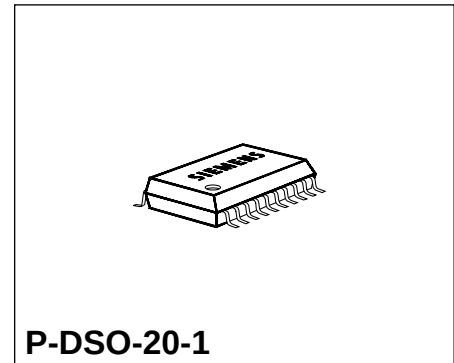


VHF/UHF-Tuner IC

MTI 3006X
Bipolar IC

Features

- Few external components
- Frequency and amplitude-stable balanced oscillator for VHF (I and II) and UHF
- Mixer stages with optimized suppression of oscillator and input frequency at IF-output
- Mixer with low intermodulation if large input signals are applied
- Balanced mixer with wide dynamic range and low-impedance inputs
- Internal band switch
- Low-noise, internal reference voltage



Type	Ordering Code	Package
MTI 3006X	Q67000-A5152	P-DSO-20-1 (SMD)
MTI 3006X	Q67006-A5152	P-DSO-20-1 Tape & Reel (SMD)

Functional Description and Application

This integrated circuit permits the design of TV-tuners covering the entire frequency range from 48 ... 900 MHz split into 2 parts with 3 frequency bands.

The application is suitable for all tuners in TV-and VCR-sets.

Circuit Description

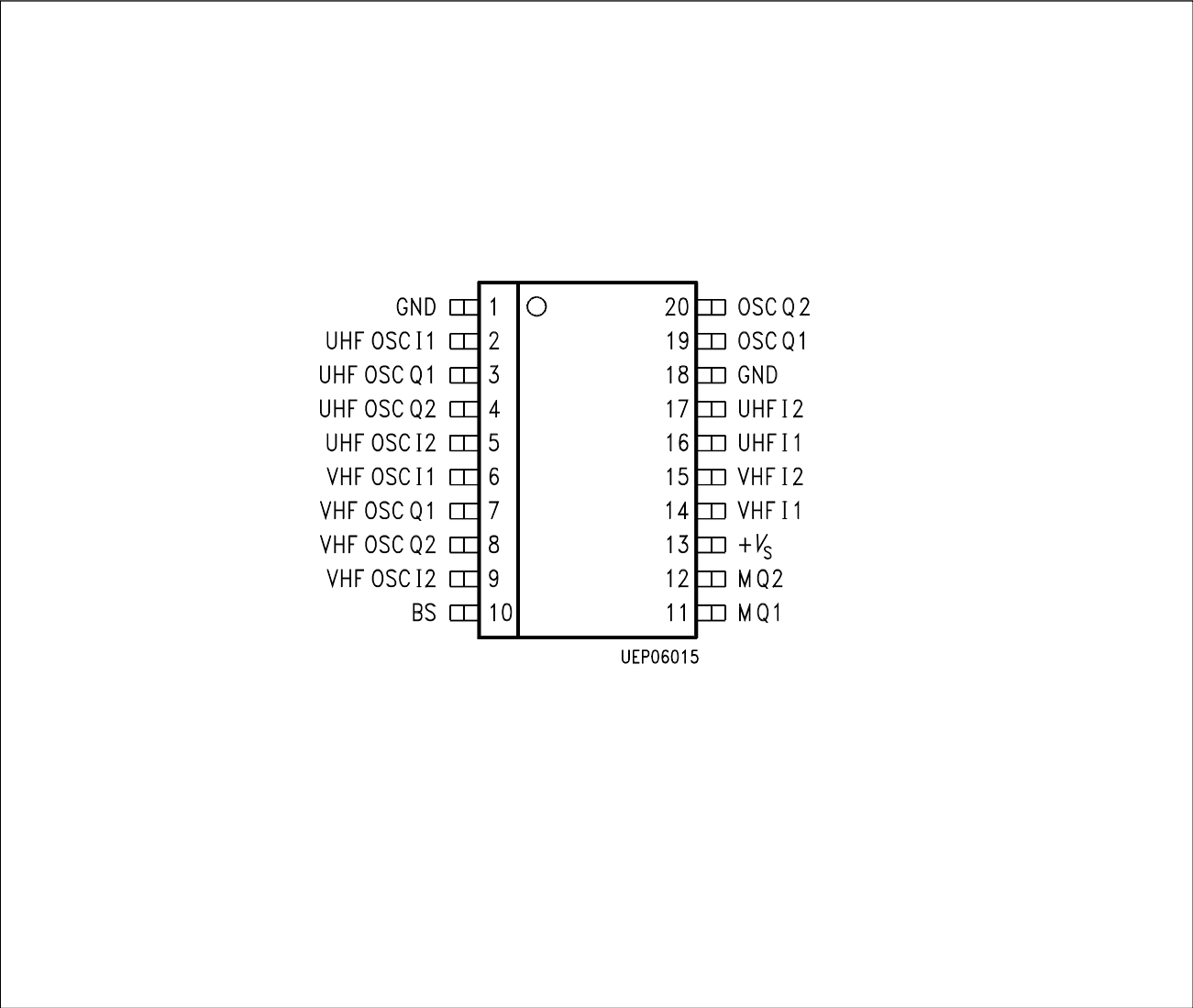
This IC includes 2 balanced mixers (double balanced mixer/ring mixer), two balanced oscillators for VHF (I and II) and UHF, a reference voltage source and band switch.

