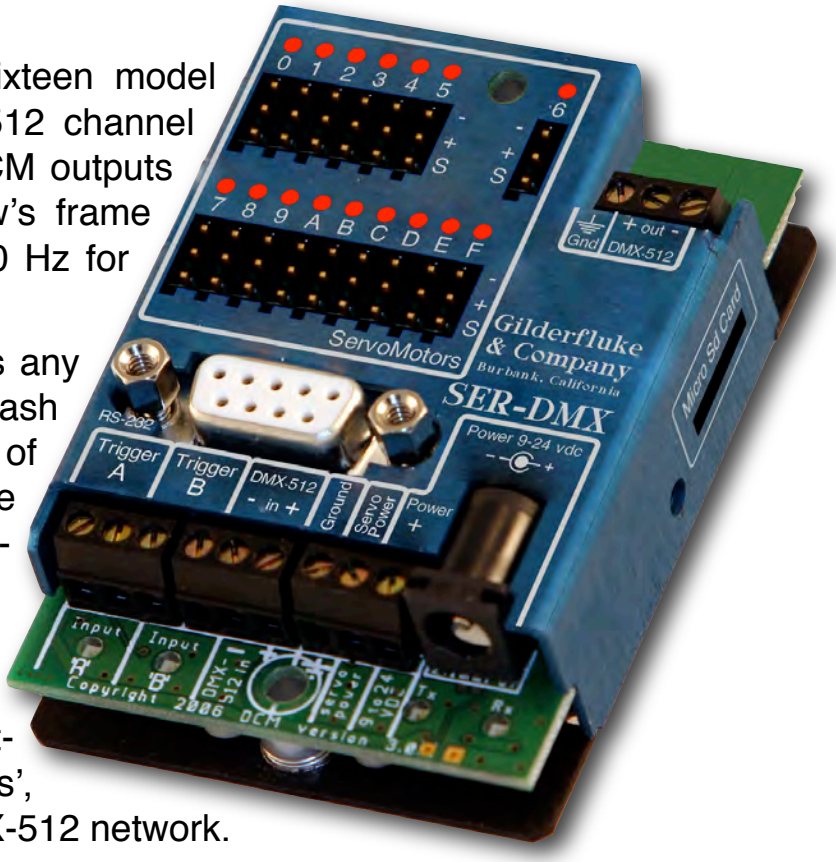
Gilderfluke & Co. ROBOTICS & SOUND SYSTEMS

SER-DMX

Sixteen ServoMotor PCM Output Card v3.nn

The SER-DMX is used when you need to control up to sixteen model airplane-style PCM ServoMotors. Uses include animated shows, museum displays, special effects, signs, fountains, and more.

A Digital device is either on or off, like a light switch. An Analog device is on, off, or at any point between, like a light dimmer. The speed of the change is set by how fast you turn the knob. In animation, analog movements give the fluid, lifelike movements needed to bring an animated figure to life. They can move fast, slow or in between.



The SER-DMX is a controller with sixteen model airplane-style PCM outputs, and a full 512 channel universe of DMX-512 in and out. The PCM outputs are oversampled at four times the show's frame rate, so they are typically updated at 120 Hz for ultra smooth ServoMotor outputs.

For storing shows, the SER-DMX uses any standard micro Sd or micro SdHC flash cards. These can hold months worth of shows! For triggering those shows, there are two optically isolated inputs, or the RS-232 serial port can be used.

SER-DMXs can be used as standalone show controllers, as a 'master', controlling slaves attached to a DMX-512 network, or they themselves can be 'slaves', following data sent to them through a DMX-512 network.

Safety Disclaimer: Any electronic or mechanical system has a potential to fail. Certain applications using Gilderfluke & Company equipment may involve potential risks of death, personal injury, or severe property, or environmental damage ("Critical Application"). Gilderfluke & Company equipment is not designed, intended, authorized, or warranted to be suitable in life support applications, devices, or systems, or other critical applications. Inclusion of Gilderfluke & Company products in such applications is understood to be fully at the risk of the customer. In order to minimize risks associated with the customer's applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazards.

Gilderfluke & Company assumes no liability for applications assistance, customer produced design, software performance, or infringement of patents or copyrights. Nor does Gilderfluke & Company warrant or represent that any license, either express, or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of Gilderfluke & Company covering or relating to any combination, machine, or process in which Gilderfluke & Company products or services might be or are used.

this page is not blank

A note about this manual:

This manual covers the specifics of the **SER-DMX**. To program the **SER-DMX** you will also want to refer to the **PC•MACs** manual sections that cover the **PC•MACs** software.

The **SER-DMX** is typically programmed in 'Software-only' or 'Hardwareless RealTime' mode. If you are using the **USB-DMX** for programming your **SER-DMX** through the DMX-512 inputs, please refer to the **PC•MACs** 'Unlimited' mode.

The full **PC•MACs** manual can be downloaded from our web site at:

http://www.gilderfluke.com

SER-DMX Overview

The SER-DMX has sixteen PCM ServoMotor outputs. The SER-DMX comes in the popular ‘miniBrick’ form factor and is typically mounted right on whatever it is controlling. The SER-DMX uses the smaller micro Sd or micro SdHC flash cards for storing shows. The shows stored on the SER-DMX can be triggered using the two optically isolated inputs, or through the standard nine pin RS-232 serial port. To talk to a local or remote computer, you can use a WiFi-to-Serial (Modem-Wi-Fly), Ethernet-to-Serial (Modem-Internet). USB-to-Serial (USB-RS232/422 or C-USB-RS232), or BlueTooth-to-Serial (Bt-Rs232Rx and Bt-USBTx) adapter to connect your computer to this serial port.

The outputs on the SER-DMX can be set to use either eight or twelve bits of resolution. The SER-DMXs are designed to be used as stand-alone show controllers, as a ‘master’ sending data to other devices that act as ‘slaves’ on a DMX-512 network, or as ‘slaves’ themselves, receiving DMX-512 data from a ‘master’ elsewhere on the DMX-512 network:

1) **SER-DMX running standalone or acting as a ‘Master’**: In this mode of operation, data for the outputs is stored in the standard micro Sd or micro SdHC flash cards.

   When being running as a standalone controller or as a ‘master’, a SER-DMX act just like any other 'Dumb' Brick playing animation data from the micro Sd or micro SdHC Flash card. The SER-DMX can be set to start and play a show at power up, or only play when triggered to do so. The start trigger can come through the two optically isolated trigger inputs or the RS-232 serial port. The SER-DMX then uses the show data stored in the Flash Memory to update its outputs and the DMX-512 network at the appropriate frame rate.

   Multiple SER-DMXs (and other GilderGear) can be triggered simultaneously, but this is not generally recommended as a way to synchronize multiple units. The far better way of synchronizing is by sending data stored on the designated ‘master’ to all the ‘slaves’ attached to a DMX-512 network.

2) **SER-DMX as a ‘Slave’**: In this mode the SER-DMX receives data from and external source and uses this data to update its outputs. Data can come from:

   a) RealTime serial updates from a Pc•MACs programming system through the serial port. Up to sixteen eight-bit wide channels of animation control data can be received through the serial port at 9600 baud. The

SER-DMX can be addressed to use any address from 0 to 15 for Real-Time serial data.

b) DMX-512 data from a Pc•MACs programming system (or any other source of DMX-512). Up to 512 eight-bit wide channels of animation control data can be received through the DMX-512 port. The SER-DMX can be addressed to use any DMX-512 address from 0 to 511 (or 1-512 if using one-based DMX-512 addressing). The DMX-512 input allows the SER-DMX to be used as a permanent 'slave' as a part of a larger Control System. If the incoming DMX-512 contains GilderChecksums, the SER-DMX will automatically update only on valid data packets.

The animation sequence which is to be used on the SER-DMX is generated on a PC•MACs Animation Control System. During programming, the DMX-512 or serial port RealTime updates can be used so that you can see the animation sequence as it is programmed. Once programming is completed and your show(s) are saved to disk, the data is downloaded to the Micro Sd/SdHC flash card onboard the SER-DMX. It is generally much faster and easier to save the completed shows' AutoDownload file to your computer's hard drive, then drag-n-drop the AutoDownload file onto the Micro Sd/SdHC flash card which is then plugged into the SER-DMX. You may choose to also include the .SET, .SHO, .STE and other files on the flash card as well, but the only file the SER-DMX actually reads is the AutoDownload (.A00) file.

On the SER-DMX, sixteen channels of data are converted to the individual PCM signals and sent out the ServoMotor connectors. If twelve bit resolution has been selected for the outputs, then twenty-four channels of DMX-512 data are converted to PCM signals.

The PCM outputs of the SER-DMX are oversampled for ultra-smooth outputs, typically to four times the current frame rate. This means that even with eight bit resolution data arriving at 30 FPS, the outputs will have four sub-frame outputs at 16 bit resolution at 120 Hz between each full frame of data that arrives.

The PCM outputs' range can be scaled or even reversed without affecting the resolution of the outputs. For the PCM outputs, this means that the outputs can be adjusted for anywhere between 0.5 ms and 2.5 ms. endpoints (typical 90º servo travel range uses a 1.0 ms to 2.0 ms. pulse width). This allows you to limit the range of travel of an motor movement, usually without losing any resolution on the output.

All 512 channels of data is transmitted through the DMX-512 output on a SER-DMX. The DMX-512 output can be used to control other GilderGear, light dimmers, automated spotlights, color changers, fog and wind machines, or any other pieces of equipment which will accept standard DMX-512 inputs. If there are less than 512

channels of data in the shows, channels past the last channel are sent as 'zeros'. If you are transmitting DMX-512 data with GilderChecksums, you will want to avoid addressing dimmers and other devices to the same addresses that are used for the checksums (257 and 258).

The SER-DMX can be mounted on standard 2-¾" Augat snap track, on DIN rails (using a pair of the DIN-Adapt blocks), using screws through the provided mounting holes, or simply velcro'd to whatever they are controlling. Rack mounting is normally accomplished using a DIN rail mounted to a 2U (3.5") tall 'top hat' plate, and then using the DIN-Adapt blocks on the backs of the units.

Power requirements for SER-DMXs are 7 to 24 VDC. The actual current requirements are determined by the ServoMotors attached to the unit. The SER-DMX itself draws just xx ma..

The revision 3.nn SER-DMX is a complete redesign from all earlier version of the earlier SER-DMXs. The chief differences are:

1) The earlier SER-DMXs had no on-board show storage capacity. They needed to be fed a DMX-512 signal form another controler. The v3.0+ SER-DMX does not need any other controller to run. They have their own trigger inputs, DMX-512 inputs and outputs and micro Sd and micro SdHC flash card show storage.
2) The earlier SER-DMX had only a single LED that showed the analog command level of a single (user selected) PCM output at one time. The v3.0+ DAC-Quad has sixteen PCM output indicator LEDs, so you can see activity on all the channels at a glance
3) The earlier SER-DMXs were a 2-¾" x 2.5" PCB with no case. The v3.0+ SER-DMXs come in a aluminum case, and measure only 2-¾" x 2.0", just like a Br-miniBrick8.

