



DVB-S2X Modulator IP Core  
Specification

## Release Information

|                        |                           |
|------------------------|---------------------------|
| Name                   | DVB-S2X Modulator IP Core |
| Version                | 3.0                       |
| Build date             | 2022.09                   |
| Ordering code          | ip-dvb-s2x-modulator      |
| Specification revision | r1900                     |

## Features

The IP core is a digital DVB-S2/DVB-S2X modulator and is fully compatible with this standard:

- ETSI EN 302 307-2 (v1.1.1)

## License

License:

- Netlist for One FPGA Family or Full Source Code (Verilog, SDC/XDC)
- Perpetual
- Without Quantitative Restrictions
- Worldwide
- Royalty-free
- Free Remote Technical Support for 1 Year

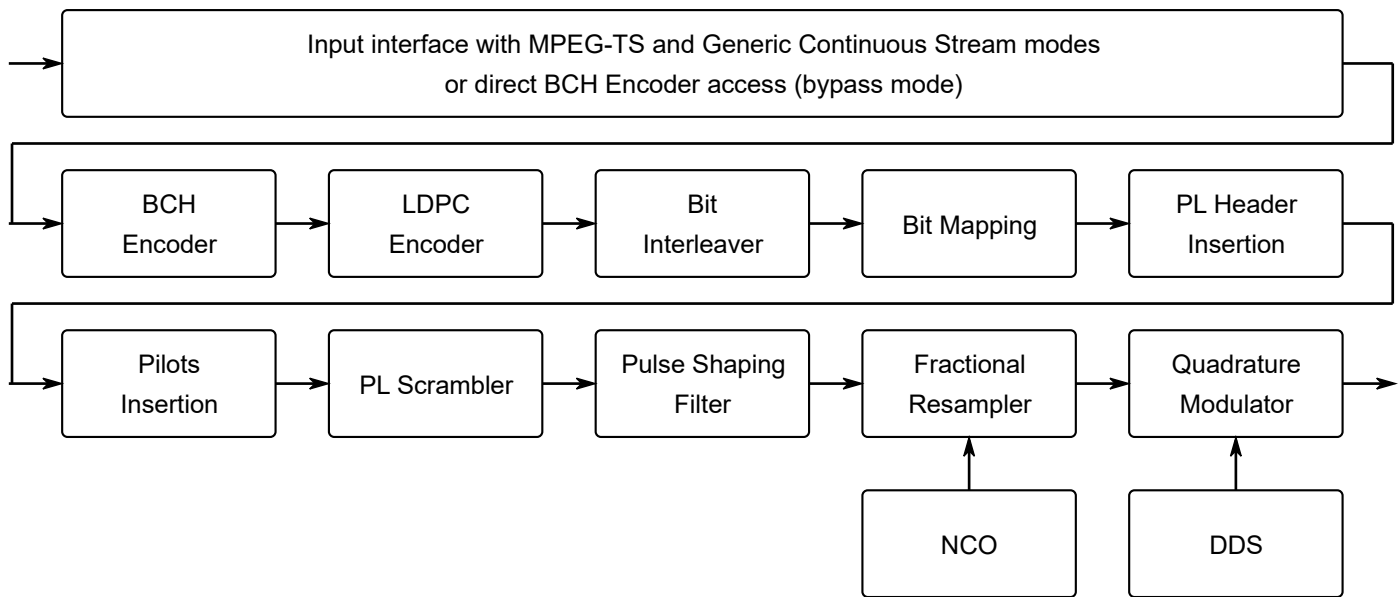
## Deliverables

The DVB-S2X Modulator IP Core includes:

- EDIF/NGC/QXP/VQM netlist for Xilinx Vivado/ISE, Intel (Altera) Quartus, Lattice Diamond or Microsemi (Actel) Libero SoC
- IP Core testbench scripts
- Design examples for Xilinx, Intel (Altera), Lattice, and Microsemi (Actel) evaluation boards