Filters between tuner input and IC separate the TV-frequency signal into two bands. The band switch ensures that only one band at a time is activated. In the activated band the signal passes a frontend stage with MOSFET-amplifier, a double-tuned bandpass filter and is then fed to the activated balanced mixer input of the IC which is a low-impedance stage for the VHF- and UHF-range, respectively.

The input signal is mixed there with the oscillator signal from the activated oscillator section and fed to a common IF-stage for all bands.

Pin Configuration

(top view)

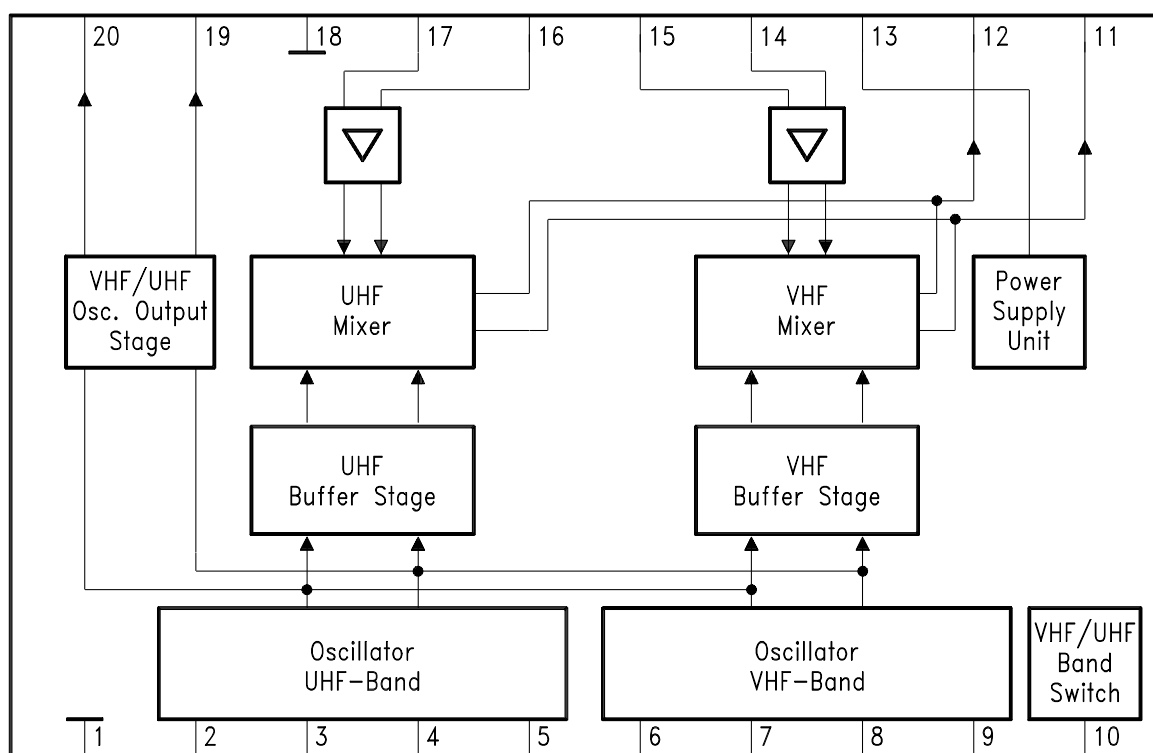


Pin Definitions and Functions

Pin No.	Symbol	Function
1	GND	Ground
2	UHF Osc. Input 1	UHF-oscillator amplifier, high-impedance base input, symmetrical to pin 5
3	UHF Osc. Output 1	UHF-oscillator amplifier, high-impedance collector output, symmetrical to pin 4

Pin Definitions and Functions (cont'd)

Pin No.	Symbol	Function
4	UHF Osc. Output 2	UHF-oscillator amplifier, high-impedance collector output, symmetrical to pin 3
5	UHF Osc. Input 2	UHF-oscillator amplifier, high-impedance base input, symmetrical to pin 2
6	VHF Osc. Input 1	VHF-oscillator amplifier, high-impedance base input, symmetrical to pin 9
7	VHF Osc. Output 1	VHF-oscillator amplifier, high-impedance collector output, symmetrical to pin 8
8	VHF Osc. Output 2	VHF-oscillator amplifier, high-impedance collector output, symmetrical to pin 7
9	VHF Osc. Input 2	VHF-oscillator amplifier, high-impedance base input, symmetrical to pin 6
10	Band Switching	VHF/UHF-band switching
11	Mixer Output 1	Open collector mixer output, high-impedance, symmetrical to pin 12
12	Mixer Output 2	Open collector mixer output, high-impedance, symmetrical to pin 11
