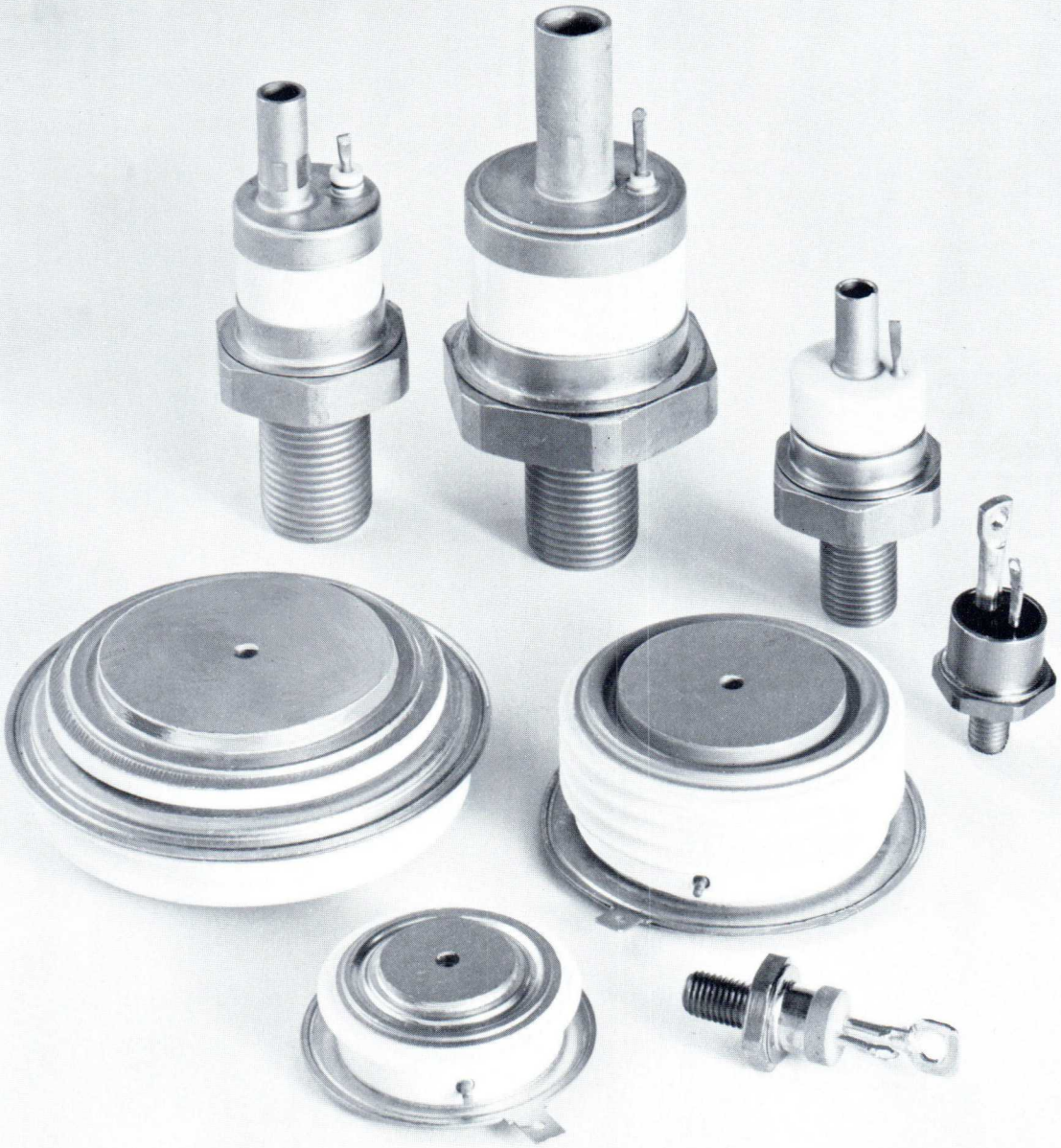
NATIONAL® SCR'S



NATIONAL ELECTRONICS

a varian division

GENEVA, ILLINOIS 60134

16, 25 and 35 Amps

RMS On-State Current			16 Amps		25 Amps		35 Amps					
NATIONAL TYPE NO.			NL-C36	NL-511	NL-C37		NL-C35	NL-C38	NL-C40	NL-C135	NL-C137	NL-570
JEDEC NO.			2N1844-50			2N683-92				2N3754-61		
V_{DRM} and V_{RRM} Volts	A	100 V.	X		X	X	X	X	X	X		X
	G	150 V.	X			X	X	X	X			
	B	200 V.	X		X	X	X	X	X	X		X
	H	250 V.	X			X	X	X	X			
	C	300 V.	X		X	X	X	X	X	X		X
	D	400 V.	X		X	X	X	X	X	X		X
	E	500 V.	X		X	X	X	X	X	X	X	X
	M	600 V.	X		X	X	X			X	X	X
	S	700 V.	X		X	X	X			X	X	
	N	800 V.	X	-3	X	X	X			X	X	
	T	900 V.					X				X	
	P	1000 V.		-4			X				X	
	PA	1100 V.									X	
	PB	1200 V.		-6							X	
	PC	1300 V.										
	PD	1400 V.										
	PE	1500 V.										
	PM	1600 V.										
	PS	1700 V.										
	PN	1800 V.										
	PT	1900 V.										
ELECTRICAL CHARACTERISTICS	$I_{T(AVE.)}$ Amps @ 180° Cond. @ T_C		10 A @ 54° C	10 A @ 70° C	16 A @ 38° C	16 A @ 65° C	22 A @ 66° C	22 A @ 90° C	22 A @ 66° C	22 A @ 66° C	22 A @ 66° C	22 A @ 66° C
	I_{TSM} Amps Peak Half Cycle Surge Current		175	200	175	150	225	200	150	200	200	600
	Max. I_{GT} mA. @ T_J = 25°C		80	80	80	40	40	40	40	80	80	80
	Max. V_{GT} Volts @ T_J = 25°C		3.0	2.5	3.0	2.5	2.5	2.5	2.5	2.5	2.5	3.0
	Max. On-State Volts @ T_J = 25°C		2.7 V @ 50 A	2.7 V @ 50 A	2.25 V @ 30 A	2.0 V @ 50 A	2.0 V @ 50 A	2.0 V @ 50 A	2.0 V @ 50 A	2.3 V @ 70 A	2.3 V @ 70 A	1.7 V @ 50 A
	Max. Turn-Off Time tq μ Sec.		—	—	—	—	—	—	12	75	75	—
	Min. dv/dt V/μ Sec.		A-E 50 M-N 10	200	—	—	A-E 25 M-P 10	20	A-E 25	200	100	200
	Max. di/dt A/μSec.		*	*	—	10	*	—	*	200	150	35
	Max. Off-State & Reverse Blocking Current mA. @ T_J		A-C 5 D-N 2 @ 100° C	2 @ 100° C	A-C 5 D-N 2 @ 105° C	*	A-C 10 D-P 4 @ 125° C	A-C 5 D-E 2 @ 150° C	A-C 10 D-E 4 @ 125° C	3 @ 125° C	E-T 3 P-PB 2 @ 125° C	3 @ 110° C
	Max. Stud Torque or Mounting Force		30 in.-lbs.	30 in.-lbs.	30 in.-lbs.	30 in.-lbs.	30 in.-lbs.	30 in.-lbs.	30 in.,-lbs.	30 in.-lbs.	30 in.-lbs.	30 in.-lbs.
	Case Type		TO-48	TO-48	TO-48	TO-48	TO-48	TO-48	TO-48	TO-48	TO-48	TO-48

X Indicates that the device is available in this voltage classification.

* Consult Data Sheet.

55 Amps				63 Amps		110 Amps					
 5/16-24 Stud				 1/4-28 Stud							
55 Amps				63 Amps		110 Amps			RMS On-State Current		
NL-576	NL-577	NL-C45	NL-C46	NL-578	NL-579	NL-C50	NL-C55	NL-C60	NATIONAL TYPE NO.		
						2N1911-16 2N1805-07		2N2025-30	JEDEC NO.		
		X	X			X	X	X	A	100 V.	V_{DRM} and V_{RRM} Volts
		X	X			X	X	X	G	150 V.	
X	X	X	X	X	X	X	X	X	B	200 V.	
		X	X			X	X	X	H	250 V.	
X	X	X	X	X	X	X	X	X	C	300 V.	
X	X	X	X	X	X	X	X	X	D	400 V.	
X	X	X	X	X	X	X	X	X	E	500 V.	
X	X	X	X	X	X	X	X		M	600 V.	
X	X	X	X	X	X	X			S	700 V.	
X	X	X	X	X	X	X			N	800 V.	
X	X	X	X	X	X	X			T	900 V.	
X	X			X	X				P	1000 V.	
X	X			X	X				PA	1100 V.	
X	X			X	X				PB	1200 V.	
									PC	1300 V.	
									PD	1400 V.	
									PE	1500 V.	
									PM	1600 V.	
									PS	1700 V.	
									PN	1800 V.	
									PT	1900 V.	
35 A @ 90° C	35 A @ 90° C	35 A @ 87° C	35 A @ 87° C	40 A @ 102° C	40 A @ 102° C	70 A @ 62° C	70 A @ 82° C	70 A @ 102° C	$I_{T(AVE.)}$ Amps @ 180° Cond. @ T_C		ELECTRICAL CHARACTERISTICS
700	700	700	700	1000	1000	1000	1200	1600	I_{TSM} Amps Peak Half Cycle Surge Current		
150	150	70	70	150	150	70	70	70	Max. I_{GT} mA. @ T_J = 25°C		
3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.5	Max. V_{GT} Volts @ T_J = 25°C		
2.4 V @ 110 A	2.4 V @ 110 A	3.0 V @ 500 A	3.0 V @ 500 A	3.0 V @ 500 A	3.0 V @ 500 A	2.5 V @ 500 A	2.5 V @ 500 A	2.5 V @ 500 A	Max. On-State Volts @ T_J = 25°C		
—	—	—	—	—	—	—	20	—	Max. Turn-Off Time tq μ Sec.		
B-E 50 M-PB 10	B-N 200 T-PB 100	A-D 30 E-T 20	A-D 30 E-T 20	B-E 50 M-PB 10	B-N 200 T-PB 100	A-D 30 E-T 20	A-D 30 E-M 20	—	Min. dv/dt V/μ Sec.		
B-S 35 N-PB 20	B-S 35 N-PB 20	*	*	B-S 35 N-PB 20	B-S 35 N-PB 20	*	*	—	Max. di/dt A/μSec.		
B-T 8 P-PB 6 @ 125° C	B-T 8 P-PB 6 @ 125° C	A-C 8 D-T 4 @ 125° C	A-C 8 D-T 4 @ 125° C	B-T 12 P-PB 8 @ 125° C	B-T 12 P-PB 8 @ 125° C	A-C 8 D-T 4 @ 125° C	A-C 8 D-M 4 @ 125° C	A-C 8 D-E 4 @ 150° C	Max. Off-State & Reverse Blocking Current mA. @ T_J		
50 in.-lbs.	50 in.-lbs.	150 in.-lbs.	150 in.-lbs.	30 in.-lbs.	30 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	Max. Stud Torque or Mounting Force		
TO-103	TO-103	TO-83	TO-94	TO-65	TO-65	TO-94	TO-94	TO-94	Case Type		

X Indicates that the device is available in this voltage classification.

