# MODEVA Technical Reference Manual

## Disclaimer



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# 1 MODEVA Product Overview

The MODEVA™ system, an elegantly designed, easy to use lighting, drapes, and amenities control system, provides an unrivaled guestroom management experience. The MODEVA system allows guest control of multiple loads from many locations. MODEVA (comprising a logic board and user interface), in combination with the Load Assembly infrastructure (see below), consists of user interfaces, low voltage interfaces, wired and wireless communications, dimmers, and switches designed to operate within INNCOM's Integrated Room Automation System (IRAS). The MODEVA system brings all guestroom control features into a sleekly designed unit housed in either a capacitive glass or a more traditional keypad user interface.


**Figure 1 MODEVA Triple Gang System**

The MODEVA system was designed by the engineers at INNCOM International Inc., who pioneered Energy Management Systems in the hotel industry long before "green" was a marketing concept. INNCOM is again blazing a trail for enhanced guestroom controls with the MODEVA and Load Assembly system.

The MODEVA system brings an unmatched level of design flexibility by utilizing a "system in a box" approach. Mixing a variety of individual components and actuators, the MODEVA system provides endless guestroom control features and options that interoperate seamlessly with INNCOM's e4 Smart Digital Thermostat for an unparalleled energy management and lighting control platform. With the fully configurable user interface and logic board, which allows the hotelier and the INNCOM design team to create a unique look and feel while customizing functionality, the MODEVA system can meet nearly any design requirement conceived for the hotel guestroom.

MODEVA itself contains all of the hardware components (including logic operations, radio communications, and user interface functionality) necessary to operate as a low voltage controls interface within a thin (8mm thick) assembly that rests outside of the wall box cavity. This brings an incredible advantage to MODEVA by allowing it to be decoupled safely from the line power switching and dimming performed by the system's Load Assembly actuators. Since the MODEVA user interface is 12VDC powered and equipped with wired S5-bus communications and a 2.4 GHz RF radio, it can be used as a standalone, low voltage controls interface for load center style applications. This also frees the MODEVA from the mechanical confines of gang box dimensions. Coupled with Load Assembly WBI actuators, the MODEVA becomes a complete load controlling system in the gang box that can perform every function conceived for guestroom controls.

# 2 MODEVA System Block Diagram

The MODEVAI system comprises 3 segments: the mounting frame / touch user interface, the logic board, and the Load Assembly components (mounting brackets and actuators). The exploded diagram below illustrates the high level functionality of each of the 3 segments.

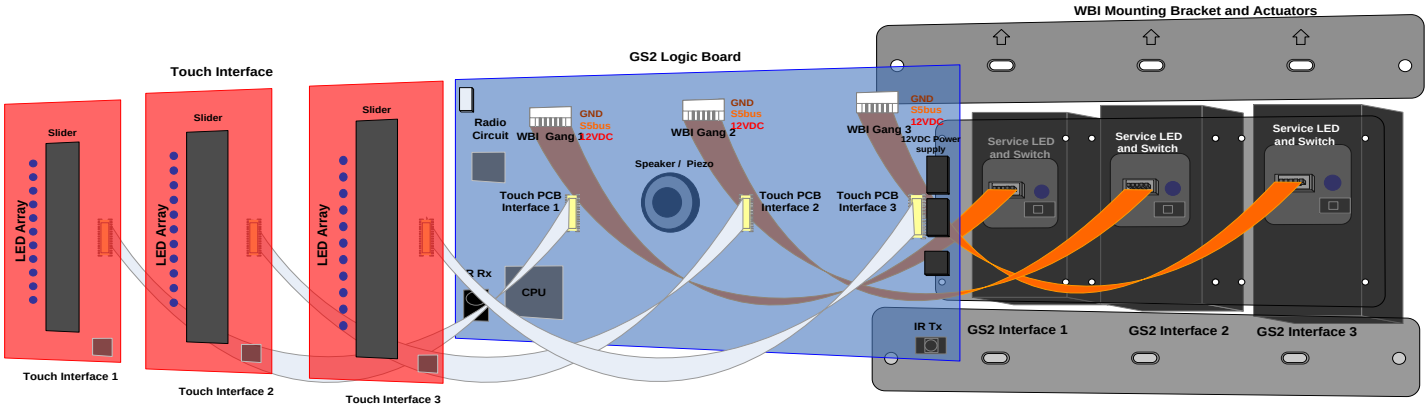



**Figure 2 MODEVA System Block Diagram**

Note the modular concepts that contribute to the flexibility in the MODEVA system. For instance, the triple gang assembly uses three touch user interfaces with the same layout and mechanical dimensions but configured in four different ways (refer to Figure 2 above and Figure 3 below). On the back end, the system's three actuators can be used as dimmers or as simple load switchers and can be arranged in any configuration that the application requires. In between lies the logic board containing all logic and communications control required for nearly any IRAS application.

# 3 Touch User Interface

The MODEVA touch user interface contains the touch sensors and indicator LEDs for system input and output. The touch user interface can be fabricated with a specific geometry and sensor layout to accommodate multiple applications (while also easing assembly and production) by designing only one touch user interface dimension that is used for single gang, double gang, and triple gang assemblies.