13	+ V_S	Supply voltage
14	VHF Input 1	VHF-mixer input low-impedance, symmetrical to pin 15
15	VHF Input 2	VHF-mixer input low-impedance, symmetrical to pin 14
16	UHF Input 1	UHF-mixer input low-impedance, symmetrical to pin 17
17	UHF Input 2	UHF-mixer input low-impedance, symmetrical to pin 16
18	GND	Ground
19	Osc. Output 1	VHF/UHF-oscillator signal output to PLL, symmetrical to pin 20
20	Osc. Output 2	VHF/UHF-oscillator signal output to PLL, symmetrical to pin 19



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Block Diagram

Absolute Maximum Ratings $T_A = 0$ to $70\text{ }^{\circ}\text{C}$

Parameter	Symbol	Limit Values		Unit
		min.	max.	
Supply voltage	$V_{11, 12, 13}$	- 0.3	14.5	V
Switching voltage	V_{10}	- 0.3	V_S	V

According to the test circuit 1, only the provided circuitry can be connected to pins 1 to 9 and 14 to 20

Junction temperature	T_j		150	$^{\circ}\text{C}$
Storage temperature	T_{stg}	- 40	125	$^{\circ}\text{C}$
Thermal resistance	R_{th}		125	K/W

Operating Range

Supply voltage	V_S	10	13.2	V
VHF-mixer input frequency range	f_{VHF}	30	500	MHz
UHF-mixer input frequency range	f_{UHF}	30	900	MHz
VHF-oscillator frequency range	f_{OVHF}	30	500	MHz
UHF-oscillator frequency range	f_{OUHF}	30	900	MHz
Ambient temperature	T_A	0	70	$^{\circ}\text{C}$

AC/DC Characteristics $T_A = 25\text{ °C}$; $V_S = 12\text{ V}$

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Current consumption	I_{13}	20	28	36	mA	$V_{10} > 1.6\text{ V}$	1
Oscillator output impedance	$R_{19, 20}$		200		Ω	Parallel equivalent circuit	2
	$C_{19, 20}$		2		pF	Parallel equivalent circuit	2
Mixer output impedance	$R_{11, 12}$		10		k Ω	Parallel equivalent circuit	2
	$C_{11, 12}$		2		pF	Parallel equivalent circuit	2

