## FEATURES

- **Low-Phase-Noise Mixer/Oscillator and PLL Synthesizer**
- **VHF-L, VHF-H, UHF Three-Band Local Oscillator**
- **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 TSSOP Package**

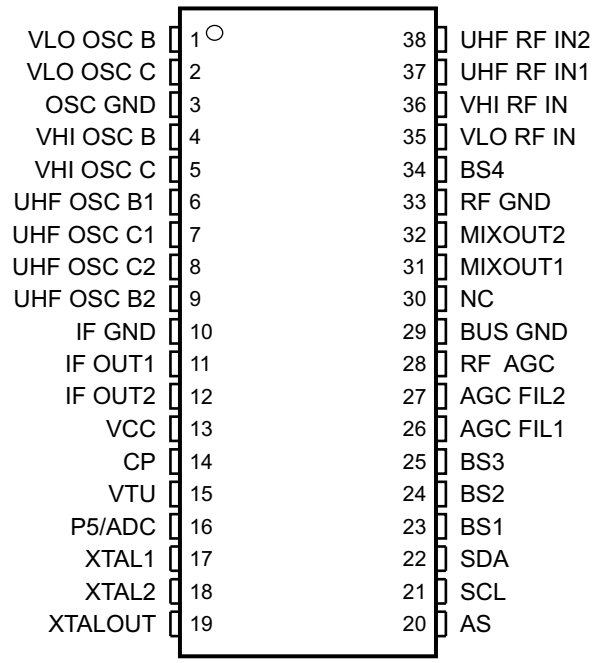
## APPLICATIONS

- **Digital TV**
- **Digital CATV**
- **Set-Top Box**

## DESCRIPTION

The SN761662 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, 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.

**DBT PACKAGE**
**(TOP VIEW)**

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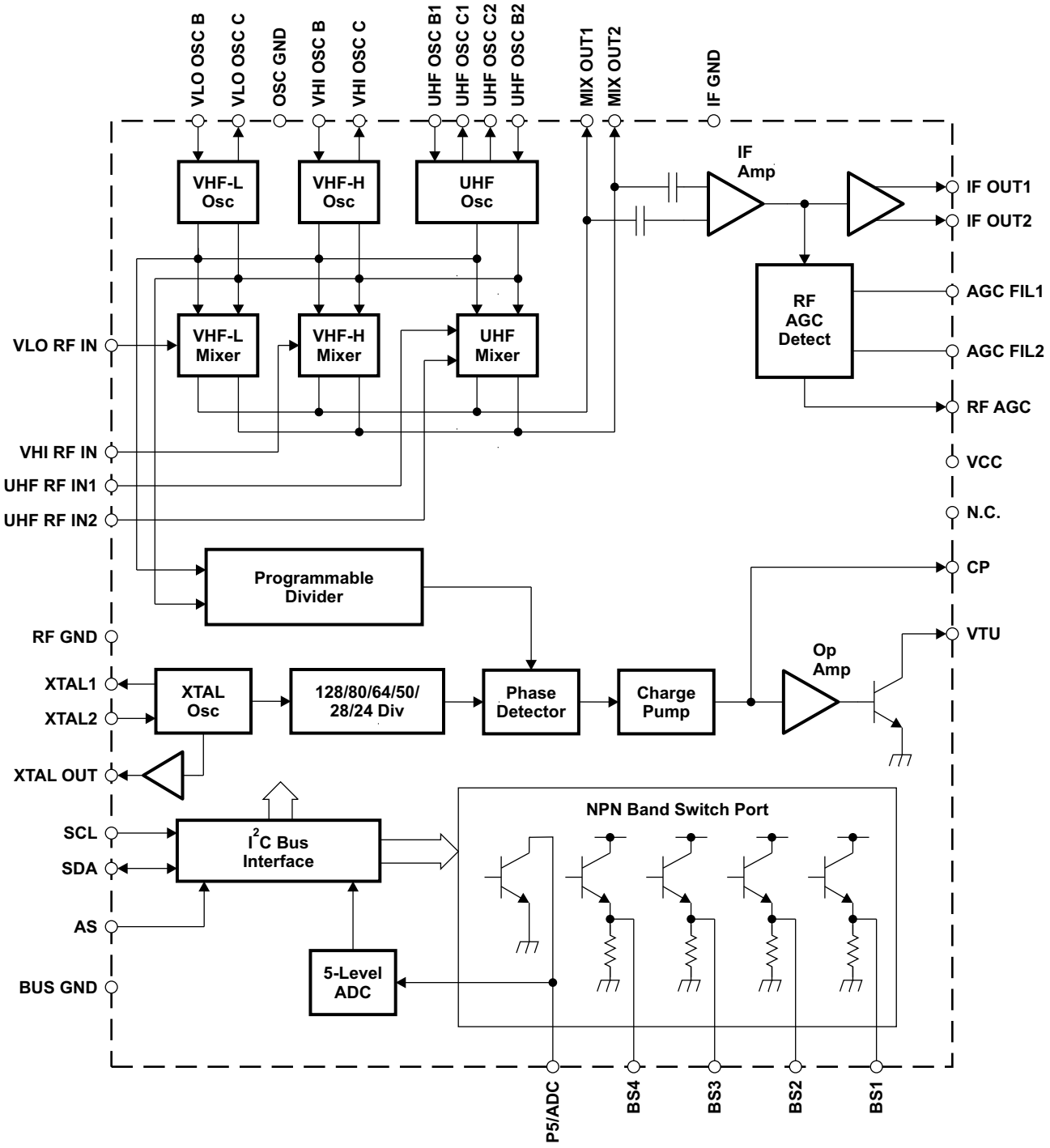
This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

MIXOUT1 and MIXOUT2 (pins 31 and 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

