

# SIEMENS

## Components for Entertainment Electronics

2 Band TV Tuner

KTS6027, KTS6029

Mixer-Oscillator-PLL  
with unbalanced IF-Amplifier

Preliminary Data Sheet    06.99

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**KTS6027, KTS6029****Revision History: Current Version: 06.99**

Previous Version: 03.99

old Page	new Page	Subjects (major changes since last revision)
	15	Voltage gain for VHF and UHF changed

**Data Classification****Maximum Ratings**

Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.

**Characteristics**

The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not otherwise specified, typical characteristics apply at  $T_A = 25\text{ °C}$  and the given supply voltage.

**Operating Range**

In the operating range the functions given in the circuit description are fulfilled.

For detailed technical information about "**Processing Guidelines**" and "**Quality Assurance**" for ICs, see our "**Product Overview**".

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## 2 Band TV Tuner Mixer-Oscillator-PLL with unbalanced IF-Amplifier

KTS6027, KTS6029

Preliminary Data Sheet

BIPOLAR

### 1 Features

#### General

- Suitable for TV tuners
- Full ESD protection

#### Mixer/Oscillator

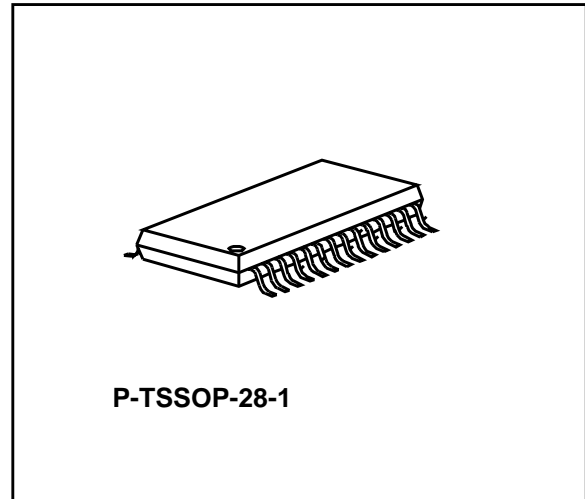
- High impedance mixer input for VHF
- Low impedance mixer input for UHF
- 4 pin oscillator for VHF
- 4 pin oscillator for UHF

#### IF-Amplifier

- unbalanced SAW preamplifier
- Low output impedance

#### PLL

- PLL with short lock-in time;  
no asynchronous divider stage
- High voltage VCO tuning output
- Fast I<sup>2</sup>C bus
- 4 NPN bandswitch buffers
- Internal VHF/UHF switch
- Lock-in flag
- Power-down reset
- Programmable reference divider ratio  
(64, 80, 128)
- Programmable charge pump current



Package

### 2 Ordering Information

Type	Package	Ordering Code
KTS6027XS	P-TSSOP-28-1	Q67037-A1087
KTS6027-K	P-TSSOP-28-1	Q67037-A1088
KTS6027-S	P-TSSOP-28-1	Q67037-A1059
KTS6029XS	P-TSSOP-28-1	Q67037-A1089
KTS6029-K	P-TSSOP-28-1	Q67037-A1090
KTS6029-S	P-TSSOP-28-1	Q67037-A1091

### 3 Functional Description

The **KTS6027, KTS6029** device combines a digitally programmable phase locked loop (PLL), with a mixer-oscillator block including two balanced mixers and oscillators for use in TV tuners.

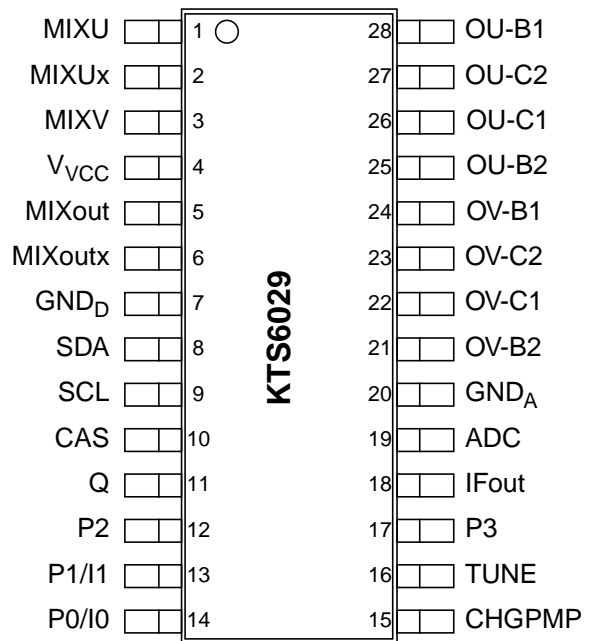
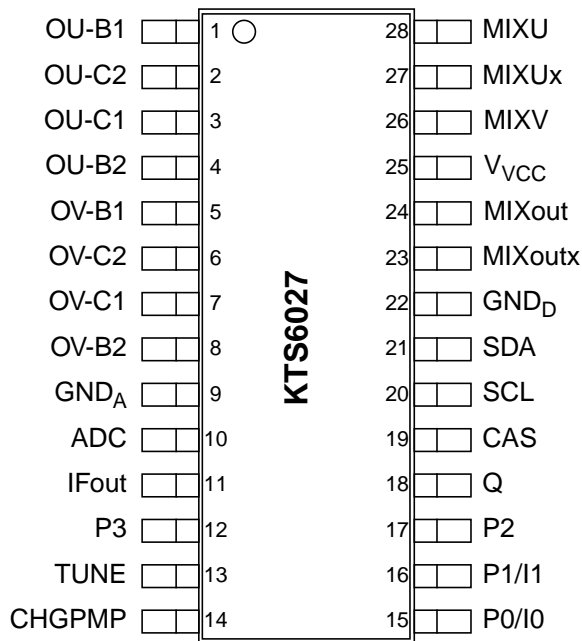
The PLL block with four hard-switched chip addresses forms a digitally programmable phase locked loop. With a 4 MHz quartz crystal, the PLL permits precise setting of the frequency of the tuner oscillator up to 850 MHz in increments of 62.5 kHz. The tuning process is controlled by a microprocessor via an I<sup>2</sup>C bus. The device has four output ports, two of them (P0 and P1) can also be used as TTL input ports. A flag is set when the loop is locked. The input ports and lock flag can be read by the processor via the I<sup>2</sup>C bus.

The mixer-oscillator block includes two balanced mixers (one mixer with high-impedance input and one mixer with a balanced low-impedance input), two frequency and amplitude-stable balanced oscillators for VHF, HYPER and UHF, a low-noise reference voltage source and a band switch.

