Tornado F-3
Motor Controller

Operator Manual

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Global Production Solutions

Tornado F-3 Motor Controller

OPERATOR MANUAL

Revision 2.3

Change Log

Rev	Date	By	Description
2.3	Apr-25-2012		Inserted RS-485 pin descriptions & typical connections. GPS. Formatting.

Table of Contents

Chapter

1 Specifications

Motor Controller Unit

- Size (w x l x h): 5.87" x 7.62" x 2.00" (base plate dimensions)
- Weight: 2.5 pounds
- NEMA rating: NEMA 1
- Power – 110V AC (+- 10%), 0.25A load
- Digital Inputs – 2 dry contact inputs, can be configured as NO or NC, 5A Form“C”
- Analog Inputs – 2, 0-10VDC full scale. Only AI1 has high and low set points.
- CT Inputs – 3, one for each phase. CT range is 0-5 amps and should be set according to the tap point during installation to obtain correct operation.
- PT Input – 1 – PT input is to Pins 1 and 2 on the Control Unit, and monitors the voltage between Phase A and Phase C.
- Hand/Off/Auto – Control Unit has inputs for manual (Hand) or auto (Auto) operational control.
- Outputs – 3, Contactor, Amber indicator and Red indicator closure for front panel indicators. Output may be 110VAC or Ground, depending on relay common configuration.

Communications – 2, Comm 1 and Comm 2. Comm 1 has two connectors allowing either RS/232 or RS/485 protocols. The RS/232 uses a 9-pin connector, while the RS/485 use a 5 pin phoenix connector. Comm 1 is the primary channel for external communications. Comm 2 is configured only for RS485 (RJ45 type connector), and is used to interface to the Operator Display, Backspin Relay and Data Logger units. Standard protocol control is set to 9600 baud, 8 data bits, no parity, one stop bit, and no flow control.

Display Unit Specs

- Size – (w x l x h) – 3.10" x 4.25" x 1.37" (excludes mounting tabs)
- Weight – 0.5 pounds
- NEMA rating – NEMA 1
- Power – Derives its power via the communications cable from the motor controller. Approximately 0.05A load.
- Display –The unit is equipped with an operator's panel equipped with four micro-switches and two displays. The micro-switches control scrolling through the unit parameters and settings. One display is to indicate which parameter is being displayed; the second display is the current value of the parameter. The display unit is hermetically sealed to prevent liquid entry into the unit.
- Communications – 1, Comm1. Comm. 1 has two RS/485 ports (RJ45 type connectors) to be used. Comm. 1 is used to interface to the Motor Controller.

Chapter

2 Overview

Safety Warnings

Read and follow all Warnings, Precautions, Notes, and Instructions included in this document.

- A Warning identifies an immediate hazard that exists that poses some probability of causing death or serious injury.
- A Caution identifies potential conditions and actions that have the possibility of death or severe injury.
- A Note identifies the need for general safety practices which, if violated, could cause injury to personnel or damage to equipment.

High voltages are exposed during operation. Do not touch exposed surfaces during test.

Caution Verify wiring connections prior to applying power to the system. Damage to the equipment could result from incorrect connections.

Note Inspect system ground and bonds prior to power application. Shock hazard could exist if proper ground is not maintained.

Motor Control Unit

Warning

The Motor Control unit derives its power from the Power Transformer (PT), which is connected to the high voltage lines into the switchboard. High voltages are present during operation and set-up, and should be considered hazardous.

Specific connections for the Motor Control unit as well as parameter definition and values are given in other sections within this manual. In this section, an overview will be provided as an introduction to the operation of the Motor Control unit. Reference Figure 1 in the following descriptions.

