Bardac drives

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A P P L I C A T I O N   N O T E

Drive Applications Support Library

Application Note	AN-P2-034
Title	Using Hoist Mode
Related Products	P2 Series AC Drives
Level: **4**	1 - Fundamental - No previous experience necessary. 2 - Basic - Some basic drives knowledge recommended. 3 - Advanced - Some basic drives knowledge required. 4 - Expert - Good experience in topic of subject matter recommended.

Important Safety Notice:

⚠️	All Bardac Drives application notes are intended to provide general guidance concerning the use of drives in relevant applications. The information and diagrams contained within are for guidance purposes only, and do not claim to be complete, nor specifically relate to any customer applications. It is the responsibility of the system designer, installer and commissioning engineer to ensure that the drive operates in a safe manner throughout all operating conditions. By using this Application Note, you accept that Bardac Corporation has no liability for any damage or claims resulting from the use of the information contained herein.
	All Application notes are subject to continuous updates, and may be changed at any time without prior notice.
	Bardac Drives products should not be used to perform any safety function beyond which they are certified for.

⚠️ Hoist applications are inherently dangerous. Incorrect selection of components, installation or commissioning can result in loss of control of the suspended load, potentially causing personal injury and/or equipment damage. The drive or a mechanical brake must always control the load.

Hoist application should only be commissioned by engineers with sufficient experience and knowledge of the application to ensure safety is maintained at all times.

All hoists should be designed with essential features to ensure safe operation such as end of travel limits, over-speed detection and fault monitoring. Correct control system and implementation is required to ensure that the drive may only operate the hoist when no other potentially dangerous condition exists.

The Parameters listed in this Application Note are intended to assist with lifting/torque proving applications. It is the responsibility of the engineer and/or end user to correctly and safely configure the drive parameters, test all functionality and ensure all safety requirements in accordance with all applicable codes and standards are maintained in all conditions.

Overview:

P2 Series drives provide a dedicated Hoist Mode function to assist with safe commissioning of the drive in hoist applications.

Hoist mode provides the following operation features:

• Direct control of the motor electromechanical holding brake.

• Pre-magnetization and pre-torque of the motor prior to brake release.

• Detection of brake fault and trip.

• Holding torque during brake application on stopping.

This document describes how to enable the Hoist Mode function, and the parameters which can be adjusted to optimize its operation.

Hoist Specific Application Requirements:

In a hoisting or lifting application, a load will be raised or lowered, and it must be possible for the load to be held in position. For this reason, an electro-mechanical holding brake with sufficient torque capacity must be fitted. In order to safely lift the load, high starting torque must be available immediately when the brake is released, whilst stopping in position requires holding torque for a short period during which the brake is applied.

Hoist applications should be handled with care, and careful attention to the system design and operation. It is essential when using drives in hoist applications to consider the following points as a minimum.

Drive Selection

It is of utmost importance to ensure that the drive operates at all times within its designed capacity to ensure safe operation in hoist applications. In many cases, hoist motors are selected based on intermittent duty, therefore the motor may operate infrequently and for short periods, often above the rated nameplate current or power capacity. For this reason, it is always advisable to select a drive power rating at least one rating higher than the motor rated power, e.g. for a 50HP / 37kW motor, the drive should be at least 60HP / 45kW.

In cases where the application has extremely high peak load demands, or is vitally important for production operation or safety critical, it is advisable to select a drive two ratings above the motor size, e.g. for a 50HP / 37kW motor, select a 75HP / 55kW drive. This over-sizing is intended to ensure the drive never operates close to its limit, and thereby remains safe at all times.

Brake Resistor Selection

It is of utmost importance to ensure that the drive operates at all times within its designed capacity to ensure safe operation in hoist applications. In many cases, hoist motors are selected based on intermittent duty, therefore the motor may operate infrequently and for short periods, often above the rated nameplate current or power capacity. For this reason, it is always advisable to select a drive power rating at least one rating higher than the motor rated power, e.g. for a 50HP / 37kW motor, the drive should be at least 60HP / 45kW.

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Configuring the Slave Drive(s):

Drive Address

Each connected slave drive must have a unique Slave communications address set in P5-01. The range of slave addresses available is 2 – 63.

Note - The Communications address Parameter P5-01 also affects the communication address used by the drive on any connected Fieldbus networks (e.g. Modbus, CAN Open, Profibus, DeviceNet or Ethernet) and the communications address used with Oport / Opad remote keypads.

