



**MU-X15 System
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:

- (1) This device may not cause harmful interference and
- (2) 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 Canadian 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.

L'installateur de cet équipement radio doit s'assurer que l'antenne est située ou orientée de façon à ne pas émettre un champ RF dépassant les limites de Santé Canada pour la population générale; consulter le Code de sécurité 6, disponible sur le site Web de Santé Canada <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.

IC 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 (e.i.r.p.) is not more than that necessary for successful communication.

Partie 1 : 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.

Partie 2 : 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.

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Definitions/Notes

Association: When a handheld is programmed with a receiver's identification (ID) during the Association process.

Pairing: When a handheld takes control of a receiver for operation.

DSSS: Direct Sequence Spread Spectrum; an advanced wireless communications technology.

Warrior Receiver: "Receiver" mounted to the crane or machine.

Line of Sight (aka Direct Line of Sight): Term used to describe radio frequency (RF) communication where the pathway between units is clear of physical obstacles such as walls, earth, and other obstructions.

TX/RX: Wireless transmission and reception of data.

CAN TX/RX: Transmit and receive data over Control Area Network (CAN).

Transmitter: Handheld or portable unit.

Receiver: Machine-mounted unit.

Cervis, Inc. **Safety Precautions**

- ✓ **Read and follow all instructions.**
- ✓ **Failure to abide by Safety Precautions may result in 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.**
- ✓ **Changes or modifications made to equipment 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 certain that it is safe to do so.**
- ✓ **Turn off the handheld remote and remove power from the machine unit before attempting any maintenance. This prevents accidental operation of the controlled machinery.**
- ✓ **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 handheld or machine unit enclosures. Do not use high-pressure equipment to clean the handheld remote or machine unit.**
- ✓ **Disconnect the radio machine unit before welding on the machine. Failure to disconnect the base 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 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.**

1.0 Warrior MU-X15 System

The Warrior MU-X15 System consists of a receiver (MU-9X15) and one or more Warrior MU-X15 System handheld remotes (HH2S-9XW10).

1.1 Warrior MU-9X15 Receiver

An MU-9X15 can communicate with one handheld at a time (first come/first serve). The MU-9X15 can connect to any handheld that has its receiver ID stored in its memory. The rugged construction and relay output configurability allows Warrior MU-X15 receivers to be used in a wide variety of typical crane control applications.

Standard (DIP Switch Set) Configurations include:

- 3-motion, 2-speed control with A/B Select configurations
- 3-motion, 2-speed control with momentary or latching AUX functions
- 3-motion, 2-speed control with “4 wire” hoist set up
- 4-motion, 2-speed control

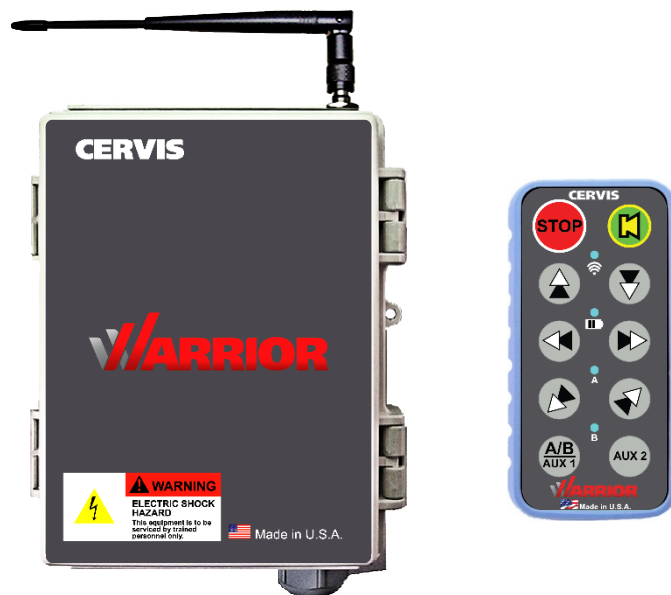


Figure 1. Warrior MU-X15 System Receiver and Handheld Remote

Warrior MU-9X15 Features

- 16 Form A relays
- Rugged, compact design
- 900 MHz license-free operation
- Designed to ICS 8 NEMA Crane Specification
- Eight DIP switches allow for configurability
- High VAC, Low VAC, and DC input ranges available
- Operating temperature: -40°C to $+70^{\circ}\text{C}$ (-40°F to $+158^{\circ}\text{F}$)
- Storage temperature: -40°C to $+80^{\circ}\text{C}$ (-40°F to $+176^{\circ}\text{F}$)

1.2 Warrior MU-X15 HH2S-9XW10 Handheld Remote

A Warrior MU-X15 HH2S-9XW10 handheld has eight 2-stage buttons plus STOP and HORN/START. The handheld is powered by two 1.5V AAA cell batteries. Once associated to a receiver, the handheld stores **one** receiver ID in its memory. One or more handhelds are associated with the receiver at Cervis, Inc. before it is shipped. Users use the Association process described in Section 4.0 to change the ID in a handheld memory. See Section 4.4 (Factory Reset) to clear the handheld memory so that it will not control any receiver.

The Warrior MU-X15 HH2S-9XW10 has four LEDs that identify system status and provide diagnostics. LEDs as shown in Figure 2 are: **Transmit/Receive (TX/RX)**; **Battery Status**; **A Selection**; and **B Selection**.



Figure 2. Warrior MU-X15 HH2S-9XW10 Handheld Remote

Warrior MU-X15 HH2S-9XW10 Handheld Remote Features

- Powered by two 1.5V AAA cell batteries
- Low Battery Warning and Low Battery Auto-Shutdown
- 900 MHz license free operation @ 100 mW
- Rugged compact design
- Protective rubber bumper and detachable wrist lanyard
- Four Diagnostic LED indicators
- Ten two-step actuators
- Operating temperature: -40°C to $+60^{\circ}\text{C}$ (-40°F to $+140^{\circ}\text{F}$)
- Storage temperature: -40°C to $+85^{\circ}\text{C}$ (-40°F to $+185^{\circ}\text{F}$)

2.0 Warrior MU-9X15

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 fused at 5A. The fourth relay is independent rated at 8 A @ 250 VAC. Bank 4 features one independent Horn/Light relay, two series relays that form the Main Line Contact (MLC) output, and one Start relay. The Start and MLC circuits share a common fused at 5 A (Reference Appendix C for details regarding MLC safety logic).

The independent relays (K13, K04, K08, K12) are rated at 8 A @ 250 VAC.

