

- **Single Chip Mixer/Oscillator and Synthesizer**
- **VHF-L, VHF-H, UHF 3-Band Local Oscillator**
- **I²C Bus Protocol**
- **Bidirectional Data Transmission**
- **30-V Tuning Voltage Output**
- **4-Channel NPN Type Band Switch Drivers**
- **Programmable Reference Divider Ratio (512, 640 or 1024)**
- **5-V Power Supply**
- **32-Pin TSSOP Package**

**DA PACKAGE
(TOP VIEW)**

VOL OSC B	□	1	○	32	□	UHF RF IN2
VOL OSC C	□	2		31	□	UHF RF IN1
OSC GND	□	3		30	□	VHF RF IN2
VHS OSC B	□	4		29	□	VHF RF IN1
VHS OSC C	□	5		28	□	RF GND
UHF OSC B1	□	6		27	□	MIX OUT2
UHF OSC C1	□	7		26	□	MIX OUT1
UHF OSC C2	□	8		25	□	BS4
UHF OSC B2	□	9		24	□	BS3
IF GND	□	10		23	□	BS2
IF OUT1	□	11		22	□	BS1
IF OUT2	□	12		21	□	NC
V _{CC}	□	13		20	□	ADC
CP	□	14		19	□	AS
VTU	□	15		18	□	SDA
XTAL	□	16		17	□	SCL

NC – No internal connection

description

SN761672A is a single chip synthesized tuner IC designed for TV/VCR tuning systems. The circuit consists of a PLL synthesizer, 3-band local oscillators and mixer, a 30-V output tuning amplifier, and four NPN band switch drivers. It is available in a small package outline. The 15-bit programmable counter and reference divider is controlled by I²C bus protocol. Tuning step frequency is selectable by this reference-divider ratio for a 4-MHz crystal oscillator.



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.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



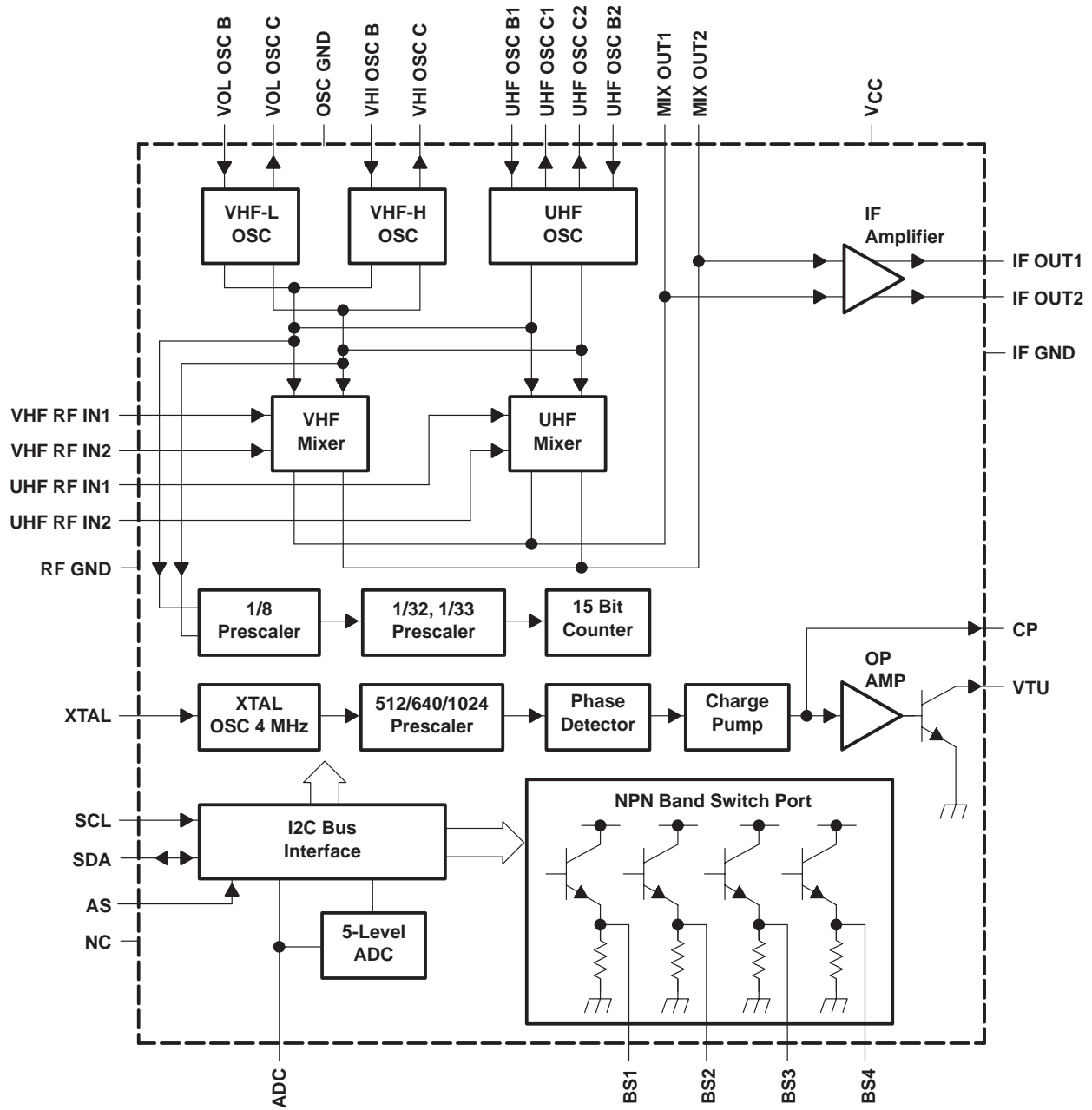
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2001, Texas Instruments Incorporated

