1 IEC-ANSI can only be controlled by the external system controller e. g. PC.

A reset to the condition "local" can be made from the system controller by sending a "GTL" Command (Go To Local), by turning the power of the generator OFF and ON or by pressing the buttons RUN, Power ON/OFF.

12.2 Organisation of MIG Remote-Control Commands

12.2.1 Syntax of the Commands

12.2.1.1 Separation signs:

Within a command, or when limiting a command or ending a command block the following signs must be used:

< > space after the header command
< ; > ending a command within a command block

<EOS> Closing the command block (End Of Sequence) :

12.2.1.2 Commands Format

Integer positive number in the range 0 to 29999, transmitted as an ASCII-string. The units and the formats correspond to inputs/outputs in the MIG-display.
Real floating decimal point in the format .xxx to xxx. without an exponent, transmitted as ASCI-string. The units and the format correspond to the inputs/outputs in the MIG-display
Character sequence of letter and numbers

12.2.2 Set-up Commands:

Set-up commands consist of the following three parts:

<set command>=<head>< ><argument>

<head> Sequence of 2 to 4 ASCII-characters 'A'..'Z'; 'a'..'z' as start of a command. It will not be differ between capital and small letters.

< > Separation sign between <head> and <argument>

<argument> argument, in form of a integer-, real- or a sequence of numbers. No difference is made between capital and small letters.

Example: VNOM 2000<EOS> or POL POS<EOS>

Several commands can be reduced to single command, and be terminated with the sign <EOS>. Single command are separated by semicolons:

<set command> { ; <set command> } . . . <EOS>

Example: VNOM 4000;POL NEG;Rep 10<EOS>

12.2.3 Inquire Commands

Inquire commands start MIG transmitting internal data to the system controller. The data consists of two parts:

<Inquire commands>=<head>{< >}<?>
Instead of the argument, a question mark is used in Inquire Commands. A command contains a maximum of one Inquire Command which must be located at the end of the command. On the other hand several set-up Commands are allowed:

Examples:

Based on the Inquire Command ...	VNOM ?<EOS>
the following answer can occur:	2000
or: controller:	POL?<EOS>
MIG:	NEG
or: controller:	VNOM 1000;E?<EOS>
MIG:	0

12.2.4 Failure messages:

. input buffer ovfl	...	overflow of the read buffer (>100 characters)
. time-out occurred	...	Time-out at transmission end
. header >4 characters	...	header larger than 4 characters
. unknown header	...	unknown command
. invalid argument	...	
. time-out while talk	...	handshake error
. no query here	...	no query for this command
. query expected	...	
. not valid in local	...	this command is not allowed in local mode
. not valid while run	...	this command is only allowed in standby mode

Remote Control Debug Utility
The remote control debug utility make it possible to check interfaces and user software on the system controller e.g. PC.

With the command DEB ON<EOS>

the debug-mode will be turned on. The display immediately shows a range of error messages and the contents of the reader buffer.

With DEB OFF<EOS>, the debug-mode will be turned off.

12.3 Remote Control Command set

Command *TST* (TeST)

Explanation: set or query the test mode. This command resets all test-specific parameters to the factory initialisation defaults. The reset must be at the beginning of a parameter set-up.

Arguments: *characters* IMP1, IMP2, IMP3....., IMP11

Example: TST IMP1
This command must be used at a generator with different wave shapes.

Command VNOM (Voltage NOMinal)

Set or query V-peak [in V]

Argument: *Integer*
0..Vmax resp. 0..110 bei DIP

Example: VNOM 1500

VNOM?
Answer: 1500

Command POL (POLarity)
Explanation: Set or query the Polarity.

Argument: *Characters* POS, NEG

Example: VNOM 1500
POL NEG

Command REP (REPetition)
Explanation: depends on the type of test:

Argument: *Integer*

Example: VNOM 1500
POL NEG
REP 10

Command NBR (NumBeR)
Explanation: depends on the type of test:

Argument: *Integer* 0..30000

Example: NBR 10

Command TRIG (TRIGger)
Explanation:
Set or query **Trigger Mode**.

Argument: *Characters* AUTO, MAN

Example: TRIG MAN

TRIG?
Answer: MAN

Command SYM (SYncro Mode)
Explanation: Set or query Syncro Mode.

Argument: *Characters* ON, OFF

Example: **SYM ON**
SYF F3
SYA 180

Command SYF (SYncro Frequency)
Explanation: Set or query Syncro Frequency (fundamental frequency).

Argument: *Characters* F1 correspond 16 Hz
F2 corresponds 40 Hz
F3 corresponds 50 Hz
F4 corresponds 60 Hz
F5 corresponds 400 Hz

Example: SYM ON
SYF F3
SYA 180

Command SYA (SYncro Angle)
Explanation: Set or query **Syncro Angle** [in degrees].

Argument: Integer 0..360

Example: SYM ON
SYF F3
SYA 180

Command DEF (DEFaults)
Explanation: All parameter will be resetted to the default values. This function is made automatically after the command TST or after a Power-up.

Argument: no argument

Command CIO (Coupling Impulse Output)

Explanation: Set or query **Impulse Outputs**.

Argument: *Characters* ON, OFF

Example: VNOM 2000
CIO ON

These command is only useful with automatic switch to different impulse outputs.

Command CLN (Coupling path L-N)

Explanation:
Set or query the coupling path **L-N** at SURGE.
The coupling path is only active if the impulse output is turned off (CIO=OFF).
When more than one coupling path is chosen the coupling paths are switched in the following sequence:
L-N, L-PE, N-PE

Argument: *Characters* ON, OFF

Example: CLN ON; CLN?
Answer: ON

These command is only useful with automatic external CDN.

Command CLP (Coupling path L-PE)

Explanation: Set or query of the coupling path **L-PE** at SURGE.
The coupling path is only active if the impulse output is turned off (CIO=OFF).
When more then one coupling path is selected the coupling paths are switched in the following sequence:
L-N, L-PE, N-PE

Argument: *Characters* ON, OFF

Example: CIO OFF;CLN OFF;CLP ON

These command is only useful with automatic external CDN.

Command CNP (Coupling path N-PE)

Explanation: Set or query the coupling path **N-PE** at SURGE.
The coupling path is only active if the impulse output is turned off (CIO=OFF).
When more than one coupling path is chosen the coupling paths are switched in the following sequence:
L-N, L-PE, N-PE

Argument: *Characters* ON, OFF

Example: CIO OFF;CLN OFF;CLP ON;CNP ON

These command is only useful with automatic external CDN.

Command PON (Power ON)
Explanation:
Turn on/off the **EUT power**, or query the condition of the EUT power e. g. voltage value. These command is only useful with automatic external CDN.

Argument: *Characters* ON, OFF

Example: SYF F3 (50Hz)
PON ON (turn on the EUT power)
PON?
Answer: ON
PON OFF (turn off the EUT power)

Command RAK (RAmp Kind)
Explanation: Set or query the different Ramps.

Argument: *Characters*

N :	No ramps
V :	Voltage Ramp
P :	Alternate Polarity
S :	Syncro Ramp

Example: **RAK V**

RAK?
Answer: V

Command RAVS (RAmp Voltage Start)

Explanation: depends on the test type
Set or query **V-peak start** [in V].

Argument: *Integer*

Example: RAK V;VNOM 2000;RAVS 500;**RAVS 100**
(Voltage-Ramps from 500V up to 2000V in 100V steps)

Command RAVD (RAmp Voltage Delta)

Explanation: depends on the test type

Argument: *Integer*

Example: RAK V;VNOM 2000;RAVS 500;**RATD 100**
(Voltage-Ramps from 500V up to 2000V in 100V steps)

Command RASS (RAmp Syncro Start)

Set or query **Syncro start** [in degrees].

Argument: *Integer* 0..360

Example: RAK S;SYM ON;SYA 360;**RASS 0**;RASD 10
(Syncro-Ramps from 0degree up to 360degrees in steps of 10degrees)

Command RASD (RAmp Syncro Delta)

Explanation: depends on the test type:
Set or query **Syncro step** [in degrees].

Argument: *Integer* 0..360

Example: RAK S;SYM ON;SYA 360;RASS 0;**RASD 10**
(Syncro-Ramps from 0degree up to 360degrees in steps of 10Grad)

Command RACA (RAmp Change After)

Explanation: Set or query **Change after**.

Argument: *Integer* 1..30000

Example:
RAK P;POL POS;**RACA 5**
(Alternate Polarity, starts with positive polarity, changes after 5 pulses)

Command EUT (EUT failed action)

Explanation: Set or query Action if EUT failed.

Argument: *Characters* OFF No Action
STOP Stop RUN
INFO Info only

Example: IMAX 500;**EUT STOP**

Command VMAX (Voltage MAX)
Explanation: Set or query EUT failed Limit, Surge Voltage max. [in V].