* Consult Data Sheet.

110 Amps

Regenerative Gate

RMS On-State Current			110 Amps				110 Amps				
NATIONAL TYPE NO.			NL-C150	NL-C151	NL-C154	NL-C155	NL-F150	NL-F151	NL-F154	NL-F155	NL-F158
JEDEC NO.											
V_{DRM} and V_{RRM} Volts	A	100 V.			X	X			X	X	X
	G	150 V.									
	B	200 V.			X	X	X	X	X	X	X
	H	250 V.									
	C	300 V.			X	X	X	X	X	X	X
	D	400 V.			X	X	X	X	X	X	X
	E	500 V.	X	X	X	X	X	X	X	X	X
	M	600 V.	X	X	X	X	X	X	X	X	X
	S	700 V.	X	X			X	X			X
	N	800 V.	X	X			X	X			X
	T	900 V.	X	X			X	X			X
	P	1000 V.	X	X			X	X			X
	PA	1100 V.	X								
	PB	1200 V.	X								
	PC	1300 V.	X								
	PD	1400 V.									
	PE	1500 V.									
	PM	1600 V.									
	PS	1700 V.									
	PN	1800 V.									
	PT	1900 V.									
ELECTRICAL CHARACTERISTICS	$I_{T(AVE.)}$ Amps @ 180° Cond. @ T_C		70 A @ 90° C	70 A @ 80° C	70 A @ 85° C	70 A @ 85° C	70 A @ 90° C	70 A @ 90° C	70 A @ 90° C	70 A @ 90° C	70 A @ 90° C
	I_{TSM} Amps Peak Half Cycle Surge Current		1800	1400	1400	1400	1600	1400	1400	1400	1400
	Max. I_{GT} mA. @ T_J = 25°C		150	150	200	200	150	150	150	150	150
	Max. V_{GT} Volts @ T_J = 25°C		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Max. On-State Volts @ T_J = 25°C		2.6 V @ 500 A	3.5 V @ 500 A	3.0 V @ 500 A	3.0 V @ 500 A	2.6 V @ 500 A	2.6 V @ 500 A	2.6 V @ 500 A	2.6 V @ 500 A	2.6 V @ 500 A
	Max. Turn-Off Time tq μ Sec.		—	50	10	20	150	50	10	20	40
	Min. dv/dt V/μ Sec.		200	200	200	200	200	200	200	200	200
	Max. di/dt A/μSec.		E-P 75 PA-PC 50	75	*	*	800	800	800	800	800
	Max. Off-State & Reverse Blocking Current mA. @ T_J		E-N 10 T-PC 6 @ 125° C	8 @ 125° C	8 @ 125° C	8 @ 125° C	B-C 8 D-P 4 @ 125° C	A-E 8 M-P 4 @ 125° C	A-E 8 M-4 @ 125° C	A-E 8 M 4 @ 125° C	A-E 8 M-P 4 @ 125° C
	Max. Stud Torque or Mounting Force		150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.
	Case Type		TO-94	TO-94	TO-94	TO-94	TO-94	TO-94	TO-94	TO-94	TO-94

X Indicates that the device is available in this voltage classification.

* Consult Data Sheet.

110 Amps

Regenerative Gate											
110 Amps							110 Amps		RMS On-State Current		
NL-C52	NL-C56	NL-C62	NL-C152	NL-C153	NL-C156	NL-C157	NL-F152	NL-F153	NATIONAL TYPE NO.		
2N1793-1803									JEDEC NO.		
X	X	X			X	X			A	100 V.	V_{DRM} and V_{RRM} Volts
X	X	X							G	150 V.	
X	X	X			X	X	X	X	B	200 V.	
X	X	X							H	250 V.	
X	X	X			X	X	X	X	C	300 V.	
X	X	X			X	X	X	X	D	400 V.	
X	X	X	X	X	X	X	X	X	E	500 V.	
X	X		X	X	X	X	X	X	M	600 V.	
X			X	X			X	X	S	700 V.	
X			X	X			X	X	N	800 V.	
X			X	X			X	X	T	900 V.	
			X	X			X	X	P	1000 V.	
			X						PA	1100 V.	
			X						PB	1200 V.	
			X						PC	1300 V.	
									PD	1400 V.	
									PE	1500 V.	
									PM	1600 V.	
									PS	1700 V.	
									PN	1800 V.	
									PT	1900 V.	
70 A @ 62° C	70 A @ 82° C	70 A @ 102° C	70 A @ 90° C	70 A @ 80° C	70 A @ 85° C	70 A @ 85° C	70 A @ 90° C	70 A @ 90° C	$I_{T(AVE.)}$ Amps @ 180° Cond. @ T_C		ELECTRICAL CHARACTERISTICS
1000	1200	1600	1800	1400	1400	1400	1600	1400	I_{TSM} Amps Peak Half Cycle Surge Current		
70	70	70	150	150	200	200	150	150	Max. I_{GT} mA. @ T_J = 25°C		
3.0	3.0	2.5	2.5	2.5	2.5	2.5	2.5	2.5	Max. V_{GT} Volts @ T_J = 25°C		
2.5 V @ 500 A	2.5 V @ 500 A	2.5 V @ 500 A	2.6 V @ 500 A	3.5 V @ 500 A	3.0 V @ 500 A	3.0 V @ 500 A	2.6 V @ 500 A	2.6 V @ 500 A	Max. On-State Volts @ T_J = 25°C		
—	20	—	—	50	10	20	150	50	Max. Turn-Off Time t_q μ Sec.		
A-D 30 E-T 20	A-D 30 E-M 20	—	200	200	200	200	200	200	Min. dv/dt V/μ Sec.		
*	*	—	E-P 75 PA-PC 50	75	*	*	800	800	Max. di/dt A/μSec.		
A-C 8 D-T 4 @ 125° C	A-C 8 D-M 4 @ 125° C	A-C 8 D-E 4 @ 150° C	E-N 10 T-PC 6 @ 125° C	8 @ 125° C	8 @ 125° C	8 @ 125° C	B-C 8 D-P 4 @ 125° C	A-E 8 M-P 4 @ 125° C	Max. Off-State & Reverse Blocking Current mA. @ T_J		
150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	Max. Stud Torque or Mounting Force		
TO-83	TO-83	TO-83	TO-83	TO-83	TO-83	TO-83	TO-83	TO-83	Case Type		

X Indicates that the device is available in this voltage classification.

* Consult Data Sheet.

			110 Amps			175 Amps					
									Regenerative Gate		
RMS On-State Current			110 Amps			175 Amps			175 Amps		
NATIONAL TYPE NO.			NL-F156	NL-F157	NL-F159	NL-C350	NL-C354	NL-C355	NL-F350	NL-F354	NL-F355
JEDEC NO.											
V_{DRM} and V_{RRM} Volts	A	100 V.	X	X	X	X	X	X	X	X	X
	G	150 V.									
	B	200 V.	X	X	X	X	X	X	X	X	X
	H	250 V.									
	C	300 V.	X	X	X	X	X	X	X	X	X
	D	400 V.	X	X	X	X	X	X	X	X	X
	E	500 V.	X	X	X	X	X	X	X	X	X
	M	600 V.	X	X	X	X	X	X	X	X	X
	S	700 V.			X	X			X		
	N	800 V.			X	X			X		
	T	900 V.			X	X			X		
	P	1000 V.			X	X			X		
	PA	1100 V.				X					
	PB	1200 V.				X					
	PC	1300 V.				X					
	PD	1400 V.									
	PE	1500 V.									
	PM	1600 V.									
	PS	1700 V.									
	PN	1800 V.									
	PT	1900 V.									
ELECTRICAL CHARACTERISTICS	$I_{T(AVE.)}$ Amps @ 180° Cond. @ T_C		70 A @ 90° C	70 A @ 90° C	70 A @ 90° C	112 A @ 88° C	112 A @ 88° C	112 A @ 88° C	112 A @ 88° C	112 A @ 88° C	112 A @ 88° C
	I_{TSM} Amps Peak Half Cycle Surge Current		1400	1400	1400	1800	1400	1400	1800	1400	1400
	Max. I_{GT} mA. @ T_J = 25°C		150	150	150	150	150	150	150	150	150
	Max. V_{GT} Volts @ T_J = 25°C		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Max. On-State Volts @ T_J = 25°C		2.6 V @ 500 A	2.6 V @ 500 A	2.6 V @ 500 A	2.6 V A 500 A	2.6 V @ 500 A	2.6 V @ 500 A	2.6 V @ 500 A	2.6 V @ 500 A	2.6 V @ 500 A
	Max. Turn-Off Time tq μ Sec.		10	20	40	—	10	20	150	10	20
	Min. dv/dt V/μ Sec.		200	200	200	200	200	100	200	100	100
	Max. di/dt A/μSec.		600	600	600	A-E 100 M-P 75 PA-PC 50	100	100	800	800	800
	Max. Off-State & Reverse Blocking Current mA. @ T_J		A-E 8 M-4 @ 125° C	A-E 8 M-4 @ 125° C	A-E 8 M-P 4 @ 125° C	A-T 10 P-PC 6 @ 125° C	10 @ 125° C	10 @ 125° C	A-T 8 P-4 @ 125° C	8 @ 125° C	8 @ 125° C
	Max. Stud Torque or Mounting Force		150 in.-lbs.	150 in.-lbs.	150 in.-lbs.	800-lbs.	800-lbs.	800-lbs.	800-lbs.	800-lbs.	800-lbs.
	Case Type		TO-83	TO-83	TO-83	P-1	P-1	P-1	P-1	P-1	P-1

X Indicates that the device is available in this voltage classification.

★ Consult Data Sheet.

