



M4 Sciences Embedded micro-Controller MEC PA11033A User Manual

MEC-PA11033A M4 Sciences Embedded Controller for driving TriboMAM® Standard, TriboMAM®-mini, and TriboMAM®-micro drilling systems: Together the MEC controller and TriboMAM drilling actuator make up the TriboMAM drilling system.

Thank you for purchasing a MEC-PA11033A Controller. The TriboMAM drilling system uses Modulation-Assisted Machining (MAM®) to enable the improvement of drill speeds and feed rates for high-aspect ratio centerline drilling in CNC lathes and in live rotating spindles. This manual provides information regarding safety precautions, installation procedures and operating protocols in the use of the MEC-PA11033A Controller.

This product is covered by United States and foreign patents, issued and pending. Information in this publication supersedes that in all previously published material. Specifications are subject to change without notice.

© Copyright 2014 all rights reserved. Printed in the U.S.A.

TABLE OF CONTENTS

1	<u>Safety</u>	4
1.1	Safety Precautions	4
1.2	Product Protection Precautions.....	5
1.3	Safety Terms and Symbols	5
2	<u>Introduction</u>	7
2.1	Receiving Inspection	7
2.2	Installation	7
2.3	TriboMAM Connection procedure.....	9
3	<u>Operation</u>	13
3.1	Software Instructions.....	14
3.1.1	Startup.....	14
3.1.2	Program Menu	15
3.1.3	Remote Menu	18
3.1.4	Setting Menu.....	19
3.1.5	Tools Menu	20
3.2	Indicator Lights.....	22
4	<u>Specifications</u>	23
4.1	Output.....	23
4.2	Features	23
4.3	Performance	24
4.4	General Specifications	24
5	<u>Accessories</u>	25
6	<u>Certification</u>	25
7	<u>Maintenance</u>	25
7.1	Safety	25
7.2	Maintenance Assistance	26
7.3	Servicing the Fuses.....	26
7.4	Servicing the fan filter	27
7.5	Air knife installation and filter servicing (optional)	28
8	<u>Communications Protocol</u>	29
8.1	DB50 Port Pin Layout	30
8.2	Input Control of the MEC functions.....	33
8.3	MEC Relay Logic Output Control Functions	41

1 Safety

Review the following precautions to maintain safety and prevent damage to the instrument or equipment connected to it. The safety features of this instrument may be ineffective if the equipment is not operated in the manner stated in this manual. Refer all maintenance procedures to qualified personnel.

1.1 Safety Precautions

- Use the Proper Power Cord. To avoid fire hazard, use only the power cord provided with this instrument.
- Avoid Electric Overload. To avoid electric shock or fire hazard, do not apply a voltage to a terminal that is outside the range specified for that terminal.
- Avoid Electric Shock. To avoid electric shock, do not touch the metal surfaces of the HV connector while the instrument is on.
- Ground the Product. This product is grounded through the ground conductor of the power cord. To avoid electric shock, the ground conductor must be connected to earth ground. Before making connections to the input and output terminals of the product, ensure that the product is properly grounded.
- Do Not Operate Without Covers. To avoid electric shock or fire hazard, do not operate this instrument with the covers removed.
- Use Proper Fuses. To avoid fire hazard, use only the fuse type and rating specified for this instrument.
- Indoor Use Only. This instrument is intended for indoor use only.
- Do Not Operate in Wet or Damp Conditions. To avoid electric shock, do not operate this instrument in wet or damp conditions.
- Do Not Operate in an Explosive Environment. To avoid injury or fire hazard, do not operate this instrument in an explosive environment.

1.2 Product Protection Precautions

- Use the Proper Power Source. Do not operate this instrument with a power source that is different from the voltage specified on the serial number tag.
- Provide Proper Ventilation. To prevent the instrument from overheating, do not block air-cooling fins in back of unit.
- Do Not Operate with Suspected Failures. If you suspect there is damage to this instrument, contact M4 Sciences.

1.3 Safety Terms and Symbols

- These terms may appear in this manual:

Warning: Warning statements identify conditions or practices that could result in injury or loss of life.

Caution: Caution statements identify conditions or practices that could result in damage to this product or other equipments.

- These symbols may appear on the instrument:



Warning, risk of electric shock



Caution, refer to Operator's Manual

CAT I Installation category I (overvoltage category): Classification for the operation of a unit using voltage systems or circuits with required standardized limits for transient voltages. Category I pertains to voltages

supplied at the peripheral level, with smaller tolerances for transient voltages as specified by the Low-Voltage Safety standard (EN 61010-1).

CAT II Installation category II (overvoltage category): Classification for the operation of a unit using voltage systems or circuits with required standardized limits for transient voltages. Category II pertains to using voltage supplied on the local level (example: local wall outlets) with smaller tolerances for transient voltages as specified by the Low-Voltage Safety standard (EN 61010-1).

Danger: High-voltage generating equipment, including this amplifier and related supplies are not designed, rated, or qualified to be operated in an environment or atmosphere which contains combustible or explosive materials or gases which may be ignited by electrical discharges.

2 Introduction

The M4 Sciences MEC-PA11033A is used to drive TriboMAM-standard, TriboMAM-mini and TriboMAM-micro type piezo-based drilling system. The unit utilizes computer control interfaces for input, monitoring and control functions. The graphical front panel display with a keypad is used for local input and control.

2.1 Receiving Inspection

Visually inspect the instrument for physical damage such as dents, nicks, scratches, broken fittings, etc. External damage may indicate more serious damage has occurred within the instrument. In the event of damage, notify M4 Sciences and request instructions. Do not attempt to use a damaged instrument.

2.2 Installation

The MEC-PA11033A is designed for operation on a bench top. The MEC-PA11033A is air-cooled. Allow a minimum of 50 mm (2 in) of free space around the heat exchange fins on the rear panel. Refer to Figures on pages 13 for descriptions of front and rear panel features.

Caution: Do not operate the instrument with the covers removed. The covers must be installed completely to ensure proper cooling.

Power Connection

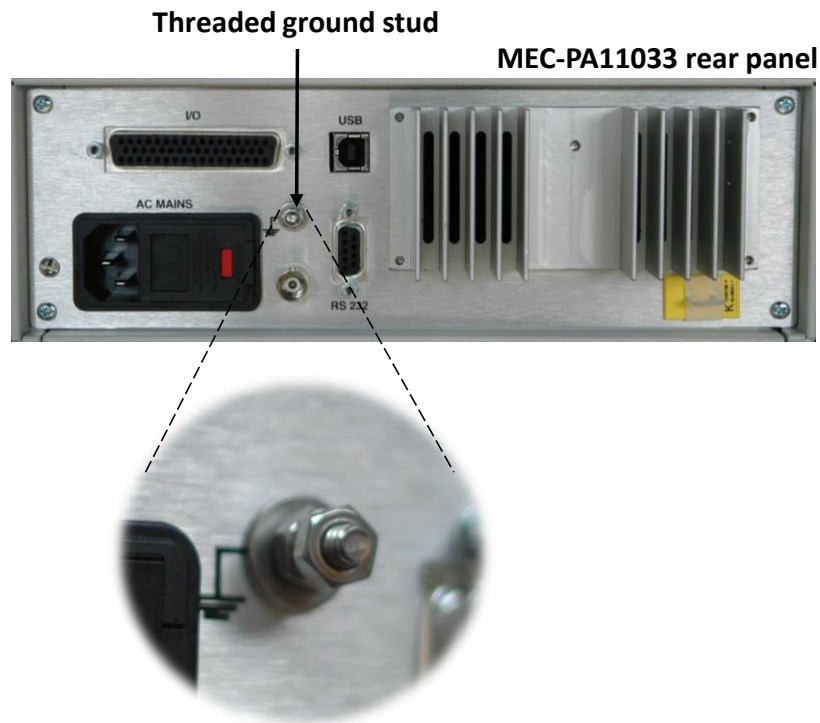
The MEC-PA11033A is designed for power sources of 100 to 240 V AC, at 50 to 60 Hz.

Caution: The MEC-PA11033A may be damaged if operated at an incorrect voltage. Check the voltage to ensure that configuration matches the line voltage in your area.

Warning: Make no attempt to bypass the ground prong in the power cord. This is a protective ground and any attempt to negate it could result in an electrical shock.

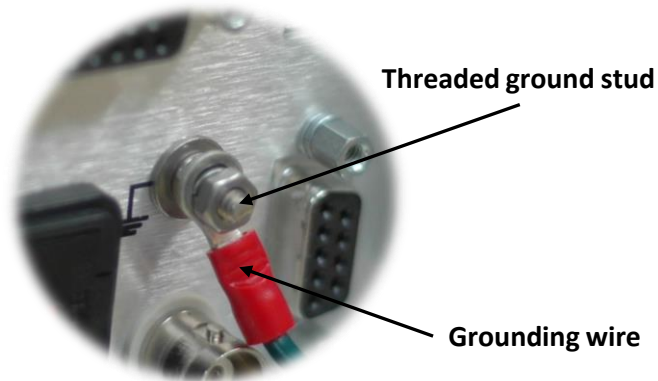
1. Verify that power source has ground to the power cord.