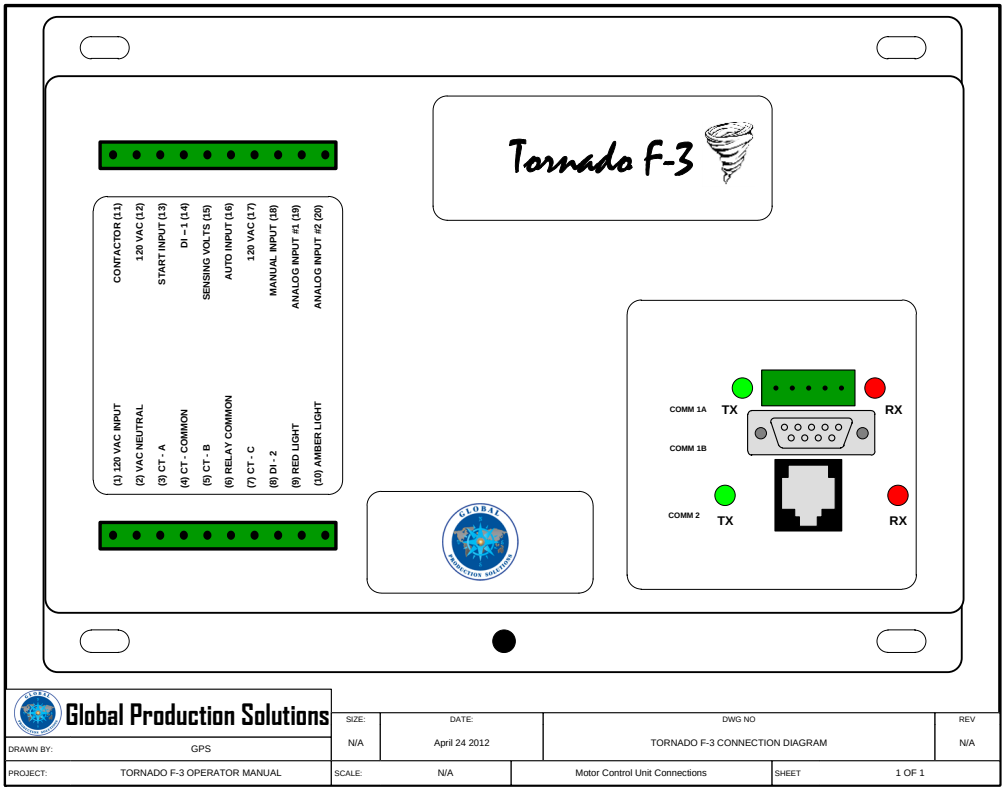

Figure 1- Motor Controller Unit Connection

PINS 1 & 2	These two pins are connected to the Power Transformer (PT), and provide the voltage base between Phase A and Phase C of the motor input power. The voltage is expected to be 120 VAC, and achieves this value through tap settings on the PT. Care must be taken to ensure the correct PT tap is set to prevent possible damage to the Motor Control unit.
PINS 3, 4, 5, & 7	These pins are associated with the Current Transformers (CT). Pins 3, 5, and 7 are the inputs from the CT's associated with the three phases of current flowing to the motor. Pin 4 is the common for the three taps. The CT's are all 0-5 amp range, and must have the proper tap setting to provide the correct sensing and check values during system operation. The tap setting should be the lowest that will permit the CT to maximize the amps/amp range of the input, with some allowance for over current occurrences. In conjunction with the CT inputs, the Motor Controller has parameter set points for over and under current sensing conditions. These provide motor shutdown signals as required for motor safe operation. There is also a start-up time delay that allows the motor to come to normal operation before the over/under sensing begins.
PINS 6, 12, & 17	These pins provide AC power and Common for use with switches, relays, or other devices requiring AC power for operation. Pin 6 can be tied to Pin 1 to switch hot, or Pin 2 to switch neutral.
PINS 8 & 14	These are the Digital Inputs and can be used with dry type contacts. They can be used as normally open (NO) or normally closed (NC) configured sensors, as determined by the parameter setting for each. Their use is installation requirement driven.
PIN 9 (Red Indicator)	Will normally be on for any of the following conditions: • an alarm is active • last shutdown caused by alarm configured as Lockout • Hand/Off/Auto switch is in OFF or HAND position
PIN 10 (Amber Indicator)	Will normally be on for any of the following conditions: • all alarms are clear • automatic restart will occur on delay timeout complete and H/O/A in Auto position
PIN 11 (Contactor and Green Indicator)	Enables motor contactor to energize, turning on motor. A green indicator may be tied to this line for motor running indication.
PIN 13 (Start)	Start button on the front of the switchboard. Causes the motor to start given all conditions are correct.
PIN 15 (Phase AB)	Sensing input point if phase AB is to be sensed and monitored. A second PT will have to be installed for this function.
PIN 16 (Auto)	Input from AUTO position of the H/O/A switch.
PIN 18 (Manual)	Input from HAND position of the H/O/A switch.
PIN 19 & 20 (Analog Inputs)	0-10 V analog input control signals.

Operator Display

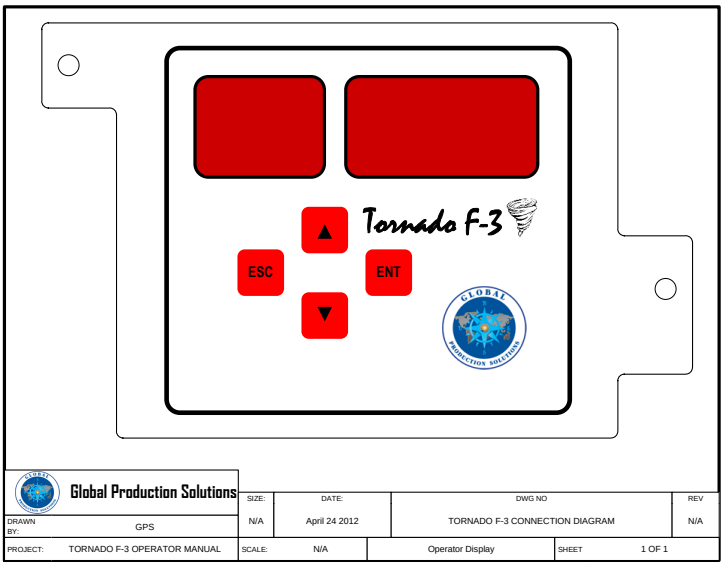

Figure 2 - Operator Display

The Operator Display unit can be either a permanently installed piece of equipment, or plugged in as desired to check and/or set system operating parameters. The unit is plugged into the Comm. 2 port using an RJ-45 type connector. The ESC arrow key permits the operator to switch back to the last menu. Once the selection is made via the ENT (Enter) key, the UP and DOWN arrow keys permit the operator to increase the displayed value (UP) or decrease the value (DOWN) to arrive at the desired parameter or set point. Once the desired point is reached, the ENT (Enter) key can be pressed to enter the data into the motor controller memory.

Typical operation would be to select ESC and then UP or DOWN to arrive at the parameter of interest. The selection would be followed by UP or DOWN to arrive at the value required for operation of that parameter. The operator would then depress ENT to save the value into memory. The parameters and range of value is given in the section covering parameter setting. Reference Figure 2 for the Operator Interface unit.

Chapter

3 PC Interface

An application support program is provided to support the Motor Controller in a fashion similar to the Operator Display. Through the Comm. 1 interface (either RS/232 or RS/485), the PC can, using the same key convention as the Operator Display unit, select, view, and set the various parameters in the Motor Controller.

In addition to the functions of the Operator Display, the PC can also make status checks of analog and digital inputs, check the current value of current measurements on CT1, CT2, and CT3, check the status of the light outputs (RED and AMBER), and other items of operational interest that have been saved in the Motor Controller memory.

Chapter

4 Installation

The Motor Control unit derives its power from the Power Transformer (PT), which is connected to the high voltage lines into the switchboard. High voltages are present during operation and set-up, and should be considered hazardous.

Control Unit

The Motor Controller is extremely easy to install. A typical wiring diagram is included in the Figure 4. The settings required for the parameter list must be determined prior to turning on the unit, and must be entered prior to attempting to operate the downhole unit.

Any fault that cannot be cleared must be resolved before continuing in the operation. Faults should not be bypassed or over ridden without explicit understanding of the underlying reasons for the fault.

Operator Display

The Operator Interface can be mounted inside the ammeter enclosure using the existing hardware.

There are no special connections required for the Operator Display. A typical installation is shown in Figure 3, with the cable being an industry standard UTP patch cord.

