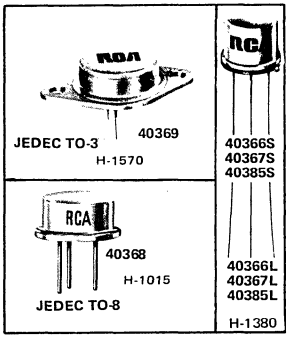
RCA
Solid State
Division

Power Transistors
40366-40369
40385



High-Reliability Silicon N-P-N Power Transistors

For Power Switching and Amplifier Applications

Features

- High reliability assured by five preconditioning steps
- Group A test data included*
- Transistors utilize JEDEC hermetic packages;
  - 40369 – TO-3
  - 40368 – TO-8
  - 40366, 40367, 40385 } See Note at right

These devices are available with either 1½-inch leads (TO-5 package) or ½-inch leads (TO-39 package). The longer-lead versions are specified by suffix "L" after the type number; the shorter-lead versions are specified by suffix "S" after the type number.

RCA-40366–40369 and 40385 are silicon n-p-n power transistors derived from JEDEC types 2N2102, 2N1482, 2N1486, 2N1490, and 2N3439. They are specially preconditioned for use in power-switching and amplifier applications in those instances where high reliability is a requisite.

- High voltage ratings:
  - V_{CER} = 80 V max. (40366)
  - V_{CEV} = 100 V max. (40367, 40368 & 40369)
  - V_{CEO} = 350 V max. (40385)
- High power-dissipation capability:
  - P_T = 5 W max. (40366, 40367 & 40385)
  - = 25 W max. (40368)
  - = 75 W max. (40369)

* Group A test data shown on pages 2 & 3.

MAXIMUM RATINGS, *Absolute-Maximum Values:*		40366	40367	40368	40369	40385	
COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	120	100	100	100	450	V
COLLECTOR-TO-EMITTER VOLTAGE:							
With external base-to-emitter resistance (R_{BE}) $\leq$ 10 Ω	V_{CER}	80	–	–	–	–	V
With −1.5 V (V_{BE}) of reverse bias	V_{CEV}	–	100	100	100	–	V
With base open	V_{CEO}	65	55	55	55	350	V
EMITTER-TO-BASE VOLTAGE	V_{EBO}	7	12	12	10	7	V
CONTINUOUS COLLECTOR CURRENT	I_C	1	1.5	3	6	1	A
CONTINUOUS BASE CURRENT	I_B	–	1	1.5	3	–	A
TRANSISTOR DISSIPATION:	P_T						
At case temperature up to 25°C		5	5	25	75	10	W
At free-air temperature up to 25°C		1	1	–	–	1	W
At temperatures above 25°C		← Derate linearly to 0 watts at 200°C →					
TEMPERATURE RANGE:							
Storage & Operating (Junction)		← −65 to 200 →					°C
PIN or LEAD TEMPERATURE (During soldering):							
At distances ≥ 1/32 in. (0.79 mm) from seating plane for 10 s max.		255	255	235	235	255	°C

