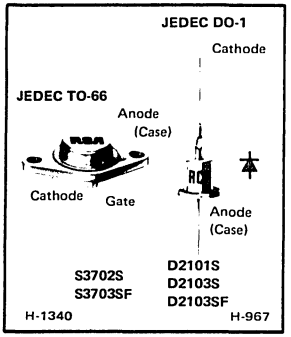
RCA
Solid State
Division

Thyristors/Rectifiers
S3702S D2101S
S3703SF D2103S
D2103SF



SCR's and Rectifiers for Horizontal-Deflection Circuits

For 110° Large-Screen Color TV

Features:

- Operation from supply voltages between 150 and 270 V (nominal)
- Ability to handle high beam current; average 1.6 mA dc
- Ability to supply as much as 8 mJ of stored energy to the deflection yoke, which is sufficient for 29-mm-neck and 36.5-mm-neck picture tubes operated at 31 kV (nominal value)
- Highly reliable circuit which can also be used as a low-voltage power supply

Package \ Voltage	700 V Types	750 V Types
TO-66	S3702S (40889)	S3703SF (40888)
DO-1	D2101S D2103S (40892) (40891)	D2103SF (40890)

Numbers in parentheses are former RCA type numbers.

These RCA types are designed for use in a horizontal output circuit such as that shown in Fig. 1.

The S3703SF silicon controlled rectifier and the D2103SF silicon rectifier are designed to act as a bipolar switch that controls horizontal yoke current during the beam trace interval. The S3702S silicon controlled rectifier and the D2103S silicon rectifier act as the commutating switch to initiate trace-retrace switching and control yoke current during retrace.

The D2101S silicon rectifier may be used as a clamp to protect the circuit components from excessively high transient voltages which may be generated as a result of arcing in the picture tube or in a high-voltage rectifier tube.

To facilitate direct connection across each silicon controlled rectifier, S3702S and S3703SF, the anode connections of silicon rectifiers D2103S and D2103SF are reversed as compared to that of a normal power-supply rectifier diode.

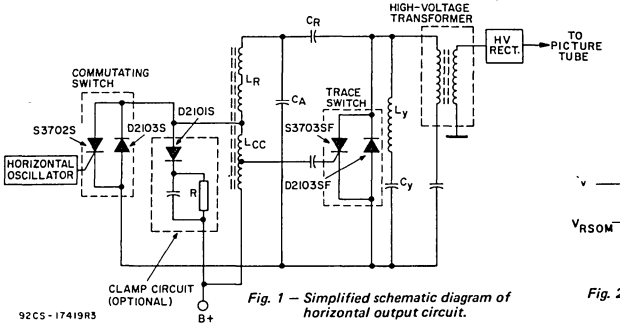


Fig. 1 — Simplified schematic diagram of horizontal output circuit.

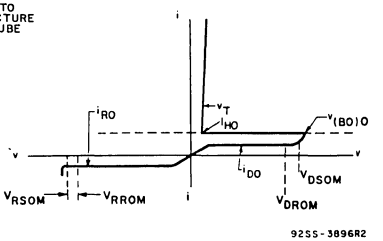


Fig. 2 — Principal voltage-current characteristic for S3702S and S3703SF.

