



User Manual
Solenoid Controller
BI-SC1001

NOTICE

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1 General Safety Information

The following general safety precautions must be observed to avoid injury and prevent damage to this product or any products connected to it. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates the safety standards of design, manufacture and intended use of the product. Brandstrom Instruments assumes no liability for the customer's failure to comply with these requirements.

USE DC POWER ONLY.

DO NOT EXCEED THE RATED INPUT VOLTAGE AND POWER.

AVOID SHORT CIRCUITING THE OUTPUT TERMINALS.

DO NOT OPERATE IN WET/DAMP CONDITIONS.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERE.

2 Device Overview

The Brandstrom Instruments BI-SC1001 Solenoid Controller is used to control the power provided to a Brandstrom Instruments bi-stable or self-restoring rotary solenoid at user-defined output power ON (pulse) and OFF (dwell) periods. Output pulses can be user-actuated or automatically cycled either **locally** (using the Manual Trigger Switch and the Pulse Width and Dwell Time Control Knobs) or **remotely** from a PC (via TTL serial communication).

The Controller is rated for 3V to 24V DC, maximum 2 W input/output power.

NOTE: The output voltage (to the solenoid) will be slightly lower than the input voltage (to the Controller) and should not be an issue in most cases. However, if a specific output voltage is desired, it is recommended that the output voltage be measured with the intended load (i.e., rotary solenoid) connected and the input voltage then adjusted accordingly.

The Controller's overall dimensions are shown in Figure 1.

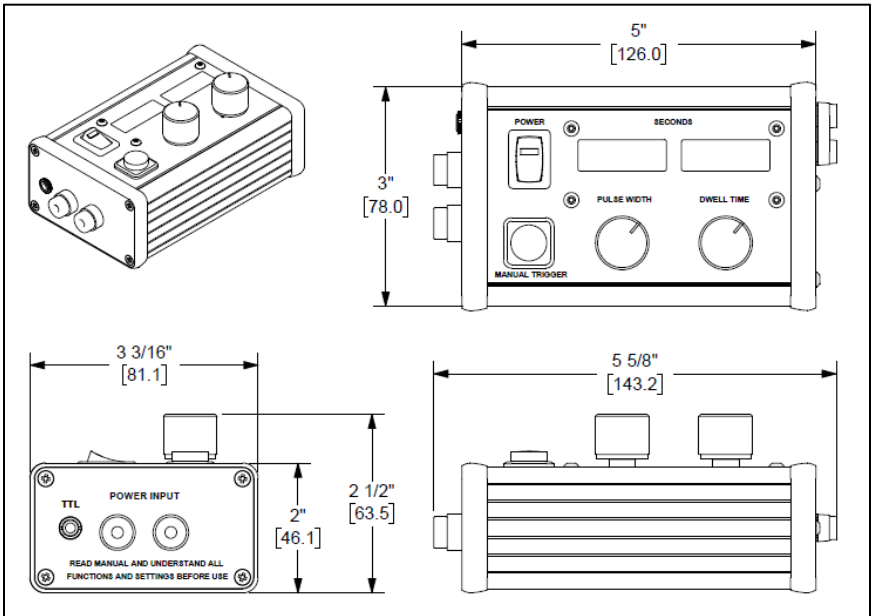


Figure 1. Overall dimensions of Controller in inches [millimeters].

The Controller's physical and interface attributes (see Figure 2) are described as follows.

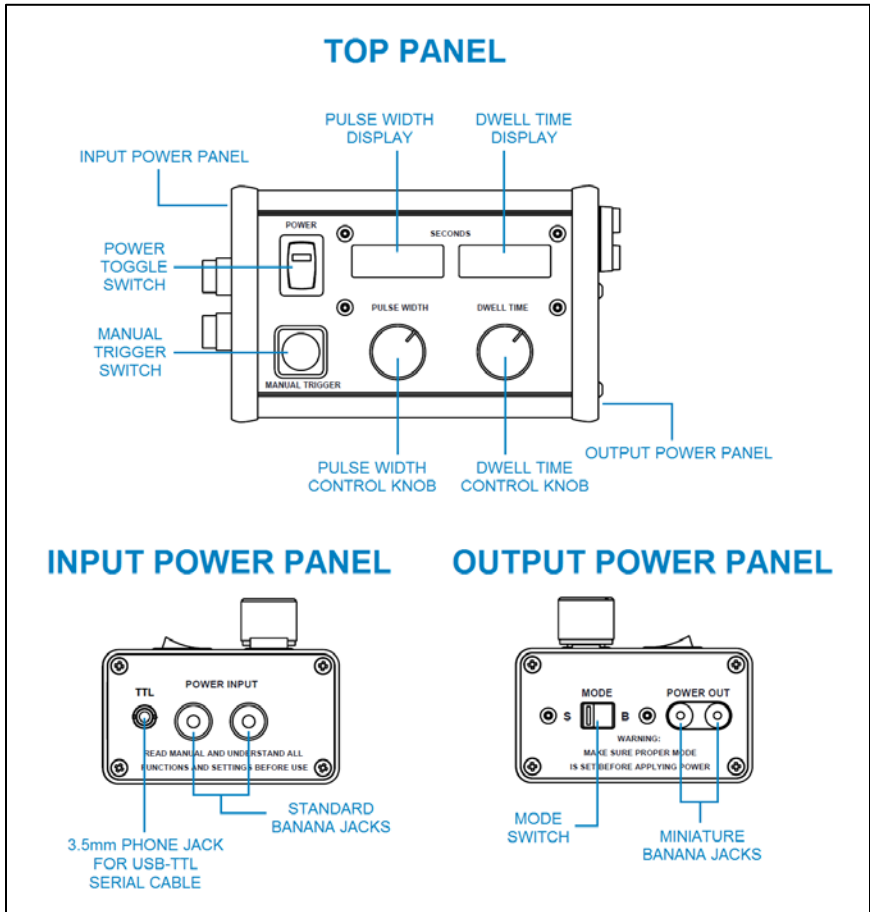


Figure 2. Controller physical and interface attributes.