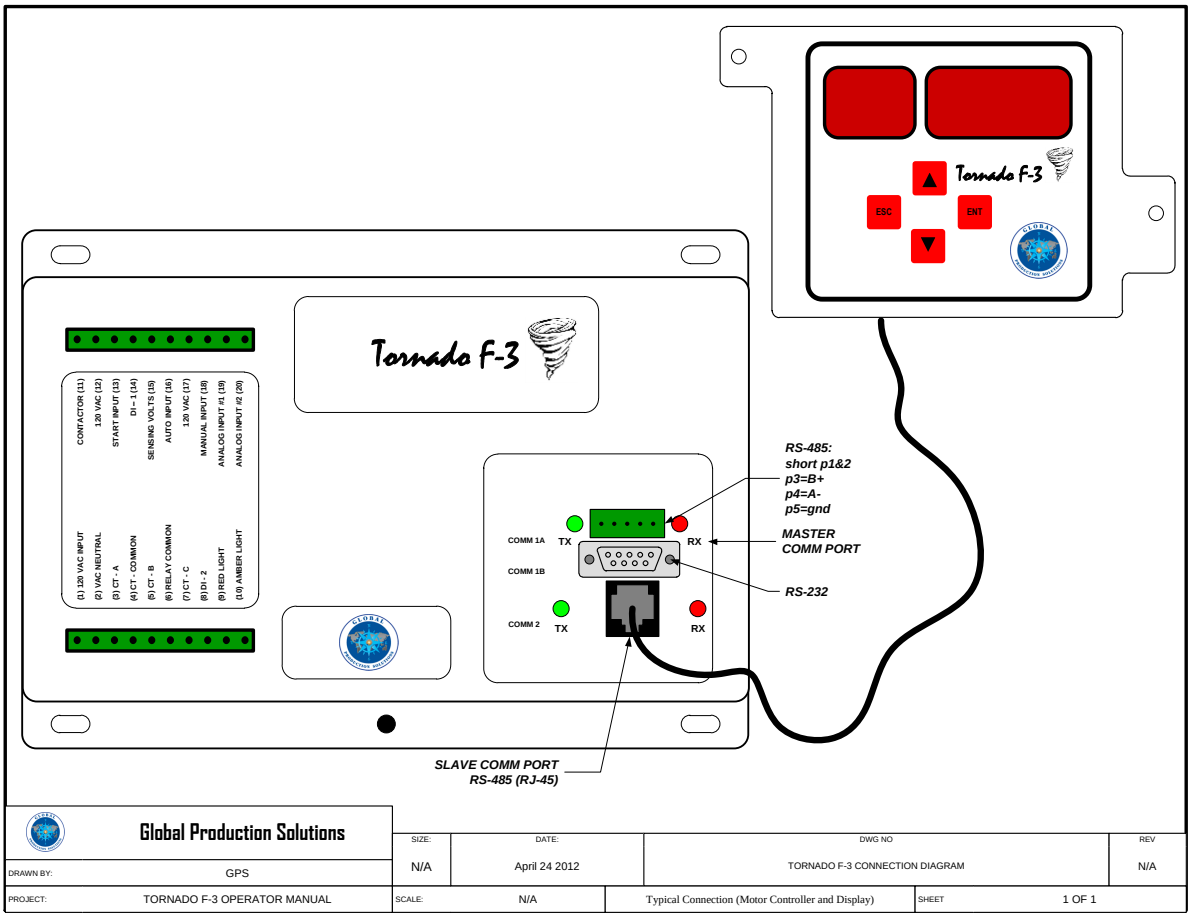

Figure 3 - Typical Connection

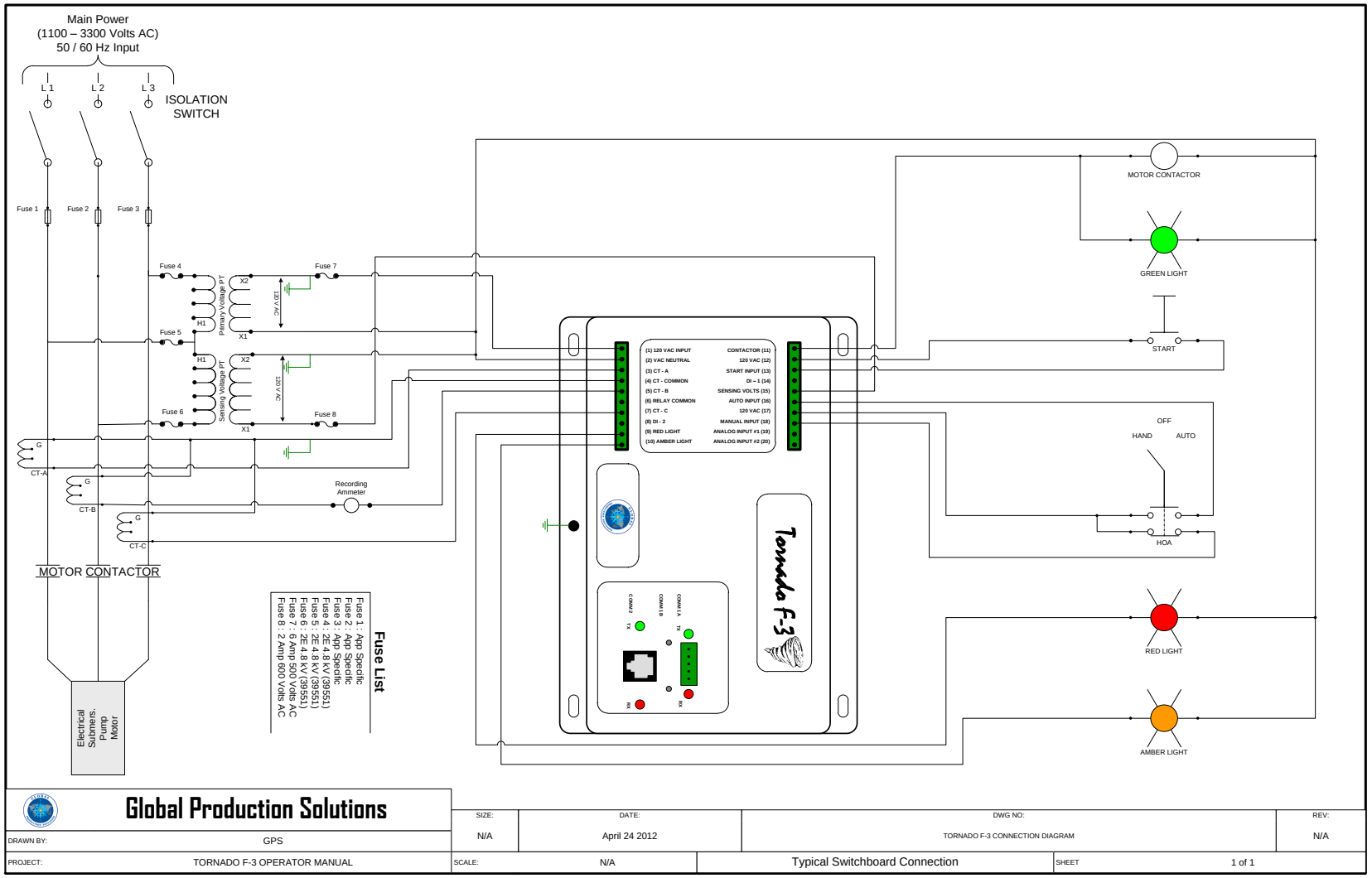

Figure 4 - Typical Switch Board Connection

Chapter

5 Digital Inputs (DI)

The Motor Controller has two each digital inputs. These can be utilized for dry contact remote shutdowns. The digital inputs can be configured for either N/O or N/C operations via software parameter list.

