

CERVIS STANDARD USER MANUAL

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FCC Statements

15.19 – Two-Part Warning

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference and
- This device must accept any interference received, including interference that may cause undesired operation.

15.21 – Unauthorized Modification

NOTICE: The manufacturer is not responsible for any unauthorized modifications to this equipment made by the user. Such modifications could void the user's authority to operate the equipment.

15.105(b) – Note:

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.

Industry Canada Statement

This device complies with Industry Canada RSS-210.

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population; consult Safety Code 6, obtainable from Health Canada's website <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/safety-code-6-health-canada-radiofrequency-exposure-guidelines-environmental-workplace-health-health-canada.html>.

Le présent appareil est conforme à la norme CNR-210 d'Industrie Canada.

Le programme d'installation de cet équipement radio doit s'assurer que l'antenne est située ou fait telle qu'elle n'émet pas de champ RF dépassant les limites de Santé Canada pour la population générale ; consulter le Code de sécurité 6, disponible auprès de Santé Canada site Web <https://www.canada.ca/en/health-canada/services/environmental-workplace-health/reports-publications/radiation/safety-code-6-health-canada-radiofrequency-exposure-guidelines-environmental-workplace-health-health-canada.html>.

Industry Canada Statement

This device complies with Industry Canada licence-exempt RSS standard(s). 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.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Industry Canada Unlicensed Devices EIRP Statements for Removable Antennas

Part 1: Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (EIRP) is not more than that necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Part 2: This radio transmitter (LOBSRF-310) has been approved by Industry Canada to operate with the antenna type listed below with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (LOBSRF-310) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Cervis, Inc. Safety Precautions

- **Read and follow all instructions.**
- Failure to abide by Safety Precautions may cause equipment failure, loss of authority to operate the equipment, and personal injury.
- Use and maintain proper wiring. Follow equipment manufacturer instructions. Improper, loose, and frayed wiring can cause system failure, equipment damage, and intermittent operation.
- Equipment changes or modifications not expressly approved by the manufacturer will void the warranty.
- Equipment owner/operators must abide by all applicable Federal, State, and Local laws concerning equipment installation and operation. Failure to comply could result in penalties and could void user authority to operate the equipment.
- Make sure that the machinery and surrounding area is clear before operating. Do not activate the remote control system until you are certain that it is safe to do so.
- Turn off the remote control and disconnect power from the machine unit before attempting any maintenance. This will prevent accidental operation of the controlled machinery.
- Power can safely be disconnected from the remote by removing the source power (batteries) from the unit.
- Power can be removed from the machine unit by disconnecting the source power from the circuit.
- Use a damp cloth to keep units clean. Remove mud, concrete, dirt, etc. after use to prevent obstructing or clogging the buttons, levers, wiring, and switches.
- Do not allow liquid to enter the remote control or machine unit enclosures. Do not use high-pressure equipment to clean the remote control or machine unit.
- Disconnect the machine unit before welding on the machine. Failure to disconnect the machine unit may cause destruction of or damage to the machine unit.
- Operate and store units only within the specified operation and storage temperatures defined in this document's Specifications.
- Keep high-energy radio frequency (RF) devices away from handheld remotes. Activating high-power communication radios, for instance, in close proximity to handheld remotes can cause interference and "false" circuit activation.
- Do not key two-way radios while using the handheld remote.
- Abide by the recommendations in **Appendix A, Exposure to Radio Frequency Energy.**
- If the radio system is employed on a machine with a safety circuit (stop button, crash bar, etc.), you must ensure that the safety circuit is still completely functional after the radio system is wired into the control circuits of the machine.

RoHS Compliance Statement

Cervis, Inc. complies with the requirements of Restriction of Hazardous Substances (RoHS/WEEE) Specification based on in-house practice and declaration of compliance from our vendors. For additional information concerning RoHS compliance, please contact Cervis, Inc. at:

170 Thorn Hill Road • Warrendale, PA 15086
Phone: 724.741.9000 • Fax: 724.741.9001



This product may contain material that may be hazardous to human health and the environment. In compliance with EU Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE):



- Do not dispose of the product as unsorted municipal waste.
- This product should be recycled in accordance with local regulations. Contact local authorities for detailed information.
- This product may be returnable to the distributor for recycling. Contact your distributor for details.

Definitions/Notes

Associate - When you program a transmitter with a receiver's identity code (ID) during the association process.

Pairing - When a transmitter takes control of a receiver for operation.

First Come First Serve – A transmitter : receiver pairing that uses unique serial numbers in the RF addressing to prevent more than one transmitter communicating with a receiver at the same time.

RF - Abbreviation for Radio Frequency, which is used to carry data wirelessly.

DSSS - Direct Sequence Spread Spectrum, a frequency hopping (RF) method of wireless communication.

Receiver (RX) - Referring to the unit mounted on the crane that is hard-wired to the crane controls.

Transmitter (TX) - The handheld unit that the operator uses to send commands to the receiver.

Line of Sight - The path radio frequencies (RF) travel between transmitting antennas and the receiving antenna. This term implies Direct Line of Sight, meaning there are no obstructions between the antennas that would reduce the RF's ability to travel between antennas.

EMI - Electro Magnetic Interference.

RFI - Radio Frequency Interference.

CN - Used in Cervis Standard part numbers to indicate a 24 pin, rectangular connector has been installed on the end of the receiver wiring harness.

HRN - Used in Cervis Standard part numbers to indicate a that a horn has been installed into the enclosure of a receiver

Cervis Standard Radio Systems Introduction

The Cervis Standard Radio Systems for overhead crane applications provides a versatile right-sized solution to handle over 120 different crane control configurations. Engineered, manufactured, and fully supported by Cervis, it is designed to be the only radio control system that you need to cover most of the crane applications in use, including 2 speed, 3 speed and Tandem configurations.

Using the receiver's easily accessible DIP switches, you can quickly configure the system for most cranes. No other radio control system offers so much in a single package. The Cervis Standard reduces inventory cost while increasing application coverage.

The Cervis Standard Systems offerings include the following:

- Cervis Standard System Offerings - See **Table 1**
- Available Transmitter Models - See **Table 2**
- Available Receiver Models - See **Table 3**

System Item Number	Popular Configuration	Receiver Powered by	# of TX	Special Notes
Cervis 22-2-HV	• Up to 2 motion, 2 speed	110 - 220 VAC	2	• Compact sized MU-9X9 receiver with redundant MLC relays
Cervis 22-2-LV		7 - 32 VDC or 10 - 28 VAC		
Cervis 32-2-HV	• 3 motion • 2 speed • A/B select	110 - 220 VAC	2	• 34 different A/B select configurations, • 16 variations of 3 motions with AUX, • 4 relay hoist control options, • 4 motion configurations, • 20 different below the hook options
Cervis 32-2-LV		7 - 32 VDC or 10 - 28 VAC		
Cervis HHMS-1-HV	• 3 motion • 2 speed • A/B select	110 - 220 VAC	1	• 34 different A/B select configurations, • 16 variations of 3 motions with AUX, • 4 relay hoist control options, • 4 motion configurations, • 20 different below the hook options
Cervis HHMS-1-LV		7 - 32 VDC or 10 - 28 VAC		
Cervis HHMS-3-HV	• 3 motion • 3 speed	110 - 220 VAC	1	• 7 configurations for 3 motion 3 speed control
Cervis HHMS-3-LV		7 - 32 VDC or 10 - 28 VAC		
Cervis HHMS-2-HV-TDM	• 3 motion • 2 speed • A/B select	110 - 220 VAC	2	• 27 configurations for Tandem crane control
Cervis HHMS-2-LV-TDM		7 - 32 VDC or 10 - 28 VAC		

Table 1 - Cervis Standard System Offerings

Transmitter Part Number	Description	Powered by	Special Notes
Cervis HH2S-08	• 8 each 2 speed push buttons	AAA alkaline batteries	Compact size medium duty
Cervis HH2S-10	• 10 each 2 speed push buttons	AAA alkaline batteries	Compact size medium duty
Cervis HHMS 2 Speed	• 8 each 2 speed push buttons • 2 each single step push buttons, Mushroom Style M-STOP	Rechargeable LiPO battery pack	Heavy duty
Cervis HHMS 3 Speed	• 6 each 3 speed push buttons • 2 each 2 speed push buttons • 2 each single step push buttons • Mushroom Style M-STOP	Rechargeable LiPO battery pack	Heavy duty
Cervis HHMS Tandem	• 8 each 2 speed push buttons, • 2 each single step push buttons, • Mushroom Style M-STOP • and OLED display	Rechargeable LiPO battery pack	Heavy duty

Table 2 - Available Transmitter Models

Receiver Part Number	Description	Powered by	Special Notes
MU-9X9-HV	10 each Form A relays	110-220 VAC	Factory fixed configuration
MU-9X9-LV	10 each Form A relays	7-32 VDC or 10-28 VAC	Factory fixed configuration
MU-9X15-HV	16 each Form A relays	110-220 VAC	DIP Switch to select over 120 crane configurations
MU-9X15-LV	16 each Form A relays	7-32 VDC or 10-28 VAC	DIP Switch to select over 120 crane configurations

Table 3 - Available Receiver Models

Contents Included with a System Purchase

Every system comes with its transmitters and receivers already associated at the factory. After the receiver has been installed and the transmitter is powered with batteries, they will be ready to operate with each other.

Each type of system comes pre-configured with a default configuration. Please reference the configuration section of this manual on Page 30 for details.

What's New in Cervis Standard?

Cervis Standard Radio controls bring many new benefits to wireless crane controls. To achieve these new benefits, their RF messaging method differs from that of existing Cervis Warrior products.

Project Address (PAN ID)

The RF link between Cervis Standard transmitters and receivers requires many values to be validated before a receiver will link with a transmitter. PAN ID is one of those values. The PAN ID is common across all Cervis Standard products and is what prevents Cervis Standard from linking with Warrior Standard and Warrior Engineered.

11th Pushbutton

The existing Warrior Standard family was based on a 10-button transmitter. Despite the later addition of an 11th button transmitter to the product line, it remained bound to the 10-button limitation. Cervis Standard transmitter to receiver mapping is based on the inclusion of the 11th pushbutton.

110 Added configurations

With the inclusion of the 11th pushbutton, Cervis Standard offers 110 more configurations than Warrior Standard, all of which can be set in the field with no special tools.

Tandem

Another primary improvement with the Cervis Standard is how RF Links are managed throughout a tandem lift. Cervis Standard provides the operator the ability to maintain control of a crane even when toggling to the second crane to make an adjustment to the second crane's position. Also, the receiver on the first crane retains the RF Link with the transmitter and will keep its main line contactor relay output closed. This results in less cycling of the MLC and keeps the crane energized during a lift, which can result in safer lifts.

Control Release

Another added benefit provides the operator with the ability to have both receivers in a tandem configuration remain locked on the serial number of the transmitter through RF

NOTE

Cervis Standard products will only operate with other products that have also been loaded with Cervis Standard software. A Cervis Standard product will not communicate with any existing Warrior Standard or Warrior Engineered products.

Link loss. This can assure the operator that, during rigging adjustments, no other transmitter can take control of the receivers.

Crane Selection on Display

Cervis Standard HHMS transmitters with a display show which crane or cranes are actively selected on the screen. This information remains displayed throughout a tandem lift to improve clarity for the operator's awareness of what selection is currently active.

Maintenance Mode

While Cervis Standard HHMS transmitters with a display are primarily used for Tandem Operation, they can also be configured for 1:1 crane control through the increased capabilities of the Maintenance Mode when combined with a display.

What's the Same in Cervis Standard?

Warrior Standard offered 16 unique transmitter and receiver configurations. All those configurations have been included within Cervis Standard's expanded set of configurations

Anything not mentioned as new functionality in this manual will see Cervis Standard performing like the existing Warrior Standard product line. You may reference those product specification manuals for details as needed

Transmitter Hardware Specifics

The HH2S and HHMS transmitters in Cervis Standard have new button number assignments that are consistent across models.

- STOP & B9 reserved for On / Off & Start / Horn
- B1 - B6 reserved for motion control
- B7 - B8 fully configurable
- B7 is the only location for A/B Select
- B8 is the only location for Crane Select
- B10 is the back right button of the HHMS transmitter

HH2S Transmitter

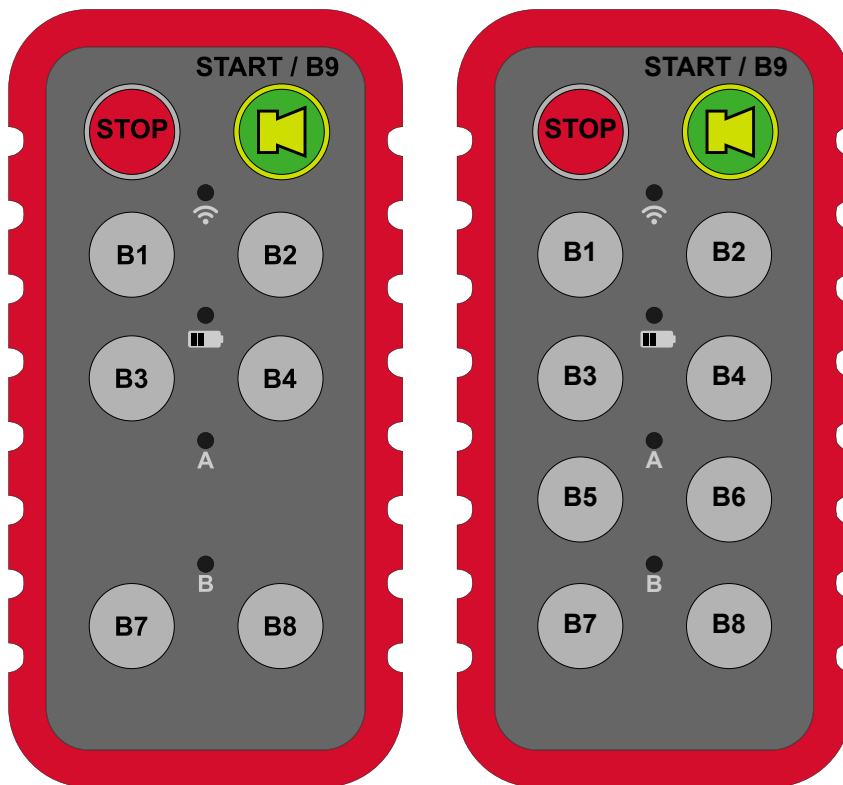


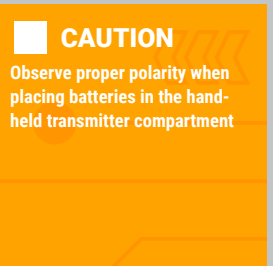
Figure 1 - HH2S Button Layouts (8 Button, Left, 10 Button, right)

HH2S Battery information

Two AAA cell batteries power HH2S handheld units. When installing batteries, be sure to observe proper polarities as marked on the inside of the battery compartment to avoid damaging the unit.

To replace or install batteries in the handheld:

1. Loosen the four small Phillips screws from the Battery Compartment cover and lift the cover from the handheld. The screws remain attached to the cover.
2. If installing batteries in an empty battery compartment, install two fresh size AAA cell batteries. Be sure to position the batteries as shown in Figure 2.



3. If replacing expired batteries, remove the old batteries, and install two fresh size AAA batteries. (Discard the used batteries according to local regulations.) Be sure to position the batteries as shown in Figure 2.
4. Replace the compartment cover and tighten the four Phillips screws. Do not over-tighten these screws but make sure they are tight enough for the gasket to create a proper seal.

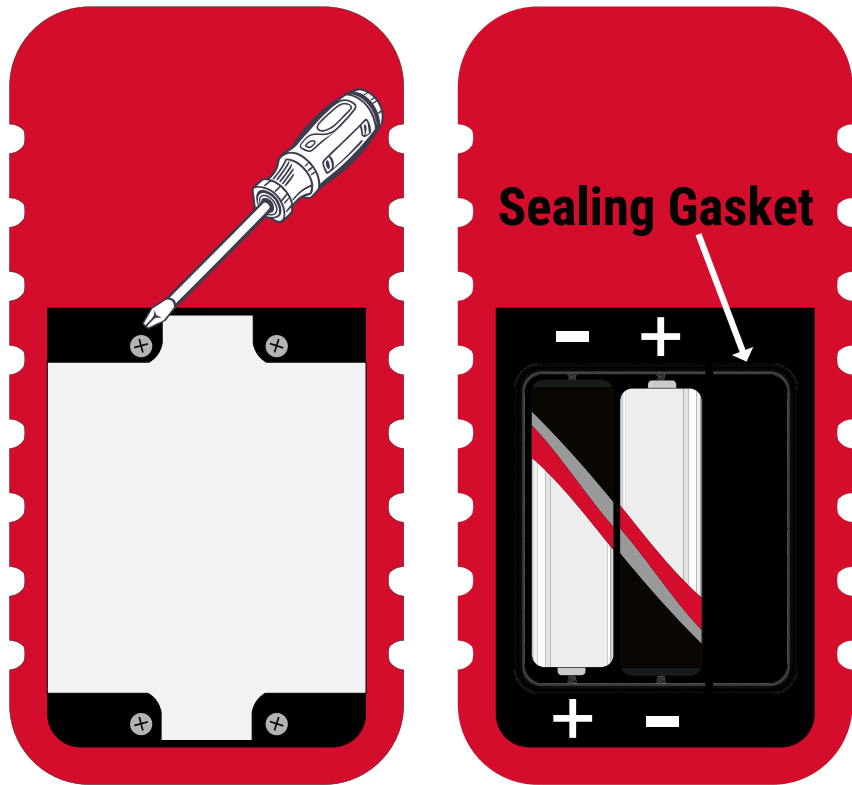


Figure 2 - HH2S Battery Compartment

HH2S LED Information

The HH2S has four red light-emitting diodes (LEDs) that indicate transmitter status and are also used for troubleshooting. See **Table 4** below for additional information on the LED symbols and their meanings.

LED Symbol		Meaning
		RF Transmit/Receive
		Battery
	A	A Select
	B	B Select

Table 4 - HH2S LED Symbols and Meaning

HHMS Transmitter

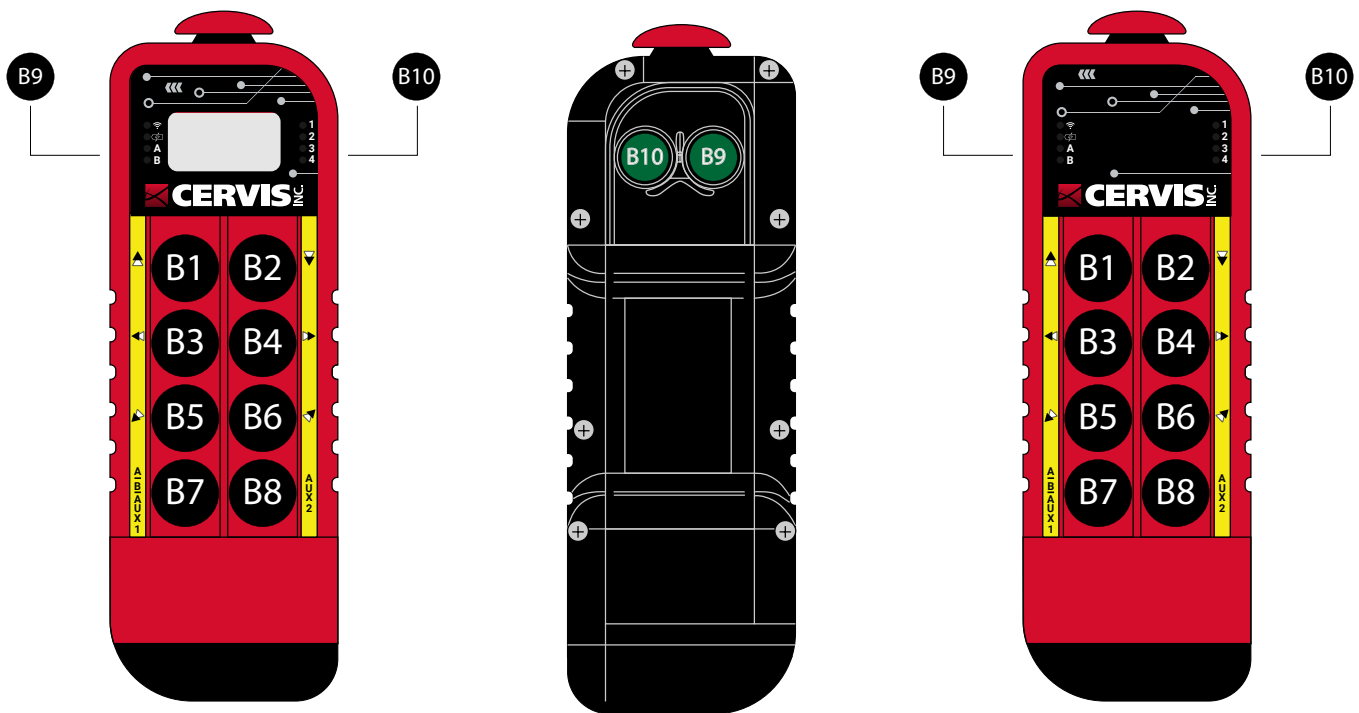


Figure 3 - HHMS Button Layout (With Display - Left; Back - Middle; No Display - Right)

HHMS Battery information

A rechargeable Lithium Polymer (LiPO) battery pack powers HHMS transmitters. When installed and fully charged, the battery supplies power to the transmitter for 80 continuous operating hours. When installing the battery, be sure that the metallic battery contacts properly align with those inside the unit.

