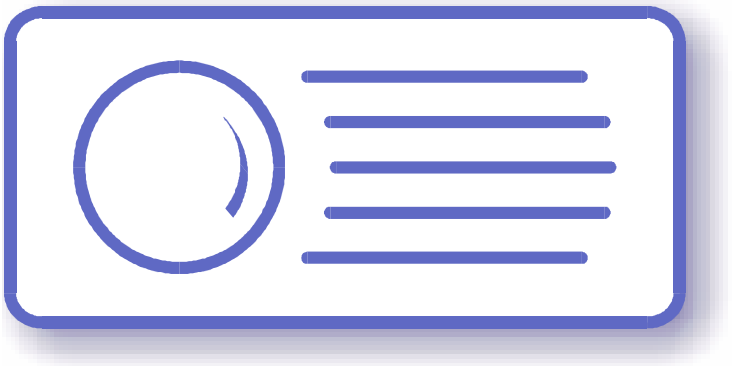

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FLEXMod-CM011

module

Connectors, pin description and programming protocol

Rev A, August, 29th 2012

Hardware revision 2.00

Firmware version 0.02

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3. The contents of this manual are subject to change without notice.
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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.
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Revision history:

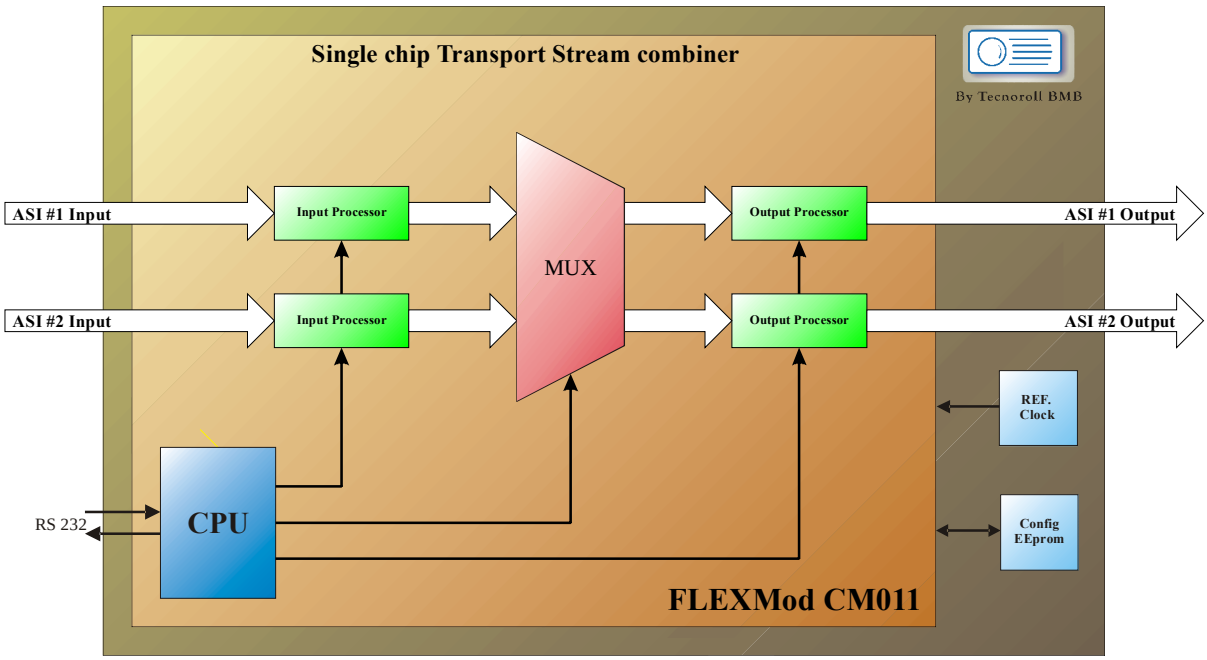
Rev A, August, 29th 2012, abesani@tecnoroll.it
First release

Index

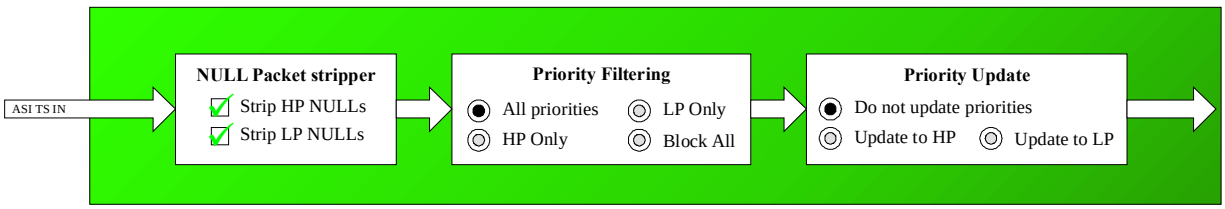
1. FLEXMod Block Diagram

1.1. FLEXMod-CM011

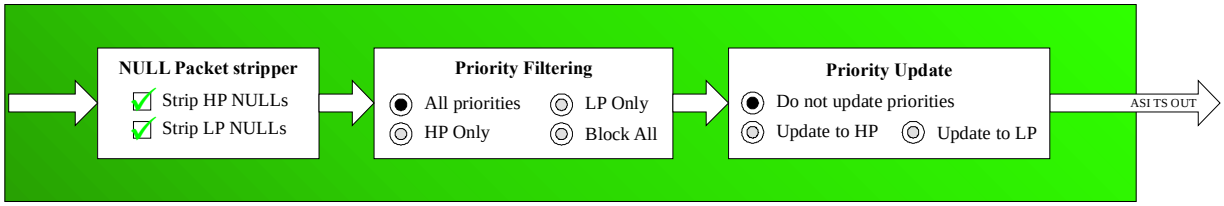
The FLEXMod-CM011 is a TS Combiner/Splitter. It can combine two different Transport Streams using the Priority bit (one TS is encoded as high priority, the other one as normal/low priority). It can also split an incoming combined transport stream into two different output streams, optionally changing the priority bit.



