RCA

Solid State
Division

RF Power Transistors

2N5102

JEDEC TO-60

H 1307

High-Power Silicon N-P-N Overlay Transistor

For Class C, AM Operation in VHF Circuits

Features:

- **15 W output min. at 136 MHz**
- **For 24 V aircraft communication**
- **Load mismatch protection**
- **High voltage ratings**
- **Emitter grounded to case**

RCA-2N5102• is an epitaxial silicon n-p-n planar transistor of the overlay emitter-electrode construction. It is especially designed with integral ballast resistors in each emitter site to provide high power as a class C rf amplifier for vhf aircraft communications service (108 to 150 MHz) with amplitude modulation and 24-volt power supply.

The transistor features complete protection against any load mismatch. Each unit is tested at 118 MHz with full modulation and no current limiting for all load-mismatch conditions from short-circuit to open-circuit.

In the overlay structure, a number of individual emitter sites are connected in parallel and used in conjunction with a common collector region. When compared with other structures, this arrangement provides a substantial increase in emitter periphery for higher current or power, and a corresponding decrease in emitter and collector areas for lower input and output capacitances. The overlay structure thus offers greater power output, gain efficiency, frequency capability, and linearity.

•Formerly RCA Dev. No. TA2791

MAXIMUM RATINGS, *Absolute-Maximum Values:*

*COLLECTOR-TO-BASE VOLTAGE	V_{CBO}	90	V
COLLECTOR-TO-EMITTER VOLTAGE:			
With base-emitter junction reverse-biased, $V_{BE} = -1.5$ V	V_{CEV}	100	V
*With external base-to-emitter resistance, $R_{BE} = 5\ \Omega$	V_{CER}	50	V
*EMITTER-TO-BASE VOLTAGE	V_{EBO}	4	V
*CONTINUOUS COLLECTOR CURRENT	I_C	3.3	A
PEAK COLLECTOR CURRENT		10	A
*CONTINUOUS BASE CURRENT	I_B	1	A
*TRANSISTOR DISSIPATION:	P_T		
At case temperatures up to 25°C		70	W
At case temperatures above 25°C		See Fig. 6	
*TEMPERATURE RANGE:			
Storage & Operating (Junction)		−65 to 200	°C
*LEAD TEMPERATURE (During soldering):			
At distances ≥ 1/32 in. (0.8 mm) from insulating wafer for 10 s max		230	°C

*In accordance with JEDEC registration data.

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	SYMBOL	TEST CONDITIONS: VOLTAGE V dc V_{CB}	V_{CE}	V_{BE}	CURRENT mA dc I_E	I_B	I_C	LIMITS MIN.	MAX.	UNITS
* Collector Cutoff Current: With base-emitter junction reverse biased	I_{CEV}		83	−1.5				–	20	mA
* At T_C = 150°C	I_{CEV}		30	−1.5				–	10	mA
With external base-to-emitter resistance (R_{BE}) = 5 Ω	I_{CER}		50					–	10	mA
* Emitter Cutoff Current	I_{EBO}			−4				–	10	mA
* Collector-to-Emitter Sustaining Voltage: With base-emitter junction reverse biased	$V_{CEV}(sus)$			−1.5			600[a]	100	–	V
With external base-to-emitter resistance (R_{BE}) = 5 Ω	$V_{CER}(sus)$						200[a]	50	–	V
With base open	$V_{CEO}(sus)$					0	200[a]	35	–	V
Emitter-to-Base Breakdown Voltage	$V_{(BR)EBO}$				10		0	4	–	V
* DC Forward Current Transfer Ratio	h_{FE}		4 4				3 A 0.5 A	10 10	– 100	
* Magnitude of Common-Emitter, Small-Signal, Short-Circuit Forward Current Transfer Ratio (f = 150 MHz)	$\|h_{fe}\|$		24				500	1	–	
* Output Capacitance (f = 1 MHz)	C_{ob}	30			0			–	85	pF
* Available Amplifier Signal Input Power[b] (P_o = 15 W, Z_G = 50 Ω, f = 136 MHz)	P_i							–	6	W
* Collector Circuit Efficiency (P_{IE} = 6 W, Z_G = 50 Ω, f = 136 MHz)	η_C							70	–	%
Modulation[c] (f = 118 MHz)	M		24 (V_{CC})					80	–	%
Load Mismatch[d] (f = 118 MHz)	LM		24 (V_{CC})				1100	Will not be damaged		
Dynamic Input Impedance (See Fig. 10) (P_{IE} = 6 W, f = 150 MHz)	Z_{IN}		24 (V_{CC})					1.7 + j 2.6 (typ)		Ω
Thermal Resistance (Junction to Case)	$R_{\theta JC}$							–	2.5	°C/W

*In accordance with JEDEC registration data.

