VHF / UHF-Tuner IC

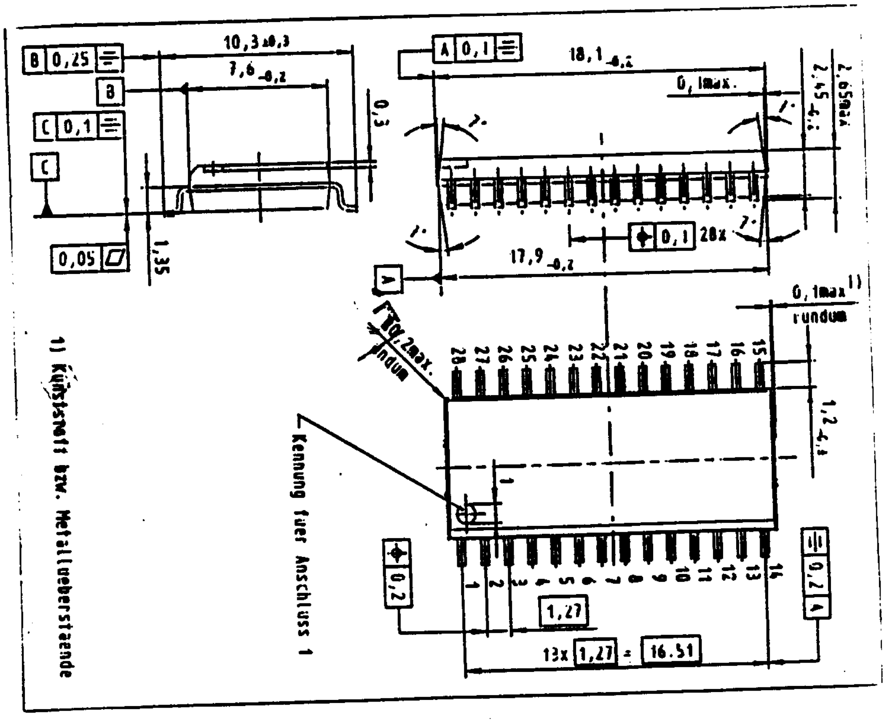
This integrated circuit permits the design of TV tuners covering the entire frequency range from 48...860 MHz with a division into 3 bands.

Application
All tuners in TV- and VCR-sets

Features:

- Combined UHF /Hyperband / VHF-Tuner-IC
- 3 oscillators and 3 mixers
- Only 3 frequency bands for the complete frequency range required

Type	Order-No.	Package
TUA 2007 X	Q67000 - A 8195	P-DSO-28



Circuit Description

The IC includes 3 symmetrical mixers (double push-pull mixer / ring mixer), one asymmetrical oscillator for VHF and two symmetrical oscillatoren for HYPER and UHF, a SAW driver as well as a reference voltage source and a band switch. A frequency separating filter at the tuner input assigns the TV signal to one of the three bands. The band switch ensures that only one band at a time is activated. In the activated band the signal passes frontend stage with MOSFET amplifier, a double-tuner bandpass filter and is then fed to the activated symmetrical mixer input of the TUA 2007, which is a high-impedance stage for the VHF range and a low-impedance stage for the hyperband and UHF range, respectively. The signal is mixed there with the oscillator signal from the activated oscillator section and fed to a common IF stage for all bands. After passing the IF intermediate circuit filter the IF signal is amplified further by a SAW driver section to drive the low-impedance SAW filter.

Features:

- few external components
- frequency and amplitude-stable unsymmetrical oscillator for the frequency ranges VHF.
- frequency and amplitude-stable symmetrical oscillators for the frequency ranges HYPER and UHF.
- optimum suppression of oscillator and input frequency at IF output
- optimum decoupling of input frequency from oscillator
- mixer stage with high deviation and high-impedance symmetrical inputs for the VHF range
- mixer stage with high deviation and low-impedance symmetrical inputs for the hyperband and UHF range
- high-impedance symmetrical SAW driver input
- low-impedance SAW filter output
- SAW driver with high signal-handling capability
- high decoupling of SAW driver input from output
- internal band switch
- low-noise, internal reference voltage

Maximum Ratings

Maximun ratings cannot be exceeded without causing irreversible damage to the integrated circuit

Pos.	Maximum rating for T_{amb} = 25°C	Symbol	min	max	dim	remarks
1	Supply voltage V_S	$U_{17,18,19/2,26}$	-0,3	14	V	
2	Current	$I_{17/18/19}$		60	mA	
3	Switch-on voltage	U_{12}	-0,3	+ V_S	V	
4	Only the considered external circuitry,conform to the measurement circuit 1, can be applied at the pins 1,3,4,5,6,7,8,9,10,11,13,14,15,16,20,21,22,23,24,25,27,28					
	Junction temperature	T_J		+ 150	°C	
	Storage temperature	T_S	-40	+ 125	°C	
	Thermal resistance system air	R_{thSA}			k/W	typ. value 75

Range of functions

Within the functional range, the integrated circuit operates as described; deviations from the characteristic data are possible

Pos.	Functional range	Symbol	min	max	dim	remarks
1	Supply voltage	V_S	10	13,2	V	
2	Current consumption	$I_{17,18,19}$	25	53	mA	
3	VHF mixer input frequency range	f_{VHF}	30	500	MHz	
4	HYPER mixer input frequency range	f_{HYPER}	30	900	MHz	
5	UHF mixer input frequency range	f_{VHF}	30	900	MHz	
6	VHF oscillator-frequency range	f_{OVHF}	30	500	MHz	
7	VHF oscillator-frequency range	f_{OHYPER}	30	900	MHz	
8	VHF oscillator-frequency range	f_{OUHF}	30	900	MHz	
9	Ambient temperature	T_{amb}	0	70	°C	

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 stated otherwise, typical characteristics will apply at t_{amb} = 25°C and the listed supply voltage.

