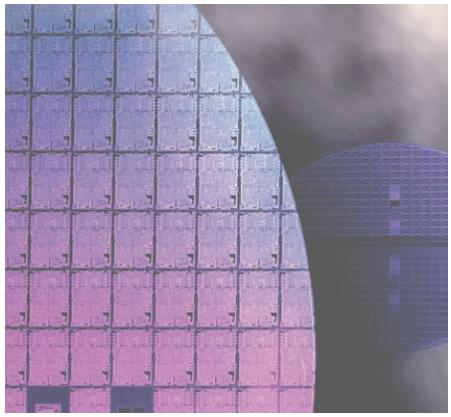
Opteon

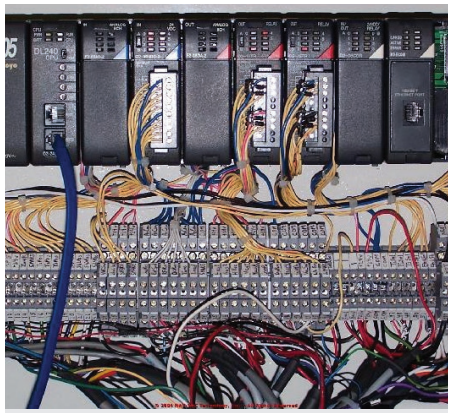
Unparalleled Integration

Opteon Gen V Maestro®

& StrobeMaster®

Distributed Controls Outperform Conventional Machine Controls by Every Measure.





Sample *of* conventional control cabinet

Eliminate

90%

of the connections required by conventional controls

The Problem & Solution

Conventional machine controls lack integration, requiring separate units for one or more PLCs, multiple power supplies, multiple dedicated I/O blocks for each type of input and output, and frequently a dedicated I/O interface unit for individual signals. Poor integration of conventional controls leads to high system latencies, lower reliability, and much greater cost than system designers should accept.

The Problem

Lack of integration also requires dedicated electrical cabinets for controls and their support electronics. Controls cabinets require custom design and drafting of unique wiring harnesses customized for each application. These must be hand wired by electricians experienced with the unique requirements of controls, sensors, and actuators.

It requires weeks or months simply to install and debug the cable harnesses for conventional controls. There are almost no returns to scale. Manufacturing the nth system is essentially as costly as assembling the first.

Even after successful assembly, the unnecessarily complex wiring of conventional systems remains the largest single contributor to system failures in service of modern manufacturing machines.

The Solution

Modern distributed controls eliminate over 90% of the connections required for conventional systems, at less than 40% of the cost, while providing higher performance in terms of higher throughput, lower latencies, and higher reliability.

Machines using distributed controls can be designed, fabricated, and commissioned in a small fraction of the time required for conventional systems.

Opteon Gen V Maestro

Opteon Gen V Maestro machine controllers can eliminate controls cabinets entirely.

- They are small (105mm x 190 mm x 30 mm)
- And hardened (IP67) to deploy inside manufacturing machines adjacent to the sensors, motors, robots, and actuators which they are controlling or with which they are collaborating.

Unparalleled Integration

Maestro system controllers incorporate appliances for direct control of motors, interfacing with digital and analog sensors as well as more complex instrumentation, and control of actuators. This eliminates the need for discrete motor controllers and instrumentation interfaces.

Maestro System Controllers

- Flex I/O in each Maestro eliminates the need for discrete DIN Rail I/O units and allows each Maestro channel to be directly connected to machine elements using industry standard, IP67 I/O breakout boxes and cables.
- Maestro control channels can implement any of twenty-two digital and analog interface modes. Modes are selectable over the Ethernet and can be changed to accommodate the details of a given machine or depending on which job a machine may be currently running.
- Complex machines can be managed by a single Maestro unit
- Maestros can also be distributed throughout a system or factory at local concentrations of motors, actuators, and sensors
- Groups of Maestros collaborate with system-wide **latencies of just 2 µS**
- Unlike conventional PLCs, system latency with Maestros does not change with increasing numbers of sensors and actuators.
- Maestros also incorporate peer to peer coordination of cameras, light controllers, and machine vision systems with the same low latencies.

Power and Isolation

- When connected to Ethernet switches capable of supplying 60W of power over Ethernet (IEEE 802.3bt), Maestros require no other power connections and can supply 25W each of isolated 5V and 24V to facilitate communication with sensors, actuators, and instruments to which they may be connected. If connected to switches supporting PoE at lower power levels (ex: IEEE 802.3af, 15W) or that can supply no PoE power at all, 48VDC may optionally be connected directly via a 4 pin M12 connector dedicated for this task. If local power is available, the Maestro will automatically use local power.
- Regardless of whether PoE power or power from an alternate source is used, ground for the Flex I/O channels is isolated from the 48V power source as are the 5V and 24V supplies available for Flex I/O connections.
- The eight high current Relay control channels are further isolated from both the source of 48V power and the sixteen Flex I/O channels as well as the 5VDC and 24VDC power supplies dedicated for Flex I/O connections. Provision in the form of another four pin M12 is made in the Relay section for a different source of power to control high current solenoids and other actuators in the system.

