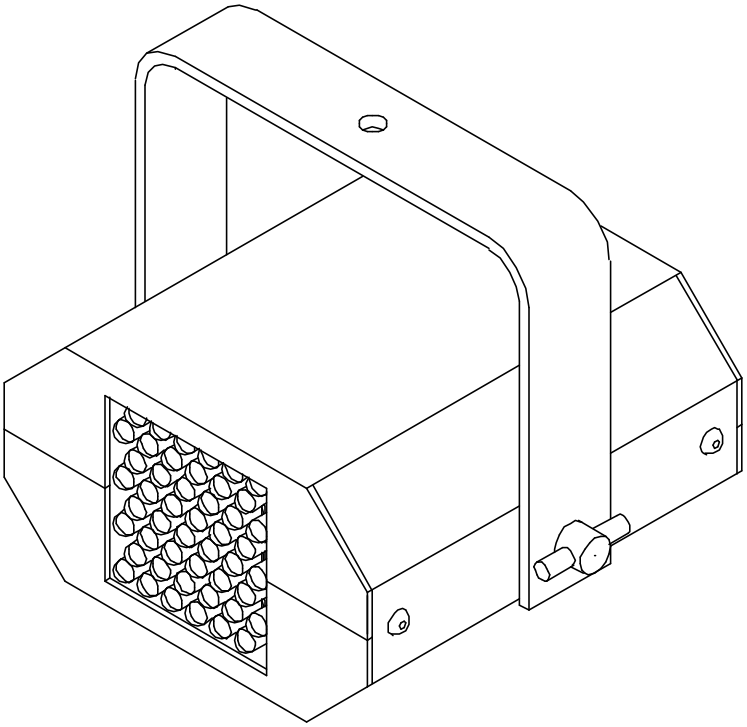
BL-48 DMX Ultraviolet Illuminator

The BL-48 Ultraviolet Illuminator is a state of the art lighting instrument based on an array of 48 Ultraviolet LED's and a computer micro-controller. This unit permits ultraviolet effects to be faded or strobed under DMX control. These effects cannot be created with other types of UV illumination. The LED UV devices do not require replacement, produce little or no heat, and are available in a range of dispersion angles and UV or near-UV wavelengths. From one to four channels of DMX-512 data controls UV intensity, strobe rate, or other parameters as determined by the LED configuration, and the settings of internal mode jumpers. The unit may also be operated in manual mode without DMX as a stand-alone fixture with preset intensity and strobe timing if desired. Illuminators may be controlled by any DMX lighting system for professional displays, or may be set up for independent operation at a preset intensity or strobe rate in stand-alone UV lighting applications.



A range of UV LED options are now available for installation in the unit. For replacing existing fluorescent or incandescent UV light sources, 395 nanometer UV LED's may be installed to duplicate the deep blue-violet output common to those fixtures. For pure ultraviolet displays, 385 nanometer LEDs, which produce very little visible light may be selected. UV LED sources of different types, or with different dispersion angles may be installed in the same fixture, with each LED type then controlled independently through DMX, providing unprecedented flexibility in an ultraviolet fixture. All LED emissions are long wavelength UV-A light, which is not considered a skin or an eye hazard under normal conditions.

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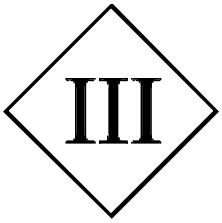
Precautions For Use

This device is intended for indoor use only, in dry locations free of excessive moisture or condensation. The unit is intended for permanent installations in areas where the ambient temperature is an average of 70 degrees Fahrenheit (F), and remains within the range of 40°F to 90°F at all times the unit is operational. Safe operation of the unit depends upon installation and operation according to the following guidelines.

Rated Operating Voltage

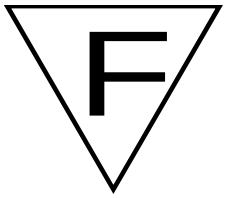
The BL-48 unit is rated for operation from DC voltage sources from 22 volts minimum to 24 volts maximum. Application of power supply voltages in excess of the maximum rating may result in damage to the unit electronics, and possible hazards including fire and the risk of electrical shock.

