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Hardware, software and DSP design

Design partners for:
Analog Devices
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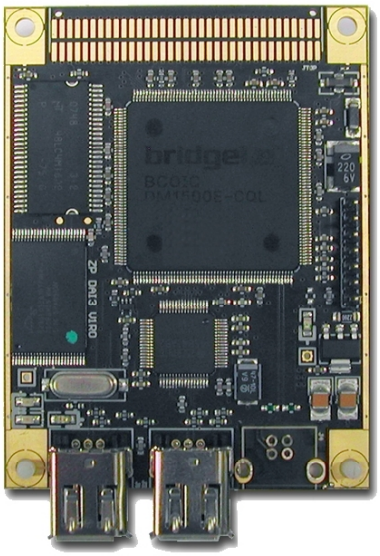
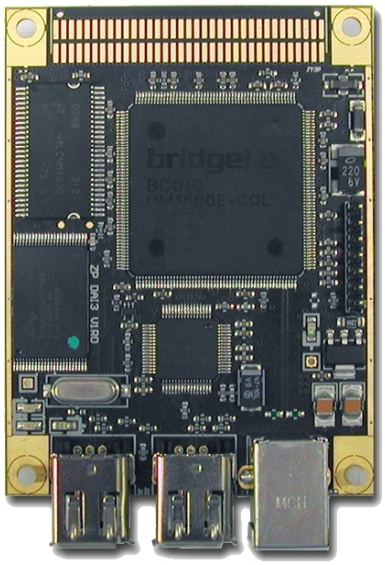
picoDM

small Digital Modules for OEM digital connectivity

picoDM 1





picoDM 3

version:3.0beta
30 ottobre 2008

The picoDM concept

A series of small form-factor modules has been designed, with the goal of enabling the addition of specialized I/O interfaces to existing designs in the pro audio field.
The picoDM module series deploys custom IP blocks (in firmware, in hardware or both) and share a common connector pin-out, allowing the usage of different modules on the same design.
Various interfaces with external world are available, providing up to 64 audio channels in both directions, with flexible sync options and auxiliary data ports (SPI, UART).
Standard firmware releases are available for each picoDM module; as a standard practice, ZP Engineering offers customization services for firmware and/or VHDL code on existing picoDM modules, enabling the integration of additional functions and specific capabilities.

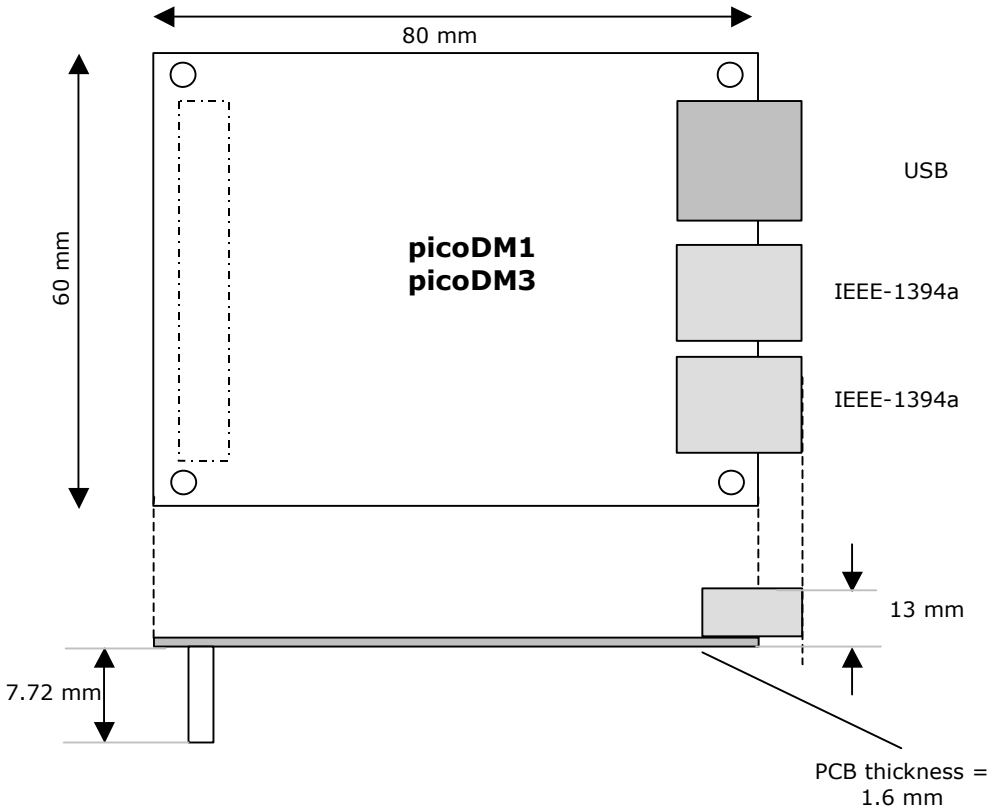
Audio ports are available in one of two data formats:

- I2S, up to 16 data lines
- I8S, up to 16 data lines

Additional formats are available when requesting customized firmware builds.

PicoDM mechanical details

The first member of the picoDM series offers a high channel-count IEEE-1394a interface, with the following specifications:



Holes offsets:
top left: X = 3.5mm, Y = 3.5mm
top right: X = 3.5mm, Y = 56.5mm
bottom right: X = 76.5mm, Y = 56.5mm
bottom left: X = 76.5mm, Y = 3.5mm

Hole size = 3.2mm

Button hole size = 6 mm (plated)

Connectors

The **standard picoDM module** is fitted with the following connector (7.72 mm mated height):
SAMTEC FW-35-03-G-D-215-065

The corresponding female mating connector we suggest is the following:
SAMTEC CLP-135-02-G-D

Customizations

Different connector heights are possible, subject to minimum order quantities (100 pieces lot minimum); as an example, a higher height connector can be provided as follows:

Connector:	**SAMTEC FW-35-05-G-D-340-230**
Mating connector:	**SAMTEC CLP-135-02-G-D**

Furthermore, subject to the same minimum order quantity, other connectors can be fitted, i.e.:

- male connector mounted on top of the module
- 90 degrees connector for in-line assembly, mounted on top or on bottom

Please notice that if the connector is mounted on top, pin numberings must be reversed accordingly.

picoDM modes

Module name →		picoDM 1	picoDM 3	
Mode	Format	Firewire	Firewire or USB	
		IEEE-1394a	IEEE-1394a	USB 2.0
0	I2S DEMO	8in+8out	8in+8out	8in+8out
1	I2S	8in+8out	8in+8out	8in+8out
2	I2S	12in+12out	12in+12out	12in+12out
3	I2S	16in+16out	16in+16out	--
4	I8S	32in+32out	32in+32out	--

A total of 5 operating modes are available on picoDM1 and picoDM3 when using the IEEE-1934a interface.
In USB mode, the first 3 modes can be selected.

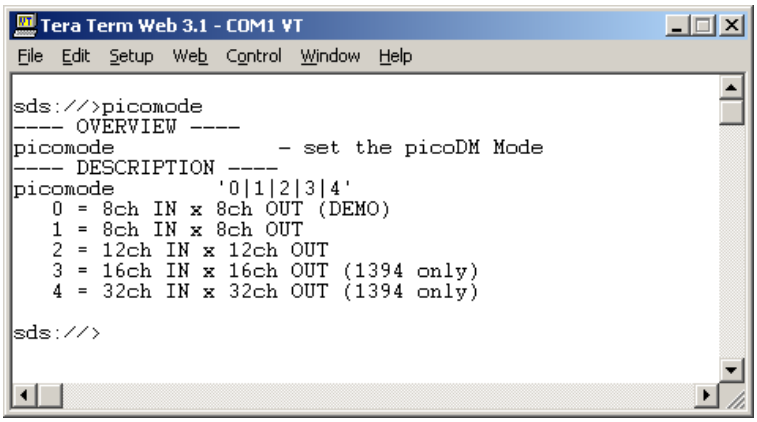
Please notice that mode 0 is the DEMO mode, developed for the **picoEVB** evaluation board; the DEMO mode enables a total of 8 inputs and 8 outputs, and the external CODEC is properly initialized and handled during sample rate or sync changes.