2.1 Input Power Panel

The Input Power Panel contains standard banana jacks for supplying the input power to the Controller and a 3.5mm phone jack for TTL serial communication with a PC.

NOTE: One USB-TTL serial cable (1.8m, 3.5mm phone plug) is included with the Controller for user convenience.

2.2 Output Power Panel

The Output Power Panel contains the Mode Switch and miniature banana jacks for supplying the output power to a rotary solenoid.

NOTE: One set of miniature banana jack cables are included with the Controller for user convenience.

2.2.1 Local Control

In local control, the Mode Switch toggles between the two types of operational modes required for a bi-stable (“B”) and self-restoring (“S”) rotary solenoid.

CAUTION: The Mode Switch must be set correctly prior to enabling power to the Controller. Incorrectly setting the Mode Switch can result in damage to a rotary solenoid.

2.2.2 Remote Control

In remote control, the Mode Switch is ignored and toggling between the two types of rotary solenoid operational modes is accomplished remotely.

2.3 Top Panel

2.3.1 Power Toggle Switch and Indicator Light

The Power Toggle Switch is used to turn the Controller ON/OFF and has an Indicator Light which illuminates when ON.

2.3.2 Manual Trigger Switch and Indicator Light

In local control, the Manual Trigger Switch has multiple functions as follows:

1. When pressed and immediately released **during user-actuated output pulsing in bi-stable or self-restoring mode** (see 4.1.1, 4.2.1), triggering a pulse (output power ON) at a user-defined pulse width setting;
2. When pressed and held **during user-actuated output pulsing in self-restoring mode only** (see 4.2.1), triggering a pulse and holding the output power ON for as long as it is held pressed;

3. When pressed and immediately released **during automatic cycling in bi-stable or self-restoring mode** (see 4.1.3, 4.2.3), restarting the pulse cycle;
4. When pressed and held **during automatic cycling in self-restoring mode only** (see 4.2.3), triggering a pulse and holding the output power ON for as long as it is held pressed, and then restarting the pulse cycle upon release.

The Switch's Indicator Light illuminates when pressed and stays illuminated as long as it is held pressed. During cycling, it flashes on and off at the pulse width and dwell time settings, respectively.

In remote control, the pushbutton action of the Switch is ignored, but the Indicator Light illuminates in accordance with the remotely controlled output.

2.3.3 *Pulse Width Control Knob*

In local control, rotating the Pulse Width Control Knob adjusts the output power ON period (pulse width). **In bi-stable mode**, the ON period is adjustable between **20 and 200 milliseconds**; **in self-restoring mode**, the ON period is adjustable between **250 milliseconds and 300 seconds**.

Pressing the Knob locks/unlocks the ON period setting.

In remote control, the Knob is ignored.

2.3.4 *Dwell Time Control Knob*

In local control, rotating the Dwell Time Control Knob adjusts the output power OFF period (dwell time). **In either bi-stable or self-restoring mode**, setting the Knob to the fully counter-clockwise position enables single user-actuated output pulses; rotating the Knob clockwise from the fully counter-clockwise position enables automatic cycling of output pulses and adjustment of the OFF period from **10 seconds to 200 milliseconds**.

Pressing the Knob locks/unlocks the OFF period setting.

In remote control, the Knob is ignored.

2.3.5 *Pulse Width and Dwell Time Displays*

The Pulse Width and Dwell Time Displays are both four digits and display the output power ON and OFF periods, respectively, **in seconds** when **in local control**.

NOTE: When delivering user-actuated output pulses, the Dwell Time Display will show four dashes (see Figure 3).

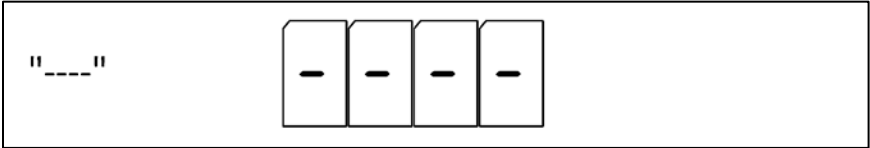


Figure 3. Dwell Time Display during user-actuated output pulsing.

In remote control, the Displays show eight dots by default (see Figure 4). The user can also use the “disp” command to display a custom 8-character message (see 5.8).

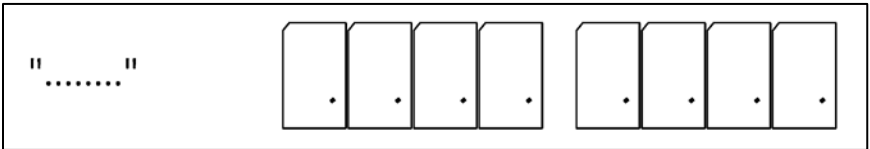


Figure 4. Pulse Width and Dwell Time Displays, by default, in remote control.

During the Controller start-up sequence (see 3.2), the Displays also show a series of start-up messages regardless of local or remote control.

3 Device Setup

3.1 Controller Input and Output Connections

Recommendations:

1. Always make/break Controller input and output connections while the Controller is turned OFF.
2. Always make/break the Controller input connection to your power supply with your power supply output set to zero or turned off.

3.2 Controller Start-Up Sequence

Upon turning the Controller ON, the Pulse Width and Dwell Time Displays will momentarily display the following start-up messages (see Figure 5) in sequence:

1. *"biSC1001"* (the Controller model number);
2. *"YYYYMMDD"* (the Controller software/firmware compile date);
3. *"Sn#####"* (the Controller serial number).
4. *"biStAbLE"* or *"SElFrEst"* (respectively indicating that the operating mode is set to either bi-stable or self-restoring);

At the conclusion of the start-up sequence, the Controller will be in local or remote control, whichever was last implemented, and the Pulse Width and Dwell Time Displays will show information accordingly.