Class III Product



The BL-48 unit provides protection meeting the requirements for Class III electrical products. The unit is intended for operation with external power supplies which comply with the SELV (Safety Extra Low Voltage) requirements. Operation of the unit from power sources which do not meet the SELV standard is not recommended, and may result in an increased risk of electrical shock .

Suitable Mounting Surfaces



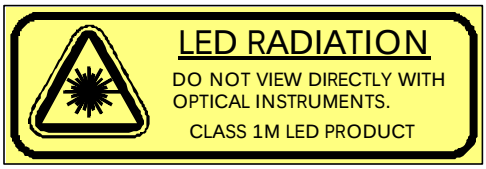
The BL-48 unit may be mounted to any suitable surface, including those consisting of normally flammable materials such as wood or plastic. Mounting may be accomplished using the five ¼-20 female threaded attachment points along the back of the unit, or by drilling holes as necessary in the flanges on either side of the unit, and then securing it to the support structure with appropriate fasteners. The unit may be mounted in any orientation.

Product Compliance

The BL-48 unit has been tested for compliance with the General and Particular Standards for Luminaires, under EN 60598-1 (2004), and EN 60598-2-1 (1989), and also for compliance with the Electromagnetic Compatibility (EMC) standards under EN 610000-6-3 (2001) and EN 610000-6-1 (2001), and are certified to comply with these standards.

CAUTION

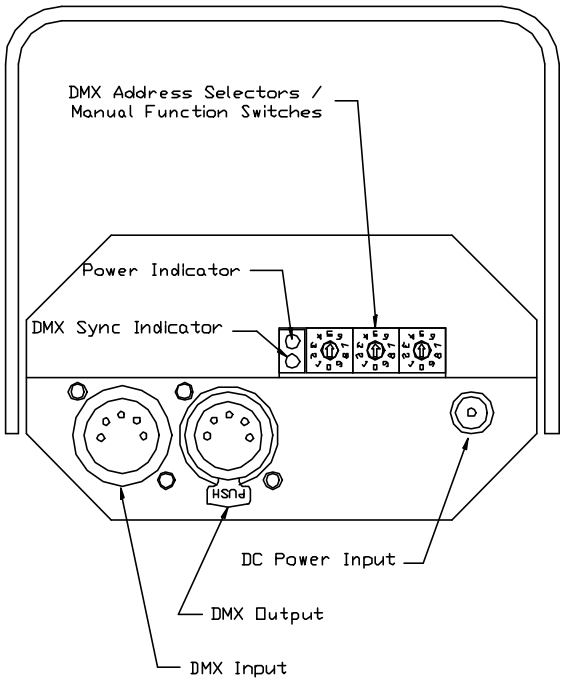
This product contains Ultraviolet Light Emitting Diodes (LED's). During operation, the LED's emit intense ultraviolet light. Precautions should be taken to avoid looking directly into the UV output for prolonged periods with the unaided eye, viewing the UV output at close range, or viewing through optical systems which enhance or concentrate the UV light. The use of UV light protective glasses is recommended when the direct or reflected UV output must be viewed for extended periods, at close range, or through optics.



Controls and Connections

The rear panel of the unit includes a power input jack for a UL approved Class II 24 volt DC power source, a red LED power indicator, and three rotary selector switches to choose the base DMX address for the device. A slide switch to the left of the address switches can be set to provide a resistive termination to the DMX data lines if the unit is the last device in the DMX data string. A green LED DMX sync indicator is located to the left of the termination switch to provide a positive indication of DMX data reception, and to confirm the mode setting of the unit on power up. The DMX input and output connections are located on the lower half of the unit, to the left of the power input socket.

Control Panel Connections



CAUTION

Connection of the unit to AC power sources, or to alternative power supplies other than the universal input DC power pack provided with the unit may result in damage to the unit. Do not attempt to operate the unit if you are unsure of the rating of the AC power source, or of the voltage and polarity of any alternative DC power supply. Connections made to the DMX Input and Output terminals must conform to the US-ITT DMX-512 standard to insure proper operation of the unit. Any damage resulting from accidental application of incorrect power supply or DMX signal voltages will not be covered by the system warranty.