Caution: If the power source is not grounded, then ground the MEC-PA11033A using the rear panel threaded ground stud connection.



Ground connection example

Note: This ground connection is only required if the power source is not grounded.



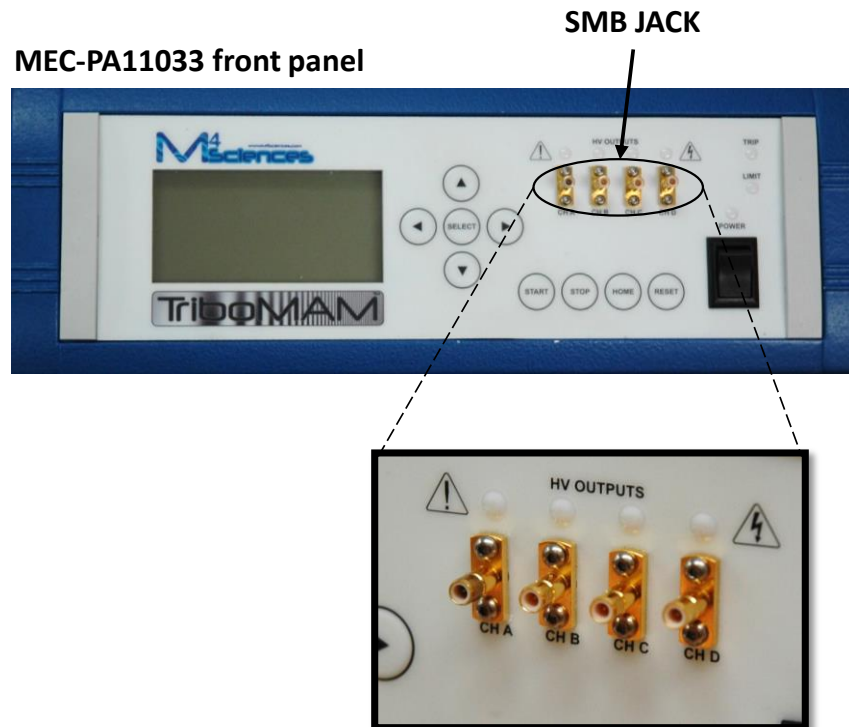
Warning: Make no attempt to operate the MEC-PA11033A without ground connection. A ground connection is required for proper operation.

2. Ensure that the power switch is off before connecting the power source.
3. Plug the power cord into the power connector on the rear panel.
4. Plug the free end of the power cord into the power source.

2.3 TribomAM Connection procedure

1. Connect the high-voltage cable to the SMB output jack (labeled HV OUTPUTS) on the MEC-PA11033A as shown below.

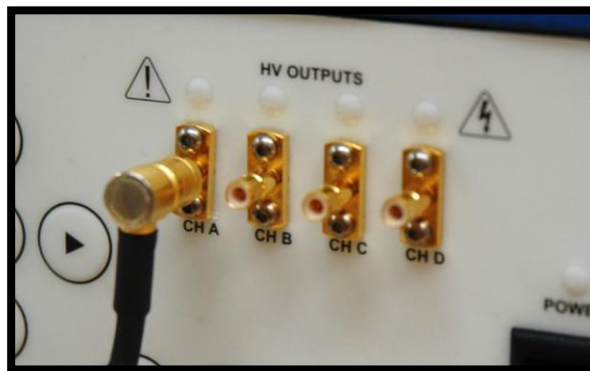
The high-voltage cable assembly for TribomAM to MEC-PA11033A connection is of the SMB type. **Only cables supplied by M4 Sciences may be used for connecting the TribomAM system to the MEC-PA11033A Controller.**



SMB COAXIAL PLUG
(For MEC-PA11033 coaxial jack)
SMB-RIGHT ANGLE

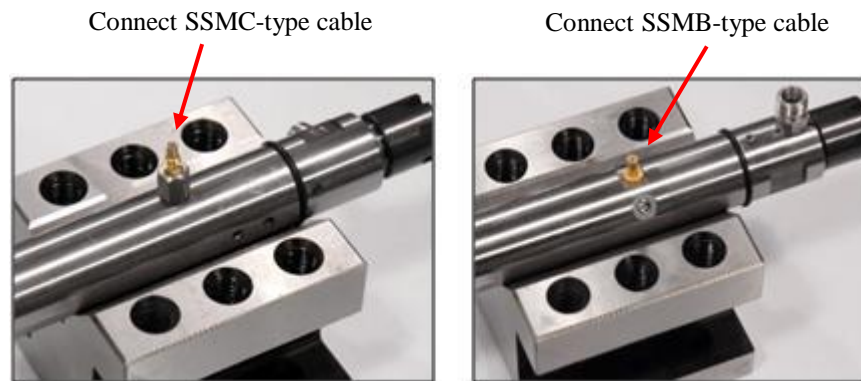


SMB coaxial plug connected to SMB jack at the front panel



2. Connect the high-voltage cable to the SSMB (or SSMC) jack located on the TriboMAM drilling actuator.

Route the coaxial cable as directly as possible to the TriboMAM drilling system. This minimizes the effects of stray capacitance on the performance of the MEC-PA11033A. It is desirable to keep the high-voltage output cable un-bundled from other cabling and away from grounded structures. These measures will minimize capacitive loading of the amplifier and reduce extraneous coupling to other devices.



SSMC-type (left) and SSMB-type (middle) connectors on TriboMAM-mini drilling actuator Power cable attached to front panel of MEC-PA11033A Controller

The high-voltage cable assembly for TriboMAM connection may be configured with one of two types of coaxial cable connectors. These are SSMB and SSMC type plugs. The SSMC plug connector can be readily identified as it uses a threaded connection to the SSMC jack.

The SSMB connector is a small version of the standard *SubMiniature Version B* or SMB connector. The SSMB connector is a 'snap-on' type coupling.

The SSMB cable assembly connection may be configured with one of two types. These are *SSMB-STRAIGHT* and *SSMB-RIGHT ANGLE*.

TriboMAM power cable connector configurations

SSMB-STRAIGHT



SSMB-RIGHT ANGLE

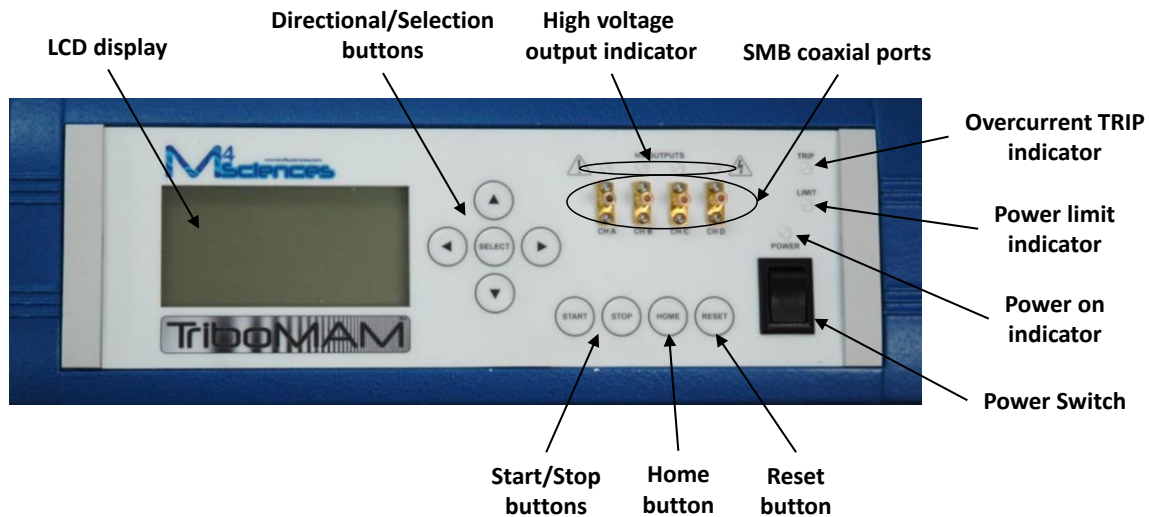


Warning: The high voltage output connector carries high voltage. DO NOT touch the high voltage output connector or the load circuit while the MEC-PA11033A is operating. An electrical shock could result. Always turn off the MEC-PA11033A before making changes to the connections. The maximum voltage at the high voltage output connector is 150 V.