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## Pin Assignments

### Pin Description

| TERMINAL NAME | TERMINAL NO. | DESCRIPTION | SCHEMATIC |
|---|---|---|---|
| AGC FIL1 | 26 | Additional peak-hold capacitor pin | Figure 1 |
| AGC FIL2 | 27 | RF AGC LPF capacitor pin | Figure 1 |
| AS | 20 | Address selection input | Figure 2 |
| BS1 | 23 | Band-switch1 output | Figure 3 |
| BS2 | 24 | Band-switch2 output | Figure 3 |
| BS3 | 25 | Band-switch3 output | Figure 3 |
| BS4 | 34 | Band-switch4 output | Figure 3 |
| BUS GND | 29 | Serial bus/band-switch ground | |
| CP | 14 | Charge pump output | Figure 4 |
| IF GND | 10 | IF ground | |
| IF OUT1 | 11 | IF amplifier output | Figure 5 |
| IF OUT2 | 12 | IF amplifier output | Figure 5 |
| MIX OUT1 | 31 | Mixer output | Figure 6 |
| MIX OUT2 | 32 | Mixer output | Figure 6 |
| N.C. | 30 | No connection | |
| OSC GND | 3 | Oscillator ground | |
| P5/ADC | 16 | Port 5 output/ADC input | Figure 7 |
| RF AGC | 28 | RF AGC output | Figure 8 |
| RF GND | 33 | RF ground | |
| SCL | 21 | Serial clock input | Figure 9 |
| SDA | 22 | Serial data input/output | Figure 10 |
| UHF OSC B1 | 6 | UHF oscillator base1 | Figure 11 |
| UHF OSC B2 | 9 | UHF oscillator base2 | Figure 11 |
| UHF OSC C1 | 7 | UHF oscillator collector1 | Figure 11 |
| UHF OSC C2 | 8 | UHF oscillator collector2 | Figure 11 |
| UHF RFIN1 | 37 | UHF RF input | Figure 12 |
| UHF RFIN2 | 38 | UHF RF input | Figure 12 |
| VCC | 13 | Supply voltage for mixer/oscillator/PLL: 5 V | |
| VHI OSC B | 4 | VHF HIGH oscillator base | Figure 13 |
| VHI OSC C | 5 | VHF HIGH oscillator collector | Figure 13 |
| VHI RFIN | 36 | VHF-H RF input | Figure 14 |
| VLO OSC B | 1 | VHF LOW oscillator base | Figure 15 |
| VLO OSC C | 2 | VHF LOW oscillator collector | Figure 15 |
| VLO RFIN | 35 | VHF-L RF input | Figure 18 |
| VTU | 15 | Tuning voltage amplifier output | Figure 4 |
| XTAL1 | 17 | 4-MHz crystal oscillator output | Figure 16 |
| XTAL2 | 18 | 4-MHz crystal oscillator input | Figure 16 |
| XTALOUT | 19 | 4-MHz oscillator output | Figure 17 |

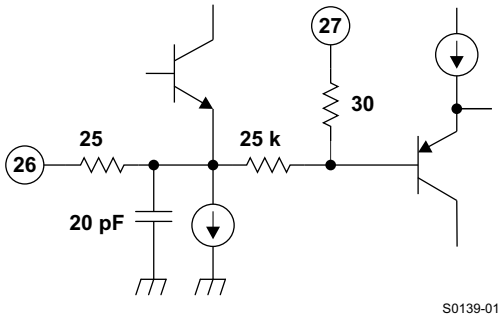



**Figure 1.**

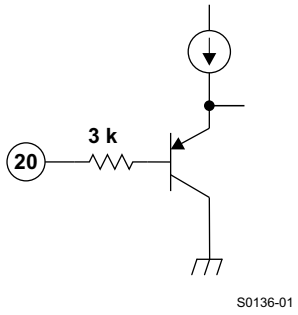



**Figure 2.**

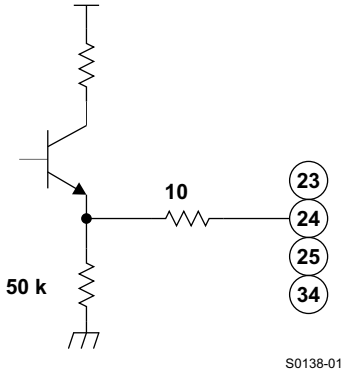



**Figure 3.**

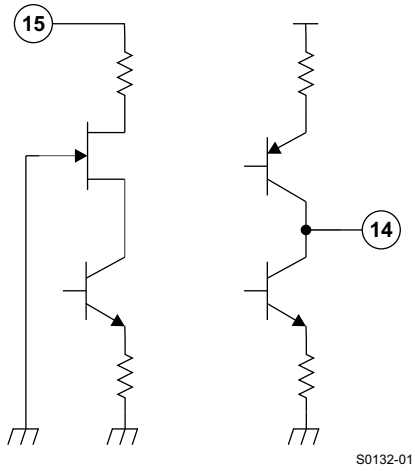



**Figure 4.**

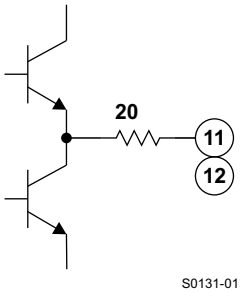



**Figure 5.**

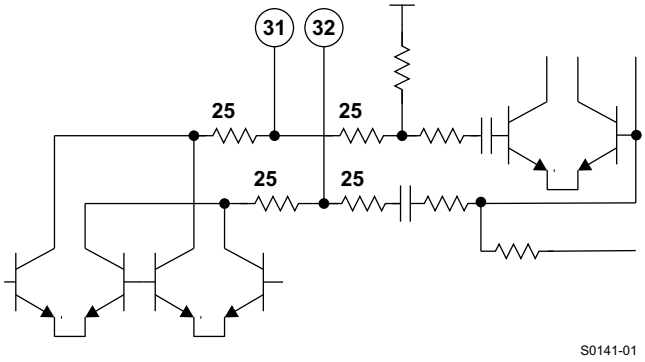



**Figure 6.**

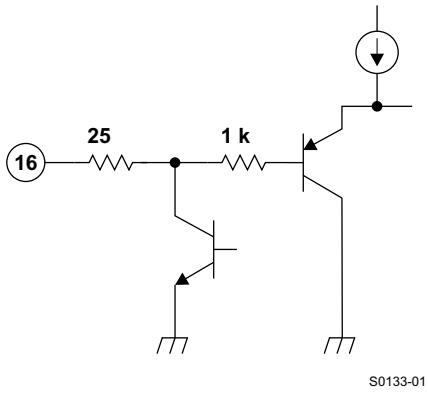



Figure 7.

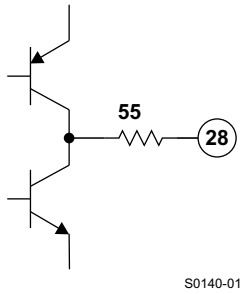



Figure 8.

