DATA SHEET

TDA5630CT
Low power VHF, UHF and hyperband mixer/oscillator for TV and VCR 3-band tuners

Product specification
File under Integrated Circuits, IC02

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Philips Semiconductors

PHILIPS

Low power VHF, UHF and hyperband mixer/oscillator for TV and VCR 3-band tuners

TDA5630CT

FEATURES

- Balanced mixer with a common emitter input for band A (single input)
- 2-pin oscillator for bands A and B
- Balanced mixer with a common base input for bands B and C (balanced input)
- 3-pin oscillator for band C
- Local oscillator buffer output for external synthesizer
- SAW filter preamplifier with a low output impedance to drive the SAW filter directly
- Band gap voltage stabilizer for oscillator stability
- Electronic band switch.

DESCRIPTION

The TDA5630CT is a monolithic integrated circuit that performs the bands A, B and C mixer/oscillator functions in TV and VCR tuners. This low-power mixer/oscillator requires a power supply of 9 V and is available in a very small package.

The device gives the designer the capability to design an economical and physically small 3-band tuner.

The tuner development time can be drastically reduced by using this device. In addition, when hyperband is not necessary, the TDA5630CT may be used in a VHF/UHF tuner with an appropriate tuned circuit for VHF I and VHF III in band A, and the tuned circuit of band C for UHF.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_P	supply voltage		–	9.0	–	V
I_P	supply current		–	35	–	mA
f_{RA}	frequency range; band A	RF input	45	–	180	MHz
f_{RB}	frequency range; band B	RF input	160	–	470	MHz
f_{RC}	frequency range; band C	RF input	430	–	860	MHz
N_A	noise figure; band A		–	7.5	–	dB
N_B	noise figure; band B		–	8	–	dB
N_C	noise figure; band C		–	9	–	dB
V_{IA}	input voltage; band A	1% cross-modulation	–	93	–	dBμV
V_{IB}	input voltage; band B	1% cross-modulation	–	82	–	dBμV
V_{IC}	input voltage; band C	1% cross-modulation	–	82	–	dBμV
G_v	voltage gain	band A	–	25	–	dB
		band B	–	36	–	dB
		band C	–	36	–	dB

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA5630CT	SO20M	plastic small outline package; 20 leads; body width 7.5 mm	SOT336-1

