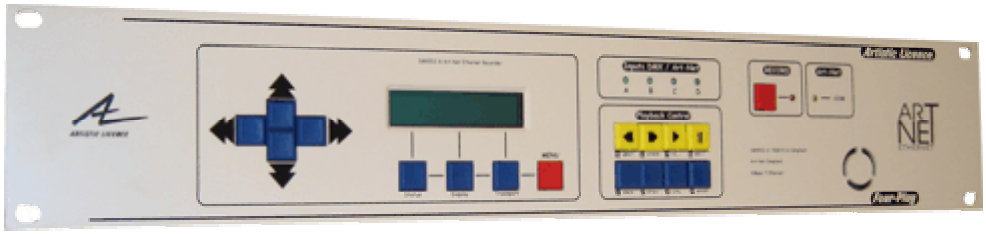
Four-Play



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Artistic Licence (UK) Ltd

Firmware Version V2.52 Manual Revision V4.0

ARTISTIC LICENCE PRODUCT REGISTRATION FORM

Product: Four-Play	Version No.
Serial No.	Date Purchased:

Supplier:

Name:	
Company Name:	
Address:	
Email:	
Post/Zip Code:	Phone No.

Comments:

Please return to: Artistic Licence (UK) Ltd.
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INTRODUCTION

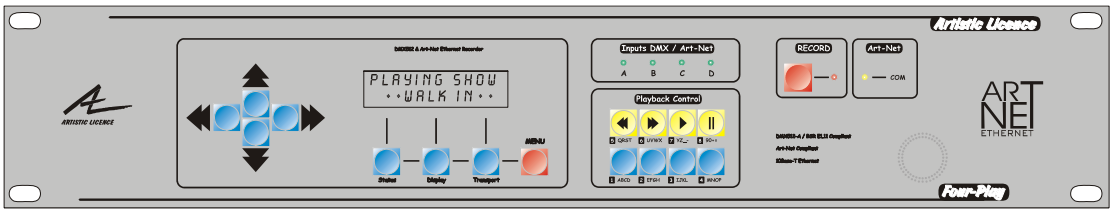
QUICK START

Welcome to the Four-Play user guide.

Four-Play is a hard disc based real time recorder for lighting control. It supports both DMX512 and Ethernet Art-net. It can also translate between these protocols. The product serves three key purposes:

- Tracking backup.
- Lighting console replacement.
- Protocol conversion.

Please remember to return your product registration card, so that we can keep you informed of new developments.



FEATURES

Four-Play has a rich feature set including:

- Receives four universes or 2048 channels.
- Input source of DMX512 or Art-Net.
- Transmits four universes of DMX512 and Art-Net.
- Records over twenty hours of real time data.
- Remote control via keypad, MIDI or Ethernet.
- Real time triggers.
- MIDI time code tracking.
- Received data analysis.
- Remote monitoring via Ethernet.
- File backup and restore via Ethernet
- Multiple unit synchronisation.
- Remote control via Internet (requires additional components).
- DMX-Workshop compatible.

WHAT'S NEW IN FOUR-PLAY

For users familiar with the predecessor 'No-Worries', the following list details the key differences:

1. Addition of the 10BaseT Ethernet connection.
2. A mixture of DMX512 and Art-Net inputs can now be received and transmitted.
3. Approximately double the recording time is now available.
4. The user interface has been streamlined and transport keys added as standard.
5. Fast switching between display modes has been added.
6. Single press record mode has been added.
7. Multiple units can now be slaved via the network using the macro keys.
8. All file backup and restore is now performed using the network. This significantly improves backup and restore time.
9. The product firmware can be updated via the network. This protects your investment and provides you with free of charge maintenance and feature updates.
10. Four-Play is fully integrated with DMX-Workshop which allows network remote control, monitoring, show file backup and restore and firmware upload.
11. Real time clock synchronisation has been implemented. This allows a single unit to be designated as master. The master then synchronises all other devices on the network.
12. The synchronisation feature can also be slaved to DMX-Workshop. This allows all Four-Plays connected to a network to synchronise to Internet time. This feature can be used to provide automatic daylight saving correction.

OPERATING MODES

This section discusses the key operating modes and how they can be used.

PROTOCOL CONVERSION

Protocol Conversion mode is used to convert between DMX512 and Art-Net. The following combinations are supported:

- Any input universe can be attached to a physical DMX512 input.
- Any input universe can be attached to a virtual Art-Net Ethernet universe.
- All outputs provide DMX512 in all modes.
- Any or all outputs can output Art-Net Ethernet.

To summarise, any combination of four DMX512 inputs, four DMX outputs and four universes of Art-Net Ethernet can be converted.

Whilst this mode of operation would not in itself justify purchase or the product, it does provide some useful opportunities:

- Using Four-Play as a 'console replacement': A console with either DMX512 or Art-Net output can be used for programming.
- Implementing a 'wireless DMX' link: The Ethernet output of Four-Play can be connected directly to the Access Point, removing a second level of DMX to Ethernet conversion.

CONSOLE REPLACEMENT

Console Replacement mode is perhaps the key operating mode of Four-Play.

This mode can be viewed as identical to the operation of a VCR:

A lighting console is used to generate the lighting show. The show is then played back in real time whilst Four-Play records the entire show. At this point, the lighting console can be returned to the hire company and Four-Play used to play back the show.

This is of significant cost and space benefit in fixed installation projects.

Show playback can be triggered by numerous events including:

- Real time clock at specific time and or day.

- Front panel button press.
- Contact closure input.
- DMX512 level.
- MIDI note command.
- MIDI time code.
- Ethernet packet.
- Event from another Four-Play.

The addition of an Artistic Licence 'Common-Sense' interface opens up an even greater range of triggering options.

TRACKING BACKUP

Tracking Backup uses the recording facility of Four-Play to operate in parallel with the lighting console. Four-Play then monitors the console and takes control of the show in the event of a failure.

The entire show is recorded into Four-Play in real time. Four-Play connects between the lighting console and the lights.

A trigger channel is allocated, such that Four-Play can detect when the lighting console starts playback. At this point, Four-Play starts playback internally, but the outputs stay in loop through mode. The console has total control of the lights.

In the event of a console failure, Four-Play activates its outputs and disconnects the console. The changeover is seamless and occurs within a few frames of DMX. Four-Play locks into this mode until an operator intervenes. This guards against intermittent faults, or a console reboot.

THE CONTROL SURFACE

KEYBOARD

Four-Play operation is primarily controlled by the three soft keys and the MENU button.

General key functions are discussed below:

CURSOR

LEFT: The Left cursor key is used to toggle through the menu options and to select editing points for text editing of macro, file, and remote trigger names.

RIGHT: The Right cursor key is used to toggle through the menu options and to select editing points for text editing of macro, file, and remote trigger names.

UP: The Up cursor key is used to increment the number displayed at the cursor position for selecting files, macros and remote triggers. It is also used for incrementing the letter value in editing functions, along with the numeric keys.

DOWN: The Down cursor key is used to decrement the number displayed at the cursor position for selecting files, macros and remote triggers. It is also used for decrementing the letter value in editing functions, along with the numeric keys.

EDIT

MENU: In any mode of operation the Menu key is used to display or exit the menu.

SOFT KEYS: The operation of the soft keys changes dependent upon the menu currently displayed.

The function that will occur when the key is pressed is displayed in the LCD screen above each key, and also in the bottom right-hand corner of the optional VGA monitor.

When a menu is not active, the Soft Keys operate as short cuts to the Status, Display and Transport menus respectively.

Soft Key 1 is used as a BACK key in most menus. This allows the user to return to the previous menu level.

PLAYBACK

The bank of eight Playback Keys operate in numerous modes dependent upon the active menus. These keys are also used for text entry using the text message 'multi-tap' format of data entry.

When there is no menu active, the eight keys operate as macro triggers. The macros are fully programmable and each is displayed in the status screen of the optional VGA monitor.

By default, the macro settings are as follows:

1. Play File 1
2. Play File 2
3. Loop On (All outputs connect to input)
4. Loop Off (All outputs connect to playback)
5. Scan Rev
6. Scan Fwd
7. Play Current File.
8. Pause.

Please note that 1 to 4 are located on the bottom row of buttons. Keys 5 to 8 are located on the top row and have engraved key caps.

The key caps are removable and can be engraved to customer specification as required.

When any menu that requires numeric entry is active, the keys operate as numerals 1 to 8.

When any menu that requires text entry is active, the keys operate as multi-tap text keys.

These keys are echoed to the network connection. This means that all Four-Plays connected to the network will respond to the button press.

RECORD

The Record key is used to start recording.

If there is an existing file, the system will prompt to confirm an 'overwrite'. If no file exists, recording is instantaneous.

DISPLAYS

Four-Play provides a number of status and feedback displays as detailed below.

Whilst the VGA monitor is optional, it is highly recommended during programming.

LCD

The LCD is used for both status monitoring and programming.

When a menu is active, the lower line of the display is used to label the Soft Keys.

INPUTS

The four Input LEDs indicate the state of each input. Static illumination indicates that the relevant input is good and active.

RECORD

The Record LED indicates that recording is active. Static illumination indicates recording is in progress. A flashing indicator shows that Record Pause is activated.

ART-NET

The Art-Net indicator illuminates when Art-Net traffic is active on the network.

MONITOR

The optional monitor provides a wealth of system information. Whilst it is possible to program Four-Play without the monitor, we do not recommend this.