Operating Mode

Each Slave must also be configured to operate in Slave Mode using P1-12 = 5.

Minimum and Maximum Speeds

The Slave drive operating speed will always be limited by the programmed Minimum and Maximum Speeds. This means that if the Minimum Speed programmed in the Slave drive is greater than the Minimum Speed programmed in the Master drive, the Slave speed will not follow the Master Speed once operating below the Slave drive minimum speed.

In general, where it is intended for the Slave drive to operate at the same frequency as the Master drive, the minimum speed can simply be left at zero in the Slave drive, and the Slave will then follow the Master drive Minimum Speed.

Acceleration and Deceleration Ramp Times

During Acceleration and Deceleration, the Slave drive operation will be limited by it's own internal ramp times, while following the Master drive. This means that if the ramp times in the Slave are longer than those in the Master, the Slave speed will briefly lag behind the Master. When setting Slave ramp times, it is advisable to set as follows:

$$\text{Slave Ramp Time} = \frac{\text{Master Ramp Time x 100\%}}{\text{Slave Speed Scaling (P2-29)}}$$
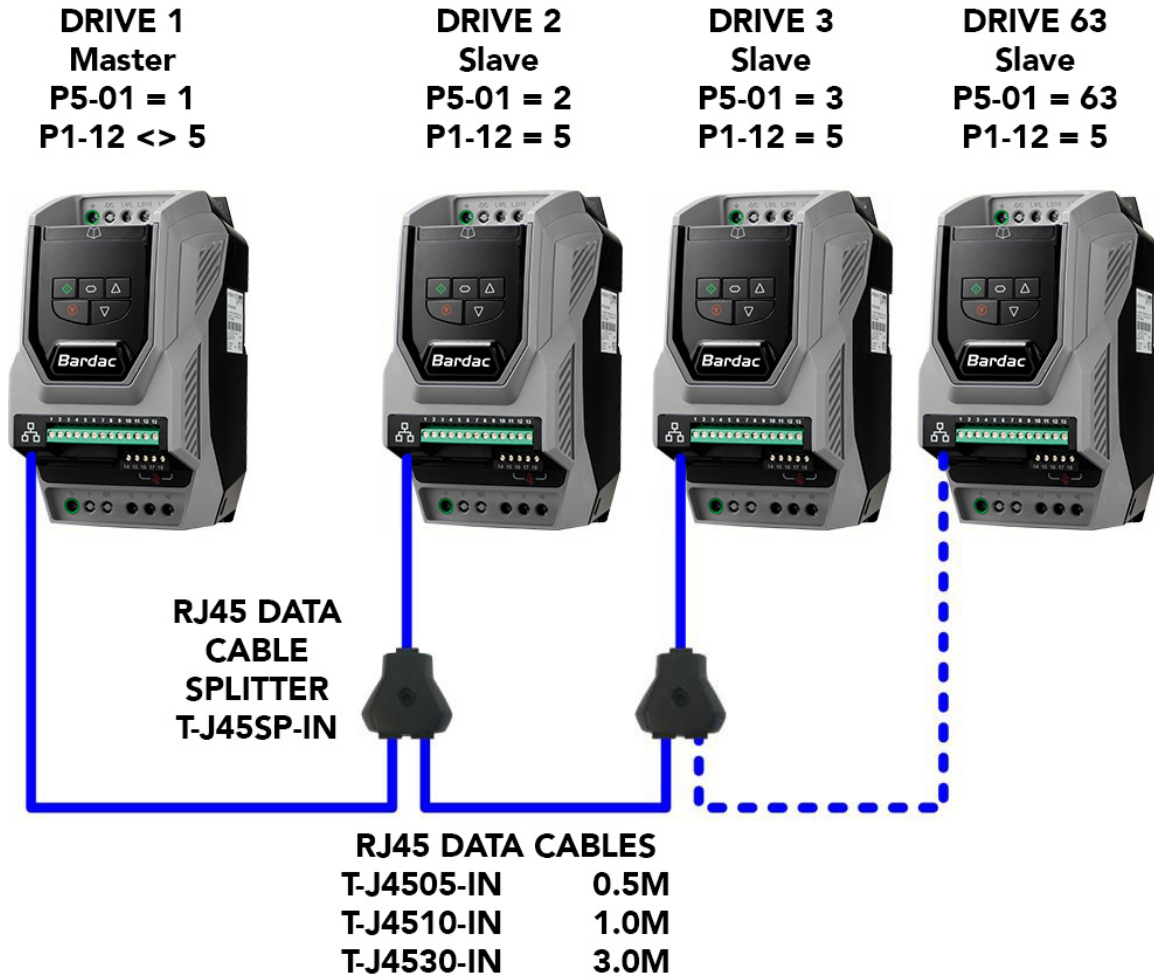
Slave Drive Speed Scaling and Offset:

Each Slave drive receives the output frequency reference from the Master drive, and this is then used as the Slave drives frequency setpoint. The drives internal parameters then allow an offset and scaling factor to be applied to this reference. This is controlled using parameters P2-28 and P2-29.

