
# Tecnoroll BMB srl

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# FLEXMod-621

## module

Connectors, pin description and programming protocol


Rev B, August, 28th 2012

Hardware revision 2.00

Firmware version 0.18

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## Revision history:

**Rev A, January, 10th 2011, abesani@tecnoroll.it**
First release

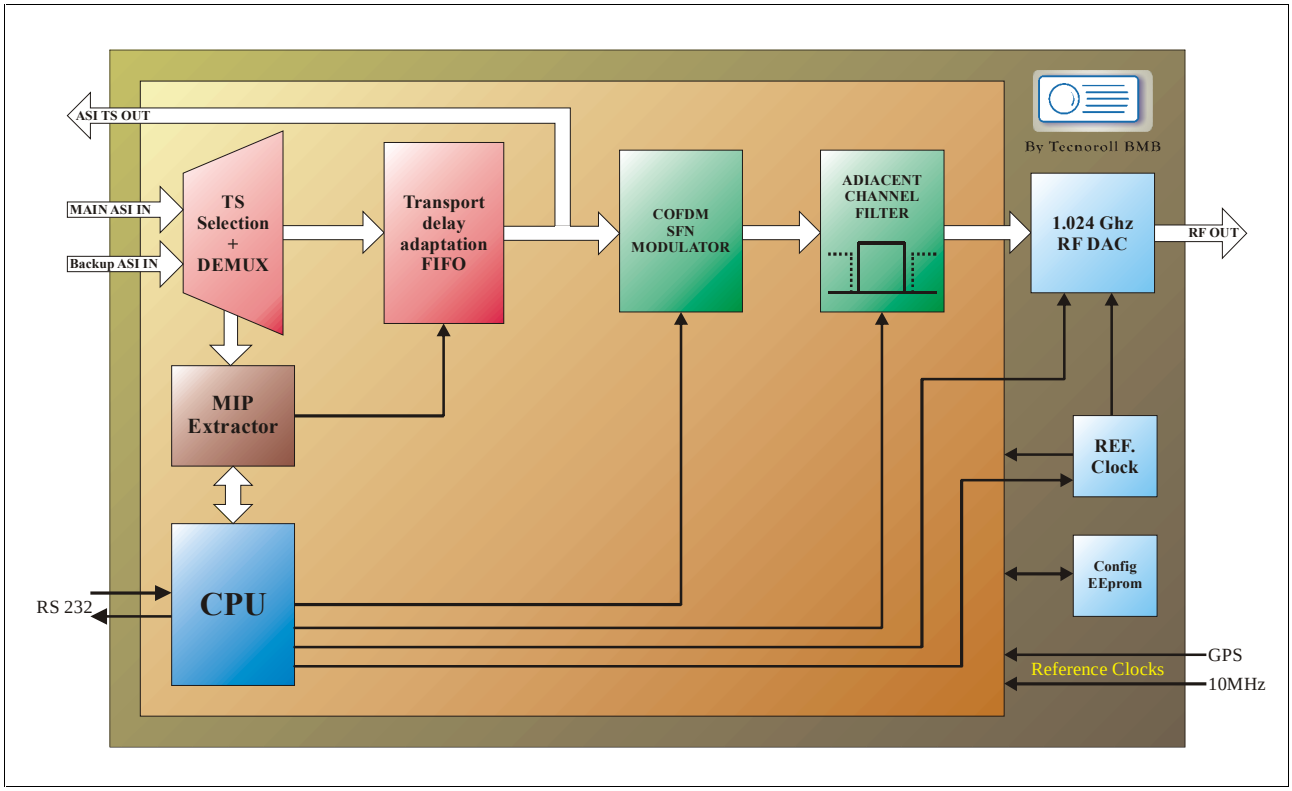
**Rev B, August, 28th 2012, abesani@tecnoroll.it**
Updated the ASI In sample schematics.
Added *CrestClipper*, *FilterGain*, *StaticDelay* commands.
Expanded *Trim* limits.
Added firmware upgrade warning.

# Index

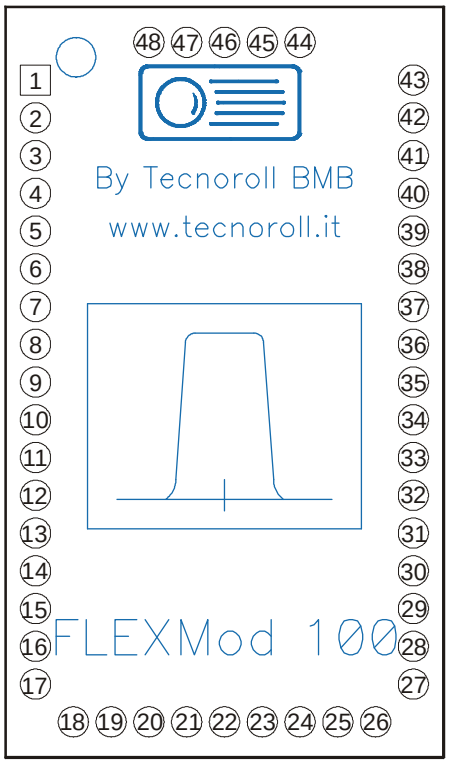
# 1. FLEXMod Block Diagram

### 1.1. FLEXMod-621

The FLEXMod-621 is an ETSI EN 300 744/TS 101 191 compliant modulator with an integrated microprocessor, enhanced output filtering and a 1GHz output DAC.