MODEVA incorporates a capacitive controller capable of detecting touch on up to 6 sensors or one single slider per touch user interface. The sensors sense fields through any dielectric material such as glass or plastic up to 10mm thick. Each sensor can be tuned to a unique sensitivity level. INNCOM plans to provide a single touch user interface layout at the product launch based on a single slider that can be configured in one of the four following ways:

- Basic Slider
  0–255 levels of control operated by the slide of a finger across the glass in the up or down direction. This slider array makes use of all 11 LEDs with the exception of the Red LED. This layout is optimal for slide dimming a dimmable lighting load or as a drape control.
- Five segmented slider layout
  This layout segments the slider into five evenly distributed discrete sensor locations in software using a unified hardware layout. In Figure 3 below, the five-segment layout makes use of the corresponding Blue LEDs. In the five segment configuration, the LEDs change from array functionality to indicator functionality. This layout is optimal where five or fewer functions (such as lighting control, amenities such as Do Not Disturb and Make Up Room, and general purpose functionality) are required.
- Six segmented slider layout
  This layout segments the slider into six evenly distributed discrete sensor locations in software using a unified hardware layout. In Figure 3, the six-sensor layout makes use of the corresponding Blue LEDs. In the six-sensor configuration, the LEDs change from array functionality to indicator functionality. This

layout is optimal where six or fewer functions (such as lighting control, amenities such as Do Not Disturb and Make Up Room and general purpose functionality) are required. The Red LED is reserved for Do Not Disturb functionality.

- Proximity sensor layout
  Optionally, a sensor on MODEVA can operate as a proximity sensor by increasing the proximity sensitivity. This would be ideal for an application where the MODEVA assembly is backlighting text or LED arrays located close to the nightstand or bed (see Backlighting below). When the unit is not in use, the backlight LEDs can be dimmed to a very low level so as not to disrupt the guest's sleep. When a hand is waved in front of MODEVA, the unit would detect the motion and resume the backlight of the panel to the normal bright levels or could even activate a nightlight.
- Nightlight

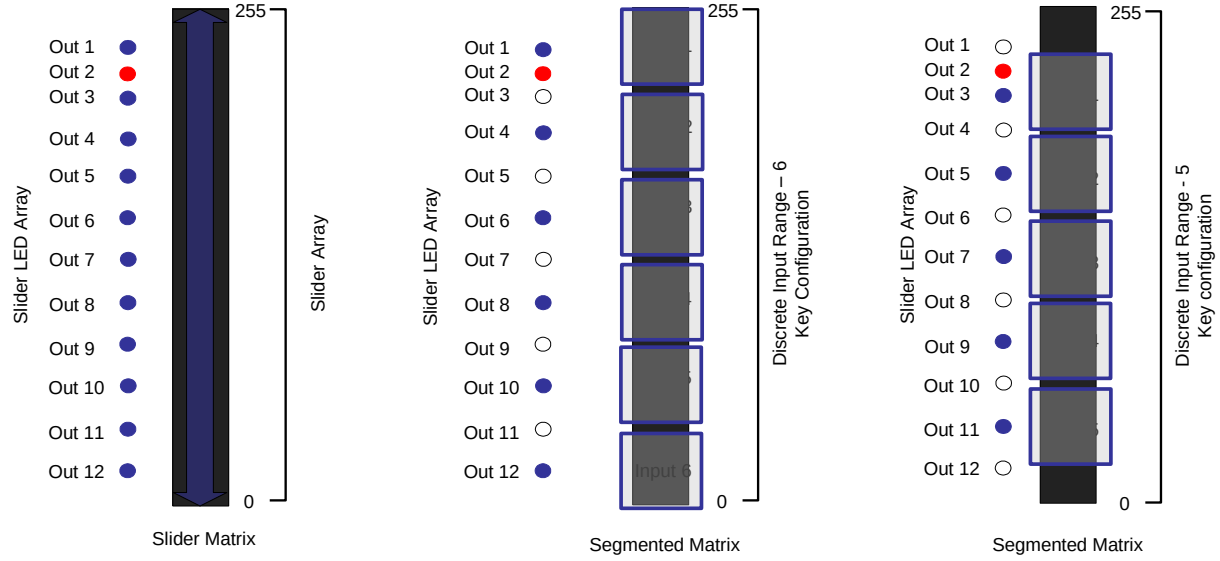



**Figure 3 Slider Layout Configurations**

MODEVA inputs and LEDs can be arranged to function as a nightlight/bath light by parsing the slider into discrete inputs through software. Bright white LEDs and suppression of backlighting combine to produce variable levels of illumination.

- Backlighting
  MODEVA touch user interface and front cover housings use LEDs and a housing material designed to diffuse the backlight to an evenly illuminated glow. This can provide a subtle backlight feature to the user interface that can illuminate text icons and other input information.

# 4 MODEVA Logic Board

The MODEVA logic board contains a 32-bit, 16Mhz microprocessor for all logic operations, system coordination, S5-bus circuit, 2.4Ghz RF radio circuit, IR Tx, and Rx components for close proximity detection; it interfaces towards the touch user interface and Load Assembly actuators. This is the brains and control center for the MODEVA system designed to support nearly any application in the guestroom environment. The logic board is available in single, double, and triple gang geometry. All features are available in each design; only the number of Load Assembly and touch user interface interconnects changes based on the mechanical requirements. Because the MODEVA contains

all logic communications and interfacing capability, it can be used as a low-voltage remote control interface for load center style applications.

### 4.1 RF capability

MODEVA shares the electrical design of the 0dB 2.4GHz 802.15.4 INNCOM TXR radio module by embedding the radio components in the logic board. This sub-circuit has been specifically tuned for optimal performance for the guestroom environment. Typically, the RF transceiver can expect to reach up to a 70ft radius in an indoor, urban environment. MODEVA communicates on the standard INNCOM RF protocol, a proprietary encrypted protocol that runs over the 802.15.4 platform stack. This is a shared protocol that is used by all other RF capable INNCOM products. The protocol's encryption method provides protection for the P5 frame being sent into the RF spectrum and makes it very difficult to interpret the data and reuse it maliciously.

**Note:** RF performance can be degraded by pre existing environmental factors.

### 4.2 S5-bus

The logic board incorporates the most modern S5-bus circuit design, to support up to 15 S5-bus devices in a single guestroom network segment.

### 4.3 IR Tx and Rx

MODEVA uses a low power IR transmitter and receiver to provide two functions: IR communications for TV and A/V system control and proximity detection. This circuit is not to be confused with IR5 and cannot be used as a wireless IR5 transceiver for IRAS and guestroom network purposes.

## 5 Load Assembly

The Load Assembly is the core of MODEVA system flexibility. The Load Assembly consists of mounting brackets and WBI actuators that provide the mechanical platform and load bearing capability for the MODEVA system. Each MODEVA (and each input located on the interface) can control any one of the individual actuators as part of the Load Assembly located within the local gang box, or it can remotely control other actuators as part of the guestroom network IRAS. This allows the designer to locate actuators with specifically designed functions throughout the guestroom network and to have control over that actuator from any user interface in the guestroom network. The MODEVA platform uses magnets located on the back side of the logic board that adhere to the large flat metal surfaces of the Load Assembly brackets, allowing for screwless mounting that adds to the aesthetic product design.

### 5.1 Categories of Load Assembly Load Switching

#### *5.1.1 TRIAC Dimmer Power Supply*

- The TRIAC dimmer provides dimming control of resistive light loads such as incandescent, halogen, and TRIAC dimmable LEDs. The TRIAC dimmer can dim 100–120VAC loads up to 500W.
- The TRIAC Actuator also provides a class-2, 12VDC output used to power the MODEVA logic and touch user interface and to provide connection and power for a wired S5-bus IRAS network.

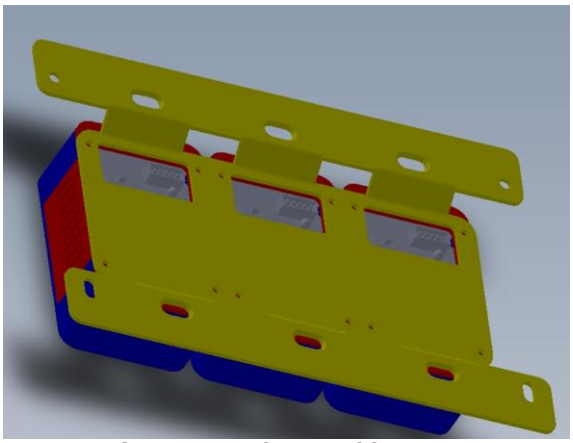


**Figure 4 Load Assembly Frame**

### 5.1.2 MOSFET Dimmer Power Supply

- The MOSFET dimmer is specifically designed to dim capacitive loads such as dimmable fluorescent lamps and electronic ballast. Secondarily, it can also dim resistive loads such as incandescent, halogen, and dimmable LEDs. The MOSFET dimmer is designed to dim 100–120VAC up to 350W.
- The MOSFET Actuator also provides a class-2, 12VDC output used to power the MODEVA logic and touch user interface and to provide connection and power for a wired S5-bus IRAS network.

### 5.1.3 Relay Switched Power Supply

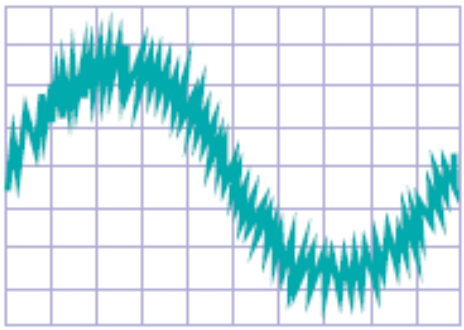
- The Relay power supply is specifically designed to switch capacitive, inductive, resistive, and general purpose loads up to 500W.
- The WBI Relay Actuator also provides a class-2, 12VDC output used to power the MODEVA logic and touch user interface and to provide connection and power for a wired S5-bus IRAS network.

## 5.2 Load Assembly Dimming

With the MODEVA product offering, INNCOM presents a "lighting control system in a box" that provides a multifaceted range of modular and component level flexibility competitors cannot offer. Because of this, INNCOM's lighting control hardware quality must be on par with or exceed the competitions'. To achieve the highest level of smooth dimming operation with both the MOSFET and TRIAC dimmers, a clean power line must be available for the Load Assembly actuators. Corrupt zero crossing information will affect turn-on points and turn-on time of the TRIAC and MOSFET dimmers, which ultimately affects dimming quality. Zero crossing information and accurate line frequencies are a problem for dimming products because they are more sensitive to line voltage problems. AC line evaluation to ascertain that it meets INNCOM's minimum technical requirements for dimming light loads is essential.

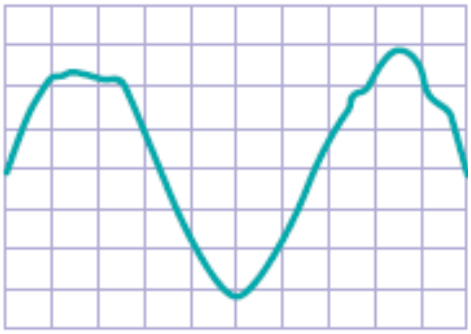
Typically, there are six different types of power line noise that can be found in the industrial commercial and hotel environments:

### 5.2.1 High-frequency noise



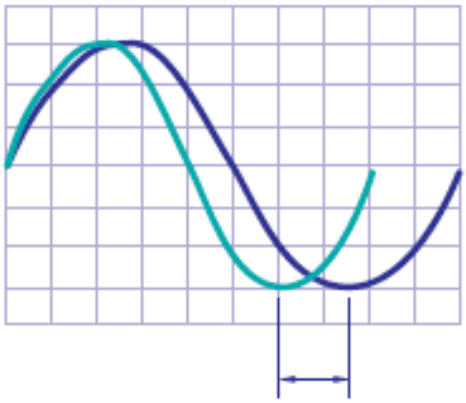
Caused by variable-speed motor drives, on-line UPS systems.

### 5.2.2 Low-frequency non-harmonics:



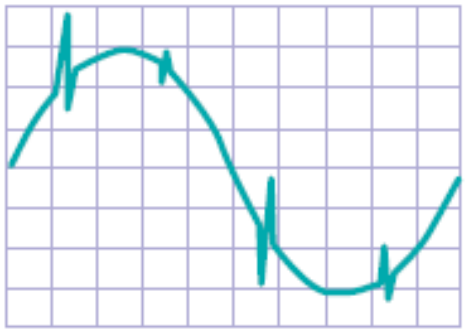
Caused by signaling systems, power line carrier communications.

### 5.2.3 Variable baseline frequency



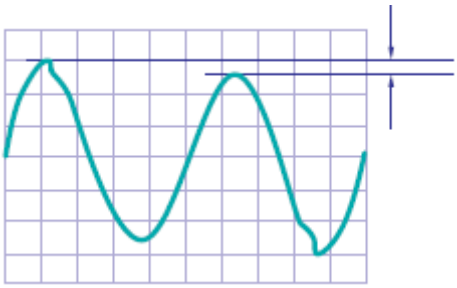
Caused by backup generators and small power grids.

### 5.2.4 Impulse noise



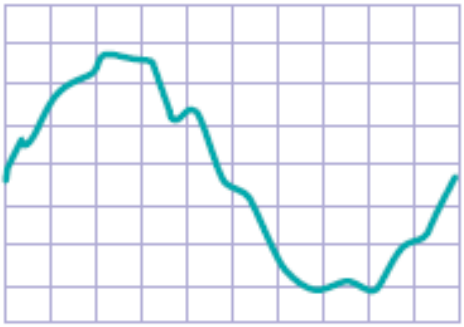
Caused by switch arcing (loads switching on and off).

### 5.2.5 RMS voltage changes



Caused by heavy load switching.

### 5.2.6 Notch and low frequency noise



Caused by elevators and large industrial loads

TRIAC and MOSFET dimmers can withstand certain levels of any one kind of the noises listed above. However, if any single noise is present at a high magnitude, or multiple noise conditions occur simultaneously, the poor quality conditions on the line will result in poor quality dimming performance. INNCOM application engineering, operations, and customer service need to be aware of these property conditions to ensure proper operation of the MODEVA light dimmers. A site survey that includes the evaluation of the line voltage at each property must be conducted.

## 5.3 Air-Gap Switch

The TRIAC and MOSFET Load Assemblies are equipped with an air gap switch (relay) to ensure that the load is safely turned off and that there is no leakage current to the fixture during routine lamp maintenance. The air gap switch engages each time the load is dimmed completely off under normal operation.

## 5.4 Overload Protection

If a MOSFET or TRIAC Dimmer is continuously overloaded, a thermal shut down will occur to protect the solid state circuitry. This thermal shutdown temperature can be configured and monitored with INNCOM configuration tool such as the PC-501.

The MOSFET Dimmer is equipped with an additional overload detection circuit that detects a catastrophic overload / short and shuts down the dimmer to protect the solid state circuitry.

## 5.5 Load Assembly Parallel Power Supplies

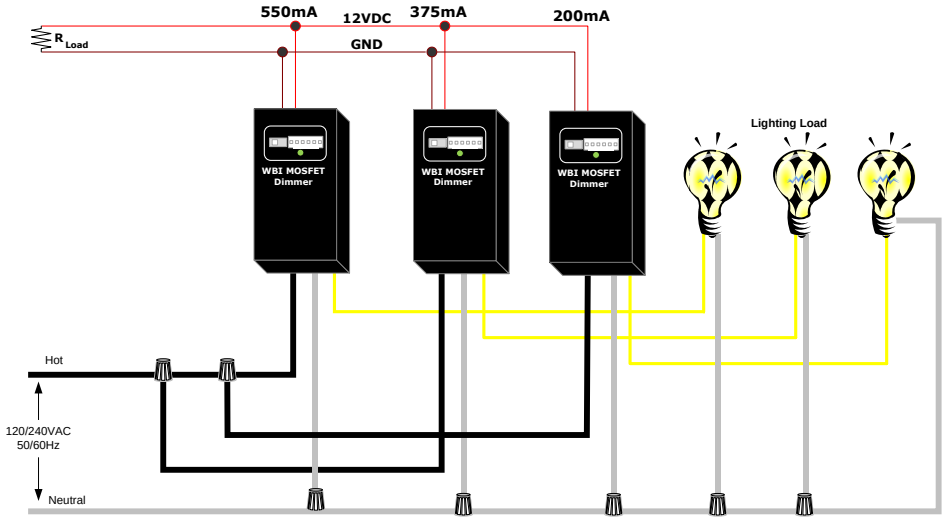



**Figure 5 Parallel Power Supplies**

The WBI actuators operate in parallel to supply a higher load capacity than that achievable by a single actuator. The total output power of the actuators in parallel is based on the voltage specifications at maximum load versus the output current at maximum load and a nominal recover time after a fold back condition occurs. Therefore, the sum of paralleled power supplies is not simply I1 + I2 + I3= I max. However, aggregate power of the paralleled supplies is greater than that available from a single source.

The benefit of this design is the ability to aggregate actuators into a system that permits load sharing without concern for back feeding voltage that typically occurs when more than one supply is used. A triple ganged MODEVA system can provide up to 550mA to power 12VDC S5-bus devices in the circuit. INNCOM recommends the use of up to seven power supplies in any given network segment. A disadvantage is that a short condition on any one of the actuators will drag all of the actuators into a fold-back state until the short condition is resolved.

| Number of Load Assemblies | Nominal Voltage | Voltage at Maximum Load | Output Rating |
|---|---|---|---|
| Single Actuator | +12VDC | +11.0VDC | 200mA |
| Two Actuators | +12VDC | +11.0VDC | 400mA |
| Three Actuators | +12VDC | +11.1VDC | 600mA |
| Four Actuators | +12VDC | +11.1VDC | 700mA |
| Five Actuators | +12VDC | +11.2VDC | 800mA |
| Six Actuators | +12VDC | +11.2VDC | 900mA |

# 6 MODEVA System Technical Specification

| Mechanical Package | Length | Width | Height |
|---|---|---|---|
| American Single Gang | 119mm | 74mm | 8.0mm |
| American Double Gang | 119mm | 124mm | 8.0mm |
| American Triple gang | 119mm | 174mm | 8.0mm |

| Glass Touch Surface Area | Length | Width | Height |
|---|---|---|---|
| American Single Gang | 115mm | 70mm | 2.0mm |
| American Double Gang | 115mm | 120mm | 2.0mm |
| American Triple gang | 115mm | 170mm | 2.0mm |

| Electrical Characteristics | Parameter |
|---|---|
| User Interface | Capacitive touch sensor / slider |
| Maximum # of inputs | 1-6 sensor inputs, or 1 slider per gang |
| Alternate User Interface | Keypad—traditional mechanical switches |
| Communications | 1. Wired S5-bus<br>2. 2.4Ghz RF<br>3. IR Infrared (not IR5) |
| Output Power | 12VDC, up to 200mA* |
| Micro controller | 16Mhz, 32-bit ARM based MCU |

### 6.1 MODEVA/Load Assembly Current Consumption Characteristics

| Device | Peak Current Consumption |
|---|---|
| Logic Board (basic) | 50mA |
| Logic Board w/ 1mW Radio | 60mA |
| Logic board with IR transceiver | 70mA |
| Capacitive Touch PCBA (02-7060) | 10mA(n x 3.5mA) (logic board current plus the number of LEDs) |
| Load Assembly Relay Actuator | 35mA |
| Load Assembly TRIAC Actuator | 35mA |
| Load Assembly MOSFET Actuator | 35mA |

For example, a MODEVA assembly that

- uses the capacitive touch PCBA for a 6 input / output user interface,
- communicates wirelessly using the 2.4Ghz radio, and
- uses the MOSFET dimmer to actuate a load

would have a peak current consumption figured as follows:

| | | |
|---|---|---|
| Logic Board w/ 1mW Radio | 60mA | |
| Capacitive Touch PCBA (02-7060) | 10mA(6 x 3.5mA)=31mA | **=121mA (Peak Current Consumption)** |
| MOSFET Actuator | 30mA | |

The total DC load rating of a single actuator is 200mA. Therefore, a single actuator has 80mA remaining to provide 12VDC power to S5-bus devices.

## 7 Load Specifications

### 7.1 Single gang installation

The following table provides load ratings at absolute maximum based on the load type in a single gang wall box.

| Actuator | Ratings | | | |
|---|---|---|---|---|
| | Voltage | Frequency | Power / Amperes | Load Type |
| Relay Actuator | 120-240 Vac | 50/60 Hz | 4.1 A | Resistive |
| | 120-240 Vac | 50/60 Hz | 4.1 A | General Purpose |
| | 120-240 Vac | 50/60 Hz | 500 W | Tungsten / ELV |
| | 120-240 Vac | 50/60 Hz | 250 VA | Electric Ballast |
| TRIAC Dimmer | 120 Vac | 60 Hz | 2.9 A | Resistive |
| | 120 Vac | 60 Hz | 2.9 A | General Purpose |
| | 120 Vac | 60 Hz | 500 W | Tungsten / ELV |
| | 120 Vac | 60 Hz | 250 VA | Electronic Ballast |

| Actuator | Ratings | | | |
|---|---|---|---|---|
| | Voltage | Frequency | Power / Amperes | Load Type |
| MOSFET Dimmer | 120 Vac | 60 Hz | 2.9 A | Resistive |
| | 120 Vac | 60 Hz | 2.9 A | General Purpose |
| | 120 Vac | 60 Hz | 350 W | Tungsten / ELV |
| | 120 Vac | 60 Hz | 250 VA | Electronic Ballast |

### 7.2 Multigang Installation

The MODEVA and Load Assembly comes in single, double and triple gang configurations; the double and triple gang assemblies may be any combination of relay, switches, MOSFET Dimmer or TRIAC Dimmer. The table below provides the derated output based on the configuration.

| Actuator | Ratings | | | |
|---|---|---|---|---|
| | Voltage | Frequency | Power / Amperes | Load Type |
| TRIAC Dimmer | 120 Vac | 60 Hz | 2.9 A | Resistive |
| | 120 Vac | 60 Hz | 2.9 A | General Purpose |
| | 120 Vac | 60 Hz | 400 W | Tungsten |
| | 120 Vac | 60 Hz | 250 VA | Electronic Ballast |
| MOSFET Dimmer | 120 Vac | 60 Hz | 2 A | Resistive |
| | 120 Vac | 60 Hz | 2 A | General Purpose |
| | 120 Vac | 60 Hz | 250 W | Tungsten |
| | 120 Vac | 60 Hz | 250 VA | Electronic Ballast |

## 8 Multigang Installation Derating Chart

### 8.1 Actuator Ratings

| Actuator | Ratings | | | |
|---|---|---|---|---|
| TRIAC Dimmer | Voltage | Frequency | Power / Amperes | Load Type |
| | 120 Vac | 60 Hz | 2.9 A | Resistive |
| | 120 Vac | 60 Hz | 2.9 A | General Purpose |
| | 120 Vac | 60 Hz | 400 W | Tungsten |
| | 120 Vac | 60 Hz | 250 VA | Electronic Ballast |
| MOSFET Dimmer | Voltage | Frequency | Power / Amperes | Load Type |
| | 120 Vac | 60 Hz | 2 A | Resistive |
| | 120 Vac | 60 Hz | 2 A | General Purpose |

| Actuator | Ratings | | | |
|---|---|---|---|---|
| | 120 Vac | 60 Hz | 250 W | Tungsten |
| | 120 Vac | 60 Hz | 250 VA | Electronic Ballast |

# 9 Standard Wiring

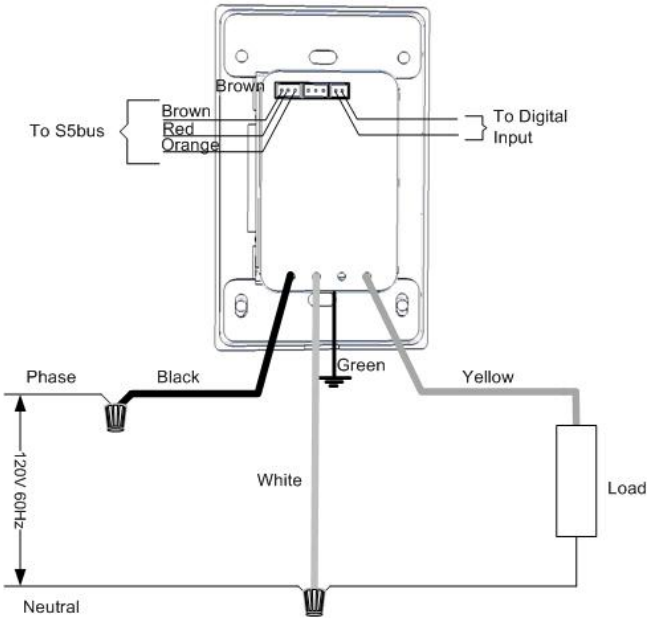



**Figure 6 Single Gang Wiring Diagram**

In Figure 6, the MODEVA and Load Assembly is configured for switching or dimming the level of AC power delivered to a load, such as a Tungsten lighting load.

