

DATA SHEET

TSA5520; TSA5521 1.3 GHz universal bus-controlled TV synthesizer

Product specification
Supersedes data of 1995 Mar 16
File under Integrated Circuits, IC02

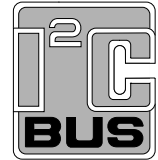
1996 Oct 10

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

FEATURES

- Complete 1.3 GHz single chip system
- Four PNP band switch buffers (40 mA)
- 33 V output tuning voltage
- In-lock detector
- 15-bit programmable divider
- Programmable reference divider ratio (512, 640 or 1024)
- Programmable charge-pump current (60 or 280 μ A)
- Varicap drive disable
- Universal bus protocol I²C-bus or 3-wire bus (the TSA5520/TSA5521 I²C-bus mode only includes the write mode; if both read and write modes are required the TSA5526/TSA5527 devices should be selected):
 - bus protocol for 18 or 19 bits transmission (3-wire bus)
 - extra protocol for 27 bits for test and features (3-wire bus)
 - address plus 4 data bytes transmission (I²C-bus)
 - three independent I²C-bus addresses
- Low power and low radiation.



APPLICATIONS

- TV tuners and front ends
- VCR tuners.

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TSA5520M	SSOP16	plastic shrink small outline package; 16 leads; body width 4.4 mm	SOT369-1
TSA5520T	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
TSA5521M	SSOP16	plastic shrink small outline package; 16 leads; body width 4.4 mm	SOT369-1
TSA5521T	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V _{CC1}	supply voltage (+5 V)		4.5	–	5.5	V
V _{CC2}	band switch supply voltage (12 V)		V _{CC1}	12	13.5	V
I _{CC1}	supply current		–	20	25	mA
I _{CC2}	band switch supply current	note 1	–	50	55	mA
f _{RF}	RF input frequency		64	–	1300	MHz
V _{i(RF)}	RF input voltage	80 to 150 MHz	–25	–	+3	dBm
		150 MHz to 1 GHz	–28	–	+3	dBm
		1 to 1.3 GHz	–15	–	+3	dBm
f _{xtal}	crystal oscillator input frequency		3.2	4.0	4.48	MHz
I _{o(PNP)}	PNP band switch buffers output current	note 2	4	–	50	mA
P _{tot}	total power dissipation	note 3	–	250	400	mW
T _{stg}	IC storage temperature		–40	–	+150	°C
T _{amb}	operating ambient temperature		–20	–	+85	°C

Notes

- One band switch buffer ON with 40 mA.
- One buffer ON, I_o = 40 mA; two buffers ON, maximum sum of I_o = 50 mA.
- The power dissipation is calculated as follows:

$$P_D = V_{CC1} \times I_{CC1} + V_{CC2} \times (I_{CC2} - I_o) + I_o \times V_{CE(satPNP)} + (V_{33}/2)^2 / 27 \text{ k}\Omega$$

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

GENERAL DESCRIPTION

The device is a single-chip PLL frequency synthesizer designed for TV and VCR tuning systems. The circuit consists of a divide-by-eight prescaler with its own preamplifier, a 15-bit programmable divider, a crystal oscillator and its programmable reference divider and a phase/frequency detector combined with a charge-pump which drives the tuning amplifier and the 33 V output. Four high-current PNP band switch buffers are provided for band switching. Two PNP buffers can be switched on simultaneously. The sum of the collector currents is limited to 50 mA.

Depending on the reference divider ratio (512, 640 or 1024), the phase comparator operates at 3.90625 kHz, 6.25 kHz or 7.8125 kHz using a 4 MHz crystal.

The lock detector output is LOW when the PLL loop is locked. In the test mode, this output is used as a test output for f_{ref} and $1/2f_{div}$ (see Table 6). The device can be controlled in accordance with the I²C-bus format or the 3-wire bus format depending on the voltage applied to the SW input (see Table 2).

I²C-bus format (SW = LOW)

Five serial bytes (including address byte) are required to address the device, select the VCO frequency, program the four PNP band switch buffers, set the charge-pump current and the reference divider ratio.

The device has three independent I²C-bus addresses which can be selected by applying a specific voltage on the CE input (see Table 5). The general address C2 is always valid. When the I²C-bus format is fully used, TSA5520 and TSA5521 are equal.

3-wire bus format (SW = V_{CC1} or open-circuit)

Data is transmitted to the device during a HIGH level on the CE input (enable line pin 15). The device is compatible with 18-bit and 19-bit data formats. The first four bits are used to program the PNP band switch buffers and the remaining bits are used to control the programmable divider. A 27-bit data format may also be used to set the charge-pump current, the reference divider ratio and for test purposes. The difference between TSA5520 and TSA5521 are given in Table 1.

When the 27-bit format is used, the TSA5520 and TSA5521 are equal and the reference divider is controlled by the RSA and RSB bits (see Table 7). More details are given in Chapter "Functional description" Section "3-wire bus mode (SW = open-circuit or V_{CC1}); see Figs 3, 4 and 5".

Table 1 Differences between TSA5520 and TSA5521

TYPE NUMBER	DATA WORD	REFERENCE DIVIDER	FREQUENCY STEP (kHz)
TSA5520	18-bit	512 ⁽¹⁾	62.5
TSA5520	19-bit	1024 ⁽¹⁾	31.25
TSA5521	18-bit or 19-bit	640 ⁽²⁾	50

Notes

1. The selection of the reference divider is given by an automatic identification of the data word length.
2. The reference divider is set to 640 at power-on reset.

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

BLOCK DIAGRAM

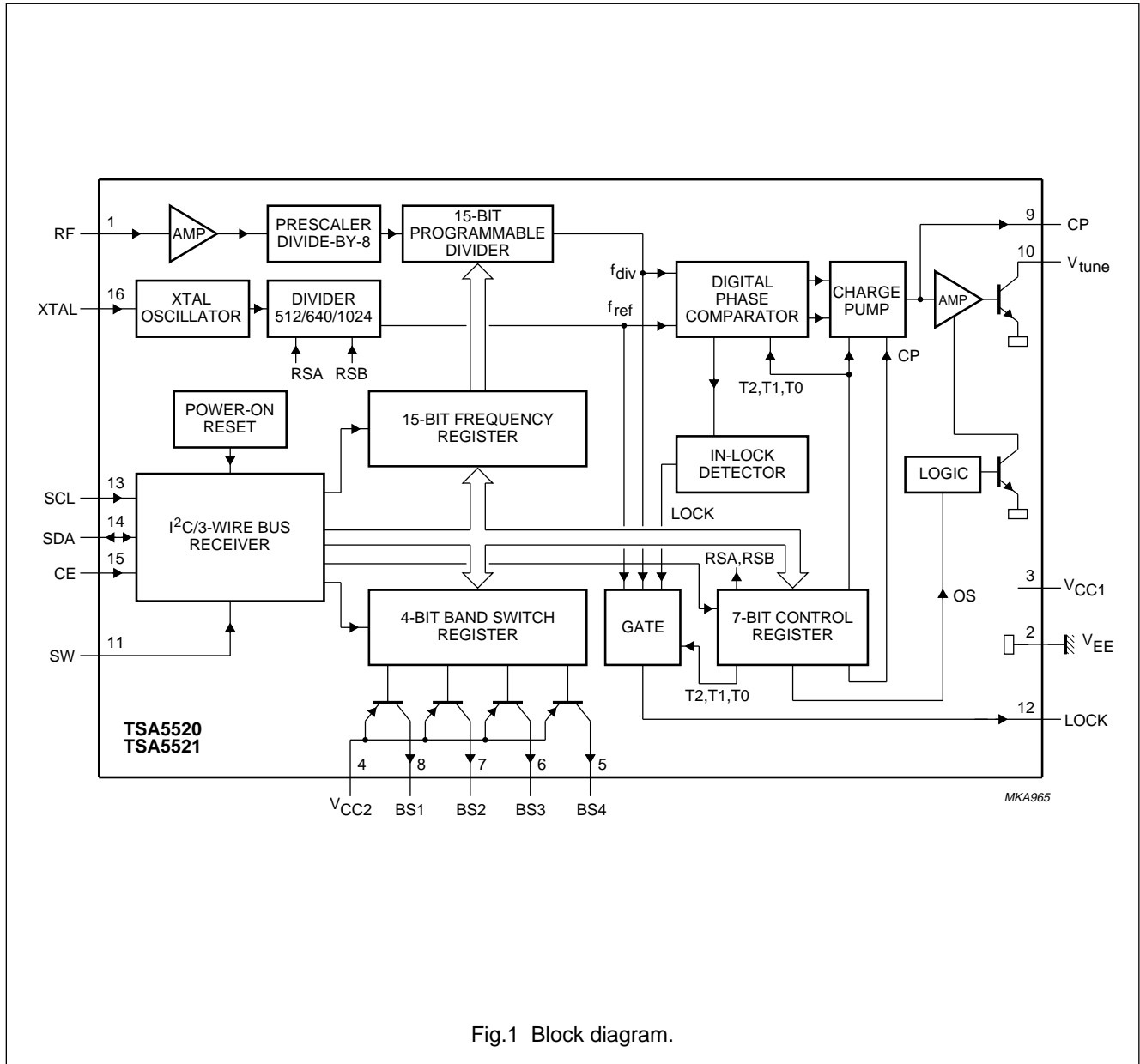


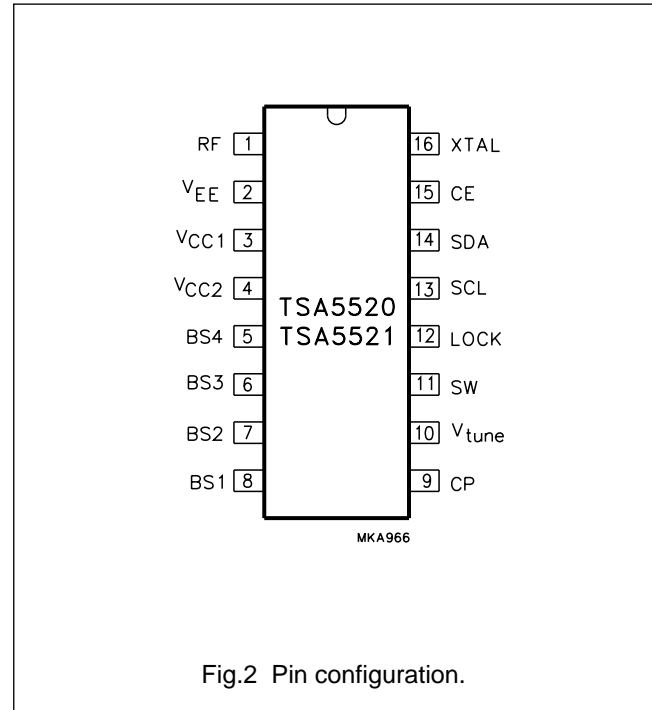
Fig.1 Block diagram.

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

PINNING

SYMBOL	PIN	DESCRIPTION
RF	1	RF signal input
V _{EE}	2	ground
V _{CC1}	3	supply voltage (+5 V)
V _{CC2}	4	band switch supply voltage (+12 V)
BS4	5	PNP band switch buffer output 4
BS3	6	PNP band switch buffer output 3
BS2	7	PNP band switch buffer output 2
BS1	8	PNP band switch buffer output 1
CP	9	charge-pump output
V _{tune}	10	tuning voltage output
SW	11	bus format selection input, I ² C-bus or 3-wire
LOCK	12	lock detector output
SCL	13	serial clock input
SDA	14	serial data input/output
CE	15	chip enable/address selection input
XTAL	16	crystal oscillator input



FUNCTIONAL DESCRIPTION

The device is controlled via the I²C-bus or the 3-wire bus depending on the voltage applied to the SW input (pin 11). A HIGH level on the SW input enables the 3-wire bus inputs which are Chip Enable (CE), serial data input (SDA) and serial clock input (SCL). A LOW level on the SW input enables the I²C-bus inputs which are CE [Address Selection (AS) input], serial data input/output (SDA) and serial clock input (SCL). The bus format selection is given in Table 2.

I²C-bus mode (SW = LOW); see Table 3

Data bytes can be sent to the device after the address transmission (first byte). Four data bytes are required to fully program the device. The bus receiver has an auto-increment facility which permits the programming of the device within one single transmission (address + 4 data bytes).

The device can also be partially programmed providing that the first data byte following the address is Divider Byte 1 (DB1) or the Control Byte (CB). The bits in the data bytes are defined in Table 3.

The first bit of the first data byte transmitted indicates whether frequency data (first bit = 0) or control and band switch data (first bit = 1) will follow. Until an I²C-bus STOP command is sent by the controller, additional data bytes can be entered without the need to re-address the device. The frequency register is loaded after the 8th clock pulse of the second Divider Byte (DB2), the control register is loaded after the 8th clock pulse of the Control Byte (CB) and the band switch register is loaded after the 8th clock pulse of the Band switch Byte (BB).

I²C-bus address selection

The module address contains programmable address bits (MA1 and MA0) which offer the possibility of having several synthesizers (up to 3) in one system by applying a specific voltage to the CE input.

The relationship between MA1 and MA0 and the input voltage applied to the CE input is given in Table 5.

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

Table 2 Bus format selection

PIN	NAME	3-WIRE BUS MODE	I ² C BUS MODE
11	SW	open or HIGH	LOW
13	SCL	clock input	SCL input
14	SDA	data input	SDA input/output
15	CE	chip enable input	address selection input

Table 3 I²C-bus data format

BYTE	MSB	DATA BYTE						LSB	SLAVE ANSWER
Address Byte (ADB)	1	1	0	0	0	MA1	MA0	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 (CB)	1	CP	T2	T1	T0	RSA	RSB	OS	A
Band switch Byte (BB)	X	X	X	X	BS4	BS3	BS2	BS1	A

Table 4 Description of Table 3

SYMBOL	DESCRIPTION
A	acknowledge
MA1 and MA0	programmable address bits (see Table 5)
N14 to N0	programmable divider bits; $N = N14 \times 2^{14} + N13 \times 2^{13} + \dots + N1 \times 2 + N0$
CP	charge-pump current; CP = 0 = 60 μ A; CP = 1 = 280 μ A
T2 to T0	test bits (see Table 6); for normal operation T2 = 0, T1 = 0 and T0 = 1
RSA and RSB	reference divider ratio select bits (see Table 7)
OS	tuning amplifier control bit; for normal operation OS = 0 and tuning voltage is ON; when OS = 1 tuning voltage is OFF (high impedance)
BS4 to BS1	PNP band switch buffers control bits; when BS _n = 0 buffer n is OFF; when BS _n = 1 buffer n is ON
X	don't care

Table 5 I²C-bus address selection

VOLTAGE APPLIED TO THE CE INPUT (SW = LOW)	MA1	MA0
0 to 0.1V _{CC1}	0	0
Always valid	0	1
0.4V _{CC1} to 0.6V _{CC1}	1	0
0.9V _{CC1} to V _{CC1}	1	1

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

3-wire bus mode (SW = open-circuit or V_{CC1});
see Figs 3, 4 and 5

During a HIGH level on the CE input, the data is clocked into the data register at the HIGH-to-LOW transition of the clock pulse. The first four bits control the band switch buffers and are loaded into the internal band switch register on the 5th rising edge of the clock pulse. The frequency bits are loaded into the frequency register at the HIGH-to-LOW transition of the chip enable line when an 18-bit or 19-bit data word is transmitted.

At power-on the charge-pump current is set to 280 µA, the tuning voltage output is disabled ($V_{tune} = 33$ V in application; see Fig.12), the test bits T2, T1 and T0 are set to the normal mode and RSB is set to 1 (TSA5520) or 0 (TSA5521). When an 18-bit data word is transmitted, the most significant bit of the divider N14 is internally set to 0 and bit RSA is set to 1. When a 19-bit data word is transmitted, bit RSA is set to 0.

When a 27-bit word is transmitted, the frequency bits are loaded into the frequency register on the 20th rising edge of the clock pulse and the control bits at the HIGH-to-LOW transition of the chip enable line. In this mode, the reference divider is given by the RSA and RSB bits (see Table 7). The test bits T2, T1 and T0, the charge-pump bit CP, the ratio select bit RSB and the OS bit can only be selected or changed with a 27-bit transmission. They remain programmed if an 18-bit or a 19-bit transmission

occurs. Only RSA is controlled by the transmission length when the 18-bit or 19-bit format is used.

A data word of less than 18 bits will not affect the frequency register of the device. The definition of the bits is unchanged compared to the I²C bus mode.

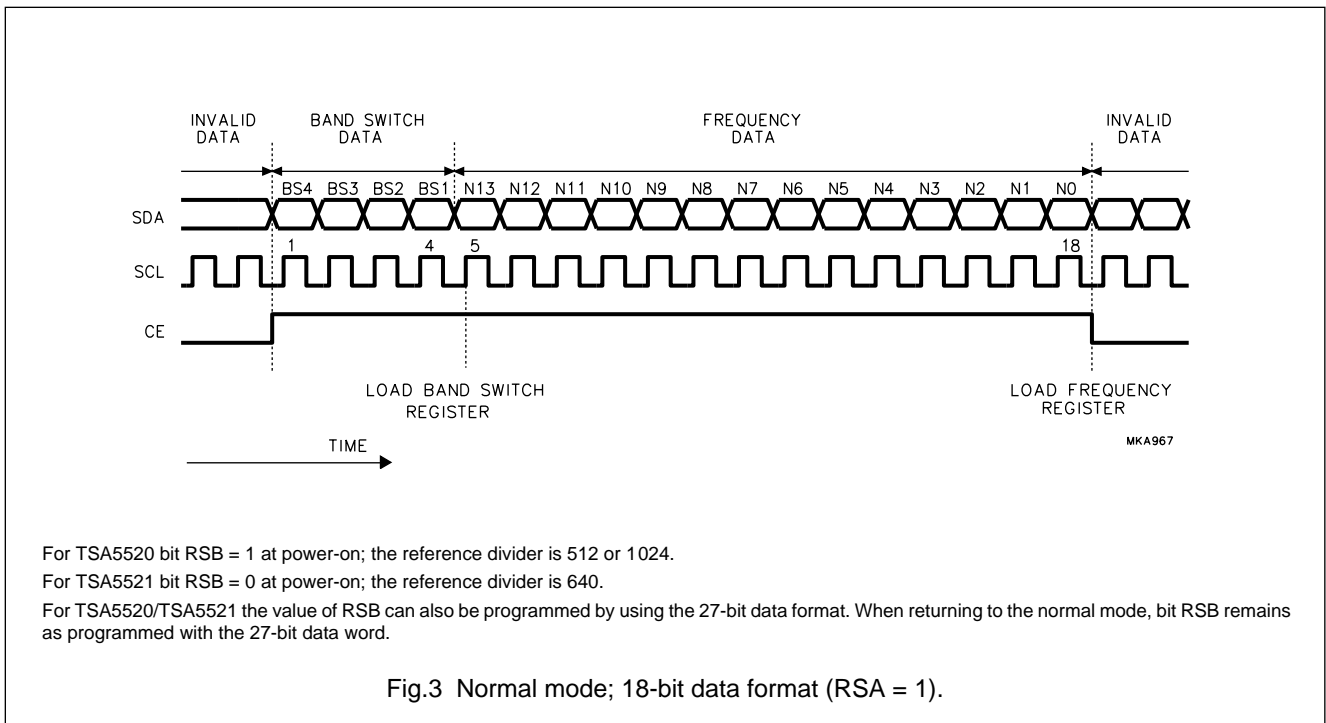
The power-on detection threshold voltage V_{POR} is fixed to $V_{CC1} = 2$ V at room temperature. Below this threshold, the device is reset to the power-on state described above.

Table 6 Test bits

T2	T1	T0	DEVICE OPERATION
0	0	1	normal mode
0	1	X	charge-pump is OFF
1	1	0	charge-pump is sinking current
1	1	1	charge-pump is sourcing current
1	0	0	f_{ref} is available at LOCK output
1	0	1	$\frac{1}{2}f_{div}$ is available at LOCK output

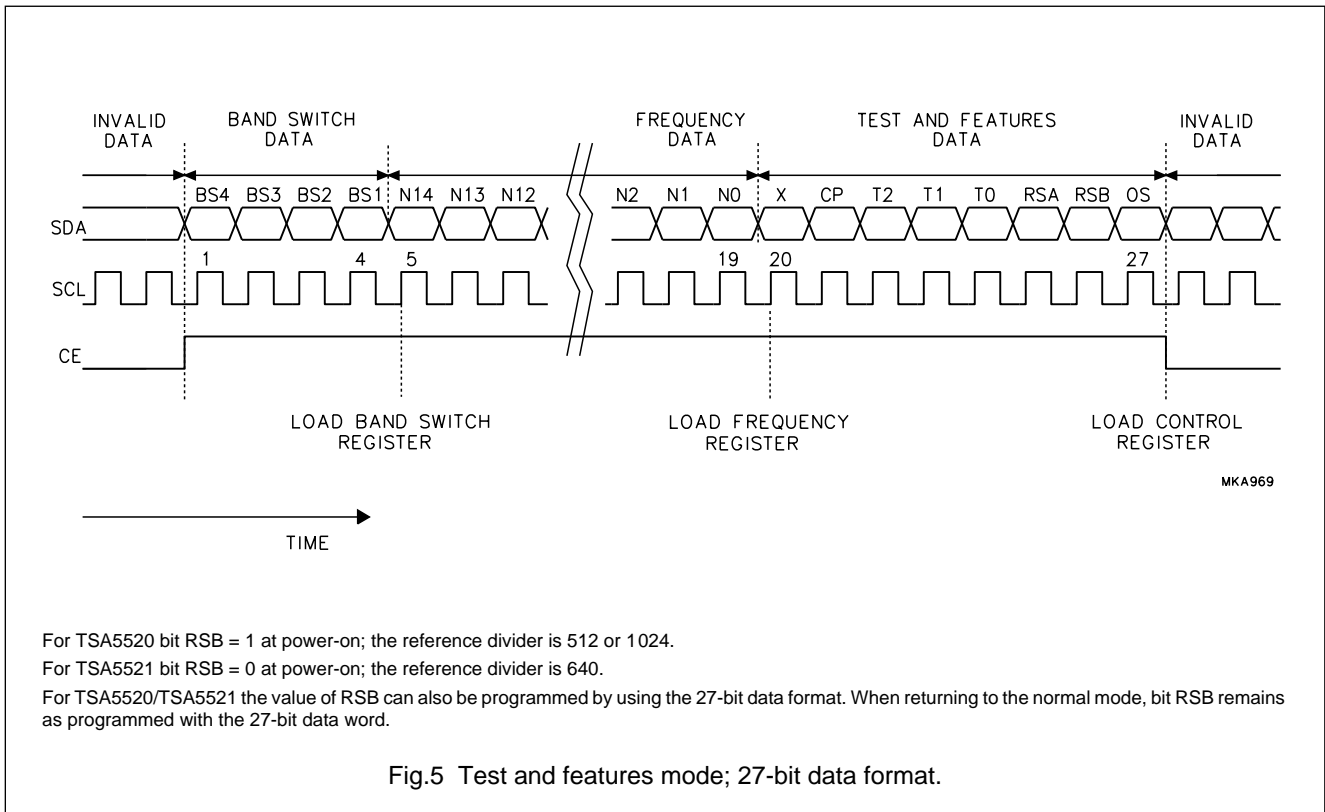
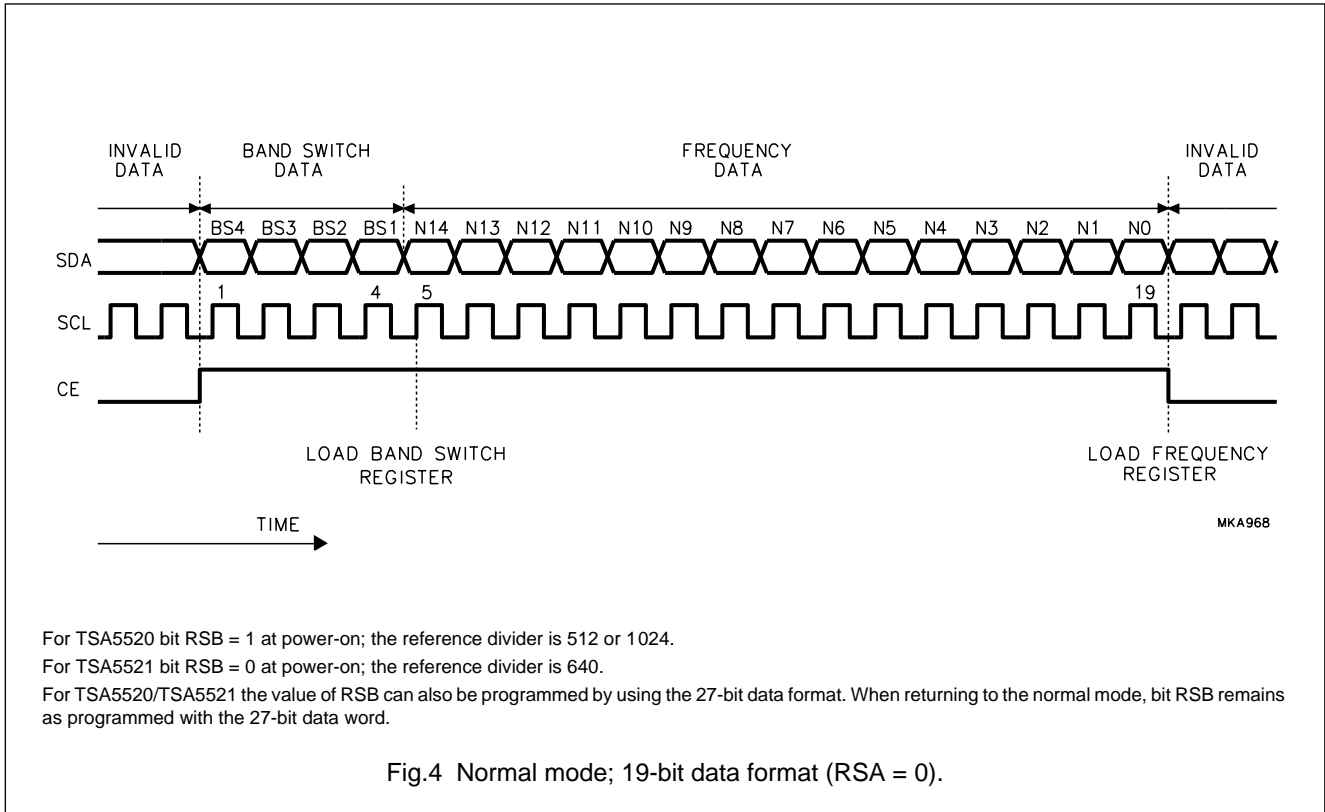
Table 7 Ratio select bits

RSA	RSB	REFERENCE DIVIDER
X	0	640
0	1	1024
1	1	512



1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521



1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC1}	supply voltage; +5 V (pin 3)		-0.3	+6.0	V
V_{CC2}	band switch supply voltage; +12 V (pin 4)		-0.3	+16	V
$V_{i(RF)}$	prescaler input voltage		-0.3	V_{CC1}	V
$V_{o(BSn)}$	band switch buffers output voltage (pins 5 to 8)		-0.3	V_{CC2}	V
$I_{o(BSn)}$	band switch buffers output current		-1	+50	mA
$V_{o(CP)}$	charge-pump output voltage (pin 9)		-0.3	V_{CC1}	V
$V_{o(tune)}$	output tuning voltage (pin 10)		-0.3	+35	V
$V_{i(SW)}$	input switching voltage (pin 11)		-0.3	V_{CC1}	V
$V_{o(LOCK)}$	lock output voltage (pin 12)		-0.3	V_{CC1}	V
$V_{i(SCL)}$	serial clock input voltage (pin 13)		-0.3	+6.0	V
$V_{i/o(SDA)}$	serial data input/output voltage (pin 14)		-0.3	+6.0	V
$I_{o(SDA)}$	serial data output current		-1	+10	mA
$V_{i(CE)}$	chip enable input voltage (pin 15)		-0.3	+6.0	V
$V_{i(xtal)}$	crystal oscillator input voltage (pin 16)		-0.3	V_{CC1}	V
T_{stg}	IC storage temperature		-40	+150	°C
T_j	maximum junction temperature		-	+150	°C
t_{sc}	short-circuit time; every pin except pin 4 to pin 3 and every pin to pin 2	note 1	-	10	s

Note

- Short-circuit between V_{CC1} and V_{CC2} is allowed provided the voltage applied to V_{CC2} is less than the 6 V maximum rating at V_{CC1} .

HANDLING

Inputs and outputs are protected against electrostatic discharge in normal handling. However, to be totally safe, it is desirable to take normal precautions appropriate to handling bipolar devices. Every pin withstands the ESD test in accordance with "MIL-STD-883C category B" (2000 V). Every pin withstands the ESD test in accordance with Philips Semiconductors Machine Model 0 Ω , 200 pF (200 V).

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient in free air		
	SO16	110	K/W
	SSOP16	142	K/W

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

CHARACTERISTICS
 $V_{CC1} = 4.5$ to 5.5 V; $V_{CC2} = V_{CC1}$ to 13.2 V; $T_{amb} = -20$ to $+85$ °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
V_{CC1}	supply voltage		4.5	–	5.5	V
V_{CC2}	band switch buffers supply voltage		V_{CC1}	12	13.5	V
I_{CC1}	supply current	at power-on	–	20	25	mA
I_{CC2}	band switch buffers supply current	at power-on	–	0.5	1	mA
		one band switch buffer is ON; $I_{source} = 40$ mA	–	50	55	mA
		two band switch buffers are ON; $I_{source} = 40$ mA + 5 mA (any combination)	–	56	62	mA
V_{POR}	supply voltage below which POR is active		1.5	2.0	–	V
f_{RF}	RF input frequency		64	–	1300	MHz
DR	divider ratio	15-bit frequency word	256	–	32767	
		14-bit frequency word	256	–	16383	
f_{xtal}	crystal oscillator input frequency	$R_{xtal} = 25$ to 200 Ω	3.2	4.0	4.48	MHz
Z_{xtal}	crystal oscillator input impedance (absolute value)	$f_i = 4$ MHz	600	1200	–	Ω
Prescaler (see Figs 8 and 9)						
$V_{i(RF)}$	RF input level	$f_i = 80$ to 150 MHz	–25	–	3	dBm
		$f_i = 150$ to 1000 MHz	–28	–	3	dBm
		$f_i = 1000$ to 1300 MHz	–15	–	3	dBm
$Z_{i(RF)}$	input impedance	see Fig.8				
PNP band switch buffers outputs (pins 5 to 8)						
I_{LO}	output leakage current	$V_{CC2} = 13.5$ V; $V_o = 0$ V	–10	–	–	μ A
$V_{o(sat)}$	output saturation voltage	$I_{source} = 40$ mA; $V_{o(sat)} = V_{CC2} - V_o$	–	0.2	0.4	V
LOCK output (PNP collector output)						
$I_{o(ool)}$	output current when out-of-lock	$V_{CC1} = 5.5$ V; $V_o = 5.5$ V	–	–	100	μ A
$V_{osat(ool)}$	output saturation voltage when out-of-lock	$I_{source} = 200$ μ A; $V_{o(sat)} = V_{CC1} - V_o$	–	0.4	0.8	V
$V_{o(LOCK)}$	LOCK output voltage		–	0.01	0.4	V
SW input (bus format input)						
V_{IL}	LOW level input voltage		0	–	1.5	V
V_{IH}	HIGH level input voltage		3	–	V_{CC1}	V
I_{IH}	HIGH level input current	$V_{SW} = V_{CC1}$	–	–	10	μ A
I_{IL}	LOW level input current	$V_{SW} = 0$ V	–100	–	–	μ A

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
CE input (chip enable/address selection)						
V _{IL}	LOW level input voltage		0	–	1.5	V
V _{IH}	HIGH level input voltage		3	–	5.5	V
I _{IH}	HIGH level input current	V _{CE} = 5.5 V	–	–	10	μA
I _{IL}	LOW level input current	V _{CE} = 0 V	–10	–	–	μA
SCL and SDA inputs						
V _{IL}	LOW level input voltage		0	–	1.5	V
V _{IH}	HIGH level input voltage		3.0	–	5.5	V
I _{IH}	HIGH level input current	V _{BUS} = 5.5 V; V _{CC1} = 0 V	–	–	10	μA
		V _{BUS} = 5.5 V; V _{CC1} = 5.5 V	–	–	10	μA
I _{IL}	LOW level input current	V _{BUS} = 1.5 V; V _{CC1} = 0 V	–	–	10	μA
		V _{BUS} = 0 V; V _{CC1} = 5.5 V	–10	–	–	μA
f _{clk}	clock frequency		–	100	400	kHz
SDA outputs (I²C-bus mode)						
I _{LO}	output leakage current	V _{SDA} = 5.5 V	–	–	10	μA
V _o	output voltage	I _{sink} = 3 mA	–	–	0.4	V
Charge-pump output CP						
I _{ICPH}	HIGH charge-pump current	CP = 1	–	280	–	μA
I _{ICPL}	LOW charge-pump current	CP = 0	–	60	–	μA
V _{CP}	output voltage	in-lock; T _{amb} = 25 °C	–	1.95	–	V
I _{LI(off)}	off-state leakage current	T ₂ = 0; T ₁ = 1	–15	–0.5	+15	nA
Tuning voltage output V_{tune}						
I _{LO(off)}	leakage current when switched-off	OS = 1; V _{tune} = 33 V	–	–	10	μA
V _o	output voltage when the loop is closed	OS = 0; T ₂ = 0; T ₁ = 0; T ₀ = 1; R _L = 27 kΩ; V _{tune} = 33 V	0.2	–	32.7	V
3-wire bus timing (see Figs 6 and 7)						
t _{HIGH}	clock high time		2	–	–	μs
t _{SU;DAT}	data set-up time		2	–	–	μs
t _{HD;DAT}	data hold time		2	–	–	μs
t _{SU;ENSCL}	enable to clock set-up time		10	–	–	μs
t _{HD;ENDAT}	enable to data hold time		2	–	–	μs
t _{EN}	enable between two transmissions		10	–	–	μs
t _{HD;ENSCL}	enable to clock active edge hold time		6	–	–	μs

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

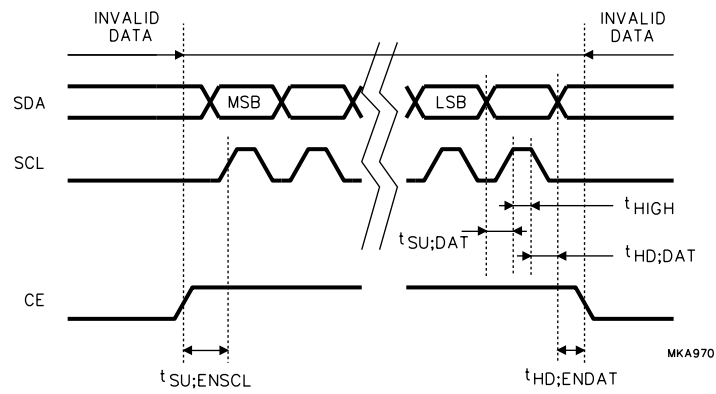


Fig.6 Timing diagram for 3-wire bus; SDA, SCL and CE.

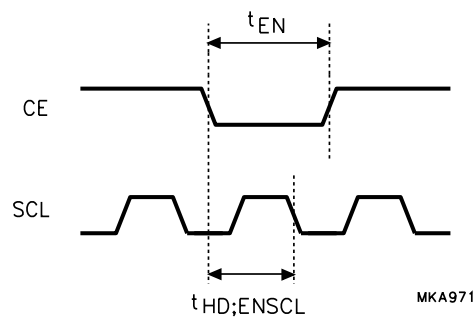


Fig.7 Timing diagram for 3-wire bus; CE and SCL.

1.3 GHz universal bus-controlled
TV synthesizer

TSA5520; TSA5521

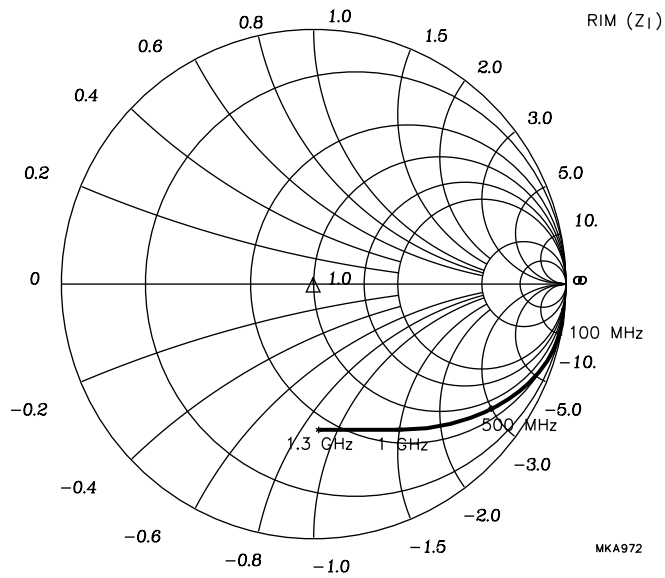


Fig.8 Prescaler Smith chart of typical input impedance at pin 1.

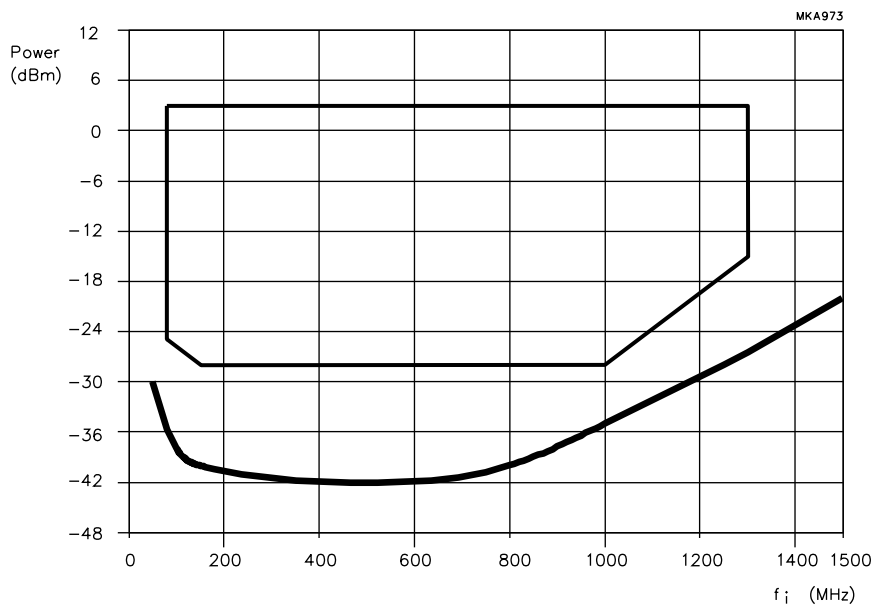


Fig.9 Prescaler typical input sensitivity curve.

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

INTERNAL PIN CONFIGURATION

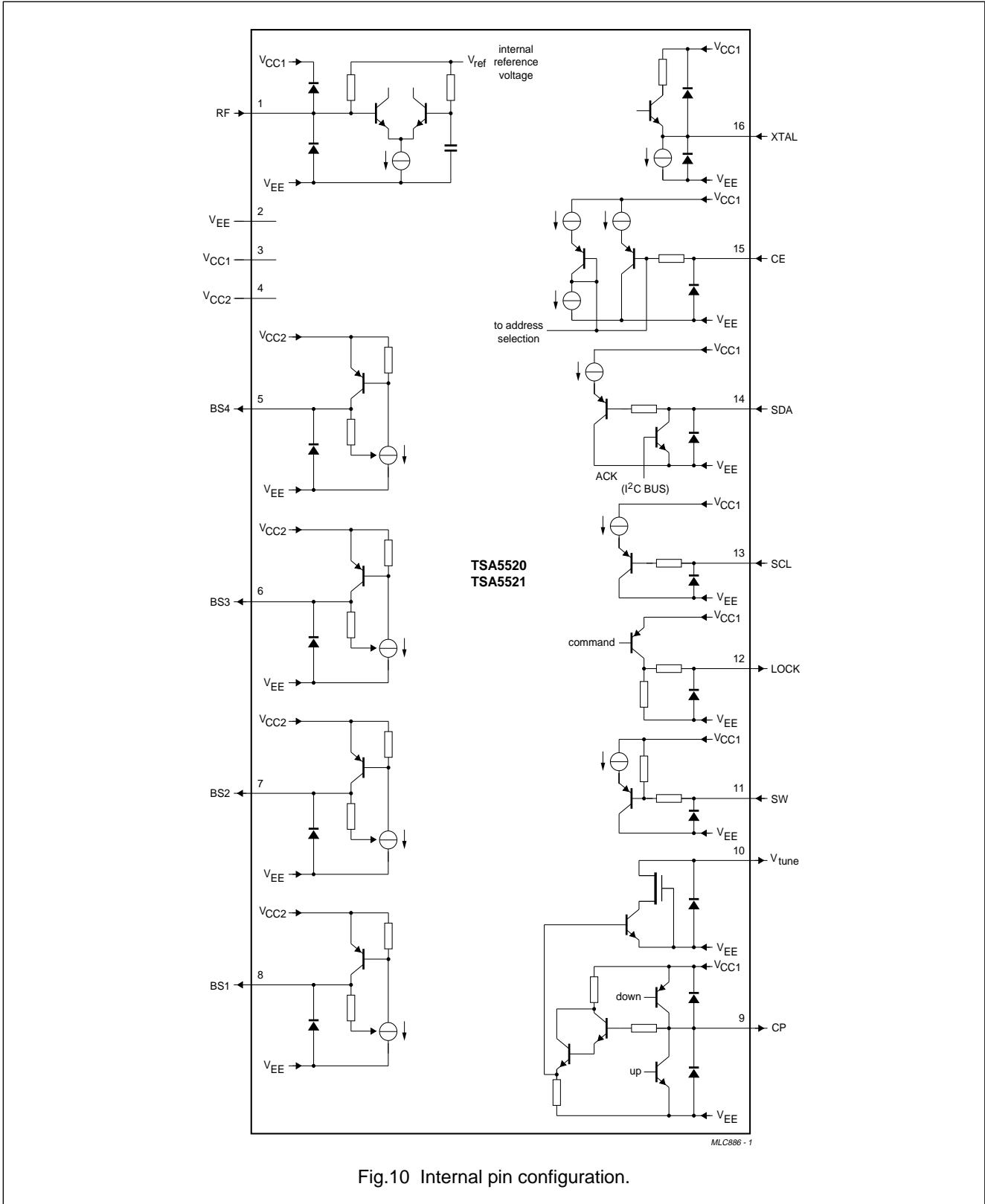


Fig.10 Internal pin configuration.

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

APPLICATION INFORMATION

Tuning amplifier

The tuning amplifier is capable of driving the varicap voltage without an external transistor. The tuning voltage output must be connected to an external load of 27 kΩ which is connected to the tuning voltage supply rail. Figures 11 and 12 show a possible loop filter. The component values depend on the oscillator characteristics and the selected reference frequency.

Crystal oscillator

The crystal oscillator uses a 4 MHz crystal connected in series with an 18 pF capacitor thereby operating in the series resonance mode. Connecting the oscillator to the supply voltage is preferred but it can, however, also be connected to ground.

Examples of I²C-bus sequences (SW = LOW)

Tables 8 to 12 show the various sequences where $f_{osc} = 100$ MHz, BS4 = ON, $I_{CP} = 280$ μA, N = 512, $f_{xtal} = 4$ MHz,

S = START, A = acknowledge and P = STOP. The sequence is as follows:

START + address byte + divider byte 1 + divider byte 2 + control byte + band switch byte + STOP.

For the complete sequence see Table 8 (sequence 1) or Table 9 (sequence 2).

Table 8 Complete sequence 1

S	C2	A	06	A	40	A	CE	A	08	A	P
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Table 9 Complete sequence 2

S	C2	A	CE	A	08	A	06	A	40	A	P
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Table 10 Divider bytes only sequence

S	C2	A	06	A	40	A	P
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Table 11 Control and band switch bytes only sequence

S	C2	A	CE	A	08	A	P
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Table 12 Control byte only sequence

S	C2	A	CE	A	P
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Other I²C-bus sequences are not allowed. Other I²C-bus addresses may be selected by applying an appropriate voltage to the CE input.

Examples of 3-wire bus sequences (TSA5520; SW = OPEN)

Table 13 18-bit sequence ($f_{osc} = 800$ MHz, BS4 = ON)

1	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Table 14 19-bit sequence ($f_{osc} = 650$ MHz, BS3 = ON)

0	1	0	0	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

The reference divider is automatically set to 512 unless RSB has been programmed to 0 during a 27-bit sequence.

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

Table 15 27-bit sequence ($f_{osc} = 750$ MHz, BS1 = ON, N = 640, $I_{CP} = 60$ μ A, no test function)

0	0	0	1	0	1	1	1	0	1	0	1	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

The reference divider is automatically set to 1024 unless RSB has been programmed to 0 during a 27-bit sequence. This sequence sets RSA = RSB = 0; CP = 0.

Table 16 19-bit sequence

0	0	0	1	0	1	0	1	1	1	1	0	1	1	1	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

This sequence will program f_{osc} to 600 MHz in 50 kHz steps. I_{CP} remains at 60 μ A.

Table 17 18-bit sequence

0	0	0	1	1	0	1	1	1	1	0	1	1	1	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

This sequence will program f_{osc} to 600 MHz in 50 kHz steps. I_{CP} remains at 60 μ A.

Table 18 27-bit sequence ($f_{osc} = 650$ MHz, BS1 = ON)

0	0	0	1	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	1	1	0	0	1	0	1	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

This sequence sets RSA to 0, RSB to 1 and CP to 1. After this sequence $I_{CP} = 280$ μ A, N = 1024 (19-bit transmission) and N = 512 (18-bit transmission), RSB = 1.

Example of 3-wire bus sequence (TSA5521; SW = OPEN)

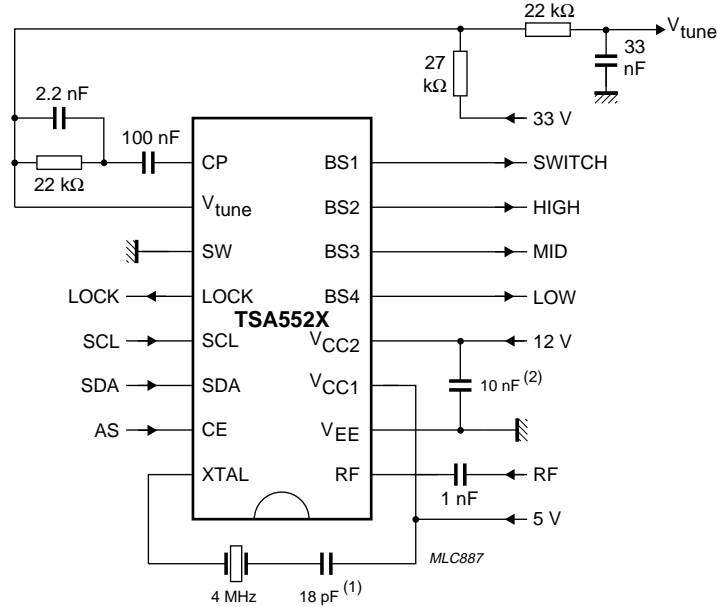
Table 19 19-bit sequence ($f_{osc} = 700$ MHz, BS3 = ON)

0	1	0	0	0	1	1	0	1	1	0	1	0	1	1	0	0	0	0
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

N = 640 unless RSB has been programmed to 0 during a 27-bit sequence.

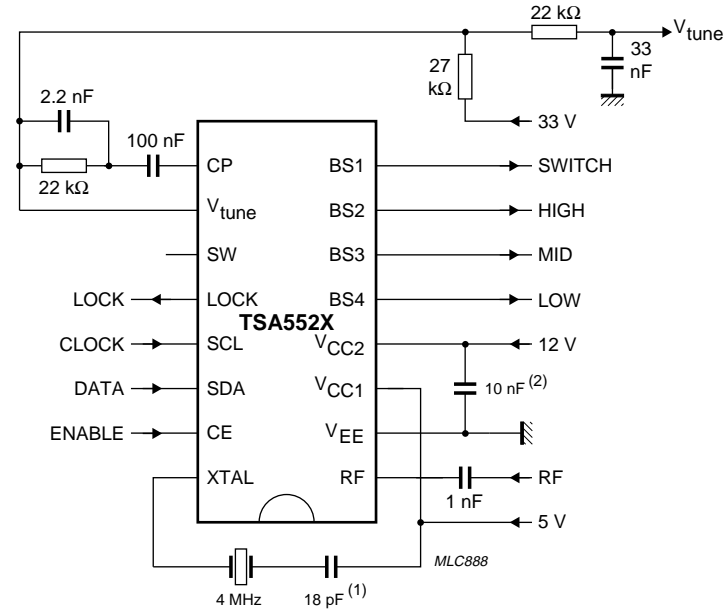
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TSA5520; TSA5521



- (1) Connection to ground is also allowed.
- (2) Capacitor prevents parasitic oscillation on the V_{CC2} line.

Fig.11 Typical I²C-bus application.



- (1) Connection to ground is also allowed.
- (2) Capacitor prevents parasitic oscillation on the V_{CC2} line.

Fig.12 Typical 3-wire bus application.

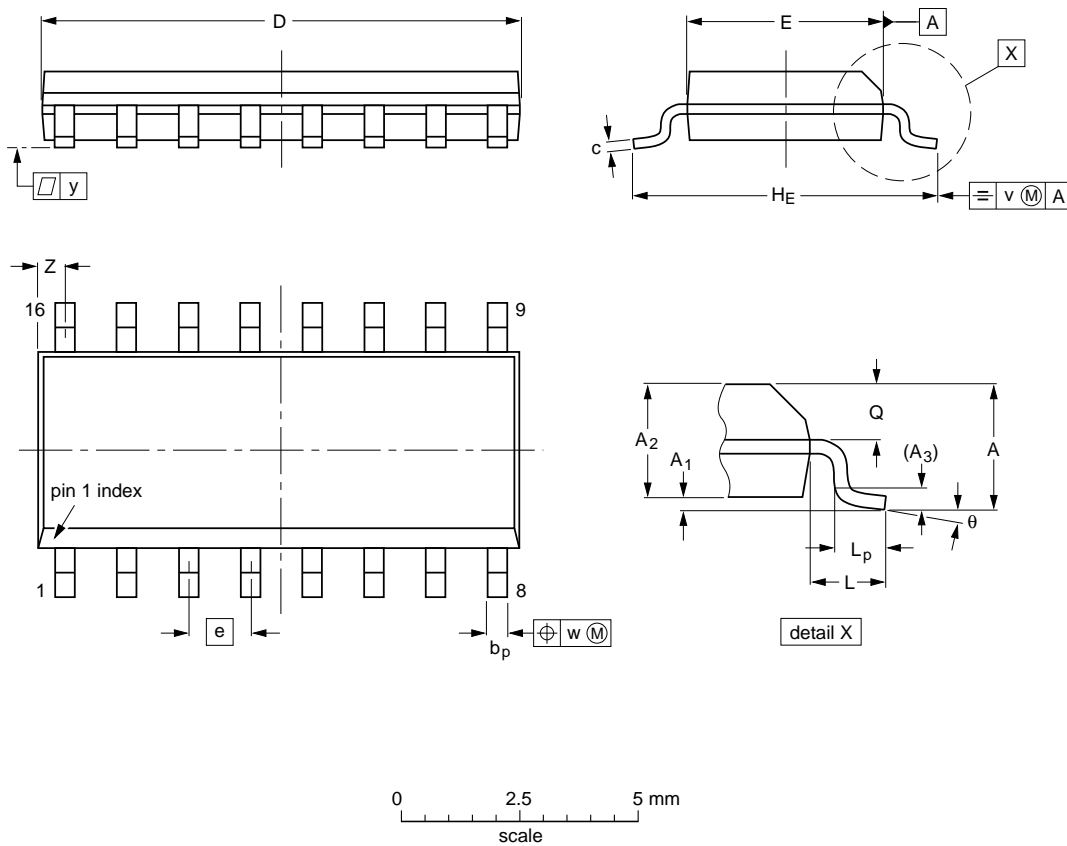
1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

PACKAGE OUTLINES

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.0098 0.0039	0.057 0.049	0.01	0.019 0.014	0.0098 0.0075	0.39 0.38	0.16 0.15	0.050	0.24 0.23	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

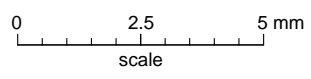
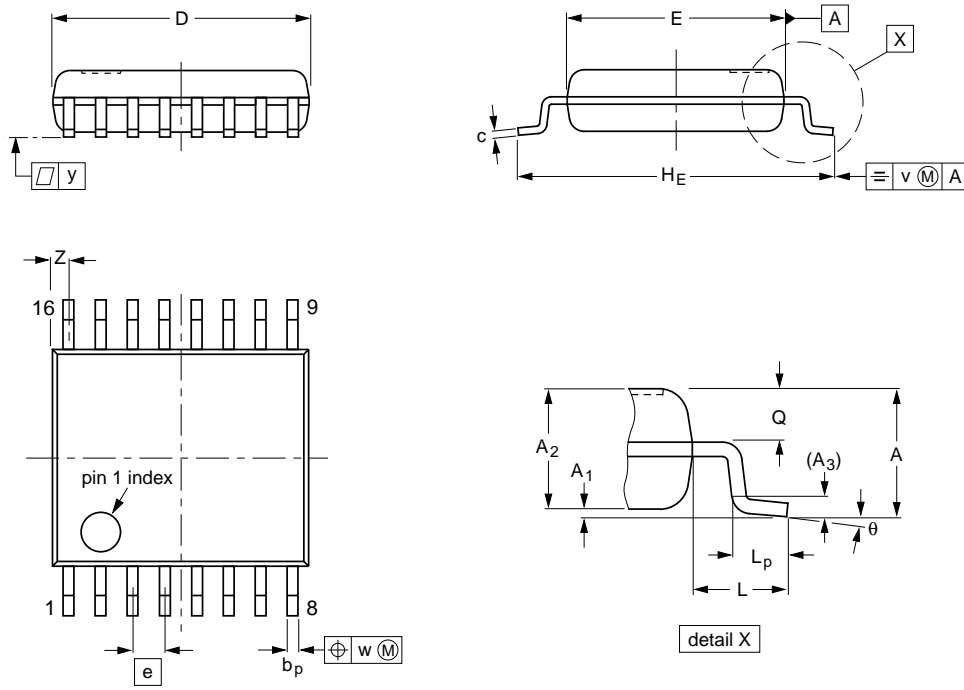
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT109-1	076E07S	MS-012AC				91-08-13 95-01-23

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

SSOP16: plastic shrink small outline package; 16 leads; body width 4.4 mm

SOT369-1



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A ₁	A ₂	A ₃	b _p	c	D ⁽¹⁾	E ⁽¹⁾	e	H _E	L	L _p	Q	v	w	y	Z ⁽¹⁾	θ
mm	1.5	0.15 0.00	1.4 1.2	0.25	0.32 0.20	0.25 0.13	5.30 5.10	4.5 4.3	0.65	6.6 6.2	1.0	0.75 0.45	0.65 0.45	0.2	0.13	0.1	0.48 0.18	10° 0°

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ		
SOT369-1					94-04-20 95-02-04

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

SOLDERING SO or SSOP

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these cases reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our "IC Package Databook" (order code 9398 652 90011).

Reflow soldering

Reflow soldering techniques are suitable for all SO and SSOP packages.

