# X3-SD

**PCI Express XMC Module with 16 A/D Channels of 24-bit, 216kSPS, >110 dB, and 1M FPGA with 4 MB Memory**

## FEATURES

- 16 Sigma-Delta A/D Channels
- >110 dB S/N
- Fully differential, +/-10V inputs
- Sample rates up to 216 KSPS
- Xilinx Spartan3, 1M gate FPGA
- 4MB SRAM
- Programmable PLL or external timebase
- Framed, software or external triggering
- Log acquisition timing and events
- 44 bits digital IO on P16
- Power management features
- PCI Express XMC Module (75x150 mm)
- Use in any PCI Express desktop, compact PCI/PXI, or cabled PCI Express application

## APPLICATIONS

- Vibration measurement
- Audio and acoustic testing
- Data acquisition

## SOFTWARE

- Data acquisition, logging and analysis applications provided
- Windows/Linux drivers
- C++ host tools
- VHDL/MATLAB logic tools


## DESCRIPTION

The X3-SD is an XMC IO module featuring 16 simultaneously sampling, 24-bit sigma delta A/D channels designed for vibration, acoustic and high dynamic range measurements. The module delivers over 110 dB S/N ratio and a -130 dB noise floor.

A programmable low-jitter timebase or external clock may be used for sample rate generation. Sample rates up to 216 kHz, with <10 Hz programmable resolution, are supported as well as standard audio rates. Flexible trigger methods include counted frames, software triggering and external triggering. Multiple cards can be synchronized to sample simultaneously for large systems.

Data acquisition control, signal processing, buffering, and system interface functions are implemented in a Xilinx Spartan3 FPGA, 1M gate device. Two 1Mx16 memory devices are used for data buffering and FPGA computing memory.

The logic can be fully customized using VHDL and MATLAB using the FrameWork Logic toolset. The MATLAB BSP supports real-time hardware-in-the-loop development using the graphical, block diagram Simulink environment with Xilinx System Generator.

The PCI Express interface supports continuous data rates up to 180 MB/ s between the module and the host. A flexible data packet system implemented over the PCIe interface provides both high data rates to the host that is readily expandable for custom applications.



11/13/13

# X3-SD

This electronics assembly can be damaged by ESD. Innovative Integration recommends that all electronic assemblies and components circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

## ORDERING INFORMATION

| Product | Part Number | Description |
|---|---|---|
| X3-SD | 80168-0 | X3-SD Module - 16 Channel, 216 KHz, 24-bit Analog Input XMC/PCI Express Module with 1M FPGA |
| **Logic** | | |
| X3-SD FrameWork Logic | 55016 | Framework Logic support for X3-SD module. |
| **Cables** | | |
| MDR68 cable | 65057 | IO cable with MDR68 plug on each end, 3 feet length (0.92m) |
| MDR68 breakout | 80116-0 | Breakout module with MDR68 Connector and screw terminal connection |
| MDR cable | 80116-1 | 68-pin and screw terminal block |
| **Adapters** | | |
| XMC-e Adapter Board | 80167-0 | XMC-e Adapter Board |
| XMC-PCIe x1 Adapter | 80172-0 | PCI Express Carrier card for XMC PCI Express modules, x1 lanes |
| PCIe to XMCe Adapter Board | 80173-0 | PCIe to XMCe Adapter Board (eight lane |
| PCIe X1 Cable Adapter | 80186-0 | Laptop PCI Express X1 Cable Adapter |
| XMC to CompactPCI Adapter | 80207-0 | CompactPCI to XMCe Adapter Board |
| XMC Adapter for 3U OpenVPX | 80260-3 | VPX-XMC 3U ADAPTER, conduction cooled, without REDI covers for X3 modules |
| XMC Adapter for 3U OpenVPX | 80260-5 | VPX-XMC 3U ADAPTER, conduction cooled, without REDI covers for X5 modules |
| XMC-Cabled PCIe Adapter | 90181 | Cabled PCI Express Carrier card for XMC PCI Express modules, single-lane. |
| eInstrument-DAQ Node | 90181-0 | XMC module carrier with 2.5 Gbps cabled PCI Express link to Host Computer housed in a rugged aluminum enclosure. |