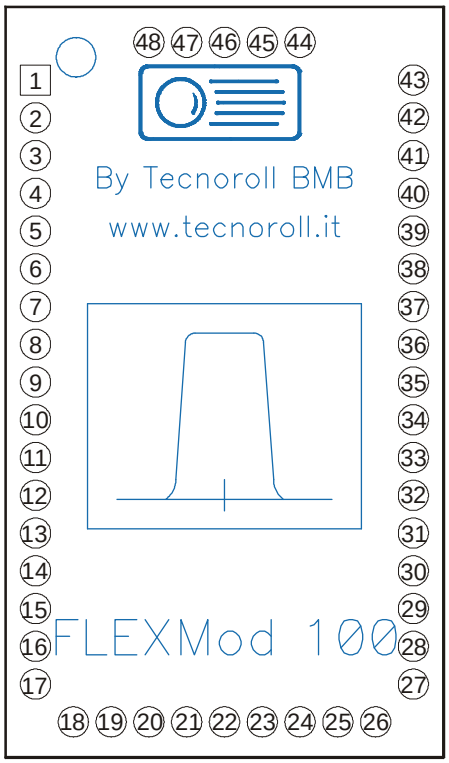
1.2. FLEXMod-CM011 Input processor structure



1.3. FLEXMod-CM011 Output processor structure



2. Connectors and pin description



FLEXMod-CM011, Top view

Pin	Symbol	Type	Description
1	GND	P	Digital Ground
2	1V8	P	+1.8V Digital Power Supply
3	1V8	P	+1.8V Digital Power Supply
4	GND	P	Digital Ground
5	RSVD	-	Reserved
6	ASI_IN_1	I_{LVDS+}	LDVS TS ASI Input #1. Requires a Cable equalizer and an adaptation network. See *ASI Input* on page 21 .
7		I_{LVDS-}	
8	ASI_IN_2	I_{LVDS+}	LDVS TS ASI Input #2. Requires a Cable equalizer and an adaptation network. See *ASI Input* on page 21 .
9		I_{LVDS-}	
10	RSVD	-	Reserved
11	RSVD	-	Reserved
12	RSVD	-	Reserved
13	RSVD	-	Reserved
14	RSVD	-	Reserved
15	RSVD	-	Reserved
16	RSVD	-	Reserved
17	RSVD	-	Reserved

Pin	Symbol	Type	Description
18	GND	P	Digital Ground
19	1V2	P	+1.2V Digital Power Supply
20	3V3	P	+3.3V Digital Power Supply
21	TxD	O_3	RS232 TX Line
22	RxD	I_3	RS232 RX Line
23	RSVD	-	Reserved
24	3V3	P	+3.3V Digital Power Supply
25	1V2	P	+1.2V Digital Power Supply
26	GND	P	Digital Ground
27	RSVD	-	Reserved
28	RSVD	-	Reserved
29	RSVD	-	Reserved
30	RSVD	-	Reserved
31	RSVD	-	Reserved
32	RSVD	-	Reserved
33	ASI_ OUT_2	O_{LVDS-}	LDVS TS ASI Output #2. Requires an adaptation network and a Cable Driver. See *ASI Output* on page 22 for more information.
34		O_{LVDS+}	
35	FLAGS_CLK	O_3	Flags SPI Clock Signal (1)
36	FLAGS_DATA	O_3	Flags SPI Data Signal (1)
37	ASI_ OUT_1	O_{LVDS-}	LDVS TS ASI Output #1. Requires an adaptation network and a Cable Driver. See *ASI Output* on page 22 for more information.
38		O_{LVDS+}	
39	FLAGS_LD	O_3	Flags SPI Load Signal (1)
40	GND	P	Digital Ground
41	3V3	P	+3.3V Digital Power Supply
42	3V3	P	+3.3V Digital Power Supply
43	GND	P	Digital Ground
44	GND	P	Digital Ground
45	RSVD	-	Reserved
46	GND	P	Digital Ground
47	RSVD	-	Reserved
48	GND	P	Digital Ground

See Appendix A on page 27 for *type* description.
([1]) See *Flags SPI sample schematic* on page 23

3. Serial port usage

The Rs232 serial port allows the configuration and the operation of the FLEXMod boards.
This serial port normally operates at 115200 bps, 8 data bits, 1 stop bit, no parity but the operating baud rate can be changed using the *Baud* command. Regardless of the setting done with the *Baud* command, the FLEXMod-CM011 will always boot using a baud rate of 115200 bps.

This serial port normally echoes back to the terminal the characters received. When this is not desirable (because you are using a microcontroller, for example) echoing can be disabled using the *ECHO* command (see *Echo* on page 11).
Most of the command used to set values with one or more parameters, returns the current configured value if issued without any parameter.

A list of available commands can be obtained using the *HELP* command.

3.1. HELP

Used for:	FLEXMod Help.
Parameters:	None
Example:	Help ↵

4. FLEXMod system configuration

The configuration setup of the operating parameters is stored in an onboard EEPROM. Commands change the current operating parameters in ram: to make any configuration change permanent, the *SAVE* command (see below) should be issued.

4.1. Save

Used for:	Saves operating parameters into EEPROM.
Parameters:	None
Example:	Save↵
Notes:	-.

4.2. Clear

Used for:	Clears EEPROM values to factory defaults.
Parameters:	None
Example:	Clear↵
Notes:	The factory defaults will be loaded and the system rebooted.

4.3. Reboot

Used for:	Restart the FLEXMod.	
Parameters:	Option	
Example:	Reboot↵	*(Reboot both FPGA and microprocessor)*
	Reboot 0↵	*(Reboot microprocessor only)*
Notes:	-.	

