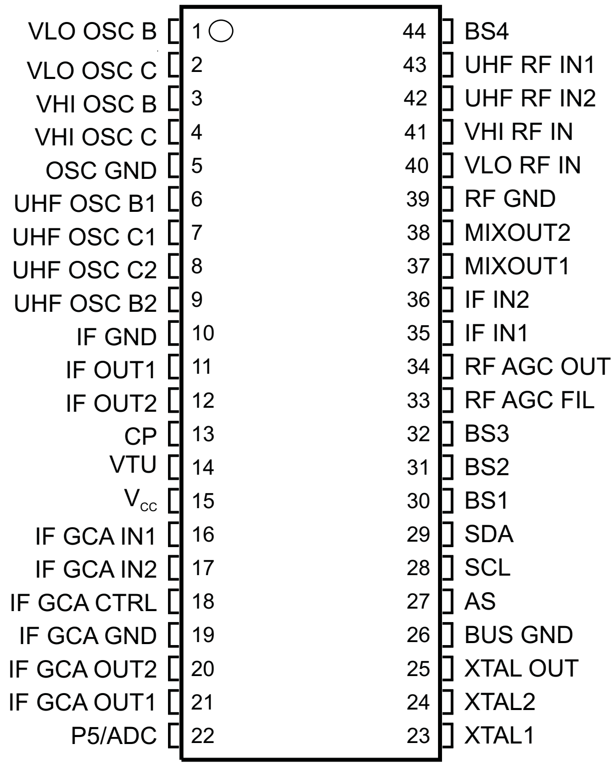
DIGITAL TV TUNER IC

FEATURES

- **Integrated Mixer/Oscillator/PLL and IF GCA**
- **VHF-L, VHF-H, UHF 3-Band Local Oscillator**
- **RF AGC Detector Circuit**
- **External 4-Pin IF Filter Between Mixer Output and IF Amplifier Input**
- **I²C Bus Protocol Bidirectional Data Transmission**
- **High-Voltage Tuning Voltage Output**
- **Four NPN-Type Band-Switch Drivers**
- **One Auxiliary Port/5-Level ADC**
- **Crystal Oscillator Output**
- **Programmable Reference Divider Ratio (24/28/50/64/80/128)**
- **Low Distortion IF Gain Controlled Amplifier**
- **Standby Mode**
- **5-V Power Supply**
- **44-Pin Thin Shrink Small-Outline Package (TSSOP)**

DBT PACKAGE (TOP VIEW)



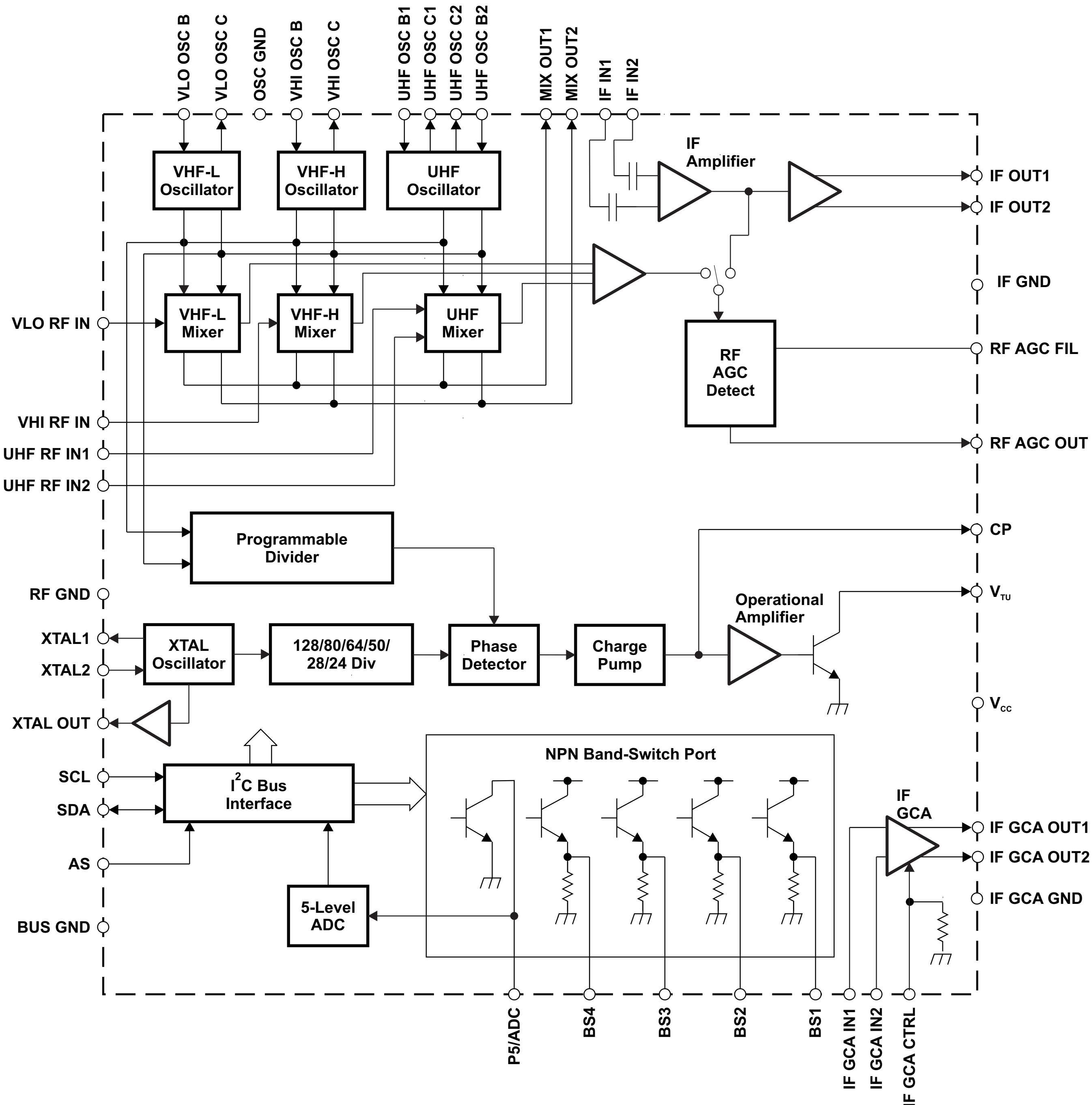
APPLICATIONS

- **Digital TVs**
- **Digital CATVs**
- **Set-Top Boxes**

DESCRIPTION

The SN761668 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, RF AGC detector circuit, and IF gain-controlled amplifier. The SN761668 is available in a small-outline package.

