

## Introduction

A tertiary encoder is a third incremental input device that can be used when the normal primary or secondary feedback devices ports are not available.

## Hand Wheel Encoder & Master Slave

The tertiary encoder input used with incremental encoder hand wheel on high speed digital inputs could be single ended IN4, IN6, but shown as recommended differential encoder at IN3,4 & IN5,6.

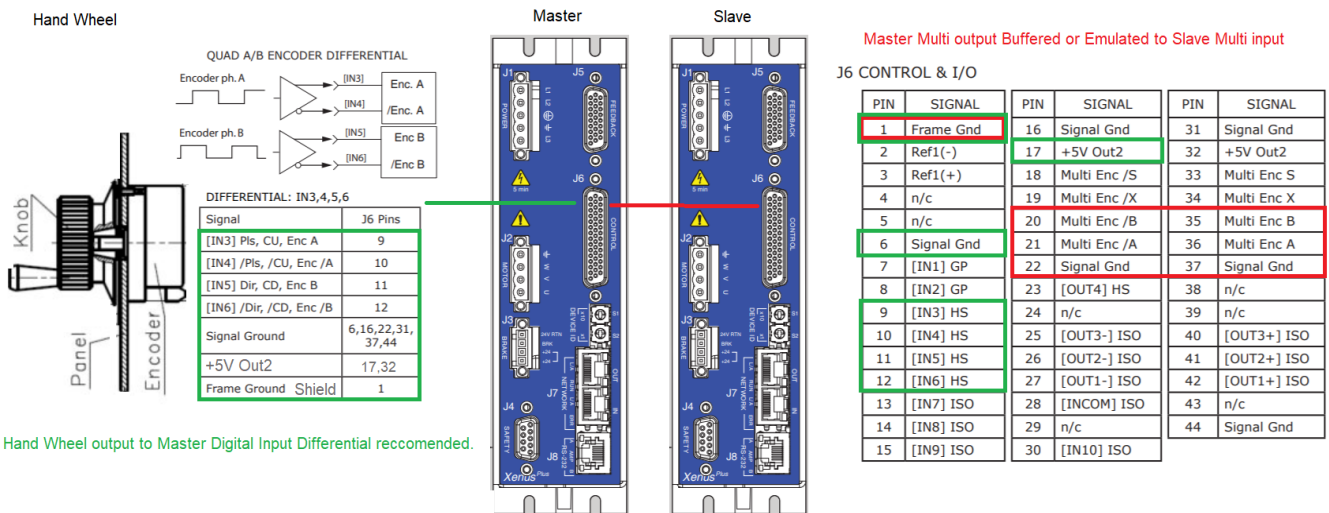
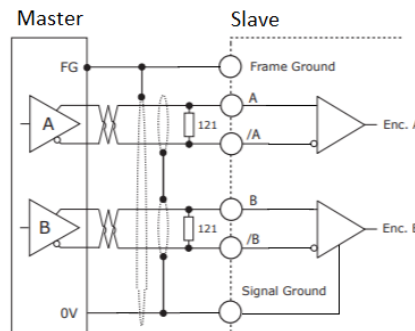


Figure 1. Xenus Compact wired for hand wheel as master and slave.

The outer shield must find a path to earth. If there is an inner shield for the twisted pair, then with respect to signal ground for optimal noise immunity. The multi-mode port has no terminators in the drive so add 120 Ohms to the last slave on network. If there are multiple slave drives be sure to keep stub length less than a few inches and only terminate at the last slave node. Common single grounds with earth at the drive. Do no hot swap while power is on.



## CME Configurations for Hand Wheel, Master, and Slave

The CME virtual drive can be used to check hardware, firmware, and software compatibility of any mode. In this case, the motor will use the primary feedback port and can be anything from incremental with Halls to Absolute. The Master will be configured to input the hand wheel incremental encoder pulse (typically in quadrature), and then the multi-mode encoder port will output buffered incremental quadrature from motor or emulated from absolute or even simulated from just Halls.

