Control Class Summaries
and Control Class IV
from April, 1990

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Editor

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Introduction

The D0 cryogenic control system is a complicated system with many facets. Because of the large number and variety of features in the system, a series of ongoing control system training seminars, or control classes, were created in order to keep people up to date on the operation of the system. As of the writing of this engineering note, there have been four classes. The original lecture notes from each class can be found in the cryogenic control room at the D0 Assembly Building, or in the Co-op office.

This note provides a summary of the first three control classes, and it includes the entire set of notes from the fourth class, which was held in April of 1990. This class was taught by Jeff Wendlandt and Dan Markley. Dan should be consulted for more complete explanations than those given in the notes. The notes are, in fact, more of a reference for someone who has some experience with the system, than they are a training manual. Most of the pages include pictures and printouts of different menus and functions, useful for finding details without searching through the actual program. In general, this note serves as a pointer to the existence of the control class lecture notes, and as an explanation of their overall contents and purpose.

Summary of Control Class I (March 1989)

Lesson 1 - "Control System Hardware Overview"

- A. Programmable Logic Controller (PLC)
- B. I/O Bases
 - 1. I/O Modules
 - a. Analog Input (AI)
 - b. Analog Output (AO)
 - c. Digital Input (DI)
 - d. Digital Output (DO)
 - e. TTL Input (TTL)
 - f. LVDC 32 Point Output (LVDC)
 - 2. Remote Base Controllers (RBC)
 - a. With Communication Port
 - b. Without Communication Port
 - 3. Module Logic Power Supply (PS)
 - 4. Vax TIWay Communication Module (TIWAY)
- C. 24 VDC Power Supply (SOLA)
- D. Vax Unilink Host Adaptor (UNILINK)
- E. Loop Access Module (LAM)
- F. Token Ring
- G. AST Premium 286 IBM Compatible (PC)
 - 1. NEC Color Video Monitor
 - 2. Epson FX-850 9-pin Printer
- H. Junction Box/Hoffman Boxes
- I. Relay Racks
- J. System Security Overview

Lesson 2 - "AST PC MS-DOS Ver. 3.3 Training"

- A. Directory Structure
 - 1. Changing Drives/Directories
 - 2. Creating/Deleting Files/Directories
 - 3. Printing Directory Contents/Tree
- B. How to look at a file/How to execute a file
- C. How to print a file/How to print a screen
- D. Memory Types
 - 1. Conventional
 - 2. Expanded (Paged)
 - 3. Extended
 - 4. Problems
- E. Backing up files/Copying files
- F. How to use the line editor
- G. How to create batch files
- H. Software Overview
 - 1. DOS Directory
 - 2. Mouse Directory
 - 3. XL Directory
 - 4. XL/Pictures Subdirectory
 - 5. TI Directory
 - 6. TI/D0 Subdirectory
 - 7. Historical Directory

Lesson 3 - "I/O Up Close and Module Wiring"

- A. Analog Inputs
 - 1. WX Addresses
 - 2. Used for Transmitters
 - 3. 0 to 32000 Word Representation in PLC
 - 4. 20% Offset Method
 - 5. Calculating Engineering Units Ranges
- B. Analog Outputs
 - 1. WY Addresses
 - 2. Used for Loops as Storage Registers
- C. 110 VAC Digital Input Module
 - 1. X Addresses
 - 2. Used for Switches/ "Status" Inputs
- D. 110 VAC Digital Output Module
 - 1. Y Addresses
 - 2. Used for Open/Close Signals to Solenoids
- E. Transistor - Transistor Logic Inputs
 - 1. TTL Signal
 - 2. Transmitter Sends TTL Signal to TTL Module for Contaminated Mirror
- F. LVDC 32 Point Output
 - 1. Y Addresses
 - 2. Used for _____
- G. TIWay Network Interface
- H. How to wire all above I/O Modules
 - 1. Use of Resistor for Analog Inputs
 - 2. Correct Power Supply to all Modules

Lesson 4 - "XpressLink Up Close"

- A. How to start program -- Run XL.BAT
 - 1. On-Line Help (F1 is Menu Help, Alt-F1 is Item Help)
 - 2. Exiting to DOS Window ("EXIT" to Return to Main Menu)
 - 3. Exiting (F-10) (Confirmation Code (Alt-Y))
- B. Use of Mouse - Only for Draw/Edlin/DOS/Lotus
 - 1. LMK - Left Mouse Key - Acts as Return
 - 2. MMK - Middle Mouse Key - Acts as F1 or Help
 - 3. RMK - Right Mouse Key - Acts as F10 or Exit
- C. Main Menu Structure - Programs Available
 - 1. View (Pixel Version) (VIEW.EXE) (Foreground Functions)
 - 2. Draw (Pixel Version) (DRAW.EXE)
 - 3. Database Builder (DBB.EXE)
 - 4. Historical Trend Assign (HTA.EXE)
 - 5. Historical Data Display (HDD.EXE)
 - 6. Database Configurator (DBMAKE.EXE)
 - 7. Key Macro Editor (KME.EXE)
 - 8. Tag Group Editor (TGE.EXE)
 - 9. Report Builder (REP.EXE)
 - 10. Scheduler Menu (SMENU.EXE)
 - 11. DOS 3.3 Window (COMMAND.COM)
 - 12. Historical Collect (HTRCOL.EXE) (Background Functions)
 - 13. Alarm Logger Task (ALMTASK.EXE)
 - 14. Sample Background Program (SHLSAMPL.EXE)
 - 15. Clock Test Program (TICK2.EXE)
 - 16. Scheduler (SCHED.EXE)
- C. I/O Driver Up Close/CONFIG.POL
- D. View Up Close
 - 1. Entering Passwords
 - 2. Acknowledging Alarms
- E. Draw Up Close
 - 1. Creating Subpictures
 - 2. Adding Links

Lesson 5 - "Database Programming"

A. Database Configuration (DBC) (DBMAKE.EXE)

B. Database Building (DBB) (DBB.EXE)

1. Adding Blocks

a. Types of Blocks

1. Analog Input
2. Digital Input
3. Analog Output
4. Digital Output
5. Coil Value
6. Register Value
7. Statistical
8. Boolean Logic
9. General Calculation
10. Trend
11. Totalizer
12. Stat Control

b. Specifics, Default Values, etc...

2. Modifying Blocks
3. Duplicating Blocks
4. Deleting Blocks
5. Reporting Blocks
6. List Tags
7. Checking for Missing Tags
8. Saving the Database to Disk
9. Loading the Database from Disk
10. Reading an Input File from Disk

Lesson 6 - "TISoft Up Close"

- A. On-Line vs. Off-Line Programming
- B. On-Line Baud Rate is 9600 (F5 Key)
- C. Auxiliary Support Functions/Uploading and Downloading
Logic Programs, Memory
- D. Configuring Memory
- E. Configuring I/O
- F. Viewing and Entering Ladder Logic Programs Introduction
- G. Debugging Mode
- H. Viewing and Entering Loops Introduction
- I. Adding Comments and Synonyms Off-Line to Ladder Logic
- J. SFBox Function Modules (On-Line Only)
- K. Getting Printouts/Selecting Printing Parameters

Lesson 7 - "Programming Relay Ladder Logic and Control Loops"

A. Programming Relay Ladder Logic

1. Moving Around the Ladder

a. Up

b. Down

c. Find

2. Modifying Existing Ladder Logic

3. Adding New Ladder Logic/Saving Ladder Logic

4. Use of Memory Protect Key in On-Line Mode

5. Use of Debug Function

6. Adding Comments and Synonyms Off-Line Only

7. Printing Out Ladders/Options

B. Programming Control Loops

1. PID Loop Directory

2. Modifying an Existing Loop

3. Copying a Loop/Saving a Loop

4. Giving Titles to Loops

5. Inputting All the Parameters

C. Programming Analog Alarms

1. Up to 128 Analog Alarms

2. Simple Format

D. Programming Special Functions Programs and Subroutines

Lesson 8 - "Loop Access Module Operation and Use"

A. Installation and Startup

1. Power to LAM
2. Necessary Cabling
3. Internal Tests
4. Communication Errors Due to Wrong Baud Rate

B. Configuration

1. Starting
2. Selecting Update Time
3. Selecting Scan Rate
4. Selecting Loop Status
5. Selecting Engineering Units

C. Operation

1. Special Features and Functions
2. Control Loop Operating Modes
3. Displaying Loop Parameters
4. Changing Loop Setpoint Value
5. Changing Loop Output Value
6. Scanning Loops
7. Loop Alarms
8. Operating the LAM in Tune Mode
9. Displaying and Changing PID Tuning Constants

Summary of Control Class II (July 1989)

Lesson 1 - "General Introduction"

A. Review

1. General Organization
2. Planned Equipment Layout
3. Equipment Arrival Schedule

B. Tour

1. Installed Equipment Walking Tour
2. Functional Equipment
3. Work List

C. Memory Management

1. Review Organization and Characteristics of Memory

D. Architecture

1. Current Status and Why
2. Organization of Future Extensions

E. General Demonstration

1. Current View
2. Current TISoft
3. Historical Trending

F. LAM Operation

1. Review
2. Hands-on Demonstration

Lesson 2 - "LN₂ Controls"

- A. System Architecture Review
- B. Vaporizer Demonstration
 - 1. Change Gain Through LAM
 - 2. Practice Turning Loop Controls On
- C. Dewar Field Trip
 - 1. Locate Solenoids, I/P's, Transmitters
 - 2. Overfill Circuit Demonstration
 - 3. Demonstrate Back Pressure Regulator
 - 4. Demonstrate Vaporizer Loop
 - 5. Indicate Ambient Heat Exchanger
 - 6. Show Backup Air Supply

Lesson 3 - "Historical Trends: Assignment, Display, Report"

A. Material Handouts

1. Exercise 9, Quick Demonstration of Capability
2. Chapter 4, Textbook
3. Help Files
 - a. HTA, Historical Trend Assignment
 - b. HDD, Historical Data Display
 - c. HDR, Historical Data Report

B. Historical Trend Assignment

1. Base Collection Rate
 - a. File Length
 - b. Save Data For Last
2. Collection Mode
 - a. Limit
 - b. Scan Period

C. Historical Data Display

1. Group Name
 - a. Time Period of Data
2. Color
 - a. Tag Name
 - b. Field
 - c. Mode
 - d. LOEGU
 - e. HIEGU

D. Historical Data Report

1. Group Name
 - a. Interval
2. Outputs
 - a. LOTUS
 - b. Printer
 - c. ASCII

E. Historical Trend Collection

1. Turn On, Off
2. Managing

Lesson 4 - "The Alarm System"

A. Handouts

1. XpressLink Operator's Guide
 - a. Chapter 2: Operating View
 - b. Chapter 3: Operating with Alarms
2. XPressLink Development Guide
 - a. Chapter 2: Developing the Database
 - b. Chapter 3: Developing the Displays
3. Printouts of Online Help for Alarm Topics

B. Alarm Indication and Information

1. Scan and Alarm Program (SAC) in Background
2. View Screen - LN2 Dewar Screen
3. Lesson 4 Make Believe Screen
4. Additional Alarm History Options
 - a. Printer Output After Alarm
 - b. History of Alarms Stored in Fixed Disk File

C. Setting Up the Alarms

1. In Database Builder - Developing Alarm Parameters
 - a. Analog Input
 1. LL - Lo Lo Alarm
 2. AL - Lo Alarm
 3. AH - Hi Alarm
 4. HH - Hi Hi Alarm
 5. RC - Rate of Change Alarm
 6. DB - Dead Band
 7. AP - Alarm Priority
 8. AD - Alarm Destination
 9. AE - Alarm Enable
 10. CC - Alarm Contact
 11. CM - CC Alarm Mode
 - b. Digital Input
2. In Draw - developing Alarm Related Displays
 - a. Addlink or Modlink

D. Lesson 4 Hands On and/or Question Period

Lesson 5 - "Draw"

- A. Direct
- B. Delete
- C. Sub-Dir
- D. Sub-Del
- E. Help
- F. New or Modify
 - 1. Line
 - 2. Circle
 - 3. Box
 - 4. Bar
 - 5. Text
 - 6. Fill
 - 7. Cut
 - 8. Paste
 - 9. Getsub
 - 10. Putsub
 - 11. Undo
 - 12. Erase
 - 13. Clear
 - 14. Grid
 - 15. Rotate
 - 16. Fatbit
 - 17. Scale
 - 18. Addlink
 - 19. Color
 - 20. Special
 - 21. Display
 - 22. Modlink
 - 23. Dellink
- G. Bottom of Screen
- H. Exit
- I. 110 VAC Wiring
- J. Analog 4-20 ma Input Wiring

Lesson 6 - "DOS and the Control System"

- A. Review of Drive Specifications
 - 1. Floppy Drive
 - 2. Hard Drive or Fixed Disk
- B. DOS Directories and Sub-Directories
 - 1. Directory Structure - Tree
 - 2. Commands
- C. Backing Up and Restoring Hard Drive
 - 1. Why?
 - 2. Backup Files That Were Created or Modified
 - 3. Restoring the Hard Drive to Its Original Status
- D. Editing Files (EDLIN)
 - 1. Commonly Used Commands
- E. CONFIG.POL and Its Use
 - 1. Format
 - 2. Example
 - 3. Words/Bits Read/Write
 - 4. AI, AO, DI, DO Modules
 - 5. Future Changes
- F. RUNXL.BAT and Its Use
 - 1. Startup for XpressLink
 - 2. Changes Made
 - 3. Best Modified Using EDLIN
- G. DOS Window
 - 1. Unusable Commands - Program Locks
 - 2. EXIT to XpressLink

Summary of Control Class III (Nov. 1989)

Lesson 1 - "DOS and Various Files"

- A. Quick Review of Entire Control System
 - 1. D0 Cryogenic Control System Review
- B. Review DOS Commands
 - 1. DOS Commands You Can't Live Without
- C. Examine Various Files
 - 1. AUTOEXEC.BAT
 - 2. BACKUP.BAT
 - 3. AST1.BAT
 - 4. XAST1X.BAT
 - 5. ASTEND.BAT
 - 6. RUNXL.BAT
 - 7. CONFIG.POL
- D. Norton Utilities

Lesson 2 - "Ladder Logic I (The Ladder)"

A. Programming the Ladder

1. Configuring I/O Hierarchy
2. Basic Menu Hierarchy
3. Ladder Hierarchy
4. Insert/Modify Hierarchy
5. Find Hierarchy
6. Debug Hierarchy
7. Comment Function Hierarchy
8. Synonym Function Hierarchy
9. Printing Hierarchy

B. Study of Current Ladder

1. Revised Ladder Logic Flow
2. Ladder Dump

C. Trouble Shooting

1. PLC Trouble Shooting
2. Partial Auxiliary Function Explanations

Lesson 3 - "Ladder Logic II (Loops and SFPGS)"

- A. Programming Loops
 - 1. Loop Programming Table
 - 2. C - Flags
 - 3. V - Flags
 - 4. Appendix A
- B. Study of Current Loops
 - 1. Dump of Current Loops
- C. Accessing Loops Via LAM
 - 1. LAM Notes from .CNTRL ROOM INFO
- D. Programming SFPGS
 - 1. SFPGS Notes from .CNTRL ROOM INFO
 - 2. Help Display
 - 3. 565 Special Function Statements
 - 4. Intrinsic Functions in SF 05 MATH
 - 5. Operators Supported in SF 05 MATH
 - 6. Operators Supported by SF 06 Integer MATH
 - 7. Operators and Functions Supported by SF 07 IF
- E. Study of Current SFPGS
 - 1. Dump of Current SFPGS

Lesson 4 - "XpressLink"

- A. Startup
- B. Draw/DataBase
 - 1. Draw Notes from .CNTRL ROOM INFO
 - 2. DataBase Notes from .CNTRL ROOM INFO
 - 3. Sample I/O Block
- C. Alarms
 - 1. Alarm Notes from .CNTRL ROOM INFO
 - 2. See Sample I/O Block
- D. Historic Trending
 - 1. Historic Trending .CNTRL ROOM INFO
- E. Key Macro Editor

Control Classes

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Lesson 5 - "Miscellaneous"

- A. XL INFO
- B. Other
- C. Review

Control Class IV Syllabus

LECTURE

- 4/5 1. General Review
- 4/12 2. TISOFT ver. 3.0 overview I
- 4/19 3. TISOFT ver. 3.0 overview II
- 4/26 4. Xpresslink overview I
- 5/3 5. Xpresslink overview II
- 5/10 6. PID loop theory
- 5/17 7. Control Examples
- 5/24 8. Upsets, Emergencies
- 5/31 9. Final Exam

LAB

- General Review/Lab
- Lab-ladder create
- Lab-forcing, status, PID
- Lab-picture create, links
- Lab-historical trending
- Lab-tuning
- Lab-solving a control problem
- Lab-simulated upset

TI560/565 Glossary

April 18, 1990

AD	Alarm Destination (T, H, and/or F).
AE	Alarm Enable.
AH	High Alarm.
AL	Low Alarm.
AP	Alarm Priority(L, M, or H).
AT	Alarm Type.
AST 1,2	The name of the manufacturer of the AT clone used as the PLC monitor. The numbers uniquely identify each of the two units.
C register	The coil register in the PLC.
CC	Alarm Contact.
CM	CC Alarm Mode.
Base	A PLC I/O base for 14 modules, one Power Supply and a RBC.
DB	Dead Band.
DOS	Disk Operating System.