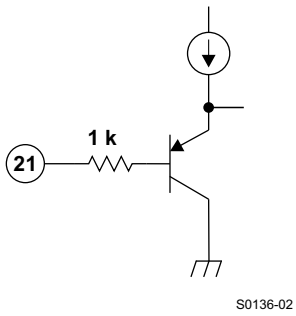



Figure 9.

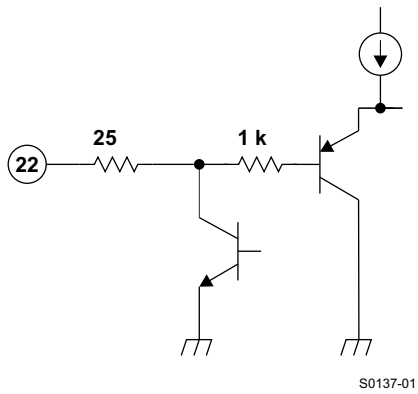



Figure 10.

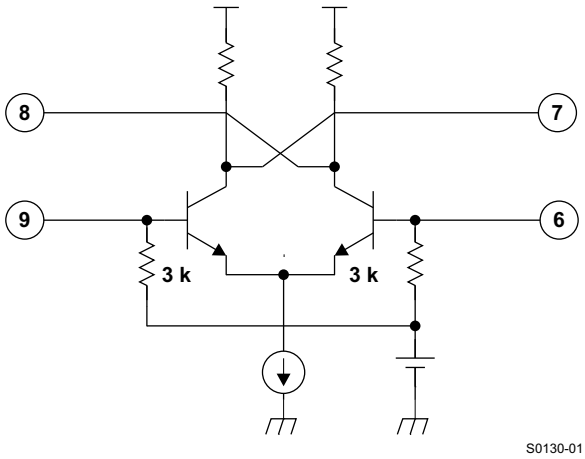



Figure 11.

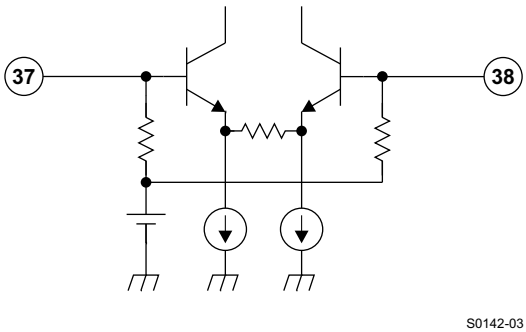
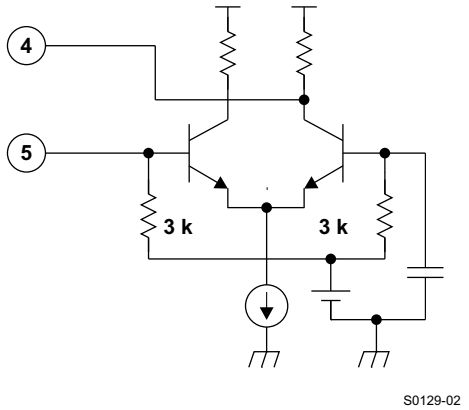



Figure 12.

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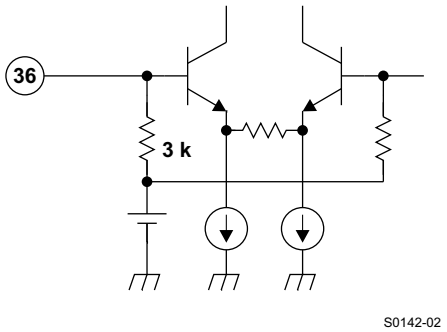



**Figure 14.**

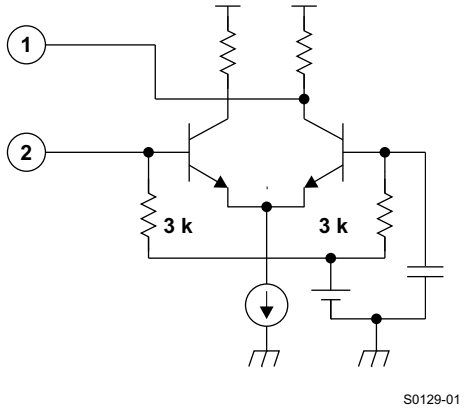



**Figure 15.**

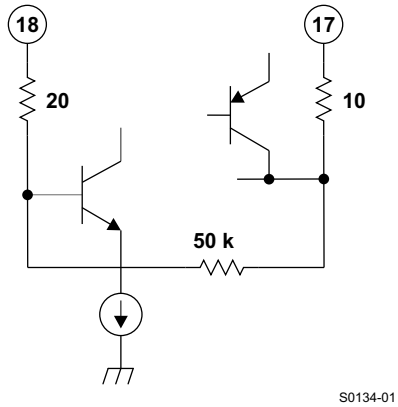



**Figure 16.**

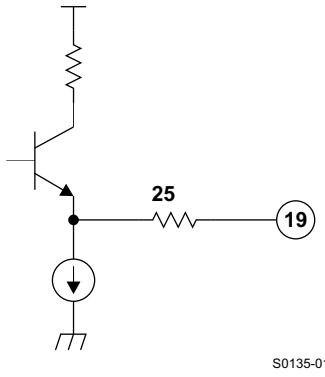



**Figure 17.**

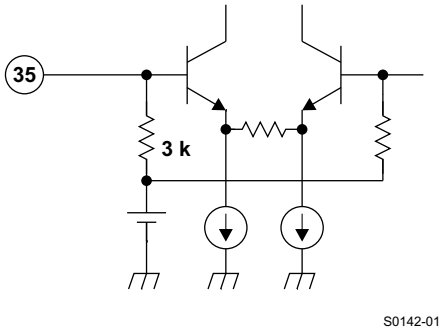



**Figure 18.**

## ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted) (1)

| | | |
|---|---|---|
| Supply voltage, $V_{CC}$ (2) | VCC | –0.4 V to 6.5 V |
| Input voltage 1, $V_{GND}$ (2) | RF GND, OSC GND, BUS 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) | $T_A \leq 25°C$ | 1276 mW |
| Operating free-air temperature, $T_A$ | | –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 $T_A \geq 25°C$.