Customized front panel artwork is available on all GilderGear, including the SER-DMX. These can be custom branded, or labeled for specific installation names. Please contact the Gilderfluke & Company factory for details on generating custom SER-DMX labels.

this page is not blank

SER-DMX Panel Indicators

There are eight LED indicators on the SER-DMX. They are used as follows:

A) Output Level Indicators

(Sixteen Red LEDs)

These sixteen red LEDs show the output level on all sixteen of the PCM ServoMotor outputs. You will see these LEDs fade in and out as the signals on the outputs change. Unlike the LEDs on the Br-ANA, these LEDs are not directly connected to the ServoMotor outputs. They do not reflect the ‘minimum’ and ‘maximum’ endpoint settings. If the command from the show file in the AutoDownload or through the DMX-512 calls for the output at 0%, the LED will be off. If it asks for 100%, it will be fully on.

B) Trigger Input LEDs

(Two Green LEDs)

These LEDs indicate the status of the two optically isolated trigger inputs on the SER-DMX. They are on the isolated side of the optoisolators. If they are not on when you send a trigger to the SER-DMX, then there is an external wiring problem or the optoisolator has been damaged.

C) Running LED

(One Green LED)

This LED will be lit when the SER-DMX is running a show from its internal clock and Flash memory.

During AutoDownloads of show data to the SER-DMX, this LED will flash alternately with the DMX-512 LED to show that a AutoDownload is in process.

D) Heartbeat LED

(One Amber LED)

a) This LED Flashes continuously while the CPU is running. If it ever stops for more than a fraction of a second, the 'Deadman' circuit in the SER-DMX will automatically reset the CPU. While performing an Ease-In, the heart rate will double.

this page is not blank

SER-DMX Connectors

A) Micro Sd/SdHC Flash Memory Card Slot

(One Micro Sd/SdHC compatible socket)

This socket is compatible with both standard Micro Sd flash cards and Micro SdHC flash cards. It will support flash cards up to 32 GBytes in size. It will not currently support SdXC cards (64 GBytes and larger), which require licensing payments from Microsoft.

B) Input Connector

(9 Position Pluggable Screw Terminal)

The Input connections are through a nine position, pluggable screw terminal.

Terminal #	wire function
1	'A' Optoisolated Trigger Input
2	
3	'B' Optoisolated Trigger Input
4	
5	- DMX-512 Input
6	+ DMX-512 Input
7	Power Supply Ground/DMX Shield
8	Servo Motor Power Input (0-24 VDC)
9	Power Supply Positive (15-24 VDC)

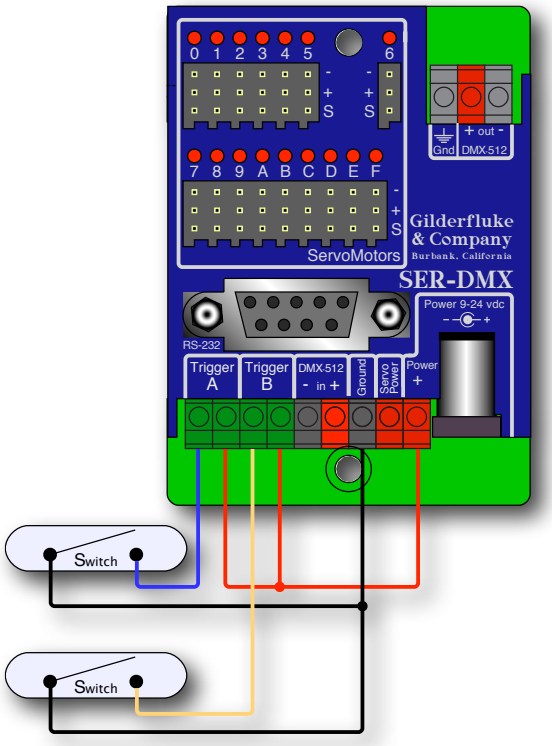
1) Trigger Inputs

(Terminals #1, #2, #3, #4)

Terminals one through four are used for the two optically isolated Trigger Inputs. These inputs are non polarized, so you can't possibly hook them up backwards.

There are two green LEDs that indicate the inputs are active. They are on the isolated side of the optoisolators. If they are not on when you send a trigger to the SER-DMX, then there is an external wiring problem or the optoisolator has been damaged.

The trigger inputs will accept any voltage from 5 to 24 volts DC. You can provide an external voltage, or you can borrow some power from the SER-DMX to power them, as shown here:



2) DMX-512 Input

(Terminals #5, #6)

Screw terminal positions five and six are used for the DMX-512 input. Terminal five is The negative, and terminal six is The positive. The DMX-512 shield should be connected to the ground terminal (number seven). The SER-DMX will stop all shows and follow any valid DMX-512 data it hears whenever there is a DMX-512 signal present on this input.

The DMX-512 standard was developed by the United States Institute for Theatrical Technology (USITT) for a high speed (250 KBaud) asynchronous serial data link. Although it was originally designed for controlling light dimmers, it is now supported by hundreds of suppliers throughout the world for controlling all kinds of theatrical equipment.

Addresses 256 and 257 are optionally used in GilderGear for transmitting a checksum. The SER-DMX will automatically use this to verify that the data received from PC•MACs has no transmission errors in it. If you address a light dimmer or other DMX-512 device to addresses 256 or 257, you will see this verification data displayed as a flickering pattern. Most GilderGear will automatically start requiring GilderChecksums after receiving DMX-512 that has GilderChecksums in it. Once it starts requiring Gil-

derChecksums, the only way to get the SER-DMX to stop requiring it is to cycle power on it.

Note that at higher frame rates (above about 40 FPS), not all 512 channels can be transmitted through DMX-512.

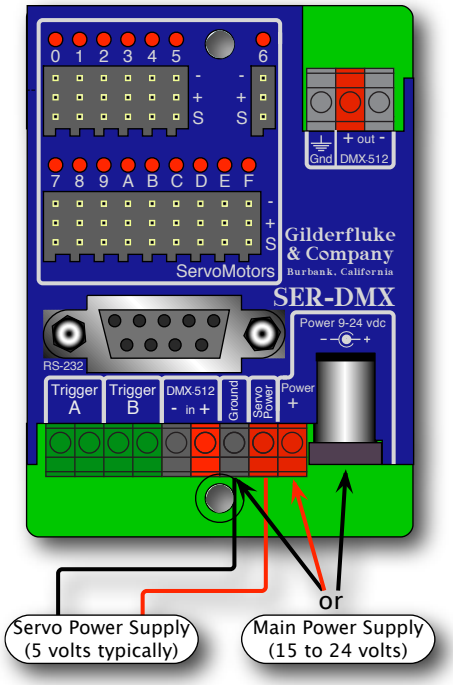
The DMX-512 standard calls out a 5 pin XLR connector or screw terminals for all connections. Many less expensive DMX-512 devices use three pin XLR connectors. More devices are starting to use CAT-5 (or better) ethernet cables for carrying DMX-512. The SER-DMX provides screw terminals for attaching the DMX-512 input and output.

3) Power Input

(Terminals #7, #8, #9)

The last three positions of thee screw terminals are used to provide power to the SER-DMX and any ServoMotors that are attached to it. If you are not using the servo motor outputs, you do not need to attach any power to the servo power terminal.

The power input is protected from reversed polarity. An idle SER-DMX draws only about ?? milliamperes. The loads which the SER-DMX is controlling will usually draw far more current than the SER-DMX itself.



The SER-DMX is rated for operation from 9 to 24 vdc. ServoMotors typically run on voltages between 4 and 7.2 volts (check the ServoMotors you plan to use to see what their optimal voltage level is). Some larger

ServoMotors run their motors at 12 or 24 vdc, but these typically have separate connections for feeding this supply voltage to the motors or their controllers.

The SER-DMX-512 can be run from as low as a 5 vdc supply, if you are a little bit careful. This is a typical voltage as most ServoMotors want to run from. You may be able to use the same lower voltage power supply as the ServoMotors for running the SER-DMX. Just make sure that your Servo-Motor power supply has enough capacity that it won't 'dip' below 5 vdc when the ServoMotors are running under a heavy load.

C) Power Jack

(2.1 mm Power Jack)

This is a standard 2.1mm i.d., 5.5 mm o.d power jack. It is wired in parallel with the main power supply terminals. The screw terminals are typically used for permanent installations.

The power input is protected from reversed polarity. An idle SER-DMX draws only about ?? milliamperes. The loads which the SER-DMX is controlling will usually draw far more current than the SER-DMX itself.

D) Servo Motor PCM Outputs

(Sixteen 3 pin Male Headers)

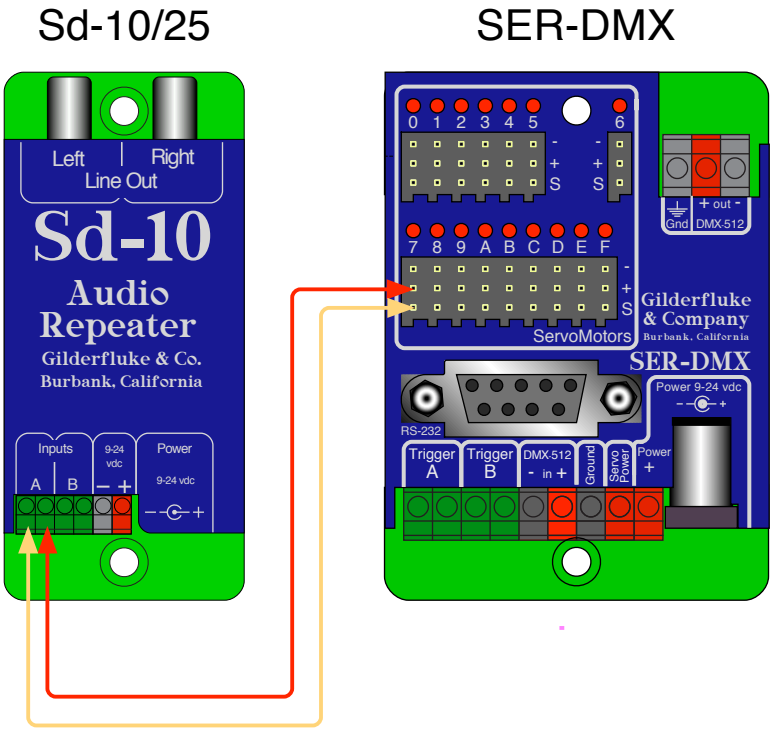
Typical model airplane-style PCM ServoMotors use a three pin female connector. These can be plugged into the matching three pin headers on the SER-DMX. The ground wire (typically black or brown on most Servo-Motors) go to pin #1, which are at the end closest to the label for these connectors. If your ServoMotor's connector has a polarizing ridge on one side of the connector, you will find that the case is made to make it difficult to plug these in backwards.

Starting with firmware version 3.17 and above, it is possible to take over any of the servo PCM outputs to use them as digital output functions. One or two of these can be used to trigger an Sd-10 or Sd-25 audio player if you don't need all sixteen of the PCM servo outputs.

The SER-DMX is shown controlling an Sd-10. The inputs to an Sd-25 are wired identically. In this case, we are using the ServoMotor PCM output #7, but you can use any output you like. Only a single connection to

the Sd-10's 'A' input is shown, but you can use two connections if you need to control both the 'A' and 'B' inputs to the player.

Because the inputs to the players are non-polarized, you can't wire the inputs backwards. Because they are isolated, no connection to the PCM ServoMotor's output's 'ground' pin is needed:



Using a 'ready-made' servo extension cable (available at most hobby shops), or the pigtail cut from a dead ServoMotor makes this wiring much easier.