## IP Core Structure

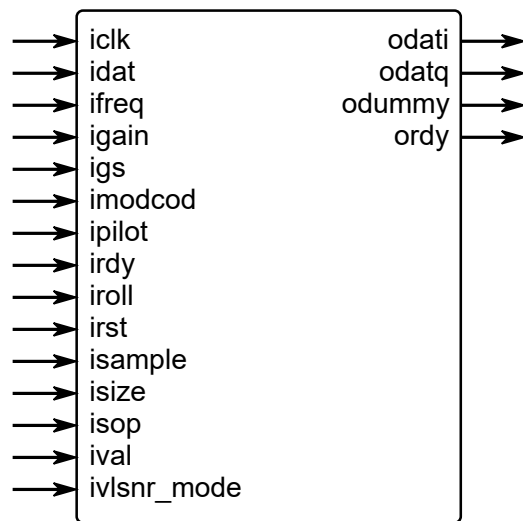
Figure 1 shows the DVB-S2X Modulator IP Core block diagram.



**Figure 1. The DVB-S2X Modulator IP Core block diagram**

## Port Map

Figure 2 shows a graphic symbol, and Table 1 describes the ports of the DVB-S2X Modulator IP Core.



**Figure 2. The DVB-S2X Modulator port map**

| Table 1. The DVB-S2X Modulator port map description |       |  |
|---|-------|--|
| Port  | Width | Description  |
| iclk  | 1     | The main system clock. The IP Core operates on the rising edge of iclk.  |
| idat  | 8     | input (information) data   |
| ifreq   | 32    | output intermediate frequency  |
| igain   | 16    | output gain control  |
| igs   | 2     | input interface mode:<br>0 - MPEG-TS<br>1 - Generic Continuous Stream<br>2 - Direct access to BCH Encoder (bypass BBFramer)            |
| imodcod   | 8     | MODCOD value. See Annex A for values.  |
| ipilot  | 1     | pilot mode:<br>0 - without pilot<br>1 - with pilot   |
| irdy  | 1     | Modulator output data request.   |
| iroll   | 3     | RRC filter roll-off factor:<br>0 - alpha=0.35<br>1 - alpha=0.25<br>2 - alpha=0.2<br>3 - alpha=0.15<br>4 - alpha=0.10<br>5 - alpha=0.05 |
| irst  | 1     | The IP Core synchronously reset when irst is asserted high.  |
| isample   | 32    | bandwidth control (symbol rate):<br>0.01% to 50% of iclk   |
| isize   | 1     | LDPC frame size (only for DVB-S2):<br>0 - Normal FECFrame (Nldpc = 64800 bits)<br>1 - Short FECFrame (Nldpc = 16200 bits)              |
| isop  | 1     | input sync-word byte marker (0x47 TS)  |
| ival  | 1     | input data valid   |
| ivlsnr_mode   | 3     | VL-SNR type. See Annex A for values.   |
| odati   | W_DAC | modulator output at baseband (I channel) or at an intermediate frequency   |
| odatq   | W_DAC | modulator output at baseband (Q channel)   |
| odummy  | 8     | counter of inserted DUMMY Frames   |

|      |   |                            |
|------|---|----------------------------|
| ordy | 1 | ready to accept input data |
|------|---|----------------------------|

## IP Core Parameters

Table 2 describes the DVB-S2X Modulator IP Core parameters, which must be set before synthesis.

| Table 2. The DVB-S2X Modulator IP Core parameters description |  |
|---|--|
| Parameter   | Description  |
| W_DAC   | Width of output DAC symbols ( <b>odati/odatq</b> )<br>Increasing the width of odati/odatq, increases the quality of waveform but also increases FPGA required resource |

Performance and Resource Utilization

The values were obtained by automated characterization, using standard tool flow options and the floorplanning script delivered with the IP Core. The IP Core fully supports all Xilinx and Altera FPGA families, including Spartan, Zynq, Artix, Kintex, Virtex, Cyclone, Arria, MAX, Stratix. Table 3 summarizes the DVB-S2X Modulator IP Core measurement results.