Basic Operation

The unit may be operated from any AC power source from 100 to 240 volts AC, 50 or 60 Hz. The universal voltage AC adapter provided with the unit will convert any AC power source within this range to the 24 volts DC at .5 ampere maximum required by the unit. The unit is ready for operation once the AC adapter is plugged into a suitable power source, and the DC output power from the adapter is applied to the unit.

The LED power indicator on the rear panel will illuminate in green when the unit is on. When power is first applied, the green DMX Sync indicator will blink from 1 to 4 times to indicate which internal mode setting is selected. The internal processor will then read the address information selected on the three DMX address switches, and will respond to appropriate DMX commands, or to manual operation instructions as established by those switch settings and the internal mode selected. After the start sequence is complete, the DMX Sync indicator will illuminate steadily in green when valid DMX data is being received, and will not illuminate, or will flash intermittantly if DMX data is absent or unstable.

Default Settings

Unless otherwise specified, all units are shipped with factory default mode and DMX address settings. The default factory mode is Mode 1, single channel mode, where one DMX channel will control the intensity of the UV emission from the unit. The default DMX address setting is to a base address of 001.

The default setting of Mode 1 will allow access to the manual mode functions, which allow the unit to be operated or evaluated without the need for a DMX signal source. Manual mode operation is described more completely in a later section of this manual.

Base DMX Address Settings

The three rotary address switches are set to select the base DMX address for the unit. The address switches should be preset to the desired base DMX address before the unit is powered up, as the address settings are read during the power up sequence. If it is necessary to change the DMX address for the unit, the address settings may be changed at any time, but the unit will not read or respond to the new channel assignment until power is removed, and restored once again.

DMX Channel Useage and Allocation

Once the base DMX address is read, the unit will respond to changes in the DMX data for the selected channel or channels depending upon the selected operational mode. From 1 to 4 DMX data channels may be occupied by each unit depending on the internal mode setting. For all multi-channel modes, the additional DMX channels occupied are sequentially higher than the base DMX address selected by the selector switches. For example, a unit operating in Mode 2, which uses two DMX channels, and set to a base DMX address of 100 would occupy and respond to information on DMX channels 100 and 101. A unit set to Mode 4, which uses four DMX channels, and a base DMX address of 200 would occupy and respond to information on DMX channels 200, 201, 202, and 203.

DMX Data Connection

Once the base DMX address setting is complete, the unit may be connected to a DMX data source. The green "Sync" indicator will illuminate steadily if valid DMX data is being received by the unit. In normal operation, the unit will respond to changes in the DMX data for the selected channel or channels by increasing or decreasing the intensity of each LED emitter, or varying the motor speed in direct response to the DMX channel control levels. When normal DMX data is being received, the unit will retain the last valid data for about 5 seconds after the DMX data is removed. This data retention allows the unit to tolerate minor interruptions in the DMX data stream caused by poor connections or brief "dropouts". After this interval, the unit will default to the normal "no DMX data" state, with all output channels inactive. Normal operation will resume immediately when the normal data stream is restored.

DMX Troubleshooting

If the "Sync" indicator is not steadily illuminated when DMX data is connected, then there is either a problem with the DMX data or cables, or an internal problem with the unit. If the unit does not operate, and the "Sync" indicator flashes at a regular interval, the DMX address is set to an invalid range, either to zero, or to a number higher than 512, which is the highest base address setting which will allow control of the fixture in single channel mode. If the "Sync" indicator is erratic, then the DMX data connection is either intermittent due to a poor electrical connection, or the DMX data is dropping out, which can be caused by poor connections, poor quality cables, long data runs, or poor signal quality in general. Test the unit with different cables, or in a different location closer to the DMX data source to determine what or where the problem is.

Operational Mode Settings

The BL-48 unit may be operated in any one of four modes as selected by internal programming jumpers. Power must be removed from the unit before opening the cover to change the mode jumper settings. Once the unit is inactive, the upper housing of the unit may be opened by removing the four screws along the sides. Once the screws are removed, the top cover may be opened to gain access to the internal circuit board with the jumpers.