SN761672A TV/VCR TUNER IC

SLLS437 – JANUARY 2001

block diagram



Terminal Functions

TERMINAL NAME	NO.	I/O	DESCRIPTION
ADC	20	I	ADC input (see Figure 7)
AS	19	I	Address selection input (see Figure 7)
BS1	22	O	Band switch1 output (NPN emitter follower) (see Figure 8)
BS2	23		
BS3	24		
BS4	25		
CP	14	O	Charge pump output (see Figure 5)
IF GND	10		IF ground (see Figure 4)
IF OUT1	11	O	IF output (see Figure 4)
IF OUT2	12	O	IF output (see Figure 4)
MIX OUT1	26	O	Mixer outputs (see Figure 9)
MIX OUT2	27		
OSC GND	3		OSC ground
RF GND	28		RF ground
SCL	17	I	Serial clock input (see Figure 7)
SDA	18	I/O	Serial data input/output (see Figure 7)
UHF OSC B1	6	I	UHF oscillator input, base 1 (see Figure 3)
UHF OSC B2	9	I	UHF oscillator input, base 2 (see Figure 3)
UHF OSC C1	7	O	UHF oscillator output, collector 1 (see Figure 3)
UHF OSC C2	8	O	UHF oscillator output, collector 2 (see Figure 3)
UHF RF IN1	31	I	UHF RF inputs (see Figure 11)
UHF RF IN2	32		
VCC	13		Supply voltage for mixer/oscillator/PLL: 5 V
VHF RF IN1	29	I	VHF RF inputs (see Figure 10)
VHF RF IN2	30		
VHI OSC B	4	I	VHF hi oscillator input base (see Figure 2)
VHI OSC C	5	O	VHF hi oscillator output collector (see Figure 2)
VLO OSC B	1	I	VHF low oscillator input base (see Figure 1)
VLO OSC C	2	O	VHF low oscillator output collector (see Figure 1)
VTU	15	O	Tuning voltage amplifier output (see Figure 5)
XTAL	16	I	4-MHz crystal oscillator input (see Figure 6)

schematics

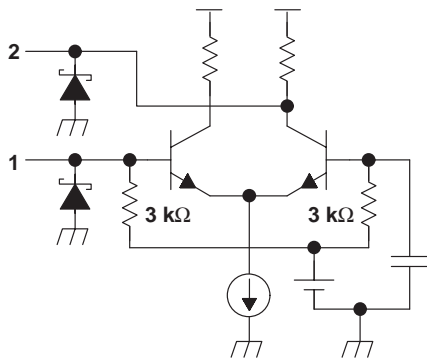


Figure 1

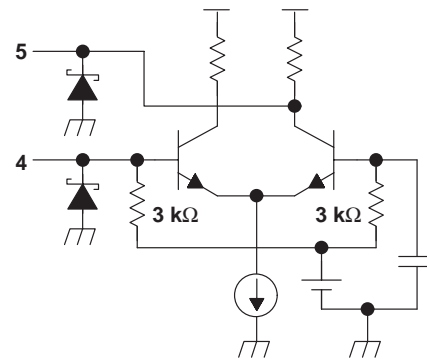


Figure 2

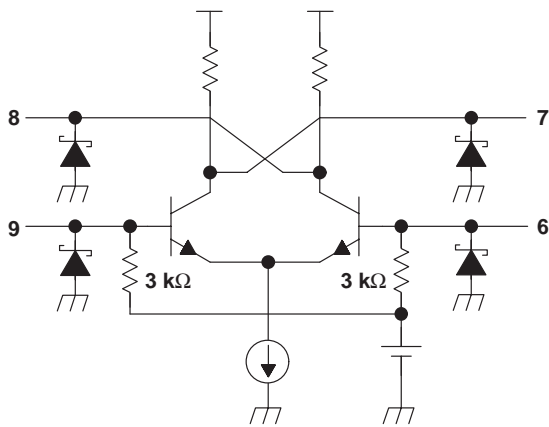


Figure 3

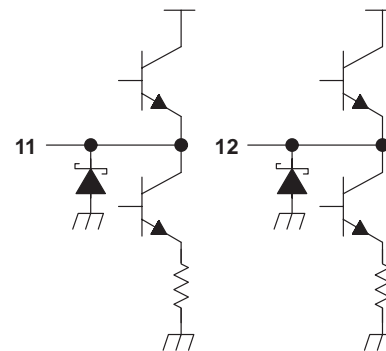


Figure 4

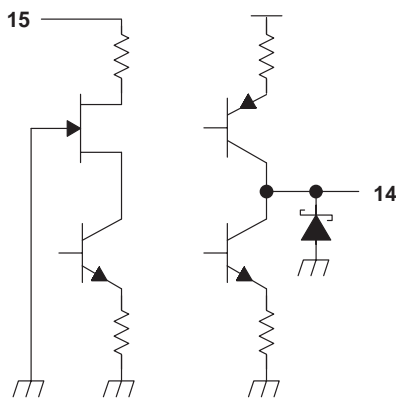


Figure 5

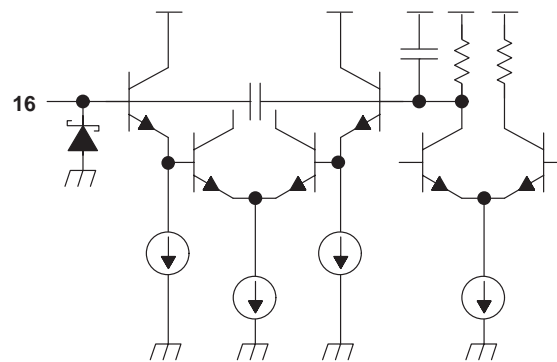


Figure 6

schematics (continued)

