4736 PY5 RF TUNER MODULE (3X7713, 3X7829, 3X7909)

ADVANCE DATA SHEET **CABLE MODEM APPLICATIONS**

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1 APPLICATIONS

The 4736 PY5 RF Tuner Module is designed for subscriber-side cable modems and digital cable applications.

2 FEATURES

- DOCSIS compatible
- VHF Low, VHF High, and UHF
- Internal tuning voltage (33V)
- Single 5V power supply
- All functions controlled by I^2C bus
- Reverse channel via pin to antenna input
- Antenna input: F-connector (flat F-connector 3x7829)
- Additional ESD protection provided (3x7909)
- Dimensions (l x h x d): 66 x 39 x 14 mm
- Optional horizontal or vertical positioning

3 INTRODUCTION

The 4736 PY5 RF Tuner Module covers a frequency range from 50 MHz to 860 MHz for downstream signals, and 5 MHz to 42 MHz for upstream signals.

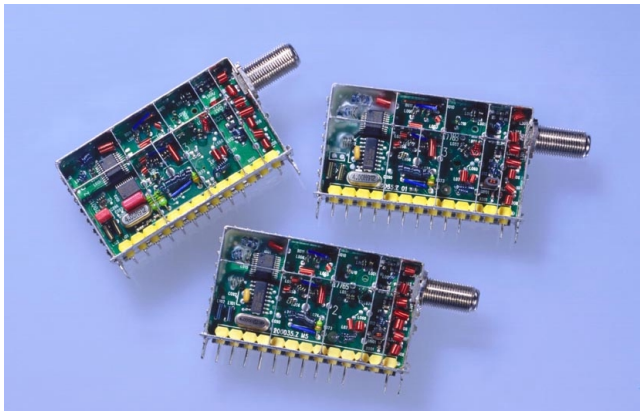


Figure 1 4736 PY5 RF Tuner Modules

The receiver uses a single-conversion approach with the reception frequency range divided into VHF low, VHF high, and UHF.

Band selection and tuning is done via the I^2C -bus.

The IF output is able to drive a standard surface acoustical wave (SAW) filter directly.

The common antenna input/output is realized by an F-connector (75Ω) per [IPS-sp-406].

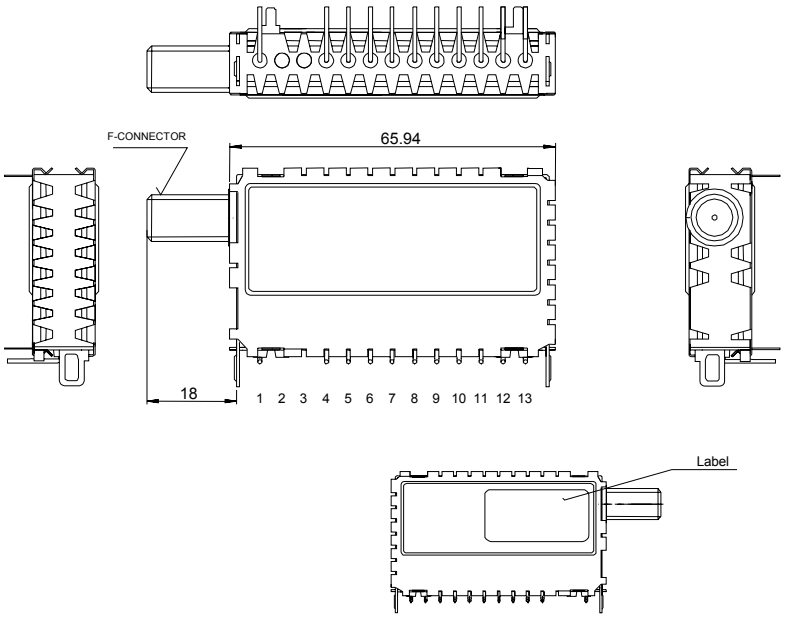
A digital AFC function can also be realized — the AFC voltage generated by the IF demodulator is fed to a built-in analog/digital converter available via pin 6 and readable via the I²C-bus.

