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THK VLA Indexer

Introduction

The THK VLA Indexer allows a user to "program" motion on a
VLA slide without ever learning or knowing a programming
language.

The user simply answers a series of questions about the slide
being used, the load connected to it, and what will cause it to
energize and home. Then the user creates one or more sequences
that the slide is required to perform using pre-defined events like
"Move Start". Once all of the parameters are entered into the
events chosen by the user, a program can be generated and sent to
the controller by compiling and downloading.

The program created and downloaded will begin running
immediately. It will set all necessary parameters, wait for the
condition chosen to energize the servomotor, and then enter
either the manual or automatic mode. The manual or automatic
mode is dictated by the state of input 8. If input 8 is high or off
the program enters Manual mode, if it is low or on, Auto mode is
run; but only after the servo is enabled the first time.

Manual mode allows the user to enable and disable the servo (if
the choice to energize the servo was by input or variable), and
once the servo is enabled, to jog forward or reverse.

Auto mode will home the servo once after a power-up when the
condition to home is true, and then run sequences when their
individual start conditions are true. If there is more than one
sequence defined and the condition to start each sequence is true,
then the sequences will be run in order one after the other, and
will continue to run until the start condition is false. Remember,
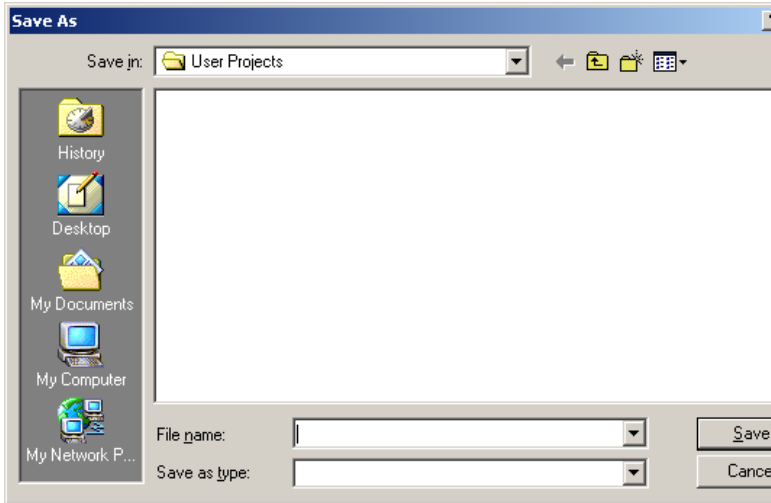in order to enter the Auto mode, the servo must be energized.

Opening Screen
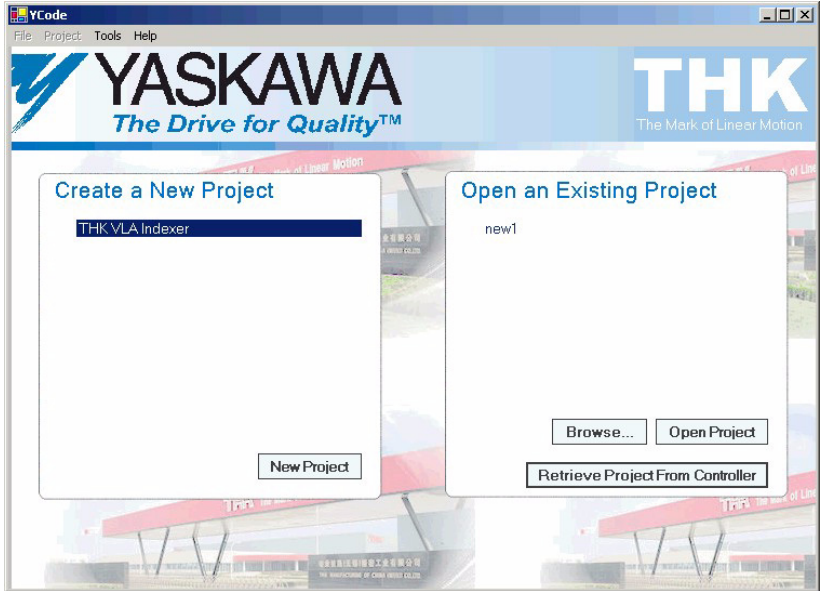
When the application is started, the user is presented with the opening screen, which allows the user to create a new project or open an existing project.