WITH MAESTROS

System latency does not change with increasing numbers of sensors & actuators

The two horizontal lines marked on the Maestro illustrate the boundaries of the three regions of isolation: PoE/48V, Flex I/O Channels, and Relay Channels.

- If both terminals of the servo control power supply are provided to the Relay section of the Maestro, a pair of pins are provided for each of eight relay control channels to facilitate directly energizing actuators in the system.
- Alternatively, the return of a power supply dedicated to energizing actuators in a machine may be connected to the negative on the Relay power connector of the Maestro.

  In the latter case, only one connection is sufficient from each Relay Channel on the Maestro to the negative connection of the actuator to be controlled by that channel. In this latter case, the positive of the power supply used for energizing actuators should be directly connected to the positive connection on each actuator.

Types of Channels

There are two major categories of interfaces available from Maestro Devices: Relay Channels for controlling High Current Actuators, and Flex I/O channels for a very wide variety of lower power signaling methods.

Relay Channels

- Relay Channels provide solid-state switches capable of sinking very large currents from devices powered from 5VDC to 30VDC.

Flex I/O Channels

- Flex I/O Channels are reconfigurable from software to implement 21 different Analog and Digital, Input and Output modes, described below. Flex I/O channels can operate from 3.3VDC to 30VDC, but are most typically run from either 5VDC or 24VDC provided by the Maestro.

  Which of these two voltages is supplied for a given group of four channels delivered through a particular eight pin female M12 connector is selectable from software.

- To minimize ground loops, if an external power supply is used for signaling, its return (ground) should be connected on just one connector. This can be via any one of the four M12 Connectors of the Flex I/O Channels, or via the ground connection of the four position M8 Aux Power Out connector. Just one termination to ground should be made for each connected sensor or actuator. Ideally, connected sensors and actuators would receive signal ground from the Maestro in a star configuration without ground loops.

- With the appropriate terminations, Differential Flex I/O Modes support the electrical requirements of RS485, RS422, and PROFIBUS

- The mating connector to each group of four Relay Channels or Flex I/O Channels is a male, 8 position, A Coded M12 Connector.

STROBEMASTERS

Each channel is independently programmable to energize a wide range of lighting systems from those comprised of a single LED, to very large devices incorporating thousands of LEDs.

Light Control Channels

- StrobeMaster devices combine Maestro machine control capability including eight Flex I/O Channels but also include Light Control Channels dedicated to controlling and energizing LED light sources.
- Each channel is independently programmable to energize a wide range of lighting systems from those comprised of a single LED, to very large devices incorporating thousands of LEDs.
- Voltage from 5V to 45V as well as current from 100mA to 50A is independently programmable for each channel (or 200mA to 100A).

Light Controllers

Up to two of the same light controller channels are also available in the cameras.

Each of the 4-position female M8 connectors at the bottom of three of these cameras is a light controller with voltage selectable from 5V to 45V and current from 100mA to 50A.

Light Control Channels

- For both types, the compliance voltage is programmable independently on each channel to any value from 5V to 45V and the current during a strobe event to any value between 100 mA to 50A (or 200 mA to 100A for channels capable of 100A). This allows each channel to be optimized to operate most efficiently for the particular light connected to it. This much greater efficiency results from two sources. First, the ability to set the compliance voltage to roughly a volt over the level required to fully energize a light at the brightness ideal for a particular application means that 95% of the energy utilized is dissipated in the light and almost none in the controller. Second, limiting energy dissipation to only the time cameras are exposing their images reduces total energy requirements by an additional 90% to 99% and increases lamp life by the same ratio.
- The instantaneous value of the accumulated thermal energy present in each of the light and in the light controller are independently updated every microsecond and compared against the rated value for each. Whenever the local thermal energy approaches the rated thermal budget for either the light or the controller, the current strobe event is terminated and additional strobe requests will not be honored until the thermal energy has been dissipated sufficiently for another strobe event to begin.
- If a StrobeMaster is operating from a sufficiently large local power supply, the eight light control channels together may provide up to 230 W rms power and up to 4.5 KW per channel during the illumination time programmed for that channel's LED device.

- If operating from PoE power, the total rms power available for Lighting and Flex I/O channels combined will be limited by the power available from the port of the PoE Ethernet Switch to which the device is connected. This may be as great as 100W rms.
- As with a Maestro, the Flex I/O Channels and 5V and 24V supplies are isolated from the source of 48V power received by the StrobeMaster regardless of whether the 48V is received as PoE from an Ethernet switch, or provided directly to the StrobeMasters' 48V In connector.
- The compliance voltages generated by the StrobeMaster independently for each Lighting Channel share a ground with the source of 48V. Consequently, the Light Ground for each LED system connected to the StrobeMaster must not be connected to any other ground: signal, power, frame, or earth.
- The mating cable for Light Control Channels should incorporate a male, 4-position, A-Coded M8 Connector.
- External 48VDC power can optionally be applied using cables terminated in a 4 position, female, A-Coded, M12 Connector.