Available modes on picoDM1 and picoDM3 are summarized more in detail in the following table:

MODE	PicoDM IEEE1394	PicoDM3 USB	Channel arrangement	Supported Sample Rates	Notes
0	YES	YES	8 in, 8 out (I2S)	44.1-48-88.2-96 kHz	CODEC on picoEVB enabled
1	YES	YES	8 in, 8 out (I2S)	44.1-48-88.2-96 kHz	
2	YES	YES	12 in, 12 out (I8S)	44.1-48-88.2-96 kHz	
3	YES	NO	16 in, 16 out (I2S)	44.1-48-88.2-96 kHz	
4	YES	NO	32 in, 32 out (I8S)	44.1-48-88.2-96 kHz	

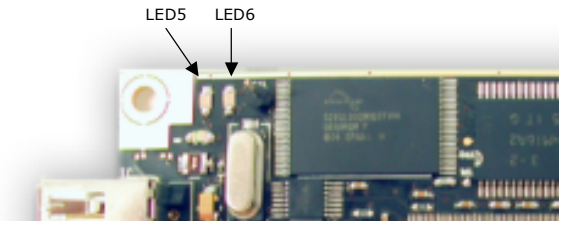
Changing mode is a critical operation, as conflicts may arise when the wrong operating mode is selected. Mode can be changed from the **debug serial port only**, being an operation not accessible to the normal user, and generates a reboot of the onboard processor.

A specific command is available on the debug serial port (which runs at 115200, 8N1, no handshaking), as visible on the left; the **picomode** command changes a non-volatile parameter, then automatically reboots the processor, as it affects the startup initialization.
Please notice that the mode value affects both USB and IEE1394; if a non –valid mode is selected when in USB mode, then it defaults to mode 0.



Both picoDM1 and picoDM3 have two onboard LEDs (see picture below), which change function if the module is in DEMO mode. A red LED is available to indicate the there are no Firewire cables attached to a host (the same LED has no meaning when in USB mode).

LED	MODE 1 and 2	MODE 0 (DEMO)
5	AUDIO CLOCK OK (same as pin 27 of connector, GPIO12)	CODEC ACTIVE
6	HOST OK (same as pin 25 of connector, GPIO16)	SYNCH SOURCE (same as pin 53, GPIO19)



Selected output control signals are available to ensure proper interfacing with additional hardware (converters, FPGA, DSP, etc…):

Signal	DAI1 pin	picoEVB J3/J4 pin	Meaning	Notes
SR2 SR1 SR0	20 22 24	J3-18 J3-20 J3-22	Selected Sample Rate (as selected by host)	000 = 44.1 kHz 001 = 48 kHz 010 = 88.2 kHz 011 = 96 kHz 100 = 176.4 kHz (if supported) 101 = 192 kHz (if supported) 110 = *not used* 111 = invalid sample rate
HOST OK	25	J3-23	Host driver is up and running	HI = OK LO = host not connected, or settings on driver are different from settings on DAI module
AUDIO CLK OK	27	J3-25	Audio clocks status	HI = STABLE AUDIO CLOCKS LO = UNLOCKED
SYNC MODE	53	J4-33	sync mode (as selected by host)	LO = HOST HI = EXTERNAL
MODE2 MODE1 MODE0	14 32 29	J3-12 J3-30 J3-27	Currently selected picoDM mode	000 = MODE 0 (DEMO, default) 001 = MODE 1 010 = MODE 2 011 = MODE 3 100 = MODE 4 101-111 = reserved

The HOST OK signal can be used as a strobe for changes on the following pins:

- SYNC MODE
- MODE[2:0]
- SR[2:0]

If HOST OK goes inactive (LOW), then the picoDM unit is changing status, which assumes a valid state on the pins listed above when HOST OK become active again (LOW to HIGH).