The PCM ServoMotor outputs use the same power as your servomotors. Since this is typically around five volts DC, and the current output capacity of these outputs is somewhat limited, you should only drive non-inductive loads (LEDs, Solid State relays, etc.) If you are controlling inductive loads (electromechanical relays, solenoid valves, and motors), you must use a solid state relays between the SER-DMX and the loads.

To convert a SER-DMX output to a digital function, all that you need to do is set both the minimum and maximum endpoints to zero. The easiest way to do this is to enter configuration using GilderTerm and:

1. Select the output you want to convert using:
   a) 'J' Address to Test command to directly select the DMX-512 address of the channel you wish to use.

b) 'N' Next Command to move the arrow pointing to the selected output downwards.

c) 'L' Last Command to move the arrow pointing to the selected output upwards.

2) 'w' Set Analog Endpoints command. Just enter zero values for both the endpoints when prompted.

From the programming side, these channel still need to be created and programmed in Pc•MACs as though they are analog channels. The digital output will be turned 'on' when the value of the analog channel goes above 50%, and turned off when it drops below 50%.

If you are using the OffLine Window to draw in audio triggers, select the desired output channel for a second or two of time and use the 'Set Analog to a Value' command to set it to 100%. If you find that Pc•MACs 'cleans up' the two ends of your edit by ramping them, you can turn off this feature by going to the preferences menu, and selecting 'Cut/Paste Options'. Temporarily select 'none' for the ramping on both the start and end of edits. This will eliminate the ramping into and out of the sharp pulses you draw.

E) DMX-512 Output Connector

(3 Position Pluggable Screw Terminal)

The pinout for this connector is as follows:

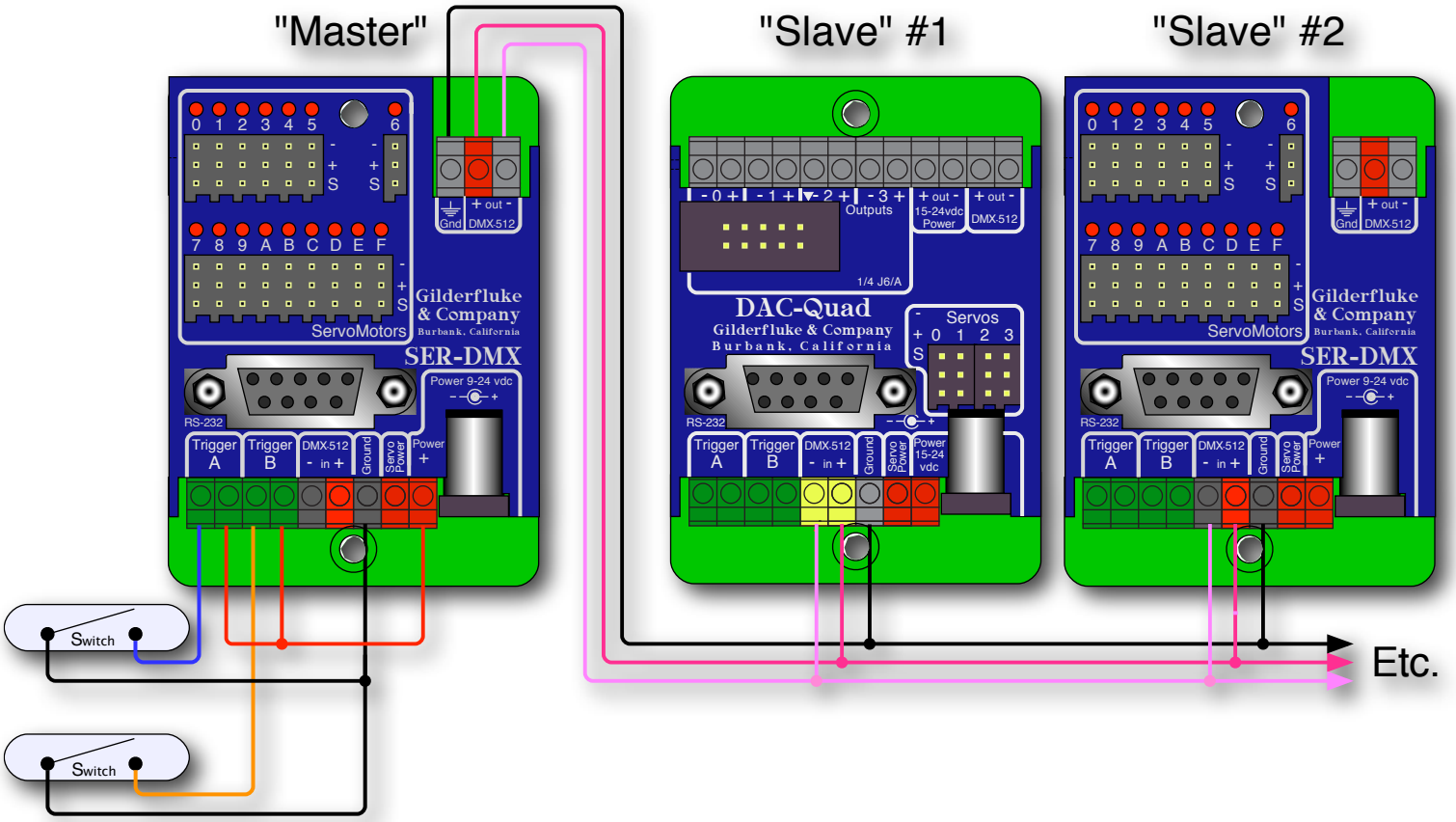
Terminal #	wire function
1	circuit ground
2	- DMX-512 Output
3	+ DMX-512 Output

These three terminals are used for the DMX-512 output from the SER-DMX.

The DMX-512 standard was developed by the United States Institute for Theatrical Technology (USITT) for a high speed (250 KBaud) asynchronous serial data link. Although it was originally designed for controlling light dimmers, it is now supported by hundreds of suppliers throughout the world for controlling all kinds of theatrical equipment. The DMX-512 standard calls out a 5 pin XLR connector, screw terminals or a Rj-45 for all connections. The SER-DMX provides screw terminals.

The following illustration shows using a single SER-DMX as the 'DMX-512 'Master', and a DAC-Quad and SER-DMX as two DMX-512 'Slaves'.

Almost any other piece of GilderGear, or any intelligent lights, dimmers, strobes, smog machines or other pieces of DMX-512 compatible can be used as the 'slaves' [1].



All of the equipment on the DMX-512 network can be in one cabinet or control room, but are more commonly distributed throughout the installation. This allows the individual controllers to be prewired to whatever they are controlling and completely pretested before the installation even starts. During installation, instead of running hundreds (or thousands) of wires to each control point, a single DMX-512 network is daisy-chained through each local controller.

A DMX-512 network can be as long as a mile, or as short as a few inches. The DMX-512 network needs to be one long line, with no long side branches. If the network is longer than a few feet, you may need to provide a terminating resistor at the two far ends of the network (120Ω, ½ Watt is typically used). The resistors suppress 'echos' on the DMX-512 wires.

1 Most modern DMX-512 equipment will allow you to attach up to 256 'Slaves' to a network. Some older gear limited you to 32 or 64 'Slaves' on a DMX-512 line. You can use a isolated DMX-512 buffer or DMX-512 splitter to allow you to attach any number of DMX-512 'Slaves' to a system, until you have used up all 512 channels of the data that can be sent down one DMX-512 network.

If the network runs throughout a facility, it is prudent to use a some isolated splitters. These will keep an electrostatic zap or lightning hit on the network from damaging the entire network. An isolated splitter also allows you to run side branches on the network, since each isolated branch is treated as a separate DMX-512 network (daisy chained from DMX-512 'Slave' to 'Slave', it can be run up to a mile, and may need its own termination resistors).

Addresses 256 and 257 are optionally used in GilderGear for transmitting a checksum. The SER-DMX will automatically use this to verify that the data received from PC•MACs has no transmission errors in it. If you address a light dimmer or other DMX-512 device to addresses 256 or 257, you will see this verification data displayed as a flickering pattern. Most GilderGear will automatically start requiring GilderChecksums after receiving DMX-512 that has GilderChecksums in it. Once it starts requiring GilderChecksums, the only way to get the SER-DMX to stop requiring it is to cycle power on it.

Note that at higher frame rates, not all 512 channels can be transmitted through DMX-512.

If you are connecting multiple SER-DMXs (or other GilderGear) as 'Slaves', you will want to use the DMX-512 'input' screw terminals for connecting the downstream units as well. This is because the SER-DMX will receive and verify each frame of data completely before retransmitting it out the DMX-512 output pins. This delays the retransmission slightly, which can become noticeable if running through several units.

The typical wires used for carrying a DMX-512 network are a single shielded twisted pair or wires. For short runs, just about any 'microphone cable' can be used. For longer runs, a low capacitance twisted pair is recommended. Recommended wires include:

Manufacturer	Part #	Gauge	Wire Stranding
Belden	3105A	22 AWG	7 x 30
Belden	3106A	22 AWG	7 x 30
Belden	9841	24 AWG	7 x 32
Belden	7200A	24 AWG	41 x 40 (high flexibility)
Proplex	PC222P	22 AWG	19 x 34
Dataplex	WDP222TBK	22 AWG	16 x 0.2mm

Recent revisions of the DMX-512 standards have included specifications for running raw DMX-512 signals through standard Cat-5 (or better) ethernet cables. The recommended pinout is as follows:

Pair	Wire #	Color	Function	DMX-512 Pin
Pair 2	1	White / Orange	Data 1+	DMX-512 Pin 3
	2	Orange	Data 1-	DMX-512 Pin 2
Pair 3	3	White / Green	no connection	no connection
	6	Green		
Pair 1	4	Blue		
	5	White / Blue		
Pair 4	7	White / Brown	Signal Common	DMX-512 Pin 1
	8	Brown		
Shield		Drain		

G) RS-232 Serial Port

(Nine Position DE-09 Female)

This is used for configuration, uploading and downloading configurations, status enquiries, AutoDownloading show data to Flash memory, and serial port RealTime updates. It is compatible with all the RS-232 Serial Ports and protocols used on Gilderfluke & Company products.

The serial data signals from the SER-DMX are brought out on a nine position DE-09 female connector. This uses the industry standard pinout:

WIRE #	SIGNAL NAME:
1	n/c

WIRE #	SIGNAL NAME:
2	RS-232 Serial Tx Out
3	RS-232 Serial Rx In
4	n/c
5	Ground
6	n/c
7	n/c
8	n/c
9	n/c

Computers don't normally come with serial ports on them anymore. Instead, you use a USB-to-Serial (USB-RS232/422 or C-USB-RS232) adapter, BlueTooth-to-Serial (Bt-Rs232Rx and Bt-USBTx), Ethernet-to-Serial (Modem-Internet) adapter, or WiFi-to-Serial (Modem-Wi-Fly) adapter. For the SER-DMX you will need one that provides the more common RS-232. These are available from a number of different sources, including Gilderfluke & Company. Our part number is USB-RS232/422 provides both RS-232 and RS-422 connections. Our lower cost C-USB-RS232 provides just a single RS-232 serial connection.

The SER-DMX expects to see the serial data in the following format:

ONE START BIT
EIGHT DATA BITS
ONE STOP BIT

SER-DMX responds appropriately to all commands which are used by other Gilderfluke & Co. serially controlled devices. These are used for configuration, uploading and downloading configurations, status enquiries, AutoDownloading show data to Flash memory, and serial port RealTime updates. It will ignore all commands which are not addressed to it, or not appropriate for it to respond to. On the SER-DMX, the serial address is permanently set to '00'.

