Tecnoroll BMB srl

Via Olona 9, 21040 Vedano Olona VA

www.tecnoroll.it

FLEXMod-811

module

Connectors, pin description and programming protocol

Rev A, September, 10th 2012

Hardware revision 2.00

Firmware version 0.12

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Revision history:

Rev A, September, 10th 2012, abesani@tecnoroll.it
First release

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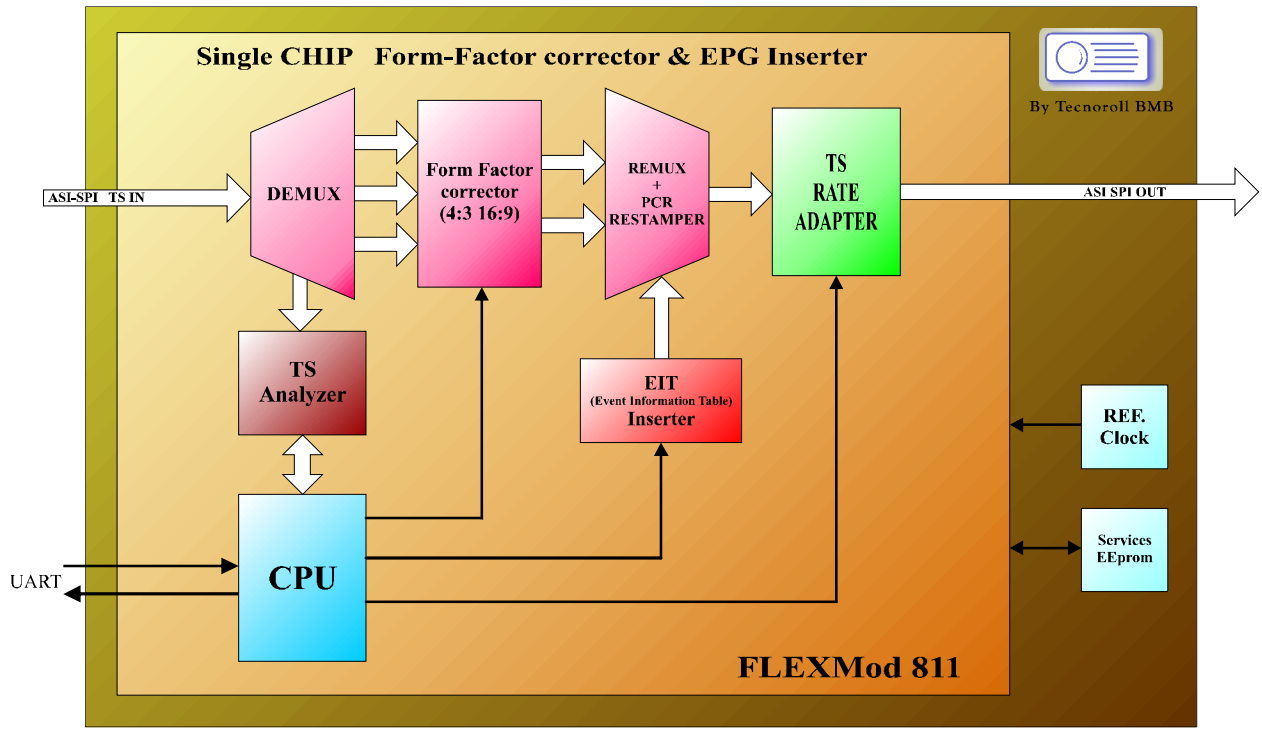
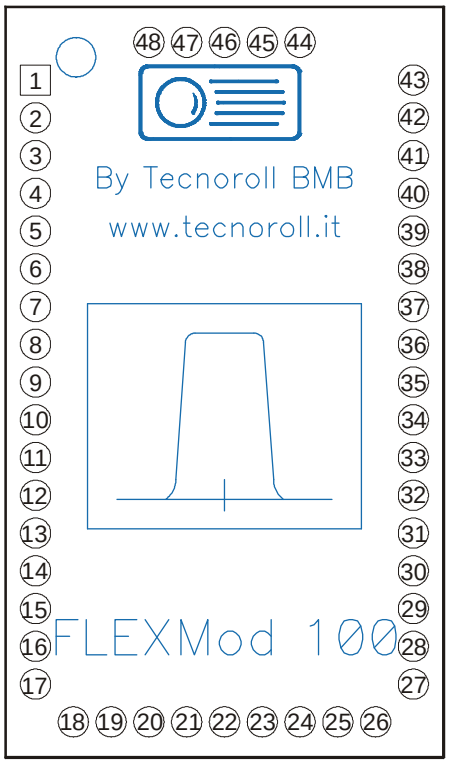
1. FLEXMod Block Diagram

