

# HITACHI WJ BASIC INSTRUCTION MANUAL

## DH PROGRAM #27

Detroit Hoist & Crane LLC, Co.  
6650 Sterling Drive North, Sterling Height Michigan 48312  
+1 586-268-2600



# Stop Read First!

**Important!** – This manual is for program number #27 from Detroit Hoist. Please verify the program number before using this manual by navigating to VFD parameter d024. To navigate to d024 and check your VFD's program number follow the steps chart below.

<b>Step</b>	<b>Instruction</b>
1	Power up the VFD.
2	Press the ESC button on the display one time and the screen will change to d001.
3	Use the UP arrow button to navigate to d024.
4	Press the SET button to view the value of d024.
5	To return to the main screen press and hold the ESC button until the display returns to 0.00 or you can simply cycle power.

# Contents

BASIC SPECIFICATIONS .....	4
POWER CIRCUIT WIRING .....	5
CONTROL CIRCUIT WIRING.....	6
CONFIGURING SPEED CONTROL METHOD .....	7
CONFIGURING SPEEDS / FREQUENCIES.....	8
ACCELERATION / DECELERATION TIMES .....	9
ALTERNATE ACCELERATION / DECELERATION TIMES.....	9
MICRO-SPEED FUNCTION .....	10
LIMIT TO 1 <sup>ST</sup> SPEED FUNCTION.....	10
AUTO-SPEED 90HZ FUNCTION.....	11
SETTING THE AUTO-SPEED ACTIVATION VALUE.....	11
125% FIELD LOAD TESTING / OVER-WEIGHT BYPASS.....	12
HOIST OVER-WEIGHT FUNCTION .....	13
HOIST OVER-WEIGHT PARAMETERS.....	13
SETTING HOIST OVER-WEIGHT .....	14
CARRIER FREQUENCY .....	15
AUTOMATIC CARRIER FREQUENCY REDUCTION .....	15
RESET FAULT USING INPUT.....	16
OUTPUT SIGNAL WHEN FAULT OCCURS.....	16
ELECTRONIC MOTOR THERMAL PROTECTION.....	16
MOTOR BRAKE PARAMETERS.....	17
VFD CONTROL MODES.....	17
CONSTANT TORQUE CONTROL MODE / MANUAL TORQUE BOOST .....	18
CONSTANT TORQUE CONTROL MODE / AUTOMATIC TORQUE BOOST .....	19
FINE TUNING AUTOMATIC TORQUE BOOST.....	19
SENSORLESS VECTOR CONTROL MODE.....	20
FINE TUNING SENSORLESS VECTOR.....	21
AUTO-TUNING .....	22
REDUCED LOAD SWING .....	23
TANDEM HOIST / TROLLEY EZCOM (SPEED / COMMAND SYNCING) .....	24
EZCOM SETUP GUIDE .....	25
EZCOM PARAMETERS .....	25
EZCOM CIRCUIT WIRING.....	26
VIEW FAULT HISTORY .....	27
CLEARING FAULT HISTORY.....	28
FAULT / ERROR CODES DESCRIPTION.....	29

## BASIC SPECIFICATIONS

For specifications that are not listed please contact Detroit Hoist for further information.

- Input power 3-phase 50/60hz (recommended).
- Single phase applications must derate VFD to 70% and may require a larger VFD to supply the required motor current. Please contact Detroit Hoist for further information on single phase applications.
- 380-480Vac (400v class models WJ-\*\*\*\*\*-HF).
- 208-240Vac (200v class models WJ-\*\*\*\*\*-LF).
- Digital I/O's are 24vdc (27vdc max).
- Voltage fluctuation must be -15% to +10% or less.
- Voltage imbalance must be  $\pm 3\%$  or less.
- Frequency variation must be  $\pm 4\%$  or less.
- Total harmonic distortion (THD) of voltage must be  $\pm 10\%$  or less.
- Ambient temperature -10 to 50°C | 14 to 122 °f.
- In case of utilization at an altitude of 1000m or more, consider that the atmospheric pressure is reduced by 1% for every 100m up. Apply 1% derating from the rated current by increasing every 100m and conduct an evaluation test.
- IP20 – UL Open Type.
- Overload Current Rating 150% 60sec / 200% 3sec.
- All Digital I/O is 24vdc.
- Suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes.
- Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.
- Pollution degree 2 environment and Overvoltage category III.
- Built-in dynamic braking chopper circuit.

## POWER CIRCUIT WIRING



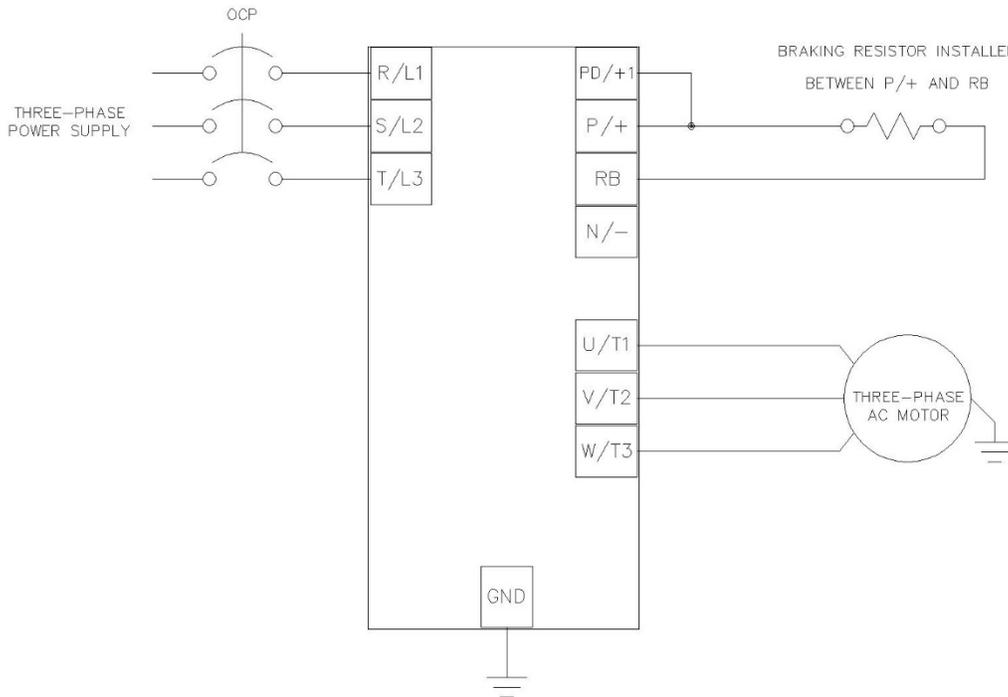
### • Risk of electric shock!

- Before inspecting the inverter, be sure to turn off the power supply and wait for more than 10 or 15 minutes depending on the inverter model\*1. (Before inspection, confirm that the Charge lamp on the inverter is off and the DC bus voltage between terminals P and N is 45 V or less.)



### • Risk of electric shock!

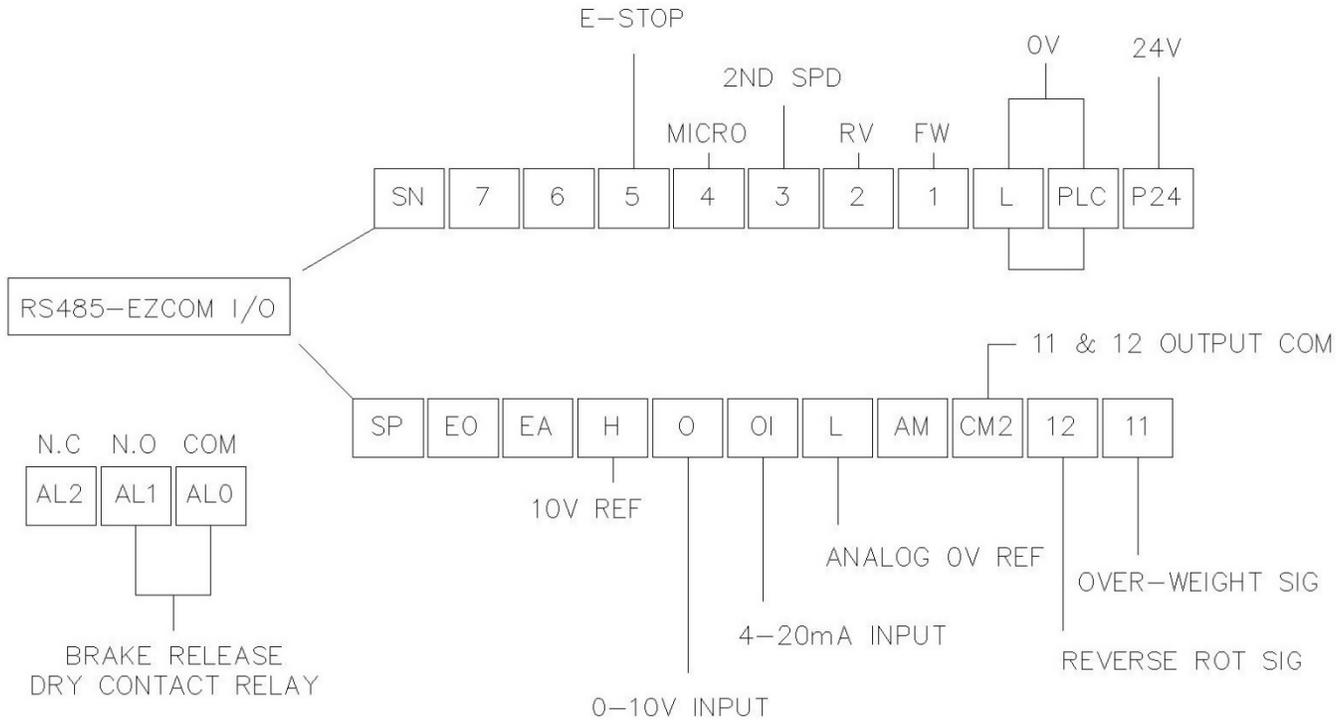
- Before inspecting the inverter, be sure to turn off the power supply and wait for more than 10 or 15 minutes depending on the inverter model\*1. (Before inspection, confirm that the Charge lamp on the inverter is off and the DC bus voltage between terminals P and N is 45 V or less.)



Terminal Symbol	Basic Description	Extended Description
R, S, T (L1, L2, L3)	Main power input (3-ph 50/60hz)	Connect to the AC power supply. Leave these terminals unconnected when using a front end regenerative converter.
U, V, W (T1, T2, T3)	Inverter motor output	Connect three-phase motor or load reactor.
PD, P (+1, +)	DC link choke connection terminal	Remove the PD-P jumper from terminals, and connect the optional DC link choke for power factor improvement.
P, N (+, -)	DC bus positive and negative terminals.	Connection of a back end regenerative converter or external braking unit.
P, RB (+, RB)	Dynamic braking chopper circuit	Connect braking resistor.

## CONTROL CIRCUIT WIRING

Below is a basic example of the control circuit for the Hitachi WJ with the DH firmware and may differ from the actual configuration please reference the provided electrical drawing. Please consult Detroit Hoist if you plan to make changes to the control circuit for specific functions to ensure compatibility with the DH firmware. Please note that not all functions provided by standard Hitachi manual are compatible with the DH firmware and the use of them may cause the VFD to become unusable or unsafe.



Terminal Symbol	Description
P24	Internal 24V power supply.
1 - 7	24v digital inputs for command functions. 5.6mA Terminal 4, 6, 7 can be configured for allowed functions.
CM2	COM for 24v digital outputs 11 & 12
11 & 12	24v digital outputs. 60mA max
AL0 (COM), AL1 (N.O), AL2 (N.C) ( not configurable )	Brake release relay SPDT   250vac 5A(resistive) \ 250vac 1A(inductive)
L	0v / ground reference for all analog I/O's
O	Analog input 0-10V
OI	Analog input 4-20mA
H	Internal 10v reference.
SN, SP	RS485 / Ezcom communication terminals. Used for Modbus or Ezcom communication. Shielded twisted wire required and grounding of shield.
L / PLC	0V reference for internal 24V power supply and ground reference for I/O return.

## CONFIGURING SPEED CONTROL METHOD

Detroit Hoist VFD controls come factory pre-configured for 2-Step speed control unless otherwise specified during the ordering process.

Use the chart below to configure the speed control method that is required.

Speed Control Method	Parameters	Values
<b>2-Step</b>	P108	0
<b>2-Step Infinitely Variable</b>	P108	1
<b>3-Step</b>	P108	2
	P113	1
	C006	61
<b>3-Step Infinitely Variable</b>	P108	3
<i><b>*Note - 3-step infinitely variable uses the 2<sup>nd</sup> step as a frequency hold.</b></i>	P113	1
	C006	61
<b>0-10V Analog</b>	P108	4
<b>4-20mA</b>	P108	5

## CONFIGURING SPEEDS / FREQUENCIES

Speed / frequency values are stored as whole numbers (*example is 15.25 Hz = 1525*).

Use the chart below to configure the speeds / frequencies for the configured speed control method.

If operating at frequencies below or at 5hz for an extended amount of time an external motor cooling device may be required to prevent motor overheating.

Speed Control Method	Speeds	Speed Parameters	Example Values
<b>2-Step (factory default)</b>	1 <sup>st</sup> speed / low speed	P101	1000 (10.00 Hz)
	2 <sup>nd</sup> speed / high speed	P102	6000 (60.00 Hz)
<b>2-Step Infinitely Variable</b>	1 <sup>st</sup> speed / low speed	P101	1000 (10.00 Hz)
	2 <sup>nd</sup> speed / high speed	P102	6000 (60.00 Hz)
<b>3-Step</b>	1 <sup>st</sup> speed / low speed	P101	1000 (10.00 Hz)
	2 <sup>nd</sup> speed	P102	3500 (35.00 Hz)
	3 <sup>rd</sup> speed / high speed	P103	6000 (60.00 Hz)
<b>3-Step Infinitely Variable</b>	1 <sup>st</sup> speed / low speed	P101	1000 (10.00 Hz)
	n/a	n/a	n/a
	3 <sup>rd</sup> speed / high speed	P103	6000 (60.00 Hz)
<b>0-10V / 4-20mA</b>	1 <sup>st</sup> speed / low speed	P101	1000 (10.00 Hz)
	2 <sup>nd</sup> speed / high speed	P102	6000 (60.00 Hz)
<b>Auto-Speed</b>	Auto-Speed	P104	9000 (90.00 Hz)

## ACCELERATION / DECELERATION TIMES

Changing the acceleration time to a shorter time can cause a E01, E02, or E03 over-current and or E05 over-load fault /trip, if this occurs due to a short acceleration time increase the acceleration time and test again.

Changing the deceleration time to a shorter time can cause a E07 over-voltage fault/trip, if this occurs due to a short deceleration time increase the deceleration time and test again.