If you have hooked up the SER-DMX to your computer and it still doesn't seem to respond to the keyboard, the first thing to check is that you are attached to the right serial port. The easiest way to do this is with 'The Paperclip Test'. Disconnect the SER-DMX and short between the Tx data and Rx data pins on your USB-to-Serial converter. For a RS-232 port, this means temporarily shorting between pins #2 and #3.

While still running the modem program, anything you type should be shown on the screen while the paper clip is in place, while nothing will ap-

pear when you remove the paper clip. If your computer passes this test, then you are using the right serial port and the problem is most likely the baud rate setting or in your wiring to the SER-DMX. If you get characters on the screen even with the jumpers removed from the serial port, it means you probably need to set the 'echo' mode to 'none' or 'full duplex' and try this test again.

this page is not blank

SER-DMX Software Configuration

The SER-DMX can be accessed through the serial port from any computer running just about any modem or terminal program. We provide a free terminal program called GilderTerm that makes working with GilderGear through the serial port a little easier. The computer you are using doesn't even need to have any PC•MACs software installed on it.

Most Gilderfluke & Co products can be controlled through their RS-232 or RS-422 Serial ports. The SER-DMX has a single RS-232 serial port on it. You can attach operator panels to access and control the SER-DMX, or you can use a WiFi or Ethernet modem so that it can be accessed from around the block or around the world.

If you don't have access to GilderTerm, typical modem programs you can use are Terminal.exe (which came with Windows 3.1) and HyperTerm.exe (which comes with later versions of Windows). The terminal program must support VT-52 commands to position the cursor and clear the screen.

GilderTerm is available free from Gilderfluke & Co. for use with all of our products. It can be downloaded from our web page, and is included on all of our CD-ROMs. GilderTerm has been optimized for use with all Gilderfluke & Company equipment. All the commands are built in, and it will even let you use your mouse to select commands by clicking on the menus.

If you are using GilderTerm, all the settings are fixed at the appropriate settings. All you will need to do is select the appropriate 'COM' port. To talk to the SER-DMX, just configure your terminal program for 9600 baud, no parity, eight data bits, one stop bit and no flow control handshaking.

Computers don't normally come with serial ports on them anymore. Instead, you use a USB-to-Serial (USB-RS232/422 or C-USB-RS232) adapter, BlueTooth-to-Serial (Bt-Rs232Rx and Bt-USBTx), Ethernet-to-Serial (Modem-Internet) adapter, or WiFi-to-Serial (Modem-Wi-Fly) adapter. For the SER-DMX you will need one that provides the more common RS-232. These are available from a number of different sources, including Gilderfluke & Company. Our part number is USB-RS232/422 provides both RS-232 and RS-422 connections. Our lower cost C-USB-RS232 provides just a single RS-232 serial connection.

If not using GilderTerm, your terminal emulation program must support VT-52 terminal emulation to do cursor positioning, clearing the screen, and a handful of other functions. You should set your program NOT to insert an extra LineFeed (LF) character after each Carriage Return (CR) it receives. You should also tell it NOT to scroll automatically after the eightieth column is filled. If either of these are on, the screen

will be displayed 'double spaced'. This won't cause any problem, but will make it hard to see the whole screen at one time.

To enter the configuration mode you need to press the ‘configure’ button on GilderTerm, or type the following if you are not using GilderTerm. The (address) is replaced by ’00’ on a SER-DMX:

m5AA5(address)

If any other card is in configuration mode (or even if it just thinks another card is in configuration), the SER-DMX won't be able to enter configuration mode. To exit any other card from configuration type 'XN'. You can then try entering configuration again.

For a version v1.1 AutoDownload file, the menu will appear as follows. Decimal values and pulse width (for the servo endpoints) have been selected for the numbers. At the top of the screen the information about the AutoDownload file and show that is loaded (if any) is shown. With a v1.1 AutoDownload file, the SER-DMX will skip channels that are assigned as digital functions, can mix and match between different resolution outputs, and will display the last lines as blank if it runs out of analog channels to display.

```
- Gilderfluke & Co. -  SER-DMX Servo Card  - version 3.17 - copyright 2013 DCM -
               Shows: 8, Ch: 123 @___0, ADL: AutoDownload_Filename
                                Serial Address- __0
                    _11 ShowName.sho looping @ frame _____516
inputs: a/green:    | b/red:       DMX-512    E minimum maximum "forced" PowerOn
                                   address    I  scale   scale  position default
a) 1st addr: __0 (addr. from ADL)    __4 (0) |Y|1.000ms|2.000ms|________|_____0_
b) twelve bit resolution- xxx        __5 (1) |Y|1.000ms|2.000ms|________|_____0_
c) sequencer enabled- yes         -> __7 (2) |Y|0.500ms|0.500ms|________|_____0_
d) DMX: Tx only w/CS,  g) 0-based    __8 (3) |Y|1.000ms|2.000ms|________|_____0_
e) auto EaseIn- 5.00 seconds         _10 (4) |Y|1.000ms|2.000ms|________|_____0_
f) numbering- decimal/millisecond    _11 (5) |Y|1.000ms|2.000ms|________|_____0_
                                     _12 (6) |_|1.000ms|2.000ms|________|_____0_
j) addr. to test- __7 [12bit Rez]    _13 (7) |_|1.000ms|2.000ms|________|_____0_
k) test output- none                 _14 (8) |_|1.000ms|2.000ms|________|_____0_
figure: MiniBase                     _15 (9) |_|1.000ms|2.000ms|________|_____0_
output: Axis 3                       _16 (A) |_|1.000ms|2.000ms|________|_____0_
                                     _17 (B) |_|1.000ms|2.000ms|________|_____0_
u) set min/max/force using keypad    _18 (C) |_|1.000ms|2.000ms|________|_____0_
q) force output to a value           xxx (D) |_|_______|_______|________|_______
t) set PowerOn defaults              xxx (E) |_|_______|_______|________|_______
w) set analog endpoints              xxx (F) |_|_______|_______|________|_______
n) Next, l) Last, i) info, o) def., p) looP, h) Halt, r) save, v) Verify, x) Xit
                                   Command-
```

To redraw the screen at any time, just press the <ESC>ape key or <SPACE> bar.

All numeric values are entered in HEXadecimal (0 through 9 and A through F) or Decimal numbers (0 through 9), as selected on the menu. Each number consist of one or more ASCII characters followed by a <RETURN> (<ENTER> on some keyboards). If more characters have been entered before the <RETURN> than are allowed, then the characters already entered will scroll to the left to make room for the new entries. Once a command has been invoked, characters can be erased one-by-one by using the <DELETE> key (<BACKSPACE> on some keyboards). An entire entry can be erased by hitting the <ESC>ape key. A command can be canceled altogether by hitting the <RETURN> key (<ENTER> on some keyboards) or <ESC>ape key after all the characters have been erased or before any have been entered.

Once you have configured a SER-DMX, you can 'lock' the configuration by moving the 'Write Protect' switch to the 'Write Protected' position from the 'Write Enabled' position. This should protect your configuration from anything short of a lightning hit. The menu will change to show that the Flash Memory has been protected and warn you that you can no longer make any changes. Configuration changes can be re-enabled at any time by moving the switch back to the 'Enabled' position.

If you want to keep a hard copy printout of the current configuration of the SER-DMX, you should use the <ESC>ape key to redraw the screen while 'saving to file' in the modem program running on your computer. This file can be printed out at any time, or spliced into the documentation package for your project.

A) First Address

Because the SER-DMX has a RS-232 serial port on it, it has a fixed serial address of 00. This toggle selects whether the outputs' address is set from:

1) Address stored in the AutoDownload file. This is the Default.

2) Addressed at a location you specify.

If twelve bit resolution has been selected, then any 'illegal'[2] twelve bit address will be skipped.

B) Twelve Bit Resolution

If using a v1.1 AutoDownload file generated with Pc•MACs version 2.02.212.xxx or later, this will be set automatically for you from data in the AutoDownload file.

[2] A twelve bit value cannot be addressed at any address that can evenly be divided by three (0, 3, 6, etc.).

When toggled ON, the output resolution will be twelve bits. This works out to a resolution of one part in 4096. With a 1.0 millisecond to 2.0 millisecond output, each full step will be 0.000244140625 milliseconds. If you are using 12 bit resolution ServoMotor outputs, you must carefully account for the locations and number of output channels you are using. Each 12 bit resolution input takes 1-1/2 eight bit channels. The SER-DMX won't let you set the first address for a 12 bit analog channel to any address that can be evenly divided by three (0, 3, 6, 9, etc.). This is because it uses these bytes for storing the least significant four bits of the next two 12 bit resolution channels. Any 12 bit resolution channel that is addressed at an address that can be divided evenly by three plus one (addresses 1, 4, 7, 10, etc.) will need to have the previous address sent (or burnt into the Flash Memory) so that its lowest four bit nibble isn't lobbed off. Any 12 bit resolution channel that is addressed at an address that can be divided evenly by three plus two (addresses 2, 5, 8, 11, etc.) will need to have the previous two addresses sent (or burnt into the Flash Memory) so that its lowest four bit nibble isn't lobbed off.

C) Sequencer Enabled

This toggle enables and disables the SER-DMX to use the Animation Data Flash Memory. When it is OFF, nothing will be output from the Auto-Download file on the micro Sd/SdHC flash card. Any output data must come from either the DMX-512 or Serial Port inputs. If it is ON, then the data from the micro Sd/SdHC flash card will be sent out.

D) DMX-512 mode

If using a v1.1 AutoDownload file generated with Pc•MACs version 2.02.212.xxx or later, this will be set automatically for you from data in the AutoDownload file.

If there isn't a v1.1 AutoDownload file being used, this command is a toggle which can be used to enable and disable the DMX-512 reception and transmission, as well as the GilderChecksums.

The GilderChecksums allow GilderGear to recognize errors in DMX-512 data. With GilderChecksums, the outputs won't be updated when a bad data packet is received. GilderChecksums should be left ON whenever sending DMX-512 to other GilderGear.

The SER-DMX, and most other GilderGear will automatically sense when it is receiving GilderCheckSums. Once it does this, the GilderGear will have to be reset before it will accept DMX-512 data without Gilder-CheckSums.

G) DMX-512 Zero-Based or One-Based

If using a v1.1 AutoDownload file generated with Pc•MACs version 2.02.212.xxx or later, this will be set automatically for you from data in the AutoDownload file.

If there isn't a v1.1 AutoDownload file being used, this command is a toggle between displaying DMX-512 addresses as 0-511 numbers, or as 1-512 numbers.

E) Auto Ease-In

If using a v1.1 AutoDownload file generated with Pc•MACs version 2.02.212.xxx or later, this will be set automatically for you from data in the AutoDownload file.

When enabled, this feature will keep all the selected channels from jumping at a high rate of speed if:

1) The DMX-512 data starts being received.
2) The DMX-512 signal drops out for more than ten seconds.
3) An output is forced to a specific value.
4) One or more outputs are put into or taken out of the internal test mode.
5) At boot up as the outputs assume their default values.