FUNCTIONAL BLOCK DIAGRAM



TERMINAL FUNCTIONS

TERMINAL		DESCRIPTION	SCHEMATIC
NAME	NO.		
AS	27	Address selection input	Figure 1
BS1	30	Band-switch 1 output	Figure 2
BS2	31	Band-switch 2 output	Figure 2
BS3	32	Band-switch 3 output	Figure 2
BS4	44	Band-switch 4 output	Figure 2
BUS GND	26	BUS ground	
CP	13	Charge-pump output	Figure 3
IF GCA CTRL	18	IF GCA CTRL voltage inout	Figure 4
IF GCA GND	19	IF GCA ground	
IF GCA IN1	16	IF GCA input 1	Figure 5
IF GCA IN2	17	IF GCA input 2	Figure 5
IF GCA OUT1	21	IF GCA output 1	Figure 6
IF GCA OUT2	20	IF GCA output 2	Figure 6
IF GND	10	IF ground	
IF IN1	35	IF amplifier input 1	Figure 7
IF IN2	36	IF amplifier input 2	Figure 7
IF OUT1	11	IF amplifier output 1	Figure 8
IF OUT2	12	IF amplifier output 2	Figure 8
MIXOUT1	37	Mixer output 1	Figure 9
MIXOUT2	38	Mixer output 2	Figure 9
OSC GND	5	Oscillator ground	
P5/ADC	22	Port-5 output/ADC input	Figure 10
RF AGC FIL	33	RF AGC additional capacitor pin	Figure 11
RF AGC OUT	34	RF AGC output	Figure 12
RF GND	39	RF ground	
SCL	28	Serial clock input	Figure 13
SDA	29	Serial data input/output	Figure 14
UHF OSC B1	6	UHF oscillator base 1	Figure 15
UHF OSC B2	9	UHF oscillator base 2	Figure 15
UHF OSC C1	7	UHF oscillator collector 1	Figure 15
UHF OSC C2	8	UHF oscillator collector 2	Figure 15
UHF RF IN1	43	UHF RF input 1	Figure 16
UHF RF IN2	42	UHF RF input 2	Figure 16
V_{CC}	15	Supply voltage for mixer/oscillator/PLL: 5 V	
VHI OSC B	3	VHF-H oscillator base	Figure 17
VHI OSC C	4	VHF-H oscillator collector	Figure 17
VHI RF IN	41	VHF-H RF input	Figure 18
VLO OSC B	1	VHF-L oscillator base	Figure 19
VLO OSC C	2	VHF-L oscillator collector	Figure 19
VLO RF IN	40	VHF-L RF input	Figure 20
VTU	14	Tuning voltage amplifier output	Figure 3
XTAL1	23	4-MHz crystal oscillator output	Figure 21
XTAL2	24	4-MHz crystal oscillator input	Figure 21
XTALOUT	25	4-MHz crystal oscillator output	Figure 22

