IMPULSE™ VG+ *Series 3*

Drive Synchronization Software Instruction Manual

MAGNETEK
UNCOMMON POWER

Electromotive Systems

DANGER, *WARNING*, *CAUTION*, and *NOTE*

Statements
DANGER, WARNING, CAUTION, and *Note* statements maybe used in this manual to emphasize important and critical information. You must read these statements to help ensure safety and to prevent product damage.

NOTE: *A NOTE statement is used to notify of installation, operation, programming, or maintenance information that is important, but not hazard-related.*

Warning
Improper programming of a drive can lead to unexpected, undesirable, or unsafe operation or performance of the drive.

Disclaimer of Warranty
Magnetek hereafter referred to as Company, assumes no responsibility for improper programming of a drive by untrained personnel. A drive should only be programmed by a trained technician who has read and understands the contents of this manual. Improper programming of a drive can lead to unexpected, undesirable, or unsafe operation or performance of the drive. This may result in damage to equipment or personal injury. Company shall not be liable for economic loss, property damage, or other consequential damages or physical injury sustained by the purchaser or by any third party as a result of such programming. Company neither assumes nor authorizes any other person to assume for Company any other liability in connection with the sale or use of this product.

Introduction

Synchronization Software allows one or more IMPULSE VG+ Series 3® driven motors to be synchronized to a Master Encoder signal. The Master Encoder provides a pulse reference to the Slave VFD that results in the Slave VFD commanding its motor to rotate at the speed commanded by the pulse reference. The Slave VFD monitors the pulse feedback from both the Master Encoder and its own encoder while also sending timing status information back to the Master. The Slave will then compensate for any position errors by adjusting its motor's speed, resulting in near perfect alignment between the Master and the Slave motor shafts.

Automatic Re-Synchronization

While both drives are running there is no accumulation of position error, so alignment will always be maintained. The Slave VFD possesses the ability to automatically re-synchronize the motors. This feature is accomplished by storing the position error generated when either the Master or the Slave hoists are run independently. (Optional - The position error may be stored in memory while the VFD is powered down, but can not keep track of shaft movements while powered down). When the hoists are again run together, the Slave VFD is first commanded to run in order to cancel the accumulated position error with the Master VFD. Once the position error has been resolved, the Master VFD will begin to run at the commanded speed, and the Slave will again track the pulse reference generated by the Master.

While running in Synchronization mode, the speed at which the Slave is allowed to cancel the accumulated position error is limited to 4 Hz. This allows the Slave motor to potentially rotate up to four (4) Hz faster than the Master in order to compensate for position error. While re-synchronizing, the speed at which the Slave is allowed to cancel the accumulated position error is limited to the Proportional and Integral Limits to allow for a faster Re-Synchronization.

Setting Position Error

It is a good practice to manually align the hoists by eye to get them close to their respective positions and then let automatic Re-Synchronization finish eliminating the position error. If the automatic Re-Synchronization is enabled, any position error is stored in the Slave.
- The position error will be cleared by running the hoists in Synchronization Mode and allowing the Slave to cancel the error.
- The error may also be cleared in another manner. If C15-14 is set to 1, the position error will be cleared by an upper limit 2 input (MFDI 7 or B – Upper Limit Stop) when the run command is removed. This acts as a "home" position for the hoists, at which they will begin operation with no accumulated error.
- Another option is to set C15-14 = 2. With this option, a multi-function input to the Slave(s) is programmed to clear the accumulated error. This allows the hoists to be set to any position (aligned with or offset from each other) and have the accumulated error cleared. The hoists will then run at the set position while in hoist Synchronization Mode.

If position error is not stored in memory during power down (C15-17 = 0), position error will always be zero upon power up.

Electronic Gearing

The Slave also possesses an electronic gearing feature. This allows the Slave to operate at a ratio of the Master to accommodate differences in hoist speeds. Two separate ratios may be used if the Slave is required to follow different Masters. The software can also accommodate encoders

with PPRs (Pulses Per Revolution) that differ from the Slave. If multiple Masters are used, they must have identical PPR.

How TO apply this software

• Speed Matching – Two (2) or more Independent systems, such as independent hoists, bridges or trolleys that are not mechanically linked or bound together.

How NOT to apply this software

• Load Sharing applications where there are two (2) or more mechanically coupled systems. This includes directly coupled motor shafts, trolleys or bridges which are mechanically coupled together, or two or more motors which are indirectly tied together through a structure, such as a bridge or trolley. Also, driving two (2) or more wheels on the same rail, such as, the swing motion on a log handling crane, or a bridge motion on a polar crane.

Programming Parameters

Parameter Code	Display	Function	Range	Initial Value	Access Level
C15-01	Sync Mode 0/1	Determines whether Sync Mode is enabled.	0-2	0	Adv
0 Disabled					
1 Enabled by MFDI = 68 "Sync Mode enable"					
2 Always Enabled					
C15-02	Master Encoder	Number of PPR from Master Encoder. Same as F1-01 in master drive.	0-60000 Pulses/Rev	1024	Adv
C15-03	Master # of Poles	Motor poles of master motor. Same as E2-04 in master drive.	2-48	4	Adv
C15-04	Sync Ratio Num 1	Sync ratio numerator 1 used in conjunction with C15-06 to set up the ratio of the Slave. When MFDI = 6A, it will override C15-04 and use C15-05. It is best to make the slowest hoist the master to avoid over speeding the Slave(s).	1-10000	1	Adv
C15-05	Sync Ratio Num 2	(Alternate) Sync ratio numerator 2 used in conjunction with C15-06 to set up the ratio of the Slave. When MFDI = 6A, it will override C15-04. It is best to make the slowest hoist the master to avoid over speeding the Slave(s). All hoists must be stopped to switch gear ratios. Example: If C15-04 = 250 and C15-06 = 1000, then for every revolution of the master, the Slave will make 0.25 revolutions.	1-10000	1	Adv
C15-06	Sync Ratio Den	Sync ratio denominator used in conjunction with C15-04 and C15-05 to setup a gear ratio.	1-1000	1	Adv
C15-07	Position P Gain	Position Error Proportional gain adjusts the Slaves speed reference to compensate for any position error between the Master and the Slave. Increasing this parameter increases the responsiveness of the Slave to position error. The maximum correction speed will not exceed 4 hz. Also see C15-18.	0-100	10	Adv