BLOCK DIAGRAM

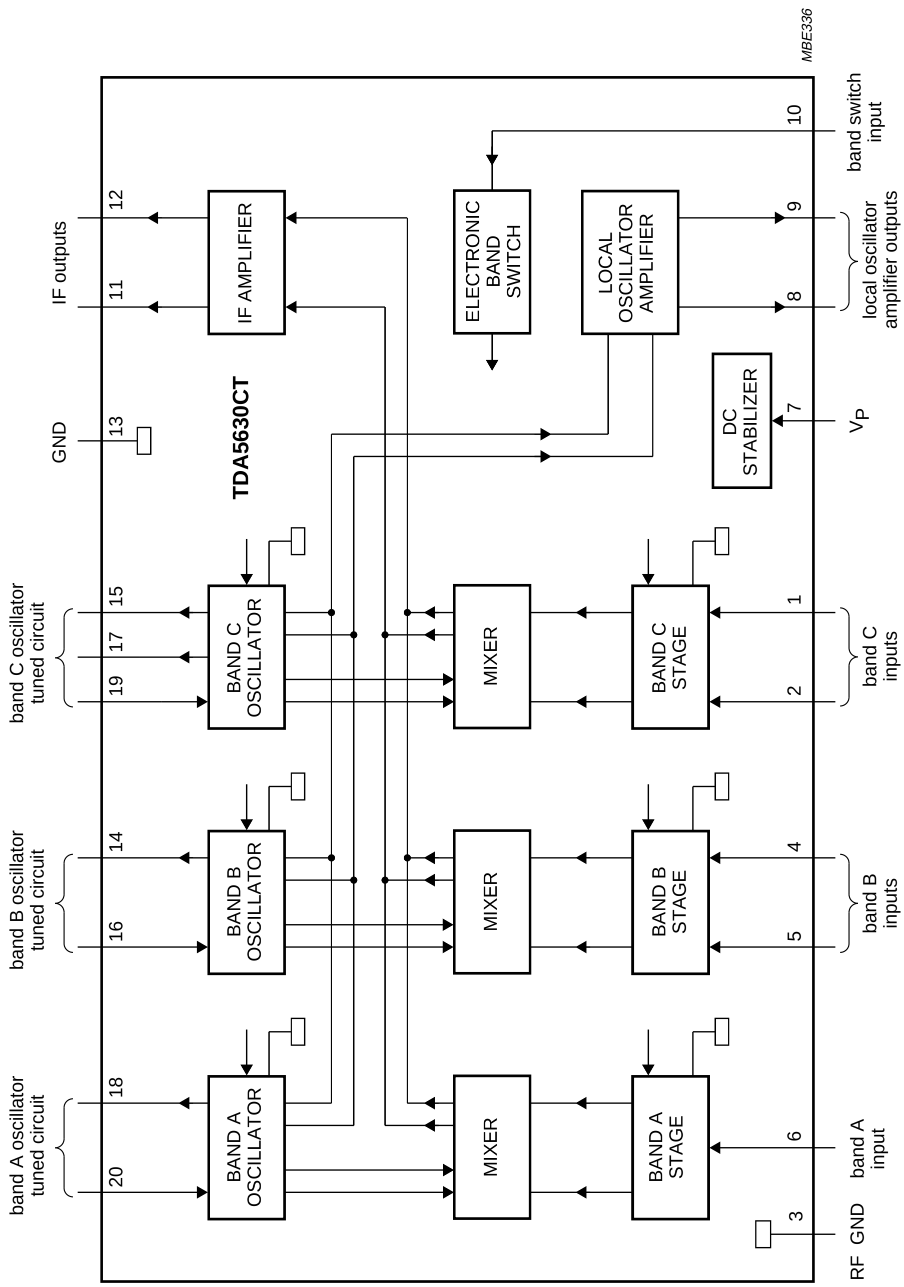


Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
CIN1	1	band C input 1
CIN2	2	band C input 2
RFGND	3	ground for RF inputs
BIN1	4	band B input 1
BIN2	5	band B input 2
AIN	6	band A input
V_P	7	supply voltage
LOOUT1	8	local oscillator amplifier output 1
LOOUT2	9	local oscillator amplifier output 2
BS	10	electronic band switch input
IFOUT1	11	IF amplifier output 1
IFOUT2	12	IF amplifier output 2
GND	13	ground (0 V)
BOSCOC	14	band B oscillator output collector
COSCOC1	15	band C oscillator output collector 1
BOSCIB	16	band B oscillator input base
COSCOC2	17	band C oscillator output collector 2
AOSCOC	18	band A oscillator output collector
COSCIB	19	band C oscillator input base
AOSCIB	20	band A oscillator input base

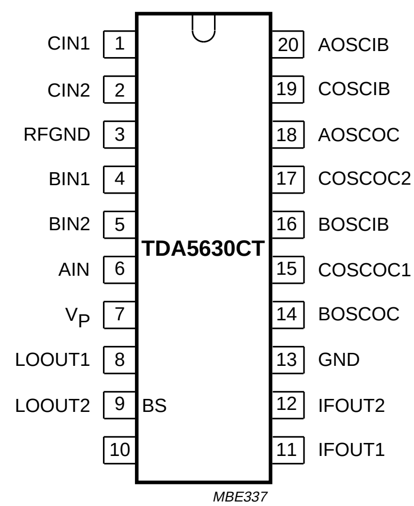


Fig.2 Pin configuration.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_P	supply voltage range	–0.3	+10.5	V
V_{SW}	switching voltage	0	10.5	V
I_O	output current of each pin to ground	–	–10	mA
t_{sc}	maximum short-circuit time (all pins)	–	10	s
T_{stg}	storage temperature	–55	+150	°C
T_{amb}	operating ambient temperature	–10	+80	°C
T_j	junction temperature	–	150	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient in free air	102	K/W

HANDLING

Human body model: the IC withstands 2250 V in accordance with *UZW-BO-FQ-A302* (stress reference pins 3, 7 and 13 shorted together).