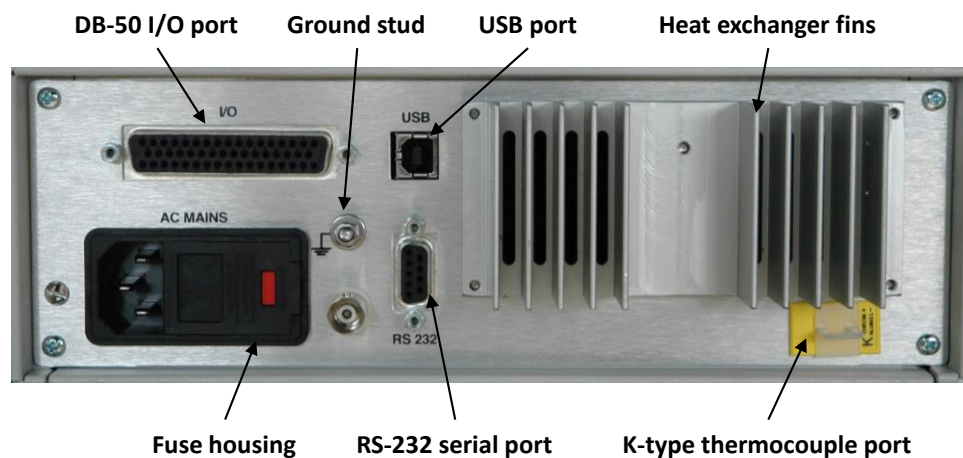
3 Operation

The following pictures show the location of various controls, displays, indicator lights and components on the Front and Rear Panels of the MEC-PA11033A Controller.

Front panel



Rear panel



***RS232 serial port, USB port and K-type thermocouple port are for M4Sciences Engineering use only unless specified otherwise**

- RS-232 9 pin female interface port with a 300-19.2 k baud rate (minimum) (115.2 k desired) with flow control hardware. This port can be used for communication between PA11033A controller and CNC lathe control. Please contact M4 Sciences for additional information.
- USB 2.0 full speed compliant with a maximum transfer data rate of 12 Mbits/second. The USB port is used only for transfer of new software to the MEC-PA11033A by M4 Sciences personnel.

3.1 Software Instructions

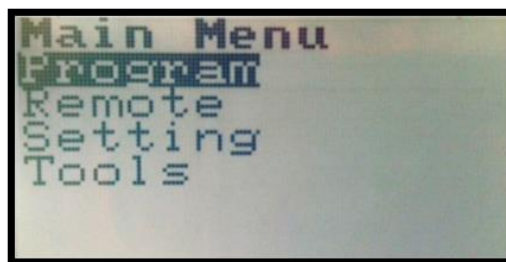
3.1.1 Startup

When MEC-PA11033A controller is turned on, a welcome screen with software version number (v X.X) will be first displayed.



Welcome screen

Press any key to enter the *Main Menu*.



Main Menu

There are four options in the main menu:

Program – edit and run drilling programs, up to 5 programs can be stored

Remote – run program through remote I/O control

Setting – change English/SI units, I/O remote control, display contrast/brightness, etc.

Tools – various tests for TriboMAM system check

Press *UP* or *DOWN* button to navigate the options; press *SELECT* button to enter the submenu; press *HOME* button to return to the *Main Menu* from the submenu.

3.1.2 Program Menu

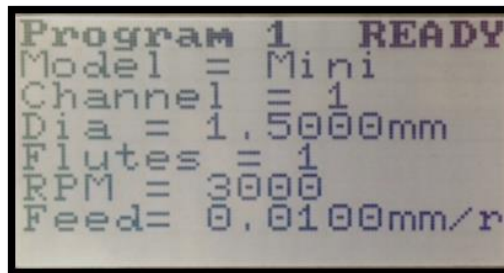
When *Program* menu is entered, the currently selected drilling program will be displayed on the screen. The first line displays program number (1 to 5 available) and program status. The following status are possible:

READY – program is ready for run; press *START* button to run the program

RUN – program is running; high voltage output is on

EDIT – program parameters can be edited; program cannot run in this status

ERROR – indicate the input value is out of range when editing the program



Drilling program

Select program

In the **READY** status, press *UP* or *DOWN* button to change the program. The program displayed on screen is the currently selected program.

Start/Stop program

In the READY status, press *START* button to run the program; high voltage output is on; program status changes to RUN.

In the RUN status, press *STOP* button to stop the program; high voltage output is off; program status changes to READY.

System alarms and reset

When running the program, the TriboMAM system is being monitored in real time. When an unwanted event occurs, an alarm will be triggered and the system will alarm out automatically.

The events that can trigger the alarm include: 1) TriboMAM disconnection, 2) overcurrent trip, 3) heat sink temperature exceeds limit, 4) temperature inside controller housing exceeds limit, 5) external temperature by thermocouple exceeds limit (if assigned by M4 sciences specification).

For example, if TriboMAM is not connected to the controller when running the program, the “Open loop” alarm will be triggered as below:

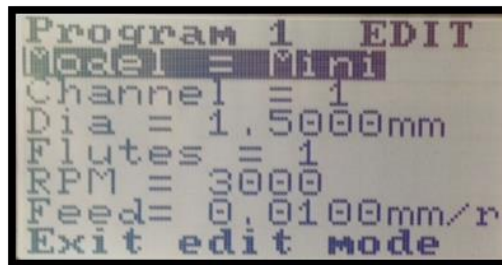


“Open loop” alarm

Press *RESET* button to reset MEC from any alarms!

Edit Program

In the READY status, press *SELECT* button to enter the EDIT status for editing the current program. Program status changes to EDIT.



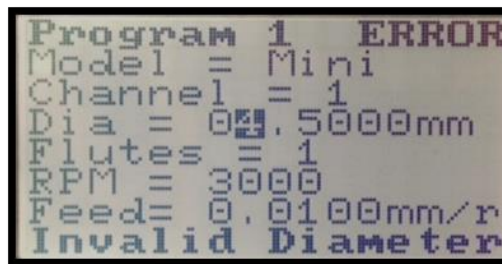
Program edit mode

Press *UP* or *DOWN* button to navigate the parameter to be edited; the corresponding parameter line will be highlighted.

Press *SELECT* button to start adjusting the value of the variable; press *UP* or *DOWN* button to adjust the value of the variable; press *LEFT* or *RIGHT* button to change the digit to be adjusted (for diameter and feed); press *SELECT* button to finish adjusting and saving the value.

Select "Exit edit mode" to return back to the READY status.

During editing the program, if the value of the parameter is adjusted to be out of the processing envelope of the TriboMAM system, program status changes to ERROR. A corresponding error message will be displayed on the bottom line. Adjust the corresponding variables until the error is cleared. The error has to be cleared before returning back to the READY status.



Error in program edit

Note: Maximum values for spindle rotation RPM and drill feed depend on the other drilling parameters. The maximum values specified in the TriboMAM drilling system user manual are absolute maximums for the TriboMAM system. Actual drilling application limits are process dependent.

Note: The actual CNC program conditions must be set to the same conditions in the MEC controller in order to ensure proper operation of the TriboMAM.

Note: The maximum RPM and maximum feed cannot be reached at the same time, they depend on each other and also on other variables (flutes and diameter).

3.1.3 Remote Menu

When *Remote* menu is entered, then the TriboMAM system can be operated remotely through I/O communication. The remotely controlled drilling program is displayed on the screen.



Basic remote I/O control

Basic remote

In basic remote, the following input control functions are enabled: 1) start/stop the program, 2) emergency stop and 3) reset the controller. However, program selection cannot be controlled remotely. It is done manually in the *Program Menu*. The basic remote does not support multiple channel outputs.

Full remote (requires optional software upgrade SOFTMEC from M4 Sciences)

In full remote, the following control functions are enabled: 1) select the program, 2) start/stop the program, 3) emergency stop and 4) reset the controller. The upgraded remote supports multiple channel outputs.

Note: The standard MEC Controller is configured with single channel output and basic remote control. An optional software upgrade from M4 Sciences enables multiple channel outputs and full remote control. [SOFTMEC option, contact M4 Sciences for details]

For remote operation, the controller must remain in the *Remote* menu (displayed on the screen) and either basic or full remote mode is selected in the *System* menu.

Refer Communications Protocol for more information about the wire connections for I/O communications.

Press *HOME* button to exit the *Remote* menu and return to the *Main* menu. This will also disable remote I/O communications.

3.1.4 Setting Menu

The *Setting* menu is used to change system parameters. When the *Setting* menu is entered, the following screen appears. Press *UP* or *DOWN* button to navigate the options; press *SELECT* button to proceed further.



System Menu

Unit

Set the length unit in the drilling program (affect diameter and feed per revolution). It can be set to either metric (denoted as *mm* for “millimeter”) or standard units (denoted as *In* for “inch”).