Pos	Parameter	Symbol	Test conditions	Test circuit	Min	Typ	Max	Dim
	Supply voltage		V_S = 12V					
	Ambient temperature		T_V = 25 °C					
1	Current consumption	I_{19}	$V_{17,18}$ = V_S; V_{12} > 2,2V	1	21	30	39	mA
2	Current consumption	I_{19}	$V_{17,18}$ = V_S; V_{12} < 0,9V	1	19	28	37	mA
3	Current consumption	$I_{17/18}$	$V_{17,18}$ = V_S	1	7	10	13	mA
		VHF CIRCUIT SECTION						
4	Switch-on voltage	V_{12}		1	0		1,2	V
5	Switch-on current	I_{12}	V_{12} = 0,5V	1		0	10	µA
6	Oscillator frequency range	f_{VHF}	Vd = 0...28 V	1	80		216	MHz
7	Oscillator drift	Δf_{VHF}	V_S = 12V ± 10%	1			200	kHz
8	Oscillator drift	Δf_{VHF}	ΔT = 25°C	1			400	kHz
9	Oscillator drift	Δf_{VHF}	t = 5sec. to 15 min. after switching on	1			200	kHz
10	Oscillator level	$V_{27,28}$	K2 symmetrically tested	1		140		$mV_{eff.}$
11	Oscillator level	$V_{27,28}$	S10 symmetrically tested	1		100		$mV_{eff.}$
12	Oscillator-	$R_{27,28}$	parallel equivalent circuit	2		100		Ω
13	Output impedance	$C_{27,28}$	parallel equivalent circuit	2		2		pF
14	Harmonic ratio	$a_{27,28}$		1			-10	dB
15	Interference ratio	$a_{27,28}$	V_{RF} = $1V_{rms}$	1			-10	dB
16	Oscillator pulling	$V_{24,25}$	Δf = 10 kHz in channel K2	1	100	108		dBµV
12	Oscillator pulling	$V_{24,25}$	Δf = 10 kHz in channel S10	1	100	108		dBµV
18	Oscillator pulling	$V_{24,25}$	Δf_{int} = K2 + (N + 5-1MHz)	1	80	88		dBµV
19	Oscillator pulling	$V_{24,25}$	Δf_{int} = S10 + (N + 5-1MHz)	1	80	88		dBµV
20	Mixer gain	G_{VHF}	Channel 2	1		5		dB
21	Mixer gain	G_{VHF}	Channel S10	1		5		dB
22	Mixer noise figure	F_{VHF}	Channel 2	1		7,5	9	dB
23	Mixer noise figure	F_{VHF}	Channel S10	1		7,5	9	dB
24	Interference voltage	V_{int}	1% cross mod.; K2 ± 2	1		70		dBµV
25	Interference voltage	V_{int}	1% cross mod.; S10 ± 2	1		70		dBµV
26	Mixer input	$R_{24,25}$	parallel equivalent circuit	3		1		KΩ
27	impedance	$C_{24,25}$	parallel equivalent circuit	3		2		pF
28	Mixer input	$R_{17,18}$	parallel equivalent circuit	4		10		kΩ
29	impedance	$C_{17,18}$	parallel equivalent circuit	4		2		pF
30	IF suppression	a_{IF}	Channel 2	1		20		dB
31	IF suppression	a_{IF}	Channel S10	1		20		dB

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 stated otherwise, typical characteristics will apply at t_{amb} = 25°C and the listed supply voltage.

Pos	Parameter	Symbol	Test conditions	Test circuit	Min	Typ	Max	Dim
	Supply voltage		V_S = 12V					
	Ambient temperature		T_{amb} = 25 °C					
		HYPER CIRCUIT SECTION						
32	Switch-on voltage	V_{12}		1	2,0		2,7	V
33	Switch-on current	I_{12}	V_{12} = 2,3	1		13	30	µA
34	Oscillator frequency range	f_{HYPER}	Vd = 0...28 V	1	190		485	MHz
35	Oscillator drift	Δf_{HYPER}	V_S = 12V ± 10%	1			400	kHz
36	Oscillator drift	Δf_{HYPER}	ΔT = 25°C	1			500	kHz
37	Oscillator drift	Δf_{HYPER}	t = 5sec. to15 min. after switchin on	1			200	kHz
38	Oscillator level	$V_{27,28}$	K5 symmetrical tested	1		100		$mV_{eff.}$
39	Oscillator level	$V_{27,28}$	S37 symmetrical tested	1		80		$mV_{eff.}$
40	Oscillator-	$R_{27,28}$	parallel equivalent circuit	2		100		Ω
41	Output impedance	$C_{27,28}$	parallel equivalent circuit	2		2		pF
42	Harmonic ratio	$a_{27,28}$		1			-10	dB
43	Interference ratio	$a_{27,28}$	V_{HF} = $1V_{eff.}$	1			-10	dB
44	Oscillator pulling	$V_{22,23}$	Δf = 10 kHz in channel K5	1	100	108		dBµV
45	Oscillator pulling	$V_{22,23}$	Δf = 10 kHz in channel S37	1	100	108		dBµV
46	Oscillator pulling	$V_{22,23}$	Δf_{int} = K5 + (N + 5-1MHz)	1	80	88		dBµV
47	Oscillator pulling	$V_{22,23}$	Δf_{int} = S37 + (N + 5-1MHz)	1	80	88		dBµV
48	Mixer gain	G_{HYPER}	channel 5	1		5		dB
49	Mixer gain	G_{HYPER}	channel S37	1		5		dB
50	Mixer noise figure	F_{HYPER}	channel 5	1		7,5	9	dB
51	Mixer noise figure	F_{HYPER}	channel S37	1		7,5	9	dB
52	Interference voltage	V_{int}	1% cross mod.;K5 ± 2	1	97	100		dBµV
53	Interference voltage	V_{int}	1% cross mod.;S37 ± 2	1	97	100		dBµV
54	Mixer input	$R_{22,23}$	parallel equivalent circuit	3		1		kΩ
55	impedance	$C_{22,23}$	parallel equivalent circuit	3		2		pF
56	Mixer output	$R_{17,18}$	parallel equivalent circuit	4		10		kΩ
57	impedance	$C_{17,18}$	parallel equivalent circuit	4		2		pF
58	IF-suppression	a_{IF}	channel 5	1		20		dB
59	IF-suppression	a_{IF}	channel S37	1		20		dB