NOTE: The Controller ships from the factory set to local control.

WARNING: DO NOT EXCEED THE RATED VOLTAGE AND POWER OF THE CONTROLLER OR THE ROTARY SOLENOID BEING CONTROLLED, WHICHEVER IS LOWER.

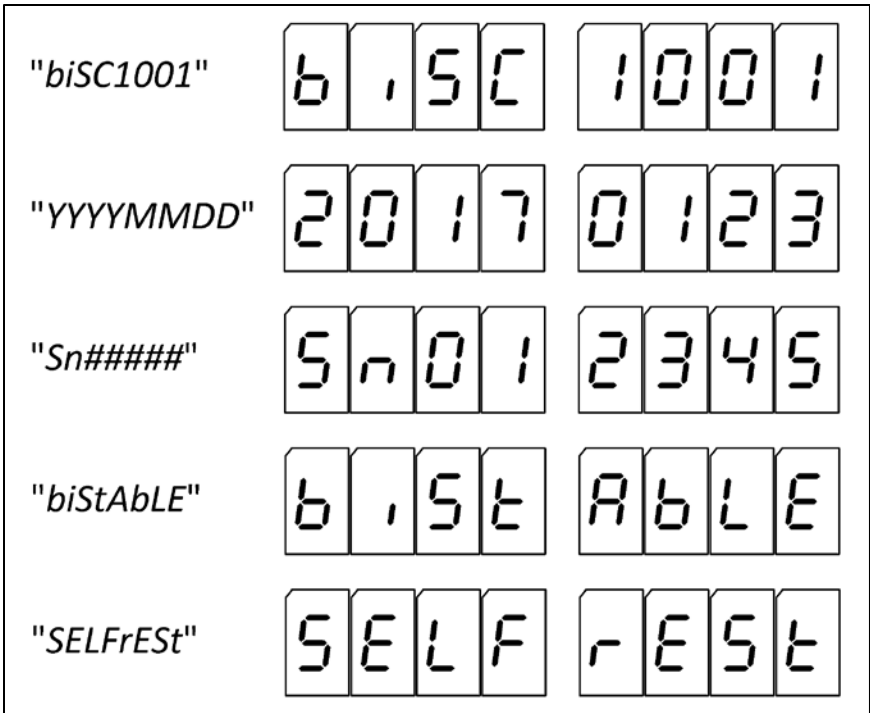


Figure 5. Start-up sequence display messages.

4 Device Operation – Local Control

The Controller is shipped from the factory set to local control. The following describes how to operate the device in local control.

4.1 Bi-stable Mode

CAUTION: Do not operate the Controller in bi-stable mode with a rotary solenoid that is not bi-stable. Doing so may induce premature wear to a non-bi-stable solenoid's internal components.

4.1.1 User-actuated Output Pulsing

During user-actuated output pulsing in bi-stable mode, the Controller provides output power in **individual** pulses of alternating polarity triggered by the user at a pulse width set by the user.

Figure 6 is a graphical illustration of bi-stable mode user-actuated output pulsing in local control.

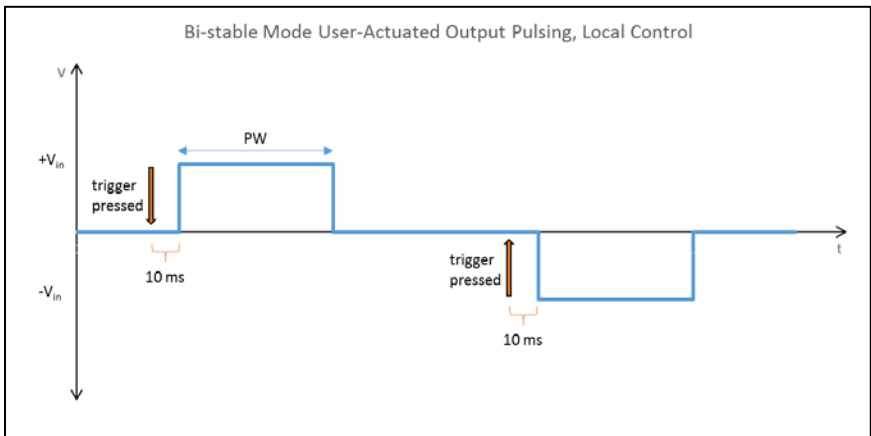


Figure 6. User-actuated output pulsing in bi-stable mode, local control.

4.1.2 Automatic Cycling

During automatic cycling in bi-stable mode, the Controller provides output power automatically in **continuous** pulses

of alternating polarity at a pulse width and dwell time set by the user.

Figure 7 is a graphical illustration of bi-stable mode automatic cycling in local control.

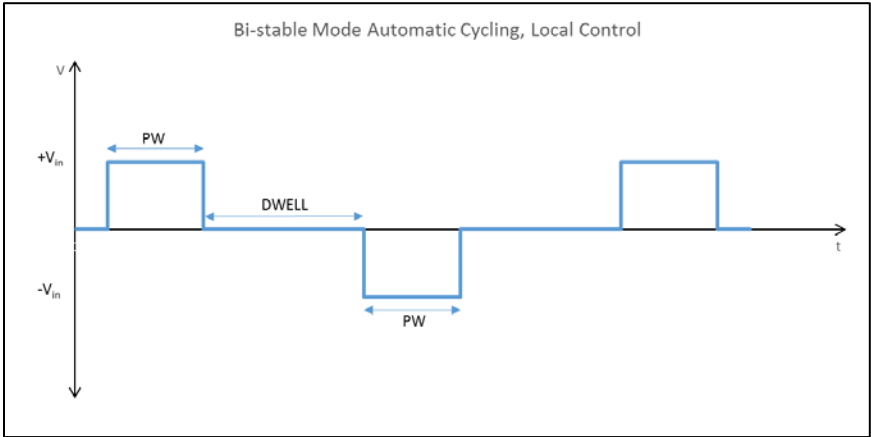


Figure 7. Automatic cycling in bi-stable mode, local control.