| Table 3. The DVB-S2X Modulator performance |  |                                       |                           |          |
|--|--|---------------------------------------|---------------------------|----------|
| IP Core parameters                         | FPGA type  |                                       |                           |          |
|  | Resource   | Speed grade, maximal system frequency |                           |          |
| W_DAC=16                                   | Altera Cyclone V 5CEFA7  |                                       |                           |          |
|  | 7503 ALMs (14%)<br>114 M10K RAM blocks (17%)<br>15 DSP (18x18) (10%) | -8, Fmax                              | -7, Fmax                  | -6, Fmax |
| 96.0 MHz<br>48.0 Msymb/s                   |  | 111.0 MHz<br>55.5 Msymb/s             | 132.0 MHz<br>66.0 Msymb/s |          |
| W_DAC=16                                   | Xilinx Virtex-7 XC7VX330T  |                                       |                           |          |
|  | 6126 Slices (12%)<br>58 18K RAM blocks (4%)<br>14 DSP (18x18) (2%)   | -1, Fmax                              | -2, Fmax                  | -3, Fmax |
| 145.0 MHz<br>72.5 Msymb/s                  |  | 176.0 MHz<br>88.0 Msymb/s             | 196.0 MHz<br>98.0 Msymb/s |          |

IP Core Interface Description

IP core has two ways of forming the output spectrum:

- Baseband (using **odati** and **odatq**), **ifreq** equal 0
- Intermediate frequency (using **odati**), **ifreq** not equal 0

Digital-to-analog converters must operate synchronously with the DVB-S2X Modulator IP core. Figure 3 shows the DAC connection diagram for baseband mode and Figure 4 shows the timing diagram for this mode.

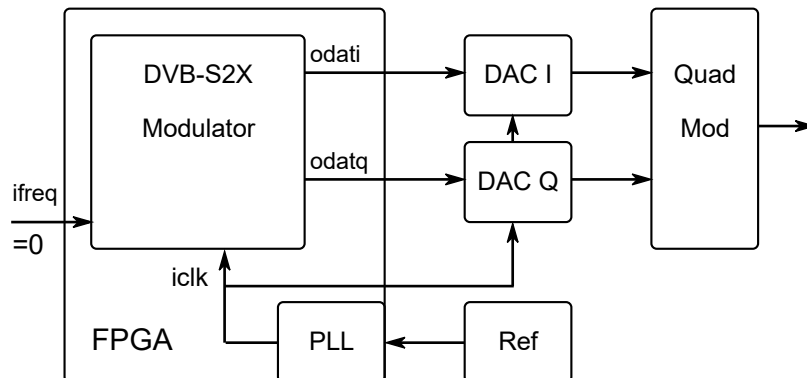
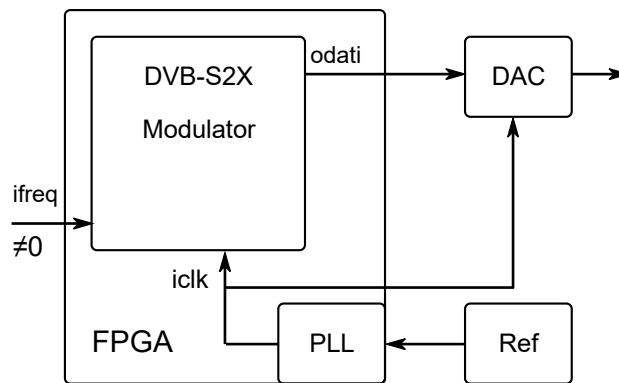


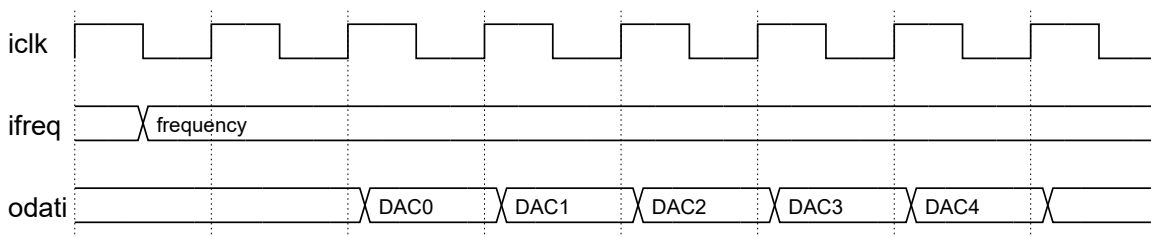
Figure 3. The DAC connection diagram for baseband mode.