Programming Parameters

Parameter Code	Display	Function	Range	Initial Value	Access Level
C15-08	Position I Time	Position Error Integral Time adjusts the Slave's speed reference to compensate for any position error between the Master and the Slave. Increasing this parameter increases the responsiveness of the Slave to position error. The maximum correction speed will not exceed 4 hz. Also see C15-18.	0-100 Sec.	10	Adv
C15-09	Proportional Lim	Proportional limit, Limits the output of the position Regulator for high speed re-sync, C15-18.	0.000 – 30.000 Hz	22.500	Adv
C15-10	Integral limit	Integral limit, limits the output of the position regulator for high speed re-sync, C15-18.	0.000 – 30.000 Hz	22.500	Adv
C15-11	Derivative Time	Derivative Time provides control of the PID loop to stabilize oscillation in position error. A setting of zero will disable this parameter.	0.00-100.00 Sec	0.00	Adv
C15-12	Sync Err Detect Lvl	Sync error detection level sets the maximum position error in motor revolutions between the Master and the Slave. If this level is exceeded then the drive will respond per C15-13 setting.	0-1000 Rev	1	Adv
C15-13	Sync Err Action	Action taken at C15-12 position error level	0-2	2	Adv

0 None
1 Alarm Only (flashing) "SYNC-Out of Sync" operation continues
2 Fault "SYNC-Out of Sync" operation stops
Note: A setting of 0 or 1 should only be used for troubleshooting purposes.

Programming Parameters

Parameter Code	Display	Function	Range	Initial Value	Access Level
C15-14 Auto Resync 0/1		Automation Re-Synchronization Enable/Disable. The Slave can be configured to accumulate or ignore position error. With a setting of 1or 2 the Slave will correct any position error when given a run command. With a setting of 1, the upper limit switch will clear the error. With a setting of 2, error can be cleared at any point with a MFDI=69.	0-2	0	Adv

0 Disabled
1 Enabled 0 by UL2 (Position error is corrected at next run or cleared by Upper Limit 2 input)
2 Enabled 0 by MFI (Position error is corrected at next run or cleared by MFDI=69

Parameter Code	Display	Function	Range	Initial Value	Access Level
C15-15	Switching Speed	Master must be at or less than this speed which the user can switch to Sync Mode. When switching out of sync, the Slave must be at or below before it will follow a speed reference other than the Master.	0.0-10.0 Hz	0.5	Adv
C15-16	Adv/Rtd Trim Rate	Rate of advance / retard by MFDI "Sync Advance" or "Sync Retard". The Slave can be advanced or retarded at this rate without accumulating position error. (Units in pulse counts/20 msec.)	0-1000	20	Adv
C15-17	Store Pos Err	A setting of 1 will store position at power down.	0-1	1	Adv

0 Disabled
1 Enabled

Parameter Code	Display	Function	Range	Initial Value	Access Level
C15-18	H-spd Resync Rev	Number of Slave motor revolutions at which high speed re-sync will occur. If U1-63, *sync error revs,* is greater than C15-18, then re-sync speed will be C15-9 or C15-10. Normal re-sync speed is a maximum of 4 Hz.	5-60000 Rev	100	Adv
F1-19	PG-Z2 Output Sel	The PG-Z2 card's output can be configured for either 0 Select by MFDI=41 Channel 1 or channel 2 encoder signal. This is required when configuring for more than 1 Master.	0-4	4	Adv

1 Channel 1
2 Channel 2
3 Select by MFDI=64 (Off= Ch2, On=Ch1)
4 Change by Sync Mode MFDI=68 (Off= Ch1, On=Ch2)

Programming Parameters

Parameter Code	Display	Function	Range	Initial Value	Access Level
F3-01	DI Option Setup	Sets the digital reference input method.	0-7	7	Adv

0 BCD 1%
1 BCD 0.1%
2 BCD 0.01%
3 BCD 1Hz
4 BCD 0.1 Hz
5 BCD 0.01 Hz
6 BCD 0.01 Hz (DI-16H2 option card only)
7 Binary

Parameter Code	Display	Function	Range	Initial Value	Access Level
C9-01	Digital In Sel	Digital input option card configuration.	0-5	0	Adv

0 Disabled (No input cards used)
1 G5IN4 using C9-02 matrix.
2 G5IN4 using C9-03 thru C9-06.
3 F7IN8 or DI-08 using C9-03 thru C9-10.
4 DI-16H2 using C9-03 thru C9-12.
5 Serial communication using C9-03 thru C9-12.

Parameter Code	Display	Function	Range	Initial Value	Access Level
C9-03	*DI Terminal 1*	Multi-Function Digital Input terminal 1 setting.	0-FF	0F	Adv

See H1-0x parameter for a complete list of settings.
Setting 4, 5, 15-19, 1F, 20-2F, 31, 34, 35, 38, 47, 51, 52 and 58 are not allowed.