To install the battery pack in the transmitter body:

1. Pinch the clamps on each side of the battery in.
2. Slide the battery pack into the transmitter body until you hear a click.

To charge the battery pack:

1. Pinch the clamps on each side of the battery in.
2. Slide the battery pack into the battery charger. (Make sure the battery contacts are oriented correctly with those inside the charger.)
3. Plug the charger into a nearby wall socket. The LED on the plug indicates charging status.
 - a. Solid RED = charging
 - b. Solid GREEN = charged
 - c. Maximum charging time = Five hours from zero charge
4. When the battery has finished charging, unplug the charger from the wall socket, remove the battery from the charger base, and insert it into the transmitter.

HHMS Battery Warning and Shutdown

The HHMS will alert you if the remaining battery life is getting low or is too low for normal operation through the battery LED indicators.

HHMS LED identification

The HHMS has eight red light-emitting diodes (LEDs) that indicate transmitter status and are also used for troubleshooting. See **Table 5** for additional information.

LED Symbol	Meaning
	RF Transmit/Receive
	Battery
A	A Select
B	B Select
1	LED 1
2	LED 2
3	LED 3
4	LED 4

Table 5 - HH2S LED Symbols and Meaning

NOTE

When a battery is inserted, and the STOP switch is already pulled up, the battery and B select LEDs will flash, followed by the RX/TX and A select LEDs. Cycle the STOP switch to reset.

NOTE

All the LEDs will flash briefly one time when a battery is inserted, and the STOP switch is already pushed down.

Receiver Hardware Specifics

MU-9X9 Receiver

Electrical

The MU-9X9 has ten Form A system relays, divided into two groups of three relays (K1 through K3, and K4 through K6), and one group of four relays (K7 through K10).

- Groups 1 and 2 perform related motion functions.
- Group 3 contains the MLC (Main Line Contact) redundant-contact safety circuit, the Start, and the Horn/Light relays.

See **Figure 4** for more information.

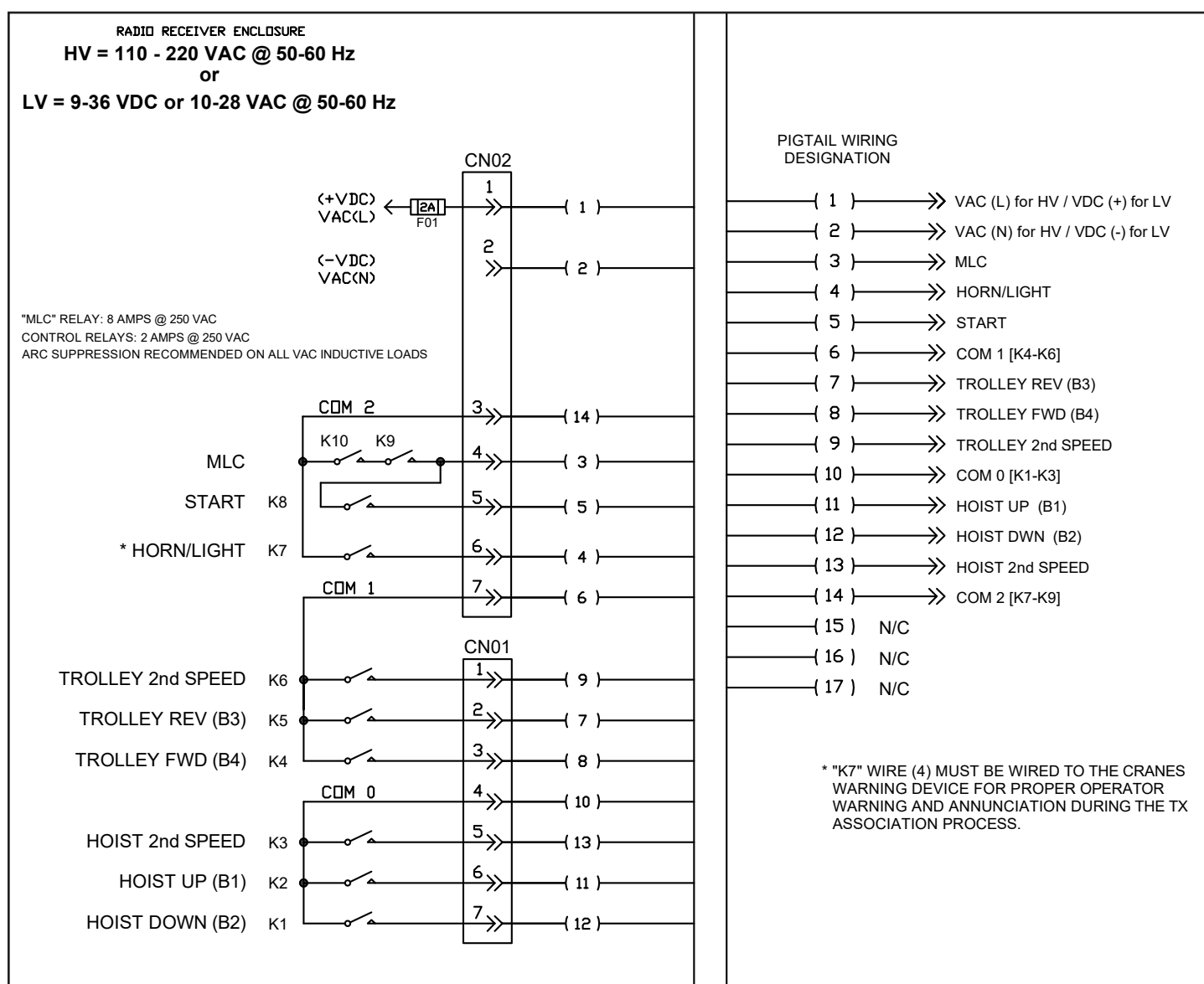
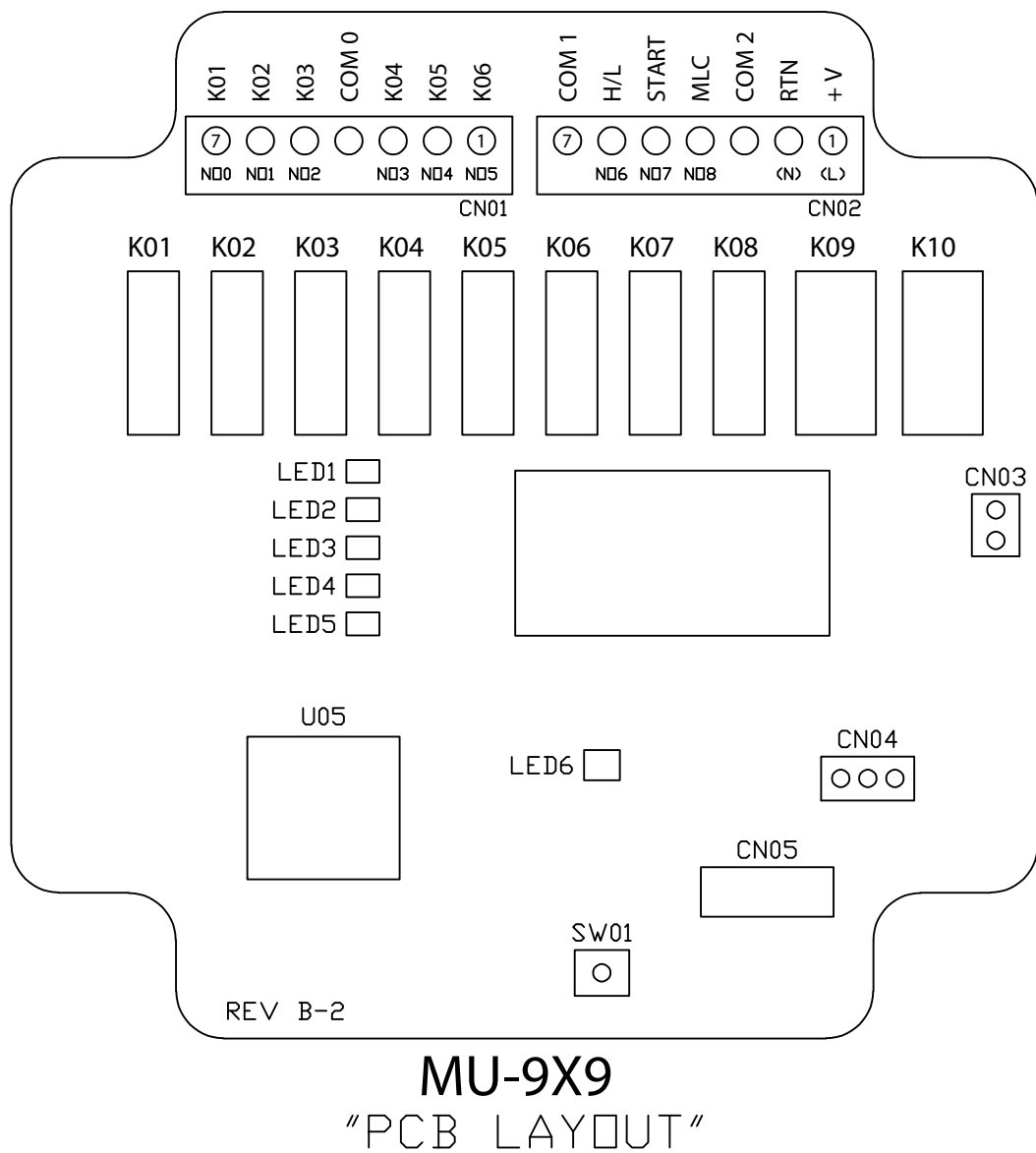
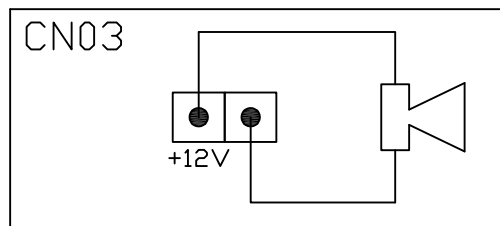


Figure 4 - MU-9X9 Wiring Diagram



DIAGNOSTIC LED'S:

LED 1	HEARTBEAT
LED 2	TX
LED 3	RX
LED 4	OUTPUT
LED 5	12 VDC
LED 6	STROBE



** BUZZER-MOUNTS TO LID
#15114311 (OPTIONAL)

Figure 5 - MU-9X9 PCB Layout

Input Voltages

Depending on the model, the MU-9X15 accepts the following input voltages:

- High Voltage: 110 - 220 VAC @ 50-60 Hz
- Low Voltage: 9-36 VDC or 10-28 VAC @ 50-60 Hz

Model	Input Voltage	Range	Frequency
CERVIS MU-9X9-HV	High Voltage AC	110-220 VAC	50-60 Hz
CERVIS MU-9X9-LV	Low Voltage AC or DC	9-36VDC or 10-28 VAC	50-60 Hz

Table 6 - MU-9X9 Power Configurations

MU-9X9 Power

The unit receives power through the control cable. The cable is part of the final assembly and comes attached to the receiver. The MU-9X9 is available in the input power configurations listed in **Table 6**.

LEDs

The MU-9X9 receiver has five board-mounted system status LEDs that can be used as diagnostic tools to verify operation. Removing the MU-9X9 cover allows access to the LEDs. These LEDs (shown in **Figure 5**) are:

1. LED 1=Health
2. LED 2=TX
3. LED 3=RX
4. LED 4=Output
5. LED 5=System 12V

See **Table 55 in troubleshooting section** for more info.

The Strobe LED in **SW01 in Figure 5** illuminates the MU-9X9 enclosure when active by flashing at a rate of once per second. It is active:

- When a Cervis Standard transmitter attempts to associate (link communications) with the receiver
- When the MLC initially activates
- While the MLC is active

Strobe Stop Switch

The Strobe Shut-Off Switch (**SW01 in Figure 5**) is primarily used to turn off the strobe when the MU-9X9 cover is removed for troubleshooting. When pressed, the strobe will remain off for an hour. While off, the strobe will become active anytime a Cervis Standard transmitter attempts to associate with the receiver.

Low Battery Mode

When the transmitter battery voltage drops to or below 2.2V (Low Battery Warning Mode), the handheld transmitter LED 2 begins flashing, and the MU-9X9 Horn/Light relay (K7) energizes four times per minute to alert the operator that the transmitter

**CAUTION**

The Strobe LED is extremely bright. Use caution when removing the MU-9X9 cover while the unit is powered. Avoid looking directly at the Strobe. Press the Strobe Shut Off Switch immediately after removing the cover when the unit is powered.

CAUTION

Replace transmitter batteries as soon as possible after the Low Battery Warning begins. If the transmitter battery voltage drops to 2.0V, the transmitter will shut down and cannot be used until fresh batteries are installed.

batteries need to be replaced with a fresh set. The K7 relay will continue to activate four times per minute until the handheld transmitter batteries are replaced.

Antennas

The MU-9X9 comes with a 900-MHz external antenna that attaches to the receiver (**see Figure 6**) using the external unit connector. Antenna extension cables are available for when the receiver is being mounted inside a control enclosure and/or when the receiver is mounted in a location that is out of the line of sight from the transmitter.

Mounting

The MU-9X9 can be mounted using the molded enclosure mounting flanges that permit the option of using the four predrilled 0.20 holes with bolts or screws; or by using the two 0.425 holes with the 0.225 x 1.00 shank-slides. The sturdy enclosure allows the machine unit (MU) receiver to operate worry-free in harsh weather conditions and factory environments.

See **Figure 6** for more info.

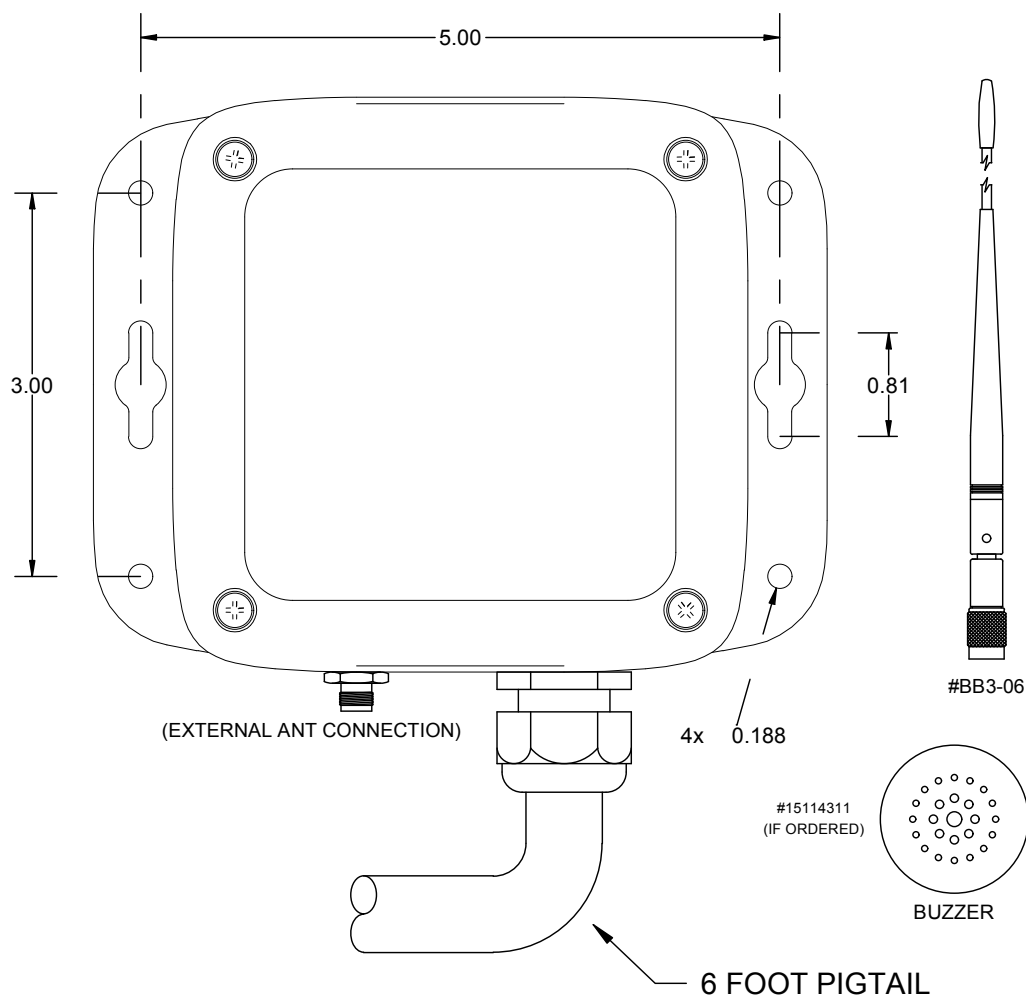


Figure 6 - MU-9X9 Mounting Hole Locations and Accessories

Association

Cervis Standard system receivers and transmitters are associated before the system is shipped.

Association is the process that places the receiver's serial number in the transmitter, allowing the receiver to accept the transmitter's messages and enabling pairing between the two. If the association process has not been completed, the units will not complete the RF Link to close the MLC output, and command motion outputs cannot be controlled.

When a spare unit is placed into service with an existing system, the association process must be completed before the transmitter and receiver allow control. **If association is needed**, see the steps for association described in the **Association Section**. The associate process is used when necessary to first associate transmitters and receivers to allow a RF communication link between them.

The MU-9X9 must be turned on before attempting to associate using the handheld.

See the **Maintenance Mode Section** for additional steps required by the transmitter to complete the Association process.

NOTE

MU-9X9 association can only occur during the first two minutes following unit power-up. If this window is missed, the MU-9X9 must be powered off and then turned on again, allowing for the two-minute window to reactivate.

NOTE

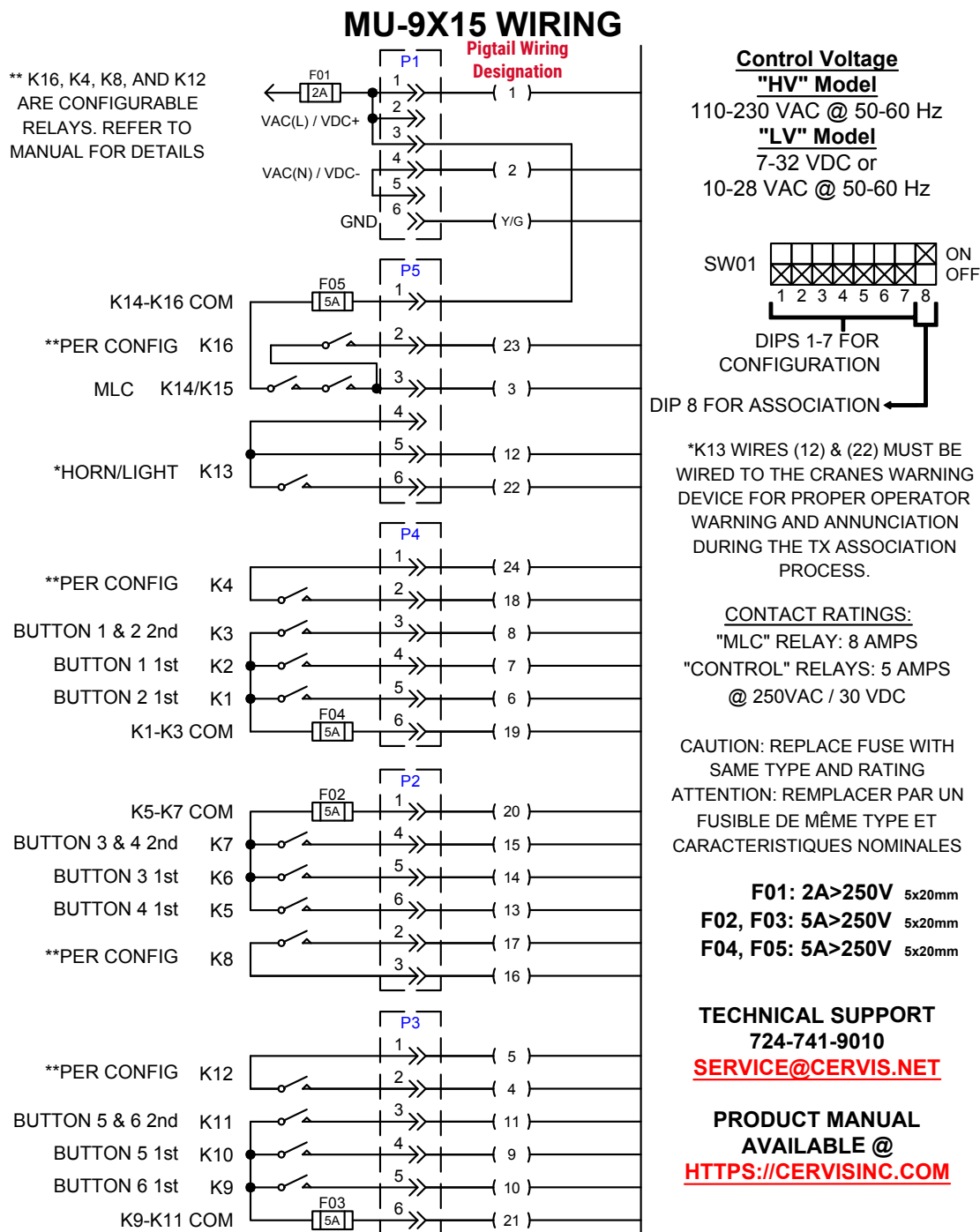
A receiver that is in use with another handheld transmitter cannot be associated.