Connector pin-out

Output from picoDM (1)	VCABLE	1	2	VCABLE	Output from picoDM (1)
Power supply input	IN_VCC3.3	3	4	IN_VCC3.3	Power supply input
	IN_VCC3.3	5	6	IN_VCC3.3	
Reset input, active LO (2)	picoDM FORCE RESET	7	8	GND	
Reset output, active LO	NRESET	9	10	TXD1	Debug serial port
MIDI port	TXD0	11	12	RXD1	
	RXD0	13	14	GPIO3	MODE2
SPI port (reserved)	SPI MOSI	15	16	reserved	
	SPI MISO	17	18	reserved	
	SPI CS0	19	20	GPIO9	SR2
	SPI CS1	21	22	GPIO8	SR1
	SPI CLK	23	24	GPIO7	SR0
HOST OK or SYNC (5)	GPIO16	25	26	GND	
AUDIO CLK OK or CODEC (6)	GPIO12	27	28	GND	
MODE0	GPIO1	29	30	reserved	
	reserved	31	32	GPIO2	MODE1
	reserved	33	34	GND	
WORD CLOCK OUTPUT (3)	WC_OUT	35	36	WC_IN	WORD CLOCK INPUT (3)
Digital audio out	AOUT_H	37	38	AOUT_G	Digital audio out
Digital audio out	AOUT_F	39	40	AOUT_E	Digital audio out
	reserved	41	42	reserved	
	reserved	43	44	GND	
Digital audio in	AINP_H	45	46	AINP_G	Digital audio in
Digital audio in	AINP_F	47	48	AINP_E	Digital audio in
Digital audio in	AINP_C	49	50	AINP_B	Digital audio in
Digital audio in	AINP_A	51	52	GND	
SYNC	GPIO19	53	54	AOUT_D	Digital audio out
Digital audio out	AOUT_C	55	56	AOUT_B	Digital audio out
Digital audio out	AOUT_A	57	58	ASCLK	Digital audio control out (6)
Digital audio control out (6)	ALRCK	59	60	GND	
Digital audio control out (6)	AMCLK	61	62	reserved	
Digital audio in	AIN_D	63	64	reserved	
	reserved	65	66	reserved	
	reserved	67	68	GND	
	reserved	69	70	MCLK_I8S	256*FS MCLK for I8S mode (6)

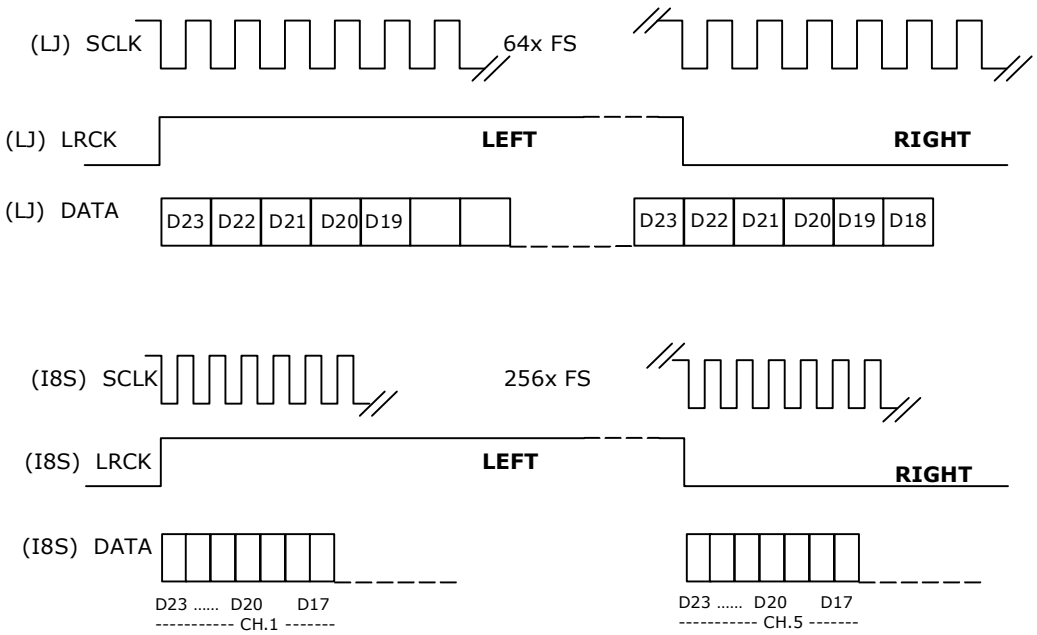
Notes:

1. Unregulated power supply, directly from IEEE-1394 socket
2. Reset input is open-drain and optional; an onboard reset controller is present on the picoDM
3. Word Clock in/out, at sample rate (1X)
4. SYNC indication when in mode 0 (DEMO)
5. CODEC ACTIVE indication when in mode 0 (DEMO)

Audio clock signals are always outputs

Audio formats

	MODE 1, MODE 3	MODE 2
Channels per line	2	8
Wordlength	24 (left-aligned on 32-bit word)	24 (left-aligned on 32-bit word)
SCLK	64xLRCLK	256xLRCLK
Format	Left-Justified	I8S
LR polarity	LEFT when LRCK = HI	Ch. 1-4 when LRCK = HI
Audio data shifted out	On SLCK falling edge	On SLCK falling edge
Audio data sampled in	On SLCK rising edge	On SLCK rising edge



The output master clock (picoDM pin 1) frequency changes with selected sample rate:

Sample rate (kHz)	44.1	48	88.2	96
MCLK = 256xFS	YES	YES		
MCLK = 128xFS			YES	YES

Please notice that in I8S mode, a different pin (picoDM pin 32) is provided for master clock output that is always running at 256xFS.

When the picoDM is working in **slave SYNC mode**, it is retrieving the clock reference from its Word Clock input pin (picoDM pin 2). When it is working in **host SYNC mode**, it ignores the clock on Word Clock input and generates all clocks as derived from the recovered Firewire audio sample rate.
In both cases, LRCLK and SCLK are always generated by picoDM.

Pins and picoDM modes

Several picoDM pins change function according to the current mode, as detailed in the following tables:

picoDM pin	Low-level name	MODE 0, 1 8x8 (I2S)	MODE 2 12x12 (I2S)	MODE 3 16x16 (I2S)	MODE 4 32x32 (I8S)
57	AOUT_A	OUT 1-2	OUT 1-2	OUT 1-2	OUT 1-8
56	AOUT_B	OUT 3-4	OUT 3-4	OUT 3-4	OUT 9-16
55	AOUT_C	OUT 5-6	OUT 5-6	OUT 5-6	OUT 17-24
54	AOUT_D	OUT 7-8	OUT 7-8	OUT 7-8	OUT 25-32
40	AOUT_E	*NOT USED*	OUT 9-10	OUT 9-10	*NOT USED*
39	AOUT_F	*NOT USED*	OUT 11-12	OUT 11-12	*NOT USED*
38	AOUT_G	*NOT USED*	*NOT USED*	OUT 13-14	*NOT USED*
37	AOUT_H	*NOT USED*	*NOT USED*	OUT 15-16	*NOT USED*
51	AIN_A	IN 1-2	IN 1-2	IN 1-2	IN 1-8
50	AIN_B	IN 3-4	IN 3-4	IN 3-4	IN 9-16
49	AIN_C	IN 5-6	IN 5-6	IN 5-6	IN 17-24
63	AIN_D	IN 7-8	IN 7-8	IN 7-8	IN 25-32
48	AIN_E	*NOT USED*	IN 9-10	IN 9-10	*NOT USED*
47	AIN_F	*NOT USED*	IN 11-12	IN 11-12	*NOT USED*
46	AIN_G	*NOT USED*	*NOT USED*	IN 13-14	*NOT USED*
45	AIN_H	*NOT USED*	*NOT USED*	IN 15-16	*NOT USED*
59	ALRCK	LRCK (out)	LRCK (out)	LRCK (out)	LRCK (out)
58	ASCLK	SCLK (out) = 64*FS	SCLK (out) = 64*FS	SCLK (out) = 64*FS	SCLK (out) = 256*FS
61	AMCLK	MCLK (out)	MCLK (out)	MCLK (out)	*RESERVED*
70	MCLK I8S	*RESERVED*	*RESERVED*	*RESERVED*	SCLK buffered
35	WC_OUT	LRCK (out)	LRCK (out)	LRCK (out)	LRCK (out)
36	WC_IN	WORD CLK	WORD CLK	WORD CLK	WORD CLK
42	*RESERVED*				
41	*RESERVED*				
43	*RESERVED*				
66	*RESERVED*				
67	*RESERVED*				
62	*RESERVED*				
64	*RESERVED*				
65	*RESERVED*				

