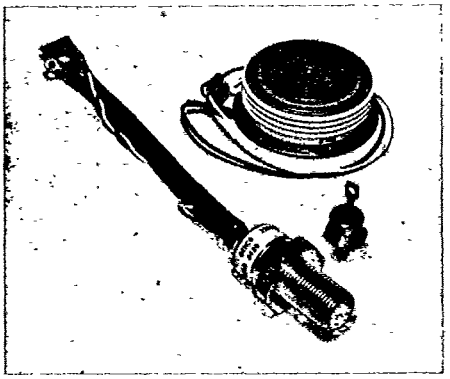
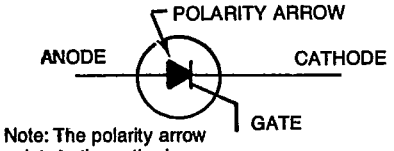
Silicon Controlled Rectifiers



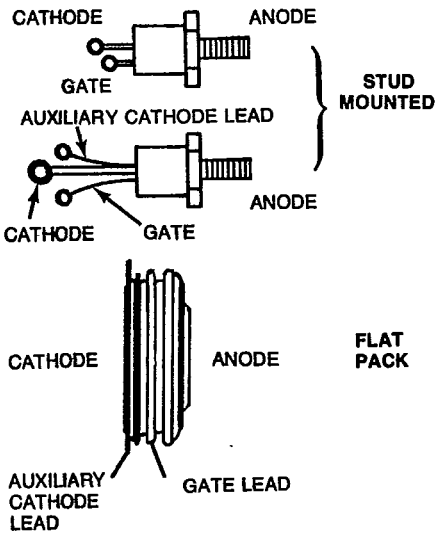
Silicon Controlled Rectifiers (SCR's) are used primarily to control the flow of electrical current in much the same way that potentiometers and relays are used. High-current SCR's are used in many different applications, including alternating current and direct current controls, power supplies, power inverters, and power converters.

The schematic symbol for an SCR is:



Note: The polarity arrow points to the cathode.

Like diodes, SCR's come in different packages. But unlike diodes, there are no reverse polarity SCR's. Also unlike diodes, SCR's have gate leads for phase control or static firing.
The following are examples of the types available:



SCR's are also similar to diodes in that they conduct current only in one direction. The major difference is that SCR's (when they are forward biased—see the earlier discussion on diodes) only conduct if their gate circuits are "triggered" by the application of an external signal which sets the gate positive with respect to the cathode. And then, once they are triggered, they continue conducting (even if the trigger signal is removed) until the flow of current drops to near zero or until the polarity is reversed.

There is another aspect of SCR operation that is especially important: The point at which the gate voltage turns on controls the amount of current flowing through the SCR. Thus, SCR's make excellent solid-state controls in electrical and electronic circuits. Note: CEHCO firing circuits for phase control (covered later) provide an easy means of controlling when the gate voltage turns on.

To turn off the SCR, the current through it must be reduced to near zero. This can be accomplished by voltage reversing or forcing the voltage to zero by capacitor discharge.

Note: The SCR also would turn off if circuitry were provided to raise the voltage at the cathode to equal or exceed the voltage at the anode.

Several characteristics are particularly important when SCR's are being selected for use in a circuit:

1. $I_{t(av)}$ — The maximum continuous current that may flow through the SCR without causing harm. It is important to select SCR's with maximum continuous current ratings higher than the maximum current expected in the circuit.
2. V_{rm} — The peak reverse blocking voltage for an SCR is analogous to the PRV of a rectifier diode and it must not be exceeded.
3. V_{bo} — The forward breakover voltage. If the forward voltage across an SCR exceeds this value, the SCR may turn on without a trigger signal at its gate.
4. V_{gt} — The maximum gate voltage to trigger is the gate voltage at or above which the SCR will conduct current. (See also item 5.)
5. V_{gd} — The maximum non-triggering gate voltage is the voltage below which the SCR will not turn on. Note: The current values in the gate circuit are also important (see items 6, 8 and 9) and for this reason, SCR specifications include gate power limits.
6. V_{gm} — The maximum gate voltage that can be applied without damaging the SCR.
7. I_h — The holding current is the current below which a conducting SCR, in the absence of a gate signal, will switch to the off state.
8. I_{gt} — The maximum gate current to trigger is the current above which the SCR gate will turn on reliably. (See also item 9.)
9. I_{gm} — The maximum peak gate current that should never be exceeded.

SCR Testing

Without specialized equipment, such as the CEHCO T100, it is difficult to test SCR's outside of the circuits in which they operate. Therefore, the best method for occasional SCR testing is to replace the questionable SCR with a duplicate that is known to be good and see if the circuit resumes proper operation.