Argument: *Integer 0..9999*

Example: **VMAX 600**;VMIN 300;EUT INFO

Command VMIN (Voltage MIN)
Explanation: Set or query EUT failed Limit, Surge Voltage min [in V]

Argument: *Integer 0..9999*

Command IMAX (current MAX)
Explanation: Set or query EUT failed Limit, Surge Current max. [in A]

Argument: *Integer 0..9999*

Example: **IMAX 500**;IMIN 300;EUT INFO

Command IMIN (current MIN)
Explanation: Set or query EUT failed, Surge Current min [in A].

Argument: *Integer 0..9999*

Command NAME (setup NAME)
Explanation: Set or query Setup term.
The set-up term is a freely defined character sequence of maximum 12 characters. The name is displayed in the test list of the MIG.

Argument: *Characters* max. 12 Character

Example: NAME first TEST

NAME?
Answer: first TEST

Command SETN (SETup Next)
Explanation: Set or query Next Setup.

Argument: *Integer* 0..23

Example: SETN 1

Command SETS (SETup Store)
Explanation: Stores of a Setup.
No query possible
If a memory place is occupied, it must first be reset using the SETD command.

Argument: *Integer* 1..23

Example: NAME of the test;SETD 1;**SETS 1**

Command SETR (SETup Recall)
Explanation: Activation of a stored set-up
No query possible.

Argument: *Integer* 1..23

Example: SETR 5

Command SETD (SETup Delete)
Explanation: Deletion of a stored set-up.
No query possible

Argument: *Integer* 1..23

Example: NAME of the test; **SETD 1**;SETS 1

Command PRT (PRinTer)
Explanation: Set or query Print Protocol to Port 11.

Argument: *Characters* ON, OFF

Example: PRT ON

Command BTR (Beep on TRigger)
Explanation: Set or query Beep on Trigger.

Argument: *Characters* ON, OFF

Example: BTR?
Answer: ON

Command BOF (Beep On Failed)
Explanation: Set or query Beep on Failed

Argument: *Characters* ON, OFF

Example: BOF ON

Command STOP (STOP run)
Explanation: Interrupts the Run-Mode.
No query possible. Run-Mode can be recognised by the command ST?..

Argument: no argument

Example:
START
ST?
Answer: R (Generator is in Run-Mode)
STOP
Answer: S (Generator is in standby-Mode)

Command STRT (STaRT run)
Explanation: Start of the Run-Mode.
No query possible. Run-Mode can be recognised by the command ST?..

Argument: no argument

Example:
START
ST?
Answer: R (Generator is in Run-Mode)
STOP
ST?
Answer: S (Generator is in Standby-Mode)

Command PAU (PAUse)
Explanation: Set or query the condition pause

Argument: *Characters* ON, OFF

Example:
START
PAU ON

Command IT (Initiate Trigger)
Explanation: Trigger with the same function as the trigger button on the front panel of the MIG
The trigger mode manual must be chosen (TRIG=MAN).
No query possible.

Argument: n o argument

Example:
TRIG MAN
START
...
IT (Trigger of the pulses)

Command M (Message number)
Explanation: inquiry of Generator Error-Code.
The Error-Code will be reset by the STRT command (Start). Each SURGE will also reset the error code

Argument: no argument

Answer: Integer with the following Code:

0:	no error
100:	value out of range
101:	Safety circuit open
103:	V-start > V-nominal
105:	no path defined
107:	repetition too low
109:	printer not ready
110:	Trafo overheat
111:	wait for discharge
112:	No discharge
113:	Spacing spikes to low
202:	generator error
301:	EUT failed (external event)
302:	EUT failed (V-peak > limit)
303:	EUT failed (V-peak < limit)
304:	EUT failed (I-peak > limit)
305:	EUT failed (I-peak < limit)
500:	manual trigger time out

Example: M?
Answer: 304

Command SR (Status Register)
Explanation: query of Generator Status Register

Argument: no argument

Answer:

Byte	: the different Bits have the following meanings:
Bit1	: EUT failed
Bit2	: Error Code >0 (question A?)
Bit3	: Generator in Local Mode
Bit4	: Transmitting error (will be reset by the command E?)
Bit5	: Command error (will be reset by the command E?)
Bit6	: Generator in Run-Mode
Bit8	: New Trigger

Command ST (generator STatus)
Explanation: query of Generator Status .

Argument: no argument

Answer: Characters have the following meanings:
S : Standby
B : Busy (e.g. during charging process)
R : Run-Mode

Example: START
ST?
Answer: R (Generator im Run-Mode)
STOP
ST?
Answer: S (Generator im Standby-Mode)

Command LN (Last Number)
Explanation: query of the last pulses

Argument: no argument

Answer: Integer

Example: LN?
Answer: 5

Command LV (Last Voltage)
Explanation: query of the current voltage [in V] or. Level [in %] at ramps.

Argument: no argument

Answer: Integer

Example: LV?
Answer: +2100

Command LS (Last Syncro)
Explanation: query of the current syncro angle [in degrees] at ramps.

Argument: no argument

Answer: Integer 0..360

Example: LS?
Answer: 190

Command LC (Last Coupling)
Explanation: query of the current coupling paths. Only with external automatic CDN relevant

Argument: no argument

Answer: Characters
IMP-OUT, L-N, L-PE, N-PE

Example: LC?
Answer: IMP-OUT

Command VPK (Voltage PeaK)
Explanation: query of the Surge voltage peak measurement [in V] of the last pulse.

Argument: no argument

Answer: Integer 0..5000

Example: VPK?
Answer: 2345 (positive Impulse)
or Answer: -2100 (negative Impulse)

Command IPK (current PeaK)
Explanation: query of the Surge peak current measurement [in A] of the last pulse.

Argument: no argument

Answer: Integer 0..2500

Example: IPK?
Answer: 1345 (positive Impulse)
or Answer: -1100 (negative Impulse)

Command ID (IDentification)
Explanation: Inquiry of the type of equipment.

Argument: no argument

Answer: Characters : MIG v.vv
v.vv stays for the software version

Example: ID?
Answer: MIG 1.15

Command REN (REmote Enable)
Explanation: change-over into Remote Control Mode.
No query possible

Argument: no argument

Command GTL (Go To Local)
Explanation: change-over into Local Mode. (manipulation from the MIG front panel)
No query possible

Argument: no argument

Command E (Error number)
Explanation: query of Remote Error-Code.
The remote error-code will be reset by the command E?

Argument: no argument

Answer: Integer with the follow codes
0: no error

1:	Command only allowed in remote
2:	unknown command
3:	unpermissible argument
4:	no query allowed
5:	command only allowed in standby-mode
8:	timeout at transmitting end
16:	parity errror at transmitting end
32:	overflow of the input buffer
64:	other errors

Error-Code 1 to.5 always relate in any case to the preceding command.
The Error-Codewill be reset after each query.

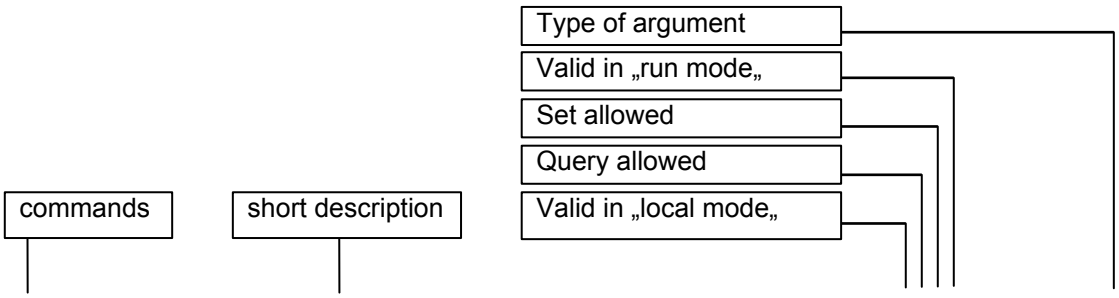
Example: VNOM 4ç*"6
E?
Answer: 3

Command DEB (DEBug mode)
Explanation: Set and query of Remote Control Debug Mode.

