SHoW DMX Neo® OEM Guide

Rev 2.2

SHoW DMX Neo devices are covered by U.S. Patent #7,432,803.

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1 Revision History

Table 1: Revision History

Revision	Date	Description	Author/Changed
1.0	Oct. 12, 2011	Initial Release	P. Kleissler
1.1	Oct. 24, 2011	Moved Logic Level Specification in Table 2 to DC Characteristics section. Updated Table 4 for internal pull-ups and removed 3.3v references	P. Kleissler
2.0	May 12, 2014	Split Classic from Neo. Added Neo examples	P. Kleissler
2.1	June 30, 2014	Minor edits and revisions	V. Tisdale
2.2	Dec 08, 2014	Added extended frequency range and 5-channel sub-bands Updated approved antennas list Removed “and other patents pending” from cover page	B. Au

2 Product Overview

The SHoW DMX Neo (Neo) radio module was designed by City Theatrical, Inc. (CTI) to use in the SHoW DMX line of wireless theatre lighting control equipment. This equipment is used for wireless transmission and reception of DMX512-A and RDM protocol data.

The Neo radio module was designed to provide enhanced interference rejection, to reduce latency of both DMX and RDM packet delivery and provide an easier interface to implement. The Neo radio module can operate in two different modes: Neo and Classic. It is recommended, however, to implement only Neo mode. Classic mode is backwards compatible with the previous generation technology, formally known as SHoW DMX. .

The SHoW DMX product line uses SHoW IDs to allow devices to communicate with each other. As long as two (or more) devices are programmed to share a SHoW ID, they will be able to communicate. The SHoW ID is programmed into the module via the “config” protocol, RDM or an external button.

2.1 Part Numbers

The Neo radio module comes in two different versions. The part numbers and differences are found below.

2.1.1 5792 SHoW DMX Neo Radio Module for OEM

The 5729 uses a 40-pin low profile header. The header contains all signals allowing the unit to be integrated in the most flexible way. The signals are all TTL (transistor –transitor logic) and the voltage source is fixed at 5Vdc.

2.1.2 5794 SHoW DMX Neo Radio Module for W-DMX

The 5794 uses a 10-pin header. The header contains signals that directly map to the W-DMX module. This version has an on board RS-485 driver and can accept voltages of 5Vdc fixed or 7-30Vdc using the onboard switching regulator.

3 About this Manual

Section 4 provides the specifications, notifications and regulations necessary for safe and effective operation of the SHoW DMX Neo Radio.

This manual divides the two operating modes into separate sections: Neo operation mode implementation and Classic operation mode implementation. It is not recommended to implement the latter.

Section 5 describes implementing Neo mode. The section is broken into two sub sections, one for the 5792 (SHoW DMX Neo Radio for OEM) and one for 5794 (SHoW DMX Neo Radio for W-DMX). Neo mode implementations are the preferred method of integration.

Section 5.1.2 gives examples of common implementations. It is suggested to follow one of these examples.

Section 6 was intended to describe the implementation of Classic mode. However, CTI strongly recommends its customers avoid implementing Classic mode and thus has excluded section 6 from this manual. If compatibility to older SHoW DMX products is required, Classic mode must be implemented as an addition to Neo mode. If you are interested in pursuing such functionality, please contact City Theatrical at (201)-549-1160.

Section 7 describes the protocol and command set for the configuration mode.

4 Specifications

Table 2: Radio Module Specifications

Physical Characteristics		
Size	1.90 x 2.65 x 0.20 inches	
Connector	40 pin header – Amp P/N 177986-1	
Antenna connector	Horizontal MMCX coaxial receptacle	
Operating Temperature	-20 to +70 deg C	
Storage Temperature	-40 to +85 deg C	
DC Characteristics		
Input Voltage	5 Volts DC ±2%, ±5mV ripple	
Current draw	0.18 Amps maximum	
Sleep mode current	20mA maximum	
Logic levels	3.3 Volt / 5V Tolerant	
Transmitter Characteristics		
TX power	Selectable 1mW to 72mW in four steps	
Frequency range	2406 to 2480 MHz	
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; 2 sets of partial band fixed patterns	
Receiver Characteristics		
RX sensitivity	-95 dBm @ 1% PER	
Error checking	CRC32	
Serial Interface		
Bit rate	Classic: 1.25 Mbps Neo: 250Kbps	
Data Format	Classic: 8 N 1; Neo: 8 N 2	
Flow Control	None	

Note 1: The effective bit rate will be 800Kbps rather than 1Mbps using 8B/10B coding.

4.1 Regulatory Specifications

4.1.1 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:

- Re-orient or re-locate 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.

4.1.2 Radio Frequency Notifications

4.1.2.1 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.

4.1.2.2 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.

4.1.2.3 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

Table 3 below. Antennas not included in this list are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

The device can be configured with any one of the approved antennas listed in Table 3 for fixed, point-to-point (one server and one client) configuration. When the device is configured for point-to-multipoint (one server and multiple clients, clients talk to server only one at a time) configuration, the client can use any of the approved antennas server can use any approved antenna listed in Table 3 except the 14dBi Yagi directional antenna.

Table 3: List of Approved Antennas

	Manufacturer	Model	Type	Connector	Gain (dBi)
1	Nearson	S151AH-2450S	Omni whip	SMA plug reverse polarity	5
2	Nearson	DG102N-2.4/5.25	Omni whip	SMA plug reverse polarity via provided antenna cable	5
3	Tekfun	F40-N	Omni whip	SMA plug reverse polarity via provided antenna cable	4.5
4	Nearson	S152AH-2450S	Omni whip	SMA plug reverse polarity	4
5	Nearson	S141AH-2450	Omni whip	SMA plug reverse polarity	2
6	Nearson	S131AH-2450S	Omni whip	SMA plug reverse polarity	2
7	Centurion	WCP2400-MMCX4	Omni whip	MMCX jack on 4” coax pigtail	2.5
8	Nearson	SPCB07257	Omni Printed Trace	MMCX jack on 4” coax pigtail	2
9	PCTEL Maxrad	MP24008XFPT	Panel	SMA plug reverse polarity via provided antenna cable	8
10	PCTEL Maxrad	MYP24010PT	Yagi	SMA plug reverse polarity via provided antenna cable	10
11	PCTEL Maxrad	MYP24014PT	Yagi	SMA plug reverse polarity via provided antenna cable	14

4.1.2.4 FCC & IC ID Label

The FCC & Industry Canada (IC) ID label on the CTI # 5792/5794 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 texts: “Contains FCC ID: VU65792M” and “Contains IC ID: 7480A-5792M”.

4.1.2.5 CE Mark Conformity

City Theatrical Inc. declares that this product conforms to the specifications listed in the 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 100mW 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&TTE directive 1999/5/EC. For more details on legal combinations of power levels and antennas, contact City Theatrical Inc.

Do not use this product near water, for example, in a wet basement or near a swimming pool.

Avoid using this product during an electrical storm. There may be a remote risk of electric shock from lightning.