Connectivity

Use industry standard breakout boxes to connect your;

- Motors
- Sensors
- Light Curtains
- Switches
- Actuators

List of Flex I/O Modes

Digital Modes

Input Modes

Non-Differential Digital Input Modes

- Passive (Mode 1)
- Pull-Up (Mode 2)
- Pull-Down (Mode 3)

Differential Digital Input Modes

- Bias to High (100KΩ) (Mode 4)

Output Modes

Non-Differential Digital Output Modes

- Bi-Level (Mode 5)
- Pull-Up (Mode 6)
- Pull-Down (Mode 7)
- High Current Pull-Down (Mode 8)

Differential Digital Output Modes

- Bi-Level (Mode 9)

Bi-Directional Modes

UART, Half Duplex

- Non-Differential (Mode 10)
- Differential (Mode 11)
  - Profibus
  - RS485
  - RS422
  - 3V Low Voltage Differential Signaling

UART, Full Duplex

- Non-Differential (Mode 12)
- Differential (Mode 13)
  - Profibus
  - RS485
  - RS422
  - 3V Low Voltage Differential Signaling

Analog Modes

Input Modes

Non-differential Analog Input Signal Voltage Receiver (Mode 14)

Differential Analog Input Signal Voltage Receiver (Mode 15)

Analog Input Signal Current Receiver (Mode 16)

Output Modes

Non-differential Analog Output Signal Voltage Transmitter (Mode 17)

Differential Analog Output Signal Voltage Transmitter (Mode 18)

Analog Output Signal Current Transmitter (Mode 19)

Analog Input/Output Modes

Analog Output Signal Current Transceiver with HART (Mode 20)

Analog Current Output and Voltage Input Measurement (Mode 21)

List of Flex I/O Modes

Maestro

Maestros also include eight additional Relay Channels that may be used to sink high current levels to the return of an external power supply dedicated to energizing solenoids in actuators of various types.

This may in some sense be considered an additional mode of operation. (Mode 22)

Notes

A total of 25 watts each of isolated 5V and 24V can be supplied by a Maestro to energize sensors and controls connected to it. Which of these two voltages is available to each set of four channels sharing an M12 connector is user selectable from software. While the internally generated 5V and 12V are isolated from PoE or externally supplied 48V supplies that may be used to power the Maestro, the Flex I/O channels share a common signal ground.

Signaling voltage (Vc) can be 5V or 24V if supplied internally, or any value from 3.3V to 30V if an externally generated voltage is used for signaling to channels set to act as inputs. If external voltages are to be used to energize signaling circuits, they should not be connected to the Vc pins of Flex I/O connectors, but their ground(s) must be connected to the ground pin of one (and to minimize ground loops in the system, preferably only one) Flex I/O connector on any Maestro that will be expected to receive signals energized by that external power supply.

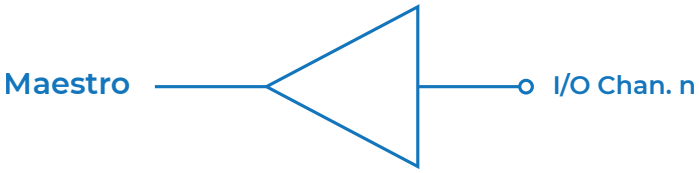
Depending on the sensors used, it may be possible to connect one side of an external differential driver to any channel to receive a digital signal from a differential source, though with lower noise immunity than if both A and B connections had been made to an even numbered channel. Consult your vendors' applications engineers for guidance on specific connections.

Equivalent Circuits by Mode

Mode 1
Non-Differential Digital Input, Passive

Select Termination Menu Selection: Digital/Input/Passive

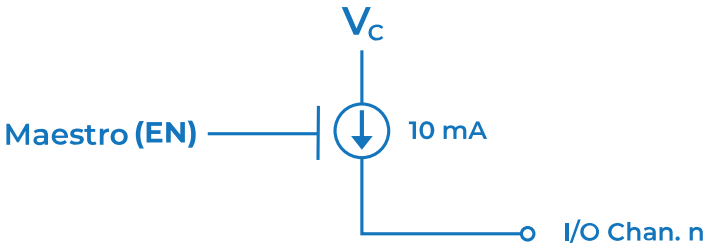
Use this mode for receiving digital signals from external devices capable of actively driving both high and low states. Can be implemented using any Flex I/O Channel. In some cases, it may be feasible to receive differential signals, albeit with lower noise immunity on odd numbered channels by connecting the ground of the remote sender to a ground connection on the Maestro.



Mode 2
Non-Differential Digital Input with Pull Up

Termination Menu Selection:
Digital/Input/Pull Up

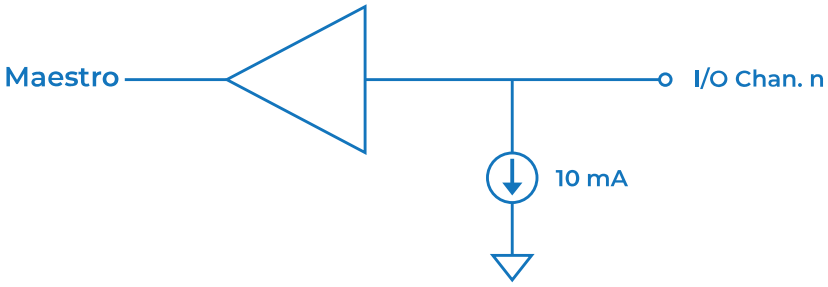
Use this mode for receiving digital signals from external devices capable of actively driving only a low state, ex: open collector drivers. Can be implemented using any Flex I/O Channel.



