Owner's Hardware Service Manual

Frank Control Computer System

Revision 0105

ABOUT THIS MANUAL

This section describes the contents of this manual and how to use this manual effectively. It was designed for a wide range of different types of users.

Manual Overview

This manual is divided into the following sections:

Section 1.0 – ***Introduction*** product features, list of all components.
Section 2.0 – ***Component Description*** describes the use of each component along with a picture.
Section 3.0 – ***Technical Theory*** explains the general electronic theory and appropriate connections for each component.
Section 4.0 – **Troubleshooting**

How To Use This Manual

Your Frank Control Computer System Operating manual is both a reference book and a tutorial of how to solve some common problems.

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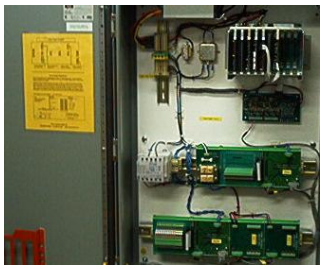
INTRODUCTION

Thank you for purchasing a Frank Control Computer System. You made an excellent choice for performance, reliability, and value. Your Frank Control Computer System uses a high performance Z80 CPU and 8085 CPU. An 8051 micro controller is used to read in all the digital temperatures; freeing time for the main processors to do more important things. The Frank Control Computer System talks to a PC to allow for a user-friendly control interface. It also talks to an Allen Bradley PLC that handles all the I/O's. Here are some of the professional features of your new Frank Control Computer System.

Features

- Up to 48 Isolated Digital Temperatures per Kiln
- Easy Temperature Probe Replacement
- Control up to 5 Kilns per System
- Triple Processor Computer System
- Battery Back Up and Real Time Clock
- Power Fail Monitor and Watchdog Timer
- RS232 communication to Allen Bradley PLC
  -80 inputs, 32 outputs, and 32 analog outputs
- RS232 communication to PC



Note: Each cabinet is customize depending on the kilns design

Main Components

Note: Components included depend on the Kilns needs. All components and connections are defined in the Operating instructions of this manual.

- 110-Volt / 220-Volt Power Supply Board
- Programmable Data-Acquisition Temperature Board (DAQT)
- Bulb Connection Board
- Eprom Card
- CPU Card

- Power Fail Card
- Battery Back-Up Card
- Digital Temperature Card (DIGT)
- Digital to Analog Board
- Isolation Board
- ATX Power Supply
- Hammond 166F16
- Curtis Line Filter

COMPONENT DESCRIPTION

This section has been designed to assist the user in understanding how the Frank Control Computer System functions. It shows a picture of each component with a description about its use.

110-Volt / 220-Volt Power Supply Board supplies 12V AC to the regulator on the Data-Acquisition board. Note: See Installation Instructions for 220-Volt operation.

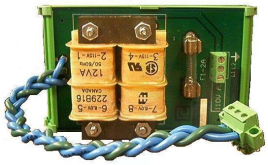


Figure 1 Power Supply Board

WARNING !!! Power Supply is shipped as a default of 110-Volt operation

Programmable DAQT Board holds the firmware that determines the functions of the Data Acquisition System.

Figure 2 Data-Acquisition Temperature Board

Bulb Connection Board allows connection of digital devices.

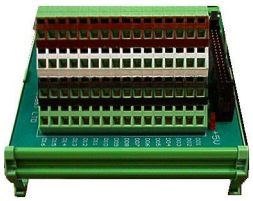


Figure 3 Digital Connection Board

40-Pin Bus Cable connects the Bulb Connection board to the DAQT board.

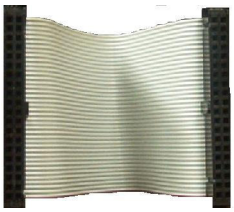


Figure 4 40-Pin Bus Cable

6 Pin Serial Communication Connector allows connection to the serial communication on the DAQT Board.

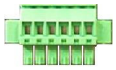


Figure 5 Serial Communication Connector

Eprom Card holds the main program that runs the kilns.