## RECOMMENDED OPERATING CONDITIONS

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

| | | 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 V to 5.5 V, $T_A$ = –20°C to 85°C, unless otherwise noted

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $I_{CC}1$ | Supply current 1 | | | 75 | | mA |
| $I_{CC}2$ | Supply current 2 | One band switch on ($I_{BS}$ = 10 mA) | | 87 | | mA |
| $I_{CC\text{-}STBY}$ | 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 |
| **$I^2C$ INTERFACE** | | | | | | |
| $V_{ASH}$ | Address-select high-input voltage (AS) | $V_{CC}$ = 5 V | 4.5 | | 5 | V |
| $V_{ASM1}$ | Address-select mid-input1 voltage (AS) | $V_{CC}$ = 5 V | 2 | | 3 | V |
| $V_{ASM2}$ | Address-select mid-input2 voltage (AS) | $V_{CC}$ = 5 V | 1 | | 1.5 | V |
| $V_{ASL}$ | Address-select low-input voltage (AS) | $V_{CC}$ = 5 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 V | –10 | | | µA |
| $V_{OL}$ | Low-level output voltage (SDA) | $V_{CC}$ = 5 V, $I_{OL}$ = 3 mA | | | 0.4 | V |
| $I_{SDAH}$ | High-level output leakage current (SDA) | $V_{SDA}$ = 5.5 V | | | 10 | µA |
| $f_{SCL}$ | Clock frequency (SCL) | | | 100 | 400 | kHz |
| $t_{HD\text{-}DAT}$ | Data hold time | See timing chart, Figure 19 | 0 | | | µs |
| $t_{BUF}$ | Bus free time | | 1.3 | | | µs |
| $t_{HD\text{-}STA}$ | Start hold time | | 0.6 | | | µs |
| $t_{LOW}$ | SCL-low hold time | | 0.6 | | | µs |
| $t_{HIGH}$ | SCL-high hold time | | 0.6 | | | µs |
| $t_{SU\text{-}STA}$ | Start setup time | | 0.6 | | | µs |
| $t_{SU\text{-}DAT}$ | Data setup time | | 0.1 | | | µs |
| $t_r$ | SCL, SDA rise time | | | | 0.3 | µs |
| $t_f$ | SCL, SDA fall time | | | | 0.3 | µs |
| $t_{SU\text{-}STO}$ | Stop setup time | | 0.6 | | | µs |

## ELECTRICAL CHARACTERISTICS, PLL and Band Switch

$V_{CC}$ = 4.5 V to 5.5 V, $T_A$ = –20°C to 85°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 Ω to 300 Ω | | 4 | | MHz |
| $Z_{XTAL}$ | Crystal oscillator input impedance | | | 1.6 | | kΩ |
| $V_{XLO}$ | XTALOUT output voltage | Load = 10 pF/5.1 kΩ, $V_{CC}$ = 5 V, $T_A$ = 25°C | | 0.37 | | Vp-p |
| $V_{VTUL}$ | Tuning amplifier low-level output voltage | $R_L$ = 20 kΩ, $V_{TU}$ = 33 V | 0.2 | 0.3 | 0.46 | V |
| $I_{VTUOFF}$ | Tuning amplifier leakage current | Tuning amplifier = off, $V_{TU}$ = 33 V | | | 10 | µA |
| $I_{CP11}$ | Charge-pump current | CP[1:0] = 11 | | 600 | | µA |
| $I_{CP10}$ | | CP[1:0] = 10 | | 300 | | |
| $I_{CP01}$ | | 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 V, $T_A$ = 25°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 mA | 3 | | | V |
| $V_{BS2}$ | | $I_{BS}$ = 10 mA, $V_{CC}$ = 5 V, $T_A$ = 25°C | 3.5 | 3.9 | | |
| $I_{BSOFF}$ | Band-switch driver leakage current (BS1–BS4) | $V_{BS}$ = 0 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 mA, $V_{CC}$ = 5 V, $T_A$ = 25°C | | | 0.6 | V |

## ELECTRICAL CHARACRTERISTICS, RF AGC

$V_{CC}$ = 5 V, $T_A$ = 25°C, measured in Figure 20 reference measurement circuit at 50-Ω system, IF = 44 MHz, IF filter characteristics: $f_{peak}$ = 44 MHz, unless otherwise noted

