Chapter-7

DEVELOPMENT AND FABRICATION OF 4-PARAMETERS TRV SYNTHETIC TEST CIRCUITS (PROTO TYPE) WITH AUTOMATIC CONTROLLER FOR CIRCUIT-BREAKERS

7.1 Development and Fabrication of 4-parameters TRV synthetic test circuit for Terminal fault test duty

In order to verify the designed and simulated results, a laboratory model (Prototype) of 4-parameters TRV control circuit has been developed and fabricated. The values of components taken the same as obtained by computer aided design and simulation. Only thing the main capacitor bank Cn is charged in volts instead of kV.

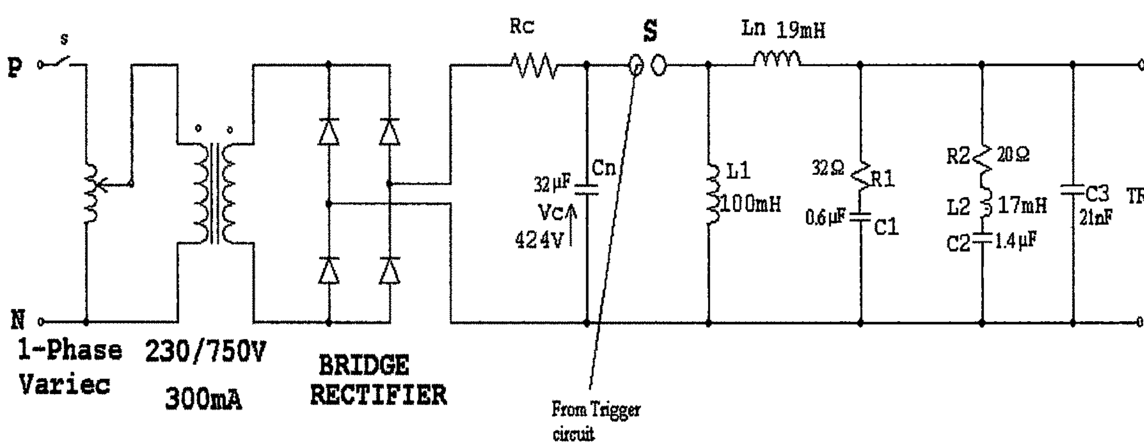


Fig.7.1 Schematic diagram of a developed 4-parameters TRV parallel current injection synthetic test circuit for terminal fault test duty as per case-I for 420 kV CBs

Figure7.1 shows the schematic diagram of a developed 4-parameters TRV parallel current injection synthetic test circuit for terminal fault test duty as per case-I (TRV envelope represented in Fig.3.9 as per IEC) for 420kV rating circuit-breakers. The complete circuit consists of charging unit and 4-parameters TRV shaping circuit.

The charging unit consists of step up transformer, metal diode full-wave bridge rectifier and charging resistors. The charging unit is capable to give variable dc voltage of either polarity for charging the main capacitor bank to the required value.

The TRV shaping circuit consists of the following components:

- Main capacitor bank Cn
- TRV capacitor banks C_1 and C_2
- Stray capacitor bank C_3
- Reactors Ln, L_1 and L_2
- Resistors R_1 and R_2

The transformer raises the voltage. The metal diode full-wave bridge rectifier converts alternating input voltage to variable direct voltage. This variable dc voltage is used to charge the main capacitor bank Cn to give the required recovery voltage. Cn is charged to a voltage which is equal to the peak power frequency voltage which will appear across the contacts at the moment the circuit-breaker under test interrupts the current. The TRV capacitor banks C_1 and C_2, reactors (Ln, L_1 and L_2) and resistors (R_1 and R_2) are used to get the desired test conditions i.e. to control transient recovery voltage (TRV) and RRRV. The magnitude and the frequency of transient recovery voltage (TRV) depend on the voltage to which the main capacitor Cn is charged and the above circuit components.

Here the main capacitor Cn is charged in volts instead of kV. In order to verify the designed and simulated results, the values of circuit components are taken the same that obtained by computer aided design and simulation. Fig.7.3 shows the complete hardware set up of 4-parameters TRV synthetic test circuits.

The values of circuit components chosen for terminal fault TRV as per case-I to test 420 kV rating circuit-breakers are as follows:

Rating of CB	Circuit components		Terminal Fault Test Duty
			As per case-I
	Capacitor Banks		
	Main Capacitor Bank:	C_n	32 μF
	TRV Capacitor Bank:	C_1	0.6 μF
		C_2	1.4 μF
420kV	Stray capacitor Bank:	C_3	21 nF
	Reactors :	L_n	19 mH
		L_1	100 mH
		L_2	17 mH
	Resistors :	R_1	32 Ω
		R_2	20 Ω
	Charging Voltage	Vc	424 V

Similarly, the following values of circuit components chosen for terminal fault TRV as per case-II(TRV envelope represented in Fig.3.10 as per IEC) to test 420kV rating circuit-breakers are as follows:

Rating of CB	Circuit components		Terminal Fault Test Duty
			As per case-II
	Capacitor Banks		
	Main Capacitor Bank:	C_n	32 μF
	TRV Capacitor Bank:	C_1	0.5 μF
420kV		C_2	2.5 μF
	Stray capacitor Bank:	C_3	21 nF
	Reactors :	L_n	18 mH
		L_1	100 mH
		L_2	9 mH
	Resistors :	R_1	16 Ω
		R_2	10 Ω
	Charging Voltage	Vc	424 V

7.2 Development and Fabrication of 4-parameters TRV synthetic test circuit for Short-line fault test duty

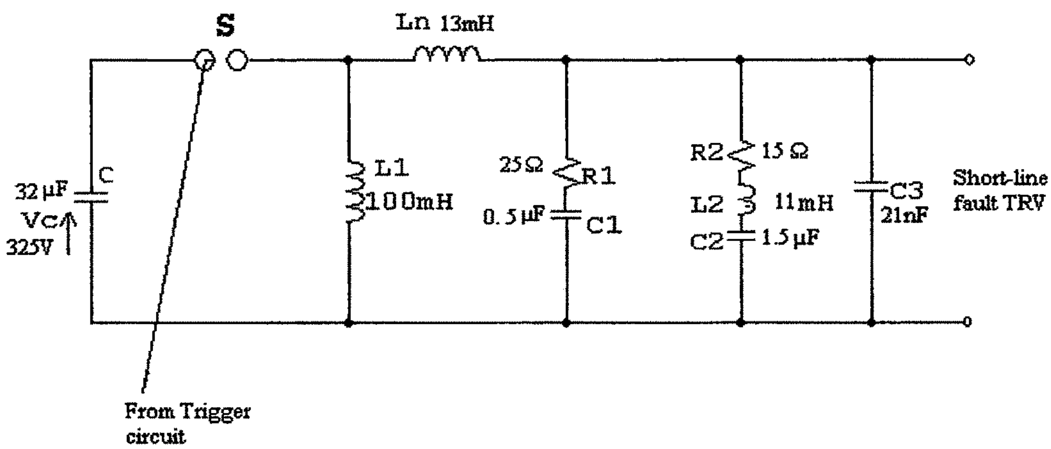


Fig.7.2 Schematic diagram of a developed 4-parameters TRV parallel current injection synthetic test circuit for short-line fault test duty as per case-I for 420kV CBs

The following values of circuit components were chosen for short-line fault TRV as per case-I (TRV envelope represented in Fig.3.9 as per IEC) to test 420kV rating circuit-breakers.

Rating of CB	Circuit components		Terminal Fault Test Duty
			As per case-I
	Capacitor Banks		
	Main Capacitor Bank:	C_n	32 µF
	TRV Capacitor Bank:	C_1	0.5 µF
		C_2	1.5 µF
420kV	Stray capacitor Bank:	C_3	21 nF
	Reactors :	L_n	13 mH
		L_1	100 mH
		L_2	11 mH
	Resistors :	R_1	25 Ω
		R_2	15 Ω
	Charging Voltage	Vc	326 V

7.3 Specifications/ ratings of circuit components

Charging Unit: The charging unit consists of following components:

1. Transformer

The transformer used in the charging unit is of step-up type. The transformer raises the primary voltage (230V) to secondary voltage (750V).

Specifications: 230V/ 750V, 300mA

2. Rectifier

The full wave bridge rectifier made of 4 power diodes is used for conversion of alternating input voltage to direct output voltage. This dc voltage is used to charge the main capacitor.

Specifications: 1200V, 6A metal diodes, 4 numbers

3. Charging resistor (R_C)

The charging resistor is used to limit the charging current. The charging resistor Rc is chosen to limit the charging current to about 50mA.