4.4. Baud

Used for:	Changes the serial port baud rate.
Parameters:	BaudRate
Example:	Baud 9600↵ Baud 115200↵
Notes:	Boot baud rate will always be 115200. Nearly all baud rates can be selected up to 3Mbps.

4.5. Echo

Used for:	Activates/Deactivates character echoing.
Parameters:	0 or 1
Example:	Echo 0↵ Echo 1↵
Notes:	Echoing could be disabled to ease the use of a microcontroller. When operating the FLEXMod using a terminal program, having the FLEXMod echoing the characters back simplifies its use.

4.6. HexMode

Used for:	Activates/Deactivates hexadecimal replies.

Parameters:	0 or 1
Example:	HexMode 0↵ HexMode 1↵
Notes:	Hexadecimal replies could be enabled to ease the processing by a microcontroller.

4.7. GetFWVersion

Used for:	Query FLEXMod product name and firmware version.
Parameters:	None
Example:	GetFWVersion↵
Notes:	Return value is: *FlexMOD CM011 - TS Combiner* *Version:x.xx*

4.8. GetSN

Used for:	Query FLEXMod serial number.
Parameters:	None
Example:	GetSN↵
Notes:	Return value is: *SN: xx.xx.xx.xx.xx.xx.xx*

4.9. Welcome

Used for:	Activates/Deactivate welcome message.
Parameters:	0 to 1
Example:	Welcome 0↵ *(Welcome message disabled)* Welcome 1↵ *(Standard welcome message)*
Notes:	There is a special welcome message sent by the FLEXMod when receiving the first ENTER (CR, 0x0D) character after a boot. This is helpful when using the FLEXMod connected to a USB serial port since the original power-up message will be lost because the USB is not yet connected. It is advisable to disable this welcome message when operating the FLEXMod using a microcontroller.

4.10. GetTemp

Used for:	Display currently FlexMOD temperature.
Parameters:	None
Example:	GetTemp↵
Notes:	The temperature is shown in Celsius degree.

4.11. TempAlarm

Used for:	Set point for output alarm signal.
Parameters:	30 to 125
Example:	TempAlarm 75↵ *(Set the alarm temperature to 75 °C)*
Notes:	Temperature is set in Celsius degrees. When FlexMOD temperature is above this set value the OverTemp bit on the *Flags* SPI (see on page 23) will be signaled.

5. CM011 operation and status commands

5.1. SetInputMode

Used for: Set or get ASI input configuration mode.
Parameters: ASI,PASS,PRIO,HP,LP
Example: SetInputMode 1,0,0,1,1↵ *(ASI 1 input pass all priority types, the priority is not changed and both high and low priority TS are cosidered SFN).*
Notes: Parameters are as follow:
ASI: 1,2 (ASI 1 or 2)
PASS: 0-3 (0 = Pass all priorities, 1 = Pass high priority packets only, 2 = Pass normal priority packets only, 3 = Do not pass anything, input is disabled)
PRIO: 0-2 (0 = No priority forcing, 1 = Force all packets to high priority, 2 = Force all packets to normal priority)
HP: 0,1 (0 = MFN, 1 = SFN on high priority TS)
LP: 0,1 (0 = MFN, 1 = SFN on normal priority TS).
If an input is set to SFN, all priority types must configured to pass (the PASS parameter must be set to 0).
See **FLEXMod-CM011 Input processor structure** on page 6 for a description of the CM011 inpu.

5.2. SetInputStripper

Used for: Set or get ASI input NULL packet stripper configuration.
Parameters: ASI,HP,LP
Example: SetInputStripper 1,0,1↵ *(ASI 1 input pass high priority NULL packets while, discarding low/normal priority ones).*
Notes: Parameters are as follow:
ASI: 1,2 (ASI 1 or 2)
HP: 0,1 (0 = High priority NULL packets are preserved, 1 = NULL packets are discarded
LP: 0,1 (0 = Low/Normal priority NULL packets are preserved, 1 = NULL packets are discarded
See **FLEXMod-CM011 Input processor structure** on page 6 for a description of the CM011 input.

5.3. SetOutputMode

Used for: Set or get ASI output configuration mode.
Parameters: ASI,PASS,PRIO
Example: SetOutputMode 1,1,2↵ *(ASI 1 output pass high priority packets only and forces them to normal priority).*
Notes: Parameters are as follow:
ASI: 1,2 (ASI 1 or 2)

PASS: 0-3 (0 = Pass all priorities, 1 = Pass high priority packets only, 2 = Pass normal priority packets only, 3 = Do not pass anything, output is disabled)
PRIO: 0-2 (0 = No priority forcing, 1 = Force all packets to high priority, 2 = Force all packets to normal priority)
See **FLEXMod-CM011 Output processor structure** on page 7 for a description of the CM011 output.

5.4. SetOutputStripper

Used for: Set or get ASI output null packet stripper configuration.
Parameters: ASI,HP,LP
Example: SetOutputStripper 1,0,1↵ *(ASI 1 output pass high priority NULL packets while, discarding low/normal priority ones).*
Notes: Parameters are as follow:
ASI: 1,2 (ASI 1 or 2)
HP: 0,1 (0 = High priority NULL packets are preserved, 1 = NULL packets are discarded
LP: 0,1 (0 = Low/Normal priority NULL packets are preserved, 1 = NULL packets are discarded
ASI output works in either MFN or SFN mode. The mode is automatically chosen based on input configuration and output mode.
Output stripper works only in MFN mode. If the ASI output is in SFN mode, this configuration is ignored.
See **FLEXMod-CM011 Output processor structure** on page 7 for a description of the CM011 output.