VHF-Circuit Section

Switching voltage	V_{10}	1.6		2.3	V		1
Switching current	I_{10}		10	30	μA	$V_{10} = 2.1\text{ V}$	1
Oscillator frequency range	$f_{\text{VHF I}}$	80		170	MHz	$V_d = 0 \dots 28\text{ V}$	1
	$f_{\text{VHF II}}$	140		450	MHz	$V_d = 0 \dots 28\text{ V}$	
Oscillator drift	Δf_{VHF}			200	kHz	$V_S = 12\text{ V} \pm 10\%$	1
	Δf_{VHF}			400	kHz	$\Delta T = 25\text{ °C}$	1
	Δf_{VHF}			200	kHz	$t = 5\text{ s to }15\text{ min.}$ after switching on	1
Oscillator level	$V_{19, 20}$	- 17	- 14	- 11	dBm	voltage on $50\ \Omega$	1
Harmonic wave ratio	a_H	10	15		dB		1
Crosstalk f_{in}/LO	$V_{14/15}$	150	1000		mVrms	max. input level for 10-dB distance f_{in}/LO	1
Mixer gain	G_{VHF}	11	14	17	dB		1
Mixer noise figure	$F_{\text{VHF I}}$		6.5	11	dB	VHF 1; DSB	1
	$F_{\text{VHF II}}$		7.5	11	dB	VHF 2; DSB	
Mixer input impedance	$R_{14/15}$		25		Ω	serial equivalent circuit	1
	$L_{14/15}$		10		nH	serial equivalent circuit	1

AC/DC Characteristics (cont'd) $T_A = 25\text{ °C}; V_S = 12\text{ V}$

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			

**VHF-Circuit Section (cont'd)
(Design Hints only)**

IF-suppression	a_{IF}		20		dB	$V_{14/15} = 80\text{ dB}\mu\text{V}$	1
IM2	a_{IM2}	60	70		dB	$f_D = 50\text{ MHz}$ $f_U = 100.5\text{ MHz}$	3
	a_{IM2}	60	67		dB	$f_D = 200\text{ MHz}$ $f_U = 400.5\text{ MHz}$	3
IM3	a_{IM3}	60	65		dB	$f_D = 100\text{ MHz}$ $f_{U1} = 150\text{ MHz}$ $f_{U2} = 160\text{ MHz}$	4
	a_{IM3}	60	64		dB	$f_D = 200\text{ MHz}$ $f_{U1} = 250\text{ MHz}$ $f_{U2} = 260\text{ MHz}$	4
N + 5 pulling	a_{N+5}	50	60		dB	$f_D = 50\text{ MHz}$	5
	a_{N+5}	50	60		dB	$f_D = 200\text{ MHz}$	5