# 2. Connectors and pin description




**FLEXMod-621, Top view**

| Pin | Symbol | Type | Description |
|---|---|---|---|
| 1 | GNDA | P | Analog ground |
| 2 | 1V8A | P | +1.8V Analog Power Supply |
| 3 | 1V8 | P | +1.8V Digital Power Supply |
| 4 | GND | P | Digital Ground |
| 5 | RSVD | - | Reserved |
| 6 | MAIN_ASI_IN | $I_{LVDS+}$ | Main LDVS TS ASI Input. Requires a Cable equalizer and an adaptation network. See *ASI Input* on page 21 . |
| 7 | | $I_{LVDS-}$ | |
| 8 | Backup_ASI_IN | $I_{LVDS+}$ | Backup LDVS TS ASI Input. 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 | REF_10MHz | $I_3$ | 10Mhz reference input |

| 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 | PPS_INPUT | $I_3$ | 1 Pulse-per-second reference clock input (GPS). |
| 24 | 3V3 | P | +3.3V Digital Power Supply |
| 25 | 1V2 | P | +1.2V Digital Power Supply |
| 26 | GND | P | Digital Ground |
| 27 | RSVD | $O_3$ | Reserved |
| 28 | RSVD | $O_3$ | Reserved |
| 29 | RSVD | $O_3$ | Reserved |
| 30 | RSVD | $O_3$ | Reserved |
| 31 | RSVD | $O_3$ | Reserved |
| 32 | RSVD | $O_3$ | Reserved |
| 33 | RSVD | $O_3$ | Reserved |
| 34 | RSVD | $O_3$ | Reserved |
| 35 | FLAGS_CLK | $O_3$ | Flags SPI Clock Signal (1) |
| 36 | FLAGS_DATA | $O_3$ | Flags SPI Data Signal (1) |
| 37 | ASI_ OUT | $O_{LVDS-}$ | LDVS TS ASI Output. 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 | 3V3A | P | +3.3V Analog Power Supply |
| 43 | GNDA | P | Analog ground |
| 44 | GNDA | P | Analog ground |
| 45 | $\overline{\text{IFOUT}}$ | $O_a$ | Analog output (current mode): Open source DAC complementary output source. Connect through 50Ω to GNDA. |
| 46 | GNDA | P | Analog ground |
| 47 | IFOUT | $O_a$ | Analog output (current mode): Open source DAC output source. Connect through 50Ω to GNDA. |
| 48 | GNDA | P | Analog ground |

See Appendix A on page 28 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-621 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 10).
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↵<br>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/Deactivate character echoing. |
| Parameters: | 0 or 1 |
| Example: | Echo 0↵<br>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. GetFWVersion

| | |
|---|---|
| Used for: | Query FLEXMod product name and firmware version. |

Parameters: None
Example: GetFWVersion ↵
Notes: Return value is:
*FLEXMod-SFN*
*Version:x.xx*

### 4.7. GetSN

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

### 4.8. 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.

### 4.9. GetTemp

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

### 4.10. SetOvertemp

Used for: Set point for output alarm signal.
Parameters: -128 to 127
Example: SetOvertemp 75 ↵
Notes: Temperature is set in Celsius degrees. Output LED will light when FlexMOD temperature is above this set value.

# 5. FLEXMod-621 DVB-T SFN modulator configuration

### 5.1. Frequency

Used for: Set DVB-T SFN output frequency.
Parameters: 0 to 50000000.
Example: Freq 36000000↵

### 5.2. Spectrum

Used for: Set output spectrum.
Parameters: 0 or 1
Example: Spect 0↵
Notes: Select 1 to invert the output spectrum.

### 5.3. RFTest

Used for: Force RF Output On.
Parameters: [active], [chbw], [const], [carriers]
Example: RFTest 1,8,64,8↵ *(Enable RFTest, 8MHz bandwidth, 64-QAM, 8K)*
RFTest 1,8,4,2↵ *(Enable RFTest, 8MHz, QPSK, 2K)*
RFTest 1↵ *(Enable RFTest with last settings)*
RFTest 0↵ *(Disable RFTest)*
Notes: Since the RF output is not enabled until all the SFN syncronization is achieved, it is not possible to see any output until the full SFN setup has been completed. To test the system, it is possible to activate the output regardless of the SFN status using this command.

### 5.4. RFPower

Used for: Set RF output power.
Parameters: 0 to 255
Example: Power 128↵
Notes: Programs the AD 9957 output power. Default value is 128.

### 5.5. PreCorr

Used for: Enables/Disables the digital precorrector function.
Parameters: 0 or 1
Example: Precorr 0↵ *(Disables digital precorrector)*
Precorr 1↵ *(Enables digital precorrector)*
Notes: -.

### 5.6. PrecLoad

Used for: Loads Digital precorrector table.
Parameters: 1 or 2
Example: PrecLoad 1↵ *(Prepare for loading the Amplitude correction table)*
PrecLoad 2↵ *(Prepare for loading the Phase correction table)*

Notes: Both amplitude and phase correction tables requires 1024 coefficients entered one per line, 0 to $2^{17}$-1 for amplitude, $-2^{17}$ to $2^{17}$-1 for phase.
Amplitude coefficients are scaled by $2^{17}$, so amplitude correction is 0 to $(2^{17}-1)/2^{17}$=0.99999, while phase coefficients are scaled by $2^{17}/180$ degrees, so phase correction is $(-2^{17})/(2^{17}/180)$=-180 degrees to $(2^{17}-1)/(2^{17}/180)$=179.99 degrees.
Notes: -.