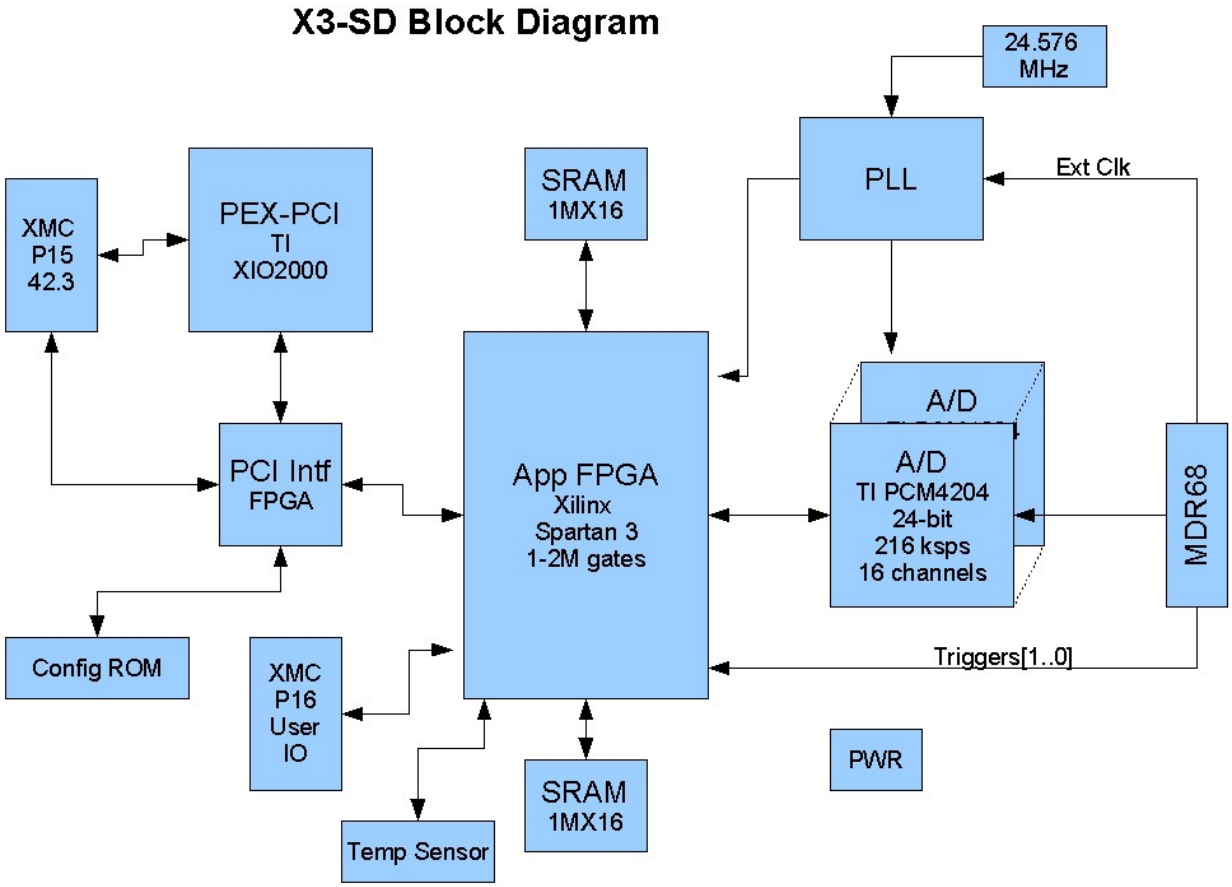
| | | |
|---|---|---|
| CPEX4 Hub | 90241-0 | Cabled PCI Express 4-port Hub including chassis |
| **Embedded PC Host** | | |
| eInstrument PC | 90199 | Embedded PC XMC host with support for two XMC modules for standalone applications. |
| **Custom Engineering and Consulting Services** | | |
| Engineering Services | 56004 | Software/hardware/firmware development |
| Technician Services | 56005 | Mechanical fabrication - Electronics prototyping |
| Premium Services | 56006 | Rapid turnaround premium, Engineering or Technician Services (add to base rate) |
| Visit | 56009 | Engineer Visit On Site for installation, application assistance, in-house training, custom SW |
| **IP Blocks** | | |
| IP-PSK-DEMOD | 58001-0 | Single channel, symbol rate up to 18.5 MSPS Netlist bundle with hardware |
| IP-PSK-DEMOD | 58001-1 | Single channel, symbol rate up to 18.5 MSPS Netlist |
| IP-XLFFT | 58011-0 | Core for 64K to 1M points FFT for 1-D, 2-D signal Netlist undle with hardware |
| IP-XLFFT | 58011-1 | Core for 64K to 1M points FFT for 1-D, 2-D signal Netlist |
| IP-WINDOWING | 58012-0 | Run-time configurable Hann, Blackman, and Boxcar data windowing functions Netlist bundle with hardware |
| IP-WINDOWING | 58012-1 | Run-time configurable Hann, Blackman, and Boxcar data windowing functions Netlist |
| IP-DDC4i | 58014-0 | 4 independent channels of DDC support four different output bandwidths Netlist bundle with hardware |
| IP-DDC4i | 58014-1 | 4 independent channels of DDC support four different output bandwidths Netlist |
| IP-DDC128 | 58015-0 | 128 equispaced channels of DDC support single output bandwidth Netlist bundle with hardware |
| IP-DDC128 | 58015-1 | 128 equispaced channels of DDC support single output bandwidth Netlist |
| IP-DDCC-2GSPS | 58016-0 | 4 channels of 16-bit DDC with input rate up to 2 GSPS Netlist bundle with hardware |
| IP-DDCC-2GSPS | 58016-1 | 4 channels of 16-bit DDC with input rate up to 2 GSPS Netlist |
| IP-DDC | 58021-0 | Single channel wideband DDC, decimation 2-32768 Netlist bundle with hardware |
| IP-DDC | 58021-1 | Single channel wideband DDC, decimation 2-32768 Netlis |
| IP-OFDM-LTE-TX | 58029-0 | LTE OFDM transmitter core Netlist bundle with hardware |
| IP-OFDM-LTE-TX | 58029-1 | LTE OFDM transmitter core Netlist |
| IP-OFDM-LTE-RX | 58034-0 | LTE OFDM receiver PHY layer core with timing recovery and synchronization Netlist bundle with hardware |
| IP-OFDM-LTE-RX | 58034-1 | LTE OFDM receiver PHY layer core with timing recovery and synchronization Netlist |

| | | |
|---|---|---|
| IP-PSK-DEMOD4 | 58035-0 | 4 channels, symbol rate up to 682.5 KSPS Netlist bunde with hardware |
| IP-PSK-DEMOD4 | 58035-1 | 4 channels, symbol rate up to 682.5 KSPS Netlist |
| **VPX** | | |
| VPX-COMEX | 80271-0 | 3U VPX CPU Card, Spartan6 Forced Air Cooling, no REDI covers |
| VPX-COMEX | 80271-0-L1 | 3U VPX CPU Card, Spartan6 Conduction Cooling, no REDI covers |
| VPX-COMEX | 80271-0-L2 | 3U VPX CPU Card, Spartan6 Conduction Cooling, no REDI covers |
| VPX-COMEX | 80271-0-L3 | 3U VPX CPU Card, Spartan6 Conduction Cooling, no REDI covers |
| VPX-COMEX | 80271-0R-L0 | Intel I7 @ 2.53 GHz, 128GB SSD Card with REDI covers |
| VPX-COMEX | 80271-0R-L1 | Intel I7 @ 2.53 GHz, 128GB SSD Card with REDI covers |
| VPX-COMEX | 80271-0R-L3 | Intel I7 @ 2.53 GHz, 128GB SSD Card with REDI covers |
| RTM-ComEx | 80276-0 | Rear terminal module for VPX-ComEx |
| RTM-ComEx | 80276-0-L1 | Rear terminal module for VPX-ComEx |
| RTM-ComEx | 80276-0-L3 | Rear terminal module for VPX-ComEx |
| VPXI-Extension | 90277-0 | VPXI-Extension |
| **Media** | | |
| DVD | 57001 | Innovative Integration Installation DVD |
| **Recorders** | | |
| Andale Turnkey Logging System | 90036-1 | 2.4 TB RAID0 Array, 700 MB/s |
| Andale Turnkey Logging System | 90036-11 | Sustained rates limited to 1600 MB/s |
| Andale Turnkey Logging System | 90036-12 | 14.4 TB RAID0 Array, 1600 MB/s |
| Andale Turnkey Logging System | 90036-13 | 9.6 TB RAID0 Array, 1200 MB/s |
| Andale Turnkey Logging System | 90036-14 | 48 TB RAID0 Array, 2400 MB/s |
| Andale Turnkey Logging System | 90036-2 | Sustained rates limited to 300 MB/s |
| Andale Turnkey Logging System | 90036-4 | 4.8 TB RAID0 Array, 850 MB/s |
| Andale Turnkey Logging System | 90036-5 | Sustained rates limited to 850 MB/s |

