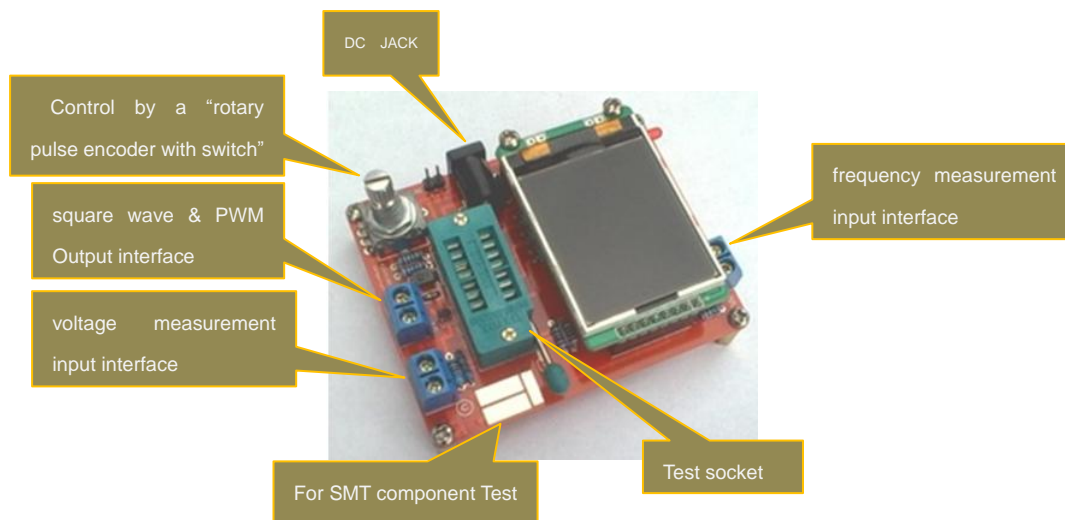# The Transistor Tester user manual

Power：

　　Transistor Tester can be powered from 6.8V – 12V DC. This can be achieve by a 9V layer-built battery. Two 3.7V Lithium-ion battery in series. Or AC adapter. When power on , the current is about 30mA at DC 9V.


Control:

　　Transistor Tester is control by a "rotary pulse encoder with switch" , or　RPEWS for short , this component have four mode of operation, Short time press, long time press , Rotation of left or Rotation right.

　　when Transistor Tester is powered.　a Short time press of the RPEWS will switch on the Transistor Tester, and start a Test. Transistor Tester will waiting for user input at the end of a test.

　　During a end of test ,before it's auto switch off.　A long time press or Rotation of left and right the RPEWS　will enter the function menu. In the function menu, a ">"　at left column to index the Selected menu item. To enter the Specific function , just a short press the RPEWS. Within the Specific function, a long time press will exit and back to the function menu.

Test：

Transistor Tester have three Test point(TP1,TP2,TP3), within the Test socket, the three is allocation as follow.
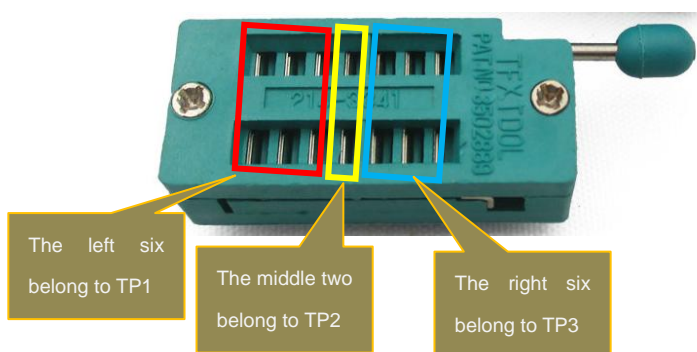
　　At right side of the Test socket is the SMT test pad, also have number to Identify each.

　　When test two lead component(resistor, capacitor, inductor), the two lead can select any two test point .　if TP1 and TP3 is selected, the Test will enter to" series test mode" when the　test is Completes.　Else the test is start again by a short press RPEWS.

⚠️Attention: All ways be sure to discharge capacitors before connecting them to the Tester! The Tester may be damaged before you have switched it on. There is only a little protection at the MCU's　ports.

　　Extra caution is required if you try to test components mounted in a circuit. In either case the equipment should be disconnected from power source and you should be sure, that no residual voltage remains in the equipment.

