

3875081 G E SOLID STATE  
Silicon Controlled Rectifiers

01E 17678 D T-25-17

2N3654, 2N3655, 2N3656, 2N3657, 2N3658, S7412M

File Number 724

### 35-A Silicon Controlled Rectifiers

For Inverter Applications

**Features:**

- Fast turn-off time — 10  $\mu$ s max.
- High di/dt and dv/dt capability
- Low thermal resistance

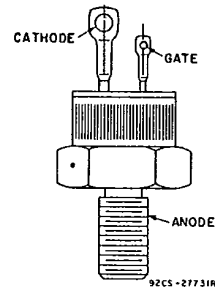
RCA-2N3654 to 2N3658, inclusive, and the S7412M\* are all-diffused silicon controlled rectifiers (reverse-blocking triode thyristors) intended for high-speed switching applications such as power inverters, switching regulators, and high-current pulse applications. They feature fast turn-off, high dv/dt, and high di/dt characteristics and may be used at frequencies up to 25 kHz.

The 2N3654 to 2N3658 have forward and reverse off-state voltage ratings of 50, 100, 200, 300, and 400 volts, respectively. Type S7412M has a forward and reverse off-state voltage rating of 600 volts.

These SCR's employ a hermetic JEDEC TO-208AA package.

\*Formerly RCA Type No. S7432M.

**TERMINAL DESIGNATIONS**



JEDEC TO-208AA

PDF Support

**MAXIMUM RATINGS, Absolute-Maximum Values:**

	2N3654	2N3655	2N3656	2N3657	2N3658	S7412M	
*V <sub>RSOM</sub> †	75	150	300	400	500	700	V
V <sub>DSOM</sub> †	75	150	300	400	500	700	V
*V <sub>RRM</sub> †	50	100	200	300	400	600	V
V <sub>DRM</sub> †	50	100	200	300	400	600	V
I <sub>T(RMS)</sub> (T <sub>C</sub> = 40°C, $\theta$ = 180°)				35			A
I <sub>T(AV)</sub> (T <sub>C</sub> = 40°C, $\theta$ = 180°)				25			A
*I <sub>TSM</sub> : For one full cycle of applied principal voltage 60-Hz (Rectangular wave-pw = 5 ms, t <sub>r</sub> = 50 $\mu$ s), T <sub>C</sub> = 40°C				180			A
*di/dt:							A
V <sub>D</sub> = V <sub>DRM</sub> , I <sub>GT</sub> = 200 mA, t <sub>r</sub> = 0.1 $\mu$ s (See Fig. 15)				400			A/ $\mu$ s
I <sub>2t</sub> :				165			A2s
T <sub>J</sub> = -65 to 120°C, t = 1 to 8.3 ms				40			W
*P <sub>GM</sub> ‡: Peak (forward or reverse) for 10 $\mu$ s maximum, See Fig. 7)				1			W
*P <sub>G(AV)</sub> ‡: Averaging time = 10 ms maximum				-65 to 150			°C
*T <sub>stg</sub> *: Storage temperature				-65 to 120			°C
*T <sub>C</sub> *: Case temperature							°C
T <sub>r</sub> : Soldering temperature (terminal and case)				225			°C
$\tau_s$ : Recommended				35			in-lbf
Maximum (DO NOT EXCEED)				0.4			kgf-m
				50			in-lbf
				0.57			kgf-m

\* In accordance with JEDEC registration data format (JS-14, RDF-1) filed for the JEDEC (2N series) types.

† 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.

• For temperature measurement reference point, see Dimensional Outline.