175 Amps	200 and 235 Amps						
					Regenerative Gate		
175 Amps	200 Amps	235 Amps			235 Amps		RMS On-State Current
NL-F358	NL-C178	NL-C180	NL-C181	NL-C185	NL-F180	NL-F185	NATIONAL TYPE NO.
							JEDEC NO.
X	X	X	X	X	X	X	A 100 V.
							G 150 V.
X	X	X	X	X	X	X	B 200 V.
							H 250 V.
X	X	X	X	X	X	X	C 300 V.
X	X	X	X	X	X	X	D 400 V.
X	X	X	X	X	X	X	E 500 V.
X	X	X	X	X	X	X	M 600 V.
X	X	X	X		X		S 700 V.
X	X	X	X		X		N 800 V.
X	X	X	X		X		T 900 V.
X	X	X	X		X		P 1000 V.
	X	X					PA 1100 V.
	X	X					PB 1200 V.
		X					PC 1300 V.
							PD 1400 V.
							PE 1500 V.
							PM 1600 V.
							PS 1700 V.
							PN 1800 V.
							PT 1900 V.
112 A @ 88° C	125 A @ 80° C	150 A @ 90° C	150 A @ 80° C	150 A @ 80° C	150 A @ 80° C	150 A @ 80° C	$I_{T(AVE.)}$ Amps @ 180° Cond. @ T_C
1400	2500	3500	2500	3500	3500	3500	I_{TSM} Amps Peak Half Cycle Surge Current
150	300	150	300	300	150	150	Max. I_{GT} mA. @ T_J = 25°C
2.5	2.5	2.5	2.5	2.5	2.5	2.5	Max. V_{GT} Volts @ T_J = 25°C
2.6 V @ 500 A	3.5 V @ 1500 A	2.85 V @ 1500 A	3.5 V @ 1500 A	2.85 V @ 1500 A	2.85 V @ 1500 A	2.85 V @ 1500 A	Max. On-State Volts @ T_J = 25°C
40	—	—	—	A-E 20 M 30	150	20	Max. Turn-Off Time tq μ Sec.
200	200	200	200	200	200	200	Min. dv/dt V/μ Sec.
600	A-E 100 M-P 75 PA-PB 50	A-E 100 M-P 75 PA-PC 50	A-E 100 M-P 75	A-E 100 M 75	800	800	Max. di/dt A/μSec.
A-T 8 P 4 @ 125° C	12 @ 125° C	A-N 6 T-PC 4 @ 125° C	12 @ 125° C	12 @ 125° C	A-N 6 T-P 4 @ 125° C	A-M 6 @ 125° C	Max. Off-State & Reverse Blocking Current mA. @ T_J
800-lbs.	300 in.-lbs.	300 in.-lbs.	300 in.-lbs.	300 in.-lbs.	300 in.-lbs.	300 in.-lbs.	Max. Stud Torque or Mounting Force
P-1	TO-93	TO-93	TO-93	TO-93	TO-93	TO-93	Case Type

V_{DRM} and V_{RRM} Volts

ELECTRICAL CHARACTERISTICS

X Indicates that the device is available in this voltage classification.

★ Consult Data Sheet.

			380 Amps				470 Amps			
										
					Regenerative Gate				Regenerative Gate	
RMS On-State Current			380 Amps		380 Amps		470 Amps		470 Amps	
NATIONAL TYPE NO.			NL-C380	NL-C385	NL-F380	NL-F385	NL-C290	NL-C295	NL-F290	NL-F295
JEDEC NO.										
V_{DRM} and V_{RRM} Volts	A	100 V.	X	X	X	X	X	X	X	X
	G	150 V.								
	B	200 V.	X	X	X	X	X	X	X	X
	H	250 V.								
	C	300 V.	X	X	X	X	X	X	X	X
	D	400 V.	X	X	X	X	X	X	X	X
	E	500 V.	X	X	X	X	X	X	X	X
	M	600 V.	X	X	X	X	X	X	X	X
	S	700 V.	X		X		X		X	
	N	800 V.	X		X		X		X	
	T	900 V.	X		X		X		X	
	P	1000 V.	X		X		X		X	
	PA	1100 V.	X				X			
	PB	1200 V.	X				X			
	PC	1300 V.	X							
	PD	1400 V.								
	PE	1500 V.								
	PM	1600 V.								
	PS	1700 V.								
	PN	1800 V.								
	PT	1900 V.								
ELECTRICAL CHARACTERISTICS	$I_{T(AVE.)}$ Amps @ 180° Cond. @ T_C		250 A @ 75° C	250 A @ 75° C	250 A @ 75° C	250 A @ 75° C	300 A @ 75° C	300 A @ 75° C	300 A @ 75° C	300 A @ 75° C
	I_{TSM} Amps Peak Half Cycle Surge Current		3500	3500	3500	3500	5500	4500	5500	5500
	Max. I_{GT} mA. @ T_J = 25°C		150	150	150	150	150	300	150	150
	Max. V_{GT} Volts @ T_J = 25°C		2.5	2.5	2.5	2.5	3.0	3.5	2.5	2.5
	Max. On-State Volts @ T_J = 25°C		2.85 V @ 1500 A	2.85 V @ 1500 A	2.85 V @ 1500 A	2.85 V @ 1500 A	1.21 V @ 500 A	2.3 V @ 500 A	1.21 V @ 1500 A	2.3 V @ 500 A
	Max. Turn-Off Time tq μ Sec.		—	20	150	20	—	20	150	20
	Min. dv/dt V/μ Sec.		200	200	200	200	100	100	100	100
	Max. di/dt A/μSec.		A-E 100 M-P 75 PA-PC 50	100	800	800	50	50	800	800
	Max. Off-State & Reverse Blocking Current mA. @ T_J		A-T 10 P-PC 5 @ 125° C	10 @ 125° C	A-T 10 P 5 @ 125° C	10 @ 125° C	15 @ 125° C	15 @ 125° C	15 @ 125° C	15 @ 125° C
	Max. Stud Torque or Mounting Force		800 -lbs.	800 -lbs.	800 -lbs.	800 -lbs.	300 in.-lbs.	300 in.-lbs.	300 in.-lbs.	300 in.-lbs.
	Case Type		P-1	P-1	P-1	P-1	TO-118	TO-118	TO-118	TO-118

X Indicates that the device is available in this voltage classification.

★ Consult Data Sheet.

470 Amps				625, 700, 850 and 1200 Amps						
										
		Regenerative Gate			Regenerative Gate					
470 Amps		470 Amps		625 Amps	700 Amps				RMS On-State Current	
NL-C291	NL-C297	NL-F291	NL-F297	NL-1580	NL-F394	NL-F395	NL-F397	NL-F398	NATIONAL TYPE NO.	
									JEDEC NO.	
X	X	X	X	X	X	X	X	X	A	100 V.
									G	150 V.
X	X	X	X	X	X	X	X	X	B	200 V.
									H	250 V.
X	X	X	X	X	X	X	X	X	C	300 V.
X	X	X	X	X	X	X	X	X	D	400 V.
X	X	X	X	X	X	X	X	X	E	500 V.
X	X	X	X	X	X	X	X	X	M	600 V.
X		X		X			X	X	S	700 V.
X		X		X			X	X	N	800 V.
X		X		X			X	X	T	900 V.
X		X		X			X	X	P	1000 V.
X				X			X	X	PA	1100 V.
X				X			X	X	PB	1200 V.
				X					PC	1300 V.
				X					PD	1400 V.
				X					PE	1500 V.
				X					PM	1600 V.
				X					PS	1700 V.
									PN	1800 V.
									PT	1900 V.
300 A @ 75° C	300 A @ 75° C	300 A @ 75° C	300 A @ 75° C	400 A @ 70° C	550 A @ 62° C	550 A @ 62° C	550 A @ 62° C	550 A @ 62° C	$I_{T(AVE.)}$ Amps @ 180° Cond. @ T_C	ELECTRICAL CHARACTERISTICS
5500	4500	5500	5500	5500	8000	8000	7500	7500	I_{TSM} Amps Peak Half Cycle Surge Current	
150	300	150	150	150	200	200	150	150	Max. I_{GT} mA. @ T_J = 25°C	
3.0	3.5	2.5	2.5	6.5	2.5	2.5	2.5	2.5	Max. V_{GT} Volts @ T_J = 25°C	
1.21 V @ 500 A	2.3 V @ 500 A	1.21 V @ 1500 A	2.3 V @ 500 A	2.0 V @ 1000 A	2.5 V @ 3000 A	2.5 V @ 3000 A	2.95 V @ 3000 A	2.95 V @ 3000 A	Max. On-State Volts @ T_J = 25°C	
—	20	150	—	300	15	20	45	30	Max. Turn-Off Time tq μ Sec.	
100	100	100	100	100	200	200	200	200	Min. dv/dt V/μ Sec.	
50	50	800	800	A-E 75 M-P 50 PA-PS 30	800	800	800	800	Max. di/dt A/μSec.	
15 @ 125° C	15 @ 125° C	15 @ 125° C	15 @ 125° C	35 @ 125° C	60 @ 125° C	60 @ 125° C	45 @ 125° C	45 @ 125° C	Max. Off-State & Reverse Blocking Current mA. @ T_J	
—	—	—	—	2200-lbs.	2200-lbs.	2200-lbs.	2200-lbs.	2200-lbs.	Max. Stud Torque or Mounting Force	
F-1	F-1	F-1	F-1	P-2	P-2	P-2	P-2	P-2	Case Type	

V_{DRM} and V_{RRM} Volts

X Indicates that the device is available in this voltage classification.

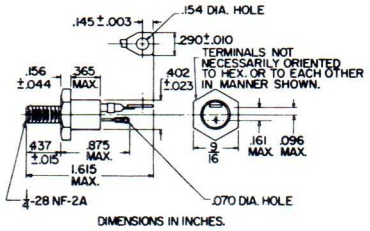
✱ Consult Data Sheet.

