CITY THEATRICAL

NEW YORK • LONDON

5792 SHoW DMX Neo™ Radio Module User's Manual

Rev 1.4

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SHoW DMX Neo™ devices are covered by U.S. Patent # 7,432,803 and other patents pending.

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Specifications

Table 1: Radio Module Specifications

Physical Characteristics		
Size	1.65 x 2.7 x 0.26 " [42.0 x 68.75 x 6.5mm]	
Mounting holes	Compatible with Aerocomm AC5124	
Connector	40 pin header – Amp P/N 177986-1	
Antenna connector	Horizontal MMCX coaxial receptacle	
Operating Temperature	-20° to +70°C [-4 to 158°F]	
Storage Temperature	-40° to +85°C [-40 to 185°F]	
DC Characteristics		
Input Voltage	5 Volts DC ±2%, ±5mV ripple	
Current draw	400mA maximum	
Sleep mode current	25mA maximum	
Transmitter Characteristics		
TX power	Selectable 5mW to 75mW in four steps	
Frequency range	2406 to 2477 MHz	
Channels	2 sets 36 with 2 MHz channel spacing (72 total)	
Modulation	FSK frequency hopping	
Over-the-air data rate	1 Mbps	
Channel coding	8B/10B line coding	See note 1
Hopping patterns	2 sets of 36 full band, 2 sets of 16 low, mid, & high partial band selectable patterns with low cross-correlation, and selectable adaptive hopping algorithms.	
Receiver Characteristics		
RX sensitivity	-90 dBm @ 1% PER	
Hop timing	Synchronized with master transmitter	
Error checking	CRC16	
Serial Interface		
Logic levels	3.3 Volt / 5V Tolerant	
Bit rate	Classic: 1.25 Mbps Neo: 250Kbps	
Data Format	Classic: 8 N 1; Neo: 8 N 2	
Flow Control	None	

Note 1: Since there could be long stretches of continuous 1s or 0s in the transmitted data the radio transceiver IC will use 8B/10B line coding to ensure a more even distribution of 1s and 0s in the transmitted signal. This will provide better radio performance at the expense of a lower effective over-the-air bit rate. 8B/10B line coding is a method that encodes a symbol of 8 bits in to a 10 bit symbol and ensures that on average there is an even number over 1's and 0's and a minimum number of transitions. The effective bit rate becomes 8/10s of the radio bit rate so it will be 800kbps rather than 1Mbps.

Regulatory Specifications

FCC Part 15

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/ TV technician for help.

Radio Frequency Notifications

FCC Notifications

RF Radiation: The Product is an intentional radiator of Radio Frequency (RF) energy. In order to limit RF exposure to personnel in the immediate area, the Product should be located and installed such that a separation of at least 20 centimeters is maintained between the Product's antenna and personnel in the vicinity of the device. The antenna used for this transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

Modification warning: Caution - changes or modifications to this equipment, not expressly approved by City Theatrical Inc. could void the user's authority to operate the equipment.

Industry Canada Notifications

This Class B digital apparatus complies with Canadian ICES-003. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

Product Installation and Configuration Guide © City Theatrical Inc. 2010

Approved Antennas

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that required for successful communication. This device has been designed to operate with the antennas listed in below. Antennas not included in this list are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

FCC ID Label
The FCC ID label on the CTI # 5792 module must be visible through a window on the final product or it must be visible when an access panel, door or cover is easily removed. If not, a second label must be placed on the outside of the final product that contains the following text: "Contains FCC ID: VU65792"

CE Mark Conformity
City Theatrical Inc. declares that this product conforms to the specifications listed in this manual, following the provisions of the European R&TTE directive 1999/5/EC:
City Theatrical Inc. vakuuttaa täten että dieses produkt tyyppinen laite on direktiivin 1999/5/EY oleellisten vaatimusten ja sitä koskevien näiden direktiivien muiden ehtojen mukainen.

City Theatrical Inc. déclare que le produit est conforme aux conditions essentielles et aux dispositions relatives à la directive 1999/5/EC.
• EN 301 489-1, 301 489-17 General EMC requirements for Radio equipment.
• EN 60950 Safety
• EN 300 328 Technical requirements for Radio equipment.

CAUTION—This equipment is intended to be used in all EU and EFTA countries. Outdoor use may be restricted to certain frequencies and/or may require a license for operation. Contact local Authority for procedure to follow.

Note: ESD precautions should be used when attaching or removing the antenna.