Argument: *Characters* ON, OFF

12.4 Overview of TRANSIENT-2000 Commands

TRANSIENT-2000 Remote Control Commands



Main Parameters:

TST	Test Kind	.xx.	EFT,ESD SURGE,DIP, VAR,MF
VNOM	ESD,EFT,SURGE: V-charge resp. V-peak (in V) DIP: Dip Level (in %) MF: MF Level (in A/m)	.xx.	Integer
POL	ESD,EFT,SURGE: Polarity	.xx.	Pos,Neg
REP	SURGE,DIP: Repetition (in sec) EFT: Repetition (in msec) ESD: Repetition (in Imp/sec)	.xx.	Integer
NBR	ESD,SURGE: Number of Pulses DIP: Number of Periods or Dip Duration (in msec) VAR: Number of Cycles	.xx.	Integer
TTM	EFT,DIP,MF: Test-Time (in sec)	.xx.	Integer
TRIG	ESD,EFT,SURGE,DIP: Trigger Mode (Auto/Man)	.xx.	Auto,Man
SYM	EFT,SURGE: Syncro Mode (ON/STBY)	.xx.	On,Off
SYF	EFT,SURGE,DIP: Syncro Frequency (F1..F5)	.xx.	F1,F2,F3,F4,F5
SYA	EFT,SURGE,DIP: Syncro Angle (in Deg.)	.xx.	Integer
ESF	EFT: Spikes Frequency (in KHz)	.xx.	Integer
EBD	EFT: Burst Duration (in ms)	.xx.	Real
MD	ESD: On=Air-Discharge, Off=Contact-Discharge EFT: On=Random-Mode DIP: On=High-Z at 0%	.xx.	On,Off
MO	ESD: 0=Count every pulse, 1=Count discharge SURGE: 0=CWG,1=Ringwave,2=CCITT 3=MF1000-1, 4=MF1000-2 DIP: 0=Less than 1 Period, 1=More than 1 Period 2=DC DIP MF: 0=MF1000-1, 1=MF1000-2, 2=MF1000-3	.xx.	Integer
D1B	DIP: Dip1 Begin (in Deg.)	.xx.	Integer
D1E	DIP: Dip1 End (in Deg.)	.xx.	Integer
D2B	DIP: Dip2 Begin (in Deg.)	.xx.	Integer
D2E	DIP: Dip2 End (in Deg.)	.xx.	Integer
DEF	Set Power-Up Default values	..x.	

Coupling:

CIO	EFT,SURGE: Impulse Output	.xx.	On,Off
CL	EFT: Coupling to L SURGE: 2xVpeak for L-PE, N-PE	.xx.	On,Off
CN	EFT: Coupling to N SURGE Syncro on Peak	.xx.	On,Off
CP	EFT: Coupling to PE	.xx.	On,Off
CLN	EFT,SURGE: Coupling to L,N	.xx.	On,Off
CLP	EFT,SURGE: Coupling to L,PE	.xx.	On,Off
CNP	EFT,SURGE: Coupling to N,PE	.xx.	On,Off

CLNP	EFT: Coupling to L,N,PE	.xx.	On,Off
Coupling with PFS32/SRC32:			
CL13	DIP: Switch from PFS32 to PFS32-with-SRC32	.xx.	On,Off
CIO	DIP: EUT-Power	.xx.	On,Off
CL	DIP: Coupling to L1	.xx.	On,Off
CN	DIP: Coupling to L2	.xx.	On,Off
CP	DIP: Coupling to L3	.xx.	On,Off
CLN	DIP: Coupling to ALL	.xx.	On,Off
CLP	DIP: Coupling to L1/L2	.xx.	On,Off
CNP	DIP: Coupling to L2/L3	.xx.	On,Off
CLNP	DIP: Coupling to L3/L1	.xx.	On,Off
Coupling with CDN 3-phase:			
C3P	Coupling to CDN-3-phase	.xx.	On,Off
CL12	SURGE: Coupling to L1-L2	.xx.	On,Off
CL13	SURGE: Coupling to L1-L3	.xx.	On,Off
CL23	SURGE: Coupling to L2-L3	.xx.	On,Off
CLN	SURGE: Coupling to L1-N	.xx.	On,Off
CL2N	SURGE: Coupling to L2-N	.xx.	On,Off
CL3N	SURGE: Coupling to L3-N	.xx.	On,Off
CLP	SURGE: Coupling to L1-PE	.xx.	On,Off
CL2P	SURGE: Coupling to L2-PE	.xx.	On,Off
CL3P	SURGE: Coupling to L3-PE	.xx.	On,Off
CNP	SURGE: Coupling to N-PE	.xx.	On,Off
CLNP	SURGE: Coupling to L1+L2+L3+N-PE	.xx.	On,Off
CL	EFT: Coupling to L1	.xx.	On,Off
CN	EFT: Coupling to N	.xx.	On,Off
CP	EFT: Coupling to PE	.xx.	On,Off
CLN	EFT: Coupling to L2	.xx.	On,Off
CLP	EFT: Coupling to L3	.xx.	On,Off
CNP	EFT: Coupling to N+PE	.xx.	On,Off
CLNP	EFT: Coupling to L1+L2+L3+N+PE	.xx.	On,Off
Power Control:			
PONS	EUT Power ON Syncro (in Deg.)	.xx.	Integer
POFS	EUT Power OFF Syncro (in Deg.)	.xx.	Integer
PON	EUT Power ON/STBY	.xxx	On,Off
POCL	EUT Power Current Limit	.xxx	Integer
VAFV	Power from Variac ON/STBY	.xx.	On,Off
VAN	Variation Nominal (in V)	.xx.	Integer
VA1	Variation Level 1 ON/STBY	.xx.	On,Off
VA2	Variation Level 2 ON/STBY	.xx.	On,Off
VA3	Variation Level 3 ON/STBY	.xx.	On,Off
VAL1	Variation Level 1 (in %)	.xx.	Integer
VAL2	Variation Level 2 (in %)	.xx.	Integer
VAL3	Variation Level 3 (in %)	.xx.	Integer
VAT1	Variation Time To Level 1 (in sec)	.xx.	Integer
VAT2	Variation Time To Level 2 (in sec)	.xx.	Integer
VAT3	Variation Time To Level 3 (in sec)	.xx.	Integer
VATN	Variation Time To Nominal (in sec)	.xx.	Integer
VAD1	Variation Duration on Level 1 (in sec)	.xx.	Integer
VAD2	Variation Duration on Level 2 (in sec)	.xx.	Integer
VAD3	Variation Duration on Level 3 (in sec)	.xx.	Integer
VADN	Variation Duration on Nominal (in sec)	.xx.	Integer
EUT Control:			
EUT	Action if EUT Failed	.xx.	Info,Next,Stop
VMAX	Failed Limit: Surge Max.Voltage (in V)	.xx.	Integer
VMIN	Failed Limit: Surge Min.Voltage (in V)	.xx.	Integer
IMAX	Failed Limit: Surge Max.Current (in A)	.xx.	Integer
IMIN	Failed Limit: Surge Min.Current (in A)	.xx.	Integer
Ramps:			
RAK	Ramp Kind	.xx.	N,V,S,P,F,D
RATM	EFT: Ramp Time (in sec)	.xx.	Integer
RAVS	EFT,ESD,SURGE: V-peak- resp. V-ch-Start (in V) DIP: Level Start (in %)	.xx.	Integer
RAVD	ESD,SURGE: V-peak- resp. V-ch-Step (in V)	.xx.	Integer

	DIP: Level Step (in %)		
RAFS	EFT: Spike Freq. Start (in KHz)	.xx.	Integer
	DIP: Dip Begin Start (in Deg.)		
RAFD	DIP: Dip Begin Step (in Deg.)	.xx.	Integer
RASS	EFT,SURGE: Syncro Start (in Deg.)	.xx.	Integer
	DIP: Dip End Start (in Deg.)		
RASD	EFT,SURGE: Syncro Step (in Deg.)	.xx.	Integer
	DIP: Dip End Step (in Deg.)		
RADS	DIP: Duration Start (in ms)	.xx.	Integer
	EFT: Duration Start (in msec)	.xx.	Real
RADD	DIP: Duration Step (in msec)	.xx.	Integer
RACA	Change after	.xx.	Integer
SPB	EFT: Spikes per Burst , for Freq. Ramp	.xx.	Integer

Setup:

NAME	Setup Name	.xx.	String[12]
SETN	Next Setup	.xx.	Integer
SETS	Store Setup	..x.	Integer
SETR	Recall Setup	..x.	Integer
SETD	Delete Setup	..x.	Integer

General Parameters:

PRT	Printer	.xx.	On,Off
BTR	Beep on Trigger	.xx.	On,Off
BOF	Beep on Failed	.xx.	On,Off

Generator Control:

STOP	Stop RUN	..xx	
STRT	Start RUN	..x.	
PAU	Pause	.xxx	On,Off
IT	Initiate Trigger	..xx	

Generator Supervision:

M	Generator Error Message Number (Integer)	xx.x
SR	Status Register (Byte)	.x.x
ST	Actual Status of Generator (S,B,R)	.x.x
LN	Number of last Pulse (Integer)	.x.x
LV	Nominal Voltage of last Pulse (in V, Integer)	.x.x
LS	Syncro of last Pulse (in Degree, Integer)	.x.x
LC	Coupling of last Pulse	.x.x