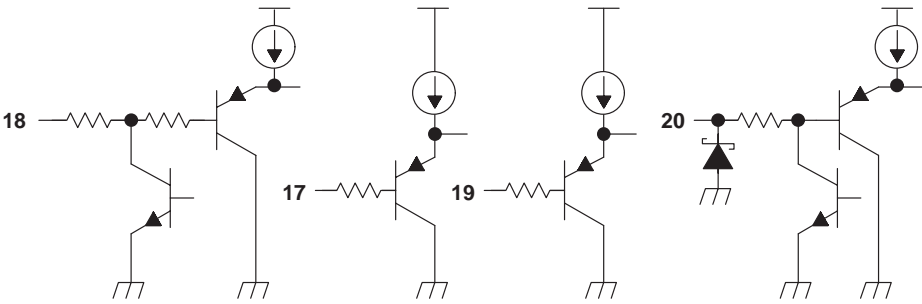


Figure 7

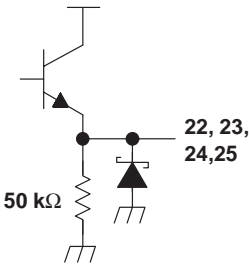


Figure 8

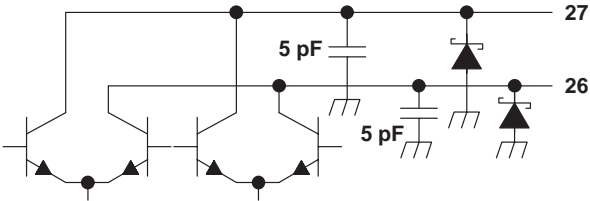


Figure 9

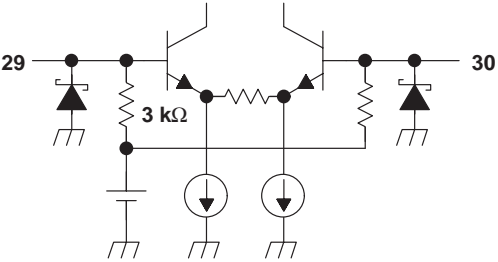


Figure 10

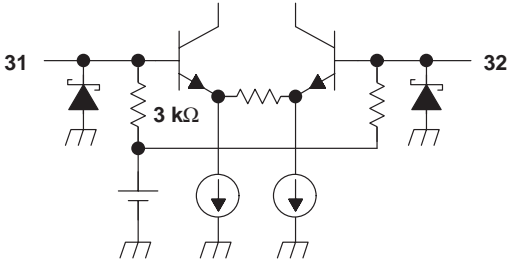


Figure 11

SN761672A TV/VCR TUNER IC

SLLS437 – JANUARY 2001

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

Supply voltage, V_{CC} (see Note 1)	-0.4 V ~ 7 V
Input voltage 1, $V_{I(GND)}$ (see Note 1)	-0.4 V ~ 0.4 V
Input voltage 2, $V_{I(VTU)}$	-0.4 V ~ 35 V
Input voltage 3, $V_{(VTU)}$ (see Note 1)	-0.4 V ~ 7 V
Continuous total dissipation at (or below $T_A = 25^\circ\text{C}$)	See Dissipation Rating Table
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 lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
Maximum short circuit time, $t_{(SCMAX)}$, All pins to V_{CC}	TBD

† 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.

NOTE 1: Voltage values are with respect to the IF GND of the circuit.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	OPERATING FACTOR $T_A \leq 25^\circ\text{C}$
DA	1040 mW	8.33 mW/ $^\circ\text{C}$

recommended operating conditions

	MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}	4.5	5	5.5	V
Tuning supply voltage, $V_{SS(TU)}$		30	33	V
Output current of band switch, one port ON, I_O			10	mA
Operating free-air temperature, T_A	-20		85	$^\circ\text{C}$

CAUTION:

It is advised that precautions to be taken to avoid damage due to high static voltages or electrostatic fields in handling this device. Pins 4–6 and 9 withstand 150 V, and all other pins withstand 200 V, according to EIAJ (0 Ω , 200 pF).



electrical characteristics

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$I_{CC(1)}$	Supply current 1			60	80	mA
$I_{CC(2)}$	Supply current 2	One band switch ON – $I_{(BS)} = 10$ mA		70	90	mA
V_{IH}	High-level input voltage (SCL, SDA)		3			V
V_{IL}	Low-level input voltage (SCL, SDA)				1.5	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
$V_{(ASH)}$	Address select input voltage (AS)	High	0.9 $V_{CC} \sim V_{CC}$		5	V
$V_{(ASM)}$		Mid	0.4 $V_{CC} \sim 0.6 V_{CC}$		3	
$V_{(ASL)}$		Low	0 $V_{CC} \sim 0.1 V_{CC}$		0.5	
$I_{(ASH)}$	Address select input current (AS)	High			10	μA
$I_{(ASL)}$		Low			-10	
$V_{(ADC)}$	ADC input voltage	See Table 9	0		V_{CC}	V
$I_{IL(ADH)}$	ADC high-level input current	$V_{(ADC)} = V_{CC}$			10	μA
$I_{IL(ADL)}$	ADC low-level input current	$V_{(ADC)} = 0$ V	-10			μA
$f_{(SCL)}$	Clock frequency (SCL)			100	400	kHz
$t_{h(HLD)}$	Data hold time	See timing chart, Figure 1	0			μs
V_{OL}	Low-level output voltage (SDA)	$V_{CC} = 5$ V, $I_{OL} = 3$ mA			0.4	V
$I_{lkg(SDA)}$	High-level output leakage current (SDA)	$V_{(SDA)} = 5.5$ V			10	μA