4.1.3 Manual Triggering During Automatic Cycling

During the output power ON period, the Manual Trigger Switch is ignored.

During the output power OFF period, pressing the Trigger Switch will cut the dwell time short and initiate the pulsing sequence anew.

Figure 8 is a graphical illustration of manual triggering in bi-stable mode automatic cycling in local control.

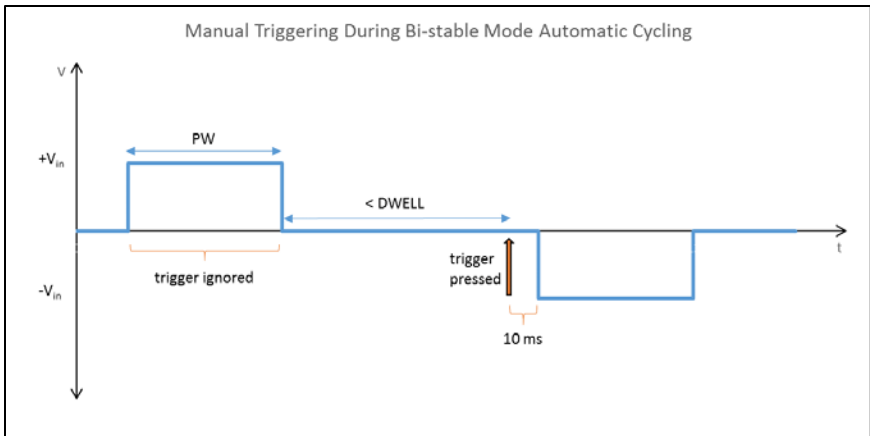


Figure 8. Manual triggering during bi-stable mode automatic cycling.

4.2 Self-restoring Mode

CAUTION: Do not operate the Controller in self-restoring mode with a rotary solenoid that is not self-restoring. Doing so may cause a non-self-restoring solenoid to overheat and become seriously damaged.

4.2.1 Single, User-actuated Output Pulsing

During single, user-actuated output pulsing in self-restoring mode, the Controller provides output power in **individual** positive-only pulses triggered by the user at a pulse width set by the user OR for as long as the Manual Trigger Switch is held pressed by the user.

CAUTION: Pursuant to the intended application, Brandstrom Instruments self-restoring rotary solenoids are designed and manufactured to be powered ON indefinitely when operated at their stated specifications and ratings and thus do not overheat. However, additional precaution is recommended when holding the Trigger Switch for extended periods of time.

Figure 9 is a graphical illustration of self-restoring mode user-actuated output pulsing in local control.

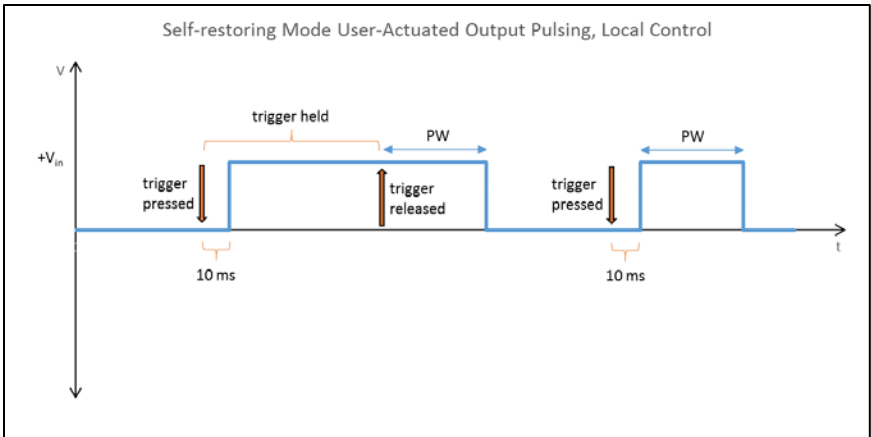


Figure 9. User-actuated output pulsing in self-restoring mode, local control.

4.2.2 Automatic Cycling

During automatic cycling in self-restoring mode, the Controller provides output power automatically in **continuous** positive-only pulses at a pulse width and dwell time set by the user.

Figure 10 is a graphical illustration of self-restoring mode automatic cycling in local control.

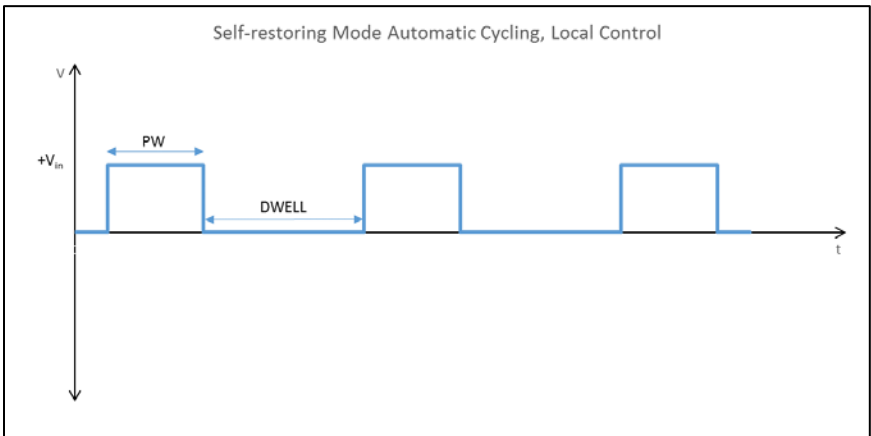


Figure 10. Automatic cycling in self-restoring mode, local control.