UHF-Circuit Section

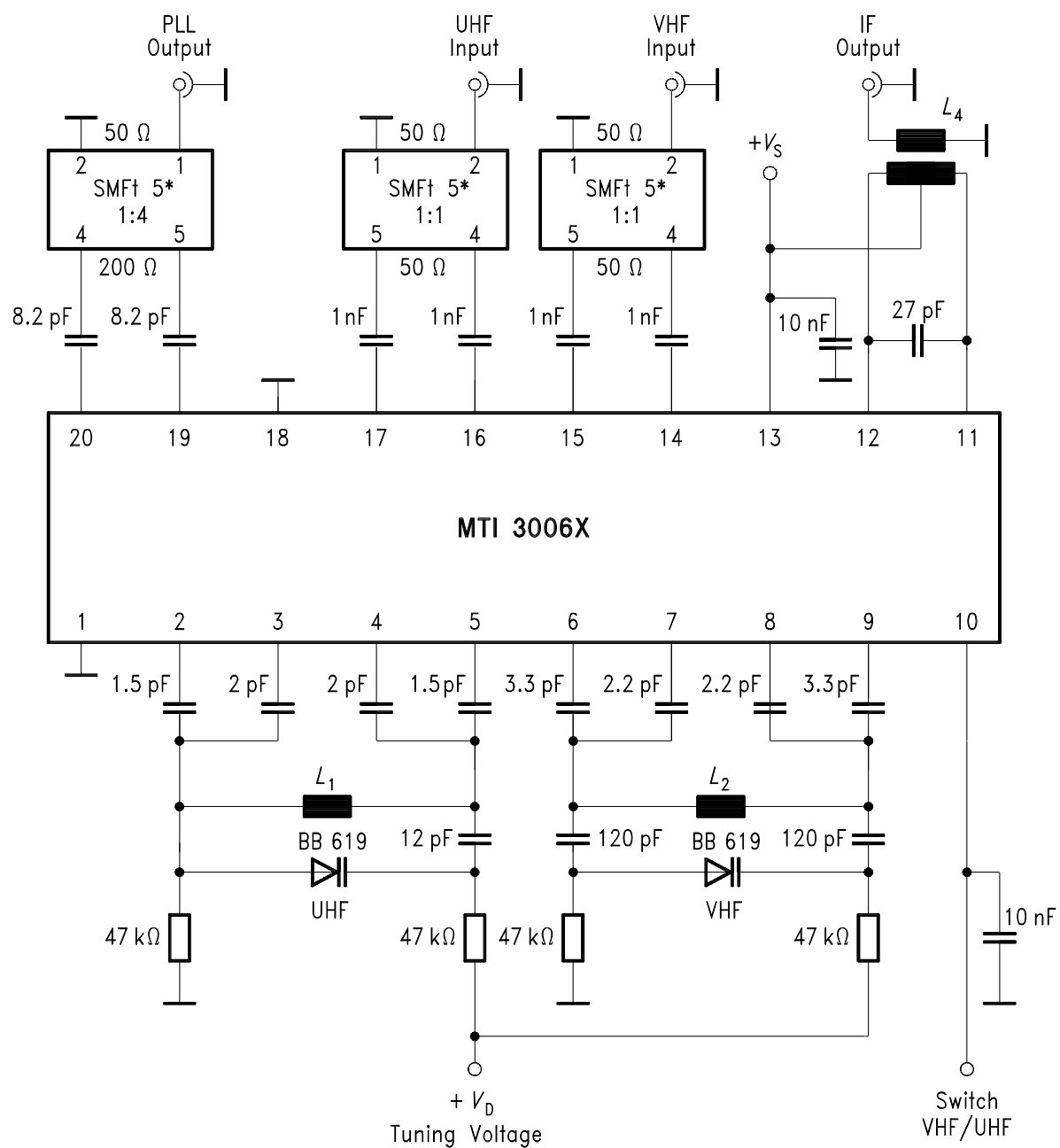
Switching voltage	V_{10}	3.2		$\leq V_S$	V		1
Switching current	I_{10}		60	300	μA	$V_{10} = V_S$	1
Oscillator frequency range	f_{UHF}	440		900	MHz	$V_d = 0 \dots 28\text{ V}$	1
Oscillator drift	Δf_{UHF}			400	kHz	$V_S = 12\text{ V} \pm 10\%$ $\Delta T = 25\text{ °C}$ $t = 5\text{ s to }15\text{ min.}$ after switching on	1
	Δf_{UHF}			800	kHz		1
	Δf_{UHF}			200	kHz		1
Oscillator level	$V_{19, 20}$	- 22	- 17	- 13	dBm	voltage on $50\ \Omega$	1
Harmonic wave ratio	a_H	10	20		dB		1
Crosstalk f_{in}/LO	$V_{16/17}$	150	1000		mVrms	max. input level for 10-dB distance f_{in}/LO	1
Mixer gain	G_{UHF}	11	14	17	dB		1

AC/DC Characteristics (cont'd) $T_A = 25\text{ °C}; V_S = 12\text{ V}$

Parameter	Symbol	Limit Values			Unit	Test Condition	Test Circuit
		min.	typ.	max.			
Mixer noise figure	F_{UHF}		8	12	dB	DSB	1
Mixer input impedance	$R_{16/17}$		25		Ω	serial equivalent circuit	2
	$L_{16/17}$		10		nH	serial equivalent circuit	2