**5.7. PrecList**

Used for: Shows the loaded precorrector table.
Parameters: 1 or 2
Example: PrecList 1↵ *(Shows Amplitude precorrection table)*
PrecList 2↵ *(Shows Phase precorrection table)*
Notes: -.

**5.8. FirLoad**

Used for: Load the linear precorrector fir filter coefficients.
Parameters: None
Example: FirLoad↵
Notes: With this command you can load 181 18 Bit wide coefficient numbers (one per line) for a 181 TAP FIR Filter.

**5.9. FirSelect**

Used for: Select which FIR filter should be used.
Parameters: 0 or 1
Example: FirSelect 0↵ *(Select internal, standard, FIR filter)*
FirSelect 1↵ *(Select user loaded FIR filter)*
Notes: -.

**5.10. FirList**

Used for: Shows the loaded FIR filter coefficients.
Parameters: None
Example: FirList↵ *(Shows current user loaded FIR filter coefficients)*
Notes: -.

**5.11. IQOffset**

Used for: I/Q manual offset and balancing compensation.
Parameters: p1,p2
Example: IQOffset 12,18↵
Notes: p1 is the compensation value for 7MHz bandwidth, p2 is the compensation value for 6 and 8 MHz bandwidths.

**5.12. CrestClipper**

Used for: Set the Crest-Factor clipping level.
Parameters: CrestClippingFactor

Example: CrestClipper 0↵
Notes: CrestClippingFactor is a number between 0 (no clipping, default value) to 255 (maximum crest clipping factor).

### 5.13. FilterGain

Used for: Internal filters gain.
Parameters: 0 to 65535
Example: FilterGain 32768↵
Notes: This value is the internal filters gain. Value is scaled by $2^{15}$ (32768) so actual values are between 0 and 1.9999 (65535/32768). Default value is 32768 (Gain 1.0).

# 6. SFN management and status commands

### 6.1. TxIdentifier

Used for: Set the TX identifier number.
Parameters: 0 to 65535
Example: TxIdentifier 0↵

### 6.2. LocalFunct

Used for: Use Local or remote (From MIP) Functions.
Parameters: 0 or 1
Example: LocalFunct 0↵
Notes: When *LocalFunct* is set to 1, the CellID and TimeOffset (see below) are not read from the MIP, but set with the *CellID* and *TimeOffset* commands.

### 6.3. CellID

Used for: Set the local Cell Identifier.
Parameters: 0 to 65535
Example: CellID 44↵ *(Set the Cell ID to 44)*
Notes: The value set with this command is ignored, unless the modulator is set to use local defined parameters with the *LocalFunct 1* command.

### 6.4. TimeOffset

Used for: Set an arbitrary SFN Startup Delay in 0.1 uSec step.
Parameters: -32768 to 32767
Example: TimeOffset 1000↵ *(Set a startup delay of 1ms)*
Notes: The value set with this command is ignored, unless the modulator is set to use local defined parameters with the *LocalFunct 1* command.

### 6.5. SubNetwork

Used for: Enable the SFT-DVB-T to SFN-DVB-T repeater mode.
Parameters: 0 or 1
Example: SubNetwork 1↵ *(Enable repeater mode)*
Notes: SFN repeater mode is the mode used when the input TS comes from a received SFN network. The original network 'MaxDelay' is zeroed and a new, local, delay (set with the *SubNetMaxDel* command) is used.

### 6.6. SubNetMaxDel

Used for: Set the Subnetwork Max-Delay in 0.1 uSec step.
Parameters: 50000 to 9999999
Example: SubNetMaxDel 1000000↵ *(Set the subnetwork Max Delay to 100ms)*
Notes: This value is not used unless the FlexMOD is in repeater (SubNetwork) mode.

### 6.7. ForceResync

Used for: Force the SFN modulator to Resync.
Parameters: None
Example: ForceResync ↵

### 6.8. SetMaxDrift

Used for: Set the maximum allowed drift between Megaframe & PPS in nSec.
Parameters: 2000 to 32767
Example: SetMaxDrift 25000 ↵ *(Set the maximum allowed drift to 25µS)*
Notes: If the drift between the MegaFrame and the Pulse Per Second exceeds the maximum value set, the modulator is stopped and restarted when a new sync has been achieved.

### 6.9. SfnCleaner

Used for: Enable/Disable the SFN Null Packet cleaner.
Parameters: 0 or 1
Example: SfnCleaner 1 ↵ *(Enable SFN Cleaner mode)*
Notes: When other FlexMOD modulator are used to create a SFN compatible link, with the transmitting FlexMOD set in SFN mode, inserted NULL packets are specially signed. The SFN Cleaner, if activated, removes these specially signed packets in order to restore the original, SFN, transport stream.

### 6.10. GetModFlags

Used for: Return the current modulator status flags.
Parameters: None
Example: GetModFlags ↵
Notes: Returned flags are:
*SFN, MIP, PPS, OSC, TS1, TS2, CTS, TPS*
All are 0 (indicating 'not working') or 1 (indicating 'OK') except TPS which are all the TPS bits. CTS is the Current TS used (0 = Main, 1 = Backup).
An example of a working SFN modulator is:
*1, 1, 1, 1, 1, 0, 0, 00978000*

### 6.11. GetMaxDel

Used for: Return the Network MAX Delay in 0.1 uSec step.
Parameters: None
Example: GetMaxDel ↵
Notes: The Network maximum delay as set in the MIP is returned.