Use the chart below to configure the standard acceleration and deceleration times.

Function	Parameters	Example Value
Acceleration Time	F002	2.50 seconds
Deceleration Time	F003	1.00 seconds
Acceleration Curve	A097	00 = liner-curve
		01 = S-curve (default)
		02 = U-curve
		03 = Inverse U-curve
Deceleration Curve	A098	00 = liner-curve
		01 = S-curve (default)
		02 = U-curve
		03 = Inverse U-curve

## ALTERNATE ACCELERATION / DECELERATION TIMES

The alternate acceleration and deceleration function can be used to switch from the standard acceleration and deceleration times to an alternate acceleration and deceleration time based on a digital input, frequency break point, or reversal of direction command (aka reverse plugging). If you plan to use switch by input [2CH] you will need to configure an available digital input function for 09:[2CH] (example C006 = 09) and add the 24v circuit for that input.

Use the chart below to configure the standard acceleration and deceleration times.

Function	Parameters	Example Value
ALT Acceleration Time	A092	2.50 seconds
ALT Deceleration Time	A093	1.00 seconds
Method to switch to ALT Accel / Decel	A094	00 = Switching by input [2CH] (configure available digital input function to 09: 2CH)
		01 = Switching by frequency break point
		02 = Switching by direction reversal
Accel to ALT Accel break point	A095	15.00 Hz
Decel to ALT Decel break point	A096	15.00 Hz

## MICRO-SPEED FUNCTION

Micro-speed is designed to temporarily restrict the speed of the hoist to a lower speed and to prevent high speed operations until the function is released. The micro-speed function can be configured two ways.

**2-STEP MAINTAINED MODE** – This mode will switch to a 2-Step maintained speed set. This is helpful where the micro-speeds need to be specific. This mode can also be used to provide a single speed by setting the low and high micro speed values the same value. To use this mode P106 must have a value of 0.

**PERCENTAGE MODE** – This mode will take the value from P106 as a percentage of the standard speed set. Setting P106 to a value of 50 will provide a 50% reduction in speed to the standard speed sets for the configured speed control method.

In the chart below the digital input 4 is configured from the factory for micro-speed.

Function	Parameters	Value
Digital Input 4 Mirco-Speed Activation Input	C004	59:MI4
Mirco-Speed Low-Speed	P100	500 (5.00 Hz)
Mirco-Speed High-Speed	P105	1000 (10.00 Hz)
Micro-Speed Mode	P106	Value = 0 ( 2-STEP MAINTAINED )
		Value > 0 ( PERCENTAGE MODE )

## LIMIT TO 1<sup>ST</sup> SPEED FUNCTION

For applications where it is required to limit the VFD to 1<sup>st</sup> speed frequency you can configure an available digital input for that function. This is typically used for travel limits or when approaching an upper / lower hook limit. The parameter chart below references setting either digital input 6 or digital input 7.

Function	Parameter	Value
Input 6 Configuration	P113	2
Digital Input 6 Function	C006	61
Digital Input 6 Contact Status	C016	00 = N.O 01 = N.C
Input 7 Configuration	P114	2
Digital Input 7 Function	C007	62
Digital Input 7 Contact Status	C017	00 = N.O 01 = N.C

## AUTO-SPEED 90HZ FUNCTION

The auto-speed function will allow the VFD to increase the high speed to up to 90Hz when there is an empty hook or a light load. You can set this function for automatic or for input activation. The auto-speed function is not available when using 0-10V/4-20mA speed control methods, when micro-speed is active, and or when in tandem mode.

HOW IT WORKS – When the hoist is commanded in the forward/up direction and the frequency reaches the set high speed frequency, the VFD will check to see if the load monitor value is less than the auto-speed activation value and allow the frequency to increase to the auto-speed frequency.

Use the charts below to properly configure the auto-speed function. If you don't want Auto-Speed to activate unless there is an input, you can configure digital input 6 or digital input 7 for the Auto-Speed enable command.

Function	Parameter	Example Value
Auto-Speed Activation Value	P111	50
Auto-Speed Activation Method	P110	0 = Automatic 1 = With Input Enable
Auto-Speed Frequency	P104	9000 (90.00 Hz)
Input 6 Configuration	P113	3
Digital Input 6 Function	C006	61
Digital Input 6 Contact Status	C016	00 = N.O 01 = N.C
Input 7 Configuration	P114	3
Digital Input 7 Function	C007	62
Digital Input 7 Contact Status	C017	00 = N.O 01 = N.C

## SETTING THE AUTO-SPEED ACTIVATION VALUE

Step	Instruction
1	Attached 30% rated load to the hook block and lift the load just off the ground. <i>*NOTE – 30% should be the max load for 90 Hz &amp; 60% should be the max load for 75 Hz</i>
2	Navigate to VFD parameter d027. This will display the load value that will be used to set the auto-speed activation level.
3	Using the pushbutton or radio, command the hoist in the up/forward direction with high speed and record the value of VFD parameter d027 while the load is operating at the high-speed frequency.
4	Navigate to VFD parameter P111 and set the value to the value recorded from d027 + 3%. (example d027 = 37, set P111 = 40)
5	Verify the auto-speed function works by lifting the same load at high speed. If the auto-speed function is configured for automatic then you should see the speed increase to 90hz, if you are using the input activation function then make sure the input is active and you should see the speed increase to 90hz

## 125% FIELD LOAD TESTING / OVER-WEIGHT BYPASS

Each hoist is factory load tested prior to shipment. If a field load test is required, you will need to bypass the over-weight signal.

To bypass the over-weight signal, locate the bypass terminal knife disconnect it should be labeled “BPS” (use images below as reference) and pull the yellow/orange tab to open.

**IMPORTANT** - Be sure to close the over-weight bypass terminal knife disconnect “BPS” after the load test is complete, failure to do so may result in damage to the hoist in the case of an overload.

**NOTE** – Detroit Hoist recommends that 125% load tests should only be conducted by operating the hoist in low speed when the 125% load is suspended or the VFD may fault.



## HOIST OVER-WEIGHT FUNCTION

The VFD is setup to use the output current to the motor as the over-weight function. The VFD uses (2) over-weight current parameters. Over-weight (1) is when operating less than or equal to the low-speed frequency and over-weight (2) is when operating above low-speed frequency. The VFD automatically switches between over-weight (1) and over-weight (2) based on the frequency. Having (2) over-weights greatly increases over-weight accuracy and decreases the likelihood of a false over-weight condition.

The VFD has (3) configurations for the over-weight signal, external momentary, external maintained, Internal.

**External momentary** - will output a signal when the condition is met but will not maintain the output after the condition is no longer met. This configuration also uses digital output 12 assigned to 52:Reverse DIR with a N.C contact status which is used to latch a relay.

**External maintained** - will output a signal when the condition is met and maintain the signal until the reset condition is met or power is cycled.

**Internal** - does not require any external circuits to function. Internal works the same way as the external maintained but will internally prevent the hoist up function until the reset condition is met or power is cycled.

HOW IT WORKS – When the output current to the motor exceeds the value in the conditional over-weight current parameter for an amount of time that exceeds the detection delay time, the conditional digital output will turn on and activate a 24v relay to interrupt the hoist E-Stop circuit. The signal is turn off once the hoist has lowered for 2.0 seconds.

