

ELECTRONIC CONTROL SYSTEM OF TESTING BENCH

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ABSTRACT

Control electronics described in this paper allows using and control of testing bench, designed for testing of low voltage circuit breakers. In first part a short information about testing bench and its block circuit diagram is placed. Second part contains schematics and functional description of capacitor bank charger. In third part a thyristor controlling electronic is described with complete circuit diagram and functional description.

1 INTRODUCTION

Control electronics designed for testing bench, allows automatized operating and using of bench for testing low voltage circuit breakers. Testing bench allows testing for short-circuit currents, up to 7,2 kA. It has been designed for experimental studying of processes in low voltage circuit breakers and for education.

2 DESCRIPTION OF TESTING BENCH

Principle of testing bench is syntetic test circuit. Basement of test circuit is capacitor bank built-up from maximally 32 pieces concurrently combined electrolytic capacitors. Every capacitor has capacity 4700 μF and maximum operation voltage 400 V. In the end of charging, energy stored in capacitor bank may be up to 6 kJ. Capacitor bank in combination with short-circuit coil are electrical oscilation circuit with very low $\cos \phi$. This circuit is tuned for main industrial frequency - 50 Hz.

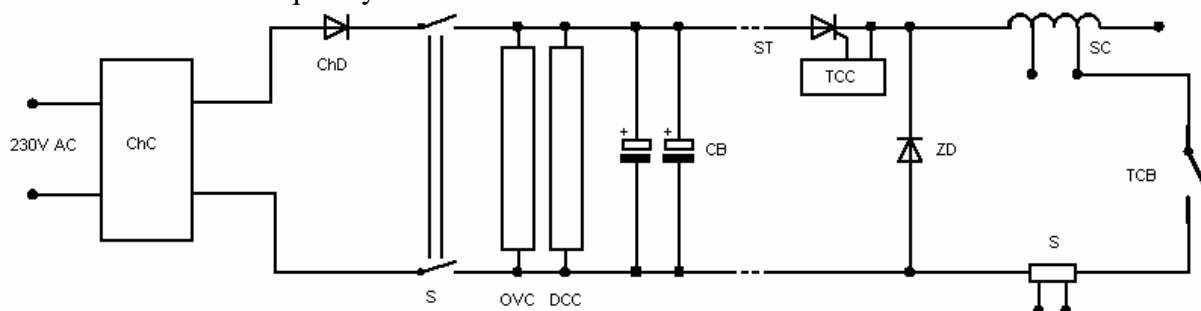


Fig. 1: Block diagram of testing bench

ChC – Charging circuit

ChD – Charging diode

S – Switch

OVC – Overvoltage Control

DCC – Discharging circuit

C – Capacitor bank

ST – Switching thyristor

TCC – Thyristor control circuit

ZD – Zero diode

SC – Shortage coil

TCB – Tested circuit breaker

S – Shunt

3 CAPACITOR BANK CHARGER

Charging circuit makes practical charging of capacitor bank. First part of this circuit is toroid transformer with two secondary windings. On these windings are connected two limiting resistors and full-wave rectifier is connected as subsequently. Output of this rectifier supplies capacitor bank and is protected by fuses. Limiting resistors are intended for limiting of charging current and dedicates charging time constant. In serial combination with primary winding is connected thermistor, which reduces current impulse rising when transformer is switched-on.

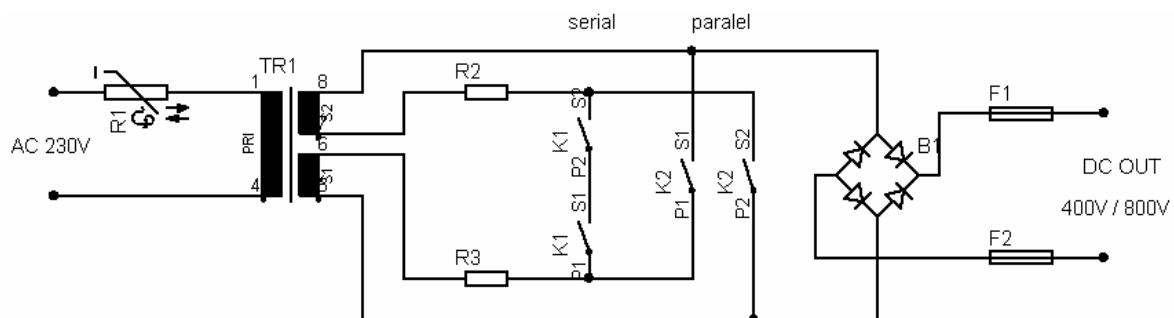


Fig. 2: Schematics of capacitor bank charger

Rectifier is really built-up from 12 pieces of diodes. It is because necessary of reducing voltage stress of diodes. Same reason leads to using two fuses in every place. Couple of contactors allows serial or parallel combination of secondary windings, which allows switching of output voltage of charging circuit for 400 V DC or 800 V DC. Contacts of contactor K1 are connected serially to reduce voltage stress.

