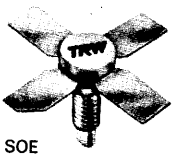
RF Power Transistors

- PT 8809 : 2 W
- PT 8810 : 5 W
- PT 8811 : 10 W
- 12.5 V
- 470 MHz



280 SOE

The PT 8809, 10 and 11 are designed for 12.5 volt, UHF applications. Power output is usable to the top of their ratings and they are able to withstand infinite VSWR at all phase angles at rated output power.

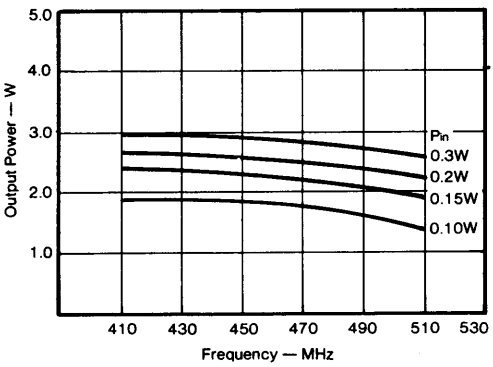
Electrical Characteristics (T_{CASE} = 25 °C)

	SYMBOL	CHARACTERISTICS	TEST CONDITIONS	PT 8809	PT 8810	PT 8811	UNIT
DC Test	BV_{EBO}	Min. Emitter - Base Breakdown	I_B = 1 mA, I_C = 0 I_B = 2 mA, I_C = 0 I_B = 5 mA, I_C = 0	4	4	4	V
	BV_{CES}	Min. Collector - Emitter Breakdown	I_C = 5 mA, V_{BE} = 0 I_C = 10 mA, V_{BE} = 0 I_C = 20 mA, V_{BE} = 0	36	36	36	V
	BV_{CEO}	Min. Collector - Emitter Breakdown	I_C = 25 mA, I_B = 0 I_C = 50 mA, I_B = 0	16	16	16	V
	I_{CBO}	Max. Collector Cutoff Current	V_{CB} = 15 V, I_E = 0	1	1	2	mA
	H_{FE}	Min. D.C Current Gain	V_{CE} = 5 V, I_C = 100 mA V_{CE} = 5 V, I_C = 200 mA V_{CE} = 5 V, I_C = 500 mA	20	20	20	—
RF Test	P_{GAIN}	Min. Power Gain	V_{CE} = 12.5 V, F = 470 MHz, P_{in} = 0.2 W P_{in} = 0.7 W P_{in} = 2.5 W	2	5	10	W
	η	Min. Collector Efficiency	V_{CE} = 12.5 V, F = 470 MHz, P_{out} = 2 W P_{out} = 5 W P_{out} = 10 W	60	55	55	%
	VSWR	Mismatch Tolerance	V_{CE} = 12.5 V, F = 470 MHz, P_{out} = 2 W P_{out} = 5 W P_{out} = 10 W	∞ : 1	∞ : 1	∞ : 1	
	C_{OB}	Max. Collector - Base Capacitance	V_{CB} = 15 V, F = 1 MHz, I_E = 0	8	17	30	pF
Operating	I_C	Continous Collector Current		0.75	1.7	3.4	A
	θ_{j-c}	Thermal Resistance	T_C = 25 °C	10	5	3.5	°C/W
	T_{STG}	Storage Temperature and Junction Temperature		— 65° to + 200°			°C
	P_D	Power Dissipation	T_C = 25 °C	17.5	35	50	W

