

- **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**

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.

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



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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.

**TEXAS
INSTRUMENTS**

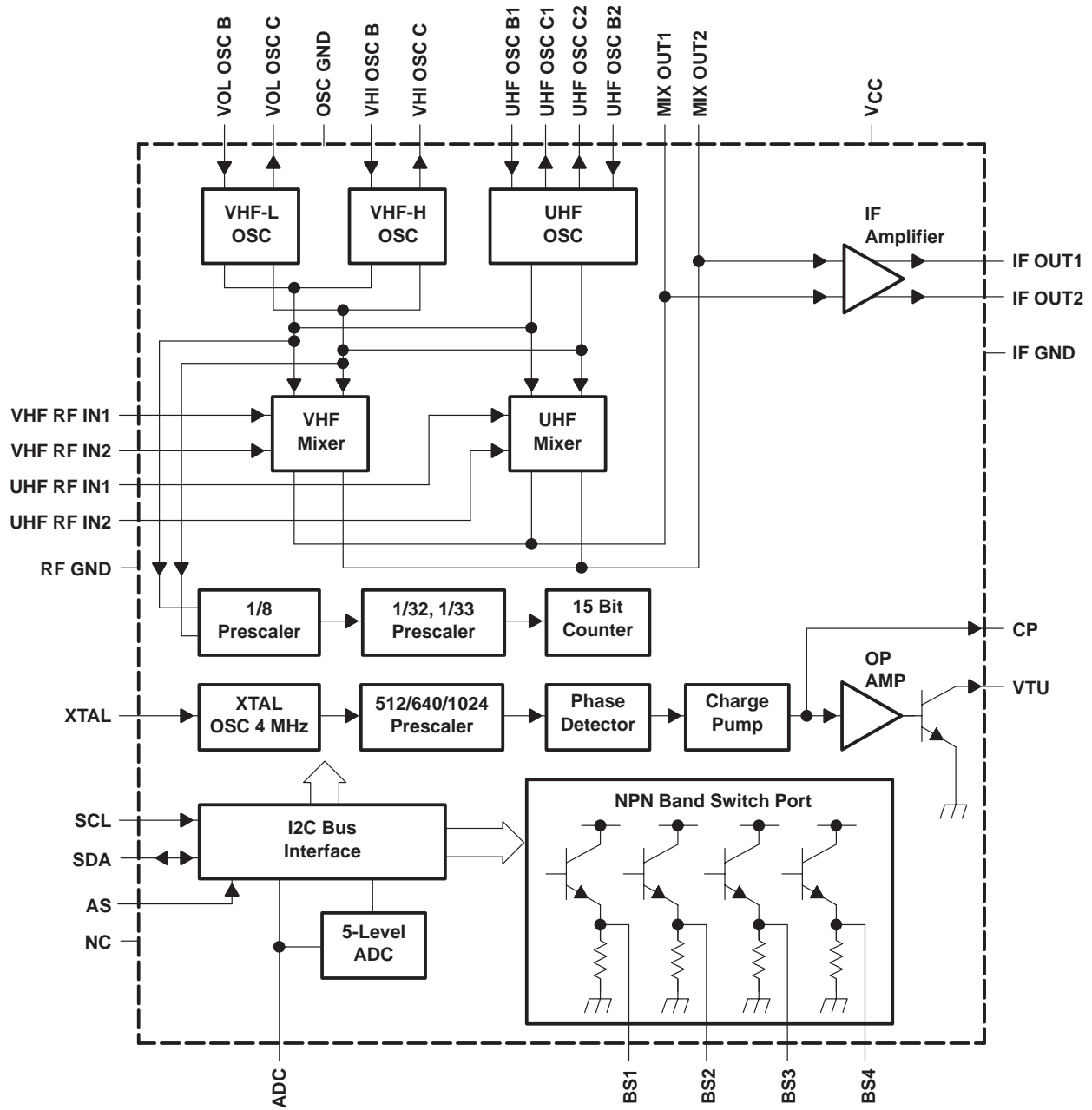
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SN761672A TV/VCR TUNER IC