4.2.3 Manual Triggering During Automatic Cycling

During the output power ON period, pressing and holding the Manual Trigger Switch will hold the pulse; upon releasing the Switch, the pulse will continue for one full pulse width and resume the pulsing sequence.

CAUTION: Pursuant to the intended application, Brandstrom Instruments self-restoring rotary solenoids are designed and manufactured to be powered ON indefinitely when operated at their stated specifications and ratings and thus do not overheat. However, additional precaution is recommended when holding the Trigger Switch for extended periods of time.

During the output power OFF period, pressing the Switch will cut the dwell time short and will initiate the pulsing sequence anew.

Figure 11 is a graphical illustration of manual triggering in self-restoring mode automatic cycling in local control.

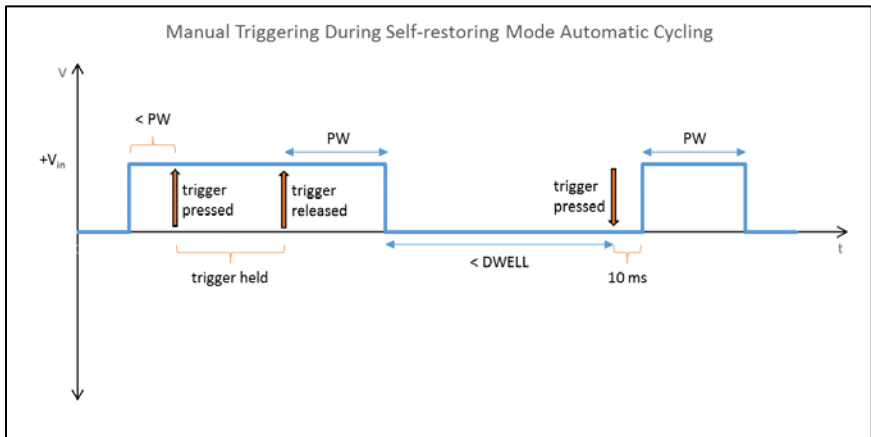


Figure 11. Manual triggering during self-restoring mode automatic cycling.

4.3 Adjusting Pulse Width and Dwell Time

Both the Pulse Width and Dwell Time Control Knobs have a built-in pushbutton feature that allows the user to lock in the desired settings to prevent inadvertent misadjustment. Press the Knob once

to lock-in the current setting; press again to unlock and enable setting adjustment.

In either bi-stable or self-restoring mode, the output power ON and OFF periods can be adjusted at any time. During automatic cycling in either mode, the new pulse width and/or dwell time settings will take effect at the next new pulse. The new settings can also be put into immediate effect during cycling by pressing the Manual Trigger Switch (see 4.1.3 and 4.2.3).

5 Device Operation – Remote Control

The Controller is capable of being operated remotely from a PC via TTL serial communication through a terminal emulator using the included USB-TTL serial cable (1.8m, 3.5mm phone plug). The following describes how to operate the Controller in remote control.

NOTE: The Pulse Width and Dwell Time Control Knobs and the Manual Trigger Switch are ignored in remote control. However, the Indicator Light of the Switch illuminates in accordance with the remotely controlled output.

5.1 Connecting to a PC

1. Ensure that the Controller is turned ON and all other input and output connections are made in accordance with 3.1 above.
2. Using the included USB-TTL serial cable, insert the 3.5mm phone plug end of the cable into the TTL phone jack located on the Controller's Input Panel (see Figure 2). Plug the USB end of the cable into any available USB port on your PC.
3. Unless already present, install any necessary drivers as prompted/required.
4. Launch your preferred terminal emulator program.
5. Make sure the terminal emulator is configured as specified in 5.2 below.
6. Open the session.

5.2 Terminal Emulator Configuration

The following are the required settings for terminal emulator configuration. Refer to Figure 12.

NOTE: This manual uses screenshots of the PuTTY, Release 0.68 terminal emulator user interface. Consult your specific terminal emulator program's user guide/manual to ensure proper configuration setup.