TYPICAL POWER GAIN PERFORMANCE IN BROADBAND CIRCUIT

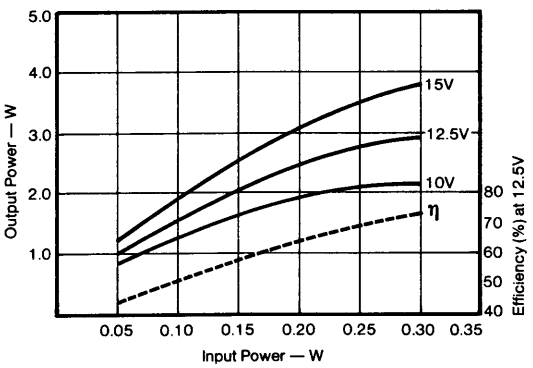
Power Output Frequency
V_{CE} = 12.5 V

PT 8809

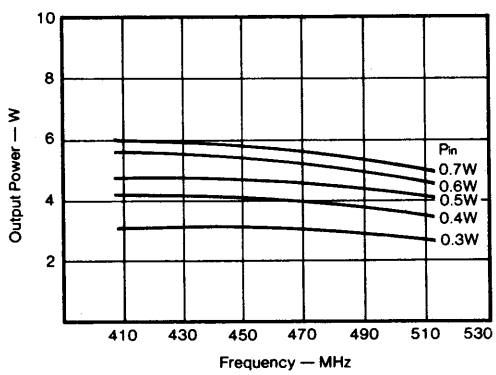


Power Output vs Power Input
f = 470 MHz

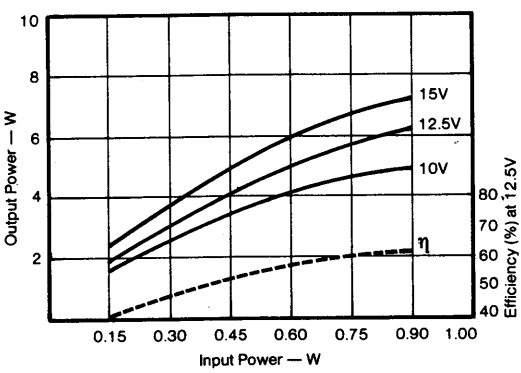
PT 8809



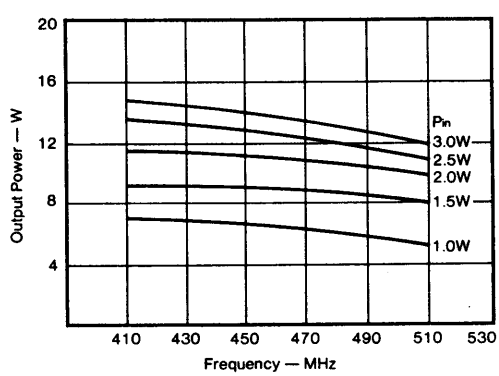
PT 8810



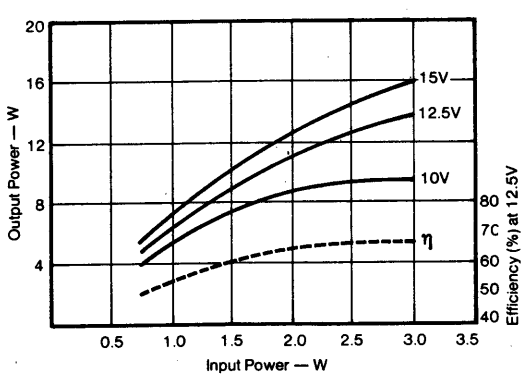
PT 8810



PT 8811



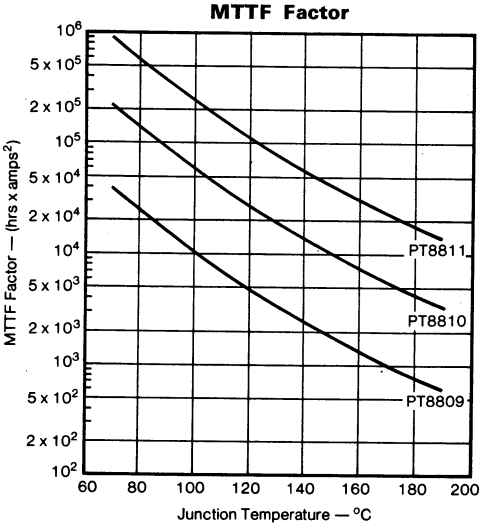
PT 8811



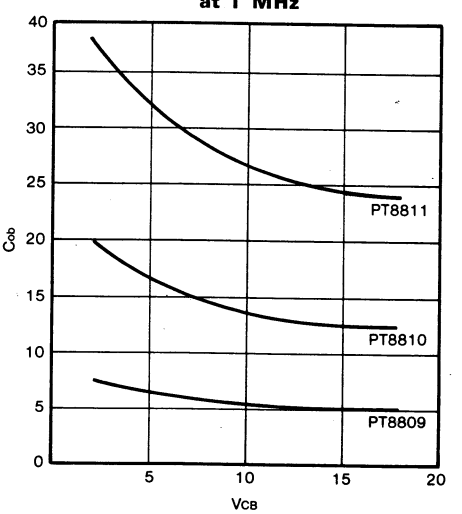
DEVICE IMPEDANCE PARAMETERS AT 12.5 V AND RATED INPUT POWER

DEVICE	FREQUENCY (MHz)	Z_{in} (Ω)	Z_{out} (Ω)
PT 8809	410	1.70 + j 1.92	15.7 — j 20.4
	430	1.79 + j 2.09	15.5 — j 19.7
	450	1.87 + j 2.26	15.4 — j 18.9
	470	1.96 + j 2.44	15.2 — j 18.2
	490	2.03 + j 2.61	15.1 — j 17.5
	510	2.11 + j 2.77	14.9 — j 16.7
PT 8810	410	1.49 + j 2.60	9.95 — j 6.20
	430	1.52 + j 2.90	9.80 — j 6.05
	450	1.56 + j 3.20	9.65 — j 5.90
	470	1.60 + j 3.50	9.55 — j 5.75
	490	1.63 + j 3.80	9.40 — j 5.60
	510	1.67 + j 4.10	9.30 — j 5.45
PT 8811	410	1.25 + j 2.65	6.00 — j 1.70
	430	1.24 + j 2.77	5.85 — j 1.64
	450	1.23 + j 2.89	5.70 — j 1.58
	470	1.22 + j 3.00	5.55 — j 1.62
	490	1.21 + j 3.12	5.40 — j 1.46
	510	1.20 + j 3.24	5.25 — j 1.40

MTTF Factor



Collector Base Capacitance (pF) at 1 MHz



MTTF factor is derived from calculations based on metal migration theory. The following example will serve to demonstrate the use of the MTTF factor charts shown above. Consider the PT 8810 operating at 470 MHz under normal conditions.

P_o = 5 W
V_c = 12.5 V
P_{in} = 0.6 W
η = 60 %

From this we calculate I_c = 0.67 A; therefore, the total power dissipated is 4 watts.

The junction temperature can then be calculated from :

$$T_j = T_{stud} + Pd \times \theta_{jC}$$

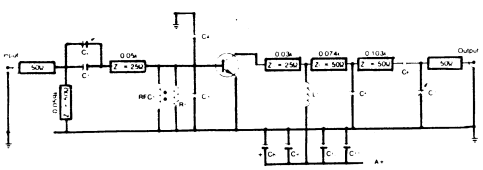
In this example $P_d \times \theta_{jC}$ is 20 °C.

For a stud temperature of 100 °C, T_j is 120 °C. From the chart above, we find the PT 8810 has an MTTF factor of 2.75 × 10^4 hours amps² at 120 °C. We calculate MTTF as follows :

$$MTTF = \frac{2.75 \times 10^4 \text{ hrs.amps}^2}{(0.67 \text{ amps})^2}$$

MTTF = 61,300 hours

PT 8809 TEST CIRCUIT BROADBAND (450-510 MHz)



COMPONENT AND MATERIAL LIST

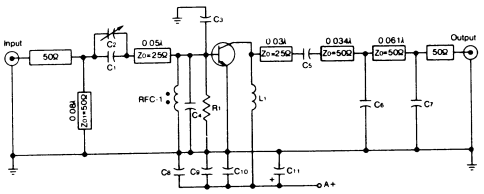
C_1 3.9 pF, ceramic chip
$C_{2,7}$ 0.8-10 pF, Voltronics AP 10, variable
$C_{3,4}$ 27 pF, ceramic chip
C_5 15 pF, ceramic chip
C_6 470 pF, ceramic chip
C_8 5 μF, electrolytic
C_9 1000 pF, Underwood
C_{10} 0.1 μF, disc-ceramic
C_{11} 0.1 μF, disc-ceramic

L_1 2 turns # 22 enameled, 0.1" I.D.

