

Commissioning and troubleshooting electrical equipment can sometimes be complicated. Having testing equipment on hand is not always sufficient or available at the necessary time. I have found it very helpful to always have a set of testing equipment available. Portable testing equipment is not meant to replace manufactured and calibrated equipment but as a valuable addition.

Protective relays and transfer schemes were tested using a calibrated Omicron tester. Expensive and heavy equipment is no longer required. A portable three-phase AC source can be used to demonstrate the operation of a transfer scheme to a client or to simulate SCADA inputs.

The rental cost, weight, and shipping cost of professional equipment can be prohibitive when trying to have all possible testing equipment available just in case. I came up with the idea of having a set of small portable devices, wires, and wire jumpers connected with quick connectors.



Set on the picture above weights only 5kg and can be taken anywhere.

Breaker test station and programmable controller are special devices. I could not buy them so I needed design and built them to use.

Programmable controller

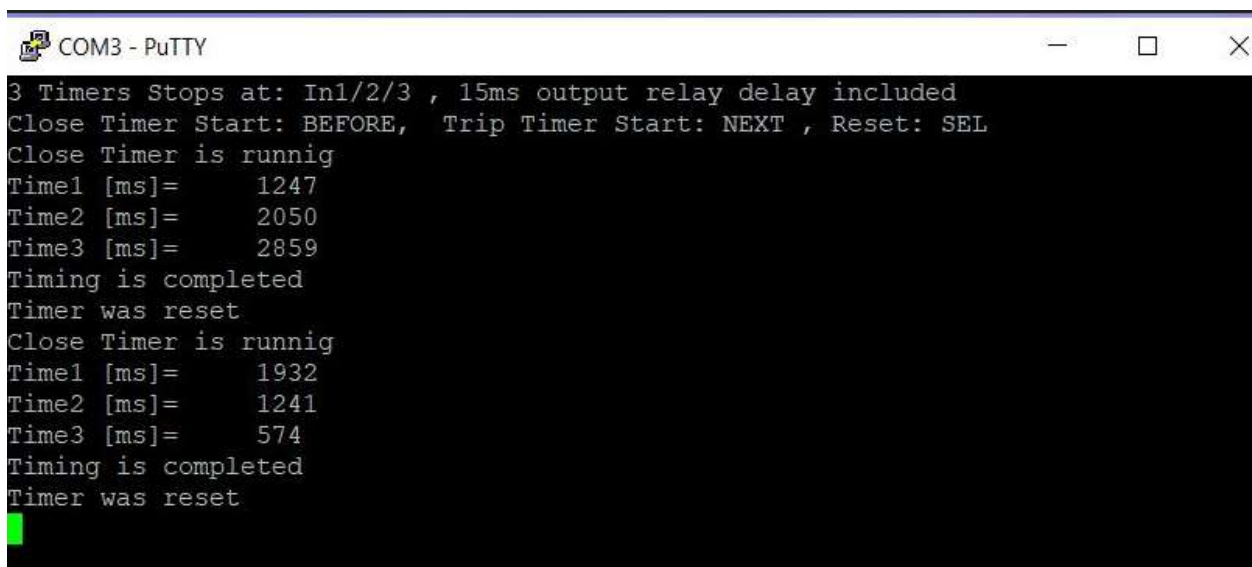


The programmable controller has 4 inputs (5-170VDC), 4 outputs (10A dry contacts), and a DC current sensor, weighing only 0.4 kg. It can be operated by a 5V power bank or a laptop USB port thanks to its low power consumption. The controller's inputs and outputs are optically isolated, making it safe to connect to and operate with a laptop. The controller is programmed using the powerful and flexible C/C++ language. I can create or modify C/C++ programs for particular troubleshooting or testing requirements.

The 25 multicolor programmable LEDs allow for flexible communication with the operator. Messages can be sent to a laptop and read on any terminal program. The device can be operated using mini buttons, input statuses, or a laptop keyboard.

Functional examples:

- **Breaker Simulator:** Allows saving the breaker mechanism while testing relays or testing a transfer scheme with a missing or defective breaker.
- **Multichannel Timer:** Helps find the operation sequence and time event spacing, aiding in systems troubleshooting and breaker operation (quick timing verification).
- **Visual Input Sensor:** Allows the operator to visually catch short pulses or loose input wires. The bottom input diodes are green when the input is open and red when closed. The second row of diodes is programmed to illuminate blue for 1 second when the associated input changes from open to close or yellow when the input changes from close to open.