Characteristics

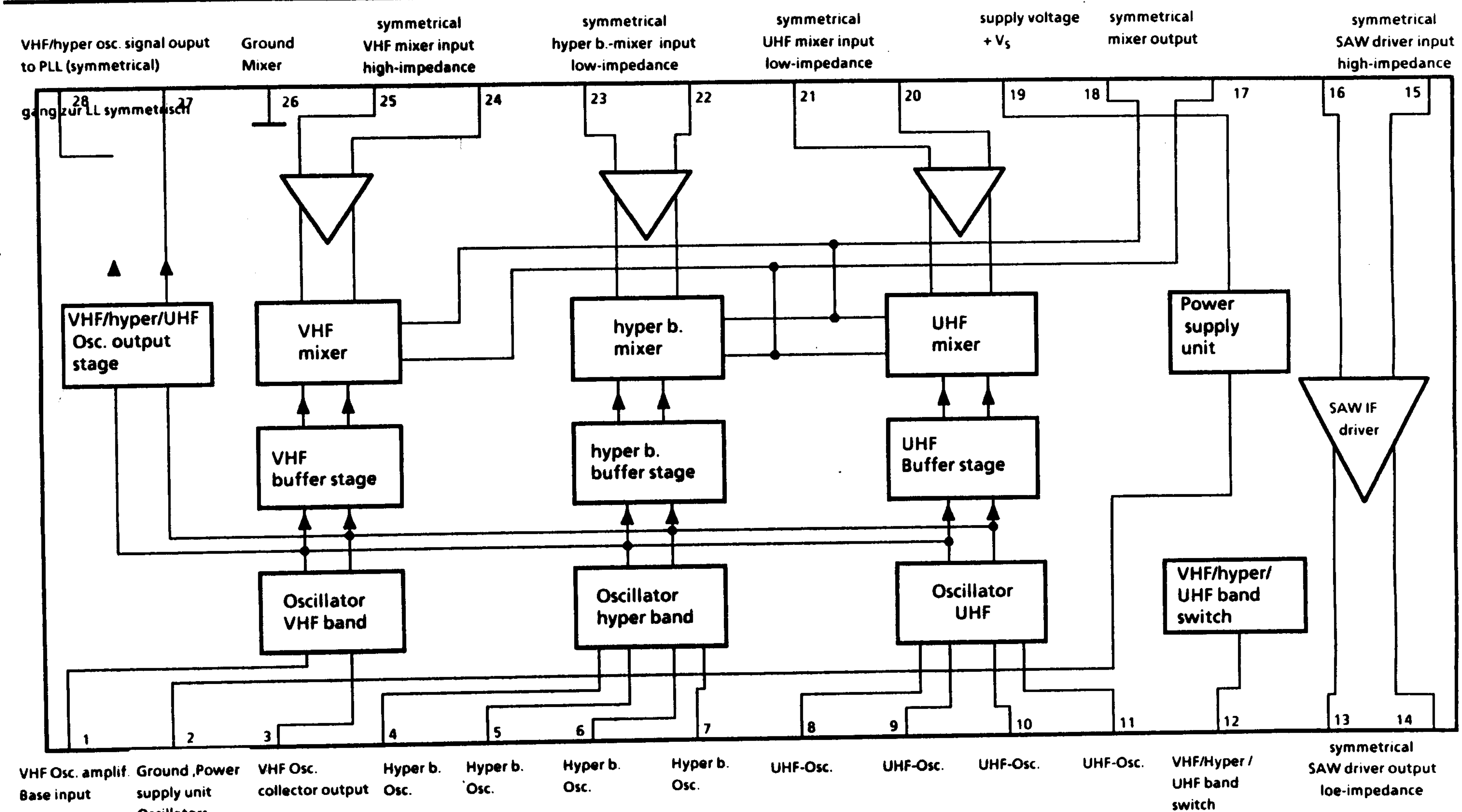
The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not stated otherwise, typical characteristics will apply at t_{amb} = 25°C and the listed supply voltage.

Pos	Parameter	Symbol	Test conditions	Test circuit	Min	Typ	Max	Dim
	Supply voltage		V_S = 12V					
	Ambient temperature		T_{amb} = 25 °C					
		UHF - CIRCUIT SECTION						
60	Switch-on voltage	V_{12}		1	3,5		≤V_S	V
61	Switch-on current	I_{12}	$V_{12} = V_S$	1		45	300	µA
62	Oscillator frequency range	f_{VHF}	Vd = 0...28 V	1	470		900	MHz
63	Oscillator drift	Δf_{UHF}	V_S = 12V ± 10%	1			400	kHz
64	Oscillator drift	Δf_{UHF}	ΔT = 25°C	1			800	kHz
65	Oscillator drift	Δf_{UHF}	t = 5sec. to15 min. after switching on	1			200	kHz
66	Oscillator level	$V_{27,28}$	K21 symmetrical tested	1		80		$mV_{eff.}$
67	Oscillator level	$V_{27,28}$	K68 symmetrical tested	1		50		$mV_{eff.}$
68	Oscillator	$R_{27,28}$	parallel equivalent circuit	2		100		Ω
69	Output impedance	$C_{27,28}$	parallel equivalent circuit	2		2		pF
70	Harmonic ratio	$a_{27,28}$		1			-10	dB
71	Interference ratio	$a_{27,28}$	$V_{HF} = 1V_{eff.}$	1			-10	dB
72	Oscillator pulling	$V_{20,21}$	Δf = 10 kHz in channel K21	1	100	108		dBµV
73	Oscillator pulling	$V_{20,21}$	Δf = 10 kHz in channel K68	1	100	108		dBµV
74	Oscillator pulling	$V_{20,21}$	Δf_{int} = K21 + (N + 5-1MHz)	1	80	88		dBµV
75	Oscillator pulling	$V_{20,21}$	Δf_{int} = K68 + (N + 5-1MHz)	1	80	88		dBµV
76	Mixer gain	G_{UHF}	channel 21	1		5		dB
77	Mixer gain	G_{UHF}	channel K68	1		5		dB
78	Mixer noise figure	F_{UHF}	channel 21	1		8	10	dB
79	Mixer noise figure	F_{UHF}	channel K68	1		9	11	dB
80	Interference voltage	V_{int}	1% cross mod.;K21 ± 2	1	97	100		dBµV
81	Interference voltage	V_{int}	1% cross mod.;K68 ± 2	1	97	100		dBµV
82	Mixer input	$R_{20,21}$	parallel equivalent circuit	3		1		KΩ
83	impedance	$C_{20,21}$	parallel equivalent circuit	3		2		pF
84	Mixer output	$R_{17,18}$	parallel equivalent circuit	4		10		kΩ
85	impedance	$C_{17,18}$	parallel equivalent circuit	4		2		pF
86	IF - suppresion	a_{IF}	channel 21	1		20		dB
87	IF - suppresion	a_{IF}	channel 68	1		20		dB

