



WorldNet Milano Operational Manual

Declaration of Conformance

We the manufacturer

Audio Processing Technology Ltd.
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Declare that the product

WorldNet Milano

is in conformance with the

Radio Equipment & Telecommunications Terminal Equipment (R&TTE) Directive 1999/5/EC.

On behalf of Manufacturer/Importer

Date:

Signature:

Name:

Company Profile

Audio Processing Technology is at the forefront of digital audio data compression technology, supplying that technology in a variety of forms to leading manufacturers of broadcast, professional audio, associated video and telecommunications equipment throughout the world.

The highly acclaimed apt-X™ 4:1 compression algorithm was created at the company's Belfast headquarters where a continuing programme of research and development ensures that future generations of APT products will be equally commercially attractive.

The standard and enhanced versions of the apt-X™ algorithm have been designed to permit wide bandwidth audio, stereo or mono to be carried over low capacity digital telecommunications networks. Alternatively, four times as much audio data can be stored on hard disk, optical and other solid state storage systems.

APT has been acknowledged worldwide as an authority in the field of digital audio data compression. The magnitude of their success can be measured by the hundreds of thousands of apt-X™ based devices in daily use.

IMPORTANT NOTICE:

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APT Ltd reserves the right to make any changes, without notification, to their products and manual.

Important safety notices

Electrical Supply (UK and Ireland users only)

The connecting wires in the electrical supply comply with the following colour code.

Green & Yellow	Earth
Blue	Neutral
Brown	Live

The green & yellow coloured wire must be connected to the supply plug terminal marked with the letter E or by the  symbol and coloured green or green & yellow.

The blue coloured wire must be connected to the supply plug terminal marked with the letter N or coloured black or blue.

The brown coloured wire must be connected to the supply plug terminal marked with the letter L or coloured red or brown.

Main Fuse Characteristics

The mains supply fuse is located on the rear panel.

Voltage rating (Vu)	= 250VAC
Current rating	= 5A
Breaking capacity	= 35A @ Vu
Fuse characteristics	= Quickblow (Time lag)

Any replacement fuse should conform to IEC127 specifications with the above characteristics.

SELV Ports

SELV stands for Safe Extra Low Voltages as defined in EN60950. All SELV ports must only be connected to SELV type equipment.

TNV1 Ports

TNV1 stands for Telecommunications Network Voltages type 1. All TNV1 ports must only be connected to TNV1 networks.

CAUTION: to reduce the risk of fire, use only No 26 AWG or larger telecommunications line cord when connecting to the ISDN ports.

Warning

To prevent fire or shock hazard, do not expose this unit to rain or any type of moisture.

General Precautions

The Worldnet Milano is designed to be installed in a 19" (483mm) rack or standalone environment. It is important that the unit is installed in a horizontal position only, in order to maintain the correct internal airflow pattern for cooling purposes. The unit may become a fire hazard if this precaution is not observed.

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About this manual

The operations manual is intended for installers and operators of the WorldNet Milano digital audio network transmission link. This manual describes the function, installation and use of the unit and provides an overview of the apt-X™ technology.

Unpacking and inspection

After unpacking:

Check the unit for damage during shipping. Immediately report any damage back to the distributor.

Check that the list of contents is complete.

WorldNet Milano Serial Number.....(please complete)

Mains supply connector lead.

Product Overview

The WorldNet Milano is a full duplex, multi-channel, multi-algorithm audio codec offering analog/digital audio I/O's and operating through both fixed line and ISDN data interfaces. It was designed to meet the requirement for a universal codec and additionally, would interface with any of APT's previous products. This is the latest commercial product from APT to incorporate both the Standard and Enhanced versions of the apt-X™ algorithm.

The unit is capable of delivering high quality audio found in inter studio networking, remote/outside broadcasts and STL/TSL applications. It is suitable for use in either AM, FM, DAB and many other broadcast and professional audio environments. Enhanced apt-X™ offers 16, 20 and 24 bit operation as an extension to the performance of the original Standard 16 bit algorithm. This has advantages for users involved in audio track mastering applications requiring increased bandwidth and dynamic range.

Audio modes and bandwidths are dependent on the network bit rate, the algorithm selected and the bit resolution of the desired audio. Bandwidths will range from 3.81kHz to 22.86kHz in stereo mode and 7.62kHz to 24.38kHz when set for mono operation, the minimum usable bandwidth in 20 and 24 bit enhanced apt-X™ is 15kHz mono at 168kbit/s.

In an application where program continuity and integrity is required then the Milano can be configured with the primary X21 data port defined as the main circuit and, should that main circuit fail, then the ISDN module can be set for an automatically dialled backup circuit.

For occasional use situations the ISDN can be used as the main data path.

When the primary data port is interfaced with an X21 formatted digital telecom network, such as Fractional T1 and E1 the input/output data rates required to deliver the above audio bandwidths range from 56kbit/s through to 576kbit/s.

For connection to ISDN the unit has an integral 8 channel Inverse Multiplexer (I-MUX) and approved Terminal Adapter (TA). With RJ45 based 'S' or optional 'U' line interfaces it has the capacity to connect with up to four ISDN lines offering eight 64kbit/s bearer channels. This enables any user defined data rate between 56 and 512kbit/s to be used.

The ISDN operation is supported by an on board locations directory. This has the capacity to store the dialling information for at least eight ISDN numbers in each of twenty location slots. Manual dialling of ISDN numbers is also supported by fast speed dialling from the directory and "one touch" dialling for any two preferred locations.

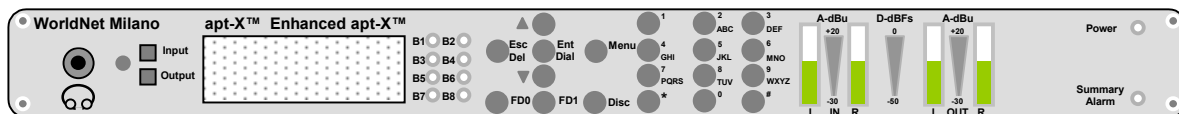
The WorldNet Milano is fully software driven, being menu controlled, configured and monitored through the front panel keyboard and eight line LCD display. A headphone socket provides for additional monitoring of the audio input or output. The rear panel audio I/O's can be switched to accept either analogue or digital signals and if required the digital output can be synchronised/locked to an external digital reference signal.

Advances in DSP technology led to the introduction of the enhanced version of the apt-X™ algorithm. A single Motorola DSP56362 device provides increased stereo and mono audio channel capability and simultaneous coding and decoding operation. New digital filtering techniques has led to a reduction in signal processing delay and the introduction of 20 and 24 bit operation provides for improved audio quality and increased dynamic range.

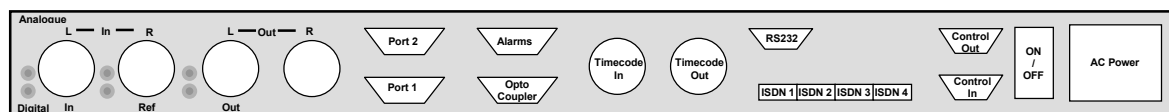
The WorldNet Milano can be configured for operation in **Standard apt-X™** mode at 16bit PCM. This ensures that the unit is backwards compatible with existing standard apt-X™ products based on the Lucent DSP16A device. Operating in **Enhanced apt-X™ mode** at 16bit, 20bit or 24bit PCM offers improvements and extensions in the performance of apt-X™ and guarantees that the algorithm will meet the demands of current and future PCM standards.

Additional interfaces allow for the connection of Auxiliary and optional Timecode data plus Alarms and Opto-coupled control inputs. Additional RS232/RS485 control ports make it possible for PC control for up to nine Milano codecs.

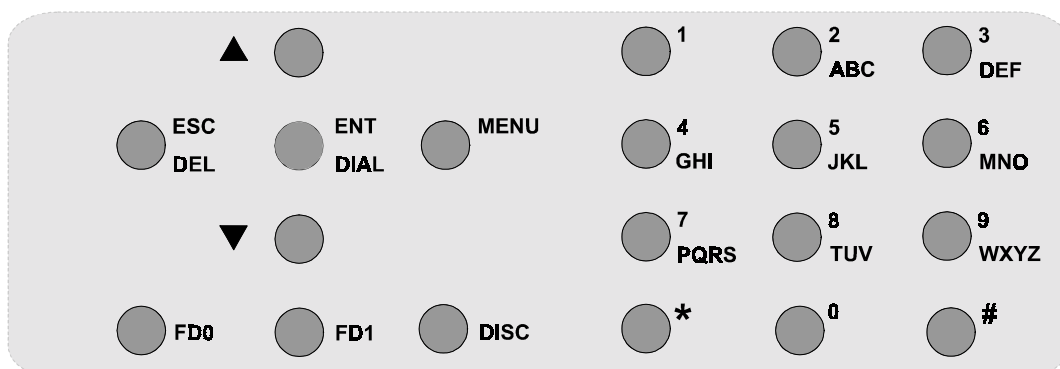
Front Panel Layout



Rear panel layout



Keypad



When entering a name the **0**, and **ABC/1** through to **WXYZ/9** keys are used to select letters, other characters and numbers.

For example, selecting the **JKL/5** key for the first time will display the character **J**. If this is not the required character, then quickly selecting the same key again will show **K**. A third press will display **L** and another will display **5**. Each new key press will scroll through the characters available on the selected key (see table).

Having chosen one character, then after a short pause the next is selected using the appropriate key. If however, the next character is on the same key as the previous one then again after a short pause select the desired character as before.

If a mistake is made then delete the incorrect character by selecting the **DEL** key.

When the name is complete and correct select **ENTER**

A number of keys have two functions as defined in the following table.

