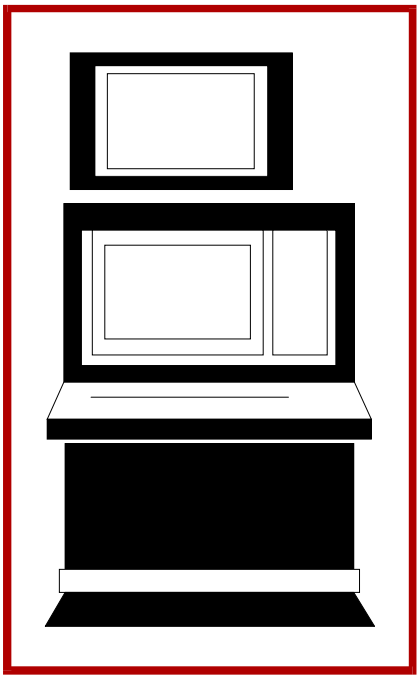
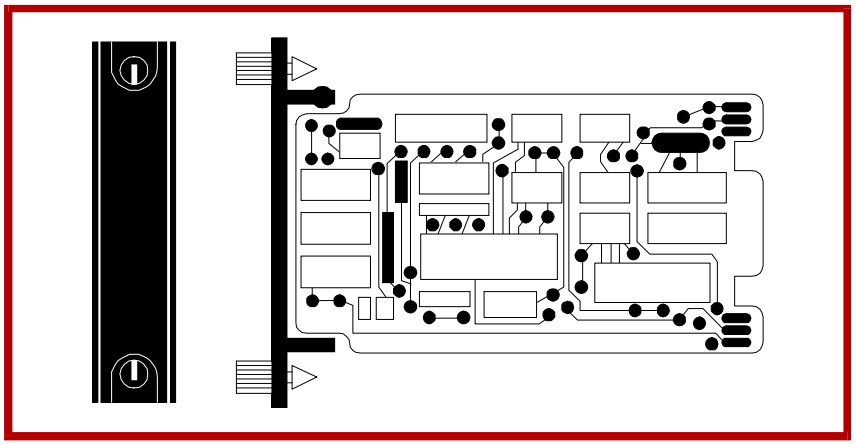
Bailey® infi 90®

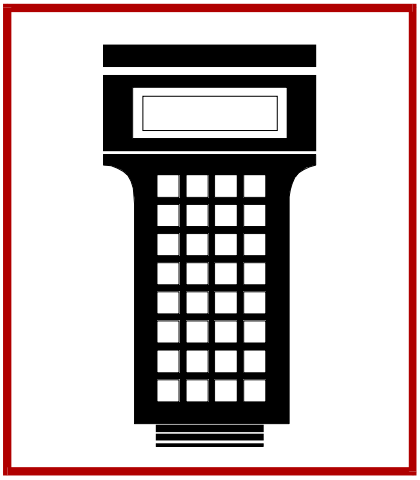
E96-314

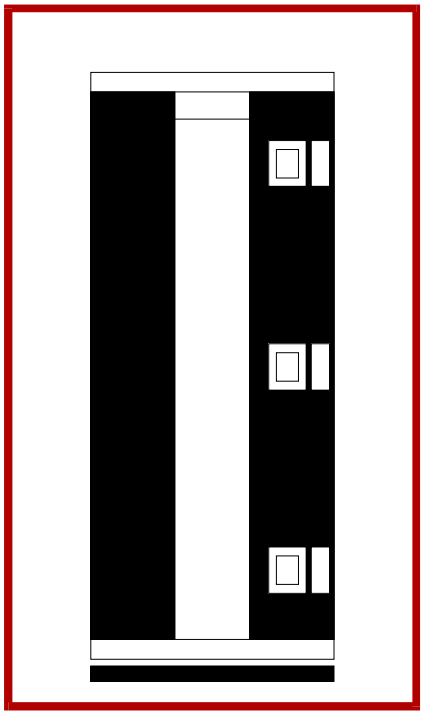
Instruction

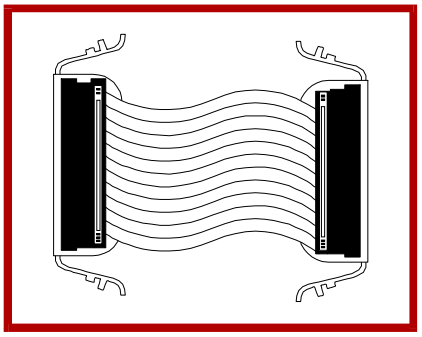
Frequency Counter Slave
(IMFCS01)

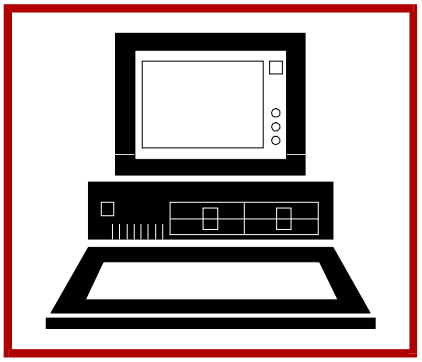












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WARNING notices as used in this instruction apply to hazards or unsafe practices that could result in personal injury or death.

CAUTION notices apply to hazards or unsafe practices that could result in property damage.

NOTES highlight procedures and contain information that assists the operator in understanding the information contained in this instruction.

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Preface

The Frequency Counter Slave Module (IMFCS01) is a single channel frequency input for the Multi-Function Processor (MFP), Multi-Function Controller (MFC) and Hydraulic Servo Slave Module (HSS). It interfaces a steam or gas turbine to the MFP or MFC, providing them with accurate frequency count and time period data. The MFP or MFC uses the frequency count to calculate turbine speed and initiate speed control through the HSS.

This manual provides the user with information and instructions for installation, operation and troubleshooting of the FCS. Anyone involved with the installation and operation of the frequency counter slave should carefully read and understand this manual.

General information about the module and related equipment is contained herein.

List of Effective Pages

Total number of pages in this instruction is 36, consisting of the following:

Page No.	Change Date
Preface	Original
List of Effective Pages	Original
iii through vi	Original
1-1 through 1-6	Original
2-1 through 2-7	Original
3-1 through 3-5	Original
4-1	Original
5-1 through 5-9	Original
6-1	Original
7-1	Original

When an update is received, insert the latest changed pages and dispose of the superseded pages.

NOTE: On an update page, the changed text or table is indicated by a vertical bar in the outer margin of the page adjacent to the changed area. A changed figure is indicated by a vertical bar in the outer margin next to the figure caption. The date the update was prepared will appear beside the page number.

Safety Summary

GENERAL WARNINGS	**Equipment Environment** All components, whether in transportation, operation or storage, must be in a noncorrosive environment. **Electrical Shock Hazard During Maintenance** Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing. **Special Handling** This module uses Electrostatic Sensitive Devices (ESD).

Sommaire de Sécurité

AVERTISSEMENTS D'ORDRE GÉNÉRAL	**Environnement de l'équipement** Ne pas soumettre les composants à une atmosphère corrosive lors du transport, de l'entreposage ou l'utilisation. **Possibilité de chocs électriques durant l'entretien** Débrancher l'alimentation ou prendre les précautions pour éviter tout contact avec des composants sous tension durant l'entretien. **Precautions de Mantention** Ce module contient des composantes sensibles aux decharges electro-statiques.

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SECTION 1 - INTRODUCTION

OVERVIEW

The Frequency Counter Slave Module (IMFCS01) is a single channel frequency input for the Multi-Function Processor (MFP) or Multi-Function Controller (MFC) modules. The FCS conditions, converts and processes pulse inputs from a magnetic pickup attached to the front standard of a steam or gas turbine. The converted digital data represents a count of the input pulses and the period of the count. The MFP or MFC uses the data to calculate frequency and consequently turbine speed. The FCS provides exceptional frequency counting accuracy required by steam or gas turbine control systems.

INTENDED USER

Anyone who installs, operates, or maintains the FCS module should read and understand the contents of this manual. Installation and troubleshooting of the FCS requires a technician or engineer with electrical experience.

HARDWARE DESCRIPTION

The FCS is a smart module, having an on-board microprocessor and memory to process input data and communicate with the controller. It consists of a printed circuit board with a faceplate and mounts in one slot of the Module Mounting Unit (MMU). The FCS receives power and links to the slave expander bus via the module mounting unit backplane. Field connection is made through a cable to a termination unit or module.