MU-9X15 Receiver

Electrical

The MU-9X15 receiver features 16 Form A relays arranged in four banks of four. Bank 1 through Bank 3 each have three relays, sharing a common fuse at 5 A; the fourth relay is independently rated at 8A @ 250 VAC. Bank 4 features one independent Horn/Light relay, two series relays that form the Main Line Contactor (MLC) output, and one Start relay. The Start and MLC circuits share a common fuse at 5 A.

The independent relays (K13, K04, K08, and K12) are rated at 8 A @ 250 VAC. See **Figure 7** for reference.



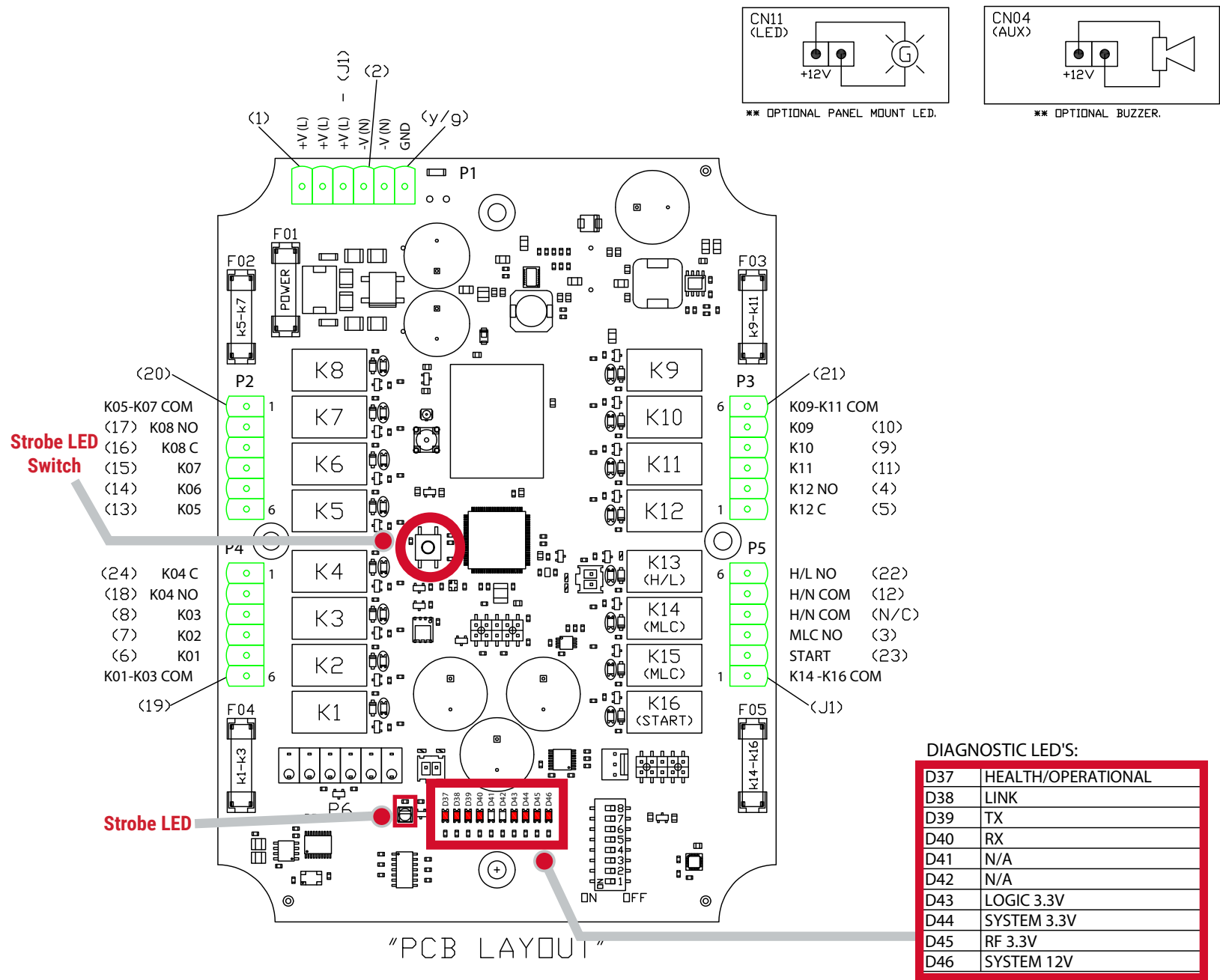


Figure 8 - MU-9X15 PCB Layout

Input Voltages

Depending on the model, the MU-9X15 accepts the following input voltages:

- High Voltage: 110 - 220 VAC @ 50-60 Hz
- Low Voltage: 9-36 VDC or 10-28 VAC @ 50-60 Hz

Model	Input Voltage	Range	Frequency
CERVIS MU-9X15-HV	High Voltage AC	110-220 VAC	50-60 Hz
CERVIS MU-9X15-LV	Low Voltage DC or AC	9-36VDC or 10-28 VAC	50-60 Hz

Table 7 - MU-9X15 Power Configurations

MU-9X15 Power

The unit receives power through the control cable. The cable is part of the final assembly and comes attached to the receiver. The MU-9X15 is available in the input power configurations listed in **Table 7**.

LEDs

The MU-9X15 has three system status light-emitting diodes (LEDs), 16-relay status LEDs, and four power LEDs that can be used as diagnostics tools (**see Troubleshooting Section for more information**).

The MU-9X15 has one internal LED indicator visible from outside the enclosure that is used for association and health status. The strobe LED can be shut off for one hour by pressing the shut-off switch (see the RED circle in **Figure 8**) and will reactivate either after one hour has passed or the association is performed.

DIP Switch

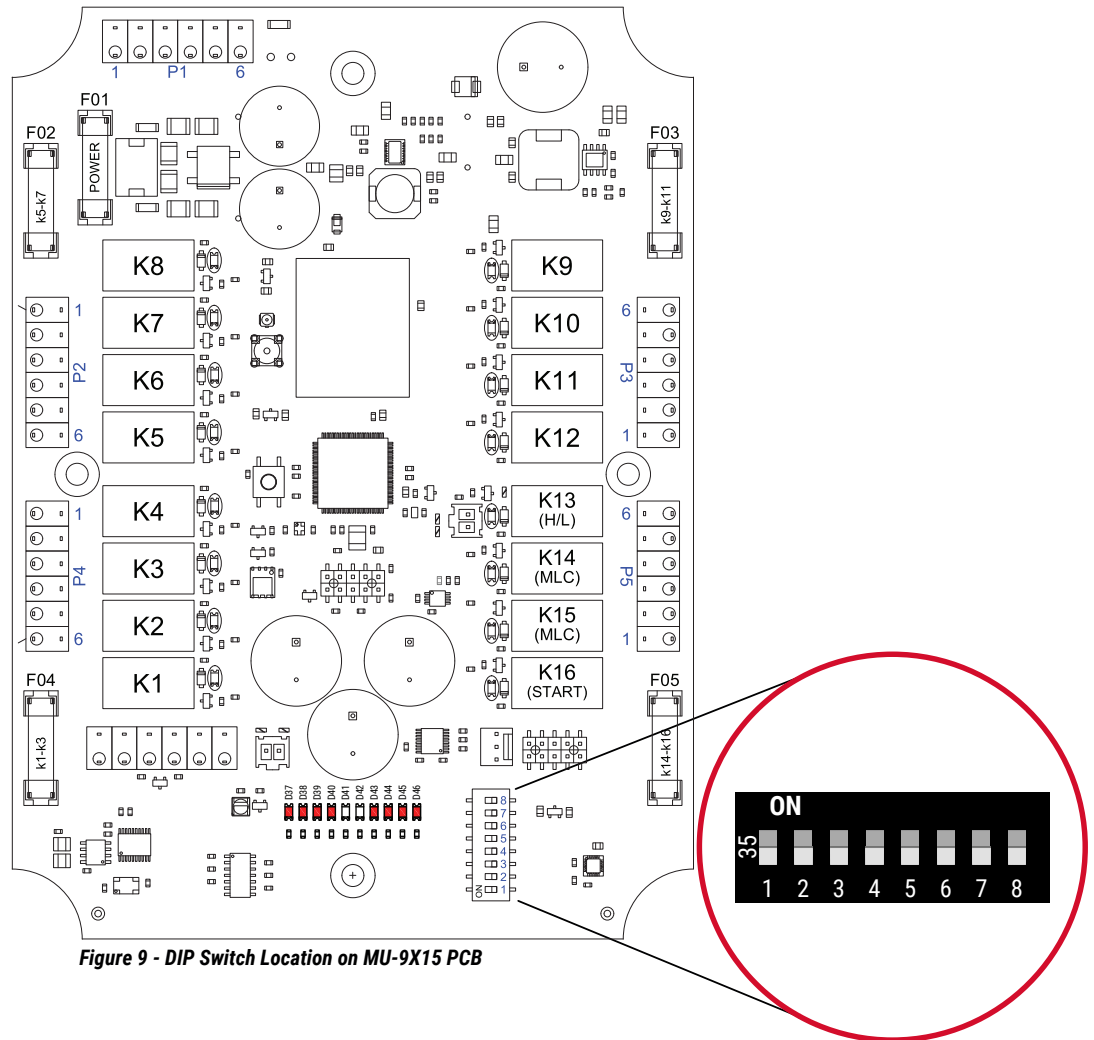


Figure 9 - DIP Switch Location on MU-9X15 PCB

NOTE

Replacement MU-9X15 receivers will be shipped with the DIP switches set to ALL DOWN. DIP switches in replacement receivers will need to be set in the field to match the receiver it is replacing.

The MU-9X15 uses **SEVEN** DIP switches to allow for system configuration to any of the 126 possible settings. When the switch is in the down position, close to the numbers, it is in the OFF (0) position. When the switch is cycled away from the numbers, it is in the ON (1) position. See **Figure 9** above for the location of the DIP Switches on the MU-9X15 PCB. Also, please see the **Configurations Section** for more info on DIP Switch configuration settings.

Antennas

The MU-9X15 comes with a 900-MHz external antenna that attaches to the receiver (see **Figure 10**) using the external unit connector.

Mounting

Use the configuration diagrams that Cervis, Inc. supplied to guide you in mounting the receiver and connecting your wire harness. Receiver mounting is left much to your discretion, with the following guidelines:

- Make sure that the configuration diagrams supplied with the system are available. Keep them where they can be easily accessed when needed.
- Mount the receiver away from any intense radio or electric disturbance sources.

- Mount the receiver where there is enough room to make wiring harness terminations
- Make sure the mount is secure
- The external antenna must be connected only as recommended by Cervis, Inc., with parts recommended by Cervis, Inc. **Under no circumstances can a signal amplifier be used.**
- Mount the receiver so that the operator can see the unit antenna. Apply an antenna extension cable, if needed.

See **Figure 10** for more info.

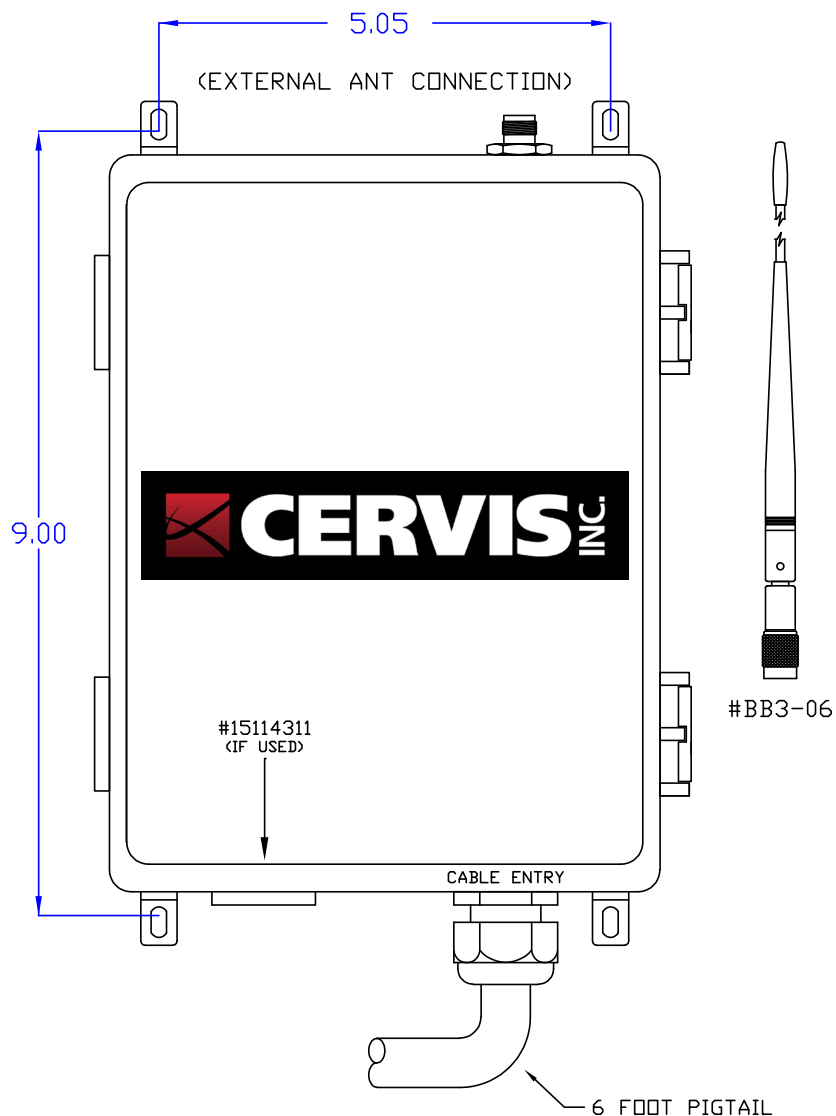


Figure 10 - MU-9X15 Hole Locations and Accessories

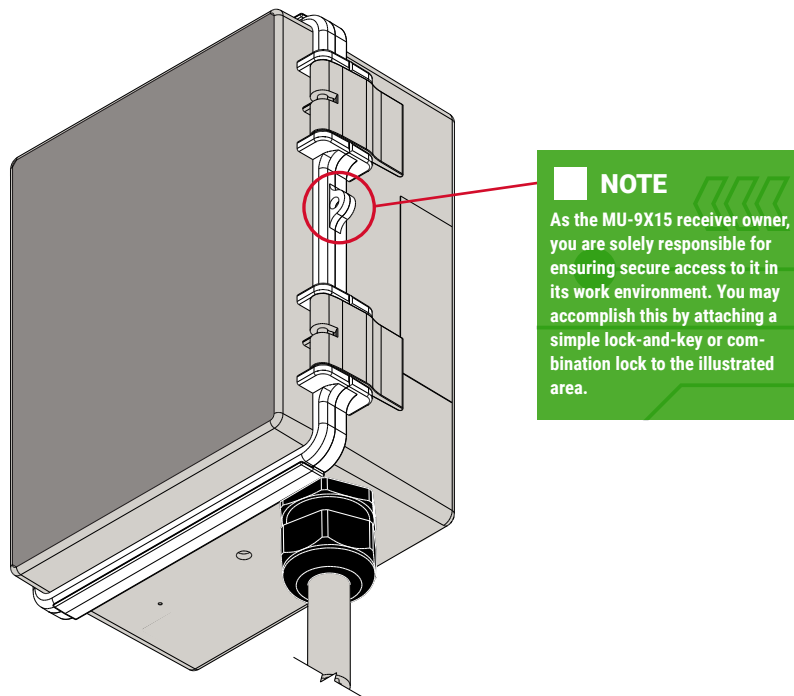


Figure 11 - MU-9X15 Locking Mechanism

Association

Cervis Standard system receivers and transmitters are associated before the system is shipped.

Association is the process that places the receiver's serial number in the transmitter, allowing the receiver to accept the transmitter's messages and enabling pairing between the two. If the association process has not been completed, the units will not complete the RF Link to close the MLC output, and command motion outputs cannot be controlled.

When a spare unit is placed into service with an existing system, the association process must be completed before the transmitter and receiver allow control. **If an association is needed**, see the steps for association described in this section.

The Associate process is locked in the MU-9X15 receiver by the DIP switch 8 being set to 0 (OFF) (see **Figure 9** for DIP Switch Location).

Unlocking the MU-9X15 for the association process is achieved by moving DIP 8 to the 1 position (ON). The receiver does not require a power cycle to read new DIP switch settings. The only thing that will prevent the receiver from reading updated DIP switch settings is an active RF Link with a transmitter. Once that RF link is broken, the receiver will apply DIP switch settings.

Keeping DIP 8 to 0 (OFF) will prevent the receiver from being located by a transmitter during its receiver scan portion of the association process. This method can be implemented when a deliberate process requiring access to the receiver is desired to restrict receiver access. Keeping the DIP 8 to 1 (ON) makes the receiver easily accessible from the floor to complete the association process.

The receiver will only pair with transmitters it is associated with. When necessary, other Cervis Standard transmitters can be associated with the receiver as additional spares or to replace damaged transmitters.

See the **Maintenance Mode Section** for additional steps required by the transmitter to complete the Association process.

RF Performance

Optimum RF performance begins with providing a line of sight between the transmitters and receivers antennas. It is not always feasible to provide a perfect line of sight. Consider the range of where the transmitter will be used and determine the mounting location of the receiver's antenna that provides the best average line of sight while giving weight to the most common locations of operation.

Receiving Antenna

- Must be externally mounted and not inside a metal enclosure
- Should be mounted in the location of the receiver's antenna that provides the best average line of sight while avoiding sources of EMI/RFI. Common sources of EMI/RFI include:
 - Other wireless device antennas (especially if operating in the same frequency band)
 - Variable frequency drives, including general-purpose VFDs
 - Transformers
 - High amperage/voltage lines
 - Lighting ballasts
- Shall present the length of itself to the transmitter, not pointing at the transmitter
- Should not be mounted parallel to and in very close proximity to metal (such as on the underside of a bridge girder)
- Provided with Cervis Standard systems, are dipole antennas
 - Do not require a ground reference to operate
 - Mounting them in an electrically isolated manner can prevent unexpected performance issues

Antenna Cables

- Should be routed with the same precautions to EMI/RFI as mentioned with antennas (see The Receiving Antenna section above).
- If required to be in proximity to EMI/RFI, routing the cable through a metal conduit can reduce the effects of interference
- Should be the shortest length possible to achieve installation requirements
- Should not be coiled to manage the extra length of the cable

Receiver

- Should be mounted with the same precautions to EMI/RFI as mentioned with antennas & antenna cables (see The Receiving Antenna section above).
- Should be mounted in an upright, vertical position
- When mounted inside a steel enclosure, or in a position that does not provide a line of sight to the transmitter, external antenna and antenna cables are required to be properly routed to achieve the best possible line of sight.

Transmitter to Receiver Interface

Transmitter	Paired with	
	MU9X9	MU9X15
HH2S-08	PBs 1-4, 9 and STOP function PBs 5-8, no relay response	Full Function*
HH2S-10	PBs 1-4, 9 and STOP function PBs 5-8, no relay response	Full Function*
HHMS 2 SPEED	PBs 1-4, 9 and STOP function PBs 5-8 & 10, no relay response	Full Function*
HHMS 2 SPEED CFG'D TANDEM	WILL NOT PAIR	Full Function*
HHMS 3 SPEED	PBs 1-4, 9 and STOP function PBs 5-8 & 10, no relay response 3rd step no relay response	Full Function*

Table 8 - Interface Chart

**Dependent upon receiver configuration*

Any Cervis Standard transmitter can associate with any Cervis Standard receiver.

Receiver features and operating capabilities are predetermined by specific receiver and transmitter pairing combinations. For example, certain configurations of the MU-9X15 will prohibit pairing with certain models of transmitters.

Please view the **Configurable Settings** section to determine the appropriate transmitter and receiver pairings for your specific applications.

MU-9X9 WIRING

RADIO RECEIVER ENCLOSURE

HV = 110 - 220 VAC @ 50-60 Hz

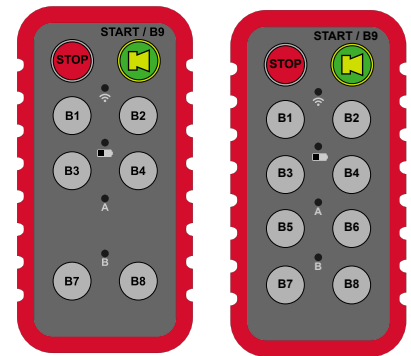
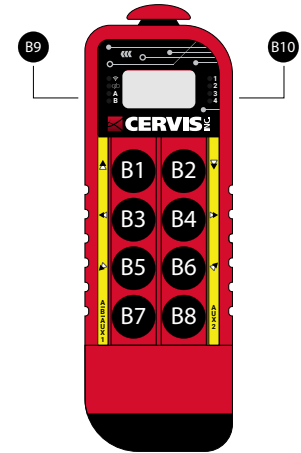
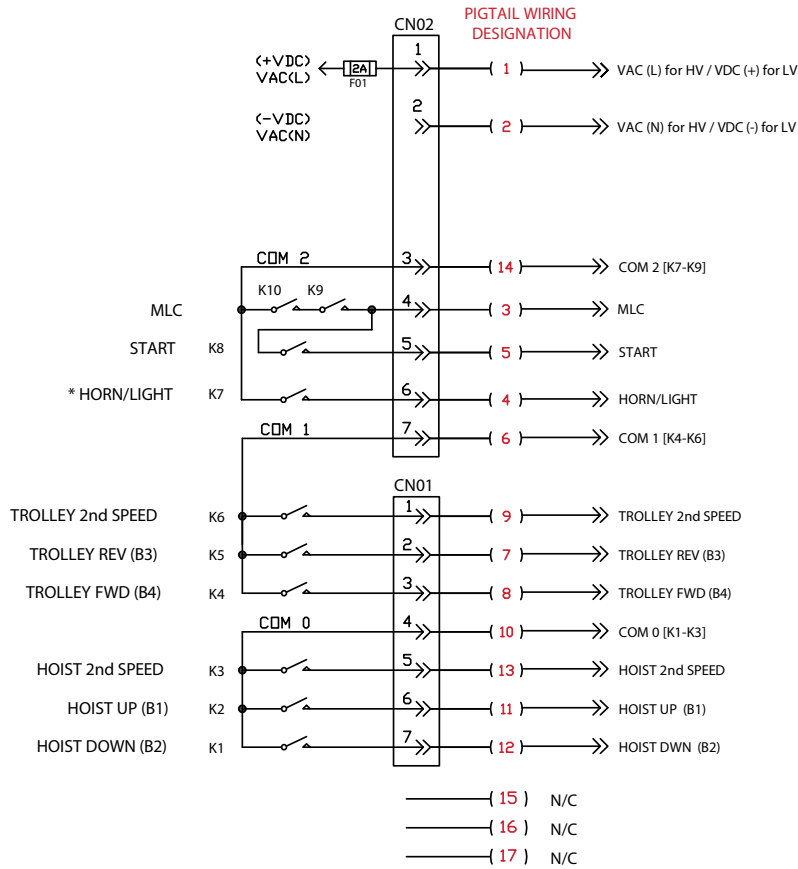
or

LV = 9-36 VDC or 10-28 VAC @ 50-60 Hz

"MLC" RELAY: 8 AMPS @ 250 VAC

CONTROL RELAYS: 2 AMPS @ 250 VAC

ARC SUPPRESSION RECOMMENDED ON ALL VAC INDUCTIVE LOADS



* "K7" WIRE (4) MUST BE WIRED TO THE CRANES WARNING DEVICE FOR PROPER OPERATOR WARNING AND ANNUNCIATION DURING THE TX ASSOCIATION PROCESS.

Figure 12 - MU-9X9 and Wiring Diagram and Transmitter Button Layouts

MU-9X15 WIRING

** K16, K4, K8, AND K12
ARE CONFIGURABLE
RELAYS. REFER TO
MANUAL FOR DETAILS

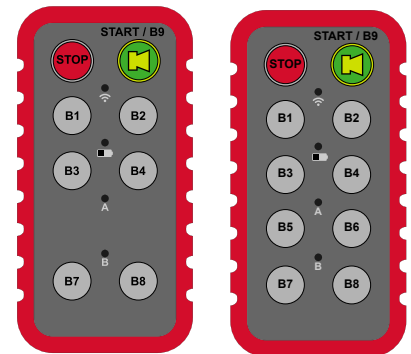
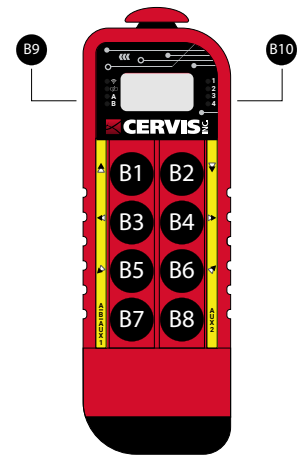
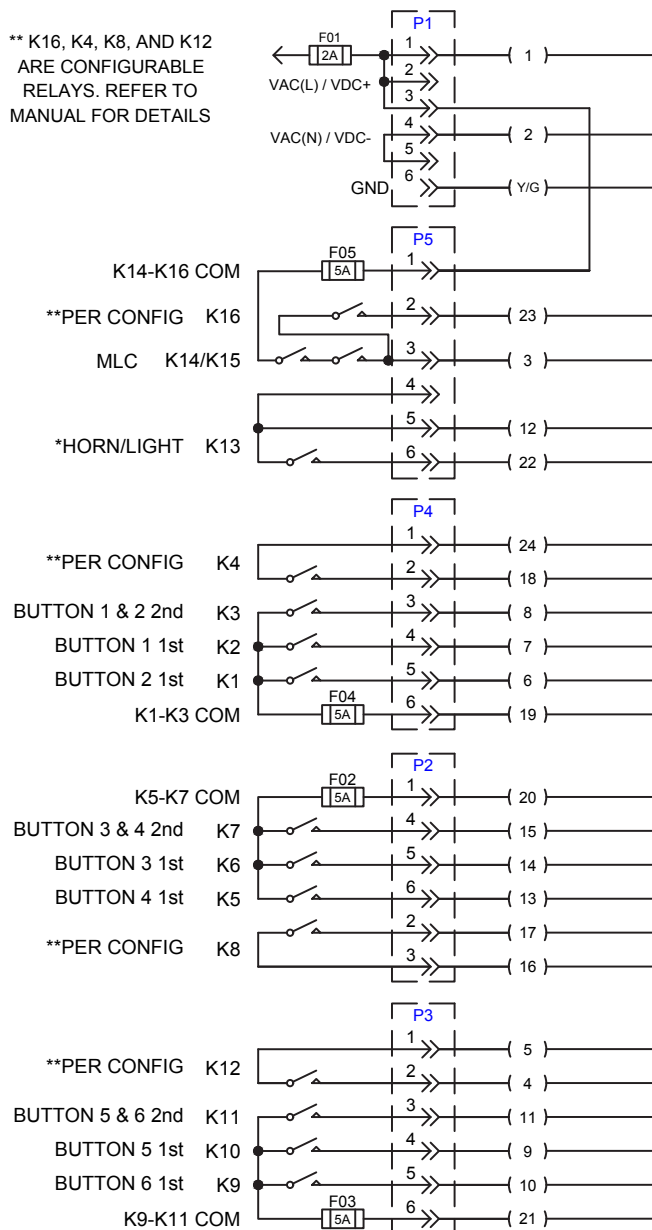


Figure 13 - MU-9X15 and Wiring Diagram and Transmitter Button Layouts

Configurable Settings Overview

Cervis Standard offers 126 configurations for the most common crane control requirements. This section is broken down into smaller groups. The groups are named by their most common crane control aspect.

However, **the group names do not represent limitations on the functionality available within a group**. Other functionality may be available within these configuration groupings, even for functions that may also have their own category names assigned to them.

In essence, functionality is not limited to the group names, and some configurations may be altered further to incorporate additional functions that aren't represented in the group name.

Each category below will briefly describe likely applications, though use cases are not limited to them.

The charts throughout the next few sections show all 126 configurations available.

Each row within the DIP Switch Settings charts represents how the system will respond when the DIP switches are set to the value in the leftmost column.

The rows have columns that list out the following and how they are connected within the configuration:

- Button #
- LED ID
- Relay #
- Relay Operation (Latched or Momentary)
- Interlocks
- Enable
- Pairing Ability
- Tandem (where applicable)
- Control Release (where applicable)

Each system type will come from the factory preset to a configuration based on its type. The configuration can be changed to match the control requirements of the crane. The section on DIP Switch Settings goes into detail, showing how the system responds to each configuration. The images below with the button to relay mappings match the configurations.

When DIP switches are changed, the MU-9X15 receiver does not need to have its power cycled. It will read the new DIP switch settings when it is not actively linked to a transmitter.

General Auxiliary Function

If the crane has control requirements beyond the bridge, trolley, and hoist, the bottom two buttons and the back right button can be used to control these aux functions as applicable. In addition to providing different relay output mappings with these configurations, LEDs 1-3 are also included with the transmitter's response to these configurations.

These configurations offer both interlocked and non-interlocked functionality. In an interlocked configuration, if the operator presses both interlocked buttons at the same time, the receiver will not close either of the associated relays.

Enable Functions for Below-the-Hook Lifting Devices

Common examples of devices suspended below a hook for holding loads are magnets, grabs, and vacuum lifters. These have the potential to release their holding power from electrical controls rather than a fixed mechanical holding device. Due to these devices ability to release a load from controls, added safeguards should be put in place.

The Cervis Standard radio controls offer one version of added safeguards by making a release command a two-handed operation to minimize the chance of unintentionally commanding a release to the device. The Cervis Standard systems offer configurable settings that require the operator to enable the change before the receiver will change the state of the affected output.

These systems use normally open relays that cannot hold a circuit closed in case of power loss to the receiver. Any device requiring a holding circuit through power loss shall include normally closed relays not provided with these systems.

START Function

The START function in Cervis Standard was included to replicate the original 16 configurations from Warrior Standard. This enables a Cervis Standard system to be wired identically to an existing control with a Warrior Standard installed that uses the START function.

The START function is a momentary auxiliary output that could be used in many ways. Warrior Standard applied the term START to it in case there was a need for a momentary output dedicated to a “Seal In” circuit for the main-line contactor.

Tandem Crane Control

The term Tandem can often be applied to controlling a crane in different ways. In this manual, Tandem is referring to the control of two independent bridge cranes from a single transmitter. A receiver is mounted on each crane, and the transmitter can select 1, 2, or 1+2 receivers/cranes.

All Cervis Standard Tandem Systems share the following capabilities.

1. Uses the HHMS with the Display model transmitter only
2. Field configurable for use with most 3-motion/2-speed Tandem crane controls
3. 3 or 4-wire control of motion 1.
4. 3-wire control of motions 2 and 3
5. One button A/B select available
6. One Button AUX available
7. One button receiver select with confirmation required using the START / HORN button
8. Control release of the receivers if desired

Configurations by Group

See the list of group configurations to quickly find the requirements you need.

OR

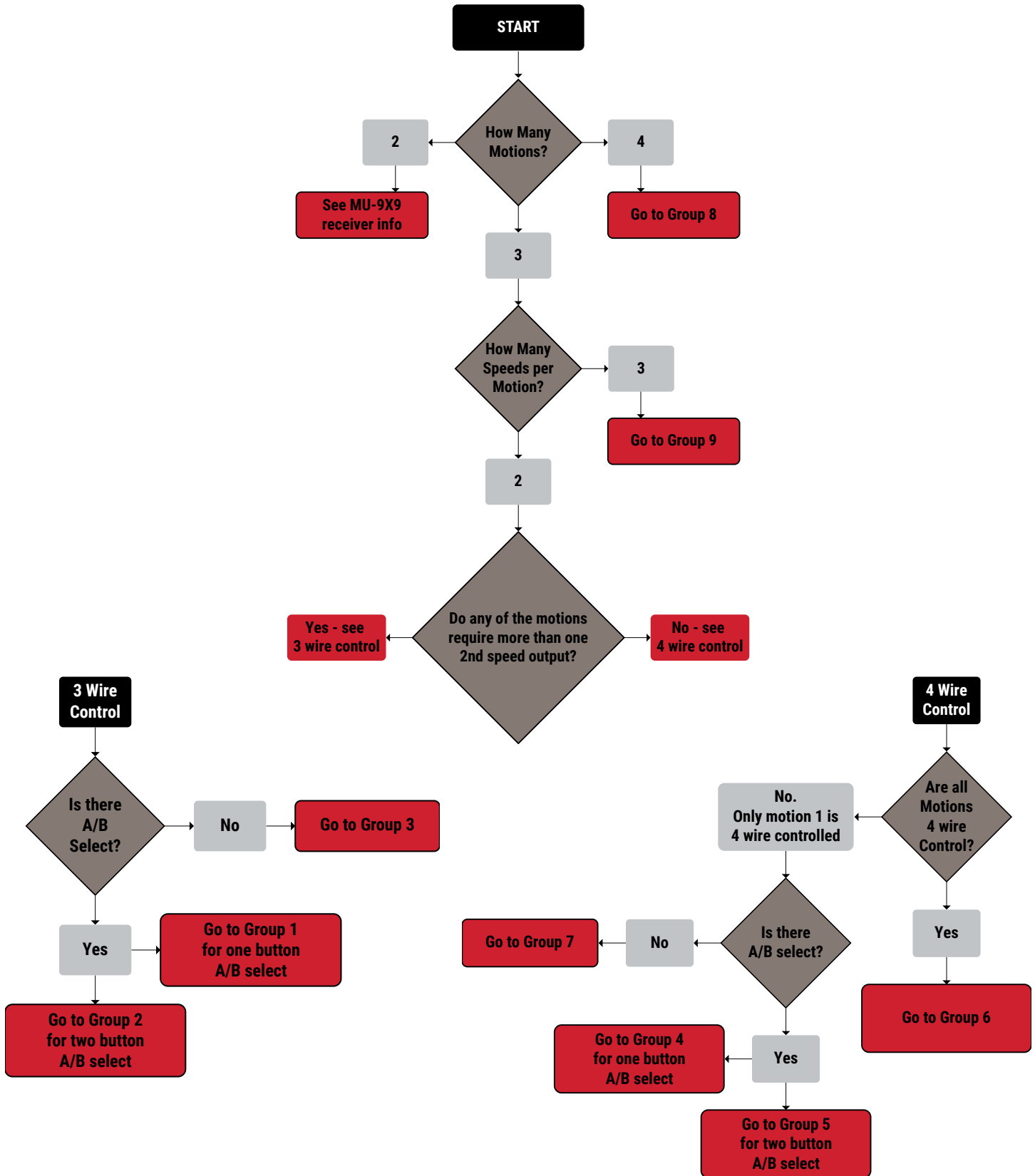
See the flow chart beginning on the next page to help determine which group of configurations applies to your specific crane control requirements.

CAUTION
CAUTION: When configurations are changed, the transmitter button labeling should also be updated to match the new button controls.

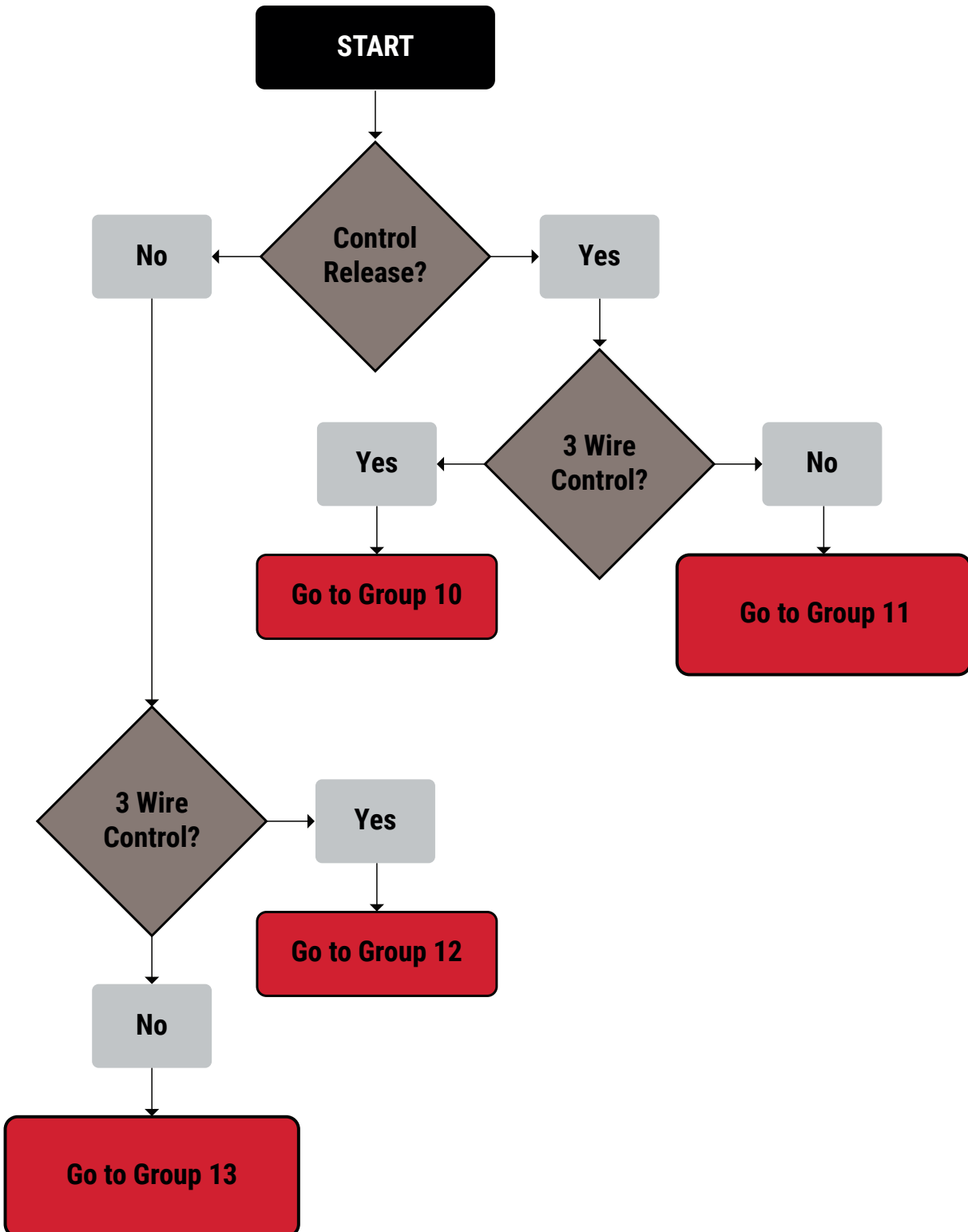
Configuration Group Contents

GROUP 1: 3 Motion, 2 Speed, 3 Wire Control, and One Button A/B Select	34
GROUP 2: 3 Motion, 2 Speed, 3 Wire Control and Two Button A/B Select	36
GROUP 3: 3 Motion, 2 Speed, 3 Wire Control, and 3 AUX Selections - No A/B Select	38
GROUP 4: 3 Motion, 2 Speed, 4 Wire for Motion # 1 and One Button A/B Select	43
GROUP 5: 3 Motion, 2 Speed, 4 Wire for Motion # 1 and Two Button A/B Select	45
GROUP 6: 3 Motion, 2 Speed, 4 Wire All Motions	47
GROUP 7: 3 Motion, 2 Speed, 4 Wire for Motion # 1 and 3 Aux.	49
GROUP 8: 4 Motion, 2 Speed, 3 Wire Control and 1 AUX	54
GROUP 9: 3 Motion, 3 Speed and 1 AUX	55
GROUP 10: Tandem 3 Motion 2 Speed with Control Release	57
GROUP 11: Tandem 3 Motion, 2 Speed, 4 Wire for Motion # 1 with Control Release	59
GROUP 12: Tandem 3 Motion, 2 Speed	61
GROUP 13: Tandem 3 Motion, 2 Speed, 4 Wire for Motion # 1	63

Configuration Groups Flow Chart - Single Crane



Configuration Groups Flow Chart - Tandem Crane



GROUP 1: 3 MOTION, 2 SPEED, 3 WIRE CONTROL, AND ONE BUTTON A/B SELECT

About this configuration group:

- All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.
- Speed 2 is sequential and shared by each motion direction.
- The A and or B functions are selected using button B7.
- There are two AUX functions available in this configuration. The AUX functions can be programmed to be commanded by buttons B8 and B10. The selections are labeled AUX 2 and AUX 3 in Table 11. Reference Figure 3 for HHMS button layout.
- See Table 10 for the conditions under which each transmitter LED indicator is active.

For cranes with multiple trolleys/hoists, Cervis Standard offers an A/B select feature. The configurable function requires the use of external relays to complete the controls. There are multiple means of configuring the system for A/B. Regardless of which configuration is selected, the transmitter will make use of its dedicated A and B LEDs to convey to the operator the current selection.

The section of the DIP switch chart below shows the available options, including a single button approach that cycles through the selection. Options include a No Function when required.

Any configuration referencing A / B will make use of the A and B LEDs. These are on the top left of the HHMS transmitter and in the center of the HH2S transmitter.

Table 11 shows DIP switch settings that make use of one button A / B select.

Motion	Button	1st speed	2nd speed
1 REV	B1	Relay K2	Relay K3
1 FWD	B2	Relay K1	Relay K3
2 REV	B3	Relay K6	Relay K7
2 FWD	B4	Relay K5	Relay K7
3 REV	B5	Relay K10	Relay K11
3 FWD	B6	Relay K9	Relay K11

Table 9 - Group 1 - 3 Motion, 2 Speed, 3 Wire Control, One Button A/B Select Button Functions

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A (relay K4)	✓	-	-	-	-	-
B (relay K8)	-	✓	-	-	-	-
AUX 2	-	-	-	✓	-	-
AUX 3	-	-	-	-	✓	-

Table 10 - Group 1 - LED Indicators 3 Motion 2 Speed 3 Wire Control One Button

Configuration Number	MU-9X15 DIP Switch 1234567	B7 (NEXT Sequence)	B8 (AUX 2)	B10 (AUX 3)	LED 2 (relay K12)	LED 3 (relay K16)	B9 Start / Horn
1	1000000	A, B, Both	Relay K12 Momentary	Relay K16 Momentary	AUX 2 on	AUX 3 on	*
2	0100000	A, B, Both	Relay K12 Momentary	Relay K16 Latching	AUX 2 on	AUX 3 on	*
3	1100000	A, B, Both	Relay K12 Latching	Relay K16 Momentary	AUX 2 on	AUX 3 on	*
4	0010000	A, B, Both	Relay K12 Latching	Relay K16 Latching	AUX 2 on	AUX 3 on	*
5	1010000	A, B, Both	Relay K12 Momentary	No	AUX 2 on	No	**
6	0110000	A, B, Both	Relay K12 Latching	No	AUX 2 on	No	**
7	1110000	A, B	Relay K12 Momentary	Relay K16 Momentary	AUX 2 on	AUX 3 on	*
8	0001000	A, B	Relay K12 Momentary	Relay K16 Latching	AUX 2 on	AUX 3 on	*
9	1001000	A, B	Relay K12 Latching	Relay K16 Momentary	AUX 2 on	AUX 3 on	*
10	0101000	A, B	Relay K12 Latching	Relay K16 Latching	AUX 2 on	AUX 3 on	*
11	1101000	A, B	Relay K12 Momentary	No	AUX 2 on	No	**
12	0011000	A, B	Relay K12 Latching	No	AUX 2 on	No	**
13	1011000	A, B, OFF	Relay K12 Momentary	Relay K16 Momentary	AUX 2 on	AUX 3 on	*
14	0111000	A, B, OFF	Relay K12 Momentary	Relay K16 Latching	AUX 2 on	AUX 3 on	*
15	1111000	A, B, OFF	Relay K12 Latching	Relay K16 Momentary	AUX 2 on	AUX 3 on	*
16	0000100	A, B, OFF	Relay K12 Latching	Relay K16 Latching	AUX 2 on	AUX 3 on	*
17	1000100	A, B, OFF	Relay K12 Momentary	No	AUX 2 on	No	**
18	0100100	A, B, OFF	Relay K12 Latching	No	AUX 2 on	No	**

Table 11 - Group 1 - DIP Switch Settings

* B9 activates relay K13, a momentary function.

** B9 activates relay K13 and K16, both are momentary functions.

GROUP 2: 3 MOTION, 2 SPEED, 3 WIRE CONTROL AND TWO BUTTON A/B SELECT

About this configuration group:

- All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.
- Speed 2 is sequential and shared by each motion direction.
- The A and or B functions are selected using buttons B7 and B8.
- There is one AUX function available in this configuration. The AUX function can be programmed to be commanded by button B10.
- The selection is labeled AUX 3 in Table 14.

Any configuration referencing A / B will make use of the A and B LEDs. These are on the top left of the HHMS transmitter and in the center of the HH2S transmitter.

Table 14 shows DIP switch settings that make use of two button A / B select.

Motion	Button	1st speed	2nd speed
1 REV	B1	Relay K2	Relay K3
1 FWD	B2	Relay K1	Relay K3
2 REV	B3	Relay K6	Relay K7
2 FWD	B4	Relay K5	Relay K7
3 REV	B5	Relay K10	Relay K11
3 FWD	B6	Relay K9	Relay K11

Table 12 - Group 2 - 3 Motion, 2 Speed, 3 Wire Two Button A/B Select Button Functions

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A (relay K4)	✓	-	-	-	-	-
B (relay K8)	-	✓	-	-	-	-
AUX 2	-	-	-	-	-	-
AUX 3	-	-	-	-	✓	-

Table 13 - Group 2 - LED Indicators 3 Motion, 2 Speed, 3 Wire Control, Two Button

Configuration Number	MU-9X15 DIP Switch 1234567	B7 (Select A)	B8 (Select B)	B10 (AUX 3)	LED 3 (relay K12)	B9 Start / Horn	A / B Interlocked
19	1100100	Relay K4 Latch / Unlatch	Relay K8 Latch / Unlatch	Relay K12 Momentary	AUX 3 on	Relay K13 & K16 Momentary	No
20	0010100	Relay K4 Latch / Unlatch	Relay K8 Latch / Unlatch	Relay K12 Latching	AUX 3 on	Relay K13 & K16 Momentary	No
85	1010101	Relay K4 Latch / Unlatch	Relay K8 Latch / Unlatch	Relay K12 Momentary	AUX 3 on	Relay K13 & K16 Momentary	Yes
86	0110101	Relay K4 Latch / Unlatch	Relay K8 Latch / Unlatch	Relay K12 Latching	AUX 3 on	Relay K13 & K16 Momentary	Yes

Table 14 - Group 2 - DIP Switch Settings

GROUP 3: 3 MOTION, 2 SPEED, 3 WIRE CONTROL, AND 3 AUX SELECTIONS - NO A/B SELECT

About this configuration group:

- All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.
- Speed 2 is sequential and shared by each motion direction.
- The A and or B functions and LED A and LED B indicators are not used in this configuration. See Table 16.
- There are three AUX functions available in this configuration. The AUX functions can be programmed to be commanded by buttons B7, B8, and B10. The selections are labeled AUX 1, AUX 2, and AUX 3 in Tables 16-17.
- Button B9 (Start / Horn) activates relay K13 and K16. Both are momentary functions.

Motion	Button	1st speed	2nd speed
1 REV	B1	Relay K2	Relay K3
1 FWD	B2	Relay K1	Relay K3
2 REV	B3	Relay K6	Relay K7
2 FWD	B4	Relay K5	Relay K7
3 REV	B5	Relay K10	Relay K11
3 FWD	B6	Relay K9	Relay K11

Table 15 - Group 3 - 3 Motion, 2 Speed, 3 Wire Control, 3 Aux, No AB

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A	-	-	-	-	-	-
B	-	-	-	-	-	-
AUX 1	-	-	✓			
AUX 2	-	-	-	✓	-	-
AUX 3	-	-	-	-	✓	-
Enable	-	-	-	-	-	✓

Table 16 - Group 3 - LED Indicators 3 Motion 2 Speed 3 Wire Control 3 Aux, No AB

The following AUX functions are NOT interlocked with each other:

Configuration Number	MU-9X15 DIP Switch 1234567	B7 (AUX 1)	B8 (AUX 2)	B10 (AUX 3)	LED 1 (relay K4)	LED 2 (relay K8)	LED 3 (relay K12)
30	0111100	Relay K4 Momentary	Relay K8 Momentary	Relay K12 Momentary	AUX 1 on	AUX 2 on	AUX 3 on
31	1111100	Relay K4 Momentary	Relay K8 Momentary	Relay K12 Latching	AUX 1 on	AUX 2 on	AUX 3 on
32	0000010	Relay K4 Momentary	Relay K8 Latching	Relay K12 Momentary	AUX 1 on	AUX 2 on	AUX 3 on
33	1000010	Relay K4 Momentary	Relay K8 Latching	Relay K12 Latching	AUX 1 on	AUX 2 on	AUX 3 on
34	0100010	Relay K4 Latching	Relay K8 Momentary	Relay K12 Momentary	AUX 1 on	AUX 2 on	AUX 3 on
35	1100010	Relay K4 Latching	Relay K8 Momentary	Relay K12 Latching	AUX 1 on	AUX 2 on	AUX 3 on
36	0010010	Relay K4 Latching	Relay K8 Latching	Relay K12 Momentary	AUX 1 on	AUX 2 on	AUX 3 on
37	1010010	Relay K4 Latching	Relay K8 Latching	Relay K12 Latching	AUX 1 on	AUX 2 on	AUX 3 on

Table 17 - Group 3 - DIP Switch Settings - Aux Not Interlocked

ENABLE with NO Interlocking

- B10 is the Enable.
- Press and hold B10, plus press and hold B7 within 5 seconds to activate AUX 1, relay K4.
- AUX 1 Momentary will clear if B10 or B7 are released.
- AUX 1 Latching & Unlatching requires B10 + B7
- For configuration 125; AUX 2 Momentary will clear if B10 or B8 are released.
- For configuration 126; AUX 2 Latching & Unlatching requires B10 + B8
- The B10 Enable will clear in 5 seconds if B7 is not pressed.

Config- uration Number	MU-9X15 DIP Switch 1234567	B7 (AUX 1)	B8 (AUX 2)	B10 (enable)	LED 1 (relay K4)	LED 2 (relay K8)	LED 4 (relay K12)
117	1010111	Press and hold B10 + B7 Relay K4 Momentary	Relay K8 Momentary	Relay K12 Momentary	AUX 1 on	AUX 2 on	Enable active
118	0110111	Press and hold B10 + B7 Relay K4 Momentary	Relay K8 Latching	Relay K12 Momentary	AUX 1 on	AUX 2 on	Enable active
119	1110111	Press and hold B10 + B7 Relay K4 Latching	Relay K8 Momentary	Relay K12 Momentary	AUX 1 on	AUX 2 on	Enable active
120	0001111	Press and hold B10 + B7 Relay K4 Latching	Relay K8 Latching	Relay K12 Momentary	AUX 1 on	AUX 2 on	Enable active
125	1011111	Press and hold B10 + B7 Relay K4 Momentary	Press and hold B10 + B8 Relay K8 Momentary	Relay K12 Momentary	AUX 1 on	AUX 2 on	Enable active
126	0111111	Press and hold B10 + B7 Relay K4 Latching	Press and hold B10 + B8 Relay K8 Latching	Relay K12 Momentary	AUX 1 on	AUX 2 on	Enable active

Table 18 - Group 3 - DIP Switch Settings - ENABLE with NO Interlocking

ENABLE with Interlocking

- AUX 1 and AUX 2 are interlocked and both cannot be active at the same time.
- If active, AUX 1 or AUX 2 will clear the other if attempting both to be active at the same time.
- B10 is the Enable.

- Press and hold B10, plus press and hold B7 within 5 seconds to activate AUX 1, relay K4.
- AUX 1 Momentary will clear if B10 or B7 are released.
- AUX 1 Latching & Unlatching requires B10 + B7
- For configuration 83; AUX 2 Momentary will clear if B10 or B8 are released.
- For configuration 84; AUX 2 Latching & Unlatching requires B10 + B8
- The B10 Enable will clear in 5 seconds if B7 is not pressed.

Configuration Number	MU-9X15 DIP Switch 1234567	B7 (AUX 1)	B8 (AUX 2)	B10 (enable)	LED (relay K4)	LED 2 (relay K8)	LED 4 (relay K12)
75	1101001	Press and hold B10 + B7 Relay K4 Momentary	Relay K8 Momentary	Relay K12 Momentary	AUX 1 on	AUX 2 on	Enable active
76	0011001	Press and hold B10 + B7 Relay K4 Momentary	Relay K8 Latching	Relay K12 Momentary	AUX 1 on	AUX 2 on	Enable active
77	1011001	Press and hold B10 + B7 Relay K4 Latching	Relay K8 Momentary	Relay K12 Momentary	AUX 1 on	AUX 2 on	Enable active
78	0111001	Press and hold B10 + B7 Relay K4 Latching	Relay K8 Latching	Relay K12 Momentary	AUX 1 on	AUX 2 on	Enable active
83	1100101	Press and hold B10 + B7 Relay K4 Momentary	Press and hold B10 + B8 Relay K8 Momentary	Relay K12 Momentary	AUX 1 on	AUX 2 on	Enable active
84	0010101	Press and hold B10 + B7 Relay K4 Latching	Press and hold B10 + B8 Relay K8 Latching	Relay K12 Momentary	AUX 1 on	AUX 2 on	Enable active

Table 19 - Group 3 - DIP Switch Settings - ENABLE with Interlocking

AUX 1 and 2 with Interlocking, no Enable

- AUX 1 and AUX 2 are interlocked and both cannot be active at the same time.
- If active, AUX 1 or AUX 2 will clear the other if attempting both to be active at the same time.
- AUX 3 is NOT interlocked with AUX 1 and or AUX 2

Configuration Number	MU-9X15 DIP Switch 1234567	B7 (AUX 1)	B8 (AUX 2)	B10 (AUX 3)	LED 1 (relay K4)	LED 2 (relay K8)	LED 3 (relay K12)
61	1011110	Relay K4 Momentary	Relay K8 Momentary	Relay K12 Momentary	AUX 1 on	AUX 2 on	AUX 3 on
62	0111110	Relay K4 Momentary	Relay K8 Momentary	Relay K12 Latching	AUX 1 on	AUX 2 on	AUX 3 on
63	1111110	Relay K4 Momentary	Relay K8 Latching	Relay K12 Momentary	AUX 1 on	AUX 2 on	AUX 3 on
64	0000001	Relay K4 Momentary	Relay K8 Latching	Relay K12 Latching	AUX 1 on	AUX 2 on	AUX 3 on
65	1000001	Relay K4 Latching	Relay K8 Momentary	Relay K12 Momentary	AUX 1 on	AUX 2 on	AUX 3 on
66	0100001	Relay K4 Latching	Relay K8 Momentary	Relay K12 Latching	AUX 1 on	AUX 2 on	AUX 3 on
67	1100001	Relay K4 Latching	Relay K8 Latching	Relay K12 Momentary	AUX 1 on	AUX 2 on	AUX 3 on
68	0010001	Relay K4 Latching	Relay K8 Latching	Relay K12 Latching	AUX 1 on	AUX 2 on	AUX 3 on

Table 20 - Group 3 - DIP Switch Settings - AUX 1 and 2 with Interlocking, NO Enable

GROUP 4: 3 MOTION, 2 SPEED, 4 WIRE FOR MOTION # 1 AND ONE BUTTON A/B SELECT

This group is applicable for use when one motion or a hoist requires a dedicated 2nd speed command for each motion direction.

About this configuration group:

- All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.
- Motion 1: Each motion direction has a separate Speed 2 relay output.
- Motion 2 and 3: Speed 2 is sequential and shared by each motion direction.
- The A and or B functions are selected using button B7.
- There is one AUX function available in this configuration. The AUX function can be programmed to be commanded by button B8. The selections are labeled AUX 2 in Table 22-23.

Motion	Button	1st speed	2nd speed
1 REV	B1	Relay K2	Relay K12
1 FWD	B2	Relay K1	Relay K3
2 REV	B3	Relay K6	Relay K7
2 FWD	B4	Relay K5	Relay K7
3 REV	B5	Relay K10	Relay K11
3 FWD	B6	Relay K9	Relay K11

Table 21 - Group 4 - 3 Motion, 2 Speed, 4 Wire for Motion # 1, One Button A/B Select

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A (relay K4)	✓	-	-	-	-	-
B (relay K8)	-	✓	-	-	-	-
AUX 2	-	-	-	✓	-	-
AUX 3	-	-	-	-	-	-

Table 22 - Group 4 - LED Indicators - 3 Motion, 2 Speed, 4 Wire for Motion # 1, One Button A/B Select

Configuration Number	MU-9X15 DIP Switch 1234567	B7 (NEXT) A/B select	B8 (AUX 2)	LED 2 (AUX 2)	B9 Start / Horn
21	1010100	A, B, Both	Relay K16 Momentary	AUX 2 on	*
22	0110100	A, B, Both	Relay K16 Latching	AUX 2 on	*
23	1110100	A, B, Both	-	-	**
24	0001100	A, B	Relay K16 Momentary	AUX 2 on	*
25	1001100	A, B	Relay K16 Latching	AUX 2 on	*
26	0101100	A, B	-	-	**

Table 23 - Group 4 - DIP Switch Settings

GROUP 5: 3 MOTION, 2 SPEED, 4 WIRE FOR MOTION # 1 AND TWO BUTTON A/B SELECT

About this configuration group:

All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.

- Motion 1: Each motion direction has a separate Speed 2 relay output.
- Motion 2 and 3: Speed 2 is sequential and shared by each motion direction.
- The A function is selected using button B7 and relay K4.
- The B function is selected using button B8 and relay K8.
- There is one AUX function available in this configuration. The AUX function can be programmed to be commanded by buttons B10. The selections are labeled AUX 3 in Table 25-26.

Motion	Button	1st speed	2nd speed
1 REV	B1	Relay K2	Relay K12
1 FWD	B2	Relay K1	Relay K3
2 REV	B3	Relay K6	Relay K7
2 FWD	B4	Relay K5	Relay K7
3 REV	B5	Relay K10	Relay K11
3 FWD	B6	Relay K9	Relay K11

Table 24 - Group 5 - 3 Motion, 2 Speed, 4 Wire for Motion # 1, Two Button A/B Select

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A (relay K4)	✓	-	-	-	-	-
B (relay K8)	-	✓	-	-	-	-
AUX 2	-	-	-	-	✓	-
AUX 3	-	-	-	-	-	-

Table 25 - Group 5 - LED Indicators 3 Motion, 2 Speed, 4 Wire for Motion # 1, Two Button A/B Select

Configuration Number	MU-9X15 DIP Switch 1234567	B7 (A select)	B8 (B select)	B10 (AUX 3)	LED 3 (AUX 3)	B9 Start / Horn
27	1101100	Relay K4 Latching	Relay K8 Latching	Relay K16 Momentary	AUX 3 on	*
28	0011100	Relay K4 Latching	Relay K8 Latching	Relay K16 Latching	AUX 3 on	*
29	1011100	Relay K4 Latching	Relay K8 Latching	-	-	**
87	1110101	Relay K4 Latching ***	Relay K8 Latching ***	Relay K16 Momentary	AUX 3 on	*
88	0001101	Relay K4 Latching ***	Relay K8 Latching ***	Relay K16 Latching	AUX 3 on	*
89	1001101	Relay K4 Latching ***	Relay K8 Latching ***	-	-	**

Table 26 - Group 5 - DIP Switch Settings

*** B9 activates relay K13, a momentary function.**

**** B9 activates relay K13 and K16, both are momentary functions.**

***** A and B are interlocked as follows:**

A and B are interlocked and both cannot be active at the same time.

If active, A or B will clear the other if attempting both to be active at the same time.

GROUP 6: 3 MOTION, 2 SPEED, 4 WIRE ALL MOTIONS

This group is applicable for use when up to 3 motions require a dedicated 2nd speed command for each motion direction.

About this configuration group:

- All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.
- Speed 2 is sequential, and each motion direction has a dedicated 2nd speed relay.
- The A and or B functions and LED indicators are not used in this configuration.
- There is one AUX function available, using Relay K16, in this configuration. This AUX function can be programmed to be commanded by button B7 or B8. The selections are labeled AUX 1 and AUX 2 in Table 28-29.

Motion	Button	1st speed	2nd speed
1 REV	B1	Relay K2	Relay K4
1 FWD	B2	Relay K1	Relay K3
2 REV	B3	Relay K6	Relay K8
2 FWD	B4	Relay K5	Relay K7
3 REV	B5	Relay K10	Relay K12
3 FWD	B6	Relay K9	Relay K11

Table 27 - Group 6 - 3 Motion, 2 Speed, 4 Wire All Motions

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A	-	-	-	-	-	-
B	-	-	-	-	-	-
AUX 1	-	-	✓	-	-	-
AUX 2	-	-	-	✓	-	-

Table 28 - Group 6 - LED Indicators 3 Motion, 2 Speed, 4 Wire All Motions

Configuration Number	MU-9X15 DIP Switch 1234567	B7 (AUX 1)	B8 (AUX 2)	LED 1 (relay K16)	LED 2 (relay K16)	B9 Start / Horn
56	0001110	Relay K16 Momentary	-	AUX 1 on	-	*
57	1001110	Relay K16 Latching	-	AUX 1 on	-	*
58	0101110	-	Relay K16 Momentary	-	AUX 2 on	*
59	1101110	-	Relay K16 Latching	-	AUX 2 on	*
60	0011110	-	-	-	-	**

Table 29 - Group 6 - DIP Switch Settings

* B9 activates relay K13, a momentary function.

** B9 activates relay K13 and K16, both are momentary functions.

*** A and B are interlocked as follows:

A and B are interlocked and both cannot be active at the same time.

If active, A or B will clear the other if attempting both to be active at the same time.

GROUP 7: 3 MOTION, 2 SPEED, 4 WIRE FOR MOTION # 1 AND 3 AUX

About this configuration group:

- All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.
- Motion 1: Each motion direction has a separate Speed 2 relay output
- Motion 2 and 3: Speed 2 is sequential and shared by each motion direction.
- The A and or B functions and LED A and LED B indicators are not used in this configuration.
- There are three AUX functions available in this configuration. The AUX functions can be programmed to be commanded by button B7, B8, and B10. The selections are labeled AUX 1, AUX 2 and AUX 3 in Table 31-32.
- Button B9 (Start / Horn) activates relay K13 as a momentary function.

Motion	Button	1st speed	2nd speed
1 REV	B1	Relay K2	Relay K12
1 FWD	B2	Relay K1	Relay K3
2 REV	B3	Relay K6	Relay K7
2 FWD	B4	Relay K5	Relay K7
3 REV	B5	Relay K10	Relay K11
3 FWD	B6	Relay K9	Relay K11

Table 30 - Group 7 - 3 Motion, 2 Speed, 4 Wire for Motion # 1 and 3 Aux

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A	-	-	-	-	-	-
B	-	-	-	-	-	-
AUX 1	-	-	✓			
AUX 2	-	-	-	✓	-	-
AUX 3	-	-	-	-	✓	-
Enable	-	-	-	-	-	✓

Table 31 - Group 7 - LED Indicators 3 Motion, 2 Speed, 4 Wire for Motion # 1 and 3 Aux

3 AUX functions. No interlocking and no enable

- The following AUX functions are NOT interlocked with each other.

Configuration Number	MU-9X15 DIP Switch 1234567	B7 (AUX 1)	B8 (AUX 2)	B10 (AUX 3)	LED 1 (relay K4)	LED 2 (relay K8)	LED 3 (relay K16)
38	0110010	Relay K4 Momentary	Relay K8 Momentary	Relay K16 Momentary	AUX 1 on	AUX 2 on	AUX 3 on
39	1110010	Relay K4 Momentary	Relay K8 Momentary	Relay K16 Latching	AUX 1 on	AUX 2 on	AUX 3 on
40	0001010	Relay K4 Momentary	Relay K8 Latching	Relay K16 Momentary	AUX 1 on	AUX 2 on	AUX 3 on
41	1001010	Relay K4 Momentary	Relay K8 Latching	Relay K16 Latching	AUX 1 on	AUX 2 on	AUX 3 on
42	0101010	Relay K4 Latching	Relay K8 Momentary	Relay K16 Momentary	AUX 1 on	AUX 2 on	AUX 3 on
43	1101010	Relay K4 Latching	Relay K8 Momentary	Relay K16 Latching	AUX 1 on	AUX 2 on	AUX 3 on
44	0011010	Relay K4 Latching	Relay K8 Latching	Relay K16 Momentary	AUX 1 on	AUX 2 on	AUX 3 on
45	1011010	Relay K4 Latching	Relay K8 Latching	Relay K16 Latching	AUX 1 on	AUX 2 on	AUX 3 on

Table 32 - Group 7 - DIP Switch Settings - 3 AUX Functions, NO Interlocking, NO Enable

AUX 1 ENABLE with NO Interlocking

- B10 is the Enable.
- Press and hold B10, plus press and hold B7 within 5 seconds to activate AUX 1, relay K4.
- AUX 1 Momentary will clear if B10 or B7 are released.
- AUX 1 Latching & Unlatching requires B10 + B7
- The B10 Enable will clear in 5 seconds if B7 is not pressed.

Config- uration Number	MU-9X15 DIP Switch 1234567	B7 (AUX 1)	B8 (AUX 2)	B10 (enable)	LED 1 (relay K4)	LED 2 (relay K8)	LED 4 (relay K16)
121	1001111	Press and hold B10 + B7 Relay K4 Momentary	Relay K8 Momentary	Relay K16 Momentary	AUX 1 on	AUX 2 on	Enable active
122	0101111	Press and hold B10 + B7 Relay K4 Momentary	Relay K8 Latching	Relay K16 Momentary	AUX 1 on	AUX 2 on	Enable active
123	1101111	Press and hold B10 + B7 Relay K4 Latching	Relay K8 Momentary	Relay K16 Momentary	AUX 1 on	AUX 2 on	Enable active
124	0011111	Press and hold B10 + B7 Relay K4 Latching	Relay K8 Latching	Relay K16 Momentary	AUX 1 on	AUX 2 on	Enable active

Table 33 - Group 7 - DIP Switch Settings - AUX 1 ENABLE with NO Interlocking

AUX 1 ENABLE with Interlocking

- AUX 1 and AUX 2 are interlocked and both cannot be active at the same time.
- If active, AUX 1 or AUX 2 will clear the other if attempting both to be active at the same time.
- B10 is the Enable.
- Press and hold B10, plus press and hold B7 within 5 seconds to activate AUX 1, relay K4.
- AUX 1 Latching & Unlatching requires B10 + B7
- The B10 Enable will clear in 5 seconds if B7 is not pressed.

Configuration Number	MU-9X15 DIP Switch 1234567	B7 (AUX 1)	B8 (AUX 2)	B10 (enable)	LED 1 (relay K4)	LED 2 (relay K8)	LED 4 (relay K16)
79	1111001	Press and hold B10 + B7 Relay K4 Momentary	Relay K8 Momentary	Relay K16 Momentary	AUX 1 on	AUX 2 on	Enable active
80	0000101	Press and hold B10 + B7 Relay K4 Momentary	Relay K8 Latching	Relay K16 Momentary	AUX 1 on	AUX 2 on	Enable active
81	1000101	Press and hold B10 + B7 Relay K4 Latching	Relay K8 Momentary	Relay K16 Momentary	AUX 1 on	AUX 2 on	Enable active
82	0100101	Press and hold B10 + B7 Relay K4 Latching	Relay K8 Latching	Relay K16 Momentary	AUX 1 on	AUX 2 on	Enable active

Table 34 - Group 7 - DIP Switch Settings - AUX 1 ENABLE with Interlocking

AUX 1 and 2 with Interlocking, no Enable

- AUX 1 and AUX 2 are interlocked and both cannot be active at the same time.
- If active, AUX 1 or AUX 2 will clear the other if attempting both to be active at the same time.
- B10 is the Enable.
- Press and hold B10, plus press and hold B7 within 5 seconds to activate AUX 1, relay K4.
- AUX 1 Latching & Unlatching requires B10 + B7
- The B10 Enable will clear in 5 seconds if B7 is not pressed.

Config- uration Number	MU-9X15 DIP Switch 1234567	B7 (AUX 1)	B8 (AUX 2)	B10 (AUX 3)	LED 1 (relay K4)	LED 2 (relay K8)	LED 3 (relay K6)	B9 Start Horn
69	1010001	Relay K4 Momentary	Relay K8 Momentary	Relay K16 Momentary	AUX 1 on	AUX 2 on	AUX 3 on	*
70	0110001	Relay K4 Momentary	Relay K8 Momentary	Relay K16 Latching	AUX 1 on	AUX 2 on	AUX 3 on	*
71	1110001	Relay K4 Momentary	Relay K8 Momentary	-	AUX 1 on	AUX 2 on	-	**
72	0001001	Relay K4 Latching	Relay K8 Latching	Relay K16 Momentary	AUX 1 on	AUX 2 on	AUX 3 on	*
73	1001001	Relay K4 Latching	Relay K8 Latching	Relay K16 Latching	AUX 1 on	AUX 2 on	AUX 3 on	*
74	0101001	Relay K4 Latching	Relay K8 Latching	-	AUX 1 on	AUX 2 on	-	**

Table 35 - Group 7 - DIP Switch Settings - AUX 1 and 2 with Interlocking, NO Enable

* B9 activates relay K13, a momentary function.

** B9 activates relay K13 and K16, both are momentary functions.

GROUP 8: 4 MOTION, 2 SPEED, 3 WIRE CONTROL AND 1 AUX

If the crane controls require a dedicated fourth motion, buttons 7 & 8 can be configured to function as a motion with the buttons being interlocked and a shared second speed relay output.

About this configuration group:

- All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.
- Speed 2 is sequential and shared by each motion direction.
- The A and B functions and the A and B LED indicators are not used in this configuration.
- There is one AUX function available, using Relay K16, in this configuration. This AUX function can be programmed to be commanded by button B10. The selections are labeled AUX 3 in Table 37-38.

Motion	Button	1st speed	2nd speed
1 REV	B1	Relay K2	Relay K3
1 FWD	B2	Relay K1	Relay K3
2 REV	B3	Relay K6	Relay K7
2 FWD	B4	Relay K5	Relay K7
3 REV	B5	Relay K10	Relay K11
3 FWD	B6	Relay K9	Relay K11
4 REV	B7	Relay K4	Relay K12
4 FWD	B8	Relay K8	Relay K12

Table 36 - Group 8 - LED Indicators 4 Motion, 2 Speed, 3 Wire Control And 1 AUX

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A	-	-	-	-	-	-
B	-	-	-	-	-	-
AUX 3	-	-	-	-	✓	-

Table 37 - Group 8 - 4 Motion, 2 Speed, 3 Wire Control and 1 AUX

Configuration Number	MU-9X15 DIP Switch 1234567	B10 (AUX 3)	LED 3 (relay K16)	B9 Start / Horn
46	0111010	Relay K16 Momentary	AUX 3 on	*
47	1111010	Relay K16 Latching	AUX 3 on	*
48	0000110	-	-	**

Table 38 - Group 8 - DIP Switch Settings- 4 Motion, 2 Speed, 3 Wire Control And 1 AUX

* B9 activates relay K13, a momentary function. ** B9 activates relay K13 and K16, both are momentary functions.

GROUP 9: 3 MOTION, 3 SPEED AND 1 AUX

About this configuration group:

- All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.
- Speed 2 and Speed 3 are sequential and shared by each motion direction.
- The A and B functions and the A and B LED indicators are not used in this configuration.
- There is one AUX function available using Relay K16. This AUX function can be programmed to be commanded by button B7, B8 or B10. The selections are labeled AUX 1, AUX 2 and AUX 3 in Table 40-41.

Motion	Button	1st speed	2nd speed	3rd speed
1 REV	B1	Relay K2	Relay K3	Relay K4
1 FWD	B2	Relay K1	Relay K3	Relay K4
2 REV	B3	Relay K6	Relay K7	Relay K8
2 FWD	B4	Relay K5	Relay K7	Relay K8
3 REV	B5	Relay K10	Relay K11	Relay K12
3 FWD	B6	Relay K9	Relay K11	Relay K12

Table 39 - Group 9 - 3 Motion, 3 Speed and 1 AUX

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A	-	-	-	-	-	-
B	-	-	-	-	-	-
AUX 1	-	-	✓	-	-	-
AUX 2	-	-	-	✓	-	-
AUX 3	-	-	-	-	✓	-

Table 40 - Group 9 - LED Indicators 3 Motion, 3 Speed and 1 AUX

Configuration Number	MU-9X15 DIP Switch 1234567	B7 (AUX 1)	B8 (AUX 2)	B10 (AUX 3)	LED 1 (relay K16)	LED 2 (relay K16)	LED 3 (relay K16)	B9 Start / Horn
49	1000110	Relay K16 Momentary	-	-	AUX 1 on	-	-	*
50	0100110	Relay K16 Latching	-	-	AUX 1 on	-	-	*
51	1100110	-	Relay K16 Momentary	-	-	AUX 2 on	-	*
52	0010110	-	Relay K16 Latching	-	-	AUX 2 on	-	*
53	1010110	-	-	Relay K16 Momentary	-	-	AUX 3 on	*
54	0110110	-	-	Relay K16 Latching	-	-	AUX 3 on	*
55	1110110	-	-	-	-	-	-	**

Table 41 - Group 9 - DIP Switch Settings - 3 Motion, 3 Speed and 1 AUX

* B9 activates relay K13, a momentary function.

** B9 activates relay K13 and K16, both are momentary functions.

GROUP 10: TANDEM 3 MOTION 2 SPEED WITH CONTROL RELEASE

About this configuration group:

- All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.
- Speed 2 is sequential and shared by each motion direction.
- The A/B or AUX 1 functions are selected using button B7.
- Button B8 selects Receiver 1 or 2 or both.
- Button B10 is the Control Release of the selected receiver.

Motion	Button	1st speed	2nd speed
1 REV	B1	Relay K2	Relay K3
1 FWD	B2	Relay K1	Relay K3
2 REV	B3	Relay K6	Relay K7
2 FWD	B4	Relay K5	Relay K7
3 REV	B5	Relay K10	Relay K11
3 FWD	B6	Relay K9	Relay K11

Table 42 - Group 10 - Tandem 3 Motion, 2 Speed, 3 Wire Control With Control Release

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A (relay K4)	✓	-	-	-	-	-
B (relay K8)	-	✓	-	-	-	-
AUX 1 (relay K4)	-	-	✓	-	-	-

Table 43 - Group 10 - LED Indicators Tandem 3 Motion, 2 Speed, 3 Wire Control With Control Release

Configuration Number	MU-9X15 DIP Switch 1234567	B7 A/B select or Aux 1	Relay K4 (A or AUX1)	B8 Receiver select (*)	B10 Control Release	LED 1 (relay K4)	B9 Start / Horn
90	0101101	A, B, Both	Latching (A)	Relay K12 Latching		-	**
91	1101101	A, B	Latching (A)	Relay K12 Latching		-	**
92	0011101	A, B, Off	Latching (A)	Relay K12 Latching		-	**
96	0000011	Aux 1	Momentary(AUX 1)	Relay K12 Latching		AUX 1 on	**
97	1000011	Aux 1	Latching (AUX 1)	Relay K12 Latching		AUX 1on	**

Table 44 - Group 10 - DIP Switch Settings - Tandem 3 Motion, 2 Speed, 3 Wire Control With Control Release

* Relay K12 latches on in the selected receiver when chosen by the transmitter.

** B9 activates relays K13 and K16. Both are momentary functions.

GROUP 11: TANDEM 3 MOTION, 2 SPEED, 4 WIRE FOR MOTION # 1 WITH CONTROL RELEASE

About this configuration group:

- All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.
- Motion 1: each motion direction has a separate sequential Speed 2 relay output.
- Motion 2 and 3: Speed 2 is sequential and shared by each motion direction.
- The A/B or AUX 1 functions are selected using button B7.
- Button B8 selects Receiver 1 or 2 or both.
- Button B10 is the Control Release of the selected receiver.

Motion	Button	1st speed	2nd speed
1 REV	B1	Relay K2	Relay K16
1 FWD	B2	Relay K1	Relay K3
2 REV	B3	Relay K6	Relay K7
2 FWD	B4	Relay K5	Relay K7
3 REV	B5	Relay K10	Relay K11
3 FWD	B6	Relay K9	Relay K11

Table 45 - Group 11 - Tandem 3 Motion, 2 Speed, 4 Wire for Motion # 1 with Control Release

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A (relay K4)	✓	-	-	-	-	-
B (relay K8)	-	✓	-	-	-	-
AUX 1 (relay K4)	-	-	✓	-	-	-

Table 46 - Group 11 - LED Indicators Tandem 3 Motion, 2 Speed, 4 Wire for Motion # 1 with Control Release

Configuration Number	MU-9X15 DIP Switch 1234567	B7 A/B select or Aux 1	Relay K4 (A or AUX1)	B8 Receiver select (*)	B10 Control Release	LED 1 (relay K4)	B9 Start / Horn
93	1011101	A, B, Both	Latching (A)	Relay K12 Latching		-	**
94	0111101	A, B	Latching (A)	Relay K12 Latching		-	**
95	1111101	A, B, Off	Latching (A)	Relay K12 Latching		-	**
98	0100011	Aux 1	Momentary (AUX 1)	Relay K12 Latching		AUX 1 on	**
99	1100011	Aux 1	Latching (AUX 1)	Relay K12 Latching		AUX 1 on	**

Table 47 - Group 11 - DIP Switch Settings - Tandem 3 Motion, 2 Speed, 4 Wire for Motion # 1 with Control Release

* Relay K12 latches on in the selected receiver when chosen by the transmitter.

** B9 activates relays K13, a momentary function.

GROUP 12: TANDEM 3 MOTION, 2 SPEED

About this configuration group:

- All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.
- Speed 2 is sequential and shared by each motion direction.
- The A/B or AUX 1 functions are selected using button B7.
- Button B8 selects Receiver 1 or 2 or both.
- Button B10 selects AUX 3 of the selected receiver.

Motion	Button	1st speed	2nd speed
1 REV	B1	Relay K2	Relay K3
1 FWD	B2	Relay K1	Relay K3
2 REV	B3	Relay K6	Relay K7
2 FWD	B4	Relay K5	Relay K7
3 REV	B5	Relay K10	Relay K11
3 FWD	B6	Relay K9	Relay K11

Table 48 - Group 12 - Tandem 3 Motion, 2 Speed

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A (relay K4)	✓	-	-	-	-	-
B (relay K8)	-	✓	-	-	-	-
AUX 1 (relay K4)	-	-	✓	-	-	-
AUX 3 (relay K8 or 16)	-	-	-	-	✓	-

Table 49 - Group 12 - LED Indicators Tandem 3 Motion, 2 Speed

Configuration Number	MU-9X15 DIP Switch 1234567	B7 A/B select or Aux 1	Relay K4 (A or AUX1)	B8 Receiver select (*)	B10 AUX 3 (relay K 8 or K16)	LED 1	LED 3	B9 Start / Horn
100	0010011	A, B, Both	Latching (A)	Relay K12 Latching	K16 Momentary	-	AUX 3 on	***
101	1010011	A, B, Both	Latching (A)	Relay K12 Latching	K16 Latching	-	AUX 3 on	***
102	0110011	A, B	Latching (A)	Relay K12 Latching	K16 Momentary	-	AUX 3 on	***
103	1110011	A, B	Latching (A)	Relay K12 Latching	K16 Latching	-	AUX 3 on	***
104	0001011	A, B, Off	Latching (A)	Relay K12 Latching	K16 Momentary	-	AUX 3 on	***
105	1001011	A, B, Off	Latching (A)	Relay K12 Latching	K16 Latching	-	AUX 3 on	***
109	1011011	AUX 1	Momentary (AUX 1)	Relay K12 Latching	K8 Momentary	AUX 1 on	AUX 3 on	**
110	0111011	AUX 1	Momentary (AUX 1)	Relay K12 Latching	K8 Latching	AUX 1 on	AUX 3 on	**
111	1111011	AUX 1	Latching (AUX 1)	Relay K12 Latching	K8 Momentary	AUX 1 on	AUX 3 on	**
112	0000111	AUX 1	Latching (AUX 1)	Relay K12 Latching	K8 Latching	AUX 1 on	AUX 3 on	**

Table 50 - Group 12 - DIP Switch Settings - Tandem 3 Motion, 2 Speed

* Relay K12 latches on in the selected receiver when chosen by the transmitter.

** B9 activates relays K13 and K16. Both are momentary functions.

*** B9 activates K13 only. A momentary function.

GROUP 13: TANDEM 3 MOTION, 2 SPEED, 4 WIRE FOR MOTION # 1

About this configuration group:

- All transmitter Motion commands, and their receiver wiring are the same in each of the following configurations.
- Motion 1: Each motion direction has a separate sequential Speed 2 relay output.
- Motion 2 and 3: Speed 2 is sequential and shared by each motion direction.
- The A/B or AUX 1 functions are selected using button B7.
- Button B8 selects Receiver 1, 2, or both.
- Button B10 selects AUX 3 of the selected receiver.

Motion	Button	1st speed	2nd speed
1 REV	B1	Relay K2	Relay K16
1 FWD	B2	Relay K1	Relay K3
2 REV	B3	Relay K6	Relay K7
2 FWD	B4	Relay K5	Relay K7
3 REV	B5	Relay K10	Relay K11
3 FWD	B6	Relay K9	Relay K11

Table 51 - Group 13 - Tandem 3 Motion, 2 Speed, 4 Wire for Motion # 1

Active Function	LED A	LED B	LED 1	LED 2	LED 3	LED 4
A (relay K4)	✓	-	-	-	-	-
B (relay K8)	-	✓	-	-	-	-
AUX 1 (relay K4)	-	-	✓	-	-	-
AUX 3 (relay K8)	-	-	-	-	✓	-

Table 52 - Group 13 - LED Indicators Tandem 3 Motion, 2 Speed, 4 Wire for Motion # 1

Configuration Number	MU-9X15 DIP Switch 1234567	B7 A/B select or Aux 1	Relay K4 (A or AUX1)	B8 Receiver select (*)	B10 AUX 3 (relay K 8)	LED 1	LED 3	B9 Start / Horn
106	0101011	A, B, Both	Latching (A)	Relay K12 Latching	-	-	-	**
107	1101011	A, B,	Latching (A)	Relay K12 Latching	-	-	-	**
108	0011011	A, B, Off	Latching (A)	Relay K12 Latching	-	-	-	**
113	1000111	AUX 1	Momentary (AUX 1)	Relay K12 Latching	K8 Momentary	AUX 1 on	AUX 3 on	**
114	0100111	AUX 1	Momentary (AUX 1)	Relay K12 Latching	K8 Latching	AUX 1 on	AUX 3 on	**
115	1100111	AUX 1	Latching (AUX 1)	Relay K12 Latching	K8 Momentary	AUX 1 on	AUX 3 on	**
116	0010111	AUX 1	Latching (AUX 1)	Relay K12 Latching	K8 Latching	AUX 1 on	AUX 3 on	**

Table 53 - Group 13 - DIP Switch Settings - Tandem 3 Motion, 2 Speed, 4 Wire for Motion # 1

* Relay K12 latches on in the selected receiver when chosen by the transmitter.

** B9 activates K13 only. A momentary function.

General Operation - Single Crane

Starting Operation

The initiation of an RF Link and closing the mainline contactor output from the receiver are very similar between the HH2S and HHMS transmitters.

HH2S Transmitter

- Press the STOP button to turn on the transmitter
- The transmitter will conduct a switch scan and begin searching for its associated receiver
- Once the transmitter and receiver have made an RF Link, the top LED with the  icon will flash to indicate the system is ready for operation
- All motion relays will remain inoperable when the MLC output is open
- Press B9 (START/HORN) to close the MLC output from the receiver
- The MLC output will remain closed throughout the duration of the RF Link. **NOTE: If the RF link is broken for any reason, the MLC output will open and the transmitter will display the RF Link Loss LED code. Press B9 (START/HORN) to acknowledge the condition, then press B9 (START/HORN) again to resume operation and close the MLC output.**

HHMS Transmitter

- Pull the machine STOP button UP at the top of the transmitter to turn it on
- If the battery was inserted with the STOP switch in the UP position, *quickly* cycle STOP switch by pressing it DOWN and pull it back UP to complete STOP switch scan.
- The transmitter will conduct a switch scan and begin searching for its associated receiver
- Once the transmitter and receiver have made an RF Link, the top LED with the  icon will flash to indicate the system is ready for operation
- All motion relays will remain inoperable when the MLC output is open
- Press B9 (START/HORN) to close the MLC output from the receiver
- The MLC output will remain closed throughout the duration of the RF Link. **NOTE: If the RF link is broken for any reason, the MLC output will open and the transmitter will display the RF Link Loss LED code. Press B9 (START/HORN) to acknowledge the condition, then press B9 (START/HORN) again to resume operation and close the MLC output.**

Ending operation

- There are several ways in which the operation will cease, resulting in the MLC output opening.

Operator Initiated

HH2S

- Press B1 (STOP) on the HH2S transmitter to end RF communication. The transmitter will send a shutdown command to the receiver, and the transmitter will power down

HHMS

Press the machine STOP switch down on the top of the HHMS transmitter to end RF communication. The transmitter will send a shutdown command to the receiver, and the transmitter will power down.

System Initiated

Transmitter inactivity

- This occurs when the Transmitter Inactivity Timer value is reached
- The Transmitter Inactivity Timer setting is found in the Maintenance Mode section on **Page 71**.
- When the timer is reached, the following will occur
 - Transmitter sends a STOP command to the receiver
 - Receiver disables all motion outputs and opens MLC output
 - RF Link is terminated
 - Transmitter powers down

RF Inactivity

- The receiver must see repeated messages from its paired transmitter
- If the receiver begins missing messages, its RF Inactivity timer begins to count
- If the receiver's RF inactivity timer is reached, the following occurs
 - Transmitter sends a STOP command to the receiver
 - Receiver disables all motion outputs and opens MLC output
 - RF Link is terminated
 - Transmitter displays RF Link Loss LED pattern

Low Battery

- Transmitter sends a STOP command to the receiver
- Receiver disables all motion outputs and opens MLC output
- RF Link is terminated
- Transmitter powers down

General Operation - Tandem Cranes

This section is dedicated to operations that can only be achieved with a CERVIS HHMS 2 SPEED DISPLAY type transmitter. The two sections described below are determined by how the transmitter has been configured. Reference the Maintenance Mode section on **Page 71**.

1 OR 2

The first configuration is “1 OR 2”. In this configuration, the transmitter must be associated with two receivers. Crane Select is available, but in this mode, the operator can only select one crane or the other at startup. Crane select is only available one time after the transmitter is powered on.

To switch from one crane to the other, the transmitter must first be powered down, then powered back on to reactivate Crane Selection. Only then can the second crane be selected.

Whenever the transmitter is powered down, the RF link will cease, and the main line contactor output from the receiver will open.

Button 8 serves as the crane select function that will scroll through cranes with each press of the button.

Starting Operation

- Pull the machine STOP button UP at the top of the transmitter to turn it on
- If the battery was inserted with the STOP switch in the UP position, *quickly* cycle the STOP switch by pressing it DOWN and pulling it back UP to complete the STOP switch scan.
- The screen on the transmitter will show which receiver is currently selected for Pairing
- Press B8 to cycle through available receiver selections until the desired receiver is shown on the screen
- When a transmitter is configured to “1 OR 2”, the only receiver options that are available by cycling are: 1 → 2 → 1 → 2 → 1 → 2
- Press B9 (START/HORN) to close the MLC output from the receiver
- The MLC output will remain closed throughout the duration of the RF Link.

Ending operation

There are several ways in which the operation will cease, resulting in the MLC output opening.

Operator Initiated

Press the machine STOP switch DOWN on the top of the HHMS transmitter to end RF communication. The transmitter will send a shutdown command to the receiver, and the transmitter will power down.

System Initiated

Transmitter inactivity

- This occurs when the Transmitter Inactivity Timer value is reached
- The Transmitter Inactivity Timer setting is found in Maintenance Mode
- When the timer is reached, the following will occur:
 - RF Link will cease
 - All receiver outputs will open

- The transmitter will power down

RF Inactivity

- The receiver must see repeated messages from its paired transmitter
- If the receiver begins missing messages, its RF Inactivity timer begins to count
- If the receiver's RF inactivity timer is reached, the following occurs:
 - All receiver outputs will open

Low Battery

- The transmitter sends a shutdown command to the receiver
- Transmitter powers down
- All receiver outputs will open

1 AND 2

The second configuration is "1 AND 2". In this configuration, the transmitter must be associated with two receivers.

Full crane select functionality remains available throughout operation, and button 8 is used as the crane select function to scroll through cranes with each press of the button.

Cervis Standard's tandem operation keeps a transmitter paired with its receiver(s) while making changes to crane selection. This results in two things with the receiver that has been paired, but is not currently selected:

- MLC output remains closed
- Retains active RF communication with the transmitter, keeping First Come First Serve in place

Another added layer of safety that is available with Cervis Standard tandem operation is Controlled Release. When a configurable setting with Controlled Release is in use, there is an added requirement that must be met before the receivers will clear their serial number lock of the current transmitter.

Starting Operation

- Pull the machine STOP button UP at the top of the transmitter to turn it on
- If the battery was inserted with the STOP switch in the UP position, *quickly* cycle the STOP switch by pressing it DOWN and pulling it back UP to complete the STOP switch scan.
- The transmitter will conduct a switch scan and begin searching for its associated receivers
- The screen on the transmitter will show which receiver is currently selected for Pairing
- Press B8 to cycle through available receiver selections until the desired receiver is shown on the screen
- When a transmitter is configured to "1 AND 2", the receiver options that are available by cycling are: 1 → 2 → 1+2 → 1 → 2 → 1+2 →

NOTE

The DIP switch settings must be identical in both the receivers that are associated with the transmitter for "1 AND 2" functionality to be allowed.

- Press B9 (START/HORN) to start the search for selected receivers(s), establish RF Link(s) and close the MLC output(s).
- The MLC output(s) will remain closed throughout the duration of the RF Link.

Crane Select During Operation

After the transmitter has been paired with a receiver(s), normal crane operation is available. When the lift requires the operator to change the crane(s) selected for operation, pressing B8 will place the system into Crane Select mode.

During Crane Select mode:

- All motion outputs are disabled
- MLC output(s) will remain closed
- B8 now cycles through Crane Select options on the screen
- Once the new crane selection is shown on the screen, B9 (START) must be pressed to:
 - Confirm the new crane selection
 - Place the system back into normal operating mode from Crane Select mode
- The process of entering and exiting Crane Select mode can occur as often as needed throughout
- If only 1 crane was paired during the initial Crane Select, the second crane can be added by:
 - Pressing B8 to enter Crane Select
 - Pressing B8 to cycle through selections until "1+2" is shown
 - Pressing B9 to pair with the second receiver
- If the intent is to stop using the first crane and switch to exclusively controlling the second crane
 - Turn the transmitter OFF to cease the RF link with the first receiver, and the MLC output will open
 - Turn the transmitter ON and use B8 to select the other crane.

Ending operation

- There are several ways in which the operation will cease, resulting in the MLC output opening.

Operator Initiated

Press the machine STOP switch DOWN on the top of the HHMS transmitter to end RF communication. The transmitter will send a shutdown command to the receiver, and the transmitter will power down.

System Initiated

Transmitter inactivity

- This occurs when the Transmitter Inactivity Timer value is reached
- The Transmitter Inactivity Timer setting is found in the Maintenance Mode section on **Page 71**.
- When the timer is reached, the following will occur
 - Transmitter sends a STOP command to the receiver
 - Receiver disables all motion outputs and opens MLC output
 - RF Link is terminated
 - Transmitter powers down

RF Inactivity

- The receiver must see repeated messages from its paired transmitter
- If the receiver begins missing messages, its RF Inactivity timer begins to count
- If the receiver's RF inactivity timer is reached, the following occurs
 - Transmitter sends a STOP command to the receiver
 - Receiver disables all motion outputs and opens MLC output
 - RF Link is terminated
 - Transmitter displays RF Link Loss LED pattern

Low Battery

- Transmitter sends a STOP command to the receiver
- Receiver disables all motion outputs and opens MLC output
- RF Link is terminated
- Transmitter powers down

NOTE

If two receivers have been paired and one receiver reaches its RF Inactivity time out, the transmitter will stop communicating with the other receiver, display a fault, and both receivers will open all outputs.

Maintenance Mode

All Cervis Standard transmitter models have the following configurable settings:

All models

Association

- This process is used for a transmitter to learn a new receiver. Primarily used when managing spare or replacement transmitters.

Factory Reset

- This process clears stored receiver(s) information from a transmitter. Primarily used to take a transmitter out of service or as a known, blank starting point before associating a transmitter with a receiver.

Transmitter Inactivity Timer

- This feature will turn off the transmitter when it is not used for the amount of time set

HHMS with display only

- Tandem
- Password

Below are the required steps for each model needed to make changes to these settings, as well as a helpful table that summarizes the LED patterns the operator should expect to see while using Maintenance Mode.

Status	Description	Resolution
	Waiting to Enter Maintenance Mode: B LED lights up solid.	Only occurs at power up.
	Maintenance Mode Active: LEDs repeatedly "scroll" from bottom to top: B , A ,  ,  .	Normal operation for Maintenance Mode, complete desired changes or cycle power to exit.
	Association Started:  lit solid; A LED blinks on and off rapidly.	Normal operation, wait for process to advance
	Association Scanning:  & B LEDs are lit solid.	Normal operation. Wait for scan to complete. If no receivers are found TX will time out or cycling power is required.
	Association Select Active:  & A LEDs are lit solid.	Normal operation
	Factory Reset Ready: A and B LEDs are lit solid.	Normal operation
	Timeout Setting Started: A and B LEDs blink quickly.	Normal operation

Table 54 - Maintenance Mode LEDs

HH2S

Entering Maintenance Mode

Maintenance Mode provides the means to change settings in the transmitter. To enter Maintenance Mode, follow the steps below:

1. Turn on the transmitter by pressing and releasing the STOP button
2. **B** LED will light for approximately 1.5 seconds
3. While the **B** LED is lit, press and release B7 & B8 at the same time
4. Maintenance Mode is shown as being active by the following LED pattern: **B** → **A** →  →  → **B** → **A** →  → 

Association

Complete Cervis Standard Systems have the receivers and transmitters associated before the system is shipped.

Association is the process that places the receiver's serial number in the transmitter, allowing the receiver to accept the transmitter's messages and enabling pairing between the two. If the association process has not been completed, the units will not complete the RF Link to close the MLC output, and command motion outputs cannot be controlled.

When a spare unit is placed into service with an existing system, the association process must be completed before the transmitter and receiver allow control. **If association is needed**, see the steps for association described in this section.

- Enter Maintenance Mode
- Press and hold B1 & B2 for about 5 seconds
- **A** LED will begin blinking to indicate Association mode
- Release B1 & B2
-  & **B** LEDs will be lit solid while the transmitter is searching for receivers in the area that are available for Association

Available receiver IDs will be temporarily stored in the transmitter to be cycled through until the desired receiver is identified

-  and **A** LEDs will blink together when a receiver(s) has been found
- The first receiver found by the transmitter will begin flashing its Association strobe LED and will repeatedly close and open its Horn output
- If the receiver flashing its strobe and cycling its horn is not the intended receiver, press B7 to cycle to the next receiver
- Continue the above step until the intended receiver identifies itself with the strobe and horn
- Press B8 to complete the Association process with that receiver
- The  LED will begin blinking rapidly, indicating a successful Association, and the system is ready for the START (B9) command to close the MLC output and begin operation.

NOTE

Replacement transmitters shipped from Cervis do not have a receiver associated with them, and this process must be completed with the intended receiver.

CAUTION

All functions, including stop, must be tested after association.

Factory Reset

Performing a Factory Reset will clear all receiver associations within the transmitter. Follow these steps to perform a factory reset on the handheld transmitter. Once this process is complete, the transmitter's memory is cleared, and it will not communicate with any receivers.

- Enter Maintenance Mode
- Press and hold B7 & B8 simultaneously
- Then press and release STOP
- The transmitter will power down
- After a successful Factory Reset, attempting to power on the transmitter will result in it powering right back down because it is no longer associated with the receiver stored in its memory. When this condition is present, enter Maintenance and proceed with an Association to a receiver.

Transmitter Inactivity Timeout

The Transmitter Inactivity Timeout feature serves two primary benefits. Increased safety by disabling a transmitter that was set down without being turned off to prevent unintentional activation. Preserving battery life to prevent draining battery life if the transmitter is set down without being turned off.

HH2S transmitters ship from the factory configured with a 10-minute inactivity timer. To adjust the timeout interval, follow these steps:

- Enter Maintenance Mode (see the Entering Maintenance section above)
- Press and hold Trolley Forward (B4) until LEDs **A** & **B** light solid (about 5 seconds)
 - When B4 is pressed the LEDs will stop scrolling
- Release Trolley Forward (B4) to be able to select the desired timeout interval
- A/B Aux 1 (B7) will cycle through available selections indicated by the following LEDs
 -  LED = 4 minutes
 -  LED = 10 minutes
 - **A** LED = 20 minutes
 - **B** LED = Disabled / no time out
- When the LED corresponding to the desired timeout interval is lit, press AUX 2 (B8) to select that setting
- Press Horn/Start to return to normal operation

HHMS – No Display

Entering Maintenance Mode

Maintenance Mode provides the means to change settings in the transmitter. To enter Maintenance Mode, follow the steps below:

- Turn on the transmitter by raising the STOP switch
- **B** LED will light for approximately 1.5 seconds
- While the **B** LED is lit, press and release B7 & B8 at the same time
- Maintenance Mode is shown as being active by the following LED pattern: **B** → **A** →  →  → **B** → **A** →  → 

Association

Complete Cervis Standard Systems have the receivers and transmitters associated before the system is shipped.

Association is the process that places the receiver's serial number in the transmitter, allowing the receiver to accept the transmitter's messages and enabling pairing between the two. If the association process has not been completed, the units will not complete the RF Link to close the MLC output, and command motion outputs cannot be controlled.

When a spare unit is placed into service with an existing system, the association process must be completed before the transmitter and receiver allow control. **If an association is needed**, see the steps for association described in this section.

- Enter Maintenance Mode
- Press and hold B1 & B2 for about 5 seconds
- **A** LED will begin blinking to indicate Association mode
- Release B1 & B2
-  & **B** LEDs will be lit solid while the transmitter is searching for receivers in the area that are available for Association
- Available receiver IDs will be temporarily stored in the transmitter to be cycled through until the desired receiver is identified
-  and **A** LEDs will blink together when a receiver(s) has been found
- The first receiver found by the transmitter will begin flashing its Association strobe LED and will repeatedly close and open its Horn output
- If the receiver flashing its strobe and cycling its horn is not the intended receiver, press B7 to cycle to the next receiver
- Continue the above step until the intended receiver identifies itself with the strobe and horn
- Press B8 to complete the Association process with that receiver
- The  LED will begin blinking rapidly, indicating a successful Association, and the system is ready for the START (B9) command to close the MLC output and begin operation.

Factory Reset

Performing a Factory Reset will clear all receiver associations within the transmitter. Follow these steps to perform a factory reset on the handheld transmitter. Once this process is complete, the transmitter's memory is cleared, and it will not communicate with any receivers.

- Enter Maintenance Mode
- Press and hold B1 & B2
- Then press B9
- **A** & **B** LEDs will light solid when Factory Reset is complete
- Release buttons
- Press down the STOP switch

NOTE

Replacement transmitters shipped from Cervis do not have a receiver associated with them, and this process must be completed with the intended receiver.

NOTE

Cervis Standard transmitters and receivers will only Associate with each other. If a receiver is not showing up after the scanning process, ensure that it is a Cervis Standard receiver.

CAUTION

All functions, including stop, must be tested after association.

After a successful Factory Reset, the transmitter will repeatedly flash all 4 LEDs (RF, Batt, A & B) when turning the transmitter on to indicate that it is not associated with a receiver. To associate a receiver, cycle power to the transmitter and enter Maintenance Mode and perform Association process.

Transmitter Inactivity Timeout

The Transmitter Inactivity Timeout feature serves two primary benefits. Increased safety by disabling a transmitter that was set down without being turned off to prevent unintentional activation. Preserving battery life to prevent draining battery life if the transmitter is set down without being turned off.

HHMS transmitters ship from the factory configured with a 10-minute inactivity timer. To adjust the timeout interval, follow the following steps:

- Enter Maintenance Mode
- Press and hold B4
- **A** & **B** LEDs will light solid
- Release B4
- Press B7 to cycle through timeout settings indicated by LEDs
 - **B** = No time out
 - **A** = 20 minute
 -  = 10 minute
 -  = 4 minute
- Once the desired time out (LED) is shown, press B8 to confirm
- Transmitter will return to Maintenance Mode

HHMS with Display

The HHMS with display offers additional, unique settings in Maintenance Mode. This section includes how to enter and navigate Maintenance Mode, and lists all available settings for the HHMS with display.

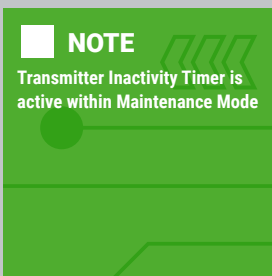
Entering Maintenance Mode

To enter Maintenance Mode, follow the steps below:

- Turn on the transmitter by pulling the STOP switch up
- Splash screen with Cervis and serial number will briefly appear
- **B** LED will light for approximately 1.5 seconds
- While the **B** LED is lit, press and release B7 & B8 at the same time
- When successful activation of Maintenance Mode occurs, the info below will be shown on the display and LEDs



- LED pattern; **B** → **A** →  →  → **B** → **A** →  → 



Navigating Maintenance Mode Main Screen

When in Maintenance Mode the following indicators and functions are available to select the desired function and select the specific value for a function.

- Yellow font with black background is an available selection
- Black font with yellow background indicates current selection
- B8 scrolls the current selection down
- B7 scrolls the current selection up
- B9 selects the current selection
- There are more settings than are shown on the initial screen. Additional settings could be off screen. Cycle up or down until the desired selection is visible



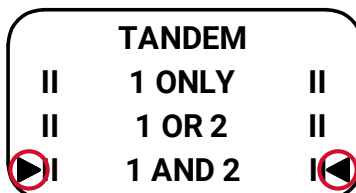
- B10 normally serves as the Back function, but is not available on the Main Screen
- To leave the Main Screen of Maintenance Mode, either the EXIT function must be selected or the transmitter must be powered down

Main Screen Options

- ASSOCIATE
- IDLE TIME
- TANDEM
- SECURITY
- ABOUT
- EXIT

Navigating Maintenance Mode Sub Menus

- Navigate into a Maintenance Mode Sub Menu by scrolling up (B7) and down (B8) until the desired selection is shown in black font with a yellow background, and press Start (B9) to enter that selection.
- Once a sub menu has been selected, B10 now serves as a Back function to return to the Main Menu
- Look at the outer edges of each selection to determine which selection has been chosen and is not just an available selection
- Selected values are shown with ► & ◀ on the outer edges



- Available selections are shown with || & || on the outer edges



- Use B7 and B8 to scroll to the desired selection
- Press B9 to confirm the selection of the value
- Watch to ensure the outer column icons change to confirm the selection has been made
- Press B10 to exit Sub Menu and return to Main Menu

ASSOCIATE (Association)

Complete Cervis Standard Systems have the receivers and transmitters associated before the system is shipped.

Association is the process that places the receiver's serial number in the transmitter, allowing the receiver to accept the transmitter's messages and enabling pairing between the two. If the association process has not been completed, the units will not complete the RF Link between transmitter and receiver.

When a spare unit is placed into service with an existing system, the association process must be completed before the transmitter and receiver allow control. **If association is needed**, see the steps for association described in this section.

STATUS

Shows the serial number of the receiver(s) that the transmitter is currently associated with

The receiver serial number shown in location "1:" will be the Crane 1 reference in Crane Select mode

The receiver serial number shown in location "2:" will be the Crane 2 reference in Crane Select mode

START

This begins the association process with 1 or 2 receivers, depending upon whether Tandem selection is currently active. If only 1 receiver is being associated, it will show in the 1 position of the STATUS screen. If 2 receivers are being associated, there will be 2 lines shown in STATUS. The order in which they are associated will determine whether the receiver is identified as 1 or 2.

The first receiver associated will become Crane 1 in Crane Select mode and 1 in the STATUS screen. The second receiver associated will become Crane 2 in Crane Select mode and 2 in the STATUS screen

Association Process

Once START has been initiated, the display will show "Scanning"

NOTE

As soon as a value is selected, the transmitter automatically stores that value. The EXIT function does not need to be performed for the modified values to become active in the transmitter's memory.

NOTE

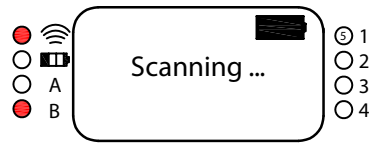
Replacement transmitters shipped from Cervis do not have a receiver associated with them, and this process must be completed with the intended receiver.

NOTE

Cervis Standard transmitters and receivers will only Associate with each other. If a receiver is not showing up after the scanning process, ensure that it is a Cervis Standard receiver.

NOTE

The association process for a HHMS with Display is dependent upon the Tandem selection that is currently active. See the Tandem section below for more information.



During this time the transmitter is searching for available receivers within range for the association process.