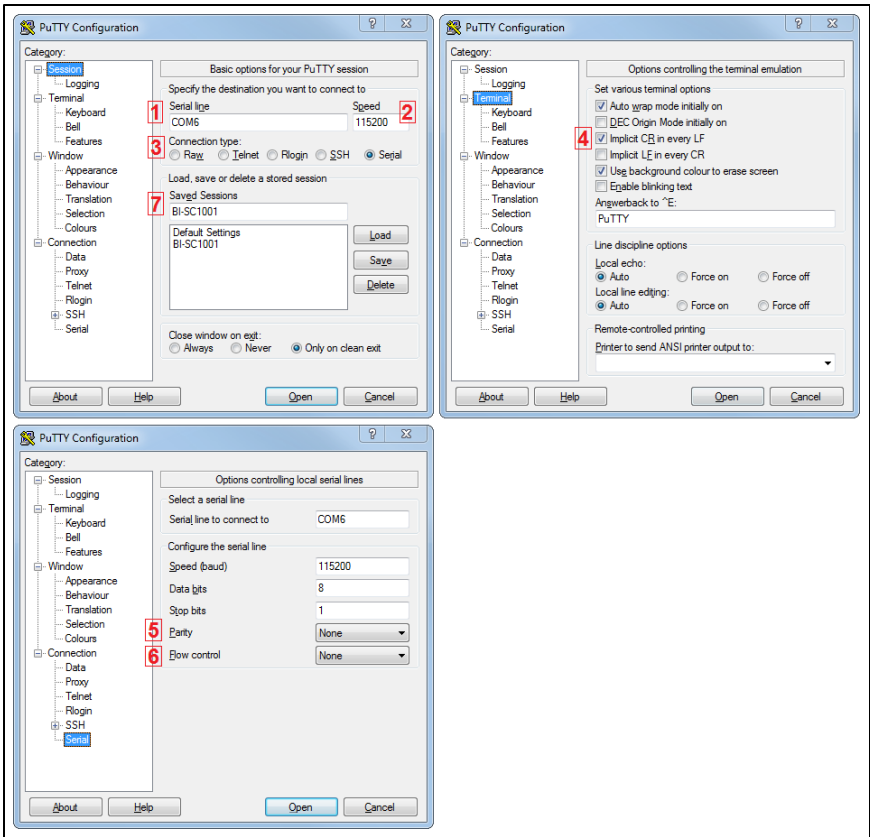


Figure 12. Terminal emulator configuration settings (PuTTY, Release 0.68).

1. Serial Line – must be set to the COM port to which the cable is connected;
2. Speed – must be set to 115200;
3. Connection Type – must be set to “Serial”;
4. Implicit CR in every LF – must be activated;
5. Parity – must be set to “None”;
6. Flow control – must be set to “None”.

7. Saved Sessions – consider saving the session for future use and convenience; remember to load the saved session whenever launching the terminal emulator anew.

All other settings can be left as default.

5.3 Commands

Table 1 below lists the available commands; whether they are available in local and/or remote control; descriptions of their function and use; and their associated available parameters (where applicable).

Table 1. Available serial communication commands.

COMMAND (AVAILABILITY)	FUNCTION & USE	AVAILABLE PARAMETERS
bi (local or remote)	Enables remote bi-stable mode.	None
control (local or remote)	Returns the active control state (“remote” or “local”).	None
cls (local or remote)	Clears the screen.	None
cycle (local or remote)	When used alone, returns the current saved cycle; when used with the available parameter(s), saves a new cycle accordingly.	1 st Parameter: total cycle count (1 million max.) 2 nd Parameter: initial output state of entire cycle run (“pos”, “neg” in bi-stable, “on”, “off” in self-restoring) 3 rd up to 18 th Parameters: durations in milliseconds (1 million ms max.) of up to 16 alternating output states
erasescycle (local or remote)	Erases the current saved cycle.	None
Date (local or remote)	Returns the device firmware build date.	None
disp (remote only)	When used alone, returns what is displayed on the Pulse Width and Dwell Time Displays; when used with available parameter(s), displays a new character string accordingly on the Displays.	One Parameter Only: any string of up to 8 characters (includes letters, numbers, spaces, etc.)
echo (local or remote)	Returns whatever characters are typed following the command string.	One Parameter Only, no length limit

COMMAND (AVAILABILITY)	FUNCTION & USE	AVAILABLE PARAMETERS
enc (local or remote)	Returns the raw encoder counts and button states.	None
factoryreset (local or remote)	Restores the factory defaults (cycle list cleared; pulse width = 20ms; bi-stable mode; output state = unknown, verbose messages).	None
help (local or remote)	Returns a list of available commands and some helpful tips.	None
led (remote only)	Turns the Manual Trigger Switch light on or off.	None
local (local or remote)	Puts the Controller in local control.	None
mode (local or remote)	Returns the current remote operating mode (“bi-stable” or “self-restoring”).	None
model (local or remote)	Returns the Controller model number.	None
ms (local or remote)	Returns the current position of the Mode Switch.	None
neg (remote only)	Outputs a negative pulse in bi-stable mode; not available in self-restoring mode.	None
off (remote only)	Turns the output off in self-restoring mode; not available in bi-stable mode.	None
on (remote only)	Turns the output on in self-restoring mode; not available in bi-stable mode.	None
pause (remote only)	Pauses a running cycle.	None
pos (remote only)	Outputs a positive pulse in bi-stable mode; not available in self-restoring mode.	None
pw (local or remote)	When used alone, returns the current remote pulse width setting in milliseconds; when used with available parameter(s), sets the remote pulse width anew accordingly.	One Parameter Only: bi-stable pulse width value in milliseconds (200ms max.)
quiet (local or remote)	Enables terse messages.	None
remote (local or remote)	Puts the Controller in remote control.	None
reset (local or remote)	Resets the Controller processor.	None
resume (remote only)	Resumes a paused running cycle.	None
sr (local or remote)	Enables remote self-restoring mode.	None
sn (local or remote)	Returns the Controller serial number.	None
start (remote only)	Starts a cycle.	None

COMMAND (AVAILABILITY)	FUNCTION & USE	AVAILABLE PARAMETERS
state (local or remote)	Returns the remote output state (“POS”, “NEG” or “UNK” (unknown) in bi-stable mode; “ON” or “OFF” in self-restoring mode.	None
stop (remote only)	Stops a running cycle.	None
trig (local or remote)	Returns the Manual Trigger Switch state.	None
ver (local or remote)	Returns the Controller firmware version.	None
verbose (local or remote)	Enables verbose messages.	None

5.4 Command Syntax

When inputting a command with one or more of its associated available parameters, they are to be separated from each other by a single space (see 5.6.2 and 5.7.2 for examples).

5.5 Enabling Remote Control

The Controller is shipped from the factory set to local control. To enable remote control, use the “remote” command. To switch back to local control, use the “local” command.

5.6 Bi-stable Mode

CAUTION: Do not operate the Controller in bi-stable mode with a rotary solenoid that is not bi-stable. Doing so may induce premature wear to a non-bi-stable solenoid’s internal components.

Enable remote bi-stable mode using the “bi” command and set the desired pulse width using the “pw” command.

5.6.1 User-actuated Output Pulsing

To provide a single positive or negative output pulse in bi-stable mode, use the “pos” or “neg” commands, respectively.