To create a new project

Select the template name "THK VLA Indexer" and click on the *New Project* button.
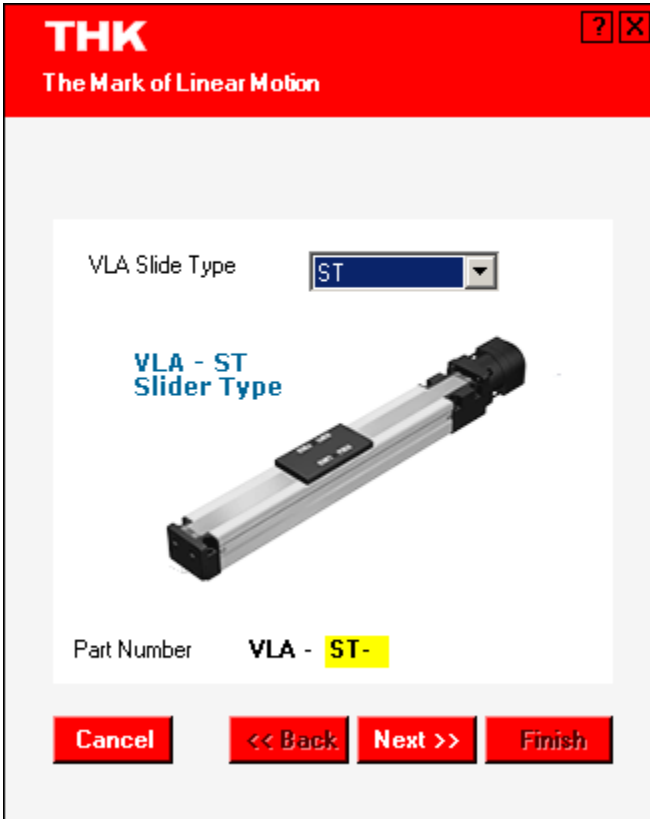
Enter a project name, select "*OK*", and the THK Wizard will appear.

To open an existing project

An existing project can be opened by selecting it from the list and clicking on "*Open Project*", or by clicking on "*Browse…*" to locate the ***.yap file. A project can also be opened from the controller (if it was previously saved using the save project to controller option) by selecting "*Retrieve Project From Controller*" while connected online.

THK Wizard

The THK Wizard will guide the user through entering the THK part number of the VLA slide and selecting the load connected.

Locate the part number of the VLA slide. The part number is located on the left side of the actuator if the motor is positioned on the left.

Select the type of VLA slide by choosing either ST or CT. The picture changes as the selection is changed. Navigate through the screens using the *Next* button to advance.
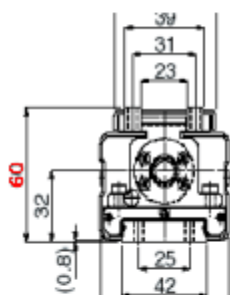
Next enter the Slide Height.

THK
The Mark of Linear Motion

Ball screw lead   `12` ▼   mm

Part Number   **VLA - ST - 60 - 12 -**

Cancel   **<< Back**   **Next >>**   **Finish**

A ball screw lead must be selected if using an ST type slide. For the CT type, accept the 12mm default.

THK
The Mark of Linear Motion

Stroke Length   300 mm

Min Length is 24mm, Max Length is 700mm

Part Number   **VLA - ST- 60 - 12 - 300**

Cancel   << Back   Next >>   Finish

Enter the Stroke Length.

THK
The Mark of Linear Motion

⦿ Slide is mounted Horizontally

◯ Slide is mounted Vertically

Load Weight [   ] kg ▼

Max Load for the slide is 16 kg, 35.3 lb.

Part Number   **VLA - ST - 60 - 12 - 300**

Cancel   **<< Back**   **Next >>**   **Finish**

Specify the Load Direction and Weight.

THK
The Mark of Linear Motion

Unit Selection   mm

Max resolution of slide:
0.00146 mm or 0.00372 inches

Sample Unit display:
    Position (mm)
    Velocity (mm/sec)
    Acc/Dec (mm/sec2)

Part Number   **VLA - ST- 60 - 12 - 300**

Cancel   << Back   Next >>   Finish
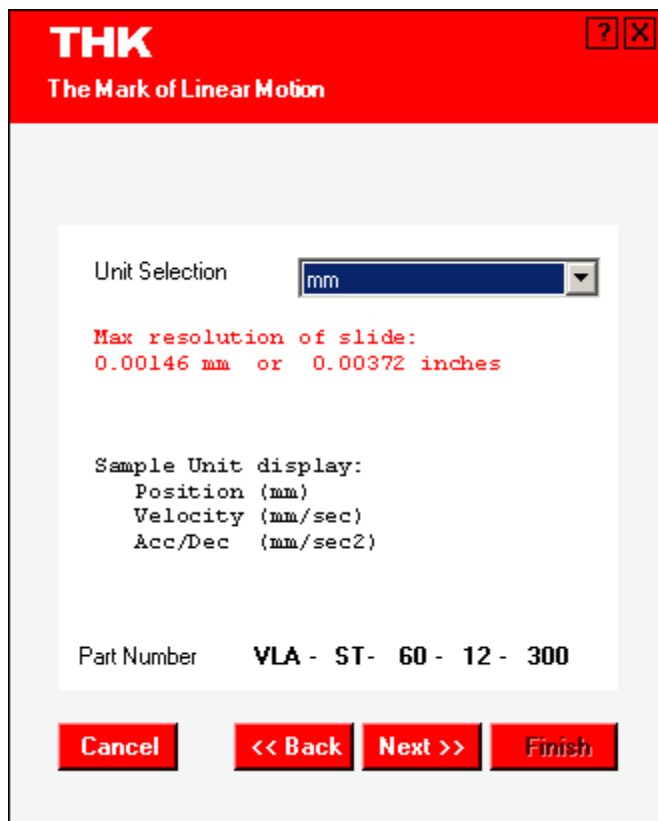
Select the Units.

Select the side on which the actuator will home and click on "*Finish*".