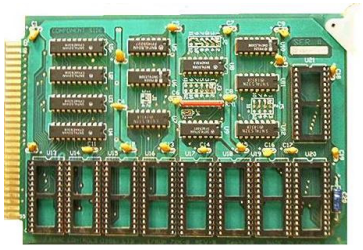


Figure 6 Eprom Card

SIO Card converts parallel data from the STD bus to serial data. The ports the Frank Control Computer System uses to talk with the PC and PLC.

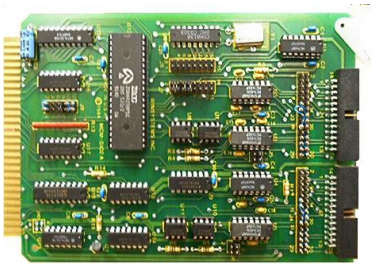


Figure 7 SIO Card

CPU Card The Motherboard that controls all the other cards. Runs the program in the Eprom Card.

Figure 8 CPU Card

Power Fail Card Monitors the power line.

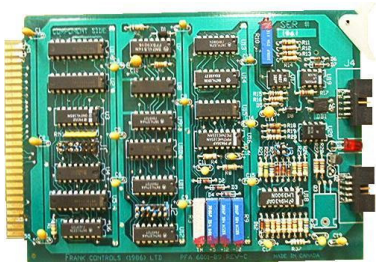


Figure 9 Power Fail Card

Battery Back-Up Card Holds the RAM that the Frank Control Computer System uses. A real time clock chip allows the computer to keep track of time. Contains a battery to hold memory in the RAM on a power failure.

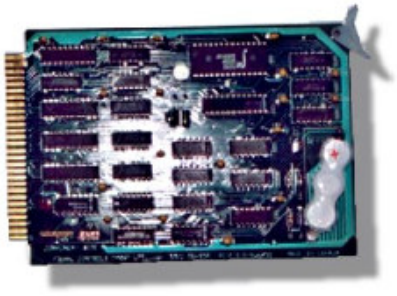


Figure 10 Battery Back-Up Card

DIGT Card Holds the program that allows communication through the Isolation board to the DAQT boards.

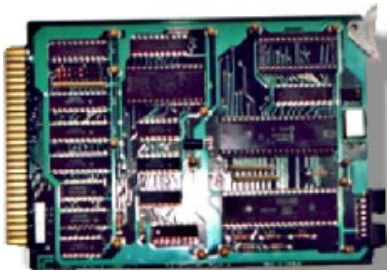


Figure 11 Digital Temperature Card

DAC Board Converts serial data from the DAQT board to eight 4-20mA analog output channels.

Figure 12 Digital to Analog Board

Isolation Board Optically isolates the Digital Temperature card from the Data-Acquisition Temperature System.

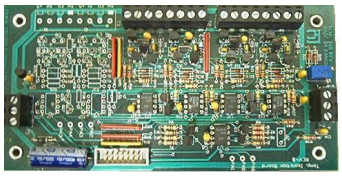


Figure 13 Isolation Board

ATX Power Supply Supplies power to the Card Cage. See Appendix for details on connections.

Hammond 166F16 Supplies 12v power to the Isolation board and AC to J4 on the PFA card.

Curtis Line Filter Filters the AC line before the ATX Power Supply and the Hammond 166F16 transformer.

10-Pin Bus Cable Connects the DIGT card to the Isolation board.

TECHNICAL THEORY

This section has been broken down into two sub sections explaining in detail each component in the Frank Control Computer System.

FC Card Cage

This sub section explains the Technical Operation of all the STD cards in the Frank Control Computer System.

Figure 14 Most common card configuration

Eprom Card
This card has six 64k EPROM chips witch hold the main program that runs the kiln. The card comes pre loaded with a program and can only be changed if sent into Frank Controls Ltd. It is the brains behind the operation of the kiln.

SIO Card
This card allows the Frank Control Computer System to communicate with the Desktop PC and PLC. The top channel (Channel 1) is the port for communicating to the PC. The bottom channel (Channel 2) is the port for communicating to the PLC.

CPU Card
This card is the Z80 CPU. It runs the program in the EPROM chips.