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $I_{OAGC0}$ | RF AGC output current | ATC = 0 | | 900 | | nA |
| $I_{OAGC1}$ | | ATC = 1 | | 9 | | µA |
| $V_{AGCSP00}$ | Start-point IF output level | T1/ATSS = 0, ATP[2:0] = 000 | | 117 | | dBµV |
| $V_{AGCSP01}$ | | 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 V, $T_A$ = 25°C, measured in Figure 20 reference measurement circuit at 50-Ω system, IF = 44 MHz, IF filter characteristics: $f_{peak}$ = 44 MHz (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| $G_{c1}$ | Conversion gain (mixer-IF amplifier), VHF-LOW | $f_{in}$ = 57 MHz (1) | | 35 | | dB |
| $G_{c3}$ | | $f_{in}$ = 171 MHz (1) | | 35 | | |
| $G_{c4}$ | Conversion gain (mixer-IF amplifier), VHF-HIGH | $f_{in}$ = 177 MHz (1) | | 35 | | dB |
| $G_{c6}$ | | $f_{in}$ = 467 MHz (1) | | 35 | | |
| $G_{c7}$ | Conversion gain (mixer-IF amplifier), VHF-UHF | $f_{in}$ = 473 MHz (1) | | 35 | | dB |
| $G_{c9}$ | | $f_{in}$ = 864 MHz (1) | | 35 | | |
| $NF_1$ | Noise figure, VHF-LOW | $f_{in}$ = 57 MHz | | 9 | | dB |
| $NF_3$ | | $f_{in}$ = 171 MHz | | 9 | | |
| $NF_4$ | Noise figure, VHF-HIGH | $f_{in}$ = 177 MHz | | 9 | | dB |
| $NF_6$ | | $f_{in}$ = 467 MHz | | 9 | | |
| $NF_7$ | Noise figure, UHF | $f_{in}$ = 473 MHz | | 12 | | dB |
| $NF_9$ | | $f_{in}$ = 864 MHz | | 12 | | |
| $CM_1$ | 1% cross-modulation distortion, VHF-LOW | $f_{in}$ = 57 MHz (2) | | 79 | | dBµV |
| $CM_3$ | | $f_{in}$ = 171 MHz (2) | | 79 | | |
| $CM_4$ | 1% cross-modulation distortion, VHF-HIGH | $f_{in}$ = 177 MHz (2) | | 79 | | dBµV |
| $CM_6$ | | $f_{in}$ = 467 MHz (2) | | 79 | | |
| $CM_7$ | 1% cross-modulation distortion, UHF | $f_{in}$ = 473 MHz (2) | | 77 | | dBµV |
| $CM_9$ | | $f_{in}$ = 864 MHz (2) | | 77 | | |
| $V_{IFO1}$ | IF output voltage, VHF-LOW | $f_{in}$ = 57 MHz | | 117 | | dBµV |
| $V_{IFO3}$ | | $f_{in}$ = 171 MHz | | 117 | | |
| $V_{IFO4}$ | IF output voltage, VHF-HIGH | $f_{in}$ = 177 MHz | | 117 | | dBµV |
| $V_{IFO6}$ | | $f_{in}$ = 467 MHz | | 117 | | |
| $V_{IFO7}$ | IF output voltage, UHF | $f_{in}$ = 473 MHz | | 117 | | dBµV |
| $V_{IFO9}$ | | $f_{in}$ = 864 MHz | | 117 | | |
| $\Phi_{PLVL11}$ | Phase noise, VHF-LOW | $f_{in}$ = 57 MHz, offset = 1 kHz (3) | | –90 | | dBc/Hz |
| $\Phi_{PLVL12}$ | | $f_{in}$ = 57 MHz, offset = 10 kHz (4) | | –95 | | |
| $\Phi_{PLVL31}$ | | $f_{in}$ = 171 MHz, offset = 1 kHz (5) | | –85 | | |
| $\Phi_{PLVL32}$ | | $f_{in}$ = 171 MHz, offset = 10 kHz (4) | | –95 | | |
| $\Phi_{PLVL41}$ | Phase noise, VHF-HIGH | $f_{in}$ = 177 MHz, offset = 1 kHz (3) | | –85 | | dBc/Hz |
| $\Phi_{PLVL42}$ | | $f_{in}$ = 177 MHz, offset = 10 kHz (4) | | –90 | | |
| $\Phi_{PLVL61}$ | | $f_{in}$ = 467 MHz, offset = 1 kHz (5) | | –77 | | |
| $\Phi_{PLVL62}$ | | $f_{in}$ = 467 MHz, offset = 10 kHz (4) | | –90 | | |
| $\Phi_{PLVL71}$ | Phase noise, UHF | $f_{in}$ = 473 MHz, offset = 1 kHz (3) | | –80 | | dBc/Hz |
| $\Phi_{PLVL72}$ | | $f_{in}$ = 473 MHz, offset = 10 kHz (4) | | –85 | | |
| $\Phi_{PLVL91}$ | | $f_{in}$ = 864 MHz, offset = 1 kHz (5) | | –77 | | |
| $\Phi_{PLVL92}$ | | $f_{in}$ = 864 MHz, offset = 10 kHz (4) | | –90 | | |

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

| SYMBOL | DESCRIPTION | DEFAULT |
|---|---|---|
| MA[1:0] | Address-set bits (see Table 3, *Address Selection*) | |
| N[14:0] | Programmable counter set bits<br>$N = N14 \times 2^{14} + N13 \times 2^{13} + ... + N1 \times 2 + N0$ | N14 = N13 = N12 = ... = N0 = 0 |
| CP[1:0] | Charge-pump current-set bit<br>60 µA (CP = 0); 280 µA (CP = 1) | CP = 1 |
| T[2:0} | RF AGC start-point control bits (see Table 4, *RF AGC Start Point*) | ATP[2:0] = 011 |
| RSA, RSB | Reference divider ratio-selection bits (see Table 5, *Reference Divider Ratio*) | RSA = 0, RSB = 1 |
| OS | Tuning amplifier control bit<br>Tuning voltage on (OS = 0)<br>Tuning voltage off, high impedance (OS = 1) | OS = 0 |
| BS[4:1] | Band-switch control bits<br>BSn = 0: OFF BSn = 1: ON | BSn = 0 |
| | Band selection by BS[1:2]<br>**BS1 BS2**<br>1 0 VHF-LO<br>0 1 VHF-HI<br>0 0 UHF<br>1 1 Reserved | |
| X | Don't care | |

### Table 3. Address Selection

| MA1 | MA0 | Voltage Applied on AS Input |
|---|---|---|
| 0 | 0 | 0 V to 0.1 $V_{CC}$ |
| 0 | 1 | OPEN, or 0.2 $V_{CC}$ to 0.3 $V_{CC}$ |
| 1 | 0 | 0.4 $V_{CC}$ to 0.6 $V_{CC}$ |
| 1 | 1 | 0.9 $V_{CC}$ to $V_{CC}$ |

### Table 4. RF AGC Start Point

| T1/ATSS | ATP2 | ATP1 | ATP0 | IFOUT Level, dBμV |
|---|---|---|---|---|
| 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 | MA1 | MA0 | R/$\overline{W}$ = 1 | A |
| Status byte (SB) | POR | FL | 1 | 1 | X | A2 | A1 | A0 | – |

**Table 9. Description of Data Symbols**

| SYMBOL | DESCRIPTION | DEFAULT |
|---|---|---|
| MA[1:0] | Address set bits (see Table 3, *Address Selection*) | |
| POR | Power-on-reset flag<br>POR set: power on<br>POR reset: end-of-data transmission procedure | POR = 1 |
| FL | In-lock flag<br>PLL locked (FL = 1), unlocked (FL = 0) | |
| A[2:0] | Digital data of ADC (see Table 10, *ADC Level*)<br>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 $0.03 \times V_{CC}$.