Parameter Code	Display	Function	Range	Initial Value	Access Level
C9-04	*DI Terminal 2*	Multi-Function Digital Input terminal 2 setting.	0-FF	0F	Adv
C9-05	*DI Terminal 3*	Multi-Function Digital Input terminal 3 setting.	0-FF	0F	Adv
C9-06	*DI Terminal 4*	Multi-Function Digital Input terminal 4 setting.	0-FF	0F	Adv
C9-07	*DI Terminal 5*	Multi-Function Digital Input terminal 5 setting.	0-FF	0F	Adv
C9-08	*DI Terminal 6*	Multi-Function Digital Input terminal 6 setting.	0-FF	0F	Adv
C9-09	*DI Terminal 7*	Multi-Function Digital Input terminal 7 setting.	0-FF	0F	Adv
C9-10	*DI Terminal 8*	Multi-Function Digital Input terminal 8 setting.	0-FF	0F	Adv
C9-11	*DI Terminal 9*	Multi-Function Digital Input terminal 9 setting.	0-FF	0F	Adv
C9-12	*DI Terminal 10*	Multi-Function Digital Input terminal 10 setting.	0-FF	0F	Adv

Monitor Parameters

Parameter Code	Display	Content	Output Signal Level	Range
U1-01	Frequency Ref	Frequency reference of Slave, while In sync, after gear ratio and proportion/integral compensation.	10V= F max	0 — E1-04
U1-25	Digital Input Reference	Input option card terminal status (in Hex)	disabled	0 — 4000
U1-60	Master Reference	Sync frequency reference from Master prior to gear ratio adjustment.	10V=Fmax	-400 — +400 Hz
U1-61	Gear ratio Reference	Sync frequency reference from Master after gear ratio adjustment.	10V=Fmax	-400 — +400 Hz
U1-62	Sync Error Counts	Sync position error between Master and pulses Slave. Used to correct over/undershoot when tuning the P/I regulator.	10V=4096 pulses	-4096 — +4096
U1-63	Sync Error Revs	Sync position error between Master and Slave in motor revolutions.	disabled	-65535 — +65535
U1-64	Proportion Corr	Proportional gain correction to the Slave's frequency reference per C15-07 setting.	10V=30.000	-30.00 — +30.00 Hz
U1-65	Integral Correct	Integral gain correction to the Slave's frequency reference per C15-08 setting.	10V=30.000	-30.00 — +30.00 Hz

Multi-function Digital Inputs (MFDI) selectable by H1-0x and C9-0x

Setting Value	Display	Function
64	PG Channel 1 output	Allows the selection of channel 1 of the PG option card to be passed to the output of the PG-Z2 card when multiple Masters are required. *Open = Channel 2 is passed to TA3* *Closed = Channel 1 is passed to TA3*
67	Slave Ready In	The slave drive is ready to follow the master drive *Open = Slave is not ready, Master will hold position.* *Closed = Slave drive is ready to follow the master drive*
68	Sync Mode Enable	Sync Mode enable/disable *Open = Sync is disabled.* *Closed = Sync is ENABLED (C15-01 =1).*
69	Clear Sync Error	Clear position error *Open = Sync error is allowed to accumulate.* *Closed = Accumulated error is reset to zero.*
6A	Sync Ratio Num 2	Sync Ratio Numerator 2 *Open = Sync ratio numerator 1 is used (C15-04).* *Closed = Sync ratio numerator 2 is used (C15-05)*
6B	Sync Advance	Slave will increase speed without accumulating position error. *Open = Normal speed* *Closed = Advance speed.*
6C	Sync Retard	Slave will decrease speed without accumulating position error. *Open = Normal speed* *Closed = Retard speed.*

Multi-function Digital Inputs (MFDI) selectable by H1-0x and C9-0x

Setting Value	Display	Function

6D   Sync Ultra Lift   Enable Ultra Lift during Synchronization

To use Ultra Lift during Synchronization Mode, some precautions must be taken. Ultra Lift should be configured such that it will not be automatically enabled unless there is a near empty hook. It is crucial that the Slave has enough motor torque above base speed to not only maintain and lift the load, but also to correct for position error. For this reason, in independent mode, set the UltraLift Enabling Torque so Ultra Lift is not enabled when there is a load present. The Master and Slave(s) must also be interlocked. Each Slave must be configured with an output (MFDO 3D - Sync Ultra Lift) that will permit the Master to utilize Ultra Lift Speeds. The Master must then accept this signal via MFDI 6D Sync Ultra Lift.
If using multiple Slaves, the output signals must be wired in series.
Open: Ultra-lift is disabled
Closed: Slave is indicating to Master that is has sufficient torque to use Ultra Lift

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6E   Sync Slc Cbl In   Slack Cable detection during Synchronization

To use Slack Cable detection during Synchronization Mode, interlock wiring must be used. This input will cause the Master to take action according to the setting of C11-02. A 'SLC2 - Slack Cable Det' Alarm will be displayed on the keypad.
The Slave takes no action on its own other than sending an output to the Master. The Master will shut the system down according to C11-02. The MFDI is disabled in Sync Mode and has no effect. This is useful when the VFD is capable of being a Master or a Slave.

Open: Operation is Normal
Closed: Slave is indicating to Master that is has detected a Slack Cable condition.

6F   Sync Load Chk In   Load Check detection during Synchronization

To use Load Check detection during Synchronization Mode, interlock wiring must be used. This input will cause the Master to take action according to the setting of C5-02. An 'LC2 - Load Check Det' Alarm will be displayed on the keypad. The Slave takes no action on its own other than sending an output to the Master. The Master will shut the system down according to C5-02. The MFDI is disabled in Sync Mode and has no effect. This is useful when the VFD is capable of being a Master or a Slave.
Open: Operation is Normal
Closed: Slave is indicating to Master that is has detected a Load Check condition.

Multi-function Digital Outputs (MFDO) selectable by H2-0x

Setting Value	Display	Function
3A	Slave Ready Out	Slave is ready to follow the Master (set in Slave) Enabled when C15-01 = 2 or MFDI 68 = ON

Open: Slave is not ready. Master should hold the current position until Slave Ready signal is received.
Closed: Slave inverter is ready and waiting to follow the master.

Setting Value	Display	Function
3B	Run Slave(s)	Run command from Master to Slave(s). (set in Master) Enabled when MFDI 68 = OFF and C15-01 ≠ 2

Open: No run command to Slave(s).
Closed: Command Slave(s) to Run.

