

[V1.3]

# DMX / MIDI DECODER Model DMX648 Operating Instructions

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# **1. INTRODUCTION**

The DMX648 is a DMX / MIDI decoder designed to receive either DMX512, MIDI Music or MIDI Show Control signals and to convert them into a number of analogue outputs.

The decoder has 48 output channels, which can provide control signals of from 0 to  $\pm$ 10 Volts. The unit can be preset so that there is a linear rise from 0 to 10 Volts, or a non-linear rise which gives an 'S' type dimming law.

In addition the decoder contains a back-up memory which can be pre-programmed by the user. The unit can then be set to monitor the incoming signal and in the event of signal loss will switch the back-up scene to the outputs. Alternatively the user can set the decoder so that if the input signal is lost the last levels received remain on the outputs. As the back-up memory is non-volatile the back-up state is retained when there is no power to the unit.

A test mode is also available which cycles through every output in sequence ramping the output from 0V to +10V and back to 0V again.

The decoder can be powered from either the mains supply, or from a suitable d.c. power supply unit, such as a dimmer rack . The unit is housed in a 19" by 1U case, which can be rack mounted.

This document assumes that the reader has a basic knowledge of the MIDI Music and MIDI Show Control communications protocols. If any difficulty occurs whilst setting the operating conditions of the decoder it is recommended that the user also refers to the relevant protocol's specification.

# **2. FRONT PANEL LAYOUT**

# 2.1 MONITOR

The MONITOR window contains two lights. The first light labelled REC. DATA illuminates when the unit is receiving DMX or MIDI signals. In the event of signal loss the light will turn off. The second light labelled WATCH DOG indicates the general state of the decoder. In normal operation, when power is applied to the unit the light will turn on. If the light fails to illuminate it indicates that a hardware fault or a software crash has occurred and the unit should be returned to the dealer or manufacturer for repair.

# 2.2 CODE

When decoding DMX data the CODE switches are used to select the DMX Start Code to which the decoder will respond.

When decoding MIDI Music commands the switches are used to select the MIDI Channel Number and when decoding MIDI Show Control commands the Command Format.

# 2.3 OPTIONS

The OPTIONS switch labelled PROG. LOCK is used to lock the back-up memory. When the switch is in the up position the PROG. function is enabled and when in the down position disabled. When the switch labelled S-LAW 1-24 is in the down position the outputs 1 to 24 operate under an S type dimming law. When the switch is in the up position the outputs operate in a linear mode. The OPTIONS switch labelled S-LAW 25-48 has the same effect but on the outputs 25 to 48.



The switch labelled MSC / MUSIC is used to select the MIDI input format . When the switch is in the MSC position the unit will decode MIDI Show Control commands and in the MUSIC position MIDI Music commands.

The switches labelled VELOCITY and NOTE OFF are used to tell the decoder how it is to interpret MIDI Music Velocity and Note Off messages.

# 2.4 START ADDRESS

When decoding DMX512 data the START ADDRESS switches are used to select the DMX Channel Number which corresponds to the first output of the decoder. For example if the unit was receiving DMX data containing levels for 512 dimmers it can be set to decode any block of 48 levels from the 512 received.

When decoding MIDI Music commands the switches are used to select the start Note Number which corresponds with the first output of the decoder. For example if the decoder was being driven by a MIDI Keyboard with a Note Number range of 0 to 127, it could be set to decode any block of 48 Notes from the 128 that could be received.

When decoding MIDI Show Control commands the START ADDRESS switches are used to select the Device Identification Number to which the decoder will respond.

## 2.5 MEMORY

The MEMORY switch has three positions : USER, LAST and PROG. Moving the switch to the PROG position, when the OPTIONS switch PROG. LOCK is up, will cause the output levels to be stored in the back-up memory. If the PROG. LOCK switch is in the down position the PROG function is disabled and the back-up memory cannot be written to.

The positions LAST and USER instruct the unit how it is to respond if the input signal is disconnected. When in the LAST position the unit will leave the outputs at the current levels. When in the USER position the unit will set the output levels to those stored in the back-up memory.

The MEMORY functions can be selected during normal operation without having to press the RESET button.

# 2.6 MODE

The MODE switch is used to select the main operating mode of the decoder. So that the unit cannot be accidentally switched from one mode to another the MODE switch is only read immediately after power-up or when the RESET button has been pressed.