Specifications: 10kΩ, 20W

4-parameters TRV shaping circuits

(A) Component values for terminal fault TRV as per case-I (TRV envelope represented in Fig.3.9 as per IEC) to test 420kV rating circuit-breaker :

- Main Capacitor Bank Cn

  Specifications: 32 μF, 600V, 50Hz, AC, ± 5%

  Actual measured value: 32.63 μF

- TRV Capacitor Banks

  1. TRV Capacitor Bank-I (C_1)

     Specifications: 1.5 μF, 440V, 50Hz, AC, ± 5%
     1.0 μF, 440V, 50Hz, AC, ± 5%

     The above capacitors were connected in series. Therefore the equivalent capacitance will be 0.6 μF.

     Actual measured value: 0.611 μF

2. TRV Capacitor Bank-II (C_2)

Specifications: 1.5 μF, 440V, 50Hz, AC, ± 5%

Actual measured value: 1.45 μF

- Stray Capacitor Bank

Specifications: 21nF, 1200V, 50Hz, AC, ± 5%

Reactors:

Specifications:

L_n = 19mH, Current rating =3A

L_1 = 100mH, Current rating =3A

L_2 = 17mH, Current rating =3A

Resistors:

R_1 = 32 Ω, 10A

R_2 = 20 Ω, 10A

(B) Component values for terminal fault TRV as per case-II (TRV envelope represented in Fig.3.10 as per IEC) to test 420kV rating circuit-breaker :

- Main Capacitor Bank Cn

  Specifications: 32 μF, 600V, 50Hz, AC, ± 5%

  Actual measured value: 32.63 μF

- TRV Capacitor Banks

  1. TRV Capacitor Bank-I (C_1)

  Specifications: 1.0 μF, 440V, 50Hz, AC, ± 5%
  1.0 μF, 440V, 50Hz, AC, ± 5%

  The above capacitors were connected in series. Therefore the equivalent capacitance will be 0.5 μF.

  Actual measured value: 0.512 μF

2. TRV Capacitor Bank-II (C_2)

Specifications: 2.5 μF, 440V, 50Hz, AC, ± 5%

Actual measured value: 2.49 μF

- Stray Capacitor Bank

Specifications: 21nF, 1200V, 50Hz, AC, ± 5%

Reactors:
Specifications:

Ln = 18mH, Current rating =3A

L_1 = 100mH, Current rating =3A

L_2 = 9mH, Current rating =3A

Resistors:
R_1 = 16 Ω, 10A

R_2 = 10 Ω, 10A

Fig.7.3. Complete hardware set up of 4-Parameters TRV synthetic test circuits.

7.4 TRV envelopes obtained by laboratory (Proto type) models

The TRV envelopes obtained for terminal fault as well as short-line fault duty condition to test 420 kV rating circuit-breakers by laboratory models are as follows:

The terminal fault TRV envelope as per case-I (TRV envelope represented in Fig.3.9 as per IEC) obtained for testing 420kV rating circuit-breaker is shown in Fig. 7.4.

The terminal fault TRV envelope as per case-II (TRV envelope represented in Fig.3.10 as per IEC) obtained for testing 420kV rating circuit-breaker are shown in Fig. 7.5 and Fig.7.6.

The short-line fault TRV envelope as per case-I (TRV envelope represented in Fig.3.9 as per IEC) obtained for testing 420kV rating circuit-breaker is shown in Fig. 7.7.

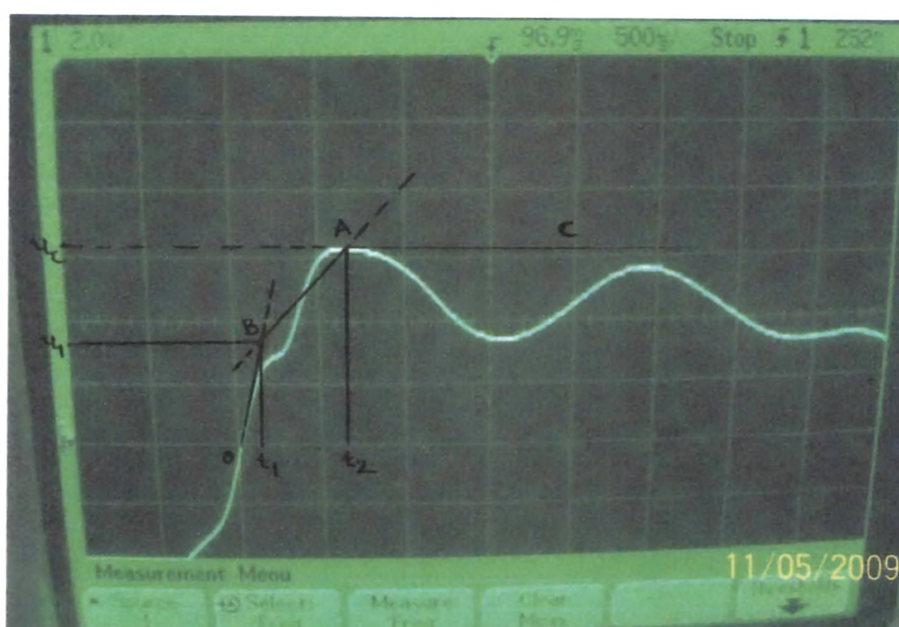


Fig.7.4 Terminal fault TRV for 420 kV circuit breaker as per case-I (TRV envelope represented in Fig.3.9) by laboratory model (Y-axis 1 div. = 200V, X-axis 1 div. = 500μs)

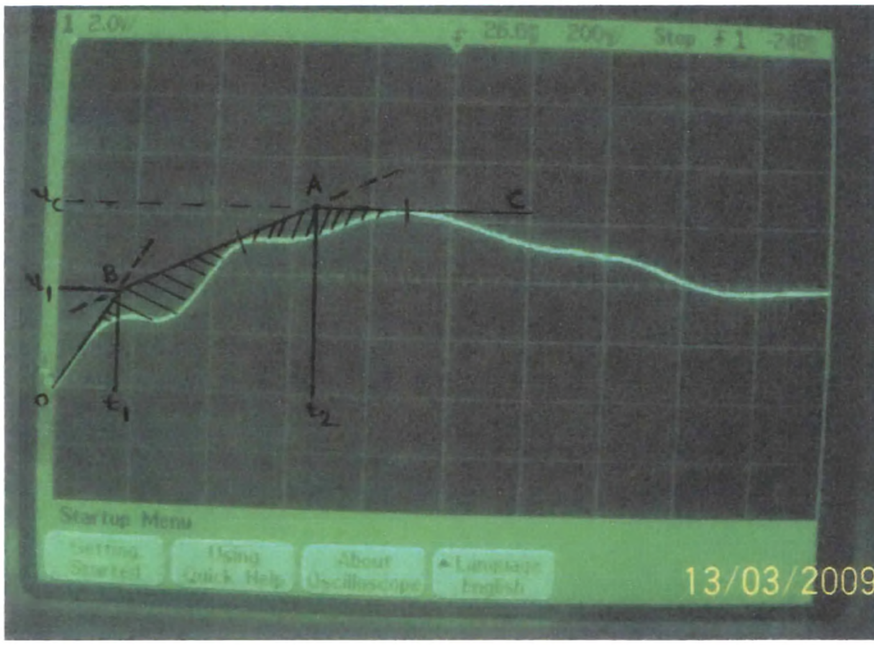


Fig.7.5 Terminal fault TRV for 420 kV circuit breaker as per case-II (TRV envelope represented in Fig.3.10) by laboratory model (Y-axis 1 div. = 200V, X-axis 1 div. = 200μs)