HARDWARE APPLICATION

One application of the frequency counter slave is turbine speed control. The FCS converts pulse inputs from a magnetic sensing device on a turbine into digital data and sends the data to the MFP or MFC through the slave expander bus. The control module calculates turbine speed using the data the FCS provides. The configuration within the control module uses the calculated speed to control servo valve outputs according to the user's control strategy. Figure 1-1 shows an example of a FCS application.

In most applications, the FCS works with the Hydraulic Servo Slave (IMHSS01). The HSS allows the operator to position (manual or automatic) a hydraulic actuator using a servo valve. The hydraulic actuator positions a gas turbine fuel valve or steam turbine governor valve. As the valve opens or closes, it regulates the fuel or steam flow to the turbine thus controlling the turbine speed.

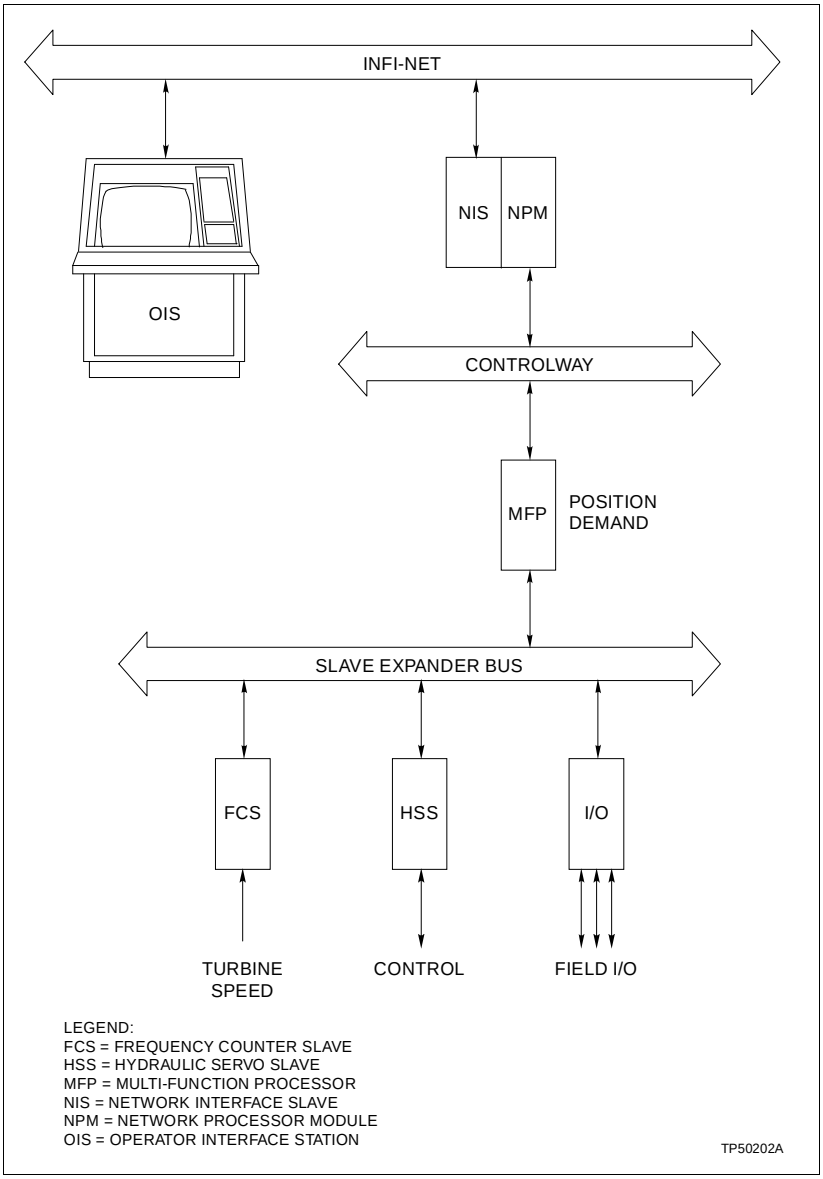

Figure 1-1. Example of FCS Applications

MANUAL CONTENT

This manual provides introductory, installation, operation, configuration, troubleshooting and maintenance information. Read this document before installing or operating the FCS. A summary of section content follows:

Introduction This section is an overview of the system. It contains a description of hardware, glossary, reference documentation and product specifications.

Theory of Operation This section explains FCS operation as major functional blocks using schematics, block diagrams and text.

Installation The Installation section covers handling, inspection, field wiring, switch settings and configuration. Proper installation requires configuration of the controller module, wiring from the magnetic pickup and dipshunt configuration on the termination unit.

Operation The Operation section explains the start-up procedure and how to operate the FCS. Operation is automatic.

Troubleshooting This section supplies flowcharts and gives corrective action for system start-up and operational problems.

Maintenance The maintenance section contains a list of maintenance procedures.

Support Services This section explains the services and training that Bailey Control Co. makes available to their customers.

HOW TO USE THIS MANUAL

Read this manual before handling the FCS. Refer to a specific section for information as needed.

1. Read Section 4 thoroughly before installing the IMFCS01.

2. Read and do the steps in Section 3.

3. Refer to Section 5 for what to do if a problem occurs.

4. Use Section 7 for a list of replacement parts and warranty information.

GLOSSARY

Term	Definition
Dipshunt	Dual in-line package with shorting bars.
Dipswitch	A dual in-line package that contains single pole switches.
ESD	Electrostatic Sensitive Devices - Electronic components subject to damage or failure when exposed to an electrostatic discharge; require special handling.
Slave Expander Bus	Parallel communication bus between the master module and the slave located on the backplane of the MMU.
FCS	Frequency Counter Slave Module (IMFCS01).
Function Code	An algorithm that defines specific functions. These functions link together to form the control strategy.
HSS	Hydraulic Servo Slave Module (IMHSS01).
Latch Register	A temporary storage buffer that holds a piece of data until instructed to move it elsewhere.
MCU	Microcontroller - An independent microprocessor with on-board memory, I/O ports, and support circuitry.
MFC	Multi-Function Controller Module (NMFC03/04/05).
MFP	Multi-Function Processor Module (IMMFP01/02).
MMU	Module Mounting Unit - a circuit card cage provides electrical and communication support to the modules.
PCB	Printed Circuit Board
TMU	Termination Mounting Unit - a circuit card cage providing slots to mount termination modules and cables.
TU/TM	Termination Unit/Termination Module - a PCB assembly which provides an interface linking field wiring to input or output modules such as the FCS.
Watchdog Timer	An on-board self check, verifies that the module is operating correctly.

REFERENCE DOCUMENTS

Refer to the following Bailey documents for additional information about module configuration, operation or related hardware:

Description	Document No.
Function Code Applications Manual	I-E93-900-20
Operator Interface Station (OIS20) Operation/Configuration Manual	I-E96-100
Configuration/Tuning Module (NCTM01)	I-E93-903
Configuration/Tuning Terminal (CTT01)	I-E92-501-1
Multi-Function Controller Module (IMMFP01)	I-E96-201
Multi-Function Controller Module (NMFC03)	I-E93-906-7
Multi-Function Controller Module (NMFC04)	I-E93-906-12
Multi-Function Controller Module (NMFC05)	I-E93-906-13
Hydraulic Servo Slave Module (IMHSS01)	I-E96-315
Digital Input Termination Unit (NTDI01)	I-E96-424
Digital Input Termination Module (NIDI01)	I-E96-410

RELATED HARDWARE

Hardware	Nomenclature
Multi-Function Processor Module	IMMFP01/02/03
Multi-Function Controller Module	NMFC03/04/05
Hydraulic Servo Slave Module	IMHSS01
Termination Module, Digital Input	NIDI01
Termination Unit, Digital Input	NTDI01
Cable, IMFCS01 to ITIDI01	NKTM01, NKTU02
Cable, IMFCS01 to ITTIDI01	NKTU01

SPECIFICATIONS

General	
Microprocessor	MC68701 with 2k EPROM, 128 bytes RAM, 16 bit internal timer
Process I/O	1 frequency input (from termination unit)
System Communications	8 bit parallel
Operating	
Input Voltage Range	300 mVp-p to 120 Vrms (150 mVp to 170 Vp)
Input Frequency Response	1 Hz to 12.5 kHz
Accuracy	±0.25 Hz @ 1 Hz to 5 kHz ±0.50 Hz @ 5 kHz to 10 kHz ±0.63 Hz @ 10 kHz to 12.5 kHz
Resolution	24 bits
Module Time Base **Frequency** **Accuracy** **Count**	 1 MHz 0.005% ±1 of time base
Electrical	
Operating	+5 VDC @ 241 mA +15 VDC @ 6.88 mA -15 VDC @ 5.39 mA
Consumption	1.2 watts @ +5 VDC 185 milliwatts @ ±15 VDC
Surge Protection	Meets IEEE-472-1974 Surge Withstand Capability Test
Environmental	
Electromagnetic/ Radio Frequency Interference	No values available at this time. Keep cabinet doors closed. Do not use communication equipment closer than 2 meters from the cabinet.
Ambient Temperature	0^{o} to 70^{o} C (32^{o} to 158^{o} F)
Humidity	5% to 90% RH (±5%) up to 55^{o} C (non-condensing) 5% to 40% RH (±5%) at 70^{o} C (non-condensing)
Atmospheric Pressure	Sea level to 3 km (1.86 miles)
Air Quality	Noncorrosive
Certification	
CSA certified for use as process control equipment in an ordinary (nonhazardous) location.	