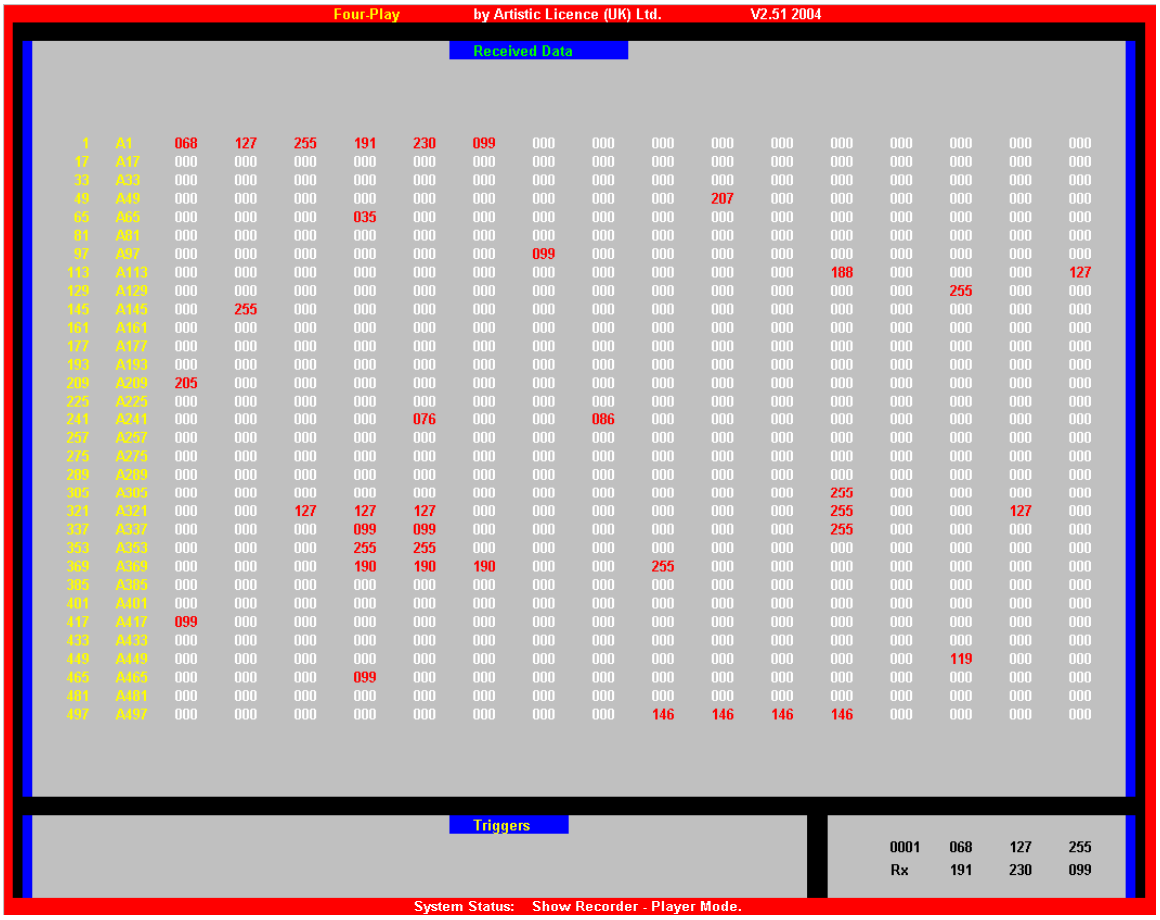
There are five display modes. These are selected by the Display Menu. To activate this menu press Soft Key 2. The LCD will display the following:

The chevron indicates that the menu is multi-page. Use the Left & Right cursor keys to select each page. The second page of the Display Menu is as follows:

The section below describes each of the five display modes:

Rx

The Rx or receive display shows a mimic of received DMX512 or Art-Net data.

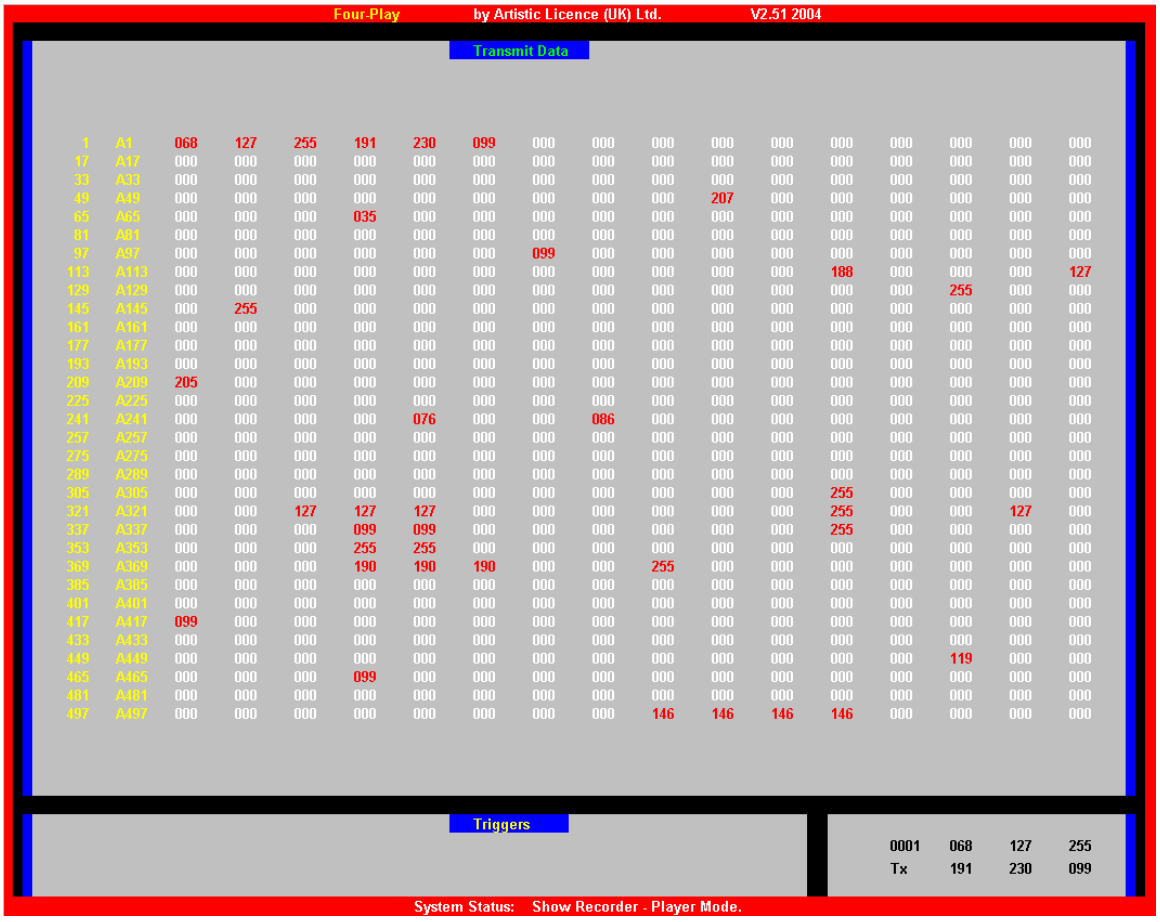


The LCD displays six consecutive channels in decimal format. The monitor displays an entire universe.

The start channel from which data is displayed is set using the cursor keys. The Left & Right cursor keys select the numeric character to be edited. The Up & Down cursor keys edit the selected digit.

Tx

The Tx or transmit display shows a mimic of transmitted DMX512 or Art-Net data.

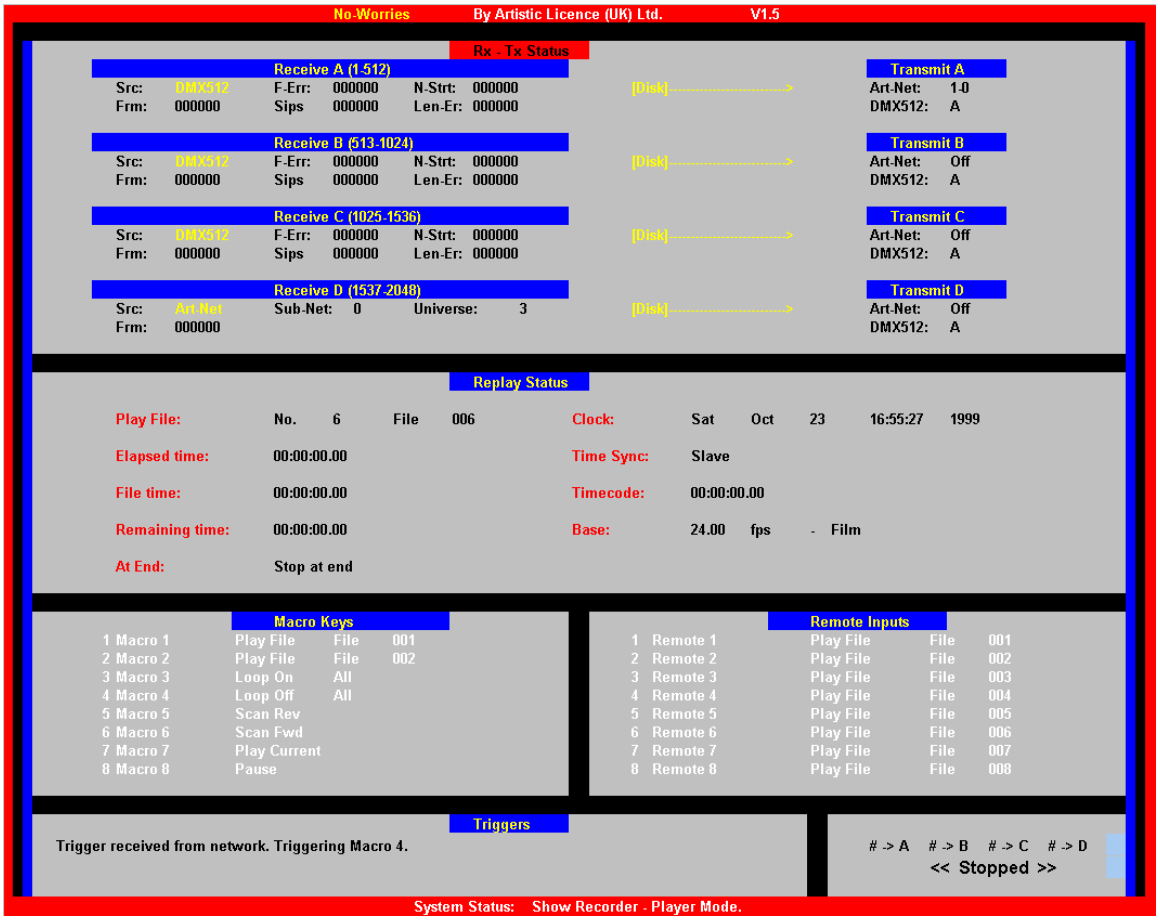


The LCD displays six consecutive channels in decimal format. The monitor displays an entire universe.

The start channel from which data is displayed is set using the cursor keys. The Left & Right cursor keys select the numeric character to be edited. The Up & Down cursor keys edit the selected digit.

Status

The Status display provides a view of the overall machine status.



Tx – Rx Status

The Tx – Rx Status display shows both the input diagnostics and the output connectivity.

The four boxes to the left represent each of the four inputs. An input can be either a DMX512 input or an Art-Net input.

The four boxes to the right represent each of the outputs. The DMX512 output is always active. Each output can also be assigned to transmit Art-Net data.

The arrow lines that connect the input boxes to the output boxes indicate the playback status. A solid line connecting the two shows that the output is connected to the input.