[a]Pulsed through a 9-mH inductor; duty factor = 50%.

[b]Unmodulated carrier.

[c]See Figs. 9 & 10. Carrier Power, P_{CAR}, = 15 W; V_{CC} modulation = 100%; $M = \sqrt{\frac{2(P_{AM} - P_{CAR})}{P_{CAR}}} \times 100\%$.

[d]Under conditions of *footnote* c, the transistor is subjected to all conditions of load mismatch from short-circuit to open-circuit.

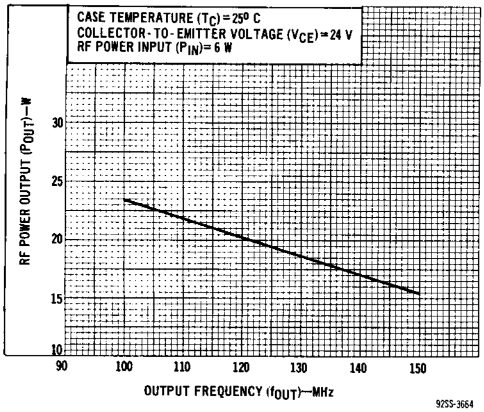


Fig. 1—Typical power output vs. frequency.

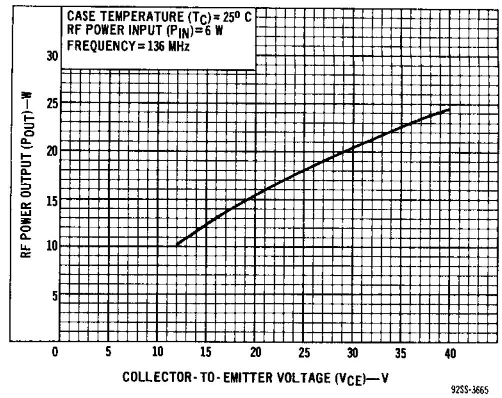


Fig. 2—Typical rf power output vs. collector-to-emitter voltage.

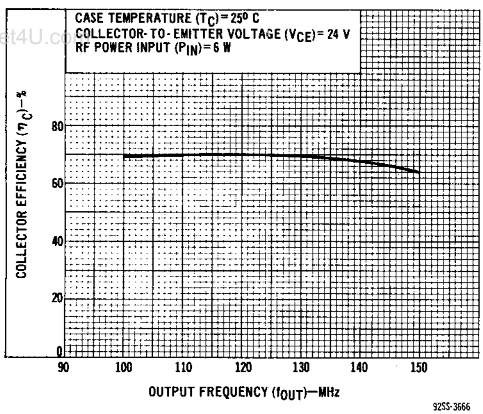


Fig. 4—Typical power output vs. power input.

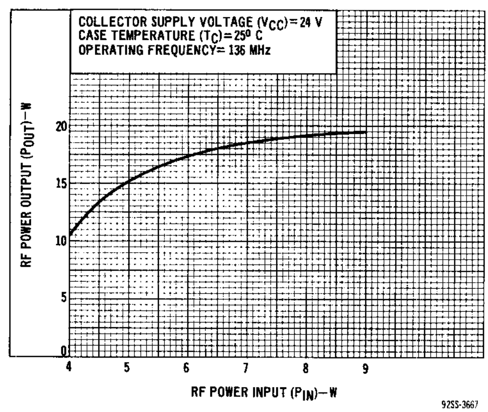


Fig. 3—Typical collector efficiency vs. frequency.

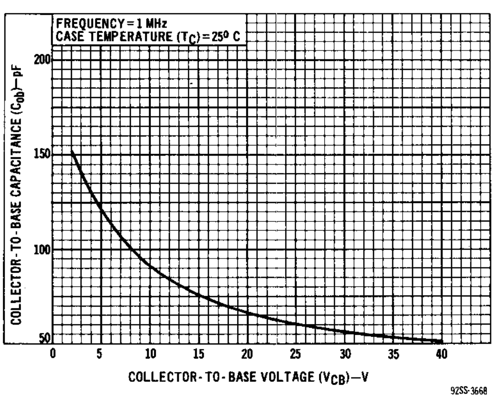


Fig. 5—Typical variation of collector-to-base capacitance.