5.6.2 Automatic Cycling

To program an automatic cycle in bi-stable mode, use the “cycle” command as described in Table 1. Use the “start”, “pause”, “resume” and “stop” commands to correspondingly control the cycle run.

NOTE: When pausing a cycle run, the current output state duration will continue to time out and the Controller will wait for the command to resume before engaging the next output state in the program. If the paused cycle run is resumed prior to the current output state duration timing out, the cycle run will resume as if there were no interruption.

Some examples of simple bi-stable cycle programs and their resulting outputs are as follows:

1. Command string: “cycle 2 POS 1000 2000”

Result:

- +pulse @ pw setting and dwell, 1000ms
- pulse @ pw setting and dwell, 2000ms
- +pulse @ pw setting and dwell, 1000ms
- pulse @ pw setting and dwell, 2000ms

See Figure 13 for a graphical illustration.

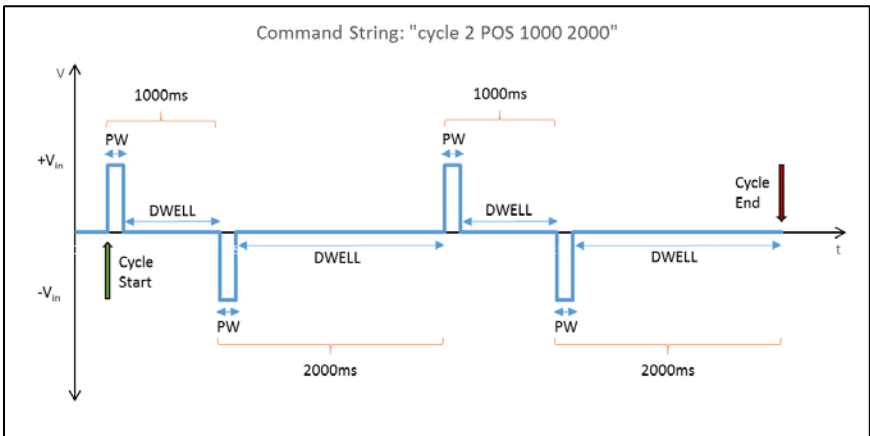


Figure 13. Resulting output for an example command string: “cycle 2 POS 1000 2000” (not to scale).

2. Command string: "cycle 2 NEG 1000 2000 3000"

Result:

- pulse @ pw setting and dwell, 1000ms
- +pulse @ pw setting and dwell, 2000ms
- pulse @ pw setting and dwell, 3000ms
- +pulse @ pw setting and dwell, 1000ms
- pulse @ pw setting and dwell, 2000ms
- +pulse @ pw setting and dwell, 3000ms

See Figure 14 for a graphical illustration.

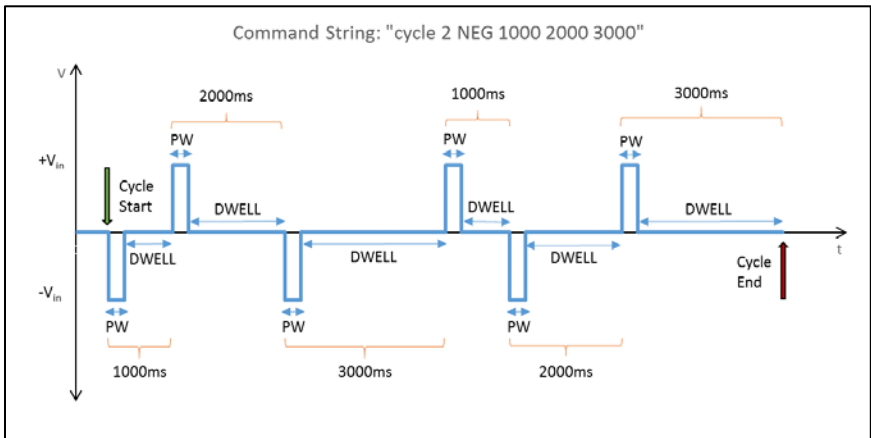


Figure 14. Resulting output for an example command string: "cycle 2 NEG 1000 2000 3000" (not to scale).

5.7 Self-restoring Mode

CAUTION: Do not operate the Controller in self-restoring mode with a rotary solenoid that is not self-restoring. Doing so may cause a non-self-restoring solenoid to overheat and become seriously damaged.

Enable remote self-restoring mode using the "sr" command.

5.7.1 User-actuated Output Pulsing

To provide a single output pulse in self-restoring mode, use the "on" and "off" commands one after the other.

CAUTION: The “on” command provides continuous output power indefinitely and will NOT turn off until the “off” command is used.

Alternatively, the “cycle” command can be used to program a cycle having a total cycle count of 1, an initial output state of “on”, the third parameter set to the desired power ON duration and the fourth parameter set to some nominal duration, thereby providing a single output pulse of finite duration after which the output power turns and remains off.

5.7.2 Automatic Cycling

To program an automatic cycle in self-restoring mode, use the “cycle” command as described in Table 1. Use the “start”, “pause”, “resume” and “stop” commands to correspondingly control the cycle run.

CAUTION: Depending on how a cycle run is programmed, the output power may remain on at the end of the cycle.

CAUTION: The output power may also remain on depending on when the “stop” or “pause” commands are used.

NOTE: When pausing a cycle run, the current output state duration will continue to time out and the Controller will wait for the command to resume before engaging the next output state in the program. If the paused cycle run is resumed prior to the current output state duration timing out, the cycle run will resume as if there were no interruption.

Some examples of simple self-restoring cycle programs and their resulting outputs are as follows:

1. Command string: “cycle 2 ON 1000 2000”

Result:

+pulse for 1000ms
dwell for 2000ms
+pulse for 1000ms
dwell for 2000ms

See Figure 15 for a graphical illustration.