1.1. FLEXMod-811

The FLEXMod-811 is a ETSI EN 300 468 compliant EPG inserter and optionally a ISO/IEC 13818-2 compliant aspect ratio modifier/fixer.



2. Connectors and pin description



FLEXMod-811, 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	REF_CLOCK	O_3	Optional 27 MHz Reference Clock Output
6	ASI_IN	I_{LVDS+}	LDVS TS ASI Input. Requires a Cable equalizer and an adaptation network. See *ASI Input* on page 22 .
7		I_{LVDS-}	
8	TSin_CLK	I_3	Transport Stream Input CLOCK signal
9	TSin_VALID	I_3	Transport Stream Input VALID signal
10	TSin_D0	I_3	Transport Stream Input Data line, bit 0
	TSin_D7		Transport Stream Input Data line, bit 7 (1)
11	TSin_D1	I_3	Transport Stream Input Data line, bit 1
	TSin_D6		Transport Stream Input Data line, bit 6 (1)
12	TSin_D2	I_3	Transport Stream Input Data line, bit 2
	TSin_D5		Transport Stream Input Data line, bit 5 (1)
13	TSin_D3	I_3	Transport Stream Input Data line, bit 3
	TSin_D4		Transport Stream Input Data line, bit 4 (1)

Pin	Symbol	Type	Description
14	TSin_D4	I_3	Transport Stream Input Data line, bit 4
	TSin_D3		Transport Stream Input Data line, bit 3 (1)
15	TSin_D5	I_3	Transport Stream Input Data line, bit 5
	TSin_D2		Transport Stream Input Data line, bit 2 (1)
16	TSin_D6	I_3	Transport Stream Input Data line, bit 6
	TSin_D1		Transport Stream Input Data line, bit 1 (1)
17	TSin_D7	I_3	Transport Stream Input Data line, bit 7
	TSin_D0		Transport Stream Input Data line, bit 0 (1)
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	TSout_D7	O_3	Transport Stream Output Data line, bit 7
	TSout_D0		Transport Stream Output Data line, bit 0 (2)
28	TSout_D6	O_3	Transport Stream Output Data line, bit 6
	TSout_D1		Transport Stream Output Data line, bit 1 (2)
29	TSout_D5	O_3	Transport Stream Output Data line, bit 5
	TSout_D2		Transport Stream Output Data line, bit 2 (2)
30	TSout_D4	O_3	Transport Stream Output Data line, bit 4
	TSout_D3		Transport Stream Output Data line, bit 3 (2)
31	TSout_D3	O_3	Transport Stream Output Data line, bit 3
	TSout_D4		Transport Stream Output Data line, bit 4 (2)
32	TSout_D2	O_3	Transport Stream Output Data line, bit 2
	TSout_D5		Transport Stream Output Data line, bit 5 (2)
33	TSout_D1	O_3	Transport Stream Output Data line, bit 1
	TSout_D6		Transport Stream Output Data line, bit 6 (2)
34	TSout_D0	O_3	Transport Stream Output Data line, bit 0
	TSout_D7		Transport Stream Output Data line, bit 7 (2)
35	TSout_VALID	O_3	Transport Stream Output VALID signal
36	TSout_CLK	O_3	Transport Stream Output CLOCK signal
37	ASI_ OUT	O_{LVDS-}	LDVS TS ASI Output. Requires an adaptation network and a Cable Driver. See *ASI Output* on page 23 for more information.
38		O_{LVDS+}	
39	TSout_PSYNC	O_3	Transport Stream Output PSYNC signal
40	GND	P	Digital Ground
41	3V3	P	+3.3V Digital Power Supply
42	3V3	P	+3.3V Digital Power Supply

Pin	Symbol	Type	Description
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]) Use the *TSInput* command (see page 18) to select normal or reveresed input bus.
([2]) Use the *TSOutput* command (see page 19) to select normal or reveresed output bus.