The MODE lights show in which mode the unit is currently operating. If the MODE switch is moved during operation all the MODE lights will turn off. If the switch is then returned to its initial position the current MODE light will re-illuminate.

When the MODE switch is in the TEST position the decoder runs a self test program which cycles through every output in sequence ramping each one from 0V to 10V and back to 0V. By moving the MODE switch out of the TEST position the test cycle can be frozen. To re-instate the test cycle the MODE switch must be returned to the TEST position.

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When the MODE switch is set to the DMX position the decoder accepts DMX512 signals as its input.

When the MODE switch is in the MIDI position the decoder accepts either MIDI Music or MIDI Show Control signals as its input, depending on the position of the MUSIC / MSC OPTIONS switch.

## 2.7 SYSTEM

The SYSTEM window contains the RESET button and the POWER indicator. The POWER indicator illuminates when the unit is being powered either by mains input or by a suitable D.C. power supply unit.

Pressing the RESET button causes the unit to perform a complete systems reset. The output levels are reset to 0V and the front panel switches are read to establish the operating mode of the decoder. The back-up memory is not affected by a systems reset.

If the CODE, OPTIONS or START ADDRESS switch settings are altered during operation of the decoder the RESET button must be pressed for the new settings to take effect.

# 3. DMX512 (1990) INPUT

Connect the unit to the DMX source via the DMX INPUT connector situated at either the front or rear of the decoder and set the MODE switch to the DMX position.

Once the relevant switch settings have been made, as detailed below, either RESET or power up the decoder. The REC. DATA light will illuminate when DMX data is being received.

## 3.1 Setting the DMX Start Code

The CODE switches allow the user to select the DMX Start Code to which the decoder will respond. The Start Code range is 0 to 15 and is encoded on the switches in binary. Example.

Consider that the decoder is to respond to DMX data with a Start Code of 9. The CODE switches would be set as follows :

START

Where 0 = Off (Switch up) and 1 = On (Switch Down).

At present the DMX specification does not state how the different Start Codes are to be implemented therefore for the majority of applications the decoder will be set to respond to the NULL Start Code, all CODE switches up.



### 3.2 Setting the DMX Channel Number

The START ADDRESS switches allow the user to select the DMX Channel Number at which the unit will start decoding the DMX Levels and writing them to the outputs.

Example.

Consider that the decoder is being sent 512 DMX levels by a lighting desk and it is required that 48 channels from DMX Channel 15 onwards are decoded. The units START ADDRESS would be set as follows :

CHANNEL NO. 1 - 511  $1 \ 2 \ 4 \ 8 \ 16 \ 32 \ 64 \ 128 \ 256$ Switch state : 1 1 1 1 0 0 0 0 0 Total : 1 + 2 + 4 + 8 = 15.

Where 0 = Off (Switch up) and 1 = On (Switch down).

So the 15th DMX Level received will be written to output 1, the 16th to output 2..etc, up to the 62nd DMX Level received which will be written to output 48.

The Channel Number range is 0 to 511 where 0 and 1 are both interpreted as DMX Channel 1, 2 as DMX Channel 2 etc., up to 511 which is interpreted as DMX Channel 511.

# **4. MIDI INPUT**

The decoder is capable of decoding either MIDI Music or MIDI Show Control commands. Begin by setting the MODE switch to the position labelled MIDI.

Once the relevant switch settings have been made, as detailed below, either RESET or power up the decoder. The REC. DATA light will illuminate when MIDI data is being received.

# 4.1 MIDI Music Input

Connect the decoder to the MIDI Music source via the 5 pin DIN socket, labelled MIDI IN, situated at the rear of the unit. Then set the OPTIONS switch labelled MSC / MUSIC to the MUSIC position.

#### 4.1.1 Setting the MIDI Channel Number

The CODE switches allow the decoder to be set to respond to any one of the 16 MIDI Channel Numbers.

Example.

Consider that a MIDI Sequencer has been programmed to drive the decoder with a lighting track on MIDI Channel Number 8. The decoders Channel Number would be set on the CODE switches as follows :

_	1	2	4	8	

Switch state : 1 1 1 0

#### CHANNEL

Total : 1 + 2 + 4 = 7.

Where 0 = Off (Switch up) and 1 = On (Switch down).

The Channel Number is encoded on the switches in binary so that MIDI Channel 1 is coded as 0, MIDI Channel 2 as 1, MIDI Channel 3 as 2..etc. Up to MIDI Channel 16 which is coded as 15.