### 6.12. GetTrspDel

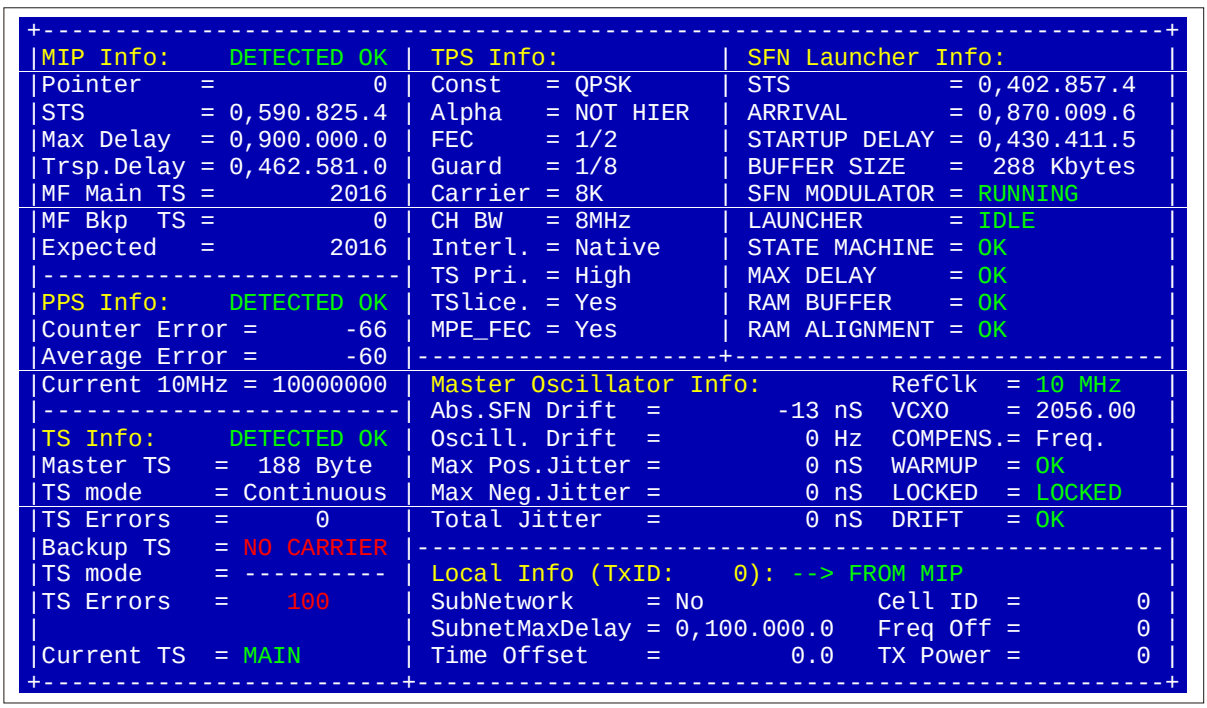
Used for: Return the Network Transport Delay in nS.
Parameters: None
Example: GetTrspDel ↵
Notes: The current network transport delay as measured by the modulator is returned.

### 6.13. GetMipFunc

Used for: Return the Network MIP Functions.
Parameters: None
Example: GetMipFunc↵
Notes: Returned functions are:
*TimeOffset, FreqOffset, Power, CellID.*

### 6.14. MainMonitor

Used for: Show the current modulator status.
Parameters: [ANSIMode],[RefreshRate]
Example: MainMonitor 0↵ *(80x25 screen, maximum refresh rate)*
MainMonitor 1↵ *(80x24 screen, maximum refresh rate –default option–)*
MainMonitor 0,2↵ *(80x25 screen, refreshed every 2 seconds)*
Notes: With Windows Hyperterminal, use the 80x24 screen.




**Modulator status page example**

# 7. Input Transport Stream and GPS configuration

### 7.1. SelInputASI

| | | |
|---|---|---|
| Used for: | Select the ASI Input Interface. | |
| Parameters: | 0, 1 or 2 | |
| Example: | SelInputAsi 0↵ | *(Select Main ASI input)* |
| | SelInputAsi 1↵ | *(Select Backup ASI input)* |
| | SelInputAsi 2↵ | *(Auto input selection)* |
| Notes: | If Automatic input selection is selected, the FlexMOD will use the Main ASI input, switching to the Backup input if the Main ASI input fails. | |

### 7.2. PpsEdge

| | | |
|---|---|---|
| Used for: | Set the PPS edge detection. | |
| Parameters: | 0 or 1 | |
| Example: | PpsEdge 0↵ | *(Select Falling edge)* |
| | PpsEdge 1↵ | *(Select Rising edge)* |

### 7.3. RefClock

| | | |
|---|---|---|
| Used for: | Select the modulator reference clock input. | |
| Parameters: | 0 to 3 | |
| Example: | RefClock 0↵ | *(Do not use to 10MHz reference clock)* |
| | RefClock 1↵ | *(Use the dedicated input pin)* |
| | RefClock 2↵ | *(Use the Main ASI input)* |
| | RefClock 3↵ | *(Use the Backup ASI input)* |
| Notes: | If the 10MHz reference clock is not used, the FlexMOD will frequency lock to the PPS input, but the output will have higher jitter and drift. If the Main or Backup ASI inputs are used, the ASI input function will be disabled, and a differential 10MHz clock should be given to the LVDS input pins. | |

### 7.4. Trim

| | | |
|---|---|---|
| Used for: | Compensate for the modulator startup time and PPS datapath delay. | |
| Parameters: | -5000000 to 5000000 | |
| Example: | Trim 38↵ | *(Set the delay to 3.8µs)* |
| Notes: | Unit is 0.1µs. | |

### 7.5. StaticDelay

| | | |
|---|---|---|
| Used for: | Extra SFN startup delay added to the incoming Time Offset value. | |
| Parameters: | -9999999 to 9999999 | |
| Example: | StaticDelay 110↵ | *(Set the delay to 11.0µs)* |
| Notes: | Unit is 0.1µs, default is 0. | |

# 8. 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
Note also that this procedure will erase the welcome/manufacturer message.