Self test and Calibration:

the self test can be prepared by connecting all three test point together and pushing of the RPEWS, the color of the Tester's LCD will change to white font and black background. Prompt string "Selftest mode..?", To begin the self test, the RPEWS must be pressed again within 2 seconds, else the tester will continue with a normal measurement.

Now self test is start, the tester will prompt you for next step. Wait for a time until Prompt string "isolate Probes!", at that time remove the connecting . Tester will wait , until it's sense the disconnect. Then Tester continue the self test process. If this is the first time use self test(the Transistor Tester is assemble by yourself from scratch), Tester will soon Prompt string " 1-||-3 > 100nf", A capacitor with any capacity between 100nF and 20μF connected to pin 1 and pin 3 is required for the last task of calibration, You should connect the capacitor not before this text is shown. With this capacitor the offset voltage of the analog comparator will be compensated for better measurement of capacity values.

special using hints:

Normally the Tester shows the battery voltage with every start. If the voltage fall below a limit, a warning is shown behind the battery voltage. If you use a rechargeable 9V battery, you should replace the battery as soon as possible or you should recharge. the measured supply voltage will be shown in display row two for 1 second with" VCC=x.xxV". It cannot repeat often enough, that capacitors should be discharged before measuring. Otherwise the Tester can be damaged before the start button is pressed. If you try to measure components in assembled condition, the equipment should be all ways disconnected from power source. Furthermore you should be sure, that no residual voltage reside in the equipment. Every electronical equipment has capacitors inside!

If you try to measure little resistor values, you should keep the resistance of plug connectors and cables in mind. The quality and condition of plug connectors are important, also the resistance of cables used for measurement. The same is in force for the ESR measurement of capacitors. With poor connection cable a ESR value of 0.02Ω can grow to 0.61Ω.

You should not expect very good accuracy of measurement results, especially the ESR measurement and the results of inductance measurement are not very exact

Components with problems:

You should keep in mind by interpreting the measurement results, that the circuit of the Transistor Tester is designed for small signal semiconductors. In normal measurement condition the measurement current can only reach about 6 mA. Power semiconductors often make trouble by reason of residual current with the identification and the measurement of junction capacity value. The Tester often cannot deliver enough ignition current or holding current for power Thyristors or Triacs. So a Thyristor can be detected as NPN transistor or diode. Also it is possible, that a Thyristor or Triacis detected as unknown. Another problem is the identification of semiconductors with integrated resistors. So the base -emitter diode of a BU508D transistor cannot be detected by reason of the parallel connected internal 42Ω resistor. Therefore the transistor function cannot be tested also. Problem with detection is also given with power Darlington transistors. We can find often internal base - emitter resistors, which make it difficult to identify the component with the undersized measurement current.

Measurement of PNP and NPN transistors:

For normal measurement the three pins of the transistor will be connect in any order to the measurement inputs of the Transistor Tester. After pushing the RPEWS, the Tester shows in row1 the type (NPN or PNP), a possible integrated protecting diode of the Collector - Emitter path and the sequence of pins. The diode symbol is shown with correct polarity. Row 2 shows the current amplification factor (hfe=...) and the Base - Emitter threshold voltage. You should know, that the Tester can measure the amplification factor with two different circuits, the common Emitter and the common Collector circuit (Emitter follower). Only the higher result is shown on the LCD.

With Germanium transistors often a Collector cutoff current ICEO with current less base or a Collector residual current ICES with base hold to the emitter level is measured.

Measurement of JFET and D-MOS transistors:

Because the structure of JFET type is symmetrical, the Source and Drain of this transistor cannot be differed. Normally one of the parameter of this transistor is the current of the transistor with the Gate at the same level as Source. This current is

often higher than the current, which can be reached with the measurement circuit of the Transistor Tester with the 680Ω resistor. For this reason the 680Ω resistor is connected to the Source. Thus the Gate get with the growing of current a negative bias voltage. The Tester reports the Source current of this circuit and additionally the bias voltage of the Gate. So various models can be differed. The D-MOS transistors (depletion type) are measured with the same method.

You should know for enhancement MOS transistors (P-E-MOS or N-E-MOS), that the measurement of the gate threshold voltage (Vth) is more difficult with little gate capacity values. You can get a better voltage value, if you connect a capacitor with a value of some nF parallel to the gate/source. The gate threshold voltage will be find out with a drain current of about 3.5mA for a P-E-MOS and about 4mA for a N-E-MOS

Function menu descriptions:

1. Switch off

Enter this Function Tester will shut down immediately.