P2-28 – Digital Speed Scaling Source & P2-29 Digital Scaling Factor

P2-28	Function	
0	Disabled – No scaling applied.	Slave Output Frequency = Master Output Frequency
1	Fixed digital scaling.	Slave Output Frequency = Master Output Frequency x P2-29
2	Fixed digital scaling with an analog offset.	Slave Output Frequency =(Master Output Frequency x P2-29) + Analog Input 1 Reference
3	Digital and Analog Scaling.	Slave Output Frequency = Master Output Frequency x P2-29 x Analog Input 1 Reference

Analog Input 1 Reference = P0-01 = (Applied Analog Signal Level (%) - P2-32) x P2-31

Note: P0-01 cannot be > 100.0%

DRIVE 1
Master
P5-01 = 1
P1-12 <> 5

DRIVE 2
Slave
P5-01 = 2
P1-12 = 5

DRIVE 3
Slave
P5-01 = 3
P1-12 = 5

DRIVE 63
Slave
P5-01 = 63
P1-12 = 5

RJ45 DATA
CABLE
SPLITTER
T-J45SP-IN

RJ45 DATA CABLES
T-J4505-IN   0.5M
T-J4510-IN   1.0M
T-J4530-IN   3.0M

Master Slave Operation Notes:

All Slave drives require an enable signal, e.g. Digital Input 1 (terminal 2) must be closed in order for the Slave to operate. This means that individual Slave drives can be disabled if required by switching off Digital Input 1.

If Digital Input 1 opens during operation, the Slave drive will ramp to standstill at the rate set in P1-04, hence this parameter should be set to a suitable value to ensure correct Master Slave operation, but still allowing adequate stopping time to prevent any nuisance trips.

Master Slave operation can be used in conjunction with other drive functions (e.g. Dynamic braking can be used on all Slaves), and can be combined with Droop Control to provide a very simple load sharing system – see AN-P2-039 for further information.

Practical Examples:

Example 1 – Simple Master Slave Operation for Conveyer Speed Matching

If two or more identical conveyers are required to operate at the same speed, and also to be controlled (e.g. started and stopped) together, the following system can be used.

- Connect the external control circuit or enable signal to the first drive, this will be used as the Master drive.

- Ensure P5-01 = 1 on this drive only.

- On each Slave drive, set a unique Slave address in P5-01, e.g. First Slave = set to 2, Second Slave = set to 3 etc.

- On each Slave drive, set P1-12 = 5.

- On each Slave drive, ensure the acceleration (P1-03) and deceleration (P1-04) Ramp Times are set equal to those in the Master drives.

- Connect the RJ45 connectors on P2 drives together using the required RJ45 cables and splitters.

Example 2 – Scaled Slave Speed

Some applications can require two motors to operate with a scaled offset between the two speeds. This could be required in an Air Handling application with supply and extract fans where a positive pressure is required in the room, hence the extract fan must operate slower than the supply fan, e.g. Extract Fan Speed = 90% of Supply Fan Speed. In this case:

- Connect the external control circuit or enable signal to the first drive, this will be used as the Master drive for the Supply Fan.

- Ensure P5-01 = 1 on the Master drive only.

- On the Slave drive, set a unique Slave address in P5-01, e.g. First Slave = set to 2, Second Slave = set to 3 etc.

- On the Slave drive which will be used to control the Extract Fan, set P1-12 = 5.

- In this case, since the Slave drive output speed is intended to be 90% of the Master drive speed, the ramp times of the Slave drive must be set to 90% or less than those of the Master drive.

- On the Slave drive, set P2-28 = 1 and P2-29 = 90.0%

- Connect the RJ45 connectors on P2 drives together using the required RJ45 cables and splitters.