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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

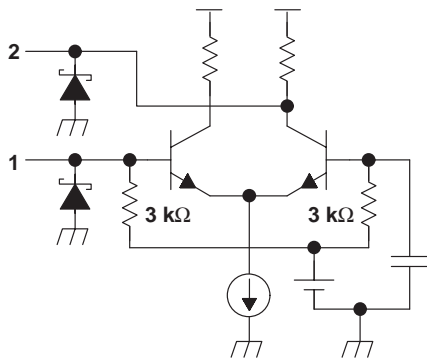


Figure 1

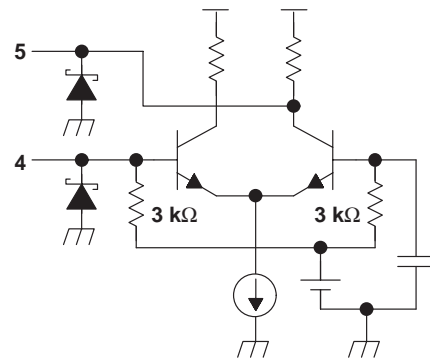


Figure 2

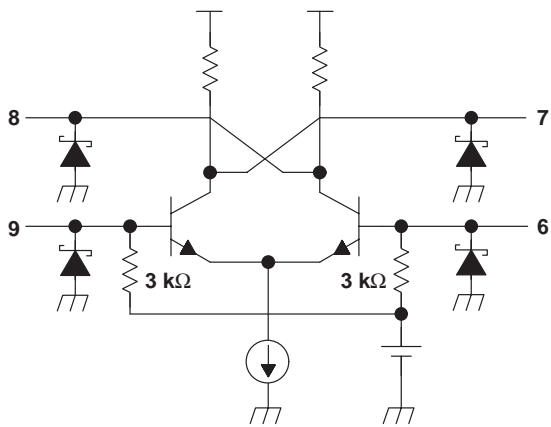


Figure 3

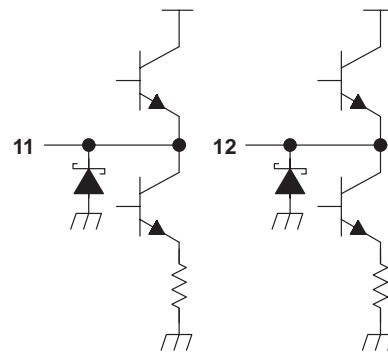


Figure 4

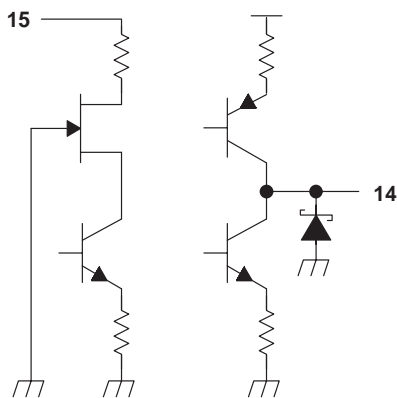


Figure 5

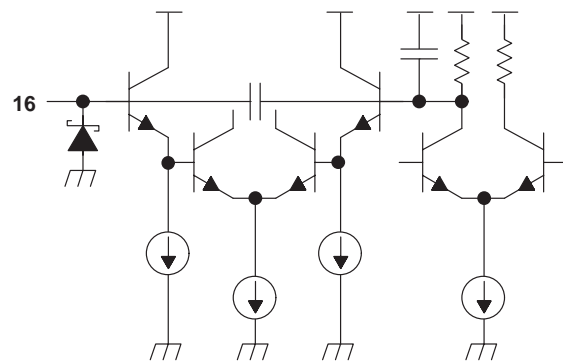


Figure 6

schematics (continued)