The diagnostics data is as follows:

Src: The input source data. This can be DMX512 or Art-Net.

Frm: The number of data frames received.

F-Err: The number of framing errors detected.

N-Strt: The number of non-zero start codes detected.

Sips: The number of System Information Packets received.

Len-Er: The number of frames detected that exceed 512 channels.

Replay Status

The Replay Status display shows numerous file timing parameters as detailed below:

Play File: The file number and name that will be played or recorded.

Elapsed Time: The elapsed time from the beginning of the last play or record operation.

File Time: The total time recorded in the current file.

Remaining Time: The time remaining until the end of the current file playback.

At End: The command that will be processed when playback reaches the end of the current file.

Clock: The current time and date.

Time Sync: The Time Sync mode is either Master or Slave. In Master mode, Four-Play transmits a network synchronisation signal at one minute past the hour. This synchronises the real time clocks of all other devices connected to the network. In Slave mode, Four-Play listens to the network for a synchronisation signal.

Timecode: The current value of received MIDI time code.

Base: The time base of the received MIDI time code.

Macro Keys

The Macro Keys display shows the functions assigned to each of the eight front panel macro keys.

Remote Keys	The Remote Keys display shows the functions assigned to each of the eight remote contact closures.
Triggers	The Triggers Keys display shows a text description of the last trigger event received and the action taken.
LCD	The LCD display is echoed to the monitor display for ease of operation.

MENUS

The menu system is hierarchical. Pressing the Menu Key activates the main menu.

The main menu consists of three pages. Each page is selected using the Left & Right keys.

The main menu is displayed thus:

The following section details each of the sub menus.

TRANSPORT MENU

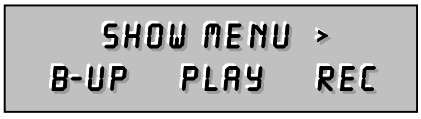
The Transport Menu provides access to playback controls. It is used in conjunction with the macro keys to provide shortcuts for commonly used functions. Exit the Transport menu by pressing Menu.

The available Transport functions are:

Key	Function	Where
Pause	Pause playback or record. If already paused, effect is the same as stop.	Transport Menu, Macro.
Cont	Continue playback or record if in pause. If stopped, effect is same as play.	Transport Menu, Macro.
Stop	Stop playback or record.	Transport Menu, Macro.
Scan Fwd	Scan forward in file by 10 seconds and starts playback.	Macro.
Scan Rev	Scan reverse in file by 10 seconds and starts playback.	Macro.
Play	Start playback of current file.	Macro.
Record	Start recording to current file.	Macro, Rec key.

SHOW MENU

The Show Menu provides access to primary record, playback and backup functions.



Backup

The Backup function is used to provide automatic backup to a lighting console. Before this function can be used, the lighting console show must be recorded into Four-Play. To do this, see the Record section below.

Backup operates as follows:

- The user defines a 'Trigger Channel' that will be used to synchronise Four-Play to the lighting console. Any unused channel can be used for this purpose.
- The lighting console show is authored such that the first playback event is a transition of the Trigger Channel from off to full. The Trigger Channel must not change at any other time in the show. This allows Four-Play to detect when the lighting console starts playback.
- The outputs of the lighting console are connected to the inputs of Four-Play. The outputs of Four-Play connect to the stage.
- When Four-Play enters Backup Mode, the inputs are connected to the outputs. This means that the lighting console has control of the stage.
- Four-Play monitors the Trigger Channel, watching for a change in level. When it sees the level change, it starts internal playback of the backup file. At this point, the lighting console still controls the stage, but Four-Play is now running in synchronism.
- Four-Play monitors the output of the lighting console. If it detects a DMX512 failure (or loss of Art-Net data) it shuts of the lighting console and connects its own playback to the stage.

The Backup menu operates as a selection wizard as shown below. Please note that Four-Play can be programmed to power on in Backup Mode. See the chapter on Configuration for details.

The first menu allows the backup file to be selected. Use the cursor keys to select the file and press NEXT.

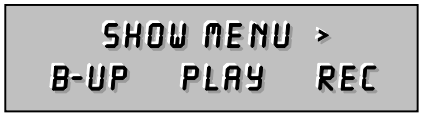
The second menu is used to select the trigger channel. The final channel, 2048, is offered as a default. When complete, press the DONE key.

The display reverts to status display. The top line indicates that each DMX input is connected to the respective DMX output, giving control to the external lighting console.

The bottom line shows the Backup status. The possible modes of Backup Status are detailed below:

- WAITING-AUTO-TRIG: Four-Play has not yet detected a transition of the Trigger Channel. The lighting console has control.
- CONSOLE IS GOOD: Four-Play has detected the Trigger Channel and is running in synchronism. The lighting console has control.
- CONSOLE FAILED: Four-Play detected a failure of the lighting console and has taken control of the show.

Play



The Play function is used to playback a file. Playback can be instantaneous or synchronised to a trigger channel. Before this function can be used, the lighting console show must be recorded into Four-Play. To do this, see the Record section below.

When the Play button is pressed, the following menu is displayed. Three options are then available. The Back key returns to the previous menu. The Play key is used to select a file for instantaneous playback. The Trig key is used to select a file for triggered playback.

The cursor keys are used to select the file required for playback.

Instant Playback

The cursor keys are used to select the file required for instantaneous playback. Once the file has been selected, press Go to start playback.

The outputs instantly switch to playback mode.

Trigger Playback

Triggered playback operates as follows: A channel is defined for triggering purposes. This channel can be any unused channel. When Four-Play enters triggered playback mode, the outputs are not changed until the trigger is detected.

This is the key difference between Backup mode of operation and Triggered Playback.

When Four-Play detects a transition between zero and full on the trigger channel, the outputs switch to playback mode and playback commences.

When Triggered Playback mode starts, the display shows: WAITING-PLAY-TRIG.

Record

The Record function is used to record a file from the external lighting console.

Record can be instantaneous or can be synchronised to a trigger channel.

When the Rec button is pressed, the following menu is displayed. The cursor keys are used to select the file number to be recorded.

The Edit key allows the file name and playback parameters to be changed. See below. Press Next to move on to the Record mode menu.

Four-Play now asks for confirmation as you are about to overwrite the previously recorder file. Press Yes to continue with the recording process.

Three options are then available. The Back key returns to the previous menu. The Go key is used to select a file for instantaneous record. The Trig key is used to select a file for triggered record.

The cursor keys are used to select the file required for playback.

Trigger Record

Triggered record is particularly useful for recording a file to be used in Backup mode. It allows the start of the recording to be perfectly synchronised to the lighting console show.

Operation is as follows: A channel is defined for triggering purposes. This channel can be any unused channel. When Four-Play enters triggered record mode, record is started but paused. Four-Play monitors the Trigger Channel for a transition between zero and full. When the trigger is detected, recording starts.

When Triggered Playback mode starts, the display shows: WAITING-REC-TRIG.

Record Edit

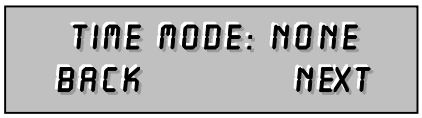
The Edit key is used to edit all of the file parameters including file name and playback mode. Use the cursor keys to select the file to be edited. Please note that this menu does not record the file contents.

File Name

Pressing the Edit key displays the filename menu. Use the Left & Right cursors to select the character. Use the Up & Down cursors to change characters. The Macro keys can be used for multi-tap character entry in this mode. Press Next to move on to the Time Mode menu.

Time Mode

The Time Mode setting of a file defines the parameter that will start playback. Use the cursor keys to adjust the setting. The available options are:



- None
- Clock
- MTC
- DMX

None

No specific triggering is associated with the file. This means that the file can be played back using manual start, triggered start, backup mode or macro key.

Clock

The file will be automatically played back when a specific time and day occurs.

If the trigger occurs when another file is being played, that file will stop and the new file will start.

The cursor keys are used to edit the required trigger time. The time is entered using the 24 hour clock in the format HH:MM:SS.TT.

- HH: Hours 0-23
- MM: Minutes 0-59
- SS: Seconds 0-59
- TT: Decimal Seconds .00-.99

MTC

The file will playback locked to the received MIDI Time Code.

If no time code input is detected, MTC triggers are ignored. When the MTC input is active, all other triggering modes are ignored.

The cursor keys are used to edit the required trigger time. The time is entered using the 24 hour clock in the format HH:MM:SS.FF.

- HH: Hours 0-23
- MM: Minutes 0-59
- SS: Seconds 0-59
- FF: If MTC received is Film (24FPS) 00-23
- FF: If MTC received is EBU (25FPS) 00-24
- FF: If MTC received is DF (29.97FPS) 00-29
- FF: If MTC received is SMPTE (30FPS) 00-29

It is only necessary to set the start timecode number for any file. This is because Four-Play uses the duration of the file to calculate the end timecode value.

Whenever timecode is active, Four-Play will shuttle playback in order to keep locked. This is true across multiple files that are configured to accept timecode. Files can be set to any timecode start times in any order.

Timelock is best described by way of the following example.

File001 is configured for MTC at time 01:00:00.00. Duration is 59 seconds. So this file has a timecode window from 01:00:00.00 to 01:00:59.00

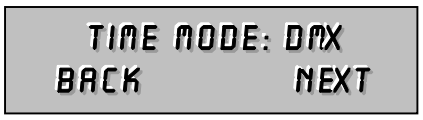
File002 is configured for MTC at time 01:02:00.00. Duration is 59 seconds. So this file has a timecode window from 01:02:00.00 to 01:02:59.00

Let's say that timecode starts at 00:59:00.00. The following table shows how file playback tracks time code:

Timecode	File Active	Time offset in File	Outputs
00.59.00.00	None	--.--.--.--	Undefined
01.00.00.00	File001	00.00.00.00	File playing.
01.00.30.00	File001	00.00.30.00	File playing.
01.00.59.00	File001	00.00.59.00	Holding last state.
01.01.00.00	None	--.--.--.--	Holding last state.
01.01.30.00	None	--.--.--.--	Holding last state.
01.02.00.00	File002	00.00.00.00	File playing.
01.02.30.00	File002	00.00.30.00	File playing.
01.02.59.00	File002	00.00.59.00	Holding last state.

DMX

The file playback can be triggered by a DMX512 or Art-Net input.



The source of data to be used for remote triggering must be connected to the A input.