| | | |
|---|---|---|
| Andale Turnkey Logging System | 90036-6 | Sustained rates limited to 1000 MB/s |
| Andale Turnkey Logging System | 90036-7 | Sustained rates limited to 500 MB/s |
| Andale Turnkey Logging System | 90036-8 | 14.4 TB RAID0 Array, 2400 MB/s |
| Andale Turnkey Logging System | 90036-9 | Sustained rates limited to 1600 MB/s |
| **Systems** | | |
| Mezzanine Card | 80242-0 | Mezzanine card for eInstrumentPC and SBC-ComEx exposing J16 signals from XMC sites 0 and 1, plus SBC-ComEx baseboard digital I/O signals, 1 ppb stability clock with GPS |
| Precision GPS Option | 80247-0 | Precision GPS Option for eInstrument PC and Atom. Includes Trimble Mini-T GPS receiver, Bullet III antenna and 10 M cable |
| eInstrument-PC | 90199-1 | Rackmount Adapter Kit |
| Extreme eInstrument-PC | 90200-6 | Extreme eInstrument PC with SBC-ComEx carrier, DC supply, (10-945 MHz SI570 VCO range) I7 dual core at 2.5 Ghz, 4GB RAM and Enclosure for SBC-ComEx and SBC COMEX Power Supply, AC (110-240) input, 125W, USA/Japan/Korea/Taiwan power cord. |
| Low Power eInstrument ATOM PC | 90201-3 | Low-power eInstrument-PC ATOM PC with SBC-ComEx carrier, DC supply, ATOM CPU, 1GB RAM and Enclosure for SBC-ComEx and SBC COMEX Power Supply, DC (12V) input, 125W. |
| Extreme eInstrument ATOM PC | 90201-5 | Extreme eInstrument ATOM PC with SBC-ComEx carrier, DC supply I7 dual core, 4GB RAM and enclosure for SBC-ComEx plus SBC COMEX power supply, DC (12V) input, 125W. |
| **Storage** | | |
| Hitachi HTS722020K9A300 | 306019 | 200GB 7200 RPM SATA 3.0Gb/s Hard Drive |
| Disk Drive | 36028 | Solid state disk drive for SBC ComEx - 160 GB |
| Flash Drive | 49016 | 4 Gigabytes memory USB Embedded |
| Western Digital Scorpio WD800BEVS | 49017-0 | 80GB 5400 RPM SATA 1.5Gb/s Hard Drive |
| Flash Drive | 49018 | 16 Gigabytes memory USB Embedded |
| Hard Disk | 80212-0 | Hard Disk Drive for SBC COMEX, eInstrument-PC; 200 GB |
| Hard Disk | 80212-1 | High Performance Hard Disk Drives for SBC COMEX, eInstrument-PC; two drives, 200 GB each |
| VelociRaptor WD6000HLHX | 80212-3 | 600GB 10000 RPM 32MB Cache 2.5" Hard Drive |

| | | |
|---|---|---|
| Disk Drive | 80263 | INTEL SOLID STATE DRIVE V SERIES SNV125-S2BD/30GB 2.5" |
| **GPS** | | |
| Tyco A1029-D GPS antenna | 68013G | Active, +25dB, 3.3V, SMA cable |
| GPS RECEIVER MODULE | 68015G | Trimble Mini-T, high accuracy, 10 MHz output |
| GPS Antenna | 68016G | Trimble Bullet III, 5V |
| NavSync CW25 | 80261 | GPS Module for SBC-ComEx |
| GPS receiver and active antenna | 90196-0 | GPS receiver and active antenna (P/Ns 68013G + 80261) |
| GPS receiver and active antenna | 90198-0 | Trimble Mini-T GPS receiver and active antenna (P/Ns 68015G + 68013G |

# X3-SD


X3-SD Block Diagram
24.576 MHz
PLL
Ext Clk
SRAM 1MX16
XMC P15 42.3
PEX-PCI TI XIO2000
PCI Intf FPGA
App FPGA Xilinx Spartan 3 1-2M gates
A/D
A/D TI PCM4204 24-bit 216 ksps 16 channels
MDR68
Config ROM
XMC P16 User IO
Triggers[1..0]
PWR
SRAM 1MX16
Temp Sensor

# X3-SD

## Standard Features

| Analog | |
|---|---|
| Inputs | 16 |
| Input Range | +10V to -10V differential, Vin+ to Vin- |
| Input Type | Differential, DC Coupled |
| Input Impedance | 10K ohm |
| Output Format | 2's complement, 32-bit integer |
| A/D Device | TI PCM4204 |
| Connector | MDR68 |
| Sample Rate | 216 KSPS maximum |
| Clock Rate | 6.144MHz to 38.4MHz |
| Calibration | Factory calibrated. Gain and offset errors are digitally corrected in the FPGA. Non-volatile EEPROM coefficient memory. |

| FPGA | |
|---|---|
| Size | 1M gate equivalent |
| Flip-Flops | 17,280 |
| Multipliers | 24 |
| CLB | 19,200 |
| Block RAMs | 24 (432K bits) |
| FPGA Device | Xilinx Spartan3<br>XC3S1000-4FGG456 |
| Configuration | SelectMAP from PCIe interface<br>JTAG during development |
| Clock Rate | 66 MHz |

| Memory | |
|---|---|
| Size | 4 MB total<br>2 devices @ 1Mx16 each |
| Type | Synchronous ZBT SRAM |
| SRAM Devices | Cypress CY7C1383D-100AXC |
| Uses | FPGA Buffer Memory<br>FPGA computation memory |
| Clock Rate | 66 MHz |