- **Conditions that will prevent a receiver from being available for association:**

- Receiver not powered
- The receiver actively locked onto another transmitter
- DIP switch setting requiring additional action for association, see **Troubleshooting section**
- The receiver is locked onto a transmitter serial number via Control Release functionality. **See Troubleshooting section** for more information.
- & LEDs will be lit solid while the transmitter is searching for receivers in the area that are available for Association
- Available receiver IDs will be temporarily stored in the transmitter to be cycled through until the desired receiver is identified
- LED will turn off and LED will turn on when a receiver(s) has been found
- The first receiver found by the transmitter will begin flashing its Association strobe LED and repeatedly close and open its Horn output
- If the receiver flashing its strobe and cycling its horn is not the intended receiver, press B7 to cycle to the next receiver
- Continue the above step until the intended receiver identifies itself with the strobe and horn
- Press B8 to complete the Association process with that receiver
- If the transmitter has been configured as “1 ONLY” in the TANDEM menu, the Association process is complete.
- If the transmitter has been configured as “1 OR 2” or “1 AND 2” in the Tandem menu, the Association process will continue on to the second receiver to be Associated.
- Once Association is completed, either use the EXIT function in Maintenance Mode or cycle power to the transmitter to begin operation.

IDLE TIME (Transmitter Inactivity Timer)

This Sub Menu sets the Transmitter Inactivity Timer. Once a transmitter has been turned on, a timer starts running. Any time a button is pressed, the timer is reset. While the transmitter is idle, the timer runs. The timer runs at all times regardless of what mode the transmitter is in.

When the timer reaches the value selected in this Sub Menu, the transmitter will send a shutdown command to the receiver and stop transmitting messages, as well as power down.

Available Values

- 4 MIN
- 10 MIN

CAUTION

All functions, including stop, must be tested after association.

- 20 MIN
- DISABLED (When selected, this value turns off the timer, and the transmitter will not time out due to inactivity.)

TANDEM

This Sub Menu determines how the transmitter handles the Association Process and general operation. Confirm the value of this setting to ensure proper operation is provided and the Association Process is adjusted to match intended operation.

1 ONLY

The association process will only allow one receiver to be associated. The transmitter | receiver pairing will function as normal 1:1(operator to crane) control. This setting can be used to create a dedicated transmitter when used with receivers that are configured as tandem by eliminating the transmitter's ability to perform Crane Select.

This setting can also be applied to non-tandem crane control configurations when the added benefits of a display on the transmitter are preferred.

1 OR 2

The association process requires two receivers to be associated. The order in which they are associated will determine which receiver is Crane 1 and which receiver is Crane 2.

This setting provides the operator to select Crane 1 or Crane 2 at start up only. Crane Select is required after turning on the transmitter. After a selection has been made, Crane Select is no longer available to the operator until the power is cycled on the transmitter.

If there is a need to switch from one crane to the other, the transmitter needs to be turned off and then powered back on. Selecting the other crane is now available through Crane Select.

1 AND 2

The association process requires two receivers to be associated. The order in which they are associated will determine which receiver is Crane 1 and which receiver is Crane 2.

This setting provides the operator full tandem control functionality that includes having Crane Select available throughout operation. Crane Select is required after turning on the transmitter. Once the receiver(s) has been initially selected, B8 remains available to activate Crane Select to change current selection at any time during operation.

SECURITY

The two sub-menus under SECURITY provide the ability to reset the transmitter to factory defaults and set a password limiting access to Maintenance Mode.

RESET

Selecting this value will reset ALL modified values back to the factory defaults and remove an existing requirement for entering a password to enter the Maintenance Mode main menu.

Factory Defaults

- ASSOCIATE = No receivers associated
- IDLE TIME = Disabled
- TANDEM = 1 ONLY
- SECURITY / PASSWORD = 0000

CAUTION

There is no back door code to unlock the Maintenance Mode if a SET LOCK 4 digit has been set and then lost. The transmitter will need to be returned to the factory for reprogramming.

CAUTION

The SET LOCK is instantly activated when B9 is pressed to confirm the SET LOCK.

CAUTION

Even if the transmitter is powered down before selecting the EXIT function from the Main Menu, the SET LOCK will be active.

SET LOCK

This function allows the access to access Maintenance Mode's to be restricted by a password to prevent the changing of settings without the password being correctly entered. This function only password protects the Maintenance Menu, it does not prevent normal operation from occurring when a password set.

It uses a 4-digit number that must be entered to access Maintenance Mode once it has been turned on.

Navigating the SET LOCK Sub Menu

Numbers

Black font with yellow background (highlighted) is the number that will be increased or decreased by B7 & B8.

Yellow font with black background is a number that will not be affected by B7 & B8.

- B2 = Move the highlight to the next number to the right
- B1 = Move the highlight to the next number to the left
- B8 = Increase the value of the highlighted number
- B7 = Decrease the value of the highlighted number
- B10 = Back out of the SET LOCK mode
- B9 = Advance the process of SET LOCK with the 4-digit number shown on the display

Confirming the SET LOCK activation

- After B9 has been pressed, a final confirmation action is required to activate the SET LOCK
- The top left of the display will show SAVE
- The top right of the display will show CANCEL
- Press B9 to SAVE
- Press B10 to CANCEL
- When B10 is pressed during the final confirmation step of SET LOCK, it will return the display back to the SECURITY Sub Menu without setting the lock
- The SET LOCK value of 0000 disables the lock and allows access to the Maintenance Mode without entering a password.
- A transmitter that had a SET LOCK value confirmed can have the password protection disabled by going through the steps above to set the lock value to 0000.

ABOUT

This is a static Sub Menu. It has more information than one screen can show.

- Press B8 to scroll down
- Press B7 to scroll up

The following information is displayed in this sub-menu:

- ABOUT (Sub Menu Name)
- CERVIS STANDARD (Project Family)
- Software version ID
- FCC ID
- Transmitter Serial Number

EXIT

This selection does not have a Sub Menu associated with it.

When it is highlighted:

- Pressing B9 will have the transmitter EXIT Maintenance Mode and move to general operation
- Pressing B10 will have no effect

Troubleshooting

This section is dedicated to identifying LED function during normal operation and when indicating Faults. The two receiver sections detail what each LED is for and what their normal operation should be. If any receiver LED is not performing as it should, contact Cervis Support for additional information.

The transmitter sections include both normal indications and error / fault reporting via LEDs and display. These sections include common resolutions to those conditions that can be explored prior to reaching out to Cervis Support. Should any of the common corrections not address the condition, please contact Cervis Support for additional information.

MU-9X9

Normal Operation			
LED	Name	Condition	Description
1	Health	Blinking	Unit OK, normal processor operation
2	Link	Solid	ON when RF link is active
3	TX (Transmit)	Fast Blink	RF messages are being transmitted from receiver
4	RX (Receive)	Fast Blink	RF messages are being received from transmitter
5	RX (Power)	Solid	ON when power is applied to the receiver

Table 55 - MU-9X9 Normal Operation LEDs

MU-9X15

Normal Operation			
LED	Name	Condition	Description
D37	Health	Blinking	Unit OK, normal processor operation
D38	Link	Solid - On/Off	ON when RF link is active; OFF when RF link is inactive.
D39	TX (Transmit)	Fast Blink	RF messages are being transmitted from receiver
D40	RX (Receive)	Fast Blink	RF messages are being received from transmitter
D43	Logic 3.3 V	Solid	Indicates logic bus on receiver circuit board is OK
D44	System 3.3 V	Solid	Indicates system bus on receiver circuit board is OK
D45	RF 3.3 V	Solid	Indicates bus on RF circuit board is OK
D46	System 12 V	Solid	Indicates system bus on receiver circuit board is OK
Relay #	1 LED per relay (1-16)	Solid	Relay is being commanded to change state

Table 56 - MU-9X15 Normal Operation LEDs

Note: LEDs D41 & D42 are not used

HH2S and HHMS without Display

Normal Operation		
LED Flash Pattern	Meaning	Resolution
ALL LEDs light up momentarily	LED check at transmitter power on	No action needed
RF Flashing	Transmitting and receiving RF messages	
Battery Off	Battery voltage normal	
A Solid	Trolley/Hoist A output is active	
B Solid	Trolley/Hoist A output is active	
1 Solid	AUX Relay 1 Closed	
2 Solid	AUX Relay 2 Closed	
3 Solid	AUX Relay 3 Closed	

Table 57 - HH2S and HHMS No Display Normal Operation LEDs

Operation Mode Error / Fault Conditions		
LED Flash Pattern	Meaning	Resolution
(RF + A), (Battery + B)	STOP switch check required after changing battery - HHMS ONLY	<i>Quickly</i> cycle STOP switch to complete the switch scan
(RF + Battery + A), (B)	STOP switch error - HHMS ONLY	Remove and install battery to trigger STOP switch scan again. Consult factory if condition persists.
RF Solid	Searching for receiver	Make sure associated receiver is within range and is without issue
Battery Flashing	Low battery voltage	Replace battery pack with charged battery pack as soon as possible
Battery solid for 1.25s then Off	Low battery shut down	Replace battery pack with charged battery pack to restart system
(RF + Battery), (A + B)	Button active before RF link	Release all buttons to proceed or, cycle power to transmitter
(RF + Battery + B), (A)	Switch fault	Cycle power to transmitter to see if fault clears. If fault does not clear consult factory.
(RF), (Battery), (A), (B)	Tilt fault	Should not occur with Cervis Standard. Consult factory.
(A+B), (A+B)	Receiver locked on different transmitter serial number	Control Release Lock present. Link same transmitter the receiver is locked on and perform Control Release or cycle power to receiver to clear lock.
(RF + B), (Battery + A)	RF Link loss	Bring transmitter back into range of receiver or check receiver for issues
(RF + Battery + A + B)	No associated receiver stored in transmitter	Review association process to ensure proper association
(A + B) Blinking	TX time out reached	TX will power down after flashing this code. Cycle power to restart system.
(RF), (Battery + A + B)	Software error - HHMS ONLY	Consult factory
(RF + Battery), (A + B)	Hardware error - HHMS ONLY	
(RF + Battery + B), (A)	Hardware error - HHMS ONLY	
(RF + A + B), (Battery)	Hardware error - HHMS ONLY	

Table 58 - HH2S and HHMS No Display Fault LEDs

HMMS with Display

The HHMS with display uses its OLED to provide additional detail when a fault occurs. Below is a list of the conditions shown on the display.

Operation Mode Error / Fault Conditions		
Fault Code Displayed	Meaning	Resolution
STOP icon and ALL LEDs	STOP switch pressed down	Normal operation for powering off the transmitter
DO ASSOC 0 (0)	No associated receiver stored in transmitter	Review association process to ensure proper association
MSTOP n(n)	STOP switch error (n = 0 - 3)	Remove and install battery to trigger STOP switch scan again. Consult factory if condition persists.
SW FAULT n (n)	Switch processor error (n = 0 - 3)	Cycle power to transmitter to see if the fault clears. Consult factory if condition persists.
SW ERROR 1 (1)	Software error - Syslog	
SW ERROR 2 (2)	Software error - LEDs	
SW ERROR 3 (3)	Software error - Screens	
SW ERROR 4 (4)	Software error - IO	
SW ERROR 5 (5)	Software error - Stack	
SW ERROR 6 (6)	Software error - State	
HW ERROR n (n)	Hardware error - IO	
HW ERROR 4 (4)	Hardware error - Radio	
HW ERROR n (n)	Hardware error - Switch processor (n = <=10)	Consult factory if condition persists.
API: INIT n(n)	Software error - Stack	

Table 59 - HHMS with Display On Screen Error Codes

Data Sheets

HH2S



HH2S Transmitter Data Sheet

POWER

- **V_{in}**: +2.0 to +3.0V
- **Batteries**: Two (2) AAA cell
- **Battery Life**: 100 hours
- **Low Voltage Warning**: 2.2V
- **Auto Shutdown**: 2.0V with programmable inactivity shutdown

RADIO

- **Frequency**: 906–924 MHz
- **RF Power**: 100mW@900 MHz
- **License**: License-Free
- **Modulation**: DSSS
- **Antenna**: Internal

ENVIRONMENT

- **Operating Temperature**: -20°C to 55°C (-4°F to 131°F)
- **Storage Temperature**: -20°C to 85°C (-4°F to 185°F)
- **Humidity**: 0 to 95% non-condensing

CONTROLS

- **Pushbuttons**: Up to Ten Two-Step Pushbuttons
- **Operate Force**:
 - 6N First Step (~1.349lbf)
 - 12N Second Step (~2.697lbf)
- **Actuations**: 100,000 Max. (per button)

LED INDICATORS

- Transmit
- Battery Status
- A Selection
- B Selection

ENCLOSURE

- **Dimensions**:
 - mm: 136.38 x 67.96 x 28.42
 - inches: 5.37 x 2.68 x 0.92
- **Total Weight**: 200g/7.2oz. (with lanyard)
- **Durability**:
 - High impact polymer case
 - Polycarbonate faceplate
 - Impact absorbing bumper



HHMS Transmitter Data Sheet

POWER

- **V_{in}**: Lithium Polymer Battery Pack
- **Battery Life**: 80-hour continuous operation until low battery indication
- **Auto Shutdown**:
 - 5-hour run-time after low battery indication
 - 5-hour charge to full from zero charge

RADIO

- **Frequency**: 906–924 MHz
- **RF Power**: 100mW@900 MHz
- **License**: License-Free
- **Modulation**: DSSS
- **Antenna**: Internal

ENVIRONMENT

- **Operating Temperature**: -20°C to 60°C (-4°F to 140°F)
- **Storage Temperature**: -30°C to 70°C (-22°F to 158°F)
- **Humidity**: 0 to 95% non-condensing

CONTROLS

- **Pushbuttons**: Eight 2-, 3-, or ANY-STEP
- **Force to Operate**: 2.3 lbf (10.23 N)
- **Actuations**: >Two Million (per button)

LED INDICATORS

- | | |
|-------------------|----------------|
| • Transmit | • Auxiliary 1 |
| • Battery Status | • Auxiliary 2 |
| • A Selection | • Auxiliary 3 |
| • B Selection | • Auxiliary 4 |

ENCLOSURE

- **Dimensions**:
 - mm: 76.2 x 220.98 x 42.67
 - Inches: 3.0 x 8.7 x 1.68
- **Total Weight**: 650g/1.43lb. (with lanyard)
- **Durability**:
 - High Impact Polymer Case
 - Impact-Absorbing Rubber Bumper with shoulder strap (optional)

MU-9X9



MU-9X9 Receiver Data Sheet

POWER

- **Operating Voltage:**
 - HV: 110-220 VAC
 - LV: 7-32 VDC or 10-28 VAC
- **Operating Power:** 50-60 Hz
- **Stop Circuit:**
 - Two (Series) Type Form A
 - Contact Rating 8A Maximum @ 250VAC

RADIO

- **Frequency:** 906-924 MHz @ 100mW
- **License:** License-Free
- **Antenna:** External (RP-TNC)

ENVIRONMENT

- **Operating Temperature:** -25°C to 70°C (-13°F to 158°F)
- **Storage Temperature:** -40°C to 80°C (-40°F to 176°F)
- **Humidity:** 0 to 95% Non-Condensing

CONTROLS

- **Six Function:** Type Form A
- **Four System:** Type Form A
- **Contact Rating:** 5A Maximum @ 250VAC

LED INDICATORS

- One white LED used during association

ENCLOSURE

- **Dimensions:**
 - Millimeters: 114.3 x 61.89 x 146.05
 - Inches: 4.500 x 2.437 x 5.750
- **Durability:** NEMA 4, 4X, 6, 6P IP65/IP67
- **Mounting:**
 - Four enclosure flange screw holes;
 - Two enclosure flange hole-slide slots

MU-9X15



MU-9X15 Receiver Data Sheet

POWER

- **Operating Voltage:**
 - HV: 110-220 VAC
 - LV: 7-32 VDC or 10-28 VAC
- **Operating Power:** 50-60 Hz
- **Stop Circuit:**
 - Two (Series) Type Form A
 - Contact Rating 8A Maximum @ 250VAC

RADIO

- **Frequency:** 906-924 MHz @ 100mW
- **License:** License-Free
- **Antenna:** External (RP-TNC)

ENVIRONMENT

- **Operating Temperature:** -25°C to 70°C (-13°F to 158°F)
- **Storage Temperature:** -40°C to 80°C (-40°F to 176°F)
- **Humidity:** 0 to 95% Non-Condensing

CONTROLS

- **Sixteen:** Type Form A
- **Contact Rating:** 8A Maximum @ 250VAC
- **Banked Relays:**
 - Four banks of three, each bank fused at 5A @ 250VAC
 - 5A Maximum @ 250VAC

LED INDICATORS

- One white LED used during association

ENCLOSURE

- **Dimensions:**
 - Millimeters: 211.5 x 161.5 x 100
 - Inches: 8.327 x 6.358 x 3.937
- **Durability:** NEMA 1, 2, 4, 4X IP65/IP67
- **Mounting:**
 - Four wall mounting brackets
 - Four M4 x 10mm LG. self-tapping screws

Appendix A: Exposure to Radio Frequency Energy

Cervis Standard transmitters and machine units contain radio transceivers. When active, a transmitter sends out radio frequency (RF) energy through its internal antenna. Cervis Standard transmitters and receivers comply with limits set by the United States Federal Communications Commission (FCC) for operating distance from human tissue.

Appendix B: RF Exposure Considerations

The radio module may be used in a variety of host applications falling into two general categories:

1. Mobile applications: Any operating locations where the transmitting equipment is not on a human body. In mobile applications, the host application is typically fixed to mobile equipment, with either an internal or external antenna.
2. Portable applications: Any operating locations where the transmitting equipment is located on the hand, arm, or other part of the human body. In portable applications, the equipment is either held in the hands of an operator or affixed to either a belt or harness on the torso.

Equipment containing the radio module was evaluated for RF exposure hazards by two approaches:

1. Maximum Permissible Exposure (MPE) for mobile applications.
2. Specific Absorption Rate (SAR) for portable applications.

Required separation distances are measured from the actual location of the radiating part of the antenna. An antenna may be inside the host application, affixed to the host application enclosure, or at the end of an optional extension coaxial cable.

Mobile Applications

Equipment must be located at least 20cm away from areas likely to be occupied by an unaware person.

Transmitter Applications

All operators of transmitter equipment with any type of antenna require proper equipment operation training, and such training must include RF exposure safety instructions. They are then considered to be aware persons once training is completed.

If the portable operating position is on the hand or arm, a 5mm separation is required between the radiating part of the antenna and nearby human tissue.

Required Training

All installers and operators of host applications that include an SRF310 FT module must be trained to use proper RF safety precautions as presented in this Appendix.

DIP Switch Master Chart - Introduction

As mentioned in the MU-9X15 section, the receiver has 8 DIP Switches. Switches 1-7 can be changed in order to achieve any of the 126 crane control configurations described in the Configurations Section.

The chart below helps identify what configuration is in use in any Cervis Standard MU-9X15 receiver.

To use the chart:

- Open up the receiver cover and locate the DIP Switch on the printed circuit board
- Compare the DIP switch positions that are up and down and match it with the image from the chart
- Looking at the chart, find the configuration number using the code on the left (e.g. C1 = Configuration 1).
- On the right side of each DIP Switch image in the chart, you can also find the Configuration Group Number (e.g G1).
- Using the group number on the right, go to that section of the manual.
- Once in the correct group, you can find information regarding the specific configuration number to learn more about how that receiver is currently programmed to operate.

DIP Switch Master Chart

C 1 ON 1 2 3 4 5 6 7 8 G 1	C 1 1 ON 1 2 3 4 5 6 7 8 G 1	C 2 1 ON 1 2 3 4 5 6 7 8 G 4
C 2 ON 1 2 3 4 5 6 7 8 G 1	C 1 2 ON 1 2 3 4 5 6 7 8 G 1	C 2 2 ON 1 2 3 4 5 6 7 8 G 4
C 3 ON 1 2 3 4 5 6 7 8 G 1	C 1 3 ON 1 2 3 4 5 6 7 8 G 1	C 2 3 ON 1 2 3 4 5 6 7 8 G 4
C 4 ON 1 2 3 4 5 6 7 8 G 1	C 1 4 ON 1 2 3 4 5 6 7 8 G 1	C 2 4 ON 1 2 3 4 5 6 7 8 G 4
C 5 ON 1 2 3 4 5 6 7 8 G 1	C 1 5 ON 1 2 3 4 5 6 7 8 G 1	C 2 5 ON 1 2 3 4 5 6 7 8 G 4
C 6 ON 1 2 3 4 5 6 7 8 G 1	C 1 6 ON 1 2 3 4 5 6 7 8 G 1	C 2 6 ON 1 2 3 4 5 6 7 8 G 4
C 7 ON 1 2 3 4 5 6 7 8 G 1	C 1 7 ON 1 2 3 4 5 6 7 8 G 1	C 2 7 ON 1 2 3 4 5 6 7 8 G 5
C 8 ON 1 2 3 4 5 6 7 8 G 1	C 1 8 ON 1 2 3 4 5 6 7 8 G 1	C 2 8 ON 1 2 3 4 5 6 7 8 G 5
C 9 ON 1 2 3 4 5 6 7 8 G 1	C 1 9 ON 1 2 3 4 5 6 7 8 G 2	C 2 9 ON 1 2 3 4 5 6 7 8 G 5
C 1 0 ON 1 2 3 4 5 6 7 8 G 1	C 2 0 ON 1 2 3 4 5 6 7 8 G 2	C 3 0 ON 1 2 3 4 5 6 7 8 G 3