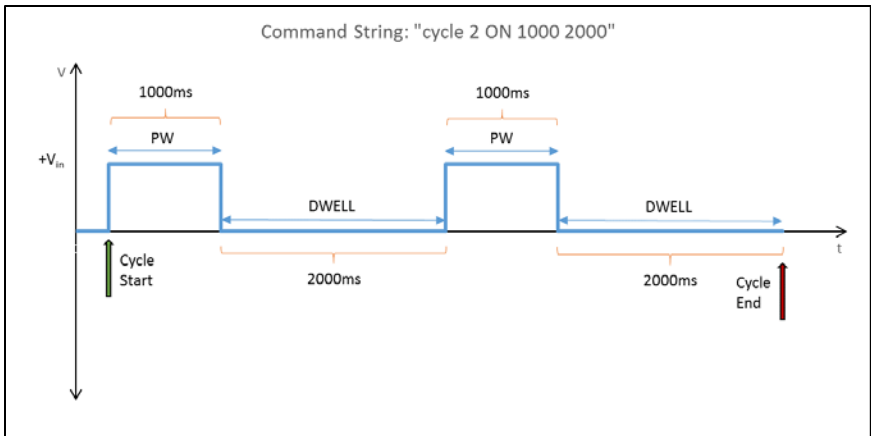


Figure 15. Resulting output for an example command string: "cycle 2 ON 1000 2000" (not to scale).

2. Command string: "cycle 2 OFF 1000 2000 3000"

Result:

- dwll for 1000ms
- +pulse for 2000ms
- dwll for 3000ms
- +pulse for 1000ms
- dwll for 2000ms
- +pulse for 3000ms

CAUTION: Because the cycle ends with pulse, output power will remain ON.

See Figure 16 for a graphical illustration.

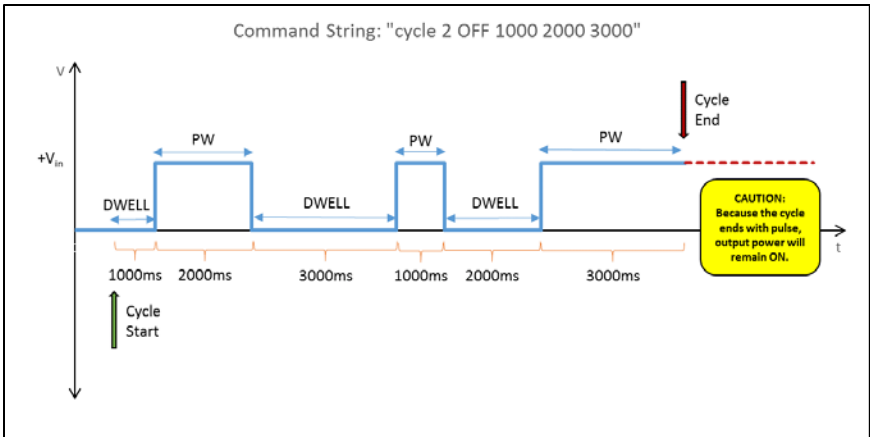


Figure 16. Resulting output for an example command string: "cycle 2 OFF 1000 2000 3000" (not to scale).

5.8 Custom Display Message

In remote control, the “disp” command may be used with its one available 8-character parameter as described in Table 1 to display a custom 8-character alphanumeric message on the Pulse Width and Dwell Time Displays.

NOTE: Spaces in the parameter string are counted as characters.

NOTE: If the parameter string is fewer than eight characters, the remaining unspecified characters are treated as blanks (i.e., spaces).

Some examples of using the “disp” command are as follows:

1. Command string: “disp 1234”
Result on Displays: “1234 ”
2. Command string: “disp 9 99 9 9”
Result on Displays: “9 99 9 9”

See also Figure 17.

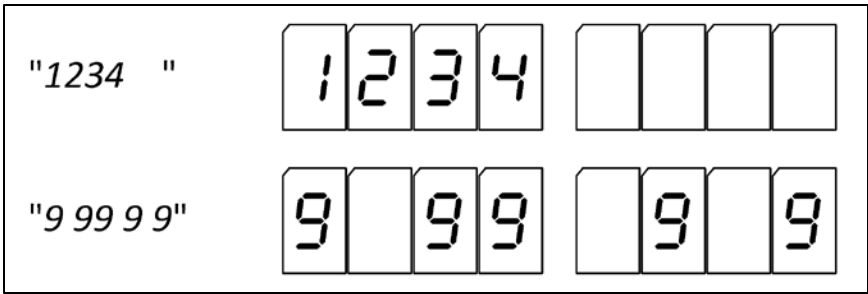


Figure 17. Examples of using the "disp" command to display a custom message.

6 Other Controller Applications

Although the Controller was designed primarily with Brandstrom Instruments rotary solenoids and optical shutter assemblies in mind, it can be used to control any small electromechanical device requiring 3 to 24V DC and up to 2 W power for operation. Such devices can include and are not limited to:

- Other types of rotary solenoids
- Linear solenoids
- Motors
- Valves
- Actuators
- Latches
- Electromagnets

NOTE: When using the Controller with any device, always make sure to heed the manufacturer's guidelines specific to that device, and that the device's power and control requirements do not exceed the ratings and capabilities of the Controller as stated in this manual.

7 OEM Controller

Brandstrom Instruments also provides an OEM controller that includes all of the Controller's remote control functions and capabilities for integration into the end user's overall system.

Like the Controller, the OEM controller operates at any DC voltage between 3 and 24 V, at a maximum power capability of 2 W; is capable of TTL serial communication; and it can be easily mounted into the end user's overall system.

Brandstrom Instruments can also customize an OEM controller solution to the end user's specific application. See the back cover for Brandstrom Instruments' contact information and contact an Engineer for assistance.

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