| Host Interface | |
|---|---|
| Type | PCI Express; single lane |
| Sustained Data Rate | 180 MB/s |
| Protocol | Packet data |
| Connector | XMC P15 |
| Interface Standard | PCIe 1.0a; VITA 42.3 |
| Logic Update | In-system reconfiguration |

| Clocks and Triggering | |
|---|---|
| Clock Sources | PLL or External |
| Sample Rate Generation | 2.5 MHz to 111 MHz |
| Sample Rate Resolution | 25 Hz (worst case) |
| PLL Jitter | <1 ps RMS |
| PLL Programming | Host programmed via PCIe |
| PLL Reference | Internal: 24.576 MHz clock<br>External reference : J16 input |
| Triggering | External, software, acquire N frame |
| Decimation | 1:1 to 1:4095 in FPGA |
| Channel Clocking | All channels are synchronous |
| Multi-card Synchronization | External triggering, clock, and PLL reference are supported. |

# X3-SD

| Acquisition Monitoring | |
|---|---|
| Alerts | Trigger, Queue Overflow, Channel Over-range, Timestamp Rollover, Temperature Warning, Temperature Failure, PLL Unlocked |
| Alert Timestamping | 15 ns resolution, 32-bit counter |

| Physicals | |
|---|---|
| Form Factor | Single width IEEE 1386 mezzanine card |
| Size | 75 x 150 mm |
| Weight | 100g |
| Hazardous Materials | Lead-free and RoHS compliant |

| P16 Digital IO | |
|---|---|
| Total Number of Bits | 44 |
| Balanced Pairs | 22 |
| Signal Standard | LVTTL<br>Configurable as LVDS 2.5V |
| Drive | +/-12 mA (LVTTL) |
| Connector | XMC P16 |

| Power Management | |
|---|---|
| Temperature Monitor | May be read by the host software |
| Alarms | Software programmable warning and failure levels |
| Over-temp Monitor | Disables analog IO power supplies |
| Power Control | Channel enables and power up enables |
| Heat Sinking | Conduction cooling supported. (subset of VITA20) |

## ABSOLUTE MAXIMUM RATINGS

Exposure to conditions exceeding these ratings may cause damage!

| Parameter | Min | Max | Units | Conditions |
|---|---|---|---|---|
| Supply Voltage, 3.3V to GND | +3.0 | +3.6 | V | |
| Analog Input Voltage, Vin+ or Vin- to GND | -12 | +12 | V | |
| Operating Temperature | 0 | 70 | C | Non-condensing, forced air cooling required |
| Storage Temperature | -65 | +150 | C | |
| ESD Rating | - | 1k | V | Human Body Model |
| Vibration | - | 5 | g | 9-200 Hz, Class 3.3 per ETSI EN 300 019-1-3 V2.1.2 (2003-04) |
| Shock | - | 40 | g peak | Class 3.3 per ETSI EN 300 019-1-3 V2.1.2 (2003-04) |

**RECOMMENDED OPERATING CONDITIONS**

| Parameter | Min | Typ | Max | Units |
|---|---|---|---|---|
| Supply Voltage | +3.15 | +3.3 | +3.45 | V |
| Analog Input Voltage, Vin+ or Vin- | -10 | - | +10 | V |
| Sampling Rate | 8 | | 216 | kHz |
| Operating Temperature | 0 | | 60 | C |