This command allows you to select the amount of time any output will take to ramp from one extreme to the other and which outputs will be using the Ease-In feature. The range of time available is:

1) Ease-In is disabled
2) ¼ second
3) ½ second
4) ¾ second
5) 1 second
6) 1-½ seconds
7) 2 seconds
8) 2-½ seconds

9) 3 seconds
10) 4 seconds
11) 5 seconds
12) 6 seconds
13) 7 seconds
14) 8 seconds
15) 9 seconds
16) 10 seconds

You can tell when an Ease-In is being performed by the Heartbeat jumping to a speed twice normal. Once all outputs have dropped out of Ease-In mode, the heartbeat will return to its regular rate.

Which outputs have been set to use the Ease-In Feature is shown under the column labeled ‘EI’. Outputs which will be Eased In are shown by the letter ‘Y’. All other channels will be unaffected by the Ease-In.

The Ease-In only affects the sixteen on-board ServoMotor outputs from the SER-DMX. All the data output on DMX-512 or Z-Buss port to the Z-Bricks are unaffected.

F) Numbering System

This toggle is used to select between HEXadecimal, Decimal, percentage or milliseconds numbering systems for display and entries. The ‘milliseconds setting is used when working with ServoMotors, where the pulse widths are normally measured in milliseconds. When the SER-DMX prompts you for a numeric entry, you will need to enter a HEXadecimal or Decimal number, depending on this setting.

J) Output to Test & Adjust

This command is used to set the output address that will be used by the 'Test Output', 'Set Analog Endpoints', 'Force output to a Value', ‘set Min/Max/forced using keypad’, and 'set PowerOn Defaults' commands. If the output address selected is one of the sixteen on the SER-DMX, then an arrow will appear to the left of it on the screen. In the eight bit resolution example screen above you can see this arrow pointing to output at address ‘1’. Since some of the adjustments can affect channels that are only transmitted through the DMX-512 and Z-Brick outputs, the address can be set to anywhere between 0 and 511 (or 1-512).

If the AutoDownload file is a v1.1 or later, the FigureName and OutputName will be displayed just below the ‘Test Output’ command.

K) Test Output

When toggled to ‘Test One Output’, the single output selected by the 'Output to Test & Adjust' command will be ramped up and down. The ramp time is about 5 seconds. The time the output dwells at each extreme is about one second.

When pressed a second time, this command will toggle to ‘Test All Outputs’. All the outputs will be ramped between their two extremes. The ramp time is still about 5 seconds. The time the output dwells at each extreme is about one second.

U) Set Minimum, Maximum and Forced using Keypad

This is the easiest way to adjust the endpoints of the ServoMotor outputs to prevent a mechanical movement from over traveling. The normal range of the outputs is between 0.5 milliseconds to 2.5 milliseconds. If your ServoMotor movement is hitting the ends of travel, you can reduce this range until it doesn’t hit the mechanical ends of travel.

Selecting his command redraws the left side of the screen. The drawing shows the numeric keypad found on most full-sized keyboards. The ‘arrow’ points to the output which has been selected. You can select a different output by pressing the ‘N) Next’ or ‘L) Last’ commands.

```
- Gilderfluke & Co. -  SER-DMX Servo Card  - version 3.17 - copyright 2013 DCM -
               Shows: 8, Ch: 123 @___0, ADL: AutoDownload_Filename
                                Serial Address- __0
                    _11 ShowName.sho looping @ frame _____516
inputs: a/green:    | b/red:       DMX-512    E minimum maximum "forced" PowerOn
                                   address    I  scale   scale  position default
          minimum maximum "forced"   __4 (0) |Y|1.000ms|2.000ms|________|_____0_
adjust-->  scale   scale  position  f__5 (1) |Y|1.000ms|2.000ms|________|_____0_
         |-----------------------|-> __7 (2) |Y|0.500ms|0.500ms|________|_____0_
    Up-> |   7   |   8   |   9   |   __8 (3) |Y|1.000ms|2.000ms|________|_____0_
         |-----------------------|   _10 (4) |Y|1.000ms|2.000ms|________|_____0_
middle-> |   4   |   5   |   6   |   _11 (5) |Y|1.000ms|2.000ms|________|_____0_
         |-----------------------|   _12 (6) |_|1.000ms|2.000ms|________|_____0_
  Down-> |   1   |   2   |   3   |   _13 (7) |_|1.000ms|2.000ms|________|_____0_
         |-----------------------|   _14 (8) |_|1.000ms|2.000ms|________|_____0_
j) addr. to test- __7 [12bit Rez]    _15 (9) |_|1.000ms|2.000ms|________|_____0_
figure: MiniBase                     _16 (A) |_|1.000ms|2.000ms|________|_____0_
output: Axis 3                       _17 (B) |_|1.000ms|2.000ms|________|_____0_
a) toggle Auto-force to 0% or 100%   _18 (C) |_|1.000ms|2.000ms|________|_____0_
1, 4, 7, -) sets "forced" to 0%      xxx (D) |_|_______|_______|________|_______
2, 5, 8, +) sets "forced" to 100%    xxx (E) |_|_______|_______|________|_______
Hit <CR> to save, <Esc> bails out    xxx (F) |_|_______|_______|________|_______
n) Next, l) Last, i) info, o) def., p) looP, h) Halt, r) save, v) Verify, x) Xit
                                     Command-
```

Use the ‘1’, ‘4’ and ‘7’ keys to adjust the ‘minimum’ position the for the selected ServoMotor output. This sets the pulse width that will be sent out from the SER-DMX when you give it a ‘zero’ position command through the DMX-512 or AutoDownload file. The default ServoMotor output (when endpoint is set to 64 (decimal) is 2.0 millliseconds. This will automatically force the output to the ‘zero’ position [3]. For cylinders and electric actuators, this is usually the fully retracted position. You can adjust the PCM Servo-Motor output to anywhere between 0.5 to 2.5 milliseconds. If you adjust the ‘minimum’ to a pulsewidth that is higher than the ‘maximum’, this is perfectly acceptable, and is the easiest way to reverse the motion of an actuator.

The keys are used as follows:

1) decrements the ‘minimum’ position value

4) sets the ‘minimum’ position value to 128 (50%)

7) increments the ‘minimum’ position value

[3] This ‘forcing’ feature can be toggled on and off using the command ‘a) toggle Auto force to 0% or 100%’, or if you entered this mode while holding down the <control> key while you pressed the ‘u’ key.

Use the ‘2’, ‘5’ and ‘8’ keys to adjust the ‘maximum’ position the for the selected ServoMotor output. This sets the pulse width that will be sent out from the SER-DMX when you give it a ‘100%’ position command through the DMX-512 or AutoDownload file. The default ServoMotor output (when set to 192 (decimal)) is 2.0 milliseconds. This will automatically force the output to the ‘100%’ position [4]. For cylinders and electric actuators, this is usually the fully extended position. You can adjust the ServoMotor output to anywhere between 0.5 to 2.5 milliseconds. If you adjust the ‘maximum’ to a pulsewidth that is lower than the ‘minimum’, this is perfectly acceptable, and is the easiest way to reverse the motion of an actuator.

The keys are used as follows:

2) decrements the ‘maximum’ position value

5) sets the ‘maximum’ position value to 128 (50%)

8) increments the ‘maximum’ position value

You can then use the ‘-’, ‘+’, ‘3’, ‘6’ and ‘9’ keys to move the ServoMotor output over the full range of output (the full range is set by the values in the ‘minimum’ and ‘maximum’ columns). You can use these keys to test your adjustments. The SER-DMX does this by using these keys to adjust the ‘forced’ value. When you are done adjusting this output, you will want to make sure you clear the ‘forced’ value, or the ServoMotor output will remain locked at the last value set in the ‘forced’ column. You can do this by hitting the ‘-’ key twice, or hitting the ‘3’ (decrement forced value) one more time after it is already at zero.

If you have console or other way of moving the channel you are adjusting, you will probably not use this feature and use the console instead.

The keys are used as follows:

‘-’) sets the ‘forced’ position value to zero (a 2nd time clears ‘forced’)

‘+’ or ‘=’)sets the ‘forced’ position value to 100%

2) decrements the ‘forced’ position value

5) sets the ‘forced’ position value to 128 (50%)

8) increments the ‘forced’ position value

[4] This ‘forcing’ feature can be toggled on and off using the command ‘a) toggle Auto force to 0% or 100%’, or if you entered this mode while holding down the <control> key while you pressed the ‘u’ key.

When you are satisfied with your adjustments, just hit the <Carriage Return>. If you don't want to save your settings, hit the <ESC>ape key to restore the original values.

Q) Force Outputs to a Value

This command is used to force an output to any value. This value can be written into EEprom Memory so that the output will never leave this value, even after the SER-DMX is reset. It can be used to 'lock down' a movement that has malfunctioned or needs to be positioned for servicing or adjustment. Any outputs which have been forced will be displayed in the 'Forced Output' column on the display.

Only the on-board PCM ServoMotor outputs can be forced. A new output address will be requested if the currently selected 'Output to Test & Adjust' is not one of the on-board ones.

T) Power On Defaults

The Power On defaults are used by the SER-DMX only if there is no AutoDownload file found. If there is a AutoDownload file on the Micro Sd/SdHC flash card in the SER-DMX, the first frame of the first show will automatically be loaded at power up. The power On defaults will have no effect.

This command allows you to set the value that will be output on any one of the 512 possible output addresses. This value will be sent out when the SER-DMX is first powered up. This command gives you the option of:

a) Capturing the current value as the default value for the currently selected output.

b) Capturing the current values as the default value for all outputs.

c) Entering a value as the default value for the currently selected output.

The PowerOn value for all outputs is displayed in the 'PowerOn Default' column on the display.

W)Set Analog Endpoints

This command is used to adjust the endpoints of the sixteen ServoMotor outputs. The 'Set Min/Max/Forced using Keypad' is a much easier way of setting these values. Use it if you can.

The ServoMotor outputs normally sweep between 1.0 milliseconds and 2.0 milliseconds. By using these commands you can set either endpoint to anywhere between 0.5 milliseconds and 2.5 milliseconds for a reduced or reversed ServoMotor output swing. If you want to invert the pulse width swing of any output, all you need to do is set the lower limit to a higher level than the upper limit. The endpoints for all sixteen outputs is displayed in the 'Minimum Scale'/'Maximum Scale' columns on the display.

As an example of the use of the ServoMotor endpoint adjustments, if you wanted to set the pulse widths on a channel to sweep from 1.0 milliseconds and 2.0 milliseconds: Looking at the chart at the end of this manual, you can see that this would be from approximately 25% to 75% of full scale. From the chart you would see that the values that should be entered would be 64 (40h) and 192 (C0h).

To set the endpoints, first clear the endpoints to the two extremes (0%/0/00h). Then use a Togglodyte, Programming Console, or the 'Force Output to a Value' command to find what values set the proper endpoints for the output. You can then enter these numbers into the endpoints for this output.

The endpoints can only be set for the on-board PCM ServoMotor outputs. A new output address will be requested if the currently selected 'Output to Test & Adjust' is not one of the on-board ones.

N) Next

This moves the ‘Output to test & Adjust’ arrow down by one line.

L) Last

This moves the ‘Output to test & Adjust’ arrow up by one line.