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

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
N	Divider ratio	14-bit frequency word	256		16383	
		15-bit frequency word	256		32767	
$F_{(XTAL)}$	Crystal oscillator	$R_{XTAL} = 25 \Omega$ to 300Ω		4		MHz
$Z_{(XTAL)}$	Crystal oscillator input impedance			1.6		k
$V_{(VTUL)}$	Tuning amplifier low-level output voltage	$R_L = 27\text{k}$, $V_{(TU)} = 33$ V	0.2	0.3	0.46	V
$I_{(VTUOFF)}$	Tuning amplifier leakage current (OFF)	OS = 1, $V_{(TU)} = 33$ V			10	μA
$I_{(CPH)}$	Charge pump high-level input current	CP = 1		280		μA
$I_{(CPL)}$	Charge pump low-level input current	CP = 0		60		μA
$V_{(CP)}$	Charge pump output voltage	In-lock		1.95		V
$I_{(CPOFF)}$	Charge pump leakage current	$T_2 = 0$, $T_1 = 1$, $T_A = 25^{\circ}\text{C}$, $V_{CP} = 2$ V	-15		15	nA
$I_{(BS)}$	Band switch driver output current				10	mA
$V_{(SBS1)}$	Band switch driver output voltage	$I_{(BS)} = 10$ mA	3			V
$V_{(SBS2)}$		$I_{(BS)} = 10$ mA, $T_A = 25^{\circ}\text{C}$, $V_{CC} = 5$ V	3.5	3.9		
$I_{lkg(BSOFF)}$	Band switch driver leakage current	$V_{(BS)} = 0$ V			3	μA

SN761672A

TV/VCR TUNER IC

SLLS437 – JANUARY 2001

electrical characteristics (continued)

mixer, oscillator, IF amplifier ($V_{CC} = 5\text{ V}$, $T_A = 25^\circ\text{C}$, measured in reference measurement circuit at 50 W system, IF filter characteristics: $f_{\text{peak}} = 43\text{ MHz}$) (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$G_{(c1)}$	Conversion gain (mixer ~ IF amplifier, VHF-low)	$f_{\text{in}} = 59\text{ MHz}$ (see Note 2)	20	23	26	dB
$G_{(c3)}$		$f_{\text{in}} = 130\text{ MHz}$	20	23	26	
$G_{(c4)}$	Conversion gain (mixer ~ IF amplifier, VHF-high)	$f_{\text{in}} = 136\text{ MHz}$ (see Note 2)	20	23	26	dB
$G_{(c6)}$		$f_{\text{in}} = 364\text{ MHz}$	20	23	26	
$G_{(c7)}$	Conversion gain (mixer ~ IF amplifier, VHF-UHF)	$f_{\text{in}} = 370\text{ MHz}$ (see Note 2)	22	25	28	dB
$G_{(c9)}$		$f_{\text{in}} = 804\text{ MHz}$	20	23	26	
NF ₁	Noise figure VHF-low	$f_{\text{in}} = 55.25\text{ MHz}$		9.5		dB
NF ₃		$f_{\text{in}} = 127.25\text{ MHz}$		9.5		
NF ₄	Noise figure VHF-low	$f_{\text{in}} = 133.25\text{ MHz}$		10		dB
NF ₆		$f_{\text{in}} = 361.25\text{ MHz}$		10		
NF ₇	Noise figure UHF	$f_{\text{in}} = 367.25\text{ MHz}$		9		dB
NF ₉		$f_{\text{in}} = 801.25\text{ MHz}$		10		
CM ₁	1% cross modulation distortion VHF-low	$f_{\text{in}} = 55.25\text{ MHz}$ (see Note 3)		91		dB μV
CM ₃		$f_{\text{in}} = 801.25\text{ MHz}$		91		
CM ₄	1% cross modulation distortion VHF-high	$f_{\text{in}} = 133.25\text{ MHz}$ (see Note 3)		91		dB μV
CM ₆		$f_{\text{in}} = 361.25\text{ MHz}$		91		
CM ₇	1% cross modulation distortion UHF	$f_{\text{in}} = 367.25\text{ MHz}$ (see Note 3)		88		dB μV
CM ₉		$f_{\text{in}} = 801.25\text{ MHz}$		88		
$V_{(\text{IFO}1)}$	IF output voltage VHF-low	$f_{\text{in}} = 55.25\text{ MHz}$ (see Note 4)		117		dB μV
$V_{(\text{IFO}3)}$		$f_{\text{in}} = 127.25\text{ MHz}$		117		
$V_{(\text{IFO}4)}$	IF output voltage VHF-high	$f_{\text{in}} = 133.25\text{ MHz}$ (see Note 4)		117		dB μV
$V_{(\text{IFO}6)}$		$f_{\text{in}} = 361.25\text{ MHz}$		117		
$V_{(\text{IFO}7)}$	IF output voltage UHF	$f_{\text{in}} = 367.25\text{ MHz}$ (see Note 4)		117		dB μV
$V_{(\text{IFO}9)}$		$f_{\text{in}} = 801.25\text{ MHz}$		117		
Prescaler beat (see Note 5)					25	dB μV

- NOTES: 2. IF = 43 MHz, RF input level = 80 dB μV
 3. $f_{(\text{undes})} = f_{(\text{des})} \pm 6\text{ MHz}$, pin = 80 dB μV , AM 1 kHz, 30%, DES/CM=S/I=46 dB
 4. IF = 45.75 MHz
 5. Design parameter, not tested



function description

The device can be controlled according to the I²C bus format.