Mode 3
Non-Differential Digital Input with Pull Down

Termination Menu Selection:
Digital/Input/Pull Down

Use this mode for receiving digital signals from external devices capable of actively driving only a high state, ex: open emitter drivers. Can be implemented using any Flex I/O Channel.

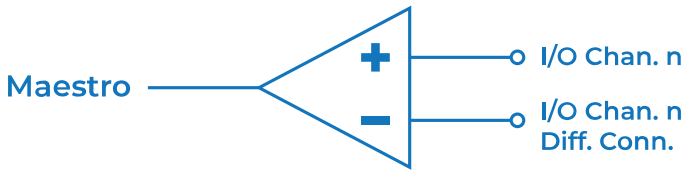


Equivalent Circuits by Mode

Mode 4
Differential Digital Input

Termination Menu Selection:
Digital/Input/Differential

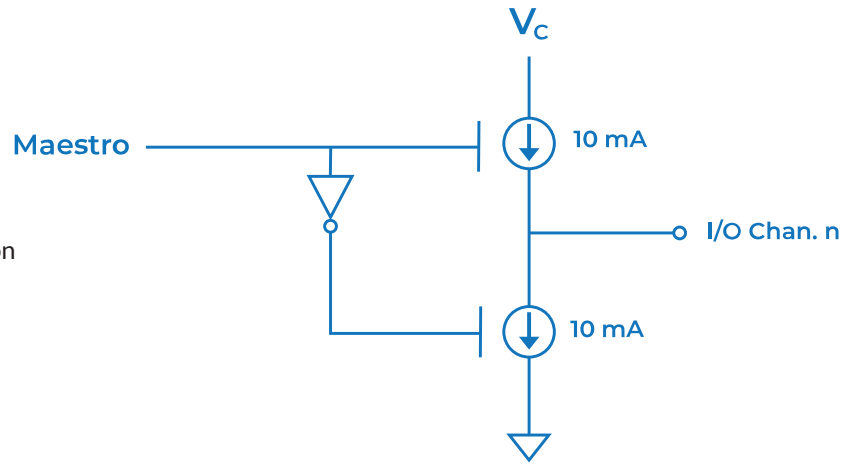
Use this mode for receiving digital signals from digital devices capable of differentially driving low and high states. Typically requires using an even-numbered Flex I/O Channel.



Mode 5
Bi-Level, Non-Differential Digital Output

Termination Menu Selection:
Digital/Output/Bi-State

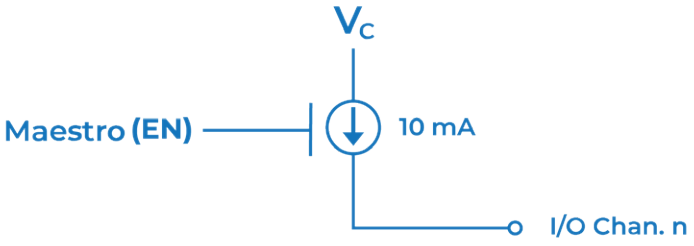
Use this mode to actively drive both high and low digital signals to non-differential receivers on external devices. Can be implemented using any Flex I/O Channel.



Mode 6
Non-Differential Digital Driver, Pull Up Only

Termination Menu Selection:
Digital/Output/Pull Up

Use this mode to transmit digital signals to external devices with their own pull-down circuits or when external circuitry includes a pull-down resistor. Equivalent to an Open Emitter Driver. Can be implemented using any Flex I/O Channel.

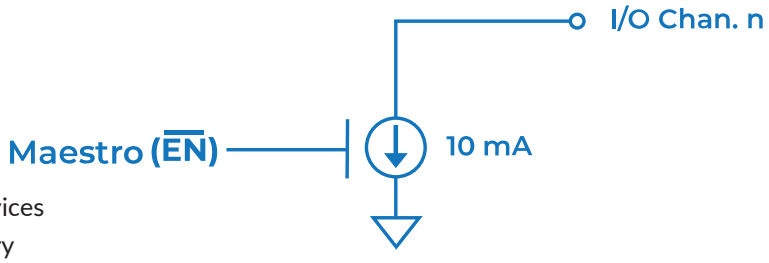


Equivalent Circuits by Mode

Mode 7
Non-Differential Digital Driver, Pull Down Only

Termination Menu Selection:
Digital/Output/Pull Down

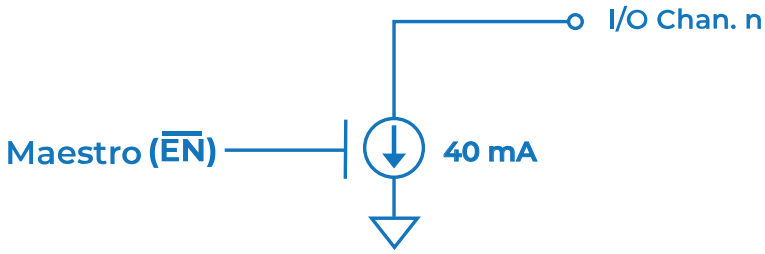
Use this mode to transmit digital signals to external devices with their own pull-up circuits or when external circuitry includes a pull-up resistor. Equivalent to an Open Collector Driver. Can be implemented using any Flex I/O Channel.



