RCA Solid State Division

Thyristors
2N3650 2N3651 2N3652 2N3653 S7430M

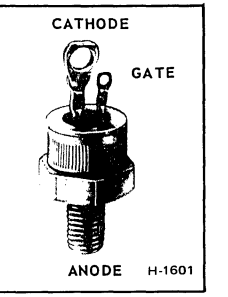
RCA-2N3650 to 2N3653, inclusive, and the S7430M* are all-diffused silicon controlled rectifiers (reverse-blocking triode thyristors) intended for high-speed switching applications such as power inverters, switching regulators, and high-current pulse applications. They feature fast turn-off, high dv/dt, 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 S7430M has a forward and reverse off-state voltage rating of 600 volts.

Formerly RCA Type No. 40735

35-A SILICON CONTROLLED RECTIFIERS

Fast Turn-Off Types for Inverter and Pulse Applications



JEDEC TO-48

FEATURES

- o **Fast turn-off time – 15 μs max.**
- o **High di/dt and dv/dt capabilities**
- o **High peak-current capability**
- o **Shorted-emitter gate-cathode construction**
- o **Forward and reverse gate dissipation ratings**
- o **All-diffused construction – assures exceptional uniformity and stability of characteristics**
- o **Symmetrical gate-cathode construction – provides uniform current density, rapid electrical conduction, and efficient heat dissipation**
- o **Hermetic construction**
- o **Low thermal resistance**

MAXIMUM RATINGS, *Absolute-Maximum Values:*

		2N3650	2N3651	2N3652	2N3653	S7430M	
*NON-REPETITIVE PEAK REVERSE VOLTAGE Gate Open	V_{RSOM}	150	300	400	500	700	V
NON-REPETITIVE PEAK FORWARD VOLTAGE Gate Open	V_{DSOM}	150	300	400	500	700	V
*REPETITIVE PEAK REVERSE VOLTAGE Gate Open	V_{RROM}	100	200	300	400	600	V
*REPETITIVE PEAK OFF-STATE VOLTAGE Gate Open	V_{DROM}	100	200	300	400	600	V
*PEAK SURGE (NON-REPETITIVE) ON-STATE CURRENT: For one cycle of applied principal voltage (60 Hz, sinusoidal)	I_{TSM}	180					A
ON-STATE CURRENT: For case temperature (T_C) = 25 °C							
* Average DC value, conduction angle of 180°	$I_{T(AV)}$	25					A
RMS value	$I_{T(RMS)}$	35					A
*RATE-OF-CHANGE OF ON-STATE CURRENT: V_{DM} = $v_{(BO)O}$, I_{GT} = 200 mA, t_r = 0.1 μs (See Fig. 2)	di/dt	400					A/μs
FUSING CURRENT (for SCR protection): T_J = −65 to 120°C, t = 1 to 8.3 ms	I^2t	165					A^2s
*GATE POWER DISSIPATION PEAK FORWARD (for 10 μs max.)	P_{GM}	40					W
AVERAGE (averaging time = 10 ms, max.)	$P_{G(AV)}$	1					W
*TEMPERATURE RANGE Storage		-65 to 150					°C
Operating (Case)		-65 to 120					°C
Soldering (10 s max. for case)		225					°C
STUD TORQUE:	τ_S						
Recommended		35					in-lb
Maximum (DO NOT EXCEED)		50					in-lb

*In accordance with JEDEC registration data format (JS-14, RDF1)--applies to the JEDEC (2N-Series) types only.

