

DATA SHEET

TD(M)1300AL
Tuner module for
digital terrestrial (OFDM) applications

Product specification

Approved by : *SKILICE*
Name / Date : *SKILICH / 07.08.2003*

PHILIPS

Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

FEATURES



- Highly integrated RF-module, UHF modulator plus active loopthrough plus 3-band tuner
- +5V supply voltage only; no external tuning voltage required
- Tuners for horizontal and vertical mounting available
- Option with DC – power output through input connector (e.g. indoor antenna supply)
- Tuners comply with relevant CENELEC standards with regard to requirements concerning signal handling capability and immunity
- Superior low noise and high sensitivity performance

- RF-in to RF-out loopthrough amplifiers
 - Low noise and excellent linearity
 - Full VHF to UHF frequency range coverage
 - Standard connectors for in- and output e.g. IEC, F-connector, RCA

- UHF PAL modulator
 - Full UHF frequency coverage
 - PAL B,G and PAL I sound subcarriers are addressable
 - Pattern generator included
 - I²C programmable
 - 400kHz Bus compliant
 - Stand-by mode addressable

- High performance and cost effective single conversion tuner
 - I²C programmable
 - 400kHz Bus compliant
 - Fast PLL tuning speed (programmable step size e.g. 62.5kHz and 166.67kHz)
 - Tuner internal gain control loop with selectable TakeOverPoint settings via I²C Bus
 - External gain control possible with internal loop disabled
 - 4.0V (max. gain) to 0V (min. gain) gain control voltage
 - Flat overall frequency response
 - High PLL loop bandwidth which ensures very low oscillator phase noise
 - 4 MHz crystal reference frequency output
 - SAW-filter and IF-amplifier included
 - Switchable 7/8 MHz SAW filter (full band tuners)
 - Fixed 8 MHz SAW filter (UHF only tuners)
 - IF-amplification controllable over a wide range

- Differential, filtered (SAW) 'digital' IF-output to directly drive the channel decoder

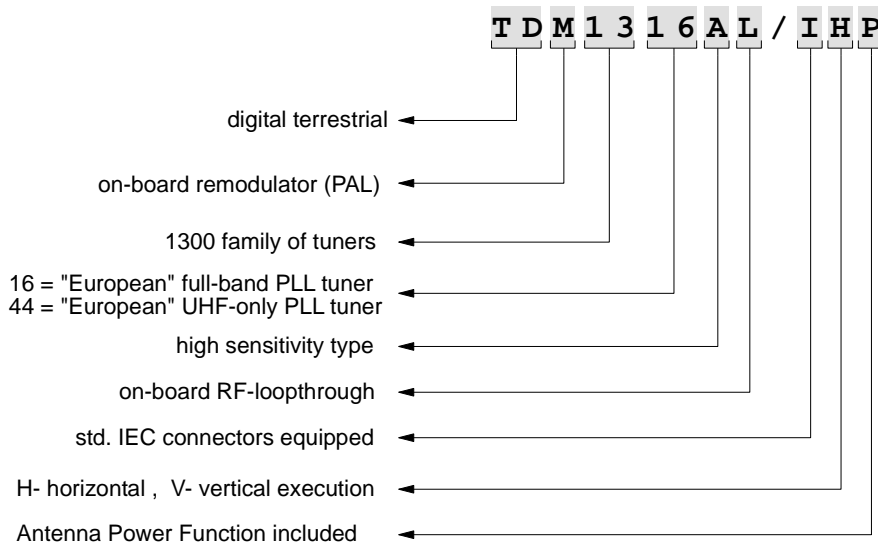
- Unbalanced, not filtered output

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TD(M)1300AL

ORDERING INFORMATION

Type name convention:



	Type name	Code number	Specialities
VHF – UHF full-band PLL tuner	With remodulator		
	<i>TDM1316AL/IHP</i>	3112 297 13501	“Antenna power” and 4MHz ref. output inclusive
	<i>TDM1316AL/IVP</i>	3112 297 13571	“Antenna power” and 4MHz ref. output inclusive
	Without remodulator		
	<i>TD1316AL/IVP</i>	3112 297 13491	“Antenna power” and 4MHz ref. output inclusive
	<i>TD1316AL/IHP</i>	3112 297 13561	“Antenna power” and 4MHz ref. output inclusive
UHF - only PLL tuner	With remodulator		
	<i>TDM1344L/IHP</i>	3112 297 13131	“Antenna power” and 4MHz ref. output incl.
	<i>TDM1344L/IVP</i>	3112 297 13121	“Antenna power” and 4MHz ref. output incl.
	<i>TDM1344L/IH</i>	3112 297 13601	Special version with pin1 connected to TV-output; no antenna power; no 4MHz ref. output
	<i>TDM1344L/IV</i>	3112 297 13591	Special version with pin1 connected to TV-output; no antenna power; no 4MHz ref. output
	Without remodulator		
	<i>TD1344L/IV</i>	3112 297 13581	Special version with pin1 connected to TV-output; no antenna power; no 4MHz ref. output

Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

PRODUCT DESCRIPTION

TDM1300AL are tuners out of the new generation of high performance devices designed to cope with the digital terrestrial COFDM transmission standard.

Function wise these tuners can be divided into three high-frequency sections, RF-loopthrough, PAL remodulator and the single conversion tuner part.

Broadband amplifiers are used in the RF-loopthrough section.

The loopthrough frequency response covers the entire frequency range from VHF to UHF.

Instead of the standard IEC-male connector for RF-output, this RF-output can optionally be rerouted to one of the pin-terminals at the bottom side.

The PAL remodulator converts the incoming audio- video-baseband signal to the UHF range, the output frequency can be chosen via the I²C-Bus.

TV-systems are covered as there are PAL I, B, G, H and can fully be controlled via the I²C-Bus as well.

This remodulator section can be left open on special request; tuner type name is TD1316AL or TD1344L.

The RF-downstream section is equipped with a state-of-the-art, 3-band, single conversion tuner which makes use of a highly integrated mixer-oscillator-PLL tuner-IC that provides the required high level of performance which becomes necessary for COFDM signal downstream.

TD1344L tuners are restricted to the UHF range only.

The tuners are provided with a DC/DC converter to generate the tuning voltage internally.

The internal 4MHz PLL crystal reference frequency is fed through one of the pin-terminals and can be used as a reference signal for a 2nd device e.g. the channel decoder.

Two IF-outputs are provided, one is a wideband, non filtered IF-output, while the other, narrow-band IF-output is equipped with a SAW-filter and a gain controllable IF-amplifier behind, to gain back the SAW-filter losses. This narrow-IF-output is differential with a min. output level of 1Vpp and can directly drive a 2nd SAW-filter or the A-to-D converter input of the latest generation of Philips channel decoders.

TD(M)1316AL/I and TD(M)1344L/I as well are equipped with two standard IEC-connectors, RF-in is IEC-female, RF-out is IEC-male.

The tuner housing is available in a vertical mountable and a horizontal mountable execution also.

Apart from the RF-connectors, all other terminals are made with wire pins at the bottom side of the tuner.