picoDM pin	Low-level name	MODE 0 (DEMO)	MODE 1, 2, 3, 4
7	RES_IN	picoDM FORCE RESET (in)	picoDM FORCE RESET (in)
9	BC_NRES	RESET OUTPUT	RESET OUTPUT
8	TXD1	Debug serial port	Debug serial port
10	RXD1	Debug serial port	Debug serial port
11	TXD0	MIDI OUT	MIDI OUT
13	RXD0	MIDI IN	MIDI IN
15	MOSI	Used for CODEC control	*NOT USED*
17	MISO	Used for CODEC control	*NOT USED*
19	CS0	Used for CODEC control	*NOT USED*
21	CS1	*NOT USED*	*NOT USED*
23	SPICLK	Used for CODEC control	*NOT USED*
25	GPIO16	SYNC	HOST OK
27	GPIO12	CODEC ACTIVE	AUDIO CLOCK OK
33	GPIO0	*NOT USED*	*NOT USED*
29	GPIO1	DAIMODE0	DAIMODE0
32	GPIO2	DAIMODE1	DAIMODE1
14	GPIO3	DAIMODE2	DAIMODE2
31	GPIO4	CODEC RESET	*NOT USED*
30	GPIO5	*NOT USED*	*NOT USED*
16	GPIO6	*NOT USED*	*NOT USED*
24	GPIO7	SR0	SR0
22	GPIO8	SR1	SR1
20	GPIO9	SR2	SR2
69	GPIO15	*NOT USED*	*SELECT (*)*
18	GPIO18	*NOT USED*	*NOT USED*
53	GPIO19	SYNC	SYNC

(*) on picoDM3 only, this pin is evaluated at boot: if LOW, picoDM3 starts in USB, in HIGH, it starts in IEEE1394.

Host drivers

A custom audio driver for host is required under Windows XP/Vista, while a native driver is available under Mac OS X (currently for IEEE1394 only). Please notice that Microsoft operating systems prior to Windows XP are not supported.

On Windows XP (IEEE1394 and USB):
- WDM audio driver
- ASIO driver
- Virtual MIDI driver