Measuring:

VPK	Peak Voltage of last Pulse (in V, Integer)	.x.x
IPK	Peak Current of last Pulse (in A, Integer)	.x.x
V	Power Voltage RMS (in V, Integer)	.x.x
I	Power Current RMS (in A, Real)	.x.x

"Remote Mode" Control:

ID	Identify System and Version	xx.x	
REN	Go to Remote Mode	x.x.	
GTL	Go to Local Mode	..x.	
E	Get Communication Error Code (Byte)	xx.x	
DEB	Remote Control Debug Utility	.xx.	On,Off

TRA2000-IN4:

MD	External Network	.xx.	On,Off

SPB x	x=1: CCITT 10/700	Rd = 0 Ω
	x=2: CCITT 10/700	Rd = 25 Ω
	x=3: Ring-wave	Rd = 12 Ω
	x=4: Ring-wave	Rd = 30 Ω
	x=5: Ring-wave	Rd = 200 Ω

External Devices:

AUX	e.g.:AUX 010055	Address: 01 Output: 055H
	AUX %01xx	Change Module Address from 01H to xxH

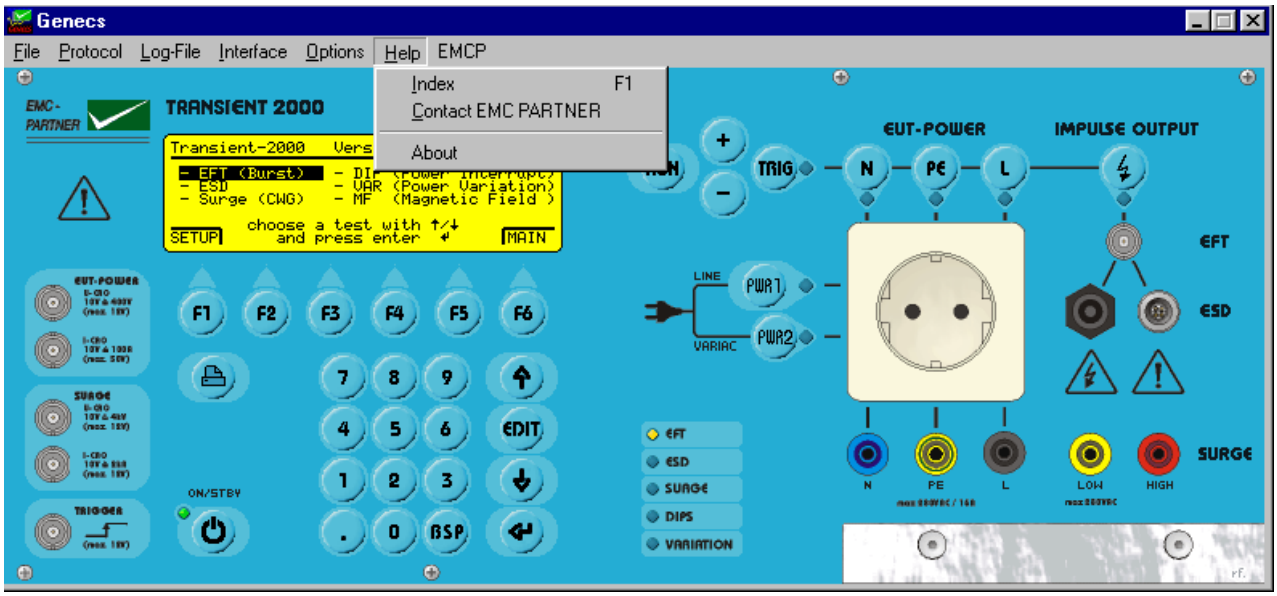
12.5 Software "GENECS" for TRANSIENT-2000 Remote Control

The GENECS software delivered on a CD (the CD can be found in the cover of the manual binder), can be used to control the TRANSIENT-2000 via the RS-232 port.

12.5.1 Setup GENECS

See instruction on the CD. Follow the instruction of the installer program. When the GENECS is installed and the TRANSIENT-2000 via the RS232 connected the display of the TRANSIENT-2000 and the display of the GENECS must show the same figure.

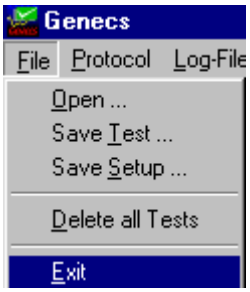
12.5.2 GENECS Windows



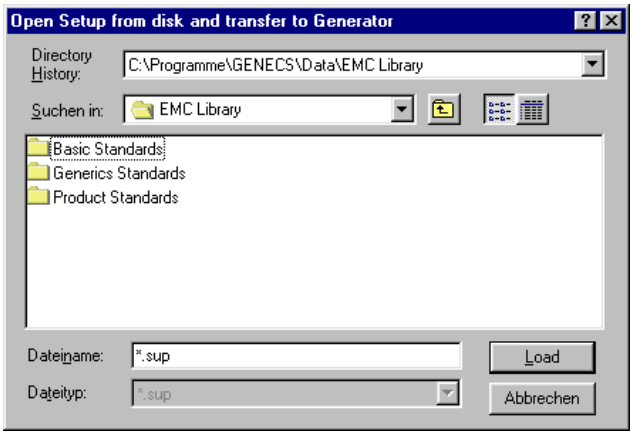
The GENECS windows is equal the TRANSIENT-2000 front plate. Online the TRANSIENT-2000 can be remote controlled by pressing the buttons with the mouse cursor as on the real front plate.

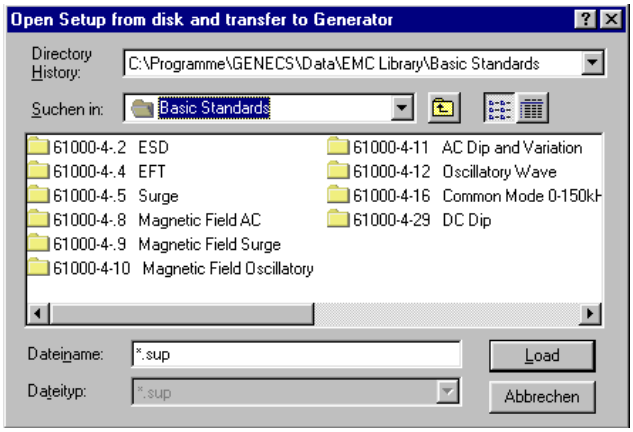
Detailed information can be get from the "help index".

12.5.3 GENECS Library



In the file pull down menu press "open" and activate Library. The Library includes all test specified in the relevant basic and generic standards.





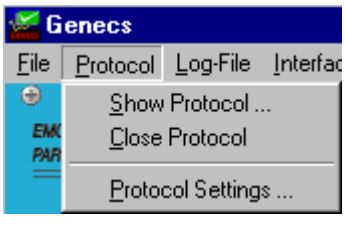
with "Load" the tests are loaded into the TRANSIENT-2000. During the loading process a pointer indicator shows the loading status.