I/O

Set I/O operation mode (remote control):

Off – remote input control disabled

Basic – basic remote input control functions enabled

Full – all remote input control functions enabled (require optional software upgrade)

Note: If the I/O option is set to “Basic” or “Full”, the MEC will automatically re-boot to the *Remote* menu the next time it is powered on (after the welcome screen).

Baud

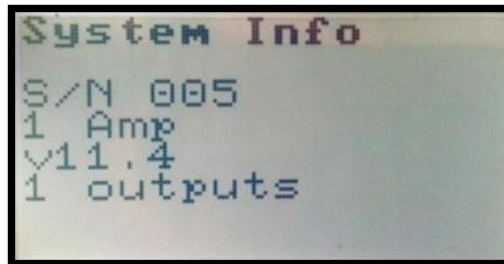
Set the baud rate for serial (RS232) communications. When “off” is selected, serial communication is disabled.

LCD Display

Set LCD display backlight and contrast.

System Info

Display system information: controller serial number, software version, number of HV outputs configured, etc.

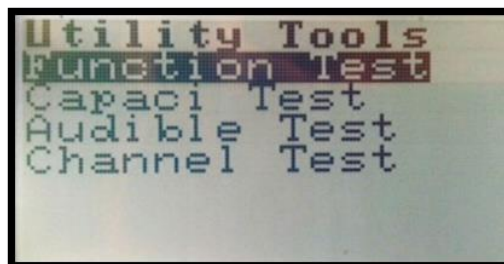


System information

Press *LEFT* button to exit System Info screen.

3.1.5 Tools Menu

The *Tools* menu contains several useful tests for check the health of the TriboMAM system. When *Tools* menu is entered, the following screen appears. Press *UP* or *DOWN* button to navigate the options; press *SELECT* button to proceed further.



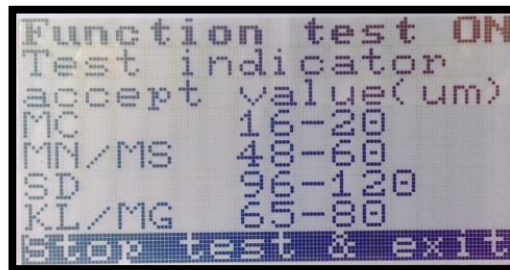
Tools menu

Function Test

HV is output at preset low frequency and full amplitude for checking the displacement of connected TriboMAM. When the test is on, the measured displacement of the TriboMAM (using a dial test indicator) should be in the specified range on the screen. (MC – micro; MN – mini; MS – meso; SD – standard; KL – kilo; MG – mega).

Refer to TriboMAM drilling system user menu for how to measure the displacement.

Press *SELECT* button to exit the test.



Function Test

Capaci Test

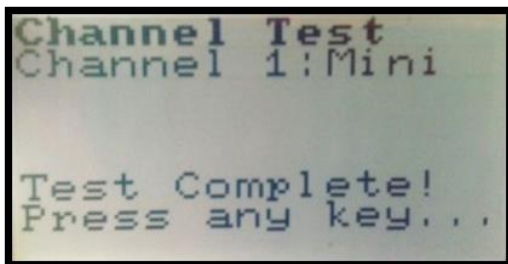
For M4 Sciences engineering only.

Audible Test

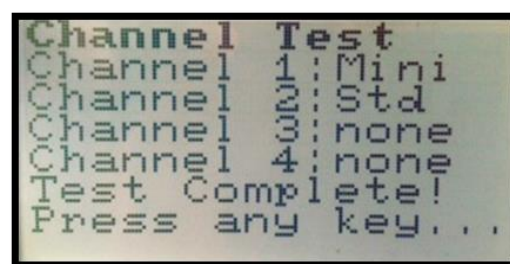
HV is output at audible frequency, enabling the TriboMAM to play tones for audible checking. Press *STOP* button to exit the test. This test does not contain full operation.

Channel Test

Channel test is used to check the model of the TriboMAM connected at each channel output. Press any button to exit the test.



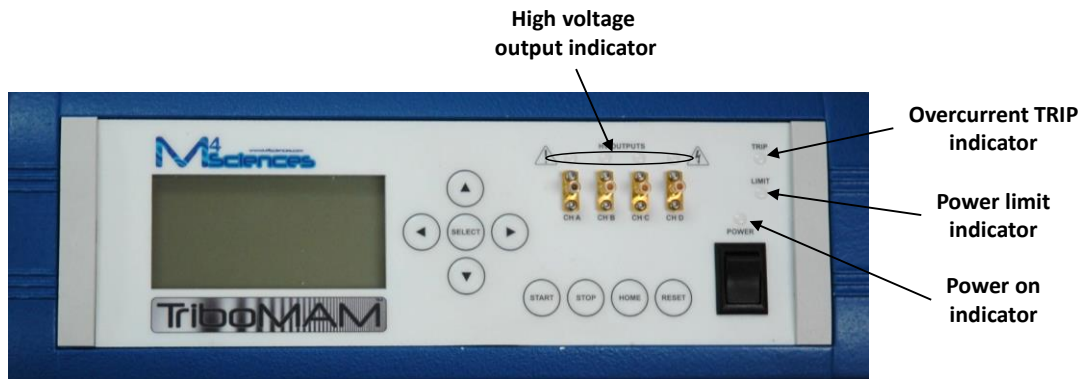
Channel test for 1 output



Channel test for 4 outputs

3.2 Indicator Lights

Several indicator lights are provided on the MEC front panel. These are as *POWER* (Green), *LIMIT* (Yellow), *TRIP* (Red) and *HV OUTPUTS* (Red).



The *POWER* indicator light indicates whether the device is on or off.

The *LIMIT* indicator light indicates if the MEC-PA11033A is near its power limit. The MEC-PA11033A will operate the TribomAM actuator with this indicator light on.

The *TRIP* indicator light illuminates when the current capacity of the MEC-PA11033A is exceeded or if output shorting occurs. The MEC-PA11033A will NOT operate the TribomAM actuator when this indicator light is on.

The *HV OUTPUT* indicator light indicates when the controller is running / sending a high-voltage signal to the corresponding *HV output* port on the front panel.

4 Specifications

4.1 *Output*

The standard configuration of the MEC-PA11033A has one output channel enabled. Additional output channels are optional. **No more than one output channel can be active at a time. Multiple output channels must be operated sequentially.**

Output Voltage Range	-50 V to +150 V DC or peak AC.
Output Current Range	0 to 2 A peak [1.414 A rms]

4.2 *Features*

RS-232 Interface, USB Port and Programming Capability, USB 2.0 full speed compliant with a maximum transfer data rate of 12 Mbits/second, a RS-232 Interface with a 300-19.2 k baud rate (minimum) (115.2 k desired) with flow control hardware.

Internal programming capabilities allow control and monitoring of features, which include:

Frequency Control	0.01 Hz to 1000 Hz.
Offset Voltage	-50 V to +150 V
Amplitude Voltage	-50 V to +150 V
Output Channel Control	One channel (optional 4 channels)
Keypad	An eight-button keypad is provided for user programming of unit operation parameters.
Waveform Generation	14 bit, 0.01 Hz to 1.0 kHz resolution (minimum) 16 K to 64 K samples per cycle, with offset capability and control range of -50 V to +150 V HV output

LCD Interface	128 x 64 dot graphic LCD display with back-light and light intensity adjustments. Displays output information.
Over Current Trip	The high voltage will turn off and the error will be indicated on the display screen when current capacity of the amplifier is exceeded or output shorting occurs. Maximum current capacity is 2 Amp.
Trip Reset	After a Trip event occurs and the high voltage is turned off, depressing a series of keys on the keypad will turn off the Over Current Trip indicator and allow the high voltage to be turned back on, once the fault has been removed.
Limit Indicator	The display indicates when the MEC-PA11033A does not provide the required high-voltage. This can occur when the load exceeds the amplifier capacity.
High-Voltage	Front panel display indicates when the high-voltage is on.
Power On	Front panel display becomes active when the power is on.

4.3 Performance

DC Voltage Gain	20 V/V
DC Voltage Gain Accuracy (input to output)	Better than 2%.
Offset Voltage	Less than ± 1 V

4.4 General Specifications

Dimensions	300mm x 275mm x 100mm (12in x 11in x 4in)
Weight	3 kg (7 lb)
High-Voltage Output Connector	SMB coaxial bulkhead jack

High-Voltage Output Impedance	0.1 ohms
I/O Connectors	One (1) 50-pin D type connector RS-232 Serial Port Connector USB Port 2.0
Power Requirements (Line Supply)	100 to 240 V AC at 50 to 60 Hz
Power Entry Module	A standard three-prong AC line connector with an integral fuse holder and an ON/OFF power switch
Operating Conditions	Temperature 0 °C to 35 °C Relative Humidity To 85%, noncondensing

5 Accessories

Line Cord (for 90 to 127 V AC operation)
Fuses, 5 mm x 20 mm, 2 A

6 Certification

M4 Sciences certifies that each Model MEC-PA11033A is tested and calibrated to specifications using measurement equipment traceable to the National Institute of Standards and Technology or traceable to consensus standards.