			625, 700, 850, and 1200 Amps Rms			1600 Amps Rms
						
			Regenerative Gate			Regenerative Gate
RMS On-State Current			850 Amps	850 Amps	1200 Amps	1600 Amps
NATIONAL TYPE NO.			NL-F390	NL-C501	NL-C601	NL-F701
JEDEC NO.						
V_{DRM} and V_{RRM} Volts	A	100 V.		X		
	G	150 V.				
	B	200 V.		X		
	H	250 V.				
	C	300 V.		X		
	D	400 V.		X		
	E	500 V.	X	X		X
	M	600 V.	X	X		X
	S	700 V.	X	X		X
	N	800 V.	X	X	X	X
	T	900 V.	X	X	X	X
	P	1000 V.	X	X	X	X
	PA	1100 V.	X	X	X	X
	PB	1200 V.	X	X	X	X
	PC	1300 V.	X	X	X	X
	PD	1400 V.		X	X	X
	PE	1500 V.		X	X	X
	PM	1600 V.		X	X	X
	PS	1700 V.		X	X	X
	PN	1800 V.				
	PT	1900 V.				
ELECTRICAL CHARACTERISTICS	$I_{T(AVE.)}$ Amps @ 180° Cond. @ T_c		550 A @ 62° C	550 A @ 62° C	875 A @ 60° C	1000 A @ 78° C
	I_{TSM} Amps Peak Half Cycle Surge Current		8000	8000	11,000	18,000
	Max. I_{GT} mA. @ T_J = 25°C		150	150	150	150
	Max. V_{GT} Volts @ T_J = 25°C		2.5	6.5	6.5	3.0
	Max. On-State Volts @ T_J = 25°C		2.4 V @ 3000 A	1.53 V @ 1000 A	2.1 V @ 3000 A	1.75 V @ 3000 A
	Max. Turn-Off Time tq μ Sec.		—	—	300	—
	Min. dv/dt V/μ Sec.		200	100	100	200
	Max. di/dt A/μSec.		800	A-E 75 M-P 50 PA-PS 30	A-M 150 N-P 100 PA-PS 80	800
	Max. Off-State & Reverse Blocking Current mA. @ T_J		45 @ 125° C	35 @ 125° C	35 @ 125° C	50 @ 125° C
	Max. Stud Torque or Mounting Force		2200-lbs.	2200-lbs.	4000-lbs.	5000-lbs.
	Case Type		P-2	P-2	P-2	P-3

X Indicates that the device is available in this voltage classification.

★ Consult Data Sheet.

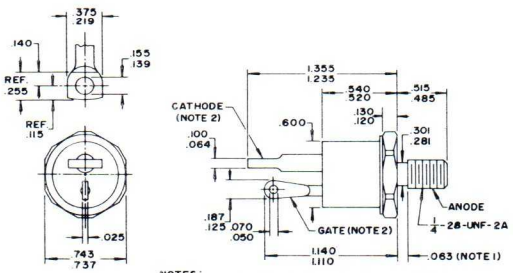
OUTLINE DRAWINGS



MOUNTING KIT:
ONE ¼-28 BRASS NUT
TWO MICA WASHERS
ONE TEFLON BUSHING
ONE LOCK WASHER
ONE TERMINAL

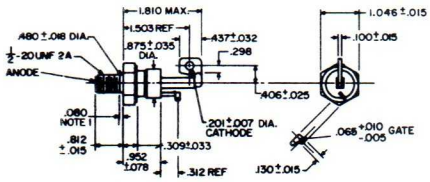
NOTES:
1. COMPLETE THREADS TO EXTEND TO WITHIN 2½ THREADS OF HEAD.
2. APPROX. WEIGHT 0.5 OZS.
3. CONFORMS TO JEDEC TO 48 OUTLINE.

TO-48



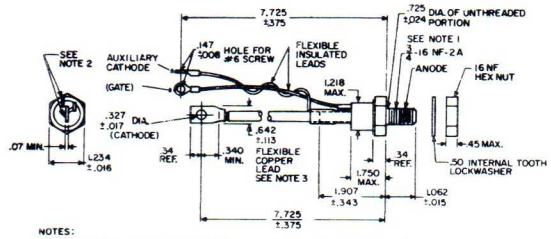
NOTES:
1. MAXIMUM LENGTH OF UNTHREADED PORTION.
2. ANGULAR ORIENTATION OF TERMINALS IS UNDEFINED.
3. NUT AND LOCKWASHER SUPPLIED.
4. CONFORMS TO JEDEC TO-65 OUTLINE.

TO-65



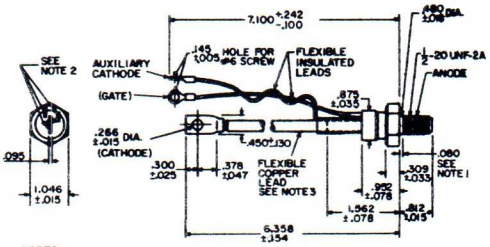
NOTES:
1. MAXIMUM LENGTH OF UNTHREADED PORTION.
2. ORIENTATION OF THESE TERMINALS NOT DEFINED.
3. CONFORMS TO JEDEC TO-83 OUTLINE.
4. DIMENSIONS IN INCHES.

TO-83



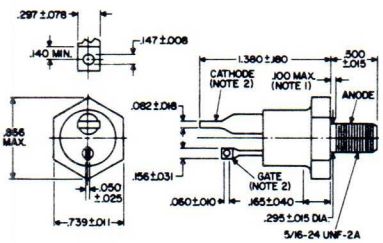
NOTES:
1. COMPLETE THRI ADS TO EXTEND TO WITHIN 2-1/2 THREADS OF HEAD.
2. ANGULAR ORGANIZATION OF THESE TERMINALS IS UNDEFINED.
3. LEAD COVERED WITH SILICONE RUBBER INSULATION (CLASS H) 600 VOLT ASTM STANDARD WALL.
4. APPROXIMATE WEIGHT: 8 OZS.
5. CONFORMS TO JEDEC TO-93 OUTLINE.
6. DIMENSIONS IN INCHES.

TO-93



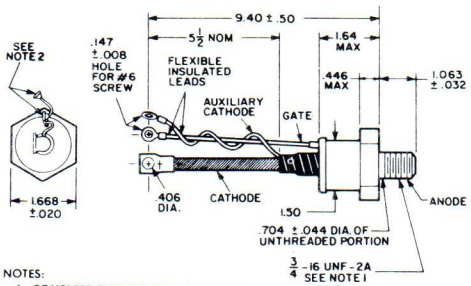
NOTES:
1. MAXIMUM LENGTH OF UNTHREADED PORTION.
2. ORIENTATION OF THESE TERMINALS IS UNDEFINED.
3. LEAD COVERED WITH SILICONE RUBBER INSULATION (CLASS H) 600 VOLT ASTM STANDARD WALL.
4. CONFORMS TO JEDEC TO-94 OUTLINE.
5. DIMENSIONS IN INCHES.

TO-94



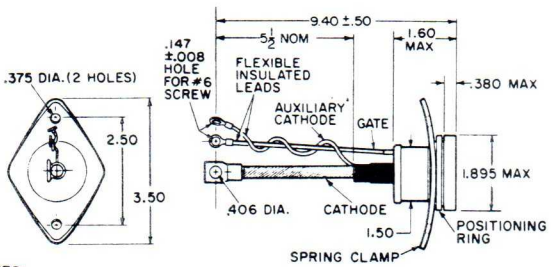
NOTES:
1. MAXIMUM LENGTH OF UNTHREADED PORTION.
2. ANGULAR ORIENTATION OF TERMINALS IS UNDEFINED.
3. CONFORMS TO JEDEC TO-103 OUTLINE.
4. DIMENSIONS IN INCHES.

TO-103



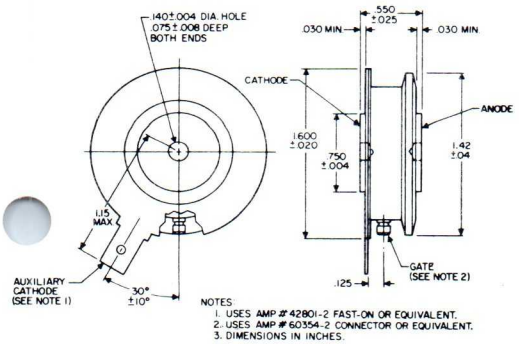
NOTES:
1. COMPLETE THREADS TO EXTEND TO WITHIN 2½ THREADS OF HEAD.
2. ANGULAR ORIENTATION OF THESE TERMINALS IS UNDEFINED.
3. APPROXIMATE WEIGHT: 13 OZS.
4. CONFORMS TO JEDEC TO-118 OUTLINE
5. DIMENSIONS IN INCHES.

TO-118



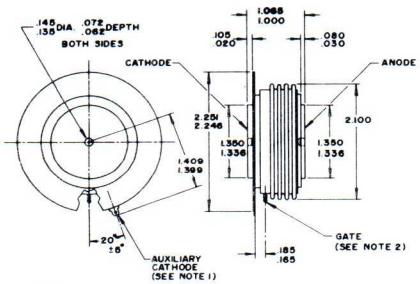
NOTES:
1. DIMENSIONS IN INCHES.

F-1



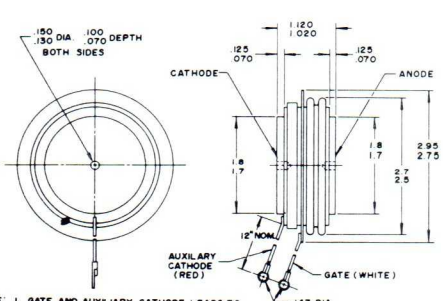
NOTES:
1. USES AMP # 42801-2 FAST-ON OR EQUIVALENT.
2. USES AMP # 60354-2 CONNECTOR OR EQUIVALENT.
3. DIMENSIONS IN INCHES.

P-1



NOTES:
1. USES AMP NO. 42801-2 FAST-ON OR EQUIVALENT.
2. USES AMP NO. 60598-1 CONNECTOR OR EQUIVALENT.
3. 12 INCH GATE AND CATHODE LEADS SUPPLIED UNLESS OTHERWISE
4. GATE AND AUXILIARY CATHODE LEADS TO BE SIZE 20 AWG, 19 x 32 STRANDED, TEFLON EE COATED.

P-2



NOTE: 1. GATE AND AUXILIARY CATHODE LEADS TO BE SIZE 20 AWG, 19 x 32 STRANDED, TEFLON EE COATED.
2. LUG TO BE AMP NO. 41580 RING TYPE.

