User manual

EFT/ Burst Generator
PEFT Junior

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Contents

1. Description

1.1 Introduction

The PEFT Junior test system, enables electromagnetic immunity testing in accordance with the standard IEC 1000-4-4 (IEC 801-4).
The built in single phase mains filter enables coupling of EFT / Burst into the EUT mains supply with minimum disturbance to the general mains.

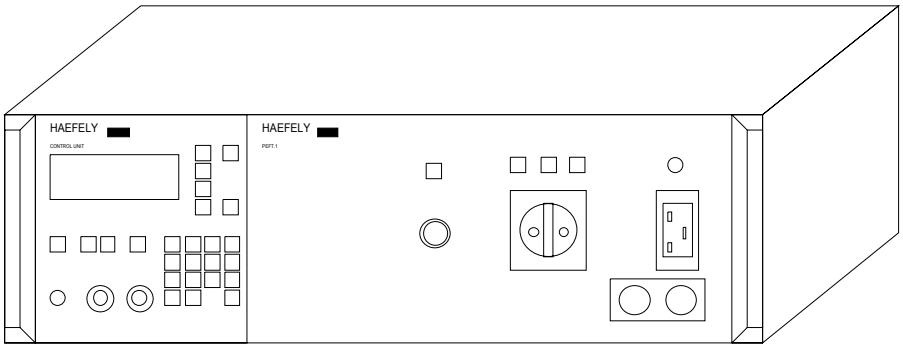


Fig. 1.1

The equipment is controlled by an integrated microprocessor control unit (P90).

In order to conduct three phase tests in accordance with the standard IEC 1000-4-4, it is necessary to use an external coupling filter. For example the FP-EFT 32.1 is a three phase filter that can be controlled directly from the PEFT Junior mainframe.
Tests in IEC 1000-4-4 which require coupling of the EFT / Burst into data and communication lines, can be achieved using the capacitive coupling clamp type IP4A.
The test system can be made fully automatic, by using the optional interface type RC 730 for RS232 and IEEE communication with the WinPATS software package.

1.2 Technical data

The PEFT Junior, has the following technical characteristics:

1.2.1 Impulse shape

Definition in accordance with the standard IEC 1000-4-4 (IEC 801-4)

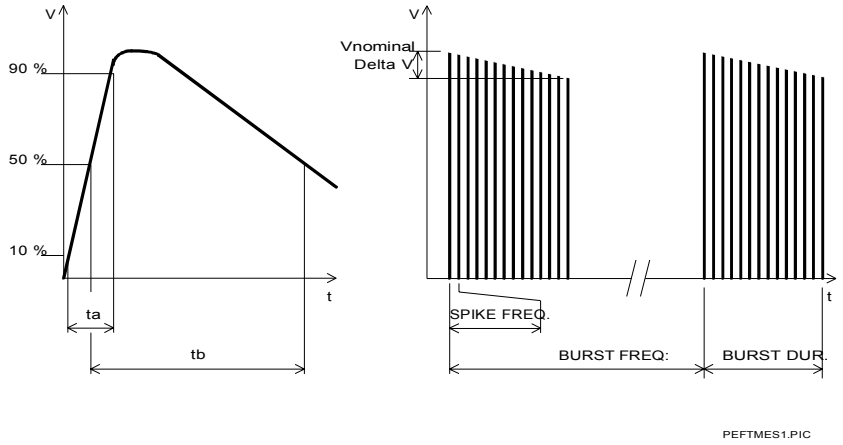


Fig.1.2.1

Voltage impulse form into 50 Ω	ta tb	5 ns ±30% 50 ns ±30%
Voltage impulse form into 1kΩ	ta tb	5 ns ±30% 35 ns...150 ns
Output impedance		50 Ω ±20%
Polarity	POLARITY	positive / negative

Tab.1.2.1

1.2.2 Voltage test levels

Open circuit test voltage	Vnominal	0.22 to 4.5 kV ±10%
delta V for 75 impules per burst	frequency=10 kHz	≤ 1%
	frequency=100 kHz	≤ 2%
	frequency=1 MHz	≤ 10%

Tab.1.2.2

1.2.3 Operating frequencies

Impulse frequency (limited as a function of test voltage, see Fig 1.2.3a)	SPIKE FREQ	1 Hz to 1 MHz ±2% for F≤100 kHz ±20% for F≤1MHz
Burst duration	BURST DUR	0.01 to 20 ms ±2%
Burst frequency	BURST FREQ	1 to 400 Hz ±2%
Impulses / second		max. 600
Impulses / burst	SPIKE/BURST	max. 150

Tab.1.2.3

Diagram of limitations

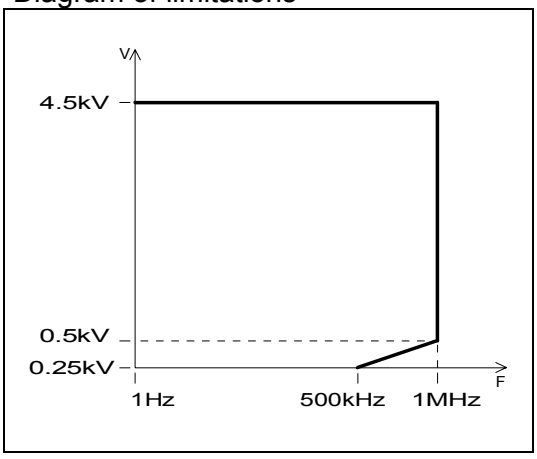


Fig.1.2.3a

1.2.4 Coupling modes

The EFT / burst can be delivered as follows.

Coupling into control lines using the capacitive coupling clamp	`To HV-OUT`	Direct output to SHV connector
Coupling into single phase mains	`To-LINE 1PHASE`	Output coupled to integrated single phase filter
Coupling into three phase mains	`To-LINE 3PHASE`	Direct output to SHV connector, with control of the external three phase filter

Tab.1.2.4

1.2.5 Single phase integrated filter

Maximum operating voltage	`Ueff`	250 V
Maximum operational current		DC max.10 A 50 Hz max. 16 A 400 Hz max. 9 A
Bandwidth		1 to 100 MHz
Coupling attenuation		< 2 dB
Asymetric filter attenuation		> 20 dB

Tab. 1.2.5

1.2.6 Connections

High voltage output	to coaxial connector type SHV
Mains input to integrated filter	connector type IEC 320 250 V / 16 A
Mains output from integrated filter	Euro (Schuko) 250 V / 16 A

Tab. 1.2.6

1.2.7 Control

Synchronisation with mains	$16^{2/3}$,40, 50, 60 ou 400 Hz
Impulse trigger	Manual or automatic
Oscilloscope trigger	Signal + 15 V on output BNC
Safety	Software: via safety circuit
External 3 phase coupling filter (option)	The connection "P90 extension" enables control of an external coupling filter.
Test report	By connecting a printer to the serial output.
Remote control (option)	Type RC730 interface for RS232 and IEEE.

Tab. 1.2.7

1.3 Dimensions

The generator is built into a 19 " case 3 " high, its dimensions are:

Case (internal)	19", 3", 480 mm
Housing	520 x 166 x 500 mm
Weight	18 kg

Tab 1.3

Attention
For optimal ventilation and access to the rear panel connectors, it is recommended that a space of approximately 25 cm be left around the generator

1.4 Electrical connections

The generator mains input is on the back panel.
Mains requirements are:

Single phase voltage	230 V (50 Hz)	± 10 %
	115 V (60 Hz)	± 10 %
Nominal power	120 VA	(230 V, 50 Hz)
		(115 V, 60 Hz)

Tab. 1.4

Mains voltage selection is made using the manual switch on the rear panel.
Connection to the mains is made using a 10 A cable fitted with the relevant plug:
Europe (CEE-7/VII)
Great Britain (BS-1363)
Switzerland (SEV Type 12)
USA (NEMA5-15P)

1.5 Lexicon

An aide memoire for the electrotechnical vocabulary used in the standard IEC 50 (161)

EUT	Equipment Under Test
EMC	Electro Magnetic Compatibility
EFT/B	Electrical Fast Transient / Burst
Coupling network	Electrical network for the purpose of transferring energy from one circuit to another
Decoupling network	Electrical network for the purpose of filtering signals
Coupling filter (single-threephase)	Electrical circuit (single-threephase) incorporating coupling and decoupling networks
HV	High Voltage

Tab 1.5

2. Safety

2.1 Safety standards

The generator has been constructed in accordance with IEC 348 and IEC 1010: Safety requirements for electronic apparatus.
This user manual contains information and warnings that must be heeded by the user for safe and efficient use of the generator.

2.2 Environmental conditions

The generator contains high voltage circuits in a very small volume, this defines the environmental conditions under which it may be operated.

Temperature	15 °C to 35 °C	
Relative humidity	45 % to 75 %	
Atmospheric pressure	86 kPa to 106 kPa	(860 to 1060 mbar)
Absence of	Frost, dew, rain, condensation, water infiltration, direct sun	

Tab. 2.2

The generator must only be used in dry rooms. In the case of visible condensation, the generator must be dried before use.

Under certain conditions sparks can be produced by the EUT or generator. Because of this the generator must not be used in an area where an explosion hazard exists.

WARNING
Persons with heart pace makers must not be in the area when the generator is operating

2.3 Operating precautions

The generator produces high volatges, it is essential that the following basic safety instructions be followed:

■ Do not approach the EUT during testing. Accesss to the EUT during operation can be prevented by use of the safety circuit. ■ Never touch high voltage cables or connections during operation. ■ When handling the EUT, the high voltage and any supply to the coupling filter must first be switched off. ■ For any service inside the generator, first disconnect the mains.

Tab. 2.3

For safety reasons, the generator must only be connected to an earthed mains supply.

2.4 Electromagnetic compatibility

The EUT may radiate electromagnetic energy. The local rules and regulations must be observed with regard to this stray energy.

The PEFT Junior should not be placed close to sensitive measuring instruments.

The PEFT Junior satisfies the requirements of the following immunity tests:

■ Electrostatic discharge	level 4	(IEC 1000-4-2)
■ Electric fast transients and burst	level 3	(IEC 1000-4-4)
■ Surge	level 3	(IEC 1000-4-5)

Fig. 2.4

2.5 Limit of liability

This operator manual is an integrated part of the PEFT Junior test system.
The safety and operating instructions must be complied with.
Emile Haefely & CO LTD. and all its sales partners refuse to accept responsibility for consequential or direct damage caused to persons and / or goods due to non-observance of the user manual or incorrect use of the PEFT Junior.

3. Technical overview

3.1 Construction

The generator comprises the following parts:
- microprocessor unit P90, contains all the control elements of the PEFT Junior.
- Main PCB, here are mounted the high voltage supply and regulation circuits, the impulse forming circuits, high voltage switch and most elements of the single phase coupling filter.
- Power supply unit, generates 24 V DC.

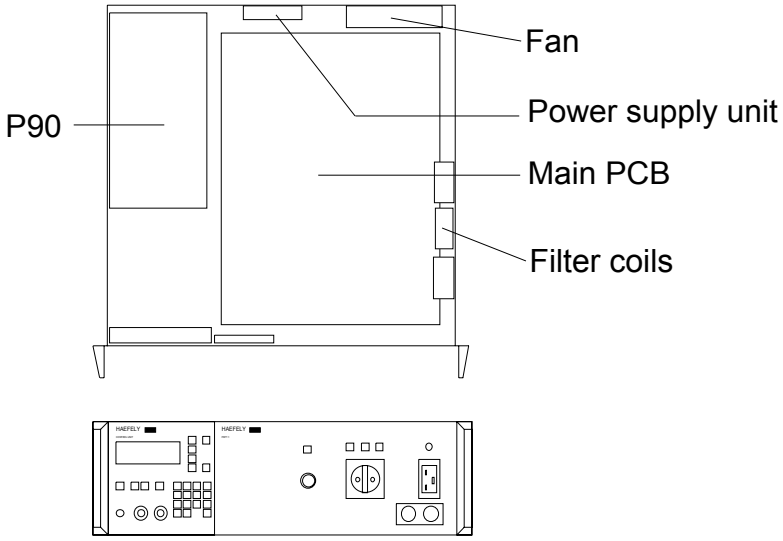


Fig. 3.1

3.2 Control circuits

the P90 microprocessor is the interface between the user and the generator. It controls all the functions of the PEFT Junior.
The LCD display has two user accesseable layers, the first is to display parameters and test sequences, the second displays the operational conditions during a test.

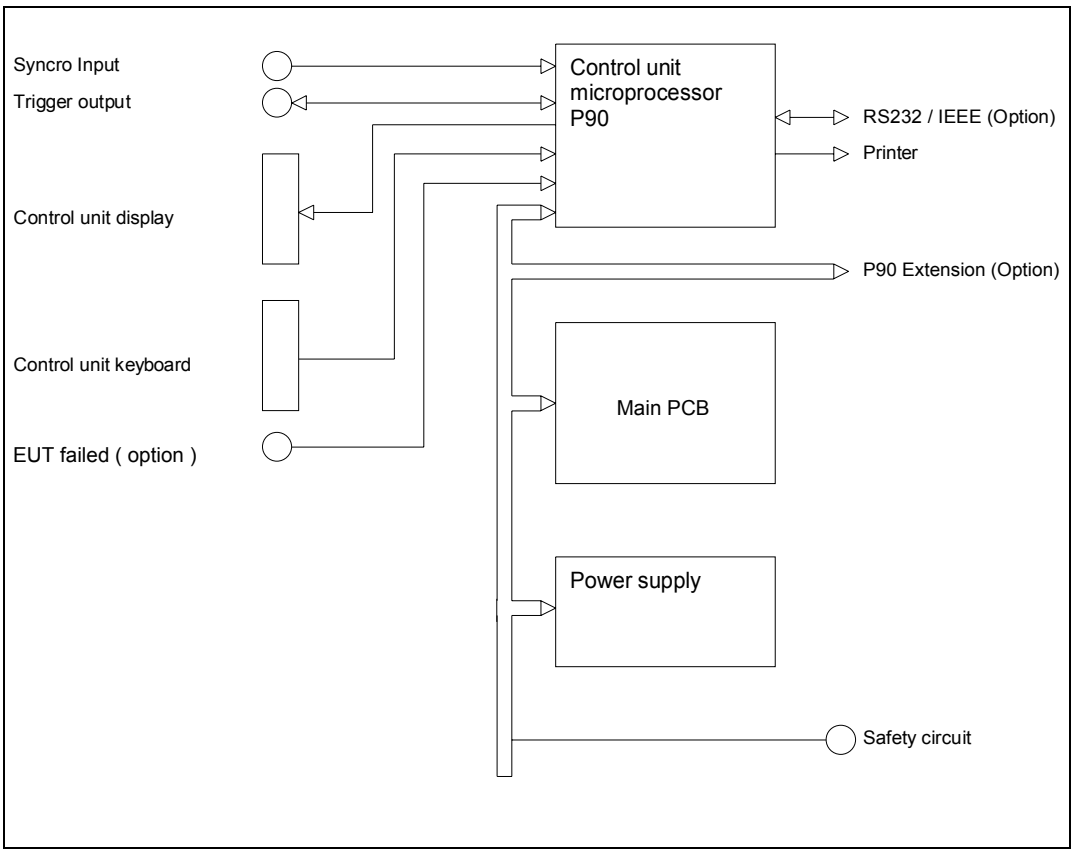


Fig. 3.2

3.3 Power supplies

the PEFT Junior must be supplied from a single phase supply of either 230 V / 50 Hz or 115 V / 60 Hz. Supply voltage changeover is accomplished by use of the manual switch on the rear panel.

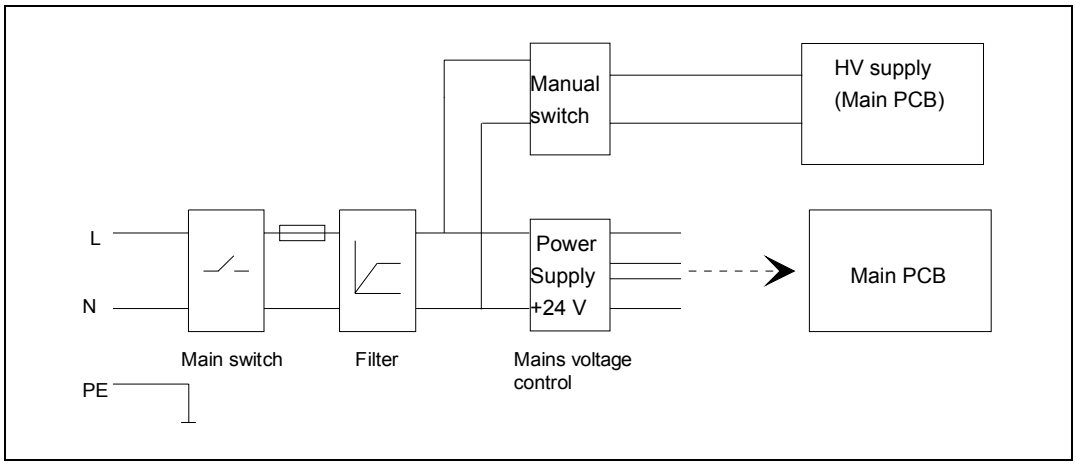


Fig. 3.3

3.4 High voltage circuit

The high voltage circuit is mounted on the main PCB and comprises, the high voltage source, an earth safety relay, high voltage switch and the energy storage capacitors.
These capacitors, 11 in series, are a charge reservoir loaded from and regulated by the high voltage source. They provide energy for the impulse, which is released by the high voltage switch.