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

SECTION 2 - THEORY OF OPERATION

INTRODUCTION

This section explains the operation of the frequency counter slave. It gives an overview of the frequency counter slave module and related modules within a process control system and explains the operation of the module circuitry.

CONTROL LOOP OPERATION

The Frequency Counter Slave (FCS), Hydraulic Servo Slave (HSS) and Multi-Function Processor (MFP) form the controlling segment of a closed loop system for turbine speed control. The MFP is the master module and directs the control process. The FCS and HSS are slaves that interface the process to the MFP. Figure 2-1 shows a diagram of the turbine speed control loop and the control signals to and from the process.

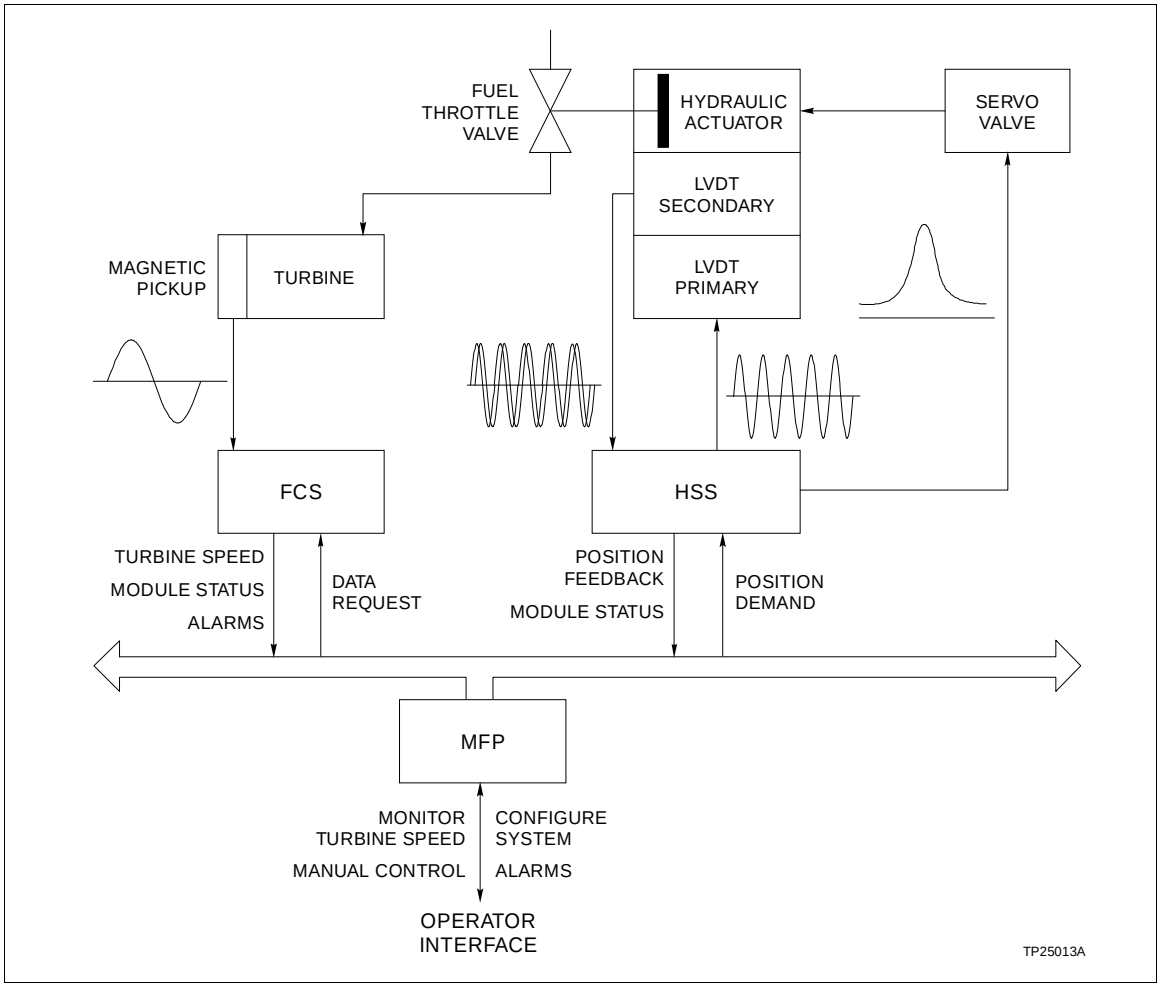

Figure 2-1. Turbine Speed Control Loop

Frequency Counter Slave

The FCS detects turbine rotation by counting pulses it receives from a magnetic pickup on the turbine shaft. Additionally, it keeps a 24 bit timer value corresponding to the period of the pulse count. It stores these values in a buffer and sets a data available status bit to notify the MFP that it has current data. FCS operation is automatic. It continuously updates the count and holds it for the MFP.

For the MFP to work with the FCS, it requires Function Code 145 in its configuration. Function Code 145 defines the slave address, high/low speed alarms and high/low rate of change alarms. The block output is frequency in hertz. The frequency counter slave continuously checks itself and notifies the MFP if a failure occurs.

Hydraulic Servo Slave

The HSS provides control of servo valves in a turbine speed control system. The MFP sends data to the hydraulic servo slave which directs the control of a hydraulic actuator (via the servo valve). By sending a position demand to the HSS, the MFP initiates a change in turbine speed. The position demand travels over the slave expander bus to the HSS. An on-board microcontroller reads the demand and loads it into a D/A converter. The resulting analog value drives the servo valve. The servo valve loads hydraulic fluid to one side of a double acting hydraulic actuator. The hydraulic actuator opens or closes a fuel throttle valve to change the turbine speed.

For the MFP to work with the HSS it requires Function Code 150 in its configuration. Function Code 150 defines the slave address, mode of operation (calibration or normal), calibration cycle time and stores calibration data. The twelve output blocks include actuator position, LVDT null position, and status outputs for the module and process equipment.

A linear variable differential transformer measures actuator position. The HSS supplies a 1000 Hz excitation voltage on the primary side of the LVDT. The secondary of the LVDT develops a differential voltage proportional to the position of the hydraulic actuator. The HSS converts the differential voltage to digital data and sends it to the MFP. Using the data the HSS stores (during valve calibration) in its configuration specifications (S8-S9), it translates the LVDT secondary differential voltage into actuator position feedback. The HSS is self checking and notifies the MFP if a failure occurs.

The operator can initiate manual control of the turbine throttle valve if a HSS communication failure occurs. The HSS provides inputs that the user hard wires to a +24 VDC source. The operator directs the HSS to raise or lower the actuator through

external inputs (pushbuttons, contacts, etc.). Also, a trip bias circuit on the HSS allows the operator to manually drive the fuel throttle valve to the closed position in an emergency.

Multi-Function Processor

The MFP is the master module of the control loop and controls turbine speed automatically. The MFP requests data from the FCS to calculate turbine speed. If the FCS has data available, it sends it to the MFP. If there is no data available the MFP must make another request. If the turbine speed goes above or below the speed limit set in the MFP configuration, the MFP will send a position demand to the HSS to adjust the fuel throttle valve. This process repeats continuously at the cycle time of the MFP.