**UHF-Circuit Section (cont'd)
(Design Hints only)**

IF-suppression	a_{ZF}		20		dB	$V_{16/17} = 80\text{ dB}\mu\text{V}$	1
IM2	a_{IM2}	60	61		dB	$f_D = 400\text{ MHz}$ $f_U = 800.5\text{ MHz}$	3
IM3	a_{IM3}	60	66		dB	$f_D = 600\text{ MHz}$ $f_{U1} = 650\text{ MHz}$ $f_{U2} = 660\text{ MHz}$	4
	a_{IM3}	60	70		dB	$f_D = 850\text{ MHz}$ $f_{U1} = 800\text{ MHz}$ $f_{U2} = 790\text{ MHz}$	4
N + 5 pulling	a_{N+5}	50	60		dB	$f_D = 500\text{ MHz}$	5
	a_{N+5}	50	60		dB	$f_D = 800\text{ MHz}$	5

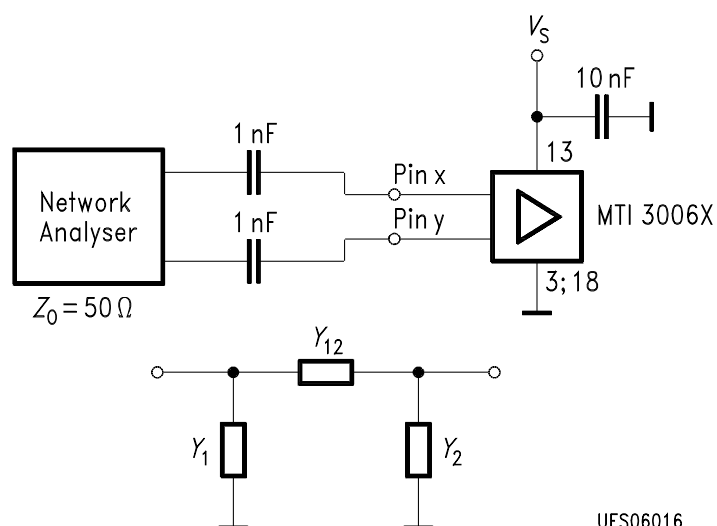


* SMD-Wideband transformer
Typ SMFt5 from Neosid

L_1 : 0.5 turns; d 4.0; 1.0 CU
 L_2 : 3.0 turns; d 3.5; 0.5 CU

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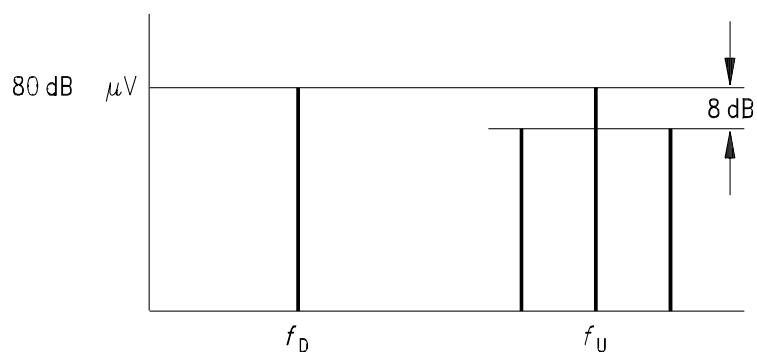
Test Circuit 1



Measurement of the 4-pole matrix
 S_{11} , S_{12} , S_{21} , S_{22} and calculation of the
 π -equivalent circuit, which follows from that