Primary Function	Action	Secondary Function	Action
▲	Scrolls up through text display		
DEL	Disconnect call on current B channel only	ESC	Escape from menus/ options
DIAL	Starts Dial routine for current B channel	ENTER	Saves text entered or selects option
MENU	Scrolls through Main Setup menus		
▼	Scrolls down through text display	-	
1	Digit in dial function	Space . ? ! , & : " () ' % £ \$	Characters for text entry
2	Digit in dial function	ABC	Characters for text entry
3	Digit in dial function	DEF	Characters for text entry
4	Digit in dial function	GHI	Characters for text entry
5	Digit in dial function	JKL	Characters for text entry
6	Digit in dial function	MNO	Characters for text entry
7	Digit in dial function	PQRS	Characters for text entry
8	Digit in dial function	TUV	Characters for text entry
9	Digit in dial function	WXYZ	Characters for text entry
*	Char in dial function	-	
0	Digit in dial function	+ - × * / = > < #	Characters for text entry
#	Char in dial function	-	
FD0	Fast Dial Key for Directory location 0	-	
FD1	Fast Dial Key for Directory location 1	-	
DISC	Disconnect all calls on all B channels	-	

Speeddial

This feature enables fast call setup for up to twenty regularly used locations, numbered 0 to 19. From the START display select ENTER. This makes the B1 channel available for manual dialling or speeddial. Speeddial is enabled by then keying in the # symbol followed by the location number and selecting ENTER again. The unit will be configured according to the ISDN dialling information for all designated channels plus the audio and data mode settings as stored in the Directory.

Fast Dial (FD0 and FD1 only)

This feature enables an extremely fast call setup for two regularly used or priority locations. These must be programmed at directory location numbers 0 and 1. A single touch of key FD0 or FD1 initiates the fast call sequence for either of these two locations. The unit will be configured according to the ISDN dialling information and audio and data mode settings as stored in the Directory.

Inverse Multiplexing (I-MUX) and CLEAR mode

When using the Milano to transmit audio over two or more ISDN B-channels there is a need to inverse multiplex the individual channels together to achieve a higher capacity data link.

To allow the receiver to correctly align the incoming channels, it is necessary to embed synchronisation information in the data streams of the transmitted channels. This means part of the overall data capacity is needed to carry non-audio data. The proprietary IMUX algorithm (MUCAS™) uses 1/65 of the overall data capacity. When eight B-channels are IMUXed together to provide a 512 kbit/s data path the data capacity available to carry audio is reduced to 504.12 kbit/s ($512 \times 64/65$). This means the maximum sampling rate for the audio is reduced to 47.26 kHz.

Whenever the source is analogue audio it is only necessary to run the ADC at this lower rate. However, when the input is digital audio that is already sampled at say 48 kHz then there is a mismatch between the sample rates. It is then necessary to convert from one sample rate to the other using the integral Sample Rate Converter (SRC).

When the unit is set to CLEAR mode it enables the exchange of 7kHz mono audio with an apt-X™ based codec made by another manufacturer. However, the bit rate is restricted to 64kbit/s or one ISDN channel.

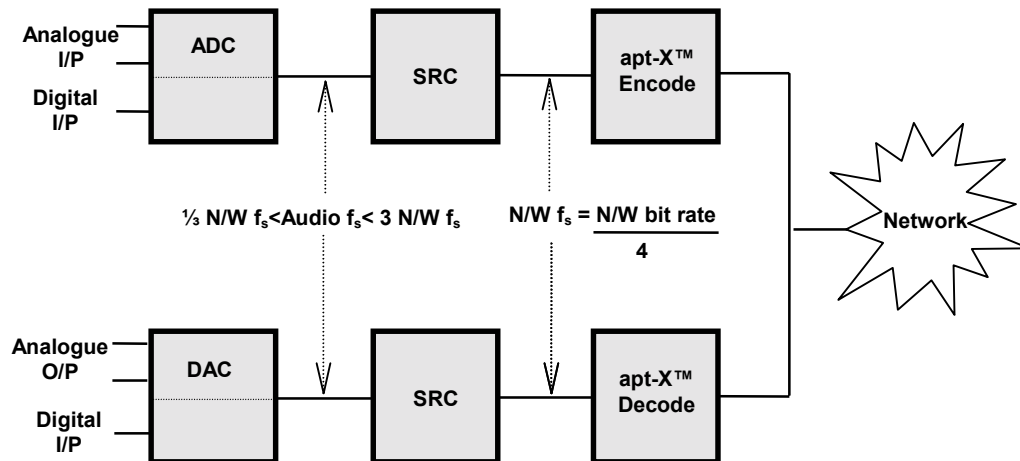
Digital Reference

The digital audio output of the Milano can be synchronised/locked to an external digital reference signal. Ideally the sampling frequency of the incoming audio signal should be at the same frequency as the reference signal. However, if the two frequencies are different but by a factor of less than 3:1 then the SRC module should function satisfactorily and pass audio to the output. The sampling frequency of the output audio will have been up or down converted to match the frequency of the reference signal.

Sample Rate Converter

When the apt-X™ algorithm is used to reduce the bit rate of a digital audio signal prior to transmission over a digital communications circuit, then the encoder/decoder sampling frequency is one quarter of the data rate of that circuit.

The sample rate converter accepts digital audio at one sample rate and either up or down converts it to match the requirements of the network. For satisfactory operation the sampling frequency of the audio signal must be somewhere in the range, greater than one third, or less than three times the network sampling frequency (see Fig).



Low Delay

In certain X21, analogue audio configurations the SRC's can be bypassed thus reducing the signal processing time through the codec. However this is not possible in any ISDN configuration since the SRC's are an essential part of the I-MUX process.

The "low delay" analogue options are highlighted in the X21 table in the USER menu/Unit Mode section of this manual.

Autosync

AutoSync is an integral feature of the WorldNet Milano and is automatically enabled when the unit is operating normally. This is a proprietary automatic synchronisation facility that enables the **apt-X™** compressed audio data stream to be decoded without prior knowledge of the compressed word boundaries. This enables the compressed audio data to be handled using only bit timing, no word clock being required.

Synchronism is normally lost only under very adverse channel error conditions (BER of 1:100) at which point the output is muted until synchronism, through autosync, is very quickly restored.

Synchronisation in Standard apt-X™ is an ON/OFF user facility and is achieved by periodically inserting a unique 10 bit sync word into the compressed audio data stream. The compressed word boundaries are established when three successive sync words have been identified by the decoder.

The process is different in Enhanced apt-X™ where autosync is always enabled. The autosync data is present at all times, a single synchronising data bit being inserted into every apt-X™ encoded sample.

Rear Panel Connectors

Analogue Input/Outputs

The analogue audio **inputs** and **outputs** consist of balanced Left and Right, line level channels. The audio bandwidth capability ranges from 10Hz to 3.5kHz stereo through to a maximum 22kHz stereo. Audio I/O levels are fixed and will accept and output audio levels up to a full scale range of +18dBu. The input impedance is selectable between 600Ω and >10kΩ and the output impedance is selectable between 600Ω and 50Ω. The I/O's are via two female and two male XLR-3 rear panel mounted connectors with pin connections as shown below.

NB: The Left audio channel I/O connectors can be switched to accept either analogue or digital audio signals. The Right audio channel **input** connector can also be switched to accept a digital reference input signal.

NB: These are SELV (Safe Extra Low Voltage) connections and must only be connected to other SELV ports

Digital Input/Output

These I/O's conform to the AES/EBU standard with impedances of 110Ω and sampling frequencies of 32, 44.1 and 48kHz. Pin connections are as shown.

NB: The Left audio channel I/O connectors can be switched to accept either analogue or digital audio signals.

NB: These are SELV (Safe Extra Low Voltage) connections and must only be connected to other SELV ports

XLR-3 MALE		XLR-3 FEMALE	
Pin No.	Function	Pin No.	Function
1	Screen	1	Screen
2	+ve Signal Out	2	+ve Signal In
3	-ve Signal Out	3	-ve Signal In

Reference In

An external digital reference signal can be connected via the Digital Reference In XLR-3 male connector on the rear panel of the unit. When switched to Reference mode the Milano digital audio O/P can be synchronised with this reference signal. The XLR male pin connections are as shown.

NB: The digital reference input connector can also be switched to accept the right audio channel input.

This is a SELV (Safe Extra Low Voltage) connection and must only be connected to another SELV port.

X21 DTE/DCE Interface

This section transmits compressed data **to** and receives compressed data, clock Indicate and byte signals **from** an externally connected NTU. It also contains the Phase Lock Loop (PLL) function to enable synchronisation with the digital network.

A 15 way D type female connectors Port 1 is found on the rear panel have the following pin connections: (Port 2 is not connected)

NB: These are SELV (Safe Extra Low Voltage) connections and must only be connected to other SELV ports.

X21 port 15 way D Type Female		
Pin No	Signal	Description
Port 1		
1	N/U	
2	Tx +	Transmit Data +ve
3	Control +	X21 Control +ve
4	Rx +	Receive Data +ve
5	Indicate +	X21 Indicate +ve
6	Clk +	X21 Clock +ve
7	Clk +	Byte Clk +
8	Common	
9	Tx -	Transmit Data -ve
10	Control -	X21 Control -ve
11	Rx -	Receive Data -ve
12	Indicate -	X21 Indicate -ve
13	Clk -	X21 Clock -ve
14	Clk -	Byte Clk -
15	N/U	

Auxiliary Data Interface

The RS232 auxiliary data channel of the Milano can offer continuous data transfer rates of 4, 6, 8 and 12kbit/s ie $\frac{1}{4}$ of the selected sampling frequency. With asynchronous characters the data stream is usually non-continuous. To enable the higher baud rates to operate when the 16kHz sampling frequency is selected the Milano utilises rate adaption, provided by FIFO's at the receive and transmit ends of the link. This is only valid as long as the average data rate is still less than $\frac{1}{4}$ of the selected sampling frequency. Special care must therefore be taken at baud rates of 4800 and 9600 when the 16kHz sampling frequency is selected.

The RS232 connector is accessed on the rear panel and is connected as follows:

NB: This is a SELV (Safe Extra Low Voltage) connection and must only be connected to another SELV port.