Main Screen
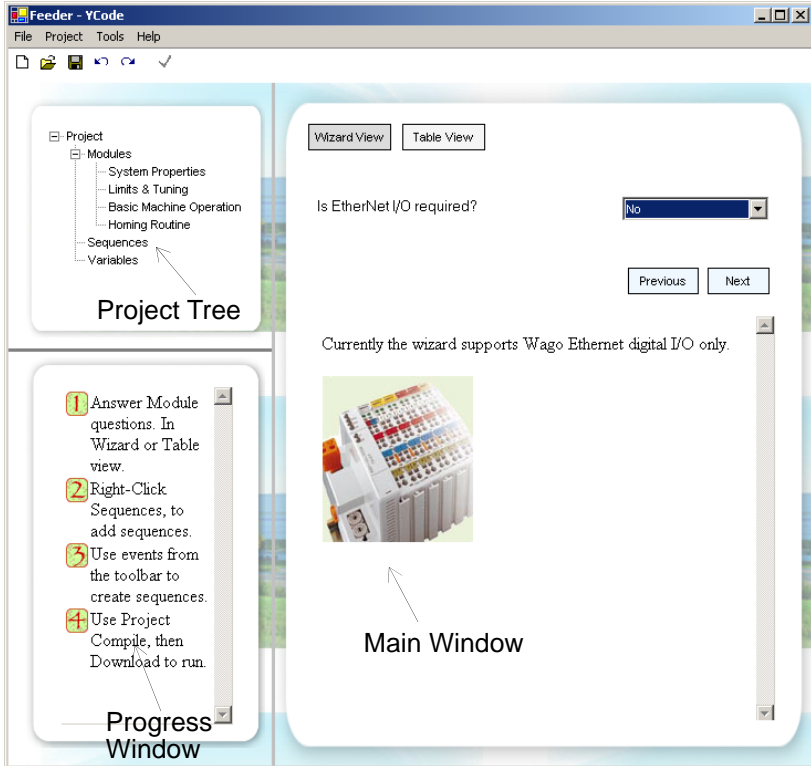
The main screen features a Project Tree that is used to display items in the main window and a Progress Window that highlights the step currently being performed. Clicking on Project Tree will access the main folders that make up the program (modules, sequences, and variables).

Modules

Clicking on "*Modules*" will display the setup questions for the application. There are two ways to view the questions, one at a time (Wizard View), or all at once (Table View). Wizard View displays questions one at a time with question specific help at the bottom of the main window. This allows the user to navigate back and forth using the *Previous* and *Next* buttons. Wizard View is the default view and is shown in the main window above.

Table View displays all of the questions at once, with all but the last unanswered question grayed out. This focuses the user's attention on the last unanswered question while allowing viewing of the entire set of questions that have been answered.

Clicking on the name of an individual module will filter the questions in Table View, displaying only the questions in that module.

Sequences

To create a sequence, right-click the word "*Sequence*" in the Project Tree and select "*Add Sequence*".

Sequence view with no sequences defined
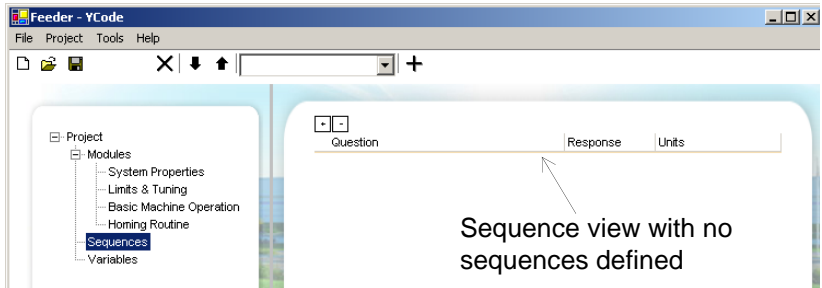
Sequences are given meaning by adding events. To add an event, select one from the drop down list at the top of the screen and click the *Add Event* (+) button.

Delete Event

Move Event, Up or Down

Add Event

List of Events
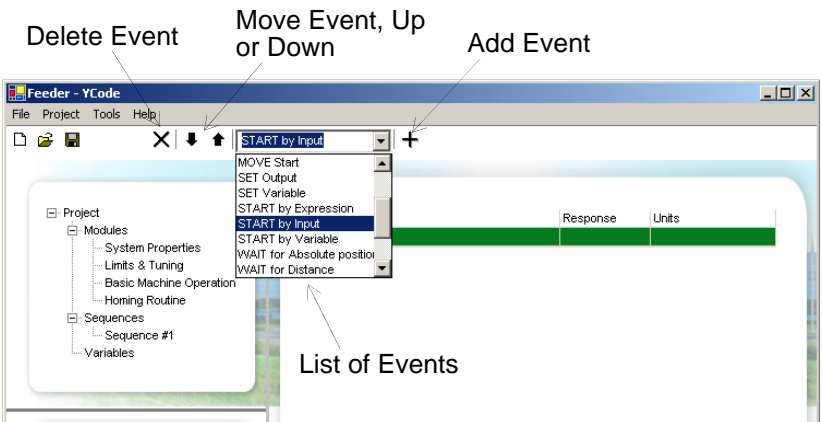
All sequences must begin with a Start By event (Input, Expression, or Variable) and there must be only one Start By event so place one of these events in the first position of the sequence window.