Machine model: the IC withstands 200 V in accordance with *UZW-BO-FQ-B302* (stress reference pins 3, 7 and 13 shorted together).

IF AMPLIFIER CHARACTERISTICS

V_P = 9 V; T_{amb} = 25 °C; measured at 36 MHz; measured in circuit of Fig.4; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.		MAX	UNIT
				MOD.	PHASE		
S_{22}	output reflection coefficient	see Fig.9	–	–10	9	–	dB/°
Z_o	output impedance ($R_s + jL_s\Omega$)	R_s	–	95		–	Ω
		L_s	–	45		–	nH

CHARACTERISTICS

V_P = 9 V; T_{amb} = 25 °C; measured in circuit of Fig.4; unless otherwise specified.

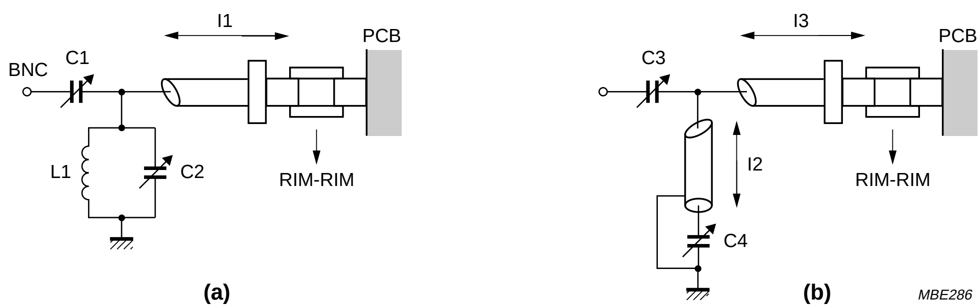
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_P	supply voltage		8.1	9.0	9.9	V
I_P	supply current		–	35	45	mA
V_{SW}	switching voltage	band A	0	–	1.1	V
		band B	1.6	–	2.4	V
		band C	3.0	–	5.0	V
I_{SW}	switching current	band A	–	–	2	μA
		band B	–	–	5	μA
		band C	–	–	10	μA
Band A mixer (including IF amplifier; pin 6)						
f_R	frequency range		45	–	180	MHz
N	noise figure	50 MHz; see Fig.3	–	7.5	9	dB
		180 MHz; see Fig.3	–	9	10	dB
g_{os}	optimum source conductance for noise figure	50 MHz	–	0.5	–	mS
		180 MHz	–	1.1	–	mS
g_i	input admittance (G_P//C_P)	50 MHz; see Fig.5	–	0.26	–	mS
		180 MHz; see Fig.5	–	0.35	–	mS
		50 to 180 MHz	–	2	–	pF
V_i	input voltage	1% cross modulation; in channel f = 180 MHz	90	93	–	dBμV
		10 kHz pulling; in channel;180 MHz	–	100	–	dBμV
G_v	voltage gain	20 log (V_{12-11}/V_6); 50 MHz	22.5	25	27.5	dB
		20 log (V_{12-11}/V_6); 180 MHz	22.5	25	27.5	dB
Band A oscillator						
f_R	frequency range		80	–	216	MHz
f_{shift}	frequency shift	ΔV_P = 10%; note 1	–	–	200	kHz
f_{drift}	frequency drift	ΔT = 25 °C with no compensation; NP0 capacitors; note 2	–	–	500	kHz
		5 s to 15 min after switch on; note 2	–	–	200	kHz