Aux data 9 way D type Female		
Pin No.	Signal	Description
2	T X	Transmit data
3	R X	Receive data
5	GND	Ground
1,4,6,7,8,9	NC	Not Connected

ISDN Interfaces

There are four RJ45 ISDN 8 pin sockets mounted on the rear panel. Depending on the customers requirements these may be connected as 2 wire 'U' or 4 wire 'S' interfaces. The pin connections are defined in the table.

NB: The RJ45 is a TNV1 (Telecommunications Network Voltage type 1) connection and must only be connected to TNV1 networks.

RJ 45 Connector		
Pin	'U' interface	'S' interface
1	NC	NC
2	NC	NC
3	NC	TX+
4	Tip	RX+
5	Ring	RX-
6	NC	TX+
7	NC	NC
8	NC	NC

Alarms

Connection to the alarms port is via a 15 way male 'D' type connector CN3–A with pin out details as shown.

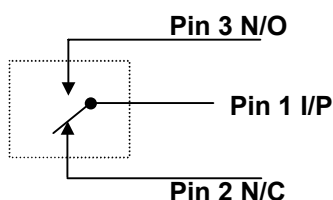
This port provides a means for remotely monitoring the status of the following five operating conditions within the unit. The summary alarm is supported by an LED on the front panel.

1. Audio
2. Autosync
3. Network
4. Port2 active
5. Summary alarm, a logical OR of alarms 1-4

Alarm port 15 way 'D' type Female		
CN3-A Pin No	Signal	Function
1	Audio I/P	Audio alarm input
2	Audio N/C	Audio alarm O/P Normally Closed
3	Audio N/O	Audio alarm O/P Normally Open
4	Autosync I/P	Autosync alarm input
5	Autosync N/C	Autosync alarm O/P Normally Closed
6	Autosync N/O	Autosync active O/P Normally Open
7	Network I/P	Network alarm input
8	Network N/C	Network alarm O/P Normally Closed
9	Network N/O	Network alarm O/P Normally Open
10	Port 2 I/P	Port 2 active alarm input
11	Port 2 N/C	Port 2 active alarm O/P Normally Closed
12	Port 2 N/O	Port 2 active alarm O/P Normally Open
13	Summary I/P	Summary alarm input
14	Summary N/C	Summary alarm O/P Normally Closed
15	Summary N/O	Summary alarm O/P Normally Open

ALARM 1

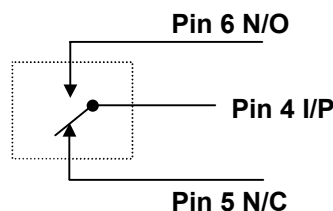
Audio alarm



Indicates a loss of digital reference. (only available when Digital Output is set to REF). This alarm will reset automatically when the digital reference is restored.

ALARM 2

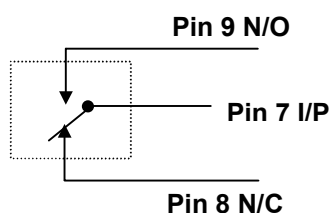
Autosync
alarm



The alarm will reset automatically when the autosync data signal is detected.

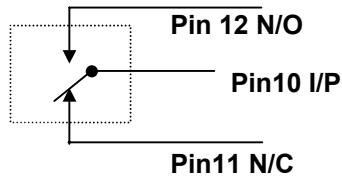
ALARM 3

Network alarm



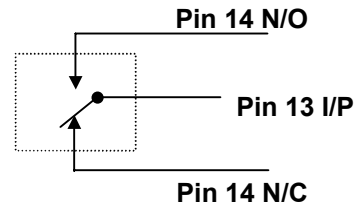
Indicates for loss of (a) Port 1 INDICATE signal, (b) network bit rate mismatch or (c) loss of PLL Lock. The alarm will automatically reset when ALL the network conditions are restored.

ALARM 4 Port 2 Active alarm



When activated this alarm indicates that the Backup function has been enabled and the data circuit through Port 2 is in use.

ALARM 5 Summary Alarm



This is a summary alarm and will be controlled by the condition of the other alarms 1-4.

NB: This is a SELV (Safe Extra Low Voltage) connection and must only be connected to another SELV port.

Opto-coupler/Isolator

This connector can only be enabled when Enhanced apt-X™ is being used. It is controlled via the Main Setup menu options:
USER/Remote Status and Remote Input.
(See Page 25)

The opto-coupler, a 15 way 'D' type female connector CN3-B will accept a mix of up to a maximum of four **DC** (+5 to -30volts) or Normally closed (**N/C**) or open (**N/O**) contacts. These signals are then converted to data and embedded in the main data stream.

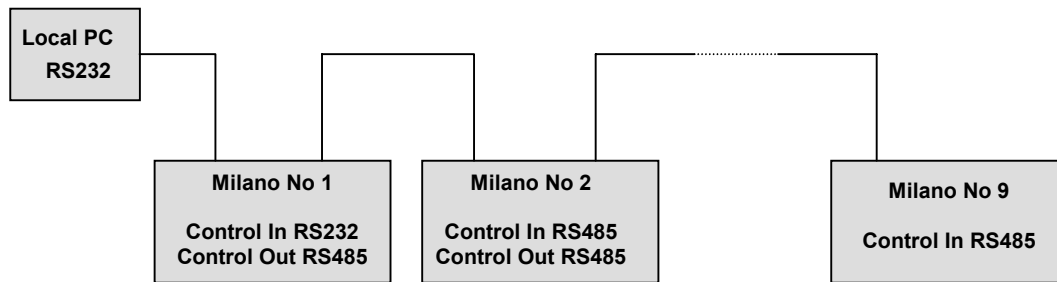
When this feature is enabled then the contacts of alarm relays 1 to 4 on both the local and remote Rio's are disconnected from their normal operation and their circuits are extended to the connector pins as shown in the table. The alarm circuitry can now be used to transport any other user defined control and/or monitoring signals for other peripheral equipment.

The Summary alarm is not affected and remains active as before.

NB: This is a SELV (Safe Extra Low Voltage) connection and must only be connected to another SELV port.

CN3-B Pin No	Signal/Function
1	+ve Alarm 1
2	Clean Alarm 1
3	+ve Alarm 2
4	Clean Alarm 2
5	+ve Alarm 3
6	Clean Alarm 3
7	+ve Alarm 4
8	Clean Alarm 4
9	-ve Alarm 1
10	Gnd
11	-ve Alarm 2
12	Gnd
13	-ve Alarm 3
14	Gnd
15	-ve Alarm 4

Remote Control



All Milano codecs are fitted with both RS232 and RS485 line drivers. Through an RS232 connection the main control microprocessor can communicate with a local PC loaded with **API commands**. This PC is now capable of controlling a single or multiple Milano units, up to a maximum of nine.

With API commands the first unit in the chain is allocated a specific seven digit ID address in the format xxxx-xxx and it communicates with the PC through the RS232 interface on its **Control In** port. This first Milano unit then converts the control signal from RS 232 to RS485 levels and extends it to the **Control Out** port. This signal can now be extended to control a second Milano, appropriately addressed. This unit has been switched to accept RS485 signal levels and if required the control signal is looped on to successive, all appropriately addressed units.

Each Milano in the chain monitors the control signal and when it recognises a command with its unique ID number attached, it responds. The other Milano's in the chain ignore this command.

ISDN Quick Start

When despatched from APT the Milano will normally be set in the Codec to ISDN mode with the Standard 16 bit algorithm selected, unless a different setup was requested. At least one 64kbit/s ISDN channel will be required to test the unit in this mode however eight ISDN channels for 512kbit/s would be required for a full ISDN test.

When the power is switched on the Milano remembers the mode and associated settings from the previous session and these will be displayed on the LCD.

Connect:

- Power cable to the AC input plug on the rear panel of the unit.
- Available ISDN lines to the RJ45 sockets.
- Analogue or digital audio source and destination equipment.
- Audio monitoring equipment.

Make a record of the numbers of **your** ISDN lines.

B1:

B2:

[In the USA this may include the area codes]

B3:

B4:

B5:

B6:

B7:

B8:

Switching ON

The LCD display will scroll through a boot up screen sequence to a typical Idle state Start Menu as shown and displaying the settings from the previous session.

With ISDN lines connected the display should show which channels are **READY** and associated channel LED's should be **RED**.

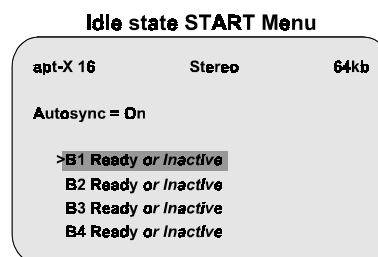
(NB: In the US the red LED will also show that the SPID (**S**ervice **P**rofile **I**dentifier) has correctly initialised with the network).

With no lines connected or if any channel(s) has failed to respond then the display will show **INACTIVE** against the affected channel and the associated LED will be **not** be illuminated.

Move cursor ▲ up or ▼ down to confirm the status of each channel, B1 through B8.

The Milano is now in the IDLE state.

Once communications have been established with another codec then the unit becomes **ACTIVE** and the LED's of those channels in use will be colour **GREEN**. Again the default options can be changed via the keypad.



QUICK TEST/ Loopback

Provides a check on the basic operation of the Milano and can be carried out if the unit is ACTIVE or IDLE and whether ISDN lines are connected or not.

From START Display select MENU three times to access Main Setup AUDIO menu
Scroll to Loopback Mode and select ENT
Configure for Local Loopback and select ENT
Select ESC to return to START display

The display should indicate that the unit is now in LOCAL LOOPBACK mode and any stereo audio signal connected to the input should now be looped back via the apt-X encode/decode processes to the output in 20kHz stereo bandwidth.

Return to the AUDIO/Loopback mode option to cancel the local loopback test.

