KOYO ADVANCED TRAINING COURSE

Course Outline

(Course Duration: 2 Days)

SUPPLIED & SUPPORTED BY

KAPP ENGINEERING

✓ QUALITY
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2-DAY KOYO ADVANCED TRAINING COURSE

COURSE OUTLINE

DAY 1

8:00am – 12:00pm

1) Introduction to Koyo Hardware

Focusing on:

- ☐ Koyo PLC series – hardware overview
- ☐ Communications capabilities
- ☐ I/O Module overview (DL205)
- ☐ Communication & specialty modules overview (DL205)
- ☐ PLC Memory Map
- ☐ Slot addressing
- ☐ I/O addressing (including examples & exercises)
- ☐ Expanding I/O beyond the CPU Rack (DL205PLC)
- ☐ Expanding I/O beyond the CPU Rack (DL405PLC)
- ☐ Remote I/O Options
  - Remote Master / Slave Modules
  - ERM / EBC Ethernet Remote I/O
  - HSIO Modules
  - Terminator I/O Modules
- ☐ CPU Scanning Sequence

Exercises:

- ☐ I/O addressing exercises (DL205)
- ☐ I/O addressing exercises (DL405)

2) Introduction to Koyo Software (DirectSOFT)

Focusing on:

- ☐ DirectSOFT keyboard shortcuts
- ☐ Creating a new project
- ☐ Editing an existing project
- ☐ Connecting to the PLC
- ☐ Compiling & downloading to the PLC
- ☐ Running the PLC program
- ☐ Using the PLC's Mode Switch (Run/Stop/Term)
- ☐ Uploading the program from the PLC
- ☐ Monitoring the status of the PLC program on-line (via Blue Status Indication, DataView Window & 'Y2=')
- ☐ Instruction Set Overview (commonly used instructions)
- ☐ Finding instruction help in DirectSOFT (via F7 function key and via Help Menu)
- ☐ Special Purpose Relays
- ☐ Ladder programming examples
- ☐ Using contacts, coils, latches, comparators (ie >,<,=,≠), timers, counters, etc
- ☐ Assigning the Retentive Memory Ranges
- ☐ Documenting a PLC Program (ie tag names, comments, etc)
- ☐ Importing/exporting documentation between PLC Programs
- ☐ Comparing one PLC program to another
- ☐ Adding password-protection to a CPU

Exercises:

- ☐ General programming exercises using contacts, coils, latches, timers & counters

3) **Trouble-shooting and Maintenance**

Focusing on:

- ☐ CPU LED Indicators
- ☐ CPU Diagnostics (using DirectSOFT's 'Diagnostics' menu)
- ☐ CPU error codes and Special Purpose Relays
- ☐ I/O module trouble-shooting
- ☐ Calculating the Power Budget
- ☐ Using the "Configure I/O" window to check the operation of the PLC Base/Rack
- ☐ Forcing Control Bits and V-Registers using 'Y2=' (Change Value) icon
- ☐ Forcing Control Bits and V-Registers using the DataView Window
- ☐ Overriding Digital Inputs and Outputs using the DataView Window
- ☐ Overriding Digital Inputs and Outputs using the "Overrides" Window

Exercises:

- ☐ Force a FATAL Error by clearing the PLC Program and forcing the PLC into RUN mode. Use Diagnostics window to troubleshoot problem

12:00pm – 12:30pm **Lunch**

2-DAY KOYO ADVANCED TRAINING COURSE

COURSE OUTLINE

DAY 1

12:30pm – 5:00pm

4) PLC Register Handling and Operations

Focusing on:

- ☐ Understanding the PLC's "Accumulator"
- ☐ Loading values into the Accumulator using the "LD" instruction
- ☐ Outputting values from the Accumulator using the "OUT" Instruction
- ☐ Common math instructions (ie MUL, DIV, ADD, SUB)
- ☐ New DirectSOFT5 IBOX Instructions
  - MATHBCD

5) Reading and Writing Analog I/O

Focusing on:

- ☐ Understanding how an Analog Module works, including principles of multiplexing, I/O Requirements and bit addressing
- ☐ How an analog module affects the addressing of surrounding I/O modules
- ☐ Using the F0-2AD2DA-2 2ch Analog Input / 2ch Analog Output Module (Typical DL06 Analog Module) – practical session
- ☐ Programming Analog I/O in a DL205 PLC (using the D2-4AD2DA Analog Combo Module as an example)
- ☐ Programming Analog I/O in a DL405 PLC (using the D4-04AD Analog Input Module as an example)
- ☐ Scaling Analog Inputs from raw values (0-4095) to scaled values (in engineering units)
- ☐ Common mistakes made when programming & testing analog I/O
- ☐ Trouble-shooting a PLC with analog inputs/outputs
- ☐ New DirectSOFT5 IBox Instructions
  - ANLGCMB
  - ANLGIN
  - ANLGOUT
  - ANSCL
  - FILTER
  - HILOAL

Exercises:

- ☐ Read in 0-10V signal via Analog Input 1
  Scale from 0-4095 to 0-100
  Invert Analog Input signal and send out via Analog Output 1
  Generate a Low-Low Level Alarm when Analog Input 1 < 10
  Generate a Low Level Alarm when Analog Input 1 < 20
  Generate a High Level Alarm when Analog Input 1 > 80
  Generate a High-High Level Alarm when Analog Input 1 > 90
  (Refer to "Analog I/O Logic Diagram")

2-DAY KOYO ADVANCED TRAINING COURSE

COURSE OUTLINE

DAY 2

8:00am – 12:00pm

6) PLC Networking (Serial)

Focusing on:

- ☐ DL06 communications capabilities
- ☐ DL205 communications capabilities
- ☐ DL405 communications capabilities
- ☐ Data Communications Module (DCM)
- ☐ Understanding communication protocols (ie K-Sequence, DirectNET, Modbus)
- ☐ Understanding electrical protocols (ie RS232 or RS422/485)
- ☐ Setting the Secondary Com Port
- ☐ PLC Network Instructions (ie WX & RX Instructions)
- ☐ Writing a communications program
- ☐ Interlocking multiple RX and WX instructions using Special Purpose Relays and Control Bits/Registers
- ☐ Monitoring the status of the communications link via a Watchdog Timer (Heartbeat Pulse)
- ☐ Setting the Secondary Com Port via Ladder Logic
- ☐ Converting octal Koyo addresses to native Modbus addresses (using the Modbus conversion utility)
- ☐ Modbus Network Instructions (ie MWX and MRX Instructions for DL06 and DL260 CPUs only)
- ☐ Common mistakes made when programming & testing serial communications
- ☐ New DirectSOFT5 IBox Instructions
    - NETCFG
    - NETRX
    - NETWX

Exercises:

- ☐ Set the Secondary Comm Port to the following settings using Ladder Logic (execute on first PLC scan only – SP0):
    - Modbus Protocol
    - 9600 Baud
    - Odd Parity
    - 1 Stop Bit
    - Station No. 1
    - Communication Timeout of 800ms (ie 100%)

- ☐ Set-up and test a point-to-point communications network between 2 x Koyo PLCs using a direct RS232 serial cable. Send the inputs from the Master to the outputs of the Slave and vice-versa. Include a Watchdog Timer at each end to monitor the status of the communications link. (Refer to “Serial Comms Logic Diagram”)

7) PLC Networking (Ethernet)

Focusing on:

- ☐ Introduction to the ECOM100 Ethernet Communications Module
- ☐ Using the Module ID as the network identifier versus using an IP Address
- ☐ Setting the ECOM100 Module ID (Using the Addressing DIP Switches on the module)
- ☐ Setting up an Ethernet Link to the PLC in DirectSOFT
- ☐ Writing a communications program
- ☐ Interlocking multiple RX and WX instructions using Special Purpose Relays and Control Bits/Registers
- ☐ Interlocking multiple RX and WX instructions using Special Purpose Relays and Control Bits/Registers
- ☐ Setting the ECOM100 Ethernet Communications Module (Using the NetEdit Software)
- ☐ New DirectSOFT5 IBox Instructions