Two triggering formats are available for DMX mode. Both modes can be used simultaneously:

- Channel number mode:
  When a channel level transitions from zero to full, a file is started. The file is defined by the channel number. So channel 3 will start File 003 playback and channel 350 will start File 350 playback.

- Signature mode:
  The first six channels are used to encode the file to be played back as defined in the following table:

DMX512 Channel	Function	Description
1	High Byte File Number	First file is 0x0001
2	Low Byte File Number	
3	0xaa (170)	Signature
4	0x55 (85)	Signature
5	0xff (255)	Signature
6	0x00 (00)	Signature

Example: To start playback of File 300 send:
0x01 0x2c 0xaa 0x55 0xff 0x00 or in decimal:
1 ,44, 170, 85, 255, 00

The file number in this encoding is in hexadecimal. 300 in decimal = 0x0144 in hexadecimal.

Day

Any file can be programmed to only playback on a specific day. This is most useful in combination with the Clock and MTC time modes as it allowed different files to be used on different days at the same time.

The Day trigger can be set to any day of the week or all days. The cursor keys are used to adjust the setting.

At End

The At End field is used to define what should occur when the file playback reaches the end.

The available options are:

- Nothing: The output freezes on the last frame of the file being played back.
- Loop: The file will playback continuously once triggered.
- Lnk File: Another user defined file will start when this file finishes.
- Go DMX: The DMX (or Art-Net) inputs will be connected to the outputs when the file completes.

When the MTC input is active, the At End setting is ignored. This is because Four-Play will always attempt to lock file playback to timecode when timecode is active.

SETUP MENU

The Setup Menu provides access to three sub menus that are used to adjust the overall operating modes of Four-Play.

These are:

- Loop: Controls whether inputs are connected to outputs.
- Keys: Sets the functions of Macro and Remote keys.
- Conf: Global configuration.

The following section details the operation of each sub-menu.

Loop

The Loop Menu is used to define the connection between the inputs and outputs. It should be noted that these functioned can be configured as macros for faster operation.

The cursor keys are used to select any one of the inputs A to D or All inputs. Press Next to continue. The cursor keys are used to select one of two modes:

- Loop: The inputs are connected to the outputs, this gives the external lighting console control of the stage.
- Norm: The inputs are disconnected and the outputs are controlled by Four-Play.

Keys

The Keys menu is used to configure the remote inputs and the macro keys. Select the type you wish to configure by pressing the relevant button.

The following menu will be displayed which allows the number of the remote or macro to be set using the cursor keys. Press next to continue.

The name of the remote or macro can then be set. Use the Left & Right cursors to select the character and the Up & Down cursors to change the alphanumeric. You can also use the Macro Keypad in multitap mode to edit the name.

The next menu allows the function of the remote or macro to be set. The following table describes the available options:

Name	Function
No Function	Nothing.
Status	Display Status Screen.
Transmit	Display Transmit Mimic.
Receive	Display Receive Mimic.
Bargraph	Display Bargraph view of inputs and outputs.
Scan Fwd	Move forward by 10 seconds in current file then start playback.
Scan Rev	Move in reverse by 10 seconds in current file then start playback.
Continue	If stopped, starts playback of last file selected. If in play pause, continues to play from current location. If in record pause, continues to record at end of file.
Pause	If recording or playing, enter pause mode. If already paused, enter stop mode.
Trig Rec	Record a specific file using Trigger Channel.
Trig Play	Play a specific file using Trigger Channel.
Rec Current	Record the current (last selected) file.
Play Current	Play the current (last selected) file.
Record File	Record a specific file number.
Play File	Play a specific file number.
Loop Toggle	Reverse the current state of all input to output connections.
Loop Off	Disconnect all inputs from outputs. (Loop Through Off).
Loop On	Connect all inputs to outputs. (Loop Through On).
Show Menu	Display the Show Menu.

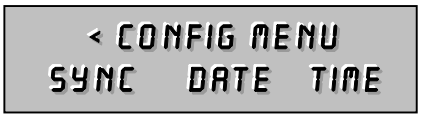
Depending upon the selection, the wizard may display an additional menu to select a specific file number. When complete, the menu reverts to select remote or Macro so that the next value can be programmed. Press the Menu key to exit this mode.

Config

The configuration Menu comprises of three sub menu's. The first is used to configure the inputs and outputs.

The second is used to control the behaviour of Four-Play at power on plus the MIDI interface.

The third is used to set time, date and automatic time synchronisation.



I/P

The I/P option is used to configure Inputs. Use the Cursor keys to select the required logical input or all inputs.

The cursor keys are used to select the source as either DMX512 or Art-Net.

If DMX512 is selected, the relevant physical DMX512 input is connected to this logical input.

If Art-Net is selected, the next menu allows the Art-Net Sub-Net and Universe to be selected. These numbers range from 0-0 to F-F. The first digit is the Sub-Net and the second the Universe.

O/P

The O/P option is used to control the output of Art-Net data for each of the four outputs. The Art-Net outputs are disabled by default, to avoid wasting bandwidth. The DMX512 outputs are always active.

Use the Cursor keys to select the required logical output or all outputs. Press Next to continue.

Use the Cursor keys to enable or disable the Art-Net output.

If Art-Net is selected, the next menu allows the Art-Net Sub-Net and Universe to be selected. These numbers range from 0-0 to F-F. The first digit is the Sub-Net and the second the Universe. Avoid setting the addresses to values used by other Art-Net devices used on the network.

Boot

The Boot Menu defines the action that Four-Play will take when it is powered on or 'booted'.

The options are:

- None: No action is performed after boot.
- Loop: The DMX512 inputs are connected to the outputs.
- Play File: A specific file is played back.

MIDI

MIDI Note Commands can be used to simulate pressing the Macro and Remote keys. This menu is used to define the MIDI Channel and MIDI Note that is used for this purpose. The MIDI Channel can be set to any number in the range 00 to 15.

The MIDI Note can be set to any value from 0 to 127. This is the offset that is subtracted from the received MIDI Note On command.

For example: If Channel = 00 and Note = 000, a received Note On command for Channel 0 at Note 0 will trigger Macro 1.

However: If Channel = 00 and Note = 100, a received Note On command for Channel 0 at Note 100 will trigger Macro 1.

The following table describes the MIDI Trigger options:

EVENT	CHANNEL	NOTE	EFFECT	HEX CODE
Note On	0	0	Trigger Macro 1	90 00 7F
Note On	0	1	Trigger Macro 2	90 01 7F
Note On	0	2	Trigger Macro 3	90 02 7F
↓	↓	↓	↓	↓
Note On	0	8	Trigger Remote 1	90 08 7F
↓	↓	↓	↓	↓
Note On	0	15	Trigger Remote 8	90 0F 7F

The MIDI velocity value must exceed 75% to generate a trigger. Note Off is ignored. Running Status is not implemented.

Sync

Sync mode defines the method by which Four-Play synchronises the internal Real Time Clock.

The menu allows one of two modes to be selected: Master or Slave.

- Master Mode: Four-Play transmits an Art-Net TimeSync packet over the network at one minute past the hour.
- Slave Mode: Four-Play listens for an Art-Net TimeSync packet and synchronises its internal real time clock.

Time Synchronisation can be used in the following four modes:

- Single Four-Play with no network connection. Setting is ignored.
- Two or more Four-Play connected together. One Four-Flay is set to Master. The others are set to Slave. All Four-Play will synchronise their clocks.
- One or more Four-Play connected to network running DMX-Workshop. All Four-Play set to Slave mode. DMX-Workshop transmits the TimeSync packet over the network. If DMX-Workshop has an Internet connection and is configured to automatically connect to a time server, all the Four-Play will synchronise to Internet time.

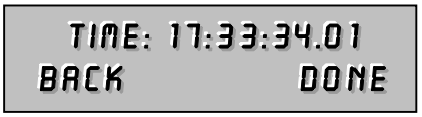
Please note the following: There can only be one Master. Setting multiple Masters or setting any Masters when connected to DMX-Worshop will cause eratic operation!

Date

The Date does not need to be set when using Time Sync mode. To set the date manually, follow the wizard then press Done.

Time

The Time does not need to be set when using Time Sync mode. To set the time manually, use the cursor keys and press Done.



APPLICATIONS

OVERVIEW

Four-Play is a remarkably versatile product that can be used in a wide range of applications. This chapter details some possible applications and the key settings required.

EXAMPLE 1 POS/POI

In this example, Four-Play is used to control lighting for a Point of Sale or Point of Information.

The requirement is simply that the lighting control starts running when the system is powered on.

A Lighting console is used to author the show, which is then recorded to Four-Play. At that point, the lighting console is no longer required.

Four-Play requires two configuration setting:

- Set the show to loop continuously. This is achieved with:

  MENU | SHOW | REC | FILE001 | EDIT | ATEND=Loop

- Set the show to start automatically. This is achieved with:

  MENU | SETUP | CONF | >> | BOOT=Play | FILE001

The above example assumes the file was recorded to File001.

EXAMPLE 2 MUSEUM EXHIBIT

In this example, Four-Play is used to control lighting for a museum exhibit.

The requirement is that the lights run a default show until a visitor walks through a beam break detector. The exhibit show then runs to completion and control returns to the default show.

The beam break sensor is connected to the remote input contact closure 1.

A Lighting console is used to record the two shows. The default show is recorded to File001 and the exhibit show to File002.

Four-Play requires four configuration setting:

- Set the default show to loop continuously. This is achieved with:

  MENU | SHOW | REC | FILE001 | EDIT | ATEND=Loop

- Set the exhibit show to return to the default show when complete. This is achieved with:

  MENU | SHOW | REC | FILE002 | EDIT | ATEND=Link File001

- Set the exhibit show to trigger from Remote Input 1. This is achieved with:

  MENU | SETUP | KEYS | REM | REM 1 | PLAY File001

- Set the default show to start automatically. This is achieved with:

  MENU | SETUP | CONF | >> | BOOT=Play | FILE001

EXAMPLE 3
GAME SHOW

In this example, Four-Play is used to control lighting for a TV Game Show. Let's say there are eight contestant positions each with an array of lights.

The requirement is that the studio lighting console has default control of the lights. When a contestant presses a button, the lights at their position sequence for a few seconds then return control to the studio lighting console.

The contestant buttons are connected to the remote input contact closure 1 - 8.

The studio lighting console is used to record the eight shows into File001 to File008.