Setting Value	Display	Function
3C	Out of Sync	Out of Synchronization Annunciation (Set in Slave)

Open: Operation is Normal.
Closed: An "Out of Sync" Alarm or Fault condition is present.

Setting Value	Display	Function
3D	Sync Ultra lift	Enable Ultra lift during Synch (Set in Slave)

To use Ultra Lift during Synchronization Mode, some precautions must be taken. Ultra Lift should be configured such that it will not be automatically enabled unless there is a near empty hook. It is crucial that the Slave has enough motor torque above base speed to not only maintain and lift the load, but also to correct for position error. In independent mode, set the Ultra Lift Enabling Torque so Ultra Lift is not enabled when there is a load present. The Master and Slave(s) must also be interlocked. Each Slave must be configured with an output (MFDO 3D - Sync Ultra Lift) that will permit the Master to utilize Ultra Lift Speeds. The Master must then accept this signal via MFDI 6D- Sync Ultra Lift. If using multiple Slaves, the output signals must be wired in series. This will insure that ALL Slaves are capable of Ultra Lift.

Note: Ultra Lift used in conjunction with Synchronization may not work in all applications. Careful review of the application should precede the use of Ultra Lift. All hoists should be of equal speed.

Open: Ultra-lift is disabled
Closed: Slave is indicating to Master that is has sufficient torque to use Ultra Lift

Alarms, Faults and OPE Conditions

Alarms

Alarm Display	Description	Master/ Slave	Cause	Corrective Action
SYNC	Out Of Sync	Slave	The position error between the Master and Slave exceeded the allowable amount.	1. Check for proper encoder feedback from Master & Slave(s). Test all hoists individually for proper functionality. 2. Check for physical obstruction of the Slave motion. i.e. brake, load hang up. 3. Insure that the load is not too heavy. 4. Decrease acceleration / deceleration time(s) on Master. 5. The maximum speed of the master drive (E1-04) should be set to at least 4 Hz less than the Slave(s) to allow for correction of position error.
Can't SW	Motor Running	Master or Slave	1. Switching between Synchronization Mode and Normal Operation while in motion. 2. Switching between Gear Ratio 1 and Gear Ratio 2 while in motion.	1. Do not switch modes while in motion. 2. Increase C15-15 for instability at zero speed.
SNR	Slave Not Ready	Master	1. The Master is waiting for the Slave Ready Signal (This may be normal for a short time.) 2. While Running, the 'Slave Ready' input is lost.	1. Is there a problem with the Slave motion? Alarm / Fault, etc.? Note: Verify proper interlock wiring scheme and wiring itself. Slave should shut down Master if it has certain alarm / faults present. 2. Check the wiring between the Master and Slave(s). 3. Verify that the Slave Ready terminal is functioning properly. Verify change in state by monitoring U1-10.
Load Share	Load Share / Sync	Master or Slave	Using Load Sharing and Synchronization simultaneously.	Load Sharing and Hoist Synchronization are not compatible and cannot be used simultaneously. 1. Insure that Load Sharing Mode is disabled during Synchronization. (Terminal with H1-0x = 66H is OFF during Synchronization.)
SLC2	Sync Slack Cable	Master	One of the Slave VFD's has detected a Slack Cable condition and is signaling the Master to take action set by C11-02.	1. There is a Slack Cable condition on one of the Slave Hoists (SLC). 2. This may be normal operation. Take up the slack. 3. Check wiring. 4. Verify Slack Cable parameter settings.
LC2	Sync Load Check	Master	One of the Slave VFD's has detected a Load Check condition and is signaling the Master to take action set by C5-02.	1. There is a Load Check condition on one of the Slave Hoists (LC). 2. The Hoist is overloaded. Set the load down. 3. Check wiring. 4. Verify Load Check parameter settings.

Faults

Fault Display	Description	Master/Slave	Cause	Corrective Action
LC2	Sync Load Check	Master	One of the Slave VFD's has detected a Load Check condition and is signaling the Master to take action set by C5-02.	1. There is a Load Check condition on one of the Slave Hoists (LC). 2. The Hoist is overloaded. Set the load down. 3. Check wiring. 4. Verify Load Check parameter settings.
SYNC	Out Of Sync	Slave	The position error between the Master and Slave exceeded the allowable amount.	1. Check for proper encoder feedback from Master & Slave(s). Test all hoists individually for proper functionality. 2. Check for physical obstruction of the Slave motion. 3. Insure that the load is not too heavy. 4. Decrease acceleration / deceleration time(s) on Master. 5. The maximum speed of the master drive (E1-04) should be set to at least 4 Hz less than the Slave(s) to allow for correction of position error. 6. High Speed Re-Synchronization is overshooting due to long deceleration. Increase C15-18 to prevent overshooting.

OPE conditions (Operator Programming Error)

OPE Display	Description	Master/Slave	Cause	Corrective Action
OPE12	Sync & Mtr 2	Master or Slave	((C15-01 = 2 or H1-0x = 68) and H1-0x = 41)	Motor 2 and Hoist Synchronization are not compatible. 1. Change H1-0x to something other than 41 (Motor 2).
OPE13	Sync & Ultralift	Master or Slave	(C15-01 ≠ 0 & C6-01 ≠ 0 & (H1-0x ≠ 6D or H2-0x ≠ 3D))	Special programming / wiring is required to use UltraLift and Hoist Synchronization. 1. Insure that the proper wiring scheme is in place to utilize Ultra Lift. 2. Set H1-0x = 6D or H2-0x = 3D or both according to interlock wiring requirements.
OPE14	Sync & Load Check	Master or Slave	(C15-01 ≠ 0 & C5-01 ≠ 0 & H2-0x ≠ 27)) OR (C15-01 ≠ 0 & C5-01 ≠ 0 & H1-0x ≠ 6F))	Special programming / wiring is required to use Load Check and Hoist Synchronization. 1. Insure that the proper wiring scheme is in place to utilize Load Check. 2. Set H2-0x = 27 or H1-0x = 6F and insure proper interlock wiring is used.
OPE15	Sync & Slack Cable	Master or Slave	(C15-01 ≠ 0 & C11-01 ≠ 0 & H2-0x ≠ 28)) OR (C15-01 ≠ 0 & C11-01 ≠ 0 & H1-0x ≠ 6E))	Special programming / wiring is required to use Slack Cable and Hoist Synchronization. 1. Insure that the proper wiring scheme is in place to utilize Slack Cable. 2. Set H2-0x = 28 or H1-0x = 6E and insure proper interlock wiring is used.