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 stated otherwise, typical characteristics will apply at t_{amb} = 25°C and the listed supply voltage.

Pos	Parameter	Symbol	Test conditions	Test circuit	Min	Typ	Max	Dim
	Supply voltage		V_S = 12V					
	Ambient temperature		T_{amb} = 25 °C					
			SAW - IF - DRIVER SECTION					
88	SAW driver	$R_{15,16}$	parallelequivalent circuit	5		3		kΩ
89	Input impedance	$C_{15,16}$	parallelequivalent circuit	5		2,5		pF
90	SAW driver	$R_{13,14}$	parallelequivalent circuit	6		100		Ω
91	Output impedance	$C_{13,14}$	parallelequivalent circuit	6		2,5		pF
92	Trasnmission gain	G_{OFW}		7		28		dB
93	Noise figure	F_{OFW}		8		10		dB
94	Output voltage linearity	V_{AOFW}	total distorsion k = 5% harmonic factor	9		26		dBm
95	permissible input voltage	V_{EOFW}	for 1 dB compression at the output	9		3		dBm



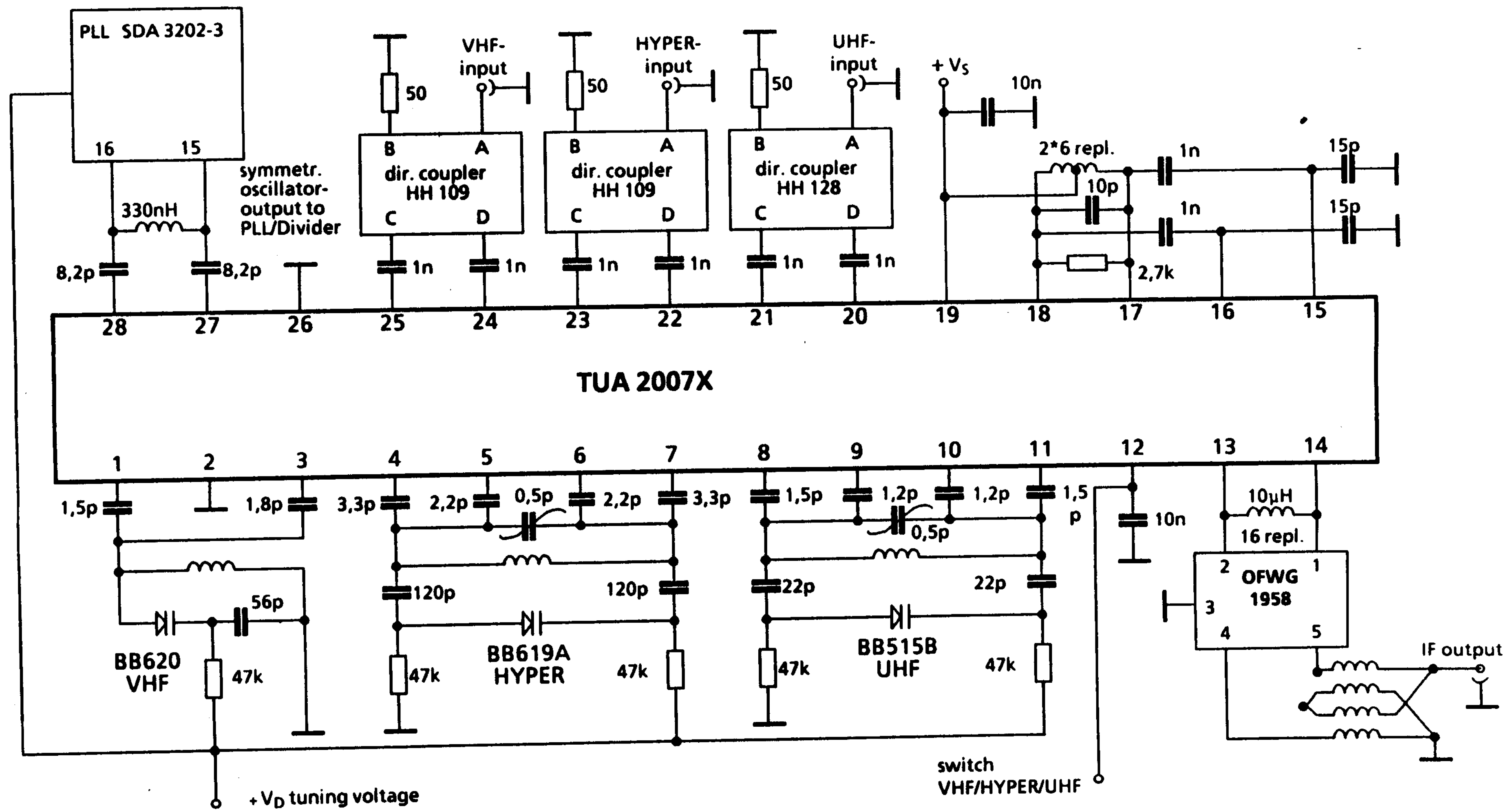
Block diagram

Pin Configuration

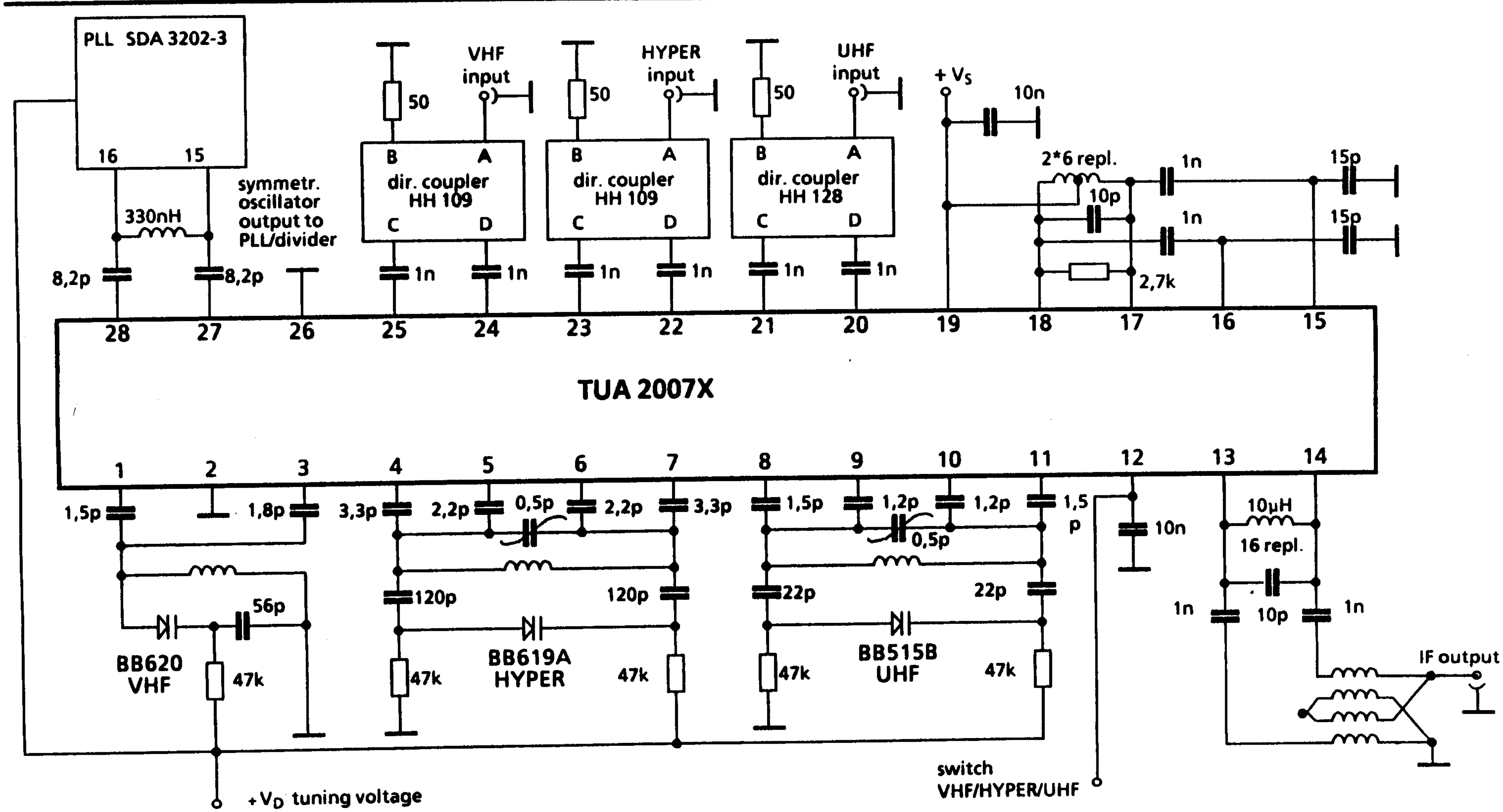
Pin 1	VHF osc. base input
Pin 2	Ground
Pin 3	VHF osc. collector output
Pin4	Hyp. osc. input 1
Pin 5	Hyp. osc. output
Pin 6	Hyp. osc. output 2
Pin 7	Hyp. osc. input 2
Pin 8	UHF osc. input 1
Pin 9	UHF osc. output 1
Pin 10	UHF osc. output 2
Pin 11	UHF osc. input 2
Pin 12	band switching
Pin 13	SAW driver output 1
Pin 14	SAW driver output 2
Pin 15	SAW driver input 1
Pin 16	SAW driver input 2
Pin 17	Mixer output 1
Pin 18	Mixer output 2
Pin 19	$+V_S$
Pin 20	UHF input 1
Pin 21	UHF input 2
Pin 22	Hyper input 1
Pin 23	Hyper input 2
Pin 24	VHF input 1
Pin 25	VHF input 2
Pin 26	Ground mixer
Pin 27	Osc. output 1
Pin 28	Osc. output 2