TI560/565 Glossary

April 18, 1990

DPS	Differential Pressure Switch.
DPT	Differential Pressure Transmitter.
EL	Engineering Unit for Low Range.
EH	Engineering Unit for High Range.
ET	Engineering Unit Tag(psi, in. h2o, etc.).
F	File - Alarm Destination
HH	High High Alarm.
H	History Window - Alarm Destination.
H	High Priority Alarm.
I/O	Input/Output.
K memory	Constant memory.
L	Low Priority Alarm.
L memory	Ladder memory.
LAM	Loop Access Module. There are two types, hardware (remote) and software (graphic).

TI560/565 Glossary

April 18, 1990

LAN	Local Area Network. The communication means.
LL	Low-Low Alarm.
M	Medium Priority Alarm
NIM	Network Interface Module. Interfaces with a LAN.
PID	Proportional, Integral, Derivative, said of the control loop output function of the error signal.
PIM	Personal Interface Module.
PLC	Programmable Logic Controller. The name of the main control computer.
PS	Pressure Switch.
PT	Pressure Transmitter.
PV	Process variable.
RBC	Remote Base Controller. Each Base has one.
RS232	Local computer output connection driver format.
RS422	Long distance computer (current) output

TI560/565 Glossary

April 18, 1990

connection driver format.

SF	Special Function
<i>SFPGM</i>	<i>Special Function Programs</i>
S memory	Special memory for the loops, analog alarms, and special functions of the PLC.
SP	Setpoint. The desired value of the PV.
TI560	The PLC Ladder logic processor.
TI565	The PLC Analog alarms and loop processor.
TISOFT	Texas Instrument Software for the PLC.
TIWAY	Texas Instrument LAN.
TMR	Timer Register.
TS	Temperature Switch.
UNILINK	A TIWAY to VAX link.
V memory	Variable memory.
V register	A register in V memory.
VAX	A Digital Equipment Corporation (DEC) computer.

TI560/565 Glossary

April 18, 1990

X register	A digital input register.
XCEL	The corporate name of the distributor of XPRESSLINK.
XPRESSLINK	The software that monitors and instructs the PLC.
Y register	A digital output register.
WX register	A PLC analog input register.
WY register	A PLC analog output register.

Control Class IV

LESSON 1

A. Equipment Layout, Cabling, Function, and Interrelationship

1. I/O Devices
2. Modules
3. Bases
4. PLC
5. LAM
6. AST's

B. Memory Registers

C. Software

1. Tisoft
2. Xpresslink

D-ZERO CRYOGENIC CONTROL SYSTEM REVIEW

CONTROL CABLING ARRANGEMENT

MODEL 560 COMPONENTS

Figure 2 560/565 Configuration

Xpresslink

Xpresslink is capable of reading V, WX, WY, X, C, and Y registers

Xpresslink can only write to V and C registers directly

Analog information is scaled in a 0-32768 integer. This requires a linear conversion for EU exchange between the PLC and Xpresslink.

PLC MEMORY REGISTERS

Analog information is represented as a 0-32000 integer			
<u>Variable(V) Memory</u>	<u>WX Register</u> analog inputs	<u>WY Register</u> analog outputs	<div> coil register</div> <div> digital input</div> <div> digital output</div>
<u>Ladder(L) Memory</u>	<u>Constant (K) Memory</u>	<u>CTR/TMR</u>	
<u>Special(S) Memory</u> loops, analog alarms, and special functions	<u>One Shot Memory</u>	Other Memory Functions	
			Ladder Logic Registers

Tisoft

Tisoft can change all registers. Inputs, such as WX and X registers, can be changed through forcing.

TISOFT
DATE: 03-29-90

PAGE 1
REMOTE 565 RUN

347	POWER C2] [	*-----*	BITP8 MANUAL LOADER STAT ML625A A: V1361 N= 4	*-----*	BITS12 MANUAL LOADER STAT ML625A A: V1361 N= 1	*-----*	DUMMY C1 ()
355	POWER C2] [	*-----*	BITP9 MANUAL LOADER STAT ML638A A: V1411 N= 4	*-----*	BITS13 MANUAL LOADER STAT ML638A A: V1411 N= 1	*-----*	DUMMY C1 ()
363	CONTROL EV601I C260] [	-----					EV 601I Y270 ()
365	CONTROL EV611I C261] [	-----					EV 611I Y271 ()
367	CONTROL EV638I C262] [	-----					EV 638I Y272 ()

DEFINING LOOPS

Figure 9 Continuous Process Loop

TISOFT
DATE: 04-04-90

PAGE 1
REMOTE 565 RUN

PID LOOP 1 TITLE: PIC501N

POS/VEL PID ALGORITHM: POS
LOOP VFLAG ADDRESS: V1011
SAMPLE RATE (SECS): +0.10000

PROCESS VARIABLE ADDRESS: WX22
PV RANGE: LOW = +0.00000
HIGH = +90.00000

PV IS BIPOLAR: NO
SQUARE ROOT OF PV: NO
20% OFFSET ON PV: YES

LOOP OUTPUT ADDRESS: V1003
OUTPUT IS BIPOLAR: NO
20% OFFSET ON OUTPUT: YES

RAMP/SOAK PROGRAMMED: NO
RAMP/SOAK FOR SP: NO

ALARM DEADBAND: +0.00000

MONITOR LOW-LOW/HI-HI: NO
MONITOR LOW/HIGH: NO
V ALARMS: LOW-LOW = +0.00000
LOW = +0.00000
HIGH = +0.00000
HIGH-HIGH = +0.00000

REMOTE SETPOINT: NONE
CLAMP SP LIMITS: LOW = +0.00000
HIGH = +90.00000

LOOP GAIN: +7.99989
RESET (INTEGRAL TIME): +INF
RATE (DERIVATIVE TIME): +0.00000
FREEZE BIAS: NO

DERIVATIVE GAIN LIMITING: NO
LIMITING COEFFICIENT: +10.00000

SPECIAL CALCULATION ON: SF
SPECIAL FUNCTION: SFPGM1

LOCK SETPOINT: NO
LOCK AUTO/MANUAL: NO
LOCK CASCADE: NO

ERROR OPERATION: NONE
REVERSE ACTING: NO

MONITOR DEVIATION: NO
DEVIATION ALARM: YELLOW = +0.00000
ORANGE = +0.00000

MONITOR RATE OF CHANGE: NO
RATE OF CHANGE ALARM: +0.00000

MONITOR BROKEN XMITTER: NO

TISOFT
DATE: 04-04-90

PAGE 2
REMOTE 565 RUN

PID LOOP 1

RAMP/SOAK FLAG ADDRESS NONE

STATUS	SETPOINT	RAMP RATE	SOAK TIME	DEADBAND
STEP R/S BIT	(UNITS)	(UNITS/MIN)	(MIN)	(UNITS)

ANALOG ALARM 1 TITLE:
ALARM VFLAG ADDRESS: NONE
SAMPLE RATE (SECS): +1.00000
PROCESS VARIABLE ADDRESS: NONE
PV RANGE: LOW = +0.00000
HIGH = +100.000
PV IS BIPOLAR: NO
SQUARE ROOT OF PV: NO
20% OFFSET ON PV: YES
ALARM DEADBAND: +0.00000
MONITOR LOW-LOW/HI-HI: NO
MONITOR LOW/HIGH: NO
PV ALARMS: LOW-LOW = +0.00000
LOW = +0.00000
HIGH = +100.000
HIGH-HIGH = +100.000
S-MEMORY AVAILABLE:12418
EXIT-F1 EDIT-F2
MONITOR REMOTE SETPOINT: NO
REMOTE SETPOINT: NONE
CLAMP SP LIMITS: LOW = +0.00000
HIGH = +0.00000
SPECIAL FUNCTION: NONE
MONITOR DEVIATION: NO
DEVIATION ALARM: YELLOW = +100.000
ORANGE = +100.000
MONITOR RATE OF CHANGE: NO
RATE OF CHANGE ALARM: +0.00000
MONITOR BROKEN XMITTER: NO
ENABLED
REMOTE 565 RUN
COMINT-F7 EN/DIS-F5

CONFIG. POL 4/5/90

of ADDRESS (S) (S) (S)

SKIP PERIOD

BEGIN SCAN HERE

ANALOG

DIGITAL

d	565:0:0	c80	2 0
d	565:0:0	c1	15 0
d	565:0:0	c200	15 1
d	565:0:0	c301	15 1
d	565:0:0	c100	15 1
a	565:0:0	v600	15 5
a	565:0:0	v900	4 1
a	565:0:0	v200	15 1
a	565:0:0	v129	15 1
a	565:0:0	v144	9 1
ai	565:0:0	wx1	15 3
ai	565:0:0	wx16	15 3
ai	565:0:0	wx31	15 3
ai	565:0:0	wx46	15 3
ai	565:0:0	wx61	4 3
a	565:0:0	wy97	15 1
a	565:0:0	wy112	15 1
d	565:0:0	y201	15 2
d	565:0:0	y216	15 2
d	565:0:0	y231	15 2
d	565:0:0	y246	15 2
d	565:0:0	y261	15 2
a	565:0:0	v500	3 2
d	565:0:0	y276	15 2
d	565:0:0	y291	15 2
d	565:0:0	x139	15 1
d	565:0:0	x144	15 1
d	565:0:0	x159	2 1
d	565:0:0	x297	15 1
d	565:0:0	x312	9 1
a	565:0:0	V1000	15 1
a	565:0:0	V1050	7 1
a	565:0:0	V1100	7 1
a	565:0:0	v1150	7 1
a	565:0:0	v1200	7 1
a	565:0:0	v1250	7 1
a	565:0:0	v1300	7 1
a	565:0:0	v1350	7 1
a	565:0:0	v1400	7 1
a	565:0:0	v1450	7 1
a	565:0:0	v1500	7 1
a	565:0:0	v1550	7 1
a	565:0:0	v1600	7 1
a	565:0:0	v1700	7 1
a	565:0:0	v1750	7 1
a	565:0:0	v1800	7 1
a	565:0:0	v1850	7 1
a	565:0:0	v1900	7 1
a	565:0:0	v1950	7 1
a	565:0:0	v2000	7 1
a	565:0:0	v2050	7 1
a	565:0:0	v2100	7 1
a	565:0:0	v2150	7 1
a	565:0:0	v2200	7 1
a	565:0:0	v2250	7 1
a	565:0:0	v2300	7 1
a	565:0:0	v2350	7 1
a	565:0:0	v2400	7 1
a	565:0:0	v2450	7 1
d	565:0:0	c210	15 3
d	565:0:0	c235	15 3
d	565:0:0	c240	15 3
d	565:0:0	c255	15 3

11-1-104286
7.15.17

DBB - Tag List

TYPE - AI	Allocated: 80	Used: 58			
DPT482N	DPT688N	DPT547N	FV615N	PT35	DPT16
PT233A	PT240A	PT234A	DPT235A	DPT222A	PT210N
PT653A	PT655N	DPT637A	PT717UV	DPT665A	DPT43
PT133A	PT333A	PT134A	PT334A	DPT135A	DPT335A
DPT122A	DPT332A	PT110N	PT310N	PV612N	PV601A
PV611A	PV625A	PV638A	PV101N	PV201N	PV301N
PV102N	PV202N	PV302N	PV110N	PV210N	PV310N
PV114A	PV214A	PV314A	PT130A	PT230A	PT330A
HT36	PT49	PT501N	PT104A	PV501N	LSP1A1
LSP4AI	LSP6AI	LSP7AI	LPT486N		

TYPE - AQ Allocated: 20 Used: 1
 TI101 *211A106 OUTPUT*

TYPE - DI	Allocated: 70	Used: 61			
HX571N	HX572N	PS119H	PS219H	PS319H	TS182E
TS232E	TS332E	DPS138A	DPS238A	BLOWER	DRIER
DRIERREG	COMPRESS	UVFUMP	CRYOINS	EV706STAC	BOTHHEO
LEADH2O	EV706STAC	EV707STAC	EV707STAC	EV710STAC	EV710STAC

<F10 - Exit> <PgUp, PgDn, Home, End - Move by TYPE> <Other - next page>

7.6.11.16
7.15.17

DBB - Tag List

TYPE - DI	(continued)				
LETDRYCOL	RTDRYCOL	DRYFAIL	EV05FAIL	EV711STAC	EV114STAC
ODH510GR	ODH511GR	ODH756PC	ODH745CR	ODH731T7E	ODH112EPR
ODH707LAD	ODH707SW	ODH700PC	ODH690SP	ODH7451E	ARI40E
CH100R5	CH100R4	ELD105	EP6POWER	EP6MASTER	EP6FLW
EP7POWER	EP7MASTER	EP7FLOW	ADREL65	ADREL16	DP666A
EP6TEST	SUMPTMP	DPS583N	DPS580N	BAYLADCTP	DEWLINEER
IOFLAG					

DIGITAL OUTPUT

TYPE - DO Allocated: 20 Used: 2
 NELTOCRV NELTOAR

TYPE - PI Allocated: 5 Used: 0

TYPE - IL Allocated: 5 Used: 0

TYPE - DR Allocated: 5 Used: 0

TYPE - RM Allocated: 5 Used: 0

<F10 - Exit> <PgUp, PgDn, Home, End - Move by TYPE> <Other - next page>

DBB - Tag List

TYPE - TR	Allocated:	10	Used:	2		
PV501NTR	PV501NTR					
TYPE - RB	Allocated:	10	Used:	0		
TYPE - DT	Allocated:	5	Used:	0		
TYPE - SS	Allocated:	10	Used:	0		
TYPE - BB	Allocated:	5	Used:	0		
TYPE - CA	Allocated:	15	Used:	8		
DPT02LCA	LNEVOLCA	PT501NCA	LARVOLCA	PV501NCA	DFT482CAL	
DPT665CAL	DPT665CAL					
TYPE - DC	Allocated:	10	Used:	0		
TYPE - CV	Allocated:	30	Used:	38		
CSSTATE	EV706V	EV707UV	EV710V	EV05	WATCHDOG	
EV714V	POWER	PIC601AMA	PIC612NMA	PIC501NMA	INERLOCK	

<F10 - Exit> <PgUp, PgDn, Home, End - Move by TYPE> <other - next page>

DBB - Tag List

TYPE - CV	(continued)					
LAIRBLOCK	PIC615NMA - PIC501CHA	EV5011	EV5131	EV5481		
EV6011	EV6111	EV6381	PIC601CHA	PIC612CHA	PIC615CHA	
EV714N	RF6CTRL	RF7CTRL	LOCFMASTR			
TYPE - RV	Allocated:	40	Used:	15		
MPV513N	MPV548N	MPV601A	MPV612N	MPV615N	MPV625A	
MPV638A	MPV611A	EV05CTDN	LTF1TPLC	MPV501N	PV513N	
PV548N	EV05TREM	LSP1	LSP4	LSP6	LSP7	

TYPE - BL	Allocated:	5	Used:	0		
-----------	------------	---	-------	---	--	--

TYPE - SD	Allocated:	5	Used:	1		
PT501STAT						

TYPE - SC	Allocated:	5	Used:	0		
-----------	------------	---	-------	---	--	--

TYPE - TT	Allocated:	5	Used:	0		
-----------	------------	---	-------	---	--	--

TYPE - PG	Allocated:	10	Used:	0		
-----------	------------	----	-------	---	--	--

<F10 - Exit> <PgUp, PgDn, Home, End - Move by TYPE> <other - next page>

ANALOG INPUT

A.....DPT637A
 V.....565
 T-H/W OPTIONS.565:0:0
 O-ADDR.....WX24
 C-SIG COND....