Configuration / Operation Notes:

1. A PG-Z2 Card must be installed on each **Slave** inverter. If a Master inverter is capable of becoming a Slave, it must also have a PG-Z2 card installed.

2. When multiple **Masters** are used, each **Master Encoder** must have the same PPR.

3. When the Master operates in its normal, forward direction, monitor U1-60 of the Slave should display a positive value. If it does not, it may be necessary to reverse the channel A wires at terminals 1 and 2 (TA2) of the Slave's PG-Z2.

4. When running the Master independently, the **Slave Ready Input** signal needs to be forced "On / Closed" with external logic. In the event that the Master is capable of becoming a Slave (H1-0x = 68 - Sync Mode Enable), forcing this input on is not necessary since the VFD knows which mode it should be in based on this input. When it doesn't have this input (H1-0x = 68), it assumes it is always a Master and will wait for the **Slave Ready input** signal before moving.

5. If the Slave's U1-60 display is positive, when the drive is commanded to run via input to terminal #1, the motor should rotate in the proper direction and the Slave's U1-05 monitor should display a positive value. If the motor direction is incorrect, it may be necessary to reverse any two of the motor leads on the VFD output. If the motor fails to rotate, or is unstable, it may be necessary to reverse the channel A wires at terminals 3 and 4 (TA1) of the PG-Z2.

6. **Slow down & Stop Limit Inputs** are ignored in the S**lave**(s) during Synchronization mode. The limits will be observed in the master drive causing the Master reference to decrease and the Slave to follow. Note: UL3 - Upper limit 3 (Weighted Limit) is always active for both Master and Slave. For the Slave, Slow down / stop limits and their respective deceleration times will be observed during automatic Re-Synchronization. During automatic Re-Synchronization, if the motor speed is greater than the slow down limit speed, the P & I limits will be limited to 1/2 the respective slow down limit speed.

7. When in Synchronization Mode, the only reference used by the Slave is the pulse input from the master drive. All other external references will be ignored.

8. For the **Master**, m**ax frequency** (E1-04) should be set 4Hz less than the Slave(s) to allow for correction of position error between the drives. Note that this value will change after an auto-tune is performed and should be changed back to having a 4Hz difference from the Slave(s). When multiple Masters are possible, it may become necessary to leave E1-04 identical for all Master and Slave and limit the maximum speed reference possible through B2-01 or B2-04. Note: B2 group parameters do not affect Synchronization speed references (during Synchronization Mode).

9. When using **Load Check** on the Slave, it may be necessary to set the Holding and Setting Timers slightly shorter than the Master on each of the slave drives. This will insure that the Slave(s) are finished checking the load prior to the Master accelerating to the next look speed. Note: The Slave will not be as accurate as the Master because it is still correcting for position error even while the Master is being held at a constant speed. If the slave detects a Load Check error, it will not stop its own motion. Instead it will display Load Check on the keypad and turn on a multi-function output set for Load Check. This should signal the Master to stop while maintaining synchronization.

10. **Weight Measurement** and **Load Check** are disabled during Automatic Re-Synchronization.

11. When using **Synchronized Weight Measurement**, it is recommended to use automatic weight measurement (C10-01 = 1) rather than by MFDI as "**Out of Sync**" faults may occur due to constant position correction.

