

## PC Controlled I/O Cards Tester

The IO card tester is a system containing software and hardware that enables:

- functional testing of single- and multi-channel IO devices
- calibration of single- and multi-channel analog IO devices
- servicing of IO devices

The subject of test performed with the tester is:

- the IO port structure (the testing of the IO structure takes place through the verification of the response of the structure to a stimulation)
- IO port protection (tests if there are any missing or wrong-value protection devices between the IO terminals or between the inputs and the EARTH)

The EUT can be an analog IO or digital IO device. The IO EUT channels can be stimulated with an AC or DC current or voltage. The hardware configuration enables direct measurement of the resistance or capacitance of a arbitrarily chosen channel. In case of multi-channel devices, it is possible to stimulate an arbitrarily chosen block of IO channels.

One of the basic ideas behind the design of the tester is to achieve repeatability of technical parameters of the conducted tests. The role of the operator is limited to a minimum and is restricted to the installation of the EUT in the system. All technical parameters of the conducted test are inputted and controlled on the software level of the tester.

The conduction of the test is confirmed with a record in a log file. Such a record contains the type and serial number of the tested device, the date and time of the test, and the test result. The result of the test can be a confirmation of the device's conformance with functional requirements of the test or the code and description of the error.

The IO TESTER is equipped with hardware and software for performing a self-test.

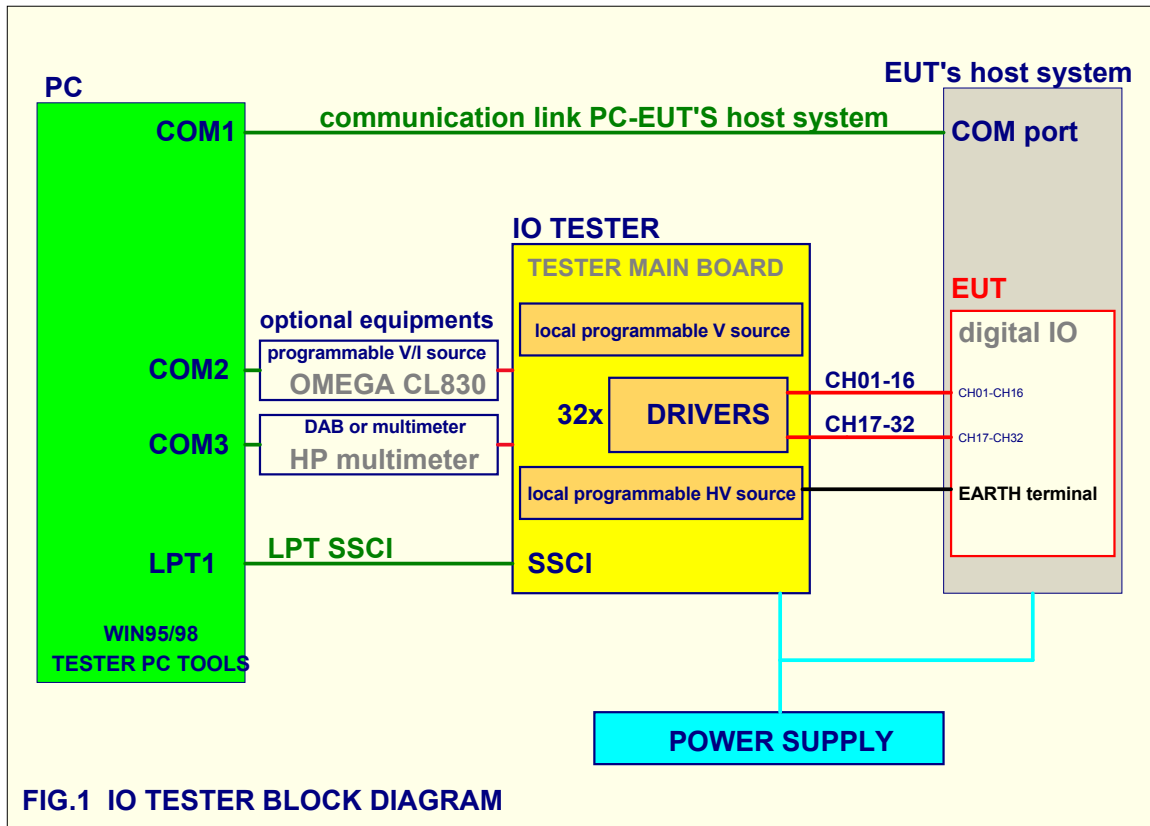
Because of the wide spectrum of analog and digital IO devices, the design of the tester is modified each time to cover the technical characteristics of the declared EUTs.