SILICON CONTROLLED RECTIFIERS

MAXIMUM RATINGS, *Absolute-Maximum Values:*

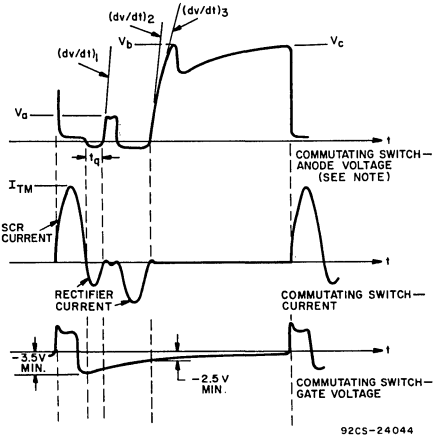
		S3703SF TRACE SCR	S3702S COMMUTATING SCR	
NON-REPETITIVE PEAK OFF-STATE VOLTAGE:*				
Gate Open	V_{DSOM}	800*	750*	V
REPETITIVE PEAK REVERSE VOLTAGE:*				
Gate Open	V_{RROM}	25	25	V
REPETITIVE PEAK OFF-STATE VOLTAGE:*				
Gate Open	V_{DROM}	750	700	V
ON-STATE CURRENT:				
T_C = 60°C, 50 Hz sine wave, conduction angle = 180°:				
RMS	$I_{T(RMS)}$	5	5	A
Average DC	$I_{T(AV)}$	3.2	3.2	A
PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT:	I_{TSM}			
For one full cycle of applied principal voltage				
50 Hz (sinusoidal), T_C = 60°C		65	65	A
For one-half sine wave, 3 ms pulse width		130	130	A
RATE OF CHANGE OF ON-STATE CURRENT:				
$V_D = V_{DROM}$, I_{GT} = 50 mA, t_r = 0.1 μs	di/dt	200	200	A/μs
FUSING CURRENT (for SCR protection):				
T_J = −40 to 80°C, t = 1 to 10 ms	I^2t	20	20	A^2s
GATE POWER DISSIPATION:■	P_{GM}			
Peak (forward or reverse) for 10 μs duration, max.				
negative gate bias = −35 V (S3703SF)		25	–	W
= −10 V (S3702S)		–	25	W
TEMPERATURE RANGE:▲				
Storage	T_{stg}	−40 to 150	−40 to 150	°C
Operating (Case)	T_C	−40 to 80	−40 to 80	°C
PIN TEMPERATURE (During soldering):				
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	T_P	225	225	°C

*Protection against transients induced by arcing or other causes must be provided.

•These values do not apply if there is a positive gate signal. Gate must be open or negatively biased.

■Any product of gate current and gate voltage which results in a gate power less than the maximum is permitted, provided that the maximum reverse gate bias (as specified) is not exceeded.

▲For temperature measurement reference point, see Dimensional Outline.



NOTE: "Commutating Switch-Anode Voltage" oscilloscope display has been modified graphically to enhance the measurement points of dv/dt.

I_{TM} = 15 A, V_a = 180 V max., V_b = 500 V max., $V_c = V_{DROM}$. Gate voltage = 12 V positive from 15 V supply. Gate current should rise to 100 mA within 0.2 μs. Minimum duration of gate current pulse = 3 μs. Minimum amplitude of gate current pulse = 200 mA. Negative gate bias at turn-off = −3.5 V minimum, negative gate bias at 2nd reapplied voltage $(dv/dt)_2$ = −2.5 V minimum.

$(dv/dt)_1$ = 400 V/μs (measured tangent to waveform from 0 to 0.8 of V_a)
$(dv/dt)_2$ = 1000 V/μs (measured tangent to waveform from 0 to 0.3 of V_b)
$(dv/dt)_3$ = 700 V/μs (measured tangent to waveform from 0 to 0.8 of V_b)

Fig. 3 — Oscilloscope display of commutating switching (S3702S) showing circuit-commutated turn-off time (tq).

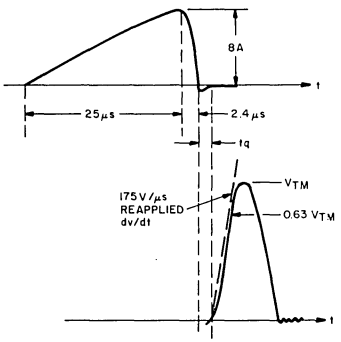
SILICON CONTROLLED RECTIFIERS

ELECTRICAL CHARACTERISTICS

At Maximum Ratings Unless Otherwise Specified and at Indicated Case Temperature (T_C)