12. **Slave Ready Output:** When Automatic Re-Synchronization is used, the Slave ready output will remain off until position error is cancelled. If the Slave is in an upper or lower limit condition (UL2 / LL2), the Slave may not be able to re-synchronize in the appropriate direction. In this case, the Slave ready signal will be energized during Re-Synchronization thus causing the Master and Slave to move simultaneously and additional position error may be accumulated without causing an "Out of Sync" fault. Note: Proper operation should correct any error as the hoists move off of the limit switches, but it may take some time to align the hooks depending on how far apart they are.
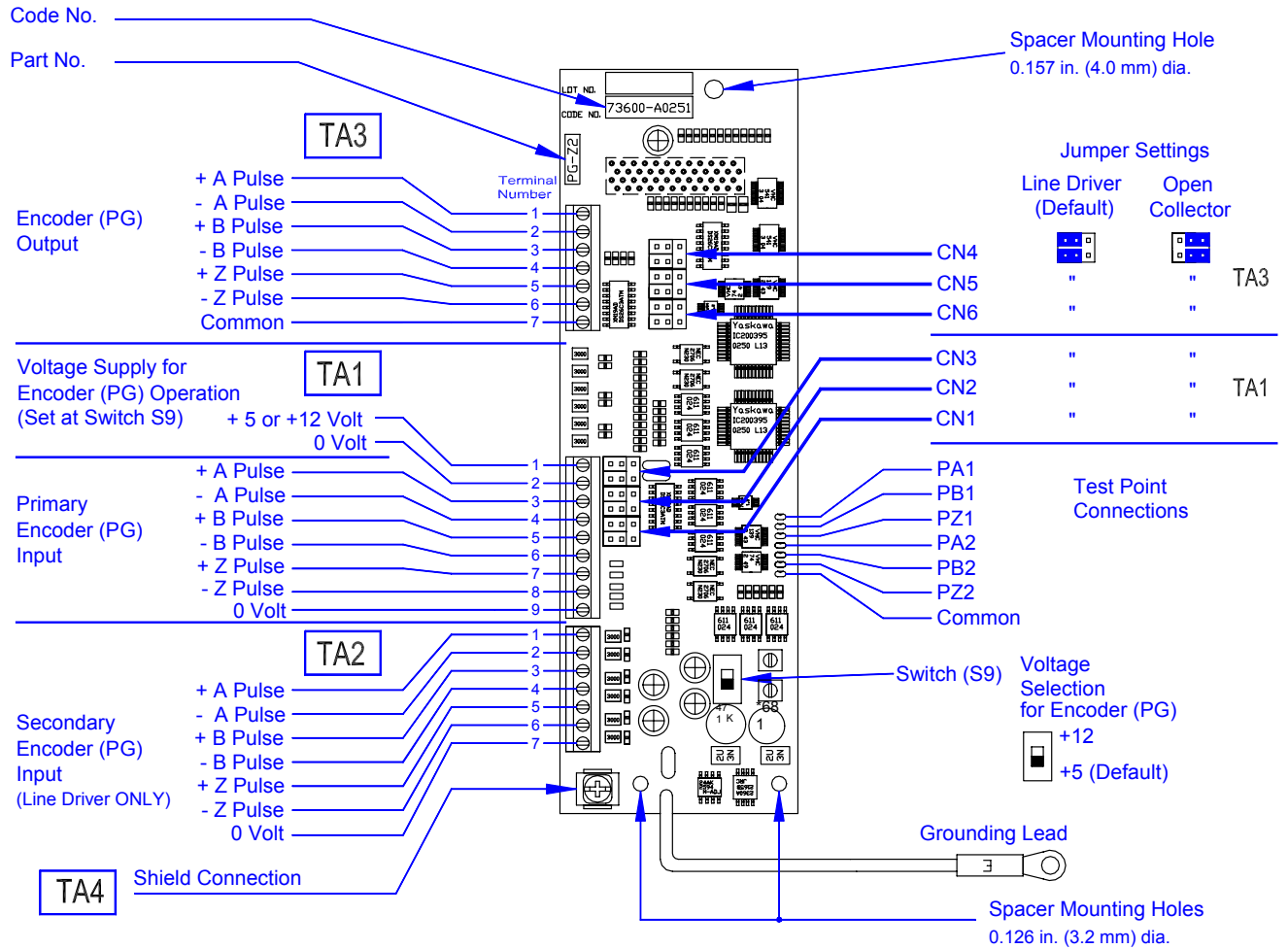
13. If the Master is capable of being powered down independently from the Slave, a **PGO-2-H** fault will occur on the **Slave** if F1-21 = Enabled and the Slave is in Synchronization Mode (C15-01 = 2 or H1-0x = 68 is on). When F1-21 = Enabled, if Synchronization Mode is not enabled, PGO-2-H will function normally. If Synchronization is enabled by MFDI, but not in Synchronization Mode (Slave may be in independent mode) PGO-2-H is automatically disabled so the Master may be powered down. If PGO-2-H faults are occurring, make certain that controls are not in Synchronization Mode while powering down the Master VFD.

14. **Ultra Lift** is not backward compatible w/ IMPULSE Series 2 Drives - An IMPULSE Series 3 Master & Slave VFD are required. When using Sync-Ultra Lift Enable while running the Master independently, the enable signal must be "ON" in order to use Ultra Lift. In some applications, it may not be possible to use Ultra-lift. It is also mandatory that Ultra Lift is configured to allow running above base speed only with **no** load.

15. If the user has **Switched Modes** while running (switched from independent to Synchronization Mode by MFDI 68 - Sync Mode Enable), the current motion will be command to stop, a "**Can't Switch - Motor Running**" alarm will be displayed until motion has stopped. The run command must be cycled at this point to completely switch to Synchronization Mode. This will allow the **Slave Ready Output** to turn on.

16. **Slack Cable** is generally intended for hoists with below the hook attachments and may not be a good application when used with Synchronization. If it is to be attempted, interlocking wiring of the Master and Slave(s) must be used. For the Slave(s), Slack Cable may be detected during automatic Re-Synchronization. In this case, the Master will be stopped (waiting for the Slave Ready) and cannot take action until it is run. This is a rare circumstance, but caution should be used when using slack cable and automatic Re-Synchronization if it is possible for the Master hook position to become lower than the Slave(s) and result in a slack condition.

Hardware (PG-Z2)

Code No.

Part No.

Spacer Mounting Hole
0.157 in. (4.0 mm) dia.

LOT NO.
CODE NO. 73600-A0251

PG-Z2

TA3

Encoder (PG)
Output

Terminal
Number

+ A Pulse ⎯⎯⎯ 1
- A Pulse ⎯⎯⎯ 2
+ B Pulse ⎯⎯⎯ 3
- B Pulse ⎯⎯⎯ 4
+ Z Pulse ⎯⎯⎯ 5
- Z Pulse ⎯⎯⎯ 6
Common ⎯⎯⎯ 7

CN4
CN5
CN6

Jumper Settings

	Line Driver (Default)	Open Collector
	"	"	TA3
	"	"

Voltage Supply for
Encoder (PG) Operation
(Set at Switch S9)

TA1

+ 5 or +12 Volt
0 Volt

Primary
Encoder (PG)
Input

+ A Pulse ⎯⎯⎯ 1
- A Pulse ⎯⎯⎯ 2
+ B Pulse ⎯⎯⎯ 3
+ B Pulse ⎯⎯⎯ 4
- B Pulse ⎯⎯⎯ 5
- B Pulse ⎯⎯⎯ 6
+ Z Pulse ⎯⎯⎯ 7
- Z Pulse ⎯⎯⎯ 8
0 Volt ⎯⎯⎯ 9

CN3
CN2
CN1

	"	"
	"	"	TA1
	"	"

PA1
PB1
PZ1
PA2
PB2
PZ2
Common

Test Point
Connections

TA2

1
2
3
+ A Pulse ⎯⎯⎯ 4
- A Pulse ⎯⎯⎯ 5
+ B Pulse ⎯⎯⎯ 6
- B Pulse ⎯⎯⎯ 7

Secondary
Encoder (PG)
Input
(Line Driver ONLY)

+ B Pulse
- B Pulse
+ Z Pulse
- Z Pulse
0 Volt

47 68
1 K   1

Switch (S9)

Voltage
Selection
for Encoder (PG)

+12
+5 (Default)

Grounding Lead

TA4   Shield Connection

Spacer Mounting Holes
0.126 in. (3.2 mm) dia.