DESC....DIFF PRESS TRANSMIT FOR LAR DEWAR LEVEL

L-LO EGU.....-31.25
 H-HI EGU.....128.75
 T-EGU TAG....."H2O"
 T-SCAN TIME...10
 M-SMOOTHING...0
 S-INIT SCAN...ON

LL-LO LO ALM... 9.62 NX-NEXT BLK....LARVOLCA
 AL-LO ALARM.... 19.23
 AH-HI ALARM.... 96.16
 HH-HI HI ALM... 110.58
 RC-ROC ALM.... 0.00
 DB-DEAD BAND... 16.00
 AP-ALM PRI.....L
 AD-ALM DEST....TH
 AE-ALM ENABLE..ENABLE
 CC-ALM CONTACT.
 CM-CC ALM MODE.ANY

HELP - FOR MORE INFO
 EXIT - LOOP DEFINITION COMPLETE

Press <F1> for help at any time

EDIT: C= ENTER IN DATA BASE(Y/N) OF CONTINOR EDIT(OTHER)
 SELECT ITEM:

10:34:53

LIQUID ARGON DEMAR SYSTEM

03-29-90

MANUAL LOADERS	SOLENOIDS	PIC601A	PIC612N	PIC615N
PV611A	EV6011 ON	PT653A	PT653A	PT655N
100.0%		SP:PSIA	SP:PSIA	SP:PSIA
14.00		14.00	14.00	14.00
PV625A	EV6111 ON	PU:PSIA	PU:PSIA	PU:PSIA
100.0%		14.48	14.48	14.31
PV638A	EV6381 ON	MAN.	MAN.	MAN.
100.0%		PU601A	PU612N	PU615N
		100.0%	100.0%	100.0%

10:28:48

06:28:40

02:28:40

PT35	124.69	PSIA	VALU SAMP	DEPT16	3.99	PSID	VALU SAMP
HT36	-45.0	DEGCHI	VALU SAMP				

TIME: 06:26:24 03-29-90

D-ZERO CRYOGENIC CONTROL SYSTEM REVIEW

4.4.2.1 Position Equation.

With the position form of the PID equation, the controller output is computed as:

$$M_n = K_c \left[E_n + \frac{T_s}{T_i} \sum_{j=0}^n E_j - \frac{T_d}{T_s} (PV_n - PV_{n-1}) \right] + M_x$$

where:

M_n - Loop output	T_i - Reset time
K_c - Proportional gain	T_d - Rate Time
E - Error (SP-PV)	M_x - Bias (M_x is the initial valve position.)
T_s - Sample time	

4.4.2.2 Velocity Equation.

The velocity form of the PID equation is obtained by subtracting the equation at time (n-1) from the equation at time (n).

$$\Delta M_n = M_n - M_{n-1}$$

$$= K_c \left[(E_n - E_{n-1}) + \frac{T_s}{T_i} E_n - \frac{T_d}{T_s} (PV_n - 2PV_{n-1} + PV_{n-2}) \right]$$

where:

M_n - Loop output	T_i - Reset time
K_c - Proportional gain	T_d - Rate Time
E - Error (SP-PV)	
T_s - Sample time	

Advantages of the velocity PID equation are:

- In the position form of the PID equation, the bias term (M_x) must be initialized prior to placing the loop in AUTO. (M_x contains the initial valve position). This step is not required in the velocity algorithm.
- Reset-windup protection is implicit in the velocity form of the equation.

CONTROL CABLING ARRANGEMENT

CCSIV Lesson 2

TISOFT

Introduction

" TISOFT is a software tool that provides a programming and diagnostic interface with your TI controller. You use TISOFT for entering and editing your programs, as well as accessing programming utilities such as comment and block operations."

Menu Driven

Handouts

Memory Configuration, I/O Configuration, Auxiliary Functions, Ladder Diagram Language, Box Instruction (tmr.), ANDing/ORing..., Chart Example, Synonym/Comment, TISOFT menu's, I/O MAP

Lab: Entering Program Elements, timer oscillator

TISOFT

Configuring Memory

Configuring Inputs and Outputs

Aux Functions

Ladder

Diagram Language

Box Instruction

Logic-AND, OR, etc.

FIND

Used to locate a specific piece of information in the ladder
addr., wx, wy, v,.....

STATUS

Reveals the status of the contacts(on, off, forced) in the
ladder

CHART

Simultaneously shows values of contacts, V memory,
words, etc.

BLOCK

Selects a group of ladder to COPY, MOVE, DELETE, and PUT(disk to controller)

Documentation

Synonyms- 3 lines x 11 characters. For more detail, a 3 line x 48 char. *descriptor* can be added.

Comments- free form entry of descriptive text up to 16 lines tied to the selected element

Add com/syn to coils, contacts, memory, label instructions, and much much more.

Title

I/O MAP-shaded boxes indicate that the device is wired into the PLC.

LAB-Creating a Ladder Segment

OBJECTIVE:

Duplicate the timer oscillator ladder logic provided in the handout and document one of the contacts with a synonym.

MEMORY CONFIGURATION

	USER MEMORY	SYSTEM MEMORY
LADDER (L).....	0016 KBYTES	... 0048 KBYTES
VARIABLE (V).....	0004 KBYTES	... 0004 KBYTES
CONSTANT (K).....	0002 KBYTES	... 0002 KBYTES
SPECIAL (S).....	0016 KBYTES	... 0016 KBYTES
TMR/CTR	0001 K	... 0005 KBYTES
DRUMS	0128	... 0006 KBYTES
SHIFT REG	0002 K	... 0002 KBYTES
TABLE MOVE	0001 K	... 0002 KBYTES
ONE SHOTS	0002 K	... 0002 KBYTES
INTERNAL C	0000 K	
P/C TYPE 565		
TOTAL SYSTEM MEMORY		0096 KBYTES
CONFIGURED SYSTEM MEMORY		0087 KBYTES
REMAINING SYSTEM MEMORY		0009 KBYTES

AUXILIARY FUNCTIONS

P/C → PLC
PROGRAMMABLE
LOCAL CONTROLS

RESETS AND RESTARTS

10. POWER/UP
11. PARTIAL RESTART
12. COMPLETE RESTART
13. CLEAR P/C
14. WATCHDOG TIMER
15. SOFTWARE PART NUMBER
16. TASK CODES PER SCAN
17. COMPARE P/C TO DISK
18. P/C TIME OF DAY
19. SET P/C SCAN TIME

CLEAR P/C MEMORY

31. LADDER
32. VARIABLE
33. CONSTANT
35. WORD
36. TCC/TCP
37. DSP/DCP
74. LOOPS
75. ANALOG ALARMS
76. SF PROGRAMS
77. SF SUBROUTINES

DIAGNOSTICS

20. P/C DIAGNOSTICS
21. REMOTE BASE DIAG
25. DISPLAY FAILED I/O
27. P/C CARD FAILURE CLASS
29. SHOW P/C DIAG CELL

SELECT P/C MODE

81. LADDER/LOOP OPERATIONAL MODES
83. P/C LOCKOUT
84. EEPROM PROGRAMMING

ENTER AUXILIARY FUNCTION NUMBER: 00

REMOTE 565

RUN

EXIT-F1 TITLE-F2 PAGE-F3

AUXILIARY FUNCTIONS

SAVE P/C

60. ALL
61. LADDER
62. VARIABLE
63. CONSTANT
64. LOOPS
65. ANALOG ALARMS
66. SF PROGRAMS
67. SF SUBROUTINES

LOAD P/C

90. ALL WITHOUT IR
91. LADDER
92. VARIABLE
93. CONSTANT
94. LOOPS
95. ANALOG ALARMS
96. SF PROGRAMS
97. SF SUBROUTINES
98. FORCED IR
99. WORD I/O

ENTER AUXILIARY FUNCTION NUMBER: 00

REMOTE 565

RUN

EXIT-F1 TITLE-F2 PAGE-F3

7-3 LADDER DIAGRAM LANGUAGE

The ladder diagram language is a symbolic instruction set that is used to create a programmable controller program. It is composed of five categories of instructions that include *relay-type*, *timer/counter*, *arithmetic*, *data manipulation*, *data transfer*, and *program control*. The ladder instruction symbols can be formatted to obtain the desired control logic that is to be entered into memory. Because the instruction set is composed of contact symbols, it is also referred to as *contact symbology*.

The main function of the ladder diagram program is to control outputs based on input conditions. This control is accomplished through the use of what is referred to as a *ladder rung*. Figure 7-1 shows the basic structure of a ladder rung. In general, a rung consists of a set of input conditions, represented by contact instructions, and an output instruction at the end of the rung, represented by the coil symbol. Throughout this section, the contact instructions for a rung may be referred to as input conditions, rung conditions, or control logic.

Figure 7-1. Ladder diagram rung format.

Basic Symbols

Coils and contacts are the basic symbols of the ladder diagram instruction set. The contact symbols programmed in a given rung represent conditions to be evaluated in order to determine the control of the output; all outputs are represented by coil symbols.

When programmed, each contact and coil is referenced with an address number which identifies what is being evaluated and what is being controlled. Recall that these address numbers reference the data table location of either an internal (storage bit) output or a connected input or output. A contact, regardless of whether it represents an input/output connection or an internal output, can be used throughout the program whenever that condition needs to be evaluated.

The format of the rung contacts is dependent on the desired control logic. Contacts may be placed in whatever *series*, *parallel*, or *series/parallel* configuration is required to control a given output. For an output to be activated or energized, at least one left-to-right path of contacts must be closed. A complete closed path is referred to as having *logic continuity*. When logic continuity exists in at least one path, it is said that the rung condition is *TRUE*. The rung condition is *FALSE* if no path has continuity.

For several years, the standard ladder instruction set was limited to performing only relay equivalent functions, using the basic relay-type contact and coil symbols similar to those illustrated in Fig. 7-1. A need for greater flexibility, coupled with developments in technology, has led to extended ladder diagram instruction sets

that perform data manipulation, arithmetic, and program flow control. It is now commonplace to find controllers that include computer-like expressions similar to the diagram in Fig. 7-2. Further enhancements to the extended ladder diagram instruction set have resulted in functional block instructions.

Although instructions and symbols may differ among controllers, the instructions described here are generic and apply to most controllers.

Figure 7-2. Computer like expressions in ladder diagram format.

Relay-Type Instructions

The relay-type instructions are the most basic of programmable controllers instructions. They provide the same capabilities as hardwired relay logic, but with greater flexibility. These instructions primarily provide the ability to examine the ON/OFF status of specific bit addresses in memory and to control the state of an internal or external output. The following is a description of relay-type instructions that are most commonly available in any controller that has a ladder diagram instruction set.

Symbol: --] [--

Name: Normally-Open Contact

The normally-open contact is programmed when the presence of the referenced signal is needed to turn an output ON. When evaluated, the referenced address is examined for an ON (1) condition. The referenced address may represent the status of an external input, external output, or internal output. If, when examined, the referenced address is ON, then the normally-open contact will close and allow logic continuity (power flow). If it is OFF (0), then the normally-open contact will assume its normal programmed state (open), thus breaking logic continuity.

Symbol: --[/--

Name: Normally-Closed Contact

The normally-closed contact is programmed when the absence of the referenced signal is needed to turn an output ON (1). When evaluated, the referenced address is examined for an OFF (0) condition. The referenced address may represent the status of an external input, external output, or an internal output. If, when examined, the referenced address is OFF, then the normally-closed contact will remain closed allowing logic continuity. If the referenced address is ON, then the normally-closed contact will open and break logic continuity.

Symbol: --()--

Name: Energize Coil

The energize coil instruction is programmed to control either an output connected to the controller or an internal (control relay) output. If any rung path has logic continuity, the referenced output is turned ON. The output is turned OFF if logic continuity is lost. When the output is ON, a normally-open contact of the same address will close, and a normally-closed contact will open. If the output goes OFF, any normally-open contact will then open, and normally-closed contacts will close. An example rung using the previous instructions is shown in Fig. 7-3.

Figure 7-3.

Symbol: --(/)--**Name: De-energize Coil**

The de-energize coil instruction is programmed to control either an internal output or an output device connected to the controller. If no rung path has logic continuity, the referenced output is turned ON. The output is turned OFF if logic continuity is achieved. When the output is ON, normally-open contacts of the same address will be closed, and normally-closed contacts will be open. If the output goes OFF, normally-open contacts will open, and normally-closed contacts will close.

Symbol: --(L)--**Name: Latch Coil**

The latch coil instruction is programmed if it is necessary for an output to remain energized, even though the status of the contacts which caused the output to energize may change. If any rung path has logic continuity, the output is turned ON and retained ON, even if logic continuity or system power is lost. The latched output will remain latched ON until it is unlatched by an unlatch output instruction of the same reference address. The unlatch instruction is the only automatic (programmed) means of resetting the latched output. Although most controllers allow latching of internal or external outputs, some are restricted to latching internal outputs only.

Symbol: --(U)--**Name: Unlatch Coil**

The unlatch coil instruction is programmed to reset a latched output of the same reference address. If any rung path has logic continuity, the referenced address is turned OFF. The Unlatch output is the only automatic means of resetting a latched output. Figure 7-4 illustrates the use of the latch and unlatch coils.

If A closes, coil 100 is latched until B closes to unlatch coil 100.

Figure 7-4. Example of latch and unlatch coil instructions.

8.3 TMR (Timer)

The TMR instruction, Figure 32, decrements in .1-second or 1-millisecond steps for timing of events.

TIMER USES THE SAME BLOCK OF MEMORY AS THE COUNTER. THUS, YOU CANNOT HAVE A COUNTER AND TIMER W/ THE SAME NUMBER.

Figure 32 TMR Format

8.3.1 Operation

When the start input of the TMR box turns on and the enable input is on, the timer decrements from the present time P down to zero. If the start input turns off and the enable input remains on, the timer stops. If the start input is turned back on with the enable input still on, the timer resumes timing. When the enable input is turned off, the timer resets to the preset time P. The output turns on when the timer reaches 0, and stays on until the timer resets.

1. **BASIC GATES.** Basic logic gates implement simple logic functions. Each gate is expressed in terms of a truth table and its Boolean expression.

Table 3-5. Example of translation from hardware logic to programmed logic.

Relay Ladder Diagram	Contact or Ladder Diagram	Boolean Equation	Boolean Statements
<p>a) Series Circuit</p>		$Y1 = X1 \cdot X2$	STR X1 AND X2 OUT Y1
<p>b) Parallel Circuit</p>		$Y2 = X3 + X4$	STR X3 OR X4 OUT Y2

LOCATION	STATUS
WY112	= 32000
WY113	= 32000
WY114	= 32000
W 5	= 32000
WY116	= 32000
WX24	= 6368
WY117	= 32000
WX25	= 6408
WX26	= 10480
WX27	= 19208
WX28	= 6480

STATUS CHART	
LOCATION	STATUS
Y270	= ON
Y271	= ON
Y272	= ON
X301	= OFF
X302	= OFF
X303	= OFF
X304	= OFF

LOCATION	STATUS
----------	--------

UPDATE IN PROGRESS

EXIT-F1 BLDCHT-F2

EDIT-F3 PG/RN-F4 S.SCAN-F5

REMOTE 565 RUN

LDCHT-F7 STATUS-F8

ELEMENT	SYNONYM	DESCRIPTOR
C1	DUMMY	
C2	POWER	
C3	INIT/ CTRL	
C4	ALL LOOP TOGGL	
C5	PRESS BUILD TOGGL	

EXIT-F1 DELCH-F2 INSCH-F3 DELLN-F4 INSLN-F5 FIND-F6 DELETE-F7 565 OFFLINE
DESCR-F8

C1

COLD HEARTED ORB THAT RULES THE NIGHT
STEALS THE COLORS FROM OUR SIGHT
BLACK IS YELLOW AND RED IS WHITE
WHO DECIDES WHICH IS RIGHT

PAGING: NONE

ABORT-F1 DELCH-F2 INSCH-F3 DELLN-F4 INSLN-F5 EDIT-F6 DELETE-F7 565 OFFLINE
ENTER-F8

Appendix A

TISOFT Menus

The menu listings in this appendix give the Ladder Display (primary menu) first. Menus accessed from the Ladder Display are given next in alphabetical order.