QUICK TEST/ Manual dialling and Disconnection of ISDN Channels

This will test the Milano and the ISDN network looped back from the telecom exchange or Central Office. It is recommended that the test should be carried out with Standard 16-bit apt-X and using a minimum of 2 ISDN lines or 4 B channels and ignoring the other four. This will provide a loop test at 15kHz stereo.

A full 20kHz stereo test with Standard apt-X would require 3 ISDN lines or 6 B channels, the remaining bearers are ignored in this situation. A full test using Enhanced apt-X in 24-bit mode at 20kHz stereo would require all 4 ISDN lines (8 B channels) to be connected.

Minimum test sequence for 15kHz stereo with Standard apt-X.

From START display scroll to B1 Ready and select ENT/DIAL.
Key in ISDN number for B2 channel and select ENT to initiate call setup.

Check display for the last nine digits of the number dialled and the audio mode now available.

Scroll to B3 Ready
Repeat dialling sequence with ISDN number for B4 channel.

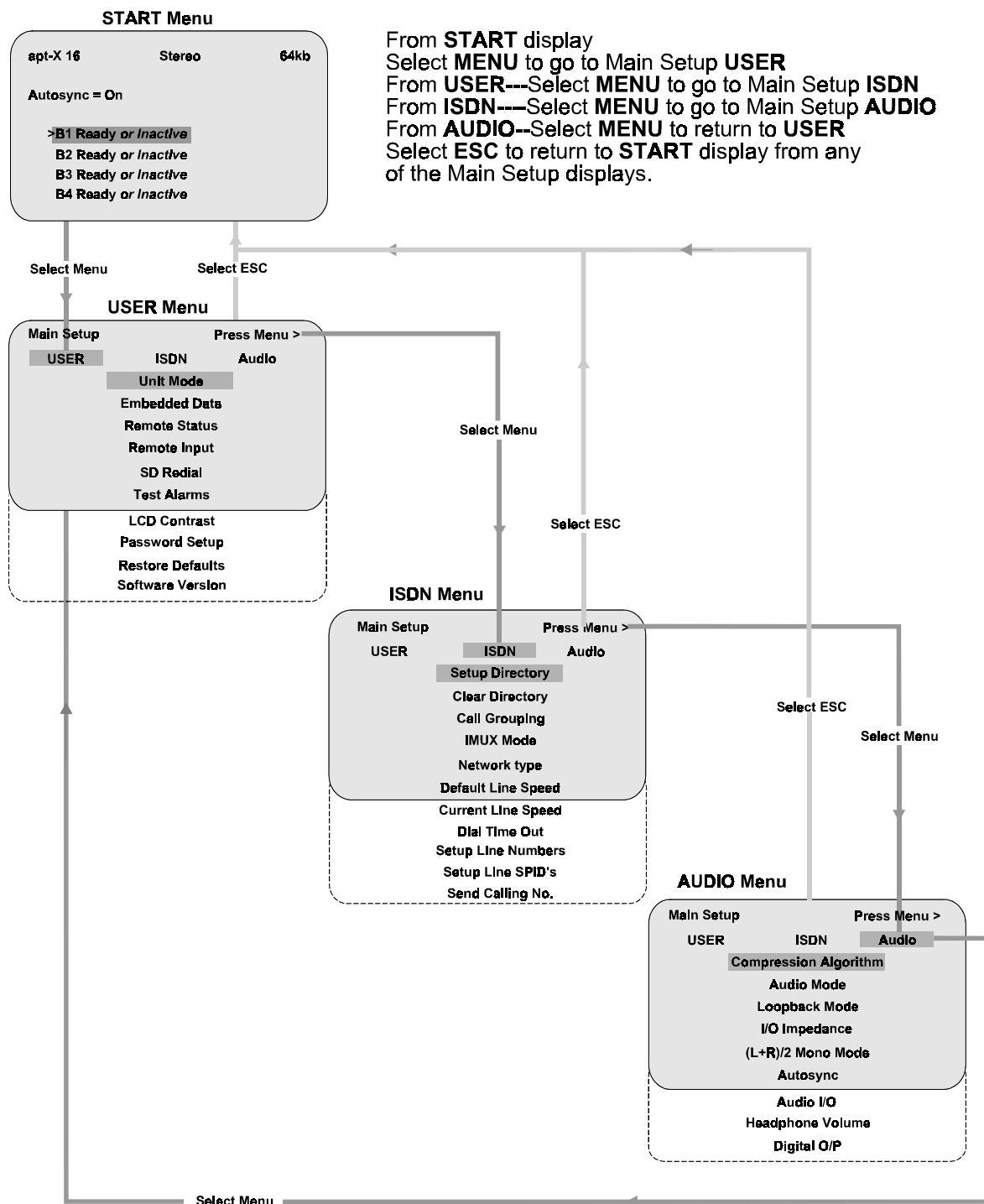
Check display

Any 15kHz stereo audio signal connected to the input will now be returned back through the ISDN exchange to the output of the Milano.

Select DISC to disconnect all ISDN channels and return to START display

Menu Navigation Guide

There are four main menu LCD displays, START and three Main Setup displays, USER, ISDN and AUDIO. Within each of the Main Setup Menu's there are sub-menu's. These menu's and their related displays enable the user to control the configuration of the Milano and to monitor its operation and status.



This main menu and others to follow are designed to assist the operator in moving through and selecting a wide range of options. A combination of MENU, ▲ and ▼ scroll, ENT and ESC keys are used to move the display in and out of the menu loops and through the various options. Any option can be changed by moving to it, selecting ENT and then following the on screen instructions. Selecting ENT again will confirm the changes. Selecting ESC a number of times will return the display to the START screen. If left in any of the menu loops, a system timer, preset usually to 3mins will revert the display to the START screen.

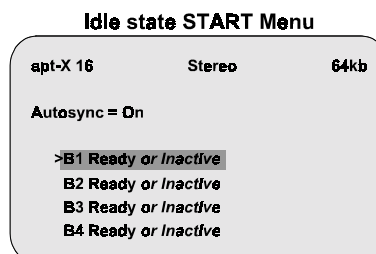
Start Menu

Codec to ISDN

When power is switched ON the Milano will eventually display the START and idle status of the unit. This eight line display will show the configuration of the unit when the power was last switched OFF. If the unit was previously configured in ISDN mode the display could be as follows:

Line 1 the algorithm currently in use,
 audio mode and line data rate
Line 2 blank
Line 3 Autosync status
Line 4 blank
Lines 5 to 8 ISDN channels B1 to B4 Ready or
 Inactive

Using the ▲ and ▼ scroll keys will move the highlighter cursor through the B1 to B8 channels. If the highlighted channel is Ready for use then selecting the ENT/DIAL key allows the ISDN number of the called unit to be manually dialled, or taken from the on board directory. Selecting ENT/DIAL again will initiate the call. If the connection was successful then the highlighted channel will display the number dialled.

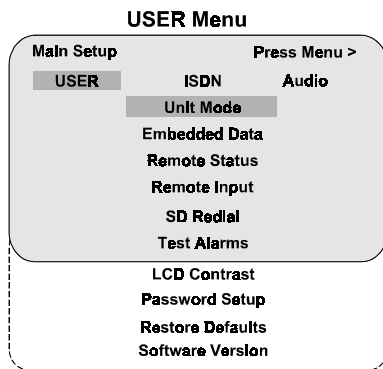


Codec to X21 network

If the Milano was last used in the X21 mode then the LCD screen will reflect that status and the ISDN channels will not be accessible as above.

Main Setup USER

The Main Setup **USER** menu enables access to any one of ten options as shown. Use ▲ or ▼ keys to move to any of these options. The current option will be highlighted and then select **ENT** to access that option or any related sub-menu.



Unit Mode

The mode of operation is dependent on whether the unit is operating over an X21 network or ISDN and the apt-X™ algorithm selected.

Having firstly selected the desired algorithm the Milano can then be configured to operate in any of the mono or stereo modes and related X21network or ISDN bit rates as shown in the tables.

It is not advisable to change algorithms during an active audio session. If attempted the Milano will almost certainly crash and the connection will have to be re-made.

A sub-menu provides access to a choice of two options that change the configuration of the unit.

- (1) Codec connected to the ISDN network.
- (2) Codec connected to an X21 formatted data network with or without the ISDN as backup.

Codec to ISDN

The line data speed, audio data bit rate and audio mode, will be determined by the number of ISDN channels being used. The minimum data rate is 56kbit/s for 3.5kHz stereo or 7kHz mono on a single ISDN channel and the maximum is 512kbit/s for 20kHz stereo utilising eight 64kbit/s channels.

Codec to X21

Master Mode

One Milano unit must be set as **Master** and the other set as the **Slave** when using ISDN backup mode. When set in Master mode the backup ISDN channels are accessed through the location numbers stored in the on board directory. The setup requires the operator to have nominated the appropriate directory location as backup. If that location is free (ie contains no valid information) then to have backup support the appropriate ISDN number must be entered.

Please see p35 in this manual for detailed information regarding X.21 backup configuration.

AutoSync will be automatically switched ON when entering this mode.

X21 network available options

Network Bit Rate (kbit/s)	Mode	Standard apt-X™	Enhanced apt-X™		
		16bit	16bit	20bit	24bit
		Audio Bandwidth (kHz)			
56	Stereo	3.5	3.5		
64	Stereo	3.5*	3.5*		
56	Mono	7	7		
64	Mono	7*	7*		
112	Stereo	7	7		
128	Stereo	7*	7*		
112	Mono	15	15		
128	Mono	15*	15*		
168	Stereo	12	12		
192	Stereo	12*	12*		
168	Mono	20	20	15	15
192	Mono	20*	20*	15	15*
224	Stereo	15	15		
256	Stereo	15*	15*		
224	Mono			20	
256	Mono			20	
280	Stereo			15	
320	Stereo			15*	
224	Mono				20
256	Mono				20
336	Stereo	20	20		15
384	Stereo	20*	20*		15*
448	Stereo			20	
504	Stereo				20
512	Stereo			20	
576	Stereo				20*

* Low delay modes when analog interface selected

ISDN available options

ISDN Bit Rate (kbit/s)	No. of ISDN channels	Mode	Standard apt-X™	Enhanced apt-X™		
			16bit	16bit	20bit	24bit
			Audio Bandwidth (kHz)			
64	1	Mono	7	7		
64	1	Stereo		3.5		
128	2	Stereo	7	7		
128	2	Mono	15	15		
192	3	Stereo	12	12		
192	3	Mono	20	20	15	15
256	4	Stereo	15	15		
256	4	Mono			20	20
384	6	Stereo	20	20	15	15
512	8	Stereo			20	20

Embedded Data

In stereo mode Timecode and Auxiliary data can be interchanged between the Left and Right audio channels.