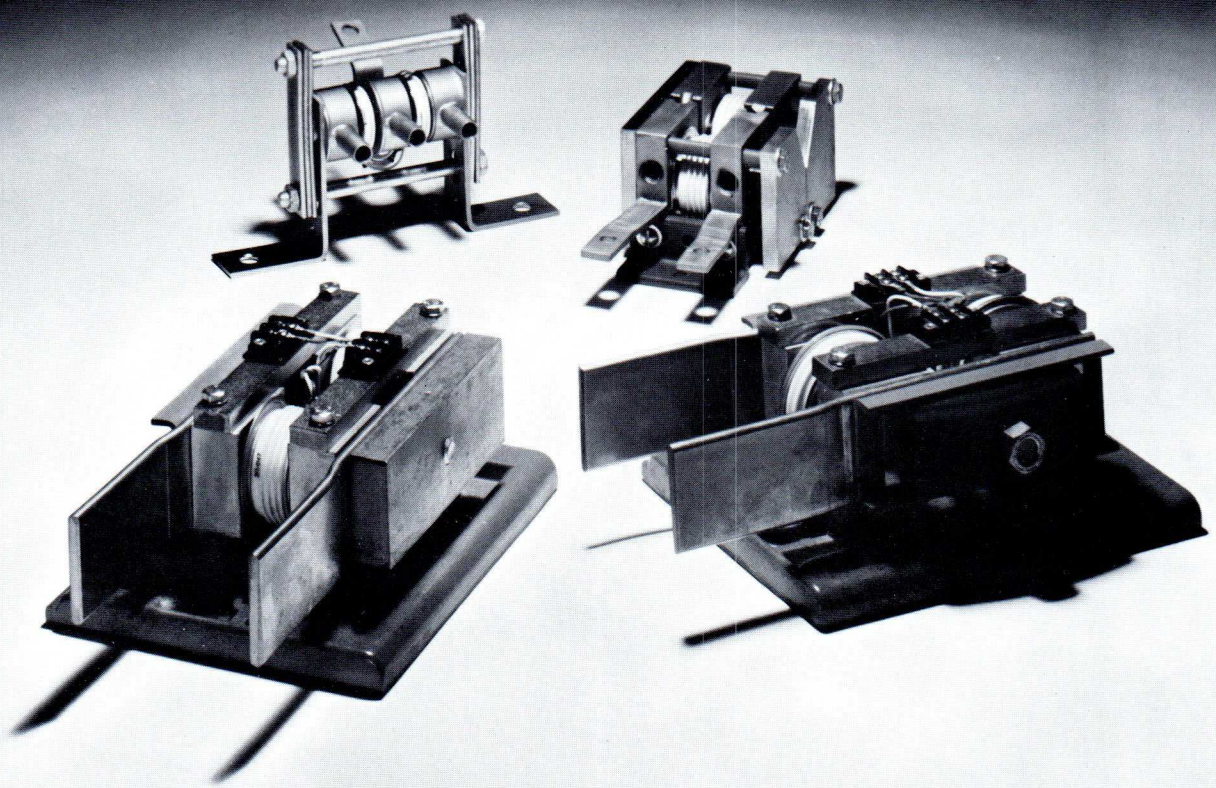
P-3

SALES OFFICES

	4940 El Camino Real Los Altos, Calif. 94022	4341 Birch St., Suite 201 Newport Beach, Calif. 92660	Keslinger Road Geneva, Ill. 60134	25 Route 22 Springfield, N.J. 07081
Telephone:	415 968-7633	714 540-2476	312 232-4300	201 467-8020
TWX:	910 379-6446	910 596-1386	910 237-1685	710 983-4455

SB-57K
Printed in U.S.A.

NATIONAL® SCR HEAT EXCHANGER ASSEMBLIES

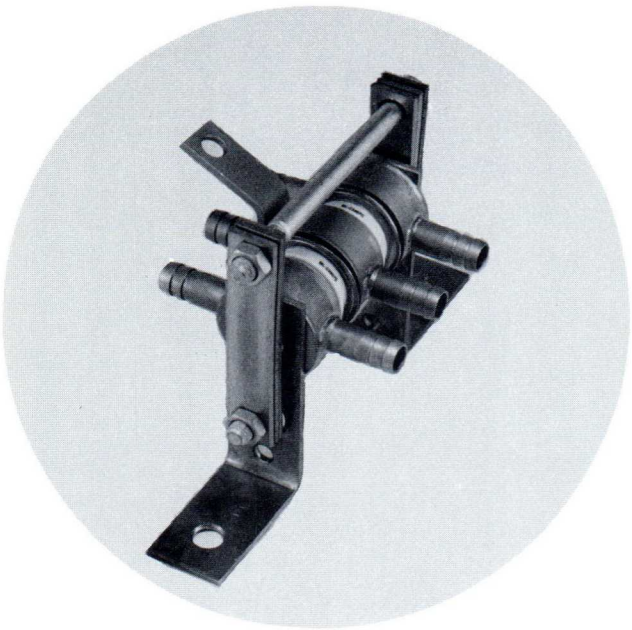


NATIONAL ELECTRONICS

a varian division

GENEVA, ILLINOIS 60134

HS-6 WATER COOLED HEAT EXCHANGER



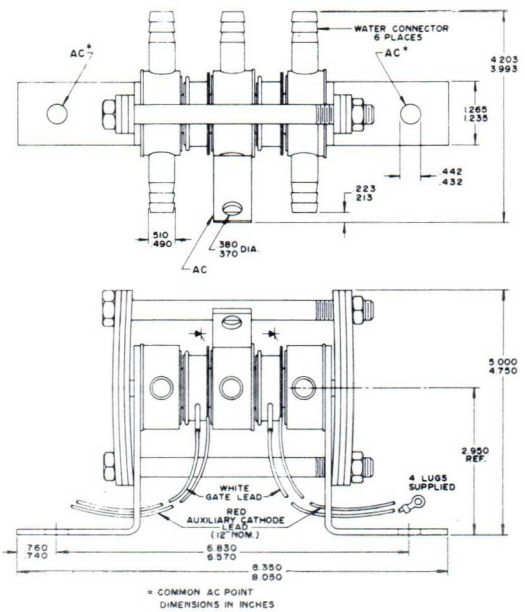
NL-C350 HS6 **250 Amps rms**
NL-C380 HS6 **535 Amps rms**

The HS-6 Water-Cooled Heat Exchanger is designed to efficiently cool a pair of NL-C350 or NL-C380 SCR'S mounted in inverse parallel.

MAXIMUM ALLOWABLE RATINGS*

	NL-C350	NL-C380
Maximum Off-State and Reverse Blocking Voltage	1300 volts	1300 volts
Switch RMS Current (100% Duty, Sinusoidal Waveform)	250 amps	535 amps
Peak One-Cycle On-State Surge Current, I_{TSM}	1800 amps	3500 amps
Maximum SCR Junction Operating Temperature	← 125°C →	
Maximum Water Temperature	← 40°C →	
Steady State Thermal Impedance-SCR junction to water, 180° conduction, Single phase, 1.2 GPM water flow rate	.18°C/watt	.135°C/watt

FIGURE 1. OUTLINE DRAWING



* For detailed information on individual SCR characteristics consult NL-C350 or NL-C380 data sheet.

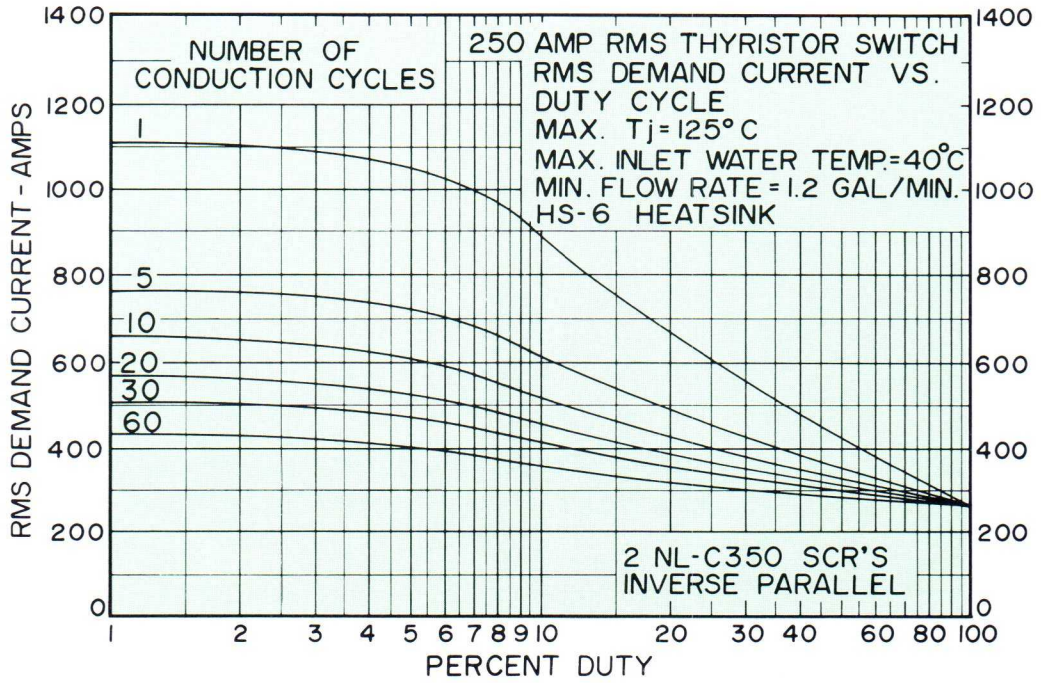


FIGURE 2. WELDER RATING CURVES – NL-C350 HS6

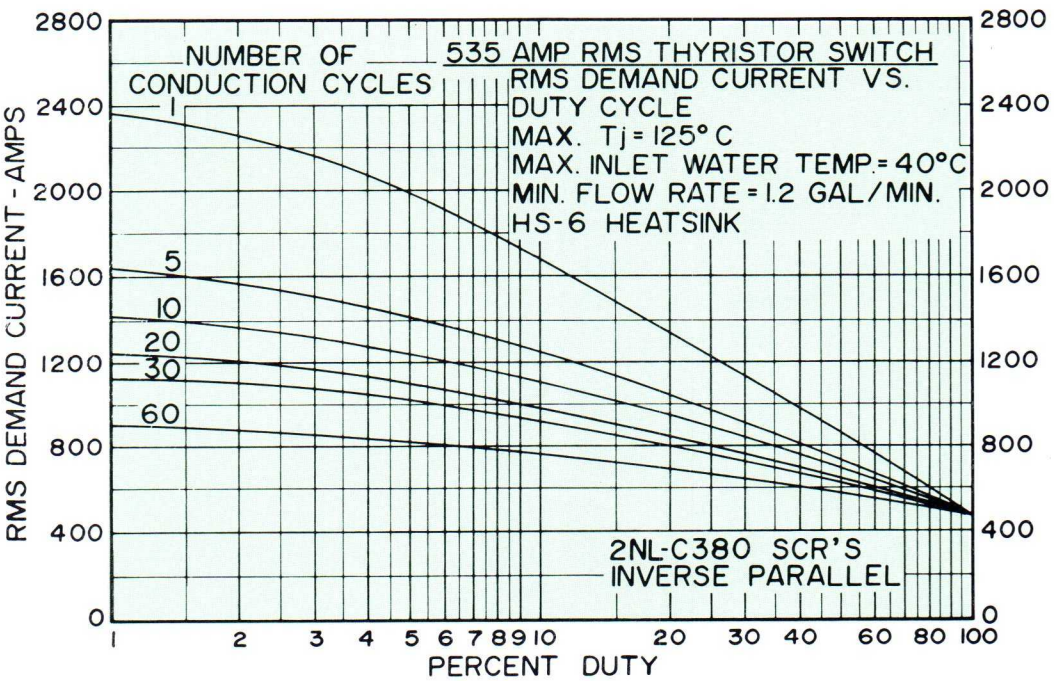
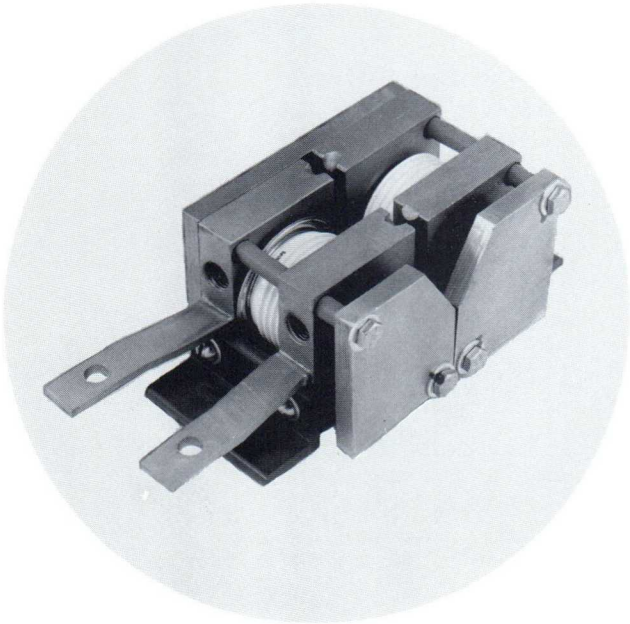


