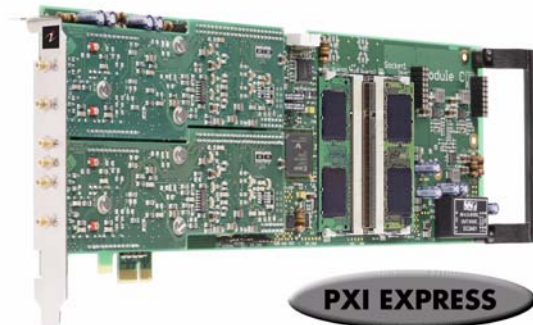
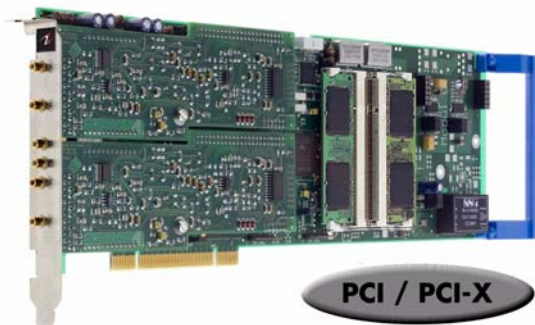


## **UF2-6000 : 125 MS/s 14 bit Arbitrary Waveform Generators, PCI**

- **Fast 14 bit arbitrary waveform generator**
- **1, 2 or 4 channels with 20 MS/s, 60 MS/s or 125 MS/s**
- **Simultaneous generation on all channels**
- **Output up to  $\pm 3$  V in 50 Ohm**
- **Amplifier option available for  $\pm 10$  V**
- **Offset and amplitude programmable**
- **3 software selectable filters**
- **Up to 2 GSamples on-board memory**
- **128 MSample standard memory installed**
- **FIFO mode continuous streaming output**
- **Synchronization of up to 16 cards per system and up to 271 cards in 17 PC's**
- **Options: Multiple Replay, Gated Replay, BaseXIO, Digital Outputs, Amplifier**



- UF2-6000 series
- 66 MHz 32 Bit PCI-X interface
- 5V / 3.3V PCI compatible
- 100% compatible to conventional PCI > V2.1
- Sustained streaming mode up to 225 MB/s

- UF2e-6000 series
- 2.5 GBit x1 PCIe Interface
- Works with x1/x4/x8/x16\* PCIe slots
- Software compatible to PCI
- Sustained streaming mode up to 160 MB/s

<b>Operating Systems</b>	<b>Recommended Software</b>	<b>Drivers</b>
<ul style="list-style-type: none"> <li>• Windows 2k, XP, Vista</li> <li>• Linux Kernel 2.4 + 2.6</li> <li>• Both 32 and 64 bit</li> </ul>	<ul style="list-style-type: none"> <li>• Visual Basic, Visual C++, Borland C++ Builder, GNU C++, Borland Delphi, .VB.NET, C#, J#</li> <li>• SBench, SPviewIT</li> </ul>	<ul style="list-style-type: none"> <li>• MATLAB</li> <li>• LabVIEW, LabWindows</li> <li>• DASYLab</li> <li>• Agilent VEE</li> </ul>

<b>Model</b>	<b>1 channel</b>	<b>2 channels</b>	<b>4 channels</b>
UF2-6011	20 MS/s	20 MS/s	
UF2-6012	20 MS/s	20 MS/s	20 MS/s
UF2-6021	60 MS/s	60 MS/s	
UF2-6022	60 MS/s	60 MS/s	60 MS/s
UF2-6030	125 MS/s		
UF2-6031	125 MS/s	125 MS/s	
UF2-6033	125 MS/s	60 MS/s	
UF2-6034	125 MS/s	125 MS/s	60 MS/s

### **General Information**

The UF2-6000 and UF2e-6000 series are unique in offering cards with up to 4 GByte memory, 2 channels at 125 MS/s or 4 channels at 60 MS/s and 20 MS/s. These boards allow the user to generate freely definable complex waveforms on several channels synchronously and with long playback times. It is possible to combine multiple AWG cards synchronously or even other instrument cards for mixed-mode testing. Each channel has it's own 14-bit DAC and three programmable reconstruction (low-pass) filters. An optional amplifier card is available to increase the output from +/-3V to +/- 10V.