Line Fuse Rated 2A @ 250VAC



Unfused Independent Relays Rated 8A @ 250VAC



8A @ 250VAC Rated Relays Fused at 5A @ 250VAC

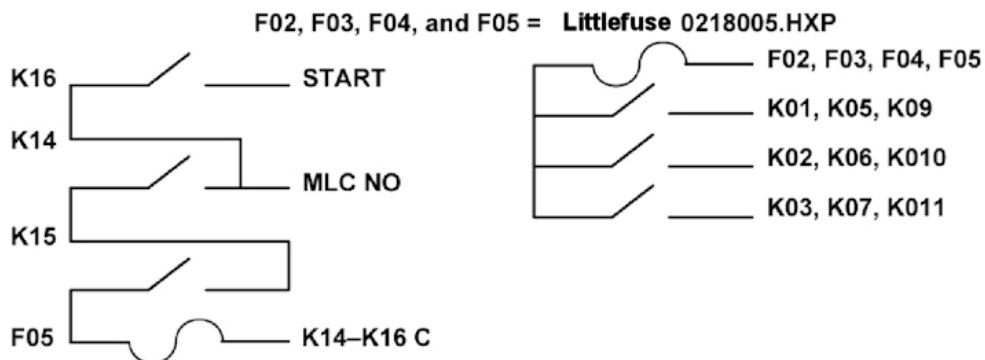


Figure 3. Bank Configuration

2.1 Input Voltages

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

- 110 to 220 VAC at 50–60 Hz (High VAC)
- 10 to 28 VAC at 50–60 Hz (Low VAC)
- 9 to 36 VDC

2.2 MU-9X15 Diagnostic LEDs

The MU-9X15 has three system status LEDs, 16 relay status LEDs, and four power LEDs that can be used as diagnostics tools (see Table 1). The MU-9X15 has one internal LED indicator used for association and health status visible from outside the enclosure. The strobe LED can be shut off for one hour by pressing the shutoff switch (see the **RED** circle in Figure 4) and will reactivate after either one hour has passed or Association (Section 4.2) is performed.

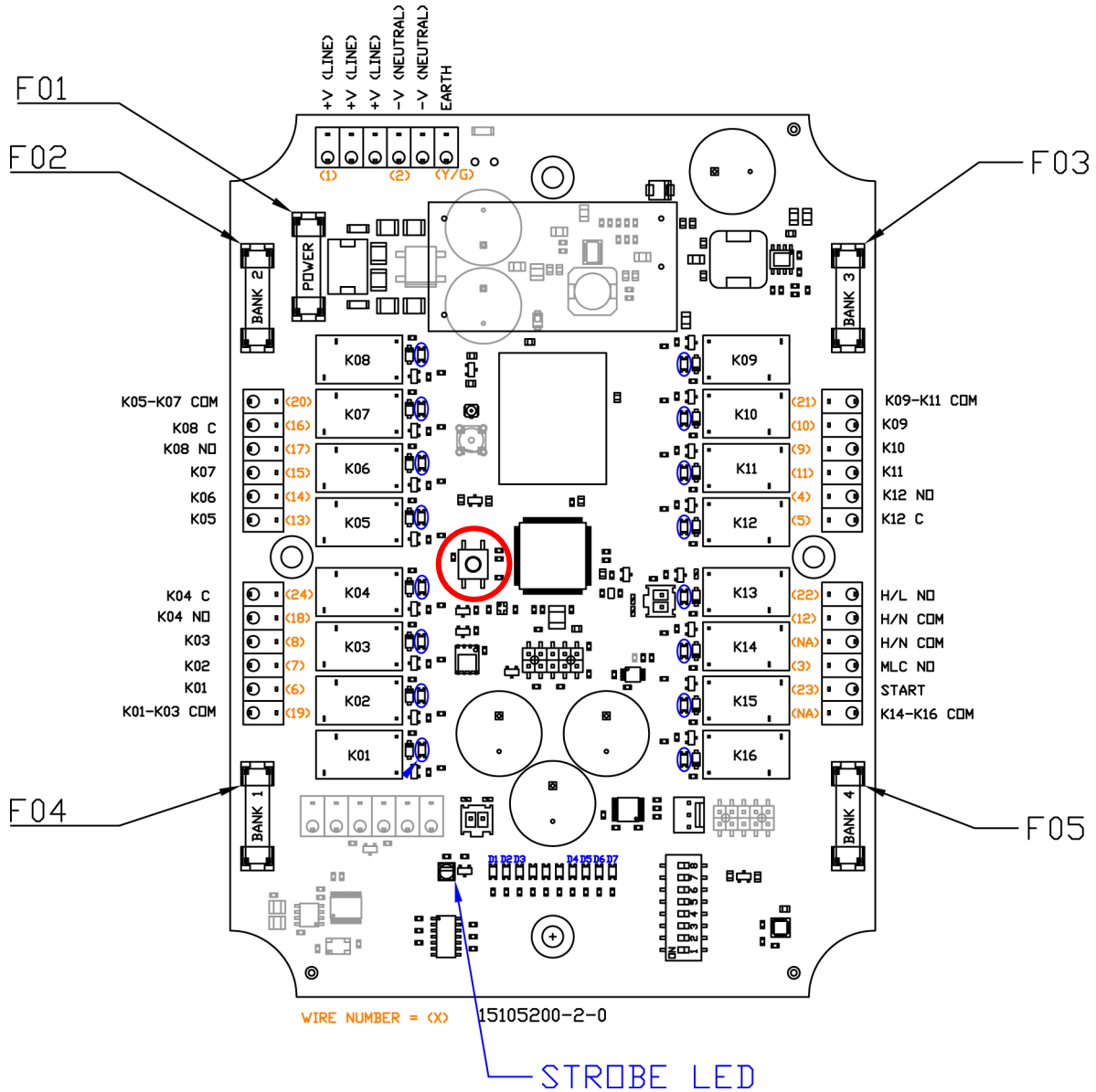


Figure 4. MU-9X15 LED Indicators and Relay Locations

Table 1. MU-9X15 Diagnostic LEDs

| LED | Name | LED State | Description |
|--------------------|---------------|---------------|--|
| 1 | Health | Blinking | Unit OK, normal processor operation |
| 2 | TX (Transmit) | Fast Blinking | Indicates RF Messages sent to handheld |
| 3 | RF 3.3 V | Steady Lit | Indicates RF 3.3 V bus OK |
| 4 | RX (Receive) | Fast Blinking | Indicates RF Messages received from handheld |
| 5 | System 12 V | Steady Lit | Indicates System 12 V bus OK |
| 6 | Logic 3.3 V | Steady Lit | Indicates Logic 3.3 V bus OK |
| 7 | System 3.3 V | Steady Lit | Indicates System 3.3 V bus OK |
| LED per Relay (16) | Relay State | Steady Lit | Relay Active |

Each of the 16 relays has its own LED. When commanded, the relay LED illuminates.

2.3 MU-9X15 Mounting

Caution!



Disable the machine on which the receiver is to be attached before installation to avoid injury.

Use the configuration diagrams supplied by Cervis, Inc. 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 device so that the unit antenna is in the operator's view. Apply an antenna extension cable if needed. Cervis, Inc. optional extension cables are 3-ft. (J5-07), 10-ft. (J5-02), or 25-ft. (J5-13). See Figure 6.

