

# Constant Voltage/Constant Current Test System

## Description

The **Constant Voltage/Current Test System** may be used for constant voltage or constant current pulse testing of automotive and aerospace igniters, LEDs or other devices that require functional validation. Standardized testing methods, such as Bruceton, may be used to determine all-fire and no-fire conditions. This instrument will provide a stable source of DC voltage or current for a fixed pulse width. The user may control the following test parameters:

1. Output voltage (0.01 to 16.00 volts DC) or current (0.001 to 5.000 amps)
2. Output pulse duration (.0001 to 0.9999 seconds)
3. Safe, Arm and Firing conditions

In addition to these user-defined parameters, the instrument has an input for an external safety interlock circuit with a front panel status indicator. A 4-digit LED panel meter accurately indicates the firing voltage or current and a separate 4-digit LED panel meter indicates the selected time duration.

## Preparation for use

Before using the Constant Current/Voltage instrument you must supply power and connect the interlock safety circuits to the rear panel inputs. Please complete the following:

- Connect a switch that is actuated by test chamber door to the rear panel inputs marked Interlock input. The switch must be closed when the door is closed to enable the internal circuitry. The total wiring and switch resistance must be less than 10 ohms.
- Determine the local AC voltage, either 115VAC or 230VAC. View the voltage setting in the small window of the power input module. If necessary, remove the AC cord to gain access to the voltage selector drum. Remove the selector drum from the AC inlet module.
- Select the appropriate AC voltage to correspond with your local power. Reinsert the selector drum *and confirm that the proper selection of voltage shows in the window.*
- Verify that the switch within the AC input module on the rear panel is set to "O". Plug the modular AC cord to the proper source of 115VAC or 230VAC and into the instrument.

## Startup

To use the instrument please follow the following sequence:

- Verify that the rear panel power on/off switch is in the off position.
- Open the test chamber door and examine the test fixture. *Be certain that all parts have been removed before proceeding or applying power.*
- Connect the test chamber interlock contacts to the rear panel input marked "interlocks".
- Connect the front panel banana jacks to the test chamber fixture that will hold parts to be tested. The red banana jack is the positive output, black is negative.
- Press the switch position marked "1" on the on the rear panel AC inlet module. The LED voltage and time meters on the front panel should illuminate. When the interlock contacts are closed the front panel interlock LED should illuminate.
- Select either the constant voltage mode or the constant current mode with the toggle switch in the middle of the front of the instrument.
- Adjust the pulse time and select the voltage (or current).

## Using the Constant Voltage Instrument; Controls and Indicators



Figure 1: Constant Voltage/Current Front Panel

The controls of the Constant Voltage/Current equipment are designed for ease of use and simplicity.

The rear panel Interlock inputs must be connected to the test chamber door safety switch before the test system may be used. The interlock connections ensure that safe conditions exist for operation of the test set and for the operator.

Verify the proper operation of the interlock contacts by opening and closing the door of the test chamber. The green LED on the instrument front marked interlock should illuminate when the door is closed.

Either constant voltage or constant current mode may be selected by changing the front panel toggle switch. The LED associated with current or voltage will light to reflect the selected mode.

The voltage (or current) may be adjusted with the knob to the left of the digital meter marked Voltage/Current *when the instrument is in the Safe mode*. By default the control is in the fine adjustment mode. For coarse adjustments push in the knob while turning. The displayed voltage or current will be placed onto the part under test when the output is active.

The pulse time may be adjusted with the knob to the right of the digital meter marked Time *when the instrument is in the Safe mode*. By default the control is in the fine adjustment mode. For coarse adjustments push in the knob while turning. The displayed time is the time, in milliseconds, that the output will be active during a test, nominally from 000.1ms to 999.9ms.

The Arm mode will only become active when the interlock is maintained and the Arm button is pressed. The Arm button LED on the front panel is illuminated when in the Arm mode.

Pressing the Safe button when the test system is Armed will return the instrument to the Safe condition. If the interlocks are broken the instrument will also return to the Safe condition.

Pressing the Fire button when the test system is in the Arm mode enables the firing circuits and will output the selected voltage or current for the selected time on the output terminals. The Fire button must be pressed within 60 seconds after the test system is Armed or the instrument will revert to the Safe condition.