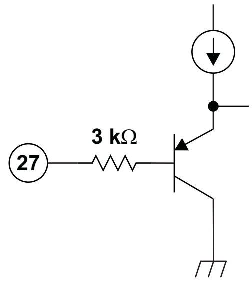


Figure 1. AS

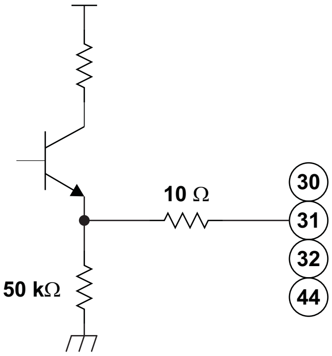


Figure 2. BS1, BS2, BS3, and BS4

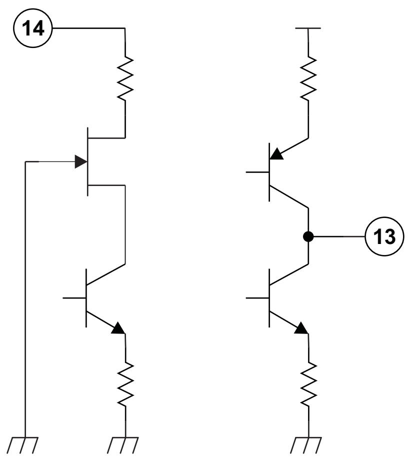


Figure 3. CP and VTU

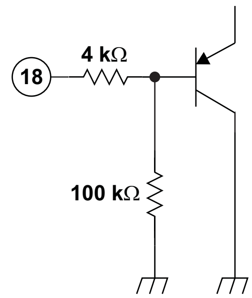


Figure 4. IF GCA CTRL

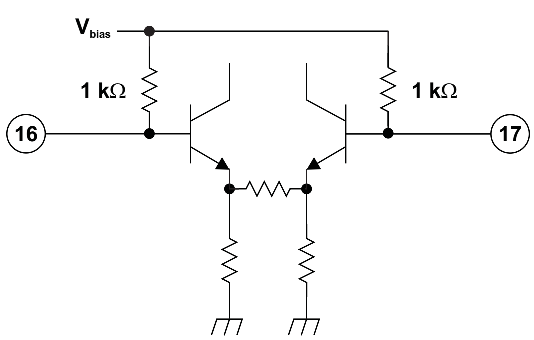


Figure 5. IF GCA IN1 and IF GCA IN2

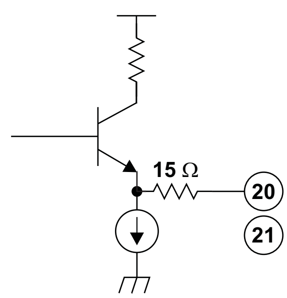


Figure 6. IF GCA OUT1 and IF GCA OUT2

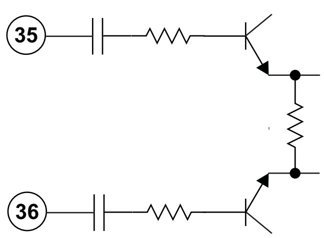


Figure 7. IF IN1 and IF IN2

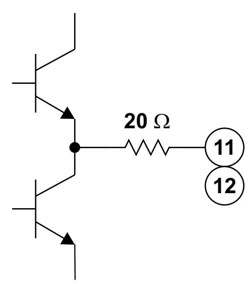


Figure 8. IF OUT1 and IF OUT2

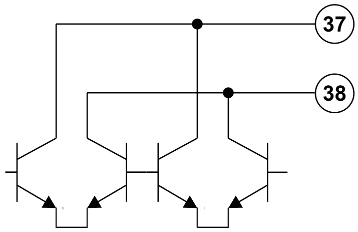


Figure 9. MIXOUT1 and MIXOUT2

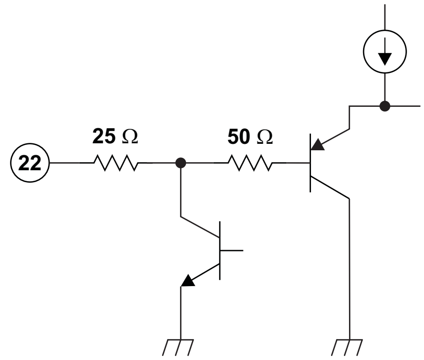


Figure 10. P5/ADC

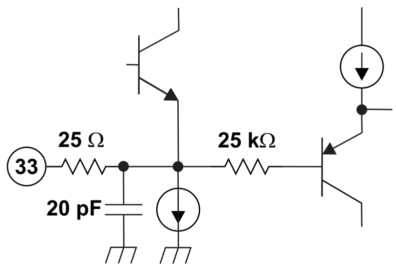


Figure 11. RF AGC FIL

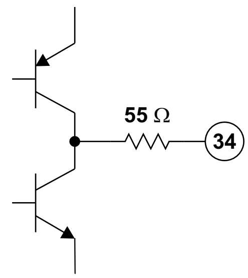


Figure 12. RF AGC OUT

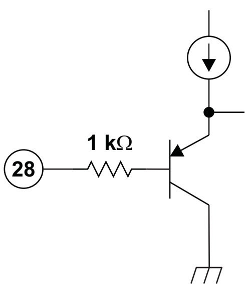


Figure 13. SCL

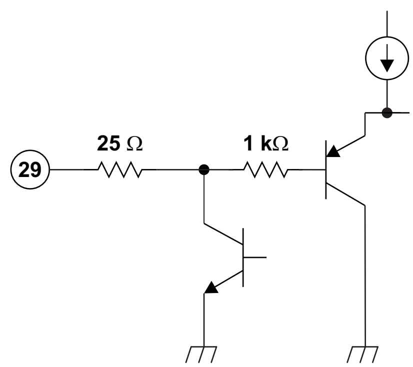


Figure 14. SDA

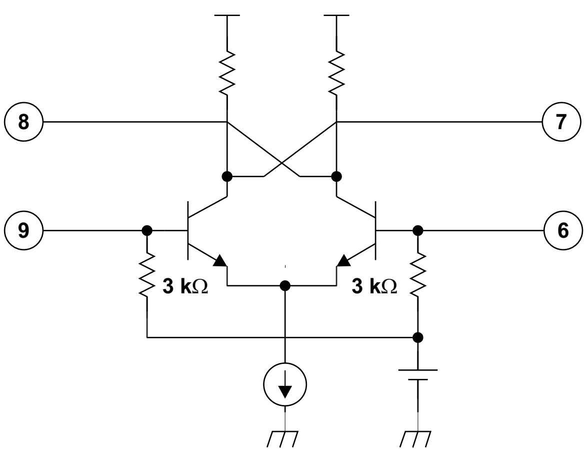


Figure 15. UHF OSC B1, UHF OSC B2, UHF OSC C1, and UHF OSC C2

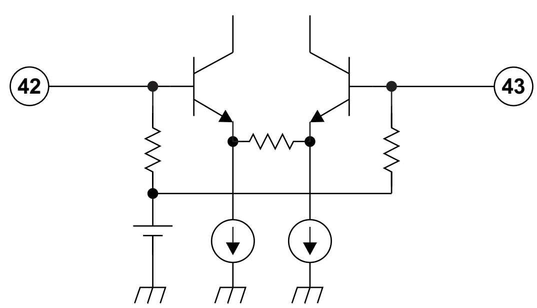


Figure 16. UHF RF IN1 and UHF RF IN2

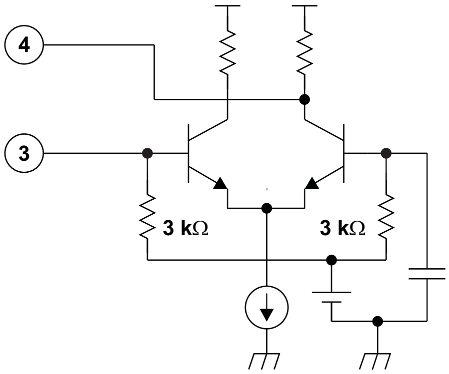


Figure 17. VHI OSC B and VHI OSC C

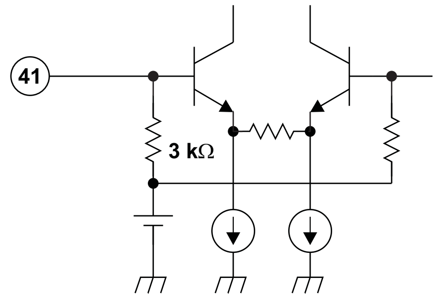


Figure 18. VHI RF IN

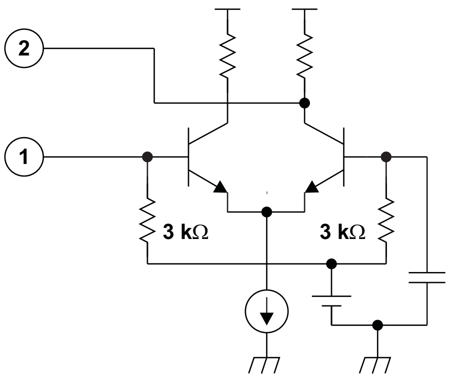


Figure 19. VLO OSC B and VLO OSC C

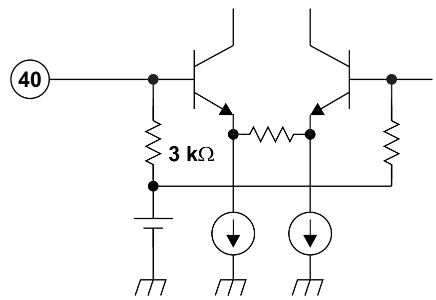


Figure 20. VLO RF IN

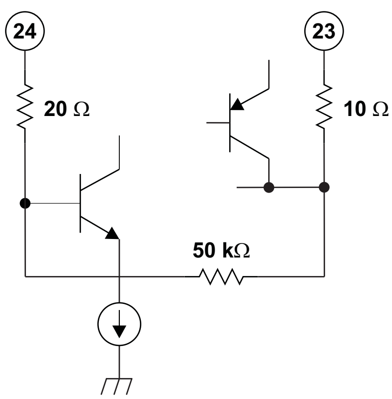


Figure 21. XTAL1 and XTAL2

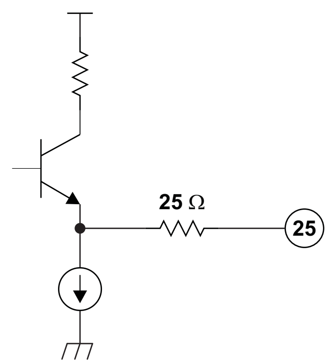


Figure 22. XTALOUT

ABSOLUTE MAXIMUM RATINGS[1]

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

			MIN	MAX	UNIT
V_{CC}	Supply voltage range [2]	V_{CC}	–0.4	6.5	V
V_{GND}	Input voltage range 1 [2]	RF GND, OSC GND	–0.4	0.4	V
VTU	Input voltage range 2 [2]	VTU	–0.4	35	V
V_{IN}	Input voltage range 3 [2]	Other pins	–0.4	6.5	V
P_D	Continuous total dissipation [3]	$T_A \leq 25°C$		1438	mW
T_A	Operating free-air temperature range		–20	85	°C
T_{stg}	Storage temperature range		–65	150	°C
T_J	Maximum junction temperature			150	°C
$t_{SC(max)}$	Maximum short-circuit time	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 11.5 mW/°C for $T_A \geq 25°C$.