Mode 8
Non-Differential Digital Driver, Pull Down Only, High Current

Termination Menu Selection:
Digital/Output/Pull Down HC

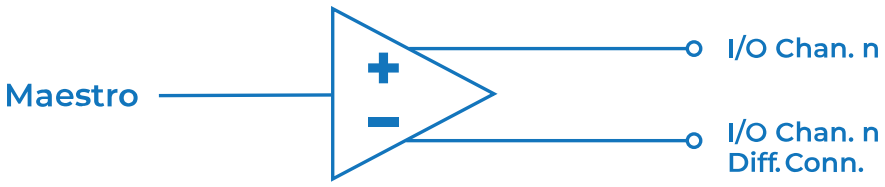
Use this mode to transmit digital signals to external devices with their own pull-up circuits or when external circuitry includes a pull-up resistor, but up to 40 mA current sinking capability is required. Equivalent to an Open Collector Driver. Can typically only be implemented using an even numbered Flex I/O Channel.



Mode 9
Differential Digital Driver

Termination Menu Selection:
Digital/Output/Differential

Use this mode to send digital signals to external devices like motors whose step, direction, A, or B inputs expect a differential signal. Typically requires using an even-numbered Flex I/O Channel.

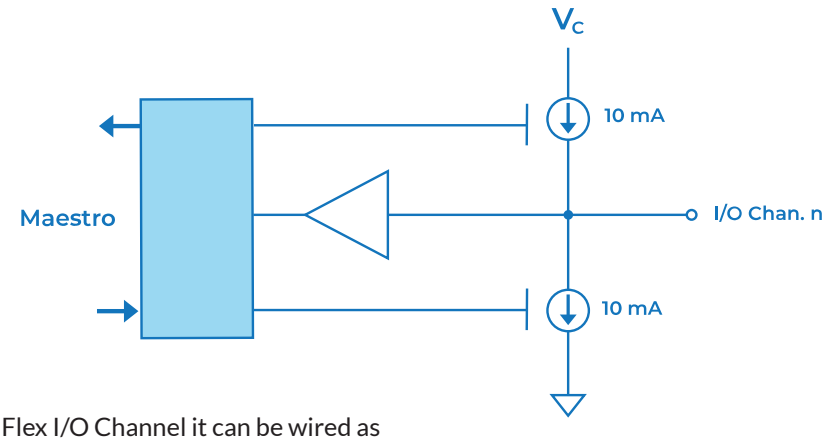


Equivalent Circuits by Mode

Mode 10
Half-Duplex Digital UART, Non-Differential

Termination Menu Selection:
Digital/Half Duplex/Bi-State

Use this mode to send and receive digital data from external devices whose protocols include explicit or implied conditions for controlling transmission or reception of digital data. Requires only one Flex-I/O Channel to implement. If using an even-numbered Flex I/O Channel it can be wired as in Mode 11. Most if not all UART Communications will be Differential as in Mode 11.

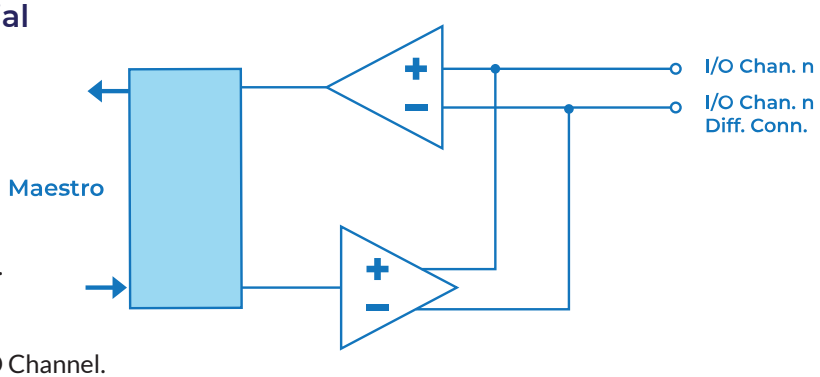


Mode 11
Half-Duplex Digital UART, Differential

Termination Menu Selection:
Digital/Half Duplex/Differential

Use this mode to send and receive digital data from external devices whose protocols include explicit or implied conditions for controlling the direction (transmission or reception) of digital data.

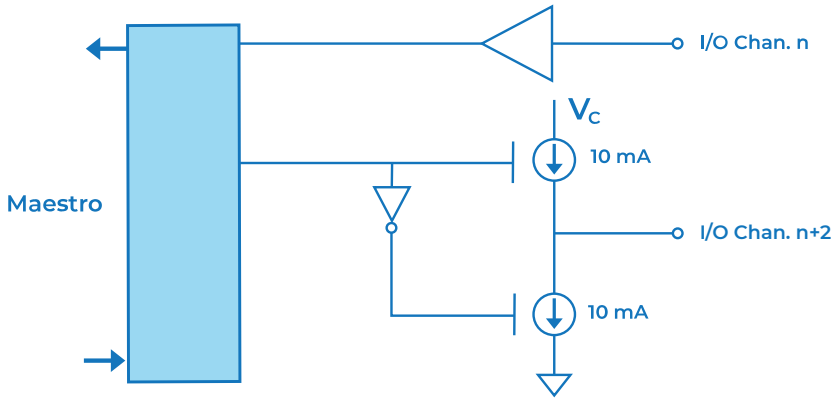
Requires only one Flex-I/O Channel to implement. Typically requires using an even-numbered Flex I/O Channel.



