

RTK4 Logic Controller User Manual

For RTK4L Revision 120326

Revised 6-20-12

RTK4 Features

Application:	PLC and Third Party Drive Interface
Number of Axis Drive Interfaces:	5
Axis DAC Resolution:	16 bits
Axis Analog Output Voltage:	-10 to +10 Volts
Spindle DAC Resolution:	14 to 16 bits depending on mode
Spindle Analog Output Voltage:	0 to +10, -10 to 10, 0 to 5, or -5 to 5 Volts
Digital Inputs:	46
Digital Outputs:	37
Control Interface:	2 fiber optics to MPU11 motion control card
Dimensions (W*D*H):	12 * 5 * 3.5 inches

Overview

RTK4 uses the PLCbus protocol to communicate with MPU11, while maintaining the wiring philosophy of RTK3. RTK4 adds several improvements to the RTK3 platform. The PLCbus protocol improves communication speed, allows for PLC expansion, and provides software programmable debounce times. Up to five third party drives can be controlled by the RTK4, eliminating the need for an additional interface board. The number of inputs and outputs has also been increased to accommodate more complex systems.

The RTK4 is intended to simplify and expedite control wiring. The goal of RTK4 is to increase wiring efficiency on standard MPU11 system configurations, just as RTK3 did for CPU10 based systems. To reduce the number of connections in the control cabinet, input and most output voltages are standardized. Logic and input power supplies are built in to the RTK4 to further simplify installation. Positive locking connectors on pre-assembled cables eliminate the need to individually connect each wire to the RTK4.

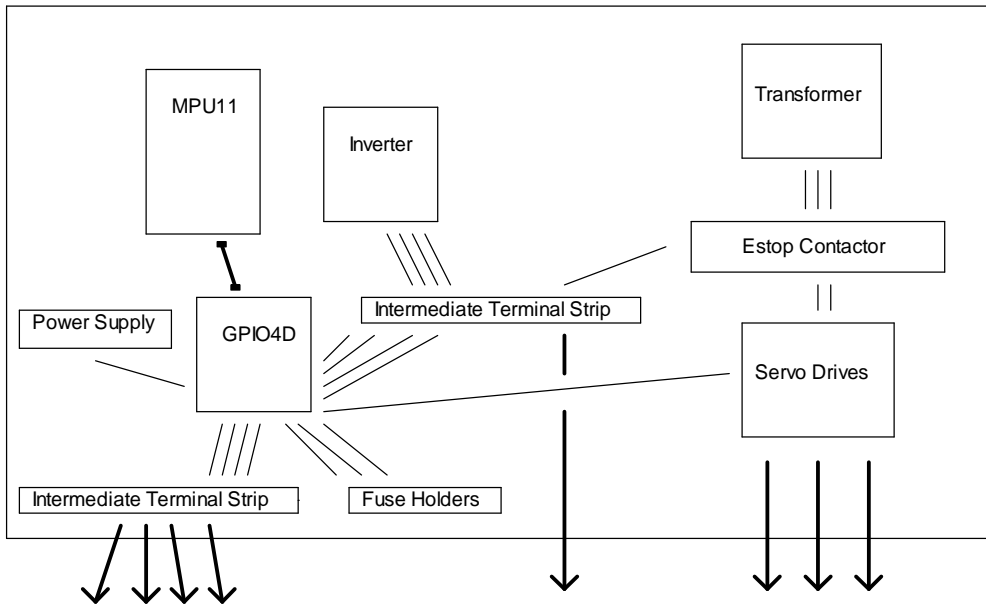
There are three layers in the RTK4 to minimize footprint and maximize cabinet efficiency. Only rarely used connectors are located on the backside of the unit to allow mounting against the cabinet wall if necessary. The bottom board has six mounting holes for direct attachment to standoffs. See the "RTK4 Mounting Dimensions" section for mounting standoff configuration. The bottom, or logic, board is home to the logic controller's processor, input isolators, spindle analog output, output drivers, and power supply section. This is where the fiber optic and almost all input connections are made. The middle board has 24VAC outputs, control interfaces for third party drives, and PLC Expansion headers. The top board is equipped with 110VAC outputs and the 110VAC power input connector.

RTK4 System Constraints

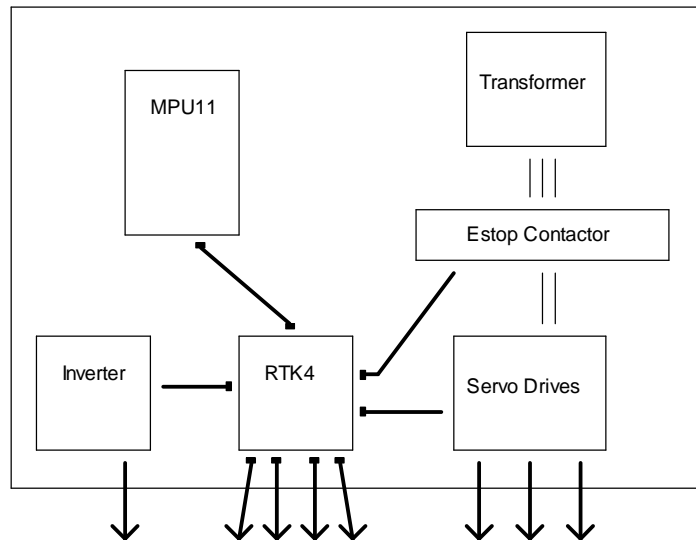
Outputs intended to drive contactors are 24VAC and the lube pump must be 110VAC. In addition, the E-stop power loop must be 24VAC, solenoids and lights must be 110VAC, and sensors must be compatible with 24VDC inputs when using an RTK4. Axis drive analog requests always swing from -10 to 10VDC, while the spindle drive analog can be set to one of four ranges.

Wiring Concept Visual Comparison

Previous ATC Wiring Sample



RTK4 Wiring Sample



Note the simplified layout and wiring enabled by the RTK4. Fewer individual wires (thin lines) are used and intermediate terminal block connections are reduced. Cables (thick lines) with quick connect ends replace many individual wires. Integrated components and specialized connection points on the RTK4 reduce the quantity of external hardware required. These advantages allow for quicker, more organized, more compact and more reliable panel wiring.

Power Connection

Two or three power connections are necessary on a full RTK4 installation. Screw terminals on the top board are used for 110VAC connection. The 110VAC input powers the on board power supply as well as 110VAC outputs. The 24VAC supply connects to the middle board. This connection powers the 24VAC outputs to external contactors such as those for the Estop, augers, or tool changer carousel. If axis holding brakes are used, a separate supply must be connected to the top board's brake connector to power the 2 brake outputs.