I) Card Status

This command displays information on the currently loaded AutoDownload file:

a) FileName of this AutoDownload file (this is set during the AutoDownload process when you save the file to disk)

b) Name of the SER-DMX card that this AutoDownload is intended for. This is set on the ‘Device Settings’ dialog. The ‘Device Settings’ dialog is accessed either by:

1) Opening the Channels List, changing the ‘Show by’ to ‘Show by Devices’, and double clicking on the SER-DMX you will be downloading to
2) Clicking on the ‘Device Settings’ button at the top of the AutoDownload dialog (next to where you select the target device)

c) AutoDownload file version number (as of this writing, this will be ‘v1.1’)

d) The number of sequencers in this AutoDownload file (this is set on the ‘ Device Settings’ dialog, where between one and eight sequencers can be assigned to a single SER-DMX. The ‘Device Settings’ dialog is accessed either by:

1) Opening the Channels List, changing the ‘Show by’ to ‘Show by Devices’, and double clicking on the SER-DMX you will be downloading to
2) Clicking on the ‘Device Settings’ button at the top of the AutoDownload dialog (next to where you select the target device)

e) The date and time when this AutoDownload file was created

f) Number of DMX-512 channels per universe. This will normally be 512, unless the frame rate is set above 32 frames per second. Above about 44 frames per second, there is not enough time to send out all 512 channels. Higher speeds are not recommended for large shows on the SER-DMX without consulting Gilderfluke & Co. first.

g) Range of DMX-512 channels in the AutoDownload file. This will normally start with universe ‘a’ channels, unless the ‘first channel’ on the AutoDownload has been offset to begin beyond the first universe.

h) Smpte Error Count. This is the number of good consecutive frames of Smpte that the SER-DMX must receive before it believes it. Typically this set to around five. This is set on the ‘Device Settings’ dialog. The ‘Device Settings’ dialog is accessed either by:

1) Opening the Channels List, changing the ‘Show by’ to ‘Show by Devices’, and double clicking on the SER-DMX you will be downloading to
2) Clicking on the ‘Device Settings’ button at the top of the AutoDownload dialog (next to where you select the target device)

i) The name of each sequencer, along with the show that each loads at startup and if it waits or plays the show. This is set for each sequencer during the AutoDownload

j) The EaseIn Speed and EaseIn Threshold for each sequencer. These are set on the 'Sequencer Settings' dialog. The 'Sequencer Settings' dialog is accessed by:

   1) Opening the Channels List, changing the 'Show by' to 'Show by Sequencers', and double clicking on the sequencer you want to change
   2) Selecting the sequencer you would like to modify and clicking on the 'Sequencer Settings' button on the AutoDownload dialog (next to where you select the sequencer for the startup and input actions)
   3) Opening the 'Device Settings' dialog and pressing the 'Sequencer Settings' buttons

k) If there is an attempt to start a show while another show which is unsteppable[5] is already running, these 'early' starts can be 'banked'. This setting shows how deeply stored starts can be 'banked'. These are set on the 'Sequencer Settings' dialog. The 'Sequencer Settings' dialog is accessed by:

   1) Opening the Channels List, changing the 'Show by' to 'Show by Sequencers', and double clicking on the sequencer you want to change
   2) Selecting the sequencer you would like to modify and clicking on the 'Sequencer Settings' button on the AutoDownload dialog (next to where you select the sequencer for the startup and input actions)
   3) Opening the 'Device Settings' dialog and pressing the 'Sequencer Settings' buttons

l) Show Names. This displays both the 'short' (DOS 8.3) names and the longer names saved in the v1.1 AutoDownload extended header

m) v1.0 AutoDownload file header

n) Each of the shows including:

   1) Show's numeric position in the AutoDownload file
   2) Show's 'short' (DOS 8.3) name
   3) Offset to the 'start' of the show
   4) Length of the show (in frames)

[5] Uninterruptible if a new show request arrives while this show is playing

5) Under the ‘S’, whether the show is
    1) ‘Steppable’ (interruptible if a new show request arrives while this show is playing) is shown by a ‘Y’
    2) ‘non-Steppable’ (uninterruptible if a new show request arrives while this show is playing) is shown by a ‘N’
6) Under the ‘L’, whether the show is
    1) ‘Loopable’ (Plays to the end of the show, then performs the ‘at end’ actions as set on the AutoDownload dialog) is shown by a ‘Y’
    2) ‘non-Loopable’ (Plays to the end of the show, and stops and waits for the next start command) is shown by a ‘N’
7) The frame rate for the show
8) The ‘next’ show defined for the show during the AutoDownload

o) the current output level of each analog/ServoMotor output:

J) Reload Defaults

This command sets all the settings of the SER-DMX back to factory defaults. It asks you an extra time if you are really sure you want to do this before it does.

If the ‘number system’ is set to milliseconds, the SER-DMX presumes you are mainly interested in the ServoMotor outputs, so instead of setting the ‘minimum’ to ‘0’ and the ‘maximum’ to ‘100%’, it will default to ‘1.000ms’ and ‘2.000ms’, which is the range of movement that most ServoMotors expect as a defuilt range.

P) Play/Loop

If operating as a ‘Dumb’ Brick, allows you to select and play a show.

H) Halt

If operating as a ‘Dumb’ Brick, allows you to stop the currently playing show.

R) Save Configs

This command is used to save the current configuration of the SER-DMX through the serial port to a file on your computer. This file can then be reloaded into this, or any other SER-DMX. To use this command, you first invoke it, then following the instructions, you set your computer to receive a string of ASCII characters.

```
- Gilderfluke & Co. -  SER-DMX Servo Card  - version 3.17 - copyright 2013 DCM -
               Shows: 8, Ch: 123 @___0, ADL: AutoDownload_Filename
                              Serial Address- __0
                __1 Show_FileName.sho looping @ frame ____1363


 Set your computer to save a stream of text to a file. The file should be 1043
   bytes long. To reload this card, just send this file back to this screen.

                            Hit any key when ready.

          Stop saving text and hit any key when the data has finished.









                         hit <ESC>ape key to cancel-

                               Enter Command-
```

You then press any key to tell the SER-DMX to send out it's configuration. When it has finished, you then tell your computer to stop saving characters, and then hit any key to tell the SER-DMX to redraw the screen.

V) Verify

This command verifies the data stored in the SER-DMX's flash memory. This will take anywhere from a few seconds to several minutes, depending of the size of the AutoDownload file that must be tested.

X) eXit

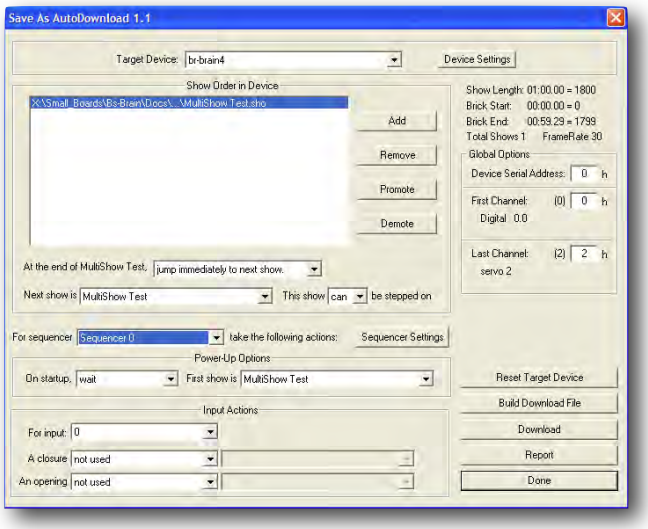
This exits the configuration mode and returns the SER-DMX to the command mode. When exiting you must enter a ‘y’ or ‘n’, to preserve compatibility with some other Gilderfluke & Company cards.

Optically Isolated Trigger Input Actions

The following Input Actions are used to start, stop, and generally control the SER-DMX through its two optically isolated trigger inputs. The optically isolated trigger inputs can be used as the sole method to control the SER-DMX, or as an adjunct to the SER-DMX's primary serial port.

You set what each of the Trigger Inputs will do on the AutoDownload dialog, (usually) after you have finished programming all of your shows and are ready to send them to the SER-DMX.

The SER-DMX has two Trigger Inputs. You can set different Input Actions for the 'closing Edge' [6] on the input and the 'opening Edge' [7].This allows you to do things like 'pause' a show on a closure of an input, and then 'continue' it on the opening of the same input.



Pc•MACs uses the 'Target Device' to know what options are available for the Trigger Inputs, number of sequencers available, and even the size of the AutoDownload memory available. It looks this up from the GilderGearList each time you do an AutoDownload, so if new features have been added to the Br-Brain4 since your last AutoDownload, you will be able to access them.

Some of the Input Actions require you to enter a second or third value from the drop downs just to their right. Typically these will be a show, or range of shows for the Input Action to use.

---

[6] The 'closing edge' is when current starts flowing through the optically isolated input, which is usually when an attached switch 'closes'. The status of all the Trigger Inputs can be seen on the Br-Brain4's 'status' command and 'main' menu.

[7] The 'opening edge' is when current stops flowing through the optically isolated input, which is usually when an attached switch 'opens'. The status of all the Trigger Inputs can be seen on the Br-Brain4's 'status' command and 'main' menu.

A) not used

This is the default setting for all inputs. Leave any unused inputs as 'not used'

B) Start Show

This is the most commonly used trigger input command. It tells the SER-DMX to start the selected show with the 'looping' flag set. On the SER-DMX's menus, the show status will be shown as 'looping', to indicate that the show will check the 'at end' actions that have been set for the show when it completes playing.

Use the drop down to the right of the Input Action to select whether this Input Action will start playing 'whatever is next' in the AutoDownload list of shows, or a specific show. All the shows in the AutoDownload list will be shown in the drop down, and you can select the specific one you would like to start.

C) Stop Show

This tells the SER-DMX to stop playing a show immediately. The show is frozen at the current frame, as are the ServoMotor and DMX-512 outputs. On the SER-DMX's menus, the show status will be shown as 'STOPPED', to indicate that the show was not allowed to play to completion. On starting another show, all the ServoMotors will be EasedIn to the new show.

D) Stop At End

This is the Input Action you use when you want to stop a show which is playing, but allow it to play through to its natural end. On the SER-DMX's menus, the show status will be shown as 'playing', to indicate that the show will NOT check the 'at end' actions that have been set for the show.

E) Pause Show

This pauses the show playing on the SER-DMX immediately. The ServoMotor and DMX-512 outputs are frozen at their current states. On the SER-DMX's menus, the show status will be shown as 'paused'.

F) Continue Show

The opposite of the 'Pause' Input Action, this will allow a paused show to return to playing. On the SER-DMX's menus, the show status will be shown as 'looping' or 'playing', depending on what its status was before the 'pause'.

G) E-stop Show

This stops a SER-DMX playing immediately, and prevents the SER-DMX from being restarted until the 'Clear E-Stop' input action is received, or the SER-DMX is reset.

Use the drop down to the right of the Input Action to select whether this Input Action will freeze the outputs at the 'Current Frame' or outputs the first frame of a specific show (ServoMotor outputs will be EasedIn so they don't jump). All the shows in the AutoDownload list will be shown in the drop down, and you can select the specific one you would like to use for E-Stops.

Freezing at the current frame is used when additional movements on the ServoMotor outputs is more hazardous than leaving them right where they are (which is often the case on motion bases).

Jumping to the first frame of a specified show allows you to define the E-Stop output levels for all ServoMotors and DMX-512. Use this to turn on emergency lighting, open doors, and return all outputs to a safe 'home' position.

The E-Stop Input Action is most commonly used on the 'opening' edge input. This is so a wire break or other fault between the SER-DMX and an E-Stop button will 'fail safe' on the SER-DMX.