7 Maintenance

7.1 *Safety*

Observe the following safety precautions when performing maintenance procedures on the Model MEC-PA11033A:

1. Do not open the panels to the MEC-PA11033A. **Warranty will be void if the panels are opened.**

2. Always turn off the Model MEC-PA11033A and disconnect it from its power source before cleaning or inspecting it. Failure to observe this precaution could result in personnel injury or equipment damage.
3. Refer all maintenance procedures to qualified personnel.

7.2 Maintenance Assistance

Preventative Maintenance/Cleaning the Instrument

Preventative maintenance consists of inspecting and cleaning the instrument. Preventative maintenance performed on a regular basis may prevent instrument failure and improve reliability.

Inspection: Visually inspect the instrument for loose or damaged controls and connectors or other undesirable conditions.

Cleaning: Disconnect the unit from all external connections prior to cleaning. Clean the Model MEC-PA11033A as operating conditions require. Clean the exterior of the instrument with a soft cloth dampened with water. Use only water to dampen the cloth. The use of solvents may damage the finish or plastic components. A small brush is effective in removing dirt from the front and rear panel controls and connectors.

7.3 Servicing the Fuses

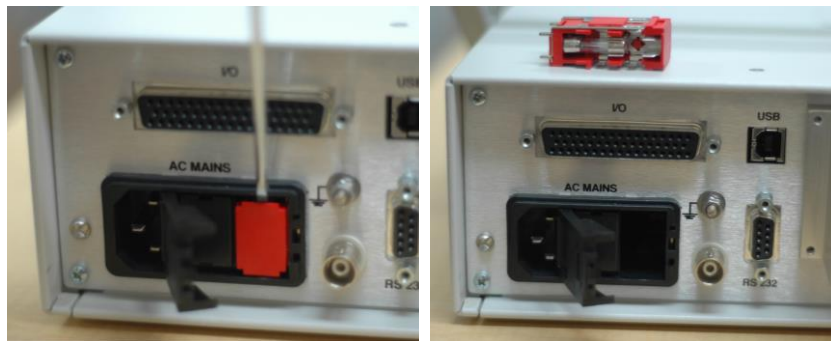
Refer servicing the fuses to qualified personnel. Always unplug the power cord from the power source before attempting to change the fuses. Always replace the fuses with fuses of the same rating.

Warning: Never attempt to service the fuses when the instrument is plugged into the power source. An electrical shock could result. The line fuses are contained in a fuse holder, which is an integral part of the power connector. These are the only user serviceable fuses.

1. On the rear panel of the controller, use a small flat head screwdriver to access the fuse door as shown below.



2. Use the screwdriver to guide existing fuse from controller.



3. Replace any blown fuses with same type and rating.

If the instrument has repetitive fuse failure, a more serious problem might exist within the instrument. Please contact M4 Sciences.

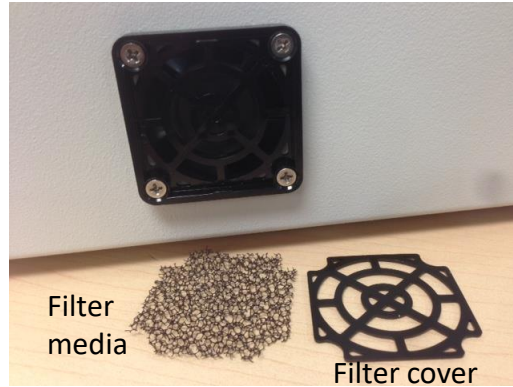
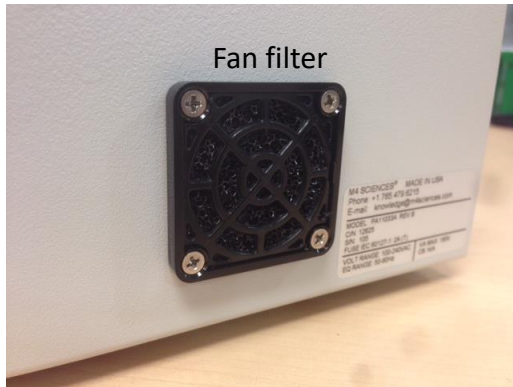
7.4 Servicing the fan filter

The fan filter is located on each side of the controller. The filter prevents dust and dirt from entering into the controller.

In order to maintain the proper air flow, the filter media needs to be replaced if too much dust and dirt are accumulated.

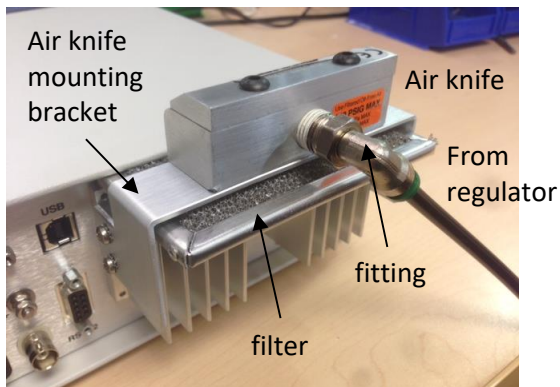
The filter media is secured by a plastic cover. To replace the filter media, open the filter cover, then change the filter media and put the cover back.

Use the filter media: Qualtek Part # 09150-M/30



7.5 Air knife installation and filter servicing (optional)

For special applications, it is necessary to provide additional cooling effect for the heat sink of the controller. This will require the installation of the air knife on the heat sink. The air knife uses compressed air to blow the heat sink fins. An air pressure regulator is used to properly adjust air flow.



8 Communications Protocol

Please refer to the Programming Instructions section earlier in this manual for a description of the *Remote Menu* functions. The communications protocols described in this section correspond directly to these *Remote Menu* functions. The MEC-PA11033A can be interfaced directly to the CNC machine tool for limited basic relay logic interaction. The **standard** MEC-PA11033A is configured for on or off type control of the HV output signal to the TriboMAM-drilling system. Additional relay driven I/O features are available, including the ability to select individual programs stored within the MEC-PA11033A memory. **These I/O features currently do not enable direct transfer of numerical data such as G-code information between the CNC controller of a particular machine tool and the MEC-PA11033A.**

NOTE: Some communication features require optional software SOFTMEC from M4 Sciences.

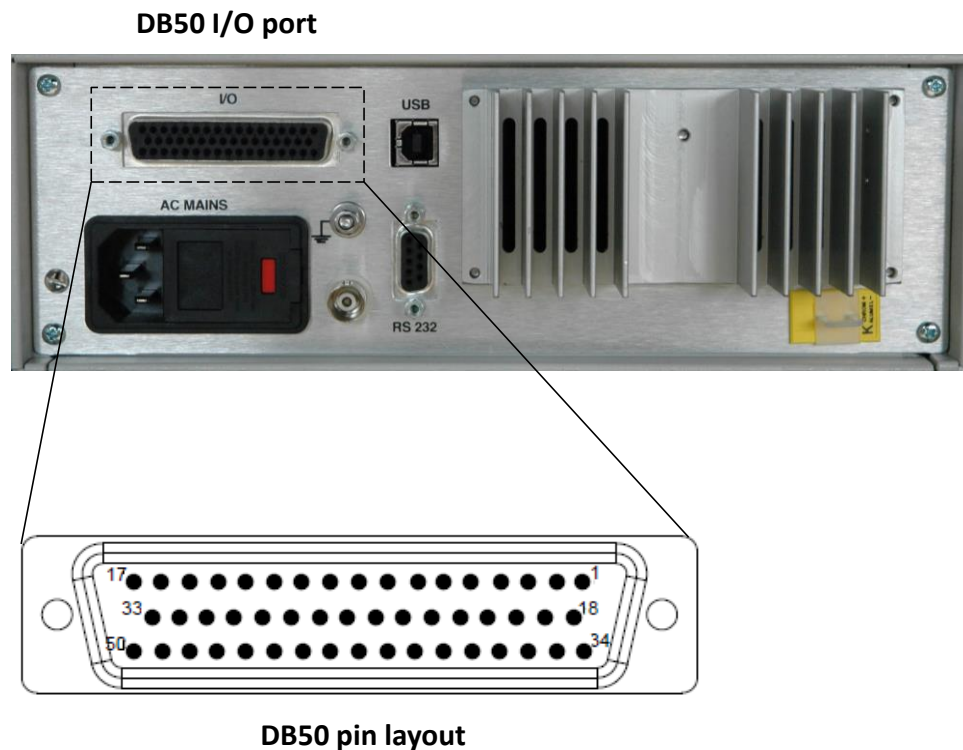
The MEC-PA11033A includes the following interface ports for relay control:

- One (1) DB 50 parallel female connectors for programmable machine tool interface. These ports are used for active relay control with the CNC machine tool.

Note: A standard installation does not require interaction with the USB, RS232 or I/O port. For further information please contact M4 Sciences.

8.1 DB50 Port Pin Layout

The interface ports are shown in the following image of the MEC-PA11033A Rear Panel. There is one DB 50 pin port connector on the back panel of the MEC-PA11033A. This connector may be linked to the CNC machine tool with the appropriate cables to allow operational interfacing to the controller directly from external input signals (+12V to +24V DC).



***Important** The DB50 pin female port numbering may be differ from numbering of some cable connectors

The following table provides a description of the designated pin function of the I/O port. For details regarding the communication protocol using these pins, consult the DB50 Pin Configuration immediately following this section.

DB50 I/O Port pin description

Pin	Name	Input/Output	Pin Description
1	IN1a	Input	Input 1a – used for program selection
18	IN2a	Input	Input 2a – used for program selection
35	IN3a	Input	Input 3a – used for program selection
3	IN4a	Input	Input 4a – used for output channel selection
20	IN5a	Input	Input 5a – used for output channel selection
37	IN6a	Input	Input 6a – start/stop operation command
31	IN7a	Input	Input 7a – emergency stop
48	IN8a	Input	Input 8a – system reset
34	IN1b	Input	Input 1b – reference for IN1a, connected to 0V reference
2	IN2b	Input	Input 2b – reference for IN2a, connected to 0V reference
19	IN3b	Input	Input 3b – reference for IN3a, connected to 0V reference
36	IN4b	Input	Input 4b – reference for IN4a, connected to 0V reference
4	IN5b	Input	Input 5b – reference for IN5a, connected to 0V reference
21	IN6b	Input	Input 6b – reference for IN6a, connected to 0V reference
15	IN7b	Input	Input 7b – reference for IN7a, connected to 0V reference
32	IN8b	Input	Input 8b – reference for IN8a, connected to 0V reference
40	K1co	Relay	Relay K1 common contact, ISOLATED
24	K1no	Relay	Relay K1 normally open contact, ISOLATED (Main power)
41	K1nc	Relay	Relay K1 normally closed contact, ISOLATED (Main power)
7	K2co	Relay	Relay K2 common contact, ISOLATED
39	K2no	Relay	Relay K2 normally open contact, ISOLATED (Run/Stop)
23	K2nc	Relay	Relay K2 normally closed contact, ISOLATED (Run/Stop)
44	K3co	Relay	Relay K3 common contact, ISOLATED
27	K3no	Relay	Relay K3 normally open contact, ISOLATED (Reset monitor)
11	K3nc	Relay	Relay K3 normally closed contact, ISOLATED (Reset monitor)
12	K4co	Relay	Relay K4 common contact, ISOLATED
28	K4no	Relay	Relay K4 normally open contact, ISOLATED (reserved)
45	K4nc	Relay	Relay K4 normally closed contact, ISOLATED (reserved)
17	Iout	Output	Current monitoring output (1V/200mA)
33	Vout	Output	Voltage monitoring output (1V/20V)
5	+12 V	Output	+12V Current limited DC supply (100-200 mA, polyswitch or equiv.)
50	GND	-	Unit ground

I/O Port includes 4 single pole double throw relays (K1, K2, K3 and K4) on the back panel DB50 female connector. The relay logic is as follows (0=relay off, 1= relay on)

Relay K1 – MEC Main power toggle switch on front panel: 0=off and 1=on

Relay K2 – MEC program running (started): 0=stopped, 1=run

Relay K3 – reset monitor: 0=system ok, 1=reset required (system needs reset button pressed on the front panel)

Relay K4 – reserved

3 terminals of each relay are accessible on the DB50 pin-outs according to table above

K1no/nc/co = pin 24/pin 41/pin 40

K2no/nc/co = pin 39/pin 23/pin 7

K3no/nc/co = pin 27/pin 11/pin 44

K4no/nc/co = pin 28/pin 45/pin 12

no = normally open, nc = normally closed, co = common

These relays can be wired with several configurations, depending on the desired type of input to the external machine.

As shown in the table above pin 5 provide a local +12V source if needed.

****The K1, K2, K3 and K4 relays are completely isolated from the MEC controller. An external DC power source (e.g., an external +12V source) may be used to energize the relays.**

8.2 Input Control of the MEC functions

The MEC can be controlled remotely using external low voltage relays (+12 to +24V)

Note: Input control of the MEC is only possible when the remote menu is selected and displayed on the LCD screen.

The input control is available with limited functionality in a standard MEC and additional capability with an optional configuration.

Standard MEC Configuration

With standard MEC configuration, only one high voltage output port (CH A) is usable and only basic remote input control functions (start/stop, e-stop and reset) are available.

Optional Configuration: SOFTMEC

Note: The MEC is available with additional output channels and software features. This option is referred to as SOFTMEC.

The SOFTMEC option enables full remote input control functions including program selection, output channel selection, start/stop high voltage output, E-Stop, and Reset, and output Relay monitor function including status of main power, HV output and controller alarm. These relay driven I/O features that can be accessed by directly linking the external I/O DB50 ports at the back of the MEC to the appropriate external relays at the machine tool.

Note: The four channel output configuration is available as an upgrade [SOFTMEC] to the standard controller. The four channel output does not operate simultaneously, and only one output channel can be active at any given time. The output channels 1-4 (or A to D) can be selected in any order but never simultaneously. Please contact M4Sciences regarding optional software [SOFTMEC].

DB50 Port Pin Configuration

Voltage signals for input pins IN1a – IN8a

IN1b – IN8b are connected to 0 V reference for input voltage IN1a – IN8a
IN1a – IN8a input voltage V_{in} specification

Recommend setting:

ON: $|V_{in}|$ between 12V to 24V

OFF: V_{in} 0V

Program Selection - IN1a through IN3a select the program when in remote mode

IN1a	IN2a	IN3a	Program Selected
OFF	OFF	OFF	Program 1
ON	OFF	OFF	Program 2
OFF	ON	OFF	Program 3
ON	ON	OFF	Program 4
OFF	OFF	ON	Program 5
ON	OFF	ON	*Optional Program 6
OFF	ON	ON	*Optional Program 7
ON	ON	ON	*Optional Program 8

*Custom option. Contact M4 Sciences if needed.

Channel Selection - IN4a and IN5a select the HV output channel in remote mode

IN4a	IN5a	Output Channel
OFF	OFF	Output 1
ON	OFF	*Optional Output 2
OFF	ON	*Optional Output 3
ON	ON	*Optional Output 4

*Custom option. Contact M4 Sciences if needed.

Operation Control - IN6a controls the HV output on/off when in remote mode

IN6a	Operation on/off
ON	Start
OFF	Stop

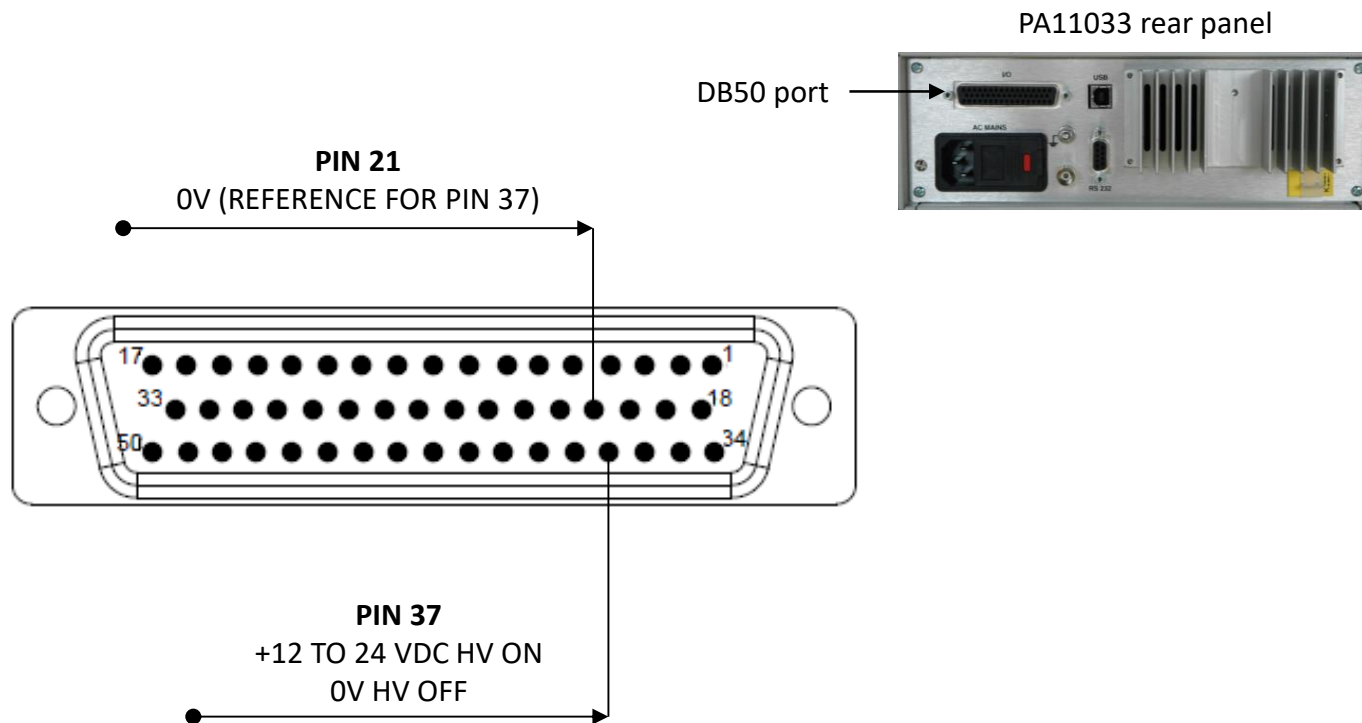
Emergency Stop - IN7a monitors the emergency stop of the CNC machine when in remote mode