Save test: Saves a test in a test place 1 to 15

Save Set-up: Saves all 1 to 15 tests. 15 tests is equal a set-up

Delete all test: Deletes all 1 to 15 tests in the TRANSIENT-2000

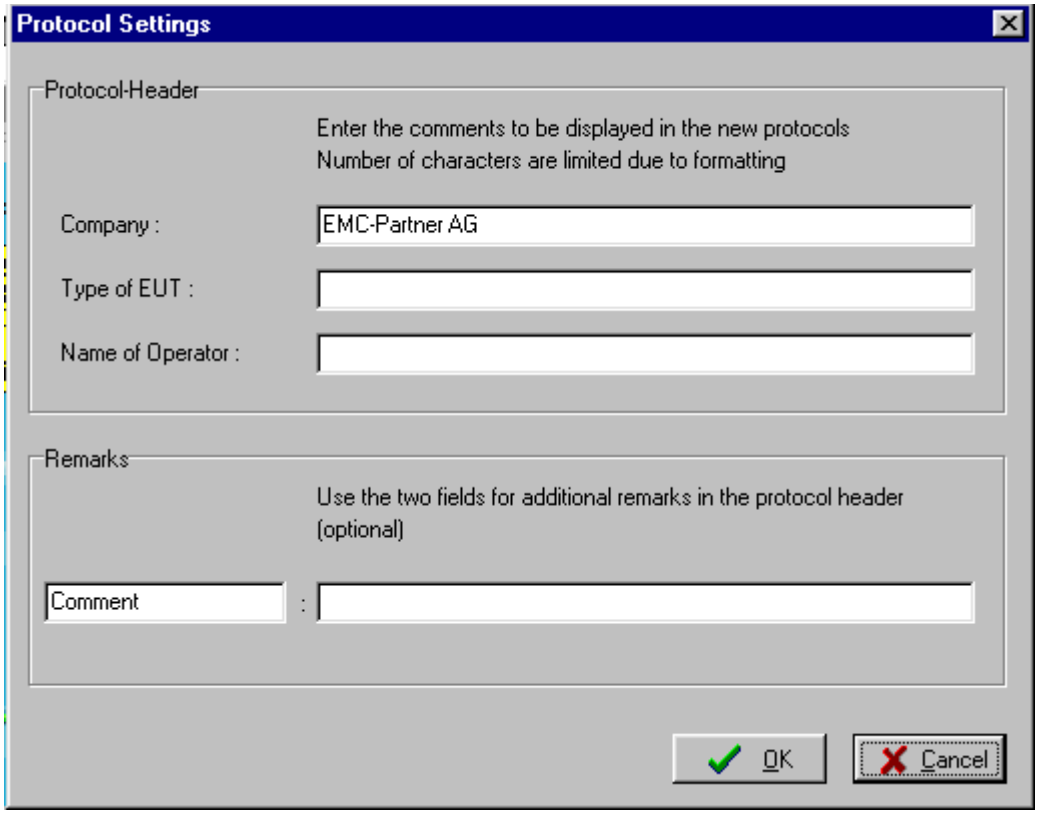
12.5.4 GENECS Protocol possibilities



Show Protocol: Protocol can be opened as set

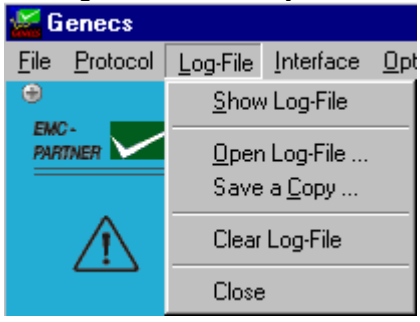
Close Protocol: Closes the protocol

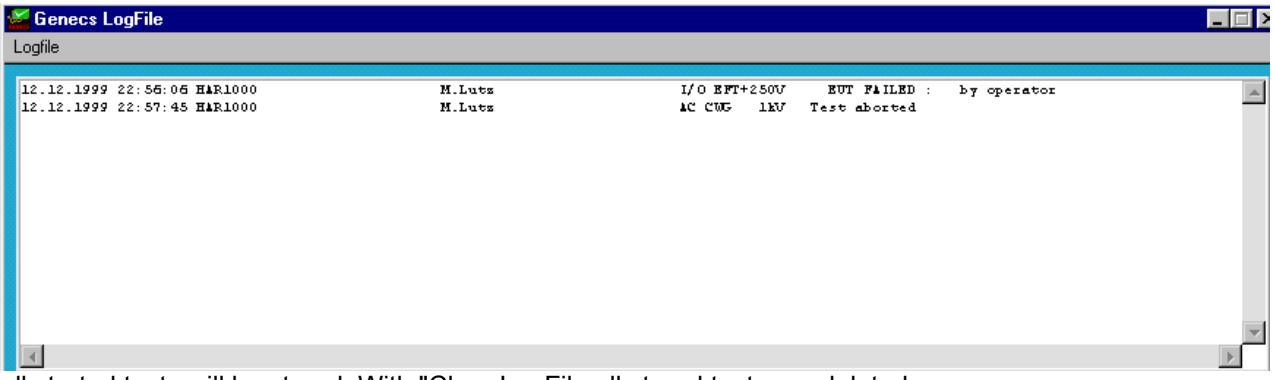
Protocol setting: For each test the EUT operator etc. can be defined. The header of the test report will include the protocol setting



12.5.5 GENECS Log File

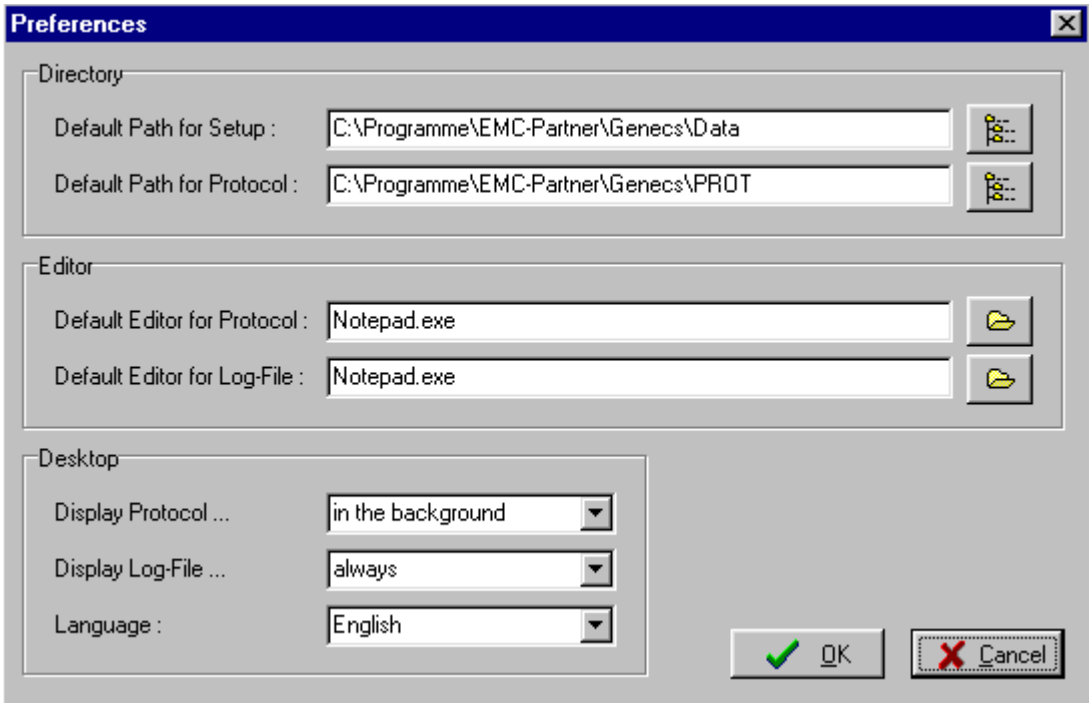
The log file automatically summarises the test results with the most important parameter.





all started tests will be stored. With "Clear LogFile all stored tests are deleted.

