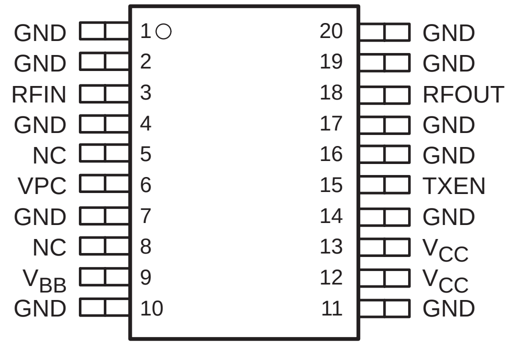
- **Operates from 3.6-V and 4.8-V Power Supplies for AMPS/NADC and GSM Applications Respectively**
- **Unconditionally Stable**
- **Wide UHF Frequency Range 800 MHz to 1000 MHz**
- **21 dBm and 23 dBm Typical Output Power in AMPS/NADC and GSM Applications Respectively**
- **Linear Ramp Control**
- **Transmit Enable/Disable Control**
- **Advanced BiCMOS Processing Technology for Low-Power Consumption, High Efficiency, and Highly Linear Operation**
- **Minimum of External Components Required for Operation**
- **Surface-Mount Thermally Enhanced Package for Extremely Small Circuit Footprint**

**PWP PACKAGE
(TOP VIEW)**



NC – No internal connection

description

The TRF8010 is an RF transmit driver amplifier for 900-MHz digital, analog, and dual-mode communication applications. It consists of a two-stage amplifier and a linear ramp controller for burst control in TDMA (time division multiple access) applications. Very few external components are required for operation.

The TRF8010 amplifies the RF signal from the preceding modulator and upconverter stages in an RF section of a transmitter to a level that is sufficient to drive a final RF power output device. The output impedance of RFOUT is approximately 50 Ω. But, since RFOUT is connected to an open-collector output device, minimal external matching is required.

The device is enabled when the TXEN input is held high. A power control signal applied to the VPC input can ramp the RF output power up or down to meet ramp and spurious emission specifications in TDMA systems. The power control signal causes a linear change in output power as the voltage applied to VPC varies between 0 V and 3 V. With the RF input power applied to RFIN at 0 dBm and TXEN high, adjusting VPC from 0 V to 3 V increases the output power from a typical value of –54 dBm at VPC = 0 V to the output power appropriate for the application:

- 21 dBm typical for AMPS/NADC (Advanced Mobile Phone Service/North American Digital Cellular) operation
- 23 dBm typical for GSM (Global System for Mobile Communications) operation

Forward isolation with the RF input power applied to RFIN at 0 dBm, VPC = 0 V, and TXEN high is typically greater than 50 dB.

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

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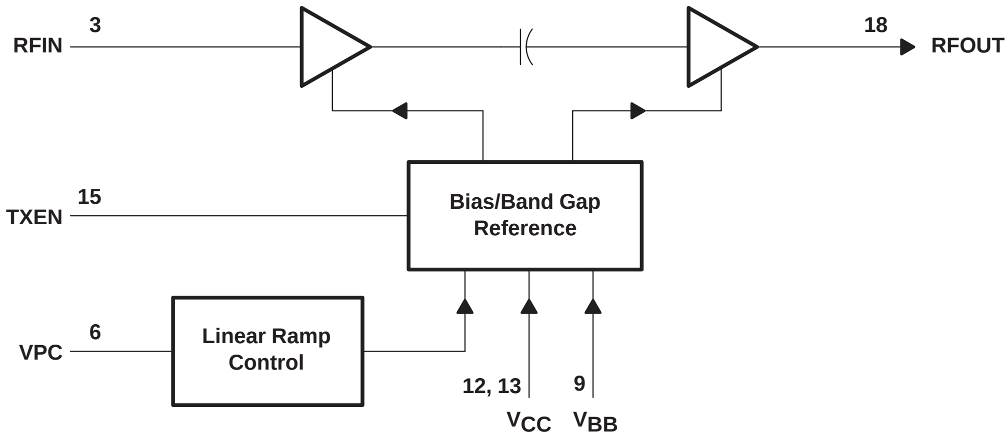
description (continued)