## HOIST OVER-WEIGHT PARAMETERS

Function	Parameters	Example Value
Over-Weight Signal Output Type	P122	0 = External Momentary
		1 = External Maintained
		2 = Internal
Over-Weight Detection Delay Time	P123	180 = (1.80 seconds)
Over-Weight Reset Time	P124	200 = (2.0 seconds)
<b>Standard Over-Weight</b>		
Standard Over-Weight (1) Value *Low Speed	C041	14.0 Amps
Standard Over-Weight (2) Value *High Speed	C111	15.0 Amps
Digital Output 11 Function	C021	44:MO1
Digital Output 11 Status	C031	00: N.O
Digital Output 12 Function	C022	52:Reverse Dir
Digital Output 12 Status	C032	01: N.C
Digital Output 12 On Delay	C132	2.0 s

## SETTING HOIST OVER-WEIGHT

Each hoist's over-weight settings will be set at the factory prior to shipment. In some cases, field adjustments may be required. Use the step chart below to set the hoist's over-weight settings.

Step	Instruction
1	Locate the terminal knife disconnect labeled "BPS" and pull the top of the yellow/orange tab outwards, this will bypass the over-weight circuit.
2	Attach the 100% rated load to the hook block.
3	On the VFD navigate to the output current monitor d002 by pressing the ESC button once and using the UP button to navigate to d002 and press the SET button to view the current monitor.
4	Proceed to lift the 100% rated load off the ground in low speed. Monitor the output current to the motor and write it down. Be sure to wait for the output current to normalize
5	Proceed to lift the 100% rated load off the ground in high speed. Monitor the output current to the motor and write it down. Be sure to wait for the output current to normalize.
6	Take the value from step 4 and multiply it by 1.05 and set over-weight (1) parameter C041 to that value.
7	Take the value from step 5 and multiply it by 1.05 and set over-weight (2) parameter C111 to that value.
8	Locate the terminal knife disconnect labeled "BPS" and close the tab.
9	Operate the hoist in low and high speed with the 100% rated load. If the over-weight circuit trips in low speed, then increase the value of over-weight (1) parameter until it no longer trips. If the over-weight circuit trips in high speed, then increase the value of over-weight (2) parameter until it no longer trips.

## CARRIER FREQUENCY

The carrier frequency is adjustable from 2.0kHz to 15kHz. The audible sound decreases at the higher frequencies, but RFI noise and leakage current may be increased. It is recommended that the carrier frequency is 2.3kHz or greater when operating in sensorless vector A044 = 03.

Function	Parameters	Value
Carrier Frequency	b083	2.0 – 15.0 kHz

## AUTOMATIC CARRIER FREQUENCY REDUCTION

The automatic carrier frequency reduction automatically reduces the carrier frequency according to the increase in output current. To enable this function, specify "01" for automatic carrier frequency reduction selection (b089).

When the output current increases to 60%, 72%, 84%, or 96% of the rated current, this function reduces the carrier frequency to 12, 9, 6, or 3 kHz, respectively. This function restores the original carrier frequency when the output decreases to 5% lower than each reduction start level.

The rate of carrier frequency reduction is 2kHz per second. The maximum limit of carrier frequency change by this function is the value specified for the carrier frequency setting (b083); the minimum limit is 3 kHz. Note: If 3 kHz or less freq. has been specified for b083, this function is disabled regardless of the setting of b089.

Function	Parameters	Value
Automatic Carrier Frequency Reduction	b089	00 = Disabled 01 = Enabled, depending on the output current 02 = Enabled, depending on the heat-sink temperature

## RESET FAULT USING INPUT

Resetting a fault remotely using an input to the VFD can be done by configuring one of the available digital inputs for reset. Use the chart below.

Function	Parameters	Value
Fault reset	C006 – C007	18 = RS

## OUTPUT SIGNAL WHEN FAULT OCCURS

You can configure a 24v digital output to turn on when a fault occurs. If the VFD is configured for hoisting, then you will need to configure the over-weight logic for either maintained or internal in order to free up digital output 12. If you need to change the over-weight logic, please reference the hoist over-weight function section to change the logic to maintained or internal.

Function	Parameters	Value
Output 12 Function	C022	05 = Faut / Alarm
Output 12 Contact Status	C032	00 = N.O 01 = N.C
Output 12 On-Delay Time	C132	0.0 – 100.0 s
Output 12 Off-Delay Time	C133	0.0 – 100.0 s

## ELECTRONIC MOTOR THERMAL PROTECTION

The VFD has a built-in electronic motor thermal protection function and is configured for constant torque loading. When the output current exceeds the value in b012 for a calculated time based on frequency and time the VFD will trip with an E05 fault.

Function	Parameters	Value
Electronic thermal level	b012	Motor FLA * 1.25

## MOTOR BRAKE PARAMETERS

The motor brake parameters can be adjusted based on the application needs.

**Brake wait time for release** – After the Brake Release Frequency Setting is reached, the inverter waits for the braking wait time (b121)

**Brake wait time for acceleration** – The inverter waits for the Brake Wait Time for Acceleration (b122), and then starts accelerating the motor up to the set acceleration frequency.

**Brake wait time for stopping** – Once the brake release signal is turned off, the inverter waits for the Brake Wait Time for Stopping (b123), and then starts decelerating the motor down to 0Hz.

Function	Parameter	Value
<b>Brake release frequency</b>	b125	2.50 Hz
<b>Brake set frequency</b>	b127	2.50 Hz
<b>Brake wait time for release</b>	b121	0.00 s
<b>Brake wait time for acceleration</b>	b122	0.00 s
<b>Brake wait time for stopping</b>	b123	0.00 s
<b>AL output relay output function</b>	C026	19: BRK

## VFD CONTROL MODES

The VFD control mode is pre-set from Detroit Hoist and should not be changed unless directed to by a Detroit Hoist employee.

Constant torque is typically used for all bridge motions and load brake hoist motions. Constant torque can be configured for manual torque boost or automatic torque boost. The default from Detroit Hoist is manual torque boost. Automatic torque boost uses the manual torque boost parameters as a start value and then adjusts based on the voltage compensation gain and slip compensation gain.