DI 1 ~ 44
DI 2 ~ 46
The Motor Controller parameter list default setting is N/O. An example of setup is illustrated below:

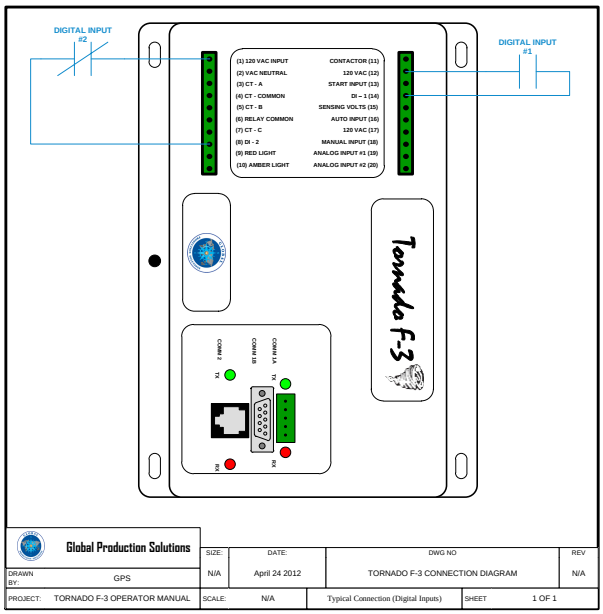

Figure 5 - Typical Digital Inputs

In the example, DI #1 is set to N/O and DI #2 is set to N/C. If the input to DI #1 is high, the motor controller will time out and shutdown. If the input to DI #2 is low, the motor controller will wait the preset time and shutdown. This is an example of N/O versus N/C configuration.

As mentioned above, there are ‘shutdown’ timers for each DI input. These are determining factors in how long the motor controller will operate the equipment in alarm status. Additionally, there are two other DI fault handling timers for DI #1 and DI #2 respectfully. The purpose of these timers is to allow the equipment to reach normal operating status after start-up. It must be noted on startup that both timers are cumulative. The ‘shutdown’ timer will not initiate its timing function until the ‘delay on start timer’ has reached its preset value.

Start W/1 Active designate restart capability with active alarm on respective DI. Since the ‘delay on start timers’ minimum value is 1 second, this parameter has been added to give the user greater control over restart and fault handling of the DI’s.

Example #1:

With Start W/1 Active set to ‘NO’. The Motor Controller receives a fault on DI #1 the contactor is opened and the alarm is still active on DI #1. The restart timer will count down to 1 minute and cease timing. It will stay in this dormant state until the alarm is cleared on DI #1. If Start W/1 Active had been set to “YES’ in this instance, the unit would have restarted automatically regardless of the active alarm state if DI #1.

Chapter

6 Analog Inputs (AI)

The Motor Controller provides two each Analog Inputs. The potential reference is based on neutral, which should be bonded to earth ground. The standard configuration is 0-10vdc. However, with the use of a shunt resistor and the correct setup of the offset menus, a 4-20 mA signal can also be accepted. It must be noted that Analog Input #1 is the only analog that can be configured to stop the equipment. Analog Input #2 is strictly for monitoring and has no control capability. With that exception both Analog Inputs have identical functionality.

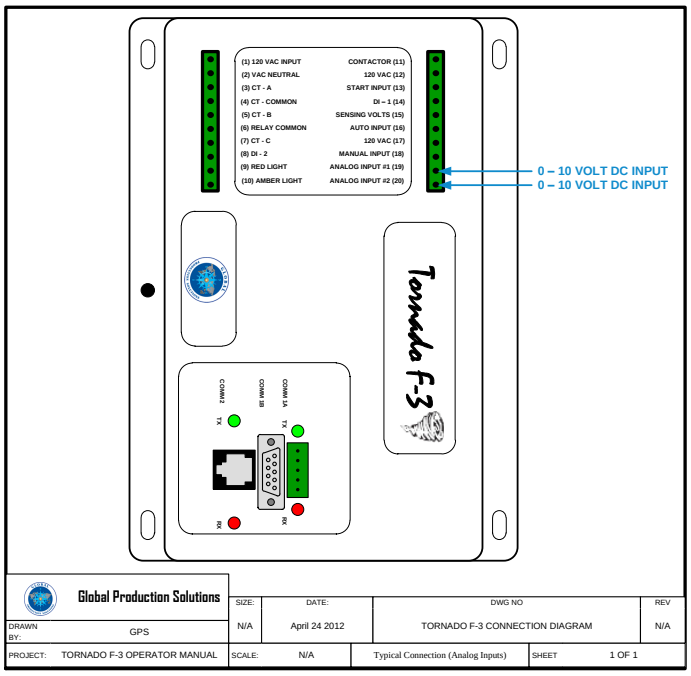

Figure 6 - Typical Analog Input Connection

EXAMPLE #1:

An external 0-10vdc signal has been connected to Analog Input #1. The external device is a downhole sensor rated at 0-5000 PSI. Conditions dictate if the pressure falls below 500 PSI or increases above 4900 PSI (indication of a loss of downhole signal) the Motor Controller must stop operation of the equipment.

SETUP

```
Analog 1 Span   = 5000
Analog 1 Offset = 0
AN. 1 High Trip = 4900
AN. 1 Low Trip  = 500
```

The actual engineering value can be seen in Analog 1 Level.

If a 4-20mA signal is used instead of a 0-10VDC, the offset and span can be adjusted accordingly. It must be stated that shunt resistance tolerances are critical to accuracy in this format.

Chapter

7 Panel Light Indication and Auto Restarts

The indicators in a normal application will consist of a Red, Amber, and Green indicators.

The green indicator is normally wired in parallel with the motor contactor off terminal 11 of the Motor Controller and is an indication of the unit operating.

The Amber indicator is connected to terminal 10 of the Motor Controller. The Amber indicator is no longer used in the Kratos functionality mode where it was used to indicate an Underload condition. An Amber indication illuminated serves to display to the user there are no active alarms and the Motor Controller is timing out and WILL allow an automatic restart when the restart timer has reached zero.

The Red indicator is connected to terminal 9 of the Motor Controller. The Red indicator is no longer used in Kratos functionality mode where it was used to indicate an overload condition. A Red indication illuminated servers to indicate to the user that an active alarm is present and an automatic restart WILL NOT be allowed.

Automatic restarts are allowed only if no active alarms are present OR an active alarm has been approved in the Parameter list to allow a restart. An example of this would be Start W/1 Active.

