

FEATURES

- Low-Phase-Noise Mixer/Oscillator and PLL Synthesizer
- VHF-L, VHF-H, UHF Three-Band Local Oscillator
- External 4-Pin IF Filter Between Mixer Output and IF Amplifier Input
- I²C Bus Protocol (Bidirectional Data Transmission)
- 30-V Tuning Voltage Output
- Four NPN-Type Band-Switch Drivers
- One Auxiliary-Port, Five-Level ADC
- RF AGC Detector Circuit
- Crystal Oscillator Output
- Programmable Reference Divider Ratio (24/28/50/64/80/128)
- Standby Mode
- 5-V Power Supply
- 38-Pin Thin Shrink Small-Outline Package (TSSOP)

DBT PACKAGE
(TOP VIEW)

VLO OSC B	1	38	UHF RF IN2
VLO OSC C	2	37	UHF RF IN1
OSC GND	3	36	VHI RF IN
VHI OSC B	4	35	VLO RF IN
VHI OSC C	5	34	BS4
UHF OSC B1	6	33	RF GND
UHF OSC C1	7	32	MIXOUT2
UHF OSC C2	8	31	MIXOUT1
UHF OSC B2	9	30	IF IN2
IF GND	10	29	IF IN1
IF OUT1	11	28	RF AGC
IF OUT2	12	27	AGC FIL2
VCC	13	26	AGC FIL1
CP	14	25	BS3
VTU	15	24	BS2
P5/ADC	16	23	BS1
XTAL1	17	22	SDA
XTAL2	18	21	SCL
XTALOUT	19	20	AS

APPLICATIONS

- Digital TV
- Digital CATV
- Set-Top Box

DESCRIPTION

The SN761664 is a low-phase-noise synthesized tuner IC designed for digital TV tuning systems. The circuit consists of a PLL synthesizer, three-band local oscillator and mixer, 30-V output tuning amplifier, and four NPN band-switch drivers, and is available in a small-outline package. A 15-bit programmable counter and reference divider are controlled by I²C bus protocol. Tuning-step frequency is selectable by this reference divider ratio for a crystal oscillator.

P0034-02



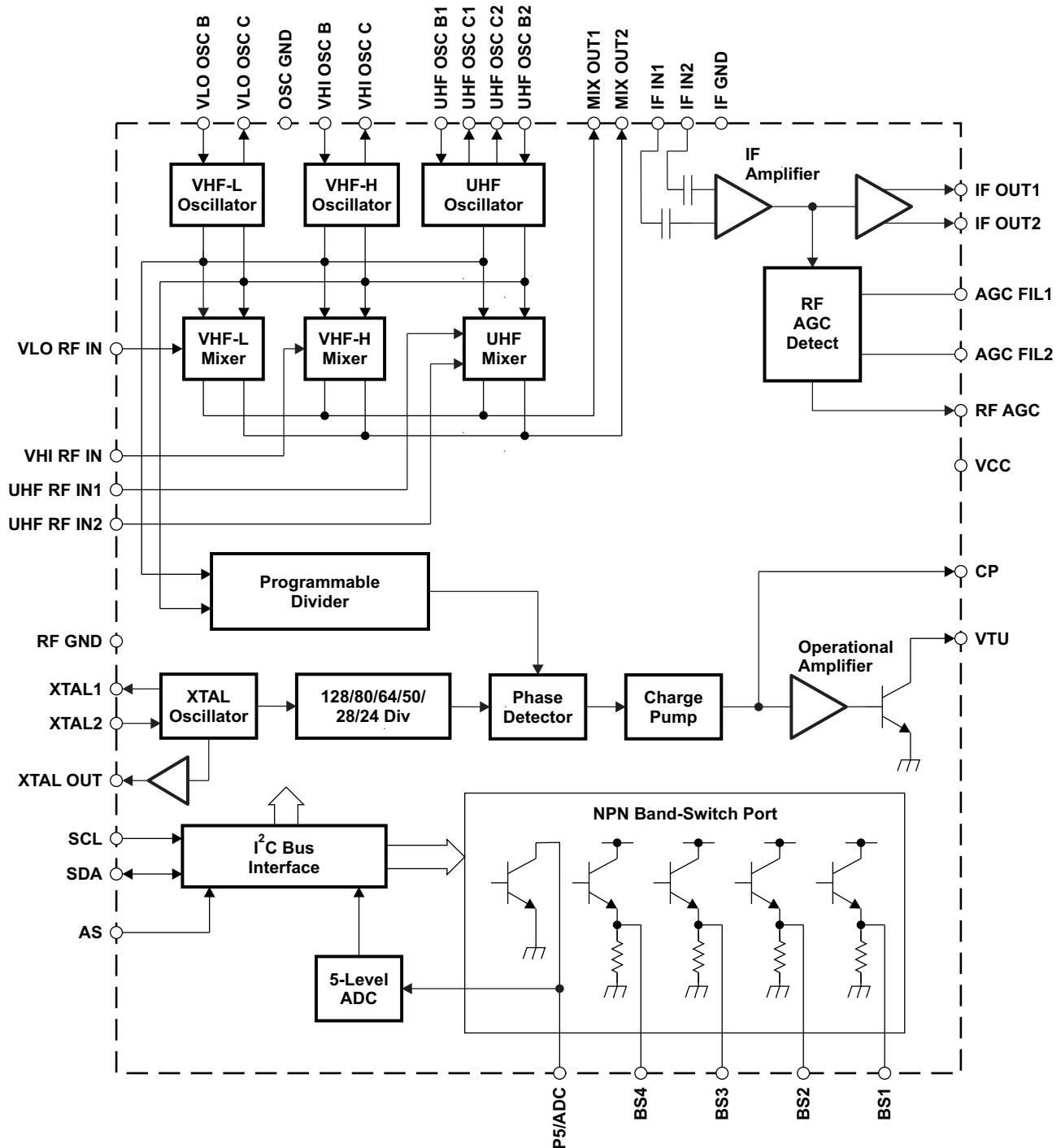
Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

MIXOUT1, MIXOUT2, IF IN1, and IF IN2 (pins 29 – 32) withstand 1.5 kV and all other pins withstand 2 kV, according to the Human-Body Model (1.5 kΩ, 100 pF).

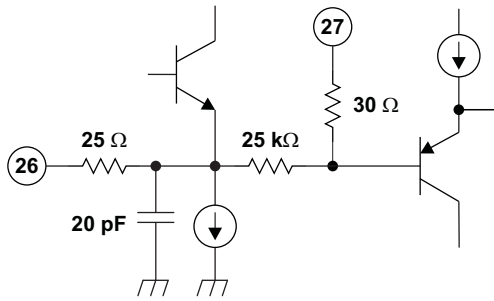
FUNCTIONAL BLOCK DIAGRAM



B0089-01

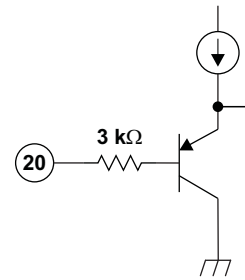
TERMINAL FUNCTIONS

TERMINAL NAME		NO.	DESCRIPTION	SCHEMATIC
AGC FIL1		26	Additional peak-hold capacitor	Figure 1
AGC FIL2		27	RF AGC LPF capacitor	Figure 1
AS		20	Address selection input	Figure 2
BS1		23	Band-switch 1 output	Figure 3
BS2		24	Band-switch 2 output	Figure 3
BS3		25	Band-switch 3 output	Figure 3
BS4		34	Band-switch 4 output	Figure 3
IF IN1		29	IF amplifier input	Figure 7
CP		14	Charge-pump output	Figure 4
IF GND		10	IF ground	
IF OUT1		11	IF amplifier output 1	Figure 5
IF OUT2		12	IF amplifier output 2	Figure 5
MIX OUT1		31	Mixer output 1	Figure 6
MIX OUT2		32	Mixer output 2	Figure 6
IF IN2		30	IF amplifier input	Figure 7
OSC GND		3	Oscillator ground	
P5/ADC		16	Port-5 output/ADC input	Figure 8
RF AGC		28	RF AGC output	Figure 9
RF GND		33	RF ground	
SCL		21	Serial clock input	Figure 10
SDA		22	Serial data input/output	Figure 11
UHF OSC B1		6	UHF oscillator base 1	Figure 12
UHF OSC B2		9	UHF oscillator base 2	Figure 12
UHF OSC C1		7	UHF oscillator collector 1	Figure 12
UHF OSC C2		8	UHF oscillator collector 2	Figure 12
UHF RFIN1		37	UHF RF input 1	Figure 13
UHF RFIN2		38	UHF RF input 2	Figure 13
VCC		13	Supply voltage for mixer/oscillator/PLL: 5 V	
VHI OSC B		4	VHF HIGH oscillator base	Figure 14
VHI OSC C		5	VHF HIGH oscillator collector	Figure 14
VHI RFIN		36	VHF-H RF input	Figure 15
VLO OSC B		1	VHF LOW oscillator base	Figure 16
VLO OSC C		2	VHF LOW oscillator collector	Figure 16
VLO RFIN		35	VHF-L RF input	Figure 19
VTU		15	Tuning voltage amplifier output	Figure 4
XTAL1		17	4-MHz crystal oscillator output	Figure 17
XTAL2		18	4-MHz crystal oscillator input	Figure 17
XTALOUT		19	4-MHz oscillator output	Figure 18