ELECTRICAL CHARACTERISTICS, *At Maximum Ratings and at Indicated Case Temperature (T_C) Unless Otherwise Specified*

CHARACTERISTIC	SYMBOL	LIMITS															UNITS
		Type 2N3650			Type 2N3651			Type 2N3652			Type 2N3653			Type S7430M			
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
INSTANTANEOUS FORWARD BREAKOVER VOLTAGE: Gate Open, T_C = 120 °C	$V_{(BO)O}$	100	–	–	200	–	–	300	–	–	400	–	–	600	–	–	V
* PEAK OFF-STATE CURRENT: (Gate Open, T_C = 120 °C) FORWARD, $V_{DO} = V_{DROM}$	I_{DOM}	–	–	6	–	–	6	–	–	5.5	–	–	4	–	–	3	mA
REVERSE, $V_{RO} = V_{RROM}$	I_{RROM}	–	–	6	–	–	6	–	–	5.5	–	–	4	–	–	3	
* INSTANTANEOUS ON-STATE VOLTAGE: For i_T = 25 A, T_C = 25 °C	v_T	–	–	2.05	–	–	2.05	–	–	2.05	–	–	2.05	–	–	2.05	V
DC GATE TRIGGER CURRENT: V_D = 6 V (DC), R_L = 4 Ω, T_C = 25 °C	I_{GT}	–	80	180	–	80	180	–	80	180	–	80	180	–	80	180	mA
V_D = 6 V (DC), R_L = 2 Ω, T_C = -65 °C		–	150	500*	–	150	500*	–	150	500*	–	150	500*	–	150	500	
DC GATE TRIGGER VOLTAGE: V_D = 6 V (DC), R_L = 4 Ω, T_C = 25 °C	V_{GT}	–	1.5	3	–	1.5	3	–	1.5	3	–	1.5	3	–	1.5	3	V
$V_D = V_{DROM}$, R_L = 200 Ω, T_C = 120 °C		0.25*	–	–	0.25*	–	–	0.25*	–	–	0.25*	–	–	0.25	–	–	
V_D = 6 V (DC), R_L = 2 Ω, T_C = -65 °C		–	2	4.5*	–	2	4.5*	–	2	4.5*	–	2	4.5*	–	2	4.5	
INSTANTANEOUS HOLDING CURRENT: Gate Open At T_C = 25 °C	i_{HO}	–	75	150	–	75	150	–	75	150	–	75	150	–	75	150	mA
* At T_C = -65 °C		–	150	350	–	150	350	–	150	350	–	150	350	–	150	350	
* CRITICAL RATE-OF-RISE OF OFF-STATE VOLTAGE: $V_{DO} = V_{DROM}$ Exponential rise, T_C = 120 °C, (See Fig. 4.)	dv/dt	200	–	–	200	–	–	200	–	–	200	–	–	200	–	–	V/μs
CIRCUIT COMMUTATED TURN-OFF TIME (Rectangular Pulse): $V_{DX} = V_{DROM}$, i_T = 10 A (pulse duration = 50 μs), I_{GT} = 200 mA at turn-on, -di/dt = 5 A/μs, dv/dt = 200 V/μs, V_{RX} = 15 min., V_{GK} = 0 V (at turn-off), T_C = 120 °C (See Fig. 4 & 5)	t_q	–	11	15	–	11	15	–	11	15	–	11	15	–	11	15	μs
CIRCUIT COMMUTATED TURN-OFF TIME (Half-Sinusoidal Waveform): $V_{DX} = V_{DROM}$, i_T = 100 A (pulse duration = 2 μs), I_{GT} = 200 mA dv/dt = 200 V/μs, V_{RX} = 30 V min., V_{GK} = 0 V (at turn-off), T_C = 115 °C (See Fig. 6 & 7)	t_q	–	12	15*	–	12	15*	–	12	15*	–	12	15*	–	12	15	μs
* THERMAL RESISTANCE: Junction-to-Case	θ_{J-C}	–	–	1.7	–	–	1.7	–	–	1.7	–	–	1.7	–	–	1.7	°C/W

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TERMINAL CONNECTIONS
Terminal 1 (Small Lug) – Gate
Terminal 2 (Large Lug) – Cathode
Terminal 3 (Stud) – Anode

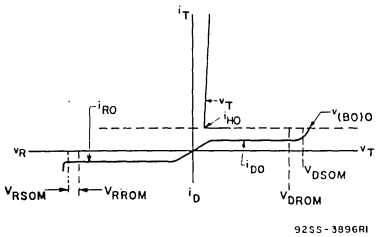

Fig. 1—Principal voltage-current characteristic.

