SKIP-LINE®

MST-14
Mini Skip-Timer
Operation Manual

MANUAL

Skip-Line®

Road Marking & Monitoring Equipment

Leading the industry since 1972.

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Last modified: 05/17/19

i. Warnings, Warranty, and Disclaimer

WARRANTY

Each MST-14 unit is covered by a 30-day return for refund satisfaction guarantee. Buyer is responsible for determining the suitability of this product for intended application prior to engaging in any contract that would rely on product functionality.

This product is also covered by a limited one year warranty. Products with defects in workmanship will be repaired or replaced at the sole discretion of Skip-Line, Inc. without charge for up to one year from the date of invoice.

DISCLAIMER

All electronic equipment is subject to failure due to: Unanticipated use, non-compatibility of accessories, stress by mechanical vibration, electrical spikes, exposure to intermittent, poorly regulated, highly inductive, or noisy power sources, overload, temperature extremes, induced load-dump and welding currents, insulation chafing, improper wiring, poor cable routing, or stressed mounting. Indiscriminate high-pressure washing can cause moisture intrusion and corrosion.

All computerized systems can fail. Skip-Line, Inc. will not be held responsible or liable for any loss as a result of the use of this device, including but not limited to loss of time, money, opportunity, or personal injury. In no case shall Skip-Line, Inc. be responsible beyond the purchase price of this product.

IMPORTANT NOTE

Not all MST-14 units have exactly the same appearance, functionality, or graphical style. Some graphics contained in this manual may show patterns, functions, or features that are not installed on every unit and should not be relied upon for operational decisions. This system depends on the proper operation, calibration, and functionality of this and other Skip-Line brand and/or non-Skip-Line brand devices on a road marking vehicle. Full functionality may require purchase of other devices.

Contents of this manual are subject to change without notice.

If your system lacks a feature found in this manual that you would like to have added, contact Skip-Line to see if it is possible.

Table of Contents

1. Overview

The Skip-Line® MST-14 Mini Skip Timer is a simple and easy-to-use skip timer designed specifically for smaller road marking equipment with up to four material guns. Featuring new and simple color LCD menus, the MST-14 pushes road marking technology further than ever before.

The MST-14 comes loaded with a capable package of standard features, as well as a large number of advanced upgrades. Many software features can be added, and for further functionality, the expansion port can be used to connect the MST-14 to additional hardware devices. This future-proofs your investment for years to come.

Some features covered in this manual may or may not be part of the feature set purchased with your particular unit. Refer to purchase documents to determine which features your system has included. Functionality of expansion devices are documented in their respective manuals.*If your system lacks a feature found in this manual that you would like to have added, contact Skip-Line to see if it is possible.*

1.1 Standard Features

Color Pattern Previewer
Large Digit Speed Display
Rugged Toggle Switches
Paint Application Rate
Four Paint & Bead Guns
Time & Distance Based Delays
Advance/Retard w/ AutoCycle
Datum Point
Single Mid-Dot
Guided Calibration Procedures
Internal Motion Pulse Multiplier
In-Field Software Upgrades
Audible Warning System
Pattern Index on Paint or Gap
Lifetime Pump Totals
Switch Test Diagnostic Tool
Counter Channels
Align Solids

1.2 Optional MST-14 Features

Some optional upgrades must be purchased at time of order, while others can be purchased and installed using an in-field software update.

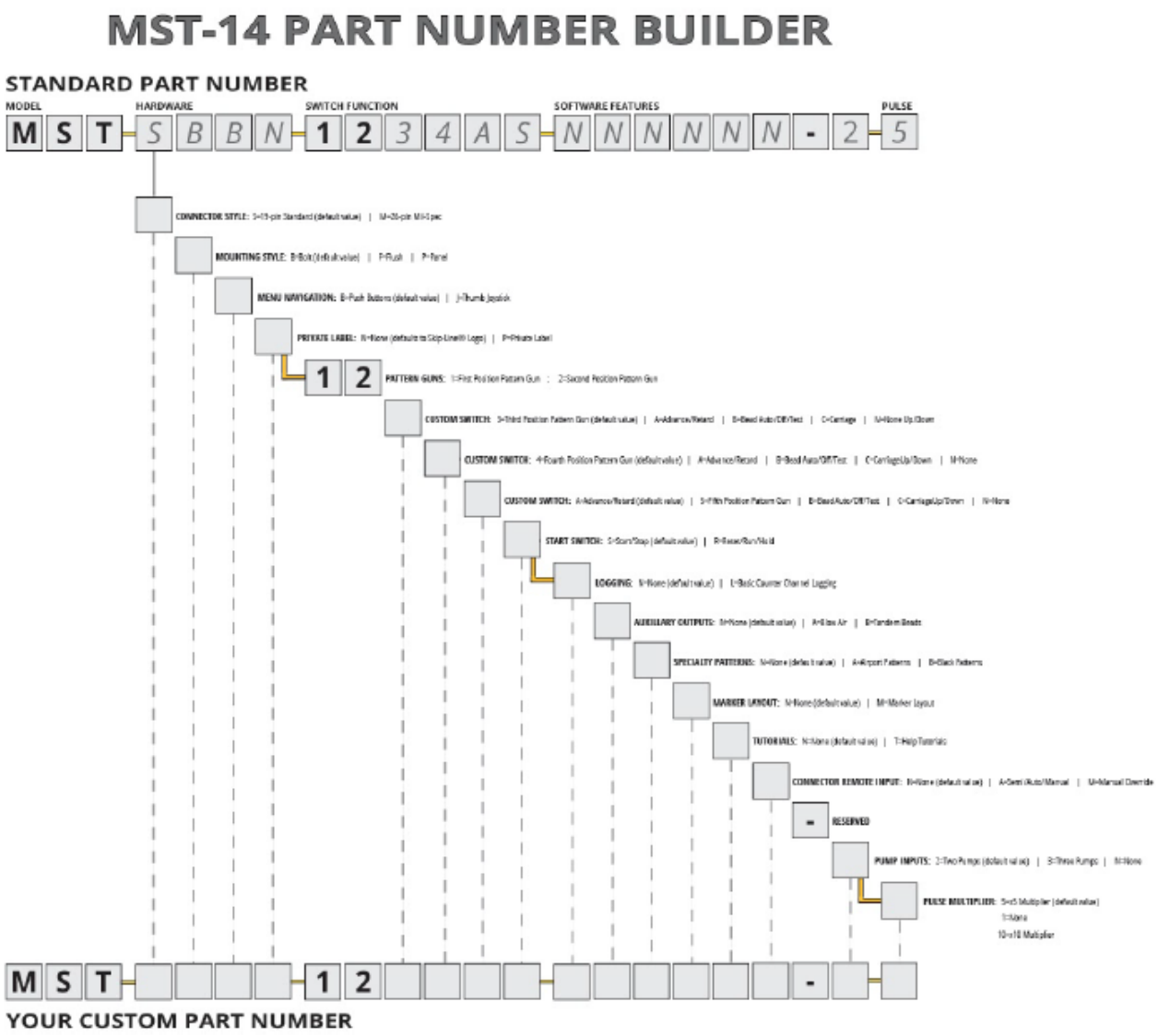
Four auxiliary outputs, for double-drop beads, blow air, or other use.
Contrast and Shadow Black Pattern Sets
Advanced Reflective Marker Layout
GPS Tagged Counter Channel USB Logging
Military Spec Cable Connector
Joystick Navigation
Audio/Visual Help Tutorials
Multiple Mid-Dot Patterns

1.3 Expansion Devices

The proprietary Skip-Line expansion port allows adding many peripherals from the Skip-Line product portfolio. In combination with a CVO-312 Video Overlay & Guidance device, the MST-14 can have the following advanced functionality:

Full-Specification Data Logging
Paper-Tape Printer
Rework Trigger
Bead Usage & Application Rate
Real-Time Application Rates
Thermocouple Sensing
Ambient Temp/Humidity Sensor
Data Transmission (WiFi)
Additional Driver Outputs
Proportional Analog Controls
Application Rate Controllers

1.4 Part Number Builder



A larger copy of this MST-14 Part Number Builder is also available in Appendix C: Ordering Guide.

Note: New features may extend this part number builder without notice. Some customizations and other features may be available, but not included in this part number builder.

1.5 Installation Requirements

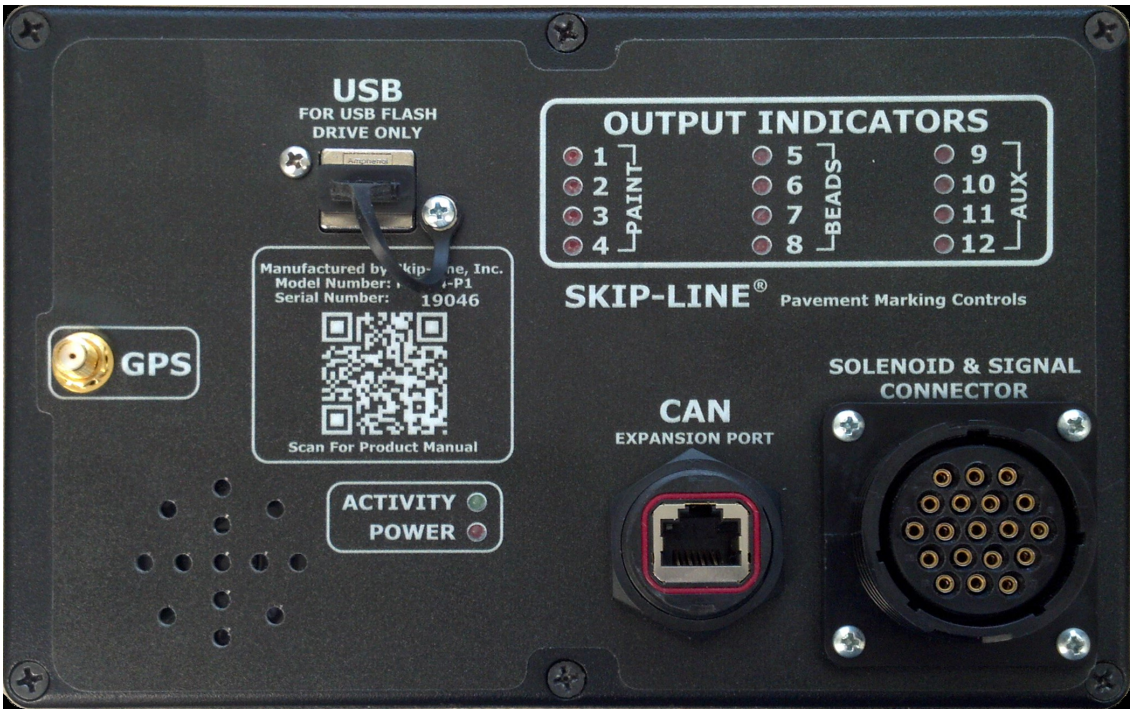
Some additional components may be needed for full and proper operation of the MST-14, including:

- *Motion pulse source, such as a magnet-wrapped driveline collar & motion sensor, transmission signal, "5th wheel" & sensor, or equivalent.*
- *Pump stroke counters, for systems with positive displacement pumps.*
- *Mounting hardware*

Please identify these components and ensure compatibility prior to purchasing the MST-14. These items are sold separately from the MST-14. *See Section 2, **Specifications**, for more information.*

Pneumatic solenoid valves, material applicators, plumbing, pumps, and other road marking mechanical hardware are not sold by nor supported by Skip-Line, Inc.

1.6 Back Panel & Connectors



1.6.1 Output Indicators

The output indicator LEDs are connected directly to the driver output. If illuminated, the MST-14 is driving the associated Paint, Bead, or Auxiliary output to ground.

1.6.2 Solenoid & Signal Connector

There are several connector options for the solenoid driver and signal inputs. Refer to the wiring diagram that came with your MST-14 for your exact connections. *For notional connection information and available connector options, see section 2.2,* ***Connectors****.*

1.6.3 Model & Serial Number

The hardware model number and unit serial number can be found on the back panel. Having these numbers readily available when reaching out for support will minimize troubleshooting time.

1.6.4 USB Port

The USB port provides two major functions for the MST-14 device: 1) In-field updates, and 2) Counter channel logging. *See section 5.4, **In-Field Software Updates** and section 5.1, **Counter Channel Logging** for more information.*

1.6.5 Speaker

The MST-14 has a built-in speaker on the rear panel. When use of MST-14 audio is desired (such as *speed alarm*, *info/warning/error chimes*, and *help tutorials*), take care to install the MST-14 such that the speaker can be heard by the operator.

1.6.6 Activity/Power Indicators

The Activity and Power indicators assist in troubleshooting issues.

The Power LED will be on when there is power provided to the unit. If the Power LED is on, but the display is not, there is an internal problem with the MST-14 unit and it should be sent in for repair.

A blinking Activity LED indicates the processor is working. If this light stops blinking, this indicates a problem that may require repair.

1.6.7 CAN Expansion Port

The CAN Expansion Port allows the MST-14 to network to other Skip-Line devices. *See section 1.3, **Expansion Devices** for more information on available devices.*

A Cat5 network cable, constructed with the EIA/TIA 568B wiring standard (*see **Appendix B: Communications Cable***), allows this device to connect to one expansion device. For further expansion, a Skip-Line BUS-012 hub device will allow connection of up to eight additional devices.

1.6.8 GPS Connector

If the Counter Channel Logging feature has been purchased with your MST-14 unit, the GPS connector should be connected to a GPS/GLONASS antenna. The antenna should be mounted on the dash or, preferably, on top of the vehicle cab.

The GPS provides satellite date/time stamps and start/stop coordinates for counter channel log records. *See section 5.1, **Counter Channel Logging** for more information.*

2. Specifications

Please observe the following operational and storage specifications for the MST-14 device. Operation or storage outside of these specifications may reduce the life of the device and, in some cases, void the warranty.

	Minimum	*Maximum*
Operating Temperature	*33°F*	*140°F*
Storage Temperature	*10°F*	*160°F*
Humidity (non-condensing)	*10 %RH*	*90 %RH*
Voltage	*10V*	*16V*
Current (self-consumed, +12V)	*--*	*0.5A*
Current (solenoid drivers to ground)	*--*	*4A*

Some additional devices and hardware may be necessary for full operation of the MST-14 skip-timer. See the sections below for more information.

Important Note!

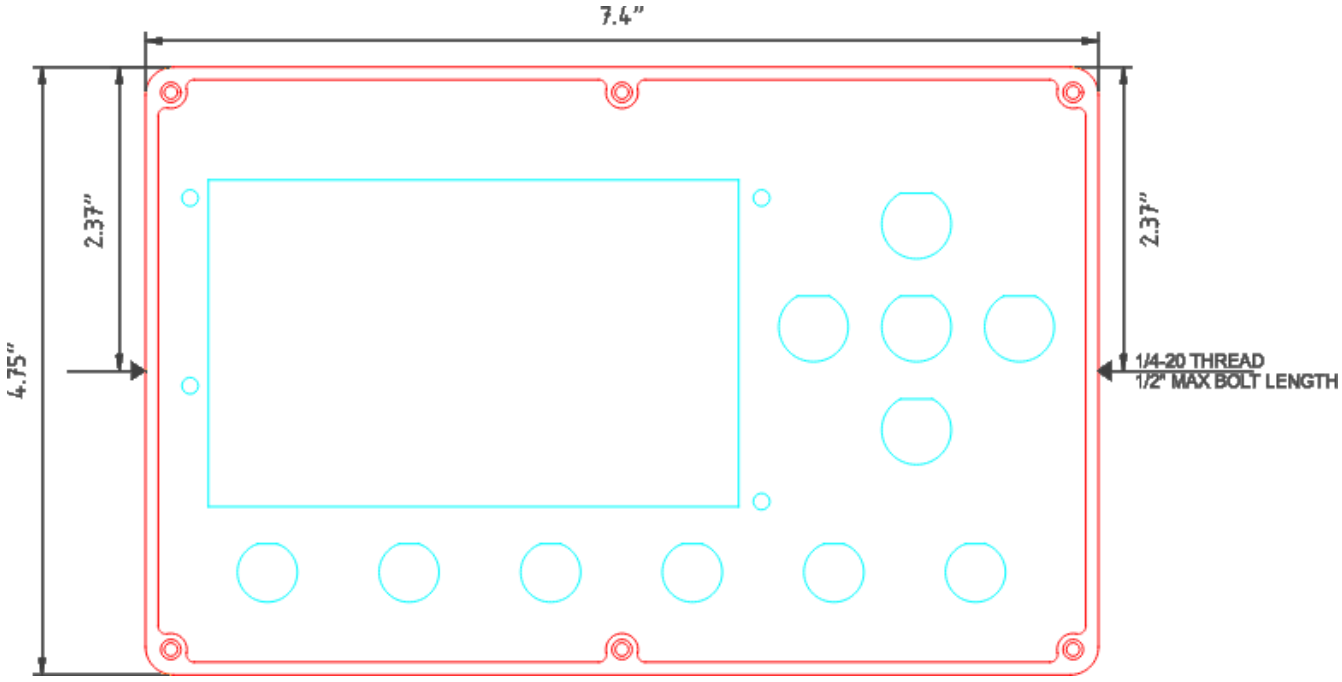
To avoid risk of severe electronic damage, always disconnect and remove the MST-14 unit before welding on the vehicle.