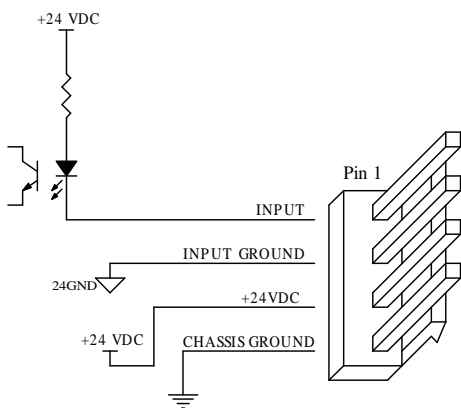
Input Wiring

All inputs on the RTK4 are optically isolated and 24VDC powered. Most inputs are sourcing, but some can sink or source, see the "Input Map" section for details. Either type of input may be used with a switch. Sourcing inputs may be used with sinking sensors that are capable of sinking 15mA at 24VDC. Sink or source compatible inputs may be used with sinking or sourcing sensors, but not a push-pull type of output. Compare sensor and RTK4 input specifications using the "RTK4 Specifications" table to ensure compatibility. Two wire sensors should not be used with the RTK4, since they normally do not meet the "Input On Voltage" and "Input Off Voltage" specifications.

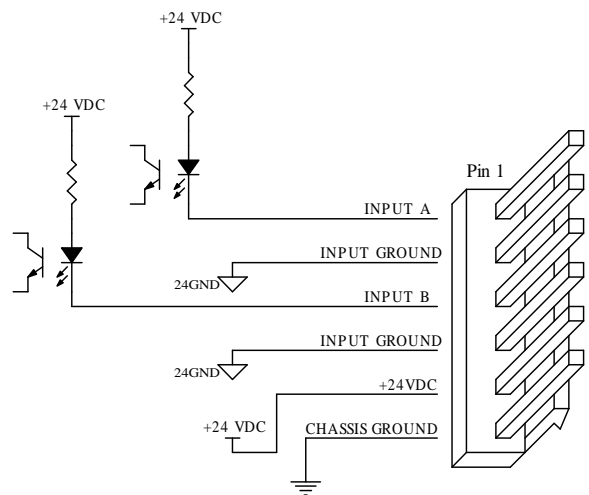
Care must be taken to wire each input correctly, as the cable for each input has signals that are not used in all cases. These include 24VDC and Input Ground for powering sensors and a shield connection that should normally be connected only to the RTK4. The 24VDC supply fuse is located on the bottom (logic) board. A short in any 24VDC circuit will blow the main 24VDC fuse, causing a loss of all input voltages.

Several types of input connectors can be found on the RTK4. The following diagrams show the layout of connectors that contain only inputs. See the "Input Map" section for exact input location assignments.

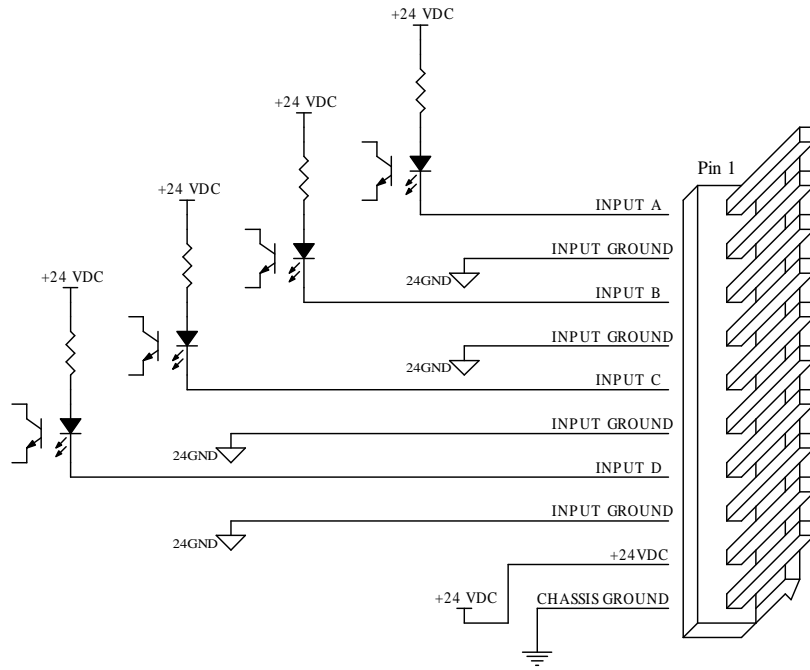
Internal Circuitry Single Input Connector