In mono mode, and using the standard apt-X™ algorithm then either Timecode or Auxiliary data (but not both) is placed in the Left audio channel.

In mono mode and using the enhanced apt-X™ algorithm then Auxiliary data is placed in the left audio channel and Timecode is compressed and placed within the capacity of the control data.

Auxiliary Data

This option enables the user to switch the auxiliary data function ON or OFF. If ON, then one of four baud rate settings, 1200, 2400, 4800 or 9600 baud can be selected. The auxiliary data I/O interface is an RS232 formatted 9 way 'D' type female connector.

Timecode

This facility will accommodate SMPTE or EBU timecode operating at 30 or 25 frames per second.

Remote Status

(Currently not available)

This option is only available with enhanced apt-X™. It allows the circuitry of alarm relays 1-4 to be disconnected from their normal function and to be then used, to convey, in both directions, between the local and remote Milano's, any other suitable external control and/or monitoring signals as defined by the user.

With Remote Status set to ON, on both the local and remote Milano's, then the Alarm circuits 1 to 4 become disconnected and only the Summary alarm is left activated.

The status of these four circuits can now be controlled from either the:

1. **Front**---locally by the buttons on the front panel.
or
2. **Rear**----remotely by an external device(s) routed via the rear panel opto-coupler connector

The opto-coupler 'D' type connector will accept a mix of up to a maximum of four **DC** (+5 to -30volts) or **Clean** signals. These signals are then converted to data and embedded in the main data stream.

At the receive end this data is decoded and will control the status of the four original alarm, board mounted relays. The various contacts of these relays are now available, as before on the Alarms connector on the rear panel and can be extended to either control or monitor other peripheral equipment.

Remote Input

(Currently not available)

This option is only available when the Remote Status is set to ON and control routed to the front panel buttons. Using these buttons the user can set the conditions of each of the four alarm relay circuits to be either High or Low. This information is then processed as described above in Remote Status.

SD Redial

SD – Redial must be switched to **ON** to enable the automatic redial facility to function. The number of redial attempts can be specified between up to a maximum of five attempts.

Test Alarms

Each of the five alarm contact conditions can be tested at the rear panel connector.

LCD Contrast

The contrast of the LCD display information can be adjusted to the desired level.

Password Setup

Setup is accessed via the Main Setup USER menu. The password function can be disabled by firstly gaining access with the appropriate passwords (see Appendix x). This action effectively disables the feature and any further operation of the unit is unrestricted, even after the power is switched OFF and ON. The user can only set or reset the passwords for Levels 1 and 2. If required APT customer support can carry out online changes or resetting of all three passwords.

Restore Defaults

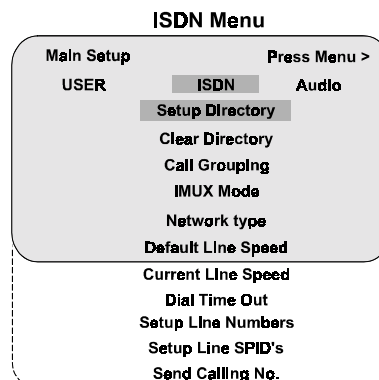
This option allows the user to restore all factory default settings for the operational parameters of the Milano.

Software Version

The LCD will display the current version of the onboard control software. This software can be updated in the field using APT's software upgrade utility available on request from Customer Support.

Main Setup ISDN

The Main Setup **ISDN** menu enables access to any one of eleven options as shown. Use ▲ or ▼ keys to move to any of these options. The current option will be highlighted and then select **ENT** to gain access to that option or any related sub-menu.



Setup Directory

For ISDN operation there are twenty programmable slots (0-19) in the onboard directory and each slot can be pre-programmed with:

- the text for a location name (max length 9 characters). Text **must** be entered, the software will check if a name has been entered and if not then a warning will be flagged.
- line data speeds 56 or 64kbit/s
- a choice of mono and stereo audio bandwidths from 3.5kHz to 20kHz as shown in the ISDN table
- a choice of Standard 16 bit or Enhanced 16, 20 or 24 bit apt-X™ algorithms.
- Autosync can be set to be ON or OFF with Standard 16 bit apt-X™ bandwidth options.

NB: Autosync can be used to force the called unit from Dual Destination to stereo mode.

- A maximum of eight ISDN telephone numbers. Each number must include all access and area codes (max length 21 digits) and with the symbols * and # as required.

These locations facilitate the SD-Redial and automatic ISDN backup dialling service. Additionally locations 0 and 1 are accessed through the fast dial keys FD0 and FD1 on the front panel. These allow the user to nominate either or both of these locations to gain faster access to the ISDN network. The first four characters of the location name and the number dialled will be displayed during active speedial sessions.

Clear Directory

Deletes the data contained in **ALL** the directory locations.

Call Grouping

(Currently not available)

This routine provides for the setting up of calling groups from the twenty onboard directory locations. When enabled this feature allows a single location or a calling group of locations to be marked ON or OFF. The Milano will check the number of an incoming call and if it finds a match within any of those directory locations marked ON then it will accept the call and display the nine characters of the calling location name. Calls from locations marked OFF will be rejected with ISDN Cause code value 54 ie incoming calls barred.

IMUX Mode

This feature can be switched to ENABLED or CLEAR.

Enables the Milano to exchange audio with apt-X based codecs made by other manufacturers. If the IMUX's are incompatible then the exchange can only be done in CLEAR mode at 64kbit/s.

Network Type

Three of the twelve listed international ISDN protocols are currently supported, DMS100, National ISDN1 and Euro ISDN ETSI. This routine allows the unit to be set for any of these three in each of the listed countries. Selection of any other protocol will cause the setting to default back to Euro ISDN ETSI.

Default line Speed

This is the default data speed for any ISDN channels to be dialled and established by the local unit. There are two options available, 56 and 64kbit/s.

If the unit is idle then this action will force any outgoing calls to use the selected data speed once the ISDN channels have been established.

Current Line Speed

This routine allows the line data speed of any active calls to be changed while on line.

If the connection is incoming, ie the local unit is receiving a call, then the data speed should be set by the rate adaption information from the network. If this does not happen (ie sometimes when dialling from USA to Europe) or, if a similar situation arises then the current line speed of the local unit can be toggled between 56 and 64kbit/s.

Dial Time Out

Settings up to 32 seconds can be allowed for any ISDN call to be established. If a connection has not been established within the preset time then the system will "timeout" and the attempt will have been deemed to be unsuccessful. The clock countdown is shown on the LCD display during any connection sequence. Connection times of around 10 seconds are not uncommon when dialling long distances.

Setup Line Numbers

This routine allows a Milano to be programmed with up to eight ISDN telephone numbers (and unit sub address if applicable) for the B1 to B8 channels associated with that unit. The numbers must also include all access and area codes as supplied by the local telecom provider. These numbers will be sent out as the "calling number" in any call setup initiated from a B channel. Also in the USA the number will be compared with the "called number" on any incoming call to a B channel. These numbers are exclusive to the ISDN channels associated with the TA allowing it to handshake with the telecom exchange. The calling unit will also be identified to the called unit by the display of the last nine digits of each channel number.

If the unit is one of a group of Milano's with access to the same ISDN lines then each unit can be given a specific ID sub address to be included with the ISDN number.

Setup Line SPID's

This routine allows the unit to be programmed with eight SPID (**S**ervice **P**rofile **I**Dentifier) numbers for the B1 to B8 channels. These numbers are supplied by the local telecom provider and are required by SPIDed networks in the USA for correct initialisation.

Send Calling Number

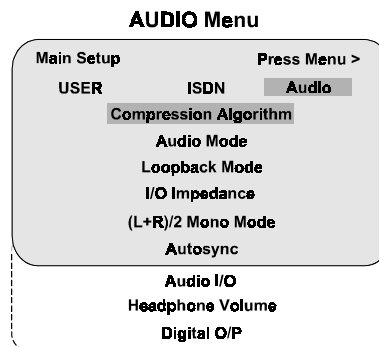
In some countries if the calling number is transmitted the service provider telecom exchange will reject the call. Setting this feature to OFF overcomes this problem. The factory default setting is OFF.

ISDN Diagnostics

This option should only be enabled if instructed to do so by a member of APT, otherwise it should not be altered. The factory default setting is OFF.

Main Setup AUDIO

The Main Setup **AUDIO** menu enables access to any one of nine options as shown. Use ▲ or ▼ keys to move to any of these options. The current option will be highlighted and then select **ENT** to gain access to that option or any related sub-menu.



Compression Algorithm

The unit is programmed with the software for 16bit Standard and Enhanced apt-X™ and 20 and 24 bit Enhanced apt-X™ algorithms. This feature enables the selection of any of these four algorithms. It is not advisable to change algorithms during an active audio session. If attempted the Milano will almost certainly crash and the connection will have to be re-made.

Audio Mode

The Audio Mode sub menu enables access to three audio configurations:

- Stereo
- Dual Mono
- WorldNet Mono Fill.