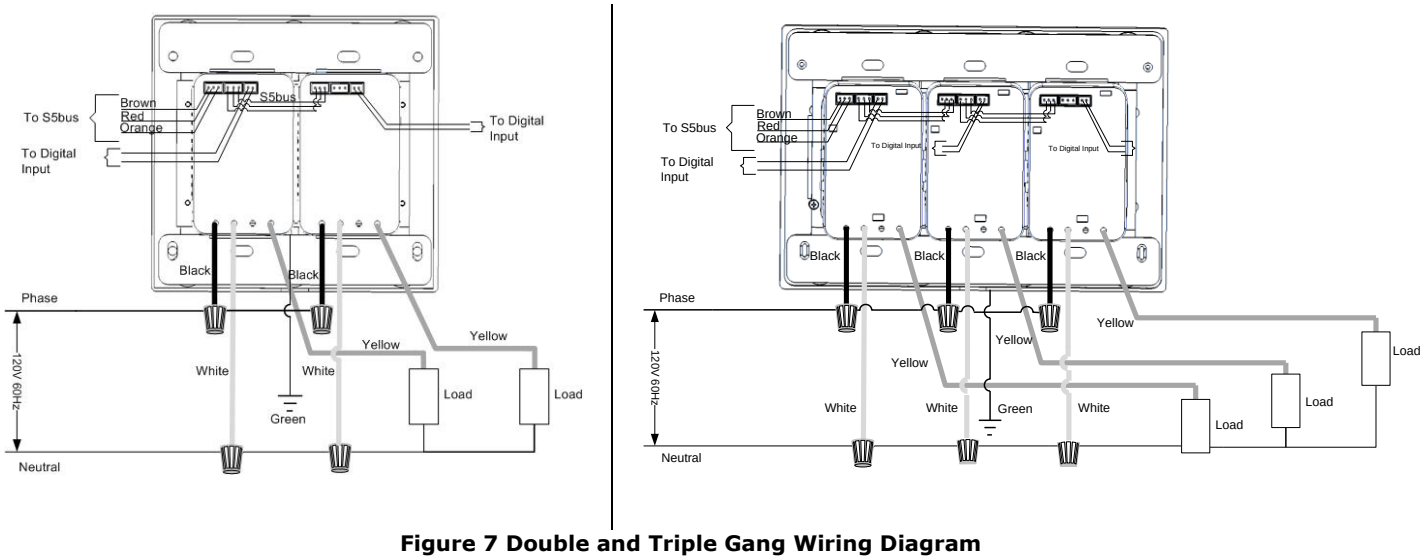



**Figure 7 Double and Triple Gang Wiring Diagram**

In Figure 7, the MODEVA and Load assembly is configured for switching or dimming the level of AC power delivered to multiple loads, such as two or three tungsten lighting loads.

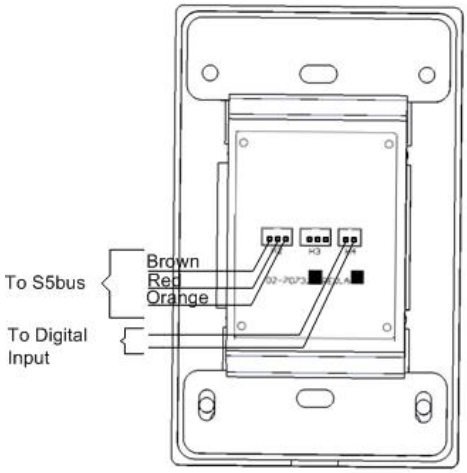



**Figure 8 Single Gang Powered Remote Control**

In the configuration shown in Figure 8, the MODEVA is used as a three-way switch to transmit S5bus or RF signals to auxiliary INNCOM devices to manage in-room communications irrespective of the location of the system devices. In this respect, the MODEVA provides remote control of auxiliary INNCOM devices.

In Figures 6, 7, and 8 each MODEVA is equipped with low voltage connections to provide +12VDC power to other devices, communicate on the S5bus, or provide a digital input for a door switch.

## 10 FCC Statement

This device contains FCC ID: GTC027060TXR.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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 when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## 11 MODEVA User Interface Assembly Ordering Information

The MODEVA and Load Assembly are designed to be modular and can be completely independent of each other. For instance, a double gang MODEVA user interface can be specified, while the system may only require a single Load Assembly actuator. Therefore, the Ordering Part Numbers (OPN) for the MODEVA and Load Assembly are separated. Both the MODEVA and Load Assembly are available in several operating ranges. The MODEVA OPN is formed by a combination of the elements, as shown in the figure below:

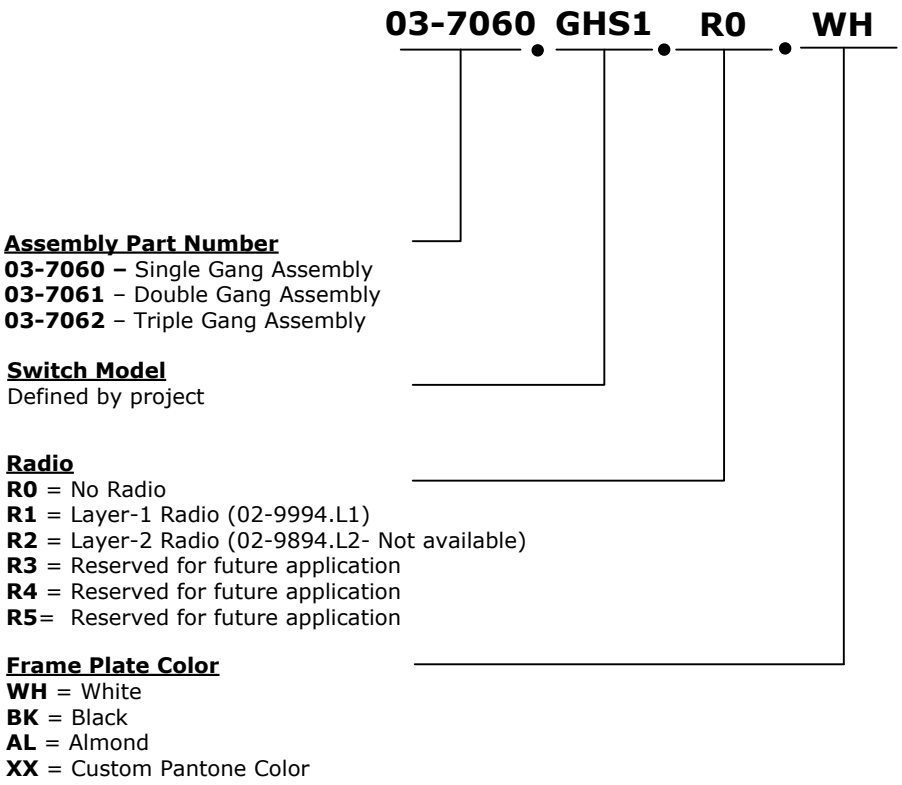



**Figure 9 User Interface Assembly Ordering Part Number**

*Examples:*

**03-7060.GHS1.R1.WH** = MODEVA user interface assembly switch #1 designed for the Grand Hyatt New York project that includes the CC2430 based radio circuit and a white framing plate. "GHS1" further defines the attributes of the Touch User interface PCB model (ex. GS-765.XXX) in the following:

- Number of capacitive touch keys or sliders
- Locations of capacitive touch keys
- Number of indicator LEDs
- LED locations
- LED colors

This information is found in the 03-7060.GHS1 Hardware Guide. Note that when a double and triple gang assembly is designed (03-7062.xxx.xx.xx) it becomes more critical to refer to the hardware guide that defines the touch user interface attributes for the left gang, center gang, and right gang. Again note that in a double and triple gang assembly two and three touch user interface PCBA's are required, but always only one logic board PCBA is required.

**03-7061.GHS2.R0.WH** = A double gangMODEVA assembly configured for the Grand Hyatt Switch position #2 that does not include the CC2430 radio circuit, uses a white framing plate, and uses a GS-765.STD in the left position, and a GS-765.NL01 in the right position. (See GS-765.STD and GS-765.NL01 hardware guide for specific details of the touch user interface).

# 12 MODEVA Load Assembly Ordering Information

## 12.1 Load Assembly Ordering Information

The Load Assembly system is available in several operating ranges but is based on the same fundamental hardware platform. The ordering part numbers (OPN) are formed by a combination of the elements, as shown in Figure 7 below.

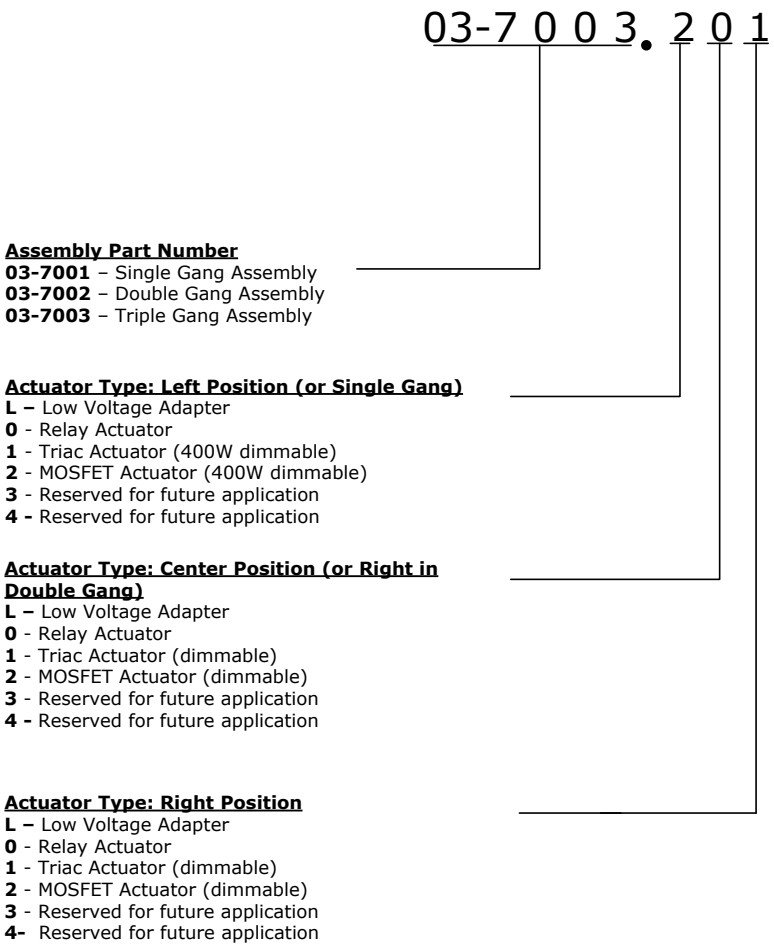



**Figure 10 Load Assembly Ordering Part Number**

*Example:*

**03-7003.L01** = A triple gang MODEVA Load Assembly that includes a low voltage adapter in the left position, a relay actuator in the center position and a TRIAC dimmer in the right position.

# 13 Document Information and Revision History

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File \\Niantic\departments\R&D\Working Documents\Reference Manuals\MODEVA\Drafts

| Date | Changes |
|---|---|
| 13-Oct-2009 | First Draft |
| 16-Oct-2009 | Edited for content and composition |
| 02-Mar-2010 | Product information added and edited |
| 09-Apr-2010 | Updated Derating chart for UL |
| 20-Apr-2010 | Updated order guide to include radio option for logic components |
| 18-Jun-2010 | Update to reflect name changes; new ratings tables |
| 07-Jul-2010 | Replaced mechanical drawings of the brackets, label drawings, etc with standard wiring drawings |
| 23-Aug-2010 | Updated FCC statement |