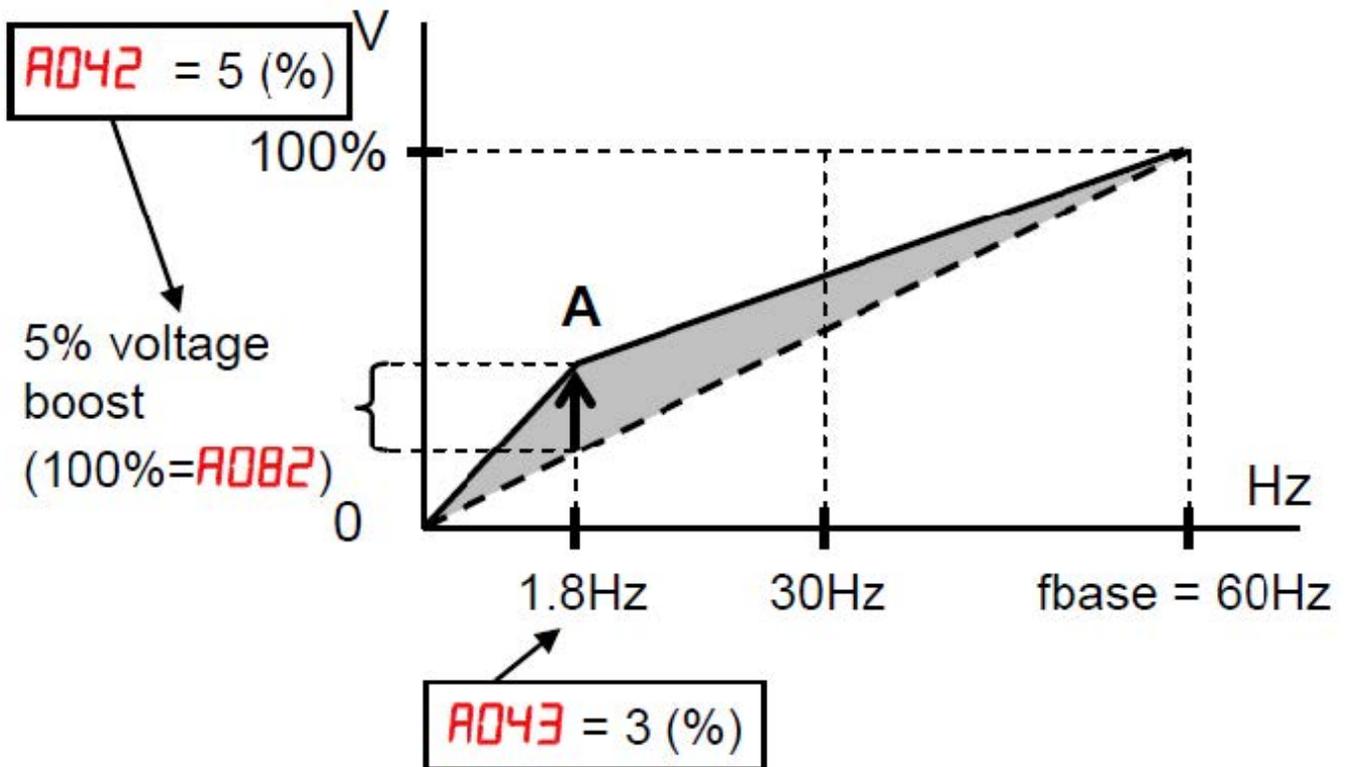
Sensorless vector is typically used for hoist trolleys to provide higher torque but can also be used for all motions if configured correctly.

Function	Parameter	Value
<b>Supported VFD Control Modes</b>	A044	00 = Constant Torque 03 = Sensorless Vector

## CONSTANT TORQUE CONTROL MODE / MANUAL TORQUE BOOST

Manual Torque Boost – The Constant and Variable Torque algorithms feature an adjustable torque boost curve. When the motor load has a lot of inertia or starting friction, you may need to increase the low frequency starting torque characteristics by boosting the voltage above the normal V/f ratio (shown below). The function attempts to compensate for voltage drop in the motor primary winding in the low-speed range. The boost is applied from zero to the base frequency. You set the breakpoint of the boost (point A on the graph) by using parameters A042 and A043. The manual boost is calculated as an addition to the standard V/f curve.

Function	Parameter	Value
Torque Boost Function	A041	00 = Manual
Torque Boost Value	A042	0.0 – 20.0
Torque Boost Break Point	A043	0.0 – 50.0
VFD Torque Control Mode	A044	00: Constant Torque



## CONSTANT TORQUE CONTROL MODE / AUTOMATIC TORQUE BOOST

In constant torque using automatic torque boost the starting torque boost value and frequency break point are used as starting points for automatic torque boost. Voltage compensation gain and slip compensation gain are used for fine tuning adjustments. Using parameters A046 and A047, you can obtain better performance under automatic torque boost mode (A041=01). See following table for the concept of adjustment, including other parameters.

Function	Parameter	Value
Torque Boost Function	A041	01 = Automatic
Torque Boost Value	A042	0.0 – 20.0
Torque Boost Break Point	A043	0.0 – 50.0
VFD Torque Control Mode	A044	00: Constant Torque
Voltage Compensation Gain	A046	0 – 255
Slip Compensation Gain	A047	0 – 255

## FINE TUNING AUTOMATIC TORQUE BOOST

Symptom	Adjustment	Parameter
<b>Motor torque is not enough at low speed (The motor does not rotate at low speed)</b>	Increase the voltage setting for manual torque boost, step by step	A042
	Increase the voltage compensation gain for automatic torque boost, step by step	A046
	Increase the slip compensation gain for automatic torque boost, step by step	A047
	Reduce carrier frequency	b083
<b>Motor speed decreases (stalls) when a load is given to the motor</b>	Increase the slip compensation gain for automatic torque boost, step by step	A047
<b>Motor speed increases when a load is given to the motor</b>	Decrease the slip compensation gain for automatic torque boost, step by step	A047
<b>The inverter trips due to overcurrent when a load is given to the motor</b>	Decrease the voltage setting for manual torque boost, step by step	A042
	Decrease the voltage compensation gain for automatic torque boost, step by step	A046
	Decrease the slip compensation gain for automatic torque boost, step by step	A047

## SENSORLESS VECTOR CONTROL MODE

Sensorless vector control can achieve high torque performance (200% torque at 0.5Hz of output frequency) without motor speed feedback (encoder feedback). Sensorless vector control enables the inverter to accurately operate the motor with a high starting torque, even at low speed. It estimates and controls the motor speed and output torque based on the inverter output voltage, output current, and the set motor constants on the inverter.

When using the sensorless vector function all parameters related to manual torque boost and automatic torque boost are disregarded.

To use sensorless vector function, set parameter A044 to the value of “3” and set parameter H003 to the closest value of the combined connected motors in kW's. In some cases, the value for H003 might need to be set (1) size larger or smaller in order to obtain good performance.

Function	Parameter	Value
VFD Torque Control Mode	A044	03: Sensorless Vector
Carrier Frequency	b083	2.3 kHz or greater
Combined Connected Motor's kW Constant	H003	0.1 – 18.5 kW

In sensorless vector you gain the ability to use the torque limit functions and torque monitor. The torque limit function can be used in traverse motions to help reduce load swing by setting the value of the forward and reverse driving torque limits to a value just over the required torque to move a 100% load. Reference the reduced load swing section for more information and setup instructions.

## FINE TUNING SENSORLESS VECTOR

In most cases fine tuning is not required with the standard motor constants that are supplied when selecting the correct motor constant profile in parameter H003. Before making adjustments, try selecting a motor constant profile (1) smaller or larger than the combined connected motors in kW's in parameter H003.

Status	Symptom	Adjustment Method	Adjustment Parameter
Powering	Momentary speed variation is negative	Increase the motor constant R2 step by step from the set value up to 1.2 times of the set value	H021
	Momentary speed variation is positive	Decrease the motor constant R2 step by step from the set value up to 0.8 times of the set value	H021
Regeneration	Torque is insufficient at low speed (~ few Hz)	Increase the motor constant R1 step by step from the set value up to 1.2 times of the set value	H020
		Increase the motor constant I <sub>o</sub> step by step from the set value up to 1.2 times of the set value	H023
Starting	Motor generates an impact at start	Reduce the motor constant J from the set value	H024
		Decrease the speed response factor	H005
	Motor runs backward for short moment at start	Set 01 (enable) on reverse run protection function (b046)	b046
Decelerating	Motor runs unsteadily	Decrease the speed response factor	H005
		Decrease the motor constant J from the set value	H024
Low Frequency Operation	Motor rotation is unstable	Increase the motor constant J from the set value	H024
		Increase the speed response factor	H005

## AUTO-TUNING

In some cases, performing an auto-tune to get the proper motor constant will help in providing optimal performance when operating in sensorless vector control mode A044 = 03. Before auto-tuning make sure that parameter H003 is set to a value of the combined connected motors in kW's, in some cases this value might be (1) size larger or smaller.

