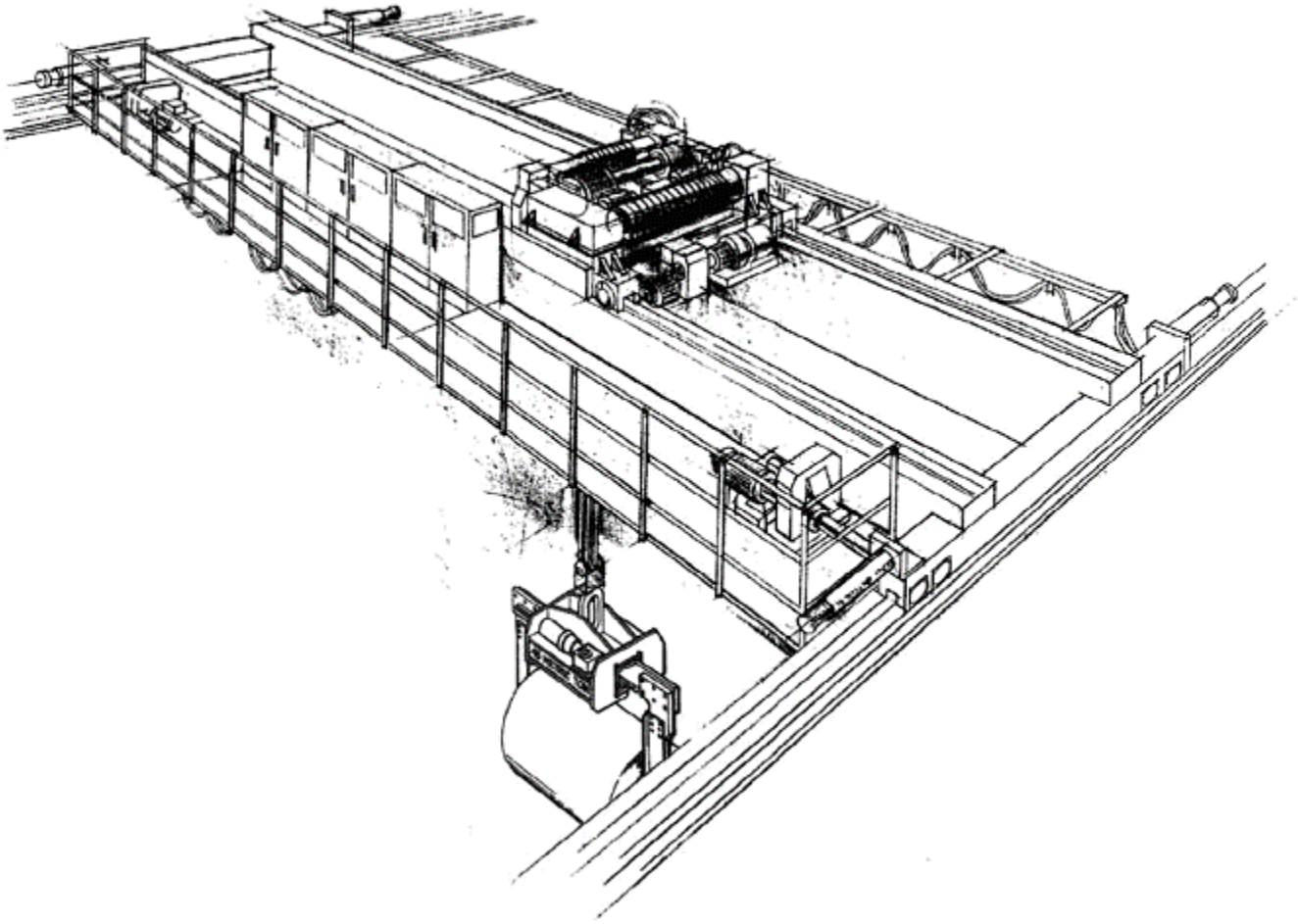


IMPULSE™ VG+ Series 3

Bucket Crane Software Instruction Manual

MAGNETEK
UNCOMMON POWER

Electromotive Systems

Software #8140.X
Part Number: 140-10331

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.

Table of Contents

Introduction to Bucket Hoists

General Application Information

Bulk material handling cranes are commonly equipped with clamshell buckets or scissors type grapples. Buckets are widely used for handling materials such as coal, coke, cement, grain, and fertilizer. However, grapples are commonly used for handling scrap, riprap, refuse, and logs. By their nature, bucket cranes are production tools, and critical to their respective processes. A thorough analysis of the intended operation is essential often including duty cycle and life cycle calculations. Consequently, it is very important that the owner provide complete information on the operation in order to obtain the desired performance and assure reliable service with minimal downtime.

These cranes frequently operate in hot, humid and extremely dusty environments. The use of "taconite" or "Inpro" seals for the motors and other mechanical components is quite common. Control enclosure are often pressurized or mounted inside of the crane girders, or in special control rooms in order to control the environment and exclude contaminants.

The rated capacity of the crane normally includes only the weight of heaped materials in the bucket or grapple, and not the dead weight of the bucket or grapple. Buckets are usually rated in cubic yard capacity. When selecting hoist motors the weight of these devices must be included in the calculations in the same manner as the bottom block and cables are included for a conventional hook crane.

Types of Buckets and Grapples

Buckets and grapples are usually classified as single-line, two-line, three-line or four-line operation.

Single-line clamshell bucket

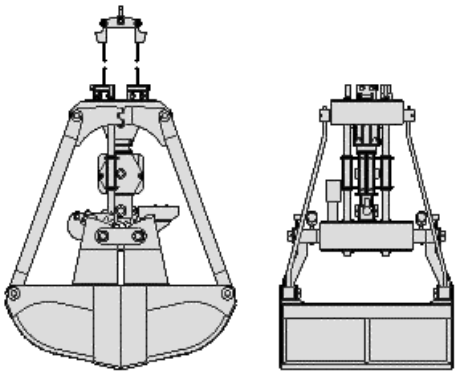


Figure 1

For use with cranes with one cable. They are commonly used with a ship's cranes for unloading bulk commodities.

Styles include:

- Manual trip - bucket is opened by someone pulling a cable to trip the latch mechanism
- Auto trip - bucket is opened by touching down the bucket to trip the latch mechanism
- Radio remote controlled - bucket is opened by a remote control device that trips the latch mechanism

2-Rope Clamshell Bucket

For use with cranes with one hold line and one close line.

Styles include:

- Rehandler - for bulk commodities such as fertilizer, grain, coal, and coke.
- Squarenose - for mud
  Roundnose - for digging and dredging

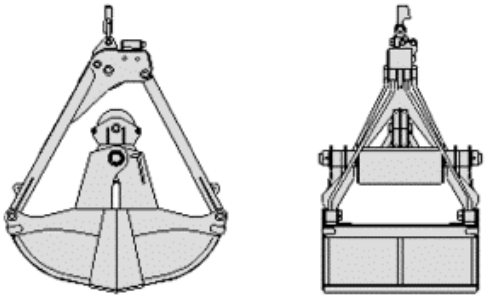
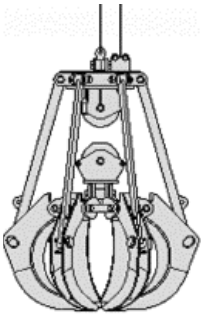


Figure 2



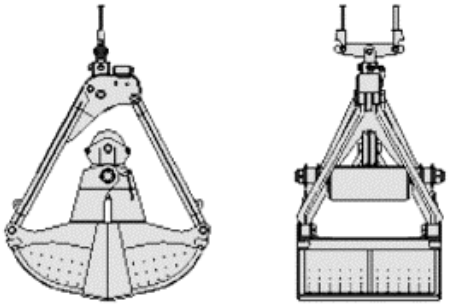
2-Rope Grapple Bucket (Orange Peel)

For use with cranes with one hold line and one close line.

Common applications:

- Scrap
- Iron ore (pig iron)
- Rip-rap
- Stone placement

Figure 3



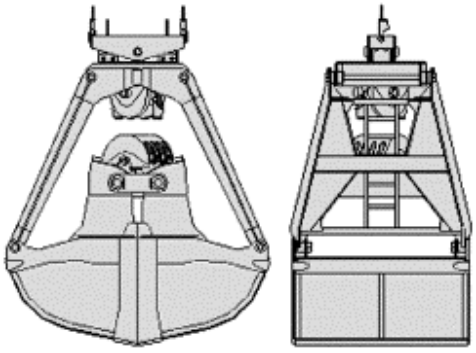
3-Rope Clamshell Bucket

For use with cranes with two hold lines and one close line.