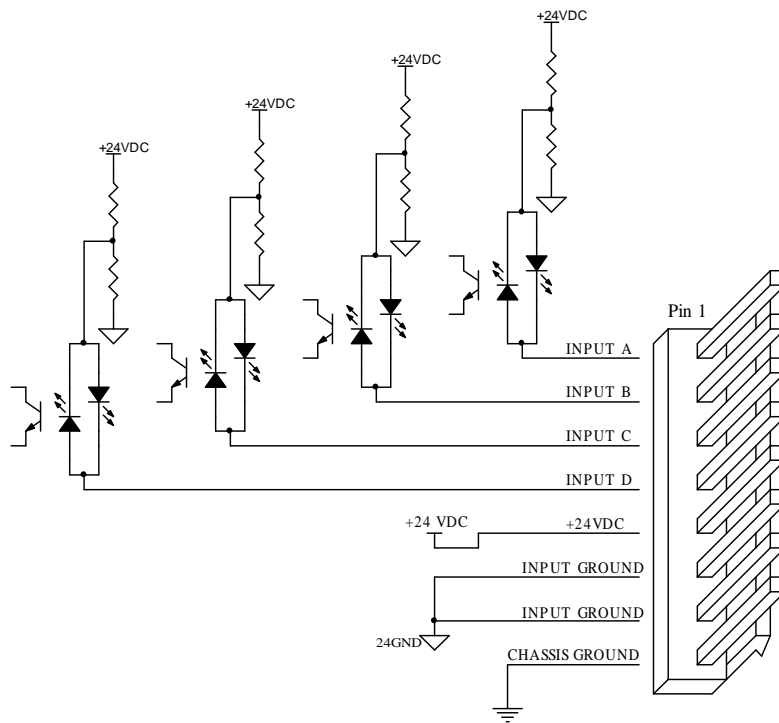
Internal Circuitry Dual Input Connector



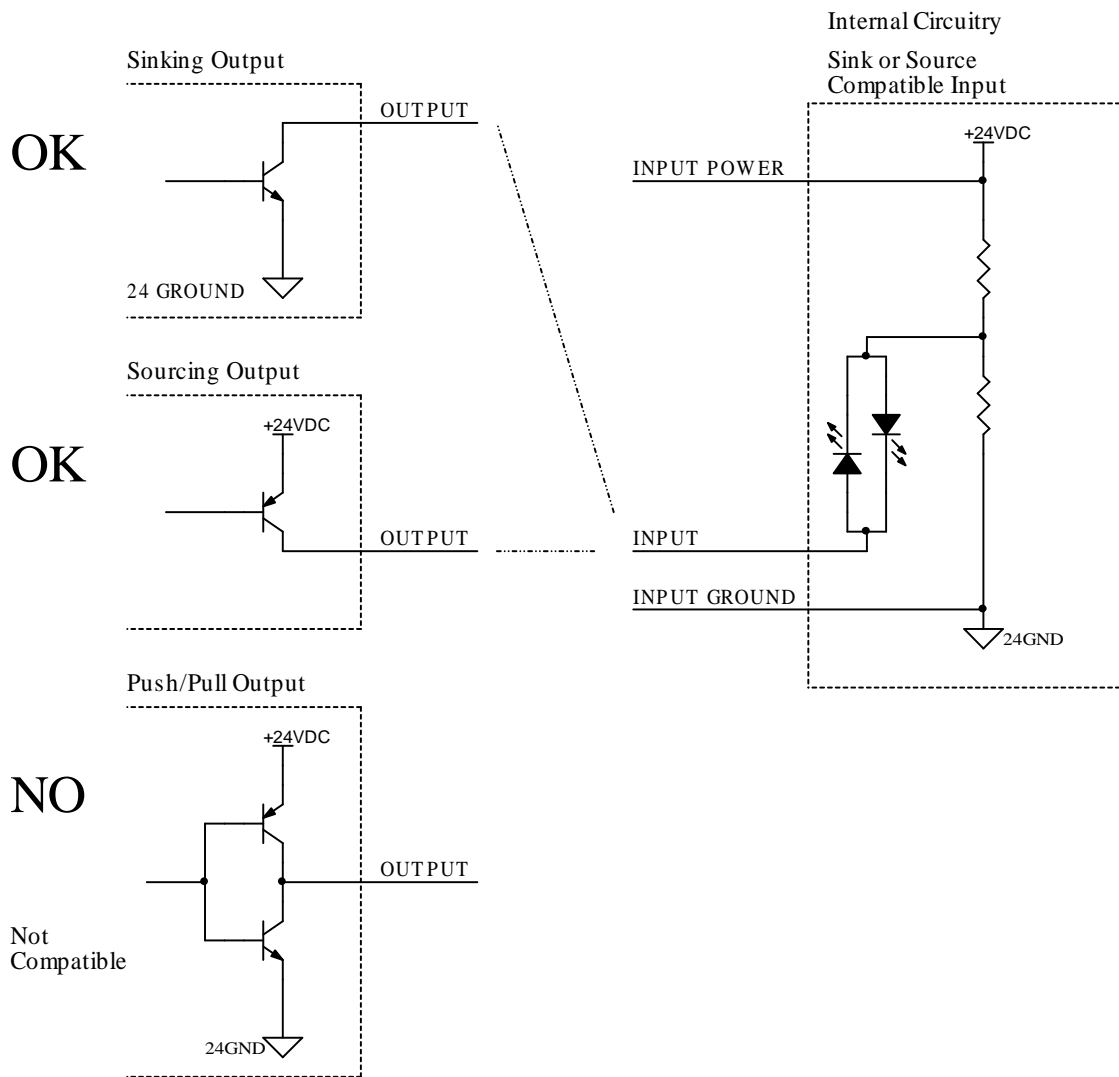
Internal Circuitry Quad Input Connector



Internal Circuitry Sink or Source Input Connector



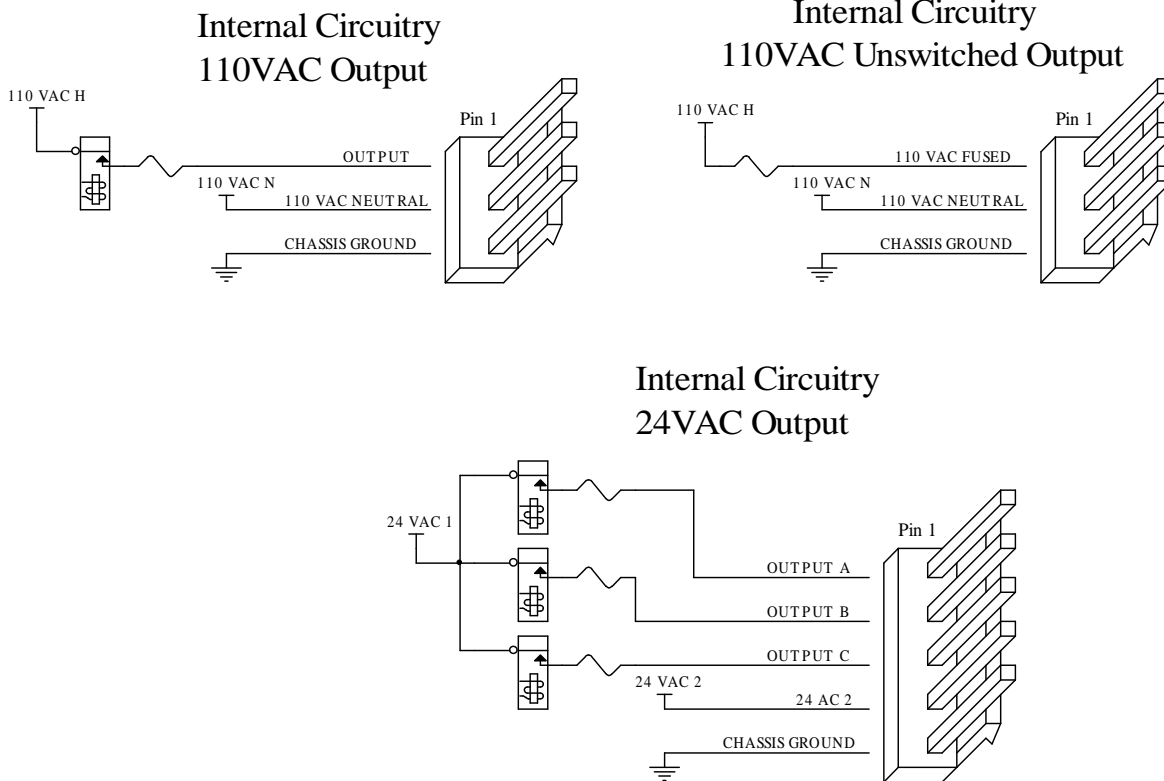
Sink Source Compatible Input Wiring Example



Output Wiring

Several output types are present on the RTK4 to reduce wiring time when interfacing with specific components. These include analog, 110VAC, 24VAC, and relay outputs. See the “Output Map” section for more information.

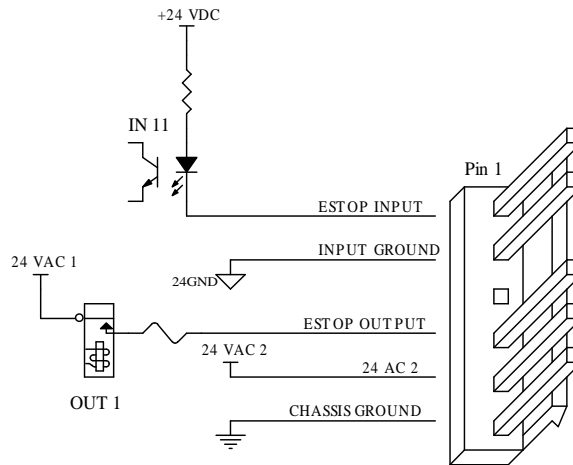
Each power relay output is protected by a fuse. The “DOOR FAN”, “AUX UNSWITCHED”, and “CONSOLE” unswitched 110VAC outputs are also fuse protected. Fuses are 5x20mm and should be rated equal to or less than the ratings printed on the RTK4 for safety. Signal relays, such as those on the inverter outputs, are not fuse protected.