Four-Play requires three configuration setting:

- Set each show to return control to the lighting console when complete. This is achieved with (repeat 8 times for each show):

  MENU | SHOW | REC | FILE001 | EDIT | ATEND=Go DMX

- Set each show to trigger from its respective Remote Input. This is achieved with (repeat 8 times for each show):

  MENU | SETUP | KEYS | REM | REM 1 | PLAY File001

- Set the power on default to give control to the lighting console. This is achieved with:

  MENU | SETUP | CONF | >> | BOOT=Loop

EXAMPLE 4 CAR LAUNCH

In this example, Four-Play is used to control lighting for a Car Launch. The lighting show is to be slaved to an AV control system that outputs timecode.

The show requires two different main shows of 30 minute duration.

The time code output of the AV system is connected to the MIDI input of Four-Play. As the show uses moving lights, it is necessary to ensure that all the lights see a reset-strike sequence when the system is first powered.

A lighting console is used to record three shows. File001 is the Main 1 show. File002 is the Main 2 show. File003 is the reset sequence.

Four-Play requires four configuration setting:

- Set the reset show to start automatically. This is achieved with:

  MENU | SETUP | CONF | >> | BOOT=Play | FILE003

- Set the reset show to stop when complete. This is achieved with:

  MENU | SHOW | REC | FILE002 | EDIT | ATEND=None

- Set the Main 1 show to track timecode starting at hour 1. This is achieved with:

  MENU | SHOW | REC | FILE001 | EDIT | TIMEMODE=MTC

  TIME=01:00:00.00 | DAY=ALL

- Set the Main 2 show to track timecode starting at hour 2. This is achieved with:

  MENU | SHOW | REC | FILE002 | EDIT | TIMEMODE=MTC

  TIME=02:00:00.00 | DAY=ALL

EXAMPLE 5 THEATRE BACKUP

In this example, Four-Play is used to backup a lighting controller in a theatre show.

The lighting controller is not using channel 2048, so that channel is chosen as the Trigger Channel. The lighting controller is programmed such that channel 2048 transitions from off to full at the very beginning of the show. It does not change for the remainder of the show.

The DMX512 outputs of the lighting console are connected to the DMX512 inputs of Four-Play. The Loop outputs of Four-Play are terminated and the Main outputs of Four-Play connect to the Stage.

- The lighting console show is recorded to File001 in Four-Play using triggered record mode. This ensures that the start of the recorded file is exactly synchronised to the start of the lighting controller show. This is achieved as follows:

  MENU | SHOW | REC | File001 | NEXT | YES

  TRIG | 2048 | GO

  Start playback of the lighting controller. Four-Play will change from Record-Pause to Record mode when the Trigger Channel fires. At the end of the show press the following to stop recording:

  PAUSE | PAUSE

- Now set Four-Play to operate in Backup mode. This is achieved with:

  MENU | SHOW | B-UP | FILE001 | TRIG | 2048 | GO

Four-Play activates loop through so that the lighting controller has control of the stage. When the trigger channel is detected, it starts playing back the show in the background. If DMX512 from the lighting controller should fail, Four-Play takes control of the outputs.

EXAMPLE 6 MULTIPLE UNIVERSE REAL TIME CONTROL

In this example, two Four-Play are used to control 8 universes of lighting via DMX512.

The show requires that triggering occur at a specific time of day.

There are two key considerations when preparing this type of show:

1. The show must be recorded accurately into both Four-Play. This is achieved using triggered record.
2. The real time clocks of each Four-Play must be synchronised.

The 8 DMX512 outputs of the lighting console are connected to the DMX512 inputs of each Four-Play. The Loop outputs of the Four-Plays are terminated and the Main outputs of the Four-Plays connect to the Stage. The network connections of the Four-Plays are connected using a cross over cable.

- The lighting console show is recorded to File001 in both Four-Plays using triggered record mode. This ensures that the start of the recorded file is exactly synchronised to the start of the lighting controller show. This is achieved as follows:

  MENU | SHOW | REC | File001 | NEXT | YES

  TRIG | 2048 | GO

  Start playback of the lighting controller. Both Four-Play will change from Record-Pause to Record mode when the Trigger Channel fires. At the end of the show press the following to stop recording:

  PAUSE | PAUSE

  The above assumes that channel 2048 and 4096 is not used by the lighting controller and are used to trigger Four-Play. The lighting controller is programmed such that channels 2048 & 4096 transition from off to full at the very beginning of the show. These channels do not change for the remainder of the show.

- On each Four-Play the show must be set to trigger at a specific time. In this example we use 1.30pm every day. This is achieved with:

  MENU | SHOW | REC | FILE001 | EDIT | TIMEMODE=CLOCK

  TIME=13:30:00.00 | DAY=ALL

  It is also possible to have different shows run on different days by adjusting the 'Day' setting.

- The final setting is to synchronise the real time clocks in the Four-Plays. This is necessary because all real time clocks have a drift rate. If not synchronised, the clocks in the two Four-Play would gradually drift apart. This is achieved with:

  First Four-Play:

  MENU | SETUP | CONF | >> | >> | SYNC=Master

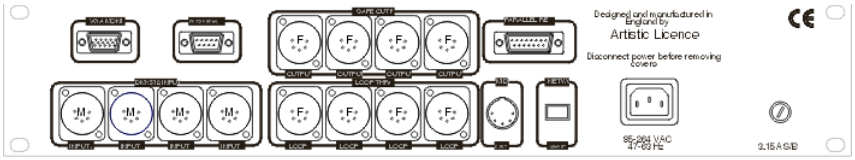
  Second Four-Play:

  MENU | SETUP | CONF | >> | >> | SYNC=Slave

C O N N E C T I O N S

OVERVIEW

All Four-Play connections are mounted on the rear of the unit as shown below:



DMX512 INPUTS

The DMX512 input of each universe is optically isolated from Four-Play. There is no connection between control ground and chassis or mains earth. The input is unterminated. The loop connector is directly connected to each input and can be used for termination or loop through as required.

Wiring for the Input and Loop connector is as follows:

Pin 1	Isolated ground
Pin 2	Data minus
Pin 3	Data Plus
Pin 4	No Connection
Pin 5	No Connection

DMX512 OUTPUTS

There are two sets of four DMX output universes on Four-Play. The "Safe" outputs are controlled by Four-Play itself and are used for replay and back-up. The "Loop through" outputs are entirely passive and provide a DMX route through Four-Play even when the power is turned off. All DMX output connectors are wired to the appropriate standards as above.

REMOTE INPUT

The Remote interface provides 8 contact closure inputs for Remote triggering. A Remote is triggered by shorting together the ground and input pin.

A Maximum cable length of 5m is advised and the cable should be screened. Do not make any connections to voltage sources or Mains Earth.

Wiring is as follows:

Pin 1	Aux 8
Pin 2	Aux 7
Pin 3	Aux 6
Pin 4	Aux 5
Pin 5	Aux 4
Pin 6	Aux 3
Pin 7	Aux 2
Pin 8	Aux1
Pin 15	Ground

RS232

The RS232 port is not used by Four-Play.

ART-NET

The RJ45 is a 10BaseT ethernet link for use with Art-Net. Amongst many other facilities, this port allows the recording of shows from Art-Net compliant consoles such as Jands Vista and Zero-88 Frog, without converting to DMX512.

MIDI

The MIDI port is used for receiving MIDI triggers and MIDI Time Code. The input is optically isolated and conforms to standard MIDI wiring.

VIDEO

The video output is a high density 15 pin DB style connector. It conforms to the S/VGA wiring standard.

POWER

The Power input is a universal voltage range mains connection. The product shall be connected to a suitable earthed outlet.

The fuse must only be changed when the product is disconnected from the power. The fuse rating is printed on the rear panel.

NETWORK ADMIN

OVERVIEW

Four-Play can be administered via the network connection. To achieve this the software package 'DMX-Workshop' must be installed on a PC running Windows XP.

DMX-Workshop offers the following functionality:

- Remote control of front panel switches.
- Viewing of file parameters and other configuration.
- Backup of show files.
- Firmware upgrade.
- Real time clock synchronisation.
- Multiple Four-Play, synchronised record.

This chapter describes installation, configuration and use of the software.

INSTALLATION

DMX-Workshop is a 32 bit application specifically designed to operate with Windows XP. Whilst it will operate on Windows 98, Windows ME, Windows NTv4 and Windows 2000, we advise Windows XP.

The minimum specification PC is:

- Processor: Pentium
- Speed: 133MHz
- RAM: 512MB
- Operating System: Windows 95 / 98 / ME / 2K / XP
- Graphics: 800 x 600 8 bit Colour

Windows 2000, NT & XP Users

The Windows 2000, Windows NT and Windows XP operating systems provide the concept of User Rights. This allows different users to be granted different access rights to the computer.

The highest level of access rights is called 'Administrator'. DMX-Workshop will NOT install correctly unless you are logged onto the computer with Administrator rights.

If your computer is part of a network, you must ask your system administrator to set the computer for Administrator rights.

If you are a single user, the following sequence shows how to change the settings:

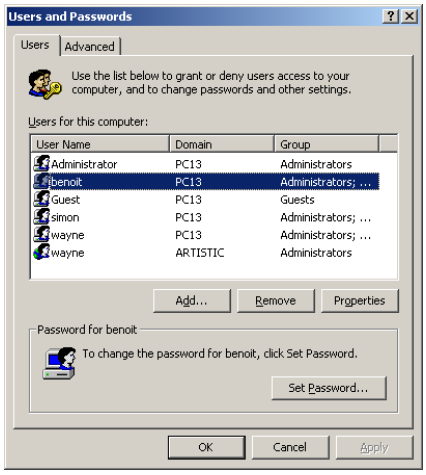
Administrator Rights

Administrator rights are set in the Windows Users & Passwords section:

To access this, select the Start Menu – Settings – Control Panel menu.

In the Control Panel, double click on the Users & Passwords icon. The following dialogue will be displayed:

Select the user who will install DMX-Workshop. In this example it is Benoit. Then press the Properties button.

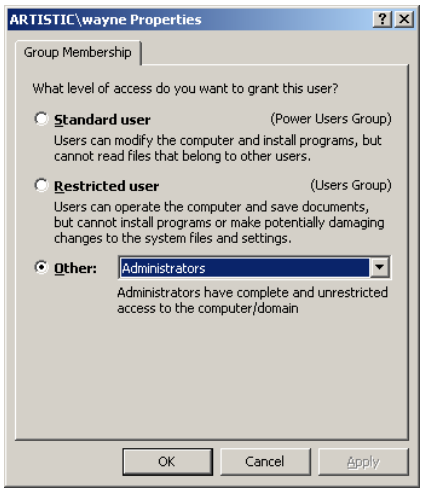


The following dialogue will then be displayed:

Select the 'Other' checkbox.

