Air Conditioning Valve Tester

ACT-2

User manual

Read before use

DeltaTech Electronics

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1. Introduction

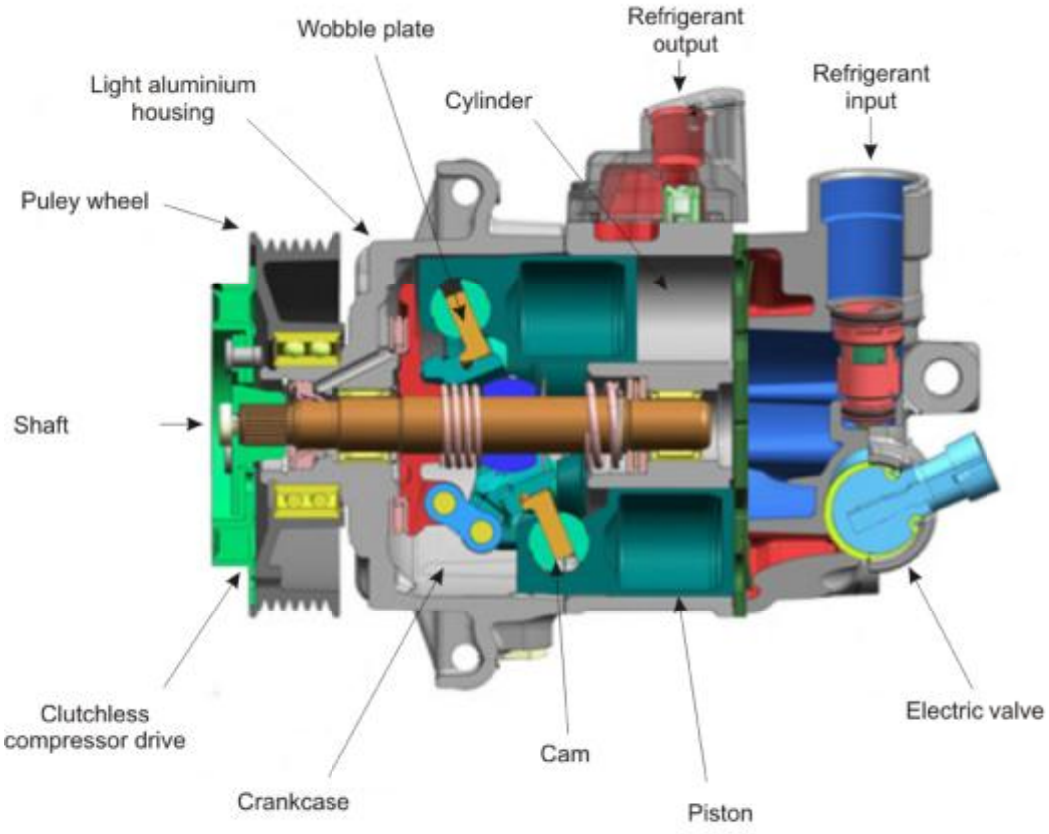
Today, almost every car is equipped with an air conditioning system. AC systems have become an active factor in driving safety, and can be considered as safety technology. Air conditioning system, like others, requires periodic maintenance and skillful diagnosis in case of malfunction. While design and operation of older systems is generally known, new solutions require more knowledge.

When there was a problem with system performance, or cooling system failed to operate at all, the first step was to check compressor drive, which was transferred by electromagnetic clutch. It was easy to check by means of ordinary multimeter capable of measuring coil resistance.

Newer air conditioning systems have compressor permanently connected to engine that operates as long as engine is running. In these systems air conditioning is controlled by special valve that increases or inhibits cooling intensity. How to check such compressor? Natural and safe solution is to use a dedicated device, ACT-2.

2. Design and operation of clutchless compressor

Exemplary construction of clutchless variable displacement air conditioning compressor is depicted below:



Principle of compressor operation is based on changing wobble plate position. The greater the tilt of plate, the greater amount of refrigerant is compressed and the greater cooling intensity.

