
Application Note

C011 Phase Locking Set up With Peer To Peer

HA502487C011

AC30P/D/A V2.17 onwards

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Requirements

Intended Users

This Application Note is to be made available to all persons who are required to install, configure or service equipment described herein, or any other associated operation.

The information given is intended to enable the user to obtain maximum benefit from the equipment.

Application Area

The equipment described is intended for industrial motor speed control utilising AC induction or AC synchronous machines.

Personnel

Installation, operation and maintenance of the equipment should be carried out by qualified personnel. A qualified person is someone who is technically competent and familiar with all safety information and established safety practices; with the installation process, operation and maintenance of this equipment; and with all the hazards involved.

Hazards

Refer to the Safety Information given at the front of the Product Manual supplied with every Parker SSD Drives product.

C011 PHASE LOCKING SET UP WITH PEER TO PEER

Abstract

This application note gives an example of setting up a phase locking application with the Phase locking application described in HA503284U011, using the Peer to Peer feature.

Pre-Requisite

The pre-requisites are :

- a AC30P, AC30D or AC30A drive used as the master drive
- a AC30P, AC30D or AC30A drive used as the slave drive

Firmware version 2.17 onwards

For using V3 or V4 firmware, changing the device library in the project (version 2.x) to the corresponding one (3.x or 4.x) is mandatory.

Introduction

Phase Control or Phase Lock, sometimes referred to as electronic gearbox, is a position trim of a slave drive to a speed to maintain the relative position between a master and a slave shaft or a precision ratio between the two shafts. The slave speed demand is composed of the master speed demand and a position trim from a counter of the accumulated differences between the Master and Slave Encoders.

The AC30P, AC30D and AC30A includes the ability to use real-time peer-to-peer communications, over Ethernet, to pass the speed/position reference from one drive to another in the system.

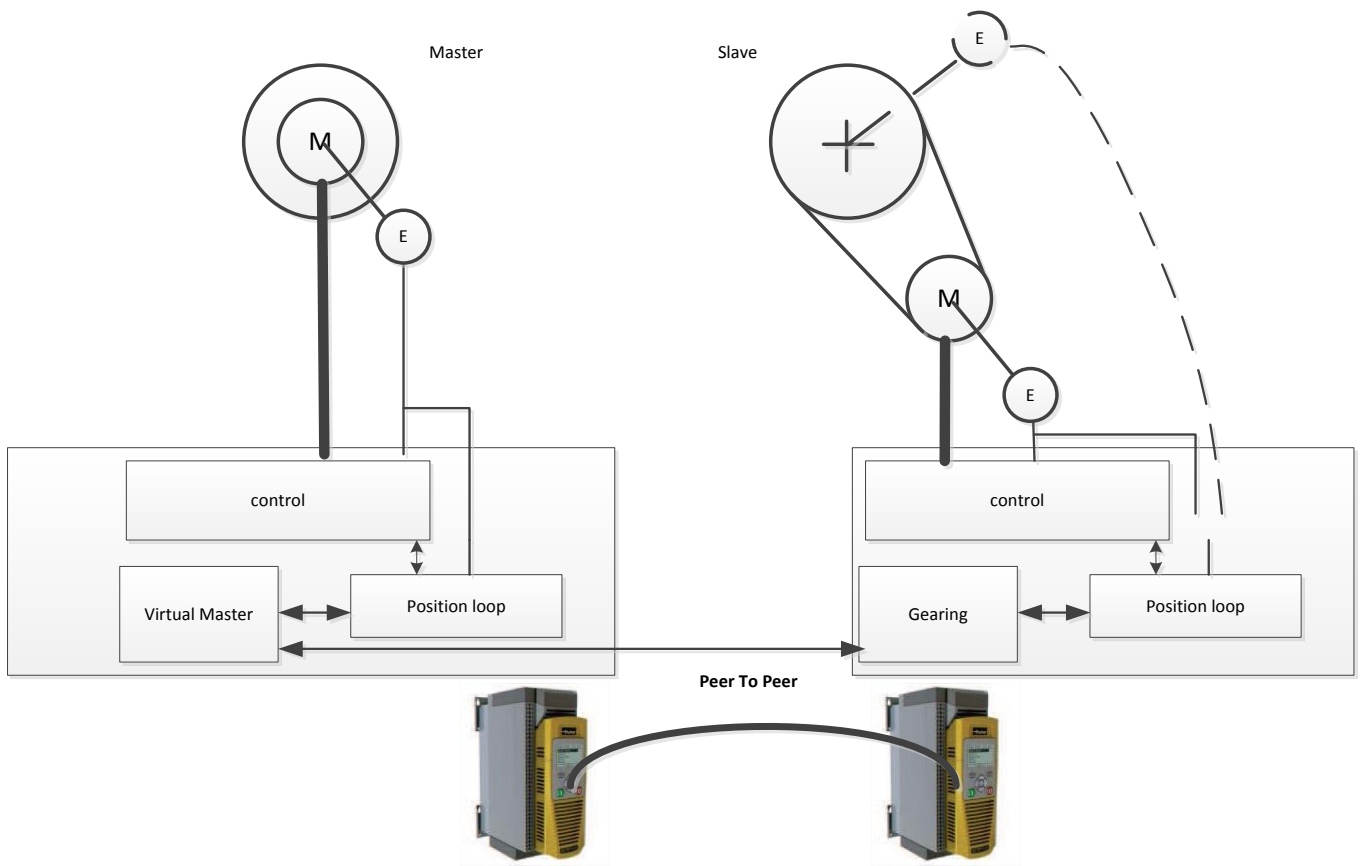
One drive (configured to be the Master) generates a speed and position command.