The IO TESTER is delivered together with a test procedure package for each EUT indicated in the system. The documentation enables the user of the system to make modifications to the test parameters and to expand the EUT system.

The descriptions and block diagrams provided below have an informative purpose, and they describe the basic functional characteristics of the tester. The entire provided documentation has been verified on the base of devices currently in use.

## IO tester block diagram

Figure FIG.1 presents an example of a block diagram of the tester for use with a multi-channel digital IO device (digital inputs with opto-insulation, outputs as relay contacts)



The EUT is tested, calibrated, or serviced in connection with its host system. The EUT's host system must be equipped with a communications port and a software interface enabling the access to data processed by the EUT.

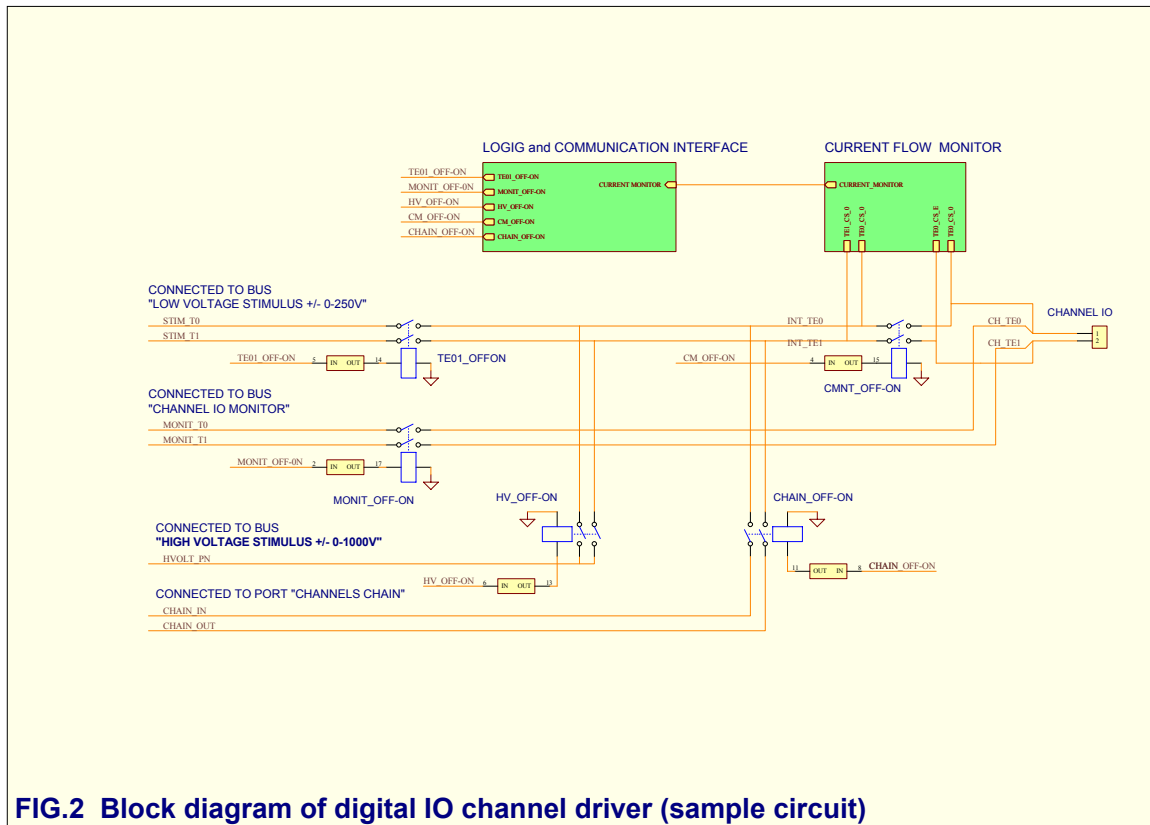
Depending on the technical requirements of the test, the IO TESTER can cooperate with assisting devices such as the OMEGA CL830 programmable precision voltage-current source or HP meters. The set of assisting devices is modified each time in order to cover the properties of the EUT and the technical requirements of the test.