5.5. TSMaxRate

Used for: Set or get maximum combined/output TS rate.
Parameters: 0,1-210000000
Example: TSMaxRate 0↵ *(TS Rate set automatically)*
TSMaxRate 20000000↵ *(TS Rate set to 20 Mbits/s)*

5.6. ConfigPreset

Used for: Set or get preset configuration.
Parameters: CONFIG
Example: ConfigPreset 4↵ *(Configure the CM011 to preset configuration 4)*
Notes: This command ease the configuration of the CM011 by automatically configuring all the operating parameters to one of eight standard configuration presets.
Available presets are as follow:
1: combine 2 SFN streams to single combined stream.
2: combine 2 MFN streams to single combined stream.
3: combine SFN (ASI 1)+ MFN (ASI 2) streams to single combined stream.
4: split a combined stream into 2 SFN streams.
5: extract a single SFN (ASI 1) stream from a combined stream

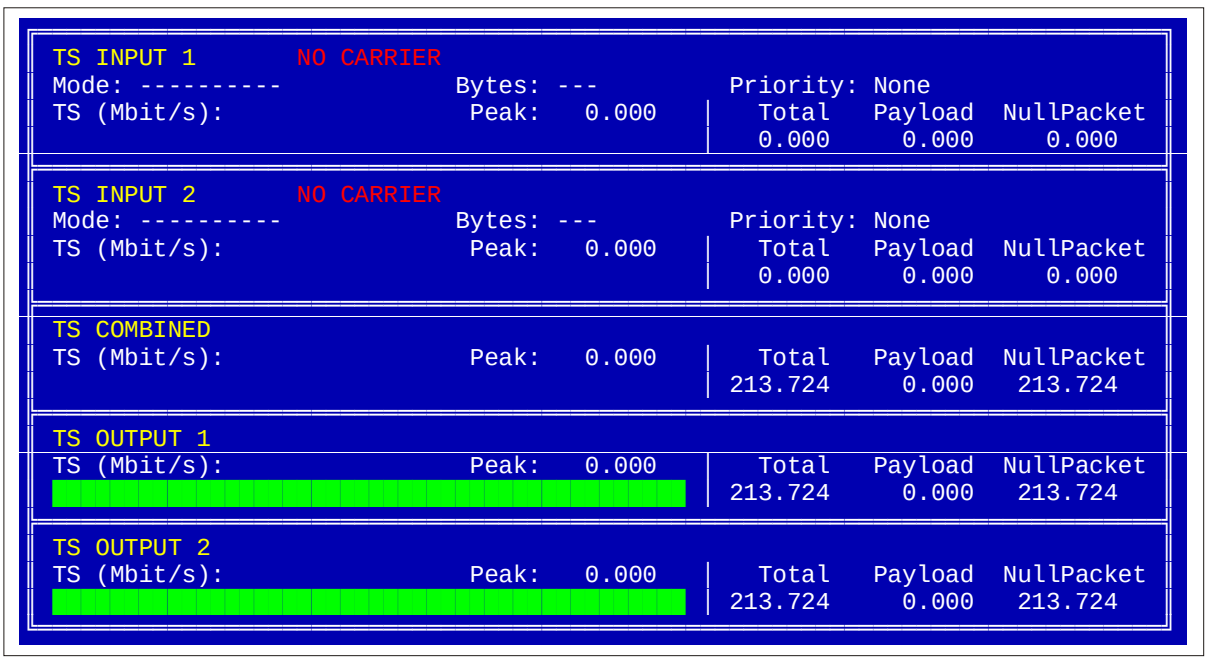
6: extract a single SFN (ASI 2) stream from a combined stream
7: extract a single MFN (ASI 1) stream from a combined stream
8: extract a single MFN (ASI 2) stream from a combined stream

5.7. TsMon

Used for: Show transport streams bitrates.
Parameters: None or 1 or 2
Example: TsMon ↵ *(Simple text output)*
TsMon 1↵ *(Numeric only –microcontroller- output)*
TsMon 2↵ *(ANSI continuous monitoring)*
Notes: The *EasyView* command is the same as *TsMon 2*.

5.8. EasyView

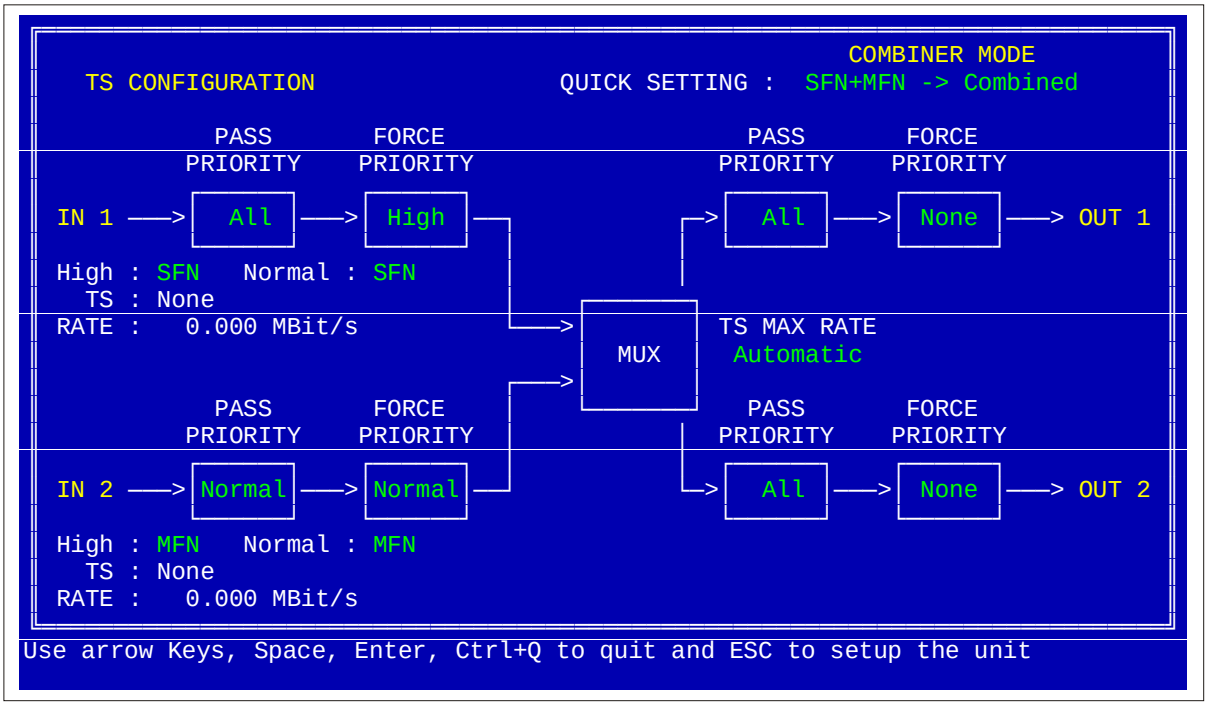
Used for: Show all functional system information.
Parameters: [RefreshRate]
Example: EasyView ↵ *(Maximum refresh rate)*
EasyView 20 ↵ *(Refreshed every 2 seconds)*
Notes: Refresh rate is in 0.1s resolution.



EasyView page example

5.9. EasyConfig

Used for: Mask for the CM011 interactive configuration.
Parameters: [RefreshRate]
Example: EasyConfig ↵ *(Maximum refresh rate)*
EasyConfig 20 ↵ *(Input status is refreshed every 2 seconds)*
Notes: Refresh rate is in 0.1s resolution.



EasyConfig page example

6. Transport Streams and I/O configuration

6.1. SetASIInput

Used for:	Select normal or inverted ASI TS input.	
Parameters:	ASI;MODE	
Example:	SetASIInput 1,0↵	*(ASI TS input 1 disabled)*
	SetASIInput 1,1↵	*(Select ASI TS input 1)*
	SetASIInput 1,2↵	*(Select inverted ASI TS input 1)*
Notes:	Inverted ASI inverts LVDS+ and LVDS- signals.	
	ASI: 1,2 (ASI 1 or 2)	
	MODE: 0,1,2 (0 = Disabled, 1 = Normal, 2 = Inverted)	

6.2. SelASIOutput

Used for:	Set or get ASI output source.	
Parameters:	ASI;OUT	
Example:	SelASIInput 1,0↵	*(ASI output 1 outputs combiner output)*
	SetASIInput 1,1↵	*(ASI output 1 outputs ASI input 1)*
	SetASIInput 1,2↵	*(ASI output 1 outputs ASI input 2)*
Notes:	Parameters are as follow:	
	ASI: 1,2 (ASI 1 or 2)	
	OUT: 0,1,2 (0 = Combiner output, 1 = ASI Input 1, 2 = ASI Input 2)	

6.3. SetASIOutput

Used for:	Select normal or inverted ASI TS output.	
Parameters:	ASI,MODE	
Example:	SetASIOutput 0↵	*(ASI TS output disabled)*
	SetASIOutput 1↵	*(Select ASI TS output)*
	SetASIOutput 2↵	*(Select inverted ASI TS output)*
Notes:	Inverted ASI inverts LVDS+ and LVDS- signals.	
	ASI: 1,2 (ASI 1 or 2)	
	MODE: 0,1,2 (0 = Disabled, 1 = Normal, 2 = Inverted)	

6.4. LedSPI

Used for:	Set or get configuration of LED SPI.	
Parameters:	MODE	
Example:	LedSPI 0↵	*(LED SPI disabled)*
	LedSPI 1↵	*(LED SPI enabled, signalling polarity is positive)*
	LedSPI 1↵	*(LED SPI enabled, signalling polarity is negative)*

7. FLEXMod module upgrade

IMPORTANT NOTE:

If the module has the "**FLEXMod 2.0 FPGA Boot Loader**" installed, do not use the following procedure to upgrade.
Please refer to the "**FLEXMod 2.0 FPGA Boot Loader**" documentation for a fail-safe and faster upgrade procedure.

The FLEXMod firmware can be user upgraded if needed.
The upgrade procedure is performed with the following steps:

1. Change the baud rate to something faster than 115200. This step is not necessary (the upgrade can also be done at any baud rate) but since the firmware is quite long it is advisable to do this.
2. Issue the *FlashFormat 741852* command which erases the onboard serial flash containing the firmware.
3. Wait for the FLEXMod signaling the end of the flash erasing procedure (it takes normally 10 seconds)
4. Issue the *Upgrade 741852* command and upload the new firmware using the XMODEM protocol.
5. When the upload has been completed, wait for the acknowledge that the upgrade has been successfully completed.
6. Power off and then back on the FLEXMod.

Please note:

Should the procedure fail for any reason, perform the procedure again starting from step 2. **Do not** power off the board since the flash has been erased (or contains an invalid firmware) and hence the board will not work (and could also, in rare occasions, be damaged). Should this happen, the board has to be returned to factory for reprogramming

7.1. FlashFormat

Used for:	Erases the onboard serial flash.
Parameters:	741852
Example:	FlashFormat ↵
Notes:	The *741852* parameter is a constant value used to avoid the risk of issuing this command by chance. Do not erase the flash if you are not ready to perform an upgrade procedure. After the flash has been erased, the FLEXMod will not be able to boot.