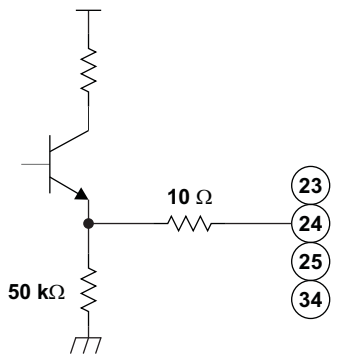
S0139-01

Figure 1.



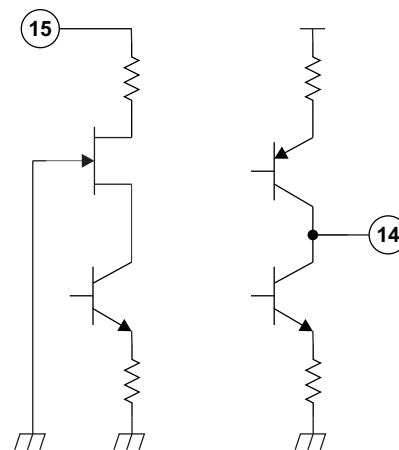
S0136-01

Figure 2.



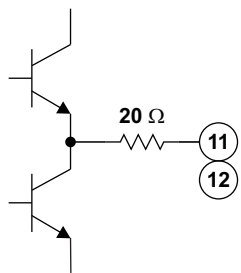
S0138-01

Figure 3.



S0132-01

Figure 4.



S0131-01

Figure 5.

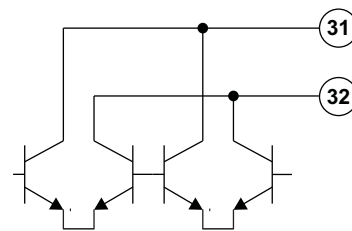


Figure 6.

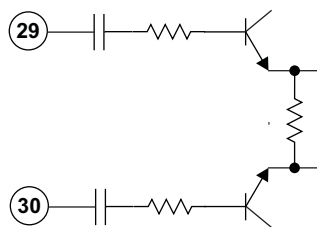
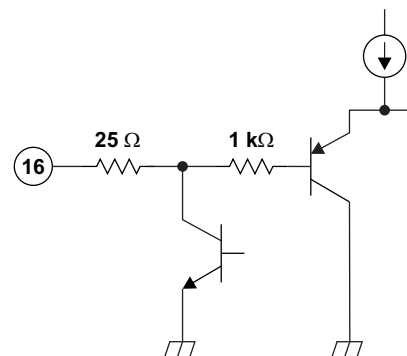
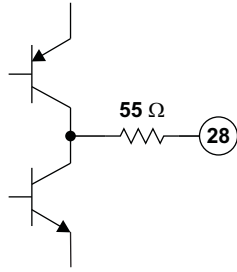


Figure 7.



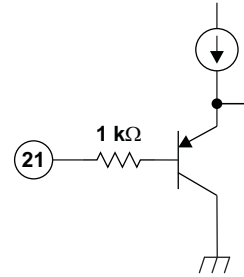
S0133-01

Figure 8.



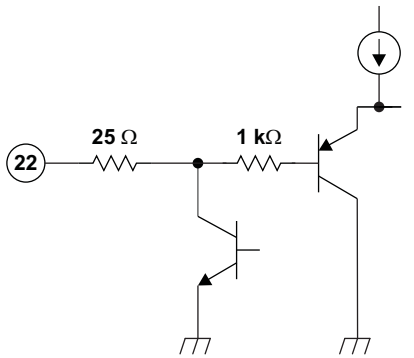
S0140-01

Figure 9.



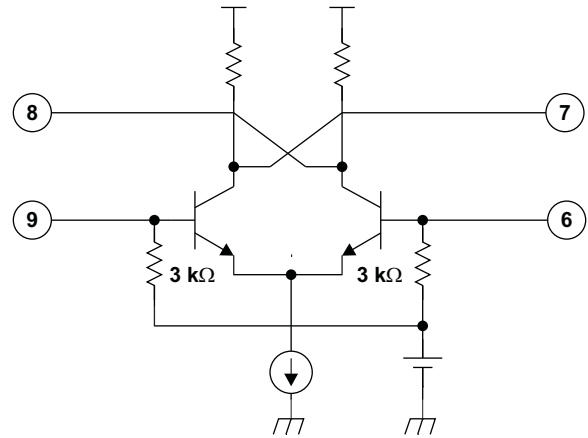
S0136-02

Figure 10.



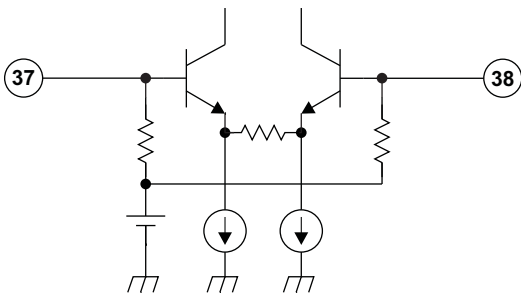
S0137-01

Figure 11.



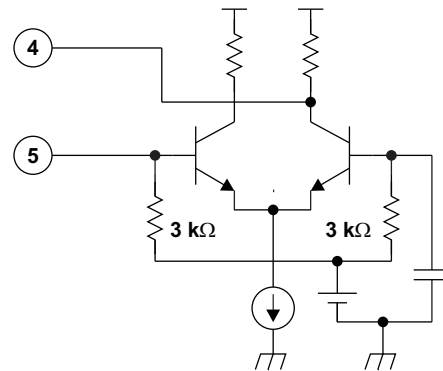
S0130-01

Figure 12.



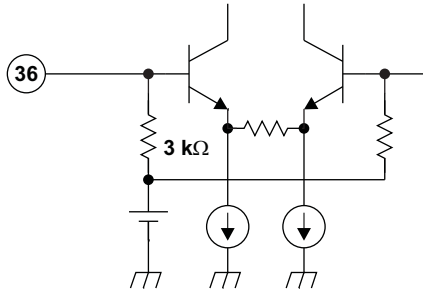
S0142-03

Figure 13.



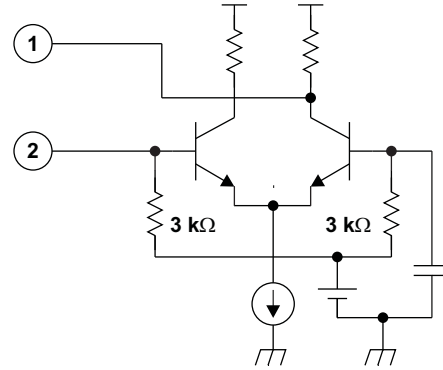
S0129-02

Figure 14.



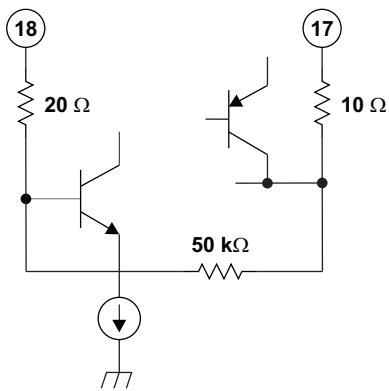
S0142-02

Figure 15.