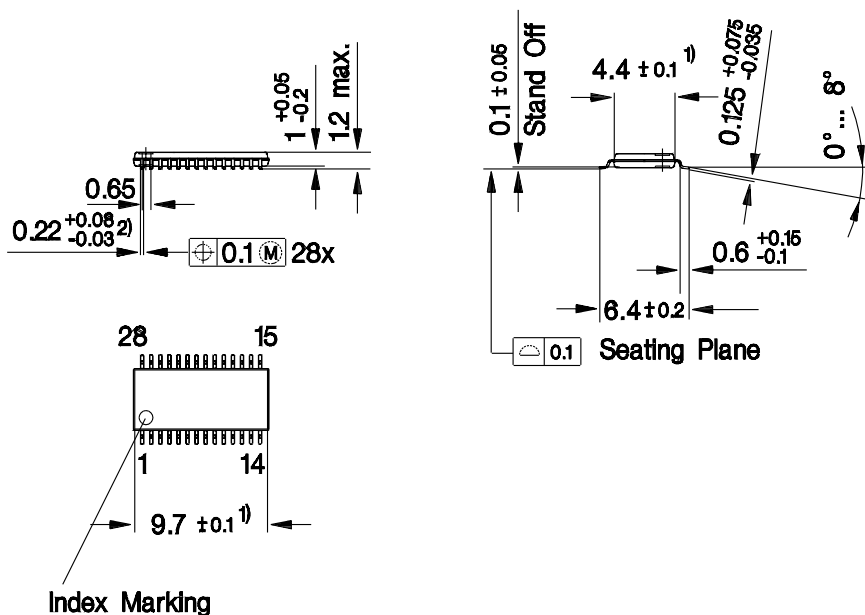
### 4 Application

The IC is suitable for NTSC tuners in TV- and VCR-sets or cable set-top receivers for analog TV and Digital Video Broadcasting.

5 Pin Configuration



6 Package Outlines

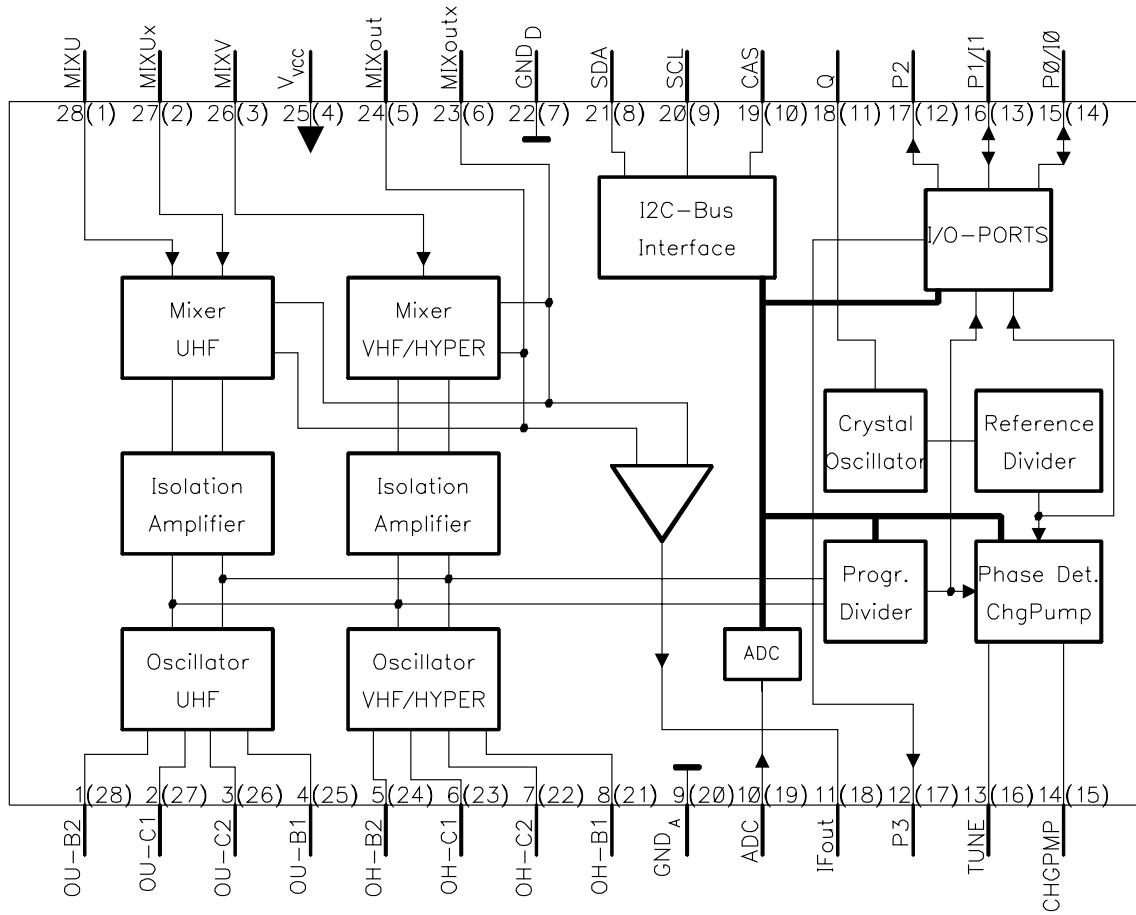


- 1) Does not include plastic or metal protrusion of 0.15 max. per side
- 2) Does not include dambar protrusion of 0.08 max. per side

## 7 Pin Definitions and Functions

Pin No.		Symbol	Function
KTS6027	KTS6029		
1	28	OU-B2	UHF oscillator amplifier, high-impedance base input, symmetrical to OU-B1
2	27	OU-C1	UHF oscillator amplifier, high-impedance collector output, symmetrical to OU-C2
3	26	OU-C2	UHF oscillator amplifier, high-impedance collector output, symmetrical to OU-C1
4	25	OU-B1	UHF oscillator amplifier, high-impedance base input, symmetrical to OU-B2
5	24	OV-B2	HYPER oscillator amplifier, high-impedance base input, symmetrical to OV-B1
6	23	OV-C1	HYPER oscillator amplifier, high-impedance collector output, symmetrical to OV-C2
7	22	OV-C2	HYPER oscillator amplifier, high-impedance collector output, symmetrical to OV-C1
8	21	OV-B1	HYPER oscillator amplifier, high-impedance base input, symmetrical to OV-B2
9	20	GND <sub>A</sub>	Analog Ground
10	19	ADC	ADC input
11	18	IFout	IF output
12	17	P3	Port output
13	16	TUNE	VCO tuning voltage output
14	15	CHGPMP	Charge pump output / loop filter
15	14	P0/I0	Port output / TTL input
16	13	P1/I1	Port output / TTL input
17	12	P2	Port output
18	11	Q	4 MHz low-impedance crystal oscillator input
19	10	CAS	Chip address select
20	9	SCL	Clock input for the I <sup>2</sup> C bus
21	8	SDA	Data input/output for the I <sup>2</sup> C bus
22	7	GND <sub>D</sub>	Digital Ground
23	6	MIXoutx	Inverse Mixer output, symmetrical to MIXout
24	5	MIXout	Mixer output, symmetrical to MIXoutx
25	4	V <sub>VCC</sub>	Analog supply voltage
26	3	MIXV	VHF mixer input, high-impedance
27	2	MIXUx	UHF mixer input, low-impedance, symmetrical to MIXU
28	1	MIXU	UHF mixer input, low-impedance, symmetrical to MIXUx