Note: Combinations of power levels and antennas resulting in a radiated power level of above 100 mW equivalent isotropic radiated power (EIRP) are considered as not compliant with the above mentioned directive and are not allowed for use within the European community and countries that have adopted the European R&TTEdirective 1999/5/EC. For more details on legal combinations of power levels and antennas, contact City Theatrical Inc.

Protect this product from water. Do not use if product gets wet.
Avoid using this product during an electrical storm. There may be a remote risk of electric shock from lightning.

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Regulatory information
Radio Frequency Notifications
Belgique Dans le cas d'une utilisation privée, à l'extérieur d'un bâtiment, au-dessus d'un espace public, aucun enregistrement n'est nécessaire pour une distance de moins de 300m. Pour une distance supérieure à 300m un enregistrement auprès de l'IBPT est requise. Pour une utilisation publique à l'extérieur de bâtiments, une licence de l'IBPT est requise. Pour les enregistrements et licences, veuillez contacter l'IBPT.

France 2.4 GHz Bande : les canaux 10, 11, 12, 13 (2457, 2462, 2467, et 2472 MHz respectivement) sont complétement libres d'utilisation en France (en utilisation intérieur). Pour ce qui est des autres canaux, ils peuvent être soumis à autorisation selon le départment. L'utilisation en extérieur est soumis à autorisation préalable et trèsrestreint. Vous pouvez contacter l'Autorité de Régulation des Télécommunications (http://www.art-telecom.fr) pour de plus amples renseignements.

Introduction

Thank you for choosing the CTI # 5792 SHoW DMX Neo™ Radio Module for your OEM application. This user's manual is intended to help you get started with the SHoW DMX Neo™ Radio Module. City Theatrical, Inc. will provide extensive support and development materials to qualified OEM partners, including:

- This SHoW DMX Neo™ Users Manual: A basic guide to explain the principal features of the SHoW DMX Neo™ Radio Module and how it can be integrated into an OEM application

- The SHoW DMX Neo™ Application Manual: The detailed technical guide to integrating, configuring and operating the SHoW DMX Neo™ Radio Module

- SHoW DMX Neo OEM Development Kits: Test platforms that support SHoW DMX Neo™ Radio Module operation and configuration via RDM. These open frame test platforms are equipped with SHoW DMX Neo™ Radio Module, Host PCBA, DMX/RDM I/O connections, Status and RSS indication, antenna, and power supply. Two SHoW DMX Neo OEM Development Kits can be configured to operate as Transmitter and Receiver.

- The SHoW DMX Neo™ OEM Reference Design: This information and document bundle includes recommended host connection schematic files for SHoW DMX Neo Receiver operation.

Features

The 5792 SHoW DMX Neo Radio Module is designed to replace the CTI 5691/92 SHoW DMX Radio Module. The Neo has many features designed to supplement and enhance the SHoW DMX product range:

- Transceiver, fully configurable for Transmit or Receive
- Plug compatible with SHoW DMX 5691/92 Radio, existing SHoW DMX units may be upgraded easily
- One model, FCC, IC and CE Certified
- Classic Mode operation communicates directly with existing SHoW DMX products
- New DMX synchronized hopping structure with increased interference immunity, reduced interference generation and lower latency in Neo Modes
- Selectable true Adaptive Spread Spectrum Frequency Hopping (ASSFH) in Neo Modes
- Extremely low latency
- Three Operating Modes:

  o SHoW DMX Classic
     - Configurable from Host UI using proprietary TTL configuration interface.
     - Communicates with existing 5600 series SHoW DMX equipment and operates like a SHoW DMX 5692 Radio

  o Neo Mode
     - Fully configurable using RDM commands from an external RDM controller or the host.
     - Replace missing packets with previously received data if any are lost
     - 7mS max latency

- - - Selectable Output power (5-75mW ETSI)
      - Selectable Bandwidth
      - Selectable Burst Length (when used with full frame sources)
      - Allows for shortened frame data (less than 512 bytes from source)
      - Enhanced RDM Proxy performance

  - Neo-Adaptive Mode
    - Fully configurable using RDM commands from an external RDM controller or the host.
    - Replace missing packets with previously received data if any are lost
    - 7mS max latency
    - Adaptive Hopping
    - Selectable Output power (.5-75mW ETSI)
    - Allows for shortened frame data (less than 512 bytes from source)
    - Enhanced RDM Proxy performance