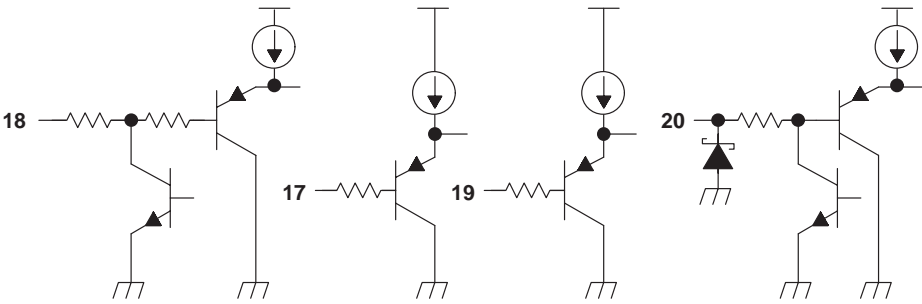


Figure 7

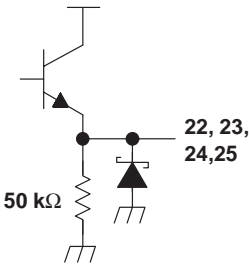


Figure 8

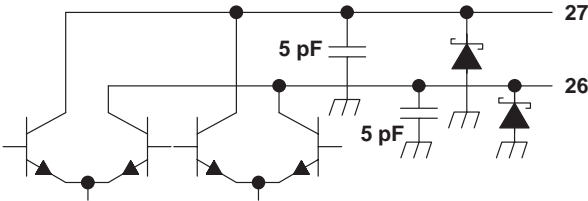


Figure 9

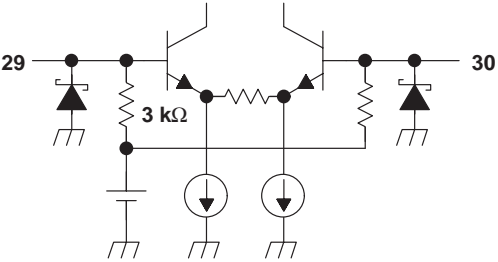


Figure 10

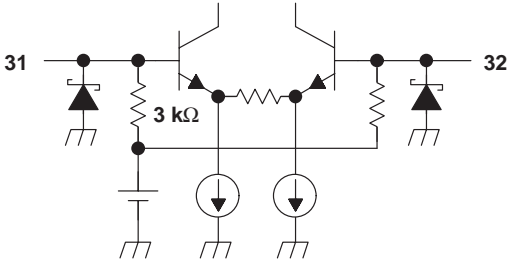


Figure 11

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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, $V_{I(VTU)}$ (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/°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	°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 – $I_{(BS)} = 10\text{ mA}$		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	$V_{(ADC)} = 0\text{ V}$	-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)	$V_{CC} = 5\text{ V}$, $I_{OL} = 3\text{ mA}$			0.4	V
$I_{lkg(SDA)}$	High-level output leakage current (SDA)	$V_{(SDA)} = 5.5\text{ V}$			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 $300\ \Omega$		4		MHz
$Z_{(XTAL)}$	Crystal oscillator input impedance			1.6		k
$V_{(VTUL)}$	Tuning amplifier low-level output voltage	$R_L = 27\text{ k}\Omega$, $V_{(TU)} = 33\text{ V}$	0.2	0.3	0.46	V
$I_{(VTUOFF)}$	Tuning amplifier leakage current (OFF)	OS = 1, $V_{(TU)} = 33\text{ V}$			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	$T_2 = 0$, $T_1 = 1$, $T_A = 25^{\circ}\text{C}$, $V_{CP} = 2\text{ V}$	-15		15	nA
$I_{(BS)}$	Band switch driver output current				10	mA
$V_{(SBS1)}$	Band switch driver output voltage	$I_{(BS)} = 10\text{ mA}$	3			V
$V_{(SBS2)}$		$I_{(BS)} = 10\text{ mA}$, $T_A = 25^{\circ}\text{C}$, $V_{CC} = 5\text{ V}$	3.5	3.9		
$I_{lkg(BSOFF)}$	Band switch driver leakage current	$V_{(BS)} = 0\text{ V}$			3	μA