FIGURE 3. WELDER RATING CURVES – NL-C380 HS6

HS-7 WATER COOLED HEAT EXCHANGER

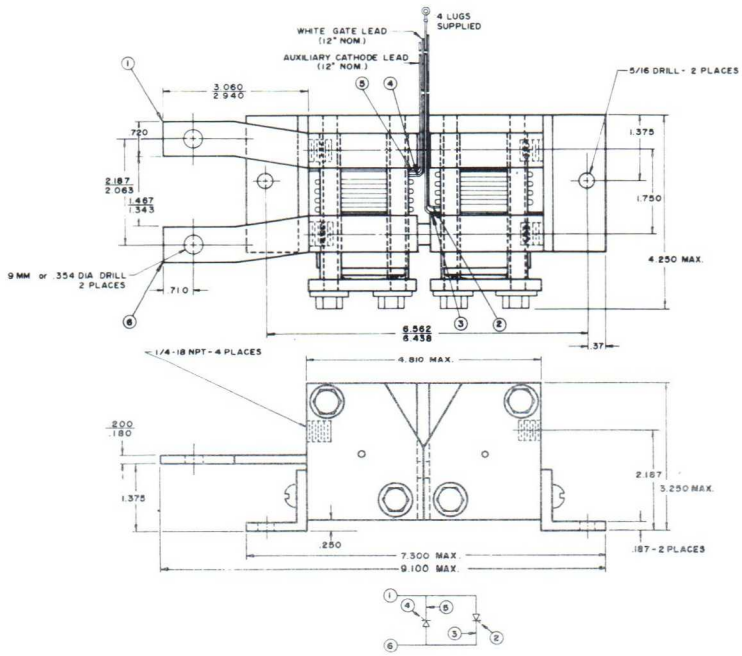


NL-1580 HS7 **880 Amps rms**
NL-C501 HS7 **1200 Amps rms**

The HS-7 Water-Cooled Heat Exchanger is designed to efficiently cool a pair of NL-1580 or NL-C501 SCR'S mounted in inverse parallel.

MAXIMUM ALLOWABLE RATINGS*	NL-1580	NL-C501
Maximum Off-state and Reverse Blocking Voltage	1700 volts	1700 volts
Switch RMS Current (100% Duty, Sinusoidal Waveform)	880 amps	1200 amps
Peak One-cycle On-state Surge Current, I_{TSM}	5500 amps	8000 amps
Maximum SCR Junction Operating Temperature	← 125°C →	
Maximum Water Temperature	← 40°C →	
Steady State Thermal Impedance-SCR junction to water, 180° conduction, Single-phase, 1.2 GPM water flow rate	← .10°C/watt →	

FIGURE 4. OUTLINE DRAWING



*For detailed information on individual SCR characteristics consult NL-1580 or NL-C501 data sheet.

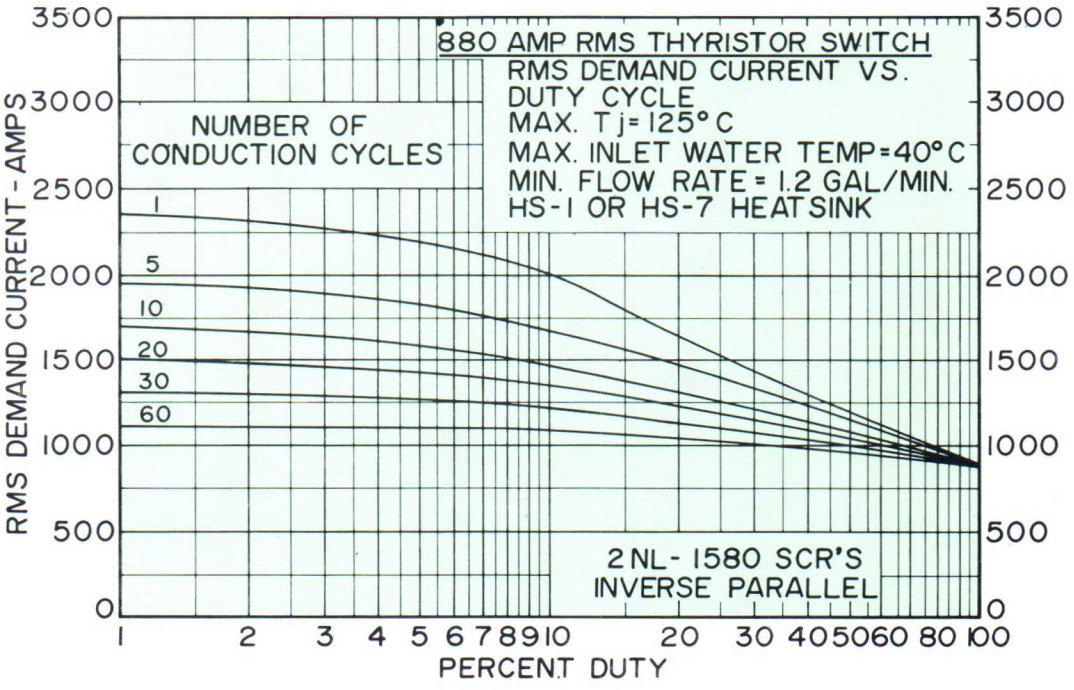


FIGURE 5. WELDER RATING CURVES – NL-1580 HS7

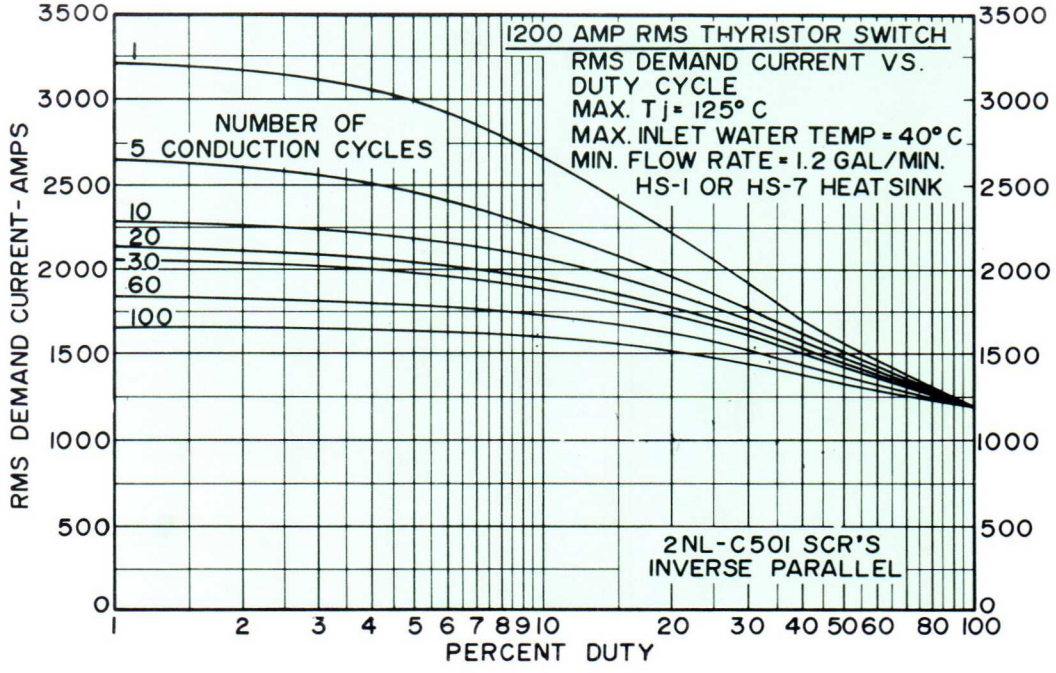
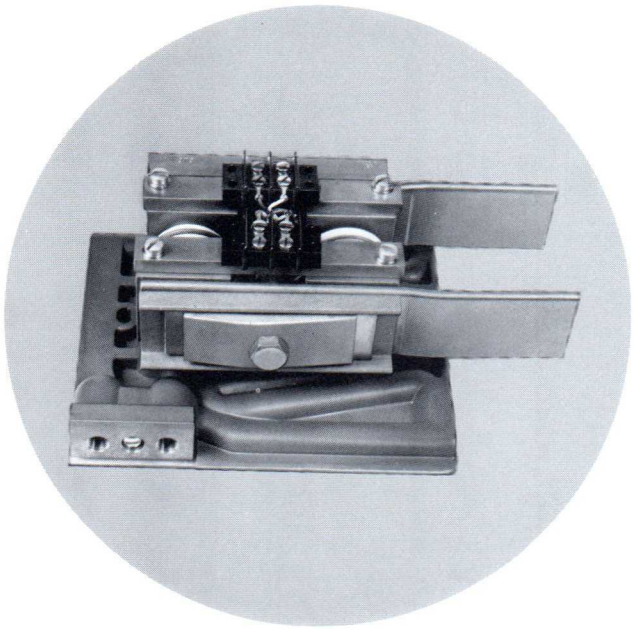