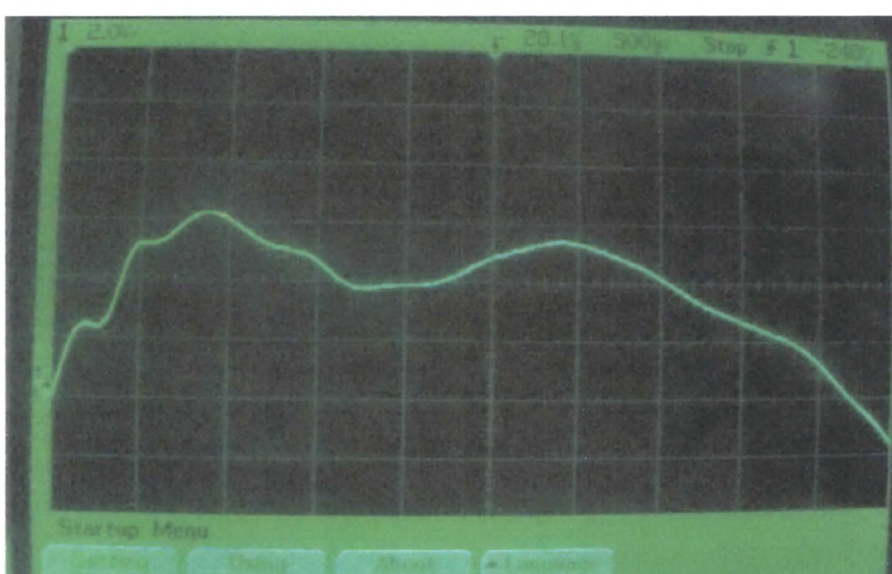


Fig.7.6 Terminal fault TRV for 420 kV circuit breaker as per case-II (TRV envelope represented in Fig.3.10) by laboratory model (Y-axis 1 div. = 200V, X-axis 1 div. = 500μs)

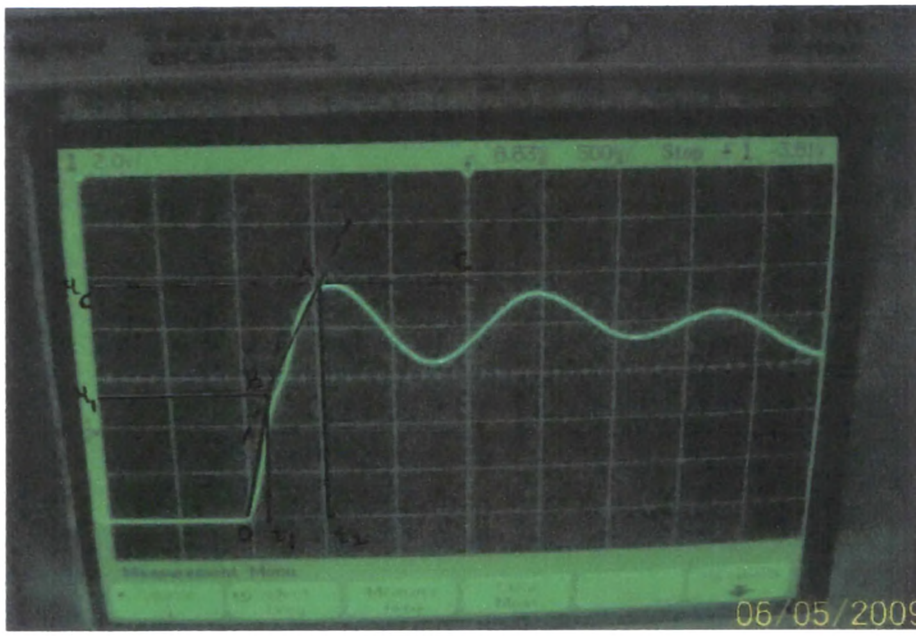


Fig.7.7 Short-line fault TRV for 420 kV circuit breaker as per case-I (TRV envelope represented in Fig. 3.9) by laboratory model (Y-axis 1 div. = 100V, X-axis 1 div. = 500μs)

7.5 Necessity of Automatic controller

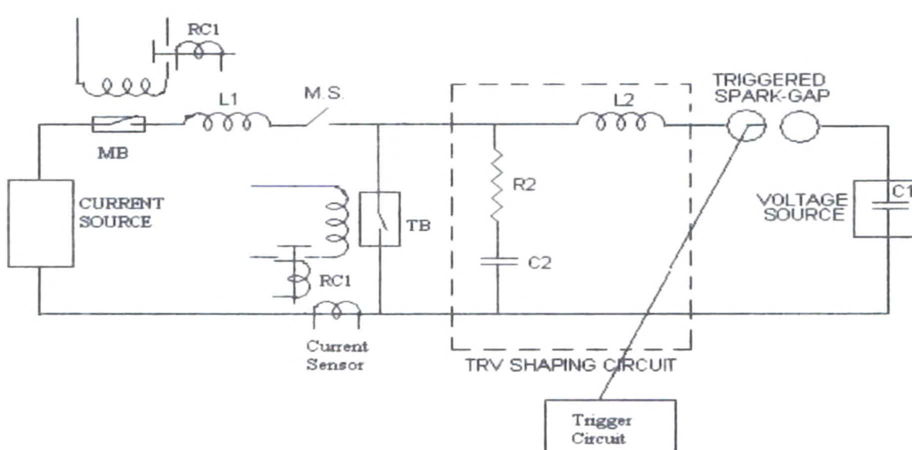


Fig.7.8 Schematic diagram of parallel current injection method synthetic test circuit with trigger circuit

Fig.7.8 shows the Schematic diagram of parallel current injection method synthetic test circuit. As discussed in chapter 2, this circuit consists of two sources of power supply for the testing: (i) Current source (ii) Voltage source.

The current source is a high current, low voltage source. It supplies short circuit current during the test. The voltage source is a high voltage low current source. It provides transient recovery voltage.

Current sensor is used to give signal to the automatic controller and also for measurement purpose. For the operation of the circuit, first of all the MB and TB are closed. Then the short circuit current is passed by closing Make switch (MS). The short circuit current is interrupted by opening the circuit breaker under test at desired moment. The closing and opening of the circuit breakers at the desired moment is done by the Automatic controller.

The capacitor bank C1 is a high voltage source. It is charged to give the required recovery voltage. The triggered spark gap is fired slightly before the short circuit current reaches its natural zero. Trigger circuit with controller is used to fire the triggered spark gap at the desired moment.

In order to test circuit breakers by synthetic testing, it is needed to accurately control the synthetic test circuit so as to satisfy the test criterion. So in the next section, the synthetic test circuit with automatic controller to interrupt short circuit current and to fire the triggered spark gap at the desired moment is presented.

7.6 Development and Fabrication of Automatic Controller with trigger circuit

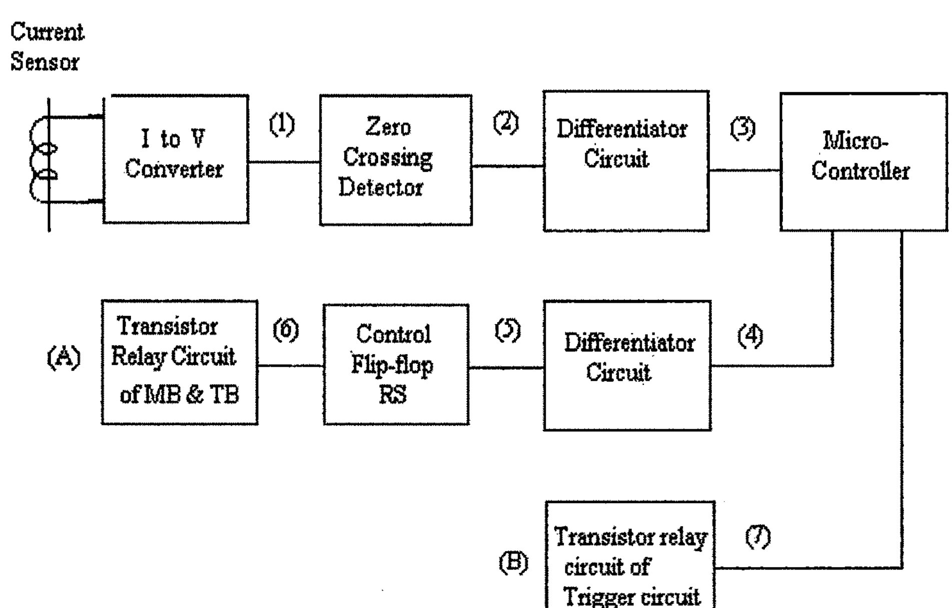


Fig.7.9. Functional block diagram of automatic controller

The automatic controller is used for the automatic closing and opening operation of circuit breakers and to fire triggered spark gap at the desired moment. Fig.7.9 shows the functional block diagram of automatic controller and Fig.7.10 shows the corresponding waveforms of each block. Fig.7.11 shows the detailed circuit diagram of Automatic Controller. The functional block diagram shown in Fig.7.9 consists of two circuit paths (A) and (B). Path (A) is for the operation of Master circuit breaker (MB) and Test breaker (TB), and path (B) is for firing triggered spark gap at the desired moment.