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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)

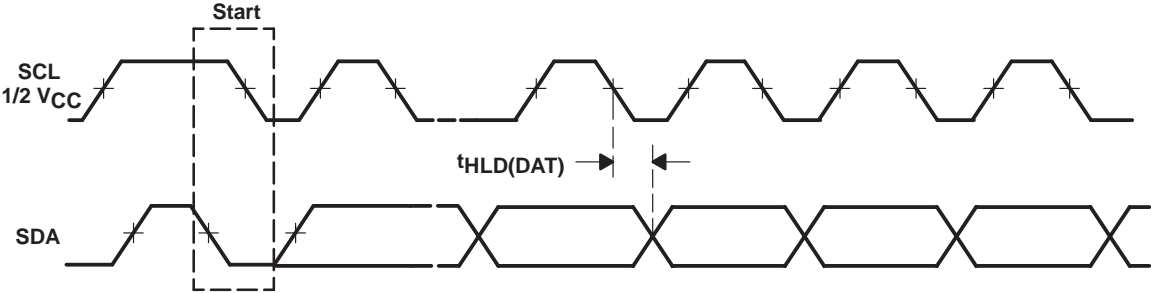
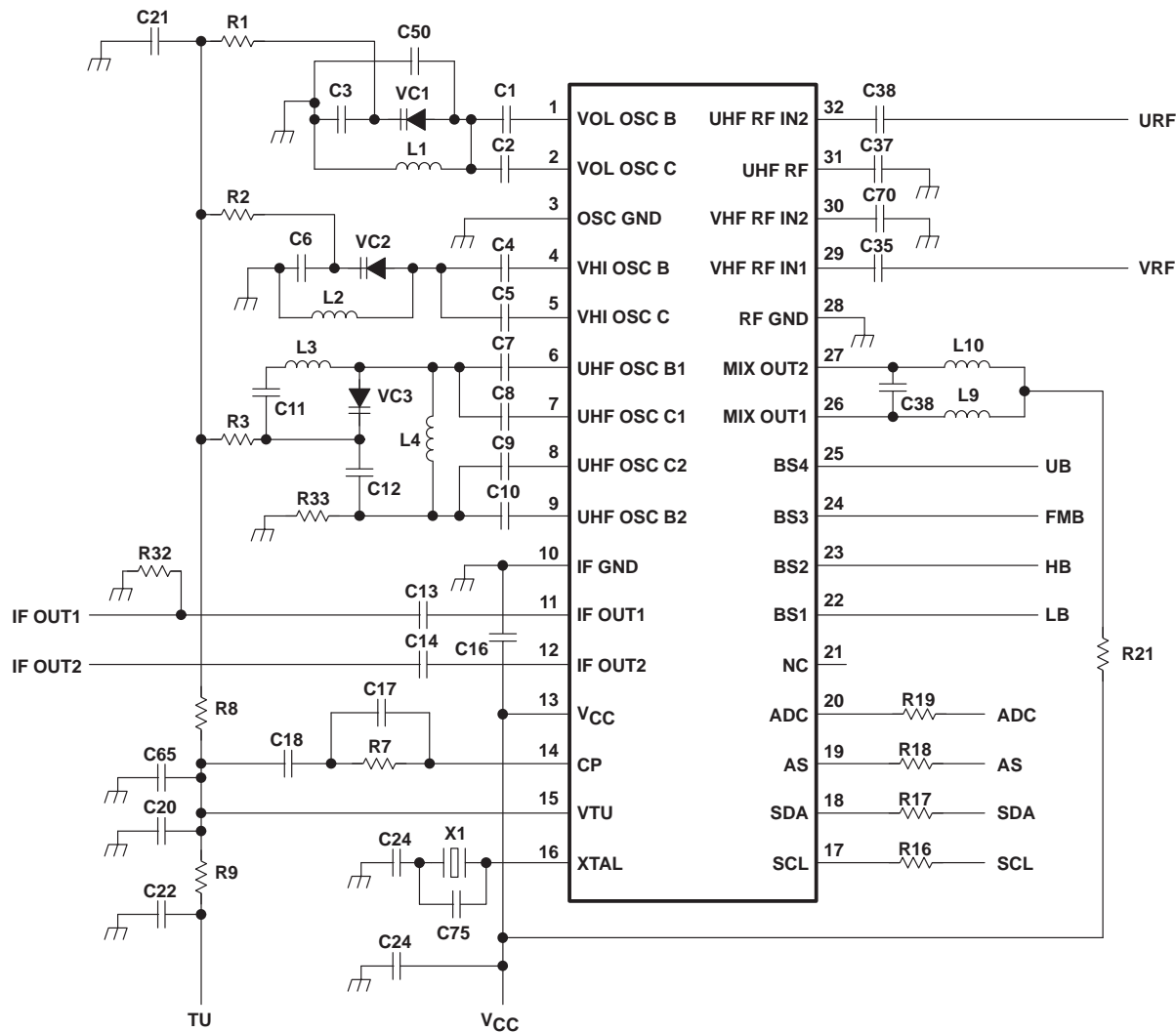