A DC/DC converter for 33V generation is built in, so that only a single supply voltage of 5V is required.

4 MECHANICAL SPECIFICATIONS

This section contains mechanical specifications for the 4736 PY5 RF Tuner Module.

4.1 MECHANICAL DRAWING



PIN	CONNECTION
1	Reverse channel in
2	
3	
4	Supply voltage VS1 + 5 V for power supply
5	AGC voltage
6	Switch port P6 output/input for ADC
7	NC
8	Supply voltage VS1 for tuner + 5 V
9	IIC bus signal SCL
10	IIC bus signal SDA
11	Address selection for I^2C bus
12	IF output
13	IF output

Figure 2 4736 PY5 RF Tuner Module Mechanical Drawing

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4.2 MECHANICAL CHARACTERISTICS

Table 1 Mechanical Characteristics

CHARACTERISTIC	DIMENSIONS
Dimensions	According to drawing in Figure 2
Weight	Approximately 41g
Plug holding strength	Plug according to SCTE spec. IPS-sp-407
Tuner connection	The tuner provides four pins at bottom cover for horizontal mounting and grounding
Screw fixing of F-connector[1]	Absolute maximum torque strength: 3.39 Nm / only once Absolute maximum cantilever strength: 3.39 Nm Absolute maximum axial strength: 8.99N

[1] If the tuner is not mounted on the chassis, the frame may be bent during the test. Regardless of mounting, the F-connector will not be pulled out of the frame.

5 FUNCTIONAL SPECIFICATIONS

5.1 ABSOLUTE MAXIMUM RATINGS

Stresses greater than those listed in Table 2 may cause permanent damage to the device. These are stress ratings only; functional operation of the device under conditions other than those listed in Table 3 is not recommended or implied. Exposure to any of the absolute-maximum rating conditions for extended periods of time may affect reliability.

Table 2 Absolute Maximum Ratings

PARAMETER	MIN	MAX	UNIT
Supply voltage		6	V
AGC Voltage		6	V
Storage temperature	-30	70	°C

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5.2 OPERATING CHARACTERISTICS

The operating characteristics listed in Table 3 reflect the conditions necessary for optimal performance and operating reliability.

Table 3 Operating Characteristics

PARAMETER	MIN	TYP	MAX	UNIT	CONDITIONS OR LOCATION
VS1 Power supply voltage					Pin 4
Voltage	4.75	5	5.25	V	
Current		160	200	mA	
AGC Voltage					Pin 5
Voltage for maximum gain	3.9	4	4.1	V	
AGC Current			12	µA	
Tuner power supply voltage					Pin 8
Voltage V_{S1}		5	±5%	V	
Voltage conditions		160	200	mA	
Permissible ripple voltage V_{S1}	Maximum 20 mVp-p, 20 Hz to 100 Hz				
Temperature					
Operating temperature	0		65	°C	
Storage temperature	-30		70	°C	
Frequency range					
VHF Low	50		162	MHz	
VHF High	156		469	MHz	
UHF	463		860	MHz	
Frequency range, referenced to center frequency of 6 MHz bandwidth					
VHF Low	53		159	MHz	
VHF High	159		466	MHz	
UHF	466		857	MHz	
Tuning resolution					
Standard tuning increment		62.5		kHz	
Recommended takeover frequencies					
VHF Low / VHF high		159		MHz	
UHF		466		MHz	
Intermediate frequency (IF)					
Oscillator operates above received frequency		43.75		MHz	
Input impedance					
VHF/UHF Common		75		Ω	Unbalanced

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6 TUNER MEASUREMENT TEST CONDITIONS

All tuner data is held under the following conditions unless otherwise noted:

- Measurement tolerance: 10% or 1 dB
- Ambient temperature: +25°C ±3°C
- Supply voltages: +5V ±2%
- AGC voltage: +4V ±2%

7 TUNER DATA

All values shown in Table 4 are referred to the RF input terminal.