R_1 270 Ω, 1/2 watt, carbon
RFC_1 2 1/2 turns # 22 AWG on Ferroxcube VK 211/17-4 B

All transmission lines reference at 480 MHz

PT 8810 TEST CIRCUIT BROADBAND (450-510 MHz)



COMPONENT AND MATERIAL LIST

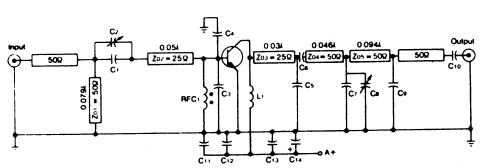
C_1 3.9 pF, ceramic chip
C_2 0.8-10 pF, Voltronics AP 10, variable
$C_{3,4}$ 25 pF, ceramic chip
C_5 1500 pF, ceramic chip
C_6 10 pF, Underwood
C_7 5 pF, Underwood
C_8 0.01 μF, disc-ceramic
C_9 0.10 μF, disc-ceramic
C_{10} 1000 pF, Underwood
C_{11} 5 μF, electrolytic

L_1 4 turns, # 22 enameled, 0.1" I.D.

R_1 750 Ω, 1/2 watt, carbon
RFC_1 2 1/2 turns # 22 AWG on Ferroxcube VK 211/17-4 B

All transmission lines reference at 480 MHz

PT 8811 TEST CIRCUIT BROADBAND (450-510 MHz)



COMPONENT AND MATERIAL LIST

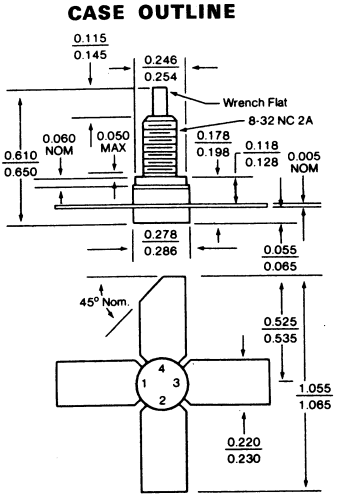
C_1 3.9 pF, ceramic chip
$C_{2,8}$ 0.8-10 pF, Voltronics AP 10, variable
$C_{3,4}$ 27 pF, ceramic chip
C_5 20 pF, Underwood
C_6 81 pF, ceramic chip
C_7 10 pF, Underwood
C_9 5 pF, Underwood
C_{10} 470 pF, ceramic chip
C_{11} 1000 pF, Underwood
C_{12} 0.1 μF, disc-ceramic
C_{13} 0.01 μF, disc-ceramic
C_{14} 5 μF, electrolytic

L_1 4 turns, # 22 enameled, 0.1" I.D.

RFC_1 2 1/2 turns # 22 AWG on Ferroxcube VK 211/17-4 B

All transmission lines reference at 480 MHz

CASE OUTLINE

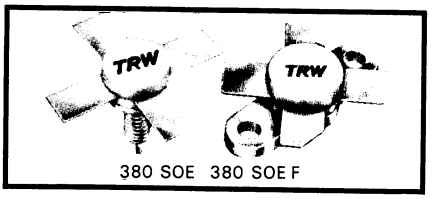


To convert inches to millimeters multiply by 25.4

STYLE 1:
PIN 1. EMITTER
2. BASE
3. EMITTER
4. COLLECTOR

RF Transistor

- 10 W
- 12.5 V
- 175 MHz
- NPN Silicon



380 SOE 380 SOE F

Designed for 12.5 V VHF amplifiers. Class B or C operation.

12.5 V characteristics :

Output power 175 MHz - 9 W min.

Minimum gain at 175 MHz - 11 dB.

Available in either stud or flange package.

Power output useable to the top ratings and capable of whithstanding infinite VSWR at all phase angles at rated output power.

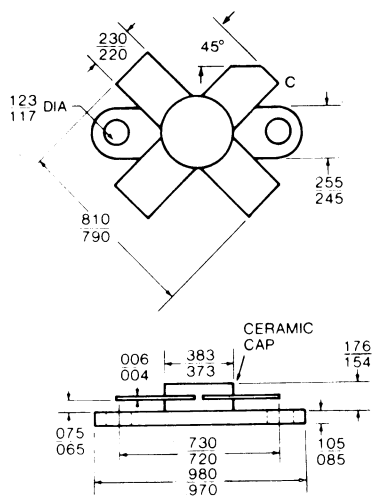
Electrical Characteristics (T_{flange} = 25 °C)

	SYMBOL	CHARACTERISTICS	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
DC Test	BV_{EBO}	Emitter - Base Breakdown Voltage	I_E = 5 mA I_C = 0	4			V
	BV_{CEO}	Collector - Emitter Breakdown Voltage	I_C = 50 mA I_B = 0	16			V
	BV_{CBO}	Collector - Base Breakdown Voltage	I_C = 20 mA I_E = 0	36			V
	I_{CBO}	Collector Cutoff Current	V_{CB} = 15 V I_E = 0			2	mA
	H_{FE}	D.C Current Gain	V_{CE} = 5 V I_C = 500 mA	20			—
RF Test	P_{GAIN}	Power Gain	V_{CE} = 12.5 V F = 175 MHz P_{in} = 0.7 W	9			W
	η	Efficiency	V_{CE} = 12.5 V F = 175 MHz P_{out} = 9 W	60			%
	Load VSWR	Mismatch Tolerance	V_{CE} = 12.5 V F = 175 MHz P_{out} = 9 W		∞ : 1		
	Z_{in}	Common Emitter Amplifier Input Impedance	V_{CE} = 12.5 V F = 175 MHz P_{in} = 0.7 W		1.8 _ j 0.1		Ω
	Z_{Load}	Common Emitter Amplifier Load Impedance	V_{CE} = 12.5 V F = 175 MHz P_{out} = 9 W		8.29 + j 2.55		Ω
	C_{OB}	Collector - Base Capacitance	V_{CB} = 15 V F = 1 MHz			30	pF
Operating	I_C	Continous Collector Current				3.4	A
	θ_{j-C}	Thermal Resistance	T_C = 25 °C			3.5	°C/W
	T_{STG}	Storage Temperature and Junction Temperature		— 65°		200°	°C
	P_D	Power Dissipation	T_C = 25 °C			50	W