8 Block Diagram



The pin numbers given in parenthesis refer to the KTS6029

## 9 Circuit Description

### 9.1 Mixer-Oscillator block

The mixer oscillator section includes two balanced mixers (double balanced mixer), two balanced oscillators for VHF and / or HYPER band and UHF, a reference voltage source and a band switch.

Filters between tuner input and IC separate the TV frequency signals into two bands. The band switching in the tuner front-end is done by using two or three port outputs. In the selected band the signal passes a tuner input stage with MOSFET amplifier, a double-tuned bandpass filter and is then fed to the balanced mixer input of the IC which has in case of VHF / Hyperband a high-impedance input and in case of UHF a low-impedance input. The input signal is mixed there with the signal from the activated on chip oscillator to the IF frequency which is filtered out at the balanced high-impedance output pair by means of a parallel tuned circuit. The following SAW preamplifier has a low output impedance to drive a 75  $\Omega$  load directly.

### 9.2 PLL block

The mixer-oscillator signal VCO/VCOx is internally DC-coupled as a differential signal at the programmable divider inputs. The signal subsequently passes through a programmable divider with ratio  $N = 256$  through 32767 and is then compared in a digital frequency / phase detector to a reference frequency  $f_{ref} = 62.5$  kHz. This frequency is derived from a unbalanced, low-impedance 4 MHz crystal oscillator (pin Q) divided by  $Q = 64$ .

The phase detector has two outputs UP and DOWN that drive two current sources I+ and I- of a charge pump. If the negative edge of the divided VCO signal appears prior to the negative edge of the reference signal, the I+ current source pulses for the duration of the phase difference. In the reverse case the I- current source pulses. If the two signals are in phase, the charge pump output (CHGPMP) goes into the high-impedance state (PLL is locked). An active low-pass filter integrates the current pulses to generate the tuning voltage for the VCO (internal amplifier, external pullup resistor at TUNE and external RC circuitry). The charge pump output is also switched into the high-impedance state when the control bit T0 = 1. Here it should be noted, however, that the tuning voltage can alter over a long period in the high-impedance state as a result of self-discharge in the peripheral circuitry. TUNE may be switched off by the control bit OS to allow external adjustments.

If the VCO is not working the PLL locks to a tuning voltage of 33V.

By means of control bit 5I the pump current can be switched between two values by software. This programmability permits alteration of the control response of the PLL in the locked-in state. In this way different VCO gains can be compensated, for example.

The software-switched ports P0, P1 and P2 are general-purpose open-collector outputs. The test bit T1 = 1, switches the test signals  $f_{ref}$  (4 MHz / 64) and  $C_y$  (divided input signal) to P0 and P1 respectively. P0, P1 are bidirectional.

The lock detector resets the lock flag FL when the width of the charge pump current pulses is greater than the period of the crystal oscillator (i.e. 250 ns). Hence, when FL = 1, the maximum deviation of the input frequency from the programmed frequency is given by

$$\Delta f = \pm I_P (K_{VCO} / f_Q) (C_1 + C_2) / (C_1 C_2)$$

where  $I_P$  is the charge pump current,  $K_{VCO}$  the VCO gain,  $f_Q$  the crystal oscillator frequency and  $C_1$ ,  $C_2$  the capacitances in the loop filter (see application circuit). As the charge pump pulses at 62.5 kHz ( $= f_{ref}$ ), it takes a maximum of 16  $\mu$ s for FL to be reset after the loop has lost lock state.

Once FL has been reset, it is set only if the charge pump pulse width is less than 250 ns for eight consecutive  $f_{ref}$  periods. Therefore it takes between 128 and 144  $\mu$ s for FL to be set after the loop regains lock.

### 9.3 I<sup>2</sup>C-Bus Interface

Data is exchanged between the processor and the PLL via the I<sup>2</sup>C bus. The clock is generated by the processor (input SCL), while pin SDA functions as an input or output depending on the direction of the data (open collector, external pull-up resistor). Both inputs have hysteresis and a low-pass characteristic, which enhance the noise immunity of the I<sup>2</sup>C bus.

The data from the processor pass through an I<sup>2</sup>C bus controller. Depending on their function the data are subsequently stored in registers. If the bus is free, both lines will be in the marking state (SDA, SCL are HIGH). Each telegram begins with the start condition and ends with the stop condition. Start condition: SDA goes LOW, while SCL remains HIGH. Stop condition: SDA goes HIGH while SCL remains HIGH. All further information transfer takes place during SCL = LOW, and the data is forwarded to the control logic on the positive clock edge.

The table "Bit Allocation" ([see 9.3.1 Bit Allocation Read / Write on page 8](#)) should be referred to the following description. All telegrams are transmitted byte-by-byte, followed by a ninth clock pulse, during which the control logic returns the SDA line to LOW (acknowledge condition). The first byte is comprised of seven address bits. These are used by the processor to select the PLL from several peripheral components (chip select). The LSB bit (R/W) determines whether data are written into (R/W = 0) or read from (R/W = 1) the PLL.

In the data portion of the telegram during a WRITE operation, the MSB bit of the first or third data byte determines whether a divider ratio or control information is to follow. In each case the second byte of the same data type has to follow the first byte.

If the address byte indicates a READ operation, the PLL generates an acknowledge and then shifts out the status byte onto the SDA line. If the processor generates an acknowledge, a further status byte is output; otherwise the data line is released to allow the processor to generate a stop condition. The status word consists of two bits from the TTL input ports, three bits from the A/D converter, the lock flag and the power-on flag.

Four different chip addresses can be set by appropriate cDC level at pin CAS ([see 9.3.4 Address selection on page 9](#)).

When the supply voltage is applied, a power-on reset circuit prevents the PLL from setting the SDA line to LOW, which would block the bus. The power-on reset flag POR is set at power-on and if  $V_{VCC}$  falls below 3.2 V. It will be reset at the end of a READ operation.