### 8.1. 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.<br>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.<br>This will also erase the welcome/manufacturer message. |

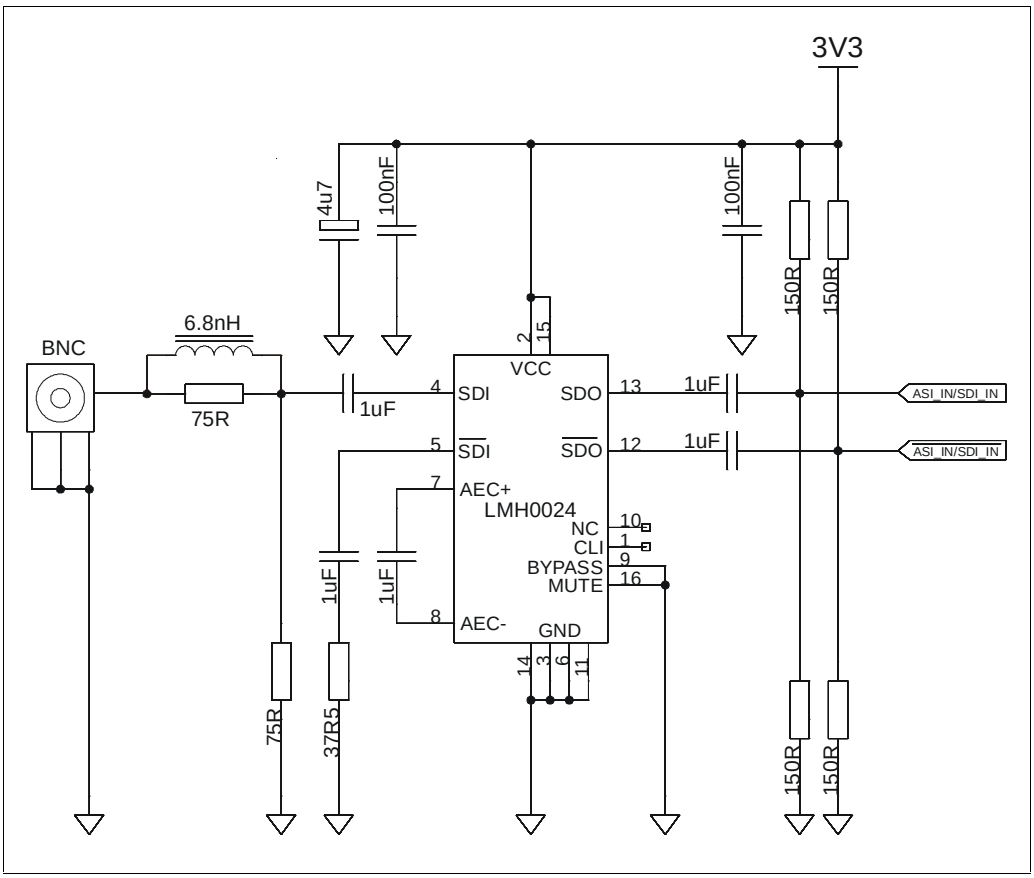
**8.2. Upgrade**

| | |
|---|---|
| Used for: | XMODEM upload of a new firmware. |
| Parameters: | 741852 |
| Example: | Upload↵ |
| Notes: | Any terminal software capable of the XMODEM protocol can be used.<br>The *741852* parameter is a constant value used to avoid the risk of issuing this command by chance. |

