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BATCH: A3

SCR CHARACTERISTICS

AIM: To study the characteristics of SCR.

APPARATUS: 1) Circuit board with SCR TYN614
2) 3½ & 4½ digit DMMs, ammeters & voltmeters.
3) Dual-trace CRO with probes.
4) 30V power supplies

THEORY:

The symbol and characteristics of a SCR are shown in Fig. 1,

CIRCUIT DESCRIPTION:

The circuit board is divided into two sections. The first section, shown in Fig. 4, is used for obtaining the V-I characteristics and latching & holding currents of the SCR

PROCEDURE:

1. V-I characteristics of SCR

1.1 Connect a DC ammeter, A1, in 100mA, between X3(+ve) & X4(-ve), in the anode circuit.

1.2 Set potentiometers R1(coarse adjustment), R2(medium adjustment),& R3(fine adjustment) in the anode circuit to center position.

1.3 Connect a 4½ digit DMM, A2, in 20mA range, between X7(+ve) & X8(-ve), in the gate circuit.

1.4 Set potentiometers R5(coarse adjustment), R6(medium adjustment),& R7(fine adjustment) in the gate circuit to center position.

1.5 Connect channel II(X) of the CRO between X9(live) and X11(common) to observe anode-cathode voltage v_{AK} .

1.6 Connect channel I(Y), **inverted**, of the CRO between X12(live) and X11(common) to observe a voltage ($i_A \times R9$) proportional to the anode current i_A .

1.7 Connect X13, SCR anode A1, to X9.

1.8 Connect X14, SCR gate G1, to X10.

1.9 Connect a DC supply, V_{GG} , in the gate circuit between X5(+ve) & X6(-ve). Set the DC supply voltage to 10V.

1.10 Connect a 32V AC supply, V_{AA}, in the anode circuit by connecting X17(16V) and X19(16V) on the transformer TR1 board to X1 and X2, respectively.

1.11 Using the X-Y mode of the CRO, observe the V-I characteristics of the SCR.

1.12 Adjust the gate current using V_{GG}, R5, R6 & R7 such that the forward breakover voltage V_{BO} is 40V. Measure the forward breakover current I_{BO}, reverse leakage current I_{BR}, on-state voltage V_T, and gate current I_G.

1.13 Sketch the V-I characteristics to **scale** .

1.14 Repeat step 1.12 for V_{BO} of 30V & 20V.

1.14 Switch-off all supplies and remove all connections on the circuit board **except** connections to the SCR anode and gate (steps 1.7 &1.8).

2. Latching and holding currents of SCR

2.1 Connect a 4½ digit DMM, A1, in 20mA range, between X3(+ve) & X4(-ve), in the anode circuit.

2.2 Set potentiometers R1, R2 & R3 in the anode circuit to center position.

2.3 Short the gate circuit ammeter terminals X7 & X8.

2.4 Set potentiometers R5, R6 & R7 in the gate circuit to center position.

2.5 Connect channel II(X) of the CRO between X10(live) and X11(common) to observe gate-cathode voltage v_{GK} .

2.6 Connect channel I(Y), **inverted**, of the CRO between X12(live) and X11(common) to observe a voltage ($i_A \times R9$) proportional to the anode current i_A .

2.7 Connect two DC supplies, in series, in the anode circuit, V_{AA} , between X1(+ve) & X2(-ve).

2.8 Connect a 16V AC supply, V_{GG}, in the gate circuit by connecting X17(16V) and X18(0V) on the transformer TR1 board to X5 and X6, respectively.

2.9 Observe the v_{GK} & i_A waveforms on the CRO. Note that the i_A waveform is a square wave if the current is below the latching current I_L , while it is a DC value if it is above I_L .

2.10 Increase the anode current using V_{AA} , R1, R2 & R3 such that the anode current waveform **just** changes from a square wave to a DC value. Measure i_A which is now the **latching current**, I_L. Verify that the SCR is latched by removing the gate supply and checking that the SCR is still on.

2.11 With the gate supply removed, **slowly** reduce the anode current using current using V_{AA} , R1, R2 & R3 till the SCR **just** turns-off. Note the value of i_A at which this occurs, which is now the **holding current**, I_H .

2.12 Switch-off all supplies and remove all connections on the circuit board.

OBSERVATIONS:

1. V-I characteristics of SCR

Sr. No.	V_{BO} V	I_G mA	I_{BO} uA	I_{BR} uA	V_T V
1.	40				
2.	30				
3.	20				

2. Latching and holding currents of SCR

I_L = mA, I_L = mA

CHARACTERISTICS & GRAPHS:

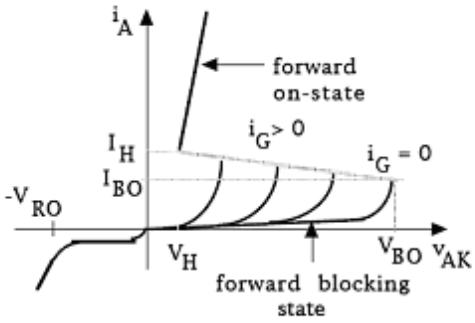
1. V-I characteristics of SCR to **scale** (step 1.13 of procedure).