Note: CEHCO manufactures a diode and SCR tester (see section 3) that comes complete with instructions for testing. Ask for part number T100.

CEHCO SCR Nomenclature

Along with an identifying number, CEHCO SCR part numbers include a CR to show that the device is an SCR. Other letters following the CR designation, such as E, G, and H, refer to package size (see the SCR dimension diagrams in this section).

SCR ORDERING INSTRUCTIONS

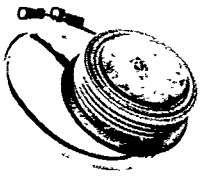
There are a few facts that you should collect before your call (if you are unable to find some of this information, call and we will be glad to assist you):

1. Determine the physical size of the SCR you need. (Use the illustrations in this section as a guide to making measurements.)
2. Determine the direct current carried by the SCR. (If you do not know how to do this, check with CEHCO for assistance.)
3. Determine the number of devices required (the number of SCR's that are wired so they work together).
4. If possible, determine the CEHCO part number from the accompanying charts and illustrations (or call and we will help you).

Notes:

1. When the average forward current (amperage) of an SCR is unknown, measure the stud or flat-pack size and select the same-size SCR with the highest average forward current rating.
2. When the peak reverse blocking voltage of an SCR is unknown, multiply the transformer secondary voltage or the direct current (dc) for the circuit times 2.5 to obtain an appropriate peak reverse blocking voltage rating.

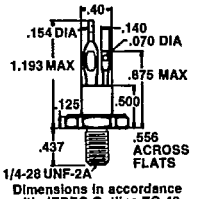
CEHCO SCR'S

	SERIES	AMPS AVG	VOLTAGE RANGE
	16 CR	16	400 - 1000 V
	40 CR	40	200 - 1200 V
	70 CR	70	200 - 1200 V
	150 CR	150	200 - 1200 V
	350 CR	350	500 - 1400 V
	180 CRE	210	200 - 1600 V
	300 CRE	300	200 - 1600 V
	500 CRE	420	200 - 1600 V
	650 CRG	500	200 - 2000 V
	950 CRG	600	200 - 2000 V
	1200 CRH	900	200 - 1800 V
	1600 CRH	1270	200 - 1800 V
	2000 CRH	1460	200 - 1800 V

Note: It is good practice to protect SCR circuits with nonpolar surge suppressors connected from anode to cathode (see the section on surge suppressors for more information).

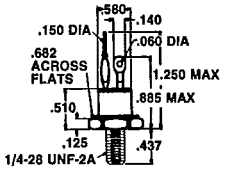
SCR DIMENSION DIAGRAMS

SERIES 16CR



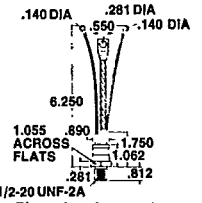
Dimensions in accordance with JEDEC Outline TO-40

SERIES 40CR



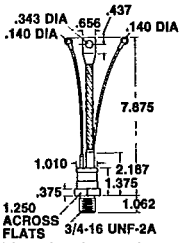
Dimensions in accordance with JEDEC Outline TO-65

SERIES 70CR



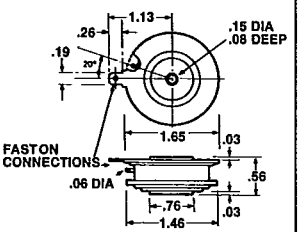
Dimensions in accordance with JEDEC Outline TO-94

SERIES 150CR



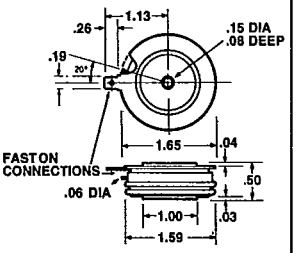
Dimensions in accordance with JEDEC Outline TO-93