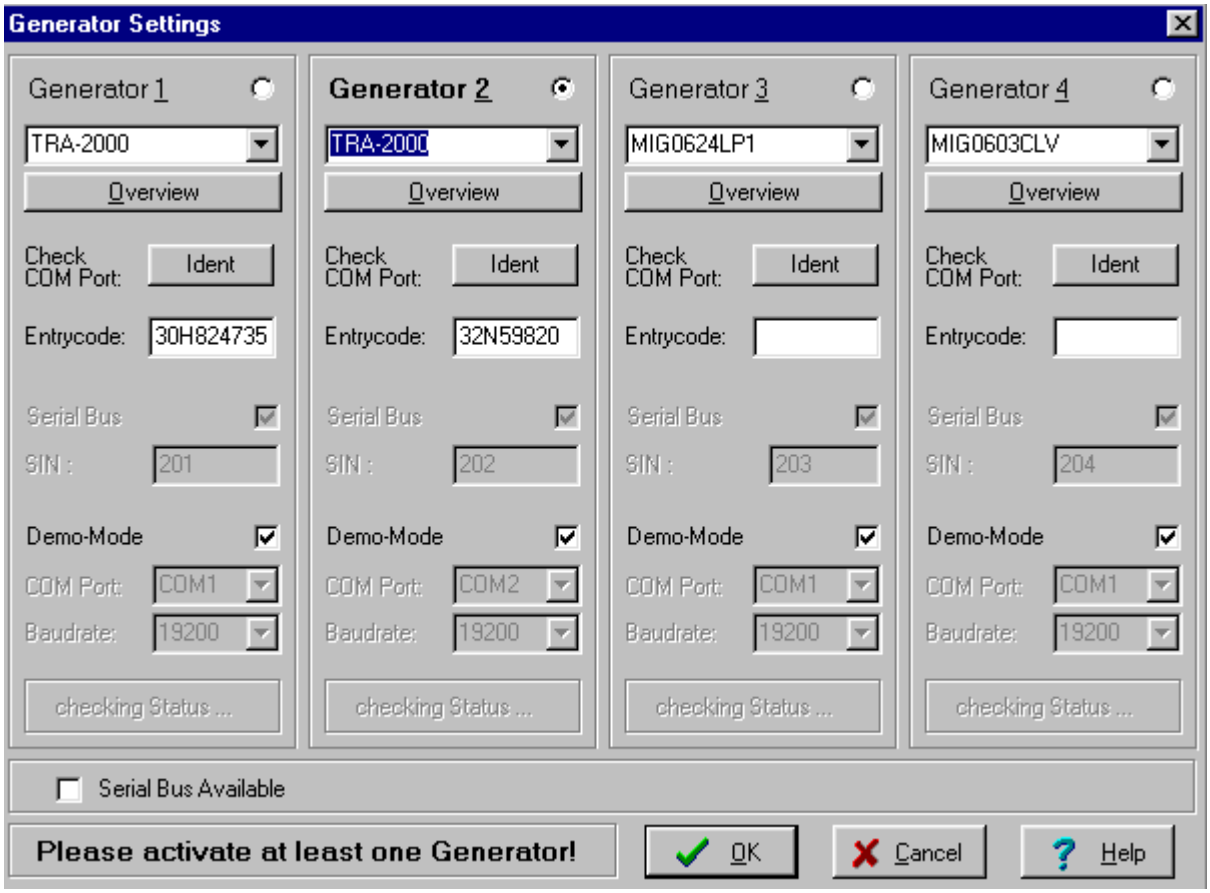
12.5.6 GENECS Preferences



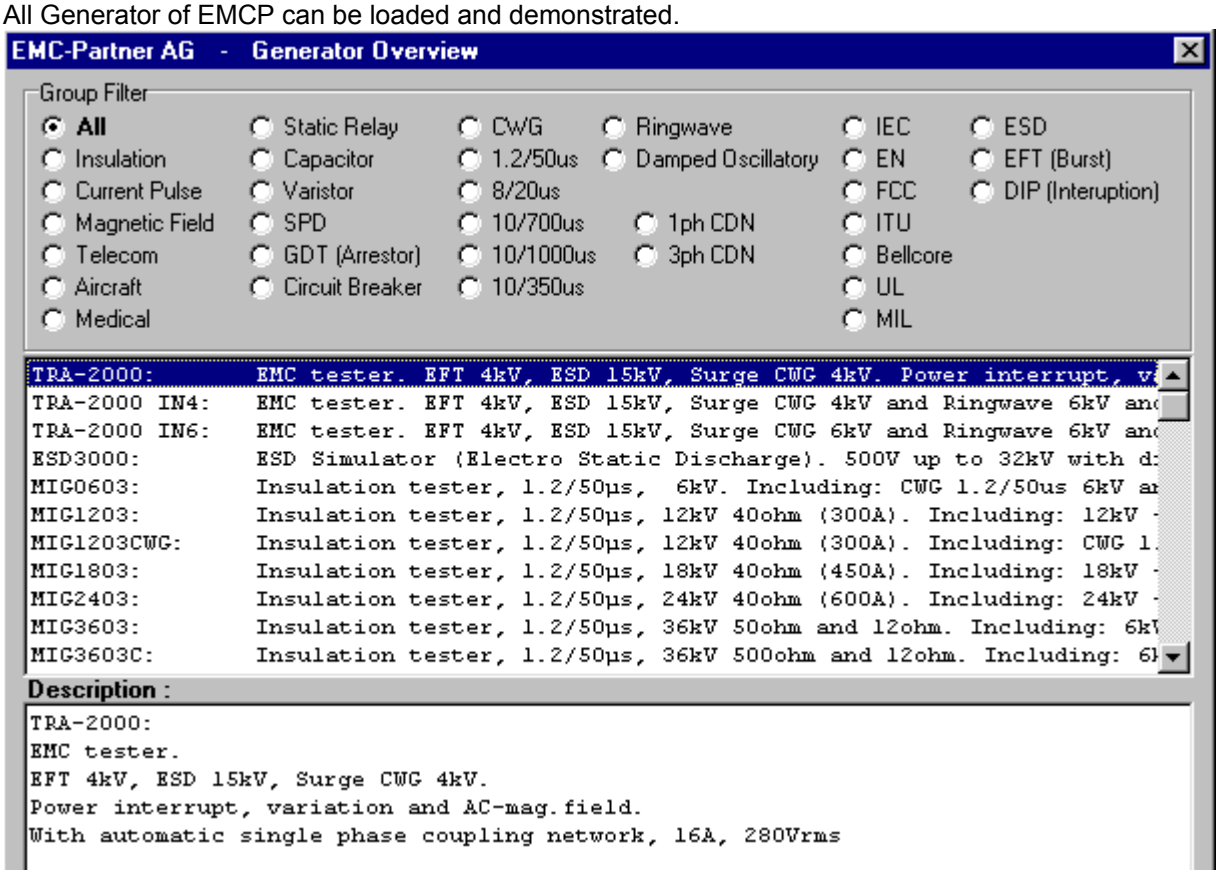
Default Editor for Protocols: With the button ... a text program on your computer can be activated and automatically the test report will be loaded into this program. e.g. Word

Default Editor for LogFile: With the button ... a data bank or calculation program on your computer can be activated and automatically the data will be loaded into this program. e.g. Access or Excel

Display LogFile: When the logfile is not necessary on the monitor it can be turned off. The Log file can be loaded with open logfile.



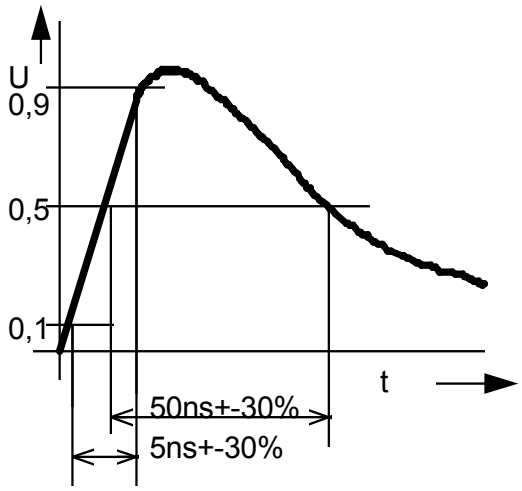
All Generator of EMCP can be loaded and demonstrated.



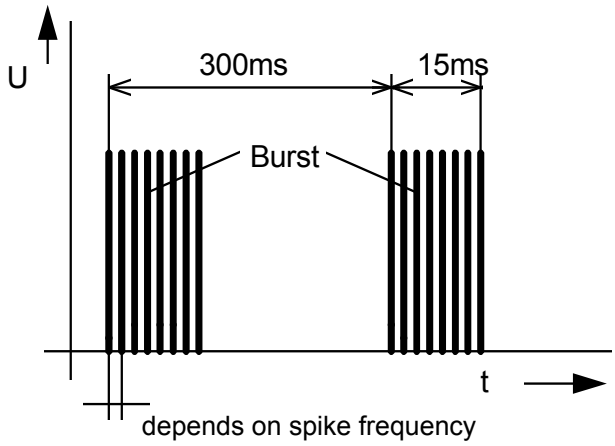
13 Appendix and Corrections

13.1 Appendix

13.1.1 Definition of the EFT Waveform

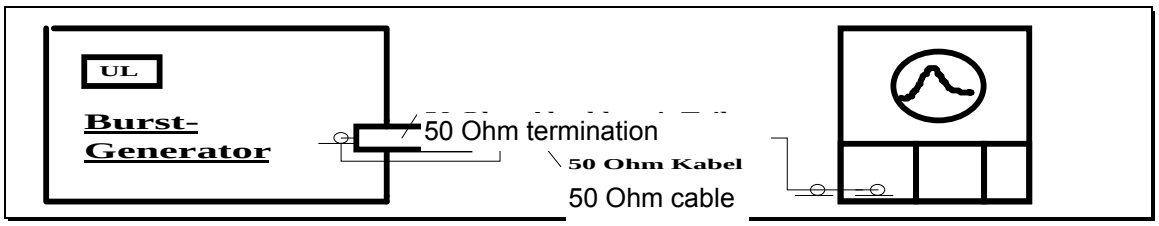


Waveform measured at 50 Ohm



Burst test sequence

In the latest draft of the 61000-4-4- a verification of the waveform at 1000 Ohm is discussed.