2. Transistor

Transistor test, it's also the default Function at switch on.

3. Frequency

Measurement of frequency, For frequencies below 25kHz the normal measurement is followed by a measurement of period time. This additional measurement is only followed after a normal frequency measurement.

4.f-Generator

Signal generation, this Function can output square wave .with various of frequency to choice.

5. 10-bit PWM

The function "10-bit PWM" (Pulse Width Modulation) generates a fixed frequency(7812.5Hz) with selectable pulse width at the pin TP2. With a short key press (< 0.5 s) the pulse width is increased by 1%, with a longer key press the pulse width is increased by 10%. If 99% is overstepped, 100% is subtracted from the result. The function can be exit with a very long key press (> 1.3 s).

6. C+ESR@TP1:3

The additional function "C+ESR@TP1:3" selects a stand-alone capacity measurement with ESR (Equivalent Series Resistance) measurement at the test pins TP1 and TP3. Capacities from 2µF up to 50mF can be measured. Because the measurement voltage is only about 300mV , in most cases the capacitor can be measured "in circuit" without previous disassembling. The series of measurements can be finished with a long press of RPEWS.

7. Rotary encoder

With the function "rotary encoder" a rotary encoder can be checked. The three pins of the rotary encoder must be connected in any order to the three probes of the transistor tester before the start of the function. After starting the function the rotary knob must be turned not too fast. If the test is finished successfully, the connection of the encoder switches is shown symbolic in display row 2. The tester finds out the common contact of the two switches and shows, if the indexed position has both contacts in open state ('o') or in closed state ('C'). A rotary encoder with open switches at the indexed positions is shows in row 2 for two seconds as "1-/-2-/-3 o". This type of encoder has the same count of indexed positions as count of pulses for every turn. Of course the pin number of the right common contact is shown in the middle instead of '2'. If also the closed switches state is detected at the indexed positions, the row 2 of the display is also shown as "1—2—3 C" for two seconds. I don't know any rotary encoder, which have the switches always closed at any indexed position. The interim state of the switches between the indexed positions is also shown in row 2 for a short time (< 0.5s) without the characters 'o' or 'C'.

8.Selftest

With the menu function "Selftest" a full self test with calibration is done. With that call all the test functions T1 to T7 (if not inhibited with the NO TEST T1 T7 option) and also the calibration with external capacitor is done every time.

9. Voltage

Voltage measurement, Because a 10:1(180K:20K) voltage divides is connected , the maximum external voltage can be 50V, The measurement can also be exit with a extra long key press (> 4 seconds).

10. Show data

The function „Show Data" shows besides the version number of the software the data of the calibration. These are the zero resistance (R0) of the pin combination 1:3, 2:3 and 1:2 .In addition the resistance of the port outputs to the 5V side

(RiHi) and to the 0V side (RiLo) are shown. The zero capacity values (C0) are also shown with all pin combinations (1:3, 2:3,1:2 and 3:1, 3:2 2:1). At last the correction values for the comparator (REF C) and for the reference voltage (REF R) are also shown. Every page is shown for 15 seconds, but you canselect the next page by a key press or a right turn of the rotary encoder. With a left turn of the rotary encoder you can repeat the output of the last page or return to the previous page.

11. FrontColor

This function can change the color of the font,   the 16bit color is encode in RGB(565) format, that mean red maximum = 31, green maximum = 63,blue maximum = 31 respectively. In the function, a short time press can index the base color to change, turn left decrease it value and turn right increase it value. A long time press will save the Result and exit the function, please keep in mind the FrontColor and the backcolor cannot be the same. This will case the LCD show nothing. If this happens, you need to do a Selftest , how to enter the Selftest is descriptions at Page 2. Selftest will change the back Color to black and font color to white automatically. When the Selftest is finish . you will have the chance to modify the color .

12. BackColor

This is function is the same as the FrontColor except it's   change the background color .

13. 1-||-3

This function can series Measurement the capacitance at TP1 ,TP3, this function can Measurement very small capacitor. A long time press will exit the function.

14. 1-▭-〜〜-3

This function can series Measurement the Resistance and inductance at TP1 ,TP3, A long time press will exit the function.

At last:
For more information about the Transistortester, please visit
   http://www.mikrocontroller.net/articles/AVR-Transistortester