# 9. Sample schematics

## 9.1. ASI Input sample schematic

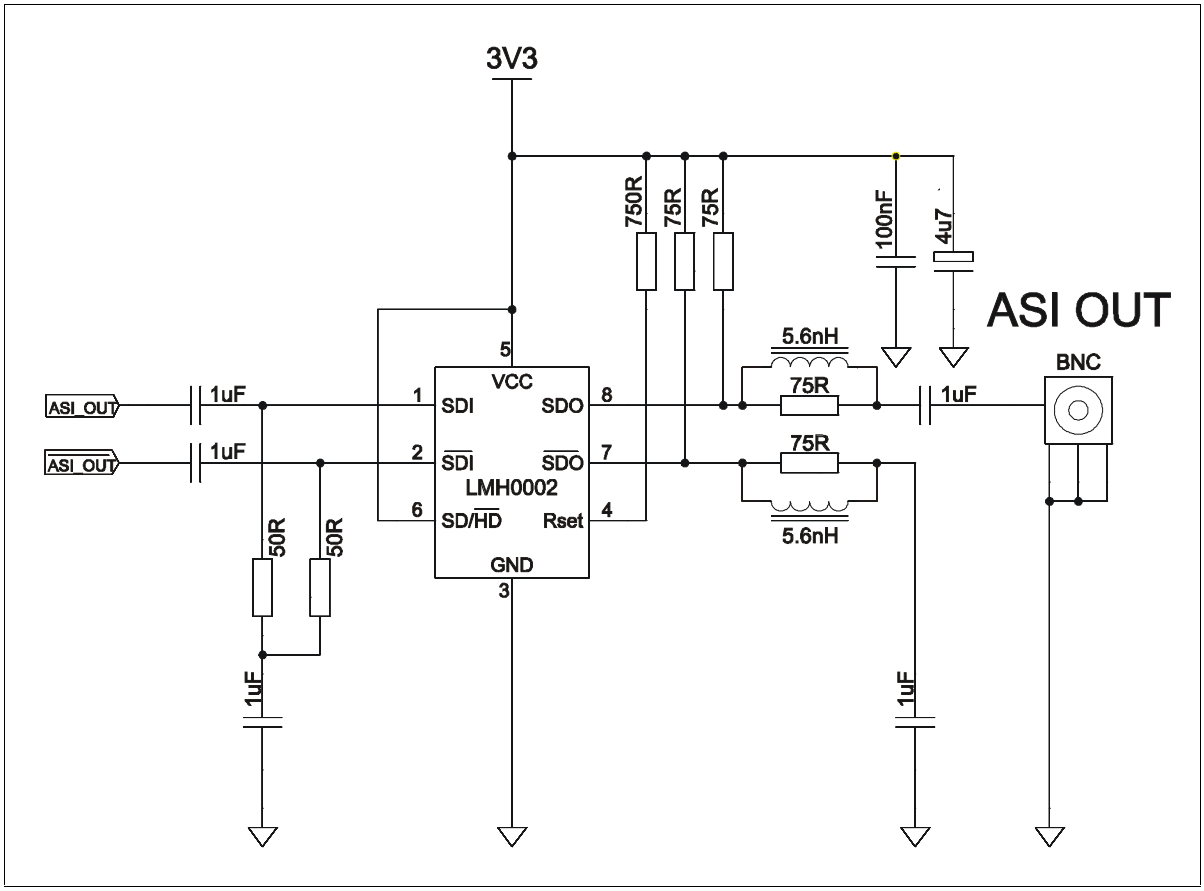
The LDVS TS ASI Input requires a cable equalizer and an adaptation network in order to adjust input levels. Note that ASI_IN is a LVDS signal, so route accordingly. The following schematics is a typical application ASI input:




**Typical ASI input**

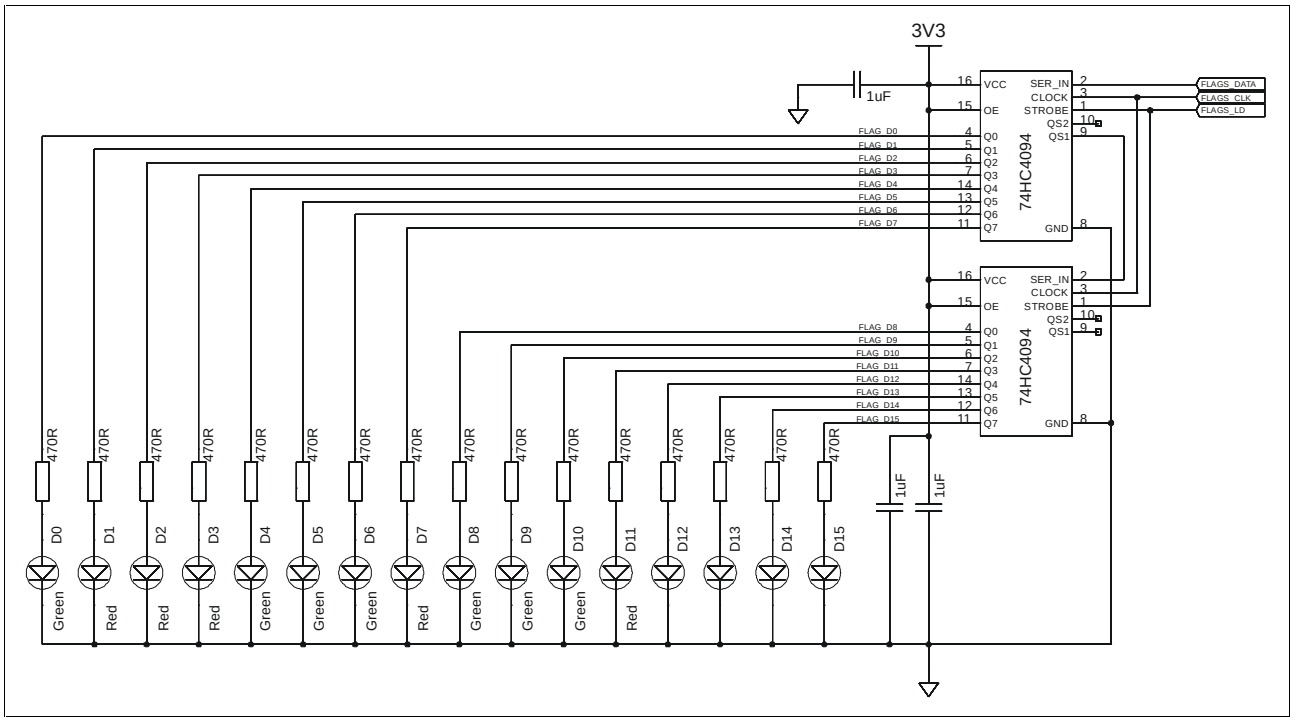
### 9.2. ASI Output sample schematic

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**

### 9.3. Flags SPI sample schematic




| Bit | Flag |
|---|---|
| D0 | Boot OK |
| D1 | OverTemp |
| D2 | SFN Unlock |
| D3 | Frequency Unlock |
| D4 | High Priority TS DCD |
| D5 | High Priority TS 204/188 |
| D6 | High Priority TS Burst |
| D7 | High Priority TS Overflow |