PG-Z2 Channel selection when using Synchronization

PG-Z2 Input Select (F1-22)	Motor Selection (H1-0x = 41)	PG-Z2 Input Channel	PG PPR	Rotation Direction	PGO Detection Time	Number of Poles	Chopping Method	PG-Z2 Output Select (F1-19)	H1-0x = 64 MFDI - ON / OFF	PG-Z2 Output (TA3)
0 Motor 1 = CH1	1	1 (TA1)	F-01	F1-05	F1-14	E2-04	B3-03	0 – Select by MFDI 4:H (Motor Selection)	Don't Care	CH1 (TA1 → TA3)
								1 – CH 1	Don't Care	CH1 (TA1 → TA3)
								2 – CH 2	Don't Care	CH2 (TA2 → TA3)
								3 – Select by MFDI 64H (PG CH1 Output)	OFF	CH2 (TA2 → TA3)
									ON	CH1 (TA1 → TA3)
								4 – Sync Mode: Disabled (C15-01 = 0, 1 or MFDI 68H = OFF) / Enabled (C15-01 = 1, 2 or MFDI 68H = ON)	Don't Care	CH1 (TA1 → TA3) / CH2 (TA2 → TA3)
	2	2 (TA2)	F-16	F1-17	F1-13	E4-04	E3-02	0 – Select by MFDI 4:H (Motor Selection)	Don't Care	CH2 (TA2 → TA3)
								1 – CH 1	Don't Care	CH1 (TA1 → TA3)
								2 – CH 2	Don't Care	CH2 (TA2 → TA3)
								3 – Select by MFDI 64H (PG CH1 Output)	OFF	CH2 (TA2 → TA3)
									ON	CH1 (TA1 → TA3)
								4 – Sync Mode: Disabled (C15-01 = 0, 1 or MFDI 68H = OFF) / Enabled (C15-01 = 1, 2 or MFDI 68H = ON)	Don't Care	CH2 (TA2 → TA3) / CH2 (TA2 → TA3)
1 Motor 1 = CH2	1	2 (TA2)	F-16	F1-17	F1-13	E2-04	B3-03	0 – Select by MFDI 4:H (Motor Selection)	Don't Care	CH2 (TA2 → TA3)
								1 – CH 1	Don't Care	CH1 (TA1 → TA3)
								2 – CH 2	Don't Care	CH2 (TA2 → TA3)
								3 – Select by MFDI 64H (PG CH1 Output)	OFF	CH2 (TA2 → TA3)
									ON	CH1 (TA1 → TA3)
								4 – Sync Mode: Disabled (C15-01 = 0, 1 or MFDI 68H = OFF) / Enabled (C15-01 = 1, 2 or MFDI 68H = ON)	Don't Care	CH1 (TA1 → TA3) / CH2 (TA2 → TA3)
	2	1 (TA1)	F-01	F1-05	F1-14	E4-04	E3-02	0 – Select by MFDI 4:H (Motor Selection)	Don't Care	CH1 (TA1 → TA3)
								1 – CH 1	Don't Care	CH1 (TA1 → TA3)
								2 – CH 2	Don't Care	CH2 (TA2 → TA3)
								3 – Select by MFDI 64H (PG CH1 Output)	OFF	CH2 (TA2 → TA3)
									ON	CH1 (TA1 → TA3)
								4 – Sync Mode: Disabled (C15-01 = 0, 1 or MFDI 68H = OFF) / Enabled (C15-01 = 1, 2 or MFDI 68H = ON)	Don't Care	CH1 (TA1 → TA3) / CH2 (TA2 → TA3)

Special Function Compatibility Table

While the Slave is in Synchronization Mode, it is required to follow the reference of the Master, hence many special functions are disabled in the slave drive. The following table illustrates the functional limitations of the slave drive.

SPECIAL FUNCTION	MASTER Can Use during Synch Mode	SLAVE Can Use during Synch Mode	Remark
MOP (Motor Operated Potentiometer) / TRIM Control: B4-01 is disabled (Hold Fref), B4-02,MFDI= 38, 3D, 3E, 45, or 46	Yes	No	Slave needs to follow reference from Master. (Automatically disabled in Sync Mode.)
Accel / Decel: B5 Group, MFDI= 1A, 1B, 1C, or 40	Yes	No	Slave needs to follow reference from Master. (Automatically disabled in Sync Mode.)
Speed Search: B6 Group, MFDI= 50	Yes	No	Slave needs to follow reference from Master. (Automatically disabled in Sync Mode.)
Jump Frequencies: B8 Group	Yes	No	Slave needs to follow reference from Master. (Automatically disabled in Sync Mode.)
Quick Stop: C1-01, C1-02	Yes	No	Slave needs to follow reference from Master. (Automatically disabled in Sync Mode.)
Reverse Plug: C1-03 ~ C1-05	Yes	No	Slave needs to follow reference from Master. (Automatically disabled in Sync Mode.)
Micro Speed:C2 Group, MFDI= E, or 10	Yes	No	Slave needs to follow reference from Master. (Automatically disabled in Sync Mode.)
Travel Limits:C3 Group, MFDI= 6 ~ D, 12 or 62	Yes	Yes	Slow down & Stop Limits are disabled during Sync. UL3 Always Active - LL1, LL2 / UL1, UL2 active during automatic resync only.
Load Float: Automatic (C8-10) or MFDI =35	Yes	Yes	
Load Check: C5 Group	Yes	Yes	Slave does not stop motion if LC detected. Alarm only action. Must interlock master and slave drive. Accuracy may not be as good in Sync Mode due to constant position correction.
Ultra-Lift	Yes	Yes	Master and Slave must be Interlocked. Intended for No load only. Be sure there is enough unused I/O.
Torque Limit: C7 Group, MFDI= 14	Yes	Yes	
No Load Brake Hoist: A1-03, C8 Group	Yes	Yes	