The final listings are the separate O.S. programs, Print Cross-Reference and SFBOX.

ALARM

BLDCHT

CONFIO

DOCUM

FIND

MEMORY

PRINT

SF PROGRAM AND SF SUBROUTINE

PRINT CROSS-REFERENCE O.S.

BASE	SLOT/PT	I/O TYPE	ADDRESS	TAG	DESCRIPTION	J.B. R/C	SEX	RANGE
0	1/1	AI	WX0001	PT 104 A	NEC PRESS MONITOR TRANSMITTER	3A		14-27 PSIA
0	1/2	AI	2	PT 110 N	NEC CONDENSER OUT PRESSURE TRANSMITTER	4A		0-60 PSIA
0	1/3	AI	3	DPT 122 A	NEC CRYOSTAT LEVEL TRANSMITTER	7A		0-10 PSID
0	1/4	AI	4	PT 130 A	NEC PRESSURE CONTROL TRANSDUCER	8A		14-27 PSIA
0	1/5	AI	5	PT 133 A	NEC UPPER PRESSURE TRANSMITTER (VPT)	9A		14-27 PSIA
0	1/6	AI	6	PT 134 A	NEC LOWER PRESSURE TRANSMITTER (VPT)	10A		14-27 PSIA
0	1/7	AI	7	PT 204 A	CC PRESSURE MONITOR TRANSMITTER	22A		14-27 PSIA
0	1/8	AI	8	PT 210 N	CC CONDENSER OUTLET PRESSURE TRANSMITTER	23A		0-60 PSIA
0	2/1	AI	WX0009	DPT 222 A	CC LEVEL TRANSMITTER	26A		0-10 PSID
0	2/2	AI	10	PT 230 A	CC PRESSURE CONTROL TRANSMITTER	27A		14-27 PSIA
0	2/3	AI	11	PT 233 A	CC UPPER PRESSURE TRANSMITTER (VPT)	28A		14-27 PSIA
0	2/4	AI	12	PT 234 A	CC LOWER PRESSURE TRANSMITTER (VPT)	29A		14-27 PSIA
0	2/5	AI	13	DPT 235 A	CC DIFF PRESS TRANS (VPT)	30A		0-2.5 PSID
0	2/6	AI	14	PT 240 A	CC MID PRESSURE TRANSMITTER (VPT)	31A		14-27 PSIA
0	2/7	AI	15	PT 304 A	SEC PRESSURE MONITOR TRANSMITTER	41A		14-27 PSIA
0	2/8	AI	16	PT 310 N	SEC CONDENSER OUTLET PRESSURE TRANSMITTER	42A		0-60 PSIA
0	3/1	AI	WX0017	DPT 322 A	SEC LEVEL TRANSMITTER	45A		0-10 PSIG
0	3/2	AI	18	PT 330 A	SEC PRESSURE CONTROL TRANSMITTER	46A		14-27 PSIA
0	3/3	AI	19	PT 333 A	SEC UPPER PRESSURE TRANSMITTER (VPT)	47A		14-27 PSIA
0	3/4	AI	20	PT 334 A	SEC LOWER PRESSURE TRANSMITTER (VPT)	48A		14-27 PSIA
0	3/5	AI	21	DPT 482 N	DIFF PRESS TRANSMITTER CONDENSER IN FLOW	58A		0-30"H2O
0	3/6	AI	22	PT 501 N	N2 DEWAR PRESSURE TRANSMITTER	2B		0-90 PSIA
0	3/7	AI	23	DPT 547 N	N2 DEWAR LEVEL TRANSMITTER	4B		0-75"H2O
0	3/8	AI	24	DPT 637 A	ARGON DEWAR LEVEL TRANSMITTER	25B		0-125"H2O
0	4/1	AI	WX0025	PT 653 A	ARGON DEWAR PRESSURE TRANSMITTER	27B		0-90 PSIA
0	4/2	AI	26	PT 655 N	ARGON DEWAR CONDENSER OUTLET PRESS TRANS	28B		0-90 PSIA
0	4/3	AI	27	DPT 665 A	DIFF PRESS TRANS FOR FLOWMETER (440LA)AR	29B		(-15)15H2O
0	4/4	AI	28	DPT 688 N	ARGON DEWAR CONDENSER INLET FLOW	30B		0-30"H2O
0	4/5	AI	29	PT 717 UV	UV MANIFOLD ABSOLUTE PRESSURE TRANSMITTER	40B		0-35 PSIA
0	4/6	AI	30	PT 724 A	ARGON BACKFILL SUPPLY PRESSURE TRANS	41B		0-2500PSIG
0	4/7	AI	31	DPT 16	INSTRUMENT AIR FILTER DROP	45B		0-27 PSID
0	4/8	AI	32	PT 35	INSTRUMENT AIR FINAL DISCHARGE	46B		0-125 PSIG
0	5/1	AI	WX0033	HT 36	INSTRUMENT AIR HYGROMETER	47B		-40C to 60C
0	5/2	AI	34					
0	5/3	AI	35	DPT 43	AIR COMPRESSOR OIL DIFFERENTIAL	49B		0-27 PSID
0	5/4	AI	36	PT 49	INSTRUMENT AIR HIGH PRESSURE BACKUP	50B		0-3000 PSIG
0	5/5	AI	37	TG 126 V	NEC DIFFUSION PUMP INLET THERMOCOUPLE	1C		
0	5/6	AI	38	CC 127 V	NEC DIFFUSION PUMP INLET COLD CATHODE	2C		
0	5/7	AI	39	CC 131 V	NEC INSULATING JACKET COLD CATHODE	3C		
0	5/8	AI	40	TG 142 V	NEC INSULATING JACKET THERMOCOUPLE	4C		
0	6/1	AI	WX0041	EI 123 A	NEC LED CRYOSTAT LEVEL INDICATOR	6C		
0	6/2	AI	42	EI 150 A	VOLTAGE ARGON LEVEL INDICATOR	7C		
0	6/3	AI	43	TG 226 V	CC DIFFUSION PUMP INLET THERMOCOUPLE	17C		

BASE	SLOT/PT	I/O	TYPE	ADDRESS	TAG	DESCRIPTION	J.B. R/C	SEX	RANGE
0	11/7	AI		87					
0	11/8	AI		88					
0	12/1	AI		WX0089					
0	12/2	AI		90					
0	12/3	AI		91					
0	12/4	AI		92					
0	12/5	AI		93					
0	12/6	AI		94					
0	12/7	AI		95					
0	12/8	AI		96					
0	13/1	TIWAY		Y0505					
0	13/2	TIWAY		506					
0	13/3	TIWAY		507					
0	13/4	TIWAY		508					
0	13/5	TIWAY		509					
0	13/6	TIWAY		510					
0	13/7	TIWAY		511					
0	13/8	TIWAY		512					
1	1/1	AO		WY0097	I/P 101 N	CONTROL SIGNAL NEC COOL DOWN LOOP INLET	1A	NO AIR - CLOSED	3-15 PSIG
1	1/2	AO		98	I/P 102 N	CONTROL SIGNAL NEC OPERATIONAL LOOP INLET	2A	NO AIR - CLOSED	3-15 PSIG
1	1/3	AO		99	I/P 110 N	CONTROL SIGNAL NEC CONDENSER OUTLET	5A	NO AIR - CLOSED	3-15 PSIG
1	1/4	AO		100	I/P 114 A	CONTROL SIGNAL NEC CRYOSTAT ARGON GAS LINE	6A	NO AIR - CLOSED	3-15 PSIG
1	1/5	AO		101	I/P 201 N	CONTROL SIGNAL CC COOL DOWN LOOP INLET	20A	NO AIR - CLOSED	3-15 PSIG
1	1/6	AO		102	I/P 202 N	CONTROL SIGNAL CC OPERATIONAL LOOP INLET	21A	NO AIR - CLOSED	3-15 PSIG
1	1/7	AO		103	I/P 210 N	CONTROL SIGNAL CC CONDENSER OUTLET	24A	NO AIR - CLOSED	3-15 PSIG
1	1/8	AO		104	I/P 214 A	CONTROL SIGNAL CC CRYOSTAT ARGON GAS LINE	25A	NO AIR - CLOSED	3-15 PSIG
1	2/1	AO		WY105	I/P 301 N	CONTROL SIGNAL SEC COOL DOWN LOOP INLET	39A	NO AIR - CLOSED	3-15 PSIG
1	2/2	AO		106	I/P 302 N	CONTROL SIGNAL SEC OPERATIONAL LOOP INLET	40A	NO AIR - CLOSED	3-15 PSIG
1	2/3	AO		107	I/P 310 N	CONTROL SIGNAL SEC CONDENSER OUTLET	43A	NO AIR - CLOSED	3-15 PSIG
1	2/4	AO		108	I/P 314 A	CONTROL SIGNAL SEC CRYOSTAT ARGON GAS LINE	44A	NO AIR - CLOSED	3-15 PSIG
1	2/5	AO		109	I/P 501 N	CONTROL SIGNAL N2 DEWAR PRESSURE BUILD	1B	NO AIR - CLOSED	3-15 PSIG
1	2/6	AO		110	I/P 513 N	CONTROL SIGNAL N2 DEWAR TO CRYOSTAT LOOPS	3B	NO AIR - CLOSED	3-15 PSIG
1	2/7	AO		111	I/P 548 N	CONTROL SIGNAL N2 DEWAR TO LN2 DEWAR LOOPS	5B	NO AIR - CLOSED	3-15 PSIG
1	2/8	AO		112	I/P 601 A	CONTROL SIGNAL LAR DEWAR PRESSURE BUILD	20B	NO AIR - CLOSED	3-15 PSIG
1	3/1	AO		WY113	I/P 611 A	CONTROL SIGNAL GAS CONTROL IN AR DEWAR	21B	NO AIR - CLOSED	3-15 PSIG
1	3/2	AO		114	I/P 612 N	CONTROL SIGNAL LAR DEWAR CONDENSER INLET	22B	NO AIR - CLOSED	3-15 PSIG
1	3/3	AO		115	I/P 615 N	CONTROL SIGNAL LAR DEWAR CONDENSER OUTLET	23B	NO AIR - CLOSED	3-15 PSIG
1	3/4	AO		116	I/P 625 I	CONTROL SIGNAL LAR DEWAR FILL VALVE	24B	NO AIR - CLOSED	3-15 PSIG
1	3/5	AO		117	I/P 638 A	CONTROL SIGNAL LAR DEWAR WITHDRAWAL	26B	NO AIR - CLOSED	3-15 PSIG
1	3/6	AO		118					
1	3/7	AO		119					
1	3/8	AO		120					
1	4/1	AO		WY121					

BASE	SLOT/PT	I/O	TYPE	ADDRESS	TAG	DESCRIPTION	J.B. R/C	SEX	RANGE
1	6/5	DI		165					
1	6/6	DI		166					
1	6/7	DI		167					
1	6/8	DI		168					
1	6/9	DI		X01169					
1	6/10	DI		170					
1	6/11	DI		171					
1	6/12	DI		172					
1	6/13	DI		173					
1	6/14	DI		174					
1	6/15	DI		175					
1	6/16	DI		176					
1	6/17	DI		X0177					
1	6/18	DI		178					
1	6/19	DI		179					
1	6/20	DI		180					
1	6/21	DI		181					
1	6/22	DI		182					
1	6/23	DI		183					
1	6/24	DI		184					
1	6/25	DI		X0185					
1	6/26	DI		186					
1	6/27	DI		187					
1	6/28	DI		188					
1	6/29	DI		189					
1	6/30	DI		190					
1	6/31	DI		191					
1	6/32	DI		192					
1	7/1	DI		X0193					
1	7/2	DI		194					
1	7/3	DI		195					
1	7/4	DI		196					
1	7/5	DI		197					
1	7/6	DI		198					
1	7/7	DI		199					
1	7/8	DI		200					
1	7/9	DI		X0201					
1	7/10	DI		202					
1	7/11	DI		203					
1	7/12	DI		204					
1	7/13	DI		205					
1	7/14	DI		206					
1	7/15	DI		207					

BASE	SLOT/PT	I/O TYPE	ADDRESS	TAG	DESCRIPTION	J.B. R/C	SEX	RANGE
1	14/24	DO	224			70D		
1	14/25	DO	225			71D		
1	14/26	DO	226			73D		
1	14/27	DO	227			73D		
1	14/28	DO	228			74D		
1	14/29	DO	229			75D		
1	14/30	DO	230			76D		
1	14/31	DO	231			77D		
1	14/32	DO	232			78D		
2	1/1	DO	Y0233	EV 501 I	SOL VALVE COOLING LOOP SHUTOFF	1E	NO PWR SOL C/L S	
2	1/2	DO	234	EV 513 I	SOL VALVE LN2 SHUTOFF	2E	NO PWR SOL C/L S	
2	1/3	DO	235	EV 548 I	SOL VALVE LN2 SHUTOFF TO ARGON DEWAR	3E	NO PWR SOL C/L S	
2	1/4	DO	236	EV 570 N	3-WAY AMBIENT HEATER SWITCHING SOL	4E	PWR ON VLV. SW.	
2	1/5	DO	237	EV	OUT SWITCH 2	5E	PWR ON VLV. SW.	
2	1/6	DO	238	EV	OUT OPTIONAL HEATER	8E	PWR ON HEAT ON	
2	1/7	DO	239					
2	1/8	DO	240					
2	2/1	DO	Y0241	EV 706 V	UV TO CRYOSTAT INSUL VAC TIE IN	33E	PWR OFF VLV CL	
2	2/2	DO	242	EV 707 V	UV SHUTOFF VALVE	34E	PWR OFF VLV CL	
2	2/3	DO	243	EV 710 V	FOREPUMP SHUTOFF VALVE	35E	PWR OFF VLV CL	
2	2/4	DO	244	EV 714 V	UV BACKFILLING VALVE	36E	PWR OFF VLV CL	
2	2/5	DO	245	EV 5	INSTRUMENT AIR RECIEVER TANK BLOWDOWN	37E	PWR OFF SOL OP	
2	2/6	DO	246	EV 108 V	NEC INSUL JACKET ROUGHING GATE VALVE	1F		
2	2/7	DO	247	EV 113 A	NEC RELIEF VALVE	2F		
2	2/8	DO	248	EV 115 A	NEC GATE VALVE UV LINE	3F		
2	3/1	DO	Y0249	EV 119 H	4WAY VALVE CONTROLLING PV119A	4F		
2	3/2	DO	250	BH 120 A	NEC FINNED ELECTRIC STRIP HEATER	6F		
2	3/3	DO	251	EV 121 V	NEC DIFF PUMP OUT GATE VALVE	7F		
2	3/4	DO	252	EV 125 V	NEC DIFF PUMP IN GATE VALVE	8F		
2	3/5	DO	253	EV 128 A	NEC VENT MANIFOLD ISO GATE FOR PUMPDOWN	9F		
2	3/6	DO	254	EV 208 V	CC ROUGHING VALVE FOR INSULATING JACKET	17E		
2	3/7	DO	255	EV 213 A	CC RELIEF VALVE	18E		
2	3/8	DO	256	EV 215 A	CC GATE VALVE UV LINE	19F		
2	4/1	DO	Y0257	EV 219 H	4WAY VALVE CONTROLLING PV219A	21F		
2	4/2	DO	258	BH 220 A	CC FINNED ELECTRIC STRIP HEATER	22F		
2	4/3	DO	259	EV 221 V	CC DIFF PUMP OUT VALVE	23F		
2	4/4	DO	260	EV 225 V	CC DIFF PUMP IN VALVE	24F		
2	4/5	DO	261	EV 228 A	CC VENT MANIFOLD ISO GATE FOR PUMPDOWN	25F		
2	4/6	DO	262	EV 308 V	SEC ROUGHING GATE FOR INSULATING JACKET	33F		
2	4/7	DO	263	EV 313 A	SEC RELIEF VALVE	34		
2	4/8	DO	264	EV 315 A	SEC GATE VALVE UV LIN	35		
2	5/1	DO	Y0265	EV 319 H	4WAY VALVE CONTROLLING PV319A	37F		
2	5/2	DO	266	BH 320 A	SEC FINNED ELECTRIC HEATER	38F		