Table 4 Electrical Characteristics

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Frequency range		55		860	MHz
Voltage gain	Measured between antenna input and IF1 and IF2. The input is loaded with 75Ω and the output is loaded with a test circuit (see Figure 3).	40	46	50	dB
Noise figure (see Figure 4)	VHF Low		8	9.5	dB
	VHF High		8	9.5	dB
	UHF		8	9.5	dB
VSWR	Antenna input			3	
AGC Range	VHF Low	50	70		dB
	VHF High	45	60		dB
	UHF	45	60		dB
Influence of AGC	The noise figure shall not increase by more than the corresponding gain reduction. The input return loss shall be maintained within the specific limits over the entire range of AGC voltage.				
IF Rejection (measured from channel center frequency to 43.75 MHz)	VHF Low	70	85		dB
	VHF High	70	85		dB
	UHF	70	85		dB
Rejection to upstream	Isolation between upstream and IF output	75			dB
Image rejection	VHF Low	60	70		dB
	VHF High	55	65		dB
	UHF	55	60		dB
RF Tilt	For all AGC settings and over a 6MHz bandwidth around center frequency			2.5	dB
	In the frequency range of 55 MHz to 80 MHz			3	dB

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8 TEST CIRCUITS

8.1 VOLTAGE GAIN

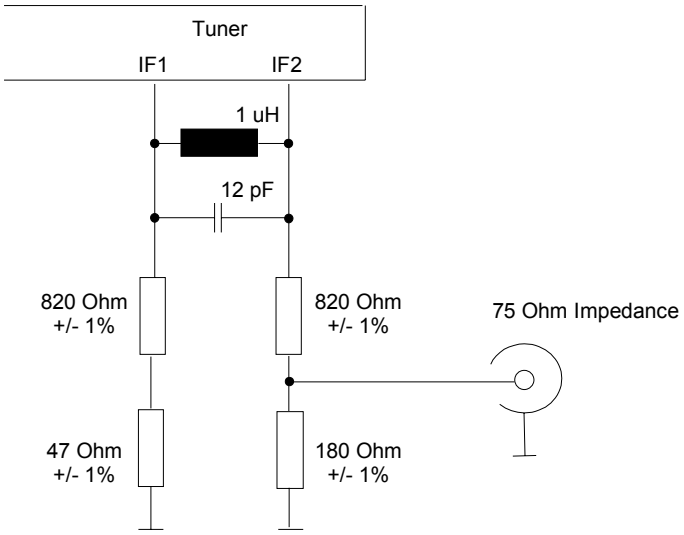


Figure 3 Test Circuit for Voltage Gain

Test circuit attenuation is 30.3 dB.

8.2 NOISE FIGURE

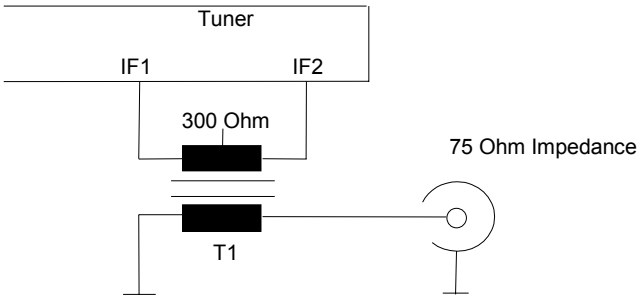


Figure 4 Test Circuit for Noise Figure

For the noise figure test circuit:

- T1 = RF - Transformer
- W - Ratio = 1:4
- Type: MCL T4-1 or equivalent

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8.3 TEST CHARACTERISTICS

Table 5 Test Characteristics

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Signal level for 1 dB gain compression	AGC deactivated with AGC=4V for maximum gain	70			dBµV
	AGC set for 15 dB gain reduction	85			dBµV
Phase noise					
VHF Low	Measured at 1 kHz distance from carrier		-71	-55	dB/Hz
VHF High			-60	-55	dB/Hz
UHF			-58	-55	dB/Hz
VHF Low	Measured at 10 kHz distance from carrier		-95	-82	dB/Hz
VHF High			-85	-82	dB/Hz
UHF			-85	-82	dB/Hz
VHF Low	Measured at 20 kHz distance from carrier		-102	-92	dB/Hz
VHF High			-92	-88	dB/Hz
UHF			-92	-88	dB/Hz
VHF Low	Measured at 100 kHz distance from carrier		-109	-105	dB/Hz
VHF High			-106	-102	dB/Hz
UHF			-105	-102	dB/Hz
Oscillator voltage at antenna terminal					
<88 MHz	Terminated with 75Ω	No oscillator signal			
<860 MHz				5	dBµV
<1740 MHz				40	dBµV
Intermodulation	With a fully loaded multi-tone signal generator (129 channels), carrier levels at +15 dBmV, and AGC set for a 15 dB reduction in gain, distortion levels shall not exceed these limits.				
Composite triple beat			-57	-50	dBc
Composite second order beat			-54	-50	dBc
Group delay	Over any 6 MHz bandwidth centered about the tuned frequency and for AGC over the range from maximum gain down to -25 dB below maximum gain, the group delay variation as measured between the antenna terminal and the IF output terminal shall not exceed these limits.				
VHF Low			60	100	ns p-p
VHF High			30	100	ns p-p
UHF			20	100	ns p-p
PLL setting time	Charge pump current high			100	ms

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9 REVERSE CHANNEL INPUT (PIN 1)

Table 6 Reverse Channel Input (Pin 1)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Insertion loss from Pin 1 to antenna terminal input					
Frequency range : 0 MHz to 42 MHz	Antenna input terminated with 75Ω		0.7	2	dB
Frequency range : 54 MHz to < 88 MHz		38			dB
Frequency range : 88 MHz to < 120 MHz		54			dB
Frequency range : 120 MHz to 860 MHz		50			dB
Antenna input to tuner part input					
Frequency range : 54 MHz to < 88 MHz	Antenna input terminated with 75Ω	38			dB
Frequency range : 88 MHz to < 120 MHz		54			dB
Frequency range : 120 MHz to 860 MHz		50			dB
Diplexer channel input VSWR (Pin 1)					
Frequency range : 5 MHz to 42 MHz			1.5	2	

9.1 DIPLEXER GROUP DELAY VARIATION

The diplexer group delay variation in any 2 MHz bandwidth within the frequency range of 5 MHz to 42 MHz shall not exceed 60 nsec.

9.2 REVERSE CHANNEL HARMONIC DISTORTION

The reverse channel path within the tuner (diplex filter) shall not generate harmonic distortion in excess of 100 dB below the level of the reverse channel signal when the level of the reverse channel signal at the antenna terminal is +58 dBmV.

9.3 FULL DUPLEX OPERATION

With an upstream signal at a level of +58 dBmV and amplitude modulation of 50%, modulation transferred to the downstream signal shall not exceed 1%. In addition, the signal-to-noise ratio of the downstream signal shall not be reduced to less than 30 dB as a result of the presence of the upstream signal.

10 I²C BUS

10.1 WRITE DATA FORMAT

Table 7 Write Data Format

	MSB							LSB	
Address byte	1	1	0	0	0	MA1	MA0	R/W[1]	A[2]
Divider byte 1	0	n14	n13	n12	n11	n10	n9	n8	A
Divider byte 2	n7	n6	n5	n4	n3	n2	n1	n0	A
Control byte 1	1	CP[3]	T2	T1	T0	RSA	RSB	OS	A
Control byte 2	P7	P6	P5	P4	P3	P2	P1	P0	A

[1] R/W = 0 is write mode
[2] A = Acknowledge
[3] CP = 1 is charge pump current high

Note: MSB is transmitted first.