Pin function

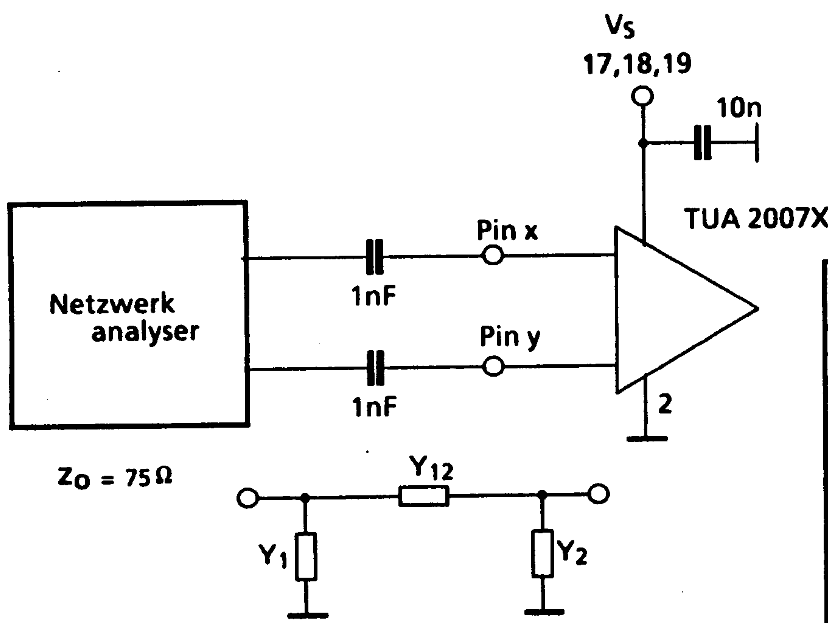
Pin 1	VHF osc. coupl. 2	VHF oscillator coupling base input
Pin 2	Ground	Ground SAW driver, power supply unit, band switch and power supply
Pin 3	VHF osc. coupl. 1	VHF oszillator coupling point, collector output
Pin 4	Hyp. osc. input 2	Hyp. oszillator amplifier, high-impedance base input, symmetrical to pin 7
Pin 5	Hyp. osc. output 2	Hyp. oszillator amplifier, high-impedance collector output, symmetrical to pin 6
Pin 6	Hyp. osc. output 1	Hyp.- oszillator amplifier, high-impedance collector output, symmetrical to pin 5
Pin 7	Hyp. osc. input 1	Hyp. oszillator amplifier, high-impedance base input, symmetrical to pin 4
Pin 8	UHF osc. input2	UHF oszillator amplifier, high-impedance base input, symmetrical to pin 11
Pin 9	UHF osc. input 2	UHF oszillator amplifier, high-impedance collector output, symmetrical to pin 10
Pin 10	UHF osc. output 1	UHF oszillator amplifier, high-impedance collector output, symmetrical to pin 9
Pin 11	UHF osc.input 1	UHF oszillator amplifier, high-impedance base input, symmetrical to Pin 8
Pin 12	Band switching	VHF/HYPER/UHF band switching
Pin 13	OFW dr. output 2	SAW driver amplifierausgang, niederohmig, symmetrical to pin 14
Pin 14	OFW dr. output 1	SAW driver amplifierausgang, niederohmig, symmetrical to pin 13
Pin 15	OFW dr.input 2	SAW driver amplifiereingang, hochohmig, symmetrical to pin 16
Pin 16	OFW dr.input 1	SAW driver amplifiereingang, hochohmig, symmetrical to pin 15
Pin 17	Mi. output 2	Open collector mixer output, hochohmig, symmetrical to pin 18
Pin 18	Mi. output 1	Open collector mixer output, hochohmig, symmetrical to pin 17
Pin 19	+ VS	Supply voltage
Pin 20	UHF input 2	UHF mixer input niederohmig, symmetrical to pin 21
Pin 21	UHF input 1	UHF mixer input niederohmig, symmetrical to pin 20
Pin 22	Hyper input 2	Hyper mixer input niederohmig, symmetrical to pin 23
Pin 23	Hyper input 1	Hyper mixer input niederohmig, symmetrical to pin22
Pin 24	VHF input 2	VHF mixer input high-impedance, symmetrical to pin 25
Pin 25	VHF input 1	VHF mixer input high-impedance, symmetrical to pin24
Pin 26	Ground mixer	Ground from mixer output switch
Pin 27	Osc. output 2	VHF/HYPER/UHF osz. signal output to PLL, symmetrical to pin28
Pin 28	Osc. output 1	VHF/HYPER/UHF osz. signal output to PLL, symmetrical to pin27



Measurement circuit 1



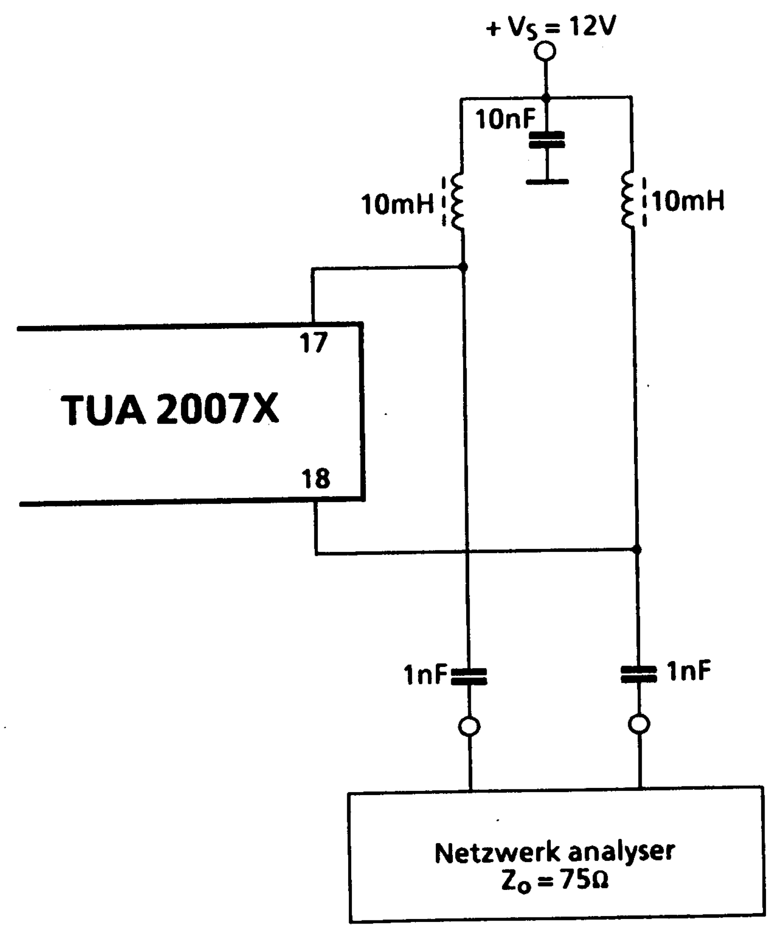
Measurement circuit 2



Measurement of the 4-pole matrix S11,S12,S21,S22 and calculation of the π-equivalent circuit, which folows from that.