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-811 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 811 - EPG Inserter
x, Version:x.xx

4.8. GetSN

Used for: Query FLEXMod serial number.
Parameters: None
Example: GetSN↵
Notes: Return value is:
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 a warning message will be displayed in the *GetTemp* command reply.

5. Time and Date configuration

5.1. ClockSet

Used for: Set the internal clock/calendar.
Parameters: Hour,Min,Seconds,Day,Month,Year
Example: ClockSet 15,54,00,25,9,2012↵ *(Set the clock at 15:54:00 -3:54:00pm-, September, 25th 2012)*
Notes: Clock must be set in UTC time.
Month should be given numeric, and years before 2000 are not accepted.

5.2. ClockGet

Used for: Reads the internal clock/calendar.
Parameters: [1]
Example: ClockGet↵ *(Return 25 Sep 2012, 15:54:04)*
ClockGet 1↵ *(Return 15, 54, 9, 25, 9, 2012)*
Notes: The optional parameter 1 returns the current clock in a microcontroller friendly version: *Hour,Minutes,Seconds,Day,Month,Year*.

5.3. TOTSetOffsetDescriptor

Used for: Set or get the TOT Local Offset Time Descriptor.
Parameters: CountryCode, RegionID, LocalTimeOffsetHour, LocalTimeOffsetMin, DateNextChangeHour, DateNextChangeMin, DateNextChangeSec, DateNextChangeDay, DateNextChangeMonth, DateNextChangeYear, NextTimeOffsetHour, NextTimeOffsetMin
Example: TOTSetOffsetDescriptor ita, 0, 2, 0, 3, 0, 0, 28, 10, 2012, 1, 0↵
Notes: The 12 parameters are as follow:

CountryCode:	ISO 639-2 Alpha3 language code
RegionID:	Region ID within the defined country. 0 in most countries
LocalTimeOffsetHour:	Local time offset (to UTC time), hours
LocalTimeOffsetMin:	Local time offset (to UTC time), hinutes
DateNextChangeHour:	Date of next change of TimeOffset, hours
DateNextChangeMin:	Date of next change of TimeOffset, minutes
DateNextChangeSec:	Date of next change of TimeOffset, seconds
DateNextChangeDay:	Date of next change of TimeOffset, day (1-31)
DateNextChangeMonth:	Date of next change of TimeOffset, month (1-12)
DateNextChangeYear:	Date of next change of TimeOffset, year
NextTimeOffsetHour:	Next time offset (to UTC time), hours
NextTimeOffsetMin:	Next time offset (to UTC time), minutes

The TOT table broadcasts the time information required by the receivers to convert EPG times (always in UTC) into local times, accounting for the Daylight Saving Time, if present. To be able to always broadcast a correct information even when the DST begins or ends, the next Date/Time of change and the next Time Offset are required.

6. EPG Configuration commands

6.1. TSID

Used for: Set Transport Stream ID.
Parameters: TsID
Example: TSID 1↵
Notes: The Transport stream ID must be set correctly to the same value used in the incoming transport stream.

6.2. ONID

Used for: Set Original Network ID.
Parameters: OriginalNetworkID
Example: ONID 8572↵
Notes: The Original Network ID must be set correctly to the same value used in the incoming transport stream.