#### 4.1.2 Setting the MIDI Note Number

When the decoder is in MIDI Music mode the START ADDRESS switches are used to set the Note Number at which the unit starts to decode the MIDI Velocity data.

Example.

Consider that the decoder is being driven by a MIDI Keyboard with a Note Number range of 36 (C1) to 96 (C6) and it is required that output 1 of the decoder corresponds to the first note on the keyboard. The START ADDRESS switches would be set as follows :

Switch state : 1 2 4 8 16 32 64 128 256NOTE No. 0 - 127 Total : 4 + 32 = 36.

Where 0 = Off (Switch up) and 1 = On (Switch down), \* = Ignored.

The start Note Number is encoded in binary on the switches so that Note Number 36 corresponds to output 1, Note Number 37 to output 2..etc. Up to Note Number 83 which corresponds to output 48.

The MIDI Note Number range is 0 to 127 therefore the switches labelled 128 and 256 have no effect when selecting the start Note Number.

#### 4.1.3 Velocity Decoding

The OPTIONS switch labelled VELOCITY is used to tell the unit how it is to interpret MIDI Music Velocity bytes.

When the VELOCITY switch is in the up position Velocity Decoding is turned off, so that when a Note On message is received the corresponding Velocity byte is ignored and the output level set to its maximum (10V).

When the VELOCITY switch is in the down position Velocity Decoding is turned on, so that when a Note On message is received the corresponding Velocity byte is interpreted as the output level. The range of the Velocity byte is 0 to 127 where 0 corresponds to a 0V output and 127 a 10V output.



#### 4.1.4 Note Off Decoding

The OPTIONS switch labelled NOTE OFF is used to tell the decoder how to decode MIDI Note Off messages and MIDI Note On messages with Velocity = 0.

When the NOTE OFF switch is in the up position Note Off Decoding is inactive, so that when a Note Off message is received it is ignored.

When Note Off Decoding is turned off the decoder also ignores Note On messages which have a Velocity = 0.

In order that the outputs can be turned on and off when Note Off Decoding is inactive the decoder toggles the outputs. So the first Note On, Velocity > 0 message received will turn the output on, the next Note On, Velocity > 0 message will turn the output off.

When the NOTE OFF switch is in the down position Note Off decoding is active, so that when a Note Off message is received the decoder sets the relevant output to 0V.

#### Table 1. Velocity and Note Off Decoding

VELOCITY	NOTE OFF	MIDI Message	Action
0	0	Note On, Vel. > 0	O/P = 10V
		Note On, Vel. = 0	No Action
		Note On, Vel. > 0	O/P = 0V
		Note Off	No Action
0	1	Note On. Vel. > 0	O/P = 10V
		Note On. Vel. = 0	O/P = 0V
		Note On. Vel. > 0	O/P = 10V
		Note Off	O/P = 0V
1	0	Note On. Vel. > 0	O/P = Velocity
		Note On. Vel. = 0	No Action
		Note On. Vel. > 0	O/P = 0V
		Note Off	No Action
1	1	Note On. Vel. > 0	O/P = Velocity
		Note On. Vel. = 0	O/P = 0V
		Note On. Vel. > 0	O/P = Velocity
		Note off	O/P = 0V

Note : Switch State 0 = Off (switch up) and Switch State 1 = On (switch down).

### Example.

Consider that the decoder is being used to interface a MIDI Keyboard to a dimmer pack which in turn is driving a number of lights.

When a key is pressed down on the MIDI Keyboard a Note On message is transmitted to the decoder which will set the relevant output and turn a light on.

When the Key is released after either a Note Off message or a Note On, Velocity = 0 message will be transmitted to the decoder. If the unit is set so that Note Off decoding is turned on, the relevant output will be set to 0V and the light turned off.

This method of controlling the lights is acceptable until a number of lights are to be left on for a long period of time. To keep the lights on the relevant keys would have to be held down to prevent the Note Off messages being transmitted. This is impractical and would become very tedious after a few minutes.

To overcome this problem simply set the decoder to ignore Note Off and Note On, Velocity = 0 messages by setting the NOTE OFF OPTIONS switch to the up position and pressing RESET. Now when a key is pressed on the keyboard a light will be turned on and when the key is released the light will remain on. The light can be turned off simply by pressing the key again.