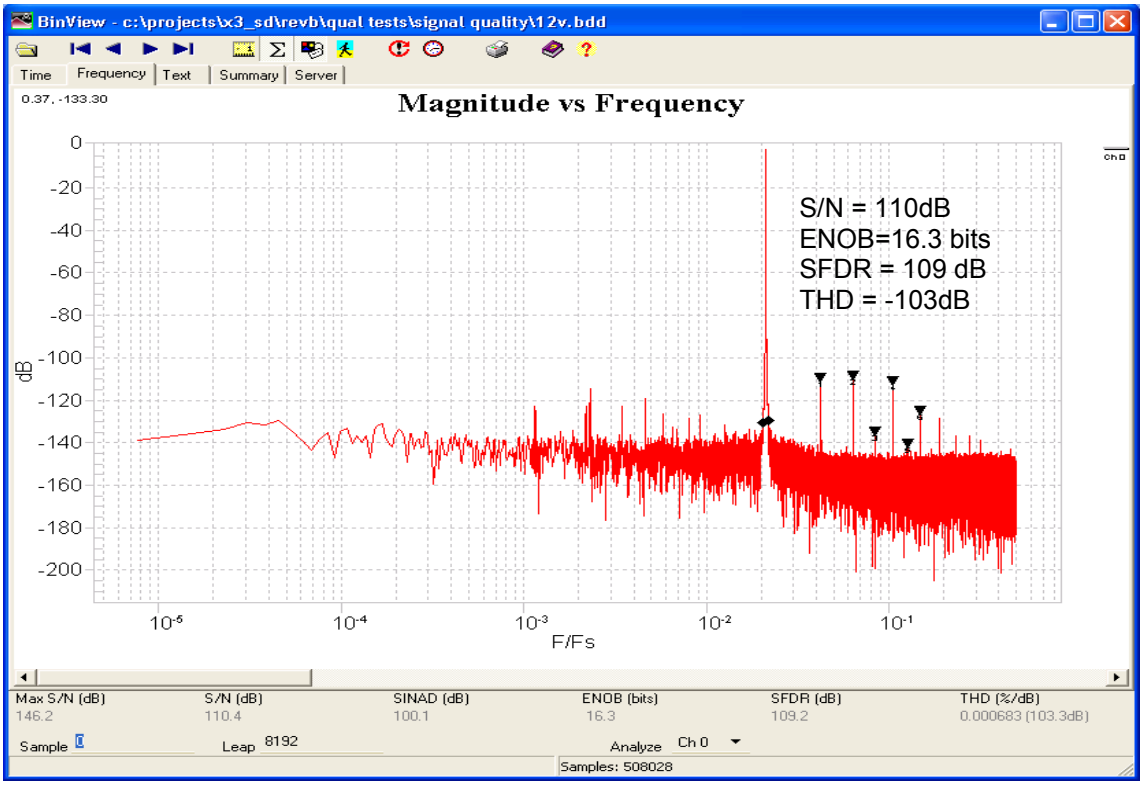
# X3-SD

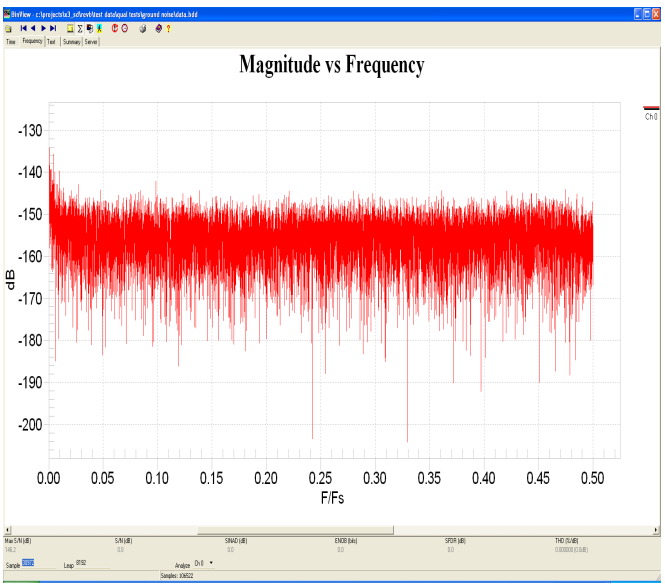
## ELECTRICAL CHARACTERISTICS

Over recommended operating free-air temperature range at 0°C to +60°C, unless otherwise noted.

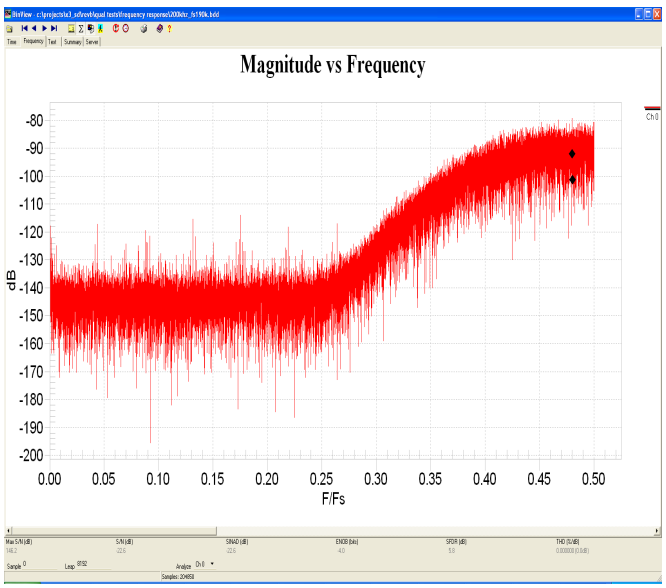
| Parameter | Typ | Units | Notes |
|---|---|---|---|
| **Analog Input** | | | |
| Analog Input Bandwidth | 650 | KHz | -3dB |
| Analog Input Range | +/-10V | V | Calibration may limit full scale to 98% |
| SFDR | 110 | dB | 1 KHz sine input, 12Vp-p differential, FS=52 ksps |
| S/N | 109 | dB | 1 KHz sine input, 12Vp-p differential, FS=52 ksps |
| THD | -103 | dB | 1 KHz sine input, 12Vp-p differential, FS=52 ksps |
| ENOB | 16.3 | bits | 1 KHz sine input, 12Vp-p differential, FS=52 ksps |
| Intermodulation Distortion | -98 | dB | 900 Hz and 1100 Hz sine, Fs = 44.1 kHz, -3dB FS |
| Common Mode Rejection | -80 | dB | 1kHz, 19.9Vp-p sine, Fs = 52ksps |
| Channel Crosstalk | -100 | dB | 20 Hz to 50 KHz, -1 dB on adjacent channels |
| Noise | 60 | µV p-p | Grounded input, Fs = 44.1kHz |
| **Calibration** | | | |
| Gain Error | <0.02 | % of FS | Calibrated |
| Offset Error | <500 | µV | Calibrated |
| Calibration Interval | 1 | year | |
| **Power** | | | |
| Power Consumption | 12.3 | W | 3.3V @ 3.7 A, all channels sampling at 216 KSPS, module temperature is 48C. |

# X3-SD



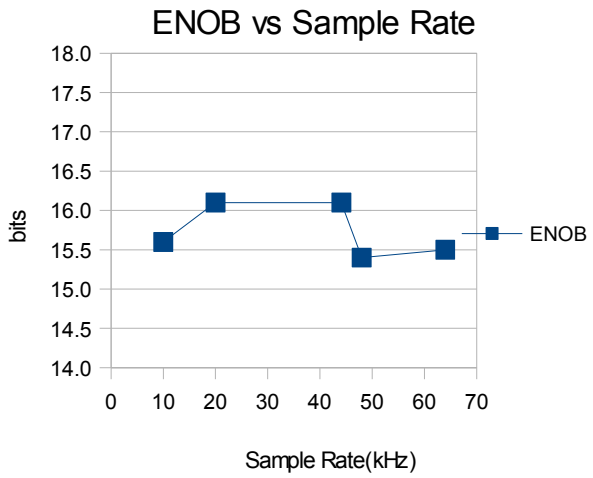



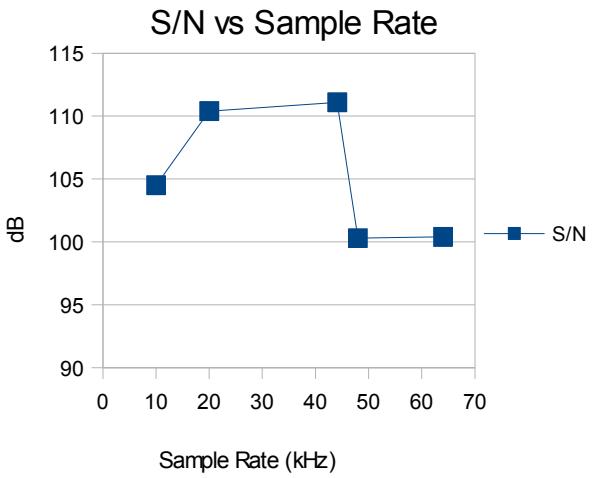

Noise Floor for Grounded Input for Fs= 48 ksps (typical for Fs < 108 ksps)