- 5 Status signals available (may be used to control LEDs, etc.):
  - Data, unit is receiving valid data from either the DMX/RDM input or RF
  - RF, In Range
  - (3) Received Signal Strength (Lo Med, Hi)

- +5VDC power (~164mA max in Transmit mode, ~188mA in Receive mode)

- Fully implemented RDM functionality including RDM Responder, RDM Proxy
- Implement in Host products with a simple and inexpensive interface
  - TTL DMX512-A I/O, just add a driver of choice
  - +5VDC power
  - CTI reference design provided

- A wide range of FCC/IC Certified Antennas
  - Small indoor Omni "whip" Antennas
  - Yagi Antennas
  - Panel Antennas
  - Outdoor Omni Antenna

Important Information for OEM Integrators
 The 5792 SHoW DMX Neo Radio Module has been designed for use by OEM users in their own host equipment. The following information is provided to help guide the OEM integrator to implement the 5792 SHoW DMX Neo Radio Module in host designs in a way that meets FCC requirements. The following instructions include marking and labeling information, acceptable antenna requirements, information that must be included in the OEM Integrator's product user's manual, and other instructions.

Regulatory Module Integration Instructions

This module has been granted modular approval for mobile applications. OEM integrators for host products may use the module in their final products without additional FCC / IC (Industry Canada) certification if they meet the following conditions. Otherwise, additional FCC / IC approvals must be obtained.

- The host product with the module installed must be evaluated for simultaneous transmission requirements.

- The users manual for the host product must clearly indicate the operating requirements and conditions that must be observed to ensure compliance with current FCC / IC RF exposure guidelines.

- To comply with FCC / IC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain including cable loss in a mobile-only exposure condition must not exceed the limits as described in the following section on approved antennas:

   5792 Approved Antennas
   To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (E.I.R.P.) is not more than that permitted for successful communication.
   This device has been designed to operate with the antennas listed below.

   The model: 5792 can be configured with any one of the approved antennas listed below for fixed, point-to point one server and one client configuration. When the model: 5792 is configured for point-to-multipoint one server and multiple clients' configuration (client's talk to server only one at a time), client's can use any of the approved antennas listed below and the server can use any of the approved antennas listed below with the exception of the 14dBi antenna.

Manufacturer	Model	Type	Connector	Gain
Nearson	S151AH-2450S	Omni whip	SMA plug reverse polarity	5dBi
Nearson	S141AH-2450	Omni whip	SMA plug reverse polarity	2dBi
Nearson	S131AH-2450	Omni whip	SMA plug reverse polarity	2dBi
Nearson	DG102N-2.4/5.25	Omni whip	SMA plug reverse polarity via provided Antenna Cable	5dBi
Centurion	WCP2400-MMCX4	Omni whip	MMCX jack on 4" coax pigtail	2.5dBi
Maxrad	MP24008XFPT	Panel	SMA plug reverse polarity via	8dBi

			provided Antenna Cable	
Maxrad	MYP24010PT	Yagi	SMA plug reverse polarity via provided Antenna Cable	10dBi
Maxrad	MYP24014PT	Yagi	SMA plug reverse polarity via provided Antenna Cable	14dBi

- A label must be affixed to the outside of the host product with the following statements:

This device contains FCCID: VU65792
This equipment contains equipment certified under ICID: 7480A5792

The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

If the final host / module combination is intended for use as a portable device (see classifications below) the host manufacturer is responsible for separate approvals for the SAR requirements from FCC Part 2.1093 and RSS-102.

Device Classifications

Since host devices vary widely with design features and configurations module integrators shall follow the guidelines below regarding device classification and simultaneous transmission, and seek guidance from their preferred regulatory test lab to determine how regulatory guidelines will impact the device compliance. Proactive management of the regulatory process will minimize unexpected schedule delays and costs due to unplanned testing activities.

The module integrator must determine the minimum distance required between their host device and the user's body. The FCC provides device classification definitions to assist in making the correct determination. Note that these classifications are guidelines only; strict adherence to a device classification may not satisfy the regulatory requirement as near-body device design details may vary widely. Your preferred test lab will be able to assist in determining the appropriate device category for your host product and if a KDB or PBA must be submitted to the FCC.

Note, the module you are using has been granted modular approval for mobile applications. Portable applications may require further RF exposure (SAR) evaluations. It is also likely that the host / module combination will need to undergo testing for FCC Part 15 regardless of the device classification. Your preferred test lab will be able to assist in determining the exact tests which are required on the host / module combination.