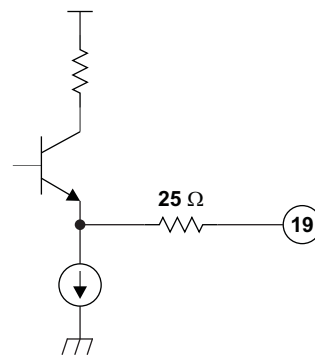
S0129-01

Figure 16.



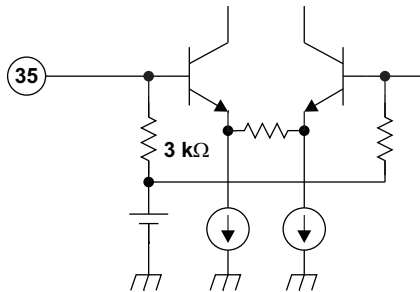
S0134-01

Figure 17.



S0135-01

Figure 18.



S0142-01

Figure 19.

Absolute Maximum Ratings⁽¹⁾

over operating free-air temperature range (unless otherwise noted)

Supply voltage range, V_{CC} ⁽²⁾	VCC	–0.4 V to 6.5 V
Input voltage 1, V_{GND} ⁽²⁾	RF GND, OSC GND	–0.4 V to 0.4 V
Input voltage 2, V_{VTU} ⁽²⁾	VTU	–0.4 V to 35 V
Input voltage 3, V_{IN} ⁽²⁾	Other pins	–0.4 V to 6.5 V
Continuous total dissipation, P_D ⁽³⁾	$T_A \leq 25^\circ\text{C}$	1276 mW
Operating free-air temperature range, T_A		–20°C to 85°C
Storage temperature range, T_{stg}		–65°C to 150°C
Maximum junction temperature, T_J		150°C
Maximum short-circuit time, $t_{SC(max)}$	Each pin to V_{CC} or to GND	10 s

- (1) 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.
- (2) Voltage values are with respect to the IF GND of the circuit.
- (3) Derating factor is 10.2 mW/°C for $T_A \geq 25^\circ\text{C}$.

Recommended Operating Conditions

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}		4.5	5	5.5	V
Tuning supply voltage, V_{TU}			30	33	V
Output current of band switch, I_{BS}	One band switch on			10	mA
Output current of port 5, I_{P5}				–5	mA
Operating free-air temperature, T_A		–20		85	°C

Electrical Characteristics – Total Device and Serial Interface

$V_{CC} = 4.5\text{ V to }5.5\text{ V}$, $T_A = -20^\circ\text{C to }85^\circ\text{C}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{CC1}	Supply current 1			75		mA
I_{CC2}	Supply current 2	One band switch on ($I_{BS} = 10\text{ mA}$)		87		mA
$I_{CC-STBY}$	Standby supply current	STBY = 1		8		mA
V_{IH}	High-level input voltage (SCL, SDA)		2.3			V
V_{IL}	Low-level input voltage (SCL, SDA)				1.35	V
I_{IH}	High-level input current (SCL, SDA)				10	μA
I_{IL}	Low-level input current (SCL, SDA)		-10			μA
V_{POR}	Power-on-reset supply voltage (threshold of supply voltage between reset and operation mode)		2.1	2.8	3.5	V
I²C Interface						
V_{ASH}	Address-select high-input voltage (AS)	$V_{CC} = 5\text{ V}$	4.5		5	V
V_{ASM1}	Address-select mid-input 1 voltage (AS)	$V_{CC} = 5\text{ V}$	2		3	V
V_{ASM2}	Address-select mid-input 2 voltage (AS)	$V_{CC} = 5\text{ V}$	1		1.5	V
V_{ASL}	Address-select low-input voltage (AS)	$V_{CC} = 5\text{ V}$			0.5	V
I_{ASH}	Address-select high-input current (AS)				10	μA
I_{ASL}	Address-select low-input current (AS)		-10			μA
V_{ADC}	ADC input voltage	See Table 10	0		V_{CC}	V
I_{ADH}	ADC high-level input current	$V_{ADC} = V_{CC}$			10	μA
I_{ADL}	ADC low-level input current	$V_{ADC} = 0\text{ V}$	-10			μA
V_{OL}	Low-level output voltage (SDA)	$V_{CC} = 5\text{ V}$, $I_{OL} = 3\text{ mA}$			0.4	V
I_{SDAH}	High-level output leakage current (SDA)	$V_{SDA} = 5.5\text{ V}$			10	μA
f_{SCL}	Clock frequency (SCL)			100	400	kHz
t_{HD-DAT}	Data hold time	See Figure 20	0			μs
t_{BUF}	Bus free time		1.3			μs
t_{HD-STA}	Start hold time		0.6			μs
t_{LOW}	SCL-low hold time		0.6			μs
t_{HIGH}	SCL-high hold time		0.6			μs
t_{SU-STA}	Start setup time		0.6			μs
t_{SU-DAT}	Data setup time		0.1			μs
t_r	Rise time (SCL, SDA)				0.3	μs
t_f	Fall time (SCL, SDA)				0.3	μs
t_{SU-STO}	Stop setup time		0.6			μs

Electrical Characteristics – PLL and Band Switch

$V_{CC} = 4.5\text{ V to }5.5\text{ V}$, $T_A = -20^\circ\text{C to }85^\circ\text{C}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
N	Divider ratio	15-bit frequency word	512		32767	
f_{XTAL}	Crystal oscillator frequency	$R_{XTAL} = 25\ \Omega$ to $300\ \Omega$		4		MHz
Z_{XTAL}	Crystal oscillator input impedance			1.6		k Ω
V_{XLO}	XTALOUT output voltage	Load = 10 pF/5.1 k Ω , $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$		0.37		V _{p-p}
V_{VTUL}	Tuning amplifier low-level output voltage	$R_L = 20\text{ k}\Omega$, $V_{TU} = 33\text{ V}$	0.2	0.3	0.46	V
I_{VTUOFF}	Tuning amplifier leakage current	Tuning amplifier = off, $V_{TU} = 33\text{ V}$			10	μA
I_{CP11}	Charge-pump current	CP[1:0] = 11		600		μA
I_{CP10}		CP[1:0] = 10		350		
I_{CP01}		CP[1:0] = 01		140		
I_{CP00}		CP[1:0] = 00		70		
V_{CP}	Charge-pump output voltage	PLL locked		1.95		V
I_{CPOFF}	Charge-pump leakage current	$V_{CP} = 2\text{ V}$, $T_A = 25^\circ\text{C}$	-15		15	nA
I_{BS}	Band-switch driver output current (BS1–BS4)				10	mA
V_{BS1}	Band-switch driver output voltage (BS1–BS4)	$I_{BS} = 10\text{ mA}$		3		V
V_{BS2}		$I_{BS} = 10\text{ mA}$, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$		3.5	3.9	
I_{BSOFF}	Band-switch driver leakage current (BS1–BS4)	$V_{BS} = 0\text{ V}$			8	μA
I_{P5}	Band-switch port sink current (P5/ADC)				-5	mA
V_{P5ON}	Band-switch port output voltage (P5/ADC)	$I_{P5} = -2\text{ mA}$, $V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$			0.6	V

Electrical Characteristics – RF AGC

$V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, measured in [Figure 21](#) reference measurement circuit at 50- Ω system, IF = 44 MHz, IF filter characteristics: $f_{peak} = 44\text{ MHz}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TYP	UNIT
I_{OAGC0}	RF AGC output current	ATC = 0	300	nA
I_{OAGC1}		ATC = 1	9	μA
$V_{AGCSP00}$	Start-point IF output level	T1/ATSS = 0, ATP[2:0] = 000	117	dB μV
$V_{AGCSP01}$		T1/ATSS = 0, ATP[2:0] = 001	114	
$V_{AGCSP02}$		T1/ATSS = 0, ATP[2:0] = 010	111	
$V_{AGCSP03}$		T1/ATSS = 0, ATP[2:0] = 011	108	
$V_{AGCSP04}$		T1/ATSS = 0, ATP[2:0] = 100	105	
$V_{AGCSP05}$		T1/ATSS = 0, ATP[2:0] = 101	102	
$V_{AGCSP06}$		T1/ATSS = 0, ATP[2:0] = 110	99	
$V_{AGCSP10}$		T1/ATSS = 1, ATP[2:0] = 000	112	
$V_{AGCSP11}$		T1/ATSS = 1, ATP[2:0] = 001	109	
$V_{AGCSP12}$		T1/ATSS = 1, ATP[2:0] = 010	106	
$V_{AGCSP13}$		T1/ATSS = 1, ATP[2:0] = 011	103	
$V_{AGCSP14}$		T1/ATSS = 1, ATP[2:0] = 100	100	
$V_{AGCSP15}$		T1/ATSS = 1, ATP[2:0] = 101	97	
$V_{AGCSP16}$		T1/ATSS = 1, ATP[2:0] = 110	94	