Battery Back-Up Card
This card holds the Random Access Memory and the Real Time Clock. It has a battery so when the Frank Control Computer System is powered down the data in the RAM is not lost. There is also an on board charger for the (3v) NICAD battery.

Power Fail Card
This card monitors Power Failure. If the Frank Control Computer System has power the LED will glow red. If there is a loss of power or the card is not working, the LED will go out. Only the top of the two connectors is used for normal operation.

Digital Temperature Card
8085 microprocessor controlled onboard 8KB EPROM & 2K RAM. This card holds the program for communicating to the Data-Acquisition boards. It is connected to the Isolation board through a 14-pin bus cable.

Isolation Board
This board has six optically isolated Digital I/Os and one non-isolated channel. The first five Digital I/Os connect to the DAQT boards; one channel for each kiln up to five kilns. The sixth channel is used for resetting the DAQT boards. The non-isolated channel connects to the outside Digital Bulb. The 14-pin bus cable connects to the DIGT card. It is powered by 12 VDC from the Hammond 166F6 transformer.

Data Acquisition Temperature System

This sub section explains the Technical Operation of all the boards in the Data-Acquisition Temperature System.

Figure 15 Data-Acquisition System Mounted on Din rail

Power Supply Board
110-Volts is connected to the terminal labeled **110V AC. L1** is **HOT** and **L2** is **NEUTRAL**. If 220-Volt supply is required, contact Frank Controls Ltd. for further information on jumpering the Power Supply board for 220-Volt operation. The three-pin connector on the cable shown in Figure 1 is connected to J6 on the Data-Acquisition Board.

Data-Acquisition Temperature Board (DAQT)
This board can operate in four different modes. Board modes must be programmed at Frank Controls Ltd.

Mode 1 (Normal Operation)
Mode 2 (Master Operation)
Mode 3 (Slave Operation)
Mode 4 (PLC Operation)

Normal Operation (Mode 1)
- J2 is connected to the Frank Control Isolation board.
- J6 is the socket for the power supply board connector.

- J7 has no connection.
- J1 Digital Bulbs Connection socket is used to connect to the Bulb Connection board.

Master Operation (Mode 2)
- J2 is connected to the Frank Control Isolation board.
- J6 is the socket for the power supply board connector.
- J7 is connected to J7 on the Data-Acquisition board programmed as a Slave.
- J1 Digital Bulbs Connection socket is used to connect to the Bulb Connection board.

Slave Operation (Mode 3)
- J2 is connected to the Digital to Analog board(s) if available.
- J6 is the socket for the power supply board connector.
- J7 is connected to J7 on the Data-Acquisition board programmed as a Master.
- J1 Digital Bulbs Connection socket is used to connect to the Bulb Connection board.

PLC Operation (Mode 4)
- J2 is connected to the Digital to Analog board(s) if available.
- J6 is the socket for the power supply board connector.
- J7 is connected to the RS232 comport on the PLC.
- J1 Digital Bulbs Connection socket is used to connect to the Bulb Connection board.

Table 2 Isolation board and DAQT board connections

Isolation Board Terminals	DAQT Terminals
EG	XGND
D1	EXT-Data
+5	EXT +5

Table 3 Digital to Analog board and DAQT board connections

DAC 1 Terminals	DAC 2 Terminals	Data-Acquisition Terminals
GND	GND	XGND
SCL	SCL	S-CLOCK
SDT	SDT	S-DATA
SYNC	NC	EXT +5
NC	SYNC	EXT-DATA

Bulb Connection Board

J1 40-Pin bus socket is used to connect to the Data-Acquisition board.

The most common bulb configuration is shown below. No matter how many Dry Bulbs your kiln has the Wet Bulbs will always be the last two bulbs.