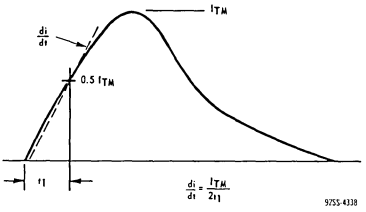

Fig. 2—Rate of change of on-state current with time (defining di/dt).

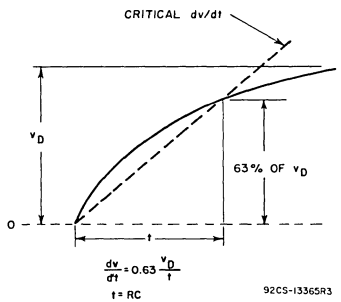

Fig. 3—Rate of rise of off-state voltage with time (defining dv/dt).

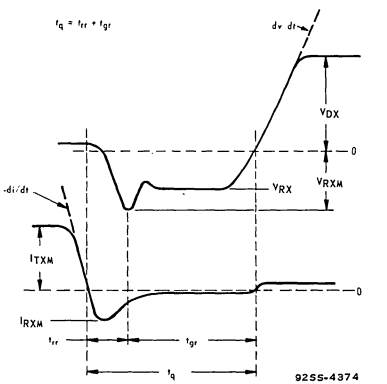

Fig. 4—Relationship between off-state voltage, reverse voltage, on-state current, and reverse current, showing reference points defining turn-off time (t_q), rectangular pulse.

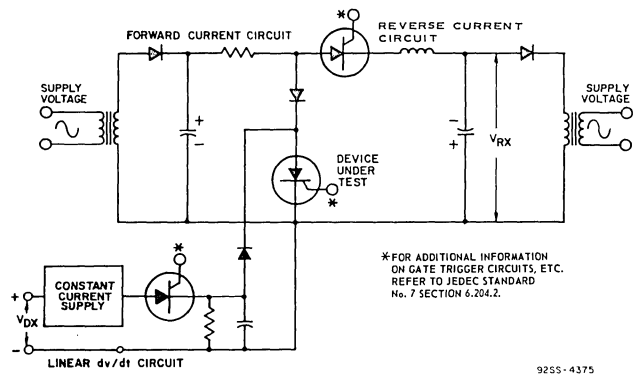

Fig. 5—Circuit used to measure turn-off time (t_q), rectangular pulse.

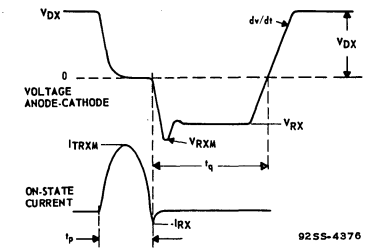

Fig. 6—Relationship between off-state voltage, reverse voltage, on-state current, and reverse current showing reference points for specification of turn-off time (t_q), half sine wave pulse.

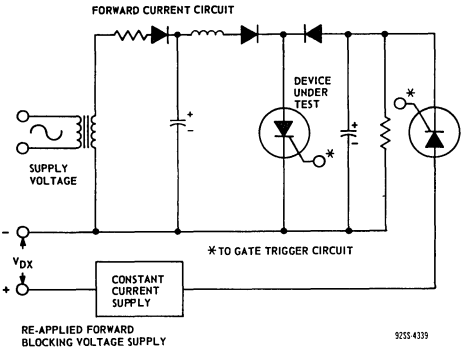

Fig. 7—Circuit used to measure turn-off time (t_q), half sine wave pulse.

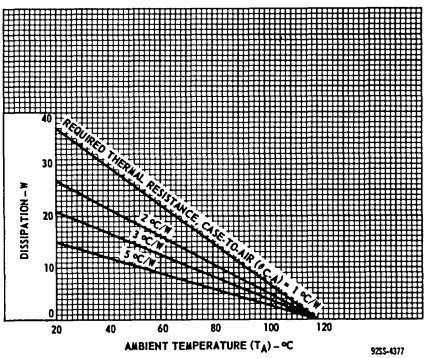

Fig. 8—Heat sink guidance.