Memory oscilloscope
50 Ohm input

Checking the EFT tester. Checking procedure

1. The 50 Ohms terminating resistor, including the voltage divider, must be examined with a sinusoidal voltage (CW) between 100 kHz and 200 MHz

2. The rise time must be between 3.5 and 6.5 ns.

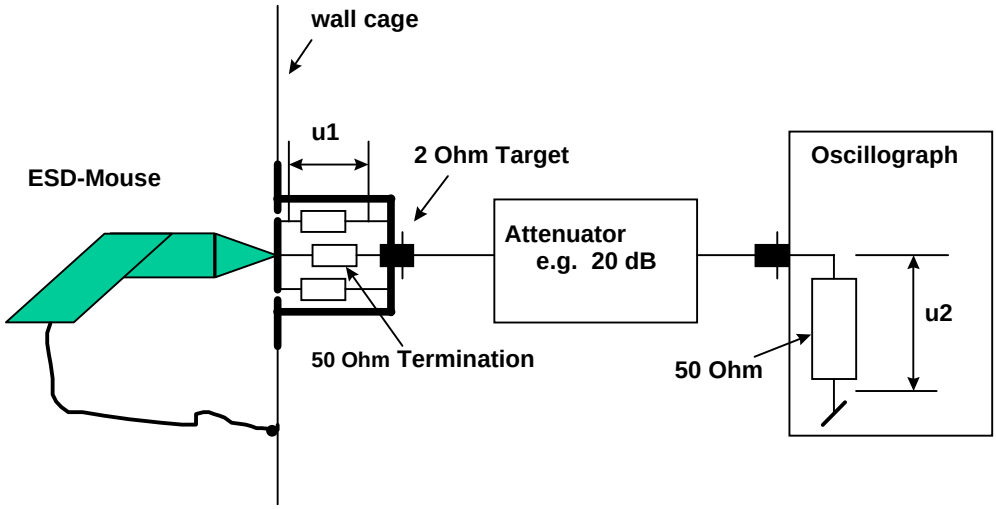
3. The time to half value must be between 35 and 65 ns.

4. The source impedance of the tester is 50 Ohm, providing the coefficient of UL/Uout =2.
   UL = charging voltage
   Uout = output voltage into 50 Ohm

13.1.2 Definition of the ESD Waveform

Level	Test voltage kV+-30%	Peak current A+-30%	Amplitude at 30ns A+-30%	Amplitude at 60 ns A+-30%	**Current peak**
1	2	7,5	4	2	
2	4	15	8	4	
3	6	22,5	12	6	
4	8	30	16	8	

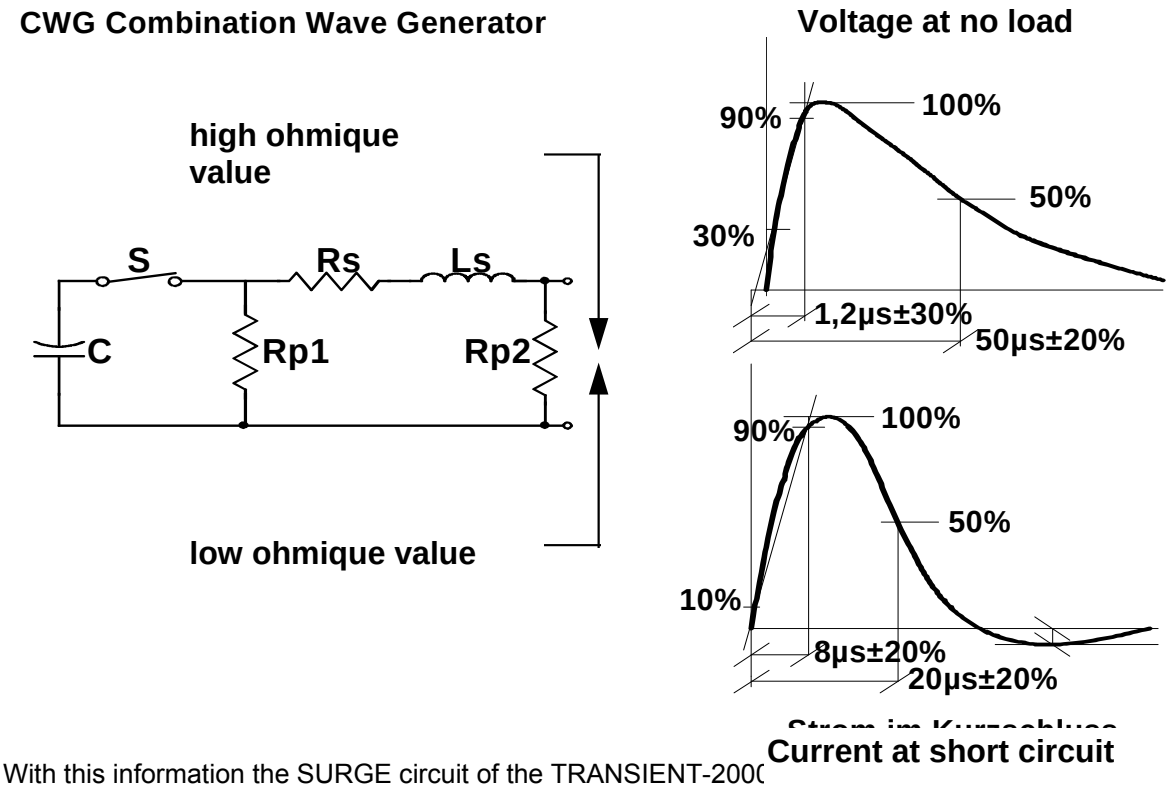
It is only possible to check the impulse current by using very expensive pieces of measuring equipment. The price of such an instrument today lies at approx. 50 k$. In addition, persons who carry out such tests must have some experience with high voltage and high frequency test work, so that they can interpret the measured values. The calibration and verification of the generators must be carried out by the manufacturer or the official calibration authorities.



The ESD-current produces on 2 Ohm Shunt a voltage trop u1. The 2 Ohm target is terminated with 50 Ohm to avoid reflection. With the 20 dB attenuator the 60V trop on the 2 Ohm will be reduced to the allowed input voltage of the oscilloscope. The memory oscilloscope must have a minimum bandwidth of 1 GHz. For all four levels (2,4,6,8 kV) the current wave-form must be within the tolerances as specified in the IEC standard 61000-4-2.

The calibration of the ESD generator should be made at manufacturer side or at a accredited test house.

13.1.3 Definition of the SURGE Waveform



With this information the SURGE circuit of the TRANSIENT-2000

Example: "Voltage"
- choose 1 kV charging voltage
- measure the no load voltage at the generator output. Check whether the wave-form is within the tolerances or not.

Surge voltage front time T1=1.2 µs ±30%	0.84 - 1.56 µs
Time to half value T2= 50 µs ±20%	40 - 60 µs

measure Umax.

Example "Current"
- choose 1 kV charging voltage
- measure the short circuit current at the generator output. Check whether the waveform is within the tolerances or not.

Surge current front time T1= 8 µs ±20%	6.4 - 9.6 µs
Time to half value T2=20 µs ±20%	16 - 22 µs

measure Imax

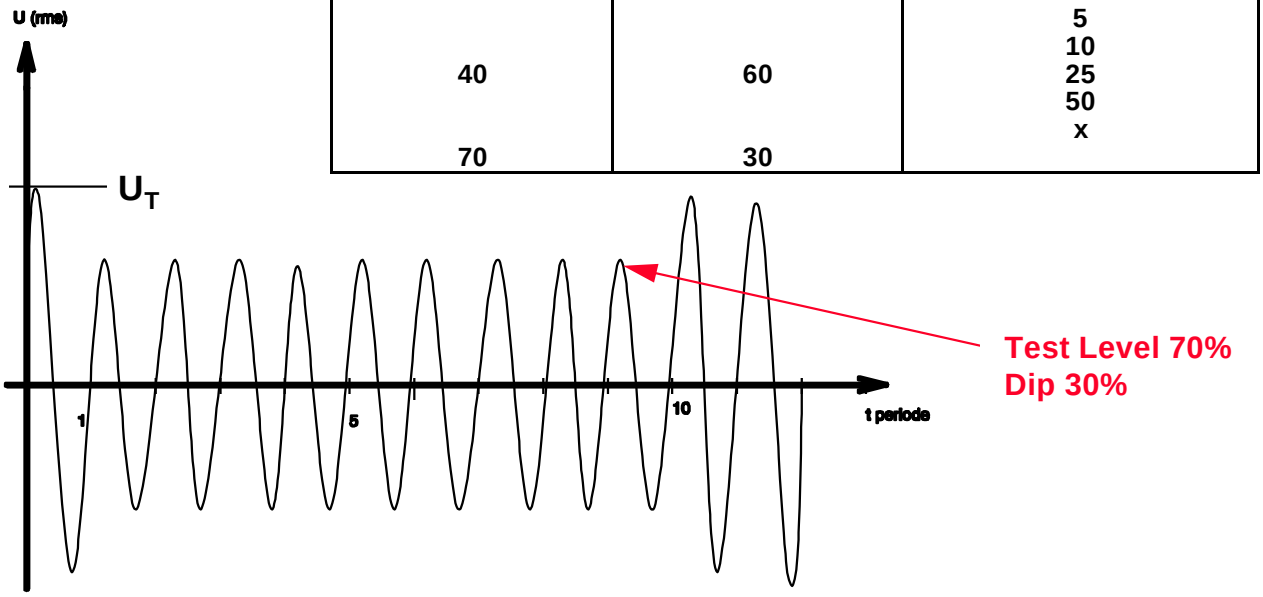
Check the source impedance:

Umax / Imax = 2 Ohm ±10%

13.1.4 DIPS Specification

Test levels DIPS

Test Level % U_T	Voltage Dip/int % U_T	Duration (in period)
0	100	0.5* 5 10
40	60	25 50 x
70	30	



In addition to the data showed in the figure, such as test levels, duration of the interruption, transition time, etc., the inrush current must be tested. Electronic equipment very often contain inrush current limitation circuits. These inrush limiting circuits are often bypassed during interrupts at the turn on part. Consequences are defective power switching modules, or the equipment can not be turned on after the test because the software has not made a restart etc.