In its basic version, the hardware of the tester can drive up to 32 channels simultaneously. Each of the available channels has a separate driver. The driver consists of a relay matrix and a control block. The planned technical requirements of the test determine the configuration of the relay matrix, the driver, and of the set of accompanying devices.

## Digital IO driver

Figure FIG. 2 presents a configuration of the driver typical for the service of a digital IO port. The driver, in a configuration as below, enables the performance of a low- and high-voltage stimulation. The low-voltage signal is conveyed to the IO port terminals, whereas the high-voltage signal used for testing the protection of the IO port is sent between the IO port and the EARTH. The output of the driver can be software-connected to the bus monitored by a voltmeter, ohmmeter, or capacitance meter, or it can be connected in chain with the output of the driver of the next channel.

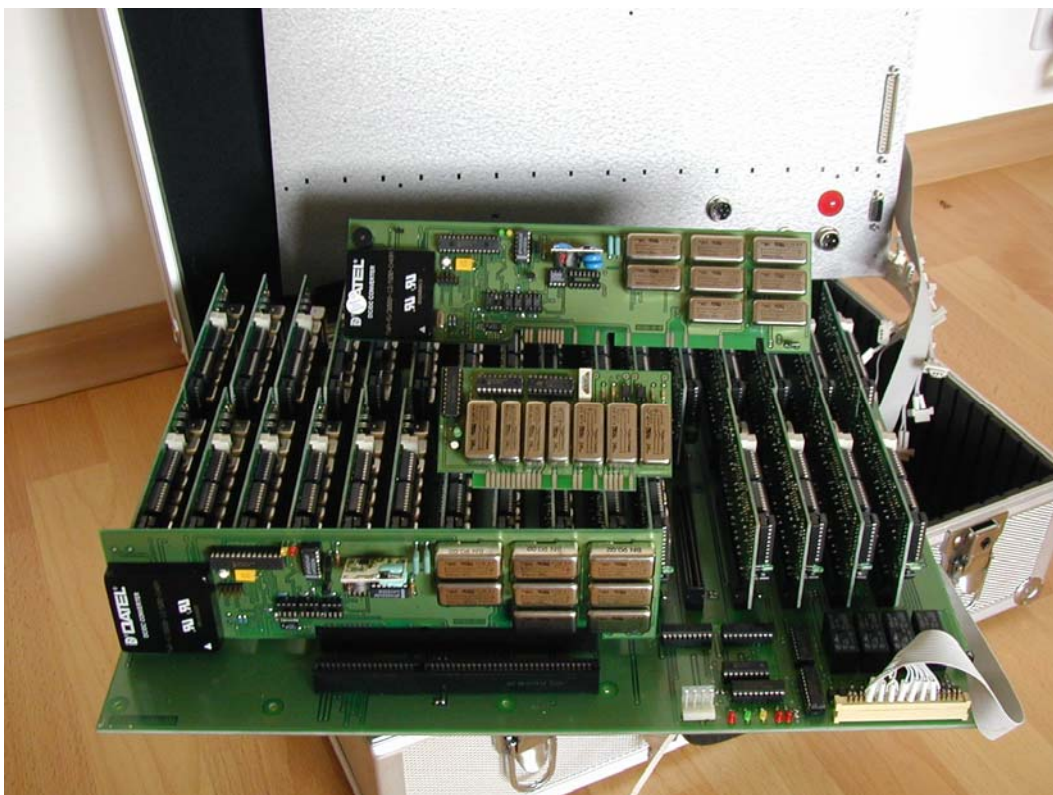
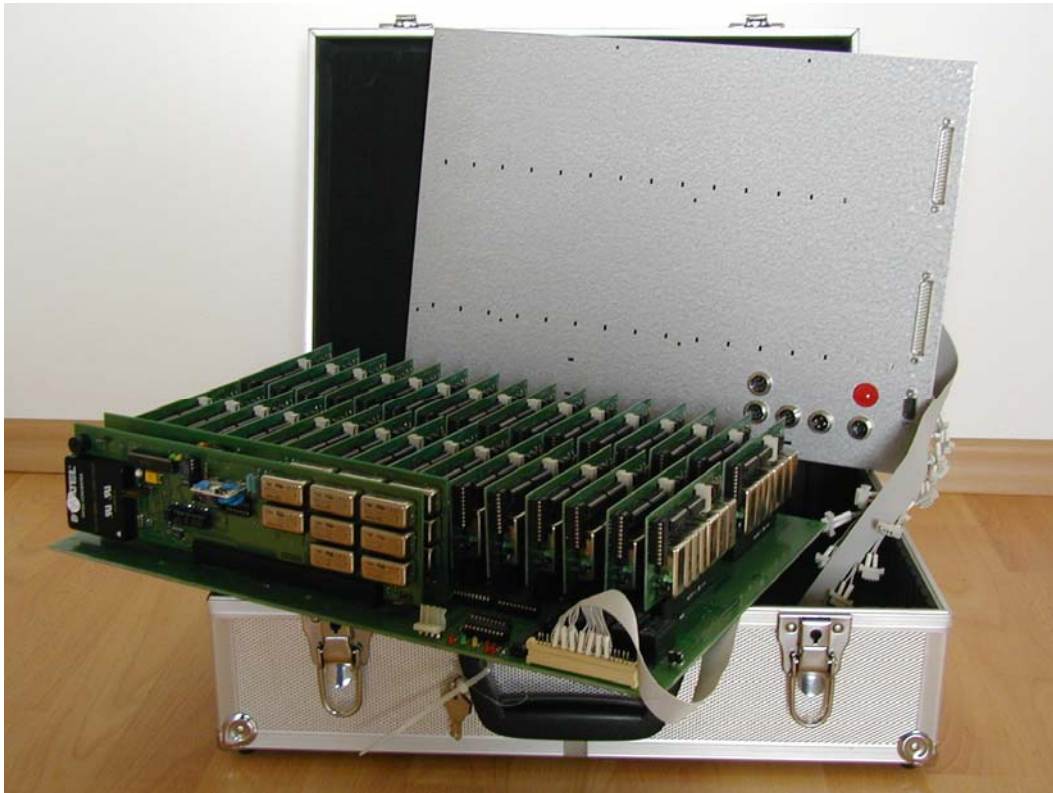
The current monitor enables the measurement of the current independently in both terminals of the IO port. Depending on the type of the test, the current monitor can be turned off with the use of software.



**FIG.2 Block diagram of digital IO channel driver (sample circuit)**

Picture PIC. 1 and 2 presents the interior of the digital type IO TESTER . The IO TESTER is a mobile device and is housed inside an aluminium suitcase of dimensions the size of the A3 format. The channel drivers take the form of plug-in modules. The mechanical design enables the rapid and simple exchange of a driver in case of damage.

The two long cards seen on the picture in a horizontal position below the driver blocks enable the upgrade of the tester with local accompanying devices such as the local programmable high-voltage generator or programmable voltage/current source, which reduces the cost of the system.