7.2. Upgrade

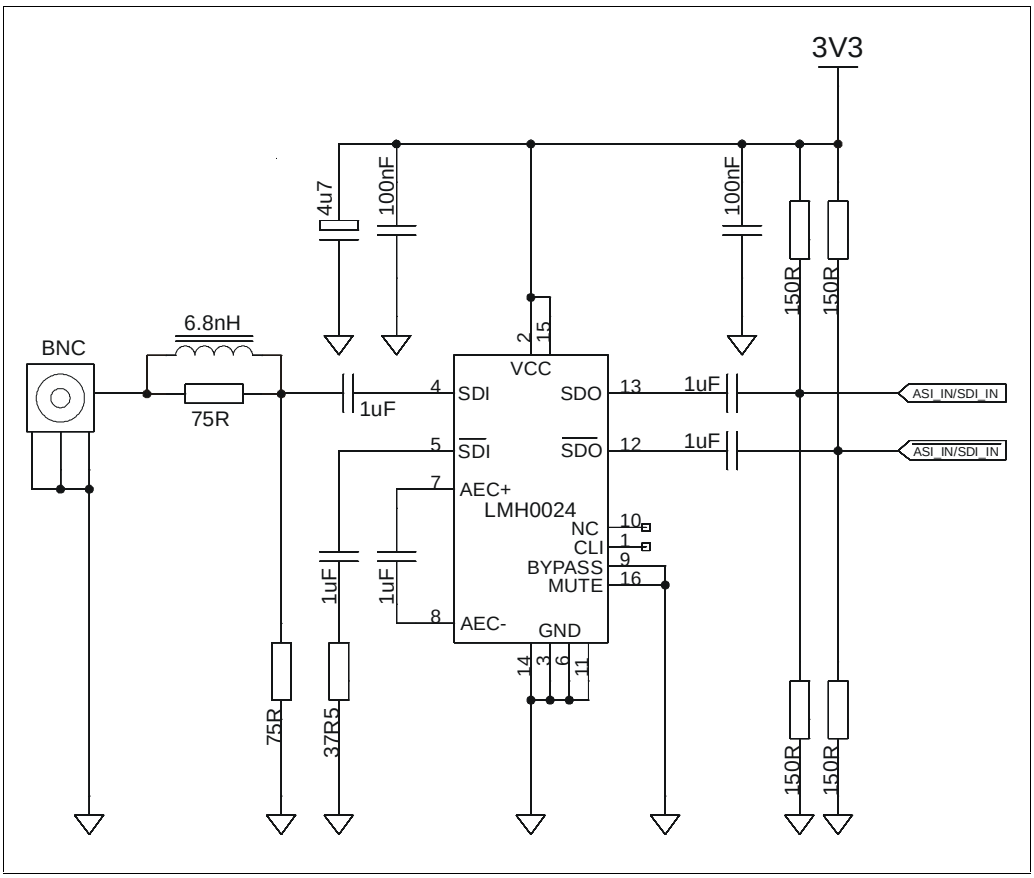
Used for:	XMODEM upload of a new firmware.
Parameters:	741852

Example: Upload↵
Notes: Any terminal software capable of the XMODEM protocol can be used.
The *741852* parameter is a constant value used to avoid the risk of issuing this command by chance.

8. Sample schematics

8.1. ASI Input sample schematic

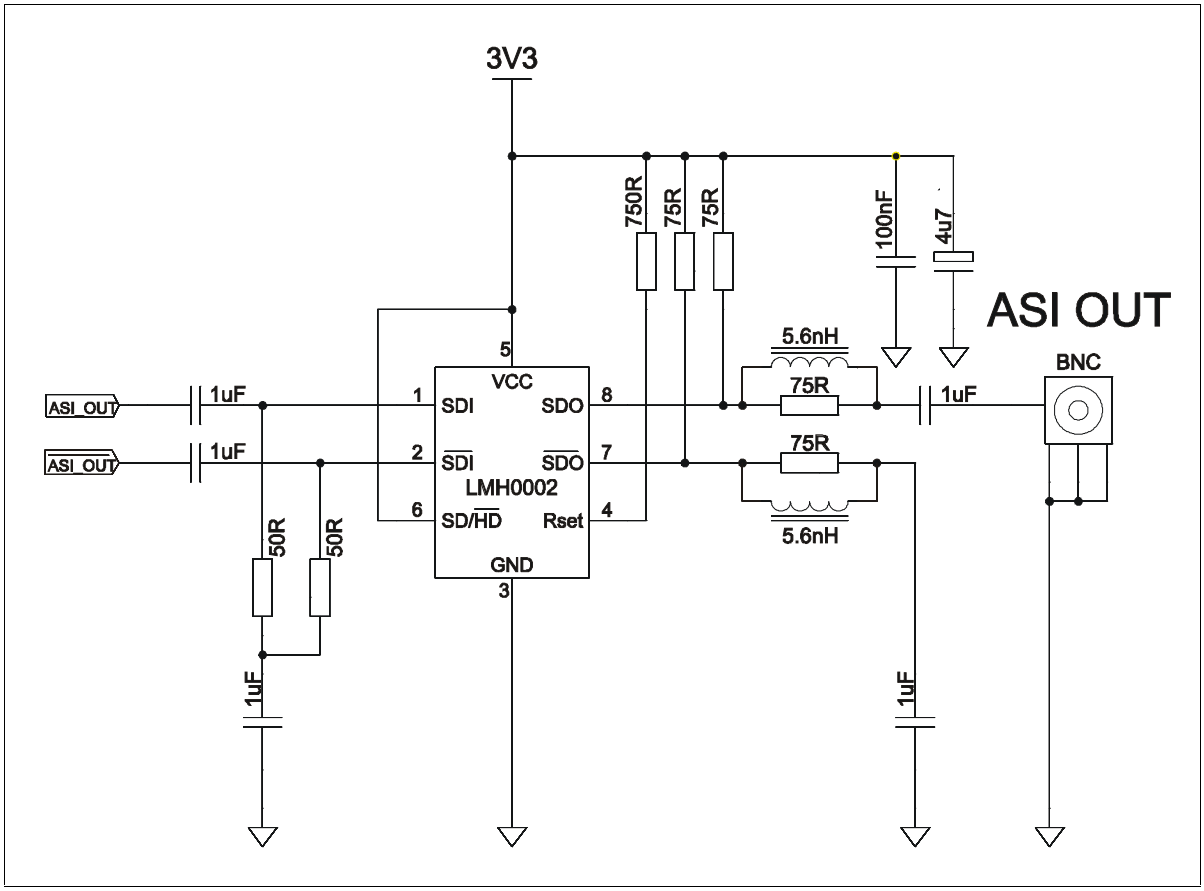
The LDVS TS ASI Input requires a cable equalizer and an adaptation network in order to adjust input levels. Note that ASI_IN is a LVDS signal, so route accordingly. The following schematics is a typical application ASI input:



Typical ASI input

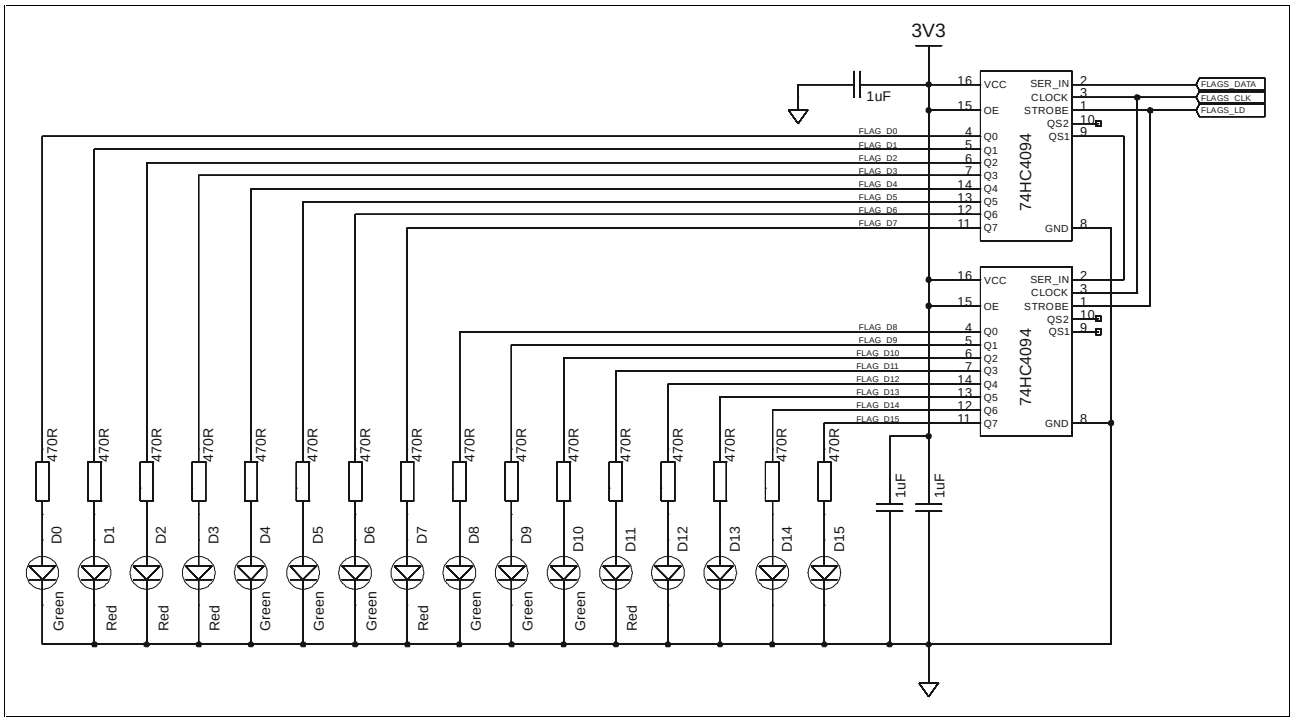
8.2. ASI Output sample schematic

The LDVS TS ASI Output requires an adaptation network in order to adjust input levels and an output driver. Note that ASI_OUT is a LVDS signal, so route accordingly. The following schematics is a typical application ASI output:



Typical ASI output

8.3. Flags SPI sample schematic



Bit	Flag
D0	Boot OK
D1	OverTemp
D2	Unused
D3	Unused
D4	ASI #1 TS DCD
D5	ASI #1 TS 204/188
D6	ASI #1 TS Burst
D7	ASI #1 TS Overflow

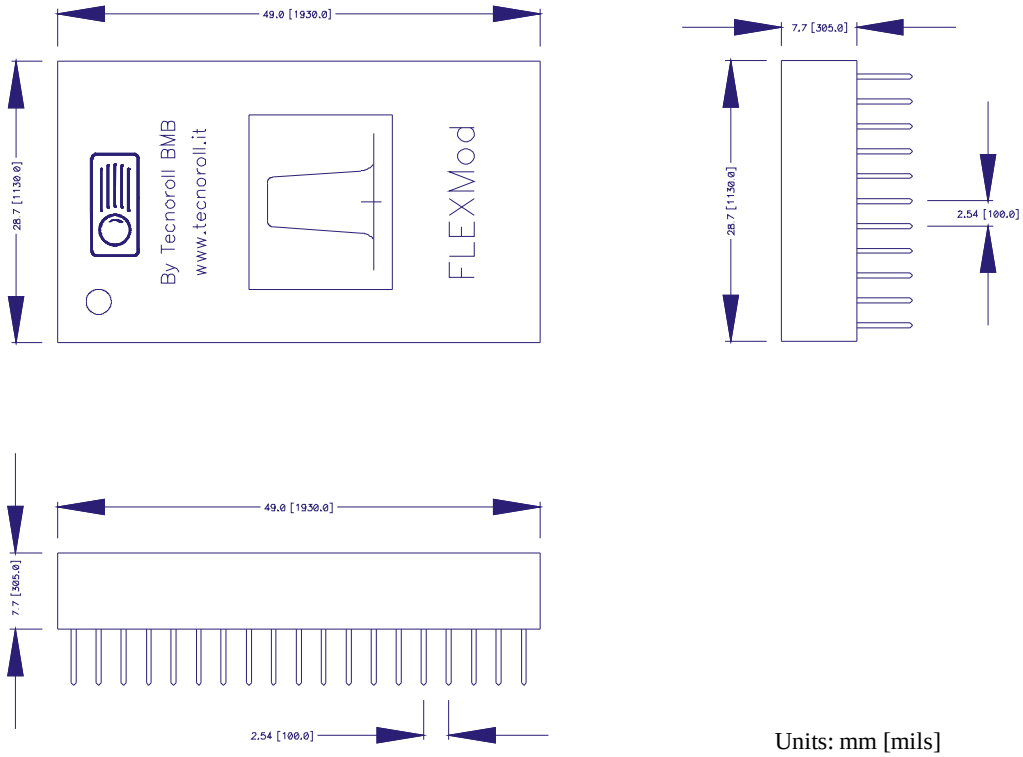
Bit	Flag
D8	ASI #2 TS DCD
D9	ASI #2 TS 204/188
D10	ASI #2 TS Burst
D11	ASI #2 TS Overflow
D12	Power ON
D13	Spare / Unused
D14	Spare / Unused
D15	Spare / Unused