Use the step chart below to perform an auto-tune and to get / set the values.

Step	Instruction
1	Navigate to parameter H001 and change the value to (1) for static no rotation or (2) for rotational tune and press the SET button to save the change.
2	IMPORTANT! – All limits are ignored during the auto-tune process. Be sure to make sure you have enough travel if using the (2) rotational tune.
3	Using the pushbutton press the desired directional command to start the auto-tune. If rotational tune is selected the motor will operate in the direction commanded.
4	Once the auto-tune is complete the display will show ( _ _ _ O). If the display doesn't show an "O" that means the auto-tune failed and you will need to restart the test.
5	Once the tune is complete, parameters H030, H031, H032 will contain the obtained R1, R2, L motor constants.
6	Set parameter H020 to the value found in H030.
7	Set parameter H021 to the value found in H031.
8	Set parameter H022 to the value found in H032.
9	Operate the VFD and verify if the changed motor constants have improved the performance. If the performance is worse then change parameter H003 to a difference value and save it, then then change it back to the original set value to restore the default motor constants.

## REDUCED LOAD SWING

In traverse applications it is possible to reduce the chance of load swing by configuring the VFD for sensorless vector control and using the torque limits to help reduce starting load swing. Also, you will use the alternate acceleration and deceleration functions to reduce load swing when accelerating and decelerating to and from high speeds.

In order to configure the torque limits correctly you will need to lift 100% of the rated load.

### Torque Limit Configuration

Step	Instruction
1	Lift 100% of the rated load off the ground.
2	Navigate to parameter d012 on the traverse VFD that you are configuring. This is the output torque monitor.
3	Operate the traverse motion in low speed in any direction and wait for the torque monitor to stabilize. Write down that value.
4	Operate the traverse motion in high speed in any direction and wait for the torque monitor to stabilize. Write down that value.
5	Using the largest value that was monitored in either step 3 or step 4, set parameters b041, b042, b043, b044 to that value.
6	The Torque limits have now been set to the required amount of torque to move 100% load. Verify operation to make sure the traverse motion can still properly move the load. If the load fails to move increment the values by 1 in parameters b041, b042, b043, b044 until the load moves properly.

### Accel / Decel with ALT Accel & Decel Configuration

The acceleration and deceleration times are examples and can be modified to the specific application. The values in parameters F002 and F003 should be double then what is in parameters A092 and A093.

Step	Instruction
1	Navigate to parameter F002 and set it to 9.00 seconds. This is acceleration time (1) and will be used when accelerating from 0hz to 1 <sup>st</sup> / low-speed.
2	Navigate to parameter F003 and set it to 9.00 seconds. This is deceleration time (1) and will be used when decelerating to 0hz from 1 <sup>st</sup> / low-speed.
3	Navigate to parameter A092 and set it to 4.50 seconds. This is acceleration time (2) and will be used when accelerating from 1 <sup>st</sup> / low-speed to high-speed or anything greater low-speed.
4	Navigate to parameter A093 and set it to 4.50 seconds. This is deceleration time (2) and will be used when decelerating to 1 <sup>st</sup> / low-speed from high-speed or anything greater that low-speed.
5	Navigate to parameter A094 and set it to "01" : transition frequency. This will enable the alternate acceleration and deceleration change over based on transition frequency A095/A096.
6	Navigate to parameter A095 and set it to 1.00 Hz over the low-speed frequency. This is the frequency in which the acceleration will switch from acceleration time (1) to acceleration time (2). <i>Example: If 1<sup>st</sup> / low-speed frequency = 15.00hz then set A095 = 16.00hz</i>
7	Navigate to parameter A096 and set it to 1.00 Hz over the low-speed frequency. This is the frequency in which the deceleration will switch from deceleration time (1) to deceleration time (2). <i>Example: If 1<sup>st</sup> / low-speed frequency = 15.00hz then set A096 = 16.00hz</i>

Once everything is configured correctly test the traverse motion for proper operation. If the acceleration or decelerations times are too long for the application, then reduce the required times.

## TANDEM HOIST / TROLLEY EZCOM (SPEED / COMMAND SYNCING)

Tandem hoist / trolley EZCOM can be used when 2 hoists / trolleys are used in tandem operation and require the frequency, command status, and run status to sync between each hoist.

The VFD's will need to be configured to communicate between each other and the internal logic activated. A 2-wire shielded cable is required to connect between the VFD's SN/SP RS485 terminals (Belden 9538 type cable is recommended). Typically, A/B relays will be used to supply an input to the VFD to activate the syncing logic when in tandem mode, digital input EA is used.

HOW IT WORKS – The VFD's use the SN/SP RS485 terminals to send frequency, drive status, and command status Modbus registers values between each other. While in sync mode the VFD's compare the directional commands based on conditional internal logic, which ensures if a hoist / trolley reaches a limit, or loses a command signal the opposite hoist will follow the command. While in tandem mode the VFD's also compare frequency values and always sync to which VFD has the lowest frequency value, this ensures the set frequencies always match.

NOTE – If the VFD's are configured for EZCOM tandem sync ( $P116 > 0$ ) and the EZCOM communication is disconnected ( $d025 = 9999$ ) the hoist / trolley will ignore all directional commands even when in individual mode and the communication disconnection must be addressed.

TROUBLESHOOTING EZCOM COMMUNICATION DISCONNECTION ( $d025 = 9999$ ) – Use the VFD monitor parameter  $d025$  to monitor the EZCOM communication disconnection. If the value shown in  $d024 = 9999$  then the communication is disconnected or timed out or not configured correctly. Check the wiring between the VFD's SN & SP terminals. Also make sure the VFD's power up at the exact same time or use a digital input to active the EZCOM communication by configuring one of the available digital inputs to 81:485 Start if power cannot be verified at the same time. Verify EZCOM parameters are configured correctly using the EZCOM parameter chart.