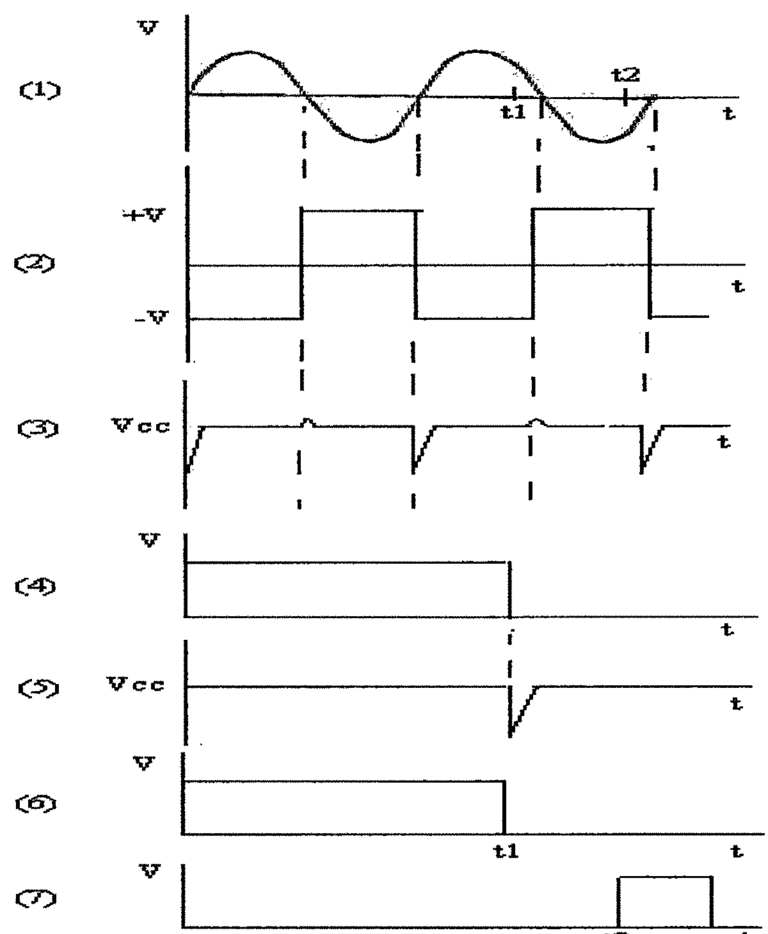


Fig.7.10 Waveforms of each block of automatic control circuit

The current sensor reduces the primary high short circuit current to the suitable low value. Since the turns ratio of current transducer is 1000, it divides the primary current by 1000. For testing purpose the primary current were set at 30A. The secondary current will be 30mA. The current signal is then converted into proportional voltage signal using I to V converter. The voltage signal is fed to Zero crossing detector circuit. The output state of this circuit changes whenever the input crosses zero. The magnitude of the output voltage becomes equal to the supply voltage. In order to obtain a negative spike output for interrupting the micro- controller, the output of zero crossing detector is differentiated by using an R-C circuit.

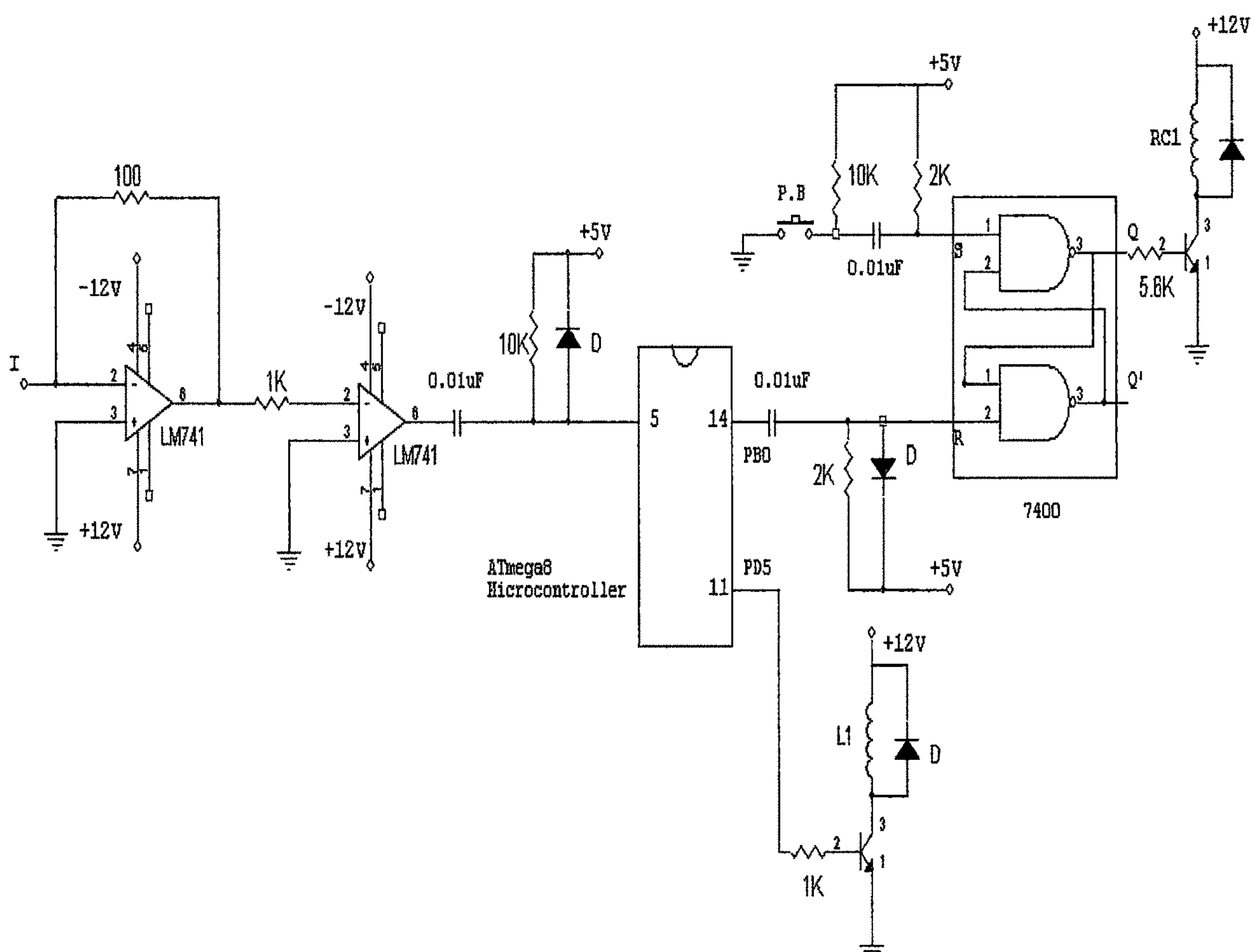


Fig.7.11 Detail circuit diagram of automatic controller for the automatic closing and opening operation of circuit breakers and to fire triggered spark gap at the desired moment

The automatic control circuit employs the following:

1. Current sensor (ratio 1:1000)
2. I to V Converter
3. Zero crossing detector
4. Differentiator circuit
5. Micro-controller (ATmega8)
6. Control Flip-flop (RS)
7. Transistor relay circuit
8. Trigger circuit

1. Current Sensor

The current sensor reduces the primary high short-circuit current to suitable low value for control and measurement purpose. The LEM module LA50-P current transducer from LEM S.A, Switzerland is used. This transducer has galvanic isolation between the primary (high power) and the secondary (electronic) circuits. Since the turns ratio of current sensor is 1:1000, it divides the primary high current by 1000. Figure 7.12 shows the connection diagram of LA50-P current transducer.

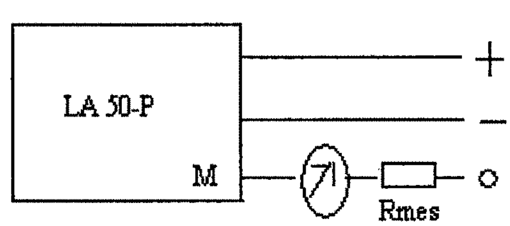


Fig.7.12 Connection diagram of LA50-P current transducer

The Electrical specifications/data of this transducer are as follows:

Nominal current I_N	: 50A rms	
Measuring range	: 0 to 70A	
Measuring resistance	: R_M min.	R_M maxi.
	50 ohm	100 ohms
Supply Voltage	: ± 15V	
Nominal analog output current	: 50mA	
Turns ratio	: 1: 1000	
Accuracy	: ± 0.5% of I_N	

2. Current to Voltage Converter

The current signal is converted into proportional voltage signal by using I to V converter. A current to voltage converter using IC 741 is shown in Fig.7.13. The output voltage in this case is given by $V_o = IR$.