Electrical characteristics – Mixer, Oscillator, IF Amplifier

$V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, measured in [Figure 21](#) reference measurement circuit at 50- Ω system, IF = 44 MHz, IF filter characteristics: $f_{peak} = 44\text{ MHz}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TYP	UNIT
G_{c1}	Conversion gain (mixer-IF amplifier), VHF-LOW	$f_{in} = 57\text{ MHz}^{(1)}$	35	dB
G_{c3}		$f_{in} = 171\text{ MHz}^{(1)}$	35	
G_{c4}	Conversion gain (mixer-IF amplifier), VHF-HIGH	$f_{in} = 177\text{ MHz}^{(1)}$	35	dB
G_{c6}		$f_{in} = 467\text{ MHz}^{(1)}$	35	
G_{c7}	Conversion gain (mixer-IF amplifier), UHF	$f_{in} = 473\text{ MHz}^{(1)}$	35	dB
G_{c9}		$f_{in} = 864\text{ MHz}^{(1)}$	35	
NF_1	Noise figure, VHF-LOW	$f_{in} = 57\text{ MHz}$	9	dB
NF_3		$f_{in} = 171\text{ MHz}$	9	
NF_4	Noise figure, VHF-HIGH	$f_{in} = 177\text{ MHz}$	9	dB
NF_6		$f_{in} = 467\text{ MHz}$	9	
NF_7	Noise figure, UHF	$f_{in} = 473\text{ MHz}$	12	dB
NF_9		$f_{in} = 864\text{ MHz}$	12	
CM_1	1% cross-modulation distortion, VHF-LOW	$f_{in} = 57\text{ MHz}^{(2)}$	79	dB μ V
CM_3		$f_{in} = 171\text{ MHz}^{(2)}$	79	
CM_4	1% cross-modulation distortion, VHF-HIGH	$f_{in} = 177\text{ MHz}^{(2)}$	79	dB μ V
CM_6		$f_{in} = 467\text{ MHz}^{(2)}$	79	
CM_7	1% cross-modulation distortion, UHF	$f_{in} = 473\text{ MHz}^{(2)}$	77	dB μ V
CM_9		$f_{in} = 864\text{ MHz}^{(2)}$	77	
V_{IF01}	IF output voltage, VHF-LOW	$f_{in} = 57\text{ MHz}$	117	dB μ V
V_{IF03}		$f_{in} = 171\text{ MHz}$	117	
V_{IF04}	IF output voltage, VHF-HIGH	$f_{in} = 177\text{ MHz}$	117	dB μ V
V_{IF06}		$f_{in} = 467\text{ MHz}$	117	
V_{IF07}	IF output voltage, UHF	$f_{in} = 473\text{ MHz}$	117	dB μ V
V_{IF09}		$f_{in} = 864\text{ MHz}$	117	
Φ_{PLVL11}	Phase noise, VHF-LOW	$f_{in} = 57\text{ MHz}$, Offset = 1 kHz ⁽³⁾	-90	dBc/Hz
Φ_{PLVL12}		$f_{in} = 57\text{ MHz}$, Offset = 10 kHz ⁽⁴⁾	-95	
Φ_{PLVL31}		$f_{in} = 171\text{ MHz}$, Offset = 1 kHz ⁽⁵⁾	-85	
Φ_{PLVL32}		$f_{in} = 171\text{ MHz}$, Offset = 10 kHz ⁽⁴⁾	-95	
Φ_{PLVL41}	Phase noise, VHF-HIGH	$f_{in} = 177\text{ MHz}$, Offset = 1 kHz ⁽³⁾	-85	dBc/Hz
Φ_{PLVL42}		$f_{in} = 177\text{ MHz}$, Offset = 10 kHz ⁽⁴⁾	-90	
Φ_{PLVL61}		$f_{in} = 467\text{ MHz}$, Offset = 1 kHz ⁽⁵⁾	-77	
Φ_{PLVL62}		$f_{in} = 467\text{ MHz}$, Offset = 10 kHz ⁽⁴⁾	-90	
Φ_{PLVL71}	Phase noise, UHF	$f_{in} = 473\text{ MHz}$, Offset = 1 kHz ⁽³⁾	-80	dBc/Hz
Φ_{PLVL72}		$f_{in} = 473\text{ MHz}$, Offset = 10 kHz ⁽⁴⁾	-85	
Φ_{PLVL91}		$f_{in} = 864\text{ MHz}$, Offset = 1 kHz ⁽⁵⁾	-77	
Φ_{PLVL92}		$f_{in} = 864\text{ MHz}$, Offset = 10 kHz ⁽⁴⁾	-90	

- (1) RF input level = 70 dB μ V, differential output
- (2) $f_{undes} = f_{des} \pm 6\text{ MHz}$, $P_{in} = 80\text{ dB}\mu\text{V}$, AM 1 kHz, 30%, DES/CM = S/I = 46 dB
- (3) CP[1:0] = 10 (CP current 350 μ A), RS[2:0] = 011 (reference divider 64)
- (4) CP[1:0] = 00 (CP current 70 μ A), RS[2:0] = 100 (reference divider 128)
- (5) CP[1:0] = 11 (CP current 600 μ A), RS[2:0] = 100 (reference divider 128)

Functional Description

I²C Bus Mode

I²C Write Mode ($R/\overline{W} = 0$)

Table 1. Write Data Format

	MSB							LSB		(1)
Address byte (ADB)	1	1	0	0	0	MA1	MA0	R/ \overline{W} = 0		A
Divider byte 1 (DB1)	0	N14	N13	N12	N11	N10	N9	N8		A
Divider byte 2 (DB2)	N7	N6	N5	N4	N3	N2	N1	N0		A
Control byte 1 (CB1)	1	0	ATP2	ATP1	ATP0	RS2	RS1	RS0		A
Band-switch byte (BB)	CP1	CP0	0	P5	BS4	BS3	BS2	BS1		A
Control byte 2 (CB2)	1	1	ATC	STBY	T3	T2	T1/ATSS	T0/XLO		A

(1) A: Acknowledge

Table 2. Write Data Symbol Description

SYMBOL	DESCRIPTION	DEFAULT															
MA[1:0]	Address-set bits (see Table 3)																
N[14:0]	Programmable counter set bits $N = N14 \times 2^{14} + N13 \times 2^{13} + \dots + N1 \times 2 + N0$	N14 = N13 = N12 = ... = N0 = 0															
ATP[2:0]	RF AGC start-point control bits (see Table 4)	ATP[2:0] = 011															
RS[2:0]	Reference divider ratio-selection bits (see Table 5)	RS[2:0] = 111															
CP[1:0]	Charge-pump current-set bit (see Table 6)	CP[1:0] = 11															
P5	Port output/ADC input control bit P5 = 0: ADC INPUT P5 = 1: Tr = ON	P5 = 0															
BS[4:1]	Band-switch control bits BS _n = 0: Tr = OFF BS _n = 1: Tr = ON Band selection by BS[1:2] <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>BS1</th> <th>BS2</th> <th></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0</td> <td>VHF-LO</td> </tr> <tr> <td>0</td> <td>1</td> <td>VHF-HI</td> </tr> <tr> <td>0</td> <td>0</td> <td>UHF</td> </tr> <tr> <td>1</td> <td>1</td> <td>Reserved</td> </tr> </tbody> </table>	BS1	BS2		1	0	VHF-LO	0	1	VHF-HI	0	0	UHF	1	1	Reserved	BS _n = 0
BS1	BS2																
1	0	VHF-LO															
0	1	VHF-HI															
0	0	UHF															
1	1	Reserved															
ATC	RF AGC current-set bit ATC = 0: Current = 300 nA ATC = 1: Current = 9μA	ATC = 0															
STBY	Power standby mode-control bit STBY = 0: Normal operation STBY = 1: Standby mode/stop MOP function (XTALOUT is available even in standby mode)	STBY = 0															
T3, T2, T1/ATSS, T0/XLO	TEST bits, RFAGC shift bit, XTALOUT control bit (see Table 7)	T[3:0] = 0010															
X	Don't care																