Like all UF2/UF2e cards it is possible to stream data direct from the PC for even longer signal generation. The Multiple Replay and Gated Replay options are especially popular for creating RADAR signals, while the Digital Outputs allows digital outputs, synchronous with the DAC's, to be output as markers.

\*Some x16 PCIe slots are for the use of graphic cards only and can not be used for other cards.

## Software Support

### Windows drivers

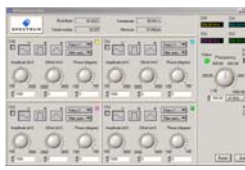
The cards are delivered with drivers for Windows 2000, XP, XP64, Vista and Vista64. Programming examples for Visual C++, Borland C++ Builder, LabWindows/CVI, Borland Delphi, Visual Basic, VB.NET, C# and J# are included.

### Linux Drivers



All cards are delivered with full Linux support. Pre compiled kernel modules are included for the most common distributions like RedHat, Fedora, Suse or Debian. The Linux support includes SMP systems, 32 bit and 64 bit systems, versatile programming examples for Gnu C++ as well as the possibility to get the driver sources for own compilation.

### SPEasyGenerator



For a fast start with the hardware the simple signal generation software SPEasyGenerator is included in the delivery. This software allows to generate simple signal shapes like sine, triangle or rectangle with programmable frequency, amplitude and phase. SPEasy-

Generator is also available as LabWindows source code.

### SBench

A full licence of the SBench measurement and waveform generation software for the UltraFast cards is included in the delivery. Version 6 is running under Windows as well as under Linux (KDE and GNOME).

### Third-party products

Additional drivers are available as a cost-option for LabVIEW, MATLAB, DASYLab and Agilent VEE. All drivers are supplied with examples and detailed documentation.

### UF Software compatibility layer

For existing customers of the older UF series cards, a special software compatibility layer is provided for the UF2/UF2e cards. This DLL converts UF calls to UF2 calls and simulates a UF card in the software.

## Hardware features and options

### PCI/PCI-X



The UF2 cards with PCI/PCI-X bus connector use 32 Bit and up to 66 MHz clock rate for data transfer. They are 100% compatible to Conventional PCI > V2.1. The universal interface allow their use in PCI slots with 5 V I/O and 3.3 V I/O voltages as well

as in PCI-X or PCI 64 slots. The maximum sustained data transfer rate is 225 MByte/s per bus segment.

### PCI Express



The UF2e cards with PCI Express use a x1 PCIe connector. They can be used in PCI Express x1/x4/x8/x16 slots, except special graphic card slots, and are 100% software compatible to Conventional PCI > V2.1. The maximum sustained data transfer rate is

160 MByte/s per slot.

### FIFO mode

The FIFO mode is designed for continuous data transfer between measurement board and PC memory or hard disk. The control of the data stream is done automatically by the driver on interrupt request. The complete installed on-board memory is used for buffer data, making the continuous streaming extremely reliable.

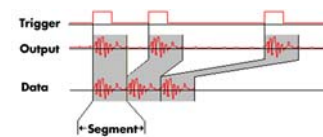
### External trigger I/O

All digital boards can be triggered using an additional external TTL signal per acquisition module. It's possible to use positive or negative edge also in combination with a programmable pulse width. An internally recognized trigger event can - when activated by software - be routed to the trigger output connector to start external instruments.

### Pulse width

Defines the minimum or maximum width that a trigger pulse must have to generate a trigger event. Pulse width can be combined with channel trigger, pattern trigger and external trigger.

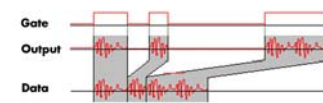
### Multiple Replay



The Multiple Replay option allows the fast repetition output on several trigger events without restarting the hardware. With this option very fast repetition rates can be achieved.

The on-board memory is divided in several segments of same size. Each of them is generated if a trigger event occurs.