4.1.2.6 Regulatory Information

Radio Frequency Notification

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 complètement libres d'utilisation en France (en utilisation intérieur). Pour ce qui est des autres canaux, ils peuvent être soumis à autorisation selon le département. L'utilisation en extérieur est soumise à autorisation préalable et très restreint. Vous pouvez contacter l'Autorité de Régulation des Télécommunications (http://www.art-telecom.fr) pour de plus amples renseignements.

5 Neo Operation Mode Implementation

This section will cover the 5792 and 5794 modules separately.

When operating in Neo mode, the radio module outputs TTL DMX/RDM protocol on its TxD/RxD serial lines. An RS-485 direction control line is available for connection to a driver IC if necessary. If RDM is enabled in the module, it will also perform RDM discovery of any RDM enabled wired devices connected to its serial port. Configuration is performed by switching the module to "config" mode using the MODE0/MODE1 signal line bits.

5.1 SHoW DMX Neo Radio for OEM (P/N 5792)

Below is a block diagram of the complete signal connections that make up the interface. See 5.1.1 for description of signal pins. It is not necessary to use all pins. See section 5.1.2 for other options.

Figure 1: SHoW DMX Neo Radio for OEM to Host Interface

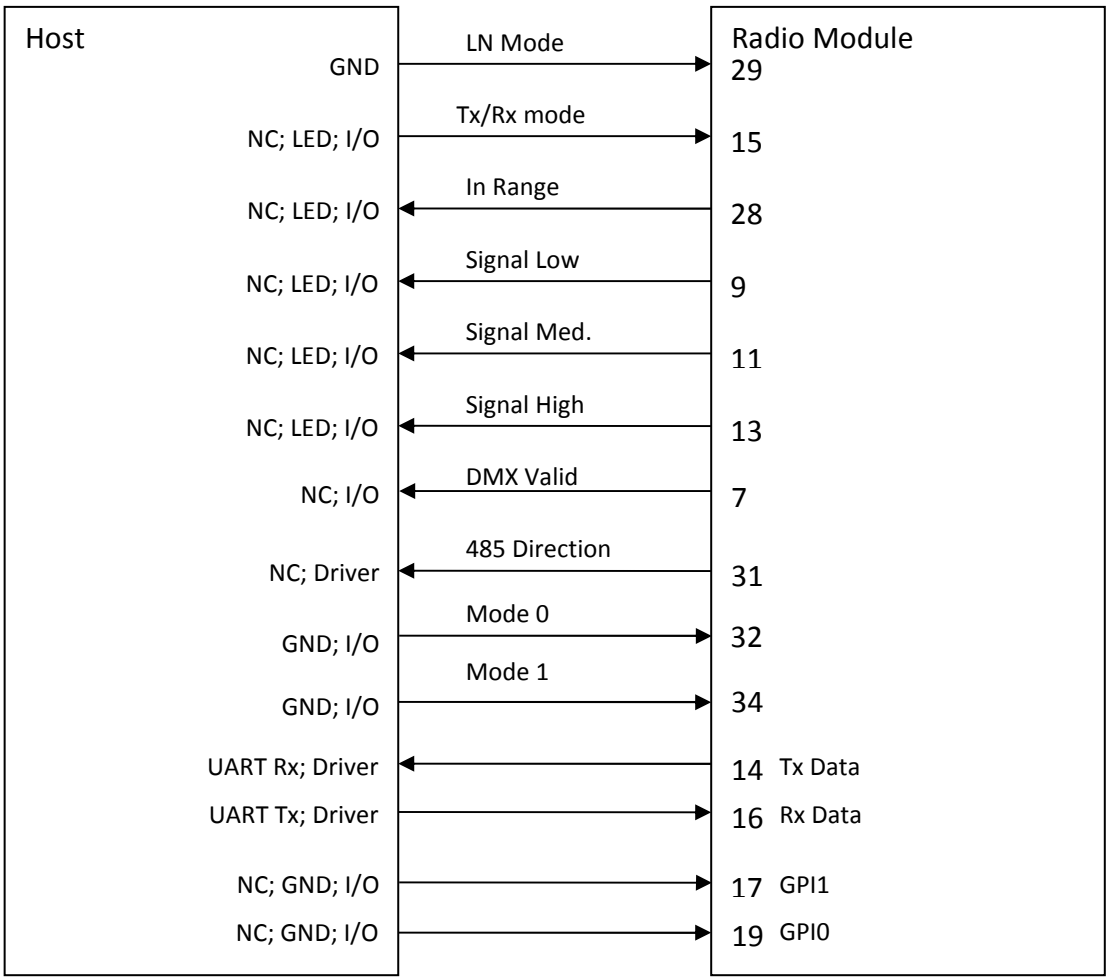


Table 4: SHoW DMX Neo Radio for OEM Signal Descriptions

Pin	Type	Signal Name	Function	Notes
1	GND	GND	Signal Ground	
3	VCC	VCC	5VDC	
5	VCC	VCC	5VDC	
7	O	DMX_VALID	DMX Valid	1/2sec toggle rate when not present
9	O	SIG_LOW	Signal Strength Low	Active high
11	O	SIG_MED	Signal Strength Medium	Active high
13	O	SIG_HI	Signal Strength High	Active high
14	O	TxD	Transmit data from radio	
15	I	Tx/Rx	Selects Tx/Rx mode	low = Tx, high = Rx, Internal Pull-up
16	I	RxD	Received data from host	
17	I	GPI1	General input Bit 1	Controls RDM personality, see docs
19	I	GPI0	General input Bit 0	Controls RDM personality, see docs
20	GND	GND	Ground	
21	GND	GND	Ground	
23	O	RED	RGB LED Red	SHoW Baby 5 SHoW ID Indication
26	O	BLUE	RGB LED Blue	SHoW Baby 5 SHoW ID Indication
27	O	GREEN	RGB LED Green	SHoW Baby 5 SHoW ID Indication
28	O	IN_RANGE	Rx in range of Tx	Active High
29	I	LN Mode	Classic/Neo mode	low = Neo, Internal Pull-Up
30	I	485 Rx Only	Wired RDM Responder mode	Active Low, Internal Pull-Up
31	O	485 Dir	RS485 Direction Control	RX = Low, TX = High
32	I	Mode Bit 0	Mode Bit 0	Internal Pull-Up
34	I	Mode Bit 1	Mode Bit 1	Internal Pull-Up
36	I	WakeUp	Take radio out of sleep	Active Low, Internal Pull-Up
37	I	Bootload	Enter Boot Loader mode	Active low, Internal Pull-Up
38	I	µP_RESET	Radio Reset	Active Low
39	VCC	VCC	5VDC	
40	GND	GND	Signal Ground	

5.1.1 Description of Signal Pins

Pin 7 – DMX_VALID: This pin indicates the presence of valid DMX frames at the input when operating in server mode or valid DMX frames at the output when operating in client mode. When no valid frames are present, the pin toggles at a ½ second rate.

Pin 9, 11 & 13 – SIG_LOW, MED, HI: These pins provide an indication of signal strength. The flowing chart defines the state of the outputs.