Sequence Events

Start By Events: Expression, Input, and Variable

- **Start by Expression** must be valid comparison expressions in the form of $x=2$, $y>7$, or similar items that evaluate to Boolean true or false. This is an advanced event allowing anything to be specified, and is NOT checked for errors. If unsure, avoid using this event.

- **Start by Input** asks the user to specify an input number and state or transition of the input. Valid input numbers are from 1~7 (and 2000~2255 if using Ethernet I/O). Specifying a state will cause the sequence to run when the input is On or Off, while specifying a transition will wait until the edge or change of the input occurs.

- **Start by Variable** requires the user to enter a variable name and value. Valid variable names are 1 to 8 characters in length, case sensitive, and accept alphanumeric characters and the underscore. The value entered is the value that will cause the sequence to run.

The user adds the remaining events as needed to form the custom sequence required for the application.

Change Events: Accel and Speed

These events are useful for changing values while moving.

- **Change Accel** allows the user to specify a new acceleration.
- **Change Speed** allows the user to specify a new speed.

Loop Events: Expression and Fixed Number

A Loop event will cause the program to loop back to a previous labeled event.

An event is labeled by entering a name for the event in the response column on the row of the event name. The Loop event will only allow program flow to return upwards. Program flow cannot be returned to the start event, or within a Move Start, Move End pair.

- **Loop Expression** will continue to loop while the expression is true. Expressions are valid comparisons in the form of x=2, y>7, or similar items that evaluate to Boolean true or false. This is an advanced event allowing anything to be specified, and is NOT checked for errors. If unsure, avoid using this event.

- **Loop Fixed Number** will loop for the number of times specified.

Move Events: Start and End

- **Move Start** has the user specify all of the move parameters.
    - ☐ Acceleration is entered in user units.
    - ☐ Deceleration is entered in user units.
    - ☐ S-Curve is the amount of motion smoothing applied to the move. A value of 1 indicates no S-Curve and .004 indicates the maximum S-Curve. Applying S-Curve smooths the acceleration and lengthens the move time.
    - ☐ Speed is entered in user units.
    - ☐ Move Type can either be absolute or incremental. Absolute moves go to that absolute position (based on where the home position is), while incremental moves advance a certain distance from where they are currently.
    - ☐ Position is entered in user units.

- **Move End** requires selection of either profiler or encoder.
    - ☐ Profiler will wait until the controller finishes calculating the move and sends the commands to the motor.
    - ☐ Encoder will wait for the actual position of the motor to reach the calculated position.

Set Events: Output and Variable

- **Set Output** specifies an output number and a state (either on or off).

- **Set Variable** specifies a variable name and value.

Wait For Events: Absolute Position, Distance, Input, Time, and Variable

- **Wait for Absolute Position** waits for the encoder to reach the position specified.

- **Wait for Distance** waits for the encoder to see a movement of the distance specified from the start of the move.

- **Wait for Input** waits for the input to be at the state specified, or for the transition to occur.

- **Wait for Time** waits for an amount of time specified in milliseconds (where 1000 = 1 second)

- **Wait for Variable** waits for the variable specified to be set to that value.

Skip Event

Allows the program to conditionally skip one or more events.

Sequence Rules

1. All sequences must begin with a Start By event, and there must be only one Start By event. So place one of these events in the first position of the Sequence window.
2. The program cannot loop back to a Start By event.
3. Every **Move Start** event must have one and only one **Move End** event.
4. Moves cannot be nested. If a **Move Start** event is placed in a sequence, then a **Move End** event must be placed in that sequence before another **Move Start** event.
5. The events **Wait for Absolute Position** and **Wait for Distance** must be placed within a **Move Start**, **Move End** pair.
6. If a Loop event is used, there must be a previous event with a label to loop back to.
7. If a Skip event is used, there must be a later event with a label to skip to.

Variables

When variables are entered into the program, they automatically appear in the variable table. Variables in the program must be initialized. Specify a value for all variables used in the program or the compiler will prompt for values.

Menu Items

The File menu contains the standard items that allow the user to create a new project (New), open an existing project (Open), save the current project (Save), and create a copy of the current project with a new name (Save As).

The Project menu allows the user to create a downloadable program file (Compile), to download the executable program to the controller (Send to Controller/Download), and to save the current project (Send Project File to Controller) on the controller.

All of the questions in the modules must be answered and at least one move sequence with a minimum of one event existing before the user is allowed to compile.

The Tools menu allows the user to rerun the VLA slide selection Wizard if the user needs to change the model number.

Program Flow

The program will begin running immediately after it is downloaded or whenever the power is cycled. It will set all necessary parameters, wait for the condition chosen to energize the servomotor, and then enter either the manual or automatic mode. If input 8 is High/Off, the program enters Manual mode. If it is Low/On, Auto mode is engaged; but only after the servo is enabled the first time.

Manual mode allows the user to enable and disable the servo (if the choice to energize the servo was by input or variable), and once the servo is enabled, to jog forward or reverse. Jogging forward or reverse is achieved by pressing the reverse or forward limit switch respectively. Jogging will continue for as long as the switch is held on.

