

## The RF Line UHF Power Transistor

The TP3021 is designed for 24 V common emitter base station amplifiers. Operating in the 820–960 MHz bandwidth, it has been specifically designed for use in analog and digital (GSM) systems as a medium power output device.

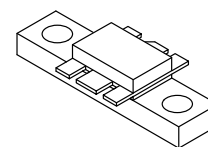
- Specified 24 Volts, 960 MHz Characteristics
  - Output Power = 10 Watts
  - Minimum Gain = 10 dB
  - Class AB
  - $I_Q = 60$  mA
- Circuit board photomaster available upon request by contacting RF Tactical Marketing in Phoenix, AZ.

**TP3021**

**10 W, 960 MHz  
UHF POWER  
TRANSISTOR  
NPN SILICON**

### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	27	Vdc
Collector-Base Voltage	$V_{CBO}$	48	Vdc
Emitter-Base Voltage	$V_{EBO}$	4.0	Vdc
Collector Current — Continuous	$I_C$	2.0	Adc
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	35 0.35	Watts W/ $^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	–65 to +150	$^\circ\text{C}$
Operating Junction Temperature	$T_J$	200	$^\circ\text{C}$



**CASE 319-07, STYLE 2**

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case (1) at $70^\circ\text{C}$ Case	$R_{\theta JC}$	5.0	$^\circ\text{C/W}$

### ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
----------------	--------	-----	-----	-----	------

### OFF CHARACTERISTICS

Collector-Emitter Breakdown Voltage ( $I_C = 25$ mA, $R_{BE} = 75$ $\Omega$ )	$V_{(BR)CER}$	40	—	—	Vdc
Emitter-Base Breakdown Voltage ( $I_C = 5.0$ mAdc)	$V_{(BR)EBO}$	4.0	—	—	Vdc
Collector-Base Breakdown Voltage ( $I_E = 50$ mAdc)	$V_{(BR)CBO}$	48	—	—	Vdc
Collector-Emitter Leakage ( $V_{CE} = 26$ V, $R_{BE} = 75$ $\Omega$ )	$I_{CER}$	—	—	5.0	mA

### ON CHARACTERISTICS

DC Current Gain ( $I_C = 1.0$ Adc, $V_{CE} = 10$ Vdc)	$h_{FE}$	15	—	100	—
--	----------	----	---	-----	---

NOTE:

- Thermal resistance is determined under specified RF operating condition.

# **ELECTRICAL CHARACTERISTICS — continued** ( $T_C = 25^\circ\text{C}$ unless otherwise noted.)

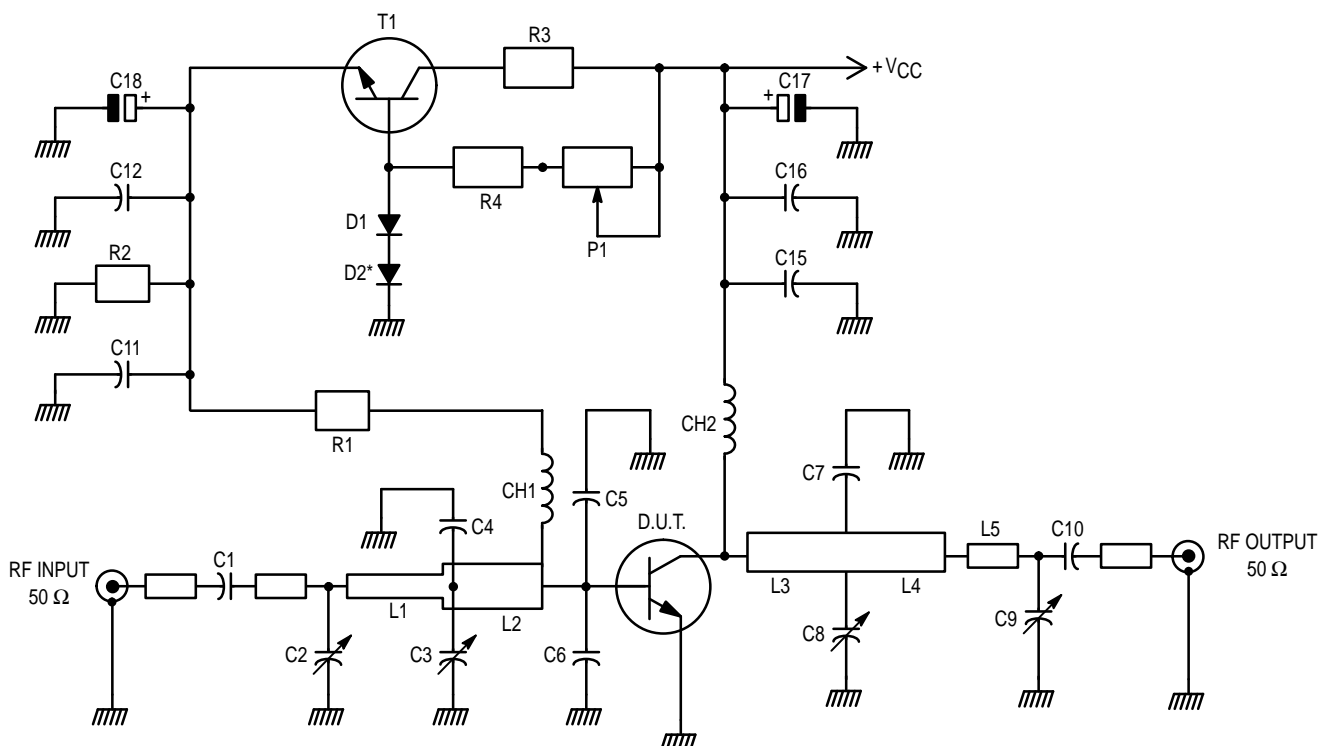
Characteristic	Symbol	Min	Typ	Max	Unit
----------------	--------	-----	-----	-----	------