Figure 12. I²C Timing Chart

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

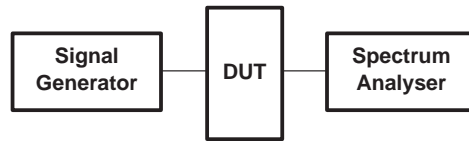


Figure 14. Measurement Circuit of Conversion Gain

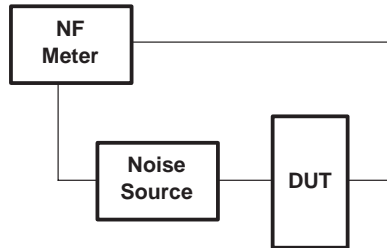


Figure 15. Noise Figure Measurement Circuit

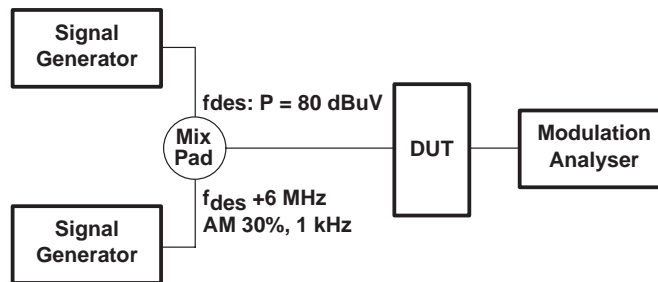


Figure 16. 1% Cross Modulation Distortion Measurement Circuit

TYPICAL CHARACTERISTICS

S-parameter