It could be a Real Master, using the position information from an external encoder connected to the drive, or a Virtual Master, internally generating position.

All the other drives must have the Virtual Master functionality enabled, and must be configured as Slaves.

The following phase blocks are also available:

- Phase inch – progressive phase advance or retard on demand
- Phase move – pre-defined phase change, at set speed and acceleration, on demand
- Phase offset – adjustment of the relative phase between the Master and the slave.
- Phase tuning – facility for the injection of square speed or phase offsets to assist loop tuning.



Phase Loop operation

The phase loop is a position loop.

The position demand is the sum of the reference position plus the offsets generated by the phase blocks belonging to the application layer.

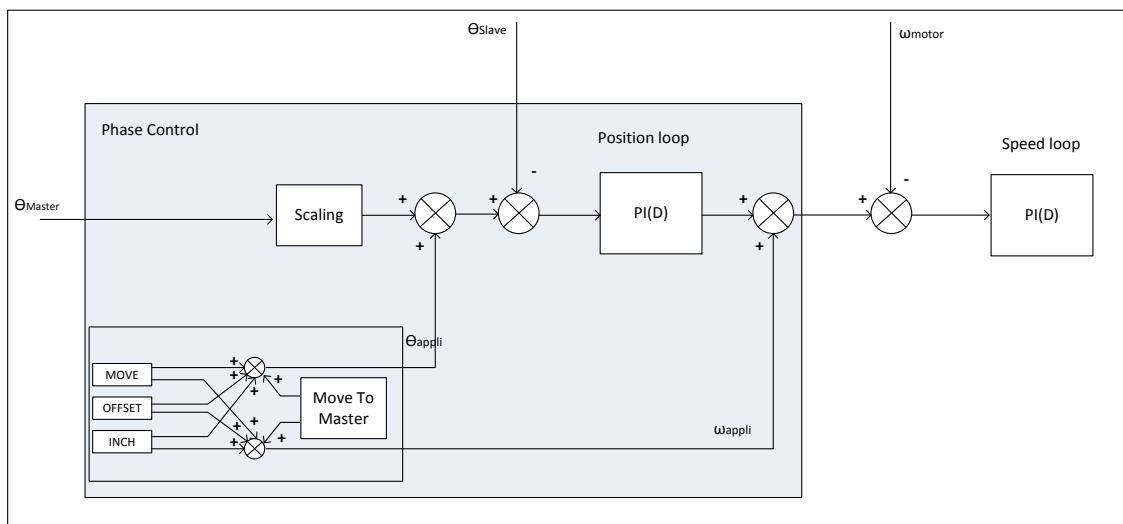
The position feedback is the position from the encoder defined as the slave encoder.

The Position Loop works on a multi turn position. The error between the Master and the slave can be a multi turn error.

It contains a PI corrector (no derivative action), a feed forward term and an output saturation.

The feed forward term is the sum of the reference speed plus the speeds generated by the phase blocks.

The output feeds the speed loop.