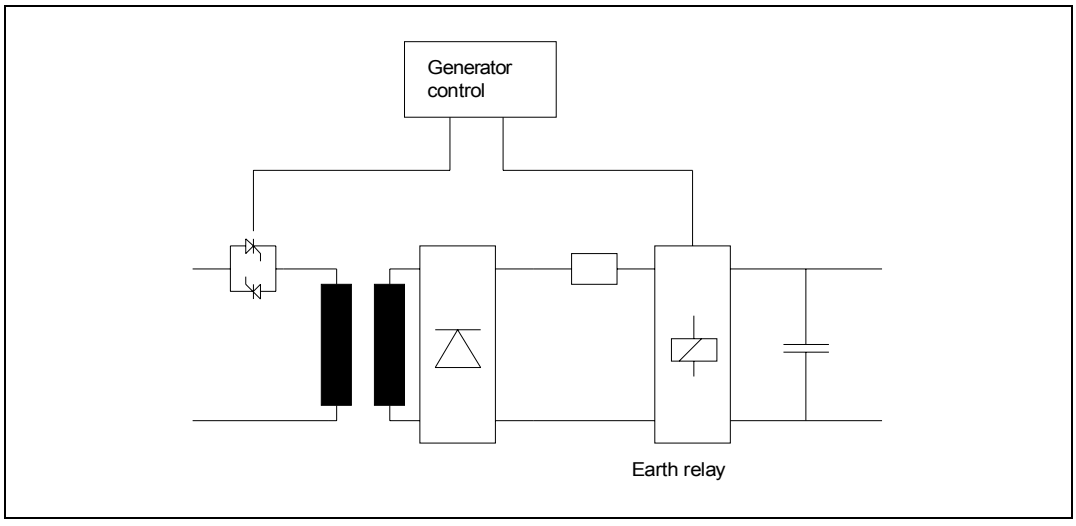


Fig. 3.4

3.5 Impulse circuits

The high voltage impulse forming circuits are located on the main PCB along with most of the components of the single phase coupling filter. The only coupling filter elements not mounted on the PCB are the 140 uH filter coils. The coupling filter comprises the coupling capacitors and decoupling (filter) elements. The coupling path is automatically switched under P90 control.

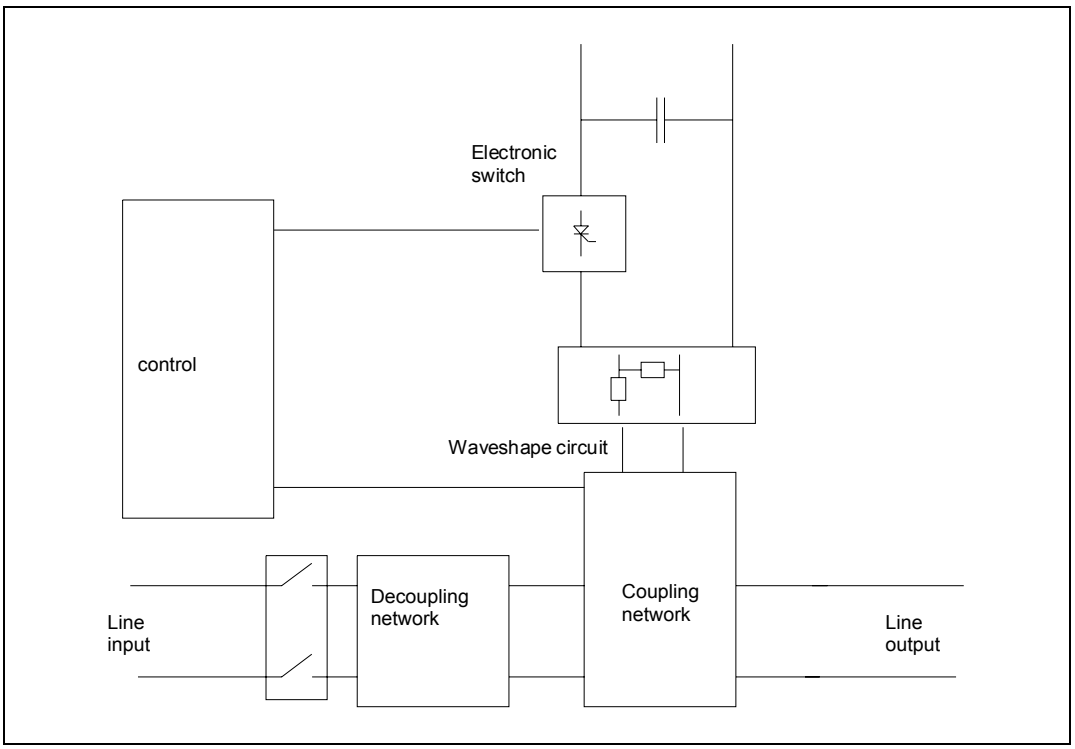


Fig. 3.5

4. Control elements

4.1 Generator rear panel

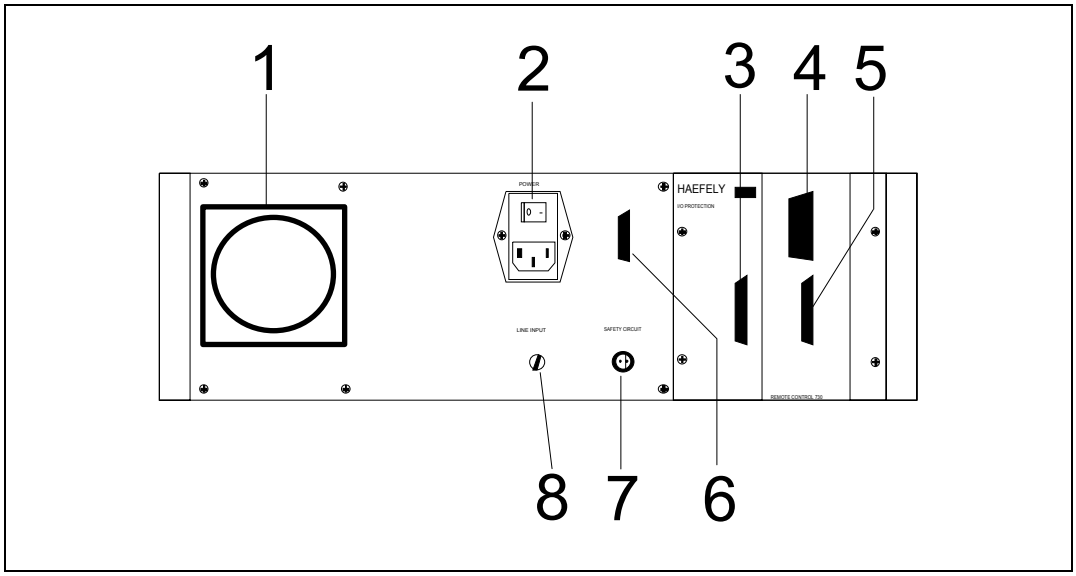


Fig. 4.1

4.1.1 Ventilation

A single fan, mounted on the rear panel, facilitates removal of warm air from the coupling filter. It is recommended that a space be left around the side of the PEFT Junior to assist in warm air dissipation

4.1.2 Primary power.

Mains primary power (2) is connected to a 10A socket with integrated mains switch, fuse and supply filter.
A mains protection fuse of the type T 0.2 A / 250 V, is mounted on the main PCB.

4.1.3 Printer connection (PRINTER)

Test reports can be generated by connecting a serial printer to the PRINTER socket (3).
the RS232 configuration is:

Baud rate	9600
Databit	8
Stopbit	2
Parity	0

The following pins are used:

Pin 2	RxD
Pin 3	TxD
Pin 20	DTR
Pin 7	GND
Pin 18	+ 5 V
Pin 1	Chassis

4.1.4 Interface IEEE/GPIB (Option)

This interface is part of the RC 730 remote control module.
For more information refer to the RC 730 user manual.

4.1.5 Interface RS 232.(Option)

This interface is part of the RC 730 remote control module.
For more information refer to the RC 730 user manual.

4.1.6 External coupling filter control - P90 EXTENSION (option)

The P90 EXTENSION connection enables control of an external three phase coupling filter type FP-EFT 32.1 directly from the PEFT Junior test system.
As for the single phase integrated filter, the generator controls automatically, the coupling mode and synchronisation source.
Further information is provided in the FP-EFT 32.1 user manual.

4.1.7 Safety circuit (SAFETY CIRCUIT)

The safety circuit connector enables the user to construct a safety loop around the test system and / or EUT.
Detection of this circuit condition is under software control.
When activated (open) the software disables the high voltage and a failure message is displayed.
The short circuit safety plug delivered with the generator can be adapted to suit the users requirements.

4.1.8 Mains voltage selection (Line input)

The mains voltage selector, can be switched using a screwdriver or small coin. The switch function is to enable selection to either 110 V or 220 V in accordance with the laboratory supply.

4.2 Generator front panel

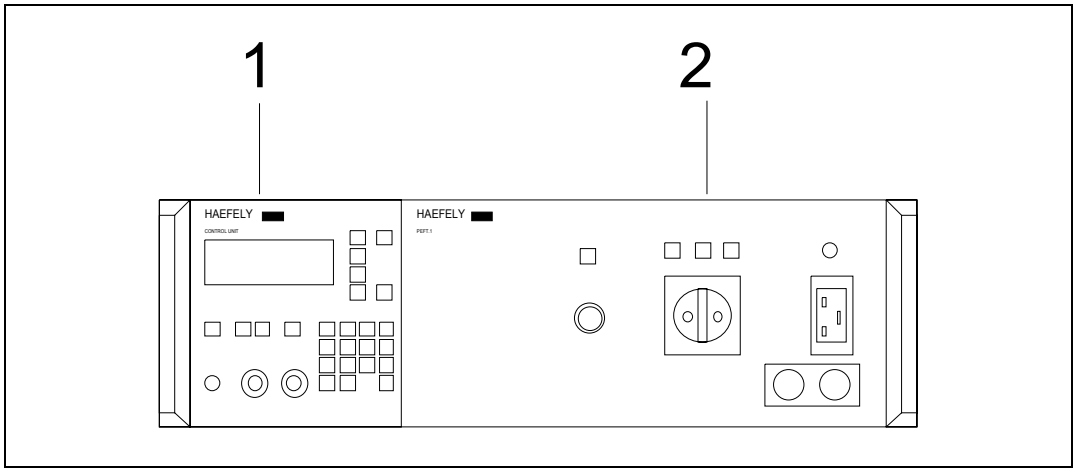


Fig. 4.2

1 - Control unit P90.1
2 - High voltage impulse output connections

4.2.1 Control unit P90

The PEFT Junior is controlled by a microprocessor control unit. The processor (8085), monitors generator functions, reads the keypad, sends information to the display, controls test parameters and facilitates the storing and recall of test sequences. The user enters all commands from the front panel. Main components of the front panel are an LCD display (1) a numerical keypad (11) and the function keys (9).

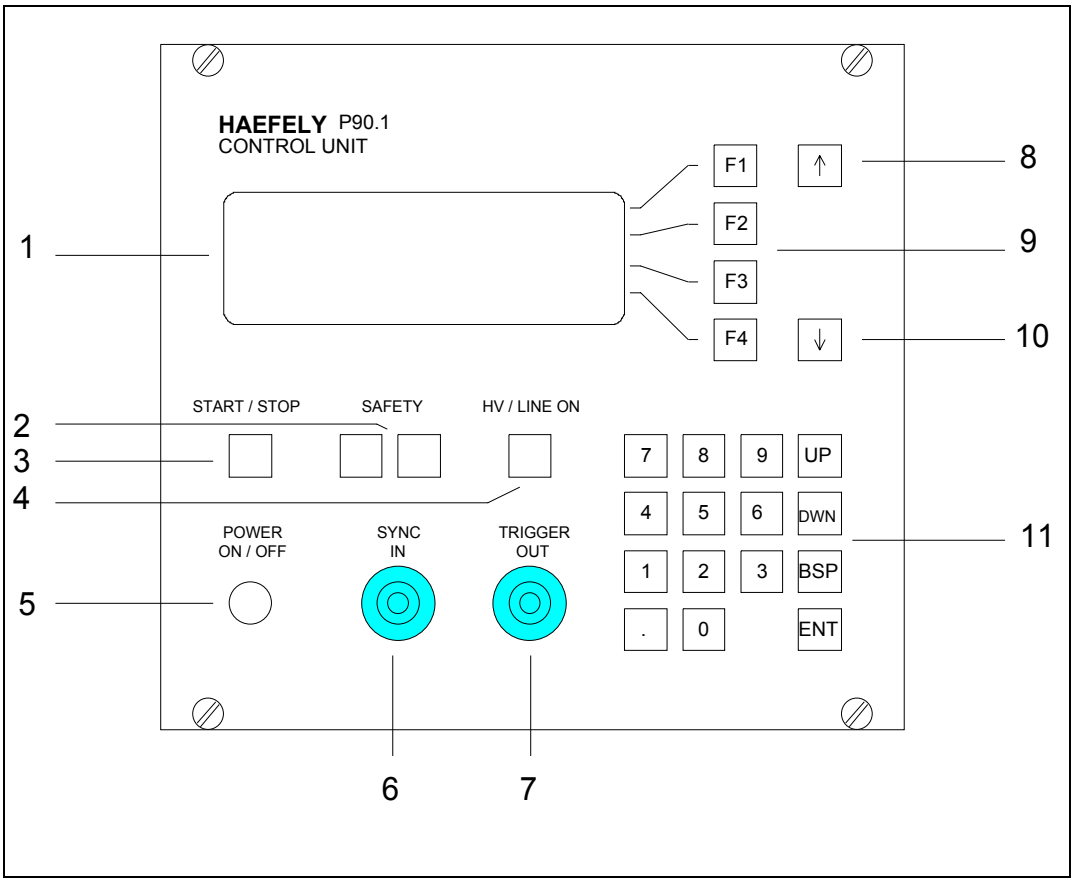


Fig. 4.2.1

4.2.1.1 Liquid crystal display (1)

PEFT Junior status information, test parameters and test sequences are available on this display. The display is four lines of twenty characters each. Each line relates to a function key (9). The last digit on the first and fourth lines is reserved for the symbol → which indicates more menu pages are available either above or below.the current position. These pages can be accessed using the keys (8) and (10).

4.2.1.2 Safety circuit indications SAFETY (2)

The state of the safety circuit is indicated by the SAFETY lamps, green indicating that the safety circuit is open and red that the circuit is closed. The function of the safety circuit has already been described in section 4.1.12.

A green lamp, open safety circuit, means that the high voltage is disabled and it is safe to work with the EUT.

A red lamp, safety circuit closed, means that the high voltage can be enabled.
Exercise caution !

4.2.1.3 START / STOP key (3)

The START / STOP key activates the high voltage and commences the test sequence. The lamp HV / LINE ON (4) illuminates, indicating the high voltage on state. Pressing START / STOP when the test is running will disable the high voltage.

During a test sequence, START / STOP enables a program to be stopped or continued depending on the generator condition. For more information refer to section 6.

4.2.1.4 HV / LINE ON indication (4)

If this lamp is illuminated, the high voltage is on and may be present at the high voltage output or on the EUT.

4.2.1.5 POWER ON / OFF switch (5)

Primary power is made available to the internal circuits when this switch is depressed.
A green lamp in the switch indicates that the generator is under power. The entry menu should be displayed on the front panel.
For safety reasons, only a low level voltage is available on this switch.

4.2.1.6 Synchronisation input SYNC IN (6)

The BNC SYNC IN enables connection of an external AC signal having the following parameters:

Voltage	24-264 Veff
Frequency	$16^{2/3}$-400 Hz

Tab. 4.2.1.6

This signal is used to synchronise the PEFT Junior output when operated in conjunction with a coupling filter.