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**ELECTRICAL CHARACTERISTICS**

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

CHARACTERISTIC	LIMITS			UNITS
	FOR ALL TYPES Except as Specified			
	MIN.	TYP.	MAX.	
$I_{DOM}$ or $I_{ROM}$ : $V_D = V_{DROM}$ or $V_R = V_{RROM}$ , $T_C = 120^\circ C$ 2N3654, 2N3655, 2N3656, S7412M ..... 2N3657 ..... 2N3658 .....	-	2	6*	mA
	-	2	5.5*	
	-	2	4*	
$v_T$ : $i_T = 25$ A (peak), $T_C = 25^\circ C$ .....	-	1.5	2.05*	V
$i_{HO}$ : $T_C = 25^\circ C$ ..... $T_C = -65^\circ C$ .....	-	75	150	mA
	-	150	350*	
* $dv/dt$ : $V_D = V_{DROM}$ , exponential voltage rise, $T_C = 120^\circ C$ (See Fig. 16) .....	200	-	-	V/ $\mu s$
$I_{GT}$ : $V_D = 6$ V (dc), $R_L = 4 \Omega$ , $T_C = 25^\circ C$ ..... $V_D = 6$ V (dc), $R_L = 2 \Omega$ , $T_C = -65^\circ C$ .....	-	80	180	mA
	-	150	500*	
$V_{GT}$ : $V_D = 6$ V (dc), $R_L = 4 \Omega$ , $T_C = 25^\circ C$ ..... * $V_D = 6$ V (dc), $R_L = 200 \Omega$ , $T_C = 120^\circ C$ ..... $V_D = 6$ V (dc), $R_L = 2 \Omega$ , $T_C = -65^\circ C$ .....	-	1.5	3	V
	0.25	-	-	
	-	2	4.5*	
* $t_q$ : Rectangular Pulse $V_{DX} = V_{DROM}$ , $i_T = 10$ A, pulse duration = 50 $\mu s$ , $dv/dt = 200$ V/ $\mu s$ , $-di/dt = 5$ A/ $\mu s$ , $I_{GT} = 200$ mA at turn-on, $V_{RX} = 15$ V minimum, $V_{GK} = 0$ V at turn-off, $T_C = 120^\circ C$ (See Figs. 17 & 18) .....	-	-	10	$\mu s$
Sinusoidal Pulse $V_{DX} = V_{DROM}$ , $i_T = 100$ A, pulse duration = 2 $\mu s$ , $dv/dt = 200$ V/ $\mu s$ , $V_{RX} = 30$ V minimum, $V_{GK} = 0$ at turn-off, $T_C = 115^\circ C$ (See Figs. 19 & 20) .....	-	-	10	
$R_{\theta JC}$ .....	-	0.85	1.7*	$^\circ C/W$

\* In accordance with JEDEC registration data format (JS-14, RDF-1) filed for the JEDEC (2N series) types.

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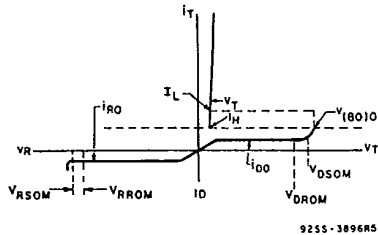


Fig. 1 - Principal voltage-current characteristic.

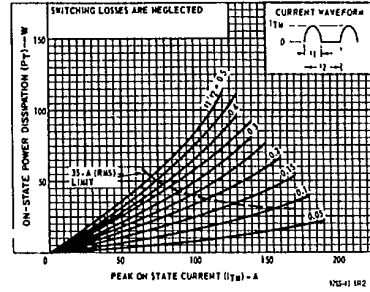


Fig. 2 - Power dissipation vs. peak on-state current.

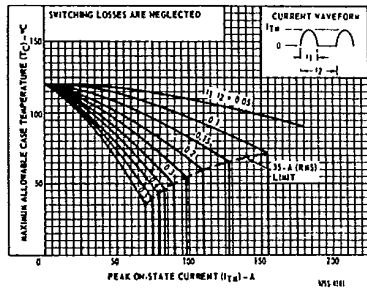


Fig. 3 - Maximum allowable case-temperature vs. peak on-state current.

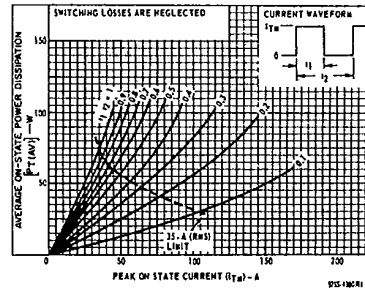


Fig. 4 - Power dissipation vs. peak on-state current.

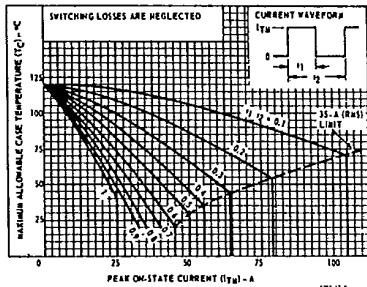


Fig. 5 - Maximum allowable case-temperature vs. peak on-state current.

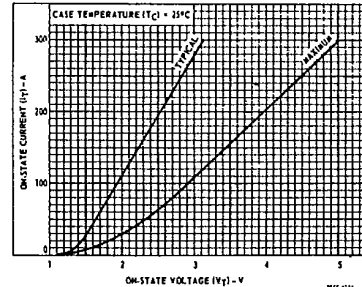


Fig. 6 - Variation of on-state with on-state voltage.

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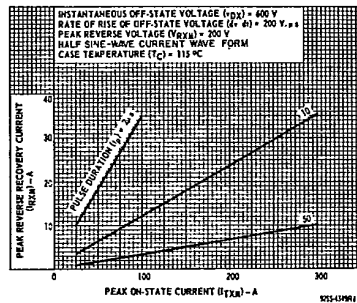


Fig. 7 — Typical variation of peak reverse-recovery current with peak on-state current (half-sine-wave pulse).

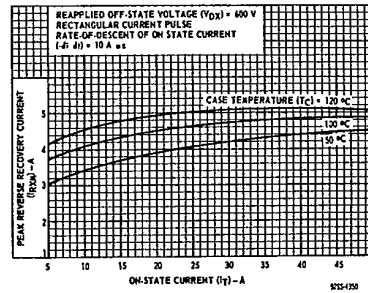


Fig. 8 — Typical variation of peak reverse-recovery current with on-state current (rectangular pulse).

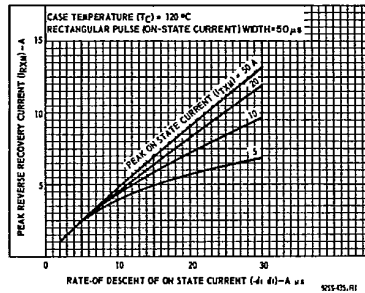


Fig. 9 — Typical variation of peak reverse-recovery current with rate-of-descent of on-state current (rectangular pulse).

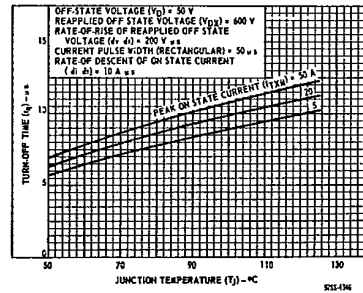


Fig. 10 — Typical variation of turn-off time with junction temperature (rectangular pulse).

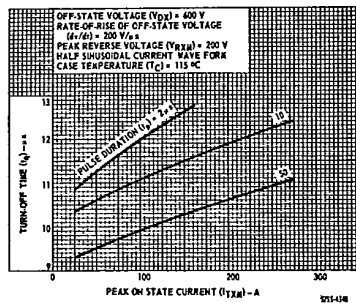


Fig. 11 — Typical variation of turn-off time with peak on-state current (half-sine-wave pulse).

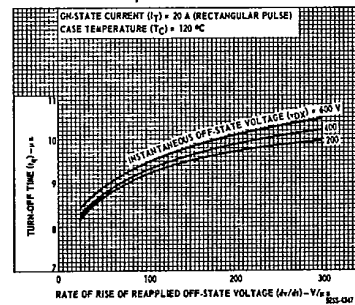


Fig. 12 — Typical variation of turn-off time with rate-of-rise of reapplied off-state voltage (rectangular pulse).

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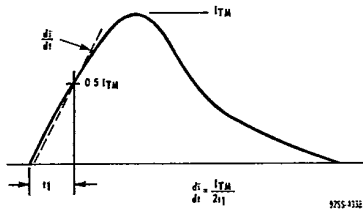


Fig. 13 — Rate-of-change of on-state current with time (defining  $di/dt$ ).

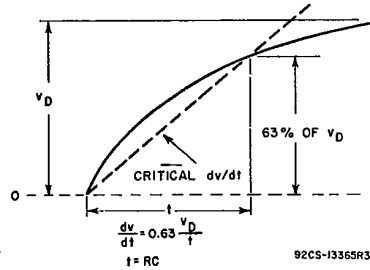


Fig. 14 — Rate-of-rise of off-state voltage with time (defining  $dv/dt$ ).

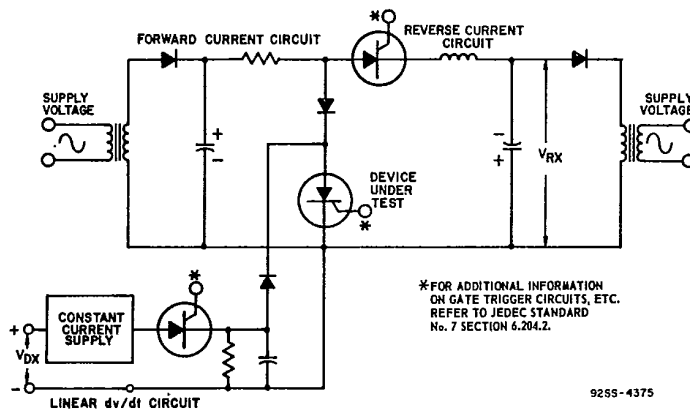


Fig. 15 — Circuit used to measure turn-off time ( $t_o$ ), rectangular pulse.

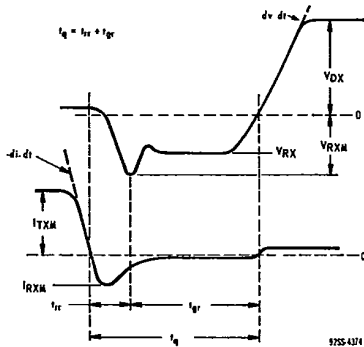


Fig. 16 — Relationship between off-state voltage, reverse voltage, on-state current, and reverse current showing reference points defining turn-off time ( $t_o$ ), rectangular pulse.

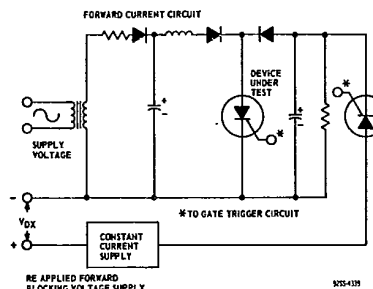


Fig. 17 — Circuit used to measure turn-off time ( $t_o$ ), half-sine-wave pulse.

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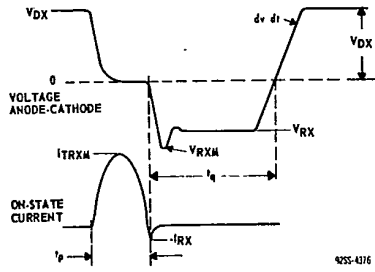


Fig. 18 — Relationship between off-state voltage, reverse voltage, on-state current, and reverse current showing reference points for specification of turn-off ( $t_a$ ), half-sine-wave pulse.

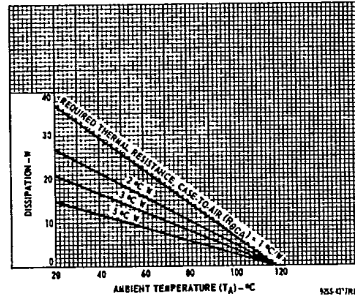


Fig. 19 — Heat sink guidance.