The TRF8010 is available in a small, surface-mount, thermally enhanced TSSOP 20-pin PWP (PowerPAD™) package and is characterized for operation from –40°C to 85°C. The PWP package has a solderable pad that can improve the package thermal performance by bonding the pad to an external thermal plane. The pad also acts as a low-inductance electrical path to ground and, for the TRF8010, must be electrically connected to the PCB ground plane as a continuation of the regular package terminals that are designated GND.

functional block diagram



Terminal Functions

TERMINAL NAME	TERMINAL NO.	I/O	DESCRIPTION
GND	1, 2, 4, 7, 10, 11, 14, 16, 17, 19, 20		Analog ground for all internal analog circuits. All signals are referenced to the ground terminals.
NC	5, 8		No connection. It is recommended that all NC terminals be connected to ground.
RFIN	3	I	RF input. RFIN accepts signals between 800 MHz and 1000 MHz.
RFOUT	18	O	RF output. RFOUT is an open-collector output and requires a decoupled connection to V_{CC} for operation.
TXEN	15	I	Transmit enable input (digital). When TXEN is high, the output device is enabled.
V_{BB}	9		Control section supply voltage.
V_{CC}	12, 13		First stage bias.
VPC	6	I	Voltage power control. VPC is a signal between 0 V and 3 V that adjusts the output power from a typical value of –54 dBm to the maximum output power appropriate for the application.

PowerPAD is a trademark of Texas Instruments Incorporated.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage range, V_{CC} (see Note 1) . . . . –0.6 V to 5.6 V
Input voltage range at TXEN, VPC . . . . –0.6 V to 5.6 V
Input power at RFIN . . . . 10 dBm
Thermal resistance, junction to case, $R_{\theta JC}$ (see Note 2) . . . . 3.5°C/W
Thermal resistance, junction to ambient, $R_{\theta JA}$ (see Note 3) . . . . 32°C/W
Continuous total power dissipation at T_A = 25°C . . . . 3.9 W
Operating junction temperature, T_J . . . . 110°C
Junction temperature, T_J max . . . . 150°C
Operating free-air temperature range, T_A . . . . –40°C to 85°C
Storage temperature range, T_{stg} . . . . –65°C to 100°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. Voltage values are with respect to GND.
2. No air flow and with infinite heatsink
3. With the thermal pad of the device soldered to a 1-ounce copper (Cu) ground plane on an FR4 board with no air flow

recommended operating conditions

	MIN	NOM	MAX	UNIT
Supply voltage, V_{CC} (see Note 1)	3		5	V
High-level input voltage at TXEN, V_{IH}	V_{CC} –0.8			V
Low-level input voltage at TXEN, V_{IL}			0.8	V
Operating free-air temperature, T_A	–40		85	°C

NOTE 1: Voltage values are with respect to GND.

electrical characteristics over full range of operating conditions

supply current, V_{CC} = 3.6 V

PARAMETER			TEST CONDITIONS	MIN	TYP‡	MAX	UNIT
I_{CC}	Supply current from V_{CC}	Operating at maximum power out	TXEN high, VPC = 3 V		163		mA
		Operating at minimum power out	TXEN high, VPC = 0 V		7		mA

‡ Typical values are at T_A = 25°C.

supply current, V_{CC} = 4.8 V

PARAMETER			TEST CONDITIONS	MIN	TYP‡	MAX	UNIT
I_{CC}	Supply current from V_{CC}	Operating at maximum power out	TXEN high, VPC = 3 V		155	210	mA
		Operating at minimum power out	TXEN high, VPC = 0 V		7		mA
		Power down	TXEN low, VPC = 0 V			0.05	mA

‡ Typical values are at T_A = 25°C.

AMPS/NADC operation, V_{CC} = 3.6 V, TXEN high, VPC = 3 V, T_A = 25°C (unless otherwise noted)

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
	Operating frequency range			824		849	MHz
P_O	Output power		P_I = 0 dBm		21		dBm
			P_I = 0 dBm VPC = 0 V		–58		
	Gain (small signal)		P_I = –20 dBm		27		dB
	Power added efficiency (PAE)		P_I = 0 dBm		28%		
	Input return loss (internally matched)		P_I = –20 dBm		11		dB
	Output return loss (externally matched, small signal)		P_I = –20 dBm		11		dB
	Noise power in 30 kHz bandwidth		45 MHz offset at P_I = 0 dBm		–97		dBm
	Harmonics	$2f_0$	P_I = 0 dBm		–20		dBc
		$3f_0$			–50		