Mode 12
Full-Duplex Digital UART, Non-Differential

Termination Menu Selection:
Digital/Full Duplex/Bi-State

Use this mode to send and receive data from external devices where it may be necessary to send and receive digital information simultaneously.

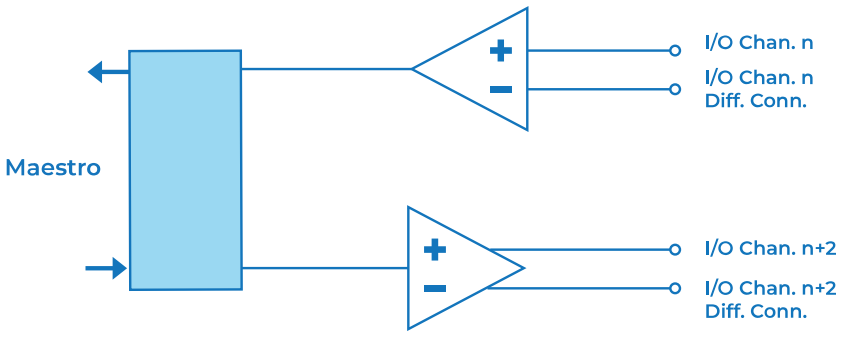


Equivalent Circuits by Mode

Mode 13
Full-Duplex Differential Digital UART

Termination Menu Selection: Digital/Full Duplex/Differential

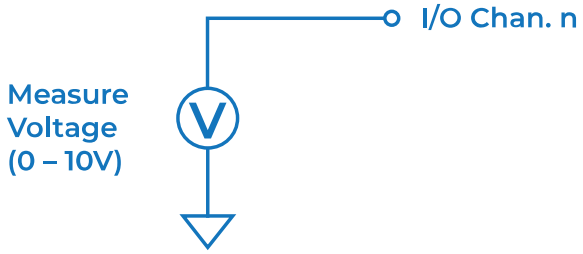
Use this mode to send and receive data from external devices where it may be necessary to send and receive digital information simultaneously to equipment requiring differential connections. Typically requires using an adjacent pair of even-numbered Flex I/O Channels to implement.



Mode 14
Non-differential Analog Input Signal Voltage Receiver

Termination Menu Selection: Analog/Input/Voltage

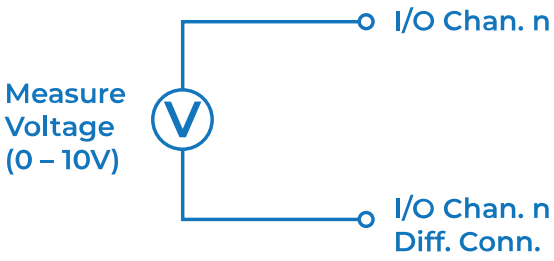
Use this mode to measure the magnitude of a signaling voltage received from external devices whose status is communicated by the level of an analog voltage referenced to ground. The resulting values are supplied to variables in user programs. Typically requires using an even-numbered Flex I/O Channel.



Mode 15
Differential Analog Input Signal Voltage Receiver

Termination Menu Selection: Analog/Input/Differential Voltage

Use this mode to measure the magnitude of a signaling voltage received from external devices whose status is communicated by the level of an analog voltage referenced to a dedicated voltage reference (Ex: Ohmic or Kelvin measurements). The resulting values are supplied to variables in user programs. Typically requires using Channel 0.

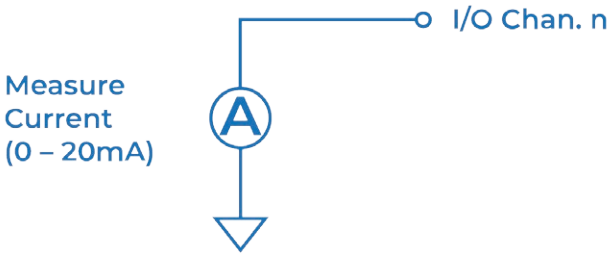


Equivalent Circuits by Mode

Mode 16
Analog Input Signal Current Receiver

Termination Menu Selection: Analog/Input/Current

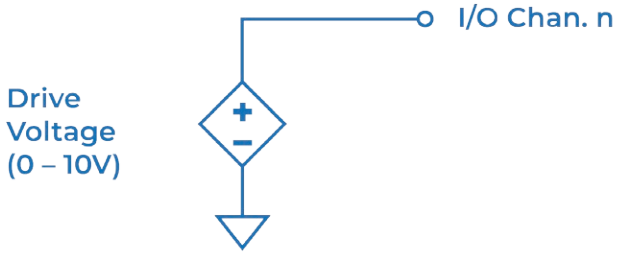
Use this mode to measure the magnitude of a signaling current supplied to ground by an external device whose status is communicated by the level of an analog current. The resulting values are delivered into variables in user programs. Typically requires using an even-numbered Flex I/O Channel.