2.1 Mounting Options and Dimensions

The MST-14 has three different options for mounting, selectable at time of order.

- *1/2" long, 1/4-20 bolt mount*
- *Flange mount*
- *Flush flange mount*

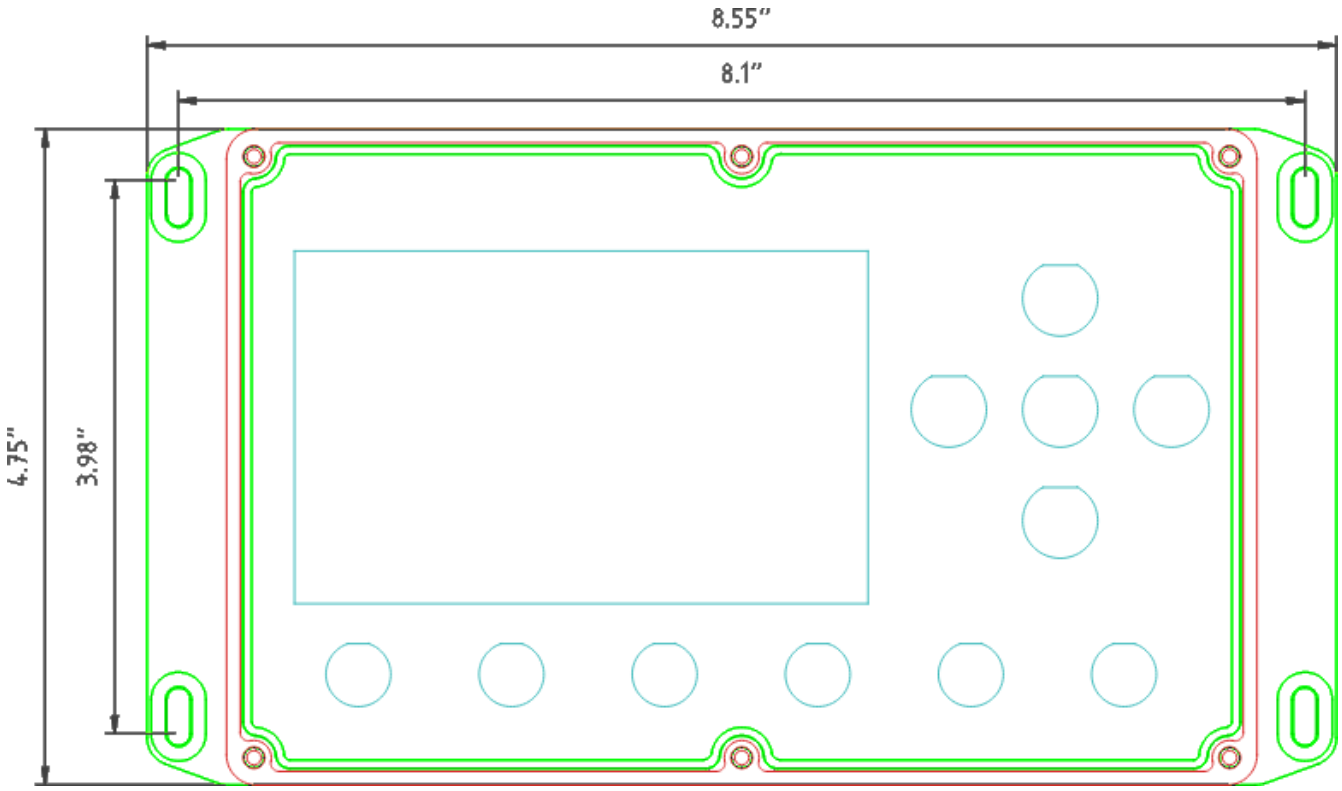
2.1.1 Bolt Mount



The bolt mount option is the most popular mounting option, and is used to install the MST-14 into a bracket mount or waterproof enclosure.

Use only 1/2” length, ¼-20 thread bolts. Longer bolts may cause internal damage.

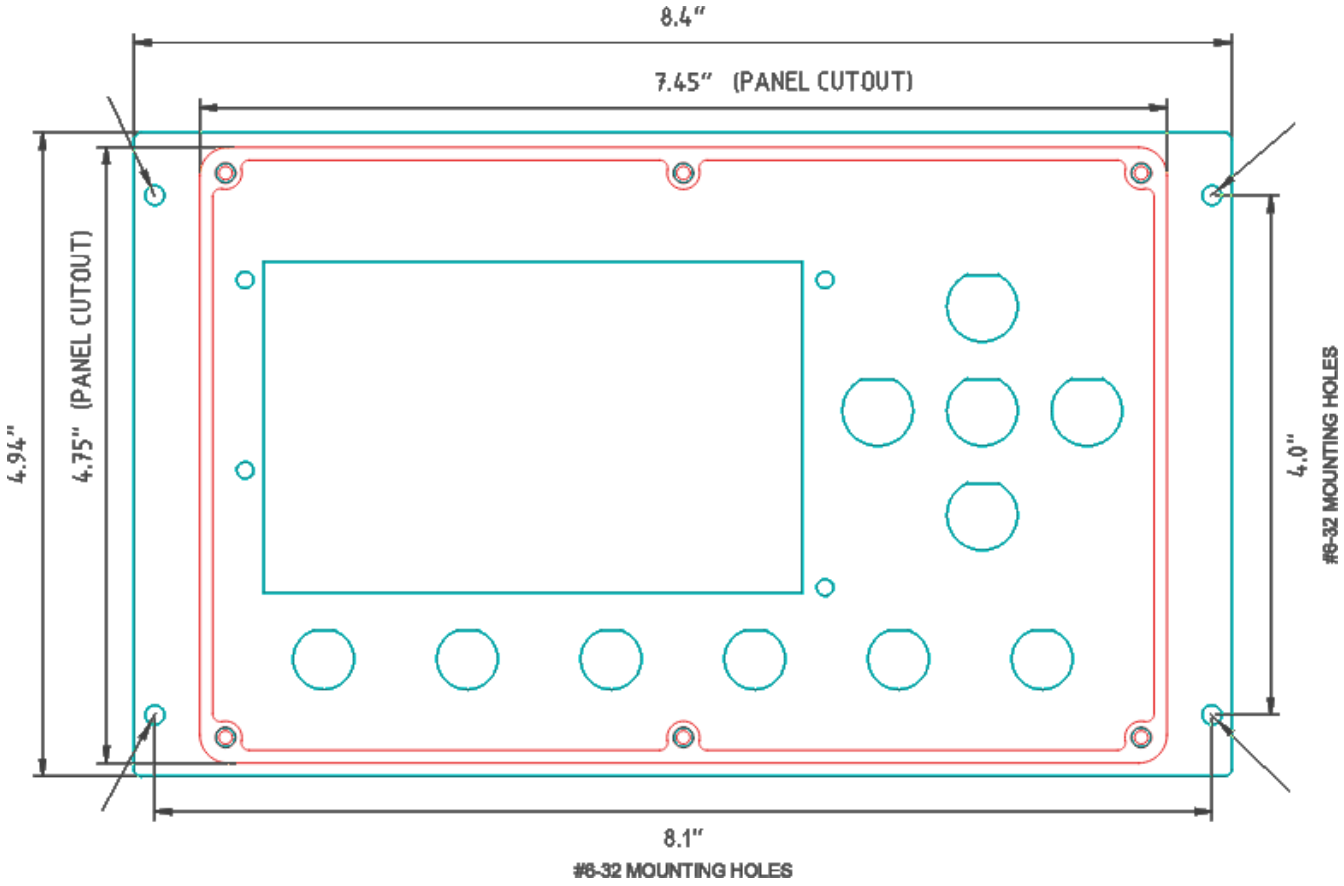
2.1.2 Flange Mount



The flange mounting method allows mounting directly to a surface. The slot mounting holes fit a #8 screw size.

Note that space must be reserved behind the box for connectors.

2.1.3 Flush Mount



The flush mounting option was designed to allow the enclosure to mount into a sealed enclosure or console.

The red outline must be cut for installation. Recommended cutouts, in CAD formats, can be provided upon request.

2.2 Connectors

There are two options for connectors, 1) a standard 19-pin connector, and 2) a 26-pin metal mil-spec connector. Because there are several options of pinouts for both connectors, **always refer to the specific wiring diagram that you received with your MST-14**.

2.2.1 19-Pin Connector

The following connections are typical of the MST-14 19-pin cable and connector. Note that the cabling is typically an 18-pin cable, and the cabling is numbered.

This pinout is provided here for notional indication of connections required, *not* for actual wiring.

Note that this connector does not provide a filtered sensor power output, whereas the 26-pin connector does.

The following pinout is the standard wiring diagram and may not match your system. Always refer to the specific wiring diagram that you received with your MST-14.

Cable Number	*Function*	*Notes*
1	*Paint 1 Output*	*Low-side driver output*
2	*Paint 2 Output*	*Low-side driver output*
3	*Paint 3 Output*	*Low-side driver output*
4	*Paint 4 Output*	*Low-side driver output*
5	*Bead 1 Output*	*Low-side driver output*
6	*Bead 2 Output*	*Low-side driver output*
7	*Bead 3 Output*	*Low-side driver output*
8	*Bead 4 Output*	*Low-side driver output*
9	*Aux Output 1*	*Auxiliary low-side driver outputs for Double-Drop Beads, Blow Air, and other special functions.*
10	*Aux Output 2*	
11	*Aux Output 3*	
12	*Aux Output 4*	
13	*Speed Signal*	*Optoisolated input for Motion Sensor*
14	*Pump 1*	*Optoisolated input for Pump 1 (Yellow)*

15	*Pump 2*	*Optoisolated input for Pump 2 (White)*
16	*Aux Input*	*Auxiliary optoisolated input*
17	*+12V Power*	*System power*
18 (Grn/Yel)	*Ground*	*System ground*
19	*N/A*	*Not connected.*

2.2.2 26-Pin Connector

The following connections are typical of the MST-14 26-pin cable and connector. Note that the cabling is typically a 25-pin cable, and the cabling is numbered. This pinout is provided to provide an idea of what the connections required are, *not* for actual wiring.

The following pinout is notional! Always refer to the specific wiring diagram that you received with your MST-14.

Cable Number	***Conn. ID***	***Function***	***Notes***
1	*Z*	*Paint 1 Output*	*Low-side driver output*
2	*N*	*Paint 2 Output*	*Low-side driver output*
3	*M*	*Paint 3 Output*	*Low-side driver output*
4	*L*	*Paint 4 Output*	*Low-side driver output*
5	*C*	*Bead 1 Output*	*Low-side driver output*
6	*B*	*Bead 2 Output*	*Low-side driver output*
7	*T*	*Bead 3 Output*	*Low-side driver output*
8	*A*	*Bead 4 Output*	*Low-side driver output*
9	*R*	*Aux Output 1*	*Auxiliary low-side driver outputs for Double-Drop Beads, Blow Air, and other special*

			functions.
10	*P*	*Aux Output 2*	
11	*S*	*Aux Output 3*	
12	*a*	*Aux Output 4*	
13	*H*	*Speed Signal*	*Optoisolated input for Motion Sensor*
14	*G*	*Pump 1*	*Optoisolated input for Pump 1 (Yellow)*
15	*W*	*Pump 2*	*Optoisolated input for Pump 2 (White)*
16	*F*	*Aux Input 1*	*Auxiliary optoisolated input*
17	*V*	*Aux Input 2*	*Auxiliary optoisolated input*
18	*E*	*Aux Input 3*	*Auxiliary optoisolated input*
19	*K*	*+12V*	*System Power*
20	*Y*	*Sensor Power (+6V)*	*Filtered Sensor Power. Max 100mA draw.*
21	*X*	*Sensor Shield*	*Signal Shield (if separate sensor cable broken out)*
22	*J*	*Ground*	*System Power Ground*
23	*b*	*Ground*	*System Power Ground*
24	*c*	*Ground*	*System Power Ground*
25 (Grn/Yel)	*U*	*Ground*	*System Power Ground*
26	*NC*	*NC*	*Not Connected*

2.3 Motion Sensor

The motion sensor signals should be a sinking type signal (sometimes called

grounding, NPN, open drain, or open collector). A push-pull type signal (sometimes called totem pole) can also be used. The MST-14 provides internal pull-up capability, so an external pull-up resistor is not necessary.

To prevent "ground loop" interference, motion sensors with either a plastic body or with a non-grounded metallic body construction are recommended. Some connector options for the MST-14 provide clean, regulated sensor supply voltage to further assist with reducing noise and to protect the sensor from electrical transients (voltage spikes and dips).

Always use sensors rated for use in automotive environments. If in doubt, use additional transient filtering devices on the sensor power line.

The recommended sensor resolution is 10 pulses per foot, but the MST-14 can accept between 2 and 20 pulse per foot motion sources.

Many standard transmission signals typically provide about 10,000 pulses per mile, or about 0.5 feet per pulse. While most skip timers cannot create sufficient accuracy with this signal, the MST-14 can internally multiply it to create 10 internal pulses per 1 external pulse. This generates sufficient resolution from even very coarse motion signal sources. If you require the 10xpulse multiplier, **please contact Skip-Line** so it can be enabled at no additional cost.

2.4 Pump Stroke Sensor

The pump stroke sensor signals should be a sinking type signal (sometimes called grounding, NPN, open drain, or open collector). These signals are internally filtered with a 50 millisecond "debounce filter", which reduces noise susceptibility and false signal counting. This limit means the very maximum volume usage frequency that can be accepted is 20Hz.

Always use sensors rated for use in automotive environments. If in doubt, use additional transient filtering devices on the sensor power line.

2.5 Vehicle Battery

The MST-14 requires a reasonably clean +12V power supply, from a healthy and properly rated battery. Overloading a battery by drawing more current than its rating, or poor battery health, can cause additional electrical system noise. This can lead to difficult-to-diagnose problems, including motion and pump signal noise, poor electromechanical device response, and electronic resets.

Properly maintain the vehicle battery. Batteries with poor test results for cranking amps and reserve capacity should be replaced. Battery cables should be replaced

if corrosion is observed, as this significantly reduces the current delivery capability of the battery.

2.6 Other Requirements

Other auxiliary sensors and devices may be required for full functionality of expansion devices. Refer to expansion device documentation for more information.

3. Installation

Installation of the MST-14 system requires both physical installation of the control box and cabling.

3.1 Preparing the installation

Check that the following are ready before getting started:

- *Select mounting locations for the MST-14 unit.*
- *Plan cabling routes from the MST-14 unit to each of the following:*
  - *+12V and Chassis Ground*
  - *Paint and bead gun solenoids*
  - *Pump stroke sensors*
  - *Motion pulse sensor*
- *OPTIONAL: If using more than one peripheral device, plan communications cabling to the BUS-012 hub. Such peripheral devices include:*
  - *Paper Tape Printer*
  - *Advanced Remote Trigger*
  - *CVO-312 Video Guidance & Data Logger*
  - *CJS-112 Bead Scale*
  - *Etc.*

Follow these precautions during installation:

- *Do not connect power to the MST-14, loads, sensors, or optional devices until all connections have been made.*
- *Double check wiring before applying power.*

For optional devices, communications cable lengths are important in order to maintain the specifications of the CAN communications bus used by the MST-14. The recommended maximum length for a communications cable is 5 meters. Select mounting locations and cable routes so that the cable lengths stay within specifications.

3.2 Physical Installation

Once the mounting location is selected, physically mount the MST-14.

Make the appropriate connections to the remainder of the system, as outlined in the sections below.

3.2.1 Solenoid & Signal Connector

Refer to the wiring diagram that came with your system. Connect each signal as needed to solenoids, motion sensors, and pump stroke sensors.

3.2.2 USB Port

The USB port should be readily accessible if the Counter Channel Logging feature will be used. If mounting considerations make the USB port inaccessible, add a short USB extension cable or panel mount cable to move the USB access to a more convenient location for the operator. Contact your OEM or Skip-Line for recommended options.

3.2.3 GPS Antenna Port

A GPS antenna should be connected to the GPS antenna port if the Counter Channel Logging feature will be used. The antenna cable should be routed carefully so that it is not in danger of abrasion or damage, and the antenna itself is ideally mounted on the roof of the vehicle, but at a minimum on the dash with a clear view of as much sky as possible. Refer to the GPS status screen (*see section 4.5.5, **GPS Status***) to analyze signal strength. If the GPS signal is weak, or requires more than 2-3 minutes to acquire a satellite fix when the vehicle is outdoors, improve the mounting position.