Stereo

As shown in the previous X21 and ISDN bandwidth tables the unit will deliver from 3.5kHz stereo at 56kbit/s to 20 kHz stereo. It should be noted that bandwidths up to 12kHz stereo are only available with Standard and Enhanced 16 bit algorithms. Audio bandwidths from 15kHz to 20kHz are available with all four algorithms. For ISDN operational modes the maximum bandwidth is 384kbit/s for Standard and Enhanced 16 bit apt-X™ and 512kbit/s for the 24 and 20 bit Enhanced algorithms. The maximum bandwidth for X21 is 20kHz at 576kbit/s.

Dual Mono/Dual Destination(ISDN only)

NB: This feature is only available with Standard 16 bit apt-X™ and autosync must be OFF.

When the unit is set in Dual Mono mode it provides for a simultaneous connection between the local unit and two geographically remote locations. However, this will be a mono audio operation using two, four or six ISDN channels ie a maximum of two 20kHz mono circuits at 192kbit/s. ISDN channels B1 to B3 will transmit the left audio channel to one location and channels B4 to B6 will transmit the right audio channel to the second location.

It is important to note that dual destination mode splits the $N \times B$ -channels into two groups of $N/2$ channels, and connecting with each destination must be executed within each of those groups, i.e. the IMUX must not be crossed. 'N' in these situations can be 2, 4, or 6.

WorldNet Mono Fill

NB: This mode is used for "one- to-one" mono audio applications

The Mono Fill audio mode provides for audio bandwidths ranging from 7kHz to 22kHz mono between two similarly configured Milano's or between a Milano and a WorldNet ProLink configured for Dual Destination mode.

Loopback Test Modes

A Milano codec has three test options:

Local Loop	in X21 mode
Remote Loop	in X21 mode ONLY
Local Loop	in ISDN mode

These three tests procedures are effective in either the analogue or digital audio modes. While there are similarities between a Local Loop test and a Remote Loop test **with** the X21 network connected, they are nevertheless different as shown in the diagrams, the test loops being placed in different sections of the Xilinx controller module.

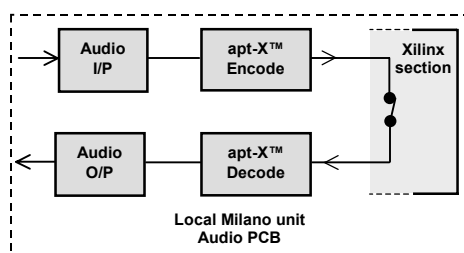
NB: Both Local Loop tests will always loop the Input audio back to the Output on the same unit.

Local Loop in X21 mode

This test can be carried out with or without an X21 network connection

(a) Local Loop with no X21 network connection.

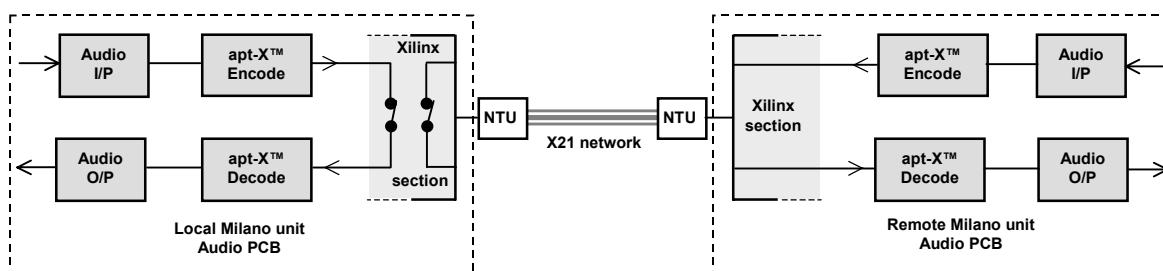
A circuit loopback is placed within the line section of the Xilinx module on the audio processor PCB. A stereo audio input will then be coded at the maximum stereo and data bandwidths available, as defined by the **selected algorithm**, (eg 20kHz stereo audio at 384kbit/s for Standard 16 bit apt-X™). The encoded signal is then looped back to the decode process and the audio outputs.



(b) Local Loop with an X21 network connection between two Milano's.

This test enables the operator at either end of the link to check the performance of both codecs and the X21 network connection.

With the X21 network connected and contact established between the two Milano's and with **Local Loop** set on the local Milano and the remote unit set to **normal** operation. From the diagram it can be seen that the local Xilinx controller will also provide a return loop back through the network to the remote Milano.



The local unit is tested as in (a) above.

The operator at the remote Milano can check the performance of that codec plus the network connection. The audio bandwidth of this test will be determined by the X21 network bit rate and the algorithm selected. (eg 20kHz stereo at 576kbit/s for Enhanced 24 bit apt-X™).

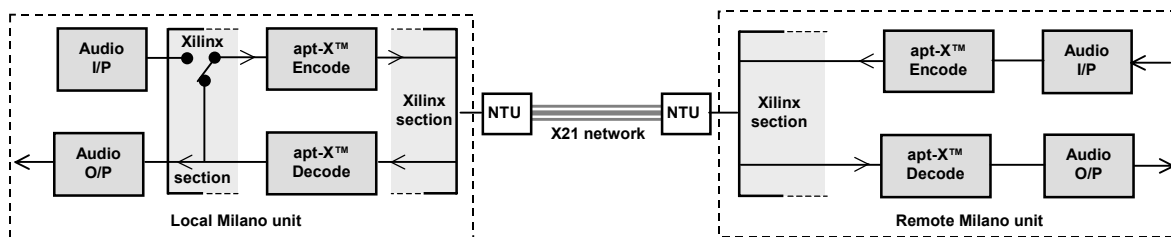
NB: *If the operator at the local Milano wants to include the network in the test then the test settings must be reversed with local unit set for normal operation and the remote Milano now set in Local Loop.*

Remote Loop in X21 mode

Remote Loop with X21 network connection between two Milano's

This test enables the operator at either end of the link to check the performance of both codecs and the X21 network connection.

With the X21 network connected and contact established between the two Milano's and with **Remote Loop** set on the local Milano and the remote unit set to **normal** operation. From the diagram it can be seen that the local Xilinx controller will **only** provide a return loop back through the network to the remote Milano. The audio input at the local Milano will be disconnected and the audio signal from the remote unit will continue to appear at the output of the local unit.



The operator at the local unit can check the performance of the encoder in the remote Milano plus the X21 network and the decoder of the local unit.

The operator at the remote Milano can check the performance of that codec plus the network connection and the encode/decode processes of the local unit.

The audio bandwidth of these tests will be determined by the X21 network bit rate and the algorithm selected. (eg 20kHz stereo at 576kbit/s for Enhanced 24 bit apt-X™).

NB: *This test can be reversed if the local Milano is set for normal operation and the remote unit set in Remote Loop.*

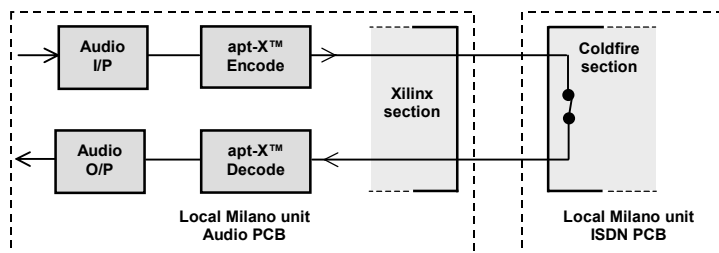
Local Loop in ISDN mode

This test can be carried out with or without an ISDN connection

(c) Local Loop with no ISDN channels connected

In this test the loop is made in the **Coldfire** controller on the ISDN interface PCB. Only four ISDN channel circuits are looped and this will enable a test at a maximum audio bandwidth 15kHz stereo and associated 256kbit/s bit rate for the **Standard** 16 bit apt-X™).

NB *this test **does not** include the IMUX module*

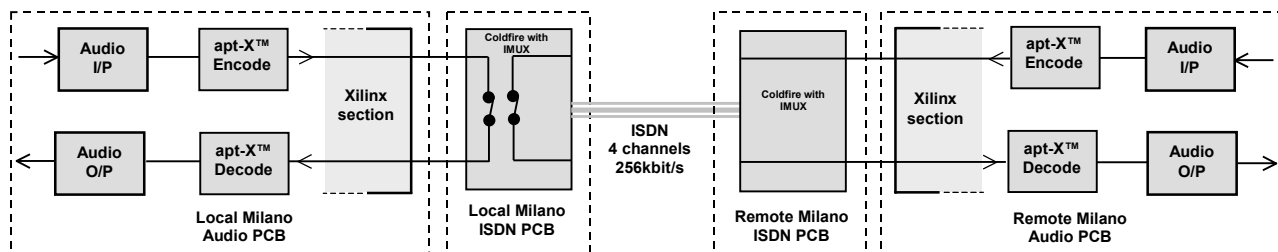


See also QUICK TEST/Loopback

(d) Local Loop with two Milano's connected via ISDN channels.

This test requires at least **four** ISDN channels to be connected and enables the operator at either end of the link to check the performance of both codecs and the ISDN connection.

With contact established between the two Milano's and with **Local Loop** set on the local Milano and the remote unit set to **normal** operation. From the diagram it can be seen that the local Coldfire controller will also provide a return loop back through the ISDN to the remote Milano.



The local unit is tested as in (c) above, at a maximum 15kHz stereo bandwidth.

The operator at the remote Milano can check the performance of that codec plus the ISDN line interfaces at both ends of the link (ie NT1, TA and IMUX's modules, not shown).

The audio bandwidth of the test as monitored at the remote Milano will be determined by the 256kbit/s ISDN bit rate and the algorithm selected. (eg 15kHz stereo for Standard 16 bit apt-X™).

NB: If the operator at the local Milano wants to include the ISDN in the test then the local unit must be set for normal operation and the remote Milano set in Local Loopback.

See also QUICK TEST/ Manual dialling and disconnection of ISDN channels

NB: There is no Remote Loop test for two Milano's connected in ISDN mode the test as indicated for Local Loop test (d) is deemed to be adequate.

I/O Impedance

This option provides a choice of 600Ω/600Ω or 10kΩ/50Ω for the input and output impedances.