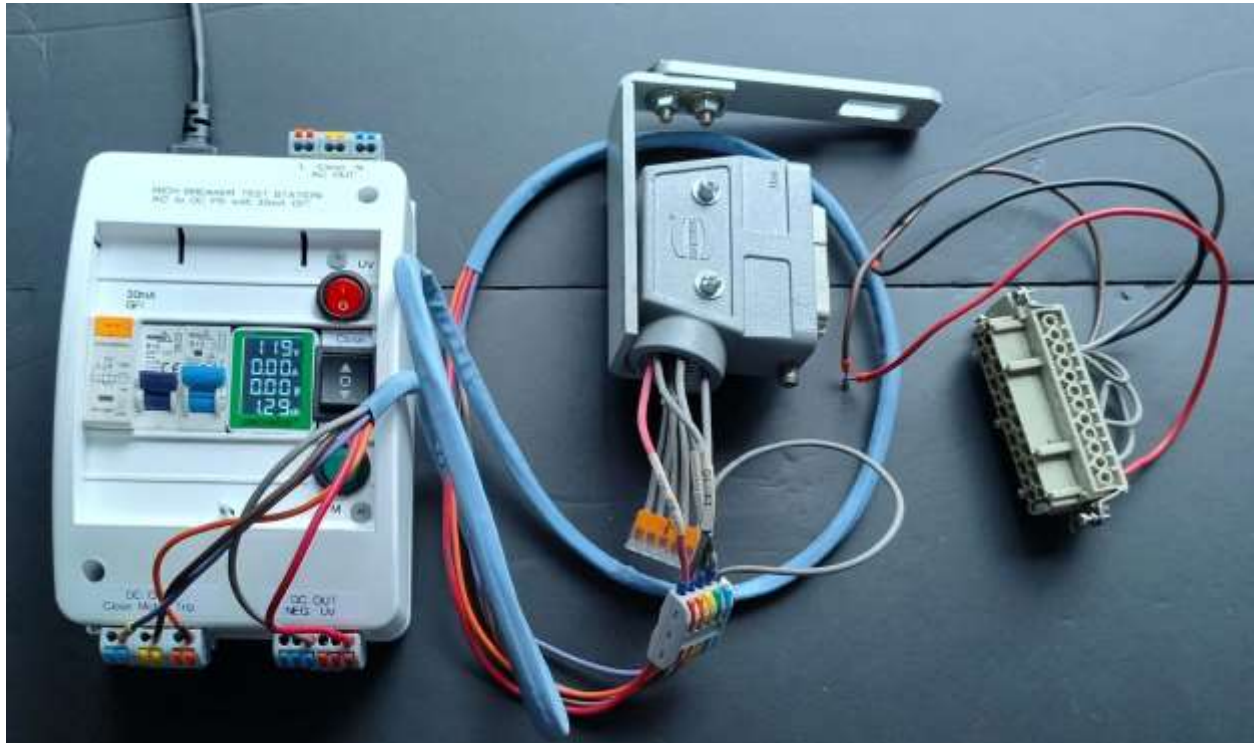
```
COM3 - PuTTY
3 Timers Stops at: In1/2/3 , 15ms output relay delay included
Close Timer Start: BEFORE, Trip Timer Start: NEXT , Reset: SEL
Close Timer is runnig
Time1 [ms]= 1247
Time2 [ms]= 2050
Time3 [ms]= 2859
Timing is completed
Timer was reset
Close Timer is runnig
Time1 [ms]= 1932
Time2 [ms]= 1241
Time3 [ms]= 574
Timing is completed
Timer was reset
█
```

Close (NO) timer operation results from laptop terminal

Breaker AC/DC test station



The AC/DC portable Breaker Test Station and DC Power Supply with a 30mA GFI weighs only 1.0 kg. The station can be powered by either AC or DC, or it can be used as just a button start/stop station for breakers and contactors. It is protected by a 16A 30mA GFI breaker combo in series with a 10A fast breaker, providing safety and fault indication. In the case of a ground fault, the 16A GFI breaker trips first. Overcurrent and short faults cause the 10A OC breaker to trip. A meter monitors current and voltage, helping to indicate problems within the attached breaker. The breaker plug is connected using simple wires attached to quick connectors.



Breaker connectors could be easily swapped.