ELECTRICAL CHARACTERISTICS, At Case Temperature (T_C) = 25°C

Characteristic	Symbol	TEST CONDITIONS					LIMITS										Units
		Voltage V dc			Current mA dc		40366		40367		40368		40369		40385		
		V_{CB}	V_{CE}	V_{EB}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
Collector-Cutoff Current	I_{CBO}	30					–	–	–	4.0	–	9.0	–	10	–	–	μA
		60					–	2.0	–	–	–	–	–	–	–	–	nA
	I_{CEO}		300			0	–	–	–	–	–	–	–	–	–	20	μA
	I_{CEV}		450	1.5			–	–	–	–	–	–	–	–	–	500	μA
Emitter-Cutoff Current	I_{EBO}			5	0		–	5.0	–	–	–	–	–	–	–	–	nA
				6	0		–	–	–	–	–	–	–	–	–	20	μA
				10	0		–	–	–	–	–	–	–	6.0	–	–	μA
				12	0		–	–	–	2.0	–	5.0	–	–	–	–	μA
DC Forward-Current Transfer Ratio	h_{FE}		4		200		–	–	35	100	–	–	–	–	–	–	
			4		750		–	–	–	–	35	100	–	–	–	–	
			4		1500		–	–	–	–	–	–	25	75	–	–	
			10		0.01		10	–	–	–	–	–	–	–	–	–	
			10		0.1		20	–	–	–	–	–	–	–	–	–	
			10		2		–	–	–	–	–	–	–	–	30	–	
			10		20		–	–	–	–	–	–	–	–	40	160	
			10		150•		40	120	–	–	–	–	–	–	–	–	
			10		500•		25	–	–	–	–	–	–	–	–	–	
			10		1000•		10	–	–	–	–	–	–	–	–	–	
Collector-to-Base Breakdown Voltage	BV_{CBV}			1.5	0.1		120	–	–	–	–	–	–	–	–	–	V
Collector-to-Emitter Breakdown Voltage	BV_{CEV}			1.5	0.25		–	–	100	–	100	–	100	–	–	–	V
Emitter-to-Base Breakdown Voltage (I_E = 0.1 mA)	BV_{EBO}						7.0	–	–	–	–	–	–	–	–	–	V
Collector-to-Emitter Sustaining Voltage: With external base-to-emitter resistance (R_{BE}) = 10 Ω	$V_{CER(sus)}$				100•		80	–	–	–	–	–	–	–	–	–	V
With base open	$V_{CEO(sus)}$				50	0	–	–	55	–	–	–	–	–	350	–	
					100•	0	65	–	–	–	–	–	–	–	–	–	V
					100	0	–	–	–	–	55	–	55	–	–	–	
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$				50	4	–	–	–	–	–	–	–	–	–	0.5	
					150•	15	–	0.5	–	–	–	–	–	–	–	–	
					200	10	–	–	–	1.4	–	–	–	–	–	–	V
					750	40	–	–	–	–	–	0.75	–	–	–	–	
					1300	100	–	–	–	–	–	–	–	1.0	–	–	
Base-to-Emitter Saturation Voltage	$V_{BE(sat)}$				150•	15	–	1.1	–	–	–	–	–	–	–	–	V
					50	4	–	–	–	–	–	–	–	–	–	1.3	
Base-to-Emitter Voltage	V_{BE}		4		200	–	–	–	–	3.0	–	–	–	–	–	–	
			4		750	–	–	–	–	–	–	2.5	–	–	–	–	V
			4		1500	–	–	–	–	–	–	–	–	2.5	–	–	

• Pulsed; pulse duration = 300μ s, duty factor = 1.8%.

GROUP-A TESTS (IN ACCORDANCE WITH MIL-S-19500)