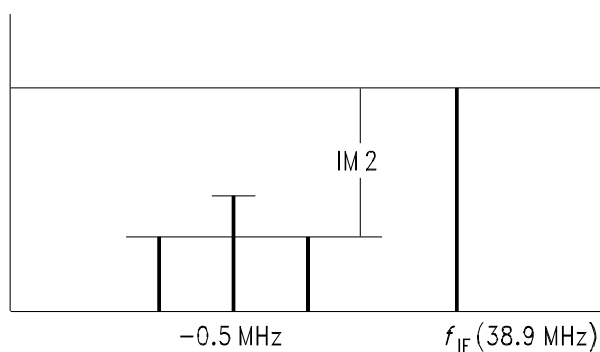
Test Circuit 2

Test Point	Test Frequency in MHz	Pin x	Pin y
Oscillator output impedance	100	19	20
Mixer input impedance VHF	100	14	15
Mixer input impedance UHF	600	17	18
Mixer output impedance VHF/UHF	100/600	11	12



Signals at mixer input
pin 14/15 or 16/17

f_D	50	200	400	MHz
f_U	100.5	400.5	800.5	MHz ; $f_{mod} = 50$ kHz ; AM = 80%

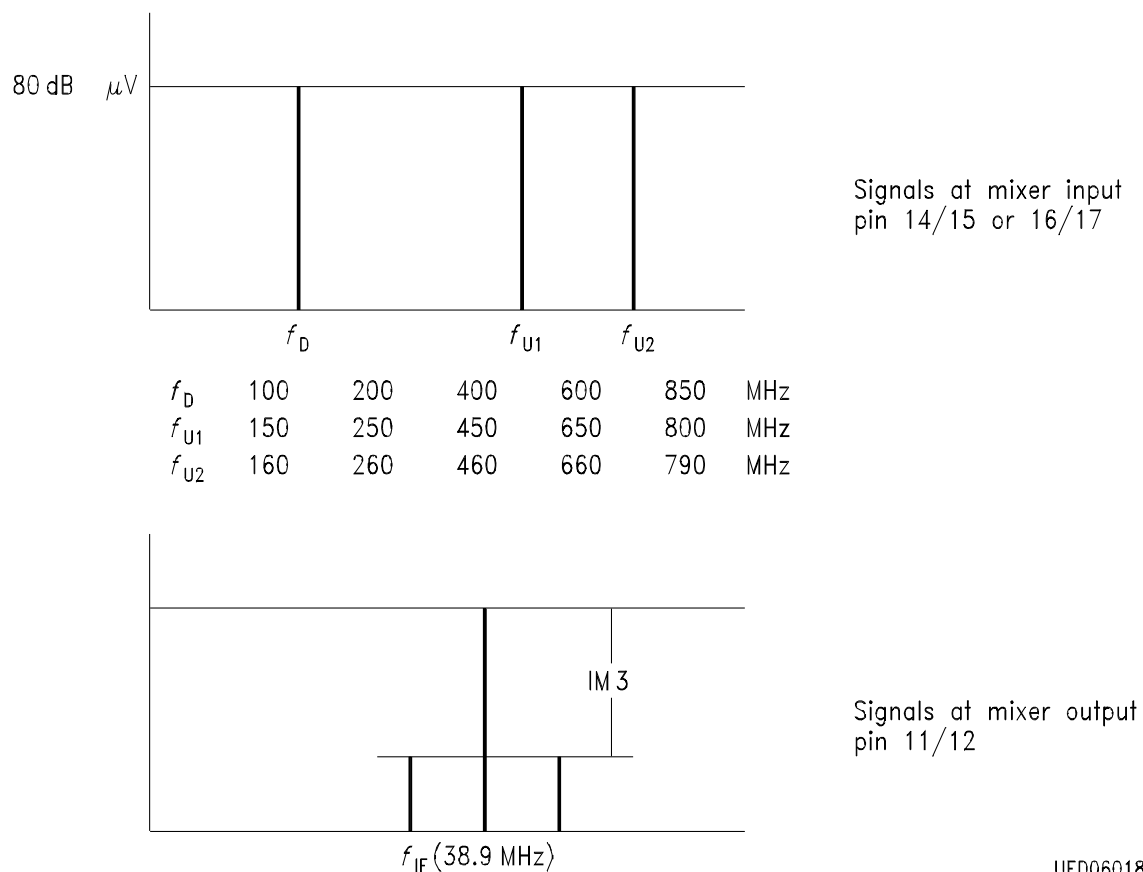


Signals at mixer output
pin 11/12

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Test Circuit 3

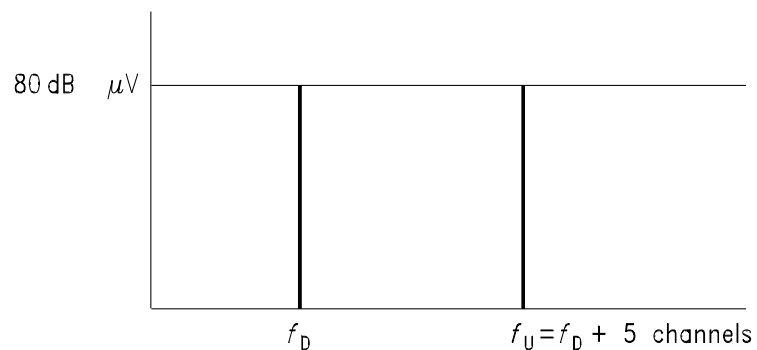
IM2 ($f_U - f_D$) Transfer to f_{IF}



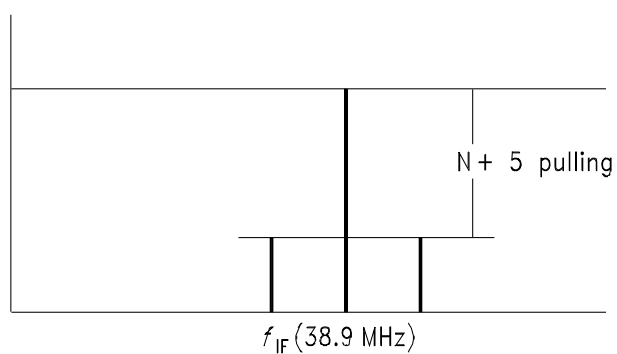
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Test Circuit 4