### 9.3.1 Bit Allocation Read / Write

Byte	MSB	bit6	bit5	bit4	bit3	bit2	bit1	LSB	Ack	Remarks
Write Data										
Address Byte	1	1	0	0	0	MA1	MA0	0	A	
Progr. Divider Byte 1	0	n14	n13	n12	n11	n10	n9	n8	A	
Progr. Divider Byte 2	n7	n6	n5	n4	n3	n2	n1	n0	A	
Control Byte 1	1	5I	T1	T0	1	RSA	RSB	OS	A	
Control Byte 2	x	x	x	x	P3	P2	P1	P0	A	
Read Data										
Address Byte	1	1	0	0	0	MA1	MA0	1	A	
Status Byte	POR	FL	x	I1	I0	A2	A1	A0	A	

### 9.3.2 Description of symbols

Symbol	Description
MA0, MA1	Address selection bits ( <a href="#">see 9.3.4 Address selection on page 9</a> )
n14 to n0	programmable divider bits: $N = 2^{14} \times n14 + 2^{13} \times n13 + \dots + 2^3 \times n3 + 2^2 \times n2 + 2^1 \times n1 + n0$
5I	charge pump current: bit = 0 : charge pump current = 50 $\mu$ A bit = 1 : charge pump current = 220 $\mu$ A
T1, T0	test bits ( <a href="#">see 9.3.5 Test modes on page 9</a> )
RSA, RSB	reference divider bits ( <a href="#">see 9.3.6 Reference divider ratio on page 9</a> )
OS	tuning amplifier control bit: bit = 0 : enable $V_{TUNE}$ bit = 1 : disable $V_{TUNE}$
P0, P1, P2, P3	NPN ports control bits bit = 0 : NPN open-collector output is inactive, TTL inputs at P0, P1 bit = 1 : NPN open-collector output is active UHF / VHF bandswitch ( <a href="#">see 9.3.3 UHF/VHF Bandswitch on page 9</a> )
A0, A1, A2	ADC bits ( <a href="#">see 9.3.7 A/D Converter levels on page 9</a> )
I0, I1	input data from P0/I0, P1/I1
FL	PLL lock flag bit = 1 : loop is locked
POR	Power-on reset flag flag is set at power-on and reset at the end of READ operation
x	don't care

### 9.3.3 UHF/VHF Bandswitch

IC is in UHF mode	Ports Pn			
	P0	P1	P2	P3
KTS6027XS, KTS6029XS	x	1	x	x
KTS6027-K, KTS6029-K	x	x	1	x
KTS6027-S, KTS6029-S	x	x	x	1

### 9.3.4 Address selection

Voltage at CAS	MA1	MA0
$(0...0.1) * V_{VCC}$	0	0
open circuit	0	1
$(0.4...0.6) * V_{VCC}$	1	0
$(0.9...1) * V_{VCC}$	1	1

### 9.3.5 Test modes

Test mode	T1	T0
Normal operation	0	0
Charge pump output, CHGPMP is in high-impedance state	0	1
P1 = Cy output, P0 = $f_{ref}$ output	1	0
TTL-inputs I1/I0 are Cy/ $f_{ref}$ inputs of phase detector	1	1

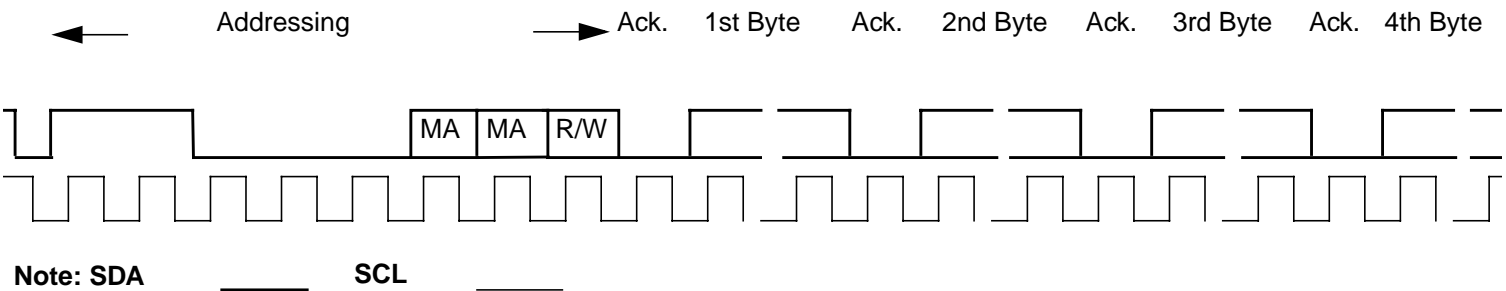
### 9.3.6 Reference divider ratio

Reference divider ratio	RSA	RSB
80	x	0
128	0	1
64	1	1

### 9.3.7 A/D Converter levels

Voltage at ADC	A2	A1	A0
$(0...0.15) * V_{VCC}$	0	0	0
$(0.15...0.3) * V_{VCC}$	0	0	1
$(0.3...0.45) * V_{VCC}$	0	1	0
$(0.45...0.6) * V_{VCC}$	0	1	1
$(0.6...1) * V_{VCC}$	1	0	0

9.3.8 I<sup>2</sup>C Bus Timing Diagram



**Telegram examples:**

- Start-Addr-DR1-DR2-CW1-CW2-Stop
- Start-Addr-CW1-CW2-DR1-DR2-Stop
- Start-Addr-DR1-DR2-Stop
- Start-Addr-CW1-CW2-Stop

**Abbreviations:**

- Start = start condition
- Addr = address byte
- DR1 = prog. divider byte 1
- DR2 = prog. divider byte 2
- CW1 = control byte 1
- CW2 = control byte 2
- Stop = stop condition

## 10 Electrical Characteristics

### 10.1 Absolute Maximum Ratings

The maximal ratings may not be exceeded under any circumstances, not even momentary and individual, as permanent damage to the IC will result.