On the SER-DMX's menus, the show status will be shown as 'E-Stop', to indicate that the SER-DMX has been locked up and will not be allowed to start any other shows until the E-Stop is E-Cleared.

H) Clear E-stop

This just clears the lock that the E-Stop puts. This lock prevents it from starting any other shows until it has been cleared.

The 'Clear E-Stop' Input Action is most commonly used on the closing edge of the same input that triggers the E-Stop. This is so that pulling the

E-Stop mushroom switch back to it's 'ready' position will also clear the E-Stop lockout.

I) Sequential From List

This input action can only be selected for the 'Closing' edge on an input. It allows you to define a range of shows that will be played when the input closes. The range can be as short as two shows up to all the shows that are loaded on the SER-DMX.

Use both of the drop downs to the right of the Input Action to select the 'first' and 'last' show to play from this Input [8]. On the first activation of this input, the SER-DMX will play the 'first' show you selected. On subsequent activations it will select and play the shows until it plays the 'last' show you selected. On the next activation, it will start over by playing the 'first' show again.

It is possible to use the 'Sequential from List' and 'Random from List' Input Actions with overlapping ranges for multiple inputs. This is all legal to do, but there is only one 'already played' flag for each show. If one input has already played a show that is in a range that overlaps with another input, that other input will consider that show as 'already played' too.

You can tell the SER-DMX to reshuffle this list at any time by using the 'Reshuffle List' input action.

J) Random From List

This input action can only be selected for the 'Closing' edge on an input. It allows you to define a range of shows that will be played when the input closes. The range can be as short as two shows up to all the shows that are loaded on the SER-DMX.

Use both of the drop downs to the right of the Input Action to select the 'first' and 'last' show to play from this Input [9]. On each activation of this input, the SER-DMX will pick at random a show that falls between the shows you defined as 'first' and 'last' and play it. When it has played all the shows in this range (including the 'first' and 'last'), it will 'reshuffle' the list. On the next activation it will pick and play any show *except* the most recently played show.

---

[8] The range of shows shown on the drop downs will change to limit your selection to 'legal' ranges of shows.

[9] The range of shows shown on the drop downs will change to limit your selection to 'legal' ranges of shows.

It is possible to use the ‘Sequential from List’ and ‘Random from List’ Input Actions with overlapping ranges for multiple inputs. This is all legal to do, but there is only one ‘already played’ flag for each show. If one input has already played a show that is in a range that overlaps with another input, that other input will consider that show as ‘already played’ too.

You can tell the SER-DMX to reshuffle this list at any time by using the ‘Reshuffle List’ input action.

K) Reshuffle List

This input action can only be selected for the ‘Closing’ edge on an input. It is used in conjunction with the ‘Sequential from List’ and ‘Random from List’ Input Actions to reset the ‘already played’ flags for a range of shows. The range can be as short as two shows up to all the shows that are loaded on the SER-DMX. The two drop downs to the right of the Input Action are used to select the ‘first’ and ‘last’ show have their ‘already played’ flags reset.

L) Binary Bit

This Input Action allows you to use as many as two of the trigger inputs to select and play shows using a binary pattern of bits. This allows you to select and play up to 3 shows through the Optically Isolated Trigger Inputs.

You can define any of the inputs to any of the binary bits zero through seven. Each of the binary bits should only be used once.

When any of the inputs that are assigned as a binary bit changes, the entire binary byte is scanned. If the result is non-zero, the binary value is used to select and play a show. Care must be taken that all the binary bits are switched simultaneously. Some PLCs have an output update rate which is slower than the SER-DMX’s input scan rate, which can result in unexpected shows being selected and played.

this page is not blank

Serial Port Commands

The following commands are used to start, stop, and generally control the SER-DMX through its primary serial port. The serial port commands can be used as the sole method to control the SER-DMX, or as an adjunct to the SER-DMX's two optically isolated trigger inputs.

The SER-DMX's serial port can be accessed from any computer running just about any modem or terminal program. The computer you are using doesn't even need to have any PC•MACs software installed on it.

One of the easiest and most flexible types of operator interfaces for accessing the serial port are the many touch screen operator panels. These can be a part of an existing PLC or room automation system (including AMX, Crestron, etc.). Stand-alone touch screen operator panels with serial port outputs are available from a number of different suppliers (Maple Systems and QSI Corp., etc.). These will easily attach directly to the SER-DMX's (and other GilderGear's) RS-232 serial port. Most of touch screens are sold with a Windows program that will allow you to 'draw' buttons and user interface icons on their screens, attach ASCII strings to these 'buttons', and then download the final configuration to the operator panel. They need no PC or other hardware once they are programmed.

Typical modem programs you can use with Gilderfluke & Co. equipment are Terminal.exe (which came with Windows 3.1) and HyperTerm.exe (which comes with later versions of Windows), or GilderTerm. The shareware Z-Term can be used on Macintosh computers.

GilderTerm is available free from Gilderfluke & Co. for use with all of our products. It can be downloaded from our web page, and is included on all of our CD-ROMs. GilderTerm has been optimized for use with all Gilderfluke & Company equipment. All the commands are built in, and it will even let you use your mouse to select commands.

To use the SER-DMX with a terminal program, just configure it for 9600 baud, no parity, eight data bits, one stop bit and no handshaking. If you are using GilderTerm, all the settings are preset. All you will need to do is select the appropriate 'COM' port.

In all the following commands, the command (shown in "quotes") is the ASCII command. You can type these from your keyboard. The commands are all UPPER/lower case sensitive.

The "(card address)" is the serial address of the single card that the will respond to the command. In the SER-DMX, the serial address for a card is permanently at '00'. The '(card address)' for a SER-DMX is always '00'.

The “(show #)” is the desired show’s position in the AutoDownload list when the AutoDownload file is saved. The ‘(show #)’ represents a two digit ASCII hexadecimal number for the desired show. Valid characters are “0” through “9”, and “A” through “F”. The chart on the back page of this manual will help you translate decimal show numbers into hexadecimal show numbers.

1) Echo Commands:

“a”(card address) ***Echo On:***
“b” ***Echo Off:***

The ‘Echo ON’ command will turn on a special mode that will cause all the other serial port commands to echo on the selected card. This used when you are setting up serial commands so you can verify all the commands you are issuing are being received correctly. In the following examples, the ‘echo’ responses are shown in bold italics:

If you send “a00”, on the card addressed at 00h the echo mode will be turned ON:

“*card __0, echo mode*”

If you send “*03A” to request a specific show on all cards:

“*card __0, requested show __3 ShowName3*”

If you send “t00A” to start the requested show playing on a specific card:

“*card __0, starting show __3 ShowName3*”

If you send “!00A” to start a show looping on a specific card:

“*card __0, looping show __4 ShowName4*”

If you send “uA” to stop all shows playing on all cards:

“*card __0, stopped show __5 ShowName5*”

Error messages will be returned whenever you ask the card to do something that it cannot do at the current time.

The ‘Echo OFF’ command turn off the echo mode on all the cards in the system. It does not echo anything.

2) Card Reset:

“j5AA5” (card address)

This command will erase the AutoDownload file on the Sd Flash Card on the SER-DMX. Needless to say, this command is only rarely used in a completed installation.

3) Card Status:

"i" (card address)

The status screen is a snapshot image of the current status of the SER-DMX. If you want to update the status information displayed, you must hit the 'Card Status' command again.

When the SER-DMX receives this command, it will respond with the following:

```
Gilderfluke & Co.
SER-DMX
v3.17 - copyright 2013 DCM
Shows: 2, Ch: 123 @ ___0, ADL: AutoDownload_Filename
SER-DMX Name @ Serial Address: __0
show #__1 Show_FileName looping @ frame ______38
input A: open
input B: open
```

Status Dump

The Status Dump shows:

a) number of shows in the AutoDownload file

b) number of channels in the AutoDownload file

c) address offset of the first channel in the AutoDownload file

d) name of the AutoDownload file

e) name of the AutoDownload target device

f) serial address of the AutoDownload target device

g) for the show which is loaded:

   a) show number the SER-DMX is playing

   b) name of the show

   c) playing status (looping, playing, stopped, paused, E-Stopped, etc.)

   d) frame number into the current show

h) Status of both of the optically isolated trigger inputs

4) Start Commands:

"t" (card address) ***Start Track:***
"u" ***Start Global:***

Instead of the 'start' commands, the 'loop' commands are generally a better choice. The difference between the 'start' and 'loop' commands are that at the end of a show which is started with a 'loop', it will check to see if any actions were set for the end of the show. A show that is started with the 'start' command will play to the end and then just stop and wait for the next command.

These commands start the animation playing on the SER-DMX(s) addressed by the command. The shows will always start from the beginning (frame zero). If an addressed SER-DMX is looping shows, it will have the 'LOOPING SHOWS' flag reset.

If the SER-DMX receives a start command after it has received a request for a specific show, it will play that show. Otherwise it will play the show that has been set as the 'next' show for the show which is currently playing (or most recently played show if it is not currently playing). If this is the first show played after a SER-DMX is reset, it will play the show which has been set as the 'first' show during the AutoDownload. Requests for specific shows can come only from the serial port.

When shows are downloaded to the SER-DMX, they can be set to ignore additional start commands while they are playing. This allows individual shows to be 'stepped' upon or not. If the SER-DMX is already playing a show which has this option set, it will ignore this command.

5) Stop Commands:

"x" (card address) ***Stop Track:***
"y" ***Stop Global:***

These commands stop the selected SER-DMX(s) unconditionally. The stop takes place at the current frame being played.

6) Loop Commands:

"!" (card address) ***Loop Track:***
" " " ***Loop Global:***

Instead of using the 'start' commands, the 'loop' commands are generally a better choice. The difference between the 'start' and 'loop' commands are that at the end of a show which is started with a 'loop', it will check to see if any actions were set for the end of the show. A show that is started with the 'start' command will play to the end and then just stop and wait for the next command.

These command acts much like the START commands, except that they also set the 'LOOPING SHOWS' flag. With the this flag set, it is possible to set a sequence of shows playing in any order. Since the 'next' show can be any show you ask for, one show can be played over and over again, or you can set up a sequence of shows which will be repeated until the SER-DMX is told to stop.

7) Stop at End Commands:

"%" (card address) ***Stop at End Track:***
"&" ***Stop at End Global:***

These commands reset the 'LOOPING SHOWS' flag in the selected SER-DMX(s). What this does is to stop them playing when the end of the current show is reached. These commands are used when you want the shows to finish gracefully, instead of stopping in the middle. The STOP commands are used when you want to stop a show immediately.

8) Select Show Commands:

")" (card address) (show#) ***Select Show Track:***
"*" (show#) ***Select Show Global:***

Up to two hundred fifty-five different animated shows can be stored on a single SER-DMX. These commands can be used to select an individual

show on the selected SER-DMX(s). Individual shows can be requested with a range of 01 to FFH. Once a show is selected, it will be played on the next serial port START or LOOP command.

If a show selection has been made inadvertently, it can be cleared by sending a request for show number 00.