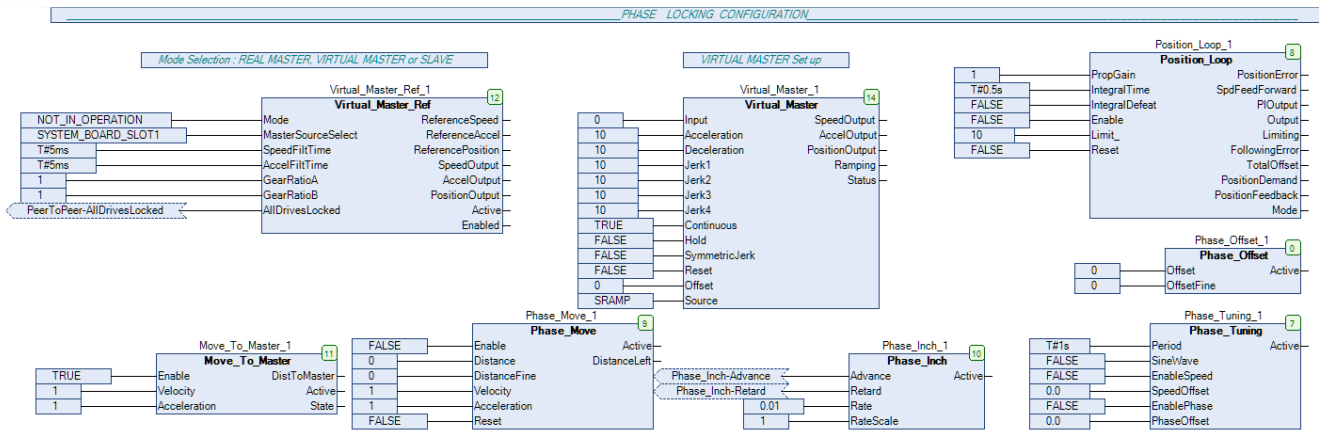
Phase Control Default application

Default application is available as RA503284U011_XXX.prj (xxx refers to a version number, 001 corresponding to the initial version, incrementing with issue corrections and additions)

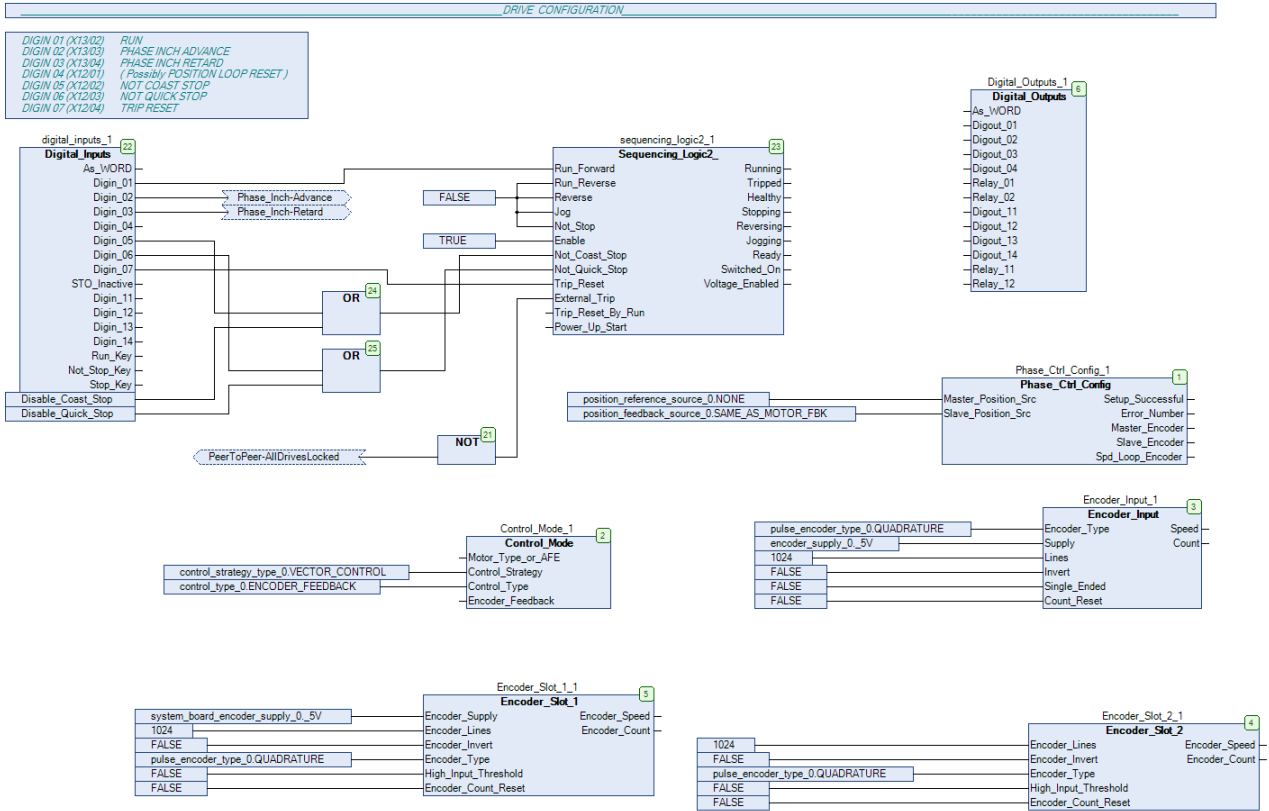
Default configuration is separated in 3 parts :

- first is dedicated to the phase control :
 - o phase blocks
 - o real/virtual master configuration
 - o phase loop (position loop)
- second is dedicated to the I/Os and sequencing of the drive
 - o Digital I/Os
 - o Encoder(s) setting
 - o Master/slave selection
- third is related to the Peer To Peer control
 - o PTP and Peer To Peer
 - o Connection control