Ambient Temperature under bias:  $T_A = -20$  to  $+85^\circ\text{C}$

Parameter <sup>1</sup>	Symbol	Limit Values		Unit	Test Conditions
		min	max		
Supply voltage	$V_{VCC}$	-0.3	6	V	
Junction temperature	$T_J$		+150	$^\circ\text{C}$	
Storage temperature	$T_{Stg}$	-40	+125	$^\circ\text{C}$	
Thermal resistance (junction to ambient)	$R_{thSA}$		120	K/W	
<b>PLL</b>					
CHGPMP	$V_{CHGPMP}$	-0.3	3	V	
	$I_{CHGPMP}$		1	mA	
Crystal oscillator pins Q	$V_Q$		$V_{VCC}$	V	
	$I_Q$	-5		mA	
Bus input/output SDA	$V_{SDA}$	-0.3	$V_{VCC}$	V	
Bus output current SDA	$I_{SDA(L)}$		5	mA	open collector
Bus input SCL	$V_{SCL}$	-0.3	$V_{VCC}$	V	
Chip address switch CAS	$V_{CAS}$	-0.3	$V_{VCC}$	V	
VCO tuning output (loop filter)	$V_{TUNE}$	-0.3	35	V	
Port outputs P0...P3	$V_P$	-0.3	$V_{VCC}$	V	
	$I_{P(L)}$	-1	15	mA	$t_{max} = 0.1$ sec. at 5.5 V
Total port output current	$\Sigma I_{P(L)}$		40	mA	$t_{max} = 0.1$ sec. at 5.5 V
<b>Mixer-Oscillator</b>					
Mix inputs VHF / Hyper	$V_{MIX V}$	-0.3	3	V	
Mix inputs UHF	$V_{MIX U}$		2	V	
	$I_{MIX U}$	-5	6	mA	
VCO base voltage	$V_B$	-0.3	3	V	
VCO collector voltage	$V_C$		$V_{VCC}$	V	
<b>ESD-Protection<sup>2</sup></b>					
all pins	$V_{ESD}$		1	kV	

1. All values are referred to ground (pin), unless stated otherwise.  
Currents with a positive sign flows into the pin and currents with a negative sign flows out of pin.

2. according to MIL STD 883D, method 3015.7 and EOS/ESD assn. standard S5.1 - 1993

## 10.2 Operating Range

*Within the operational range the IC operates as described in the circuit description.  
The AC / DC characteristic limits are not guaranteed.*

Parameter	Symbol	Limit Values		Unit	Test Conditions
		min	max		
Supply voltage	$V_{VCC}$	+4.5	+5.5	V	
Programmable divider factor	N	256	32767		
VHF Mixer input frequency range	$f_{MIXV}$	40	500	MHz	
UHF Mixer input frequency range	$f_{MIXU}$	350	900	MHz	
VHF Oscillator frequency range	$f_{OV}$	75	560	MHz	
UHF Oscillator frequency range	$f_{OU}$	380	950	MHz	
Ambient temperature	$T_{amb}$	-20	+85	°C	

### 10.3 AC/DC Characteristics

AC / DC characteristics involve the spread of values guaranteed in the specified supply voltage and ambient temperature range. Typical characteristics are the median of the production.

Parameter $T_A = 25\text{ }^\circ\text{C}, V_{VCC}$	Symbol	Limit Values			Unit	Test conditions
		min	typ	max		
<b>Supply</b>						
Supply voltage	$V_{VCC}$	4.5	5	5.5	V	
Current consumption	$I_{VCC}$	56	70	84	mA	
<b>Digital Unit</b>						
<b>PLL</b>						
<b>Crystal oscillator connections Q</b>						
Crystal frequency	$f_Q$	3.2	4.0	4.8	MHz	series resonance
Crystal resistance	$R_Q$	10		100	$\Omega$	series resonance
Oscillation frequency	$f_Q$	3,99975	4,000	4,00025	MHz	$f_Q = 4\text{ MHz}$
Input impedance	$Z_Q$	-700	-900	-1100	$\Omega$	$f_Q = 4\text{ MHz}$
<b>Charge pump output CHGPMP</b>						
HIGH output current	$I_{CPH}$	$\pm 90$	$\pm 220$	$\pm 300$	$\mu\text{A}$	$5I = 1, V_{CP} = 2\text{ V}$
LOW output current	$I_{CPL}$	$\pm 22$	$\pm 50$	$\pm 75$	$\mu\text{A}$	$5I = 0, V_{CP} = 2\text{ V}$
Tristate current	$I_{CPZ}$		+1		nA	$T_0 = 1, V_{CP} = 2\text{ V}$
Output voltage	$V_{CP}$	1.0		2.5	V	locked
<b>Drive output TUNE (open collector)</b>						
HIGH output current	$I_{TH}$			10	$\mu\text{A}$	$V_{TH} = 33\text{ V}, T_0 = 1$
LOW output voltage	$V_{TL}$			0.5	V	$I_{TL} = 1.0\text{ mA}$
<b>I<sup>2</sup>C-Bus</b>						
<b>Bus inputs SCL, SDA</b>						
HIGH input voltage	$V_{IH}$	3		5.5	V	
LOW input voltage	$V_{IL}$	0		1.5	V	
HIGH input current	$I_{IH}$			10	$\mu\text{A}$	$V_{IH} = V_S$
LOW input current	$I_{IL}$	-10			$\mu\text{A}$	$V_{IL} = 0\text{ V}$
<b>Bus output SDA (open collector)</b>						
HIGH output current	$I_{OH}$			10	$\mu\text{A}$	$V_{OH} = 5.5\text{ V}$
LOW output voltage	$V_{OL}$			0.4	V	$I_{OL} = 3\text{ mA}$
<b>Edge speed SCL, SDA</b>						
Rise time	$t_r$			300	ns	
Fall time	$t_f$			300	ns	

Parameter $T_A = 25\text{ }^\circ\text{C}, V_{VCC}$	Symbol	Limit Values			Unit	Test conditions
		min	typ	max		
<b>Clock timing SCL</b>						
Frequency	$f_{SCL}$	0		400	kHz	
HIGH pulse width	$t_H$	0.6			$\mu\text{s}$	
LOW pulse width	$t_L$	1.3			$\mu\text{s}$	
<b>Start condition</b>						
Set-up time	$t_{susta}$	0.6			$\mu\text{s}$	
Hold time	$t_{hsta}$	0.6			$\mu\text{s}$	
<b>Stop condition</b>						
Set up time	$t_{susto}$	0.6			$\mu\text{s}$	
Bus free	$t_{buf}$	1.3			$\mu\text{s}$	
<b>Data transfer</b>						
Set-up time	$t_{sudat}$	0.1			$\mu\text{s}$	
Hold time	$t_{hdat}$	0			$\mu\text{s}$	
Input hysteresis SCL, SDA <sup>(1)</sup>	$V_{hys}$		200		mV	
Pulse width of spikes which are suppressed	$t_{sp}$	0		50	ns	
Capacitive load for each bus line	$C_L$			400	pF	
<b>Port outputs P0, P1, P2,P3 (open collector)</b>						
HIGH output current	$I_{POH}$			1	$\mu\text{A}$	$V_{POH} = 5\text{ V}$
LOW output voltage	$V_{POL}$			0.4	V	$I_{POL} = 15\text{ mA}$
<b>TTL port inputs P0, P1</b>						
HIGH input voltage	$V_{PIH}$	2.7			V	
LOW input voltage	$V_{PIL}$			0.8	V	
HIGH input current	$I_{PIH}$			10	$\mu\text{A}$	$V_{PIH} = 5.5\text{ V}$
LOW input current	$I_{PIL}$	-10			$\mu\text{A}$	$V_{PIL} = 0\text{ V}$
<b>ADC port input</b>						
HIGH input current	$I_{ADCH}$			10	$\mu\text{A}$	
LOW input current	$I_{ADCL}$	-10			$\mu\text{A}$	
<b>Address selection input CAS</b>						
HIGH input current	$I_{CASH}$			50	$\mu\text{A}$	$V_{CASH} = 5\text{ V}$
LOW input current	$I_{CASL}$	-50			$\mu\text{A}$	$V_{CASL} = 0\text{ V}$