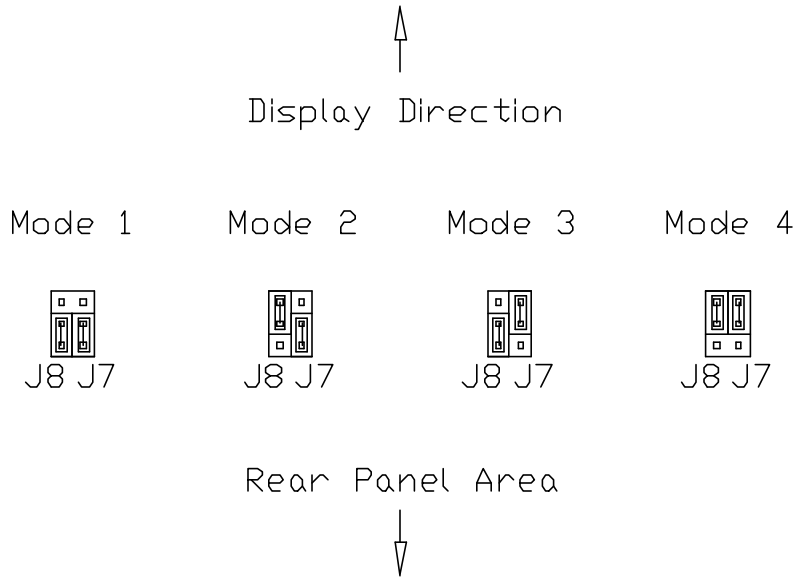
Operational Modes

The mode selection corresponds with the number of consecutive DMX channels used in each mode, beginning from the base DMX address selected by the address switches. The DMX channel function and operation of the unit in each mode is listed in the following table.

Mode	Functions	Manual	Channels	Ch. 1	Ch. 2	Ch. 3	Ch. 4
1	Intensity Only	Yes	1	Master Intensity	Unused	Unused	Unused
2	Intensity & Strobe	No	2	Master Intensity	Strobe Rate	Unused	Unused
3	3 Channel	No	3	Bank 1 Intensity	Bank 2 Intensity	Bank 3 Intensity	Unused
4	3 Channel + Master	No	4	Master Intensity	Bank 1 Intensity	Bank 2 Intensity	Bank 3 Intensity

Mode Selection

The Mode Select jumpers are J7 and J8 located near the right edge of the main circuit board between the large regulator IC and the power input socket. Move the shorting jumpers as indicated in the diagram below to change the operating mode. Refer to the parts layout drawing which appears later in this manual for further illustrations of the jumper location if necessary.



Once the desired mode settings are in place, the top cover of the unit should be replaced, and the screws reinstalled before applying power to the unit. Operation of the unit in the desired mode may be confirmed by observing the DMX Sync indicator lamp, which will blink from 1 to 4 times when power is first applied to the unit to indicate which mode is currently selected.

Mode 1 Operation: Master Intensity on 1 DMX Channel

Mode 1 is the simplest operational mode, using only a single DMX channel, corresponding to the base address selected by the three address switches. The data on that DMX channel will control the intensity of the output from the unit, with a zero level producing no output, and a maximum level of 255 producing maximum output from the unit. Manual mode operation, as described later in this document, is only available when the unit is set to Mode 1.

Mode 2 Operation: Master Intensity plus Strobe on 2 DMX Channels

Mode 2 allows control of both Intensity and Strobe rate, and uses two DMX channels beginning with the base address selected by the address switches. The data on the first DMX channel will control the intensity of the output from the unit, with a zero level producing no output, and a maximum level of 255 producing maximum output from the unit. The data level on the second DMX channel will control the flash or strobe rate of the unit, with a zero level producing a one second flash every other second, with a maximum flash rate of around 30 flashes per second at a data level of approximately 245. Data levels from 245 to the maximum of 255 will result in continuous operation. Manual operation, as described later, is not available in Mode 2.