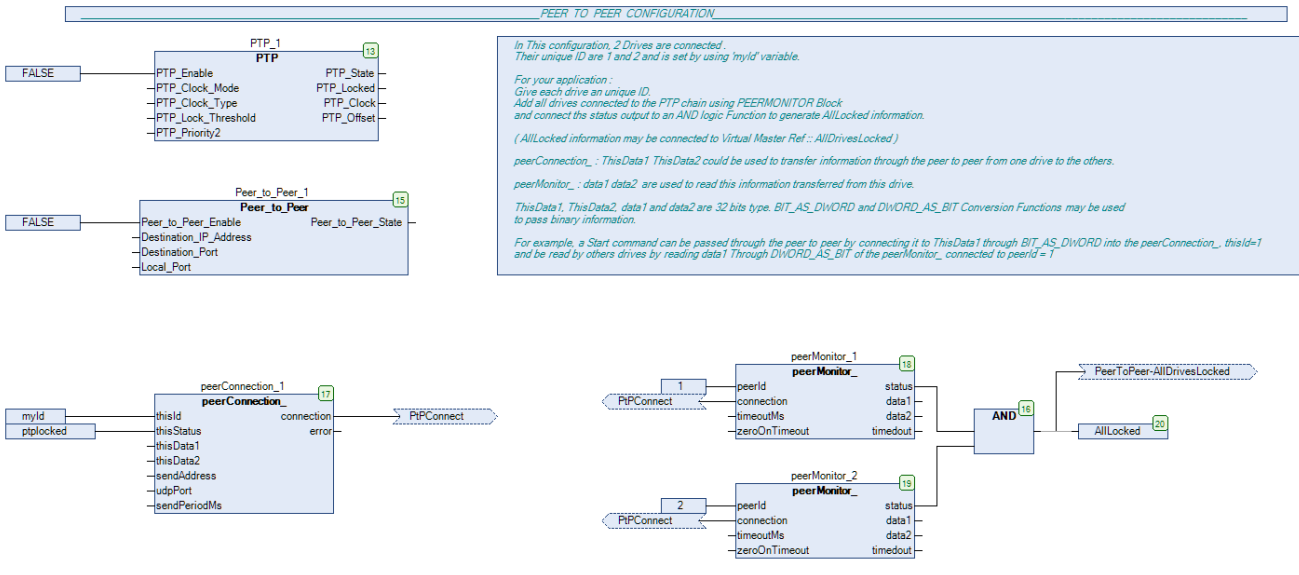
Phase Control :



I/Os and sequencing :