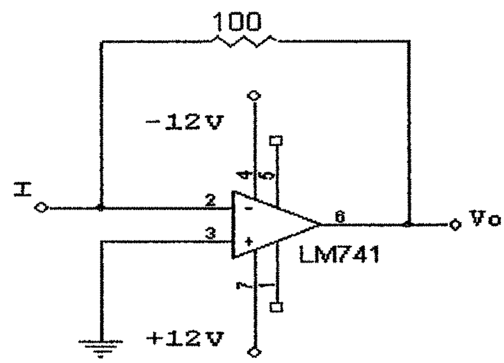


Fig.7.13 Current to Voltage Converter

3. Zero crossing detector

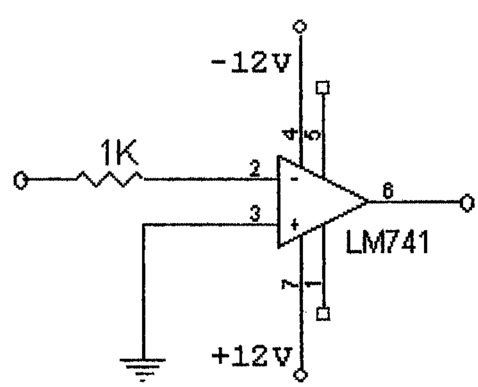


Fig.7.14 Zero crossing detector

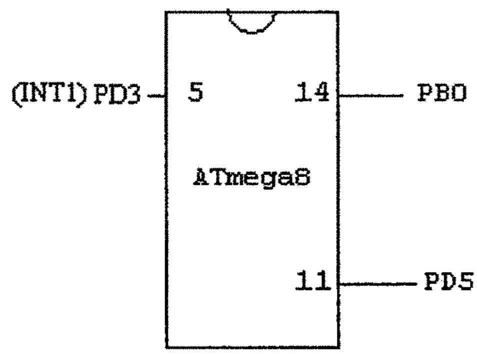
Fig.7.14 shows the circuit of a zero-cross detector using IC LM741. The circuit acts as a inverting comparator with reference voltage zero. The output state of OPAMP changes whenever the input crosses zero. The circuit is therefore called a zero detector circuit. The magnitude of the output voltage is 12V.

4. Differentiator Circuit

In order to obtain a negative spike output for interrupting the micro-controller, the output of zero cross detector is differentiated by using an RC circuit.

In this circuit, the resistor 10 kΩ and capacitor 0.01μF combination at the input forms a differentiator as shown in Fig.7.11. During the positive going edge of the trigger, diode becomes forward biased, thereby limiting the amplitude of the positive spike to 0.7 V. Diode D prevents the micro-controller from triggering on the positive going edges of input voltage.

5. ATmega8 Micro-controller



ATmega8
Microcontroller

The ATmega8 is a low power CMOS 8-bit micro-controller based on the AVR RISC architecture. It has 23 programmable I/O lines (PC0-PC6, PB0-PB7, and PDO-PD7). ATmega8 is a single chip programmable peripheral interface available in a 28-pin Dip and implemented using CMOS technology. It requires a single +5 V power supply for its operation. Figure shows the pin diagram of ATmega8 micro-controller and consists of 28 pins.

Programmable I/O lines (pins)	PC0 - PC6	7 Pins
	PB0 – PB7	8 Pins
	PD0 – PD7	8 Pins

In addition to these lines, it has following pins:

- Vcc : Digital supply voltage
- GND: Ground pin
- AVCC: It is the supply voltage pin for the A/D converter. It should be externally connected to Vcc even if the ADC is not used.
- AREF: It is the analog reference pin for the ADC converter.
- AGND: It should be externally connected to GND.

The ATmega8 provides the following features:

- 8k bytes of In-system programmable Flash with Read-While-Write capabilities,
- bytes of EEPROM,
- 1k byte of SRAM
- general purpose I/O line
- general purpose working registers
- Three flexible timers/counters
- Internal and external interrupts.

Program has been developed by using BASCOM-AVR software version 1.11.8.3 from MCS Electronics to generate the pulses at the desired moment by using timers, one for denergization of MB and TB, and the second for firing triggered spark gap at the desired moment. The program is down loaded and tested on ATmega8 Micro-controller.

6. Control Flip-flop (RS)

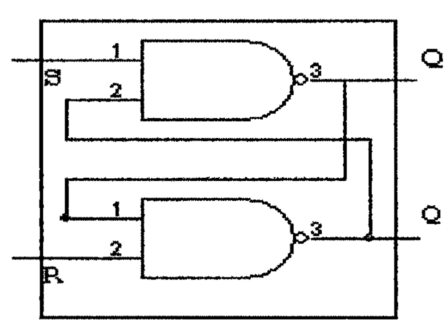


Fig.7.15 Control Flip-flop (RS)

RS control flip-flop is formed by two NAND gates using IC7400 shown in Fig.7.15. 7400 IC chip is a quadruple 2-input NAND gate available in 14 pin Dip. It requires a +5V dc supply (to be connected between Vcc and GND pins) for the operation of gates.

A control RS flip-flop has two useful states:

1. When Q = 1, and Q' = 0, it is in the SET state (or 1-state)
2. When Q = 0, and Q' = 1, it is in the CLEAR state (or 1-state)

The application of a momentary 0 to the set input causes output Q to go to 1 and Q' to go to 0, thus putting the FF into the SET state. After the SET input returns to 1, a momentary 0 to the reset input causes a transition to the clear state.

As shown in Fig.7.11, the control FF is SET when momentary 0 applied to the set input by pressing the push button (P.B.). This causes the output Q of the control FF is high (Q=1) and Q' = 0. This makes the transistor ON. The relay coil will energized and closes its contacts so MB and TB will begins to closes its contacts. After delay a negative trigger pulse at the reset input of FF causes output Q to 0 and Q' to 1. This makes the transistor OFF. The relay coil will be denergized and opens its contacts so MB and TB begins to open at time t_1.

7. Transistor -relay circuit

This consists of NPN transistor and the relay. A relay coil is placed in the collector circuit. This relay coil is energized when the transistor starts conducting.

8. Trigger Circuit

Trigger circuit consists of automatic control circuit and triggered spark gap. This circuit is used to fire the triggered spark gap at the desired moment. Fig.7.16 shows the schematic diagram of trigger circuit and Fig.7.17 shows a detailed circuit diagram of trigger circuit. The triggered spark gap is set ready to be fired. The main capacitor bank C_1 is charged to give the required recovery voltage. In Fig.7.9, the path (B) is to generate the pulse for firing triggered spark gap.

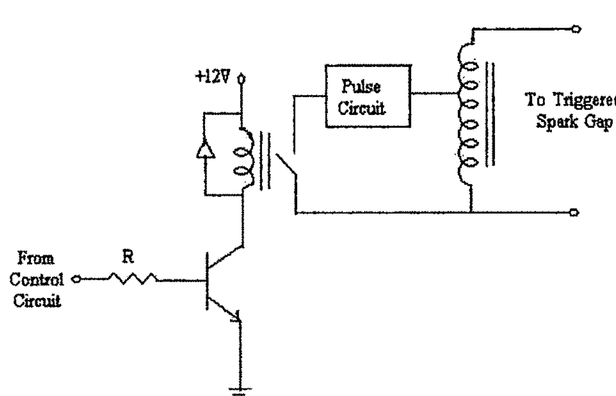


Fig.7.16 Schematic diagram of trigger circuit

The task of spark gap is to withstand the voltage on the pre charged main capacitor bank and to trigger at the right instant with least time delay. The spark gaps are generally sphere gaps. Gaps with three electrodes (by introducing auxiliary electrode) function as time dependent switching devices and are called trigatron.

A trigatron gap consist of two main electrodes and trigger electrode. The trigger electrode is a metal rod with an annular clearance of about 1 mm fitted into the main electrode through bushing. The trigatron is connected to a pulse circuit. A high voltage pulse from this circuit is applied between the trigger electrode and one of the main electrodes at the desired instant. Due to space charge effects and distortion of the field in the main gap, spark over of the main gap occurs. Trigatron gaps require a tripping voltage of about 5 kV of either polarity. The dc pulse from the pulse circuit is given to high voltage ignition coil to steps up the voltage to a peak pulse of 5kV. This tripping voltage is sufficient to cause the triggering of the third electrode i.e. trigger electrode of trigatron gap.