On Mac OS X (IEEE1394):
- CoreAudio driver
- Virtual MIDI driver

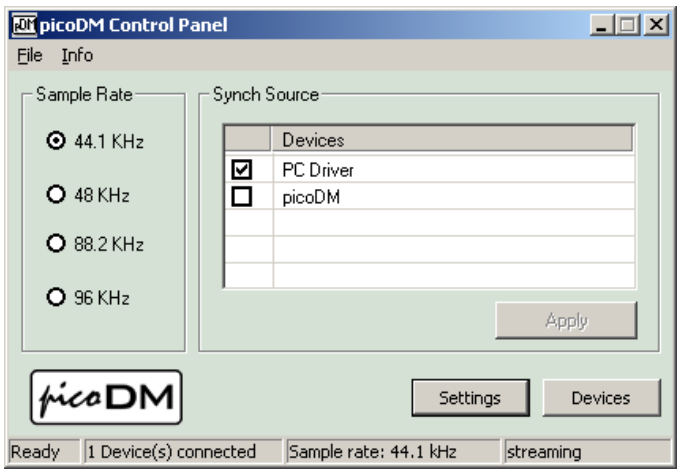
Furthermore, on Windows XP/Vista, a custom Control Panel is provided to allow manual management of settings. The Control Panel is capable of displaying up to 4 units connected at the same time; a friendly name can be entered for each unit, thus avoiding the need to identify them only by their serial number.

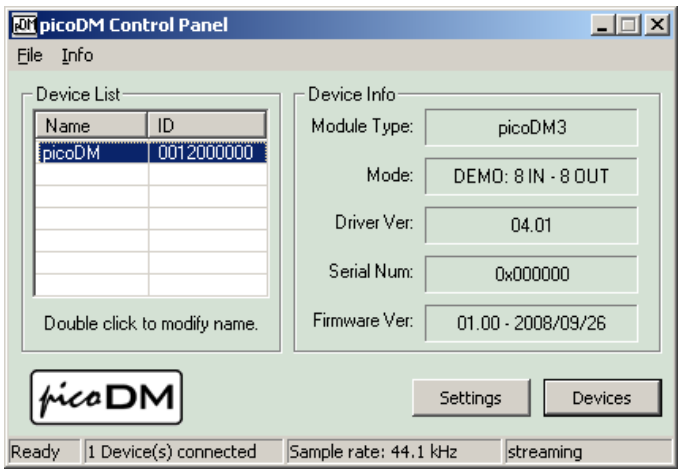
On Mac OS X there is no need to install any drivers or additional software, the picoDM will be automatically recognized on connection.

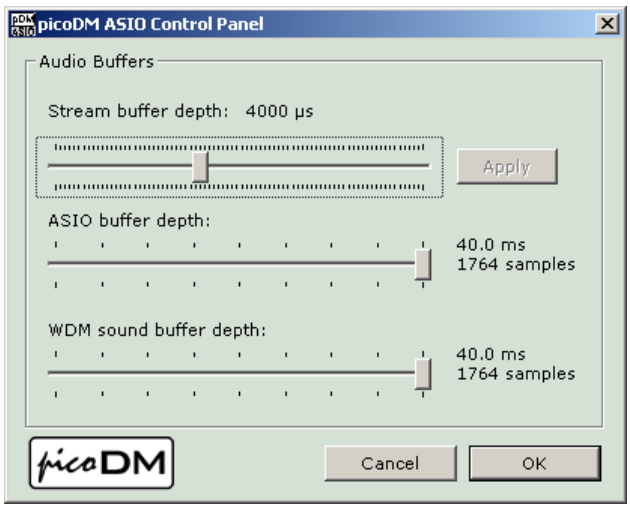
On Windows, please follow the install steps specified by the setup application. A single setup is available for Windows XP and Vista.

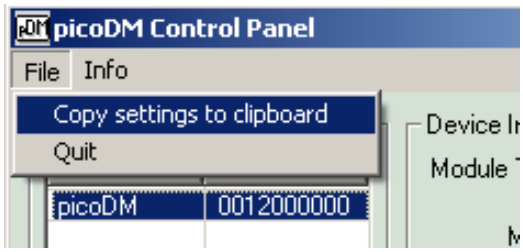
64-bit versions of these drivers are available under special request only.