The tilt of wobble plate is controlled by solenoid valve. This is possible by applying PWM signal with variable duty cycle. Valve design enables maintaining open or partially open for any period of time.
When the solenoid valve is closed, internal pressures in compressor equalize and springs sets wobble plate in vertical position, resulting in minimum piston displacement and small flow of refrigerant.

When the solenoid valve opens, it causes pressure difference that causes wobble plate to tilt by some degree, dependent on percentage of valve opening. If tilt of wobble plate is greater, the greater is also displacement of cylinders and more refrigerant flows through the compressor.

When the valve is closed this equalizes pressures inside compressor and causes the wobble plate to return to vertical position while reducing compressor efficiency.

Percentage of electromagnetic valve opening is set by air conditioning controller. When the controller, based on number of sensors and driver input, considers more cooling is required, valve opening increases. If required cooling demand is lower, the valve closes forcing lower compressor performance.

It is worth mentioning that clutchless compressors operate all the time the engine is running without possibility to stop them. Regardless of weather conditions and ambient temperature compressor of such type will work. If it does not, it means failure.

3. Device specifications

Supply voltage	DC, range 12...15V
Current draw	70 mA (tester current consumption, without load)
Control signal generator	
Frequency range	20Hz…1000Hz
Frequency generator accuracy	1Hz
Output signal amplitude	from 0V to supply voltage
Control signal type	switched ground and switched power output
Range of duty cycle	0%...100%
Duty cycle accuracy	0.1%
Number of outputs	2
Control signal measurements	
Frequency range	20Hz…1000Hz
Input signal amplitude	from 0V to supply voltage
Switching threshold	2.5V
Protection	
Voltage	Overvoltage protection (exceeding 18V)
Current	Overcurrent of 6.3A (fuse) and short circuit protection.

4. Tester application

ACT-2 is useful in diagnosis of the following types of air conditioning compressors:

- *compressor with electromagnetic clutch* – checking operation of electromagnetic clutch,
- *clutchless compressor* – checking operation of electromagnetic valve controlling compressor displacement

Attention! The tester does not support solenoid valves with built-in protective diode (valves used in Mercedes,among others). Using a tester for these types of valves may result in damage to the valve or the tester.

ACT-2 device can be used both on the test bench and in car.

5. Control signal measurement

Connection diagrams depending on type of valve connection to vehicle electrical system are shown in Figure 5.1.

Measurement probe cable is marked with the blue band.

Then using external power supply it is required to connect power supply ground with vehicle ground with cable provided (brown band cable).