Table 1. Serial Interface Function

PIN	PIN NAME	FUNCTION
17	SCL	Clock input
18	SDA	Data input/output
19	AS	Address selection input
20	ADC	ADC input/test output

I²C bus mode

I²C write mode (R/W = 0)

Table 2. Write Data Format

	MSB							LSB	ACKNOWLEDGE
Address byte (ADV)	1	1	0	0	0	MA1	MA0	R/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 (CB)	1	CP	T2	T1	T0	RSA	RSB	OS	A
Band switch byte (BB)	X	X	X	X	BS4	BS3	BS2	BS1	A

Table 3. Description of Data Symbol

SYMBOL	DESCRIPTION		DEFAULT																
MA1, MA0	Address set bits (see Table 4)																		
N14...N0	Programmable counter set bits	$N=N14*2^{14}+N13*2^{13}+...+N1*2+N0$	$Nn = 0$																
CP	Charge pump current set bit	60 μ A (CP=0) 280 μ A (CP=1)	CP = 1																
T2, T1, T0	Test bits (see table 5)	Normal Mode: T2=0, T1=0, T0=1/0	T2=0, T1=0, T0=1																
RSA, RSB	Reference divider ratio selection bits (see Table 6)		RSA=0, RSB=1																
OS	Tuning amplifier control bit	Tuning voltage on (OS=0) Tuning voltage off, high impedance (OS=1)	OS=0																
BS4...BS1	Band switch ports control bits Band selection by BS1,2,4 (X = don't care)	BSn=0:OFF BSn=1:ON	BSn=0																
		<table border="1"> <thead> <tr> <th></th> <th>BS1</th> <th>BS2</th> <th>BS4</th> </tr> </thead> <tbody> <tr> <td>VHF-LO</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>VHF-HI</td> <td>X</td> <td>1</td> <td>0</td> </tr> <tr> <td>UHF</td> <td>X</td> <td>X</td> <td>1</td> </tr> </tbody> </table>		BS1	BS2	BS4	VHF-LO	1	0	0	VHF-HI	X	1	0	UHF	X	X	1	
	BS1	BS2	BS4																
VHF-LO	1	0	0																
VHF-HI	X	1	0																
UHF	X	X	1																
X	Don't care																		

Table 4. Address Selection

VOLTAGE APPLIED ON CE INPUT	MA1	MA0
0 V to 0.1 V _{CC}	0	0
Always valid	0	1
0.4 V _{CC} to 0.6 V _{CC}	1	0
0.9 V _{CC} to V _{CC}	1	1

I²C bus mode (continued)

Table 5. Test Bits (see Note 7)

T2	T1	T0	FUNCTION	
0	0	0	Normal operation	
0	0	1	Normal operation	Default
0	1	X	Charge pump off	
1	1	0	Charge pump sink	
1	1	1	Charge pump source	
1	0	0	Reference counter output is available on ADC pin.	Not available ADC
1	0	1	Main counter output is available on ADC pin (see Note 7).	Not available ADC

NOTES: 6. Not used for other bit-patterns.
7. Main counter input is bypassed 1.8 and 1.32, 1/33 prescaler from oscillator, at this mode. (F_{OSC} ≤ 4 MHz)

Table 6. Ratio Select Bits

RSA	RSB	REFERENCE DIVIDER RATIO
X	0	640
0	1	1024
1	1	512

I²C read mode (R/W = 1)

Table 7. Read Data Format

	MSB						LSB	ACKNOWLEDGE	
Address byte (ADB)	1	1	0	0	0	MA1	MA0	R/W=1	A
Status byte (SB)	POR	FL	1	1	1	A2	A1	A0	A

Table 8. Description of Data Symbol

SYMBOL	DESCRIPTION	DEFAULT
MA1, MA0	Address set bits (see Table 4)	
POR	Power-on reset flag POR set: power on POR reset: end-of-data transmission procedure	POR = 1
FL	In-lock flag PLL lock (FL = 1) Unlock (FL = 0)	
A2...A0	Digital data of ADC (see Table 9)	

Table 9. ADC Level

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

I²C read mode (R/W = 1) (continued)