Table 5: Signal Strength Truth Table

Signal Range	State	Pin 9	Pin 11	Pin 13
-30dbm – -60dbm	HI	High	High	High
-61dbm – -75dbm	MED	High	High	Low
-76dbm – -90dbm	LOW	High	Low	Low
-91dbm – -120dbm	No Signal	Low	Low	Low

Pin 14 – TxD: This pin is the TTL serial data output from the radio module. The data conforms to DMX/RDM when in “Neo” mode or configuration protocol when in “config” mode. Modes are selected via the MODE0/MODE1 pins described in

Table 8.

Pin 15 – Tx/Rx: This pin is an input to set the radio to either transmitter mode or receiver mode. In transmitter mode the radio transmits data wireless and receives DMX data wired. In receiver mode the radio searches for a transmitter from which to receive wireless data and generates wired DMX/RDM data based on the SHoW ID setting. See Table 4 for more details.

Pin 16 – RxD: This pin is the TTL serial data input to the radio module. The data conforms to DMX/RDM when in “Neo” mode or configuration protocol when in “config” mode. Modes are selected via the MODE0/MODE1 pins described in

Table 8.

Pins 17 & 19 – General Input Bits: These two pins control the personality of the internal RDM responder. These inputs are only read at power up, and then depending on mode are used for other purposes. These inputs have internal pull-ups and can be left unconnected for personality SHoW Neo. See Table 6 for descriptions of the different personalities. Table 7 describes the function the pins take on after power up has completed.

Table 6: GPI RDM Personality Selection

GPI1, GPI0	Personality	Description
0, 0	Host	Host must assume radio's UID and answer all messages.
0, 1	SHoW Baby	Radio Module answers all RDM messages as defined for a SHoW DMX SHoW Baby product. Host is treated as a discovered device.
1, 0	Vero	Radio Module answers all RDM messages as defined for a SHoW DMX Vero product. Host is treated as a discovered device.
1, 1	SHoW Neo	Full RDM Mode. Full set of supported PIDs responded to by radio.

Table 7: GPI Function after Power-Up

RDM Personality	GPI1 Function	GPI0 Function
Host	None	None
SHoW Baby	None	Toggles SHoW ID
Vero	Reset ID to 201 if held low for .5s	None
SHoW Neo	None	Reset ID to 201 if held low for .5s

Pin 23 & 26 & 27 – Red/Blue/Green: These pins are only used when the RDM personality is SHoW Baby. SHoW Baby indicates its current SHoW ID by displaying a color on an RGB LED. Pin 23 controls the Red element, 26 controls the Blue and 27 controls the Green.

Pin 28 – IN_RANGE: This pin is an output that is only active when the radio is in receiver mode. It indicates whether the radio module is receiving and is synchronized to a transmitter or not by going high when it is synched.

Pin 29 – LN_MODE: This pin selects the operational modes, active low for SHoW DMX Neo. This pin is internally pulled high. This pin must be pulled low to enable "Neo" operation. This pin is latched at reset in register 0x15, after reset, the mode can be changed by writing to register 0x15.

Pin 30 – 485RX_ONLY: This pin puts the SHoW DMX Neo into RDM wired responder mode. This pin is internally pulled high. When pulled low, the SHoW DMX Neo will drive the "485 Dir" signal low. This can be connected to a switch to effectively deactivate the SHoW DMX Neo from the 485 bus and allow the SHoW DMX Neo to act like a RDM responder on the 485 bus.

> **Note:** This pin can only be driven active during a DMX/RDM break through byte 23 of current the DMX/RDM frame. Driving this pin active at other times can cause undefined results.

Pin 31 – 485DIR: This pin allows an off board RS485 driver to be connected directly to the TTL serial signals and allow the SHoW DMX Neo to communicate on the DMX/RDM bus without the need of a host processor.

Pin 32 & 34 – Mode Selection: These two pins are inputs that control whether the radio is in "Neo" mode or "config" mode. Neo mode is for normal DMX/RDM operation. Config mode is used to configure the internal radio registers via the serial configuration protocol found in section 7. These pins have weak pull-ups. See

Table 8 below for the mode selection truth table.

Table 8: SHoW DMX Neo Mode Selection Table

Bit 1	Bit 0	Mode	Description
0	0	Neo Mode	Normal operation DMX/RDM
0	1	N/A	Invalid
1	0	Config Mode	Read/Write internal configuration registers
1	1	N/A	Invalid

Notes:

- When the mode bits change, the radio aborts its current operation and enters the newly selected mode.
- You can only change to "config" mode during a DMX/RDM break through byte 23 of the current DMX/RDM frame. Selecting "config" mode active at other times can cause undefined results.

Pin 36 – Wakeup: After the radio has been put into sleep mode by writing to the sleep register, this pin is used to wake the radio back up. The pin is held high with an internal pull-up resistor and the host must pull it low to wake up the radio.

Pin 37 – Bootload: This pin tells the radio to enter bootloader mode. It is read on power up / reset. If logic 0, radio enters bootloader mode. Contact CTI if you need information on how to load new code into the radio module.

Pin 38 – Reset: This pin is connected directly to the reset pin of the microcontroller in the radio and is used by the host CPU to force the radio to perform a reset. After pulling this pin low and then releasing it the radio's firmware will start running from the beginning and will load all the configuration registers with the default values. After releasing the reset pin the radio takes approximately 60mS before it is ready to communicate with the host processor.

5.1.2 Recommended Interface Connection Examples

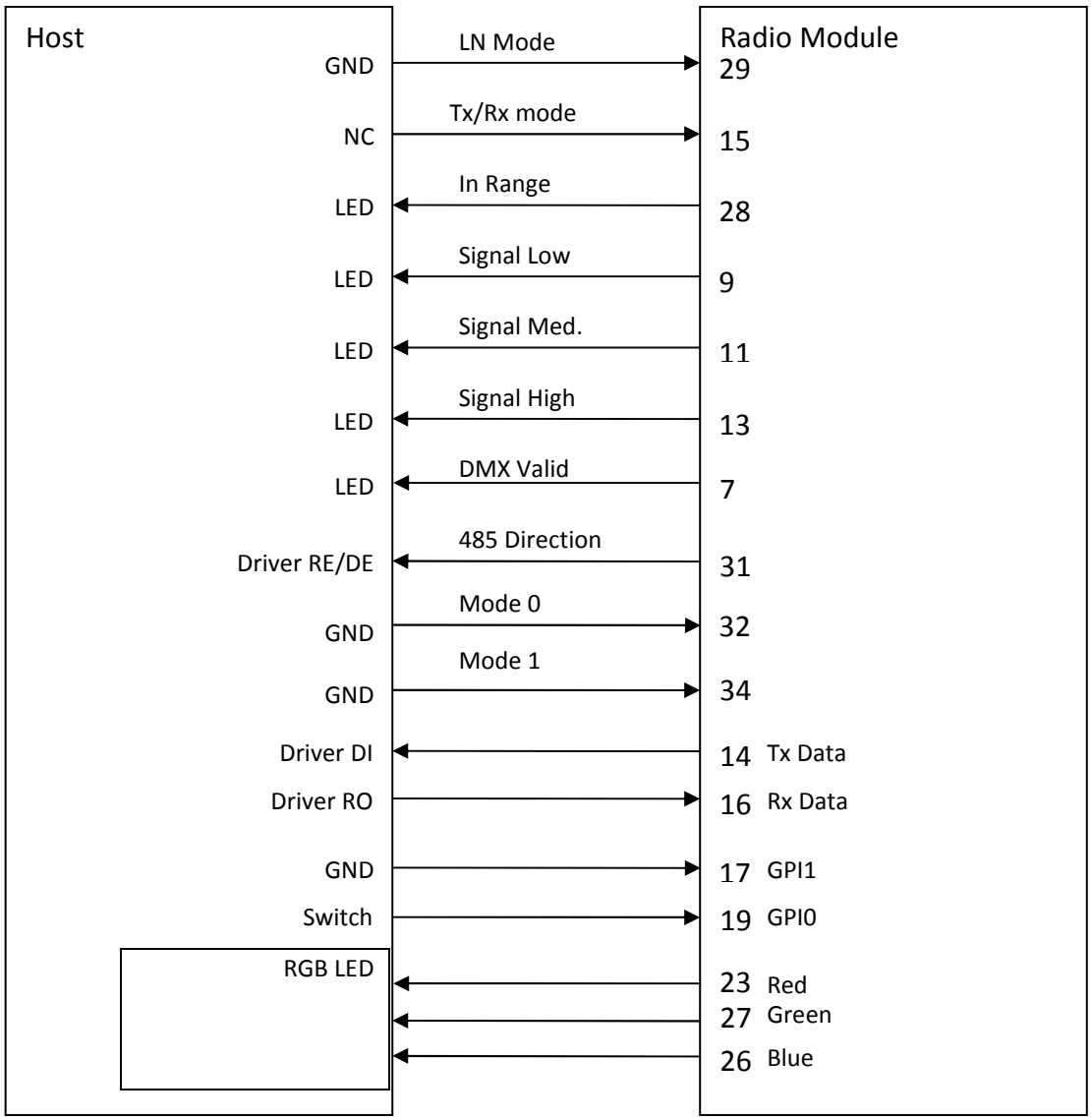
5.1.2.1 Example: SHoW Baby 5 Receiver

This example shows how to integrate the functionality of a SHoW DMX SHoW Baby 5 receiver into your application. Figure 2 below shows the connections required to simulate the feature set of the SHoW DMX SHoW Baby 5 product operating as a SHoW DMX receiver.

In this mode the LN_MODE signal is tied low to put the radio module into "Neo" operation mode. Leaving the Tx/Rx signal input unconnected causes the module to operate as a receiver. Both mode bits are tied to common to permanently leave the module in the "Neo" operation, as we will not be using the configuration protocol in this example. GPI0 is connected to a normally open switch so that we can toggle thru the 5 SHoW Baby IDs that are available in this configuration. An RS-485 half duplex driver is connected to the TxD/RxD and 485 direction lines. The remaining signals left all connect to LED indicators.

With these connections in place, DMX/RDM is delivered to the integrated product. The OEM product has a button on board to allow the end user to toggle thru the five SHoW Baby SHoW IDs (201, 102, 117, 133, 149).

Figure 2: SHoW Baby 5 Signal Implementation



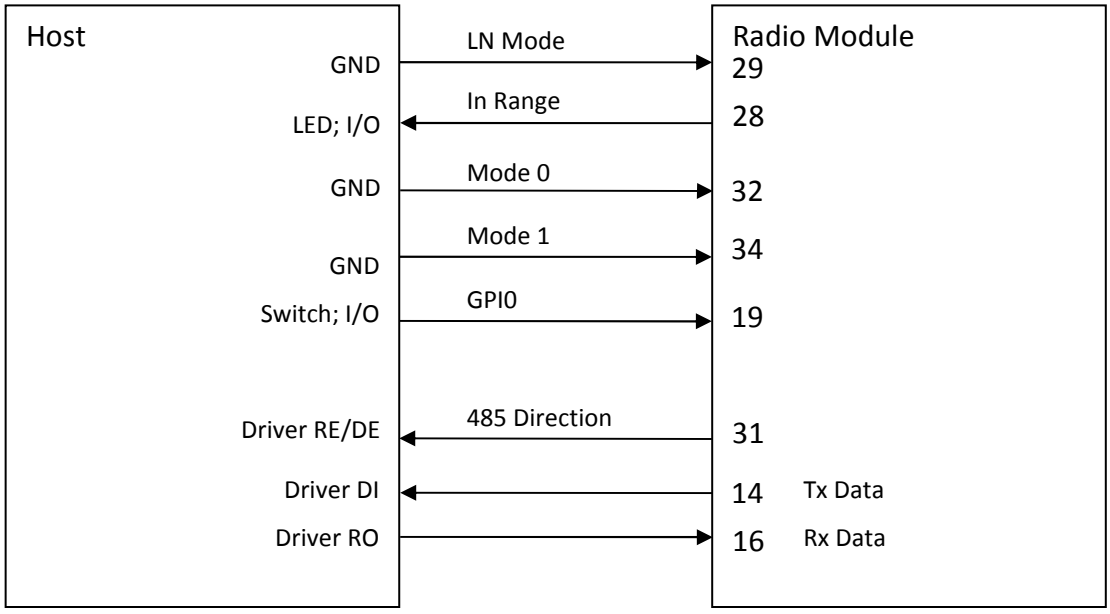
5.1.2.2 Example: Minimum Connections

This example shows how to integrate the radio module using the least possible connections to the host system. Configuration of this implementation is via an external RDM controller. A switch is provided to default the radio module to a know SHoW ID (201).

Referring to Figure 3, the TxD/Rxd and 485 direction TTL signals are routed to the hosts RS-485 half duplex driver. The mode bits are permanently tied to circuit common, as all configuration is going to occur using RDM or the default input pin GPI0. A single LED or I/O pin is used to determine if the radio module is in range of a transmitter.

When a user wants to select the default radio module, the switch is held for .5s, then the module is set back to SHoW ID 201.

Figure 3: Minimum Signal Implementation



5.2 SHoW DMX Neo Radio for W-DMX (P/N 5794)

The SHoW DMX Neo Radio for W-DMX was created to be a drop-in replacement for Wireless Solutions' OEM card. Both devices share the same footprint and pin configuration. Refer to

Table 9 for signal descriptions.

Table 9: SHoW DMX Radio for W-DMX Signal Descriptions

Pin	Type	Signal Name	Function	Notes
1	GND	GND	Signal Ground	
2	O	DMX Data-	DMX Data-	
3	O	DMX Data+	DMX Data+	
4	I	GPI0	Link	
5	O	Status LED	Status	
6	VCC	VCC	Regulated +5Vdc	
7	GND	GND	Signal Ground	
8	+V	+V	Un-Regulated +Vdc	Max voltage +30Vdc
9	NC	-	No Connection	
10	I	Tx/Rx	Transmitter/Receiver Selection	Active High for Receiver

5.2.1 Description of Signal Pins

Pin 1 – DMX Common: This pin is the DMX driver signal common. It is also the same as the radio modules common.

Pin 2 – DMX Data-: This pin is the data complement from the RS-485 driver.

Pin 3 – DMX Data+: This pin is the data line from the RS-485 driver.

Pin 4 – GPI0: This pin is used to invoke the SHoW ID linking function. When held low for .5s, the radio module will start searching for a transmitter to link with if it was in Rx mode. Once linked, the radio module will enter normal operation. If the radio module is in transmitting mode, the radio module will transmit data packets for receivers to identify it as the transmitter to link to. When you have linked all receivers to the transmitter, hold the line low again for .5s to return to normal operation.

Pin 5 – STATUS LED: This signal indicates operation status of the radio module. This signal pulses as defined in Table 10.

Table 10: Status LED function

Event	Function
No DMX	900ms On/100ms Off
DMX Present	Solid
Linking	100ms On/100ms Off

Pin 6 - +5Vdc: This pin is used to supply +5Vdc regulated power to the radio module.

Pin 7 – Gnd: This pin is used for the circuit common.

Pin 8 - +Vdc: This pin is used to supply un-regulated DC power to the radio module. Maximum input voltage should not exceed +30Vdc.

Pin 9 – NC: This pin is not used and should be left unconnected.

Pin 10 – Tx/Rx: This pin is used to switch the radio between transmitting and receiving modes. A low on this signal causes the radio module to enter transmitting mode. A high on this signal causes the radio module to enter receive mode. If this signal is left unconnected, the radio module will wake up in receive mode.

6 Classic Operation Mode Implementation

This section has been intentionally excluded from this document. Please see “About this Manual” for more information.

7 Serial Configuration Protocol

This section describes the protocol and command set for the config mode. When the radio is put into config mode it expects specific commands to read or write the config registers and it will reply with an acknowledgement. Baud for config communication occurs at the speed of the selected operating mode. (1.25Mbps for SHoW DMX Classic and 250Kbps for SHoW DMX Neo mode)

Figure 4 below shows the bit definitions for the commands and replies. The first byte sent to the radio includes one read/write bit and 7 address bits. The read/write bit is 0 for write and 1 for read. The radio replies with an acknowledgement byte for both read and write commands with the MSB (most significant bit) being a 1 for an ACK or a 0 for a NACK. If the response is an ACK then the lower 7 bits define the length of the following data in number of bytes. If the command was a write then the lower 7 bits will be zero. If it was a read then it will be 1 for single byte registers but can be longer for reads of other lengths of registers. If the response is a NACK then the lower 7 bits will define error codes. The possible errors and their codes are defined in Table 11.

Table 11: Config Error Codes

Value	Error Description
0x01	Illegal Address
0x02	Illegal Value

Figure 4: Config Register Read & Write Protocol

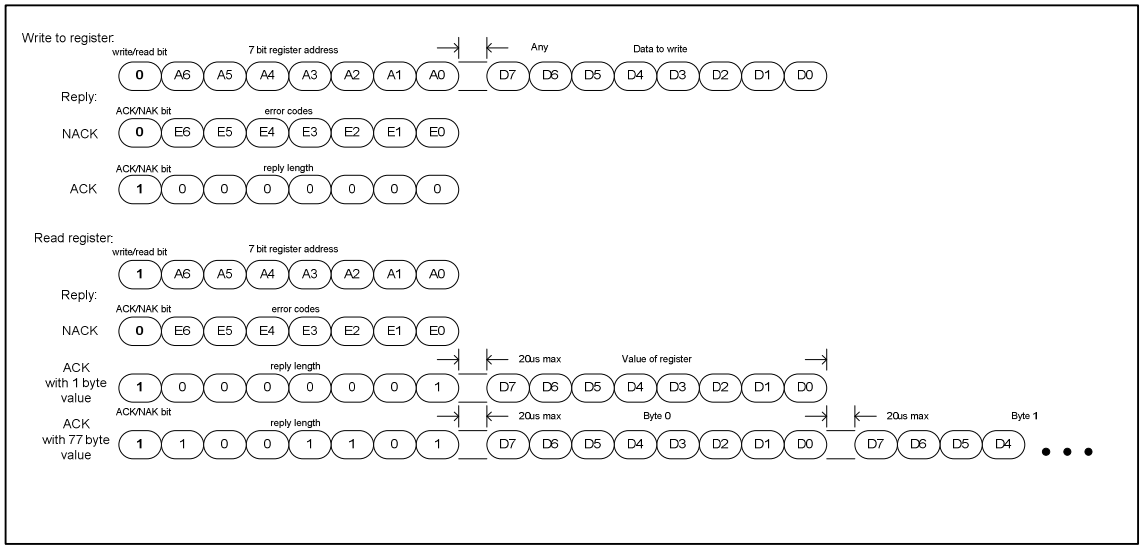


Table 12: Overview of Configuration Registers

Address	Register Name	Register Type	Description
0x00	Hop Band	R/W	Select the hop band to use
0x01	Hop Set - Full	R/W	Select hop sequence for full-band hopping out of 36 possible
0x02	Hop Set - Sub	R/W	Select hop sequence for sub-band hopping out of 16 possible
0x03	Tx Power	R/W	Select transmit output power
0x04	Packet length	R/W	Set length of packet for broadcast and half-duplex modes
0x05	Half-duplex Timeout	R	Set timeout for serial data in half-duplex mode
0x06	RSSI	R	Read the RSSI value from the previous hop
0x07	Status	R	Read the status register to check for changes in channel switches or errors
0x08	Error Count	R	Read a list of number of missed/erroneous packets per channel
0x09	Sleep Command	W	Put the radio module into sleep mode
0x0A	Sync Word	R/W	Select a sync word for the CC2400
0x11	Temperature	R	Read the temperature on the board
0x12	Firmware Version	R	Read the version of firmware present
0x13	Product ID	R	Read if the product is Euro or North American version

Address	Register Name	Register Type	Description
0x14	Latency	R/W	Sets the latency mode, Low or Normal
0x15	Operating Mode	R/W	Sets Neo or Classic mode
0x16	Start Address MSB	R/W	Sets the MSB of the start address when operating in limited burst mode.
0x17	Start Address LSB	R/W	Sets the LSB of the start address when operating in limited burst mode.
0x18	Neo Limited Burst Size	R/W	Sets the number of slots to be transmitted when operating in limited burst mode.
0x19	Adaptive Hopping ON - OFF	R/W	Set or read the current adaptive hopping state.
0x1A – 0x1F	RDM UID	R	Read the RDM unique ID as programmed at the factory. Stored in Network byte order (i.e. 0x1A MSB)
0x20	DMX/RDM Interleave Rate	R/W	Set or read the current DMX/RDM Interleave rate.
0x21	SHoW ID	R/W	Set or read the SHoW ID.
0x22	RdmTrafficEnable	R/W	Sets whether RDM traffic is enabled or not.
0x23	DeviceCount MSB	R	Returns MSB of proxy device count
0x24	DeviceCount LSB	R	Returns LSB of proxy device count

Table 13: Detailed Description of Configuration Registers

Hop Band (0x00)