4.2.1.7 Oscilloscope trigger output TRIGGER OUT (7)

Available at the TRIGGER OUT socket is a square wave of + 15 V amplitude with the negative edge synchronised to each burst.

4.2.1.8 Menu previous page (8)

The ↑ key enables scrolling backwards, only if the → character is available at the end of the first line.

4.2.1.9 Function keys F1 to F4 (9)

The keys F1 to F4 activate user access to the functions shown on the respective lines of the display. After pressing a key, the cursor is visible, and the parameter can be changed. After entering the new value, press the function key again and the parameter is entered. Parameter values consist of both alphabetic and numerical characters.

4.2.1.10 Menu next page (10)

The key ↓ enables scrolling forwards, only if the → character is available at the end of the fourth line.

4.2.1.11 Numerical keypad (11)

The numerical keypad is used to enter numerical values or change predefined values.

The keys 0 to 9 are used to change a parameters numerical value. When a parameter has been selected with one of the function keys, the cursor is placed on the last digit of the parameter value. New data entered from the keypad automatically overwrites the previous value. When a change is confirmed with the ENT key, the internal memory replaces the old data with the new value.
The cursor is no longer visible.

· is the numerical comma.

Press ENT to place the current parameter value in memory.

The BSP key shifts the cursor by one digit to the left. the key is useful for corrections.

The UP key increments a numerical value or changes the value of a pre defined alphanumeric character.

The DWN key decrements a numerical value or changes the value of a pre defined alphanumeric character.

4.2.2 High voltage impulse output connections

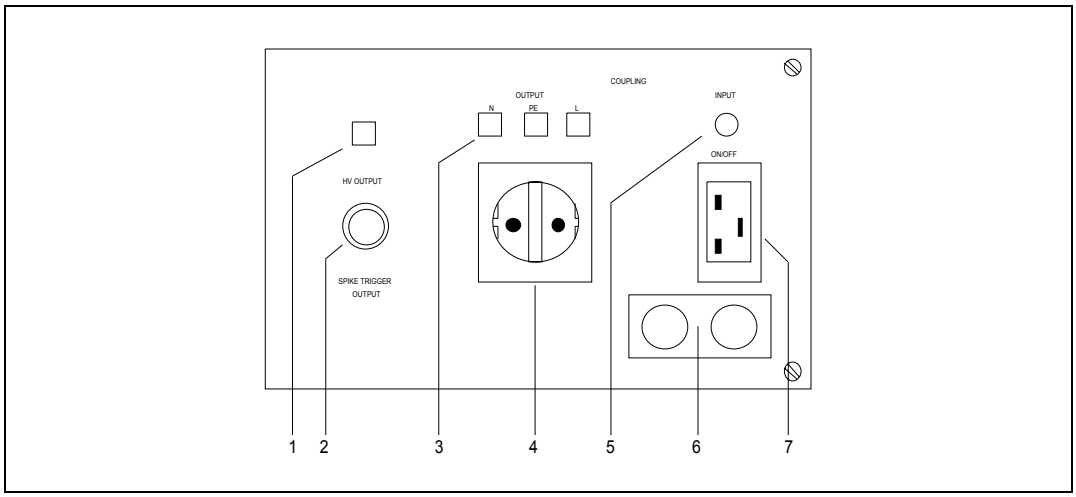


Fig. 4.2.2

4.2.2.1 EUT mains supply

The single phase mains input connector (7) is on the right hand side of the front panel, and the EUT connection (4) is in the centre.
Mains input is connected using a 16 A cable. The EUT connection is via a Schuko type output cable
After a test using EUT mains power has terminated, it is recommended that the mains be switched OFF using the INPUT ON/OFF switch (5).

4.2.2.2 Coupling paths

Coupling paths are indicated by the lamps L, N, and PE (3).
The generator can perform all the coupling paths required by the standard IEC 1000-4-4.

4.2.2.3 EUT mains protection

There is no EUT mains protection. Protection of EUT circuits is the responsibility of the user.

4.2.2.4 High voltage burst output

The lamps 1 and 3 indicate the selected burst output path. The following table shows the state of the high voltage output connector (2) for different coupling modes.

Direct output: "TO HV-OUT"	This mode is used for: - coupling into signal line - verification of the pulse form
Output to single phase coupling filter "TO LINE 1PHASE"	Output is inactive
Output to three phase coupling filter "TO LINE 3PHASE"	This mode is only used for external coupling filters

Tab. 4.2.2.4

The high voltage connector is of a type SHV.

4.2.2.5 Ground connection

The ground connection (6), is a reference point to be used when the PEFT Junior is operated in conjunction with an FP-EFT 32.1, for three phase coupling. It is recommended that a braided cable or copper band be used for this connection.

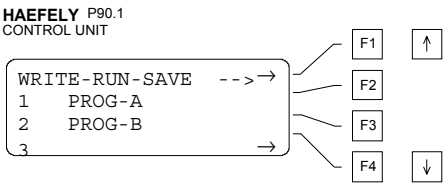
4.3 Control modes

The PEFT Junior can be used in several modes for different applications.
Local control is often sufficient in a laboratory application where the operator can directly adjust the test parameters for different tests of short duration.
In quality laboratories however, it is often necessary to make endurance tests. For this application the PEFT Junior can be used in remote control mode. Remote operation has the advantage that several tests can be run sequentially and the test results can be printed directly into a user defined test report.
In ECM test laboratories, where the PEFT Junior is used with other test equipment to conduct tests on an EUT, it is important to remember that switching between an EFT / burst source and a surge source is sometimes important without interrupting the EUT supply. In this case, the remote control mode is the only one possible.

4.3.1 Local control

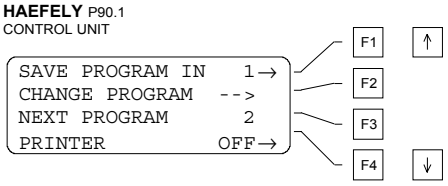
In local mode, the user has to set the test parameters and store them as programs in the control unit memory. It is possible to store up to eleven programs. Each program can be run independantly, be looped with other programs or be run continuously.
This is the normal mode of operation after power on.

For more details refer to section 6.



The operator can choose between:
Write, run or save a program
Recall program A or B
(Place 3 is free for storing another program which will be named PROG-C).

Program menu

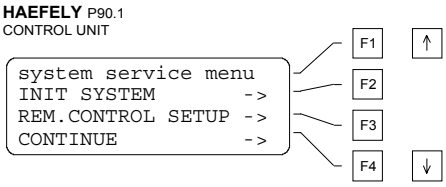


The current parameters can be stored in memory location 1.
After running program 1, the next program 2 will be automatically recalled and run.

Store menu

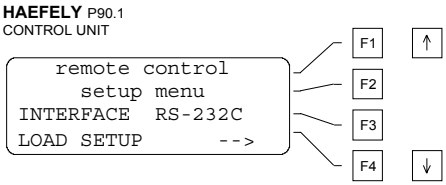
4.3.2 Remote control

In remote control mode, the generator can be operated through the communication interface type RC 730 in both RS232 and IEEE modes.
Control using the software P90U allows programs to be transfered in both directions between the PEFT Junior and a PC.
It is also possible to control the generator from a PC using the WinPATS software running under windows. This has the advantage that the parameters are fully accessable from the PC.
Before entering the remote operating mode, the interface has to be correctly configured.
Interface parameters are accessed by holding down any key on the keypad, while simultaneously powering the PEFT Junior on. For more details, see section 6.4.



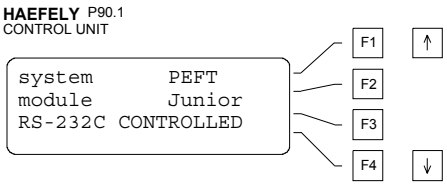
This screen apears after pressing any key and the power on switch together.
To modify the remote configuration, press F3.

Service menu



Press F3 to select the transmission parameters.

Interface menu



During the remote mode, this page is displayed.

Remote control menu

5. Test set up

5.1 Instruction for set up

Before using the PEFT Junior, this user manual should be read carefully.

5.2 Operating personnel

Operating the PEFT Junior without having read the user instructions, can expose the operator to potential dangers.
It is recommended that only trained personnel be allowed to operate the PEFT Junior.

WARNING
Persons with heart pacemakers must not be in the area when the PEFT Junior is operating.

Remember:
the presence of high voltages is a potential danger even to trained personnel.

5.3 Initial operation

Before initial operation, please check the following points:

5.3.1 Optical control

During transport, all material is subjected to vibrations and mechanical shocks. Before initial operation check for mechanical damage. All modules and blank plates should be fitted so that they make good contact with the chassis.

5.3.2 Mains power

Check the mains power available in your laboratory is compatible with the PEFT Junior.
The mains voltages and frequencies are given in section 1.4

5.4 Installation in accordance with IEC 1000-4-4

The EFT / burst generator PEFT Junior is designed to meet the requirements of the standard IEC 1000-4-4.

5.4.1 Installation for single phase testing

The following installation is described in the standard.

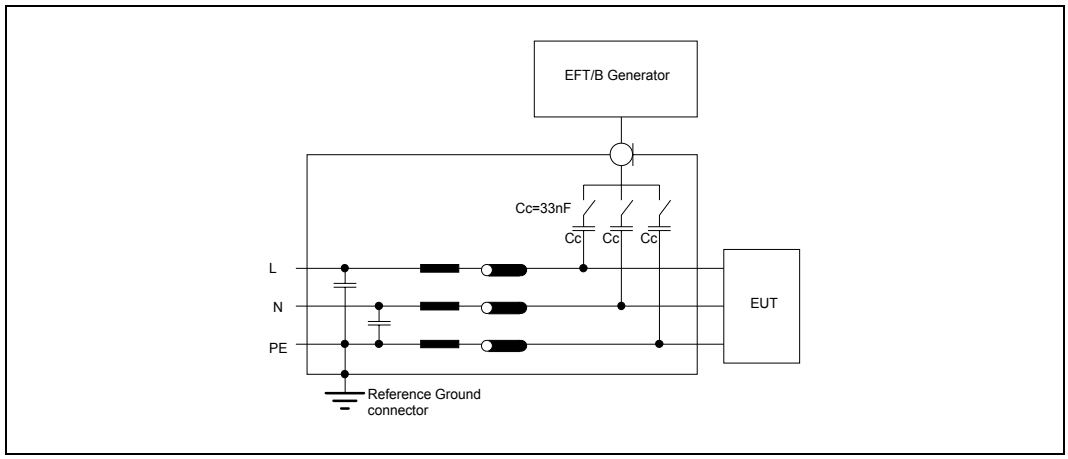


Fig. 5.4.1.a

Without further accessories, a PEFT Junior enables testing of levels 1 to 5.

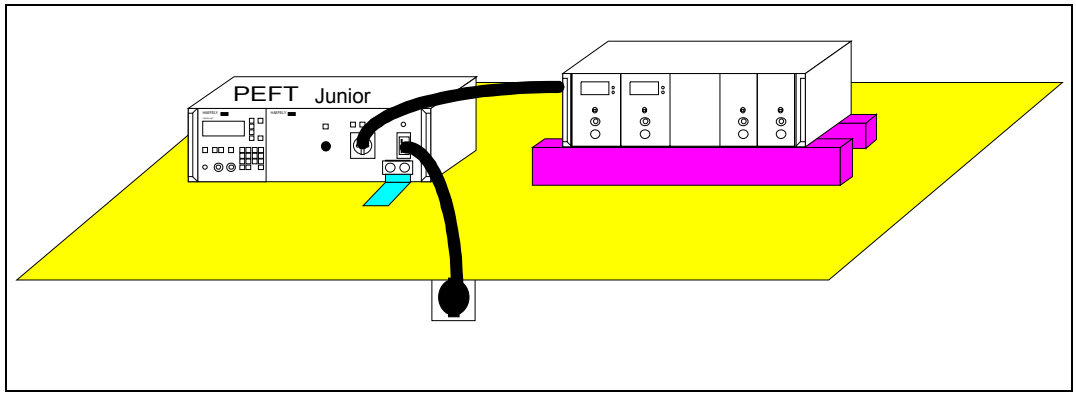


Fig. 5.4.1.b

5.4.2 Installation for three phase testing

The following installation is described in the standard.

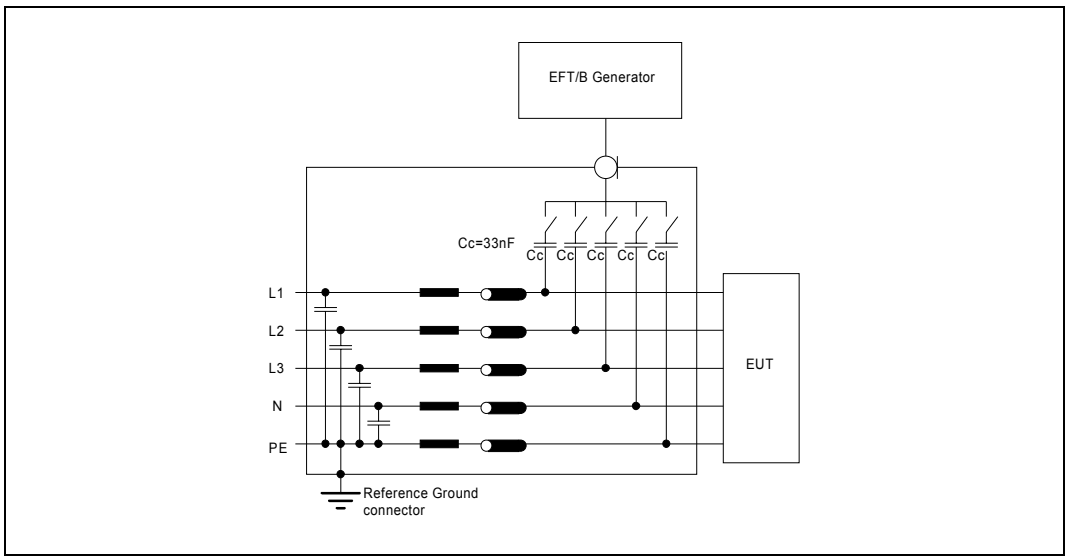


Fig. 5.4.2.a

To comply with this tests requirements, it is necessary to use a three phase coupling filter type FP-EFT 32.1. This filter has the same advantages as the single phase integrated filter, that is automatic control of the coupling paths from the PEFT Junior menu.
A system comprising a PEFT Junior and a filter FP-EFT 32.1 enables testing to all levels as for the single phase filter.

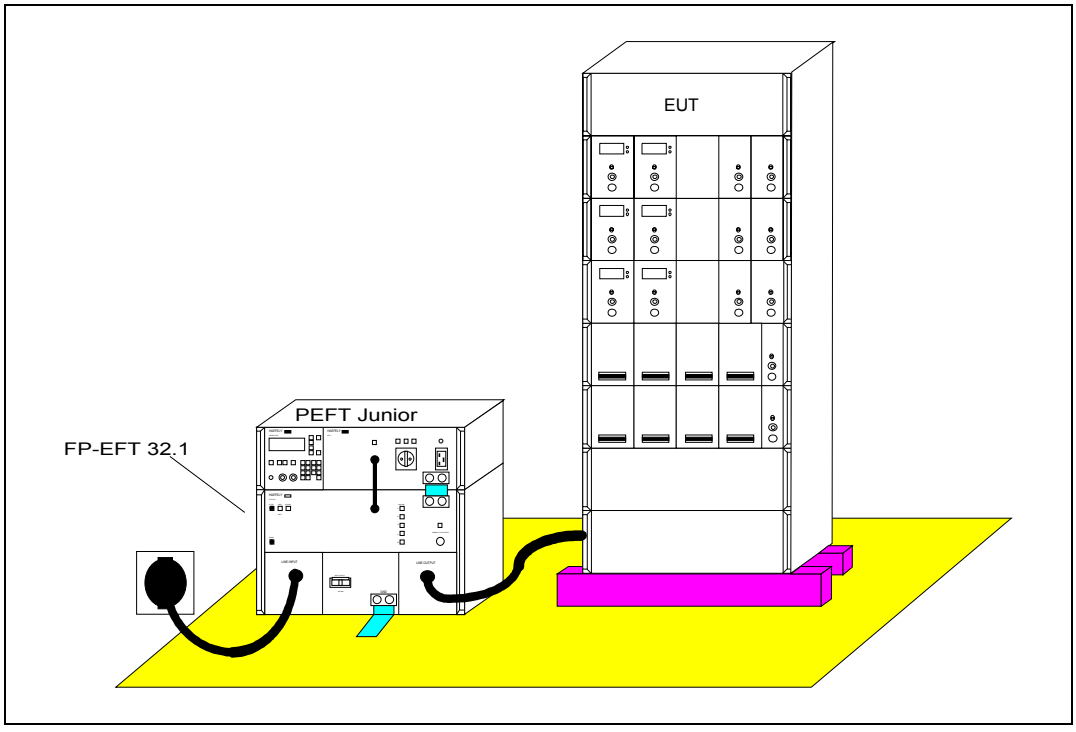


Fig. 5.4.2.b

5.4.3 Installation for coupling into control lines.

To couple into data lines as described in the standard, the capacitive coupling clamp type IP4A is neccessary.