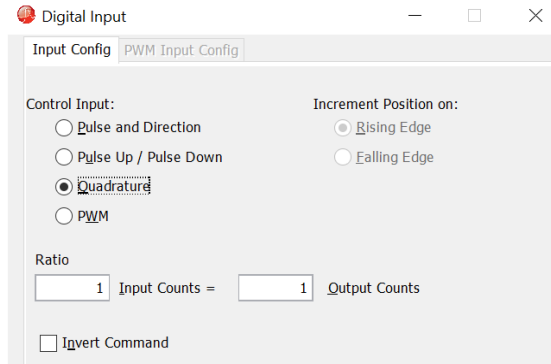
### CME Setup

**Master:** On the Setup screen select Position in the Operating Mode field, and then select Digital Input in the Command Source field to take hand wheel commands. For master only, select multi-mode port to output buffered motor encoder, or emulated motor encoder.

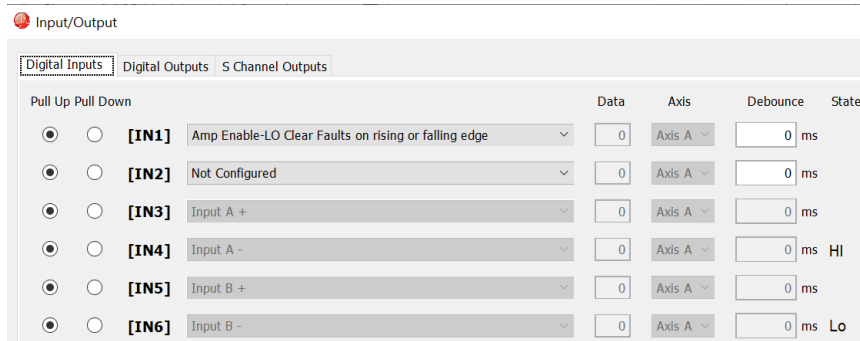
The image displays two screenshots of the CME Setup interface. The top screenshot shows the 'Operating Mode Options' section. The 'Operating Mode' dropdown is set to 'Position', and the 'Command Source' dropdown is set to 'Digital Input'. Under the 'Digital Input Source' section, three radio buttons are visible: 'High Speed Inputs', 'Multi-mode Port', and 'Differential Inputs', with 'Differential Inputs' being selected. The bottom screenshot shows the 'Miscellaneous Options' section. The 'Commutation Mode' section has three radio buttons: 'Sinusoidal' (selected), 'Trapezoidal', and 'Estimated Sinusoidal'. Below this, there are two more radio buttons: 'Use Back EMF For Velocity' and 'Use Halls for Velocity and Position', with 'Use Halls for Velocity and Position' selected. The 'Multi-mode Port' dropdown is set to 'Emulated Motor Feedback', and the 'Count Divide' dropdown is set to 'None'.

Some absolute encoders have 19 bits of resolution (524,288 counts/rev), so going to 6,000rpm (100rev/sec) is over 52 mega counts/second. If the output count frequency is over 20 Mega counts/second, then divide it down and later gear it up in the slave drive.

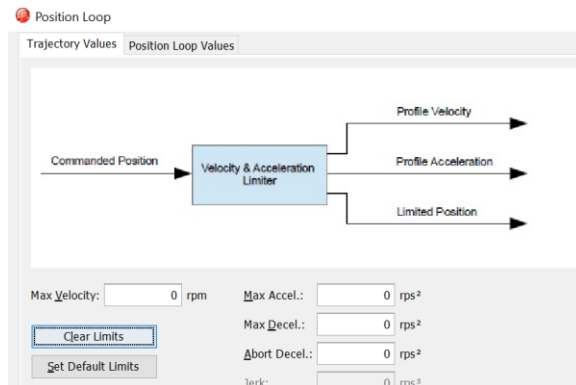
Next, open the Digital Input screen and select quadrature, assuming the hand wheel is incremental, and not some other pulse format. If the pulse encoder is required to produce one motor rev for one-wheel rev, and if the count ratio of wheel to motor is same, then using a ratio of 1:1 is fine. However, to have the motor to make several revs for one turn on the wheel then the user will need to calculate the count ratio of input counts (wheel) to output counts (load) required to make proper motion.



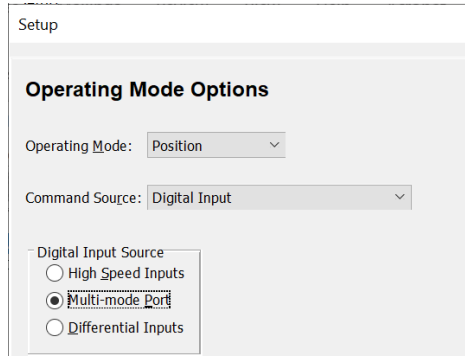
The results of the selection will appear on the Input/Output screen, and even displays the state of the input change Hi and Lo as the wheel rotates.