EXAMPLE #1:

Volt UNBAL Set (Voltage Unbalance Setpoint) ~ 10%
Restart Set (Restart Time) ~30 Minutes

A voltage unbalance occurs due to an overhead line fuse opening. The Motor Controller ceases motor operation. The Red indicator will illuminate. The restart timer will count from the preset of 30 minutes. Once the restart timer has reached 1 minute and the active alarm has not cleared, the timer will stop at 1 minute. If the alarm clears the timer will continue its count. If however between its counts from 1 minute to zero an alarm becomes active, the count will automatically be reset to 1 minute.

Chapter

8 Shutdowns and Fault Handling

The restart counters are broken into 3 categories.

1) – Overload
2) – Underload
3) – Faults

Each has its own specific set of allowable restart counters in the Parameter list.
Parameter #41 is used strictly to control the maximum allowed Underload restarts. Parameter #42 only deals with the maximum number of Overload restarts. Parameter #43 handles all other restarts OTHER than Overload and Underload to include the Di's.

The reset time (Parameter #53) functions as an internal counter reset to clear all three categories of start counters. It is a time based value. Simply stated, if the unit operates the motor for a time exceeding the value in the reset time all internal shutdown counts are reset. This does not change the values entered in Parameters #41, #42, or #43. It clears the internal memory that tracks these shutdowns.

Chapter

9 Parameter List

ID	Parameter	Maximum	Minimum	Units	Field Adjustable	Default	Description
1	A Phase Current	999.9	0	Amps	X	N/A	Real Time A Phase Current – True RMS Value; Scaled Via CT Ratio
2	B Phase Current	999.9	0	Amps	X	N/A	Real Time B Phase Current – True RMS Value; Scaled Via CT Ratio
3	C Phase Current	999.9	0	Amps	X	N/A	Real Time C Phase Current – True RMS Value; Scaled Via CT Ratio
4	Average Current	999.9	0	Amps		N/A	Real Time Current Average; (‘A’ Amps + ‘B’ Amps + ‘C’ Amps) / 3
5	Current Unbalance	999.9	0	Percent		N/A	Real Time Current Unbalance In Prevent
6	Voltage A-B	9999	0	Volts	X		Real Time Voltage For Phase A & B
7	Voltage A-C	9999	0	Volts	X		Real Time Voltage For Phase A & C
8	Voltage B-C	9999	0	Volts	X		Real Time Voltage For Phase B & C
9	Average Voltage	9999	0	Volts			In Single Phase, Volts AB = Average Volts. In 3 Phase Mode, Average Volts = (Volts AB + Volts AC + Volts BC) / 3
10	Voltage Unbalance	9999	0	Percent			Real Time Voltage Unbalance
11	Rotation	ABC	CBA	Text			Real Time Rotation Indication
12	Time Until Auto Restart	999	0	Minutes			Real Time Until Auto Restart Is Attempted
13	Reason No Restart						Reason Unit Will Not Auto Restart
14	Reserved						
15	Reserved						

16	Reserved						
17	Reserved						
18	Reserved						
19	Reserved						
20	Reserved						
21	Underload Setpoint	999.9	0	Amps	X	20.0	Trip Is Determined From Average Current
22	Overload i2t Factor	128	0	N/A	X	64	Time Factor Considered In i2t Calculations
23	Overload Setpoint	999.9	0	Amps	X	80.0	Trip Is Determined From Average Current
24	Current Unbalance Setpoint	100.0	0	Percent	X	15.0	
25	Undervoltage Setpoint	9999	0	Volts	X	1000	
26	Overvoltage Setpoint	9999	0	Volts	X	2000	
27	Voltage Unbalance Setpoint	100.0	0	Percent	X	10.0	
28	Rotation Setpoint	ABC	CBA	Text	X	ABC	
29	Backspin Enable	Yes	No	Text	X	No	
30	Reserved						
31	Reserved						
32	Reserved						
33	Reserved						
34	Reserved						
35	Reserved						
36	Reserved						
37	Wait For Restart Timer	Yes	No	N/A	X	No	“Yes” Value In The Register Will Not Allow A Restart Remotely Or Locally Unless Restart Time Is At ZERO
38	Monitor 3 Phase Voltage	Yes	No	N/A	X	No	If Parameter Is Set To “No”, Parameters 7,8,9,27 & 28 Are Removed From The Menu List
39	Current XFMR Ratio (X:5)	9999	0	Amps	X	100	
40	PT Ratio (X:120)	9999	0	Volts	X	1500	
41	Number Of Allowed Underload Restarts	100	0	N/A	X	3	

42	Number Of Allowed Overload Restarts	100	0	N/A	X	0	
43	Number Of Allowed Fault Restarts	100	0	N/A	X	3	
44	Discrete Inputs #1 (N/O or N/C)	N/O	N/C	N/A	X	N/O	
45	Allowed To Restart With Active Alarm On Di - 1	Yes	No	N/A	X	No	
46	Discrete Inputs #2 (N/O or N/C)	N/O	N/C	N/A	X	N/O	
47	Allowed To Restart With Active Alarm On Di - 2	Yes	No	N/A	X	No	
48	Reserved						
49	Reserved						
50	Reserved						
51	Reserved						
52	Restart Time	999	0	Minutes	X	30	
53	Reset Time	999	0	Minutes	X	30	
54	Fault Delay On Restart	9999	0	Minutes	X	5	
55	Fault Shutdown Delay	9999	0	Seconds	X	5	
56	Underload Delay On Start	999	0	Seconds	X	10	
57	Underload Shutdown Delay	999	0	Seconds	X	30	
58	Discrete #1 Delay On Start	999	0	Seconds	X	5	
59	Discrete #1 Shutdown Delay	999	0	Seconds	X	5	
60	Discrete #2 Delay On Start	999	0	Seconds	X	5	
61	Discrete #2 Shutdown Delay	999	0	Seconds	X	5	
62	Reserved						
63	Reserved						

64	Reserved						
65	Reserved						
66	Reserved						
67	Reserved						
68	Reserved						
69	Reserved						
70	Alarm @ Last Shutdown	N/A	N/A	N/A			
71	Alarm @ 2nd Last Shutdown	N/A	N/A	N/A			
72	Alarm @ 3rd Last Shutdown	N/A	N/A	N/A			
73	Alarm @ 4th Last Shutdown	N/A	N/A	N/A			
74	Alarm @ 5th Last Shutdown	N/A	N/A	N/A			
75	Total Starts Counter	65535	0	Text			
76	Resettable Starts Counter	65535	0	Text			
77	Total Run Time	65535	0	Hours			
78	Resettable Run Time	65535	0	Hours			
79	Reserved						
80	Reserved						
81	Reserved						
82	Reserved						
83	Reserved						
84	Reserved						
85	Reserved						
86	Reserved						
87	Reserved						
88	Reserved						
89	Analog Input #1 Real Time Value	9999	0	N/A			
90	Analog Input #2 Real Time Value	9999	0	N/A			
91	Analog Input #1 Span	9999	0	N/A	X	5000	
92	Analog Input #1 Offset	9999	0	N/A	X	0	
93	Analog Input #1 High Trip	9999	0	N/A	X	5000	