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	CONDITIONS	LTPD*	LIMITS										UNITS
				40366		40367		40368		40369		40385		
				Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
2071	Subgroup 1 Visual and Mechanical Examination	–	10 –	– –	– –	– –	– –	– –	– –	– –	– –	– –	– –	–
3036D	Subgroup 2 I_{CBO}	V_{CB} = 30V, I_E = 0 V_{CB} = 60V, I_E = 0	5 –	– –	– 2.0	– –	4.0 –	– –	9.0 –	– –	10 –	– –	– –	μA nA
3041A	I_{CEV}	V_{CE} = 450V, V_{BE} = -1.5V	–	–	–	–	–	–	–	–	–	–	500	μA
3041D	I_{CEO}	V_{CE} = 300V, I_E = 0	–	–	–	–	–	–	–	–	–	–	20	μA
3061D	I_{EBO}	V_{EB} = 5V, I_C = 0 V_{EB} = 6V, I_C = 0 V_{EB} = 10V, I_C = 0 V_{EB} = 12V, I_C = 0	– – – –	– – – –	5.0 – – –	– – – –	– – – 2.0	– – – –	– – – 5.0	– – – –	– – 6.0 –	– – – –	– 20 – –	nA μA μA μA
3001A	BV_{CBV}	I_C = 100μA, V_{EB} = 1.5V	–	120	–	–	–	–	–	–	–	–	–	V
3026D	BV_{EBO}	I_E = 100μA, I_C = 0	–	7.0	–	–	–	–	–	–	–	–	–	V
3011A	BV_{CEV}	I_C = 0.25mA, V_{EB} = 1.5V I_C = 0.5mA, V_{EB} = 1.5V	– –	– –	– –	100 –	– –	100 –	– –	– 100	– –	– –	– –	V V
3011D	$V_{CEO(sus)}$	I_C = 50mA, I_B = 0 I_C = 100mA●, I_B = 0 I_C = 100mA, I_B = 0	– – –	– 65 –	– – –	55 – –	– – –	– – 55	– – –	– – 55	– – –	350 – –	– – –	V V V
3011B	$V_{CER(sus)}$	I_C = 100mA●, R_{BE} = 10Ω I_C = 50mA, I_B = 4mA	– –	80 –	– –	– –	– –	– –	– –	– –	– –	– –	– 0.5	V V
3071	Subgroup 3 $V_{CE(sat)}$	I_C = 150mA●, I_B = 15mA I_C = 200mA, I_B = 10mA I_C = 750mA, I_B = 40mA I_C = 1.5A, I_B = 100mA	5 – – –	– – – –	0.5 – – –	– – – –	– 1.4 – –	– – – –	– – 0.75 –	– – – –	– – – 1.0	– – – –	– – – –	V V V V
3066A	$V_{BE(sat)}$	I_C = 50mA, I_B = 4mA I_C = 150mA●, I_B = 15mA	– –	– –	– 1.1	– –	– –	– –	– –	– –	– –	– –	1.3 –	V V
3066A	V_{BE}	I_C = 200mA, V_{CE} = 4V I_C = 750mA, V_{CE} = 4V	– –	– –	– –	– –	3.0 –	– –	– 2.5	– –	– –	– –	– –	V V

GROUP-A TESTS (CONT.)

TEST METHOD PER MIL-STD-750	EXAMINATION OR TEST	CONDITIONS	LTPD*	LIMITS										UNITS
				40366		40367		40368		40369		40385		
				Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3076	h_{FE}	I_C = 0.01 mA, V_{CE} = 10V	–	10	–	–	–	–	–	–	–	–	–	
		I_C = 0.1 mA, V_{CE} = 10V	–	20	–	–	–	–	–	–	–	–	–	
		I_C = 2 mA, V_{CE} = 10V	–	–	–	–	–	–	–	–	–	30	–	
		I_C = 20 mA, V_{CE} = 10V	–	–	–	–	–	–	–	–	–	40	60	
		I_C = 150 mA●, V_{CE} = 10V	–	40	120	–	–	–	–	–	–	–	–	
		I_C = 200 mA, V_{CE} = 4V	–	–	–	35	100	–	–	–	–	–	–	
		I_C = 500 mA●, V_{CE} = 10V	–	25	–	–	–	–	–	–	–	–	–	
		I_C = 750 mA, V_{CE} = 4V	–	–	–	–	–	35	100	–	–	–	–	
		I_C = 1 A●, V_{CE} = 10V	–	10	–	–	–	–	–	–	–	–	–	
		I_C = 1.5 A, V_{CE} = 4V	–	–	–	–	–	–	–	25	75	–	–	

●Pulsed; pulse duration = 300 μs, duty factor = 1.8%. *Lot tolerance per cent defective.

The RCA-40366, 40367, 40368, 40369, and 40385 are high-reliability versions of the RCA-2N2102, 2N1482, 2N1486, 2N1490 and 2N3439*, respectively. These transistors are intended for medium- and high-power switching and amplifier applications in military and industrial equipment.

The 40366 and 40385 are silicon n-p-n types with a power-dissipation capability of 5 watts each. The 40367 is a silicon n-p-n hometaxial type with a power-dissipation capability of 5 watts. These devices are available with either 1-½-inch leads (TO-5 package) or ½-inch leads (TO-39 package).