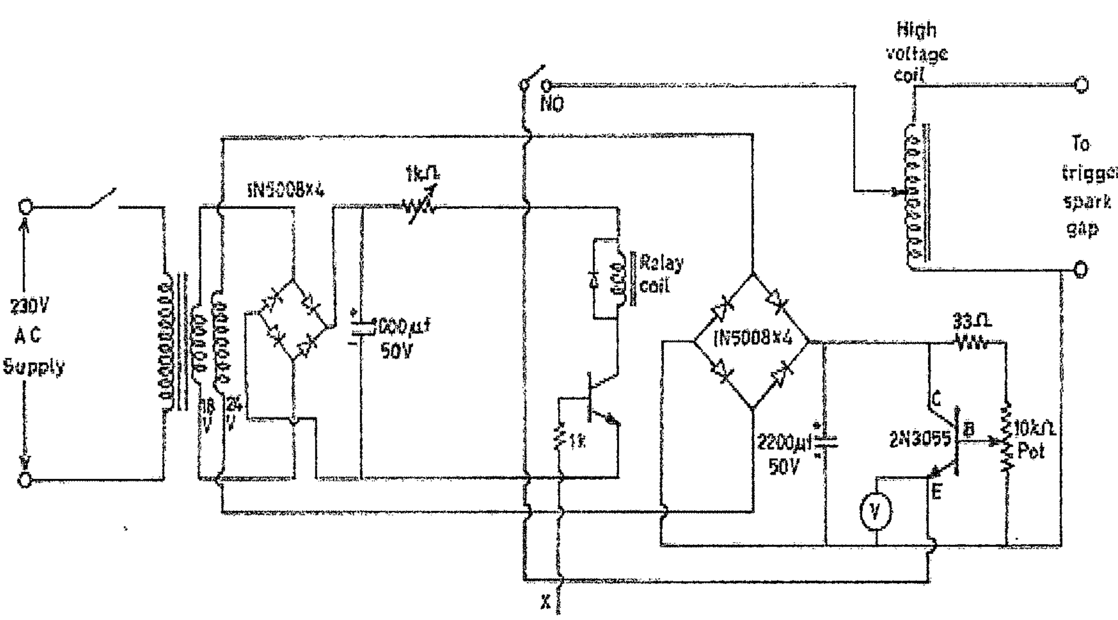


Fig.7.17 Detailed circuit diagram of trigger circuit

7.7 Operation of automatic control circuit

- The high current source injects a high short circuit current i_1 into the CB under test at relatively reduced voltage.
- The test is initiated by closing the making switch (MS) which initiates the flow of the short circuit current i_1 from the high current source through the Master CB.
- According to the test criterion, it is needed to denergize the MB and TB at time t_1 i.e. Before the current zero (delay after first positive zero). The MB and circuit breaker under test (TB) are tripped. These CBs are fully opened by the time t_3.
- The triggered spark gap is fired at time t_2 (greater delay after first positive zero) slightly before the short circuit current reaches its natural zero.

The current sensor is used in the circuit to give the signal to automatic control circuit and for measurement purpose. For the operation of the circuit, First of all, the MB and the breaker under test (TB) are closed by applying momentary zero to the SET input of control RS Flip flop, then the short circuit current is passed by closing the make switch (MS). The short circuit current is interrupted by opening the breaker under test (TB) at the desired moment. The closing and opening of CBs at the desired instant is done by Automatic control circuit. The main capacitor bank C_1 is charged to give the required recovery voltage. The triggered spark gap S is fired at the desired moment. The triggered spark gap is set ready to be fired. The flowchart and time scale for the automatic sequence of operation of developed CB synthetic test circuit are shown in Fig.7.18 and Fig.7.19 respectively.

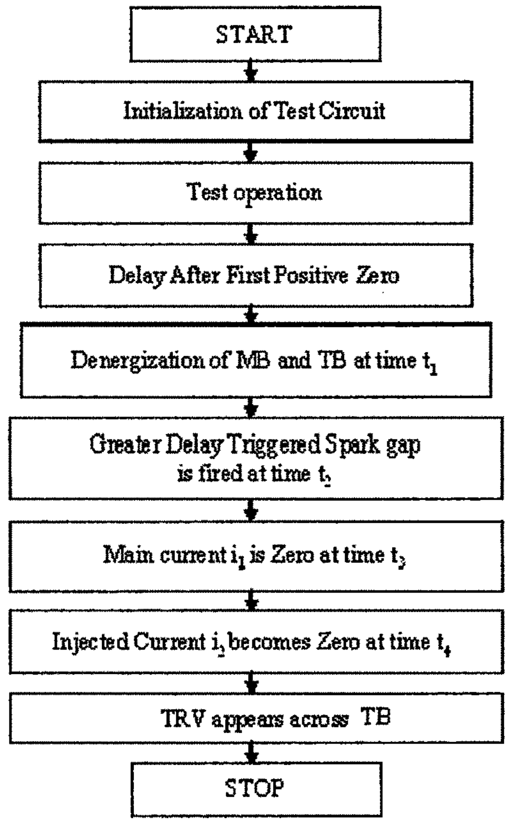


Fig.7.18 Flowchart for the automatic sequence of operation of developed CB synthetic test circuit

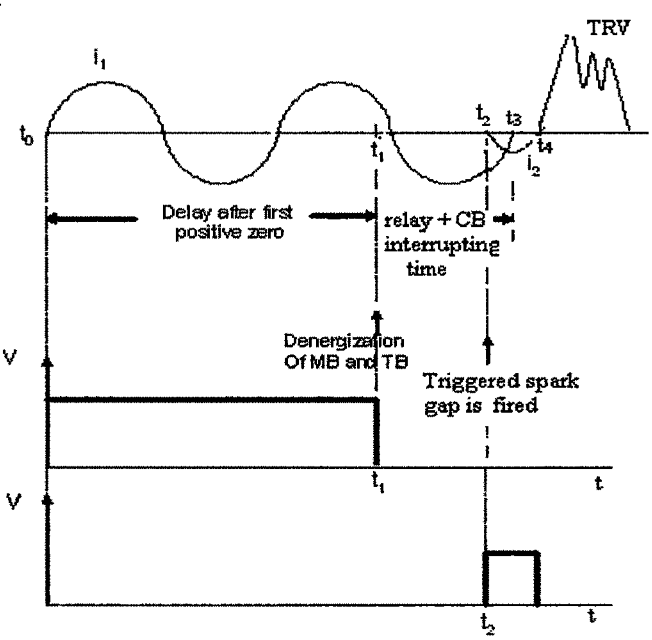


Fig.7.19 Time scale for the automatic sequence of operation of developed CB synthetic test circuit

7.8 Testing of Controller

According to the test criterion, it is needed to interrupt the MB and TB at time t_1 i.e. Before the current zero (delay after first positive zero). The MB and circuit breaker under test (TB) are tripped. These CBs are fully opened by the time t_3. Also it is needed to ignite the sphere gap of high voltage circuit at time t_2, (greater delay after first positive zero) slightly before the short circuit current reaches its natural zero. Program has been developed by using BASCOM-AVR Compiler from MCS Electronics to generate the pulses at the desired moment by using timers, one for denergization of MB and TB i.e. at time t_1 (for testing purpose delay after first positive zero was provided 28ms) and the second for firing triggered spark gap at the desired moment i.e. at time t_2 (38ms after first positive zero, just before short circuit current reaches its natural zero) .

In order to test controller, a circuit for high current, low voltage source (Proto type) is developed. Fig.7.20 shows the schematic diagram of this developed circuit. In this circuit a high current transformer of rating 2.4 kVA, 240/12V is used as a high current source to supply short circuit current. Contactors are used in place of circuit-breakers, as contactor is also a mechanical switching device. Contactor has magnetic coil that controls the operation of contacts.