Frequency allocation table:

	TDM1316AL / TD1316AL	TDM1344L / TD1344L
RF frequency range	51MHz – 858MHz ^(*)	474MHz – 858MHz ^(*)
Channel bandwidth	7/8MHz	8 MHz
RF-loopthrough range	ch E2 - ch E69	ch E2 - ch E69
Modulator range (for tuners with modulator only)	ch E21 - ch E69	ch E21 - ch E69
IF-center frequency	36.13MHz	36.13MHz
RF input connector	IEC female	IEC female
RF output connector	IEC male	IEC male

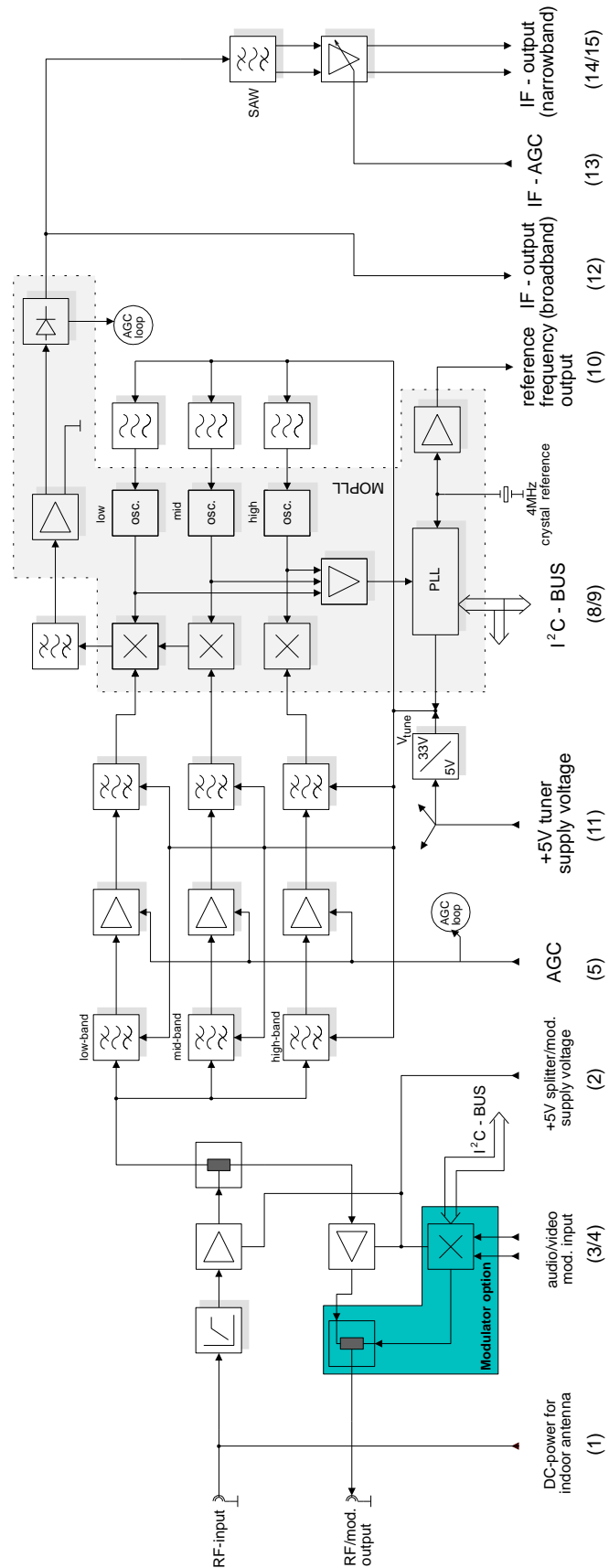
^(*) data refer to RF-channel center frequency.

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BLOCK DIAGRAMM

Tuners TD(M)1316L

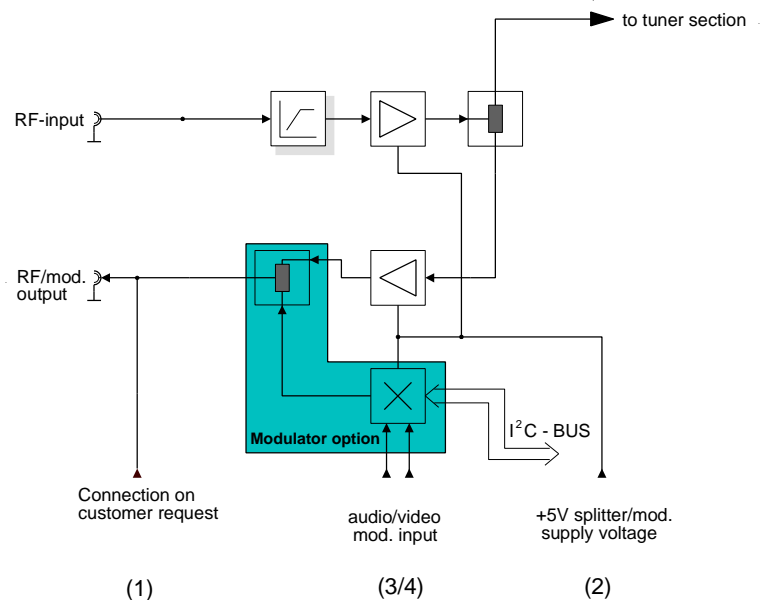


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BLOCK DIAGRAMM

Special execution tuners TDM1344L/IV , TDM1344L/IH and TD1344L/IV



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RATINGS

Environmental conditions

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
Non-operational Conditions					
T_{AMB}	Ambient temperature		-25	+85	°C
RH	Relative humidity		-	95	%
g_B	Bump acceleration	25g	-	245	m/s ²
g_S	Shock acceleration	50g	-	490	m/s ²
	Vibration amplitude	10 to 55 Hz	-	0.35	mm
Operational conditions					
T_{AMB}	Ambient temperature		-10	+60	°C
RH	Relative humidity		-	95	%

Limiting values under operational conditions

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

SYMBOL	PARAMETER	PIN	MIN	TYP.	MAX.	UNIT	
V_L	DC-loopthrough to input connector (optional)	1			20	V	
I_L	Max. permissible current				100	mA	
V_S	Loopthrough / modulator supply voltage	2	4.75	5.00	5.25	V	
I_S	Relevant supply current			115	127	mA	
V_S	Loopthrough (tuners without remodulator)	2	4.75	5.00	5.25	V	
I_S	Relevant supply current			-	30	37	mA
V_{TU}	Tuner supply voltage	11	4.75	5.00	5.25	V	
I_{TU}	Relevant supply current			-	155	170	mA
V_{AGC}	Tuner AGC input voltage	5	-	4.0	4.5	V	
ΔV_{AGC}	AGC input voltage range			0.3	-	4.0	V
I_{AGC}	AGC control current (at 0V AGC voltage)			-2	-	-	mA
V_{IF-AGC}	IF- AGC input voltage	13	-	3.0	4.0	V	
ΔV_{IF-AGC}	IF- AGC input voltage range			0	-	3.5	V
I_{IF-AGC}	IF- AGC input current			-	-	10	µA
V_{AS}	Address select input voltage	7	-	-	5.25	V	
V_{SCL}	Serial clock input voltage	8	-0.3	-	5.25	V	
V_{SDA}	Serial data input voltage	9	-0.3	-	5.25	V	
I_{SDA}	Serial data input current			-1	-	5	mA

Tuner module for digital terrestrial (OFDM) applications

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SPECIFICATION DATA

If not otherwise stated the electrical performance refers to:

- ambient temperature : 22°C ±2°C
- relative humidity : 60% ±10%
- supply voltages : 5V ±0.1V
- RF-gain control voltage : 4.0V ±0.1V (internal AGC detector disabled; see application notes)
- IF-gain control voltage : 1V max.
- RF-input termination : 75 ohms
- RF-output termination : 75 ohms

Next specification data refer to the overall performance from RF-input to IF-output.

If not otherwise stated, all data are assigned to broadband IF-output.

The tuner has to be tuned as such that coincidence between RF-channel center and IF-center frequency of 36.13MHz is given.