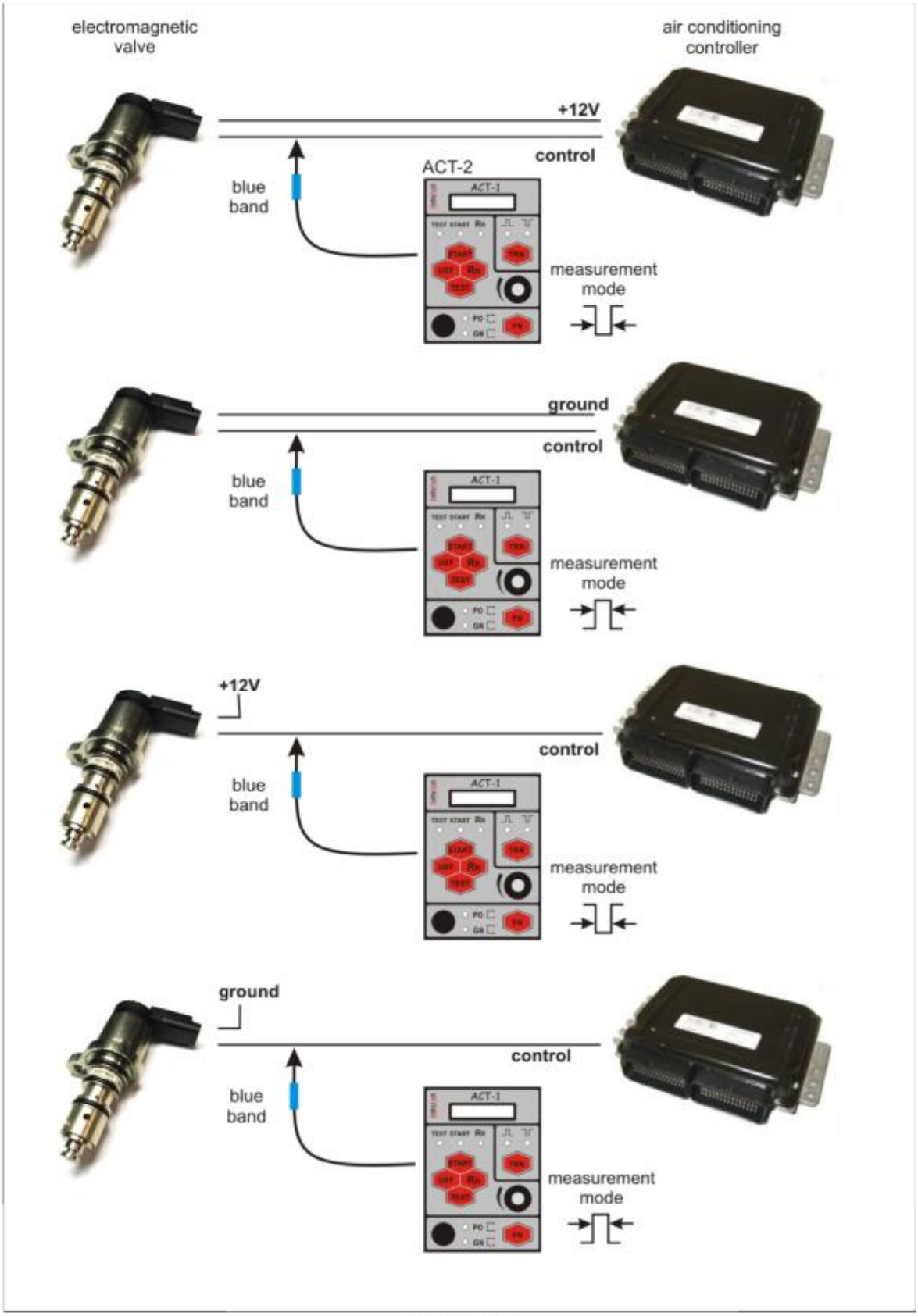

electromagnetic valve
air conditioning controller
+12V
control
ACT-2
blue band
measurement mode
ground
control
blue band
measurement mode
+12V
control
blue band
measurement mode
ground
control
blue band
measurement mode

Figure 5.1

6. Connection of electromagnetic valve

Connection diagrams for electromagnetic valve is shown in Figure 6.1.

Then using external power supply it is required to connect power supply ground with vehicle ground with cable provided (brown band cable).