Table 3. Address Selection

MA1	MA0	VOLTAGE APPLIED ON AS INPUT
0	0	0 V to 0.1 V _{CC} (Low)
0	1	OPEN, or 0.2 V _{CC} to 0.3 V _{CC} (Mid2)
1	0	0.4 V _{CC} to 0.6 V _{CC} (Mid1)
1	1	0.9 V _{CC} to V _{CC} (High)

Table 4. RF AGC Start Point

T1/ATSS	ATP2	ATP1	ATP0	IFOUT LEVEL (dB _μ V)
0	0	0	0	117
0	0	0	1	114
0	0	1	0	111
0	0	1	1	108
0	1	0	0	105
0	1	0	1	102
0	1	1	0	99
0	1	1	1	Disabled
1	0	0	0	112
1	0	0	1	109
1	0	1	0	106
1	0	1	1	103
1	1	0	0	100
1	1	0	1	97
1	1	1	0	94
1	1	1	1	Disabled

Table 5. Reference Divider Ratio

RS2	RS1	RS0	REFERENCE DIVIDER RATIO
0	0	0	24
0	0	1	28
0	1	0	50
0	1	1	64
1	0	0	128
1	X	1	80

Table 6. Charge-Pump Current

CP1	CP0	CHARGE PUMP CURRENT (μA)
0	0	70
0	1	140
1	0	350
1	1	600

Table 7. Test Bits/XTALOUT Control ⁽¹⁾

T3	T2	T1/ATSS	T0/XLO	DEVICE OPERATION	XTALOUT 4-MHz OUTPUT
0	0	X	0	Normal operation	Enabled
0	0	X	1	Normal operation	Disabled
X	1	X	X	Test mode	Not available
1	X	X	X	Test mode	Not available

(1) RFAGC and XTALOUT are not available in test mode.

Example I²C Data Write Sequences

Telegram examples:

Start-ADB-DB1-DB2-CB1-BB-CB2-Stop
 Start-ADB-DB1-DB2-Stop
 Start-ADB-CB1-BB-CB2-Stop
 Start-ADB-CB1-BB-Stop
 Start-ADB-CB2-Stop

Abbreviations:

ADB: Address byte
 BB: Band-switch byte
 CB1: Control byte 1
 CB2: Control byte 2
 DB1: Divider byte 1
 DB2: Divider byte 2
 Start: Start condition
 Stop: Stop condition

I²C Read Mode ($R/\overline{W} = 1$)

Table 8. Read Data Format (A: Acknowledge)

	MSB							LSB		
Address byte (ADB)	1	1	0	0	0	0	MA1	MA0	$R/\overline{W} = 1$	A
Status byte (SB)	POR	FL	1	1	X		A2	A1	A0	–

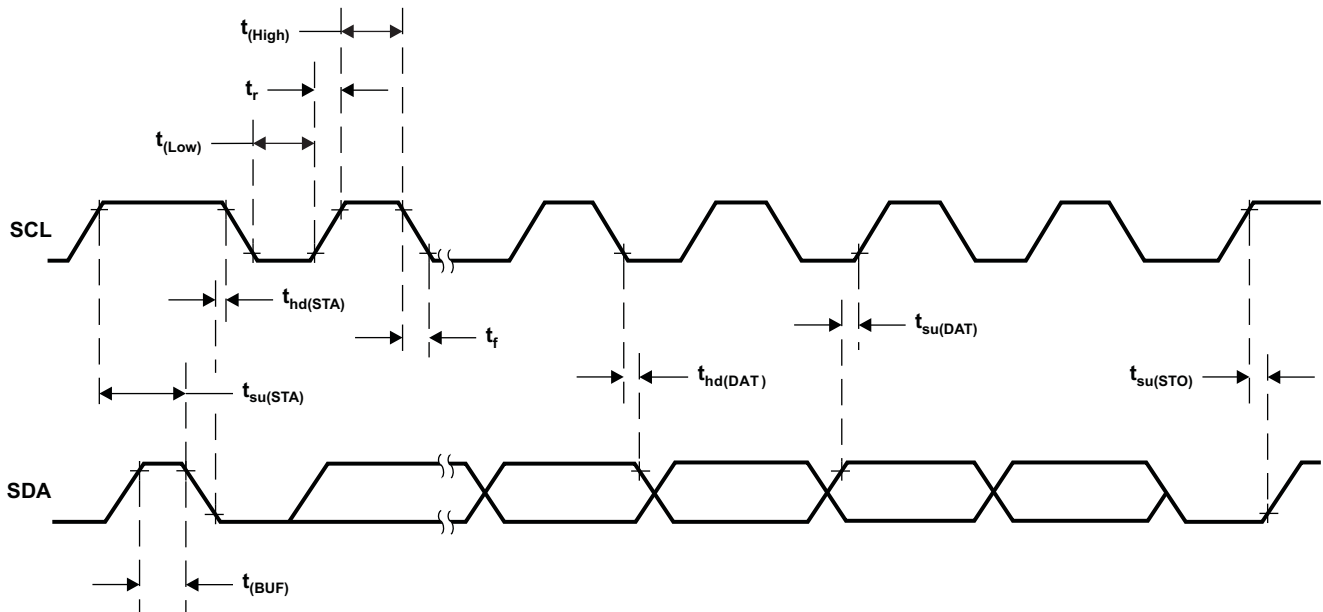
Table 9. Read Data Symbol Description

SYMBOL	DESCRIPTION	DEFAULT
MA[1:0]	Address set bits (see Table 3)	
POR	Power-on-reset flag POR set: power on POR reset: end-of-data transmission procedure	POR = 1
FL	In-lock flag PLL locked (FL = 1), unlocked (FL = 0)	
A[2:0]	Digital data of ADC (see Table 10) Bit P5 must be set to 0.	

Table 10. ADC Level⁽¹⁾

A2	A1	A0	VOLTAGE APPLIED ON ADC INPUT
1	0	0	0.6 V _{CC} to V _{CC}
0	1	1	0.45 V _{CC} to 0.6 V _{CC}
0	1	0	0.3 V _{CC} to 0.45 V _{CC}
0	0	1	0.15 V _{CC} to 0.3 V _{CC}
0	0	0	0 V to 0.15 V _{CC}