## 4.1.5 Additional MIDI Music Messages

The decoder responds to the following Channel Mode Messages :

Status Binary	Data Bytes Binary	Description / Action
1011nnnn	01111001 00000000 Sets all outputs to 0V.	Reset All Controllers.
1011nnnn	01111011 00000000 Sets all outputs to 0V.	All Notes Off.
Note : 1011nnnn = C	ontrol Change Message. nnnn	= Decoder Channel Number.

The decoder also responds to the following System Real Time Messages :

Status Binary	Description / Action
11111110	Active Sensing. This is used when the decoder is operating in the USER MEMORY mode. See section 5.0 for details.
11111111	System Reset. Sets all outputs to 0V.

The execution time of the Reset and All Notes Off MIDI messages is approximately 200uS during which time the decoders input is disabled. So that data is not misinterpreted it is recommended that a short delay is left after transmitting these commands. This delay can be achieved by transmitting an Active Sensing byte immediately after the commands.



## 4.2 MIDI Show Control Input

Connect the decoder to the MIDI Show Control source via the 5 pin DIN socket, labelled MIDI IN, at the rear of the unit. Then set the OPTIONS switch labelled MSC / MUSIC to the MSC position.

#### 4.2.1 Setting the Command Format

The CODE switches enable the decoder to be set to respond to one of the MIDI Show Control General Category Command Formats.

#### Table 2. Command Format Encoding.

COD	E Sw 2	itch S 4	Settings 8	MSC Hex Code	General Category Command Format
0	0	0	*	01	Lighting
1	0	0	*	10	Sound
0	1	0	*	20	Machinery
1	1	0	*	30	Video
0	0	1	*	40	Projection
1	0	1	*	50	Process Control
0	1	1	*	60	Руго
1	1	1	*	7F	All Types Only

Note : CODE Switch Settings : 0 = Off (switch up), 1 = On (switch down), \* = Ignored. The decoder will always respond to the "All Types" Command Format whatever Format it is set to.

#### 4.2.2 Setting the Device Identification Number

Using the START ADDRESS switches the decoder can be set to respond to a particular Device Identification Number.

#### Table 3. Device Identification Encoding.

S 1	TA 2	RT 4	AD 8	DRI 16	ESS 32	Sw 64	itch 12	Setting 28 256	Devi	ice Identification Numbers.
0	0	0	0	0	0	0	*	*	00h 	Individual Id Nos. 00h - 6Fh
1	1	1	1	0	1	1	*	*	6Fh	
0	0	0	0	1	1	1	*	*	70h 	Group Id Nos. 70h - 7Eh
0	1	1	1	1	1	1	*	*	7Eh	
1	1	1	1	1	1	1	*	*	7Fh	"All-Call" Id No. Only

Note : START ADDRESS Switch State : 0 = Off (switch up), 1 = On (switch down), \* = Ignored. The decoder will always respond to the "All-Call" Id No. no matter what Device Id Number it is set to.

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### 4.2.3 MIDI Show Control Commands

The decoder is programmed to respond to the following MIDI Show Control Commands.

#### Table 4. Implemented MSC Commands.

Command	Hex Code	Action
SET	06	Used to store the required output levels in the decoders memory.
GO	01	Writes the output levels stored in decoder memory to output buffers
ALL OFF	08	Turns all the outputs off without erasing the memory.
RESTORE	09	Sets outputs to their state before the ALL OFF command issued.
RESET	0A	Clears the decoders memory and turns all outputs off.

#### a) The SET Command

The SET command is used to store the required output levels in the decoder's memory.

#### Table 5. Format of the SET Command.

Byte	Hex	Description.
1	F0	Start of Systems Exclusive.
2	7F	Universal Real Time Sys. Ex. Id.
3	00 - 7F	Device Id Number.
4	02	MIDI Show Control Sub Id.
5	See Table 2	General Command Format.
6	06	SET Command.
7	00 - 2F	Output Ch. No. 1 - 48. (0 - 47)
8	00	Delimiter.
9	00 - 7F	Output Level L.S. byte.
10	00 - 01	Output Level M.S. byte.
11	F7	End of Systems Exclusive.

Byte 7 is used to select the output channel which is being set. The channel range is 0 to 47 corresponding with outputs 1 to 48.



Bytes 9 and 10 are used to set the outputs level, where byte 9 is the least significant byte and byte 10 the most significant byte. This gives a range of 0 to 255 where 0 = 0V output level and 255 = 10V output level.

Example.