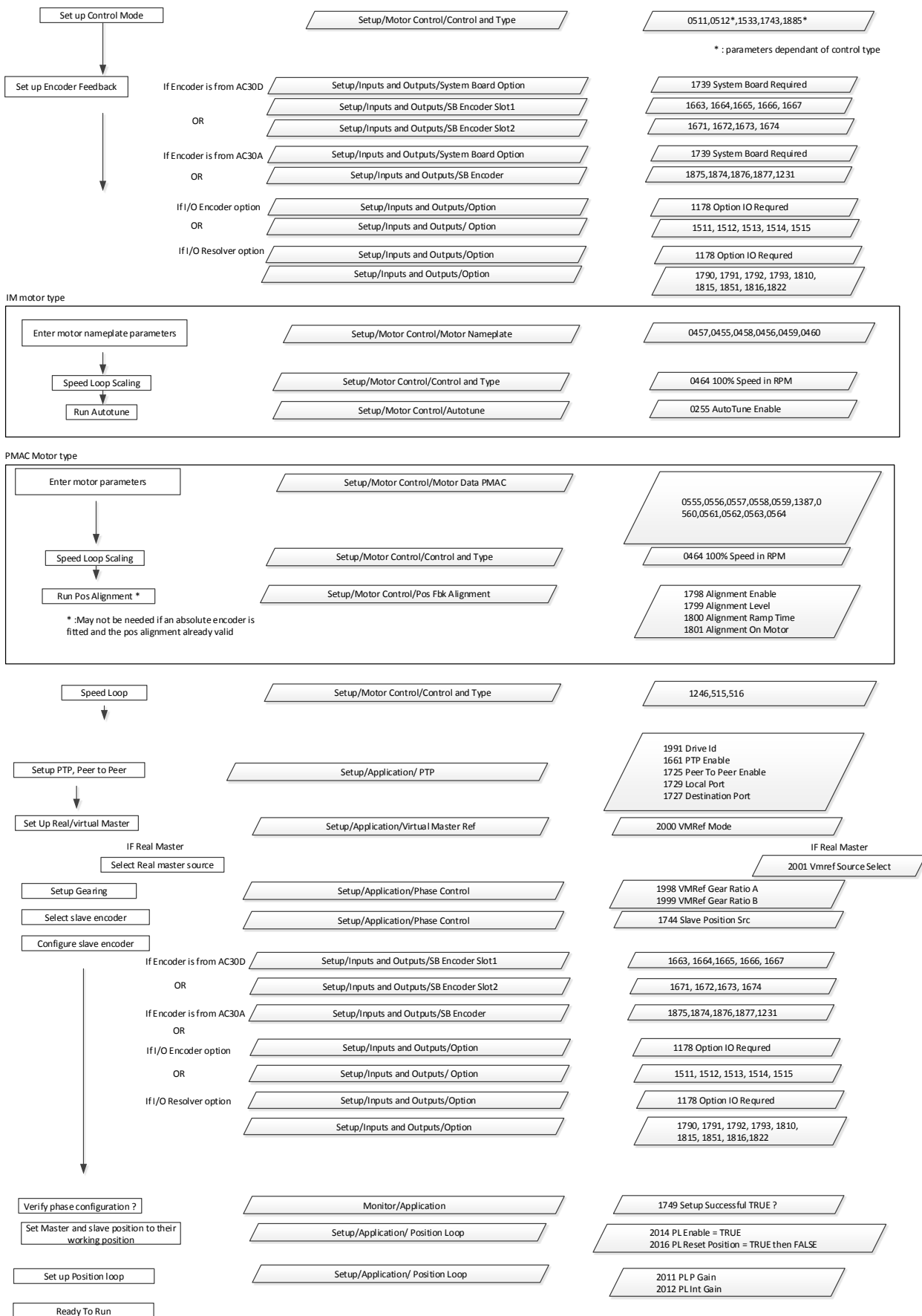


Peer To Peer Control



Step to Configure Both drives

BASIC CONFIGURATION



Setup Control Mode:

Selection of the control mode (Vector control) and selection of the encoder feedback for the speed loop control.

Setup Encoder Feedback :

Depending of the encoder feedback selected :

- if MAIN SPD FEEDBACK Selected, an IO option pulse encoder is required and the settings of the encoder are done in **Setup::Inputs and Outputs::Option**
- if MAIN SPD FEEDBACK Selected, an IO Resolver option is required and the settings of the Resolver are done in **Setup::Inputs and Outputs::Option**
- if SYSTEM BOARD SLOT 1 or SLOT 2 is selected, a system board is required and the settings of the encoder are done in **Setup::Inputs and Outputs::SB Encoder Slot1** or **Setup::Inputs and Outputs::SB Encoder Slot2**
- if Encoder from AC30A, settings are done in **Setup::Inputs and Outputs::SB Encoder**

Motor Nameplate parameters :

Enter the motor parameters.

Speed Loop Scaling:

Enter the scaling for the speed loop control. This value represents 100% speed

Autotune :

Run Autotune. This is mainly for IM Motor type

For PMAC Motor, preferably enter the values from the motor datasheet

Pos Alignment :

Only required for PMAC motors, if the alignment has not been done mechanically in factory.

Run Pos Alignment.

Speed Loop :

By default, speed loop settings gives a safe control of the motor. For a better dynamic and behaviour, it may be better to try to optimize the speed loop settings.

Real Master / Virtual Master:

Selection of the Real Master or Virtual Master mode for the Master drive

If Real Master; selection of the encoder input used as the Real Master. And also selection of the filters applied to the speed and acceleration

If Virtual Master, selection of the internal ramp and parameter associated to the generator.

Connection of the user input to the speed input of the Virtual Master block

Selection of the Slave mode for Slave drives

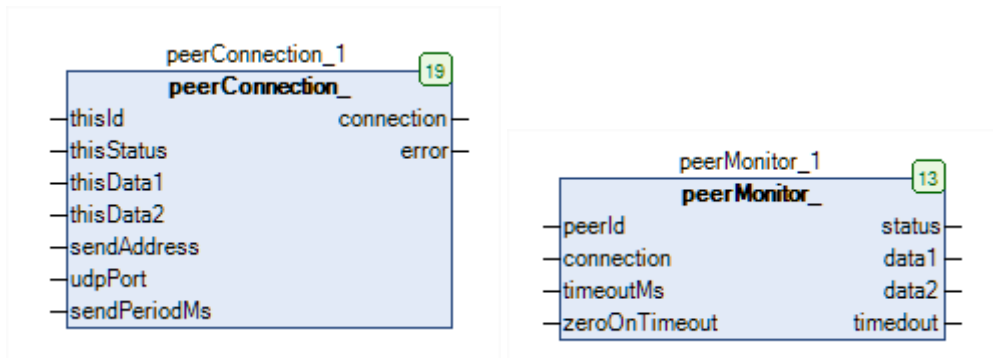
PTP and Peer To Peer :

Configure PTP and Peer to Peer.