Common styles:

- Coke buckets
- Cement mill buckets

Figure 4



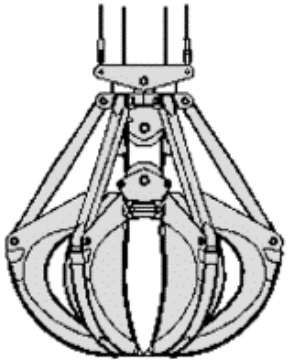
4-Rope Clamshell Bucket

For use with 4-rope operated cranes

Common uses:

- Rehandler - for bulk commodities
- Coal buckets
- Coke buckets
- Ash buckets

Figure 5



4-Rope Grapples (Orange Peel)

Normally consist of two hold lines dead ended on the head and two close lines dead ended inside the grapple (direct reeved). These grapples are commonly used in refuse plants, but can be used for many other applications.

Figure 6

Bucket Nomenclature

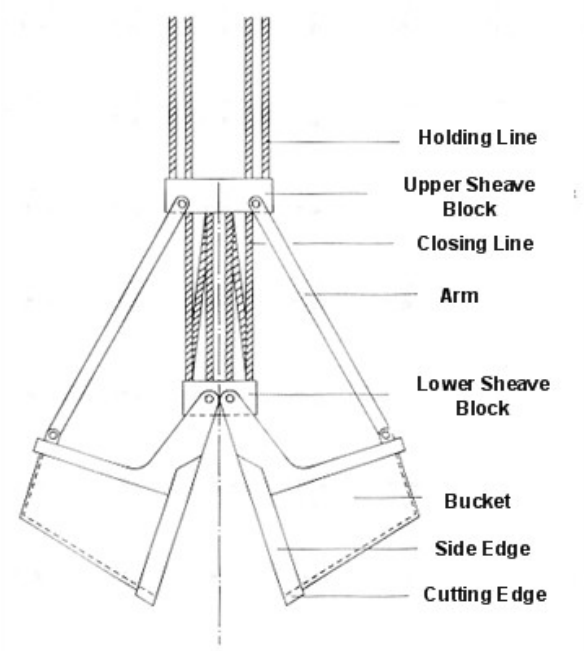


Figure 7

Clamshell buckets consist of six main bodies. They are the upper sheave block, the lower sheave block, the two arms and the two buckets. In between the two sheave blocks the closing line (wire rope) is reeved with a certain number of parts of line. The holding (raising and lowering) line is mounted on top of the upper sheave block.

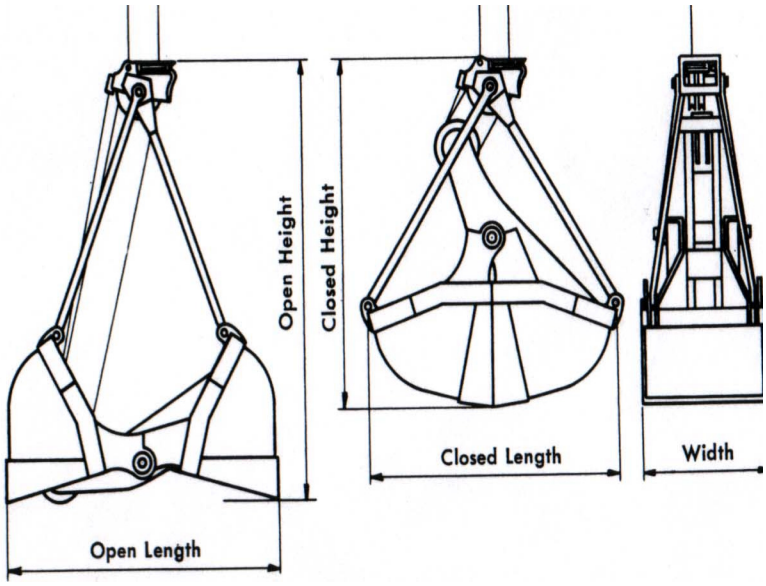


Figure 8

Typical Bucket Reeving Arrangements

Direct - Reeved

The bucket operates on a man-trolley. The two closing cable ends are reeved from one drum to a dead end on the bucket. The two holding cables are attached to the head of the bucket eliminating the use of a holding sheave in the head. The sheaves will only rotate during opening or closing.

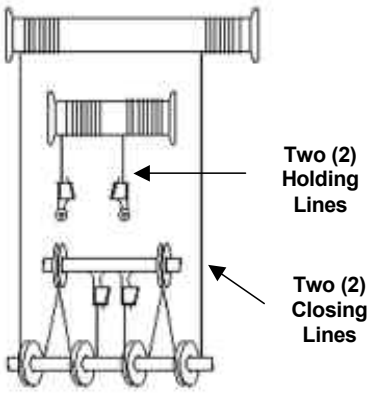


Figure 9

Fleet-Through

The bucket operates on a sheave-trolley (flying trolley), where the operator does not move when the trolley is in motion. The hold and close lines dead end along the bridge or boom so the sheaves rotate when the bucket is raised, lowered, opened, closed, and racked.This arrangement is commonly used on tower cranes, dock cranes, coal-unloaders, and log handling cranes It is used infrequently on overhead traveling cranes.

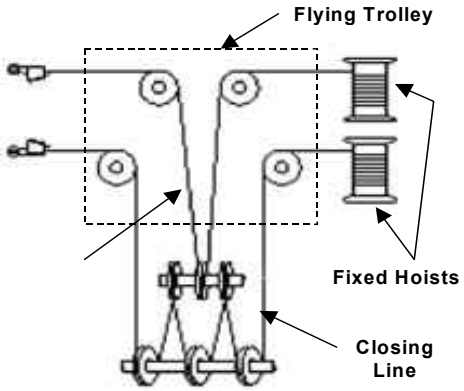


Figure 10

Bight-of-Line

The bucket operates on a man-trolley. Both hold and close lines reeve through the bucket and dead end on the trolley. The sheaves rotate when the bucket is raised, lowered, opened, and closed.

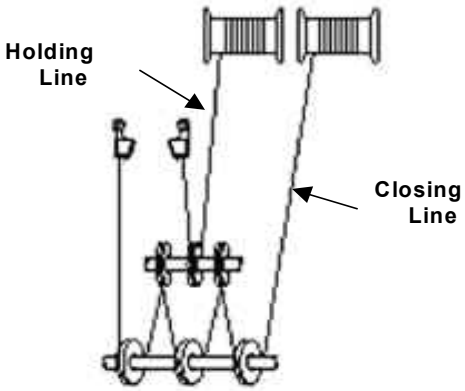


Figure 11

Bucket Hoist Operation

The photo on the right shows a typical bucket trolley with two cable drums. The drums are of the same diameter and are independently controlled by individual motors through separate gear reduction units.

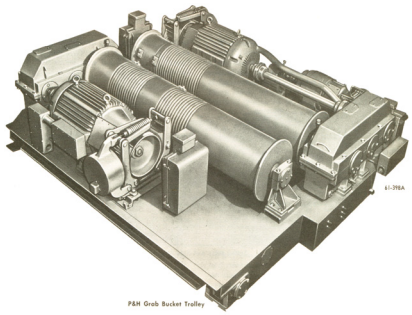


Figure 12

Bucket applications present several unique application requirements that are easily accomplished through the use of this software.

Lowering Open Bucket

In order to maintain the bucket in the open position while lowering, both hoists must operate at the same speed. Should the closing line, for example, outpace the holding line (i.e. slacken), the bucket would tend to close while lowering. To lower an open bucket (assuming the bucket is fully opened after a dump), move the master switch into the lower/open corner (see Figure 19). This will lower both hoists at an equal speed and the bucket will remain open.

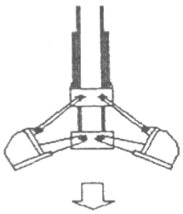


Figure 13

Slack Cable and Digging (Closing the bucket on a pile)

Slack cable protection is required. If the bucket were to land on the pile and the operator would fail to quickly stop the lowering movement, the ropes would continue to unwind, resulting in the ropes coming out of their grooves.

Digging is accomplished by gradually raising the closing line (putting the master switch in the "close" position) while the holding line remains stationary or slightly slack. This action will close the bucket. During digging operations, the closing line may be required to momentarily carry the full weight of the bucket and load until the bucket is fully closed and all slack is removed from the hold line. The master switch is then moved into the close/raise corner (see Figure 19) to begin raising the holding line also. Note: Although the closing hoist is capable of carrying the full weight of the bucket, it should not achieve full speed until the holding hoist catches up and load sharing resumes.

