

5 1.01 MX Dimmer Bank

A. General

The installation rack shall be the MXas manufactured by Electronics Diversified, Inc. The fully digital dimmer rack shall contain up to 48 dimmer module spaces. MXrack systems shall be UL and cUL listed and shall be so labeled when delivered to job site.

B. Physical

- 1. The MXdimmer rack shall be a free-standing, dead front switchboard, substantially framed and enclosed with code gauge steel panels. All rack components shall be properly treated, primed and finished. Exterior surfaces shall be finely textured with scratch resistant, two-part polyurethane or equal. Removable top, side, and bottom panels shall facilitate conduit termination.
- 2. Racks shall be available in three sizes, with the following configurations:

MODEL #	RACK DIMENSIONS (HxWxD)	MAXIMUM MODULE COUNT	
		With Main Breaker	Main Lugs Only
MX-12	36" x 21" x 21"		12
MX-24	48" x 21" x 21"	12	24
MX-48	84" x 21" x 21"	36	48

- 3. Racks shall be designed for front access to allow back-to-back or side-by-side installation.
- 4. Racks shall be designed to allow easy insertion and removal of all modules without the use of tools. Internal supports shall be provided for precise alignment of dimmer modules into power and signal connector blocks. With modules removed, racks shall provide clear front access to all load, neutral and control terminations. Racks that require removable panels to access load, neutral or control terminations shall not be acceptable.
- 5. An optional buss kit shall be available from the factory to allow adjacent racks to be powered by a single line feed.
- 6. The rack shall be configurable to accept mixed dimmer types and sizes throughout the rack.
- 7. Each rack shall provide a lockable full-height door containing an electrostatic air filter that shall be removable for easy cleaning. Forced air cooling of the rack shall be provided via a low noise fan. The fan shall draw all intake air through an integral electrostatic air filter, over the surfaces of the module housing and out of the rack. The fan shall maintain all components at proper operating temperature when dimmers are under full load, provided the ambient temperature of the dimmer room does not exceed 40⁰ C (non condensing). The fan shall turn on whenever any dimmer in the system is activated. In the event of an over-temperature condition, only the affected dimmer module(s) shall shut down and an LED indicator shall appear on the affected dimmer module(s) and control module. The fans shall remain on during thermal shutdown of individual dimmer modules.
- 8. Each rack shall be supplied with a convenience panel containing a 20 Amp, 120 volt, 60 Hz, AC (220/240 Volt, 50 Hz) grounded duplex power outlet.
- 9. The dimmer rack shall be equipped with an illuminated LCD status beacon. The LCD status beacon shall display current status of the rack and display the following messages:
 - a. DMX port A or B status.
 - b. Phase A, B or C is below safe operating voltage.
 - c. Phase A, B or C is above safe operating voltage.
 - d. Rack has shut down due to improper startup voltage.
 - e. Over temperature protection has caused a dimmer module to shut down.
 - f. Ambient temperature is below safe operating temperature.
 - g. Ambient temperature is above safe operating temperature.
 - h. Rack's "Service Mode" is activated.
 - i. Backup look is active/stored.
- 10. In addition, racks equipped with the optional Dimmer Information System shall display dimmer module location with the following messages:
 - a. Load condition.
 - b. DC detected on dimmer output.
 - c. SCR failure.

- 5 d. Circuit breaker has tripped.
 e. Removal of Dimmer.
 f. "No Load" detected.
11. The dimmer rack shall have the capacity to house an optional system main breaker. The main
breaker shall serve as a disconnect for the system. The system shall have an AIC rating
10 limited by the main breaker. (Specify if required.)
12. Each MX dimmer rack shall include a single duplex receptacle (Service Outlet) and 20-amp
breaker for testing and service equipment. Dimmer racks that do not include a service outlet
for testing and service must provide at a minimum a 20 amp duplex receptacle in the same
15 location as the dimmer rack.

C. Electrical

1. The rack shall operate on 120/208V, three phase, four wire + ground, 50/60 Hz or 120/240V
Single Phase 50/60 Hz. Other voltage and phase options are available upon request.
2. The rack will have a vertical phase buss rated for 100% continuous duty and a system fault
20 current rating of up to 100,000 AIC.
3. The dimmer modules will be sequentially numbered, labeled and addressed from top to
bottom.
4. No two consecutive dimmer modules shall be on the same phase. Dimmer racks which
require electronic addressing to meet this requirement are not acceptable.
- 25 5. All control wiring shall conform to the recommended practices for DMX512 and Ethernet
specifications as published by USITT and ESTA.