**Figure 4. The timing diagram for baseband mode.**

Figure 5 shows the DAC connection diagram for IF mode and Figure 6 shows the timing diagram for this mode. The output intermediate frequency port **ifreq** sets the central frequency for **odati** modulator output port.

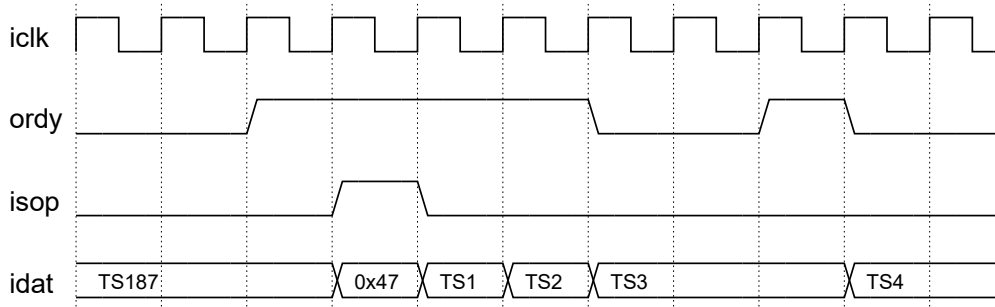


**Figure 5. The DAC connection diagram for IF mode.**



**Figure 6. The timing diagram for IF mode.**

Figure 7 shows an example of the waveform of the input interface. Handshake port **ordy** controls input dataflow. Input data is read from the input **idat** only when **ordy** is equal to logical one ("1").



**Figure 7. The timing diagram of the IP Core input interface.**

### Upgrade and Technical Support

Free remote technical support is provided for 1 year and includes consultation via phone, E-mail and Skype. The maximum time for processing a request for technical support is 1 business day.

For up-to-date information on the IP Core visit this web page

<https://www.modemica.com/>

### Feedback

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### Revision history

| Version | Date       | Changes  |
|---------|------------|--|
| 3.0     | 2022.09.20 | Added input interface with MPEG-TS, Generic Continuous Stream and bypass modes |
| 2.0     | 2017.11.14 | Added support for AD9361, AD9363, AD9364, AD9371, AD9375 and AD9789            |
| 1.0     | 2015.06.16 | Official release   |



**MODCOD setup**

Table A.1 shows the correct settings for **imodcod**, **isize**, **ipilot**, and **ivlsnr\_mode** ports.

Table A.1. The DVB-S2/DVB-S2X Modulator settings

DVB-S2 Modes, ipilot controls Pilot Mode Off and On

| MODCOD       | Mode        | Code Type and Pilot   |  |
|--------------|-------------|---|--|
| imodcod = 1  | QPSK 1/4    | <b>isize:</b><br>0 - Normal FEC block (64800 bits)<br>1 - Short FEC block (16200 bits)<br><b>ipilot:</b><br>0 - Pilot Off<br>1 - Pilot On |  |
| imodcod = 2  | QPSK 1/3    |   |  |
| imodcod = 3  | QPSK 2/5    |   |  |
| imodcod = 4  | QPSK 1/2    |   |  |
| imodcod = 5  | QPSK 3/5    |   |  |
| imodcod = 6  | QPSK 2/3    |   |  |
| imodcod = 7  | QPSK 3/4    |   |  |
| imodcod = 8  | QPSK 4/5    |   |  |
| imodcod = 9  | QPSK 5/6    |   |  |
| imodcod = 10 | QPSK 8/9    |   |  |
| imodcod = 11 | QPSK 9/10   |   |  |
| imodcod = 12 | 8PSK 3/5    |   |  |
| imodcod = 13 | 8PSK 2/3    |   |  |
| imodcod = 14 | 8PSK 3/4    |   |  |
| imodcod = 15 | 8PSK 5/6    |   |  |
| imodcod = 16 | 8PSK 8/9    |   |  |
| imodcod = 17 | 8PSK 9/10   |   |  |
| imodcod = 18 | 16APSK 2/3  |   |  |
| imodcod = 19 | 16APSK 3/4  |   |  |
| imodcod = 20 | 16APSK 4/5  |   |  |
| imodcod = 21 | 16APSK 5/6  |   |  |
| imodcod = 22 | 16APSK 8/9  |   |  |
| imodcod = 23 | 16APSK 9/10 |   |  |
| imodcod = 24 | 32APSK 3/4  |   |  |
| imodcod = 25 | 32APSK 4/5  |   |  |