Exercises:

- ☐ Set-up a peer-to-peer communications network between multiple Koyo PLCs. Assign each ECOM module a unique Module ID (1, 2, 3, 4) and connect all PLCs to an Ethernet Switch. Program each PLC to read in the Analog Inputs from each of the remote PLCs on the Ethernet network and display them on the Analog Output of the local PLC, using X0-X3 to select which value will be displayed.
(Refer to "Ethernet Comms Logic Diagram")

- ☐ Expand the above program to also read in the first 16 x Digital Inputs from each of the remote PLCs on the Ethernet network and display them on the 16 x Digital Outputs of the local PLC, using X0-X3 to select which PLC's Digital Inputs will be displayed.

Notes:

1) IPX/SPX and NetBIOS network protocols must be installed and activated for your network card in order to create an Ethernet link to the PLC
2) Firewalls must be turned off in order to create an Ethernet link to the PLC

12:00pm – 12:30pm **Lunch**

2-DAY KOYO ADVANCED TRAINING COURSE

COURSE OUTLINE

DAY 2

12:30pm – 5:00pm

8) Stage Programming (RLL^{Plus})

Focusing on:
- ☐ Introduction to Stage (Flow Chart) Programming
- ☐ Benefits of Stage Programming
- ☐ Stage Programming Demonstration
- ☐ Using the StageView window

Exercises:
- ☐ Write a program using RLL^{Plus} to start a series of pumps is sequence (refer to "Stage Programming (RLL Plus) Example Flow Chart")

9) Introduction to Implementing PID Control Loops

Focusing on:
- ☐ Introduction to PID Control Loops
- ☐ Setting up a simple PID Control Loop in DirectSOFT
- ☐ Overview of the PID Loop Register Table and Control Bits
- ☐ Controlling the PID Loop parameters via Ladder Logic
- ☐ Set up and operate a simple PID Control Loop using the DL06 PLC and analog inputs and outputs

Exercises:

- ☐ Set up a simple PI Control Loop with the following settings:

  Loop Starting Address = V3000
  Forward Acting
  PV = Analog Input 1 (0-4095)
  CV = Analog Output 1 (0-4095)
  SP = 2048
  Sample Rate = 0.5 seconds
  Proportional Gain (P) = 2
  Integral Gain (I) = 10 seconds

  Use the PID View Window to monitor the operation of the loop

- ☐ Add a small ladder program to control the operating mode of the PI Loop (ie Auto or Manual) via Digital Input X0. When X0 is ON, force the PI loop into Manual mode and set the CV = Analog Input 1. When X0 is OFF, force the PI Loop back into Auto Mode. Use Bumpless Transfer Mode II to minimise the step change in the CV when switching from Manual Mode back to Auto Mode.

- ☐ Use the DataView Window to change the values of the Setpoint (SP), Proportional Gain (P) and Integral (I) terms by forcing values into their associated holding registers. Also monitor the PV, CV and Bias values.

10) New IBOX Instructions in DirectSOFT5

Focusing on:

☐	OFFDTMR	*Off Delay Timer*
☐	ONDTMR	*On Delay Timer*
☐	ONESHOT	*One Shot (same as PD instruction)*
☐	PONPOFF	*Push On - Push Off (ie a FlipFlop)*
☐	MOVEW	*Move data from one word to another*
☐	MOVEDW	*Move data from one word to another (double word)*
☐	MATHBCD	*Perform math operations in a single instruction*
☐	SQUARE	*Performs mathematical Square operation*
☐	SUMBCD	*Sums all values stored in a range of registers*
☐	Analog I/O Setup & Control Boxes	
☐	Ethernet Communications Setup & Control Boxes	
☐	Serial Communications Setup & Control Boxes	
☐	Counter Module Setup & Control Boxes	