94	Analog Input #1 Low Trip	9999	0	N/A	X	0	
95	Analog Input #2 Span	9999	0	N/A	X	100	
96	Analog Input #2 Offset	9999	0	N/A	X	0	
97	Controller Serial #	9999	0	N/A			
98	Controller Firmware Revision	9999	0	N/A			
99	Display Firmware	9999	0	N/A			
A1	Display Firmware #	9999	0	N/A			
A2	Backspin Module Serial #	9999	0	N/A			
A3	Backspin Module Firmware #	9999	0	N/A			
A4	Reserved						
A5	Reserved						
A6	Reserved						
A7	Reserved						
A8	Reserved						
A9	Reserved						
B1	Reserved						
B2	Reserved						
B3	Reserved						
B4	Reserved						
B5	Reserved						
B6	Reserved						
B7	Reserved						
B8	Reserved						
B9	Reserved						
C1	Reserved						
C2	Reserved						
C3	Reserved						
C4	Reserved						
C5	Reserved						
C6	Comm Port #1 Baud Rate	28800	12200	N/A	X	1200	Changes Baud Rate Of Comm Port #1
C7	Modbus ID (Slave Address)	255	0	Text	X		
C8	Timeout	999	0	MS	X		
C9	Code	9999	0	N/A	X		Not Used By Field Personal

Chapter

10 Parameter Definitions

Parameter #1 **A Phase Current**	This is a real time value of the actual current passing through the A Phase current transformer. This parameter is adjustable for fine tuning purposes.
Parameter #2 **B Phase Current**	This is a real time value of the actual current passing through the B Phase current transformer. This parameter is adjustable for fine tuning purposes.
Parameter #3 **C Phase Current**	This is a real time value of the actual current passing through the C Phase current transformer. This parameter is adjustable for fine tuning purposes.
Parameter #4 **Average Current**	This is a real time value. It is the average of A, B, and C Phase currents.
Parameter #5 **Current Unbalance**	This is a real time value and represents the % of imbalance between the highest and lowest of the three currents.
Parameter #6 **Voltage A-B**	This is a real time value of the voltage potential between A Phase and B Phase line. This reading is a product of the actual voltage scaled via the PT Ratio. This parameter is adjustable for fine tuning. **Not available in menu list if parameter #38 is set to 'NO'**
Parameter #7 **Voltage A-C**	This is a real time value of the voltage potential between A Phase and C Phase line. This reading is a product of the actual voltage scaled via the PT Ratio. This parameter is adjustable for fine tuning. This is also the input that provides the primary power for the MOTOR CONTROLLER. **Not available in menu list if parameter #38 is set to 'NO'.**
Parameter #8 **Voltage B-C**	This is a real time value of the voltage potential between A Phase and C Phase line. This reading is a calculated voltage based off of A-C and A-B inputs. This parameter is adjustable for fine tuning. **Not available in menu list if parameter #38 is set to 'NO'.**
Parameter #9 **Average Voltage**	This is a real time value the average of the three line voltages. **Not available in menu list if parameter #38 is set to 'NO'.**
Parameter #10 **Voltage Imbalance**	This is a real time value representing the % of imbalance between the highest and lowest of the three line voltages. **Not available in menu list if parameter #38 is set to 'NO'.**

<table>
<tr><td>Parameter #11
Rotation</td><td>This is a real time value representing the actual rotation sequence of the incoming line.
Not available in menu list if parameter #38 is set to ‘NO’.</td></tr>
<tr><td>Parameter #12
Time Until Auto-Restart</td><td>This is a real time value representing the time until the MOTOR CONTROLLER will attempt to automatically restart the equipment.</td></tr>
<tr><td>Parameter #13
Reason For No-Restart</td><td>This give the user indications of what active alarms are present prohibiting the MOTOR CONTROLLER from starting the equipment. Below is a list of possible display and corresponding meanings.
<table>
<tr><td>OVT Overvoltage</td></tr>
<tr><td>UVT Undervoltage</td></tr>
<tr><td>VUB Voltage Unbalance</td></tr>
<tr><td>ROT Rotation error</td></tr>
<tr><td>DI1 Digital Input 1 Active</td></tr>
<tr><td>DI2 Digital Input 2 Active</td></tr>
<tr><td>AN1L Analog 1 Below "Low Setpoint"</td></tr>
<tr><td>AN1H Analog 1 Above "Hi Setpoint"</td></tr>
<tr><td>SPIN Backspin Active</td></tr>
</table>
Table 1: Alarm Indications</td></tr>
<tr><td>Parameter #14 through # 20</td><td>Reserved</td></tr>
<tr><td>Parameter #21
Underload Setpoint</td><td>This is a user defined value. If the AVERAGE of the three currents (parameter #4) falls below this setpoint for a duration that exceeds the Underload delay timer, the MOTOR CONTROLLER will stop the operation of the equipment.</td></tr>
<tr><td>Parameter #22
Overload I(2)T Factor</td><td>This is a user defined parameter. This is the reaction factor for initiating an Overload trip. The lower the number the quicker the reaction to an Overload.</td></tr>
<tr><td>Parameter #23
Overload Setpoint</td><td>This is a user defined parameter. If the average current (parameter #4) exceeds this setpoint the MOTOR CONTROLLER will stop the operation of the equipment.
The time it take to initiate an overload trip spends on the amount the average current exceeds the overload setpoint and the I(2)T factor in parameter #22.</td></tr>
<tr><td>Parameter #24
Current Unbalance Setpoint</td><td>This is a user defined setpoint. If the actual current unbalance (parameter #5) exceeds this setpoint for duration greater than the fault shutdown delay timer (parameter #55) the MOTOR CONTROLLER will stop the operation of the equipment.</td></tr>
</table>