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Band B mixer (pins 4 and 5; including IF amplifier) measurements using hybrid; see Fig.4; note 3						
f_R	frequency range		160	–	470	MHz
N	noise figure (not corrected for image)	170 MHz	–	8	10	dB
		470 MHz	–	8	10	dB
Z_I	input impedance (R_S + $jL_S\Omega$)	R_S; see Fig.6	–	30	–	Ω
		L_S; see Fig.6		8		nH
V_i	input voltage	1% cross-modulation; in channel; 170 MHz	79	82	–	dBμV
		1% cross-modulation; in channel; 470 MHz	79	82	–	dBμV
		10 kHz pulling; in channel; 470 MHz	–	87	–	dBμV
		N + 5 – 1 MHz pulling; 430 MHz; note 4	–	81	–	dBμV
G_v	voltage gain	170 MHz; note 5	33	36	39	dB
		470 MHz; note 5	33	36	39	dB
Band B oscillator						
f_R	frequency range		200	–	500	MHz
f_{shift}	frequency shift	ΔV_P = 10%; note 1	–	–	400	kHz
f_{drift}	frequency drift	ΔT = 25 °C with no compensation: NP0 capacitors; note 2	–	–	2	MHz
		5 s to 15 min after switch on; note 2	–	–	300	kHz
Band C mixer (pins 1 and 2; including IF amplifier) measurements using hybrid; see Fig.4; note 3						
f_R	frequency range		430	–	860	MHz
N	noise figure (not corrected for image)	430 MHz	–	9	11	dB
		860 MHz	–	9	11	dB
Z_I	input impedance (R_S + $jL_S\Omega$)	R_S; 430 MHz; see Fig.7	–	40	–	Ω
		R_S; 860 MHz; see Fig.7	–	53	–	Ω
		L_S; 430 to 860 MHz	–	9	–	nH
V_i	input voltage	1% cross-modulation; in channel; 430 MHz	79	82	–	dBμV
		1% cross-modulations channel; 860 MHz	79	82	–	dBμV
		10 kHz pulling; in channel; 860 MHz	–	90	–	dBμV
		N + 5 – 1 MHz pulling; 820 MHz; note 4	–	61	–	dBμV
G_v	voltage gain	430 MHz; note 5	33	36	39	dB
		860 MHz; note 5	33	36	39	dB

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Band C oscillator						
f_R	frequency range		470	–	900	MHz
f_{shift}	frequency shift	ΔV_P = 10%; note 1	–	–	400	kHz
f_{drift}	frequency drift	ΔT = 25 °C with no compensation; NP0 capacitors; note 2	–	–	2.5	MHz
		5 s to 15 min after switching on; note 2	–	–	600	kHz
LO output (pins 8 and 9; R_L = 100 Ω)						
Y_O	output admittance (G_P//C_P)	80 MHz; see Fig.8	–	2.5	–	mS
			–	0.9	–	pF
		900 MHz; see Fig.8	–	3.5	–	mS
			–	0.7	–	pF
V_O	output voltage		83	91	100	dBμV
SRF	spurious signal on LO output w.r.t. LO output signal	note 6	–	–	–10	dB
SHD	LO signal harmonics w.r.t. LO signal		–	–	–10	dB