6.3. EITEvent

Used for: Set an EIT event.
Parameters: 0|1, ServiceID, EvtID, Hour, Min, Sec, Day, Month, Year, DurationHour, DurationMin, DurationSec, LangCode, EventName[, EventText]
Example: EITEvent 0,77,123,20,0,0,25,9,2012,1,0,0,ita,Event Name↵ *("Now" event)*
EITEvent 1,77,124,21,0,0,25,9,2012,2,0,0,ita,Event Name↵ *("Next" event)*
Notes: The 15 parameters are as follow:

0|1:	0=Now, 1=Next event. The texts *Now* or *Next* can be used in place of 0 or 1
ServiceID:	The service ID this event refers to
EvtID:	The ID for this event. Range 0 to 65535.
Hour:	Time/date when this event begins: hours
Min:	Time/date when this event begins: minutes
Sec:	Time/date when this event begins: seconds
Day:	Time/date when this event begins: day
Month:	Time/date when this event begins: month
Year:	Time/date when this event begins: year
DurationHour:	Duration of this event: hours
DurationMin:	Duration of this event: minutes
DurationSec:	Duration of this event: seconds
LangCode:	ISO 639-2 Alpha3 language code for this event
EventName:	Name of this event
EventText:	(optional) Text describing this event

The maximum length of EventName and EventText should not exceed 250 characters.
If there was an older event defined for this Service ID, the new event replaces the older one. It is not necessary to manually delete the old event.

6.4. EITClearAll

Used for:	Clear all EIT events.
Parameters:	none
Example:	EITClearAll↵
Notes:	All the programmed EIT events are deleted and no longer broadcast.

6.5. EITClearEvent

Used for:	Clear an EIT event.
Parameters:	0|1,ServiceID
Example:	EITClearEvent 0,77↵ *(Clear "Now" event for Service ID 77)*
Notes:	The 0|1 parameter is 0=Now, 1=Next event. The texts *Now* or *Next* can be used in place of 0 or 1. It is not necessary to delete an event before changing it. Just give the new EITEvent command. This command can be used to clear some event when NO events are to be broadcast.

7. Aspect Ratio related commands

7.1. ARFixSet

Used for:	Modifies a MPEG2 video Aspect Ratio.
Parameters:	PID,NewAR
Example:	ARFixSet 256,3↵ *(Changes the AR for the Video PID 256 to 16:9)*
	ARFixSet 256,0↵ *(Disables AR modification for the Video PID 256)*
Notes:	A maximum of 16 PIDs can be fixed.
	The NewAR value is: 0=Disabled, 1=1:1, 2=4:3, 3=16:9, 4=2.21:1

7.2. ARFixList

Used for:	List currently defined MPEG2 Video Aspect Ratio.
Parameters:	none
Example:	ARFixList↵

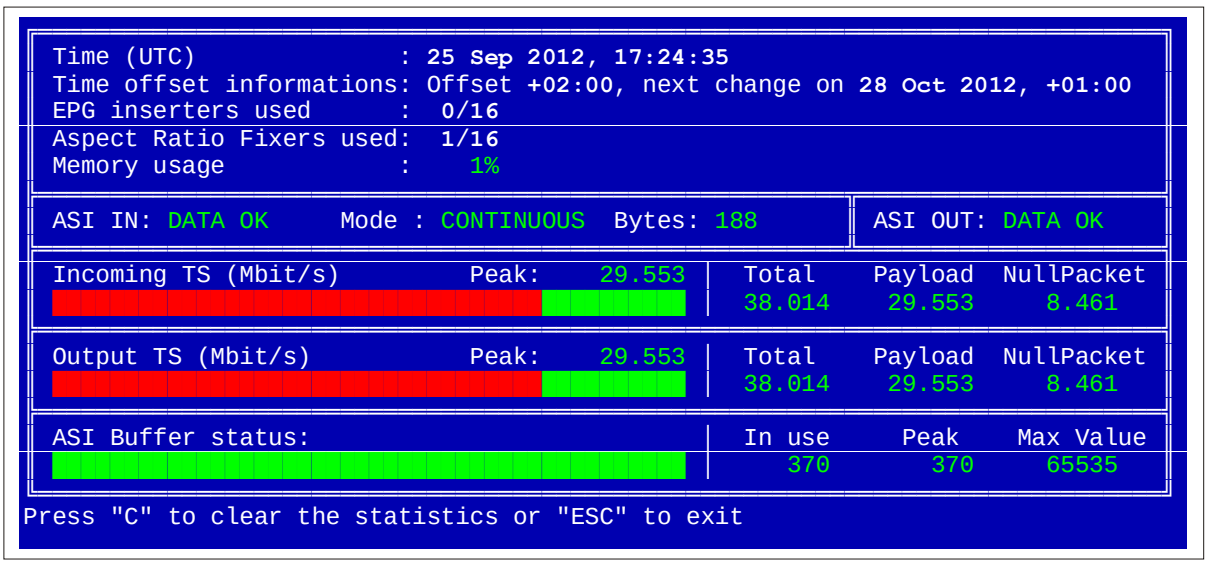
8. Interactive configuration, status and misc commands

8.1. TsMon

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

8.2. EasyView

Used for: Shows all functional system information.
Parameters: TIME
Example: EasyConfig ↵ *(Default refresh delay of 0.1s)*
EasyConfig 10 ↵ *(Refresh every 1 second)*
Notes: Refresh rate is in 0.1s resolution.



EasyView page example

8.3. KillPID

Used for: Set or get the PID killer configuration.
Parameters: SLOT,PID
Example: KillPID ↵ *(Report the PID killers status)*
KillPID 0,220 ↵ *(Pid 220 is removed from the TS, using slot 0)*
Notes: The KillPID command allows the removal of a generic PID from the TS.
10 slots are available, so a maximum of 10 PIDs can be removed from the TS.

9. Transport stream I/O configuration

9.1. ASIInput

Used for: Set or get ASI input format.
Parameters: MODE
Example: SetASIInput 0↵ *(ASI TS input disabled)*
SetASIInput 1↵ *(Select normal ASI TS input)*
SetASIInput 2↵ *(Select inverted ASI TS input)*
Notes: Inverted ASI inverts LVDS+ and LVDS- signals.
MODE: 0,1,2 (0 = Disabled, 1 = Normal, 2 = Inverted)
If this command is given without parameters, it returns both the current ASI input configuration and the current ASI input status.
This command configures the ASI input but does not select it. Use the *SelInput* command to select the ASI or Parallel input.

9.2. TSInput

Used for: Set or get parallel TS input format.
Parameters: EN,CLK,VAL,BUS,REF
Example: TSInput 1,1,1,0,0↵ *(Parallel TS input enabled, sample on clock rising edge, Valid active high, no reference clock out)*
Notes: The parameters are as follow:

EN:	0=Input disabled, 1=Input enabled
CLK:	Sample on 0=falling, 1=rising clock edge
VAL:	0=Valid active low, 1=Valid active high
BUS:	0=Normal TS input, 1=Reversed TS input
REF:	27 MHz reference clock output, 0=No, 1=Yes

This command configures the Parallel input but does not select it. Use the *SelInput* command to select the ASI or Parallel input.

9.3. SelInput

Used for: Set or get input selection.
Parameters: Input
Example: SelInput 0↵ *(Parallel input selected)*
SetInput 1↵ *(ASI input selected)*
Notes: 0 selects parallel input, 1 selects ASI input.

9.4. ASIOutput

Used for: Select normal or inverted ASI TS output.
Parameters: 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.
MODE: 0,1,2 (0 = Disabled, 1 = Normal, 2 = Inverted)

9.5. ASIOutRate

Used for: Set or get ASI output rate.
Parameters: 0,1-210000000
Example: ASIOutRate 0↵ *(Uses input rate)*
ASIOutRate 24000000↵ *(Set the output rate to 24MBits)*
Notes: When the parameter is 0, the Transport Stream rate is not changed: this requires enough free bandwith already to be present in the TS to be able to insert the EIT tables correctly.

9.6. TSOutput

Used for: Set or get parallel TS output format.
Parameters: EN,CLK,VAL,BUS,SYNC
Example: TSInput 1,1,1,0,0↵ *(Parallel TS input enabled, sample on clock rising edge, Valid active high, no reference clock out)*
Notes: The parameters are as follow:

EN:	0=Output disabled, 1=Output enabled
CLK:	Change data on 0=rising, 1=falling clock edge
VAL:	0=Valid active low, 1=Valid active high
BUS:	0=Normal TS output, 1=Reversed TS output
SYNC:	0=PSYNC active low, 1= PSYNC active high

The Clock output is fixed at 27MHz.

10. 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

10.1. 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.