Mode 3 Operation: 3 Bank Intensity on 3 DMX Channels

Mode 3 allows individual control of Intensity for each of the three banks of 16 LED devices installed in the unit. This mode uses three DMX channels beginning with the base address selected by the address switches. The data on the first DMX channel will control the intensity of the LED devices in Bank 1, with a zero level producing no output, and a maximum level of 255 producing maximum output. The data levels on the second and third DMX channels will control the output of the LED devices in Banks 2 and 3 in a similar manner. This mode is most commonly used with a mixture of LED dispersions, wavelengths, or with banks of UV and White LED's. Manual operation, as described later, is not available in Mode 3.

Mode 4 Operation: Master Intensity plus 3 Bank Intensity on 4 DMX Channels

Mode 4 allows individual control of Intensity for each of the three banks of LED devices installed in the unit, plus a master level control. This mode uses four DMX channels beginning with the base address selected by the address switches. The data on the first DMX channel will control the intensity of all LED devices in all banks, with a zero level producing no output, and a maximum level of 255 producing maximum output, up to the levels set by the individual bank controls. The data levels on the second, third, and fourth DMX channels will control the output of the LED devices in Banks 1, 2, and 3 in a similar manner. This mode is most commonly used with a mixture of LED dispersions, wavelengths, or with mixed banks of UV and White LED's. Manual operation, as described later, is not available in Mode 4.

Manual Mode Displays

The manual mode displays are intended to provide the unit with a reasonable capability for demonstrating the properties of the unit, and are also useful for testing This capability may also be sufficient to complete simple effect installations where the cost or complexity of DMX controls are not necessary, but the benefits of a compact and very low maintenance UV source would be attractive. For those installations where the manual mode capacity of the unit are not precise or flexible enough, the use of the DMX control features should allow the unit to perform exactly as required.

Manual Mode Operation

Manual Mode operation is available only when the internal Mode jumpers in the unit are set to Mode 1, and the DMX address switches on the unit are set to addresses 600 and higher, which are beyond the normal range of the DMX-512 standard of 512 channels. The address switch settings in the range of from 600 to 699 and from 700 to 799 correspond to distinct manual mode functions as described in the following table:

Manual Mode	Minimum	Maximum	Minimum Effect	Maximum Effect
Intensity	600	699	0%	100%
Strobe	700	799	.5 Hz.	30 Hz.

Manual Display Programming

Operation of the unit in Manual Mode is controlled by the settings of the DMX address switches. The output of the unit may be adjusted using the address switch settings to obtain a wide range of intensity levels and strobe rates. Once established, manual mode settings are retained when power is removed from the unit, and will be restored when power is reapplied provided that no changes are made to the address switch settings. The manual settings may be altered by adjusting the settings at any time. The unit will resume normal DMX operations when the address switches are set to a value of 512 or less.

Manual Mode Intensity Control

When the base address switches are set to a range of 600 to 699 when power is first applied to the unit, the unit will produce UV output from 0 to 100 percent intensity, with no output at a setting of 600, and maximum output at a setting of 699. Output within this range is continuous, and is not affected by any other setting.