Parameter $T_A = 25\text{ °C}, V_{VCC}$	Symbol	Limit Values			Unit	Test conditions
		min	typ	max		
<b>Analog Unit</b>						
<b>VHF low and VHF high Band Section (including IF amplifier)</b>						
Voltage gain	$G_{\text{MixV}}$	15	18	21	dB	$f_{\text{RF}} = 43.25$ to $463.25$ MHz, $f_{\text{IF}} = 33.4$ to $58.75$ MHz
Mixer noise figure	$F_{\text{MixV}}$		9	11	dB	$f_{\text{RF}} = 43.25$ to $463.25$ MHz
Mixer input impedance	$R_{\text{MixV}}$	1	2	3	k $\Omega$	serial equivalent circuit, $f_{\text{MixV}} = 100$ MHz
	$C_{\text{MixV}}$		2	3	pF	serial equivalent circuit, $f_{\text{MixV}} = 100$ MHz
Oscillator drift, PLL unlocked	$\Delta f_{\text{OscV}}$			400	kHz	$V_S = 5\text{ V} \pm 10\%$
				500	kHz	$\Delta T = 25\text{ °C}$
				100	kHz	$t = 5\text{ s}$ up to $15\text{ min}$ after switching on
Oscillator pulling, PLL unlocked	$V_{\text{MIXV}}$	100	108		dB $\mu\text{V}$	$\Delta f = 10\text{ kHz}$ $f_{\text{RF}} = 48.25\text{ MHz}$
		80	88		dB $\mu\text{V}$	$\Delta f = 10\text{ kHz}$ $f_{\text{RF}} = 399.25\text{ MHz}$
Oscillator phase noise	$L(\text{fm})_{\text{VHF}}$	-80	-86		dBc/Hz	$f_m = 10\text{ kHz}$ , application circuit
IF suppression	$a_{\text{IF}}$	15	20		dB	$V_{\text{MixB}} = 80\text{ dB}\mu\text{V}$
<b>UHF Band Section (including IF amplifier)</b>						
Voltage gain	$G_{\text{MixU}}$	26	29	32	dB	$f_{\text{RF}} = 367.25\text{ MHz}$ to $863.25\text{ MHz}$ , $f_{\text{IF}} = 33.4\text{ MHz}$ to $58.75\text{ MHz}$
Mixer noise figure	$F_{\text{MixU}}$		6	9	dB	$f_{\text{RF}} = 367.25$ to $615.25\text{ MHz}$
			7	10	dB	$f_{\text{RF}} = 623.25$ to $863.25\text{ MHz}$
Mixer input impedance	$R_{\text{MixU}}$	14	20	26	$\Omega$	serial equivalent circuit, $f_{\text{MixU}} = 600\text{ MHz}$
	$L_{\text{MixU}}$	6	10	14	nH	serial equivalent circuit, $f_{\text{MixU}} = 600\text{ MHz}$
Oscillator drift, PLL unlocked	$\Delta f_{\text{OscU}}$			400	kHz	$V_S = 5\text{ V} \pm 10\%$
				800	kHz	$\Delta T = 25\text{ °C}$
				100	kHz	$t = 5\text{ s}$ up to $15\text{ min}$ after switching on

Parameter $T_A = 25\text{ °C}, V_{VCC}$	Symbol	Limit Values			Unit	Test conditions
		min	typ	max		
Oscillator pulling, PLL unlocked	$V_{MIXU}$	100	108		$\text{dB}\mu\text{V}$	$\Delta f = 10\text{ kHz}$ $f_{RF} = 375.25\text{ MHz}$
		100	108		$\text{dB}\mu\text{V}$	$\Delta f = 10\text{ kHz}$ $f_{RF} = 847.25\text{ MHz}$
Oscillator phase noise	$L(fm)_{UHF}$	-80	-86		$\text{dBc}/\text{Hz}$	$f_m = 10\text{ kHz}$ , application circuit
IF suppression	$a_{IF}$	15	20		$\text{dB}$	$V_{MixB} = 80\text{ dB}\mu\text{V}$

### SAW preamplifier

IF output impedance	$R_{IFout}$			80	$\Omega$	serial equivalent circuit, $f_{IF} = 38.9\text{ MHz}$
	$L_{IFout}$		tbf		$\text{nH}$	