3.2.4 Expansion Port

If a single expansion device is to be used, route a Cat5 rated (or better) twisted pair cable to the device. If multiple devices are to be used, connect the MST-14 to the ***UPLINK*** port of a BUS-012 hub.

Important Note!

Do not leave cables connected to only the expansion port, without being connected to another device. Improperly terminated cables can cause malfunction.

A dust plug is recommended to protect this connector.

The MST-14 is now ready to be powered on and configured.

4. Menu System

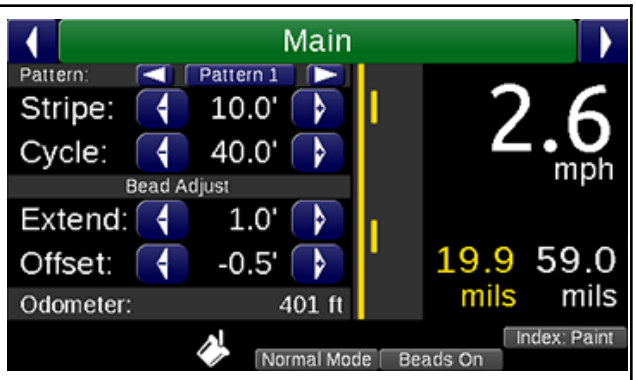
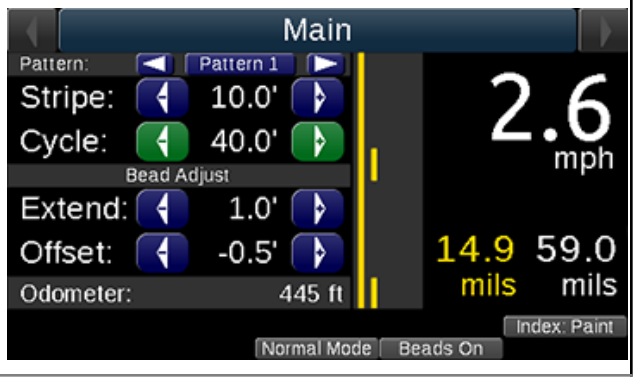
The Skip-Line color LCD menu system is simple and intuitive, yet more capable than older skip timer menu systems.

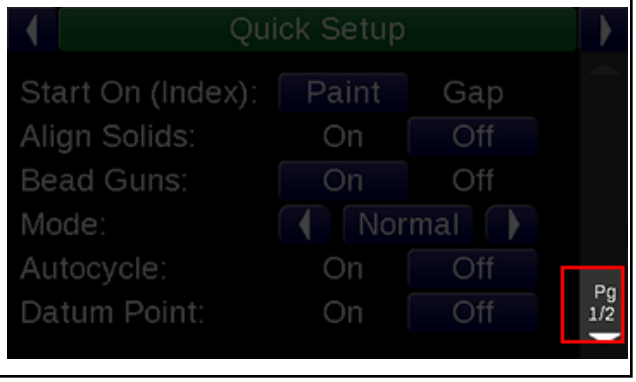
There are two navigation options – joystick and pushbutton. Either input type is equivalent, and will be referenced with the same functions throughout this section.

4.1 General Navigation

There are four navigational buttons (or directions, in the case of menus with the joystick navigation option), which behave differently between two different contexts—***Menu Bar*** and ***Action Screen***.

The "***cursor***" indicates the current navigation location.

*In this screenshot, the Cursor is on the top-level menu **Main**.*	
*In this screenshot, the Cursor is on the **Action Screen** parameter **Cycle**.*	

Begin Button Test *in this screenshot is an example of a* ***Command Button****. The cursor is currently on it here.*	
When there are ***multiple pages*** *of information available on a screen it is indicated in the lower right hand corner.* ***Pg ½*** *means that there are two pages available and you are currently viewing page one.* *To access the next page simply scroll your cursor down through all the menu items on the screen.*	

4.1.1 Menu Bar Navigation

The ***menu bar*** is visible on almost every screen, making it easy to know your current location within the menu. The uppermost menu bar is called the ***Top-Level Menu***. Some menus have sub-menus, while others do not. ***Navigation buttons*** have the following behaviors when the cursor is on the menu bar:

- *: Navigate to the next menu to the right.*
- *: Navigate to the previous menu to the left.*
- *: Navigate up a menu level.*
- *: Navigate down into a sub-menu, or into an action screen.*

If a menu does not have a sub-menu, pressing down will enter an ***Action Screen***. Pressing and holding returns the Cursor to the menu bar on all Action Screens.

4.1.2 Action Screen Navigation

Pressing  from a menu enters the ***Action Screen*** associated with the menu. While the Cursor is on an Action Screen, the navigation buttons have the following behaviors:

 *: Increase the value of the currently selected parameter. If the Cursor is on a command button, that will "**click**" the command button.*

 *: Decrease the value of the currently selected parameter.*

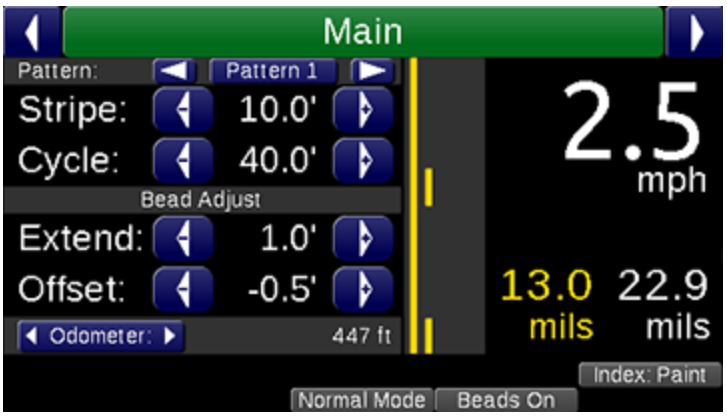
 *: Navigate up. If the Cursor is on the uppermost parameter, navigating up will exit the current Action Screen. Pressing and holding this will also exit the current Action Screen, regardless of where the Cursor is.*

 *: Navigate down to the next parameter on the current Action Screen.*

Note: Most parameters are immediately affected when altered on an Action Screen. There is no need to do anything further to "***save***" the new value.

4.2 Main Screen

The ***main screen*** is the first of the top-level menus, which provide fast access to the most important day-to-day parameters of operation.

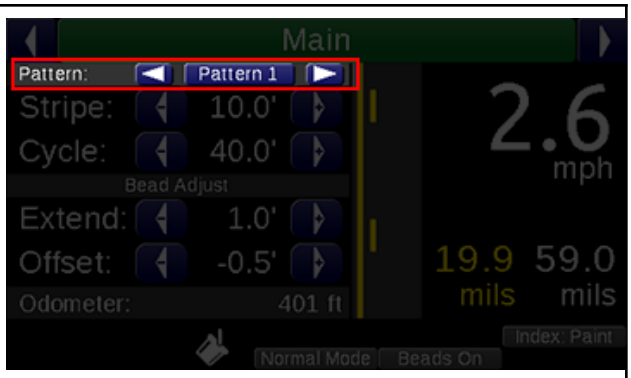


The Main Screen is the recommended screen to use during striping operations. It is organized into several sections.

4.2.1 Main Screen Parameters

There are four parameters that can be changed from the main screen.

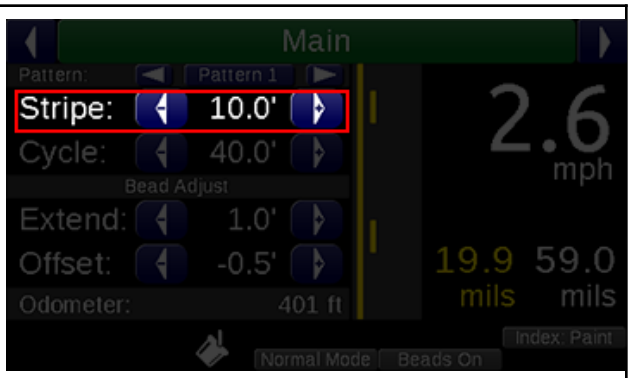
Pattern Selector

*The **Pattern Selector** allows you to select between three (or more) saved patterns. When **Pattern 1** is selected, any changes to Stripe and Cycle will be memorized to Pattern 1. When **Pattern 2** is selected, the previously entered settings for Pattern 2 will be restored. This can be changed on-the-fly in the gap during striping operations. The pattern will change at the beginning of the next cycle.*	

Info

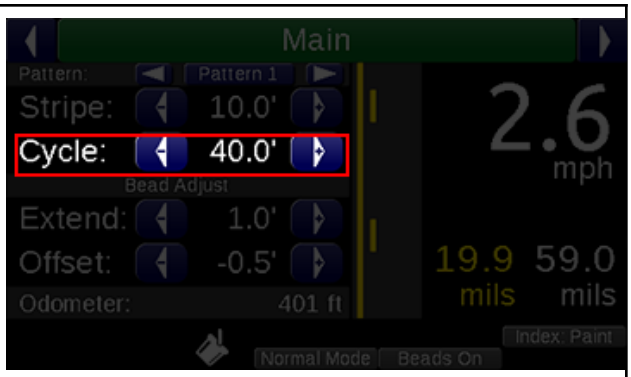
*The **Pattern Selector** feature was previously called **ALT CYCLE** and was controlled with a switch on older skip timers. The functionality described here is roughly the same.*

Stripe

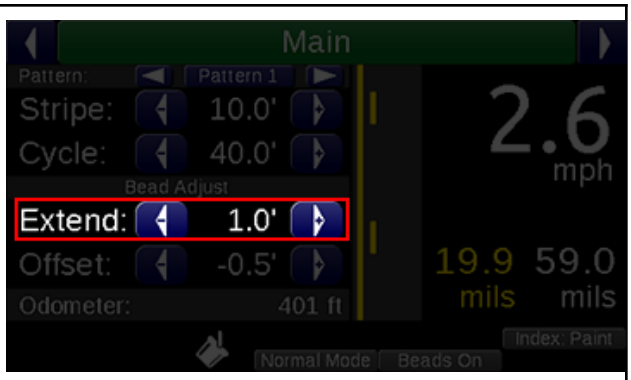
***Stripe** sets the length of the skip pattern on the road. This is calculated from two numbers: the distance calibration number, and the Gun Delays.* *If your stripe length on the road does not match the entered Stripe length, correct this error with Gun Delays. **Do not** change the stripe from the desired length as a corrective measure.*	

(*See section 4.5.2, **Gun Delays** for more information on Gun Delays.*)

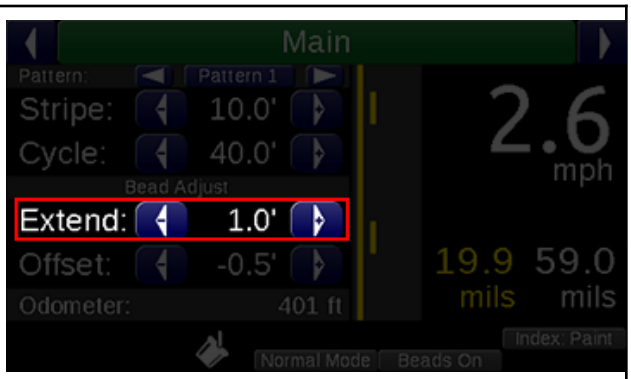
Cycle

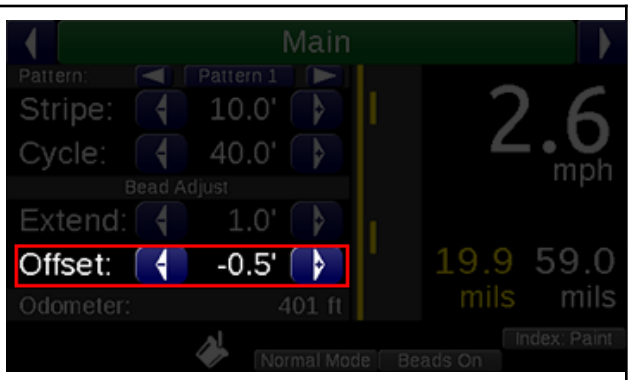
Cycle *is the distance from the start of one stripe to the start of the next stripe.* *If the cycle is not correct, check your distance calibration number or check the troubleshooting guide. Do not adjust this number as a corrective measure from the actual distance desired.*	

Bead Extend

To help ensure complete bead coverage, the ***Bead Extend*** *adds a user specified amount of bead coverage distance to the end of the stripe length.*	

Bead Extend and Bead Offset

When using ***Bead Extend****, Bead Offset is also used to center the additional length. For example, if 0.5' of bead coverage is desired on the beginning and end of the stripe, set Bead Extend to 1.0', and Bead Offset to -0.5'. Then, during operations, only the Bead Offset will need to be shifted in order to adjust for truck speed and wind variables.*	

Bead Offset *shifts the entire length of the* ***bead stripe****, to assist with bead coverage. This is particularly useful for dealing with shifting head and tail winds.*	

4.2.2 Pattern Preview

The innovative ***Pattern Preview*** screen provides a preview of the current pattern that will be emitted from guns. While not every pattern-altering feature can be accounted for, the Pattern Preview is the skip timer's best guess as to the pattern that will be painted when striping begins.

Gun colors are shown on the preview, which helps the operator clearly see which guns will be counting towards application rates.

4.2.3 Rate Indicators

Speed is shown in large, high contrast digits for easy operator viewing.

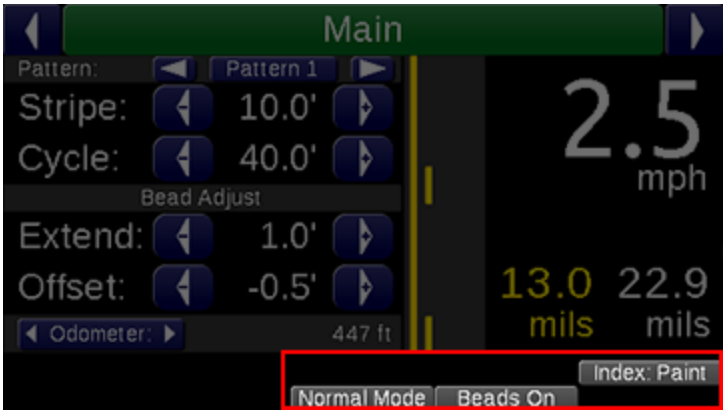
Average wet thickness calculations are shown just below the speed. These rates are calculated with the current counter channel values. For accuracy, ensure the gun colors and widths are set correctly in the setup menu (*see 4.5.2,* ***Gun Setup***).

The *odometer* shows the total distance traveled with the ***START*** switch on, regardless of material switch positions, since the last counter channel clear.

Info

Note that wet thickness will not match dry thickness measurements, due to material shrinkage. Refer to your road marking material vendor for more information.

4.2.4 Feature Status Indicators



Many features can change the painted pattern. To help avoid confusion, when a setting causes a pattern change and is not indicated on the Pattern Preview, it is accounted for in the ***Feature Status Indicators***. Refer to the manual section for each feature to understand these messages.

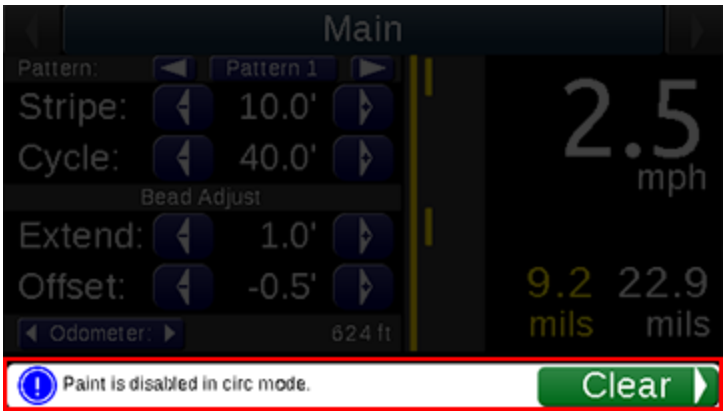
4.2.5 Status Indicators

There are several ***system status indicators*** that help show what is currently detected by or occurring on the skip timer.

Icon	Description
	**Start Switch On:** The start switch is on. Solid guns may be on, but skip guns are not.

	**Skip-Watch:** The start switch is on, and the paint guns are in the skip portion of the pattern (as opposed to the gap).
	**GPS:** The GPS icon indicates the status of the GPS. Animated signal bars indicate the GPS is searching for a satellite lock. No bars indicates a failure to associate (check antenna!).
	**USB Drive Attached:** A USB drive is attached to the skip timer. Typically, USB drives should not be left attached after the counter channel export process is complete.
	**USB Error:** A USB device is attached, but it is either not a USB drive or it is not compatible.