Mode 17
Non-Differential Analog Voltage Transmitter

Termination Menu Selection: Analog/Output/Voltage

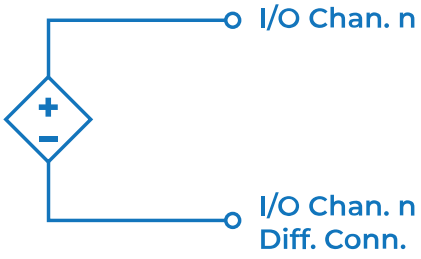
Use this mode to send an analog voltage equivalent to the value of a variable in a user program to external devices whose behavior is controlled by the level of a received analog voltage referenced to ground. Typically requires using an even-numbered Flex I/O Channel.



Mode 18
Differential Analog Voltage Transmitter

Termination Menu Selection: Analog/Output/Differential Voltage

Use this mode to send an analog voltage equivalent to the value of a variable in a user program, to external devices whose behavior is controlled by the level of a received analog voltage referenced to to a dedicated reference voltage (Ohmic or Kelvin referenced voltage). Typically requires using an even-numbered Flex I/O Channel.

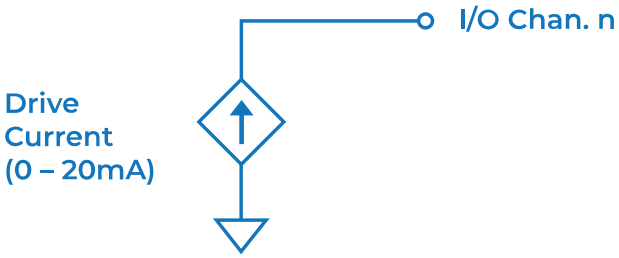


Equivalent Circuits by Mode

Mode 19
Analog Current Transmitter

Termination Menu Selection: Analog/Output/Current

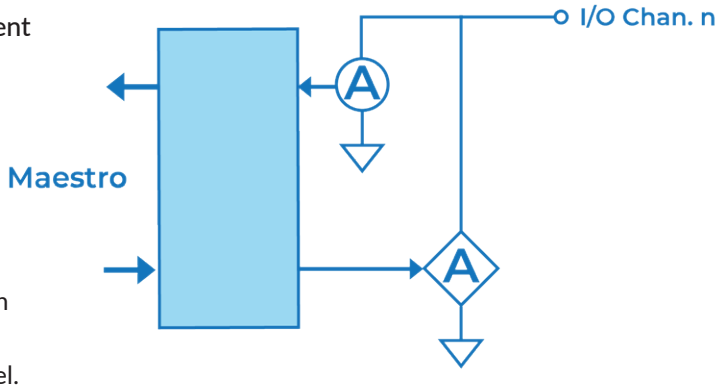
Use this mode this mode to send an analog current equivalent to the value of a variable in a user program to external devices whose behavior is controlled by the level of a received analog current delivered to ground. Typically requires using an even-numbered Flex I/O Channel.



Mode 20
Analog Current Transceiver with HART

Termination Menu Selection: Analog/Half Duplex/Current

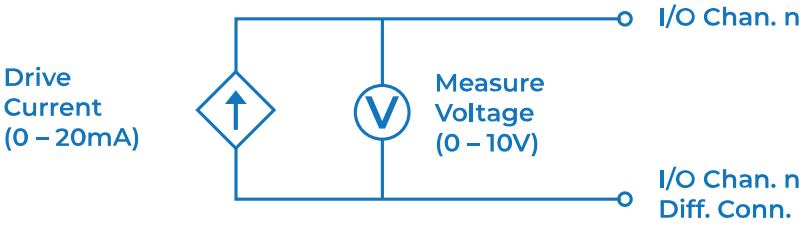
Use this mode to drive an analog current equivalent to the value of a variable in a user program with, or without serial data superposed on the current OR to receive into a variable in a user program the magnitude of the current received from a remote device with or without reception of serial data the remote device may superpose on the current it is supplying. Switching direction of current and data is under the control of a user program. Typically requires using an even-numbered Flex I/O Channel.



Mode 21
Differential Impedance Measurment Instrument

Termination Menu Selection: Analog/Full Duplex/Current

Use this mode to measure a voltage from an external device relative to a dedicated reference, send the resulting value to a variable in a user program, while driving a current to the external device which is returned through the same dedicated path, where the magnitude of the current is equivalent to the value of another variable in the user program. One application of this mode would allow a measurement of the resistance of an external thermistor to determine the local temperature in the neighborhood of the external thermistor.

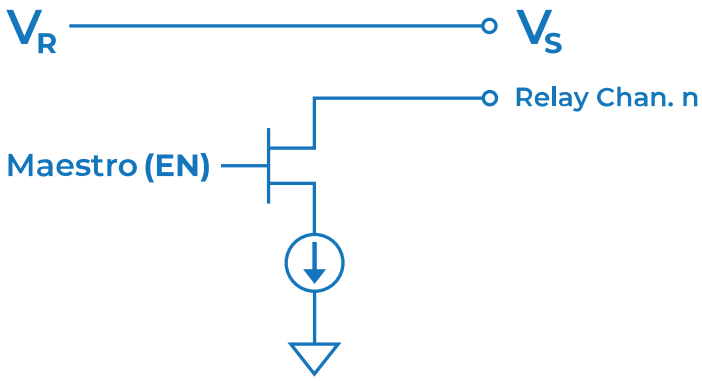


Equivalent Circuits by Mode

Mode 22
High Current Relay for Solenoid Control

Termination Menu Selection: None required.