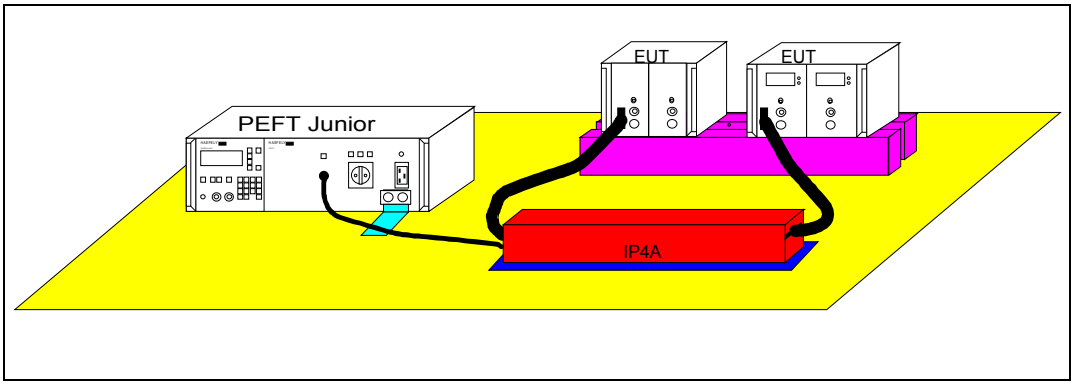


Fig. 5.4.3

5.5 Other test system possibilities

It is possible to include the PEFT Junior in many different test configurations.
The following examples illustrate some of the possibilities.

5.5.1 System controlled by PC

The PEFT Junior can be directly programed from a PC. Using the remote control interface type RC 730 it is possible to communicate directly with a remote PC using either RS232 or IEEE formats.
The WinPATS software running under Windows 3 is an example of communication software curently available.
The following example shows the connections necessary for a computer controlled three phase test system.

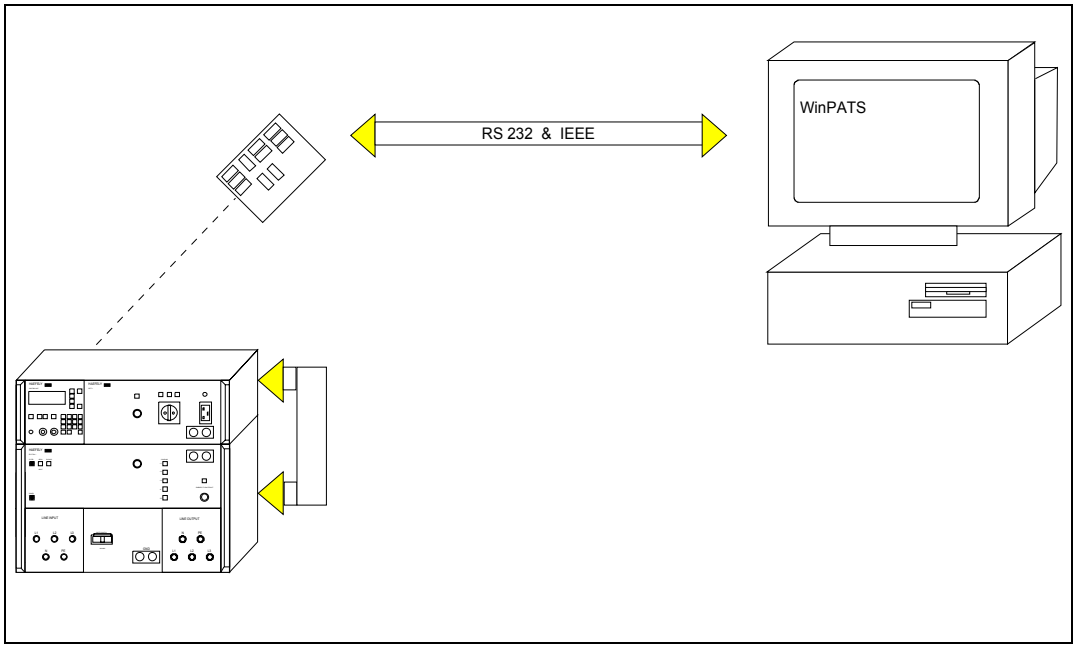


Fig. 5.5.1

5.5.2 Single phase "on line" system

The objective of such a system, is to conduct several EMC tests on the EUT's single phase mains without powering off the EUT.
The following example, using a PEFT Junior and PSURGE 4.1, enables the superimposition of EFT / burst and surge without interrupting the EUT power.
The BYPASS function of the PSURGE 4.1 delivers a continuous power supply to the EUT and ensures the EFT / burst is not affected by coupling elements in the PSURGE 4.1 filter.
It is recommended the test system be connected as follows, EFT / burst, then surge, then EUT.
In this configuration, the attenuation requirements of IEC 1000-4-5 are satisfied.

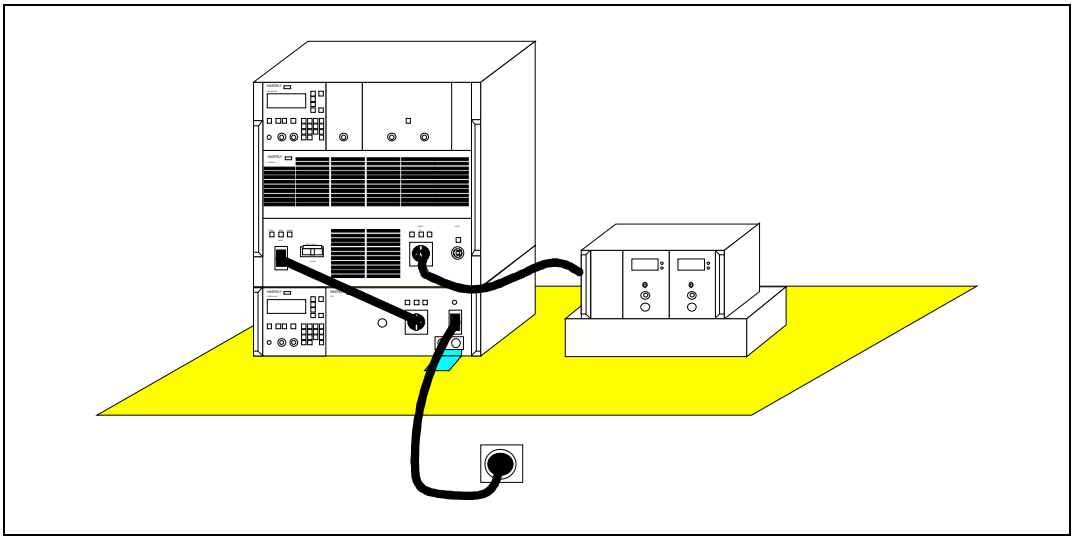


Fig. 5.5.2

5.5.3 Three phase "on line" system

This is the same as for the single phase system, except the generators are connected to their respective three phase coupling filters.

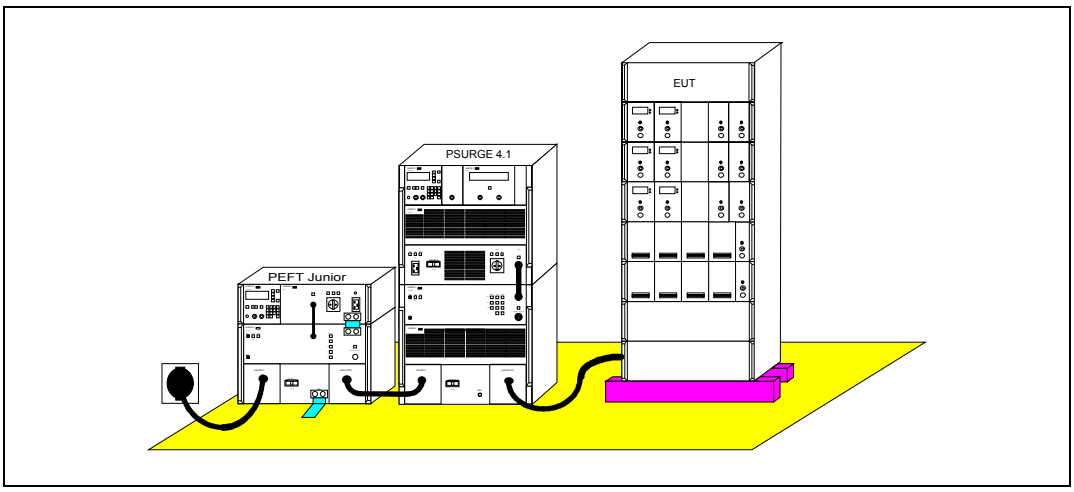


Fig. 5.5.3

5.5.4 EMC test system PATS

Using testers available from Haefely, it is possible to assemble a complete EMC test suite. This is called PATS, is modular and allows testing to the following standards:

- EMC test, line interference; IEC 1000-4-10,...
- EMC test, EFT / Burst; IEC 1000-4-4
- EMC test, surge; IEC 1000-4-5

In addition the system offers:

- Automatic verification of the test equipment
- Monitoring and detection of EUT failures
- Test report printout
- Storing test parameters

For more information please ask for a brochure from our sales department or local representative.

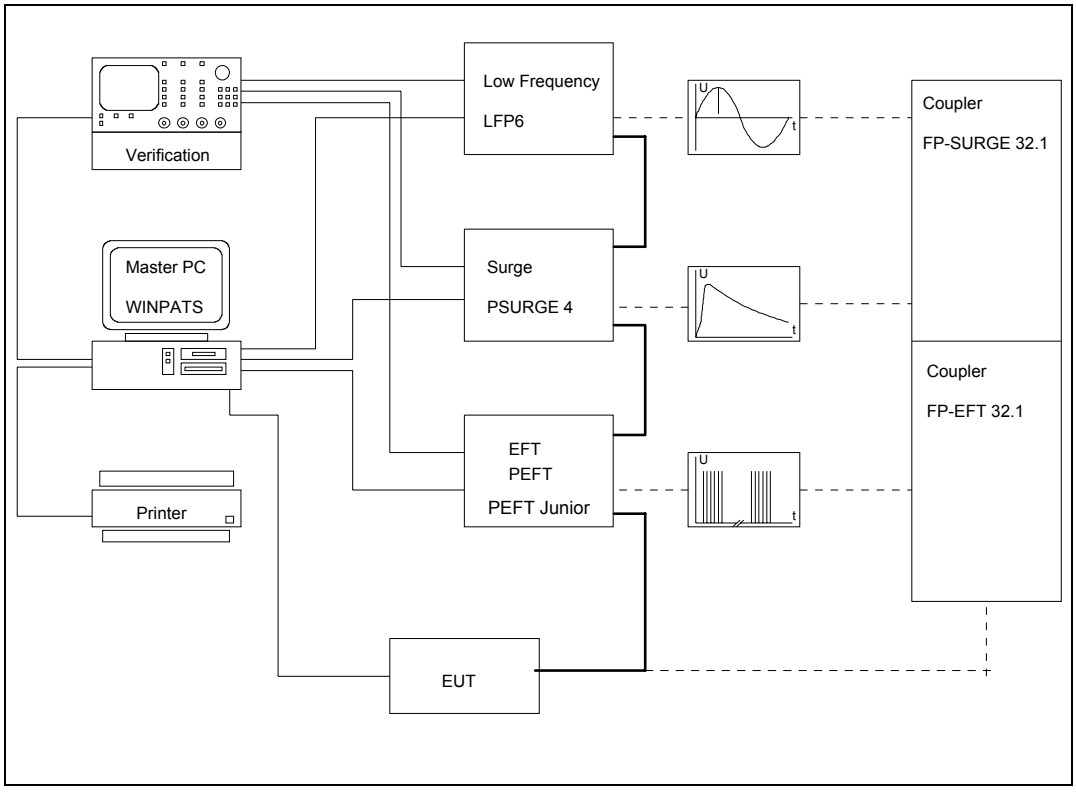
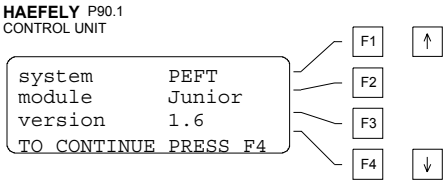


Fig. 5.5.4

6. Operation

6.1 Parameter definition

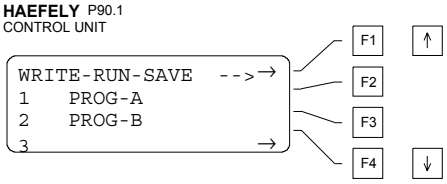
The P90 microprocessor controls all the PEFT Junior functions. Using the P90, test sequences can be written, saved, recalled and edited.
After powering the PEFT Junior, the following page is displayed.



Confirmation of the tester configuration. In case of failure an error message is displayed.

First menu

If programs have been saved to the microprocessor memory, then three pages are available which display the program names PROG-A etc.
It is now possible to recall one of the eleven possible programs.



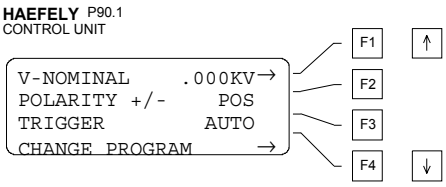
The operator can choose between:
Write, run or save a program
Recall program A or B
(Place 3 is free for storing another program which will be named PROG-C).

Program menu

If a program has been saved to memory (ex PROG-A), it is easy to recall simply by pressing the corresponding key (ex F2). The program can then be run by pressing START / STOP.
To write a program, press key F1 and follow the procedure in 6.1.1.

6.1.1 Input menu

The entry menu gives access to the first four parameters in a test.



This page displays the first four test parameters.

Entry menu

6.1.1.1 Nominal test voltage V-NOMINAL

This parameter defines the output voltage level into an open circuit. Out of range parameters are corrected by the program to the parameter limit. In the case of a voltage transition, the test voltage will not exceed the value of V-NOMINAL.
NB:
- the test voltage can be changed manually during a test by pressing the UP/DWN keys. At the end of the test, a message will be displayed, indicating that the voltage has been changed manually.
- with the exception of V-NOMINAL, all the parameters have default values. This means that after entering a value for the test voltage, it is possible to start a test immediately. The default parameters correspond to the requirements of the standard IEC 1000-4-4.

6.1.1.2 Burst polarity POLARITY

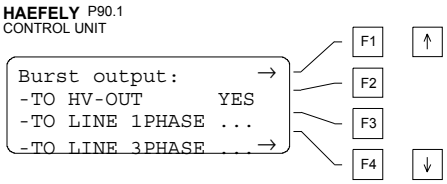
Burst polarity is defined by this parameter. The possible options are POS for positve and NEG for negative.

6.1.1.3 Burst trigger TRIGGER

The burst can be triggered one of two ways:
- manually (MAN): a burst sequence can be triggered by pressing any button on the keypad. In this mode, BURST FREQ transition is not available.
- automatically (AUTO): a burst sequence is released at the frequency defined by BURST FREQ.

6.1.2 Burst output BURST OUTPUT

The PEFT Junior delivers the burst :
- direct to the high voltage output.
For example, when coupling into data lines using the IP4A.
- through the integrated single phase filter.
For coupling into the single phase supply of an EUT connected to the coupling filter output.
- through the external three phase filter.
For coupling into three phase mains using the FP-EFT 32.1.



Only one of the outputs can be selected

Burst output menu

6.1.2.1 Direct output TO HV-OUT
Press (F2), to select burst output to high voltage connector.

6.1.2.2 Coupling to single phase mains TO LINE 1PHASE
Press (F3), to select burst output to the integrated single phase filter.

6.1.2.3 Coupling to three phase mains TO LINE 3PHASE
Press (F4), to select burst output to high voltage connector. The three phase coupling filter FP-EFT 32.1 is connected to the P90 EXTENSION, it is possible to select all the coupling paths required by the standard.

This mode is exclusively for use with the Haefely FP-EFT 32.1 in single or three phase applications.

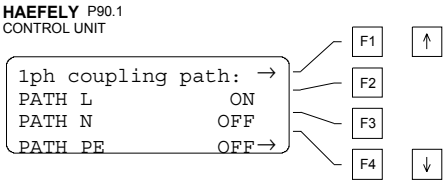
After selecting the coupling mode, the next menu enables definition of the coupling path.