Bit	Field Name	Reset	R/W	Description
7-3	-	0	W0	Not used - write 0
2-0	Band	Neo: Last Classic: 0x00	R/W	Set or read which hop band to use: 0000: Full-band even - 2406 - 2476 MHz in 36 channels 0001: Full-band odd – 2407 – 2477 in 36 channels 0010: Low-band even - 2406 - 2434 MHz in 15 channels 0011: Low-band odd - 2407 - 2435 MHz in 15 channels 0100: Mid-band even - 2428 - 2456 MHz in 15 channels 0101: Mid-band odd - 2429 - 2457 MHz in 15 channels 0110: High-band even - 2448 - 2476 MHz in 15 channels 0111: High-band odd – 2449 – 2477 MHz in 15 channels 1001: Sub-band even – 2472 – 2480 MHz in 5 channels 1010: Sub-band odd – 2471 – 2479 MHz in 5 channels Factory Default: 0x00

Hop Set - Full-band (0x01)

Bit	Field Name	Reset	R/W	Description
7	-	0	W0	Not used - write 0
6 - 0	Hop_Set_F	Neo: Last Classic: 0b000000	R/W	Set or read the hop set for full-band hopping out of 36 possible 0000000: hop set 0 (Factory Default) 0000001: hop set 1 0000010: hop set 2 . . . 100011: hop set 35

Hop Set - Sub-bands (0x02)

Bit	Field Name	Reset	R/W	Description
7 - 4	-	0	W0	Not used - write 0
3 - 0	Hop_Set_S	Neo: Last Classic: 0b0000	R/W	Set or read the hop set for sub-band hopping out of 16 possible 0000: hop set 0 (Factory Default) 0001: hop set 1 0010: hop set 2 . . . 1111: hop set 15

Transmit Power (0x03) – North American Version

Bit	Field Name	Reset	R/W	Description
7 - 3	-	0	W0	Not used - write 0
2 - 0	TX_Pwr	Neo: Last Classic: 0b100	R/W	Set or read the transmit power 000: Not valid 001: Not Valid 010: 72mW(Factory Default) 011: 28mW 100: 14mW 101: 1mW

Packet Length (0x04)

Bit	Field Name	Reset	R/W	Description
7 - 4	Packet_L_HD	Neo: N/A Classic: 0b0111	R	Set or read the packet length for **H**alf-**D**uplex mode 0000: Invalid 0001: Invalid 0010: Invalid 0011: Invalid 0100: Invalid 0101: Invalid 0110: Invalid 0111: 257 Bytes (Factory Default)
3 - 0	Packet_L_BC	Neo: N/A Classic: 0b1111	R/W	Set or read the packet length for **B**road**C**ast mode 0000: 33 Bytes 0001: 65 Bytes 0010: 97 Bytes 0011: 129 Bytes 0100: 161 Bytes 0101: 193 Bytes 0110: 225 Bytes 0111: 257 Bytes 1000: 289 Bytes 1001: 321 Bytes 1010: 353 Bytes 1011: 385 Bytes 1100: 417 Bytes 1101: 449 Bytes 1110: 481 Bytes 1111: 513 Bytes(Factory Default)

This register only applies to Classic operation mode.

In half duplex mode, packet length is always set to the default 257 bytes.

In broadcast mode, when the packet length is set to any value other than the default 513 bytes the format of the data transmitted is as follows:

Byte 0 = Start Code
Byte 1 = Start Address MSB
Byte 2 = Start Address LSB
Byte 3 = DMX Data @ Start Address Slot
Byte 3 + n = Remaining DMX Slot data up to packet length

SHoW DMX Classic SHoW DMX receivers always transmit a full DMX frame. Embedding the start address in the data block allows a receiver to correctly place the block of data in the DMX frame. This maintains correct device addressing downstream of the DMX output. The unused DMX slots in the frame are set to 0x00.

Half-duplex Timeout (0x05)

Bit	Field Name	Reset	R/W	Description
7-0	Timeout	0	R	This register is no longer used

RSSI (0x06)

Bit	Field Name	Reset	R/W	Description
7	RSSI_Noise	1	R	This bit indicates whether or not the RSSI value was read while a packet was being received during the previous hop. If this bit is a 1 that means that the RSSI value indicates the signal level of the background noise or signal from other devices. 0: Packet received 1: No packet was received
6-0	RSSI	0	R	Read the receive signal strength measured during the previous hop from a client. This value is measured during each hop while the client is receiving a packet from a server and the value is buffered. At the next hop the value is transferred into the register and can then be read by the host. If there was no packet received then the signal strength is still measured during that hop and will indicate the background noise level. This condition is specified by Bit 7 being set as noted above. The value of the signal strength will be in the range of 20 to 120 but will indicate –dBm so the host must multiply it by -1.

Status (0x07)

Bit	Field Name	Reset	R/W	Description
7-3	-	0	R	Not used
2	Packet_size_ changed	0	R	Tells the host processor in a client that the packet just received has a length different than that in the packet length register.
1	GPI1	0	R	Stores the status of radio pin 17 - gets updated during power on initialization and then anytime there is a change in level.
0	GPI0	0	R	Stores the status of radio pin 19 - gets updated during power on initialization and then anytime there is a change in level.

Error Count (0x08)

Bit	Field Name	Reset	R/W	Description
7-0	Error_Cnt	0	R	This command will return either 36 bytes or 15 bytes – one for each channel of the hop-set being used. Each byte will represent an accumulated count of missed packets + erroneous packets for that particular channel. The count will be reset to zero after the values are read and will then start accumulating again.

Sleep Command (0x09)

Bit	Field Name	Reset	R/W	Description
7-0	Sleep	N/A	W	Write all zeros to this register to put the radio module into low power sleep mode. The radio will return an acknowledgement and then will go to sleep after finishing transmission of any packet in progress. After being put into sleep mode the radio must be woken up by pulling the wakeup pin low.

Sync Word Register (0x0A)

Bit	Field Name	Reset	R/W	Description
7-4	-	0000	W0	Not used – write 0.
3-0	Sync	Neo: Last Classic: 0b0000	R/W	Set or read the sync word selection. The sync word must be set the same on all radios that are meant to work together – i.e. all radios in one DMX universe. Radios to be used in a different universe should be set to use a different sync word. For Classic mode only. 0000: sync word 0 (Factory Default Classic) 0001: 0010: 0011 0100: 0101: 0110: 0111: 1000: 1001: 1010: 1011: 1100: 1101: 1110: 1111: sync word 15 (Factory Default Neo)

Temperature Register (0x11)

Bit	Field Name	Reset	R/W	Description
7	Temp_sign	sign of current temp	R	Sign bit
6 - 0	Temp	current temp.	R	Read the latest temperature sample from the on-board temperature sensor. Temperature in degrees C as a signed character.