Consider that output 24 is to be set to 10V. Bytes 7, 9 and 10 would be as follows :

Byte	Hex	Binary De	ecimal	Comments
7	17h	00010111	23	Output Channel Address 23. Actual Channel Number 24.
9	7Fh	01111111	l 127	Level L.S. byte.
10	01h	00000001	l 1	Level M.S. byte.

Note : Only the least significant bit of Byte 10 is used, all other bits are ignored by the decoder.

#### b) The GO Command

The GO command instructs the decoder to write the levels stored in its memory to the output buffers.

#### Table 6. Format of the GO Command.

Byte	Hex.	Description
1	F0	Start of Systems Exclusive.
2	7F	Universal Real Time Sys. Ex. Id.
3	00 - 7F	Device Id Number.
4	02	MIDI Show Control Sub Id.
5	See Table 2	General Command Format.
6	01	GO Command.
7	F7	End of Systems Exclusive.

Note : The decoder will ignore any cue lists supplied with the GO Command.

#### c) The Other MSC Commands

Details of the other MSC Commands shown in Table 4 can be found in the MIDI Show Control Specification available from the MIDI Music Association.

#### 4.2.4 Execution Times

The execution time of the MSC Commands GO and RESET is approximately 200uS during which time the decoders input is disabled. So that data is not misinterpreted-interpreted it is recommended that a short delay is left after transmitting these commands. This delay can be achieved by transmitting an Active Sensing byte immediately after the commands.

# **5. MEMORY FUNCTIONS**

The decoder has an internal memory which can be programmed with a back-up scene. The decoder can then be set so that if the input signal is disconnected the back-up scene is written to the outputs.

## 5.1 Programming the Back-up Memory

To program the back-up memory set the outputs to the required levels and set the OPTIONS switch labelled PROG. LOCK to the up position. Now push the MEMORY switch to the position marked PROG. and the 48 output levels will be stored in the back-up memory.

# 5.2 USER Mode

When the MEMORY switch is in the USER position the decoder monitors the input signal and if it fails to receive data for a period of 2 seconds it will write the levels in the back-up memory to the outputs. If the input signal is then restored the decoder switches back to the last levels received and continues from where it left off.

If the decoder is to be used in the USER MEMORY mode whilst receiving MIDI data the MIDI source must transmit Active Sensing bytes whenever there is no other data being transmitted. This will prevent the decoder from incorrectly assuming that the MIDI cable has been disconnected.

# 5.3 LAST Mode

If the MEMORY switch is set to the LAST position and the input signal is disconnected the decoder leaves the outputs at the last levels received. If the input signal is then re-connected the decoder continues from where it left off.

# **6. INSTALLATION**

This unit is designed for 19" Rack mounting and will occupy 1 Unit of panel height when installed. It is supplied fitted with 2m of 0.5mm sqr. mains cable, which should be connected to 220-240V A.C. supply.

If the decoder is to be used on a 110-120V A.C. supply the 240V link wire between the terminal block and the mains transformer should be removed. 2 additional links should be fitted in the positions marked 120V.

The cable is connected to an internal terminal block. If required the cable can be removed and the mains input wired in directly.

To gain access to the mains input terminal block, links and fuse, remove the 4 self tap screws on the top of the unit and slide back the top cover.

The output connections are made via  $6 \ge 8$  pin Locking DIN sockets. If the unit is to be powered by an external D.C. supply instead of mains input, pin 7 of one of the output sockets should be connected to +V and pin 8 to GND.

The MIDI connections are made to the  $2 \ge 5$  pin DIN sockets on the rear. The DMX connections are normally made to the  $2 \ge 5$  pin XLR sockets on the front panel. If required these can be moved to the holes provided in the rear panel and the front panel holes blanked off.



# 7. INPUT AND OUTPUT CONNECTORS

#### 7.1 MIDI In and MIDI Thru



#### 7.2 DMX In and DMX Thru



### 7.3 Output Connectors



# **8. TECHNICAL SPECIFICATION**

Mains Supply :	210 - 250V A.C. 50Hz 110 - 120V A.C. 60Hz by changing internal links.
D.C. Supply Input :	15 - 20V, 500mA un-stabilised.
Output Channels :	48 x 0 - 10V D.C.
Output Current :	1mA @ 10V per channel.
Dimensions :	44mm H x 482mm W x 110mm D. (19" x 1U).
Weight :	1.8Kg.