Small space takes out make charging circuit on two separated PCB. On first PCB is placed primary thermistor and limiting resistors (sized for 50 W) and terminals for connecting of contactors. Second PCB contains rectifier and fuses.

4 THYRISTOR CONTROL ELECTRONIC

Thyristor control circuit provides operating of thyristors and synchronized starting of measuring equipment. Circuit may be started manually with S1 switch of external (for example

by measuring computer) by sending starting impulse to terminal X1.

Integrated circuit IC1 (NE 555) generates impulse, which opens T1 transistor. This makes transistors T2 to T5 open to which gates of thyristors are connected. Thyristor opens and shorts capacitor bank through tested circuit breaker. Secondary is this impulse led through optoisolator to output X2. This output is determined to connecting measuring computer or oscilloscope. Second integrated circuit IC2 (NE 555) is connected to LED indicating pass of shortage. This circuit extends time of lightening to 7 seconds. It is necessary to safety using of testing bench.

On designed PCB are also two separated power sources of 5 V DC. Main source supports timing and starting circuits, second isolated circuit gives voltage for starting measuring equipment.

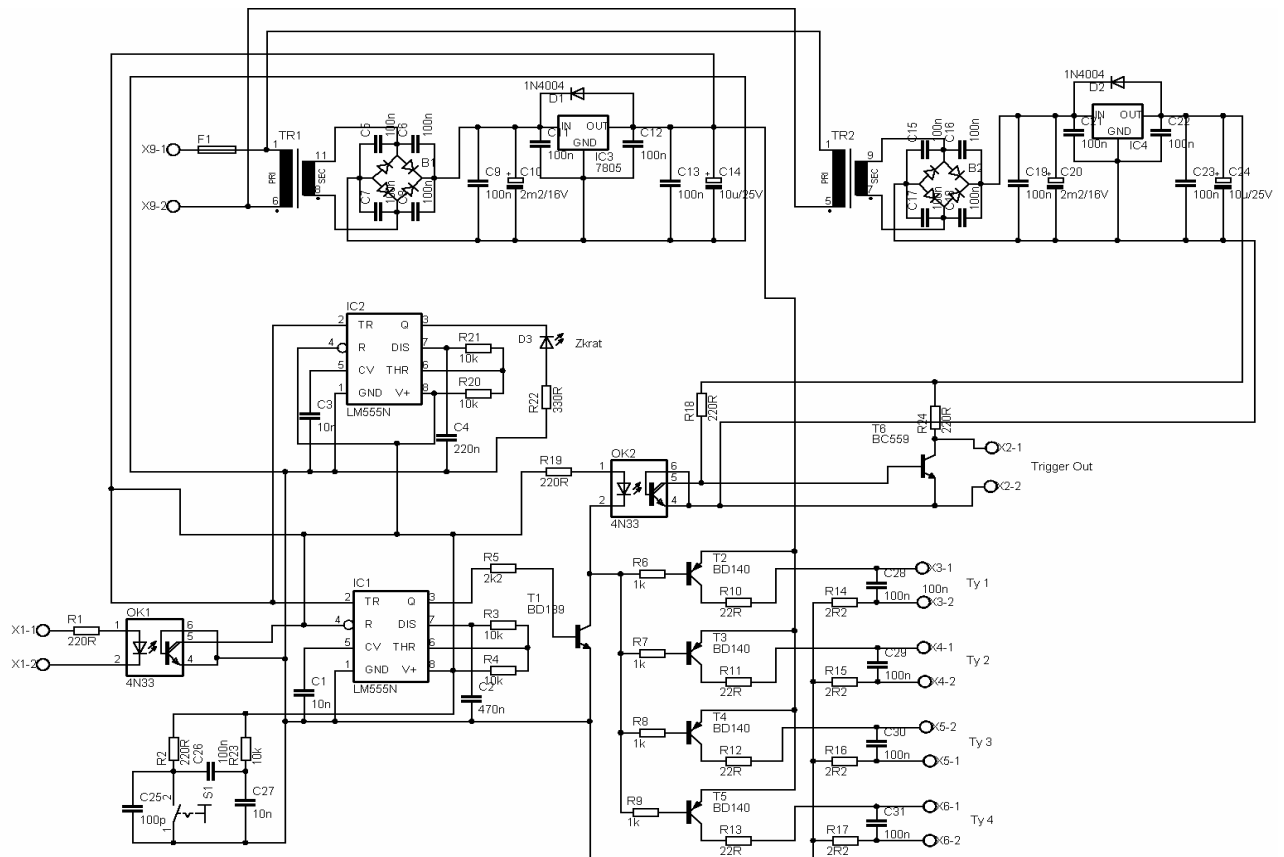


Fig. 3: *Thyristor control circuit*

5 CONCLUSION

Testing bench allows testing of circuit breakers and is usable for education. Described parts are necessary to operation with testing bench. Capacitor bank charger is necessary for basic function of bench, thyristor control circuit makes using very simple and exact.