Notes

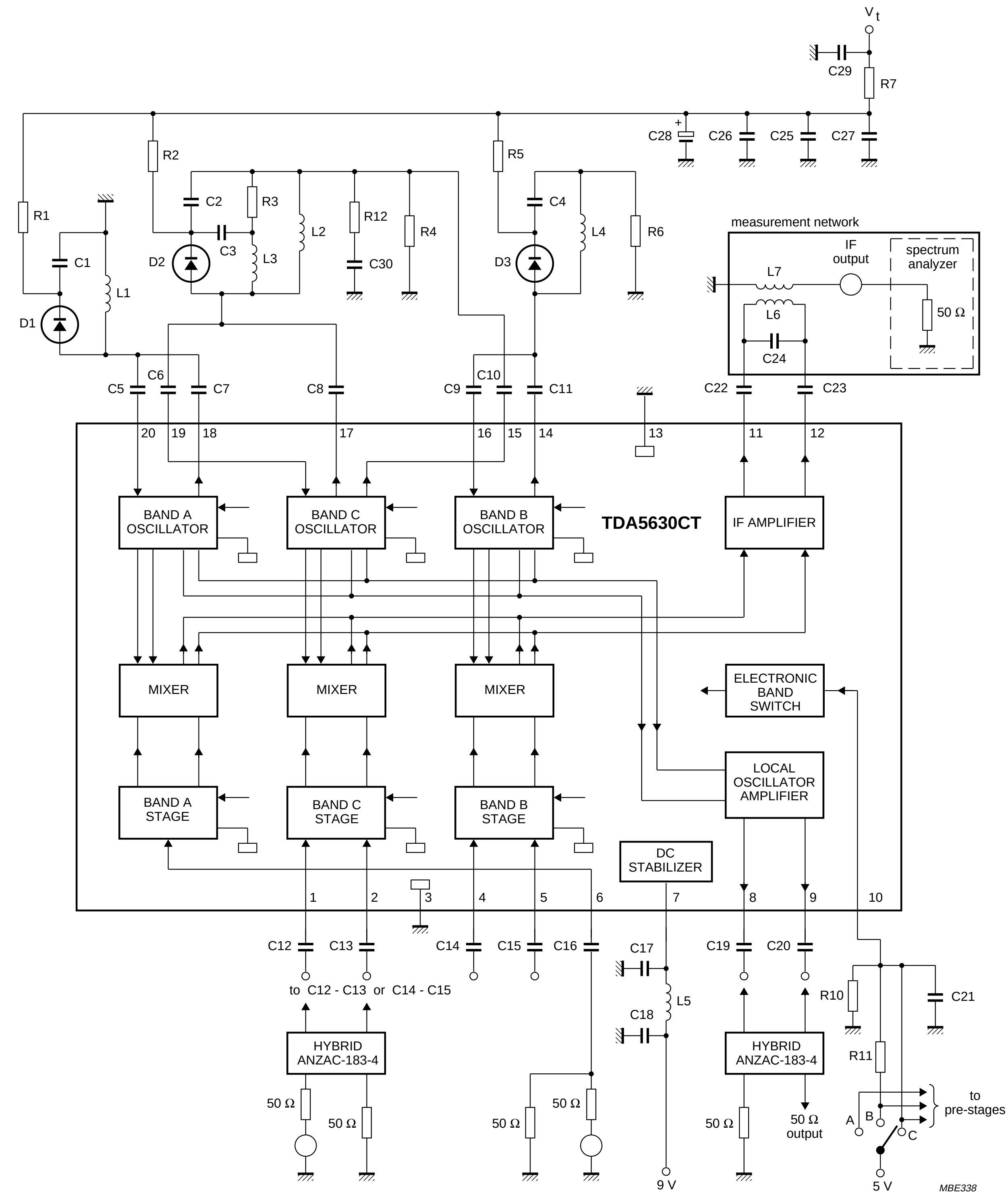
1. The frequency shift is defined for a variation of power supply, first from V_P = 9 to 8.1 V, then from V_P = 9 to 9.9 V. In both cases, the frequency shift is below the specified value.
2. The frequency drift is defined for a variation of ambient temperature, first from T_{amb} = 25 °C to T_{amb} = 0 °C, then from T_{amb} = 25 °C to T_{amb} = 50 °C. In both cases, the frequency drift is below the specified value with NP0 capacitors. Capacitor types C1 to C11, as specified in Fig.4 for non-PLL applications, must be changed to series with other temperature coefficients (e.g. N330, N750 etc.).
3. The values have been corrected for hybrid and cable losses. The symmetrical output impedance of the circuit is 100 Ω.
4. The input level of a N + 5 – 1 MHz signal which gives a signal 30 dB below the oscillator carrier at the LO output.
5. The gain is defined as the transducer gain (measured in Fig.4) plus the voltage transformation ratio of L6 to L7 (6 : 1, 15.4 dB).
6. Measured at 50 Ω, with RF input voltage:
   a) RF voltage = 120 dBμV at f_i < 180 MHz
   b) RF voltage = 107.5 dBμV at f_i = 180 to 225 MHz
   c) RF voltage = 97 dBμV at f_i = 225 to 860 MHz.