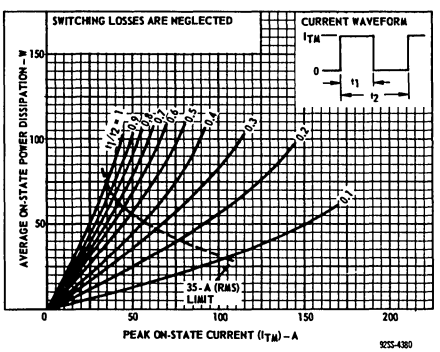

Fig. 9—Power dissipation vs. on-state current.

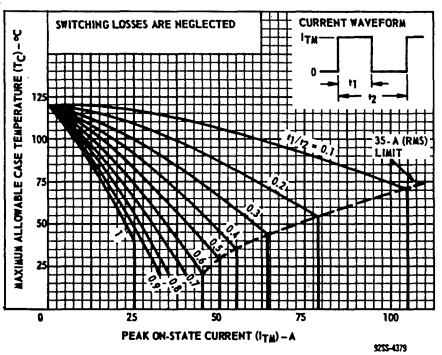

Fig.10—Maximum allowable case-temperature vs. on-state current.

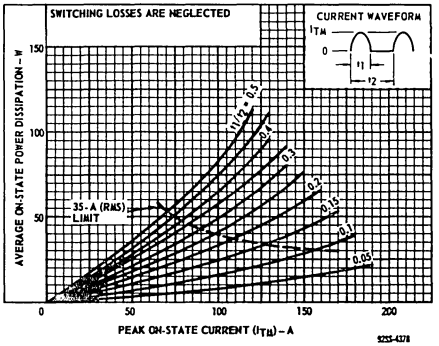

Fig. 11—Power dissipation vs. on-state current.

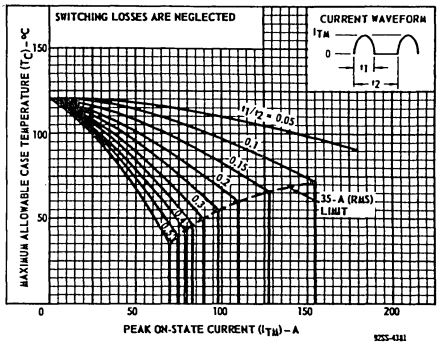

Fig. 12—Maximum allowable case-temperature vs. on-state current.

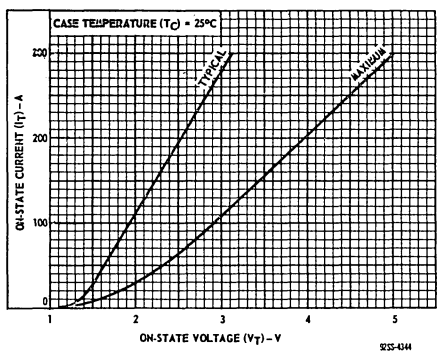

Fig. 13—Variation of on-state current with on-state voltage.

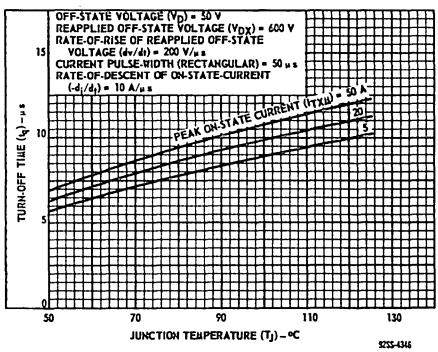

Fig. 14—Typical variation of turn-off time with junction temperature (rectangular pulse).

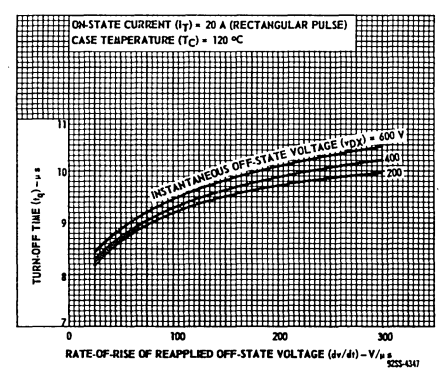

Fig. 15—Typical variation of turn-off time with rate of rise of reapplied off-state voltage (rectangular pulse).