D. Electronics

1. Dimmer control electronics shall be contained in one plug-in control module.
2. A hand-held remote control keypad with LCD display shall be provided for system
configuration, testing and diagnostics. The LCD shall also display rack status and messages.
3. The control module shall include, but not be limited to, the following user indicators:
- 35 a. DMX port A or B status.
b. Phase A, B or C is below safe operating voltage.
c. Phase A, B or C is above safe operating voltage.
d. Rack has shut down due to improper startup voltage.
e. Over temperature protection has caused a dimmer to shut down.
f. Ambient temperature is below safe operating temperature.
g. Ambient temperature is above safe operating temperature.
40 h. Rack's "Service Mode" is activated.
4. The remote control shall include, but not be limited to, the following displays:
- a. Dimmer display shall allow a dimmer or dimmers to be set at a level. (Control module
shall allow user to set single dimmers or groups of dimmers from remote keypad.)
- 45 b. Backup display to program and activate system-wide backup looks.
c. Display information shall allow monitoring of system, rack or dimmer status.
d. System information shall provide information about DMX outputs, panic circuits, backup
looks and system name.
e. Rack information shall provide information about rack voltage, starting addresses,
ambient temperature and rack type.
50 f. Dimmer information shall provide information about dimmer size, type, location, output
levels and control source.
g. Setup display shall allow, but not be limited to, configuring of rack addresses, dimmer
firing mode and line compensation values.
5. The control module shall respond to control changes in less than 25 milliseconds. Dimmer
55 outputs shall exhibit no oscillating or hunting for levels.
6. Dimmer output shall be regulated for incoming line voltages. The control module shall monitor
and adjust each dimmer's output to maintain a constant power to the load. Regulation shall
maintain the desired output voltage for the entire operating range (90-140V AC) with the
exception that the maximum output will be no greater than the line voltage minus dimmer
60 insertion loss. There shall be no interaction between dimmers or any other equipment in the
system. Line compensation shall be field adjustable on a dimmer-by-dimmer basis to allow for

- 5 varying cable length.
7. A minimum of two (2) optically isolated DMX512 inputs shall be provided, allowing overlapping or separation of any control level. Twenty-five hundred volts (2,500V) of optical isolation shall be provided between the DMX512 inputs and the control module. Optical isolation shall protect the DMX512 inputs from a failed control module and shall protect the control module from failed DMX512 inputs. Systems that do not have optical isolation shall not be acceptable.
 8. The control module shall include a DMX512 input connector for testing purposes. Dimmer racks which do not include a DMX 512 input connector in the control module must provide at a minimum a DMX512 input in the same location as the dimmer rack for testing/servicing.
 9. There shall be the provision for a minimum of twelve (12) 0-10V analog inputs to allow for analog control of the rack. Each dimmer may be assigned to any one of the twelve analog inputs. When so supplied, the analog input option shall not reduce the number of incoming DMX512 signals.
 10. With the exception of the optional analog inputs, the control module shall be completely digital without employing any digital-to-analog de-multiplexing schemes or analog ramping circuits. Each rack shall, in the event of signal loss, maintain the last level for a user-programmable time. Systems that do not offer this feature shall not be acceptable.
 11. The control module shall contain diagnostic routines to allow the user to test and troubleshoot the system.
 12. A system-wide panic circuit shall be provided. Any dimmer or group of dimmers in any rack may be assigned proportionally to the panic circuit.
 13. Each dimmer may be individually assigned a specific address for each DMX512 input.
 14. The control module shall be able to record backup looks. Backup looks may be programmed by any of the following methods: recording current dimmer levels (as set by the console or other remote programming device); entering dimmer levels on the control module directly; entering dimmer levels at a remote station.
 15. Multiple backup looks may be active simultaneously with inputs operating on a highest take precedence basis.
 16. Two separate and distinct patches shall be available. Selection between the patches shall be possible by a remote control.
 17. All control module system functions may be activated by a hand-held remote control keypad. Systems that do not offer this feature shall not be acceptable.
 18. The control module shall include a single function service switch that shall allow the end user to bypass the control electronics configuration. When activated the service switch shall drive all circuits to full output. Control modules which do not include a service switch are not acceptable.
 19. The control module shall accommodate optional remote control devices via the Multi-Link Network.