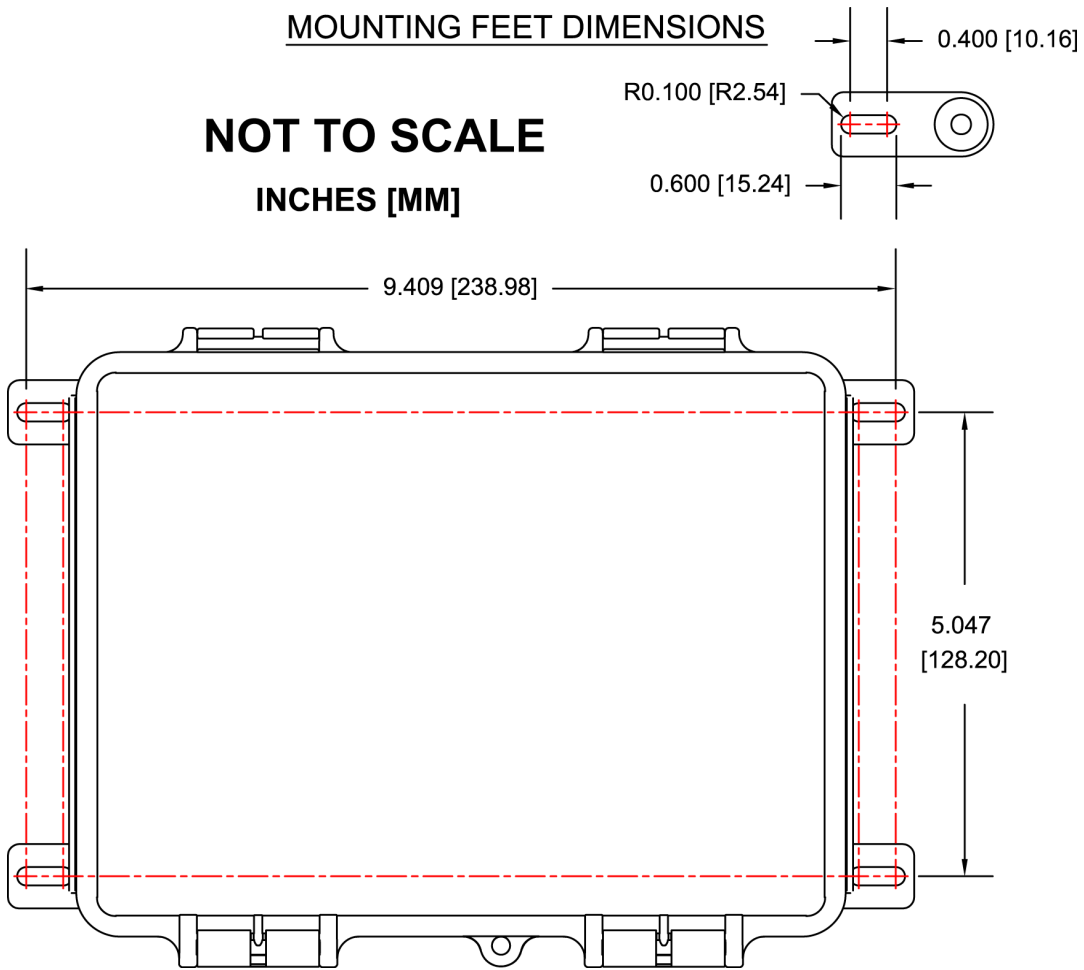


Figure 5. MU-9X15 Mounting Dimensions

2.4 MU-9X15 Power

The unit is supplied power through the control cable. The cable is part of the final assembly and comes attached to the receiver. MU-9X15 is available in the following input power configurations:

Table 2. MU-9X15 Power Configurations

| Model | Input Voltage | Range | Frequency |
|--------------------|-----------------|--------------------------|-----------|
| MU-9X15-HVA | High Voltage AC | 115–230 V _{rms} | 50–60 Hz |
| MU-9X15-LVA | Low Voltage AC | 10–28 V _{rms} | 50–60 Hz |
| MU-9X15-LVD | DC | 7–36 V | — |

2.5 MU-9X15 External Antenna

The Warrior MU-9X15 comes with a 900 MHz external antenna that attaches to the receiver using the external unit connector. Antenna extensions are available in 3-, 10-, and 25-foot lengths.



Figure 6. MU-9X15 900 MHz External Antenna and Optional Extension Cables

2.6 MU-9X15 Cable and Field Wiring

✓ **Note:** The control cable is individually marked on the insulation of each wire. Negative VDC (-VDC) should be connected directly to the power supply negative terminal.