Note : The Peer to Peer module broadcasts data at a high rate, as such, **when the Peer to Peer module is enabled, it is recommended not to connect the inverters to a corporate or other sensitive network.**

Verify Connection of the Ethernet link.

If using the Control of the Peer To Peer connection in the default application (which is almost mandatory to keep in control the system in case of disconnection), Set **up Application::PTP::Drive Id** with the correct number and verify **Virtual Master Ref::AllDrivesLocked** input is TRUE.



Please note that AllDrivesLocked information is also connected to External Trips input of Sequencing_Logic2_. This is very useful, especially for the drive which will be the master for the PTP (Precision Time Protocol)

For sending and reading informations, please refers the the corresponding library and application note (006 Sender Receiver Library)

Gearing:

Setup Gearing A and Gearing B input to their values.

Enable Position Loop:

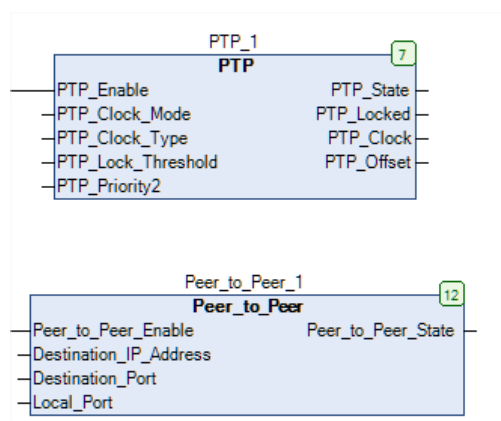
Insure your drive is torque OFF.

Enable Position Loop(**Position Loop::Enable** = TRUE).

To reset the Position Loop to the actual motor position, set **Position Loop::ResetTotal** to TRUE, then to FALSE.

By default, position loop settings gives a safe control of the motor. For a better dynamic and behaviour, it may be better to try to optimize the settings.

Peer to Peer Control



PTP and **Peer_To_Peer** should be set up and Enabled (for more details [please refer to the Drive Manual](#))

PTP :

The PTP will synchronize the internal clocks over the Ethernet to better than 1 microsecond. No external master is required for the PTP network; any of the inverters may become a PTP master.

The initial use of the PTP is for shaft locking applications using the Virtual Master or Real Master control.

Note: Currently up to 16 inverters are supported on a PTP network.

Peer To Peer :

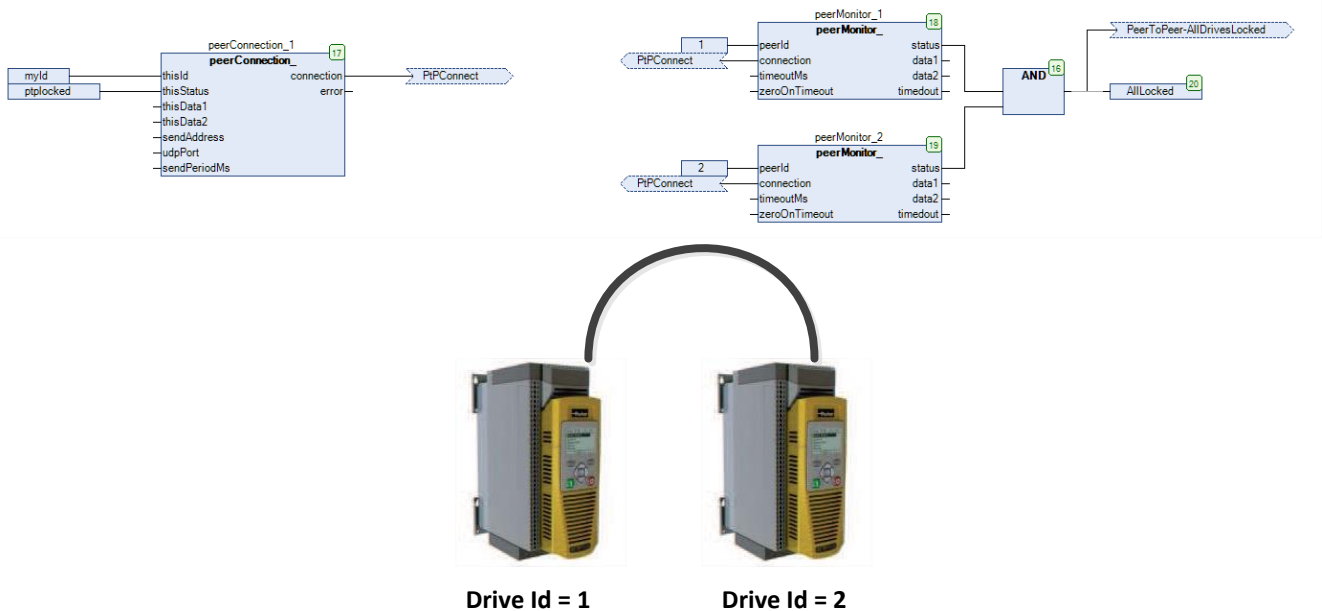
The Peer to Peer module is implemented in the AC30P ,AC30D and AC30A inverters and provides Ethernet communications between inverters.