Firmware Version Register (0x12)

Bit	Field Name	Reset	R/W	Description
7 - 0	Firmware Version	Version	R	Read the installed firmware version – Reading from this register will return 3 bytes for the Radio FW revision. The first byte is the Major, the next is the minor and the third is the build number. Eg. [1][4][6] represents 1.4.6

Product ID Register (0x13)

Bit	Field Name	Reset	R/W	Description
7 - 2	-	0		Not used
1 - 0	Product_ID	ID	R	Read if the product is programmed as a Euro or North American version. 01: Euro 10: North American

Latency Register (0x14)

Bit	Field Name	Reset	R/W	Description
7 - 2	-	0		Not used
1 - 0	Latency	Neo: Last Classic: N/A	R/W	Set or read the current latency selection. 00: Normal 01: Low (Factory Default)

Operating Mode Register (0x15)

Bit	Field Name	Reset	R/W	Description
7 - 2	-	0		Not used
1 - 0	LN_Mode	Reset value of pin 29	R/W	Set or read the current operating mode. At reset pin 29 is read and register is set accordingly. After reset, the mode can only be changed by writing to this register. 00: Classic 01: SHoW DMX Neo Note: When changing the mode, you will not receive an ACK and you must wait 100ms before accessing the radio again.

Start Address MSB (0x16)

Bit	Field Name	Reset	R/W	Description
7-1	-	0		Not used
0	StartAddMSB	Neo: Last Classic: N/A	R/W	Write or read the MS bit of the start address for limited burst operation. Only valid when Packet Length is less than 512 slots. Only writable when in server mode. Range is 0x00 to 0x01. Factory Default: 0x00

Start Address LSB (0x17)

Bit	Field Name	Reset	R/W	Description
7-0	StartAddLSB	Neo: Last Classic: N/A	R/W	Write or read the LSB start address for limited busrt operation. Only valid when Packet Length is less than 512 slots. Only writable when in server mode. Range is 0x00 to 0xff. Factory Default: 0x00

SHoW DMX Neo Limited Burst Size (0x18)

Bit	Field Name	Reset	R/W	Description
7 - 4	-	0		Not Used
3 - 0	Limited Burst	Neo: Last Classic: N/A	R/W	Set or read the packet length for **Neo** mode 0000: 51 slots 0001: 103 slots 0010: 155 slots 0011: 207 slots 0100: 259 slots 0101: 311 slots 0110: 363 slots 0111: 415 slots 1000: 467 slots 1001: 512 slots (Factory Default)

Adaptive Hopping (0x19)

Bit	Field Name	Reset	R/W	Description
7 - 1	-	0		Not used
0	Adaptive ON-OFF	Neo: Last Classic: N/A	R/W	Set or read the current adaptive hopping state. 0: OFF 1: ON (Factory Default)

RDM UID (0x1A)

Bit	Field Name	Reset	R/W	Description
7-0	Mfg. ID HB	Factory Set	R	Read the high byte of the manufacture ID byte

RDM UID (0x1B)

Bit	Field Name	Reset	R/W	Description
7-0	Mfg ID LB	Factory Set	R	Read the low byte of the manufacture ID byte

RDM UID(0x1C)

Bit	Field Name	Reset	R/W	Description
7-0	Device ID MB	Factory Set	R	Read the most significant byte of the device ID

RDM UID(0x1D)

Bit	Field Name	Reset	R/W	Description
7-0	Device ID UB	Factory Set	R	Read the upper byte of the device ID

RDM UID (0x1E)

Bit	Field Name	Reset	R/W	Description
7-0	Device ID HB	Factory Set	R	Read the high byte of the device ID

RDM UID (0x1F)

Bit	Field Name	Reset	R/W	Description
7-0	Device ID LB	Factory Set	R	Read the low byte of the device ID

DMX/RDM Interleave Rate (0x20)

Bit	Field Name	Reset	R/W	Description
7 - 0	DMX_RDM_INTLV	Neo: Last Classic: N/A	R/W	Set or read the current DMX/RDM Interleave rate 0: Illegal 1: 1:1 DMX/RDM rate 2: 2:1 DMX/RDM rate (Factory Default) … 255: 255:1 DMX/RDM rate.

SHoW ID (0x21)

Bit	Field Name	Reset	R/W	Description
7-0	ShowId	Neo: Last Classic: N/A	R/W	Classic: 1 thru 64 Neo: 101 thru 164 and 201 thru 204 Factory Default Neo: 201 Factory Default Classic: 1

Writing to the SHoW ID register also writes to Band, Hop Set – Full Band, Hop Set – Sub Band and Sync word registers to create the appropriate SHoW ID settings based on Table 14: SHoW DMX Neo ID to Radio Registers and Table 15: SHoW DMX Classic ID to Radio Registers.

When writing a Classic ID while in Neo operating mode, returns invalid data, as does writing a Neo ID when operating in Classic mode. You cannot change the mode via writing a SHoW ID.

In Neo operating mode it is possible to create an incompatible system by writing to the SHoW ID register, then changing Band, Hop Set or sync word registers.

RDM Traffic Enable (0x22)

Bit	Field Name	Reset	R/W	Description
7 - 1	-	0		Unused
0	RdmTrafficEnable	Neo: Last Classic: N/A	R/W	Set or read the current adaptive hopping state. 0: OFF (Factory Default) 1: ON

Device Count MSB (0x23)

Bit	Field Name	Reset	R/W	Description
7 – 0	DeviceCount MSB	Neo: 0 Classic: N/A	R	MSB byte count of discovered proxied devices

Device Count LSB (0x24)

Bit	Field Name	Reset	R/W	Description
7 – 0	DeviceCount LSB	Neo: 0 Classic: N/A	R	LSB byte count of discovered proxied devices

7.1 SHoW ID to Register Tables

Table 14: SHoW DMX Neo ID to Radio Registers

SHoW ID	Hop Band	Hop Set - Full	Hop Set - Sub	Sync Word	Adaptive On/Off	Operating Mode
101	0x00	0x00	N/A	0x0F	0x00	0x01
102	0x01	0x01	N/A	0x0E	0x00	0x01
103	0x00	0x02	N/A	0x0D	0x00	0x01
104	0x01	0x03	N/A	0x0C	0x00	0x01
105	0x00	0x04	N/A	0x0B	0x00	0x01
106	0x01	0x05	N/A	0x0A	0x00	0x01
107	0x00	0x06	N/A	0x09	0x00	0x01
108	0x01	0x07	N/A	0x08	0x00	0x01
109	0x00	0x08	N/A	0x07	0x00	0x01
110	0x01	0x09	N/A	0x06	0x00	0x01
111	0x00	0x0A	N/A	0x05	0x00	0x01
112	0x01	0x0B	N/A	0x04	0x00	0x01
113	0x00	0x0C	N/A	0x03	0x00	0x01
114	0x01	0x0D	N/A	0x02	0x00	0x01
115	0x00	0x0E	N/A	0x01	0x00	0x01
116	0x01	0x0F	N/A	0x00	0x00	0x01
117	0x02	N/A	0x00	0x0F	0x00	0x01
118	0x03	N/A	0x01	0x0E	0x00	0x01
119	0x02	N/A	0x02	0x0D	0x00	0x01
120	0x03	N/A	0x03	0x0C	0x00	0x01
121	0x02	N/A	0x04	0x0B	0x00	0x01
122	0x03	N/A	0x05	0x0A	0x00	0x01
123	0x02	N/A	0x06	0x09	0x00	0x01
124	0x03	N/A	0x07	0x08	0x00	0x01
125	0x02	N/A	0x08	0x07	0x00	0x01
126	0x03	N/A	0x09	0x06	0x00	0x01
127	0x02	N/A	0x0A	0x05	0x00	0x01
128	0x03	N/A	0x0B	0x04	0x00	0x01
129	0x02	N/A	0x0C	0x03	0x00	0x01
130	0x03	N/A	0x0D	0x02	0x00	0x01
131	0x02	N/A	0x0E	0x01	0x00	0x01
132	0x03	N/A	0x0F	0x00	0x00	0x01
133	0x04	N/A	0x00	0x0F	0x00	0x01
134	0x05	N/A	0x01	0x0E	0x00	0x01