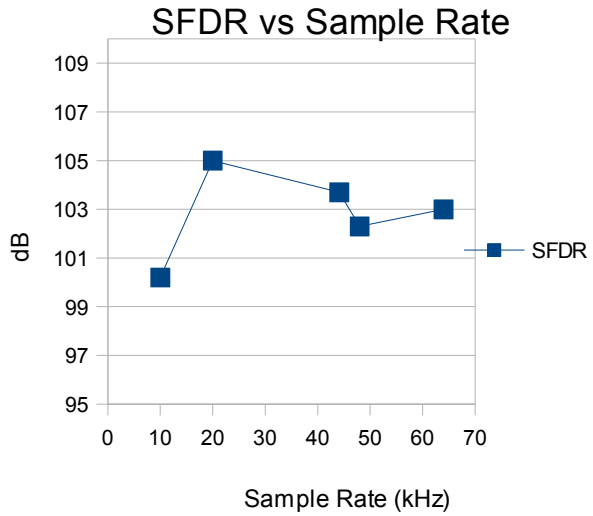


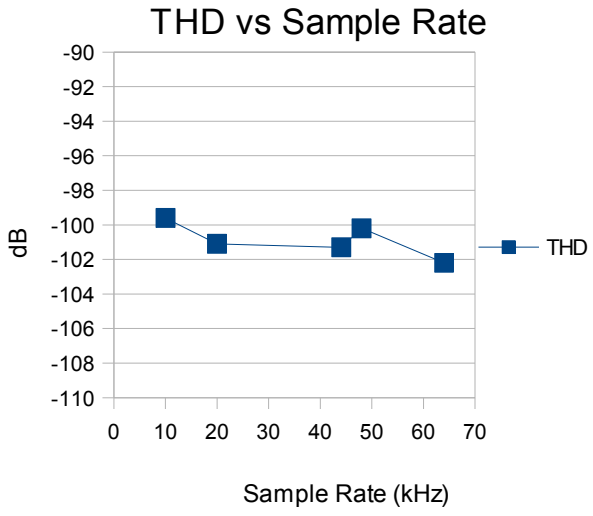

Noise Floor for Grounded Input with Fs = 216ksps (typical for Fs > 108 ksps)

# X3-SD

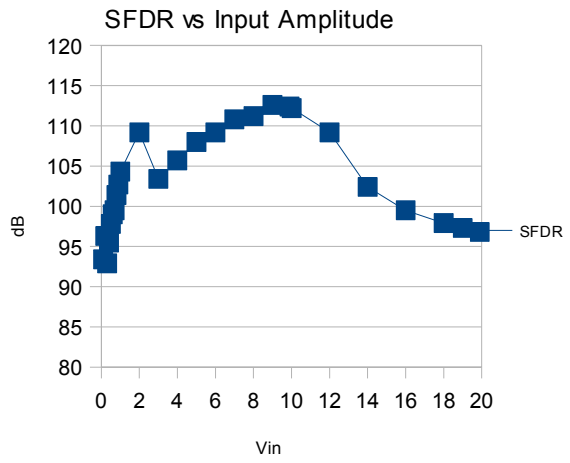

ENOB vs Sample Rate
18.0
17.5
17.0
16.5
16.0
15.5
15.0
14.5
14.0
bits
0
10
20
30
40
50
60
70
Sample Rate(kHz)
ENOB

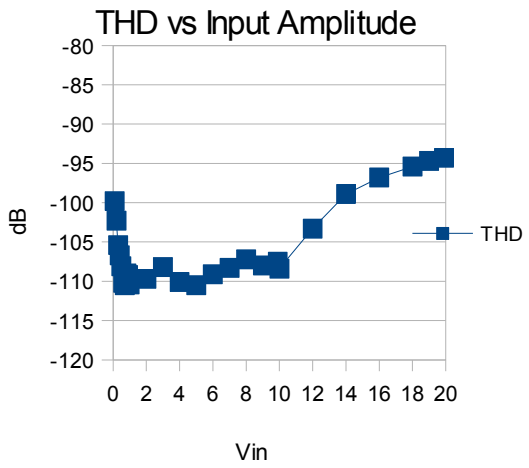

S/N vs Sample Rate
115
110
105
100
95
90
dB
0
10
20
30
40
50
60
70
Sample Rate (kHz)
S/N

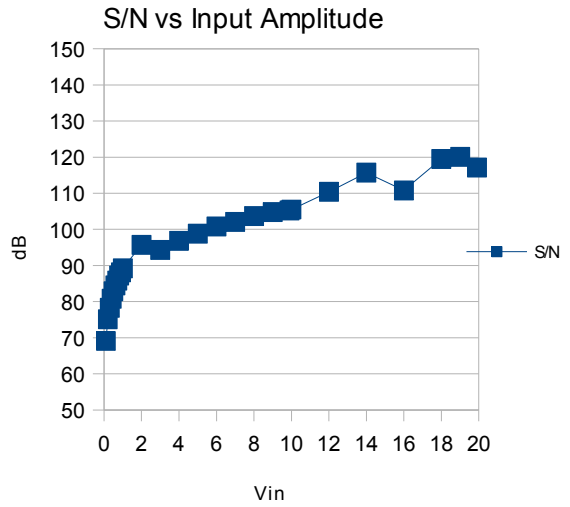

SFDR vs Sample Rate
109
107
105
103
101
99
97
95
dB
0
10
20
30
40
50
60
70
Sample Rate (kHz)
SFDR

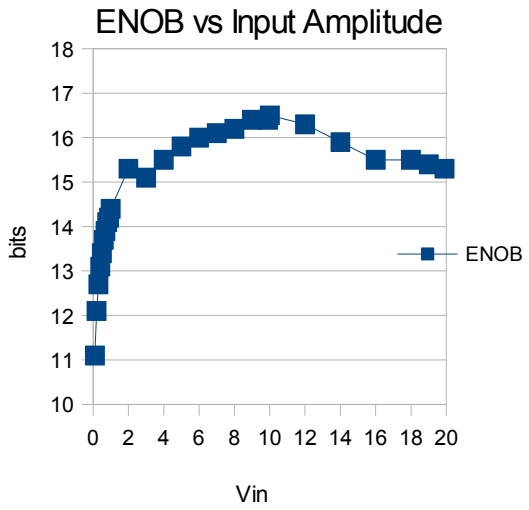

THD vs Sample Rate
-90
-92
-94
-96
-98
-100
-102
-104
-106
-108
-110
dB
0
10
20
30
40
50
60
70
Sample Rate (kHz)
THD