6.1.3 Coupling path options COUPLING PATH

6.1.3.1 Single phase coupling

The integrated coupling filter enables the following path selections:

Coupling path selection	Coupling path selection
- PATH L	Phase 1
- PATH N	Neutral
- PATH PE	Protection earth
- PATH L+N	Phase and neutral
- PATH L+PE	Phase and Protection earth
- PATH N+PE	neutral and Protection earth
- PATH L+N+PE	All coupling paths simultaneously



By selecting all three modes to ON the paths will be switched successively after test time has expired.

Single phase coupling menu

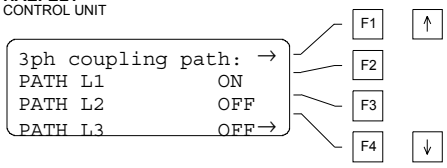
6.1.3.2 Three phase coupling

The external three phase coupling filter type FP-EFT 32.1 enables the following path selections (all are referenced to GND):

Coupling path selection	Coupling path selection
- PATH L1	Phase 1
- PATH L2	Phase 2
- PATH L3	Phase 3
- PATH N	Neutral
- PATH PE	Protection earth
- PATH L1+N	Phase 1 and neutre
- PATH L1+PE	Phase 1 and Protection earth
- PATH N+PE	Neutral and Protection earth
- PATH L1+N+PE	Phase 1, neutral and Protection earth
- PATH L123	Phase 1, 2 and 3
- PATH L123+N	Phase 1, 2, 3 and neutral
- PATH L123+PE	Phase 1, 2, 3 and Protection earth
- PATH L123+N+PE	All coupling paths simultaneously

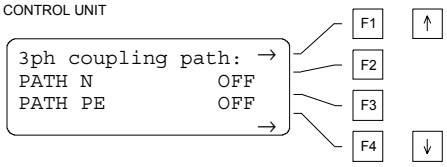
Three phase coupling menu

HAEFELY P90.1
CONTROL UNIT



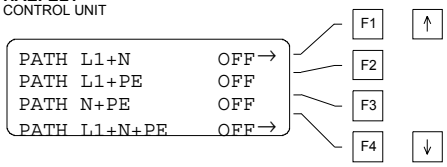
The three modes if selected together, will be executed sequentially

HAEFELY P90.1
CONTROL UNIT



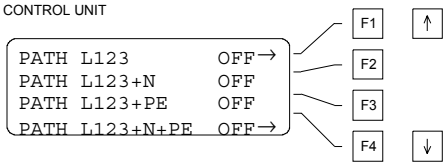
The two modes if selected together, will be executed sequentially

HAEFELY P90.1
CONTROL UNIT



The four modes if selected together, will be executed sequentially

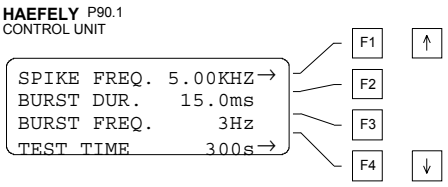
HAEFELY P90.1
CONTROL UNIT



The four modes if selected together, will be executed sequentially

6.1.4 Repetition frequency

The repetition frequency menu, enables definition of the parameters SPIKE FREQ, BURST DUR and BURST FREQ.



Frequency parameters can be input from this page.

Repetition frequency menu

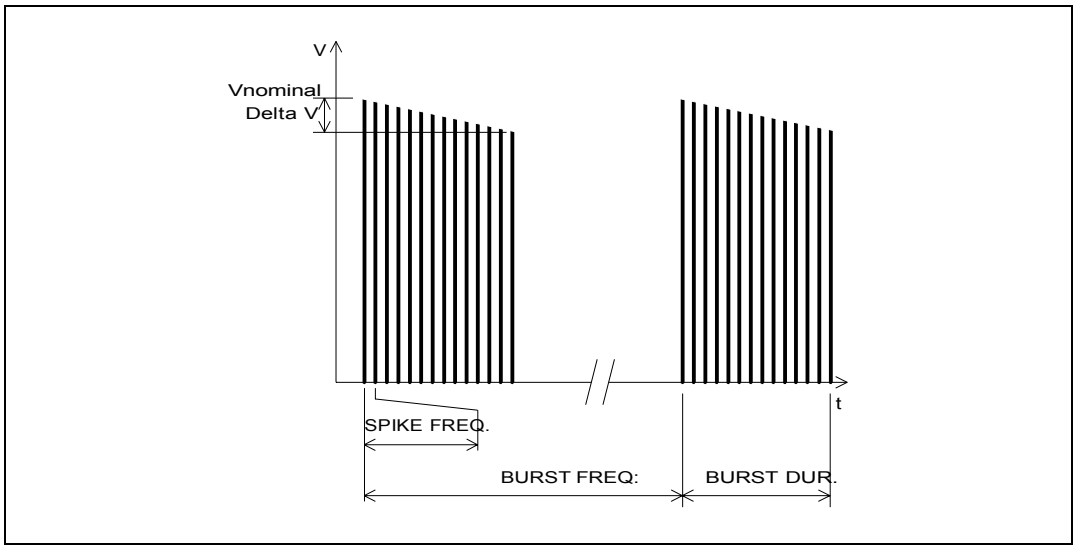


Fig. 6.1.4

6.1.4.1 Spike repetition frequency SPIKE FREQ.

The repetition frequency of spikes in a burst. The unit is kHz. The default value is 5 kHz.

6.1.4.2 Burst duration BURST DUR.

The duration of each burst in units of mS. The default value is 15 ms.

6.1.4.3 Burst repetition frequency BURST FREQ.

The repetition frequency of bursts in units of Hz. the standard specifies a value of 300 ms ± 20%, the default value of 3 Hz corresponds to a repetition frequency of 1 / 333 ms.

The three parameters are inter-related through the following formula:

SPIKE FREQ. x BURST DUR. x BURST FREQ. ≤ Max.Nb impulses per second.

For the PEFT Junior the maximum is 600.

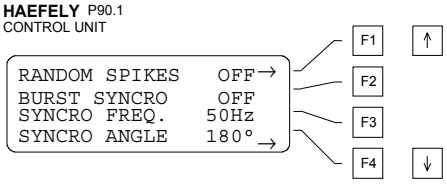
6.1.4.4 Test duration TEST TIME.

The test duration can be selected between 1 and 29999 s (8h33). This is the test time per coupling path. In the case of multiple coupling paths, eg. L, then N, then PE the total time to complete all three paths will be TEST TIME x 3.
To increase the test time, it is possible to loop a program with itself so it runs continuously until START / STOP is pressed.

6.1.5 Synchronisation

The Synchronisation menu enables spikes to be produced at random, or to be synchronised to a defined source.
Internal detection of the reference source is between the following:
- a signal from the external filter available at the connector P90 EXTENSION.
- a signal from the front panel SYNC IN connector.
- an internal signal (50 or 60 Hz) corresponding to the supply frequency of the PEFT Junior.

Synchronisation is defined in relation to the first impulse of a burst.



The synchronisation possibilities are available on this page.

Synchronisation menu

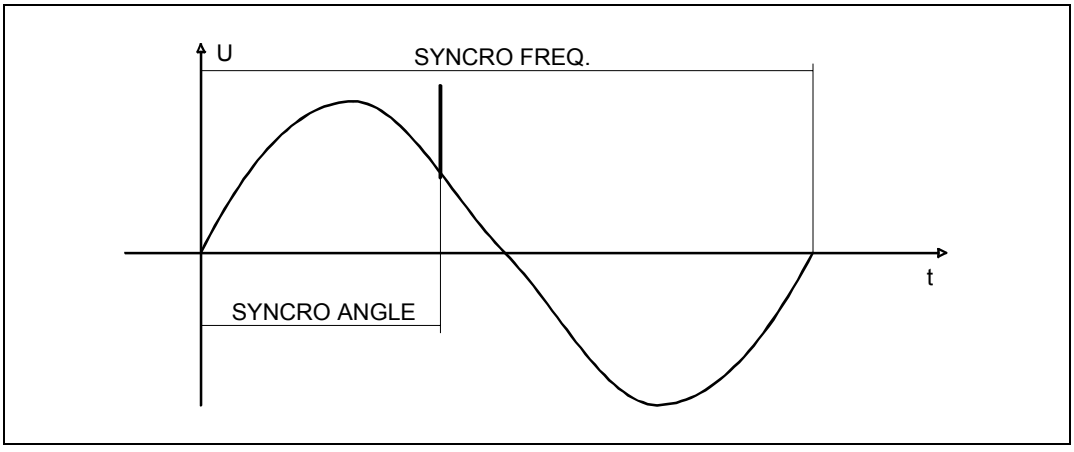


Fig. 6.1.5

6.1.5.1 Random burst distribution RANDOM

The RANDOM function, enables impulses to be distributed in no fixed relationship within the range SPIKE FREQ.to SPIKE FREQ. - 50 %.

6.1.5.2 Burst synchronisation BURST SYNCRO.

This function is a software switch, burst synchronised to reference or not synchronised.
In the OFF condition, impulse distribution is determined by the parameters SPIKE FREQ., BURST DUR. and BURST FREQ.
In the ON condition, the first impulse of each burst is synchronised to the selected angle. Impulse distribution is determined by the parameters SPIKE FREQ., BURST DUR, and the burst repetition by BURST FREQ.

6.1.5.3 Frequency of synchronisation signal SYNCRO FREQ.

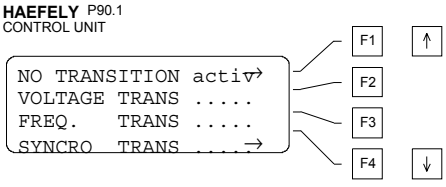
To synchronise with an external AC signal, the frequency must be defined. Possible frequencies are $16^{2/3}$ Hz, 40 Hz, 50 Hz, 60 Hz and 400 Hz.

6.1.5.4 Synchronisation to a phase angle SYNCRO ANGLE

The parameter SYNCRO ANGLE defines the angle in degrees, after the zero crossing point, to which the impulses will be synchronised.

6.1.6 Transitions

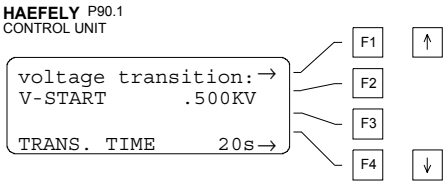
The transition function allows a parameter to be varied during a test. It is posible to change the test voltage, repetition frequency and synchronisation angle during a test.



This page displays the functions which can be varied during a test.

Transition menu

6.1.6.1 Test voltage transition VOLTAGE TRANS.



From this page it is possible to define the voltage change parameters.

Voltage transition menu

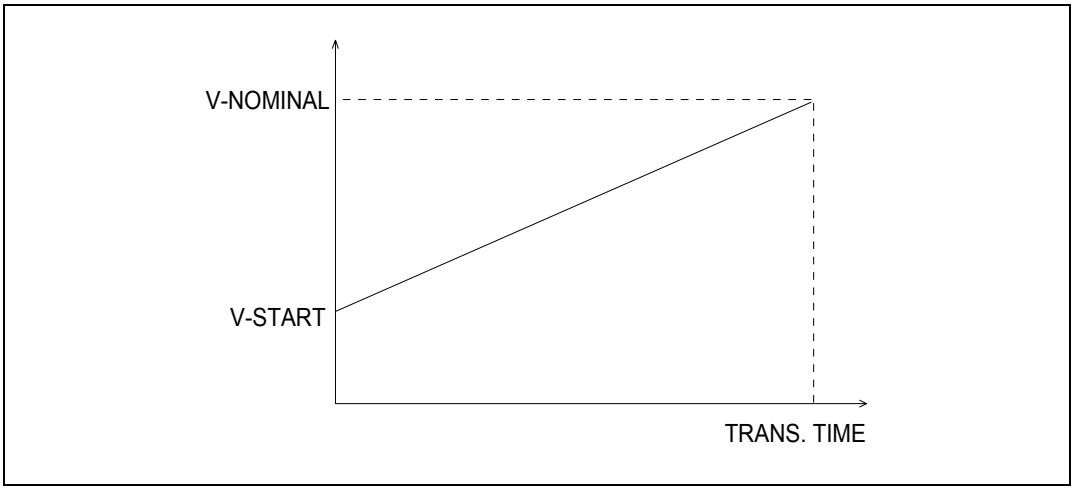
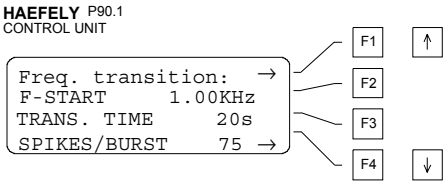


Fig. 6.1.6.1

6.1.6.2 Burst frequency transition FREQ. TRANS.



From this page it is possible to define the frequency change parameters.

Frequency transition menu

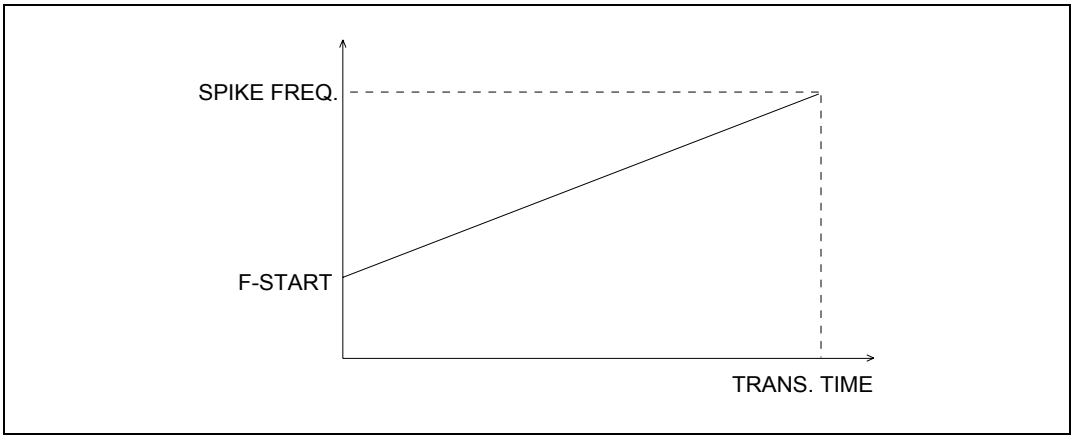
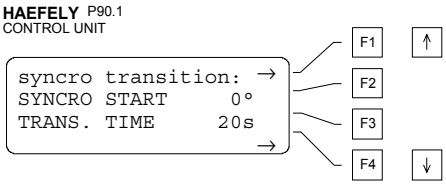


Fig. 6.1.6.2

SPIKE/BURST defines the number of impulses per burst. It enables generation of a constant energy ramp, each burst being composed of the same number of impulses.

6.1.6.3 Synchronisation transition SYNCRO TRANS.



From this page it is possible to define the synchronisation change parameters.

Synchronisation transition menu

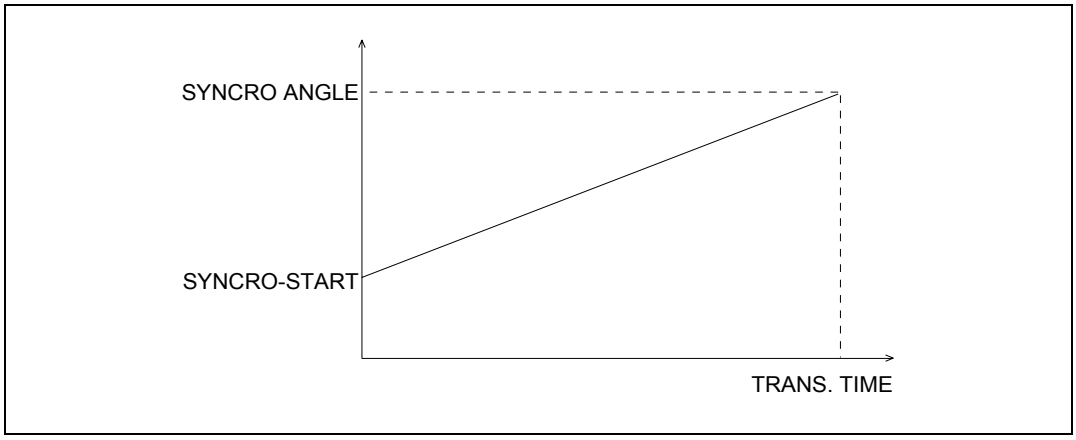
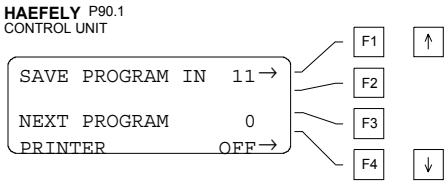


Fig. 6.1.6.3

The parameter SYNCRO START defines the ramp start angle in relation to the zero crossing point. The angle starts to increment from this point.