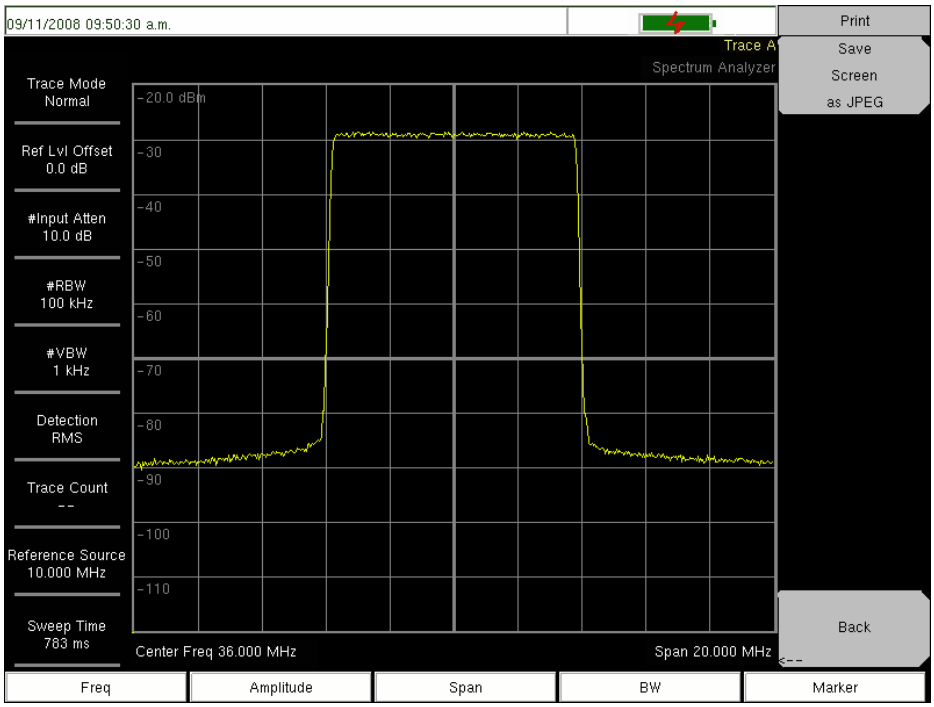
| Bit | Flag |
|---|---|
| D8 | Low Priority TS DCD |
| D9 | Low Priority TS 204/188 |
| D10 | Low Priority TS Burst |
| D11 | Low Priority TS Overflow |
| D12 | Spare / Unused |
| D13 | Spare / Unused |
| D14 | Spare / Unused |
| D15 | Spare / Unused |

# 10. Power supplies characteristics

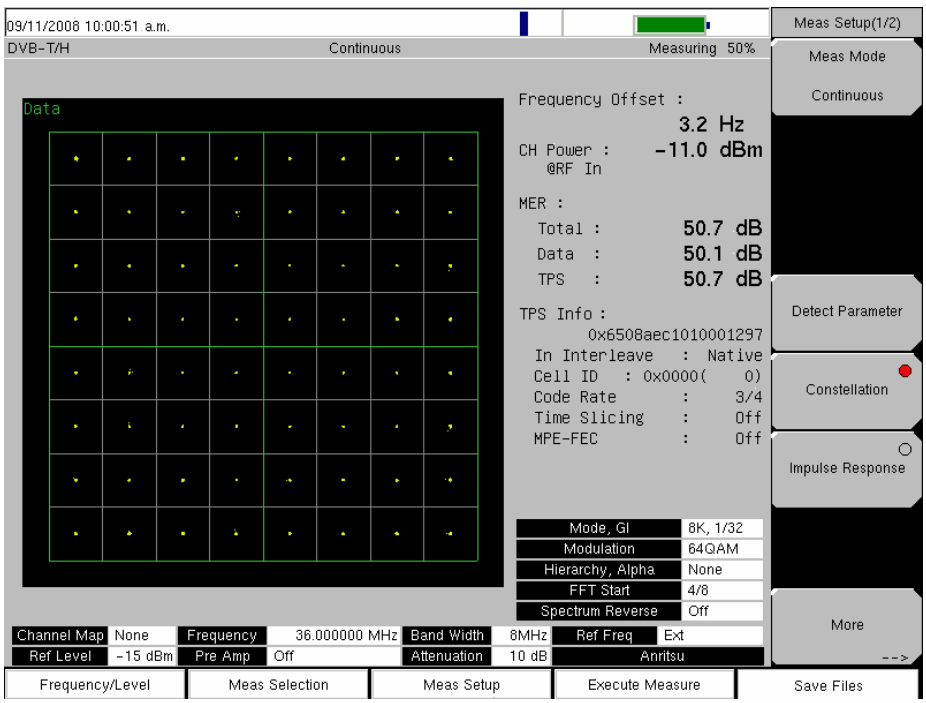
| SYMBOL | PARAMETER | CONDITIONS | MIN | TYP. | MAX | UNIT |
|---|---|---|---|---|---|---|
| 1V2 | Core voltage | | | 640 | | mA |
| 1V8 | DAC voltage | | | 330 | | mA |
| 1V8A | Analog voltage | | | 110 | | mA |
| 3V3 | I/O voltage | | | TBD | | mA |
| 3V3A | Analog voltage | | | 90 | | mA |