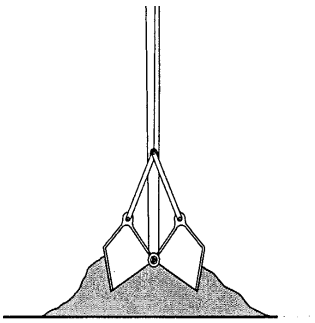


Figure 14

A cycle of picking material that is hard to dig consists of first lowering the clamshell fully opened, and placing it on the material to be excavated. When the clamshell is resting on the material the holding line is kept slack so the clamshell will penetrate vertically into the material by its own weight. This is called the initial penetration. The distance between the two sheave blocks is at a maximum during the initial penetration. Secondly the closing line is hauled in, resulting in the two sheave blocks being pulled toward each other, thus causing the closing of the buckets. During this second stage the holding line is kept slack so the buckets are allowed to penetrate into the material.

In soft materials it may be necessary to keep the holding line taut. This will prevent the clamshell from penetrating too deeply into the material resulting in excessive of spillage.

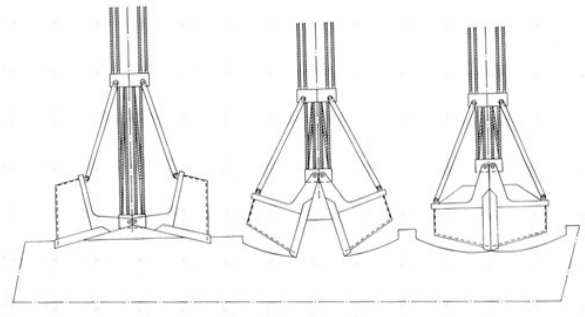


Figure 15

Raising a Closed Bucket

In order to keep a full bucket closed while raising it out of the pile, torque must be proportionally shared between the two hoists. This means that the load sharing must be a minimum of 50% between the "hold" and "close" motions. Likewise, in the lower direction, speed must be matched. To raise a closed bucket (loaded or unloaded), move the master switch into the close/raise corner (see Figure 19). This will raise both the closing and the holding hoists at an equal reference. The closing hoist will always have a slightly greater torque reference in order to ensure the bucket remains closed during the lift. The load sharing is handled in the inverter software. It is important that the operator gives equal reference to both hoists while raising a loaded bucket. Most operators give full reference up/down even though in between speeds can be accomplished. If it is important that occasionally an operator must be able to raise a closed bucket at speeds less than the maximum, a master switch with stepped movement is recommended. This will allow the operator to confidently give an equal reference to each inverter.

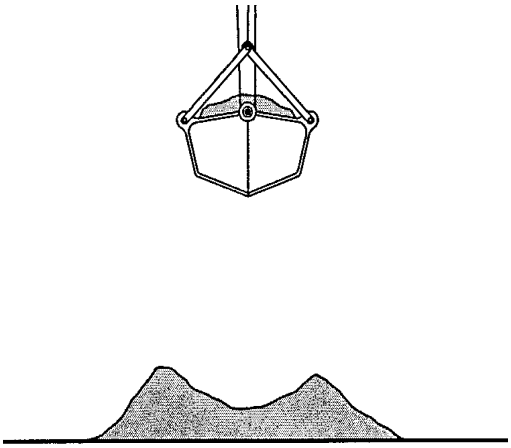


Figure 16

Raising an Open Bucket

In order to maintain the bucket in the open position while raising it, both hoists must operate at the same speed. Since the bucket is unloaded, it is generally no problem for both hoists to achieve maximum speed in a minimal amount of time.

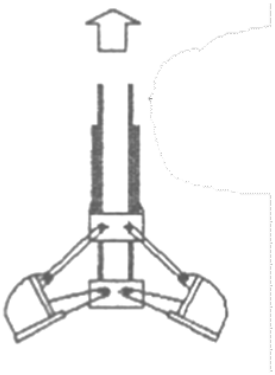


Figure 17

Stopping With a Loaded Bucket

To stop the hoisting motion, return the master switch to the center position. Both hoists will decelerate to a complete stop and load float for an adjustable time before setting and checking the electric brake. The bucket will remain in the position it was in prior to stopping. Quick Stop times should generally be identical. It may even be desirable to set the Quick Stop time slightly shorter on the closing hoist to insure the bucket sinches tight when stopping.

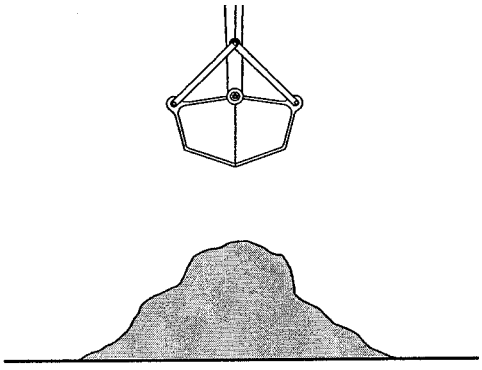


Figure 18

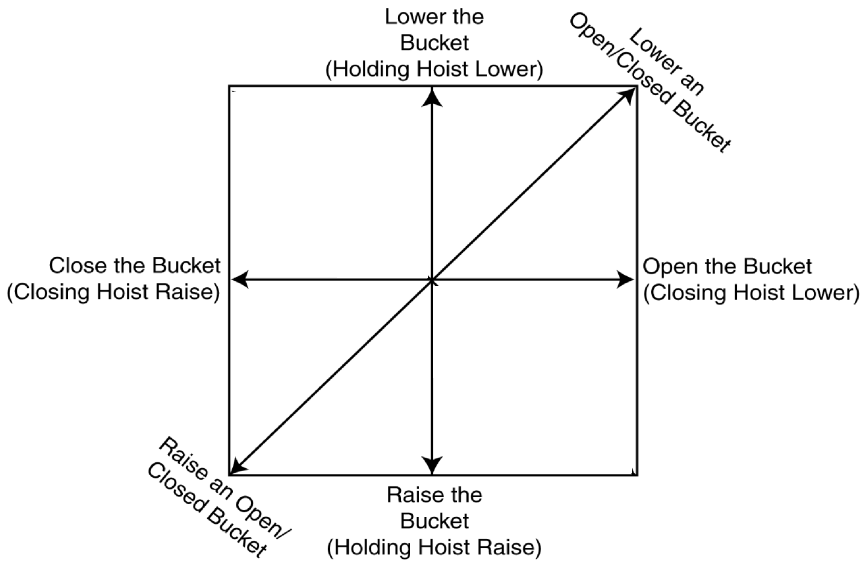
Typical Dual Axis Master Switch Configuration

Notes for selecting the appropriate Stepped or a Stepless Master Switch for Bucket Control:

- *** Uni-Polar Analog** (0-10V, 4-20ma) - Inputs independent raise, lower and uni-polar (stepless) analog speed and torque references.
- **2 -Multi-Step** - Digitally inputs independent raise, lower and 2nd speed and torque references.
- **3 -Multi-Step** - Digitally inputs independent raise, lower, 2nd and 3rd speed and torque references.
- *** 5 - Step Multi-Step** - Digitally inputs independent raise, lower, 2nd, 3rd, 4th and 5th speed and torque references.
- **Gates are NOT recommended**. They can restrict the operators precision and timing control of the bucket.
- **Detents are helpful** for insuring equal reference to both hoists during certain operations.
- **Spring return to center -** not required by control but may be required by other standards.

*** Recommended**

Figure 19



Programming

Table 1: Parameters

Function	Parameter	Name (Digital Operator Display)	Content	Range	Initial Value	Access Level
Initialization: A1	A1-03	Motion Selection (**Select Motion**)	Application motion is selected. 0: Traverse 1: Standard Hoist (w/ Mechanical Load Brake) 2: No Load Brake Hoist (NLB Hoist) 3: Bucket Hoist (*See Table 5-Parameters changed by X-Press Programming when A1-03=Bucket Hoist)*	0 ~ 3	3	Adv
	A1-04	Speed Reference Select (**Speed Reference**)	0: 2-Spd Multi-Step 1: 3-Spd Multi-Step 2: 5-Spd Multi-Step 5: Uni-Polar Analog (0-10V, 4-20ma) 7: G5IN4 Opt Card (Other than MFI H1-01 ~ 06) 8: Serial Opt Card	0 ~ 8	5	Adv
Run Mode Sel: B3	B3-03	Stopping Method Selection (**Stopping Method**)	Stopping method when Run command is removed. 0: Decel to stop 1: Coast to stop 2: DC Injection braking (DB) stop 4: Decel w/ timer 6: No Load Brake 7: Bucket Hoist	0 ~ 7	7	Adv
Bucket Control: B7	B7-01	**Torque-Ref 1**	Torque reference when a digital multi-step torque reference is used (B7-06 = Enabled).	0 ~ 300 %	20	Adv
	B7-02	**Torque-Ref 2**			40	Adv
	B7-03	**Torque-Ref 3**			60	Adv
	B7-04	**Torque-Ref 4**			80	Adv
	B7-05	**Torque-Ref 5**			100	Adv
	B7-06	Digital Torque Ref 0/1 **(Digital Tref 0/1)**	When a multi-step master switch is used, it is possible to input up to 5 preset torque references by enabling B7-06. B7-06 is changed automatically by X-press programming. 0: Disabled 1: Enabled	0, 1	1 *	Adv
	B7-08	**Auto Spd/Trq Sw**	Automatic Speed / Torque Changeover - Torque Control is automatically enabled / disabled. It may be desirable to Enable / Disable Torque Control "on the fly" by means of MFDI 34H for certain applications where load sharing is desired in the lower direction or during certain bucket maneuvers. In this case, set this function to disabled. This only functions in Legacy Mode. 0: Disabled 1: Enabled	0, 1	1	Adv
	B7-09	**Bucket Open Revs**	Bucket Fully Open Delta Revolutions - Enter the number of revolutions displayed in U1-62 (system must be homed first) while the bucket is fully open. This will set up the 100% scaling for analog output if a Meter or some form of display is used in the cab. (H4-0x = 62).	0 ~ 65535	250	Adv
	B7-10	**Closed Threshold**	Bucket Fully Closed Threshold - This parameter allows for some tolerance / hysteresis in the multi-function output that indicates whether the bucket is closed or open. For example, if the bucket is digging in a river and clamps on a log, the closed indicator output may never turn on because the bucket starts to raise before it can fully close. Adjust this threshold in terms of motor revolutions to offset the closed position. This can also be used in the case where the closing hoist is digging (raising) and the operator wants to time when to begin raising the holding line (slightly before the bucket is fully closed).	0 ~ 65535	0	Adv