RECOMMENDED OPERATING CONDITIONS

			MIN	NOM	MAX	UNIT
V_{CC}	Supply voltage		4.5	5	5.5	V
VTU	Tuning supply voltage			30	33	V
I_{BS}	Output current of band switch	BS1 – BS4, one band switch on			10	mA
I_{P5}	Output current of port 5	P5/ADC			–5	mA
T_A	Operating free-air temperature		–20		85	°C

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.

IF IN1, IF IN2, MIXOUT1, and MIXOUT2 (pins 35–38) withstand 1.5 kV, and all other pins withstand 2 kV, according to the Human-Body Model (1.5 kΩ, 100 pF).

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			115	140	mA
$I_{CC}2$	Supply current 2	One band switch on (I_{BS} = 10 mA)		125	150	mA
$I_{CC-STBY}$	Standby supply current	STBY = 1		9		mA
V_{IH}	High-level input voltage (SCL, SDA)		2.5			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-input 1 voltage (AS)	V_{CC} = 5 V	2		3	V
V_{ASM2}	Address-select mid-input 2 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)				50	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-DAT}	Data hold time	See Figure 23	0		0.9	µs
t_{BUF}	Bus free time		1.3			µs
t_{HD-STA}	Start hold time		0.6			µs
t_{LOW}	SCL-low hold time		1.3			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

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	V_{CC} = 5 V, T_A = 25°C	1.6	2.4		kΩ
V_{XLO}	XTALOUT output voltage	Load = 10 pF/5.1 kΩ, V_{CC} = 5 V, T_A = 25°C		0.4		Vp-p
V_{VTUL}	Tuning amplifier low-level output voltage	R_L = 22 kΩ, VTU = 33 V	0.2	0.3	0.46	V
I_{VTUOFF}	Tuning amplifier leakage current	Tuning amplifier = off, VTU = 33 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 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	3.7		
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

RF AGC

V_{CC} = 5 V, T_A = 25°C, measured in Figure 24 reference measurement circuit at 50-Ω system, IF = 44 MHz,
IF filter characteristics: f_{peak} = 44 MHz (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TYP	UNIT
I_{OAGC0}	RF AGC output source current	ATC = 0	300	nA
I_{OAGC1}		ATC = 1	15	µA
$I_{OAGCSINK}$	RF AGC peak sink current	ATC = 0	100	µA
$V_{AGCSP00}$	Start-point IF output level(1)	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	

(1) When AISL = 1, RF AGC function is not available at VHF-L band.

Mixer, Oscillator, IF Amplifier

V_{CC} = 5 V, T_A = 25°C, measured in Figure 24 reference measurement circuit at 50-Ω system, IF = 44 MHz, IF filter characteristics: f_{peak} = 44 MHz (unless otherwise noted)

PARAMETER		TEST CONDITIONS	TYP	UNIT
G_{c1}	Conversion gain (mixer-IF amplifier), VHF-L	f_{in} = 57 MHz(1)	35	dB
G_{c3}		f_{in} = 171 MHz(1)	35	
G_{c4}	Conversion gain (mixer-IF amplifier), VHF-H	f_{in} = 177 MHz(1)	35	dB
G_{c6}		f_{in} = 467 MHz(1)	35	
G_{c7}	Conversion gain (mixer-IF amplifier), UHF	f_{in} = 473 MHz(1)	35	dB
G_{c9}		f_{in} = 864 MHz(1)	35	
NF_1	Noise figure, VHF-L	f_{in} = 57 MHz	9	dB
NF_3		f_{in} = 171 MHz	9	
NF_4	Noise figure, VHF-H	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	Input voltage causing 1% cross-modulation distortion, VHF-L	f_{in} = 57 MHz(2)	79	dBμV
CM_3		f_{in} = 171 MHz(2)	79	
CM_4	Input voltage causing 1% cross-modulation distortion, VHF-H	f_{in} = 177 MHz(2)	79	dBμV
CM_6		f_{in} = 467 MHz(2)	79	
CM_7	Input voltage causing 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-L	f_{in} = 57 MHz	117	dBμV
V_{IFO3}		f_{in} = 171 MHz	117	
V_{IFO4}	IF output voltage, VHF-H	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	
Φ_{PLVL11}	Phase noise, VHF-L	f_{in} = 57 MHz, Offset = 1 kHz(3)	–90	dBc/Hz
Φ_{PLVL12}		f_{in} = 57 MHz, Offset = 10 kHz(4)	–95	
Φ_{PLVL31}		f_{in} = 171 MHz, Offset = 1 kHz(5)	–85	
Φ_{PLVL32}		f_{in} = 171 MHz, Offset = 10 kHz(4)	–95	
Φ_{PLVL41}	Phase noise, VHF-H	f_{in} = 177 MHz, Offset = 1 kHz(3)	–85	dBc/Hz
Φ_{PLVL42}		f_{in} = 177 MHz, Offset = 10 kHz(4)	–90	
Φ_{PLVL61}		f_{in} = 467 MHz, Offset = 1 kHz(5)	–77	
Φ_{PLVL62}		f_{in} = 467 MHz, Offset = 10 kHz(4)	–90	
Φ_{PLVL71}	Phase noise, UHF	f_{in} = 473 MHz, Offset = 1 kHz(3)	–80	dBc/Hz
Φ_{PLVL72}		f_{in} = 473 MHz, Offset = 10 kHz(4)	–85	
Φ_{PLVL91}		f_{in} = 864 MHz, Offset = 1 kHz(5)	–77	
Φ_{PLVL92}		f_{in} = 864 MHz, Offset = 10 kHz(4)	–90	

(1) IF = 44 MHz, RF input level = 70 dBμV, differential output
(2) f_{undes} = f_{des} ±6 MHz, P_{in} = 70 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] = 011 (reference divider 64)