6.1.7 Save menu

It is possible to link several programs together to form a single program. When the end of a program is reached and the value of NEXT PROGRAM is 0, the generator switches off the high voltage and returns to the run menu. If the value of NEXT PROGRAM is not 0, but another program number or the current program number again, then the high voltage is switched off the next program is loaded and the new program is run.



the parameter NEXT PROGRAM defines which program will be automatically started after the end of a program. Linking a program to itself is possible.

Program save menu

6.1.7.1 Saving a program SAVE PROGRAM IN

Press the key F1 then enter the memory location the program is to be saved in (1 to 11). Pressing ENT saves the currently defined parameters, automatically giving a program name from PROG-A to PROG-K.

6.1.7.2 Linking programs NEXT PROGRAM

Press the key F3 and enter the value of the program to follow the current program. Press ENT to save the chosen value.

6.1.7.3 Selecting the printer PRINTER

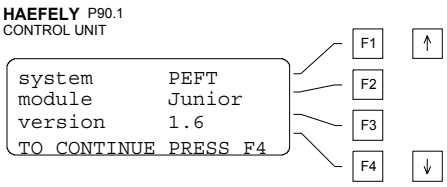
Press the key F4 to activate or deactivate the printout function.
A printout contains the parameter settings as well as the measured test data.
Note: It is possible to select printer on or off even when the generator is running a test.

The following is an example of a test printout:

```
HAEFELY  EMC-TEST-SYSTEMS   BASEL/SWITZERLAND          DATE:.....  TIME:.....
-------------------------------------------------------------------------------
SYSTEM:  PEFT     MODULE:Junior     VERSION:  1.60   PROGRAM:     PROG-A
-------------------------------------------------------------------------------

VOLTAGE NOMINAL: 4.00KV          POLARITY: POS          TRIGGER: AUTO

SPIKE FREQUENCY: 5.00KHz         RANDOM SPIKES:   OFF
BURST DURATION : 15.0ms          PHASE SYNCRO :   ON
BURST FREQUENCY:    3Hz          SYNCRO ANGLE :   90Deg/ 60 Hz

VOLTAGE TRANSITION:           V-START:             .500KV
                              TRANSITION TIME :    60s

      TEST TIME:              60Hz

       ============================================================================

       1. BURST OUTPUT TO L

                     TEST TIME:    60s
                                          Pause at 2.20KV
                                          Pause at 2.61KV


       2. BURST OUTPUT TO N

                     TEST TIME:    60s
                                          Pause at 2.02KV
                                          Pause at 2.54KV

       3. BURST OUTPUT TO PE

                     TEST TIME:    31s   EUT failed

                                          fail at 2.41KV
```

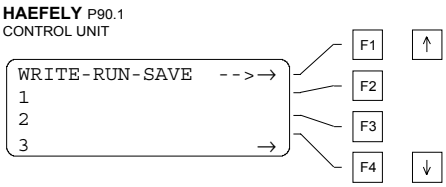
6.2 Function operation

To begin testing with the PEFT Junior, the minimum of parameters have to be entered. Never the less it is necesary to understand how to program the generator.



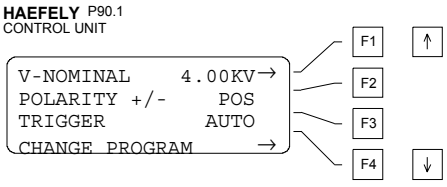
Confirmation of the tester configuration. In case of failure an error message is displayed. Press F4 to continue.

First menu



From here it is posible to WRITE, RUN or SAVE a program. Press F1 to enter the edit menu.

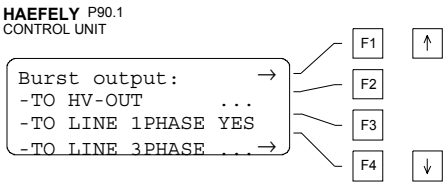
Program menu



Enter the following parameters:
Test voltage 4 kV.
Press F1, enter 4 then press ENT.

Edit menu

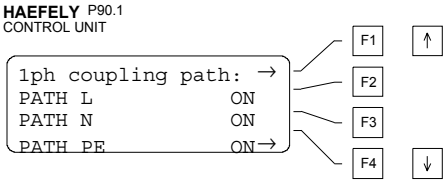
Press ↓ to enter the next menu



To select the integrated single phase filter press F3.

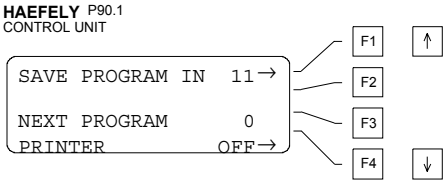
Burst output menu

Press ↓ to enter the next menu



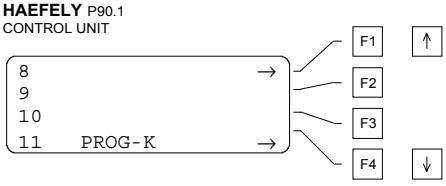
To activate all three coupling modes in succession, press F2, then UP, then ENT. Repeat the operation for F3 and F4
Press ↓ until the following menu is reached

Single phase coupling menu



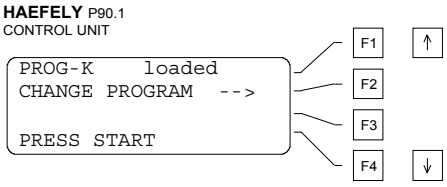
Press F1, enter the number 11 then press ENT to save the current program to memory location 11.

Program save menu



Press ↓ twice to reach memory location 11. The program is saved with the name PROG-K.
Press F4 to enter the run menu

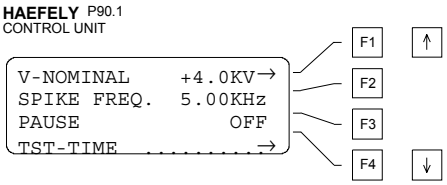
Program menu



Press START / STOP to start the program execution

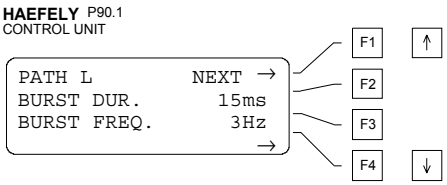
Run menu

The lamp HV / LINE ON illuminates and the test commences.



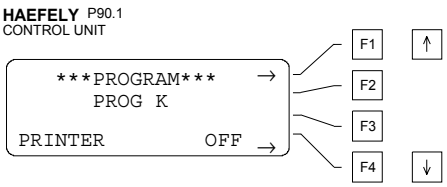
Voltage and frequency selections for the current test are displayed. Test duration is shown as a bar. Press F3 to activate the PAUSE function, the high voltage remains ON but the test is suspended.

Control menu



The values of BURST DUR and BURST FREQ are displayed for information.
Press F1, and the coupling path is switched to the next programmed selection.
Press ↓ to enter the next menu

Operational menu



The printer is not active. Press F4 then UP / DWN to change the selection

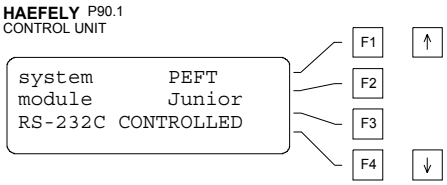
Program menu

In the case where a printer is connected and the output is activated, program interventions such as PAUSE, NEXT and EUT FAILED are recorded on the printout.

6.3 Interface operation

6.3.1 Operation in remote mode

If an RS232/IEEE Type 730 interface is fitted, it is possible to control the P90 from a remote device. It is necessary to set the interface for communication in the correct mode.
The remote configuration is entered from the P90.

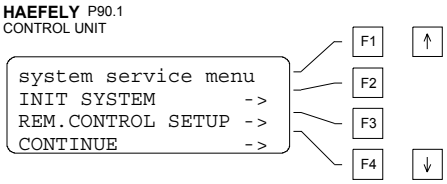


Control is passed to the RS-232C interface.

Remote control menu

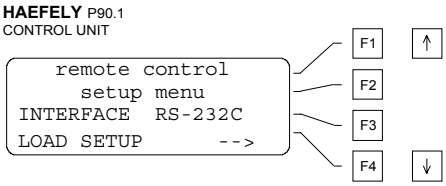
6.3.2 P90 interface configuration

The configuration menu is accessed, by pressing and holding any key while selecting power ON at the P90 front panel. The configuration menu structure is detailed below:



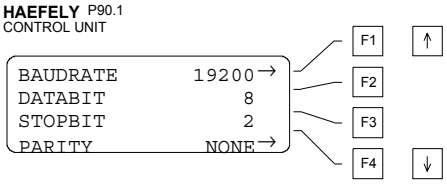
Press and hold any key when selecting power ON to reach this menu. Press F3 to enter the interface menu.

Service menu



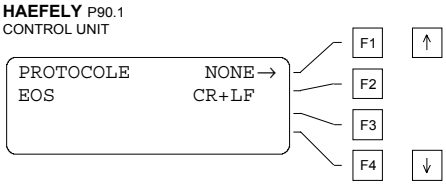
The operator can select the interface RS-232C by pressing F3.
Press ↓ to define the parameters.

Interface menu



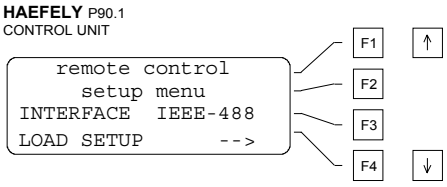
Press ↓ to define the parameters.

Configuration menu RS-232C



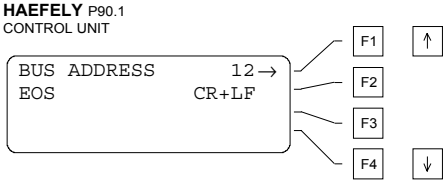
After entry of all the parameters, press ↑ twice to return to the interface menu. To save this configuration and continue, press F4.

Configuration menu RS-232C



The parameter menu for IEEE-488 is active. Press ↓ to define the parameters.

Interface menu



After entry of all the parameters, press ↑ to return to the interface menu. Press F4 to save this configuration and continue

Configuration menu IEEE-488

Configuration parameters for the RS-232C and IEEE-488 are pre defined. It is not possible to select other values to those contained in the communication file.

6.3.3 PC Configuration

The control device or PC must be configured to be compatible with the sytem communication requirements.

Example 1: Using the HP48SX controller, and serial communication.

HP48SX		**P90**	
From the "I/O setup" menu			
IR/WIRE	WIRE	BAUDRATE	9600
ASCII/BINARY	ASCII	DATABIT	8
BAUD	9600	STOPBIT	1
PARITY	NONE 0	PARITY	NONE
CHEKSUM TYPE 3		PROTOCOL	XON/XOFF
TRANSLATE CODE 1		EOS	CR+LF

Tab. 6.3.3a

Example 2: Using the HP300 controller communicating by IEEE.

HP9000 series300	**P90**	
HP-IB configuration	BUS ADRESS	12
	EOS	CR+LF

Tab. 6.3.3b

6.3.4 Using the RS232/IEEE type 730 interface

The Remote-Control type 730 interface contains two communication standards, IEEE-488 and RS-232C.

6.3.4.1 Entry format

Given in ASCII characters (7 digit). Block and line terminations use the conventional CR (Carriage Return), LF (LineFeed), etc.

Source Handshake	SH1	complete capability	
Acceptor Handshake	AH1	complete capability	
Talker:	T5	Basic type of talker	Series enquiry, sounds always faulty De-addressing with MLA
Listener:	L3	Basic type of listener	Sounds always faulty De-addressing with MTA
Service Request	SR1	complete capability	
Remote Local	RL2	no control with interlock	
Parallel Poll	PP0	no capability	
Device clear	DC0	no capability	
Device Trigger	DT0	no capability	
Controller:	C0	no capability	

Tab. 6.3.4.2

The bus address MTA (My Talk Address) and MLA (My Listen Address) are programable in the range 0 to 30.

6.3.4.2 Entry format

Given in ASCII characters (7 digit). Block and line terminations use the conventional CR (Carriage Return), LF (LineFeed), etc.

6.3.4.3 Serial Interface RS-232C

This interface uses the TxD and RxD lines for communication. For communication the hardware RTS/CTS and the software XON/XOFF can be used.

6.3.4.4 Switching remote mode / local mode

Two modes of operation exist (LOCAL) and (REMOTE).
Equipment not fitted with a REMOTE CONTROL type 730, is automatically set to local mode when primary power is applied.
If the REMOTE CONTROL type 730 is fitted, local mode is set by the command "`GTL`" (`Go To Local`). Remote operation is selected with the command "`REN`" (`Remote ENable`).

6.3.5 Programing

The P90 controller, can be operated by a remote device. The data is composed of parameter commands plus handshake information. Control commands sent to the P90 are held in a buffer

of 128 characters. The memory can be used in two ways. The first uses 98 characters as a buffer memory. The other accepts program blocks until an end of block character is recognised.

6.3.5.1 Command syntax
Seperation characters:

< >	No command (space) after the command header.
<;>	End of a command unit within a block.
<EOS>	End of a command block or blocks, signifies end of current input (End Of Sequence).

Tab. 6.3.5.1a

Bit format:

Integer	positive whole numbers in the range 0 to 29999. transferred as ASCII strings. The format corresponds with the input and output of the P90 display
Real	positive decimal numbers.with a maximum of 6 significant digits, transferred as ASCII strings. The format corresponds with the input and output of the P90 display

Tab. 6.3.5.1b

Character strings:

set command=<header>< ><argument>	
<header>	A sequence of from 2 to 4 ASCII characters using.'A'..'Z';'a'..'z'. There is no differentiation between upper and lower case
< >	separation character between <header> and <argument>.
<argument>	In the form of either an integer,real number or string.

Tab. 6.3.5.1c

Entering several commands consequtively:

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

Tab. 6.3.5.1d

example: CHV 4.0;POL neg;PL on;PRT on<EOS>

6.3.5.2 Interrogation commands
Interrogation commands cause the P90 to transfer internal data to the system controller.

<interrogation command>=<header>{< >}<?>

Tab. 6.3.5.2a

A question mark is placed after the argument. Each command can only contain one question, which must be at the end of the command line.

examples:

Interrogation command	P90 response
CACT?<EOS>	4.0
Actual impulse voltage?	4.0kV
POL?<EOS>	NEG
polarity?	negative
CHV 1.00;ERR?<EOS>	0
Charging voltage=1kV,error?	no error

Tab. 6.3.5.2b

6.3.5.3 Remote Control Debug utility
The remote control debug utility can be accessed from either the remote control module or the application program
The following commands activate and deactivate this utility

DEB ON<EOS>	activate utility
DEB OFF<EOS>	deactivate utility

Tab. 6.3.5.3a

Error messages:

Error number	Meaning
0	no error
101	Safety circuit open
102	No nominal voltage defined
103	Ramp start point is greater than the maximum value
104	Ramp end point is greater than the maximium value
105	No coupling path defined
106	SPIKE FREQ too large
107	BURST FREQ too large
108	Voltage range problem
109	Printer not ready
110	Nominal voltage too big
111	Nominal changed manually
201	EUT failure
202	General error
400	No external filter connected

Tab. 6.3.5.3b

The following error messages, can be accessed from the P90 using the option "Remote Control Debug":

Error Message	Meaning
input buffer ovfl	The input buffer memory has exceeded 100 characters
timeout occured	timeout exceeded in listen mode
header >4 characters	Header exceeds 4 characters
option required	the option part of a command is missing
unknown header	command not recognised
invalid argument	parameter incorrect
timeout while talk	timeout exceeded in talk mode
no query here	this is not an interrogation command
query expected	waiting for an interrogation
not valid in local	command not allowed in local mode
not valid while run	command only valid in standby mode

Tab. 6.3.5.3c

6.3.5.4 Error control

A list of options specific to the PEFT Junior is given in 6.3.5.5.
The options available for systems equiped with the P90 are given below.

ERR	(ERRor query)	The response to a command ERR?, is a number
	Code	Description
	0	no error
	1	command only valid in remote mode
	2	unknown command
	3	argument not valid
	4	no query available
	5	command only valid in standby mode
	8	timeout during transmit
	16	parity error during RS-232C transfer
	32	overflow in receive buffer
	64	other failure
		The codes 1 to 5 are applicable to the immediately preceeding command. The error signal is reset after each interrogation.

Tab. 6.3.5.4a

examples	Interrogation command	response
	CHV 1.25;ERR?<EOS>	0
	CHV &%;ERR?<EOS>	3

GTL	(Go To Local)	Terminate remote operation. Control is only possible from the P90 front panel.