(L + R)/2 Mono Mode

This feature is not currently available.

Autosync

With Standard apt-X™ autosync can be switched ON or OFF.

With any of the Enhanced apt-X™ algorithms then autosync is automatically set to ON at all times.

Audio I/O

The unit has both analogue and digital audio I/O interfaces. This feature enables the user to select either operational mode. The XLR-3 connectors for LEFT analogue audio I/P and LEFT analogue audio O/P are also used for digital audio I/P and O/P respectively. These have to be set to the desired mode via the front panel controls. An LED located beside each connector displays the current mode.

Headphone Volume

The volume of the headphone output can be adjusted through xx selectable levels.

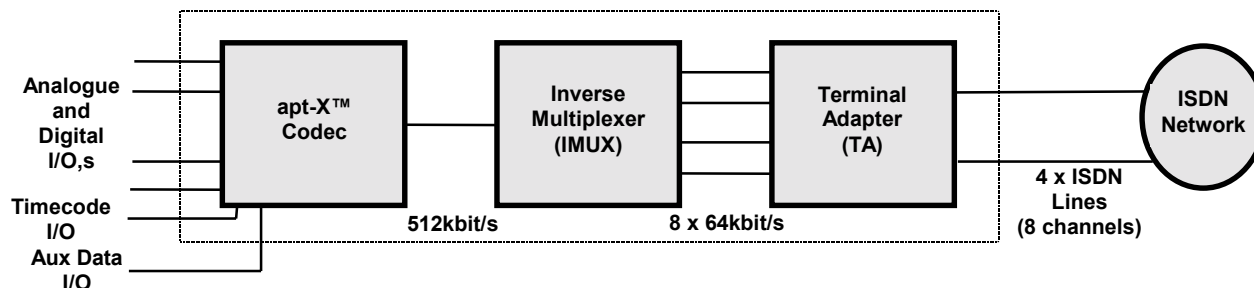
Digital O/P

This feature is only available when the Audio I/O has been set for digital.

The digital audio output can be set to be any of three sampling frequencies 32kHz, 44.1kHz or 48kHz. Additionally, when REF is selected the output can be locked or synchronised to an external reference clock signal (ie Studio Reference). The frequency of the reference signal will be displayed.

General Principles of Operation:

Codec to ISDN



This operational mode allows the two-way exchange of high quality audio up to 22kHz stereo or mono and with bit rates up to 512kbit/s, via the ISDN dial up network. This can be achieved not only between similar Milano units but also between the Milano and other APT ISDN codecs, WorldNet ProLink, DRT 128 and DSM 100, all fitted with MUCAS IMUX and internal or external TA. Additionally in clear mode (no IMUX) at 64kbit/s the Milano will exchange 7kHz mono audio with any other apt-X™ based OEM ISDN codec. An OEM also using the APT MUCAS inverse multiplexer, eg Nicral, can exchange audio at higher bit rates with the Milano.

Manual dialling of ISDN calls is via the front panel keypad. However, through an on-board 20 location directory the Milano offers speedial call set-up plus an additional feature of two “Fast Dial” keys. These latter pre-programmed keys are only applicable to the first two directory locations and will initiate the dialling process with a single key touch. Text lines of the LCD display will show the audio bandwidth and the ISDN number dialled for each of the eight B channels. The unit being called will also display the last nine digits of the ISDN numbers of the calling unit.

The Milano will operate in most countries around the world and APT continues to seek approvals for other networks. The Milano terminal adapter currently conforms to the following international ISDN network protocols:

Euro ISDN ETSI

DMS100

National ISDN 1

Dual Mono Mode

NB: This feature is only available with Standard 16 bit apt-X™ and autosync must be OFF.

When the unit is set in Dual Mono mode it provides for a simultaneous connection between the local unit and two geographically remote locations. However, this will be a mono audio operation using two, four or six ISDN channels ie a maximum of two 20kHz mono circuits at 192kbit/s. ISDN channels B1 to B3 will transmit the left audio channel to one location and channels B4 to B6 will transmit the right audio channel to the second location.

Milano to WorldNet ProLink in Mono

In this situation the Milano is configured in Mono Fill mode with the Standard 16 bit apt-X™ algorithm and the WorldNet ProLink set in Dual Destination mode. Using the Left audio channel to Left audio channel and connecting three ISDN channels for 192kbit/s it is possible to deliver 22kHz mono audio. Any three of the eight ISDN channels in the Milano can be used. However, to keep the IMUX in the ProLink balanced then either B1 to B3 or B4 to B6 must be used.

Milano to BCF256/384

The Milano should be set for Standard apt-X™ when connecting to any BCF.

Milano to BCF256/384 in Mono

In this situation the Milano is configured in Mono Fill mode with the Standard 16 bit apt-X™ algorithm and the BCF256 or 384 set in Mono or Dual Destination mode.

Milano to DSM100

The Milano should be set for Standard 16 bit apt-X™ when connecting to any DSM100. Milano autosync must also be set to OFF

Codec to X.21 mode with ISDN backup.

When the Milano is configured for ISDN backup operation - in X.21 mode, any break in the X.21 link will force the codec's to establish a back-up ISDN link. For reliable operation it is essential that both codec's be properly configured. The following guide should be read before attempting this configuration. Please note, if both codec's on a link are to run without any ISDN backup, it is advisable to configure both units for 'Slave' configuration.

Step 1 – Slave Codec

ISDN backup works on a Master/Slave arrangement, it is therefore essential that the Slave codec be configured before the Master, so as to avoid unnecessary operation of the back-up routine.

First select the algorithm you intend to use on the X.21 link by pressing the 'Menu' key and selecting 'Compression Algorithm' from the 'Audio Menu'. Next, decide what audio mode you wish the back-up to be in – mono or stereo? Go to the 'Audio Mode' menu and make your choice. Please note if you wish your ISDN backup to be in mono, select the 'WorldNet Monofill' mode under the audio mode menu.

Next press the 'Menu' key again, select 'Unit Mode' from the 'User Menu' and press 'Enter'. The codec's two modes of operation will now be displayed: Codec – ISDN and Codec EXT.X21. Highlight 'Codec EXT.X21' and press enter. Network bit-rates along with the corresponding bandwidths and audio modes will now be displayed. Select from the list the appropriate rate that you wish to run your X.21 link at and press 'Enter'. You will then be prompted to select the back-up mode. From the two options, select 'Slave' and press 'Enter'. The Slave codec configuration is now complete.

Step 2 – Master Codec

When in Master mode, the Milano codec accesses the ISDN numbers stored in the on-board directory. This directory can be programmed by either accessing the 'Set up directory' menu or via the 'Master' option when configuring the codec for X.21 operation.

First configure the codec for the same algorithm as selected for the Slave unit. Next, as before, select 'Unit Mode' then 'Codec EXT.21' and then chose the X.21 rate that corresponds with the rate chosen for the Slave codec. After selecting the network rate, you will then be prompted to choose the 'X.21 back up mode'. This time select 'Master', the on-board directory locations will now appear. Please select 'location 0' and enter the following ISDN details: name, speed, algorithm, rate/bandwidth and numbers. Finally, exit the menu screen to the top menu, where the codec should now reflect that it is the Master unit. If quick changes need to be made to the directory, instead of accessing it via the X.21 set-up routine, access to it can be gained under the 'Setup directory' option located under the 'ISDN menu'.

Note: Always ensure the ISDN configuration stored in the directory reflects the Slave codec's configuration, otherwise ISDN backup may prove unsuccessful. It is also advisable to turn 'Speed dial-redial' to ON, on the Master codec as this will further enhance the backup routine, should an ISDN line fail.

Technology Review

Standard 16 bit apt-X™

This low complexity hardware based solution to data compression is implemented on a single AT&T ROM masked DSP16A 84 pin PLCC package. The proprietary design allows for 2 channels each of the coding and decoding algorithms to be housed in a single IC.

The apt-X™ algorithm with the subband ADPCM (Adaptive Differential Pulse Code Modulation) prediction approach to compression reduces the bit rate of 16 bit linear PCM by a factor of 4:1 without subjective loss of audio quality. This algorithm continuously filters fixed time blocks of the PCM signal into four equal width frequency subbands. A fixed number of signal samples in each subband are then analysed and using a continuing prediction process each section is able to predict what the level of subsequent samples are going to be. When this prediction is compared with the level of the actual sample it generates a so called difference or "error" signal, still with 16 bit resolution. This small signal is then re-coded or re-quantised with a lower bit resolution for each subband and the resulting four outputs are multiplexed together to produce a final data stream at 16 bits per word which is ¼ the data rate of the original PCM input.

apt-X™ is renowned for its excellent immunity to bit errors which can be induced during transmission over the signal path; acceptable speech quality can be delivered even with bit errors as low as 1 in 1000. Signal processing delay is a crucial factor if two way working or off air monitoring is an operational requirement. apt-X™ is very suitable for such applications with delay of less than 3ms at the 48kHz sampling frequency.

Timing and synchronisation of the encode and decode processes can be achieved by communicating the bit and word boundaries. In a telecommunications application where this is not possible then both processes can be locked to a network clock signal

The decoding process is the exact opposite of the coding. A 16 bit PCM signal is reconstructed by adding back a predicted level of signal to the small, but now decoded difference signal. The level of the predicted signal will be similar to that identified and made redundant in the coder. The accuracy of this process is such that 98% of the original signal is returned at the output of the decoder.

The IC design allows for in-channel auxiliary data up to 12kbit/s to be embedded with the compressed audio data signal. This facility, when incorporated into the design of certain equipment makes it possible to additionally transmit alternative programming or equipment control data without adversely affecting the bandwidth of the audio signal.