| imodcod = 26  | 32APSK 5/6                   |                                   |                  |
|---|------------------------------|-----------------------------------|------------------|
| imodcod = 27  | 32APSK 8/9                   |                                   |                  |
| imodcod = 28  | 32APSK 9/10                  |                                   |                  |
| <b>DVB-S2X VL-SNR set1 Modes, ipilot does not work in this mode</b> |                              |                                   |                  |
| <b>MODCOD</b>   | <b>Canonical MODCOD name</b> | <b>Implementation MODCOD name</b> | <b>Code Type</b> |
| imodcod = 129<br>ivlsnr_mode = 0                                    | QPSK 2/9                     | QPSK 2/9                          | Normal           |
| imodcod = 129<br>ivlsnr_mode = 1                                    | BPSK 1/5                     | p/2 BPSK 1/5                      | Medium           |
| imodcod = 129<br>ivlsnr_mode = 2                                    | BPSK 11/45                   | p/2 BPSK 11/45                    | Medium           |
| imodcod = 129<br>ivlsnr_mode = 3                                    | BPSK 1/3                     | p/2 BPSK 1/3                      | Medium           |
| imodcod = 129<br>ivlsnr_mode = 4                                    | BPSK-S 1/5                   | p/2 BPSK 1/5 SF 2                 | Short            |
| imodcod = 129<br>ivlsnr_mode = 5                                    | BPSK-S 11/45                 | p/2 BPSK 11/45 SF 2               | Short            |
| <b>DVB-S2X VL-SNR set2 Modes, ipilot does not work in this mode</b> |                              |                                   |                  |
| <b>MODCOD</b>   | <b>Canonical MODCOD name</b> | <b>Implementation MODCOD name</b> | <b>Code Type</b> |
| imodcod = 131<br>ivlsnr_mode = 0                                    | BPSK 1/5                     | p/2 BPSK 1/5                      | Short            |
| imodcod = 131<br>ivlsnr_mode = 1                                    | BPSK 4/15                    | p/2 BPSK 4/15                     | Short            |
| imodcod = 131<br>ivlsnr_mode = 2                                    | BPSK 1/3                     | p/2 BPSK 1/3                      | Short            |
| <b>DVB-S2X Modes, ipilot controls Pilot Mode Off and On</b>         |                              |                                   |                  |
| <b>MODCOD</b>   | <b>Canonical MODCOD name</b> | <b>Implementation MODCOD name</b> | <b>Code Type</b> |
| imodcod = 132   | QPSK 13/45                   | QPSK 13/45                        | Normal           |
| imodcod = 134   | QPSK 9/20                    | QPSK 9/20                         | Normal           |
| imodcod = 136   | QPSK 11/20                   | QPSK 11/20                        | Normal           |
| imodcod = 138   | 8APSK 5/9-L                  | 2+4+2APSK 100/180                 | Normal           |