Tab. 6.3.5.4b

ID	(IDdentification)	The identification command (only as a question) replies with the equipment details in the form. sssssss mmmmmmm vvvv
	s	system
	m	module
	v	version

Tab. 6.3.5.4c

example	Interrogation command ID?<EOS>	response PEFT Nr.-- 1.60

NAME		A maximum 10 character name can be assigned to the current program. in query mode, the name of the current program is returned.

Tab. 6.3.5.4d

example	controller NAME Testprog.<EOS>	P90 a program is saved under the name Testprog.
	NAME?<EOS>	Testprog.

PROG	(store PROGram)	Saves the current program to a memory location defined by the argument. (same as "Save Program in XX" from local mode).
	argument:	Integer (within the system range)

Tab. 6.3.5.4e

example	controller PROG 5<EOS>	P90 save program in memory position 5

PRT	(PRinTer) argument.	Enables or disables the printer. ON, OFF

Tab. 6.3.5.4f

example	controller PRT ON<EOS> PRT?<EOS>	P90 printer active ON

REC	(RECall program)	Recalls a program designated by the argument (function inverse of PROG).

Tab. 6.3.5.4g

REN	(Remote ENable)	the equipment is in remote mode, controllable only from a remote device.

Tab. 6.3.5.4h

SP	(Serial Poll)	Reads the Status Bit . See the table, corresponding to the possible values at the end of this paragraph.

Tab. 6.3.5.4i

example	controller SP?<EOS>	P90 The character "!" corresponds to 00100001 in binary. The bit 1 indicates EUT failed.
		8 7 6 5 4 3 2 1
	1. EUT Failed	x x x x x x x 1
	2. Generator Error	x x x x x x 1 x
	3. Local Mode	x x x x x 1 x x
	4. Transmission Error	x x x x 1 x x x
	5. Command Error	x x x 1 x x x x
	6. Run Mode	x x 1 x x x x x
	7. Service Request	x 1 x x x x x x
	8. Triggering	1 x x x x x x x
		(x = 0 or 1)
		The bits identifying errors 4 and 5 can be accessed by the command ERR?. The function SRQ identified by 7 can be accessed by the command SRQ. The bit "EUT Failed" is only present when the entry "EUT Failed" is active, It is reset to zero by the following operation.

STOP	(STOP)	Halts the program immediately (function analogous to START/STOP in local mode).

Tab. 6.3.5.4j

STRT	(STaRT)	Runs the current program from memory (function analogous to START/STOP in local mode).

Tab. 6.3.5.4k

SRQ	(Service ReQuest)	Activates or deactivates access to the IEEE-488.
	argument	ON / OFF

Tab. 6.3.5.4l

STAT	(STATus)	Check of the status bit (only interrogation).
	Response	Description
	STBY	Equipment in standby mode
	BUSY	Equipment in run mode (system specific)
	READY	Equipment ready for run mode

Tab. 6.3.5.4m

example	controller	P90
	STAT?<EOS>	STBY
		Equipment in standby mode

TMO	(TiMe Out)	Defines the time limit for communication.
	argument	Integer from 0 to 9

Tab. 6.3.5.4n

6.3.5.5 PEFT Junior remote control commands

Command	Description	actif en mode locale	autorisation d'interrogation	autorisation d'argument	actif en état de fonctionnement	Type of parameter	
CHV	V-NOMINAL (kV)		x	x		Real	
POL	POLARITY		x	x		POS, NEG	
TRIG	TRIGGER		x	x		Auto, Man	
HVOT	TO HV OUT		x	x		On, Off	
P3PH	TO LINE 3PHASE		x	x		On, Off	
PL	PATH L or PATH L1		x	x		On, Off	
PN	PATH N		x	x		On, Off	
PPE	PATH PE		x	x		On, Off	
PLN	PATH L+N or PATH L1+N		x	x		On, Off	
PLPE	PATH L+PE or PATH L1+PE		x	x		On, Off	
PNPE	PATH N+PE		x	x		On, Off	
PLNP	PATH L+N+PE or PATH L1+N+PE		x	x		On, Off	
PL2	PATH L2		x	x		On, Off	
PL3	PATH L3		x	x		On, Off	
PLA	PATH L1+L2+L3		x	x		On, Off	
PAN	PATH L123+N		x	x		On, Off	
PAPE	PATH L123+PE		x	x		On, Off	
PANP	PATH L123+N+PE		x	x		On, Off	
SFRE	SPIKE FREQuency		x	x		Real	
BDUR	BURST DURation		x	x		Real	
BFRE	BURST FREQuency		x	x		Integer	
RAN	RANDOM mode		x	x		On, Off	
SYNC	Synchronisation function		x	x		On, Off	
SDEG	SYNCRO ANGLE		x	x		Integer	
SYNF	SYNCRO FREQuency		x	x		F1...F5	F1= 16 2/3 Hz
TRA	Transition function		x	x		Off,V,F,S	F2= 40 Hz
SSRT	SYNCRO START		x	x		Integer	F3= 50 Hz
STTM	Syncro TRANSition TIME		x	x		Integer	F4= 60 Hz
SPB	Number SPIKE / BURST		x	x		Integer	F5= 400 Hz
VSRT	Voltage transition VSTART		x	x		Real	
VTRT	Voltage transition time		x	x		Integer	
FSRT	Frequency transition FSTART		x	x		Real	
FTRT	Frequency transition VSTART		x	x		Integer	
TTME	Frequency transition time		x	x		Real	
NPRO	Next Program after Stop [0-11]		x	x		Integer	Tab. 6.3.5.5a

Command	Description	actif en mode locale	autorisation d'interrogation	autorisation d'argument	actif en état de fonctionnement	Type of parameter
PRT	PRINTER		x	x		On, Off
NAME	Program NAME		x	x		String[10]
PROG	STORE Program			x		Integer
REC	RECALL Programme			x		Integer
ID	Identification, system, module...	x	x		x	
REN	Remote Enable	x		x		
GTL	Go To Local			x		
DEB	DEBUG mode		x	x		On, Off
SP	Serial Poll		x		x	(Byte)
SRQ	Service Request		x	x		On, Off
ERR	Error code	x	x		x	(Byte)
EMSG	Error message	x	x		x	(Integer)
CACT	Actual Test voltage		x		x	
FACT	Actual Spike frequency		x		x	
SACT	Actual Syncro angle		x		x	
PACT	Actual coupling path		x		x	R1= L R2= N R3= PE R4= L+N R5= L+PE R6= N+PE R7= L+N+PE
STAT	Geneartor status (STBY,BUSY,READY)		x		x	
CONF	Actual configuration		x	x		String[20]
TR	Initiate trigger			x	x	
STOP	STOP generator			x	x	
STRT	START generator			x		
PAUS	Pause		x	x	x	On, Off
TMO	Time Out	x	x	x		Integer

Tab. 6.3.5.5b

6.3.6 Program examples

Example 1: Controlling HP48SX serial interface.

The program initialises a voltage ramp, with no error reporting.

```
TEST1
<< "REN" PR1 "CHV 4" PR1 "POL NEG" PR1 "HVOT OFF" PR1 "PL ON" PR1 "TRA
V" PR1 "TTME 60" PR1 "VTRT 55" PRI "STRT" PR1 CLLCD "TEST VOLTAGE" 1
DISP 1 55 START "CACT?" PR1 0.5 WAIT 128 SRECV DROP SWAP DROP 'A' STO
'A' RCL 4 DISP "NEXT "STOP" PR1 "GTL" PR1 CLEAR>>
```

Explanations:

`TEST1`	program name
`"REN" PR1`	source control
`"CHV 4" PR1`	test voltage = 4 KV
`"POL NEG" PR1`	negative polarity
`"HVOT OFF" PR1`	HV OUT deselected
`"L ON" PR1`	coupling path L
`"TRA V" PR1`	voltage transition
`"TTME 60" PR1`	test duration
`"VTRT 55" PR1`	voltage ramp duration
`"STRT" PR1`	start the program
`CLLCD`	control indication to HP48SX
`"TEST VOLTAGE" 1 DISP`	comment
`1 55 START`	begin loop
`"CACT?" PR1`	request the actual charging voltage
`0.5 WAIT`	wait 0.5s
`128 SRECV`	read 128 characters from the buffer
`DROP SWAP DROP`	prepare display
`'A' STO 'A' RCL 4 DISP`	store value of CACT then display at line 4
`NEXT`	link programs
`"STOP" PR1 "GTL" PR1`	turn off the high voltage and return to local mode
`CLEAR`	end

Tab. 6.3.6a

The programs are a quick demonstration of command principles. The parameters not definrd in the examples are set to their default values.

Example 2: Controlling HP9000 series 300 BASIC interface using IEEE

This program contains , voltage ramp error checking and a check for EUT failed.

```
10 DIM Name$ [30]                          !
20                                         !
30                                         ! Remote control and identification
40                                         !
50 OUTPUT 712;"REN"                        ! Remote enable
60 OUTPUT 712;"ID?"                        ! Identification
70 WAIT 0.5                                ! delay for communication
80 ENTER 712;Name$                         ! enter identification's name
90                                         !
100                                        ! Prepare computer's display
110                                        !
120 PRINT TABXY(20,2)"HELLO USER ! MY NAME IS ";A$
130 PRINT TABXY(20,4)"DEMO PROGRAM FOR IEEE/PEFT CONTROL"
140 PRINT TABXY(35,8)"PARAMETERS"          !
150 PRINT TABXY(70,8)"ERRORS"              !
160                                        !
170                                        ! Input parameters in PEFT/P90
180                                        !
190 CHVset=4                               ! Test voltage = 4kV
200 OUTPUT 712;"CHV ";CHVset               ! Setting test voltage
210 OUTPUT 712;"CHV?"                      ! Control test voltage real
220 WAIT 0.5                               ! Delay for communication
230 ENTER 712;CHVreal                      !
140 IF CHVreal<CHVset THEN ErrChv$="LIMIT VOLTAGE MAX"
                                           ! Test overlimit
150 IF CHVreal>chvset THEN ErrChv$="LIMIT VOLTAGE MIN"
                                           ! Test underlimit
160 ErrChv$="ok"                           !
170 PRINT TABXY(35,10);"TEST VOLTAGE:";Chv,ErrChv$
                                           ! Display
180                                        !
190                                        !
200 OUTPUT 712;"POL NEG"                   ! Setting Polarity
210 OUTPUT 712;"POL?"                      ! Control Polarity
220 WAIT 0.5                               ! Delay for communication
230 ENTER 712;POL$                         !
240 OUTPUT 712;"ERR?"                      ! Error test
250 WAIT 0.5                               !
260 IF ERR=0 THEN ErrPOL$="OK" Else ErrPOL$=ERR;" see table"
270 PRINT TABXY(35,11);"POLARITY    :";POL$,ErrPOL$
                                           ! Display
280                                        !
290                                        !
300 TTMEset=500                            ! Test time = 500s
310 OUTPUT 712;"TTME ";TTMEset             ! Setting test time
320 OUTPUT 712;"TTME?"                     ! Control test time real
330 WAIT 0.5                               ! Delay for communication
340 ENTER 712;TTMEreal                     !
350 IF TTMEreal<TTMEset THEN ErrTTME$="LIMIT Test Time MAX"
                                           ! Test overlimit
360 IF TTMEreal>TTMEset THEN ErrTTME$="LIMIT Test Time MIN"
                                           ! Test unterlimit
370 ErrTTME$="ok"                          !
380 PRINT TABXY(35,12);"Test Time   :";TTMEreal,ErrTTME$! Display
390                                        !
400                                        !
```

```
410 OUTPUT 712;"TRA V"                      ! Setting voltage transition
420 OUTPUT 712;"TRA?"                       ! Control transition
430 WAIT 0.5                                ! Delay for communication
440 ENTER 712;TRA$                          !
450 OUTPUT 712;"ERR?"                       ! Error test
460 WAIT 0.5                                !
470 IF ERR=0 THEN ErrTRA$="OK" Else ErrTRA$=ERR;" see table"!
480 PRINT TABXY(35,13);"TRANSITION  :";TRA$,ErrTRA$
                                            ! Display
490                                         !
500                                         !
510 VTRTset=100                             ! Transition time = 100s
520 OUTPUT 712;"VTRT ";VTRTset              ! Setting Transition time
530 OUTPUT 712;"VTRT?"                      ! Control Trans.time real
540 WAIT 0.5                                ! Delay for communication
550 ENTER 712;VTRTreal                      !
560 IF VTRTreal<VTRTset THEN ErrVTRT$="LIMIT TIME MAX"
                                            ! Test overlimit
570 IF VTRTreal>VTRTset THEN ErrVTRT$="LIMIT TIME MIN"
                                            ! Test unterlimit
580 ErrVTRT$="ok"                           !
590 PRINT TABXY(35,14);"TRANS TIME :";VTRTreal,ErrVTRT$
                                            ! Display
600                                         !
610                                         !
620                                         !
1000 OUTPUT 712;"STRT"                      ! Test start
1010 OUTPUT 712;"STAT?"                     ! Status ?
1020 WAIT 0.5                               ! Delay for communication
1030 ENTER 712;STAT$                        ! Control status
1040 PRINT TABXY(35,16);"TEST STATUS:";STAT$
                                            ! Display
1050 IF STAT$="STBY" THEN GOTO beforeend    ! End of test?
1060                                        !
1070                                        !
1080 OUTPUT 712;"SP?"                       ! Test serial poll
1090 ENTER 712;SP$                          ! Control serial poll
1100 IF BIT(NUM(SP$),1)=1 THEN stop ELSE continu
                                            ! Test EUT failed
1110 stop                                   !
1120 PRINT TABXY(35,18);"TEST ABORTED:";SPtest$
                                            ! Display
1130 OUTPUT 712;"GTL"                       ! return to local mode
1140 END IF                                 !
1150                                        !
1160                                        !
1170 continu                                !
1180 OUTPUT 712;"CACT?                      ! Actual test voltage ?
1190 WAIT 0.5                               ! Delay for communication
1200 ENTER 712;CACT                         ! Control actual test voltage
1210 PRINT TABXY(10,10);"ACTUAL TEST VOLTAGE"
                                            ! Display
1220 PRINT TABXY(10,12);CACT;" kV"          ! Display
1230                                        !
1240                                        !
1250 beforeend                              !
1260 OUTPUT 712;"STOP"                      ! Savety in case of none stop
1270 OUTPUT 712;"GTL"                       ! Go to local mode
1500 END                                    !
```

This program is a quick demonstration, using many commands. Parameters not defined in the example are set to their default values.

6.3.7 Test programs

Verify numerical values from the program to be within the correct range (the values are automatically limited to their maximum and minimum).

example:

```
180                                     !
190 CHVset=4                            ! Test voltage = 4kV
200 OUTPUT 712;"CHV ";CHVset            ! Setting test voltage
210 OUTPUT 712;"CHV?"                   ! Control test voltage real
220 WAIT 0.5                            ! Delay for communication
230 ENTER 712;CHVreal                   !
140 IF CHVreal<CHVset THEN ErrChv$="LIMIT VOLTAGE MAX"
                                        ! Test overlimit
150 IF CHVreal>chvset THEN ErrChv$="LIMIT VOLTAGE MIN"
                                        ! Test underlimit
160 ErrChv$="ok"                        !
170 PRINT TABXY(35,10);"TEST VOLTAGE:";Chv,ErrChv$
                                        ! Display
```

Verify the input of alphanumeric characters is accepted by the P90:

example:

```
400                                     !
410 OUTPUT 712;"TRA V"                  ! Setting voltage transition
420 OUTPUT 712;"TRA?"                   ! Control transition
430 WAIT 0.5                            ! Delay for communication
440 ENTER 712;TRA$                      !
450 OUTPUT 712;"ERR?"                   ! Error test
460 WAIT 0.5                            !
470 IF ERR=0 THEN ErrTRA$="OK" Else ErrTRA$=ERR;" see table"!
```

Never forget to stop the test:

example:

```
1260 OUTPUT 712;"STOP"                  ! Safety in case of none stop
```

Never forget to return to local mode:

example:

```
1270 OUTPUT 712;"GTL"                   ! Go to local mode
```

To select an output, do not forget, the HV OUT socket is active by default (HVO=ON) and all other coupling paths are inactive. If coupling to a filter is required, first deactivate the path HV OUT before entering a coupling path.