The user sets the turbine speed limits and high/low speed alarms during configuration of the MFP and slave modules. Additionally, the user calibrates the hydraulic actuator and LVDT. The MFP sends data, module status and alarms to the operator interface during normal operation. The operator can monitor system operation and initiate automatic or manual control through the operator interface.

FCS MODULE OPERATION

The FCS interfaces the MFP to a steam or gas turbine, providing the MFP with turbine speed data. The FCS microcontroller (MCU) carries the work load. It is able to perform multiple tasks with the help of the module support circuitry. The MCU provides the intelligence (firmware) needed to count and time input pulses, update process data buffers, do self check diagnostics and give module status information. The MFP retrieves data from the FCS without interrupting the counting and updating process. Therefore the most current values are available. There are eight functional blocks (see Figure 2-2):

Microcontroller (MCU)
Input Signal Conditioning
Module Status (MOD STAT)
Watchdog
Storage Areas (Doubled Buffered and Latched Data)
Sequencing Logic
Slave Expander Bus Address (XBUS ADD)
Slave Expander Bus Interface (XBUS I/O)

All the blocks of the support circuitry work together to condition the input, time the input, write to buffers and communicate with the master module. Power enters the board by way of the module mounting unit backplane.

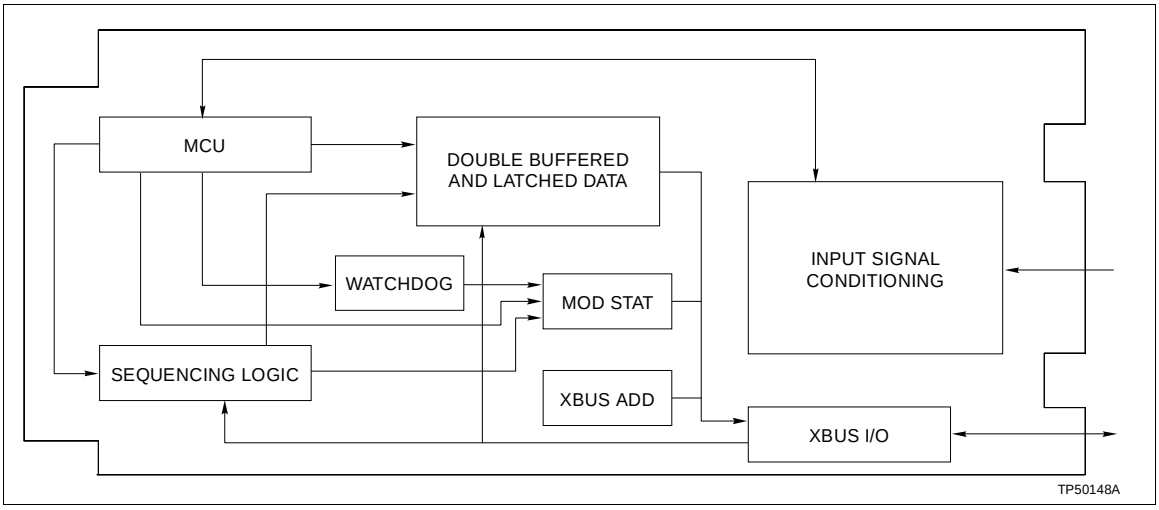

Figure 2-2. Block Diagram - FCS Module

The input enters the board via the P3 connector. The input signal conditioning circuit chops and squares the AC input into TTL digital levels, making it electrically compatible with the MCU. This digital signal is fed to the MCU interrupt. As the microcontroller detects pulses, it increments the event counter and memorizes the count in an internal timer. After a 20 ms period, the MCU writes the count and time interval value to the double buffered storage area and sets a status bit to tell the MFP current data is available. The data is double buffered such that the MCU will not overwrite current data when the MFP is reading that data. The MFP clocks the data from the doubled buffered storage area to the slave expander bus interface when it is ready to receive count and timer information. The sequencing logic prevents the MCU and MFP from accessing the storage area simultaneously. The MCU posts the module status in the module status buffer. Module status is always available to the processor module through the slave expander bus interface.

FCS MODULE CIRCUITRY

The following text explains the operation of the eight functional blocks that make up the frequency counter slave module.

Input Signal Conditioning

The FCS receives the input signal through its cable connection to the termination unit. The incoming signal is an analog waveform. The input signal conditioning circuit changes the analog input into a digital input usable by the MCU. Figure 2-3 shows the input signal conditioning circuit and how the circuit converts input signals into a digital waveform.

Figure 2-3 is a typical example of a sinusoidal input signal (E1). Diodes CR4-CR7 clip the input signal at ±10 V limiting the input amplitude to 20 Vp-p (E2). R4 through R7 limit the inrush current. This circuit can process input signals that range from 300 mVp-p to 120 Vrms at frequencies in the range of 1 Hz to 12.5 KHz.

The comparator works as a zero crossing circuit. It converts the input signal to a digital waveform (E3). A high frequency filter (R4,R5,C3) removes noise from the input signal before reaching the comparator (operational amplifier).

The NAND gate provides gating for the input enable function. No input signal can pass until the MCU is ready to count and process data from the field.

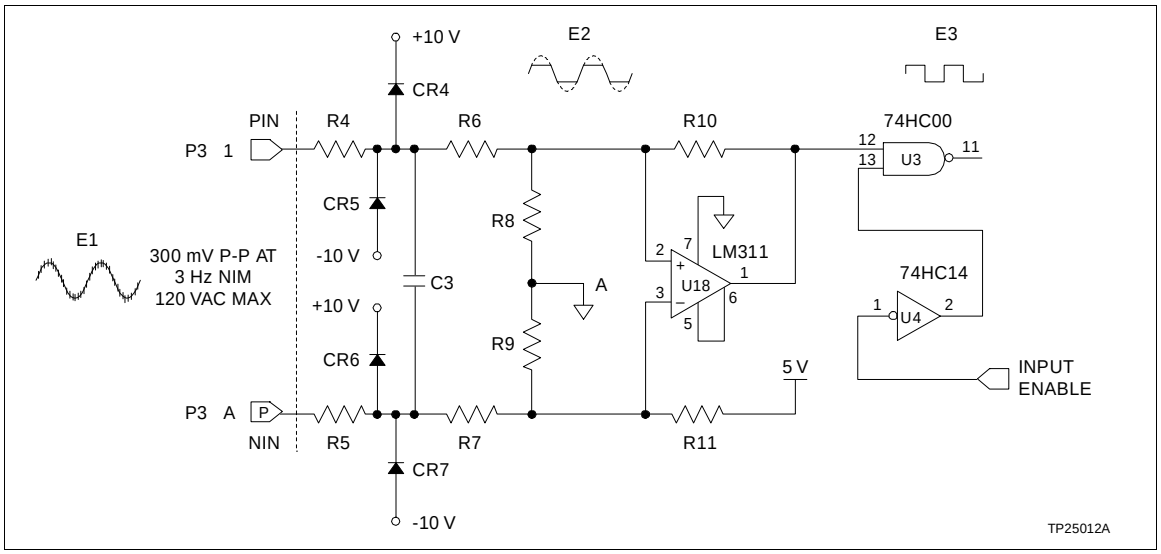

Figure 2-3. Input Signal Conditioning Circuit

Microcontroller

The microcontroller (MCU) is responsible for collecting data, timing the data and communicating with the MFP. Residing in the MCU is the firmware that directs the FCS operation. The MCU counts pulses at the interrupt level. When the MCU interrupt is ready to receive input pulses, it enables an input gate to allow data to pass. An internal program in the MCU compiles the count and formats it for the processor module. The MCU sends the count and timer information to the double buffered storage area.

Data from the MCU goes to the first set of buffered latches. A data request from the MFP transfers data from the buffered latches to the slave expander bus interface.

Status bits set by the MCU control the transfer of information and inform the MFP of module status. If the input signal is lost, the MCU tells the processor module by generating a status bit. The MCU sends the bit to the Module Status Block (MOD STAT). The MFP reads the module status block for the FCS status. The MCU generates a data available status bit when it has data for the processor module. It also provides the 20 millisecond clock to reset the watchdog timer. Additionally, the MCU performs checksum diagnostics as a background task.

Storage Areas

There are two 32 bit (4 bytes) buffered latch storage areas. Their function is to hold and stage data that is available for the process module. The double buffer allows the MFP to retrieve data without interrupting the MCU from the counting process. The double buffer insures that the data being read is current; not a mixture of the previous count and the current count. The MCU loads the first buffer one byte at a time. When the data transfers to the second buffer, all four bytes of data move in a group.

Sequencing Logic

The sequencing logic block controls the transfer of data in the buffers. There are four bytes of data latched in the storage area. The MFP transfers data from the second buffered latch to the slave expander bus interface by requesting bytes in a logical sequence. The MCU continues to clock new data into the buffered latches. The sequencing logic prevents the second buffer from receiving data from the first buffer when the MFP is clocking data to the slave expander bus. It monitors processor module activity (slave expander bus communication) and transfers data to the second buffer when there is no activity on the slave expander bus.

Watchdog Timer

The watchdog timer verifies the status of the module. As long as the MCU is processing code internally it outputs a 20 millisecond clock. The timer must sense the 20 millisecond clock from the MCU or it expires and sets a status bit, warning the processor module of a MCU failure. The processor module automatically resets the FCS if operation stops because of a watchdog timeout.

Module Status

The module status block handles all module status messages from the MCU and holds them in a buffer on the slave expander bus interface for the processor module to read. The three module status bits are data available, data loss and watchdog timeout.

Data Available The MCU sends the data available status bit to the module status block when it has data for the MFP. When the MFP reads the status block and sees the data available bit set, it can send a data request to the FCS.

Input Loss The MCU communicates to the status block that the input signal is lost. The MFP knows that there is no data available when it reads this status bit. The input signal may be temporarily lost when an abrupt change in the input signal frequency occurs or the input frequency drops below 1 Hz. Operation returns to the beginning of the process cycle and repeats until the MCU recovers the signal.

Watchdog Timeout This status bit warns the MFP of a MCU failure. The watchdog timer constantly monitors the 20 millisecond clock from the MCU. The status bit is set when the clock fails to reset the watchdog timer.

Slave Expander Bus Interface and Address Buffer

The slave expander bus interface block provides the circuitry that enables communication between the processor module and the FCS. A Bailey designed integrated circuit provides a data bus for interfacing the storage area and the module status buffer to the processor module. This block follows the Bailey designed protocol for master/slave communications. It performs address compare, R/W strobe generation and contains bus drivers and receivers.

The operator selects the slave expander bus address by setting a dipswitch on the FCS. The address byte precedes every data transfer between the FCS and the MFP. The slave expander bus integrated circuit enables the address buffer and does an address comparison before allowing data to transfer to the slave expander bus. If the addresses match, the MFP can strobe data to the slave expander bus.

SECTION 3 - INSTALLATION

INTRODUCTION

This section covers the proper handling of electrostatic sensitive devices, slave module installation and configuration. Read and do the steps in this section before placing the Frequency Counter Slave (FCS) into operation. Refer to Section 1 (Related Documents) for a list of documents needed to configure the MFP to function with the FCS.

HANDLING

NOTICE	**Always use Bailey's Field Static Kit (Kit P/N 1948385A2 - consisting of wrist strap, ground cord assembly and alligator clip) when working with modules. The kit is designed to connect a technician and the static dissipative work surface to the same ground point to prevent damage to the modules by electrostatic discharge.**

Special Handling

The slave uses Electrostatic Sensitive Devices (ESD). Follow these handling procedures:

1. Always wear the wrist ground strap when handling any circuit board.

2. Keep the module in the special anti-static bag until you are ready to install it in the system. Save the bag for future use.

3. Ground the anti-static bag before opening.

4. Verify that all devices connected to the module are properly grounded before using them.

5. Avoid touching the circuitry when handling the modules.

General Handling

1. Examine the module immediately to verify that no damage has occurred in transit.

2. Notify the nearest Bailey Controls Sales Office of any damage.

3. File a claim with the transportation company for any damage to the shipment.

4. Use the original packing material and container to store the module.

5. Store the module in an environment of good air quality, and free from temperature and moisture extremes.

INSTALLING THE TERMINATION UNIT/MODULE AND FIELD WIRING

For information about installing process wiring and the digital input termination unit (TDI) or the digital input termination module (IDI), refer to the TDI or IDI termination instruction. To install the termination unit or module and field wiring:

Termination Unit Installation

1. Install the magnetic pickup according to the manufacturer's directions.

2. Configure the dipshunt on the termination unit. (Refer to the TDI instruction I-E96-424 for dipshunt settings.)

3. Install the termination unit on the termination mounting panel and secure into place.

4. Connect the wiring from the magnetic pickup to the termination unit.

5. Connect the hooded end of the NKTU01 cable to the rear of the Module Mounting Unit (MMU) slot for the FCS. Connect the other end of the cable to the P1 connector on the termination unit.

Termination Module Installation

1. Install the magnetic pickup according to the manufacturer's directions.

2. Configure the jumpers on the termination module. (Refer to the IDI instruction I-E96-410 for jumper settings.)

3. Connect one end of NKTM01 or NKTU02 cable to the rear of the Termination Mounting Unit (TMU) slot for the termination module. Connect the other end of the cable to the rear of the MMU slot for the FCS.

4. Insert the termination module in assigned slot of the TMU leaving the terminals for process wiring exposed.

5. Connect the wiring from the magnetic pickup to the termination module.

6. Push the module into the TMU until it seats in the termination module connector.

SETTING THE SLAVE EXPANDER BUS ADDRESS

The FCS must have its slave expander bus address set to be able to communicate with the processor module. The user can select an address for the FCS from 0 to 63. The address is set with switch SW1, an 8-pole dipswitch. Poles 1 and 2 ***must be*** set to 0 (closed or on). Pole 3 has a binary value of 32. Pole 8 is the least significant bit with a binary value of 1 (open or off). See Figure 3-1 for the dipswitch location. Refer to Table 3-1 for examples of address settings. Record your address in the user setting column.

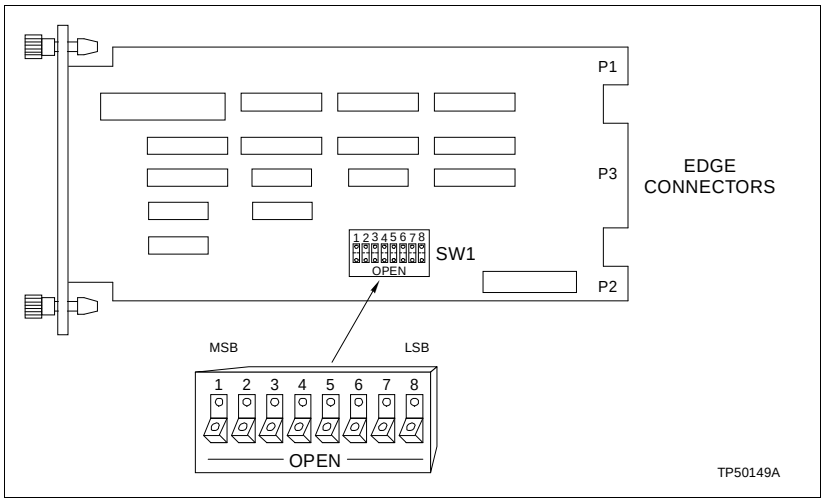

Figure 3-1. Switch SW1 - Slave Expander Bus Address

Table 3-1. Slave Expander Bus Address Examples

Example Settings									
Address Example	Switch Position	1	2	3	4	5	6	7	8
	Binary Value	128	64	32	16	8	4	2	1
15		0	0	0	0	1	1	1	1
32		0	0	1	0	0	0	0	0
63		0	0	1	1	1	1	1	1

User Settings									
User Assigned Address	Switch Position	1	2	3	4	5	6	7	8
	Binary Value	128	64	32	16	8	4	2	1

INSERTING THE FCS IN THE MODULE MOUNTING UNIT

To install the module in the module mounting unit:

1. Verify the module mounting unit slot assignment for the module.

2. Check the slave expander bus dipshunt socket on the backplane of the MMU. The dipshunt must be installed with all pins shorted. This provides a communication path from the master module to the slave module.

3. Guide the top and bottom edges of the circuit card along the top and bottom rails of the MMU.

4. Slide the module into the slot. Push until the module is seated in the backplane connector. Turn the two thumbscrews on the faceplate a half turn until the module locks in place.

CONFIGURATION

The controller or processor module must have Function Code 145 in its configuration to be able to communicate with the FCS. Configure the controller before attempting to operate the FCS. Refer to the Function Code Applications Manual E93-900-20 for information about Function Code 145.

Function Code Specifications

The Function Code Applications Manual lists the function code specifications, output blocks and configuration information. The operation/configuration manual for the operator interface you are using lists configuration instructions. Refer to those manuals for specific information about the steps listed below.

1. Determine the specification settings for Function Code 145 in advance.

2. Reserve four blocks for the outputs of Function Code 145.

3. Choose the specifications that will configure the MFP to properly interface the FCS in the system.

4. Enter the configuration into the system.

EDGE CONNECTOR PIN ASSIGNMENTS

Tables 3-2 through 3-4 show the pin assignments for the module connectors.

Table 3-2. Edge Connector P1 (Module Power) Pin Assignments

Pin	Signal	Pin	Signal
1	+ 5 V dc	2	+ 5 V dc
3	Unused	4	Unused
5	Common	6	Common
7	+ 15 V dc	8	- 15 V dc
9	PFI	10	PFI
11	Unused	12	Unused

Table 3-3. Edge Connector P2 (Slave Expander Bus) Pin Assignments

Pin	Signal	Pin	Signal
1	Data Bit 1	2	Data Bit 0
3	Data Bit 3	4	Data Bit 2
5	Data Bit 5	6	Data Bit 4
7	Data Bit 7	8	Data Bit 6
9	Clock	10	Sync
11	Unused	12	Unused

Table 3-4. Edge Connector P3 (Process Interface) Pin Assignments

Pin	Signal	Pin	Signal
1	Input +	A	Input -
2	N/C	B	N/C
3	N/C	C	N/C
4	N/C	D	N/C
5	N/C	E	N/C
6	N/C	F	N/C
7	N/C	H	N/C
8	N/C	J	N/C
9	N/C	K	N/C
10	N/C	L	N/C
11	N/C	M	N/C
12	N/C	N	N/C
13	N/C	P	N/C
14	N/C	R	N/C
15	N/C	S	N/C

SECTION 4 - OPERATION

INTRODUCTION

This section contains information about Frequency Counter Slave (FCS) operation. The FCS requires no operator action. Completing the instructions in Section 3 assures successful start-up and operation.

START-UP PROCEDURES

FCS module start-up is fully automatic. When the FCS comes on line, the MFP establishes communication with it.

At the segment cycle time, the processor module polls the FCS for information. If the FCS has data available, the MFP can request that information.

NORMAL OPERATING PROCEDURES

The on-board microcontroller controls the FCS operation. There are no user actions during normal operation. Operation is fully automatic.

The processor module continuously monitors the FCS status. The following situations result in bad status for the FCS:

1. There is a sudden loss of the pulse input source.

2. The FCS microcontroller fails.

If either occurs, the processor module generates a module problem report to the user's interface device. Refer to Section 5 for troubleshooting information if the frequency counter slave fails to start and come on line.

SECTION 5 - TROUBLESHOOTING

INTRODUCTION

This section contains information about troubleshooting frequency counter slave failures. It explains troubleshooting procedures using text, flowcharts and reference documents.

HOW TO USE THIS SECTION

The operator can effectively troubleshoot a failure by using the flowcharts to isolate the failure. After locating the failure, refer to the text or other documents for more information about the failure and the corrective action. You will need product instructions for the controller or processor module, the operator interface (i.e., OIS, PCV, CTM/CTT) and the Function Code Applications Manual. Contact the manufacturer for information about the magnetic pickup.

The first part of this section covers installation and start-up failures. If the failure is preventing module start-up, go to the ***START-UP FAILURES*** paragraphs and the steps of the troubleshooting procedure. The second part covers failures during operation. If the failure occurs during operation, go to the ***ON-LINE FAILURE*** paragraphs and the steps of the troubleshooting procedure.

NOTICE

Troubleshooting involves physical contact with the system, including the handling of boards with electrostatic sensitive devices. To avoid creating additional problems while troubleshooting, always use Bailey's Field Static Kit (P/N 1948385A2) when working with the modules. The kit is designed to connect a technician and the static dissipative work surface to the same ground point to prevent damage to the modules by electrostatic discharge.

START-UP FAILURES

Configuration Errors

This part of the troubleshooting section covers start-up failures that occur as a result of module configuration errors. Figure 5-1 shows a troubleshooting flowchart for configuration errors. If the Frequency Counter Slave (FCS) fails to come on-line after completing the installation:

1. Look for configuration errors by checking the LEDs (binary codes) on the processor module.

2. Refer to the instruction manual for the processor module for a list of error codes and corrective action.

3. If the FCS continues to fail to start and there are no configuration errors, go to the hardware failure troubleshooting procedure.

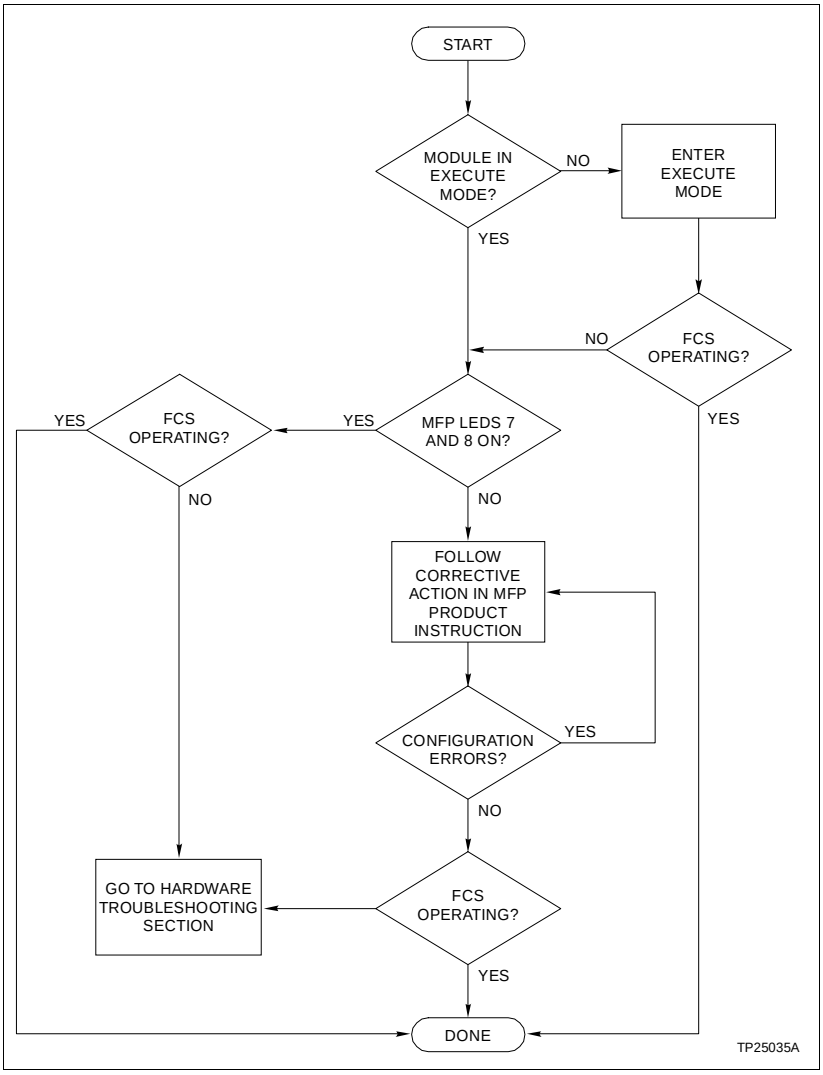

Figure 5-1. Configuration Error Troubleshooting Flowcharting

Hardware Failure

This part of the troubleshooting section covers start-up failures that do not appear as configuration errors and how to troubleshoot those failures. Hardware failures are a result of incomplete or incorrect installation of the related FCS hardware or a failure of the FCS module.

The operator interface will display an error message if there is a hardware failure. If the operator interface is an OIS, the operator can access the Module Problem Report (MPR). The OIS displays a NOT RESPONDING message in the MPR when there is a hard failure or the processor module receives BAD QUALITY from the frequency counter slave. Refer to the OIS Product Instruction for information explaining how to access the module problem report. For instructions to access error messages on other operator interfaces (i.e. PCV, CTM, CTT) refer to the instruction manual for those devices.