(a) For f_R = 50 MHz:
mixer A frequency response measured = 57 MHz, loss = 0 dB
image suppression = 16 dB
C1 = 9 pF
C2 = 15 pF
L1 = 7 turns (∆ 5.5 mm, wire dia. = 0.5 mm)
l1 = rigid cable (RIM): 5 cm long (rigid cable (RIM); 33 dB/100 m; 50 Ω, 96 pF/m).

(b) For f_R = 180 MHz:
mixer A frequency response measured = 150.3 MHz, loss = 1.3 dB
image suppression = 13 dB
C3 = 5 pF
C4 = 25 pF
l2 = rigid cable (RIM): 30 cm long
l3 = rigid cable (RIM): 5 cm long (rigid cable (RIM); 33 dB/100 m; 50 Ω; 96 pF/m).

Fig.3 Input circuit for optimum noise figure.



L6, L7 and C24 are only required for measurement purposes; they are not used in a tuner.

Fig.4 Measurement circuit.

Component values for measurement circuit

Table 1 Capacitors (all SMD and NPO except C28)

COMPONENT	VALUE
C1	82 pF
C2	5.6 pF
C3	100 pF
C4	150 pF
C5	2.2 pF
C6	1 pF
C7	2.2 pF
C8	1 pF
C9	1.8 pF
C10	2.2 pF
C11	3.9 pF
C12	1 nF
C13	1 nF
C14	1 nF
C15	1 nF
C16	1 nF
C17	1.5 nF
C18	1.5nF
C19	1 nF
C20	1 nF
C21	1.5 nF
C22	1 nF
C23	1 nF
C24	18 pF
C25	1.5 nF
C26	1.5 nF
C27	1.5 nF
C28	1 µF; 40 V electrolytic
C29	1.5 nF
C30	0.56 pF

Table 2 Resistors (all SMD)

COMPONENT	VALUE
R1	47 kΩ
R2	22 kΩ
R3	2.2 kΩ
R4	22 kΩ
R5	47 kΩ
R6	22 Ω
R7	1 kΩ
R10	15 kΩ
R11	22 kΩ
R12	470 Ω

Table 3 Diodes and IC

COMPONENT	VALUE
D1	BB911
D2	BB405/215
D3	BB909/219
IC	TDA5630CT

Table 4 Coils (wire size 0.4 mm)

COMPONENT	VALUE
L1	7.5 turns; dia. 3 mm
L2	2.5 turns; dia. 3 mm
L3	1.5 turns; dia. 2.5 mm
L4	1.5 turns; dia. 4 mm
L5	4.7 µH; choke coil

Table 5 Transformers; note 1

COMPONENT	VALUE
L6	2 × 5 turns
L7	2 turns

Note

1. Coil type: TOKO 7 kN; material: 113 kN; screw core 03-0093; pot core 04-0026.

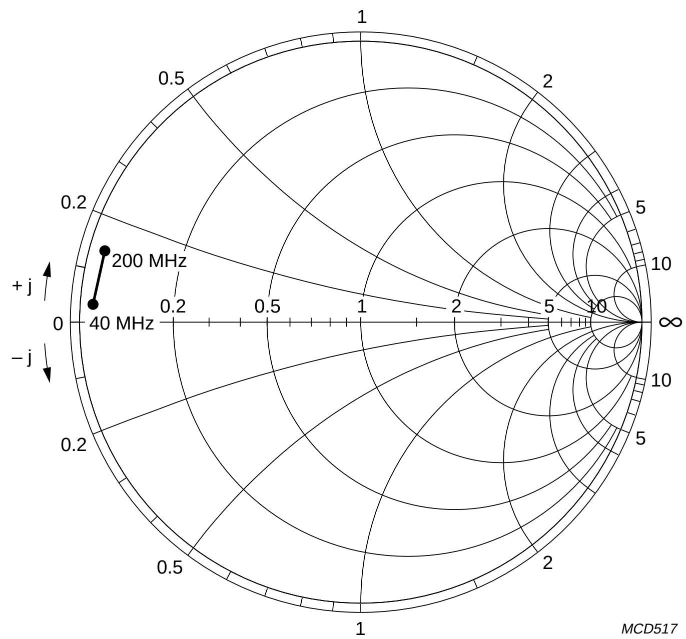


Fig.5 Input admittance (S_{11}) of the band A mixer input (40 to 200 MHz) (Y chart).

