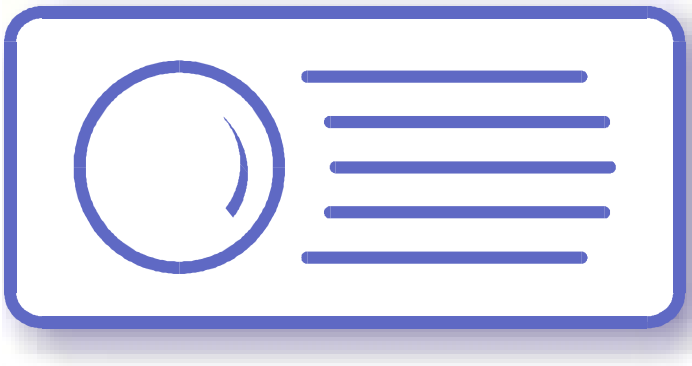

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COFDM Modulator module, v1.10

User manual

Rev C, May, 31 2007

1. The use of this product in conformity with the MPEG2 Standard is prohibited in any case, unless the license of patents applicable to the MPEG2 patent group is granted.
2. It's the purchaser's duty to check which patents with potentially payable author's rights are used in his/her own final project and act accordingly with the bodies in charge.
3. The contents of this manual are subject to change without notice.
4. Of the specifications described in this manual, the functions and performance the supply of which is assured with this product are only those that can be confirmed with the separate Basic Firmware attached.
5. When the product or information described in this manual is used, our company does not guarantee or grant any license of the intellectual property rights and other rights of our company or of third parties. If any problems concerning the ownership rights of third parties attributable to the above use occur, our company will not be responsible for them.
6. Since the product described in this manual was not developed specially for equipment related to human life, those who intend to use it for equipment whose failure or malfunction may directly threaten human life or endanger the human body or for special applications requiring high reliability (such as aerospace, nuclear power control, submarine repeaters, travel control, and medical equipment for life support) must consult our sales responsible personnel in advance. Our company will not be responsible for any damages that may occur due to such use without consulting us.
7. Although our company is endeavoring to improve quality and enhance reliability, semiconductor products will fail with a certain probability. Users are requested to pay due attention to safe design techniques such as redundant design, preventive measures against the spreading of fire, over-current, and malfunctions, so that failure of the products described in this manual will not result in accidents leading to injury or death, fire, or social damage.
8. The product described in this manual is not designed to be radiation-resistant.
9. This board is just an 'electronic component' that cannot work in a standalone mode, therefore all the tests and qualifications for electromagnetic compatibility, all the CE certifications and any other regulations concerning the final product implemented by the customer are to be carried out by the customer himself referring to the final product for which this electronic component has been used.

Revision history:

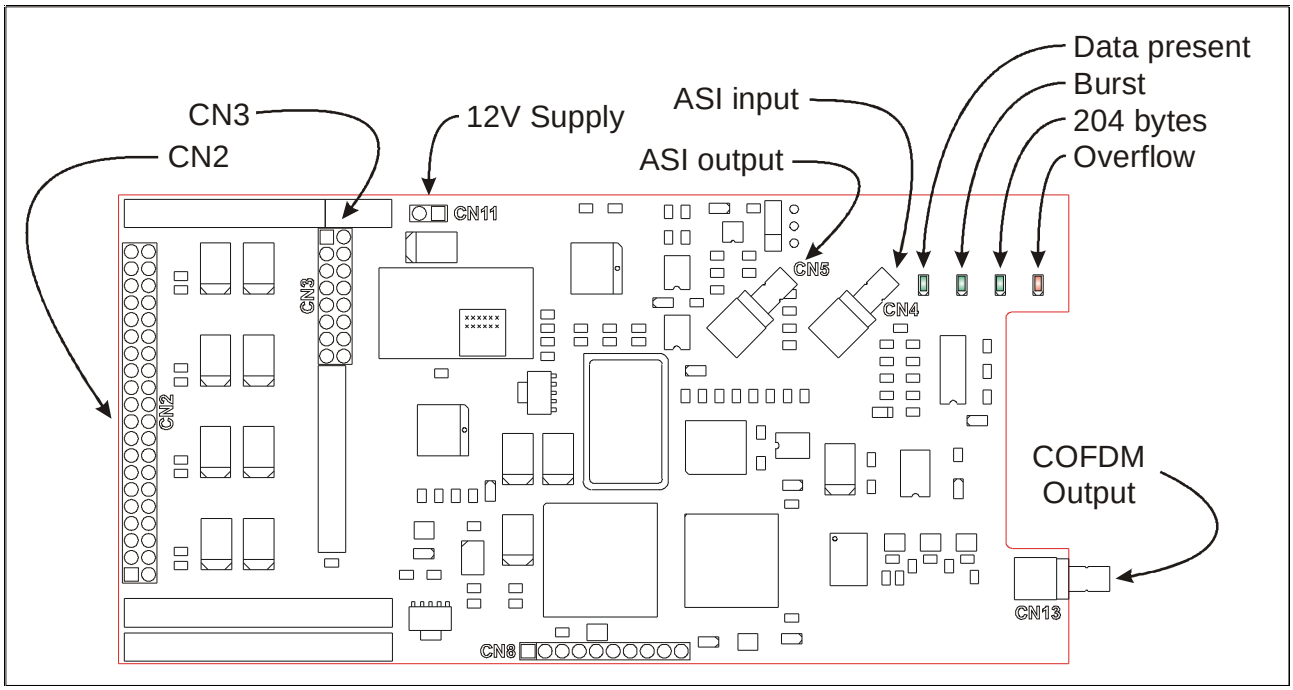
Rev A, October, 20 2006, abesani@tecnoroll.it
First release

Rev B, March, 8 2007, abesani@tecnoroll.it
Fixed 109.714 MHz output frequency notes
Fixed AD9857 Tuning word formula.

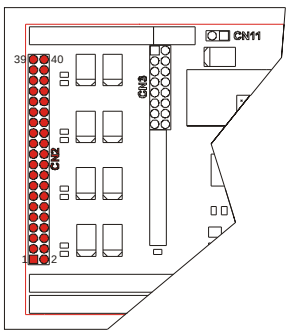
Rev C, May, 31 2007, abesani@tecnoroll.it
Updated documentation for PCB release 1.1

Index

1 COFDM Board layout (TOP)



1.1 Connector CN2 (A/V, I/O and 5V Power supply)



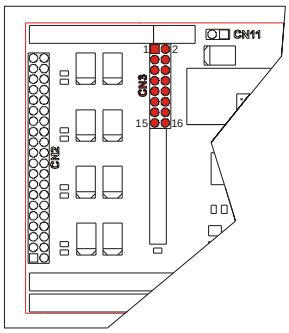
CN2 in the main COFDM modulator connector. It's the connector with ALL the required signal to operate the COFDM modulator/DigiPEG board. The 5V supply is used when the 12V optional regulator is not installed.

CN2 (A/V, I/O and 5V Power supply)			
Pin	**Symbol**	**Type**[1]	**Description**
1	5V0	P	+5.0V Power supply
2	AUDIO_OUT_R	O_a	Analog right channel audio line output
3	5V0	P	+5.0V Power supply
4	AUDIO_OUT_L	O_a	Analog left channel audio line output
5	5V0	P	+5.0V Power supply
6	CVBS_OUT	O_a	Analog composite video (CVBS) output. 1Vpp on 75Ω. Used for sync output when RGB output is selected.