To troubleshoot a hard failure:

1. Use the flowchart in Figure 5-2 to find the location of the hard failure.

2. Refer to Table 5-1 for corrective action.

3. If there are no configuration errors or hard failures and the FCS continues to fail to start, replace the FCS module.

4. If replacing the module does not correct the problem, call Bailey Controls Company for assistance.

Table 5-1. Troubleshooting FCS Start-Up Failures

Problem	Cause	Action
FCS fails to start	Module not in the execute mode	Place module in the execute mode.
	Configuration errors	Check the operator interface for error messages.
		Refer to the operator interface instruction and Function Code Applications Manual for corrective action.
FCS fails to start and there are no configuration errors.	Module not in the execute mode	Place the module in the execute mode.

Table 5-1. Troubleshooting FCS Start-Up Failures (continued)

Problem	Cause	Action
FCS fails to start and there are no configuration errors. (continued)	Improper installation	Verify proper installation of FCS module and related hardware. 1. Check the Slave expander Bus dipshunt. All the dipshunt pins should be shorted. 2. Check the slave expander bus address setting on SW1 of the FCS. SW1 should be the same value as S1 of Function Code 145. 3. Reinsert the module in the MMU. 4. Check the Termination Unit cable. The cable should connect the FCS (MMU slot) to the TU. 5. Verify the correct dipshunt configuration on the Termination Unit. 6. Verify the magnetic pickup is connected to the correct terminals on the TU. 7. Check the magnetic pickup installation.
	Magnetic pickup failure	Check the input signal from the magnetic pickup. 1. Connect an oscilloscope to the input terminals on the termination unit. Verify there is a signal from the magnetic pickup. 2. If there is no signal from the magnetic pickup, check the continuity of the cables connecting the pickup to the termination unit. 3. Replace any open cable or cables having an unusually high impedance. 4. Replace the magnetic pickup if there is no input signal and the cable continuity checks good.
FCS fails to start and the related hardware installation is correct with no configuration errors.	FCS module failure	Replace the Frequency Counter Slave Module.
The replacement FCS fails to start and all other areas check good.		Call Bailey Controls Company for assistance.