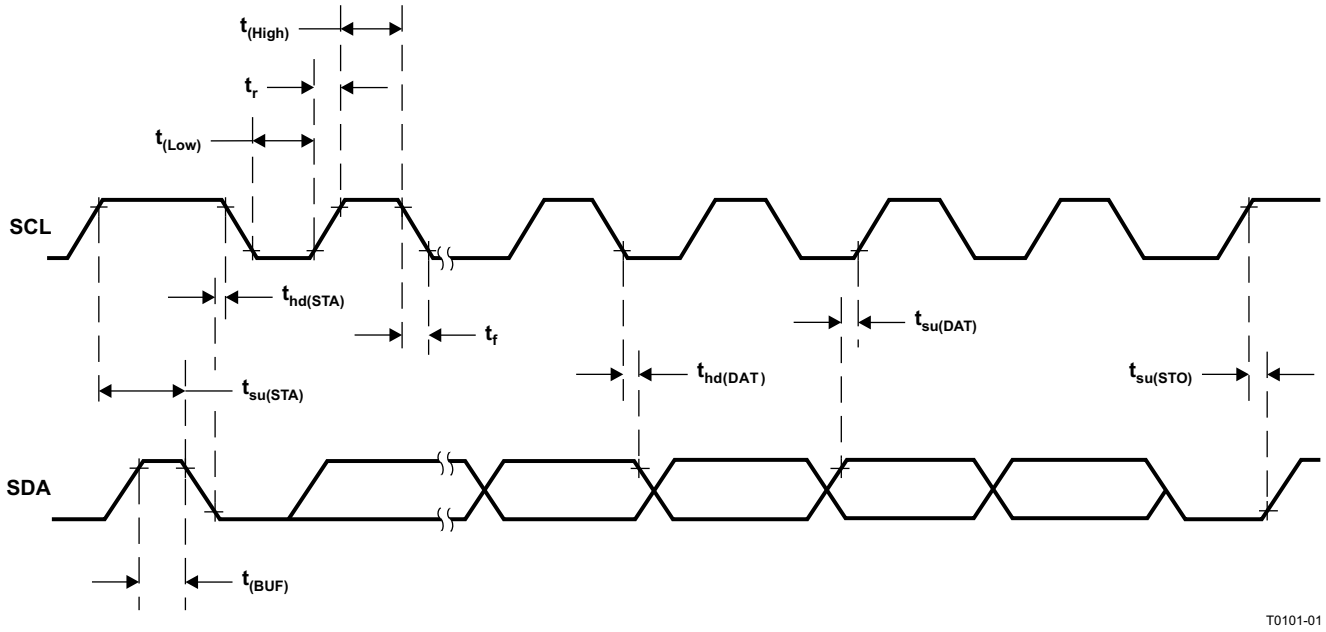
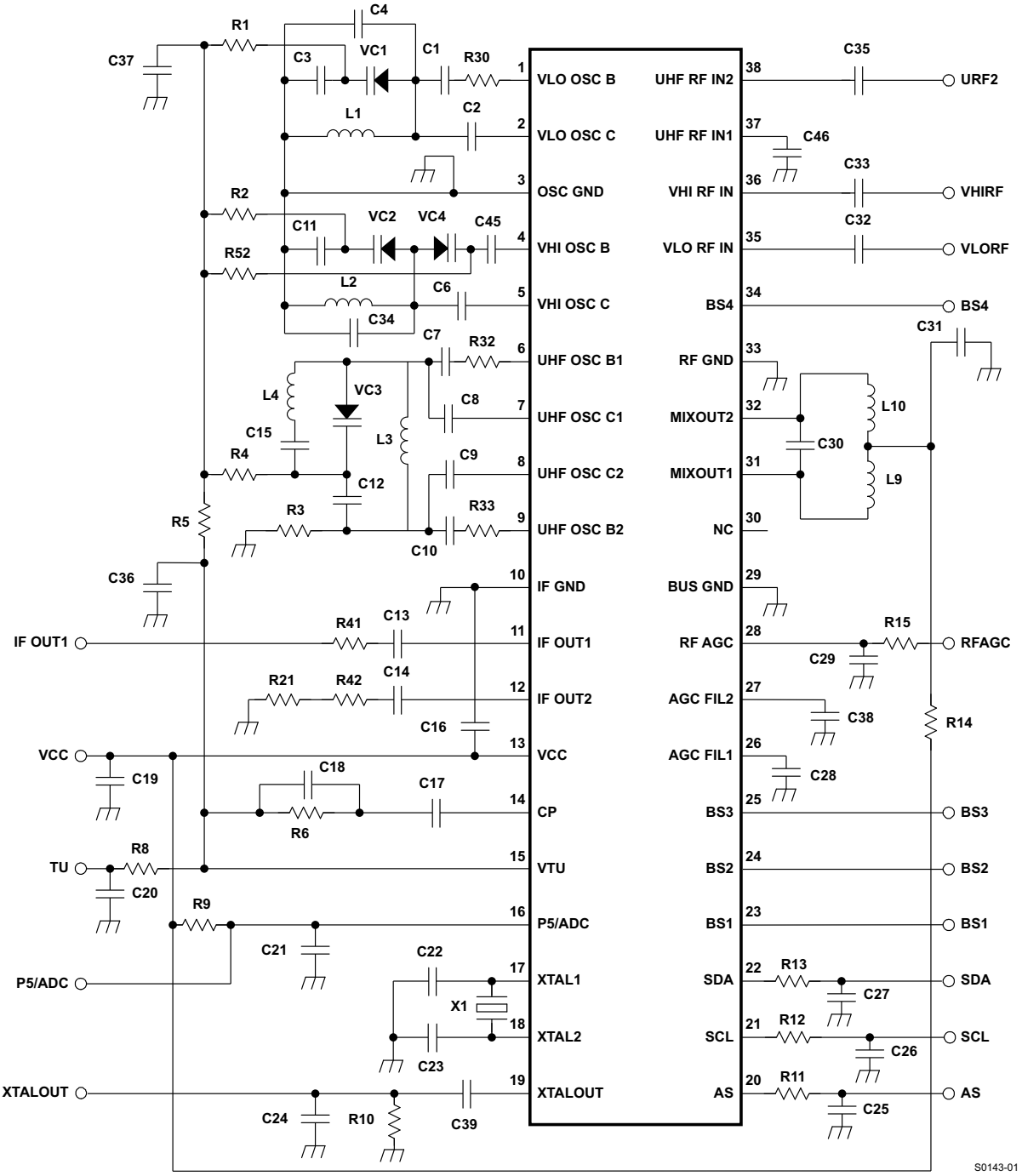



**Figure 19. I²C Timing Chart**

## APPLICATION INFORMATION

### Reference Measurement Circuit




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 which may result from its use.