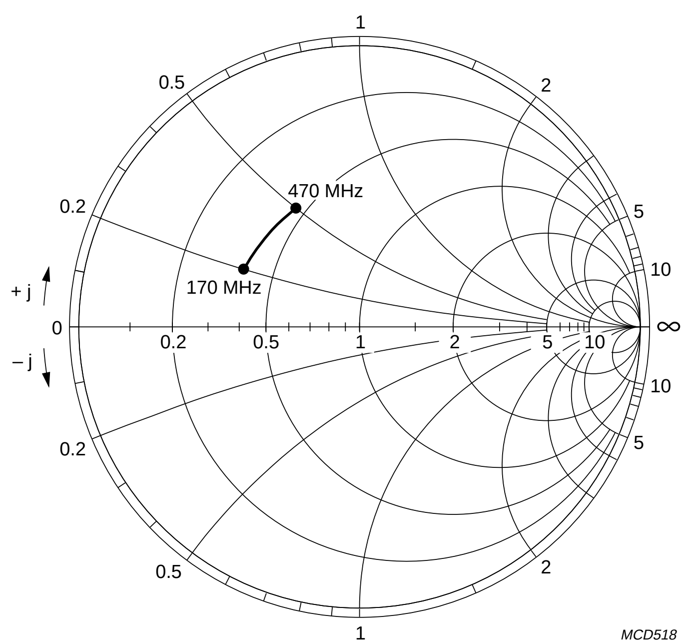


Fig.6 Input impedance (S_{11}) of the band B mixer input (170 to 470 MHz) (Z chart).

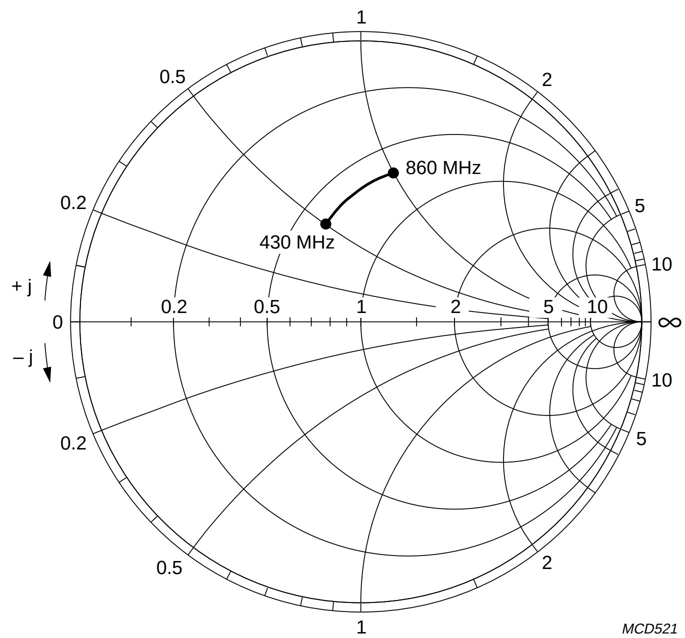


Fig.7 Input impedance (S_{11}) of the band C mixer input (430 to 860 MHz) (Z chart).