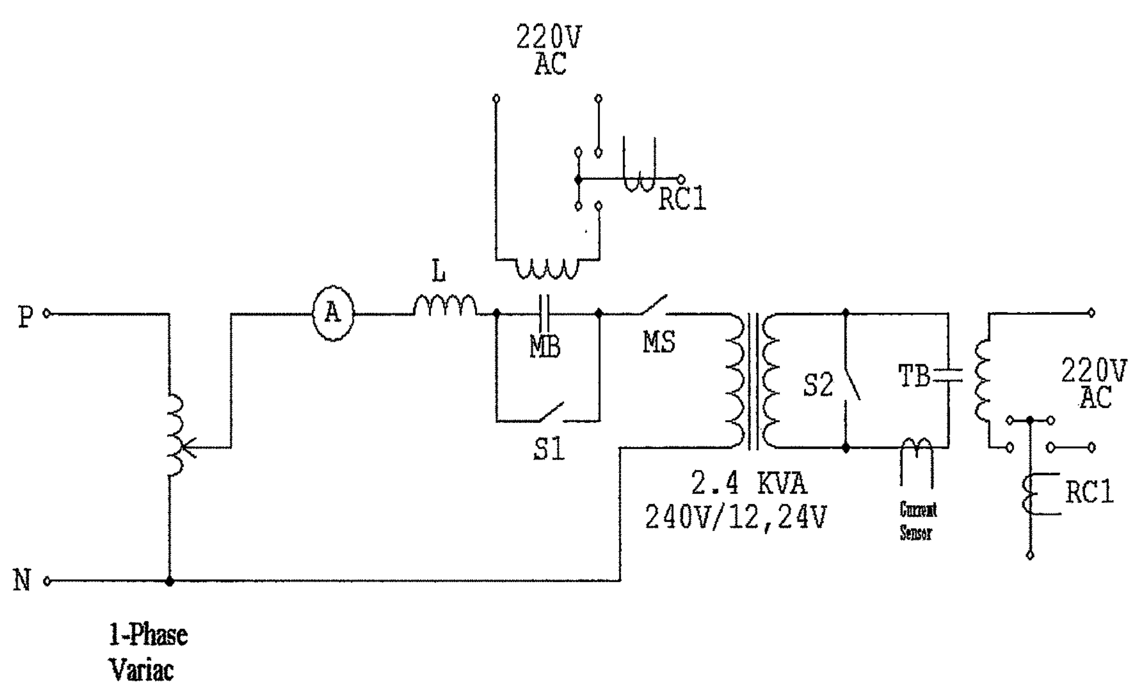


Fig.7.20 Schematic diagram of a developed circuit for testing controller

Fig.7.21 shows the complete hardware set up of automatic controller for circuit-breaker synthetic test circuit.

The developed automatic controller was tested and the following oscillographs were recorded:

1. Oscillograph record of input and output waveforms of zero crossing detector
2. Oscillograph record of output of differentiator circuit (Negative spike output for interrupting the Micro-controller)
3. Oscillograph record of a generated pulse for denergization of MB and TB (Test-breaker)
4. Oscillograph record of a generated pulse for firing Triggered spark gap
5. Oscillographs recorded for both the generated pulses by the Micro-controller one for denergization of MB and TB and second for firing Triggered spark gap

These oscillographs are shown in Fig.7.22 to Fig.26. For testing purpose the primary current were set at 30A. So the secondary current is 30mA. The experiment results shows a good agreement with the predictions and according to the desired test criterion.

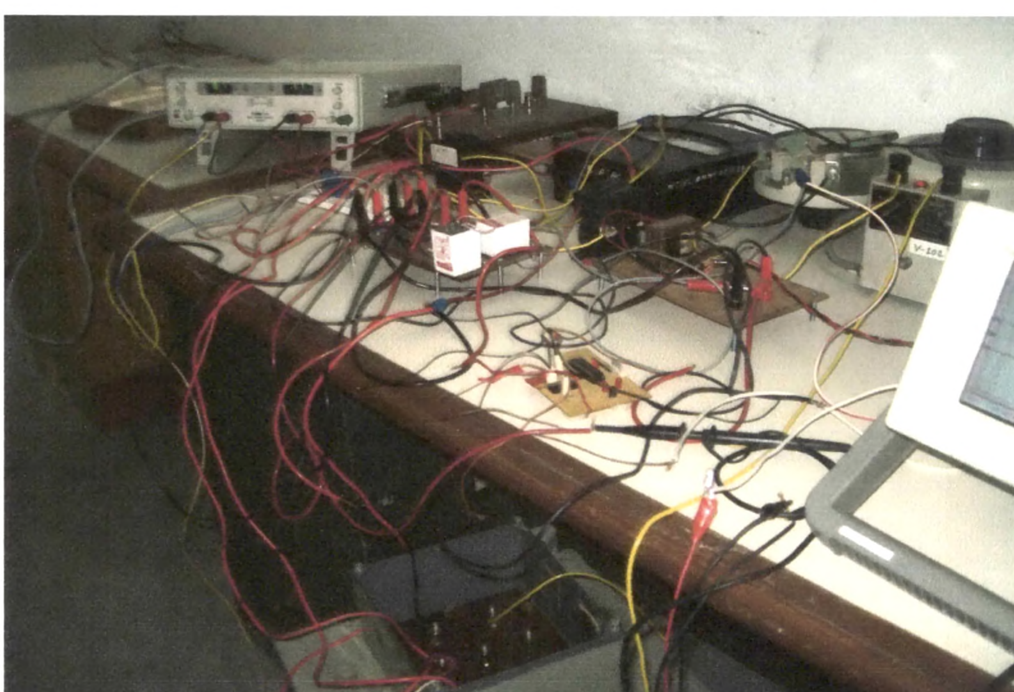


Fig.7.21 Complete hardware set up of automatic controller for circuit-breaker synthetic test circuit

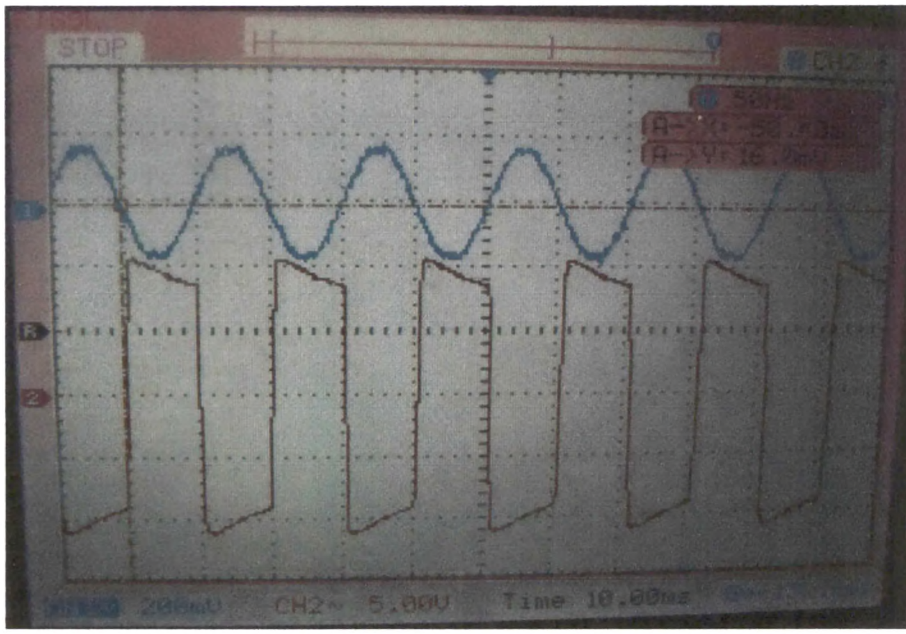


Fig.7.22 Oscillograph record of input and output waveforms of zero crossing detector

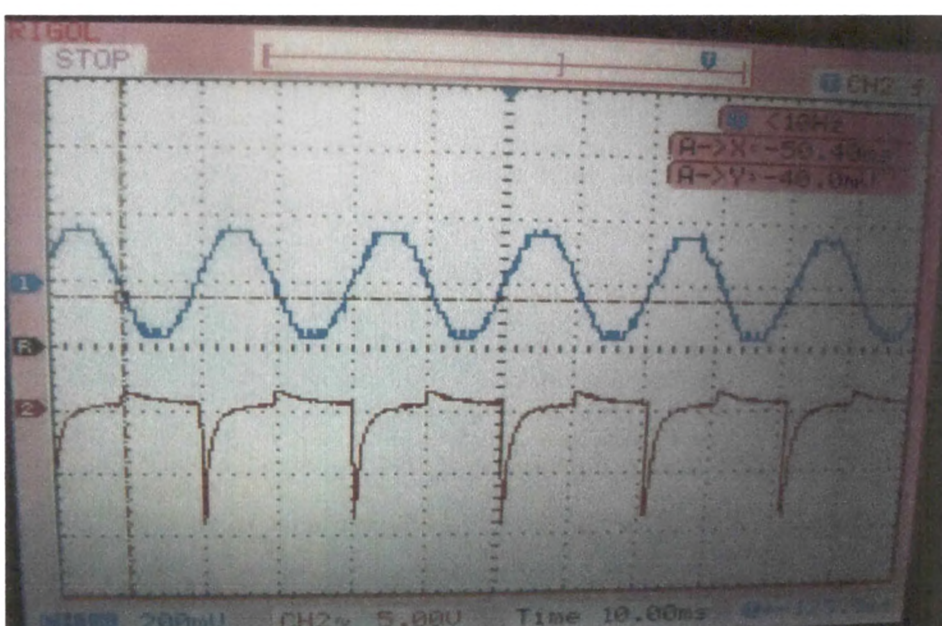


Fig.7.23 Oscillograph record of output of differentiator circuit (Negative spike output for interrupting the Micro-controller)