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- E. Multi-Link Network
1. The Multi-Link Network (MLN) shall provide remote monitoring, programming and backup functions for the system through any compatible console, PC or hand-held remote device. System information shall also be displayed on any system interface including the control module and the devices listed above.
 2. The Multi-Link Network shall provide an integral link to connect all racks in the system for rack-to-rack communication. Information for all configuration and backup looks shall be stored in all control modules to allow swapping of control modules throughout the system. Systems not storing all configuration data and backup looks for each dimmer in all control modules shall not be acceptable.
 3. The Multi-Link Network off-line editing software shall allow user programming and remote storage of the system parameters. These parameters shall include, but not be limited to, defining rack type, module type, output voltage (Line Compensation) for each dimmer, firing mode, curve, dimmer numbering and DMX512 port assignments. Systems that do not offer these user programmable features will not be acceptable.
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- 5 F. Dimmer Information System
1. The Dimmer Information System (DIS) option shall allow monitoring of current and output voltage on a dimmer-by-dimmer basis and shall provide information on dimmer status and input voltages via the DIS Display.
 - 10 2. Dimmer specific information, such as dimmer failure or SCR failure shall be displayed as an error on the control module and the DIS Display. DIS Display messages shall include, but not be limited to, the following:
 - a. Load condition.
 - b. DC detected on dimmer output.
 - 15 c. SCR failure.
 - d. Circuit breaker has tripped.
 - e. Removal of Dimmer .
 - f. "No Load" detected.
 3. The control module shall allow the user to record the loads of all DIS dimmers in the system.

20 1.02 MXSCR INCANDESCENT Dimmer Modules

A. General:

1. The dimmer modules shall be the MX as manufactured by Electronics Diversified, Inc. Furnish and install dimmer modules in types and quantities as shown on the drawings and specified herein.

25 B. Physical

1. Dimmer modules shall be fully plug-in and factory wired. Dimmer modules shall consist of a heavy duty chassis with integral top, bottom, side and face panels. No tools shall be required for module removal and insertion.
- 30 2. The removal of any single module shall not expose line or low voltage terminations less than six (6) inches from the front of the rack.
3. Each module shall be labeled with the manufacturer's name, catalog number and rating. Modules constructed of molded plastic for structural support are not equivalent and are not acceptable. Dimmer modules shall be UL and cUL Recognized.
- 35 4. Dimmer modules shall be available as dual 2.4kw, dual 1.2kw or single 6kw.

C. Electrical

1. Each dimmer shall provide, but not be limited to, the following:
 - 40 a. The dimmer module shall contain a circuit breaker for each circuit, a solid state switching module, associated toroidal filters, status indicators and power and control connectors.
 - b. The dimmer module shall not have any protruding pins subject to physical damage when the module is not installed.
 - 45 c. Circuit breakers shall be fully magnetic and UL listed. The trip current shall not be affected by ambient temperature.

D. SCR Assembly

1. Each dimmer module shall use a solid state module (SSM) consisting of two silicon-controlled rectifiers (SCRs) in an inverse parallel configuration and all required gating circuitry on the high voltage side of an integral, opto-coupled control voltage isolator. The (SSM) shall be thermally protected, independent of the control module.

E. Filtering

1. Each dimmer shall have a toroidal, copper-wound, iron-core, high performance choke. The rise time ratings for a 2k dimmer shall be as noted in the manufacturer's oscilloscope data, but in no case shall be less than the following:

350 Microseconds (Standard)	
<u>Watts</u>	<u>Rise Time</u>
1000 (8.33A)	300 Microseconds

5 1500 (12.5A) 325 Microseconds
 2400 (20A) 350 Microseconds

500 Microseconds (High Performance)

<u>Watts</u>	<u>Rise Time</u>
1000	400 microseconds
1500	450 microseconds
2400	500 microseconds

10 2. All Rise Time measurements are between 10%-90% with dimmer output at 50%. Alternate manufacturers must supply either high performance chokes or certified test data ensuring compliance with the above.