BASE	SLOT/PT	I/O	TYPE	ADDRESS	TAG	DESCRIPTION	J.B. R/C	SEX	RANGE
2	10/6	DI		310	CRY O INS	CRYO INSULATING PUMP "ON"	55E	PWR ON SW CLS	
2	10/7	DI		311	LEA DH2 O	LEAD H2O PUMP FAIL	56E	FAIL SW CLOSES	
2	10/8	DI		312	BOT HH2 O	BOTH H2O PUMP FAIL	57E	FAIL SW CLOSES	
2	11/1	DI		X0313	EV7 06S TAC	EV706V "OPEN"	58E	VLV OP SW CLS	
2	11/2	DI		314	EV7 06S TAC	EV706V "CLOSED"	59E	VLV CLS SW CLS	
2	11/3	DI		315	EV7 07S TAC	EV707V "OPEN"	60E	VLV OP SW CLS	
2	11/4	DI		316	EV7 07S TAC	EV707V "CLOSED"	61E	VLV CLS SW CLS	
2	11/5	DI		317	EV7 10S TAC	EV710V "OPEN"	62E	VLV OP SW CLS	
2	11/6	DI		318	EV7 10S TAC	EV710V "CLOSED"	63E	VLV CLS SW CLS	
2	11/7	DI		319	PS 812 H	PRESS SWITCH ON HE MAIN SUPPLY LINE	69E		
2	11/8	DI		320	PS 813 H	PRESS SWITCH ON HE RESERVE LINE	70E		
2	12/1	DI		X0321	PS 119 H	CLOSING SUPPLY PRESSURE FOR PV119A	5F		
2	12/2	DI		322	TS 132 E	NEC VENT MANIFOLD TEMPERATURE SWITCH	10F		
2	12/3	DI		323	DPS 138 A	NEC FLOW SWITCH ON FM139A	11F		
2	12/4	DI		324	PS 151 A	SPILL THROUGH VPT SPILL SENSOR	12F		
2	12/5	DI		325	PS 152 A	SPILL THROUGH VPT SPILL SENSOR	13F		
2	12/6	DI		326	PS 219 H	CLOSING SUPPLY PRESS SWITCH FOR PV219A	20F		
2	12/7	DI		327	TS 232 E	CC VENT MANIFOLD TEMP SWITCH	26F		
2	12/8	DI		328	DPS 238 A	FLOW SWITCH ON FM139A	27F		
2	13/1	DI		X0329	PS 251 A	SPILL THROUGH VPT SPILL SENSOR	28F		
2	13/2	DI		330	PS 252 A	SPILL THROUGH VPT SPILL SENSOR	29F		
2	13/3	DI		331	PS 319 H	CLOSING SUPPLY PRESS SWITCH FOR PV319A	36F		
2	13/4	DI		332	TS 332 E	SEC VENT MANIFOLD TEMP SWITCH	42F		
2	13/5	DI		333	DPS 338 A	FLOW SWITCH ON FM139A	43F		
2	13/6	DI		334	PS 351 A	SPILL TROUGH VPT SPILL SENSOR	44F		
2	13/7	DI		335	PS 352 A	SPILL TROUGH VPT SPILL SENSOR	45F		
2	13/8	DI		336					
2	14/1	DI		X0337		LEFT DRIER COLUMN SWITCH			
2	14/2	DI		338		RIGHT DRIER COLUMN SWITCH			
2	14/3	DI		339					
2	14/4	DI		340					
2	14/5	DI		341					
2	14/6	DI		342					
2	14/7	DI		343					
2	14/8	DI		344					

3.3 Entering Program Elements

3.3.1

Entering Contacts

To enter/edit a contact, position the cursor within the input columns. To make the entry, you can use the contact function keys or the X, Y, C hardkeys for the element type. Key in the element identifier with the numeric keys. If you decide not to complete a change, you can press ☐ ABORT-F1 to restore the original ladder element. After completing the entry, press ☐ RETURN to write the contact to the network.

3.3.2

Entering Coils

To enter/edit a coil, position the cursor on the network. You can use the coil function or hardkeys to position the cursor in the output column and make the entry. Key in the element identifier with the numeric keys. If you decide not to complete a change, press ☐ ABORT-F1 to restore the original ladder element. After completing the entry, press ☐ RETURN to write the coil to the network.

3.3.3

Drawing Lines for Complex Networks

Use HORZ-F1 and VERT-F2, or the H and J hardkeys, to add the connecting lines when you are entering a complex network. You cannot draw a horizontal line in the last column of a row. With the vertical line key, you cannot draw a line from the first column, on the last row, or on the top of a box.

If you need to make changes, use HORZD-F3 and VERTD-F4, or the M and N hardkeys, to delete lines.

3.3.4

Inserting Elements

To insert empty rows or columns in an existing network, use the insert function. You can invoke the function with the INSERT hardkey. After pressing insert, horizontal and vertical function keys appear. Use the horizontal function key to insert rows, the vertical function key to insert columns.

3.3.5

Inserting Rungs

To insert a NOP rung in a display, use INSERT-F8 available in the edit mode function keys.

3.3.6

Entering Boxes

To enter/edit a box, position the cursor in the column of the rung where the box is to be created. Press ☐ BOX-F6. Select the box type by using function keys, or type in the mnemonic for the box. After the box type is displayed, key in the parameters. Use the arrow keys to move from field to field inside the box. If you decide not to complete a change, you can press ☐ ABORT-F1 to restore the original ladder element. After completing the entry, press ☐ RETURN to write the box to the network.

3.4 Creating Documentation at Program Entry

3.4.1

Accessing the Documentation Editors

Complete documentation of your programs—title, comments, synonyms, and descriptors—can be entered from the Documentation menus (DOCUM-F4 from the main ladder display menu). For your convenience, TISOFT also provides the option of adding or editing documentation for your program while in the Edit menus.

3.4.2

Invoking the Synonym Editor

To create or edit a synonym or descriptor for any elements in the rung you have just entered, press ☐ CTRL L. The synonym editor can be accessed throughout TISOFT. See Chapter 5 for details on using the synonym editor.

3.4.3

Invoking the Comment Screen

To use the comment operation while entering programs, press ☐ SPACEBAR, then press ☐ COMMNT-F7 to invoke the display for entering comments.

```
410  ! C80      *-----*
      *-]/[-----! TMR7      !-----C81 !
      !         !         !         !         !
      !         ! P=  0001.0 !         !
      ! C80      *-----*
      *-]/[-----!         !         !
      ! C81      *-----*
415  *-] [-----! TMR8      !-----C80 !
      !         !         !         !
      !         ! P=  0002.0 !         !
      ! C81      *-----*
      *-] [-----!         !         !
      !         !         !         !
```

CCSIV Lesson 3

TISOFT

Handouts

Updated PLC Glossary, hardkeys, V/K memory display, print selectin/setup, special function example w/ statements, loop example, loop flag address bit assignments, analog alarm entry form, alarm flag address assignments

Lab: BITP(bit pick) instruction

TISOFT

Hardkeys- quick access to frequently used operations through keys.

EDIT(off of main menu)

INSERT- Inserts a rung for editing before the displayed rung. Page up and page down moves you through the rungs. After a single rung is created, you must enter it before adding an additional rung. To edit a Box, you must place the cursor on the upper left corner of the box and then hit the BOX function.

MEMORY- used to change or read V and K memory or their formats(bin, real, integer,etc.)

STATUS(online)- displays the current status of contacts and boxes in PLC.

EDIT

READ- reads status of an element

SEEK- seeks the forced element of a selected type

FORCE-writes a value to an element

UNFORC-unforces elements

UN.ALL-unforces all elements

PG/RN-set PLC mode

PGMFRZ-turns program off but leaves contacts in previous condition

PGMOFF

RUN

PRINT

PRINT SELECTION

PRINT SETUP

CTRL PRINT SCREEN-prints current display after prompting for execution/setup line. Good for sections of ladder

PRINT SCREEN-prints screen with varying degrees of success. Use ctrl prtscr for ladder where alignment is necessary.

SPECIAL FUNCTION PROGRAM(SFPGM)- A SF program is a series of SF statements that can be called from loops, ladder logic, or analog alarms.

Types of SF programs

Nonpriority-queued for execution when power flow into the ladder box changes from off to on.

Priority-same as nonpriority but given twice as much execution time.

Cyclic-queued for execution upon power flow, requeued after execution, and executed after the specified cycle time.

Restricted-can only be called from loops or analog alarms.

LOOPS

loop flag address-contains control and status bits that can be stored in a 16 bit word or 15 digital contacts.

ANALOG ALARM

alarm flag address

ARE SIMILAR TO SUBROUTINES?

LAB-Creating an Analog Alarm

OBJECTIVE:

Create an Analog Alarm for the address wx22(0-90psia) which closes contact c500 upon a high alarm of 60 psia. Hint: The alarm flag address is important in this problem. Ladder programming, such as contacts and/or special boxes, may be involved.

TISOFT Hard Keys

FUNCTION	IBM	TIPC
ABORT	ESC	ESC
EXIT	ESC	ESC
PG/RN	R	R
ENTER	ENTER or + (pad)	
FIND	TAB	TAB or TAB (pad)
AUX	A	A
STATUS	S	S
FORCE	F	F
UNFORC	U	U
HORZ	H	H
VERT	J	J
S. SCAN	V	V
DHORZ	N	N
DVERT	M	M
-] [-	F9	F9
-]/[-	F10	F10
-()-	HOME	HOME
-(/)-	END	
BOX	B	B
INSCH	INS	INS
DELCH	DEL	DEL
POP-UP SYNONYM EDITOR	CNTL L	CNTL L
EXECUTE	ENTER or + (pad)	
ROLL UP	PG UP or E	E
ROLL DOWN	PG DOWN or D	D
PRINT SCREEN	CTRL PRN	PRNT
X	X	X
Y	Y	Y
C	C	C
YES	Y	Y
NO	N	N
V	V	V
ON SCREEN CROSS-REF	X	X
HELP	?	?
K	K	K

V1	INTEGER	00008	V21	INTEGER	00000
V2	INTEGER	00000	V22	INTEGER	00000
V3	INTEGER	00000	V23	INTEGER	00000
V4	INTEGER	00008	V24	INTEGER	00000
V5	INTEGER	00021	V25	INTEGER	00000
V6	INTEGER	00000	V26	INTEGER	00000
V7	INTEGER	00000	V27	INTEGER	00000
V8	INTEGER	00000	V28	INTEGER	00000
V9	INTEGER	00000	V29	INTEGER	00000
V10	INTEGER	00000	V30	INTEGER	00000
V11	INTEGER	00000	V31	INTEGER	00000
V12	INTEGER	00000	V32	INTEGER	00000
V13	INTEGER	00000	V33	INTEGER	00000
V14	INTEGER	00000	V34	INTEGER	00000
V15	INTEGER	00000	V35	INTEGER	00000
V16	INTEGER	00000	V36	INTEGER	00000
V17	INTEGER	00000	V37	INTEGER	00000
V18	INTEGER	00000	V38	INTEGER	00000
V19	INTEGER	00000	V39	INTEGER	00000
V20	INTEGER	00000	V40	INTEGER	00000

FMT: OFF

REMOTE 565 RUN

EXIT-F1 FIND-F2 V-F3 K-F4 SYNTGL-F5 FMTGL-F6 READ-F7 WRITE-F8 -

K1	INTEGER	00000	K21	HEX	0000 ..
K2	INTEGER	00000	K22	REAL	+0.00000
K3	INTEGER	00000	K23		
K4	INTEGER	00000	K24	BINARY	0000000000000000
K5	INTEGER	00000	K25	INTEGER	00000
K6	INTEGER	00000	K26	INTEGER	00000
K7	INTEGER	00000	K27	INTEGER	00000
K8	INTEGER	00000	K28	INTEGER	00000
K9	INTEGER	00000	K29	INTEGER	00000
K10	INTEGER	00000	K30	INTEGER	00000
K11	INTEGER	00000	K31	INTEGER	00000
K12	INTEGER	00000	K32	INTEGER	00000
K13	INTEGER	06400	K33	INTEGER	00000
K14	INTEGER	06400	K34	INTEGER	00000
K15	INTEGER	06400	K35	INTEGER	00000
K16	INTEGER	00000	K36	INTEGER	00000
K17	INTEGER	00000	K37	INTEGER	00000
K18	INTEGER	00000	K38	INTEGER	00000
K19	INTEGER	00000	K39	INTEGER	00000
K20	INTEGER	00000	K40	INTEGER	00000

2.4 mA

FMT: OFF

REMOTE 565 RUN

HEX-F1 BIN-F2 INT-F3 +/- -F4 DOUBLE-F5 REAL-F6 TMR.1S-F7 TMR1MS-F8 -

	Y/N	FROM	TO	SYN	CON
DISK TITLE:.....	N				
MEMORY CONFIGURATION:	N				
LADDERS:					
RANGE:.....	N	000001	008192	N	N
NOPS:.....	N				
DESCRIPTORS:....	N				
V-MEMORY:.....	N	000001	002048	N	
K-MEMORY:.....	N	000001	001024	N	
S-MEMORY:					
LOOPS:.....	N	01	64		N
ANALOG ALARMS:..	N	001	125		N
SF PROGRAMS:....	N	0001	1023		N
SF SUBROUTINES:..	N	0001	1023		N
I/O CONFIGURATION:					
(CHANNEL, BASE):	N	1 00	2 15	N	
SYNONYM CHARTS:					
I/O ELEMENTS:....	N	0001	2048		
CONTROL RELAYS:..	N	00001	02048		
SKP/LBL/GTS/SBR:	N	001	255		
JMP/MCR/END:.....	N				

REMOTE 565 RUN

EXIT-F1 EXECUTE-F2 SETUP-F3

PAGE HEADER:

LINES PER PAGE:(65 TO 132)..... 66
 DATE:..... 04-17-90
 PRINT RIGHT MARGINS:(YES NO)..... YES
 FORM FEED:(YES NO)..... YES
 PRINT LINE FEED ON CARRIAGE RETURN:(YES NO)..... NO
 PRINT OUTPUT:(PRINTER FILE)..... PRINTER
 FILE NAME: PRFILE.LIS

FROM OPERATOR

REMOTE 565 RUN

EXIT-F1 READDK-F2 WRITDK-F3 PRTCTL-F4 RDDATE-F5

TITLE: LOOP1

SF PROGRAM

CONTINUE ON ERROR (Y,N): NO
 ERROR STATUS ADDR (Y,C,WY,V):
 PROGRAM TYPE (N,P,C,R): PRIORITY
 CYCLE TIME (SEC): 0.0

```

00001 V1001 IS LOOP 1 SET POINT FROM SOFTWARE LAM
00002 V1002 STORES LAST VALUE OF LOOP 1 SET POINT
00003 LSP1 IS LOOP SET POINT FROM HARDWARE LAM AND IS VALUE LOOP 1
      USES TO DETERMINE OUTPUT
00004 IF V1002 <> V1001
00005 IMATH LSP1 := V1001
00006 ENDIF
00007 IMATH V1001 := LSP1
00008 IMATH V1002 := LSP1
END
  
```

S-MEMORY AVAILABLE:1241E

ENABLED

REMOTE 565 RUN

EXIT-F1 EDIT-F2 FIND-F4 DELST-F5 INSET-F6 COMMENT-F7 EN/DIS-F8

SF INSTRUCTIONS:

MATH/IF FUNCTIONS:

ELEMENTS:

			(INTEGER)	(REAL)	(INT/REAL)
FTSR-IN	ABS	FRAC	DCP	AACK	APVH
FTSR-OUT	ARCCOS	LN	DSC	ACF	APVL
COBIN	ARCSIN	LOG	DSP	ACFH	ARCA
SCALE	ARCTAN	ROUND	STW	ACFL	ATS
UNSCALE	CEIL	SIN	TCC	AVF	LKC
MATH	COS	SQRT	TCP	LACK	LKD
IMATH	EXP	TAN	C	LCF	LPVH
IF	FLOOR	TRUNC	X	LCFH	LPVL
ELSE			Y	LCFL	LRCA
ENDIF			SFEC	LVF	LTD
SDT			LRSF	LRSN	LTJ
CDT					LTS
SSR					