GSM operation, V_{CC} = 4.8 V, TXEN high, VPC = 3 V, T_A = 25°C (unless otherwise noted)

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
	Extended GSM operating frequency range			870		925	MHz
P_O	Output power		P_I = 0 dBm	21.5	23	24.5	dBm
			P_I = 0 dBm VPC = 0 V		–54		
	Gain (small signal)		P_I = –20 dBm		28		dB
	Power added efficiency (PAE)		P_I = 0 dBm		29%		
	Input return loss (internally matched)		P_I = –20 dBm		11		dB
	Output return loss (externally matched, small signal)		P_I = –20 dBm		11		dB
	Harmonics	$2f_0$	P_I = 0 dBm		–28	–22	dBc
		$3f_0$			–40	–35	
	Noise power in 30 kHz bandwidth	20 MHz above f_0	P_I = 0 dBm		–95		dBm
		10 MHz above f_0			–96		

stability, AMPS/NADC and GSM operation

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Stability	Output VSWR† < 6:1 all phases, V_{CC} < 5.6 V, P_I = 0 dBm, $P_O \le$ 22 dBm, Output frequency band: 200 MHz – 1200 MHz		‡		

† VSWR = voltage standing wave ratio
‡ No parasitic oscillations (all spurious < –70 dBc)

switching characteristics

AMPS/NADC and GSM operation, V_{CC} = 3.6 V or 4.8 V, T_A = 25°C

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{on}	Switching time, RF output OFF to ON	TXEN = high, VPC stepped from 0 V to 3 V		1		µs
t_{off}	Switching time, RF output ON to OFF	TXEN = high, VPC stepped from 3 V to 0 V		1		µs