CHARACTERISTIC	SYMBOL	LIMITS				UNITS
		S3703SF TRACE SCR		S3702S COMMUTATING SCR		
		TYP.	MAX.	TYP.	MAX.	
Peak Forward Off-State Current: Gate open, $V_D = V_{DROM}$ $T_C = 85°C$ . .	I_{DOM}	0.5	1.5	0.5	1.5	mA
Instantaneous On-State Voltage: i_T = 30 A (peak), $T_C = 25°C$	v_T	2.2	3	2.2	3	V
Critical Rate of Rise of Off-State Voltage: $V_D = V_{DROM}$, exponential voltage rise, Gate open, $T_C = 70°C$ (See Fig.3)	dv/dt	–	–	700 (min.) $(dv/dt)_3$		V/μs
DC Gate Trigger Current: V_D = 12 V (dc), R_L = 30 Ω, $T_C = 25°C$	I_{GT}	15	32	15	45	mA
DC Gate Trigger Voltage: V_D = 12 V (dc), R_L = 30 Ω, $T_C = 25°C$	V_{GT}	1.8	4	1.8	4	V
Circuit Commutated Turn-Off Time:♦ $T_C = 70°C$, minimum negative gate bias during turn-off time = −20 V (S3703SF) and −2.5 V (S3702S), rate of reapplied voltage (dv/dt)						
= 175 V/μs (See Fig. 4)	t_q	–	2.4	–	–	μs
= 400 V/μs (See Fig. 3		–	–	–	4.2	μs
Thermal Resistance, Junction-to-Case . . .	$R_{\theta JC}$	–	4	–	4	°C/W

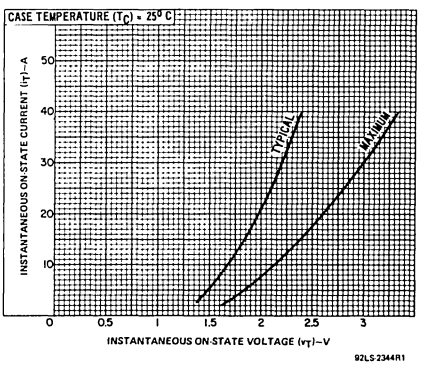
♦This parameter, the sum of reverse recovery time and gate recovery time, is measured from the zero crossing of current to the start of the reapplied voltage. Knowledge of the current, the reapplied voltage, and the case temperature is necessary when measuring t_q. In the worst conditions (high line, zero-beam, off-frequency, minimum auxiliary load, etc.), turn-off time must not fall below the given values. Turn-off time increases with temperature; therefore, case temperature must not exceed 70°C. See Figs. 3 and 4.



I_{TM} = 8 A, $V_{TM} = V_{DROM}$, reapplied dv/dt = 175 V/μs (measured from 0 to 0.63 of V_{TM}), negative gate voltage source = −24 V, source impedance = 15 Ω.

92CS-24045

Fig. 4 — Oscilloscope display of trace switching (S3703SF) showing circuit-commutating turn-off time (tq).



92LS-2344R1

Fig. 5 — Instantaneous on-state current vs. on-state voltage for S3702S and S3703SF.

SILICON RECTIFIERS

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		D2103SF TRACE	D2103S COMMUTATING	D2101S CLAMP	
REVERSE VOLTAGE:**					
Repetitive Peak	V_{RRM}	750	700	700	V
Non-Repetitive Peak●●	V_{RSM}	800	800	800	V
FORWARD CURRENT (operating in 15 kHz deflection circuit):					
RMS	$I_{F(RMS)}$	3■■	3■■	1**	A
Peak Surge (Non-Repetitive)●●	I_{FSM}	70♦♦	70♦♦	30♦♦	A
Peak (Repetitive)	I_{FRM}	7	12	0.5	A
TEMPERATURE RANGE					
Storage	T_{stg}	−30 to 150			°C
Operating (Case)	T_C	−30 to 80			°C
LEAD TEMPERATURE (During Soldering):▲▲					
For 10 s maximum	T_L	225			°C

** For ambient temperatures up to 45°C.

●● For a maximum of 3 pulses, each less than 10 μs duration, during any 64-μs period.

■■ Maximum current rating applies only if the rectifier is properly mounted to maintain junction temperature below 150°C. See Fig.15 and Fig.16.

▲▲ At distances no closer to rectifier body than points A and B on outline drawing.