Table 1: Parameters

Function	Parameter	Name (Digital Operator Display)	Content	Range	Initial Value	Access Level
Digital In Setup: C9	C9-01	**Digital In Sel**	There are several **D**igital **I**nput **O**ption cards that may be used depending on how much I/O is required for the application. The G5IN4 yields 4 additional 120VAC inputs, the F7IN8 yields 8 additional 120VAC inputs or the DI-08 yields 8 additional 24VDC inputs, the DI-16H2 yields 10 additional 24VDC inputs. 0: Disabled (No additional Input cards are being used.) 1: G5IN4 / C9-02 (C9-02 assigns G5IN4 Terminal settings using matrix method.) 2: G5IN4 / C9-03~06 (C9-03 ~ C9-06 assigns G5IN4 Terminals) 4 CH Individual 3: DI-08 / C9-03~10 (C9-03 ~ C9-10 assigns DI-08 Terminals) 8 CH Individual 4: DI-16 / C9-03~12 (C9-03 ~ C9-12 assigns DI-16 Terminals) 10 CH Individual 5: Serial / C9-03~12 (C9-03 ~ C9-12 assigns Serial Comm Terminals.) 10 CH Individual	0 ~ 5	0	Adv
	C9-03	**DIO Terminal 1**	Multi-Function Digital Input by G5IN4 / F7IN8 / DI-08 / DI-16 Options. See programming of H1-0x Terminal for a complete list of programming options. (Hidden and Disabled when C9-01 < 2). See DI-08 and DI-16H2 Hardware Installation and Wiring in this document.	0 ~ FF	0F	Adv
	C9-04	**DIO Terminal 2**	MFDI by G5IN4 / F7IN8 / DI-08 / DI-16 Options. (Hidden and Disabled when C9-01 < 2)	0 ~ FF	0F	Adv
	C9-05	**DIO Terminal 3**	MFDI by G5IN4 / F7IN8 / DI-08 / DI-16 Options. (Hidden and Disabled when C9-01 < 2)	0 ~ FF	0F	Adv
	C9-06	**DIO Terminal 4**	MFDI by G5IN4 / F7IN8 / DI-08 / DI-16 Options. (Hidden and Disabled when C9-01 < 2)	0 ~ FF	0F	Adv
	C9-07	**DIO Terminal 5**	MFDI by G5IN4 / F7IN8 / DI-08 / DI-16 Options. (Hidden and Disabled when C9-01 < 3)	0 ~ FF	0F	Adv
	C9-08	**DIO Terminal 6**	MFDI by G5IN4 / F7IN8 / DI-08 / DI-16 Options. (Hidden and Disabled when C9-01 < 3)	0 ~ FF	0F	Adv
	C9-09	**DIO Terminal 7**	MFDI by G5IN4 / F7IN8 / DI-08 / DI-16 Options. (Hidden and Disabled when C9-01 < 3)	0 ~ FF	0F	Adv
	C9-10	**DIO Terminal 8**	MFDI by G5IN4 / F7IN8 / DI-08 / DI-16 Options. (Hidden and Disabled when C9-01 < 3)	0 ~ FF	0F	Adv
	C9-11	**DIO Terminal 9**	MFDI by G5IN4 / F7IN8 / DI-08 / DI-16 Options. (Hidden and Disabled when C9-01 < 4)	0 ~ FF	0F	Adv
	C9-12	**DIO Terminal 10**	MFDI by G5IN4 / F7IN8 / DI-08 / DI-16 Options. (Hidden and Disabled when C9-01 < 4)	0 ~ FF	0F	Adv
Torque Control: D5	D5-01	**Torque Control**	Selects Speed or Torque control. The torque reference is set via analog input A2 or A3 when it is set for "torque reference" (H3-05 or H3-09 = 13H). Torque reference is set as a percentage of motor rated torque. To use this function for switching between speed and torque control, set to 0 and set a multi-function input to "Speed / Torque Control Change" (H1-0x = 34H). 0: Speed Control (Controlled by D4-01 ~ 07) 1: Torque Control	0, 1	0	Adv
	D5-02	**Torque Ref Filter**	Primary Delay time for Torque Reference Input. This setting will help eliminate noise spikes. Increase setting if Instability or vibration occurs during Torque Control.	0 ~ 1000 msec	0	Adv
	D5-03	**Speed Limit Sel**	Sets the speed limit command method for the torque control method. 1: Analog Input - Limited by the output of the soft starter (B3-01 selection and active acceleration/deceleration and S-curve settings). 2: Program Setting - Limited by D5-04 setting value.	1, 2	2	Adv
	D5-04	**Speed Limit Val**	Speed Limit Value % E1-04. Setting is used when D5-03 = 2. Run command and the Fwd direction is set at + and Rev at -.	-120 ~ +120 %	100	Adv
	D5-05	**Speed Limit Bias**	Speed Limit Bias % E1-04 Sets the speed limit bias as a percentage of the maximum output frequency (E1-04). Bias is given to the specified speed limit. It can be used to adjust the margin for the speed limit.	0 ~ 120 %	0	Adv
	D5-06	**Ref Hold Time**	Speed / Torque Switching Timer Sets the delay time from inputting the multi-function input "Speed / Torque Control Change" (from On to OFF or OFF to ON) until the control is actually changed. This function is enabled when the multi-function input "Speed / Torque Control Change" (H1-0x, C9-0x = 34H) is programmed to an input terminal. While in the Speed / Torque control switching timer, the analog inputs hold the value present at the time "Speed / Torque Control Change" is received.	0 ~ 1000 ms	0	Adv
	F3-01	**DI Option Setup**	Sets the digital reference input method. 0: BCD 1 % 1: BCD 0.1 % 2: BCD 0.01 % 3: BCD 1 Hz 4: BCD 0.1 Hz 5: BCD 0.01 Hz 6: BCD (5 Digit) 0.01 Hz (only with DI-16H2) 7: Binary	0 ~ 7	7	Adv

Table 2: Monitors

Monitors Selectable by: F4-01, F4-03, H4-01, H4-04, H6-06, O1-01

Function	Monitor	Name (Digital Operator Display)	Content	Output Signal Level at Multi-function Analog Output	Min. Unit	Range	Access Level
Monitor: U1	U1-09	**Torque Reference**	**Torque Reference** Displays the torque reference to motor.	10V: Motor Rated Torque (0 ~ ±10V applicable)	0.01Hz	0 ~ E1-04	Adv
	U1-25	**Digital Input Reference**	Digital Input Option Card Terminal status Displayed in Hex format.	(Output Disabled)	1	0 ~ 4000	Adv
	U1-60	**Closing Revs**	Closing Hoist Motor Revolutions since home position	(Output Disabled)	1	-32768 ~ 32767	Adv
	U1-61	**Holding Revs**	Holding Hoist Motor Revolutions since home position	(Output Disabled)	1	-32768 ~ 32767	Adv
	U1-62	**Delta Revs**	Closing Hoist - Holding Hoist Motor Revolutions since home position.	10V: B7-09 (0 ~ ±10V applicable)	1	- B7-09 ~ + B7-09	Adv

Table 3: Multi-function Digital Inputs selectable by H1-0x and C9-0x (MFDI)