9. Power supplies characteristics

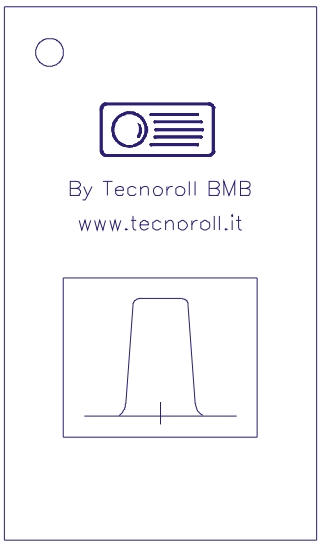
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP.	MAX	UNIT
1V2	Core voltage			TBD		mA
1V8	DAC voltage			TBD		mA
3V3	I/O voltage			TBD		mA

10. Alphabetical command list

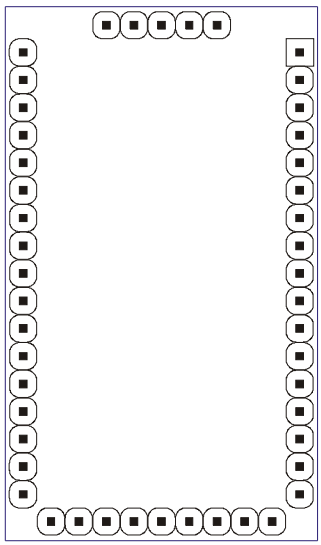
11. Packaging information



Units: mm [mils]
Controlling dimensions: mm



Top View

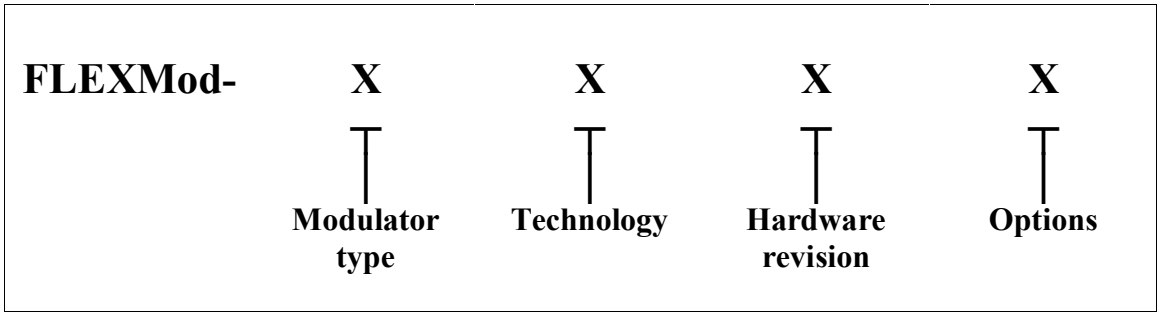


Bottom View

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
$I_{LVDS\pm}$	Positive/Negative LVDS input
O_a	Analog output
O_3	3.3V output
O_5	5V output
OC_3	3.3V output, Open Collector
$O_{LVDS\pm}$	Positive/Negative LVDS output
P	Power supply line
P_o	Power supply output line

Appendix B FLEXMod Product Identification System



Modulator type	
0	Unprogrammed hardware
1	DVB-T MFN: *ETSI EN 300 744* compliant COFDM modulator.
2	DVB-S: *ETSI EN 300 421* compliant QPSK modulator.
3	DVB-C: *ETSI EN 300 429* compliant QAM modulator.
4	ATSC (A/53) compliant modulator.
5	DVB-S/S2: *ETSI EN 300 421/302 307* compliant QPSK/8PSK/16,32APSK modulator.
6	DVB-T SFN: *ETSI EN 300 744/TS 101 191* compliant COFDM modulator.
7	SFN Adapter/MIP Inserter
8	Aspect Ratio corrector and EPG inserter
9	Transport Stream Converter/Remultiplexer
AV1	DVB-T MFN: ETSI EN 300 744 compliant COFDM TR391AV Controller
AV2	DVB-S: ETSI EN 300 421 compliant QPSK TR391AV Controller
AV3	DVB-C: ETSI EN 300 429 compliant QAM TR391AV Controller
CM0	Transport stream Combiner

Technology	
0	Reference clock: 1.024 GHz.
1	Professional tunable reference clock (VCXO): 1.024 GHz.
2	Professional tunable reference clock (VCXO): 1.024 GHz and SFN input FIFO
8	Reference clock: 16 MHz.

Options	
P	Premium type.
N	Unboxed (naked) version.
NP	Unboxed (naked) version, no pins, panelized

Examples:
FLEXMod-101 Consumer grade DVB-T modulator, reference clock 1.024GHz, HW revision 1
FLEXMod-281 Consumer grade DVB-S modulator, reference clock 16MHz, HW revision 1