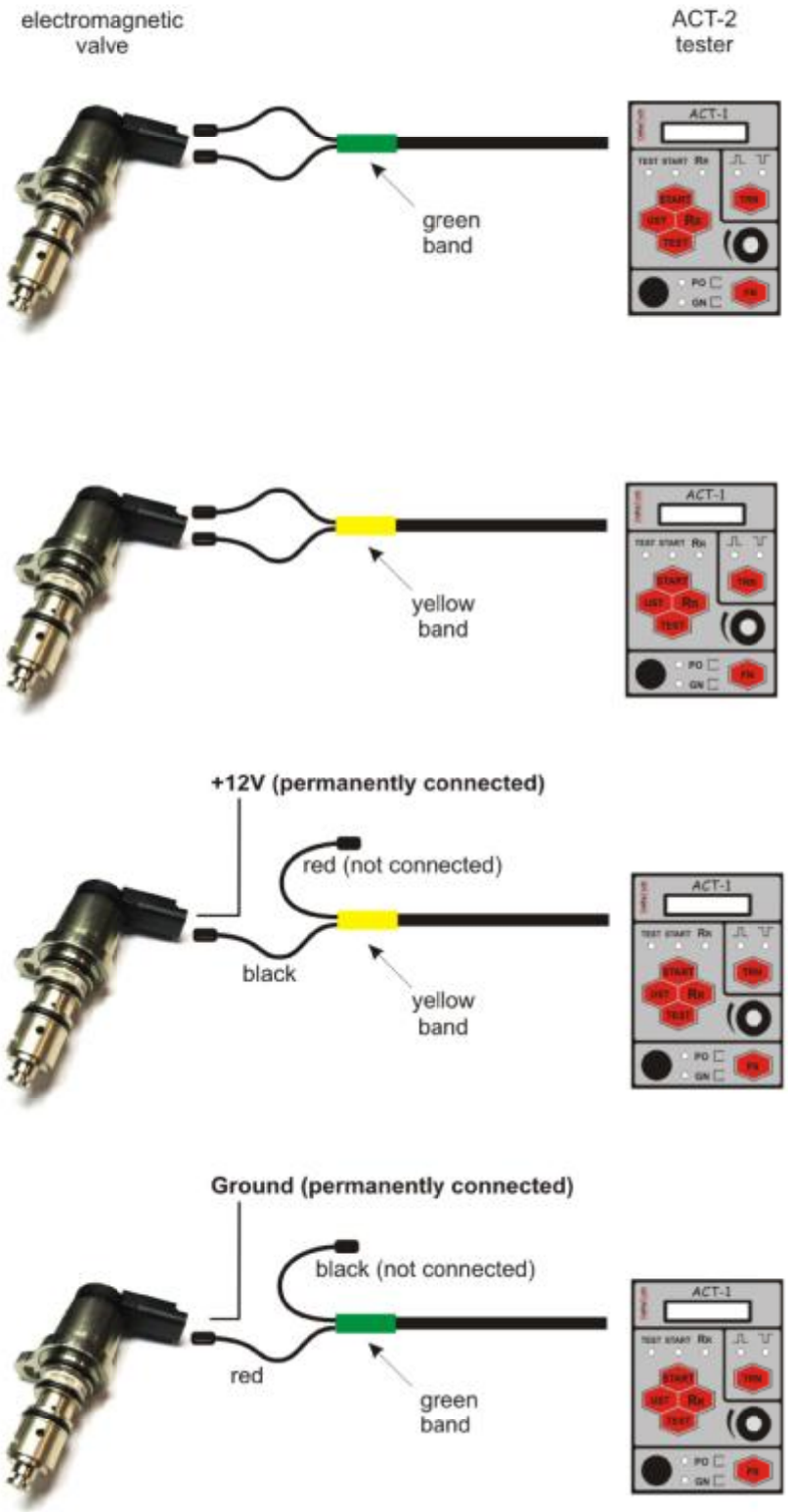

electromagnetic valve
ACT-2 tester
green band
yellow band
+12V (permanently connected)
red (not connected)
black
yellow band
Ground (permanently connected)
black (not connected)
red
green band

Figure 6.1

7. Device operation

ACT-2 tester is operated with the panel depicted in Figure 7.1.