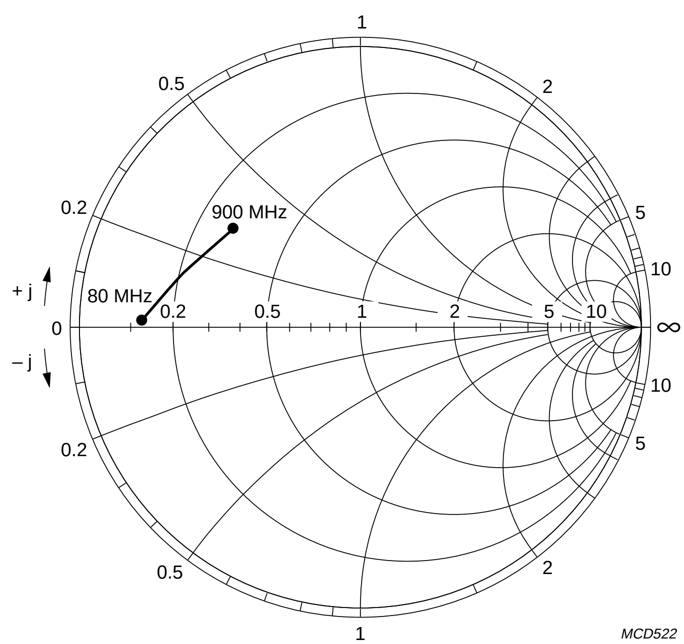


Fig.8 Output admittance (S_{11}) of the LO output (80 to 900 MHz) (Y chart).

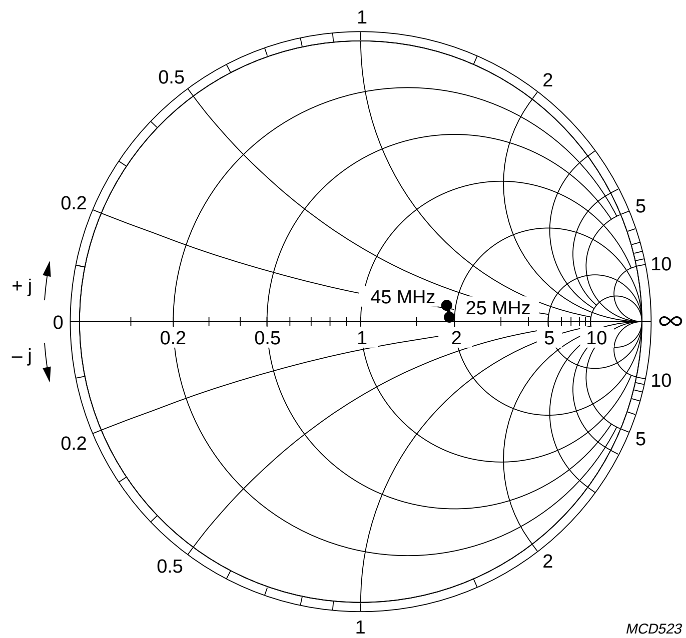


Fig.9 Output reflection coefficient (S_{22}) of the IF amplifier (25 to 45 MHz) (Z chart).

PACKAGE OUTLINE

DRAWING WILL BE INSERTED WHEN AVAILABLE

SOLDERING

Plastic small outline packages

BY WAVE

During placement and before soldering, the component must be fixed with a droplet of adhesive. After curing the adhesive, the component can be soldered. The adhesive can be applied by screen printing, pin transfer or syringe dispensing.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder bath is 10 s, if allowed to cool to less than 150 °C within 6 s. Typical dwell time is 4 s at 250 °C.

A modified wave soldering technique is recommended using two solder waves (dual-wave), in which a turbulent wave with high upward pressure is followed by a smooth laminar wave. Using a mildly-activated flux eliminates the need for removal of corrosive residues in most applications.

BY SOLDER PASTE REFLOW

Reflow soldering requires the solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the substrate by screen printing, stencilling or pressure-syringe dispensing before device placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt, infrared, and vapour-phase reflow. Dwell times vary between 50 and 300 s according to method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 min at 45 °C.

REPAIRING SOLDERED JOINTS (BY HAND-HELD SOLDERING IRON OR PULSE-HEATED SOLDER TOOL)

Fix the component by first soldering two, diagonally opposite, end pins. Apply the heating tool to the flat part of the pin only. Contact time must be limited to 10 s at up to 300 °C. When using proper tools, all other pins can be soldered in one operation within 2 to 5 s at between 270 and 320 °C. (Pulse-heated soldering is not recommended for SO packages.)

For pulse-heated solder tool (resistance) soldering of VSO packages, solder is applied to the substrate by dipping or by an extra thick tin/lead plating before package placement.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.