CN2 (A/V, I/O and 5V Power supply)			
Pin	**Symbol**	**Type**[1]	**Description**
7	GND	P	Ground
8	RED_OUT	O_a	Analog RED (RGB), Chroma (C, S-VHS) or CVBS video output.
9	GND	P	Ground
10	GREEN_OUT	O_a	Analog GREEN (RGB), Luma (Y, S-VHS) or CVBS video output.
11	GND	P	Ground
12	BLU_OUT	O_a	Analog BLUE (RGB) output. Not used for S-VHS or CVBS output.
13	GND	P	Ground
14	AV_IN_0	I_a	Analog composite video input (CVBS0) or analog Y (luma) input (S-VHS2)
15	SDA	I_3/O_3	I^2C bus data line.
16	AV_IN_1	I_a	Analog composite video input (CVBS1) or analog Y (luma) input (S-VHS1)
17	SCL	I_3/O_3	I^2C bus clock line.
18	AV_IN_2	I_a	Analog composite video input (CVBS2) or analog C (Chroma) input (S-VHS2)
19	SERV_CLK	$I_{3/5}/O_3$	DevBoard Xbus clock line
20	AV_IN_3	I_a	Analog composite video input (CVBS3) or analog C (Chroma) input (S-VHS1)
21	SERV_CS	$I_{3/5}/O_3$	DevBoard Xbus CS line
22	AUDIO_IN_R	I_a	Analog right channel audio line input
23	SERV_DATA	$I_{3/5}/O_3$	DevBoard Xbus Data line
24	AUDIO_IN_L	I_a	Analog left channel audio line input
25	EX_CTRL7	$I_{3/5}/O_3$	User GPIO pin, bit 7
26	EX_CTRL6	$I_{3/5}/O_3$	User GPIO pin, bit 6
27	EX_CTRL5	$I_{3/5}/O_3$	User GPIO pin, bit 5. Input for Tx service channel serial port.
28	EX_CTRL4	$I_{3/5}/O_3$	User GPIO pin, bit 4. Output for Rx service channel serial port.
29	EX_CTRL3	$I_{3/5}/O_3$	User GPIO pin, bit 3. Used as Menu button.
30	EX_CTRL2	$I_{3/5}/O_3$	User GPIO pin, bit 2. Used as ESC button.
31	EX_CTRL1	$I_{3/5}/O_3$	User GPIO pin, bit 1. Used as Down button.
32	EX_CTRL0	$I_{3/5}/O_3$	User GPIO pin, bit 0. Used as Up button.
33	RU_RXD	I_3	RS232 Upgrade/Debug Port RX Data line
34	RU_TXD	O_3	RS232 Upgrade/Debug Port TX Data line
35	USER_RX	$I_{3/5}$	User RS232 RX line
36	USER_TX	O_3	User RS232 TX line
37	SER_RX_CLK	$I_{3/5}$	Serial Transport Stream RX clock input
38	SER_RX_DATA	$I_{3/5}$	Serial Transport Stream RX data input
39	SER_TX_CLK	$I_{3/5}$	Serial Transport Stream TX clock input
40	SER_TX_DATA	O_3	Serial Transport Stream TX data output

(1) See Appendix A for a description of these values

1.2 Connector CN3 (Digital Audio)



CN3 connector is the optional Digital Audio extension for the DigiPEG/COFDM modulator. If present but not required, install 8 jumpers to provide audio signals and clocks for the DigiPEG encoder and decoder. If not present, these jumpers have been already installed on the DigiPEG board itself.

CN3 (Digital Audio)			
Pin	**Symbol**	**Type**[(1)]	**Description**
1	R_AOLRCLK	I_3	I^2S LRCLK input to analog audio DAC
2	RU_AOLRCLK	O_3	I^2S LRCLK output from MPEG audio decoder
3	R_AOBCLK	I_3	I^2S BCLK input to analog audio DAC
4	RU_AOBCLK	O_3	I^2S BCLK output from MPEG audio decoder
5	R_AODATA	I_3	I^2S DATA input to analog audio DAC
6	RU_AODATA	O_3	I^2S DATA output from MPEG audio decoder
7	R_AOCLK	O_3	I^2S SCLK input to analog audio DAC
8	RU_AOCLK	I_3	I^2S SCLK output from MPEG audio decoder
9	T_ASCLK	O_3	I^2S SCLK output from analog audio ADC
10	TU_ASCLK	I_3	I^2S SCLK input to MPEG audio encoder
11	T_ADATA	O_3	I^2S DATA output from analog audio ADC
12	TU_ADATA	I_3	I^2S DATA input to MPEG audio encoder
13	T_ALRCK	O_3	I^2S LRCLK output from analog audio ADC
14	TU_ALRCK	I_3	I^2S LRCLK input to MPEG audio encoder
15	T_ACLK	O_3	I^2S BCLK output from analog audio ADC
16	TU_ACLK	I_3	I^2S BCLK input to MPEG audio encoder