TYPICAL CHARACTERISTICS

OUTPUT POWER vs INPUT POWER

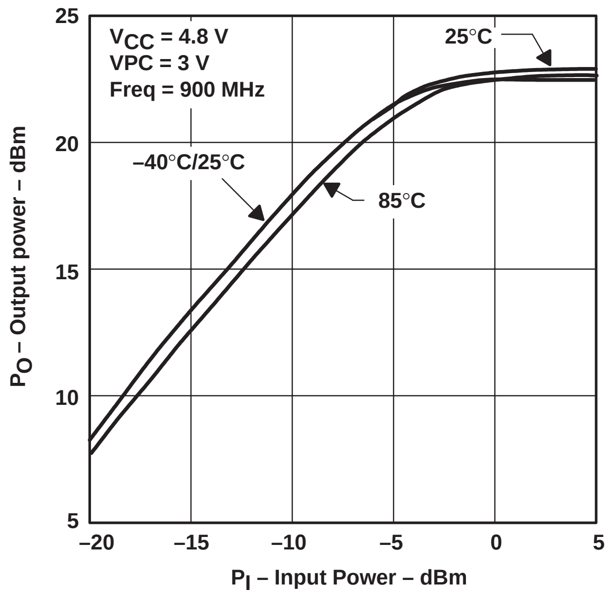


Figure 1

POWER ADDED EFFICIENCY vs INPUT POWER

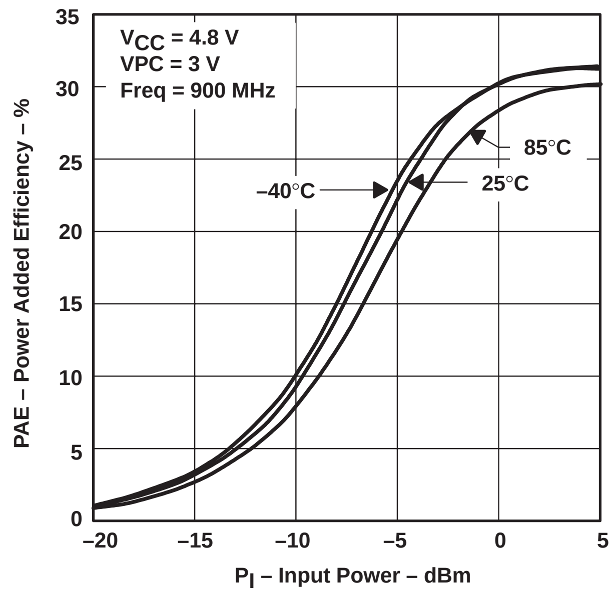


Figure 2

OUTPUT POWER AND POWER ADDED EFFICIENCY vs FREQUENCY

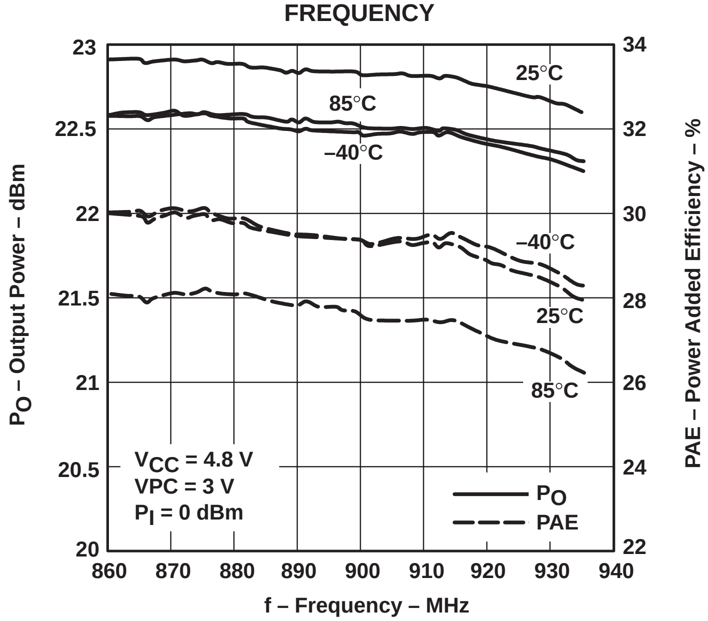


Figure 3

TYPICAL CHARACTERISTICS

OUTPUT POWER
vs
VPC GAIN CONTROL RANGE

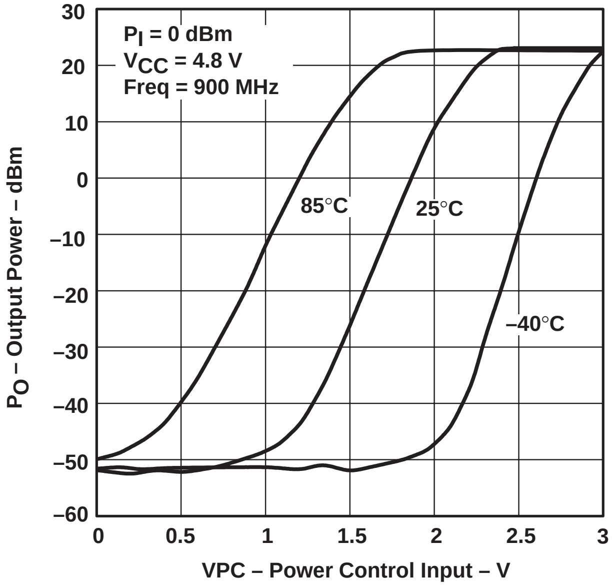


Figure 4

OUTPUT POWER
vs
SUPPLY VOLTAGE

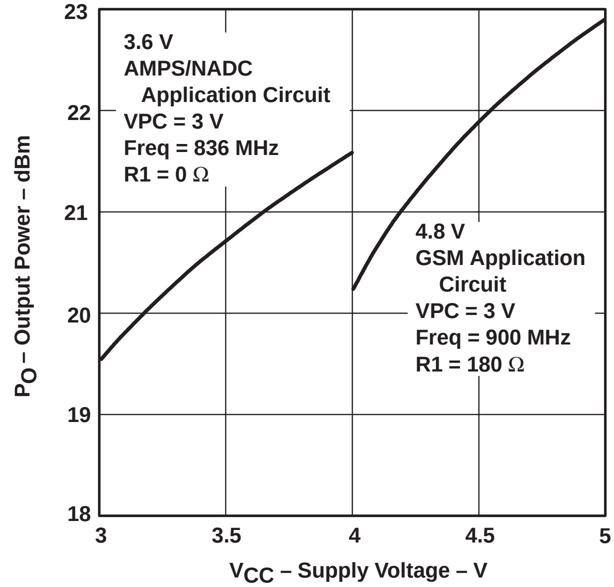