F. Performance

15 1. At the maximum rated load with 120 volts input the dimmer shall have an insertion loss of no more than 3.8 volts rms. The maximum heat loss for each 2.4 kw dimmer shall be no greater 108 BTU's per hour per connected kilowatt of load.

1.03 MX Universal Fluorescent Dimmer Module

A. General:

20 1. The dimmer modules shall be the MX UFD as manufactured by Electronics Diversified, Inc. Furnish and install dimmer modules in types and quantities as shown on the drawings and specified herein.

B. Physical

25 1. Dimmer Module chassis shall be constructed of heavy-gauge (.063) sheet aluminum formed so to integrate all sections without exposing any electrical components to the exterior. Dimmer modules shall be fully plug-in and factory wired. No tools shall be required for module removal and insertion.

30 2. Module dimensions shall be: 16.25" w X 1.126" h X 6.880" d. Construction shall be such that no line nor low voltage connections are within five (5) inches of the front of the module. Input and output connections shall be flush mounted.

3. Modules of plastic construction or exposed live electrical components upon removal are not equivalent and are not acceptable.

4. The modules shall be entirely painted on the exterior with non-lead gray polyurethane enamel. Nomenclature shall be black, permanent paint, applied via silk-screen.

35 C. Electrical

1. Each dimmer shall provide, but not be limited to, the following:

2. The front panel shall indicate manufacturer, model, and the number and capacity of the module dimmer (s). This panel shall allow monitoring of dimmer status via lighted display. This display shall include a separate indicator of Fault status.

40 3. The dimmer shall be protected against overcurrents, and withstand inrush currents, hot-patches and short circuits of 0.02 ohms or more without damage. The dimmer shall employ fully magnetic primary circuit breakers, UL listed, rated at 100% capacity, with must trip capacity @ 125%.

45 4. Except for circuit breakers, the module shall contain no moving parts. The module shall employ a heatsink with thermal sensor, and silicon- controlled rectifiers. The SCRs shall be configured in inverse parallel.

5. The solid state switch devices shall be mounted in substrate designed for maximum heat dissipation. The devices so mounted shall include an optical isolator, a snubbing network, and necessary gating circuitry on the high voltage side of a integral, optically coupled control voltage isolator providing a minimum of 2500 V rms. isolation between line and control in the switch device.

50 6. The solid state module shall be thermally protected independent of the control module. There shall be a shut down circuit. The circuit shall activate when the heatsink temperature exceeds 85 degrees centigrade. This circuit shall restart automatically when temperature drops to safe levels.

55 7. All load circuit wiring shall be constructed of tin-coated, stranded copper wire, encased in

- 5 insulation, in compliance with the National Electrical Code in all applicable specification. The module shall be recognized by Underwriters Laboratories.
8. The module shall carry two dimmer circuits of 20 amps each. Each circuit shall carry a maximum of 32 ballasts.
- D. Performance
- 10 1. The dimmer shall operate over an input range of 90-140 VAC, 50/60 Hz. Standard, nominal input shall be 120VAC, 50/60Hz, unless otherwise specified at the time of manufacture.
2. The standard dimmer shall have an insertion voltage drop of no more than 3.4 volts rms. at the maximum rated load with 120 VAC input. The 2.4kw rated SCR heat loss shall not be greater than 100 BTU per hour per kilowatt of connected load.
- 15 3. The dimmer control voltage shall be internally switchable at 0-10 and / or 0-120 volts. The dimmer shall be designed for use with digital memory controllers employing USITT standard DMX 512 protocol.
4. The module control connectors shall be constructed such that a module of a greater capacity cannot be substituted nor operated in that position.
- 20 5. The dimmer curve shall be any one of the following: conform to the Square Law, Linear curve, or such a profile as is digitally programmed by the user. Any given control setting shall give the same dimmer output regardless the direction of control movement. The dimmer shall also function as a non-dim or dimmer for incandescent and inductive loads.
- E. The dimmer module shall be the MX Universal Fluorescent Dimmer Module as manufactured by
- 25 Electronics Diversified, Inc., Hillsboro, Oregon, USA.