IN7a	Emergency Stop
ON	e-stop on
OFF	e-stop off

Reset - IN8 monitors the external reset when in remote mode

IN8a	Reset on/off
ON	Reset on
OFF	Reset off

Start: High Voltage (HV) on



PROGRAM SELECTION

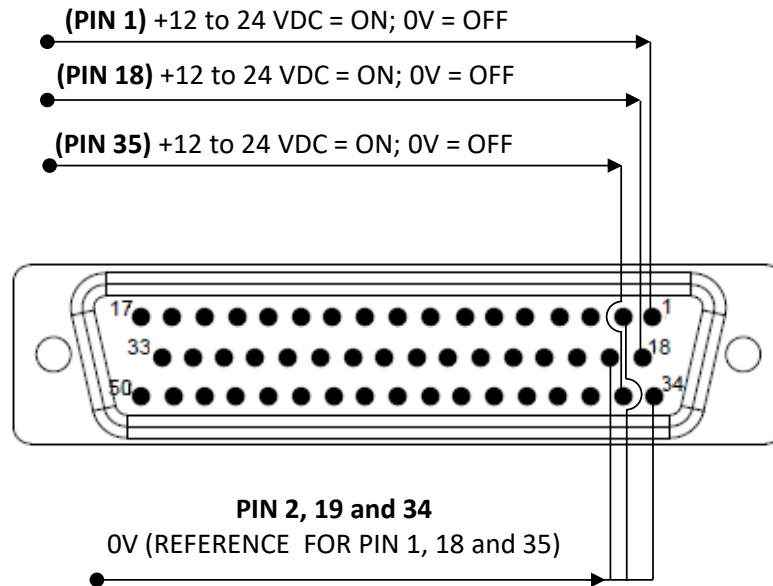
IN1a through IN3a select the program when in remote mode

CAUTION

If the MEC is placed in the "Remote Menu" then inputs from an external device (such as relay inputs from a CNC machine control) will override manually selected output channels or program numbers

PA11033 rear panel

DB50 port



PIN 1 (IN1a)	PIN 18 (IN 2a)	Pin 36 (IN 3a)	Program Selected
OFF	OFF	OFF	Program 1
ON	OFF	OFF	Program 2
OFF	ON	OFF	Program 3
ON	ON	OFF	Program 4
OFF	OFF	ON	Program 5
ON	OFF	ON	*Optional Program 6
OFF	ON	ON	*Optional Program 7
ON	ON	ON	*Optional Program 8

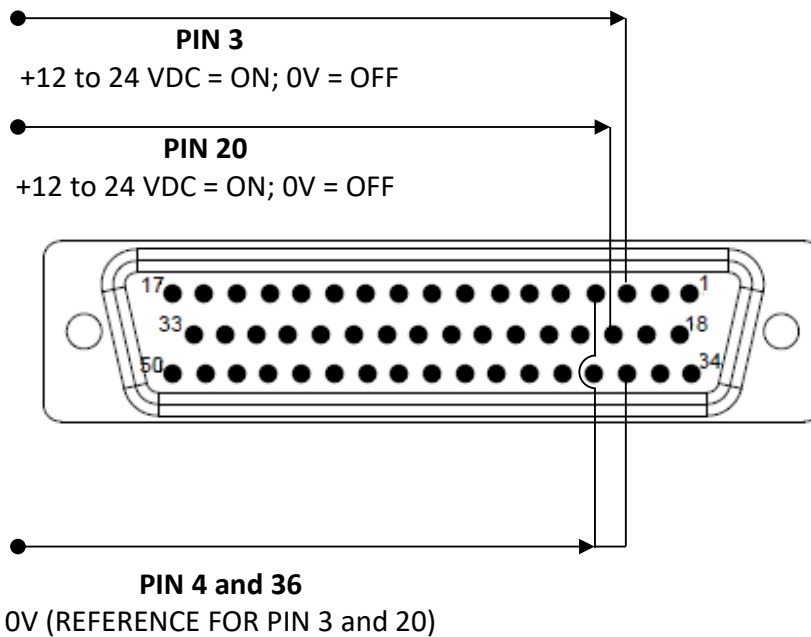
*Custom option. Contact M4 Sciences if needed

CHANNEL SELECTION

IN4a and IN5a select the HV output channel in remote mode

CAUTION

If the MEC is placed in the “Remote Menu” then inputs from an external device (such as relay inputs from a CNC machine control) will override manually selected output channels or program numbers



PA11033 rear panel

DB50 port



PIN 3 (IN4a)	PIN 20 (IN5a)	Output Channel
OFF	OFF	Output 1
ON	OFF	*Optional Output 2
OFF	ON	*Optional Output 3
ON	ON	*Optional Output 4

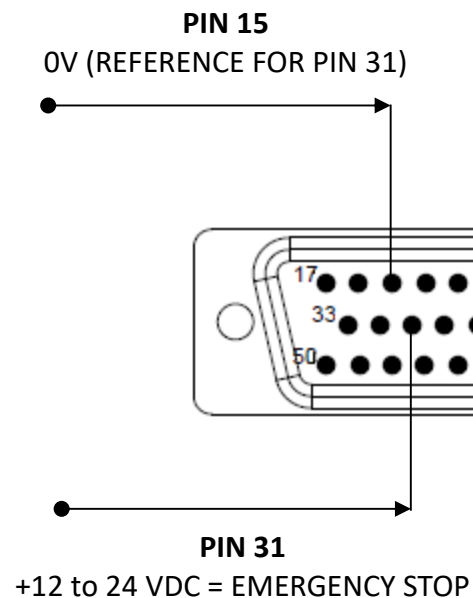
*Custom option. Contact M4 Sciences if needed