FIGURE 6. WELDER RATING CURVES – NL-C501 HS7

HS-1 WATER COOLED HEAT EXCHANGER



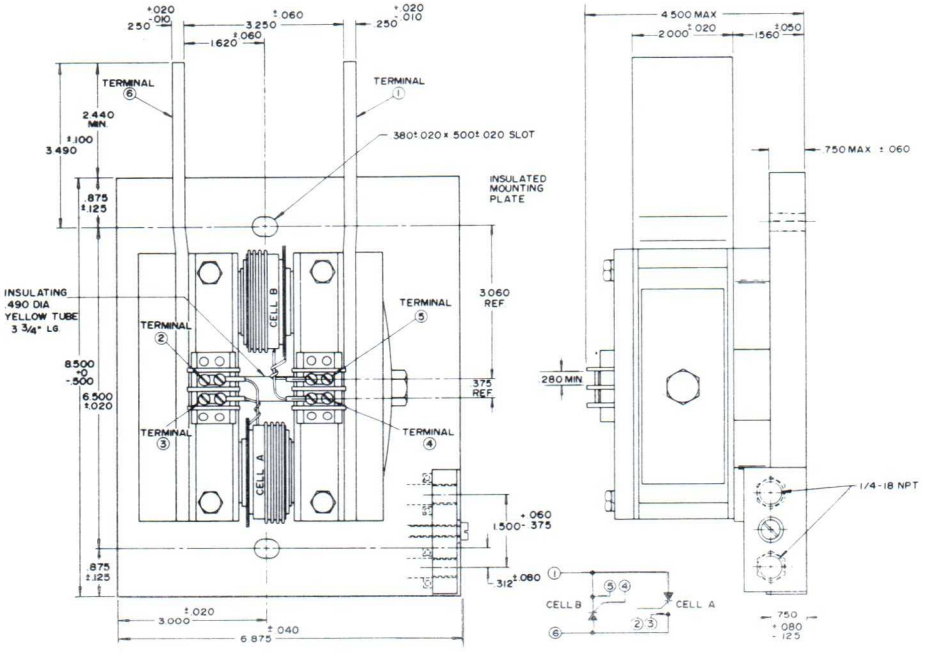
NL-1580 HS1 **880 Amps rms**
NL-C501 HS1 **1200 Amps rms**

The HS-1 Water-Cooled Heat Exchanger is designed to efficiently cool a pair of NL-1580 or NL-C501 SCR'S mounted in inverse parallel. The HS-1 is also available with the power tangs rotated 180° on the manifold.††

MAXIMUM ALLOWABLE RATINGS*

	NL-1580	NL-C501
Maximum Off-state and Reverse Blocking Voltage	1700 volts	1700 volts
Switch RMS Current (100% Duty, Sinusoidal Waveform)	880 amps	1200 amps
Peak One-Cycle On-State Surge Current, I_{TSM}	5500 amps	8000 amps
Maximum SCR Junction Operating Temperature	← 125°C →	
Maximum Water Temperature	← 40°C →	
Steady State Thermal Impedance-SCR junction to water, 180° conduction, Single phase, 1.2 GPM water flow rate	← .10°C/watt →	

FIGURE 7. OUTLINE DRAWING



*For detailed information on SCR characteristics consult NL-1580 or NL-C501 data sheet.

†† Order NL-1580 HS26 or NL-C501 HS26

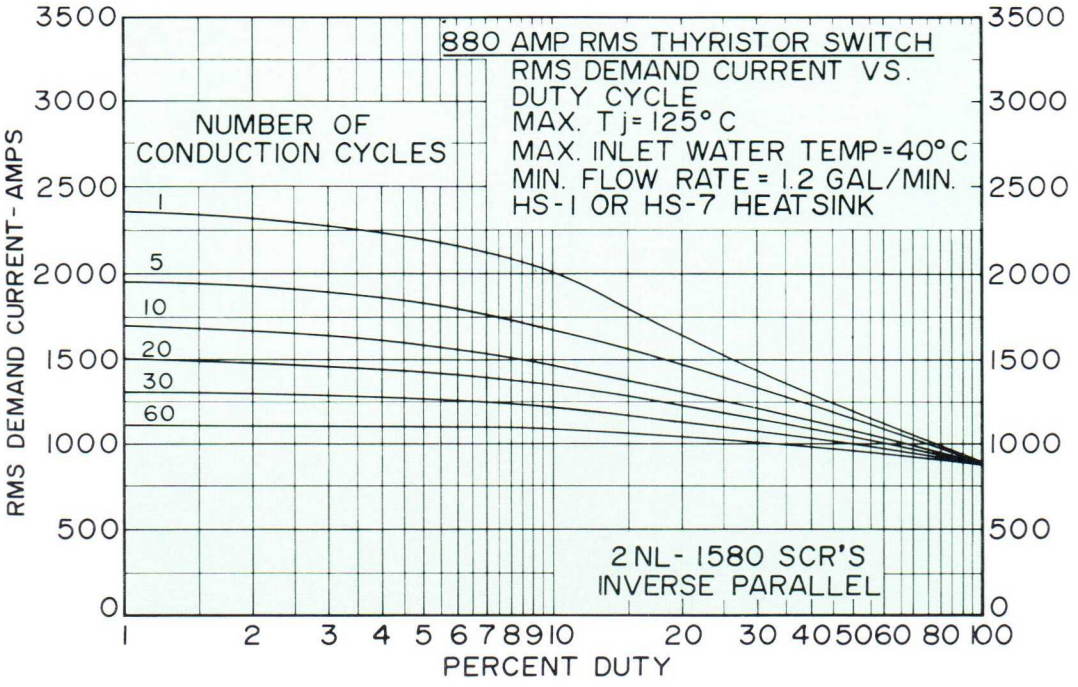


FIGURE 8. WELDER RATING CURVES – NL-1580 HS1

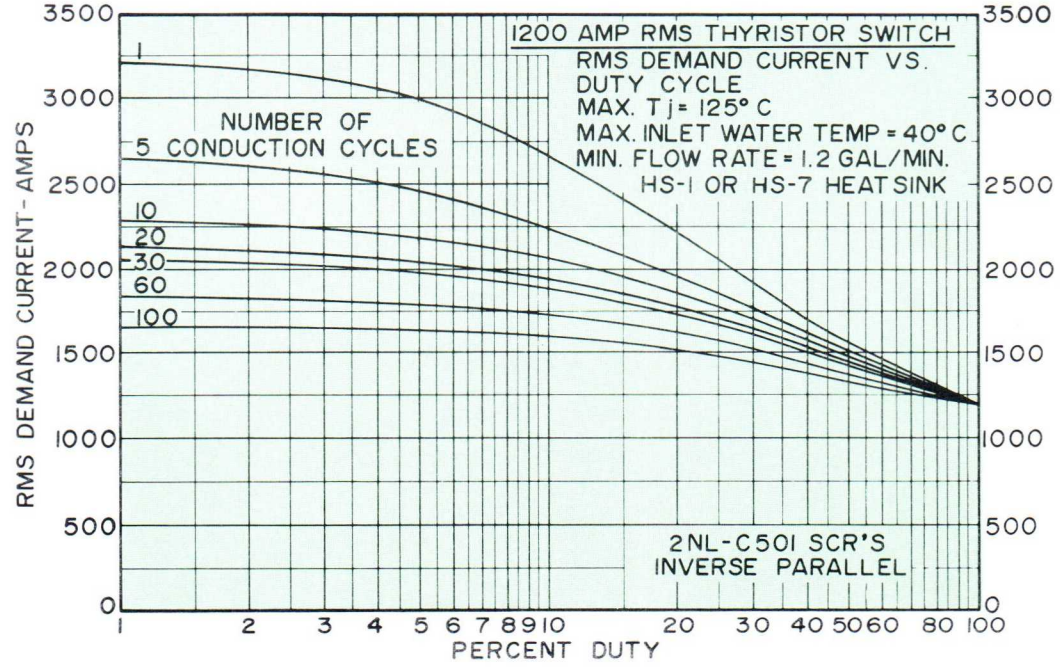
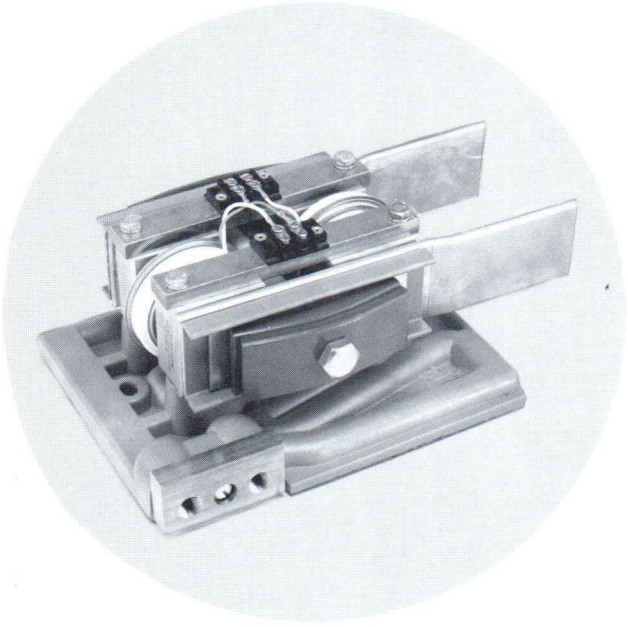


FIGURE 9. WELDER RATING CURVES – NL-C501 HS1

HS-27 WATER COOLED HEAT EXCHANGER



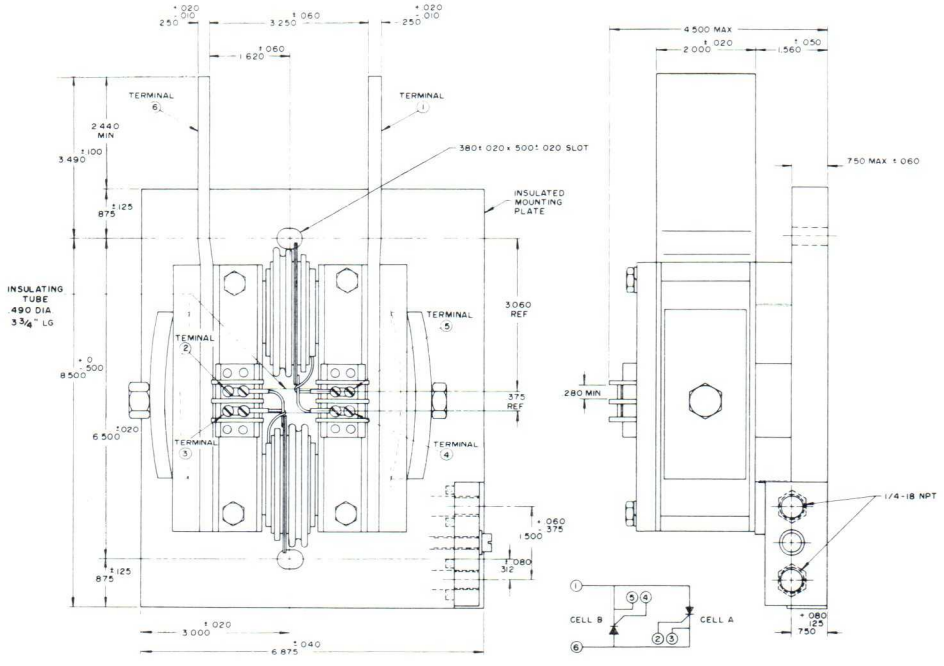
NL-C601 HS-27	1600 Amps rms
NL-C602 HS-27	1300 Amps rms
NL-F701 HS-27	2000 Amps rms