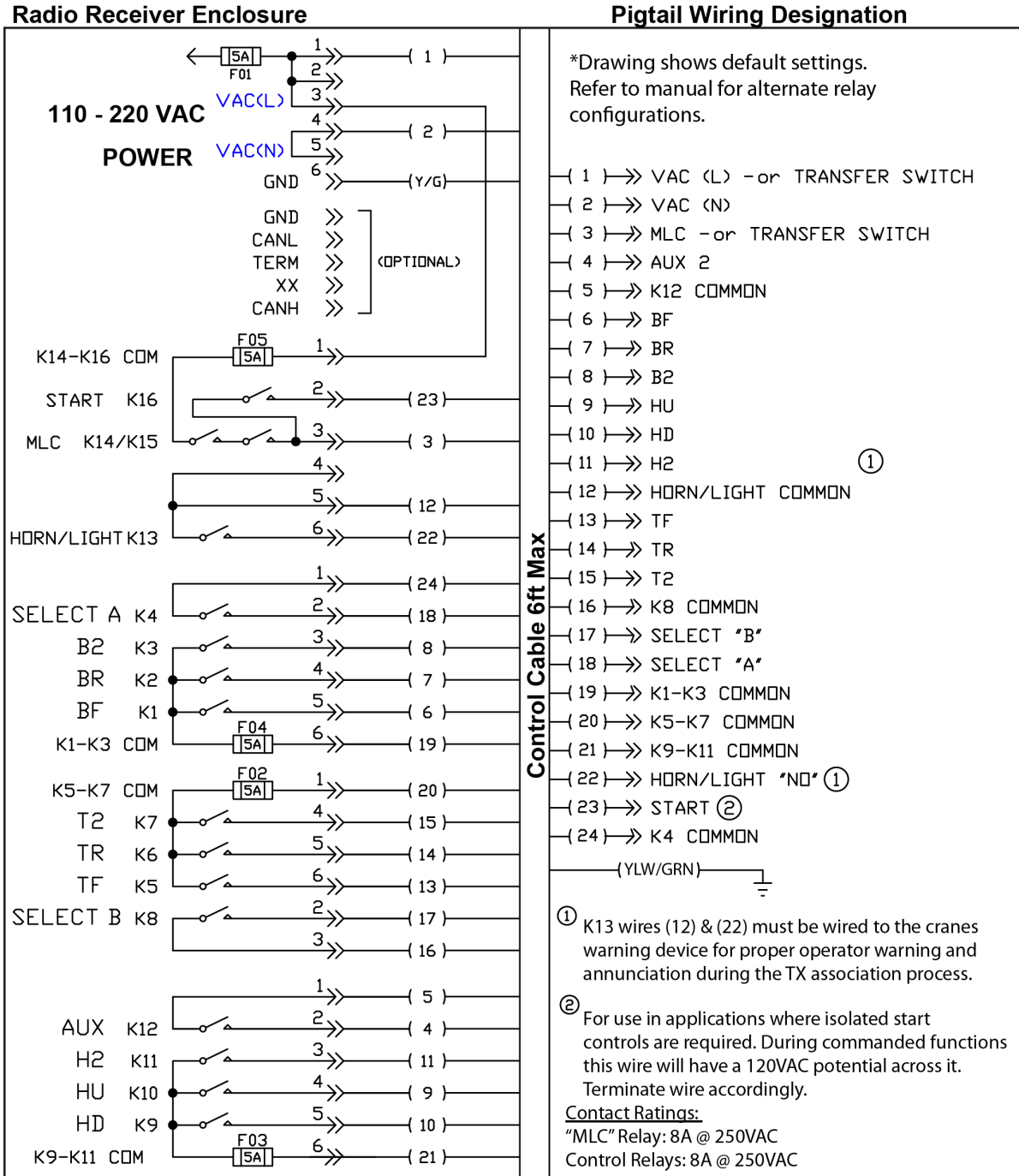


Figure 7. MU-9X15 Wiring Diagram

2.7 MU-9X15 Fuse Information

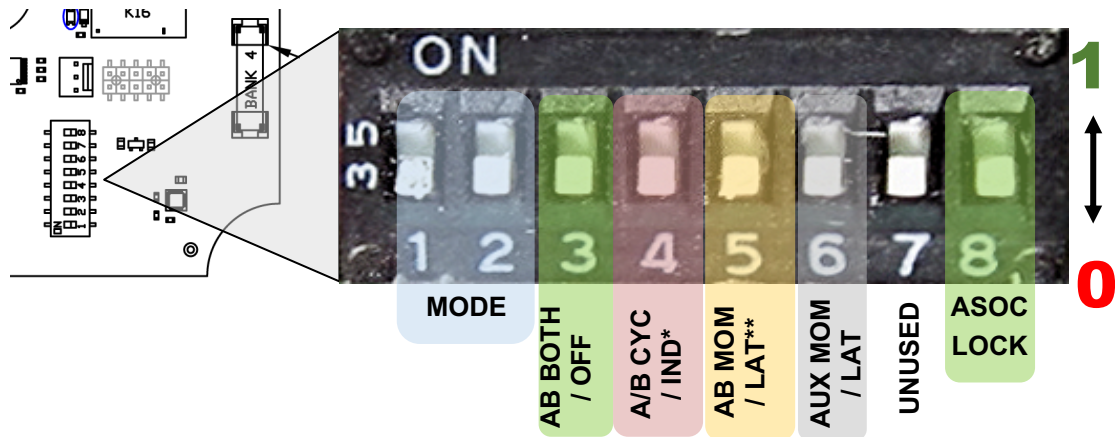
Use Table 3 to find replacement fuse part numbers based on your system's rated input voltage rating.

Table 3. MU-9X15 Fuse Identification

| Model | Fuse Package | Bank 1-4 Fuse P/N | F01 Fuse P/N |
|-------------|---------------|-------------------|--------------|
| MU-9X15-HVA | 5x20 MM Glass | 0218005.HXP | 0217002.H |
| MU-9X15-LVA | 5x20 MM Glass | 0218005.HXP | 0217002.H |
| MU-9X15-LVD | 5x20 MM Glass | 0218005.HXP | 0217002.H |

2.8 MU-9X15 DIP Switch Configurations

The MU-9X15 uses eight DIP switches to allow for relay configuration of A/B cycling sequences, configuring relays for 3 or 4-wire hoist control systems, configuration of Aux Relay A, and configuration of Aux Relay B for momentary or latching control.



*Applies only to HH, only in MODE 00 and 01

**Applies only to HH, only in MODE 00 and 01, only if SW4 = 1

Figure 8. MU-9X15 SW01 DIP Switch Assignments

2.9 MU-9X15 Mode Definitions

Table 4. Switches 1 and 2 Mode Configurations

| Mode | Definition |
|------|---|
| 00 | 3-Motion. Bridge, Trolley, and Hoist 3 relays. A, B, and AUX functions available. |
| 01 | 3-Motion. Bridge, Trolley 3 relays, Hoist 4 relays. A and B functions available, AUX unavailable. |
| 10 | 3-Motion. Bridge, Trolley, Hoist 4 relays. A, B, and AUX functions unavailable. |
| 11 | 4-Motion. Bridge, Trolley, Hoist, 4 th axis 3 relays. A, B, and AUX functions unavailable. |

Table 5. DIP Switch 3: Applies to All Modes and All Transmitters

| Name | Set | Definition |
|-------------|-----|---|
| AB BOTH/OFF | 0 | HH: Cycle pattern is A, B, Both. MCB: Middle position of A/B switch is BOTH. |
| | 1 | HH: Cycle pattern is A, B, Off. MCB: Middle position of A/B switch is OFF. |

Table 6. DIP Switch 4: Applies to HH, Only Applies to Mode 00 or 01

| Name | Set | Definition |
|------------|-----|---|
| AB CYC/IND | 0 | HH: Button 9 cycles A/B (See AB BOTH/OFF). MCB: No effect. |
| | 1 | HH: Button 9 activates A, button 10 activates B, NO AUX (see AB MOM/LAT) MCB: No effect. |

Table 7. DIP Switch 5: Only Applies to HH AND Only Applies to HH in Mode 00 or 01 and Only Applies if AB CYC/IND = 1

| Name | Set | Definition |
|------------|-----|---|
| AB MOM/LAT | 0 | HH: A and B are momentary outputs. MCB: No effect. |
| | 1 | HH: A and B are latching outputs. MCB: No effect. |

Table 8. DIP Switch 6: Only Applies in Mode 00 (HH: AB CYC/IND Needs Set to 0)

| Name | Set | Definition |
|-------------|-----|---|
| AUX MOM/LAT | 0 | HH: AUX is momentary. MCB: AUX is momentary. |
| | 1 | HH: AUX is latching. MCB: AUX is latching. |

Table 9. DIP Switch 8: Applies to HH, Only Applies in Mode 00 or 01

| Name | Set | Definition |
|-----------|-----|----------------------------|
| ASOC LOCK | 0 | Association NOT permitted. |
| | 1 | Association permitted. |

✓ **Note:** DIP switches may be changed at any time. However, changes will only be applied when there is no active RF connection.