When operating the Extract fan will always operate at 90% of the Supply Fan speed, hence if the Master speed is 40Hz, the Slave speed = 40Hz x 90% = 36Hz

Example 3 – Master Slave with Manual Slave Speed Trim (Hz)

Where an application requires the operator to be manually able to adjust a small speed offset between 2 pieces of machinery, this can be very easily achieved using the Master Slave function and a trim pot connected to the Slave drive. For example, the slave speed should follow the Master speed, with the operator being able to trim the speed by + / - 2Hz. This would mean that if the Master drive were to operate at 20Hz, the Slave speed would be 18 – 22Hz depending on the trim pot setting.

- Connect the external control circuit or enable signal to the Master drive.

- Ensure P5-01 = 1on the Master Drive only

- On the Slave drive,

    - Set a unique Slave address in P5-01, e.g. 2.

    - Select Slave Mode by settting P1-12 = 5

    - Ensure the acceleration (P1-03) and deceleration (P1-04) Ramp Times are set equal to or less than those in the Master drives.

    - Assuming a pot is being used to trim the speed, and the pot is connected to terminals 5, 6, & 7 on the slave drive, set P2-28= 2.

    - Adjusting the possible range of offset is achieved using the offset and scaling parameters for anlog input 1. These can be determined as follows :

        - If a negative speed offset is required (e.g. + / - 2Hz), ensure the analog input mode is set for bipolar signals by setting P2-30 = -10 – 10 Volt

        - Calculate the required value of P2-31 as follows :-

            - Decide on the trim bandwidth, e.g. if a + / - 3Hz trim is required, the bandwidth will be 6Hz.

            - P2-31 = Trim Bandwidth / P1-01 (%), e.g. if P1-01 = 80Hz, and a trim of + / - 5Hz is required, P2-31 = 10 / 80 = 12.5%

        - Set P2-32 = 50%

- Connect the RJ45 connectors on P2 drives together using the required RJ45 cables and splitters.

Revision History			
Version	Comments	Author	Date
1.01	Connection Diagram Added	JP	03/02/12
1.00	Document Creation	KB	02/20/12

In this example, it is desired that the Slave will follow the Master speed reference, but with an adjustable offset as a percentage of the speed reference controlled from a potentiometer connected to Analog Input 1 of the Slave drive.

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- Connect the external control circuit or enable signal to the Master drive.

- Ensure P5-01 = 1on the Master Drive only

- On the Slave drive, set a unique Slave address in P5-01, e.g. 2.

- On the Slave drive, set P1-12 = 5

- On the Slave drive, ensure the acceleration (P1-03) and deceleration (P1-04) Ramp Times are set equal to or less than those in the Master drives.

- In this case, the scaling and offset of Analog Input 1 needs to be set to allow the correct adjustment range. When P2-28 = 3, the Slave drive output Frequency is defined as follows:

    - Slave Output Frequency = Master Output Frequency x P2-29 x P0-01

    - P0-01 = (Applied Analog Signal Level % - P2-32) x P2-31

    - Note : P0-01 cannot be > 100.0%!)

- From the above formulas, we must determine settings of P2-29, P2-31 and P2-32 to achieve the desired final scaling. This is done as follows:

    - Firstly, determine the value required in P2-29. In our example, Slave Speed = Master Speed + 12% / - 25%

        - P2-29 = 100 + Maximum Scaling required, e.g. for +10%, P2-29 = 110%

    - From this, we can determine the range for P0-01 (Analog Input 1 Scaled Result) required to achieve the target speed range

        - When Analog Signal Level = 0%, Slave Speed should be 100 – 10 = 90% of Master Speed

        - When Analog Signal Level = 100%, Slave Speed should be 100 + 10% = 110% of Master Speed

    - Since P2-29 = 110%, the required range of P0-01 is

        - Minimum Level : 90 / 110 (%) = 81.8% (Maximum 1 Decimal Place)

        - Maximum Level : Always 100%

    - Then calculate the value of P2-31 as follows:

        - P2-31 = P0-01 Maximum – P0-01 Minimum, e.g. 100 – 81.8 = 18.2%

    - Now determine the value for P2-32 as follows:

$$P2\text{-}32 = \frac{P0\text{-}01 \text{ Minimum Level}}{P2\text{-}31} \times -1, \text{ e.g. } \frac{P0\text{-}01 \text{ Minimum Level}}{18.2\%} = -449.5\%$$

Note :

The possible setting ranges of P2-31 and P2-32 are limited, which will determine the scaling limits possible in any application, e.g.

P2-31 Range = 0.0 to 500.0%

P2-32 Range = -500.0 to + 500.0%

Appendix: