DISPLAY COMPONENTS

DATA HANDBOOK

Television Tuners Coaxial Aerial Input Assemblies

BOOK DC03 1992

Philips Components

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DC 03 TELEVISION TUNERS/COAXIAL AERIAL INPUT ASSEMBLIES 1992 PHILIPS

TELEVISION TUNERS
COAXIAL AERIAL INPUT ASSEMBLIES

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.
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

SELECTION GUIDES

Television Tuners
Coaxial Aerial Input Assemblies

Selection guide

VHF/UHF TELEVISION TUNERS

PRODUCT TYPE VST FST PLL	UV617 UV618	UV816/6456 UV816/PLL	UV913 UV914	UV915E UV916E
System	CCIR: B, G, H	CCIR: B, G, H, I, I', L, L'	CCIR: B, G	CCIR: B, G, H, I, I', L, L', D2MAC
Region	Europe	Europe	Europe	Europe
Off-air channels VHF UHF	 E2 to C E5 to E12 E12 to E69	 E2 to C E5 to E21 E21 to E69	 E2 to C M4 to E21 E21 to E69	 E2 to C E5 to E21 E21 to E69
Cable channels	S01 to S2 S2 to S20	S01 to S1 S11 to S39 S40 to S41	S01 to S10 S2 to S20	S01 to S10 S11 to S39 S40 to S41
Frequency ranges (MHz) at picture carrier	48.25 to 105.25 112.25 to 294.25 471.25 to 855.25	48.25 to 168.25 175.25 to 447.25 455.25 to 855.25	48.25 to 82.25 163.25 to 224.25 471.25 to 855.25	48.25 to 168.25 175.25 to 447.25 455.25 to 855.25
IF frequency (MHz) picture sound1 sound2	 38.9 33.4 33.16	see data sheet	 38.9 33.4	see data sheet
Voltage gain (dB) min. max.	 36 50	 40 50	 40 52	 38 50
Noise figure (dB) max. typ.	 11 7	 11 7	 10 7	 10 7
Min. AGC range (dB) min.	 30	 30	 30	 30
Tuning voltage (V)	0.8 to 28	1 to 28	0.3 to 28	0.7 to 28
Overall dimensions l x w x h (mm)	 84 x 20 x 55	 84 x 20 x 25	 66 x 20 x 46	 66 x 20 x 46
Aerial input plug	IEC	IEC	IEC, phono	IEC, phono
Compliance with radio interference	Amtsblatt	Amtsblatt CENELEC	CISPR 13 CENELEC	Amtsblatt CENELEC CISPR 13
Page	65	77	95	109
Remarks				

PRODUCT TYPE VST FST PLL	UV916H	UV933 UV934	UV935 UV936E	U943C U944C
System	CCIR: B, G, H, I, I', L, L', D2MAC	RTMA: M, N	RTMA: M, N	CCIR: I
Region	Europe	S. America	USA	UK
Off-air channels VHF UHF	 E2 to C E5 to E21 E21 to E69	 A2 to A13 A14 to A83	 A2 to A13 A14 to A69	 E21 to E69
Cable channels	S01 to S10 S11 to S39 S40 and S41	A-2 to I	A-2 to 65	
Frequency ranges (MHz) at picture carrier	48.25 to 168.25 175.25 to 447.25 455.25 to 855.25	55.25 to 211.25 471.25 to 885.25	55.25 to 157.25 162.00 to 451.25 457.25 to 801.25	 471.25 to 855.25
IF frequency (MHz) picture sound1 sound2	 see data sheet	 45.75 41.25	 45.75 41.25	 38.9 32.9 32.4
Voltage gain (dB) min. max.	 38 52	 38 50	 38 50	 40 52
Noise figure (dB) max. typ.	 9 6	 12 8	 10 7	 9 6
Min. AGC range (dB) min.	 30	 30	 30	 30
Tuning voltage (V)		0.3 to 28	0.3 to 28	0.3 to 28
Overall dimensions l x w x h (mm)	 66 x 20 x 46	 66 x 20 x 46	 66 x 20 x 46	 66 x 20 x 46
Aerial input plug	IEC, phono IEC-Long	phono	IEC, phono IEC-Long	IEC, phono IEC-Long
Compliance with radio interference	Amtsblatt CENELEC CISPR 13	CISPR 13	FCC	CENELEC
Page	121	141	155	167
Remarks	symmetrical output optional ADC high performance		UV936H symmetrical output	

Television Tuners
Coaxial Aerial Input Assemblies

Selection guide

PRODUCT TYPE VST FST PLL	UV953 UV954	UV963 UV964	UV973 UV974	UV983 UV984
System	OIRT: D, K	CCIR: B, G, H	CCIR: I	Japanese M
Region	China USSR	Australia	S. Africa	Japan
Off-air channels VHF UHF	 C1 to C5 C6 to E12 C13 to C57	 0 to 5 5A to 12 21 to 69	 SA4 to SA13 E21 to E69	 J1 to J3 J4 to J12 J13 to J62
Cable channels				
Frequency ranges (MHz) at picture carrier	48.25 to 93.25 168.25 to 224.25 471.25 to 855.25	46.25 to 102.25 138.25 to 224.25 471.25 to 855.25	175.25 to 247.43 471.25 to 855.25	91.25 to 103.25 171.25 to 217.25 471.25 to 765.25
IF frequency (MHz) picture sound1 sound2	 38.0 31.5	 36.875 31.375 31.133	 38.9 32.9	 58.75 54.25
Voltage gain (dB) min. max.	 40 52	 38 50	 38 50	 40 50
Noise figure (dB) max. typ.	 10 7	 11 7	 9 7	 10 7
Min. AGC range (dB) min.	 30	 30	 30	 30
Tuning voltage (V)	0.3 to 28	0.3 to 28	0.3 to 28	0.3 to 28
Overall dimensions l x w x h (mm)	 66 x 20 x 46	 66 x 20 x 46	 66 x 20 x 46	 66 x 20 x 46
Aerial input plug	IEC, phono	IEC, phono	IEC, phono	phono
Compliance with radio interference	CISPR 13	CISPR 13 AS2839	SABS	
Page	179	193	207	219
Remarks				

VHF/UHF TELEVISION FRONT ENDS

TYPE	REGION	SYSTEM MAIN/ SEC.	TUNER EQUIVALENT CHARACTE-RISTICS	SOUND	CONNECTOR	HOUSING DIMENSIONS L x W x H (mm) (note 1)	PAGE
FE618Q	Europe	CCIR: B, G, H/-	UV618	quasi-split sound (stereo)	IEC	147 x 20 x 55	15
FQ816 FQ816/IF (note 2)	Europe	CCIR: B, G/-	UV816	quasi-split sound (stereo)	IEC	147 x 20 x 55	29
FQ816ME FQ816ME/IF (note 2)	Europe	CCIR: B, G/L, M	UV816	quasi-split sound (stereo)	IEC	147 x 20 x 55	29
FQ816MF FQ816MF/IF (note 2)	Europe	CCIR: L, L'/B, G, I	UV816	quasi-split sound (stereo)	IEC	147 x 20 x 55	29
FQ844 FQ844/IF (note 2)	UK	CCIR: I/-	UV816	quasi-split sound (stereo)	IEC	147 x 20 x 55	29
FI916	Europe, S.E. Asia	CCIR: B, G/-	UV916E	intercarrier sound	IEC, phono	100 x 20 x 47	–
FS916	Europe, S.E. Asia	CCIR: B, G/-	UV916E	split sound (stereo)	IEC, phono	100 x 20 x 47	41
FS936	USA	RTMA: M, N/-	UV936E	split sound (stereo)	IEC, phono	100 x 20 x 47	53
FS986	Japan	Japan: M/-	UV936E	split sound (stereo)	IEC, phono	100 x 20 x 47	–

Notes

1. Including connectors and tags.
2. "/IF" versions for D2MAC application.

SATELLITE FRONT ENDS

Product range

TYPE NUMBER	INPUT	CONNECTOR	FREQUENCY BAND (MHz)	AFC	IF OUTPUT	PAGE
SFE212S	single	IEC (f)	950 – 1750	external	no	233
SF914	single	IEC (f)	950 – 1750	external	no	247
SF914D	double	IEC (f + m)	950 – 1750	external	no	247
SF916 (note 1)	single	IEC (f)	950 – 2000	external	no	247
SF916D	double	IEC (f + m)	950 – 2000	external	no	247
SF916/F	single	F	950 – 2000	external	no	247
SF916D/A	single	IEC (f)	950 – 2000	internal	no	247
SF916D/F	double	IEC (f + m)	950 – 2000	internal	no	247
SF916D/F/IF	double	F	950 – 2000	external	yes	247

Note

1. The data sheets for the SF916 family will be available soon.

LOW NOISE BLOCK CONVERTERS

Product range

TYPE NUMBER	INPUT	CONNECTOR	FREQUENCY BAND (GHz)	NOISE FIGURE (dB)	HORN/ FLANGE	PAGE
SC813	single	F	10.95 – 11.70	1.3	horn	261
SC813/FL	single	F	10.95 – 11.70	1.3	flange	261
SC815	single	F	10.95 – 11.70	1.1	horn	261
SC815/FL	single	F	10.95 – 11.70	1.1	flange	261

COAXIAL AERIAL INPUT ASSEMBLIES

With mains separation:	
Frequency range	40 to 890 MHz
Impedance	75 Ω asymmetrical
Input connector	meets the demands of IEC 169.2 and DIN 45325 (diameter 9.5 mm), and of SNIR (diameter 9.0 mm)
Safety requirements	IEC 65; approbation approvals have been received or sought from BSI, D4EMKO, EI, FEMKO, KEMA, LCEE, NEMKO, SEMKO, SEV and VDE.

INSERTION LOSS		CATALOGUE NUMBER	PAGE
AT FREQUENCY (MHz)	(dB)		
40–300	≤1	3122 127 21300 (note 1)	267
470–890	≤1		
40–230	≤1	3122 127 24140	271
230–300	≤1.5		
470–890	≤1.5		

Note

1. This assembly complies with the requirements of immunity from radiated interference of BS905.

PIN COMPATIBILITY AND CONSISTENCY

All tuners and front ends of the 800- and 900-series are pin compatible, i.e. the pins for the same function are located at the same place on the housing, despite the reduced size of the 900-series in comparison with the 800-series (see Fig.1).
The mounting tags (ground) at the aerial input side of the 900-series (MT4) have a different position, because these tuners are smaller. The height of the aerial input connector is the same for all tuners and front ends. Some tuners and front ends of the 900-series (for example: UV916E, UV916H, U944C, FQ916, etc.) are available with an IEC-LONG connector to achieve optimum interchangeability with products of the 800-series.

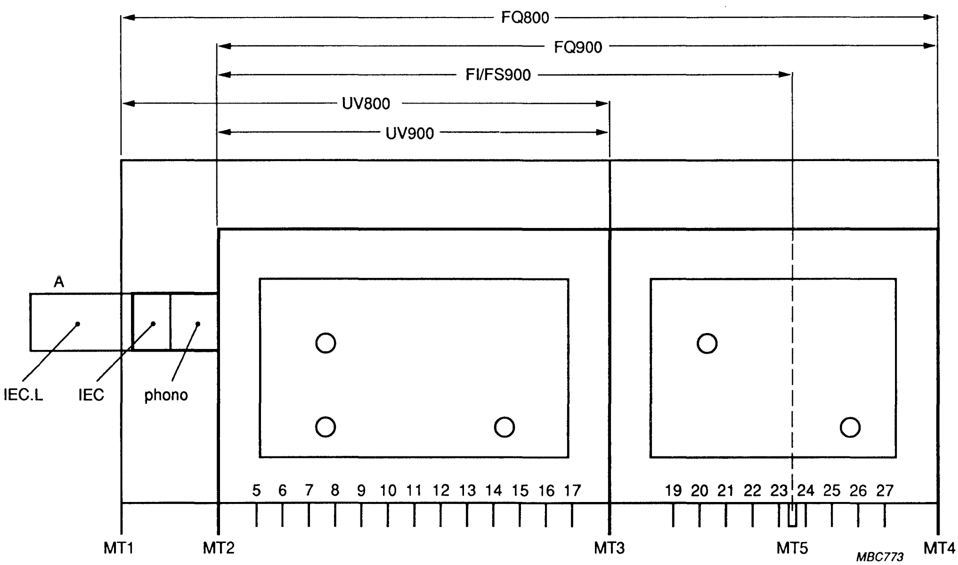


Fig.1 Comparison of pin locations 800- and 900-series.

Terminal designation for 800- and 900-series

PIN NUMBER	DESCRIPTION VST-VERSIONS	DESCRIPTION PLL-VERSIONS
A	aerial input connector	
5	AGC voltage	AGC voltage
6	supply voltage (12 V)	supply voltage (12 V)
7	low band supply voltage (12 V)	
8	mid band supply voltage (12 V)	
10	high band supply voltage (12 V)	
11	tuning voltage (≈ 0.3 to 28 V)	tuning supply voltage (33 V via 22 kΩ)
12	(note 1)	supply voltage (5 V)
13	(note 1)	SCL serial clock (I^2C)
14	(note 1)	SDA serial data (I^2C)
15	(note 1)	multiple address selection
16	ground/IF output (note 2)	ground/IF output (note 2)
17	IF output	IF output
19		audio mute
20		audio/video mute
21		AFC output
22		second IF sound
23		video output
24		supply voltage IF (12 V)
25		AF1/AM sound output
26		audio ground
27		AF2 sound output

Notes

1. Pins 12 to 15 are not used in VST tuners with the exception of the UV816/6456 (divider).
2. Both pins 16 and 17 are IF output for tuners with symmetrical outputs (for example: UV816, UV916H).

VHF/UHF TELEVISION TUNERS
AND FRONT ENDS

VHF / UHF TELEVISION TUNER AND IF DEMODULATOR

QUICK REFERENCE DATA

Systems	CCIR systems B, G and H	
Channels	off-air	cable
low VHF	E2 to C	S01 to S1
high VHF	E5 to E12	S2 to S20
UHF	E21 to E69	
Intermediate frequencies		
picture	38.90 MHz	
colour	34.47 MHz	
sound 1	33.40 MHz	
sound 2	33.16 MHz	
Video output signal		
peak-to-peak voltage	2.1 to 2.8 V	
top sync level	2.2 to 2.6 V	
Intercarrier sound output signals		
5.50 MHz	200 to 500 mV RMS	
5.74 MHz	90 to 225 mV RMS	

APPLICATION

Designed to cover the tuner function according to the CCIR systems B, G and H with extended VHF frequency ranges, combined with a quasi split sound IF function to demodulate the video signal and to convert the sound signal.

The tuner parts of the FE618Q/256 and the FE168Q/6456 are equipped with a frequency divider, which makes them suitable for digital tuning systems based on frequency synthesis.

This tuner complies with the requirements of radiation, signal handling capability, and immunity from radiated interference of Amtsblatt DBP69/1961, and for Finland E.I.S. bulletin T33-82, section 4, when installed professionally in an adequate TV receiver.

Table 1 Available versions

	aerial input connector	frequency divider (IC)	catalogue number
FE618Q/256	IEC	1 : 256	–
FE618Q/6456 (note 1)	IEC	1 : 64 or 1 : 256	3112 297 10251

Note to the Table

1. The frequency divider is switchable.

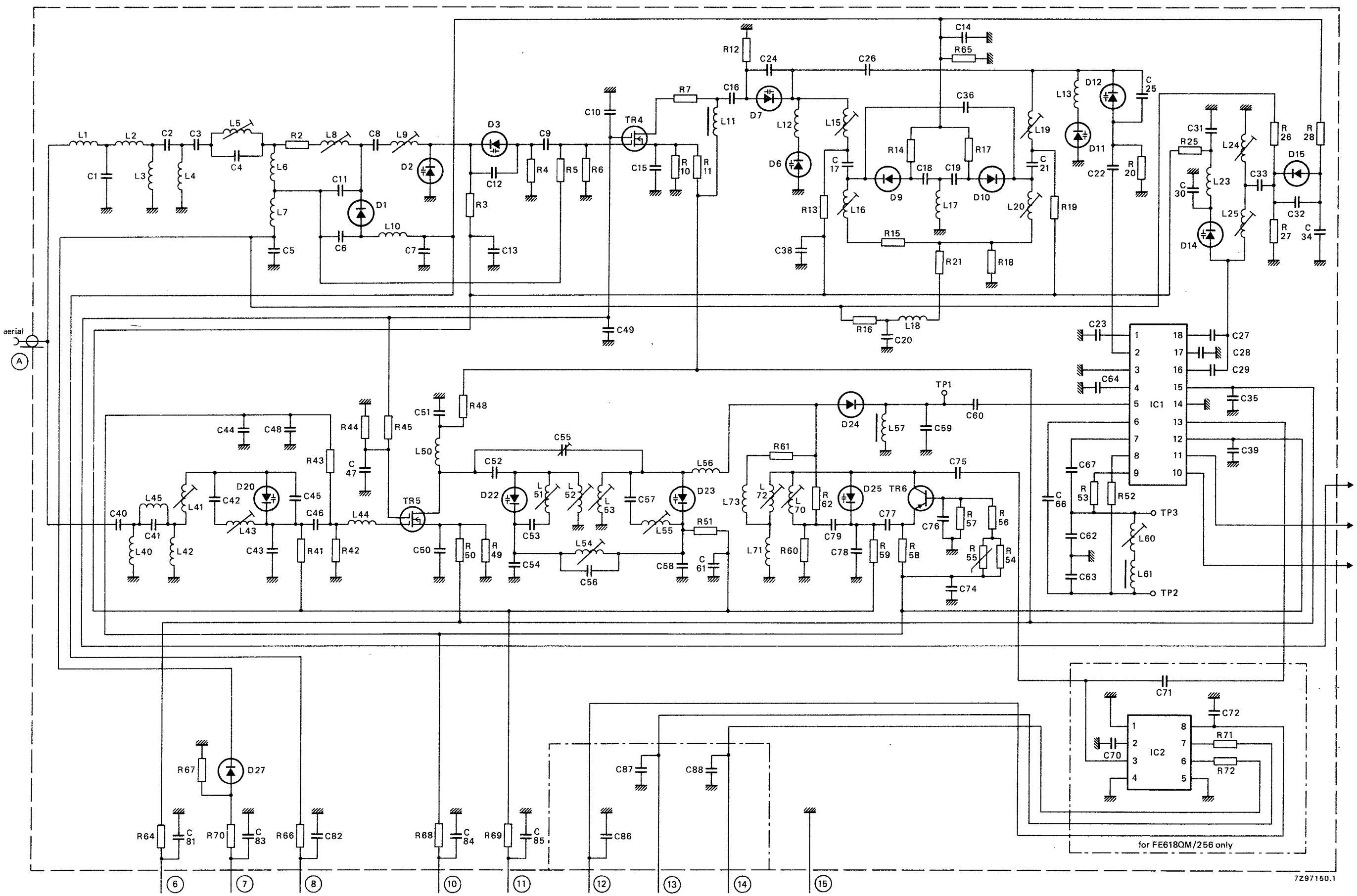


Fig. 1 Tuner part.

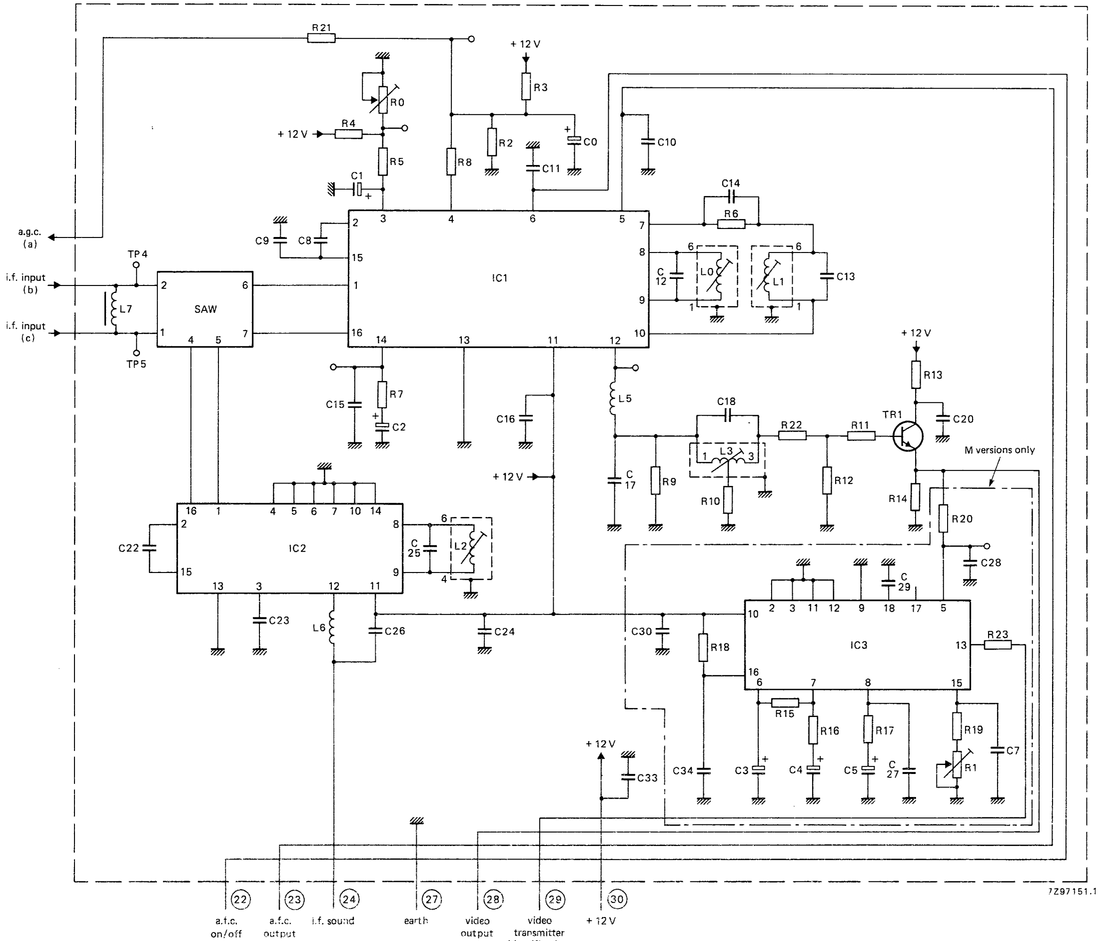


Fig.2; for connections see Fig.3.

DESCRIPTION

The front end contains a VHF/UHF tuner with electronic tuning and band switching, covering the low VHF band (frequency range 46 to 110 MHz), the high VHF band (frequency range 111 to 300 MHz), and the UHF band (frequency range 470 to 860 MHz).

Mechanically, the front end consists of a tuner part and an i.f. part built on separate low-loss printed-wiring boards, carrying all components, in a housing made of a rectangular diecast metal frame and front and rear covers (see Fig. 3). The common IEC coaxial aerial connector (75 Ω) is integrated in one of the frame sides of the housing, all other connections (supply voltages, a.g.c. voltage, tuning and switching voltages, IF output) are made via terminals in the underside. The mounting method is shown in Fig. 4.

Electrically, the tuner part consists of VHF and UHF parts (see Fig. 1). They are equipped with a common aerial input and provided with RF MOSFET input stages. The VHF mixer, VHF oscillator and IF amplifier functions are provided by a tuner IC. This IC has terminals between mixer and i.f. amplifier to connect the IF preselection.

The RF band pass filter and oscillator circuits are tuned by 7 tuning diodes; band switching is achieved by 4 switching diodes.

The UHF part of the tuner has a high-pass input circuit connected to gate 1 of an input MOSFET tetrode (with internal gate protection against surge). The drain load of this MOSFET tetrode is formed by a double tuned circuit transferring the RF signal to the Schottky barrier mixer diode. The IF signal from the mixer diode is amplified by the IF pre-amplifier of the tuner IC.
The RF band pass filter and oscillator circuits are tuned by 4 tuning diodes.

In all bands the tuner is gain-controlled via gate 2 of the input MOSFET tetrode.

A test point TP1 is provided for IF injection.

The electrical circuit of the FE618Q/256 is extended with a frequency divider (division ratio of 256) and that of the FE618Q/6456 with a switchable divider (division ratio 64 or 256), with inputs connected to the VHF and UHF oscillators. The symmetrical ECL outputs are connected to terminals 13 and 14.

The IF part is of the quasi-split sound type. It has separate ICs for video demodulation and sound conversion (see Fig.2).

The demodulated (CVBS–) video signal is available at the video output of the front end and the converted sound signal, with intercarrier frequencies of 5.50 MHz and 5.74 MHz, is available at the sound output.

Terminal designations in Fig. 3

A	= aerial input (IEC female 75 Ω)
6	= supply voltage, tuning part, + 12 V
7	= supply voltage, low VHF + 12 V
8	= supply voltage, high VHF + 12 V
10	= supply voltage, UHF + 12 V
11	= tuning voltage, + 0.48 to + 28 V
12	= supply voltage, frequency divider, + 5 V
13, 14	= balanced output voltage of frequency divider (1 kΩ)
15	= to be grounded for 256 ratio, floating for 64 ratio (FE618Q/6456 only)
22	= switching voltage AFC
23	= AFC output
24	= IF sound
27	= earth
28	= video output
30	= supply voltage IF demodulation, + 12 V

MECHANICAL DATA

Dimensions in mm

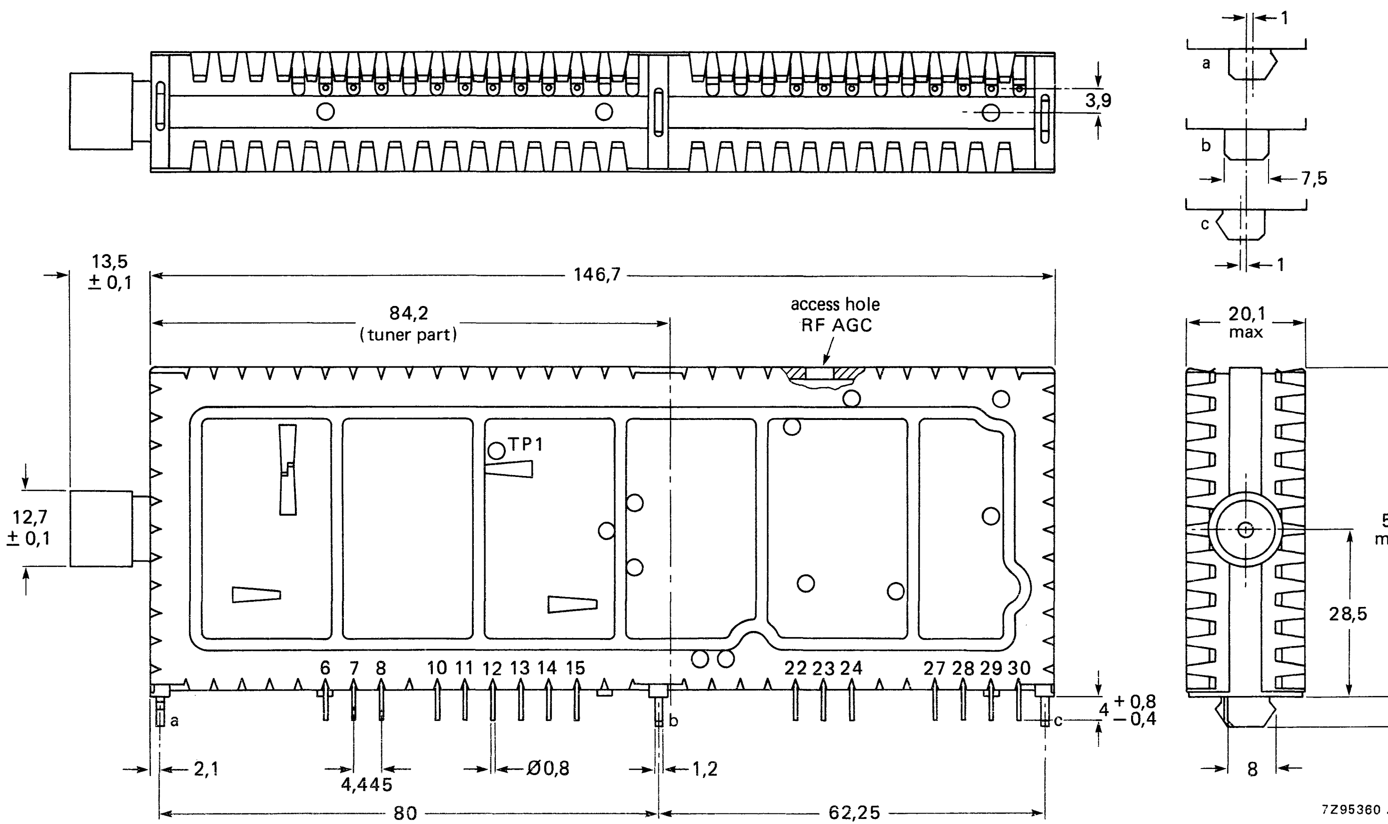


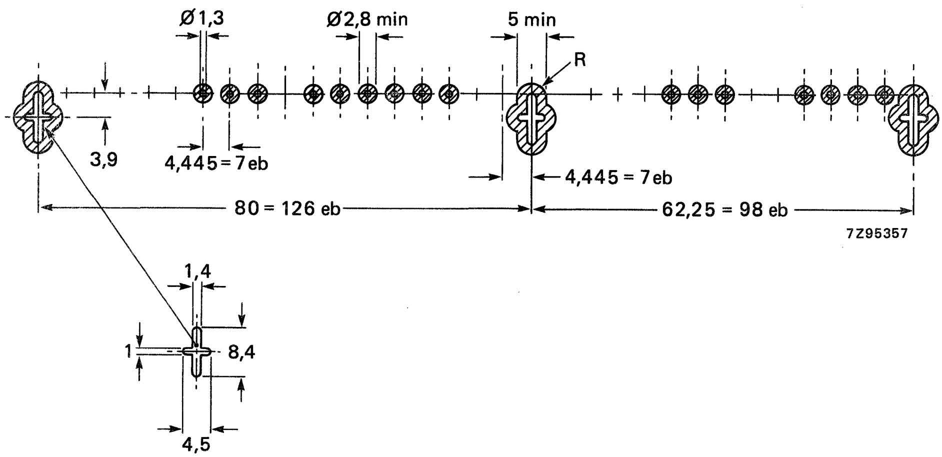
Fig. 3 Unless otherwise stated the tolerance is ± 0,05 mm.

Mass approx. 160 g

Mounting

The unit may be mounted by soldering it on to a printed-wiring board (using the piercing diagram shown in Fig. 4). The construction and positioning of the 3 mounting tags is such that a 'click' indicates the correct seating of the unit on the printed-wiring board. The unit may be mounted anywhere in the receiver and there are no restrictions on orientation.

The solderability of the terminals and mounting tags is according to IEC 68-2, test Ta (235 ± 5 °C, 2 ± 0,5 s). The resistance to soldering heat is according to IEC 68-2, test Tb (260 ± 5 °C, 10 ± 1 s).



1 eb = 0,025 inch

Fig. 4 Piercing diagram viewed from solder side of board. Unless otherwise stated the tolerance is ± 0,05 mm.

In order to withstand vibrations, shocks and bumps that could damage the solder joints of the mounting tags, the front end should be mounted and soldered without clearance between the supporting area and the printed-wiring board.

This can be achieved by:

– twisting the mounting tags 18° (–3°); or
– pressing the front end against the printed-wiring board during soldering; or
– supporting the front end at its aerial connector.

If the aerial connector is used as a direct input to the television set, it should be supported to prevent the printed-wiring board from stress.

ELECTRICAL DATA

Unless otherwise specified all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, supply and band switching voltages of 12 ± 0,3 V.

General

Semiconductors, VHF bands	
RF amplifier	BF992
mixer, oscillator	TDA5030
tuning diodes	7 x BB909
switching diodes	4 x BA482/483/484
d.c. blocking diodes	2 x BAS15
Semiconductors, UHF bands	
RF amplifier	BF990
oscillator	BF970
mixer	1SS99
tuning diodes	4 x BB405
Frequency divider	SP4653
Semiconductors, IF	
IF amplifier and demodulator	TDA2541
quasi-split-sound circuit	TDA2545A
synchronization circuit	TDA2577A
video output transistor	BC548
S.A.W. filter	OFW G3203
Ambient temperature range	
operating	−10 to + 60 °C
storage	−25 to + 85 °C
Relative humidity	max. 95%

Voltages and currents

Supply voltages (tuner and IF part)	+ 12 V ± 10%
Current drawn from + 12 V supply	
VHF bands	max. 50 mA
UHF bands	max. 45 mA
bandswitching	max. 15 mA
IF part	max. 200 mA, without mute 140 mA

For operation in all bands the terminals 6 and 30 are permanently connected to their voltage supplies. Additionally the supply voltage for band switching is connected to:

terminal 7 for operation in low VHF band
terminal 8 for operation in high VHF band
terminal 10 for operation in UHF bands

Tuning voltage range	+ 0.8 to + 28 V
Current drawn from 28 V tuning voltage supply	
at T_{amb} = 25 °C and 60% R.H.	max. 0.5 μA
at T_{amb} = 25 °C and 95% R.H.	max. 2 μA
at T_{amb} = 60 °C and 60% R.H.	max. 2 μA

Note: The source impedance of the tuning voltage offered to terminal 11 must be maximum 47 kΩ.

Aerial input characteristics

Input impedance	75 Ω
VSWR and reflection coefficient (values between picture and sound carrier, as well as values at picture carrier)	
VSWR	at nominal gain and during gain control
VHF bands	max. 4
UHF bands	max. 5
reflection coefficient	
VHF bands	max. 60%
UHF bands	max. 66%
Gain limited sensitivity level	
VHF CCIR channels and UHF channels	typ. 25 dB (μV), max. 33 dB (μV)
S-channels	typ. 29 dB (μV), max. 37 dB (μV)
A.G.C. limited aerial input level	
VHF bands	min. 100 dB (μV)
UHF bands	min. 90 dB (μV)
Oscillator voltage level (fundamental and harmonics up to 1000 MHz) at the input	
VHF bands	max. 44 dB (μV)
UHF bands	max. 66 dB (μV)
Surge protection	max. 5 kV

Tuning characteristics

Frequency ranges	
low VHF band	channel E2 (picture carrier 48.25 MHz) to channel S1 (picture carrier 105.25 MHz).
high VHF band	channel S2 (picture carrier 112.25 MHz) to channel S20 (picture carrier 294.25 MHz).
UHF bands	channel E21 (picture carrier 471.25 MHz) to channel E69 (picture carrier 855.25 MHz).

The frequency ranges remain valid under the specified operating conditions during the entire life time of the unit.
The oscillator frequency is higher than the aerial signal frequency.

Slope of tuning characteristic			
low VHF band,	channel E2	5 MHz/V	typical values
	channel S1	1 MHz/V	
high VHF band,	channel S2	10 MHz/V	
	channel S20	2 MHz/V	
UHF bands,	channel E21	22 MHz/V	
	channel E69	5 MHz/V	

Tuning voltage range within which the divided oscillator frequency increases monotone with the tuning voltage — 0,45 to 30 V

Slope of tuning characteristic	
low VHF band	1 to 6 MHz/V
high VHF band	2 to 14 MHz/V
UHF bands	4 to 25 MHz/V
Tuning voltage range within which the tuning frequency increases monotone with the tuning voltage	0.45 to 30 V
Time constant of varicap voltage	1.5 ms
Aerial input level causing detuning of −300 or + 1000 kHz	
VHF bands	min. 100 dB (μV)
UHF bands	min. 90 dB (μV)

Oscillator characteristics

Shift of oscillator frequency at a change of the supply voltage of 5%	
VHF bands	max. 250 kHz
UHF bands	max. 500 kHz
Drift of oscillator frequency	
during warm-up time (after the tuner has been completely out of operation for 15 min, measured between 5 s and 15 min after switching on)	max. 250 kHz
during warm-up time (after the input stage is in operation for 15 min, measured between 2 s and 15 min after band switching)	max. 250 kHz
at a change of the ambient temperature from + 25 to + 50 °C and from + 25 to + 0 °C	
VHF bands	max. 500 kHz
UHF bands	max. 1000 kHz
at a change of humidity from 60 ± 15% to 93 ± 2%, at T_{amb} = 25 ± 5 °C	
low VHF band	max. 500 kHz
high VHF band	max. 1000 kHz
UHF bands	max. 1500 kHz

Frequency divider characteristics

Frequency division ratio	
FE618Q/256	256
FE618Q/6456	switchable, 64 or 256
Supply voltage	+ 5 V ± 5%
Current drawn from + 5 V supply	max. 35 mA; typ. 25 mA
Output voltage, unloaded, measured with probe 10 MΩ/11 pF	min. 0.5 V(p-p)
Output impedance	typ. 1 kΩ
Output imbalance	max. 0.1 V

AFC output characteristics

Output capacitance	typ. 1.2 nF
Output voltage, when loaded with 25 kΩ	
AFC switched off	6 V
AFC switched on	
voltage for an aerial input of 50 dB (μV)	
correctly tuned	6 V
detuning of + 100 kHz	max. 1.5 V
detuning of −100 kHz	min. 10.5 V
AFC output slope at V_{afc} = 6 V and V_{aerial} = 50 dB (μV)	min. 50 V/MHz, max. 150 V/MHz
AFC voltage when no aerial input	min. 3 V, max. 8 V

Video output characteristics

Measuring conditions: video output (terminal 28) loaded with 155 Ω, decoupling of i.f. supply (terminal 30) with 220 μF.

Video peak-to-peak voltage, video modulation 100%, rest carrier 10%	min. 2.1 V, max. 2.8 V
Top sync level	min. 2.2 V, max. 2.6 V
No-signal level	min. 5.0 V, max. 5.7 V
Video signal expansion for a change of the aerial input signal level from 40 dB (μV to 90 dB (μV)	max. 0.5 dB
Unweighted video signal to noise ratio for an aerial input level of 50 dB (μV)	
VHF CCIR channels	typ. 36 dB, min. 33 dB
S-channels	typ. 34 dB, min. 31 dB
UHF channels	typ. 32 dB, min. 29 dB

Unweighted video S/N-ratio for V_{aerial} = 70 dB (μV)			
VHF CCIR channels	typ. 46 dB		
S-channels	typ. 44 dB		
UHF channels	typ. 46 dB		
Flatness (0.1 – 3.5 MHz)			
VHF/UHF for V_{aerial} up to 70 dB (μV)	max. 3 dB		
VHF for V_{aerial} = 100 dB (μV)	max. 4 dB		
UHF for V_{aerial} = 90 dB (μV)	max. 4 dB		
Group delay time deviation (0.1 – 3.5 MHz) for V_{aerial} up to 70 dB (μV)			
VHF, channels E3 and up; UHF channels	max. 50 ns		
VHF, channel E2 minus 1 MHz	max. 60 ns		
Gain drop at colour carrier for V_{aerial} = 70 dB (μV); 1 MHz reference			
at 4.43 MHz	typ. 5 dB	max. 8.5 dB	
at 4.00 MHz	typ. 2 dB		
at 4.80 MHz	typ. 11 dB		
Group delay time deviation at colour carrier frequency (4.43MHz)	typ. 60 ns		
2T-impulse response			
top level referred to black-white response	typ. 105%	min. 85%	max. 125%
50% level width	min. 180 ns	max. 220 ns	
K-rating	max. 4%		
Differential gain	typ. 4%	max. 10%	
Differential phase	typ. 2°	max. 10°	
Field time waveform distortion	max. 10%		
Line time waveform distortion	max. 10%		
1.07 MHz sound-chroma interference level conditions			
gain control	30 dB		
picture carrier/colour carrier ratio	16 dB		
picture carrier/sound carrier ratio	10 dB		
40 dB interference distance at video output	typ. 90 dB (μV)		

Sound carriers rejection		
5.48 MHz to 5.52 MHz	min.	50 dB
5.74 MHz	min.	35 dB
Level residual IF carrier and harmonics	max.	3.5 mV
Frequency divider interference distance for V_{aerial} = 50 dB (μV) (referred to 1 MHz)	min.	40 dB
Image rejection for V_{aerial} = 70 dB (μV)		
VHF bands	min.	66 dB
UHF bands	min.	53 dB
First repeat spot interference aerial input level		
VHF bands	min.	75 dB (μV)
UHF bands	min.	63 dB (μV)
Unwanted aerial input level for 1% cross modulation at a wanted signal level of 50 dB (μV)		
N ± 1 VHF	min.	74 dB (μV)
N ± 1 UHF	min.	74 dB (μV)
In-band VHF -low, N ± 2	typ.	92 dB (μV)
In-band VHF -high, N ± 3	typ.	92 dB (μV)
In-band UHF , N ± 5	typ.	100 dB (μV)
Out-of-band	min.	100 dB (μV)
Breakthroughs	typ.	80 dB (μV)
Ripple susceptibility		
at pins 7, 8 and 10	min.	5 mV (p-p)
at pins 6 and 30	min.	30 mV (p-p)

Video identification (QM versions only)

Load impedance 100 kΩ	
Output voltage (terminal 29)	
no video	min. 10 V
video	max. 0.5 V
Line frequency for guaranteed video identification	min. 15.0 kHz; max. 16.2 kHz
Aerial input sensitivity level	typ. 25 dB (μV)

Sound carrier output characteristics

Measuring conditions:	
Sound output load impedance (via DC block capacitor)	3 kΩ
Sound carrier levels related to picture carrier level:	
first sound carrier (5.50 MHz)	typ. −13 dB
second sound carrier (5.74 MHz)	typ. −20 dB
Nominal RMS signal level	
5.50 MHz	min. 200 mV; max. 500 mV
5.74 MHz	min. 90 mV; max. 225 mV
DC voltage level (terminal 24)	min. 4.8 V; max. 7 V
Signal to noise ratio weighted according to CCIR 468-3, determined after f.m.-detection for aerial input signal level 70 dB (μV) and video contents:	
black, 5.50 MHz	typ. 50 dB
black, 5.74 MHz	typ. 55 dB
5 kHz sine wave, 5.50 MHz	min. 42 dB; typ. 50 dB
5 kHz sine wave, 5.74 MHz	min. 40 dB; typ. 50 dB
250 kHz sine wave, 5.50 MHz	min. 42 dB; typ. 50 dB
250 kHz sine wave, 5.74 MHz	min. 32 dB; typ. 34 dB

Miscellaneous

Radio interference Oscillator radiation and oscillator voltage at the aerial terminal	Within the limits of C.I.S.P.R. 13 (1975) + amendment 1 (1983), VDE0872/7.72., Amtsblatt DBP69/1981, and for Finland E.I.S., bulletin T33-82, section 4, when applying the unit in an adequate TV receiver
Microphonics	There will be no microphonics, provided the unit is installed in a professional manner.
Surge protection of aerial input against voltages	max. 5 kV

Note: 10 discharges of a 470 pF capacitor into the aerial terminal.

Protection against flashes	max. 30 kV, 400 mWs

Note: A flashover circuit producing flashes with frequencies of 1 to 20 Hz for 30 s is connected to the aerial terminal.

VHF/UHF TELEVISION MULTINORM FRONTENDS

QUICK REFERENCE DATA

Systems		
FQ816	CCIR systems B and G	
FQ844	CCIR system I	
FQ816ME	CCIR systems B, G, L and M	
FQ816MF	CCIR systems L, L′, B, G and I	
Channels	off-air	cable
low band	E2 to C	S01 to S10
mid band	E5 to E12	S11 to S39
High band	E21 to E69	S40 to S41
Video output signal		
peak-to-peak voltage	2.0 V	
Audio output signal	tbf	

Intermediate frequencies (MHz)

System	B/G	L	L′	I	M	D2MAC
Picture	38.9	38.9	33.9	38.9	38.9	38.9
Sound 1	33.4	32.4	40.4	32.9	34.4	—
Sound 2	33.158	—	—	—	—	—
Nicam	33.05	—	—	32.348	—	—
Band edge	—	—	—	—	—	30.50

APPLICATION

The frontends are part of the 800 family of tuners and frontends which are designed to meet a wide range of applications.

The frontends consist of an all band tuner (high band only for FQ844) and a mono/multi standard IF demodulation unit giving baseband video and audio (mono/stereo) out.

The all band tuner sections of the FQ816 series frontends are also suitable for D2MAC-AM system reception for channels between 300 and 470 MHz.

The tuner parts of the frontends are equipped with a built-in digitally controlled (I^2C) PLL tuning system. Band and system switching is also carried out via the I^2C-bus. The AFC signal can also be read via the I^2C-bus.

Available versions

Type	optimal system coverage	secondary system coverage	catalogue number
FQ816	B and G	–	3122 237 10430
FQ844	I	–	3122 237 10440
FQ816ME	B and G	L and M	3122 237 10450
FQ816MF	L and L′	B, G and I	3122 237 10460

Note

These frontends comply with the following requirements of radiation, signal handling capability and immunity from radiated interference:

FQ816 : CISPR13 (1975) including amendment 1 (1983), Amtsblatt 69 (1981), DIN VDE 0872, CENELEC EN55013 (radiation) and EN55020 (immunity) and Finland EIS Bulletin T33-86, section 4.

FQ844 : CISPR13 (1975) including amendment 1 (1983), CENELEC EN55013 (radiation) and EN55020 (immunity) and BS905.

FQ816ME: : CISPR13 (1975) including amendment 1 (1983), Amtsblatt 69 (1981), DIN VDE 0872, CENELEC EN55013 (radiation) and EN55020 (immunity) and Finland EIS Bulletin T33-86, section 4.

FQ816MF : CISPR13 (1975) including amendment 1 (1983), CENELEC EN55013 (radiation) and EN55020 (immunity) and Finland EIS Bulletin T33-86, section 4.

DESCRIPTION

The frontends consist of a tuner section and an IF demodulation section. The tuner section of the FQ816 series covers the low band (frequency range 47.25 to 170 MHz), the mid band (frequency range 170 to 450 MHz) and the high band (frequency range 450 to 855.25 MHz). The tuner section of the FQ844 covers the high band only.

The tuner and IF sections are constructed on separate printed-wiring boards and housed in a die-cast metal housing with front and rear covers. A common IEC and SNIR aerial connector is integrated in one of the frame sides of the housing, all other connections are made via pins on the underside of the housing.

The tuner part is equipped with 3 tuned RF MOSFET input stages, with a 3-band mixer-oscillator IC, containing the oscillators, mixer and IF amplifier. Tuning and band switching in the tuner section is carried out via a digitally programmable (I^2C) PLL tuning system. This enables tuning with a 62.5 kHz pitch with crystal accuracy.

The IF section of the frontend has the vision carrier fixed at 38.9 MHz (33.9 MHz for FQ816MF using system L'). The units use QSS-SAW filter except for the FQ816MF using system L' where a double Nyquist QSS-SAW filter is used in the vision channel.

Quasi-synchronous vision IF demodulation is used and this is suitable for positive and negative modulation.

The IF sound filtering is done by means of a QSS-SAW filter for systems B, G and I and via a separate bandpass filter for systems L and L'.

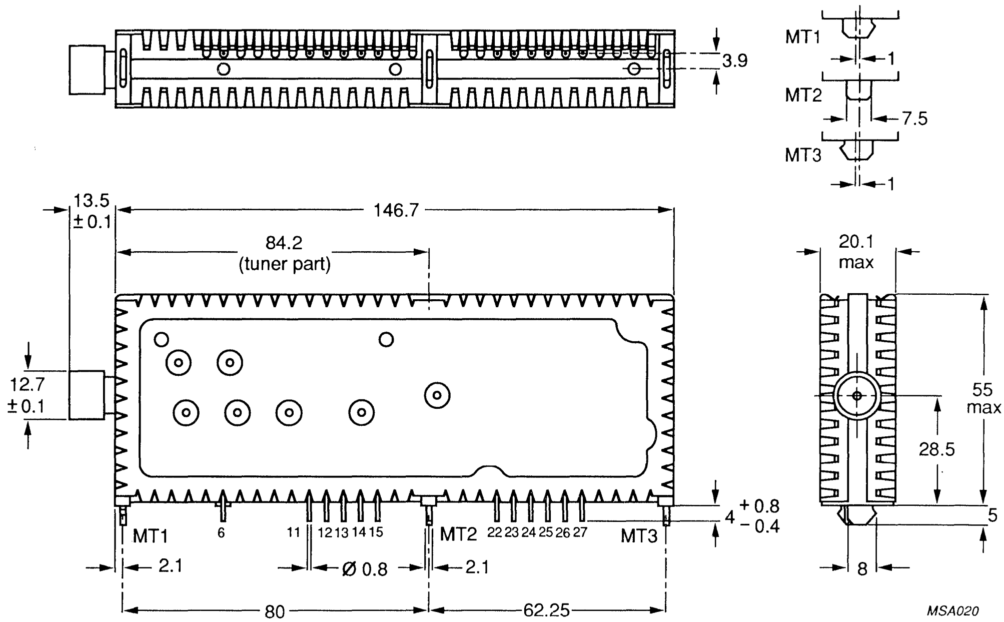
The sound IF demodulation used offers two FM discriminator circuits and one AM detector circuit. It also has two switchable, independent symmetrical sound IF inputs, system selection and automute in the case of mono transmission or AM sound, as is the case with systems L and L'.

The frontends also have a 2nd IF sound output for use with digital sound (NICAM) or D/K/K1 sound. An additional audio ground pin is also available for applications requiring separate audio and video grounds.

System switching is carried out internally using the I^2C-bus. The internal analog AFC signal is fed to the A/D converter present in the PLL IC and can be read via the I^2C-bus.

MECHANICAL DATA

Dimensions in mm



A	aerial input	IEC/SNIR female, 75 Ω
6	supply voltage, tuner section	+12 V
11	tuning supply voltage	+33 V via 22 kΩ series resistor
12	supply voltage PLL	+5 V
13	SCL	serial clock line (I^2C-bus)
14	SDA	serial data line (I^2C-bus)
15	AS	address selection line
22	2nd IF sound	intercarrier sound for NICAM, system D/K/K1.
23	CVBS out	video output
24	supply voltage, IF section	+12 V
25	AF1/AM	AF sound out (for 2CS and L/L′ sound)
26	audio ground	
27	AF2	AF sound out (for 2CS) (FQ816 types only)
MT1 MT2 MT3	mounting tab	grounded

Fig.1 Mechanical detail.

Note: VTI, and MAC AGC mode will be introduced to the frontend in the future.

Mass : approximately 160 grams.

Mounting

The unit may be mounted by soldering it to a printed-wiring board without clearance between the unit supporting surface and the board using the piercing diagram shown in Fig.3. The connection pins should be bent in accordance with Fig.4. The tuner may be mounted anywhere in the receiver and there are no restrictions on orientation.

The solderability of the pins and mounting tabs is in accordance with IEC 68-2-20, test Ta ($230^{o} \pm 10\ ^{o}C$, 2 ± 0.5 s). The resistance to soldering heat is in accordance with IEC 68-2-20, test Tb ($260^{o} \pm 5\ ^{o}C$, 10 ± 1 s).

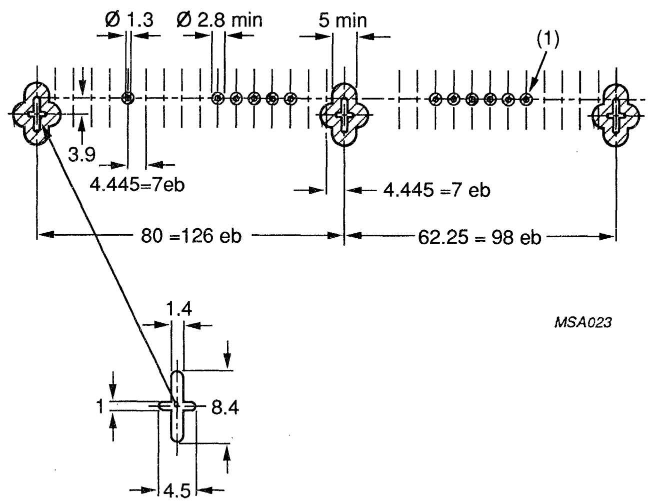
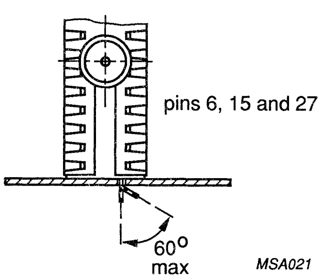
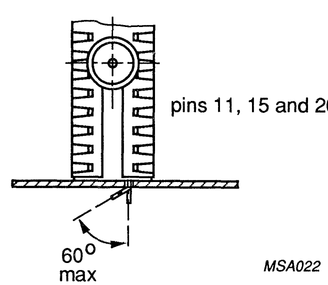


Fig.2 Piercing diagram viewed from solder side of board.





Note: In order to prevent any stress to the printed-wiring board, the unit should be supported at its aerial connector.

Fig.3 Bending of connecting pins.

ELECTRICAL DATA

Unless otherwise stated all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0.2 V, a PLL supply voltage of 5 ± 0.2 V, an aerial source impedance of 75 Ω and a tuning supply voltage of 33 ± 0.5 V via a 22 kΩ series resistor.

General

Semiconductors, low band	
RF amplifier	BF998
tuning diodes	BB911
coupling diodes	BB901/BBY31
Semiconductors, mid band	
RF amplifier	BF998
tuning diodes	BB910
coupling diodes	BB405
Semiconductors, high band	
RF amplifier	BF998
tuning diodes	BB405
Tuning/bandswitching IC	TSA5512
Tuning voltage transistor	BC847B
Mixer/oscillator IC	TDA5330
Semiconductors, IF section	
SAW filter	OFWG3254/OFWK3255/OFWJ3251
vision demodulator IC	TDA4439B
sound demodulator IC	TDA3857/TDA3856
switching diodes	RLS135
Ambient temperature range	
operating	−10 to +60 °C
storage	−25 to +85 °C
Relative humidity	
operating	95%
storage	100%

Voltages and currents

Supply voltages (operational range)	
tuner and IF sections	+12 V ± 10%
PLL	+5 V ± 10%
Current drawn from +12 V supply	
tuner section	max. 85 mA
IF section	max. 200 mA
Current drawn from +5 V supply	
PLL	max. 50 mA

ELECTRICAL DATA (continued)

Voltages and currents (continued)

Tuning voltage supply (note 1)	min. 30 V typ. 33 V max.35 V
Current drawn from tuning supply	max. 1.7 mA

Aerial input characteristics

Input impedance	75 Ω
VSWR referred to 75 Ω impedance and picture carrier	
low band	max. 4
mid band 170 - 300 MHz	max. 4
mid band 300 - 450 MHz	max. 3
high band	max. 4
Reflection coefficient	
low band	max. 60%
mid band 170 - 300 MHz	max. 60%
mid band 300 - 470 MHz	max. 50%
high band	max. 60%
Oscillator voltage at aerial input (fundamental and harmonics)	
up to 860 MHz	34 dBμV
860 to 1000 MHz	44 dBμV
Surge protection	min. 5 kV

Tuning characteristics

Frequency ranges	
low band	channel E2 (picture carrier 48.25 MHz) to channel S10 (picture carrier 168.25 MHz).
mid band	channel E5 (picture carrier 175.25 MHz) to channel S39 (picture carrier 447.25 MHz).
high band	channel E21 (picture carrier 471.25 MHz) to channel E69 (picture carrier 855.25 MHz).
Voltage gain	
all channels	min. 40 dB max. 50 dB
gain difference of the off-air channels	max. 7 dB
Noise figures	
low band	typ. 6 dB max. 9 dB
mid band	typ. 7 dB max. 10 dB
high band	typ. 8 dB max. 11 dB

Note

1. An external pull-up resistor of 22 kΩ ± 5% must be connected between the tuning supply and terminal 11. The tuning supply current is 1.7 mA max.

AGC range		
low and mid band	min.	40 dB
high band	min.	30 dB
Overloading		
Input signal producing 1 dB compression at nominal gain		
all channels	typ.	90 dB/μV
PLL lock-out		
Input signal producing either a detuning of the oscillator of +300 kHz or −1000 kHz or stopping the oscillations completely at nominal gain		
all channels	min.	100 dB/μV
Image rejection for 10 dB gain reduction		
at frequencies less than 300 MHz	min.	70 dB
	typ.	75 dB
at frequencies between 300 MHz and 450 MHz	min.	66 dB
	typ.	70 dB
at frequencies between 450 MHz and 470 MHz	min.	60 dB
	typ.	65 dB
at frequencies above 470 MHz	min.	53 dB
	typ.	65 dB
IF rejection		
channel E2	min.	50 dB
all other channels	min.	60 dB

Cross modulation

The interfering carrier level required to produce 1% transfer of its modulation depth on the desired carrier N shall equal or exceed the desired carrier level for levels of this carrier of 60 dB/μV to 100 dB/μV (90 dB/μV for high band) or be:

in channel (except systems L and L′)	min.	74 dB/μV
in channel for systems L and L′	min.	70 dB/μV
in band N ± 2 low band	typ.	100 dB/μV
in band N ± 3 mid band	typ.	100 dB/μV
in band N ± 5 high band	typ.	100 dB/μV
Out of band	typ.	100 dB/μV

Video output characteristics

Video peak-to-peak voltage, video modulation 100%, rest carrier 10% (for B/G mode only), minimum load 600 Ω	typ.	tbf
No-signal level		tbf
DC level of sync pulse at terminal 23	typ.	2.7 V
Residual intercarrier sound signal in video channel		
for FQ816, FQ816ME in B/G mode and FQ816MF in B/G mode		
level at terminal 23 for 5.5 MHz	max.	68 dB/μV
5.74 MHz	max.	74 dB/μV
for FQ816ME in M mode		
level at terminal 23 for 4.5 MHz	max.	70 dB/μV
for FQ844		
level at terminal 23 for 6.0 MHz	max.	68 dB/μV

ELECTRICAL DATA (continued)

Sound carrier output characteristics

Measuring conditions

Sound output load impedance	min. 1.2 kΩ
Sound carrier levels related to picture carrier level:	
first sound carrier (5.50 MHz)	−13 dB
second sound carrier (5.74 MHz)	−20 dB

Audio output levels

Systems B, G and I measured with 1 kHz audio signal, 27 kHz FM deviation.

audio output level (peak-to-peak value)	typ. 1.4 V
total harmonic distortion	max. 2%

System M measure with 1 kHz audio signal, 13.5 kHz FM deviation.

audio output level (peak-to-peak value)	typ. 1.4 V
total harmonic distortion	max. 2%

Systems L and L′ measure with 1 kHz audio signal, 54% AM modulation.

audio output level (peak-to-peak value)	typ. 1.2 V
total harmonic distortion	max. 2%

Miscellaneous

Radio interference, oscillator radiation and oscillator voltage at aerial terminal

Within the limits of DBP Amtsblatt 69/1981 item 5.3.2 ans European standard EN55013

Microphonics

For sound signals in the audio frequency range 100 Hz to 10 kHz and sound pressure levels up to 105 dB (20 μPa) the video signal to sound interference ratio will be greater than 40 dB.

ESD protection at the terminals

All terminals of the front end are protected against electrostatic discharge up to 2 kV. The product is classified in category B (MIL-STD-883C).

APPLICATION INFORMATION

For further information regarding general aspects of I^2C-bus control refer to:
"The I^2C-bus specification", published by Philips Components.

I^2C-bus requirements

$V_{IL(max)}$ = 1.5 V (maximum input LOW voltage)
$V_{IL(min)}$ = 3.0 V (minimum input HIGH voltage)
$I_{IL(max)}$ = −10 μA (maximum LOW input current)
$I_{IH(max)}$ = 10 μA (maximum HIGH level current)
$V_{OL(max)}$ = 0.4 V (maximum output LOW voltage at 3 mA sink current)

Logic diagram (WRITE mode, R/$\overline{W}$ = 0)

	MSB							LSB	
Address byte	1	1	0	0	0	MA1	MA0	R/$\overline{W}$	ACK
Prog. Div. byte 1	0	n14	n13	n12	n11	n10	n9	n8	ACK
Prog. div. byte 2	n7	n6	n5	n4	n3	n2	n1	n0	ACK
Control byte 1	1	CP	T1	T0	1	1	1	OS	ACK
Control byte 2	P7	P6	P5	P4	P3	P2	P1	P0	ACK

ACK = Acknowledge

Address selection

voltage at port P3	MA1	MA2	address
0 . . 0.1 V_{PLL}	0	0	C0
always valid	0	1	C2
0.4 . . 0.6 V_{PLL}	1	0	C4
0.9 V_{PLL} . . 13.5 V	1	1	C6

Programmable divider setting (byte 1 and 2)

Divider ratio: $N = 16 \times (f_{RF,\ pc}\ (MHz) + f_{IF,\ pc}\ (MHz))$

$$N = 16384 \times n14 + 8192 \times n13 + 4096 \times n12 + 2048 \times n11 + 1024 \times n10 + 512 \times n9 + 256 \times n8 + 128 \times n7 + 64 \times n6 + 32 \times n5 + 16 \times n4 + 8 \times n3 + 4 \times n2 + 2 \times n1 + n0$$

Control byte 1

Charge pump setting

Charge pump setting CP = 0 for all bands.
Improved tuning speed is achieved by setting CP = 1 for channels above channel S5 in low band, S29 in mid band and E47 in high band.

Test mode setting

T1 = 0, T0 = 0 for normal operation.

Op amp output

OS = 0 for normal operation

Control byte 2

Bandswitching, tuner section, all types

	P3	P4	P5	P6	P7
low band	0	0	1	0	1
mid band	0	1	0	0	1
high band	0	1	1	0	0

P3 - P7: ports on PLL device

System switching, IF section

For FQ816ME type

	P0	P1	P2
B/G mode	1	0	x
L mode	1	1	x
M mode	0	0	x

For FQ816MF type

	P0	P1	P2
L mode	1	1	1
L′ mode	1	1	0
B/G mode	1	0	1
I mode	0	0	1

P0 - P2: ports of PLL device.
x = don't care.

Telegram examples, WRITE mode

Start – ADD – ACK – DIV1 – ACK – DIV2 – ACK – CB1 – CB2 – ACK – Stop

Start – ADD – ACK – DIV1 – ACK – DIV2 – ACK – DIV1 – ACK – Stop

Start – ADD – ACK – DIV1 – ACK – DIV2 – ACK – Stop

Start – ADD – ACK – CB1 – ACK – CB2 – ACK – Stop

Start – ADD – ACK – CB1 – ACK – CB2 – ACK – DIV1 – ACK – Stop

Logic diagram (READ mode, $R/\overline{W} = 1$)

	MSB							LSB	
address byte	1	1	0	0	0	MA1	MA0	$R/\overline{W}$	ACK
status byte	POR	FL	I2	I1	I0	A2	A1	A0	ACK

ACK = acknowledge.

POR = power-on reset flag. POR = 1 on power-on.

FL = in-lock flag. FL = 1 when PLL is in lock.

A2, A1, A0 = value of AFC signal.

I2, I1, I0 = not used in this application.

ADDITIONAL INFORMATION

Tuning voltage

A tuning voltage of 33 V must be connected via 22 kΩ series resistor to pin 11. A preferred method is a constant current supply of 1.5 mA to the pin. Figure 4 shows this with a 140 V supply. The zener diode prevents the voltage at pin 11 exceeding 33 V.

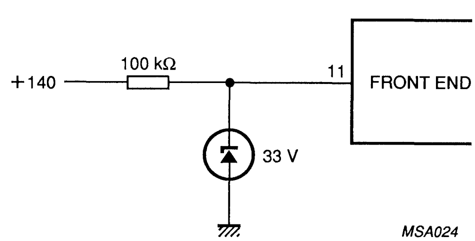


Fig.4 Constant current supply.

VHF/UHF television frontend FS916E

APPLICATION

The FS916E frontend is designed to cover all the frequencies in the channel 2 (48.25 MHz) to channel 69 (855.25 MHz) range of CCIR systems B and G.

The frontend is equipped with an I^2C-bus for digitally programmable phase-locked loop frequency synthesis with crystal accuracy. Bandswitching is also carried out via the I^2C-bus. Since the address of the I^2C device can be set externally, more I^2C-controlled tuners/frontends can be used in the application (e.g. a second tuner for PIP applications).

The frontend complies with the radiation, signal handling capability and immunity regulations of:

- CISPR 13 (1973) including amendment 1 (1983)
- German regulations according to 'Amtsblatt' 69, 1981 + DIN VDE 0872
- CENELEC proposal European Standard EN55013, EN55020.

QUICK REFERENCE DATA

Systems	CCIR systems B and G
Channels	
VHF	channels E2 to C, E5 to E12
UHF	channels E21 to E69
CATV	channels S01 to S41
Intermediate frequencies	
picture	38.90 MHz
sound	33.40 MHz
colour	34.47 MHz

DESCRIPTION

The FS916E frontend is a combination of a VHF/UHF tuner with an IF demodulator. It covers the low band (frequency range 48.25 to 168.25 MHz), the mid band (frequency range 175.25 to 447.25 MHz) and the high band (frequency range 455.25 to 855.25 MHz).

The tuner and IF sections are constructed on separate printed circuit boards, and the entire unit is housed in a metal case consisting of a rectangular frame with front and rear covers. The aerial connector is mounted on one end of the housing. All other connections are made via pins on the underside of the tuner.

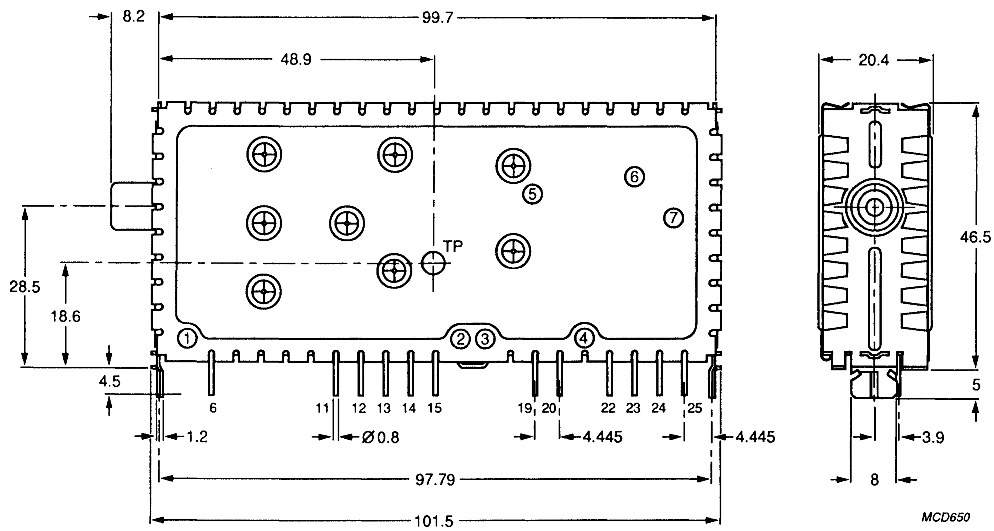
The output of the tuner section is internally connected to the IF section. The IF section has a split sound PLL IF demodulator IC, and has the following output signals:

- demodulated video output
- non-decoded AF sound
- second IF output.

Semiconductors and key components used

FUNCTION	DEVICE USED		
	LOW BAND	MID BAND	HIGH BAND
Tuner section			
RF amplifier	BF998R	BF998R	BF998R
Mixer	BFS17	2SC2480	2S3841
Oscillator	BFS17	2SC3545	2SC2480
Tuning diodes	BB911	OF633	OF976
Coupling diodes	BF901	OF633	–
IF amplifier	BFS17		
PLL tuning IC	TSA5511T/C1		
Charge pump buffer transistor (NPN)	BC847B		
IF section			
PLL IC	LA7570		
Video amplifier	BC548		
Video SAW filter	OFWG3963		
Sound SAW filter	SAF41MC70Z		
Ceramic filter	TPS5.5MB2		
Ceramic trap	SFS5.5ME2		

MECHANICAL DATA



Dimensions in mm.

Fig.1 Mechanical detail.

Mass

The mass of the tuner is approximately 85 g.

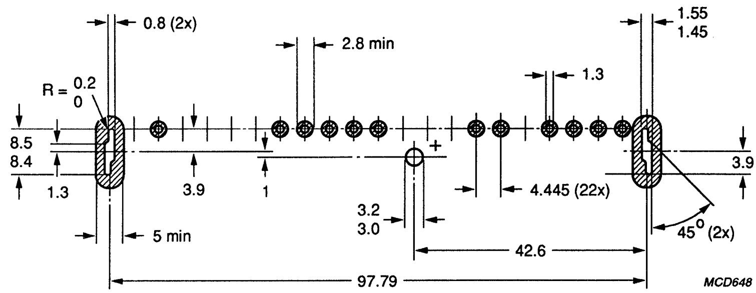
Mounting

The frontend may be mounted by soldering it to a printed circuit board, using the piercing diagram shown in Fig.2, without clearance between the tuner supporting surface and the board. The mounting tabs should be bent in accordance with Fig.3. The frontend may be mounted anywhere in the receiver and there are no restrictions on orientation.

The solderability of the pins and mounting tabs is in accordance with IEC 68-2-20, test Ta (230 ±10 °C, 2 to 5 s). The resistance to soldering heat is in accordance with IEC 68-2-20, test Tb (260 ±5 °C, 10 ±1 s).

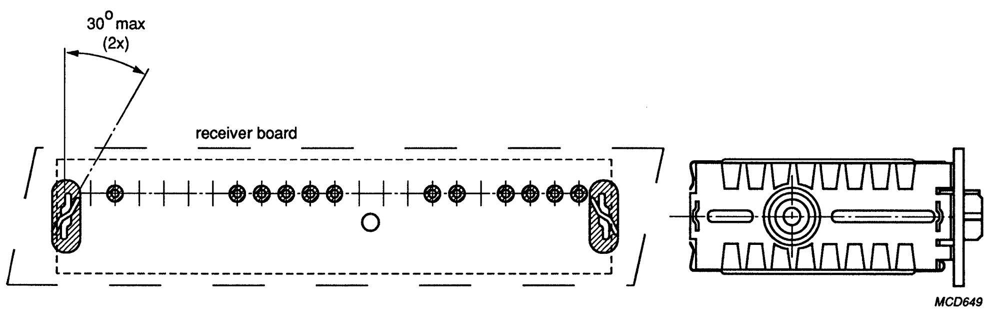
Pinning

PIN	FUNCTION
A	aerial input
6	supply voltage, tuner section, +12 V
11	tuning voltage 33 V through 22 kΩ resistor
12	PLL supply voltage, +5 V
13	SCL serial data line
14	SDA serial data line
15	address selection input
22	2nd IF sound output
23	video output
24	supply voltage, IF section, +12 V
25	AF sound output
MT1, MT2	mounting tab, grounded



+ = additional hole for extra fixing of frontend by means of a tap pan screw, 4 N, max. length 4.5 mm.

Fig.2 Piercing diagram viewed from solder side of board.



Tab twist method seen from solder side.

Fig.3 Bending of mounting tabs.

ELECTRICAL DATA

Unless otherwise stated, all electrical values apply at an ambient temperature of 25 ±5 °C, a relative humidity of 60 ±15%, a supply voltage of 12 ±0.3 V, an AGC voltage of 9.2 ±0.2 V, a PLL supply voltage of 5 ±0.5 V and a tuning supply voltage of 33 ±0.5 V via a 22 kΩ series resistor.

PARAMETER	MIN.	TYP.	MAX.	UNIT
Environmental				
Ambient temperature range				
operating	−10	−	60	°C
storage	−25	−	85	°C
Relative humidity	−	−	95	%
Voltages and currents				
Supply voltage, tuner section	10.8	12	13.2	V
Supply voltage, IF section	10.8	12	13.2	V
Supply voltage, PLL section	4.5	5	5.5	V
Current drawn				
tuner section	−	−	60	mA
IF section	−	−	75	mA
PLL section	−	−	55	mA
Tuning supply voltage	30	33	35	V
Tuning supply current	−	−	1.7	mA
Frequencies				
Low band	channel 2 (picture carrier 48.25 MHz) to channel S10 (picture carrier 168.25 MHz). Margin at extreme channels: min. 1.5 MHz.			
Mid band	channel E5 (picture carrier 175.25 MHz) to channel S39 (picture carrier 447.25 MHz). Margin at extreme channels: min. 3.0 MHz.			
High band	channel S40 (picture carrier 455.25 MHz) to channel 69 (picture carrier 855.25 MHz). Margin at extreme channels: min. 3.0 MHz.			

Tuner section

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Wanted signal characteristics					
Aerial input impedance		–	75	–	Ω
VSWR	referred to 75 Ω	–	–	4	
Reflection coefficient		–	–	60	%
RF bandwidth		–	11	–	MHz
RF curves, tilt	on any channel, the amplitude difference between the top of the overall curve and the picture carrier, the sound carrier, or any frequency between them will not exceed 3 dB for SC at nominal gain.				
AGC characteristics					
low - mid band		40	–	–	dB
high band		30	–	–	dB
Voltage gain		40	–	52	dB
Gain taper	off-air channels	–	–	7	dB
Noise figure					
low band		–	–	9	dB
mid band		–	–	10	dB
high band		–	–	11	dB
Overloading					
input signal producing 1 dB signal compression		–	90	–	dB/μV
PLL lockout		90	–	–	dB/μV
Image rejection					
nominal gain reduction to 10 dB gain reduction					
low - mid band	< 300 MHz	70	–	–	dB
	> 300 MHz	66	–	–	dB
mid band	< 470 MHz	60	–	–	dB
	> 470 MHz	53	–	–	dB
IF rejection					
channel E2		45	–	–	dB
other channels		60	–	–	dB
1/2 IF susceptibility					
low - mid band	< 300 MHz	80	–	–	dB
mid band	> 300 MHz	75	–	–	dB
high band		60	–	–	dB

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Unwanted signal characteristics					
Cross modulation (note 1)					
in channel	gain reduction 0 dB	72	76	–	dB/μV
in band N ±2: low band	gain reduction 0 dB	80	90	–	dB/μV
in band N ±3: mid band	gain reduction 0 dB	80	90	–	dB/μV
in band N ±5: high band	gain reduction 0 dB	84	95	–	dB/μV
out of band		–	100	–	dB/μV
PLL tuning characteristics					
Accuracy		–	–	80×10^{-6}	
Resolution		–	–	62.5	kHz
Oscillator voltage at all terminals		–	–	70	dB/μV

Note

1. The undesired carrier level required to produce a 1% transfer of its modulation on to the desired carrier shall be equal to or exceed the desired carrier level (60 dB/μV at nominal gain) for all gain values between maximum gain and 30 dB gain reduction, or be as shown.

Overall performance

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Unweighted CVBS S/N video channel all bands	antenna input level: 66 dB/μV, 100% modulation, (12.5% rest carrier)	44	–	–	dB
Sensitivity (all bands)	antenna input level: 100% modulation, (10% rest carrier); 15.75 kHz line frequency square wave	–	–	30	dB/μV
Audio sensitivity	antenna input level: 70 dB/μV per channel; video modulation: black; sound modulation: standard, 1 kHz/±27 kHz deviation; measure with 50 μs de-emphasis & CCIR 468-4 filter.				
The main sound carrier level at aerial	for audio S/N of 45 dB	–	38	–	dBμV
Stability with antenna load	with the antenna open, shorted or properly terminated at any input signal, there is no evidence of instability on any channel.				
PLL function	proper PLL function for all channels in the bands and when switched from any one band to another for both charge pump low and high under any combination of the operational conditions.				
Radio interference	oscillator radiation and oscillator voltage at the aerial terminal are within the limits of: • CISPR 13 (1975) amendment No. 1 (1983) • Amtsblatt 69/1981 + DIN VDE 0872 • CENELEC proposal European Standard EN55013, EN55020.				
Immunity from radiated interference	the frontend meets the requirements of DBP Amtsblatt 69/1981 item 5.3.2 and CENELEC EN55013.				
Microphonics	for sound signals in the audio frequency range 100 Hz to 10 kHz and sound pressure levels up to 105 dB (20 μPa), the video signal to sound interference ratio will be more than 40 dB.				
ESD protection	all the terminals of the frontend are protected against electrostatic discharge up to 2 kV. The product is classified in the category B (MIL-STD-883C).				

APPLICATION INFORMATION

For information regarding general aspects of I²C-bus control, refer to : '*I²C–bus specification*', published by Philips Components.

For a more detailed description of the PLL IC, see the device specification TSA5511T/C1.

Programmable divider setting

Bytes 1 and 2

Divider ratio:
$N = 16 \times (f_{rf}, \text{pc (MHz)} + f_{if}, \text{pc (MHz)})$

$f_{osc} = N/16$ (MHz)

$N = (8192 \times n13) + (4096 \times n12) + (2048 \times n11) + (1024 \times n10) + (512 \times n9) + (256 \times n8) + (128 \times n7) + (64 \times n6) + (32 \times n5) + (16 \times n4) + (8 \times n3) + (4 \times n2) + (2 \times n1) + n0$

Control byte 1

CHARGE PUMP SETTING

Charge pump (CP) setting can be set to low current (logic 0) or high current (logic 1). CP = 1 results in faster tuning, CP = 0 in moderate tuning speed with slightly better residual FM. It is recommended to use CP = 0 for fine search. In addition, CP = 0 should be used at the end of each tuning.

TEST MODE SETTING

T1, T0 = for normal operation

PLL DISABLING

OS is set to logic 0 for normal operation. OS set to logic 1 switches the charge pump transistor to the non-conducting state, enabling the tuner to be manually tuned by applying a variable tuning voltage to pin 11. When setting OS to logic 1, it is recommended to set T0 to logic 1 simultaneously.

I²C-bus requirements

SDA and SCL pins

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{IL}	maximum input LOW voltage	–	1.5	V
V_{IH}	minimum input HIGH voltage	3.0	–	V
I_{IL}	maximum input LOW current	−10.0	–	μA
I_{IH}	maximum input HIGH current	–	10.0	μA
V_{OL}	maximum output LOW voltage at 3 mA sink current	–	0.4	V

Logic diagram

WRITE mode, R/W = 0

BYTE	BITS							
	7 MSB	6	5	4	3	2	1	0 LSB
Address	1	1	0	0	0	MA1	MA0	R/W
Prog. div. 1	0	0	n13	n12	n11	n10	n9	n8
Prog. div. 2	n7	n6	n5	n4	n3	n2	n1	n0
Control 1	1	CP	T1	T0	1	1	1	OS
Control 2	P7	P6	P5	P4	P3	P2	P1	P0

Address selection

MA1	MA0	ADDRESS	VOLTAGE AT PIN 15
0	0	C0	0 to 0.1 V_{PLL}
0	1	C2	don't care
1	0	C4	0.4 to 0.6 V_{PLL}
1	1	C6	0.9 V_{PLL} to 13.5 V

Note

The tuner will always respond to address C2. The second address will depend on the voltage applied at pin 15.

Control byte 2

Band switching

BAND	BIT							
	P0	P1	P2	P3	P4	P5	P6	P7
Low band	x	x	x	0	0	1	0	1
Mid band	x	x	x	0	1	0	0	1
High band	x	x	x	0	1	1	0	0

Notes

x = don't care.

P0 - P7: band selection.

P3 must be programmed to 0. The address selection voltage is applied at this pin.

Telegram examples

WRITE mode

start - ADR - ACK - DR1 - DR2 - CW1 - CW2 - stop
start - ADR - CW1 - CW2 - DR1 - DR2 - stop
start - ADR - DR1 - DR2 - CW1 - stop
start - ADR - DR1 - DR2 - stop

start = start condition
ADR = address
DR1 = divider ratio byte 1
DR2 = divider ratio byte 2
CW1 = control byte 1
CW2 = control byte 2
stop = stop condition

Logic diagram

READ mode, R/W = 1

BYTE	BITS							
	7 MSB	6	5	4	3	2	1	0 LSB
Address byte	1	1	0	0	0	MA1	MA0	R/W
Status byte	POR	FL	12	11	10	A2	A1	A0

FL indicates when the tuning loop of the PLL is in lock. The loop must be phase-locked for at least 8 periods of the internal 7.8125 kHz reference frequency (i.e. 1 ms) before the FL flag is set to logic 1.

POR (power on reset) is internally set to logic 1 if the PLL voltage drops below 3 V. The POR bit is reset when an end-of-data is detected by the PLL IC.

Bits 10 to 12 do not contain any relevant data for the tuner application and can be ignored.

IMPORTANT!!!

For channel selection involving bandswitching, it is recommended that the following consideration be included, to ensure smooth tuning to the desired channel, without causing unnecessary charge pump action. (Unnecessary charge pump action will result in a very low tuning voltage, $V_t \approx 0$, which may drive the oscillator into an extreme condition.)

Step 1: Compare wanted channel frequency (f_w) to the current channel frequency (f_c).

Step 2: If $f_w > f_c$, use telegram as: start - ADR - DR1 - DR2 - CW1 - CW2 - stop.

Step 3: If $f_w < f_c$, use telegram as: start - ADR - CW1 - CW2 - DR1 - DR2 - stop.

ADDITIONAL INFORMATION

Tuning supply voltage

A tuning voltage of 33 V must be connected via a 22 kΩ series resistor to pin 11. A preferred method is a constant current supply of 1 to 5 mA to the pin. Fig.4 shows this with a 140 V supply. The Zener diode prevents the voltage at pin 11 exceeding 33 V.

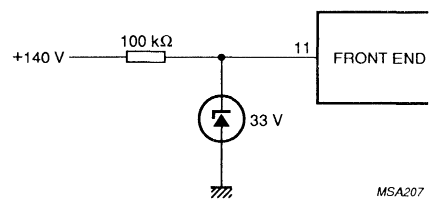


Fig.4 Constant current supply.

APPLICATION

The FS936E frontend is designed to cover all the frequencies in the channel 2 (55.25 MHz) to channel 69 (801.25 MHz) range of RTMA systems M and N.

The frontend is equipped with an I^2C-bus for digitally programmable phase-locked loop frequency synthesis with crystal accuracy. Bandswitching is also carried out via the I^2C-bus. Since the address of the I^2C device can be set externally, more I^2C-controlled tuners/frontends can be used in the application (e.g. a second tuner for PIP applications).

The frontend complies with the radiation, signal handling capability and immunity regulations of the FCC and DOC Canada.

QUICK REFERENCE DATA

Systems	RTMA systems M and N
Channels	
VHF	channels 2 to 6, 7 to 13
UHF	channels 14 to 69
CATV	channels A-2 to 65
Intermediate frequencies	
picture	45.75 MHz
sound	41.25 MHz
colour	42.17 MHz

DESCRIPTION

The FS936E frontend is a combination of a VHF/UHF tuner with an IF demodulator. It covers the low band (frequency range 55.25 to 157.25 MHz), the mid band (frequency range 163.25 to 451.25 MHz) and the high band (frequency range 457.25 to 801.25 MHz).

The tuner and IF sections are constructed on separate printed circuit boards, and the entire unit is housed in a metal case consisting of a rectangular frame with front and rear covers. The aerial connector is mounted on one end of the housing. All other connections are made via pins on the underside of the tuner.

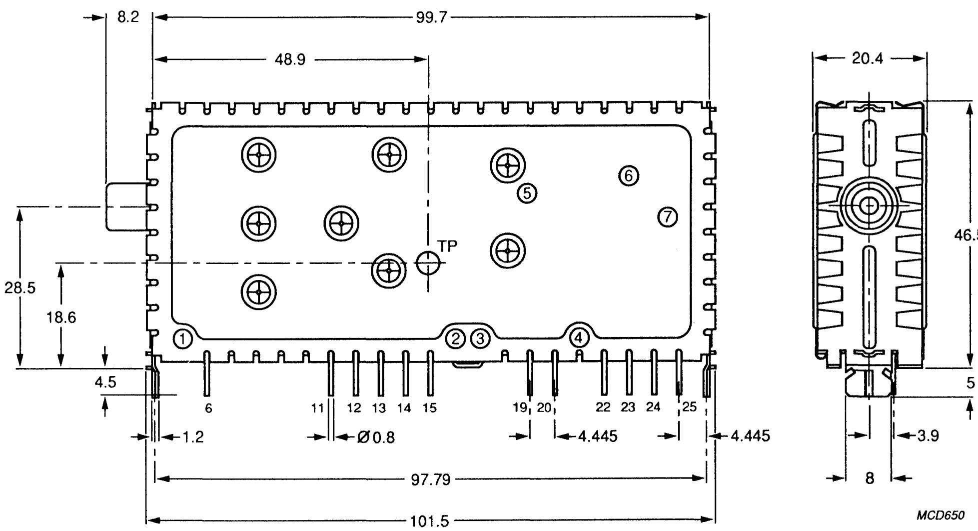
The output of the tuner section is internally connected to the IF section. The IF section has a split sound PLL IF demodulator IC, and has the following output signals:

- demodulated video output
- non-decoded AF sound
- second IF output.

Semiconductors and key components used

FUNCTION	DEVICE USED		
	LOW BAND	MID BAND	HIGH BAND
Tuner section			
RF amplifier	BF998R	BF998R	BF998R(TEG)
Mixer	2SC2480	2SC2480	2SC2734
Oscillator	2SC2736	2SC2734	2SC2480
Tuning diodes	BB910	BB910	OF643
Coupling diodes	OF4199	BB910	–
IF amplifier	BFS17		
PLL tuning IC	TSA5512T		
Charge pump buffer transistor (NPN)	BC847B		
IF section			
PLL IC	LA7570		
Video amplifier	BC548		
Video SAW filter	OFWM3951		
Sound SAW filter	SAF41MC80Z		
Ceramic filter	TPS4.5MB2		
Ceramic trap	SFS4.5ME2		

MECHANICAL DATA



Dimensions in mm.

Fig.1 Mechanical detail.

Mass

The mass of the tuner is approximately 85 g.

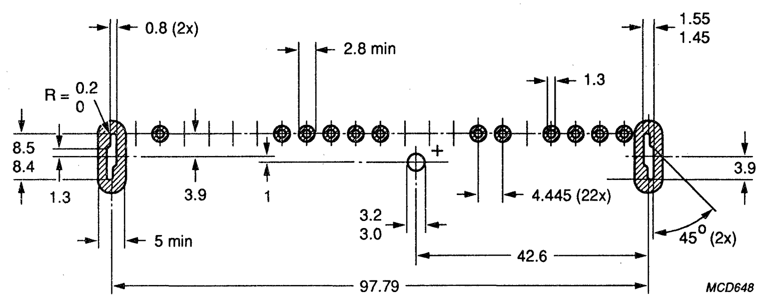
Mounting

The frontend may be mounted by soldering it to a printed circuit board, using the piercing diagram shown in Fig.2, without clearance between the tuner supporting surface and the board. The mounting tabs should be bent in accordance with Fig.3. The frontend may be mounted anywhere in the receiver and there are no restrictions on orientation.

The solderability of the pins and mounting tabs is in accordance with IEC 68-2-20, test Ta (230 ±10 °C, 2 ±0.5 s). The resistance to soldering heat is in accordance with IEC 68-2-20, test Tb (260 ±5 °C, 10 ±1 s).

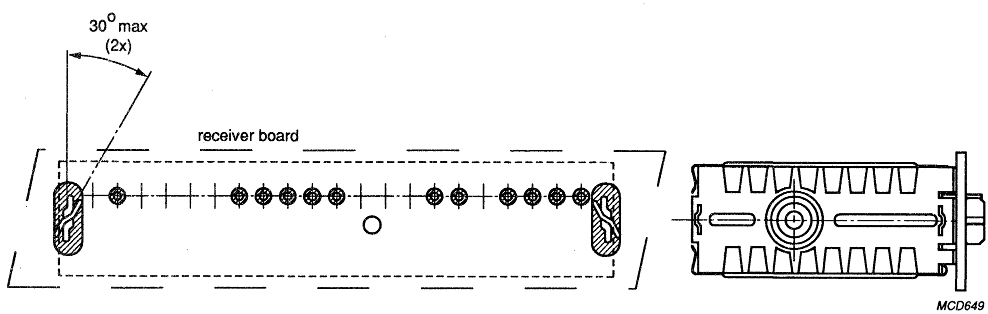
Pinning

PIN	FUNCTION
A	aerial input
6	supply voltage, tuner section, +12 V
11	tuning voltage 33 V through 22 kΩ resistor
12	PLL supply voltage, +5 V
13	SCL serial data line
14	SDA serial data line
15	address selection input
19	external IF AGC
20	black noise inverter switch
22	2nd IF sound output
23	video output
24	supply voltage, IF section, +12 V
25	AF sound output
MT1, MT2	mounting tab, grounded



+ = additional hole for extra fixing of frontend by means of a tap pan screw, 4 N, max. length 4.5 mm.

Fig.2 Piercing diagram viewed from solder side of board.



Tab twist method seen from solder side.

Fig.3 Bending of mounting tabs.

ELECTRICAL DATA

Unless otherwise stated, all electrical values apply at an ambient temperature of 25 ±5 °C, a relative humidity of 60 ±15%, a supply voltage of 12 ±0.3 V, an AGC voltage of 7.5 ±0.2 V, a PLL supply voltage of 5 ±0.3 V and a tuning supply voltage of 33 ±0.5 V via a 22 kΩ series resistor.

PARAMETER	MIN.	TYP.	MAX.	UNIT
Environmental				
Ambient temperature range				
operating	−10	–	60	°C
storage	−25	–	85	°C
Relative humidity	–	–	95	%
Voltages and currents				
Supply voltage, tuner section	10.8	12	13.2	V
Supply voltage, IF section	10.8	12	13.2	V
Supply voltage, PLL section	4.5	5	5.5	V
Current drawn				
tuner section	–	–	50	mA
IF section	–	–	75	mA
PLL section	–	–	70	mA
Tuning supply voltage	30	33	35	V
Tuning supply current	–	–	1.7	mA
Frequencies				
Low band	channel 2 (picture carrier 55.25 MHz) to channel G (picture carrier 157.25 MHz). Margin at extreme channels: min. 1.5 MHz.			
Mid band	channel H (picture carrier 163.25 MHz) to channel CCC (picture carrier 451.25 MHz). Margin at extreme channels: min. 3.0 MHz.			
High band	channel DDD (picture carrier 457.25 MHz) to channel 69 (picture carrier 801.25 MHz). Margin at extreme channels: min. 3.0 MHz.			

Tuner section

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Wanted signal characteristics					
Aerial input impedance		–	75	–	Ω
VSWR	referred to 75 Ω	–	–	5	
Reflection coefficient		–	–	66	%
RF bandwidth		6	–	20	MHz
RF curves, tilt	on any channel, the amplitude difference between the top of the overall curve and the picture carrier, the sound carrier, or any frequency between them will not exceed 4 dB for PC, 6 dB for SC at nominal gain and 4 dB in the AGC range between nominal gain and 20 dB gain reduction.				
AGC characteristics					
VHF off-air channels		45	–	–	dB
UHF off-air channels		30	–	–	dB
cable channels		35	–	–	dB
Voltage gain		40	–	52	dB
Gain taper	off-air channels	–	–	8	dB
Noise figure					
low band, except channels 2 - 6		–	–	7	dB
low band, channels 2 - 6		–	–	8	dB
mid band, except channels H & I		–	–	8	dB
mid band, channels H & I		–	–	10	dB
high band		–	–	10	dB
Overloading					
input signal producing 1 dB signal compression	VHF/UHF channels only	74	–	–	dB/μV
PLL lockout	off-air channels	100	–	–	dB/μV
	cable channels	86	–	–	dB/μV
Image rejection	channels 2 - 6, A-2-1, 7-13	60	–	–	dB
	channels J-EEE, 14 - 69	45	–	–	dB
FM rejection, channel 6	90.5 MHz, antenna level 60 dB/μV	50	–	–	dB
	93 - 108 Hz, antenna level 90 dB/μV	50	–	–	dB
IF rejection, channel 6	all channels except 2 & 3	60	–	–	dB
	channel 2	50	55	–	dB
	channel 3	55	60	–	dB
1/2 IF susceptibility					
channels 2 - 13		75	–	–	dB
channels 14 - 69		60	–	–	dB

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Unwanted signal characteristics					
Cross modulation (note 1)					
in channel	gain reduction 0 dB	65	–	–	dB/µV
in band N ±2: channels 2 - W	gain reduction 0 dB	78	–	–	dB/µV
in band N ±3: channels AA - ZZ	gain reduction 0 dB	78	–	–	dB/µV
in band N ±5: channels AAA - 69	gain reduction 0 dB	84	–	–	dB/µV
PLL tuning characteristics					
Accuracy		–	–	50×10^{-6}	
Resolution		–	–	62.5	kHz
Oscillator voltage at all terminals		–	–	70	dB/µV

Note

1. The undesired carrier level required to produce a 1% transfer of its modulation on to the desired carrier shall be equal to or exceed the desired carrier level (60 dB/µV at nominal gain) for all gain values between maximum gain and 30 dB gain reduction, or be as shown.

Overall performance

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Video S/N unweighted VHF band UHF band	antenna input level: 66 dB/μV, 100% modulation, (12.5% rest carrier)	 46 45	 – –	 – –	 dB dB
Sensitivity (all bands)	antenna input level: 66 dB/μV, 100% modulation, (12.5% rest carrier); 15.75 kHz line frequency square wave	–	–	30	dB/μV
Audio S/N VHF bands UHF bands	antenna input level: 66 dB/μV, 100% modulation, (12.5% rest carrier); full field colour bar signal, standard: 1 kHz/±25 kHz deviation; 75 μs de-emphasis, LP 200 kHz filter	 53 52	 – –	 – –	 dB dB
Stability with antenna load	with the antenna open, shorted or properly terminated at any input signal, there is no evidence of instability on any channel.				
PLL function	proper PLL function for all channels in the bands and when switched from any one band to another for both charge pump low and high under any combination of the operational conditions.				
Immunity	in the field of a synchronous television signal, having a measured field strength of 100 mV/m and the input terminated with a quarter wave stub, the IF output shall be at least 40 dB below the level of a 1 mV reference signal applied to the aerial input. In the field of a non-synchronous television signal, the IF output shall be at least 55 dB below the reference.				
Radio interference channels 2 - 6 channels 7 - 13 channels 14 - 69	 any signal frequency average of 10 frequencies	 – – – –	 – – – –	 50 150 750 350	 μV/m μV/m μV/m μV/m
Microphonics	for sound signals in the audio frequency range 100 Hz to 10 kHz and sound pressure levels up to 105 dB (20 μPa), the video signal to sound interference ratio will be more than 40 dB.				
ESD protection	all the terminals of the frontend are protected against electrostatic discharge up to 2 kV. The product is classified in the category B (MIL-STD-883C).				

APPLICATION INFORMATION

For information regarding general aspects of I²C-bus control, refer to : '*I²C–busspecification*', published by Philips Components.

For a more detailed description of the PLL IC, see the device specification TSA5512T.

Programmable divider setting

Bytes 1 and 2

Divider ratio:
$N = 16 \times (f_{rf}, \text{pc (MHz)} + f_{if}, \text{pc (MHz)})$

$f_{osc} = N/16$ (MHz)

$N = (16384 \times n14) + (8192 \times n13) + (4096 \times n12) + (2048 \times n11) + (1024 \times n10) + (512 \times n9) + (256 \times n8) + (128 \times n7) + (64 \times n6) + (32 \times n5) + (16 \times n4) + (8 \times n3) + (4 \times n2) + (2 \times n1) + n0$

Control byte 1

CHARGE PUMP SETTING

Charge pump (CP) setting can be set to low current (logic 0) or high current (logic 1). CP = 1 results in faster tuning, CP = 0 in moderate tuning speed with slightly better residual FM. It is recommended to use CP = 0 for fine search. In addition, CP = 0 should be used at the end of each tuning.

TEST MODE SETTING

T1, T0 = for normal operation

PLL DISABLING

OS is set to logic 0 for normal operation. OS set to logic 1 switches the charge pump transistor to the non-conducting state, enabling the tuner to be manually tuned by applying a variable tuning voltage to pin 11. When setting OS to logic 1, it is recommended to set T0 to logic 1 simultaneously.

I²C-bus requirements

SDA and SCL pins

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
V_{IL}	maximum input LOW voltage	–	1.5	V
V_{IH}	minimum input HIGH voltage	3.0	–	V
I_{IL}	maximum input LOW current	−10.0	–	μA
I_{IH}	maximum input HIGH current	–	10.0	μA
V_{OL}	maximum output LOW voltage at 3 mA sink current	–	0.4	V

Logic diagram

WRITE mode, R/W = 0

BYTE	BITS							
	7 MSB	6	5	4	3	2	1	0 LSB
Address	1	1	0	0	0	MA1	MA0	R/W
Prog. div. 1	0	n14	n13	n12	n11	n10	n9	n8
Prog. div. 2	n7	n6	n5	n4	n3	n2	n1	n0
Control 1	1	CP	T1	T0	1	1	1	OS
Control 2	P7	P6	P5	P4	P3	P2	P1	P0

Address selection

MA1	MA0	ADDRESS	VOLTAGE AT PIN 15
0	0	C0	0 to 0.1 V_{PLL}
0	1	C2	don't care
1	0	C4	0.4 to 0.6 V_{PLL}
1	1	C6	0.9 V_{PLL} to 13.5 V

Note

The tuner will always respond to address C2. The second address will depend on the voltage applied at pin 15.

Control byte 2

Bandswitching

BAND	BIT							
	P0	P1	P2	P3	P4	P5	P6	P7
Low band	x	x	x	0	0	1	0	1
Mid band	x	x	x	0	1	0	0	1
High band	x	x	x	0	1	1	0	0

Notes

x = don't care.

P0 - P7: band selection.

P3 must be programmed to 0. The address selection voltage is applied at this pin.

Telegram examples

WRITE mode

```
start - ADD - ACK - DIV1 - ACK - DIV2 - ACK - CB1 - ACK - CB2 - ACK - stop
start - ADD - ACK - DIV1 - ACK - DIV2 - ACK - stop
start - ADD - ACK - DIV1 - ACK - DIV2 - ACK - stop
start - ADD - ACK - CB1 - ACK - CB2 - ACK - stop
start - ADD - ACK - CB1 - ACK - CB2 - ACK - DIV1 - ACK - stop
```

start = start condition
ADD = address
ACK = acknowledge
DIV1 = divider ratio byte 1
DIV2 = divider ratio byte 2
CB1 = control byte 1
CB2 = control byte 2
stop = stop condition

Logic diagram

READ mode, R/W = 1

BYTE	BITS							
	7 MSB	6	5	4	3	2	1	0 LSB
Address byte	1	1	0	0	0	MA1	MA0	R/W
Status byte	POR	FL	12	11	10	A2	A1	A0

FL indicates when the tuning loop of the PLL is in lock. The loop must be phase-locked for at least 8 periods of the internal 7.8125 kHz reference frequency (i.e. 1 ms) before the FL flag is set to logic 1.

POR (power on reset) is internally set to logic 1 if the PLL voltage drops below 3 V. The POR bit is reset when an end-of-data is detected by the PLL IC.

Bits 10 to 12 do not contain any relevant data for the tuner application and can be ignored.

ADDITIONAL INFORMATION

Tuning supply voltage

A tuning voltage of 33 V must be connected via a 22 kΩ series resistor to pin 11. A preferred method is a constant current supply of 1 to 5 mA to the pin. Fig.4 shows this with a 140 V supply. The Zener diode prevents the voltage at pin 11 exceeding 33 V.

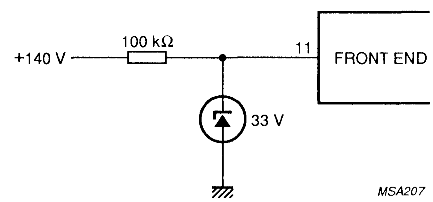


Fig.4 Constant current supply.

V.H.F./U.H.F. TELEVISION TUNERS

QUICK REFERENCE DATA

Systems	C.C.I.R. systems B, G and H	
Channels	off-air	cable
low v.h.f.	E2 to C	S01 to S1
high v.h.f.	E5 to E12	S2 to S20
u.h.f.	E21 to E69	
Intermediate frequencies		
picture	38,90 MHz	
colour	34,47 MHz	
sound 1	33,40 MHz	
sound 2	33,16 MHz	

APPLICATION

Designed to cover the v.h.f. and u.h.f. channels of C.C.I.R. systems B, G and H with extended v.h.f. frequency ranges.

The tuner parts of the UV618/256 and the UV618/6456 are equipped with a frequency divider, which makes them suitable for digital tuning systems based on frequency synthesis; for the remainder it is equal to type UV617.

Available versions

	aerial input connector	frequency divider (IC)	catalogue number
UV617	IEC	–	3122 237 00060
UV618/256	IEC	1 : 256	3122 237 00010
UV618/6456 (note 1)	IEC	1 : 256 / 1 : 64	3122 237 00371

The tuners comply with the requirements of radiation, signal handling capability, and immunity from radiated interference of Amtsblatt DBP69/1981, when installed professionally in an adequate TV receiver.

Note to the Table

1. The frequency divider is switchable.

DESCRIPTION

The UV617, UV618/256 and UV618/6456 are combined v.h.f./u.h.f. tuners with electronic tuning and band switching, covering the low v.h.f. band (frequency range 46 to 110 MHz), the high v.h.f. band (frequency range 111 to 300 MHz), and the u.h.f. band (frequency range 470 to 860 MHz).

Mechanically, the tuners are built on a low-loss printed-wiring board, carrying all components, in a die-cast metal housing made of a rectangular frame and front and rear covers (see Fig. 2). The common IEC coaxial aerial connector (75 Ω) is integrated in one of the frame sides of the housing, all other connections (supply voltages, a.g.c. voltage, tuning and switching voltages, i.f. output) are made via terminals in the underside. The mounting method is shown in Fig. 3.

Electrically, the tuners consist of v.h.f. and u.h.f. parts (see Fig. 1). They are equipped with a common aerial input and provided with r.f. MOSFET input stages. The v.h.f. mixer, v.h.f. oscillator and i.f. amplifier functions are provided by a tuner IC. This IC has terminals between mixer and i.f. amplifier to connect i.f. preselections, a 40,4 trap is provided to improve the selectivity of common SAW filters for adjacent channel N - 1 (system B).
Output impedance of the symmetrical i.f. terminals is approx. 75 Ω to insure sufficient triple transient supression of the SAW.
The r.f. band pass filter and oscillator circuits are tuned by 7 tuning diodes; band switching is achieved by 4 switching diodes.

The u.h.f. part of the tuner has a high-pass input circuit connected to gate 1 of an input MOSFET tetrode (with internal gate protection against surge). The drain load of this MOSFET tetrode is formed by a double tuned circuit transferring the r.f. signal to the Schottky barrier mixer diode. The i.f. signal from the mixer diode is amplified by the i.f. pre-amplifier of the tuner I.C..
The r.f. band pass filter and oscillator circuits are tuned by 4 tuning diodes.

In all bands the tuner is gain-controlled via gate 2 of the input MOSFET tetrode.

A test point TP1 is provided for i.f. injection.

The electrical circuit of the UV618/256 is extended with a frequency divider (division ratio of 256) and that of the UV618/6456 with a switchable divider (division ratio 64 or 256), with inputs connected to the v.h.f. and u.h.f. oscillator. The symmetrical ECL outputs are connected to terminals 13 and 14.

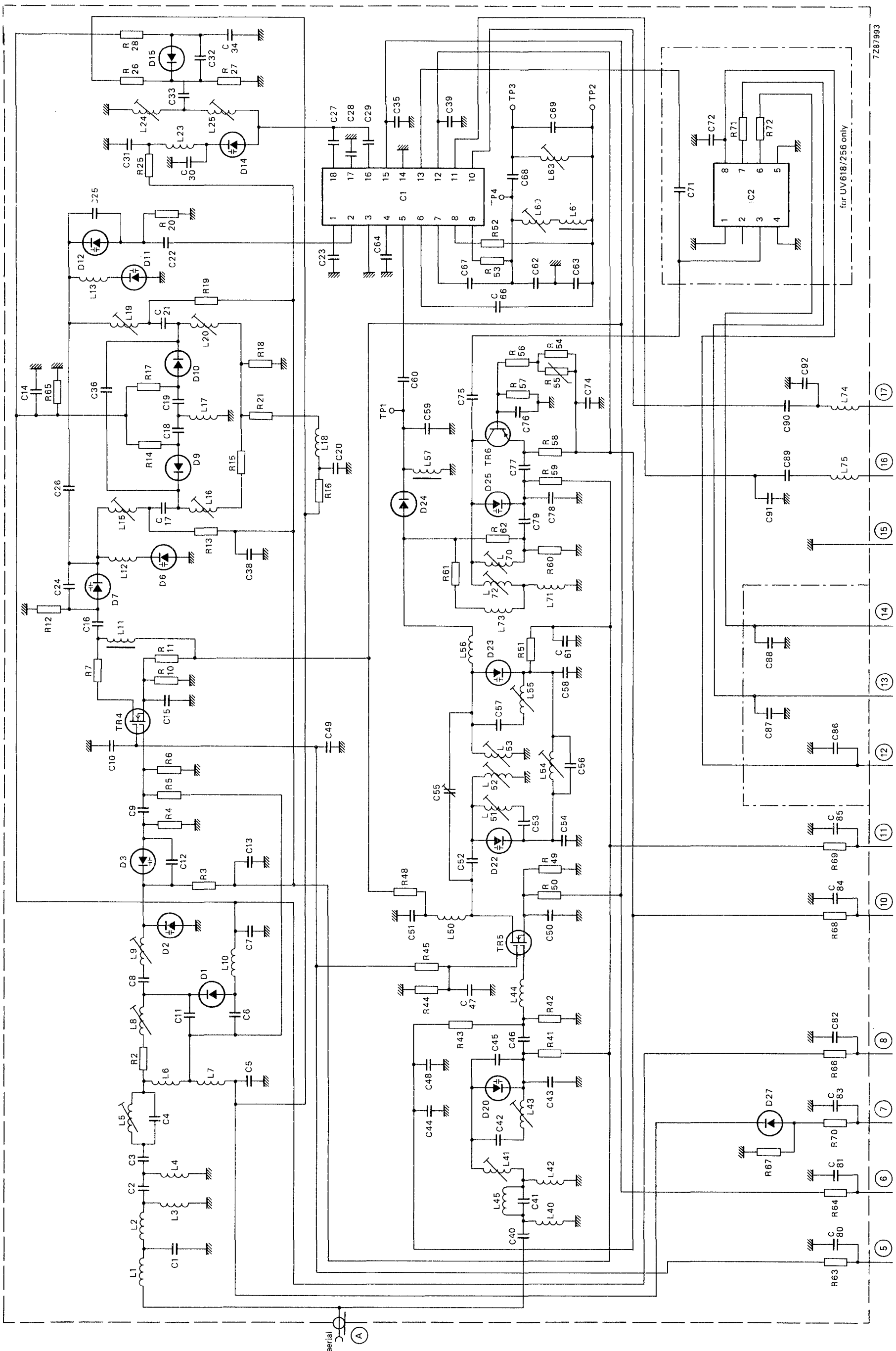
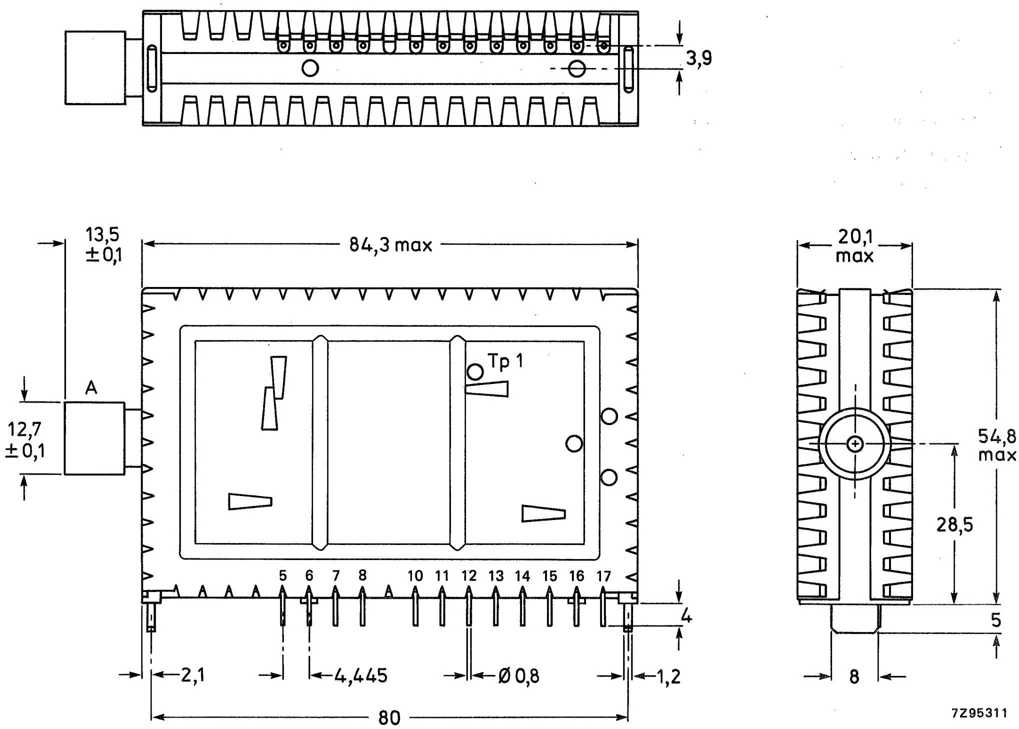


Fig. 1.

For type UV617 delete: C71, C72, C86, C87, C88, R71, R72, IC2.
For connections see next page.

MECHANICAL DATA

Dimensions in mm



Unless otherwise stated the tolerance is ± 0,05 mm.

Fig. 2.

Terminal

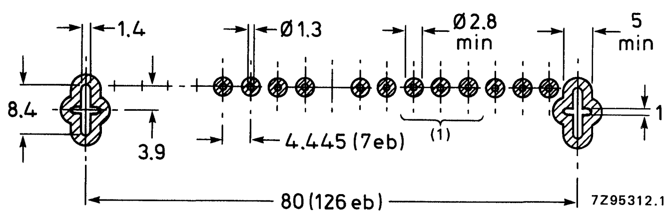
A	=	aerial input (IEC female 75 Ω)
5	=	a.g.c. voltage, + 9,2 to + 0,85 V
6	=	supply voltage, tuning part, + 12 V
7	=	supply voltage, low v.h.f., + 12 V
8	=	supply voltage, high v.h.f., + 12 V
10	=	supply voltage, u.h.f., + 12 V
11	=	tuning voltage, + 0,8 to + 28 V
12	=	supply voltage, frequency divider, + 5 V (only for UV618/256/6456)
13, 14	=	balanced output voltage of frequency divider (1 kΩ) (only for UV618/256/6456)
15	=	to be grounded for 256 ratio, floating for 64 ratio (UV618/6456 only)
16, 17	=	i.f. output, symm. (approx. 75 Ω)

Mass approx. 95 g

Mounting

The tuner may be mounted by soldering it on to a printed-wiring board (using the piercing diagram shown in Fig. 3) without clearance between tuner supporting surface and board. The connection pins should be bent according to Fig. 4. The tuner may be mounted anywhere in the receiver and there are no restrictions on orientation.

The solderability of the terminals and mounting tabs is according to IEC 68-2, test Ta (230 ± 10 °C, 2 ± 0,5 s). The resistance to soldering heat is according to IEC 68-2, test Tb (260 ± 5 °C, 10 ± 1 s).



(1) Only for UV618/256/6456 1 eb = 0,025 inch

Fig. 3 Piercing diagram viewed from solder side of board. Unless otherwise stated the tolerance is ± 0,05 mm.

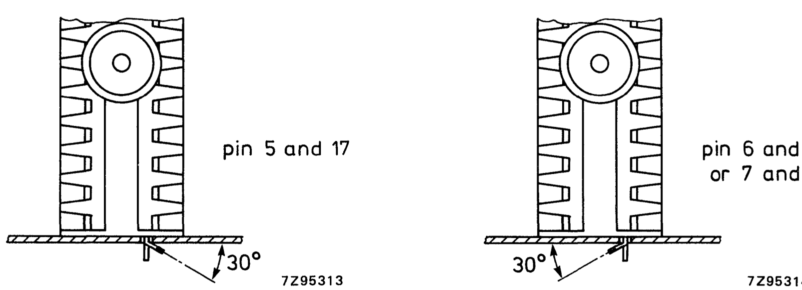


Fig. 4.

In order to prevent any stress to the printed-wiring board, the tuner should be supported at its aerial connector.

ELECTRICAL DATA

Unless otherwise specified all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0,3 V and an a.g.c. voltage of 9,2 ± 0,2 V.

General

Semiconductors, v.h.f. bands	
r.f. amplifier	BF992
mixer, oscillator	TDA5030
tuning diodes	7 x OF633
switching diodes	4 x BA482/483/484
d.c. blocking diodes	2 x BAS15
Semiconductors, u.h.f. bands	
r.f. amplifier	BF990
oscillator	BF970
mixer	1SS99
tuning diodes	4 x OF643
frequency divider	SP4653
Ambient temperature range	
operating	−10 to +60 °C
storage	−25 to +85 °C
Relative humidity	max. 95%

Voltages and currents

Supply voltage	+ 12 V ± 10%
Current drawn from + 12 V supply	
v.h.f. bands	max. 50 mA
u.h.f. bands	max. 45 mA
Bandswitching	max. 15 mA

For operation in all bands the supply voltage is permanently connected to terminal 6. Additionally the supply voltage is connected to:
terminal 7 for operation in low v.h.f. band
terminal 8 for operation in high v.h.f. band
terminal 10 for operation in u.h.f. bands

A.G.C. voltage (Figs 4, 5 and 6)	
voltage range	+ 9,2 to + 0,85 V (max. 30 μA)
voltage at nominal gain	+ 9,2 ± 0,5 V
voltage at 40 dB gain reduction	
low v.h.f. band	typ. 3 V
high v.h.f. band	typ. 2 V
voltage at 30 dB gain reduction	
u.h.f. band	typ. 2 V

Note: A.G.C. voltage between 0 and + 10,5 V may be applied without risk of damage.

A.G.C. current	max. 0,03 mA
Slope of a.g.c. characteristic, at the end of the specified a.g.c. range	
low v.h.f. bands	typ. 40 dB/V
high v.h.f. bands	typ. 80 dB/V

Tuning voltage range	+ 0,8 to + 28 V	
Current drawn from 28 V tuning voltage supply		
at T_{amb} = 25 °C and 60% R.H.	max. 0,5 μA	
at T_{amb} = 25 °C and 95% R.H.	max. 2 μA	
at T_{amb} = 60 °C and 60% R.H.	max. 2 μA	

Note: The source impedance of the tuning voltage offered to terminal 11 must be maximum 47 kΩ.

Slope of tuning characteristic			
low v.h.f. band,	channel E2	5 MHz/V	typical values
	channel S1	1 MHz/V	
high v.h.f. band,	channel S2	10 MHz/V	
	channel S20	2 MHz/V	
u.h.f. bands,	channel E21	22 MHz/V	
	channel E69	5 MHz/V	

Frequencies

Frequency ranges	
low v.h.f. band	channel E2 (picture carrier 48,25 MHz) to channel S1 (picture carrier 105,25 MHz). Margin at the extreme channels:min. 2 MHz.
high v.h.f. band	channel S2 (picture carrier 112,25 MHz) to channel S20 (picture carrier 294,25 MHz). Margin at the extreme channels:min 2 MHz.
u.h.f. bands	channel E21 (picture carrier 471,25 MHz) to channel E69 (picture carrier 855,25 MHz). Margin at the extreme channels:min 3 MHz.
Intermediate frequencies	
picture	38,90 MHz
colour	34,47 MHz
sound 1	33,40 MHz
sound 2	33,16 MHz

The oscillator frequency is higher than the aerial signal frequency.

Wanted signal characteristics

Input impedance	75 Ω
V.S.W.R. and reflection coefficient (values between picture and sound carrier, as well as values at picture carrier)	
v.s.w.r.	at nominal gain and during gain control
v.h.f. bands	max. 4
u.h.f. bands	max. 5
reflection coefficient	
v.h.f. bands	max. 60%
u.h.f. bands	max. 66%
Output impedance (i.f.)	75 Ω approx.
Capacitance between terminals	typ. 3,5 pF
Load impedance	min. 1 kΩ//max. 22 pF total capacitance load to be tuned to 36,15 MHz by means of an inductance between terminals 16 and 17 (min.L:590 nH)
R.F. curves bandwidth	
low v.h.f. band	typ. 10 MHz
high v.h.f. band	typ. 10 MHz
u.h.f. bands	typ. 15 MHz

R.F. curves, tilt	on any channel the amplitude difference between the top of the r.f. resonant curve and the picture frequency, the sound frequency, or any frequency between them will not exceed 3 dB at nominal gain, and 4 dB in the a.g.c. range between nominal gain and 20 dB gain reduction.
A.G.C. range	
v.h.f. bands	min. 40 dB
u.h.f. bands	min. 30 dB
Voltage gain	
low v.h.f. band	min. 40 dB; max. 50 dB
high v.h.f. band	
channels S2 to S6	typ. 36 dB; max. 46 dB
channels S7 to S20	typ. 40 dB; max. 50 dB
u.h.f. bands	min. 40 dB; max. 50 dB
Maximum gain difference	
between any two v.h.f. channels	typ. 6 dB
between any two u.h.f. channels	typ. 6 dB
between any v.h.f. and u.h.f. channel	typ. 6 dB
Noise figure	
v.h.f. bands	
E channels	typ. 5 dB; max. 8 dB
S channels	typ. 7 dB; max. 10 dB
u.h.f. bands	typ. 8 dB; max. 11 dB
Overloading	
Input signal producing 1 dB gain compression at nominal gain	
v.h.f. bands	typ. 90 dB (μV) into 75 Ω; min. 85 dB(μV)
u.h.f. bands	typ. 100 dB (μV) into 75 Ω; min. 90 dB(μV)
Input signal producing either a detuning of the oscillator of + 300 kHz or −1000 kHz or stopping of the oscillations at nominal gain	
v.h.f. bands	typ. 110 dB (μV) into 75 Ω; min. 100 dB(μV)
u.h.f. bands	typ. 110 dB (μV) into 75 Ω; min. 100 dB(μV)

Unwanted signal characteristics

Image rejection (measured at picture carrier frequency)	
v.h.f. bands	min. 66 dB; typ. 70 dB
u.h.f. bands	min. 53 dB; typ. 60 dB

I.F. rejection (measured at picture carrier frequency)	
low v.h.f. band	min. 60 dB
high v.h.f. band	min. 60 dB
u.h.f. bands	min. 60 dB

Note: At colour sub-carrier frequency maximum 6 dB less rejection.

Cross modulation
Input signal producing 1% cross modulation, i.e. 1% of the modulation depth of the interfering signal is transferred to the wanted signal.

In channel cross modulation (wanted signal: picture carrier frequency; interfering signal: sound carrier frequency)

v.h.f. bands	
at nominal gain (wanted input level 60 dB (μV))	typ. 80 dB (μV) into 75 Ω
at 40 dB gain reduction (wanted input level 100 dB (μV))	typ. 100 dB (μV) into 75 Ω
u.h.f. bands	
at nominal gain (wanted input level 60 dB (μV))	typ. 80 dB (μV) into 75 Ω
at 30 dB gain reduction (wanted input level 90 dB (μV))	typ. 100 dB (μV) into 75 Ω

In band cross modulation (wanted signal: picture carrier of channel N; interfering signal: picture carrier of channel N ± 2 for low v.h.f., or channel N ± 3 for high v.h.f., or channel N ± 5 for u.h.f.)

v.h.f. bands	
at nominal gain (wanted input level 60 dB (μV))	typ. 95 dB (μV) into 75 Ω
at 40 dB gain reduction (wanted input level 100 dB (μV))	typ. 100 dB (μV) into 75 Ω
u.h.f. bands	
at nominal gain (wanted input level 60 dB (μV))	typ. 94 dB (μV) into 75 Ω
at 30 dB gain reduction (wanted input level 90 dB (μV))	typ. 100 dB (μV) into 75 Ω
Out of band cross modulation at nominal gain	
low v.h.f., interfering from high v.h.f.	typ. 100 dB (μV) into 75 Ω
low v.h.f., interfering from u.h.f.	typ. 100 dB (μV) into 75 Ω
high v.h.f., interfering from low v.h.f.	typ. 100 dB (μV) into 75 Ω
high v.h.f., interfering from u.h.f.	typ. 100 dB (μV) into 75 Ω
u.h.f. interfering from low v.h.f.	typ. 100 dB (μV) into 75 Ω
u.h.f. interfering from high v.h.f.	typ. 100 dB (μV) into 75 Ω

Unwanted signal handling capability (visibility test)

For the channel combinations
v.h.f.: N ± 1, N ± 5, N + 11
u.h.f.: N ± 1, N ± 5, N + 9

The tuner meets the requirements of "Amtsblatt" DBP/1981, item 5.1.2., when measured in an adequate TV receiver. The a.g.c. circuit of the receiver has to be adjusted with an input signal of 74 dB (μV) on channel E60 in such a way, that the gain of the tuner is decreased by 10 dB.

Oscillator characteristics

Pulling

Input signal of tuned frequency producing a shift of the oscillator frequency of 10 kHz, at nominal gain	
v.h.f. bands	typ. 86 dB (μV) into 75 Ω
u.h.f. bands	typ. 86 dB (μV) into 75 Ω
Shift of oscillator frequency at a change of the supply voltage of 5%	
v.h.f. bands	max. 250 kHz
u.h.f. bands	max. 500 kHz
Drift of oscillator frequency	
during warm-up time (after the tuner has been completely out of operation for 15 min, measured between 5 s and 15 min after switching on)	max. 250 kHz
during warm-up time (after the input stage is in operation for 15 min, measured between 2 s and 15 min after band switching)	max. 250 kHz
at a change of the ambient temperature from + 25 to + 40 °C (measured after 3 cycles from + 25 to + 55 °C)	
v.h.f. bands	max. 500 kHz
u.h.f. bands	max. 500 kHz
at a change of humidity from 60 ± 15% to 93 ± 2%, at T_{amb} = 25 ± 5 °C	
low v.h.f. band	max. 500 kHz
high v.h.f. band	max. 1000 kHz
u.h.f. bands	max. 1500 kHz

Frequency divider characteristics

Frequency division ratio	
UV618/256	256
UV618/6456	switchable, 64 or 256
Supply voltage	+ 5 V ± 5%
Current drawn from + 5 V supply	max. 35 mA; typ. 25 mA
Output voltage, unloaded, measured with probe 10 MΩ/11 pF	min. 0,3 V_{p-p}
Output impedance	typ. 1 kΩ
Output imbalance	typ. 0,1 V
Interference signal on the i.f. output	max. 30 dB (μV)

Note: I.F. output of the tuner terminated with 10 MΩ/11 pF

Miscellaneous

Radio interference	
Oscillator radiation and oscillator voltage at the aerial terminal	Within the limits of C.I.S.P.R. 13 (1975) , VDE0872/7.72. and Amtsblatt DBP69/1981, when applying the tuner in an adequate TV receiver
Microphonics	There will be no microphonics, provided the tuner is installed in a professional manner.
Surge protection	
Protection against voltages	max. 5 kV

Note: 10 discharges of a 470 pF capacitor into the aerial terminal.

Protection against flashes	max. 30 kV, 400 mWs

Note: A flashover circuit producing flashes with frequencies of 1 to 20 Hz for 30 s is connected to the aerial terminal.

ADDITIONAL INFORMATION

I.F. injection

An i.f. signal from a generator (internal resistance 50 Ω or 75 Ω) should be connected to the i.f. injection point TP1, accessible through a hole in the cover (see Fig. 2) via a probe (see Fig. 5).

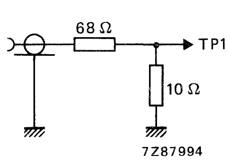


Fig. 5.

VHF/UHF TELEVISION TUNERS

QUICK REFERENCE DATA

Systems	CCIR systems B, G and H; I, I′, L, L′ and D2MAC	
Channels	off-air	cable
low band	E2 to C	S01 to S10
mid band	E5 to E12	S11 to S39
high band	E21 to E69	S40 to S41

Intermediate frequencies (MHz)

System	B, G and H	I	L	I′	L′	D2MAC
Picture	38.90	39.50	38.90	38.90	33.40	38.90
Colour	34.47	35.07	34.47	34.47	37.83	
Sound 1	33.40	33.50	32.40	32.90	39.90	
Sound 2	33.16	33.00		32.40		
Bandedge						30.50

APPLICATION

Designed to cover the VHF and UHF channels of CCIR systems B, G and H; I, I′, L, L′ and D2MAC with extended VHF/UHF frequency ranges, including cable and hyperband.

The IF output is designed to directly drive a variety of SAW filters.

The UV816/256 and UV816/6456 tuners are equipped with frequency dividers which make them suitable for digital tuning systems based on frequency synthesis; apart from this they are equivalent to type UV815.

In the UV816/PLL tuner the frequency divider is replaced by a built-in digital controlled (I^2C) PLL tuning system.

Table 1 Available versions (note 1)

	aerial input connector	frequency divider (IC)	catalogue number
UV816/6456 (note 2) UV816/PLL	IEC/SNIR IEC/SNIR	1 : 64 or 1 : 256	3112 297 10521 3122 297 10601

Notes to Table 1

1. These tuners comply with the requirements of radiation, signal handling capability and immunity from radiated interference of Amtsblatt DBP69/1981, when installed professionally in an adequate TV receiver.
2. The frequency divider is switchable.

DESCRIPTION

The UV815/816 series feature combined VHF/UHF handling capability with electronic tuning and band switching. The tuners cover the low band (frequency range 46 to 170 MHz), the mid band (frequency range 170 to 450 MHz) and the high band (frequency range 450 to 860 MHz).

The tuners are built on a low-loss printed-wiring board carring all components in a die-cast metal housing made of a rectangular frame, with front and rear covers (see Fig.2). The common IEC and SNIR aerial connector (75 Ω) is integrated in one of the frame sides of the housing, all other connections (supply voltages, AGC voltage, tuning and switching voltages, IF output) are made via pins on the underside. (For mounting method, see Figs 3 and 4).

Electrically, the tuners consist of low, mid and high band parts (see Figs 1A and 1B). They are equipped with a common aerial input and provided with three tuned mosfet input stages. The oscillators, mixers and IF amplifier are contained in a mixer-oscillator IC. The IF output is designed to directly drive a variety of SAW filters.

The output impedance of the symmetrical IF terminals is approximately 75 Ω to ensure sufficient triple transient suppression of the SAW filter.

The UV815 tuner (basic type without divider) can be controlled by a voltage synthesizer tuning system.

The frequency divider of the type UV816/256 tuner has a division ratio of 256, that of the type UV816/6456 a switchable ratio of 64 or 256, with symmetrical ECL output connected to two terminals at the underside of the tuner. The UV816 PLL is provided with a digital programmable phase-locked-loop tuning system. This enables tuning with a 62.5 kHz pitch with crystal accuracy. Besides tuning, the band switching is also carried out via the I^2C bus.

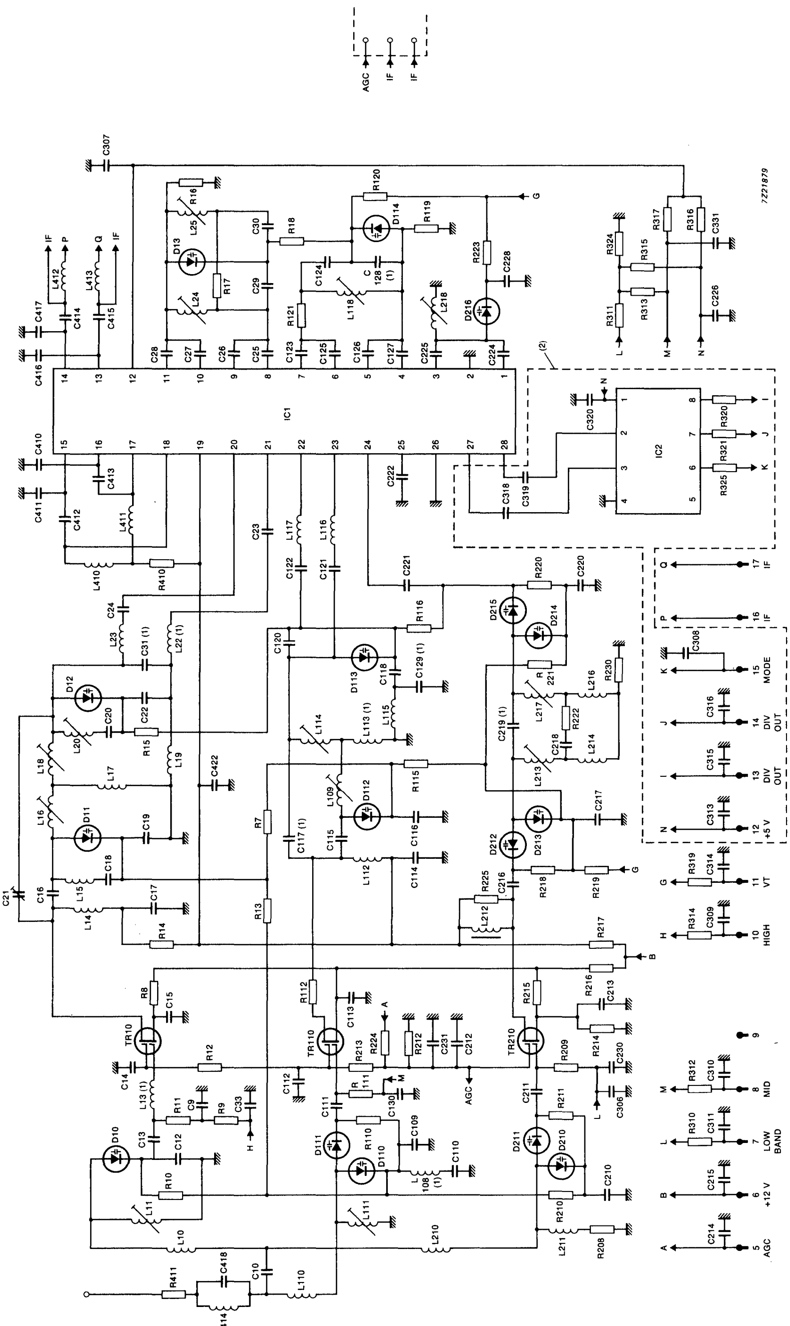
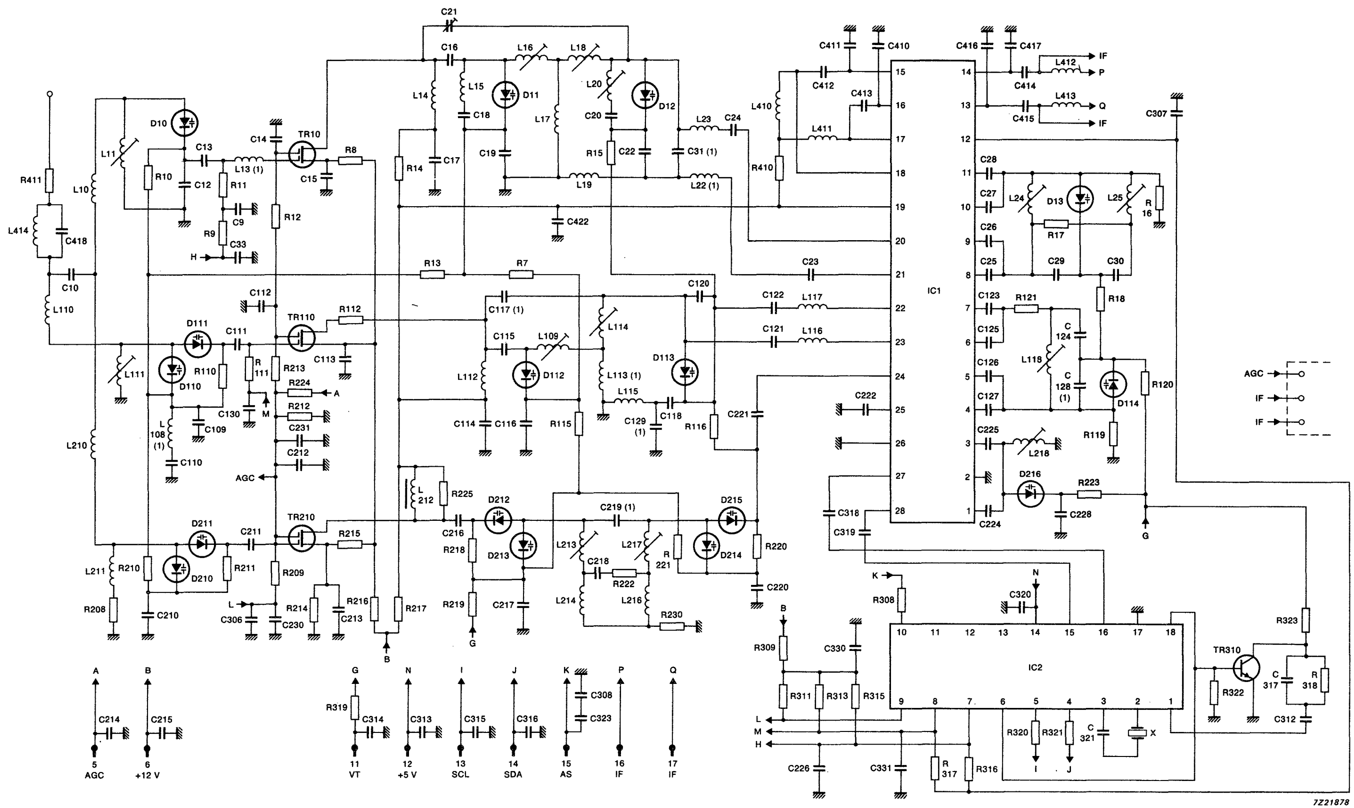


Fig.1A Circuit diagram for UV815, UV816/256, UV816/6456.

(1) Printed on board.
(2) Not used in UV815.

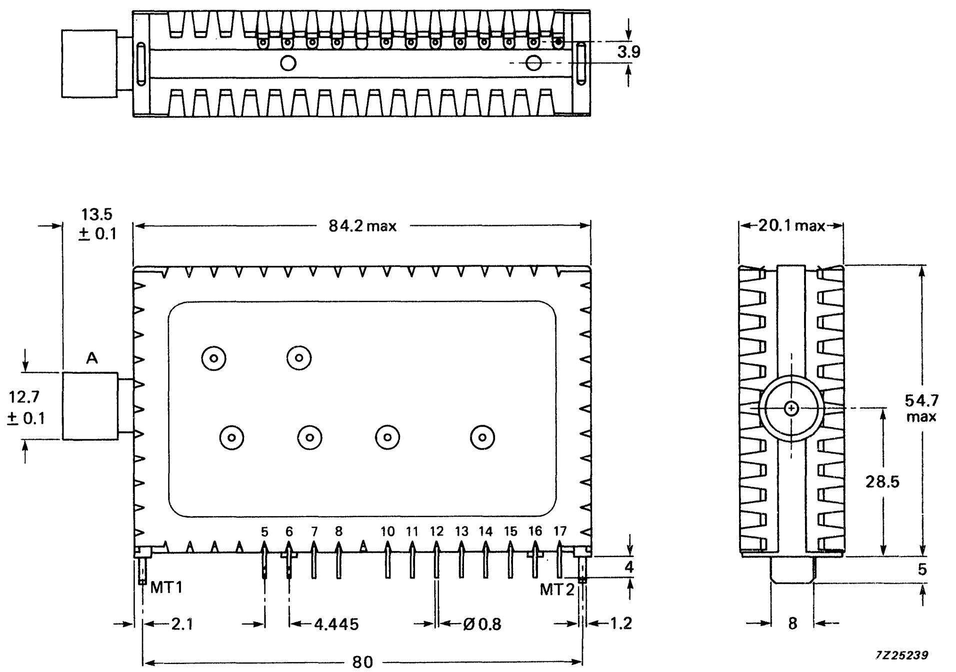


(1) Printed on board.

Fig.1B Circuit diagram for UV816 PLL.

MECHANICAL DATA

Dimensions in mm



Unless otherwise stated the tolerance is ± 0.05 mm

Pin/connector identity

	UV815	UV816/Divider	UV816 PLL
A	IEC 9.5 mm and SNIR 9 mm	IEC 9.5 mm and SNIR 9 mm	IEC 9.5 mm and SNIR 9 mm
5	AGC voltage 9.2 to 0.85 V	AGC voltage 9.2 to 0.85 V	AGC voltage 9.2 to 0.85 V
6	Supply voltage + 12 V	Supply voltage + 12 V	Supply voltage + 12 V
7	Low band supply + 12 V	Low band supply + 12 V	
8	Mid band supply + 12 V	Mid band supply + 12 V	
10	High band supply + 12 V	High band supply + 12 V	
11	Tuning voltage 0.7 to 28 V	Tuning voltage 0.7 to 28 V	33 V via 22 kΩ series resistor
12		Prescaler supply + 5 V	PLL supply + 5 V
13		Prescaler output 1.2 kΩ	SCL serial clock line } I^2C
14		Prescaler output 1.2 kΩ	SDA serial data line } bus
15		To be grounded for 256 ratio, floating for 64 ratio (UV816/6456 only)	Address selection
16	IF output symm.	IF output symm.	IF output symm.
17	Approximately 75 Ω	Approximately 75 Ω	Approximately 75 Ω
MT1 } MT2 }	Mounting tab grounded	Mounting tab grounded	Mounting tab grounded

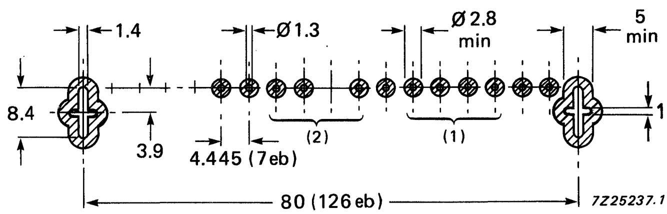
Fig.2 Mechanical detail.

Mass: approximately 95 grams

Mounting

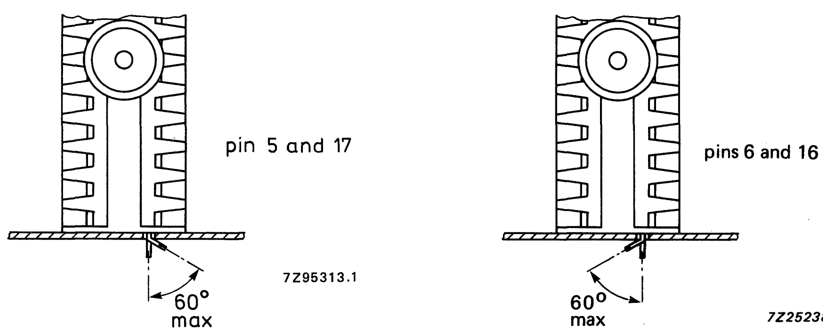
The tuner may be mounted by soldering it on to a printed-wiring board, using the piercing diagram shown in Fig.3 without clearance between tuner supporting surface and board. The connection pins should be bent according to Fig.4. The tuner may be mounted anywhere in the receiver and there are no restrictions on orientation.

The solderability of the pins and mounting tabs is in accordance with IEC 68-2, test Ta (230 ± 10 °C, 2 ± 0.5 s). The resistance to soldering heat is in accordance with IEC 68-2, test Tb (260 ± 5 °C, 10 ± 1 s).



1 eb = 0.025 inch
(1) On 816 PLL, 816/256 and 816/6456 only.
(2) On 816/256 and 816/6456 only.

Fig.3 Piercing diagram viewed from solder side of board; unless otherwise stated the tolerance is ± 0,05 mm.



Note: In order to prevent any stress to the printed-wiring board, the tuner should be supported at its aerial connector.

Fig.4 Bending of connecting pins.

ELECTRICAL DATA

Unless otherwise specified all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0.3 V and an AGC voltage of 9.2 ± 0.2 V.

General

Semiconductors, low band	
RF amplifier	BF998
tuning diodes	4 x BB911
coupling diodes	1 x BBY31 2 x BB901
Semiconductors, mid band	
RF amplifier	BF998
tuning diodes	4 x BB910
coupling diodes	1 x BB405
Semiconductors, high band	
RF amplifier	BF998
tuning diodes	4 x BB405
Mixer/oscillator IC	TDA5330
Tuning transistor (UV816/PLL only)	BC847B
PLL synthesizer (UV816/PLL only)	TSA5510 SP5510 multi addressable SDA3202 single addressable
Frequency divider	SDA4213 SP4653X SAB6457
Ambient temperature range	
operating	−10 to + 60 °C
storage	−25 to + 70 °C
Relative humidity	max. 95%

Voltages and currents

Supply voltage	+ 12 V ± 10%
Current drawn from + 12 V supply with one band selected	
low band mid band high band	max. 85 mA
Bandswitching	max. 8 mA

For operation in all bands the supply voltage is permanently connected to pin 6. Additionally the supply voltage is connected to:

pin 7 for operation in low band
pin 9 for operation in mid band
pin 10 for operation in high band

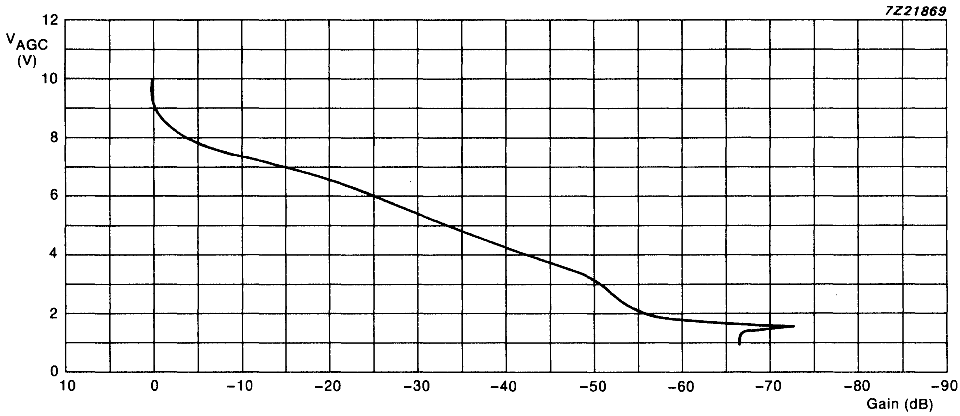
for UV815, 816/256 and 816/6456 only

Input impedance	75 Ω	
VSWR at nominal gain and during gain control		
low band	max. 4	
mid band	max. 4	max. 3 } between 300 to 450 MHz to ensure D2MAC application
high band	max. 4	max. 3 } between 300 to 450 MHz to ensure D2MAC application
Reflection coefficient		
low band	max. 60%	
mid band	max. 60%	max. 50% } between 300 to 450 MHz to ensure D2MAC application
high band	max. 60%	max. 50% } between 300 to 450 MHz to ensure D2MAC application
Output impedance (IF)	75 Ω approximately	
Capacitance between terminals	typ. 3.5 pF	
Load impedance	min. 1 kΩ/max. 22 pF total capacitance load to be tuned to 36.15 MHz by means of an inductance between pins 16 and 17 (min. L: 890 nH)	
RF curves bandwidth		
low band	typ. 8 to 11 MHz	
mid band	typ. 8 to 13 MHz	
high band	typ. 14 to 12 MHz	
RF curves, tilt	on any channel the amplitude difference between the top of the RF resonant curve and the picture frequency, the sound frequency, or any frequency between them will not exceed 4 dB at nominal gain and 5 dB in AGC range between nominal gain and 20 dB gain reduction. See Fig.8.	
AGC range		
low band	min. 40 dB	
mid band	min. 40 dB	
high band	min. 30 dB	
AGC voltage		
voltage range	+ 9.2 to + 0.85 V (max. 30 μA)	
voltage at nominal gain	+ 9.2 ± 0.5 V	
voltage at 40 dB gain reduction		
low band	typ. 3 V	
mid band	typ. 3 V	
voltage at 30 dB gain reduction		
high band	typ. 2 V	

Note: AGC voltages between 0 and + 10.5 V may be applied without risk of damage

AGC current	max. 0.03 mA
Slope of AGC characteristic at the end of the specified AGC range	
low-mid band	typ. 40 dB/V
high band	typ. 80 dB/V

AGC characteristic E2 (48.25 MHz)



AGC characteristic S10 (168.25 MHz)

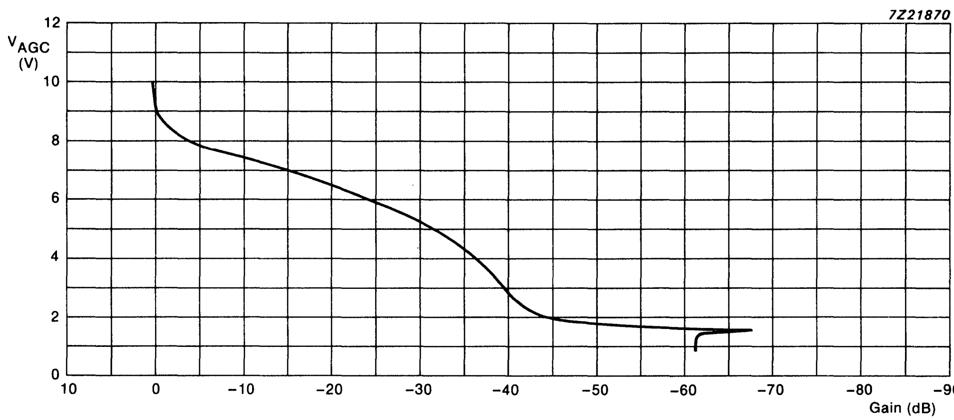
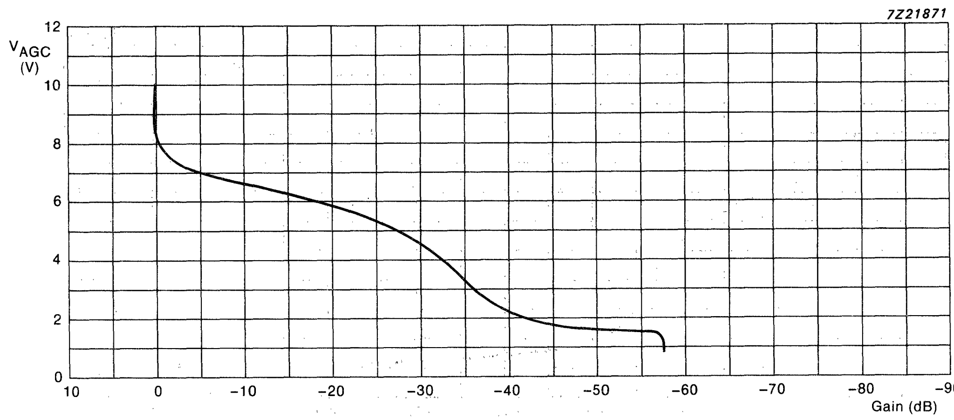


Fig.5 Typical AGC curves, low band.

AGC characteristic E5 (175.25 MHz)



AGC characteristic S39 (447.25 MHz)

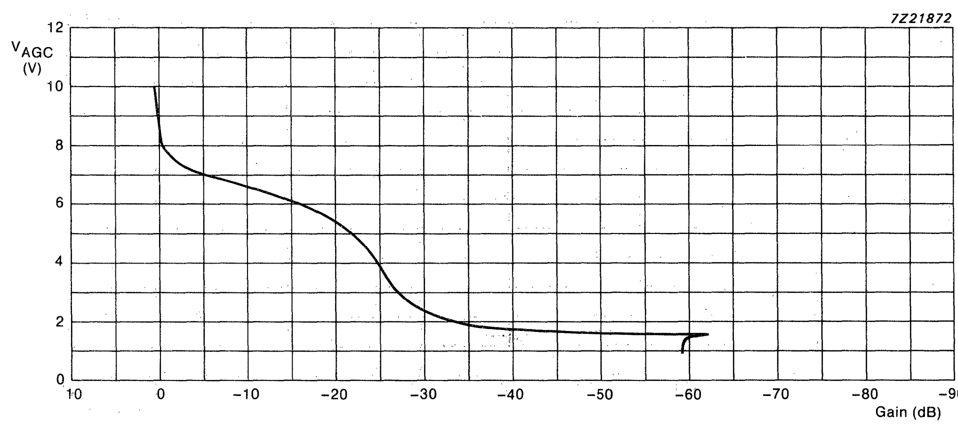
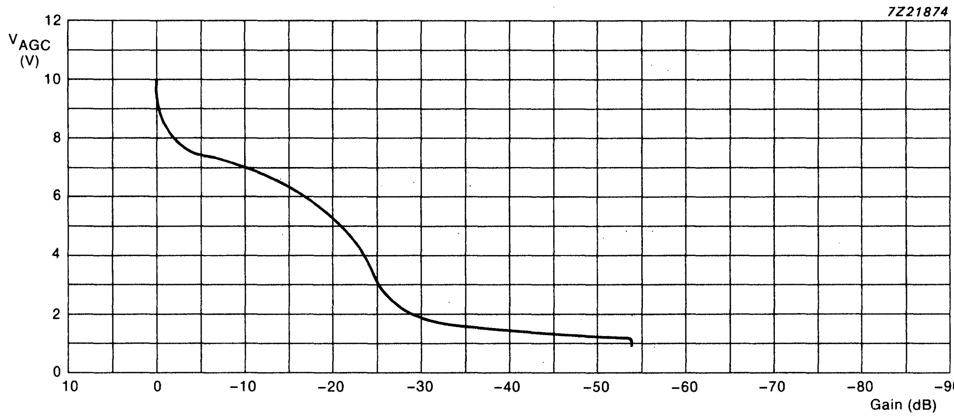


Fig.6 Typical AGC curves, mid band.

AGC characteristic S40 (455.25 MHz)



AGC characteristic E69 (855.25 MHz)

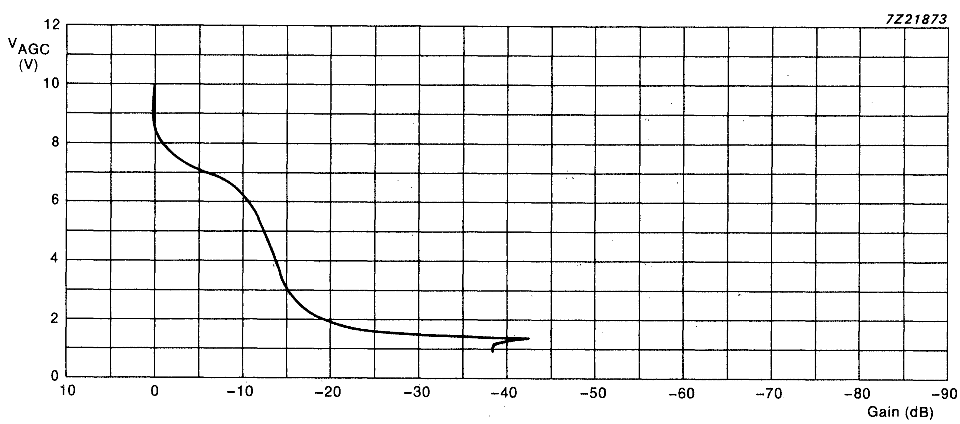
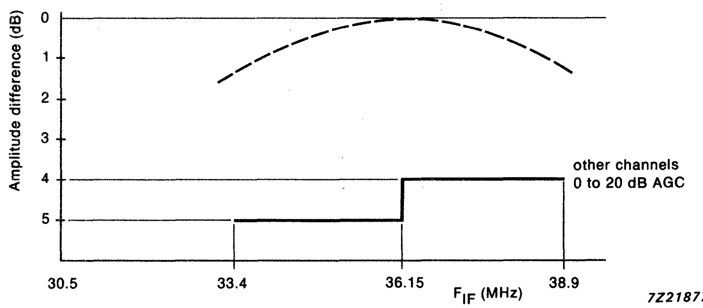
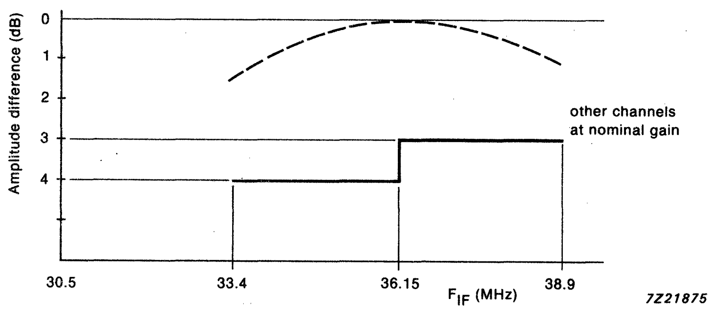


Fig.7 Typical AGC curves, high band.





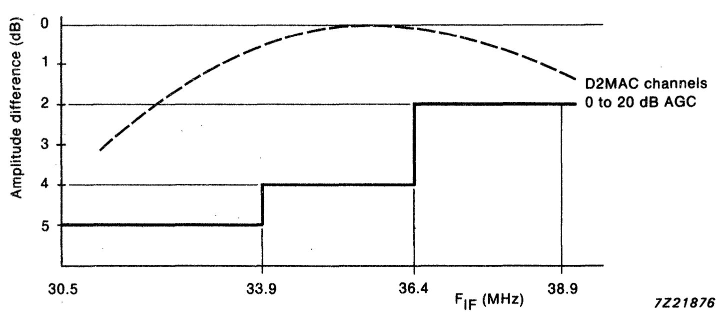


Fig.8 Tilt overall response curves.

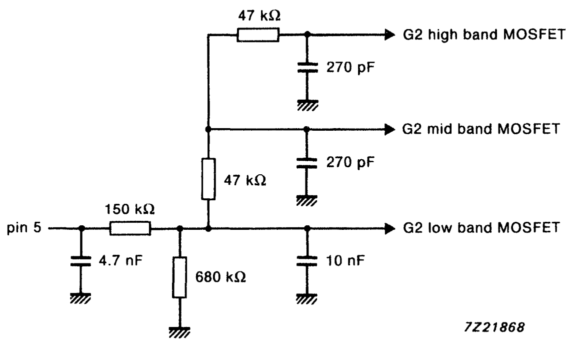


Fig.9 AGC circuit.

Tuning voltage range, UV815, UV816 with divider	+ 0.7 to + 28 V
Tuning voltage, UV816 PLL	+ 33 V nominal (via 22 kΩ)*
Current drawn from 28 V tuning voltage supply	
at T_{amb} = 25 °C and 60% RH	max. 0.5 μA
at T_{amb} = 25 °C and 95% RH	max. 2 μA
at T_{amb} = 60 °C and 60% RH	max. 2 μA
Slope of tuning characteristic	
low band	0.5 to 10 MHz/V
mid band	1 to 20 MHz/V
high band	2 to 25 MHz/V

Frequencies

low band	Channel E2 (picture carrier 48.25 MHz) to channel S10 (picture carrier 168.25 MHz). Margin at the extreme channels: min. 2.0 MHz.
mid band	Channel E5 (picture carrier 175.25 MHz) to channel S39 (picture carrier 447.25 MHz). Margin at the extreme channels: min. 2.0 MHz.
high band	Channel S40 (picture carrier 455.25 MHz) to channel E69 (picture carrier 855.25 MHz). Margin at the extreme channels: min. 2.0 MHz.

* An external pull-up resistor of 22 kΩ ± 5% has to be connected between the tuning supply voltage and terminal 11. The tuning supply current is 1.7 mA max.

Voltage gain	
low + mid + high band	min. 40 dB; max. 50 dB
Maximum gain difference	7 dB
Noise figure	
low band	typ. 6 dB; max. 9 dB
mid band	typ. 7 dB; max. 10 dB
high band	typ. 8 dB; max. 11 dB

Overloading

Input signal producing 1 dB gain compression at nominal gain	
low, mid and high band	typ. 90 dB (μV) into 75 Ω
Input signal producing either a detuning of the oscillator of + 300 kHz or −1000 kHz or stopping of the oscillations at nominal gain	
low + mid band	typ. 105 dB (μV) into 75 Ω; min. 100 dB
high band	typ. 100 dB (μV) into 75 Ω; min. 90 dB

Unwanted signal characteristics

Image rejection (measured at picture carrier frequency)	
low, mid band < 300 MHz	min. 70 dB; typ. 75 dB
low, mid band > 300 MHz	min. 66 dB; typ. 70 dB
high band < 470 MHz	min. 60 dB; typ. 65 dB
high band > 470 MHz	min. 53 dB; typ. 65 dB
IF rejection (measured at picture carrier frequency)	
all bands	min. 60 dB (Channel E2: min. 50 dB)

Note: At colour sub-carrier frequency maximum 6 dB less rejection

Cross modulation

Input signal productng 1% cross modulation, i.e. 1% of the modulation depth of interfering signal is transferred to the wanted signal.

In channel cross modulation (wanted signal: picture carrier frequency; interfering signal: sound carrier frequency)

All bands	
at nominal gain (wanted input level 60 dB (μV))	typ. 75 dB (μV) into 75 Ω for systems L and L′ 70 dB (μV)
at 40 dB gain reduction (wanted input level 100 dB (μV))	typ. 100 dB (μV) into 75 Ω

In band cross modulation (wanted signal: picture carrier of channel N; interfering signal: picture carrier of channel N ± 2 for low band or channel N ± 3 for mid channel or channel N ± 5 for high band)

low + mid band	
at nominal gain	
(wanted input level 60 dB (μV))	typ. 95 dB (μV) into 75 Ω
at 40 dB gain reduction	
(wanted input level 100 dB (μV))	typ. 100 dB (μV) into 75 Ω
high band	
at nominal gain	
(wanted input level 60 dB (μV))	typ. 100 dB (μV) into 75 Ω
at 30 dB gain reduction	
(wanted input level 90 dB (μV))	typ. 100 dB (μV) into 75 Ω

Out of band cross modulation at nominal gain
each of the low, mid or high band interfering with any of the other bands mentioned — typ. 100 dB (μV) into 75 Ω

Unwanted signal handling capability (visibility test)

For the channel combinations
VHF and hyperband: N ± 1, N ± 5, N + 9, N + 11
UHF: N ± 1, N ± 5, N + 9

Oscillator characteristics

Pulling

Input signal of tuned frequency producing a shift of the oscillator frequency of 10 kHz, at nominal gain	
all bands	min. 74 dB (μV) into 75 Ω
Shift of oscillator frequency at a change of supply voltage of ± 5%	
low band	max. 250 kHz
mid band	max. 500 kHz
high band	max. 500 kHz
Drift of oscillator frequency	
during warm-up time (after the tuner has been completely out of operation for 15 minutes, measured between 5 s and 15 minutes after switching on)	max. 250 kHz
during warm-up time (after the input stage is in operation for 15 minutes, measured between 2 s and 15 minutes after band switching)	max. 250 kHz

at a change of the ambient temperature from + 25 °C to + 50 °C (measured after 3 cycles from + 25 to 0 °C)	
low band	max. 500 kHz
mid band	max. 750 kHz
high band	max. 1000 kHz
at a change of humidity from 60 ± 15% to 93 ± 2%, at T_{amb} = 25 ± 5 °C	
low band	max. 500 kHz
mid band	max. 1300 kHz
high band	max. 1500 kHz

Frequency divider characteristics

Frequency division ratio	
UV816/256	256
UV816/6456	switchable, 64 or 256
Supply voltage	+ 5 V ± 10%
Current drawn from + 5 V supply	max. 35 mA; typ. 25 mA
Output voltage, unloaded, measured with probe 10 MΩ/11 pF	min. 0.5 V (p-p) for 256 division ratio min. 0.25 V (p-p) for 64 division ratio
Output impedance	typ. 1 kΩ
Output imbalance	typ. 0.1 V
Signal disturbance ratio at IF output, IF output terminated with 10 MΩ/11 pF	57 dB min.

Miscellaneous

Radio interference	
Oscillator radiation and oscillator voltage at the aerial terminal	Within the limits of CISPR 13 (1975), VDE0872/7.72 and Amtsblatt DBP69/1981, item 5.1.2 and CENELEC proposal European standard EN55013 and EN55020 and Finland Requirements Bulletin 33-86 when applying the tuner in an adequent TV receiver.
Microphonics	There will be no microphonics, provided the tuner is installed in a professional manner.
Surge protection	
Protection against voltages (note 1)	max. 5 kV
Protection against flashes (note 2)	max. 30 kV, 400 mW

Notes to the characteristics

1. 10 discharges of a 470 pF capacitor into the aerial terminal.
2. A flashover circuit producing flashes with frequencies of 1 to 20 Hz for 30 s is connected to the aerial terminal. (Power removed from tuner during test).

APPLICATION INFORMATION

For further information regarding general aspects of I^2C-bus control refer to:
"The I^2C-bus specification", published by Philips Components.

Logic diagram

	MSB							LSB	
Address Byte	1	1	0	0	0	MA1	MA0	0	A
Prog. div. Byte 1	0	n14	n13	n12	n11	n10	n9	n8	A
Prog. div. Byte 2	n7	n6	n5	n4	n3	n2	n1	n0	A
Control info Byte 1	1	5I	0	0	1	1	1	0	A
Control info Byte 2	P7	P6	P5	P4	0	P2	P1	P0	A

A = Acknowledge

Address selection

MA1	MA0	voltage at terminal 15
0	0	0 . . . 0 . 1 x V PLL
0	1	don't care
1	0	0 . 4 . . . 0 . 6 x V PLL
1	1	0 . 9 . . . 2 . 7 x V PLL

UHF/VHF TELEVISION TUNERS

QUICK REFERENCE DATA

Systems	CCIR systems B and G
Channels	
low band	E2 to C
mid band	M4 to E12
high band	E21 to E69
Intermediate frequencies	
picture	38.90 MHz
colour	34.47 MHz
sound	33.40 MHz

APPLICATION

The UV913/914 tuners belong to the 900 family of small size tuners which are designed to meet a wide range of applications.

The UV914 is equipped with a built-in digital controlled (I^2C) PLL tuning IC. Band switching is also carried out via the I^2C-bus. The UV913 types are intended for voltage controlled tuning and do not have the PLL synthesizer.

The tuner IF output is designed with low output impedance to directly drive a variety of SAW filters.

These tuners comply with the radiation, signal handling and immunity requirements of CISPR 13 (1975) amendment No. 1 (1983) and CENELEC proposal European Standard EN55013 and EN55020.

Table 1 Available versions

type	aerial connector	tuning method	catalogue number
UV913	phono	0.3 V - 28 V	3139 147 10750
UV913/IEC (note 1)	IEC (14.5 mm)	0.3 V - 28 V	3139 147 11390
UV914	phono	PLL/I^2C	3139 147 10980
UV914/IEC (note 1)	IEC (14.5 mm)	PLL/I^2C	3139 147 11410

Note to Table 1

1. Available on special request.

DESCRIPTION

The UV913/914 tuners are combined VHF/UHF units covering the low band (frequency range 46.25 to 102.25 MHz), the mid band (frequency range 138.25 to 224.25 MHz) and the high band (frequency range 471.25 to 855.25 MHz).

The tuners are built on a low-loss printed-wiring board carrying all components and are housed in a sheet steel housing with separated front and rear covers. The aerial connector (phono or IEC) is mounted on one side of the frame.

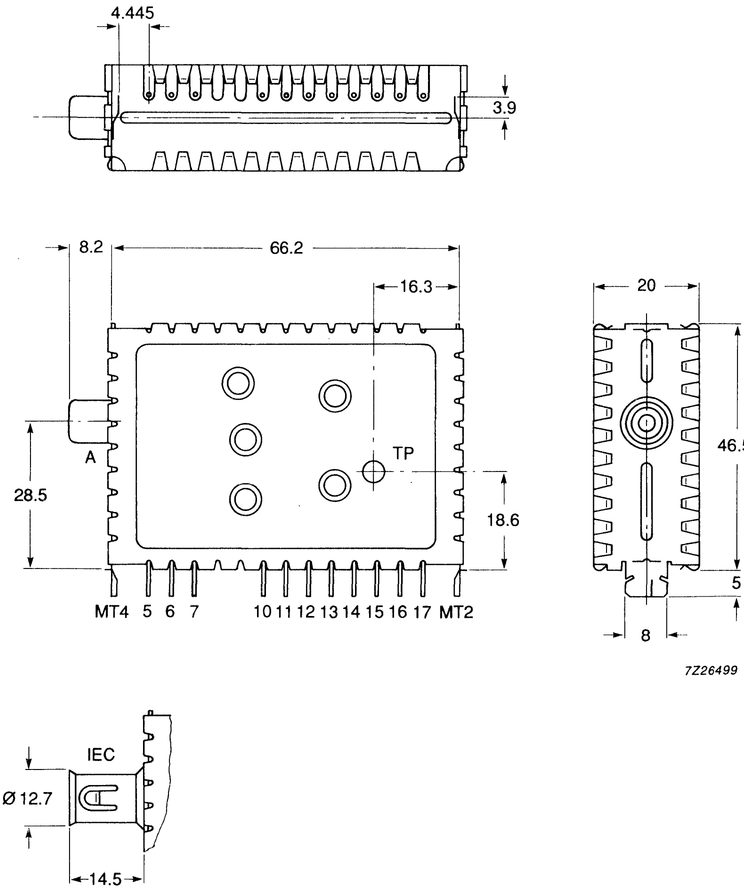
The tuners are equipped with a common aerial input connector (IEC or phono) and are provided with three tuned RF MOSFET input stages. The mixers and oscillators (bands I, II and III) and IF oscillators are biased for high signal handling capabilities.
Between the mixers and the IF amplifier, a double tuned IF filter is provided to improve IF selectivity and to maintain a flat response for the desired frequencies.

The low output impedance of the asymmetrical IF output ensures sufficient triple transient suppression of the SAW filter.

The UV914 tuner contains an I^2C-bus controlled phase-locked-loop tuning system enabling direct channel access with crystal controlled accuracy. Band switching is also carried out via the I^2C-bus.

MECHANICAL DESCRIPTION

Dimensions in mm



	UV913	UV914
A	aerial input	aerial input
5	AGC voltage 9.2 to 0.85 V	AGC voltage 9.2 to 0.85 V
6	supply voltage + 12 V	supply voltage + 12 V
7	VHF switch input	
10	UHF switch input	
11	tuning voltage 0.3 to 28 V	tuning supply voltage (33 V via 22 kΩ series resistor)
12		supply voltage PLL + 5 V
13		SCL serial clock line
14		SDA serial data line
15		address selection input
16	ground	ground
17	IF output	IF output
MT1	mounting tab grounded	mounting tab grounded
MT2	mounting tab grounded	mounting tab grounded

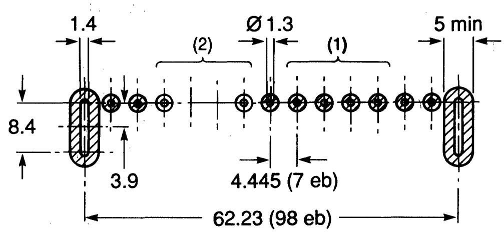
Fig.1 Mechanical detail.

Mass: approximately 55 grams

Mounting

The tuner may be mounted by soldering it to a printed-wiring board, using the piercing diagram shown in Fig.2 without clearance between the tuner supporting surface and the board. The connecting pins and mounting tabs should be bent in accordance with Fig.3.
The tuner may be mounted anywhere in the receiver and there are no restrictions on orientation.

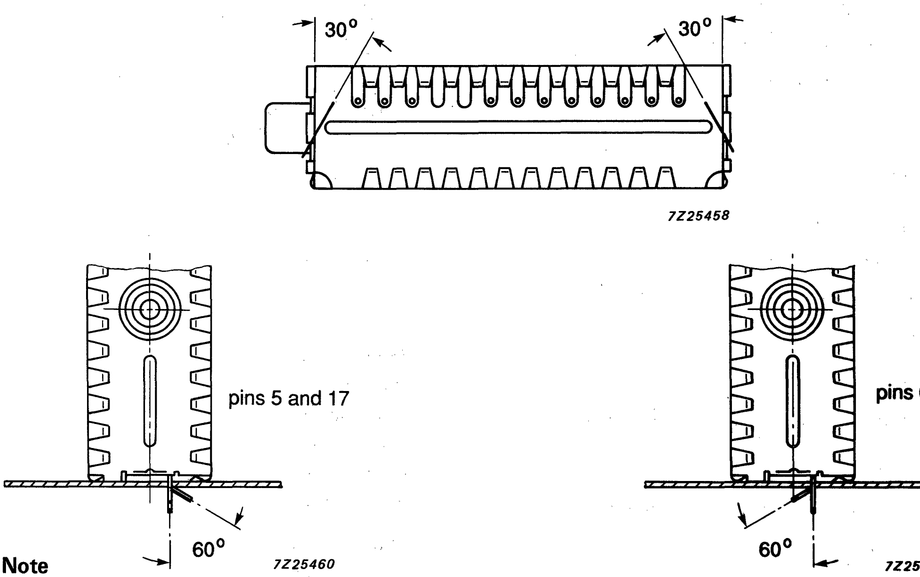
The solderability of the pins and mounting tabs is in accordance with IEC 68-2, test Ta (230 ± 10 °C, 2 ± 0.5 s). The resistance to soldering heat is in accordance with IEC 68-2, test Tb (260 ± 5 °C, 10 ± 1 s).



(1) UV914 types only
(2) UV913 types only

1 eb = 0.025 inch.

Fig.2 Piercing diagram viewed from solder side of board.



Note

In order to prevent any stress to the printed-wiring board, the tuner should be supported at its aerial connector.

Fig.3 Bending of connecting pins and mounting tabs.

ELECTRICAL DATA

Unless otherwise specified all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0.3 V, an AGC voltage of 9.2 ± 0.2 V, a PLL supply voltage of 5 ± 0.3 V and a tuning supply voltage of 33 ± 0.5 V via a 22 kΩ series resistor.

General

Semiconductors, low band	
RF amplifier	3SK186
mixer	2SC2435
oscillator	BF747
tuning diodes	BB809
Semiconductors, mid band	
RF amplifier	3SK186
mixer	2SC2435
oscillator	2SC2435
tuning diodes	1SV124
Semiconductors, high band	
RF amplifier	BF990A/01R
mixer	2SC2435
oscillator	2SC2480
tuning diodes	OF643
IF amplifier	BFS17
Tuning/bandswitching IC (UV914 types only)	SP5510 or TSA5510
Tuning voltage transistor (UV914 types only)	BC847B
Ambient temperature range	
operating	−10 °C to + 60 °C
storage	−25 °C to + 85 °C
Relative humidity	max. 95%

DEVELOPMENT DATA

Voltages and currents

Supply voltage	+ 12 V ± 10%
PLL supply voltage (UV914 types only)	+ 5 V ± 10%
Current drawn	
supply current	max. 50 mA
PLL current	max. 55 mA
Tuning supply voltage (UV914 types only)*	min. 30 V typ. 33 V max. 35 V
Tuning supply voltage (UV913 types only)	0.3 to 28 V
Tuning supply current	max. 1.7 mA
Bandswitching voltage (UV913 types only)	+ 12 V ± 10%
Bandswitching current (UV913 types only)	max. 2 mA

* Via 22 kΩ series resistor.

Aerial input characteristics

VSWR referred to 75 Ω impedance	
low band	max. 5
mid band	max. 5
high band	max. 5
Reflection coefficient referred to 75 Ω impedance	
low band	max. 66%
mid band	max. 66%
high band	max. 66%
Surge protection	min. 8 kV
Oscillator voltage at aerial terminal	
up to 860 MHz	max. 46 dB/μV
860 to 1000 MHz	max. 46 dB/μV

IF output characteristics

IF output impedance (between pins 17 and 16 (ground))	90 Ω
Permitted IF load impedance	min. 1 kΩ max. 22 pF

Frequency range

Low band	channel E2 (picture carrier 48.25 MHz) to channel C (picture carrier 82.25 MHz). Margin at extreme channels: min. 2 MHz.
Mid band	channel M4 (picture carrier 163.25 MHz) to channel E12 (picture carrier 224.25 MHz). Margin at extreme channels: min. 2 MHz.
High band	channel E21 (picture carrier 471.25 MHz) to channel E69 (picture carrier 855.25 MHz). Margin at extreme channels: min. 2 MHz.

Wanted signal characteristics

Voltage gain	
all channels	min. 40 dB max. 52 dB
gain difference of off-air channels	max. 8 dB
Noise figure	
low band	max. 8 dB
mid band	max. 8 dB
high band	max. 10 dB
AGC range	
low and mid bands	min. 40 dB
high band	min. 30 dB

Overloading	
input signal producing a gain compression of 1 dB	min. 90 dB/μV
input signal producing oscillator detuning of + 300/−1000 kHz	min. 90 dB/μV
input signal causing the PLL to fail to lock to desired signal	min. 90 dB/μV
Image rejection (between 0 and 10 dB gain reduction)	
low band	min. 66 dB
mid band	min. 66 dB
high band	min. 45 dB
IF rejection	
channel E2	min. 50 dB
other channels	min. 60 dB

Amplitude response curves

Tilt of overall response

At any channel the amplitude differences between:

Off-air channels	
top of response curve and picture	max. 4 dB
top of response curve and sound carrier	min. 0.5 dB max. 6 dB
valley	max. 1 dB
sound carrier above picture carrier	max. 3 dB

IF response

Amplitude difference between:

top of response curve and picture carrier	max. 1 dB
top of response curve and sound carrier	max. 1 dB

Unwanted signal characteristics

Break through susceptibility — min. 60 dB/μV

Cross modulation

The undesired carrier level required to produce 1% transfer of its modulation onto the desired carrier shall be equal to or exceed the desired carrier level (60 dB/μV at nominal gain) for all gain values between maximum gain and 40 dB (low band) or 30 dB (high band) reduction or be:

In channel low band	min. 66 dB/μV
In band N ± 2 low band	min. 78 dB/μV
In band N ± 3 mid band	min. 78 dB/μV
In band N ± 5 high band	min. 84 dB/μV
Out of band	typ. 100 dB/μV

FM rejection	
at channel 6 (90.5 MHz, antenna level 60 dB/μV)	min. 50 dB
at channel 6 (93 to 108 MHz, antenna level 90 dB/μV)	min. 50 dB

Oscillator characteristics (UV913 types only)

Drift of oscillator frequency	
Warm up (tuner on-off, bandswitching)	
low band	max. 250 kHz
high band, up to channel 69	max. 500 kHz
high band, channel 70 to 83	max. 500 kHz
Change of ambient temperature 25 ± 25 °C	
low band	max. 500 kHz
mid band	max. 500 kHz
high band	max. 1000 kHz
Change of humidity 60% to 93% ± 2%	
low band	max. 500 kHz
high band, up to channel 69	max. 1000 kHz
high band, channels 70 to 83	max. 1500 kHz
Shift of oscillator frequency at a change of supply voltage of 5%	
low band	max. 250 kHz
mid and high bands	max. 500 kHz
during AGC	max. 150 kHz
Pulling (10 kHz)	min. 74 dB/μV

PLL tuning characteristics (UV914 types only)

PLL tuning resolution	max. 62.5 kHz
Deviation from nominal of the locked oscillator frequency under any combination of the operation conditions	50^{-6}

Miscellaneous

Radio interference

Oscillator radiation and oscillator voltage at the aerial terminal is within the limits of CISPR 13 (1975) amendment No. 1 (1983) and CENELEC proposal European Standard EN55013 and EN55020.

Microphonics

With the tuner exposed to sound signals in the audio frequency range 100 Hz to 10 kHz and sound pressure levels up to 105 dB (20 μPa), the video signal to sound interference ratio will be:

min. 40 dB

Oscillator voltage at the pins

supply and control pins	max. 70 dB/μV
IF pins - low band	max. 95 dB/μV
IF pins - high band	max. 70 dB/μV

ESD protection at the pins
All pins of the tuner are protected against electrostatic discharge up to 2 kV.

The product is classified in category B (MIL-STD-883C).

APPLICATION INFORMATION

For information regarding general aspects of I^2C-bus control refer to:
" The I^2C bus specification ', published by Philips Components.

I^2C-bus requirements (SDA and SCL pins)

$V_{IL(max)}$ = 1.5 V (maximum input LOW voltage)
$V_{IH(min)}$ = 3.0 V (minimum input HIGH voltage)
$I_{IL(max)}$ = −10 μA (maximum LOW input current)
$I_{IH(max)}$ = 10 μA (maximum HIGH input current)
$V_{OL(max)}$ = 0.4 V (maximum output LOW voltage at 3 mA sink current)

Logic diagram (WRITE mode, R/$\overline{W}$ = 0)

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	R/$\overline{W}$
Prog. div. byte 1	0	n14	n13	n12	n11	n10	n9	n8
Prog. div. byte 2	n7	n6	n5	n4	n3	n2	n1	n0
Control byte 1	1	5I	T1	T0	1	1	1	0
Control byte 2	P7	P6	P5	P4	P3	P2	P1	P0

Address selection

MA1	MA0	Address	Voltage at pin 15
0	0	C0	0 to 0.1 V PLL
0	1	C2	irrelevant*
1	0	C4	0.4 to 0.6 V PLL
1	1	C6	0.9 V PLL to 13.5 V

The UV914 types have pin 15 (address input) biased internally using a 47 kΩ resistor to B+ (+ 12 V). Therefore, with pin 15 open circuit, the tuner will respond to address C2 and C6.

* The tuner will always respond to address C2. The second address will depend on the voltage applied at pin 15.

Programmable divider setting (bytes 1 and 2)

Divider ratio: $N = 16 \times (f_{rf}, pc\ (MHz) + f_{if}, pc\ (MHz))$
$f_{osc} = N/16\ (MHz)$.

$N = 16384 \times n14 + 8192 \times n13 + 4096 \times n12 + 2048 \times n11 + 1024 \times n10 + 512 \times n9 + 256 \times n8 + 128 \times n7 + 64 \times n6 + 32 \times n5 + 16 \times n4 + 8 \times n3 + 4 \times n2 + 2 \times n1 + n0$

Control byte 1

Charge pump (CP) setting: CP can be set to either logic 0 (low current) or logic 1 (high current). CP = 1 results in faster tuning, CP = 0 in moderate tuning speed with slightly better residual oscillator FM.

Test mode setting: T1, T0 = 0 for normal operation.

PLL disabling: OS = 0 for normal operation.
OS = 1 switches the charge pump transistor to the non-conducting state, enabling the tuner to be manually tuned by applying a variable tuning voltage to pin 11. When selecting OS to logic 1 it is recommended to simultaneously set T0 to logic 1.

Control byte 2

DEVELOPMENT DATA

Bandswitching

	P0	P1	P2	P3	P4	P5	P6	P7
low band	x	x	x	0	0	1	1	0
mid band	x	x	x	0	1	0	1	0
high band	x	x	x	0	1	1	0	0

x = don't care
P0 to P7: output ports on PLL device

P3 must be programmed with 0 since the address voltage is applied at this combined input/output port.

Telegram examples (WRITE mode)

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	CB1	ACK	CB2	ACK	Stop

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	DIV1	ACK	Stop

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	Stop

Start	ADD	ACK	CB1	ACK	CB2	ACK	Stop

Start	ADD	ACK	CB1	ACK	CB2	ACK	DIV1	ACK	Stop

Start = start condition
ADD = address
ACK = acknowledge
DIV1 = divider ratio byte 1
DIV2 = divider ratio byte 2
CB1 = control byte 1
CB2 = control byte 2
Stop = stop condition

Logic diagram (READ mode, $R/\overline{W} = 1$)

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	$R/\overline{W}$
Status byte	POR	FL	I2	I1	I0	A2	A1	A0

FL indicates when the tuning loop of the PLL to be in lock. The loop must be phase-locked for at least 8 periods of the internal 7.8125 kHz reference frequency (i.e. 1 ms) before the FL flag is set to logic 1.

POR (power on reset) is internally set to logic 1 if the PLL voltage drops below 3 V. The POR bit is reset when an end-of-data is detected by the PLL IC.

I0 to I2 and A0 to A2 do not contain any relevant data for the tuner application and can be ignored.

Telegram examples (READ mode)

Start	ADD	ACK	STB	ACK	STB		Stop	⇒ from processor

no Acknowledge = end-of-data

Start	ADD	ACK	STB		Stop	⇒ from PLL

Start = Start condition
ADD = Address
ACK = Acknowledge
STB = Status byte
Stop = Stop condition

ADDITIONAL INFORMATION

RF AGC setting

The RF AGC must be set such that the IF output level of the tuner (with IF load as stated) does not exceed 107 dB/μV.

IF injection

An IF signal from a generator (internal resistance 50 Ω or 75 Ω) should be connected to the IF injection point TP, accessible through a hole in the cover (see Fig.1) using probe 3139 147 10950.

Tuning supply voltage

A tuning voltage of 33 V must be connected via a series 22 kΩ resistor to pin 11. A preferred method is constant current supply of 1 to 1.5 mA to the pin. Figure 4 shows this with a 140 V supply. The zener diode prevents the voltage at pin 11 exceeding 33 V.

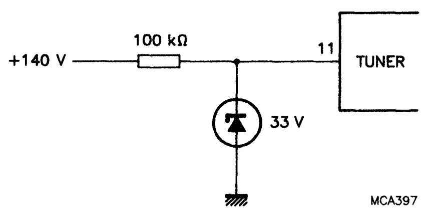


Fig.4 Constant current supply.

VHF/UHF TELEVISION TUNERS

QUICK REFERENCE DATA

Systems	CCIR systems B, G and H; I, I′, L, L′ and D2 MAC	
Channels	off-air	cable
low band	E2 to C	S01 to S10
mid band	E5 to E12	S11 to S39
high band	E21 to E69	S40 and S41

Intermediate frequencies (MHz)

System	B, G and H	I	L	I′	L′	D2MAC
Picture	38.90	39.50	38.90	38.90	33.40	38.90
Colour	34.47	35.07	34.47	34.47	37.83	
Sound 1	33.40	33.50	32.40	32.90	39.90	
Sound 2	33.16	33.00		32.40		
Bandedge						30.50

APPLICATION

Designed to cover the VHF and UHF channels of CCIR systems B, G and H, I, I′, L, L′ and D2MAC with extended VHF/UHF frequency ranges, including cable and hyperband.

The IF output is designed to directly drive a variety of SAW filters.

The UV916E/256 and UV916E/6456 tuners are equipped with frequency dividers which make them suitable for digital tuning systems based on frequency synthesis; apart from this they are equivalent to type UV915E.

In the UV916E/PLL tuner the frequency divider is replaced by a built-in digital controlled (I^2C) PLL tuning system.

Table 1 Available versions (note 1)

	aerial input connector	frequency divider (IC)	catalogue number
UV915E	phono		3139 147 10771
UV915E/IEC (note 2)	IEC (14.5 mm)		3139 147 10781
UV916E/PLL	phono		3139 147 10471
UV916E/PLL/IEC (note 2)	IEC (14.5 mm)		3139 147 10361

Notes to Table 1

1. These tuners comply with the requirements of radiation, signal handling capability and immunity from radiated interference of Amtsblatt DBP69 1981, DIN VDE 0872, CISPR (1973) including amendment 1 (1983) and CENELEC proposal European Standard EN55013, EN55020.
2. Available on special request.

DESCRIPTION

The UV915E/916E series feature combined VHF/UHF handling capability with electronic tuning and band switching. The tuners cover the low band (frequency range 46 to 170 MHz), the mid band (frequency range 170 to 450 MHz) and the high band (frequency range 450 to 860 MHz).

The tuners are built on a low-loss printed-wiring board carrying all components in a metal housing made of a rectangular frame, with front and rear covers (see Fig.1). The common IEC and SNIR aerial connector (75 Ω) is mounted on one of the frame sides of the housing, all other connections (supply voltages, AGC voltage, tuning and switching voltages, IF output) are made via pins on the underside. (For mounting method, see Figs 2 and 3).

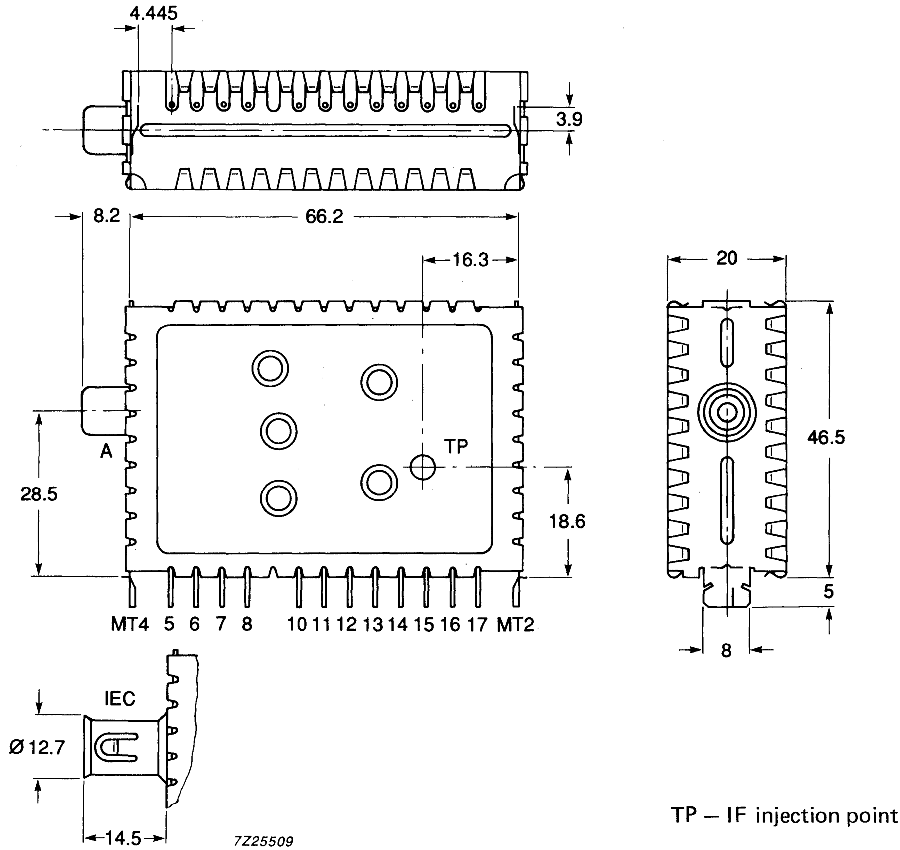
The tuners have three tuned RF input stages. The mixers and oscillators (low, mid and high bands) and IF amplifiers are biased for high signal handling capabilities. Between the mixers and the IF amplifier, a double tuned IF filter is provided to improve IF selectivity and maintain a flat response for the selected frequencies.

The IF output is designed for direct drive of a variety of SAW filters. The output impedance of the asymmetrical IF terminals is approximately 75 Ω to ensure sufficient triple transient suppression of the SAW filter.

The UV916E tuners are provided with a digital programmable phase-locked-loop tuning system. This enables tuning with a 62.5 kHz pitch with crystal accuracy. Band switching is also carried out via the I^2C-bus.

MECHANICAL DATA

Dimensions in mm



TP — IF injection point

Pin/connector identity	UV915E	UV916E/Divider	UV916E PLL
A	IEC 9.5 mm and SNIR 9 mm	IEC 9.5 mm and SNIR 9 mm	IEC 9.5 mm and SNIR 9 mm
5	AGC voltage 9.2 to 0.85 V	AGC voltage 9.2 to 0.85 V	AGC voltage 9.2 to 0.85 V
6	Supply voltage + 12 V	Supply voltage + 12 V	Supply voltage + 12 V
7	Low band supply + 12 V	Low band supply + 12 V	
8	Mid band supply + 12 V	Mid band supply + 12 V	
10	High band supply + 12 V	High band supply + 12 V	
11	Tuning voltage 0.3 to 28 V	Tuning voltage 0.3 to 28 V	33 V via 22 kΩ series resistor
12		Prescaler supply + 5 V	PLL supply + 5 V
13		Prescaler output 1.2 kΩ	SCL serial clock line
14		Prescaler output 1.2 kΩ	SDA serial data line
15		To be grounded for 256 ratio, floating for 64 ratio (UV816/6456 only)	Multiple address selection
16	Ground	Ground	Ground
17	IF output	IF output	IF output
MT1, MT2	Mounting tab grounded	Mounting tab grounded	Mounting tab grounded

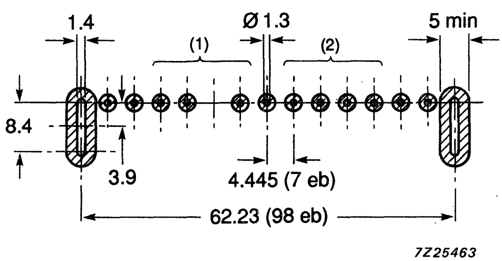
Fig.1 Mechanical diagram.

Mass: approximately 80 grams

Mounting

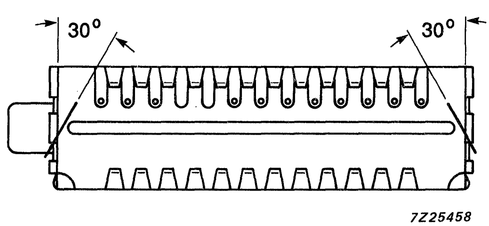
The tuner may be mounted by soldering it on to a printed-wiring board, using the piercing diagram shown in Fig.2 without clearance between the tuner supporting surface and the board. The connecting pins should be bent according to Fig.3. The tuner may be mounted anywhere in the receiver and there are no restrictions on orientation.

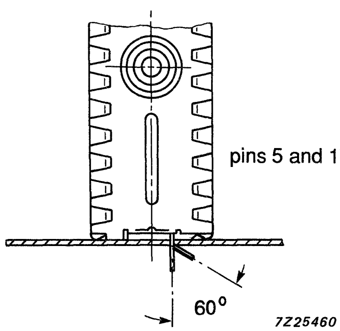
The solderability of the pins and mounting tabs is in accordance with IEC 68-2-20, test Ta (230 ± 10 °C, 2 ± 0.5 s). The resistance to soldering heat is in accordance with IEC 68-2-20 test Tb (260 ± 5 °C, 10 ± 1 s).

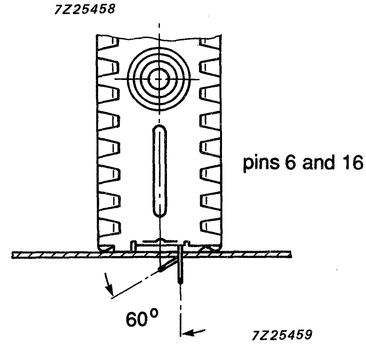


1 eb = 0.025 inch.
(1) UV916E types only.
(2) UV915E and UV916E/Divider only.

Fig.2 Piercing diagram viewed from solder side of board; unless otherwise stated the tolerance is ± 0.05 mm.







Note: In order to prevent any stress to the printed-wiring board, the tuner should be supported at its aerial connector.

Fig.3 Bending of connecting pins and mounting tabs.

ELECTRICAL DATA

Unless otherwise specified all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0.3 V and an AGC voltage of 9.2 ± 0.2 V.

General

Semiconductors, low band	
RF amplifier	BF998R
mixer	2SC2480
oscillator	BFS17
tuning diodes	BF911
coupling diodes	OF643
Semiconductors, mid band	
RF amplifier	BF998R
mixer	2SC2480
oscillator	2SC3545
tuning diodes	OF612
coupling diodes	OF612
Semiconductors, high band	
RF amplifier	BF990A/01R
mixer	2SC3841
oscillator	2SC2480
tuning diodes	OF643
IF amplifier	BFS17
PLL tuning IC	SP/TSA 5510
Charge pump buffer transistor (NPN)	BC847B
Ambient temperature range	
operating	−10 to + 60 °C
storage	−25 to + 85 °C
Relative humidity	max. 95%

Voltages and currents

Supply voltage	+ 12 V ± 10%
Current drawn from + 12 V supply with one band selected	
low band	
mid band	max. 85 mA
high band	
Bandswitching	max. 8 mA

For operation in all bands the supply voltage is permanently connected to pin 6. Additionally the supply voltage is connected to:

pin 7 for operation in low band	
pin 8 for operation in mid band	for UV915E, 916E/256 and 916E/6456 only
pin 10 for operation in high band	

Input impedance	75 Ω		
VSWR at nominal gain and during gain control			
low band	max. 4		
mid band	max. 4	max. 3	between 300 to 450 MHz to
high band	max. 4		ensure D2MAC application

ELECTRICAL DATA (continued)

Voltages and currents (continued)

Reflection coefficient	
low band	max. 60%
mid band	max. 60% max. 50% between 300 to 450 MHz to
high band	max. 60% ensure D2MAC application
Output impedance	75 Ω approximately
Load impedance	min. 1 kΩ/max. 22 pF total capacitance load to be tuned to 36.15 MHz by means of an inductance between pins 16 (ground) and 17 (min. L: 890 nH)
RF curves bandwidth	
low band	typ. 8 to 11 MHz
mid band	typ. 8 to 13 MHz
high band	typ. 14 to 12 MHz
RF curves, tilt	on any channel the amplitude difference between the top of the RF resonant curve and the picture frequency, the sound frequency, or any frequency between them will not exceed 4 dB at nominal gain and 5 dB in AGC range between nominal gain and 20 dB gain reduction
AGC range	
low band	min. 40 dB
mid band	min. 40 dB
high band	min. 30 dB
AGC voltage	
voltage range	+ 9.2 to + 0.85 V (max. 30 μA)
voltage at nominal gain	+ 9.2 ± 0.5 V
voltage at 40 dB gain reduction	
low band	typ. 3 V
mid band	typ. 3 V
voltage at 30 dB gain reduction	
high band	typ. 2 V

Note: AGC voltages between 0 and + 10.5 V may be applied without risk of damage.

AGC current	max. 30 μA
Slope of AGC characteristic at the end of the specified AGC range	
low-mid band	typ. 40 dB/V max. 100 dB/V
high band	typ. 80 dB/V max. 100 dB/V
Tuning voltage range, UV915E, UV916E with divider	+ 0.7 to + 28 V
Tuning voltage, UV916E PLL	+ 33 V nominal (via 22 kΩ)*

* An external pull-up resistor of 22 kΩ ± 5% has to be connected between the tuning supply voltage and terminal 11. The tuning supply current is 1.7 mA max.

Current drawn from 28 V tuning voltage supply	
at T_{amb} = 25 °C and 60% RH	max. 0.5 μA
at T_{amb} = 25 °C and 95% RH	max. 2 μA
at T_{amb} = 60 °C and 60% RH	max. 2 μA
Slope of tuning characteristic	
low band	0.5 to 10 MHz/V
mid band	1 to 20 MHz/V
high band	2 to 25 MHz/V

Frequencies

Frequency ranges	
low band	channel E2 (picture carrier 48.25 MHz) to channel S10 (picture carrier 168.25 MHz). Margin at the extreme channels: min. 2.0 MHz
mid band	channel E5 (picture carrier 175.25 MHz) to channel S39 (picture carrier 447.25 MHz). Margin at the extreme channels: min. 2.0 MHz
high band	channel S40 (picture carrier 455.25 MHz) to channel E69 (picture carrier 855.25 MHz). Margin at the extreme channels: min. 2.0 MHz
Voltage gain	
low + mid + high band	min. 38 dB; max. 50 dB
Maximum gain difference	
off-air	7 dB
cable	9 dB
Noise figure	
low band	max. 9 dB; typ. 6 dB
mid band	max. 10 dB; typ. 7 dB
high band	max. 11 dB; typ. 8 dB

Overloading

Input signal producing 1 dB gain compression at nominal gain	
low, mid and high band	typ. 90 dB (μV) into 75 Ω
Input signal producing either a detuning of the oscillator of + 300 kHz or −1000 kHz or stopping of the oscillations at nominal gain	
low + mid band	typ. 105 dB (μV) into 75 Ω; min. 100 dB
high band	typ. 100 dB (μV) into 75 Ω; min. 90 dB

Unwanted signal characteristics

Image rejection (measured at picture carrier frequency)	
low, mid band < 300 MHz	min. 70 dB
low, mid band > 300 MHz	min. 66 dB
high band < 470 MHz	min. 60 dB
high band > 470 MHz	min. 53 dB

ELECTRICAL DATA (continued)

Unwanted signal characteristics (continued)

IF rejection (measured at picture carrier frequency)

channel E2	min. 45 dB
all other channels	min. 60 dB

Note: At colour sub-carrier frequency maximum 6 dB less rejection.

Cross modulation
input signal producing 1% cross modulation, i.e. 1% of the modulation depth of interfering signal is transferred to the wanted signal

In channel cross modulation (wanted signal: picture carrier frequency; interfering signal: sound carrier frequency)

all systems	min. 70 dB (μV)

In band cross modulation (wanted signal: picture carrier of channel N; interfering signal: picture carrier of channel N ± 2 for low band or channel N ± 3 for mid channel or channel N ± 5 for high band)

low + mid band	typ. 80 dB (μV)
high band	typ. 84 dB (μV)

Out of band cross modulation at nominal gain each of the low, mid or high band interfering with any of the other bands mentioned — typ. 100 dB (μV) into 75 Ω

Unwanted signal handling capability (visibility test)

The tuner meets the requirements of DBP Amtsblatt 69/1981 item 5.1.2 and CENELEC EN55020 section 4.2 when measured in an adequate TV receiver.

The AGC must be adjusted such that the picture carrier level (top sync.) does not exceed 107 dB (μV) at an input signal level of 74 dB (μV) or more.

Oscillator characteristics

Pulling

Input signal of tuned frequency producing a shift of the oscillator frequency of 10 kHz, at nominal gain

all bands	min. 74 dB (μV) into 75 Ω

Shift of oscillator frequency at a change of supply voltage of ± 5%

low band	max. 250 kHz
mid band	max. 500 kHz
high band	max. 500 kHz

Drift of oscillator frequency	
during warm-up time (after the tuner has been completely out of operation for 15 minutes, measured between 5 s and 15 minutes after switching on)	max. 250 kHz
during warm-up time (after the input stage is in operation for 15 minutes, measured between 2 s and 15 minutes after band switching)	max. 250 kHz
at a change of the ambient temperature from + 25 °C and + 50 °C (measured after 3 cycles from + 25 to 0 °C)	
low band	max. 500 kHz
mid band	max. 750 kHz
high band	max. 1000 kHz
at a change of humidity from 60 ± 15% to 93 ± 2%, at T_{amb} = 25 ± 5 °C	
low	max. 500 kHz
mid	max. 1300 kHz
high	max. 1500 kHz

Frequency divider characteristics

Frequency division ratio	
UV916E/256	256
UV916E/6456	switchable, 64 or 256
Supply voltage	+ 5 V ± 10%
Current drawn from + 5 V supply	max. 35 mA; typ. 25 mA
Output voltage, unloaded, measured with probe 10 MΩ/11 pF	min. 0.5 V (p-p) for 256 division ratio min. 0.25 V (p-p) for 64 division ratio
Output impedance	typ. 1 kΩ
Output imbalance	typ. 0.1 V
Signal disturbance ratio at IF output, IF output terminated with 10 MΩ/11 pF	57 dB min.

Miscellaneous

Radio interference

Oscillator radiation and oscillator voltage at the aerial terminal are within the limits of:
– CISPR 13 (1975) amendment No. 1 (1983)
– Amtsblatt 69/1981 + DIN VDE 0872
– CENELEC proposal European Standard EN55013, EN55020.

Microphonics

For sound signals in the audio frequency range 100 Hz to 10 kHz and sound pressure levels up to 105 dB (20 μPa) the video signal to sound interference ratio will be min. 40 dB.

ESD protection at the terminals

All terminals of the tuner are protected against electrostatic discharge up to 2 kV.

The product is classified in category B (MIL-STD-883C).

APPLICATION INFORMATION

For further information regarding general aspects of I^2C-bus control refer to:
" The I^2C - bus specification ", published by Philips Components.

I^2C-bus requirements (SDA and SCL pins)

V_{IL} max. = 1.5 V (maximum input LOW voltage)
V_{IH} min. = 3.0 V (minimum input HIGH voltage)
I_{IL} max. = −10 μA (maximum LOW level input current)
I_{IH} max. = 10 μA (maximum HIGH level input current)
V_{OL} max. = 0.4 V (maximum output LOW voltage at 3 mA sink current)

Logic diagram

	MSB							LSB	
Address byte	1	1	0	0	0	MA1	MA0	0	A
Prog. div. byte 1	0	0	n13	n12	n11	n10	n9	n8	A
Prog. div. byte 2	n7	n6	n5	n4	n3	n2	n1	n0	A
Control info byte 1	1	5I	0	0	1	1	1	0	A
Control info byte 2	P7	P6	P5	P4	0	P2	P1	P0	A

A = Acknowledge

Address selection

	MA1	MA0	voltage at terminal 15
	0	0	0 . . . 0.1 x V PLL
*	0	1	don't care
	1	0	0.4 . . . 0.6 x V PLL
	1	1	0.9 . . . 2.7 x V PLL

* This general address is always valid for all tuner types of this group.

Note: It is not recommended to use the address MA1 = 0. MA2 = 0 in the set to enable a multi-addressable tuner to be used. Terminal 15 of that tuner may then be grounded.

Programmable divider setting (byte 1 and 2)

Divider ratio: N = 16 * 1 f_{RF}, pc (MHz) + f_{IF}, pc (MHz)

N = 8192 x n13 + 4096 x n12 + 2048 x n11 + 1024 x n10 + 512 x n9 + 256 x n8 + 128 x n7 +
+ 64 x n6 + 32 x n5 + 16 x n4 + 8 x n3 + 4 x n2 + 2 x n1 + n0.

Control info byte 1

Charge pump setting 5I = 0 for all bands.

Improved tuning speed is achieved by 5I = 1 for frequencies higher than channel:
S5 in low band
S29 in mid band
E47 in high band

Control info byte 2

bandswitching	P0	P1	P2	P3	P4	P5	P6	P7
low band	X	X	X	0	0	1	1	0
mid band	X	X	X	0	1	0	1	0
high band	X	X	X	0	1	1	0	0

X = don't care   P0 . . . P7: band select outputs

Telegram examples

Start – Adr – Dr1 – Dr2 – Cw1 – Cw2 – Stop
Start – Adr – Cw1 – Cw2 – Dr1 – Dr2 – Stop
Start – Adr – Dr1 – Dr2 – Cw1 – Stop
Start – Adr – Dr1 – Dr2 – Stop

Start = start condition
Dr1 = divider ratio byte 1
Dr2 = divider ratio byte 2
Cw1 = control word byte 1
Cw2 = control word byte 2
Stop = stop condition

ADDITIONAL INFORMATION

RF AGC setting

The RF AGC must be set such that the IF output level of the tuner (with IF load as stated) does not exceed 107 dB/μV.

IF injection

An IF signal from a generator (internal resistance 50 Ω or 75 Ω) should be connected to the IF injection point TP, accessible through a hole in the cover (see Fig.1) using probe 3139 147 10950.

Tuning supply voltage

A tuning voltage of 33 V must be connected via a series 22 kΩ resistor to pin 11. A preferred method is constant current supply of 1 to 1.5 mA to the pin. Figure 4 shows this with a 140 V supply. The zener diode prevents the voltage at pin 11 exceeding 33 V.

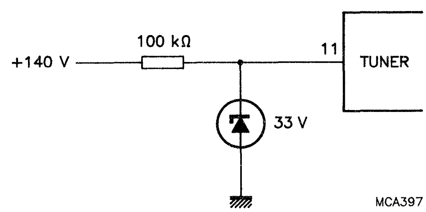


Fig.4 Constant current supply.

Channel coverage

BAND	FREQUENCY RANGE (MHz)	OFF-AIR CHANNELS	CABLE CHANNELS
Low	46.25 - 170.00	E2 - C (48.25 - 82.25 MHz)	S01 - S10 (69.25 - 168.25 MHz)
Mid	170.00 - 450.00	E5 - E12 (175.25 - 224.25 MHz)	S11 - S39 (231.25 - 447.25 MHz)
High	450.00 - 860.25	E21 - E69 (471.25 - 855.25 MHz)	S40 - S41 (455.25 - 463.25 MHz)

Derived types

UV916H/IEC	IEC	3112 297 10691
UV916H/IEC-L	long IEC connector	3112 297 10701
UV916H/phono	phono (available upon special request)	
UV916HA/IEC		

Intermediate frequencies

				PROPOSED		
SYSTEM	B, G, & H	I	L	I'	L' (BI)	D2MAC
picture	38.90	39.50	38.90	38.90	33.40	38.90
colour	34.47	35.07	34.47	34.47	37.83	
sound 1	33.40	33.50	32.40	32.90	39.90	
sound 2	33.16	33.00		32.40		
band edge						30.50

Note

The oscillator frequency is above the input signal frequency.

INTRODUCTION

The UV916H tuner belongs to the 900 family of tuners and front ends, which are designed to meet a wide range of applications. They are combined VHF, UHF all-band tuners suitable for CCIR systems B, G, H, I, I', L, L' and D2MAC (channels 300 to 470 MHz).

The /A indicates that these tuners are provided with an ADC input at a separate terminal.

The tuners comply with the requirements of radiation, signal handling capability and immunity conforming with:

- CISPR 13 (1973), including amendment 1 (1983)
- German regulations in accordance with "Amtsblatt" 69, 1981 (VDE 0872/1-5)
- European Standards EN55013, EN55020.

PRODUCT DESCRIPTION

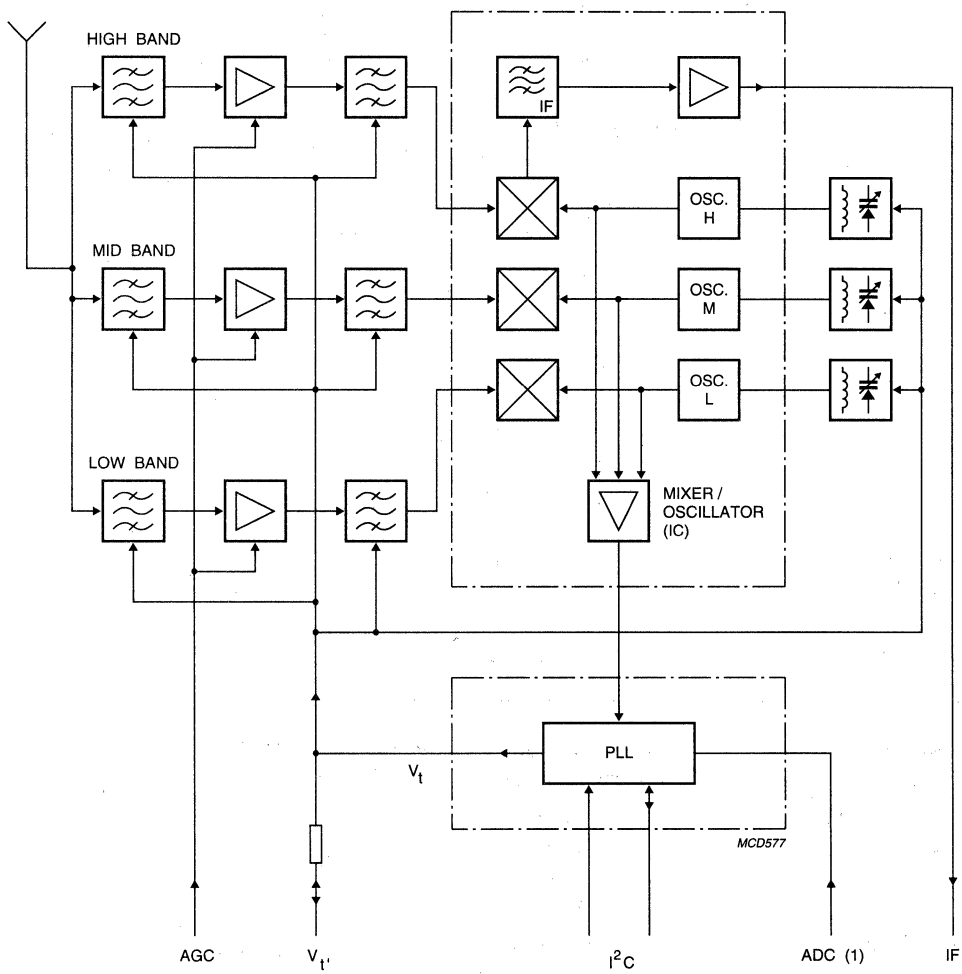
The tuner is housed in a rectangular metal box, with front and rear covers. A common 9/9.5 mm IEC (75 Ω) aerial input socket is on one of the sides of the frame. All other connections are made via pins on the base. Versions with a phono socket or a long IEC socket are also available, giving compatibility with UV816 tuners.

The tuner is provided with 3 tuned RF MOSFET input stages. The oscillators, mixers and IF amplifier are built into a mixer-oscillator IC. The IF output is designed to direct drive a variety of SAW filters. The low IF-OUTPUT impedance (load may be balanced or unbalanced) ensures sufficient triple transient suppression of the SAW filter.

In addition, the tuners are provided with a digital programmable (I^2C) phase-locked loop (PLL) tuning system, which is also suitable for multiple addressability. The PLL system enables tuning with a 62.5 kHz pitch with crystal accuracy.

Band switching can also be controlled via the two-wire I²C-bus. Tuners with the extension "A" after the type number have an ADC input at pin 10.

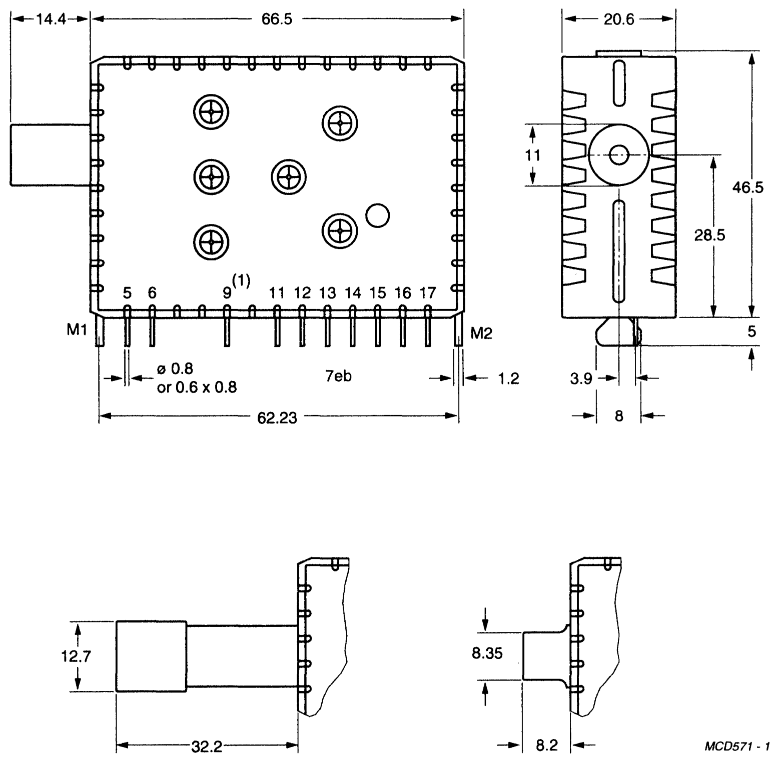
For detailed information about the I²C-bus transfer, e.g. band switching, frequency settings, address select and ADC input voltages, refer to the **APPLICATION INFORMATION** section of this data sheet.



(1) ADC input only available in tuners UV916HA

Fig.1 Electrical block diagram.

MECHANICAL DATA



Dimensions in mm.

(1) Only valid for UV916HA tuner.

Fig.2 Mechanical outline.

Aerial connection

IEC socket 9.5 mm female 75 Ω, length 14 or 32 mm. Phono socket female 75 Ω.

Mass

Approximately 50 g.

Mechanical requirements (IEC connector only)

Insertion force

measured with gauge (nominal diameter 9.5 mm): < 50 N.

Withdrawal force

measured with gauge (nominal diameter 9.5 mm): >10 N.

Marking

The following items of data are printed on the top of the tuner:

- Type number
- Code number
- Origin letter of factory
- Change code
- Year and week code.

Solderability

The solderability of the terminals and mounting tags when tested initially and after 16 hours steam ageing in accordance with IEC 68-2-20 test Ta, method 1 (solder bath 235 °C, 2 s), results in a wetted area of 95%. No de-wetting will occur when soldered at 260 °C, 5 s.

Resistance to soldering heat

The product will not be damaged when tested in accordance with IEC 68-2-20 test Tb, method 1A (solder bath 260 °C, 5 s).

Terminal strength

The terminals will not be damaged when tested in accordance with IEC 68-2-21, test Ua1, tensile of 20 N in axial direction and test Ua2, thrust of 4 N in axial direction.

Terminals

TERMINAL		DESCRIPTION
5	AGC	gain control voltage
6	B+	supply voltage
10	ADC	A/D converter input ("A" versions only)
11	VT	tuning voltage supply
12	V_{PLL}	PLL supply voltage
13	SCL	I²C serial clock
14	SDA	I²C serial data
15	AS	address select input
16	IF	symmetrical IF output
17	IF	symmetrical IF output
M1, M2	GROUND	mounting tags

LIMITING VALUES

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Under non-operational conditions					
Ambient temperature		−25	−	85	°C
Relative humidity		−	−	100	%
Bump acceleration		−	−	245	m/s²
Shock acceleration		−	−	490	m/s²
Vibration amplitude	10 to 55 Hz	−	0.35	−	mm
Under operational conditions					
Ambient temperature		−10	−	60	°C
Relative humidity		−	−	95	%
B+ supply voltage		−	−	13.2	V
AGC voltage		−	−	13.2	V
PLL supply voltage		−	−	5.5	V
Tuning voltage supply	via series resistor of 22 kΩ	−	−	35	V
Bus input voltage SDA		−0.3	−	6	V
Bus input voltage SCL		−0.3	−	6	V
Bus current SDA	open collector	−1	−	5	mA
Address select input voltage		−	−	16	V
ADC input voltage		−	−	16	V

OPERATIONAL CONDITIONS AND SUPPLY DATA

The tuner can be guaranteed to function properly under the following conditions.

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Environmental					
Ambient temperature		−10	–	60	°C
Relative humidity		–	–	95	%
Supply voltage					
B+ supply voltage		10.8	12	13.2	V
Relevant current		–	70	110	mA
Permissible ripple voltage		–	–	50	mV (p-p)
AGC voltage					
AGC voltage range		0.85	–	9.2	V
AGC current		–	–	30	µA
AGC voltage	at −40 dB				
low band		–	2	–	V
mid band		–	1.5	–	V
high band	at −30 dB	–	2	–	V
AGC slope between nominal gain and the specified AGC range					
low band		–	–	20	dB/V
mid band		–	–	55	dB/V
high band		–	–	50	dB/V
AGC source impedance		–	–	10	kΩ
PLL supply voltage					
Supply voltage		4.5	5	5.5	V
Relevant current for PLL		–	–	50	mA
Permissible ripple voltage		–	–	50	mV (p-p)
Tuning voltage supply (note 1)					
Tuning voltage supply		30	33	35	V
Relevant current		–	–	1.7	mA
Permissible ripple voltage		–	–	50	mV (p-p)
Band switching					
Refer to the Application Information section for the required bandswitching setting via the I²C-bus.					
ADC, analog input (only for UV916H/A and UV916HF/A types)					
ADC analog input voltage range (note 2)		0	–	5.5	V
AS (address select) input					
Input voltage range (note 3)		0	2.5	5.5	V

Notes

1. An external pull-up resistor of 22 kΩ ±5% must be connected between the tuning supply voltage and terminal 11. An alternative is given in the section headed **Tuning supply voltage**, in the **APPLICATION INFORMATION** section of this data sheet.
2. For detailed information about the conversion, refer to the **APPLICATION INFORMATION** section of this data sheet.
3. For detailed information about the address decoding, refer to the **APPLICATION INFORMATION** section of this data sheet.

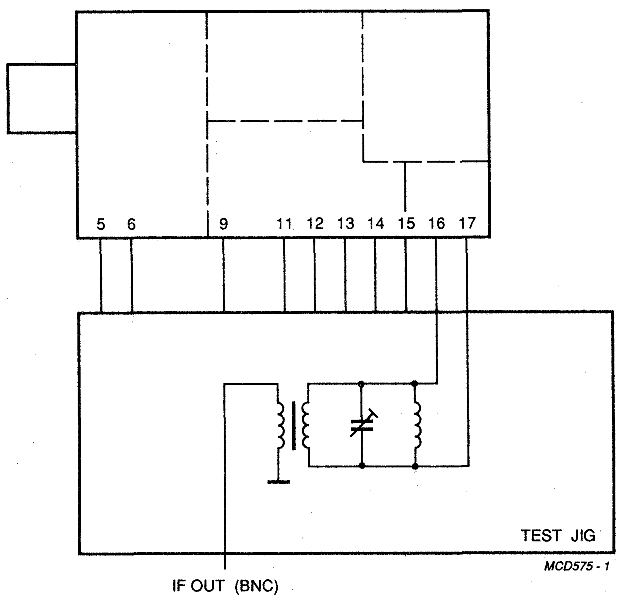


Fig.3 Typical test set-up.

ELECTRICAL DATA

Unless otherwise specified, all electrical values apply at the following levels:

Ambient temperature:	25 ±5 °C
Relative humidity:	60 ±15%
Supply voltage:	12 ±0.3 V
AGC voltage:	9.2 ±0.2 V
Aerial source impedance:	75 Ω unbalanced
PLL supply voltage:	5 ±0.2 V
Tuning supply voltage:	33 ±0.5 V (via 22 kΩ resistor).

For detailed information about the PLL programming, refer to the **APPLICATION INFORMATION** section of this data sheet.

The tuner is guaranteed to function properly within the specified operational conditions, but a certain deterioration of performance parameters may occur at the limits of the operational conditions.

The tuner characteristics are measured using the test jig shown in Fig.3.

IF output characteristics

The IF output impedance between pins 16 and 17 at 36.15 MHz is approximately 90 Ω + j80 Ω. For further information, see also the section headed **'IF loading'** in the **APPLICATION INFORMATION** section of this data sheet.

Note:
In order to achieve balanced or unbalanced output configurations, IF-OUTPUT pins 16 and 17 are internally DC coupled to ground.

Frequency range

Low band:	pc 48.25 to pc 168.25 MHz
Mid band:	pc 175.25 to pc 447.25 MHz
High band:	pc 455.25 to pc 855.25 MHz.

The tuner can always be tuned to 45.52 MHz or any channel under any combination of the specified operating conditions.

Aerial input characteristics

PARAMETER	CONDITIONS	TYP.	MAX.	UNIT
VSWR (reflection coefficient)	at picture carrier referred to 75 Ω impedance			
low band		–	4 (60%)	
mid band		–	4 (60%)	
mid band (note 1)		–	3 (50%)	
high band		–	4 (60%)	
surge protection		–	5	kV
oscillator voltage (see also **'Radiation'** section)	≤860 MHz	<34	–	dBμV
	<1750 MHz	–	46	dBμV

Note

1. For D2MAC channels, worst case between picture carrier and picture carrier +5 MHz from nominal gain to 20 dB gain reduction.

GENERAL CHARACTERISTICS

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Voltage gain					
Off-air channels		38	–	50	dB
Cable channels		38	–	52	dB
Gain taper of the off-air channels		–	–	7	dB
Noise					
Low band		–	6	9 (E2)	dB
Mid band		–	5	8 (E2)	dB
High band	S39 to E59	–	6	9	dB
	E60 to E69	–	7	9 (E69)	dB
AGC range					
Low - mid band		40	–	–	dB
High band		30	–	–	dB
Overloading					
1 dB gain compression		–	90	–	dBμV
PLL lock-out		90	–	–	dB
Image rejection					
Nominal gain to 10 dB gain reduction					
low-mid band	<300 MHz	70	–	–	dB
	>300 MHz	66	–	–	dB
high band	<470 MHz	66	–	–	dB
	>470 MHz	53	–	–	dB
IF rejection					
Channel E2		50	–	–	dB
Other channels		60	–	–	dB
I/2 IF susceptibility					
Low-mid band	<300 MHz	80	–	–	dBμV
Mid band	>300 MHz	75	–	–	dBμV
High band		70	–	–	dBμV
Sound/chroma moiré rejection					
low, mid and high band	at nominal gain	56	–	–	dB

BAND	FREQUENCY (MHz)	RF BANDWIDTH (TYP.) (MHz)
Low band	48 170	10 12.5
Mid band (D2MAC)	180 290 300 to 450	12 17 18
High band	455 855	15 10

RF bandwidth

The bandwidth of the response curve is defined as the width of the curve expressed in MHz, from the top of the curve to a line at a level of 3 dB below the top. The position of the top of the curve with respect to the picture carrier and sound carrier is irrelevant.

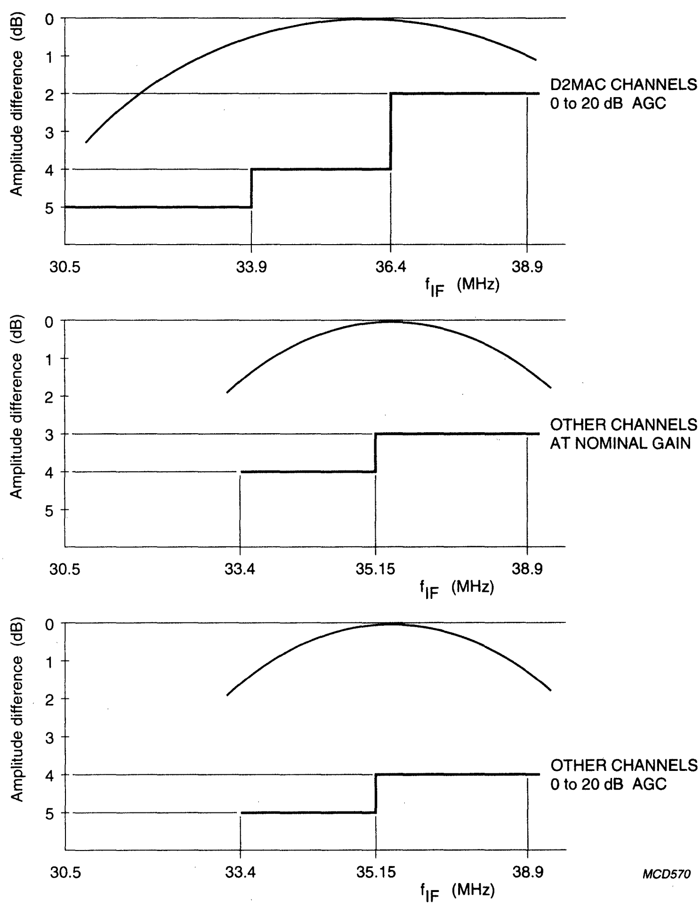


Fig.4 Tilt of overall response curves.

Cross modulation

The undesired carrier level required to produce a 1% transfer of its modulation depth on the desired carrier for all gain values between maximum gain and the specified gain reduction is given in the following table.

	MIN.	TYP.	UNIT
In channel (except systems L and L')	74	–	dBμV
In channel for systems L and L'	70	–	dBμV
In band N ± 2 low band	86	95	dBμV
In band N ± 3 mid band	86	95	dBμV
In band N ± 5 high band	94	100	dBμV
Out of band	–	100	dBμV

Visibility test

The tuner meets the requirements of DBP Amtsblatt 69/1981, item 5.1.2 (VDE 0872/1-5) and EN55020, when measured in an adequate television receiver. The AGC must be adjusted such that the picture carrier level (top sync.) at the tuner output does not exceed 107 dBμV at an input signal level of 74 dBμV or greater.

Radiation

Oscillator radiation and oscillator voltage at the aerial terminal are within the limits of:

- CISPR 13 (1975), amendment No.1 (1983)
- Amtsblatt 69/1981 (VDE 0872/1-5)
- European standard EN55013.

Immunity from radiated fields

The tuner meets the requirements of DBP Amtsblatt 69/1981, item 5.3.2 and EN 55020, clause 7.

Immunity from conducted interference

On any channel (desired signal 60 dBμV), a signal at IF and image frequencies with a 60 dBμV level applied to the tuner terminals (except IF terminals) will cause no interference ratio at the IF output less than 67 dB.

Microphonics

For sound signals in the audio frequency range 100 Hz to 10 kHz and sound pressure levels up to 105 dB (20 μPa), the video signal to sound interference ratio will be greater than 40 dB.

Tuning system interference rejection at the IF output

Tuning system interference rejection at the IF terminal in the range 33.4 to 38.9 MHz, with an aerial input level of 50 dBμV:

- Crystal harmonics rejection: min. 50 dB.

The measurements must be made using test jig 7122 030 01270.

ESD protection at the terminals

All tuner terminals are protected against electrostatic discharge up to 5 kV except terminals 13 and 14 which can withstand 2 kV. The product is classified in category B (MIL-STD-883C).

Oscillator characteristics

The oscillator is tuned with a 62.5 kHz pitch. The deviation of E and S channels in system B/G is nominally 25 kHz.

Instability of the oscillator frequency under worst case conditions (+5 V ±10%; T_{amb} = 0 to 60 °C) is max. 80 ppm.

Lock-in time is max. 150 ms. The status of the PLL can be requested by reading the in-lock flag (see **READ mode** section).

Residual carrier frequency modulation (peak deviation) caused by I^2C crosstalk is less than 2 kHz.

Oscillator voltage at the terminals

	UV916H - 916HA (dBμV max.)
Supply and control terminals	60
IF terminals	
low and mid bands	70
high band	60

ENVIRONMENTAL AND RELIABILITY DATA

Reliability test and requirements

DEFINITION OF CATASTROPHIC FAILURES

- The tuner cannot be tuned or is inoperative on one or more channels
- Gain more than 6 dB below specification limit.

ENVIRONMENTAL CONDITIONS

Maximum chamber temperature is 60 °C.

LOADING DURING CONDITIONING

Supply voltage	: 13.2 V
AGC voltage	: 9.2 V
PLL supply voltage	: 5.5 V

Tuning supply voltage via 22 kΩ series resistor (PLL tuners): 30 V.

I²C command (PLL tuners): highest programmable division ratio of the PLL in each band (for the control word, see the **APPLICATION INFORMATION** section of this data sheet).

DEGRADATION OF CHARACTERISTICS

The characteristics will be measured after a preconditioning time of one hour at nominal environmental conditions as described in the **ELECTRICAL DATA** section. Overall stability characteristics after 2000 hours:

- Change of gain : max. 3 dB
- Change of tilt overall curve : max. 2 dB
- Tuning deviation : 110 ppm.

APPLICATION INFORMATION

For information regarding general aspects of I²C-bus control, see Philips Components *I²C–bus specification* (12NC: 9398 336 70011, release November 1986).

Tuners with IEC connectors are suitable for male connectors designed in accordance with IEC 169-2.

The internal conductor pin of the mating phono plug used by the customer should not exceed 10 mm in total length.

Logic diagram

WRITE MODE

	MSB						LSB	
Address byte	1	1	0	0	0	MA1	MA0	0 (note 1)	A
Prog. div. Byte 1	0	n14	n13	n12	n11	n10	n9	n8	A
Prog. div. Byte 2	n7	n6	n5	n4	n3	n2	n1	n0	A
Control info Byte 1	1	5I	0	0	1	1	1	0	A
Control info Byte 2	P7	P6	P5	P4	P3	P2	P1	P0	A

Notes

A = Acknowledge.

1. $R/\overline{W}$ bit = 0 for WRITE mode.

ADDRESS SELECTION

V_{PLL} = PLL supply voltage = +5 V.

MA1	MA0	VOLTAGE AT TERMINAL 15
0	0	0 to 0.1 V_{PLL}
0	1	don't care (note 1)
1	0	0.4 to 0.6 V_{PLL}
1	1	0.9 to 2.4 V_{PLL}

Note

1. This general address is always valid for all tuner types of this group. It is recommended not to use this address in applications where a further tuner becomes necessary, e.g. television sets with an option for picture-in-picture or satellite television.

PROGRAMMABLE DIVIDER SETTING (BYTES 1 AND 2)

Divider ratio:
N = 16 x (Frf, pc (MHz)) + Fif, pc (MHz))
Fosc = N/16 (MHz)

N = (8192 x n13) + (4096 x n12)
+ (2048 x n11) + (1024 x n10)
+ (512 x n9) + (256 x n8)
+ (128 x n7) + (64 x n6)
+ (32 x n5) + (16 x n4)
+ (8 x n3) + (4 x n2) + (2 x n1) + n0

CONTROL INFO BYTE 1

Charge pump setting 5I = 0 for all bands. Faster tuning is achieved by 5I = 1 for all frequencies higher than channel:

S5 at low band
S29 at mid band
E47 at high band.

CONTROL INFO BYTE 2

Using Table 2 for the control info, byte 2 will also control the similar band switching as described in Table 1 for tuner type UV916H.

Telegram examples:

Start-Adr-Dr1-Dr2-Cw1-Cw2-Stop
Start-Adr-Cw1-Cw2-Dr1-Dr2-Stop
Start-Adr-Dr1-Dr2-Cw1-Stop
Start-Adr-Dr1-Dr2-Stop

where:

Start = start condition
Adr = address
Dr1 = divider ratio byte 1
Dr2 = divider ratio byte 2
Cw1 = control word byte 1
Cw2 = control word byte 2
Stop = stop condition.

For channel selection involving bandswitching, and to ensure smooth tuning to the desired channel without causing unnecessary charge-pump action, it is recommended to consider the following:

Table 1
Only valid for tuner type UV916H.

BAND SWITCHING	P0	P1	P2	P3	P4	P5	P6	P7
Low band	X	X	X	0	0	1	1	0
Mid band	X	X	X	0	1	0	1	0
High band	X	X	X	0	1	1	0	0

Note

X = don't care; P0 to P7 are band select outputs.

Table 2
Only valid for tuner types UV916HA.

BAND SWITCHING	P0	P1	P2	P3	P4	P5	P6	P7
Low band	X	X	X	0	0	1	0	1
Mid band	X	X	X	0	1	0	0	1
High band	X	X	X	0	1	1	0	0

Note

X = don't care; P0 to P7 are band select outputs.

1. Compare wanted channel frequency (fw) to the current channel frequency (fc).
2. If fw > fc, use telegram as: Start-Adr-Dr1-Dr2-Cw1-Cw2-Stop.
3. If fw < fc, use telegram as: Start-Adr-Cw1-Cw2-Dr1-Dr2-Stop.

Note

Unnecessary charge-pump action will result in very low tuning voltage ($V_t \approx 0$ V) which may drive the oscillator to extreme condition.

READ MODE

The in-lock flag can be read by setting the R/$\overline{W}$ bit to 1.

	MSB						LSB	
Address byte	1	1	0	0	0	MA1	MA0	1 (note 1)	A
Status byte	0	FL	X	X	X	A2	A1	A0	A

Notes

FL = 1: loop is phase-locked; X = don't care; A = Acknowledge.

1. R/$\overline{W}$ bit = 1 for READ mode.

The following table explains the A/D converter steps, only valid for UV916HA type. A2, A1, A0 (conversion code for the voltage level at terminal 10, ADC):

A2	A1	A0	VOLTAGE AT TERMINAL 10
1	0	0	0.6 x V_{PLL} to V_{PLL}
0	1	1	0.45 x V_{PLL} to 0.6 x V_{PLL}
0	1	0	0.3 x V_{PLL} to 0.45 x V_{PLL}
0	0	1	0.15 x V_{PLL} to 0.3 x V_{PLL}
0	0	0	0 to 0.15 x V_{PLL}

Note

V_{PLL} refers to the PLL supply voltage at terminal 12.

Tuning voltage supply

A typical tuning voltage of 33 V (max. 35 V and min. 30 V) must be connected via a 22 kΩ pull-up resistor to terminal 11. Alternatively, a constant current of 1 to 1.5 mA can also be applied. Figure 5 shows an alternative supply from a 140 V source. The Zener diode prevents the tuning voltage at pin 11 from exceeding 33 V.

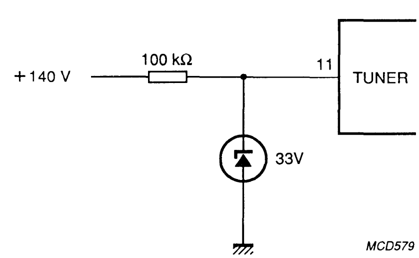


Fig.5 Recommended tuning voltage supply.

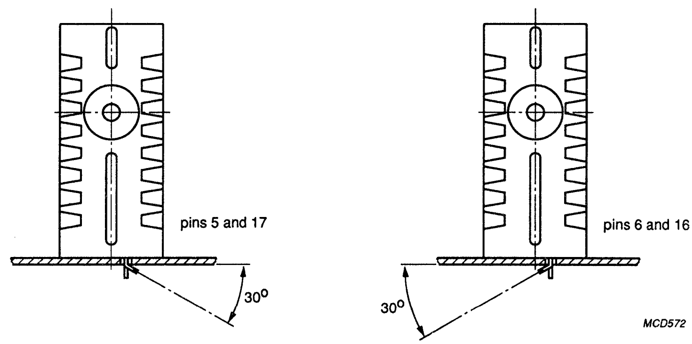
Mounting

The tuner must be mounted without clearance between the tuner supporting surface and the printed wiring board. When mounted in this way, the tuner must be soldered to the printed wiring board.

This can be achieved by:

a. Bending the connection pins (see Fig.6)
b. Pressing the tuner vertically on the PWB during soldering
c. Supporting the tuner with its aerial connector in the right position.

If the tuner is soldered to the PWB on a wave solder machine, the solder joints should be reinforced afterwards.



To prevent any stress on the PWB set, it is recommended to support the tuner at the aerial connector.

Fig.6 Recommended mounting method.

IF loading

The IF-OUTPUT of the tuner may be balanced or unbalanced.

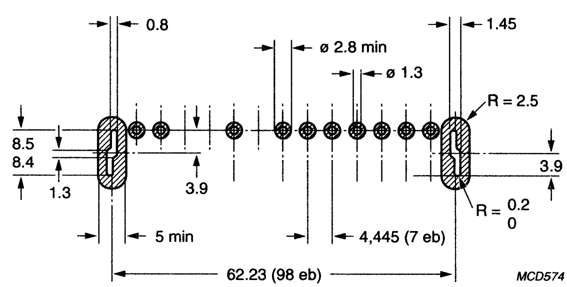
The total external loading between terminals 16 and 17 is the balanced load impedance in parallel with 4 times the unbalanced load impedance, limited to 1 kΩ minimum/30 pF maximum.

For optimum signal handling, the reactive part of the IF circuit (C_{extem}), must be tuned to the IF centre frequency. This is best achieved by connecting a coil in parallel with terminals 16 and 17.

$$L_{tune} = \frac{1}{(2\pi f_{IF}) \times (C_{extem} - 1.8\ pF)}$$

Note:

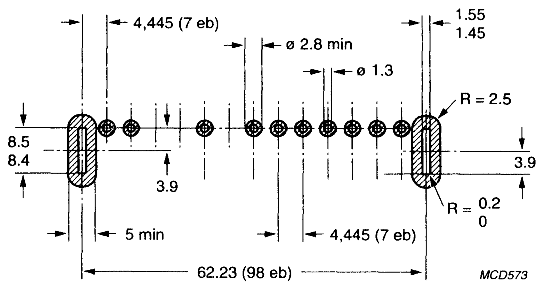
Terminals 16 and 17 of the tuner are DC coupled to ground.



Hole pattern seen from solder side.

Unless otherwise stated, the tolerance is ±0.05 mm.

Fig.7 Piercing pattern of main PWB.



Hole pattern seen from solder side.
Unless otherwise stated, the tolerance is ±0.05 mm.

Fig.8 PWB punching pattern where compatibility with UV816 is required.

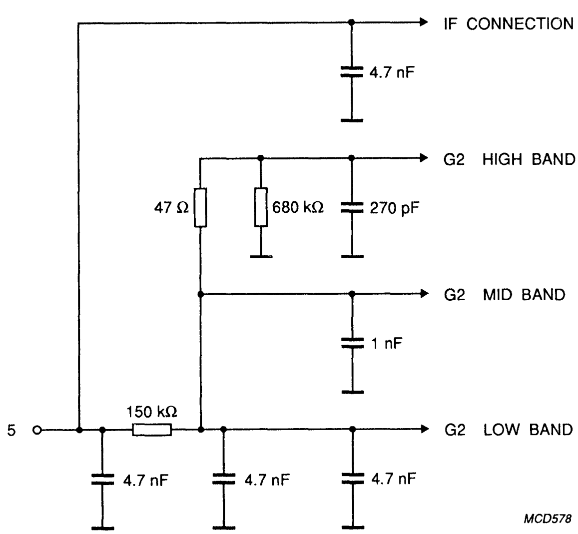
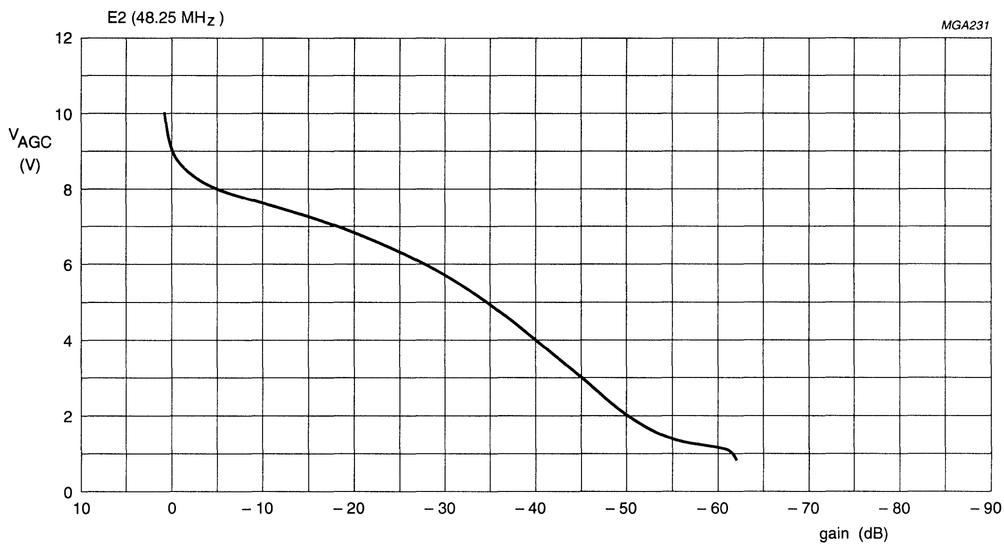


Fig.9 AGC circuit.

VHF/UHF television tuner

UV916H



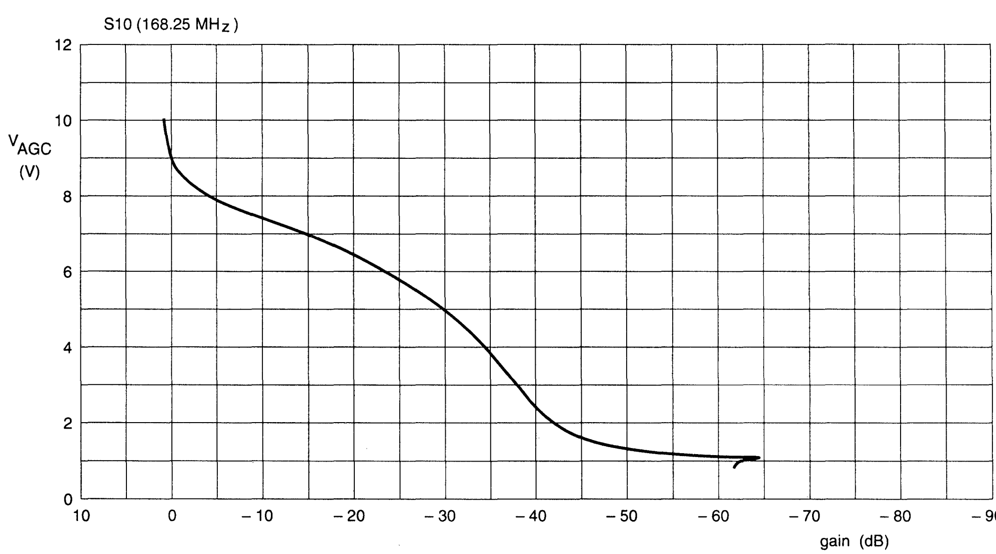
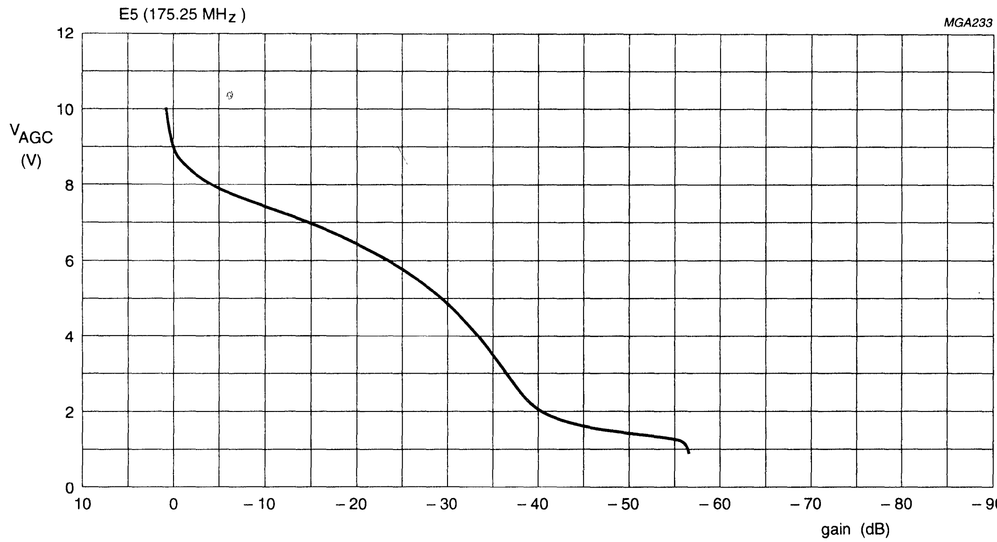


Fig.10 Typical low band AGC curves.



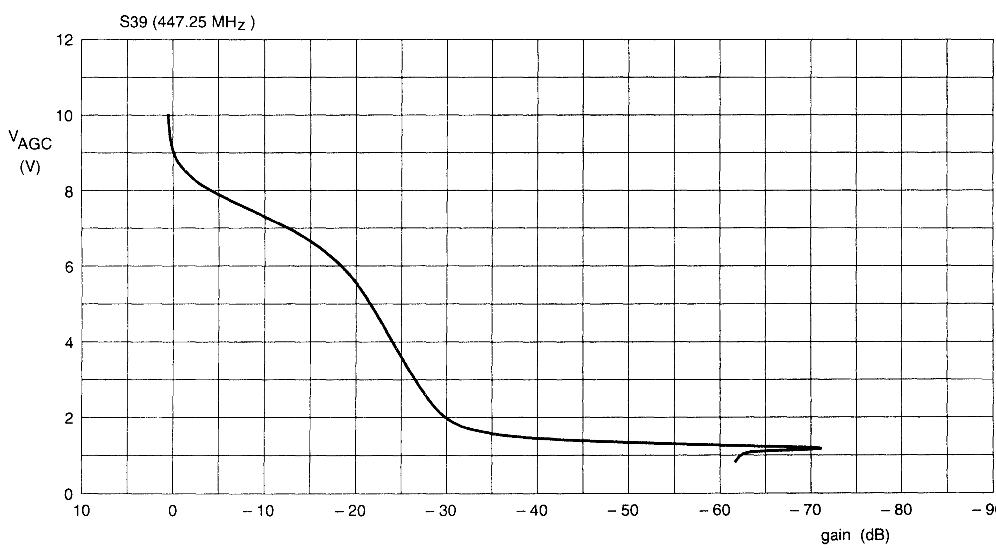


Fig.11 Typical mid band AGC curves.

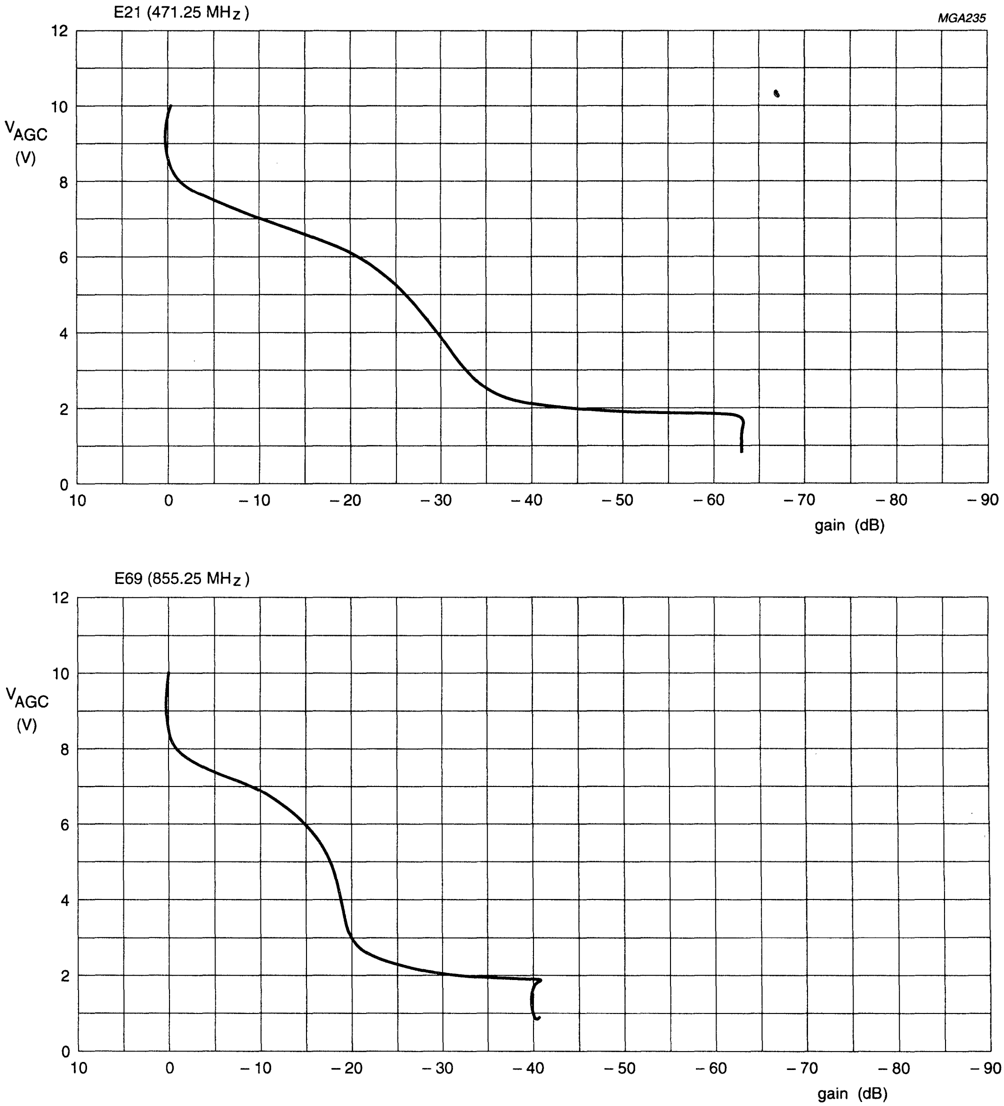


Fig.12 Typical high band AGC curves.

UHF/VHF TELEVISION TUNERS

QUICK REFERENCE DATA

Systems	RTMA M and N	
Channels	off-air	cable
low band	2 to 13	A-2 to I
high band	14 to 83	
Intermediate frequencies		
picture	45.75 MHz	
sound	41.25 MHz	
colour	42.17 MHz	

APPLICATION

The UV933/934 tuners belong to the 900 series family of small size tuners which are designed to meet a wide range of applications.

The tuners are available with separate UHF and VHF inputs (75 Ω phono for VHF, 300 Ω balanced for UHF) or with a combined, single 75 Ω input (phono or IEC).

The UV934 is equipped with a built-in digital controlled (I^2C) PLL tuning IC. Band switching is also carried out via the I^2C-bus. The UV933 types are intended for voltage controlled tuning and do not have the PLL synthesizer.

The tuner IF output is designed with low output impedance to directly drive a variety of SAW filters.

Table 1 Available types

type	catalogue number	aerial input connector	tuning system
V933 (note 1)	3122 237 00620	75 Ω phono	0.3 - 28 V
UV933	3122 237 00590	75 Ω phono	0.3 - 28 V
UV933/D	3122 237 00600	75 Ω phono/ 300 Ω balanced	0.3 - 28 V
UV933/IEC (note 2)	3122 237 00610	75 Ω IEC	0.3 - 28 V
UV934	3122 237 00570	75 Ω phono	PLL/I^2C
UV934/D	3122 237 00580	75 Ω phono/ 300 Ω balanced	PLL/I^2C
UV934/IEC (note 2)	3122 237 00640	75 Ω IEC	PLL/I^2C

Notes to Table 1

1. VHF only.
2. Available on special request.

DESCRIPTION

The UV933/934 tuners are combined VHF/UHF units covering the low band (frequency range 55.25 to 211.25 MHz) and the high band (frequency range 471.25 to 885.25 MHz).

The tuners are built on a low-loss printed-wiring board carrying all components and a small vertical printed-wiring board carrying the PLL tuning system components for the UV934. The boards are housed in a sheet steel housing with separate front and rear covers. The aerial connector (phono, IEC or balanced) is mounted on one side of the frame.

High selectivity is achieved in both low and high bands by means of a tuned aerial circuit and a double tuned bandpass filter separated by a MOSFET RF amplifier.

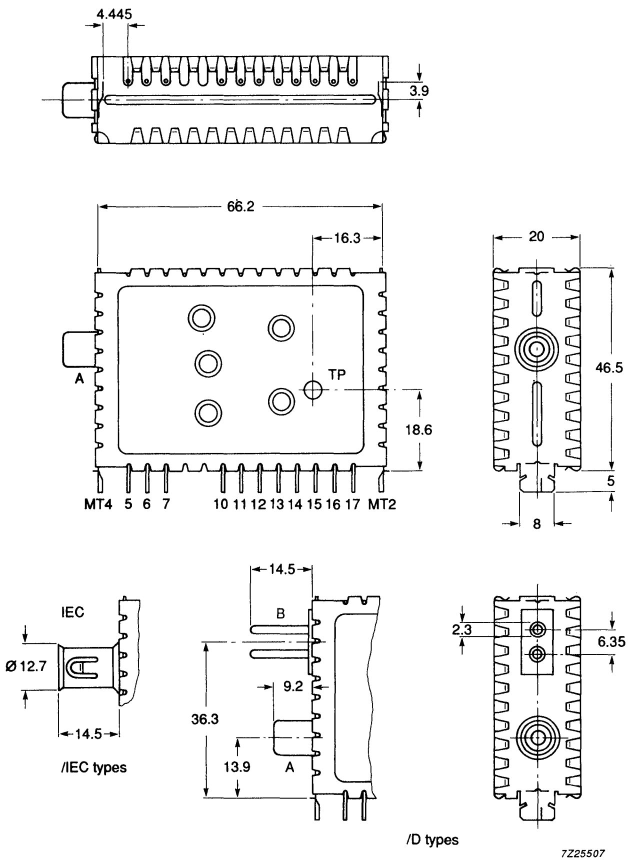
An FM bandstop filter, an IF rejection filter and a combined highpass/CB rejection filter precede the low band section. The mixers and oscillators in both bands are built using bipolar transistors in common-base configuration.

An IF bandpass filter is present between the mixers and the final IF amplifier. The output impedance at the IF output pin is approximately 90 Ω to ensure adequate triple transient suppression in the SAW filter.

The UV934 tuners contain an I^2C-bus controlled phase-locked-loop tuning system enabling direct channel access with crystal controlled accuracy.

MECHANICAL DATA

Dimensions in mm



	UV933 and V933	UV934
A	aerial input	aerial input
B	balanced UHF input (/D types only)	balanced UHF input (/D types only)
5	AGC voltage 9.2 to 0.85 V	AGC voltage 9.2 to 0.85 V
6	supply voltage + 12 V	supply voltage + 12 V
7	VHF switch input (UV933 versions only)	
10	UHF switch input	
11	tuning voltage 0.3 to 28 V	tuning supply voltage (33 V via 22 kΩ series resistor)
12		supply voltage PLL + 5 V
13		SCL serial clock line
14		SDA serial data line
15		address selection input
16	ground	ground
17	IF output	IF output
MT1	mounting tab grounded	mounting tab grounded
MT2	mounting tab grounded	mounting tab grounded

Fig.1 Mechanical detail.

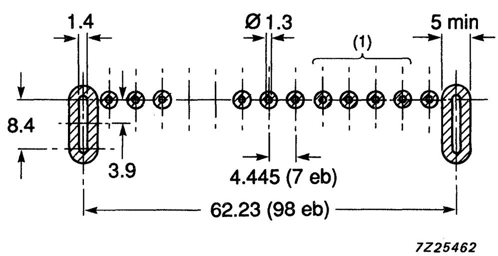
Mass: approximately 55 grams

Mounting

The tuner may be mounted by soldering it to a printed-wiring board, using the piercing diagram shown in Fig.2 without clearance between the tuner supporting surface and the board. The connecting pins and mounting tabs should be bent in accordance with Fig.3.

The tuner may be mounted anywhere in the receiver and there are no restrictions on orientation.

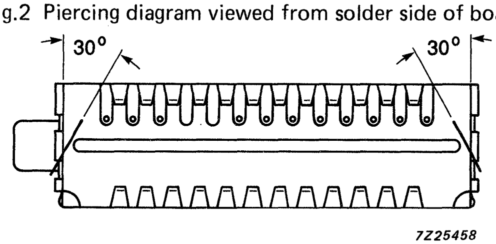
The solderability of the pins and mounting tabs is in accordance with IEC 68-2, test Ta (230 ± 10 °C, 2 ± 0.5 s). The resistance to soldering heat is in accordance with IEC 68-2, test Tb (260 ± 5 °C, 10 ± 1 s).

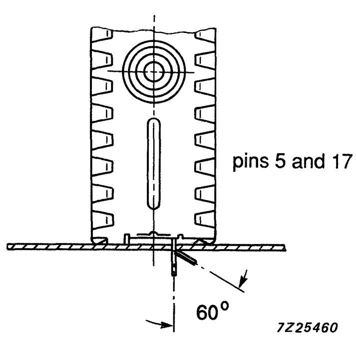


(1) UV934 types only

1 eb = 0.025 inch.

Fig.2 Piercing diagram viewed from solder side of board.





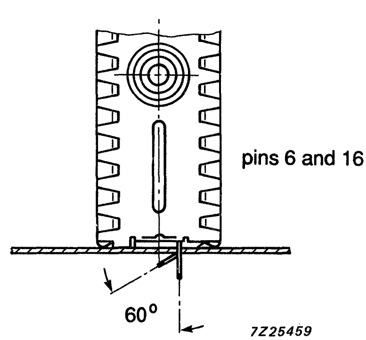


Fig.3 Bending of connecting pins and mounting tabs.

ELECTRICAL DATA

Unless otherwise specified all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0.3 V, an AGC voltage of 9.2 ± 0.2 V, a PLL supply voltage of 5 ± 0.3 V and a tuning supply voltage of 33 ± 0.5 V via a 22 kΩ series resistor.

General

Semiconductors, low band	
RF amplifier	BF998
mixer	BFS17
oscillator	BFSS17A
tuning diodes	OF4052
coupling diodes	BB901
Semiconductors, high band	
RF amplifier	BF900A/01
mixer	2SC3841
oscillator	ON4438
tuning diodes	OF643
IF amplifier	BFS17
Tuning/bandswitching IC (UV934 types only)	SP5510 or TSA5510
Tuning voltage transistor (UV934 types only)	BC847B
Ambient temperature range	
operating	−10 °C to + 60 °C
storage	−25 °C to + 85 °C
Relative humidity	max. 95%

Voltages and currents

Supply voltage	+ 12 V ± 10%
PLL supply voltage (UV934 only)	+ 5 V ± 10%
Current drawn	
supply current	max. 50 mA
PLL current	max. 55 mA
Tuning supply voltage	min. 30 V typ. 33 V max.35 V
Tuning supply current	max. 1.7 mA
Bandswitching voltage (UV933 types only)	+ 12 V ± 10%
Bandswitching current (UV933 types only)	max. 2 mA

Aerial input characteristics

VSWR referred to 75 Ω/300 Ω impedance	
low band	max. 5
high band	max. 5
Reflection coefficient referred to 75 Ω/300 Ω impedance	
low band	max. 66%
high band	max. 66%
Surfe protection	min. 6 kV
Oscillator voltage at aerial terminal	
54 - 300 MHz	max. 50 dB/μV
300 - 1000 MHz	max. 66 dB/μV
Unbalance of 300 Ω aerial terminal (D versions only)	
up to channel 64	min. 10 dB
channel 70 to channel 83	min. 10 dB

IF output characteristics

IF output impedance (between pins 17 and 16 (ground)	90 Ω
Permitted IF load impedance	min. 1 kΩ max. 22 pF

Frequency range

Low band	channel 2 (picture carrier 55.25 MHz) to channel 13 (picture carrier 211.25 MHz). Margin at extreme channels: min. 1 MHz.
High band	channel 14 (picture carrier 471.25 MHz) to channel 83 (picture carrier 885.25 MHz). Margin at extreme channels: min. 1 MHz.

Wanted signal characteristics

Voltage gain	
all channels	min. 38 dB max. 50 dB
gain difference of off-air channels	max. 8 dB
Noise figure	
low band off air channels 2 and 6	typ. 8 dB max. 10 dB
low band, all other off-air channels	typ. 6.5 dB max. 8 dB
high band up to channel 69	typ. 9 dB max. 10 dB
high band channels 70 to 83	typ. 10 dB max. 12 dB
AGC range	
low band	min. 45 dB
high band	min. 30 dB

Overloading	
input signal producing a gain compression of 1 dB	min. 74 dB/μV
input signal producing oscillator detuning of + 300/−1000 kHz	
low band	min. 90 dB/μV
high band	min. 80 dB/μV
input signal causing the PLL to fail to lock to desired signal	
low band	min. 90 dB/μV
	typ. 100 dB/μV
high band	min. 90 dB/μV
	typ. 100 dB/μV
Image rejection (between 0 and 10 dB gain reduction)	
low band	min. 65 dB
high band	min. 50 dB
IF rejection	
channel 2	min. 50 dB
	typ. 55 dB
channel 3	min. 55 dB
	typ. 60 dB
all other channels	min. 60 dB
Channel 6 beat rejection	min. 50 dB
CB susceptibility	min. 108 dB/μV

Amplitude response curves

Tilt of overall response

At any channel the amplitude differences between:

Off-air channels	
top of response curve and picture	max. 4 dB
top of response curve and sound carrier	min. 0.5 dB
	max. 6 dB
valley	max. 1 dB
sound carrier above picture carrier	max. 3 dB

IF response

Amplitude difference between:	
top of response curve and picture carrier	max. 1 dB
top of response curve and sound carrier	max. 1 dB

Unwanted signal characteristics

Break through susceptibility	min. 60 dB/μV
Cross modulation	

The undesired carrier level required to produce 1% transfer of its modulation onto the desired carrier shall be equal to or exceed the desired carrier level (60 dB/μV at nominal gain) for all gain values between maximum gain and 40 dB (low band) or 30 dB (high band) reduction or be:

In channel low band	min. 66 dB/μV
high band	min. 66 dB/μV
In band N ± 2 low band	min. 78 dB/μV
In band N ± 5 high band	min. 84 dB/μV
Out of band	typ. 100 dB/μV
FM rejection	
at channel 6 (90.5 MHz, antenna level 60 dB/μV)	min. 50 dB
at channel 6 (93 to 108 MHz, antenna level 90 dB/μV)	min. 50 dB

Oscillator characteristics (UV933 types only)

Drift of oscillator frequency	
Warm up (tuner on-off, bandswitching)	
low band	max. 250 kHz
high band, up to channel 69	max. 250 kHz
high band, channel 70 to 83	max. 500 kHz
Change of ambient temperature 25 ± 25 °C	
low band	max. 500 kHz
high band	max. 1000 kHz
Change of humidity 60% to 93% ± 2%	
low band	max. 500 kHz
high band, up to channel 69	max. 1000 kHz
high band, channels 70 to 83	max. 1500 kHz
Shift of oscillator frequency at a change of supply voltage of 5%	
low band	max. 250 kHz
high band up to channel 69	max. 500 kHz
high band, channels 70 to 83	max. 750 kHz
during AGC	max. 150 kHz
Pulling (10 kHz)	min. 74 dB/μV

PLL tuning characteristics (UV934 types only)

PLL tuning resolution	max. 62.5 kHz

Deviation from nominal of the locked oscillator frequency under any combination of the operation conditions: 50×10^{-6}.

Miscellaneous

Radio interference

When the tuner is mounted in a television chassis in such a way as to reduce chassis radiation to a minimum, the radiated signal shall be:

channels 2 to 6	max. 50 μV/m
channels 7 to 13	max. 150 μV/m
channels 14 to 69 any single frequency	max. 750 μV/m
average of any 10 individual frequencies	max. 350 μV/m

Microphonics

With the tuner exposed to sound signals in the audio frequency range 100 Hz to 10 kHz and sound pressure levels up to 105 dB (20 μPa), the video signal to sound interference ratio will be:

min. 40 dB

Oscillator voltage at the pins

supply and control pins	max. 60 dB/μV
IF terminals - low band	max. 85 dB/μV
IF terminals - high band	max. 80 dB/μV

ESD protection at the pins

All pins of the tuner are protected against electrostatic discharge up to 2 kV.

The product is classified in category B (MIL-STD-883C).

APPLICATION INFORMATION

For information regarding general aspects of I^2C-bus control refer to:
" The I^2C bus specification ", published by Philips Components.

I^2C-bus requirements (SDA and SCL pins)

$V_{IL(max)}$ = 1.5 V (maximum input LOW voltage)
$V_{IH(min)}$ = 3.0 V (minimum input HIGH voltage)
$I_{IL(max)}$ = −10 μA (maximum LOW input current)
$I_{IH(max)}$ = 10 μA (maximum HIGH input current)
$V_{OL(max)}$ = 0.4 V (maximum output LOW voltage at 3 mA sink current)

Logic diagram (WRITE mode, $R/\overline{W}$ = 0)

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	$R/\overline{W}$
Prog. div. byte 1	0	n14	n13	n12	n11	n10	n9	n8
Prog. div. byte 2	n7	n6	n5	n4	n3	n2	n1	n0
Control byte 1	1	5I	T1	T0	1	1	1	0
Control byte 2	P7	P6	P5	P4	P3	P2	P1	P0

Address selection

MA1	MA0	Address	Voltage at pin 15
0	0	C0	0 to 0.1 V PLL
0	1	C2	irrelevant*
1	0	C4	0.4 to 0.6 V PLL
1	1	C6	0.9 V PLL to 13.5 V

The UV934 types have pin 15 (address input) biased internally using a 47 kΩ resistor to B+ (+ 12 V). Therefore, with pin 15 open circuit, the tuner will respond to address C2 and C6.

* The tuner will always respond to address C2. The second address will depend on the voltage applied at pin 15.

Programmable divider setting (bytes 1 and 2)

Divider ratio: $N = 16 \times (f_{rf}, \text{pc (MHz)} + f_{if}, \text{pc (MHz)})$

$f_{osc} = N/16$ (MHz)

$N = 16384 \times n14 + 8192 \times n13 + 4096 \times n12 + 2048 \times n11 + 1024 \times n10 + 512 \times n9 + 256 \times n8 + 128 \times n7 + 64 \times n6 + 32 \times n5 + 16 \times n4 + 8 \times n3 + 4 \times n2 + 2 \times n1 + n0$

Control byte 1

Charge pump (CP) setting: CP can be set to either logic 0 (low current) or logic 1 (high current). CP = 1 results in faster tuning, CP = 0 in moderate tuning speed with slightly better residual oscillator FM.

Test mode setting: T1, T0 = 0 for normal operation.

PLL disabling: OS = 0 for normal operation

OS = 1 switches the charge pump transistor to the non-conductive state, enabling the tuner to be manually tuned by applying a variable tuning voltage to pin 11. When selecting OS to logic 1 it is recommended to simultaneously set T0 to logic 1.

Control byte 2

Bandswitching

	P0	P1	P2	P3	P4	P5	P6	P7
low band	x	x	x	0	0	1	1	x
high band	x	x	x	0	1	1	0	x

x = don't care

P0 to P7: output ports on PLL device

P3 must be programmed with 0 since the address voltage is applied at this combined input/output port.

Telegram examples (WRITE mode)

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	CB1	ACK	CB2	ACK	Stop

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	DIV1	ACK	Stop

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	Stop

Start	ADD	ACK	CB1	ACK	CB2	ACK	Stop

Start	ADD	ACK	CB1	ACK	CB2	ACK	DIV1	ACK	Stop

Start = start condition
ADD = address
ACK = acknowledge
DIV1 = divider ratio byte 1
DIV2 = divider ratio byte 2
CB1 = control byte 1
CB2 = control byte 2
Stop = stop condition

Logic diagram (READ mode, R/$\overline{W}$ = 1)

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	R/$\overline{W}$
Status byte	POR	FL	I2	I1	I0	A2	A1	A0

FL indicates when the tuning loop of the PLL to be in lock. The loop must be phase-locked for at least 8 periods of the internal 7.8125 kHz reference frequency (i.e. 1 ms) before the FL flag is set to logic 1.

POR (power on reset) is internally set to logic 1 if the PLL voltage drops below 3 V. The POR bit is reset when an end-of-data is detected by the PLL IC.

I0 to I2 and A0 to A2 do not contain any relevant data for the tuner application and can be ignored.

Telegram examples (READ mode)

Start	ADD	ACK	STB	ACK	STB		Stop	⇒ from processor

no Acknowledge = end-of-data

Start	ADD	ACK	STB		Stop	⇒ from PLL

Start = Start condition
ADD = Address
ACK = Acknowledge
STB = Status byte
Stop = Stop condition

ADDITIONAL INFORMATION

RF AGC setting

The RF AGC must be set such that the IF output level of the tuner (with IF load as stated) does not exceed 107 dB/μV.

IF injection

An IF signal from a generator (internal resistance 50 Ω or 75 Ω) should be connected to the IF injection point TP, accessible through a hole in the cover (see Fig.1) using probe 3139 147 10950.

Tuning supply voltage

A tuning voltage of 33 V must be connected via a series 22 kΩ resistor to pin 11. A preferred method is constant current supply of 1 to 1.5 mA to the pin. Figure 4 shows this with a 140 V supply. The zener diode prevents the voltage at pin 11 exceeding 33 V.

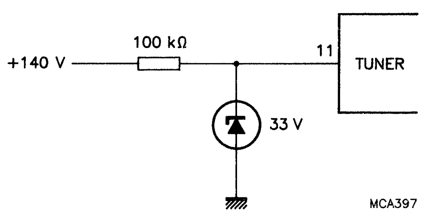


Fig.4 Constant current supply.

VHF/UHF TELEVISION TUNERS

QUICK REFERENCE DATA

Systems	RTMA systems M and N
Channels	
VHF	channels 2 to 6, channels 7 to 13
UHF	channels 14 to 69
CATV	channels A-2 to 65
Intermediate frequencies	
picture	45.75 MHz
sound	41.25 MHz
colour	42.17 MHz

APPLICATION

The tuners are designed to cover all frequencies in the range ch 2 (55.25 MHz) to ch 69 (801.25 MHz) of RTMA systems M and N.

The IF output is designed to directly drive a variety of SAW filters. The UV936 tuner is equipped with an I^2C-bus for digital programmable phase-locked-loop frequency synthesis with crystal accuracy. Bandswitching is also carried out via the I^2C-bus.

The UV935 tuner is designed for voltage controlled tuning and does not have the PLL tuning system.

The tuners comply with the requirements of radiation, signal handling capability and immunity of the FCC.

Table 1 Available versions

type	aerial connector	tuning method	catalogue number
UV935	phono	0.3 - 28 V	3139 147 11010
UV935/IEC (note 1)	IEC (14.5 mm)	0.3 - 28 V	
UV936	phono	PLL/I^2C	3139 147 10381
UV936/IEC (note 1)	IEC (14.5 mm)	PLL/I^2C	

Note to Table 1

1. Available on special request only.

DESCRIPTION

The UV935 and UV936 tuners are combined VHF/UHF tuners with electronic tuning and band switching. The tuners cover the low band (frequency range 55.25 to 157.25 MHz), the mid band (frequency range 163.25 to 451.25 MHz) and the high band (frequency range 457.25 to 801.25 MHz).

The tuners are built on a low-loss printed-wiring board carrying all components in a metal housing with front and rear covers.

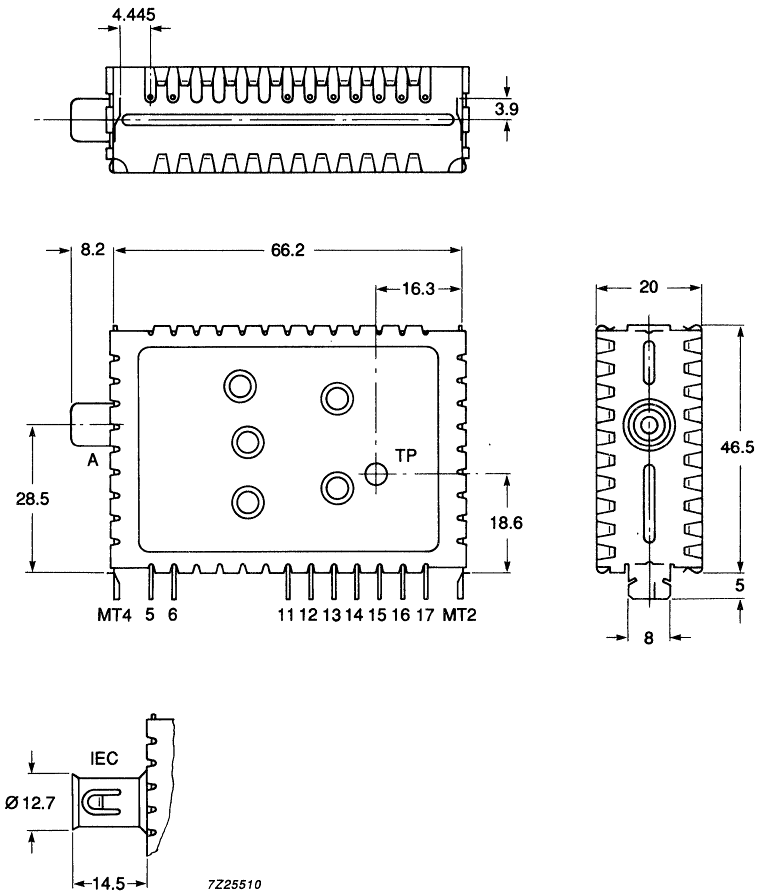
The tuners are equipped with a common phono aerial input and provided with three tuned RF MOSFET input stages. The mixers and oscillators (bands I, II and III) and IF amplifiers are biased for high signal handling capabilities. Between the mixers and the IF amplifier, a double tuned IF filter is provided to improve IF selectivity and to maintain a flat response for the desired frequencies.

The low output impedance of the asymmetrical IF terminals ensures sufficient triple transient suppression of the SAW filter.

The UV936 tuner is provided with a digital programmable (I^2C) phase-locked-loop tuning system. This enables tuning with a 62.5 kHz pitch with crystal accuracy. Band switching is also carried out via the I^2C-bus.

MECHANICAL DATA

Dimensions in mm



Pin/connector identity	UV935	UV936
A	Aerial input (phono)	Aerial input
5	AGC voltage (9.2 - 0.85 V)	AGC voltage (9.2 - 0.85 V)
6	Supply voltage B+ (+ 12 V)	Supply voltage B+ (+ 12 V)
11	Tuning supply (0.3 - 28 V)	Tuning supply (33 V via 22 kΩ series resistor)
12		Supply voltage PLL + 5 V
13		SCL serial clock line } I^2C-bus
14		SDA serial data line } I^2C-bus
15		Address select input
16	Ground	Ground
17	IF output	IF output
MT2, MT4	Mounting tabs, grounded	Grounded

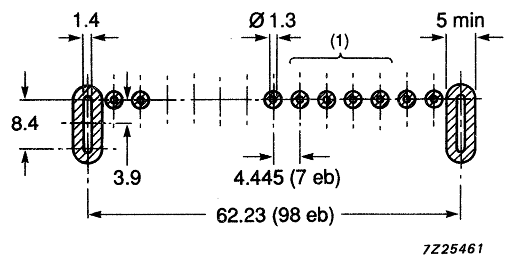
Fig.1 Mechanical diagram.

Mass: approximately 80 grams

Mounting

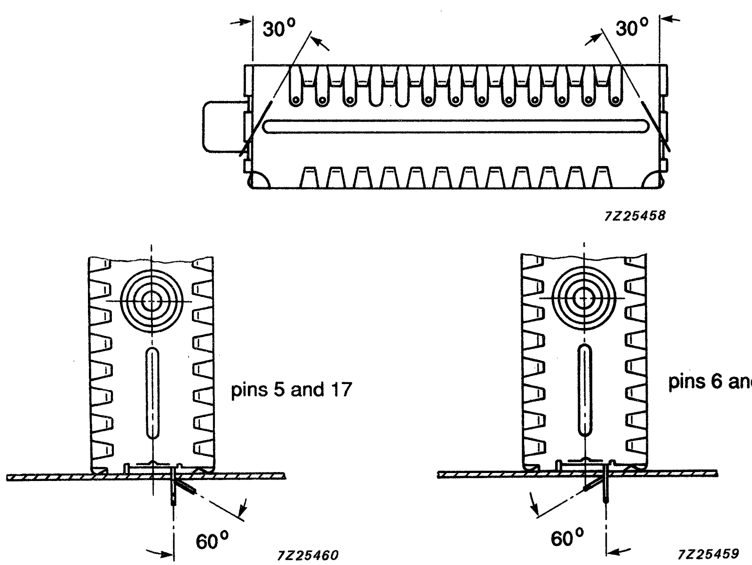
The tuner may be mounted by soldering it on to a printed-wiring board, using the piercing diagram shown in Fig.2 without clearance between the tuner supporting surface and the board. The connecting pins should be bent according to Fig.3. The tuner may be mounted anywhere in the receiver and there are no restrictions on orientation.

The solderability of the pins and mounting tabs is in accordance with IEC 68-2-20, test Ta (230 ± 10 °C, 2 ± 0.5 s). The resistance to soldering heat is in accordance with IEC 68-2-20 test Tb (260 ± 5 °C, 10 ± 1 s).



(1) UV936 only.
1 eb = 0.025 inch.

Fig.2 Piercing diagram viewed from solder side of board.



Note: In order to prevent any stress to the printed-wiring board, the tuner should be supported at its aerial connector.

Fig.3 Bending of connecting pins and mounting tabs.

ELECTRICAL DATA

Unless otherwise stated all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0.3 V, an AGC voltage of 9.2 ± 0.2 V, a PLL supply voltage of 5 ± 0.3 V and a tuning supply voltage of 33 ± 0.5 V via a 22 kΩ series resistor.

General

Semiconductors, low band	
RF amplifier	BF990A/01R
mixer	2SC2480
oscillator	BFS17
tuning diodes	OF612
coupling diodes	OF643
Semiconductors, mid band	
RF amplifier	BF998R
mixer	2SC2480
oscillator	2SC3545
tuning diodes	OF612
coupling diodes	OF612
Semiconductors, high band	
RF amplifier	BF990A/01R
mixer	2SC3841
oscillator	2SC2757
tuning diodes	OF643
IF amplifier	BF817
PLL tuning IC	TSA 5510T
Charge pump buffer transistor (npn)	BC847B
Ambient temperature range	
operating	−10 to + 60 °C
storage (non-operational)	−25 to + 85 °C
Relative humidity	
operating	max. 95%
non-operating	max. 100%

Voltages and currents

Supply voltage	
tuner	12 V ± 10%
PLL	5 ± 10%
Tuner ripple susceptability (peak-to-peak value)	max. 20 mV
PLL ripple susceptability (peak-to-peak value)	max. 20 mV
Supply current	
tuner	max. 50 mA
PLL	max. 70 mA
AGC voltage	
voltage range	+ 0.85 to + 9.2 V
AGC current	max. 1 μA
AGC source impedance	10 kΩ

ELECTRICAL DATA (continued)

Voltages and currents (continued)

Tuning supply voltage (note 1)	min. 30 V typ. 33 V max. 35 V
Ripple amplitude on tuning supply	max. 10 mV (p-p)
Tuning supply current	max. 1.7 mA

Frequencies

Frequency ranges	
low band	channel 2 (picture carrier 55.25 MHz) to channel G (picture carrier 157.25 MHz). Margin at extreme channels: min. 1.5 MHz
mid band	channel H (picture carrier 162.000 MHz) to channel CC (picture carrier 451.25 MHz). Margin at extreme channels: min. 3.0 MHz
high band	channel AAA (picture carrier 457.25 MHz) to channel 69 (picture carrier 801.25 MHz). Margin at extreme channels: min. 3.0 MHz
Intermediate frequencies	
picture	45.75 MHz
sound	41.25 MHz
colour	42.17 MHz

Wanted signal characteristics

Input impedance	75 Ω
VSWR and reflection coefficient (worst case on or between picture and sound carrier at maximum gain)	
VSWR (all channels)	max. 6
reflection coefficient	max. 66%
RF curves bandwidth	
channels 2 - 6, A-2 - I, 7 - 13	min. 5 MHz max. 13 MHz
channels J - EEE, 14 - 69	min. 5 MHz max. 18 MHz
RF curves, tilt: at any channel the amplitude difference between:	
– top of response curve and picture carrier	max. 4 dB
– top of response curve and sound carrier	max. 6 dB
– valley	max. 1.5 dB

Note

1. An external pull-up resistor of 22 kΩ ± 5% must be connected between the tuning supply and terminal 11. The tuning supply current is 1.7 mA.

AGC range	
VHF off-air channels	min. 45 dB
cable channels	min. 35 dB
UHF off-air channels	min. 30 dB
Voltage gain	min. 38 dB
	max. 50 dB
Maximum gain difference	max. 8 dB
Noise figure	
low band channels 2 and 6	max. 8 dB
low band other channels	max. 7 dB
mid band channels H and I	max. 10 dB
mid band other channels	max. 8 dB
high band	max. 10 dB
Overloading	
input signal producing 1 dB compression at nominal gain	
VHF/UHF off-air channels	min. 74 dB/μV
PLL lockout	
input signal producing either a detuning of the oscillator of + 300 kHz or −1000 kHz or stopping the oscillations at nominal gain	
off-air channels	min. 100 dB/μV
cable channels	min. 86 dB/μV

Unwanted signal characteristics

Image rejection (maximum gain)	
channels 2 - 6, A-2 - I, 7 - 13	min. 60 dB
channels J - EEE, 14 - 69	min. 45 dB
IF rejection (measured at picture carrier frequency)	
channel 2	typ. 55 dB
	min. 50 dB
channel 3	typ. 60 dB
	min. 55 dB
all other channels	min. 60 dB

Cross modulation

The undesired carrier level required to produce 1% modulation on the desired carrier shall be equal to or exceed the desired carrier level for all gain values between maximum gain and −40 dB (VHF), −30 dB (UHF) gain reduction or be:

in band N ± 2: channels 2 - W	min. 78 dB/μV
in band N ± 3: channels AA - ZZ	min. 78 dB/μV
in band N ± 5: channels AAA - 69	min. 84 dB/μV

PLL tuning characteristics

The oscillator is tuned with a 62.5 kHz pitch.

Stability of the oscillator under any operational conditions	
all channels	max. 40 ppm
Channel 69 oscillator resolution	max. 62.5 kHz
Tuning response time (charge pump is set high)	max. 100 ms

ELECTRICAL DATA (continued)

PLL tuning characteristics (continued)

Oscillator voltage at terminals	
IF output - channels 2, 3 and 4	max. 94 dB/μV
IF output - all other channels	max. 84 dB/μV
all other terminals	max. 70 dB/μV

IF output characteristics

IF output impedance (between pins 16 (ground) and 17) at 43.96 MHz	typ. 75 Ω
IF load impedance	max. 1 kΩ/22 pF

The total capacitance loading at the IF terminals must be tuned at the IF centre frequency by means of a coil between pins 16 (ground) and 17 (minimum value: 750 nH).

Miscellaneous

Radio interference

The tuner must be mounted in the television chassis in such a manner as to reduce chassis radiation to a minimum. Measurements made in accordance with IEEE standard procedure RS 207 and 54IRE 17, S1.

Channels 2 - 6		max. 50 μV/m
Channels 7 - 13		max. 150 μV/m
Channels 14 - 69	any single frequency	max. 750 μV/m
	average of 10 individual frequencies	max. 350 μV/m

Immunity (RF ingress)

In the field of a synchronous television signal having measured field strength of 100 mV/m and the input terminated in 75 Ω load with a quarter wave stub, the IF output shall be at least 40 dB below the level of a 1 mV reference signal applied to the aerial input. In the field of a non-synchronous television signal the IF output shall be at least 55 dB below the reference signal.

Microphonics

For sound signals in the audio frequency range 100 Hz to 10 kHz with sound pressure levels up to 105 dB (20 μPa) the video signal to sound interference ratio will be min. 40 dB.

ESD protection

All the terminals of the tuner are protected against electrostatic discharge up to 2 kV.

The product is classified in category B (MIL-STD-883C).

APPLICATION INFORMATION

For further information regarding general aspects of I^2C-bus control refer to:
"The I^2C-bus specification", published by Philips Components.

I^2C-bus requirements (SDA and SCL pins)

$V_{IL(max)}$ = 1.5 V (maximum input LOW voltage)
$V_{IH(min)}$ = 3.0 V (minimum input HIGH voltage)
$I_{IL(max)}$ = −10 μA (maximum LOW level input current)
$I_{IH(max)}$ = 10 μA (maximum HIGH level input current)
$V_{OL(max)}$ = 0.4 V (maximum output LOW voltage at 3 mA sink current)

Programming description

For I^2C programming, there is one module address (7 bits) and the R/$\overline{W}$ bit for selecting READ or WRITE mode.

1	1	0	0	0	MA1	MA0	R/$\overline{W}$

Logic diagram

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	0
Prog. div. byte 1	0	n14	n13	n12	n11	n10	n9	n8
Prog. div. byte 2	n7	n6	n5	n4	n3	n2	n1	n0
Control byte 1	1	5I	T1	T0	1	1	1	0
Control byte 2	P7	P6	P5	P4	P3	P2	P1	P0

Address selection

active address	voltage at terminal 15	MA1	MA0
C0	0 . . . . 0.1 V PLL	0	0
C2	don't care	0	1
C4	0.4 . . . . 0.6 V PLL	1	0
C6	0.9 . . . . 1.1 V PLL	1	1

Programmable divider setting

Divider ratio: $N = 16 \times [f_{RF,\,pc}\ (MHz) + f_{IF,\,pc}\ (MHz)]$
$f_{OSC} = N/16$ (MHz)

$$N = 16384 \times n14 + 8192 \times n13 + 4096 \times n12 + 2048 \times n11 + 1024 \times n10 + 512 \times n9 + 256 \times n8 + 128 \times n7 + 64 \times n6 + 32 \times n5 + 16 \times n4 + 8 \times n3 + 4 \times n2 + 2 \times n1 + n0$$

APPLICATION INFORMATION (continued)

Control byte 1

Charge pump setting 5I = 0 for all bands.
Test mode setting T1, T0 = 0 for normal operation.

Control byte 2

bandswitching	P0	P1	P2	P3	P4	P5	P6	P7
band I	X	X	X	0	0	1	1	0
band II	X	X	X	0	1	0	1	0
band III	X	X	X	0	1	1	0	0

X = don't care   P0 . . . . P7: band selection outputs

P7 is used to switch-off the charge pump transistor during alignment. P3 must be programmed to logic 0, as the address voltage is applied at this port.

Telegram examples WRITE mode

Start – ADD – ACK – DIV1 – ACK – DIV2 – ACK – CB1 – ACK – CB2 – ACK – Stop
Start – ADD – ACK – DIV1 – ACK – DIV2 – ACK – CB1 – ACK – CB2 – ACK – Stop
Start – ADD – ACK – DIV1 – ACK – DIV2 – ACK – DIV1 – ACK – Stop
Start – ADD – ACK – DIV1 – ACK – DIV2 – ACK – Stop
Start – ADD – ACK – CB1 – ACK – CB2 – ACK – Stop
Start – ADD – ACK – CB1 – ACK – CB2 – ACK – DIV1 – ACK – Stop

Start = start condition
ADD = address
ACK = acknowledge
DIV1 = divider ratio byte 1
DIV2 = divider ratio byte 2
CB1 = control byte 1
CB2 = control byte 2
Stop = stop condition

Read mode (R/$\overline{W}$ = 1)

Logic diagram

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	1
Status byte	POR	FL	I2	I1	I0	A2	A1	A0

FL is set to 1 when the tuning loop is in lock.

POR (power-on-reset) is intentionally set to 1 in case V PLL drops below 3 V. The POR bit is reset when an end-of-data is detected by the PLL IC.

I0 to I2 and A0 to A2 do not contain any relevant data and can be ignored.

Telegram examples READ mode

Start – ADD – ACK – STB – ACK – STB – Stop ----- From processor

Start – ADD – ACK – STB – Stop ----- From PLL

Start = start condition
ADD = address
ACK = acknowledge
STB = status byte
Stop = stop condition

ADDITIONAL INFORMATION

RF AGC setting

The RF AGC must be set such that the IF output level of the tuner (with IF load as stated) does not exceed 107 dB/μV.

IF injection

An IF signal from a generator (internal resistance 50 Ω or 75 Ω) should be connected to the IF injection point TP, accessible through a hole in the cover (see Fig.1) using probe 3139 147 10950.

Tuning supply voltage

A tuning voltage of 33 V must be connected via a series 22 kΩ resistor to pin 11. A preferred method is constant current supply of 1 to 1.5 mA to the pin. Figure 4 shows this with a 140 V supply. The zener diode prevents the voltage at pin 11 exceeding 33 V.

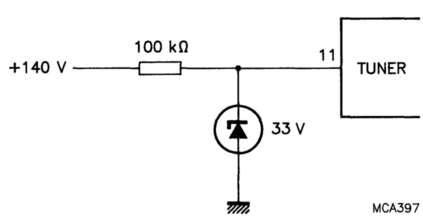


Fig.4 Constant current supply.

APPLICATION

The U943C and U944C tuners belong to the 900 series of small size tuners which are designed to meet a wide range of applications.

The U944C is equipped with a built-in digitally controlled (I^2C) PLL tuning IC. Band switching is also carried out via the I^2C-bus. The U943C types are intended for voltage controlled tuning and do not have a PLL synthesizer.

The IF output is designed with low output impedance to directly drive a variety of SAW filters.

These tuners comply with the radiation, signal handling and immunity requirements of CENELEC proposal European Standard EN55013 and EN55020.

QUICK REFERENCE DATA

System	CCIR system I		
Channels	E21 to E69		
Intermediate frequencies			
picture	39.50 MHz	or	38.90 MHz
colour	35.07 MHz		34.47 MHz
sound 1	33.50 MHz		32.90 MHz
sound 2	33.00 MHz		32.40 MHz

Table 1 Available versions

TYPE	AERIAL CONNECTOR	TUNING METHOD
U943C	phono	0.3 V to 28 V
U943(IEC)C	IEC (14.4 mm)	0.3 V to 28 V
U944C	phono	PLL/I^2C
U944(IEC)C	IEC (14.4 mm)	PLL/I^2C

DESCRIPTION

The U943C and U944C tuners are designed to cover the UHF band from 470 MHz to 860 MHz (channels E21 to E69).

The tuners are built on a low-loss, single sided printed-wiring board with an additional small vertical board carrying the PLL tuning system components in the U944C tuner. The tuners are housed in a folded sheet steel housing with separate front and rear covers. The aerial connection (phono or IEC) is mounted on one side of the housing.

Selectivity is increased by use of a tuned antenna circuit and a double tuned bandpass filter separated by a MOSFET RF amplifier.

The mixer and oscillator are constructed using bipolar transistors in common-base configuration.

An IF bandpass filter is provided between the mixer and the final IF amplifier. The output impedance at the tuner IF terminal is approximately 90 Ω to ensure adequate triple transient suppression in the SAW filter.

The U944C tuners contain an I^2C-bus controlled phase-locked-loop tuning system enabling direct channel access with crystal accuracy.

Semiconductors used

FUNCTION	DEVICE USED
RF amplifier	BF998R
Mixer	2SC3841
Oscillator	ON4438
Tuning diodes	OF643
IF amplifier	BFS17
Tuning/bandswitching IC (U944C only)	TSA5512 or SP5512
Tuning transistor (U944C only)	BC847B

MECHANICAL DATA

Pinning

PIN	TUNER TYPE	
	U943C	U944C
A	aerial input	aerial input
5	AGC voltage, 9.2 V to 0.85 V	AGC voltage, 9.2 V to 0.85 V
6	supply voltage, +12 V	supply voltage, +12 V
11	tuning voltage, 0.3 V to 28 V	tuning supply voltage, 33 V via 22 kΩ series resistor
12		PLL supply voltage, +5 V
13		SCL serial clock line
14		SDA serial data line
15		address selection input
16	ground	ground
17	IF output	IF output
MT2, MT4	mounting tab, grounded	mounting tab, grounded

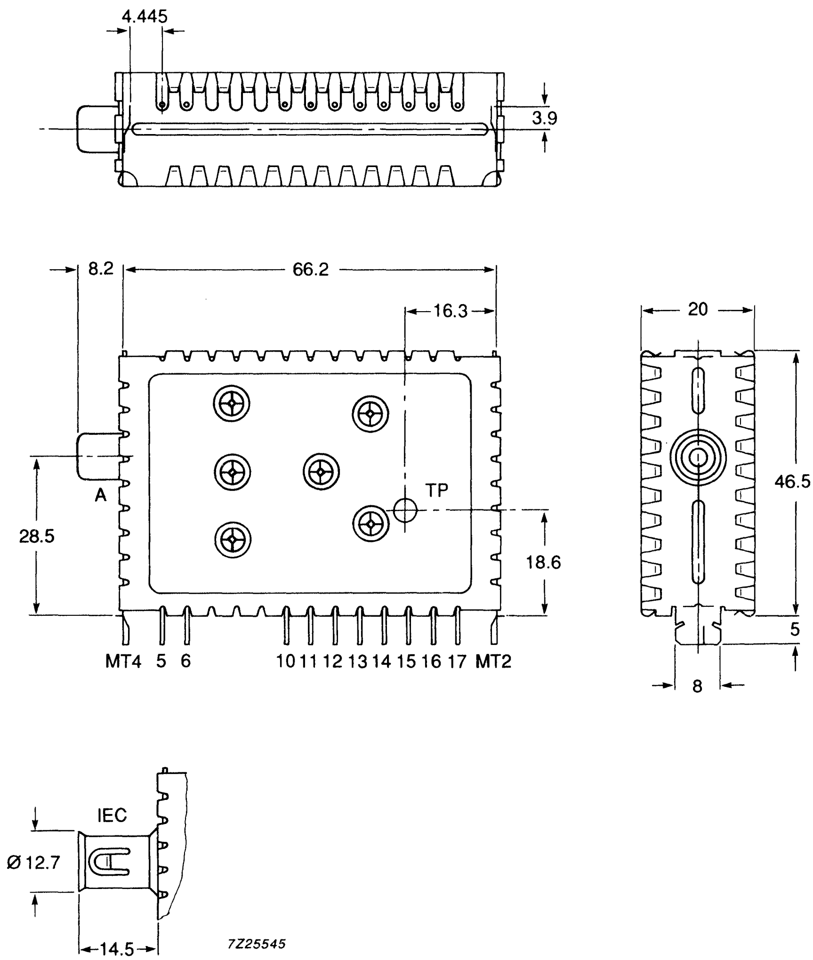
Mass

The mass of the tuner is approximately 50 grams.

Mounting

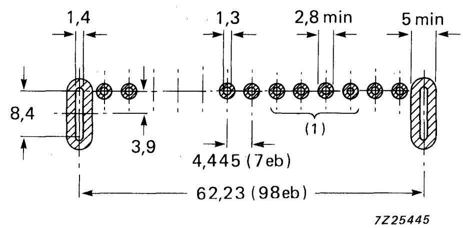
The tuner may be mounted by soldering it to a printed-wiring board, using the piercing diagram shown in Fig.2 without clearance between the tuner supporting surface and the board. The connecting pins and mounting tabs should be bent in accordance with Fig.3. The tuner may be mounted anywhere in the receiver and there are no restrictions on orientation.

The solderability of the pins and mounting tabs is in accordance with IEC 68-2, test Ta (230 ± 10 °C, 2 ± 0.5 s). The resistance to soldering heat is in accordance with IEC 68-2, test Tb (260 ± 5 °C, 10 ± 1 s).



Dimensions in mm.

Fig.1 Mechanical detail.



1 eb = 0.025 inch

(1) U944C types only

Fig.2 Piercing diagram viewed from solder side of board.

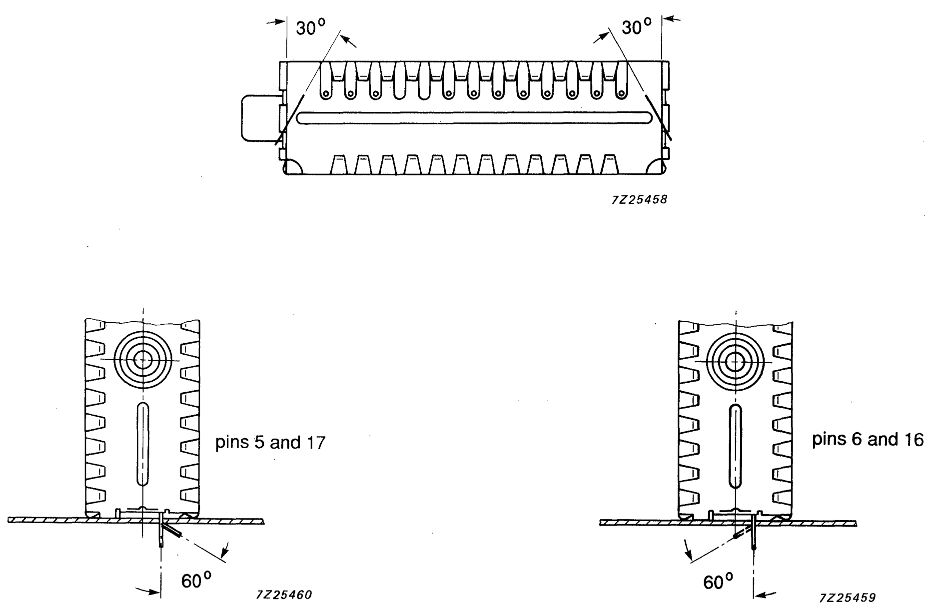


Fig.3 Bending of connecting pins and mounting tabs.

ELECTRICAL DATA

Unless otherwise stated all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0.3 V, an AGC voltage of 9.2 ± 0.2 V, a PLL supply voltage of 5 ± 0.3 V and a tuning supply voltage of 33 ± 0.5 V via a 22 kΩ series resistor.

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Environmental					
Ambient temperature range operating storage		 −10 −25	 – –	 +60 +85	 °C °C
Relative humidity		–	–	95	%
Voltages and currents					
Supply voltage		10.8	12	13.2	V
PLL supply voltage	U944C only	4.5	5	5.5	V
Ripple susceptibility (peak-to-peak)		5	–	–	mV
Current drawn supply current PLL current	 U944C only	 – –	 – –	 62 55	 mA mA
Tuning supply voltage U944 U943 (Fig.4)	 via 22 kΩ series resistor	 30 0.3	 33 –	 35 28	 V V
Current drawn from tuning supply	25 °C 60 °C 25 °C, 95% RH	– – –	– – –	0.15 2 2	µA µA µA
Tuning slope		–	4 to 30	–	MHz/V
AGC voltage (Fig.5) range nominal gain 30 dB gain reduction		 0.85 9.0 –	 – 9.5 1.5	 9.2 10.0 –	 V V V
AGC current		–	–	30	µA
Slope of AGC characteristic at end of specified range		–	30	–	dB/V
AGC slope		–	–	100	dB/V
Frequencies					
Frequency range	channel E21 (picture carrier 471.25 MHz) to channel E69 (picture carrier 855.25 MHz). Margin at extreme channels: min. 3 MHz.				

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Wanted signal characteristics					
Input impedance		–	75	–	Ω
VSWR	referred to 75 Ω	–	1.5	5	
Reflection coefficient		–	–	66	%
RF bandwidth		8	14	18	MHz
RF curves, tilt	on any channel the amplitude difference between the top of the overall curve and the picture carrier, the sound carrier, or any frequency between them will not exceed 4 dB at nominal gain and 5 dB in the AGC range between nominal gain and 20 dB gain reduction.				
AGC range		30	35	–	dB
Voltage gain		40	44	52	dB
Gain taper		–	4	6	dB
Noise figure		–	6	9	dB
Overloading input signal causing 1 dB gain compression oscillator detuning (U943C types only) PLL lock-out (U944C types only)	 +300/–1000 kHz	 74 80 90	 80 90 100	 – – –	 dB/μV dB/μV dB/μV
Image rejection	nominal gain up to 10 dB gain reduction	50	55	–	dB
IF rejection	picture, all channels	75	90	–	dB
½ IF susceptibility		60	70	–	dB/μV
Unwanted signal characteristics					
Cross modulation (note 1) in channel in band ±5 out of band		 66 84 90	 80 92 100	 – – –	 dB/μV dB/μV dB/μV

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Oscillator characteristics					
Pulling	input signal producing a shift in oscillator frequency of 10 kHz at nominal gain	74	80	–	dB/μV
Oscillator voltage at aerial terminal		–	–	46	dB/μV
Shift of oscillator frequency	U943C only				
change of supply voltage of 5%		–	–	500	kHz
during AGC		–	–	150	kHz
Drift of oscillator frequency	U943C only				
during warm-up time		–	–	250	kHz
during change of ambient temperature from +25 °C to +50 °C and +25 °C to 0 °C		–	–	1000	kHz
during change of relative humidity from 60% to 93% ±2%	T_{amb} = 25 ± 5 °C	–	–	1500	kHz
PLL tuning resolution	U944C only	–	–	62.5	kHz
Stability of lock oscillator frequency		–	–	50	ppm
IF characteristics					
IF output impedance		–	75	–	Ω
Allowable IF load impedance		1	–	–	kΩ
		–	–	22	pF
Miscellaneous					
Surge protection					
protection against voltages (note 2)		–	–	8	kV
protection against flashes (note 3)		–	–	30	kV
Immunity from radiated interference	the aerial input of the tuner meets the requirements of CENELEC, provided that the aerial cable is fitted with the appropriate plug.				
Radio interference	oscillator radiation and oscillator voltage at the aerial input are within the limits of CENELEC proposal European Standard EN55013 and EN55020.				
Microphonics	there will be no microphonics provided that the tuner is installed in a professional manner.				
ESD protection at the terminals	all the terminals of the tuner are protected against electrostatic discharge up to 2 kV. The product is classified in category B (MIL-STD-883C).				

Notes

1. The undesired carrier level required to produce 1% transfer of its modulation onto the desired carrier shall be equal to or exceed the desired carrier level (60 dB/μV at nominal gain) for all gain values between maximum gain and 30 dB gain reduction or be as shown.
2. 10 discharges of a 470 pF capacitor into the aerial terminal.
3. A flashover circuit producing flashes with frequencies of 1 to 20 Hz for 30 s is connected to the aerial terminal. Power is removed from the tuner during the test.

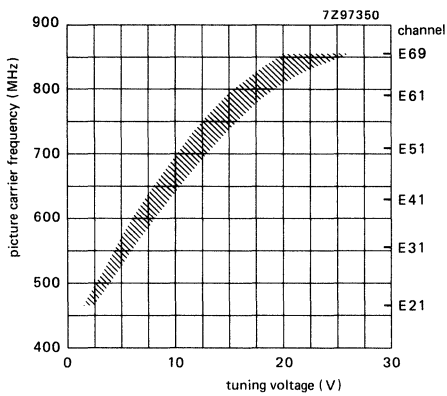


Fig.4 Tuning characteristics.

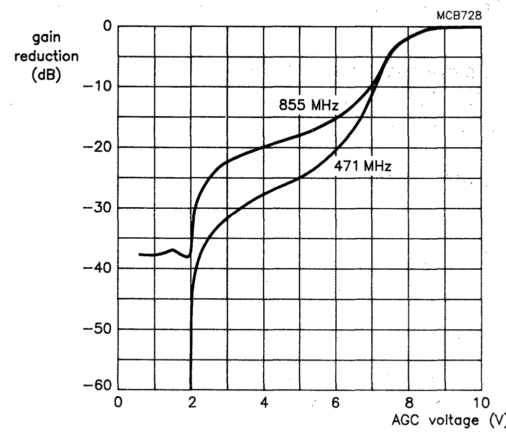


Fig.5 AGC characteristic.

APPLICATION INFORMATION

For information regarding general aspects of I^2C-bus control refer to: *'I^2C-bus specification'*, published by Philips Components.

For a more detailed description of the PLL IC see the device specification of the TSA5512.

Programmable divider setting

Bytes 1 and 2

Divider ratio:
N = 16 x (f_{rf}, pc (MHz) + f_{if}, pc (MHz))

f_{osc} = N/16 (MHz)

N = (16384 x n14) + (8192 x n13) + (4096 x n12) + (2048 x n11) + (1024 x n10) + (512 x n9) + (256 x n8) + (128 x n7) + (64 x n6) + (32 x n5) + (16 x n4) + (8 x n3) + (4 x n2) + (2 x n1) + n0

Control byte 1

CHARGE PUMP SETTING

Charge pump (CP) setting can be set to low current (logic 0) or high current (logic 1). CP = 1 results in faster tuning, CP = 0 in moderate tuning speed with slightly better residual FM.

TEST MODE SETTING

T1, T0 = for normal operation

PLL DISABLING

OS is set to logic 0 for normal operation. OS set to logic 1 switches the charge pump transistor to the non-conducting state, enabling the tuner to be manually tuned by applying a variable tuning voltage to pin 11. When setting OS to logic 1 it is recommended to simultaneously set T0 to logic 1.

I^2C-bus requirements

SDA and SCL pins

SYMBOL	PARAMETER	MIN.	MAX.	UNIT
$V_{IL(max)}$	maximum input LOW voltage	–	1.5	V
$V_{IH(min)}$	minimum input HIGH voltage	3.0	–	V
$I_{IL(max)}$	maximum LOW input current	–	−10	μA
$I_{IH(max)}$	maximum HIGH input current	–	10	μA
$V_{OL(max)}$	maximum output LOW voltage at 3 mA sink current	–	0.4	V

Logic diagram

WRITE mode, $R/\overline{W}$ = 0

BYTE	BITS							
	7 MSB	6	5	4	3	2	1	0 LSB
Address	1	1	0	0	0	MA1	MA0	$R/\overline{W}$
Prog. div. 1	0	n14	n13	n12	n11	n10	n9	n8
Prog. div. 2	n7	n6	n5	n4	n3	n2	n1	n0
Control 1	1	5I	T1	T0	1	1	1	1
Control 2	P7	P6	P5	P4	P3	P2	P1	P0

Address selection

MA1	MA0	ADDRESS	VOLTAGE AT PIN 15
0	0	C0	0 to 0.1 V_{PLL}
0	1	C2	note 1
1	0	C4	0.4 to 0.6 V_{PLL}
1	1	C6	0.9 V_{PLL} to 13.5 V

Notes

The U944C types have pin 15 (address input) left floating.

1. The tuner will always respond to address C2. The second address will depend on the voltage applied at pin 15. When pin 15 is tied to +B(+12 V) through a 47 kΩ resistor, the tuner will respond to addresses C2 and C6. When pin 15 is tied to ground through a 47 kΩ resistor, the tuner will respond to addresses C2 and C0.

Telegram examples

WRITE mode

```
start - ADD - ACK - DIV1 - ACK - DIV2 - ACK - CB1 - ACK - CB2 - ACK - stop
start - ADD - ACK - DIV1 - ACK - DIV2 - ACK - stop
start - ADD - ACK - DIV1 - ACK - DIV2 - ACK - stop
start - ADD - ACK - CB1 - ACK - CB2 - ACK - stop
start - ADD - ACK - CB1 - ACK - CB2 - ACK - DIV1 - ACK - stop
```

start = start condition
ADD = address
ACK = acknowledge
DIV1 = divider ratio byte 1
DIV2 = divider ratio byte 2
CB1 = control byte 1
CB2 = control byte 2
stop = stop condition

Logic diagram

READ mode, $R/\overline{W}$ = 1

BYTE	BITS							
	7 MSB	6	5	4	3	2	1	0 LSB
Address byte	1	1	0	0	0	MA1	MA0	$R/\overline{W}$
Status byte	POR	FL	I2	I1	I0	A2	A1	A0

FL indicates when the tuning loop of the PLL is in lock. The loop must be phase-locked for at least 8 periods of the internal 7.8125 kHz reference frequency (i.e. 1 ms) before the FL flag is set to logic 1.

POR (power on reset) is internally set to logic 1 if the PLL voltage drops below 3 V. The POR bit is reset when an end-of-data is detected by the PLL IC.

Bits I0 to I2 and A0 to A2 do not contain any relevant data for the tuner application and can be ignored.

ADDITIONAL INFORMATION

RF AGC setting

The RF AGC must be set such that the IF output level of the tuner (with IF load as stated) does not exceed 107 dB/µV.

IF injection

An IF signal from a generator (internal resistance 50 Ω or 75 Ω) should be connected to the IF injection point TP, accessible through a hole in the cover (see Fig. 1) using probe 3139 147 10950.

Tuning supply voltage

A tuning voltage of 33 V must be connected via a series 22 kΩ resistor to pin 11. A preferred method is a constant current supply of 1 to 5 mA to the pin. Figure 6 shows this with a 140 V supply. The zener diode prevents the voltage at pin 11 exceeding 33 V.

IF loading

To guarantee optimal signal handling performance to reactive load of the IF output circuit (internal capacitance, interconnections, SAW filter) has to be tuned to the IF centre frequency by means of a coil L in parallel with the SAW filter.

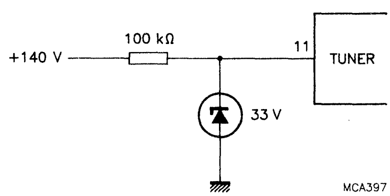


Fig.6 Constant current supply.

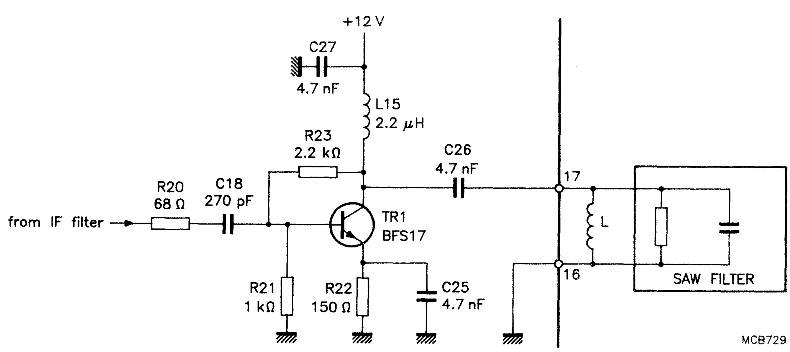


Fig.7 IF output circuit.

UHF/VHF TELEVISION TUNERS

QUICK REFERENCE DATA

Systems	systems D and K
Channels	
low band	E2 to C5
mid band	C6 to E12
high band	C13 to C57
Intermediate frequencies	
picture	38.00 MHz
colour	33.57 MHz
sound	31.50 MHz

APPLICATION

The UV953/954 tuners belong to the 900 family of small size tuners which are designed to meet a wide range of applications.

The UV954 is equipped with a built-in digital controlled (I^2C) PLL tuning IC. Band switching is also carried out via the I^2C-bus. The UV953 types are intended for voltage controlled tuning and do not have the PLL synthesizer.

The tuner IF output is designed with low output impedance to directly drive a variety of SAW filters.

These tuners comply with the radiation, signal handling and immunity requirements of CISPR13 (1975) amendment No. 1 (1983) and CENELEC proposal European Standard EN55013 and EN55020.

Table 1 Available versions

type	aerial connector	tuning method	catalogue number
UV953	phono	0.3 V - 28 V	3139 147 11400
UV953/IEC (note 1)	IEC (14.5 mm)	0.3 V - 28 V	3139 147 11380
UV954	phono	PLL/I^2C	3139 147 00120
UV954/IEC (note 1)	IEC (14.5 mm)	PLL/I^2C	3139 147 11430

Note to Table 1

1. Available on special request.

DESCRIPTION

The UV953/954 tuners are combined VHF/UHF units covering the low band (frequency range 48.25 to 93.25 MHz), the mid band (frequency range 168.25 to 224.25 MHz) and the high band (range 471.25 to 863.25 MHz).

The tuners are built on a low-loss printed-wiring board carrying all components and are housed in a sheet steel housing with separated front and rear covers. The aerial connector (phono or IEC) is mounted on one side of the frame.

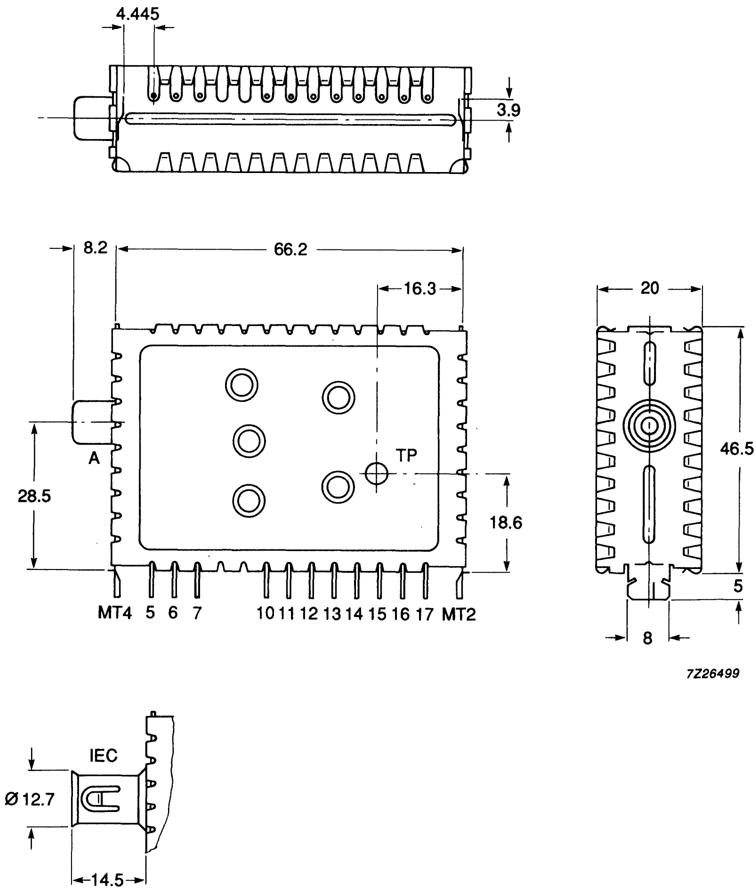
The tuners are equipped with a common aerial input connector (IEC or phono) and are provided with three tuned RF MOSFET input stages. The mixers and oscillators (bands I, II and III) and IF oscillators are biased for high signal handling capabilities.
Between the mixers and the IF amplifier, a double tuned IF filter is provided to improve IF selectivity and to maintain a flat response for the desired frequencies.

The low output impedance of the asymmetrical IF output ensures sufficient triple transient suppression of the SAW filter.

The UV954 tuner contains an I^2C-bus controlled phase-locked-loop tuning system enabling direct channel access with crystal controlled accuracy. Band switching is also carried out via the I^2C-bus.

MECHANICAL DESCRIPTION

Dimensions in mm



	UV953	UV954
A	aerial input	aerial input
5	AGC voltage 9.2 to 0.85 V	AGC voltage 9.2 to 0.85 V
6	supply voltage + 12 V	supply voltage + 12 V
7	VHF switch input	
10	UHF switch input	
11	tuning voltage 0.3 to 28 V	tuning supply voltage (33 V via 22 kΩ series resistor)
12		supply voltage PLL + 5 V
13		SCL serial clock line
14		SDA serial data line
15		address selection input
16	ground	ground
17	IF output	IF output
MT1	mounting tab grounded	mounting tab grounded
MT2	mounting tab grounded	mounting tab grounded

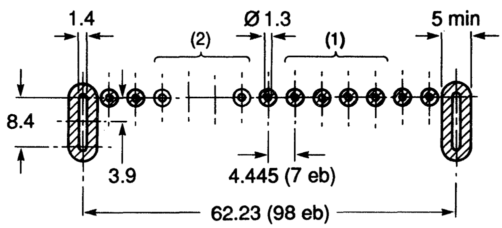
Fig.1 Mechanical detail.

Mass: approximately 55 grams

Mounting

The tuner may be mounted by soldering it to a printed-wiring board, using the piercing diagram shown in Fig.2 without clearance between the tuner supporting surface and the board. The connecting pins and mounting tabs should be bent in accordance with Fig.3.
The tuner may be mounted anywhere in the receiver and there are no restrictions on orientation.

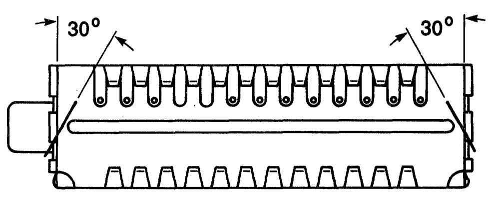
The solderability of the pins and mounting tabs is in accordance with IEC 68-2, test Ta (230 ± 10 °C, 2 ± 0.5 s). The resistance to soldering heat is in accordance with IEC 68-2, test Tb (260 ± 5 °C, 10 ± 1 s).

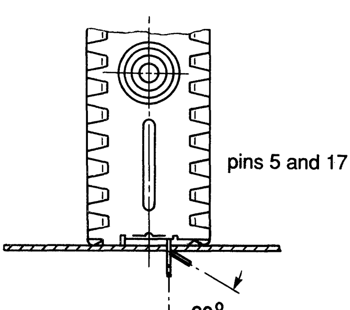


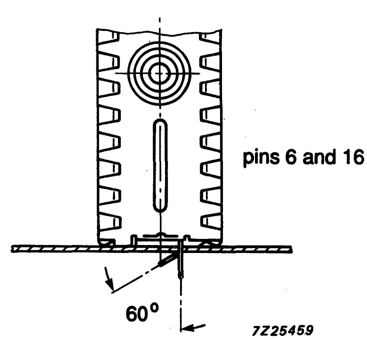
(1) UV954 types only
(2) UV953 types only

1 eb = 0.025 inch.

Fig.2 Piercing diagram viewed from solder side of board.







Note

In order to prevent any stress to the printed-wiring board, the tuner should be supported at its aerial connector.

Fig.3 Bending of connecting pins and mounting tabs.

ELECTRICAL DATA

Unless otherwise specified all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0.3 V, an AGC voltage of 9.2 ± 0.2 V, a PLL supply voltage of 5 ± 0.3 V and a tuning supply voltage of 33 ± 0.5 V via a 22 kΩ series resistor.

General

Semiconductors, low band	
RF amplifier	3SK186
mixer	2SC2435
oscillator	BF747
tuning diodes	BB809
Semiconductors, mid band	
RF amplifier	3SK186
mixer	2SC2435
oscillator	2SC2435
tuning diodes	1SV124
Semiconductors, high band	
RF amplifier	BF990A/01R
mixer	2SC2435
oscillator	2SC2480
tuning diodes	OF643
IF amplifier	BFS17
Tuning/bandswitching IC (UV954 types only)	SP5510 or TSA5510
Tuning voltage transistor (UV954 types only)	BC847B
Ambient temperature range	
operating	−10 °C to + 60 °C
storage	−25 °C to + 85 °C
Relative humidity	max. 95%

Voltages and currents

Supply voltage	+ 12 V ± 10%
PLL supply voltage (UV954 types only)	+ 5 V ± 10%
Current drawn	
supply current	max. 50 mA
PLL current	max. 55 mA
Tuning supply voltage (UV954 types only)*	min. 30 V typ. 33 V max. 35 V
Tuning supply voltage (UV953 types only)	0.3 to 28 V
Tuning supply current	max. 1.7 mA
Bandswitching voltage (UV953 types only)	+ 12 V ± 10%
Bandswitching current (UV953 types only)	max. 2 mA

* Via 22 kΩ series resistor.

Aerial input characteristics

VSWR referred to 75 Ω impedance	
low band	max. 5
mid band	max. 5
high band	max. 5
Reflection coefficient referred to 75 Ω impedance	
low band	max. 66%
mid band	max. 66%
high band	max. 66%
Surge protection	min. 8 kV
Oscillator voltage at aerial terminal	
up to 860 MHz	max. 46 dB/μV
860 to 1000 MHz	max. 46 dB/μV

IF output characteristics

IF output impedance (between pins 17 and 16 (ground))	90 Ω
Permitted IF load impedance	min. 1 kΩ max. 22 pF

Frequency range

Low band	channel E2 (picture carrier 48.25 MHz) to channel C5 (picture carrier 93.25 MHz). Margin at extreme channels: min. 2 MHz.
Mid band	channel C6 (picture carrier 168.25 MHz) to channel E12 (picture carrier 224.25 MHz). Margin at extreme channels: min. 2 MHz.
High band	channel C13 (picture carrier 471.25 MHz) to channel C57 (picture carrier 855.25 MHz). Margin at extreme channels: min. 2 MHz.

Wanted signal characteristics

Voltage gain	
all channels	min. 40 dB max. 52 dB
gain difference of off-air channels	max. 8 dB
Noise figure	
low band	max. 8 dB
mid band	max. 8 dB
high band	max. 10 dB
AGC range	
low and mid bands	min. 40 dB
high band	min. 30 dB

Overloading		
input signal producing a gain compression of 1 dB	min.	90 dB/μV
input signal producing oscillator detuning of + 300/−1000 kHz	min.	90 dB/μV
input signal causing the PLL to fail to lock to desired signal	min.	90 dB/μV
Image rejection (between 0 and 10 dB gain reduction)		
low band	min.	66 dB
mid band	min.	66 dB
high band	min.	45 dB
IF rejection		
channel E2	min.	50 dB
other channels	min.	60 dB

Amplitude response curves

Tilt of overall response

At any channel the amplitude differences between:

Off-air channels		
top of response curve and picture	max.	4 dB
top of response curve and sound carrier	min.	0.5 dB
	max.	6 dB
valley	max.	1 dB
sound carrier above picture carrier	max.	3 dB

IF response

Amplitude difference between:

top of response curve and picture carrier	max.	1 dB
top of response curve and sound carrier	max.	1 dB

DEVELOPMENT DATA

Unwanted signal characteristics

Break through susceptibility	min.	60 dB/μV

Cross modulation

The undesired carrier level required to produce 1% transfer of its modulation onto the desired carrier shall be equal to or exceed the desired carrier level (60 dB/μV at nominal gain) for all gain values between maximum gain and 40 dB (low band) or 30 dB (high band) reduction or be:

In channel low band	min.	66 dB/μV
In band N ± 2 low band	min.	78 dB/μV
In band N ± 3 mid band	min.	78 dB/μV
In band N ± 5 high band	min.	84 dB/μV
Out of band	typ.	100 dB/μV

FM rejection	
at channel 6 (90.5 MHz, antenna level 60 dB/μV)	min. 50 dB
at channel 6 (93 to 108 MHz, antenna level 90 dB/μV)	min. 50 dB

Oscillator characteristics (UV963 types only)

Drift of oscillator frequency	
Warm up (tuner on-off, bandswitching)	
low band	max. 250 kHz
high band, up to channel 69	max. 500 kHz
high band, channel 70 to 83	max. 500 kHz
Change of ambient temperature 25 ± 25 °C	
low band	max. 500 kHz
mid band	max. 500 kHz
high band	max. 1000 kHz
Change of humidity 60% to 93% ± 2%	
low band	max. 500 kHz
high band, up to channel 69	max. 1000 kHz
high band, channels 70 to 83	max. 1500 kHz
Shift of oscillator frequency at a change of supply voltage of 5%	
low band	max. 250 kHz
mid and high bands	max. 500 kHz
during AGC	max. 150 kHz
Pulling (10 kHz)	min. 74 dB/μV

PLL tuning characteristics (UV964 types only)

PLL tuning resolution	max. 62.5 kHz
Deviation from nominal of the locked oscillator frequency under any combination of the operation conditions	50^{-6}

Miscellaneous

Radio interference

Oscillator radiation and oscillator voltage at the aerial terminal is within the limits of CISPR 13 (1975) amendment No. 1 (1983) and CENELEC proposal European Standard EN55013 and EN55020.

Microphonics

With the tuner exposed to sound signals in the audio frequency range 100 Hz to 10 kHz and sound pressure levels up to 105 dB (20 μPa), the video signal to sound interference ratio will be:
min. 40 dB

Oscillator voltage at the pins	
supply and control pins	max. 70 dB/μV
IF pins - low band	max. 95 dB/μV
IF pins - high band	max. 70 dB/μV

ESD protection at the pins
All pins of the tuner are protected against electrostatic discharge up to 2 kV.

The product is classified in category B (MIL-STD-883C).

APPLICATION INFORMATION

For information regarding general aspects of I^2C-bus control refer to:
" The I^2C bus specification ', published by Philips Components.

I^2C-bus requirements (SDA and SCL pins)

$V_{IL(max)}$ = 1.5 V (maximum input LOW voltage)
$V_{IH(min)}$ = 3.0 V (minimum input HIGH voltage)
$I_{IL(max)}$ = −10 μA (maximum LOW input current)
$I_{IH(max)}$ = 10 μA (maximum HIGH input current)
$V_{OL(max)}$ = 0.4 V (maximum output LOW voltage at 3 mA sink current)

Logic diagram (WRITE mode, $R/\overline{W}$ = 0)

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	$R/\overline{W}$
Prog. div. byte 1	0	n14	n13	n12	n11	n10	n9	n8
Prog. div. byte 2	n7	n6	n5	n4	n3	n2	n1	n0
Control byte 1	1	5I	T1	T0	1	1	1	0
Control byte 2	P7	P6	P5	P4	P3	P2	P1	P0

Address selection

MA1	MA0	Address	Voltage at pin 15
0	0	C0	0 to 0.1 V PLL
0	1	C2	irrelevant*
1	0	C4	0.4 to 0.6 V PLL
1	1	C6	0.9 V PLL to 13.5 V

The UV954 types have pin 15 (address input) biased internally using a 47 kΩ resistor to B+ (+ 12 V). Therefore, with pin 15 open circuit, the tuner will respond to address C2 and C6.

* The tuner will always respond to address C2. The second address will depend on the voltage applied at pin 15.

Programmable divider setting (bytes 1 and 2)

Divider ratio: $N = 16 \times (f_{rf}, pc\ (MHz) + f_{if}, pc\ (MHz))$

$f_{osc} = N/16\ (MHz)$.

$N = 16384 \times n14 + 8192 \times n13 + 4096 \times n12 + 2048 \times n11 +$
$1024 \times n10 + 512 \times n9 + 256 \times n8 + 128 \times n7 + 64 \times n6 +$
$32 \times n5 + 16 \times n4 + 8 \times n3 + 4 \times n2 + 2 \times n1 + n0$

Control byte 1

Charge pump (CP) setting: CP can be set to either logic 0 (low current) or logic 1 (high current). CP = 1 results in faster tuning, CP = 0 in moderate tuning speed with slightly better residual oscillator FM.

Test mode setting: T1, T0 = 0 for normal operation.

PLL disabling: OS = 0 for normal operation.
OS = 1 switches the charge pump transistor to the non-conducting state, enabling the tuner to be manually tuned by applying a variable tuning voltage to pin 11. When selecting OS to logic 1 it is recommended to simultaneously set T0 to logic 1.

Control byte 2

Bandswitching

	P0	P1	P2	P3	P4	P5	P6	P7
low band	x	x	x	0	0	1	1	0
mid band	x	x	x	0	1	0	1	0
high band	x	x	x	0	1	1	0	0

x = don't care

P0 to P7: output ports on PLL device

P3 must be programmed with 0 since the address voltage is applied at this combined input/output port.

DEVELOPMENT DATA

Telegram examples (WRITE mode)

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	CB1	ACK	CB2	ACK	Stop

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	DIV1	ACK	Stop

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	Stop

Start	ADD	ACK	CB1	ACK	CB2	ACK	Stop

Start	ADD	ACK	CB1	ACK	CB2	ACK	DIV1	ACK	Stop

Start = start condition
ADD = address
ACK = acknowledge
DIV1 = divider ratio byte 1
DIV2 = divider ratio byte 2
CB1 = control byte 1
CB2 = control byte 2
Stop = stop condition

Logic diagram (READ mode, $R/\overline{W}$ = 1)

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	$R/\overline{W}$
Status byte	POR	FL	I2	I1	I0	A2	A1	A0

FL indicates when the tuning loop of the PLL to be in lock. The loop must be phase-locked for at least 8 periods of the internal 7.8125 kHz reference frequency (i.e. 1 ms) before the FL flag is set to logic 1.

POR (power on reset) is internally set to logic 1 if the PLL voltage drops below 3 V. The POR bit is reset when an end-of-data is detected by the PLL IC.

I0 to I2 and A0 to A2 do not contain any relevant data for the tuner application and can be ignored.

Telegram examples (READ mode)

Start	ADD	ACK	STB	ACK	STB		Stop	⇒ from processor

no Acknowledge = end-of-data

Start	ADD	ACK	STB		Stop	⇒ from PLL

Start = Start condition
ADD = Address
ACK = Acknowledge
STB = Status byte
Stop = Stop condition

ADDITIONAL INFORMATION

RF AGC setting

The RF AGC must be set such that the IF output level of the tuner (with IF load as stated) does not exceed 107 dB/μV.

IF injection

An IF signal from a generator (internal resistance 50 Ω or 75 Ω) should be connected to the IF injection point TP, accessible through a hole in the cover (see Fig.1) using probe 3139 147 10950.

Tuning supply voltage

A tuning voltage of 33 V must be connected via a series 22 kΩ resistor to pin 11. A preferred method is constant current supply of 1 to 1.5 mA to the pin. Figure 4 shows this with a 140 V supply. The zener diode prevents the voltage at pin 11 exceeding 33 V.

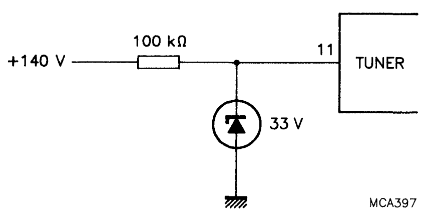


Fig.4 Constant current supply.

DEVELOPMENT DATA

UHF/VHF TELEVISION TUNERS

QUICK REFERENCE DATA

Systems	CCIR systems B, G and H
Channels	
low band	0 to 5
mid band	5A to 12
high band	21 to 69
Intermediate frequencies	
picture	38.875 MHz
colour	32.441 MHz
sound 1	31.375 MHz
sound 2	31.133 MHz

APPLICATION

The UV963/964 tuners belong to the 900 series of small size tuners which are designed to meet a wide range of applications.

The UV964 is equipped with a built-in digital controlled (I^2C) PLL tuning IC. Band switching is also carried out via the I^2C-bus. The UV963 types are intended for voltage controlled tuning and do not have the PLL synthesizer.

The tuner IF output is designed with low output impedance to directly drive a variety of SAW filters.

These tuners comply the radiation, signal handling and immunity requirements of CISPR 13 (1973) including amendment (1983) and Australian standard AS2839.1 (1986).

Table 1 Available versions

type	aerial connector	tuning method	catalogue number
UV963	phono	0.3 V - 28 V	3139 147 11031
UV963/IEC (note 1)	IEC (14.5 mm)	0.3 V - 28 V	3139 147 11041
UV963/L (note 1)	IEC (32.2 mm)	0.3 V - 28 V	–
UV964	phono	PLL/I^2C	3139 147 11061
UV964/IEC (note 1)	IEC (14.5 mm)	PLL/I^2C	3139 147 11071
UV964/L (note 1)	IEC (32.2 mm)	PLL/I^2C	–

Note to Table 1

1. Available on special request.

DESCRIPTION

The UV963/964 tuners are combined VHF/UHF units covering the low band (frequency range 46.25 to 102.25 MHz), the mid band (frequency range 138.25 to 224.25 MHz) and the high band (frequency range 471.25 to 855.25 MHz).

The tuners are built on a low-loss printed-wiring board carrying all components and are housed in a sheet steel housing with separated front and rear covers. The aerial connector (phono or IEC) is mounted on one side of the frame.

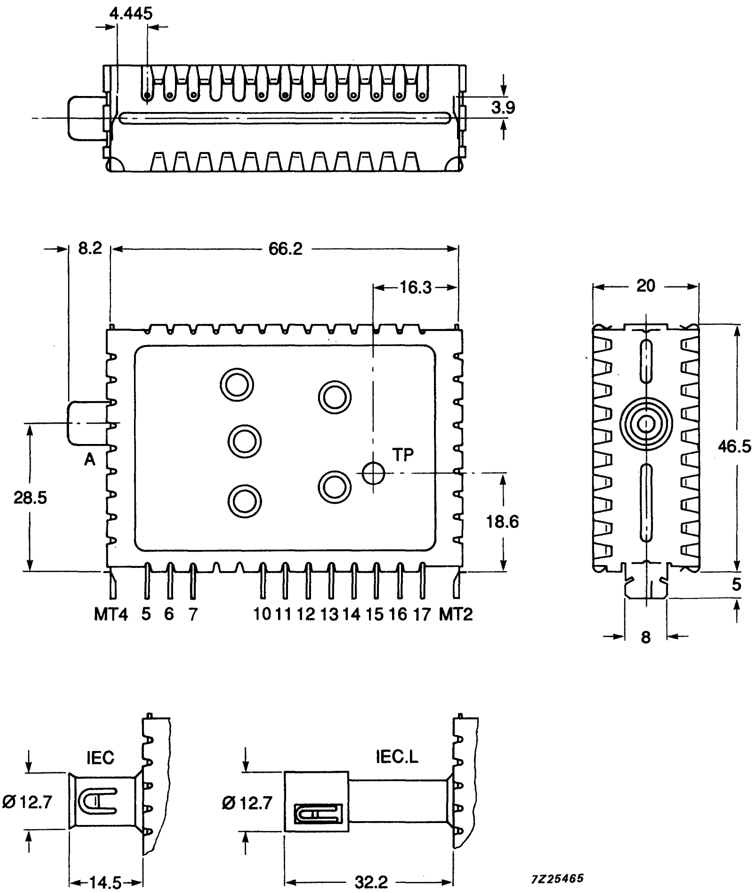
The tuners are equipped with a common aerial input connector (IEC or phono) and are provided with three tuned RF MOSFET input stages. The mixers and oscillators (bands I, II and III) and IF oscillators are biased for high signal handling capabilities.
Between the mixers and the IF amplifier, a double tuned IF filter is provided to improve IF selectivity and to maintain a flat response for the desired frequencies.

The low output impedance of the asymmetrical IF output ensures sufficient triple transient suppression of the SAW filter.

The UV964 tuners contains an I^2C-bus controlled phase-locked-loop tuning system enabling direct channel access with crystal controlled accuracy. Band switching is also carried out via the I^2C-bus.

MECHANICAL DESCRIPTION

Dimensions in mm



	UV963	UV964
A	aerial input	aerial input
5	AGC voltage 9.2 to 0.85 V	AGC voltage 9.2 to 0.85 V
6	supply voltage + 12 V	supply voltage + 12 V
7	VHF switch input	
10	UHF switch input	
11	tuning voltage 0.3 to 28 V	tuning supply voltage (33 V via 22 kΩ series resistor)
12		supply voltage PLL + 5 V
13		SCL serial clock line
14		SDA serial data line
15		address selection input
16	ground	ground
17	IF output	IF output
MT1	mounting tab grounded	mounting tab grounded
MT2	mounting tab grounded	mounting tab grounded

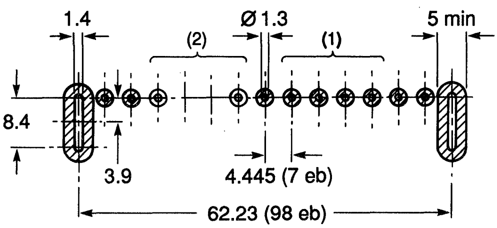
Fig.1 Mechanical detail.

Mass: approximately 55 grams

Mounting

The tuner may be mounted by soldering it to a printed-wiring board, using the piercing diagram shown in Fig.2 without clearance between the tuner supporting surface and the board. The connecting pins and mounting tabs should be bent in accordance with Fig.3.
The tuner may be mounted anywhere in the receiver and there are no restrictions on orientation.

The solderability of the pins and mounting tabs is in accordance with IEC 68-2, test Ta (230 ± 10 °C, 2 ± 0.5 s). The resistance to soldering heat is in accordance with IEC 68-2, test Tb (260 ± 5 °C, 10 ± 1 s).

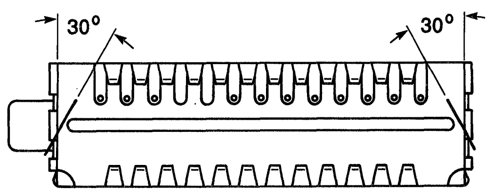


(1) UV964 types only
(2) UV963 types only

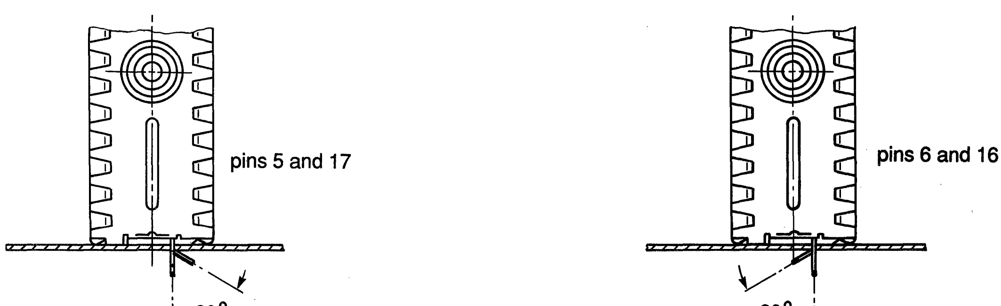
7Z25508

1 eb = 0.025 inch.

Fig.2 Piercing diagram viewed from solder side of board.



7Z25458



7Z25460 7Z25459

Note

In order to prevent any stress to the printed-wiring board, the tuner should be supported at its aerial connector.

Fig.3 Bending of connecting pins and mounting tabs.

ELECTRICAL DATA

Unless otherwise specified all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0.3 V, an AGC voltage of 9.2 ± 0.2 V, a PLL supply voltage of 5 ± 0.3 V and a tuning supply voltage of 33 ± 0.5 V via a 22 kΩ series resistor.

General

Semiconductors, low band	
RF amplifier	BF998
mixer	BFS17
oscillator	BFSS17A
tuning diodes	OF4052
coupling diodes	BB901
Semiconductors, high band	
RF amplifier	BF900A/01
mixer	2SC3841
oscillator	ON4438
tuning diodes	OF643
IF amplifier	BFS17
Tuning/bandswitching IC (UV964 types only)	SP5510 or TSA5510
Tuning voltage transistor (UV964 types only)	BC847B
Ambient temperature range	
operating	−10 °C to + 60 °C
storage	−25 °C to + 85 °C
Relative humidity	max. 95%

Voltages and currents

Supply voltage	+ 12 V ± 10%
PLL supply voltage (UV964 only)	+ 5 V ± 10%
Current drawn	
supply current	max. 50 mA
PLL current	max. 55 mA
Tuning supply voltage (UV964 only)*	min. 30 V typ. 33 V max. 35 V
Tuning supply voltage (UV963 only)	0.3 to 28 V
Tuning supply current	max. 1.7 mA
Bandswitching voltage (UV963 types only)	+ 12 V ± 10%
Bandswitching current (UV963 types only)	max. 2 mA

* Via 22 kΩ series resistor.

Aerial input characteristics

VSWR referred to 75 Ω impedance	
low band	max. 4
mid band	max. 4
high band	max. 4
Reflection coefficient referred to 75 Ω impedance	
low band	max. 60%
mid band	max. 60%
high band	max. 60%
Surge protection	min. 6 kV
Oscillator voltage at aerial terminal	
54 - 300 MHz	max. 50 dB/μV
300 - 1000 MHz	max. 66 dB/μV

IF output characteristics

IF output impedance (between pins 17 and 16 (ground))	90 Ω
Permitted IF load impedance	min. 1 kΩ max. 22 pF

Frequency range

Low band	channel 0 (picture carrier 46.25 MHz) to channel 5 (picture carrier 102.25 MHz). Margin at extreme channels: min. 1 MHz.
Mid band	channel 5A (picture carrier 138.25 MHz) to channel 12 (picture carrier 224.25 MHz). Margin at extreme channels: min. 1 MHz.
High band	channel 21 (picture carrier 471.25 MHz to channel 69 (picture carrier 855.25 MHz). Margin at extreme channels: min. 1 MHz.

Wanted signal characteristics

Voltage gain	
all channels	min. 38 dB max. 50 dB
gain difference of off-air channels	max. 8 dB
Noise figure	
low band	max. 8 dB
mid band	max. 8 dB
high band	max. 11 dB
AGC range	
low and mid bands	min. 40 dB
high band	min. 30 dB

Overloading	
input signal producing a gain compression of 1 dB	min. 74 dB/μV
input signal producing oscillator detuning of + 300/−1000 kHz	
low band	min. 90 dB/μV
high band	min. 80 dB/μV
input signal causing the PLL to fail to lock to desired signal	
low band	min. 90 dB/μV typ. 100 dB/μV
high band	min. 90 dB/μV typ. 100 dB/μV
Image rejection (between 0 and 10 dB gain reduction)	
low band	typ. 66 dB
mid band	typ. 66 dB
high band	min. 53 dB
IF rejection	
channel 0	min. 50 dB
other channels	min. 60 dB

Amplitude response curves

Tilt of overall response

At any channel the amplitude differences between:

Off-air channels	
top of response curve and picture	max. 4 dB
top of response curve and sound carrier	min. 0.5 dB max. 6 dB
valley	max. 1 dB
sound carrier above picture carrier	max. 3 dB

IF response

Amplitude difference between:

top of response curve and picture carrier	max. 1 dB
top of response curve and sound carrier	max. 1 dB

Unwanted signal characteristics

Break through susceptibility	min. 60 dB/μV

Cross modulation

The undesired carrier level required to produce 1% transfer of its modulation onto the desired carrier shall be equal to or exceed the desired carrier level (60 dB/μV at nominal gain) for all gain values between maximum gain and 40 dB (low band) or 30 dB (high band) reduction or be:

In channel low band	min. 70 dB/μV
In band N ± 2 low band	min. 80 dB/μV
In band N ± 3 mid band	min. 80 dB/μV
In band N ± 5 high band	min. 84 dB/μV
Out of band	typ. 100 dB/μV

FM rejection	
at channel 6 (90.5 MHz, antenna level 60 dB/μV)	min. 50 dB
at channel 6 (93 to 108 MHz, antenna level 90 dB/μV)	min. 50 dB

Oscillator characteristics (UV963 types only)

Drift of oscillator frequency

Warm up (tuner on-off, bandswitching)	
low band	max. 250 kHz
high band, up to channel 69	max. 250 kHz
high band, channel 70 to 83	max. 500 kHz
Change of ambient temperature 25 ± 25 °C	
low band	max. 500 kHz
mid band	max. 750 kHz
high band	max. 1000 kHz
Change of humidity 60% to 93% ± 2%	
low band	max. 500 kHz
high band, up to channel 69	max. 1000 kHz
high band, channels 70 to 83	max. 1500 kHz
Shift of oscillator frequency at a change of supply voltage of 5%	
low band	max. 250 kHz
mid and high bands	max. 500 kHz
during AGC	max. 150 kHz
Pulling (10 kHz)	min. 74 dB/μV

PLL tuning characteristics (UV964 types only)

PLL tuning resolution	max. 62.5 kHz
Deviation from nominal of the locked oscillator frequency under any combination of the operation conditions	50×10^{-6}

Miscellaneous

Radio interference

When the tuner is mounted in a television chassis in such a way as to reduce chassis radiation to a minimum, radiated signal shall be:

channels 2 to 6	max. 50 μV/m
channels 7 to 13	max. 150 μV/m
channels 14 to 69 any single frequency	max. 750 μV/m
average of any 10 individual frequencies	max. 350 μV/m

Microphonics

With the tuner exposed to sound signals in the audio frequency range 100 Hz to 10 kHz and sound pressure levels up to 105 dB (20 μPa), the video signal to sound interference ratio will be:

min. 40 dB

Oscillator voltage at the pins	
supply and control pins	max. 60 dB/μV
IF pins - low band	max. 85 dB/μV
IF pins - high band	max. 80 dB/μV

ESD protection at the pins
All pins of the tuner are protected against electrostatic discharge up to 2 kV.

The product is classified in category B (MIL-STD-883C).

APPLICATION INFORMATION

For information regarding general aspects of I²C-bus control refer to:
" The I²C bus specification ", published by Philips Components.

I²C-bus requirements (SDA and SCL pins)

$V_{IL(max)}$ = 1.5 V (maximum input LOW voltage)
$V_{IH(min)}$ = 3.0 V (minimum input HIGH voltage)
$I_{IL(max)}$ = −10 μA (maximum LOW input current)
$I_{IH(max)}$ = 10 μA (maximum HIGH input current)
$V_{OL(max)}$ = 0.4 V (maximum output LOW voltage at 3 mA sink current)

Logic diagram (WRITE mode, R/$\overline{W}$ = 0)

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	R/$\overline{W}$
Prog. div. byte 1	0	n14	n13	n12	n11	n10	n9	n8
Prog. div. byte 2	n7	n6	n5	n4	n3	n2	n1	n0
Control byte 1	1	5I	T1	T0	1	1	1	0
Control byte 2	P7	P6	P5	P4	P3	P2	P1	P0

Address selection

MA1	MA0	Address	Voltage at pin 15
0	0	C0	0 to 0.1 V PLL
0	1	C2	irrelevant*
1	0	C4	0.4 to 0.6 V PLL
1	1	C6	0.9 V PLL to 13.5 V

The UV964 types have pin 15 (address input) biased internally using a 47 kΩ resistor to B+ (+ 12 V). Therefore, with pin 15 open circuit, the tuner will respond to address C2 and C6.

* The tuner will always respond to address C2. The second address will depend on the voltage applied at pin 15.

Programmable divider setting (bytes 1 and 2)

Divider ratio: $N = 16 \times (f_{rf}, pc\ (MHz) + f_{if}, pc\ (MHz))$
$f_{osc} = N/16$ (MHz).

$N = 16384 \times n14 + 8192 \times n13 + 4096 \times n12 + 2048 \times n11 + 1024 \times n10 + 512 \times n9 + 256 \times n8 + 128 \times n7 + 64 \times n6 + 32 \times n5 + 16 \times n4 + 8 \times n3 + 4 \times n2 + 2 \times n1 + n0$

Control byte 1

Charge pump (CP) setting: CP can be set to either logic 0 (low current) or logic 1 (high current). CP = 1 results in faster tuning, CP = 0 in moderate tuning speed with slightly better residual oscillator FM.

Test mode setting: T1, T0 = 0 for normal operation.

PLL disabling: OS = 0 for normal operation.
OS = 1 switches the charge pump transistor to the non-conducting state, enabling the tuner to be manually tuned by applying a variable tuning voltage to pin 11. When selecting OS to logic 1 it is recommended to simultaneously set T0 to logic 1.

Control byte 2

Bandswitching

	P0	P1	P2	P3	P4	P5	P6	P7
low band	x	x	x	0	0	1	1	0
mid band	x	x	x	0	1	0	1	0
high band	x	x	x	0	1	1	0	0

x = don't care
P0 to P7: output ports on PLL device

P3 must be programmed with 0 since the address voltage is applied at this combined input/output port.

Telegram examples (WRITE mode)

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	CB1	ACK	CB2	ACK	Stop

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	DIV1	ACK	Stop

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	Stop

Start	ADD	ACK	CB1	ACK	CB2	ACK	Stop

Start	ADD	ACK	CB1	ACK	CB2	ACK	DIV1	ACK	Stop

Start = start condition
ADD = address
ACK = acknowledge
DIV1 = divider ratio byte 1
DIV2 = divider ratio byte 2
CB1 = control byte 1
CB2 = control byte 2
Stop = stop condition

Logic diagram (READ mode, $R/\overline{W} = 1$)

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	$R/\overline{W}$
Status byte	POR	FL	I2	I1	I0	A2	A1	A0

FL indicates when the tuning loop of the PLL to be in lock. The loop must be phase-locked for at least 8 periods of the internal 7.8125 kHz reference frequency (i.e. 1 ms) before the FL flag is set to logic 1.

POR (power on reset) is internally set to logic 1 if the PLL voltage drops below 3 V. The POR bit is reset when an end-of-data is detected by the PLL IC.

I0 to I2 and A0 to A2 do not contain any relevant data for the tuner application and can be ignored.

Telegram examples (READ mode)

Start	ADD	ACK	STB	ACK	STB		Stop	⇒ from processor

no Acknowledge = end-of-data

Start	ADD	ACK	STB		Stop	⇒ from PLL

Start = Start condition
ADD = Address
ACK = Acknowledge
STB = Status byte
Stop = Stop condition

ADDITIONAL INFORMATION

RF AGC setting

The RF AGC must be set such that the IF output level of the tuner (with IF load as stated) does not exceed 107 dB/μV.

IF injection

An IF signal from a generator (internal resistance 50 Ω or 75 Ω) should be connected to the IF injection point TP, accessible through a hole in the cover (see Fig.1) using probe 3139 147 10950.

Tuning supply voltage

A tuning voltage of 33 V must be connected via a series 22 kΩ resistor to pin 11. A preferred method is constant current supply of 1 to 1.5 mA to the pin. Figure 4 shows this with a 140 V supply. The zener diode prevents the voltage at pin 11 exceeding 33 V.

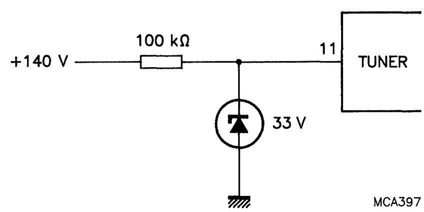


Fig.4 Constant current supply.

UHF/VHF TELEVISION TUNERS

QUICK REFERENCE DATA

System	CCIR system I
Channels (South African channel distribution)	
low band	SA4 to SA13
high band	E21 to E69
Intermediate frequencies	
picture	38.9 MHz
sound	32.9 MHz

APPLICATION

The UV973/974 tuners belong to the 900 series of small size tuners which are designed to meet a wide range of applications.

The UV974 is equipped with a built-in digital controlled (I^2C) PLL tuning IC. Band switching is also carried out via the I^2C-bus. The UV973 types are intended for voltage controlled tuning and do not have the PLL synthesizer.

The tuner IF output is designed with a low output impedance to directly drive a variety of SAW filters.

The tuners comply with the radiation, signal handling and immunity requirements of the South African Bureau of Standards (SABS).

Table 1 Available versions

type	aerial connector	tuning method	catalogue number
UV973	phono	0.3 V – 28 V	3139 147 10911
UV973/IEC	IEC (18.5 mm)	0.3 V – 28 V	–
UV974	phono	PLL/I^2C	3139 147 10931
UV974/IEC	IEC (18.5 mm)	PLL/I^2C	–

DESCRIPTION

The UV973/974 tuners are combined VHF/UHF units covering the low band (frequency range 175.25 to 247.43 MHz) and the high band (frequency range 471.25 to 855.25 MHz).

Selectivity in both low and high bands is provided by means of a tuned antenna circuit and a double tuned bandpass filter separated by a MOSFET RF amplifier.

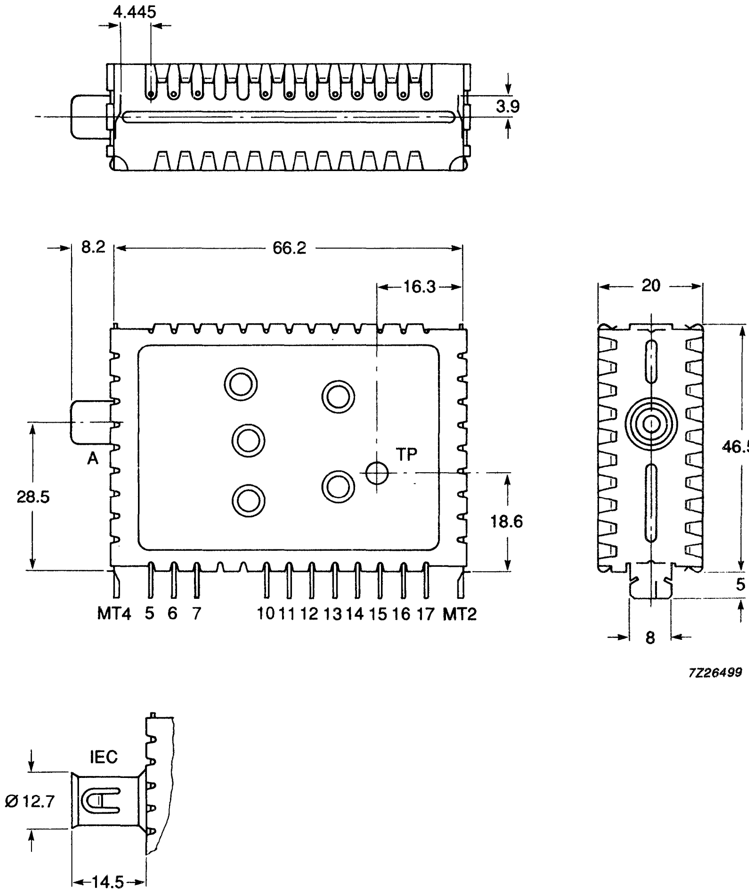
The mixers and oscillators in both bands are constructed using bipolar transistors in common base mode. An IF bandpass filter is provided between the mixers and the final IF amplifier.

The output impedance at the tuner IF terminal is approximately 90 Ω to ensure sufficient triple transient suppression in the SAW filter.

The UV974 tuners contain an I^2C-bus controlled Phase-locked-loop tuning system enabling direct channel access with crystal controlled accuracy. Band switching is also carried out via the I^2C-bus.

MECHANICAL DATA

Dimensions in mm



DEVELOPMENT DATA

	UV973	UV974
A	aerial input	aerial input
5	AGC voltage 9.2 to 0.85 V	AGC voltage 9.2 to 0.85 V
6	supply voltage + 12 V	supply voltage + 12 V
7	VHF switch input	
10	UHF switch input	
11	tuning voltage 0.3 to 28 V	tuning supply voltage (33 V via 22 kΩ series resistor)
12		supply voltage PLL + 5 V
13		SCL serial clock line
14		SDA serial data line
15		address selection input
16	ground	ground
17	IF output	IF output
MT1	mounting tab grounded	mounting tab grounded
MT2	mounting tab grounded	mounting tab grounded

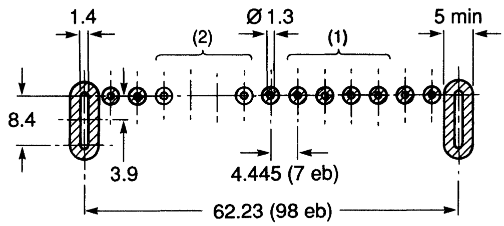
Fig.1 Mechanical detail.

Mass: approximately 55 grams

Mounting

The tuner may be mounted by soldering it to a printed-wiring board, using the piercing diagram shown in Fig.2 without clearance between the tuner supporting surface and the board. The connecting pins and mounting tabs should be bent in accordance with Fig.3.
The tuner may be mounted anywhere in the receiver and there are no restrictions on orientation.

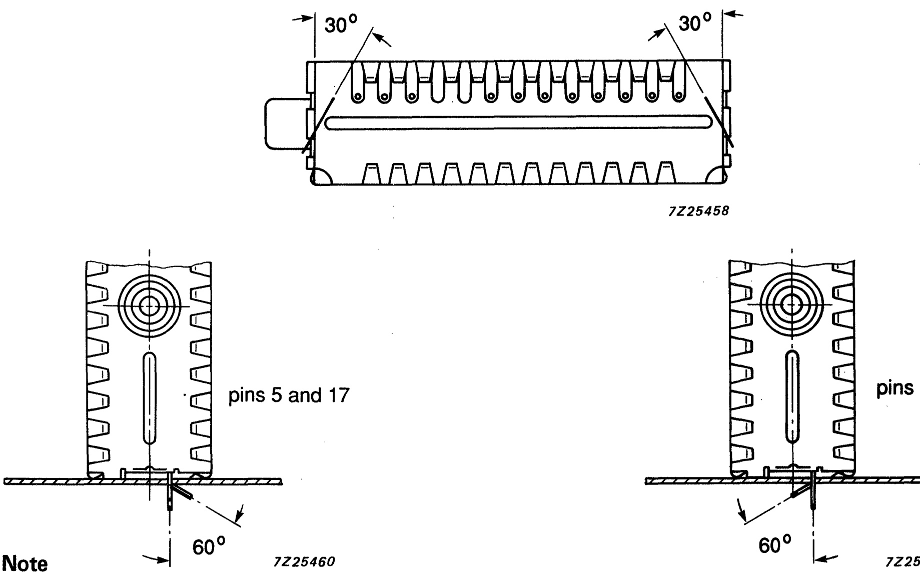
The solderability of the pins and mounting tabs is in accordance with IEC 68-2, test Ta (230 ± 10 °C, 2 ± 0.5 s). The resistance to soldering heat is in accordance with IEC 68-2, test Tb (260 ± 5 °C, 10 ± 1 s).



(1) UV974 types only
(2) UV973 types only

1 eb = 0.025 inch.

Fig.2 Piercing diagram viewed from solder side of board.



Note

In order to prevent any stress to the printed-wiring board, the tuner should be supported at its aerial connector.

Fig.3 Bending of connecting pins and mounting tabs.

ELECTRICAL DATA

Unless otherwise specified all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0.3 V, an AGC voltage of 9.2 ± 0.2 V, a PLL supply voltage of 5 ± 0.3 V and a tuning supply voltage of 33 ± 0.5 V via a 22 kΩ series resistor.

General

Semiconductors, low band	
RF amplifier	BF998R
mixer	BFS17
oscillator	2SC3545
tuning diodes	OF643
coupling diodes	BB901
Semiconductors, high band	
RF amplifier	BF998R
mixer	2SC3841
oscillator	2SC3845
tuning diodes	OF643
IF amplifier	BFS17
Tuning/bandswitching IC (UV974 types only)	SP5510 or TSA5510
Tuning voltage transistor (UV974 types only)	BC847B
Ambient temperature range	
operating	−10 °C to + 60 °C
storage	−25 °C to + 85 °C
Relative humidity	max. 95%

Voltages and currents

Supply voltage	+ 12 V ± 10%
PLL supply voltage (UV974 only)	+ 5 V ± 10%
Current drawn	
supply current	max. 50 mA
PLL current	max. 55 mA
Tuning supply voltage (UV974 only)*	min. 30 V typ. 33 V max. 35 V
Tuning supply voltage (UV973 only)	0.3 to 28 V
Tuning supply current	max. 1.7 mA
Bandswitching voltage (UV973 types only)	+ 12 V ± 10%
Bandswitching current (UV973 types only)	max. 2 mA

DEVELOPMENT DATA

* Via 22 kΩ series resistor.

Aerial input characteristics

VSWR referred to 75 Ω impedance	
low band	max. 5
high band	max. 5
Reflection coefficient referred to 75 Ω impedance	
low band	max. 66%
high band	max. 66%
Surge protection	up to 5 kV
Oscillator voltage at aerial terminal	
< 860 MHz	max. 46 dB/μV
860 – 1000 MHz	max. 46 dB/μV

IF output characteristics

IF output impedance (between pins 17 and 16 (ground))	90 Ω
Permitted IF load impedance	min. 1 kΩ max. 22 pF

Frequency range

Low band	channel SA4 (picture carrier 175.25 MHz) to channel SA13 (picture carrier 247.43 MHz). Margin at extreme channels: min. 3 MHz.
High band	channel E21 (picture carrier 471.25 MHz) to channel E69 (picture carrier 855.25 MHz). Margin at extreme channels: min. 3 MHz.

Wanted signal characteristics

Voltage gain	
all channels	min. 38 dB max. 50 dB
gain difference of off-air channels	max. 8 dB
Noise figure	
low band	max. 7 dB
mid band	max. 9 dB
AGC range	
low band	min. 40 dB
high band	min. 30 dB

DEVELOPMENT DATA

Overloading	
input signal producing a gain compression of 1 dB	min. 74 dB/μV
input signal producing oscillator detuning of + 300/−1000 kHz	
low band	min. 90 dB/μV
high band	min. 80 dB/μV
input signal causing the PLL to fail to lock to desired signal	
low band	min. 90 dB/μV typ. 100 dB/μV
high band	min. 90 dB/μV typ. 100 dB/μV
Image rejection (between 0 and 10 dB gain reduction)	
low band	typ. 65 dB
high band	typ. 55 dB
IF rejection	
all channels	min. 60 dB typ. 70 dB

Amplitude response curves

Tilt of overall response

At any channel the amplitude differences between:

Off-air channels	
top of response curve and picture	max. 4 dB
top of response curve and sound carrier	min. 0.5 dB max. 6 dB
valley	max. 1 dB
sound carrier above picture carrier	max. 3 dB
IF response	
Amplitude difference between:	
top of response curve and picture carrier	max. 1 dB
top of response curve and sound carrier	max. 1 dB

Unwanted signal characteristics

Break through susceptibility — min. 60 dB/μV

Cross modulation

The undesired carrier level required to produce 1% transfer of its modulation onto the desired carrier shall be equal to or exceed the desired carrier level (60 dB/μV at nominal gain) for all gain values between maximum gain and 40 dB (low band) or 30 dB (high band) reduction or be:

In channel low band	min. 66 dB/μV
In channel high band	min. 66 dB/μV
In band N ± 3 low band	min. 78 dB/μV
In band N ± 5 high band	min. 82 dB/μV
Out of band	typ. 100 dB/μV
FM rejection	
at channel 6 (90.5 MHz, antenna level 60 dB/μV)	min. 50 dB
at channel 6 (93 to 108 MHz, antenna level 90 dB/μV)	min. 50 dB

Oscillator characteristics (UV973 only)

Drift of oscillator frequency

Warm up (tuner on-off, bandswitching)	
low band	max. 250 kHz
high band, up to channel 69	max. 250 kHz
high band, channel 70 to 83	max. 500 kHz
Change of ambient temperature 25 ± 25 °C	
low band	max. 500 kHz
high band	max. 1000 kHz
Change of humidity 60% to 93% ± 2%	
low band	max. 500 kHz
high band, up to channel 69	max. 1000 kHz
high band, channels 70 to 83	max. 1500 kHz
Shift of oscillator frequency at a change of supply voltage of 5%	
low band	max. 250 kHz
mid and high bands	max. 500 kHz
during AGC	max. 150 kHz
Pulling (10 kHz)	min. 74 dB/μV

PLL tuning characteristics (UV974 only)

PLL tuning resolution	max. 62.5 kHz
Deviation from nominal of the locked oscillator frequency under any combination of the operation conditions	50^{-6}

Miscellaneous

Radio interference

When the tuner is mounted in a television chassis in such a way as to reduce chassis radiation to a minimum, radiated signal shall be:

channels 2 to 6	max. 50 μV/m
channels 7 to 13	max. 150 μV/m
channels 14 to 69 any single frequency	max. 750 μV/m
average of any 10 individual frequencies	max. 350 μV/m

Microphonics

With the tuner exposed to sound signals in the audio frequency range 100 Hz to 10 kHz and sound pressure levels up to 105 dB (20 μPa), the video signal to sound interference ratio will be: min. 40 dB

Oscillator voltage at the pins	
supply and control pins	max. 60 dB/μV
IF pins - low band	max. 85 dB/μV
IF pins - high band	max. 80 dB/μV

ESD protection at the pins
All pins of the tuner are protected against electrostatic discharge up to 2 kV.

The product is classified in category B (MIL-STD-883C).

DEVELOPMENT DATA

APPLICATION INFORMATION

For information regarding general aspects of I^2C-bus control refer to:
" The I^2C bus specification", published by Philips Components.

I^2C-bus requirements (SDA and SCL pins)

$V_{IL(max)}$ = 1.5 V (maximum input LOW voltage)
$V_{IH(min)}$ = 3.0 V (minimum input HIGH voltage)
$I_{IL(max)}$ = −10 μA (maximum LOW input current)
$I_{IH(max)}$ = 10 μA (maximum HIGH input current)
$V_{OL(max)}$ = 0.4 V (maximum output LOW voltage at 3 mA sink current)

Logic diagram (WRITE mode, R/$\overline{W}$ = 0)

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	R/$\overline{W}$
Prog. div. byte 1	0	n14	n13	n12	n11	n10	n9	n8
Prog. div. byte 2	n7	n6	n5	n4	n3	n2	n1	n0
Control byte 1	1	5I	T1	T0	1	1	1	0
Control byte 2	P7	P6	P5	P4	P3	P2	P1	P0

Address selection

MA1	MA0	Address	Voltage at pin 15
0	0	C0	0 to 0.1 V PLL
0	1	C2	irrelevant*
1	0	C4	0.4 to 0.6 V PLL
1	1	C6	0.9 V PLL to 13.5 V

The UV974 types have pin 15 (address input) biased internally using a 47 kΩ resistor to B+ (+ 12 V). Therefore, with pin 15 open circuit, the tuner will respond to address C0 and C6.

* The tuner will always respond to address C2. The second address will depend on the voltage applied at pin 15.

Programmable divider setting (bytes 1 and 2)

Divider ratio: $N = 16 \times (f_{rf}, pc\ (MHz) + f_{if}, pc\ (MHz))$

$f_{osc} = N/16\ (MHz)$.

$N = 16384 \times n14 + 8192 \times n13 + 4096 \times n12 + 2048 \times n11 + 1024 \times n10 + 512 \times n9 + 256 \times n8 + 128 \times n7 + 64 \times n6 + 32 \times n5 + 16 \times n4 + 8 \times n3 + 4 \times n2 + 2 \times n1 + n0$

Control byte 1

Charge pump (CP) setting: CP can be set to either logic 0 (low current) or logic 1 (high current). CP = 1 results in faster tuning, CP = 0 in moderate tuning speed with slightly better residual oscillator FM.

Test mode setting: T1, T0 = 0 for normal operation.

PLL disabling: OS = 0 for normal operation.
OS = 1 switches the charge pump transistor to the non-conducting state, enabling the tuner to be manually tuned by applying a variable tuning voltage to pin 11. When selecting OS to logic 1 it is recommended to simultaneously set T0 to logic 1.

Control byte 2

Bandswitching

	P0	P1	P2	P3	P4	P5	P6	P7
low band	x	x	x	0	0	1	1	0
mid band	x	x	x	0	1	0	1	0
high band	x	x	x	0	1	1	0	0

x = don't care
P0 to P7: output ports on PLL device

P3 must be programmed with 0 since the address voltage is applied at this combined input/output port.

Telegram examples (WRITE mode)

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	CB1	ACK	CB2	ACK	Stop

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	DIV1	ACK	Stop

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	Stop

Start	ADD	ACK	CB1	ACK	CB2	ACK	Stop

Start	ADD	ACK	CB1	ACK	CB2	ACK	DIV1	ACK	Stop

Start = start condition
ADD = address
ACK = acknowledge
DIV1 = divider ratio byte 1
DIV2 = divider ratio byte 2
CB1 = control byte 1
CB2 = control byte 2
Stop = stop condition

Logic diagram (READ mode, R/$\overline{W}$ = 1)

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	R/$\overline{W}$
Status byte	POR	FL	I2	I1	I0	A2	A1	A0

FL indicates when the tuning loop of the PLL to be in lock. The loop must be phase-locked for at least 8 periods of the internal 7.8125 kHz reference frequency (i.e. 1 ms) before the FL flag is set to logic 1.

POR (power on reset) is internally set to logic 1 if the PLL voltage drops below 3 V. The POR bit is reset when an end-of-data is detected by the PLL IC.

I0 to I2 and A0 to A2 do not contain any relevant data for the tuner application and can be ignored.

Telegram examples (READ mode)

Start	ADD	ACK	STB	ACK	STB		Stop	⇒ from processor

no Acknowledge = end-of-data

Start	ADD	ACK	STB		Stop	⇒ from PLL

Start = Start condition
ADD = Address
ACK = Acknowledge
STB = Status byte
Stop = Stop condition

ADDITIONAL INFORMATION

RF AGC setting

The RF AGC must be set such that the IF output level of the tuner (with IF load as stated) does not exceed 107 dB/μV.

IF injection

An IF signal from a generator (internal resistance 50 Ω or 75 Ω) should be connected to the IF injection point TP, accessible through a hole in the cover (see Fig.1) using probe 3139 147 10950.

Tuning supply voltage

A tuning voltage of 33 V must be connected via a series 22 kΩ resistor to pin 11. A preferred method is constant current supply of 1 to 1.5 mA to the pin. Figure 4 shows this with a 140 V supply. The zener diode prevents the voltage at pin 11 exceeding 33 V.

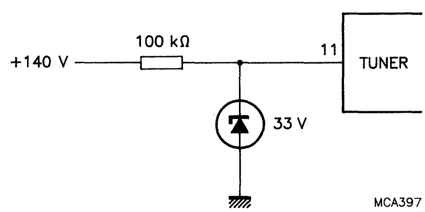


Fig.4 Constant current supply.

UHF/VHF TELEVISION TUNERS

QUICK REFERENCE DATA

Systems	Japanese system M
Channels	
low band	J1 to J3
mid band	J4 to J12
high band	J13 to J62
Intermediate frequencies	
vision	58.75 MHz
sound	54.25 MHz

APPLICATION

The UV983/984 tuners belong to the 900 family of small size tuners which are designed to meet a wide range of applications.

The tuners are available with separate UHF and VHF inputs (75 Ω phono for VHF, 300 Ω balanced for UHF) or with a combined, single 75 Ω input (phono or IEC).

The UV984 is equipped with a built-in digital controlled (I^2C) PLL tuning IC. Band switching is also carried out via the I^2C-bus. The UV983 types are intended for voltage controlled tuning and do not have the PLL synthesizer.

The tuner IF output is designed with low output impedance to directly drive a variety of SAW filters.

Table 1 Available types

type	aerial input connector	tuning system	catalogue number
UV983	75 Ω phono	0.3 - 28 V	
UV983/D	75 Ω phono/300 Ω balanced	0.3 - 28 V	
UV984	75 Ω phono	PLL/I^2C	
UV984/D	75 Ω phono/300 Ω balanced	PLL/I^2C	

DESCRIPTION

The UV983/984 tuners are combined VHF/UHF units covering the low band (frequency range 91.25 to 103.25 MHz), the mid band (frequency range 171.25 to 217.25 MHz) and the high band (frequency range 471.25 to 765.25 MHz).

The tuners are built on a low-loss printed-wiring board carrying all components and a small vertical printed-wiring board carrying the PLL tuning system components for the UV984. The boards are housed in a sheet steel housing with separated front and rear covers. The aerial connector (phono, IEC or balanced) is mounted on one side of the frame.

High selectivity is achieved in both low and high bands by means of a tuned aerial circuit and a double tuned bandpass filter separated by a MOSFET RF amplifier.

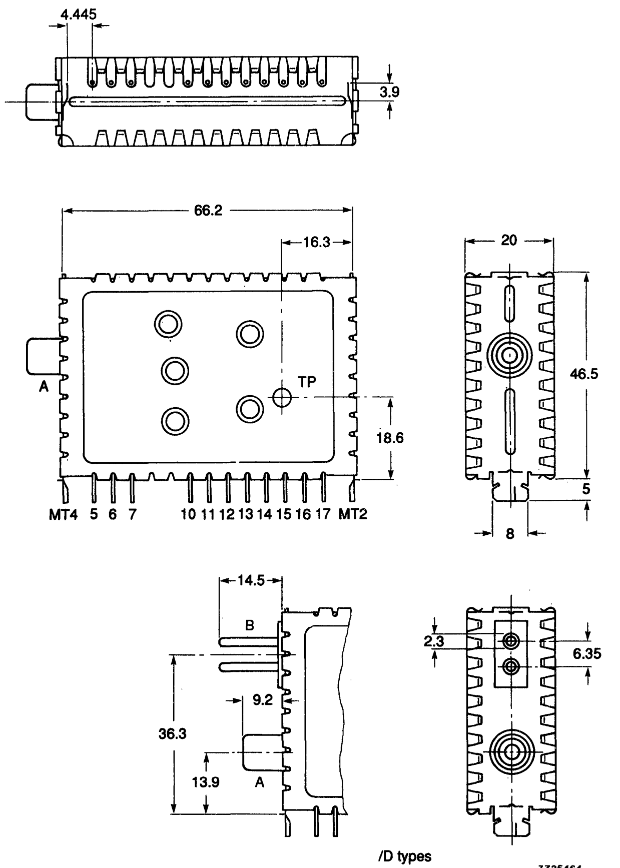
An FM bandstop filter, an IF rejection filter and a combined high-pass/CB rejection filter precede the low band section. The mixers and oscillators in both bands are built using bipolar transistors in common-base configuration.

An IF bandpass filter is present between the mixers and the final IF amplifier. The output impedance at the IF output pin is approximately 90 Ω to ensure adequate triple transient suppression in the SAW filter.

The UV984 tuners contains an I^2C-bus controlled phase-locked-loop tuning system enabling direct channel access with crystal controlled accuracy.

MECHANICAL DESCRIPTION

Dimensions in mm



	UV983	UV984
A	aerial input	aerial input
B	balanced UHF input (/D types only)	balanced UHF input (/D types only)
5	AGC voltage 9.2 to 0.85 V	AGC voltage 9.2 to 0.85 V
6	supply voltage + 12 V	supply voltage + 12 V
7	VHF switch input (UV983 versions only)	
10	UHF switch input	
11	tuning voltage 0.3 to 28 V	tuning supply voltage (33 V via 22 kΩ series resistor)
12		supply voltage PLL + 5 V
13		SCL serial clock line
14		SDA serial data line
15		address selection input
16	ground	ground
17	IF output	IF output
MT1	mounting tab grounded	mounting tab grounded
MT2	mounting tab grounded	mounting tab grounded

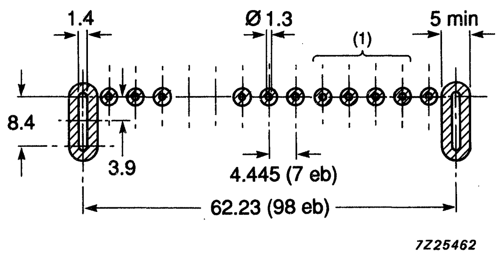
Fig.1 Mechanical detail.

Mass: approximately 55 grams

Mounting

The tuner may be mounted by soldering it to a printed-wiring board, using the piercing diagram shown in Fig.2 without clearance between the tuner supporting surface and the board. The connecting pins and mounting tabs should be bent in accordance with Fig.3.
The tuner may be mounted anywhere in the receiver and there are no restrictions on orientation.

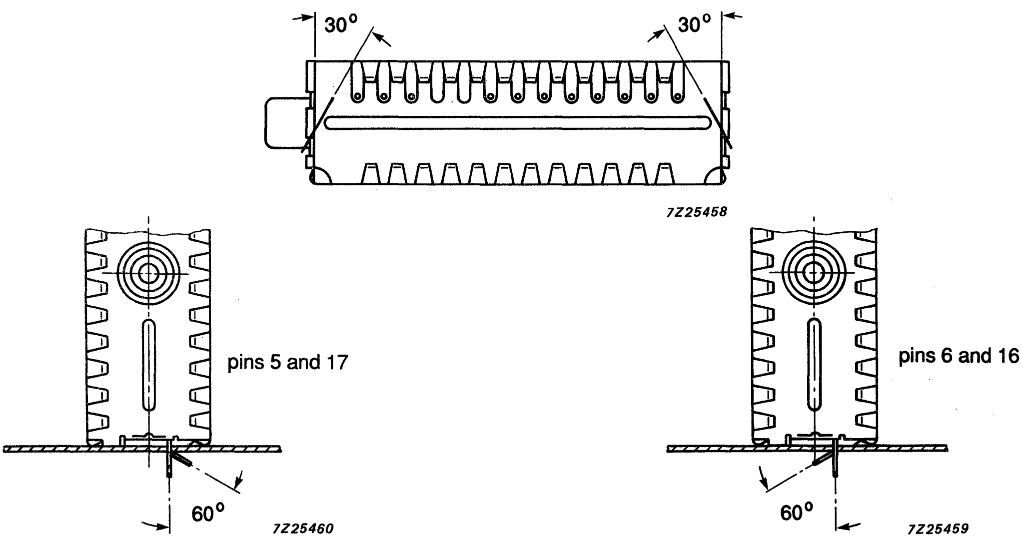
The solderability of the pins and mounting tabs is in accordance with IEC 68-2, test Ta (230 ± 10 °C, 2 ± 0.5 s). The resistance to soldering heat is in accordance with IEC 68-2, test Tb (260 ± 5 °C, 10 ± 1 s).



(1) UV984 types only

1 eb = 0.025 inch.

Fig.2 Piercing diagram viewed from solder side of board.



Note

In order to prevent any stress to the printed-wiring board, the tuner should be supported at its aerial connector.

Fig.3 Bending of connecting pins and mounting tabs.

ELECTRICAL DATA

Unless otherwise specified all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0.3 V, an AGC voltage of 9.2 ± 0.2 V, a PLL supply voltage of 5 ± 0.3 V and a tuning supply voltage of 33 ± 0.5 V via a 22 kΩ series resistor.

General

Semiconductors, low band	
RF amplifier	BF998
mixer	BFS17
oscillator	BFSS17A
tuning diodes	OF4052
coupling diodes	BB901
Semiconductors, high band	
RF amplifier	BF900A/01
mixer	2SC3841
oscillator	ON4438
tuning diodes	OF643
IF amplifier	BFS17
Tuning/bandswitching IC (UV984 types only)	SP5510 or TSA5510
Tuning voltage transistor (UV984 types only)	BC847B
Ambient temperature range	
operating	−10 °C to + 60 °C
storage	−25 °C to + 85 °C
Relative humidity	max. 95%

Voltages and current

Supply voltage	+ 12 V ± 10%
PLL supply voltage (UV984 only)	+ 5 V ± 10%
Current drawn	
supply current	max. 50 mA
PLL current	max. 55 mA
Tuning supply voltage	min. 30 V typ. 33 V max. 35 V
Tuning supply current	max. 1.7 mA
Bandswitching voltage (UV983 types only)	+ 12 V ± 10%
Bandswitching current (UV983 types only)	max. 2 mA

Aerial input characteristics

VSWR referred to 75 Ω/300 Ω impedance	
low band	max. 5
high band	max. 5
Reflection coefficient referred to 75 Ω/300 Ω impedance	
low band	max. 66%
high band	max. 66%
Surge protection	min. 6 kV
Oscillator voltage at aerial terminal	
54 - 300 MHz	max. 50 dB/μV
300 - 1000 MHz	max. 66 dB/μV
Unbalance of 300 Ω aerial terminal (D versions only)	
all channels	min. 10 dB

IF output characteristics

IF output impedance (between pins 17 and 16 (ground)	90 Ω
Permitted IF load impedance	min. 1 kΩ max. 22 pF

Frequency range

Low band	channel J1 (picture carrier 91.25 MHz) to channel J3 (picture carrier 103.25 MHz). Margin at extreme channels: min. 1 MHz.
Mid band	channel J4 (picture carrier 171.25 MHz) to channel J12 (picture carrier 217.25 MHz). Margin at extreme channels: min. 1 MHz.
High band	channel J13 (picture carrier 471.25 MHz) to channel J62 (picture carrier 765.25 MHz). Margin at extreme channels: min. 1 MHz.

Wanted signal characteristics

Voltage gain	
all channels	min. 40 dB max. 50 dB
gain difference of channels	max. 8 dB
Noise figure	
low and mid bands	max. 7 dB
high band	max. 10 dB
AGC range	
low band	min. 45 dB
high band	min. 30 dB

Overloading	
input signal producing a gain compression of 1 dB	min. 74 dB/μV
input signal producing oscillator detuning of + 300/−1000 kHz	
low band	min. 90 dB/μV
high band	min. 80 dB/μV
input signal causing the PLL to fail to lock to desired signal	
low band	min. 90 dB/μV typ. 100 dB/μV
high band	min. 90 dB/μV typ. 100 dB/μV
Image rejection (between 0 and 10 dB gain reduction)	
low and mid bands	min. 60 dB
high band	min. 50 dB
IF rejection	
low and mid bands	min. 55 dB
high band	min. 60 dB

Amplitude response curves

Tilt of overall response

At any channel the amplitude differences between:

Off-air channels	
top of response curve and picture	max. 4 dB
top of response curve and sound carrier	min. 0.5 dB max. 6 dB
valley	max. 1 dB
sound carrier above picture carrier	max. 3 dB

IF response

Amplitude difference between:

top of response curve and picture carrier	max. 1 dB
top of response curve and sound carrier	max. 1 dB

Unwanted signal characteristics

Break through susceptibility	min. 60 dB/μV

Cross modulation

The undesired carrier level required to produce 1% transfer of its modulation onto the desired carrier shall be equal to or exceed the desired carrier level (60 dB/μV at nominal gain) for all gain values between maximum gain and 40 dB (low band) or 30 dB (high band) reduction or be:

In channel	min. 66 dB/μV
In band N ± 2 low and mid bands	min. 78 dB/μV
In band N ± 5 high band	min. 84 dB/μV
Out of band	typ. 100 dB/μV

FM rejection	
at channel 6 (90.5 MHz, antenna level 60 dB/μV)	min. 50 dB
at channel 6 (93 to 108 MHz, antenna level 90 dB/μV)	min. 50 dB

Oscillator characteristics (UV983 types only)

Drift of oscillator frequency	
Warm up (tuner on-off, bandswitching)	
low and mid band	max. 250 kHz
high band, up to channel 69	max. 250 kHz
Change of ambient temperature 25 ± 25 °C	
low and mid bands	max. 500 kHz
high band	max. 1000 kHz
Change of humidity 60% to 93% ± 2%	
low band	max. 500 kHz
high band, up to channel 69	max. 1000 kHz
high band, channels 70 to 83	max. 1500 kHz
Shift of oscillator frequency at a change of supply voltage of 5%	
low and mid bands	max. 250 kHz
high band	max. 500 kHz
during AGC	max. 150 kHz
Pulling (10 kHz)	min. 74 dB/μV

PLL tuning characteristics (UV984 types only)

PLL tuning resolution	max. 62.5 kHz
Deviation from nominal of the locked oscillator frequency under any combination of the operation conditions	50×10^{-6}

Miscellaneous

Radio interference

When the tuner is mounted in a television chassis in such a way as to reduce chassis radiation to a minimum, the radiated signal shall be:

channels 2 to 6	max. 50 μV/m
channels 7 to 13	max. 150 μV/m
channels 14 to 69 any single frequency	max. 750 μV/m
average of any 10 individual frequencies	max. 350 μV/m

Microphonics

With the tuner exposed to sound signals in the audio frequency range 100 Hz to 10 kHz and sound pressure levels up to 105 dB (20 μPa), the video signal to sound interference ratio will be:

min. 40 dB

Oscillator voltage at the pins

supply and control pins	max. 60 dB/μV
IF pins - low band	max. 85 dB/μV
IF pins - high band	max. 80 dB/μV

ESD protection at the pins
All pins of the tuner are protected against electrostatic discharge up to 2 kV.

The product is classified in category B (MIL-STD-883C).

APPLICATION INFORMATION

For information regarding general aspects of I^2C-bus control refer to:
" The I^2C bus specification", published by Philips Components.

I^2C-bus requirements (SDA and SCL pins)

$V_{IL(max)}$ = 1.5 V (maximum input LOW voltage
$V_{IH(min)}$ = 3.0 V (minimum input HIGH voltage)
$I_{IL(max)}$ = −10 μA (maximum LOW input current)
$I_{IH(max)}$ = 10 μA (maximum HIGH input current)
$V_{OL(max)}$ = 0.4 V (maximum output LOW voltage at 3 mA sink current)

Logic diagram (WRITE mode R/$\overline{W}$ = 0)

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	R/$\overline{W}$
Prog. div. byte 1	0	n14	n13	n12	n11	n10	n9	n8
Prog. div. byte 2	n2	n6	n5	n4	n3	n2	n1	n0
Control byte 1	1	5I	T1	T0	1	1	1	0
Control byte 2	P7	P6	P5	P4	P3	P2	P1	P0

Address selection

MA1	MA0	Address	Voltage at pin 15
0	0	C0	0 to 0.1 V PLL
0	1	C2	irrelevant*
1	0	C4	0.4 to 0.6 V PLL
1	1	C6	0.9 V PLL to 13.5 V

The UV984 types have pin 15 (address input) biased internally using a 47 kΩ resistor to B+ (+ 12 V). Therefore, with pin 15 open circuit, the tuner will respond to address C2 and C6.

* The tuner will always respond to address C2. The second address will depend on the voltage applied at pin 15.

Programmable divider setting (bytes 1 and 2)

Divider ratio: $N = 16 \times (f_{rf}, \text{pc (MHz)} + f_{if}, \text{pc (MHz)})$
$f_{osc} = N/16$ (MHz).

$N = 16384 \times n14 + 8192 \times n13 + 4096 \times n12 + 2048 \times n11 +$
$1024 \times n10 + 512 \times n9 + 256 \times n8 + 128 \times n7 + 64 \times n6 +$
$32 \times n5 + 16 \times n4 + 8 \times n3 + 4 \times n2 + 2 \times n1 + n0$

Control byte 1

Charge pump (CP) setting: CP can be set to either logic 0 (low current) or logic 1 (high current). CP = 1 results in faster tuning, CP = 0 in moderate tuning speed with slightly better residual oscillator FM.

Test mode setting: T1, T0 = 0 for normal operation.

PLL disabling: OS = 0 for normal operation
OS = 1 switches the charge pump transistor to the non-conducting state, enabling the tuner to be manually tuned by applying a variable tuning voltage to pin 11. When selecting OS to logic 1 it is recommended to simultaneously set T0 to logic 1.

Control byte 2

Bandswitching

	P0	P1	P2	P3	P4	P5	P6	P7
low band	x	x	x	0	0	1	1	x
mid band	x	x	x	0	1	0	1	0
high band	x	x	x	0	1	1	0	x

x = don't care
P0 to P7: output ports on PLL device

P3 must be programmed with 0 since the address voltage is applied at this combined input/output port.

Telegram examples (WRITE mode)

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	CB1	ACK	CB2	ACK	Stop

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	DIV1	ACK	Stop

Start	ADD	ACK	DIV1	ACK	DIV2	ACK	Stop

Start	ADD	ACK	CB1	ACK	CB2	ACK	Stop

Start	ADD	ACK	CB1	ACK	CB2	ACK	DIV1	ACK	Stop

Start = start condition
ADD = address
ACK = acknowledge
DIV1 = divider ratio byte 1
DIV2 = divider ratio byte 2
CB1 = control byte
CB2 = control byte 2
Stop = stop condition

Logic diagram (READ mode, R/$\overline{W}$ = 1)

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	R/$\overline{W}$
Status byte	POR	FL	I2	I1	I0	A2	A1	A0

FL indicates when the tuning loop of the PLL to be in lock. The loop must be phase-locked for at least 8 periods of the internal 7.8125 kHz reference frequency (i.e. 1 ms) before the FL flag is set to logic 1.

POR (power on reset) is internally set to logic 1 if the PLL voltage drops below 3 V. The POR bit is reset when an end-of-data is detected by the PLL IC.

I0 to I2 and A0 to A2 do not contain any relevant data for the tuner application and can be ignored.

Telegram examples (READ mode)

Start	ADD	ACK	STB	ACK	STB		Stop	⇒ from processor

no Acknowledge = end-of-data

Start	ADD	ACK	STB		Stop	⇒ from PLL

Start = Start condition
ADD = Address
ACK = Acknowledge
STB = Status byte
Stop = Stop condition

ADDITIONAL INFORMATION

RF AGC setting

The RF AGC must be set such that the IF output level of the tuner (with IF load as stated) does not exceed 107 dB/μV.

IF injection

An IF signal from a generator (internal resistance 50 Ω or 75 Ω) should be connected to the IF injection point TP, accessible through a hole in the cover (see Fig.1) using probe 3139 147 10950.

Tuning supply voltage

A tuning voltage of 33 V must be connected via a series 22 kΩ resistor to pin 11. A preferred method is constant current supply of 1 to 1.5 mA to the pin. Figure 4 shows this with a 140 V supply. The zener diode prevents the voltage at pin 11 exceeding 33 V.

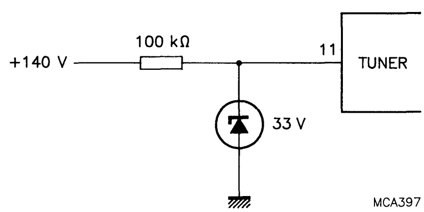


Fig.4 Constant current supply.

SATELLITE FRONT ENDS

QUICK REFERENCE DATA

System	D2-MAC, PAL, SECAM
Frequency band	950 to 1750 MHz
Intermediate frequency (note 1)	479.5 MHz
Channels	1 to 40 in accordance with WARC77

APPLICATION

The SFE212 satellite front ends are designed for reception of satellite signals in the 11.7 to 12.5 GHz band via a down converter. They are a combination of a UHF tuner, frequency range 950 to 1750 MHz, covering the 40 channels defined by the WARC77 frequency allocation, with an IF signal processing unit suitable for the D2-MAC packets system. The unit has a built-in digitally controlled (I^2C) PLL tuning system. This front end is also suitable for processing of PAL and SECAM signals broadcast throughout Europe.

Table 1 Available versions

	AFC	input connector	auxiliary IF output	catalogue number
SFE212S	external analog	IEC female	–	3111 268 5006

These tuners comply with the requirements of radiation, signal handling capability and immunity from radiated interference of Amtsblatt NR164, January 1986 and Amtsblatt vfg 754/1971.

Note

1. The oscillator frequency is higher than the aerial signal frequency.

DESCRIPTION

These satellite front ends are a combination of a UHF tuner with electronic tuning covering the frequency range from 950 to 1750 MHz and a 479.5 MHz IF signal processing unit.

The incoming FM signals are uniformly distributed over 40 channels each in right or left polarization. If channel 'n' is transmitted with left polarization, channel 'n + 1' is transmitted with right polarization. Therefore channels 'n', 'n + 2', 'n + 4' . . ., are transmitted with left polarization and channels 'n + 1', 'n + 3' . . ., with right polarization.

The unit is mounted in a metal housing constructed within a rectangular frame with front and rear covers (see Fig.3). It is equipped with one common IEC type RF female connector (75 Ω) with the possibility of supplying and controlling one down converter or a set up of several down converters via the inner conductors.

The tuner is fitted with a broadband matching network followed by the RF amplifier which is loaded with a two resonator bandpass filter.

The selected signal enters a bipolar mixer driven by a negative resistance oscillator and the converted signal is transferred to the IF unit.

The IF unit includes:

- A selective amplifier with one MOSFET gain controlled stage and two bipolar stages .
- The selectivity which is controlled by two helical filters.
- The IF IC which incorporates the PLL demodulator, the level detector and the loop amplifier.
- The AFC interface and a low ohmic output impedance video amplifier.

The unit is controlled via the I^2C-bus by a synthesiser tuning IC located in the tuner section.

A version with auxiliary IF output is available on request.

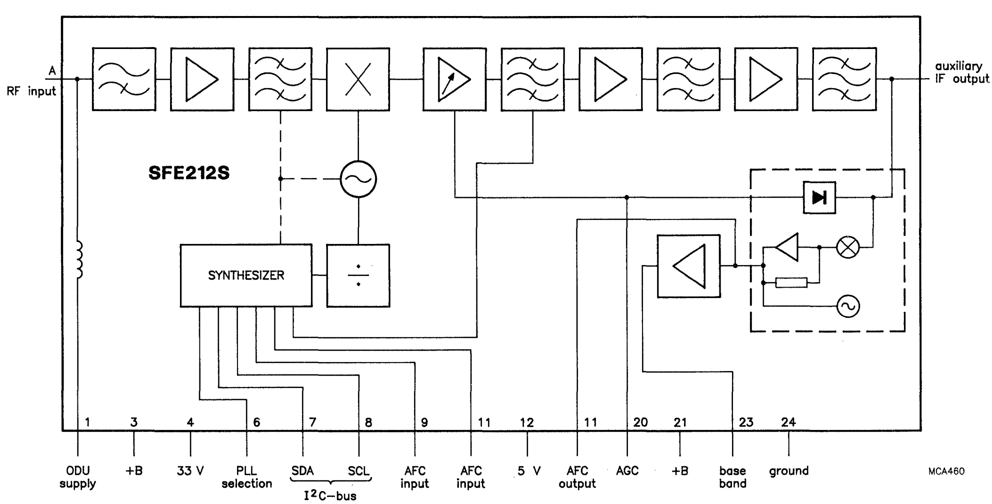


Fig.2 SFE212S block diagram.

MECHANICAL DATA

Dimensions in mm

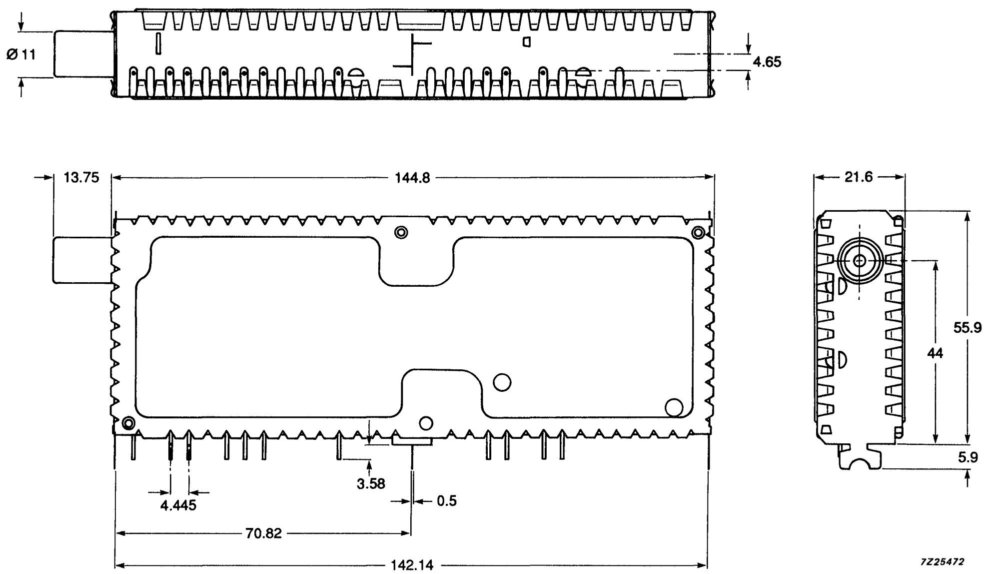


Fig. 3 Mechanical detail.

Pin/connector identity

A	Aerial input	
1	Outdoor unit supply	
3	Tuner supply voltage	12 V
4	Tuning voltage	33 V via 22 kΩ series resistor
6	PLL selection	
7	SDA serial data line	I^2C-bus
8	SCL serial clock line	I^2C-bus
9	AFC input (SFE212S & SFE212S/A only)	
11	AFC input (SFE212S & SFE212S/A only)	
12	PLL and prescaler supply voltage	5 V
19	AFC output (SFE212S & SFE212S/A only)	
20	IF AGC output	
21	IF supply voltage	12 V
23	Baseband output	
24	Ground	
MT1, MT2, MT3	Mounting tab grounded	

Mass: approx. 140 grams

Mounting

The unit may be mounted by soldering it on to a printed-wiring board using the piercing diagram shown in Fig.4. The connection pins should be bent in accordance with Fig.5. The unit may be mounted anywhere in the receiver and there are no restrictions on orientation.

The solderability of the pins and mounting tabs is in accordance with IEC 68-2-20, test Ta (230 ± 10 °C, 2 ± 0.5 s). The resistance to soldering heat is in accordance with IEC 68-2-20, test Tb (260 ± 5 °C, 10 ± 1 s).

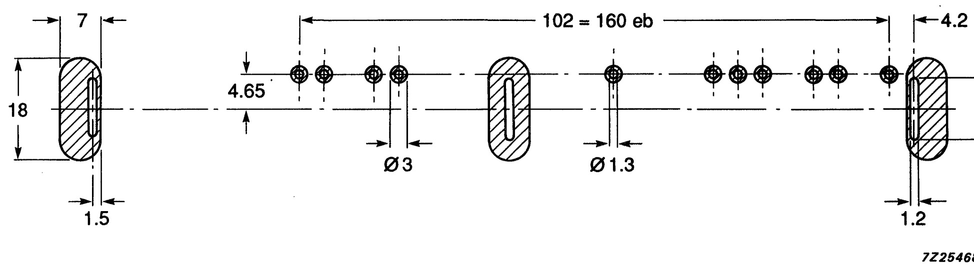


Fig.4 Piercing diagram viewed from solder side of board.

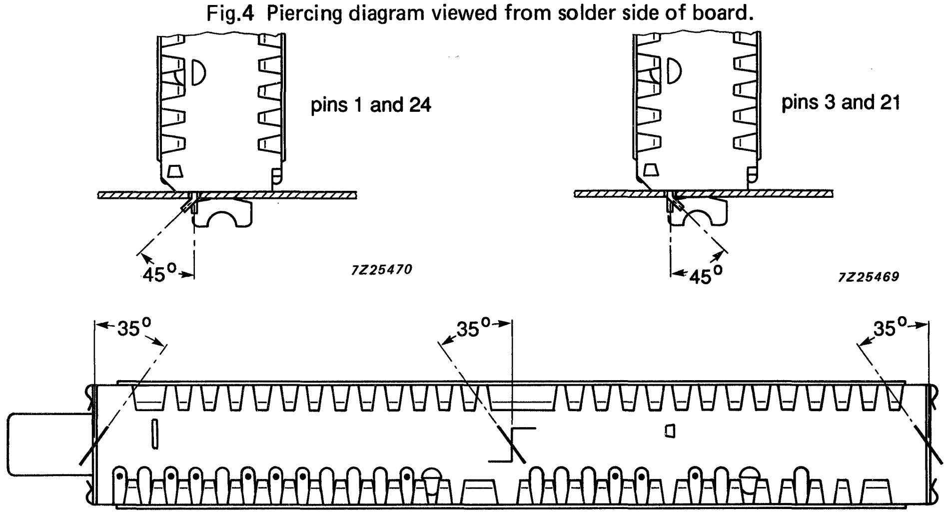


Fig.5 Bending of connecting pins and mounting tags.

Note:

In order to prevent any stress to the printed-wiring board, the tuner should be supported at its aerial connector.

ELECTRICAL DATA

Unless otherwise specified all electrical values apply at an ambient temperature of 25 ± 5 °C, a relative humidity of 60 ± 15%, a supply voltage of 12 ± 0.3 V, a prescaler and PLL supply voltage of 5 ± 0.2 V and a tuning voltage of 33 ± 0.5 V via a 22 kΩ resistor. The front end is tuned by means of a built in synthesizer. For further information refer to Application information.

General

Semiconductors and ICs	
RF amplifier	BFG67
mixer	BFR92AR
oscillator	BFR93AR
tuning diodes	6 x BB215
PLL tuning IC	TSA5510
frequency divider	SAB8726
IF amplifier	BF998, BFR92A
filter	Helical filter
switching diodes	BA682
demodulator IC	SL1451
Ambient temperature range	
operating	−10 to +60 °C
storage	−25 to +85 °C
Relative humidity	max. 95%

Voltages and currents

Supply voltage (tuner + IF)	12 V ± 10%
Current drawn from +12 V supply (tuner + IF)	max. 210 mA
PLL and prescaler supply voltage	5 V ± 10%
PLL and prescaler supply current	max. 140 mA
Tuning voltage range	33 V (via 22 kΩ) (note 1)
Tuning voltage source impedance	max. 47 kΩ

Note

1. An external pull-up resistor of 22 kΩ ± 5% has to be connected between the tuning supply voltage and terminal 4. The tuning supply current is 1.7 mA max.

Typical performance

Channel	1	20	40	
Tuning voltage	2.6	9.5	22	V
Noise figure	9	9	9	dB
Image rejection	48	39	40	dB
In channel third order intermodulation	77	90	80	dBμV
Baseband output level (note 1)	1	1	1	V
Linearity luminance (note 1)	1.5	1.5	1.5	%
Signal to noise ratio unweighted (C/N 10 dB) (note 1)	25	25	25	dB
Static demodulation threshold (note 1)		6		

Aerial input characteristics

Input impedance	75 Ω

RF input characteristics

In band VSWR referred to 75 Ω	typ. 1.5 max. 2
Return losses	min. 10 dB
RF input level range	min. –65dBm/44 dBμV max. –30dBm/79 dBμV
Oscillator voltage at aerial input (fundamental and harmonics)	
from 40 MHz to 1750 MHz	max. 46 dBμV
from 1750 MHz to 2200 MHz	max. 60 dBμV
Surge protection	max. 5 kV

Baseband output (terminal 23) characteristics

Measuring conditions
unless otherwise specified baseband output characteristics apply to:

RF input level	60 dBμV
C/N	min. 20 dB
Modulation characteristics	
frequency peak to peak deviation	13.5 MHz/V
MAC pre-emphasis	
PAL coded FDM (Frequency Division Multiplex) video signal	
Positive modulation : i.e. the frequency increases from black to white level	
Baseband output load	470 Ω ± 5%

Note

1. Measured with a PAL signal with 13.5 MHz/V deviation and MAC pre-emphasis applied.

Baseband output (terminal 23) characteristics with MAC pre-emphasis

Impedance	typ. 50 Ω
Output load	min. 470 Ω
DC level when correctly tuned (note 1)	min. 5.4 V
	typ. 5.7 V
	max. 6.0 V
Demodulation threshold	typ. C/N = 6 dB
	max. C/N = 7.5 dB
Demodulation non linearity within 10 MHz around 479.5 MHz	max. 2%
Linearity (luminance)	max. 4%
Differential gain	max. 6%
Differential phase	max. 5°
1 dB bandwidth	min. 9 MHz
Group delay inequality luminance - chrominance	max. 25 ns (peak-to-peak)
2 T pulse response	
Amplitude between	95 and 105%
Asymmetry and pulse shape	see Fig.6
2 T pulse width at 50% height of total 2 T amplitude	200 ns ± 10%

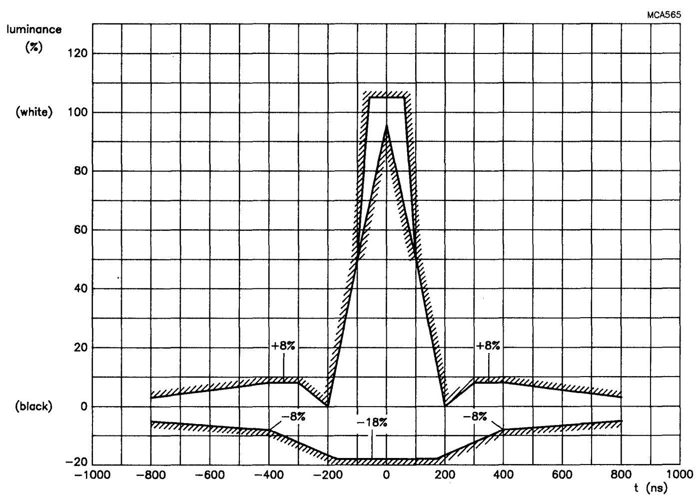


Fig.6 Luminance - chrominance graph.

Line tilt	max. 3%
Signal to noise ratio (unweighted) with 8.5 MHz low pass filter	
for C/N = 30 dB	typ. 45 dB S/N
for C/N = 18 dB	typ. 33 dB S/N
for C/N = 14 dB	typ. 29 dB S/N
for C/N = 10 dB	typ. 25 dB S/N
for C/N = 8 dB	typ. 23 dB S/N

Note

1. With 60 dBμV unmodulated RF signal.

Data signal characteristics

These assessments are carried out with a D2MAC modulated signal (duobinary data rate of 10.125 MHz)

Bit error rate (BER)	
For C/N = 13 dB	typ. 10^{-6}
For C/N = 12 dB	typ. 5.10^{-6}
For C/N = 10 dB	typ. 10^{-4}
For C/N = 8 dB	typ. 10^{-3}
For C/N = 7 dB	typ. 5.10^{-3}

AFC input (terminals 9 and 11) (SFE212S only)

Terminal 9 is connected to port P5 of the TSA5510 PLL tuning IC via an CR cell (100 pF to ground and 100 Ω aerial resistor). Terminal 11 is connected to port P4 of the same IC via a similar CR cell.

AFC output (terminal 19) (SFE212S only)

Output impedance	typ. 1 kΩ
DC voltage when correctly tuned	4.7 ± 0.2 V
Slope detuning	70 mV/MHz

IF AGC output characteristics

Output impedance	typ. 3 kΩ
Output level range with 100 kΩ load	
for 79 dBμV unmodulated input signal	typ. 1.5 V
for 44 dBμV unmodulated input signal	typ. 5 V

IF output characteristics (auxiliary IF output, /A versions only)

Phono connector output	
VSWR referred to 75 Ω	typ. 1.5
	max. 2
Output level	min. 65 dBμV
	typ. 67 dBμV
	max. 69 dBμV
Bandwidth at 3 dB	typ. 27 MHz
in band tilt between top edges 479.5 ± 10 MHz	typ. 3 dB
in band group delay (27 MHz)	typ. 25 ns (peak-to-peak)
Selectivity	
fc − 19.18 MHz	min. 8 dB
fc + 19.18 MHz	min. 8 dB
fc − 38.36 MHz	min. 40 dB
fc + 38.36 MHz	min. 40 dB

PLL selection characteristics — See application information.

Frequency range

Channel 1 (picture carrier 977.48 MHz) to channel 40 (picture carrier 1725.50 MHz). Margin at extreme channels: min. 10 MHz.

Noise figure	max. 15 dB
Image rejection	min. 30 dB
IF rejection	min. 50 dB

In channel 1% third order intermodulation

Excluding channel 1	min. 80 dBμV
For channel 1	min. 74 dBμV

Maximum level difference between any in-band channels

Note: This specification is determined by the broadband intermodulation behaviour of the tuner (channelling fully loaded).

Level difference	max. 12 dB

Out of band intermodulation

For unwanted signals in the 40 to 862 MHz range	min. 44 dBμV

Oscillator characteristics

The oscillator is tuned with 125 kHz pitch.

Instability of the oscillator under any combination of operational conditions	max. 80.10^{-6}
Time required for tuning from channel 1 to channel 40	
charge pump. current 5I	typ. 45 ms
change pump. current I	typ. 210 ms

Miscellaneous

Radio interference	in accordance with Amtsblatt 164/1986 and Amtsblatt vfg 754/1971
Immunity from radiated interference	
immunity in the wanted signal range (950 to 1750 MHz)	*
immunity in the IF range 479.5 ± 10 MHz	*

Immunity from conducted interference

On any channel (desired signal at 60 dBμV) a signal at IF and image frequencies of 60 dBμV, applied to the front end terminals (except optional IF output) will cause no impairment on the video picture.

* Value to be fixed.

Microphonics

For sound signals in the audio frequency range 100 Hz to 10 kHz and sound pressure levels up to 105 dB (20 μPa) the video signal to sound interference ratio will be greater than 40 dB.

Oscillator voltage at terminals in the 950 MHz to 1750 MHz range
supply, control and video output pins max. 60 dBμV

IF voltage at the terminals

ESD protection at the terminals

All terminals of the front end are protected against electrostatic discharge up to 2 kV.

The product is classified in category B (MIL-STD-883C).

* Value to be fixed.

APPLICATION INFORMATION

For further information regarding general aspects of I^2C-bus control refer to:
" The I^2C bus specification ", published by Philips Components.

Logic diagram

Address Byte	S	1	1	0	0	0	MA1	MA2	0	A
Prov. Div. Byte 1		0	n14	n13	n12	n11	n10	n9	n8	A
Prog. Div. Byte 2		n7	n6	n5	n4	n3	n2	n1	n0	A
Control Info. Byte 1		1	CP	TI	TO	1	1	1	0	A
Control Info. Byte 2		P7	P6	P5	P4	P3	P2	P1	P0	A	P

S = Start
A = Acknowledge
P = Stop

Programmable divider setting

Divider ratio: N = 16* [Frf, pc (MHz) + Fif, pc (MHz)]

N = 16384 * n14 + 8192 * n13 + 4096 * n12 + 2048 * n11 + 1024 * n10 + 512 * n9 + 256 * n8 + 128 * n7 + 64 * n6 + 32 * n5 + 16 * n4 + 8 * n3 + 4 * n2 + 2 * n1 + n0

Control info byte 1

TI, TO = 0 (normal setting)

Address selection

MA1	MA0	voltage at terminal 6
0	0	0 . . . 0.1 V PLL
0	1	don't care (general address)
1	0	0.4 . . . 0.6 V PLL
1	1	0.9 . . . 1.1 V PLL

Telegram examples

Start – Adr – TV2 – TV1 – ST1 – ST2 – Stop
Start – Adr – ST1 – ST2 – TV1 – TV2 – Stop
Start – Adr – TV1 – TV2 – ST1 – Stop
Start – Adr – TV1 – TV2 – Stop

Start = start condition
Adr = addressing
TV1 = divider ratio first byte
TV2 = divider ratio second byte
ST1 = control word first byte
ST2 = control word second byte
Stop = stop condition

Read mode (R/W = 1)

Logic diagram

	MSB							LSB
CIDIPS Address byte	1	1	0	0	0	MA1	MA0	1
Status byte	POR	FL	I2	I1	I0	A2	A1	A0

FL is set to 1 when the tuning loop is in lock.

POR (power on reset) is intentionally set to 1 in case V PLL drops below 3 V.
The POR bit is reset when an end-of-data is detected by the PLL IC.

I0 to I2 and A0 to A2 do not contain any relevant data and can be ignored.

Internal capacitance at terminal 8 SCL	max. 60 pF
Internal capacitance at terminal 7 SDA	max. 60 pF

ADDITIONAL INFORMATION

Tuning voltage

A tuning voltage of 33 V must be connected via a series 22 kΩ resistor to pin 4. A prefered method is a constant current supply of 1 – 1.5 mA to the pin.
Figure 7 shows this with a 140 V supply. The zener diode prevents the voltage at pin 4 exceeding 33 V.

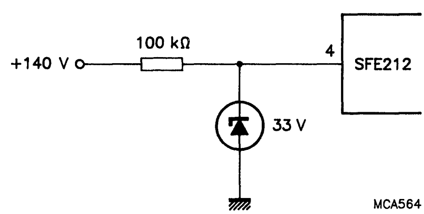


Fig.7 Constant current supply.

Satellite front ends

SF910 family

APPLICATION

The SF910 satellite front end family is designed to cover all frequencies in the range of 950 MHz to 1750 MHz. They are meant for both D-/D2-MAC DBS and PAL/SECAM FSS signals.
The SF910 has a built-in digitally controlled (I^2C-bus) PLL tuning system. The IF-part is equipped with a PLL demodulator IC.

The D-version has a dual switchable input which is controlled via an I^2C-bus. The SF914 and SF914D meet the requirements for radiation in accordance with the amendment to CENELEC EN55013 (57 dBpW).

DESCRIPTION

These satellite front ends are a combination of a tuner covering a frequency range of 950 MHz to 1750 MHz and an IF signal processing unit.
The tuner is fitted with a broadband matching network followed by an RF amplifier which is loaded with an electronically tuned bandpass filter. The selected channel is mixed with a synthesized oscillator signal to obtain an intermediate frequency (IF) which in turn passes to a filter and a gain controlled amplifier.
The IF unit contains a SAW filter followed by a buffer amplifier and a PLL FM-demodulator. The demodulated signals are applied to a video buffer amplifier to drive the video signal processing circuit.

The unit is mounted in a metal housing with front and rear covers.

QUICK REFERENCE DATA

System	D-/D2-MAC, PAL, SECAM
Frequency band	950 MHz to 1750 MHz
Channels	1 to 40 in accordance with WARC77
Intermediate frequency (note 1)	479.5 MHz
Baseband video polarity	positive

Note

1. The oscillator frequency is higher than the aerial signal frequency.

AVAILABLE VERSIONS

TYPE	INPUT CONNECTOR(S)	AMTSBLATT/ CENELEC	CATALOGUE NUMBER
SF912	IEC (female)	no	
SF912D	IEC (female) and IEC (male)	no	
SF914	IEC (female)	yes	3122 237 10551
SF914D	IEC (female) and IEC (male)	yes	3122 237 10561

BLOCK DIAGRAM

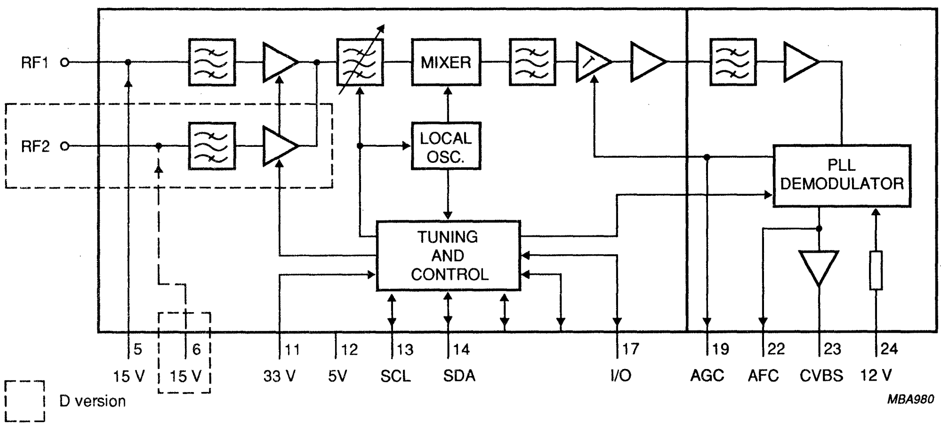


Fig.1 Block diagram.

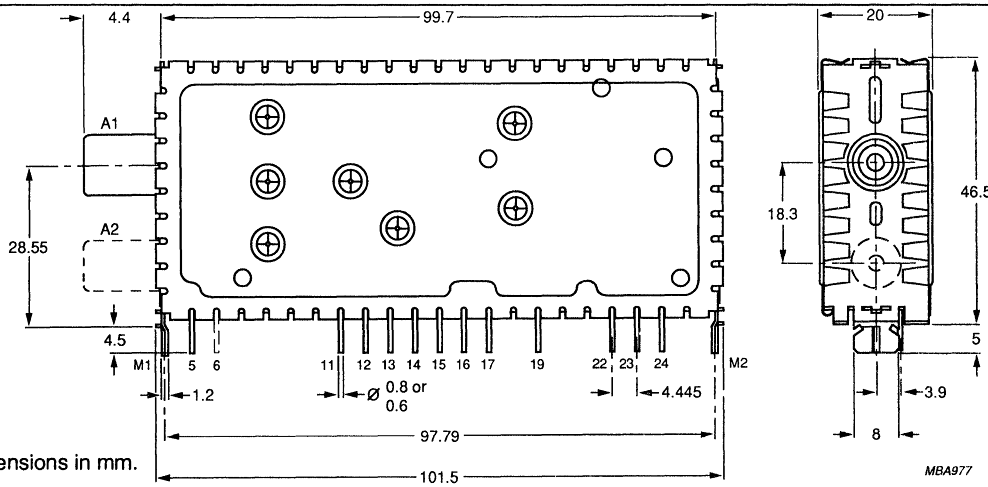
PINNING

PIN	FUNCTION
A1	aerial input 1 (female)
A2	aerial input 2 (male, D-version)
5	LNC voltage supply
6	LNC voltage supply (D-version)
11	tuning voltage supply
12	tuner section voltage supply
13	SCL (serial clock line) I^2C-bus control
14	SDA (serial data line) I^2C-bus control
17	I/O (input/output) port
19	AGC output
22	AFC output
23	CVBS baseband output
24	IF section voltage supply
M1	mounting tag
M2	mounting tag

SEMICONDUCTOR COMPONENT LIST

RF transistor	BFG93AR
PIN diode	HVR187
Mixer transistor	BFR92A
Oscillator transistor	BFR93A
Tuning diodes	BB811
PLL tuning IC	SP5055S
IF transistors	BFR92A + BFS01R
IF amp IC	µPC1688G
SAW filter	B529
PLL demodulator IC	TDA8730
Varicap diode	OF4199
Video transistor	BC848B

MECHANICAL DATA



Dimensions in mm.

Aerial connection:

SF912/SF914	IEC (female) 75 Ω
SF912D/SF914D	IEC (female) / IEC (male) 75 Ω

Fig.2 Mechanical outline.

ELECTRICAL DATA

Unless otherwise specified all electrical values apply at an ambient temperature of 25 ±5 °C, a relative humidity of 60 ±10%, tuner and PLL supply voltages at 5 ±0.2 V, an IF supply voltage of 12 ±0.3 V and a tuning supply voltage of 33 ±0.5 V via a 22 Ω series resistor. See note 1.

PARAMETER	TYP.	MAX.	UNIT
Voltages and currents			
Tuner section voltage supply	5 ±5%	–	V
Current drawn from +5 V supply	–	150	mA
IF section voltage supply	12 ±5%	–	V
Current drawn from +12 V	–	132	mA
Tuning voltage supply (note 2)	33	–	V
Tuning voltage supply current	–	1.7	mA
LNC voltage supply	–	20	V
LNC voltage supply current	–	400	mA

Notes

1. The front end is tuned by means of a built-in I^2C-bus controlled synthesizer. For further information refer to Application Information.
2. An external pull-up resistor of 22 kΩ ±5% must be connected between the tuning voltage supply and pin 11.

CHARACTERISTICS

All specified input levels refer to 75 Ω input impedance.

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
RF input characteristics					
In-band VSWR		–	1.5	3	
Return loss		6	–	–	dB
RF input level range		44	–	79	dBμV
Tuning range (carrier frequency) Margin at extreme channels		965 20	– –	1735 –	MHz MHz
Oscillator voltage at aerial input from 40 MHz to 1750 MHz from 1750 MHz to 2250 MHz		 – –	 – –	 54 76	 dBμV dBμV
Surge protection		5	–	–	kV
Noise figure		–	10	15	dB
Image rejection		35	50	–	dB
IF rejection		50	60	–	dB
Channel 1 in-channel intermodulation		79	85	–	dBμV
In-band intermodulation		79	–	–	dBμV
AFC output characteristics					
DC level when correctly tuned		3	3.4	3.8	V
Slope detuning		–	90	–	mV/MHz
Time constant		–	22	–	ns
AGC output characteristics					
Output impedance		–	10	–	kΩ
Output load		100	–	–	kΩ
Output level range for 79 dBμV unmodulated RF input signal for 44 dBμV unmodulated RF input signal		 – –	 3.5 7.5		 V V
Baseband output					
Baseband output load		–	470	–	Ω
DC level		1.8	2.3	2.8	V

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
PAL video characteristics (measurement conditions, unless otherwise specified)					
RF input level		–	60	–	dBμV
Carrier-to-noise ratio	measured in 27 MHz bandwidth	30	–	–	dB
MODULATION PARAMETERS					
Frequency deviation	CCIR-405 pre-/de-emphasis PAL coded video signal positive modulation	–	25	–	MHz/V
Video output level	no de-emphasis, measured from top sync to peak white	–	550	–	mV
Baseband frequency response	maximum amplitude deviation between 0.1 MHz and 5 MHz	–	–	0.5	dB
Dynamic threshold	the C/N limit at which clicks in a 75% saturated colour bar are just visible	–	–	13	dB
Static threshold		–	5	–	dB
Unweighted signal-to-noise ratio	C/N = 14 dB	39	40	–	dB
Differential phase	frequency deviation 16 MHz/V	–	±2	±5	deg
Differential gain	frequency deviation 16 MHz/V	–	±2	6	%
Second order intermodulation (The level difference between a 3.25 MHz video carrier and its second harmonic at 6.5 MHz)		25	30	–	dB
MAC video characteristics					
MODULATION PARAMETERS					
Frequency deviation	EBU pre-/de-emphasis D2-MAC coded video signal	–	13.5	–	MHz/V
Video output level	measured from black to white luminance level (no de-emphasis)	–	700	–	mV
Baseband frequency response	maximum amplitude deviation between 0.1 MHz and 10 MHz	–	–	1	dB
Dynamic threshold	the C/N limit at which clicks in a 75% saturated colour bar are just visible	–	–	9	dB
Bit error rate	C/N value for BER = 10^{-3}	–	–	8	dB
	C/N value for BER = 10^{-5}	–	–	11	dB

LOGIC TABLES

READ MODE ($R/\overline{W}$ = 1)

Table 1

	MSB							LSB
Address byte	1	1	0	0	0	MA1	MA0	$R/\overline{W}$
Status byte	POR	FL	I2	I1	I0	A2	A1	A0

Status byte explanation

POR	Power on reset indicator, set to logic 1 if the power supply to the device has dropped below 3 V
	The POR is set to 0 when the read sequence is terminated by a stop command
FL	Phase Lock Detect Flag:
	1 = device is phase locked
	0 = device is unlocked
I2	No relevant information
I1, I0	Status ports P5 and P4
	0 indicates LOW level
	1 indicates HIGH level
A2, A1, and A0	5 level A/D converter data from P6, can be used to feed AFC information from the IF section to the microprocessor

Telegram examples

READ MODE FROM PROCESSOR

Table 2

Start	Adr	Ack	STB	Ack	STB		Stop
Start	Adr	Ack	STB		Stop		

From PLL

No acknowledge	end of data
Start	start condition
Adr	address
Ack	acknowledge
STB	status byte
Stop	stop condition

WRITE MODE ($R/\overline{W} = 0$)

Table 3

	MSB							**LSB**
Address byte	1	1	0	0	0	MA1	MA0	$R/\overline{W}$
Prog. div. byte1	0	n14	n13	n12	n11	n10	n9	n8
Prog. div. byte 2	n7	n6	n5	n4	n3	n2	n1	n0
Control byte 1	1	CP	T1	T0	1	1	1	0S
Control byte 2	P7	P6	P5	P4	P3	P2 (note 1)	P1 (note 1)	P0

Note

1. P1 and P2 not connected in the IC package.

Address

The address of the front end is fixed to C6: (MA1, MA0) = (1, 1) and also responds to C2: (MA1, MA0) = (0, 1)

Programmable divider setting	
Divider ratio	$N = 16 \times (f_{rf,pc} + f_{if,pc})$ (MHz) $F_{osc} = N / 16$ (MHz) N = (16384 x n14) + (8192 x n13) + (4096 x n12) + (2048 x n11) + (1024 x n10) + (512 x n9) + (256 x n8) + (128 x n7) + (64 x n6) + (32 x n5) + (16 x n4) + (8 x n3) + (4 x n2) + (2 x n1) + (n0)
Control byte 1	
Charge pump setting	CP can be set to either 0 (LOW current) or 1 (HIGH current). CP = 1 results in fastest tuning
Test mode setting	T1, T0 = 0 for normal operation
PLL disabling	OS = 0 for normal operation OS = 1 switches the charge pump transistor to a non-conducting state, the front end can then be tuned manually with a variable tuning voltage applied to pin 11 When selecting OS = 1, it is recommended to set simultaneously T0 = 1.
Control byte 2	
Port P0 to P5	not used
Port P6	I/O port 3 0 for HIGH impedance output 1 for LOW impedance output If the port is to be used as an input port it should not be programmed to output a LOW impedance state
Port P7	for single input version: P7 = 0 for normal operation for dual input version (antenna input select) P7 = 0 for input RF1 P7 = 1 for input RF2

Telegram examples

WRITE MODE

Table 4

Start	Adr	Ack	DIV1	Ack	DIV2	Ack	CB1	Ack	CB2	Ack	Stop
Start	Adr	Ack	DIV1	Ack	DIV2	Ack	CB1	Ack	CB2	Ack	Stop
Start	Adr	Ack	DIV1	Ack	DIV2	Ack	DIV1	Ack	Stop		
Start	Adr	Ack	DIV1	Ack	DIV2	Ack	Stop				
Start	Adr	Ack	CB1	Ack	CB2	Ack	Stop				
Start	Adr	Ack	CB1	Ack	CB2	Ack	DIV1	Ack	Stop		

key

Start	start condition
Adr	address
Ack	acknowledge
DIV1	divider ratio byte 1
DIV2	divider ratio byte 2
CB1	control byte 1
CB2	control byte 2
Stop	stop condition

APPLICATION INFORMATION

I²C-bus control

For further information regarding general aspects of I²C-bus control, refer to *"The I²C-bus specification"* published by Philips Components.

AFC system

An example of a simple AFC system for the front end in combination with an interface circuit is briefly described below.

The system makes use of the internal A/D converter of the PLL frequency synthesizer in the tuner part.

The AFC signal coming out on pin 22 is applied to a simple first order lowpass filter (R4 - C) to remove the video and frequency dispersal signal in order to obtain a DC signal that is a measure for the centre frequency of the FM signal entering the demodulator. With R4 = 470 kΩ and C = 100 nF a suitable lowpass filter is obtained.

A simple low frequency operational amplifier is used to make a DC level shift and slope adjustment so that the output (V_O) matches the A/D converter window. The A/D converter has 5 levels ranging from 000 to 100 with the mid level 010 corresponding to the window centre around 1.88 V and a window of about 750 mV. For a tuning accuracy of ±1 MHz, a 2 MHz frequency window is required. With the demodulator slope of about 85 mV/MHz, a 2 MHz window at the AFC output equals 170 mV. Therefore the interface circuit must provide a gain of 750 mV/170 mV = 4.41.

The resistors can be calculated from the following equations:

$G = (1 + R1) \div Rx$

$Rx = R2 + R3^{+} \times R3^{-} \div (R3^{+} + R3^{-})$

where:

$R3^{+}$ is the value between the wiper of R3 and V_S

$R3^{-}$ is the value between the wiper of R3 and ground

$V_O = (V1 \times G) - (V_S \times R1 \times R3^{-}) \div (Rx \times R3)$

The digital values from the A/D converter output can be read via the I²C-bus and processed by the microcontroller that controls the tuning system. The software for the AFC tuning system must be able to handle a curve shown in Fig.4.

A demonstration software package is available from Philips Components for controlling all tuning functions of a PLL synthesized tuning system for satellite receivers. It requires a MS-DOS operating system and runs on IBM PC/XT/AT computers or compatibles. For control of the I²C-bus an interface board is required which is plugged into the computer's Centronics port.

Mounting the unit on a printed wiring board (PWB)

The unit must be mounted on the board ensuring that there is no clearance between the supporting surfaces and the PWB.
In this condition the unit is soldered in place.

This can be achieved by:

(a) Pressing the unit vertically on the PWB during soldering

(b) Supporting the unit with its aerial connector in the right position

(c) Twisting the ground tags (see Fig.5).

In order to prevent any stress to the PWB it is recommended that the unit is supported at its aerial connector.

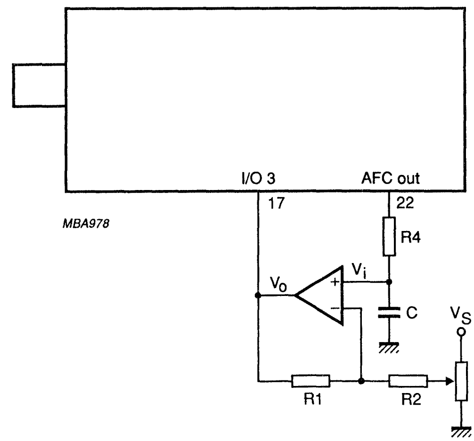


Fig.3 AFC interface circuit.

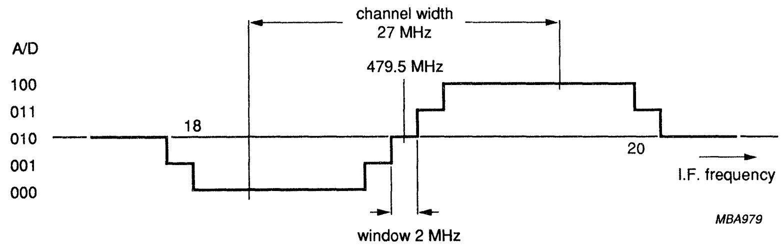
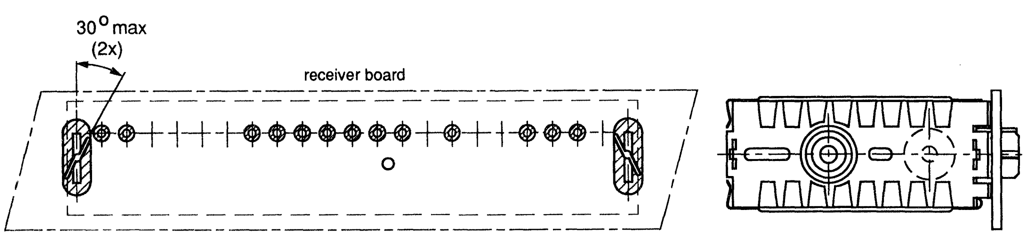
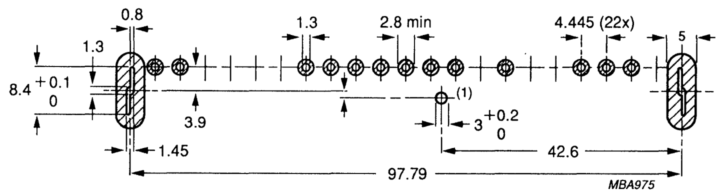


Fig.4 A/D converter window.



Viewed from the solder side.

Fig.5 Lug twist method of mounting tabs.



Dimensions in mm.

Viewed from the solder side.

(1) Additional hole for extra fixing with a pan tap screw 2N. max length 4.05 mm.

Fig.6 Piercing diagram.

LOW NOISE BLOCK CONVERTERS

FEATURES

- Ku-band Low Noise Block (LNB)
- Hermetically sealed and weatherproof
- Built-in switchable electronic depolarizer
- Intended for ASTRA 1A, 1B, (1C) and Eutelstat II
- ZZF approved
- Compact size
- Available with horn or flange.
- Low loss PTFE radome

DESCRIPTION

The SC813 and SC815 Low Noise Block (LNB) down converters are 100% hermetically sealed weatherproof units, intended as outdoor units for Ku-band double heterodyne satellite receivers. By using the latest High Electron Mobility Transistors (HEMT) and Microwave Monolithic Integrated Circuits (MMIC) technology, the noise figures have been considerably reduced. All types feature built-in electronic depolarizers switchable by the supply voltage to the unit. Both units are ZZF approved (DIN V VDE 0855 part 12, November 1988) and fulfil ETSI requirements (prETS 300 158 chapter 2).

APPLICATION

The LNB units are primarily intended for the reception of ASTRA and Eutelstat II generation of satellites.

QUICK REFERENCE DATA

Input frequency range	Ku-band
Local oscillator frequency	10 GHz
Waveguide and feed losses	0.1 dB
Gain	52 dB
Output impedance	75 Ω
Supply voltage	
vertical polarisation	9 to 14 V
horizontal polarisation	16.5 to 20 V

ORDERING INFORMATION

VERSION	NOISE	TYPE	12NC NUMBER
SC813	1.3 dB	horn	3112 298 00010
SC813/FL	1.3 dB	flange	3112 298 00020
SC815	1.1 dB	horn	3112 298 00030
SC815/FL	1.1 dB	flange	3112 298 00040

MECHANICAL DATA

Feedhorn	optimized for 0.6 f/D offset reflector
Output connector	type F, female, 75 Ω
Mass	
horn type	420 g
flange type	350 g
Dimensions (l x w x h)	
horn type	105 x 56 x 82 mm
flange type	105 x 56 x 31 mm

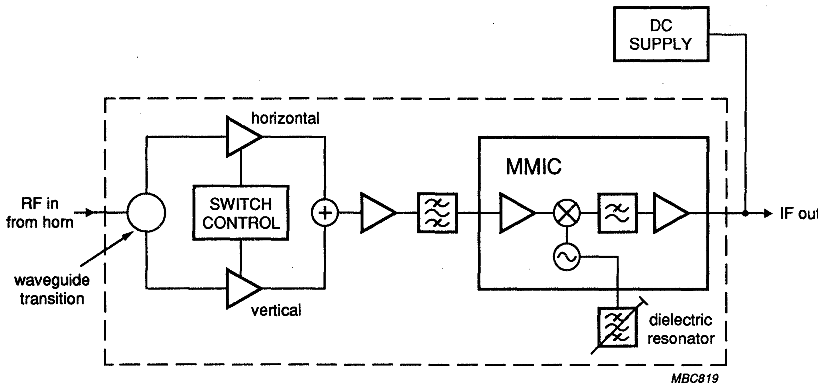
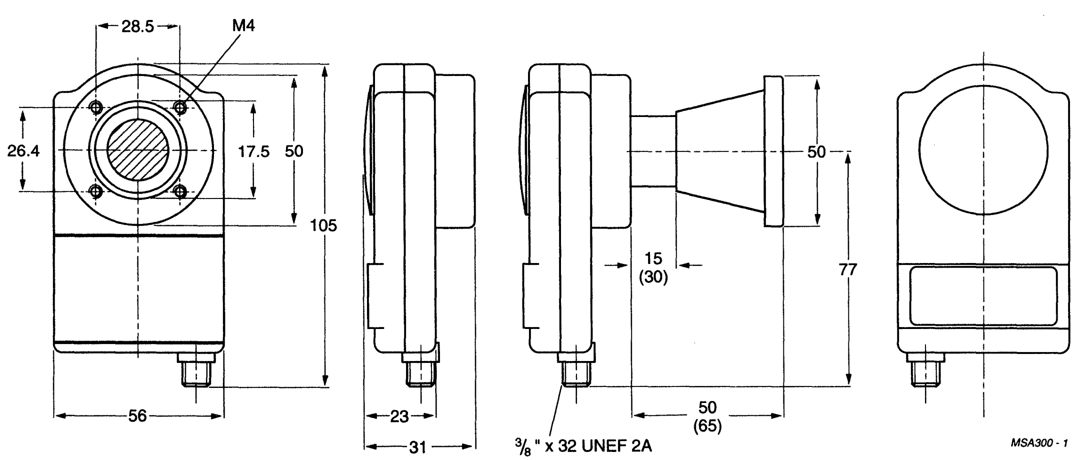


Fig.1 Block diagram.



Dimensions in mm.

Fig.2 Mechanical outline.

CHARACTERISTICS

PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Input frequency			10.95 to 11.70		GHz
Output frequency			950 to 1700		MHz
Local oscillator (LO) frequency		–	10	–	GHz
LO tolerance for alignment and T_{amb} variations		9.997	–	10.003	GHz
LO leakage	installed on waveguide	–	–	–60	dBm
Supply voltage vertical polarisation horizontal polarisation	at LNB		 9.0 to 14.0 16.5 to 20.0		 V V
Supply voltage ripple		–	–	200	mV_{p-p}
Supply current		–	160	200	mA
Noise figure SC813 SC815	at T_{amb} = 25 °C	 – –	 1.3 1.1	 – –	 dB dB
Waveguide and feed losses		–	–	0.1	dB
Overall conversion gain		46	52	–	dB
Gain ripple within any 27 MHz segment		–	–	1.0	dB
Cross polarisation discrimination	on axis	20	–	–	dB
Image band rejection		50	–	–	dB
Output terminal return loss	VSWR = 2.5:1	8	–	–	dB
Output surge protection		5	–	–	kV
In-band intermodulation. Maximum two carrier output level yielding 35 dB minimum spurious suppression		–	–	–15	dBm
Operating temperature (T_{amb})		–40	–	+60	°C

COAXIAL AERIAL INPUT ASSEMBLIES

COAXIAL AERIAL INPUT ASSEMBLY

APPLICATION

This coaxial aerial input assembly has been developed for application in TV sets with 75 Ω input impedance, for use in v.h.f. as well as in u.h.f. bands. Thanks to the use of safety capacitors in the assembly, the chassis of the TV set is separated from the aerial input. The connector for the aerial input meets the demands of the IEC standards (diameter 9,5 mm) and the French standards (diameter 9,0 mm).

The coaxial aerial input assembly complies with the requirements of immunity from radiated interference of BS 905. It meets the safety requirements of IEC 65; approbation approvals have been sought from KEMA, VDE, SEV, BSI, DEMKO, NEMKO, SEMKO, EI and LCEE.

DESCRIPTION

The assembly is provided with safety capacitors, which are moulded in thermo-setting insulation material, thus forming a capacitor block. This capacitor block is built in a metal housing, with lid, which is carried by a plastic fixing plate. All points to the safety capacitors are press contacts, achieved by the metal housing. The housing has an outlet for the coaxial cable to the television tuner.

ELECTRICAL DATA

The electrical values are measured at an ambient temperature of 25 ± 5 °C and a relative humidity of 60 ± 15%.

Input impedance of connector	75 Ω, asymmetrical
Frequency ranges	
v.h.f.	40 to 300 MHz
u.h.f.	470 to 890 MHz
Reflection	
v.h.f.	⩽ 15%
u.h.f.	⩽ 25%
Insertion loss	
v.h.f.	⩽ 1 dB; typ. 0,2 dB
u.h.f.	⩽ 1 dB; typ. 0,4 dB
Contact resistance of connector after 1 plug insertion	
inner bush	⩽ 10 mΩ
outer bush	⩽ 5 mΩ
Insulation resistance	> 500 MΩ
Immunity from radiated interference	in conformity with requirements of BS 905, provided the assembly is installed in a professional manner, and a proper coaxial cable is used.

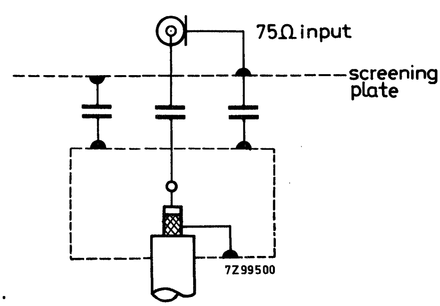


Fig. 1.

ENVIRONMENTAL DATA

Operating temperature range	0 to + 55 °C
Storage temperature range	–40 to + 85 °C
Relative humidity	⩽ 95%

MECHANICAL DATA

Dimensions in mm

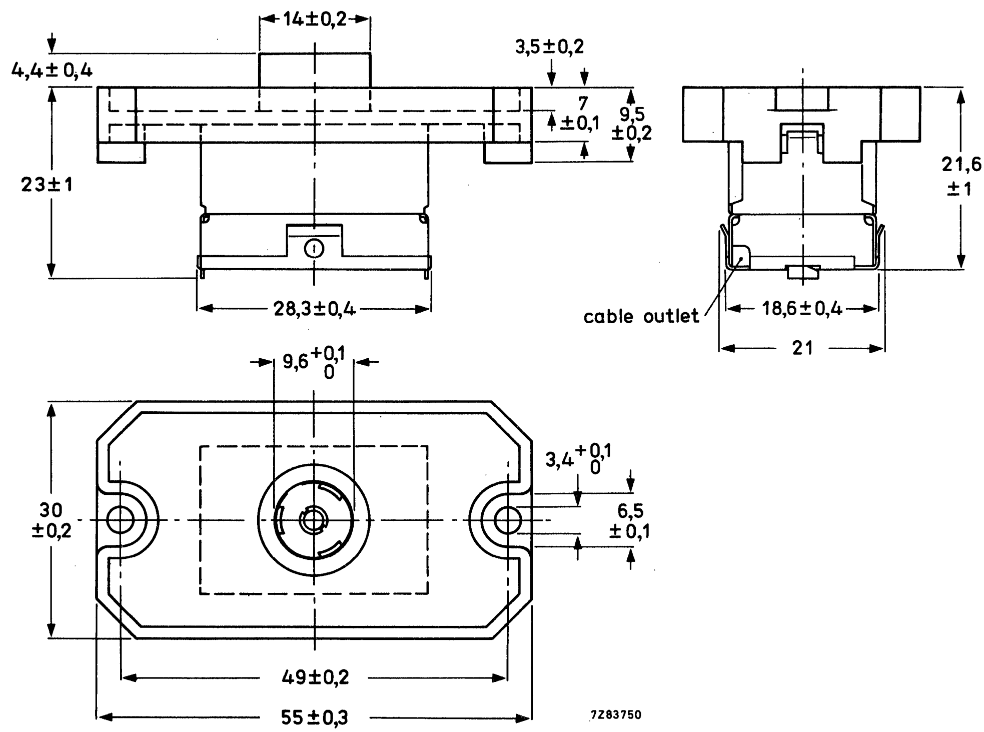


Fig. 2.

MOUNTING

The assembly can be mounted to the chassis of the TV set with two self-tapping screws, 4N x 9,5.

It must be connected to the tuner via a coaxial cable with a diameter of 3 mm. The inner cable conductor should be soldered to the metal plating of the capacitor block, and the cable earth sheath to the metal housing, see Fig. 3.

The soldering conditions are: 340 ^{o}C, 2 s.

Plugs to be used with the assembly have to comply with the properties mentioned in DIN 45325, IEC 69-2 (9,5 mm diameter) and SNIR (9 mm diameter).

It is advised not to use aluminium plugs.

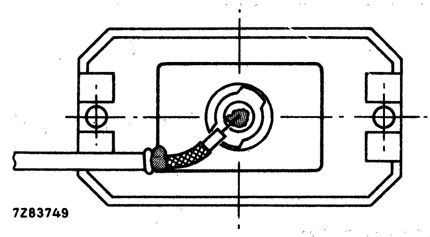


Fig. 3 Recommended fixing of the aerial cable.

7Z83749

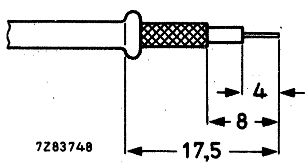


Fig. 4 Recommended cable stripping.

7Z83748

COAXIAL AERIAL INPUT ASSEMBLY

APPLICATION

This coaxial aerial input assembly has been developed for application in TV sets with 75 Ω input impedance, for use in v.h.f. as well as in u.h.f. bands. Thanks to the use of safety capacitors in the assembly, the chassis of the TV set is separated from the aerial input. The connector for the aerial input meets the demands of the IEC standards (diameter 9,5 mm) and the French standards (diameter 9,0 mm).

The coaxial aerial input assembly complies with the requirements of immunity from radiated interference of BS 905. It meets the safety requirements of IEC 65; approbation approvals have been sought from KEMA, VDE, SEV, BSI, DEMKO, NEMKO, SEMKO, EI and LCEE.

DESCRIPTION

The assembly is provided with safety capacitors, which are moulded in thermo-setting insulation material, thus forming a capacitor block. This capacitor block is built in a metal housing with lid, which is carried by a plastic fixing plate. All points to the safety capacitors are press contacts, achieved by the metal housing. A printed circuit board containing a splitter for v.h.f. and u.h.f. signals is built in the housing. The housing has two outlets for coaxial cables to the television tuner.

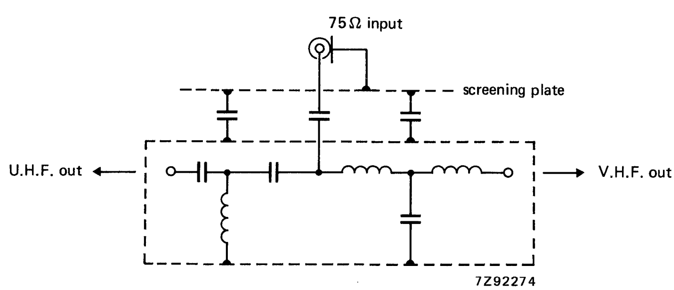


Fig. 1 Electrical diagram.

ELECTRICAL DATA

The electrical values are measured at an ambient temperature of 25 ± 5 °C and a relative humidity of 60 ± 15%.

Input impedance of connector	75 Ω, asymmetrical
Frequency ranges	
v.h.f.	40 to 300 MHz
u.h.f.	470 to 890 MHz
Reflection	
v.h.f.; u.h.f. output terminated with 75 Ω	⩽ 30%
u.h.f.; v.h.f. output terminated with 75 Ω	⩽ 30%
Insertion loss	
v.h.f., 40 – 230 MHz	⩽ 1 dB; typ. 0,7 dB
v.h.f., 230 – 300 MHz, u.h.f. terminated with 75 Ω	⩽ 1,5 dB; typ. 1,2 dB
u.h.f., v.h.f. terminated with 75 Ω	⩽ 1,5 dB, typ. 0,9 dB
Suppression	
of u.h.f. frequencies at v.h.f. output	
40 – 230 MHz	⩾ 15 dB
230 – 300 MHz	⩾ 10 dB
measured at	
40 MHz	typ. 50 dB
200 MHz	typ. 22 dB
230 MHz	typ. 18 dB
300 MHz	typ. 11 dB
of v.h.f. frequencies at u.h.f. output	
470 – 890 MHz	⩾ 13 dB
measured at	
470 MHz	typ. 14 dB
700 MHz	typ. 21 dB
890 MHz	typ. 22 dB
Contact resistance of connector after 1 plug insertion	
inner bush	⩽ 10 mΩ
outer bush	⩽ 5 mΩ
Insulation resistance	> 500 MΩ
Immunity from radiated interference	in conformity with requirements of BS 905, provided the assembly is installed in a professional manner, and a proper coaxial cable is used.

Quality assessment in production centres are according to the rules of BSI and VDE.

ENVIRONMENTAL DATA

Operating temperature range	0 to +55 °C
Storage temperature range	–40 to +85 °C
Relative humidity	⩽ 95%
Maximum bump acceleration	25g
Maximum shock acceleration	50g
Maximum vibration amplitude	0,35 mm

MECHANICAL DATA

Dimensions in mm

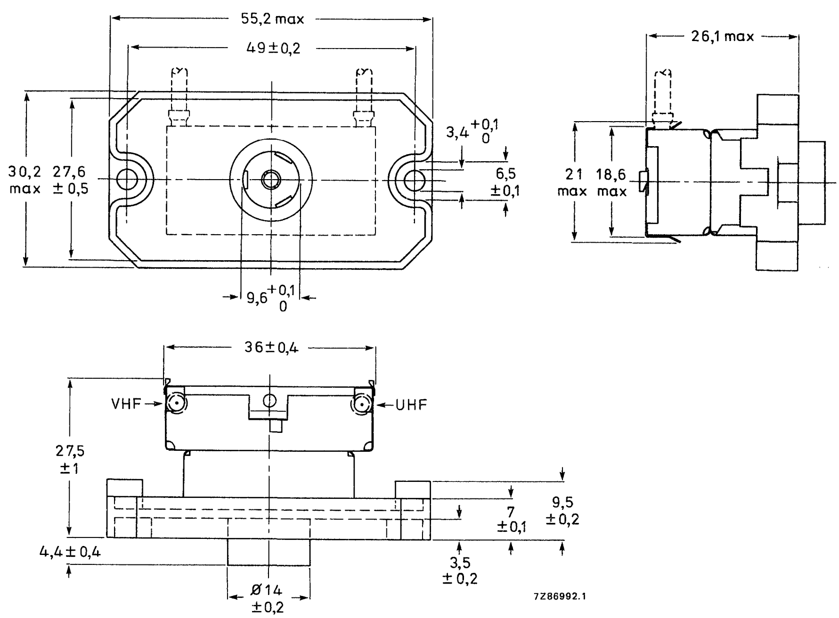


Fig. 2.

Mass 26 g approximately

Connector

Insertion force	⩽ 50 N
Pull-out force	10 to 50 N
Pull-out force of inner bush, measured with a min. gauge of 2,29 mm dia., after 5 insertions of a max. plug gauge of 2,43 mm dia.	⩾ 1 N
Loading of inner bush in axial direction for 5 s	⩽ 50 N
Pull-out force of outer bush, measured with a min. plug gauge of 9 mm dia., after 5 insertions of a max. plug gauge of 9,5 mm dia.	⩾ 1,5 N
Loading of outer bush in 4 radial and axial directions for 5 s	⩽ 50 N

Marking

Moulded at the front of the fixing plate:
– PHILIPS
– 7105 (for the National Approbation Offices regarding the safety aspects)
– 250 V~, 390 pF 3x

Punched into one of the side faces of the metal housing:
– letter code for factory of origin
– production date code (year and week)

MOUNTING

The assembly can be mounted to the chassis of the TV set with two self-tapping screws, 4N x 9,5.

It must be connected to the tuner via coaxial cables with a diameter of 3 mm stripped according to Fig. 3. The inner cable conductors should be soldered to the inputs of splitters which line up with the cable inlets, the cable earth sheaths soldered to the metal housing.

The soldering conditions are: 340 °C, 2 s.

Plugs to be used with the assembly have to comply with the properties mentioned in DIN 45325, IEC 69-2 (9,5 mm diameter) and SNIR (9 mm diameter).

It is advised not to use aluminium plugs.

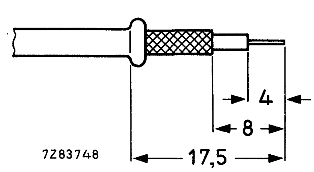


Fig. 3 Recommended cable stripping.
Cable length max. 150 mm.

TV SYSTEMS & CHARACTERISTICS

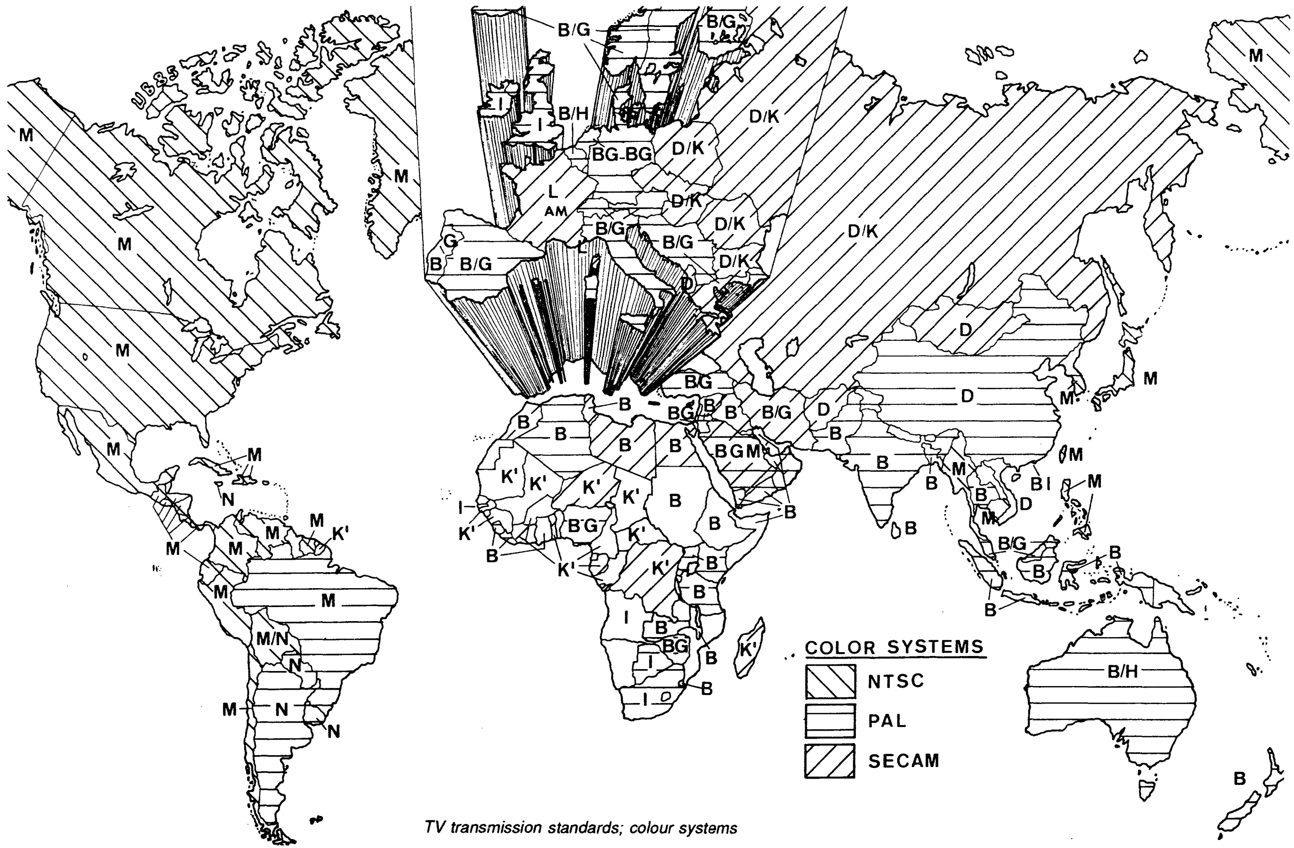
OVERVIEW OF TV TRANSMISSION STANDARDS

TV sound transmission standards

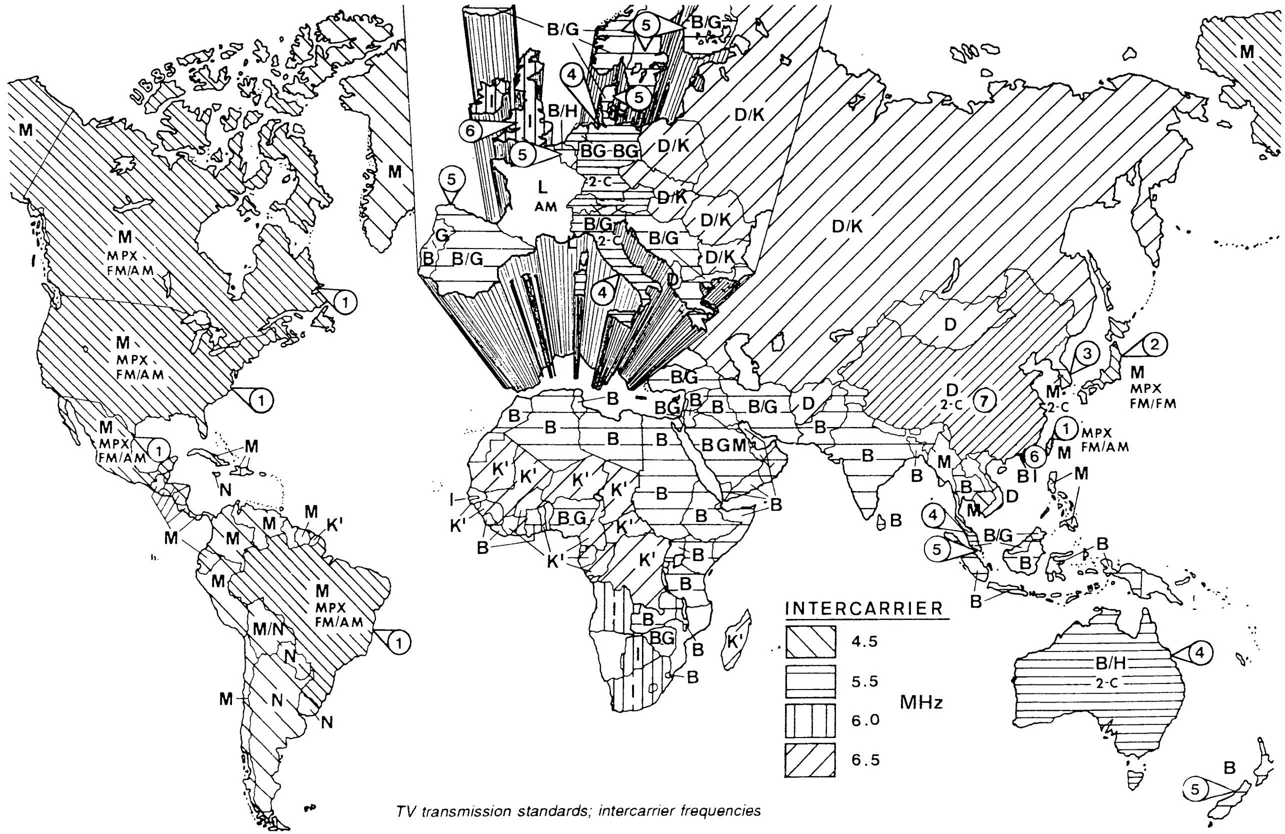
	M,N	M	M	M	B, G, H	B, G, H	I	D, K, K'	D	L
Intercarrier 1 MHz Intercarrier 2 MHz	4.5 -	4.5 -	4.5 -	4.5 4.72	5.5 5.74	5.5 5.85	6.0 6.552	6.5 -	6.5 6.74	direct AM dem. at 1st IF
Vision modulation	neg.	neg.	neg.	neg.	neg.	neg.	neg.	neg.	pos.	
Sound modulation: IC1 IC2	 FM FM	 FM FM	 FM FM	 FM FM	 FM FM	 FM digital	 FM digital	 FM FM	 FM FM	 AM AM
Audio coding AF1	M	M MPX (FM/AM) SAP	M MPX (FM/FM)	M L + R A	M (L + R)/2 A	M1	M1	M	M (L + R)/2 A	M
Audio coding AF2	-	-	-	M L – R B	M R B	L, R A, B (NICAM)	L, R A, B (NICAM)	-	M R B	-
Country of stereo sound transmission		USA Brazil Canada Mexico Taiwan	Japan	Rep. of Korea	W. Germany Australia Netherlands Italy Austria Switzerland Malaysia	Scandinavia Belgium Spain New Zealand Singapore	UK Hong Kong		Peoples Rep. of China	
Stereo system number on map		1	2	3	4	5	6		7	

Television Tuners
Coaxial Aerial Input Assemblies

TV transmission standards; colour systems



TV transmission standards; colour systems



TV transmission standards; intercarrier frequencies

system	number of lines	channel width (MHz)	vision bandwidth (MHz)	vision/sound separation (MHz)	vestigial side-band (MHz)	modulation vision	modulation sound
A	405	5	3	−3.5	0.75	Pos	AM
B	625	7	5	+5.5	0.75	Neg	FM
C	625	7	5	+5.5	0.75	Pos	AM
D	625	8	6	+6.5	0.75	Neg	FM
E	819	14	10	+11.15	2	Pos	AM
F	819	7	5	+5.5	0.75	Pos	AM
G	625	8	5	+5.5	0.75	Neg	FM
H	625	8	5	+5.5	1.25	Neg	FM
I	625	8	5.5	+6	1.25	Neg	FM
K	625	8	6	+6.5	0.75	Neg	FM
K1	625	8	6	+6.5	1.25	Neg	FM
L	625	8	6	+6.5	1.25	Pos	AM
M	525	6	4.2	+4.5	0.75	Neg	FM
N	625	6	4.2	+4.5	0.75	Neg	AM

country	VHF	UHF	colour	channels
	standard for			
A				
Afghanistan	B		PAL	CCIR
Albania	B			IT
Algeria	B	(G)	PAL	CCIR
Angola	I			Angola
Argentina	N		PAL	US
Australia	B		PAL	Austr.
Austria	B	G	PAL	CCIR
Azores	M			CCIR/US
B				
Bahamas	M		NTSC	US*
Bahrain	B		PAL	CCIR
Bangla-Desh	B			CCIR
Barbados	M		NTSC	US
Belgium	B	H	PAL	CCIR
Bermuda	M		NTSC	US
Bolivia	N		PAL	US
Brazil	M	M	PAL	US
Brunei	B		PAL	CCIR
Bulgaria	D	K	SECAM	OIRT
Burma	M		NTSC	US*
C				
Cambodia	M			
Canada	M	M	NTSC	US
Canary Isl.	B			CCIR
Centr. Afr. Rep.	B			
Chad	K1			
Chile	M		NTSC	US
China	D	D	PAL	China
Colombia	M		NTSC	US
Congo	D			FOT*
Costa Rica	M		NTSC	US
Cuba	M		NTSC	US*
Cyprus	B	G,H	PAL	CCIR
Czechoslovakia	D	K	SECAM	OIRT

country	VHF	UHF	colour	channels
	standard for			
D				
Dahomey	K1	K1*		
Denmark	B	G	PAL	CCIR
Djibouti	K1		SECAM	FOT
Dominican Rep.	M		NTSC	US
E				
Ecuador	M		NTSC	US
Egypt	B		SECAM	CCIR
El Salvador	M		NTSC	US*
Ethiopia	B			CCIR
F				
Finland	B	G	PAL	CCIR
France	L	L	SECAM	F
French Polynesia	K1			FOT
G				
Gabon	K1		SECAM	FOT
Gambia	(K1)			(FOT)
German Dem. Rep.	B	G	SECAM	CCIR
German Fed. Rep.	B	G	PAL	CCIR
Ghana	B		PAL	CCIR
Gibraltar	B		PAL	CCIR
Greece	B	G	SECAM	CCIR*
Greenland	M/B		NTSC/ PAL	US
Guadeloupe	K1		SECAM	FOT
Guatemala	M		NTSC	US
Guiana (French)	K1			FOT

country	VHF	UHF	colour	standard for channels
H				
Haiti	M		NTSC	US*
Hawaii	M		NTSC	US
Honduras	M			US
Hong Kong		I	PAL	UK
Hungary	D	K	SECAM	OIRT
I				
Iceland	B		PAL	CCIR
India	B			CCIR
Indonesia	B	G	PAL	IN
Iran	B		SECAM	CCIR
Iraq	B		SECAM	CCIR
Ireland	A,I	I	PAL	IR
Israel	B	G		CCIR
Italy	B	G	PAL	IT
Ivory Coast	K1		SECAM	IC
J				
Jamaica	M		-	US
Japan	M	M	NTSC	
Jordan	B		PAL	CCIR
K				
Kenya	B			CCIR
Korea, North	D		SECAM	OIRT
Korea, South	M	M	NTSC	US
Kuwait	B		PAL	CCIR
L				
Lebanon	B		SECAM	CCIR
Liberia	B		PAL	CCIR
Libya	B		SECAM	CCIR
Luxembourg	B	L,G	PAL/ SECAM	CCIR*

country	VHF	UHF	colour	standard for channels
M				
Madagascar	K1			FOT
Madeira	B			CCIR
Malawi	B	G*		
Malaysia	B		PAL	CCIR
Mali	K1	K1*		
Malta	B			CCIR
Martinique	K1		SECAM	FOT
Mauritania	B			
Mauritius	B		SECAM	CCIR
Mexico	M	M	NTSC	US
Monaco	G	L,G	SECAM /PAL	CCIR
Mongolia	D			OIRT
Morocco	B		SECAM	MO
Mozambique	B			
N				
Netherlands	B	G	PAL	CCIR
Neth. Antilles	M		NTSC	US
New Caledonia	K1		SECAM	FOT
New Zealand	B		PAL	NZ
Nicaragua	M		NTSC	US
Niger	K1			FOT*
Nigeria	B		PAL	CCIR*
Norway	B	G	PAL	CCIR

country	VHF	UHF	colour	channels
O				
Oman	B	G	PAL	CCIR
P				
Pakistan	B		PAL	CCIR
Panama	M		NTSC	US
Paraguay	N			US*
Peru	M		NTSC	US
Philippines	M	M	NTSC	US
Poland	D	K	SECAM	OIRT
Portugal	B	G	PAL	CCIR*
Puerto Rico	M	M	NTSC	US
Q				
Qatar	B		PAL	CCIR
R				
Rumania	D	D	I	OIRT
S				
Samoa	M		NTSC	US
Saudi Arabia	B,G PAL		SECAM	CCIR
Senegal	K1			FOT
Sierra Leone	B		PAL	CCIR
Singapore	B		PAL	CCIR
South Africa	I	I	PAL	SA
Spain	B	G	PAL	CCIR
Sri Lanka	B		PAL	CCIR
Sudan	B			CCIR
Surinam	M		NTSC	US
Swaziland	G		PAL	
Sweden	B	G	PAL	CCIR
Switzerland	B	G	PAL	CCIR
Syria	B		SECAM	CCIR

country	VHF	UHF	colour	channels
T				
Tahiti	K1			FOT
Taiwan	M		NTSC	US
Tanzania	B,I	I	PAL	CCIR
Thailand	B		PAL	CCIR
Togo Rep.	K1		SECAM	FOT
Trinidad & Tobago	M		NTSC	US
Tunisia	B		SECAM	CCIR*
Turkey	B		(PAL)	CCIR
U				
Uganda	B		PAL	CCIR
United Arab Emirates	B		PAL	CCIR
United Kingdom	A	I	PAL	UK
Upper Volta	K1			OIRT
Uruguay	N			US*
USA	M	M	NTSC	US
USSR	D	K	SECAM	OIRT

country	standard for VHF	UHF	colour	channels
V				
Venezuela	M		NTSC	US
Vietnam (Khmer)	M		NTSC	US
Virginia	M		NTSC	US
Y				
Yemen (Arab Rep.)	B		PAL	CCIR
Yemen (Dem. Rep.)	B			CCIR
Yugoslavia	B	G	PAL	CCIR
Z				
Zaire	K1		SECAM	FOT
Zambia	B		PAL	CCIR
Zanzibar	I	I	PAL	
Zimbabwe	B			CCIR

Notes: Abbreviations used in the Channel section are as shown in the following table.

FOT	French overseas territories
IC	Ivory Coast
IN	Indonesia
IR	Ireland
IT	Italy
MO	Morocco
NZ	New Zealand
SA	South Africa
UK	United Kingdom
US	United States

* Estimated

( ) There is no local broadcast station, but one can listen to a broadcast from a neighbouring country.

- There is no broadcast.

CCIR B, G

vision IF 38.9 MHz,
sound IF 33.4 MHz.

Ch	frequency range	F_p	F_s
2	47- 54	48.25	53.75
3	54- 61	55.25	60.75
4	61- 68	62.25	67.75
5	174-181	175.25	180.75
6	181-188	182.25	187.75
7	188-195	189.25	194.75
8	195-202	196.25	201.75
9	202-209	203.25	208.75
10	209-216	210.25	215.75
11	216-223	217.25	222.75
12	223-230	224.25	229.75
21	470-478	471.25	476.75
22	478-486	479.25	484.75
23	486-494	487.25	492.75
24	494-502	495.25	500.75
25	502-510	503.25	508.75
26	510-518	511.25	516.75
27	518-526	519.25	524.75
28	526-534	527.25	532.75
29	534-542	535.25	540.75
30	542-550	543.25	548.75
31	550-558	551.25	556.75
32	558-566	559.25	564.75
33	566-574	567.25	572.75
34	574-582	575.25	580.75
35	582-590	583.25	588.75
36	590-598	591.25	596.75
37	598-606	599.25	604.75
38	606-614	607.25	612.75
39	614-622	615.25	620.75

Ch	frequency range	F_p	F_s
40	622-630	623.25	628.75
41	630-638	631.25	636.75
42	638-646	639.25	644.75
43	646-654	647.25	652.75
44	654-662	655.25	660.75
45	662-670	663.25	668.75
46	670-678	671.25	676.75
47	678-686	679.25	684.75
48	686-694	687.25	692.75
49	694-702	695.25	700.75
50	702-710	703.25	708.75
51	710-718	711.25	716.75
52	718-726	719.25	724.75
53	726-734	727.25	732.75
54	734-742	735.25	740.75
55	742-750	743.25	748.75
56	750-758	751.25	756.75
57	758-766	759.25	764.75
58	766-774	767.25	772.75
59	774-782	775.25	780.75
60	782-790	783.25	788.75
61	790-798	791.25	796.75
62	798-806	799.25	804.75
63	806-814	807.25	812.75
64	814-822	815.25	820.75
65	822-830	823.25	828.75
66	830-838	831.25	836.75
67	838-846	839.25	844.75
68	846-854	847.25	852.75
69	854-862	855.25	860.75

Ch = Channel
F_p = picture carrier frequency
F_s = sound carrier frequency

CCIR, cable

vision IF 38.9 MHz,
sound IF 33.4 MHz.

Ch	frequency range	F_p	F_s
E 2	47- 54	48.25	53.75
E 3	54- 61	55.25	60.75
E 4	61- 68	62.25	67.75
S01	68- 75	69.25	74.75
S02	75- 82	76.25	81.75
S03	82- 89	83.25	88.75
S 1	104-111	105.25	110.75
S 2	111-118	112.25	117.75
S 3	118-125	119.25	124.75
S 4	125-132	126.25	131.75
S 5	132-139	133.25	138.75
S 6	139-146	140.25	145.75
S 7	146-153	147.25	152.75
S 8	153-160	154.25	159.75
S 9	160-167	161.25	166.75
S10	167-174	168.25	173.75
E 5	174-181	175.25	180.75
E 6	181-188	182.25	187.75
E 7	188-195	189.25	194.75
E 8	195-202	196.25	201.75
E 9	202-209	203.25	208.75
E10	209-216	210.25	215.75
E11	216-223	217.25	222.75
E12	223-230	224.25	229.75
S11	230-237	231.25	236.75
S12	237-244	238.25	243.75
S13	244-251	245.25	250.75
S14	251-258	252.25	257.75
S15	258-265	259.25	264.75
S16	265-272	266.25	271.75
S17	272-279	273.25	278.75
S18	279-286	280.25	285.75
S19	286-293	287.25	292.75
S20	293-300	294.25	299.75

Ch	frequency range	F_p	F_s
S21	302-310	303.25	308.75
S22	310-318	311.25	316.75
S23	318-326	319.25	324.75
S24	326-334	327.25	332.75
S25	334-342	335.25	340.75
S26	342-350	343.25	348.75
S27	350-358	351.25	356.75
S28	358-366	359.25	364.75
S29	366-374	367.25	372.75
S30	374-382	375.25	380.75
S31	382-390	383.25	388.75
S32	390-398	391.25	396.75
S33	398-406	399.25	404.75
S34	406-414	407.25	412.75
S35	414-422	415.25	420.75
S36	422-430	423.25	428.75
S37	430-438	431.25	436.75
S38	438-446	439.25	444.75
S39	446-454	447.25	452.75
S40	454-462	455.25	460.75
S41	462-470	463.25	468.75

JAPAN

vision IF 58.75 MHz
sound IF 54.25 MHz

Ch	frequency range	F_p	F_s
1	90- 96	91.25	95.75
2	96-102	97.25	101.75
3	102-108	103.25	107.75
4	170-176	171.25	175.75
5	176-182	177.25	181.75
6	182-188	183.25	187.75
7	188-194	189.25	193.75
8	192-198	193.25	197.75
9	198-204	199.25	203.75
10	204-210	205.25	209.75
11	210-216	211.25	215.75
12	216-222	217.25	221.75
13	470-476	471.25	475.75
14	476-482	477.25	481.75
15	482-488	483.25	487.75
16	488-494	489.25	493.75
17	494-500	495.25	499.75
18	500-506	501.25	505.75
19	506-512	507.25	511.75
20	512-518	513.25	517.75
21	518-524	519.25	523.75
22	524-530	525.25	529.75
23	530-536	531.25	535.75
24	536-542	537.25	541.75
25	542-548	543.25	547.75
26	548-554	549.25	553.75
27	554-560	555.25	559.75
28	560-566	561.25	565.75
29	566-572	567.25	571.75
30	572-598	573.25	577.75
31	578-584	579.25	583.75

Ch	frequency range	F_p	F_s
32	584-590	585.25	589.75
33	590-596	591.25	595.75
34	596-602	597.25	601.75
35	602-608	603.25	607.75
36	608-614	609.25	613.75
37	614-620	615.25	619.75
38	620-626	621.25	625.75
39	626-632	627.25	631.75
40	632-638	633.25	637.75
41	638-644	639.25	643.75
42	644-650	645.25	649.75
43	650-656	651.25	655.75
44	656-662	657.25	661.75
45	662-668	663.25	667.75
46	668-674	669.25	673.75
47	674-680	675.25	679.75
48	680-686	681.25	685.75
49	686-692	687.25	691.75
50	692-698	693.25	697.75
51	698-704	699.25	703.75
52	704-710	705.25	709.75
53	710-716	711.25	715.75
54	716-722	717.25	721.75
55	722-728	723.25	727.75
56	728-734	729.25	733.75
57	734-740	735.25	739.75
58	740-746	741.25	745.75
59	746-752	747.25	751.75
60	752-758	753.25	757.75
61	758-764	759.25	763.75
62	764-770	765.25	769.75

Ch = Channel
F_p = Picture carrier frequency
F_s = Sound carrier frequency

JAPAN, cable

vision IF 58.75 MHz
sound IF 54.25 MHz

Ch	vision frequency	sound frequency
C13	109.25	113.75
C14	115.25	119.75
C15	121.25	125.75
C16	127.25	131.75
C17	133.25	137.75
C18	139.25	143.75
C19	145.25	149.75
C20	151.25	155.75
C21	157.25	161.75
C22	165.25	169.75
C23	223.25	227.75
C24	231.25	235.75
C25	237.25	241.75
C26	243.25	247.75
C27	249.25	253.75
C28	253.25	257.75
C29	259.25	263.75
C30	265.25	269.75
C31	271.25	275.75
C32	277.25	281.75
C33	283.25	287.75
C34	289.25	293.75
C35	295.25	299.75
C36	301.25	305.75
C37	307.25	311.75
C38	313.25	317.75

Ch	vision frequency	sound frequency
C39	319.25	323.75
C40	325.25	329.75
C41	331.25	335.75
C42	337.25	341.75
C43	343.25	347.75
C44	349.25	353.75
C45	355.25	359.75
C46	361.25	365.75
C47	367.25	371.75
C48	373.25	377.75
C49	379.25	383.75
C50	385.25	389.75
C51	391.25	395.75
C52	397.25	401.75
C53	403.25	407.75
C54	409.25	413.75
C55	415.25	419.75
C56	421.25	425.75
C57	427.25	431.75
C58	433.25	437.75
C59	439.25	443.75
C60	445.25	449.75
C61	451.25	455.75
C62	457.25	461.75
C63	463.25	467.75

USA

vision IF 45.75 MHz
sound IF 41.25 MHz

Ch	frequency range	F_p	F_s	Ch	frequency range	F_p	F_s
2	54- 60	55.25	59.75	43	644-650	645.25	649.75
3	60- 66	61.25	65.75	44	650-656	651.25	655.75
4	66- 72	67.25	71.75	45	656-662	657.25	661.75
5	76- 82	77.25	81.75	46	662-668	663.25	667.75
6	82- 88	83.25	87.75	47	668-674	669.25	673.75
7	174-180	175.25	179.75	48	674-680	675.25	679.75
8	180-186	181.25	185.75	49	680-686	681.25	685.75
9	186-192	187.25	191.75	50	686-692	687.25	691.75
10	192-198	193.25	197.75	51	692-698	693.25	697.75
11	198-204	199.25	203.75	52	698-704	699.25	703.75
12	204-210	205.25	209.75	53	704-710	705.25	709.75
13	210-216	211.25	215.75	54	710-716	711.25	715.75
14	470-476	471.25	475.75	55	716-722	717.25	721.75
15	476-482	477.25	481.75	56	722-728	723.25	727.75
16	482-488	483.25	487.75	57	728-734	729.25	733.75
17	488-494	489.25	493.75	58	734-740	735.25	739.75
18	494-500	495.25	499.75	59	740-746	741.25	745.75
19	500-506	501.25	505.75	60	746-752	747.25	751.75
20	506-512	507.25	511.75	61	752-758	753.25	757.75
21	512-518	513.25	517.75	62	758-764	759.25	763.75
22	518-524	519.25	523.75	63	764-770	765.25	769.75
23	524-530	525.25	529.75	64	770-776	771.25	775.75
24	530-536	531.25	535.75	65	776-782	777.25	781.75
25	536-542	537.25	541.75	66	782-788	783.25	787.75
26	542-548	543.25	547.75	67	788-794	789.25	793.75
27	548-554	549.25	553.75	68	794-800	795.25	799.75
28	554-560	555.25	559.75	69	800-806	801.25	805.75
29	560-566	561.25	565.75	70	806-812	807.25	811.75
30	566-572	567.25	571.75	71	812-818	813.25	817.75
31	572-578	573.25	577.75	72	818-824	819.25	823.75
32	578-584	579.25	583.75	73	824-830	825.25	829.75
33	584-590	585.25	589.75	74	830-836	831.25	835.75
34	590-596	591.25	595.75	75	836-842	837.25	841.75
35	596-602	597.25	601.75	76	842-848	843.25	847.75
36	602-608	603.25	607.75	77	848-854	849.25	853.75
37	608-614	609.25	613.75	78	854-860	855.25	859.75
38	614-620	615.25	619.75	79	860-866	861.25	865.75
39	620-626	621.25	625.75	80	866-872	867.25	871.75
40	626-632	627.25	631.75	81	872-878	873.25	877.75
41	632-638	633.25	637.75	82	878-884	879.25	883.75
42	638-644	639.25	643.75	83	884-890	885.25	889.75

USA, cable

vision IF 45.75 MHz
sound IF 41.25 MHz

Ch		frequency range	F_p	F_s
2	2	54- 60	55.25	59.75
3	3	60- 66	61.25	65.75
4	4	66- 72	67.25	71.75
5A	1	72- 78	73.25	77.75
5	5	76- 82	77.25	81.75
6	6	82- 88	83.25	87.75
A-5	95	90- 96	91.25	95.75
A-4	96	96-102	97.25	101.75
A-3	97	102-108	103.25	107.75
A-2	98	108-114	109.25	113.75
A-1	99	114-120	115.25	119.75
A	14	120-126	121.25	125.75
B	15	126-132	127.25	131.75
C	16	132-138	133.25	137.75
D	17	138-144	139.25	143.75
E	18	144-150	145.25	149.75
F	19	150-156	151.25	155.75
G	20	156-162	157.25	161.75
H	21	162-168	163.25	167.75
I	22	168-174	169.25	173.75
7	7	174-180	175.25	179.75
8	8	180-186	181.25	185.75
9	9	186-192	187.25	191.75
10	10	192-198	193.25	197.75
11	11	198-204	199.25	203.75
12	12	204-210	205.25	209.75
13	13	210-216	211.25	215.75
J	23	216-222	217.25	221.75
K	24	222-228	223.25	227.75
L	25	228-234	229.25	233.75
M	26	234-240	235.25	239.75
N	27	240-246	241.25	245.75
O	28	246-252	247.25	251.75
P	29	252-258	253.25	257.75
Q	30	258-264	259.25	263.75
R	31	264-270	265.25	269.75
S	32	270-276	271.25	275.75
T	33	276-282	277.25	281.75
U	34	282-288	283.25	287.75
V	35	288-294	289.25	293.75
W	36	294-300	295.25	299.75

Ch		frequency range	F_p	F_s
AA	37	300-306	301.25	305.75
BB	38	306-312	307.25	311.75
CC	39	312-318	313.25	317.75
DD	40	318-324	319.25	323.75
EE	41	324-330	325.25	329.75
FF	42	330-336	331.25	335.75
GG	43	336-342	337.25	341.75
HH	44	342-348	343.25	347.75
II	45	348-354	349.25	353.75
JJ	46	354-360	355.25	359.75
KK	47	360-366	361.25	365.75
LL	48	366-372	367.25	371.75
MM	49	372-378	373.25	377.75
NN	50	378-384	379.25	383.75
OO	51	384-390	385.25	389.75
PP	52	390-396	391.25	395.75
QQ	53	396-402	397.25	401.75
RR	54	402-408	403.25	407.75
SS	55	408-414	409.25	413.75
TT	56	414-420	415.25	419.75
UU	57	420-426	421.25	425.75
VV	58	426-432	427.25	431.75
WW	59	432-438	433.25	437.75
AAA	60	438-444	439.25	443.75
BBB	61	444-450	445.25	449.75
CCC	62	450-456	451.25	455.75
DDD	63	456-462	457.25	461.75
EEE	64	462-468	463.25	467.75
	65	468-474	469.25	473.75
	66	474-480	475.25	479.75
	67	480-486	481.25	485.75
	68	486-492	487.25	491.75
	69	492-498	493.25	497.75
	70	498-504	499.25	503.75
	71	504-510	505.25	509.75
	72	510-516	511.25	515.75
	73	516-522	517.25	521.75
	74	522-528	523.25	527.75
	75	528-534	529.25	533.75
	76	534-540	535.25	539.75
	77	540-546	541.25	545.75

USA, cable

vision IF 45.75 MHz
sound IF 41.25 MHz

Ch	frequency range	F_p	F_s
78	546-552	547.25	551.75
79	552-558	553.25	557.75
80	558-564	559.25	563.75
81	564-570	565.25	569.75
82	570-576	571.25	575.75
83	576-582	577.25	581.75
84	582-588	583.25	587.75
85	588-594	589.25	593.75
86	594-600	595.25	599.75

Ch	frequency range	F_p	F_s
87	600-606	601.25	605.75
88	606-612	607.25	611.75
89	612-618	613.25	617.75
90	618-624	619.25	623.75
91	624-630	625.25	629.75
92	630-636	631.25	635.75
93	636-642	637.25	641.75
94	642-648	643.25	647.75

Ch = Channel
F_p = Picture carrier frequency
F_s = Sound carrier frequency

CHINA

picture IF 37.0 MHz
sound IF 30.5 MHz

Ch	frequency range	F_p	F_s
1	48.5-56.5	49.75	56.25
2	56.5-64.5	57.75	64.25
3	64.5-72.5	65.75	72.25
4	76- 84	77.25	83.75
5	84- 92	85.25	91.75
6	167-175	168.25	174.75
7	175-183	176.25	182.75
8	183-191	184.25	190.75
9	191-199	192.25	198.75
10	199-207	200.25	206.75
11	207-215	208.25	214.75
12	215-223	216.25	222.75
13	470-478	471.25	477.75
14	478-486	479.25	485.75
15	486-494	487.25	493.75
16	494-502	493.25	501.75
17	502-510	503.25	509.75
18	510-518	511.25	517.75
19	518-526	519.25	525.75
20	526-534	527.25	533.75
21	534-542	535.25	541.75
22	542-550	543.25	549.75
23	550-558	551.25	557.75
24	558-566	559.25	565.75
25	606-614	607.25	613.75
26	614-622	615.25	621.75
27	622-630	623.25	629.75
28	630-638	631.25	637.75
29	638-646	639.25	645.75

Ch	frequency range	F_p	F_s
30	646-654	647.25	653.75
31	654-662	655.25	661.75
32	662-670	663.25	669.75
33	670-678	671.25	677.75
34	678-686	679.25	685.75
35	686-694	687.25	693.75
36	694-702	695.25	701.75
37	702-710	703.25	709.75
38	710-718	711.25	717.75
39	718-726	719.25	725.75
40	726-734	727.25	733.75
41	734-742	735.25	741.75
42	742-750	743.25	749.75
43	750-758	751.25	757.75
44	758-766	759.25	765.75
45	766-774	767.25	773.75
46	774-782	775.25	781.75
47	782-790	783.25	789.75
48	790-798	791.25	797.75
49	798-806	799.25	805.75
50	806-814	807.25	813.75
51	814-822	815.25	821.75
52	822-830	823.25	829.75
53	830-838	831.25	837.75
54	838-846	839.25	845.75
55	846-854	847.25	853.75
56	854-862	855.25	861.75
57	862-870	863.25	869.75

FRANCE

vision IF 32.7 MHz
sound IF 39.2 MHz

Ch	F_p	F_s
FA	47.75	41.25
FB	55.75	49.25
FC1	60.50	54.00
FC	63.75	57.25
F1	176.00	182.50
F2	184.00	190.50
F3	192.00	198.50
F4	200.00	206.50
F5	208.00	214.50
F6	216.00	222.50

USSR and OIRT MEMBERS

vision IF 38.0 MHz
sound IF 31.5 MHz

Ch	F_p	F_s
R1	49.75	56.25
R2	59.25	65.75
R3	77.25	83.75
R4	85.25	91.75
R5	93.25	99.75
R6	175.25	181.75
R7	183.25	189.75
R8	191.25	197.75
R9	199.25	205.75
R10	207.25	213.75
R11	215.25	221.75
R12	223.25	229.75

IRELAND

vision IF 39.5 MHz
sound IF 33.5 MHz

Ch	F_p	F_s
A	45.75	51.75
B	53.75	59.75
C	61.75	67.75
D	175.25	181.25
E	183.25	189.25
F	191.25	197.25
G	199.25	205.25
H	207.25	213.25
J	215.25	221.25

UK

vision IF 39.5 MHz
sound IF 33.5 MHz

Ch	F_p	F_s
B1	45.00	41.50
B2	51.75	48.25
B3	56.75	53.25
B4	61.75	58.25
B5	66.75	63.25
B6	179.75	176.25
B7	184.75	181.25
B8	189.75	186.25
B9	194.75	191.25
B10	199.75	196.25
B11	204.75	201.25
B12	209.75	206.25
B13	214.75	211.25
B14	219.75	216.25

ITALY

vision IF 38.9 MHz
sound IF 33.4 MHz

Ch	F_p	F_s
A	53.75	59.25
B	62.25	67.75
C	82.25	87.75
D	175.25	180.75
E	183.75	189.25
F	197.25	192.75
G	201.25	206.75
H	210.25	215.75
H1	217.25	222.75
H2	224.25	229.75

FRENCH OVERSEAS TERRITORIES

vision IF 40.2 MHz
sound IF 33.7 MHz

Ch	F_p	F_s
K4	175.25	181.75
K5	183.25	189.75
K6	191.25	197.75
K7	199.25	205.75
K8	207.25	213.75
K9	215.25	221.75

INDONESIA

vision IF 38.9 MHz
sound IF 33.4 MHz

Ch	F_p	F_s
1A	44.25	49.75
2	55.25	60.75
3	62.25	67.75
4	175.25	180.75
5	182.25	187.75
6	189.25	194.75
7	196.25	201.75
8	203.25	208.75
9	210.25	215.75
10	217.25	222.75
11	224.25	229.75

NEW ZEALAND

vision IF 38.9 MHz
sound IF 33.4 MHz

Ch	F_p	F_s
1	45.25	50.75
2	55.25	60.75
3	62.25	67.75
4	175.25	180.75
5	182.25	187.75
6	189.25	194.75
7	196.25	201.75
8	203.25	208.75
9	210.25	215.75

TAIWAN

vision IF 45.75 MHz
sound IF 41.25 MHz

Ch	F_p	F_s
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

CHILE

vision IF 45.75 MHz
sound IF 41.25 MHz

Ch	F_p	F_s
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.75	191.75
10	193.75	197.75
11	199.75	203.75
12	205.75	209.75
13	211.75	215.75

AUSTRALIA

vision IF 36.875 MHz
sound IF 31.375 MHz

Ch	F_p	F_s
0	46.25	51.75
1	57.25	62.75
2	64.25	69.75
3	86.25	91.75
4	95.25	100.75
5	102.25	107.75
5A	138.25	143.75
6	175.25	180.75
7	182.25	187.75
8	189.25	194.75
9	196.25	201.75
10	209.25	214.75
11	216.25	221.75

Ch = Channel
F_p = Picture carrier frequency
F_s = Sound carrier frequency

ANGOLA

vision IF 39.5 MHz
sound IF 33.5 MHz

Ch	F_p	F_s
1	43.25	49.25
2	52.25	58.25
3	60.25	66.25
4	175.25	181.25
5	183.25	189.25
6	191.25	197.25
7	199.25	205.25
8	207.25	213.25
9	215.25	221.25
10	223.25	229.25

IVORY COAST

vision IF 38.0 MHz
sound IF 31.5 MHz

Ch	F_p	F_s
1	43.25	49.75
2	52.25	58.75
3	60.25	66.75
4	175.25	181.75
5	183.25	189.75
6	191.25	197.75
7	199.25	205.75
8	207.25	213.75
9	215.25	221.75

SOUTH AFRICA

vision IF 38.9 MHz
sound IF 32.9 MHz

Ch	F_p	F_s
4	175.25	181.25
5	183.25	189.25
6	191.25	197.25
7	199.25	205.25
8	207.25	213.25
9	215.25	221.25
10	223.25	229.25
11	231.25	237.25
12		
13	247.43	253.43

MOROCCO

vision IF 38.9 MHz
sound IF 33.4 MHz

Ch	F_p	F_s
M4	163.25	168.75
M5	171.25	176.75
M6	179.25	184.75
M7	187.25	192.75
M8	195.25	200.75
M9	203.25	208.75
M10	211.25	216.75
E2	48.25	53.75
E4	62.25	67.75
E5	175.25	180.75
E8	196.25	201.75
E12	224.25	229.75

Ch = Channel
F_p = Picture carrier frequency
F_s = Sound carrier frequency

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DATA HANDBOOK SYSTEM

Data handbook system

INTRODUCTION

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