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Auto mode requires that the servo be homed once after a power-up. If the servo has not been homed, no sequences will run. When the condition to home is true, the servo will find the home position and then run sequences when their individual start conditions are true. If there is more than one sequence defined and the condition to start each sequence is true, then the sequences will be run in order one after the other, and will continue to run until the start condition is false. Remember, if Input 8 is High/Off, the program enters the Manual mode. If it is Low/On, the Auto mode is engaged, but only after the servo is enabled the first time.

```
                        ┌──────────────┐
                        │   Power On   │
                        └──────┬───────┘
                               │
                     ┌─────────▼─────────┐
                     │  Set servo gains  │
                     │  Set parameters   │
                     │  Set internal     │
                     │    variables      │
                     └─────────┬─────────┘
                               │         No
                          ◇ Is servo on ───►
                          ◇ condition true
                               │ Yes
                     ┌─────────▼─────────┐
                     │   Turn Servo On   │
                     └─────────┬─────────┘
```

Manual Mode

◇ Is Manual input on ── Yes ──► ◇ Is Servo-On condition True ── No ──► Turn Servo Off

Auto Mode

◇ Is Manual input on — No

◇ Home condition = True & NOT HOMED ── Yes ──► Start Home

◇ Sequence 1 start = True & HOMED ── Yes ──► Run Sequence 1

◇ Sequence n start = True & HOMED ── Yes ──► Run Sequence n

Home Complete ── No ──► Home timeout ── Yes ──► Set Error ──► End

◇ Is Servo-On condition True — Yes ──► Turn Servo On

◇ Is Jog + input on ── Yes ──► Jog forward at + Jog speed

◇ Is Jog − input on ── Yes ──► Jog reverse at − Jog speed

Program Flow

Sequence Terms

- Encoder: The physical device used to track position mounted on the motor.

- Expression: Must be valid comparison expressions in the form of x=2, y>7, or similar items that evaluate to Boolean true or false. This field is NOT checked for errors. If unsure, avoid using events with this parameter.

- Input: Valid input numbers are from1~7 (and 2000~2255 if using Ethernet I/O). Specifying a state will cause the event to run when the input is on or off while specifying a transition will wait until the edge or change of the input occurs (i.e. the input must go from 1 to 0 or from 0 to 1 before the event will run).

- Label: Labels are applied to events by entering characters in the response column next to the event name.

- Output: Valid output numbers are from1~4 (and 2000~2255 if using Ethernet I/O).

- Variable: Valid variable names are 1 to 8 characters in length, case sensitive, and accept alphanumeric characters and the underscore. Variable values are in the range – 2147483648.9999 ~ 2147483647.9999 and have a fractional resolution of 1/65536.

Hardware

Start-up

Mounting the LEGEND-MC to the LEGEND Amplifier
1. Insert the lower two mounting notches of the LEGEND-MC into the mounting holes at the bottom of the right side of the LEGEND.
2. Push the LEGEND-MC in the direction indicated by the arrow in the figure below, and insert the upper mounting notches of the LEGEND-MC into the upper mounting holes on the right side of the LEGEND.
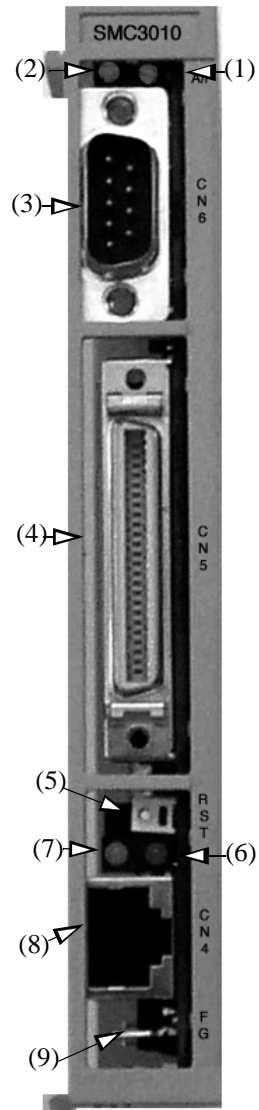
Mounting Orientation

Mount the LEGEND-MC and LEGEND vertically for proper cooling, as shown below. Allow a minimum spacing of 10mm around the left and right sides and 30mm around the top and bottom of the LEGEND-MC/LEGEND unit.

Front Panel Description

No.	Name	Description
(1)	Power ON	A lit green LED indicates that the +5 VDC power supplied to the LEGEND-MC controller from the LEGEND amplifier is working.
(2)	Alarm/ Error	A red LED that will flash on initially at power-up and stay lit for approximately 1-8 seconds. After power-up, the LED will illuminate for the following reasons: Position error occurs when the measured value is greater than the position error limit setpoint. Manual reset of the controller, noise and/or a failure in the processor can also trigger this alarm for a short time. If the error does not clear, please contact your local Yaskawa representative for assistance.
(3)	CN6	9 pin male D-Sub serial port connector
(4)	CN5	3M 50 pin high density I/O connector
(5)	RST	Reset switch. Causes the controller to reboot, and load the application program and parameters from flash.
(6)	Ethernet status	A green LED that is lit when there is an Ethernet connection to the controller. This LED tests only for the physical connection, not for an active or enabled link.
(7)	Ethernet status	The yellow LED indicates traffic across the Ethernet connection. This LED will show both transmit and receive activity across the connection. If there is no Ethernet connection or IP address assigned, the LED will flash at regular intervals to show that the BOOTP packets are being broadcast.
(8)	CN4	10 BaseT Ethernet RJ485 Connector
(9)	FG	Frame ground spade terminal. Connect to ground terminal on LEGEND Amplifier