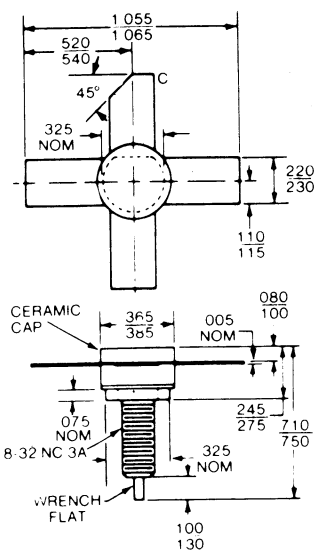
B

PACKAGE OUTLINE

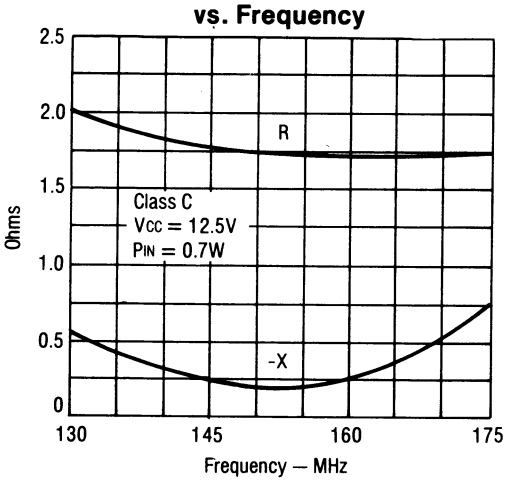
.380 SOE F



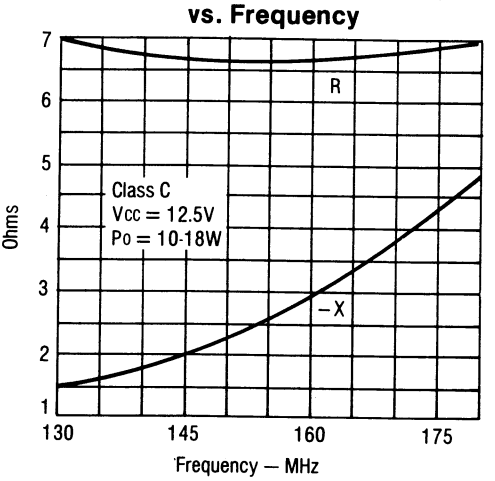
.380 SOE



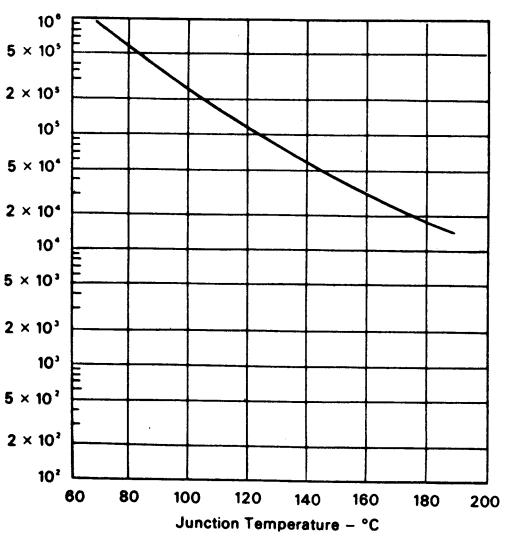
Series Input Impedance vs. Frequency



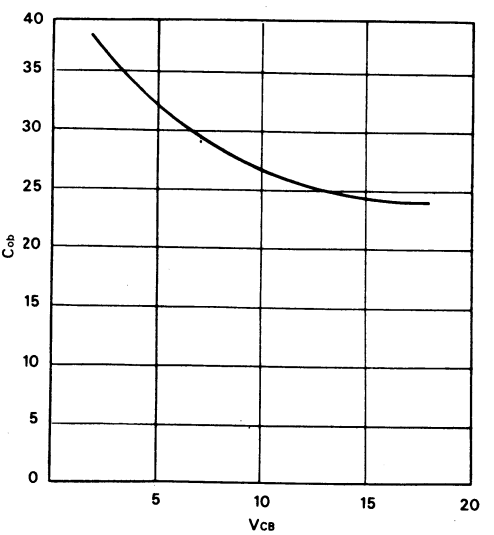
Series Load Impedance vs. Frequency



MTTF Factor

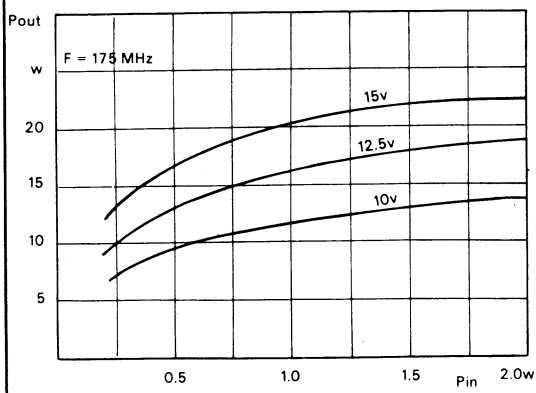


Collector Base Capacitance (pF) at 1 MHz

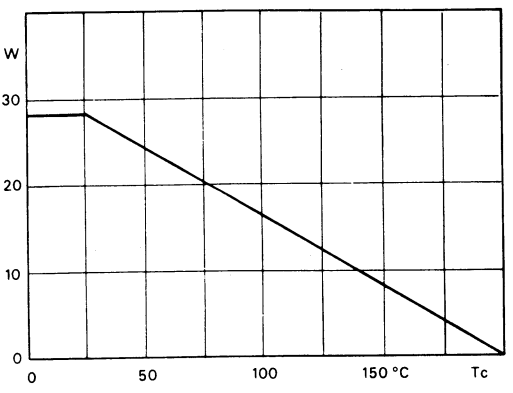


B

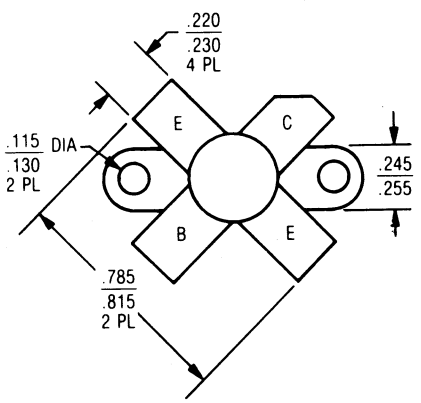
Typical characteristics

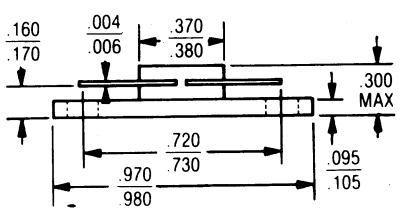


Power - Temperature Derating Curve



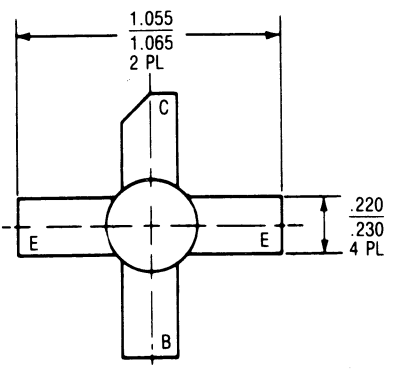
.380 SOE F

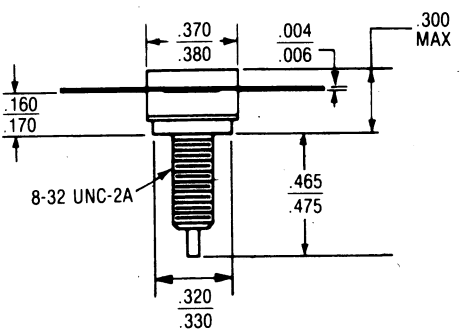




PT 8828/F

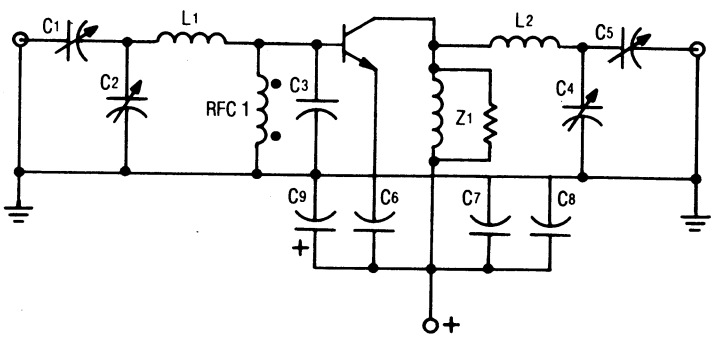
.380 SOE





PT 8828

TEST CIRCUIT



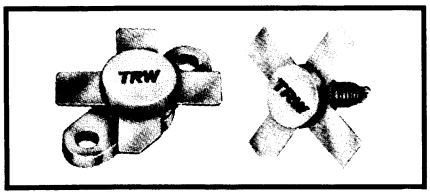
PARTS LIST:

$C_{1,2,4,5}$	Trimmer car, ARCO #462, 5-80pf.
C_3	120pf Underwood Mfg.
C_6	1000pf Underwood Mfg.
C_7	0.01μf disc ceramic.
C_8	0.02μf disc ceramic.
C_9	25μf, electrolytic, 35 WVDC.
L_1	2 T., #18 AWG., 0.25" I.D.
L_2	2 T., #18 AWG., 0.25" I.D.
Z_1	8 T., #18 AWG., wound on 330 ohms 1/2 W. resistor.
RFC 1	2-1/2 T., #22 AWG. on Ferrox cube VK211-17/4B Core.

TRW

SSB Power Transistors

- 100 W
- 28 V
- ∞ VSWR



B