If the hand wheel is spun too fast, or if acceleration becomes too high, then limits can be placed on the trajectory using the trajectory generator limits. However, if there are limits then the position command will buffer and then feed out to complete as commanded. If the user does not want the motor to move after stopping the tuning of the wheel, then they will need to clear limits and turn the dial slower.



**Slave:** To be configured after the master is tested. The slave will take the master’s buffered or emulated output as input to the slave’s multi-mode port.



Set the slave digital input ratio to match any count divide or mismatch between master and slave. Do not limit the trajectory, be sure to clear any limits set during tuning. If slave fights with the master, then detune the slave a bit.

The slave will follow the master. However, if the slave becomes disabled then a brake output of active low is inverse of enable, so could be wired to master to disable master when slave becomes disabled. If there are multiple slaves, then use slave drives FET outputs OR-tied (close to ground) to master input.

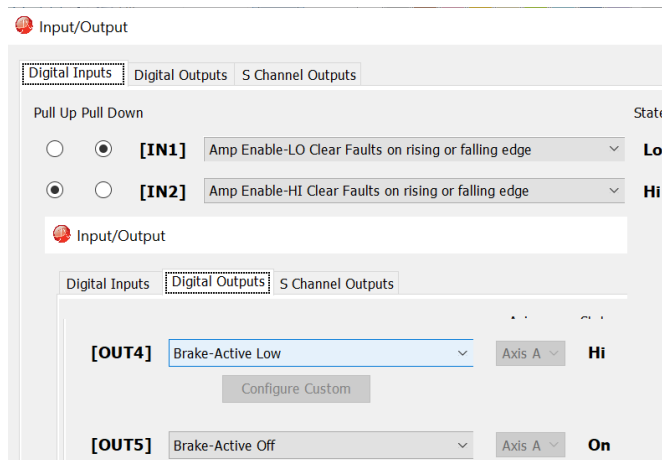
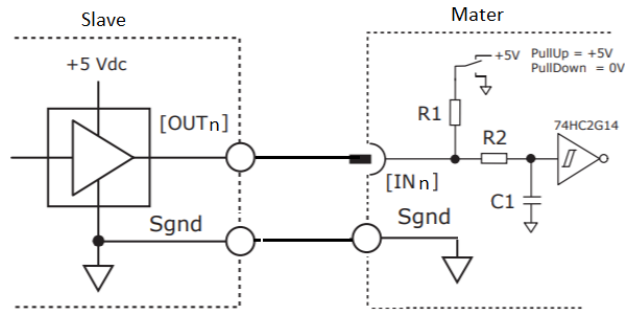
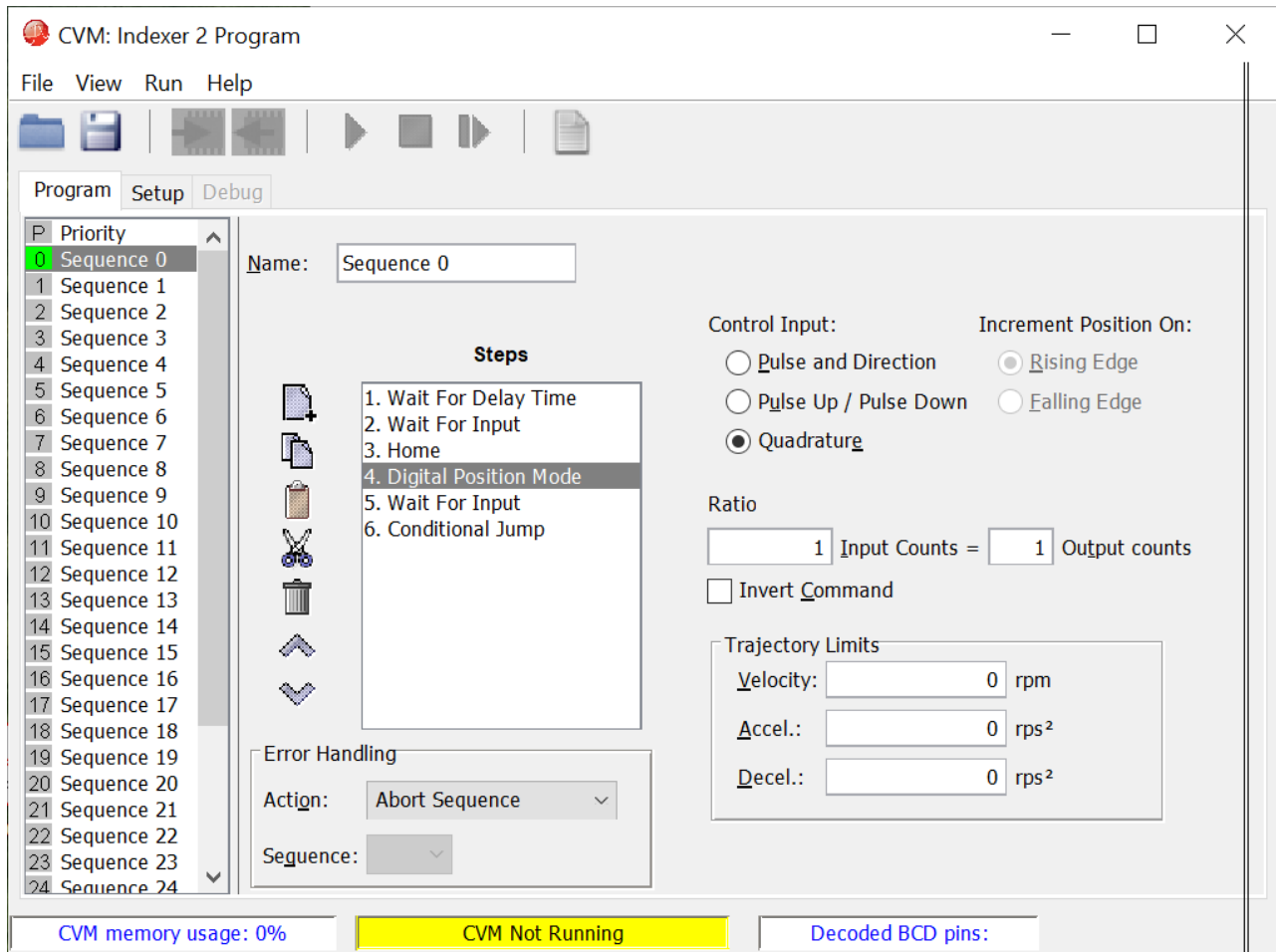