180CRE to 300CRE

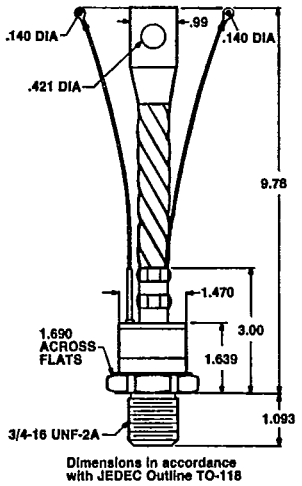


Dimensions in accordance with JEDEC Outline TO-200AB

500CRE



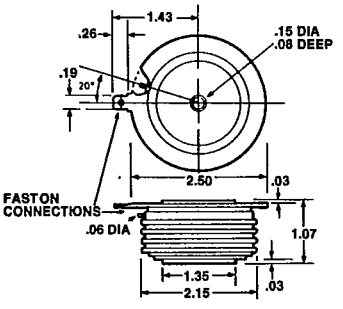
SERIES 350CR



Dimensions in accordance with JEDEC Outline TO-118

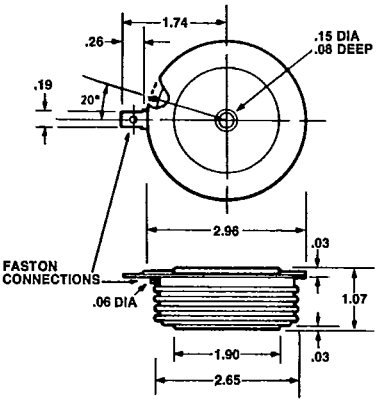
Note: Dimensions in inches.

SERIES CRG



Dimensions in accordance with JEDEC Outline TO-200AC

SERIES CRH



SCR's

UNIT SERIES Silicon Controlled Rectifiers			16CR	40CR	70CR	150CR	350CR	180CRE	300CRE	500CRE	650CRG	950CRG	1,200CRH	1,600CRH	2,000CRH
ELECTRICAL CHARACTERISTICS MAXIMUM RATINGS	**Symbol**	**Units**													
RMS Forward Current	$I_{T(RMS)}$	A	25	63	110	235	470	330	470	660	785	950	1,400	2,000	2,300
AVG. Forward Current	$I_{T(AV)}$	A	16	40	70	150	300	210	300	420	500	600	900	1,270	1,460
Peak one-cycle Surge @ 8.3ms.	$I_{T\ SM}$	A	150	1,000	1,600	3.00	8,000	3,500	5,000	5,700	6,500	8,000	14,000	20,000	24,000
I^2t @ 8ms.	I^2t	A^2/sec.	90	4,100	10,700	37,000	265,000	51,000	125,000	163,000	175,000	270,000	820,000	1,670,000	2,400,000
Forward Voltage Drop at 25° C at noted amps (peak)	V_{TM}	V A	2.00 50	1.75 125	1.85 220	1.70 500	1.21 500	1.6 500	1.64 500	1.35 500	1.50 5,000	1.20 5,000	1.80 2,500	1.25 2,500	.97 2,500
Maximum Voltage Ratings	V_{RPM} V_{DRM}	V	1,000	1,600	1,600	1,600	1,600	1,600	1,600	1,800	1,800	1,800	2,000	1,400	1,600
Maximum Thermal Resistance Junction to case	$R_{\theta JC}$	°C/W	1.50	0.35	0.28	0.20	.115	.09	.09	.09	.06	.06	.03	.03	.03
Maximum Operating Temperature	T_j	°C	125	125	125	125	125	125	125	125	125	125	125	125	125
Max. Rate of Rise on State Current (non-Rep.)	di/dt	A/μ sec.	150	200	100	800	800	200	200	500	800	800	800	800	800
Typical Turn Off Time	tq	μ sec.	100	40-100	20-100	20-100	20-80	40-200	40-200	20-80	20-200	40-200	40-200	40-200	40-200
Min. Critical Exponential Rate of rise of fwd. Blocking Voltage	dv/dt	V/μ sec.	200	200	100	200	200	200	200	200	200	200	200	200	200
Max. Gate Voltage to Trigger	$V_{GT.}$	V	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Max. Non Triggring Gate Voltage	$V_{GD.}$	V	.25	.25	.25	.25	.15	.15	.15	.15	.15	.15	.15	.15	.15
Max. Gate Current to Trigger	$I_{GT.}$	MA	40	100	150	200	150	150	150	150	150	150	300	300	300
Max. Peak Gate Power	P_{GM}	W	5.00	10	15	10	3	20	20	20	20	20	30	30	30
Avg. Peak Gate Power	$P_{G(AV)}$	W	0.50	1.00	3.00	2.00	16	5.00	5.00	5.00	5.00	10.00	10.00	10.00	10.00
Max. Peak Gate Voltage fwd. Max. Peak Gate Current	$V_{GM.}$ $I_{GM.}$	V A	10 2	20 3.00	10 4.00	10 2.00	20 5	5 5	5 5	5 4	5 4	5 4	5 5	5 5	5 5
MECHANICAL CHARACTERISTICS Note: Low figure for tq. for inverter SCR's.															
Torque inch lbs. max.		in. Lbs.	30	30	150	300	300	-	-	-	-	-	-	-	-
Thread size			¼-28	¼-28	½-20	¾-16	¾-16	-	-	-	-	-	-	-	-
Mounting force lbs.		Lbs.	-	-	-	-	-	880	1000	1100	2200	2200	4400	4400	4400

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