# 11. Alphabetical command list

# 12. Typical output characteristics

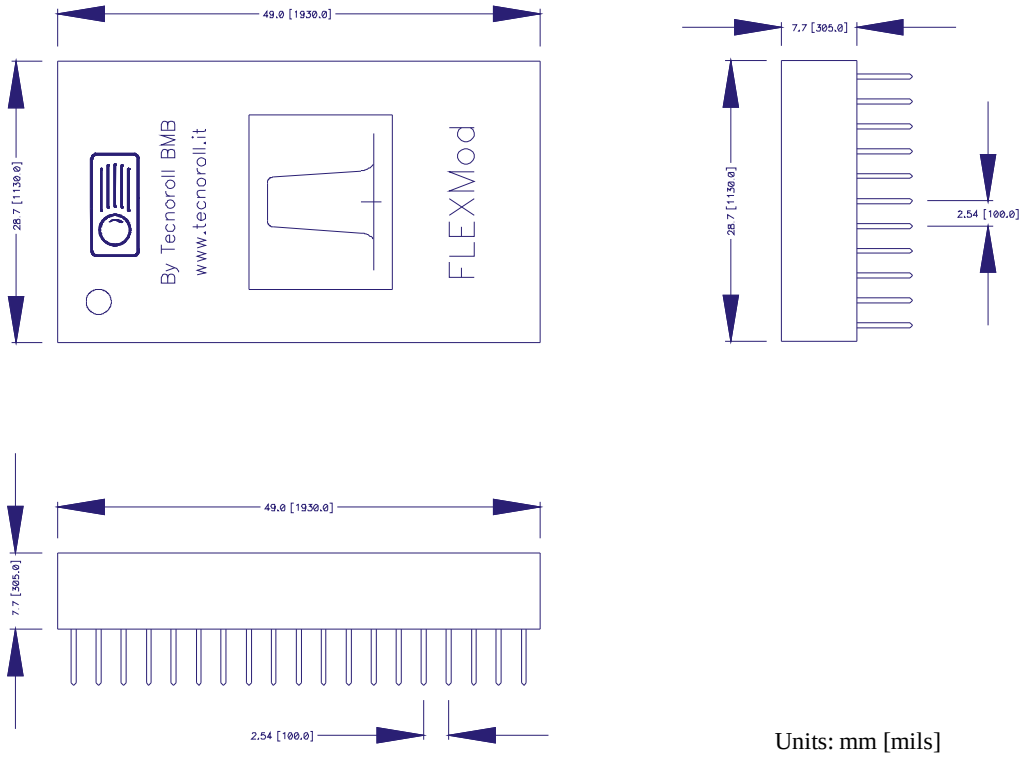



**Typical output spectrum at 36MHz**

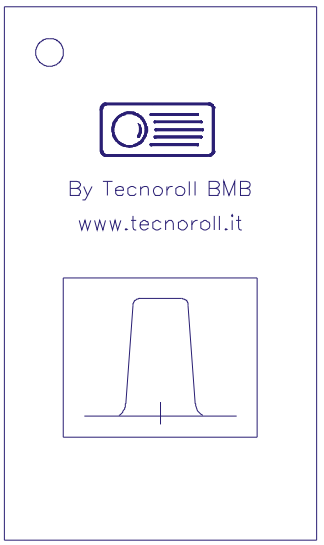



**Typical constellation at 64QAM and output MER**

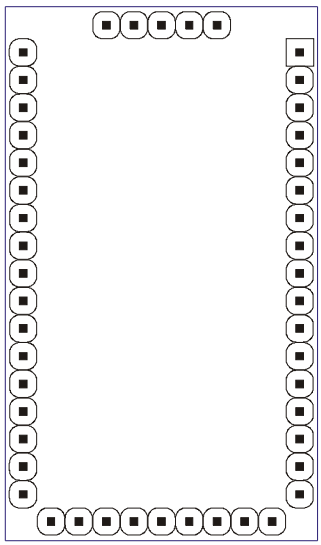
# 13. Packaging information




Units: mm [mils]
Controlling dimensions: mm




Top View

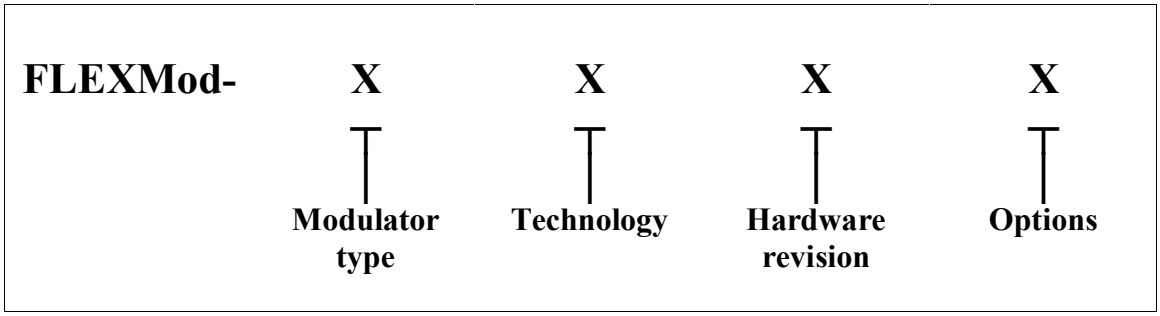


Bottom View

# 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