IEEE1394 Control Panel for Windows



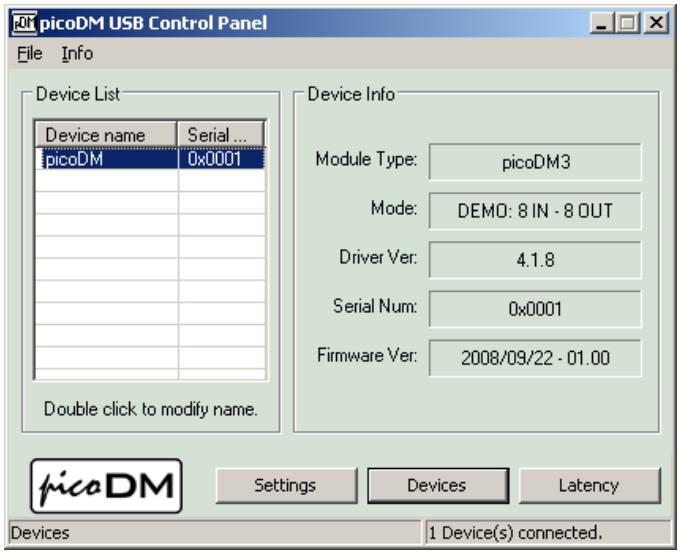


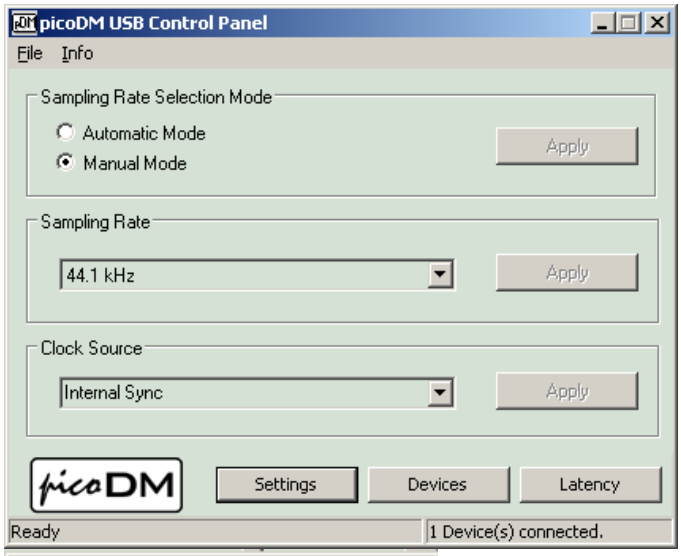


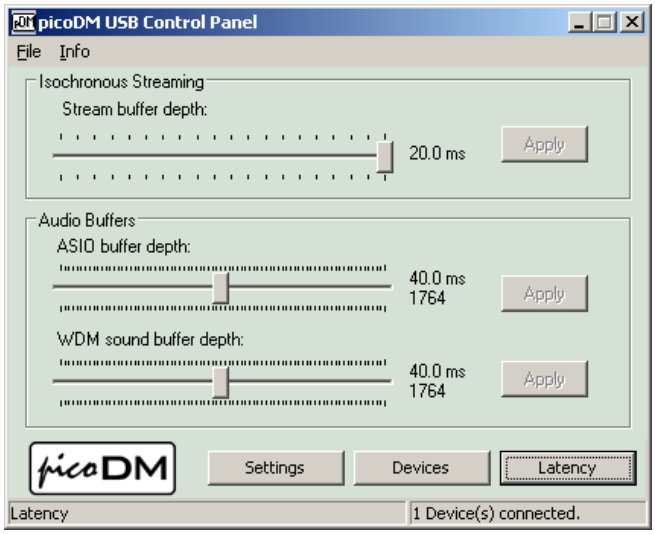


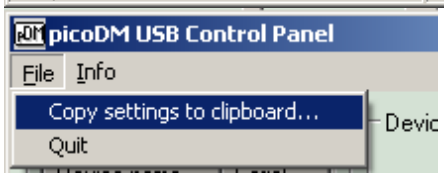
On the File menu, there is the possibility to copy current settings on clipboard, mainly for support information.
Please save this information on a text file in case you need to contact support.

USB Control Panel for Windows









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