### Rejection at the IFoutput

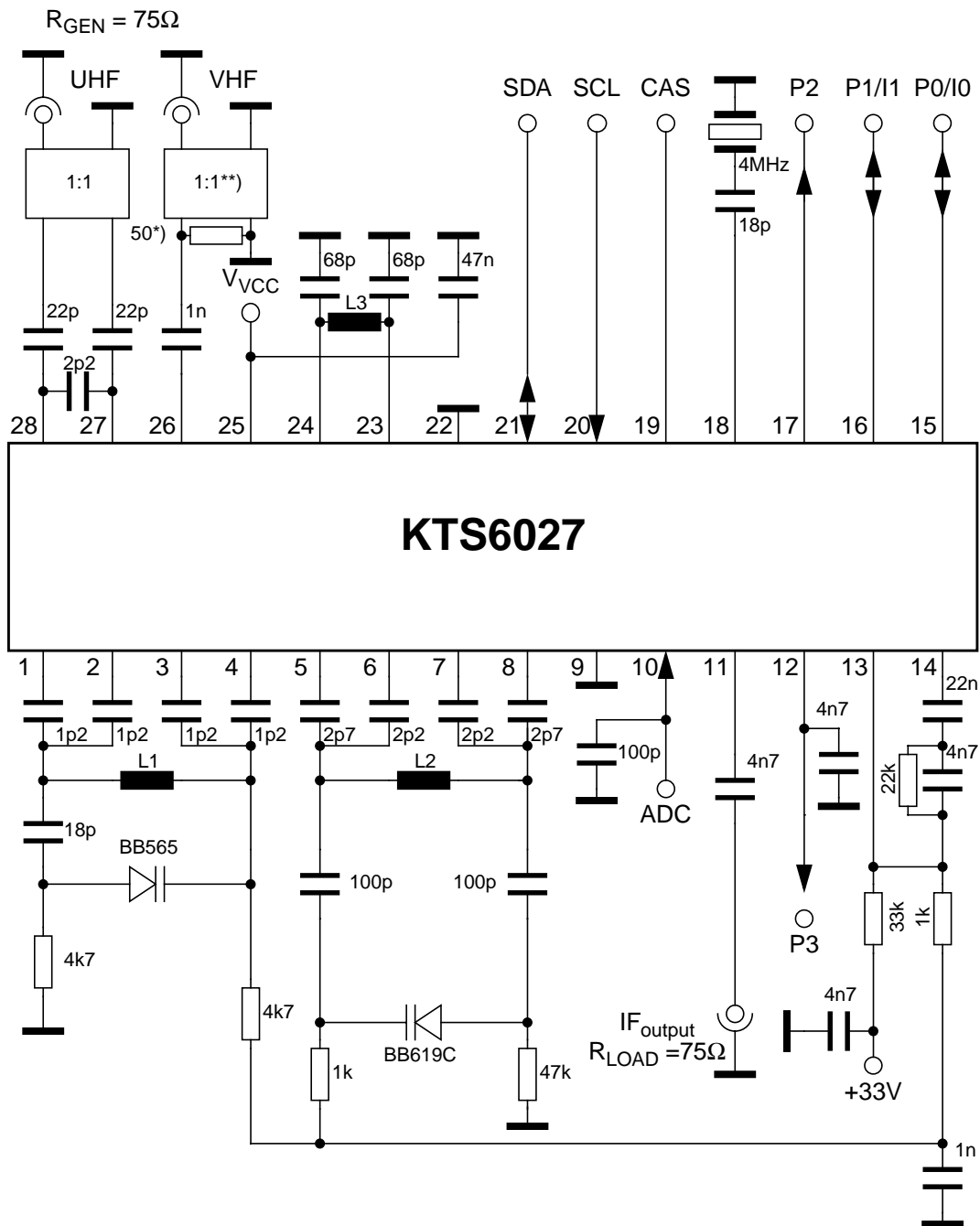
Channel 6 beat	$INT_{CH6}$	tbf	tbf		$\text{dBc}$	$V_{RFpix} =$ $V_{RFsnd} = 80\text{ dB}\mu\text{V};$ note 1
Channel A-5 beat	$INT_{CHA-5}$	tbf	tbf		$\text{dBc}$	$V_{RFpix} = 80\text{ dB}\mu\text{V};$ note 2

### Notes:

- Channel 6 beat is the interfering product of  $f_{RFpix}$ ,  $f_{RFsnd} - f_{OSC}$  of channel 6 at 42 MHz.
- Channel A-5 beat is the interfering product of  $f_{RFpix} + f_{RFsnd} - f_{OSC}$  of channel A-5,  $f_{BEAT} = 45.5\text{ MHz}$ .  
The possible mechanisms are:  $f_{OSC} - 2 \times f_{IF}$  or  $2 \times f_{RFpix} - f_{OSC}$ . For the measurement  $V_{RF} = 80\text{ dB}\mu\text{V}$ .