10.2. Upgrade

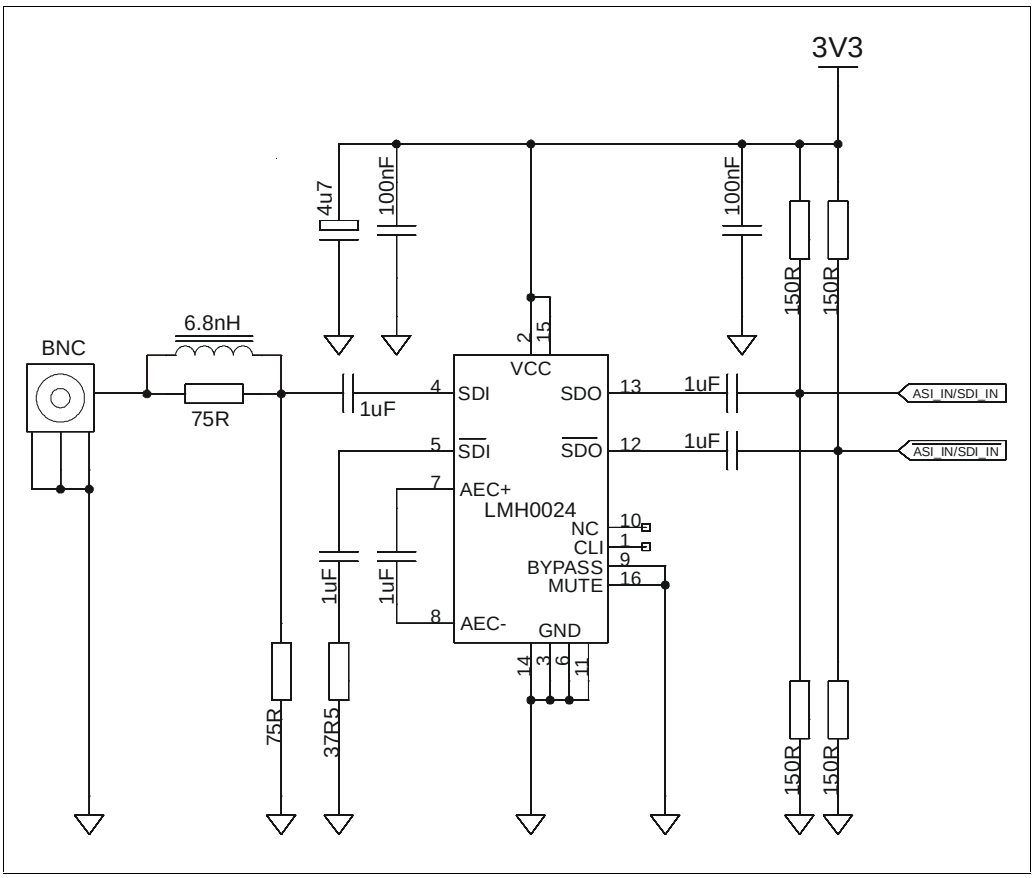
Used for:	XMODEM upload of a new firmware.
Parameters:	741852

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.