Setting Value	Name (Digital Operator Display)	Function	Access Level	Remarks	Program In:
34	**Spd/Trq Changeover**	**Spd/Trq Changeover** - Speed / Torque Control Changeover (ON: Torque Control)	Adv	For Legacy	Holding / Closing
3A	**Trm A2/A3 Enable**	**Trm A2/A3 Enable** - Multi-function analog input (A3) Enable/Disable - (When Programmed, Analog input A2/A3 is enabled by ON. A2 and A3 are enabled by Multi-Step Ref 1 and 2 respectively. H1-0x = 0 or 1.)	Adv		Holding / Closing
67	**Bucket Home**	Clears U1-60, U1-61 and U1-62 and unitizes the Bucket Position routine. The Bucket Position indication will not function until this input toggled On. When the bucket reaches a fully closed position (or a position the operator chooses to call closed for timing purposes), the operator will input the "Bucket Home" signal to clear or initialize the bucket position indication.	Adv	Available only when A1-03 = 3 - Bucket	Closing
68	**Bucket Ultra Lift**	**Enable Ultra Lift while A1-03 = Bucket - ULTRA LIFT IS FOR LOWER DIRECTION ONLY.** If it is desirable to use Ultra Lift during Bucket mode, some precautions must be taken. Ultra Lift should be configured such that it will not be automatically enabled unless there is an empty bucket. Both Hoists must "communicate" whether they are capable by using Multi-Function Digital output 3AH - "Bucket Ultra Lift". This output from both closing and holding inverters is then wired in series to form this input "Bucket Ultra Lift" which is then wired in parallel and input by MFDI to both inverters. See MFDO 3B and or example wiring diagram. Open: Ultra-lift is disabled **Closed:** closing hoist is indicating to holding that is has sufficient torque to use Ultra Lift	Adv	C6-01 = 1 - Enabled Automatic to enable MFDO 3AH.	Holding / Closing
69	**Slack Cbl In**	**Slack Cable detection. (Input is Optional)** If it is desirable to have to have both hoists take the same action when one of the other detects a slack condition, interlock wiring must be used. This input will cause the Hoist to take action according to the setting of C11-02. An 'SLC2 - Slack Cable Det' Alarm will be displayed on the keypad. Open: Operation is Normal **Closed:** Other hoist indicating that is has detected a Slack Cable condition.	Adv	C11-01 must be enabled in order for input to have any effect.	Holding / Closing

Table 4: Multi-function Digital Outputs selectable by F5-0x and H2-0x (MFDO)

Setting Value	Name (Digital Operator Display)	Function	Access Level	Remarks	Program In:
2B	**Bucket Closed**	**Bucket Is Closed Indicator** Open: Bucket is Somewhere between open and closed (or not homed properly) Closed: Bucket is closed within Threshold set by B7-10.	Adv	Available only when A1-03 = 3 - Bucket	Closing
3A	**Bucket Ultra Lift**	**Enable Ultra Lift during Bucket Mode** If it is desirable to use Ultra Lift during Bucket 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 bucket. It is crucial that the both hoists have enough motor torque above base speed to maintain and lower the load. For this reason, set the Ultra Lift Enabling Torque so Ultra Lift is not enabled when there is a load present. The Holding and Closing Hoists must also be interlocked. Both Hoists must be configured with this output (3AH - Bucket Ultra Lift) that will permit both Hoist to utilize Ultra Lift Speeds only if both are capable. See MFDI 68H and or example wiring diagram. Note: Ultra Lift used in conjunction with Bucket Mode may not work in all applications. Careful review of the application should precede the use of Ultra Lift. All Hoist should be of equal speed (motor RPM, Gearing, etc...) Open: Ultra-lift is disabled **Closed:** Closing Hoist is indicating to Holding Hoist that is has sufficient torque to use Ultra Lift	Adv		Holding / Closing

Table 5: X-Press Programming (A1-03 = 3 - Bucket Hoist)

A1-04	Description	B1-01	B1-02	B1-03	B1-04	B1-05	B1-06	B1-07	B1-08	B1-09	B1-10	B1-11	B1-12	B1-13	B1-14	B1-15	B1-16	B1-17	B1-18	B2-01	B2-03	B3-03	B5-01	B5-02
		Speed 1	Speed 2	Speed 3	Speed 4	Speed 5	Speed 6	Speed 7	Speed 8	Speed 9	Speed 10	Speed 11	Speed 12	Speed 13	Speed 14	Speed 15	Speed 16	Jog Ref	Ref Priority	Ref. Upper Limit	Ref. Lower Limit	Stopping Method	Accel Time 1	Decel Time 1
0	2-Speed Multi-Step	20.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0	100.0	2.0	7	3.0	3.0
1	3-Speed Multi-Step	15.00	30.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0	100.0	2.0	7	3.0	3.0
2	5-Speed Multi-Step	6.00	15.00	30.00	45.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0	100.0	2.0	7	3.0	3.0
5	Uni-Polar Analog	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	1	100.0	2.0	7	3.0	3.0
7	G5IN4 Opt. Card	15.00	30.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	0	100.0	2.0	7	3.0	3.0
8	Serial Opt. Card	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	1	100.0	2.0	7	3.0	3.0
* INFINITELY VARIABLE AND BI-POLAR ANALOG ARE NOT AVAILABLE IN BUCKET MODE.																								

A1-04	Description	B7-06	C1-01	C3-07	C8-10	D9-01	D9-02	D9-03	E1-03	H1-01	H1-02	H1-03	H1-04	H1-05	H1-06	H2-01	H2-02	H2-03	H3-01	H3-05
		Digital Tref 0/1	Quick Stop 0/1	Action @ LL2/UL2	Load Float Time	S-Curve Accel at Start	S-Curve Accel at End	S-Curve Decel at Start	V/F Selection	Terminal S3 Select	Terminal S4 Select	Terminal S5 Select	Terminal S6 Select	Terminal S7 Select	Terminal S8 Select	Terminal M1 / M2 Select	Terminal M3 / M4 Select	Terminal M5 / M6 Select	Terminal A1 Signal	TerminalA 3 Select
0	2-Speed Multi-Step	1	1	2	25	0.20	0.20	0.20	0F	00	0F	0F	0F	0F	0F	00	00	78	0	1F
1	3-Speed Multi-Step	1	1	2	25	0.20	0.20	0.20	0F	00	01	0F	0F	0F	0F	00	00	78	0	1F
2	5-Speed Multi-Step	1	1	2	25	0.20	0.20	0.20	0F	00	01	02	03	0F	0F	00	00	78	0	1F
5	Uni-Polar Analog	0	1	2	25	0.20	0.20	0.20	0F	0F	0F	0F	0F	0F	0F	00	00	78	0	13
7	G5IN4 Opt. Card	0	1	2	25	0.20	0.20	0.20	0F	0F	0F	0F	0F	0F	0F	00	00	78	0	1F
8	Serial Opt. Card	0	1	2	25	0.20	0.20	0.20	0F	0F	0F	0F	0F	0F	0F	00	00	78	0	1F

Alarms, Faults and OPE Conditions

Table 6: Alarms

Alarm Display	Description	Cause	Corrective Action
SLC 2	**Slack Cable 2**	MFDI 69H is on. Signal from other hoist that it has a Slack Cable condition and it slowing down this hoist.	1. No action may be necessary is this may be a normal condition. 2. Eliminate slack cable condition. 3. Check the wiring / programming.

Table 7: OPE Conditions (Operator Programming Errors)

OPE Display	Description	Cause	Corrective Action
OPE12	**Digital Trq Ref**	(B7-06 = 1 and (A1-04 = 5 or H3-05 = 13H or H3-09 = 13H))	1. Use either Digital Torque Ref or Analog, but not both.
OPE13	**Auto Spd/Trq Sw**	(B7-08 = 1 and H1-0x = 34H)	1. Use either Auto Speed / Torque Changeover or manual, but not both.
OPE14	**Ultra Lift**	(C6-01 ≠ 0 and ((A1-03 = 3 or B3-03 = 7) and C9-0x or H1-0x ≠ 68H))	1. Insure that "Bucket Ultra Lift" MFDI 68H is programmed and wired to an input terminal when using Ultra Lift in Bucket Mode.
OPE15	**Bucket Home**	((F5-0x, H2-0x = 2B or F4-01, F4-03, H4-01, H4-04 = 62) and (C9-0x,H1-0x ≠ 67H))	1. Insure that "Bucket Home" MFDI 67H is programmed and wired to an input terminal when using Bucket Position Indication.
OPE16	**Snap Shaft**	C11-08 = 1 and C9-0x, H1-0x = 67H.	1. Snap shaft & Bucket position indication can not be used simultaneously since both require PG-Z2 CH2. Chose one function or the other.
OPE20	**Slack Cable 2**	C9-0x, H1-0x = 69H and C11-01≠ 1	1. When using MFDI 69H (Slack Cable In), Insure that C11-01 is Enabled.