9) Show Pause Commands:

"<" (card address) ***Pause Show:***
">" (card address) ***Continue Show:***

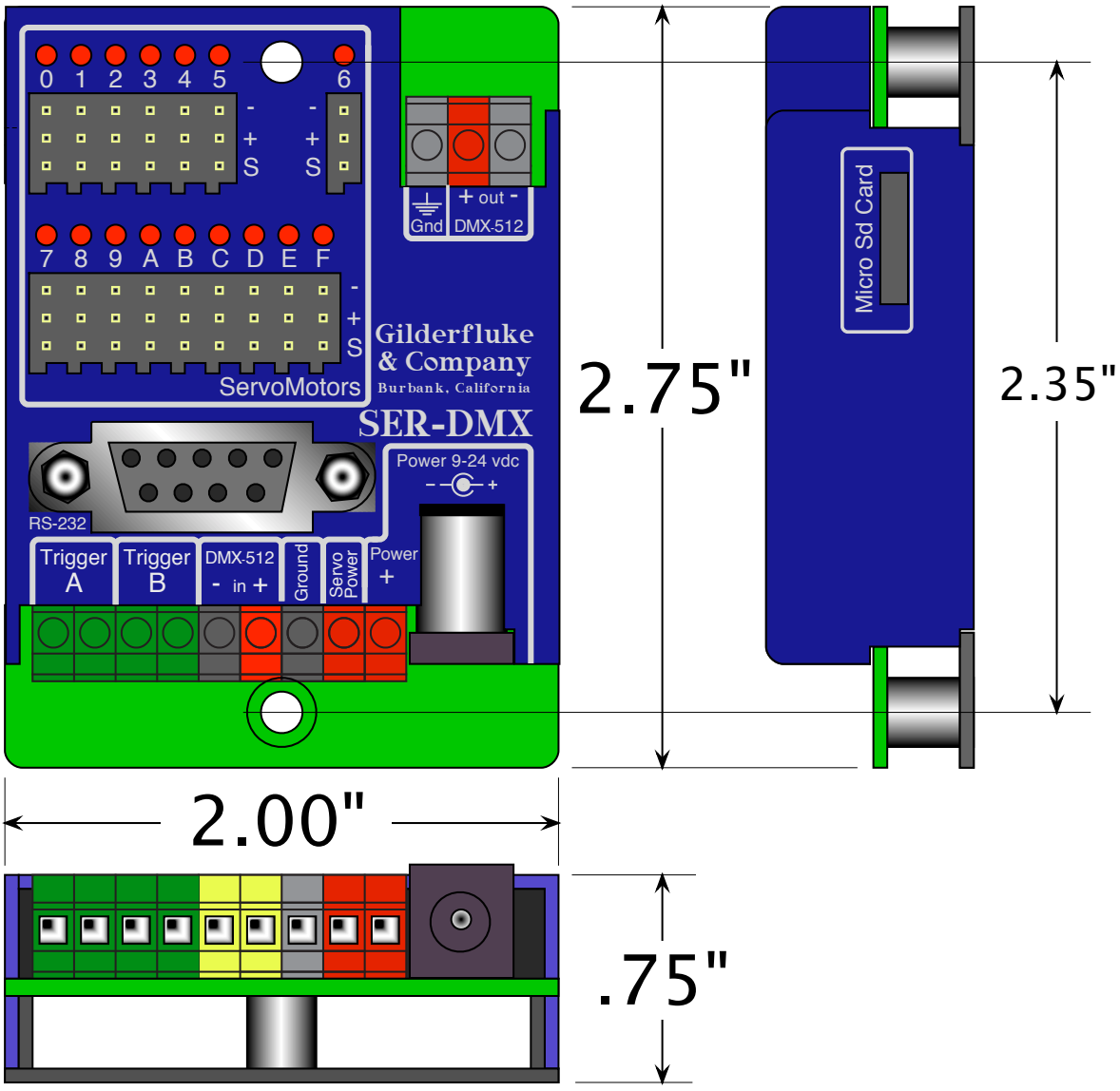
Any show can be paused at any point during its playback. The outputs are frozen at the 'levels they were at the instant the PAUSE command is received.

The CONTINUE command will resume any show playing which has previously been PAUSED.

SER-DMX Dimensions & Mounting

The SER-DMX can easily be mounted in one of several ways:

1) All of the Br-miniBrick sized pieces of GilderGear can easily be mounted in 2-¾" Snap-Track. This includes the SER-DMX.
2) A pair of DIN Adapters can be snapped onto the back of the SER-DMX. Once snapped into place, you'll have a devil of a time getting them off again. They allow the SER-DMX to attach to standard DIN rail.
3) There are two .156" diameter mounting holes for mounting the SER-DMX to a panel. They are on 2.35" centers.
4) It is not uncommon to simply attache self-adhesive Velcro to the back of a SER-DMX and stick it to your control panel.



this page is not blank

SER-DMX Firmware Updates

The firmware in a SER-DMX can easily be upgraded at any time. To update the firmware:

1) Download the SERDMXV3.FRM file from the Gilderfluke & Co. website
2) Unzip the file (if needed)
3) Place the SERDMXV3.FRM file onto a formatted Sd/SdHC flash card
4) Power down (or disable) whatever the SER-DMX is controlling. You don't want your show to do anything unexpected during the update
5) While the SER-DMX is running, remove the Sd/SdHC flash card it is using
6) Replace it with the Sd/SdHC flash card that holds the SERDMXV3.FRM file
7) The SER-DMX will update itself
8) Once the firmware update has completed, remove the Sd/SdHC flash card that has the SERDMXV3.FRM file on it
9) Insert the the Sd/SdHC flash card with your shows on it
10) Power back up (or enable) whatever the SER-DMX is controlling.

During firmware updates, the Read LED and Busy LED flash back and forth.

The first stage is comparing the SERDMXV3.FRM file on the Sd card. It then flashes a little slower as it reads the SERDMXV3.FRM file in from the Sd card. It then flashes back and forth much more quickly as it reprograms the microcontroller in the SER-DMX.

Under no circumstances remove power from the SER-DMX while firmware is being updated. A partial firmware update may 'brick' the SER-DMX, and then it will need to be returned to the factory for reprogramming.

HEXadecimal to Decimal to Percentage

The following chart shows decimal, HEXadecimal, and a few percentage equivalents to aid you when you need to convert between numbering bases:

decimal	HEX	ASCII	%	decimal	HEX	ASCII	%	decimal	HEX	ASCII	%	decimal	HEX	ASCII	%
00	00	null	0	64	40	@	25%	128	80	(null)	50%	192	C0	(@)	75%
1	01	soh/^A		65	41	A		129	81	(soh)		193	C1	(A)	
2	02	stx/^B		66	42	B		130	82	(stx)		194	C2	(B)	
3	03	etx/^C		67	43	C		131	83	(etx/)		195	C3	(C)	
4	04	eot/^D		68	44	D		132	84	(eot)		196	C4	(D)	
5	05	eng/^E		69	45	E		133	85	(eng)		197	C5	(E)	
6	06	ack/^F		70	46	F		134	86	(ack)		198	C6	(F)	
7	07	bell/^G		71	47	G		135	87	(bell)		199	C7	(G)	
8	08	bs/^H		72	48	H		136	88	(bs)		200	C8	(H)	
9	09	ht/^I		73	49	I		137	89	(ht)		201	C9	(I)	
10	0A	lf/^J		74	4A	J		138	8A	(lf)		202	CA	(J)	
11	0B	vt/^K		75	4B	K		139	8B	(vt)		203	CB	(K)	
12	0C	ff/^L		76	4C	L		140	8C	(ff)		204	CC	(L)	
13	0D	cr/^M		77	4D	M		141	8D	(cr)		205	CD	(M)	
14	0E	so/^N		78	4E	N		142	8E	(so)		206	CE	(N)	
15	0F	si/^O		79	4F	O		143	8F	(si)		207	CF	(O)	
16	10	dle/^P		80	50	P		144	90	(dls)		208	D0	(P)	
17	11	dc1/^Q		81	51	Q		145	91	(dc1)		209	D1	(Q)	
18	12	dc2/^R		82	52	R		146	92	(dc2)		210	D2	(R)	
19	13	dc3/^S		83	53	S		147	93	(dc3)		211	D3	(S)	
20	14	dc4/^T		84	54	T		148	94	(dc4)		212	D4	(T)	
21	15	nak/^U		85	55	U		149	95	(nak)		213	D5	(U)	
22	16	syn/^V		86	56	V		150	96	(syn)		214	D6	(V)	
23	17	etb/^W		87	57	W		151	97	(etb)		215	D7	(W)	
24	18	can/^X		88	58	X		152	98	(can)		216	D8	(X)	
25	19	em/^Y		89	59	Y		153	99	(em)		217	D9	(Y)	
26	1A	sub/^Z		90	5A	Z		154	9A	(sub)		218	DA	(Z)	
27	1B	ESC		91	5B	[		155	9B	(ESC)		219	DB	([)	
28	1C	FS		92	5C	\		156	9C	(FS)		220	DC	(\)	
29	1D	GS		93	5D	]		157	9D	(GS)		221	DD	(])	
30	1E	RS		94	5E	^		158	9E	(RS)		222	DE	(^)	
31	1F	VS		95	5F			159	9F	(VS)		223	DF	( )	
32	20	SP	12.5%	96	60	`	37.5%	160	A0	(SP)	62.5%	224	E0	(`)	87.5%
33	21	!		97	61	a		161	A1	(!)		225	E1	(a)	
34	22	“		98	62	b		162	A2	(“)		226	E2	(b)	
35	23	#		99	63	c		163	A3	(#)		227	E3	(c)	
36	24	$		100	64	d		164	A4	($)		228	E4	(d)	
37	25	%		101	65	e		165	A5	(%)		229	E5	(e)	
38	26	&		102	66	f		166	A6	(&)		230	E6	(f)	
39	27	‘		103	67	g		167	A7	(‘)		231	E7	(g)	
40	28	(		104	68	h		168	A8	(()		232	E8	(h)	
41	29	)		105	69	i		169	A9	())		233	E9	(i)	
42	2A	*		106	6A	j		170	AA	(*)		234	EA	(j)	
43	2B	+		107	6B	k		171	AB	(+)		235	EB	(k)	
44	2C	‘		108	6C	l		172	AC	(‘)		236	EC	(l)	
45	2D	-		109	6D	m		173	AD	(-)		237	ED	(m)	
46	2E	•		110	6E	n		174	AE	(•)		238	EE	(n)	
47	2F	/		111	6F	o		175	AF	(/)		239	EF	(o)	
48	30	0		112	70	p		176	B0	(0)		240	F0	(p)	
49	31	1		113	71	q		177	B1	(1)		241	F1	(q)	
50	32	2		114	72	r		178	B2	(2)		242	F2	(r)	
51	33	3		115	73	s		179	B3	(3)		243	F3	(s)	
52	34	4		116	74	t		180	B4	(4)		244	F4	(t)	
53	35	5		117	75	u		181	B5	(5)		245	F5	(u)	
54	36	6		118	76	v		182	B6	(6)		246	F6	(v)	
55	37	7		119	77	w		183	B7	(7)		247	F7	(w)	
56	38	8		120	78	x		184	B8	(8)		248	F8	(x)	
57	39	9		121	79	y		185	B9	(9)		249	F9	(y)	
58	3A	:		122	7A	z		186	BA	(:)		250	FA	(z)	
59	3B	;		123	7B			187	BB	(;)		251	FB	( )	
60	3C	<		124	7C			188	BC	(<)		252	FC	( )	
61	3D	=		125	7D	l		189	BD	(=)		253	FD	(l)	
62	3E	>		126	7E	~		190	BE	(>)		254	FE	(~)	
63	3F	?		127	7F	del		191	BF	(/)		255	FF	(del)	100%