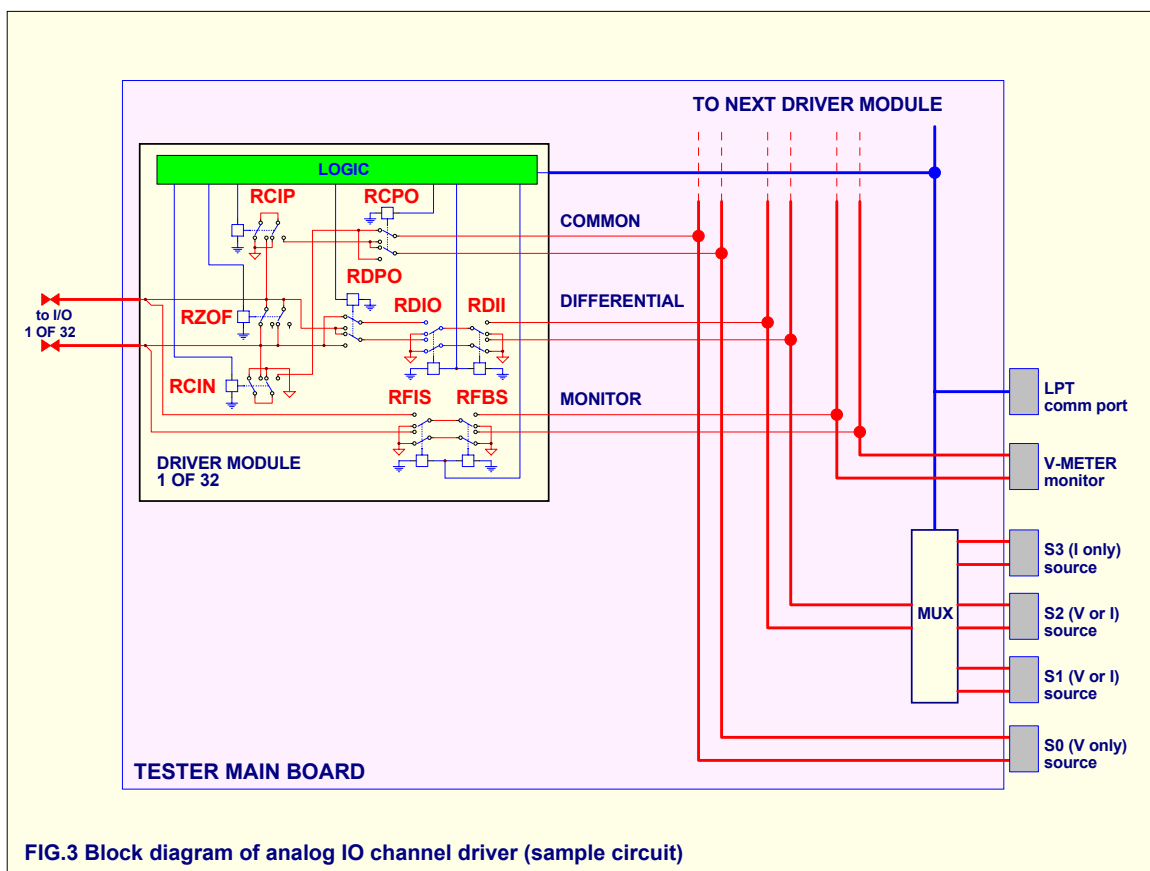
## Analog IO driver

In case of an analog IO driver, the relay matrix is more elaborate. The requirements placed on the PCB layout and electrical parameters of the relay contacts are also higher.

The analog IO driver is manufactured on a multi-layer board with the use of heretically sealed relays filled with argon in order to protect the electrical parameters of the working contacts.

Figure FIG. 3 presents the driver for use with an analog IO port. This driver enables the testing of the analog input by stimulating it with a differential signal (relays RDIO and RDII), and with a common signal overlaying it (relays RCIP and RCIN). During measurement of the zero offset, the terminals of the input port are short-circuited (relay RZOF). The polarity of stimulating signals is software-set (relays RDPO and RCPO).

Drivers of a similar design as presented below are applied in automatic calibrators for multi-channel DABs, allowing an error of less than 0.03% in the amplification range, and an error of less than 0.01% for the zero offset error of the calibrator during calibration.



## PC TOOLS software (IOT-PCtools)

The IOT-PCtools software is a script interpreter, which controls the hardware of the IO TESTER through a user-friendly and easily updateable command set. The IOT-PCtools software for the IO TESTER is designed to run under WINDOWS 95/98.