Hoist Startup and Configuration / Operation Notes

Initial Startup:

The following should be performed in numerical order:

1. De-couple the motor shafts from the gearbox and Auto-Tune both hoist drives to their respective motors. After "Tune Successful" is displayed, re-couple the motor shafts. Refer to Auto-Tuning in Chapter 4 of the Impulse VG+ Series 3 Instruction Manual.

2. Verify drive programming. A1-03 (Motion) should be programmed with data 3 (Bucket Hoist). A1-04 (Speed Reference) should be programmed according to the type of master of switch being used. All other multi-function inputs/outputs not used for Speed / Torque References (i.e. limit switches) should be programmed to perform their desired functions. Refer to Optional Digital Input Setup and Terminal Parameters in Chapter 5 of the Impulse VG+ Series 3 Instruction Manual.

3. Verify proper operation of the master switch. Refer to Figure 19 for typical master switch configuration. Verify that when raising, the FWD L.E.D. is illuminated on the keypad and that the reference is proportional to the deflection of the stick. Verify that when lowering, the REV L.E.D. is illuminated on the keypad and that the reference is proportional to the deflection of the stick. Note: U1-15, U1-16 or U1-17 (Terminals A1, A2 and A3 respectively) should have an equal reference from the master switch when using analog control.

4. Verify that the electric brake is functioning properly and no brake alarms occur when a run command is given.

5. Reeve the hoists.

6. Set the slow down and end of travel limit switch trip points. Verify they are working correctly with an empty bucket.

7. Load test

Configuration / Operation Notes:

1. In the lower direction (Speed Control), speed is ultimately limited by E1-04 - Max Frequency. When using an analog master switch, H3-02 - Terminal A1 Gain: Default = 100 % This sets the percentage of E1-04 the drive will output when the master switch is given 100 % reference in the down direction. Speed is proportional to master switch reference. When using a stepped master switch, each step is programmed to a preset speed reference not to exceed E1-04.

2. In the raise direction (Torque Control), speed is ultimately limited by D5-04 (a percentage of E1-04) or the amount of torque required to accelerate to the speed limit. For example, raising an empty bucket should not require 100 % torque and the drive will accelerate to the speed limit as fast as it can within its torque limit (Programmed Acceleration Times are not used). When using an analog Torque Reference, H3-06 or H3-10 (depending on which terminal is used) becomes the torque limit while raising. For this example, if H3-06 = 50 %, the bucket is full, and the operator is giving 100 % reference to the drive from the master switch, the output frequency may never reach 100 % (60 Hz) because the torque is being limited to 50 %. It does not have enough torque left over to accelerate the load any faster. For both analog and digital torque references, the torque output is ultimately limited by the C7 parameter group (Torque Limit).

3. After digging and the bucket is fully loaded, the closing hoist should not be able to reach the speed limit. If it does, or the holding lines seem too slow to "catch up", then if using an analog torque reference, H3-06 should be lowered or if using a digital torque reference, adjust the digital reference according to the master switch position (i.e. 5th point) so that the close line will slow down. This will allow the holding lines to "catch up" and begin sharing the load. The closing line will then be able to speed up once the holding hoist starts to help lift the bucket.

4. The Holding hoist drive should be programmed for approximately 5-10 % less torque than the closing line. This allows the closing line to apply slightly more torque and assure that the bucket remains closed. If it does not, for an analog torque reference lower H3-06 by a small percentage less than the closing hoist. For a digital torque reference, lower each Multi-step torque reference by a small percentage

less than the closing hoist. Generally, less than a 10% torque reference difference is required.

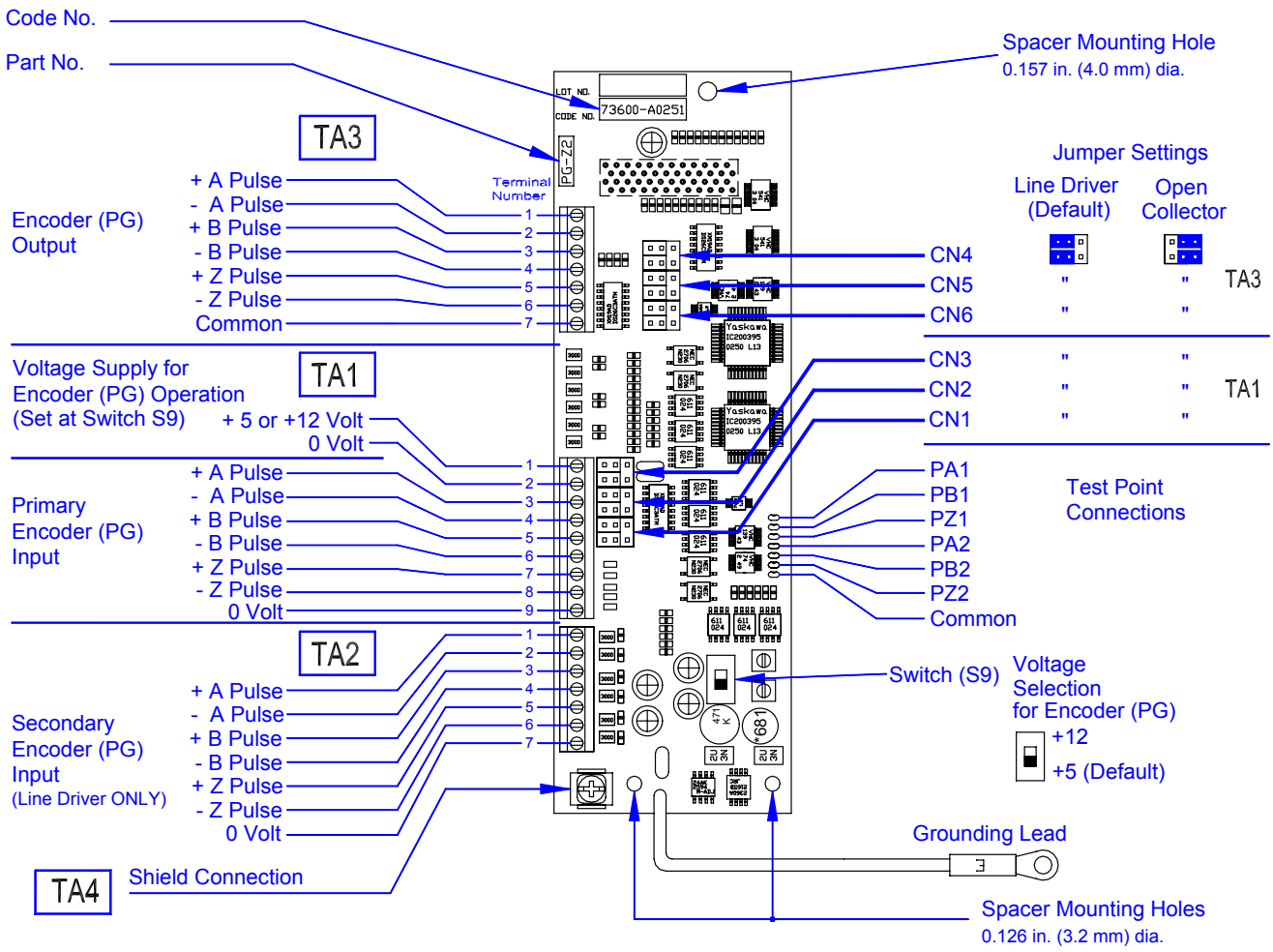
5. Accel times are ignored in the raise direction. The drive will accelerate the motor to it programmed speed limit as fast as it can within its given torque reference. B5-01 is used for the lowering acceleration time. All possible deceleration times are always in effect while stopping depending on the deceleration time priority. i.e. Quick Stop.

6. Quick Stop and decel times should generally be identical between hoists. It may even be desirable to set the Quick Stop time slightly longer on the holding hoist to insure the bucket sinches tight when stopping.