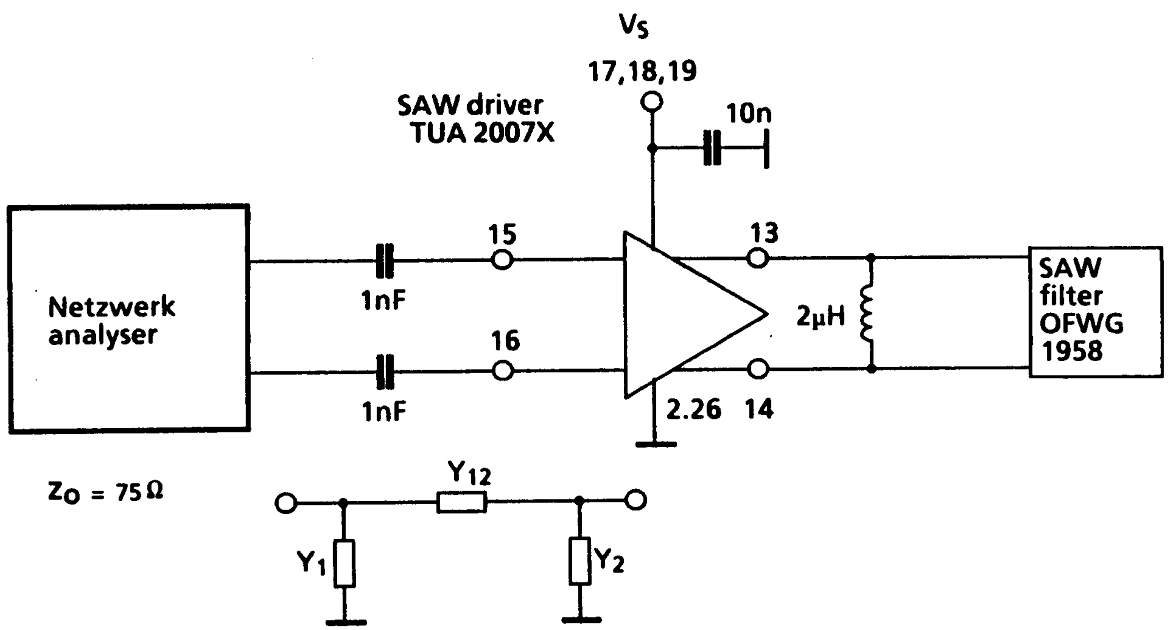
test point	Test frequency in MHz	Pin x	Pin y
Oscillator output impedance	600	27	28
Mixer input impedance VHF	100	24	25
Mixer input impedance HYPER	300	22	23
Mixer input impedance UHF	600	20	21

Measurement circuit 3



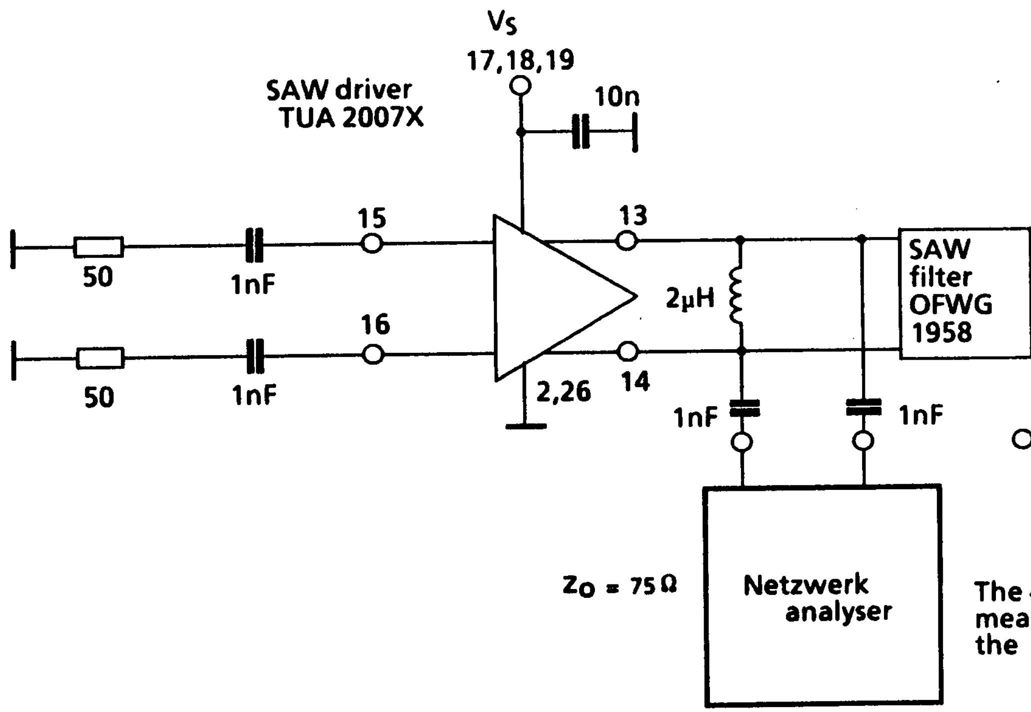
The output capacitance is computed by measuring the 4-pole matrix S_{11}, S_{12}, S_{21}, S_{22} at 37 MHz.