Parameter #25 Undervoltage Setpoint	This is a user defined setpoint. If the average voltage (parameter #9) falls below this setpoint for duration greater than the fault shutdown delay timer (parameter #55) the MOTOR CONTROLLER will stop the operation of the equipment.
Parameter #26 Overvoltage Setpoint	This is a user defined setpoint. If the average voltage (parameter #9) exceeds this setpoint for duration greater than the fault shutdown delay timer (parameter #55) the MOTOR CONTROLLER will stop the operation of the equipment.
Parameter #27 Voltage Unbalance Setpoint	This is a user defined setpoint. If the actual voltage unbalance (parameter #10) exceeds this setpoint for duration greater than the fault shutdown delay timer (parameter #55) the MOTOR CONTROLLER will stop the operation of the equipment.
Parameter #28 Rotation Setpoint	This is a user defined setpoint. If the actual rotation is different than the value entered into this setpoint the MOTOR CONTROLLER will stop the operation of the equipment.
Parameter #29 Backspin	This is a user-defined parameter. If a “YES” is entered Backspin Option is enabled. If “NO” Backspin Option is disabled.
Parameter #30 through #36	Reserved
Parameter #37 Wait For Restart Timer	This is a user defined parameter. If a “YES” is entered into this parameter the MOTOR CONTROLLER will not allow a manual restart via the HOA and Start button. The unit cannot be started until the restart timer has timed out.
Parameter #38 Monitor 3 Phase Power	This is a user defined parameter. Entering a “YES” into this parameter indicates noting is connected to the sensing volts terminal. Therefore you do not have the capability to monitor three voltages.
Parameter #39 Current Transformer Ratio (X:5)	This is a user defined parameter. The actual current transformer value is entered in this parameter. It is based on X: 5. if you are using 75:5 CT’s, then the value of 75 will be entered.
Parameter #40 PT Ratio (X:120)	This is a user defined parameter. The actual PT tap setting is entered in this parameter.
Parameter #41 Number Of Allowed Underload Restarts	This is a user defined parameter. The maximum number of allowed Underload restarts before the MOTOR CONTROLLER will perform a lockout condition.
Parameter #42 Number Of Allowed Overload Restarts	This is a user defined parameter. The maximum number of allowed overload restarts before the MOTOR CONTROLLER will perform a lockout condition.

Parameter #43 Number Of Allowed Fault Restarts	This is a user defined parameter. The maximum number of allowed fault restarts before the MOTOR CONTROLLER will perform a lockout condition.
Parameter #44 Digital Input #1 N/O or N/C	This is a user defined parameter. If “N/C” is entered into this parameter the MOTOR CONTROLLER will stop operation of the equipment if 120VAC IS NOT present on terminal #14. If “N/O” is entered into this parameter the MOTOR CONTROLLER will stop operation of the equipment if 120VAC IS present on terminal #14
Parameter #45 Allow Start With Active Alarm On Digital Input #1	This is a user defined parameter. If this parameter is set to “NO” the MOTOR CONTROLLER will not allow an automatic restart or a manual start with Di-1 alarm active.
Parameter #46 Discrete Input #2 N/O or N/C	This is a user defined parameter. If “N/C” is entered into this parameter the MOTOR CONTROLLER will stop operation of the equipment if 120VAC IS NOT present on terminal #8. If “N/O” is entered into this parameter the MOTOR CONTROLLER will stop operation of the equipment if 120VAC IS present on terminal #8.
Parameter #47 Allow Start With Active Alarm On Digital Input #2	This is a user defined parameter. If this parameter is set to “NO” the MOTOR CONTROLLER will not allow an automatic restart or a manual start with Di-2 alarm active.
Parameter #48 through #51	Reserved
Parameter #52 Restart Time	This is a user defined parameter. The value entered in this parameter is the time the MOTOR CONTROLLER must wait before it attempts an automatic restart.
Parameter #53 Reset Time	This is a user defined parameter. The value entered in this parameter is the time the MOTOR CONTROLLER must be operating the equipment (RUN) before the Underload, Overload, and Fault counters are reset
Parameter #54 Fault Delay On Start Timer	This is a user defined parameter. The value entered in this parameter is the time the MOTOR CONTROLLER will ignore an active fault on startup before it initiates a stop command.
Parameter #55 Fault Shutdown Delay Timer	This is a user defined parameter. The value entered in this parameter is the time the MOTOR CONTROLLER will ignore an active while running before it will initiate a stop command.
Parameter #56 Underload Delay On Start Timer	This is a user defined parameter. The value entered in this parameter is the time the MOTOR CONTROLLER will ignore an active Underload on startup before it initiates a stop command.
Parameter #57 Underload Shutdown Delay Timer	This is a user defined parameter. The value entered in this parameter is the time the MOTOR CONTROLLER will ignore an active Underload while running before it will initiate a stop command.

Parameter #58 Digital Input #1 Delay On Start Timer	This is a user defined parameter. The value entered in this parameter is the time the MOTOR CONTROLLER will ignore an active Digital Input #1 alarm on startup before it initiates a stop command.
Parameter #59 Digital Input #1 Shutdown Delay Timer	This is a user defined parameter. The value entered in this parameter is the time the MOTOR CONTROLLER will ignore an active Digital Input #1 alarm while running before it will initiate a stop command.
Parameter #60 Digital Input #2 Delay On Start Timer	This is a user defined parameter. The value entered in this parameter is the time the MOTOR CONTROLLER will ignore an active Digital Input #2 alarm on startup before it initiates a stop command.
Parameter #61 Digital Input #2 Shutdown Delay Timer	This is a user defined parameter. The value entered in this parameter is the time the MOTOR CONTROLLER will ignore an active Digital Input #2 alarm while running before it will initiate a stop command.
Parameter #62 through #69	Reserved
Parameter #70 Alarm @ Last Shutdown	This parameter displays the last shutdown alarm that occurred.
Parameter #71 Alarm @ 2nd Last Shutdown	This parameter displays the 2nd last shutdown alarm that occurred.
Parameter #72 Alarm @ 3rd Last Shutdown	This parameter displays the 3rd last shutdown alarm that occurred.
Parameter #73 Alarm @ 4th Last Shutdown	This parameter displays the 4th last shutdown alarm that occurred.
Parameter #74 Alarm @ 5th Last Shutdown	This parameter displays the 5th last shutdown alarm that occurred

OLD	Current overload
ULD	Current Underload
CUB	Current Unbalance
OVT	Overvoltage
UVT	Undervoltage
VUB	Voltage Unbalance
ROT	Rotation error
DI1	Digital Input 1 Active
DI2	Digital Input 2 Active
AN1L	Analog 1 Below "Low Setpoint"
AN1H	Analog 1 Above "Hi Setpoint"
MAN	Manual stop
PUV	Power failed

Table 2 – Legend for Parameters #70 - #74

Parameter #75 Total Starts Counter	This displays the TOTAL number of starts the MOTOR CONTROLLER has performed. This is not changeable.
Parameter #76 Reset Table Starts Counter	This displays the number of start the MOTOR CONTROLLER has performed since being reset.
Parameter #77 Total Run Hours	This displays the TOTAL number of hours the MOTOR CONTROLLER has run. This is not changeable.
Parameter #78 Reset Table Run Hours	This displays the number of hours the MOTOR CONTROLLER has ran since being reset.