# X3-SD

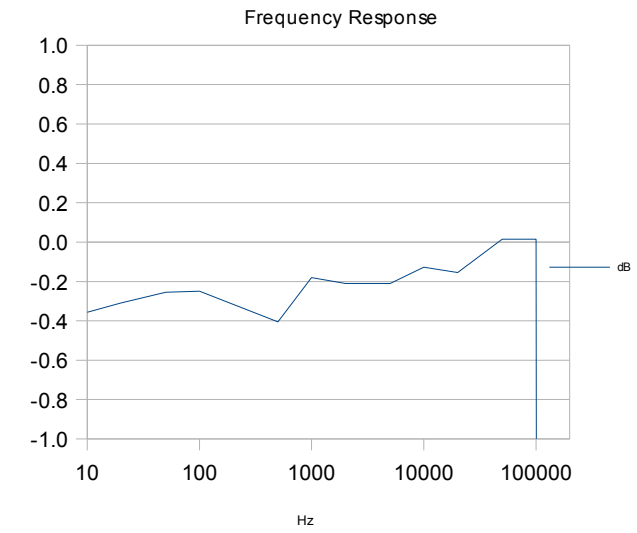

SFDR vs Input Amplitude
120
115
110
105
100
95
90
85
80
dB
0 2 4 6 8 10 12 14 16 18 20
Vin
SFDR

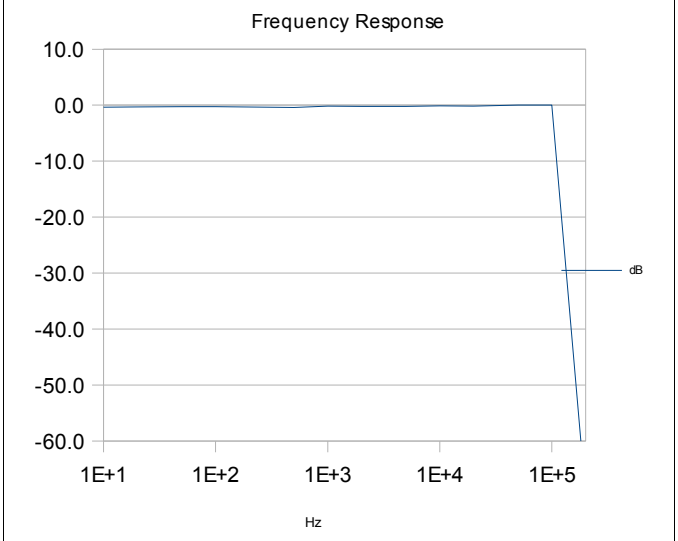

THD vs Input Amplitude
-80
-85
-90
-95
-100
-105
-110
-115
-120
dB
0 2 4 6 8 10 12 14 16 18 20
Vin
THD


S/N vs Input Amplitude
150
140
130
120
110
100
90
80
70
60
50
dB
0 2 4 6 8 10 12 14 16 18 20
Vin
S/N


ENOB vs Input Amplitude
18
17
16
15
14
13
12
11
10
bits
0 2 4 6 8 10 12 14 16 18 20
Vin
ENOB

# X3-SD


Frequency Response
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
10
100
1000
10000
100000
Hz
dB


Frequency Response
10.0
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
1E+1
1E+2
1E+3
1E+4
1E+5
Hz
dB

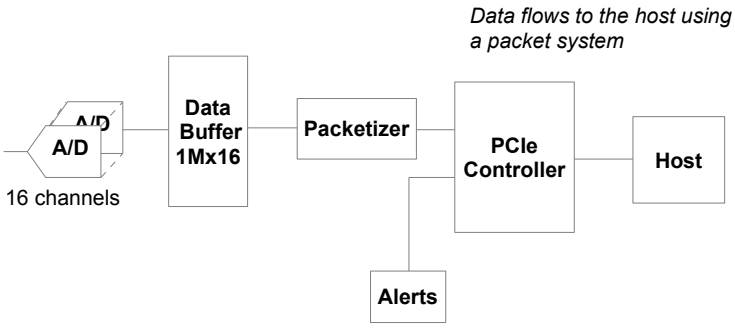
# X3-SD

## Architecture and Features

The analog front end of the X3-SD module uses the Texas Instruments PCM4204 A/D, a 24-bit sigma-delta device with an output data rate of up to 216 K samples per second (KSPS). The A/D devices have multiple modes of operation for oversampling ratios and filtering. All A/Ds sample simultaneously and are clocked synchronously. The inputs are fully differential with a +/- 10V input range.

Controls for triggering and clocks allow precise control over the collection of data. Trigger modes include frames of programmable size, external and software. Multiple X3-SD cards can sample simultaneously using external trigger inputs with synchronized sample clocks. The sample clock can be external or generated from the on-card PLL. The PLL can either use the on-card 24.576MHz reference, or can use an external reference. When an external reference is used, the sample clock is synchronous to the reference.

Data flows from the A/D channels to the FPGA where it is error corrected and stored into a data buffer. The data buffer is a 1M sample SRAM that is used as a FIFO. From the data buffer, the data is packetized and transferred to the host using the PCIe controller interface. The packet data system then controls the flow of packets to the host, or other recipient, using a credit-based system. The packets may be transmitted continuously for streams of data from the A/Ds, or as occasional packets for status, controls and analysis results.




**X3-SD Architecture**

The data acquisition process can be monitored using the X3 alert mechanism. The alerts provide information on the timing of important events such as triggering, overranges and thermal overload. Packets containing data about the alert including an absolute system timestamp of the alert, and other information such as current temperature. This provides a precise overview of the card data acquisition process by recording the occurrence of these real-time events making the X3 modules easier to integrate into larger systems.

The X3-SD supports conduction cooling and provides thermal monitoring and protection. A thermal plane in the module provides heat spreading across the card and to a thermal conduction strip on the card that can be used for conduction cooling in the system. The module will automatically power down if the temperature exceeds 70C, preventing costly failures and downtime. Air flow of 5 CFM across the module is recommended for all applications if conduction cooling is not used.