Select 'Administrators' from the pull down list.

Press OK. You should now restart Windows and then log on as the user name that you have edited.



SOFTWARE INSTALLATION

DMX-Workshop is supplied on CD. To install use the following procedure:

If you are upgrading, first uninstall the existing copy DMX-Workshop.

- Shutdown any applications running on your computer
- Insert the CD in drive.
- Wait for CD to start, then select 'Enter CD'.
- Select the 'Software' button.
- Select the 'DMX-Workshop' button.
- Install Shield will then guide you through the remainder of the procedure.

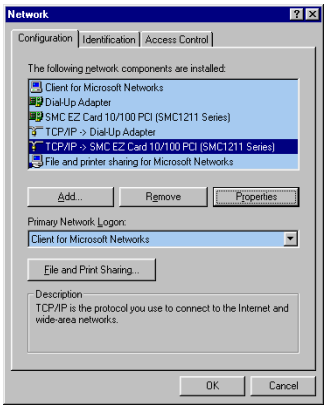
CONFIGURATION

Before starting to use the system you will need to configure your network interface. The process is very simple and is described below.

Art-Net

To communicate with Four-Play you must configure the PC Ethernet card. It is necessary to set two parameters, the IP address and the Subnet Mask.

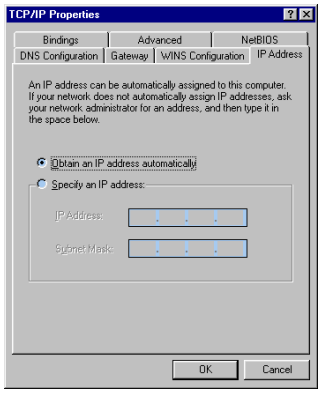
These settings are adjusted in the Windows Network Settings Dialogue. To access this, select the Start Menu – Settings – Control Panel menu.



In the Control Panel, double click on the Network Icon. The following dialogue will be displayed:

Select the TCP/IP protocol line and then press the properties button.

The following dialogue will then be displayed:

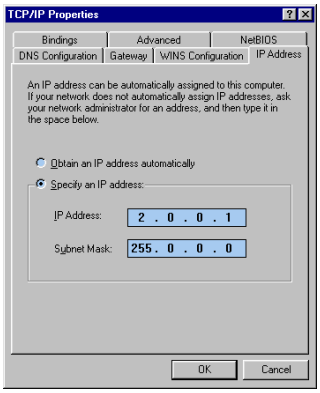


Select the radio button marked 'Specify an IP Address'.

Type the number 2.0.0.1 into the first box.

Type the number 255.0.0.0 into the second box.

The display should be as follows:



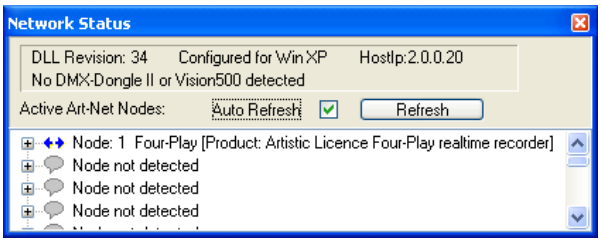
Select the DNS Tab and click on disable DNS.

Press the OK button but do not restart the computer yet.

When using the Art-Net output, ensure that your network is not connected to the Internet.

OPERATION

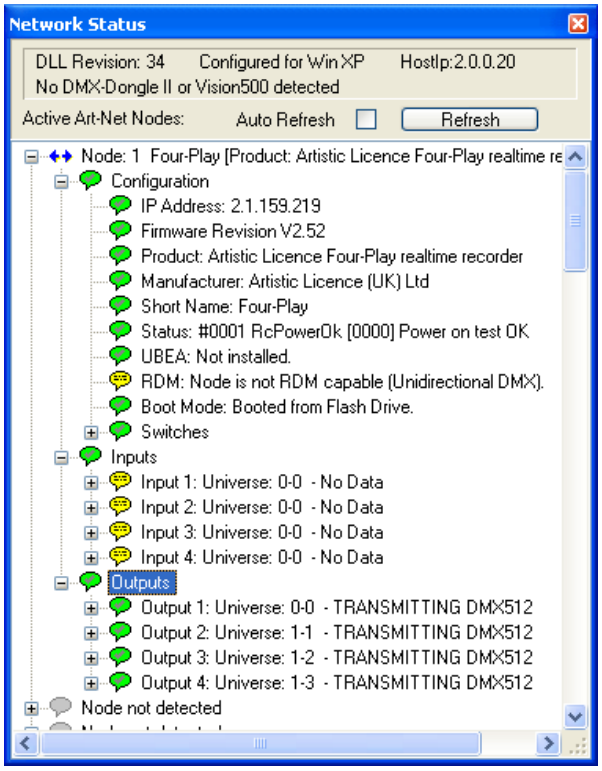
Any Four-Plays connected to the system are displayed in the Network Status dialogue.
To access this, click on the Network button.



The '+' symbol indicates that more information exists below this level. Expanding these levels results in the following display:

Icon levels are colour coded green, yellow and red. Red indicates an error condition. Yellow indicates a warning.

In this example the DMX512 inputs are shown in yellow, as there is no data received.

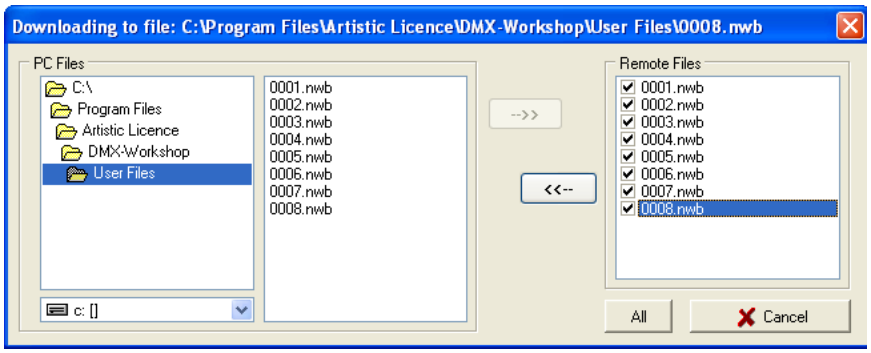


CONTROL

The Four-Play is controlled using the popup menu displayed when the mouse is right clicked over an entry. The menu provides numerous options which are described below:

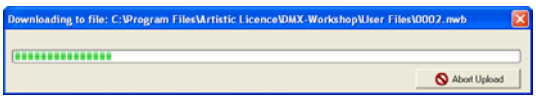
File Transfer

File transfer is used to copy or backup files between the Four-Plays and PC. Select 'File Transfer from the popup menu. The following dialogue is displayed.



The display on the right shows all the files that exist in Four-Play. To make a backup copy of these files, tick the boxes and then press the arrow button pointing left. This will transfer the files to the PC.

During the transfer, a status bar is displayed:



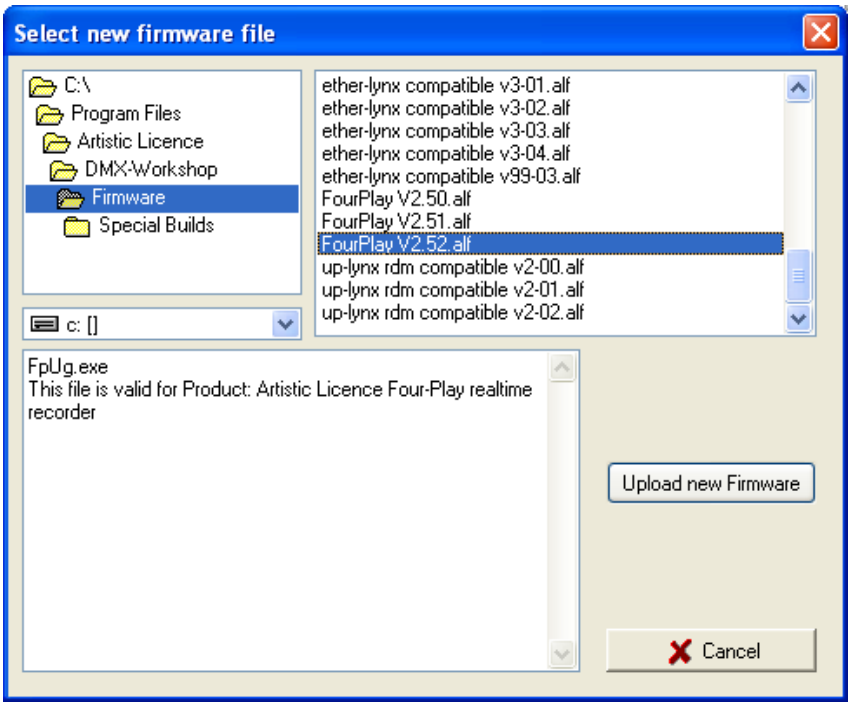
To copy a file from the PC to a Four-Play, select the file in the list to the left of the display. Press the arrow button pointing to the right.

The file copy facility is also very useful for 'cloning' a number of Four-Play with identical shows. For example, a chain of retail outlets.

Firmware Upload

From time to time, Artistic Licence release new versions of firmware for Four-Play. You can keep your product up to date by uploading these new releases.

Firmware upload is also accessed from the right click popup menu in the network display. The following dialogue is displayed.



Once you have downloaded the firmware update from the internet, copy it to:

C:\\Program Files\Artistic Licence\DMX-Workshop\Firmware\

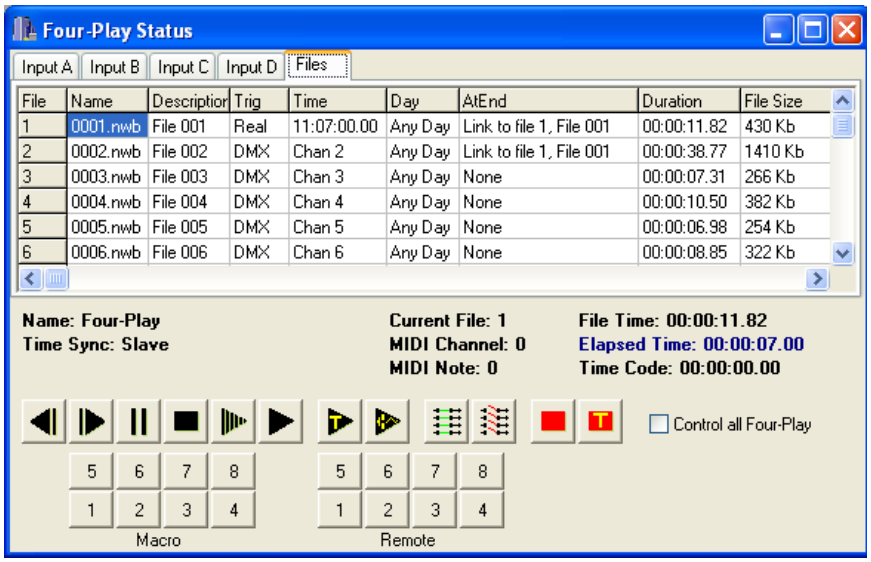
Select the FourPlay Vx.yz.alf file with the highest revision number. The status display (lower left) should confirm that the selected file is a valid file for Four-Play. Then press the upload button.