♦♦ See Fig. 9 for I_{FSM} value for 60 Hz.

SILICON RECTIFIERS

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	SYMBOL	LIMITS		UNITS
		D2103SF TRACE D2103S COMMUT.	D2101S CLAMP	
		MAXIMUM	MAXIMUM	
Reverse Current:				
Static				
For V_{RRM} = max. rated value, $I_F = 0$, $T_C = 25°C$	I_{RM}	10	10	μA
For V_R = 500 V, $T_C = 100°C$		250	250	
Instantaneous Forward Voltage Drop:				
At i_F = 4 A, $T_A = 25°C$	v_F	1.4	1.5	V
Reverse Recovery Time:				
For circuit shown in Fig. 8:				
At I_{FM} = 3.14 A, $-di_F/dt = -10$ A/μs, pulse duration = 0.94 μs, $T_C = 25°C$	t_{rr}	0.5	0.7	μs
In Tektronix type "S" plug-in unit (or equivalent):				
At I_F = 20 mA, I_R = 1 mA $T_C = 25°C$		1	1.5	
Peak Forward Voltage Drop (at turn-on):				
In Tektronic type "S" plug-in unit (or equivalent):				
At I_F = 20 mA, $T_C = 25°C$	$V_{F(pk)}$	5	6	V
Thermal Resistance (Junction-to-Case)♦	$R_{\theta JC}$	10	10	°C/W

♦ Measured at point as indicated on Dimensional Outline.

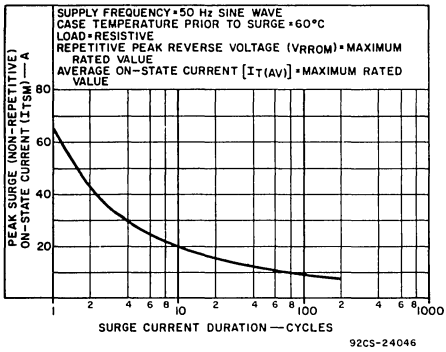


Fig. 6 — Peak surge on-state current vs. surge current duration for S3702S and S3703SF.

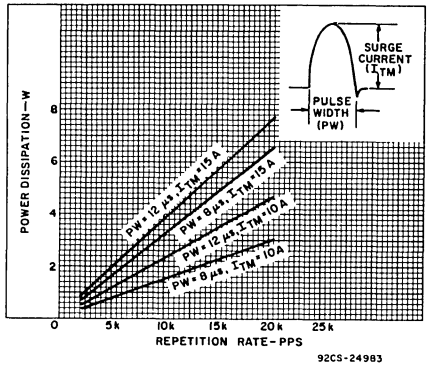


Fig. 7—Dissipation vs. repetition rate for S3702S and S3703SF

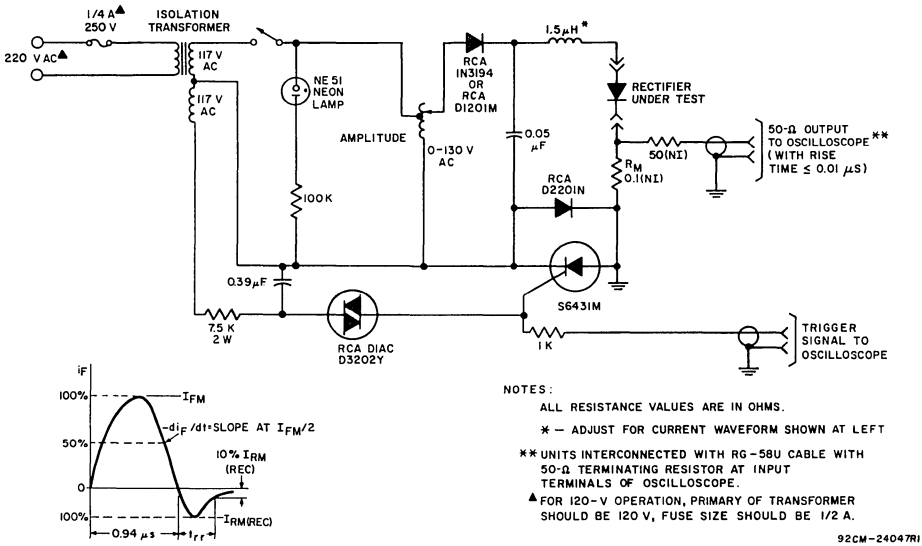


Fig. 8 — Oscilloscope display and test circuit for measurement of reverse-recovery time for D2101S, D2103S, and D2103SF.