Table 8 Address Selection

MA1	MA0	ADDRESS	VOLTAGE AT PIN 11
0	0	C0	(0 to 0.1) V_{S1}
0	1	C2	(0.2 to 0.3) V_{S1} or open circuit
1	0	C4	(0.4 to 0.6) V_{S1}
1	1	C6	(0.9 to 1) V_{S1}

Table 9 Oscillator Frequency and Divider Byte Calculation

RSA	RSB	REFERENCE DIVIDER	MINIMUM TUNING STEP	F_{REF}
1	1	512	62.5 kHz	7.8125 kHz
X	0	640	50.0 kHz	6.25 kHz
0	1	1024	31.25 kHz	3.90625 kHz

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Use the following formula to calculate oscillator frequency and divider byte.

$$f_{osc} = f_{ref} \times 8 \times SF$$

Where:

f_{osc} = Local oscillator frequency

f_{ref} = Crystal reference frequency / 512 = 4 MHz / 512 = 7.8125 kHz

SF = Programmable scaling factor

Scaling factor is SF = 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

Table 10 Control Byte 1 Settings (Default)

	MSB							LSB	
Control byte 1	1	1	0	0	1	1	1	0	A

Table 11 Control Byte 1 Settings Default Descriptions

CODE	DESCRIPTION	SETTINGS
CP	Charge pump current	1 = fastest tuning 0 = better phase noise for distance < 10 kHz to the carrier
T0, T1, T2	Test mode bit	
RSA, RSB	Reference divider	See Table 9
OS	Tuning voltage	0 = ON

Table 12 Control Byte 2 (Band Selection)

BAND	ACTIVE PORT	P7	P6	P5	P4	P3	P2	P1	P0
UHF	P0	0	0	1	1	X	X	X	X
VHF High	P2	1	0	0	1	X	X	X	X
VHF Low	P1	1	0	1	0	X	X	X	X

Note: X = not used

10.2 READ DATA FORMAT

Table 13 Read Data Format

	MSB							LSB	ACK
Address byte	1	1	0	0	0	MA1	MA0	R/W	A
Status byte	POR	FL	I2	I1	I0	A2	A1	A0	A

Note: MSB is transmitted first.

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Table 14 Read Data Format Descriptions

CODE	DESCRIPTION
R/W	1 = Read mode
POR	Power on reset flag (POR =1 at power on)
FL	In lock flag (FL= 1 when PLL is locked)
I2, I1, I0	Digital levels for I/O ports P7, P5 and P4 (not used)
A2, A1, A0	Digital output of 5-level ADC for AFC function. Value for correct tuning: A2 = 0, A1= 1, A0 = 0

10.3 A/D CONVERTER LEVELS

Table 15 A/D Converter Levels

VOLTAGE APPLIED ON PORT P6	A2	A1	A0
0.6 VS1 to VS1	1	0	0
0.45 VS1 to 0.6 VS1	0	1	1
0.3 VS1 to 0.45 VS1	0	1	0
0.15 VS1 to 0.3 VS1	0	0	1
0 to 0.15 VS1	0	0	0

11 SAFETY AND RELIABILITY

11.1 ELECTROSTATIC DISCHARGE (ESD) PROTECTION

WARNING: The tuner contains components that can be damaged by electrostatic discharge.

Observe these precautions:

- Ground yourself before handling the tuner.
- Do not touch the tuner connector pins without ESD protection.

11.2 HIGH VOLTAGE

The tuner meets specifications IEC 801.2 level 2.

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11.3 HUMIDITY

Table 16 Local Oscillator Drift

PARAMETER	DRIFT	UNIT	PROCEDURE
VHF Low	± 15	kHz	1. Run 60 hours at 55°C and 20% relative humidity. 2. Run 1 hour at 23°C and 50% relative humidity. 3. Take first measurement. 4. Run 65 hours at 40°C and 95% relative humidity. 5. Take second measurement.
VHF High	± 45	kHz	
UHF	± 75	kHz	

11.4 VIBRATION TEST

After applying vibration of 1.5 mm amplitude, frequency of 10 - 55 - 10 Hz (1 minute) each X, Y, Z direction for 2 hours (total 6 hours), tuner shall not have any rattling or loosening and shall comply with the variation to its initial value as listed in Table 17.