Traverse: A1-03	Yes	Yes	
Standard Hoist: A1-03 (Hoist Has a Mechanical Load Brake)	Yes	Yes	Consult Factory for special configuration for use with a Mechanical Load Brake. A1-03 = No Load Brake.
Brake Answerback: C8 Group, MFDI =58	Yes	Yes	BE4 / BE5 must be interlocked from Slave to Master.
G5IN4: C9 Group	Yes	Yes	
Weight Measurement: C10 Group	Yes	Yes	Accuracy may not be as good in Sync Mode due to constant position correction. Automatic measurement is recommended (C10-01 = 1). Measuring on the fly (by MFDI) may cause unwanted "Out of Sync" faults.
Slack Cable: C11 Group	Yes	Yes	Slack Cable interlock wiring must be in place. May not work consistently in Sync Mode. Depends on application. Intended for below the hook attachments.
Snap Shaft (Drive Train Discontinuity): C11 Group	Yes	No	Slave Needs PG-Z2 for Master reference. (Automatically disabled in Sync Mode.)
Timer Functions: C12 Group	Yes	Yes	
Maintenance Timer: C12-05, C12-06, MFDO= 37	Yes	Yes	Slave will not be able to limit speed, only annunciate
Inching / Indexing Control: C13 Group – MFDI= 18 ~ 1A, or 60	Yes	No	Slave needs to follow reference from Master. (Automatically disabled in Sync Mode.)
DC Injection: D1 Group	Yes	Yes	
Slip Compensation: D2 Group	Yes	Yes	
Automatic Speed Regulation (ASR): D4 Group	Yes	Yes	Uses Sync ASR + D4 Group
Torque Control: D5 Group – MFDI= 34	Yes	No	Recommended to Oversize Slave to handle extremely fast acc/dec changes. (Automatically disabled in Sync Mode.)
Droop Control: D6 Group	Yes	No	Slave needs to follow reference from Master.
Dwell: D8 Group	Yes	No	It is disabled for hoist motions. (Automatically disabled in Sync Mode.)
S-Curve Accel / Decel: D9 Group	Yes	No	Slave needs to follow reference from Master. Acc / Dec times are ignored in Sync Mode.
V/F Pattern: E1 Group	Yes	Yes	

Motor 2: E3 ~ E4 Group	Yes	Yes	OPE12 will occur
Serial / High Speed Communications: H5, F6 Group	Yes	Yes	Modbus, Modbus +, Modbus TCP, Profibus Master: Can be controlled serially Slave: Monitor Only
Pulse Input / Output: H6 Group	Yes	Yes	Slave needs to follow reference from Master. (Automatically disabled in Sync Mode.)
Motor Overload Protection: L1 Group	Yes	Yes	
Speed Agree: L4 Group	Yes	Yes	Traverse only
Under / Over Torque Detection: L6 Group	Yes	Yes	
Hardware Protection: L8 Group	Yes	Yes	
Automatic Fault Reset: L9 Group	Yes	Yes	
Jog Control: B1-17, MFDI= 15 or 16	Yes	No	Slave needs to follow reference from Master. (Automatically disabled in Sync Mode.)
Drive Enable: MFDI= 55	Yes	Yes	
DO-02C, DO-08 (Digital Output option Cards): F5 Group	Yes	Yes	
Phantom Fault: MFDI= 5F or 63	Yes	Yes	
BE6 Up Speed Limit: C8-17, MFDI= 5B	Yes	Yes	Slave needs to follow reference from Master. If Slave has BE6 detection, it must be interlocked with the Master. It will then limit the speed of the Master. The input to the Slave is ignored while Sync Mode is enabled, but may be used if the Slave can become a Master.
Brake Test: MFDI= 61	Yes	Yes	Brake test is only used while stopped. Not during Sync Mode. It is a maintenance only function.
Load Share: MFDI= 66	Yes	Yes	Cannot be used during Sync operation. If Master is a Load Share drive, Slave should be oversized to accommodate fast change in torque + quick response. SLAVE: If the Slave is also capable of Load Share, Sync and Load Share cannot be used simultaneously. A "Load Share / Sync" Alarm will occur.
Fault Annunciation: MFDO= 40 ~ FF	Yes	Yes	
Load Cell: MFAI= 16	Yes	Yes	

Hook Height: MFAI= 17	Yes	Yes	
Local Remote Control by Mode/Service Key or by MFDI= 31	Yes	Yes	Slave needs to be commanded by Master. Local / Remote will override Sync Mode. Note: Switching on the fly by B3-09 = 1 will cause Out of Sync Fault.
Change Motor Rotation: B3-04	Yes	Yes	
Change Encoder Phases: F1-05	Yes	Yes	
Load Float Extension Time	Yes	Yes	Both Master and Slave should be the same.
BE6 detection	Yes	Yes	
PGO Hardware failure detection for CH1 and CH2 of PG-Z2	Yes	Yes	CH2 disabled when Sync Mode is disabled.
AI-14B	Yes	Yes	Make sure other I/O cards are not using 2CN.
DI-08	Yes	Yes	Make sure other I/O cards are not using 2CN.
DI-16H	Yes	Yes	Make sure other I/O cards are not using 2CN.

Typical Hoist Synchronization Interconnect