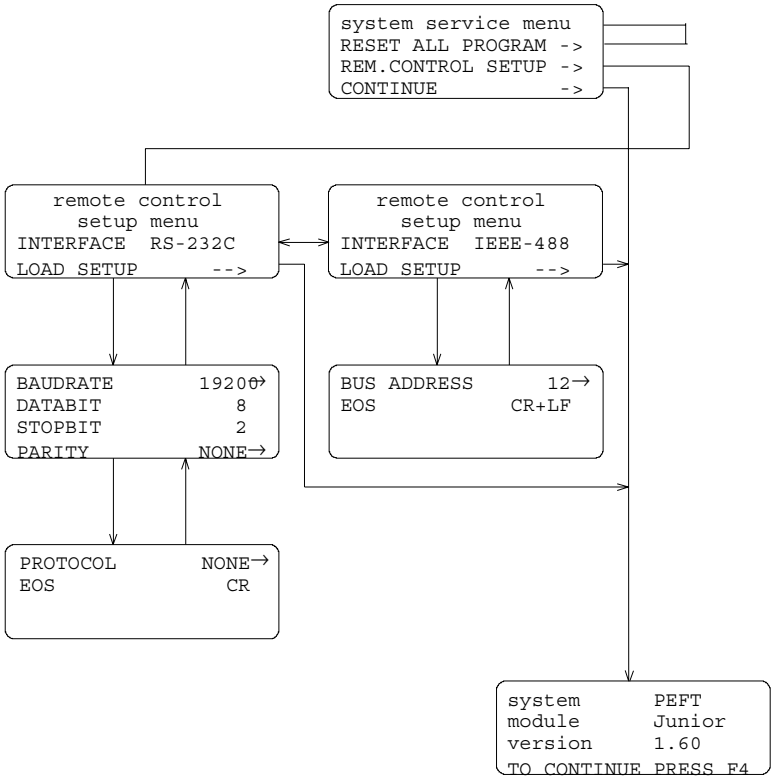
example:

```
2410 OUTPUT 712;"HVOT OFF"                ! Setting HV out off
2420 OUTPUT 712;"PL ON"                   ! Setting coupling L
```

6.4 Functional diagrams

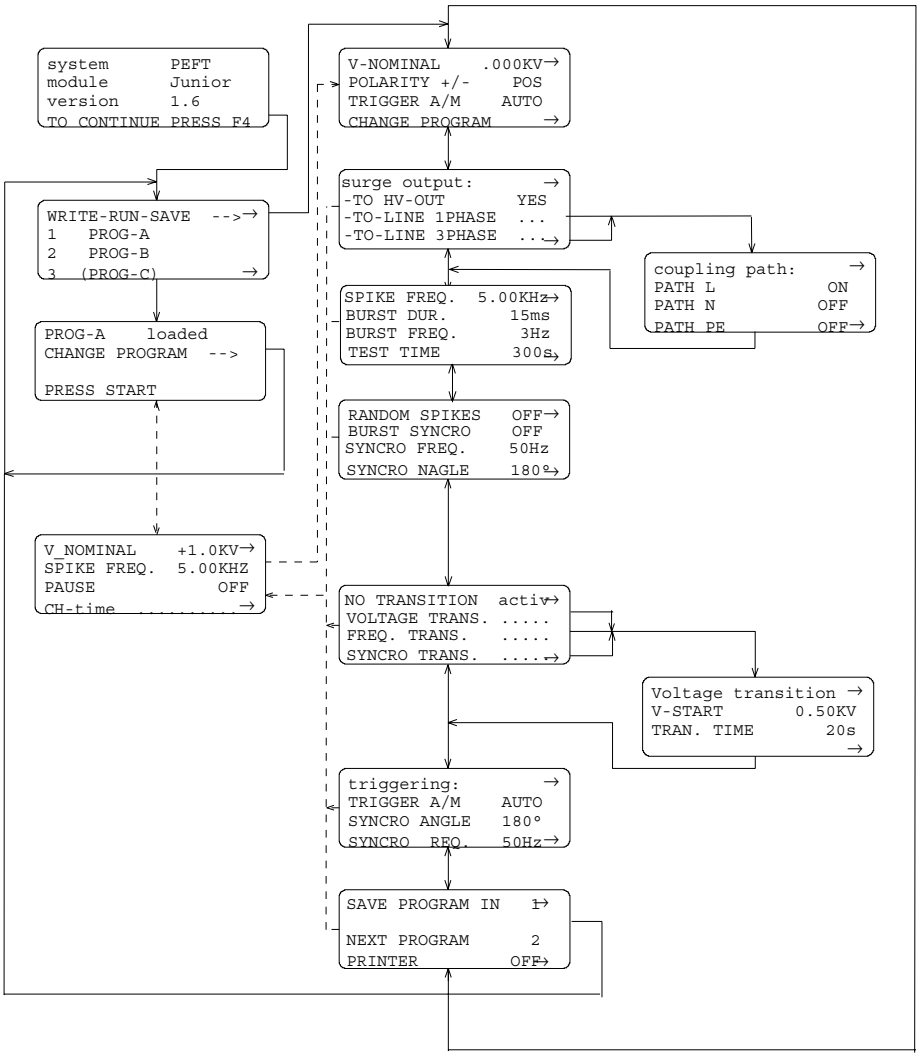
The PEFT Junior is initialised by switching on the mains.
Diagram 6.4.1 illustrates the menu possibilities.
Diagram 6.4.2 defines the procedure for programing a test sequence.
Functions which can be changed when the PEFT Junior is operating (RUN MODE) are shown in diagram 6.4.3.

6.4.1 Menu configuration



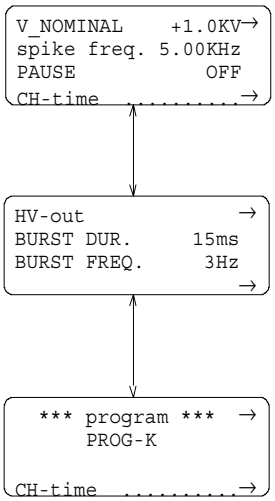
Tab. 6.4.1

6.4.2 Program functions



Tab. 6.4.2

6.4.3 Run time options



Tab. 6.4.3

7. Maintenance and verification

7.1 Maintenance

After a period without use, it is recommended that the electrical contacts and air passages be cleaned.

7.2 Measurement requirements

An attenuator to measure the voltage is available for the PEFT Junior.
The measured signal can be displayed on a storage oscilloscope. The oscilloscope should have a 400 MHz. minimum bandwidth.
The oscilloscope can be triggered from the BNC sockets " TRIGGER OUTPUT ".
The connections are shown below.

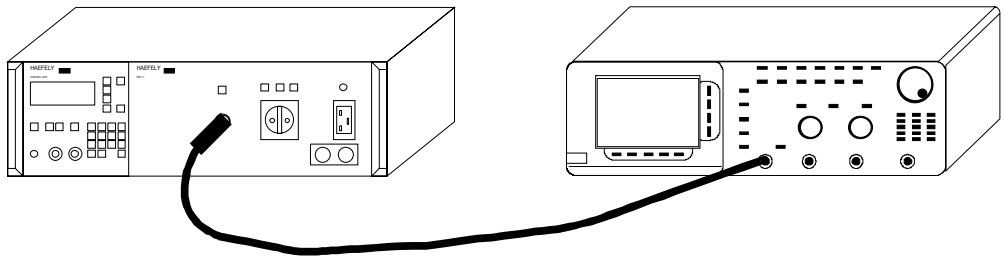


Fig. 7.2

Equipment required for verification:	Haefely reference	Quick	Full (*)
Attenuator 50 Ω	option ref. 093 577.1.1	X	X
Attenuator 1000 Ω	option ref. SPZ 54		X
Oscilloscope	TEK TDS 540,...		X
Probe /10	nc.		X
Probe /100	Tek 6009 - nc-		X
High voltage probe	Tek 6015 - 093 552.1		X
AC source (16 to 400 Hz)	LFP 6.1 - 249 202.1		X
Multimeter	nc.		X

(*) Full verification is only described in the service manual.

7.3 Quick verification of PEFT

It is recommended that a regular check of the PEFT Junior main functions is made.
The following procedure is a quick manual verification of the PEFT Junior.
Using the WinPATS (option), it is possible to make an automatic verification of the PEFT Junior.

The following is an extract from the PEFT Junior service manual.

Impulse waveform
- Connect the PEFT Junior chassis and the oscilloscope to a common earth plate.
- Place a 50 ohm divider 54dB/ terminator (option) to the high voltage BNC output or to the adaptor for filter output (Option with Service Set PEFT 249221.1)
- Connect a 50 ohm cable of less than 1 meter between the divider and the oscilloscope input.
- Make a connection between the P90 trigger output and the oscilloscope external trigger input, or use an auto trigger.
- Set your PEFT Junior with the default parameters

Use the following procedure to do the measurements:

- Set the parameters `Vnominal, POLARITY, Burst Output` listed in the test report table
- Configure the oscilloscope to display the output.

Channel 1:	DC / 50Ohm
Range:	...V/div
Time base:	2ns/div
Trigger:	CH1, Edge, 30%

- Press START/STOP.

➔ Verify the waveshape parameters ta, tb and Vp in accordance with the following tolerances.

3.5ns<ta<6.5ns
35ns<tb<65ns
Vp=Vnominal/**A** ±10%

The attenuation value (xxdB) of your 50Ohms attenuator is written on its label.
The factor A is defined as follows:
A = 10 (xxdB/20)

- Press START/STOP.

Repeat the procedure step by step, up to the end of the table on the record sheet.

7.4 Quick verification record sheet

PEFT Junior mainframe serial No. _____ Test equipment _____

_____

_____

Impulse waveform
correct to specifications i a w IEC 801-4 PASS / FAIL

Step	Vnominal	POLARITY	Burst Output active	ta [ns]	tb [ns]	Vp [kV]
1	0.5kV	POS	TO HV-OUT			
2	1kV	POS	TO HV-OUT			
3	2kV	POS	TO HV-OUT			
4	4kV	POS	TO HV-OUT			
5	0.5kV	NEG	TO HV-OUT			
6	1kV	NEG	TO HV-OUT			
7	2kV	NEG	TO HV-OUT			
8	4kV	NEG	TO HV-OUT			

Tested by _____ Date _____

8. Function failures

8.1 Error messages

The P90 processor detects and displays the following system faults:

Message	Indication
■..generator not ready for run	■. .The generator is not ready.
■..open safety circuit	■ Safety circuit open
■ no nominal defined	■ A nominal voltage is not defined
■ start > nominal	■ Ramp start voltage is bigger than the maximum
■ stop > nominal	■ Ramp stop voltage is bigger than the maximum
■ warning !!	■ System warnings:
■ *** EUT failed ***	■ EUT failure detected
■ no external filter connected	■ No external filter is connected to the P90 extension
■ generator stopped	■ System stopped:
■ printer not ready	■ The printer is not conected or not configured correctly
■ required option not implemented	■ The option selected is not available

Tab. 8.1

8.2 Fault diagnostics

The EFT / BURST generator PEFT Junior was designed and produced in accordance with the quality standard ISO 9001.
If however a functional failure does occur, it is important to complete the following table which will assist in the search for the problem and help reduce system down time.

Symptom	Questions
The PEFT Junior does not power on and no lights are illuminated !	■ Is the PEFT Junior plugged in ? ■ Is the supply within the limits specified in 1.4 ? ■ The generator fuses are intact ? ■ Is the generator mains switch selected to ON ?
Nothing is displayed on the P90 front panel and no lamps are illuminated !	■ Is the supply within the limits specified in 1.4 ? ■ Has the PEFT Junior been subjected to mechanical shocks during transport (see point 8.2) ?
The message: `generator fatal error` is displayed !	■ Switch off the PEFT Junior and wait 5 minutes, when powered on again does the same error message occur ?
The message: `generator fatal error` is displayed again !	■ Note the full error message and refer to section 8.3

Tab. 8.2

8.3 Service

For safety reasons, (and during the guarantee period), it is not recommended that internal repairs be attempted.
The PEFT Junior should only require servicing in the case where the message

```
generator fatal error .
```

is continuosly displayed.

There are many reasons for this error message and generally one of the following messages is also displayed.

```
- no CH-voltage                    - earth switch fault
- CH-voltage overshoot             - hv-regulation fault
```

In this case, please note the error message and immediately contact your Haefely representative who will inform you of the nearest service center.
To assist in the repair of your PEFT Junior, please complete the following checklist and send to your repairing agent.

Check-list to be completed when returning a PEFT Junior:

☐ Customer

		Sales WO	Repair WO
Company name			
Contact name			
Telephone number			
FAX number			

☐ Equipment

Generator		Serial number	
Software version			
High voltage module		Serial number	
Interface		Serial number	
Accessories		Serial number	

☐ Remote control

				486	EISA	Other:
Computer configuration	XT	AT	386	6.X		Other:
DOS version	3.3X		4.X	5.X		Other:
Interface	RS-232C		IEEE-488	Optical		Other:
Mouse or cursor	BUS		Serial	PS/2		Version:
Software	GENSET			P90U		WINPATS

☐ Coupling

Equipment		Serial number	
Accessories		Cables	

☐ Problem

Description of problem	
Is the problem reproducible ?	Yes / No

Is the problem associated with a process occuring in the EUT ?	Yes / No

☐ Installation

Sketch of installation					
Supply	voltage ?		AC / DC	V	Hz
	is an isolation transformer used ?			Yes / No	
	seperate EUT supply ?			Yes / No	
Test parameters					
EUT	supply ?	1 phase / 3 phase	AC / DC	V	Hz
	type				

Additional information

8.4 Replacement parts

The PEFT Junior service policy does not require the customer to order spare parts with the generator. The components used are held on stock at Haefely and can be supplied quickly to order. If any parts are required, they can be obtained by contacting the Haefely after sales service department.

8.5 After sales service

The address of Haefely's after sales service department is given below.

✉	Address	Emile Haefely & Co After sales service department (KD) Lehenmattstrasse 353 Postfach CH-4028 Basel
☎	Telephone	+41.61.315 51 11
🖷	FAX	+41.61.312 30 60

For general ordering information contact Haefely's sales department.

✉	Address	Emile Haefely & Co Sales department (V5) Christoph Merian ring 31A Postfach CH-4153 Reinach
☎	Telephone	+41.61.71.55.555
🖷	FAX	+41.61.71.20.288

9. Shutdown and storage

9.1 Daily shutdown

No special requirements have to be met, except to take care of safety considerations.
The following guide should provide a shutdown without problems :

Equipment status	**Action**
The generator is operating	Press START / STOP to disable the high voltage
The generator is powered ON	Press POWER to remove the primary power
The P90 is not powered	Switch OFF mains power on the PEFT Junior rear panel
The power switch is in the OFF position	Remove the mains cable

9.2 Storage for long periods

If the PEFT Junior is not to be used for long periods, it is recommended to remove all the supply cables and store the generator in the correct environmental conditions as in section 2.2.

10. Packaging and Transport

10.1 Packaging

The PEFT Junior packaging has been designed to withstand certain transport conditions. It will help protect the PEFT Junior from the effects of vibration, shock and water penetration. However normal precautions and care should be taken during transport.
The original packaging should be retained for future use. If it is not available, a suitable replacement must be used. Packaging information is available from our after sales service department.

10.2 Transport

When transporting the PEFT Junior the following must be observed:
- it is forbidden to carry or stack the PEFT Junior on its side.
- the generator should be kept in a vertical position.
- when possible reuse the original packaging.

11. Disposal

11.1 Disassembly information

It is not normally necessary to disassemble the generator during its operational cycle.
There are no special tools required for disassembly.

11.2 Recyclable components

The PEFT Junior is constructed from metals, aluminium, PVC, and composite materials.All the components can be recycled through the normal industrial recycling system.

11.3 Non-recyclable components

The PEFT Junior is made from 100% recyclable material and contains no dangerous substances.

12. Accessories and options

12.1 Accessories

The PEFT Junior is delivered with the following standard acessories:

1 16 Amp.cable with relevant mains plug fitted.	EUT mains cable
1 10 Amp.cable with relevant mains plug fitted.	Generator mains cable
1 User manual	
1 safety circuit connector	low voltage for safety circuit

12.2 Options

Options available for the PEFT Junior are :

Reference	Order number	Description
RC 730	249 199.1	Interface RS-232C and IEEE
P90-OPT.1	249 225.1	Optically decoupled RS-232C communication.
P90U	249 220.1	Remote control program requires minimum DOS 3.3
WINPATS	249 309.1	Remote control program that runs under windows 3.1
IP4A	249 130.1	Coupling clamp for control line coupling I A W IEC 1000-4-4
FP 16/3-1	249 148.1	Manual three phase coupling filter 380 V /16 A I A W IEC 1000-4-4
FP-EFT 32.1	249 253.1	Automatic three phase coupling filter 690 V / 32 A I A W IEC 1000-4-4
P90 extension Modification	spz 41	Modification to enable PEFT Junior to control FP-EFT 32.1
Adapter set	249 200.1	Adapter set for single phase filter.

13. Corrections and additions