Table 3 Digital Bulb Connections

Terminal Label	Device
D1	Dry Bulb 1
D2	Dry Bulb 2
D3	Dry Bulb 3
D4	Dry Bulb 4
D5	Dry Bulb 5
D6	Dry Bulb 6
D7	Dry Bulb 7
D8	Dry Bulb 8
D9	Dry Bulb 9
D10	Dry Bulb 10
D11	Dry Bulb 11
D12	Dry Bulb 12
D13	Wet Bulb 1
D14	Wet Bulb 2
D15	Spare
D16	Spare

Digital to Analog Board (DAC)

The DAC boards have eight 4-20mA channels. They communicate **only** with a DAQT programmed in either Slave or PLC operation. The six-pin connector is connected to the six-pin connector on the DAQT. See table 3. They are powered by 24 VDC. If the +24 OK and +5 OK lights are on they have power. Each of the eight analog output channels has a led when on the channel is not connected or has a problem.

Digital Bulb

The Digital Bulb has three connections: +5VDC Power (White Wire)
Data (Red Wire)
Common (Black Wire)

T ROUBLESHOOTING

This section was included to help the maintenance troubleshoot common problems that could occur while operating the Frank Control Computer System. It should be used to recognize a problem, and troubleshoot to fix the problem.

General Information

Test a probe to see if it is good or bad
Disconnect the outside temperature probe from the isolation board terminal block T4. Connect the probe you want to check in place of the outside probe. Go to the computer and look at the outside temperature to see if it is working. It could take up to 30 seconds to for the computer to receive a new outside temperature.

Temperature System

Some Temperature Values may read 265,266,267,268, or 269

These are error codes letting you know there is a problem with reading the temperature value from the probe. Regardless of the actual code value, the troubleshooting is the same.

DAQT Temperature System
(Green Data-Acquisition System)

The Digital Bulbs are connected to a DAQT system.

RECOGNIZING THE PROBLEM

A single bulb shows an error code consistently
- Bad/broken bulb, or broken wire connection to the bulb
- The corresponding channel on the Bulb Connection board is open.

A single bulb shows an error code intermittently
- Problem with an intermittent open connection to that bulb
- Bulb failure at certain temperatures

All the bulb show an error code
- The DAQT board has lost power
- The Isolation board has lost power
- Communication between the DAQT board and Isolation board is lost

TROUBLESHOOTING THE PROBLEM

Measure the Voltage

In operation the DC voltage measured at the Isolation board for each DAQT board is shown below. This will help to indicate if there is a short between the +5VDC or Data line to Common. See table 2 in the Technical Theory Section of this manual for terminal block descriptions. If some bulbs are working still then test these voltages for each bulb.

Between Common & +5VDC	constant 5.0VDC
Between Common & Data	pulsating 2.8-5.0VDC

If there is a short in the communication do the following steps:

1. Disconnect the wires to the Isolation board & measure the voltages at the Isolation board to determine if the problem is at the Isolation board.

2. Disconnect the wires to the DAQT board & measure the voltages at the DAQT board to determine if the problem is at the DAQT board.

If there is a short in the bulb itself:

1. Disconnect the Red and White wires on the shorted bulb. Connect that bulb in place of a bulb that is working and measuring the voltages again to see if the bulb is still shorted. This will determine if the bulb is shorted or the channel on Bulb Connection board is shorted. Keep in mind it could be the wire that is shorted.

2. To test the bulb one at a time connect it in place of the outside temperature and see if it works.

If there is no short but the bulb doesn't work:

1. Disconnect the wires from the Bulb Connection board of the bulb that doesn't work.

2. Connect a bulb that you know works into the channel of the Bulb Connection board that doesn't seem to work. If it works then the bulb that was taken out must be bad (open). If it doesn't work then the channel on the Bulb Connection board must be open.

Testing the Bulb Connection boards with an ohm meter

Measure the resistance between pin 1 of the 40-pin bus connector and the +5v, Data, and Common on the terminal blocks. Resistance between Red and pin 1 should be about 3000 ohms with the exception D01 will be about 0 ohms. Resistance between White and pin 1 should be about 3000 ohms. Resistance between Black and pin 1 should be about 10000 ohms.

Ground Loops / Noise

This cause can be difficult to determine without the use of an Oscilloscope. A simple test is to disconnect the Isolation board from the Terminal blocks. Use an Ohmmeter to

check for any connection between Chassis ground and the three leads. There should be no connection between Common, Data, or +5V to ground.