CALCULATIONS: Calculate on-state resistance (reciprocal of slope in ohmic region), and output resistance (reciprocal of slope in active region) for each value of v_{GS} .

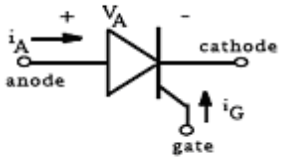
CONCLUSIONS:

LIST OF FIGURES:

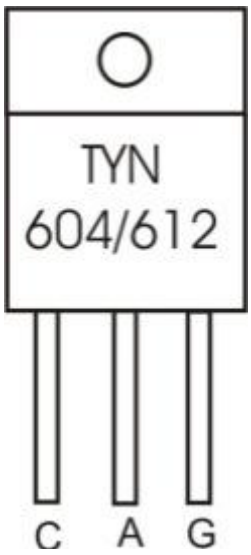
Fig. 1 Thyristor (SCR) I-V Characteristics

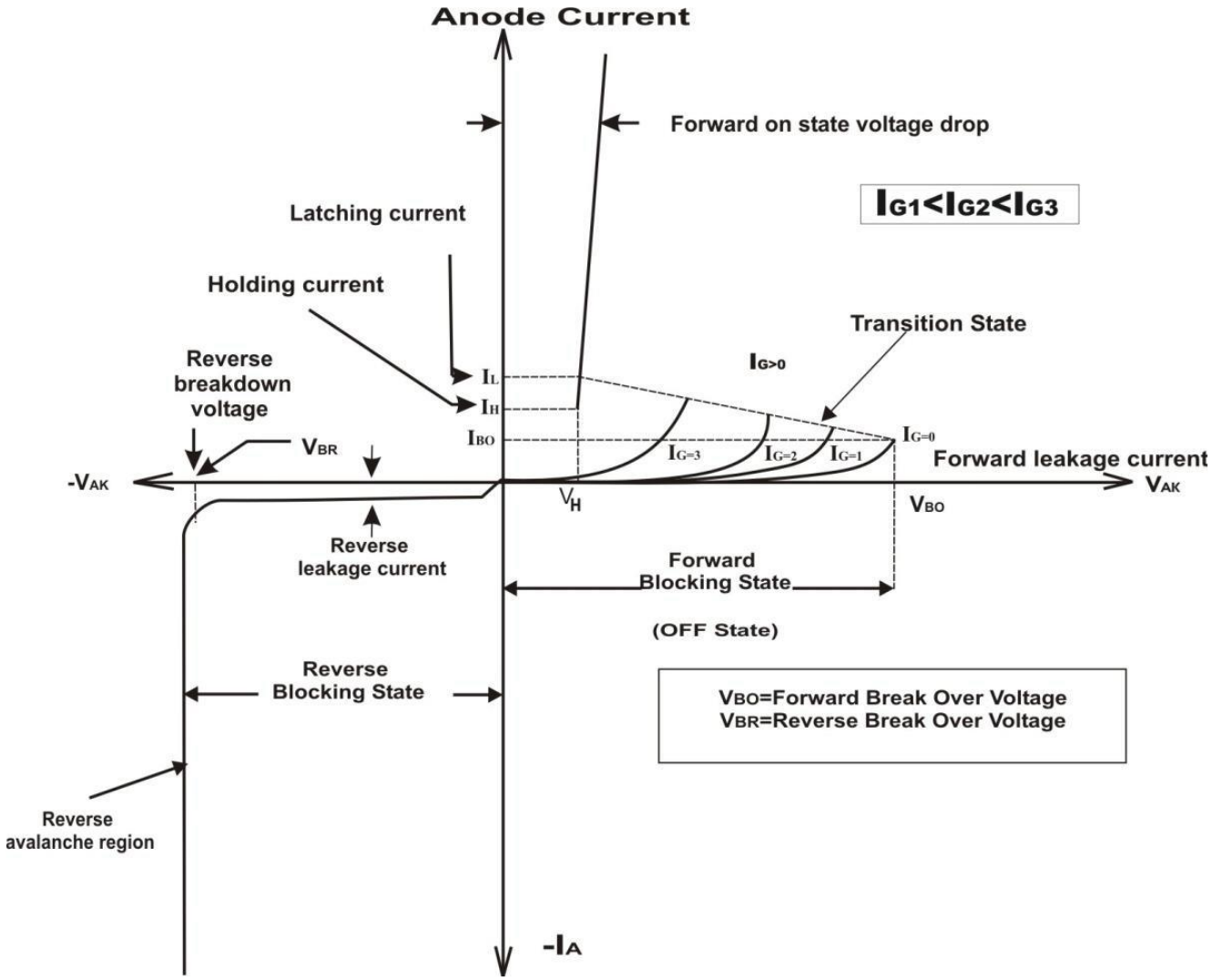


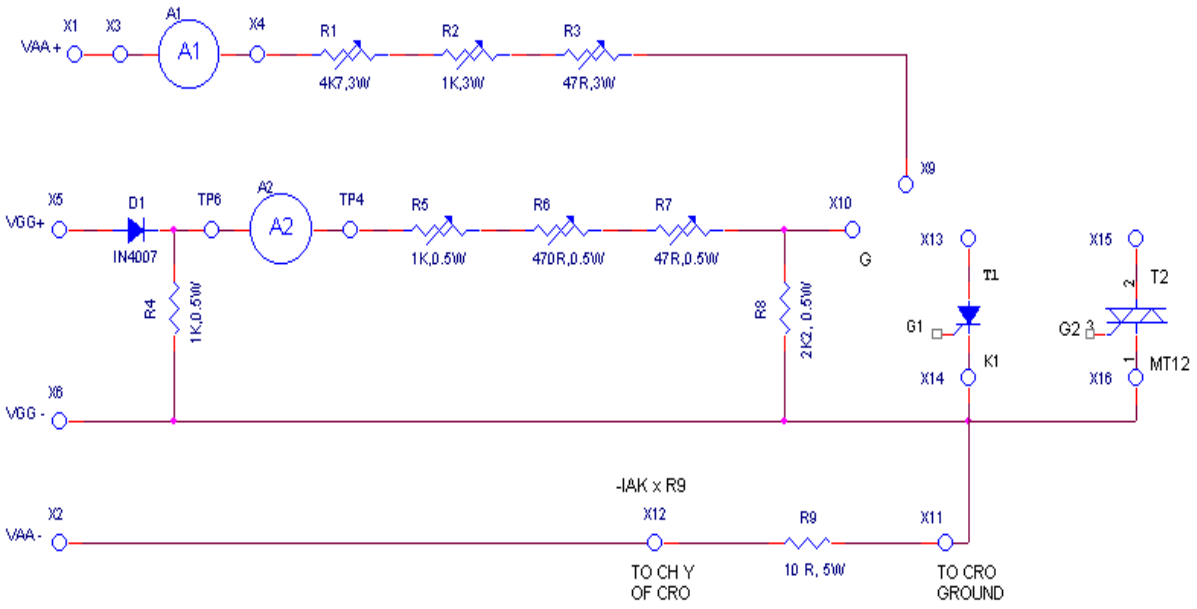
Thyristor circuit symbol.



- SCR triggerable from forward blocking state to on-state by a gate current pulse.
- Thyristor latches on and gate cannot turn it off. External circuit must force SCR off.
- Current to several kiloamps for V(on) of 2-4 volts.
- Blocking voltages to 5-8 kilovolts.
- V_{BO} = breakover voltage ; I_{BO} = breakover current
- V_{RO} = **reverse** breakover voltage
- V_H = holding voltage I_H = holding current
- Maximum junction temperature = 125 C limited by temperature dependence of V_{BO}.