FCC Definitions

Portable: (§2.1093) — A portable device is defined as a transmitting device designed to be used so that the radiating structure(s) of the device is / are within 20 centimeters of the body of the user.

Mobile: (§2.1091) (b) — A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. Per §2.1091d(d)(4) In some cases (for example, modular or desktop transmitters), the potential conditions of use of a device may not allow easy classification of that device as either Mobile or Portable. In these cases, applicants are responsible for determining minimum distances for compliance for the intended use and installation of the device based on evaluation of either specific absorption rate (SAR), field strength, or power density, whichever is most appropriate.

Simultaneous Transmission Evaluation

This module has **not** been evaluated or approved for simultaneous transmission as it is impossible to determine the exact multi-transmission scenario that a host manufacturer may choose. Any simultaneous transmission condition established through module integration into a host product **must** be evaluated per the requirements in KDB447498D01(8) and KDB616217D01,D03 (for laptop, notebook, netbook, and tablet applications).

These requirements include, but are not limited to:

- Transmitters and modules certified for mobile or portable exposure conditions can be incorporated in mobile host devices without further testing or certification when:

- The closest separation among all simultaneous transmitting antennas is $\geq$20 cm,

Or

- Antenna separation distance and MPE compliance requirements for **ALL** simultaneous transmitting antennas have been specified in the application filing of at least one of the certified transmitters within the host device. In addition, when transmitters certified for portable use are incorporated in a mobile host device, the antenna(s) must be $\geq$5 cm from all other simultaneous transmitting antennas.

- All antennas in the final product must be at least 20 cm from users and nearby persons.

OEM Instruction Manual Content

Consistent with §2.909(a), the following text must be included within the user's manual or operator instruction guide for the final commercial product *(OEM-specific content is displayed in italics.)*

Operating Requirements and Conditions:

The design of *(Product Name)* complies with U.S. Federal Communications Commission (FCC) guidelines respecting safety levels of radio frequency (RF) exposure for *(OEM manufacturer to insert device classification: Mobile or Portable)* devices.

FCC ID:

This product contains FCCID: VU65792

Note: In the case where the Host / Module combination has been re-certified the FCCID shall appear in the product manual as follows:

FCCID: *(Include Standalone FCC ID)*

Mobile Device RF Exposure Statement (If Applicable):

RF Exposure - This device is only authorized for use in a mobile application. At least 20 cm of separation distance between the *(Product Name)* device and the user's body must be maintained at all times.

Portable Device RF Exposure Statement:

RF Exposure - This device has been tested for compliance with FCC RF exposure limits in a portable configuration. At least *(Insert Required Separation Distance from RF Exposure Evaluation)* cm of separation distance between the *(Product Name)* device and the user's body must be maintained at all times. This device must not be used with any other antenna or transmitter that has not been approved to operate in conjunction with this device.

Caution Statement for Modifications:

CAUTION: Any changes or modifications not expressly approved by City Theatrical, Inc. could void the user's authority to operate the equipment.

FCC Part 15 Statement (Only Include if FCC Part 15 is Required on the End Product):

Note: This equipment has been tested and found to comply with the limits for a *(OEM to insert device type: Class A or Class B)* digital device, pursuant to Part 15 of the FCC Rules. *(OEM must follow Part 15 guidelines (§15.105 and §15.19) to determine additional statements required in this section for their device class)*

Radio Configuration and Control

The SHoW DMX Neo Radio Module can be configured and controlled via Host hardware settings and direct Host generated TTL level signals, or with RDM commands via wireless or wired DMX/RDM connections.   For details, see the *SHoW DMX Neo Radio Module Application manual.* Supported RDM PIDs are shown in the table below*.*

Classic Mode Operation

The SHoW DMX Neo Radio Module can be configured in SHoW DMX Classic Mode to communicate with Classic SHoW DMX products such as the 5600 and 5601 Transmitter, 5610 and 5611 Receiver, 6255 PDS-375 TRW (SHoW DMX version) and 6410 and 6411 MasterBlast.

In Classic mode, the 5792 SHoW DMX Neo Radio Module operates identically to a 5692 (Classic) SHoW DMX Radio Module and supports all of the 5692 features such as selectable power, bandwidth, SHoW ID, etc.
Units must be configured and controlled by the Host via the proprietary configuration interface when operating in Classic Mode.