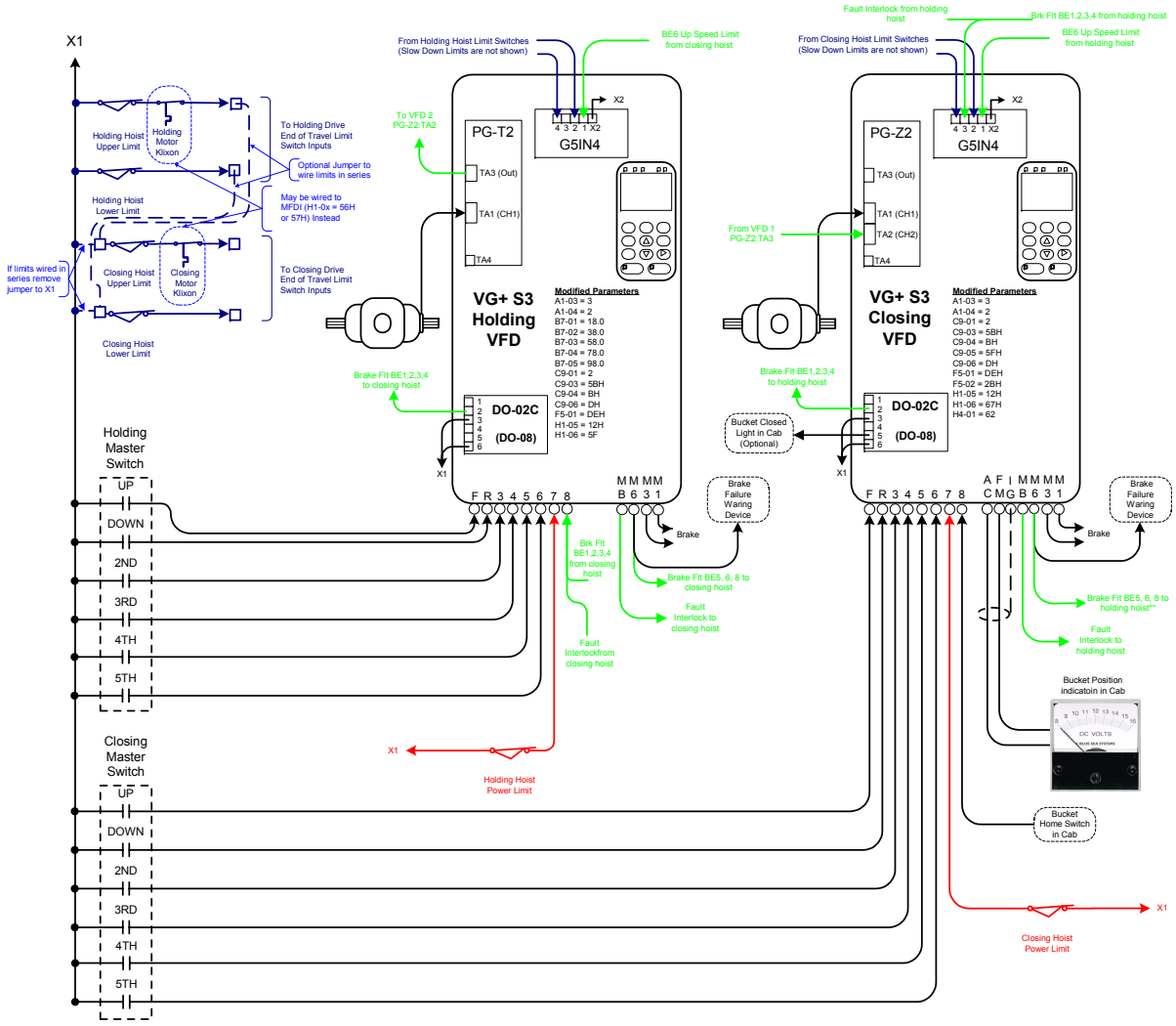
7. Ultra Lift - C6-01 can not be enabled exclusively by MFDI. There must be a combination of Enabled Automatic so that both hoists can check their load to insure they are capable of ultra lift. If they are both capable, they then send a signal back to themselves via MFDI which Enables Ultra Lift. Ultra lift is allowed in the lower direction only. C6-01 can not be programmed to 2 - Enable by MFDI.

8. Ultra Lift - When using Ultra Lift, D5-04 must be set according to the following equation: ((E1/06 / E1-04) * 100) to limit the speed in the raise direction. If this is not done, the torque may be insufficient to lift a heavy load and could result in undesired operation. Note: If operation above base speed is required in the raise direction, adjustment of D5-04 will accomplish this, however it may become difficult if not impossible to regulate torque and correctly share the load which could result in spillage.

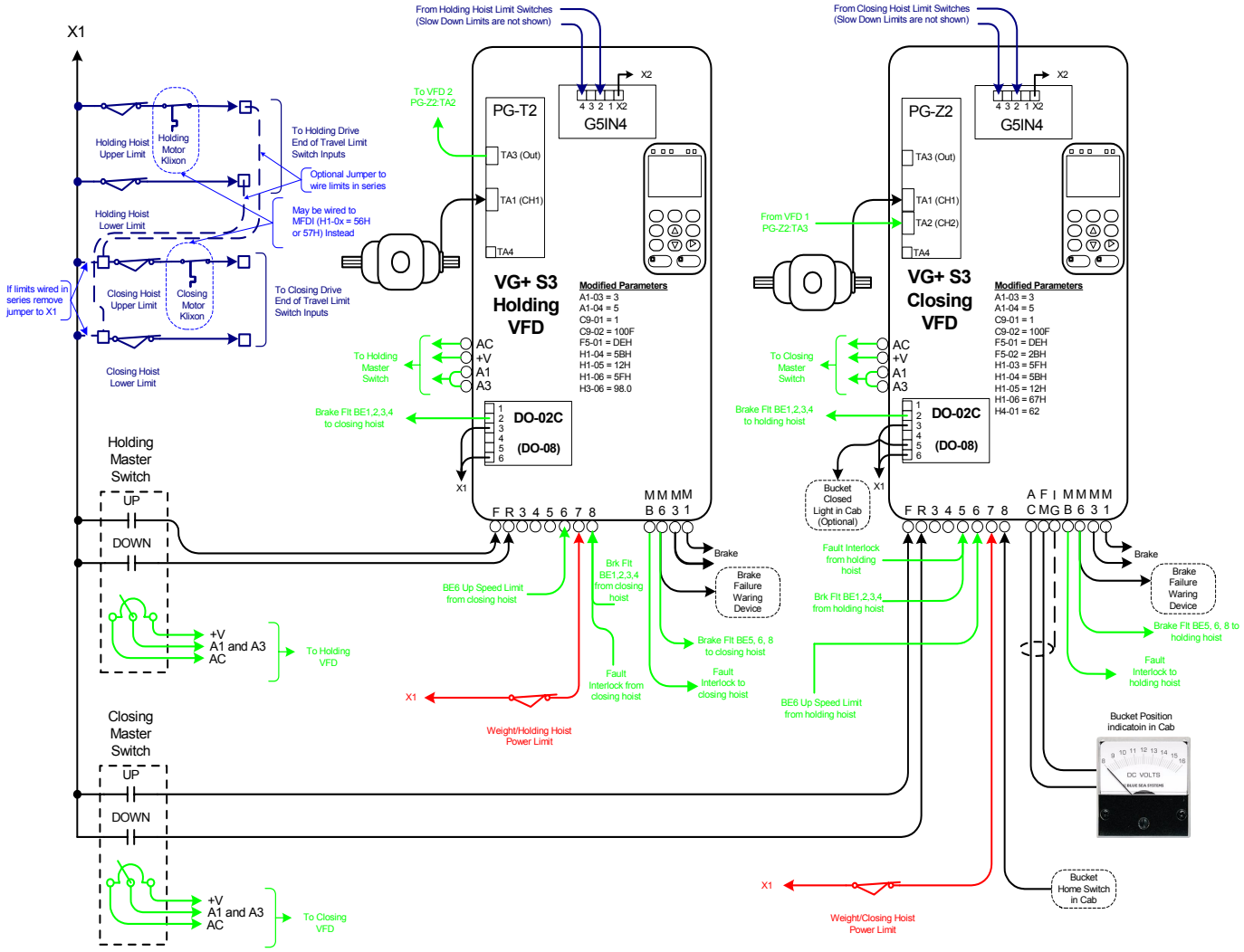
Hardware (PG-Z2)