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Power/Connections Wiring - Single Phase
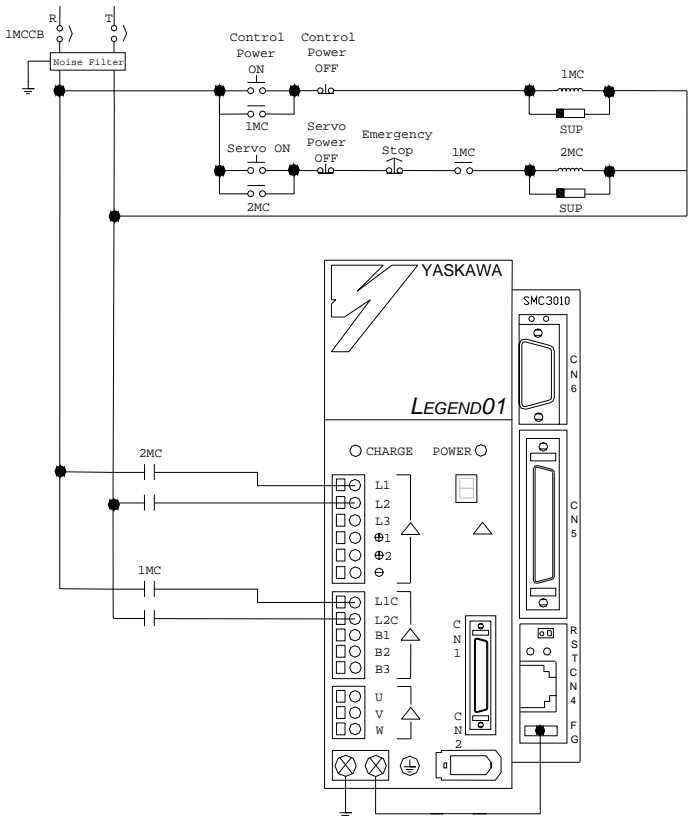
Note: The LEGEND-MC receives its power from the LEGEND amplifier through the side interface connector, however, the digital I/O receives its power from pins 46, 47, 48, and 49 on the I/O connector.
For maximum noise immunity, connect the FG to a ground terminal on the sub panel or to the ground terminal on the LEGEND.
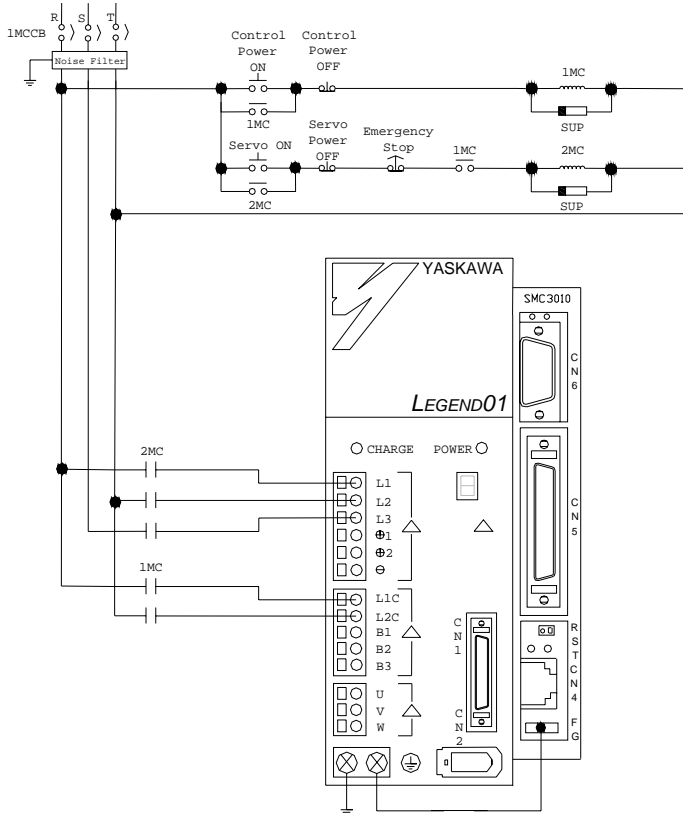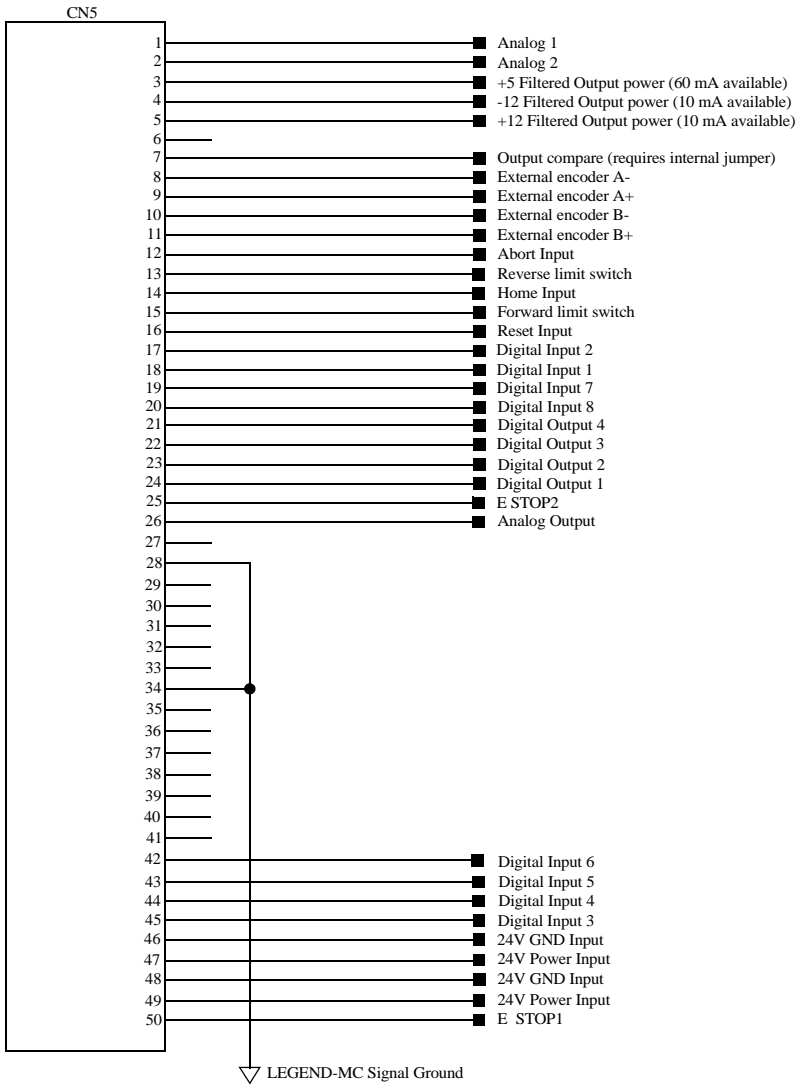
Power/Connections Wiring - Three Phase