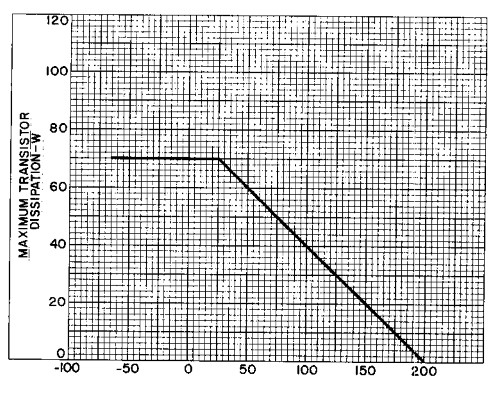


Fig. 6—Dissipation derating curve.

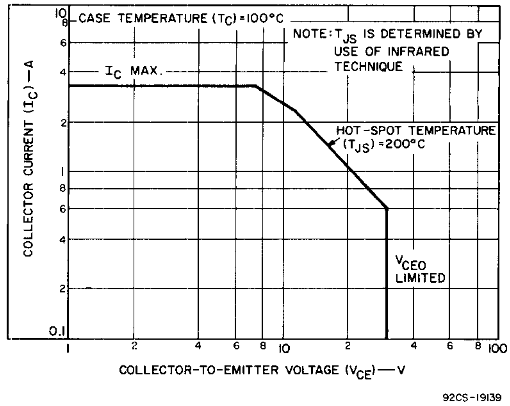
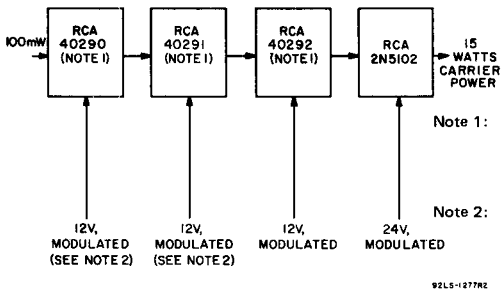


Fig. 7—Safe operation area with dc forward bias.



Note 1: For technical bulletin write RCA Solid State Division Box 3200 Somerville, N.J. 08876

Note 2: Upward modulation only.

Fig. 8—Block diagram of a typical narrowband aircraft radio transmitter chain.

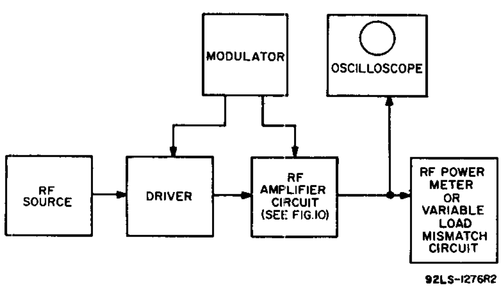
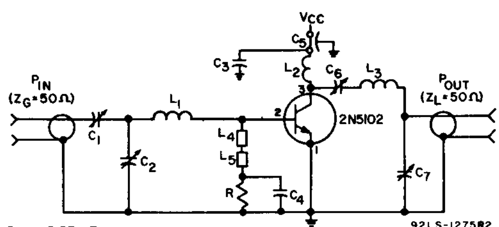
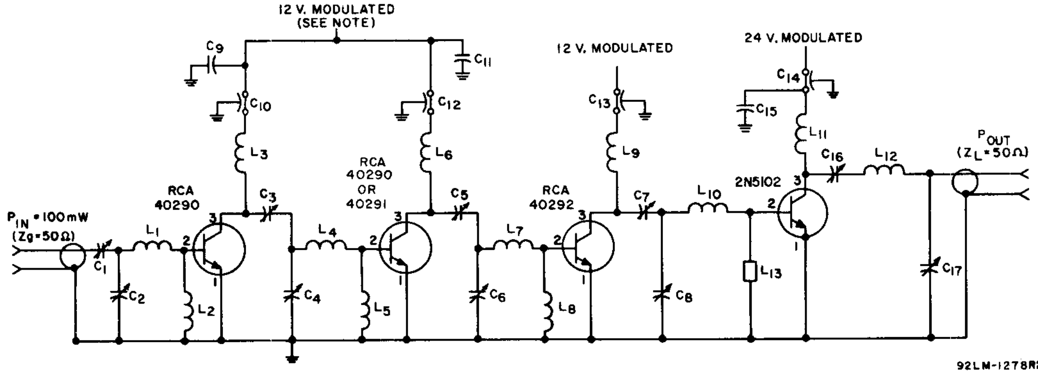


Fig. 9—Block diagram for modulation test.