(1) See Appendix A for a description of these values

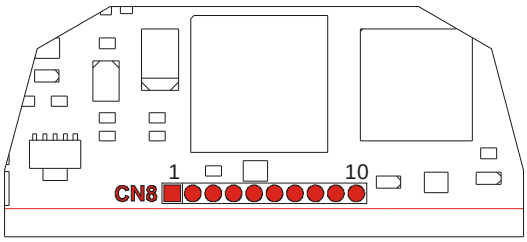
1.3 Connector CN4 (ASI Input)

This optional connector for ASI input can be used as the stand-alone COFDM modulator data input, or for cascading several DigiPEG/COFDM power supply/modulators.

1.4 Connector CN5 (ASI Output)

This connector outputs the Transport stream fed into the modulator in ASI format. Can be used to drive an external modulator or for monitoring purposes.

1.5 Connector CN8 (Aux I/O)

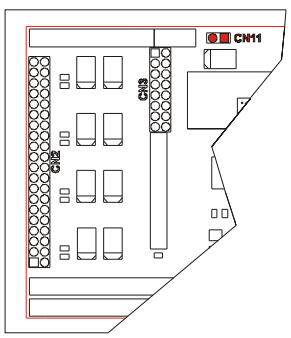


Auxiliary I/O pin from COFDM modulator FPGA

CN8 (Aux I/O)			
Pin	**Symbol**	**Type**[1]	**Description**
1	3V3	P	+3V3 Power supply
2	GND	P	Ground
3	RSVD		Reserved
4	RSVD		Reserved
5	RSVD		Reserved
6	RSVD		Reserved
7	TS_204	O_3	TS data is using 204 bytes packets
8	TS_DATA	O_3	Data present at modulator input
9	TS_OVRFL	O_3	Modulator input FIFO overflow
10	RSVD		Reserved

(1) See Appendix A for a description of these values

1.6 Connector CN11 (Optional 12V supply)



CN11 is 12 Volts input available if the optional 12 V switching regulator is installed.

CN11 (12 Volts input)			
Pin	**Symbol**	**Type**[1]	**Description**
1	12V0	P	+12.0V Power supply
2	GND	P	Ground

1.7 Connector CN13 (COFDM output)

Unfiltered COFDM output. No filter is present in the COFDM board to leave the user the possibility to tune the output frequency to any desired value.

2 DigiPEG Command Extensions

When a COFDM Modulator module is connected to a DigiPEG with a firmware revision equal to or greater than 1.17, the DigiPEG can be factory programmed to extend its command set and directly support the COFDM Modulator.
The COFDM Modulator configuration can be saved in the first 8 bytes of the DigiPEG User EEprom using the standard *SaveConfig* command. Note that the COFDM Modulator configuration is one only and hence the configuration number given to the *SaveConfig* command has no meaning to the COFDM Modulator (it HAS obviously significance for the DigiPEG configuration). For a reference of the DigiPEG User EEProm, the *WriteUserEEProm*, *ReadUserEEProm* and the *SaveConfig* commands, refer to the DigiPEG "**User Serial Configuration Protocol**" document.

2.1 COFDMAsiMux

Used for:	Set COFDM modulator ASI multiplexing.
Parameters:	COFDMASIMux StandAlone(0)|Master(1)|Slave(2).
Example:	COFDMASIMux 0↵
Notes:	*StandAlone*: use a TS Clock calculated from the Encoder settings and does not multiplex any other TS. *Master*: uses a 72mbit TS Clock and does not multiplex any other TS *Slave*: uses a 72mbit TS Clock derived from the ASI clock and setups the multiplexer to multiplex the TS received from the ASI input.