## Rear panel connections



Figure 2: Constant Voltage Rear Panel

## Testing parts with the Constant Voltage Instrument

1. *DO NOT* turn power to the Constant Voltage/Current system on or off with a part loaded in the test chamber. Examine the AC input module to verify the correct line voltage before use and change to the correct voltage if necessary. Inspect the test chamber and remove all parts before turning on power to the Constant Voltage/Current system.
2. Turn on power to the instrument with the rear panel switch on the AC input module.
3. Verify that the test system is in the Safe mode and load a part to be tested into the test chamber. Close the test chamber door. The front panel Interlock LED should illuminate when the test chamber door is closed.
4. With a part to be tested loaded in the test chamber and the test chamber door closed you may now test the part.
5. Select voltage or current and adjust the voltage/current display to the desired level.
6. Adjust the time display for the desired test time.
7. Inspect the test chamber area for safe firing conditions.
8. Press the Arm pushbutton. The Arm LED should illuminate. Note that the Fire button must be pressed within 60 seconds of Arming or it will revert to the Safe mode.
9. Press the Fire pushbutton. The output terminals will become active with the selected voltage or current for the selected time as the part is tested. The circuitry is automatically disconnected at the end of the test and the equipment is placed into the Safe mode.
10. Remove the tested part from the chamber.

## Practical Considerations

The constant current/voltage equipment is designed as a general purpose instrument. This means that there are limitations on the ability to accurately deliver voltage or current to a load. For example, if your load is five ohms you will not be able to test at the full five amp capacity of the instrument due to the limited compliance voltage (about 20VDC).

Some facilities use remote or larger test chambers with extended wiring. This wiring will add resistance to the part under test and must be allowed for when planning. If your test wiring is one ohm and you wish to test at the full 5 amp capacity of the instrument your part must not exceed three ohms, including contact resistance.

The resistance of some igniters will vary during a test due to heating effects. When testing near the limits of the equipment, and when the part has a positive temperature coefficient, this must be taken into account. A typical automotive part may start at ambient temperature near 2.00 ohms and increase to 2.100, or higher, at the end of the test pulse. This would not pose a problem, however a 3.900 ohm part tested at 5 amps may increase in resistance to the point that the compliance voltage limits are exceeded, especially if the wiring resistance is significant.

## Sample Waveforms

Equipment used: Agilent MSO-X 4024A, Tektronix A622 AC/DC current probe.