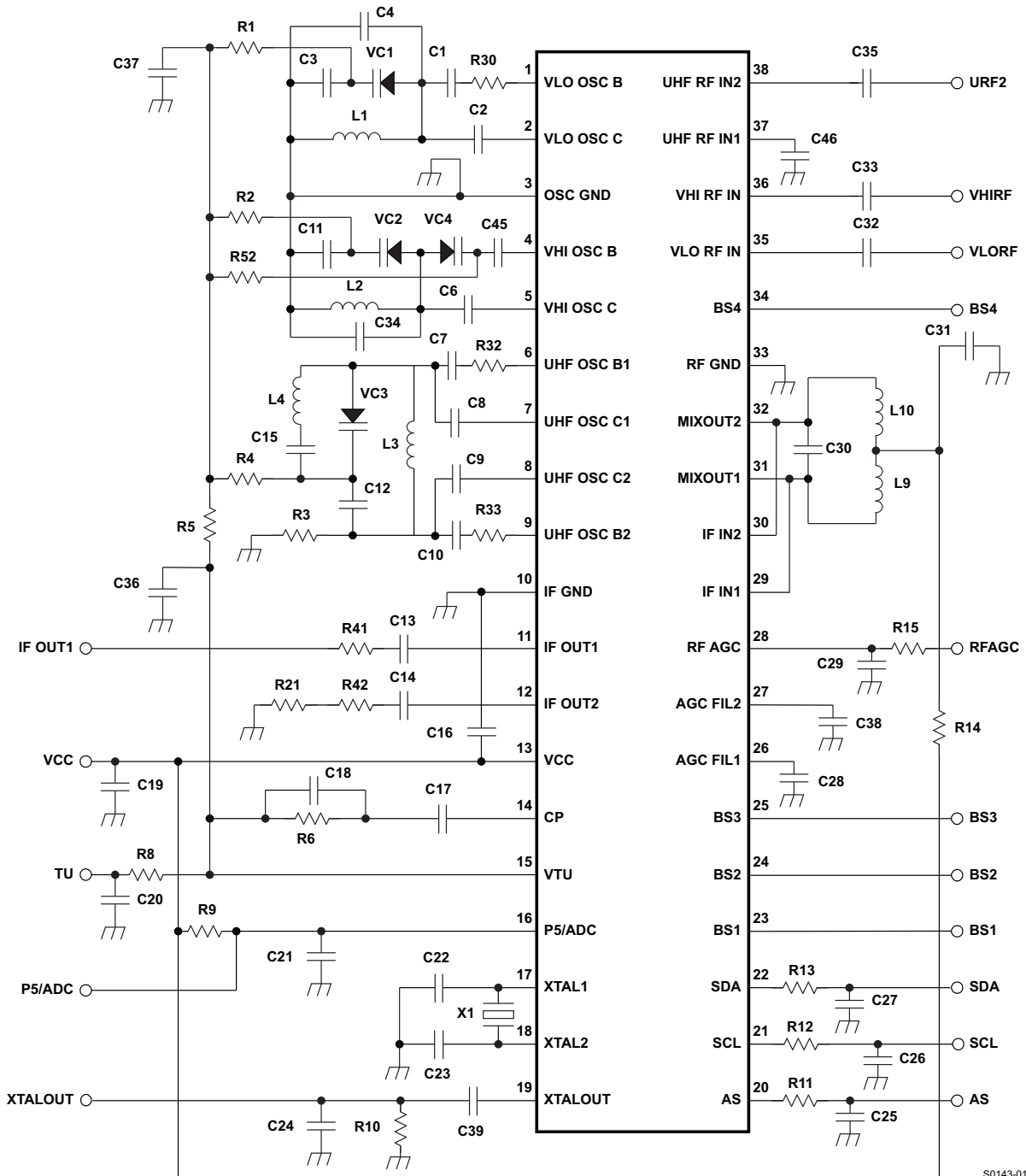
(1) Accuracy is $0.03 \times V_{CC}$.



T0101-01

Figure 20. I²C Timing Chart

APPLICATION INFORMATION



S0143-01

NOTE: This application information is advisory, and a performance-check is required for actual application circuits. TI assumes no responsibility for the consequences of the use of this circuit, nor for any infringement of patent or patent rights of third parties that may result from its use.

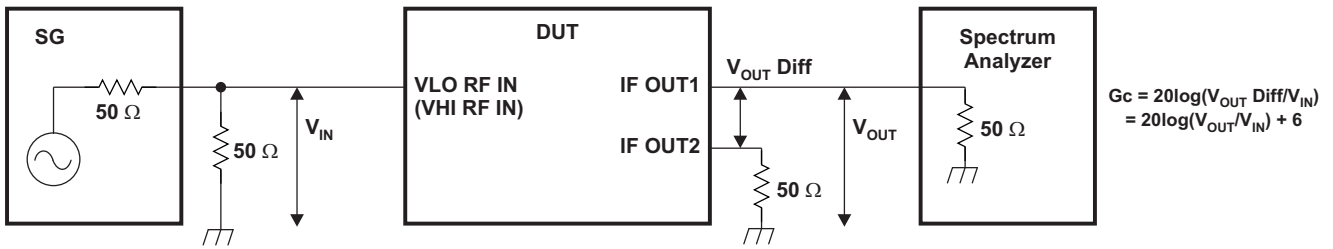
Figure 21. Reference Measurement Circuit

APPLICATION INFORMATION (continued)
Component Values for Measurement Circuit

PART NAME	VALUE	PART NAME	VALUE
C1 (VLO OSCB)	1 pF	C39 (XTALOUT)	2.2 nF
C2 (VLO OSCC)	2 pF	C45 (VHI OSC)	7 pF
C3 (VLO OSC)	47 pF	C46 (URF1)	2.2 nF
C4 (VLO OSC)	Open	L1 (VLO OSC)	φ 3,0 mm, 7T, wire 0,32 mm
C6 (VHI OSCC)	5 pF	L2 (VHI OSC)	φ2,0 mm, 3T, wire 0,4 mm
C7 (UHF OSCB1)	1 pF	L3 (UHF OSC)	φ1,8 mm, 3T, wire 0,4 mm
C8 (UHF OSCC1)	1 pF	L4 (UHF OSC)	φ1,8 mm, 3T, wire 0,4 mm
C9 (UHF OSCC2)	1 pF	L9 (MIXOUT)	680 nH (LK1608R68K-T)
C10 (UHF OSCB2)	1 pF	L10 (MIXOUT)	680 nH (LK1608R68K-T)
C11 (VHI OSC)	51 pF	R1 (VLO OSC)	3.3 kΩ
C12 (UHF OSC)	10 pF	R2 (VHI OSC)	3.3 kΩ
C13 (IFOUT)	2.2 nF	R3 (UHF OSC)	2.2 kΩ
C14 (IFOUT)	2.2 nF	R4 (UHF OSC)	1 kΩ
C15 (UHF OSC)	100 pF	R5 (VTU)	3 kΩ
C16 (VCC)	4.7 nF	R6 (CP)	47 kΩ
C17 (CP)	0.01 μF/50 V	R8 (VTU)	20 kΩ
C18 (CP)	22 pF/50 V	R9 (P5/ADC)	Open
C19 (VCC)	2.2 nF	R10 (XTALOUT)	5.1 kΩ
C20 (VTU)	2.2 nF/50 V	R11 (AS)	330 Ω
C21 (P5/ADC)	Open	R12 (SCL)	330 Ω
C22 (XTAL)	27 pF	R13 (SDA)	330 Ω
C23 (XTAL)	27 pF	R14 (VCC)	0
C24 (XTALOUT)	10 pF	R15 (RFAGC)	0
C25 (AS)	Open	R21 (IFOUT)	1 kΩ
C26 (SCL)	Open	R30 (VLO OSC)	10
C27 (SDA)	Open	R32 (UHF OSC)	0
C28 (AGCFIL1)	0.1 μF	R33 (UHF OSC)	0
C29 (RFAGC)	0.15 μF	R41 (IFOUT)	1 kΩ
C30 (MIXOUT)	5 pF	R42 (IFOUT)	0
C31 (MIXOUT)	2.2 nF	R52 (VHI OSC)	3.3 kΩ
C32 (VLORF)	2.2 nF	U1	SN761664
C33 (VHIRF)	2.2 nF	VC1 (VLO OSC)	MA2S374
C34 (VHI OSC)	0.5 pF	VC2 (VHI OSC)	MA2S374
C35 (URF2)	2.2 nF	VC3 (UHF OSC)	MA2S372
C36 (VTU)	Open	VC4 (VHI OSC)	MA2S372
C37 (VTU)	2.2 nF/50 V	X1	4-MHz crystal
C38 (RGCFIL2)	Open		

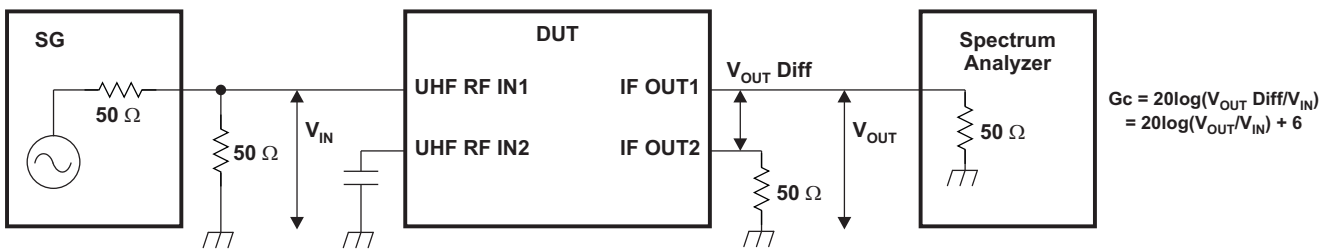
APPLICATION INFORMATION (CONTINUED)