## **DYNAMIC CHARACTERISTICS**

Output Capacitance ( $V_{CB} = 24\text{ V}$ , $I_E = 0$ , $f = 1.0\text{ MHz}$ )	$C_{ob}$	15	—	25	pF
---	----------	----	---	----	----

## **FUNCTIONAL TESTS**

Common-Emitter Amplifier Power Gain ( $V_{CC} = 24\text{ V}$ , $P_{out} = 10\text{ W}$ , $I_{CQ} = 60\text{ mA}$ , $f = 960\text{ MHz}$ )	$G_p$	10	—	—	dB
Load Mismatch ( $V_{CC} = 26\text{ V}$ , $P_{out} = 10\text{ W}$ , $I_{CQ} = 60\text{ mA}$ , Load VSWR = 20:1, at all phase angles)	$\psi$	No Degradation in Output Power Before and After Test			
Collector Efficiency ( $V_{CC} = 24\text{ V}$ , $P_{out} = 10\text{ W}$ , $f = 960\text{ MHz}$ )	$\eta_c$	50	55	—	%



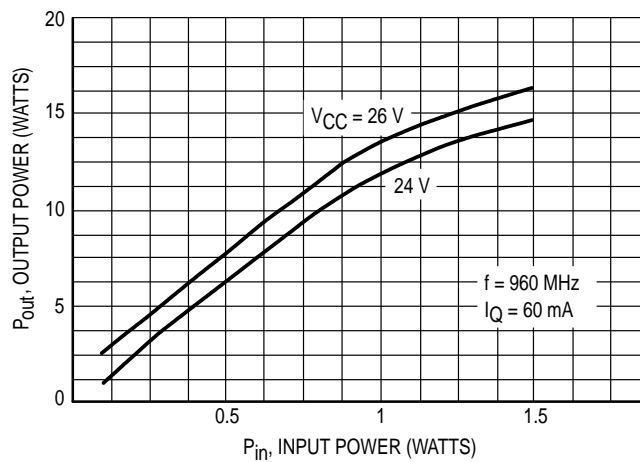
\*D2 is in Physical Contact with RF Transistor

C1, C10, C11, C15 — Capacitor Chip 0805 330 pF 5%  
C2, C4, C8, C9 — Trimmer Capacitor 0.5–4.0 pF  
C4 — Capacitor Chip 0805 3.9 pF 5%  
C5, C6 — Capacitor Chip 15 pF HQ  
C7 — Chip Resistor 0805 8.2 pF  
C12, C16 — Capacitor Chip 0805 15 nF 5%  
C17, C18 — Capacitor Chip 0805 6.0, 8.0  $\mu\text{F}$  35 V  
CH1 — Microstrip Line 80  $\Omega$  L = 40 mm  
CH2 — Microstrip Line 80  $\Omega$  L = 23 mm  
D1, D2 — Diode 1N4148