IM3 ($f_{U2} - f_{U1}$) Transfer to $f_{IF} \pm (f_{U2} - f_{U1})$



Signals at mixer input
pin 14/15 or 16/17



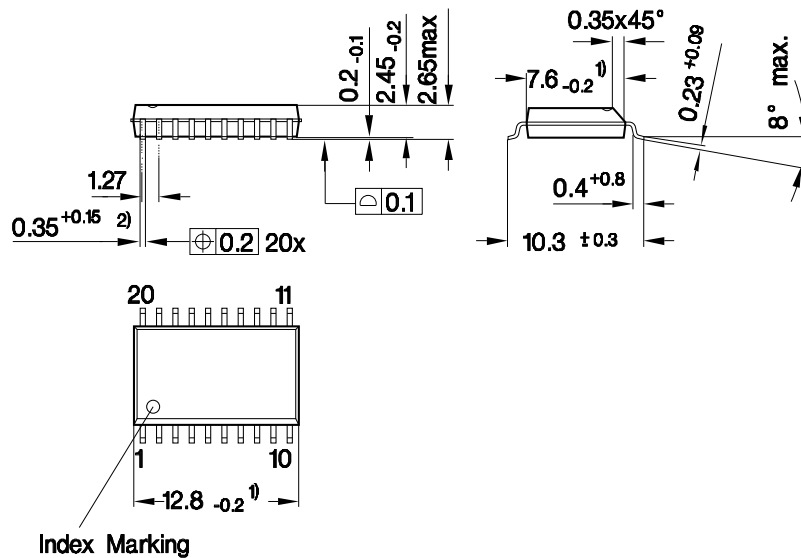
Signals at mixer output
pin 11/12

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Test Circuit 5 N + 5 Pulling

Package Outline

Plastic Package, P-DSO-20-1 (SMD) (Plastic Dual Small Outline Package)



- 1) Does not include plastic or metal protrusion of 0.15 max. per side
- 2) Does not include dambar protrusion of 0.05 max. per side

GPS05094

Sorts of Packing

Package outlines for tubes, trays etc. are contained in our Data Book "Package Information"

SMD = Surface Mounted Device

Dimensions in mm