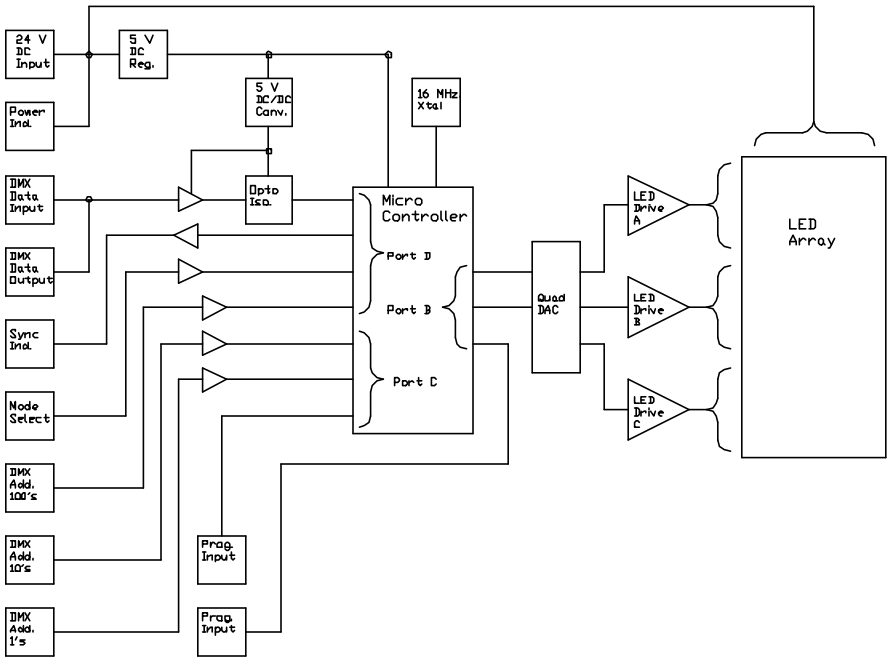
Manual Mode Strobe Rate Control

When the base address switches are set to a range of 700 to 799 when power is first applied to the unit, the unit will produce strobed UV output at 100 percent intensity, with a minimum rate of .1 Hz. (5 seconds on, 5 seconds off) at a setting of 700, and a maximum rate of approximately 30 Hz. at a setting of 799. Control settings above this level will result in continuous output.

Circuit Description

The BL-48 Illuminator circuitry is most easily described as six sections, which are the power supply, the microcontroller, the DMX interface section, the address and mode selection section, the DAC or PWM output section, and the LED drivers and array. The microcontroller is the key element in the circuit, as the data ports on the device are assigned to all key circuit and interface functions. The microcontroller responds to settings of the mode and address control switches, reads incoming DMX data with the proper address information, and generates the output data which controls the LED drivers. Each circuit section is explained in further detail below.

Circuit Block Diagram



Theory of Operation

Upon power up, the microcontroller sets the configuration of all internal registers and variables according to firmware programming, then reads the settings of the internal mode jumpers to determine the general display configuration. Once these settings are established, the controller then reads the settings of the DMX address switches, and goes into either a manual display mode if the address settings are 600 or higher, or a DMX controlled mode if the address settings are in the range of from 1 to 512. If no DMX data is available, the unit enters a "Standby" state, prepared to respond to valid DMX data input. The microcontroller monitors the DMX control lines, and awaits a signal to initiate a display. Upon receipt of a suitable signals, the controller then sets the intensity or other display variables to the to the required levels established by the DMX data. The display is maintained at the last valid level for a preset interval of about 5 seconds if DMX data is lost or interrupted. If no DMX data is received after this interval, the controller then returns to the normal standby state, and continues to monitor the inputs for additional DMX control signals.

Power Supply.

The illuminator is powered by an external DC power pack, or wall type transformer at a voltage of 24 volts DC, and a current of 350 milliamperes minimum. Suitable power sources are available with approvals from UL and other electrical safety agencies, and in several input voltage ranges. Power is applied to the illuminator unit through the 2.1 millimeter center positive DC plug J1 on the rear panel of the unit. Power applied to unit passes through a self resetting current limiter, a polarity protection diode, and a transient surge absorber before it is applied to the 5 volt regulator IC Q3, which reduces the input voltage to the 5 volt level required by the microprocessor and other logic circuitry. The higher unregulated voltage from the external power supply is applied to the power / sync indicator LED, and to the LED array, as the extra voltage is needed to drive the series connected ultraviolet LED's used in the array. A separate 5 volt DC to DC converter is used to power the DMX input section. This separate power supply allows the electrical isolation of the DMX input and output lines from the remaining circuits in the unit.

Microcontroller

The illuminator is based on an Atmel ATMEGA8 microcontroller U2, which operates all critical illuminator functions. The microcontroller uses an external 16 megahertz clock oscillator X1 for timing control, and is internally protected against transient voltage conditions. The processor operates from permanent firmware EPROM programming which controls all functions of the illuminator. This programming is performed during manufacturing, and may not be re-written by the user. The microcontroller has three 8 bit input / output ports, which may be programmed as needed for each particular application. These ports are commonly identified by letter designations, B, C, and D. In the BL-48 illuminator, the B port is used output data to the LED driver circuitry, and for device programming, the C port is used for device programming and to read DMX address settings, and the D port is to read address and mode settings, and for DMX input and sync indication.