	MIN.	TYP.	MAX.
Frequency ranges (VHF/UHF) ⁽¹⁾ (VHF low) low-band (VHF high) mid-band (UHF) high-band UHF only tuners	49MHz 162MHz 448MHz 474MHz		159MHz 444MHz 861MHz 861MHz
RF power gain ⁽²⁾	47dB	50dB	
Overall gain taper		6dB	
RF AGC range Low band Mid band High band	40dB 40dB 35dB		
Image rejection (referred to IF-center frequency) (VHF low) low-band (VHF high) mid-band (UHF) high-band	66dB 66dB 55dB	70dB 70dB 60dB	
Osc. voltage at aerial input (f < 1000MHz)		<20dBµV	
RF-input return loss (75ohms)	5dB	>7dB	
In-channel return loss ⁽³⁾		8dB	
Overloading causing 1dB gain compression		76dBµV	
Noise figure (at nom. gain)		5dB	7dB
ESD protection of terminals	2kV		
Surge protection at RF-input	5kV		
Osc. phase noise ⁽⁴⁾ (1kHz) (10kHz)		-88dBc/Hz -90dBc/Hz	-78dBc/Hz -82dBc/Hz
Overall voltage gain ⁽⁵⁾		77dB	

Note 1: channel center including tuning margin

Note 2: to be measured at 'broadband' IF-output with 75ohms load

Note 3: to be measured at RF-input in the range channel-center ± 3MHz

Note 4: PLL step size 166.667kHz; CP as recommended (see application notes)

Note 5: measured at terminals 14/15; IF-AGC voltage (terminal 13) set to 3V

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TD(M)1300AL

Cross-modulation:

Definition: The cross-modulation is defined as the transfer of the adjacent channels' modulation depth to the wanted carrier.

Measurement:

Unwanted carriers (f_{unw}) = wanted carrier (f_w) \pm 8MHz
 Level of all carriers = 70dB μ V
 Modulation = AM, 50%, 15kHz
 IF-output loaded with 1k Ω // 15pF // 1.2uH (load compensation)
 IF-output level limited to 104dB μ V

Spec. limit: max. cross-modulation is less or equal 1% (typ. 0.3%)

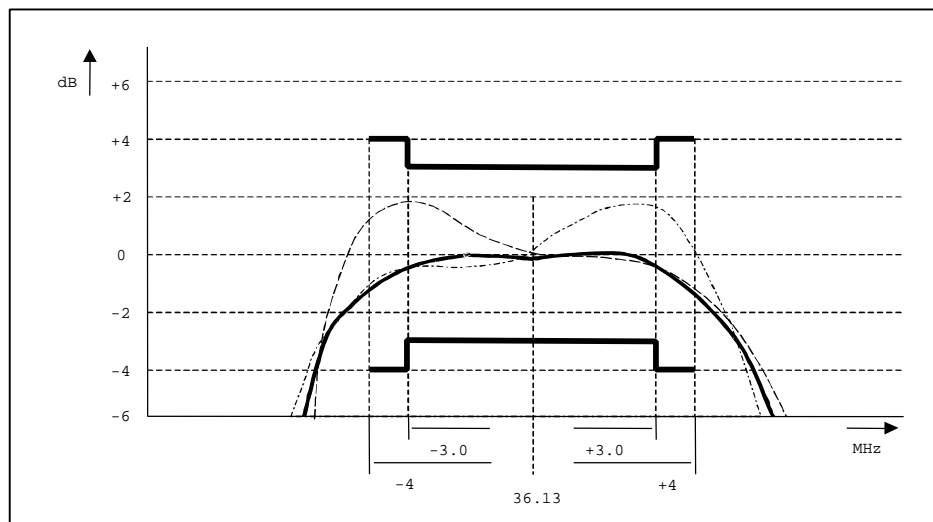
Flatness (tilt) of overall responds curve (to be measured at broad-band IF-output):

Definition: tilt of curve is defined in the specified IF-range from highest to lowest gain point at nom. gain

Measured at broadband IF-output:

in the range IF-center \pm 3MHz : 3dB max.
 in the range IF-center \pm 4MHz : 4dB max.

Deterioration of flatness during AGC (0dB to 30dB) : 1.0dB max.



Input sensitivity:

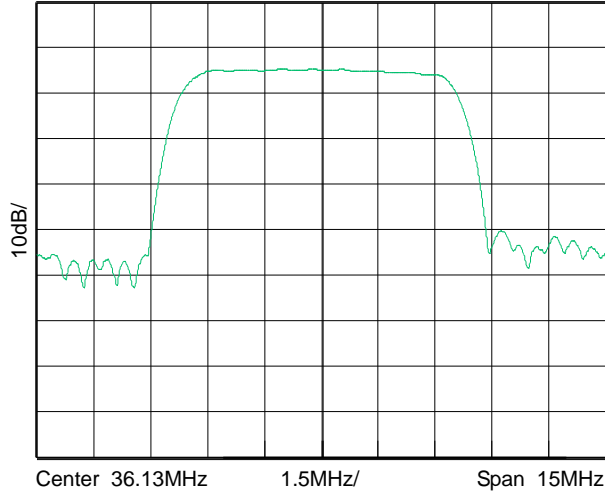
The typical input sensitivity, when measured in an adequate application (i.e. Philips Semiconductors COFDM reference board OM5754) is: - 82dBm , BER 2×10^{-4} post Viterbi

Conditions: Gaussian channel w/o added noise, 8k OFDM, 64QAM, code rate 2/3, guard interval 1/8

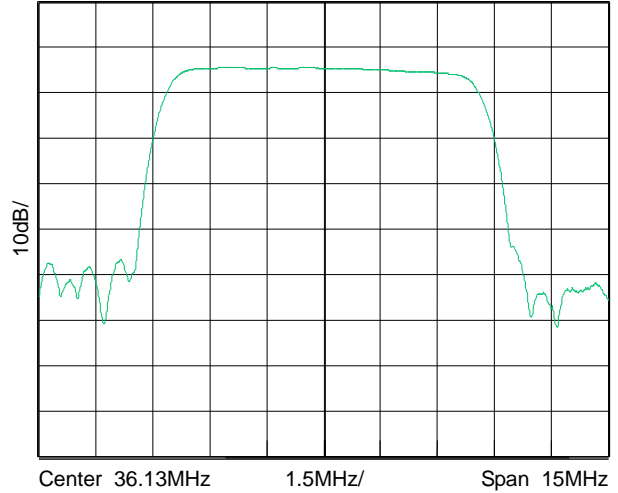
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TD(M)1300AL

Typical response curves at narrowband IF-output (tuner set to 470MHz):



7MHz wide SAW-filter selected



8MHz wide SAW-filter selected (UHF only tuners)

4MHz reference output (terminal 10):

- Frequency accuracy : 80ppm max.
- Max. permissible load : t.b.f.
- Output level : 440mVpp typ.
- [0°C - 60°C ;
- supply voltage (terminal 11) +5V±5% ;
- loaded with min. t.b.d.]
- Phase Noise @ 1kHz : -104dBc/Hz typ.

Next specification data refer to the overall performance from RF-input to RF-output. (valid for all tuners out of this family)

	MIN.	TYP.	MAX.
Frequency range (referred to channel center)	51MHz		858MHz
Power gain		3dB	
Overall gain taper		2.5dB	
Noise figure (tuners w/o remod) (tuners w. remod)		5dB 6dB	
CSO / CTB (acc. EN50083)	-57dBc		
RF-output return loss (referred to 75W)		10dB	

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TD(M)1300AL

Next specification data is assigned to tuners with remodulator.