The PT 9780 SSB/VHF Series features both high gain and high power, providing the desired power output with fewer devices. These power transistors are ballasted for ruggedness and will withstand infinite VSWR at all phase angles. A unique emitter structure provides high gain with wider emitter and base fingers resulting in high reliability. Diffused ballast resistors design enables operation at Class A, AB, and C. These rugged units are suitable for both narrow band and broadband SSB and VHF communications and instrumentation service. They are suitable for the following applications :

2-30 MHz	SSB, FM, AM
2-76 MHz	SSB, FM, AM
2-100 MHz	Linear Class A, SSB, FM, AM

Electrical Characteristics (T_{flange} = 25 °C)

	SYMBOL	CHARACTERISTICS	CONDITIONS	PT 9780 A	UNIT
DC Tests	BV_{CBO}	Collector to Base Breakdown Voltage	I_C = 100 mA I_E = 0	70	V Min.
	BV_{CEO}	Collector to Emitter Breakdown Voltage	I_C = 50 mA I_B = 0	40	V Min.
	I_{CES}	Collector - Emitter Cutoff Current	V_{CE} = 28 V	100	mA Max.
	I_{EBO}	Emitter - Base Leakage Current	V_{BE} = 4 V	5.0	mA Max.
	H_{FE}	D.C. Current Gain	V_{CE} = 5 V	10-100	
RF Tests	ΔH_{FE}	Matched Pairs	I_C = 1 A	Δ 5	
	G_P	Power Gain	V_{CE} = 28 V F = 28 MHz } PEP 100 W	14	dB Min.
	IMD	Intermodulation Distortion	V_{CE} = 28 V F = 28 MHz } PEP 100 W	−32	dB Max.
	VSWR	Mismatch Tolerance	V_{CE} = 28 V F = 28 MHz } PEP 100 W	∞	—