The 40368 is a silicon n-p-n hometaxial type in a JEDEC TO-8 package with a power-dissipation capability of 25 watts.

The 40369 is a silicon n-p-n hometaxial type in the popular JEDEC TO-3 package and has a dissipation capability of 75 watts.

The 40366, the high-reliability version of the 2N2102, features linear beta characteristics which are controlled over a wide range of collector currents (0.01 mA to 1 A).

The 40367, 40368, and 40369, the high-reliability versions of the 2N1482, 2N1486, and 2N1490, respectively, feature rugged construction, low saturation voltage, and high beta at high currents, and are designed to assure freedom from forward-bias second breakdown when operated with specified limits.

Typical applications for these transistors include: power-switching circuits such as dc-to-dc converters, inverters, choppers, solenoid- and relay-controls; oscillator, regulator, and pulse-amplifier circuits; Class A and Class B push-pull audio- and servo-amplifiers.

* Complete data for types 2N1482, 2N1486, 2N1490, 2N2102 and 2N3439 are given in separate technical bulletins (Files 135, 137, 139, 106, and 64, respectively). Bulletins are available upon request from RCA Solid State Division, Box 3200, Somerville, N.J. 08876.

RELIABILITY TESTING

Each RCA-40366, 40367, 40368, 40369 and 40385 is subjected to the following preconditioning steps:

1. Temperature Cycling-Method 102A of MIL-STD-202, 5 cycles, -65° C to 200° C
2. Bake, 72 hours min., 200° C
3. Helium Leak, 1×10^{-8} cc/s max.
4. (a) Methanol Bomb, 70 psig, 16 hours min. (For 40366)
   (b) Bubble Test (Per MIL-STD-202, COND. A), 125° C min., 1 minute, ethylene glycol (For 40367, 40368, 40369 & 40385)
5. Serialization
6. (a) Record I_{CBO} and h_{FE} (150 mA) (For 40366)
   (b) Record I_{CBO} and h_{FE} (For 40367, 40368, & 40369)
   (c) Record I_{CEV} and h_{FE} (20 mA) (For 40385)
7. (a) Power Age, $T_{FA} = 25^{\circ}$ C, $V_{CB} = 60$ V, t= 168 hours, $P_T = 1$ W, free-air (For 40366 & 40367)
   (b) Power Age, $T_C = 125^{\circ}$ C, $V_{CB} = 24$ V, t= 168 hours, $P_T = 10.5$ W, with heat-sink (For 40368) $P_T = 32$ W, with heat-sink (For 40369)
   (c) Power Age, $T_{FA} = 25^{\circ}$ C, $V_{CB} = 200$ V, t= 168 hours, $P_T = 800$ mW, free air (For 40385)
8. (a) For 40366, †record I_{CBO}, h_{FE}(150 mA), BV_{CBV}, V_{CEO}(sus), BV_{EBO}, V_{CE}(sat). Data furnished with transistor.
   (b) For 40367, 40368, & 40369, †record I_{CBO}, h_{FE}, BV_{CEV}, V_{CEO}(sus), I_{EBO}, V_{CE}(sat). Data furnished with transistors.
   (c) For 40385, †record I_{CEO}, I_{EBO}, V_{CEO}(sus), I_{CEV}, V_{CE}(sat), and h_{FE}(20 mA). Data furnished with transistor.

† Delta criteria after 168 hours Power Age:
$\Delta h_{FE} \pm 25\%$ (For all types) $\Delta I_{CBO} + 1\ \mu A$ (For 40367, 40368, & 40369)

TERMINAL CONNECTIONS FOR 40366, 40367, AND 40385

Pin 1 – Emitter
Pin 2 – Base
Case, Pin 3 – Collector

TERMINAL CONNECTIONS FOR 40368

Lead 1 – Emitter
Lead 2 – Base
Case, Lead 3 – Collector

TERMINAL CONNECTIONS FOR 40369

Pin 1 – Base
Pin 2 – Emitter
Case – Collector
Mounting Flange – Collector