## Software Tools

Software for data logging and analysis are provided with every X3 module. Data can be logged to system memory at full rate or to disk at rates supported by the drive and controller. Triggering, sample rate controls, and data logging features allow you to use X3 modules in your application without ever writing code. Innovative software applications include *Binview* which provides data viewing, analysis and export data to MATLAB for large data files, as well as support applications for logic loading, firmware updates and system configuration.

Software development tools for the X3 modules provide comprehensive support including device drivers, data buffering, card controls, and utilities that allow developers to be productive from the start. At the most fundamental level, the software tools deliver data buffers to your application without the burden of low-level real-time control of the cards. Software classes provide C++ developers a powerful, high-level interface to the card that makes real-time, high speed data acquisition easier to integrate into applications.

Support for MS Visual C++ is provided. Supported OS include Windows and Linux. For more information, the software tools and on-line help may be downloaded.

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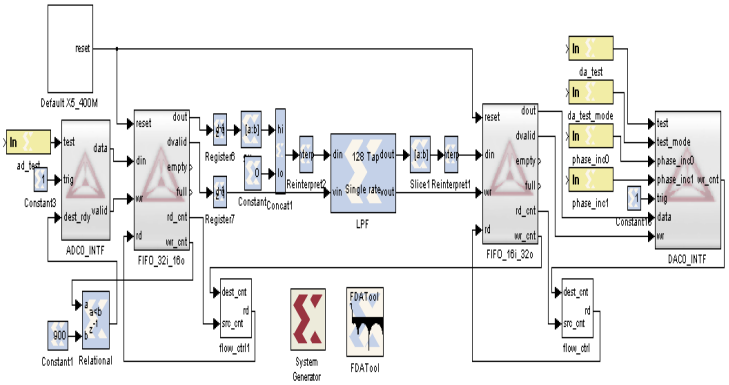
## Logic Tools

High speed DSP, analysis, customized triggering and other unique features may be added to the X3 modules by modifying the logic. The FrameWork Logic tools support RTL and MATLAB developments. The standard logic provides a hardware interface layer that allows designers to concentrate on the application-specific portions of the design. Designer can build upon the Innovative components for packet handling, hardware interfaces and system functions, the Xilinx IP core library, and third party IP. RTL source for the FrameWork Logic is provided for customization. Each design is provided as a Xilinx ISE project, with a ModelSim testbench illustrating logic functionality.

The MATLAB Board Support Package (BSP) supports logic development using Simulink and Xilinx System Generator. These tools provide a graphical design environment that integrates the logic into MATLAB Simulink for complete hardware-in-the-loop testing and development. The MATLAB tools are an extremely powerful design methodology that can be used to generate, analyze and display the signals in the logic real-time in the system. Once the development is complete, the logic can be embedded in the FrameWork logic using the Xilinx ISE tools.




The FrameWork Logic User sales brochure and User Guide more fully detail the development tools.

## Applications Information

## Maximum Data Rates

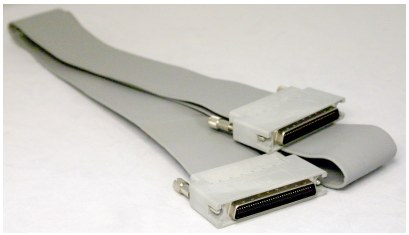
The maximum data rates supported by the module are limited by the PCI Express transfer rate when the total data rate exceeds 150 MB/s. The PCI Express transfer rate may vary according to the host computer, operating system, and other system activity that may compete for bandwidth. The X3 modules support 250MB/s full duplex during bursts, but actual sustained throughput is 150 MB/s in typical desktop PCs.

**It is important to qualify systems for performance when data rates exceeding 150 MB/s are required.**

This rate limitation does not apply to data generated in the FPGA.

## Cables

X3 modules uses a shielded, jacketed 68-wire cable assembly for the front panel IO. The pleated copper foil shield cable is “near coax” in its performance. This cable, plus the use of differential signals and use of ground signals as shields, produce the best results. A screw terminal assembly is available.



## XMC Adapter Cards

XMC modules can be used in standard desktop system or compact PCI/PXI using an adapter card. The adapter cards are software transparent.

The X3 modules use the auxiliary P16 connector for digital IO and additional clock inputs. A total of 44 bits of digital IO, directly connected to the application FPGA, are routed to the rear edge MDR connector as 22 balanced differential pairs supporting LVDS or lower speed single-ended LVCMOS signals. The X3 modules also have a sample clock input and PLL reference input to J16. The cPCI/PXI adapter uses these to connect to system clocks, while the PCIe desktop adapter provides SMB input connectors for system clock inputs.

# X3-SD

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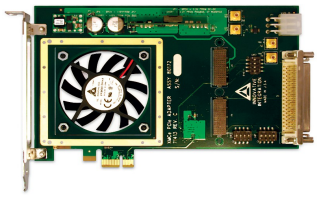
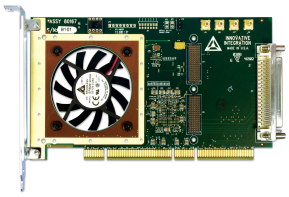
| **PCIe-XMC Adapter (80172)**<br>x1 PCIe to XMC<br>SMB Clock and trigger inputs<br>  | **PCI-XMC Adapter (80167)**<br>64-bit, 133 MHz PCI-X host<br>x4 PCIe to XMC<br>  | **Compact PCI-XMC Adapter (80207)**<br>64-bit, 133 MHz PCI-X host<br>x4 PCIe to XMC<br>PXI triggers and clock support<br>  |

Applications that need remote or portable IO can use either the eInstrument PC or eInstrument Node with X3 modules.

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| **eInstrument PC with Dual PCI Express XMC Modules (90199)**<br>Windows/Linux embedded PC<br>8x USB, GbE, cable PCIe, VGA<br>High speed x8 interconnect between modules<br>GPS disciplined, programmable sample clocks and triggers to XMCs<br>Up to 400MB/s data logging using FLASH HDD<br>12V operation<br>  | **eInstrument DAQ Node – Remote IO using cabled PCI Express (90181)**<br>PCI Express system expansion<br>Up to 7 meter cable<br>electrically isolated from host computer<br>software transparent<br>  |

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