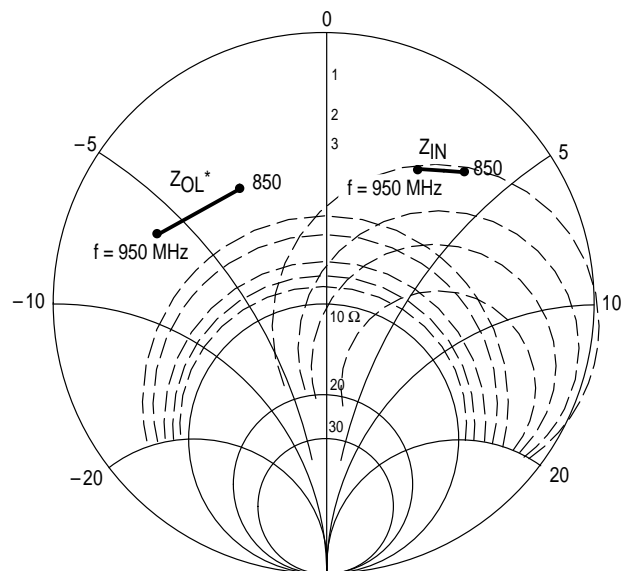
L1 — Microstrip Line 50  $\Omega$  L = 20 mm  
L2 — Microstrip Line 25  $\Omega$  L = 13 mm  
L3 — Microstrip Line 25  $\Omega$  L = 10 mm  
L4 — Microstrip Line 50  $\Omega$  L = 5 mm  
L5 — Microstrip Line 50  $\Omega$  L = 7 mm  
P1 — Trimmer 5.0 k $\Omega$   
R1 — Chip Resistor 2.2  $\Omega$  1206 5%  
R2 — Chip Resistor 75  $\Omega$  0805 5%  
R3 — Resistor 100  $\Omega$  2.0 W  
R4 — Resistor 1.0 k $\Omega$  5%  
T1 — Transistor BD135 or Similar

Board Material — 1/50", Teflon Glass, Cu Clad 2 Sides, 35  $\mu\text{m}$  Thick

**Figure 1. 960 MHz Test Circuit**



**Figure 2. Output Power versus Input Power**

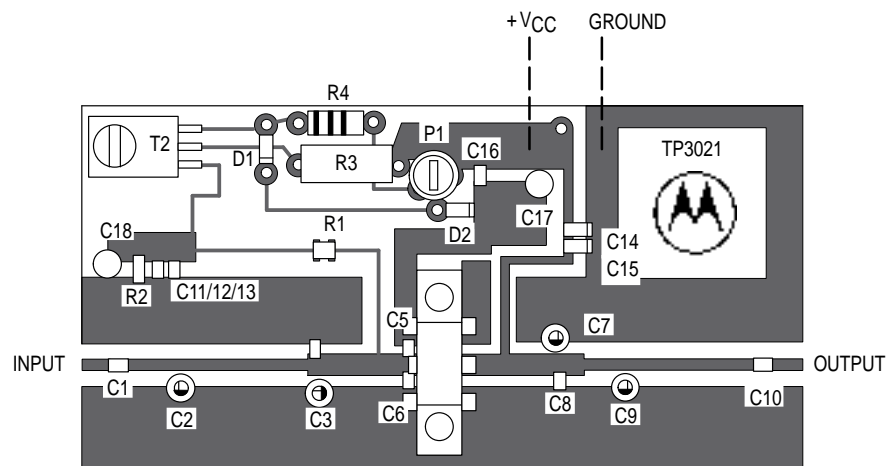


$P_{out} = 10\text{ W}$   $V_{CE} = 24\text{ V}$

f MHz	$Z_{IN}$ OHMS	$Z_{OUT}^*$ OHMS
850	$2.4 + j3.5$	$3.4 - j3.2$
900	$2.6 + j3.4$	$3.1 - j4.4$
950	$2.8 + j3.4$	$2.7 - j6.2$

$Z_{OUT}^*$  = Conjugate of the optimum load impedance. Into which the device operates at a given output power, voltage, and frequency.


**Figure 3. Series Equivalent Input/Output Impedances**



**Figure 4. Test Circuit — Component Locations**

PACKAGE DIMENSIONS



Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters can and do vary in different applications. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and  are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

**Literature Distribution Centers:**  
USA: Motorola Literature Distribution; P.O. Box 20912; Phoenix, Arizona 85036.  
EUROPE: Motorola Ltd.; European Literature Centre; 88 Tanners Drive, Blakelands, Milton Keynes, MK14 5BP, England.  
JAPAN: Nippon Motorola Ltd.; 4-32-1, Nishi-Gotanda, Shinagawa-ku, Tokyo 141, Japan.  
ASIA PACIFIC: Motorola Semiconductors H.K. Ltd.; Silicon Harbour Center, No. 2 Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong.



◇ CODELINE TO BE PLACED HERE