2.10 MU-9X15 Relay-to-Mode Output Assignments

Table 10. MU-9X15 Relay Output Assignments

| Relay | K1 | K2 | K3 | K4 | K5 | K6 | K7 | K8 | K9 | K10 | K11 | K12 | K13 | K16 |
|---------|----|----|-----|-------------------|----|----|-----|-------------------|----|-----|-----|-------------------|-------|-----|
| Mode 00 | BF | BR | B2 | A | TF | TR | T2 | B | HD | HU | H2 | AUX | A/H/L | ST |
| Mode 01 | BF | BR | B2 | A | TF | TR | T2 | B | HD | HU | HD2 | HU2 | A/H/L | ST |
| Mode 10 | BF | BR | BF2 | BR2 | TF | TR | TF2 | TR2 | HD | HU | HD2 | HU2 | A/H/L | ST |
| Mode 11 | BF | BR | B2 | 4 th R | TF | TR | T2 | 4 th F | HD | HU | H2 | 4 th 2 | A/H/L | ST |

Table 11. Table 10 Abbreviation Key

| Abbreviation Key | |
|---|--|
| BF – Bridge Forward | BR – Bridge Reverse |
| B2 – Bridge Second Speed | A – Crane A Control |
| TF – Trolley Forward | TR – Trolley Reverse |
| T2 – Trolley Second Speed | B – Crane B Control |
| HD – Hoist Down | HU – Hoist Up |
| H2 – Hoist Second Speed | AUX – Auxiliary |
| A/H/L – Associate / Horn / Light | ST – Start/Horn |
| BF2 – Bridge Forward Second Speed* | BR2 – Bridge Reverse Second Speed* |
| HU2 – Hoist Up Second Speed | HD2 – Hoist Down second Speed* |
| TF2 – Trolley Forward Second Speed* | TR2 – Trolley Reverse Second Speed* |
| 4 th R – 4 th Axis Reverse | 4 th F – 4 th Axis Forward |
| 4 th 2 – 4 th Axis Second Speed | |

**Used in four wire applications.*

3.0 Warrior MU-X15 Handheld Remote (HH2S-9XW10)

The HH2S-9XW10 handheld is a small, compact handheld remote control that interfaces with Warrior MU-9X15 receiver. The HH2S-9XW10 is made up of ten 2-step actuators. The HH2S-9XW10 uses two AAA cell batteries for power. The handheld remote enclosure is constructed of rugged polycarbonate designed to meet an ingress protection rating of IP55, according to IEC 60529. The HH2S-9XW10 has four LEDs used for diagnostics that indicate wireless link (transmit/receive), Battery, and A/B selection.

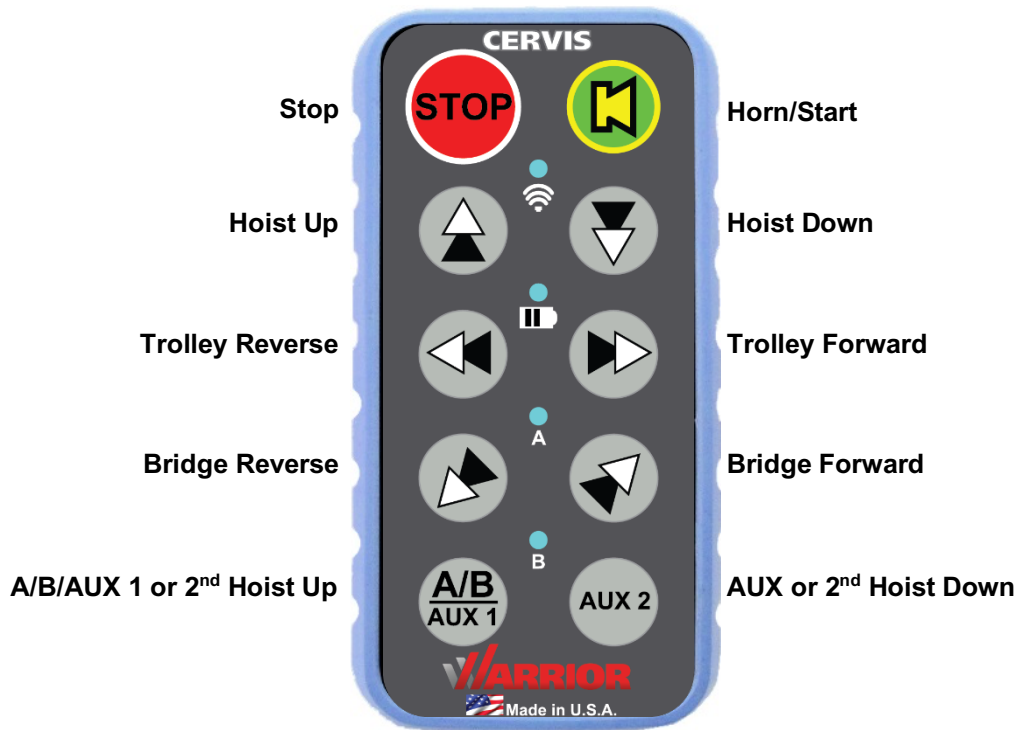
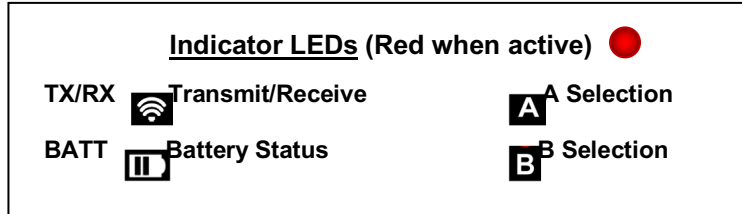


Figure 9. HH2S-9XW10 and LED Descriptions

HH2S-9XW10 handheld remote button functions are configured by manipulating the MU-9X15 DIP Switch Mode settings. These configurations and the button functions are listed in Table 10.

3.1 HH2S-9XW10 Battery Installation

HH2S-9XW10 handheld units are powered by two AAA cell batteries. When installing batteries, be sure to observe proper polarity as marked on the inside of the compartment to avoid damaging the unit. To replace or install batteries in the handheld:

1. Loosen the four small Philips screws from the battery compartment cover, and lift the cover from the handheld. The screws remain attached to the cover. Make sure the compartment sealing gasket stays in place on the handheld.
2. Install two fresh size AAA batteries. Be sure to position batteries as shown in Figure 10.
3. Replace the compartment cover and tighten the four Philips screws. Do not over-tighten these screws, but make sure they are tight enough to properly seal the gasket.

✓ **Note:** Discard expired batteries according to local regulations.

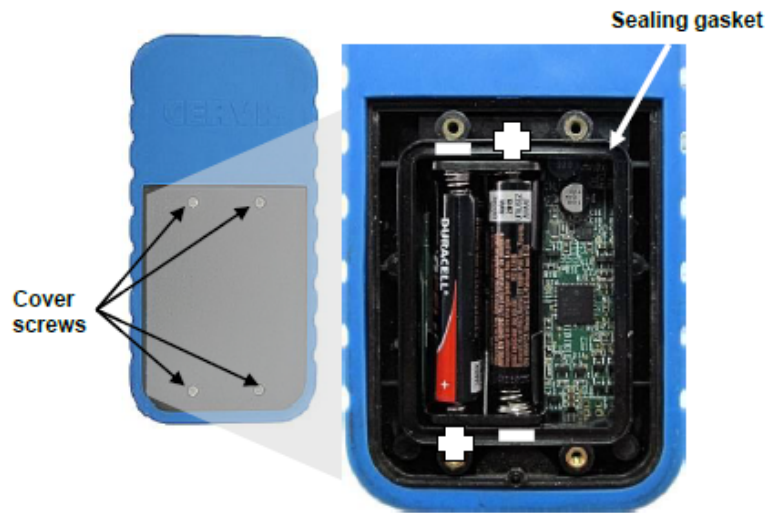


Figure 10. HH2S-9XW10 Battery Installation

Caution!