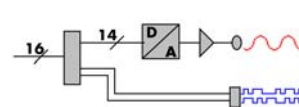
### Gated Replay



The Gated Sampling option allows data replay controlled by an external gate signal. Data is only replayed if the gate signal has a pro-

grammed level.

### Digital outputs

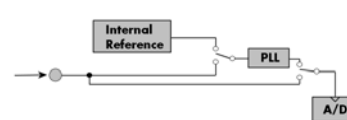


This option outputs additional synchronous digital channels phase-stable with the analog data. When this option is installed there are 2 additional digital outputs for every analog D/A channel.

### External clock I/O

Using a dedicated line a sampling clock can be fed in from an external system. It's also possible to output the internally used sampling clock to synchronize external equipment to this clock.

### Reference clock



The option to use a precise external reference clock (normally 10 MHz) is necessary to synchronise the board for high-quality

measurements with external equipment (like a signal source). It's also possible to enhance the quality of the sampling clock in this way. The driver automatically generates the requested sampling clock from the fed in reference clock.

### Singleshot output

When singleshot output is activated the data of the on-board memory is replayed exactly one time. As trigger source one can use the external TTL trigger or the software trigger.

### **Repeated output**

When repeated output is used the data of the on-board memory is replayed continuously until a stop command is executed or N times. As trigger source one can use the external TTL trigger or the software trigger.

### **Single Restart replay**

When this mode is activated the data of the on-board memory will be replayed once after each trigger event. Trigger source one can use the external TTL or software trigger.

### **±10 V Amplifier**



The amplifier board allows the output of  $\pm 10$  V on up to four channels without software modification. The standard outputs of the card are amplified by factor 3.33. The amplifier which has 30 MHz bandwidth has an output impedance of 50 Ohm. This allows  $\pm 10$  V with high impedance termination or  $\pm 5$  V with 50 ohm termination.

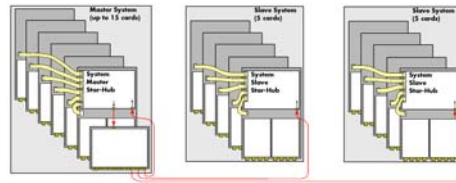
### **Star-Hub**



The Star Hub is an additional module allowing the phase stable synchronisation of up to 16 boards in one system. Regardless of the number of boards there is no phase delay between all channels. The Star Hub distributes trigger and

clock information between all boards. As a result all connected boards are running with the same clock and the same trigger. All trigger sources can be combined with OR/AND allowing all channels of all cards to be trigger source at the same time. The Star Hub is available as 5 card and 16 card version. The 5 card version doesn't need an extra slot width.

### **271 synchronous cards with the System Star-Hub**



With the help of multiple System Star-Hubs it is possible to link up to 17 system phase synchronous with each other.

Each system can then contain up to 16 cards (master only 15). In total 271 cards can be used fully synchronously in multiple PC's. One master system distributes clock and trigger signal to all connected slave systems.

### **BaseXIO (enhanced trigger)**



The BaseXIO option offers 8 asynchronous digital I/O lines on the base card. The direction can be selected by software in groups of four. Two of these lines can also be used as additional external trigger sources. This allows the building of complex trigger combinations with external gated triggers as well as AND/OR combination of multiple external trigger sources - for example, the picture and row synchronisation of video signals. In addition one of the I/O lines can be used as reference clock for the Timestamp counter.

-

## Technical Data

### Analog Outputs

Resolution	14 bit
INL, Integral linearity (DAC only)	± 1.5 LSB typ.
DNL, Differential linearity (DAC only)	± 1.0 LSB typ.
Output resistance	< 1 Ohm
Max output swing in 50 Ohm	± 3 V (offset + amplitude)
Max slew rate (no filter)	> 0.9 V/ns
Crosstalk @ 1 MHz signal ±3 V	< -80 dB
Output accuracy	< 1%
Connector (analog and trigger/clock)	3 mm SMB male

### Trigger

Multi, Gate: re-arming time	<4 Samples
Trigger output delay	One positive edge after internal trigger event

External trigger type	3.3V LVTTTL compatible (5V tolerant)
External trigger input	Low ≤ 0.8 V, High ≥ 2.0 V, ≥ 2 clock periods
External trigger maximum voltage	-0.5 V up to +5.7 V (internally clamped to 5.0V, 100 mA max. clamping current)
External trigger output levels	Low ≤ 0.4 V, High ≥ 2.4 V, TTL compatible
External trigger output drive strength	Capable of driving 50 ohm load

### Environmental and Physical details

Dimension (PCB only)	312 mm x 107 mm (full PCI length)
Width (Standard or star-hub 5)	1 full size slot
Width (star-hub 16)	2 full size slots
Width (with digital inputs)	1 full size slots + 1 half size slot
Weight (depending on options/channels)	290g (2 ch) up to 460g (4 ch + dig + sh)
Warm up time	10 minutes
Operating temperature	0°C - 50°C
Storage temperature	-10°C - 70°C
Humidity	10% to 90%

### PCI / PCI-X specific details

PCI / PCI-X bus slot type	32 bit 33/66 MHz
PCI / PCI-X bus slot compatibility	32/64 bit, 33-133 MHz, 3,3 V and 5 V I/O

### PCI EXPRESS specific details

PCIe slot type	x1
PCIe slot compatibility	x1/x4/x8/x16*

\*Some x16 PCIe slots are for graphic cards only and can not be used for other cards.

### Max channels with Star-Hub

	SH5	SH16	SSH55	SSH16
UF2-6030	5	16	85	271
UF2-60x1, 60x3	10	32	170	542
UF2-60x2, 60x4	20	64	340	1084

### Power consumption (max speed)

	PCI / PCI-X		PCI EXPRESS	
	3,3 V	5 V	3,3 V	12 V
UF2-6030 (128 MS memory)	2.6 A	0.4 A	0.4 A	0.9 A
UF2-60x1/UF2-60x3 (128 MS mem-)	2.8 A	0.7 A	0.4 A	1.1 A
UF2-60x2/UF2-60x4 (128 MS mem-)	3.2 A	1.1 A	0.4 A	1.2 A
UF2-6034 (2 GS memory), max- power	4.9 A	1.1 A	0.4 A	1.7 A

### Certifications and Compliances

EMC Immunity	Compliant with CE Mark
EMC Emission	Compliant with CE Mark

### Clock

Internal clock range (PLL mode)	1 kS/s to max (see table below)
Internal clock accuracy	20 ppm
Internal clock: max. jitter in PLL mode	TBD
Internal clock: max. jitter in quartz mode	TBD
Internal clock setup granularity (≤ 100 M)	≤1% of range (100M, 10M, 1M, 100k,...)
Internal clock setup granularity example	range 1M to 10M: stepsize ≤ 100k
Internal clock setup granularity (> 100 M)	one fixed value (160 MS/s or 200 MS/s)
Reference clock: external clock range	≥ 1.0 MHz and ≤ 125.0 MHz
External clock range	DC to max (see table below)
External clock delay to internal clock	5.4 ns
External clock type	3.3V LVTTTL compatible
External clock input	Low ≤ 0.8 V, High ≥ 2.0 V, duty 45% - 55%
External clock maximum voltage	-0.5 V up to +3.8 V (internally clamped to 3.3V, 100 mA max. clamping current)
External clock output levels	Low ≤ 0.4 V, High ≥ 2.4 V, TTL compatible
External clock output drive strength	Capable of driving 50 ohm load

### Digital Outputs (Option)

Digital outputs delay to analog sample	no delay
Output voltage	Low ≤ 0.4 V, High ≥ 2.4 V
Connector (digital outputs)	40 pole half pitch (Hirose FX2 series)

### Output Delays

Trigger to 1st sample	15/16 clocks (2/1 channel/module)
Gate end to last replayed sample	15/16 clocks (2/1 channel/module)
Gate end alignment	2 samples (1 ch), 1 sample (2 or 4 ch)

### BaseXIO (Option)

BaseXIO Connector (extra bracket)	8 x SMB (8 x MCMCX internal)
BaseXIO input	TTL compatible: Low ≤ 0.8 V, High ≥ 2.0 V
BaseXIO input maximum voltage	-0.5 V up to +4.0 V (internally clamped to 3.3V, 100 mA max. clamping current)
BaseXIO output levels	TTL compatible: Low ≤ 0.4 V, High ≥ 2.4 V

### Software programmable parameters

Output amplitude	±100 mV up to ±3 V in 1 mV steps (Amp option: ±333 mV up to ±10 V)
Output offset	±3 V selectable in 1 mV steps (Amp option: ±10 V in 3 mV steps)
Filters	no filter or one of 3 different filters as defined in technical data section
Mode	Singleshot, Repeated Replay, Single Restart
Clock mode	Int. PLL, int. quartz, ext. clock, ext. divided, ext. reference clock, sync
Clock impedance	50 Ohm / high impedance (> 4kOhm)
Trigger impedance	50 Ohm / high impedance (> 4kOhm)
Trigger mode	external TTL, software, pulsewidth, Or/And, Delay
Trigger edge	Rising edge, falling edge, both edges
Trigger pulse width	0 to [64k - 1] samples in steps of 1 sample
Trigger delay	0 to [64k - 1] samples in steps of 1 sample
Memory depth	8 up to [installed memory / number of active channels] in steps of 4
Multiple Replay segment size	8 up to [installed memory / 2 / active channels] in steps of 4
Sync clock divider	2 up to [8k - 2] in steps of 2
Channel selection	1, 2, 4

## Clock and Filter

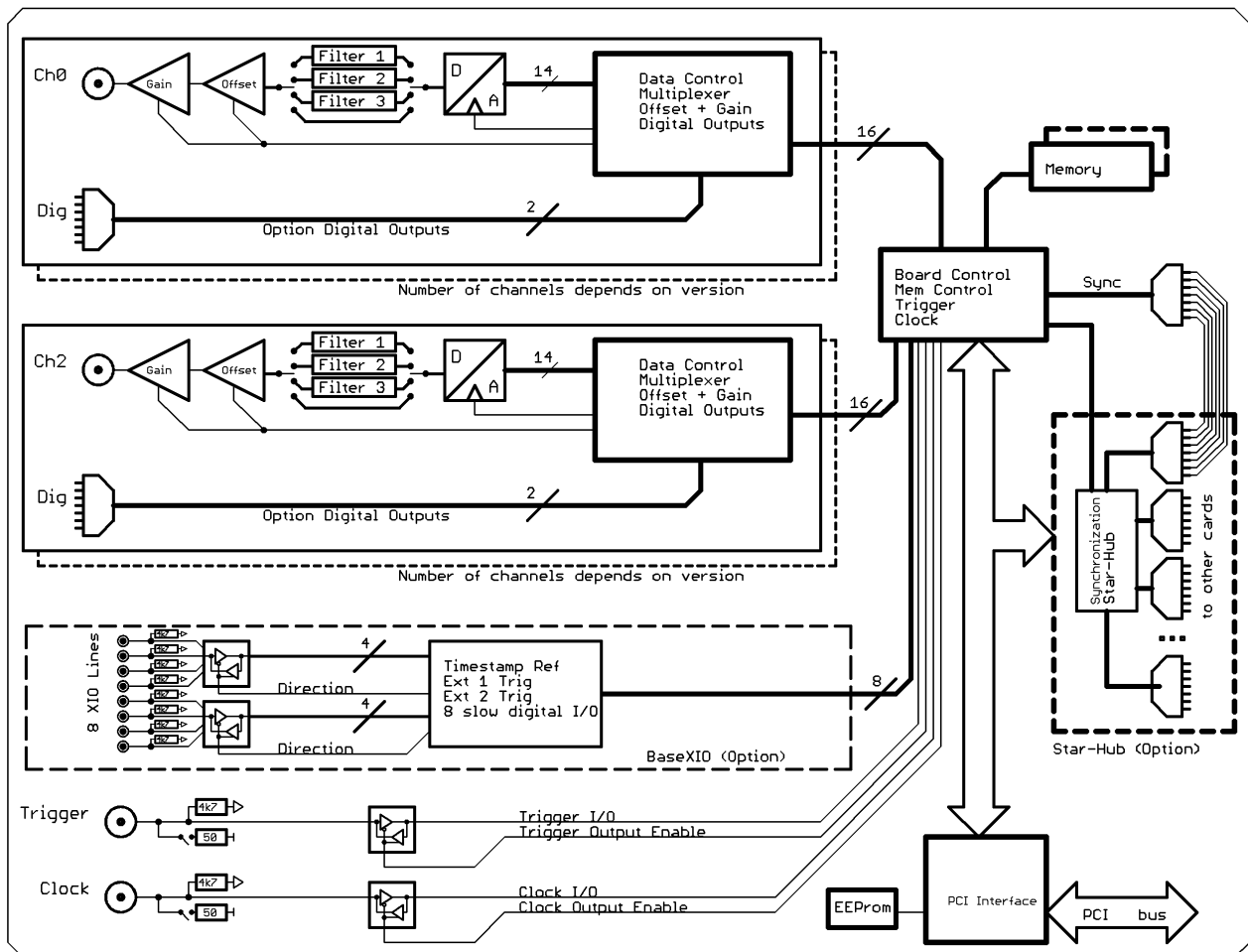
UF2/UF2e	-6011 -6012	-6021 -6022	-6030 -6033	-6031 -6034
max internal clock	20 MS/s	62.5 MS/s	125 MS/s	125 MS/s
max external clock	20 MS/s	62.5 MS/s	125 MS/s	125 MS/s
-3 dB bandwidth no filter	> 10 MHz	> 30 MHz	> 60 MHz	> 60 MHz
Filter 3: Characteristics	4th order Butterworth		5th order Butterworth	
Filter 3: -3 dB bandwidth	5 MHz	10 MHz	25 MHz	25 MHz
Filter 2: Characteristics	4th order Butterworth		4th order Butterworth	
Filter 2: -3 dB bandwidth	1 MHz	2 MHz	5 MHz	5 MHz
Filter 1: Characteristics	4th order Butterworth		4th order Butterworth	
Filter 1: -3 dB bandwidth	100 kHz	200 kHz	500 kHz	500 kHz

## Dynamic Parameters

UF2/UF2e	-6011 -6012	-6011 -6012	-6011 -6012	-6021 -6022	-6021 -6022	-6030 -6031 -6033 -6034	-6030 -6031 -6033 -6034	-6030 -6031 -6033 -6034	-6030 -6031 -6033 -6034
Test - Samplerate	20 MS/s	20 MS/s	20 MS/s	60 MS/s	60 MS/s	62.5 MS/s	62.5 MS/s	125 MS/s	125 MS/s
Output Frequency	80 kHz	800 kHz	4 MHz	170 kHz	1.7 MHz	400 kHz	4 MHz	400 kHz	4 MHz
Output Level	±2 V	±2 V	±2 V	±2 V	±2 V	±2 V	±2 V	±2 V	±2 V
Used Filter	100 kHz	1 MHz	5 MHz	200 kHz	2 MHz	500 kHz	5 MHz	500 kHz	5 MHz
SNR (typ)	> 61.5 dB	> 60.2 dB	> 54.5 dB	> 61.5 dB	> 59.5 dB	> 61.5 dB	> 55.0 dB	> 61.0 dB	> 56.0 dB
THD (typ)	< -70.4 dB	< -67.5 dB	< -45.0 dB	< -72.7 dB	< -62.5 dB	< -71.5 dB	< -55.6 dB	< -71.5 dB	< -56.0 dB
SFDR (typ), excl harm.	> 85.5 dB	> 72.0 dB	> 60.0 dB	> 81.5 dB	> 68.5 dB	> 82.8 dB	> 66.5 dB	> 72.0 dB	> 67.0 dB

Dynamic parameters are measured at the given output level and 50 Ohm termination with a high resolution data acquisition card and are calculated from the spectrum. The sample rate that is selected is the maximum possible one. All available channels are activated for the tests. SNR and SFDR figures may differ depending on the quality of the used PC. SNR = Signal to Noise Ratio, THD = Total Harmonic Distortion, SFDR = Spurious Free Dynamic Range

## Hardware block diagram



## Order Information

<b>Versions</b>	Order no.	Standard mem	1 channel	2 channels	4 channels
	UF2-6011, UF2-6011	256 MSample	20 MS/s	20 MS/s	
	UF2-6012, UF2-6012	256 MSample	20 MS/s	20 MS/s	20 MS/s
	UF2-6021, UF2-6021	256 MSample	60 MS/s	60 MS/s	
	UF2-6022, UF2-6022	256 MSample	60 MS/s	60 MS/s	60 MS/s
	UF2-6030, UF2-6030	256 MSample	125 MS/s		
	UF2-6031, UF2-6031	256 MSample	125 MS/s	125 MS/s	
	UF2-6033, UF2-6033	256 MSample	125 MS/s	60 MS/s	
	UF2-6034, UF2-6034	256 MSample	125 MS/s	125 MS/s	60 MS/s

<b>Memory</b>	Order no.	Option
	UF2-6000-256MS	Memory upgrade to 512 MB of total memory
	UF2-6000-512MS	Memory upgrade to 1 GB of total memory
	UF2-6000-1GS	Memory upgrade to 2 GB of total memory
	UF2-6000-2GS	Memory upgrade to 4 GB of total memory

<b>Options</b>	Order no.	Option
	UF2-6000-mr	Option Multiple Replay
	UF2-6000-mgt	Option pack including Multiple Replay, Gated Replay, Timestamp
	UF2-6000-mgtab	Option pack including Multiple Replay, Gated Replay, Timestamp, ABA mode
	UF2-6000-SH5 (1)	Synchronization Star-Hub for up to 5 cards, only 1 slot width
	UF2-6000-SH16 (1)	Synchronization Star-Hub for up to 16 cards
	UF2-6000-SSHM (1)	System-Star-Hub Master for up to 15 cards in the system and up to 17 systems, sync cables included
	UF2-6000-SSHS5 (1)	System-Star-Hub Slave for up to 5 cards in one system, all sync cables included
	UF2-6000-SSHS16 (1)	System-Star-Hub Slave for up to 16 cards in one system, all sync cables included
	UF2-6000-dig	Additional synchronous digital output (2 per analog channel) including Cab-d40-idc-100
	UF2-6000-bxio	Option BaseXIO: 8 digital I/O lines usable as asynchronous I/O, timestamp ref-clock and additional external trigger lines, additional bracket with 8 SMB connectors
	UF2-upgrade	Upgrade for UF2 or UF2e; later installation of option -dig or -bxio

<b>Cables</b>	Order no.	Option
	Cab-3f-9m-80	Adapter cable SMB female to BNC male, 80 cm
	Cab-3f-9f-80	Adapter cable SMB female to BNC female, 80 cm
	Cab-3f-3f-80	Adapter cable SMB female to SMB female, 80 cm
	Cab-3f-9m-200	Adapter cable SMB female to BNC male, 200 cm
	Cab-3f-9f-200	Adapter cable SMB female to BNC female, 200 cm
	Cab-3f-3f-200	Adapter cable SMB female to SMB female, 200 cm
	Cab-3f-9f-5	Adapter cable SMB female to BNC female, 5 cm (short cable especially for oscilloscopes probes)
	Cab-d40-idc-100	Flat ribbon cable 40 pole FX2 for digital connector to -2x20 pole IDC connector, 100 cm
	Cab-d40-d40-100	Flat ribbon cable 40 pole FX2 for digital connector to 40 pole digital FX2 connector, 100 cm

<b>Drivers</b>	Order no.	Option
	UF2-ml	MATLAB driver for all UF2 and UF2e cards
	UF2-6000-lv	LabVIEW driver for all UF2-6000 and UF2e-6000 cards
	UF2-6000-dl	DASyLab driver for all UF2-6000 and UF2e-6000 cards
	UF2-6000-vee	Agilent VEE driver for all UF2-6000 and UF2e-6000 cards

(1) : Only one of the options can be installed on a card at a time.

## Warranty and Software Maintenance

All UltraFast boards are supplied with a two-year hardware warranty and include life-time technical support and free software updates. This includes SDK's for future Microsoft Windows and Linux versions and third-party software drivers.

technical changes and printing errors possible