IF Gain Controlled Amplifier

V_{CC} = 5 V, T_A = 25°C, measured in Figure 24 reference measurement circuit at 50-Ω system, IF = 44 MHz (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
I_{IFGCA}	Input current (IF GCA CTRL)	V_{IFGCA} = 3 V		30	60	µA
$V_{IFGCAMAX}$	Maximum gain control voltage	Gain maximum	2.5		V_{CC}	V
$V_{IFGCAMIN}$	Minimum gain control voltage	Gain minimum	0		0.4	V
$G_{IFGCAMAX}$	Maximum gain	V_{IFGCA} = 3 V	49	53	57	dB
$G_{IFGCAMIN}$	Minimum gain	V_{IFGCA} = 0 V	–4	–1	2	dB
GCR_{IFGCA}	Gain control range	V_{IFGCA} = 0 V to 3 V		54		dB
$V_{IFGCAOUT}$	Output voltage	Single-ended output		2.1		Vp-p
NF_{IFGCA}	Noise figure	V_{IFGCA} = 3 V		8.5		dB
$IM3_{IFGCA}$	Third order intermodulation distortion	$f_{IFGCAIN1}$ = 43 MHz, $f_{IFGCAIN2}$ = 44 MHz, $V_{IFGCAOUT}$ = –2 dBm, V_{IFGCA} = 3 V		–50		dBc
IIP_{3IFGCA}	Input intercept point	V_{IFGCA} = 0 V		11		dBm
$R_{IFGCAIN}$	Input resistance (IF GCA IN1, IF GCA IN2)			1		kΩ
$R_{IFGCAOUT}$	Output resistance (IF GCA OUT1, IF GCA OUT2)			19		Ω

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	AISL	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 $N = N14 \times 2^{14} + N13 \times 2^{13} + ... + N1 \times 2 + N0$	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
AISL	RF AGC detector input selection bit AISL = 0: IF amplifier AISL = 1: Mixer output	AISL = 0
P5	Port output/ADC input control bit P5 = 0: ADC INPUT P5 = 1: Tr = ON	P5 = 0
BS[4:1]	Band-switch control bits BSn = 0: Tr = OFF BSn = 1: Tr = ON	BSn = 0
	Band selection by BS[1:2] **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 = 15 µA	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(1)

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

(1) When AISL = 1, RF AGC function is not available at VHF-L band (output level is undefined).

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 I^{2}C 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

I^{2}C 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. 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 × V_{CC}.

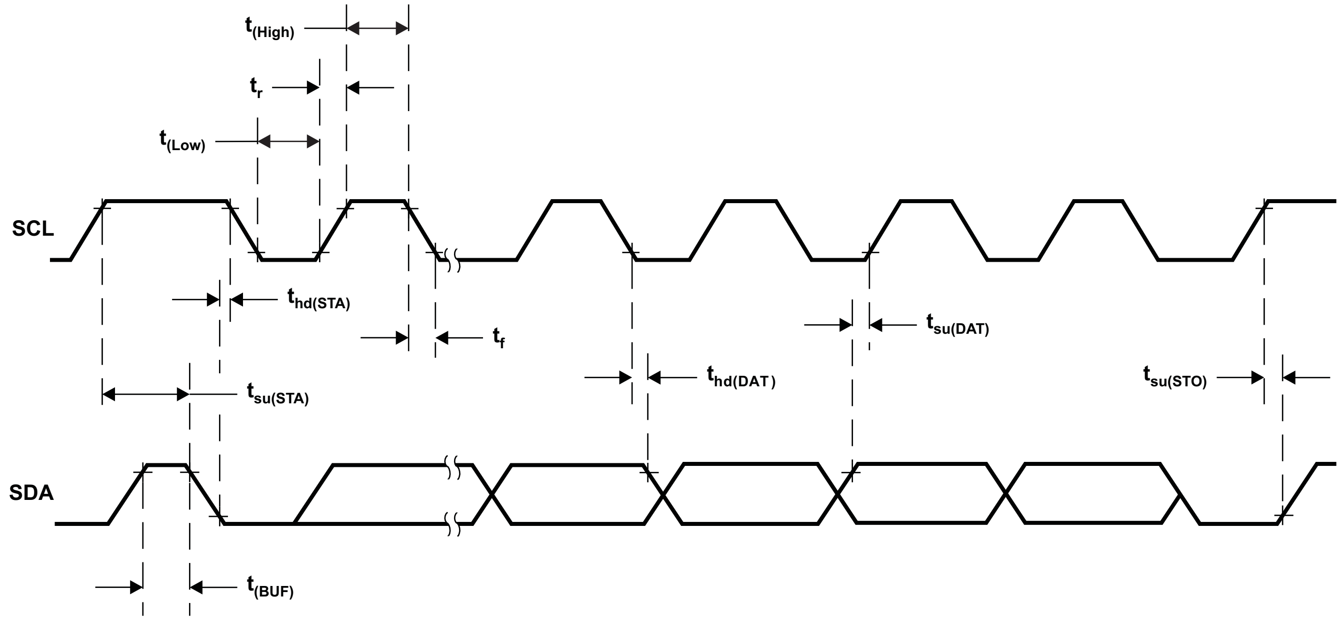
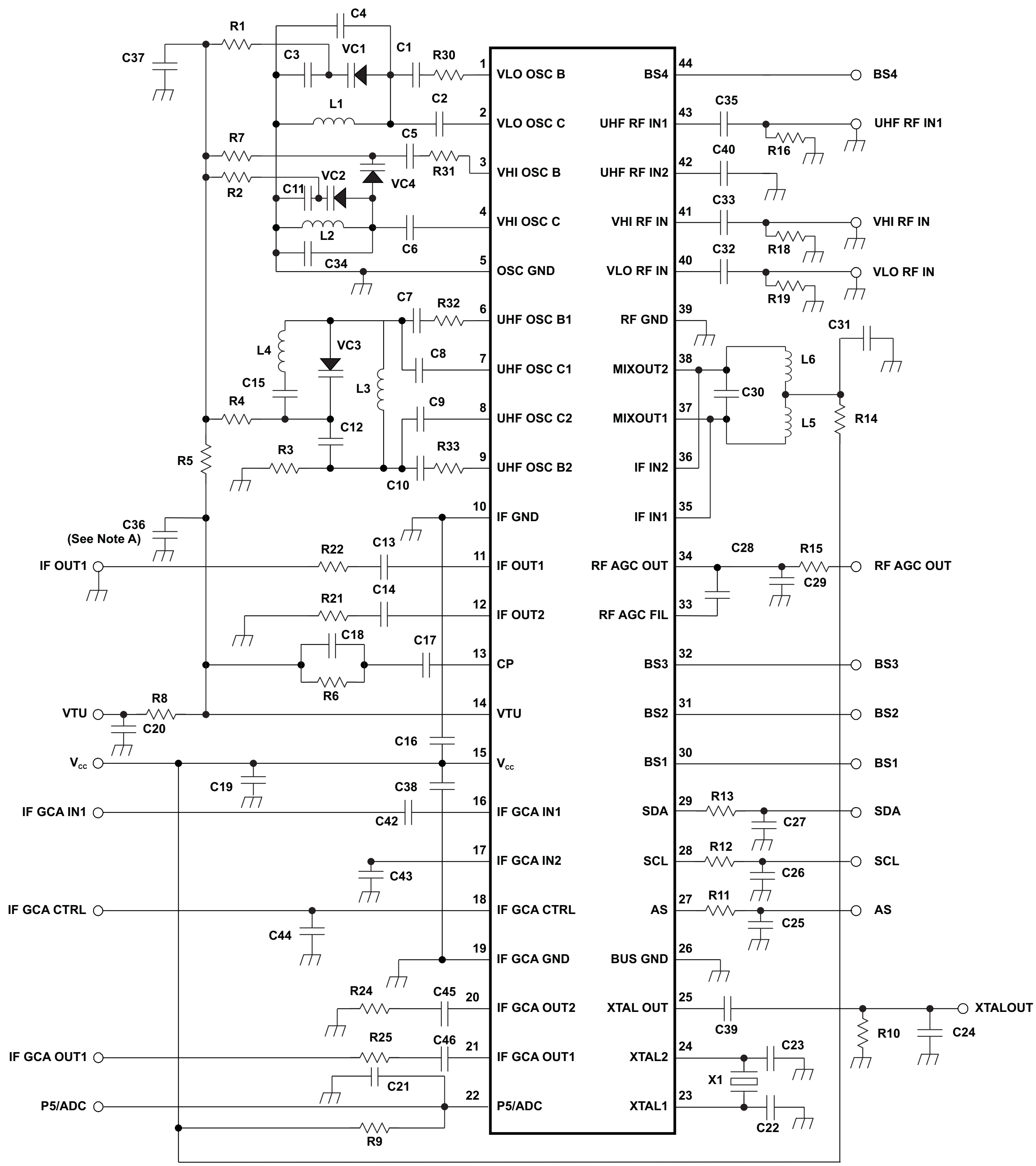