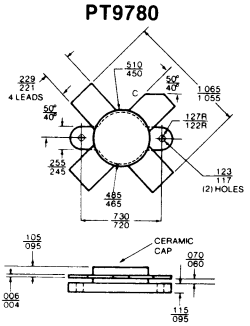
Absolute Maximum Ratings (T_{CASE} = 25°C)

Part Number*	V_{CBO} Volts	V_{CEO} Volts	V_{EBO} Volts	I_C Max Amps	P_T @ 25°C Watts	θ_{jc} °C/W	$T_{STORAGE}$ °C
PT9780	70	40	4.0	20.0	350	0.50	-65 to 200
PT9780A	70	40	4.0	20.0	250	0.70	-65 to 200

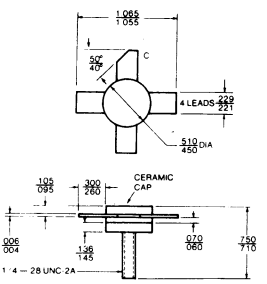
*The "A" suffix on part number denotes stud package.

Package Outlines

PT9780



PT9780A

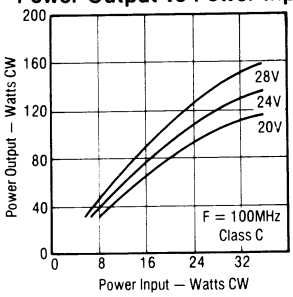


Mechanical Specifications

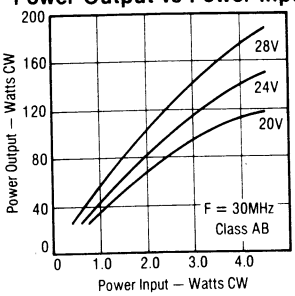
- Stud Torque, 10 in. lbs., max.
- Lead Soldering, 300°C, 15 sec. max.
- Lead Fatique, 3 bends @ 90°
- Flange Flatness, 0.0008 in. typ.