A progress bar will be displayed. When the upload completes, Four-Play will reboot. It is sensible to backup your show file prior to upgrading the product.

STATUS

The operating status and file configuration of Four-Play can be displayed. Select the configuration option from within the popup menu.

The information screen is shown below. The top section is controlled by the tab selects and allows all 4 data paths plus the file listing to be viewed.



The lower section provides remote control of the Four-Play. Note the tick box which allows this dialogue to control all Four-Play connected to the network.

From left to right, the button functions are:

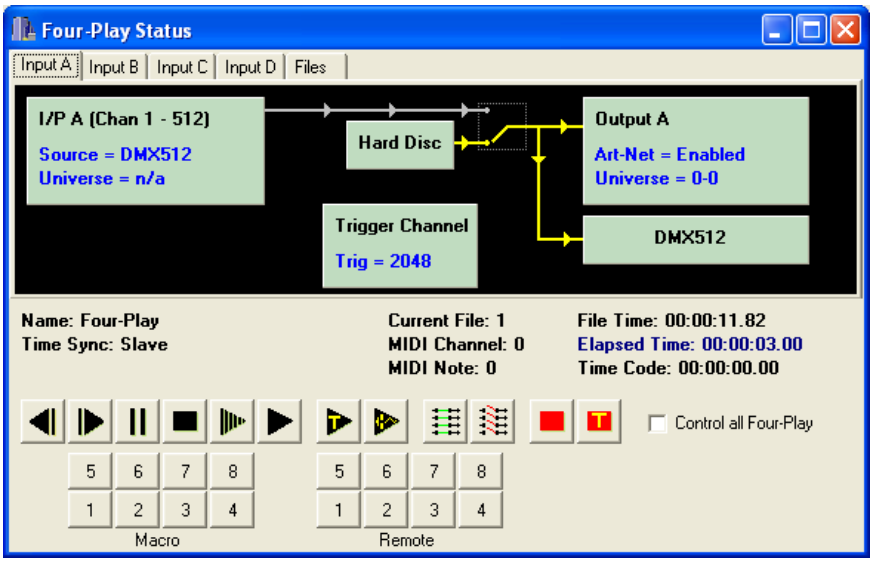
- Scan Reverse
- Scan Forward
- Pause
- Stop
- Continue
- Play
- Play Triggered
- Play Auto-Backup
- Loop On (Inputs connect to output)
- Loop Off (Inputs not connected to output)
- Record
- Record Triggered

DATA PATHS

The following section shows each of the possible data path displays.

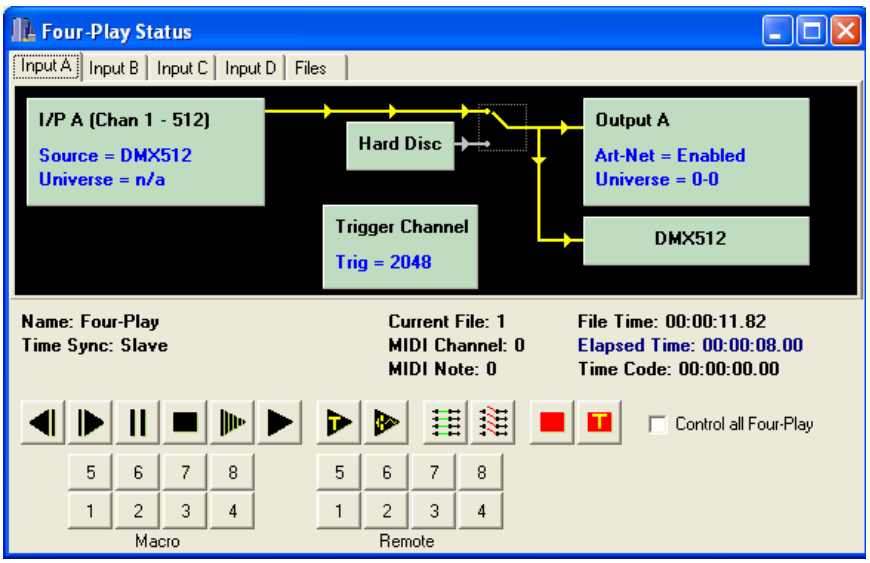
Playback

The yellow arrows show the active data path. In this example the Four-Play is playing a file and the output is both DMX512 and Art-Net.



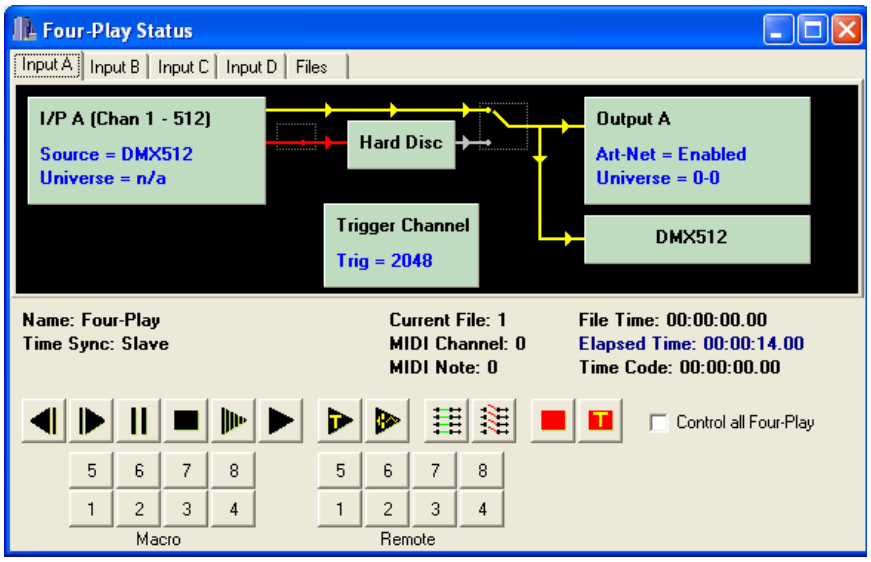
Loop Though

In this example, the DMX512 input is converted to Art-Net and also output as DMX512. This gives the external lighting controller control of the lights whilst also acting as a protocol convertor.



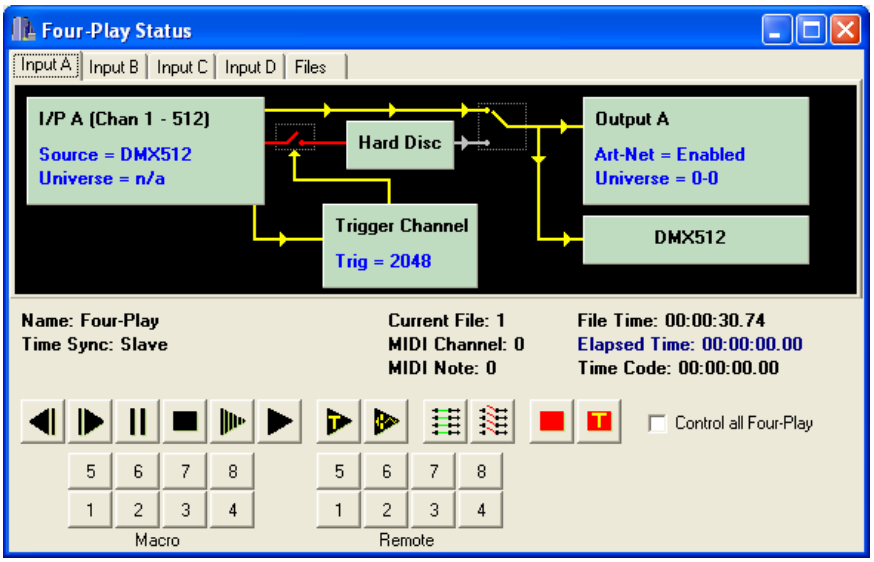
Record

The record data path is shown in red. In this example, the DMX512 input is being recorded to the hard disc. At the same time, that signal is converted to Art-Net and also output to DMX512.



Triggered Record

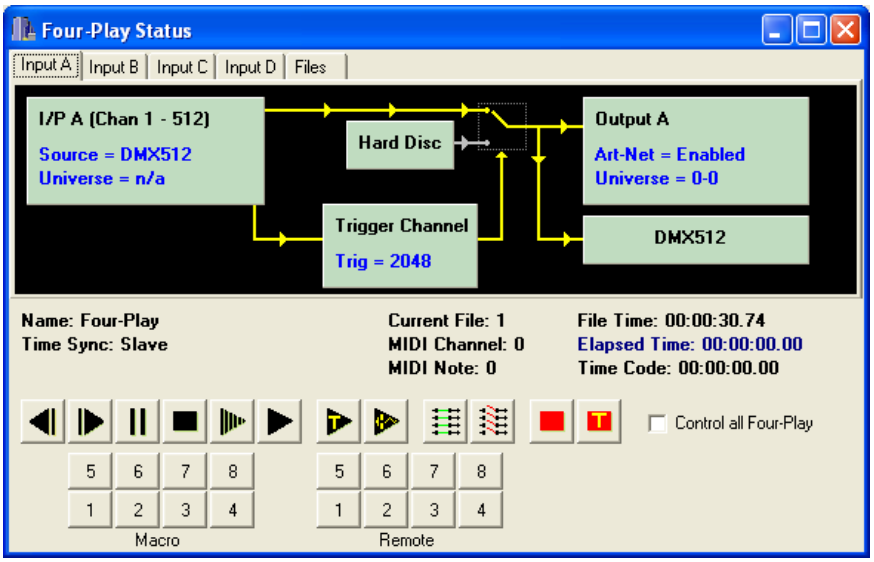
The record data path is shown in red. In this example, Four-Play is in record pause, awaiting a trigger from Channel 2048 of the input.