|               |                |                         |        |
|---------------|----------------|-------------------------|--------|
| imodcod = 140 | 8APSK 26/45-L  | 2+4+2APSK 104/180       | Normal |
| imodcod = 142 | 8PSK 23/36     | 8PSK 23/36              | Normal |
| imodcod = 144 | 8PSK 25/36     | 8PSK 25/36              | Normal |
| imodcod = 146 | 8PSK 13/18     | 8PSK 13/18              | Normal |
| imodcod = 148 | 16APSK 1/2-L   | 8+8APSK 90/180          | Normal |
| imodcod = 150 | 16APSK 8/15-L  | 8+8APSK 96/180          | Normal |
| imodcod = 152 | 16APSK 5/9-L   | 8+8APSK 100/180         | Normal |
| imodcod = 154 | 16APSK 26/45   | 4+12APSK 26/45          | Normal |
| imodcod = 156 | 16APSK 3/5     | 4+12APSK 3/5            | Normal |
| imodcod = 158 | 16APSK 3/5-L   | 8+8APSK 18/30           | Normal |
| imodcod = 160 | 16APSK 28/45   | 4+12APSK 28/45          | Normal |
| imodcod = 162 | 16APSK 23/36   | 4+12APSK 23/36          | Normal |
| imodcod = 164 | 16APSK 2/3-L   | 8+8APSK 20/30           | Normal |
| imodcod = 166 | 16APSK 25/36   | 4+12APSK 25/36          | Normal |
| imodcod = 168 | 16APSK 13/18   | 4+12APSK 13/18          | Normal |
| imodcod = 170 | 16APSK 7/9     | 4+12APSK 140/180        | Normal |
| imodcod = 172 | 16APSK 77/90   | 4+12APSK 154/180        | Normal |
| imodcod = 174 | 32APSK 2/3-L   | 4+12+16rbAPSK 2/3       | Normal |
| imodcod = 178 | 32APSK 32/45   | 4+8+4+16APSK 128/180    | Normal |
| imodcod = 180 | 32APSK 11/15   | 4+8+4+16APSK 132/180    | Normal |
| imodcod = 182 | 32APSK 7/9     | 4+8+4+16APSK 140/180    | Normal |
| imodcod = 184 | 64APSK 32/45-L | 16+16+16+16APSK 128/180 | Normal |
| imodcod = 186 | 64APSK 11/15   | 4+12+20+28APSK 132/180  | Normal |
| imodcod = 190 | 64APSK 7/9     | 8+16+20+20APSK 7/9      | Normal |
| imodcod = 194 | 64APSK 4/5     | 8+16+20+20APSK 4/5      | Normal |
| imodcod = 198 | 64APSK 5/6     | 8+16+20+20APSK 5/6      | Normal |
| imodcod = 200 | 128APSK 3/4    | 128APSK 135/180         | Normal |
| imodcod = 202 | 128APSK 7/9    | 128APSK 140/180         | Normal |

|               |                 |                     |        |
|---------------|-----------------|---------------------|--------|
| imodcod = 204 | 256APSK 29/45-L | 256APSK 116/180     | Normal |
| imodcod = 206 | 256APSK 2/3-L   | 256APSK 20/30       | Normal |
| imodcod = 208 | 256APSK 31/45-L | 256APSK 124/180     | Normal |
| imodcod = 210 | 256APSK 32/45   | 256APSK 128/180     | Normal |
| imodcod = 212 | 256APSK 11/15-L | 256APSK 22/30       | Normal |
| imodcod = 214 | 256APSK 3/4     | 256APSK 135/180     | Normal |
| imodcod = 216 | QPSK 11/45      | QPSK 11/45          | Short  |
| imodcod = 218 | QPSK 4/15       | QPSK 4/15           | Short  |
| imodcod = 220 | QPSK 14/45      | QPSK 14/45          | Short  |
| imodcod = 222 | QPSK 7/15       | QPSK 7/15           | Short  |
| imodcod = 224 | QPSK 8/15       | QPSK 8/15           | Short  |
| imodcod = 226 | QPSK 32/45      | QPSK 32/45          | Short  |
| imodcod = 228 | 8PSK 7/15       | 8PSK 7/15           | Short  |
| imodcod = 230 | 8PSK 8/15       | 8PSK 8/15           | Short  |
| imodcod = 232 | 8PSK 26/45      | 8PSK 26/45          | Short  |
| imodcod = 234 | 8PSK 32/45      | 8PSK 32/45          | Short  |
| imodcod = 236 | 16APSK 7/15     | 4+12APSK 7/15       | Short  |
| imodcod = 238 | 16APSK 8/15     | 4+12APSK 8/15       | Short  |
| imodcod = 240 | 16APSK 26/45    | 4+12APSK 26/45      | Short  |
| imodcod = 242 | 16APSK 3/5      | 4+12APSK 3/5        | Short  |
| imodcod = 244 | 16APSK 32/45    | 4+12APSK 32/45      | Short  |
| imodcod = 246 | 32APSK 2/3      | 4+12+16rbAPSK 2/3   | Short  |
| imodcod = 248 | 32APSK 32/45    | 4+12+16rbAPSK 32/45 | Short  |