2N3650, 2N3651, 2N3652, 2N3653, S7410M

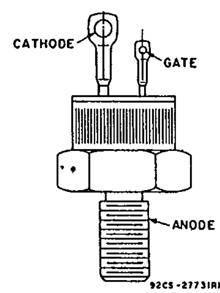
File Number **408**

35-A Silicon Controlled Rectifiers

For Inverter Applications

Features
- *Fast turn-off time — 15 μs max.*
- *High di/dt and dv/dt capabilities*
- *Low thermal resistance*

TERMINAL DESIGNATIONS



JEDEC TO-208AA

RCA-2N3650 to 2N3653, inclusive, and the S7410M* 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 2N3650 to 2N3653 have forward and reverse off-state voltage ratings of 100, 200, 300, and 400 volts, respectively. Type S7410M 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. S7430M.

MAXIMUM RATINGS, *Absolute-Maximum Values*

	2N3650	2N3651	2N3652	2N3653	S7410M	
*V_{RSOM}▲	150	300	400	500	700	V
V_{DSOM}▲	150	300	400	500	700	V
*V_{RROM}▲	100	200	300	400	600	V
*V_{DROM}▲	100	200	300	400	600	V
$I_{T(RMS)}$ (T_C = 40°C, θ = 180°)			35			A
*$I_{T(AV)}$ (T_C + 40 °C, θ = 180°)			25			A
I_{TSM}:						
For one full cycle of applied principal voltage 60-Hz (Rectangular wave-pw = 5 ms, t_r = 50 μs), T_C = 40°C			180			A
*di/dt:						
V_D = V_{DROM}, I_{GT} = 200 mA, t_r = 0.1 μs (See Fig. 13)			400			A/μs
I^2t:						
T_J = -65 to 120°C, T = 1 to 8.3 ms			165			A^2s
*P_{GM}•:						
Peak (forward or reverse) for 10 μs maximum			40			W
*$P_{G(AV)}$•:						
Averaging time = 10 ms maximum			1			W
*T_{stg}■			-65 to 150			°C
T_C■			-65 to 120			°C
T_T:						
During soldering for 10 s maximum (terminal and case)			225			°C
τ_s:						
Recommended			35			in-lbf
			0.4			kgf-m
Maximum (DO NOT EXCEED)			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 FOR ALL TYPES Except as Specified MIN.	TYP.	MAX.	UNITS
I_{DOM} or I_{ROM}: $V_D = V_{DROM}$ or $V_R = V_{RROM}$, T_C = 120°C				
2N3650, 2N3651	–	2	6*	mA
2N3652	–	2	5.5*	mA
2N3653	–	2	4*	mA
S7410M	–	–	3	mA
v_T: i_T = 25 A (peak), T_C = 25°C	–	1.5	2.05*	V
i_{HO}: T_C = 25°C	–	75	150	mA
T_C = –65°C	–	150	350*	mA
* dv/dt: $V_D = V_{DROM}$, exponential voltage rise, T_C = 120°C (See Fig 14)	200	–	–	V/µs
I_{GT}: V_D = 6 V (dc), R_L = 4 Ω, T_C = 25°C	–	80	180	mA
V_D = 6 V (dc), R_L = 2 Ω, T_C = –65°C	–	150	500*	mA
V_{GT}: V_D = 6 V (dc), R_L = 4 Ω, T_C = 25°C	–	1.5	3	V
* V_D = 6 V (dc), R_L = 200 Ω, T_C = 120°C	0.25	–	–	V
V_D = 6 V (dc), R_L = 2 Ω, T_C = –65°C	–	2	4.5*	V
* tq: Rectangular Pulse $V_{DX} = V_{DROM}$, i_T = 10 A, pulse duration = 50 µs, dv/dt = 200 V/µs, –di/dt = 5 A/µs, I_{GT} = 200 mA at turn-on, V_{RX} = 15 V minimum, V_{GK} = 0 V at turn-off, T_C = 120°C (See Figs. 15 & 16)	–	–	15	µs
Sinusoidal Pulse $V_{DX} = V_{DROM}$, i_T = 100 A, pulse duration = 2 µs, dv/dt = 200 V/µs, V_{RX} = 30 V minimum, V_{GK} = 0 at turn-off, T_C = 115°C (See Figs. 17 & 18)	–	–	15	µs
$R_{\theta JC}$	–	0.85	1.7*	°C/W

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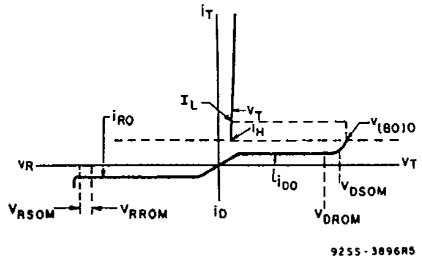

Fig. 1 – Principal voltage-current characteristic.

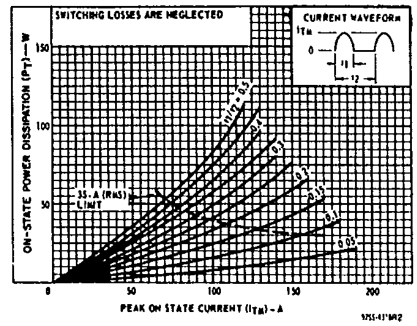

Fig. 2 – Power dissipation vs. peak on-state current.

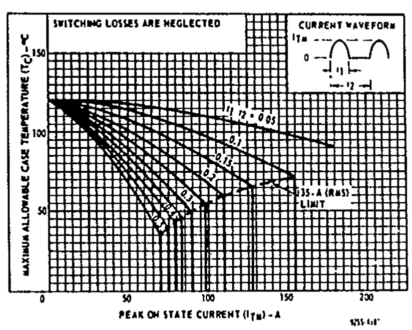

Fig. 3 – Maximum allowable case-temperature vs. peak on-state current.

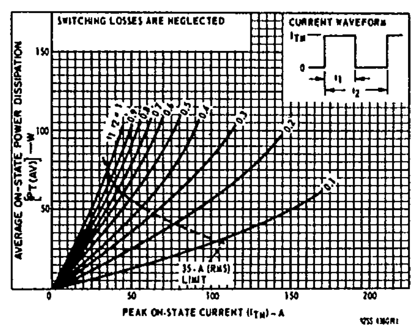

Fig. 4 – Power dissipation vs. peak on-state current.

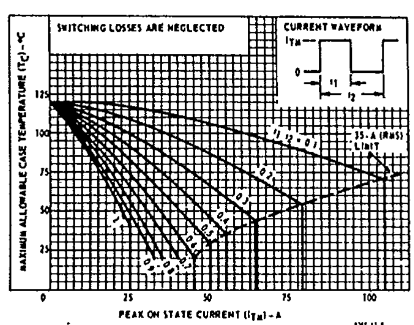

Fig. 5 – Maximum allowable case-temperature vs. peak on-state current.

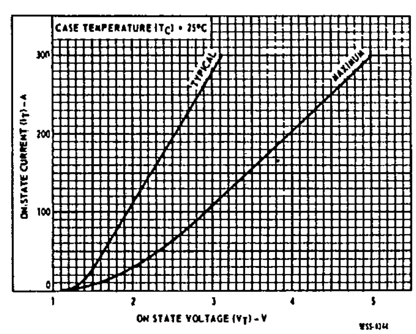

Fig. 6 – Variation of on-state with on-state voltage.

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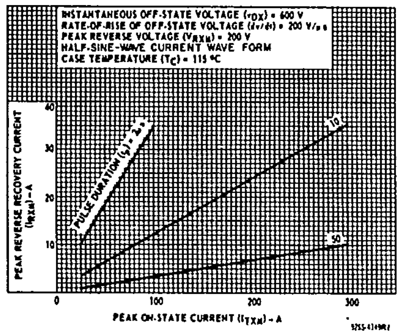

Fig. 7 — Typical variation of peak reverse-recovery current with peak on-state current (half-sine-wave pulse).

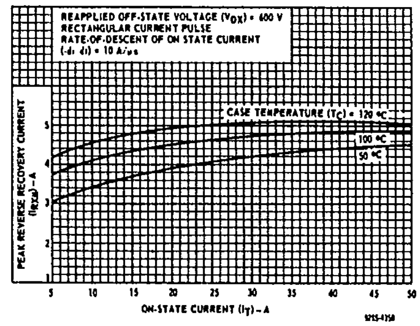

Fig. 8 — Typical variation of peak reverse-recovery current with on-state current (rectangular pulse).

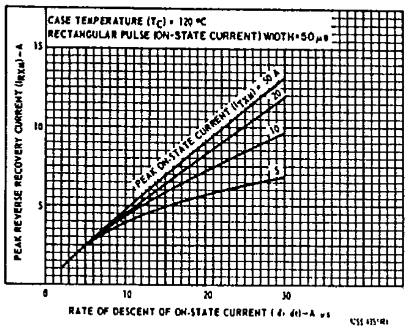

Fig. 9 — Typical variation of peak reverse-recovery current with rate-of-descent of on-state current (rectangular pulse).

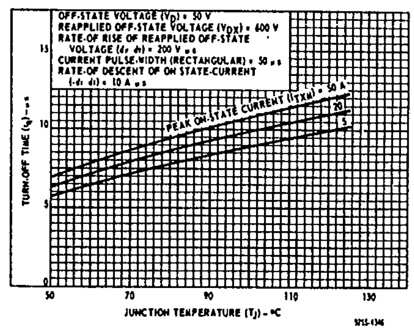

Fig. 10 — Typical variation of turn-off time with junction temperature (rectangular pulse).

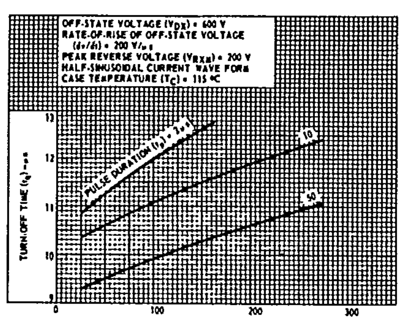

Fig. 11 — Typical variation of turn-off time with peak on-state current (half-sine-wave pulse).

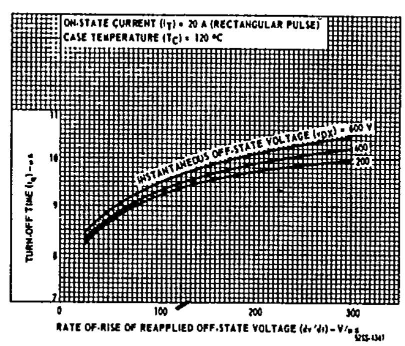

Fig. 12 — Typical variation of tune-off time with rate-of-rise of reapplied off-state voltage (rectangular pulse).

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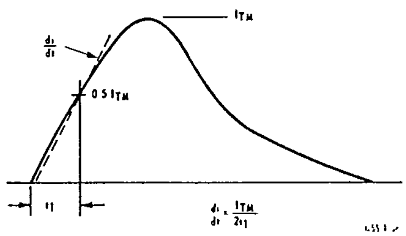

Fig. 13 — Rate-of-change of on-state current with time (defining di/dt).

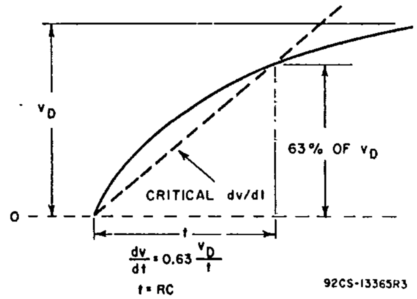

Fig. 14 — Rate-of-rise of off-state voltage with time (defining dv/dt).