Be sure to observe proper polarity when placing batteries in the handheld battery compartment.

3.2 HH2S-9XW10 Battery Warning and Shutdown

The HH2S-9XW10 will alert users if the remaining battery life is getting low or is too low for normal operation.

LOW BATTERY

The BATTERY LED flashes once per second indicating a LOW BATTERY (2.1V or less) situation is present. Replace them with two fresh AAA batteries as soon as possible. The LED will flash at one-second intervals until the batteries are changed, or until the voltage level drops to 2.0 V and Auto-Shutdown occurs.

AUTO-SHUTDOWN

At 2.0 V, the BATTERY LED flashes briefly for approximately 1.25 seconds before the handheld remote automatically shuts down.

Install two fresh AAA batteries before using the handheld again.

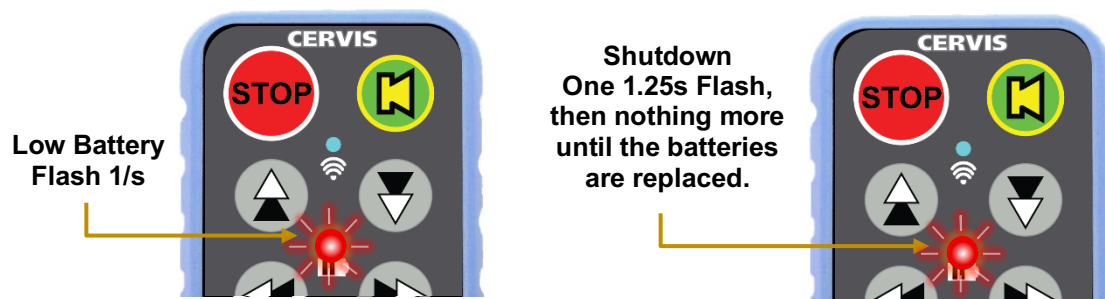


Figure 11. HH2S-9XW10 Remote Low Battery Warning and Auto-Shutdown

4.0 Warrior MU-X15 System Operation

4.1 System Startup

The following assumes that power is applied to the Warrior MU-9X15 receiver.

1. Press the handheld STOP button (B1).
2. Wait while the LEDs cycle and then the RX/TX LED begins flashing.
3. Press the Horn/Start button (B2). This energizes the MLC relays in the receiver.



The handheld is ready for normal functional operation.

4.2 Associating a Handheld with a Receiver

Warrior MU-X15 system handhelds are associated with the receiver before the system is shipped; and the Association process is locked by DIP switch 8 in the receiver being 0 (OFF). The receiver only communicates with handhelds it is associated with. When necessary, other Warrior handhelds can be associated with the receiver as additional spares or to replace damaged handhelds, but the receiver's association ability must be unlocked first.

There are two methods to unlock association:

1. By manually changing the position of DIP switch 8 in the receiver. To unlock Association, DIP Switch 8 must be changed from its default position (0 [OFF]) to (1 [ON]). Unlocking with the DIP switch unlocks association until DIP switch 8 changes back to the 0 (OFF) or LOCKED position.
2. By using an already associated handheld and performing a "virtual" UNLOCK. This process allows users to unlock the receiver from a distance without needing to access the receiver. A virtual unlock allows users to associate with the locked receiver for a limited time; after five minutes—or after a successful handheld association—the virtual unlock expires, and the receiver becomes locked again.

4.2.1 Associating a Handheld Using the DIP Switch Unlock Option.

This process will unlock association of the receiver allowing the user to associate handhelds to the receiver until the DIP switch is set back to the locked position.

1. Set the receiver SW01 DIP Switch 8 ON (UP).
2. If the receiver is **Off**, the Horn/Light relay will activate when it is powered. If the receiver is **On**, the Horn/Light relay will immediately activate.
3. Go to section 4.3

Caution!



Cervis, Inc. does not recommend leaving receivers in an UNLOCKED state. Move DIP switch 8 to the "0" (OFF) position once association is complete.

4.2.2 Associating a Handheld Using the Virtual Unlock Process

✓ **Note:** Associating a new transmitter using Virtual Unlock can only be done from a transmitter that is already associated to the receiver.

This process unlocks association for **five** minutes, allowing the user to associate another handheld to the receiver. Once association is complete—or five minutes have passed—the RECEIVER will return to a locked state.

✓ **Note:** The target receiver must be powered.

1. Turn on the handheld by pressing the STOP button.
2. Wait for the RX/TX LED to begin blinking rapidly.
3. Press and hold buttons A/B Aux1, AUX2, and then STOP.

Receiver will sound the horn and activate the Association relay to confirm the receiver is now unlocked. The handheld then powers down.

4. Go to Section 4.3.

4.3 Associate a Handheld to a Receiver

This process is required when the handheld memory slot is either empty or the user wishes to associate to a different receiver.

✓ **Note:** During this process, a receiver that is in use with another handheld cannot be associated.

1. Turn on the handheld by pressing and releasing the **STOP** button.
2. **Within 1 second**, while the **B Select LED** is active, simultaneously press and release buttons A/B and AUX 2.

Handheld LEDs will begin cycling indicating the handheld is in maintenance mode.

3. Simultaneously press and hold buttons 3 (UP) and 4 (DOWN) for approximately five seconds.
4. Release the buttons when **LED A** starts blinking.
5. TX/RX LED and **B Selection LED** become active, indicating the handheld is attempting to locate all available Warrior receivers.
6. Once the handheld has completed its search—and one or more receivers have been found—the **TX/RX LED** and **A Selection LED** become active.

If there are no receivers available, the handheld stays in scan mode until the handheld times out or is turned off.

7. A detected receiver starts blinking the association LED indicator, and the Horn/Light relay engages to sound the horn. To select this receiver, press button AUX 2. The TX/RX LED starts blinking rapidly, indicating communication is established. The receiver ID is now stored in the handheld memory slot.
8. If the found receiver unit is **NOT** the receiver desired, press the A/B AUX 1 button to scroll through the detected receivers until the desired receiver is found. (It is the one blinking its association LED indicator and pulsing its Horn/Light relay that sounds the horn.) Press button AUX 2 to select the receiver. The TX/RX LED starts flashing rapidly,



indicating communication is established. The selected receiver is stored in the handheld memory slot.