Anode Current
Forward on state voltage drop
IG1<IG2<IG3
Latching current
Holding current
Transition State
Reverse breakdown voltage
IL
IH
IBO
IG>0
IG=0
IG=3
IG=2
IG=1
VBR
-VAK
VH
VBO
Forward leakage current
VAK
Reverse leakage current
Forward Blocking State
(OFF State)
Reverse Blocking State
VBO=Forward Break Over Voltage
VBR=Reverse Break Over Voltage
Reverse avalanche region
-IA


X1
X3
A1
X4
VAA+
R1
4K7,3W
R2
1K,3W
R3
47R,3W
X9
X5
D1
TP6
A2
TP4
R5
R6
R7
X10
VGG+
IN4007
1K,0.5W
470R,0.5W
47R,0.5W
G
X13
T1
X15
T2
R4
1K,0.5W
R8
2K2, 0.5W
G1
G2
K1
MT12
X14
X16
X6
VGG -
-IAK x R9
X2
X12
R9
X11
VAA -
TO CH Y OF CRO
10 R, 5W
TO CRO GROUND

Exp-1 SCR

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* Observations -
V-I characteristics of SCR

Sr No.	V_{BO} V	I_G mA	I_{BO} uA	I_{BR} uA	V_T V
1	40	4.74	20	–	7.2
2	30	4.76	15	–	7.2
3	20	4.79	10	–	6.8

V-I characteristics of SCR