Figure 23. I²C Timing Chart

APPLICATION INFORMATION



A. To prevent abnormal oscillation, connect C36, which does not affect a PLL.

B. 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 24. Reference Measurement Circuit

Component Values for Measurement Circuit

PART NAME	VALUE	PART NAME	VALUE
C1 (VLO OSC B)	1 pF	C43 (IF GCA IN2)	2.2 nF
C2 (VLO OSC C)	2 pF	C44 (IF GCA CTRL)	2.2 nF
C3 (VLO OSC)	47 pF	C45 (IF GCA OUT1)	2.2 nF
C4 (VLO OSC)	Open	C46 (IF GCA OUT2)	2.2 nF
C5 (VHI OSC)	7 pF	L1 (VLO OSC)	ϕ3,0 mm, 7T, wire 0,32 mm
C6 (VHI OSC C)	5 pF	L2 (VHI OSC)	ϕ2,0 mm, 3T, wire 0,4 mm
C7 (UHF OSC B1)	1.5 pF	L3 (UHF OSC)	ϕ1,8 mm, 3T, wire 0,4 mm
C8 (UHF OSC C1)	1 pF	L4 (UHF OSC)	ϕ1,8 mm, 3T, wire 0,4 mm
C9 (UHF OSC C2)	1 pF	L5 (MIXOUT)	680 nH (LK1608R68K-T)
C10 (UHF OSC B2)	1.5 pF	L6 (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 (IF OUT)	2.2 nF	R3 (UHF OSC)	2.2 kΩ
C14 (IF OUT)	2.2 nF	R4 (UHF OSC)	1 kΩ
C15 (UHF OSC)	100 pF	R5 (VTU)	3 kΩ
C16 (V_{CC})	4.7 nF	R6 (CP)	47 kΩ
C17 (CP)	0.01 μF/50 V	R7 (VHI OSC)	3.3 kΩ
C18 (CP)	22 pF/50 V	R8 (VTU)	20 kΩ
C19 (V_{CC})	2.2 nF	R9 (P5/ADC)	Open
C20 (VTU)	2.2 nF/50 V	R10 (XTALOUT)	5.1 kΩ
C21 (P5/ADC)	Open	R11 (AS)	330 Ω
C22 (XTAL)	27 pF	R12 (SCL)	330 Ω
C23 (XTAL)	27 pF	R13 (SDA)	330 Ω
C24 (XTALOUT)	10 pF	R14 (V_{CC})	0
C25 (AS)	22 pF	R15 (RF AGC OUT)	0
C26 (SCL)	Open	R16 (UHF RF IN1)	(50 Ω)
C27 (SDA)	Open	R18 (VHI RF IN)	(50 Ω)
C28 (AGC FIL)	1 nF	R19 (VLO RF IN)	(50 Ω)
C29 (RF AGC OUT)	0.15 μF	R21 (IF OUT2)	1 kΩ
C30 (MIXOUT)	4 pF	R22 (IF OUT1)	1 kΩ
C31 (MIXOUT)	2.2 nF	R24 (IF GCA OUT1)	250 Ω
C32 (VLO RF IN)	2.2 nF	R25 (IF GCA OUT2)	200 Ω
C33 (VHI RF IN)	2.2 nF	R30 (VLO OSC B)	0
C34 (VHI OSC)	0.5 pF	R31 (VHI OSC B)	4.7 Ω
C35 (UHF RF IN1)	2.2 nF	R32 (UHF OSC B1)	0
C36 (VTU)	22 pF	R33 (UHF OSC B2)	0
C37 (VTU)	2.2 nF/50 V	VC1 (VLO OSC)	MA2S374
C38 (V_{CC})	0.1 μF	VC2 (VHI OSC)	MA2S374
C39 (XTALOUT)	2.2 nF	VC3 (UHF OSC)	MA2S372
C40 (UHF RF IN2)	2.2 nF	VC4 (VHI OSC)	MA2S372
C42 (IF GCA IN1)	2.2 nF	X1	4-MHz crystal

APPLICATION INFORMATION (CONTINUED)