SHoW ID	Hop Band	Hop Set - Full	Hop Set - Sub	Sync Word	Adaptive On/Off	Operating Mode
135	0x04	N/A	0x02	0x0D	0x00	0x01
136	0x05	N/A	0x03	0x0C	0x00	0x01
137	0x04	N/A	0x04	0x0B	0x00	0x01
138	0x05	N/A	0x05	0x0A	0x00	0x01
139	0x04	N/A	0x06	0x09	0x00	0x01
140	0x05	N/A	0x07	0x08	0x00	0x01
141	0x04	N/A	0x08	0x07	0x00	0x01
142	0x05	N/A	0x09	0x06	0x00	0x01
143	0x04	N/A	0x0A	0x05	0x00	0x01
144	0x05	N/A	0x0B	0x04	0x00	0x01
145	0x04	N/A	0x0C	0x03	0x00	0x01
146	0x05	N/A	0x0D	0x02	0x00	0x01
147	0x04	N/A	0x0E	0x01	0x00	0x01
148	0x05	N/A	0x0F	0x00	0x00	0x01
149	0x06	N/A	0x00	0x0F	0x00	0x01
150	0x07	N/A	0x01	0x0E	0x00	0x01
151	0x06	N/A	0x02	0x0D	0x00	0x01
152	0x07	N/A	0x03	0x0C	0x00	0x01
153	0x06	N/A	0x04	0x0B	0x00	0x01
154	0x07	N/A	0x05	0x0A	0x00	0x01
155	0x06	N/A	0x06	0x09	0x00	0x01
156	0x07	N/A	0x07	0x08	0x00	0x01
157	0x06	N/A	0x08	0x07	0x00	0x01
158	0x07	N/A	0x09	0x06	0x00	0x01
159	0x06	N/A	0x0A	0x05	0x00	0x01
160	0x07	N/A	0x0B	0x04	0x00	0x01
161	0x06	N/A	0x0C	0x03	0x00	0x01
162	0x07	N/A	0x0D	0x02	0x00	0x01
163	0x06	N/A	0x0E	0x01	0x00	0x01
164	0x07	N/A	0x0F	0x00	0x00	0x01
201	0x00	0x00	N/A	0x0F	0x01	0x01
202	0x00	0x00	N/A	0x0F	0x01	0x01
203	0x00	0x00	N/A	0x0F	0x01	0x01
204	0x00	0x00	N/A	0x0F	0x01	0x01

Table 15: SHoW DMX Classic ID to Radio Registers

SHoW ID	Hop Band	Hop Set - Full	Hop Set - Sub	Sync Word	Operating Mode
1	0x00	0x00	N/A	0x00	0x00
2	0x01	0x01	N/A	0x01	0x00
3	0x00	0x02	N/A	0x02	0x00
4	0x01	0x03	N/A	0x03	0x00
5	0x00	0x04	N/A	0x04	0x00

SHoW ID	Hop Band	Hop Set - Full	Hop Set - Sub	Sync Word	Operating Mode
6	0x01	0x05	N/A	0x05	0x00
7	0x00	0x06	N/A	0x06	0x00
8	0x01	0x07	N/A	0x07	0x00
9	0x00	0x08	N/A	0x08	0x00
10	0x01	0x09	N/A	0x09	0x00
11	0x00	0x0A	N/A	0x0A	0x00
12	0x01	0x0B	N/A	0x0B	0x00
13	0x00	0x0C	N/A	0x0C	0x00
14	0x01	0x0D	N/A	0x0D	0x00
15	0x00	0x0E	N/A	0x0E	0x00
16	0x01	0x0F	N/A	0x0F	0x00
17	0x02	N/A	0x00	0x00	0x00
18	0x03	N/A	0x01	0x01	0x00
19	0x02	N/A	0x02	0x02	0x00
20	0x03	N/A	0x03	0x03	0x00
21	0x02	N/A	0x04	0x04	0x00
22	0x03	N/A	0x05	0x05	0x00
23	0x02	N/A	0x06	0x06	0x00
24	0x03	N/A	0x07	0x07	0x00
25	0x02	N/A	0x08	0x08	0x00
26	0x03	N/A	0x09	0x09	0x00
27	0x02	N/A	0x0A	0x0A	0x00
28	0x03	N/A	0x0B	0x0B	0x00
29	0x02	N/A	0x0C	0x0C	0x00
30	0x03	N/A	0x0D	0x0D	0x00
31	0x02	N/A	0x0E	0x0E	0x00
32	0x03	N/A	0x0F	0x0F	0x00
33	0x04	N/A	0x00	0x00	0x00
34	0x05	N/A	0x01	0x01	0x00
35	0x04	N/A	0x02	0x02	0x00
36	0x05	N/A	0x03	0x03	0x00
37	0x04	N/A	0x04	0x04	0x00
38	0x05	N/A	0x05	0x05	0x00
39	0x04	N/A	0x06	0x06	0x00
40	0x05	N/A	0x07	0x07	0x00
41	0x04	N/A	0x08	0x08	0x00
42	0x05	N/A	0x09	0x09	0x00
43	0x04	N/A	0x0A	0x0A	0x00
44	0x05	N/A	0x0B	0x0B	0x00
45	0x04	N/A	0x0C	0x0C	0x00
46	0x05	N/A	0x0D	0x0D	0x00
47	0x04	N/A	0x0E	0x0E	0x00
48	0x05	N/A	0x0F	0x0F	0x00
49	0x06	N/A	0x00	0x00	0x00
50	0x07	N/A	0x01	0x01	0x00

SHoW ID	Hop Band	Hop Set - Full	Hop Set - Sub	Sync Word	Operating Mode
51	0x06	N/A	0x02	0x02	0x00
52	0x07	N/A	0x03	0x03	0x00
53	0x06	N/A	0x04	0x04	0x00
54	0x07	N/A	0x05	0x05	0x00
55	0x06	N/A	0x06	0x06	0x00
56	0x07	N/A	0x07	0x07	0x00
57	0x06	N/A	0x08	0x08	0x00
58	0x07	N/A	0x09	0x09	0x00
59	0x06	N/A	0x0A	0x0A	0x00
60	0x07	N/A	0x0B	0x0B	0x00
61	0x06	N/A	0x0C	0x0C	0x00
62	0x07	N/A	0x0D	0x0D	0x00
63	0x06	N/A	0x0E	0x0E	0x00
64	0x07	N/A	0x0F	0x0F	0x00