Test Circuits



S0144-01

Figure 22. VHF-Conversion Gain-Measurement Circuit



S0145-01

Figure 23. UHF-Conversion Gain-Measurement Circuit

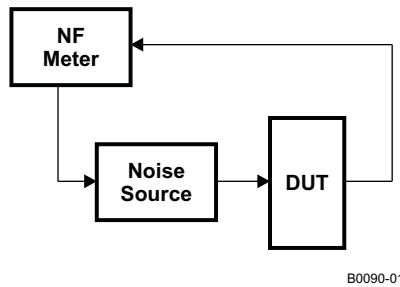


Figure 24. Noise-Figure Measurement Circuit

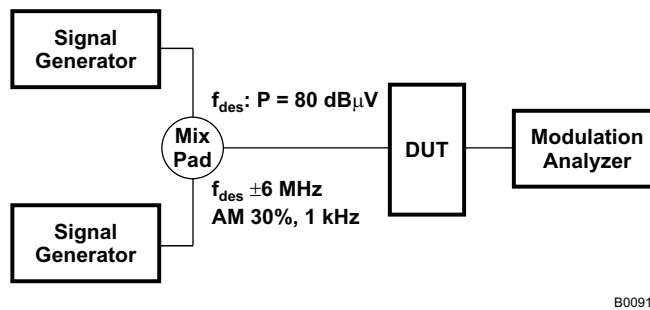


Figure 25. 1% Cross-Modulation Distortion Measurement Circuit

TYPICAL CHARACTERISTICS

Band-Switch Driver Output Voltage (BS1–BS4)

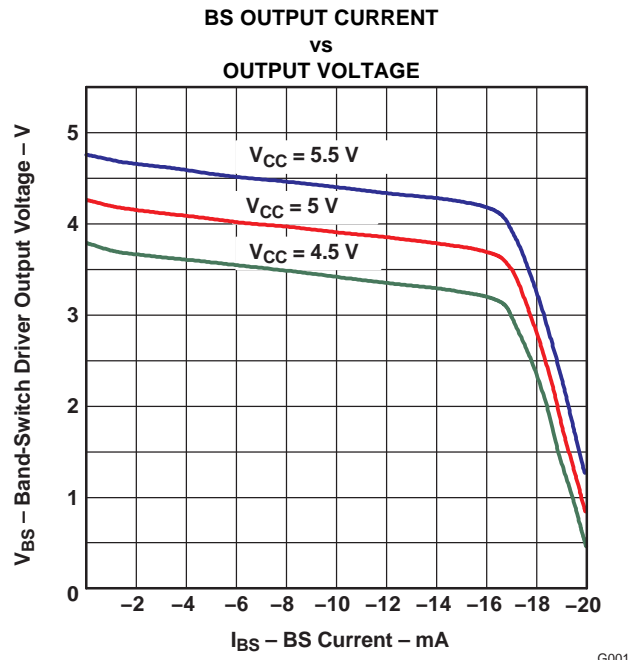


Figure 26. Band-Switch Driver Output Voltage

S-Parameter

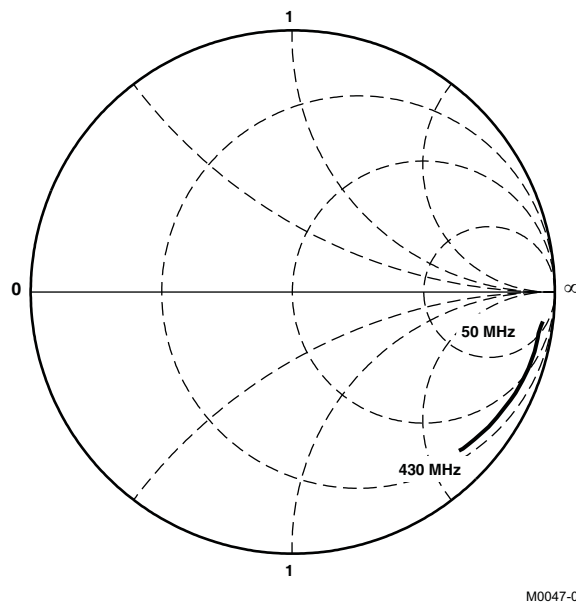
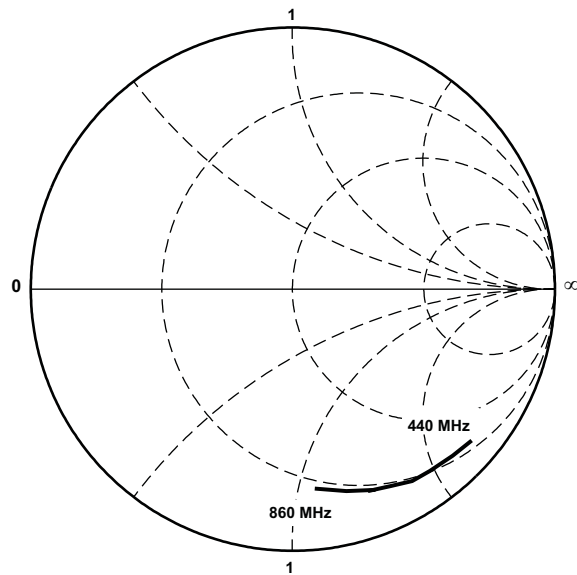


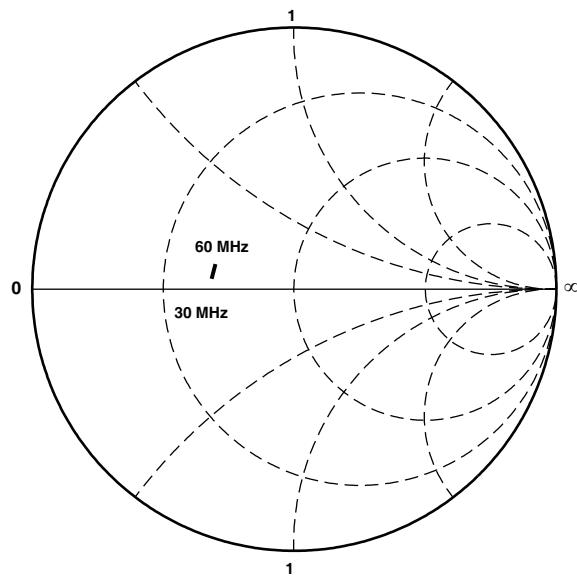
Figure 27. VLO RFIN, VHI RFIN

TYPICAL CHARACTERISTICS (continued)



M0047-02

Figure 28. UHF RFIN



M0047-03

Figure 29. IFOUT

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/ Ball Finish	MSL Peak Temp ⁽³⁾	Samples (Requires Login)
SN761664DBT	OBSOLETE	TSSOP	DBT	38		TBD	Call TI	Call TI	
SN761664DBTG4	OBSOLETE	TSSOP	DBT	38		TBD	Call TI	Call TI	
SN761664DBTR	NRND	TSSOP	DBT	38	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	
SN761664DBTRG4	NRND	TSSOP	DBT	38	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

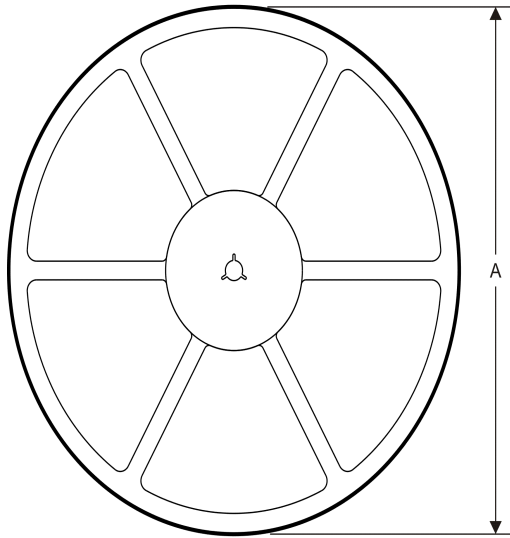
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

TAPE AND REEL INFORMATION

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN761664DBTR	TSSOP	DBT	38	2000	330.0	16.4	6.9	10.2	1.8	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