Table 17 Vibration Test

PARAMETER	MEASUREMENT	UNIT
Gain variation	< ± 3	dB
Wave variation	< ± 30	%

11.5 MICROPHONY

The microphony test is made with a TV set. The resolution is optimal. With maximum AF output of the TV set, the tuner is free of microphonic effects provided the unit is installed in a professional manner.

11.6 LOOSE CONTACT TEST OF TUNER ALONE

The test pattern is a color bar. The resolution is 3 MHz. To test, there must be no interruption effects when the edge of the tuner is knocked, provided it is fastened with a ground contact.

11.7 SOLDER LIMITS

See application note APN001.

11.8 NATIONAL REGULATIONS

The tuner meets the requirements of VDE 9872/7.72 and Amtsblatt DBP 069/1981 (FTZ), EN 55013, EN 55020 (if properly mounted into TV set, VCR, or converter).

12 ORDERING INFORMATION

The 4736 PY5 Tuner Modules may be ordered in the packaging units and quantities shown in Table 18 and Table 19. For packaging options and quantities other than those shown, contact one of the offices listed on the following page.

Table 18 Packaging Units

PACKAGING UNITS	4736 PY5 TUNER MODELS		
	3X7713	3X7829	3X7909
Number of Tuner Modules Per Box	108	108	108
Number of Boxes Per Master Box	40	40	40

Table 19 Order Quantities

NUMBER OF MASTER BOXES	TOTAL NUMBER OF TUNERS PER MASTER BOX		
	3X7713	3X7829	3X7909
0.5	2,160	2,160	2,160
1.0	4,320	4,320	4,320
1.5	6,480	6,480	6,480
2.0	8,640	8,640	8,640
2.5	10,800	10,800	10,800
3.0	12,960	12,960	12,960
3.5	15,120	15,120	15,120
4.0	17,280	17,280	17,280
4.5	19,440	19,440	19,440
5.0	21,600	21,600	21,600

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13 REVISION HISTORY

NAME	DESCRIPTION	ECN No.	APPROVED BY	DATE	REF/REV
Reiß	TEMIC TELEFUNKEN Hochfrequenztechnik GmbH TUNER 4736PY5 3X 7713, 3X 7909 2.1. Dimensions: according to drawing 3X 7713 3. 3. Recommended take over frequencies: VHF low / VHF high 158 MHz UHF 464 MHz 5.13. Intermodulation: ... and with AGC set for a 44dBmV IF output level, distortion levels shall not exceed the following limits. Composite triple beat -53 dBc Composite second order beat -53 dBc 5.15. PLL Settling Time: 100 ms 7.3. SF = 16348* n14 + ... TEMIC TELEFUNKEN Hochfrequenztechnik GmbH, Marie-Curie-Straße 1, 85055 Ingolstadt / GERMANY Phone: +49 (0)841 9378 – 020 Fax: +49 (0)841 9378 – 024	71/99	Lead Designer: Group Lead: VP Systems:	4.8.99	7713ED01
Reiß	Change Co. name/logo to: MICROTUNE™ Add new model no.: TUNER 4736PY5 3x7713, 3x7909, 3x7829 2.1. Dimensions: according to drawing 3x7713 and drawing 3x7829 (flat F-connector) 3. 3. Recommended take over frequencies (center): VHF low / VHF high 159 MHz UHF 466 MHz 5.13. Intermodulation: ... and with AGC set for a 15 dB reduction in gain, distortion levels shall not exceed the following limits. Composite triple beat -50 dBc Composite second order beat -50 dBc 5.15. PLL Settling Time (high charge pump): 100 ms 7.3. SF = 16384* n14 + ... Change name to: Microtune GmbH & Co. KG	118/00	Lead Designer: Group Lead: VP Systems:	24.2.00	7713ED02

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