Figure 3: Voltage mode; 100 millisecond, 10 volt pulse into 2-ohm load



Figure 4: Voltage mode; 10 millisecond, 16 volt pulse into 10-ohm load

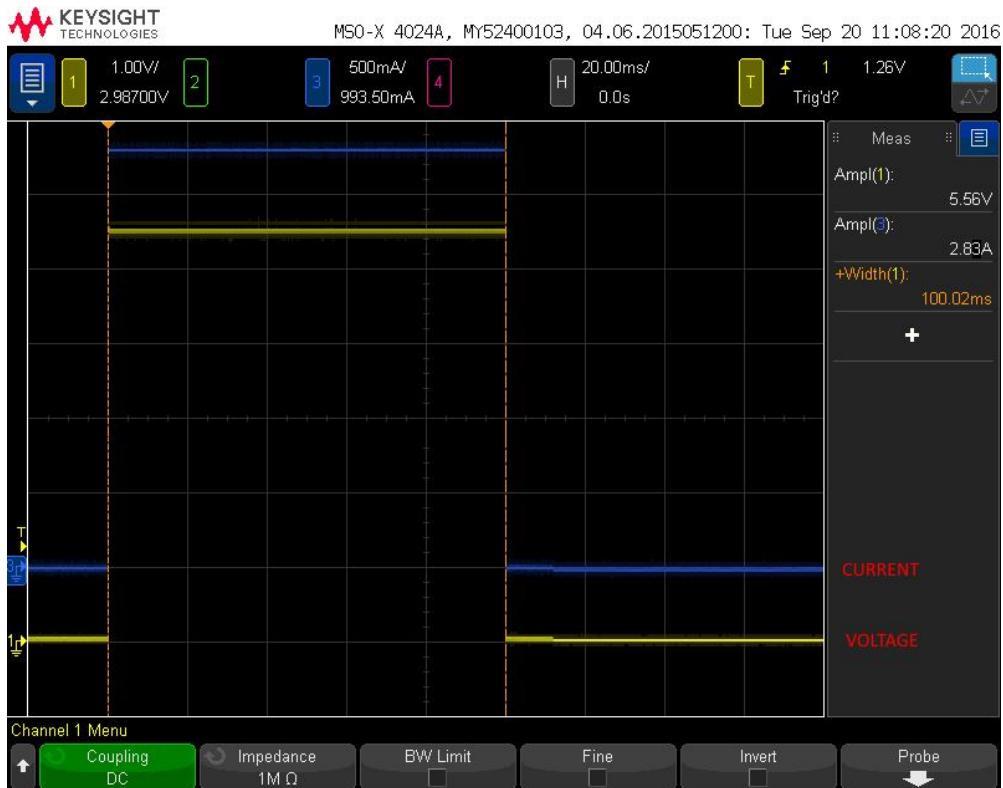


Figure 5: Voltage mode; 100 millisecond, 6 volt pulse into 2-ohm load

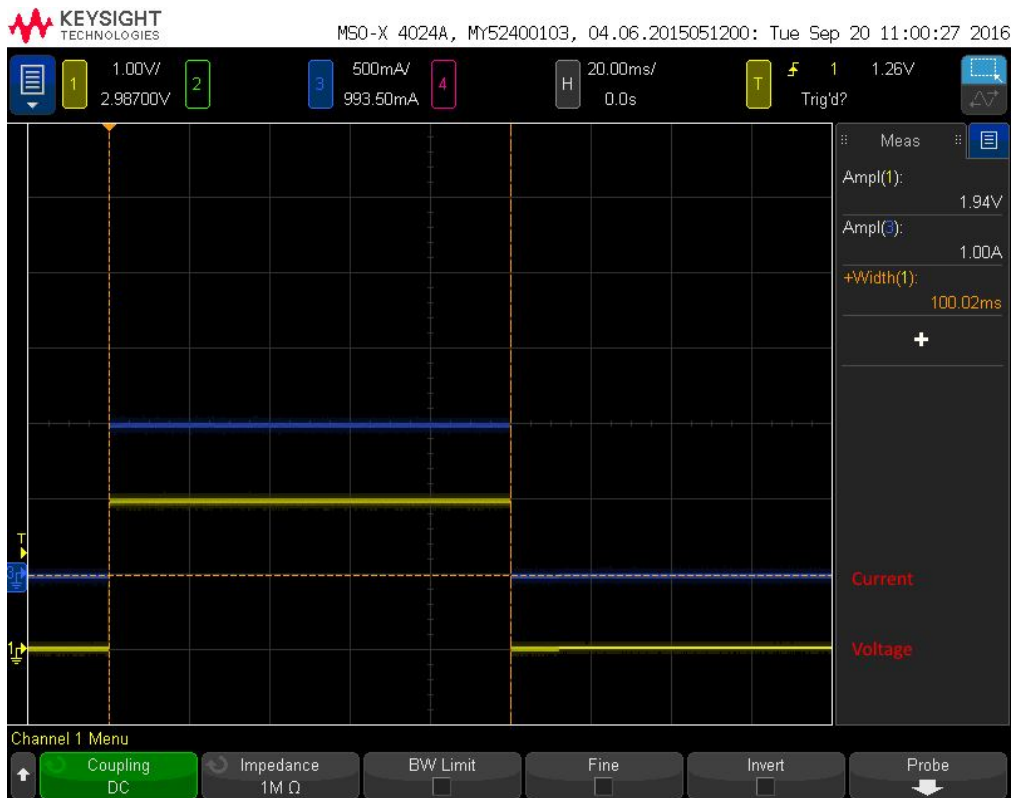


Figure 6: Current mode; 100 millisecond, 1 amp pulse into 2-ohm load

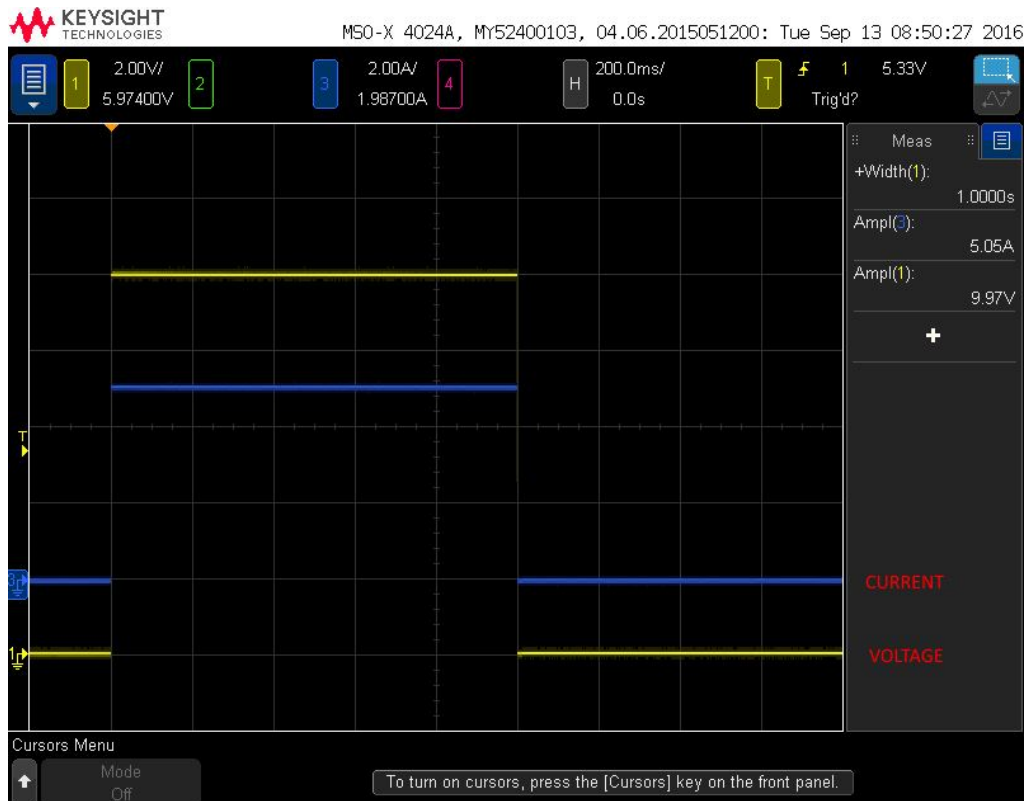


Figure 7: Current mode; One second, 5 amp pulse into a 2-ohm load



Figure 8: Rise time; voltage mode, 100ms, 16 volt pulse into a 10-ohm load