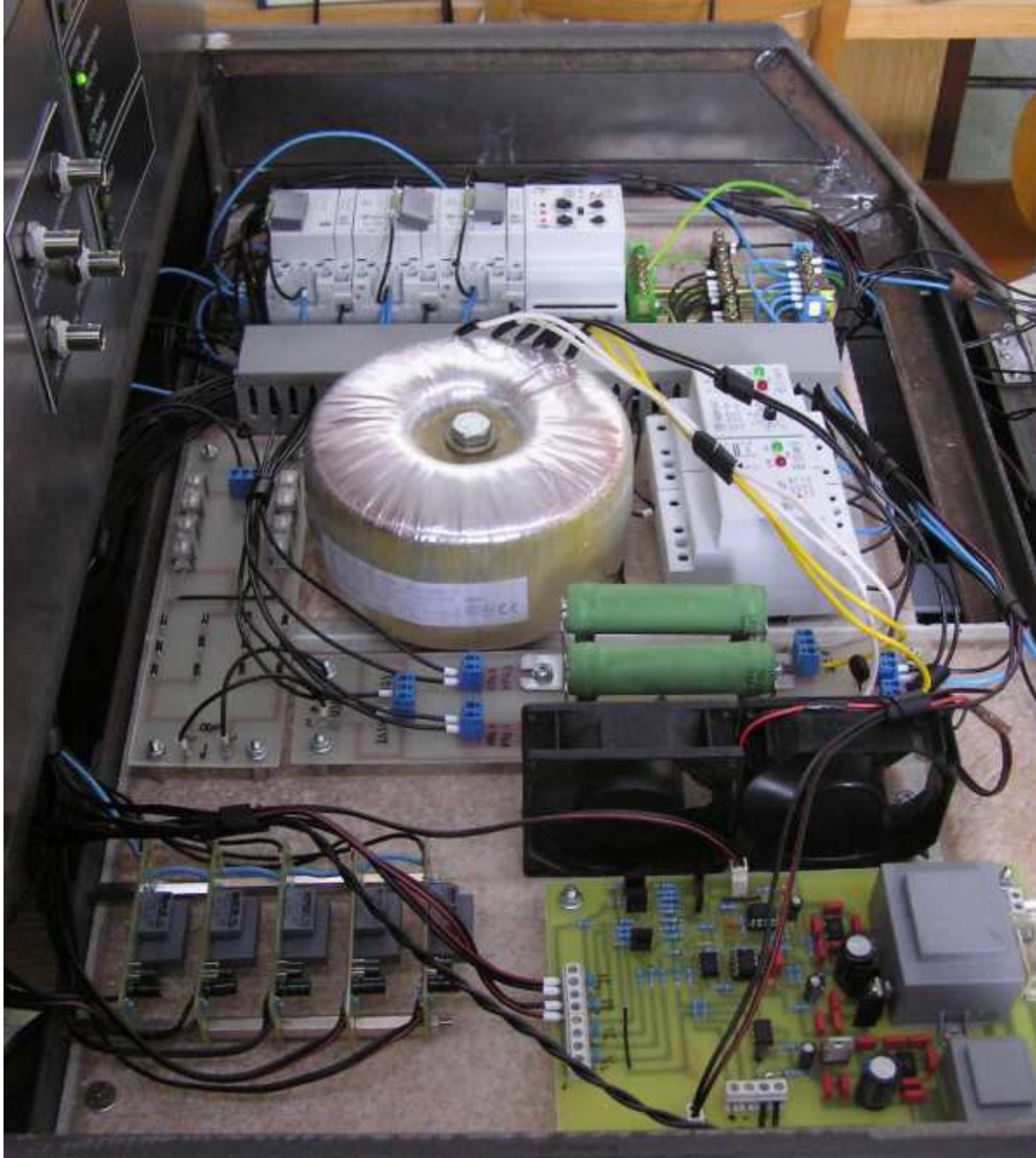


Fig. 4: *Complete electronics of testing bench*

ACKNOWLEDGEMENTS

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