DMX Interface Circuits

The DMX data stream is applied to the BL-48 unit on the 5 pin male XLR connector J2, and passed directly through to the 5 pin female XLR connector J3. DMX data is buffered by the IC U5, and the opto-isolator OP1 before it is applied to the RXD terminal of the microcontroller on pin 30 (PD0). The microcontroller processes the incoming DMX data, and indicates proper data reception by outputting a sync indication on pin 11 (PD7) to the LED driver Q1 and the power / sync indicator LED

Address / Mode Selection Circuit

The three DMX address switches S1,2 and 3 are connected directly to microcontroller inputs on pins 23 through 28, (PC0-5), on pins 31,32, 1, and 2 (PD1-4), and on pins 19 and 22 (ADC6,7). These pins to provide DMX address information to the microcontroller. Other inputs on pins 9 and 10 (PD5,6) are used to select the general operating mode of the unit. The remaining input connections on pins 14-17, and 29 (PB2-5, PC6) are used for device programming.

DAC / PWM Output Circuit

The digital output data from the microcontroller can be processed in either of two ways. The first uses a serial data output on pin 12 (PB0) which is applied to the input of the serial input Quad "digital to analog converter" or DAC IC U4 on pin 9 of that device. Analog output voltage from three of the four DAC channels is output on pins 11, 12, and 15 of U4, and applied to the inputs of the LED driver array. The second output method uses "pulse width modulation" or PWM data from the processor on pins 13, 14, and 15 (PB1, 2, and 3) which are applied to the quad op amp IC U3 on pins 12, 10, and 3, respectively. The filtered output from these op amps is then applied to the inputs of the LED driver array. Only one of these two output methods is installed on the circuit board, with the components for the alternative method omitted.

LED Array and Driver Circuit

The LED array is a separate circuit board from the microcontroller, and attaches to the CPU board through the power and signal interface plugs P1, and P2. The LED display board is the simplest portion of the circuit, as it consists of 3 identical circuits, each containing 16 LED elements, an op amp, and a driver transistor. In each section, the LED emitters D1-D16, D17-32, and D33-48 are wired as an 4 column by 4 row series-parallel array. Each array is connected to the 24 volt DC supply, with the op amps U1 and U2, and the current regulating transistors Q1, 2, and 3 responding to control voltages from the microcontroller to determine the current flow through each portion of the array. Depending on the settings of the microcontroller, each of the three section may be controlled independently ar will act as a single unit.

Service Access

The active electronics of the BL-48 illuminator are mounted on two circuit boards inside the main housing of the unit. These may be accessed by removing the four screws along the sides of the unit to open the main housing. The unit may be operated normally with the cover removed. Provided that the unit is operated with a suitable power supply, there are no hazardous voltages present in the interior of the unit

Basic Troubleshooting

With the exception of the microcontroller, the circuitry used in the illuminator is quite simple, and troubleshooting is made quite easy by using the available power and data sync indicators and manual operating modes, and by observing the LED array for any erroneous output.

In the event that the illuminator fails to produce a normal output, first check for good AC power to the power pack, and for the LED power indicator on the rear panel. If the LED indicator is not active, then the external power pack or supply is not powered or is defective.

If the power LED is lit, apply DMX data to the unit, and observe for illumination of the "Sync" indicator adjacent to the Power indicator. If the Sync LED is lit, the unit is receiving normal DMX data, and should respond to data within the proper address range. If the unit does not respond, check the settings of the DMX address switches for correct settings.

Remember that the unit loads DMX address data only when powered up, and power must be removed and restored before the unit will respond to a change in the DMX address or mode selector settings. If the settings are correct, but no display is observed, then the DMX control signal may be intermittant or low quality, or the unit may have an internal problem with the DMX address or mode selection circuitry, or with the LED display or driver circuits. .

To check the basic function of the unit, remove power and DMX connections and set the unit to manual mode by setting the DMX address switches to 699. Reapply power to the unit, and observe the display. If a normal display is observed, then the LED and driver circuits are fully functional, but the DMX control input signal is absent, or is being ignored by the illuminator. Check the setting of the mode selector and address switches for proper choice of display mode and DMX address range. Failure of the unit to respond to a known good DMX data signal when set to the proper mode and address range indicate a problem with the internal circuitry.