Neo Mode Operation

The SHoW DMX Neo Radio Module can be configured to operate in the new Neo Mode. In Neo Mode, the Module uses a new broadcast format that reduces latency to ~ 7mS max and provides further resistance to interference susceptibility or creation.
Neo Mode supports Adjustable Broadcast Power, Limited Bandwidth, Limited Burst, and provides 64 new SHoW IDs, providing 16 hopping patterns in each Bandwidth setting.
In Neo Mode, the SHoW DMX Neo Radio Module can be fully configured with RDM commands from an external RDM controller or the host.

Neo-Adaptive Mode Operation

The SHoW DMX Neo Radio Module can be configured to operate in the new Adaptive (AFHSS) Mode. In Neo Adaptive Mode, the Module uses an Adaptive Spread Spectrum Frequency Hopping broadcast format in which the Module system detects interference and adapts it's frequency hopping channel set automatically to avoid it.
Neo Adaptive Mode supports Adjustable Broadcast Power and provides 4 new Adaptive Mode SHoW IDs. Latency is also reduced to ~7mS max in Adaptive Mode.

In Neo-Adaptive Mode, the SHoW DMX Neo Radio Module can be fully configured with RDM commands from an external RDM controller or the host.

Supported RDM PIDs

For more detailed information about standard RDM PIDs and CTI manufacturer specific PIDs please refer to ANSI E1.20-2006 and CTI Tech Bulletin #1007 documents respectively. PIDs without a checkmark in the reduced RDM column are not available in reduced RDM mode. Reduced RDM mode is selected via configuration strapping in host hardware.

Get Allowed	Set Allowed	Reduced RDM	RDM Parameter	PID	Comment
		X	DISC_UNIQUE_BRANCH	0x0001	
		X	DISC_MUTE	0x0002	

		X	DISC_UN_MUTE	0x0003	
X		X	PROXIED_DEVICES	0x0010	
X		X	PROXIED_DEVICE_COUNT	0x0011	
X		X	QUEUED_MESSAGE	0x0020	
X		X	SUPPORTED_PARAMETERS	0x0050	
X		X	PARAMETER_DESCRIPTION	0x0051	
X		X	DEVICE_INFO	0x0060	Reports Category 0x0801
X		X	PRODUCT_DETAIL_ID_LIST	0x0070	Repots ID 0x0604
X		X	DEVICE_MODEL_DESCRIPTION	0x0080	
X		X	MANUFACTURE_LABEL	0x0081	City Theatrical, Inc.
X	X	X	DEVICE_LABEL	0x0082	
X	X	X	FACTORY_DEFAULTS	0x0090	
X		X	SOFTWARE_VERSION_LABEL	0x00C0	Reports CE/FCC
X	X		DMX_PERSONALITY	0x00E0	Sets Limited Burst
X			DMX_PERSONALITY_DESCRIPTION	0x00E1	
X	X		DMX_START_ADDRESS	0x00F0	
X		X	SENSOR_DEFINITION	0x0200	RSSI, Temp
X		X	SENSOR_VALUE	0x0201	
X	X	X	IDENTIFY_DEVICE	0x1000	
X	X	X	RDM_TRAFFIC_ENABLE	0x7FE2	Draft
X	X		SHOW_ID	0x8000	
X	X		OUTPUT_POWER	0x8001	
X	X		HOP_PATTERN	0x8002	
X	X		BANDWIDTH	0x8003	
X	X		LATENCY	0x8019	
X	X	X	DMX_RDM_ INTERLEAVE_RATIO	0x801B	
X	X	X	PROXIED_DEVICES_ENHANCED	0x801C	
X	X		ADAPTIVE_ON_OFF	0x801D	

Antennas and Antenna Connectors
The antenna connector is a board-edge mounted MMCX type connector and the antenna will be connected through a short coaxial cable from inside the case to a panel mounted antenna. The antennas that will be used with this product are listed in **Error! Reference source not found.**below. Antennas number 1 and 2 use a reverse polarity SMA connector that will mate to a panel mount SMA which is connected internally to the radio module's MMCX connector. Antenna number 5 has a pigtail coax and the antenna is not removable by the user.
The first five antennas are omni-directional and the highest gain they have is 5dBi. Antennas six through eight are higher gain directional antennas

Additional Support
City Theatrical, Inc. is committed to making your SHoW DMX Neo Radio Module integration project successful and profitable and our Team will help you in any way we can. If you have questions or need information contact our Sales or Engineering Departments anytime.

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