Figure 5

INPUT RETURN LOSS
vs
FREQUENCY

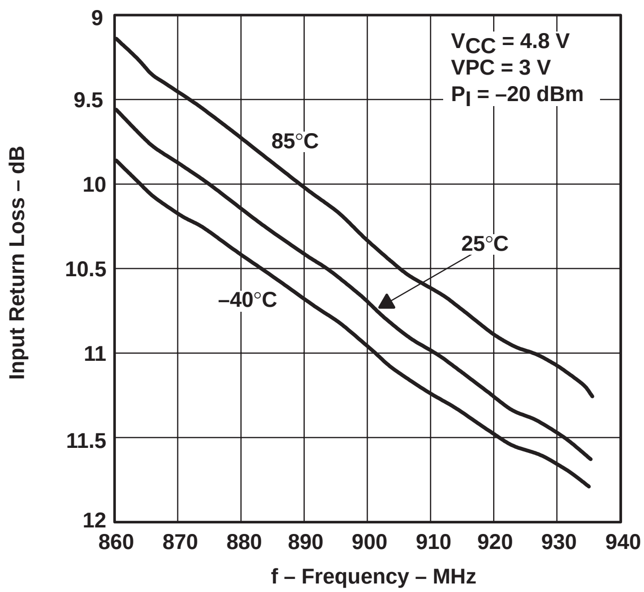


Figure 6

APPLICATION INFORMATION

A typical application example for AMPS/NADC cellular telephone systems is shown in Figure 7.

In all cases, a capacitor must be connected from the positive power supply to ground, as close as possible to the IC terminals for power supply bypassing. A dc-blocking capacitor is also required on the RF output. A list of components and their functions is given in Table 1.