PT9780 and PT9780A

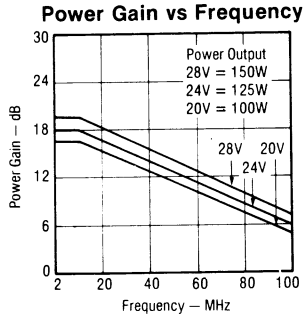
Power Output vs Power Input



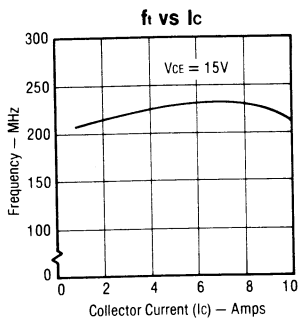
Power Output vs Power Input



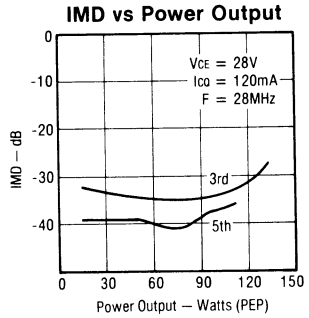
Power Gain vs Frequency



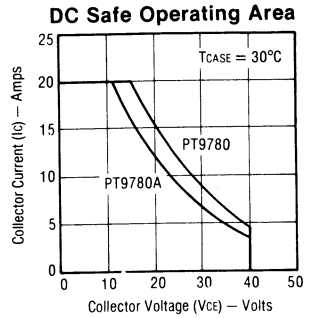
fT vs Ic



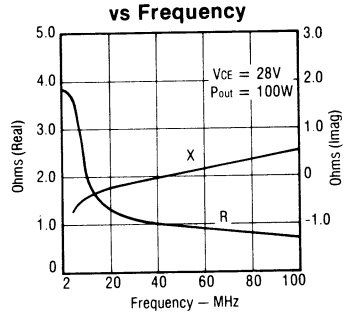
IMD vs Power Output



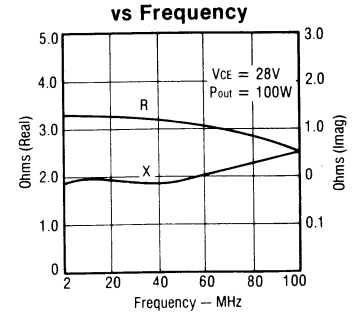
DC Safe Operating Area



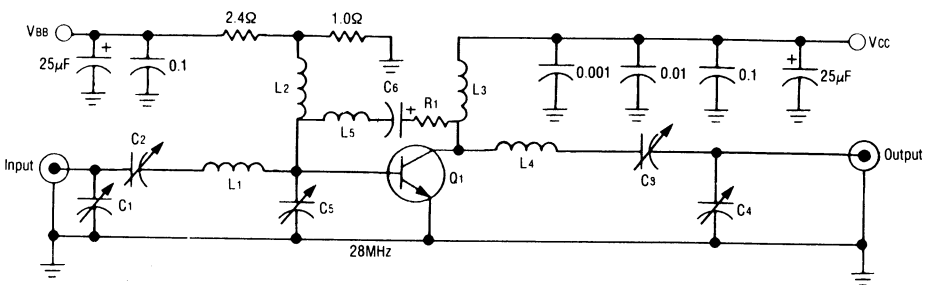
Series Input Impedance vs Frequency



Series Load Impedance vs Frequency



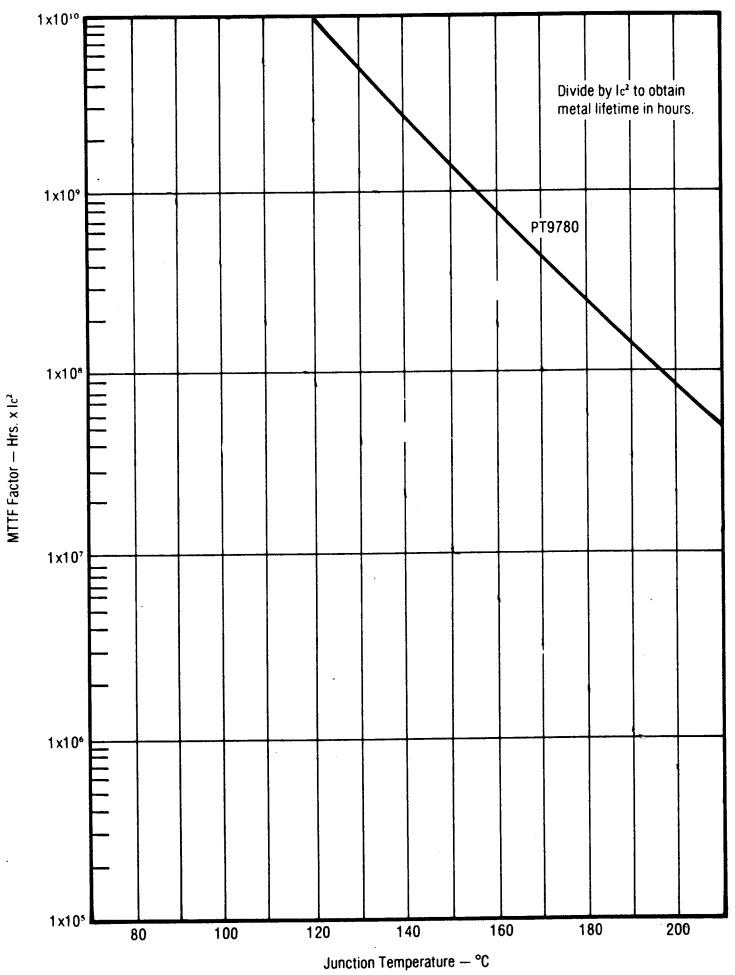
28MHz Test Circuit for PT9780/A.



C_1	ARCO #467, 110-580pF
$C_{2,3,4}$	ARCO #466, 80-480pF
C_5	ARCO #469, 170-780pF
C_6	5μF, 50V ELE
R_1	50Ω, 2W
$L_{1,4}$	5 turns #14 tinned copper, 0.5" mean diameter, 1 equals 1.0"
L_2	10 turns #18AWG, 0.5" mean diameter
L_3	4 turns #20AWG through two Stackpole #23-1838 cores
L_5	6.8μH molded
V_{CC}	28V
V_{BB}	1.6 volts (I_C[Quies] = 100mA)

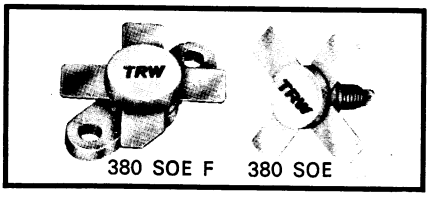
B

MTTF Factor vs Junction Temperature



SSB Power Transistors

- PT 9785 - 100 W
- PT 9784/A - 75 W
- 13.5 V
- ∞ VSWR



This Series features both high gain and high power, providing the desired power output with fewer devices. These power transistors are ballasted for ruggedness and will withstand infinite VSWR at all phase angles. A unique emitter structure provides high gain with wider emitter and base fingers resulting in high reliability. Ballast resistor design enables operation at Class A, AB and C. These rugged units are suitable for both narrow band and broadband HF communications and instrumentation service.

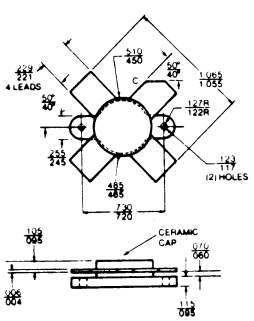
Electrical Characteristics (T_{case} = 25 °C)

	SYMBOL	CHARACTERISTICS	TEST CONDITIONS	PT 9784/A	PT 9785	UNIT
DC TESTS	BV_{CBO}	Collector - Base Breakdown	I_C = 100 mA I_C = 200 mA	50	50	V Min.
	BV_{EBO}	Emitter - Base Breakdown	I_E = 6 mA I_E = 10 mA	4.0	4.0	V Min.
	I_{CES}	Collector - Emitter Cutoff Current	V_{CE} = 13,5 V	20	20	mA Max.
	HF_E	DC Current Gain	V_{CE} = 5 V	20-100	20-100	–
	ΔHF_E	Matched Pairs	I_C = 1 A	Δ 5	Δ 5	–
RF TESTS	P_{OUT}	Output Power PEP	V_{CE} = 13,5 V P = 28 MHz	75	100	W PEP
	P_G	Power Gain	V_{CE} = 13,5 V F = 28 MHz P_{OUT} = Rated PEP	15	13	dB Min.
	IMD	Intermodulation Distortion	V_{CE} = 13,5 V F = 28 MHz P_{OUT} = Rated PEP	–32	–32	dB Max.
	VSWR	Mismatch Tolerance	V_{CE} = 13,5 V F = 28 MHz P_{OUT} = Rated PEP	∞	∞	–
THERMAL	Rth	Thermal Resistance Jonction to Heatsink (Including Contact)	V_{CE} = 13,5 V th = 40 °C Pd = 50 W Pd = 60 W	1,4	0,9	°C/W

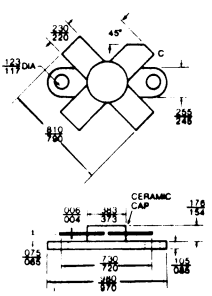
Absolute Maximum Ratings (T_{case} = 25 °C)

Part number	V_{CBO} V	V_{CEO} V	V_{CBO} V	$T_{storage}$ °C
PT 9784/A	50	20.0	4.0	— 65 to 200
PT 9785	50	20.0	4.0	— 65 to 200
The « A » suffix on part number denotes stud package				