So that the test will cover this aspect, the inrush current capability of the generator must be at least 500 A peak. The verification of the generator inrush current is defined as follow:

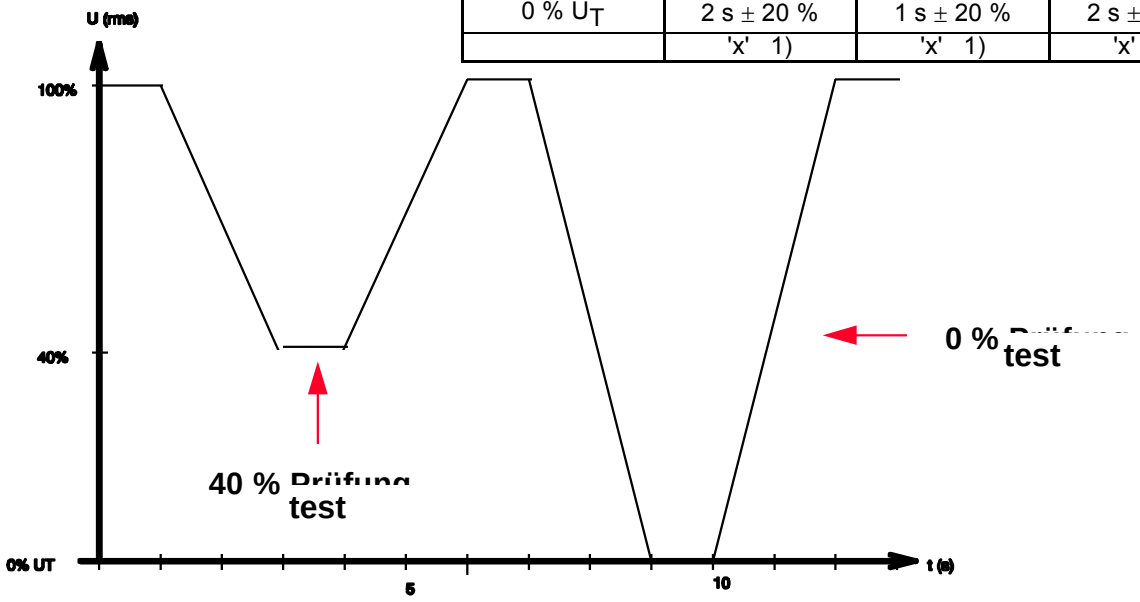
Turn on the generator at a phase angle of 90 degrees. Using a current sensor, measure the current in a capacitor of several µF. The measured amplitude must be equal to/or greater than 500 A. When the tester can generate a current amplitude of 500 A, all equipment with current consuming up to 16 A can then be tested.

If the current amplitude of 500 A is not reached, then the inrush current of the EUT must be measured. The inrush current of the tester must be a minimum of 30 % higher than the inrush current of the EUT.

13.1.5 VARIATION Specification

Test levels Voltage variation

VoltageTest Level	Time for decreasing Voltage	Time at reduced voltage	Time for increasing voltage
40 % U_T	2 s ± 20 %	1 s ± 20 %	2 s ± 20 %
0 % U_T	2 s ± 20 %	1 s ± 20 %	2 s ± 20 %
	'x' 1)	'x' 1)	'x' 1)



13.1.6 Type Test Protocol EFT, ESD, SURGE, Short DIP, Long DIP, Variation

In this section, you will find examples of test reports.

13.2 Correction

13.2.1 Declaration of conformity to the EMC directive 89/336/EEC

see appendix at the end of this documents.

13.2.2 Declaration of conformity to the LV directive 93/68/EEC

see appendix at the end of this documents.

13.2.3 Declaration of conformity to the Basic Standards

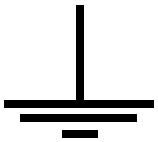
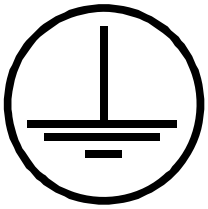
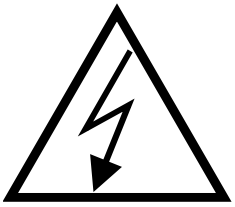
see appendix at the end of this documents.

14 Glossary

Wherever possible, definitions in accordance with IEC 50 (IEV 161) are used.

EUT EST	Equipment under Test French abbreviation of EUT
EMV = EMC = CEM	Electro Magnetic Compatibility German:Elektromagnetische Verträglichkeit French: compatibilité elctromagnetique
Hybrid pulse	Voltage at no load 1.2 / 50 µs and current at short circuit 8 / 20µs.
CWG	Definition in IEC 1000-4-5 used for Surge Tester Combination wave generator.
Coupling network	Electric circuit for transferring energy with low losses from one circuit into another circuit.
Decoupling network	Electric circuit to prevent transmitting energy from one circuit into another circuit.
CDN coupling decoupling network (single or three phase unit)	Consist of a coupling and a de-coupling network.
EFT	Electric Fast Transient (switched inductance)
ESD	Electric Static Discharge
SURGE	Transients with high energy content with relatively low frequency content as produced by lightning and switching of power lines.
DIP	Short voltage interruption or short voltage drop
IEC	International standardisation organisation for electronic technology
VARIAC	Voltage variable transformer
SPIKE	One pulse of the burst
CRO	oscilloscope
HV	High Voltage
rms.	root mean square; effective value

Used symbols:

	Direct current
	Alternating current
	Three phase alternating current
	Earth (ground) terminal
	Protective conductor terminal IEC 417, No. 5019
	Caution, risk of electric shock ISO 3864, No. B.3.6
	Caution (refer to accompanying documents) ISO 3864, No. B.3.1

15 Index

S

T

V

W

Declaration of Conformity to Standards

The EMC Tester

Type: TRA2000

complies with the following standards:

EFT	**IEC/EN 61000-4-4 Ed.2**
ESD	**IEC/EN 61000-4-2**
SURGE	**IEC/EN 61000-4-5**
a.c. MF	**IEC/EN 61000-4-8 with antenna**
Surge MF	**IEC/EN 61000-4-5 with antenna**
DIPS and INTERRUPTION on a.c. power	**IEC/EN 61000-4-11 Ed.2 single phase**
COMMON MODE	**IEC/EN 61000-4-16 with accessories.**
INTERRUPTION on d.c.	**IEC/EN 61000-4-29**

Laufen, 02. February 2004

EMC PARTNER AG

M. Lutz
Managing Director

EMC PARTNER AG

R. Casanova
Manager Development

Appendix to 14.2.3 Conformity declaration with basic standards

CE

EMC - PARTNER

Manufacturer Declaration Of Conformity

Directive 73/23/EWG; 93/68/EWG

The EMC Tester **Type: TRA2000; S/N > 500**

is designed and manufactured complying with the following harmonised standards:

Harmonised:
EN 61010-1: 1990/A1: 1992-09
EN 61010-1: 1990/A2: 1995

international
IEC 61010-1

in accordance with the regulation of LV - directive of the members states 73/23/EWG; 93/68/EWG

EMC PARTNER authorised representative established within the EC Community

H+H High Voltage
Technology GmbH
Im kurzen Busch 3
DE - 58640 Iserlohn

Laufen, 02. February 2004

EMC PARTNER AG

M. Lutz
Managing Director

EMC PARTNER AG

R. Casanova
Manager Development

Appendix to 14.2.1 Conformity declaration with the Low Voltage directive

CE

EMC - PARTNER

Manufacturer Declaration Of Conformity

Directive 89/336/EWG

The EMC Tester

Type: TRA2000, S/N > 500

has been tested in accordance with the following standards:

harmonised:
EN 61000-6-3
EN 61326:1997/A1:1998

international
IEC 61000-6-3
IEC 61326-1

fulfilling the directions of the EMC - Directive 89/336/EWG

EMC PARTNER authorised representative established within the EC Community

H+H High Voltage
Technology GmbH
Im kurzen Busch 3
DE - 58640 Iserlohn

Laufen, 02. February 2004

EMC PARTNER AG

M. Lutz
Managing Director

EMC PARTNER AG

R. Casanova
Manager Development

Appendix to 14.2.2 K Conformity declaration with the EMC directive