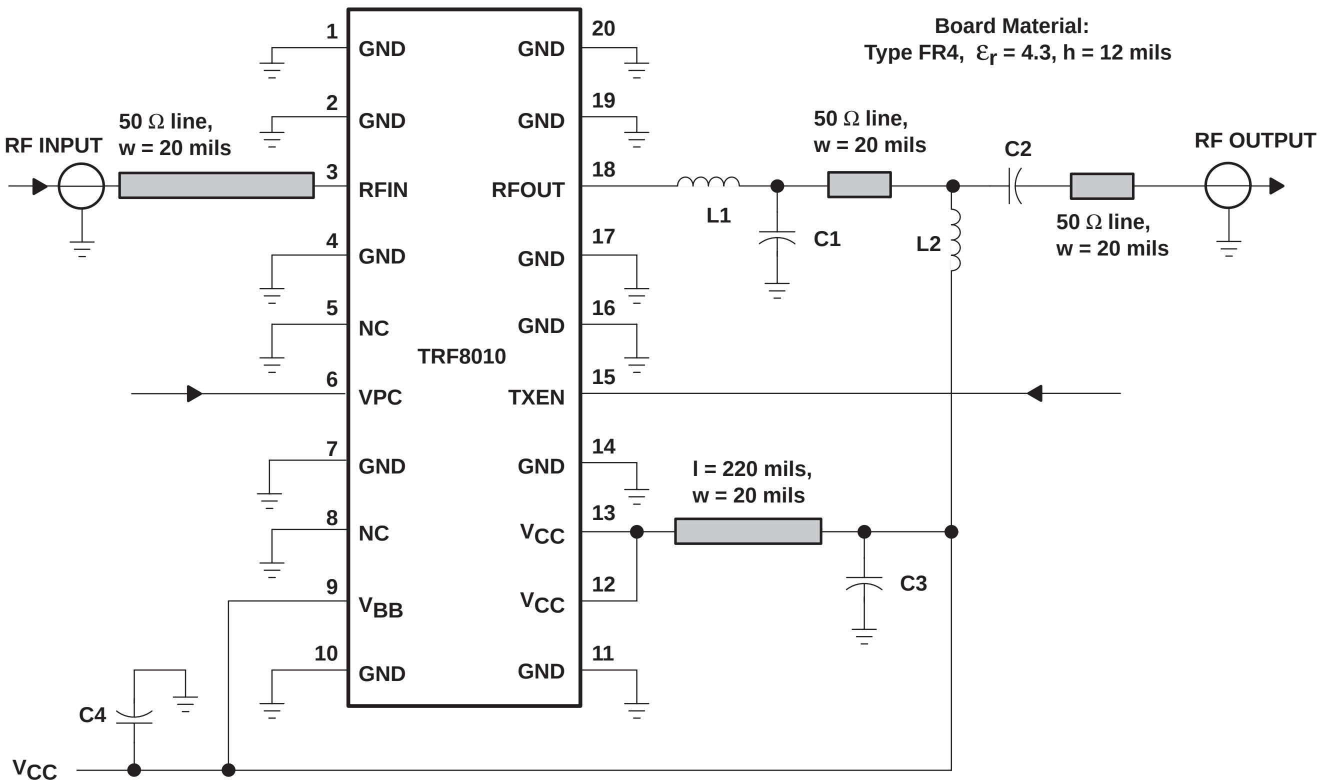


Figure 7. Typical AMPS/NADC Cellular Telephone Application

Table 1. External Component Selection (AMPS/NADC)

COMPONENT DESIGNATION	TYPICAL VALUE (AMPS/NADC)	FUNCTION
C1	3.3 pF	Output impedance matching capacitor
C2	100 pF	DC-blocking capacitor for RF output
C3	100 pF	Matching capacitor
C4	1000 pF	Power supply decoupling capacitor
L1	5.7 nH	Output impedance matching inductor
L2	100 nH	DC bias/RF choke

APPLICATION INFORMATION

A typical application example for GSM cellular telephone systems is shown in Figure 8.

In all cases, a capacitor must be connected from the positive power supply to ground, as close as possible to the IC terminals for power supply bypassing. A dc-blocking capacitor is also required on the RF output. A list of components and their functions is given in Table 2.