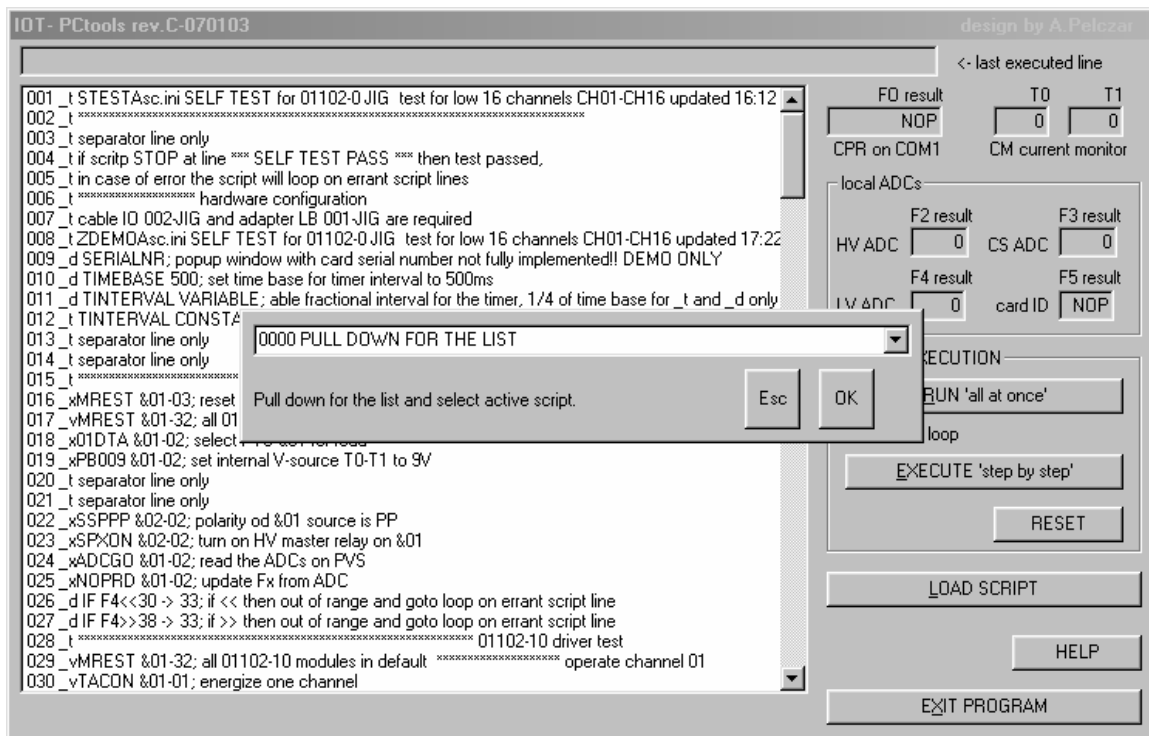
The command set includes

- a block command for the construction of decision blocks of the script (e.g. IF...GOTO..., WAIT)
- a block command for configuring the channel driver
- a block command for communicating with the EUT's host system
- a block command for communicating with accompanying devices
- a block command for setting exploitation parameters