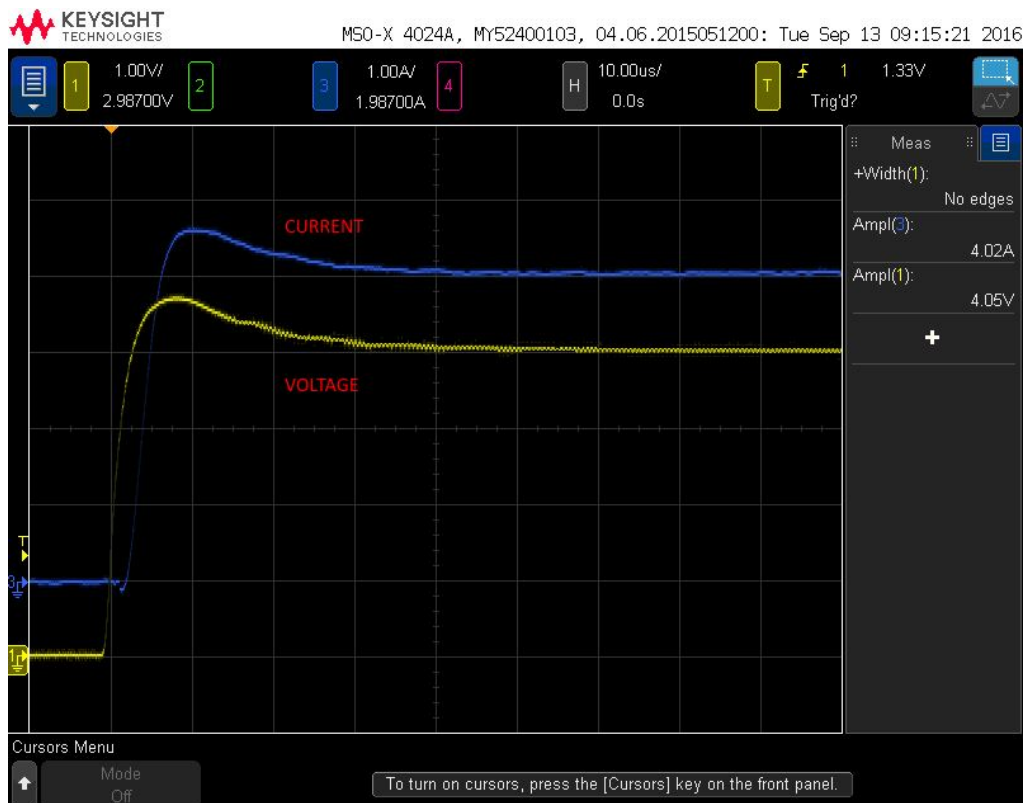


Figure 9: Rise time; current mode, 100ms 4 amp pulse into a 1-ohm load

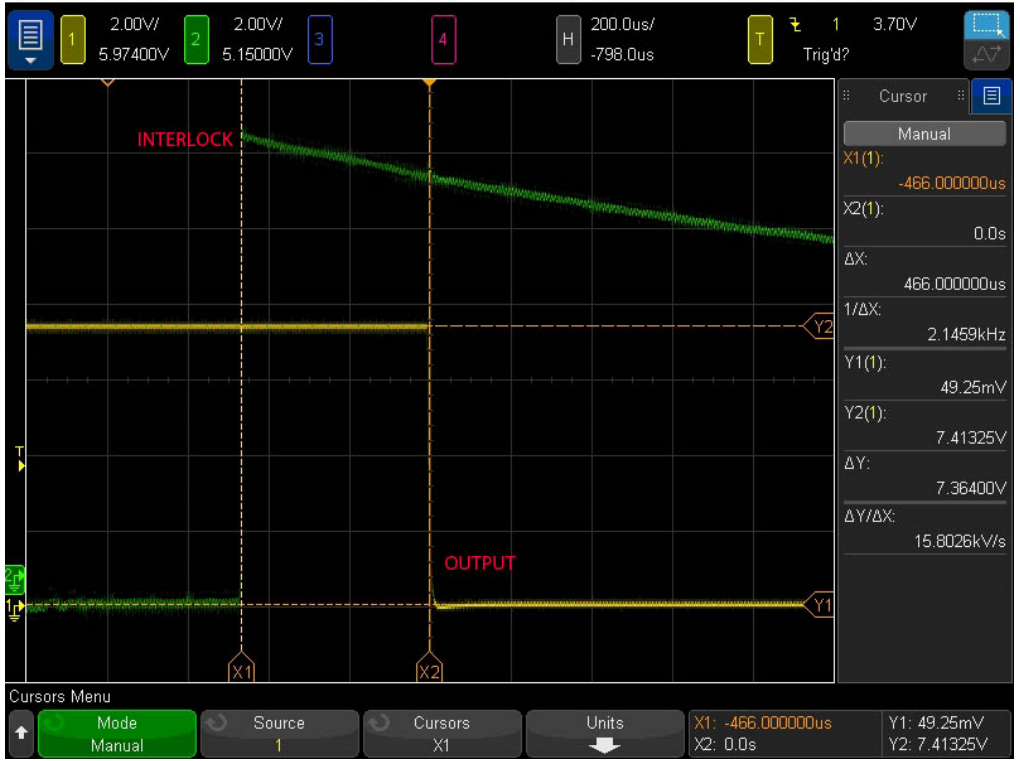


Figure 10: Time from Interlocks open until output disabled, ~500 microseconds



## **Specifications**

AC power source	115/230VAC, 50/60Hz
AC current draw	150VA
Constant voltage output	0.01 – 16.00VDC
Constant current output	0.001 – 5.000A
Absolute current limit	~ 5.2 amps**
Voltage accuracy, .100V-16.00V	< 1% *
Current accuracy, .100A-5.00A	< 2%
Time output	.0001 – 0.9999 seconds
Time accuracy	± 15uS
Compliance voltage	20VDC
Internal series resistance	~ 150 milliohms
Voltage rise time, 2 Ω load	≤ 10 microseconds
Voltage fall time, 2 Ω load	≤ 10 microseconds
Interlock voltage/current	+12 volts/12 milliamps
Interlock break to output off	≤ 500 microseconds

\* Internal resistance of safety circuits and current sense resistance create a small voltage error that increases with output current. Error measured over the range of .100V to 16.00V, typically <.070V.

\*\* Internal safety circuits provide absolute current limits of about 5.2A regardless of front panel settings.