## EZCOM SETUP GUIDE

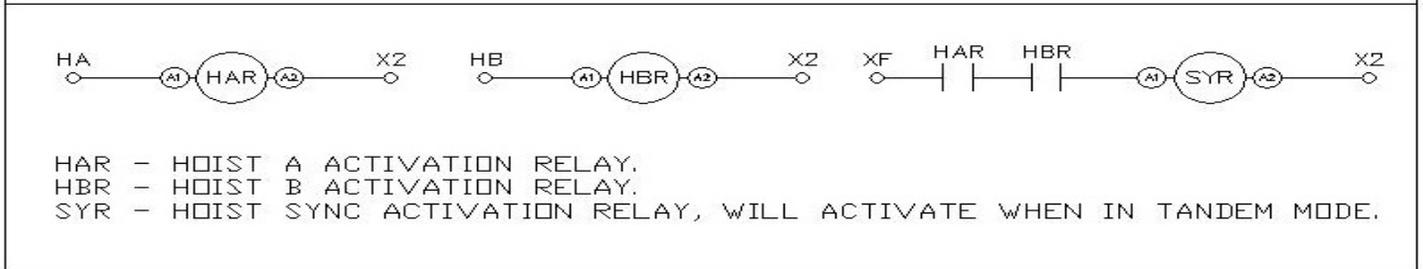
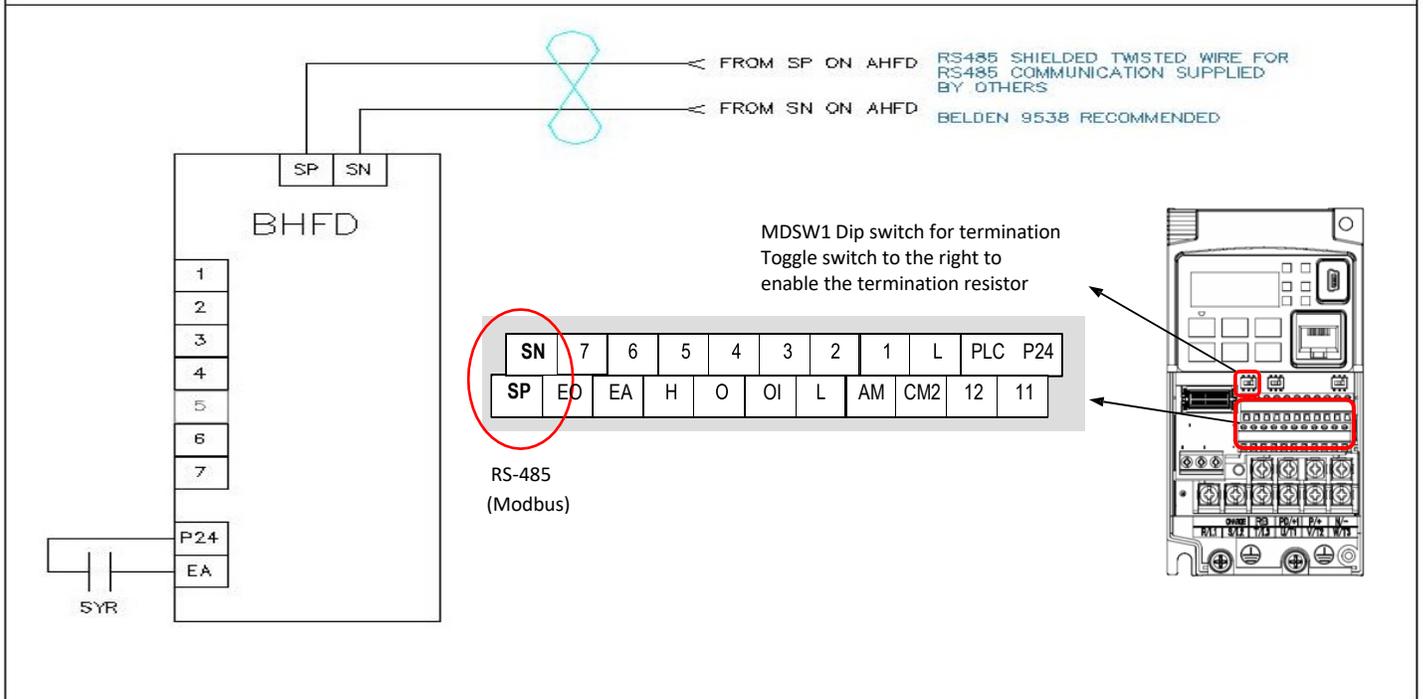
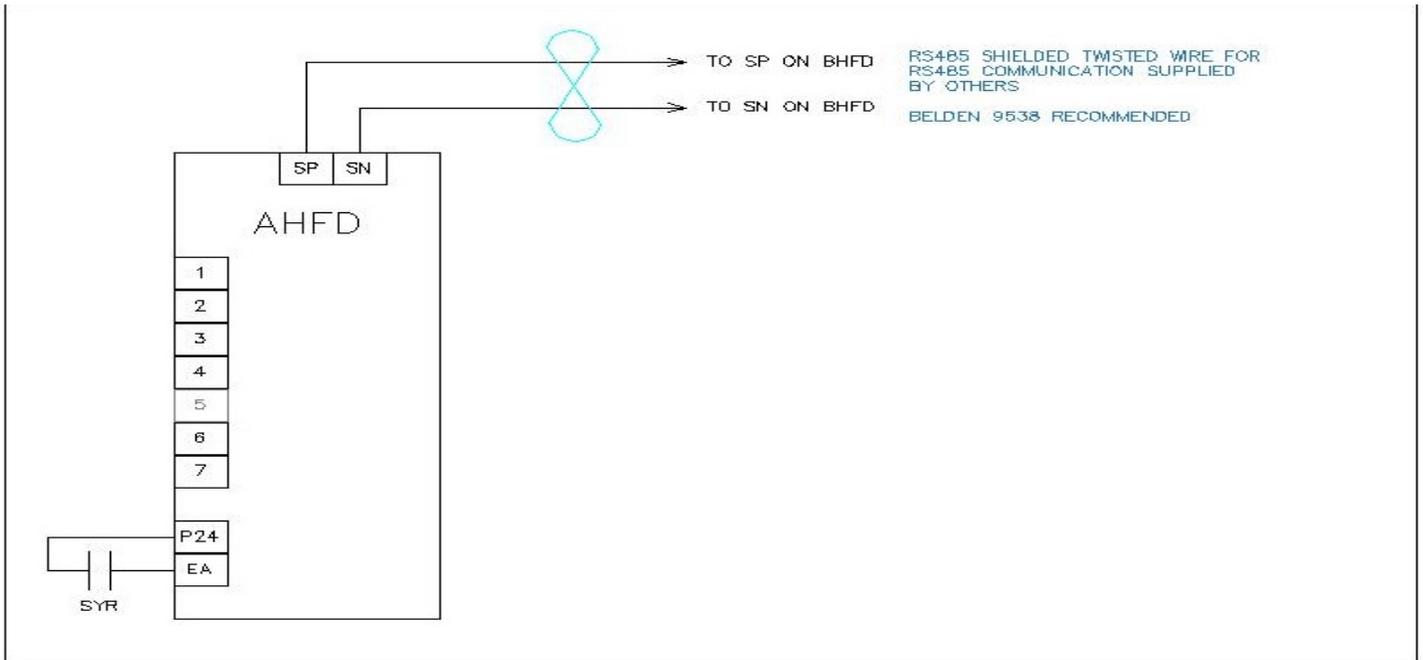
Step	Instruction
1	Configure the VFD's parameters using the EZCOM parameter chart. Most of the parameters should already be configured and only the ones highlighted in yellow should need to be changed.
2	Power down both VFD's and connect the 2-wire shielded cable to the corresponding SN & SP terminals as shown in the EZCOM circuit wiring example on the next page. Be sure to enable the RS485 termination resistor on B hoist VFD as shown on the EZCOM circuit wiring example.
3	Add the tandem activation circuit to digital input EA on each VFD as shown in the EZCOM circuit wiring example on the next page.
4	Power up the VFD's together at the same time and verify the communication is not disconnected by using the monitor parameter d025. If The value in d025 = 9999 then troubleshooting is required.
5	Operate the hoists / trolley in tandem and individually and verify correct operation.