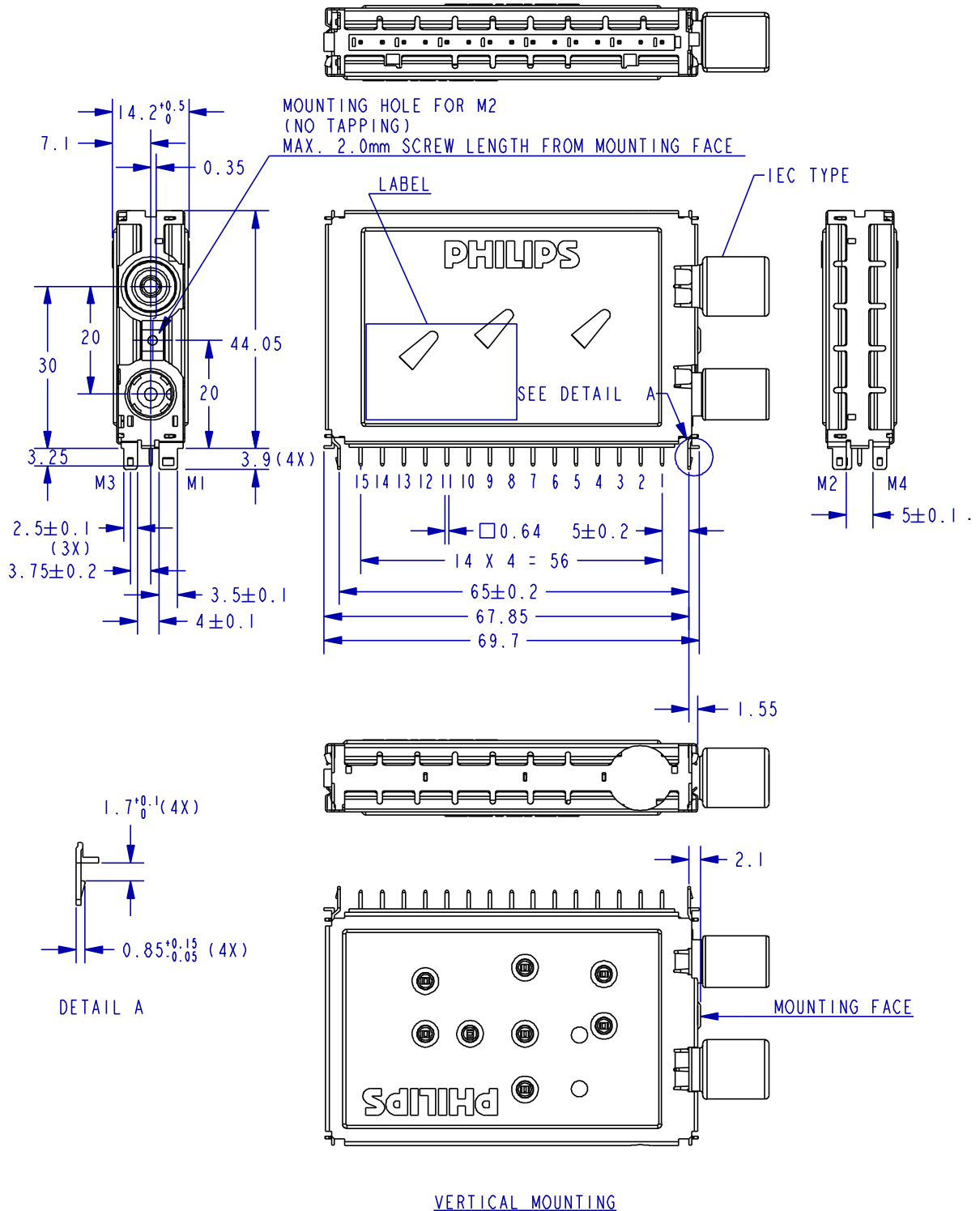
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Zi(audio)	Z audio-in		45	53	61	k Ω
Vi(audio)	Audio input level			0.23		Vrms
Vo(audio)	Deviation from ideal Audio freq. Response	F=0.1-10kHz including pre-emphasis circuit (FM)			3	dB
S/N(audio)	Audio signal to noise	EBU color bar 75% Weighting filter CCIR468-2	45	50		dB
D(audio)	Audio distortion	0.23Vrms, 1kHz sine wave			3	%
Fc(sound)	Sound carrier frequency accuracy	W/n +/- 8kHz	4492	5500	5508	kHz
ΔF (1kHz)	Deviation at 1 kHz (FM)	0.23Vrms audio-in		40		kHz
Zi(video)	Z video-in input		500			k Ω
Vi(video)	Video-in level (p-p)			1		Vp-p
M(video)	PAL video modulation depth	1Vp-p, negative sync	75	80	88	%
ΔF (video)	Deviation from ideal video frequency characteristic	Fvideo = 0.5...4.3MHz			2	dB
Vo(RF,video)	RF-out video level		65		76	dB μ V
PS	Picture to Sound distance	PS bit set to 0 PS bit set to 1		16 12		dB dB
S/N(video)	Video signal to noise ratio	Unweighted	45			dB
Gdiff	Differential gain	APL= 10 to 90%			7	%
Φ diff	Differential phase	APL= 10 to 90%			7	deg.
	Video carrier frequency	48.25...855.25MHz	21		69	CH.
	Video carrier freq accuracy		-100		100	kHz
	Thermal Stability of Video carrier frequency	Tamb = 0° to 60° C	-100		100	kHz
	Thermal stability of Sound carrier frequency	Tamb = 0° to 60° C	-12		12	kHz
	Thermal Stability of RF video output level	Tamb = 0° to 60° C	-5		5	dB
	Thermal Stability of Sound carrier output level	Tamb = 0° to 60° C	-5		5	dB
	Out of band spurious			-60	-42	dB
	In band spurious			-65	-60	dB
	Video carrier and harmonics at CATV- input	< 2150MHz			46	dB μ V
	Harmonics of Video carrier at TV-output	<2150MHz			46	dB μ V

Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

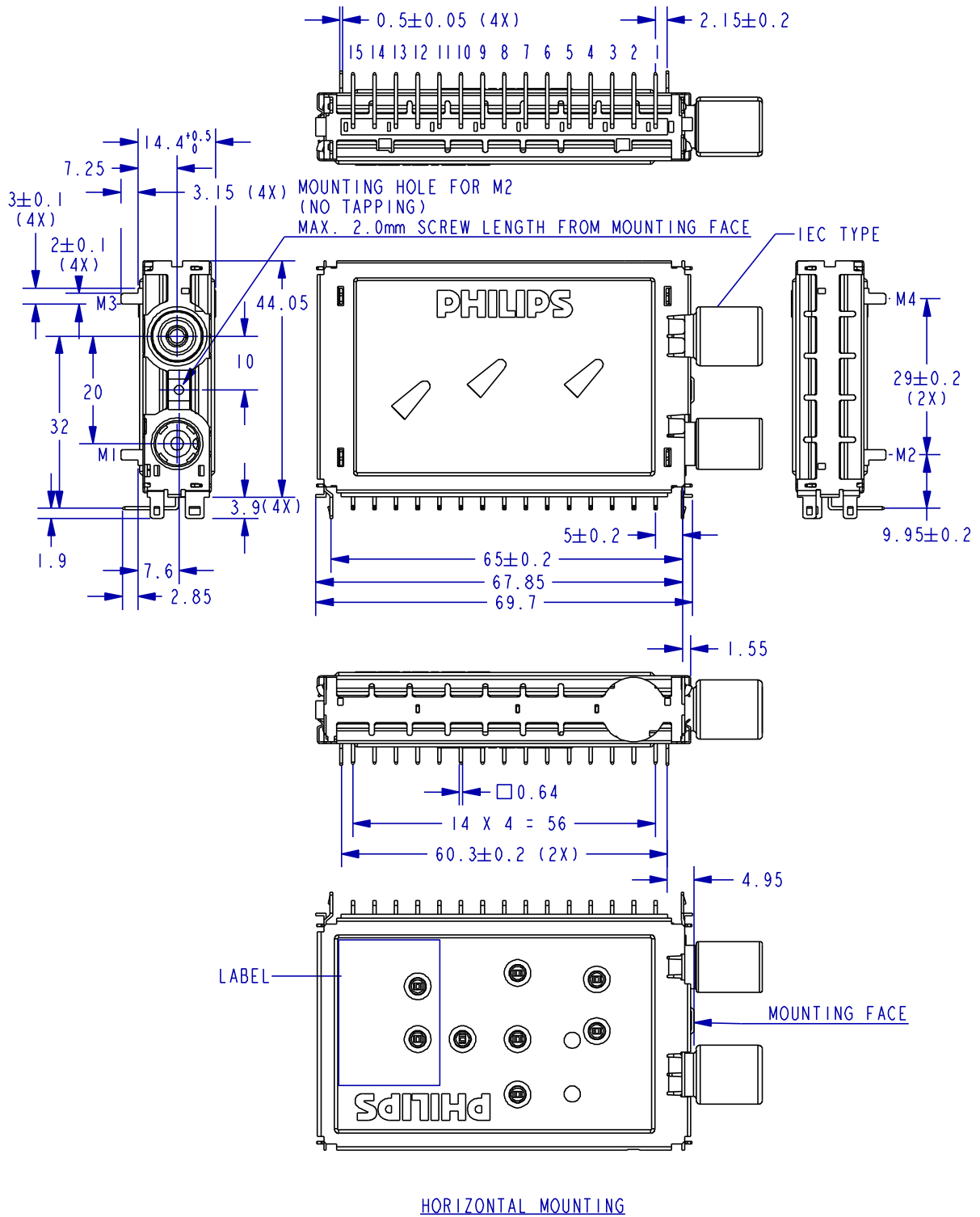
MECHANICAL DIMENSIONS

general tolerances $\pm 0.5\text{mm}$ unless otherwise stated / all dimensions in millimeter / drawings not to scale



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TD(M)1300AL

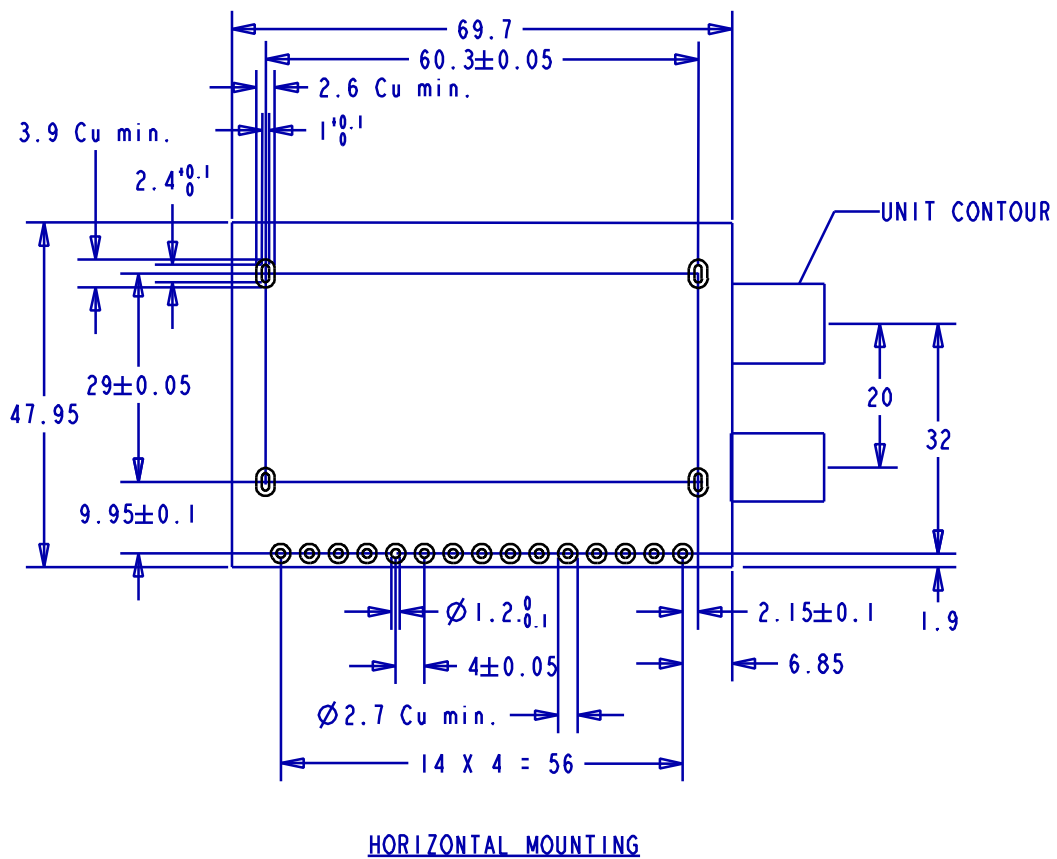
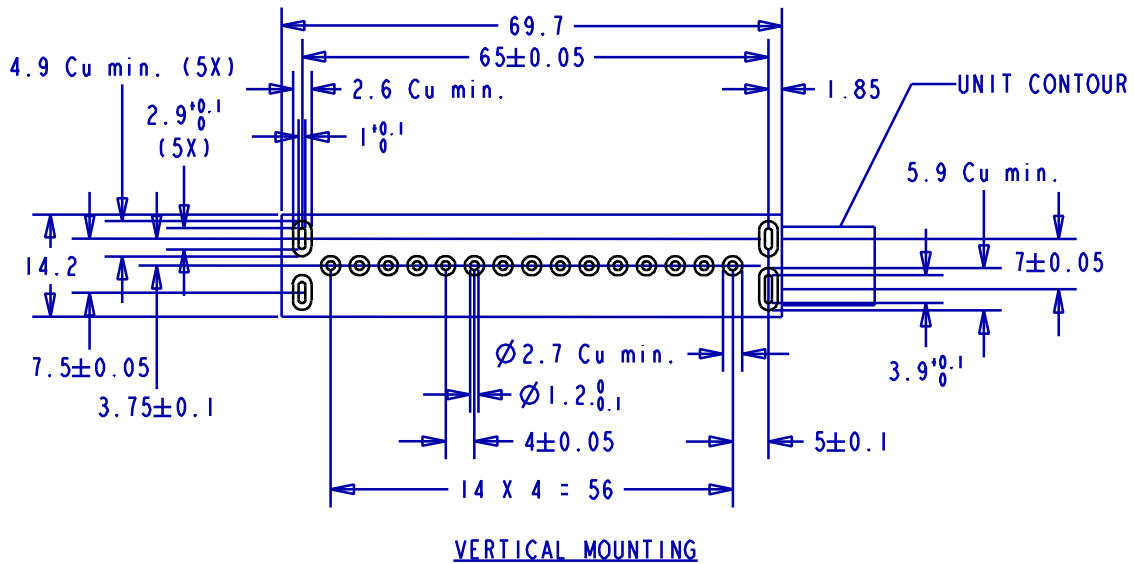


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PUNCHING PATTERN OF CHASSIS PCB

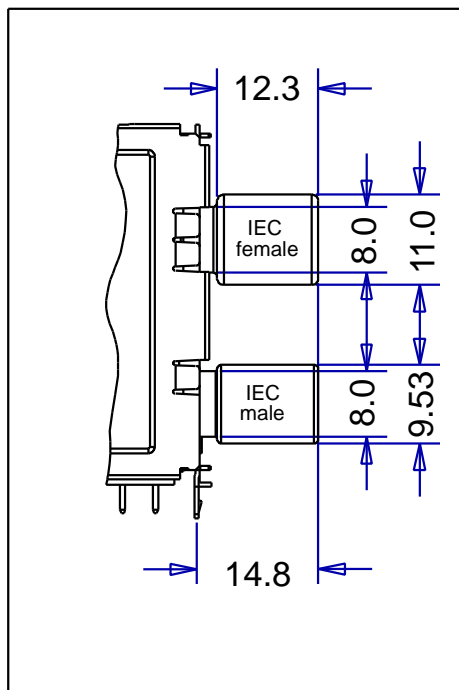
PUNCHING PATTERN SEEN FROM SOLDER SIDE



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TD(M)1300AL

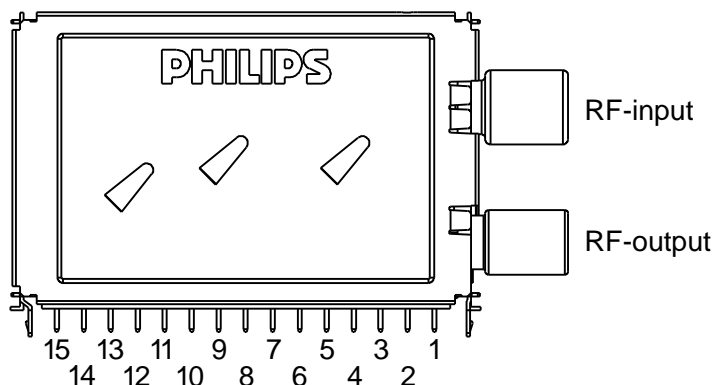
RF-connector data; RF-input is standard IEC female; RF-output is standard IEC male:



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TD(M)1300AL

DEFINITION OF TERMINALS / SUPPLY DATA



Terminal	Function	Remark
1	DC-power option for tuners with P-extension	Max. permissible current: 100mA
	Option: DC-connection to TV-output terminal (only for TDM1344L/IH, TDM1344L/IV, TD1344L/IV)	Special version on customer request
2	+5V ± 5% splitter / modulator supply voltage	max. current = 127mA (for tuners w. remodulator) max. current = 40mA (for tuners w/o remodulator)
3	Audio - baseband input (not connected for tuners w/o remodulator)	AC - coupled
4	Video - baseband input (not connected for tuners w/o remodulator)	AC - coupled
5	External RF-gain control voltage (0.5V - 4.0V)	Max. permissible control voltage source impedance limited to 200ohms (see application notes)
6	do not connect, leave terminal open	for testing only
7	PLL chip address select (I ² C / tuner)	see application notes
8	SCL (I ² C / tuner)	
9	SDA (I ² C / tuner)	
10	4MHz reference frequency output;	AC coupled
11	+5V ± 5% supply tuner (V _{TU})	max. current = 170mA
12	'broadband' IF - output	AC coupled
13	IF-gain control voltage	max. gain at 3V min. gain at 0V (see application notes)
14	'narrowband' IF - output	AC coupled
15	'narrowband' IF - output	AC coupled

Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

APPLICATION NOTES

Programming of tuner PLL

The tuner control (frequency selection and band switching) is done via the I²C bus.

One address byte and four data bytes are needed to fully program the tuner.

A PLL lock flag can be read from the tuner during 'READ' - mode.

Four independent PLL addresses are available; which one is actually valid depends on the address select voltage that is connected to terminal 7.

TD(M)1316AL tuners comply to the 5V I²C – Bus specification.

I²C-bus data format , 'WRITE' - mode:

NAME	BYTE	MSB						LSB			ACK
Addressbyte	1	1	1	0	0	0	CA1	CA0	R/W=0	A	
Prog. Divider Byte 1	2	0	N14	N13	N12	N11	N10	N9	N8	A	
Prog. Divider Byte 2	3	N7	N6	N5	N4	N3	N2	N1	N0	A	
Control Data Byte 1	4	1	D/A =1	0	0	1	R2	R1	R0	A	
	4	1	D/A = 0	0	0	ATC	AL2	AL1	AL0	A	
Control Data Byte 2	5	CP2	CP1	CP0	SP5	SP4	SP3	SP2	SP1	A	

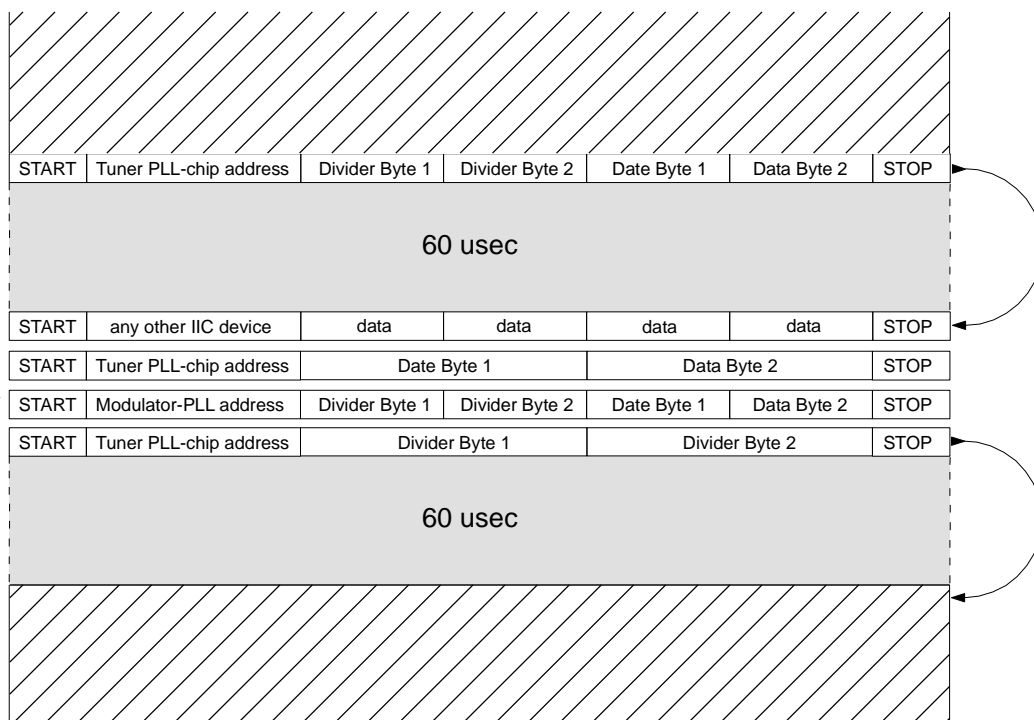
A = acknowledge

Timing of program sequences:

Because of the Tuner – PLL frequency divider settling time of min. 60usec. , the occurrence of any other I²C traffic start condition present within that periode on the Bus will disturb the divider and result in a not properly tuned tuner VCO.

Each time the Tuner-PLL frequency divider has been programmed, a 60usec wait becomes necessary before continuing the I²C bus traffic.

Following table demonstrates a correct program sequence:



Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

Description of used symbols:

- CA1, CA0 : chip address selection bits (see table: Programmable address selection bits)
- R/W : Read / Write bit ; Bit = 0 ⇒ Write mode
Bit = 1 ⇒ Read mode
- N14 to N0 : LO frequency divider bits
- D/A : D/A = 1 ⇒ following 6 bits contain test and reference divider ratio data
D/A = 0 ⇒ following 6 bits contain AGC setting data
- R2, R1, R0 : reference divider bits (see table: Reference Divider Settings)
- ATC : AGC time constant data bit; only valid with int. AGC loop active
ATC = 1 ⇒ enables fast tuning speed during channel search mode
ATC = 0 ⇒ recommended after channel acquisition; normal mode
- AL2, AL1, AL0 : AGC Take-Over-Point bits (see table: Internal AGC loop TOP)
- CP2, CP1, CP0 : PLL charge pump current selection bits (see table: Charge Pump Settings)
- SP5 SP1 : Switch ports; bit = 1 ⇒ port V_{out} is 'ON'
bit = 0 ⇒ port V_{out} is 'OFF'
(see table: Band and SAW-filter selection table)

CA1, CA0: Programmable address selection bits

CA1	CA0	Voltage applied to terminal 7
0	0	0V to 0.1xV _{TU}
0	1	terminal open
1	0	0.4xV _{TU} to 0.6xV _{TU}
1	1	0.9xV _{TU} to 1.0xV _{TU}

N14 to N0: programmable divider bits

divider ratio: $N = N14 \times 2^{14} + N13 \times 2^{13} + \dots + N1 \times 2^1 + N0$

How to calculate the divider ratio N :

$$N = \frac{(f_{input} + f_{IF}) \left[\frac{Hz}{Hz} \right]}{f_{ref}} \quad \text{whereby} \quad f_{ref} = \frac{4 \cdot 10^6}{64^{(1)}} [Hz] = 62.5 kHz$$

$$f_{ref} = \frac{4 \cdot 10^6}{24^{(1)}} [Hz] = 166.6\bar{7} kHz$$

Note ⁽¹⁾ : divider ratio to be set with Bits ' R2 R0 ' (see table below)

Do not set the divider ratio as such that the tuner is tuned into extreme conditions i.e. far below or far above the specified ranges.

Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

R2, R1, R0 : PLL reference divider settings (Control Data Byte 1):

PLL step size	PLL ref. divider ratio	R2	R1	R0
50.0 kHz	80	0	1	1
62.5 kHz	64	0	0	0
166.67 kHz	24	0	1	0

AL2, AL1, AL0 : AGC Take-Over-Point bits (Control Data Byte 1):

External AGC mode: The tuner can be controlled by an external gain control voltage applied to terminal 5 of the tuner.

In that case the ALx - bits need to be set as shown in table below.

The impedance of the control voltage source should not exceed 200ohms.

AL2	AL1	AL0	Typical TOP Level	Remarks
0	0	0	TOP = 124dBuVpp	
0	0	1	TOP = 121dBuVpp	
0	1	0	TOP = 118dBuVpp	
0	1	1	TOP = 115dBuVpp	
1	0	0	TOP = 112dBuVpp	
1	0	1	TOP = 109dBuVpp	
1	1	0	$I_{AGC} = 0$	External AGC (1)
1	1	1	$V_{AGC} = 3.5V$	Loop disabled (2)

Note 1: The tuner internal AGC current sources are disabled (default mode after power on reset).

Note 2: The tuner internal AGC detector is disabled. With no external AGC voltage applied to the tuner, the RF-gain is always set to maximum.

Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

CP2, CP1, CP0: PLL charge pump current settings

Note: during search tuning it is recommended to set the PLL to a moderate charge pump. To enable best oscillator phase noise performance during digital signal processing, the PLL charge pump current should be set to conditions as given with following table.

In analog applications the PLL charge pump current must be set to max. 60uA !

CP2	CP1	CP0	Typical CP current	Recommendations
0	0	0	40 uA	
0	0	1	60 uA	
0	1	0	90 uA	To be used during search tuning and for 50kHz, 62.5kHz PLL step sizes
0	1	1	130 uA	Low - band: 87MHz - 130MHz Mid - band: 200MHz - 290MHz High - band: 480MHz - 620MHz (*)
1	0	0	190 uA	
1	0	1	280 uA	Low - band: 130MHz - 160MHz Mid - band: 290MHz - 420MHz High - band: 620MHz - 830MHz (*)
1	1	0	410 uA	Low - band: >160MHz Mid - band: >420MHz (*)
1	1	1	600 uA	High - band: >830MHz (*)

(*) oscillator frequencies

SP5 SP1: Band and SAW-filter selection table

	SP5	SP4	SP3	SP2	SP1
Low - band	0	X	0	0	1
mid - band	0	X	0	1	0
High - band	0	X	1	0	0
7 MHz SAW - filter	0	0	X	X	X
8 MHz SAW - filter	0	1	X	X	X
UHF-only tuners 8MHz SAW – filter	0	1	1	0	0

I²C-bus data format , ' READ ' - mode:

Name	MSB					LSB			
Address byte	1	1	0	0	0	CA1	CA0	R/W=1	A
Status byte	POR	FL	0	1	AGC	1	0	0	A

A : Acknowledge

CA1 / CA0 = chip address (see address selection table)

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

FL = in-lock-flag ; FL = 1 when PLL is phase locked

AGC = internal AGC flag ; AGC = 1 when internal AGC is active

Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

Programming of remodulator PLL (only valid for tuners with remodulator)

I²C-bus data format , 'write' mode:

NAME	BYTE	BITS								ACK
		MSB				LSB				
Address byte	ADB	1	1	0	0	1	0	1	0	A
Divider byte 1	DB1	0	TPN	N11	N10	N9	N8	N7	N6	A
Divider byte 2	DB2	N5	N4	N3	N2	N1	N0	VHF1	VHF0	A
Control byte 1	CB1	1	0	STB1	0	PS	0	VHF2	0	A
Control byte 2	CB2	0	STB2	STB3	SC1	SC0	0	0	0	A

Description of symbols:

- TPN: test pattern generator bit; TPN = 0 ⇒ pattern generator off (normal operation)
TPN = 1 ⇒ pattern generator on
- N11...N0: programmable divider bits; step size = 250kHz in UHF (VHF2, VHF1, VHF0 = 0, 0, 0)
- VHF2, VHF1, VHF0 programmable prescaler bits (see table "VHF prescaler")
- PS: programmable picture to sound ratio control bit ; PS = 0 ⇒ P/S = 12dB
PS = 1 ⇒ P/S = 16dB
- STB2, STB1, STB0 = 0, 0, 0 ⇒ normal operation (see table "Stand-By")
- SC1, SC0 sound subcarrier frequency control bits (see table "Sound Subcarrier Frequencies")
- A: acknowledge bit

Important application note for tuners with modulator:

The default frequency range of the modulator output signal is restricted to UHF . In that case the CENELEC rules are covered.

For test purposes only the output range can be extended down to VHF (min. 50MHz). While operating in the VHF range, disturbances may occur at CATV input which can interfere the RF-downstream signal.

The CENELEC rules are not covered when the modulator is operating in the VHF range

'VHF prescaler' settings:

The VHF prescaler needs to be set in case the modulator output is required in the VHF frequency range (below 470MHz)

VHF2	VHF1	VHF0	Divider ratio of prescaler
0	0	0	Ratio = RF/1 ; UHF-operation; step size 250kHz
0	0	1	Ratio = RF/2
0	1	0	Ratio = RF/4
0	1	1	Ratio = RF/8
1	0	0	Ratio = RF/16

' Sound Subcarrier Frequencies ' settings:

SC1	SC0	Sound Subcarrier Frequency
0	1	5.5 MHz
1	0	6.0 MHz

Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

'Stand-By' settings:

STB1	STB2	STB3	Stand-By conditions
1	1	1	Modulator Stand-By mode: sound and UHF oscillators, and sound and video modulator sections turned off; I ² C bus section of modulator in stand-by mode

Test Pattern Generator (TPN bit) :

The MOD-IC generates a simple test pattern, which can be switched under bus control to permit a TV receiver to tune to the modulator output frequencies. The pattern consists of two white vertical bars on a black background and a 976Hz audio test signal.

How to calculate the divider ratio N:

The tuner internal 4MHz reference frequency is divided by 128 (fixed divider ratio), resulting in a remodulator reference frequency of 31.25kHz .

This reference frequency is used for both PLLs Video and Sound .