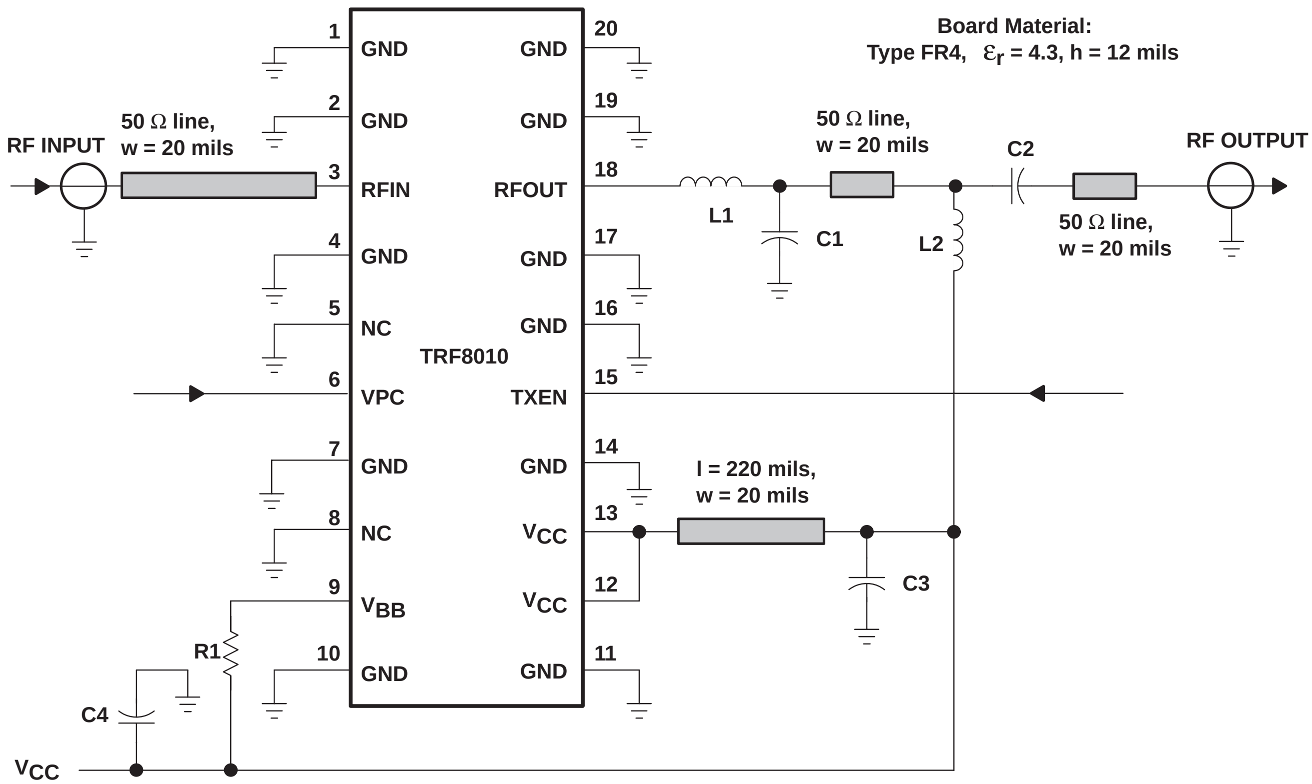


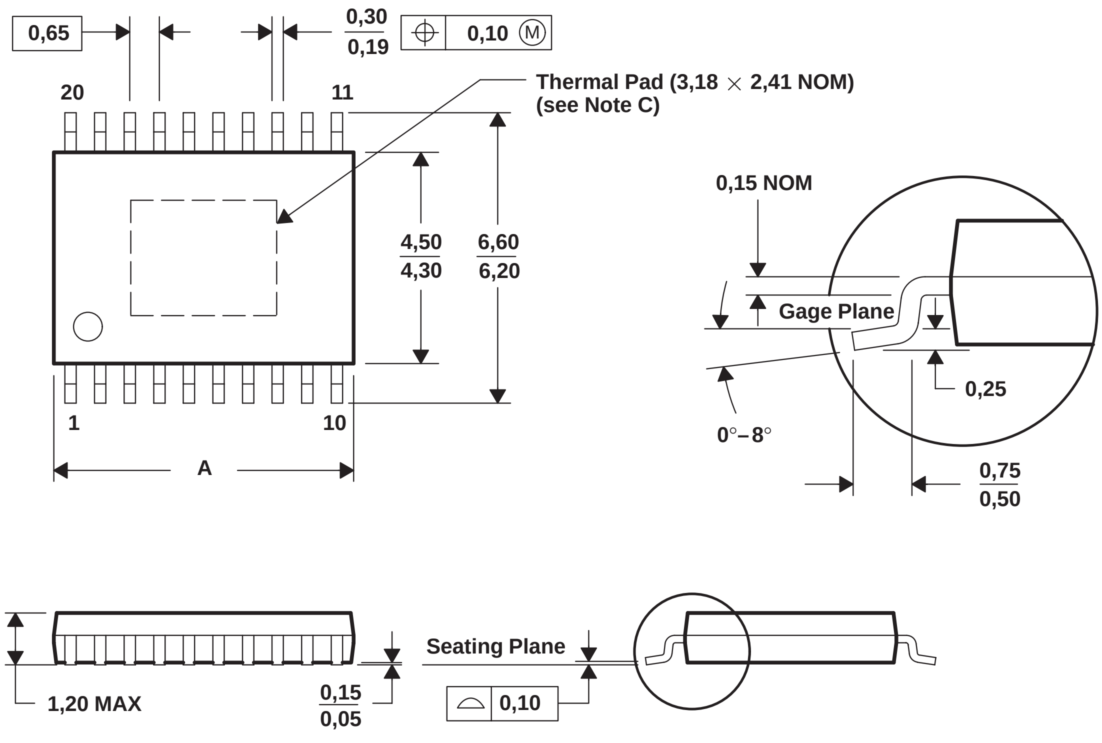
Figure 8. Typical GSM Cellular Telephone Application

Table 2. External Component Selection (GSM)

COMPONENT DESIGNATION	TYPICAL VALUE (GSM)	FUNCTION
C1	3.3 pF	Output impedance matching capacitor
C2	100 pF	DC-blocking capacitor for RF output
C3	100 pF	Matching capacitor
C4	1000 pF	Power supply decoupling capacitor
L1	6.8 nH	Output impedance matching inductor
L2	100 nH	DC bias/RF choke
R1	180 Ω	Bias supply resistor

MECHANICAL DATA

PWP (R-PDSO-G)** **PowerPAD™ PLASTIC SMALL-OUTLINE PACKAGE**



PINS ** / DIM	14	16	20	24	28
A MAX	5,10	5,10	6,60	7,90	9,80
A MIN	4,90	4,90	6,40	7,70	9,60

4073225/E 03/97

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. The package thermal performance may be enhanced by bonding the thermal pad to an external thermal plane. This solderable pad is electrically and thermally connected to the backside of the die and leads 1, 10, 11, and 20.

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