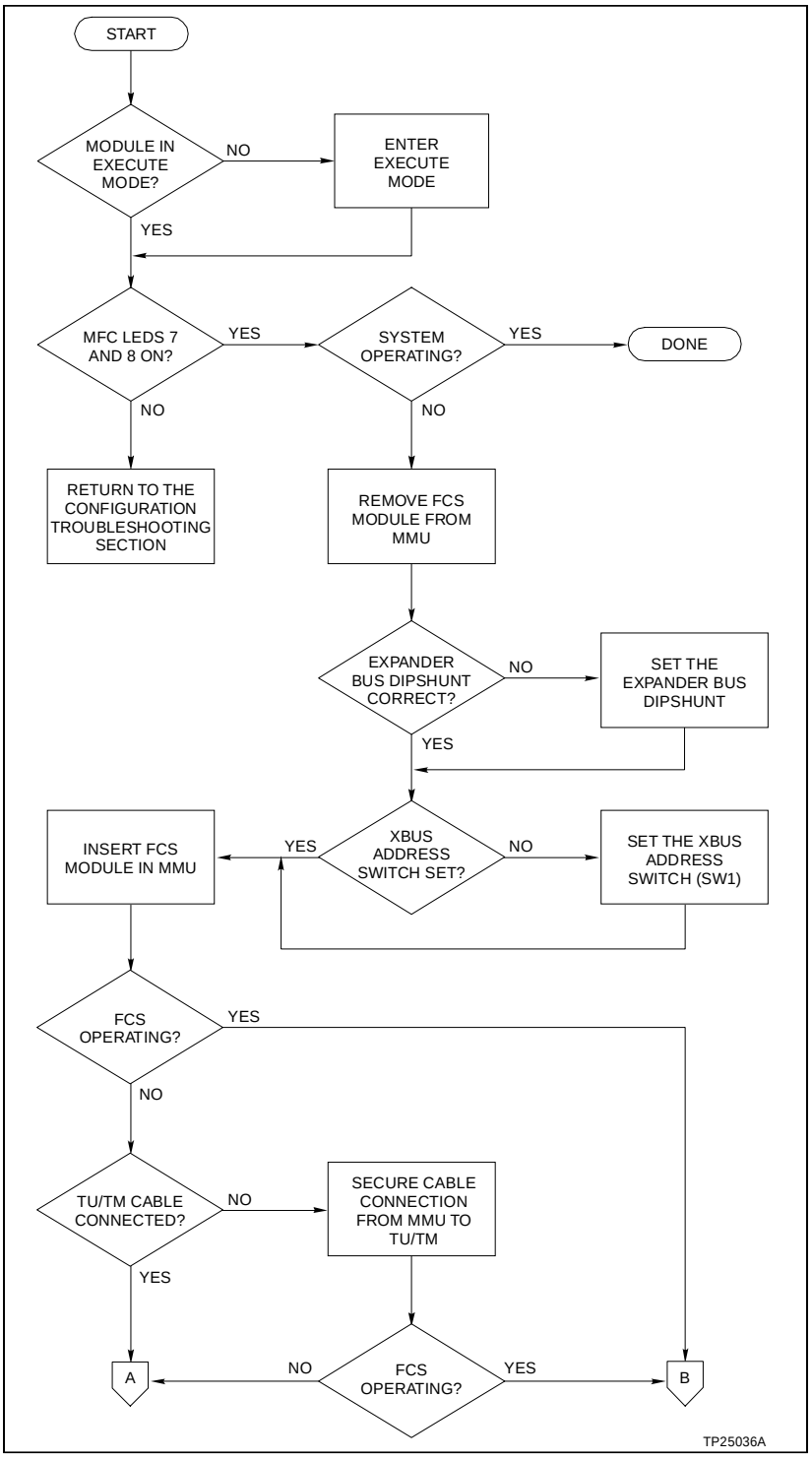

Figure 5-2. Hardware Failure Troubleshooting Flowchart

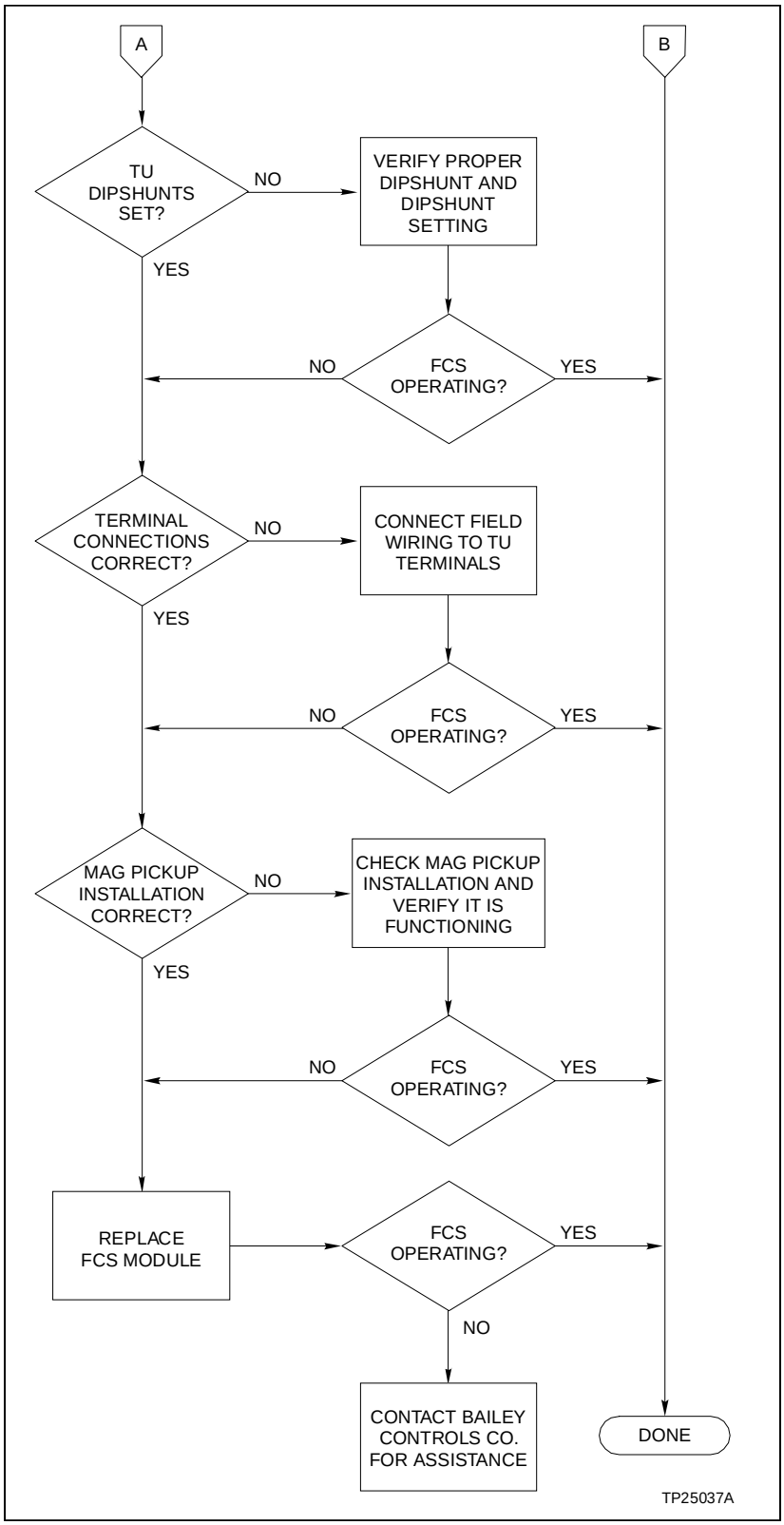

Figure 5-2. Hardware Failure Troubleshooting Flowchart (continued)

ON-LINE FAILURE

This part of the troubleshooting section covers failures that occur while the FCS is on-line and how to troubleshoot those failures. On-line failures are a result of hardware failure, loss of input signal, bad quality or the input signal is outside of the operating specifications. See Figure 5-3 for an on-line troubleshooting flowchart. Table 5-2 lists error messages, causes and corrective action. For a listing of error messages on other operator interfaces (i.e., PCV) refer to the instruction manual for those devices.

To correct an on-line failure:

1. Monitor the operator interface for error messages by checking the module problem report.

2. Follow the corrective action in Table 5-2 that applies to the error message.

3. If your operator interface is a configuration and tuning terminal/module monitor Function Code 145 output block n + 3. A 1 in function code 145 block output n + 3 indicates bad quality while a 0 indicates good quality.

4. For bad quality, go the Table 5-2, find bad quality in the cause column, and follow the corrective action listed.

Table 5-2. Troubleshooting FCS On-Line Failures

Error Message	Cause	Corrective Action
Not Responding	Bad Quality	Reseat the FCS module. 1. Turn the two thumbscrews on the module faceplate counterclockwise to release the module. 2. Grasp the module at the bottom of the faceplate and pull the module away from the backplane until it releases from the backplane connector. 3. Insert the module in the same MMU slot. 4. Push on the module faceplate until the module seats in the backplane connector. 5. Turn the two thumbscrews on the faceplate clockwise until the module is locked in place.
	Watchdog Timeout	Replace the FCS module. 1. Turn the two thumbscrews on the module faceplate counterclockwise to release the module. 2. Grasp the module at the bottom of the faceplate and pull the module out of the MMU. 3. Insert a replacement module that is known to be functioning properly in the same MMU slot. 4. Push on the module faceplate until the module seats in the backplane connector. 5. Turn the two thumbscrews on the faceplate clockwise until the module is locked in place.
Out Of Range	Loss of input due to abrupt change of signal	No action. The FCS should adjust to change as it continues to cycle. The FCS automatically recovers signal.

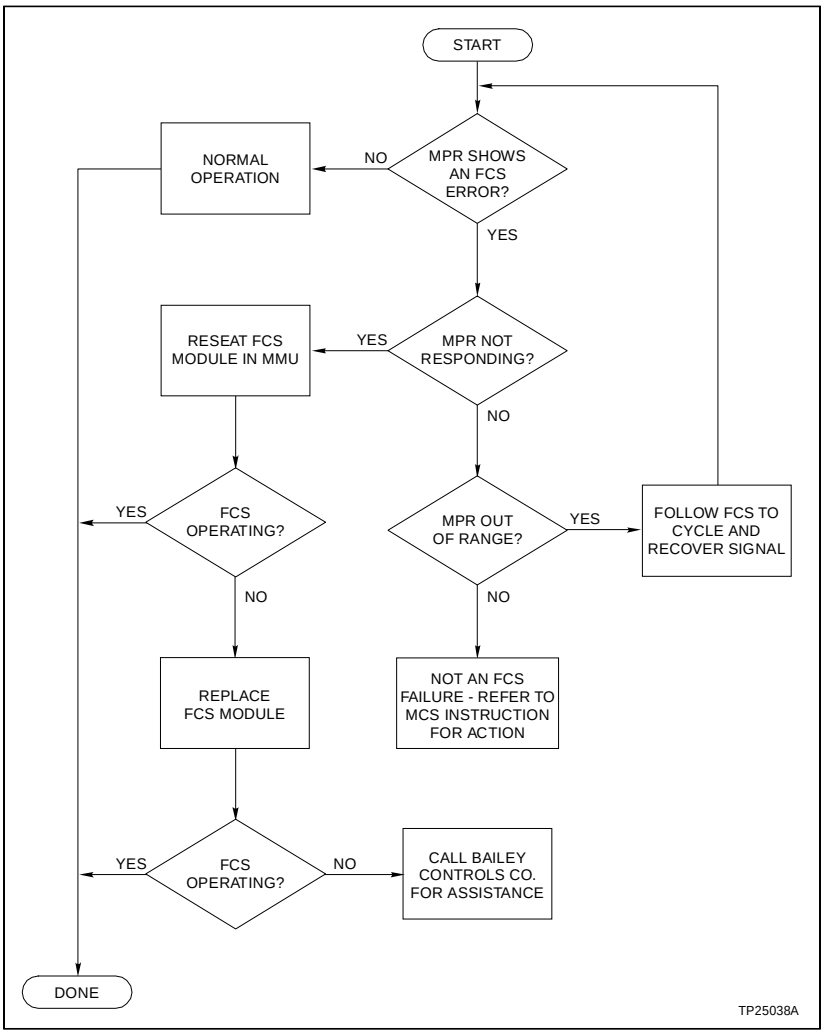

Figure 5-3. On-Line Failure Troubleshooting Flowchart

SECTION 6 - MAINTENANCE

INTRODUCTION

The frequency control slave requires minimal maintenance. The following maintenance schedule will ensure troublefree service.

NOTE: Only qualified personnel should perform maintenance.

MAINTENANCE

The FCS maintenance schedule is shown in Table 6-1. Perform these tasks at the specified intervals.

Table 6-1. Maintenance Schedule

Task	Interval
Use static safe vacuum cleaner to remove dust from: Modules Module Mounting Unit	Every 6 months or at plant shut-down, whichever occurs first.

REPAIR/REPLACEMENT PROCEDURES

The frequency control slave is designed for long, troublefree service. There are no parts on the FCS that the user can service. If a failure occurs, refer to Section 5 for information to restore operation.

SECTION 7 - SUPPORT SERVICES

INTRODUCTION

Bailey Controls is ready to assist in the use and repairs of its products. Requests for sales and/or applications services along with installation, repair, overhaul and maintenance contract services should be made to the nearest sales office.

REPLACEMENT PARTS AND ORDERING INFORMATION

If you are making repairs at your own facility, replacement parts should be ordered through a Bailey sales office. Provide the following information for parts orders:

1. Part description, part number and quantity.

2. Model, serial number (if applicable) and ratings of the assembly containing the ordered part.

3. Bailey publication number and reference used in identifying the part.

When ordering standard parts from Bailey Controls, use the part number and description from the Replacement Parts section of the manual. Parts not having a commercial description in the Replacement Parts section must be ordered from a Bailey Controls sales office.

TRAINING

Bailey Controls has a modern training facility equipped to provide service and repair instructions. This facility is available for in-plant training of your personnel. Contact a Bailey Controls sales office for information on available classes and scheduling.

TECHNICAL DOCUMENTATION

Obtain additional copies of this manual through the nearest Bailey sales office. Extra copies are available at a reasonable charge.

Visit Elsag Bailey on the World Wide Web at http://www.bailey.com

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