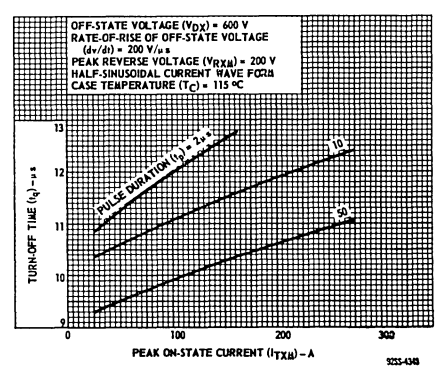

Fig. 16—Typical variation of turn-off time with peak on-state current (half-sinusoidal pulse).

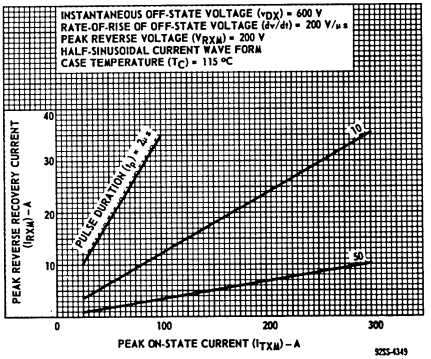

Fig. 17—Typical variation of peak reverse recovery current with peak on-state current (half) sinusoidal pulse).

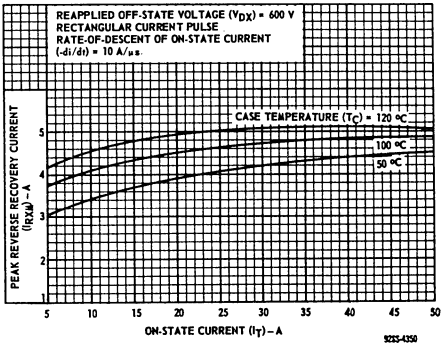

Fig. 18—Typical variation of peak reverse-recovery current with on-state current.

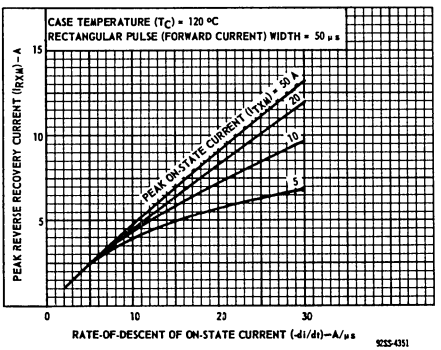

Fig. 19—Typical variation of peak reverse recovery current with rate of descent of on-state current.

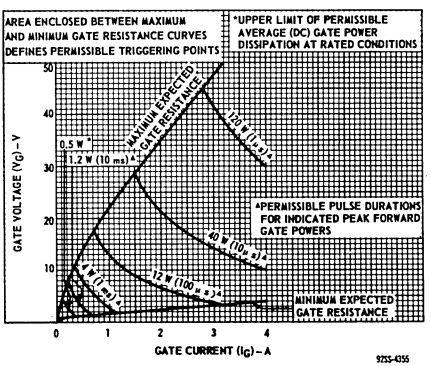

Fig. 20—Typical forward-biased gate characteristics.

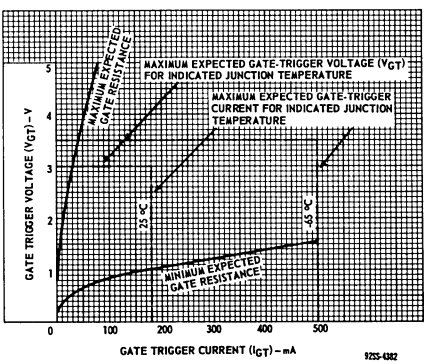

Fig. 21—Typical gate trigger characteristics.