## EZCOM PARAMETERS

Function	Parameter	Hoist A	Hoist B
Digital Input EA = Tandem Activation	P003	02	02
EZCOM sync mode	P116	1 = enabled speed + command	1 = enabled speed + command
EZCOM node ID	C072	1	2
EZCOM communication error select	C076	0 = trip with error	0 = trip with error
		2 = prevent run / without error	2 = prevent run / without error
EZCOM communication time out	C077	1.00 seconds	1.00 seconds
EZCOM communication wait time	C078	2 ms	2 ms
EZCOM communication mode	C096	02 = EZCOM Administrator	01 = EZCOM
EZCOM start node ID	C098	1	1
EZCOM end node ID	C099	2	2
EZCOM communication start method	C100	00 = digital input 81:ECOM	00 = digital input 81:ECOM
		01 = always start on power up	01 = always start on power up
EZCOM data size	P140	2	2
EZCOM destination address 1	P141	2	1
EZCOM destination register 1	P142	1676	1676
EZCOM source register 1	P143	1030	1030
EZCOM destination address 2	P144	2	1
EZCOM destination register 2	P145	1677	1677
EZCOM source register 2	P146	1678	1678

# EZCOM CIRCUIT WIRING

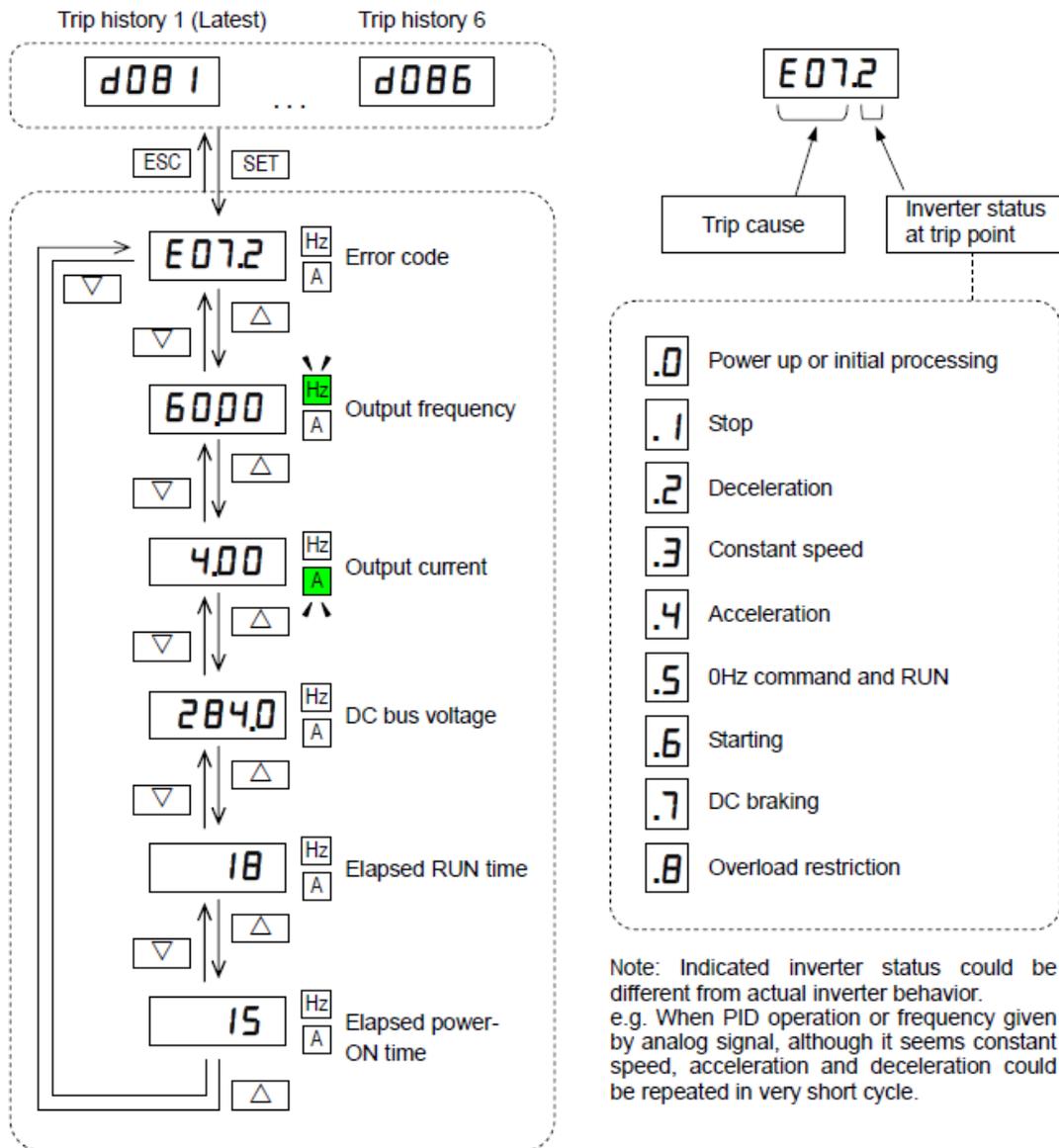
EZCOM wiring example circuit. Make sure the BVFD has the RS485 termination resistor dip switch toggled to the right.



## VIEW FAULT HISTORY

To view the fault history, use the step chart below.

Step	Instruction
1	Power on the VFD.
2	Press ESC button and use the arrow buttons to navigate to d081 – d086.
3	Press the SET button to view the fault.
<b>NOTE</b>	d081 will always be the most recent fault.



## CLEARING FAULT HISTORY

To clear the fault history, use the step chart below.

<b>Step</b>	<b>Instruction</b>
1	Power on the VFD.
2	Press the ESC button 4 times or until the screen displays b001.
3	Use the arrow buttons to navigate to parameter b084.
4	Press the SET button to enter the parameter, use the UP arrow to set the value to 01 and press the SET button to save the change.
5	Use the UP arrow to navigate to parameter b180.
6	Press the SET button to enter the parameter, use the UP arrow to set the value to 01 and press the SET button to save the change and the clearing process will begin. Once the process is complete the screen will return to d001.
7	You can use press and hold the ESC button until the screen returns to the frequency monitor or just cycle power.

## FAULT / ERROR CODES DESCRIPTION

<b>Fault / Error Code</b>	<b>Description</b>
<b>E01</b>	Over-current event while at constant speed
<b>E02</b>	Over-current event during deceleration
<b>E03</b>	Over-current event during acceleration
<b>E04</b>	Over-current event during other conditions
<b>E05</b>	Electronic thermal overload protection (motor current > b012)
<b>E06</b>	Dynamic braking resistor over used error. Check incoming voltage for spikes.
<b>E07</b>	DC-Bus over-voltage error. Check incoming voltage for spikes.
<b>E08</b>	Memory error / CPU error
<b>E09</b>	Undervoltage error. Check incoming voltage for low power / brown / sags.
<b>E10</b>	Built-in current detector error
<b>E12</b>	External trip error (digital input configured for Ext)
<b>E13</b>	<p>USP error</p> <p>This error occurs if an operation command has been input to the inverter when the power supply is turned ON. Operation command detection is carried out for 1 second after the power supply is turned ON. (When USP function is selected.)</p>
<b>E14</b>	Ground fault error
<b>E15</b>	Incoming voltage error (input power supply is too high)
<b>E021</b>	Inverter thermal trip inverter internal temperature is above the threshold
<b>E030</b>	IGBT error (ground fault to motor or on output of VFD) check motor leads or motor is shorted.
<b>E35</b>	Thermistor error
<b>E36</b>	Brake error
<b>E038</b>	Low-speed range overload error
<b>E040</b>	Operator keypad communication error
<b>E041</b>	RS485 / EZCOM communication error When C076 = 0
<b>E043 / E044 / E045</b>	<p>Internal Program illegal instruction error</p> <p>Typically indicated the internal program has been deleted using a factory default or the internal program memory is corrupted. Contact Detroit Hoist.</p>
<b>E80</b>	Encoder disconnection
<b>E81</b>	Excessive speed / Over-speed

## REVISIONS

<i>Version</i>	<i>Date</i>	<i>Changes / Updates</i>
1.0	1/7/2022	Initial release