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Chapter 1: Outline

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1.1 About This operations manual

This manual details the configuration, components, specifications, and the operation of the AFC1100 Fastening System.

The following table outlines the contents of each chapter:

Chapter	Item	Contents
Chapter 1	Outline	Basic characteristics and requirements of the AFC1100 System.
Chapter 2	Specifications	General specifications of the AFC1100 System.
Chapter 3	System Description	Description of standard and optional system components.
Chapter 4	System Setup and Wiring	Equipment installation procedure, dimensions, Input and Output signal descriptions and requirements for PLC programming.
Chapter 5	Power Up and Initial Checks	Preliminary power on and operational tests.
Chapter 6	Fastening Instructions	Basic fastening operations and presetting procedures.
Chapter 7	System Operations	Instructions for the input of preset data and monitoring explanations.
Chapter 8	Maintenance and Inspection	Guide for preventive maintenance.
Chapter 9	Troubleshooting	Descriptions of fastening rejects, equipment Abnormals, and corrective action.
Appendix A	Reference Drawings	Electrical reference drawings of standard cables and connections.

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1.2 Outline of Functions

{ The AFC1100 Fastening System is a culmination of over twenty years of electric fastening expertise integrated with the latest electronic technology. The basic elements of this system are:

1) A brushless DC permanent magnet motor
2) A combination Controller/Servo Amplifier

{ **Compact Design**

As the result of miniaturization technology, the compact Axis (Controller) unit maintains a width of 100 mm in spite of the built-in power source and Servo Amplifier. System components are mounted on the back panel inside of the NEMA 12 enclosure. All System connections, controls, and indicators are easily accessed through the door on the front of the enclosure.

{ **Fastening Function**

The following fastening control methods can be selected for either Clockwise (CW) or Counter Clockwise (CCW) opreation:

- Torque control - Angle monitoring - Torque rate monitoring - 1 fastening step.
- Torque control - Angle monitoring - Torque rate monitoring - 2 fastening steps.
- Angle control - Torque monitoring - Torque rate monitoring - 1 fastening step.
- Angle control - Torque monitoring - Torque rate monitoring - 2 fastening steps.
-

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The Two fastening steps method can be used by multiple Axis unit systems where the SYNC signal can control the simultaneous operation of all spindles. Thus, the spindles start and stop when they have reached the predefined value. They will start again simultaneously to reach the final torque.

{ **Optional Interface**

The User Console incorporates the user interface as an integral part of the total System configuration. On-screen, user-friendly nutrunner programming and data collection can be performed via the optional user console. Eight different groups of preset data may be entered using the user console and than downloaded to multiple Axis units where it is preserved on an EEPROM indefinitely.

{ **Communication Interface**

External communication is available through the following means:

Standard Discrete I/O	User Console Centronics Parallel Port (Optional)
RS422 Port	Printer InterFace unit (Optional)

{ **Motor**

A DC permanent magnet motor provides for improved fastening control. The sealed design of the motor provides greater protection from contamination without generating any excess heat.

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{ **Preamplifier**

Quality control of the tool torque transducer is accomplished electrically (digitally) through the EEPROM in the preamplifier. During factory setup of the torque transducer, the unit is Dead Weight and Dynamically tested against Standards that are certified and traceable to the National Institute of Standards and Technology. The resultant data is then programmed into the preamplifier. The AFC1100 System compares the programmed data with the actual measured data from the transducer, and then compensates for minor discrepancies. If the variance exceeds the specified limits, an Abnormal output will be generated and the fastening process will be interrupted.

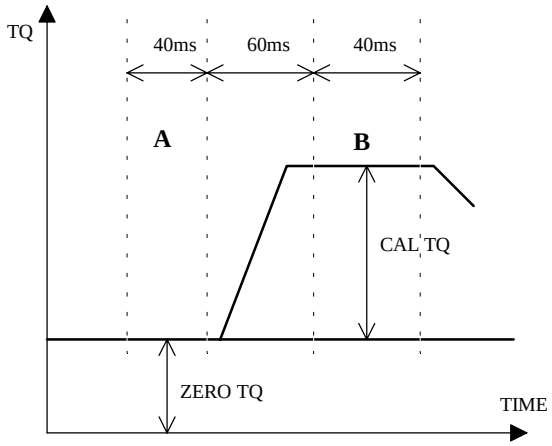
{ **Servo Amplifier (Servo Drive)**

Reduced equipment size with improved drive circuit strength is the result of incorporating Isolated Gate Bipolar Transistor (IGBT) technology into the System. Axis units are available in several models. The Servo Amplifier housed in each Axis unit determines the model type. The Servo Amplifier also dictates the nutrunner (tool) models that can be supported by the Axis unit. The AFC1100 System and the AFC1200 System both incorporate the same Servo Amplifier and nutrunner components.

{ **Self-Check Function**

The Self Check can be disabled by external PLC signals. If the self check signal is "high" (inactive) before the cycle starts, the check is done automatically. The zero voltage level of torque transducer and CAL voltage level are verified. When the torque transducer's automatic check is not required, this function can be disabled by activating the SELF CHECK signal before the cycle starts. The fastening cycle will be performed without the self check.

The zero voltage check is done at the 40 msec interval (A) and CAL check (CAL voltage) is done at the 40 msec interval of B. To get the Zero and CAL values, the system measures the voltage level 40 times during the A (zero) and B (CAL) periods, and calculates and average for each. The system compares these data to the corresponding data contained in the preamplifier's EEPROM and decides if the torque transducer condition is good or bad .



{ **Reject / Abnormal Condition Display**

When a fastening Reject has occurred, the tool stops, outputs the appropriate signal and displays the resultant data on the Axis unit front panel. The unit will not require resetting prior to the next cycle.

The System will output an Abnormal signal when it detects there is a problem (Zero Check out of limits, incorrect component connection, etc.) within the System itself. The output will be displayed as a code on the affected Axis unit. Refer to Chapter 9 Troubleshooting for more details. Manual reset of the system will be required.

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{ Axis Bypass Function

When a PLC Bypass input signal is activated or when the RUN/BYPASS switch on the front panel is switched to the Bypass position, the Bypass output signal is activated. In this condition, the system will not START, REVERSE, CAL OR RESET. The SYNC signal will be bypassed to avoid affecting synchronized operations. When the Axis unit is in the bypass mode, the "Bypass" LED on the front panel of the Axis unit will blink.

{ Tool Type Check Function

The AFC-1100 tools have an EEPROM in the preamplifier that contains the tool data. The tool type data is also contained in the Axis unit. The Tool type check function reads the information of the tool EEPROM and compares it to the information of the Axis unit; any mismatch is reported as a Tool Type error.

The tool type check is performed during the following times:

1) When the equipment is powered on.
2) When preset data is downloaded from a user console to the Axis unit.
3) When the fastening cycle starts.

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1.3 System requirements

To ensure the most effective and extended use of all equipment, adhere to the following specifications:

{ Tool Installation

Tools generate a great amount of torque during operation, and the reaction force is applied to the mounting area of the tool. Therefore, tools must be installed in the proper positions and with adequate bolts. Use the specified bolts to prevent the tool from loosening due to vibration. The tool assembly contains precision parts and electronic components, and must not be subject to excessive shocks or stresses.

When designing an application, keep in mind that the torque transducer is a type of strain gage and, although it has been designed to withstand sudden shock, repeated shock (over time) could damage the transducer. Therefore, cylinder cushions or shock absorbers should be used to decelerate the powerhead return and prevent excessive (hard stop) vibration, particularly in short cycle time applications operating at high speeds.

{ Fastening Operation

Avoid fastening beyond the full scale torque. Do not use a duty cycle (the ratio of the tool rotating time to the machine cycle time) higher than 50%, even when the torque is below the full scale value.

{ Cable Wiring

- Use the specified cables for all System connections.
- Circuit breakers or fuses are required.
- Do not use a high voltage circuit as a frame ground (FG). Also, the frame ground should be separate from the power ground.
- When multiple Axis units are used, ensure that each unit is connected to its matching numbered tool, and that all connectors are locked.
- PLC I/O cables must be run separate from any high voltage power sources or cabling, and must not exceed 50 feet in length.

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{ Control Equipment (Axis units) Installation Environment

- Controllers must be set in a NEMA 12 enclosure.

Do not use at the following locations. (If these conditions cannot be avoided, contact FEC INC.)

- Areas under direct sunlight.
- Areas where the environmental temperature is out the 32 °~122° F range.
- Areas where the relative humidity is out of the 20~90% range.
- Areas where the temperature changes quickly, which may cause moisture.
- Areas where conductive powder, oil mist, saline, or organic solvents exist.
- Areas that have corrosive or combustible gases.
- Areas that have strong electric or magnetic fields.
- Areas where a strong vibration or shock could be transmitted directly to a Controller unit or tool.

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- Axis units must be located a minimum of 600 mm from high transient voltage sources such as transformers, motor starters, AC inverters, and AC contactors. If this cannot be avoided, then the units must be properly shielded.

Static Electricity

AFC1100 System construction incorporates many electronic Surface Mounted Devices (SMD). It is advisable to strictly adhere to practices for safe electrostatic discharge in order to prevent damage to the System.

Cleaning

Do not use any organic solvents, such as thinner, to clean an Axis unit or a tool. The solvent could melt the surface paint, or penetrate inside and cause damage. A cloth dampened with alcohol or warm water should be used to lightly wipe the components.

Handling and Shipping

It is critical that AFC1100 System components are properly handled and shipped in order to maintain the System's integrity. Adhere to the following requirements for shipping and handling:

- All AFC1100 components must be removed from the enclosure(s) prior to shipping.
- AFC1100 System components must be individually packaged in an approved anti-static container or wrap to prevent damage from electrostatic discharge.
- Tool assemblies must be removed from the powerhead during shipment to prevent damage to the transducer assembly.
- Enclosures must be protected with shrink wrap.
- Enclosures and System components should be shipped on an air ride trailer whenever possible.
- Adhere to Chapter 2 Specifications for environmental requirements.

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Chapter 2: Specifications

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2.1 System Specifications

- Power Supply Voltage
  - 200~230 VAC ±10%, 3-Phase, 50/60 Hz
- Installation Requirement
  - NEMA 12 enclosure
- Range of Operation
  - Duty cycle below 50% (reference Section 2.2 Duty Cycle Calculation)
  - Additional specifications will be provided for nutrunners greater than 50 kgm.
- Operating Conditions (may be met by incorporating an Air Handling Unit into System)
  - Temperature: 0° ~ 50°C (32° ~ 122°F)
  - Humidity: 20% ~ 90%, no moisture
- Storage Conditions
  - Temperature: -5° ~ 55°C (23° ~ 131°F)
  - Humidity: Below 90%, no moisture
- Shipping Conditions
  - Temperature: -5° ~ 55°C (23° ~ 131°F)
  - Humidity: Below 90%, no moisture
  - Each item (component or assembly) must be sealed in bubble wrap.
  - All metal parts (except for the electric motor, encoder, and connectors) must be greased or oiled to prevent rust.

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2.2 Duty Cycle Calculation

The rated duty cycle for the AFC1100 System is calculated as follows:

$$\frac{\text{Tool Rotation Time}}{\text{Total Cycle Time (Tool Rotation + Tool Waiting)}} \times 100 = \text{Duty Cycle Percentage (\%)}$$

Example: Tool Rotation Time = 3 Seconds / Total Cycle Time = 12 Seconds x 100 = 25% Duty Cycle Percentage

Duty cycle ratings vary between tools. As a general rule, however, it should not exceed 50%. Refer to the specifications for each tool. If the cycle time is less than 12 seconds, contact FEC INC. for confirmation.

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2.3 User Console Requirements (Customer Supplied)

Specification is based on proposed future software upgrades. The current DOS based software has less requirements.

{ CPU: Minimum 80486-75MHZS microprocessor

{ DATA Communication: RS422 Port or RS232 port with an RS422 converter
Centronics Parallel Port

{ FLOPPY DISK Drive: 3.5" 1.44MB

{ HARD DISK DRIVE: 10 Megabytes free

{ Memory 4 Meg free while computer is operating

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2.4 Axis Unit

{

AXIS UNIT TYPE	AXIS-103			AXIS-105		AXIS-110
TOOL MOTOR TYPE	M1	W1	M2	M3	W3	M4
TOOL MOTOR MODEL NUMBER	MFA006 HA2NSA	BNE006-A117	MFA010 HA2NSA	MFA020 HA2NSA	BXE020-A912	MFA040 HA1NS
TOOL MOTOR RATING	60W	70W	100W	200W	200W	400W
AXIS UNIT PEAK CURRENT	.625A	.625A	1A	2A	2A	4A
AXIS UNIT IN-RUSH CURRENT	50A	50A	50A	70A	70A	100A
AXIS UNIT INPUT POWER	200~230 VAC, 3-Phase, 50/60 Hz					

{ CPU: V25 - NEC @ 16 bits

{ Data communications: 1 RS422 communications port configurable for User Console communications or raw data output

Example: Tool (nutrunner) model DFT-401**M2**-S has an **M2** motor type, and must be used with a Type 203 Axis Unit.

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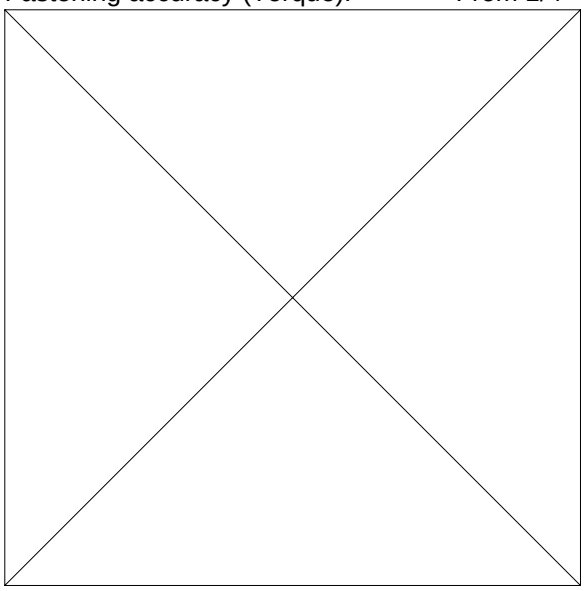
NOTE: The M1 and W1 motors are functionally identical units, and can be interchanged without any special considerations. The same is true of the M3 and W3 motors.

CAUTION: **If the equipment is powered on and off repeatedly, the circuit breakers might trip due to the in-rush current.**

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2.5 Nutrunner

{ Fastening accuracy (Torque): From 1/4 ~ full scale torque: 6



Less than 10%

{ Torque sample rate: Full Scale Torque X 1/1000

{ Torque display resolution: 4 digit display with floating decimal point.

{ Fastening accuracy (Angle): Within +1 degree

{ Angle sample rate: Below 0.036 degrees (dependent upon gear ratio).

{ Angle display resolution. 0.1 degree

{ Torque transducer accuracy: (Full Scale) ± 1%

{ Linearity of torque transducer: ± 0.5%

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NOTE: The tool lists located throughout this manual identify the specifications for the standard tools used with the AFC1100 System. If additional information is required for special tool assemblies, please contact FEC INC.

2.5.1 Nutrunner Specification Table

TOOL SPECIFICATIONS									
TOOL TYPE	SERVO TYPE	FULL SCALE TORQUE					GEAR RATIO	SPEED	
		NM	KGM	KGCM	FTLB	INLB		MAX	MIN
DFT-101M1-S1/O1	AXIS-103	9.8	1.0	100	7.2	86	19.8 :1	500	5
DFT-201M1-S/O	AXIS-103	19.6	2.0	200	14.4	173	19.8 :1	500	5

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DFT-401M1-S/O	AXIS-103	39.2	4.0	400	28.8	346	39.6 :1	250	3
DFT-401M2-S/O	AXIS-103	39.2	4.0	400	28.8	346	19.8 :1	500	5
DFT-601M3-S/O	AXIS-105	58.8	6.0	600	43.3	520	12.6:1	790	8
DFT-801M3-S/O	AXIS-105	78.4	8.0	800	57.6	693	19.8 :1	500	5
DFT-132M3-S/O	AXIS-105	127.4	13.0	1,300	94.0	1,127	25.2 :1	395	4
DFT-152M3-S/O	AXIS-105	147.0	15.0	1,500	108.0	1,300	31.5:1	315	4
DFT-202M3-S/O	AXIS-105	196.0	20.0	2,000	144.0	1,734	45.0 :1	220	3
DFT-302M3-S/O	AXIS-105	294.0	30.0	3,000	216.0	2,601	64.8 :1	150	2
DFT-502M4-S/O	AXIS-110	490.0	50.0	5,000	360.0	4,335	66.6 :1	110	2

CONVERSION GUIDE: 1 KGM = 100 KGCM = 9.8 NM = 7.2 FTLB = 86.7 INLB

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2.5.2 Nutrunner Decimal Point Display Table

POSITIONS FOR DECIMAL POINT DISPLAY										
TOOL TYPE	TORQUE DECIMAL POINT DISPLAY					TORQUE RATE DECIMAL POINT DISPLAY				
	NM	KGM	KGCM	FTLB	INLB	NM	KGM	KGCM	FTLB	INLB
DFT-101M1-S1/O1	2	3	1	3	1	3	3	2	3	2
DFT-201M1-S/O	2	2	0	2	1	3	3	2	3	2
DFT-401M1-S/O	1	2	0	2	0	3	3	2	3	2
DFT-401M2-S/O	1	2	0	2	0	3	3	2	3	2
DFT-601M3-S/O	1	2	0	2	0	3	3	2	3	2
DFT-801M3-S/O	1	2	0	2	0	2	3	1	2	1
DFT-132M3-S/O	1	2	0	1	0	2	3	1	2	1
DFT-152M3-S/O	1	2	0	1	0	2	3	1	2	1
DFT-202M3-S/O	1	2	0	1	0	2	3	1	2	1
DFT-302M3-S/O	1	2	0	1	0	2	3	1	2	1
DFT-502M4-S/O	1	2	0	1	0	2	3	1	2	1

Example: DFT-201M1-S Torque Display = 19.**00** NM (2 positions)
Torque Rate Display = 1.**999** NM/degree (3 positions)

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Chapter 3: System Description

3.1 System Block Diagram

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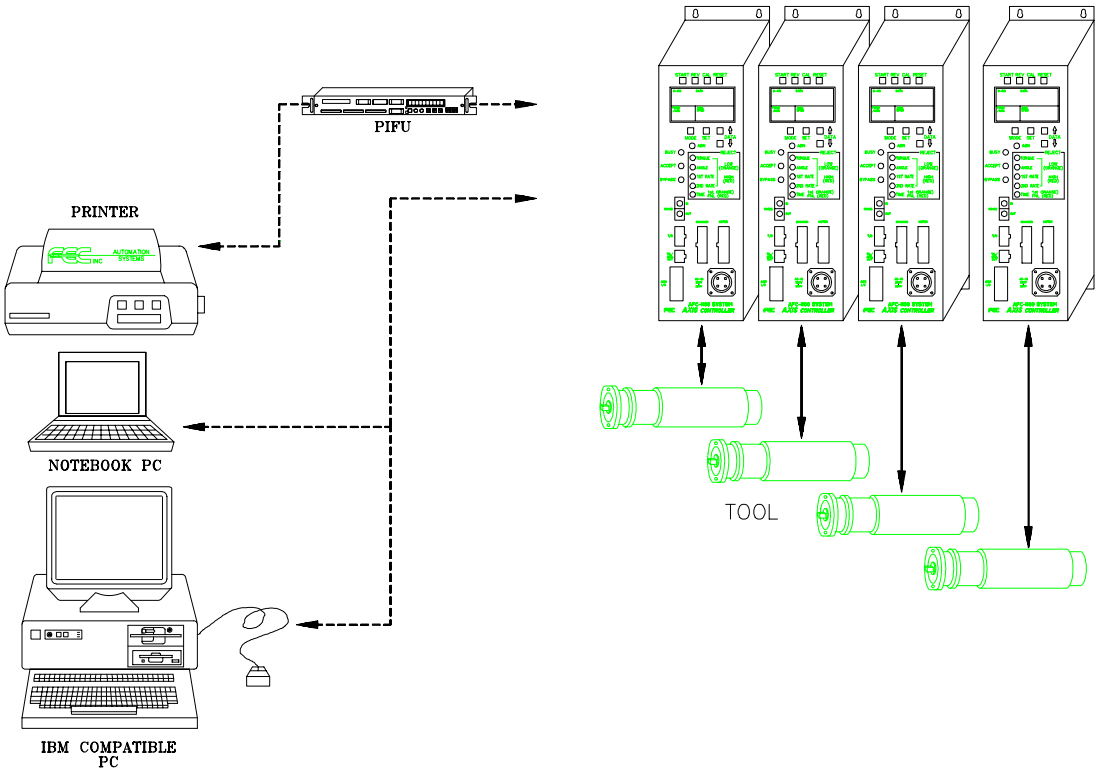


FIG. 3-1 AFC1100 Block Diagram

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3.1.1 System Block Diagram Description

{ The System construction provides programming and data collection control for up to 32 spindles through the use of a single optional User Console or Printer Interface Unit (PIFU).

{ Communication for up to 32 Axis Units (Spindle Controllers) is accomplished via an RS422 Daisy chain connection on the front of each Axis unit.

{ A PC with an RS422 interface may be used for Axis unit programming as well as for data collection and printing functions.

{ A PIFU may be used as a means to provide output data to a printer or host data collection device.

{ Discrete 24 VDC true low I/O on the Axis unit provide direct communications with the PLC for individual spindle control or for PLC controlled multiple spindle syncronous fastening operations.

{ Tool assemblies connect to their respective Axis Controller Units via a set of three homerun cables: Motor, Encoder, and Sensor / Preamp (Transducer) cables.

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3.2 Component Description

3.2.1 AFC1100 Front panel, switches and connectors

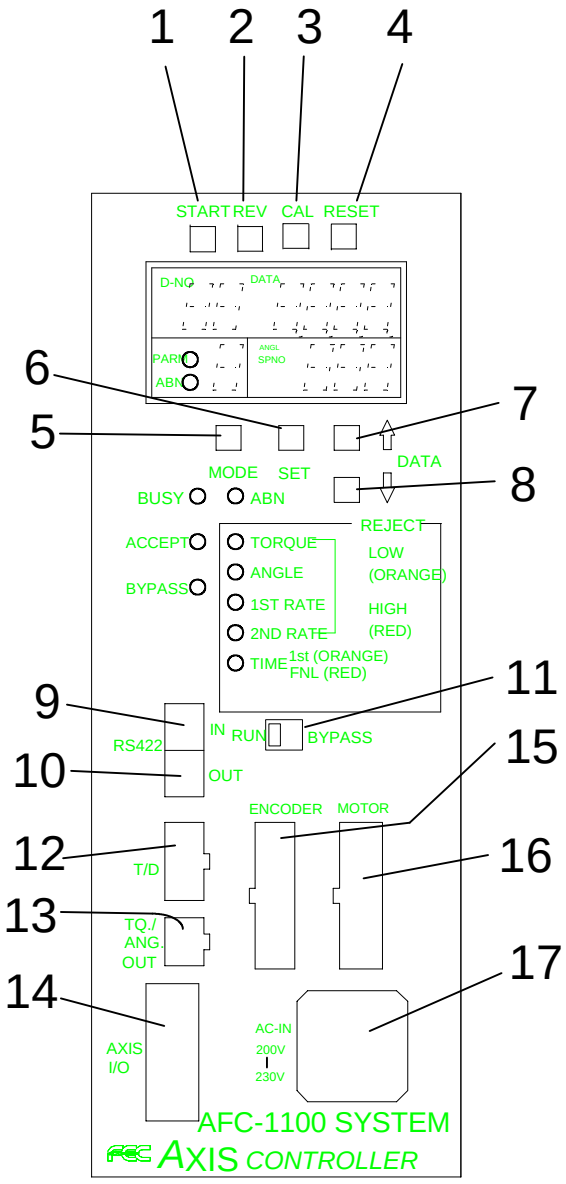


FIG. 3-2-1 Axis unit Front panel controls

Item as called out on Figure 3.2.1	Description

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Item as called out on Figure 3.2.1		Description
1	(MANUAL) START	Manual fastening start pushbutton.
2	(MANUAL) REV	Manual reverse pushbutton.
3	(MANUAL) CAL	Manual Calibration (Cal) Check pushbutton.
4	(MANUAL) RESET	Manual Zero Check and System reset pushbutton.
5	MODE	Display mode selection pushbutton. Refer to Chapter 7.
6	SET	Data change confirmation pushbutton.
7	↑ - Up	Data change increase pushbutton.
8	↓ - Down	Data change decrease pushbutton.
9	RS422 IN	Bidirectional RS422 Communications port
10	RS422 OUT	Bidirectional RS422 Communications port
11	RUN/BYPASS	Axis unit Enable / Disable switch
12	T/D	Connector for the tool torque transducer/preamplifier (PA).
13	TQ/ANG OUT	Torque analog voltage and angle pulse output.
14	AXIS I/O	Interface connector for System input/output control lines. Refer to Chapter 4 for detailed input and output descriptions.
15	ENCODER	Connector for the nutrunner (tool) encoder (ENC).
16	MOTOR	Connector for the nutrunner (tool) motor (M).
17	AC-IN 200~230V	Supply power for Axis unit (200~230 VAC, 3 Phases).

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3.2.2 AFC1100 Front panel display description

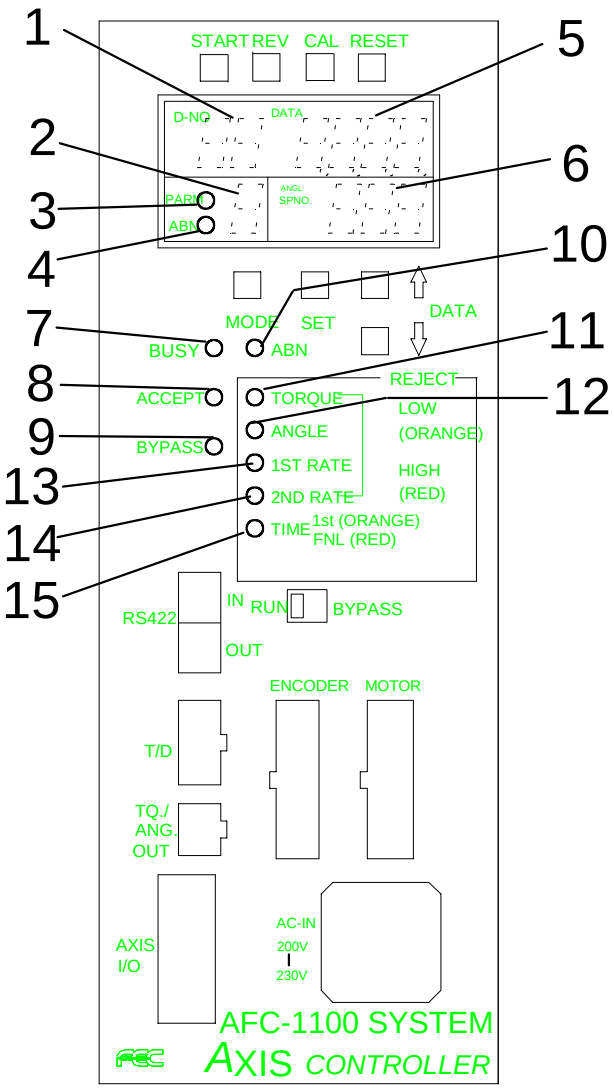


FIG. 3-2-2 Axis unit Front panel displays

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ITEM AS MARKED ON UNIT		DESCRIPTION (REFERENCE FIGURE 3-2-2)
1	D-NO	Display number that indicates what the data in the "DATA" and "ANG/SPNO" display represents.
2	PARM/ABN	Displays one-digit Parameter number and, as needed, will override Parameter output to display an Abnormal code. Refer to Chapter 9 for Abnormal display code descriptions.
3	PARM	Green LED that indicates that the "PARM/ABN" display is currently displaying the Parameter #
4	ABN	RED LED that indicates that the "PARM/ABN" display is currently displaying an Abnormal code #
5	DATA	Four digit display who's function is dependent upon the D-NO selected
6	ANG/SPNO	Two-digit display who's function is dependent upon the D-NO selected. When configured to display spindle number (SPNO) this number is set by dip switch settings (reference Section 4.10.2).
7	BUSY	Display LED (yellow) that indicates when the Axis unit is operating.
8	ACCEPT	Display LED (green) that indicates the spindle has completed an acceptable fastening, Zero Check, or Cal Check.
9	BYPASS	Display LED (red) that indicates when the Axis unit is in the Bypass mode. Spindle will not operate in this mode.
10	ABNORMAL	Display LED (red) that indicates some component of the spindle (Axis unit, nutrunner, etc.) is in an Abnormal state, and the fastening cycle has been interrupted. A failed Cal Check or Zero Check will also display as an ABNORMAL.
11	TORQUE	Torque reject dual color LED indicator. Refer to Axis unit Reject Display Table following.
12	ANGLE	Angle reject dual color LED indicator. Refer to Axis unit Reject Display Table following.
13	1ST RATE	1st Rate reject dual color LED indicator. Refer to Axis unit Reject Display Table following.
14	2ND RATE	2nd Rate reject dual color LED indicator. Refer to Axis unit Reject Display Table following.
15	TIME	Time reject dual color LED indicator. Refer to Axis unit Reject Display Table following.

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Fastening rejects are indicated by dual-color LED's on the affected spindle's Axis unit, as shown in the table below.

AXIS UNIT REJECT DISPLAY TABLE		
REJECT TYPE	L.E.D. LIT TO RED	L.E.D. LIT TO ORAN
TORQUE	HIGH REJECT	LOW REJECT
ANGLE	HIGH REJECT	LOW REJECT
1ST RATE	HIGH REJECT	LOW REJECT
2ND RATE	HIGH REJECT	LOW REJECT
TIME	FINAL STEP TIME OVER	1st STEP TIME OV

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3.2.3 Nutrunner (Tool) Unit

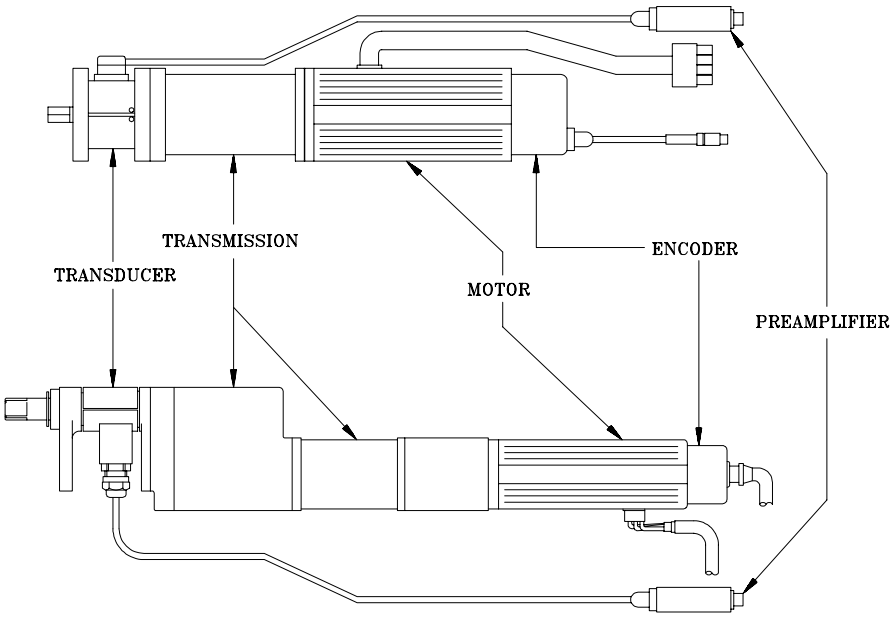


FIG. 3-2-3 Nutrunner (Tool) unit

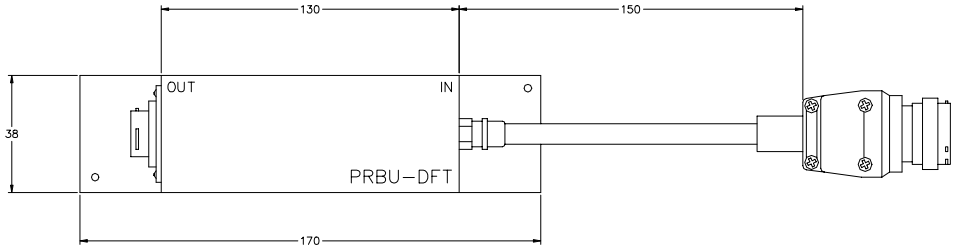
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- ENCODER
  - Environmentally isolated angle encoder.
  - Provides feedback for speed regulation to Servo Amplifier.
  - Provides angle monitoring capability to fastening operation.
- MOTOR
  - Totally enclosed DC permanent magnet motor.
  - Refer to Chapter 2 for various motor sizes.
- TRANSMISSION
  - Planetary gear transmission.
  - Available in straight and offset models.
  - Refer to Section 2.5.1 for standard tools and gear ratios.
- TRANSDUCER
  - Highly accurate strain gage transducer.
  - Durable, compact design minimizes space requirements.
- PREAMP (Transducer)
  - Intelligent transducer design accomplished through the use of EEPROM.
  - EEPROM data used to verify integrity of fastening operations.
  - Remote mounting of the transducer's preamplifier reduces space requirements.

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3.2.4 PRBU-DFT Unit (Preamplifier Cable Extender)

- This unit can extend the preamplifier cable of the DFT tool up to 100 feet.
- The maximum length of the preamplifier cable without this unit is 50 feet.
- An external power supply is not required for this unit.
- Figure 3-2-4 below illustrates the unit dimensions (in millimeters), and the recommended positioning of the unit within the system.



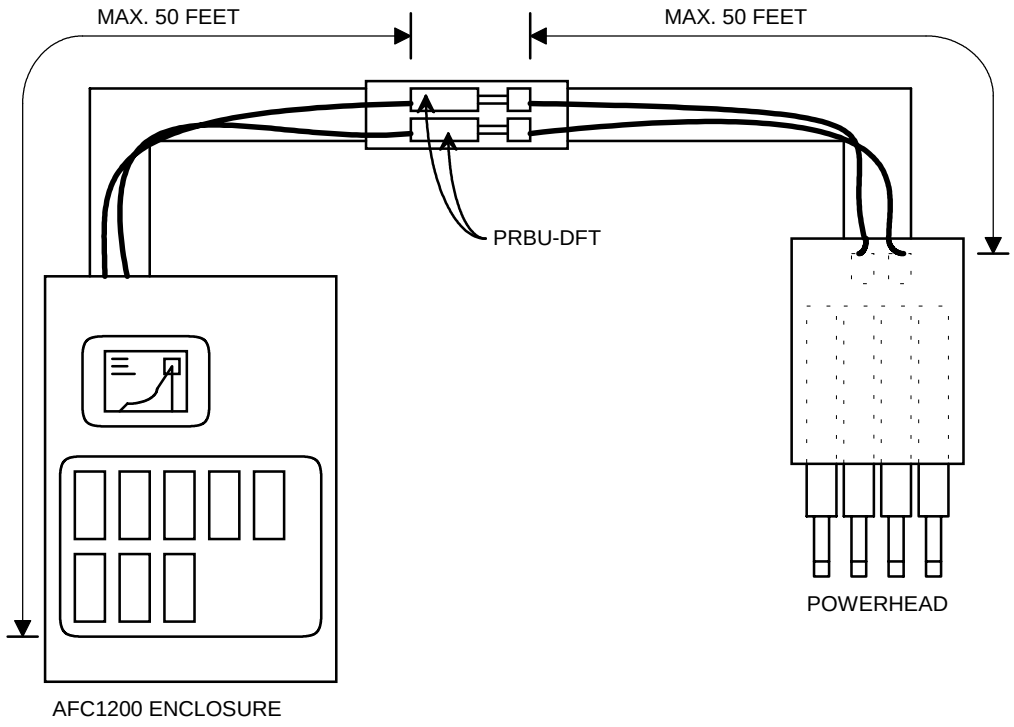


FIG. 3-2-4 PRBU-DFT Preamplifier Cable Extender

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Chapter 4: System Setup and Wiring

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4.1 Design and Build Procedure

Review Chapters 1 and 2 prior to designing a System. If the requirements and specifications in these two (2) Chapters are not addressed, there is a chance of degraded System performance.

WARNING:

Follow Lockout/Tagout and other safety precautions when connecting and/or disconnecting cabling, wiring, and equipment.

No.	Items	Comments	Reference Section
1	Select correct tool size.	Keep torque range between 50% and 75 % of tool capability for best performance. Ensure fastening bolt pattern and tool mounting patterns are compatible.	2.5.1 4.4.1 4.4.2
2	Design tool mounting plate / powerhead / spindle assemblies.	Design of mounting plate / powerhead requires adherence to several specifications.	4.4 4.4.3
3	Select correct Axis Unit for the tool selected.	Different tool motors require different Servo Amplifiers. Ensure the correct one is selected.	2.5.1
4	Select the circuit protectors.	Circuit protection for Axis Units should be separate from other units.	4.6 4.7
5	Select an air handling unit (as required).	Select an air handling unit applicable to the environmental conditions (A/C, Heat Exch., etc.)	2.1
6	Design (or review) PLC logic.	A PLC logic program can be written using signal descriptions and timing charts provided.	4.7
7	Select an adequate PLC.	Select a PLC which will facilitate direct connection to the AFC1100 System I/O (24 VDC true low).	4.7
8	Select NEMA 12 enclosure.	Keep clearances among units according to the recommended installation layout.	4.2 4.3
9	Set Axis Unit dip switches.	Check the setting before connecting the Unit.	4.10
10	Mount the Axis Units in the enclosure.	Refer to recommended installation layout.	4.2 4.3
11	Wire power connections.	Connect the power cables. **VERIFY VOLTAGE PRIOR TO APPLYING POWER.**	4.6
12	Wire PLC connections.	Connect all PLC wiring. **VERIFY VOLTAGE SOURCE PRIOR TO CONNECTION.**	4.7
13	Connect homerun cables.	**VERIFY POWER IS OFF**, then connect cables for every motor, encoder and preamplifier.	Appendix A
14	Turn on the equipment.	**VERIFY WIRING AND THE VOLTAGE OF ALL POWER SUPPLIES PRIOR TO POWERING UP.**	5.1
15	Input preset data.	Set the preset data for torque, angle, speed, time, etc.	Chapter 6 Chapter 7
16	Verify normal function.	Confirm normal operation.	5.2

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4.2 Component Dimensions

The specifications for all of the FEC INC. standard AFC1100 System equipment is outlined in this Chapter to aid in determining enclosure requirements.

4.2.1 Axis Controller Unit Dimensions

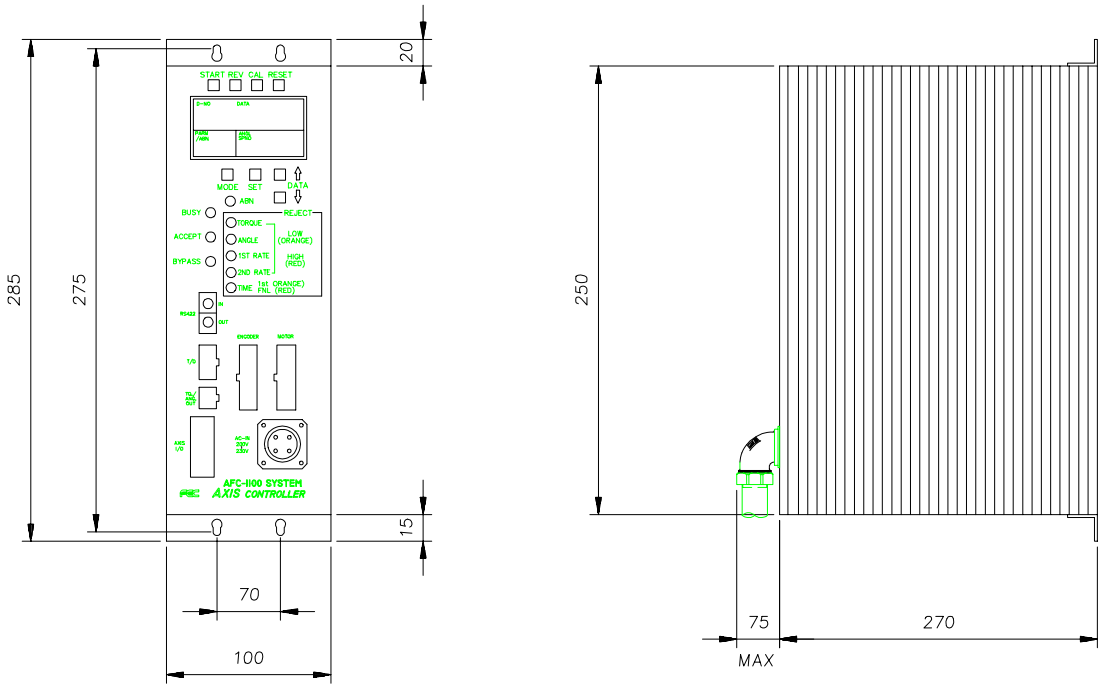


FIG. 4-2-1 Axis Controller unit Dimensions

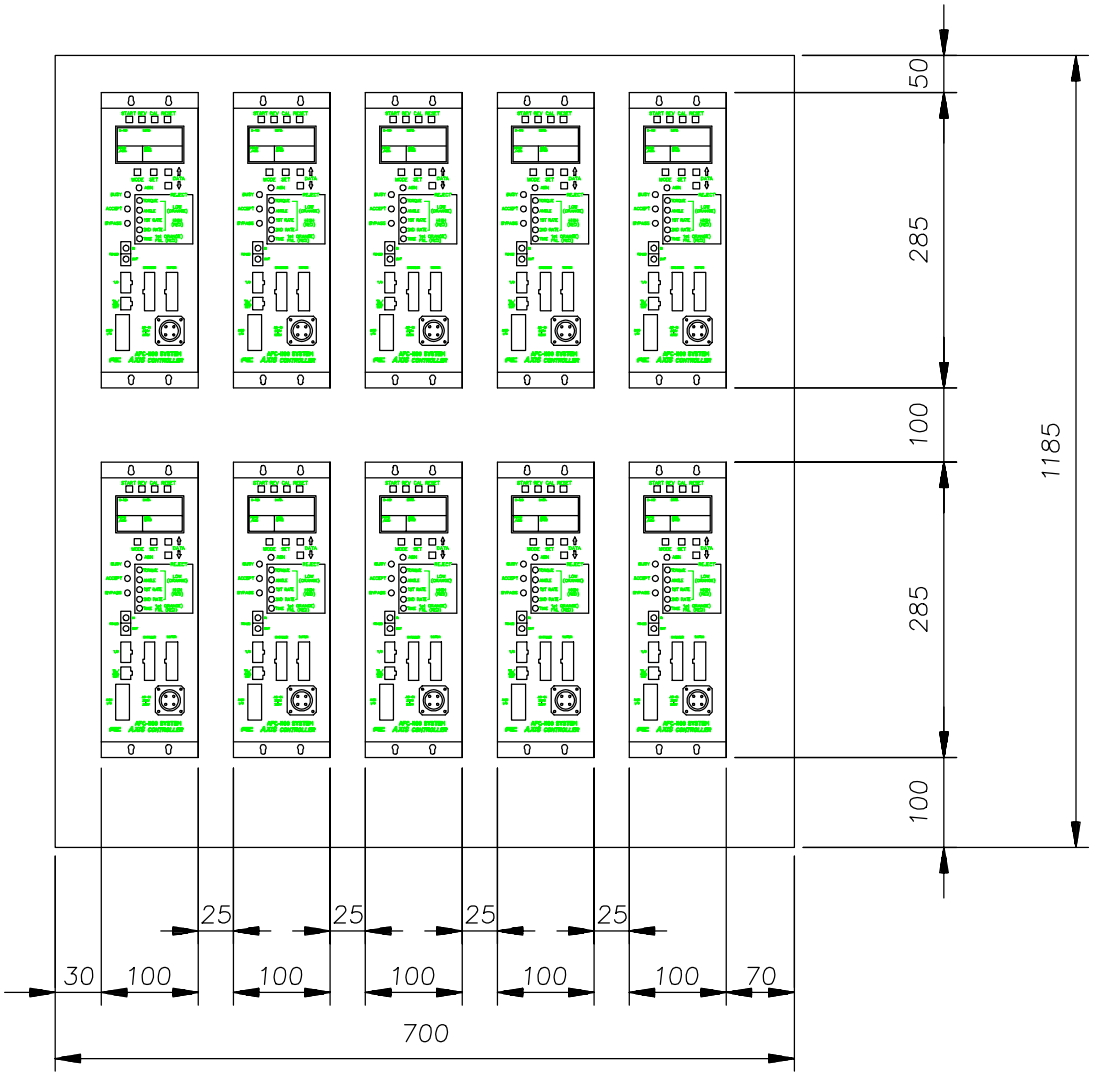
The Units must be mounted with a minimum clearance of 25 mm on each side to allow for proper heat dissipation. Cable connections on the front of the Units require 100 mm of clearance. Axis Units must be located at a minimum 300 mm from any high voltage power source. High voltage sources such as relays, contactors, disconnects, etc. will cause mis-operation of the AFC-1100 Axis unit. All motor cables and I/O cables must be run separate from all high voltage sources.

4.3 Unit Arrangement

FIG. 4-3 Unit Arrangement

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Figure 4-3 provides a reference for the layout of the AFC1100 System components. The Units may be mounted in any desired configuration as long as the minimum spacing requirements not neglected. When installing duct above and below the Units, ensure that



adequate space is provided to allow for removal and installation of the Units without removal of the mounting screws. The components of the AFC1100 System are designed with slotted mounting holes for easy mounting to the back panel of the enclosure using standard 8-32 screws.

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4.4 Nutrunner (Tool) Dimensions

Tool dimensions and mounting specifications are critical in determining the design of the powerhead that will house the tool assemblies. Caution must be taken to ensure that the tool assemblies do not come in contact with any other assembly. Failure to provide adequate clearance may result in inaccuracies in the monitoring capability of the system or possibly damage to the tool assembly. Torque capabilities of each tool assembly are specified to aid in determining tool requirements.

4.4.1 Straight Tool

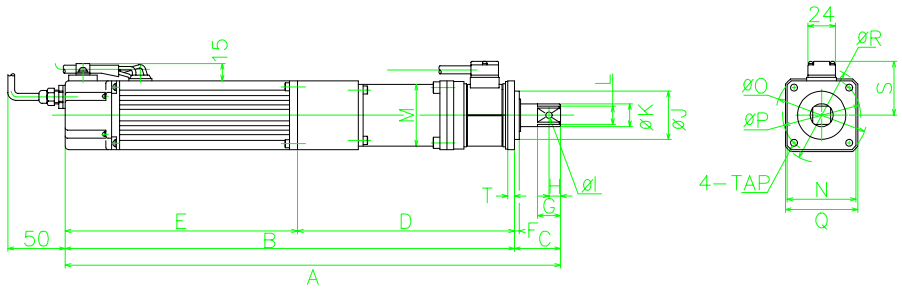


FIG. 4-4-1 Straight Tool

Numbers shown in brackets are in inches. All others shown in Millimeters as the standard.

DFT-TYPE	TORQUE (Kg. M)	SPEED (rpm)	A	B	C	D	E	F	G	H	I	J
101M1-S1	1	500	329	299	30	159	140	4	12	5	3.5	32
201M1-S	2	500	329	299	30	159	140	4	12	5	3.5	32
401M1-S	4	250	329	299	30	159	140	4	12	5	3.5	32
401M2-S	4	500	367.5	327.5	40	180	147.5	4	16	8	4.5	42
601M3-S	6	790	387.5	347.5	40	145	202.5	4	16	8	4.5	42
801M3-S	8	500	422.5	382.5	40	180	202.5	4	16	8	4.5	42
132M3-S	13	395	431.5	391.5	40	189	202.5	4	20	10	5.5	42
152M3-S	15	315	410.5	370.5	40	168	202.5	4	20	10	5.5	42
202M3-S	20	220	452.5	412.5	40	210	202.5	4	20	10	5.5	42
302M3-S	30	150	470.5	430.5	40	228	202.5	5	25	13	5.5	52
502M4-S	50	110	615	565	50	310	255	6	30	15	6.5	62

DFT-TYPE	K	L	M	N	O	P	TAP	Q	R	S	T	WEIGHT (Kg)
101M1-S1	12	9.5 (.374)	38	40	55	46	M4	40	55	36	5	1.9
201M1-S	12	9.5 (.374)	38	40	55	46	M4	40	55	36	5	3
401M1-S	12	9.5 (.374)	38	40	55	46	M4	40	55	36	5	3
401M2-S	16	12.7 (.500)	51	54	74	62	M6	60	80	43	6	3.2
601M3-S	16	12.7 (.500)	51	54	74	62	M6	60	80	43	6	5
801M3-S	16	12.7 (.500)	51	54	74	62	M6	60	80	43	6	5
132M3-S	20	15.8 (.622)	54	60	80	68	M6	60	80	47	6	5.5
152M3-S	20	15.8 (.622)	54	62	84	68	M6	62	84	47	8	6
202M3-S	20	15.8 (.622)	54	62	80	68	M8	62	80	47	8	6
302M3-S	25	19.0 (.748)	73	76	102	87	M8	76	102	54	12	10
502M4-S	32	25.4 (1.00)	73	80	110	90	M10	80	110	56	15	13

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4.4.2 Offset Tool

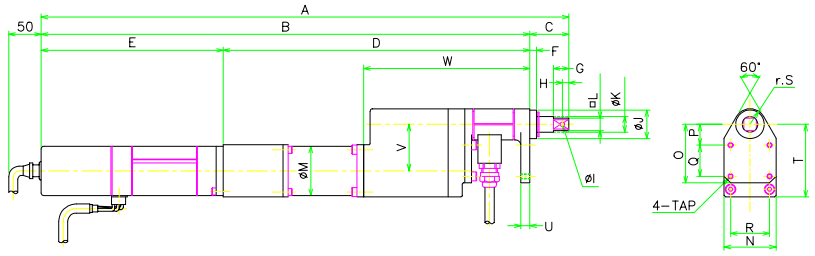


FIG. 4-4-2 Offset Tool

DFT-TYPE	TORQUE (kgm)	SPEED (rpm)	A	B	C	D	E	F	G	H	I	J	K
101M1-O1	1	500	406	376	30	236	140	5	12	5	3.5	22	12
201M1-O	2	500	406	376	30	236	140	5	12	5	3.5	22	12
401M1-O	4	250	428	398	30	258	140	5	12	5	3.5	22	12
401M2-O	4	500	456	416	40	269	147	5	16	8	4.5	30	16
601M3-O													
801M3-O	8	500	511.5	471.5	40	269	202.5	5	16	8	4.5	30	16
132M3-O	13	400	551.5	511.5	40	309	202.5	5	20	10	5.5	34	20
152M3-O	15	315	545.5	505.5	40	303	202.5	5	20	10	5.5	38	20
202M3-O	20	220	587.5	547.5	40	345	202.5	5	20	10	5.5	38	20
302M3-O	30	150	627	587.5	40	385	202.5	5	25	13	5.5	42	25
502M4-O	50	110	807	757	50	502	255	6	30	15	6.5	52	32

DFT-TYPE	L	M	N	O	P	Q	R	TAP	S	T	U	V	W	WEIGHT (Kg)
101M1-O1	9.5	38	40	45	16	24	30	M4	12	56	6	35.8	128	3
201M1-O	9.5	38	40	45	16	24	30	M4	12	56	6	35.8	128	3
401M1-O	9.5	38	40	45	16	24	30	M4	12	55.8	7	35.8	128	3
401M2-O	12.7	51	54	70	18	42	40	M6	17	86.7	8	57	142	5.5
601M3-O														
801M3-O	12.7	51	54	70	18	42	40	M6	17	86.7	8	57	142	8
132M3-O	15.8	54	60	80	18	55	45	M6	19	92.6	10	62.6	179	8
152M3-O	15.8	54	62	85	20	55	45	M8	22	99	10	68	194	8.8
202M3-O	15.8	54	62	85	20	55	45	M8	22	99	10	68	194	9
302M3-O	19	73	76	100	30	55	50	M10	27	121	12	82.7	217	14
502M4-O	25.4	73	80	122	35	72	60	M10	30	138.4	18	98.3	260	24

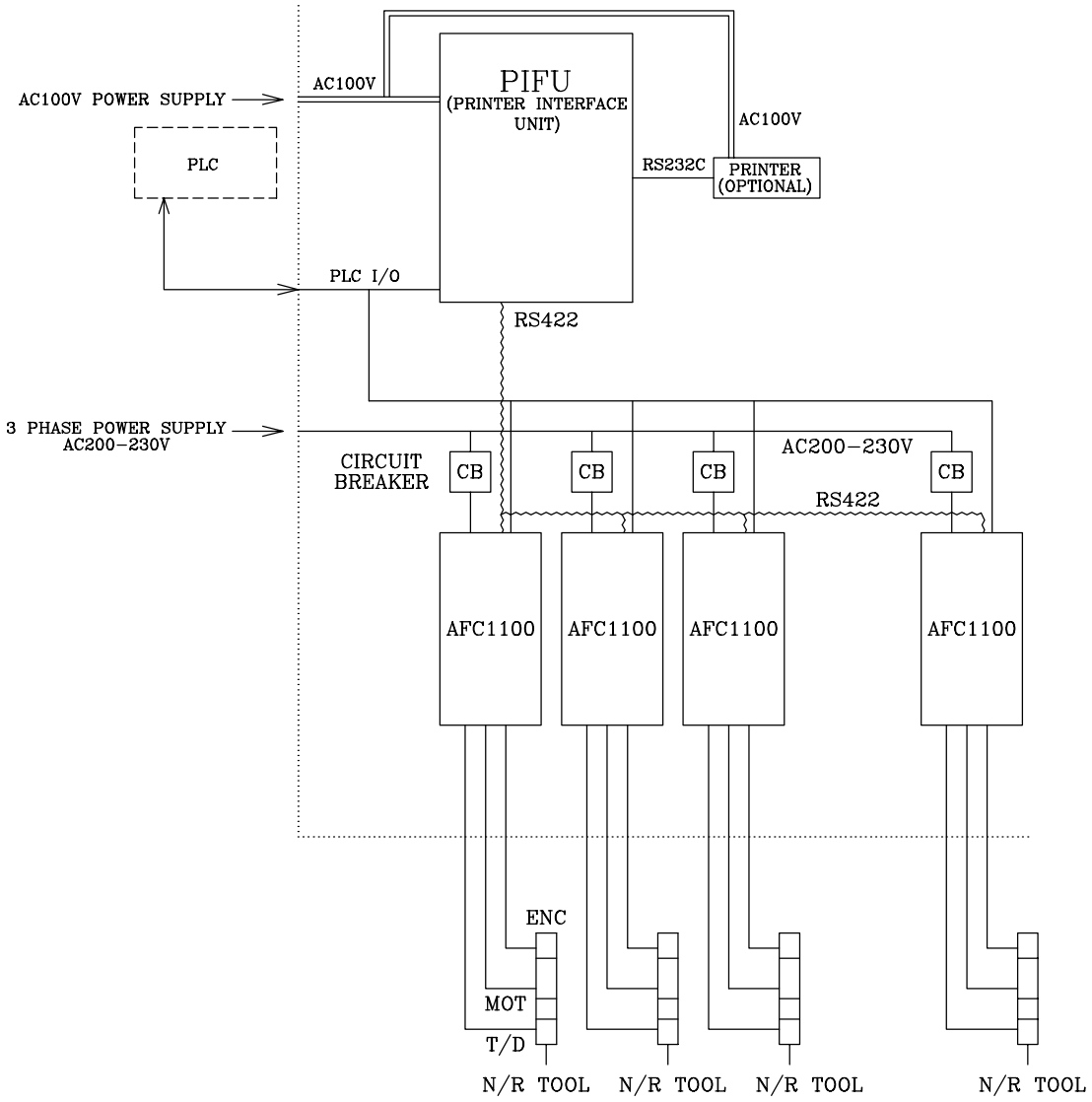
4.4.3 Mounting Plate Design Requirements

The plate to which the tools are mounted must maintain the following specifications:

- Plate must be blanchard ground (to ensure sides are adequately flat and parallel) to a thickness of 15.88 mm (.625 inch) +/- 0.05 mm (.002 inch).
- Chamfer all bores on both sides by 1.6 mm (.063 inch) x 45 degrees.
- Tools must be mounted 1.6 mm (.063 inch) apart, at a minimum.

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4.5 Wiring Diagrams



WARNING: Follow Lockout/Tagout and other safety precautions when connecting and/or disconnecting cabling, wiring, and equipment.

FIG. 4-5 Wiring Diagram

A basic layout of System component interconnection is shown in Figure 4-5. Detailed reference drawings can be found throughout this Chapter, and also in Appendix A.

The layout includes a Programmable Logic Controller (PLC) and a Printer Interface Unit (PIFU), which are not automatically supplied with the System. If a PLC is not already available at the System installation site, one can be supplied with the System as an option.

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4.6 Power Requirements and Connections

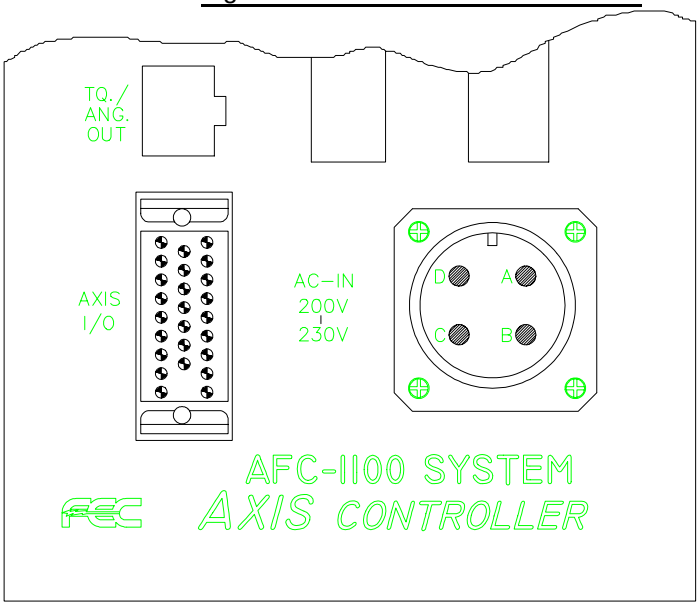
4.6.1 Axis Unit Power Requirements and Connections

WARNING:

Follow Lockout/Tagout and other safety precautions when connecting and/or disconnecting cabling, wiring, and equipment.

PIN NUMBER	DESCRIPTION
A	200~230 VAC ± 10%, 50/60Hz, 3-Phase
B	200~230 VAC ± 10%, 50/60Hz, 3-Phase
C	200~230 VAC ± 10%, 50/60Hz, 3-Phase
D	FRAME GROUND

Fig. 4-6-1 Axis unit Power Connector



NOTE: After an Axis unit is powered down, the power must not be applied again for at least five (5) seconds. Repeated power up and power down may temporarily disable an Axis unit. If an Axis unit does become disabled, turn the power off for five (5) minutes before making another attempt to power up.

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4.6.2. Calculating Circuit Protection

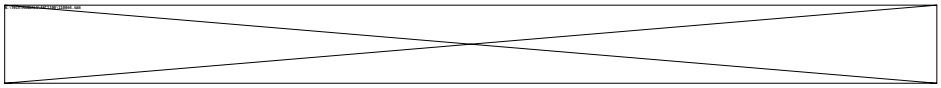
WARNING: Follow Lockout/Tagout and other safety precautions when connecting and/or disconnecting cabling, wiring, and equipment.

RATED VALUES FOR CALCULATING CIRCUIT PROTECTION			
TOOL TYPE	MOTOR WATTAGE	# OF SPINDLES PER 1 KVA	KVA PER SPINDLE
DFT-101M1-S1/O1	60	8 SPINDLES	.125 KVA
DFT-201M1-S/O	60	8 SPINDLES	.125 KVA
DFT-401M1-S/O	60	8 SPINDLES	.125 KVA
DFT-401M2-S/O	100	5 SPINDLES	.2 KVA
DFT-601M3-S/O	200	2.5 SPINDLES	.4 KVA
DFT-801M3-S/O	200	2.5 SPINDLES	.4 KVA
DFT-132M3-S/O	200	2.5 SPINDLES	.4 KVA
DFT-152M3-S/O	200	2.5 SPINDLES	.4 KVA
DFT-202M3-S/O	200	2.5 SPINDLES	.4 KVA
DFT-302M3-S/O	200	2.5 SPINDLES	.4 KVA
DFT-502M4-S/O	400	1.25 SPINDLES	.8 KVA

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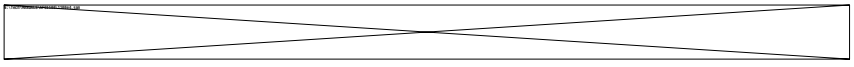
The chart above shows nominal motor ratings for standard tools, along with the power requirements (KVA) for each spindle.

Use the formula below to compute transformer secondary fuse or circuit breaker sizing:



Example:

* Use a fuse or circuit breaker with a rating just above the computed required size.



4.7 Wiring PLC I/O

All interface devices must accommodate active true low logic for correct operation with AFC1100 inputs and outputs (I/O). Outputs are rated at 12~24 VDC, 200mA. When activated, open collector sink outputs (normally high) pull the input device signal low (0 VDC). Inputs are sourced (normally high) and activated when pulled low (0 VDC).

CAUTION:

The PLC I/O wiring must be routed a minimum of 300 mm away from any transient high voltage sources. Cable length must not exceed 50 feet.
DO NOT connect a positive DC voltage source to the output common.

4.7.1 Explanation of Axis Unit I/O

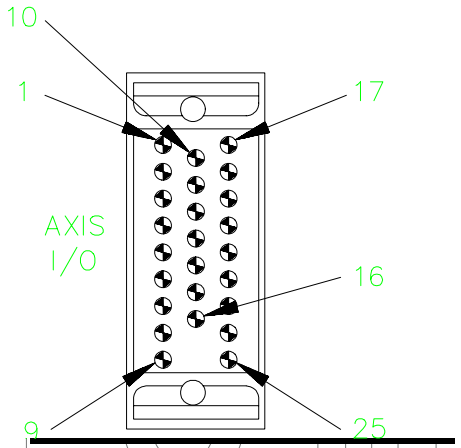


FIG. 4-7-1 Axis unit PLC Connector

CAUTION: DO NOT CONNECT A POSITIVE DC VOLTAGE SOURCE TO THE OUTPUT COMMON, OR DAMAGE MAY RESULT.

INPUT SIGNALS		
Pin #	SIGNAL NAME	DESCRIPTION
1	STOP	Emergency Stop Input (Normally Closed) This signal must be active (on) for controller operation. When this signal is inactive (off), controller operation will stop, and input/outputs will be disabled.
2	RESET	Reset Input (Normally Open) When active (on), this signal will clear all fastening data, discrete outputs, and communication buffers. A Zero Check of the torque transducer will be completed. During the Zero Check, the ACCEPT or REJECT lamp will light to indicate the result of the Zero Check. If the System has been disabled by an Abnormal output, the System will not return to normal operation until the Abnormal condition has been corrected, and this signal has been input for 200~500 milliseconds. Do not input this signal between cycles, due to the potential for data loss.
3	REVERSE	Reverse Spindle Rotation Input (Normally Open) The spindle will rotate in an opposite direction for as long as this signal is activated (on) and maintained. The Reverse input functions the same as the reverse pushbutton on the front of the Axis unit.

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4	START	Start Cycle Input (Normally Open) The Start input automatically resets the previous cycle, clears all data to zero, and initiates the next fastening cycle.The Start input requires a pulse of 200~500 milliseconds if the Axis Unit DIP switches are set up for AUTOMATIC Start input. If the Axis Unit DIP switches are set up for DEADMAN (hand-held operations) input, the Start input must be maintained "on" for the entire cycle.
5	BYPASS	Spindle Bypass Input (Normal Open) When active, all functions of this spindle are bypassed, and the Bypass output is active.
6	SYNC COMMON	Input common signal for inputs 8 and 9 "SYNC" signal
7	SYNC COMMON	Input common signal for inputs 8 and 9 "SYNC" signal
8	SYNC	Input / output signal that is directly connected to other Axis Units to provide for Syncronized 2 step fastening.
9	SYNC	Input / output signal that is directly connected to other Axis Units to provide for Syncronized 2 step fastening.
10	IN COMMON	Input signal common. Connection to +12 ~ 24 VDC required
11	SELF CHECK DISABLE	Input signal used to disable the performance of the automatic Self Check function at the beginning of the fastening cycle.
12 13	BANK SELECT 1 BANK SELECT 0	Bank Select Input Signals (Normally Open) These two (2) inputs form a binary code that is used to define the function/definition of outputs for Bank Data 0~7 (Pins 23~30). This allows up to 32 different output definitions with only 8 discrete outputs (4 Banks, 8 available outputs per Bank). See 4.7.4 Bank Select Table.
14 15 16	WORK SELECT 0 WORK SELECT 1 WORK SELECT 2	Work / Parameter Select Input (Normally Open) These 3 inputs form a binary code which is capable of selecting up to 8 different sets of Fastening Parameters. Refer to Section 4.7.2 Work Sequence Select Table.
17	OUTPUT COMMON	Output signal common. Connection to 0 VDC required
OUTPUT SIGNALS		
25 24 23 22 21 20 19 18	BANK DATA 0 BANK DATA 1 BANK DATA 2 BANK DATA 3 BANK DATA 4 BANK DATA 5 BANK DATA 6 BANK DATA 7	Bank Data Output Signals (Normally Open) These output signals designate various fastening conditions and results as determined by Bank Select 0 & 1 (Pins 13 & 12) inputs. Refer to 4.7.4 Bank Select Table for output data descriptions.

WARNING:

Follow Lockout/Tagout and other safety precautions when connecting and/or disconnecting cabling, wiring, and equipment.

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4.7.2 Work / Parameter Select Table

WORK SELECT 2 PIN 16	WORK SELECT 1 PIN 15	WORK SELECT 0 PIN 14	SELECTE WORK/PARAM
OFF	OFF	OFF	WORK 1
OFF	OFF	ON	WORK 2
OFF	ON	OFF	WORK 3
OFF	ON	ON	WORK 4
ON	OFF	OFF	WORK 5
ON	OFF	ON	WORK 6
ON	ON	OFF	WORK 7
ON	ON	ON	WORK 8

4.7.3 Bank Output Servo Error Table

	SV ERR			
SV AMP ERR	**2**	**1**	**0**	**DESCRIPTION**
ON	OFF	OFF	OFF	Encoder wire broken.
ON	OFF	OFF	ON	Over current or Axis type mismatch.
ON	OFF	ON	OFF	Encoder abnormal.
ON	OFF	ON	ON	Axis unit overheated.
ON	ON	OFF	OFF	Encoder overheated.
ON	ON	OFF	ON	Internal voltage level abnormal.
ON	ON	ON	OFF	Input voltage abnormal.
ON	ON	ON	ON	Overload.
OFF	_	_	_	

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4.7.4 Bank Select Table

	BANK SELECT INPUT		PLC / AXIS UNIT BANK DATA		
BANK #	1 PIN12	0 PIN 13	BANK DATA PINS 25 ~ 18	NAME OF SIGNAL	DESCRIPTION
1	OFF	OFF	DATA 0	REJECT	Output when the fastening result is a REJECT. Indicates that the spindle has failed the fastening limits. This output remains active until the START signal or RESET signal is input.
			DATA 1	ACCEPT	Output when the fastening result is a ACCEPT. Indicates that the spindle is within the fastening limits. This output remains active until the START signal or RESET signal is input.
			DATA 2	ABNORMAL	Output when an Abnormal condition occurs, this signal indicates that the System has detected an internal fault, and can no longer proceed. An Abnormal condition must be corrected before the System will resume normal operation.
			DATA 3	READY	Output when the system is in READY condition. Indicates system is ready to operate, and inputs are enabled. This signal is inactive (off) when the BUSY output is active (on).
			DATA 4	BUSY	Output after a START signal is received, and active until the fastening cycle is complete and the READY signal is output.
			DATA 5	WORK 0	Output confirmation of WORK SELECT 0~2 (Pins 14~16) input selections.
			DATA 6	WORK 1	
			DATA 7	BYPASS	Output when the spindle is bypass either via the PLC input or the Axis Unit front panel switch.
2	OFF	ON	DATA 0	METHOD 0	Outputs when the fastening method is Angle control.
			DATA 1	METHOD 1	not used
			DATA 2	METHOD 2	not used
			DATA 3	1ST TIME OVER REJECT	Output when Fastening resulted in a 1st Time Reject.
			DATA 4	FINAL TIME OVER REJECT	Output when Fastening resulted in a Final Time Reject.
			DATA 5	TORQUE HIGH REJECT	Output when Fastening resulted in a Torque High Reject.
			DATA 6	TORQUE LOW REJECT	Output when Fastening resulted in a Torque Low Reject.
			DATA 7	WORK 2	See Work 0 ,1

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	BANK SELECT INPUT		PLC / AXIS UNIT BANK DATA		
BANK #	1 PIN12	0 PIN 13	BANK DATA PINS 25 ~ 18	NAME OF SIGNAL	DESCRIPTION
3	ON	OFF	DATA 0	ANGLE HIGH REJECT	Output when Fastening resulted in an Angle High Reject.
			DATA 1	ANGLE LOW REJECT	Output when Fastening resulted in an Angle Low Reject.
			DATA 2	1ST RATE HIGH REJECT	Output when Fastening resulted in a 1st Torque Rate High Reject.
			DATA 3	1ST RATE LOW REJECT	Output when Fastening resulted in a 1st Torque Rate Low Reject.
			DATA 4	2ND RATE HIGH REJECT	Output when Fastening resulted in a 2nd Torque Rate High Reject.
			DATA 5	2ND RATE LOW REJECT	Output when Fastening resulted in a 2nd Torque Rate Low Reject.
			DATA 6	not used	
			DATA 7	not used	
4	ON	ON	DATA 0	ZERO CAL ERR	Outputs when an abnormal condition occurs during the SELF CHECK (CAL and Zero).
			DATA 1	PSET ERR.	Outputs when an abnormal condition occurs in the parameter setting.
			DATA 2	ENC ERR	Outputs when an abnormal condition occurs in the encoder.
			DATA 3	TOOL ERR	Outputs when a tool related abnormality occurs.
			DATA 4	SV AMP ERR	Outputs when a servo abnormality occurs, see SV ERR 0~2 codes below.
			DATA 5	SV ERROR 0	Outputs a detailed code when a SV AMP ERR is output. Error code is output in three bits. (See Section 4.7.3).
			DATA 6	SV ERROR 1	
			DATA 7	SV ERROR 2	

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4.7.5 PLC Wiring Sample

This diagram represents standard I/O connections. For the SYNC signal connection method, Please refer to section 4.7.6: Synchronized Fastening Operation.

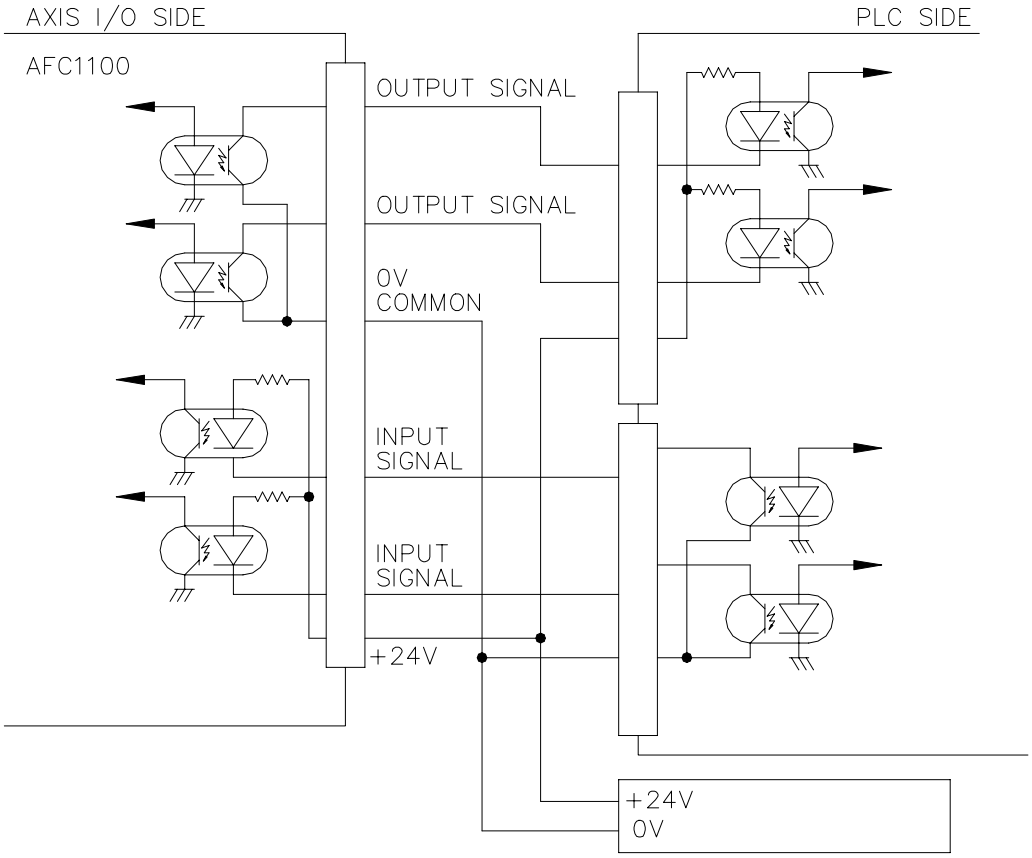


FIG. 4-7-5 PLC Wiring Sample

All AFC1100 inputs and outputs (I/O) are active true low. All interface devices must accommodate active true low logic for correct operation. Outputs are rated at +12~24 VDC, 200mA. When activated, open collector sink outputs (normally high) pull the input device signal low (0 VDC). Inputs are sourced (normally high) and activated when pulled low (0 VDC).

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4.7.6 Synchronized Fastening Operation.

{ 1 SYNC: Bi-directional signal for synchronized fastening (5V, TTL signal).

- When synchronized 2 step fastening is used in multi-Axis arrays the connection of the SYNC signals is in parallel and should be connected as shown below.
- Pins 6 & 7 and pins 8 & 9 are internally connected.

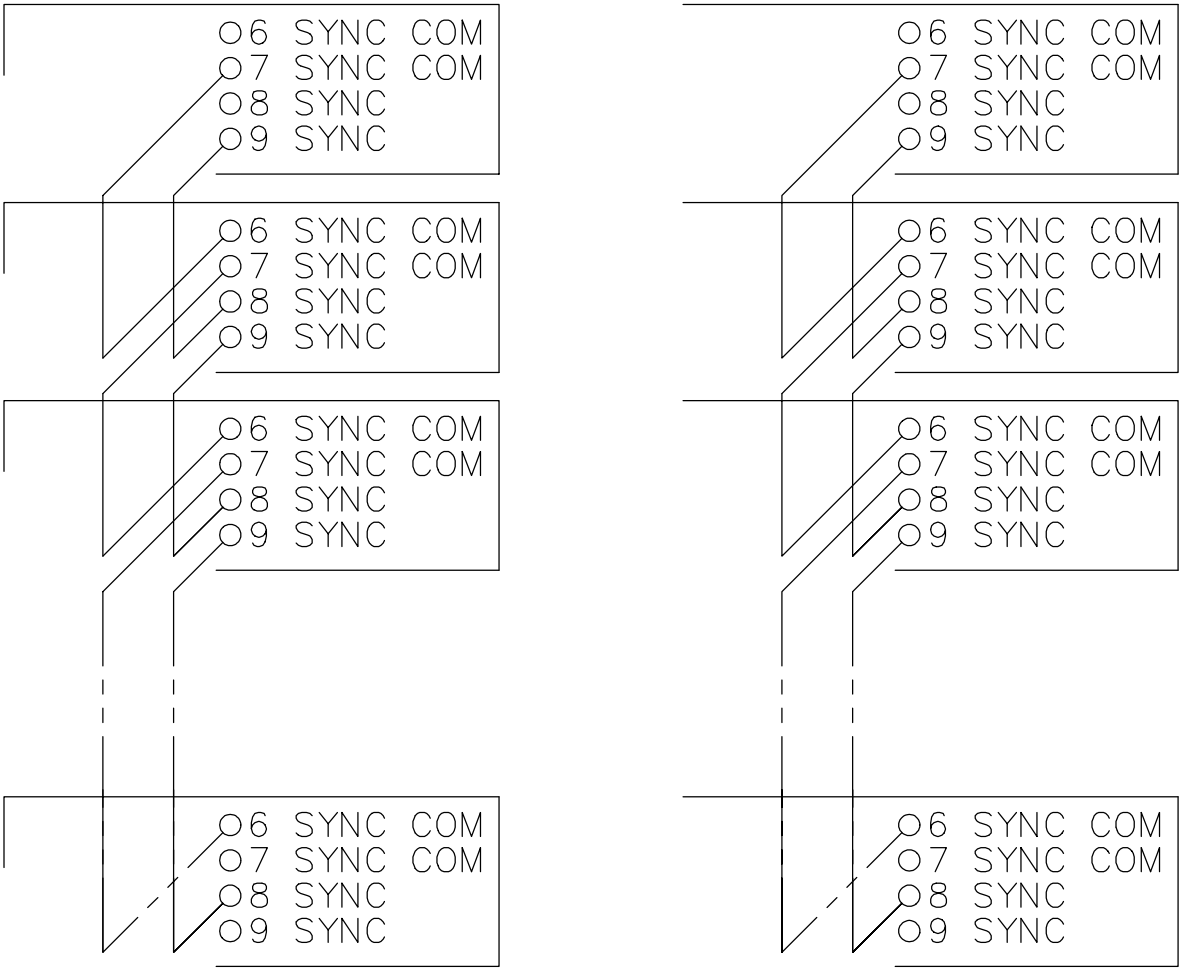


FIG. 4-7-6 Syncronizing Wiring Sample

From the start of the cycle until reaching 1st torque, the Axis SYNC signal is ON (LOW condition) to stop other Axis from continuing to the second step (wired OR). When the 1st torque is reached, the line works as an input signal. If it reads LOW - meaning that other Axis units have not reached 1st torque yet - the Axis unit stays in the standby state. When the SYNC signal is HIGH (all Axis units have completed the first step), all units simultaneously start the second step.

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4.7.7 Signal Timing Chart

A. Basic Control Signals

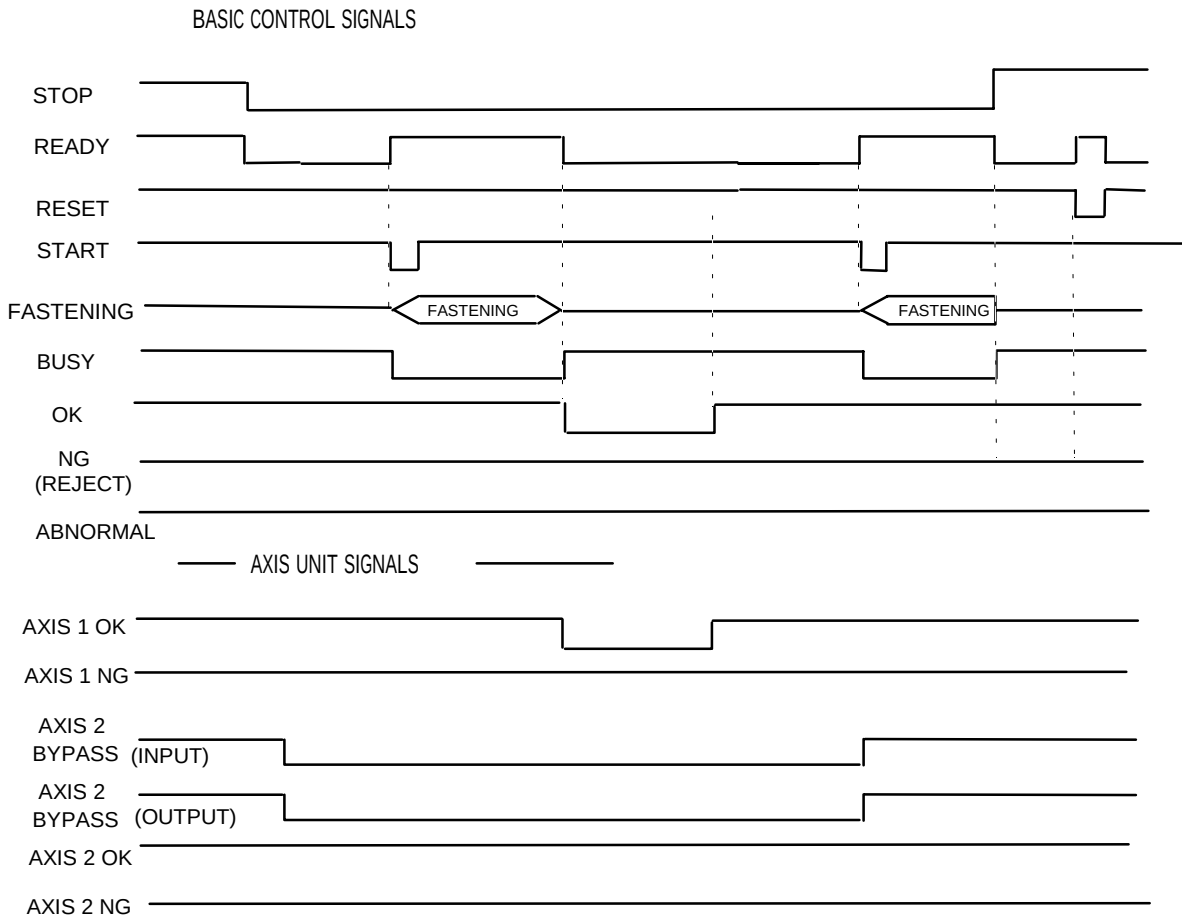


FIG. 4-7-7a Basic Control Signals

Because the RESET input clears all fastening data, discrete outputs, and communication buffers, it should be activated only to clear a System Abnormal or to perform a required Zero Check. The System will automatically reset with each fastening, and a Manual RESET activation between cycles could result in data loss. The RESET signal requires a pulse of 200~500 milliseconds.

The STOP input is Normally Closed, and enables all other functions. When STOP is Open, all operations cease and all inputs and outputs become inactive.

The READY signal enables Axis unit inputs and allows System operation.

The START signal will not operate during RESET, REVERSE, or ABNORMAL signal activation. The START signal requires a pulse of 200~500 milliseconds.

When the ABNORMAL signal is active, all other signals are disregarded. RESET is an exception, because RESET must be input to clear an Abnormal output.

REJECT, ACCEPT, ABNORMAL, READY, and BUSY output signals must be interlocked with BANK 1 and activated only when BANK 1 is selected.

When a BYPASS signal is input to the Axis unit from the PLC, the Axis unit will return a BYPASS output signal as a confirmation. Axis Units should be monitored to ensure that all

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required spindles are functioning, and that none have been bypassed in error. The PLC can be programmed to output a message whenever an "active" spindle has been set to IN BYPASS, or the equipment operator can visually monitor each Axis unit.

B. Fastening Work Selection and START signal input

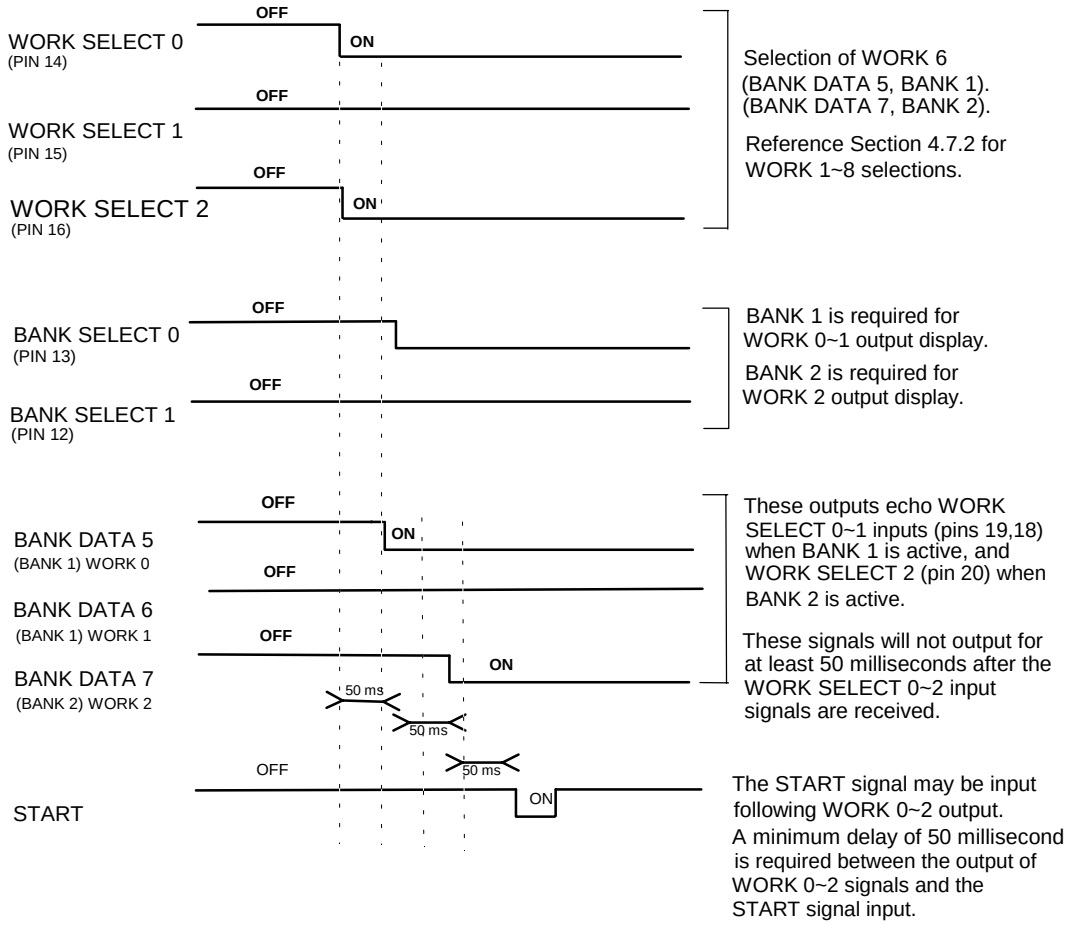


FIG. 4-7-7b Example of Sequence # 6 Selection

4.8 RS-422 Data communication ports.

RS-422 IN

PIN	SIGNAL NAME	IN/OUT	DESCRIPTION
	RX+	IN	Receive data from a host computer.
	RX-	IN	
	TX-	OUT	Send data to a host computer.
	TX+	OUT	
	GND		

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	GND	

RS-422 OUT (Used in multiple Axis connection).

PIN	SIGNAL NAME	IN/OUT	DESCRIPTION
	RX+	IN	This line is to be connected to the next Axis unit in a multi-Axis array (parallel).
	RX-	IN	
	TX-	OUT	This line is to be connected to the next Axis unit in a multi-Axis array (parallel).
	TX+	OUT	
	GND		
	GND		

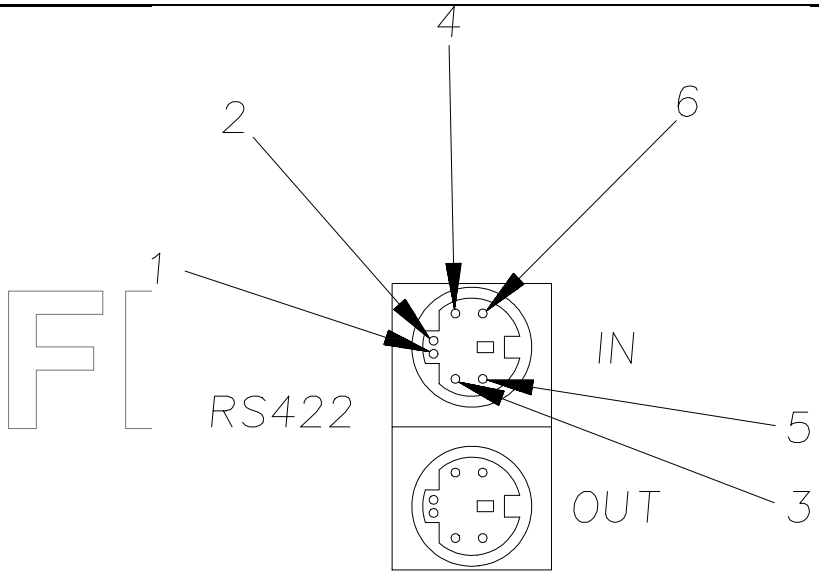
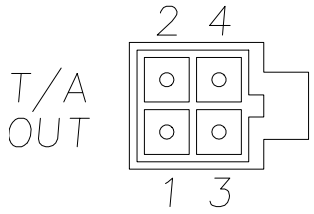


FIG. 4.8 RS-422 port connectors diagram.

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4.9 Torque/Angle OUT (external monitoring connector).

This connector outputs a torque voltage and an angle digital pulse signal.



{ Adapter plug description:

- P Manufacturer: Molex.
- P Type: Socket receptacle.
- P Model: 5557-04R, 5556* (*depending on the wire dimensions).

Currently Molex 5569-04A1 Axis unit connector.

FIG. 4-9a T/A OUT connector

Pin	Signal	IN/OUT	Description
	Angle pulses	OUT	Angle pulses monitoring output. TTL, IOL = 30 ma.
	Torque	OUT	Torque voltage monitoring output. Full scale torque = 2.5 V
	Ground		Monitoring signal output ground.
	Motor rotation	OUT	Forward/Reverse pulse monitoring output. TTL, IOL = 30 ma.

IOL = Current Output Low

{ Torque Voltage.

Analog voltage signal will show 2.5V variation from zero to full scale torque.

{ Angle pulses.

TTL signal (0V to 5V). 1 degree equals 1 pulse.

{ Motor rotation.

TTL signal (0V to 5V). The signal will be LOW to indicate Forward rotation and will be HIGH to indicate Reverse rotation.

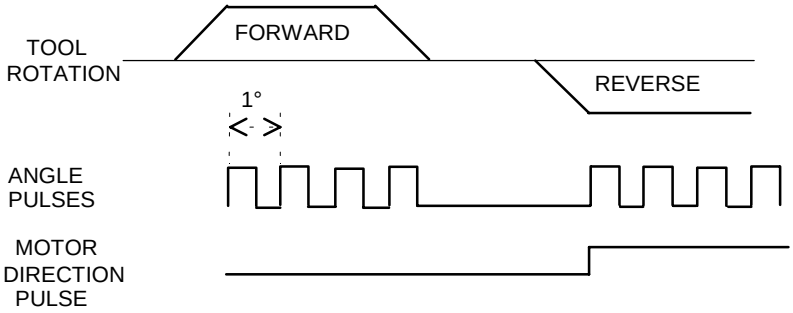


FIG. 4-9b T/A OUT signal reference

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4.10 Axis Unit DIP Switch setting.

In a multi-Axis AFC1100 system, it is necessary to number the Axis units sequentially beginning from 1. The number is set using the DIP switch located at the side of the Axis unit.

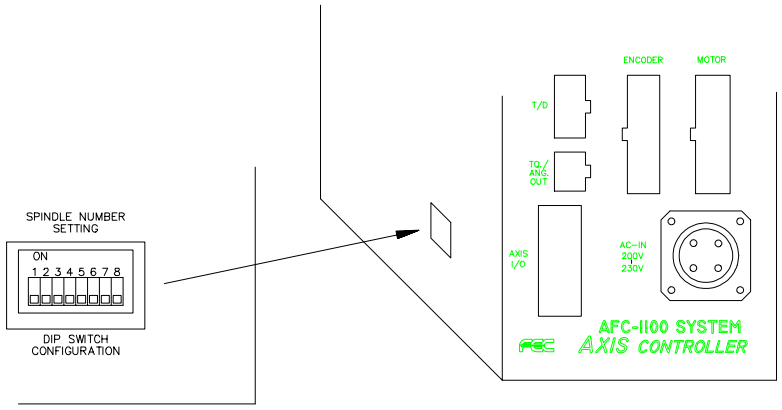


FIG. 4-10 Dip Switch settings

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4.10.1 Axis Unit DIP switch positions 1 ~ 3

{ DIP switch positions 1 ~ 3 are used for setting the special configuration features as defined in the following explaination

{ DIP Switch 1 - Calibration acceptance window selection.
Software version 1.09 and greater

- On - Calibration acceptance = +/- 10 % of Full scale torque
- Off - Calibration acceptance = +/- 4 % of Full scale torque

{ DIP Switch 2 - RS422 communications port configuration
Software version 1.14 and greater

- On - Raw data output mode. (Data Dump)
- Off - User console communications mode.

{ DIP Switch 3 - Start input type selection.
Software version 1.11 and greater

- On - Deadman - Start input must remain on for the entire cycle.
- Off - Normal mode - Start input pulse initiates automatic cycle.

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4.10.2 Axis Unit DIP switch positions 4 ~ 8

{ DIP switch positions 4 ~ 8 are used for setting the Axis unit spindle address number as described in the following table.

AXIS UNIT	DIPSWITCH NUMBER					AXIS UNIT	DIPSWITCH NUMBER				
	4	5	6	7	8		4	5	6	7	8
1	OFF	OFF	OFF	OFF	OFF	17	ON	OFF	OFF	OFF	OFF
2	OFF	OFF	OFF	OFF	ON	18	ON	OFF	OFF	OFF	ON
3	OFF	OFF	OFF	ON	OFF	19	ON	OFF	OFF	ON	OFF
4	OFF	OFF	OFF	ON	ON	20	ON	OFF	OFF	ON	ON
5	OFF	OFF	ON	OFF	OFF	21	ON	OFF	ON	OFF	OFF
6	OFF	OFF	ON	OFF	ON	22	ON	OFF	ON	OFF	ON
7	OFF	OFF	ON	ON	OFF	23	ON	OFF	ON	ON	OFF
8	OFF	OFF	ON	ON	ON	24	ON	OFF	ON	ON	ON
9	OFF	ON	OFF	OFF	OFF	25	ON	ON	OFF	OFF	OFF
10	OFF	ON	OFF	OFF	ON	26	ON	ON	OFF	OFF	ON
11	OFF	ON	OFF	ON	OFF	27	ON	ON	OFF	ON	OFF
12	OFF	ON	OFF	ON	ON	28	ON	ON	OFF	ON	ON
13	OFF	ON	ON	OFF	OFF	29	ON	ON	ON	OFF	OFF
14	OFF	ON	ON	OFF	ON	30	ON	ON	ON	OFF	ON
15	OFF	ON	ON	ON	OFF	31	ON	ON	ON	ON	OFF
16	OFF	ON	ON	ON	ON	32	ON	ON	ON	ON	ON

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4.10.3 Ramp-Up Time Setup

The ramp-up time dip switches control the duration of the initial tool speed ramp-up. If the duration is too short, the tool starting inertia may be falsely sensed by the System as a torque reading. If the duration is too long, the extended cycle time will result in reduced System efficiency.

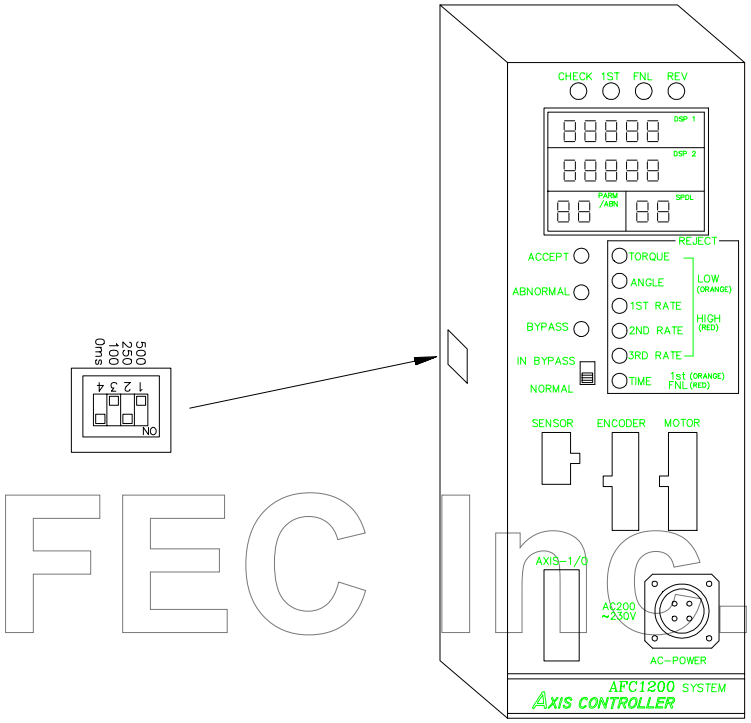


FIG. 4-10-3 Ramp-Up Time Dip Switches

The dip switches are set by the factory to 250 milliseconds, and the maximum possible duration is 500 milliseconds. Available ramp-up times and the appropriate dip switch settings are given in the table below. Setting the switches in any other combination will result in an erroneous setup.

RAMP-UP DURATION	0 msec	100 msec	250 msec	500 msec
1.0 SECOND	ON	OFF	OFF	OFF
.50 SECOND	ON	OFF	OFF	ON
.25 SECOND	ON	OFF	ON	OFF
.10 SECOND	ON	ON	OFF	OFF

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4.11 AFC1100 BUS Unit (Optional).

The function of the AFC1100 BUS unit is to simplify the wiring of the PLC I/O lines to a multi-Axis system. The I/O from each Axis unit (each I/O bus may have up to 20 lines) can be connected to an AFC1100 BUS unit. All AFC1100 BUS units are connected in parallel mode through ribbon cables, with only one AFC1100 bus unit physically wired to the PLC.

4.11.1 AFC1100 BUS Unit wiring (example).

In this example only the Bypass input signal has to be connected directly from the PLC to the each Axis unit. The input control lines from the PLC to one of the AFC1100 BUS units are connected in parallel. The output signals (fastening results) of all Axis units are in a "*OR" method. Thus a single output BUS is created with the information from all spindles.

**OR wiring means several lines connected to the same point. If all lines are OFF the result will be OFF, but will change to ON if at least one of the lines is ON.*

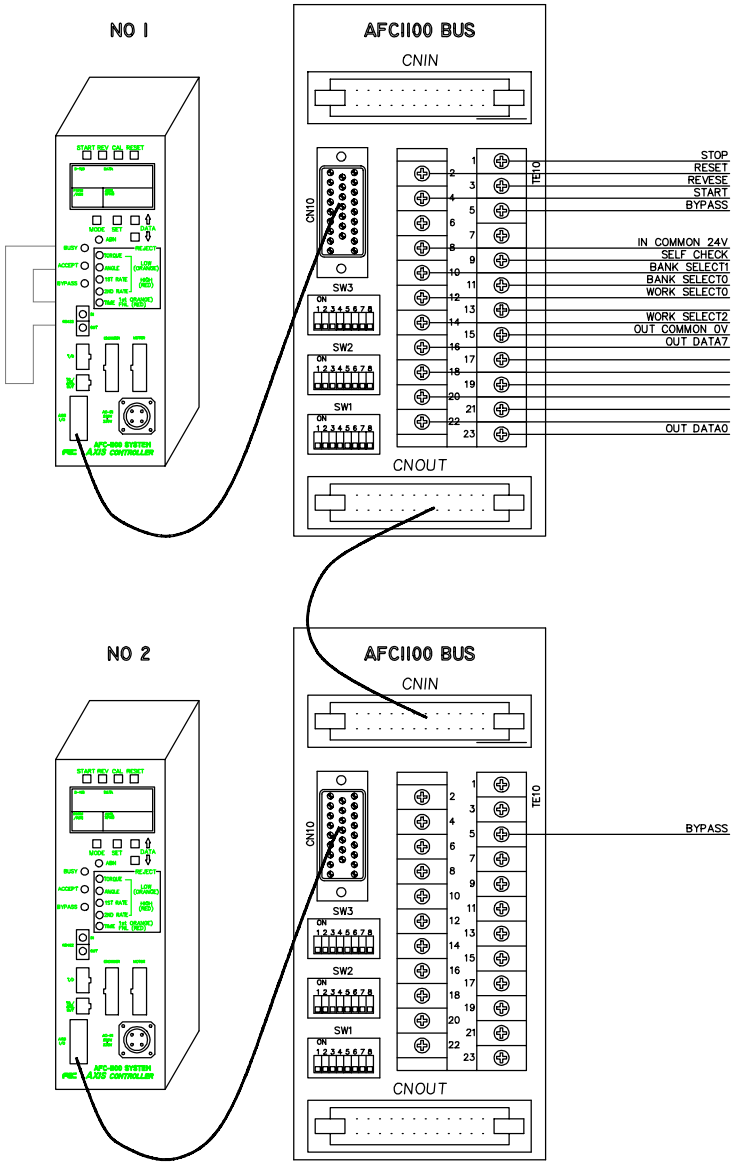


FIG. 4-11-1 AFC1100 Bus unit connection reference

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4.11.2 The AFC1100 BUS Unit front panel description.

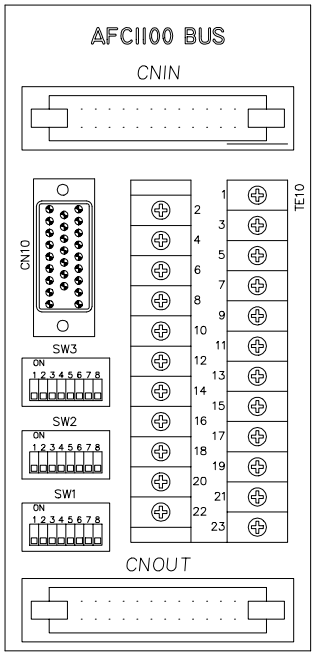


FIG. 4-11-2 AFC1100 Bus unit layout

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{ CNIO Connector.

Connected to the Axis I/O port.

{ TEIO Terminal.

This terminal strip connects the AFC1100 BUS unit to the PLC. The lines connected to this terminal are wired directly to CNIO and connected to the CNOUT through the SW1 ~ 3 switches.

{ CNIN and CNOUT Connectors.

These connectors have the same pin configuration. The CNOUT connector is connected to the CNIN connector of the next Axis unit.

{ SW1, SW2 and SW3 switches.

These switches determine which signals from one AFC1100 BUS unit are connected to the next AFC1100 BUS unit. By enabling a switch, the corresponding signal will be connected to the CNOUT connector and from there to the next AFC1100 BUS unit CNIN connector.

{ By disabling a switch, the individual signal for a single unit may be routed via the TEIO terminal block directly to the desired connection point.

Example: SW 1-5 for BYPASS signals should be turned OFF when the individual bypass signals are being connected to a PLC input.

{ AFC1100 BUS unit comes with 2 cables:

- AFC1100 - AFC1100 BUS cable. It connects the AFC1100 Axis I/O to the AFC1100 BUS CNIO connection.
- AFC1100 BUS ribbon cable. Connects the AFC1100 BUS CNIN to the CNOUT of another AFC1100 BUS unit.

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4.11.3 AFC1100 BUS Unit interconnection / pin out.

CONNECTOR PIN/ TERMINAL No.	SIGNAL	IN/OUT	NC/ NO	SWITCH
1	STOP	IN	NC	SW 1-1
2	RESET	IN	NO	SW 1-2
3	REVERSE	IN	NO	SW 1-3
4	START	IN	NO	SW 1-4
5	BYPASS	IN	NO	SW 1-5
6	SYNC COM	IN	NO	SW 1-6
7	SYNC	IN/OUT	NO	SW 1-7
8	IN COMMON			SW 1-8
9	SELF CHECK DISABLE	IN	NO	SW 2-1
10	BANK SELECT 1	IN	NO	SW 2-2
11	BANK SELECT 2	IN	NC	SW 2-3
12	WORK SELECT 0	IN	NO	SW 2-4
13	WORK SELECT 1	IN	NO	SW 2-5
14	WORK SELECT 2	IN	NO	SW 2-6
15	OUT COMMON			SW 2-7
16	OUT DATA 7	OUT	NO	SW 3-1
17	OUT DATA 6	OUT	NO	SW 3-2
18	OUT DATA 5	OUT	NO	SW 3-3
19	OUT DATA 4	OUT	NO	SW 3-4
20	OUT DATA 3	OUT	NO	SW 3-5
21	OUT DATA 2	OUT	NO	SW 3-6
22	OUT DATA 1	OUT	NO	SW 3-7
23	OUT DATA 0	OUT	NO	SW 3-8

{ **Refer to section 4.7 for PLC I/O descriptions**

4.11.4 AFC1100 BUS Unit internal circuit.

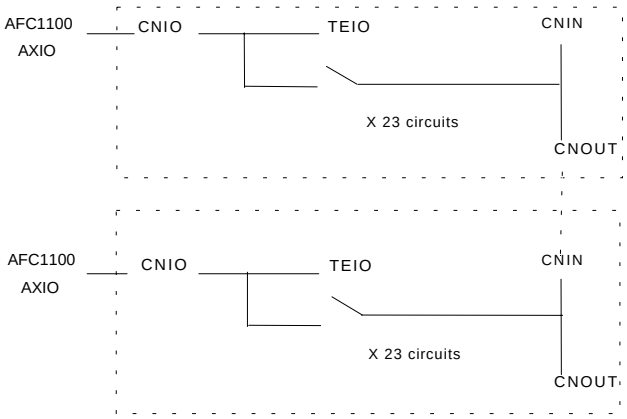


FIG. 4-11-4 AFC1100 Bus unit internal circuit

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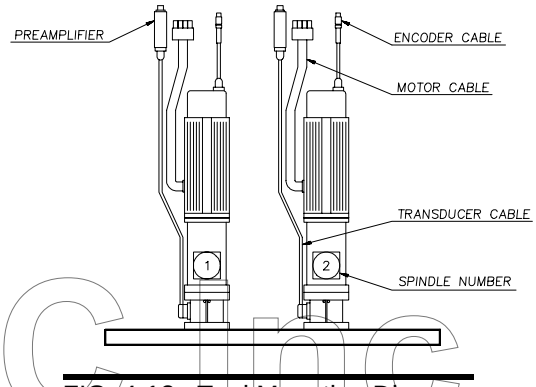
4.12 tool connection

{ Connect the encoder cable, the motor cable, and the transducer (sensor) cable to the corresponding numbered tool. Ensure that the cable tag numbers match the tool tag numbers.

{ Attach the preamp to the enclosure frame as shown in the following diagrams.

{ Ensure that the cable is tied so that there is no undue stress on it when the powerhead moves.

CAUTION: Use cylinder cushions or shock absorbers to decelerate the powerhead return and prevent excessive (hard stop) vibration, especially in short cycle time applications operating at high speeds. Repeated shock (over time) could damage a tool.



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FIG. 4-12a Tool Mounting Diagram

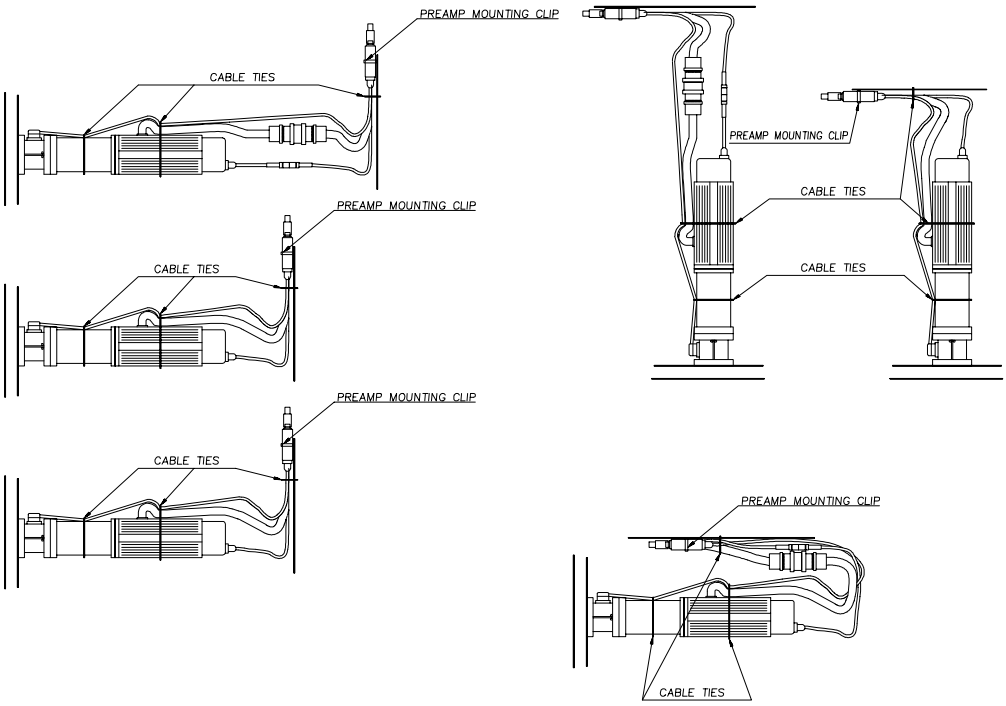


FIG. 4-12b Tool Mounting Methods

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Each tool has a preamplifier which must be securely mounted to ensure accurate System performance. Dimensions given below are in millimeters.

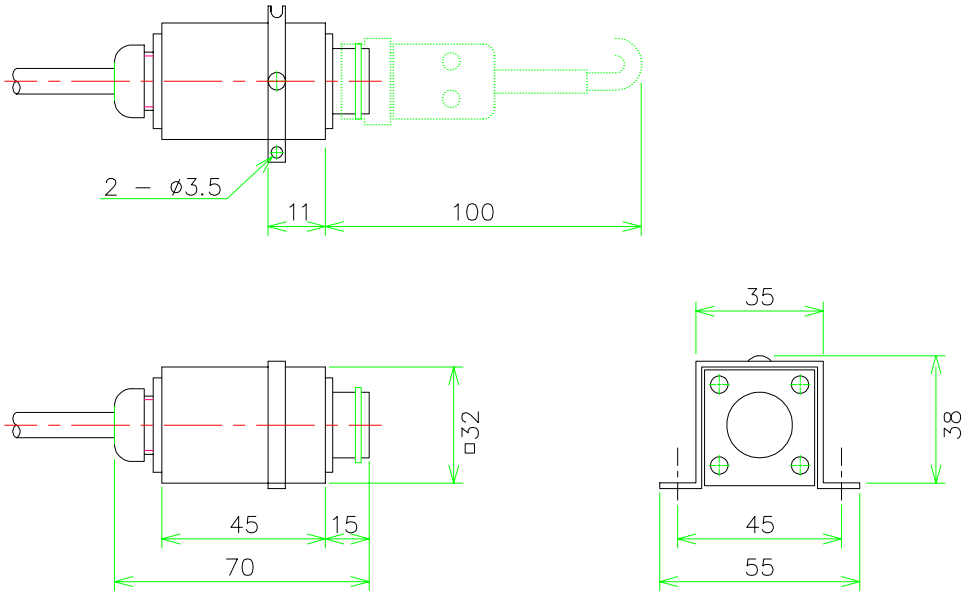


FIG. 4-12c Nutrunner (Tool) Preamp Unit Mounting

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Chapter 5: Power Up and Initial Checks

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5.1 Before Powering On

WARNING: Follow Lockout/Tagout and other safety precautions when connecting or disconnecting cabling, wiring, and equipment.

Each item below lists the manual Section(s) that will provide a reference for that specific item. Also refer to **Section 3.1** System Block Diagram and **Section 4.5** Wiring Diagram.

CAUTION: Damage may occur if the 24 VDC and 0 VDC Commons are improperly connected.

1. **Verify Axis Unit dip switch settings (4.10.1 and 4.10.2)**
   - Verify that the eight (8) dip switches visible on the left side of each unit are set to indicate the appropriate spindle number and options.
   - Verify the Ramp-Up Speed dip switches are set to the appropriate length of time for each Axis unit. (Axis Units with a model number ending with "A" are preset at the factory to 250 milliseconds. The Axis unit cover must be removed to access the dip switches.)

2. **Confirm PLC connection (4.7)**
   - Verify that the Axis unit PLC wiring is connected to the corresponding PLC terminals.

3. **Check connections between the tool and the Axis unit (3.2.1)**
   - Verify that the three (3) homerun cables (encoder, motor, and transducer/sensor) connecting the tool and Axis unit are secure. Ensure that each numbered set of three (3) cables is connected to the identically-numbered tool and Axis unit.
   - If the layout contains moveable parts, visually inspect all components to ensure that there is proper clearance and that cables have sufficient length. If movement would create any excessive stress on a cable, or create any potential for damage to the System or other components in the layout, then make appropriate adjustments.

4. **Check the input voltage (3.2.1, 4.6)**
   - Verify input power is connected in accordance with the instructions in Chapter 4.
   - Ensure input power voltage to the Axis Units is 200~230 VAC.
   - After turning on the power, verify the voltage again to ensure it has not dropped as a result of loading.

NOTE: After an Axis unit is powered down, the power must not be applied again for at least five (5) seconds. Repeated power up and power down may temporarily disable the Axis unit. If an Axis unit does become disabled, keep the power off for five (5) minutes, then power on again.

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5.2 Initial Data Setting

After completion of the System verification/power on procedure in Section 5.1, the System is ready for the input of data required for the fastening operation. Chapters 6 and 7 give details on the types of information required, and the procedure for entering data into the System.

NOTE: All AFC1100 Systems are delivered with application-specific fastening data already setup. The data input referred to above will be necessary if there is a change to the System application, and may be necessary in other circumstances such as the replacement of a System component or a change (oily, oversize, etc.) in the parts being processed.

After the System is setup with the appropriate data, verify all Axis unit RUN/BYPASS switches are set to NORMAL. Perform the following procedure:

1. **Check the transducer ZERO output.**
   - Press the RESET button on front of the Axis unit. The Axis unit will output a number to the DATA display and the "ACCEPT" LED will light. (See NOTE1 below.)
2. **Check the transducer CAL output.**
   - Press the CAL button on front of the Axis unit. The Axis Units will output a number to the DATA display and the "ACCEPT" LED will light. (See NOTE1 below.)

NOTE1: If the Zero and/or Cal check results in an "ABNORMAL" LED output from the Axis unit refer to Section 9 for guidance.

WARNING: VERIFY THERE ARE NO PERSONNEL OR OBSTRUCTIONS IN THE TOOL AREA PRIOR TO ACTIVATING A SPINDLE OR OTHER MOVEABLE COMPONENT.

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3. **Check manual reverse operation.**

   A. Set the IN BYPASS/NORMAL switch on each Axis unit as follows:
      1. Verify Axis unit #1 is set to RUN.
      2. Set all other Axis Units to the BYPASS position.

   B. Press the manual REV button on front of the Axis unit. Verify that spindle #1 is turning in the appropriate direction (opposite the preset direction), and that all other spindles are motionless. (See NOTE2 below.)

   C. Switch Axis unit #1 to the BYPASS position. Switch Axis unit #2 to RUN, and verify spindle #2 reverse operation (reference Step B).

   D. Repeat this procedure for each Axis unit/spindle. **It is important to complete this step for each Axis unit/spindle prior to performing the next step.**

NOTE2: If any Axis unit fails to activate the appropriate spindle, correct the situation before continuing to the next unit. First, check the nutrunner (tool) cables going to the Axis unit to verify correct connections to the appropriate components.

   E. After all Axis Units are verified individually, ensure that each of the BYPASS switches are set to the RUN position. Press the REV button on the Main Operator panel to operate all spindles simultaneously.

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4. Verify operation of manual start.

- Press the START button on the Main operator panel and verify that all tools run in the correct direction until the pre-programmed time elapses, creating both a TIME reject and a TORQUE reject. The TIME and TORQUE on each Axis unit will light (orange). (See NOTE3).
- Press the RESET button on the Main operator panel to clear the REJECT light and LED outputs from the Axis Units.

NOTE3: If any Axis unit fails to indicate a TIME and/or TORQUE reject (and assuming the previous verifications were completed), then verify that the correct presets have been entered into the System for that spindle.

5. Verify System operation by external commands.

- Confirm that the equipment operates correctly when PLC inputs and outputs are activated. Use the PLC to perform all of the functions (START, CAL, etc.) that were manually activated earlier in this Section.

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Chapter 6:
Fastening Instructions

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6.1 Fastening Control Methods

The AFC1100 System is user programmable to select from two different fastening methods, referred to as Torque Control, and Angle Control methods. Each method can be configured to perform the fastening in 1 to 2 incremental steps.

6.1.1 Torque Control Method

In Torque Control method, fastening is performed based upon attaining a desired torque value. Fastening can be performed in 1 to 2 incremental step which will successively secure the fastener to the specified torque values.

- One-Step Fastening
  - The System fastening parameters must be configured in accordance with the Engineered fastening specification.
  - One-step fastening will be used primarily for joints which have no requirement to synchronize with another spindle during the final stage of the rundown. Examples: Pipe plugs, single spindle applications.
  - The System will fasten to the STD torque value during the specified 1ST STEP time. Once SPEED CHANGE TORQUE is reached, the System will switch to the specified TORQUE SPEED (Section 6.3).

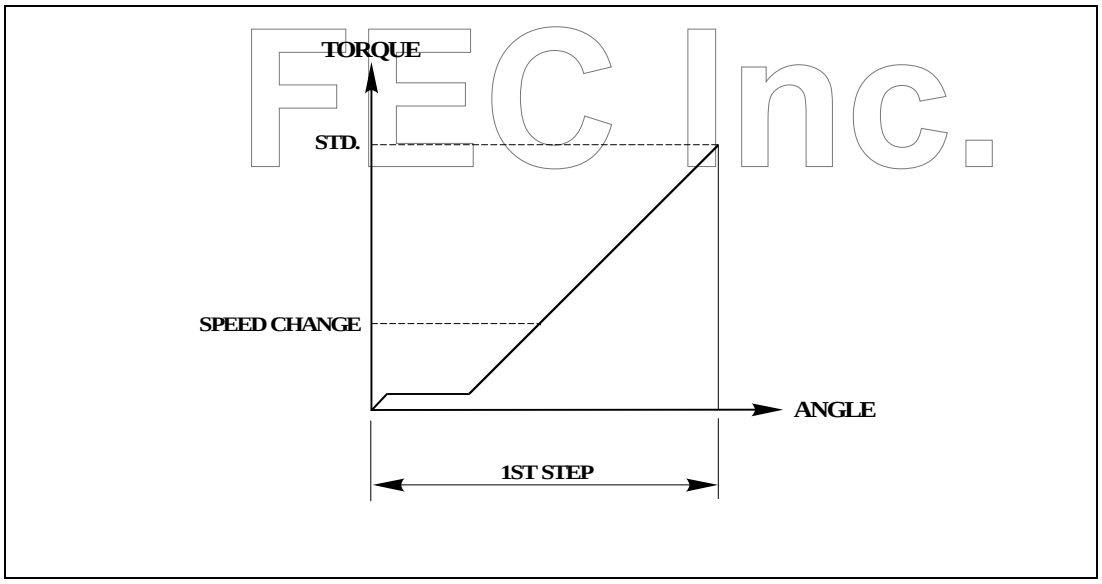


FIG. 6-1-1a Torque Control Functions for One-Step Fastening

FUNCTION	RECOMMENDATION
STD	Engineered fastening specification
SPEED CHANGE (TORQUE)	30 ~ 50% of STD for Hard joints 50 ~ 90% of STD for Soft joints
1ST STEP (TIME)	Maximum allowable fastening cycle time

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{ Two-Step Fastening

- The System fastening parameters must be configured according to the Engineered fastening specification.
- Two-step fastening will be used primarily for joints that have a requirement to synchronize with another spindle during the final stage of the rundown. Examples: Connecting rod, main bearing cap, any multiple-spindle application.
- The System will fasten to the 1st TORQUE value during the specified 1ST STEP time. Once either SPEED CHANGE TORQUE or 1st TORQUE is reached, the System will switch to the specified TORQUE SPEED (Section 6.3). When all fasteners have reached 1st torque, the spindles will synchronize and fasten simultaneously to STD during FINAL TIME.

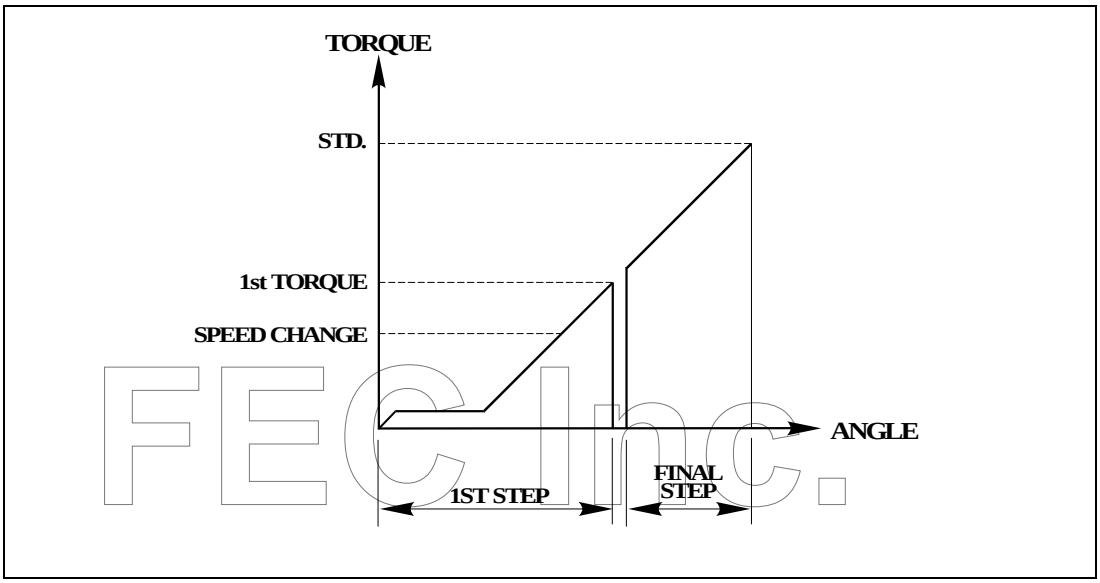


FIG. 6-1-1b Torque Control Functions for Two-Step Fastening

FUNCTION	RECOMMENDATION
STD (TORQUE)	Engineered fastening specification
1st TORQUE	30 ~ 50% of STD for Hard joints 50 ~ 90% of STD for Soft joints
SPEED CHANGE (TORQUE)	30 ~ 50% of STD for Hard joints 50 ~ 90% of STD for Soft joints
1ST STEP (TIME)	Maximum allowable 1st step cycle time
FINAL STEP (TIME)	Maximum allowable Final step time

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6.1.2 Angle Control Functions

In Angle Control method, fastening is performed based upon attaining a desired torque value and then rotating the fastener a specified number of degrees. Fastening can be performed in from 1 to 2 incremental steps that will successively secure the fastener to a specified torque or angle value before attaining the final number of degrees of rotation. Angle Control method is primarily used when greater control of clamp load is required.
(Example: Connecting rods, main bearing caps, cylinder heads.)

- One-Step Fastening
  - The System fastening parameters must be configured according to the Engineered fastening specification.
  - One-step fastening will be used primarily for joints that have no requirement to synchronize with another spindle during the final stage of the rundown. Examples: Pipe plugs, any single-spindle application.
  - The System will fasten to the STD ANGLE value during the specified 1ST STEP time. Once SPEED CHANGE TORQUE is reached, the System will switch to the specified TORQUE SPEED (Section 6.3). Once SNUG TORQUE is reached, the System will rotate the fastener the number of degrees specified by STD ANGLE.

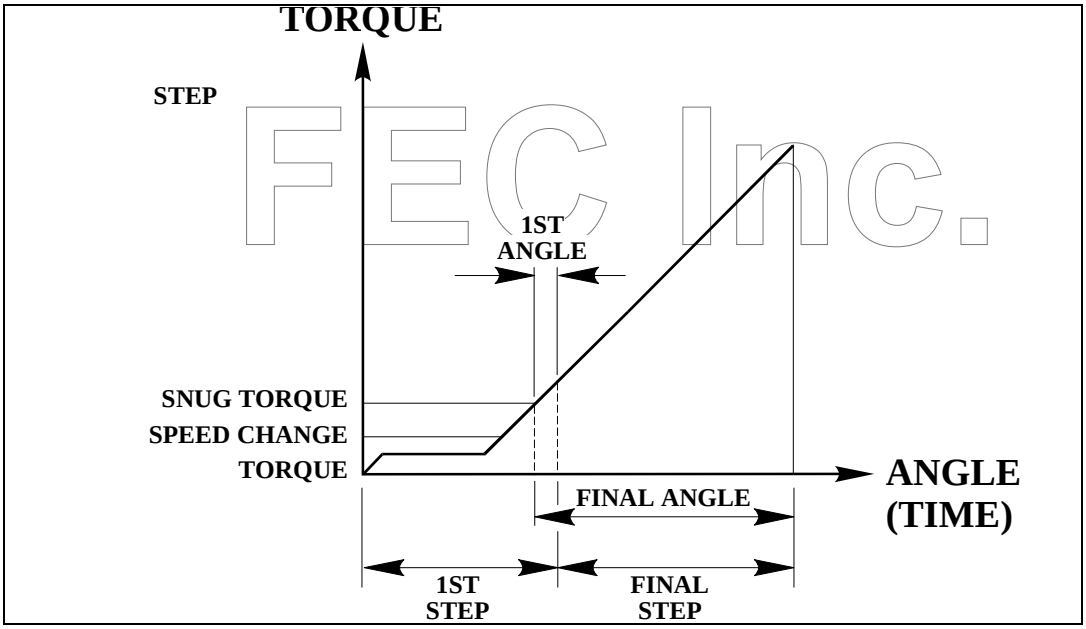


FIG. 6-1-2a Angle Control Functions for One-Step Fastening

FUNCTION	RECOMMENDATION
SNUG (TORQUE)	Engineered fastening specification at which angle control begins
SPEED CHANGE (TORQUE)	30 ~ 50% of STD for Hard joints 50 ~ 90% of STD for Soft joints
STD ANGLE	Engineered fastening specification for rotation angle
1ST STEP (TIME)	Maximum allowable fastening cycle time

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{ Two-Step Fastening

- The System fastening parameters must be configured according to the Engineered fastening specification.
- Two-step fastening will be used primarily for joints that have a requirement to synchronize with another spindle during the final stage of the rundown. Examples: Connecting rod, main bearing cap, any multiple-spindle unit.
- The System will fasten to the 1st TORQUE/ANGLE during the specified 1ST STEP time. Once either SPEED CHANGE TORQUE or 1st TORQUE/ANGLE is reached, the System will switch to the specified TORQUE SPEED (Section 6.3). When all fasteners have reached 1st TORQUE/ANGLE, the spindles will synchronize and rotate simultaneously the specified number of degrees from SNUG TORQUE to STD ANGLE within the specified FINAL STEP time.

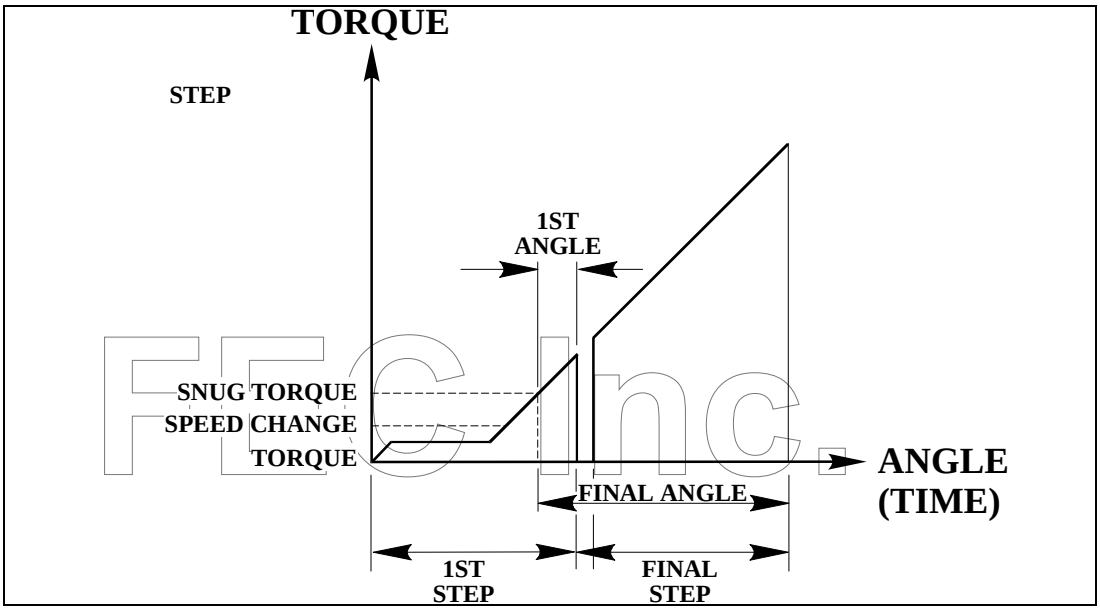


FIG. 6-1-2b Angle Control Functions for Two-Step Fastening

FUNCTION	RECOMMENDATION
1st TORQUE/ANGLE	30 ~ 50% of FINAL ANGLE or resultant torque for Hard joints 50 ~ 90% of FINAL ANGLE or resultant torque for Soft joints
SNUG (TORQUE)	Engineered fastening specification at which angle control begins
SPEED CHANGE (TORQUE)	30 ~ 50% of resultant torque for Hard joints 50 ~ 90% of resultant torque for Soft joints
STD ANGLE	Engineered fastening specification for rotation angle
1ST STEP (TIME)	Maximum allowable fastening cycle time
FINAL STEP (TIME)	Maximum allowable Final step time

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6.2 Monitoring Functions

The AFC1100 System is user programmable to select and set the monitoring limits for torque, angle, time and two independent torque rate stages.

6.2.1 Torque Monitoring

Torque Monitoring is a continuous process whenever the System is operating. In Torque Control method, the High and Low Torque limits are set based upon the engineering specification for that specific fastener. For Angle operations, the High and Low Torque limits are either set by the engineering specification for that specific fastener, or by determining the acceptable limits from a study of known good and bad assemblies. The High Torque limit will stop the fastening process for Angle Control operations if it is reached before attaining the desired angle.

6.2.2 Angle Monitoring

Angle Monitoring commences upon reaching the preset SNUG TORQUE value, and continues until completion of the fastening process or until the High angle limit is reach, whichever occurs first. In Angle Control method, the High and Low Angle limits are set based upon the engineering specification for that specific fastener. For Torque Control operations, the High and Low Angle limits are either set by the engineering specification for that specific fastener, or by determining the acceptable limits from a study of known good and bad assemblies. The High Angle limit will stop the fastening process for Torque Control operations if it is reached before attaining the desired torque.

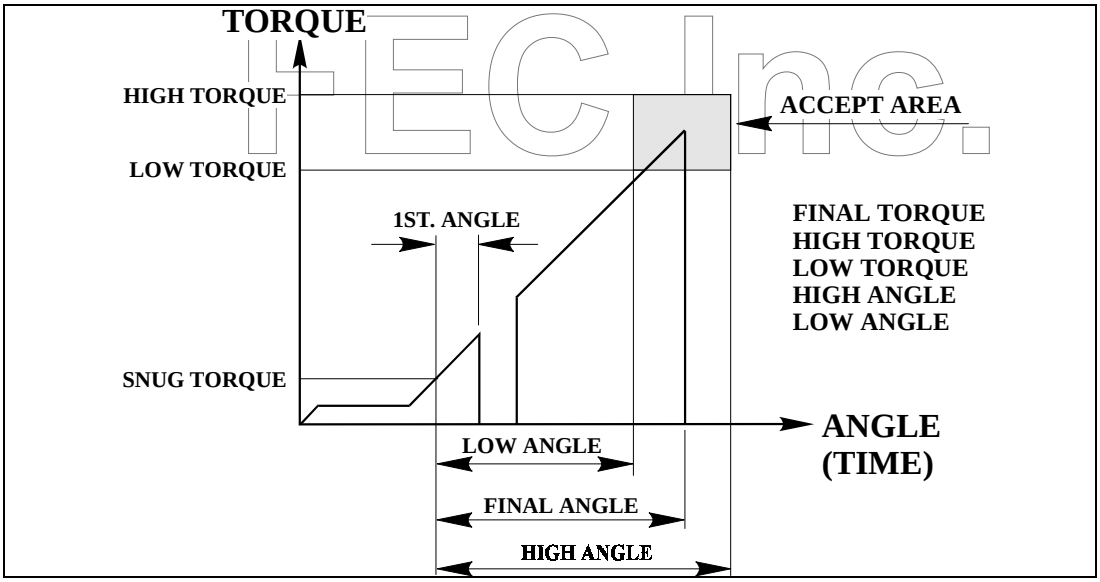


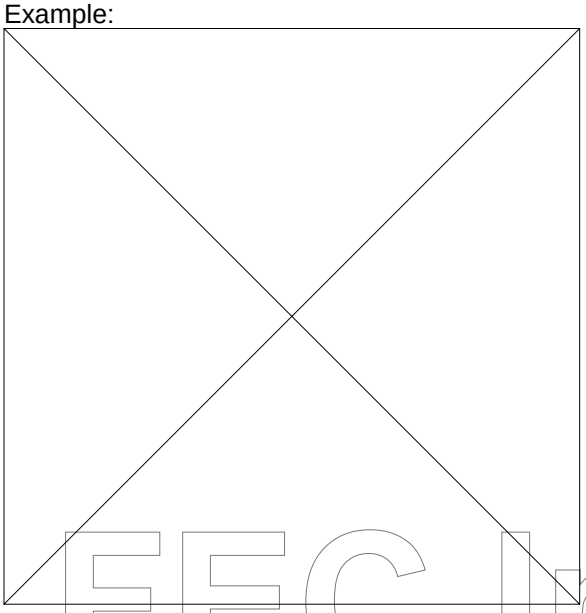
FIG. 6-2-2 Torque and Angle Monitoring Functions

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6.2.3 Point-to-Point Torque Rate Monitoring

The AFC1100 System is capable of performing two independent torque rate calculations. This method performs the calculation based upon completing a step of the process, and then calculating the rate for the full duration of that step. Each Torque Rate is calculated by dividing the change in torque during the specific period by the change in angle.

Example:



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STAGE	START POINT	STOP POINT
1ST TORQUE RATE	THRESHOLD 1	1st TORQUE/ANGLE
2ND TORQUE RATE	CROSSOVER TORQUE	FASTENING END

For all control operations, the High and Low Torque Rate limits are set by determining the acceptable limits from a study of known good and bad assemblies.

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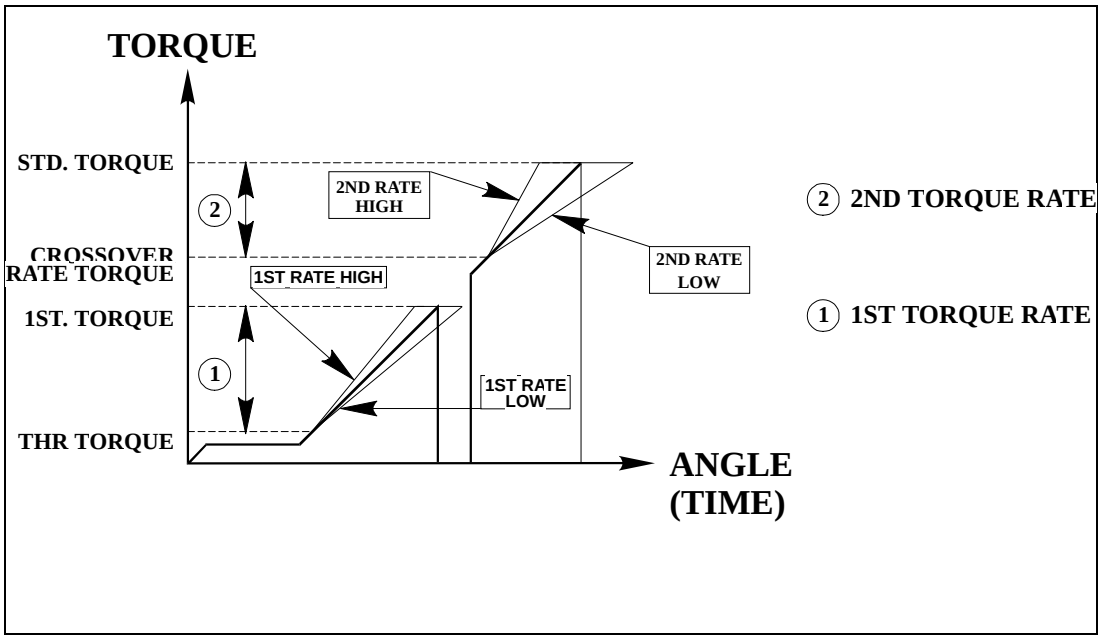


FIG. 6-2-3 Point-to-Point Torque Rate Monitoring

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6.2.4 Time

As outlined in the Fastening Control Methods portion of this Chapter, this System is capable of performing multiple-step fastening operations. The duration of each of these steps is governed by one of two independent watchdog time settings. If the step fails to attain the desired result before the completion of the specified time, a reject condition will occur.

p

STEP	START POINT	STOP POINT	TIME PRESET
1ST STEP	START	1ST TORQUE/ANGLE	1ST TIME
2ND STEP	1ST (TORQUE/ANGLE)	FASTENING END	FINAL TIME

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6.3 Speed Functions

The AFC1100 System is user-programmable for operations involving multiple speed settings. The use of multiple speeds during the fastening process aids in socket engagement, achieving cycle time, and controlling the applied torque during all stages.

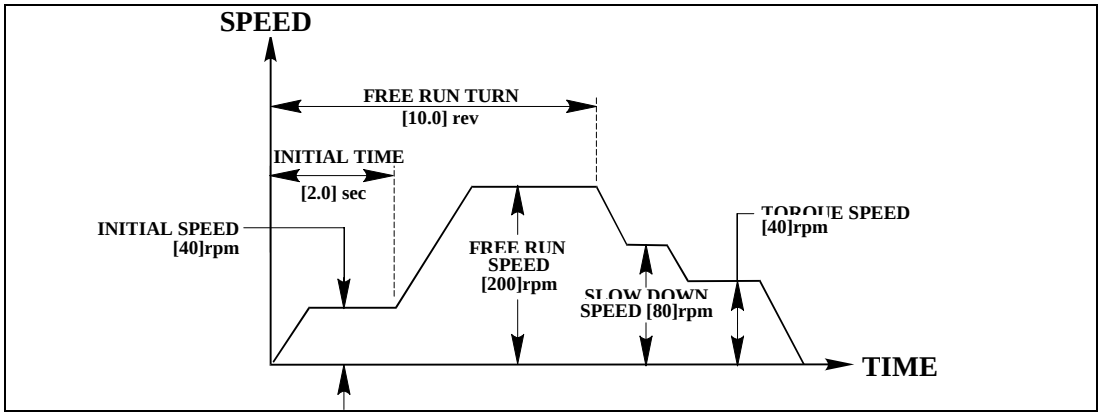


FIG. 6-3a Speed Functions

{ The System will run at INITIAL SPEED for the time specified by the setting of INITIAL TIME.

{ Once INITIAL TIME has elapsed, the System will switch to FREERUN SPEED (High Speed Rundown) for the number of revolutions specified by FREERUN REVOLUTIONS. If the System has been set up properly, the nutrunner will shift to SLOWDOWN SPEED before seating the fastener. The nutrunner will run at SLOWDOWN SPEED until either 1st TORQUE/ANGLE is reached or until 1st STEP TIME expires. If 1st STEP TIME expires before reaching 1st TORQUE/ANGLE, the System will output a Time Over reject.

NOTE: The System will shift to TORQUE SPEED if either SPEED CHANGE TORQUE or 1st TORQUE/ANGLE is sensed, no matter which step is being performed.

{

FUNCTION	RECOMMENDATION
INITIAL TIME	SET to a duration which will provide sufficient time for the socket to fastener engagement. set in seconds.
INITIAL SPEED	SET to the rpm which will allow for easy socket to fastener engagement.
FREERUN REVOLUTIONS	FOR joints that do not react properly to high speed seating, the freerun time should be calculated to eliminate the "crash" effect.
FREERUN SPEED	Set based upon cycle time requirements. THIS speed is used to run down the bolt quickly.
SLOWDOWN SPEED	FIRSt torque fastening speed. SET based upon the joint type to allow for a controlled seating. LESS THAN 150 RPMs.
TORQUE SPEED	FINal torque speed to which the nutrunner will shift once 1st TORQUE/ANGLE or SPEED CHANGE Torque is reached. SET based upon the joint type to allow for a controlled final fastening. LESS THAN 50 RPMs.

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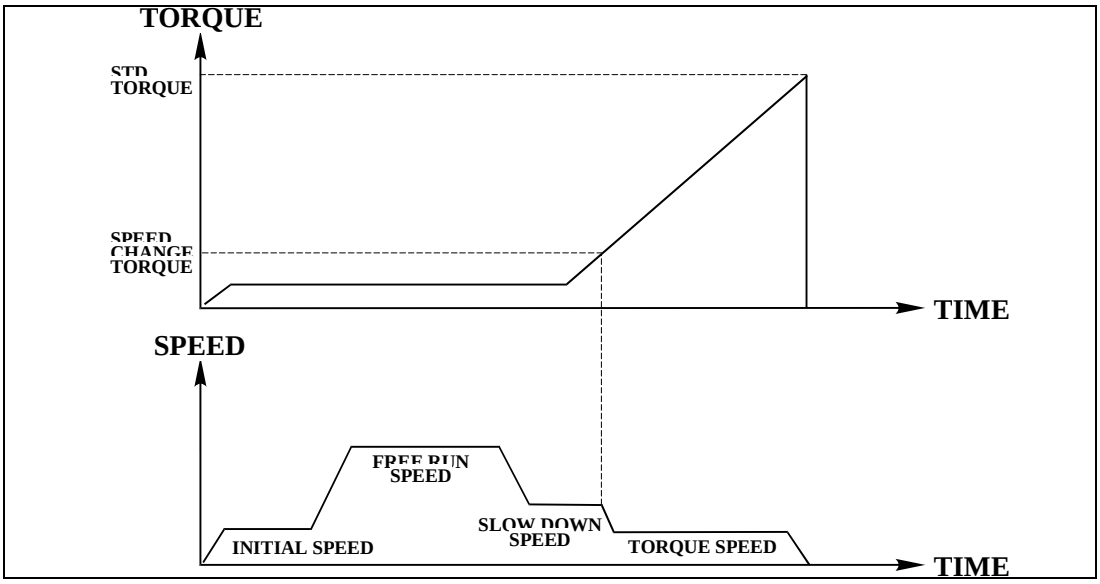


FIG. 6-3b Ideal Relationship of Speed and Torque

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6.4 Reverse Functions

The AFC1100 System is capable of reverse operations using the manual reverse input on the Axis unit front panel or via the PLC input. The PLC input can be used for automated reverse operations

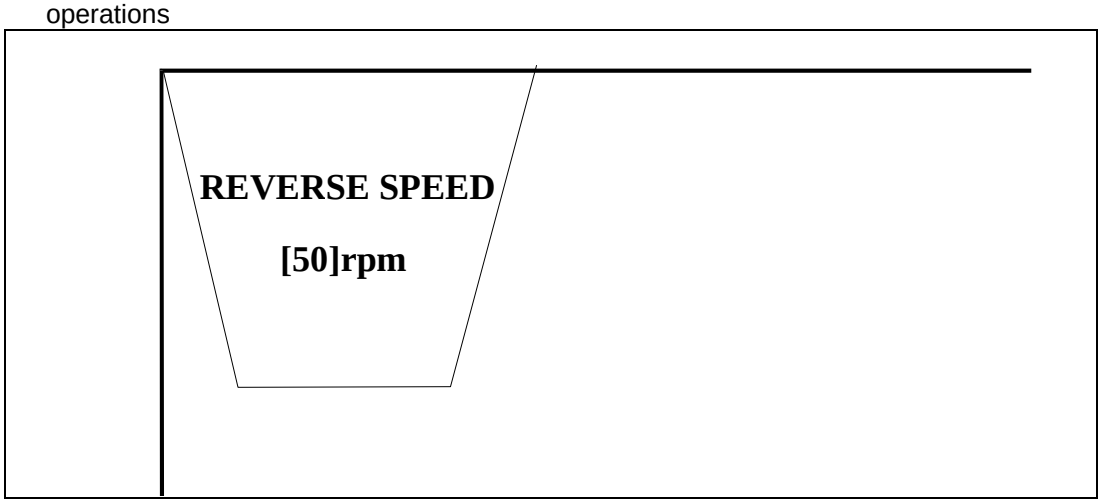


FIG. 6-4 Reverse Functions

FUNCTION	RECOMMENDATION
RPM	The desired speed may be set independent for each of the three reverse modes.

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Chapter 7: System Operations

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7.1 AFC1100 indicators, display and key operation.

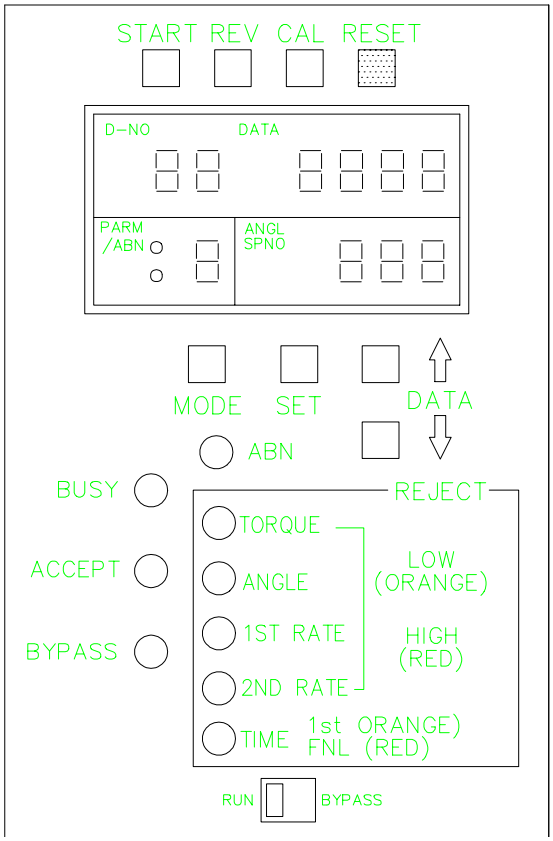


FIG. 7-1 Operational controls and indicators

7.1.1 Manual Fastening controls.

wSTART.
This push-button initiates the fastening cycle.

wREV (Reverse).
Manual reverse. While this push-button is depressed, the nutrunner turns in the counter-clockwise direction.

wCAL (Calibration).
CAL voltage checking push-button. Depress this push-button to obtain the CAL voltage level of the tool pre-amplifier. This level is compared to the data stored in memory. If the difference is within the allowed range the accept LED will light, otherwise the REJECT LED will light. The calibration voltage level is converted to the full-scale torque, according to the parameter setting and is shown in the "DATA" display.

wRESET.
This is used to reset the Axis unit. If this key is pressed during fastening, the process will stop, and all the fastening data and output signals will be reset. At the same time, the Zero level of the torque transducer will be checked. If it is within the acceptable range, the ACCEPT LED will light. If it is not within range, the torque REJECT LED will light.

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7.1.2 Fastening Indicators.

wBUSY LED (Yellow).
Indicates when the Axis unit is performing a fastening or reverse operations.

wABNORMAL LED (Red).
Indicates when an abnormal condition occurs during fastening or during the system SELF CHECK function.

wACCEPT LED (Green).
Indicates when the fastening results are within acceptable limits.

wBYPASS LED (Red).
Indicates by flashing when the Axis unit is in a bypass condition.

wTORQUE LED (Orange and red).
Orange indication represents a LOW TORQUE REJECT as the fastening result.
Red indication represents a HIGH TORQUE REJECT as the fastening result..

wANGLE LED (Orange and red).
Orange indication represents a LOW ANGLE REJECT as the fastening result.
Red indication represents a HIGH ANGLE REJECT as the fastening result.

w1ST RATE LED (Orange and red).
Orange indication represents a LOW 1ST RATE REJECT as the fastening result.
Red indication represents a HIGH 1ST RATE REJECT as the fastening result.

w2ND RATE LED (2ND RATE).
Orange indication represents a LOW 2ND RATE REJECT as the fastening result.
Red indication represents a HIGH 2ND RATE REJECT as the fastening result.

wTIME LED.
Orange indication represents a 1ST TIME REJECT as the fastening result.
Red indication represents a FINAL TIME REJECT as the fastening result.

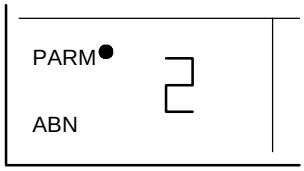
7.1.3 Fastening Preset / Result displays.

w[D-NO] Data number indicator (2 digits).
Indicates the Display mode and data type by number.

w[DATA] Data value indicator (4 digits).
Displays the current torque value of the torque transducer while in the real-time indication mode. Displays the data specified by [D-NO] while in the fastening data indication mode.

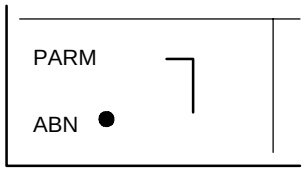
w[PARM/ABN] Parameter number/abnormal number indicator (1 digit).
Display for the parameter number of the last fastening. If an abnormal condition occurs, it shows the abnormality number.

1. Parameter number "2" is shown

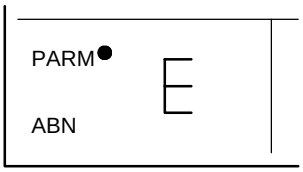


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2. Abnormal number "7" is shown



3. When the CAL switch is pressed, "E" is shown if the FULL-SCALE preset value is missing or a wrong tool is connected.



Indicates the parameter number used for the previous fastening operation. Should an abnormal condition occur the display will indicate the nature of the abnormality through a code number (Refer to Chapter 9).

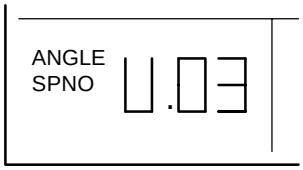
w[ANGL/SPNO] Angle data/Axis unit number indicator.

Display for the final angle value of the previous fastening operation. The angle value is given in integers numbers. Directly after the power is turned on and while the RESET signal is active the spindle number is displayed.

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ANGLE DISPLAY



SPINDLE NUMBER

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7.1.4 Fastening Presetting / Result Display Controls.

wMODE.
- PUsed to change modes while in the Run state. (Refer to 7.2)
- PUsed to move the cursor while in the Bypass (program) state. (Refer to 7.3)

wSET.
- PUsed to enter the Data Edit mode, and to confirm data setting change.

w[↑] and [↓] Cursor key (vertical arrows).
- PUsed to scroll through available parameter numbers. (PARM)
- PUsed to scroll through available data preset items. (D-NO)
- PUsed to change display data values. (DATA)
- PUsed as YES/NO acknowledge for Tool type and Torque unit changes. (Fig 7-3-8b)

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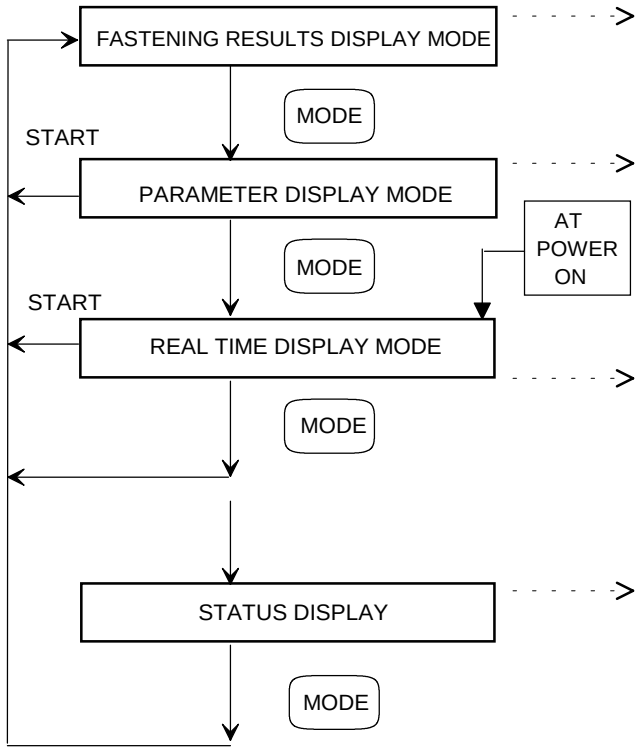
7.2 Run State Modes.

The AFC 1100 system has two operational states that are controlled by the selection of the Run/Bypass switch on the front of the Axis unit or by the PLC Bypass input. The operational modes availible in the Run State are identified below. Under this condition the BYPASS switch on the front panel is in the RUN position and the BYPASS external signal is not active (the BYPASS LED is off). During the RUN condition, the display mainly shows the results of fastening, abnormalities, preset values, etc.

7.2.1 Display indication modes.

Three modes can be selected while in the RUN state by pressing the MODE push-button. By using the [↓] and [↑] keys to change the D-NO selected the DATA Display contents for parameters may be varied. The displays will remain blank, and mode selection will be disabled while the nutrunner is active. (BUSY)

The **Fastening results display mode** is active when the D-No displays one digit in the right hand location, and one, two or three dashes in the left hand location. The results' details can be scrolled by using the [↑] and [↓] keys to change the D-No. This display does not function while the nutrunner is Busy.



The **Parameter display mode** is active when the D-No displays digits in both the right and left hand locations. The parameter data can be scrolled by using the [↑] and [↓] keys to change D-No.

The **Real time display mode** is active when one digit is active in the right hand display only. When the power is turned on, the default display mode is the REAL TIME display mode. The display contents can be scrolled by using the [↑] and [↓] keys to change D-NO.

The Axis unit is in **Status display mode** when no digits are displayed. The STATUS display indicates if an abnormal condition occurs or if an emergency stop has halted the system.

FIG. 7-2-1 Run State Display Modes

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7.2.2 Real-time display indication mode.

While the mode is in real-time data indication ([D-NO] shows **0**, **1 or 2.** You can choose the desired type of data by pressing the [↓] and [↑] keys to change the [D-NO] (data number). The indicator will show the following data in "DATA" AND "ANGL.SPNO" for the selected D-No..

D-No	DATA	ANGL.SPNO
0	Torque value.	Axis unit number
1	Torque voltage.	Axis unit number
2	Maximum torque (maximum hold).	Rotated angle.

- Torque value: The real-time (current) torque value on the torque transducer is shown.
- Torque voltage : The real-time (current) torque signal voltage on the torque transducer is shown.
- Maximum torque: The peak torque, measured since the last resetting of the switch within the current mode, is shown.
- Axis unit number: The Axis unit No. as set up on the unit via dip switches
- Rotated angle: The real-time angle of rotation of the tool output shaft (in the fastening direction CW), measured since the last resetting of the switch within the current mode. (-119° to 999°).

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Key operation during the real-time data indication mode.
Indication shown in "DATA"

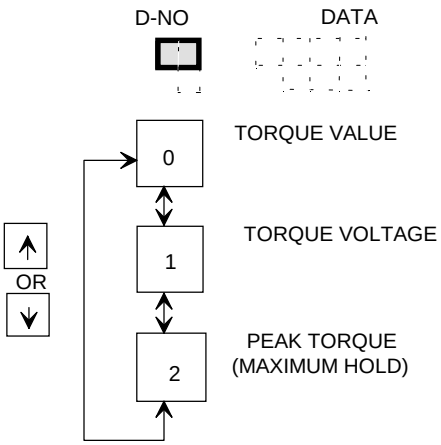


FIG. 7-2-2 Real time display selection

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7.2.3 Fastening results display mode.

In fastening results display mode (when [D-NO] shows _**0** ~ **≡4**), data can be obtained by pressing the [↓] and [↑] keys to scroll [D-NO] until the desired DATA item is displayed. The following information will be displayed in the [DATA] and [ANGL/SPNO] display sections for the displayed [D-NO]:

D-No	DATA	ANGL/SPNO
_0	PEAK TORQUE.	FINAL ANGLE.
_1	FINAL ANGLE	SPINDLE NO.
_2	1ST TORQUE RATE	SPINDLE NO.
_3	2ND TORQUE RATE.	SPINDLE NO
_4	1ST STEP TIME.	SPINDLE NO.
_5	FINAL STEP TIME.	SPINDLE NO
_6	CYCLE TIME	SPINDLE NO
_7	FASTENING MODE.	SPINDLE NO
=0	FASTENING MODE.	SPINDLE NO
=1	FASTENING STEPS	SPINDLE NO
=2	NOT USED	SPINDLE NO
=3	SELF CHECK (ON: enabled, OFF: disabled)	SPINDLE NO
=4	REVERSE FLAG (ON: BACKED OUT, OFF: NOT BACKED OUT)	SPINDLE NO
=5	CAUSE OF FASTENING STOP: 0: RESET / NO DATA / AFTER REVERSE. 1: ABNORMAL SIGNAL. 2: BYPASS SIGNAL. 3: STOP SIGNAL. 4: REJECT. 5: ACCEPT.	SPINDLE NO
≡0	1ST INCREMENT TORQUE.	1ST INCREMENT ANGLE.
≡1	2ND INCREMENT TORQUE.	2ND INCREMENT ANGLE.
≡2	1ST FINAL TORQUE	1ST FINAL ANGLE.
≡3	1ST PEAK TORQUE.	1ST PEAK ANGLE.
≡4	FINAL TORQUE.	ANGLE @ PEAK TORQUE.

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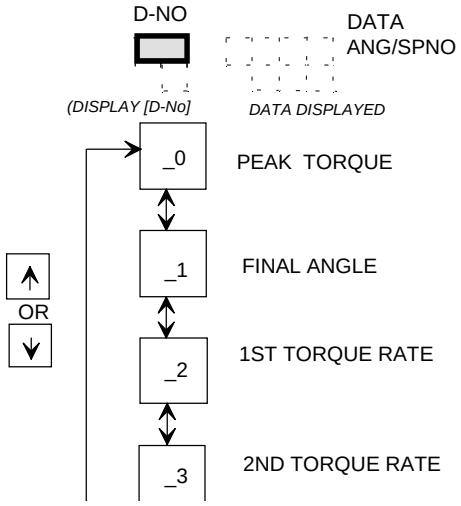


FIG. 7-2-3 Fastening results display selection

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7.2.4 Parameter display mode

Parameter means a group of values that configures a fastening operation. Combined these values are named preset data. The AFC1100 system can store up to 8 different parameters that can be selected by WORK SELECT 0 ~ 2 (see section 4.7.2) PLC inputs.

In addition to parameter 1 ~ 8 there is a PARAMETER 0 that contains configuration data common to all parameters.

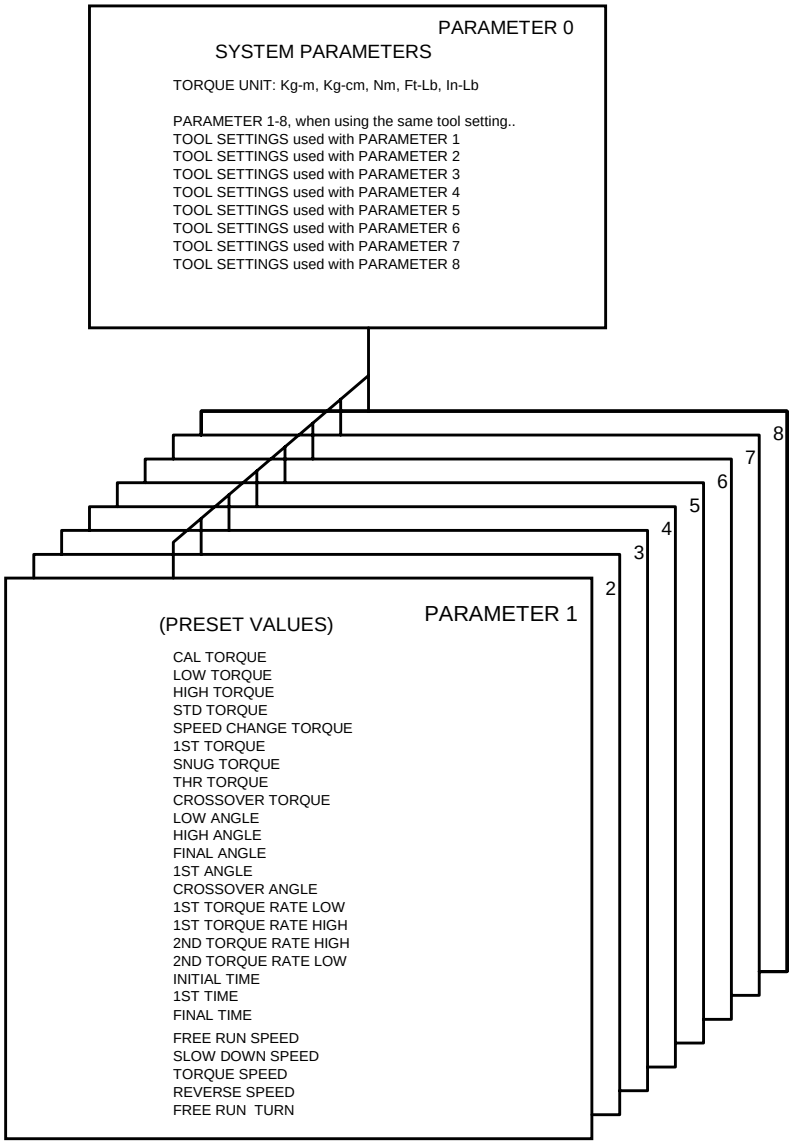


FIG. 7-2-4a Parameter number selection

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ITEM	* PARM No.	D- No **	DATA ***
System.	0	**00**	TORQUE UNIT #.
	0	**01**	ROM VERSION (Not adjustable)
Tool Data.	0	**10**	TOOL # (not adjustable)
	0	**11**	TOOL CAL TORQUE.
	0	**12**	COMPANY'S SUPERVISOR DATA.
		1A	
Tool type.	0	**20**	TOOL # (When parameters use the same tool).
	0	**21**	PARAMETER 1 TOOL #
	0	**22**	PARAMETER 2 TOOL #
	0	**23**	PARAMETER 3 TOOL #
	0	**24**	PARAMETER 4 TOOL #
	0	**25**	PARAMETER 5 TOOL #
	0	**26**	PARAMETER 6 TOOL #
	0	**27**	PARAMETER 7 TOOL #
	0	**28**	PARAMETER 8 TOOL #
Torque.	1~8	**00**	FASTENING MODE (method + steps)
	1~8	**01**	FASTENING METHOD
		02	STEP
	1~8	**10**	FULL SCALE TORQUE
	1~8	**11**	TORQUE LOW LIMIT
	1~8	**12**	TORQUE HIGH LIMIT
	1~8	**13**	STD TORQUE
	1~8	**14**	SPEED CHANGE
	1~8	**15**	1ST TORQUE
	1~8	**16**	SNUG TORQUE
	1~8	**17**	THR TORQUE
	1~8	**18**	CROS TORQUE
Angle	1~8	**20**	LOW ANGLE LIMIT
	1~8	**21**	HIGH ANGLE LIMIT
	1~8	**22**	STD ANGLE
	1~8	**23**	1ST ANGLE
	1~8	**24**	CROS ANGLE (2nd torque rate start).
Rate	1~8	**30**	1ST TORQUE RATE LOW LIMIT
	1~8	**31**	1ST TORQUE RATE HIGH LIMIT
	1~8	**32**	2ND TORQUE RATE LOW LIMIT
	1~8	**33**	2ND TORQUE RATE HIGH LIMIT
Time	1~8	**40**	INITIAL TIME
	1~8	**41**	1ST STEP TIME
	1~8	**42**	FINAL TIME
Speed	1~8	**50**	INITIAL SPEED
	1~8	**51**	FREE RUN SPEED
	1~8	**52**	SLOW DOWN SPEED
	1~8	**53**	TORQUE SPEED
	1~8	**54**	REVERSE SPEED
Revolutions	1~8	**60**	FREE RUN REVOLUTIONS

0: Nm	
1: Kg.m	
2: kgcm	
3: ftlb	
4: inlb	

0010	CW torque, 1 step
0011	CW angle, 1 step
0020	CW torque, 2 step
0021	CW angle, 2 step
0110	CCW torque, 1 step
0111	CCW angle, 1 step
0120	CCW torque, 2 step
0121	CCW angle, 2 step

** Displayed in PARM/ABN display. ** Displayed in D-NO display. *** Display in DATA display.*

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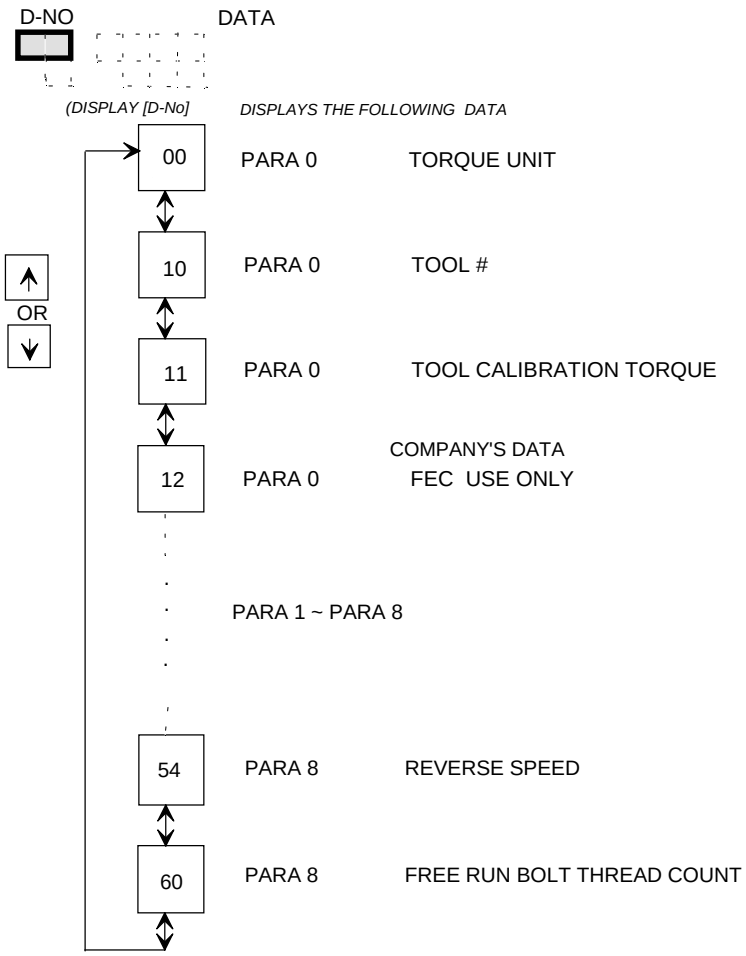


FIG. 7-2-4b Parameter display D-No selection

When parameter display mode is on, the [D-No] display will show 2 digits (00-60) representing the preset data number. The [DATA] display will show the corresponding preset data value and the parameter display [PARM] will indicate the parameter number (from 0 ~ 8). Use the [↓] and [↑] keys to change the preset data number [D-NO]. If the [D-NO] display is showing the number 60 of the *parameter number 1*, pressing the [↑] key will change the [D-NO] display to the number 00 of the *parameter number 2*.

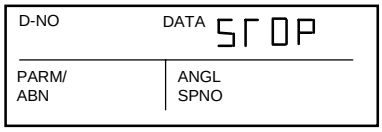
You can verify the fastening parameters by pressing the [↓] and [↑] keys. It is not possible to alter these settings (RUN state).

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7.2.5 STATUS display

This display will indicate when the STOP signal has halted the AFC 1100. The STATUS display will indicate conditions as shown below (the [D-NO] display is not active).

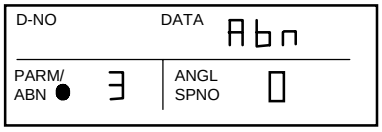
1) When the STOP signal is activated:
The [DATA] display will show STOP.



2) When an abnormal condition occurs:
The [DATA] display will show ABN.

The display will indicate ABN and the ANGL/SPNO display will show the corresponding SERVICE CODE #.

This shows a case where the abnormal number is 3 and the service code is 0. (Refer to chapter 9)



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7.3 Bypass state operation.

The AFC 1100 system has two operational states that are controlled by the selection of the Run/Bypass switch on the front of the Axis unit or by the PLC Bypass input. The operational modes availible in the Bypass State are identified below. Under this condition the BYPASS switch on the front panel is in the BYPASS position or the BYPASS external signal is active (the BYPASS LED is on). During the BYPASS condition, the display shows preset values.

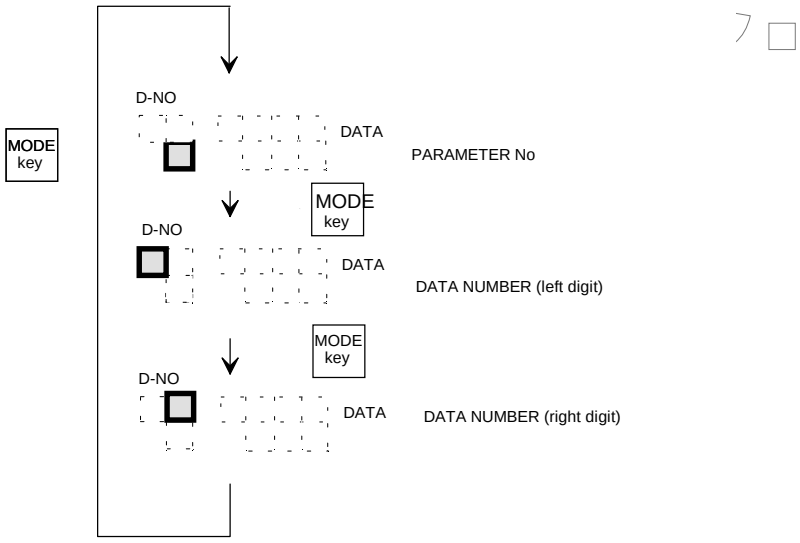
7.3.1 Download Mode selection

Immediately after the bypass condition has been entered, the unit is in the download mode, which allows the system to be set up by a user console via the RS-422 port. Press the [MODE] key to change from the download mode to the setup mode. If the Axis unit is performing some data communication to an external computer, the download mode will be maintained until the operation is completed.

7.3.2 Setup Mode selection

Depressing the Mode button will initiate the Setup mode. Immediately after the setup mode is established, a blinking number will appear in the [PARM/ABN] display. This number can be changed with the [⇓] and [⇑] keys to select a different parameter number. The [D-NO] display will show the number corresponding to the [DATA] display function while the [DATA] display will show the actual value as it is currently set. You may change the currently indicated data using the Data Edit mode

FIG. 7-3-2 Setup mode D-No selection

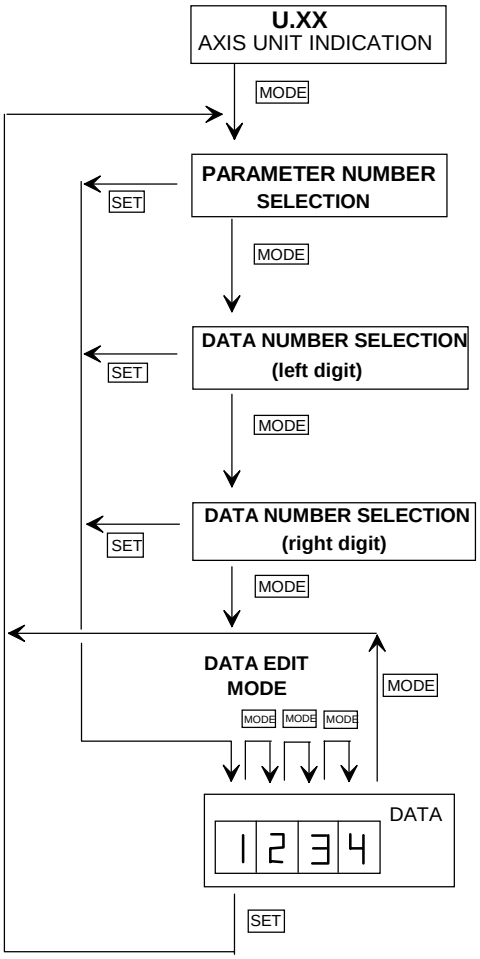


The cursor (blinking mode) will move each time the [MODE] key is pressed.

Press the [SET] key to enter into the Data Edit mode.

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7.3.3 Setup mode operation.



Depressing the [MODE] switch will bring up the setup mode. A blinking digit will appear in the [PARM] display specifying the cursor position.

Use the [↓] and [↑] keys to select the desired parameter number.

Press the [SET] key to enter the Data Edit mode, where you can change the values appearing in the [DATA] display section or press [MODE] to select a different [DATA] display function.

Use the arrow keys to change the data number. (Data Number Correspondence Chart, section 7.3.6)

Pressing the [MODE] key Moves the cursor. Pressing it four times causes the system to exit out of the edit mode, returning to the parameter number selection without saving any changes. Use the [↓] and [↑] keys to decrease or increase the value number.

Pressing the [SET] key will enter the new values shown in the DATA display. If the entered values are inappropriate, "Err" will appear, and the new data will be ignored. In this case return to the parameter number selection (using the [MODE] key) and retry.

FIG. 7-3-3 Setup mode operation

When the torque unit number or the tool type is changed, the [DATA] display will show "CHNG," and the ANGL.SPNO display will show "NO." Use the vertical arrow keys to choose YES or NO; YES means that the data will be entered if the confirmation SET key is pressed. The [SET] and [MODE] switches will have no effect when "NO" appears. If no key is pushed in five seconds, the new data will be ignored, and the system will exit the Data Edit mode

.

Warning:

When the torque unit (PARM 0, and D-NO 00) or the tool type (PARM 0, and D-No 20-28) is changed, the torque (D-No 00-18) and the speed (D-No 50-54) will be cleared.

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7.3.4 Parameter # selection

When the cursor is in the PARM/ABN display, the settings can be changed from 0 ~ 8 with the [↓] and [↑] keys.

Data corresponding to the selected parameter number will be displayed in the [DATA] display.

w

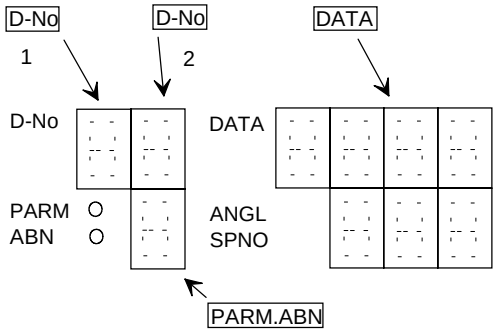


FIG. 7-3-4 Parameter display D-No selection

7.3.5 Data # selection

The value for digit 1 and 2 of the [D-No] display may only be changed when the cursor is in the respected position. The [D-NO] value is changed with the [↓] and [↑] keys. Data corresponding to the data number [D-NO] display will appear in the [DATA] display (Refer to section 7.3.6).

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7.3.6 Data number correspondence chart

Relationship of the PARAMETER #, DATA # and PARAMETER DATA (preset data).

ITEM	* PARM No.	D- No **	DATA ***		
System.	0	**00**	TORQUE UNIT #.	0: Nm	
	0	**01**	ROM VERSION (Not adjustable)	1: Kg.m	
Tool Data.	0	**10**	TOOL # (not adjustable)	2: kgcm	
	0	**11**	TOOL CAL TORQUE.	3: ftlb	
	0	**12**	COMPANY'S SUPERVISOR DATA.	4: inlb	
		1A			
Tool type.	0	**20**	TOOL # (When parameters use the same tool).		Refer to following page for tool list.
	0	**21**	PARAMETER 1 TOOL #		
	0	**22**	PARAMETER 2 TOOL #		
	0	**23**	PARAMETER 3 TOOL #		
	0	**24**	PARAMETER 4 TOOL #		
	0	**25**	PARAMETER 5 TOOL #		
	0	**26**	PARAMETER 6 TOOL #		
	0	**27**	PARAMETER 7 TOOL #		
	0	**28**	PARAMETER 8 TOOL #		
Torque.	1~8	**00**	FASTENING MODE (method + steps)	0010	CW torque, 1 step
	1~8	**01**	FASTENING METHOD	0011	CW angle, 1 step
		02	STEP	0020	CW torque, 2 step
	1~8	**10**	FULL SCALE TORQUE	0021	CW angle, 2 step
	1~8	**11**	TORQUE LOW LIMIT	0110	CCW torque, 1 step
	1~8	**12**	TORQUE HIGH LIMIT	0111	CCW angle, 1 step
	1~8	**13**	STD TORQUE	0120	CCW torque, 2 step
	1~8	**14**	SPEED CHANGE	0121	CCW angle, 2 step
	1~8	**15**	1ST TORQUE		
	1~8	**16**	SNUG TORQUE		Fastening method and step are set automatically via Fastening mode.
	1~8	**17**	THR TORQUE		
	1~8	**18**	CROS TORQUE		
Angle	1~8	**20**	LOW ANGLE LIMIT		
	1~8	**21**	HIGH ANGLE LIMIT		
	1~8	**22**	STD ANGLE		
	1~8	**23**	1ST ANGLE		
	1~8	**24**	CROS ANGLE (2nd torque rate start).		
Rate	1~8	**30**	1ST TORQUE RATE LOW LIMIT		
	1~8	**31**	1ST TORQUE RATE HIGH LIMIT		
	1~8	**32**	2ND TORQUE RATE LOW LIMIT		
	1~8	**33**	2ND TORQUE RATE HIGH LIMIT		
Time	1~8	**40**	INITIAL TIME		
	1~8	**41**	1ST STEP TIME		
	1~8	**42**	FINAL TIME		
Speed	1~8	**50**	INITIAL SPEED		
	1~8	**51**	FREE RUN SPEED		
	1~8	**52**	SLOW DOWN SPEED		
	1~8	**53**	TORQUE SPEED		
	1~8	**54**	REVERSE SPEED		
Revolutions	1~8	**60**	FREE RUN REVOLUTIONS		

Please see Chapter 9 for parameter setting examples.

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w1) Tool type input items.

TOOL NUMBER	TOOL NAME	TOOL NUMBER	TOOL NAME
1	DFT-051M1-S	201	DFT-051M1-SR
2	DFT-101M1-S	202	DFT-101M1-SR
3	DFT-101M1-S1	203	DFT-201M1-SR
4	DFT-201M1-S	204	DFT-401M1-SR
5	DFT-401M1-S	205	DFT-401M2-SR
6	DFT-401M2-S	206	DFT-801M3-SR
7	DFT-801M3-S	207	DFT-132M3-SR
8	DFT-132M3-S	208	DFT-202M3-SR
9	DFT-202M3-S	209	DFT-302M3-SR
10	DFT-302M3-S	210	DFT-802M4-SR
11	DFT-802M4-S		
12	DFT-802W4-S		
13	DFT-203N1-S1		
14	DFT-403N1-S		
15	DFT-502M4-S		
16	DFT-153N1-S		
101	DFT-051M1-O	301	DFT-051M1-OR
102	DFT-101M1-O	302	DFT-101M1-OR
103	DFT-101M1-O1	303	DFT-201M1-OR
104	DFT-201M1-O	304	DFT-401M1-OR
105	DFT-401M1-O	305	DFT-401M2-OR
106	DFT-401M2-O	306	DFT-801M3-OR
107	DFT-801M3-O	307	DFT-132M3-OR
108	DFT-132M3-O	308	DFT-202M3-OR
109	DFT-202M3-O	309	DFT-302M3-OR
110	DFT-302M3-O	310	DFT-802M4-OR
111	DFT-802M4-O		
112	DFT-802W4-O		
113	DFT-203N1-O		
115	DFT-502M4-O		
116	DFT-153N1-O		

2) Fastening mode and fastening steps.

SET VALUE	FASTENING MODE / STEPS
0010	CW TORQUE CONTROL, 1 STEP.
0011	CW ANGLE CONTROL, 1 STEP.
0020	CW TORQUE CONTROL, 2 STEP.
0021	CW ANGLE CONTROL, 2 STEP.
0110	CCW TORQUE CONTROL, 1 STEP.
0111	CCW ANGLE CONTROL, 1 STEP.
0120	CCW TORQUE CONTROL, 2 STEP.
0121	CCW ANGLE CONTROL, 2 STEP.

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7.3.7 Data Edit Mode.

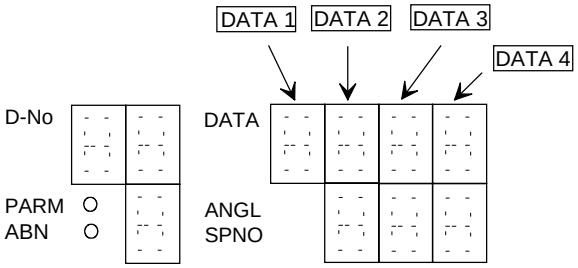


FIG. 7-3-7a Data edit positions

The cursor will appear in the [DATA] display when the machine is in DATA EDIT mode. In the DATA EDIT mode the MODE key is used as the cursor key. When the MODE key is pressed, the cursor moves from the 1st data field (at the left) to the 4th data field (right). The [↓] and [↑] keys can be used at any position to change or enter data. Once the cursor is in the last data field (4th), pressing the MODE key returns the system to the PARAMETER SELECTION mode without finalizing the data. Data that has been entered in DATA EDIT mode and confirmed with the [SET] key will be displayed.

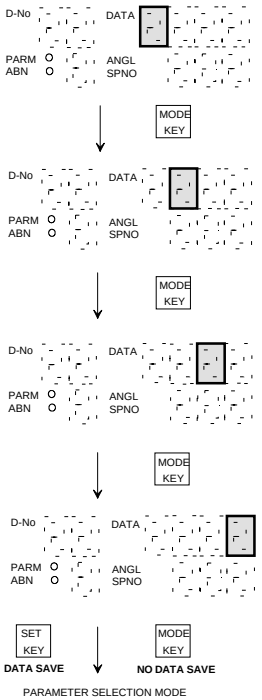


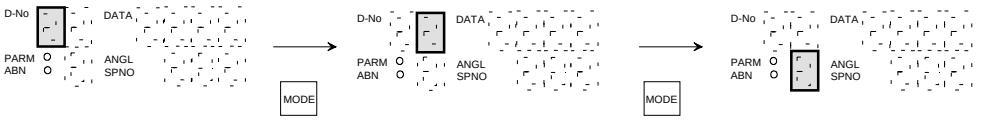
FIG. 7-3-7b Data edit operation

Values in the DATA fields can be changed from 0~9 in the DATA EDIT mode using the [↓] and [↑] keys. Once the values have been selected, pressing the [SET] key saves them and returns you to PARAMETER CHANGE mode.

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7.3.8 Data setup procedure.

Changing Data numbers by the Setup mode.



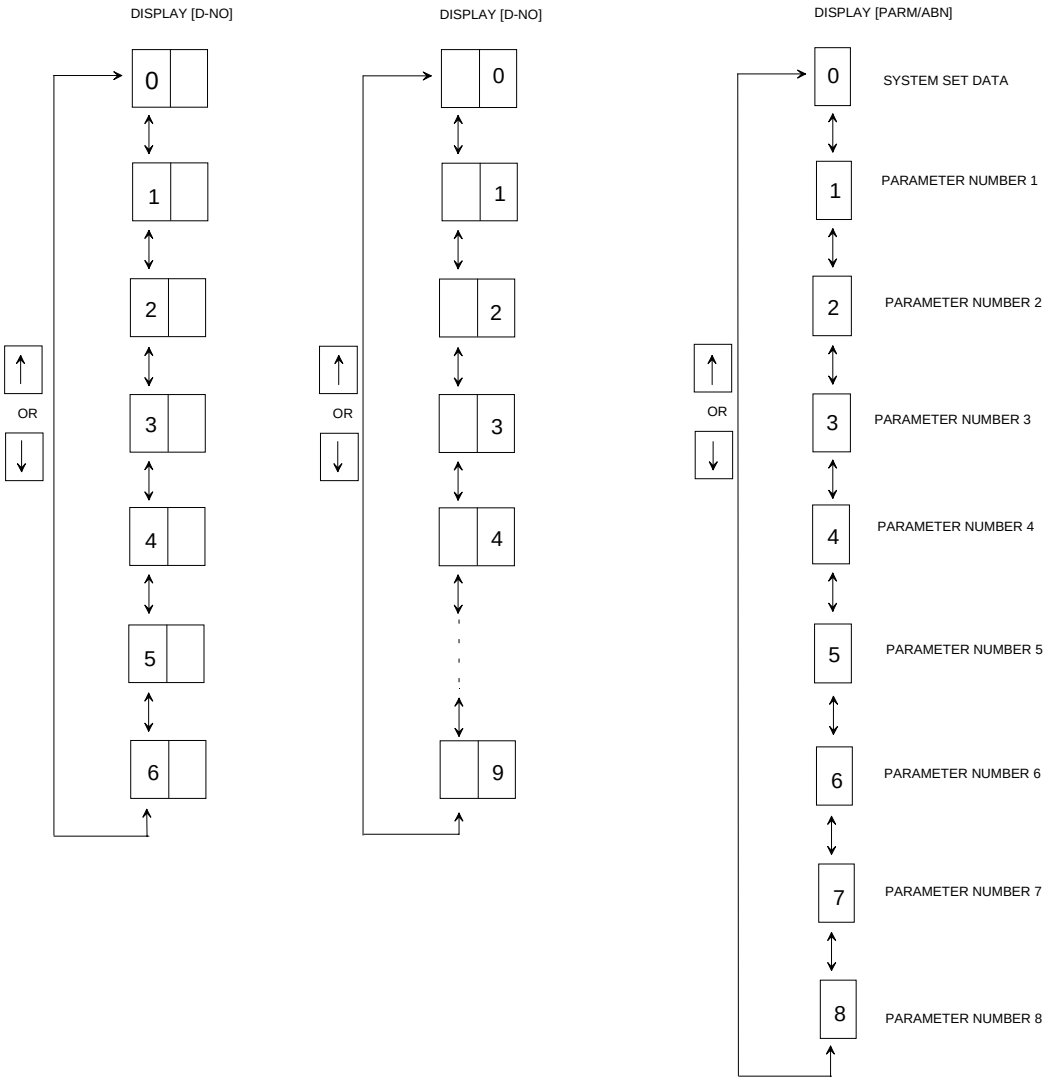


FIG. 7-3-8a Data setup procedure

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wData Edit Mode key operations / example.

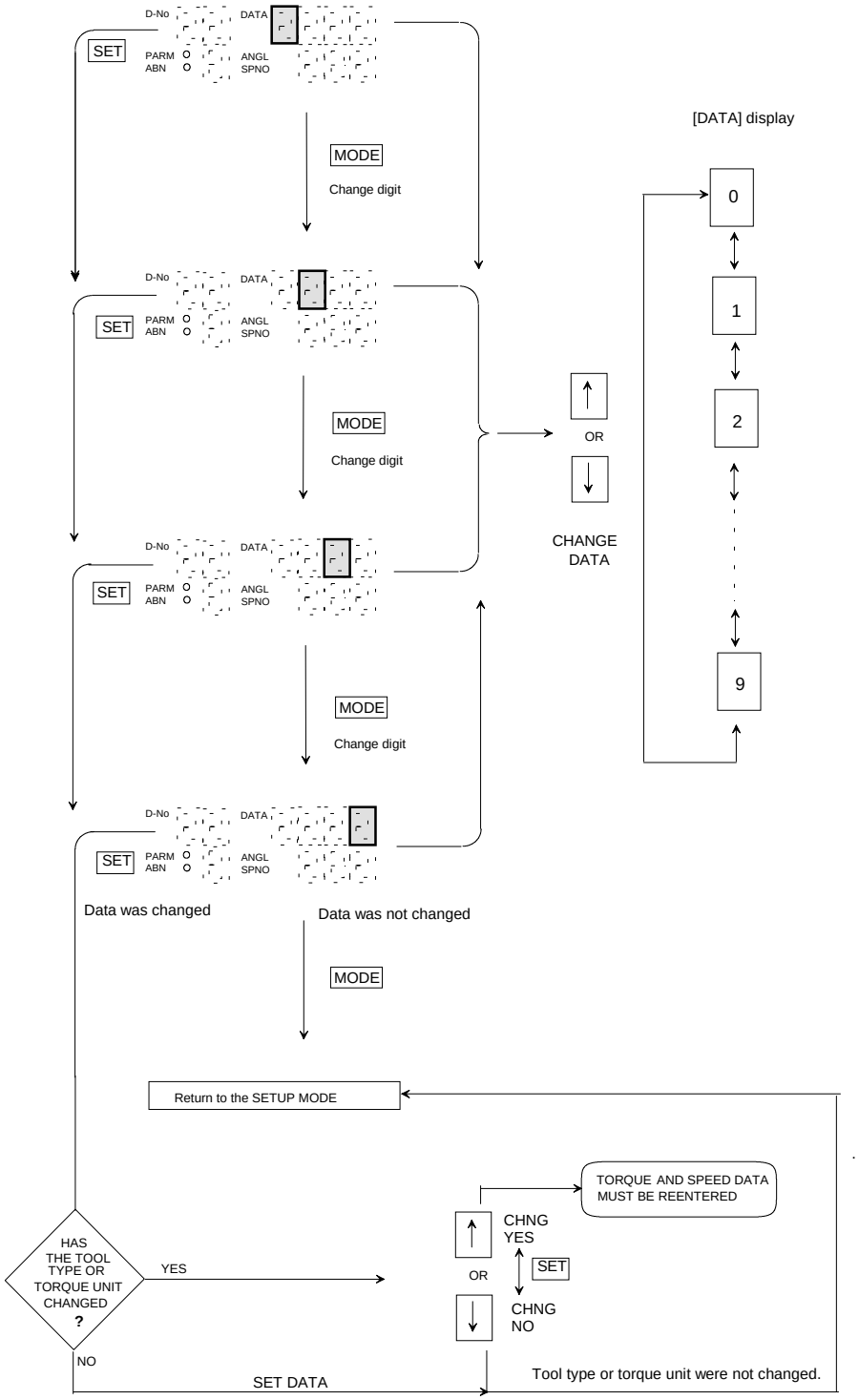


FIG. 7-3-8b Data setup example

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7.4 Calibration adjustment.

The calibration value is set according to the tool type (capacity). However, depending on the application characteristics or on the prevailing torque generated by the spindle assembly, the value of the current torque and the torque display by the Axis unit may mismatch. In this case it is possible to adjust the FULL SCALE TORQUE (CAL) value, so the displayed torque matches the real value registered by an external torque transducer (Master).

The CAL value can be adjusted up to ± 10% of the FULL SCALE TORQUE value.

Example:
Let's consider the DFT-801M3-S tool.
Nominal CAL value = 8.0 Kg.m.
Range of adjustment: from 7.2 Kg.m to 8.8 Kg.m.

The torque unit must be the same for all terms.

The FULL SCALE TORQUE value is read from Parameter 1 ~8 D-No 10.

Use the following formula on a collection of at least 10 fastenings when a calibration correction is necessary:

New CAL value = Master transducer mean/ FEC transducer mean x Existing CAL value

If the new CAL value is out of the adjustable range, the [Err] message will be displayed in the [ANGL/SPNO] display.

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Example.
Tool Full Scale value (EXISTING CAL)is 78.4 Nm.
STD torque is 49.0 Nm.
Master transducer mean for 10 piece run is measuring only 47.5 Nm.
FEC transducer mean for 10 piece run is measuring 49.0 Nm.

The new CAL value is obtained as follows:

(47.5/49.0 x 78.4) = 76.0

*The **FULL SCALE TORQUE (CAL) value** must be corrected to **76.0 Nm**.*

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Chapter 8: Maintenance and Inspection

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8.1 Inspection Items

A scheduled inspection is recommended to keep the AFC1100 System in the best condition. A preventive maintenance routine should be practiced monthly.

WARNING: Follow Lockout/Tagout and other safety precautions when connecting or disconnecting cabling, wiring, and equipment. Always verify the System is disabled prior to touching any moveable components.

8.1.1 Nutrunner (Tool)

It is important to keep the nutrunners clean and properly adjusted to ensure correct fastening and accurate System outputs. Inspect each tool, and ensure the following conditions exist:

{ All environmental conditions are within the specified ranges.

{ The duty cycle is within specifications, and the motor is producing normal heat levels.

{ The tool is producing normal levels of noise and vibration.

{ The tool is free from excessive contamination and foreign matter.

{ The tool is securely mounted, with mounting bolts properly tightened.

{ The preamplifier, mounting clips, and cable ties are correctly and securely fastened.

{ The homerun cables are securely connected to the tool.

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8.1.2 Spindle Assembly

The torque and stress generated during each fastening is applied directly to the spindle assembly. Inspect each assembly, and ensure the following specifications are met:

{ The spindle assembly is producing normal levels of noise and vibration.

{ The assembly is free from excessive contamination and foreign matter.

{ The spindle assembly is securely mounted, with mounting bolts properly tightened.

{ The square drive or socket is in good condition, and there is no excessive wear.

{ The spindle assembly rotates and compresses freely, with no binding.

8.1.3 Homerun cables

These cables connect the tool to the Axis unit. Ensure the following conditions are met:

{ The cables are free from unnecessary force and tension.

{ The cables are secured away from any movement.

{ The cables are in good condition, sufficiently insulated with no indication of broken wires.

{ The cables are free from excessive contamination and foreign matter.

{ The cables are securely connected to the Axis unit and to the nutrunner.

{ The cables are free from heat distortion, and are not warm or hot to the touch.

{ The cables, cable connectors, and connector screws are securely and correctly fastened.

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8.1.4 Axis unit

The Axis unit requires careful use and handling. Inspect each Axis unit and ensure the following requirements are met:

{ The environmental conditions are within specifications.

{ There is no dust, oil, or foreign matter on the unit.

{ The unit is securely mounted, with appropriate clearance on all sides.

{ All screws (for the cover of the unit and for mounting) are correctly tightened.

{ The input power remains within specifications at all times.

{ The unit is not producing any abnormal (excessive) heat.

{ Unit cables are securely fastened and without damage.

8.1.5 Air Handling Units (Air Conditioner, Heat Exchanger, etc.)

Equipment supporting the AFC1100 System's environment must be sufficiently maintained. Verify support equipment meets the following requirements, as applicable to the unit type:

{ The unit is free from dust, oil, and foreign matter.

{ All filtration devices are clean, and no replacements are required.

{ The unit is securely and correctly mounted.

{ The input power remains within specifications at all times.

{ All fans are functioning properly with no abnormal sound or vibration.

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8.2 Basic operational tests

WARNING: Follow Lockout/Tagout and other safety precautions when connecting or disconnecting cabling, wiring, and equipment. When performing the following inspections, verify that the System is disabled prior to touching any moveable components.

8.2.1 Torque transducer.

The system can perform a transducer check before each fastening cycle, comparing the values from the torque transducer (zero and calibration) to the data stored in the system memory. The system is maintenance free, however it is important to check it occasionally as follows :

{ 1. Be sure that the nutrunner is in the READY mode.

{ 2. Check that the torque display shows 0 when the Axis unit RESET button is being pressed.

{ 3. At the same time as 2 (above), check that the ACCEPT LED is lit.

{ 4. Check that the display is showing the full scale torque value when the Axis unit CAL button is being pressed.

{ 5. At the same time as 4 (above), check that the ACCEPT LED is lit.

{ 6. If for any reason the accuracy of the tool transducer is in question, the transducer should be calibrated in accordance with Section 7.4.

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NOTE1: If the Zero and/or Cal check results in an "ABNORMAL" LED output to the Axis Unit (and/or an illuminated "REJECT" light on the Axis unit), refer to Chapter 9.

8.2.2 Encoder.

Take the following steps to inspect the encoder:

{ 1. Make sure that the system will not be started up by the PLC (use the manual mode).

{ 2. Place the Axis unit into the real-time display mode (Chapter 7). The [D-NO] display must be set to [2] using the [MODE] key in order to see the angle of rotation on the ANGL/SPNO display.

{ 3. If the socket of the tool is turned clockwise direction, the angle indication should increase.

{ 4. Verify that the angle of rotation matches the indicated angle.

8.2.3 Motor.

To check the motor, measure the winding's resistance and the isolation resistance.

{ 1. **Disconnect the motor connector from the tool assembly**.

{ 2. Measure the resistance between windings. (Refer to Fig 8-2-3)

{ 3. Measure the isolation resistance between each pair and the frame.

Insulation resistance: Using a megohmmeter, 500 VDC, 50 Mohms or more, test the insulation resistance between the motor windings and the motor case. The values should register in excess of 50 Mohms for each winding.

WARNING: Follow Lockout/Tagout and other safety precautions when connecting or

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disconnecting cabling, wiring, and equipment.
When performing the following inspections, verify that the System is disabled prior to touching any moveable components.

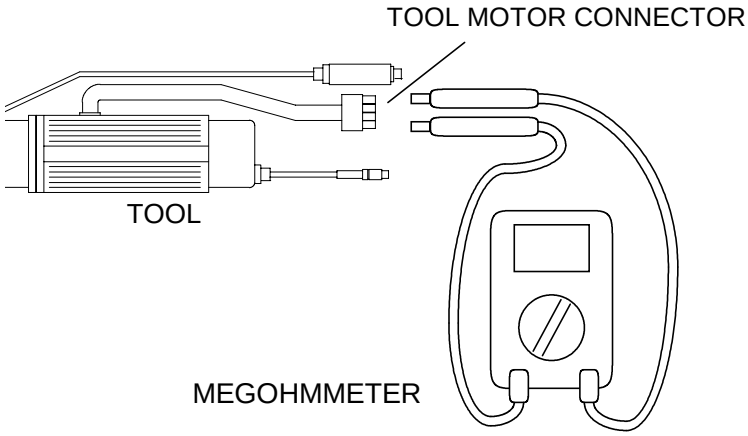


FIG. 8-2-3 motor inspection

Motor Winding Resistance*			
MOTOR SIZE	**A - B**	**A - C**	**B - C**
60W (M1)	12.8Ω	12.8Ω	12.8Ω
70W (W1)	15.3Ω	15.3Ω	15.3Ω
100W (M2)	4.4Ω	4.4Ω	4.4Ω
200W (M3)	1.9Ω	1.9Ω	1.9Ω
200W (W3)	4.0Ω	4.0Ω	4.0Ω
400W (M4)	.7Ω	.7Ω	.7Ω

*Rev. 1/8/01

INSULATION Resistance			
MOTOR SIZE	**A - D**	**B - D**	**C - D**
60W (M1)	More than 50 megohms at 500 VDC		
70W (W1)			
100W (M2)			
200W (M3)			
200W (W3)			
400W (M4)			

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8.2.4 Transmission Disassembly and Inspection

- The planetary gear transmissions used in the AFC1100 System's tool assemblies are designed to withstand the forces exerted upon them by the production requirements of modern assembly plants.

- To prolong the life of the transmission assembly, the components must be inspected and greased at regular intervals.

  - FEC INC. recommends performing this procedure initially after equipment has been in use for one year or 500,000 cycles, whichever is reached first.

  - When the initial maintenance is performed, the condition of the transmission assembly should be analyzed to determine future maintenance requirements. Systems operating under more severe conditions may require maintenance every 500,000 cycles, while other systems may only require maintenance every 2,000,000 cycles. Maximum time between inspections should be one (1) year.

1. REMOVE TRANSMISSION FROM TOOL ASSEMBLY. Separate the transmission from the motor by removing four (4) screws. Remove the snap ring from the output shaft. Separate the transducer from the transmission by removing four (4) screws.

2. DISASSEMBLE TRANSMISSION. Refer to the appropriate transmission assembly drawing while disassembling the transmission for cleaning.

3. CLEAN TRANSMISSION PARTS. Clean all parts with an appropriate solvent, such as mineral spirits, to remove all excess grease and contamination. Parts should be carefully wiped dry with a lint-free cloth to remove any residue. Allow the parts to dry thoroughly in an area free from contamination.

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4. INSPECT TRANSMISSION PARTS. Examine all gears, pins, bearings, etc. for signs of excessive wear. Replace any part that appears it may fail.

5. LUBRICATE TRANSMISSION PARTS. Reassemble the transmission in a contaminant-free area. Re-pack all bearings and grease all gears. Do not pack the transmission housing with excessive grease; overgreasing could damage the tool. Recommended grease: Sunoco Sunaplex 992 EP or equivalent.

6. REASSEMBLE TRANSMISSION. Refer to the appropriate transmission assembly drawing while reassembling the transmission. If needed, rotate the gears to aid in the assembly process. If the transmission does not rotate freely after reassembly, then disassemble the transmission again to isolate and correct the cause.

7. REASSEMBLE TOOL. Connect the transmission to the motor with four (4) screws. If needed, rotate the output shaft to align the transmission planetary gears with the motor output splined shaft. Connect the transducer to the transmission with four (4) screws. Install the snap ring onto the output shaft to hold the outer bearing in place. If the transmission does not rotate freely after reassembling the tool, then disassemble the tool again to isolate and correct the cause.
   NOTE: Snap ring installation must be the last step in reassembly.

8. INSPECT SPINDLE ASSEMBLY. Prior to installing the tool into an application, inspect the spring loaded spindle assembly that will connect to the tool. The assembly should compress evenly, without binding. Rotate the assembly in the spindle housing and verify there is no binding. Visually inspect the entire assembly for signs of wear or fatigue. Replace parts as required, and reassemble. Lubricate the inner bearings of the housing as required, and reinspect the final assembly. Install the tool into the application and verify there is no binding.

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8.3 Replacements

WARNING: DO NOT CONNECT OR DISCONNECT CABLES OR OTHER SYSTEM COMPONENTS WITH POWER APPLIED. FOLLOW LOCKOUT/TAGOUT AND OTHER APPLICABLE SAFETY PRECAUTIONS WHEN CONNECTING OR DISCONNECTING CABLING, WIRING, AND EQUIPMENT.

NOTE: When replacing the AFC1100 System Axis unit, ensure that the new unit is configured with the same hardware and software as the unit being replaced.

8.3.1 Axis Unit Replacement (No Partial Replacement - Complete Unit Only)

When one Axis unit is being replaced with another, it is important to verify that both Units are the same Type. (Refer to Section 2.4 Axis unit and to the chart, below.)

Note: Although "A" type Axis units (AXIS-103A, for example) accomodate the same nutrunners as their older style counterparts, they are not fully interchangeable. REPLACE OLDER STYLE AXIS UNITS WITH THE SAME, AND REPLACE THE "A" TYPE UNITS WITH OTHER "A" TYPE UNITS. If it is necessary to intermix older style Units with "A" type Units, contact FEC INC. for guidance.

TOOL TYPE	AXIS UNIT
DFT-101M1-S1/O1	AXIS-103 / 10
DFT-201M1-S/O	AXIS-103 / 10
DFT-401M1-S/O	AXIS-103 / 10
DFT-401M2-S/O	AXIS-103 / 10
DFT-601M3-S/O	AXIS-105 / 10
DFT-801M3-S/O	AXIS-105 / 10
DFT-132M3-S/O	AXIS-105 / 10
DFT-152M3-S/O	AXIS-105 / 10
DFT-202M3-S/O	AXIS-105 / 10
DFT-302M3-S/O	AXIS-105 / 10
DFT-502M4-S/O	AXIS-110 / 10

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1. Verify the enclosure power is off. Ensure all cables connected to the front of the Axis unit are clearly marked (for reconnection).
2. Disconnect all cables from the front of the unit.
3. Loosen (do not remove) the four (4) screws that secure the Axis unit to the back panel. The upper bracket of the Axis unit has two slotted holes, and the bottom bracket has two open-ended slots.
4. Lift up and out on the Axis unit to remove.
5. Verify the Axis unit dip switches are set to the appropriate spindle number and ramp-up time. Refer to Section ?.
6. Verify the Axis Units have the same configuration (hardware and software).
7. Install the new Axis unit in reverse order of removal.
8. Apply power to the enclosure. After approximately 30 seconds, the System will finalize the Power On Self Test (POST).
9. The Axis unit will require reentry of the preset data. Refer to Chapters 6 and 7.

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8.3.2 Replace nutrunner (tool)

Do not attempt to replace a component of the tool - the tool must be replaced as a complete assembly. The tool type identification can be found on the identification tag affixed to the tool and on the System [PREAMP EEPROM DATA] screen.

WARNING: DO NOT CONNECT OR DISCONNECT CABLES OR OTHER SYSTEM COMPONENTS WITH POWER APPLIED.

1. Verify all System power is off.
2. Ensure that the three (3) homerun cables are marked for reconnection, then disconnect them from the tool.
3. Ensure the spindle assembly is supported, and remove the two (2) bolts securing it to the mounting plate.
   WARNING: These two (2) bolts also secure the nutrunner, with the two (2) bolts removed in the next step. Some tool models are very heavy. Use precautions when disconnecting, removing, and installing these components.
4. The preamplifier is secured to the powerhead frame with two (2) screws. When possible, it is more convenient to disconnect the preamp from the powerhead frame prior to removing the nutrunner.
   CAUTION: The preamp is also connected to the nutrunner, and this connection must not be subject to stress or shock which could cause damage and result in inaccurate System output. Do not allow any pull on the preamp cable.
5. To remove the nutrunner, first verify the preamplifier removal status (Step 4, above). Ensure the nutrunner is supported, and remove the two (2) remaining bolts (two of the four were removed in Step 3).
6. Follow all safety precautions to install an identical nutrunner/preamp assembly by performing the removal procedure in reverse order.

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8.3.3 Replace homerun cables

FEC INC. provides a spare set of homerun cables with each System.

1. Verify all System power is off.
2. Disconnect the damaged cable(s) from the nutrunner and the Axis unit, and replace with the spare cable(s).

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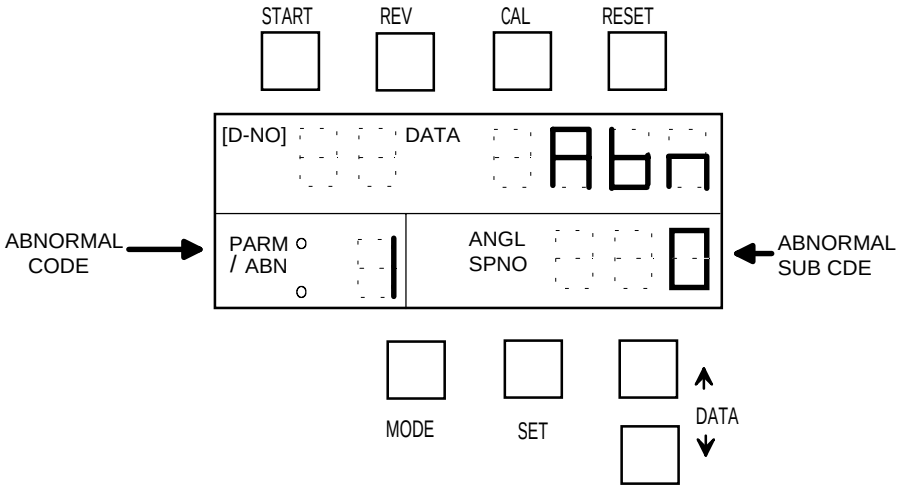
Chapter 9: Troubleshooting

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9.1 Abnormal Conditions.

When an abnormal condition is detected, the system,halts with the ABNORMAL LED lit. For ease of troubleshooting the nature of the abnormal, the system provides an abnormal code in the [PARM/ABN] display and an abnormal sub-code in the [ANGL.SPNO] display.

wAbnormal code display.
When an Abnormal condition occurs (ABNORMAL LED is lit), depress the [MODE] key several times until the data in the [D-NO] display disappears and the "Abn" message appears in the [DATA] display. At this time the [PARM/ABN] display will be showing an abnormal display code that can help identify the cause of the fault through the use of the following sections.



wAbnormal Sub-code display.
The abnormal sub-code is shown in the [ANGL/SPNO] display. This sub-code can be used in conjunction with the following sections to further narrow down the cause of the fault.

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9.2 Axis Unit Abnormal Help Screen Explanation

After the applicable ABNORMAL CODE and ABNORMAL SUB CODE have been identified from the affected Axis unit a review of the following troubleshooting guide will identify the nature of the failure and the recovery method.

Example:
Abnormal code 1 with an Abnormal sub code of 0 can be found immediately following this example as "Code 1-0". The remainder of abnormal codes can be found in numerical order.

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9.3 Torque Transducer

9.3.1 code 1-0 TORQUE TRANSDUCER / ZERO VOLTAGE ERROR

Zero level voltage error during power on initialization.
This abnormal is caused from only 3 items.
1. When the tool transducer is sensing excessive torque due to pressure on the tool body.
2. If the controller or the transducer cable is located in an electric or magnetic noise field.
3. When the torque transducer, transducer (T/D) cable or the controller malfunctions.

RECOVERY:
1. Check that the tool has no external force applied to it.
2. Verify that the cable or controller are not located near any high voltage transient power sources. Relocate as required and reinitialize.
3. Exchange transducer (T/D) cable, tool and/or controller with known working units. Reinitialize the system after each exchange, and make note of any change in the location of the abnormal.
4. Replace the defective component.

9.3.2 code 1-1 TORQUE TRANSDUCER / cal VOLTAGE ERROR

Calibration voltage error during power on initialization.
This abnormal is caused from only 3 items.
1. When the tool transducer is sensing excessive torque due to pressure on the tool body.
2. If the controller or the transducer cable is located in an electric or magnetic noise field.
3. When the torque transducer, transducer (T/D) cable or the controller malfunctions.

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RECOVERY:
1. Check that the tool has no external force applied to it.
2. Verify that the cable or controller are not located near any high voltage transient power sources. Relocate as required and reinitialize.
3. Exchange transducer (T/D) cable, tool and/or controller with known working units. Reinitialize the system after each exchange, and make note of any change in the location of the abnormal.
4. Replace the defective component.

9.3.3 Code 1-2 TORQUE TRANSDUCER / ZERO check ERROR

Zero level voltage error during a fastening start input.
This abnormal is caused from only 3 items.
1. When the tool transducer is sensing excessive torque due to pressure on the tool body.
2. If the controller or the transducer cable is located in an electric or magnetic noise field.
3. When the torque transducer, transducer (T/D) cable or the controller malfunctions.

RECOVERY:
1. Check that the tool has no external force applied to it.
2. Verify that the cable or controller are not located near any high voltage transient power sources. Relocate as required and reattempt the fastening start input.
3. Exchange transducer (T/D) cable, tool and/or controller with known working units. Input the start signal after each exchange, and make note of any change in the location of the abnormal.
4. Replace the defective component.

9.3.4 code 1-3 TORQUE TRANSDUCER / selfcheck cal ERROR

Calibration voltage error during a fastening start input.

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This abnormal is caused from only 3 items.
1. When the tool transducer is sensing excessive torque due to pressure on the tool body.
2. If the controller or the transducer cable is located in an electric or magnetic noise field.
3. When the torque transducer, transducer (T/D) cable or the controller malfunctions.

RECOVERY:
1. Check that the tool has no external force applied to it.
2. Verify that the cable or controller are not located near any high voltage transient power sources. Relocate as required and reattempt a fastening start input.
3. Exchange transducer (T/D) cable, tool and/or controller with known working units. Input the start input after each exchange, and make note of any change in the location of the abnormal.

4. Replace the defective component.

9.3.5 code 1-4 TORQUE TRANSDUCER / started on ZERO ERROR condition

The start signal was input while a Zero voltage abnormal condition existed.
RECOVERY:
1. Interlock the PLC circuit to disable the start signal during an existing abnormal condition.
2. Follow the <ZERO VOLTAGE ERROR>(CODE 1-0) abnormal help procedure.

9.3.6 code 1-5 TORQUE TRANSDUCER / started on cal ERROR condition

The start signal was input while a Cal voltage abnormal condition existed.
RECOVERY:
1. Interlock the PLC circuit to disable the start signal during an existing abnormal condition.
2. Follow the <CAL VOLTAGE ERROR>(CODE 1-1) abnormal help procedure.

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9.3.7 code 1-6 TORQUE TRANSDUCER / selfcheck ZERO ERROR

Zero level voltage error during power on initialization.
This abnormal is caused from only 3 items.
1. When the tool transducer is sensing excessive torque due to pressure on the tool body.
2. If the controller or the transducer cable is located in an electric or magnetic noise field.
3. When the torque transducer, transducer (T/D) cable or the controller malfunctions.

RECOVERY:
1. Check that the tool has no external force applied to it.
2. Verify that the cable or controller are not located near any high voltage transient power sources. Relocate as required and reinitialize.
3. Exchange transducer (T/D) cable, tool and/or controller with known working units. Reinitialize the system after each exchange, and make note of any change in the location of the abnormal.
4. Replace the defective component.

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9.4 Preamplifier / Tool EEPROM

9.4.1 code 3-0 preamplifier / tool eeprom error

Communications error between the tool preamplifier and the controller.
This abnormal is caused from only 2 items.
1. If the controller or the transducer cable is located in an electric or magnetic noise field.
2. When the torque transducer, transducer (T/D) cable or the controller malfunctions.

RECOVERY:
1. Verify that the cable or controller are not located near any high voltage transient power sources. Relocate as required and reinitialize the system.
2. Exchange transducer (T/D) cable, tool and/or controller with known working units. Reinitialize the system after each exchange, and make note of any change in the location of the abnormal.
3. Replace the defective component.

9.4.2 code 3-1 preamplifier / tool type error

The connected tool type does not match the tool type programmed into the controller connected to that tool. This error may occur in the multi tool type application or when controllers are replaced and not reprogrammed with the correct configuration.

RECOVERY:
1. Verify the tool type name from the tool identification tag
2. Compare the tool tag name with the setup value. Refer to section 7.3.6.

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9.4.3 code 3-2 preamplifier / started without tool connected

The start signal was applied while a <Tool is not connected> abnormal condition existed.
RECOVERY:
1. Interlock the PLC circuit to disable the start signal during an existing abnormal condition.
2. Follow the <TOOL IS NOT CONNECTED>(CODE 3-3) abnormal help procedure.

9.4.4 code 3-3 preamplifier / tool is not connected

Communications error between the tool preamplifier and the controller.

This abnormal is caused from only 3 items.
1. The transducer cable is not connected
2. If the controller or the transducer cable is located in an electric or magnetic noise field.
3. When the torque transducer, transducer (T/D) cable or the controller malfunctions.

RECOVERY:
1. Verify that the transducer cable is connected
2. Verify that the cable or controller are not located near any high voltage transient power sources. Relocate as required and reinitialize the system.
3. Exchange transducer (T/D) cable, tool and/or controller with known working units. Reinitialize the system after each exchange, and make note of any change in the location of the abnormal.
4. Replace the defective component.

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9.5 System Memory / Tool EEPROM

9.5.1 code 4-0 system memory error / tool eeprom write error

Communications error between the tool preamplifier and the controller.
This abnormal is caused from only 2 items.
1. If the controller or the transducer cable is located in an electric or magnetic noise field.
2. When the torque transducer, transducer (T/D) cable or the controller malfunctions.

RECOVERY:
1. Verify that the cable or controller are not located near any high voltage transient power sources. Relocate as required and reinitialize the system.
2. Exchange transducer (T/D) cable, tool and/or controller with known working units. Reinitialize the system after each exchange, and make note of any change in the location of the abnormal.
3. Replace the defective component.

9.5.2 code 4-1 system memory error / tool eeprom read error

Communications error between the tool preamplifier and the controller.

This abnormal is caused from only 2 items.
1. If the controller or the transducer cable is located in an electric or magnetic noise field.
2. When the torque transducer, transducer (T/D) cable or the controller malfunctions.

RECOVERY:
1. Verify that the cable or controller are not located near any high voltage transient power sources. Relocate as required and reinitialize the system.
2. Exchange transducer (T/D) cable, tool and/or controller with known working units. Reinitialize the system after each exchange, and make note of any change in the location of the abnormal.
3. Replace the defective component.

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9.5.3 code 4-2 system memory error / power on ram check error

Verification error while reading/writing the controller RAM.

This abnormal is caused from only 2 items.
1. If the controller is located in an electric or magnetic noise field.
2. When the controller malfunctions.

RECOVERY:
1. Verify that the controller is not located near any high voltage transient power sources. Relocate as required and reinitialize the system.
2. Exchange the controller with known working unit. Reinitialize the system after the exchange.

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9.6 Servo Amplifier Response / Encoder

9.6.1 code 5-0 servo amplifier reply error / no reply from encoder

The controller is trying to turn the tool assembly, but is not receiving any angle count back from the encoder to indicate that the tool is actually turning.

This abnormal is caused from only 4 items.
1. The motor cable is damaged or not connected
2. If the encoder cable is damaged.
3. When the encoder, motor, or the controller malfunctions.
4. If there is excessive binding in the fastener, transmission, or the spindle assembly.

RECOVERY:
1. Verify that the motor cable is connected and not damaged.
2. Connect all spare tool cables to the existing tool.
3. Exchange tool and/or controller with known working units. Reinitialize the system after exchanges, noting any change in the location of the abnormal.
4. Inspect and correct any binding in the spindle assembly, transmission or fasteners.

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9.7 Servo Type

9.7.1 code 6-0 servo type error / servo type mismatch

The servo amplifier does not match the connected motor type.

Verify the servo type tag with the motor type tag.

There are 4 type of servo amplifiers (controllers) available.

Servo	Tool Type
AXIS 103	DFT-051M1,DFT-101M1,DFT-201M1,DFT-401M1
AXIS 105	DFT-201M2,DFT-401M2,DFT-601M3,DFT-801M3 DFT-132M3,DFT-202M3,DFT-302M3
AXIS 110	DFT-401W4,DFT-502M4,DFT-802M4,DFT-802W4
AXIS 120	DFT-153N1,DFT-203N1,DFT-403N1

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9.8 Power voltage / Inside Power Supply

9.8.1 code 7-0 power voltage error / inside power supply abnormal

The controller internal power supply circuit is not working properly.

This abnormal is caused from only 3 items.
1. The controller internal power supply has failed
2. If the environment temperature is more than 113 degrees Fahrenheit (45 degree centigrade) without any air flow.
3. Source voltage is very close to the limit (253 volts ac) and the environment temperature is also close to the limit.

RECOVERY:
1. Replace the controller
2. Provide additional cooling to the enclosure.
3. Verify and correct the source voltage as required.

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9.9 Servo Amplifier / Encoder cable

9.9.1 code 8-0 servo amplifier error / encoder cable is broken

The controller can not detect the presence of an encoder.

This abnormal is caused from only 2 items.
1. If the encoder cable is damaged or disconnected.
2. When the encoder or the controller malfunctions.

RECOVERY:
1. Connect the spare encoder cable to the existing tool.
2. Exchange tool and/or controller with known working units. Reinitialize the system after each exchange, and make note of any change in the location of the abnormal.
3. Replace the defective component.

9.9.2 code 8-1 servo amplifier error / over current

Over current or servo type mismatch.

The servo amplifier does not match the connected motor type. Verify the servo type tag with the motor type tag.

There are 4 type of servo amplifiers (controllers) available.

Servo	Tool Type
AXIS 103	DFT-051M1,DFT-101M1,DFT-201M1,DFT-401M1
AXIS 105	DFT-201M2,DFT-401M2,DFT-601M3,DFT-801M3 DFT-132M3,DFT-202M3,DFT-302M3
AXIS 110	DFT-401W4,DFT-502M4,DFT-802M4,DFT-802W4
AXIS 120	DFT-153N1,DFT-203N1,DFT-403N1

9.9.3 code 8-2 servo amplifier error / encoder abnormal

The controller can not detect the presence of an encoder.

This abnormal is caused from only 2 items.
1. If the encoder cable is damaged or disconnected.
2. When the encoder or the controller malfunctions.

RECOVERY:
1. Connect the spare encoder cable to the existing tool.
2. Exchange tool and/or controller with known working units. Reinitialize the system after each exchange, and make note of any change in the location of the abnormal.
3. Replace the defective component.

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9.9.4 code 8-3 servo amplifier error / servo is over heated

The controller Servo circuit is not working properly.

This abnormal is caused from only 3 items.
1. The controller servo drive circuit has failed
2. If the environment temperature is more than 113 degrees Fahrenheit(45 degree centigrade) without any air flow.
3. Source voltage is very close to the limit (253 volts ac) and the environment temperature is also close to the limit.

RECOVERY:
1. Replace the controller
2. Provide additional cooling to the enclosure.
3. Verify and correct the source voltage as required.

9.9.5 code 8-4 servo amplifier error / encoder is over heated

The controller Encoder circuit is not working properly.

This abnormal is caused from only 3 items.
1. the controller encoder circuit has failed
2. If the environment temperature is more than 113 degrees Fahrenheit(45 degree centigrade) without any air flow.
3. Source voltage is very close to the limit (253 volts ac) and the environment temperature is also close to the limit.

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RECOVERY:
1. Replace the controller
2. Provide additional cooling to the enclosure.
3. Verify and correct the source voltage as required.

9.9.6 code 8-5 servo amplifier error / over source voltage

The controller internal power supply circuit is not working properly or the input voltage is above the maximum limit.

This abnormal is caused from only 2 items.
1. The controller internal power supply has failed
2. Source voltage is very close to the limit (253 volts ac) and the environment temperature is also close to the limit.

RECOVERY:
1. Replace the controller
2. Provide additional cooling to the enclosure.
3. Verify and correct the source voltage as required.

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9.9.7 code 8-6 servo amplifier error / source voltage abnormal

The controller internal power supply circuit is not working properly or the input voltage is above the maximum limit.

This abnormal is caused from only 2 items.
1. The controller internal power supply has failed
2. Source voltage is very close to the limit (253 volts ac) and the environment temperature is also close to the limit.

RECOVERY:
1. Replace the controller
2. Provide additional cooling to the enclosure.
3. Verify and correct the source voltage as required.

9.9.8 code 8-7 servo amplifier error / over load (i square T)

The duty cycle of the fastening application is too severe for this size of tool, or for the parameters currently setup.

RECOVERY:
1. Try to increase the amount of time allocated for fastening and slow down the fastening speed of the tool.
2. If the problem remains, a larger tool assembly may be required for this application. Please contact FEC.

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9.10 Preset Error

9.10.1 code 9-0 preset error / reverse speed does not exist

The reverse speed preset is not setup or the wrong parameter number has been selected by the PLC.

RECOVERY:
1. Verify that the parameter number that is being selected by the PLC is configured in the controller.
2. Check that the reverse speed preset is not <0> or out of the specified speed range of the tool.

9.10.2 code 9-1 preset error / insufficient preset data

The fastening presets are not setup or the wrong parameter number has been selected by the PLC.

RECOVERY:
1. Verify that the parameter number that is being selected by the PLC is configured in the controller.
2. Check that the fastening presets are not <0> or out of the specified range for the tool.

9.10.3 code 9-2 preset error / system abnormal 1

The system controller experienced an internal processing error.

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This abnormal is caused from only 2 items.
1. If the controller is located in an electric or magnetic noise field.
2. When the controller malfunctions.

RECOVERY:
1. Verify that the controller is not located near any high voltage transient power sources. Relocate as required and reinitialize the system.
2. Exchange the controller with known working unit. Reinitialize the system after the exchange.

9.10.4 code 9-3 preset error / system abnormal 2

The system controller experienced an internal processing error.

This abnormal is caused from only 2 items.
1. If the controller is located in an electric or magnetic noise field.
2. When the controller malfunctions.

RECOVERY:
1. Verify that the controller is not located near any high voltage transient power sources. Relocate as required and reinitialize the system.
2. Exchange the controller with known working unit. Reinitialize the system after the exchange.

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9.10.5 code 9-4 preset error / system abnormal 3

The system controller experienced an internal processing error.

This abnormal is caused from only 2 items.
1. If the controller is located in an electric or magnetic noise field.
2. When the controller malfunctions.

RECOVERY:
1. Verify that the controller is not located near any high voltage transient power sources. Relocate as required and reinitialize the system.
2. Exchange the controller with known working unit. Reinitialize the system after the exchange.

WARNING: DO NOT CONNECT OR DISCONNECT CABLES OR OTHER SYSTEM COMPONENTS WITH POWER APPLIED.

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9.11 AFC1100 Axis Unit Fastening Faults and Causes

9.11.1 Accept Conditions

THE ACCEPT LED will light for the three following reasons:

1. tHE RESET input is active on either the front panel or via a PLC input, and the reset condition (ZERO LEVEL) of the TRANSDUCER is within acceptable limits.
2. tHE CAL input is active on either the front panel or via a PLC input, and the calibration condition (CAL LEVEL) of the transducer is within acceptable limits.
3. tHE previous fastening was completed within all preset limits (TORQUE, ANGLE, 1st RATE, 2nd RATE, and TIME).

9.11.2 Torque Reject Conditions

THE TORQUE Reject LED will light for the following reasons:

1. THE ZERo Level is outside acceptable limits.
2. tHE CAl Level is outside acceptable limits.
3. THE final fastening torque is not between the LOW and HIGh TORque limits set in the PARAMETERs.

AFC Inc.

4a. A "RED" TOrque Reject LED on the AXIS unit indicates a HIGH TORQue reject, which can normally be attributed to excessive speed (crashing). IN ANGLE Control this may be caused by increased friction or reduced joint compression.

4b. aN "ORANGE" TORQue Reject LED on the AXIS unit indicates a LOW TORque reject, which was caused by the failure of one or more of the other preset limits (ANGLE, Time, 1st RATE, or 2nd RATe). IN ANGLe Control this may be caused by reduced friction or increased joint compression.

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9.11.3 ANGLE REJECT conditions

THE ANGLe Reject LED will light for the following reasons:

1. A "REd" ANGLE Reject LED on the AXIS unit indicates a HIGH ANgle reject. THIS type of reject is caused when the degrees of rotation the fastener turns after sensing the Snug torque is in excess of the preset HIGH Angle limit as specified in the PARameters. MAy cause a LOW TORQue reject.

CAUSES: EXCessive lubrication, thread obstacle, excessive joint compression.

2. AN "ORANge" ANgle display LED on the AXIS unit indicates a LOW ANgle reject. THIS type of reject is caused when the degrees of rotation the fastener turns after sensing the Snug torque is below the preset LOW Angle limit as specified in the PARAmeters.

CAUSES: REDuced lubrication, thread obstacle, reduced joint compression.

9.11.4 TIME REJECT conditions

THe TIMe Reject LED will light for the following reasons:

1. A "RED" TIme Reject LED on the AXIS unit indicates a Final step Time Reject.

2. An "ORANGE" TIme Reject LED on the AXIS unit indicates a 1st step TIme Reject. May cause a LOW TOrque Reject.

REC Inc.

CAUSES:

1. THE amount of time specified in the Parameters is insufficient.

2. THe socket did not engage the fastener properly.

3. THe fastener did not engage the workpiece properly.

4. The socket is split or damaged.

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9.11.5 TORQUE RATE REJECT conditions

TorquE RAte (RAte) is defined as the change in torque divided by the change in degrees of rotation (ANgle) during a specific interval.

1ST RATE

1. A "RED" 1ST RATE Reject LED on the AXIS unit indicates that the Torque Rate, as measured from Threshold (THR) to 1st TORque, is above the high limit specified in the PARameters. May cause a LOW TOrque Reject.

2. AN "ORAnge" 1ST RATE Reject LED on the AXIS unit indicates that the Torque Rate, as measured from THR to 1st TOrque, is below the low limit specified in the Parameters. MAy cause a LOW Torque Reject.

2ND RATE

1. A "RED" 2ND RATE Reject LED on the AXIS unit indicates that the Torque Rate, as measured from 1st TORque to CROSSOVER RAte 2 Torque, is above the high limit specified in the Parameters. May cause a LOW TORQUE REJECT.

2. AN "ORANGE" 2ND RATE Reject LED on the AXIS unit indicates that the torque RATE, as measured from 1st TORque to CROSSOVER RAte 2 Torque, is below the low limit specified in the PArameters. MAY cause a LOW TORQUE REJECT.

CAUSES of HIGH RATE Rejects:
Reduced lubrication, thread obstacle, reduced joint compression.

FEC Inc.

CAUSES of LOW RATe Rejects:
EXcessive lubrication, thread obstacle, excessive joint compression.

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