**Figure 20. 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) | $\phi$ 3,0 mm, 7T, wire 0,32 mm |
| C6 (VHI OSCC) | 5 pF | L2 (VHI OSC) | $\phi$2,0 mm, 3T, wire 0,4 mm |
| C7 (UHF OSCB1) | 1 pF | L3 (UHF OSC) | $\phi$1,8 mm, 3T, wire 0,4 mm |
| C8 (UHF OSCC1) | 1 pF | L4 (UHF OSC) | $\phi$1,8 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 | SN761662 |
| 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 | | |

## Test Circuits

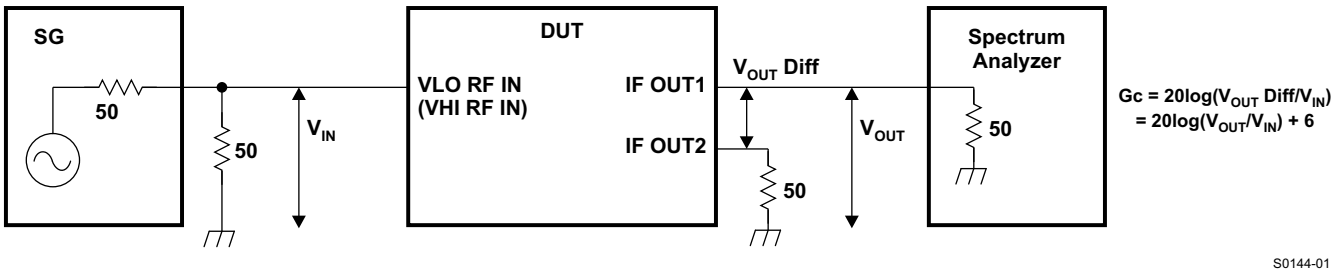



**Figure 21. VHF-Conversion Gain-Measurement Circuit**

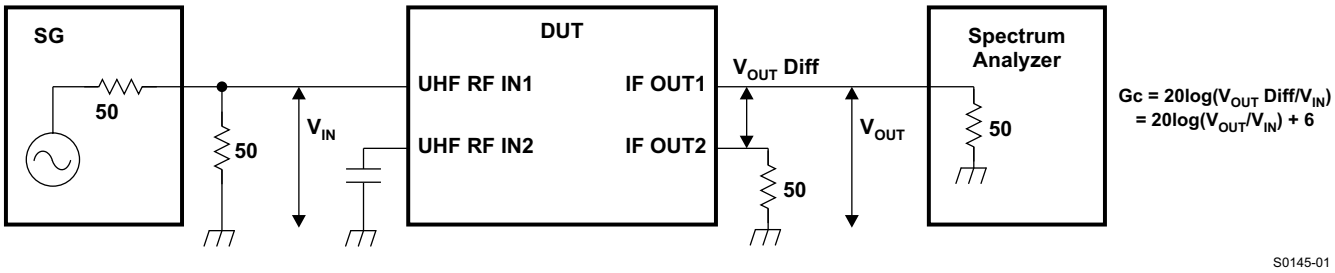



**Figure 22. UHF-Conversion Gain-Measurement Circuit**

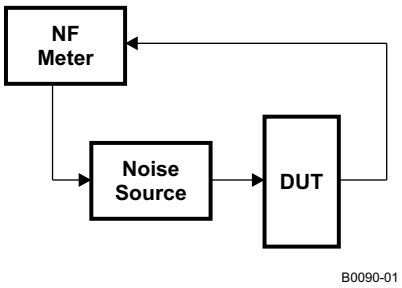



**Figure 23. Noise-Figure Measurement Circuit**

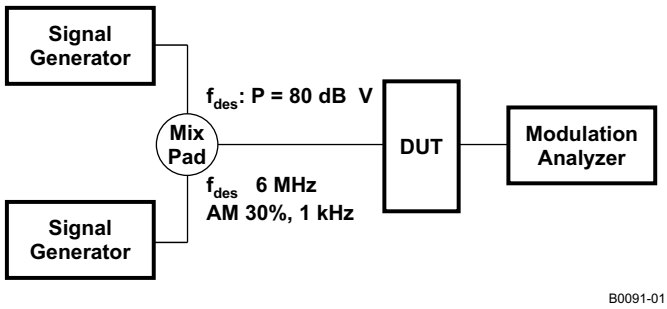



**Figure 24. 1% Cross-Modulation Distortion Measurement Circuit**

## TYPICAL CHARACTERISTICS

### Band-Switch Driver Output Voltage (BS1–BS4)

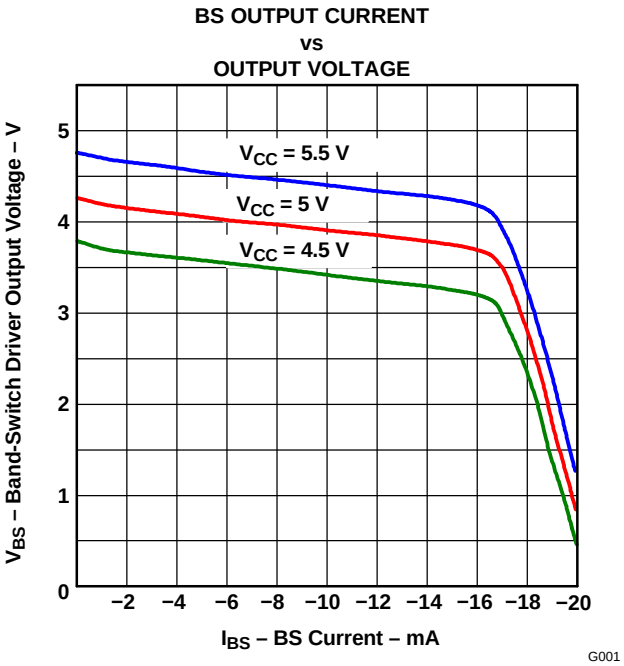



**Figure 25. Band-Switch Driver Output Voltage**

### S-Parameter

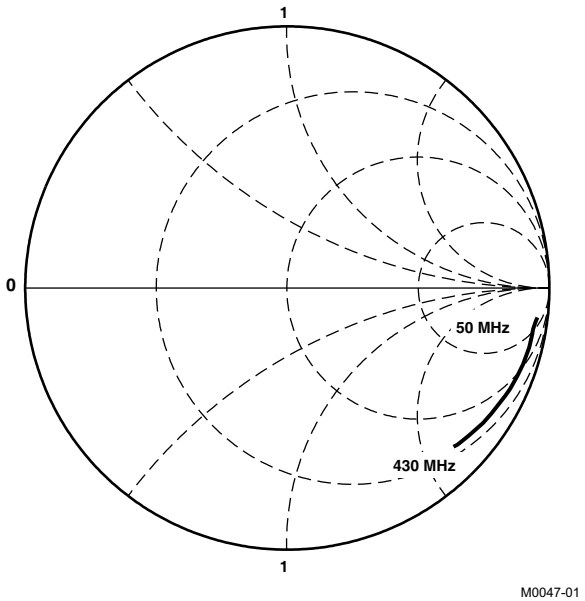



**Figure 26. VLO RFIN, VHI RFIN**

## TYPICAL CHARACTERISTICS (continued)

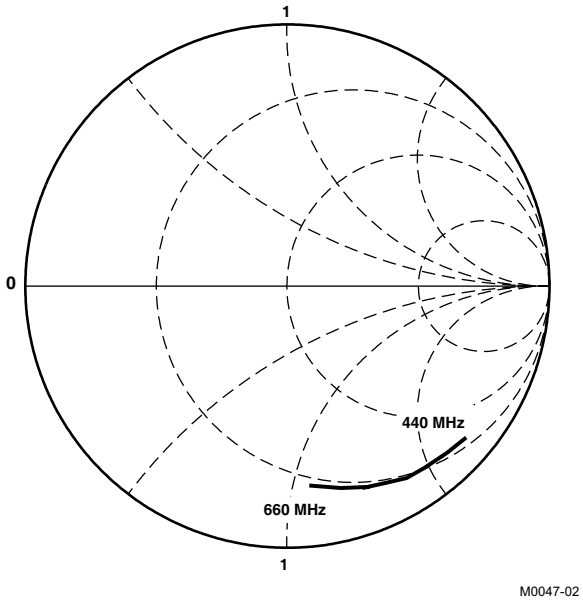