Emergency Stop Connector

The E-stop connector has an input and output, unlike most RTK4 connectors. The input notifies the control of an external E-stop press. The output allows an E-stop to be triggered by the PLC program. Because the E-stop connector sources 24VAC, a 24VAC contactor coil must be used. This reduces the number of connections at the cost of some versatility.

Internal Circuitry Estop Connector



Spindle Outputs

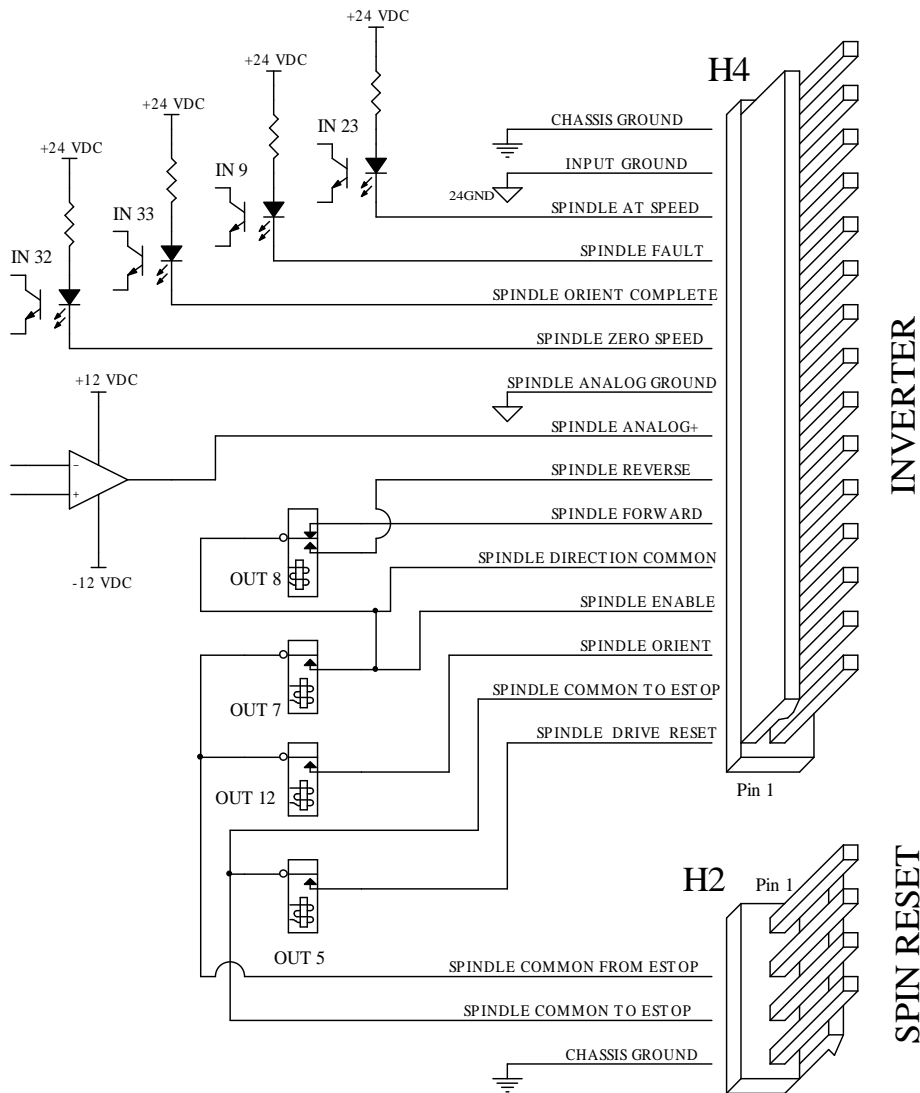
The RTK4 is equipped with an analog output and specialized relay outputs to simplify spindle drive wiring. The analog output takes 16-bit commands and can be configured for 0 to +5VDC, -5 to +5VDC, -10 to +10VDC, or 0 to +10VDC output. Range setting is accomplished through outputs 30 and 31. The effective resolution of the spindle analog output will be reduced in ranges that have less total voltage span.

Spindle Range Settings

Output 31	Output 32	Range	Resolution
1	1	-10 to 10	16 bits
1	0	-5 to 5	15 bits
0	1	0 to 5	14 bits
0	0	0 to 10	15 bits

The analog ground should not be connected to other grounds on the RTK4. Using the spindle analog ground wire only to reference the analog command provides optimum performance by keeping noise levels low. All input and output functions required for a standard inverter connection are located on the 15 pin “INVERTER” connector.

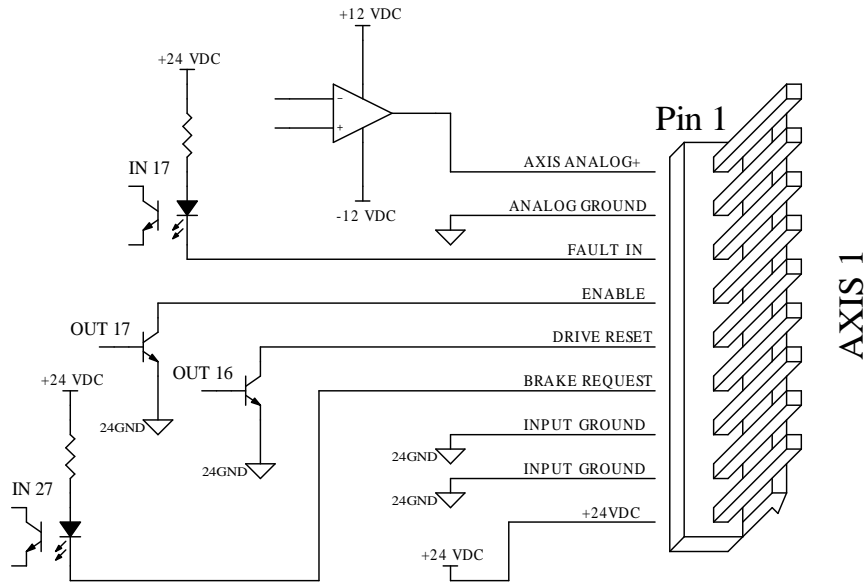
Internal Circuitry Spindle Drive Connections



Axis Drive Connections

The RTK4 is equipped with connectors for five third party axis drives. Each connector has an analog output, fault, reset, and enable signals typically used for drive connection. In addition, there is a brake request input to simplify wiring. This allows the drive's brake control to be read by the PLC program and echoed back to a brake output on the top RTK4 board. Extra wires and an extra relay card are not needed for an axis brake when the RTK4 is used this way.

Internal Circuitry Axis Drive Connections

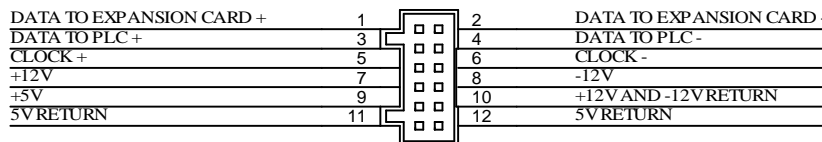


*Axis 1 used as example, see “Input Map” and “Output Map” for axis 2 through axis 5 I/O assignments

PLC Expansion

PLC I/O expansion is possible through the four “PLC ADD” connectors. Each PLC expansion port can accept 16 – 128 inputs, outputs, or inputs and outputs in 16 bit increments. This allows for digital I/O, DACs, ADCs, or other devices to be added to the system as needed.

PLC ADD 1 – 4 Connector Pinouts



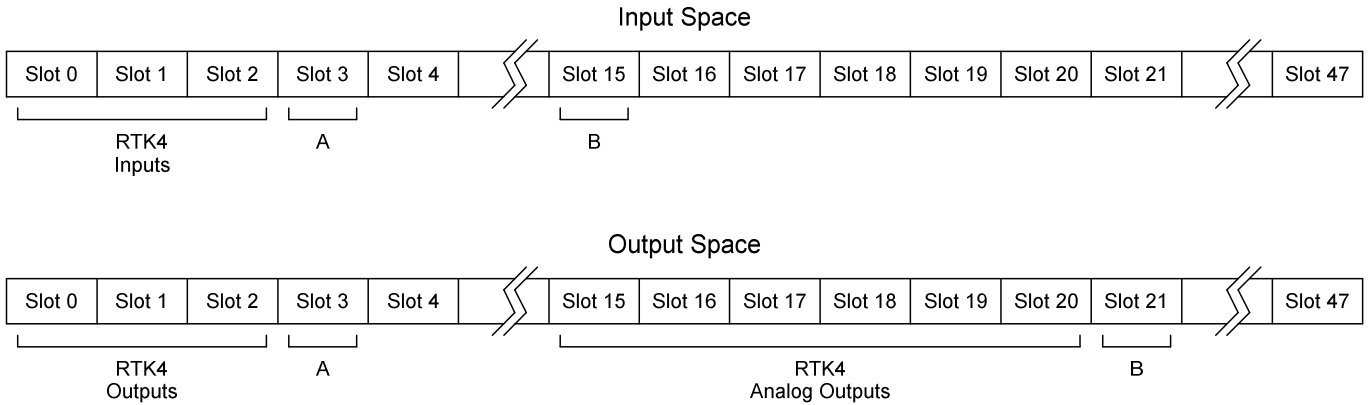
PLC I/O is arranged in 16 bit groups or slots. As a general rule, slots 0-14 are used for individual I/Os such as switches and have a programmable debounce time for the inputs. Slots 15-47 are reserved for ADCs, DACs, or other grouped I/O that do not require debounce. Every device using I/O space must use space in 16 bit multiples by reserving slots. PLC expansion boards with inputs and outputs must have a matching number of input and output slots.

A RTK4 uses 3 slots for its inputs and 9 slots for outputs. Note that the RTK4 outputs are not assigned contiguously. The individual outputs take slots 0-2, while the DACs are assigned to the group output area starting at slot 15.

Assignment of I/O slots occurs sequentially starting at the main PLC, then PLC ADD port 1, PLC ADD port 2, etc. In the “RTK4 I/O Organization” example, RTK4 I/O will always be at the same location since local PLC resources are assigned slots first. Other devices may change locations if they are plugged into PLC ADD ports in a different order. Devices plugged into the PLC ADD ports that require debounce will be assigned

starting at the slots marked “A”, while devices that do not require debounce will start being assigned at the slots marked “B”.

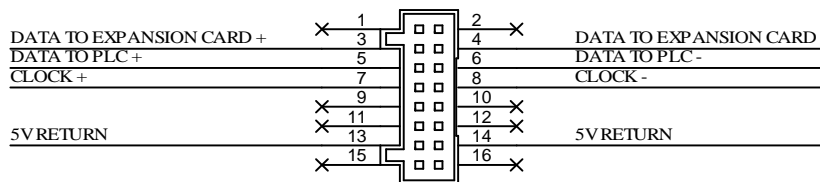
RTK4 I/O Organization



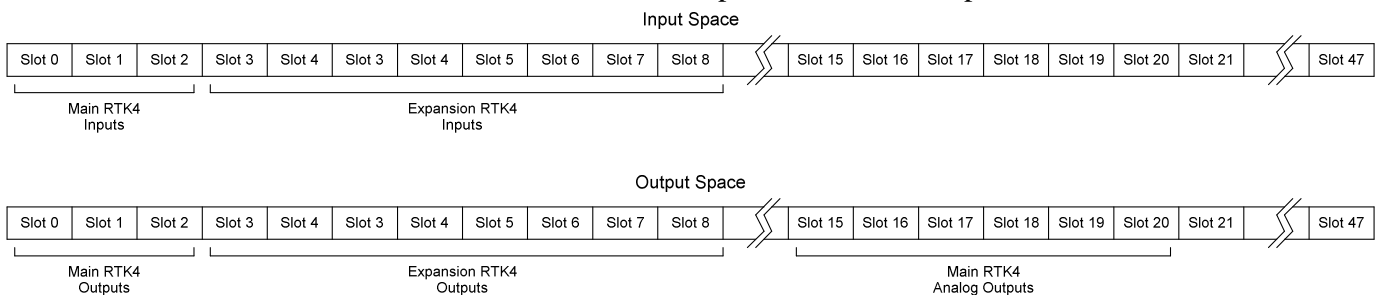
RTK4 as a PLC Expansion Board

The RTK4 may be used as a PLC expansion board to another PLC. The “PLC SLAVE” jumper J1 must first be installed to configure the RTK4 to communicate over HM8 “I/O to PLC” connector. A PLC expansion cable can then be run from HM8 to a “PLC ADD” connector on another PLC. Note that the spindle analog output on the expansion RTK4 will not be usable. This is because the RTK4 has more than 128 output bits, which is too many to fit in the expansion protocol. Also notice how the expansion RTK4 reserves 5 extra input slots that are not used, because the number of input and output slots in the expansion protocol must match.

I/O to PLC Connector Pinout



RTK4 with RTK4 as an Expansion Card Example



Status Indicator LEDs

Eleven green indicator LEDs (lights) on the RTK4 display status. All LEDs will be lit under normal operating conditions. Five LEDs on the middle board indicate the presence of required operating voltages. The 110VAC input feeds the power supply to generate these voltages. The “PLC OK” LED lights when the RTK4 and motion control card (MPU11) have a working communication link. This LED will not be lit as soon as power is applied. After the control software (CNC11) has initialized the motion control card, communication can be established with the RTK4, which lights the “PLC OK” LED. The remaining five LEDs show the enable state of each axis drive. Once a request for motion is made, the enable LED for the requested axis will light, and motion will be possible.