Use this mode to energize actuators, grippers, etc. that require up to 5A of holding current from dedicated voltage sources up to 30 VDC. Voltage from a power supply can be connected directly to the Relay Control section (currently eight dedicated channels) using a four position M12 connector dedicated to this function.

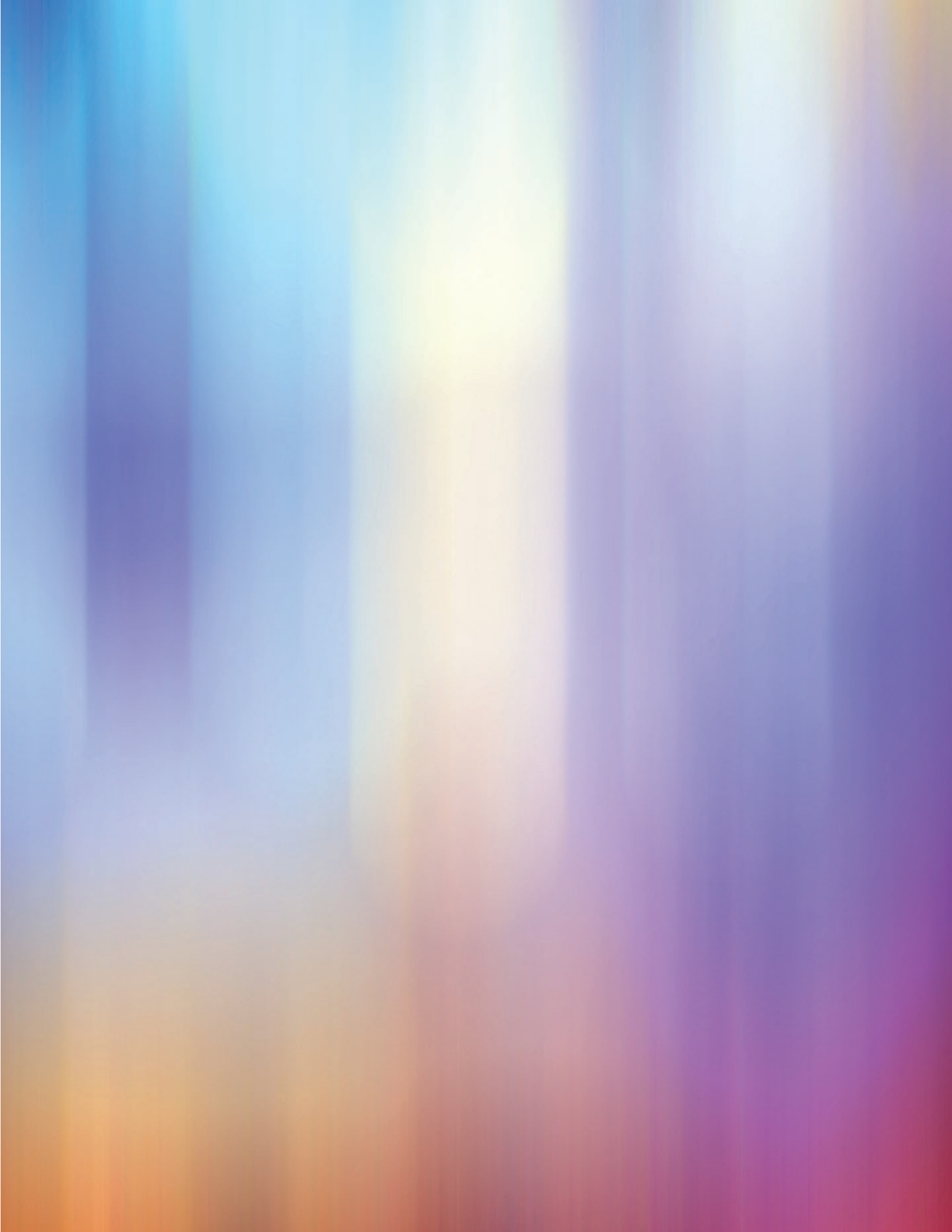


If the power supply is connected directly to the Maestro, then a dedicated pair of wires is available from each High Current Relay channel for direct connection to the remote load. Alternatively, the positive output of the power supply can be connected to one or more loads and only the returns from each load need be connected to the current sinking side of the Relay Channel.

If this second method is used, only the return connection of the power supply is required to be connected to the 4 position M12 connector in the Relay section of the Maestro. Requires a Flex I/O Relay Channel, typically Channels 17 to 23.

Terms

HART	Highway Addressable Remote Transducer
FSK	Frequency Shift Keying



Opteon

info@opteontech.com
www.opteontech.com/contact

1 Cabot Road, Suite 245
Hudson, MA 01749
617.798.1444