Note: The LEGEND-MC receives its power from the LEGEND amplifier through the side interface connector, however, the digital I/O receives its power from pins 46, 47, 48, and 49 on the I/O connector.
For maximum noise immunity, connect the FG to a ground terminal on the sub panel or to the ground terminal on the LEGEND.

I/O Connections (50-pin CN5)

CN5

Pin	Signal
1	Analog 1
2	Analog 2
3	+5 Filtered Output power (60 mA available)
4	-12 Filtered Output power (10 mA available)
5	+12 Filtered Output power (10 mA available)
6	
7	Output compare (requires internal jumper)
8	External encoder A-
9	External encoder A+
10	External encoder B-
11	External encoder B+
12	Abort Input
13	Reverse limit switch
14	Home Input
15	Forward limit switch
16	Reset Input
17	Digital Input 2
18	Digital Input 1
19	Digital Input 7
20	Digital Input 8
21	Digital Output 4
22	Digital Output 3
23	Digital Output 2
24	Digital Output 1
25	E STOP2
26	Analog Output
27	
28	
29	
30	
31	
32	
33	
34	
35	
36	
37	
38	
39	
40	
41	
42	Digital Input 6
43	Digital Input 5
44	Digital Input 4
45	Digital Input 3
46	24V GND Input
47	24V Power Input
48	24V GND Input
49	24V Power Input
50	E STOP1

LEGEND-MC Signal Ground

Digital I/O

Digital Input

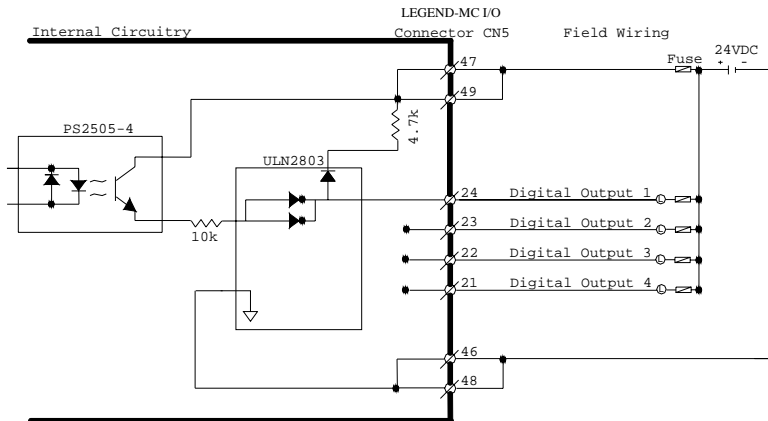| Item	Specifications
Number of Input Points	8
Input Format	Sinking
Isolation	Optical
Voltage	24 VDC ± 20%
Current Rating (ON)	5.3 mA to activate
Input Impedance	2.2k Ω
Operation Voltage	Logic 0 <5V Logic 1 >15V
OFF Current	0.9 mA or less
Response Time	OFF to ON: <0.5 ms ON to OFF: <1.5 ms
Latch Response Time	Less than 25 µsec
Minimum Latch Width	9 µsec