**Figure 27. UHF RFIN**

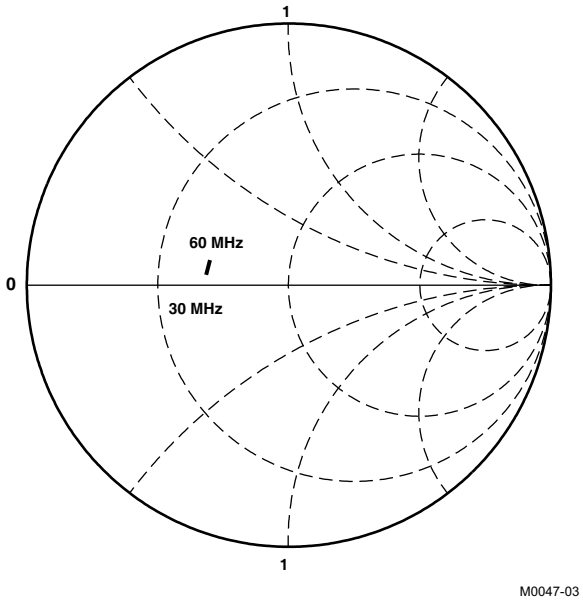



**Figure 28. IFOUT**

## PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) |
|---|---|---|---|---|---|---|---|---|
| SN761662DBT | ACTIVE | SM8 | DBT | 38 | 50 | TBD | Call TI | Call TI |
| SN761662DBTR | ACTIVE | SM8 | DBT | 38 | 2000 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-2-260C-1 YEAR |
| SN761662DBTRG4 | ACTIVE | SM8 | 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) 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.
**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.

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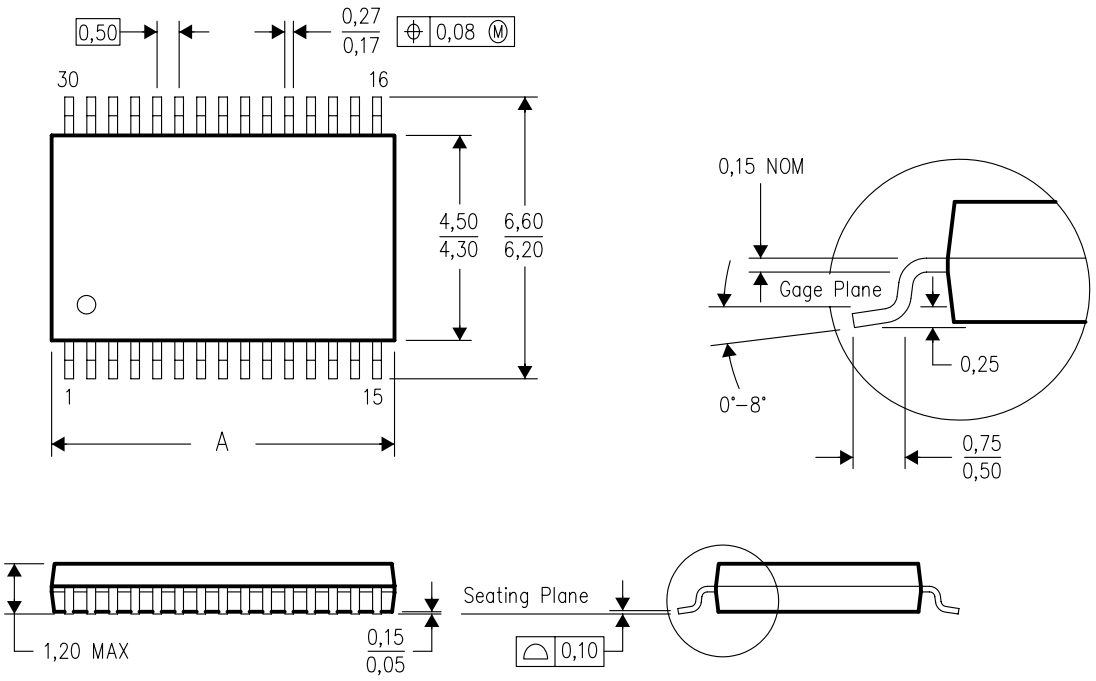
## DBT (R–PDSO–G**) PLASTIC SMALL–OUTLINE PACKAGE

30 PINS SHOWN




| DIM \ PINS ** | 20 | 24 | 28 | 30 | 38 | 44 | 50 |
|---|---|---|---|---|---|---|---|
| A MAX | 5,10 | 6,60 | 7,90 | 7,90 | 9,80 | 11,40 | 12,60 |
| A MIN | 4,90 | 6,40 | 7,70 | 7,70 | 9,60 | 11,20 | 12,40 |

4073252/F 09/05

NOTES:
A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion.
D. Falls within JEDEC MO–153 except 44 pin package length.

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