4.4 HH2S-9XW10 Handheld Factory Reset (Memory Clear)

The following steps will perform a factory reset on the handheld. Once this process is complete, the handheld memory slot is cleared and it will not communicate with any receivers.

✓ **Note:** *The memory of spare handhelds from the factory will be clear upon arrival.*

1. Turn on the handheld by pressing and releasing button 1 (STOP).
2. Within 1s of activating the handheld, while only LED 4 is active, simultaneously press and release buttons 9 and 10. The LEDs will start scrolling indicating maintenance mode.
3. Simultaneously press and hold buttons 9 and 10.
4. Press and release button 1 (STOP).
5. The handheld will turn off indicating the factory reset was successful.

A handheld that has been cleared will power up and immediately shutdown indicating that it has no receiver in its memory.



Figure 12. HH2S-9XW10 with Numbered Buttons

5.0 Warrior MU-X15 System Specifications

5.1 MU-9X15 Receiver Specifications

Table 12. MU-9X15 Receiver Specifications

| Item | Description | |
|---------------------------|----------------|---|
| Power (V_{in}) | MU-9X15-HVA | 115 to 230 V_{rms} @ 50–60 Hz |
| | MU-9X15-LVU | 9–36VDC or 10–28 VAC @ 50–60 Hz |
| Environment | Operating Temp | –13 °F to 158 °F (–25 °C to 70 °C) |
| | Storage Temp | –40 °F to 176 °F (–40 °C to 80 °C) |
| | Humidity | 0–95% non-condensing |
| Radio | Frequency | 906–924 MHz @ 100mW |
| | License | No license required |
| | Modulation | Channel-Hopping DSSS |
| | Antenna | External (RP-TNC) |
| Enclosure | Dimensions | mm: 200 x 150 x 100 Inches: 7.87" x 5.9" x 3.93" |
| | Weight | 1.5 lbs. |
| | Durability | NEMA 1, 2, 4, 4X IP65/67 |
| LED Indicator | White | Used during association |
| Control Relays | Function | Nine Form A Relays, 8 A @ 250 VAC each Three banks of three relays each bank fused at 5 A @ 250 VAC |
| Main Line Contactor (MLC) | Safety Circuit | Two (series) Type Form A 8 A @ 250 VAC Fused @ 5 A @ 250 VAC |
| Isolated Relays | Independent | Four Form A, 8 A @ 250 VAC |
| Input Fuse | Line | One 2 A @ 250 VAC |

5.2 HH2S-9XW10 Handheld Specifications

Table 13. HH2S-9XW10 Handheld Specifications

| Item | Description | |
|-------------|----------------------|--|
| Power | V _{in} | +2.1 V to +3.2 V |
| | Source | Two (2) AAA cell batteries |
| | Low Battery Warning | ~2.1V – batteries should be immediately replaced |
| | Low Battery Shutdown | <2.0V – batteries must be replaced to operate |
| Environment | Operating Temp | –20 °C to 55 °C (–4 °F to 131 °F) |
| | Storage Temp | –20 °C to 85 °C (–4 °F to 185 °F) |
| | Humidity | 0–95% non-condensing |
| Radio | Frequency | 904–926 MHz @ 100 mW |
| | License | No license required |
| | Modulation | Channel-Hopping DSSS |
| | Antenna | Internal |
| Enclosure | Dimensions | mm: 136.38 x 68.96 x 28.42 Inches: 5.37" x 2.68" x 0.92" |
| | Weight | 200 g / 7.2 oz. (With lanyard or belt clip) |
| | Durability | High Impact Polymer case Polycarbonate faceplate Impact absorbing bumper |
| Indicators | Wireless | Indicates wireless communications |
| | Battery | Indicates battery status |
| | A | Indicates A selected when lit |
| | B | Indicates B selected when lit |
| Pushbuttons | Ten | Two-step |
| | Force to Operate | 6N first step 12N second step |

6.0 Trouble Shooting

Table 14. Trouble Shooting

| Description | Possible Solutions |
|-----------------------------------|--|
| TX/RX LED and B do not illuminate | <ul style="list-style-type: none"> Perform factory reset, see Section 4.4, Factory Reset. Contact Cervis, Inc. |

Appendix A: Exposure to Radio Frequency Energy

Warrior system transmitter and receiver units contain radio transceivers. When active, transmitters/receivers send out radio frequency (RF) energy through an internal (or external) antenna. The Warrior Locomotive CB transmitter complies with limits set by the FCC for operating distance from human tissue.

Appendix B: RF Exposure Considerations

Radio modules 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 in a location at least 20 cm away from areas likely to be occupied by an unaware person.

Handheld Applications

All operators of the handheld equipment with any type of antenna require training in the proper operation of the equipment and such training must include RF exposure safety instructions. Once training is completed, they are considered to be aware persons.

If the portable operating pose in on the hand or arm, a 5-mm 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 section.

Appendix C: MU-9X15 Safety Circuit

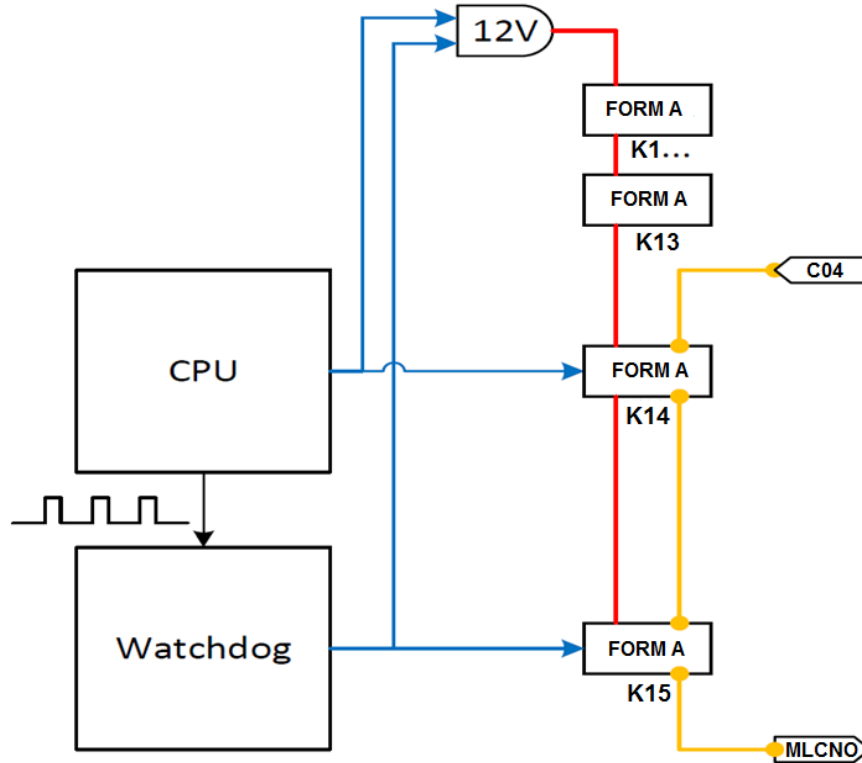


Figure 13. MU-9X15 MLC Safety Circuit Logic Diagram

Figure 13 illustrates a high-level view of the system's safety architecture. This architecture is based around redundant enable signals that are generated by separate hardware circuits. The microprocessor generates an enable signal to K14 when all conditions are met and the user activates the start sequence. The watchdog circuit generates an independent enable signal to K15 as long as the microprocessor generates the proper signaling to the watchdog. Additionally, these two independent enable signals are AND-ed together to enable an internal 12V bus that provides coil power to all relays*. The system is not capable of any relay closures until both watchdog and microprocessor enables are asserted. The loss of either signal immediately causes the MLC path to open and all output relays to de-energize.