PRINT OPTIONS:	
%NNN	:TIME
<FF>	:DATE

EXPRESSION OPERATORS:	
() (: :) NOT	MOD + - << >> WAND WDR WXOR :=
NOT VALID IN IMATH:	= <> < <= > >= AND OR
HEX CONSTANT: 0H	BINARY CONSTANT: 0B

(READ ONLY)	
ASPH	LSPH
ASPL	LSPL
AYDA	LYDA

EXIT-F1

TISOFT
ATE: 04-04-90

PAGE 1
REMOTE 565 RUN

PID LOOP 1 TITLE: PIC501N

1 /VEL PID ALGORITHM: POS
LOOP VFLAG ADDRESS: V1011
SAMPLE RATE (SECS): +0.10000

PROCESS VARIABLE ADDRESS: WX22
PV RANGE: LOW = +0.00000
HIGH = +90.0000

PV IS BIPOLAR: NO
SQUARE ROOT OF PV: NO
20% OFFSET ON PV: YES

LOOP OUTPUT ADDRESS: V1006
OUTPUT IS BIPOLAR: NO
20% OFFSET ON OUTPUT: YES

RAMP/SOAK PROGRAMMED: NO
RAMP/SOAK FOR SP: NO

ALARM DEADBAND: +0.00000

MONITOR LOW-LOW/HI-HI: NO
MONITOR LOW/HIGH: NO
V ALARMS: LOW-LOW = +0.00000
LOW = +0.00000
HIGH = +0.00000
HIGH-HIGH = +0.00000

REMOTE SETPOINT: NONE
CLAMP SP LIMITS: LOW = +0.00000
HIGH = +90.0000

LOOP GAIN: +7.99989
RESET (INTEGRAL TIME): +INF
RATE (DERIVATIVE TIME): +0.00000
FREEZE BIAS: NO

DERIVATIVE GAIN LIMITING: NO
LIMITING COEFFICIENT: +10.0000

SPECIAL CALCULATION ON: SP
SPECIAL FUNCTION: SFPCM1

LOCK SETPOINT: NO
LOCK AUTO/MANUAL: NO
LOCK CASCADE: NO

ERROR OPERATION: NONE
REVERSE ACTING: NO

MONITOR DEVIATION: NO
DEVIATION ALARM: YELLOW = +0.00000
ORANGE = +0.00000

MONITOR RATE OF CHANGE: NO
RATE OF CHANGE ALARM: +0.00000

MONITOR BROKEN XMITTER: NO

TISOFT
DATE: 04-04-90

PAGE 2
REMOTE 565 RUN

PID LOOP 1

RAMP/SOAK FLAG ADDRESS NONE

STEP	R/S	STATUS	SETPOINT	RAMP RATE	SOAK TIME	DEADBAND
		BIT	(UNITS)	(UNITS/MIN)	(MIN)	(UNITS)

Table 9 V-Flags

VALUE	BIT NO.	FUNCTION
	Control Bits	
$2^{15} = 32768$	1	1 = Go to manual mode <u>NOT 2^1</u>
$2^{14} = 16384$	2	1 = Go to auto mode
$2^{13} = 8192$	3	1 = Go to closed cascade mode
	Status Bits	
$2^{12} = 4096$	4	1 = Loop is in auto mode
$2^{11} = 2048$	5	1 = Loop is in closed cascade mode
$2^{10} = 1024$	6	0 = Error is positive 1 = Error is negative
$2^9 = 512$	7	1 = PV is in high-high alarm
$2^8 = 256$	8	1 = PV is in high alarm
$2^7 = 128$	9	1 = PV is in low alarm
$2^6 = 64$	10	1 = PV is in low-low alarm
$2^5 = 32$	11	1 = PV is in yellow deviation alarm
$2^4 = 16$	12	1 = PV is in orange deviation alarm
$2^3 = 8$	13	1 = PV is in rate-of-change alarm
$2^2 = 4$	14	1 = Broken transmitter alarm
$2^1 = 2$	15	1 = Loop is overrunning <u>NOT 2^{15}</u>

ANALOG ALARM 1 TITLE:

ALARM VFLAG ADDRESS: NONE

SAMPLE RATE (SECS): +1.00000

PROCESS VARIABLE ADDRESS: NONE

PV RANGE: LOW = +0.00000

HIGH = +100.000

PV IS BIPOLAR: NO

SQUARE ROOT OF PV: NO

20% OFFSET ON PV: YES

ALARM DEADBAND: +0.00000

MONITOR LOW-LOW/HI-HI: NO

MONITOR LOW/HIGH: NO

PV ALARMS: LOW-LOW = +0.00000

LOW = +0.00000

HIGH = +100.000

HIGH-HIGH = +100.000

S-MEMORY AVAILABLE:12418

EXIT-F1 EDIT-F2

MONITOR REMOTE SETPOINT: NO

REMOTE SETPOINT: NONE

CLAMP SP LIMITS: LOW = +0.00000

HIGH = +0.00000

SPECIAL FUNCTION: NONE

MONITOR DEVIATION: NO

DEVIATION ALARM: YELLOW = +100.000

ORANGE = +100.000

MONITOR RATE OF CHANGE: NO

RATE OF CHANGE ALARM: +0.00000

MONITOR BROKEN XMITTER: NO

ENABLED

REMOTE 565 RUN

COMMNT-F7 EN/DIS-F8

The Alarm Flag Address requested in Figure 19 is the address of a set of eleven discretes or a word that is used to control and monitor the alarm. Table 10 lists the bits of the alarm flag and gives the meaning indicated by each bit.

Table 10 Alarm Flag Bits

Control Flags	-	These bits are set by the user to control the alarm.
Bit 1		1 = Enable alarm.
Bit 2		1 = Disable alarm.
Status Flags	-	These bits are set by the Analog Alarm to indicate the status of the alarm. If the alarm is disabled, then all of these bits are reset.
Bit 3		1 = PV is in high-high alarm.
Bit 4		1 = PV is in high alarm.
Bit 5		1 = PV is in low alarm.
Bit 6		1 = PV is in low-low alarm.
Bit 7		1 = PV is in yellow deviation alarm.
Bit 8		1 = PV is in orange deviation alarm.
Bit 9		1 = PV is in rate-of-change alarm.
Bit 10		1 = Broken transmitter alarm.
Bit 11		1 = Analog Alarm is overrunning.

7.2 BITP (Bit Pick)

The BITP instruction, Figure 26, tests a selected bit of a specified memory word to determine its status. The selected bit is not affected by the BITP instruction, and retains its value in memory.

Figure 26 BITP Format

7.2.1 Operation

When the input of the BITP box is on, the instruction checks the status of bit nn of the word located in memory location A. If the status of the selected bit is 1, the output of the box turns on. If the status of the selected bit is 0, the output of the box remains off. If the BITP input is left on, the instruction executes every memory scan.

7.3 BITS(Bit Set)

The BITS instruction sets a selected bit of a word to 1. Figure 27 illustrates the format of the Bit Set instruction.

Figure 27 BITS Format

7.3.1 Operation

When the input of the BITS box is on, the instruction sets bit nn of a word in memory location A to 1. When the instruction is completed, the output of the box turns on. If the BITS input is left on, the instruction executes each memory scan.

CCSIV Lesson 4

XPRESSLINK

Handouts

Database Create Menu, Database Builder/ Block Define Function, Analog Input/General Calculation, Summer '89 lecture outlines: Database, Alarm System, Draw

CONFIG.POL- This is a file which configures the data acquisition (polling) of the TI565 to Xpresslink Driver. The Driver is the liaison between Xpresslink and the PLC.

A 565:0:0 V1200 7 1

A- analog or digital are the options

565:0:0- PLC:communication port(COMM1(0) or COMM2(1): station number which is always 0

V1200- starting of address read

7- Words/bits read/write

Starting Address	# Words/bits Read
0-1010	15
1011-1012	14
1012-1014	13
1015-1016	12
1017-1018	11
1019-1020	10
1021-1022	9
1023-1024	8
1025-99999	7

1- Poll time. -1 is write only, 0 is fast as possible, 1-32767 seconds

XL Database

DBC-database create

Used to allocate space for different types of blocks. Can always make a database larger but never smaller.

DBB- database builder- used to define names to I/O points, place alarm points, and select other options. After changes are made to the database and saved to the disk, the database must be reloaded into the memory through the LOAD command.

AI-analog input. Items are scaled to 0-32767 integer but most of the real engineering values are represented as a 6400-32000 integer. This requires a linear scaling.

NEXT BLOCK- leads to a secondary block such as a general calculation block or a trending block

GENERAL CALCULATION BLOCK- Enter constants or tag names in 'B-H' and input the equation using these variables to the right of the output. 'A' is used for the previous block

LAB-Creating a Link

OBJECTIVE: WX60 is an imaginary 0-100psia(4-20ma) pressure transmitter with the following alarm points: 20LL, 40L, 60H, 80HH. Dead band is 1 psia. Upon any alarm, we wish to close coil C30. Upon a low alarm, we want to flash the pressure in VIEW any color of your choosing. Also, multiply the pressure by 0.67 and display this value next to the pressure.

ALT-F1 brings up the help function of the selected item.

0 psia SHOULD CORRESPOND TO 4 mA → 6400
100 psia SHOULD CORRESPOND TO 20 mA → 32000

MUST SCALE FROM ~~0~~ 32,767

-----DATABASE CREATE FUNCTION-----

-----PRIMARY BLOCKS-----

AI - ANALOG INPUT	80
- ANALOG OUTPUT	20
DI - DIGITAL INPUT	70
DO - DIGITAL OUTPUT	20

-----SECONDARY BLOCKS-----

CA - GENERAL CALC	15
TR - TREND	10

BL - BOOLEAN BLOCK	5
--------------------	---

CV - COIL VALUE	30
RV - REGISTER VALUE	40

SD - STATISTICAL DATA	5
-----------------------	---

HE - HELP	
EX - EXIT DBMAKE	

TT - TOTALIZER	5
SC - STATISTICAL CONTROL	5

OLD - OLD DATABASE NAME	DATABASE
NEW - NEW DATABASE NAME	DATABASE
CR - CREATE DB FILE	

Total db size: 54.23 K

Press <F1> for help at any time

Reading database: DATABASE
SELECT ITEM:

→ 500K AVAILABLE

DBB - DATA BASE BUILDER

ADD - ADD A BLOCK
MOD - MODIFY A BLOCK
DUP - DUPLICATE A BLOCK
DEL - DELETE A BLOCK

REP - REPORT BLOCK(S)
LIST - LIST TAGS
CHECK- CHECK FOR MISSING TAGS

SAVE - SAVE DATA BASE TO DISK
LOAD - RELOAD A DATA BASE FROM DISK

READ - READ AN INPUT FILE FROM DISK

HELP - FOR MORE INFORMATION
EXIT - EXIT FROM DBB

Press <F1> for help at any time

Current Database Location: c:\xl\database\

SELECT FUNCTION:

BLOCK DEFINE FUNCTION

---PRIMARY BLOCKS---

AI - ANALOG INPUT
AO - ANALOG OUTPUT
DI - DIGITAL INPUT
DO - DIGITAL OUTPUT

CV - COIL VALUE
RV - REGISTER VALUE
SD - STATISTICAL

---PROGRAM BLOCK---

BL - BOOLEAN LOGIC

HE - HELP
EX - EXIT TO MAIN MENU

---SECONDARY BLOCKS---

CA - GENERAL CALC

TR - TREND

TT - TOTALIZER
SC - STAT CONTROL

Press <F1> for help at any time

Key Selection:

ANALOG INPUT

AG.....DPT547N	DESC....DIF. PRESS. BETWEEN DEWAR TOP AND BOTTOM
V-DEVICE.....565	
T- N OPTIONS.565:0:0	
O-ADDR.....WX23	
C-SIG COND....	LL-LO LO ALM... 25.00 NX-NEXT BLK....LN2VOLCA
	AL-LO ALARM.... 26.00
L-LO EGU..... -18.75	AH-HI ALARM.... 72.00
H-HI EGU..... 77.25	HH-HI HI ALM... 76.00
T-EGU TAG....."H2O	RC-ROC ALM..... 0.00
	DB-DEAD BAND... 0.00
T-SCAN TIME...10	AP-ALM PRI.....H
M-SMOOTHING...0	AD-ALM DEST....THF
S-INIT SCAN...ON	AE-ALM ENABLE..ENABLE
	CC-ALM CONTACT.
	CM-CC ALM MODE.ANY

→ RATE OF CHANGE ALARM

HELP - FOR MORE INFO
EXIT - LOOP DEFINITION COMPLETE

Press <F1> for help at any time

SELECT ITEM:

GENERAL CALC

TAG.....LN2VOLCA		NX-NEXT BLK....
	A - PREVIOUS BLOCK	CP-COPY TO.....
EL-LO EGU..... 0	B - INPUT 2.... 396.74	
EH-HI EGU..... 21027	C - INPUT 3.... 69.881	
ET-EGU TAG.....GAL	D - INPUT 4.... 5.5364	
EN-ROUND ENAB..N	E - INPUT 5.... 2.0000	
	F - INPUT 6.... 0.0416	
	G - INPUT 7.... 3.0000	
	H - INPUT 8.... 0.00	

THE CALCULATION: (USE A THROUGH H AS TERMS)

OUTPUT = ((((-B)+(C*A)))+(D*(A^E)))-(F*(A^G))

HELP - FOR MORE INFO
EXIT - LOOP DEFINITION COMPLETE

Press <F1> for help at any time

SELECT ITEM:

THE DATABASE AND YOU

CCS LESSON 7

8/16/89 KDD/JMW

SEPERATE EXPLANATIONS ARE ONLY GIVEN
TO NON-OBVIOUS TOPICS

I. Hand Outs

A. Menus

1. Database create function
2. Databse builder
3. Block define function
4. Analog inputs(2)
5. Analog output
6. Digital input
7. Digital output
8. Coil value
9. Register value
10. Statistical data
11. Boolean logic
12. General calculations(3)
13. Trend
14. Totalizer
15. Statistical control

B. Tag list

C. Help files

II. DBC- Database Create

- A. Create the initial size of the database by specifying the estimated amount of tags in each block.
- B. Can increase but not decrease the size of the database once it is configured and data is entered.

III. DBB- Database builder

A. ADD

1. Primary Blocks
 - a) AI-analog input
 - 1) TAG
 - 2) SC-signal condition
 - 3) SM-smoothing
 - 4) IS-initial scan

- 5) NX-next block
- b) AO-analog output
 - 1) OR-out reverse
 - 2) LR-rate limit
 - 3) NX-next block
 - 4) CP-copy to
- c) DI-digital input
- d) DO-digital output
- e) CV-coil value
- f) RV-register value
- g) SD-statistical data
 - 1) WT-wait time
 - 2) IA-initial A/M
 - 3) IN-input
 - 4) NO-obsrv/group
 - 5) NG-number groups
 - 6) XB-auto xbarbar
 - 7) A1-1
 - 8) A3-3
 - 9) R1-1
 - 10) TR-trend runs
 - 11) LR-len runs
 - 12) CR-critical runs
- 2. Program Block
 - a) BL-boolean logic
 - 1) A:H-input 1:8
 - 2) OUTPUT
- 3. Secondary Block
 - a) CA-general calculation
 - 1) B:H-input 2:8
 - 2) OUTPUT
 - b) TR-trend
 - 1) AT-average/compress
 - c) TT-totalizer
 - 1) DF-display format
 - 2) PER
 - d) SC-statistical control
 - 1) SL-slope con
 - 2) DE-dev con
 - 3) AT-add to
 - 4) DT-delay time
 - 5) RE-recalc
 - 6) TR-track message

7) SH-show calc

B. MOD

C. DUP

D. DEL

E. REP

F. LIST

1. "ctrl-prtsc" advances the list one screen size which is approximately 1/2 a paper page

G. CHECK

H. SAVE

I. LOAD

J. READ

K. HELP

L. EXIT

CCS4, THE ALARM SYSTEM

1. Handouts

XpressLink Operator's Guide:

Chapter 2: Operating VIEW, p. 20-22

Chapter 3: Operating with Alarms, p. 23-27

XpressLink Development Guide:

Chapter 2: Developing the Database, p. 45-49, p. 52-53

Chapter 3: Developing the Displays, p.102-103, p.145-146

Printouts of online help for alarm topics.

2. Alarm indication and information:

The scan and alarm program (SAC) runs in the background.

The view screen- The LN2 dewar system (a familiar screen).

The lesson four make believe screen - all the options.

- Link color
- Alarm status link
- Alarm enable link
- Analog input alarm bar graph link
- Change color based on alarm status link
- Alarm history link
- System alarm mask link

Additional alarm history options:

- Printer output after alarm
- History of alarms stored in fixed disc file - initiated by the alarm logger background function

CCS4, THE ALARM SYSTEM

3. Setting up the alarms:

In database builder- developing alarm parameters in a primary block

- Analog input
 - * LL-LO LO ALARM
 - * AL-LO ALARM
- Analog input (cont.)
 - * AH-HI ALARM
 - * HH-HI HI ALARM
 - * RC-RATE OF CHANGE ALARM
 - * DB-DEAD BAND
 - * AP-ALARM PRIORITY.....L (LOW-L, M, OR H ALARMS ARE PRINTED), M (MEDIUM-M OR H ALARMS ARE PRINTED) or H (HIGH-H ALARMS ARE PRINTED)
 - * AD-ALARM DESTINATION.....T (PRINTER), H (HISTORY WINDOW) and/or F (FILE)
 - * AE-ALARM ENABLE.....Y (ENABLE) or N (DISABLE)
 - * CC-ALARM CONTACT
 - * CM-CC ALARM MODE.....ANY OR NEW
- Digital input
 - * AT-ALARM TYPE.....COS (CHANGE OF STATE), OPN (NORMALLY OPENED-ALARMED WHEN CLOSED), CLS (NORMALLY CLOSED-ALARMED WHEN OPENED) OR NONE (NO ALARM PROCESSING)
 - * AD-ALARM DESTINATION.....T (PRINTER), H (HISTORY WINDOW) and/or F (FILE)
 - * AP-ALARM PRIORITY.....L (LOW-L, M, OR H ALARMS ARE PRINTED), M (MEDIUM-M OR H ALARMS ARE PRINTED) or H (HIGH-H ALARMS ARE PRINTED)
 - * AE-ALARM ENABLE.....Y (ENABLE) or N (DISABLE)
 - * CC-ALARM CONTACT
 - * CM-CC ALARM MODE.....ANY OR NEW

CCS4, THE ALARM SYSTEM

In draw - developing alarm related displays

-Addlink or modlink

- * TEXT

- ALM-STA.....ALARM STATUS
- ALM-ENA.....ALARM ENABLE
- AIALM-B.....BAR GRAPH

- * COLOR

- COL-ALM.....COLOR ALARM MAP

- * SPECIAL

- ALM-HIS.....HISTORY WINDOW
- ALM-PRI.....ALARM PRIORITY

4. Lesson four hands on and/or question period

JW/JU 8/89

CCS Lesson 5- DRAW

8/9/89 JMW

DRAW

Direct- Lists displays

Delete- Delete a display

Sub-Dir- Lists subpictures

Sub-Del- Deletes a sub-picture

Help

New or Modify

Line

Circle

Box

Bar- a box colored in the foreground(F) and background(B) colors.

Text

Fill- colors a closed in area in the F and B colors selected.

Cut- cuts the items in a selected window/this function also places the selected item in the paste buffer for sub-picture defining and item movement.

Paste- pastes an item in the paste buffer

Getsub- gets a specified sub-picture and places it in the paste buffer

Putsub- adds a sub-picture selected through the Cut function

Undo- negates the last operation performed

Erase- resembles an eraser and is activated when the left mouse key is depressed(erases by coloring the area the background color)

Clear- erases entire screen

Grid- places a grid on the surface as an aid to display building

Rotate- rotates about a diagonal line in a selection box

Fatbit- allows the user to select a small area on the screen and modify it on a pixel by pixel basis

Scale- allows the user to increase or decrease the size of an object

Addlink

Text

Output- used to display the output of a block

Tar-sp- not applicable_we don't have PI or RM blocks

Alm-sta- displays the alarm status of the link(lolo, lo, hi, etc.)

Out-bar- displays output in a bar graph format
Tar-bar- Not applicable_PI or RM
Subpic- displays subpictures dependant on the value of a
 block(Note prefix in help file)
Tag- used to display the tag group associated with a block
Sel-area- used to define an area on the screen for cursor
 movement
Egu-tag- displays the units tag associated with a block
Desc- used to display the descriptor of a tag
Alm-ena- used to show and enable/disable an alarm
Aialm-b- draws a tick bar graph of an alarm
Tuning- Not applicable

Color

Col-alm- changes the color of a portion of the screen
 depending on the status of an alarm
Col-val- changes color depending on the status of a
 tag(blow down)

Special

Newpic- links to a new picture
Time
Date
Alm-his- displays a portion or all of the 24 line alarm
 buffer
Trend- used to link a trend block to a portion of the
 picture/the actual time represented depends on the
 trend interval and scan time of the previous block
Alm-pri- displays alarm priority(low, med, or hi)
Sta- Displays system status(SAC, CPU usage, and
 Overruns)
Sda- displays XBAR or R data in a chart form
Mac- screen macro link

Display

Password- defines password for page(use F-9 and then
 password in view)
Pgup- defines pgup key
Pgdn- defines pgdn key
Fcn-key- defines .EXE to be run at the stroke of a function
 key
Key- used to set up the key macros
Modlink- modify links created in Addlink
Dellink- deletes links
Bottom of screen
Foreground color- each pixel has a foreground color....

Background color- ...and a background color

Fill- determines the pattern of the fill

Line- determines line size

Text- Determines a line size

CMD- shows command in use

Exit

110 VAC Wiring

Module wiring

Terminal wiring

Analog 4-20 ma input wiring

CCSIV Lesson 5

XPRESSLINK II

Handouts

Key Macro Editor Menu/File, Historical Data Display and Report Forms

Solution to Last Week's Lab

Both addresses must be in the CONFIG.POL file. In this case, WX60 was but C30 was not (contrary to what I told you). We made another mistake in defining the Alarm Contact in the Analog Input. The value in this item must be a tag name that is in the database and not the contact itself. You must then create an additional Digital Output block with the same name as that indicated in the Alarm Contact. This DO must then reference contact C30.

KEY MACRO EDITOR-KME- Used to provide a series of keystrokes based on the input of a single ASCII character, e.g. "ctrl k" or "esc". There is a default Key Macro File which is used in every picture in VIEW only if a different Key Macro File isn't requested from the picture being viewed.

Enter from main menu(KME)

Modify or create a new file

Place cursor before left space, hit return, and enter a single ASCII character. Enter key strokes to be activated to the right in the same manner.

To access a non-default Key Macro File from a picture, enter the picture in draw, select ADDLNK, select DISPLAY, select KEY, and then enter the name of the file you created in KME.

HISTORICAL TRENDING (revised from GTM document of 7/89)

HTA- Historical Trending Assignment

MODIFY TAG ASSIGNMENTS- Up to 150 Tags. Manual indicates that you must re-boot XL(<F10> until prompted, <ALT-

Y>,<CTRL-ALT-DEL>, and <RUNXL>) to load in the modified Tag Assignments. I am testing this statement.

Generic parameters for all Data Groups

BASE COLLECTION RATE 2,6,30, or 60 sec(6 sec default)
FILE LENGTH 2,4,8, or 24 hrs on the hour
SAVE DATA FOR __ Days (0= no deletion)
(deletes Data older than __ Days)

Specific parameters for all Data Groups

COLLECTION MODE SAMPLE;discrete samples
AVERAGE over the scan period
LIMIT 0.00 TO 100.00%, default 1.00%
A data point is recorded if the difference between its value and the previous value is greater than the limit.
SCAN PERIOD 2,6,10,30 sec,1,5,10,30 min,1hr

HDD-Historical Data Display

GROUP Specify Group. After entering the group, XL lists up to 8 Tags in the group each assigned a different color.

LIST GROUP

DATA TIME PERIOD Start Time, Start Date, Duration. Previous 1,2, or 8 hrs. and repeat for next 1,2, or 8 hrs.

FIELD Data VALUE Only

MODE Same as Collection Mode in HTA

LOEGU Low engineering unit

HIEGU High engineering unit

DISPLAY TREND SCREEN Activates the Display

<up arrow> Toggles Y-axis Eng. Unit Labels

<down arrow> Toggles Y-axis Eng. Unit Labels

<rt. arrow> Move VALBAR or crosshair rt.

<lft. arrow> Move VALBAR or crosshair lft.

INSert changes VALBAR step by 10 or 0.1

<ctrl-rt. arrow>	Slide Time Window forward
<ctrl-lft. arrow>	Slide Time Window backward
<ALT-G>	Toggles Grid on display
<ALT-P>	Pan(compress) the Graphic Display
<ALT-Z>	Zoom Mode (mouse inactive)
<up/down arrow>	Move crosshair up/down
<left/right arrow>	Move crosshair rt./lft.
<ALT-A>	Send graphic data to an ASCII file
<ALT-L>	Send graphic data to Lotus .PRN file
<ALT-R>	Send graphic data to Printed Report

HDR-Historical Data Report

Same as HDD with the following additions

INTERVAL	report interval(secs, up to 9998)
REPORT TO:	Lotus file, printer, ASCII file

HTC- Historical Trending Collection

E	stops program
<ALT-X>	returns to main menu
S	shows status

LAB-USING HDD

OBJECTIVE: Display the group associated with the Lar dewar for 12 hours starting at 10:00AM on 4/27/90. Zoom in on a small 1" by 1" section in the middle of the graph and then pan out until the time range is at least 20 hours.

THE KEY MACRO EDITOR

EDITOR OPTIONS

NEW - CREATE A NEW KEY MACRO FILE
MOD - MODIFY A KEY MACRO FILE
DEF - MODIFY DEFAULT KEY MACROS
DEL - DELETE A KEY MACRO FILE
DIR - DIRECTORY OF KEY MACRO FILES

UTILITIES

HELP- FOR MORE INFORMATION
EXIT- EXIT FROM KME

Hit <ALT><F1> for help on a selected topic.
SELECT FUNCTION:

KEY MACRO EDITOR

KEY	*****MACRO*****	**KEY**	*****MACRO*****
ESC <ALT-P>DIR<cr>		<F2> <ALT-P>ALARM<cr>	
<ALT-P>SYSCTRL<cr>			
CTRL W <ALT-P>AUTHORS<cr>		CTRL-N <ALT-P>LN2DE	
WAR<cr>			
CTRL A <ALT-P>LARDEWAR<cr>		CTRL-I <ALT-P>IASYSTEM<cr>	
CTRL-V <ALT-P>VACUUM<cr>		CTRL-O <ALT-P>GIB<cr>	

HELP - FOR MORE INFORMATION

EXIT - EXIT BACK TO MAIN MENU

SELECT FUNCTION:

--- HISTORICAL DATA DISPLAY MENU ---

GR - GROUP NAME: IASYSTEM
ST - START TIME: 12:49:38
SD - START DATE: 05-02-90

P1 - PREVIOUS 1 HOUR
P2 - PREVIOUS 2 HOURS
P8 - PREVIOUS 8 HOURS

DD:HH:MM:SS
DU - DURATION: 00:02:00:00

SA - SAVE DATA AS A GROUP
LI - LIST GROUP DIRECTORY
HE - FOR MORE INFORMATION
EX - EXIT HDD PACKAGE

DI - DISPLAY TREND SCREEN

COLOR		TAG NAME	FIELD	MODE	LOEGU	HIEGU
WHITE	-	PT35	VALUE	SAMPLE	0.00000	140.000
RED	-	DPT16	VALUE	SAMPLE	0.00000	25.0000
BLUE	-	HT36	VALUE	SAMPLE	-60.000	20.0000
GREEN	-		VALUE	SAMPLE	DEFAULT	DEFAULT
YELLOW	-		VALUE	SAMPLE	DEFAULT	DEFAULT
CYAN	-		VALUE	SAMPLE	DEFAULT	DEFAULT
MAGENTA	-		VALUE	SAMPLE	DEFAULT	DEFAULT
BROWN	-		VALUE	SAMPLE	DEFAULT	DEFAULT

Group Read Complete.
SELECT FUNCTION:

--- HISTORICAL DATA REPORT MENU ---

GR - GROUP NAME: IASYSTEM
ST - START TIME: 12:53:44
SD - START DATE: 05/02/90

DD:HH:MM:SS
DU - DURATION: 00:02:00:00
IN - INTERVAL: 240

P1 - PREVIOUS 1 HOUR
P2 - PREVIOUS 2 HOURS
P8 - PREVIOUS 8 HOURS

LO - REPORT TO LOTUS PRN FILE
PR - REPORT DATA TO PRINTER
AS - REPORT TO ASCII DATA FILE

SA - SAVE DATA AS A GROUP
LI - LIST GROUP DIRECTORY

HE - FOR MORE INFORMATION
EX - EXIT HDR PACKAGE

	TAG NAME	FIELD	MODE
TAG #01	PT35	VALUE	SAMPLE
TAG #02	DPT16	VALUE	SAMPLE
TAG #03	HT36	VALUE	SAMPLE
TAG #04		VALUE	SAMPLE
TAG #05		VALUE	SAMPLE
TAG #06		VALUE	SAMPLE
TAG #07		VALUE	SAMPLE
TAG #08		VALUE	SAMPLE
TAG #09		VALUE	SAMPLE
TAG #10		VALUE	SAMPLE
TAG #11		VALUE	SAMPLE
TAG #12		VALUE	SAMPLE
TAG #13		VALUE	SAMPLE
TAG #14		VALUE	SAMPLE
TAG #15		VALUE	SAMPLE
TAG #16		VALUE	SAMPLE
TAG #17		VALUE	SAMPLE
TAG #18		VALUE	SAMPLE
TAG #19		VALUE	SAMPLE
TAG #20		VALUE	SAMPLE

Group Read Complete.
SELECT FUNCTION:

control class IV

Lesson 6

**Introduction to PID loop
process control**

D0 cryo Control

Dan Markley 5/10/90

PNEUMATIC CONTROL

ADVANTAGES:

COMPONENTS UNDERSTANDABLE BY OPERATORS
MAINTAINABLE BY PLANT-LEVEL TECHNICIANS
ENVIRONMENTALLY TOLERANT - NON-EXPLOSIVE
MIX-AND-MATCH COMPONENTS FROM ANY VENDOR
PREDICTABLE PROJECT COST
ALMOST OBSOLESCENCE-PROOF

DISADVANTAGES:

MANY SEPARATE DEVICES IN THE LOOP
CONTROL LOOPS USUALLY OVERLY SIMPLE
DUE TO SIGNAL TRANSMISSION LAG,
CONTROL LOOPS USUALLY SLOW
LOOP MANIPULATION (I.E., A/M SWITCHING) NOT EASY
DIFFICULT TO MAINTAIN CALIBRATION
EACH VARIATION OF A DEVICE REQUIRED A DIFFERENT MODEL
NON-STANDARD RANGES
HIGH INSTALLATION COSTS
LOOP MODIFICATION A MAJOR TASK

HOME HEATING SYSTEM

PROCESS DYNAMICS

Control Actions/Modes

- Two-Position (On-Off) Control
- Proportional (Gain) Control
- Integral (Reset) Control
- Derivative (Rate) Control

PROPORTIONAL Gain Settings

$$m = K_c \left[e + \frac{1}{T_i} \int e \, dt \right]$$

Integral (Reset) Control Action

INTERGAL Rate Settings

Two-Position:

Inexpensive
Extremely simple

Proportional:

Simple
Inherently stable when properly tuned

Proportional-plus-reset:

No offset
Better dynamic response than reset alone
Possibilities exist for instability due to lag introduced

Proportional-plus-reset-plus-rate:

Most complex
Most expensive
Rapid response
No offset
Difficult to tune
Best control if properly tuned

DERIVATIVE
ONLY ON SLOW
PROCESS

CONTROL MODE ADVANTAGES/DISADVANTAGES

Controller Response and Product Quality

Other Guidelines for Good Control
(Minimum Disturbance/Minimum Amplitude)

Stabilize the Process on Manual Control

Proper Setting
(1/4 Decay Ratio)

Proportional Gain
Setting Too Low
(PB too high)

Proportional Gain
Setting Too High
(PB too low)

Trial and Error Tuning (Proportional Mode)

(b) Proper Setting

(c) Too little reset action
(Reset time too high)

(d) Too much reset action
(Reset time Too Low)

Trial and Error Tuning (Reset)

SU - Cycle period
PB - Proportional band
T_i = Time integral
T_d = Time derivative
K_c = Gain

Proportional Only:

$$K_c = 0.5 S_u$$

$$(PB = P_{Bu} \times 2)$$

Proportional + Integral:

$$K_c = 0.45 S_u$$

$$(PB = P_{Bu} \times 2.2)$$

$$T_i = P_u / 1.2$$

Proportional + Integral + Derivative:

$$K_c = 0.6 S_u$$

$$(PB = P_{Bu} \times 1.7)$$

$$T_i = 0.5 P_u$$

$$T_d = P_u / 8$$

Ziegler/Nichols "ultimate" Method

Determining the Process Reaction Curve

Proportional only:

$$K_c = 1/L_r R_r$$

Proportional-plus-reset:

$$K_c = 0.9/L_r R_r$$

$$T_i = 3.33 L_r$$

Proportional-plus-reset-plus-rate:

$$K_c = 1.2/L_r R_r$$

$$T_i = 2.0 L_r$$

$$T_d = 0.5 L_r$$

Z/N Reaction Curve Method

VARIATIONS OF THE BASIC PID STRATEGY

- Cascade Control
- Ratio Control
- Feedforward Control

Ratio Control (Two Controlled Streams)

Combined Feedforward and Feedback Control

4: DEFINING LOOPS

4.1 INTRODUCTION

This section describes the process control features of the Model 565, gives the PID algorithms used, and discusses definition and entry of loop parameters.