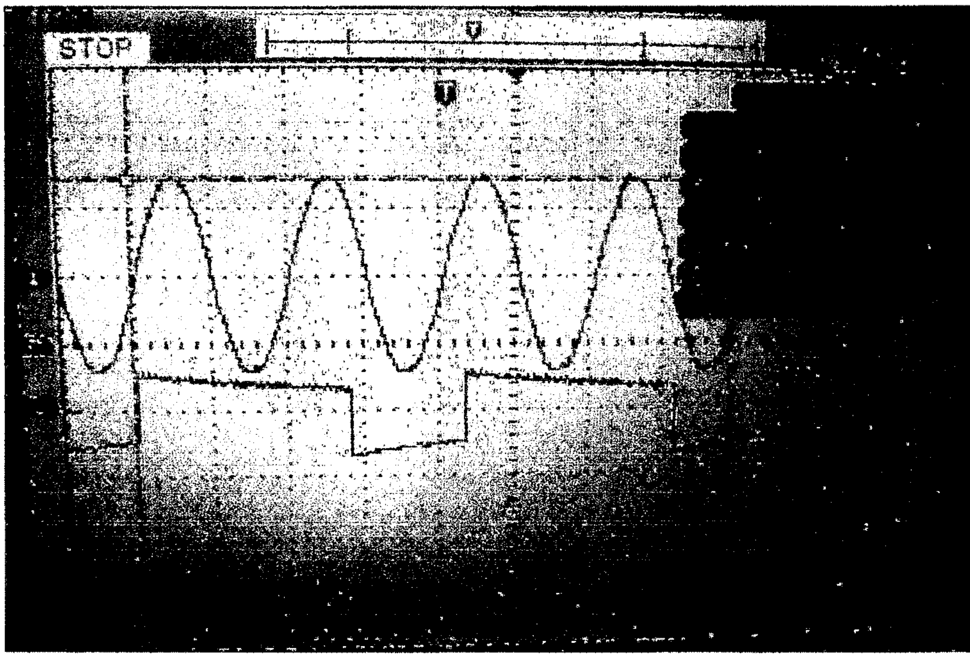


Fig.7.24 Oscillograph record of a generated pulse for denergization of MB and TB (Test-breaker)

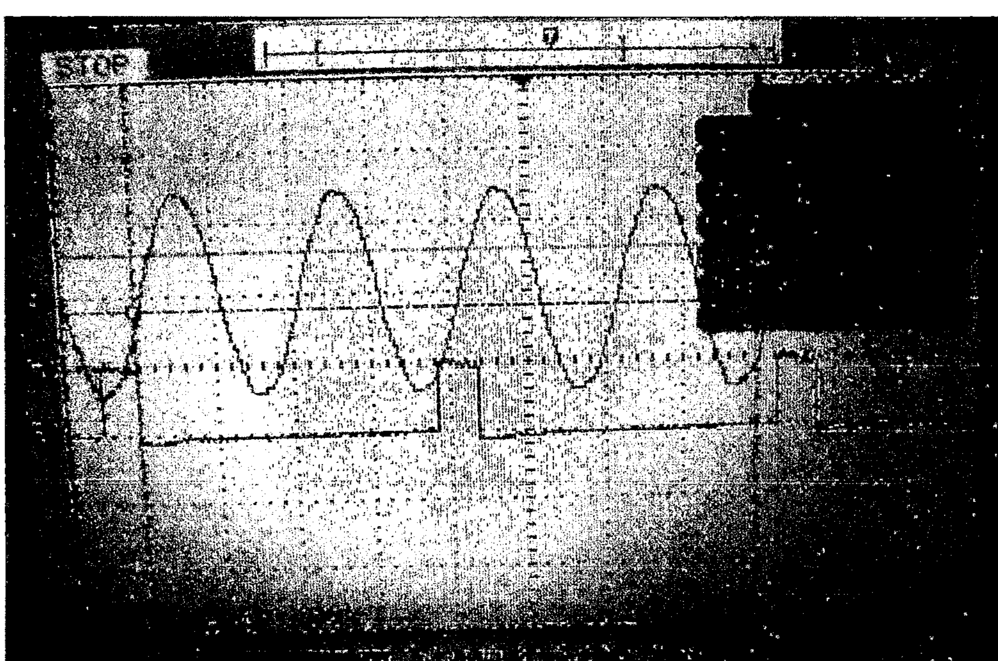


Fig.7.25 Oscillograph record of a generated pulse for firing Triggered spark gap

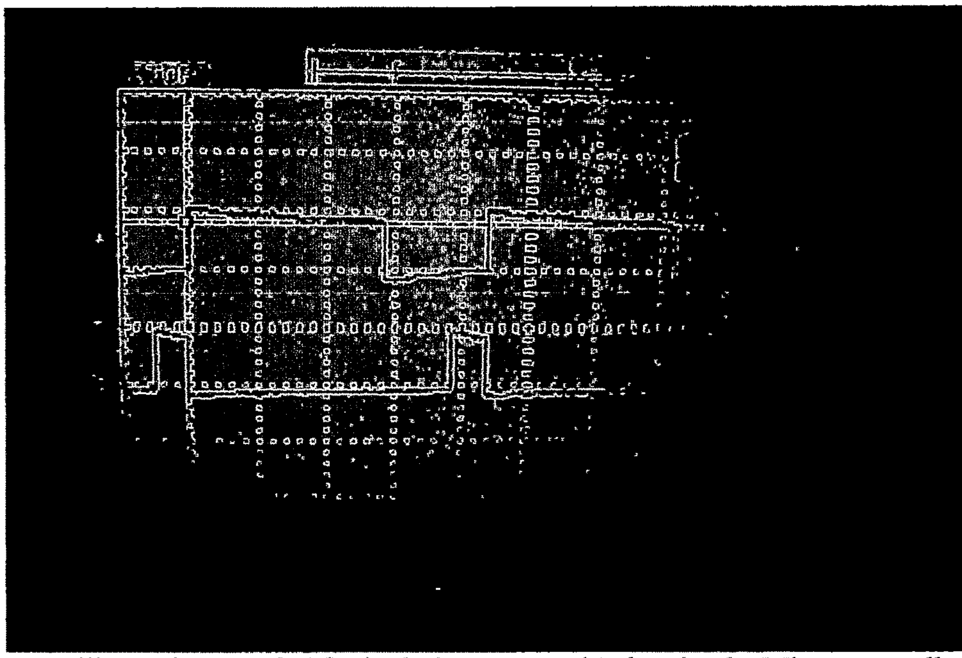


Fig.7.26 Oscillographs recorded for both the generated pulses by the Micro-controller one for denergization of MB and TB and second for firing Triggered spark gap
(Scale: X-axis 1 div. =10ms, Y-axis 1 div. =5V)

7.9 Conclusion

The proto type models of 4-parameters TRV synthetic test circuits are developed and fabricated to verify the designed and simulated results. The experimental results show a good agreement with the predictions. The results shown are almost the same according to IEC standards. The slight changes in the TRV parameters and envelopes are due to the tolerances of circuit components.

The TRV parameters obtained/realized from the TRV envelopes for the terminal fault as well as short-line fault test duty are given in Table 7.1.

TABLE 7.1
TRV PARAMETERS OBTAINED OR REALISED FOR 420KV RATING CBS BY PROTO TYPE MODELS

TRV Parameters	Test duty: Terminal fault		Test duty: Short line fault
	as per case-I of IEC	as per case-II of IEC	as per case-I of IEC
First reference voltage u_1, V	340	335	260
Time to reach u_1, t_1 μs	170	168	130
TRV peak value , u_c V	625	624	480
Time to reach u_c, t_2 μs	668	668	520
Rate of rise, u_1/t_1, V/μs	2	2	2

An automatic controller to interrupt short circuit current and to fire the triggered spark gap at the desired moment has been developed, fabricated and successfully tested. The automatic controller is used for the automatic closing and opening operation of circuit breakers and to fire triggered spark gap at the desired moment. The developed automatic controller was tested and Oscillographs were recorded for pulses, one for interruption of MB and TB, and the second high pulse generated for firing triggered spark gap. The control circuit has been setup. The experiment results show a good agreement and according to the desired test criterion.