Test Circuits

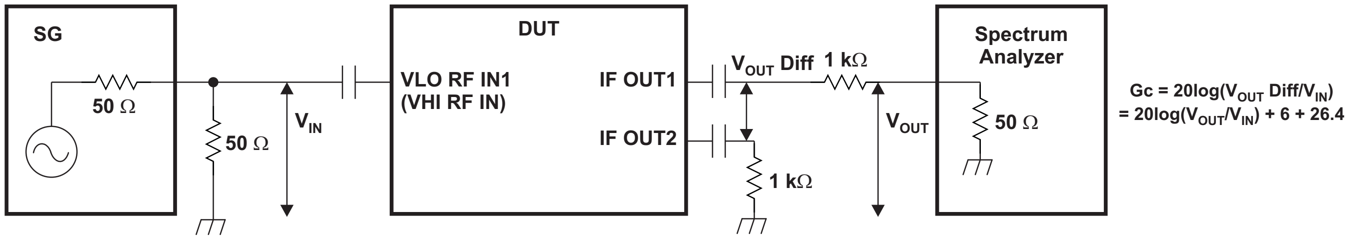


Figure 25. VHF-Conversion Gain-Measurement Circuit

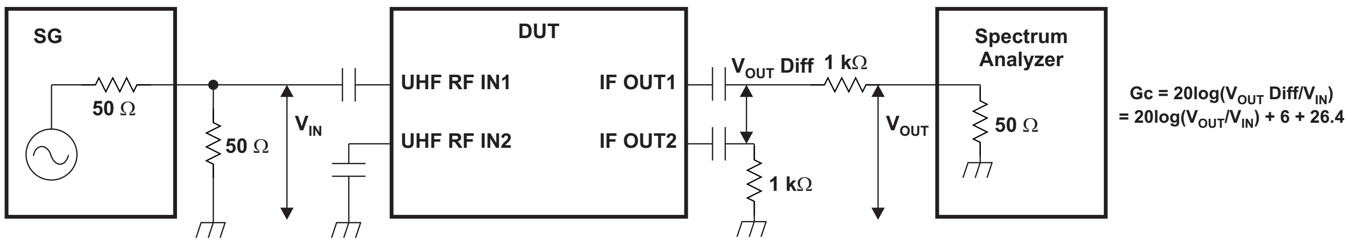


Figure 26. UHF-Conversion Gain-Measurement Circuit

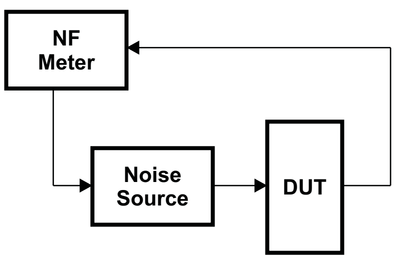


Figure 27. Noise-Figure Measurement Circuit

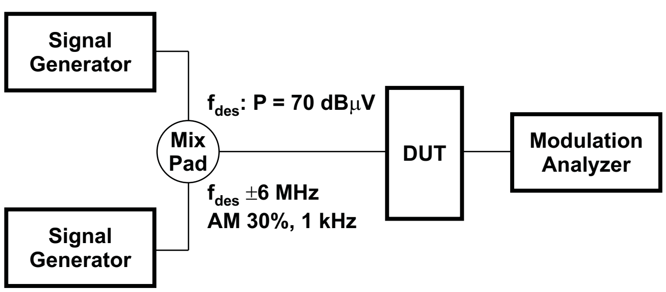


Figure 28. 1% Cross-Modulation Distortion Measurement Circuit

TYPICAL CHARACTERISTICS

Band-Switch Driver Output Voltage (BS1–BS4)

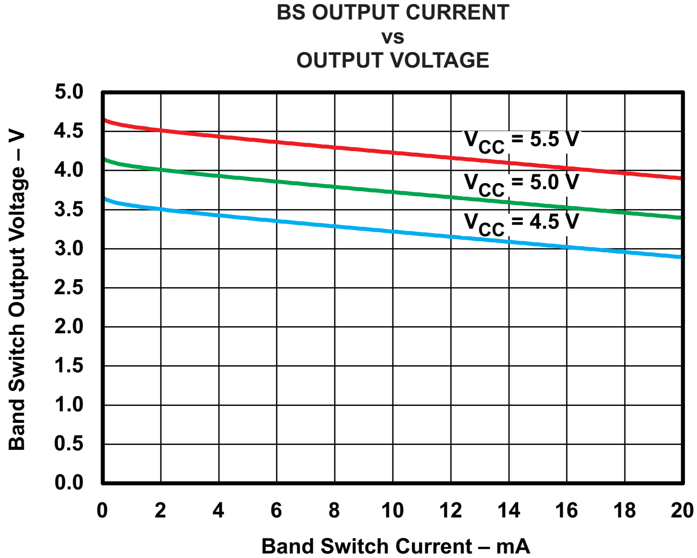


Figure 29. Band-Switch Driver Output Voltage

S-Parameter

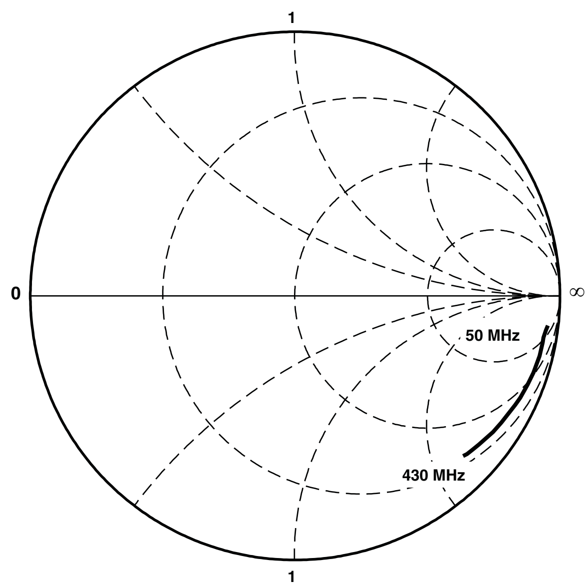


Figure 30. VLO RFIN, VHI RFIN

TYPICAL CHARACTERISTICS (continued)

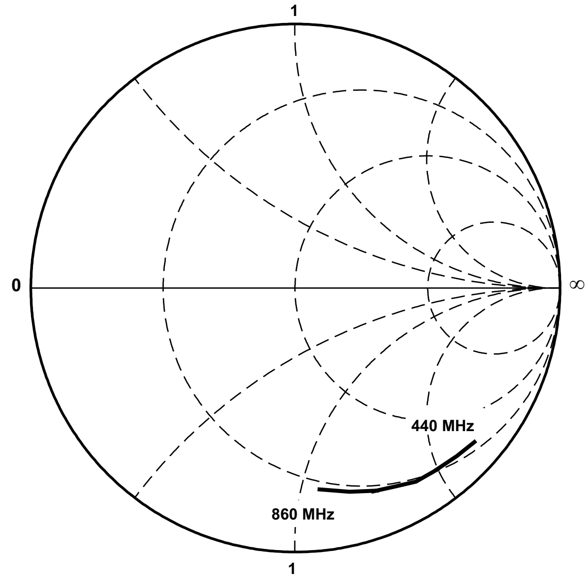


Figure 31. UHF RFIN

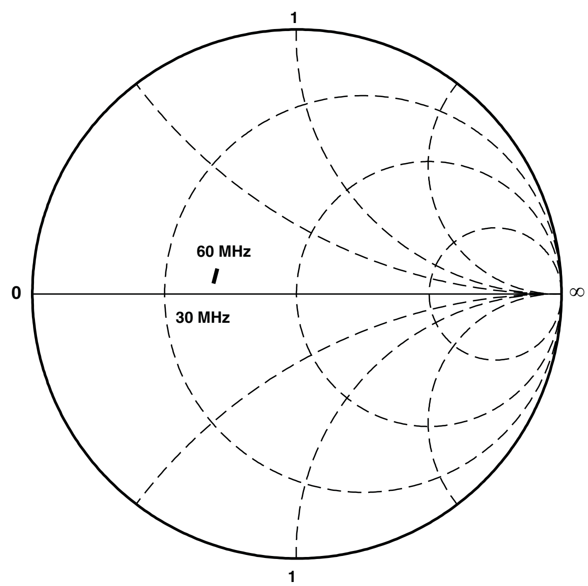


Figure 32. IFOUT

TYPICAL CHARACTERISTICS (continued)