At the same time, that signal is converted to Art-Net and also output to DMX512.

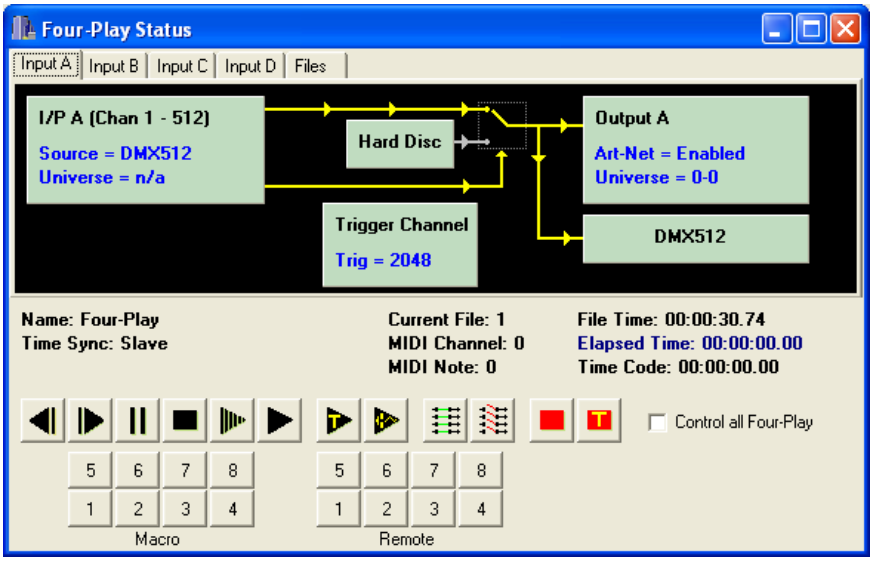
Triggered Playback

In this example, Four-Play is in triggered playback mode. The inputs are connected to the outputs and will switch to playback when trigger channel 2048 fires.



Auto Backup

In this example, Four-Play is in auto backup mode. The inputs are connected to the outputs and the show file is playing back in the background. Four-Play will disconnect the inputs and take control of the show if a loss of data is detected.



TROUBLE SHOOTING

OVERVIEW

This chapter is intended to give guidance on trouble shooting during setup and configuration.

NETWORK

PC shows 'network cable unplugged' but Four-Play is connected.	Most likely caused by incorrect type of network cable. If connecting the Four-Play directly to PC use a cross over cable. If using a hub, use straight wired patch cable.
Four-Play is displayed with a 'no entry' icon in the network list.	The IP address or sub net mask of the PC is set incorrectly. DMX-Workshop has detected the Four-Play but cannot communicate properly due to the incorrect network settings.
Four-Play is not displayed in the network list.	a) Check cable type is correct. b) Check IP address. c) Check correct NIC is selected in Driver menu.
When using Art-Net input, data is flickering.	This can be caused if the Art-Net output of Four-Play is enabled and incorrectly set to a duplicate universe address.
Attempting to merge multiple streams of Art-Net data to a logical input does not work correctly.	Four-Play does not currently support Art-Net merge. If this functionality is required, use Art-Merge.

CLOCK

Four-Play real time clock is not synchronised to PC clock.	Ensure synchronisation is enabled in DMX-Workshop. Menu selection is: Art-Net Driver Time Synchronisation Automatic
Real time clock behaves erratically.	One or more Four-Play is set to Master Time Sync mode as well as the PC. There can only be one master time clock.
Real time clock is not synchronised to Internet Time.	Ensure the PC has a permanent Internet connection. Internet time is enabled by: Start Control Panel Date & Time Internet Time

CONVERSION TABLES

Dec	Hex	Binary	Dec	Hex	Binary	Dec	Hex	Binary
0	00	0000 0000	32	20	0010 0000	64	40	0100 0000
1	01	0000 0001	33	21	0010 0001	65	41	0100 0001
2	02	0000 0010	34	22	0010 0010	66	42	0100 0010
3	03	0000 0011	35	23	0010 0011	67	43	0100 0011
4	04	0000 0100	36	24	0010 0100	68	44	0100 0100
5	05	0000 0101	37	25	0010 0101	69	45	0100 0101
6	06	0000 0110	38	26	0010 0110	70	46	0100 0110
7	07	0000 0111	39	27	0010 0111	71	47	0100 0111
8	08	0000 1000	40	28	0010 1000	72	48	0100 1000
9	09	0000 1001	41	29	0010 1001	73	49	0100 1001
10	0A	0000 1010	42	2A	0010 1010	74	4A	0100 1010
11	0B	0000 1011	43	2B	0010 1011	75	4B	0100 1011
12	0C	0000 1100	44	2C	0010 1100	76	4C	0100 1100
13	0D	0000 1101	45	2D	0010 1101	77	4D	0100 1101
14	0E	0000 1110	46	2E	0010 1110	78	4E	0100 1110
15	0F	0000 1111	47	2F	0010 1111	79	4F	0100 1111
16	10	0001 0000	48	30	0011 0000	80	50	0101 0000
17	11	0001 0001	49	31	0011 0001	81	51	0101 0001
18	12	0001 0010	50	32	0011 0010	82	52	0101 0010
19	13	0001 0011	51	33	0011 0011	83	53	0101 0011
20	14	0001 0100	52	34	0011 0100	84	54	0101 0100
21	15	0001 0101	53	35	0011 0101	85	55	0101 0101
22	16	0001 0110	54	36	0011 0110	86	56	0101 0110
23	17	0001 0111	55	37	0011 0111	87	57	0101 0111
24	18	0001 1000	56	38	0011 1000	88	58	0101 1000
25	19	0001 1001	57	39	0011 1001	89	59	0101 1001
26	1A	0001 1010	58	3A	0011 1010	90	5A	0101 1010
27	1B	0001 1011	59	3B	0011 1011	91	5B	0101 1011
28	1C	0001 1100	60	3C	0011 1100	92	5C	0101 1100
29	1D	0001 1101	61	3D	0011 1101	93	5D	0101 1101
30	1E	0001 1110	62	3E	0011 1110	94	5E	0101 1110
31	1F	0001 1111	63	3F	0011 1111	95	5F	0101 1111

Dec	Hex	Binary	Dec	Hex	Binary	Dec	Hex	Binary
96	60	0110 0000	128	80	1000 0000	160	A0	1010 0000
97	61	0110 0001	129	81	1000 0001	161	A1	1010 0001
98	62	0110 0010	130	82	1000 0010	162	A2	1010 0010
99	63	0110 0011	131	83	1000 0011	163	A3	1010 0011
100	64	0110 0100	132	84	1000 0100	164	A4	1010 0100
101	65	0110 0101	133	85	1000 0101	165	A5	1010 0101
102	66	0110 0110	134	86	1000 0110	166	A6	1010 0110
103	67	0110 0111	135	87	1000 0111	167	A7	1010 0111
104	68	0110 1000	136	88	1000 1000	168	A8	1010 1000
105	69	0110 1001	137	89	1000 1001	169	A9	1010 1001
106	6A	0110 1010	138	8A	1000 1010	170	AA	1010 1010
107	6B	0110 1011	139	8B	1000 1011	171	AB	1010 1011
108	6C	0110 1100	140	8C	1000 1100	172	AC	1010 1100
109	6D	0110 1101	141	8D	1000 1101	173	AD	1010 1101
110	6E	0110 1110	142	8E	1000 1110	174	AE	1010 1110
111	6F	0110 1111	143	8F	1000 1111	175	AF	1010 1111
112	70	0111 0000	144	90	1001 0000	176	B0	1011 0000
113	71	0111 0001	145	91	1001 0001	177	B1	1011 0001
114	72	0111 0010	146	92	1001 0010	178	B2	1011 0010
115	73	0111 0011	147	93	1001 0011	179	B3	1011 0011
116	74	0111 0100	148	94	1001 0100	180	B4	1011 0100
117	75	0111 0101	149	95	1001 0101	181	B5	1011 0101
118	76	0111 0110	150	96	1001 0110	182	B6	1011 0110
118	77	0111 0111	151	97	1001 0111	183	B7	1011 0111
119	78	0111 1000	152	98	1001 1000	184	B8	1011 1000
120	79	0111 1001	153	99	1001 1001	185	B9	1011 1001
121	7A	0111 1010	154	9A	1001 1010	186	BA	1011 1010
122	7B	0111 1011	155	9B	1001 1011	187	BB	1011 1011
123	7C	0111 1100	156	9C	1001 1100	188	BC	1011 1100
124	7D	0111 1101	157	9D	1001 1101	189	BD	1011 1101
125	7E	0111 1110	158	9E	1001 1110	190	BE	1011 1110
126	7F	0111 1111	159	9F	1001 1111	191	BF	1011 1111

Dec	Hex	Binary	Dec	Hex	Binary
192	C0	1100 0000	224	E0	1110 0000
193	C1	1100 0001	225	E1	1110 0001
194	C2	1100 0010	226	E2	1110 0010
195	C3	1100 0011	227	E3	1110 0011
196	C4	1100 0100	228	E4	1110 0100
197	C5	1100 0101	229	E5	1110 0101
198	C6	1100 0110	230	E6	1110 0110
199	C7	1100 0111	231	E7	1110 0111
200	C8	1100 1000	232	E8	1110 1000
201	C9	1100 1001	233	E9	1110 1001
202	CA	1100 1010	234	EA	1110 1010
203	CB	1100 1011	235	EB	1110 1011
204	CC	1100 1100	236	EC	1110 1100
205	CD	1100 1101	237	ED	1110 1101
206	CE	1100 1110	238	EE	1110 1110
207	CF	1100 1111	239	EF	1110 1111
208	D0	1101 0000	240	F0	1111 0000
209	D1	1101 0001	241	F1	1111 0001
210	D2	1101 0010	242	F2	1111 0010
211	D3	1101 0011	243	F3	1111 0011
212	D4	1101 0100	244	F4	1111 0100
213	D5	1101 0101	245	F5	1111 0101
214	D6	1101 0110	246	F6	1111 0110
215	D7	1101 0111	247	F7	1111 0111
216	D8	1101 1000	248	F8	1111 1000
217	D9	1101 1001	249	F9	1111 1001
218	DA	1101 1010	250	FA	1111 1010
219	DB	1101 1011	251	FB	1111 1011
220	DC	1101 1100	252	FC	1111 1100
221	DD	1101 1101	253	FD	1111 1101
222	DE	1101 1110	254	FE	1111 1110
223	DF	1101 1111	255	FF	1111 1111

INDEX

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