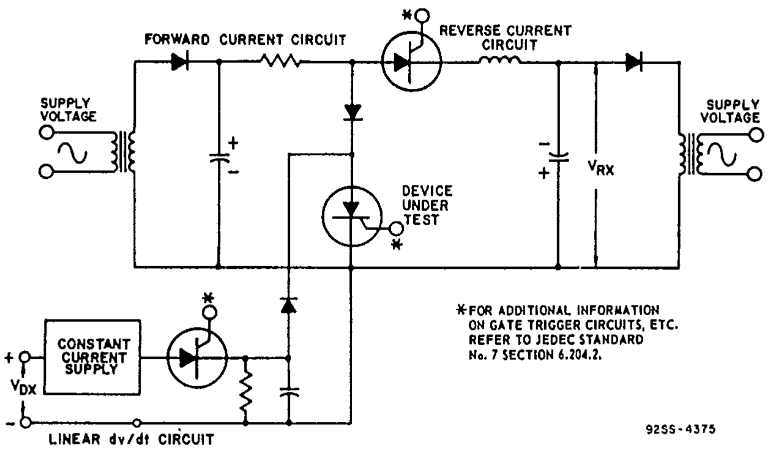

Fig. 15 — Circuit used to measure turn-off time (t_q), rectangular pulse.

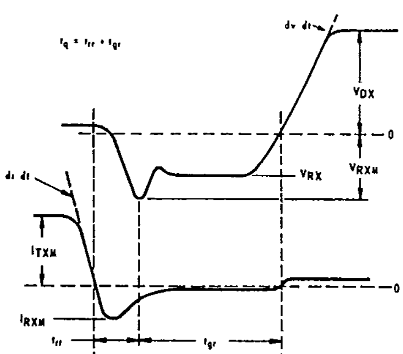

Fig. 16 — Relationship between off-state voltage, reverse voltge, on-state current, and reverse current showing reference points defining turn-off time (t_q), rectangular pulse.

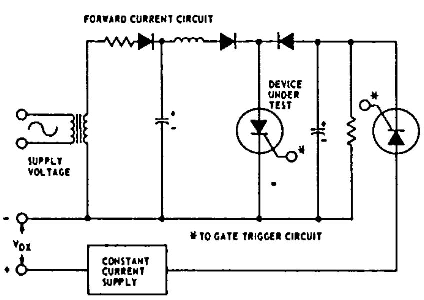

Fig. 17 — Circuit used to measure turn-off time (t_q) half-sine-wave pulse.

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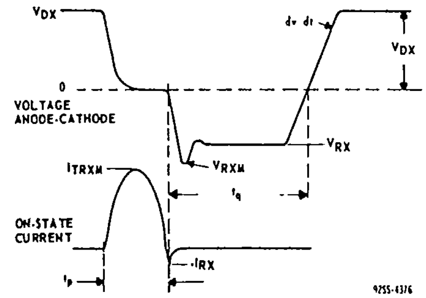

Fig. 18 — Relationship between off-state voltage, reverse voltage, on state current, and reverse current showing reference points for specification of turn-off time (t_q), half-sine-wave pulse.

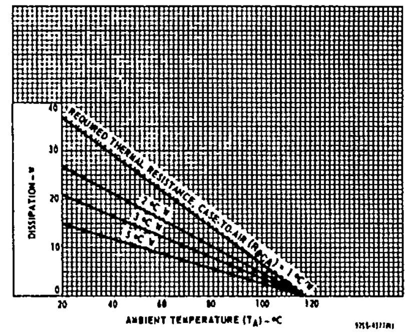

Fig. 19 — Heat sink guidance.