Note: Inputs float high unless the input is held low.
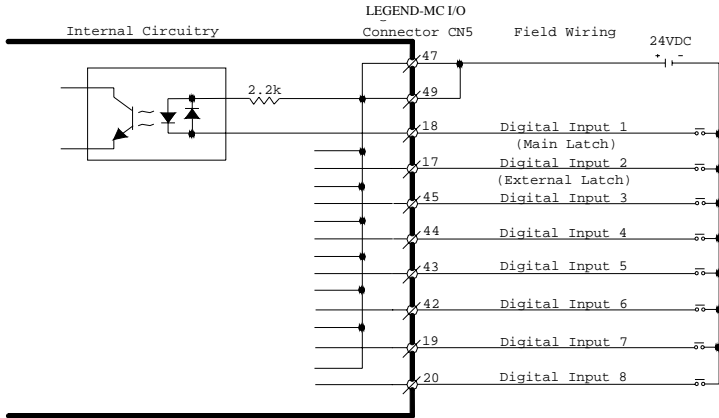
Digital Output

Item	Specifications
Number of Output Points	4
Output Format	Sinking
Output Classification	Transistor Output
Isolation	Optical
Load Voltage	24 VDC ± 20%
Load Current	200 mA/Output (600 mA if activated individually)
Response Time	OFF to ON <0.25 ms ON to OFF <0.5 ms
External Common Power	24 VDC ± 20% 15 mA
Common User Fuse Rating	1A
Individual User Fuse Rating	200 mA recommended

Note: The ULN 2803 output chip is capable of 600mA at a single output, or 800mA for the four outputs simultaneously.
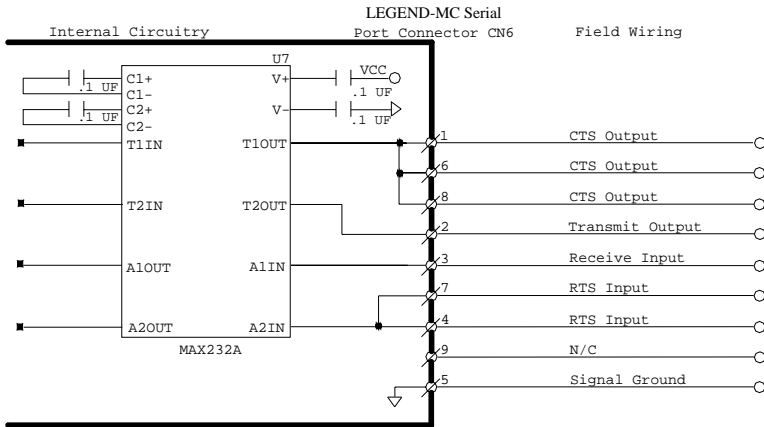
Emergency Stop Chain
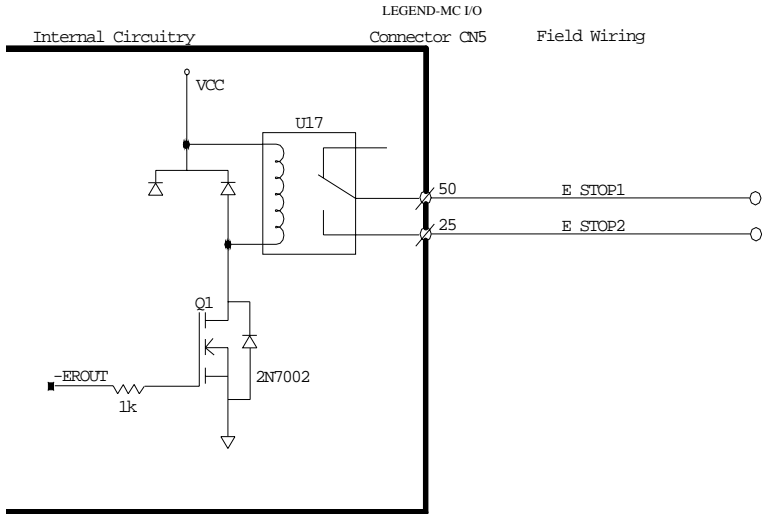
Note: Note: The LEGEND-MC closes the relay contact under normal operating
conditions.
Ratings: 1.0A @ 24 VDC
0.5A @ 125 VAC
Maximum switching power: 62.5VA, 30W

Serial Communication

Item	Specifications
Baud Rate	9600 or 19200 set by jumper JP1, default is 19200
Data Bits	8
Parity	None
Stop Bits	1

LEGEND-MC Serial
Internal Circuitry   Port Connector CN6   Field Wiring

Pin	Signal
1	CTS Output
6	CTS Output
8	CTS Output
2	Transmit Output
3	Receive Input
7	RTS Input
4	RTS Input
9	N/C
5	Signal Ground

Note: NOTE: Hardware handshaking must be used with the LEGEND-MC. If it is impos-
sible to implement hardware handshaking, use a jumper between pins 1 and 4 in
the connector.

Note: NOTE: Do not connect pin 5 to a 24V ground.

YASKAWA

The Drive for Quality™

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Phone: 55-11-5071-2552 Fax: 55-11-5581-8795 Internet: http://www.yaskawa.com.br