If there is a software fault in the microprocessor, the watchdog will not assert its enable output, which will cause K15 to open. Additionally, this will disable the internal 12V bus resulting in all relay outputs returning to their non-active state regardless of what the microprocessor is commanding.

If there is a fault in the watchdog circuit that causes its output to never assert, the unit will be safe as the MLC path cannot close because K15 will be open and the internal 12V bus will be disabled. If the fault causes the watchdog circuit to never de-assert (perhaps the contacts on K15 weld closed), the system is still safe because the microprocessor has independent control of K14 that can break the MLC path and internal 12V bus.

This architecture has been devised such that any one fault will not cause loss of control of the MLC path.

*Except the K13 H/L relay because it is necessary to operate the H/L when the MLC is open.

Appendix D: MU-9X15 Control Cable Internal Wiring Diagram

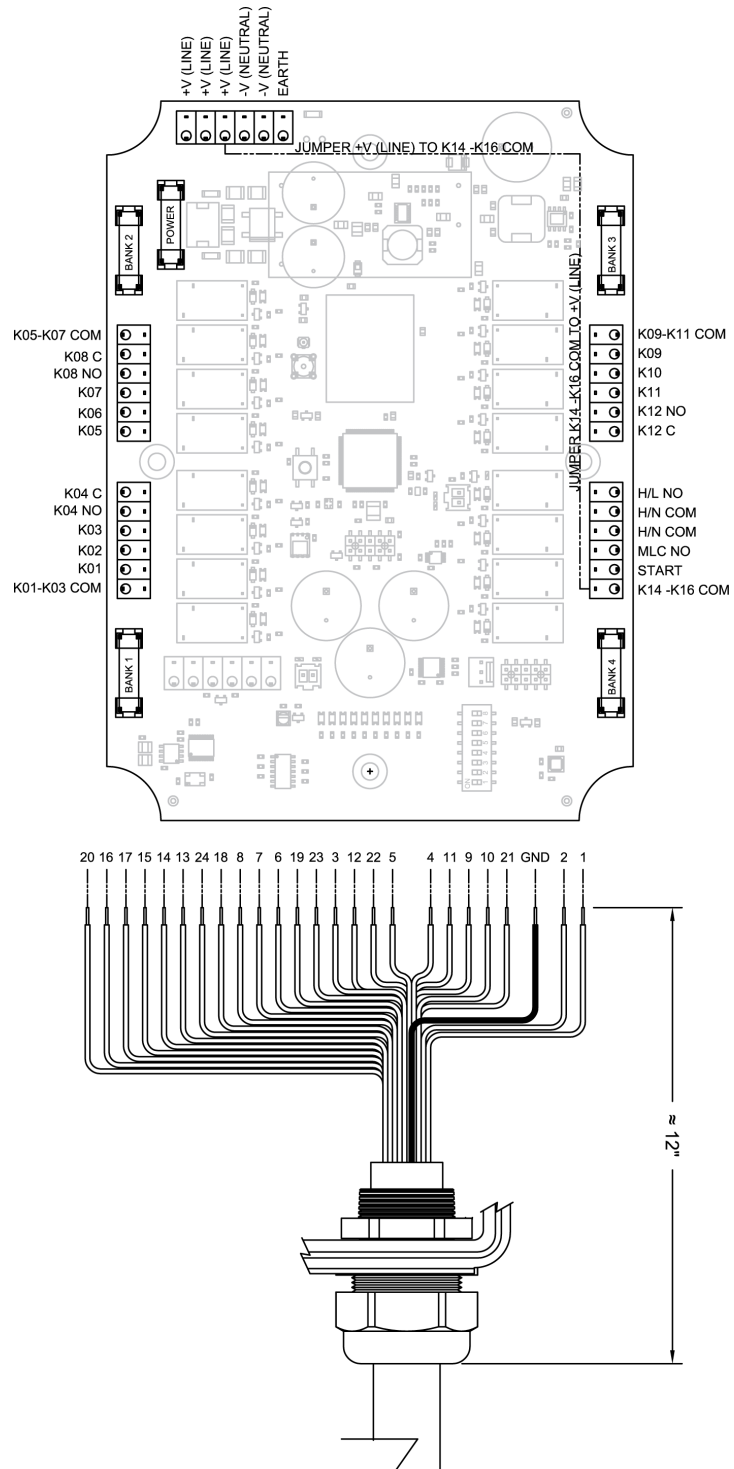


Figure 14. MU-9X15 Control Cable Internal Wiring Description

Appendix E: Warrior System Options

The following table lists available system options.

Table 15. Warrior System Options

| Item | Description |
|-------------|---|
| J5-07 | 3 ft. antenna extension cable |
| EXT-ANT10-1 | 10 ft. antenna cable extension kit. Includes J5-02 extension cable & J5-12 antenna bracket w/ isolation washers |
| EXT-ANT25-1 | 25 ft. antenna cable extension kit. Includes J5-13 extension cable & J5-12 antenna bracket w/ isolation washers |
| 15114311 | HORN Mini 12VDC Onboard 90db Horn / Buzzer installed |
| 15104112 | Two Point mounting plate for receiver |
| OPT-K24 | Add Prewired 24 pin connector to the receiver pigtail |
| TS2L | 2 pole Transfer Switch only. Includes (G4-02A & 2 ea. G4-02B) |
| TS-6P-1 | Pre-wired external Transfer Switch Assy. (up to 6 circuits) |

Table 16. Aftermarket Support & Spare Parts

| Item | Description |
|------------|--|
| HH2S-9XW10 | Spare transmitter |
| L152 | Warrior MU-X15 alternative button label sheet |
| L154 | Warrior MU-X15 15100403 replacement handheld overlay |
| L159 | Handheld Warning Tag |
| 15100110 | Handheld "Work Safe" orange wrist breakaway lanyard |
| 07127150 | Warrior handheld boot |
| 07100376 | Handheld battery door |
| AA8-015A | Handheld battery compartment sealing gasket |
| AA5-05 | Handheld lanyard mounting pin |
| BB3-06 | Receiver antenna |
| 1708006 | NiMH Battery Charger (for AA / AAA batteries only) |
| 1708005 | NiMH AAA Battery (2 per handheld) |
| L147 | Laminated "Quick Reference" safety card |