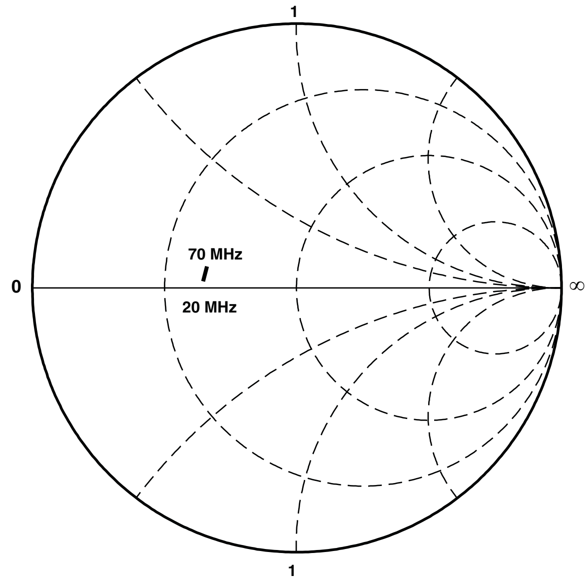


Figure 33. IF GCA OUT

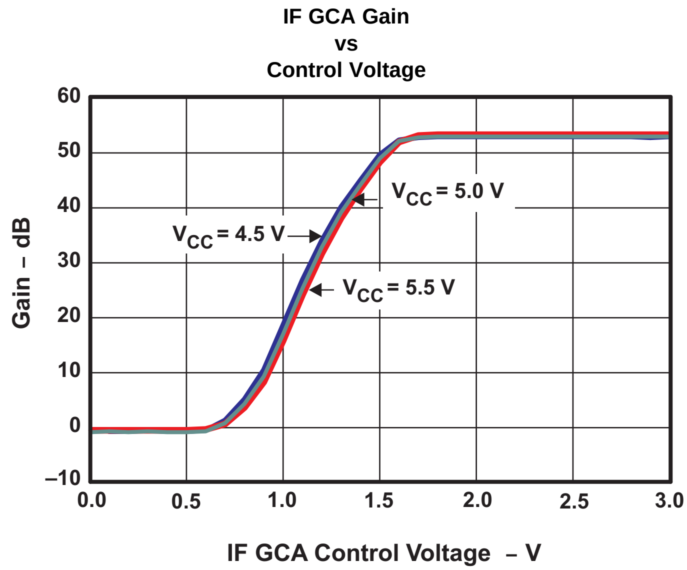


Figure 34. IF GCA Gain vs Control Voltage

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
SN761668DBTR	OBSOLETE	TSSOP	DBT	44		TBD	Call TI	Call TI	-20 to 85	SN761668	
SN761668DBTR-M	OBSOLETE	TSSOP	DBT	44		TBD	Call TI	Call TI		SN761668	

(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.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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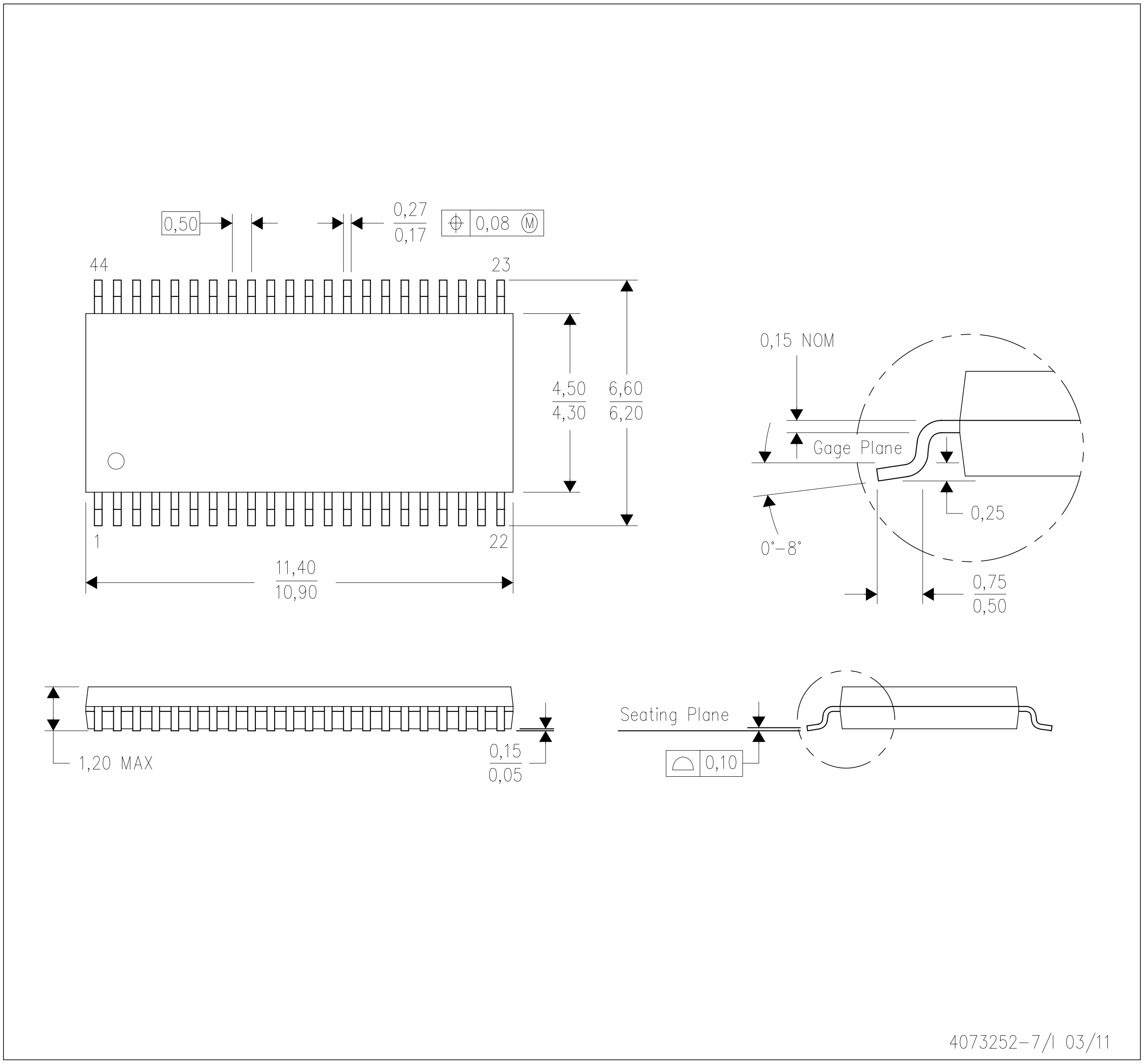
DBT (R-PDSO-G44) PLASTIC SMALL OUTLINE



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