With a fixed, internal 1:8 divider, the divider ratio N for a wanted frequency F is given by:

$$N = \frac{F}{8} \cdot \frac{128}{4 \cdot 10^6} \frac{[Hz]}{[Hz]}$$

with: $N = 2048 \times N_{11} + 1024 \times N_{10} + \dots + 4 \times N_2 + 2 \times N_1 + N_0$

Note: Do not set the divider ratio as such that the UHF oscillator of the modulator is tuned into extreme conditions i.e. below or above the specified UHF range

I²C-bus data format , 'read' mode:

NAME	BYTE	BITS								ACK
		MSB				LSB				
Address byte	ADB	1	1	0	0	1	0	1	1	A
Status byte	SB	0	0	0	0	0	Y2	Y1	OOR	A

Description of symbols:

- $Y2 = 0 \Rightarrow$ UHF VCO is active
- $Y1 =$ VCO Out-Of-Range information ; $Y1^{(*)} = 0 \Rightarrow$ VCO frequency too low
 $Y1^{(*)} = 1 \Rightarrow$ VCO frequency too high
(*) only valid if OOR = 1
- OOR = VCO range status ; OOR = 0 \Rightarrow VCO in range (normal operation)
OOR = 1 \Rightarrow VCO out of range

Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

Max. IF-output level:

In order not to drive the tuner into extreme signal handling conditions, e.g. analog applications, it is recommended to set the RF-gain control loop for a max. 'broadband' IF-output level of

115dBuVpp (AL2, AL1, AL0 = 0, 1, 1)

Max. Permissible IF-load impedance:

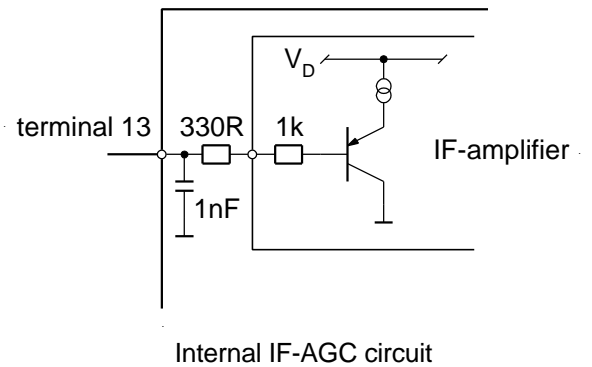
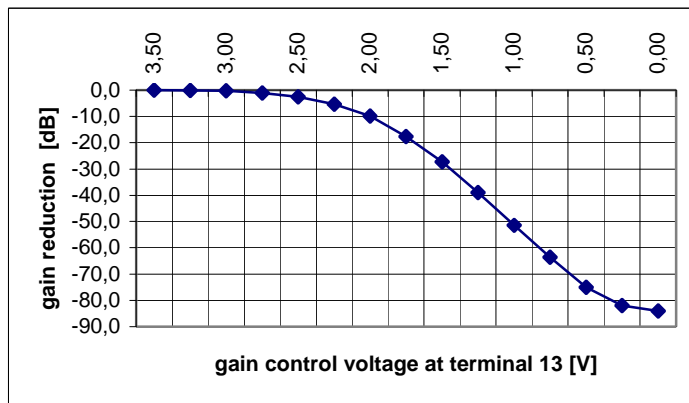
The max. load applied to the 'broadband' IF-output of the tuner should not exceed:

2kΩ min./15pF max.

The reactive load has to be compensated (tuned-out to the IF-center frequency) by an inductance connected in parallel to the load.

The max. load applied to the 'narrowband' balanced IF-output of the tuner is limited to 1kΩ min. .

Gain control characteristic of IF-amplifier (terminal 13) :



With an IF-gain control voltage of about 1.3V applied to terminal 13 of tuner, the narrowband IF-output level is about the same of the broadband IF-output.

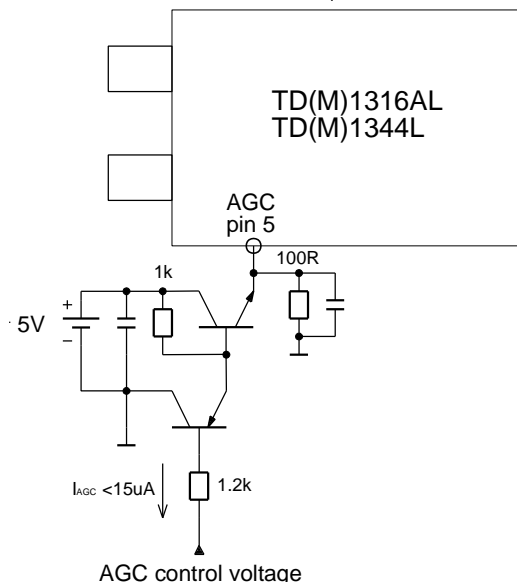
Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

External RF-Gain Control Voltage; recommended schematic

To ensure a smooth gain control characteristic, the following schematic is recommended:

Note: In case the below recommended AGC control voltage source is not used, alternatively a control voltage source with a max. 200ohms impedance can be used !



Phase noise, I²C bus traffic and crosstalk

The low noise PLL used in these tuners will clean up the noise spectrum of the VCOs close to the carrier to reach noise levels @ 1 kHz offset from the carrier compatible with e.g. OFDM reception.

Linked to this noise improvement, some disturbances may become visible while they were not visible because they were hidden into the noise in analog dedicated applications and circuits.

This is especially true for disturbances coming from the I²C bus traffic, whatever this traffic is intended for the MOPLL or for another slave on the bus.

To avoid this I²C bus crosstalk and be able to have a clean noise spectrum, it is necessary to use a bus gate that enables the signal on the bus to drive the MOPLL. This is used only when the communication is intended for the tuner part (such a kind of I²C bus gate is included into the Philips terrestrial channel decoders), and to avoid unnecessary repeated sending of the same information.

Main board recommendations :

The tracks on the main board connected to the tuners' terminals should be kept as short as possible in order to avoid interferences because of immunity problems and/or to avoid problems with regard to radiation of the local oscillator.

Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

For tuners with antenna-power function (tuners with type name extension “P”)

Attention:

Tuners with type name extension 'P' do have the DC-supply option through out the RF-input connector on board. The max. permissible current drive is limited to 100mA .

For tuners with pin1 to TV-output connection (TDM1344L/IV , TDM1344L/IH , TD1344L/IV)

The connection has been done via a 4R7 resistor; all decoupling elements at pin1 and the TV-output connector are removed.

Any load impedance below 1kohms can deteriorate the frequency response of the loopthrough and remodulator section.

Load impedances with a capacitive as well as inductive part have to be avoided.

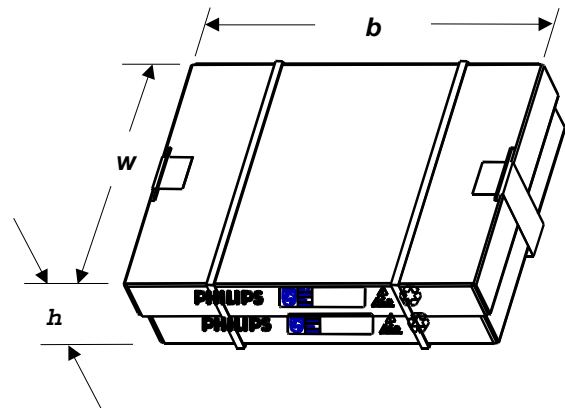
PACKAGING INFO

The products are packed in the carton box and transferred to customers by Pallet Transport.

	Dimension b x w x h (cm)	No. of sets	Gross Wt (Kg)
Carton	46 x 34 x 12.2	90	5.7
Pallet	120 x 105 x 105	4590	309

Carton Boxes are made of Corrugated Fibreboard which are free of environmentally banned substances.

Example of Carton Box:



Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

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

LIFE SUPPORT APPLICATIONS

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

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Tuner module for digital terrestrial (OFDM) applications

TD(M)1300AL

DOCUMENT REVISION HISTORY

<i>Date</i>	<i>Document status</i>	<i>Rev. no.</i>	<i>Revised by</i>	<i>Revision details</i>
10.04.2003	Preliminary spec.	0.1	T. Fenkes	Basic data are taken from TD(M)1316L tuner data sheet; Data sheet only for high sensitivity types ; gain, noise, input matching and sensitivity data changed/added
10.06.2003	Preliminary spec.	0.2	T. Fenkes	Digital-only specification; min. image rej. figures added; loopthrough CSO/CTB -57dBc; incl. UHF-only tuners
07.08.2003	Product spec.	1.0	F. Langenberg	Specification status changed from preliminary to product spec.