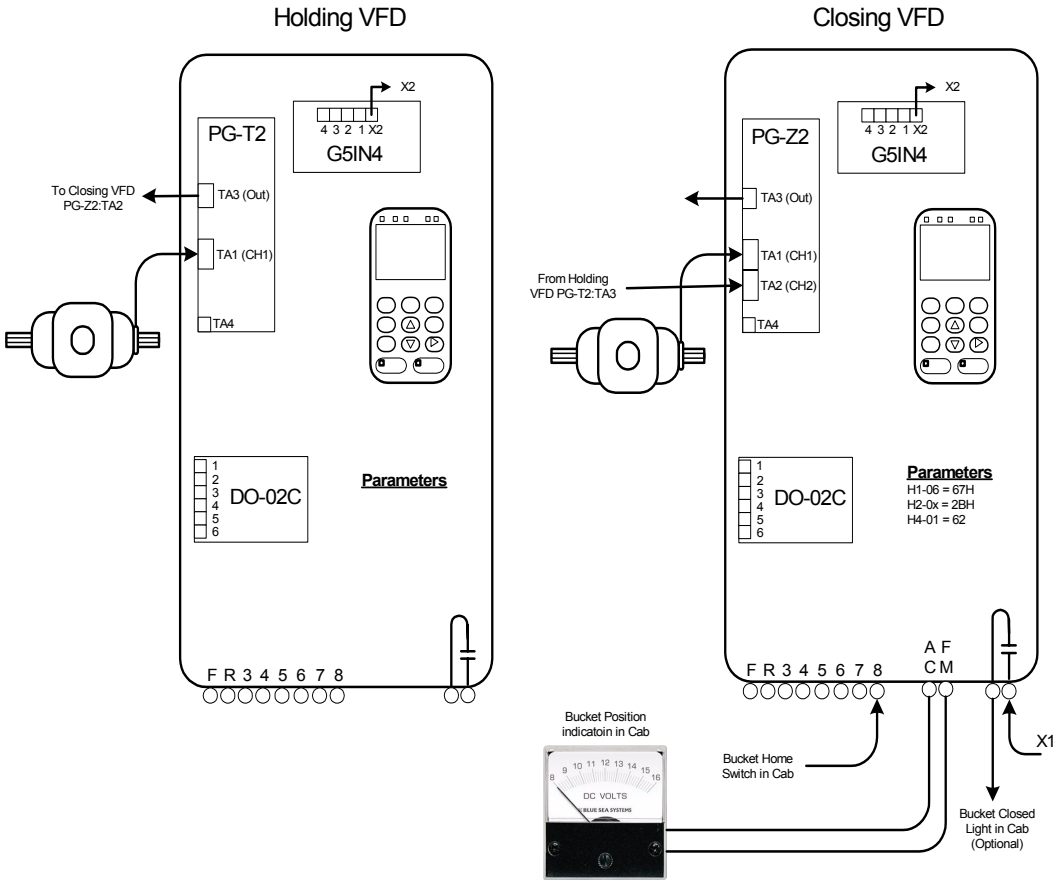
Typical Interconnect Wiring Diagram / Programming for VG+ Series 3 - Multi-Step Master Switch



Typical Interconnect Wiring Diagram / Programming for VG+ Series 3 - Analog Master Switch



Bucket Position Indication



Notes:

1. The diagram shown is not a complete Bucket Hoist control schematic. It only represents the bare minimum requirements for bucket position indication.
2. A PG-Z2 Option card is required for the closing inverter.
3. VG+ Series 3 Bucket position indication is backward compatible with VG+ Series 2 when an Impulse VG+ Series 3 inverter is used for one of the hoists. i.e. Series 2 Holding, Series 3 Closing.
4. When using Bucket Position indication, an MFDI must be programmed for 67H or an OPE will result.
5. The bucket position indication analog output (62 - Delta Revs) can be configured for 0-10V, ± 10V or 4-20ma.

Special Function Compatibility and Limitations Matrix

Due to the Load Sharing / Speed Matching capabilities, certain functions may be disabled or have special limitations. .

SPECIAL FUNCTION	Use in BUCKET MODE?	Remark
MOP (Motor Operated Potentiometer) / TRIM Control: B4-01 is disabled (Hold Fref), B4-02, MFDI 38H, 3DH, 3EH, 45H, 46H	No	Can not select when A1-03 = Bucket
Accel / Decel: B5 Group, MFDI 1AH, 1BH, 1CH, 40H,	*Yes	Acceleration times are ignored during Fwd Run Cmd
Speed Search: B6 Group, MFDI 50H	No	
Jump Frequencies: B8 Group	*Yes	Lower Direction Only
Quick Stop: C1-01, C1-02	Yes	
Reverse Plug: C1-03 ~ C1-05	No	Can not Enable when A1-03 = Bucket
Micro Speed:C2 Group, MFDI EH, 10H	*Yes	Fwd Run: uses D5-04 instead of fref.
Travel Limits:C3 Group, MFDI 6H ~ DH, 12H, 62H	*Yes	Fwd Run: Limits use Speed Limit. Speed Limit Ramp down time is not programable.
Load Float: Automatic (C8-10)	Yes	
Load Float by MFDI: MFDI 11H or 35H	No	
Load Check: C5 Group	No	Can not Enable when A1-03 = Bucket
Ultra-Lift	*Yes	Enable Automatic Only - NO MFDI. Lower Direction Only using interlock wiring. See Config notes.
Torque Limit: C7 Group, MFDI 14H	Yes	C7 Group has priority over analog / digital T-Ref
No Load Brake Hoist:A1-03, C8 Group	*Yes	Fwd Run: No BE3 Detection (possible to stall)
Traverse: A1-03	Yes	
Standard Hoist: A1-03 (Hoist Has a Mechanical Load Brake)	No	
Brake Answerback: C8 Group, MFDI 58H	Yes	BE4 / BE5 must be interlocked between hoists.
G5IN4: C9 Group	Yes	
Weight Measurement: C10 Group (Weight Limit Output by Load Cell input to set MFDO 33H)	*Yes	C10-01 = 4 Only - Load Cell
Slack Cable: C11 Group	*Yes	Slack Cable interlock wiring **optional**.
Snap Shaft (Drive Train Discontinuity): C11 Group	*Yes	Can not be used in conjuction with Bucket Position Indication - OPE16.
Timer Functions:C12 Group	Yes	
Maintenance Timer: C12-05, C12-06, MFDO 37H, U1-52	Yes	Uses Speed Limit * maintenace gain.
Inching / Indexing Control: C13 Group - MFDI 17 ~ 19H, 60H	No	
Swing Stop: C14 Group	No	
DC Injection: D1 Group	Yes	
Slip Compensation: D2 Group	Yes	
Automatic Speed Regulation (ASR): D4 Group	Yes	
Torque Control: D5 Group - MFDI 34H	Yes	
Droop Control: D6 Group	No	
PID Control: D7 Group, MFAI B, C, MFDI 48H ~ 4BH	No	
Dwell: D8 Group	No	Settings will be ignored for Hoist modes
S-Curve Accel / Decel: D9 Group	Yes	When Acc/Dec Times are used, S-curves are used.
V/F Pattern: E1 Group	Yes	
Motor 2: E3 ~ E4 Group	*Yes	Not recommended for application

SPECIAL FUNCTION	Use in BUCKET MODE?	Remark
Serial / High Speed Communications: H5, F6 Group	Yes	Modbus, Modbus +, Modbus TCP, Profibus When using communications for Control, Set B2-03 = Comms, (B3-01 = 1 Terminals to use digital Multi-Step Tref). T-Ref can also be sent by comms, but then a torque limit must also be sent when running in speed control.
Pulse Input / Output: H6 Group	No	
Motor Overload Protection: L1 Group	Yes	
PowerLoss RideThrough: L2 Group	No	
Speed Agree: L4 Group	*Yes	Fwd Dir: Speed Agree becomes speed Limit (D5-04)
Under / Over Torque Detection: L6 Group, MFDI 70 - OT / UT 0/1	Yes	
Hardware Protection: L8 Group	Yes	
Automatic Fault Reset: L9 Group	Yes	
Jog Control: B1-17, MFDI 15H, 16H	*Yes	Will use NLB Start / Stop (No Load Share) Use to reeve hoists by push buttons in control panel?
Drive Enable: MFDI 55H	Yes	
Allow Run at Powerup: B3-10	Yes	
DO-02C, DO-08 (Digital Output option Cards): F5 Group	Yes	
Phantom Fault: MFDI 5FH, 63H	Yes	
BE6 Up Speed Limit: C8-17, MFDI 5BH	Yes	Need to Handle Speed Limit in Trq Control
Brake Test: MFDI 61H	Yes	Brake test is only used while stopped. Not during Bucket Control . It is a maintenance only function.
Load Share: MFDI 66H	No	
Fault Annunciation: MFDO 40 ~ FFH	Yes	
Load Cell: MFAI 16H, MFDO 33H, C10-01 = 4	Yes	
Hook Height (Height Measurement): U1-50, U1-51	Yes	
Local Remote Control by Mode/Service Key or by MFDI 31H	Yes	Will Override bucket Control - could use for reeve?
Change Motor Rotation: B3-04	Yes	
Change Encoder Phases: F1-05	Yes	
Load Float Extension Time by MFDI 5D	Yes	Both Hoists should be set identically
BE6 / BE8 detection	Yes	
PGO Hardware failure detection for CH1 and CH2 of PG-Z2 (PG-T2 - CH1)	Yes	
AI-14B	Yes	Make sure other I/O cards are not using 2CN.
Load Catch (BE8)	Yes	Must be interlocked like BE6. (BE8)
DI-08	Yes	Make sure other I/O cards are not using 2CN.
DI-16H	Yes	Make sure other I/O cards are not using 2CN.
Test Mode 0/1by MFDI 71H - L5 Group	No	
Bucket Position Indication (Analog Meter and/or Discrete Out): MFDI 67H, MFDO 2BH, MFAO 62H.	Yes	Requires PG-Z2 card.
Klixon MFDI 56H, 57H, C3-11	Yes	