Enhanced 16, 20 and 24 bit apt-X™

This is a development based on the Standard 16 bit apt-X™ 4:1 data compression algorithm. On a new platform provided by the Motorola 563xx DSP chip Standard 16 bit and Enhanced 16, 20 and 24 bit apt-X™ algorithms are available. This flexibility of operation has also been designed to permit full backwards compatibility with existing 16 bit Standard apt-X™ based audio systems and to meet the current and future demands of 20 and 24bit PCM architectures.

The 563xx chip is a very low power CMOS device capable of operation at 100 million instructions per second (MIPS). The implementation of both standard and enhanced apt-X™-algorithms on this platform enables it to deliver four discrete audio channels with bandwidths up to 24kHz at 48kHz sampling frequency and network data rates up to 576kbit/s.

In **SIMPLEX** mode these can be configured as:-

- Four discrete mono encode or decode channels
or
- Two stereo encode or two stereo decode pairs
or

in full **DUPLEX** mode as:-

- Two encode channels plus two decode channels

Enabling any two channels to be configured with differing bit resolutions from the remaining two channels further increases flexibility of operation.

Modifications of the various coefficients within the apt-X™ algorithm itself has led to typical improvements in performance from the original 16 bit technical specification. Operating with 20 and 24 bit resolution the dynamic range capability has been increased by approximately 20 – 25dB respectively and the total harmonic distortion (THD) separation has been improved from a nominal –68 to –74dB and –80dB for 20 bit and 24 bit operation respectively.

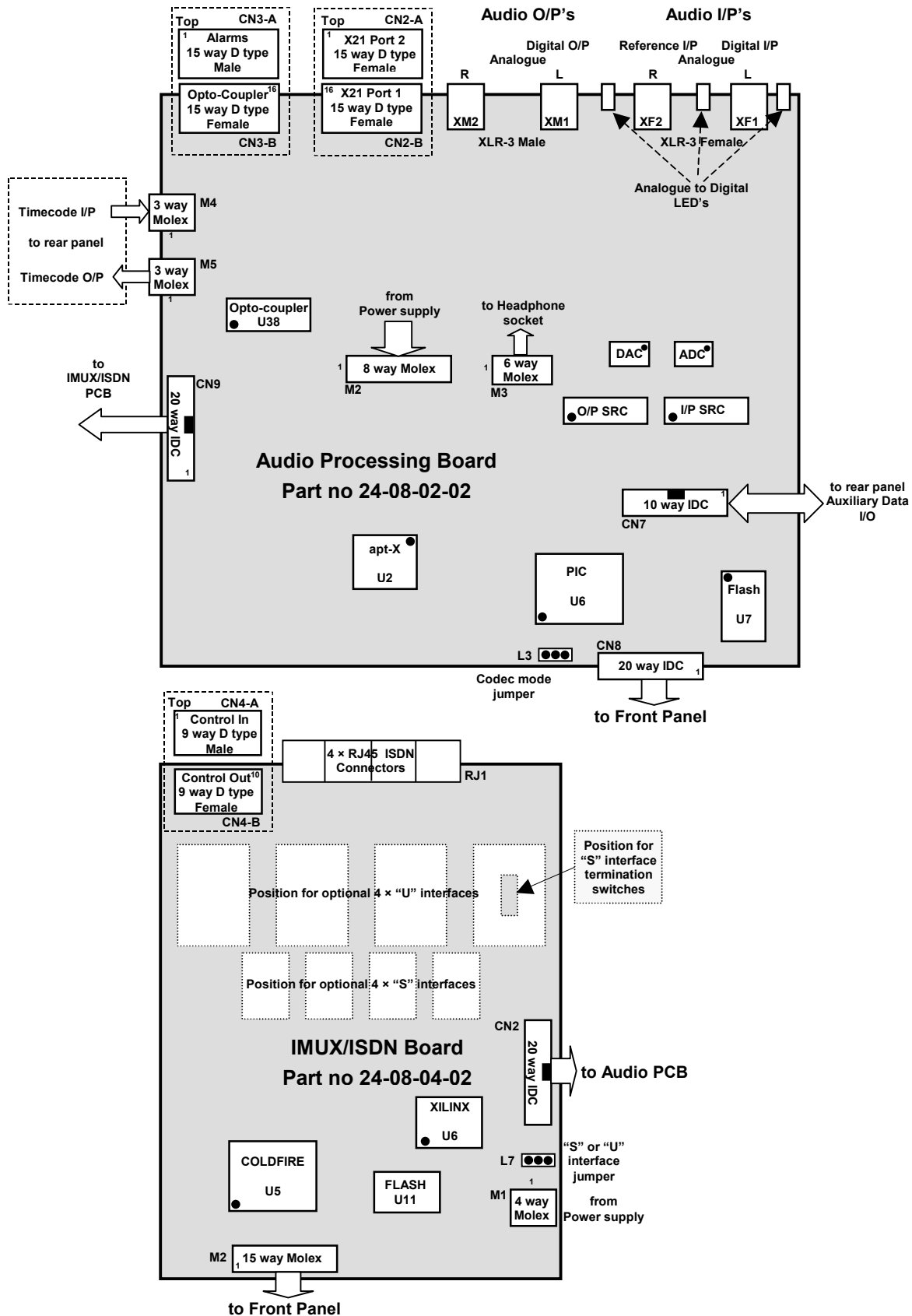
The signal processing delay introduced by a complete encode/decode cycle has also been slightly improved to around 2msec at 48kHz sampling frequency.

The benefits thus accruing from utilisation of the enhanced apt-X™ algorithm are:-

- Increased stereo and mono audio channel capability.
- Simultaneous full duplex operation with a single device.
- Bit compatibility with current 16, 20 and future 24 bit AES/EBU architecture.
- Asymmetrical bit resolution operation.
- Backwards compatibility with existing 16 bit apt-X™ systems.
- Low complexity implementation and integration on a single DSP device.

Synchronisation of the audio data between encoder and decoder can also be achieved through autosync. This is a proprietary facility which enables the standard and enhanced apt-X™ compressed data streams to be synchronously decoded without prior knowledge of the compressed word boundaries. As with the auxiliary data facility no data overheads and no audio bandwidth penalties are incurred through the use of the autosync facility.

PCB layouts



Appendix 1

Passwords

Access to the operation and setup of the Milano can be password protected on three levels. If the unit has been protected then further operation will only be allowed when the correct passwords have been entered.

- | | |
|-----------------------|---|
| Access Level 1 | Dial access, Speeddial and Fast dial, disconnect one channel and disconnect all channels. |
| Access Level 2 | Complete access to all options and setup routines. |
| Access Level 3 | APT personnel only. |

When the unit is despatched from APT the password for Level 1 is ACCESSL1 and for Level 2, ACCESSL2. These may have been changed.

Password Setup

Setup is accessed via the Main Setup USER menu. The password function can be disabled by firstly gaining access with the appropriate passwords. This action effectively disables the feature and any further operation of the unit is unrestricted, even after the power is switched OFF and ON. The user can only set or reset the passwords for Levels 1 and 2. If required APT customer support can carry out online changes or resetting of all three passwords.

Appendix 2

Technical Specification

Physical

Size	1U × 19" rack mount (44mm(H) × 482mm(W) × 255mm(D))
Weight	2.25kg
Power Supply	100-250VAC, 50-60Hz (optional 48VDC supply)
Consumption	<25W
Environmental	0°C to 50°C, 95% Humidity

Interfaces

ISDN	S/optional U interfaces, 4 × RJ45, (TNV1 see Note 2) Data rates 56-512kbit/s
X21/V35	Port 1 15 way Female D type DTE interface, RS422, (SELV see Note 1) Data rates 56-576kbit/s (<i>Port 2 is not connected</i>)
Digital Operation	Audio I/O, 2 × AES/EBU, balanced XLR-3, (SELV see Note 1) Impedance 110Ω Digital Reference Input, XLR-3
Analog Operation	Audio I/O, 4 × balanced XLR-3 (SELV see Note 1) Input Impedance >10kΩ/600Ω Output Impedance <50Ω/600Ω
Auxiliary Data	9 way Female D type, RS232, (SELV see Note 1) Data rates 1200, 2400, 4800, 9600 baud
Alarms	15 way Male D type
Timecode I/O	2 × XLR-3 (SELV see Note 1)
Opto-coupler	15 way Female D type
Remote Control	9 way Female D type RS232/RS485

Audio

Sampling Frequencies:	
Digital Operation	32kHz, 44.1kHz, 48kHz
Analog Operation	8kHz to 48kHz
Sample Rate Converter	3:1 or bypassed
Audio Bandwidth:	
Digital Operation	10Hz to 22.5kHz mono & stereo
Analog Operation	10Hz to 22.5kHz mono & stereo
Source Coding	Standard 16 bit apt-X™ and Enhanced 16, 20, and 24 bit apt-X™
Compression Ratio	Fixed 4:1 ratio
Coding Delay:	
Standard apt-X™	2.5ms @ 48kHz sampling
Enhanced apt-X™	1.9ms @ 48kHz sampling
Dynamic Range	16 bit >85dB, 20 bit >105dB, 24 bit >110dB
Phase Response	Linear: DC to $F_s/2$
Pass Band Ripple	<-0.2dB

(Note 1: The interface connectors marked SELV are Safe Extra Low Voltages and must only be connected to other SELV equipment)

(Note 2: The interface connectors marked TNV1 are Telecomms Network Voltages type 1 and must only be connected to TNV1 networks.)

Service & Customer Support:

If attempts to solve any problem are unsuccessful call APT Customer Support Services.

Europe & Rest of The World	Phone	+44-28 9037 1110
	Fax	+44-28 9037 1137
	E-mail	customersupportuk@aptx.com
North America	Phone	+1-323-463 2963
	Fax	+1-323-463 8878
	E-mail	customersupportusa@aptx.com

Please have the following information ready:

WorldNet Milano serial number (found on rear panel) Ser No.....

Purchase date for equipment.

Distributor Name

Fault conditions details.

Configuration of the WorldNet Milano system.

Contact Addresses

Should you require any assistance please do not hesitate to contact one of the following:

HEADQUARTERS

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