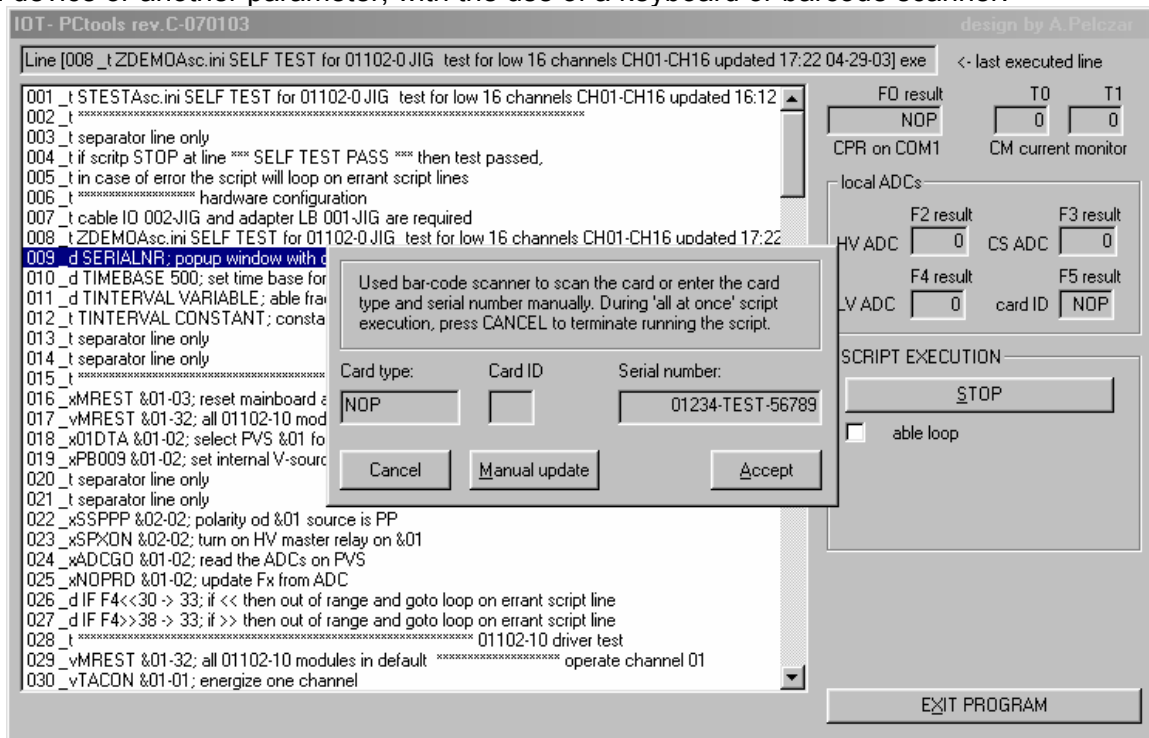
The command set is modified depending on the technical requirements of the test and the set of accompanying devices. The command description provided in the documentation enables the system user to change the test parameters and to expand the EUT set according to his needs.

The active script is selected from the menu list and is loaded for execution as read only. The IOT-PCtools software can run one script at a time.

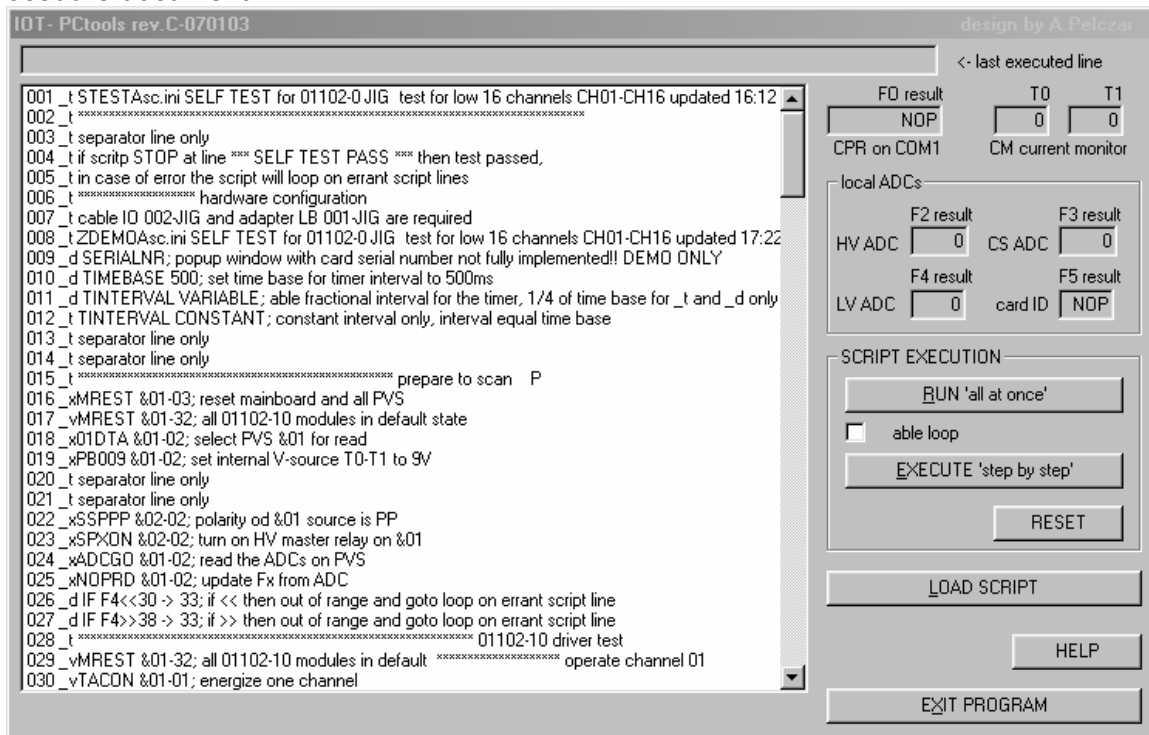
The list of scripts available in the menu is managed by the person responsible for quality control.