Figure 2. Xenus Compact wired for slave to disable master. OUT4 not for fan out.

## CVM Indexer – Home then change to Digital Input mode.

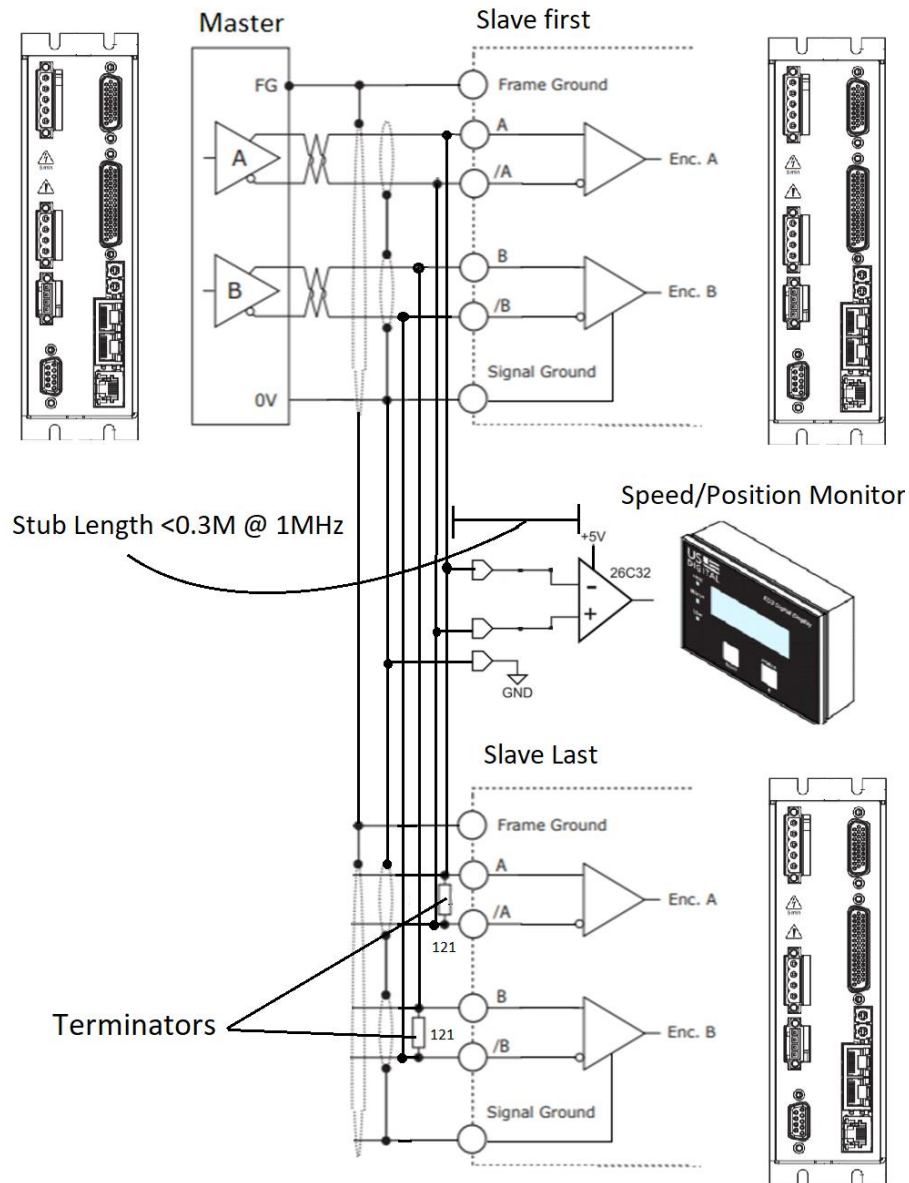
The CVM will run on power or reset and can be made to initiate sequence 0 immediately. It is best to wait for a second to allow the drive to power-up before homing; wait for Delay Time and then for input such as hardware to enable Home.



As a program only does what the program is told to do, ensure that proper testing is done on the program. As a suggestion, if using master then homing first, then switch to digital input to follow command from hand wheel, or if using slave then wait for the master to be done before homing and switching to digital input.

### Multiple Slaves or Monitor on Distributed Encoder Network.

When using multiple slaves or monitors, make sure that only the last device has 121 Ohms terminating resistors and that all devices conform to RS422 without altering the differential signals. It is critical that stub length does not exceed 0.3 meters at 1MHz.



## Tertiary Incremental for Dual Loop with buffered or emulated output

Motor Encoder Type (0x60) Value 24. Digital inputs used as tertiary encoder inputs. Inputs configured as single ended or differential by using Digital Input Command Configuration (0xA8). Not used in Desired State (0x24) modes 3, 13 and 23 (PWM or Digital Input Command Modes).

The image displays three overlapping software configuration windows for a motor encoder.

- Top Window (Feedback Options):**
  - Hall Type: Digital
  - Hall Phase Correction
  - Input Source:
    - Primary
    - Secondary
    - Tertiary
  - Motor Feedback: Incremental
  - Load Feedback: BiSS
    - Primary
    - Secondary
- Middle Window (Motor Feedback):**
  - 1000 lines = 4000 counts
  - Digital Input Source:
    - High Speed Inputs Single Ended
    - Differential Inputs
- Bottom Window (Load Feedback):**
  - Basic Settings | Advanced Settings
  - Bits: 19 = 524288 counts/rev
  - Number of Revolutions: 4096 turns
  - Number of Alignment Bits: 0
  - BiSS B |  BiSS C
- Left Window (Miscellaneous Options):**
  - Commutation Mode:
    - Sinusoidal
    - Trapezoidal
    - Estimated Sin
  - Use Back EMF For Velocity
  - Use Halls for Velocity and Position
  - Multi-mode Port: Emulated Motor Feedback
  - Count Divide: None

Using Differential Tertiary is recommended. Using single-ended is at the risk of the user.

## Revision History

Date	Version	Revision
03/09/2021	Rev 00	Initial release