4.2.6 Information System



The menu provides a ***descriptive alert system*** to assist with understanding current activity, warnings, and critical errors that need attention. The ***Information System*** messages cover the status indicator area.

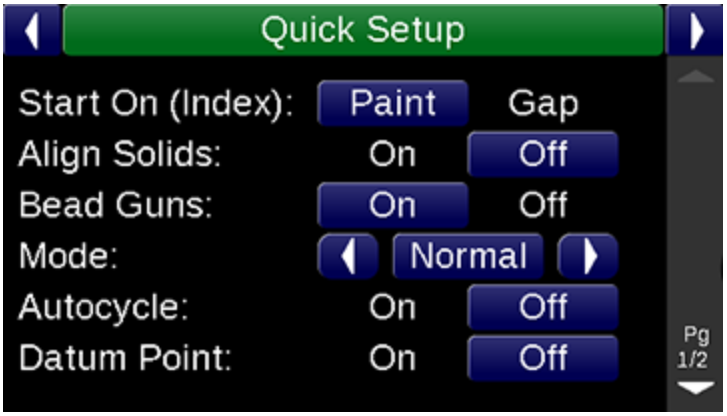
To view status and feature indicators again, clear the message. These messages can be cleared by scrolling the Cursor down to the ***Clear*** command button on the message. Warning and Error Messages will automatically disappear after the problem is no longer detected.

Information messages assist the operator in understanding certain behaviors or conditions that may be intentional, but could be confusing or interpreted as incorrect behavior due to setting configurations (the three levels of Information Messages are info, warning, error).

Information Messages will not reappear for the same event when cleared by the

operator. However, Warning and Critical Error messages will, if the problem is still detected by the system, reappear two minutes after being cleared by the operator. Refer to the section titled ***Menu Messages*** for more information.

4.3 Quick Setup



The ***Quick Setup*** menu provides quick access to enable or disable many features that may be used during day-to-day operations.

Some of the basic setup items are covered here, but your particular Quick Setup menu may not have all the features mentioned here. For features that may appear on your particular skip timer system, refer to supplemental documentation. If your system lacks a feature found in this manual that you would like to have added, contact Skip-Line to see if it is possible.

4.3.1 Mode

The Mode determines how the skip timer will behave:

- **Normal**: Normal skip-timing behavior.
- **Test**: Guns will come on immediately. This allows operators to test guns, regardless of datum offsets or other settings.
- **Black**: Black patterns are enabled, per the configuration in the Setup menu.
- **Marker:** Marker layout patterns are enabled, per the configuration in the Setup menu.

Note that not all modes are available on all systems.

4.3.2 Bead Guns

The ***Bead Guns*** option enables and disables bead guns from engaging during striping operation.

4.3.3 AutoCycle

AutoCycle causes the cycle to change +/ –0.1'after the Advance/Retard switch has been pressed in the same direction three times. This assists with correcting the cycle to match previous markings during rework operations.

4.3.4 Midspot

Midspot adds a dot in the middle between the end of one stripe and the start of the next. Midspot can occur every cycle, or every other cycle with a ***½*** midspot setting. The ***½ Odd*** setting adds the midspot on odd cycles (1st, 3rd, etc.) while the ***½ Even*** settings adds the midspot on even cycles (2nd, 4th, etc.).

Midspot length is determined by the Dot Length parameter in the Marker Layout menu.

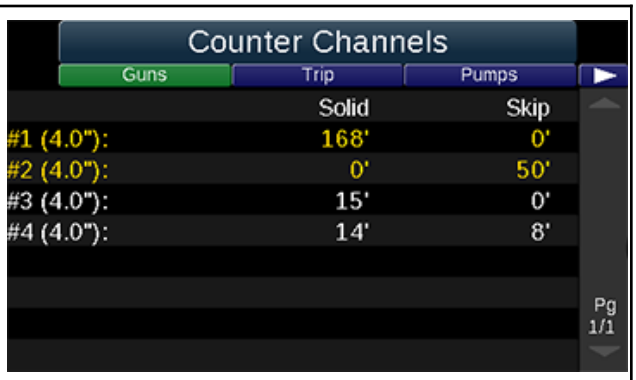
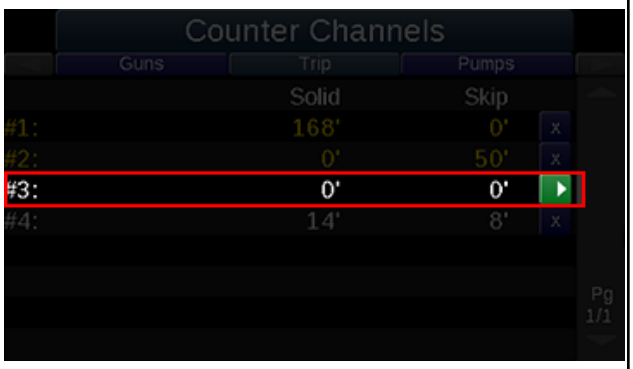
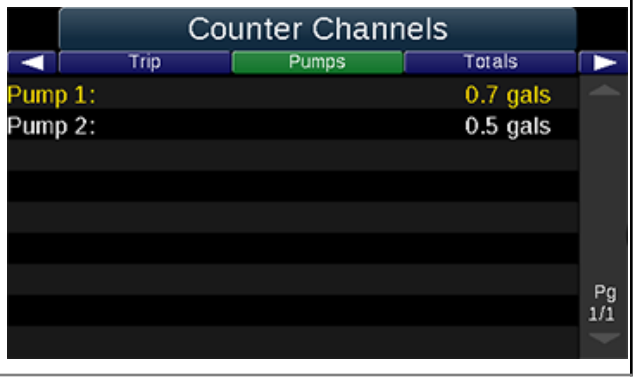
4.3.5 Index

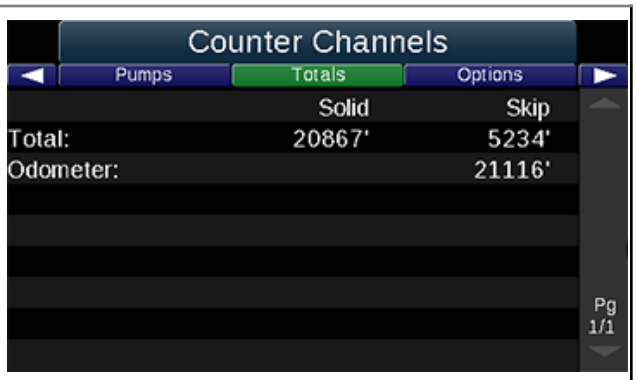
This setting allows the skip timer to start the pattern on either the stripe or the gap when the START switch is engaged.

4.4 Counter Channel Menu

The ***Counter Channel*** menu provides access to distance and volume usage counters. Clearing the counter channels is common at the beginning of a new job.

The counter channels allow the user to record width and/or color changes individually for each gun, providing enhanced records and job tracking. Counter Channels fill in dynamically during operation. Guns only appear in the counter channels once they have a footage associated with them.

Distance counters are separated between solid and skip distances. Gun colors are indicated by text color. (Black is a faded gray, for visibility). *Use left*  *and right*  *to navigate the submenu and view the various counters available on your system.*	
*The **Trip Counter** feature acts like the trip odometer on vehicles. Any trip counter can be cleared individually, but the regular counters will remain intact, preserving job footages and application rates.*	
*To clear an individual **Trip Counter**, simply scroll the cursor down to the appropriate selection and*  *navigate right to clear the channel.*	
*Paint usage by pump is tracked under **Pumps.***	

*Tallies are displayed under **Totals**.*	
*If your skip timer has the **Counter Channel Logging** feature, the "Save and Clear" option will appear. Select it to save the counter channels to internal memory.* *See section 5.1, "Counter Channel Logging" for more information.*	
*If a paper tape printer option was purchased, the skip timer will automatically detect this and present a **Print** button.*	
*Select **Save and Clear** or **Clear Without Saving** to clear the counter channels.* *This option will not save the counter channels. This is useful to clear usage or distances from testing or setup, without adding clutter among meaningful data.*	

For more information about Counter Channel Logging, see section 5.1.

4.4.1 Pattern Counter Channels

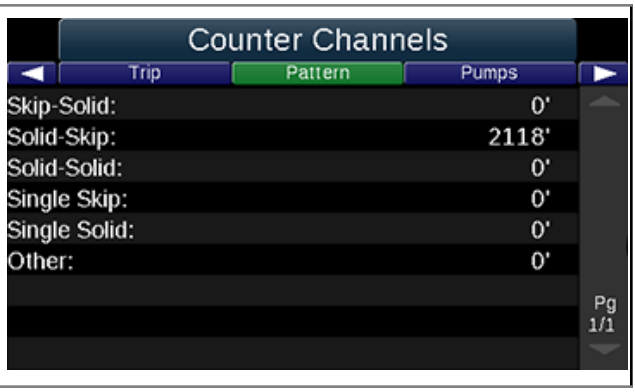
In addition to standard counter channels, each system can be customized to track specific patterns by total distance. These channels are in addition to the standard counters, and may better match the billing and reporting requirements in a given locale.

Standard counter channels and pattern counter channels both count at the same time, and should not be combined. For example, an advanced ***Double Solid*** counter counts distance traveled when Material #1 and Material #2 are turned on in solid. The standard #1 and #2 counter channels will each individually count distance as well. You cannot combine the standard #1 channel and the advanced Double Solid counter channels, since that would be double-counting.

Some pattern counter examples:

- *When Gun 1 and Gun 2 are in solid, count into Double Solid.*
- *When Gun 1 or Gun 2 are in skip, but not both, count into Single Skip.*
- *When Gun 1 is solid and Gun 2 is skip, count into Skip-Solid.*
- *When the width of Gun 4 is 8", count into White 8".*
- *When Right Gun 1 and Right Gun 2 are both on, count into White 12".*

Pattern Counter Channels may be custom ordered for your specific needs—please contact your preferred OEM or Skip-Line for availability and compatibility.

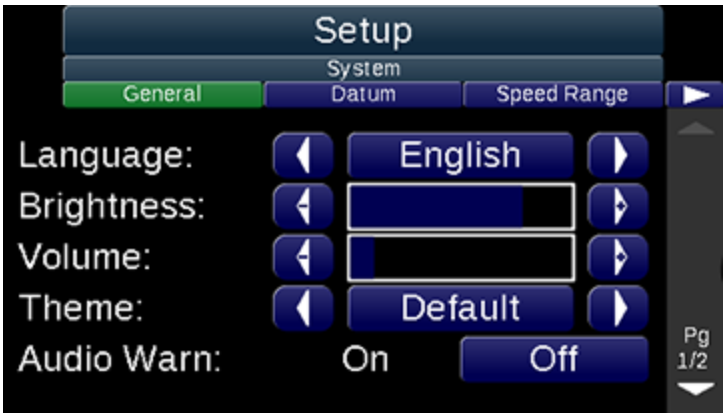
Pattern Counter Channels *are located in the* ***Counter Channels*** *menu under* ***Pattern****.*	

4.5 Setup

The ***Setup menu*** is split up into several sub-sections for fast and easy navigation of advanced system configurations.

4.5.1 System

General



- **Brightness**: Screen brightness
- **Volume**: System volume, for the startup sounds, audio warnings, and tutorials.
- **Theme**: The color theme for the menus. Dimmer themes reduce eye strain at night, while more colorful themes are easier to see during the day.
- **Audio Warnings**: Turn on to enable an audible chime when information, warning, or error messages occur.
- **Time Zone**: If your system has the Counter Channel Logging feature, this option will be available. Select the time zone you wish to export stored data with.

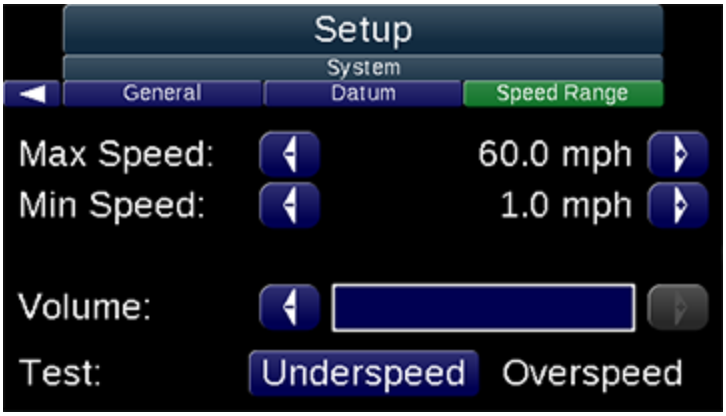
Note that other general items may be added to this list for various future system functions.

Datum

Datum Length: The ***delay*** distance in front of the first gun, the point where the pattern will actually begin. *Refer to section 5.2,* ***Datum Point*** *for more information.*

Speed Range

These alarms will trigger when the START switch is on.



- ***Max Speed:*** *The maximum acceptable speed. If the speed rises above this value, the Overspeed alarm will be triggered.*
- ***Min Speed:*** *The minimum acceptable speed. If the speed falls below this value, the Underspeed alarm will be triggered.*
- ***Volume:*** *The volume of the speed alarm. If set to zero, the visible alarm flashing of the speed on the Main Screen will still occur.*
- ***Test:*** *When selected, the alarm volume is tested. Use*  *and*  *to sample the Overspeed and Underspeed alarms for familiarity.*

Life Totals

Life totals provide a total number of painted distance and gallons pumped. This number survives counter channel resets. The primary purpose of Life Totals is to assist the operator in knowing when to service pumps and other equipment.

The Life Totals are often reset at the time of equipment maintenance or rebuilds. To reset the Life Totals, select ***Reset***.

4.5.2 Gun Setup

Gun Colors

Gun Colors sets the color for each gun. Note that proper color setting is important for accuracy in mil thickness calculations, pump control features, data logging, and report printouts.

Scroll down using , and note that for systems with more than five material guns, you may need to scroll down to further pages.

Gun Widths

Gun Widths sets the gun widths to match the actual application width of the material on the road.
Note that setting proper gun widths is important for accuracy in mil thickness calculations, data logging, pump control features, and report printouts.

Gun Offsets

Set ***Gun Offsets*** for all items in the gun line, including *Paint*, *Beads*, *Tandem Beads*, or *Blow Air*. Only available guns will appear in the ***Gun Setup*** menu.

- *Gun Offsets are the distance from the front-most gun rank to the current gun. The front-most gun rank should be set to 0.0'.*
- *Gun Offsets account for distance delays when marking the pattern. When the pattern starts, all guns will attempt to turn on at the same longitudinal position as the front*

gun on the road as they move past that position.

➢ ***IMPORTANT**: Do not correct time factors with distance. Only distance factors should be corrected with distance, otherwise, the skip timer will not be as accurate in placing paint and bead materials on top of each other at different vehicle speeds.*

Gun Delays

Paint Gun Delays correct the mechanical response delay of the gun. Most material applicators experience a time delay between the time the electrical signal is applied from the skip timer, until the gun actually opens and material can flow.

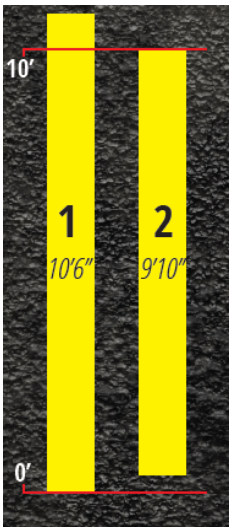
Most applicators take longer to turn off (pushing against high pressure) than to turn on (pushing with high pressure). This causes a 10.0' stripe, for example, to be longer, i.e. 10.5' to 11.0'.

Gun delays account for this delay with TIME. With the gun offsets already set correctly, adjust the gun delays to correct the line length:

➢ *If the stripes on the road are too long, use a negative Off Delay*

➢ *If the stripes on the road are too short, use a negative On Delay*

IMPORTANT: Do not correct distance factors with time. Otherwise, the material guns will not accurately register material on top of each other at different vehicle speeds.



If the desired line length is ten feet, then in the above example the line marked 1 is 10'6"—*six inches too long (ending late)*—and the line marked as 2 is 9'10"— *two inches too short (starting late)*. To solve the delay, use the following equation:

$$\left(\frac{56.8}{MPH}\right) \times distance\ (in\ inches)$$

Take 56.8, divided by the speed at which you were striping, and multiply it by the number

of inches that you were off by. Use a positive number. The result will be time in *ms*. In our above examples, line 1 is off by 34.08 *ms*, and line 2 is off by 11.36 *ms*. Round to the nearest whole (down if the decimal value is below four, up if the value is above five).

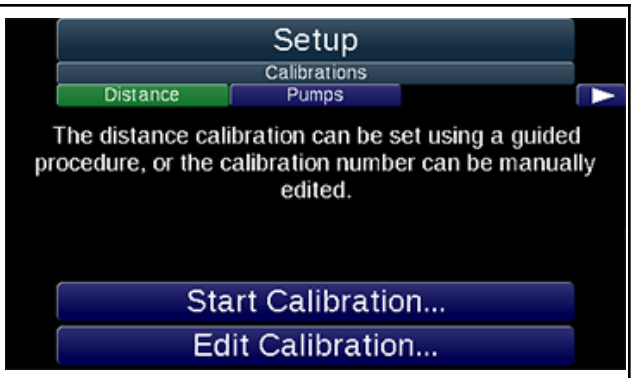
To fix line 1, we would set the gun's ***off delay*** to -34*ms*. This would essentially remove 6 inches worth of active striping time from the gun, ensuring future lines are 10 feet in length. This means it will shut off 34 *ms* earlier than without the delay. (*If it were a positive value it would shut off* ***later*** *instead*).

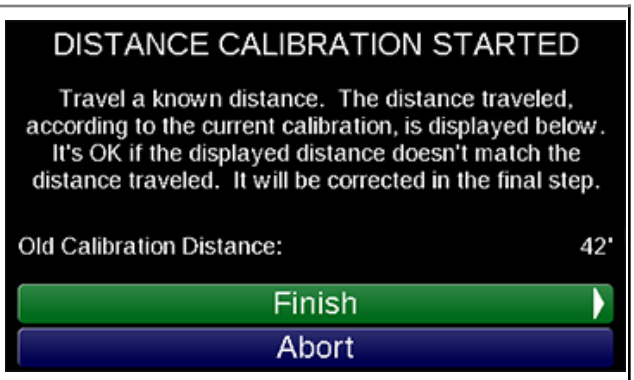
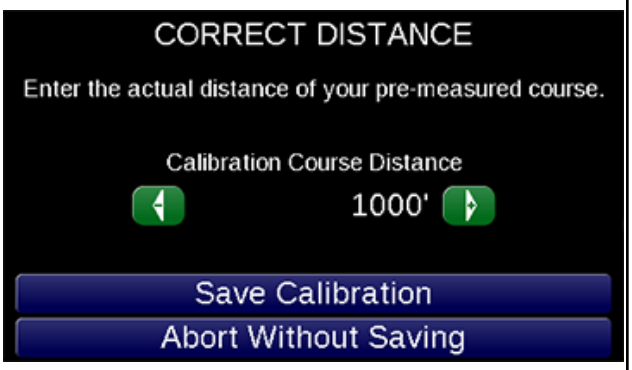
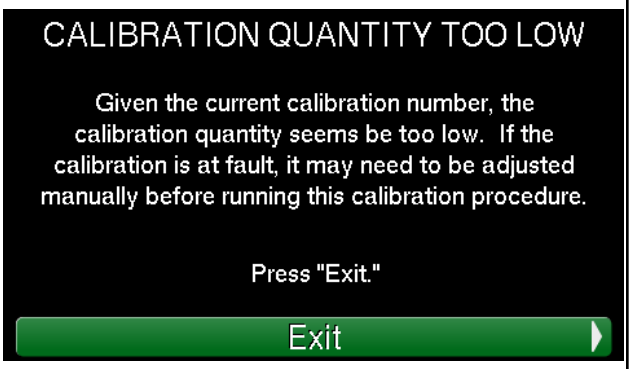
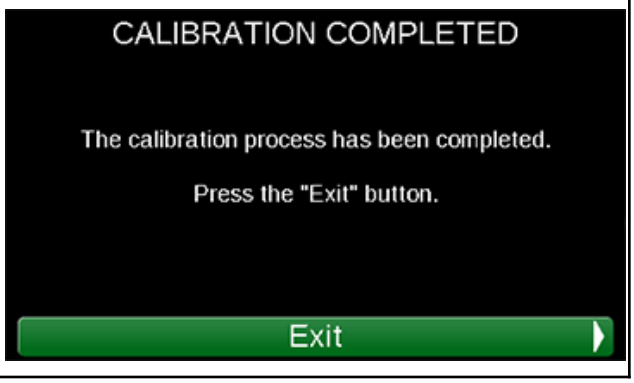
To fix line 2, we would set the gun's ***on delay*** to -11*ms*. This would essentially add 2 inches worth of striping time to the start of the cycle. This means it will activate 11 *ms* earlier than without the delay. (*If it were a positive value, it would activate* ***later*** *instead*).

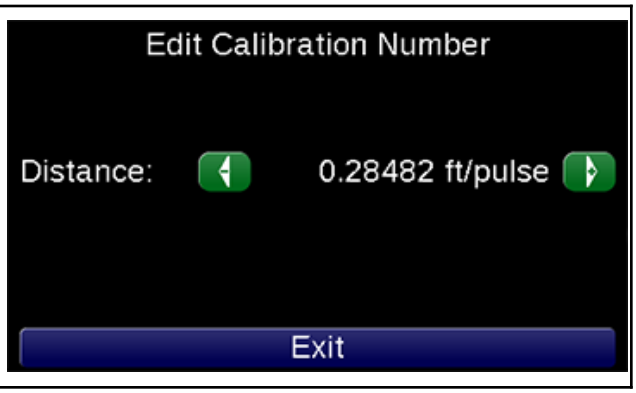
4.5.3 Guided Calibrations

The skip timer must be properly calibrated before use.

Distance

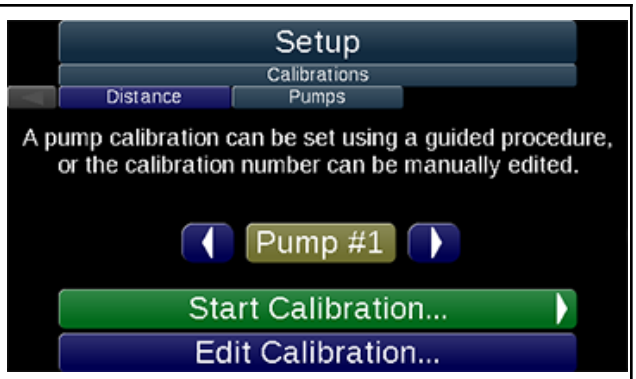
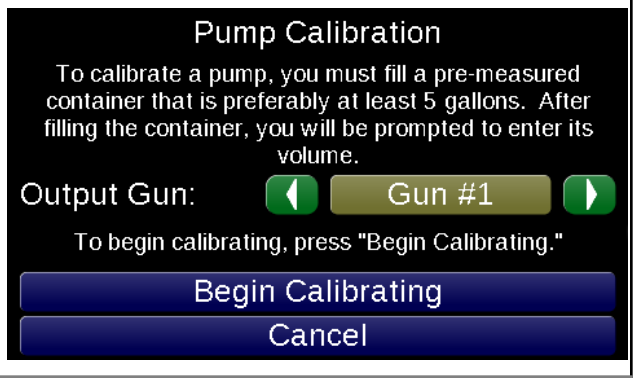
Select ***Start Calibration...*** *to begin the guided calibration process. This is the recommended process for calibration.* *Alternately, select* ***Edit Calibration...*** *to view or directly modify the calibration number.*	
To begin a ***Distance Calibration****, align the vehicle with the start of a calibration course and then select* ***Begin Calibrating****.* *A* ***calibration course*** *is a pre-measured distance for the vehicle to drive. Make your own easily by measuring out a distance of 1,000 feet or greater.*	

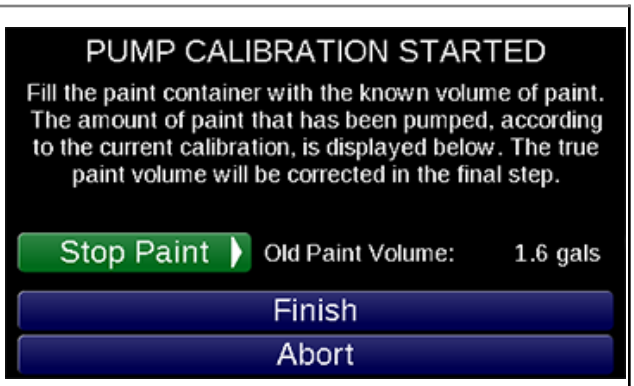
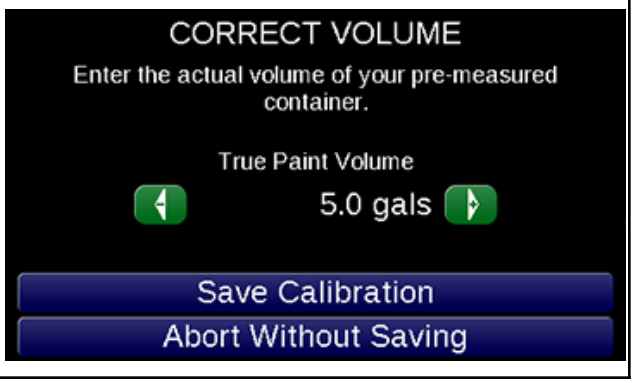
Drive the distance of the course. *Note that the **Old Calibration Distance** number is likely incorrect. It is useful to see to ensure that motion pulses are being received, but is not the actual distance traveled.*	
Correct the distance measured, to the actual distance traveled. *For example, if your course was 1000', and the measured distance was 932', you would change 932' to be 1000'.* ***Save Calibration** to complete this process.*	
If there was an error, verify the motion sensor is installed correctly. *The motion pulse source should provide between 2 pulses per foot and 20 pulses per foot.*	
Once you have finished calibrating select  ***Exit** to return to the **Setup** menu.*	

*From the **Distance** screen, **Edit Calibration Number** allows you to manually edit the calibration number (in feet per pulse).*	

Pump

If the system was purchased without pump inputs (i.e. for material application that does not have a positive displacement pump), these menus may not be present.

Start by selecting a Pump to calibrate. The pump system color is indicated by the background color of the pump. *Select **Start Calibration...** to begin the guided calibration process. This is the recommended process for calibration.* *Alternately, select **Edit Calibration...** to view or directly modify the calibration number.*	
Select a gun to use for the calibration. Only select a gun that is plumbed to the pump you are calibrating. *Place a container with known volume under this gun. Lower pump pressure and disable any atomizers to minimize overspray. Select*  ***Begin Calibrating** to enter the start screen.*	

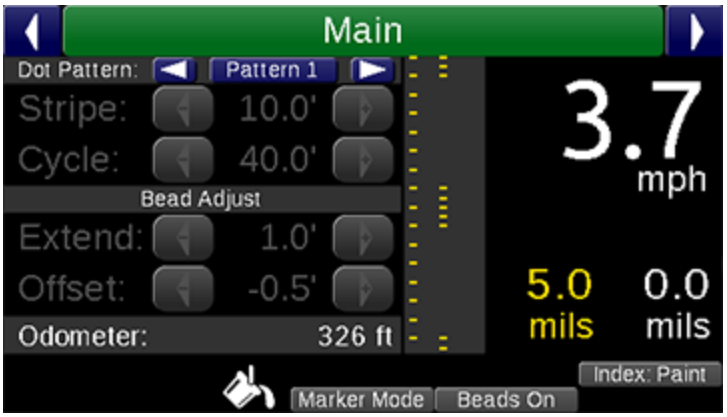
*Once the pre-measured container is under the selected gun, press **Start Paint** to begin the calibration. The button will change to **Stop Paint**.* *Once the container has been filled to its pre-measured capacity, press **Stop Paint**. If not yet filled, use **Start Paint/Stop Paint** until paint level is at the correct height.* *Press **Finish** when done.*	
Adjust the number displayed to match the volume of the pre-measured container.	

If an error occurs, verify the pump stroke sensor is installed and connected correctly.

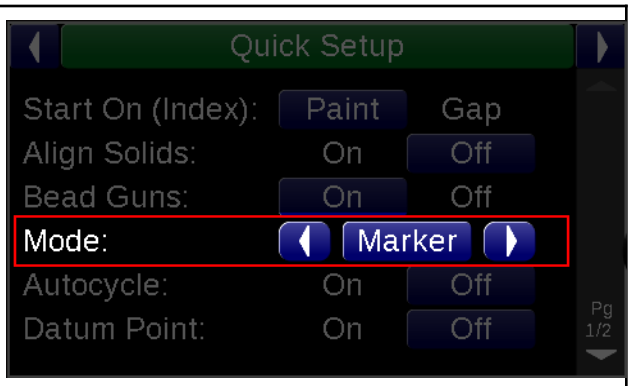
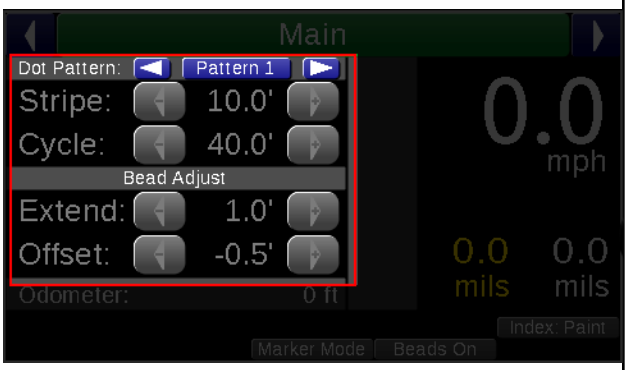
4.5.4 Extras

Some features are not part of the standard package, and are organized under other menus when purchased with the system.

Marker Layout



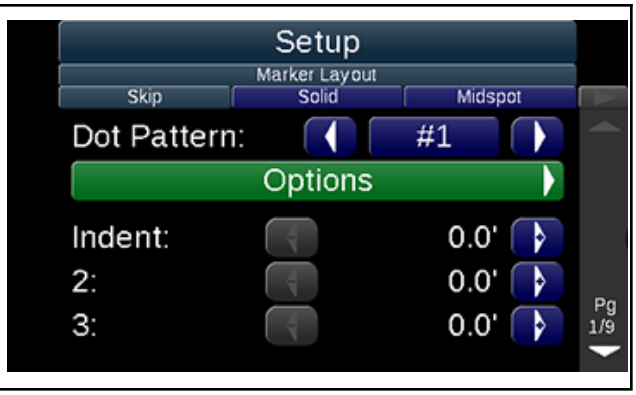
Marker layout mode can be enabled on the ***Quick Setup*** menu (*see 4.3.1,* ***Mode***). When enabled, the main screen Stripe and Cycle parameters are disabled.

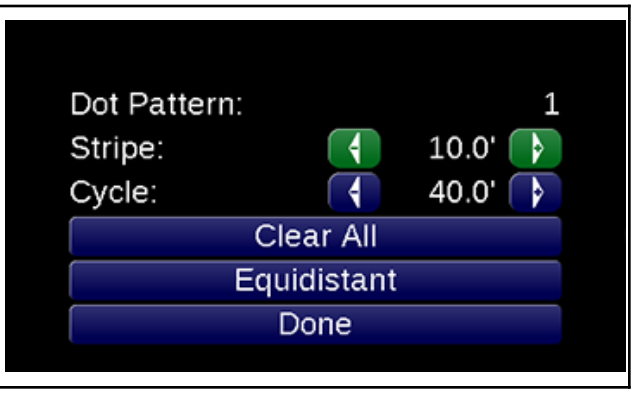
Enter Marker Layout Mode	
Main Screen Options Disabled	

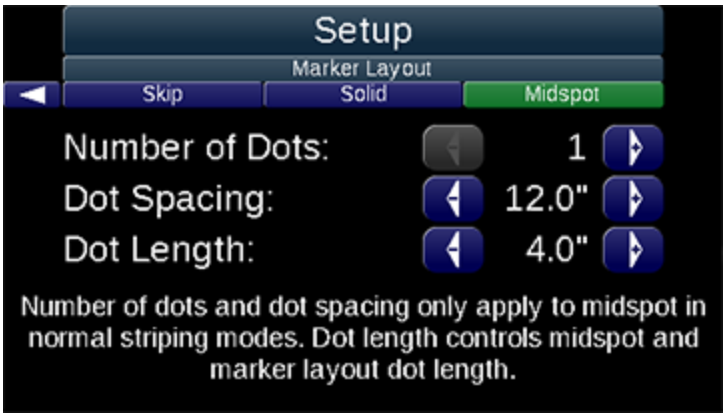
Each Marker Layout pattern consists of distinct settings for *Skip* and *Solid.* In the example below, Dot Pattern 1 contains the separate settings for *Skip* and *Solid*. Gun 1 is on SOLID, and Gun 3 is on SKIP. Gun 1 has been set to dot at 5’ intervals, while Gun 3 is set to do a 10’ Stripe of dots at 2.5’ spacing.

Create the desired pattern by setting the distance between markers in the Skip and Solid pattern sub-menus.

- *Use and to scroll between function buttons and the marker positions.*
- *When highlighting a marker position, use or to increase or decrease the distance between the last marker and this marker.*
- *The pattern will end on the first 0.0' marker position after Indent.*
- ***Clear All**: Clears all marker positions. Only the first marker will be present.*
- ***Equidistant**: Allows you to set the distance of the Stripe or Cycle, and the number of dots desired in that distance. The dots will be separated equally across the entered distance.*

*Under either **Skip** or **Solid**, depending on what pattern you would like to edit, select a **Dot Pattern** and then select **Options** for more settings on that specific pattern.*	

***Clear All**: Clears all marker positions. Only the first marker will be present.* ***Equidistant**: Allows you to set the distance of the Stripe or Cycle, and the number of dots desired in that distance. The dots will be separated equally across the entered distance.*	



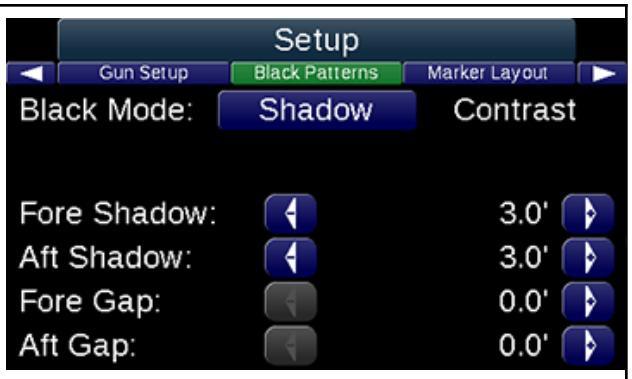
Dot Length controls the length of the dot, in inches. Set it to a length sufficient for the paint gun to emit material at the desired vehicle speed.

Midspot length is also determined by the Dot Length parameter.

Black Patterns

Black patterns cause the special Black Gun to have specific behavior. On some skip timers, this is configurable. On others, the special Black Gun behavior is fixed to Gun #4. Physical mounting of the black material gun is important when using this special mode. Refer to the ***Pattern Preview*** area on the ***Main screen*** to see the expected pattern.

The Black Pattern setup is engaged when the ***Black*** mode is enabled on the ***Quick Setup*** menu (*see 4.3.1,* ***Mode***).

If your system is equipped with ***Carriage Layout*** *your* ***Black Patterns*** *screen will look slightly different.*	

There are two Black Pattern modes that can be selected in the setup:

- **Shadow**: Shadow mode applies paint before and/or after the stripe. When the black gun is in *Skip*, the fore shadow/aft shadow lengths will be applied as entered. When the black gun is in *Solid*, it will *Gap Fill* (i.e., black paint will be on for the entire gap between the end of the last stripe and the start of the next).
  - **Fore Shadow**: The length of black paint to be applied before the beginning of the stripe.
  - **Aft Shadow**: The length of black paint to be applied after the end of the stripe.

- **Fore Gap**: The indent/gap between Fore Shadow and a stripe.
- **Aft Gap**: The indent/gap between a stripe and an Aft Shadow.

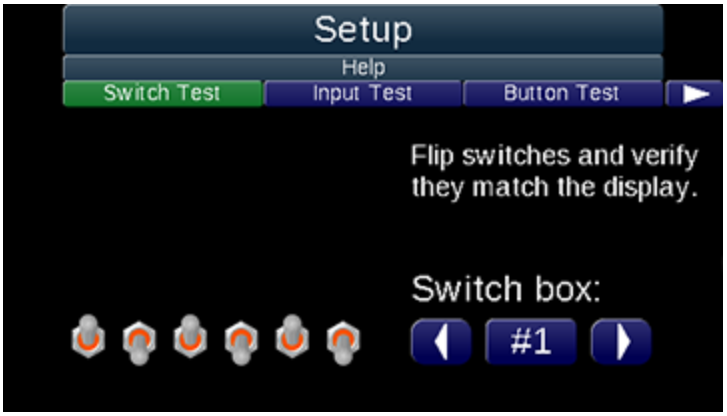
➢ **Contrast**: *Contrast* mode applies paint between two adjacent guns.

- Refer to the *Pattern Preview* area on the *Main Screen* to see the expected patterns.

Note: Black paint is often desired to not overlap with other paint colors and beads. Proper Gun Delays and Gun Offsets values will ensure accurate cross-color positional registration between color gun, black gun, and bead guns.

4.5.5 Help

Switch Test



Switch failures are a common cause of difficult-to-identify operational issues. Use the Switch Test to detect malfunctioning switches.

To test the switches, flip each switch on the system. If the switches exhibit erratic behavior or do not switch cleanly on the on-screen graphic, contact Skip-Line for service.

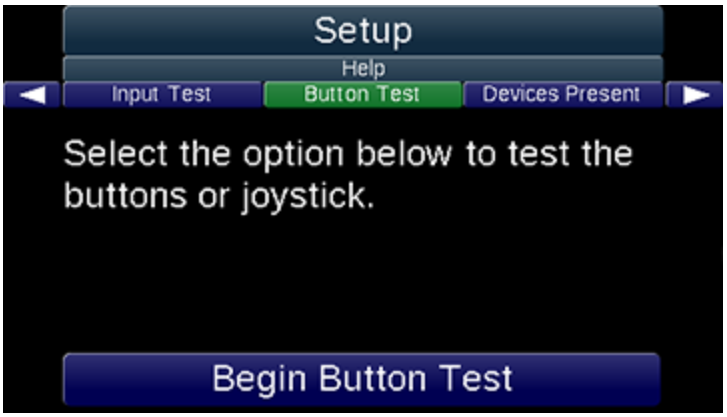
To view the status of switches from other units on the skip timer system, which may or may not have a display (including custom switch boxes, remote push buttons, etc.), select a different number under the ***Switch box:*** label.

Switches will still function during this test!

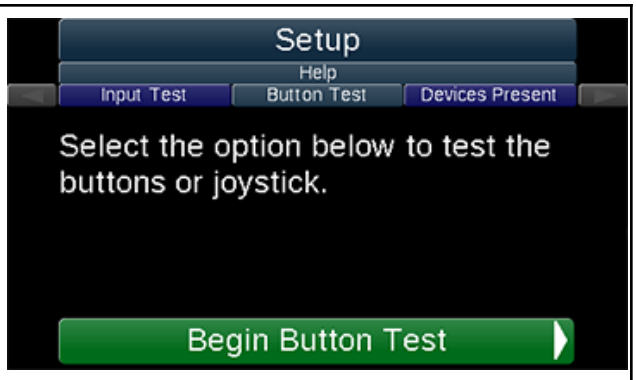
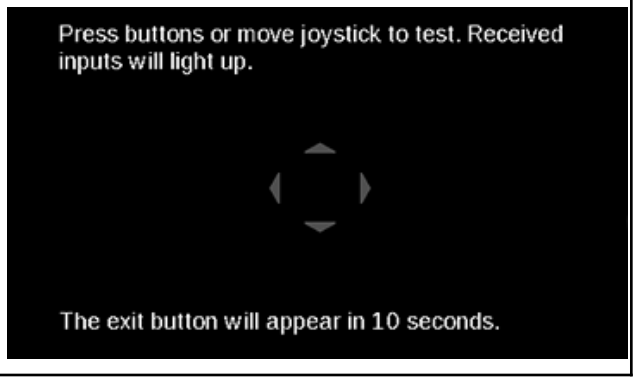
Remove load power and/or disconnect any equipment that would cause a safety hazard or undesired effects if a switch engaged that equipment.

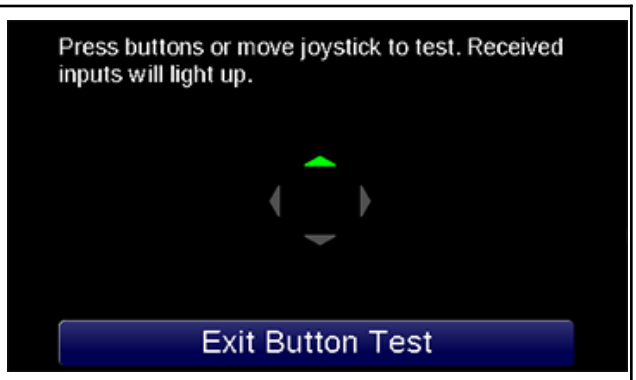
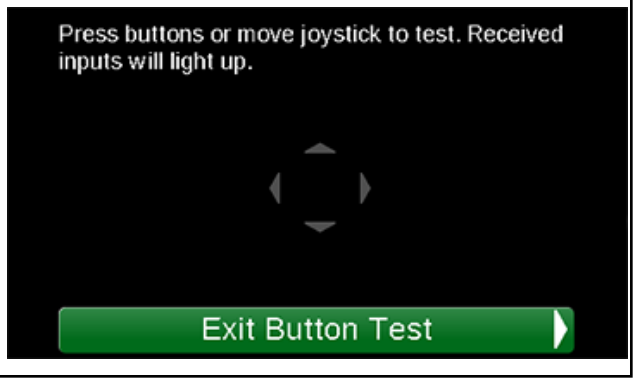
Important Note!

Button Test

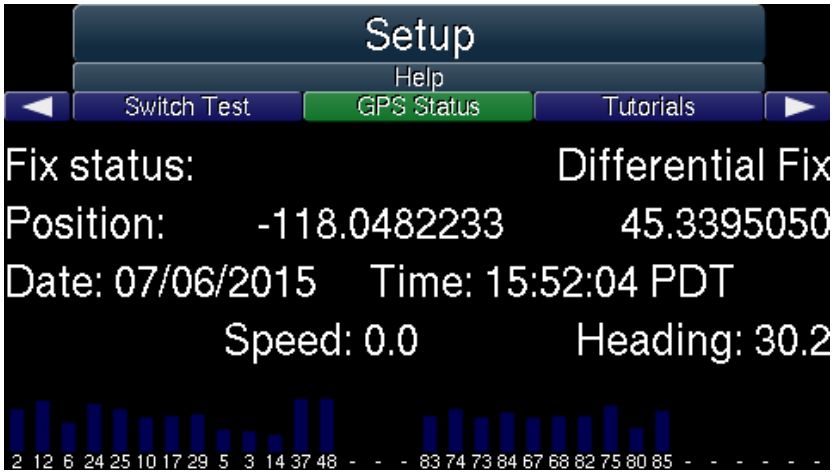


To troubleshoot issues with buttons, a ***Button Test*** is included in the Help options of the box's Setup menu (it also tests the Joystick if there is one). This is a quick and responsive way to check if there is an issue with the buttons.

*Scroll your cursor to the **Begin Button Test** option and navigate right*  *to begin.*	
*Once the **Button Test** begins, a countdown of 10 seconds will be displayed at the bottom of the screen. At the end of the countdown, the **exit** button will appear and you will be able to exit the Button Test.*	

Press the navigation buttons and watch the graphic displayed on the screen. When a button is pressed, the corresponding arrow should turn green for the duration of the press and return to gray when it is released. 	
*After the 10 second countdown completes the **Exit Button Test** button will appear. To exit the button text, scroll down to the **Exit Button Test** button and navigate to the right*  *. You will be returned to the **Help** menu.*	

GPS Status



This screen provides GPS information.

- *Fix Status: If No Fix, then GPS coordinates are not available.*
- *Position: GPS Coordinates of your current location.*
- *Date/Time: Current satellite date & time information, adjusted to time zone entered in*

the General Setup (see section 4.5.1, "General Setup").

- ➢ *Speed and Heading indicate GPS derived speed and heading information.*
- ➢ *The bar graph across the bottom of the screen indicates the signal strength of each satellite in the GPS and GLONASS constellations.*

About

The About screen provides information that is useful for troubleshooting your particular system when technical support is required. Refer to this page to find your particular system's revision number. This information, along with the model and serial numbers of your device, speeds troubleshooting efforts.

4.6 Other Menus

Other menus may arise at various time in operation, due to an event or external action that is detected by the system.

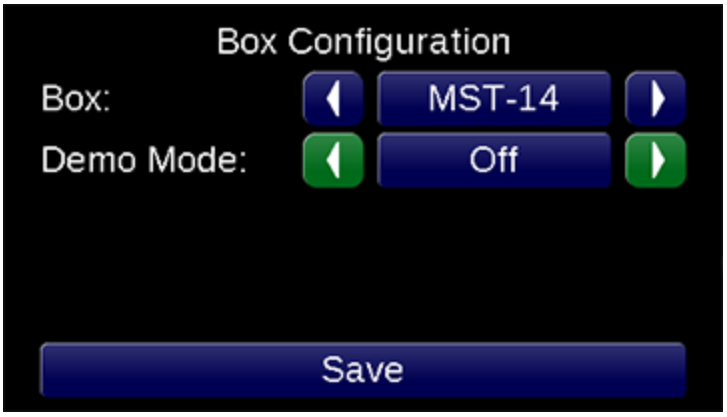
Splash Screen

The Splash Screen appears as the device boots up. This screen appears for approximately three seconds, and if the system volume is on, will also play a startup sound.

USB Menu

The USB menu appears when a USB drive is inserted. It is primarily used to export Counter Channel data, although future USB functionality may be here as well. *For more information, see the 5.1,* ***Counter Channel Logging****.*

Box Configuration



The ***Box Side Configuration*** menu allows a Master Box to be selected as the left or right master. Being able to easily swap left and right master boxes gives flexibility when a box fails or troubleshooting is required.

- ➢ *Start with power removed from your skip timer.*
- ➢ *Press and hold the right navigation button, or hold the joystick to the right, then apply power to the skip timer.*
- ➢ *This will enter the* ***Box Configuration*** *menu.*

Select the box configuration desired, then press ***Save***. The box will restart now and the new configuration will be in use.

Demo Mode

Demo Mode can be enabled and disabled to simulate speed on the skip timer. This is useful for office demonstrations as well as for testing skip timer functionality in the shop.

Demo Mode simulates motion and/or pump inputs, but the system is still fully operational. Demo Mode effectively tricks the system into thinking inputs are present when they may not be. Outputs will still come on (gun solenoids will fire).

Important Note!

DO NOT USE DEMO MODE DURING NORMAL OPERATIONS

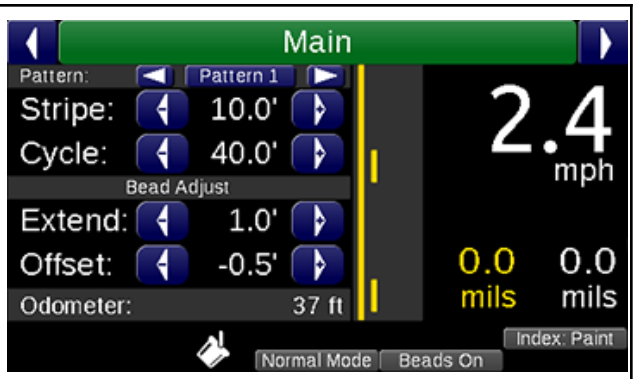
Make sure you disable demo mode before engaging equipment during actual striping operations. Speed will not be accurate, causing incorrect patterns to be emitted from material applicators.

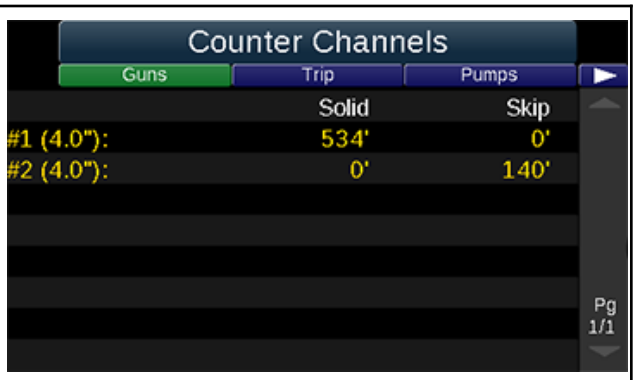
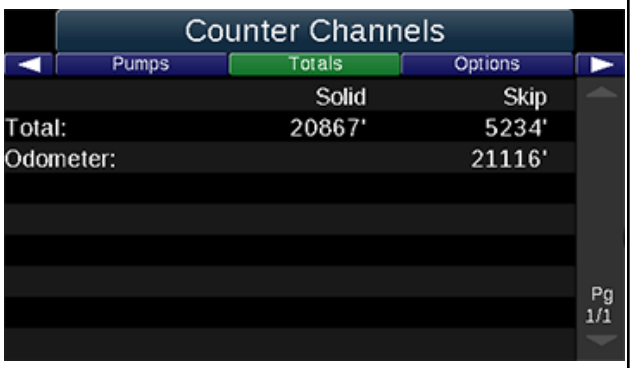
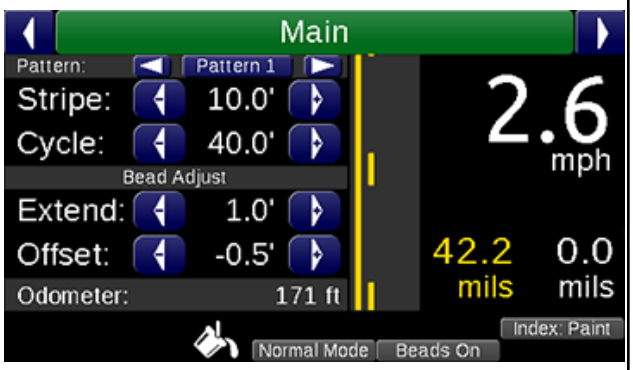
Enter the box configuration menu and set ***Demo Mode*** to your desired Demo Mode.

- **OFF:** Demo Mode will not be activated when you finish starting your system.
- **MOTION:** This will simulate speed on the skip timer.
- **PUMPS:** This will simulate pump strokes.
- **BOTH:** This mode will simulate both pump strokes and speed.

When your box is in a Demo Mode the word DEMO will steadily flash on the screen.

*While you are in the **Motion Demo Mode**, the Odometer will record distance when you switch on the START switch. You can toggle patterns on and off to change the preview display. This will provide a simulation of data as if the pattern had been painted.*



While in the Motion Demo Mode you will be able to view a simulation of the truck in motion. This includes ***Counter Channels****. Motion mode will not track simulated pumpstrokes.*	
In the ***Pumps Demo Mode*** *you will be able to view a simulation of pump strokes. These are reflected in the Counter Channels.*	
The ***Both Demo Mode*** *will simulate both motion and pump strokes.*	

5. Additional Features

5.1 Counter Channel Logging

The logging feature records the counter channels when they are cleared. The typical use case is for the operator to:

- Clear counter channels before a job (especially any counters due to equipment testing, etc.).
- Perform the road marking job.
- Save and Clear the counter channels at the end of the job.
- At the end of the day/week/etc., the operator or supervisor plugs a USB drive into the skip timer's USB port to export the logged records to a spreadsheet.

5.1.1 Counter Channel Logging Operation

When the counter channels are cleared using the ***Save and Clear*** option in the ***Counter Options*** menu, the distance and volume counters for each gun and pump are stored to internal memory.

GPS information is only recorded at the start and end of operations between counter channel clears:

- *The start GPS date/time and coordinates are recorded the first time the START switch is engaged after clearing counter channels.*
- *The end GPS date/time and coordinates are recorded the last time the START switch was moved to the STOP position before clearing counter channels.*

Info

To ensure accurate GPS coordinate association with the records, wait a few minutes after power up to ensure the GPS has sufficient time to acquire satellite lock.

*Verify GPS satellite signal acquisition using the **Setup** → **Help** → **GPS Status** screen.*

For more advanced data logging, with full GPS path and mapping, please contact your preferred OEM for information about our full-specification data logger options.

5.1.2 Spreadsheet Export

Although the internal memory can hold over a thousand counter channel records, it is recommended that the data is periodically exported as part of regular reporting procedures. To export the data, insert a USB drive into the USB port on the back of your skip timer. The following menu will appear.

Select ***Export Log Data***. This will export the data to a spreadsheet on the USB drive, and erase the internal memory.

The largest supported USB drive size is 32GB. The USB flash drive must be formatted as FAT32. Most retail USB drives are shipped from the factory this way. ***If your particular drive does not appear to work, try this assistance from USB flash vendor SanDisk at http://goo.gl/r1KpOh.***

The exported spreadsheet can be opened using any spreadsheet software, such as Microsoft Excel, Google Sheets, or OpenOffice Calc. The title of the

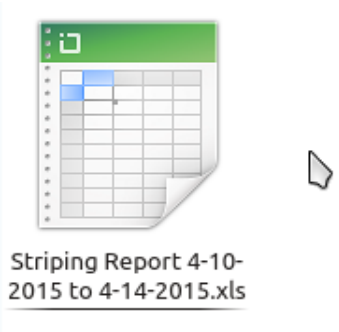
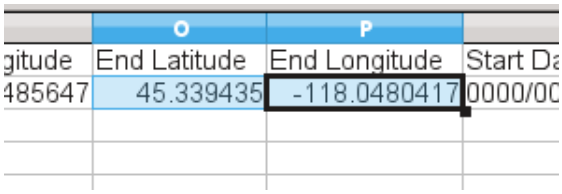
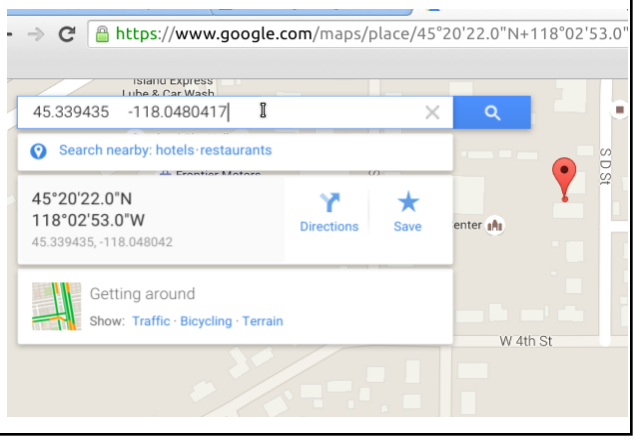
exported file will be ***"Striping Report <Start Date> to <End Date>.xls***". Some spreadsheet programs may ask you to import this file – if so, select ***Comma*** for the delimiter.

The columns exported are explained in the table below.

Column Title	***Description***
Odometer	*Total distance traveled with START switch on.*
Left Gun # Skip *Left Gun # Solid*	*Distance of Skip and Solid guns. Number of guns depends on the system.*
Pump #	*Total volume usage of the particular pump. Pump count depends on the system. Pump 1 is Yellow, Pump 2 is White, and Pump 3 is Black.*
Yellow App Rate *White App Rate* *Black App Rate*	*Average application rate over the surface area painted, per color system.*
Start Latitude *Start Longitude*	*The start GPS coordinates of the job, recorded at the time the START switch was first moved to the start position after clearing the counter channels.*
End Latitude *End Longitude*	*The end GPS coordinates of the job, recorded at the time the START switch was last moved to the stop position before Clearing and Saving the counter channels.*
Start Date/Time	*The date and time the START switch was first moved to the start position after clearing the counter channels.*
End Date/Time	*The date and time the START switch was last moved to the stop position before Clearing and Saving the counter channels.*

Other columns may appear when the ***Pattern Counter Channel*** feature is enabled. Refer to your ordering information for specific advanced counter channel rules and functionality.

To geolocate a job indicated in the spreadsheet using Google Maps:

After inserting the USB drive and opening it in your file browser, click on the file to open it with your spreadsheet software.	
Highlight the spreadsheet cells that contain the GPS latitude/longitude pair you wish to find. *Copy the text by right-clicking on the highlighted cells, and selecting "Copy".*	
Open your browser of choice (Chrome or Firefox are recommended), and navigate to http://maps.google.com. *Paste the GPS coordinates into the search field and press the Enter key.* *A "pin" icon will appear to indicate the location on the map.*	

5.1.3 Paper-Tape Printing

Skip-Line provides an optional paper-tape printer. It prints current counter channel information.

Under ***Counter Channels***, ***Options***, select ***Print Counters*** to print. The following is a printout example, showing the information contained in a standard printout.

```
------------------------------
      Current Activity
------------------------------
JOB_____________________________
```

____
CREW_____
_____
HWY_____
_____
MILEPOST_____
____

Start Switch On Dist:
1880 ft

	SOLID FT	SKIP FT
Gun 1 (Yellow 4.00")	**1254**	**626**
Gun 2 (Yellow 4.00")	**915**	**0**
Yellow Subtotal:	**2169**	**626**
Yellow Usage:	**9.4 gal**	
Yellow App Rate:	**16.1 mils***	
Yellow Cal Number:	**0.2560**	

	SOLID FT	SKIP FT
Gun 3 (White 4.00")	**1751**	**0**
White Subtotal:	**1751**	**0**
White Usage:	**5.3 gal**	
White App Rate:	**15.2 mils***	
White Cal Number:	**0.2537**	

FOOTAGE TOTALS:

SOLID FT	SKIP FT
3920	**626**

FOOTAGE CAL NUMBER:
0.09780

*** Mil calculation based on line widths shown**

All report items based on calibration numbers.

Verify calibration frequently

to ensure correct reports.

5.2 Datum Point

Datum point allows the skip timer to create a point in front of the guns that is the target point for material.

This can be advantageous or even necessary in several situations:

- *When bead coverage is critical when paint first turns on.*
- *For single-operator setups, where the operator is also the driver and/or cannot see the guns.*
- *For high precision applications, so the vehicle can align with the target from the front of the vehicle, allowing the vehicle to reach a reasonable application speed before material is emitted from the guns.*

5.2.1 The Bead Registration Concept

Beads are gravity fed and are relatively slow to reach the pavement (around 100 to 500 milliseconds depending on bead gun type and installation variables). In comparison, high pressure paint reaches the road nearly instantaneously in around five milliseconds.

Therefore, a properly operating skip timer will need to turn on the bead guns before the paint guns. At 15MPH, a bead gun with 250ms total time delay turned on electrically at the same time as a paint gun will have the beads arrive on the ground ~5.5 feet AFTER the paint reaches the pavement. This is obviously unacceptable in most situations.

This difference **should only be corrected with time**, and not with distance. If 5.5' is entered as a bead distance offset, and the vehicle subsequently is operating at 10MPH, the beads will arrive 2.3' before the paint. This is obviously not the intended result either.

By correcting the combination of bead gun mechanical delay time plus bead drop time with a time factor, the vehicle speed is no longer part of the equation, and bead registration will be much more reliable at varying vehicle speeds. Typically at this point, the only remaining variable* is wind speed, which can be corrected for using the Bead Offset parameter on the main screen during striping operations.

** Some bead gun styles may also be affected by variations in pneumatic air pressure*

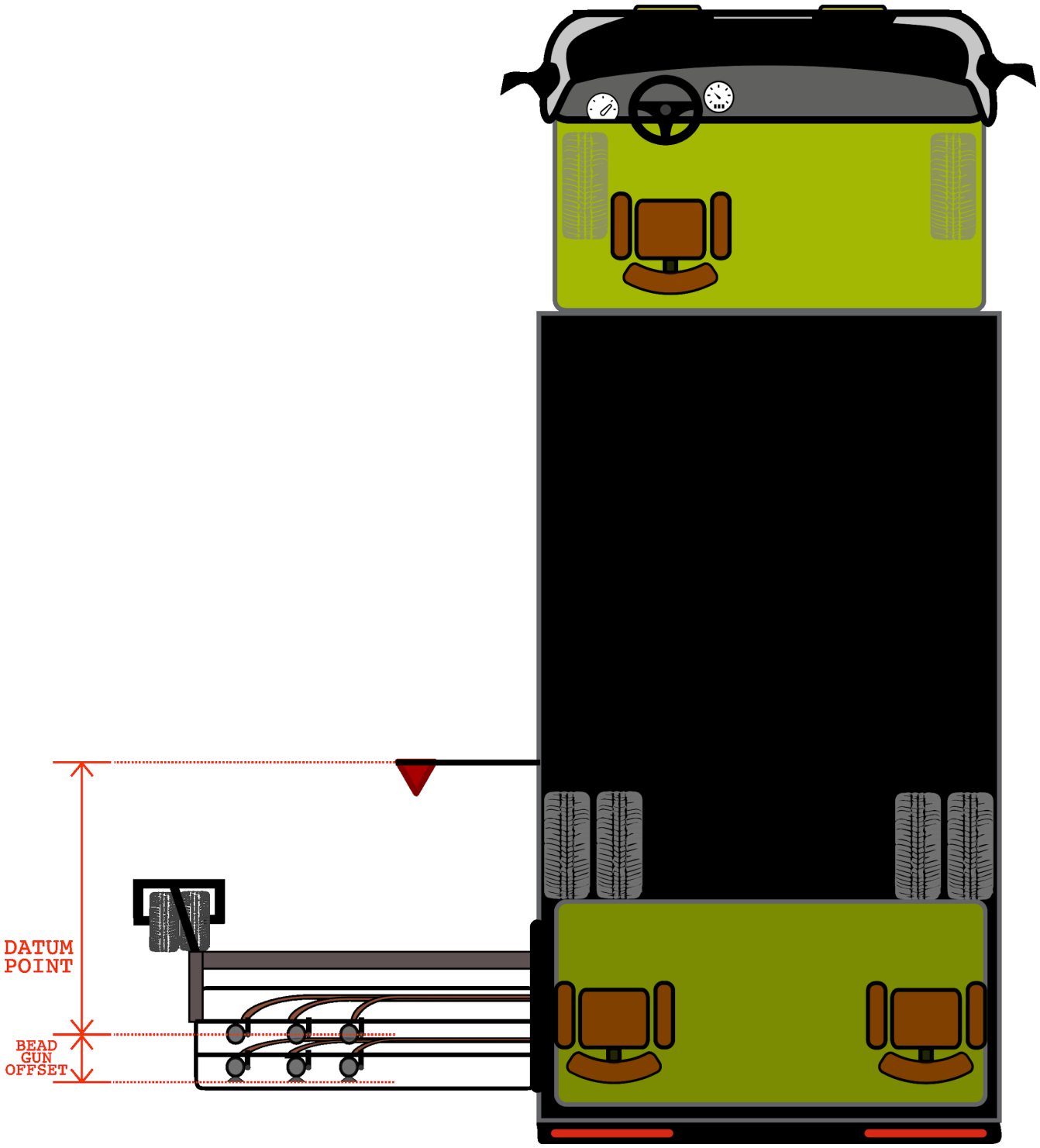
systems.

5.2.2 Datum Point Correction

When striping first starts, there is no time for the skip timer to turn on the bead guns before the paint guns to ensure proper registration. This means that the first few feet of markings are not covered with beads.

By enabling Datum Point and setting the Datum Offset to some distance in front of the guns, this provides the skip timer with enough time to accurately account for required paint and bead timings.

It is recommended to attach a flag or identifier to the vehicle at the desired datum point. Then, measure from the datum point to the front material gun, as shown in the illustration below:



Enter the measured Datum Length distance (see 4.5.1, “Datum”) and then enable Datum Point usage in the Quick Setup menu to engage this feature.

5.3 Tandem Beads

Tandem beads (also called ***double-drop*** bead systems) allow two different types of bead materials to be applied from two aligned bead guns in the same pass, including standard bead mixes, premium bead mixes, high-friction grit, high retroreflectivity materials (3M Element), or curing agents (Potter's VisiLok).

This function can be provided either using a toggle switch, or through the Quick Setup menu.

The Quick Setup function that enables this feature is labeled **Tandem Beads** and has the options of **Tandem/Front/Rear.** This function selects between both bead guns (double-drop), the front gun, or the rear gun (respectively) to be active during striping operations.

5.4 In-Field Software Updates

Software updates can be applied to Skip-Line skip timers in the field using a file, delivered via email or web download, placed on a USB flash drive.

This provides a quick and easy way to provide new features, functionality, or bug fixes remotely without vehicle down time.

There may be one or more files. Follow this procedure to accomplish the update on the skip timer:

1. *From a PC, download all email attachments or Internet links to files.*
2. *Place all files in a folder called **updates** on the root of the USB drive from a computer.*
3. *Close all file explorer windows. Properly eject the USB drive.*
4. *With the skip timer system powered off, insert the USB drive.*
5. *Power on the skip timer. The skip timer should detect the USB drive, find the files, and commence with the update.*
6. *Once the update is complete, remove USB drive and power cycle the device.*
7. *Verify the new functionality is in place.*

The new software should now be installed on the skip timer system. Note that updates for other devices (with the exception of CVO-312 devices) will have received their updates through the communications network at the same time.

USB Update Note

Update files are created on a serial number basis. Attempting installation of an update file created for a different serial number will fail.

Make sure your OEM and/or Skip-Line has the correct serial numbers prior to requesting an update.

6. Menu Messages

There are many information, warning, and error messages that can appear on the MST-14. Review the following sections for information about what these messages mean, and what (if any) corrective actions should be taken.

6.1 Message Icons

Messages have three levels of importance.

Icon	Importance	Description
	*Information*	Informational messages typically do not mean that anything is necessarily wrong, but provide additional information that will help the operator understand what is happening. If cleared, the information will not reappear for the same instance.
	*Warning*	Warning messages indicate that at some level, something is not functioning as expected. It may not cause the system to fail completely, but may limit functionality until the error is corrected. ➢ If the message is cleared, the

		warning will reappear in two minutes if the error still exists.
	*Critical Error*	Critical messages indicate the system may not be able to function without correcting the error. ➢ If the message is cleared, the critical error message will reappear in two minutes if the problem still exists.

6.2 Message Descriptions

Icon	Message Text	Description
	*Core Skipper is initializing...*	This appears on startup to indicate that the system is not quite ready for operations yet. It will disappear once the system is ready.
	*Gun #X Disabled - Change color from 'None' to fix.*	Guns can be disabled by setting the color to “None”. If the color is set to none, but the switch is not in the “OFF” position, this message reminds the operator of the gun's current status. ➢ If the gun is intended to be used, change the gun color from “None” to the correct color in the Gun Setup menu. ➢ If the gun is not intended to be in use, move the pattern switch to OFF.
	*Attached USB device has an error.*	The system has detected a USB device is plugged in, but can't determine what kind of device it is. ➢ Remove the device from the USB port. ➢ If the device was a USB flash drive, it is not compatible – try a different USB drive.

	*Attached USB device is not a flash drive.*	The system has detected a USB device is plugged in, but that device is not a flash drive. ➢ Only USB flash drives are compatible with this USB port – unplug any other devices. ➢ If the device was a USB flash drive, it is not compatible – try a different USB drive.
	*Output #X is shorted.*	A short circuit has been detected on an output pin. Remove the short circuit, and clear the error to resume use of this pin.
	*Turn Run switch to Hold to continue.*	On systems with a “RUN-HOLD” switch, the switch must be in the HOLD position before operations can begin after system power-on. This prevents inadvertently engaging material at power-on.
	*Turn off Start switch to continue.*	On systems with a “START-STOP” switch, the switch must be in the STOP position before operations can begin after system power-on. This prevents inadvertently engaging material at power-on.
	*Flash image mismatch: update image via USB.*	Images and audio files for the program do not match the main program installed on the system. ➢ Insert a USB drive with the correct update file. ➢ Contact Skip-Line for support.
	*Flash memory unreadable.*	The flash memory that contains graphics, audio files, and logged counter channel records is not communicating. ➢ Contact Skip-Line for support.
	*Duplicate switch detected. Fix and cycle power.*	A switch with the same function is connected via the CAN expansion port, or devices with incompatible programs are

		both on the same system. ➢ Remove other devices from the CAN bus. ➢ A full system power cycle is required to clear this error. ➢ Contact Skip-Line for support.
	*No communication with Core Skipper.*	The MST-14 has two internal components that separately handle the menu interface and the striping algorithms. If they cannot communicate with each other, this error will appear. ➢ Remove cable from the CAN expansion header. ➢ Check CAN expansion receptacle for dirt, corrosion, or damage. ➢ Contact Skip-Line.
	*The memory in the Core Skipper isn't responding.*	A memory circuit has failed internally. Contact Skip-Line for service.
	*Switch communication error. Check cables.*	The MST-14 has had an internal failure. Contact Skip-Line for service.

7. Auxiliary Devices

7.1 Remote Trigger

Remote trigger devices are available to assist with manual retrace of old work. Contact Skip-Line for more information.

There are three modes for Remote Trigger: Auto, Semi-Auto, and Manual. This can be set using a rocker switch (on the trigger itself), or in the Quick Setup menu under the “Remote Trigger” item, depending on the specific remote trigger option purchased.

7.1.1 Semi/Auto/Manual Auto Trigger Modes

Auto Trigger Mode allows the skip timer to operate normally. The trigger will not have any effect on operations.

Semi-Auto Trigger Mode causes one skip to be emitted per trigger press. The skip timer will:

1. Emit paint for guns with pattern switches in the SOLID position normally, and
2. Only emit paint for guns in the SKIP position upon a trigger press. The skip emitted will be of the stripe length set in the skip timer.

Manual trigger mode causes the skip timer to:

1. Emit paint for guns with pattern switches in the SOLID position normally, and
2. Only emit paint for guns in the SKIP position when the trigger is pressed. The skip will continue to emit until the trigger is released.

7.1.2 Override Trigger Option

The ***Override Trigger*** option allows the trigger to override the *START* switch. Override Trigger causes any gun with its pattern switch in either *SOLID* or *SKIP* to turn on while the trigger is pressed. The guns will remain on until the trigger is released.

Even though any pattern switch not in the *OFF* position will cause its gun to turn on, the counter channels will still record distances to the respective *SOLID* or *SKIP* position of the pattern switch.

Important Note!

Be sure to engage other safeties when the Override Trigger is not in use to avoid inadvertent paint emission.

Unexpected paint emission can cause eye and body injuries.

7.2 Video Guidance and Overlay

Skip-Line provides a video crosshair and overlay device, the CVO-312, which provides speed, mil thickness, and other application rate information directly on

the video signal. This provides the operator with greater situational awareness and higher overall striping quality.

7.3 Full Specification Data Logging

Some states mandate specific reporting requirements for work done by contractors within the state. This often includes cellular reporting, full GPS path, bead monitoring, full page report printer, and other advanced requirements.

An MST-14 in combination with a CVO-312 can fulfill the full specifications of these logging requirements. Contact Skip-Line or your preferred OEM for more information about additionally required sensors and reporting requirements for your particular state.

8. Switch Functions

The MST-14 has the following switches available. Each has a specific function. The switches required can be custom ordered at the time of purchase.

MATERIAL PATTERN SWITCH (SOLID-OFF-SKIP)

The ***SOLID-OFF-SKIP*** switch changes the gun pattern for its associated gun number. For each respective position:

- **SOLID**: The gun will apply a solid line on the road.
- **OFF**: The gun will not apply any material.
- **SKIP**: The gun will apply a skip with the STRIPE length denoted on the master box once every CYCLE.

During either new work or rework operations, it is generally not recommended to use these switches to manually create a skip on every cycle. For example, the operator should not turn the gun on and then off using the switch once every cycle.

CARRIAGE UP-DOWN

The ***Carriage UP-DOWN*** switch controls the vertical position of the carriage. This is an optional switch on the MST-14.

ADV-RET

The ***ADV*** (advance) and ***RET*** (retard) controls are used while applying stripes over previous work. The ADV and RET controls shift the entire pattern forward or backward on the pavement to help the new paint cover exactly over the road marking patterns already on the road.

While striping, move the ADV switch to the UP position momentarily to shift the pattern forward on the pavement. The RET control shifts the pattern backwards.

START-STOP

The ***START-STOP*** switch is used for controlling the pattern and resetting the cycle.

- ***START*** *is used to start the pattern. Any pattern switches that are in SKIP or SOLID will engage the guns for paint, as well as any enabled bead, air, or tandem paint guns.*
- ***STOP*** *is used to stop the pattern AND reset the cycle.*

Important Note!

Clear personnel from the spray path of all guns before engaging the START switch. Once moved to the START position, any gun pattern switch moved out of the OFF position can immediately actuate the material gun.

BEADS AUTO-OFF-TEST

The ***Beads AUTO-OFF-TEST*** switch controls whether beads are used during striping operations.

- ***AUTO****: Beads will be dispensed for pattern switches that are not in the OFF position when the START-STOP switch is in the START.*
- ***OFF****: Beads will not be dispensed.*
- ***TEST****: Beads will be dispensed for pattern switches that are not in the OFF position, regardless of the START-STOP switch position.*

RESET-RUN-HOLD

The ***RESET-RUN-HOLD*** switch is an alternative to the standard START-STOP switch.

- ***HOLD*** *is equivalent to STOP, and is used to stop the pattern AND reset the cycle.*
- ***RUN*** *is equivalent to START, and is used to start the pattern. Any pattern switches that are in the SKIP or SOLID will engage the guns for paint, as well as any enabled bead, air, or tandem paint guns.*
- ***RESET*** *is a momentary position on the switch that withholds any SKIP guns while allowing SOLID to continue. Upon release and return of the switch to the RUN position, the skip pattern restarts from the beginning of the cycle.*

Important Note!

Clear personnel from the spray path of all guns before engaging the RUN switch. Once moved to the RUN position, any gun pattern switch moved out of the OFF position can immediately actuate the material gun.

Appendix A: Glossary

Stripe
The ***skip*** length, i.e. the length of the paint on the road for a skip.

Cycle
The cycle is the distance from the start of one skip to the start of the next skip.

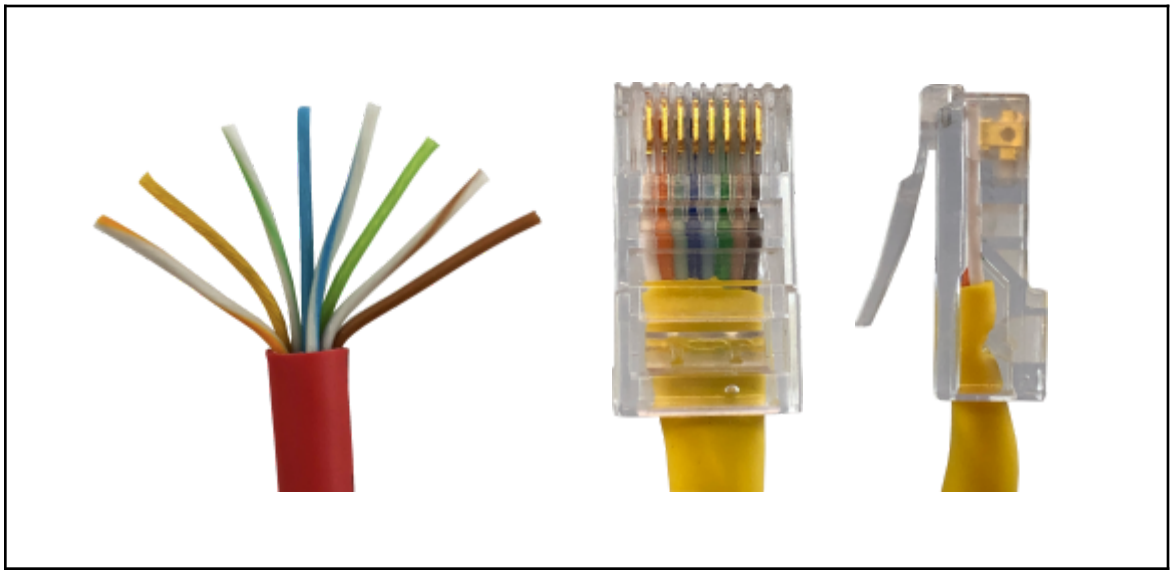
Gap
This is the portion of the Cycle between skips where paint is not applied.

Appendix B: Communications Cable

Communications cables for the SC-12 system follow the EIA/TIA 568-B cable wiring standard. These are commonly referred to as Cat5, RJ45, or simply as a network patch cable.

A communications cable should be constructed using the following pin assignments on both ends of the cable.

- Pin 1 - white / orange stripe
- Pin 2 - orange
- Pin 3 - white / green stripe
- Pin 4 - blue
- Pin 5 - white / blue stripe
- Pin 6 - green
- Pin 7 - white / brown stripe
- Pin 8 - brown



TIA/EIA 568-B

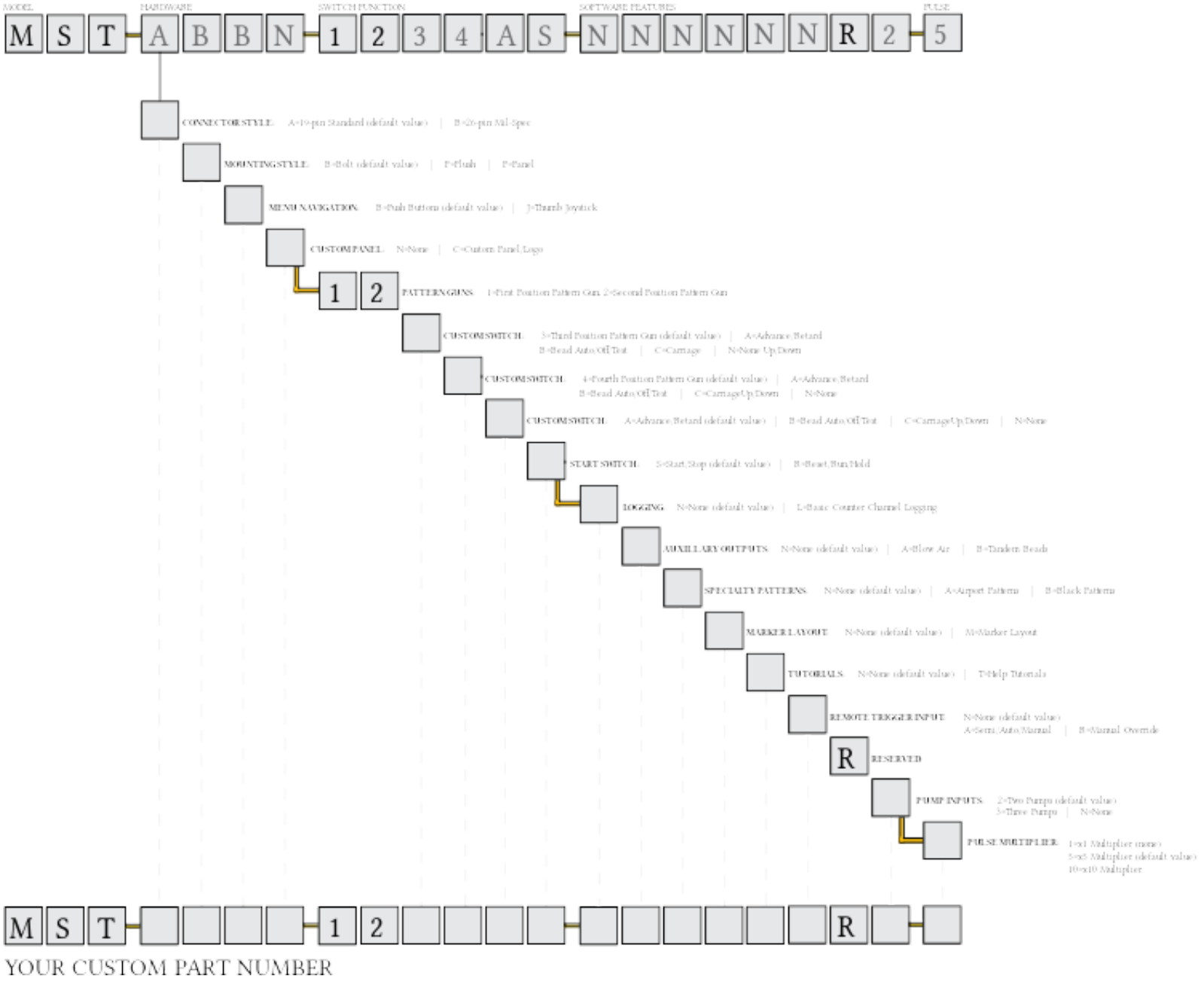
These cables can also be purchased pre-assembled from your local computer store or big box retailer in varying lengths.

A sealed waterproof RJ-45 connector with strain relief is available from your OEM or Skip-Line.

Appendix C: Ordering Guide

MST-14 PART NUMBER BUILDER

DEFAULT OPTIONS



YOUR CUSTOM PART NUMBER

Appendix D: Repairs Form

If your device fails any of the tests included in this manual and needs to be sent in for repairs, there is a form that can be filled out to help streamline the process. The most up to date version of the form can be found on www.skipline.com and is also included in every Skip-Time newsletter.

A copy of the repairs form is included on the following page in this manual. You may reproduce this form via photocopy, scanning, etc.

If for any reason you are unable to reproduce or print the form, please include a note with the following information in the box with your Skip-Line device(s):

Contact name
Phone number where contact can be reached during business hours
Return shipping address (no PO Boxes)
Return shipping method (Next day, 2nd day, 3rd day, or ground)
Billing address (if different from return address)
A description of the problem
PO number (if required by your organization's accounts payable department)

Boxes containing a note with the above information can be sent to us at:

Skip Line, Inc.
10514 N. McAlister Rd
La Grande, OR 97850

Should any information above be missing, we cannot guarantee the repaired unit will be returned in the manner expected.

UPS is the preferred shipping provider as our local UPS delivers earlier in the morning and picks up later in the evening than any other local courier.
The unit(s) being sent in should be relatively clean. Units should be wrapped in large bubble wrap (3/4" to 1" bubbles) and surrounded by newspaper or packing filler. Particular care should be taken for units with LCD displays by ensuring there are no other objects with sharp corners packed in such a way that they could damage the screen while the shipment is in transit. There should be two inches of filler between the unit and the edge of the shipping box.

If you have any questions about the process, please call (541) 963-0111.

SKIP-LINE BY SPEC-RITE

Inspection or Repair Information Form

Company: _____

Contact Name: _____

Phone Number: _____

Email: _____

P/O Number: _____

Return Method:
☐ Ground ☐ Next Day Air ☐ 2 Day ☐ 3 Day
☐ Saturday Delivery

Return Address (No PO Box):

_____
_____
_____

Date Sent: _____

Model(s): _____

Serial Number(s): _____

This is an: ☐ Inspection ☐ Repair ☐ Update ☐ Other: _____

Please provide a detailed description of the problems/issues you are experiencing below.

_____

_____

_____

_____

_____

Affix your business card here (optional)

Billing Address (Required if different from above):

_____
_____
_____

Thank You!

Ship this form with your equipment to:

Skip-Line Repairs
10514 N. McAlister Road
La Grande OR 97850

Contact Us:

Hours: 8am-4:30pm Pacific Time
Monday-Friday
repairs@skipline.com
541-963-0111