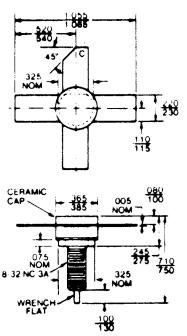
PT 9785



PT 9784



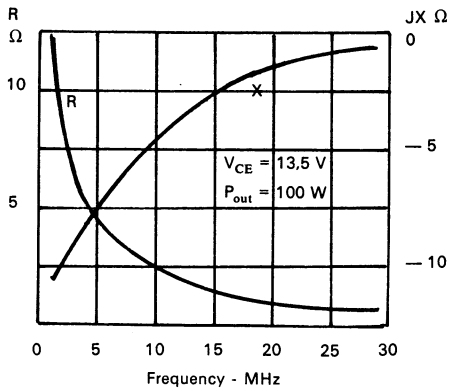
PT 9784 A



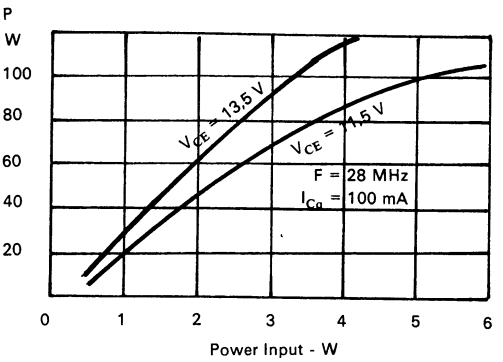
Mechanical Specifications

- Stud Torque, 10 in. lbs., max.
- Lead Soldering, 300°C, 15 sec. max.
- Lead Fatique, 3 bends @ 90°
- Flange Flatness, 0.0008 in. typ.

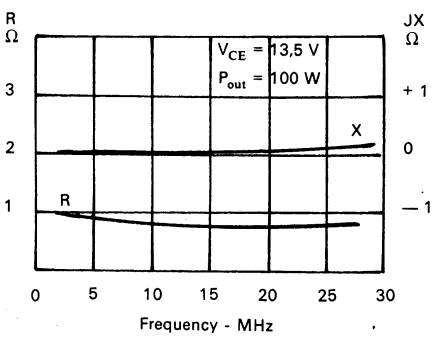
Series Input Impedance vs Frequency



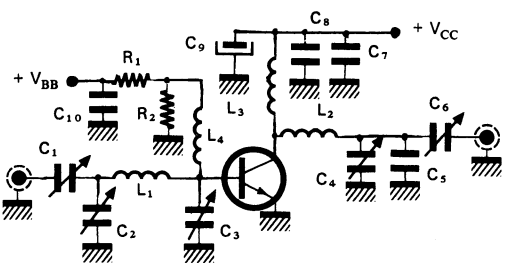
Power Output vs Power Input



Series Load Impedances vs Frequency



28 MHz Test Circuit



Test Circuit Ports List

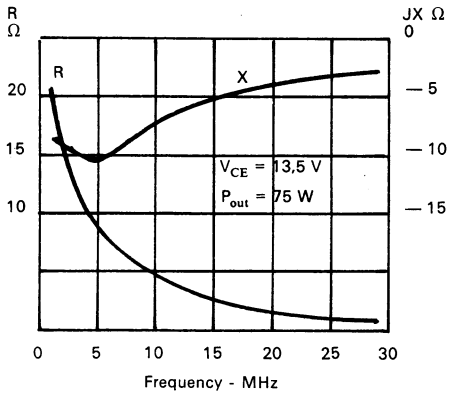
C_1 ARCO 423 7-100 pF
C_2 ARCO 467 110-680 pF
C_3 ARCO 469 170-780 pF
C_4 ARCO 466 80-480 pF
C_5 400 pF UNELCO
C_6 ARCO 423 7-100 pF
C_7 1000 pF UNELCO
C_8 0,1 µF
C_9 470 µF Electrolytic
C_{10} 0,1 µF

L_1 3 turns ⌀ 11 mm 1 mm wire L = 15 mm
L_2 3 turns ⌀ 15 mm 1,8 mm wire L = 20 mm
L_3 Sturns ⌀ 12 mm 1,8 mm wire
L_4 VK 200 ferrite choke

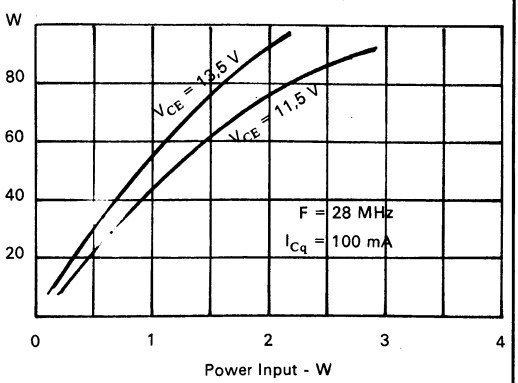
R_1 1,5 Ω
R_2 10 Ω/5 W

B

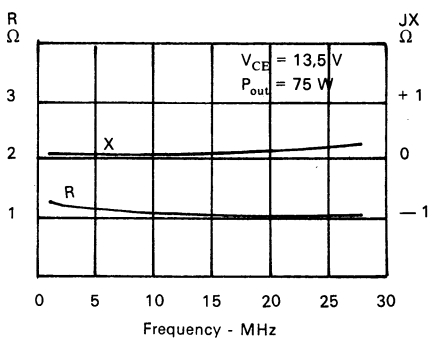
Series Input Impedance vs Frequency



Power Output vs Power Input



Series Load Impedance vs Frequency



Test Circuit Parts List

L_1	3 turns ⌀ 12 mm 1,4 mm wire
L_2	2 turns ⌀ 13 mm 1,8 mm wire L = 10 mm
L_3	8 turns ⌀ 12 mm 1,2 mm wire
L_3	VK 200 ferrite choke
C_1	400 pF UNELCO
C_2	ARCO 427 55-300 pF
C_3	ARCO 469 170-780 pF
C_4	ARCO 469 170-780 pF
C_5	ARCO 427 55-300 pF
C_6	300 pF UNELCO
C_7	ARCO 425 24-200 pF
C_8	1000 pF UNELCO
C_9	0,1 μF
C_{10}	470 μF Electrolytic
C_{11}	0,1 μF
R_1	1,5 Ω
R_2	10 Ω/5 W

28 MHz Test Circuit