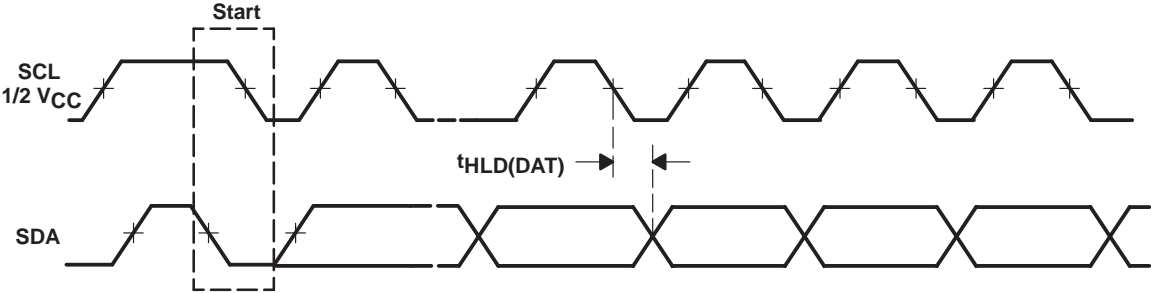
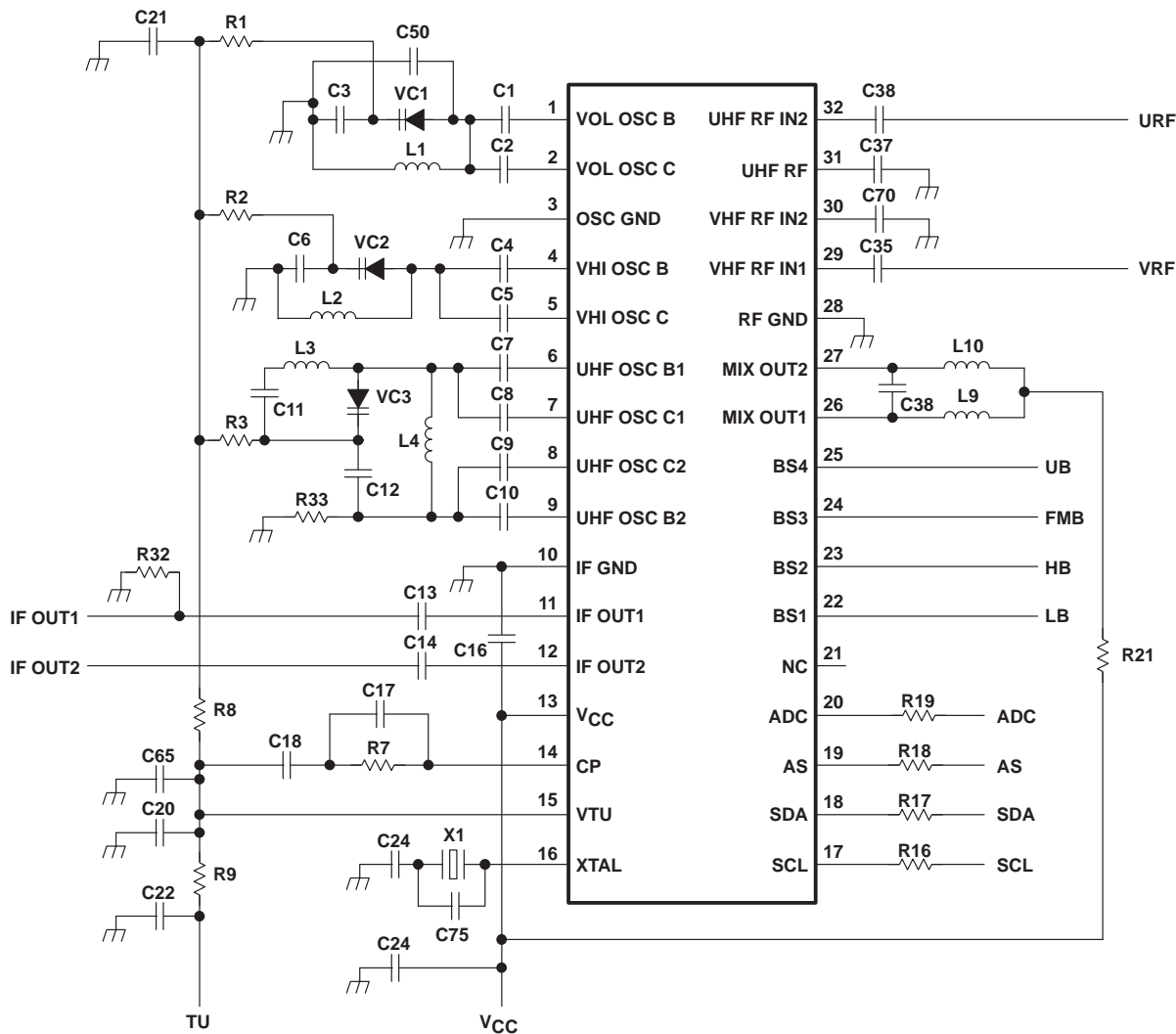


Figure 12. I²C Timing Chart

APPLICATION INFORMATION



NOTE 8: This application information is advisory and performance-check is required at actual application circuits.

Figure 13. Reference Measurement Circuit

APPLICATION INFORMATION

component values for measurement circuit

PARTS NAME	VALUE	PARTS NAME	VALUE
U1	SN761672A	C1	1 pF
VC1	1T363A	C2	1 pF
VC2	1T363A	C3	47 pF
VC3	1T363A	C4	2 pF
L1	Diameter 3.0 mm 8T	C5	3 pF
L2	Diameter 2.4 mm 4T	C6	86 pF
L3	Diameter 3.0 mm 2T	C7	1.5 pF
L4	Diameter 2.0 mm 3T	C8	1.5 pF
L9	Diameter 2.4 mm 15T	C9	1.5 pF
L10	Diameter 2.4 mm 15T	C10	1.5 pF
X1	X'tal 4 MHz	C11	100 pF
R1	33 k Ω	C12	12 pF
R2	33 k Ω	C13	2.2 nF
R5	33 k Ω	C14	2.2 nF
R7	22 k Ω	C16	2.2 nF
R8	33 k Ω	C17	2.2 nF
R9	22 k Ω	C18	0.1 μ F
R16	330 Ω	C20	2.2 nF
R17	330 Ω	C21	2.2 nF
R18	330 Ω	C22	2.2 nF
R21	0 Ω	C24	5 pF
R19	330 Ω	C33	27 pF
R32	56 Ω	C35	2.2 nF
R33	22 k Ω	C37	2.2 nF
		C38	2.2 nF
		C39	2.2 nF
		C50	3 pF
		C65	2.2 nF
		C70	2.2 nF
		C75	10 pF