Input Map

Input Specification			Input Location		
Number	Function	Type	Board	Connector	Pin
1	X Minus Limit	Sourcing	Bottom	H12	1
2	X Plus Limit	Sourcing	Bottom	H12	3
3	Y Minus Limit	Sourcing	Bottom	H12	5
4	Y Plus Limit	Sourcing	Bottom	H12	7
5	Z Minus Limit	Sourcing	Bottom	H13	1
6	Z Plus Limit	Sourcing	Bottom	H13	3
7	4th Minus Limit	Sourcing	Bottom	H14	1
8	4th Plus Limit	Sourcing	Bottom	H14	3
9	Lube OK	Sourcing	Top	HT8	1
10	Spindle Inverter OK	Sourcing	Bottom	H4	12
11	Estop OK	Sourcing	Bottom	H15	1
12	No Tool	Sink / Source	Bottom	H11	3
13	Fourth Home	Sourcing	Bottom	H1	1
14	Door Closed	Sourcing	Bottom	H5	3
15	Door Locked	Sourcing	Bottom	H5	1
16	Fourth Clamp	Sourcing	Bottom	H1	3
17	X Drive OK	Sourcing	Middle	HM6	3
18	Y Drive OK	Sourcing	Middle	HM8	3
19	Z Drive OK	Sourcing	Middle	HM10	3
20	4th Drive OK	Sourcing	Middle	HM15	3
21	5th Minus Limit	Sourcing	Bottom	H14	5
22	5th Plus Limit	Sourcing	Bottom	H14	7
23	TT1	Sourcing	Bottom	H3	1
24	Inverter at speed	Sourcing	Bottom	H4	13
25	Spindle Range	Sourcing	Bottom	H6	1
26	5th Drive OK	Sourcing	Middle	HM14	3
27	Axis 1 Brake Request	Sourcing	Middle	HM6	6
28	Axis 2 Brake Request	Sourcing	Middle	HM8	6
29	Axis 3 Brake Request	Sourcing	Middle	HM10	6
30	Axis 4 Brake Request	Sourcing	Middle	HM15	6
31	Axis 5 Brake Request	Sourcing	Middle	HM14	6
32	TT2 Detect	Sourcing	Bottom	H3	3
33	Inverter Zero Speed	Sourcing	Bottom	H4	10
34	Inverter Orient Complete	Sourcing	Bottom	H4	11
35	Tool Clamped	Sink / Source	Bottom	H11	2
36	Tool Unclamped	Sink / Source	Bottom	H11	1
37	Tool Release Button	Sink / Source	Bottom	H11	4
38	Chiller OK	Sourcing	Bottom	H8	1
39	Carousel Home	Sink / Source	Bottom	H9	3
40	J2 Jumper State	Internal	-	-	-
41	Tool Counter	Sink / Source	Bottom	H9	4
42	Carousel Out / Pot Up	Sink / Source	Bottom	H9	2
43	Carousel In / Pot Down	Sink / Source	Bottom	H9	1
44	Not Implemented	-	-	-	-
45	Air Pressure OK	Sourcing	Bottom	H7	1
46	Arm Clamp Input	Sink / Source	Bottom	H10	1
47	Arm Stop Input	Sink / Source	Bottom	H10	2
48	Arm Home Input	Sink / Source	Bottom	H10	3

Output Map

Output Specification			Output Location		
Number	Function	Type	Board	Connector	Pin
1	No Fault Out	24VAC	Bottom	H15	4
2	Lube Out	110VAC	Top	HT7	1
3	Flood Out	24VAC	Middle	HM5	3
4	Mist Out	110VAC	Top	HT9	1
5	Spindle Inverter Reset	Relay Contact	Bottom	H4	1
6	4th Clamp	110VAC	Top	HT16	1
7	Spindle Enable Out	Relay Contact	Bottom	H4	4
8	Spindle Direction Out	Relay Contact	Bottom	H4	5,6,7
9	5th Clamp	110VAC	Top	HT15	1
10	Not Implemented	-	-	-	-
11	Worklight	110VAC	Top	HT10	1
12	Inverter Orient Request Out	Relay Contact	Bottom	H4	3
13	Spindle Chiller Out	24VAC	Middle	HM5	1
14	Tool Unclamp Out	110VAC	Top	HT2	1
15	Air Blow Out	110VAC	Top	HT5	1
16	Drive Reset	Open Collector	Middle	HM6, HM8, HM10, HM14, HM15	5
17	Axis 1 Enable	Open Collector	Middle	HM6	4
18	Axis 2 Enable	Open Collector	Middle	HM8	4
19	Axis 3 Enable	Open Collector	Middle	HM10	4
20	Axis 4 Enable	Open Collector	Middle	HM15	4
21	Axis 5 Enable	Open Collector	Middle	HM14	4
22	Brake 1	Ext. Supply	Top	HT17	3
23	Brake 2	Ext. Supply	Top	HT17	5
24	Chip Wash	24VAC	Middle	HM2	1
25	Not Implemented	-	-	-	-
26	Not Implemented	-	-	-	-
27	Not Implemented	-	-	-	-
28	Not Implemented	-	-	-	-
29	Not Implemented	-	-	-	-
30	Not Implemented	-	-	-	-
31	Spindle DAC mode bit 1	Internal	-	-	-
32	Spindle DAC mode bit 2	Internal	-	-	-
33	Red Light Out	110VAC	Top	HT11	1
34	Amber Light Out	110VAC	Top	HT13	1
35	Green Light Out	110VAC	Top	HT12	1
36	Carousel Out / Pot Up	110VAC	Top	HT4	1
37	Carousel In / Pot Down	110VAC	Top	HT3	1
38	Door Lock 110V	110VAC	Top	HT14	1
39	Carousel / Magazine Motor CW	24VAC	Middle	HM4	2
40	Carousel / Magazine Motor CCW	24VAC	Middle	HM4	3
41	Arm Motor	24VAC	Middle	HM5	2
42	Not Implemented	-	-	-	-
43	Door Lock	24VAC	Middle	HM3	1
44	Not Implemented	-	-	-	-
45	Auger 1 CW Out	24VAC	Middle	HM2	2
46	Auger 1 CCW Out	24VAC	Middle	HM2	3
47	Auger 2 CW Out	24VAC	Middle	HM3	2
48	Auger 2 CCW Out	24VAC	Middle	HM3	3
				0	
				0	
				0	
				0	
241-256	Axis 1 Analog	16 bit DAC	Middle	HM6	1
257-272	Axis 2 Analog	16 bit DAC	Middle	HM8	1
273-288	Axis 3 Analog	16 bit DAC	Middle	HM10	1
289-304	Axis 4 Analog	16 bit DAC	Middle	HM15	1
305-320	Axis 5 Analog	16 bit DAC	Middle	HM14	1
321-336	Spindle Analog	16 bit DAC	Bottom	H4	8
	Door Fan	Unswitched 110V	Top	HT1	1
	Console	Unswitched 110V	Top	HT19	1
	Aux Unswitched	Unswitched 110V	Top	HT18	1