11 Test Circuit

11.1 DC and RF Parameter Measurement

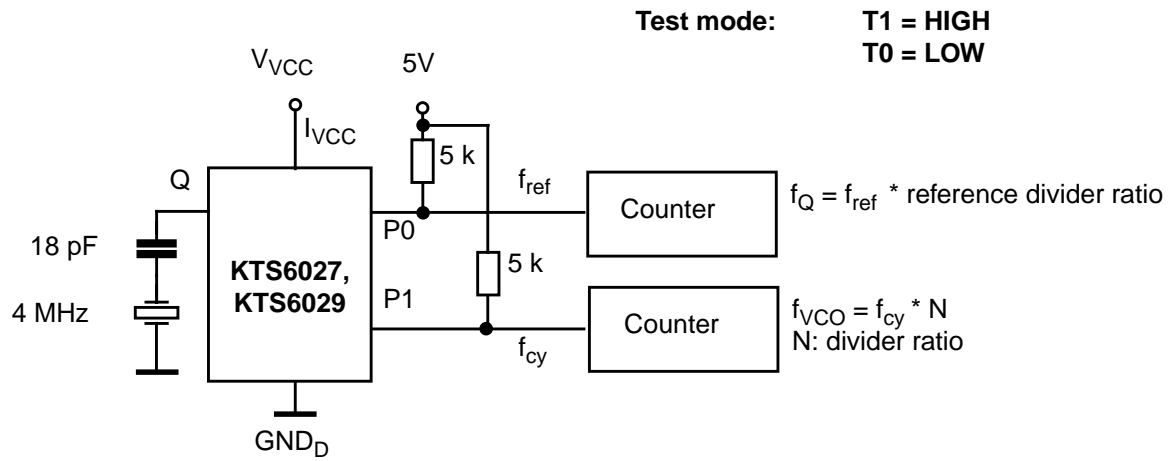


\*) not for noise measurement  
 \*\*) 1:2 transformer for noise measurement

**Coils:**

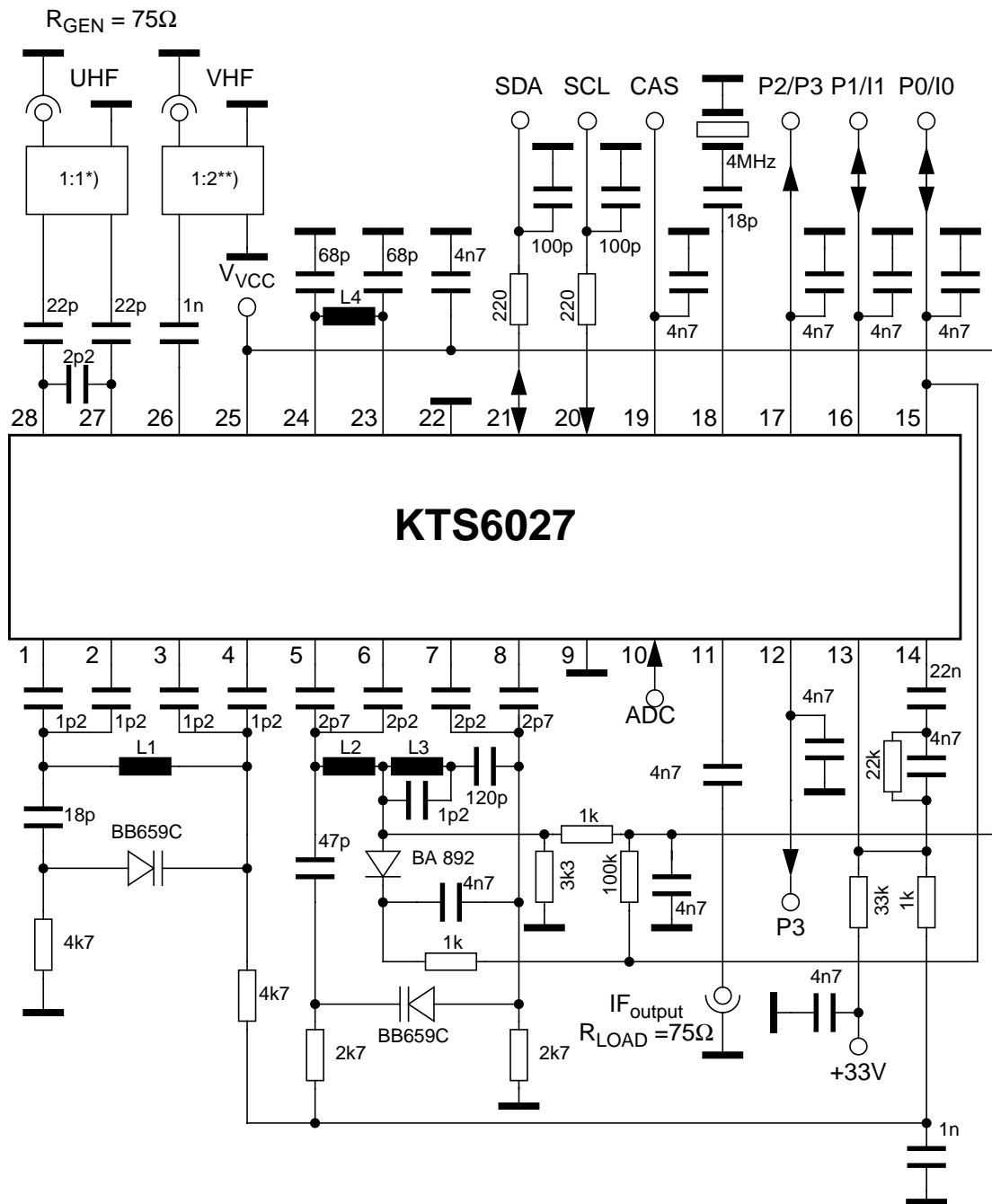
coil	turns	wire size [mm]	coil diameter [mm]
L1	2	0.4	3
L2	4	0.4	3
L3	Neosid Part-No. 00503600 0.58μH		

**11.2 Measurement of Crystal Oscillator Frequency**



12 Application Circuit

12.1 Application Circuit (Evaluation Board)



Transformers:

- \*) TOKO B4F Type 617DB-1023
- \*\*\*) TOKO B4F Type 617PT-1026

RF-Bands:

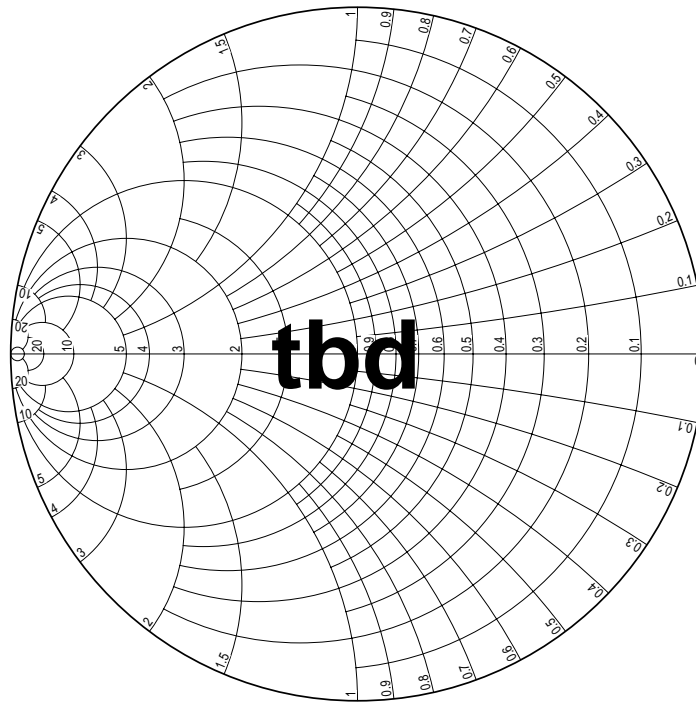
- 55.25 MHz to 127.25 MHz
- 133.25 MHz to 361.25 MHz
- 367.25 MHz to 803.25 MHz

Coils:

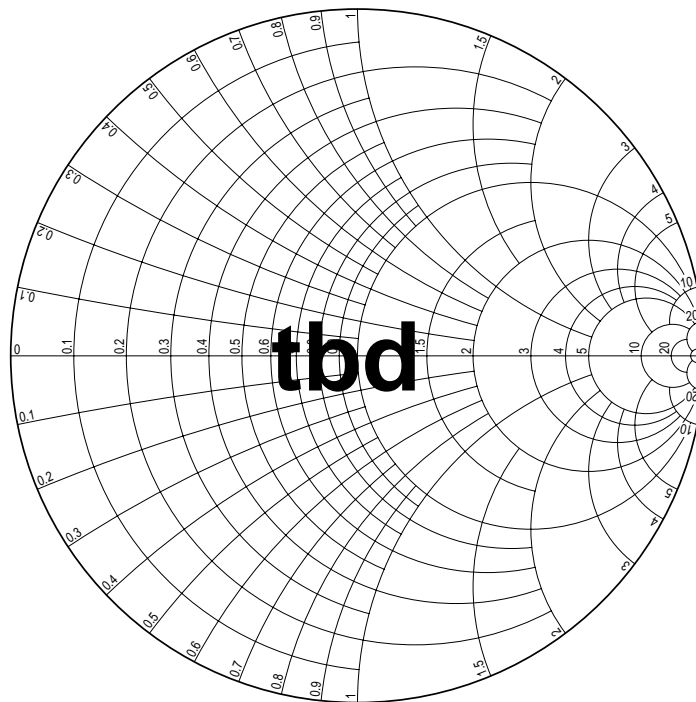
coil	turns	wire size [mm]	coil diameter [mm]
L1	1.5	0.4	2
L2	3.5	0.4	2.5
L3	9.5	0.4	2.5
L4	12.5	0.3	3.5

**13 Electrical Diagrams**

**13.1 Input admittance VHF mixer input  $Y_0 = 20\text{mS}$  (single ended)**



**13.2 Input impedance UHF mixer input  $Z_0 = 50 \Omega$  (symmetrical)**



13.3 Output impedance IF output  $Y_0 = 20\text{mS}$  (single ended)