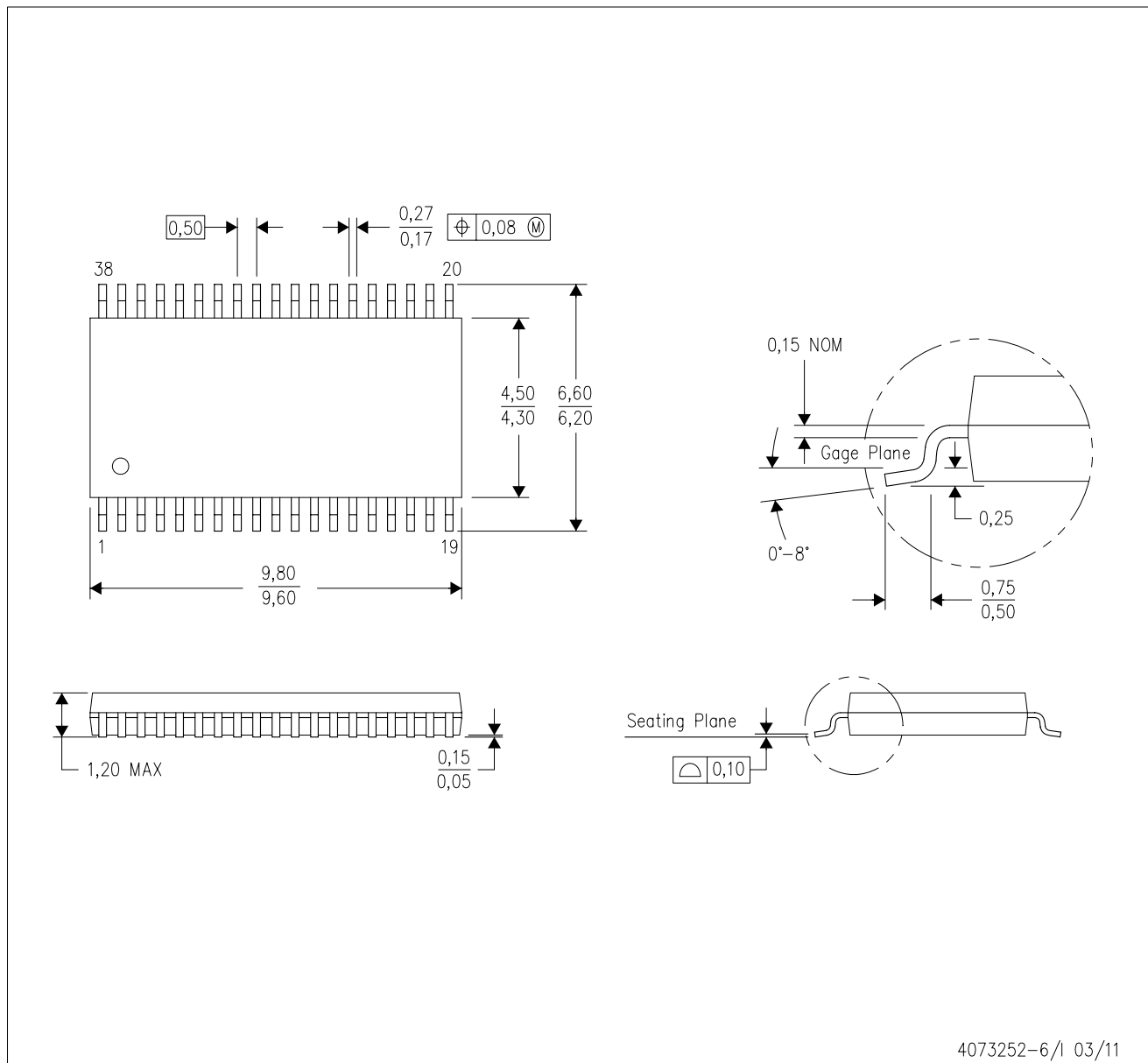
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN761664DBTR	TSSOP	DBT	38	2000	367.0	367.0	38.0

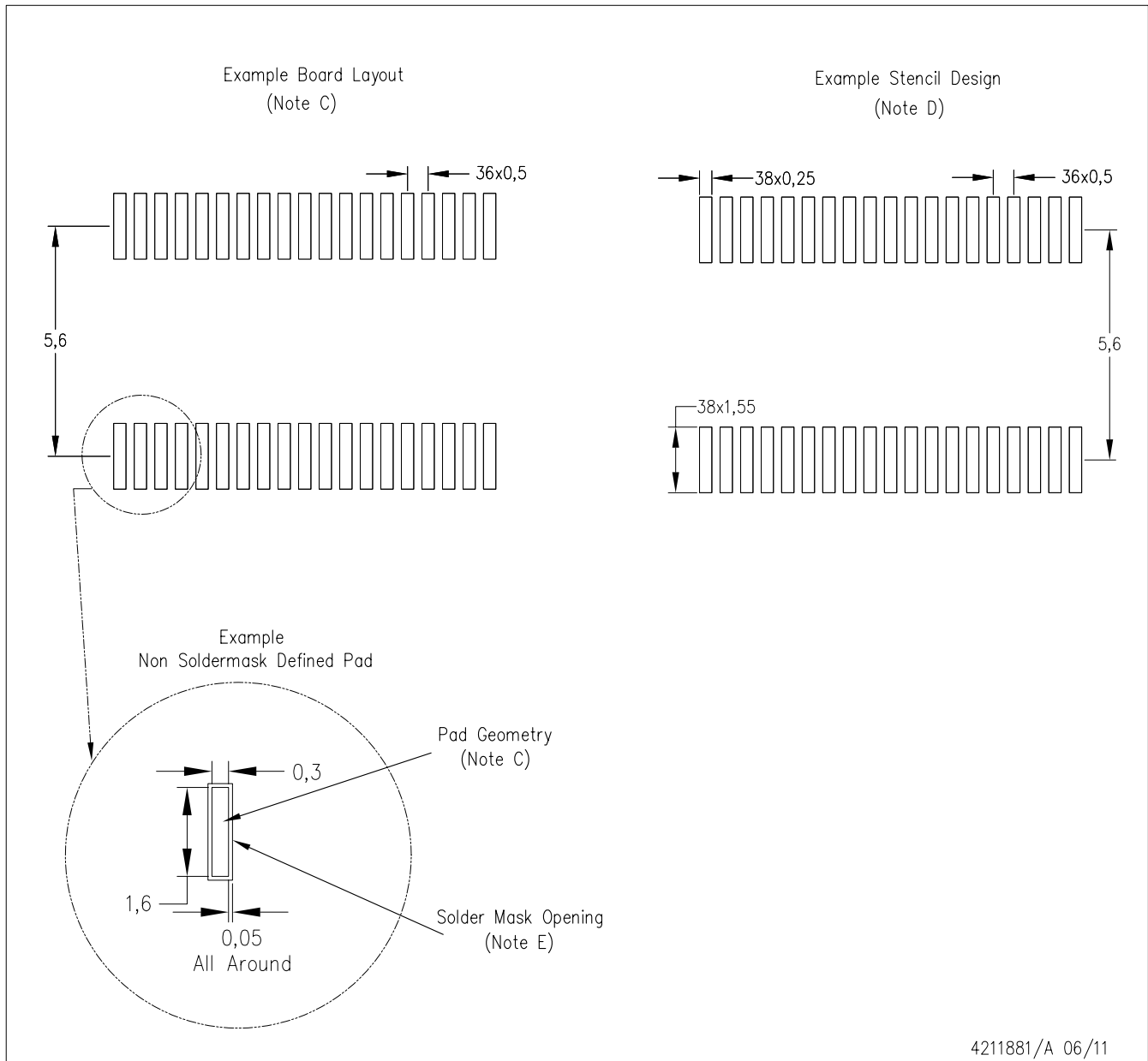
MECHANICAL DATA

DBT (R-PDSO-G38)

PLASTIC SMALL OUTLINE



- NOTES:
- All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - This drawing is subject to change without notice.
 - Body dimensions do not include mold flash or protrusion.
 - Falls within JEDEC MO-153.



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46C and to discontinue any product or service per JESD48B. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Mobile Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community e2e.ti.com