C_1, C_6:	3-35 pF	L_1:	3 1/4 turns, 1/8 in. (3.17 mm) dia. No. 14 wire
C_2, C_7:	7-100 pF	L_2:	2 turns, 3/8 in. (9.52 mm) dia. No. 14 wire
C_3:	0.1 μF	L_3:	4 turns, 3/8 in. (9.52 mm) dia. No. 14 wire
C_4:	0.05 μF	L_4, L_5:	350 Ω Ferrite choke, Ferroxcube # VK200 01-3B
C_5:	1,000 pF		
R:	1 Ω wire wound		

Fig. 10—RF amplifier circuit for power output test.

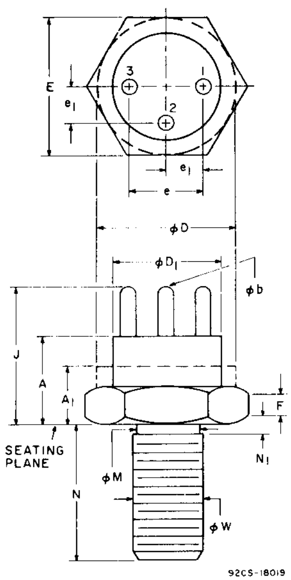


$C_1, C_3, C_5, C_7, C_{16}$: 3-35 pF
$C_2, C_4, C_6, C_8, C_{17}$: 8-60 pF
C_9, C_{11}, C_{13}: 0.03 μF
C_{10}, C_{12}, C_{14}: 1,000 pF
C_{15}: 0.1 μF
L_1, L_9: 3 turns, 1/4 in. (6.35 mm) dia., No. 16 wire
L_2, L_5: Ferrite choke, Z = 450 ohms, Ferroxcube # VK200 01-4B
L_3: RF choke, 1.5 μH
L_4, L_7: 4 turns, 1/4 in. (6.35 mm) dia., No. 16 wire
L_6: RF choke, 1.0 μH
L_8: wire-wound resistor, R = 2.4 ohms
L_{10}: 3 turns, 1/8 in. (3.17 mm) dia., No. 14 wire
L_{11}: 2 turns, 1/2 in. (12.7 mm) dia., No. 16 wire
L_{12}: 4 turns, 1/2 in. (12.7 mm) dia., No. 16 wire
L_{13}: 350 Ω ferrite choke, Ferroxcube # VK200 01-3B

Note: Upward modulation only.

Fig. 11 – Circuit diagram of a typical narrowband aircraft radio transmitter chain.

DIMENSIONAL OUTLINE JEDEC TO-60



TERMINAL CONNECTIONS

Case, Pin No. 1 — Emitter
Pin No. 2 — Base
Pin No. 3 — Collector

SYMBOL	INCHES MIN.	INCHES MAX.	MILLIMETERS MIN.	MILLIMETERS MAX.	NOTES
A	0.215	0.320	5.46	8.13	
A_1	–	0.165	–	4.19	2
φb	0.030	0.046	0.762	1.17	4
φD	0.360	0.437	9.14	11.10	2
$φD_1$	0.320	0.360	8.13	9.14	
E	0.424	0.437	10.77	11.10	
e	0.185	0.215	4.70	5.46	
e_1	0.090	0.110	2.29	2.79	
F	0.090	0.135	2.29	3.43	1
J	0.355	0.480	9.02	12.19	
φM	0.163	0.189	4.14	4.80	
N	0.375	0.455	9.53	11.56	
N_1	–	0.078	–	1.98	
φW	0.1658	0.1697	4.212	4.310	3, 5

NOTES:

1. Dimension does not include sealing flanges
2. Package contour optional within dimensions specified
3. Pitch diameter – 10-32 UNF 2A thread (coated)
4. Pin spacing perimts insertion in any socket having a pin-circle diameter of 0.200 in. (5.08 mm) and contacts which will accommodate pins with a diameter of 0.030 in. (0.762 mm) min., 0.046 in. (1.17mm) max.
5. The torque applied to a 10-32 hex nut assembled on the thread during installation should not exceed 12 inch-pounds.