2.2 COFDMFreqOut

Used for:	Set COFDM modulator output frequency and spectrum inversion.
Parameters:	COFDMFreqOut Freq,SpectrInv
Example:	COFDMFreqOut 36000000,0↵
Notes:	The output frequency is given in Hz and must be less than 64Mhz. SpectrInv=0 selects normal spectrum 1 inverts the output spectrum.

2.3 COFDMParms

Used for:	Set COFDM modulator operating parameters.	
Parameters:	COFDMParms Constellation,Carriers,GuardInt,FEC,BandWidth	
Example:	COFDMParms QAM64,8k,1/32,2/3,8Mhz↵ COFDMParms 0,1,2,3,8↵	
Notes:	Constellation:	QPSK(0) | QAM16(1) | QAM64(2)
	Carriers:	2k(0) | 8k(1)

GuardInt:	1/4(0) | 1/8(1) | 1/16(2) | 1/32(3)
FEC:	1/2(0) | 2/3(1) | 3/4(2) | 5/6(3) | 7/8(4)
BandWidth:	6Mhz(6) | 7Mhz(7) | 8Mhz(8)

2.4 COFDMSingleCarrier

Used for:	Set COFDM modulator single carrier output.
Parameters:	On(1) | Off(0)
Example:	COFDMSingleCarrier On↵
Notes:	Output a single carrier centered on the output frequency instead the COFDM modulation signal.

3 The COFDM User Flash File

The COFDM Modulator board in conjunction with a DigiPEG board can be operated also using the On Screen DigiPEG menus and 4 push buttons connected to the EX_CTRL3 to EX_CTRL0 pins on CN2 (see Connector CN2 (A/V, I/O and 5V Power supply) on page 5).
The COFDM operating parameters can be set using separated menus for Constellation, Carriers, Guard Interval, FEC, Bandwidth, Spectrum Inversion and Single Carrier Output.
The COFDM output frequency can be selected from a built-in table of 8 values as follow:

Output Frequency	Notes
36.00 MHz	
36.15 MHz	
36.20 MHz	
54.00 MHz	
70.00 MHz	This selection actually sets a frequency of 58.00 MHz. Since no filter is normally installed on the COFDM output, a 70.00 MHz signal is present as an image output.
56.00 MHz	Standard frequency for VHF channel 13
474.00 MHz	Standard UHF channel 21. Nth harmonic of a base frequency of 38.00 MHz
109.714 MHz	Imaginary output of base frequency of 18.29 MHz

This table can be overridden by uploading in the DigiPEG User Flash a file named COFDM. If this file is present, the frequency listed in it will be used in place of the built-in table.
The format of the COFDM file is as follows: every line is a menu entry (no comments allowed) and has two parameter separated by a comma. The first parameter is the 32 bit AD9857 Tune Word in decimal, octal (leading 0) or hexadecimal (leading 0x) format and the second parameter is the description of this entry to be displayed on the DigiPEG On Screen menu.
Starting from DigiPEG firmware release 1.18, the first parameter can also be the desired output frequency in Hz, given in the "`Freq=`*`Number`*" format. The DigiPEG firmware will convert this frequency in the correct Tune Word.

Here following, an example of the COFDM file

```
Freq=36000000, Standard 36MHz
0x74000000, Standard 70MHz
0x4c000000, Test, CH 21
```

The tune word for a desired output frequency of the COFDM modulator module can be computed as follows:

$$FTWORD = \frac{FreqOut \times 2^{32}}{SysClk}$$

Where:
FreqOut is the desired output frequency in Hz;
SysClk is the modulator system clock, 128 MHz

4 Power supplies characteristics

4.1 5 Volts Version

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP.	MAX	UNIT
5V0	Supply voltage		4.5	5.0	5.5	V
	Supply current			tbd		A

4.2 12 Volts Version

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP.	MAX	UNIT
12V	Supply voltage		10.8	12.0	13.2	V
	Supply current			tbd		A

Appendix A 'Type' description for connector pins

Type	Description
I_a	Analog input
I_5	5V compatible input
I_3	3.3V compatible input
$I_{3/5}$	3.3V compatible input, 5V tolerant
O_a	Analog output
O_3	3.3V output
O_5	5V output
P	Power supply line
P_o	Power supply output line