TERMINAL CONNECTIONS FOR TYPES S3702S AND S3703SF

Pin 1 — Gate
Pin 2 — Cathode
Case, Mounting Flange — Anode

TERMINAL CONNECTIONS FOR TYPES D2101S, D2103S, AND D2103SF

Case, Lead No. 1 — Anode
Lead No. 2 — Cathode

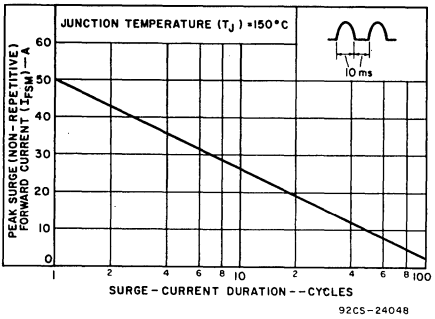


Fig. 9 – Peak surge (non-repetitive) forward current vs. surge-current duration for D2101S, D2103S, and D2103SF.

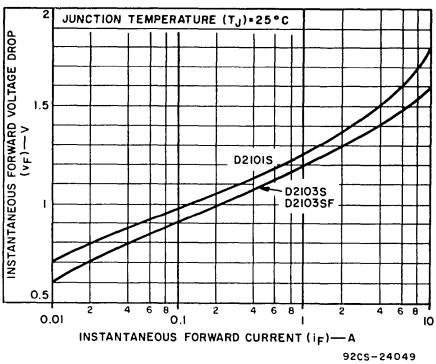


Fig. 10 – Forward-voltage drop vs. forward current for D2101S, D2103S, and D2103SF.

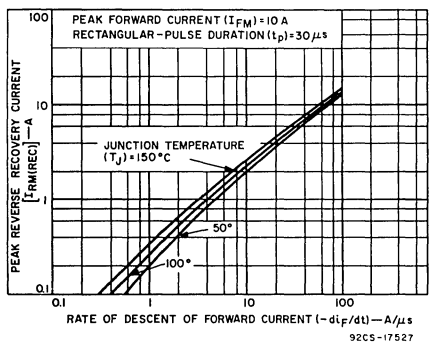


Fig. 11—Typical peak reverse recovery current vs. rate of descent of forward current for D2101S, D2103S, and D2103SF.

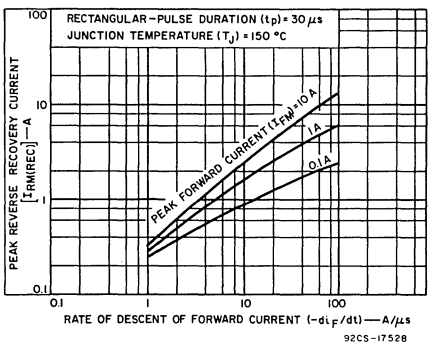


Fig. 12—Typical peak reverse recovery current vs. rate of descent of forward current for D2101S, D2103S, and D2103SF.

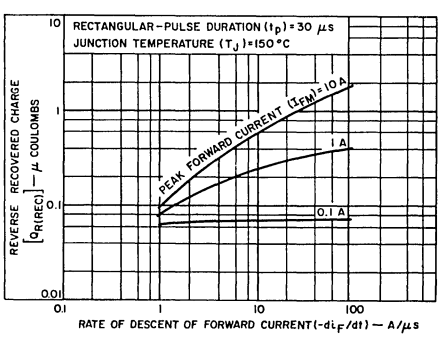


Fig. 13—Typical reverse recovered charge vs. rate of descent of forward current for D2101S, D2103S, and D2103SF.