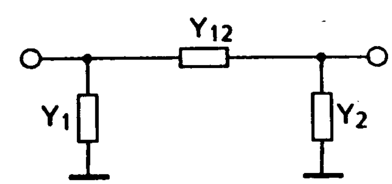
Measurement circuit 4



The 4-pole matrix S11,S12,S21,S22 is measured at 37 MHz for computing the π-equivalent circuit

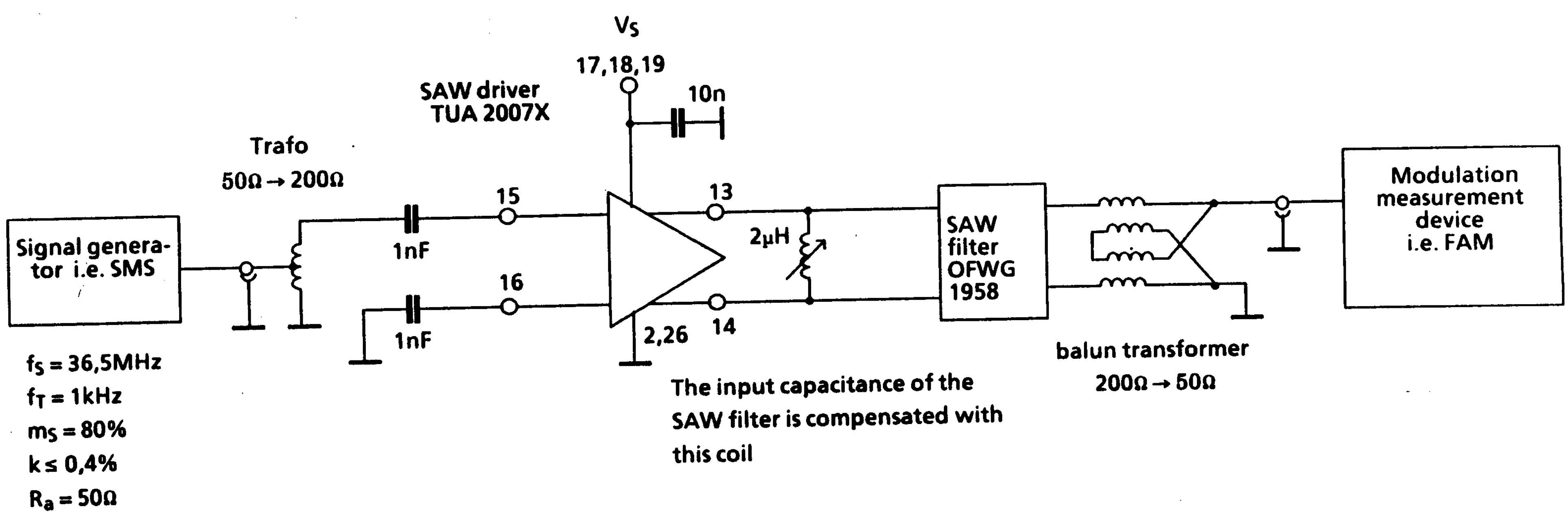
Measurement circuit 5



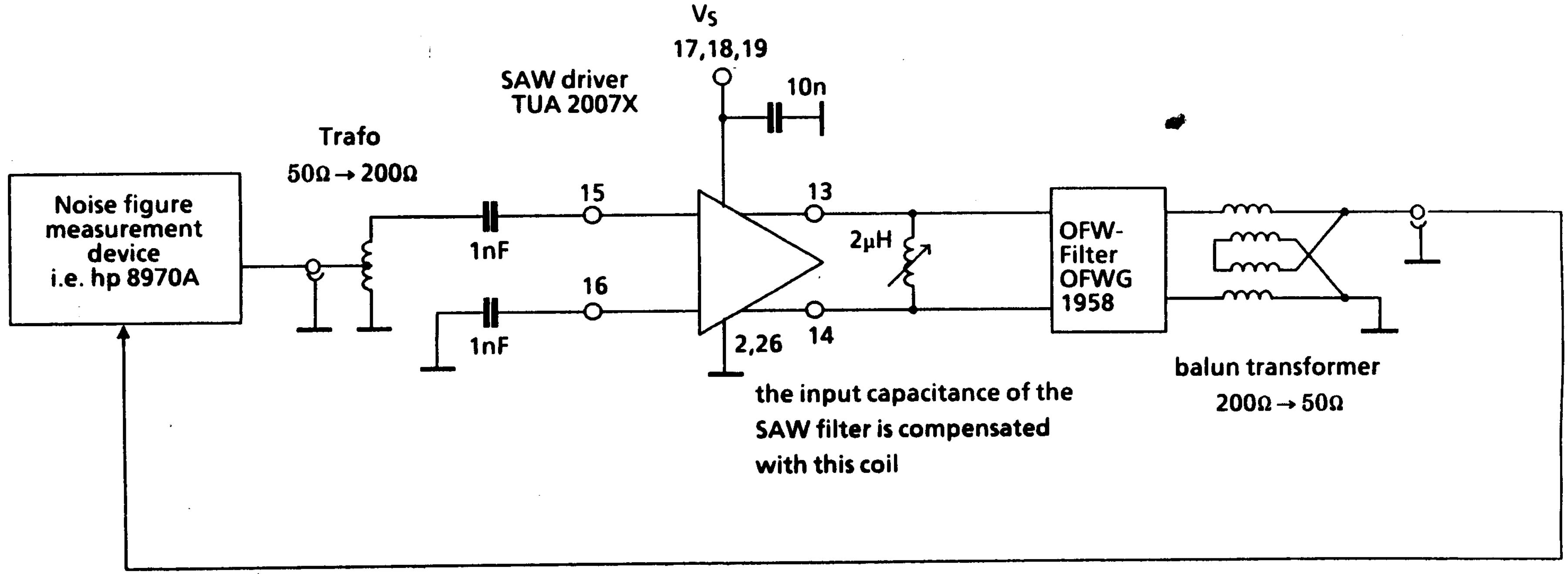


The 4-pole matrix S11,S12,S21,S22 is measured at 37 MHz for computing the π-equivalent circuit.

Measurement circuit 6



Measurement circuit 7



Measurement circuit 8