4.2 GUIDELINES FOR DESIGNING A LOOP

In general, the following guidelines should be observed in developing loops for control of continuous processes. Figure 9 illustrates a configuration for a continuous process loop.

1. Develop a control configuration for the process. This involves several steps, which include:
 - Defining the control application
 - Drawing of a block diagram to illustrate the application
 - Determining the number and types of loops required.
2. Determine the specific parameters for each loop, such as the input hardware addresses, spans of the field transmitters for each input, output hardware addresses, etc.
3. Complete a Loop Program Sheet for each loop.
4. Enter the parameters into the 565 memory.

4.4 PROCESS CONTROL PID THEORY

The most commonly used control equation is the proportional-integral derivative (PID). Along with the basic PID control, the Model 565 offers error squared and error deadband options and incorporates an anti-windup algorithm on reset. The Model 565 implementations of PID control provide for bumpless transfer of configurations.

4.4.1 Proportional Control (Gain).

In the automatic mode, the controller generates an output based upon a value, called error, with error being the difference between the setpoint (the value the process would be under ideal conditions) and the actual value of the process variable. The error is represented by $E = SP - PV$. The simplest output derived from this relationship is ON or OFF; however, a more precise control of a process is often required. For example, it may be necessary for the output to be proportional to the error. With proportional control, the following equation is used.

4.4.1.1 Proportional Control Equation.

$$MO = KCe \quad \text{where}$$

MO = output
KC = gain
e = error = SP-PV

A typical output versus process variable graph is shown in Figure 10.

DEFINING LOOPS

Figure 11 Output vs Process Variable - KC of 2

The previous examples assume that, with a 50% PV, a 50% output is required to maintain the PV at SP. In many processes, this may not be the case. It may be that a 20% output is required, but a gain of 2 is still needed to maintain system response. The output at SP is then defined as the bias. To accomplish a 20% bias, the PB is shifted to the right, as shown in Figure 12.

4.4.1.4 Integral Equation.

In the error versus time curve, illustrated in Figure 13, the integral sum is the area under the curve. This can be expressed as:

$$I = \frac{T_S}{T_I} \sum_{i=0}^n e_i \quad \text{where}$$

T_S = sampling time
 T_I = reset time

Figure 13 Error Vs Time Curve

The reset time is the amount of time required for the integral sum to become equal to the proportional contribution. If $K_C e$ gives a 20% change in output after T_I minutes, the integral action will contribute another 20%, for a total output of 40%. It is assumed that e is not changing. Any change in output should reduce the error, eventually shifting the proportional band until the error is eliminated and the controller is reset automatically.

DEFINING LOOPS

4.4.2.1 Position Equation.

With the position form of the PID equation, the controller output is computed as:

$$M_n = K_c \left[E_n + \frac{T_s}{T_i} \sum_{J=0}^n E_J - \frac{T_d}{T_s} (PV_n - PV_{n-1}) \right] + M_x$$

where:

M _n - Loop output	T _i - Reset time
K _c - Proportional gain	T _d - Rate Time
E - Error (SP-PV)	M _x - Bias (M _x is the initial valve position.)
T _s - Sample time	

4.4.2.2 Velocity Equation.

The velocity form of the PID equation is obtained by subtracting the equation at time (n-1) from the equation at time (n).

$$\Delta M_n = M_n - M_{n-1}$$

$$= K_c \left[(E_n - E_{n-1}) + \frac{T_s}{T_i} E_n - \frac{T_d}{T_s} (PV_n - 2PV_{n-1} + PV_{n-2}) \right]$$

where:

M _n - Loop output	T _i - Reset time
K _c - Proportional gain	T _d - Rate Time
E - Error (SP-PV)	
T _s - Sample time	

Advantages of the velocity PID equation are:

- In the position form of the PID equation, the bias term (M_x) must be initialized prior to placing the loop in AUTO. (M_x contains the initial valve position). This step is not required in the velocity algorithm.
- Reset-windup protection is implicit in the velocity form of the equation.

DEFINING LOOPS

Table 8 C-Flags

BIT NO.	FUNCTION
1	0 = PV scale 0% offset 1 = PV scale 20% offset (only valid if PV is unipolar-see Bit 20)
2	1 = Take square root of PV
3	1 = Monitor HIGH/LOW alarms
4	1 = Monitor HIGH-HIGH/LOW-LOW alarms
5	1 = Monitor Yellow/Orange Deviation Alarm
6	1 = Monitor Rate-of-change alarm
7	1 = Monitor Broken Transmitter alarm
8	PID Algorithm type 0 = Position algorithm 1 = Velocity algorithm
9	0 = Direct Acting 1 = Reverse Acting
10	1 = Control based on error squared
11	1 = Control based on error deadband
12	1 = Auto-mode lock
13	1 = Cascade-mode lock
14	1 = Setpoint lock
15	0 = Output scale 0% offset 1 = Output scale 20% offset (only valid if output is Unipolar-see Bit 19)
16	1 = Special Function on the Process Variable
17	1 = Special Function on the Setpoint
18	1 = Freeze bias when output is out-of-range
19	1 = RAMP/SOAK on the setpoint
20	0 = Output is unipolar 1 = Output is bipolar
21	0 = PV is unipolar 1 = is bipolar
22	1 = Perform derivative gain limiting
23-32	Contains SF PGM number (if a special calculation has been designated for the PV or setpoint).

DEFINING LOOPS

4.6 SPECIFYING LOOP PARAMETERS

The following paragraphs provide information on the type of entries required in the Loop Programming Table. The entries are discussed in the order they appear in the Loop Programming Table.

4.6.1 PID Algorithm.

The PID algorithm to be used must be specified as either Position or Velocity. The differences between the two algorithms are discussed in the preceding paragraphs.

4.6.2 Loop Flag Address.

An entry in this field creates a destination for the data to be written from the V-flag table, with control and status bits as defined in Table 9. The address may either be a bit (Y or C, which allocates 15 contiguous bits) or an address (WY or V, which requires only one word). In either case, bits 1-3 are designated as control flags and may be changed to control the loop mode. Bits 4-15 indicate the status of the loop and are modified by the loops during execution.

HINTS

1. When working with control loops on the computers you must remember what you do affects actual process controls and associated equipment.
2. Setting the integral and the derivative to 0 eliminates them from the PID control equation.
3. When tuning start simple with less gain than you should need and proportional only, if possible. Then slowly add what you need by observing the reaction curve of the process.
4. Proportional gain--Where process is now
Integral gain --Where process has been (reset)
Derivative gain --Where process is going (rate)
5. If you get a loop in trouble such as in oscillation, windup, or process out of tolerance, break the loop by putting it in manual.
6. Bumpless means everytime you switch from auto to man you have to reset the % out. Everytime you switch from man to auto you will have to reset the setpoint.
7. Make sure when you tune a loop you consider other parameters besides pure tuning such as min/max process variables, valve movement, process quality, wear and tear on devices, sample rates, and indirect affects on other processes and parameters.
8. After making any changes look at the system as a whole and check to see that all loops are in the right mode and that the entire system is still functioning properly before you run away. It's surprisingly often that after a parameter change, there will be a direct or indirect upset with some time delay. This has been known as tweek and run, the invisible tweaker strikes again, or screwing the next shift (in this case the the poor man on call at home watching the football game).
9. When tuning a loop remember that, what gains are appropriate at one parameter may not work for another parameter, such as gains when a vessel is full compared to gains when a vessel is near empty.

CCSIV Lesson 7

Control Example

SLAM LAM Loop Control

Handouts

Loop 1/SFPGM 1(SP), Loop V flag defined, Ladder segment for loop1 and a manual loader, SFPGM 101(loop output), LN2 dewar Xpresslink SLAM.

Loop page

V1003 is the loop output

Call Special Function for SP control from loop page.

SFPGM 1

V1001 is the set point from the SLAM

V1002 stores the last value of the set point

LSP1 is the actual set point of the loop and is scaled according to the PV range. It does not have a 20% offset.

Loop flag address

Ladder segment

Line 165: A Bit Pick is used to determine if the loop is in auto mode. If it is, C102 is turned on.

Line 170: C100 is in series with C101 before a One Shot and a Bit Set. A one shot lets power flow through it for only one scan after its input changes from off to on. Bit Set sets go to auto control bit to 1. In order for the SLAM to send the loop to auto mode, C100 must be on.

Line 177: Normally closed C100 and C101 are in parallel ahead of One Shot 6 and go to manual mode Bit Set in series. Changing either C100 or C101 off(changes normally closed C100 or C101 on) sends the loop to manual mode.

Line 184: When C102 is on(loop is in auto mode), the loop output is sent to the valve and to the variable address Xpresslink location. The go to auto mode control bit is cleared to 0 with a Bit Clear.

Line 197: When loop is in manual mode, the program executes SFPGM 101(needed for valve position control) and clears the go to manual bit to 0.

SFPGM 101

Program remarks w.r.t. integer math and scaling.

Same function as SP SFPGM 1 with the actual valve position,WY109, remembering the last value.

LN2 dewar SLAM

C102 is STAT

C101 is CHANGE

This programming leads to the following complication. An operator on the hardware LAM changes the loop to manual mode. CHANGE indicates A(auto) but STAT indicates manual. To change the loop to auto from the SLAM, CHANGE must be set to M, the PLC must receive the modification(2to3s) and then CHANGE must be set to A.

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PID LOOP 1 TITLE: PIC501N

POS/VEL PID ALGORITHM: POS
LOOP VFLAG ADDRESS: V1011
SAMPLE RATE (SECS): +0.10000

PROCESS VARIABLE ADDRESS: WX22
PV RANGE: LOW = +0.00000
HIGH = +90.0000

PV IS BIPOLAR: NO
SQUARE ROOT OF PV: NO
20% OFFSET ON PV: YES

LOOP OUTPUT ADDRESS: V1003

OUTPUT IS BIPOLAR: NO
20% OFFSET ON OUTPUT: YES

RAMP/SOAK PROGRAMMED: NO
RAMP/SOAK FOR SP: NO

ALARM DEADBAND: +0.00000

MONITOR LOW-LOW/HI-HI: NO
MONITOR LOW/HIGH: NO
AV ALARMS: LOW-LOW = +0.00000
LOW = +23.0006
HIGH = +43.3987
HIGH-HIGH = +56.2609

Table 9 V-Flags

VALUE	BIT NO.	FUNCTION
	Control Bits	
$2^5 = 32768$	1	1 = Go to manual mode <u>NOT 2^1</u>
$2^4 = 16384$	2	1 = Go to auto mode
$2^3 = 8192$	3	1 = Go to closed cascade mode
	Status Bits	
$2^{12} = 4096$	4	1 = Loop is in auto mode
$2^{11} = 2048$	5	1 = Loop is in closed cascade mode
$2^{10} = 1024$	6	0 = Error is positive 1 = Error is negative
$2^9 = 512$	7	1 = PV is in high-high alarm
$2^8 = 256$	8	1 = PV is in high alarm
$2^7 = 128$	9	1 = PV is in low alarm
$2^6 = 64$	10	1 = PV is in low-low alarm
$2^5 = 32$	11	1 = PV is in yellow deviation alarm
$2^4 = 16$	12	1 = PV is in orange deviation alarm
$2^3 = 8$	13	1 = PV is in rate-of-change alarm
$2^2 = 4$	14	1 = Broken transmitter alarm
$2^1 = 2$	15	1 = Loop is overrunning <u>NOT 2^{15}</u>

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	POWER	BITP1	LOOP MODE
165	C2 *-----] [-----*	PIC501N STATUS WORD A: V1011 N= 4 *-----*	STATUS ON-A OFF-M C102 ()-----*
170	SEND + LOCK CHANGE LOOPS IN LOOP1 MODE MANUAL MODE ON-A OFF-M C100 C101 5 *-----] [-----] [-----:0:-----*	BITS1 PIC501N STATUS WORD A: V1011 N= 2 *-----*	DUMMY C1 ()-----*
177	SEND + LOCK LOOPS IN MANUAL MODE C100 6 *-----] [-----:0:-----*	BITS2 PIC501N STATUS WORD A: V1011 N= 1 *-----*	DUMMY C1 ()-----*
	CHANGE LOOP1 MODE ON-A OFF-M C101 *-----] [-----*		

184	LOOP STATUS ON-A C102 *--] [---	MOVW4 A: V1003 B: V1004 N= 1	MOVW5 A: V1003 I/P 501N P: WY109 N= 1	BITC1 PIC501N STATUS WORD A: V1011 N= 2	DUMMY C1 ()
197	LOOP MODE STATUS ON-A OFF-M C102 *---]/[---	SFPGM101	BITC2 PIC501N STATUS WORD A: V1011 N= 1	DUMMY C1 ()	
203	POWER C2 *---] [---	BITP5 MANUAL LOADER STAT ML513N A: V1061 N= 4	BITS9 MANUAL LOADER STAT ML513N A: V1061 N= 1	DUMMY C1 ()	

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T. LE: MANLOOP1

SF PROGRAM 101

CONTINUE ON ERROR (Y,N): NO
ERROR STATUS ADDR (Y,C,WY,V):
PROGRAM TYPE (N,P,C,R): CYCLIC
CYCLE TIME (SEC): 1.0

```
=====
00001 *      V1004 IS XPRESSLINKS MEMORY LOCATION FOR THE VALVE POSITION
00002 *      LMN1 IS THE LOOP OUTPUT WHICH IS MODIFIED BY THE HARDWARE LAM.
           LMN1 IS SCALED WITHOUT 20 PERCENT OFFSET WHICH REQUIRES SCALING
           TO TRANSFER TO WY109 AND V1004.
00003 *      THE ORDER OF THE SCALING OPERATIONS IS IMPORTANT.  THE INTEGER
           MATH IS CARRIED OUT FROM LEFT TO RIGHT.  ANY OPERATION MUST NOT
           EXCEED 32000, 8/10=0.8 CONVERTS TO 0, AND 10/8*V1004 CONVERTS TO
           1*V1004.
00004 IF      V1004 <> WY109
00005 IMATH    LMN1 := V1004 / 8 * 10 - 8000
00006 ENDIF
00007 IMATH    V1004 := LMN1 / 10 * 8 + 6400
00008 IMATH    WY109 := LMN1 / 10 * 8 + 6400
****  END  ****
```

WAVES

05-16-98