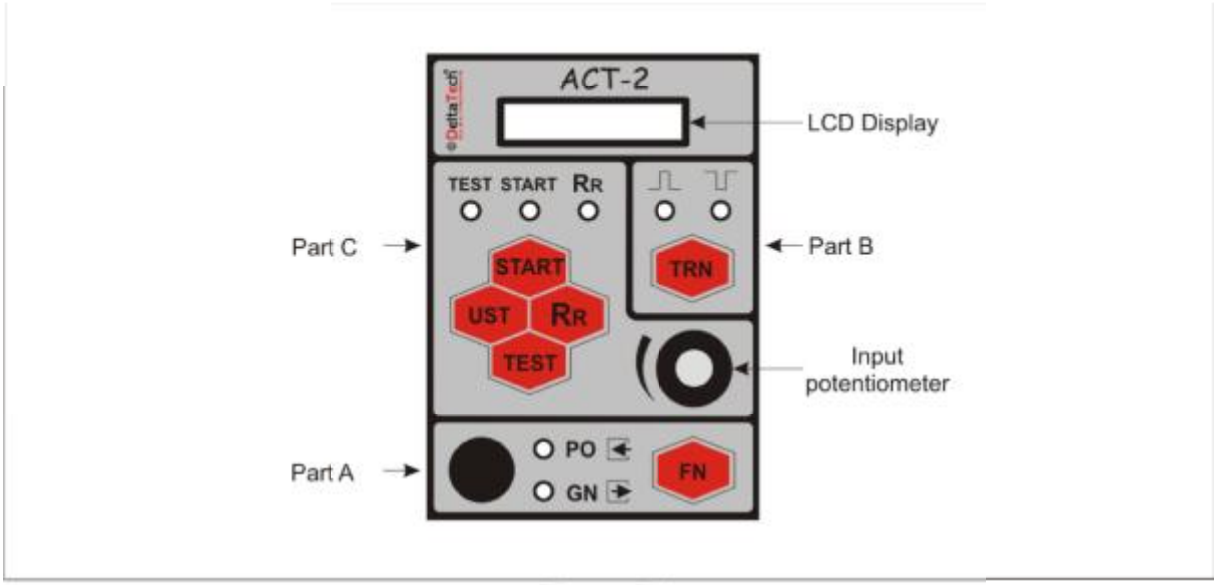


Figure 7.1

The panel consist of three parts:

Part A – Changing tester function

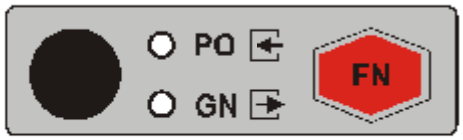


Figure 7.2

Part A enables switching between measurement mode and generator mode. To switch, press ***Fn*** button.

Current tester function is indicated by ***PO*** and ***GN*** indicator lights. ***PO*** means measurement mode, ***GN*** means generator mode.

Part B – Measurement setting.

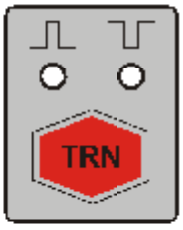


Figure 7.3

Part B allows changing input signal interpretation in measurement mode. Proper setting is required to get adequate signal parameters (duty cycle and frequency).

Press ***TRN*** button to change interpretation of input signal duty cycle. Current selection is indicated by indicator lights and .

Details on usage of panel components are provided in description of each tester function.

Part C – generator module

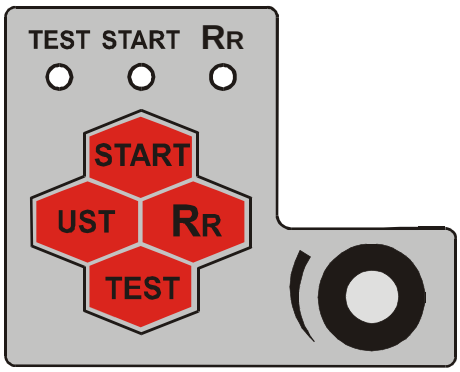


Figure 7.4

Part C allows to control PWM signal generator module. Use buttons to select desired action. The meaning of individual buttons is as follows:

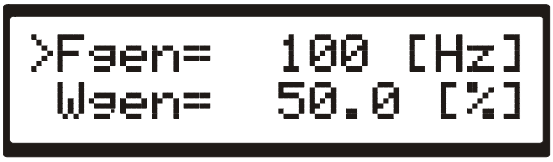
- ***START*** – starts and stops signal generation with specific parameters;
- ***UST*** - pressing this button will switch between duty cycle and frequency to be adjusted,
- ***Rr*** – changes input precision,
- **TEST** – this button starts cyclic enabling and disabling control signal with parameters specified.

Details on usage of panel components are provided in description of each tester function.

8. Tester functions

After connecting the power device will display the splash screen.

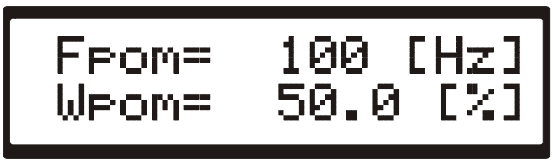
This screen is displayed for 3 seconds, then the device automatically switches to generator mode and displays parameters of generated PWM signal.



Use ***FN*** button (see Fig. 7.2) to switch between measurement and signal generator mode. Current choice is indicted by PO and GN indicators.

8.1 PWM measurement mode

There are two measured values displayed on the screen:
- frequency
- duty cycle.



Measurement module detects signal change connected to cable marked with blue band (see Fig. 5.1). If the signal exceedes 2.5V it is interpreted as a high state. Lower voltage means low state.

Depending on type of valve connection the pulse duration is interpreted as a duration of input being in low or high state. It is necessary to set how device should interpret input signals. Current selection is indicated by indicator lights:
-  means that pulse duration is duration of input in high state,
-  means, that pulse duration is duration of output in low state.

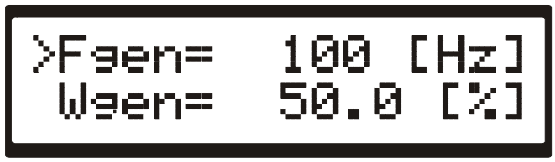
By pressing the **TRN** button it is possible to change between these two modes. Selecting the right interpretation method affect correctness of measured PWM parameters readout.

Methods for checking control signal:

1. Depending control signal mode attach connection cables according to Figure 5.1.
2. Using ***FN*** button select PWM measurement mode (***PO*** indicator should light up).
3. Select correct pulse duration interpretation by pressing **TRN**,
4. Start the engine.
5. Enable air conditioning (A/C) and observe tester readouts.
6. With correct PWM control, the signal duty cycle should increase along with increasing compressor output.

8.2 PWM generator function

In this mode there are two signal parameters displayed on the screen:
- frequency
- duty cycle.



Use ***UST*** button (see Fig. 7.4) to change parameter to be adjusted – frequency or duty cycle. Current choice is indicated by symbol > on the display.
To adjust value use input potentiometer. Depending on input precision chosen the adjustment is coarse or fine. Current input precision is selected by ***Rr*** button. **Rr** indicator lights up when small steps (fine tuning) is selected.

START button toggles on and off signal generator connected to electromagnetic valve. ***START*** indicator will light up when the generator is operating

If the output draw by the connected device exceeds limit, the overcurrent protection will turn off the output (to protect both the generator and connected device) and the ***START*** indicator begins to blink. Press the ***START*** button to resume PWM signal generation.

Use ***TEST*** button to start cyclic turning on and off PWM control signal with parameters specified to test electromagnetic valve operation.

Methods for testing electromagnetic valve

1. Depending on type of valve connection properly connect the device according to Figure 6.1.
2. Use ***FN***, button to select PWM generator mode. (***GN*** indicator will light up).
3. Set frequency of generated signal ***Fgen*** according to specifications of tested valve. If not known, set 500 Hz.
4. Set duty cycle of generated signal ***Wgen*** to 0%.
5. Start the engine.
6. Enable PWM control signal by pressing ***START***
7. While increasing ***Wgen*** value observe compressor performance.

After performing the test remember to clear fault codes recorded by air conditioning controller.

Warning !!!

DeltaTech Electronics company is not responsible for any damage and consequences of misuse of ACT-2 tester.

The warranty do not cover any damage caused by incorrect use.