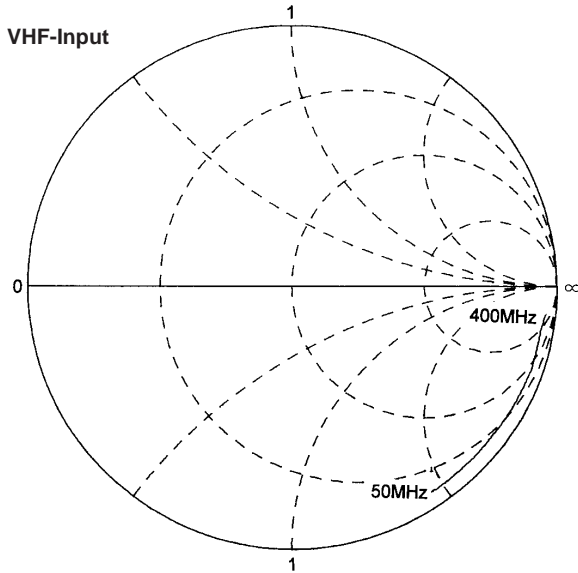


Figure 17

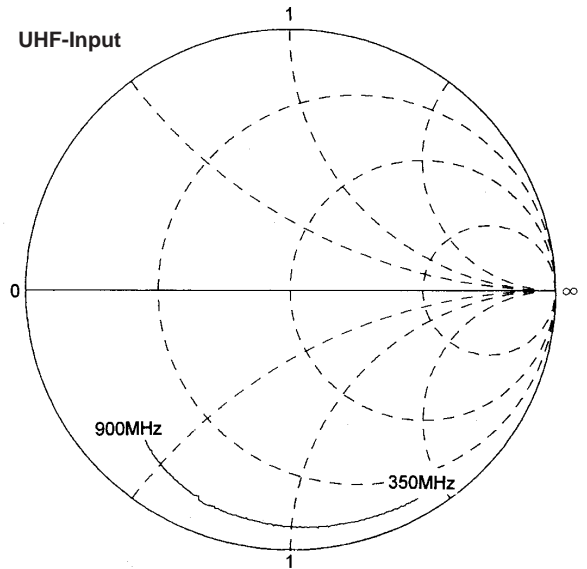


Figure 18

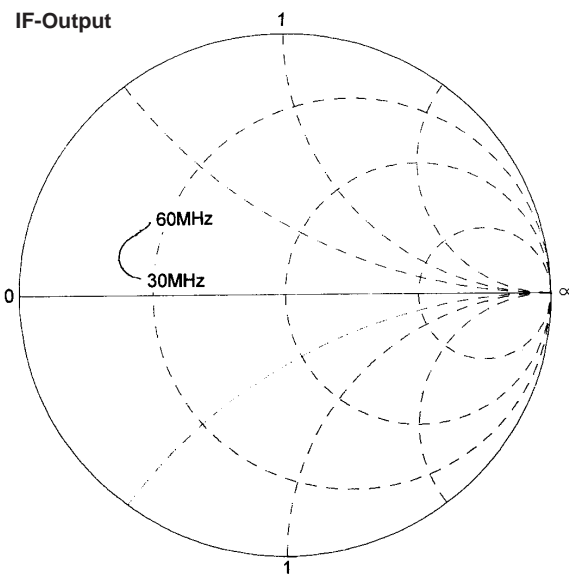


Figure 19

TYPICAL CHARACTERISTICS

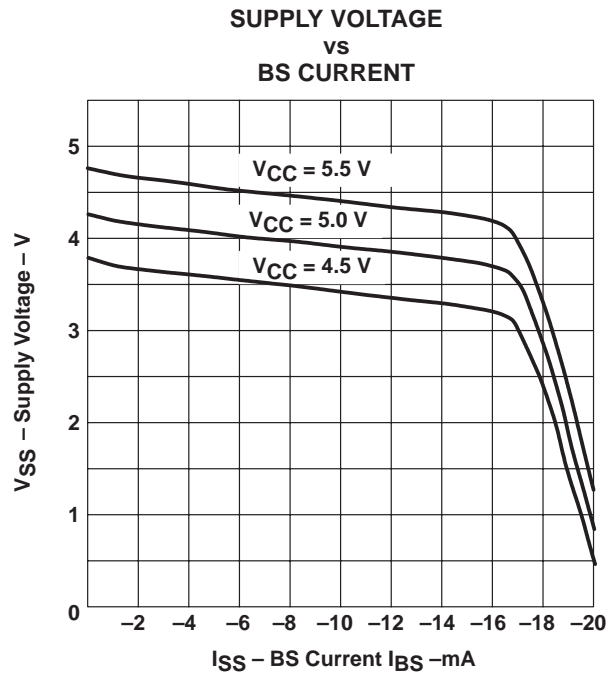


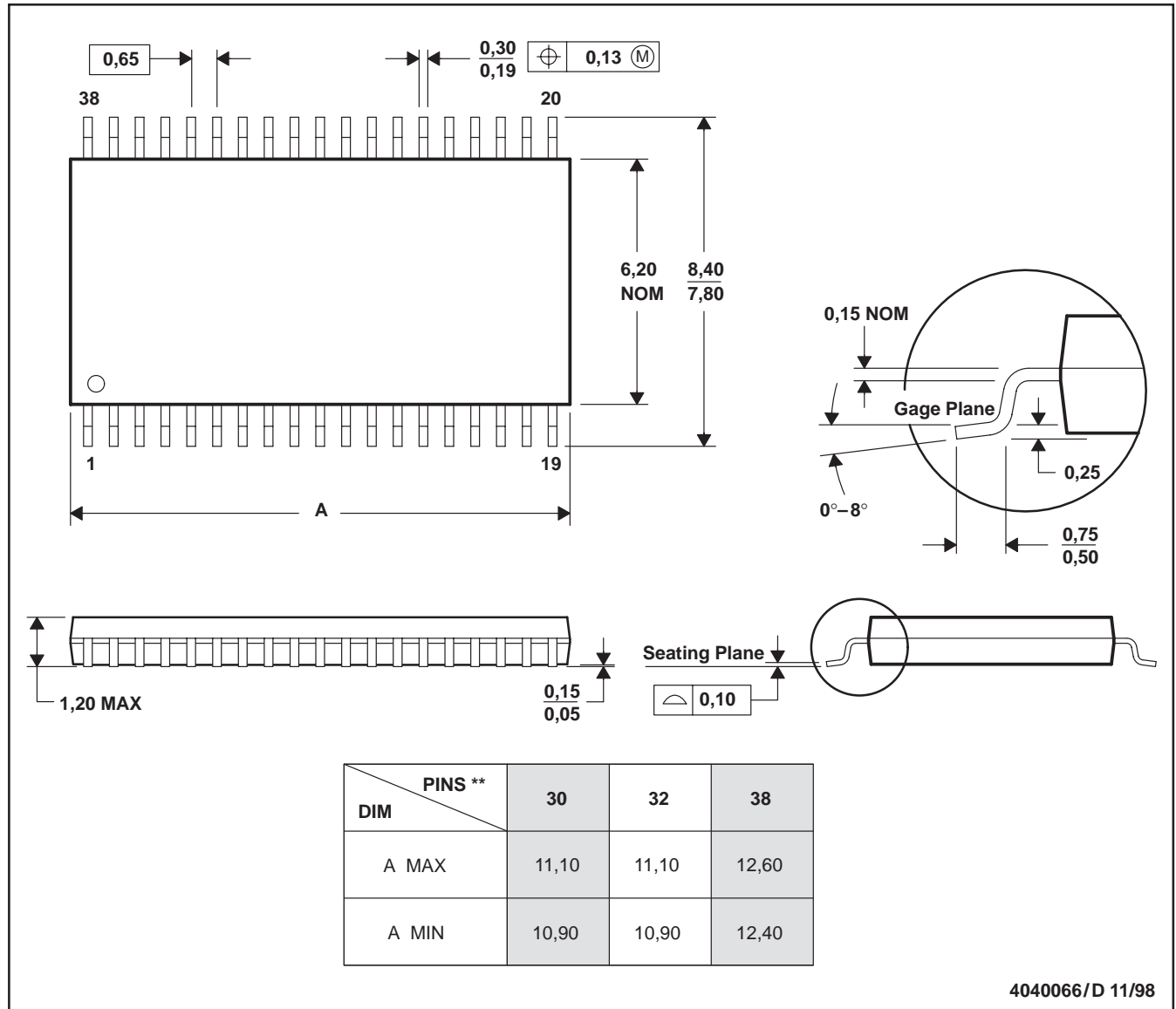
Figure 20. Band Switch Driver Output Voltage

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

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN761672ADA	ACTIVE	TSSOP	DA	32	46	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
SN761672ADAR	ACTIVE	TSSOP	DA	32	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR
SN761672ADARG4	ACTIVE	TSSOP	DA	32	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.

OBSELETE: 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.

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