All the exploitation parameters of the tester are set from the level of the script. With the help of script commands, it is possible to open a dialog window enabling the input of data, such as the serial number of the tested device or another parameter, with the use of a keyboard or barcode scanner.



The first line of the script seen after loading the script into the execution window contains the confirmation of the script name and version. Before using the script, one must compare these parameters with the data in the test procedure document.



The active script can be executed all at once or step by step. The operator can terminate the running test at any time.

IOT- PCtools rev.C-070103 design by A. Pelczar

Line [165 \_xNOPRD &01-02; update Fx] executed [C780] ← last executed line

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137 _xNOPRD &01-02; update Fx from ADC
138 _d IF F4<<68 -> 145; if << then out of range and goto loop on errant script line
139 _d IF F4>>70 -> 145; if >> then out of range and goto loop on errant script line
140 _vMREST &01-32; all 01102-10 modules in default ***** operate channel
141 _vTAADN &01-32; energize add channels
142 _vDTALD &01-32; read from bank CH01-CH16
143 _vDTARD &01-32; update T0 and T1
144 _d IF T0!=AAAA -> 157; if != then out of range and goto loop on errant script line
145 _d IF T1!=AAAA -> 157; if != then out of range and goto loop on errant script line
146 _vMREST &01-32; all 01102-10 modules in default ***** operate channel
147 _vTAEDN &01-32; energize even channels
148 _vDTALD &01-32; read from bank CH01-CH16
149 _vDTARD &01-32; update T0 and T1
150 _d IF T0!=5555 -> 163; if != then out of range and goto loop on errant script line
151 _d IF T1!=5555 -> 163; if != then out of range and goto loop on errant script line
152 _t ***** current sensor on 01102-10 test end here
153 _t ***** PVS 01102-20A test
154 _xMREST &01-03; reset mainboard and all PVS
155 _vMREST &01-32; all 01102-10 modules in default state
156 _x00DTA &01-02; select unit &00
157 _vCSEOF &01-32; turn OFF 01102-10 current sensor on all channels
158 _v01HDN &01-01; energize channel 01 only
159 _xAUDON &01-01; turn audio alarm ON
160 _xSSPPP &01-01; polarity od &01 source is PP
161 _xSPXON &01-01; turn on HV master relay on &00
162 _xPA600 &01-01; set internal V-source T0/T1-EARTH to 600V
163 _d WAIT 50;
164 _xADCGD &01-02; read the ADCs on PVS
165 _xNOPRD &01-02; update Fx
166 _xAUDOF &01-01; turn audio alarm OFF
    
```

FO result T0 T1

NOP FFFF FFFF

CPR on COM1 CM current monitor

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local ADCs:

F2 result	F3 result
HV ADC <span style="margin-left: 20px;">FF</span>	CS ADC <span style="margin-left: 20px;">FF</span>
F4 result	F5 result
LV ADC <span style="margin-left: 20px;">FF</span>	card ID <span style="margin-left: 20px;">FF</span>

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SCRIPT EXECUTION

STOP

able loop

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EXIT PROGRAM