RTK4 Specifications

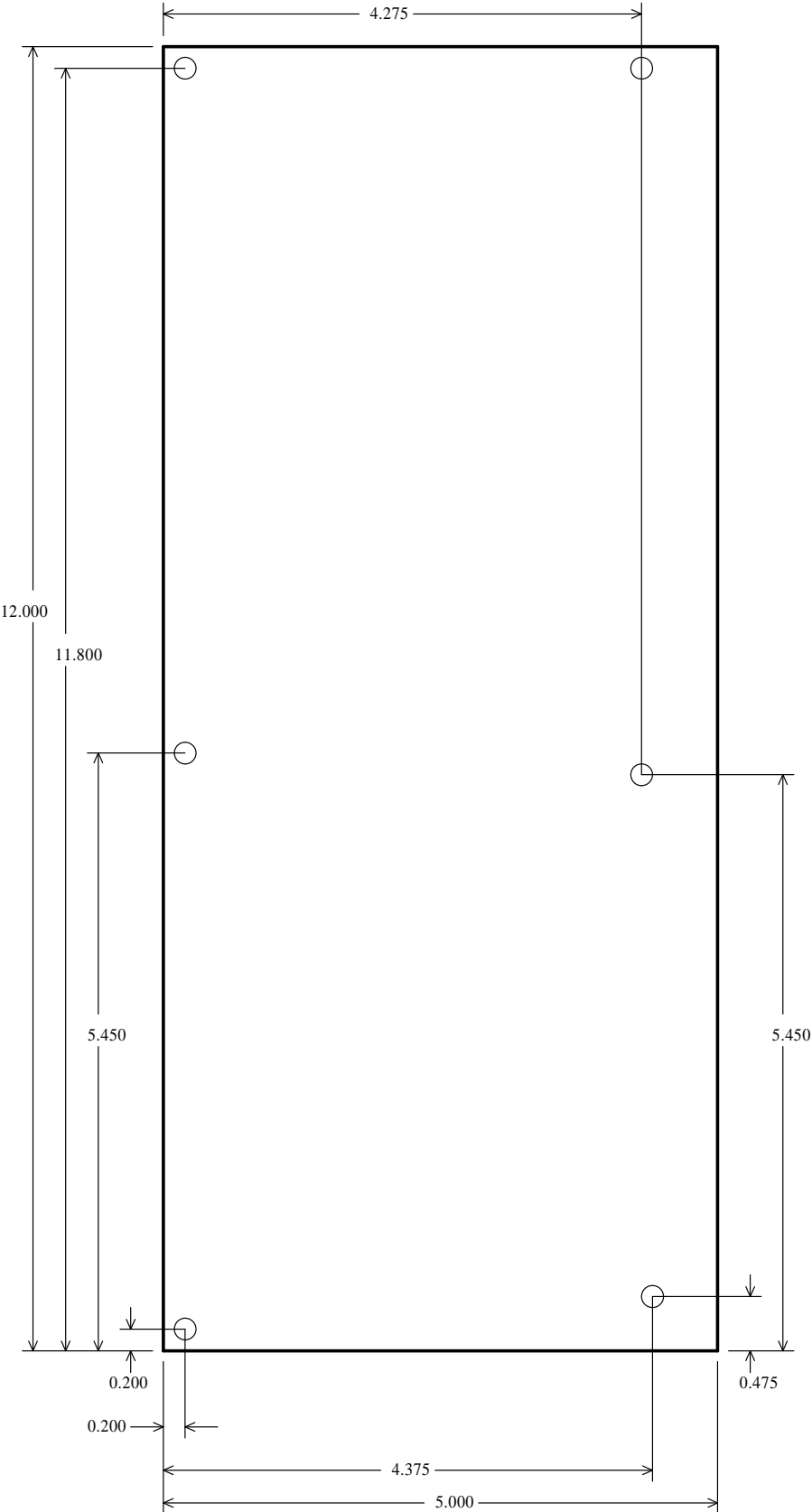
Characteristic	Min.	Typ.	Max.	Unit
5 Volt Supply Current	2	3	-	A
12 Volt Supply Current	0.1	0.9	-	A
-12 Volt Supply Current	0.1	0.5	-	A
24 Volt Supply Current	0.5	0.9	-	A
Input Pullup Voltage	-	24	-	V
Input On Voltage	22	-	-	V
Input Off Voltage	-	-	1.25	V
Power Relay Output Current	0.01	-	10	A @ 250VAC
Power Relay Output Current	0.01	-	5	A @ 30VDC
Power Relay Output Current	10	-	400	mA @ 100VDC
Signal Relay Output Current	0.001	-	0.5	A @ 125VAC
Signal Relay Output Current	0.001	-	1	A @ 24VDC
Open Collector Output Current	-	-	23	mA
110 VAC Input Current	-	9	30	A
Input Operating Current	9	11	15	mA
Analog Output Resolution	14	15	16	bits
Analog Output Voltage	-10	-	10	V
Analog Output Current	0	1	5	mA
Analog Output Error	-	<0.1	-	%
Size: 12*5*3.5 (W*D*H)				