APPLICATION INFORMATION

test circuit

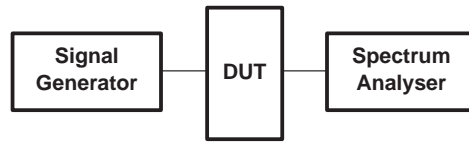


Figure 14. Measurement Circuit of Conversion Gain

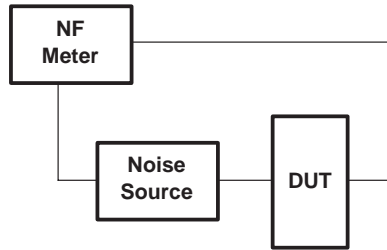


Figure 15. Noise Figure Measurement Circuit

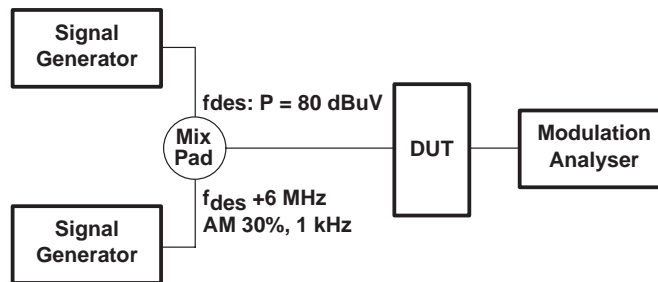


Figure 16. 1% Cross Modulation Distortion Measurement Circuit

TYPICAL CHARACTERISTICS

S-parameter

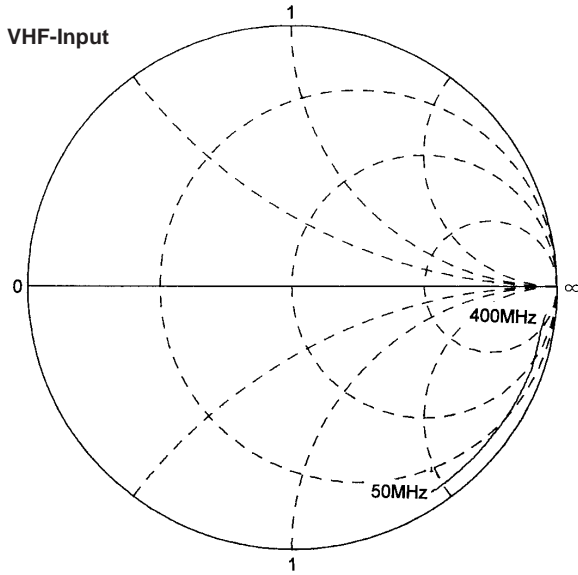


Figure 17

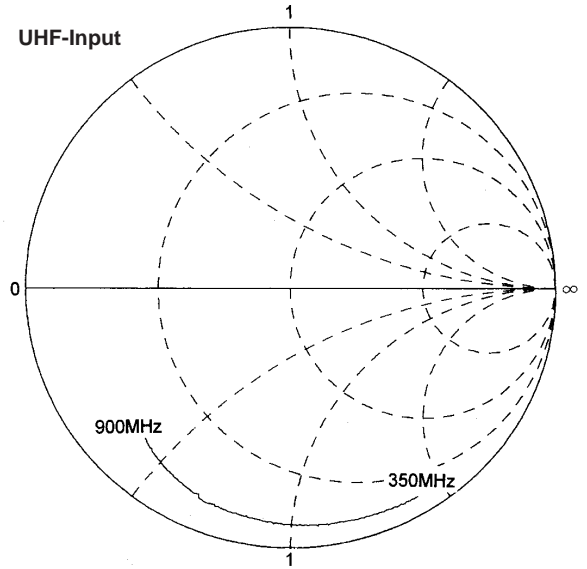


Figure 18

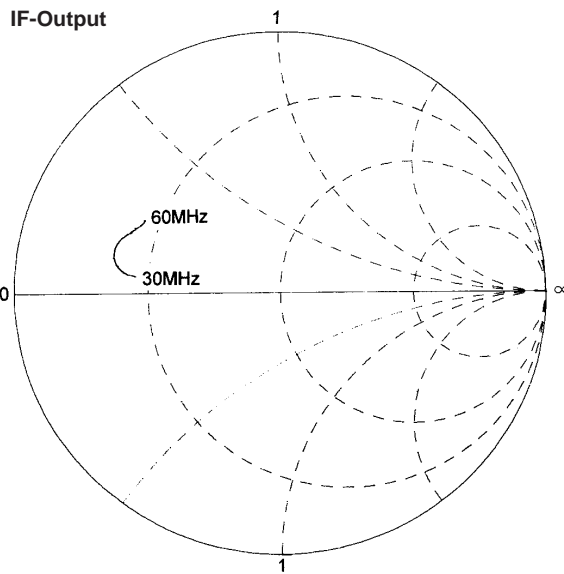


Figure 19

TYPICAL CHARACTERISTICS

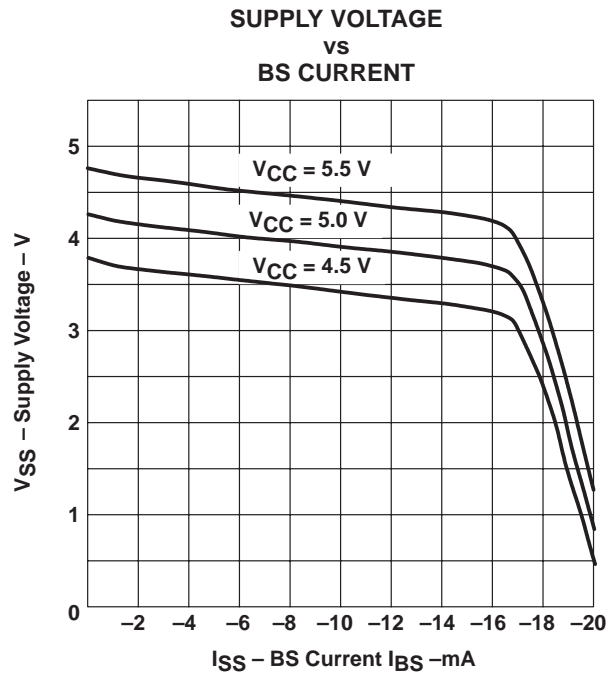


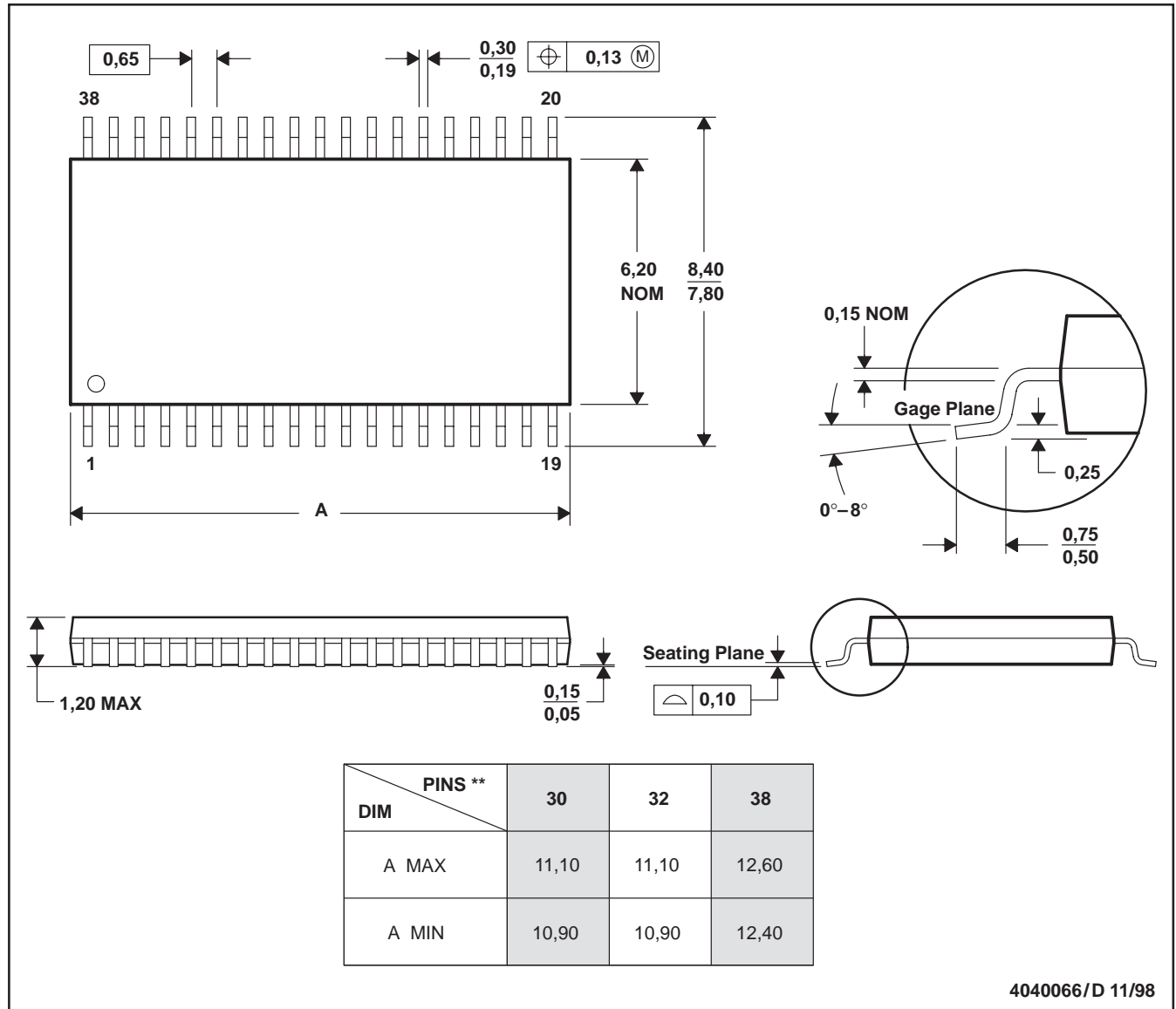
Figure 20. Band Switch Driver Output Voltage

MECHANICAL DATA

DA (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

38 PINS SHOWN



- 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

IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgment, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

Customers are responsible for their applications using TI components.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. 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 of TI covering or relating to any combination, machine, or process in which such products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, license, warranty or endorsement thereof.

Reproduction of 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. Representation or reproduction of this information with alteration voids all warranties provided for an associated TI product or service, is an unfair and deceptive business practice, and TI is not responsible nor liable for any such use.

Resale of TI's products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service, is an unfair and deceptive business practice, and TI is not responsible nor liable for any such use.

Also see: [Standard Terms and Conditions of Sale for Semiconductor Products](http://www.ti.com/sc/docs/stdterms.htm). www.ti.com/sc/docs/stdterms.htm

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265