11. Sample schematics

11.1. ASI Input sample schematic

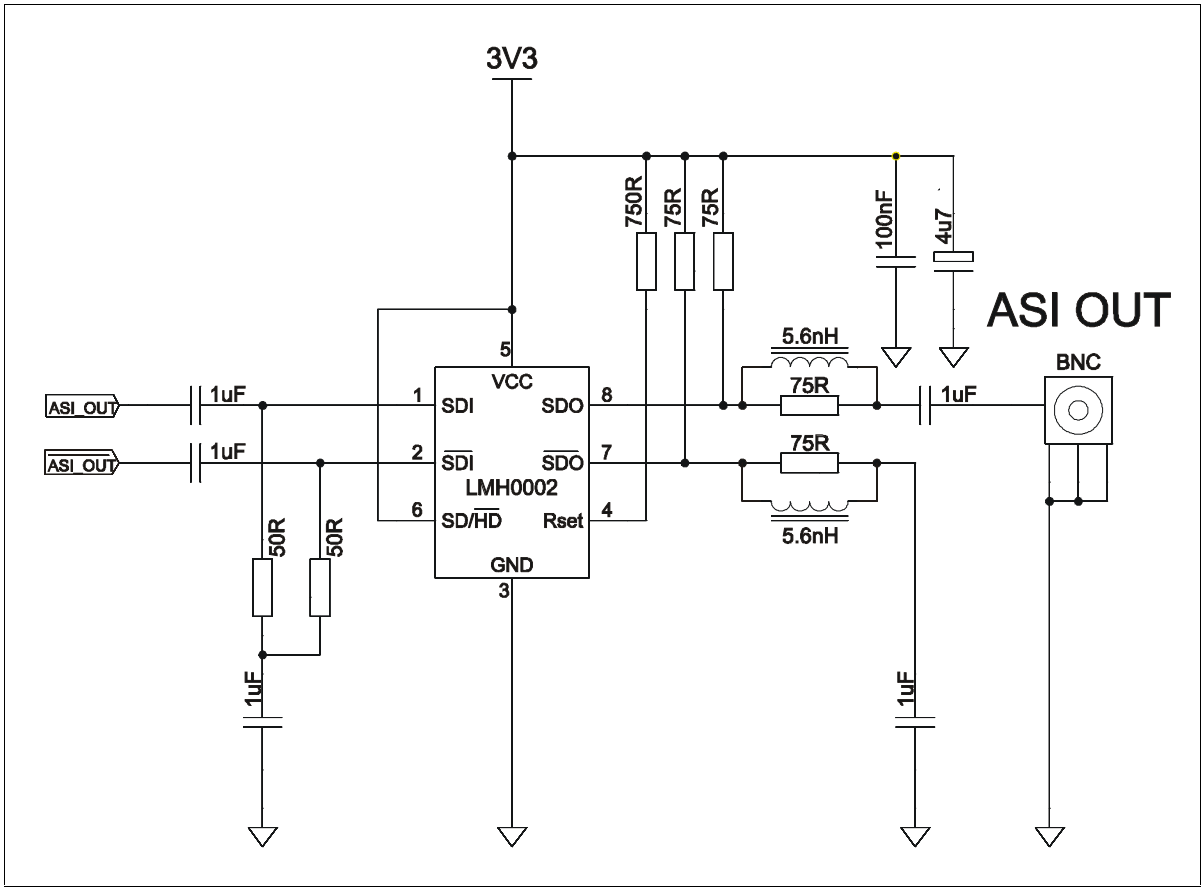
The LDVS TS ASI Input requires a cable equalizer and an adaptation network in order to adjust input levels. Note that ASI_IN is a LVDS signal, so route accordingly. The following schematics is a typical application ASI input:



Typical ASI input

11.2. 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:



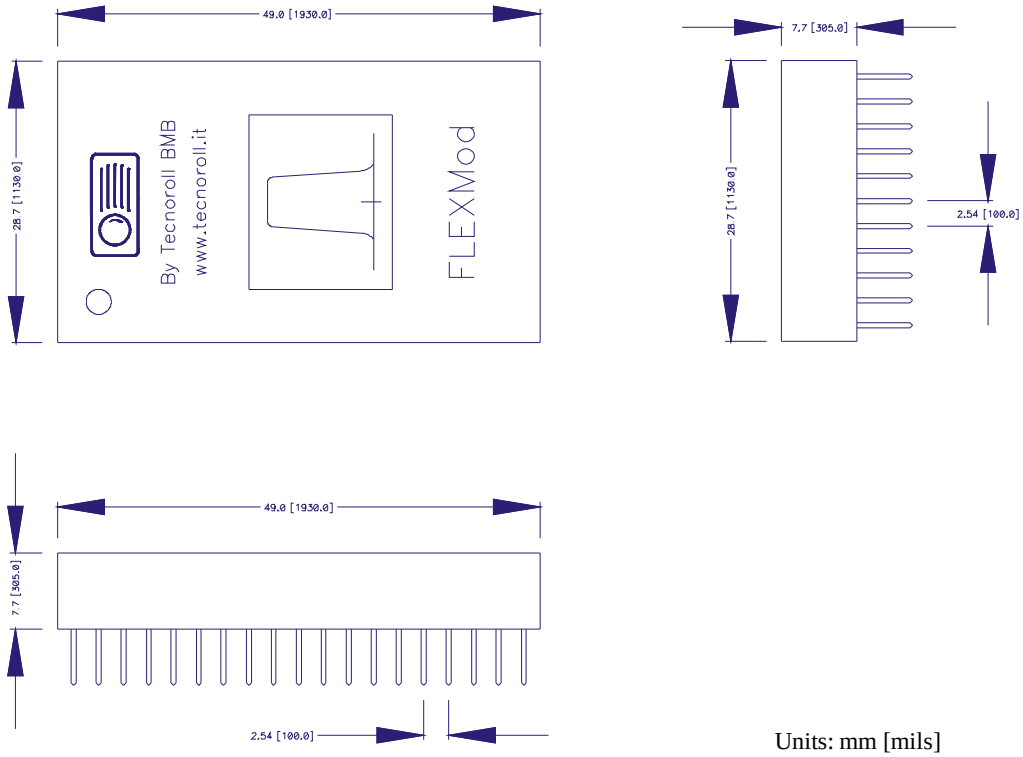
Typical ASI output

12. Power supplies characteristics

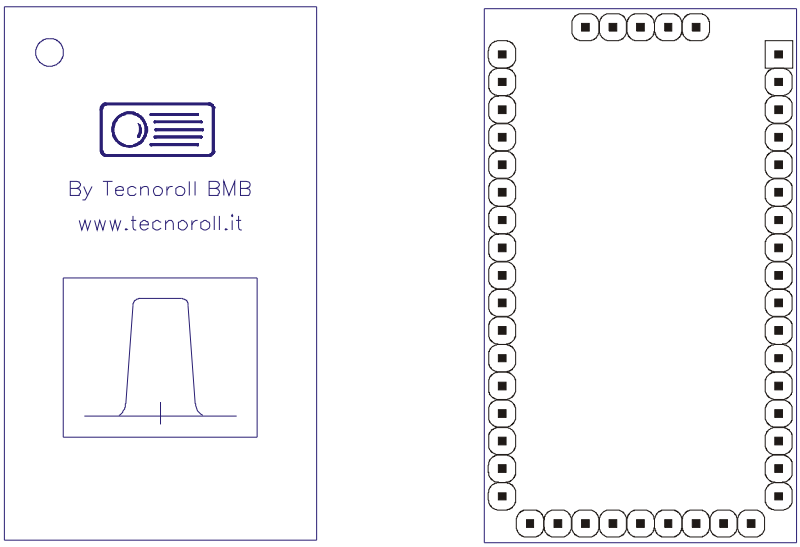
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP.	MAX	UNIT
1V2	Core voltage			TBD		mA
1V8	DAC voltage			TBD		mA
3V3	I/O voltage			TBD		mA

13. Alphabetical command list

14. Packaging information



Units: mm [mils]
Controlling dimensions: mm

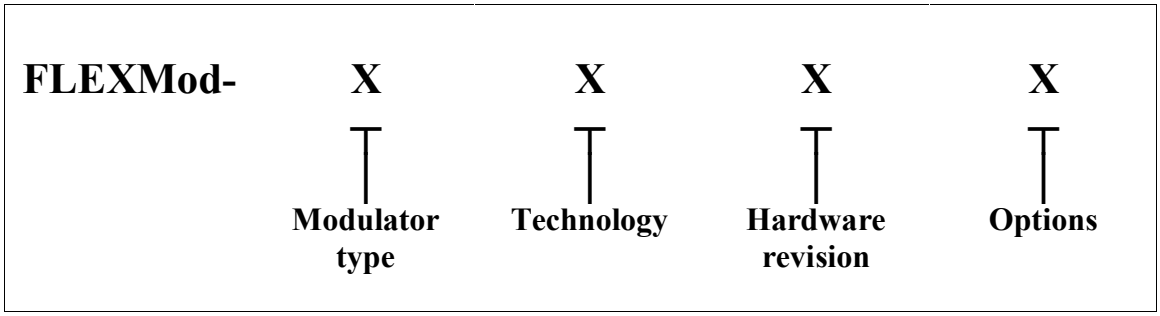


Top View Bottom View

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