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

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating 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 minutes at 45 °C.

Wave soldering

SO

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

SSOP

Wave soldering is **not** recommended for SSOP packages. This is because of the likelihood of solder bridging due to closely-spaced leads and the possibility of incomplete solder penetration in multi-lead devices.

If wave soldering cannot be avoided, the following conditions must be observed:

- **A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.**
- **The longitudinal axis of the package footprint must be parallel to the solder flow and must incorporate solder thieves at the downstream end.**

Even with these conditions, only consider wave soldering SSOP packages that have a body width of 4.4 mm, that is SSOP16 (SOT369-1) or SSOP20 (SOT266-1).

METHOD (SO OR SSOP)

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

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

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

Repairing soldered joints

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds at 270 to 320 °C.

1.3 GHz universal bus-controlled TV synthesizer

TSA5520; TSA5521

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.	

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NOTES

Philips Semiconductors – a worldwide company

Argentina: see South America

Australia: 34 Waterloo Road, NORTH RYDE, NSW 2113,
Tel. +61 2 9805 4455, Fax. +61 2 9805 4466

Austria: Computerstr. 6, A-1101 WIEN, P.O. Box 213,
Tel. +43 1 60 101, Fax. +43 1 60 101 1210

Belarus: Hotel Minsk Business Center, Bld. 3, r. 1211, Volodarski Str. 6,
220050 MINSK, Tel. +375 172 200 733, Fax. +375 172 200 773

Belgium: see The Netherlands

Brazil: see South America

Bulgaria: Philips Bulgaria Ltd., Energoproject, 15th floor,
51 James Bourchier Blvd., 1407 SOFIA,
Tel. +359 2 689 211, Fax. +359 2 689 102

Canada: PHILIPS SEMICONDUCTORS/COMPONENTS,
Tel. +1 800 234 7381

China/Hong Kong: 501 Hong Kong Industrial Technology Centre,
72 Tat Chee Avenue, Kowloon Tong, HONG KONG,
Tel. +852 2319 7888, Fax. +852 2319 7700

Colombia: see South America

Czech Republic: see Austria

Denmark: Prags Boulevard 80, PB 1919, DK-2300 COPENHAGEN S,
Tel. +45 32 88 2636, Fax. +45 31 57 1949

Finland: Sinikalliontie 3, FIN-02630 ESPOO,
Tel. +358 9 615800, Fax. +358 9 61580/xxx

France: 4 Rue du Port-aux-Vins, BP317, 92156 SURESNES Cedex,
Tel. +33 1 40 99 6161, Fax. +33 1 40 99 6427

Germany: Hammerbrookstraße 69, D-20097 HAMBURG,
Tel. +49 40 23 53 60, Fax. +49 40 23 536 300

Greece: No. 15, 25th March Street, GR 17778 TAVROS/ATHENS,
Tel. +30 1 4894 339/239, Fax. +30 1 4814 240

Hungary: see Austria

India: Philips INDIA Ltd, Shivsagar Estate, A Block, Dr. Annie Besant Rd.
Worli, MUMBAI 400 018, Tel. +91 22 4938 541, Fax. +91 22 4938 722

Indonesia: see Singapore

Ireland: Newstead, Clonskeagh, DUBLIN 14,
Tel. +353 1 7640 000, Fax. +353 1 7640 200

Israel: RAPAC Electronics, 7 Kehilat Saloniki St, TEL AVIV 61180,
Tel. +972 3 645 0444, Fax. +972 3 649 1007

Italy: PHILIPS SEMICONDUCTORS, Piazza IV Novembre 3,
20124 MILANO, Tel. +39 2 6752 2531, Fax. +39 2 6752 2557

Japan: Philips Bldg 13-37, Kohnan 2-chome, Minato-ku, TOKYO 108,
Tel. +81 3 3740 5130, Fax. +81 3 3740 5077

Korea: Philips House, 260-199 Itaewon-dong, Yongsan-ku, SEOUL,
Tel. +82 2 709 1412, Fax. +82 2 709 1415

Malaysia: No. 76 Jalan Universiti, 46200 PETALING JAYA, SELANGOR,
Tel. +60 3 750 5214, Fax. +60 3 757 4880

Mexico: 5900 Gateway East, Suite 200, EL PASO, TEXAS 79905,
Tel. +9-5 800 234 7381

Middle East: see Italy

Netherlands: Postbus 90050, 5600 PB EINDHOVEN, Bldg. VB,
Tel. +31 40 27 82785, Fax. +31 40 27 88399

New Zealand: 2 Wagener Place, C.P.O. Box 1041, AUCKLAND,
Tel. +64 9 849 4160, Fax. +64 9 849 7811

Norway: Box 1, Manglerud 0612, OSLO,
Tel. +47 22 74 8000, Fax. +47 22 74 8341

Philippines: Philips Semiconductors Philippines Inc.,
106 Valero St. Salcedo Village, P.O. Box 2108 MCC, MAKATI,
Metro MANILA, Tel. +63 2 816 6380, Fax. +63 2 817 3474

Poland: Ul. Lukiska 10, PL 04-123 WARSZAWA,
Tel. +48 22 612 2831, Fax. +48 22 612 2327

Portugal: see Spain

Romania: see Italy

Russia: Philips Russia, Ul. Usatcheva 35A, 119048 MOSCOW,
Tel. +7 095 247 9145, Fax. +7 095 247 9144

Singapore: Lorong 1, Toa Payoh, SINGAPORE 1231,
Tel. +65 350 2538, Fax. +65 251 6500

Slovakia: see Austria

Slovenia: see Italy

South Africa: S.A. PHILIPS Pty Ltd., 195-215 Main Road Martindale,
2092 JOHANNESBURG, P.O. Box 7430 Johannesburg 2000,
Tel. +27 11 470 5911, Fax. +27 11 470 5494

South America: Rua do Rocio 220, 5th floor, Suite 51,
04552-903 São Paulo, SÃO PAULO - SP, Brazil,
Tel. +55 11 821 2333, Fax. +55 11 829 1849

Spain: Balmes 22, 08007 BARCELONA,
Tel. +34 3 301 6312, Fax. +34 3 301 4107

Sweden: Kottbygatan 7, Akalla, S-16485 STOCKHOLM,
Tel. +46 8 632 2000, Fax. +46 8 632 2745

Switzerland: Allmendstrasse 140, CH-8027 ZÜRICH,
Tel. +41 1 488 2686, Fax. +41 1 481 7730

Taiwan: PHILIPS TAIWAN Ltd., 23-30F, 66,
Chung Hsiao West Road, Sec. 1, P.O. Box 22978,
TAIPEI 100, Tel. +886 2 382 4443, Fax. +886 2 382 4444

Thailand: PHILIPS ELECTRONICS (THAILAND) Ltd.,
209/2 Sanpavuth-Bangna Road Prakanong, BANGKOK 10260,
Tel. +66 2 745 4090, Fax. +66 2 398 0793

Turkey: Talatpasa Cad. No. 5, 80640 GÜLTEPE/ISTANBUL,
Tel. +90 212 279 2770, Fax. +90 212 282 6707

Ukraine: PHILIPS UKRAINE, 4 Patrice Lumumba str., Building B, Floor 7,
252042 KIEV, Tel. +380 44 264 2776, Fax. +380 44 268 0461

United Kingdom: Philips Semiconductors Ltd., 276 Bath Road, Hayes,
MIDDLESEX UB3 5BX, Tel. +44 181 730 5000, Fax. +44 181 754 8421

United States: 811 East Arques Avenue, SUNNYVALE, CA 94088-3409,
Tel. +1 800 234 7381

Uruguay: see South America

Vietnam: see Singapore

Yugoslavia: PHILIPS, Trg N. Pasica 5/v, 11000 BEOGRAD,
Tel. +381 11 625 344, Fax. +381 11 635 777

For all other countries apply to: Philips Semiconductors, Marketing & Sales Communications,
Building BE-p, P.O. Box 218, 5600 MD EINDHOVEN, The Netherlands, Fax. +31 40 27 24825

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Printed in The Netherlands

537021/50/02/pp24

Date of release: 1996 Oct 10

Document order number: 9397 750 01353

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