The data sent is not accessible to the user. The initial use of the Peer to Peer module is for shaft locking applications using the Virtual Master or Real Master control and used in conjunction with the Precision Time Protocol (PTP).

Note: The Peer to Peer module broadcasts data at a high rate, as such, when the Peer to Peer module is enabled it is recommended not to connect the inverters to a corporate or other sensitive network.

In default configuration appears some others blocks used to control and give diagnostics about the Peer To Peer connection. This is to detect a disconnection or a lost of Peer To Peer connection in the chain between drives.

The output information ‘*AllLocked*’ is TRUE when all drives are connected and the Peer To Peer connection is Safe. ‘*AllLocked*’ is FALSE when the drives are not connected. This output can feed *AllDrivesLocked* input of *Virtual Master Ref.*



The default configuration is designed for 2 drives connected together.

Each drive should contain this control feature.

Each drive is identified by a unique Id accessible by the GKP under *Application::PTP::Drive Id*. In the default application, Drive Ids are 1 and 2.

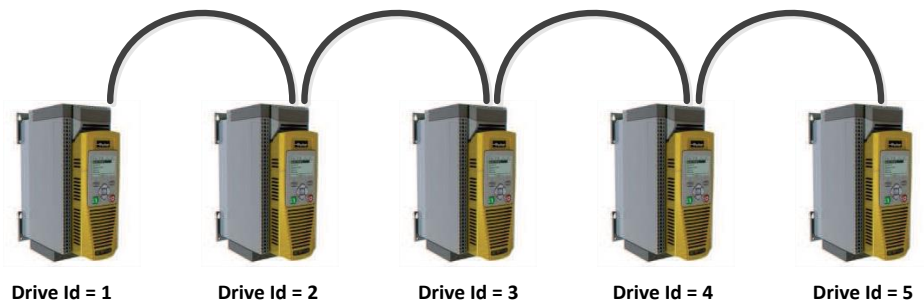
If the Peer To Peer connection is lost between drive 1 and drive 2, then the diagnostic *AllLocked* becomes FALSE. If connected to *Virtual Master Ref::AllDriveLocked*, then drives are informed that the peer to peer connection has been lost and can take on their side the correct decision to stop safely the motor.

Please note that *AllDrivesLocked* informations is also connected to *External Trips input of Sequencing_Logic2_*. This is very useful, especially for the drive which will be the master for the PTP (Precision Time Protocol).

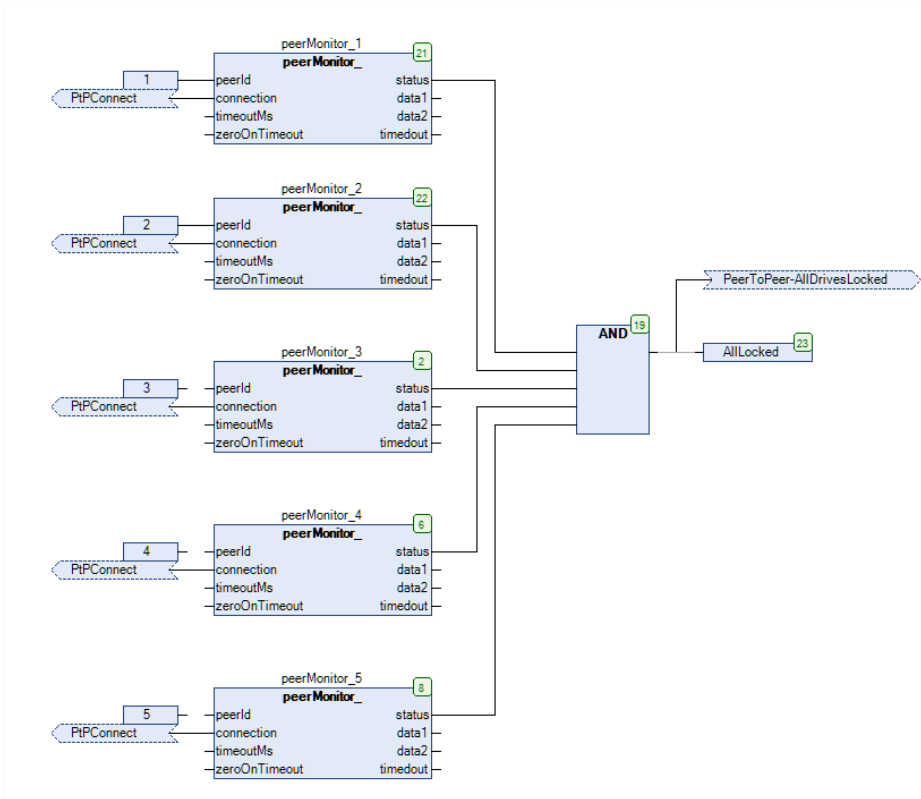
If nothing else is added to the configuration, the drive will return in speed control mode and move back the motor to the user speed setpoint (values of the speed setpoint feeding the speed loop in speed control mode, usual settings of a speed setpoint in *Parameters::Motor Control::Sequencing*) by using the system ramp acceleration/deceleration set up in the Ramp block (*Parameters::Motor Control::Ramp*).