*signal relays are outputs 5, 7, 8, and 12

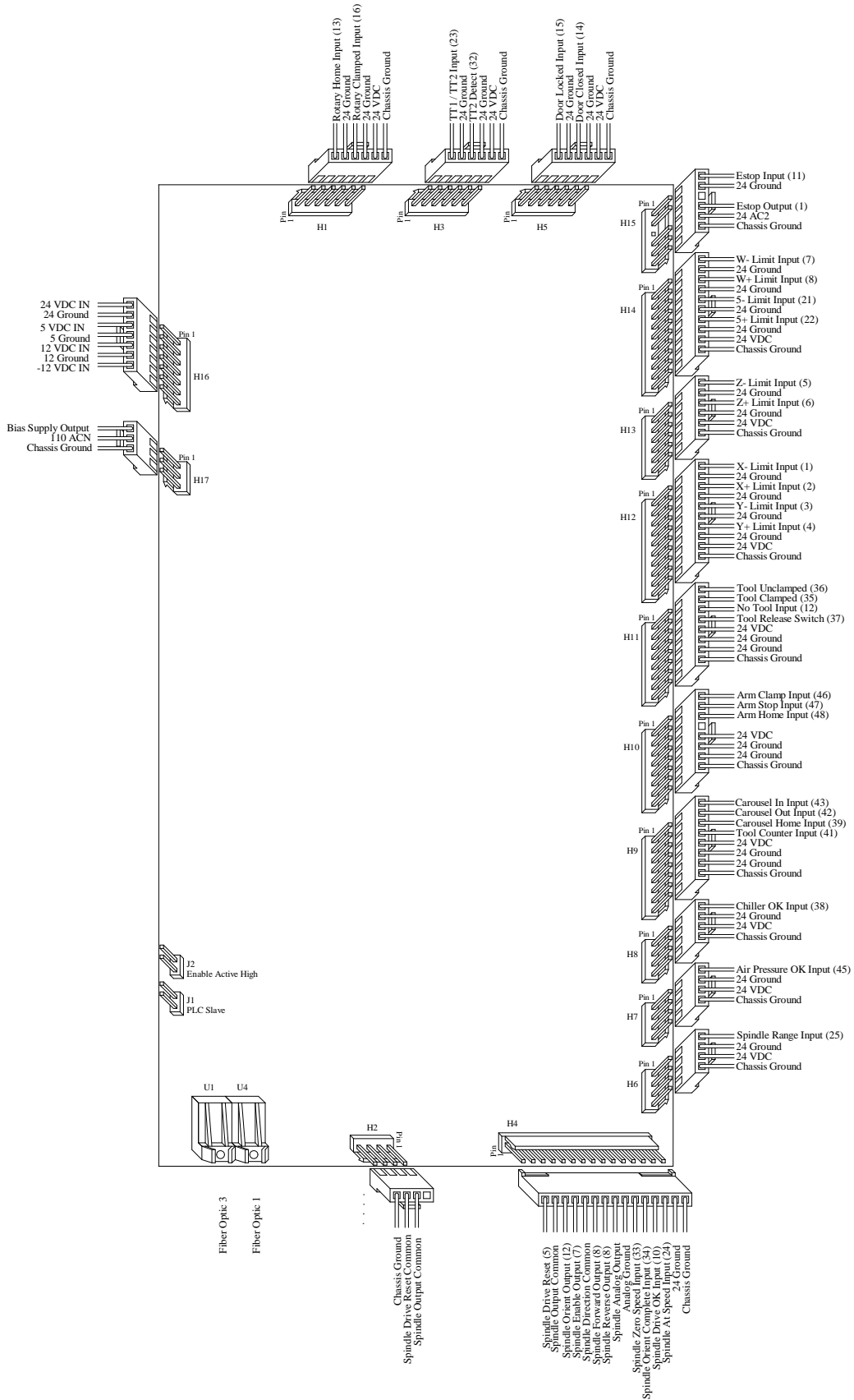
RTK4 Troubleshooting

Symptom	Possible Cause	Corrective Action
All status LEDs out	110VAC not connected	connect 110VAC supply to HT6 on top board, check voltage between 110ACN and 110ACH terminals
	Power supply cables not connected	Check cables to H16 and H17
	F1 Fuse on logic board blown	Replace Fuse
PLC OK LED out	Motion control card not initialized	Start CNC11 software
	PLC SLAVE jumper J1 is installed while connected to MPU11	Make sure J1 is set properly for use as the main PLC or as an expansion board
	Fibers faulty or incorrectly connected	Check connections, inspect or swap fibers
+24 LED out	Fuse blown or poor connection	Check +24VDC fuse and fuseclips on bottom board
Incorrect Spindle Analog Voltage	Incorrect range setting	Verify output 31 and 32 settings
Estop contactor or other 24VAC outputs not working	24VAC not connected	plug 24VAC cable into 24VAC input on middle board, check connections and voltage

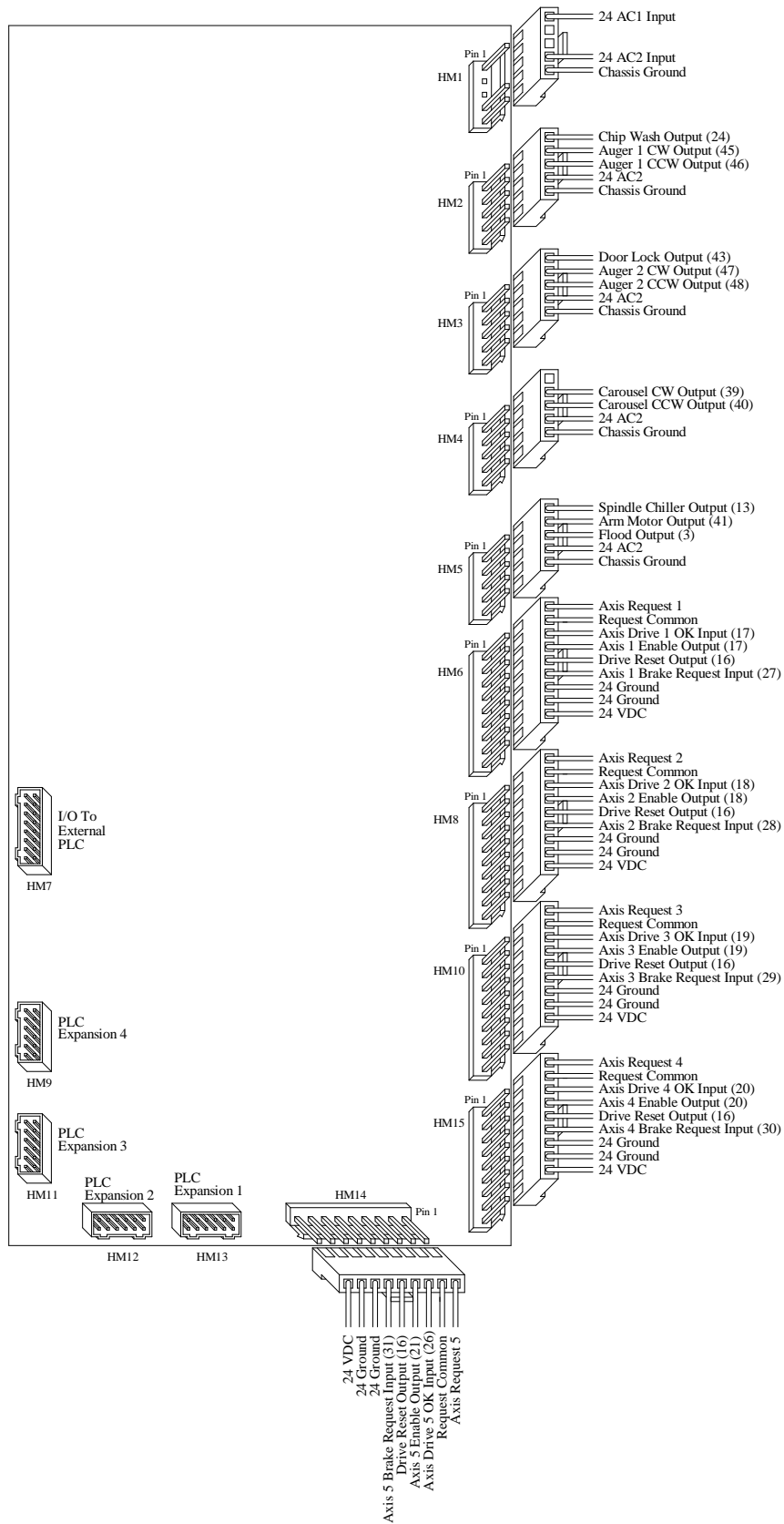
RTK4 Mounting Dimensions



RTK4L (Bottom) Board Connections



RTK4M (Middle) Board Connections



RTK4T (Top) Board Connections