Parameter #79 through #88	Reserved
Parameter #89 Analog Input #1 Real Time Value	This parameter displays the real time engineered value of Analog Input #1.
Parameter #90 Analog Input #2 Real Time Value	This parameter displays the real time engineered value of Analog Input #2.
Parameter #91 Analog Input #1 Span	This is a user defined value. The maximum number displayed when the raw value input of 10vdc is applied to terminal #19 of the MOTOR CONTROLLER.
Parameter #92 Analog Input #1O FF Set	This is a user defined value. When utilizing this analog input with a process value where 0 engineered value is not equivalent to a raw value of zero. Calculating the offset will allow the user to make a positive process value be displayed as zero without distorting the linear display to span.
Parameter #93 Analog Input #1 High Trip	This is a user defined setpoint. If the engineered value (parameter #89) exceeds this setpoint for duration greater than the fault shutdown delay timer (parameter #55) the MOTOR CONTROLLER will stop the operation of the equipment.
Parameter #94 Analog Input #1 Low Trip	This is a user defined setpoint. If the engineered value (parameter #89) falls below this setpoint for duration greater than the fault shutdown delay timer (parameter #55) the MOTOR CONTROLLER will stop the operation of the equipment
Parameter #95 Analog Input #1 Span	This is a user defined value. The maximum number displayed when the raw value input of 10vdc is applied to terminal #19 of the MOTOR CONTROLLER.
Parameter #96 Analog Input #2 Offset	This is a user defined value. When utilizing this analog input with a process value where 0 engineered value is not equivalent to a raw value of zero. Calculating the offset will allow the user to make a positive process value be displayed as zero without distorting the linear display to span.
Parameter #97 Controller Serial Number	Displays the Serial Number of the Motor Controller
Parameter #98 Controller Firmware Revision	Displays the firmware residing in the Motor Controller
Parameter #99 Display Serial Number	Displays the Serial Number of the Display

Parameter #A1 Display Firmware Revision	Displays the firmware residing in the Display
Parameter #A2 Backspin Module Serial Number	Displays the Serial Number of the Backspin Module
Parameter #A3 Backspin Module Firmware Revision	Displays the Firmware residing in the Backspin Module
Parameter #A4-#A9 #B1-#B9 #C1-#C5	Reserved
Parameter #C6 Commport #1 Baud Rate	This is a user-defined parameter. Enter the Baud Rate from 1200 to 28800.
Parameter #C7 Modbus ID	This is a user-defined parameter. Enter the MODBUS Slave ID Number.
Parameter #C8 Timeout	This is a user-defined parameter. Comms timeout value.
Parameter #C9 Code	NOT TO BE USED BY FIELD PERSONAL

Appendix

A Product Warranty

WARRANTY COVERAGE:

Global Production Solutions (“GPS”) warrants GPS manufactured products (“Product”) to be free of workmanship and material defects for a period of eighteen (18) months from the date of shipment to Buyer or twelve (12) months from the date of installation.

GPS, at its option, will at no charge either repair, replace, or refund the purchase price of the Product during the warranty period, provided it is returned in accordance with the terms of this warranty to 35431 Hardesty Road, Shawnee, Oklahoma USA 74801, at GPS option, may include the replacement of parts or boards with functionally equivalent reconditioned or new parts or boards. Replaced parts or boards are warranted for the balance of the original applicable warranty period. All replaced parts, boards or Product shall become the property of GPS. Shipping costs are to be borne by the purchasing party.

This express warranty is extended by GPS to the party purchasing the Product (“Buyer”) and is not assignable or transferable to any other party. This is the complete warranty for the Products, except as modified by separate agreement between GPS and Buyer.

GPS is not responsible under this warranty for ancillary equipment, whether or not manufactured by GPS, which is attached to or used in connection with the Product, nor for operation of the Product with any such with any such ancillary equipment.

Because each Product system is unique, GPS disclaims liability for range, coverage, or operation of the system as a whole under this warranty.

This warranty applies within the fifty (50) United States and the District of Columbia.

WHAT THIS WARRANTY DOES NOT COVER:

Defects or damage resulting from use of the Product in other than its normal and customary manner, (b) Defects or damage from misuse, accident or neglect, (c) Defects or damage from improper testing, operation, maintenance, installation, alteration, modification or adjustment, (d) Product disassembled or repaired in such a manner as to adversely affect performance or prevent adequate inspection and testing to verify any warranty claim, (e) Product which has had the serial number removed or made illegible.

HOW TO GET WARRANTY SERVICE:

To receive warranty service, call toll free +1-877-574-9292.

GENERAL PROVISIONS:

This warranty sets forth the full extent of GPS's responsibilities and liability regarding the Product, and repair, replacement, or refund of the purchase price, at GPS's option, is Buyer's exclusive remedy.

THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, WHICH ARE SPECIFICALLY EXCLUDED INCLUDING, WITHOUT LIMITATION, IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE IN NO EVENT SHALL GPS BE LIABLE FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCT, FOR ANY LOSS OF USE, LOSS OF TIME, INCONVENIENCE, COMMERCIAL LOSS, LOST PROFITS OR SAVINGS OR OTHER INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE SUCH PRODUCT.

PATENT AND SOFTWARE PROVISIONS:

GPS will defend at its own expense any suit brought against Buyer to the extent that it is based on a claim that the Product or parts infringes a United States patent, and GPS will pay those costs and damages finally awarded against Buyer in any such suit which are attributable to any such claim, but such defense and payments are conditioned on the following: (i) that GPS will be notified promptly in writing by Buyer of any notice of such claim; and (ii) that GPS will have sole control of the defense of such suit and all negotiations for its settlement or compromise; and (iii) should the Product or parts become, or in GPS's opinion be likely to become, the subject of a claim infringement of a United States patent, that Buyer will permit GPS, at its option and expense, either to procure for Buyer the right to continue using the Product or parts or to replace or modify the same so that it becomes non-infringing or to grant Buyer a credit for the Product or parts as depreciated and accept its return. The depreciation will be an equal amount per year over the lifetime of the Product or parts as established by GPS.

GPS will have no liability with respect to any claim of patent infringement, which is based upon the combination of the Product or parts furnished by GPS, nor will GPS have any liability for the use of ancillary equipment or software not furnished by GPS, which is attached to or used in connection with the Product. The foregoing states the entire liability of GPS with respect to infringement of patents by the Product or any parts thereof.

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