When and if the Connection is recovered, than the motor will move back in position loop. All drives will then resynchronize themselves to the master position.

Below is an example of 5 drives connected together, with Drive Id from 1 to 5.



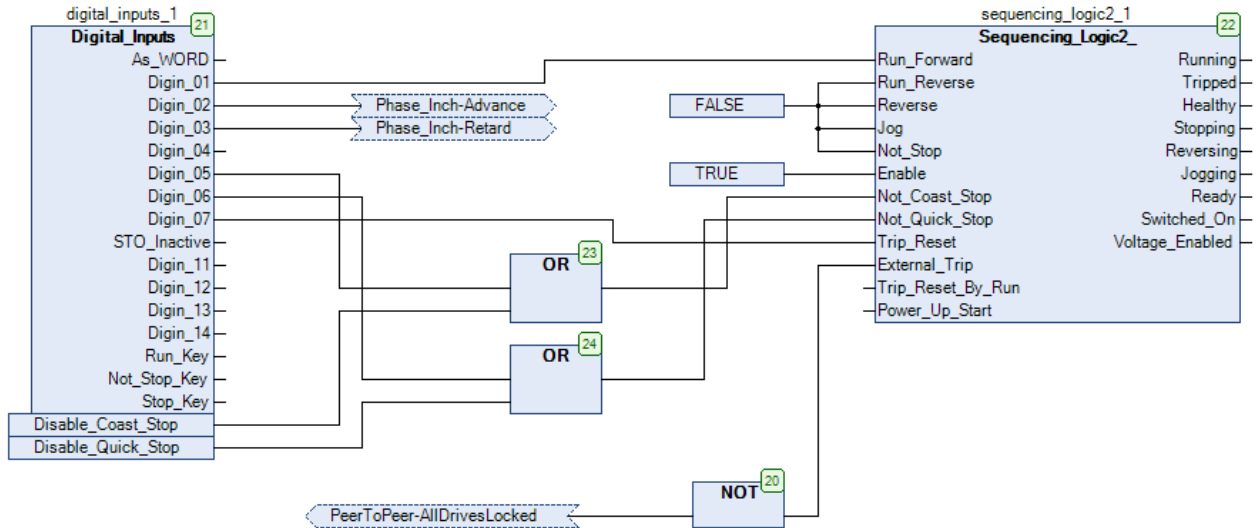
Each drive owns its own Id (1 to 5 , Application::PTP::Drive Id), and should contain this control diagram in its application.



Inputs and Outputs

In the default application, Inputs are connected as below :

DIGIN 01 (X13/02)	RUN
DIGIN 02 (X13/03)	PHASE INCH ADVANCE
DIGIN 03 (X13/04)	PHASE INCH RETARD
DIGIN 04 (X12/01)	(Possibly POSITION LOOP RESET)
DIGIN 05 (X12/02)	NOT COAST STOP
DIGIN 06 (X12/03)	NOT QUICK STOP
DIGIN 07 (X12/04)	TRIP RESET



2 inputs Digin_02 and Digin_03 are connected to the Phase Inch Blocks to synchronize the Slave to the Master position. Rate and Rate scale parameters allows to control the change in position when the inputs are TRUE.

Conditions to be in phase control

The phase control mode is in action when the output *Position Loop::Mode* = MASTER ABSOLUTE POSTION.

To Access this state :

- One of the Virtual Master mode should be selected : *Virtual Master Ref::Mode* = REAL MASTER, MASTER or SLAVE.
- PTP and Peer to Peer must be set up. *PTP::PTP_Enable* = TRUE and *Peer to Peer::Peer_to_Peer_Enable* = TRUE
- *Virtual Master Ref::AllDrivesLocked* input should be TRUE.
- Phase loop must be enabled : *Position Loop::Enable* = TRUE
- Torque on the drive must be switched ON.

Various Master Slave configurations

Please refers to the corresponding Application Note (009 Peer to Peer Phase Locking Modes)