The HS-27 Heat Exchanger is designed to efficiently cool a pair of NL-C601, NL-C602, or NL-F701 SCR'S mounted in inverse parallel. The HS-27 is also available with the power tangs rotated 180° on the manifold.††

MAXIMUM ALLOWABLE RATINGS*

	NL-C601	NL-C602	NL-F701
Maximum Off-state and Reverse Blocking Voltage	1700 volts	2500 volts	1700 volts
Switch RMS Current (100% Duty, Sinusoidal Waveform)	1600 amps	1300 amps	2000 amps
Peak One-cycle On-state Surge Current, I_{TSM}	11,000 amps	10,000 amps	18,000 amps
Maximum SCR Junction Operating Temperature	← 125°C →		
Maximum Water Temperature	← 40°C →		
Steady-state Thermal Impedance-SCR junction to water, 180° conduction, Single phase, 1.2 GPM water flow rate	.08°C/watt	.08°C/watt	.07°C/watt

FIGURE 10. OUTLINE DRAWING



*For detailed information on SCR characteristics consult NL-C601, NL-C602 or NL-F701 data sheet.

††Order NL-C601 HS-28, NL-C602 HS-28, or NL-F701 HS-28

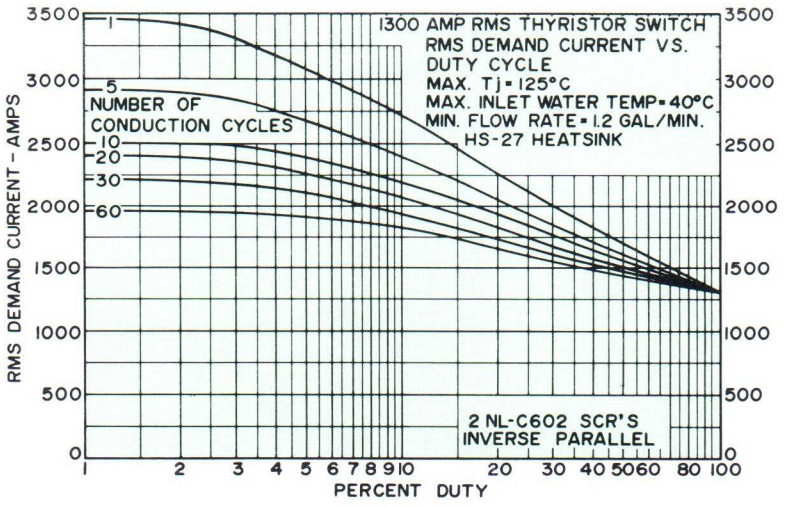


FIGURE 11 - WELDER RATING CURVES — NL-C602 HS-27

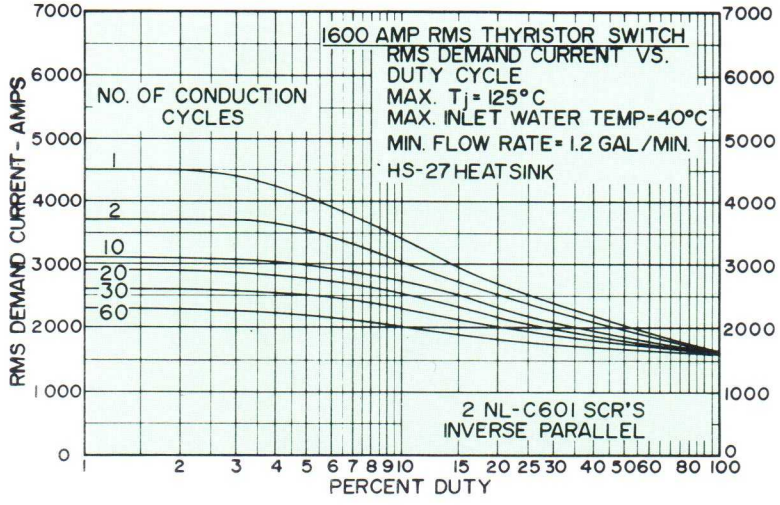


FIGURE 12 - WELDER RATING CURVES — NL-C601 HS-27

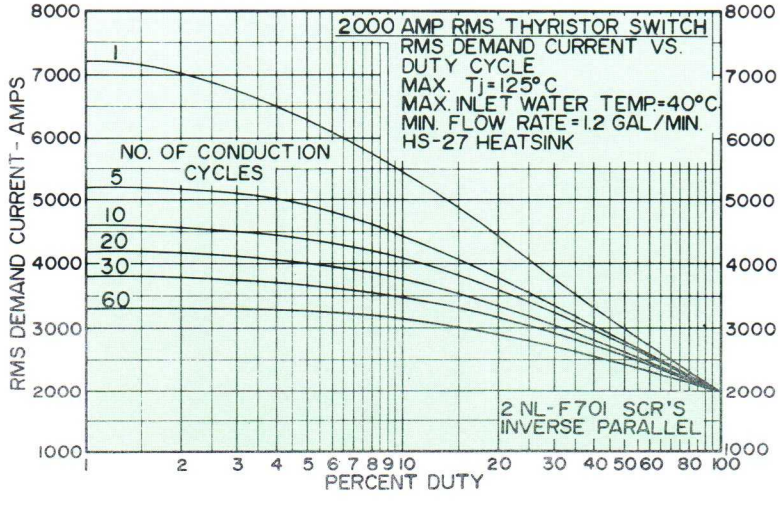


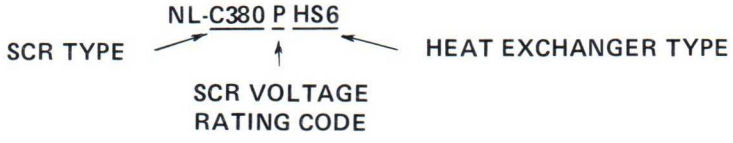
FIGURE 13 - WELDER RATING CURVES — NL-F701 HS-27

HEAT EXCHANGER ORDERING GUIDE

		HS6		HS7		HS1		HS27		
V_{DRM} V_{RRM}	VOLT. CODE	NL C350-HS6	NL C380-HS6	NL 1580-HS7	NL C501-HS7	NL 1580-HS1	NL C501-HS1	NL C601-HS27	NL C602-HS27	NL F701-HS27
500	E	X	X							X
600	M	X	X							X
700	S	X	X	X	X	X	X			X
800	N	X	X	X	X	X	X	X		X
900	T	X	X	X	X	X	X	X		X
1000	P	X	X	X	X	X	X	X		X
1100	PA	X	X	X	X	X	X	X		X
1200	PB	X	X	X	X	X	X	X		X
1300	PC	X	X	X	X	X	X	X		X
1400	PD			X	X	X	X	X		X
1500	PE			X	X	X	X	X		X
1600	PM			X	X	X	X	X		X
1700	PS			X	X	X	X	X	X	X
1800	PN								X	
1900	PT								X	
2000	L								X	
2100	LA								X	
2200	LB								X	
2300	LC								X	
2400	LD								X	
2500	LE								X	

X - INDICATES THAT EXCHANGER IS AVAILABLE WITH SCR'S MEETING THIS VOLTAGE RATING.

EXAMPLE: To order an HS6 Heat Exchanger with NL-C380 SCR'S rated at 1000 volts, specify:



MOUNTING AND HANDLING INSTRUCTIONS

1. Inspect the heat exchanger and its manifold base (NL-HS1 and NL-HS27) to make certain water passageways are unobstructed and that no damage has occured during shipping.

2. In order to avoid feeding heat back into the SCR'S from the power tangs, a good low-resistance electrical connection should be made to the power tangs.

3. Use a sealing agent on water pipe connections to limit the torque needed to get a good fit.

4. Take the following precautions to avoid distorting the plastic manifold. (NL-HS1 and NL-HS27)

   a) The mounting surface is to be flat within 0.030".
   b) Maximum torque for bolts holding the exchanger to the equipment.

1/4" bolts	8ft.-lbs. max
5/16" bolts	15ft.-lbs. max.

   c) Use flat washers between the bolts and the plastic base.

5. Do not ship heat exchangers without first removing any remaining water from the passageways by blowing air through the passageways at a maximum pressure of 40 PSI. This must be done to prevent damage to the heat sink from freezing water.

WATER QUALITY

Tap water should meet the following requirements:

a) Slightly alkaline pH 7.0 to 9.0
b) Resistivity greater than 2000 ohm-cm. at 25°C
c) Chloride content less than 20 parts per million, sulphate content less than 250 parts per million, total solids content less than 100 parts per million.
d) Total hardness as calcium carbonate less than 250 parts per million.

HIGH HUMIDITY OPERATION

Operating a water-cooled exchanger in a high humidity environment frequently causes moisture to condense on the surfaces of copper cooling blocks and on the ceramic surfaces of the SCR'S providing a short circuit path across the SCR'S which may lead to catastrophic failure of the SCR'S. The most effective way to eliminate this problem is to keep the temperature of the cooling water above the prevailing due point.

National Electronics DOES NOT recommend the use of water-proofing sprays and varnishes on the SCR surfaces. National Electronics WILL NOT honor warranty claims for SCR'S and/or heat exchangers which have been treated in this manner.

DISASSEMBLY OF HEAT EXCHANGERS

Should a malfunction or failure involving an exchanger occur, DO NOT attempt to replace suspected faulty SCR'S in the field. For warranty consideration, refer to National Electronics Standard Terms and Conditions of Sale (SB-79), available on request.

National Electronics WILL NOT honor warranty claims for exchangers which have been disassembled by a customer.

SALES OFFICES

	4940 El Camino Real Los Altos, Calif. 94022	4341 Birch St., Suite 201 Newport Beach, Calif. 92660	Keslinger Road Geneva, Ill. 60134	25 Route 22 Springfield, N.J. 07081
Telephone:	415 968-7633	714 540-2476	312 232-4300	201 467-8020
TWX:	910 379-6446	910 596-1386	910 237-1685	710 983-4455

SB-83A
Printed in U.S.A.