E-STOP -- Emergency Stop

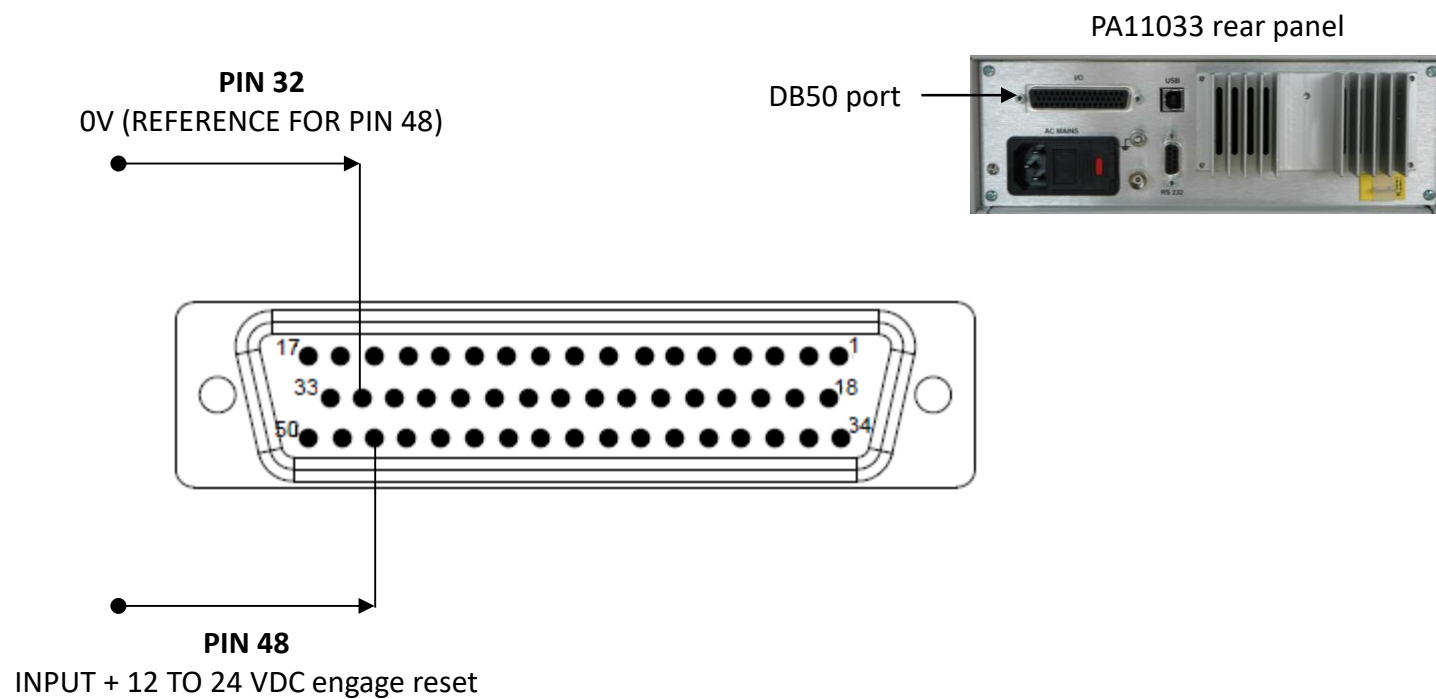
Warning: The Emergency Stop does NOT disable the main power to the MEC-PA11033 controller. It disables the power to the HV out connector on the front panel.

PA11033 rear panel

DB50 port



RESET ON



8.3 MEC Relay Logic Output Control Functions

The DB50 I/O port interfaces to 4 single pole double throw relays located internally on the MEC controller printed circuit board.

****These four internal relays are completely isolated from the MEC controller. An external DC power source (e.g., an external +12V - +24V source) may be used to energize the relays.**

A +12V source is available on the I/O Port DB 50 connector at pin 5 if needed.

These relays can be wired with several configurations, depending on the desired type of input to the external machine. The following pages outline typical configurations for the I/O port wiring typical of a machine installation and interface to a CNC controller with spare relays and M-codes already available on the CNC machine tool.

These relays are summarized as follows:

The relay logic is as follows (0=relay off, 1= relay on)

Relay K1 – MEC Main power toggle switch on front panel: 0=off and 1=on

Relay K2 – MEC program running (started): 0= stopped, 1= run

Relay K3 – MEC alarm: 0=no alarm, 1=system alarm (reset required; system needs reset button pressed on the front panel)

A MEC alarm can occur when a) current limit exceeded, b) heat sink temperature limit exceeded, c) temperature limit exceeded inside housing of MEC controller, c) external thermocouple temperature limit exceeded, d) TriboMAM is not connected properly or d) short circuit.

Relay K4 – reserved

3 terminals of each relay accessible on the DB50 pin-outs

K1no/nc/co = pin 24/pin 41/pin 40

K2no/nc/co = pin 39/pin 23/pin 7

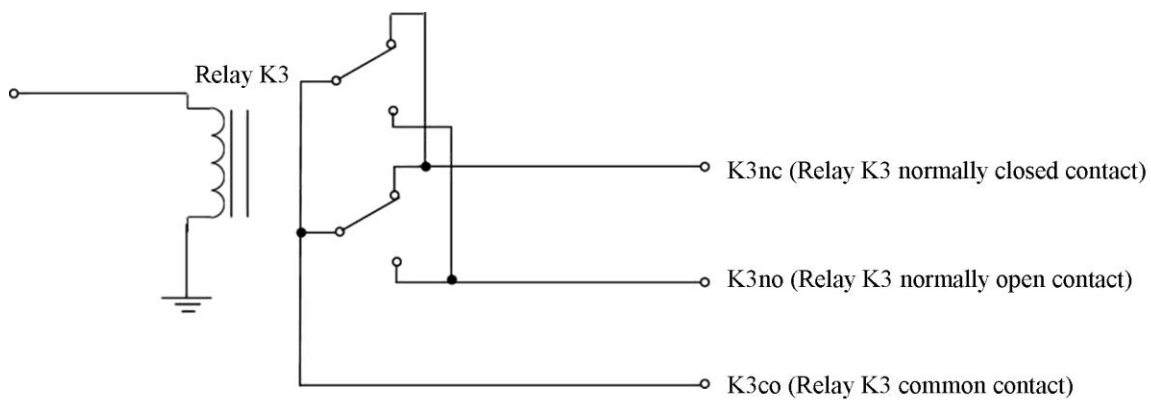
K3no/nc/co = pin 27/pin 11/pin 44

K4no/nc/co = pin 28/pin 45/pin 12

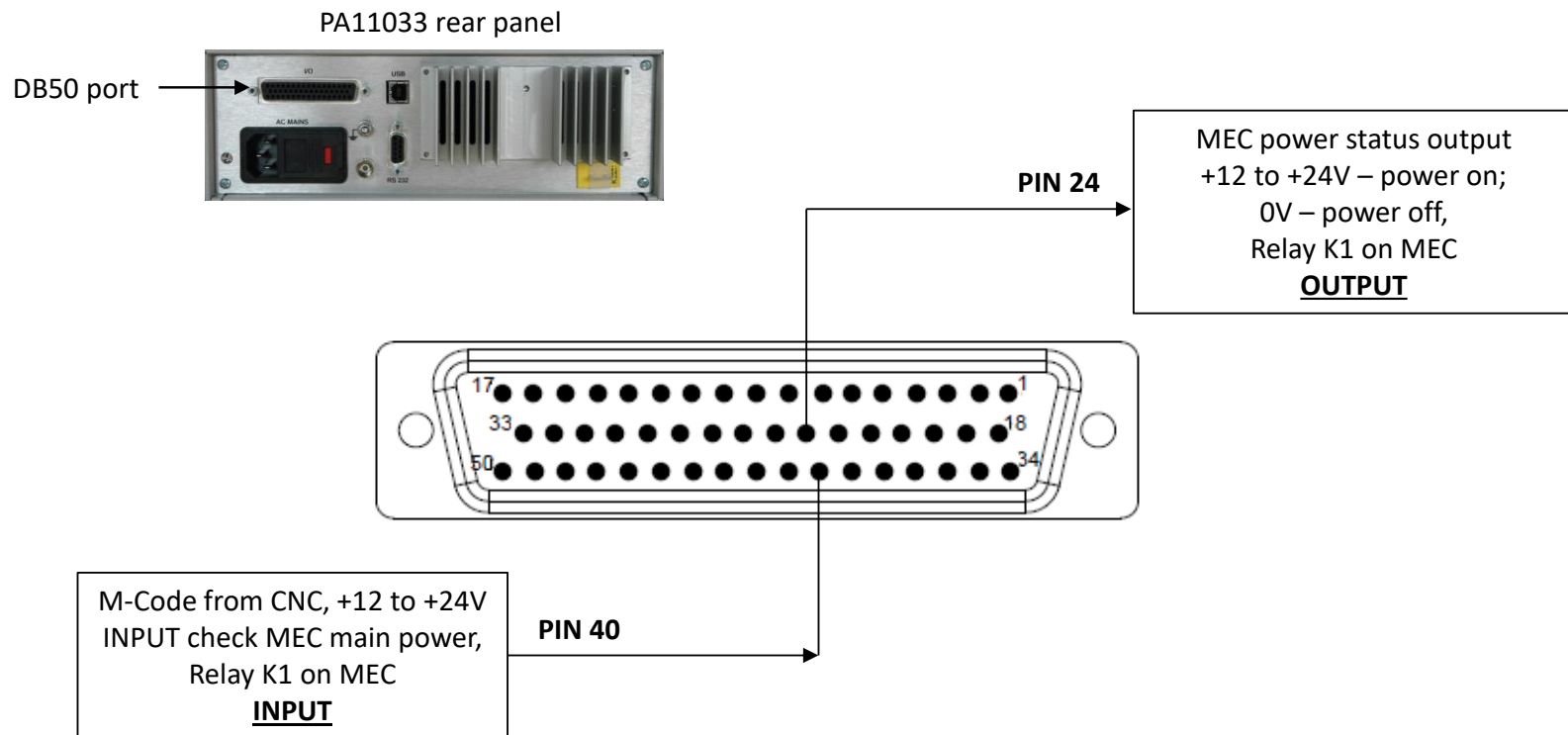
no = normally open, nc = normally closed, co = common

Relay Circuit

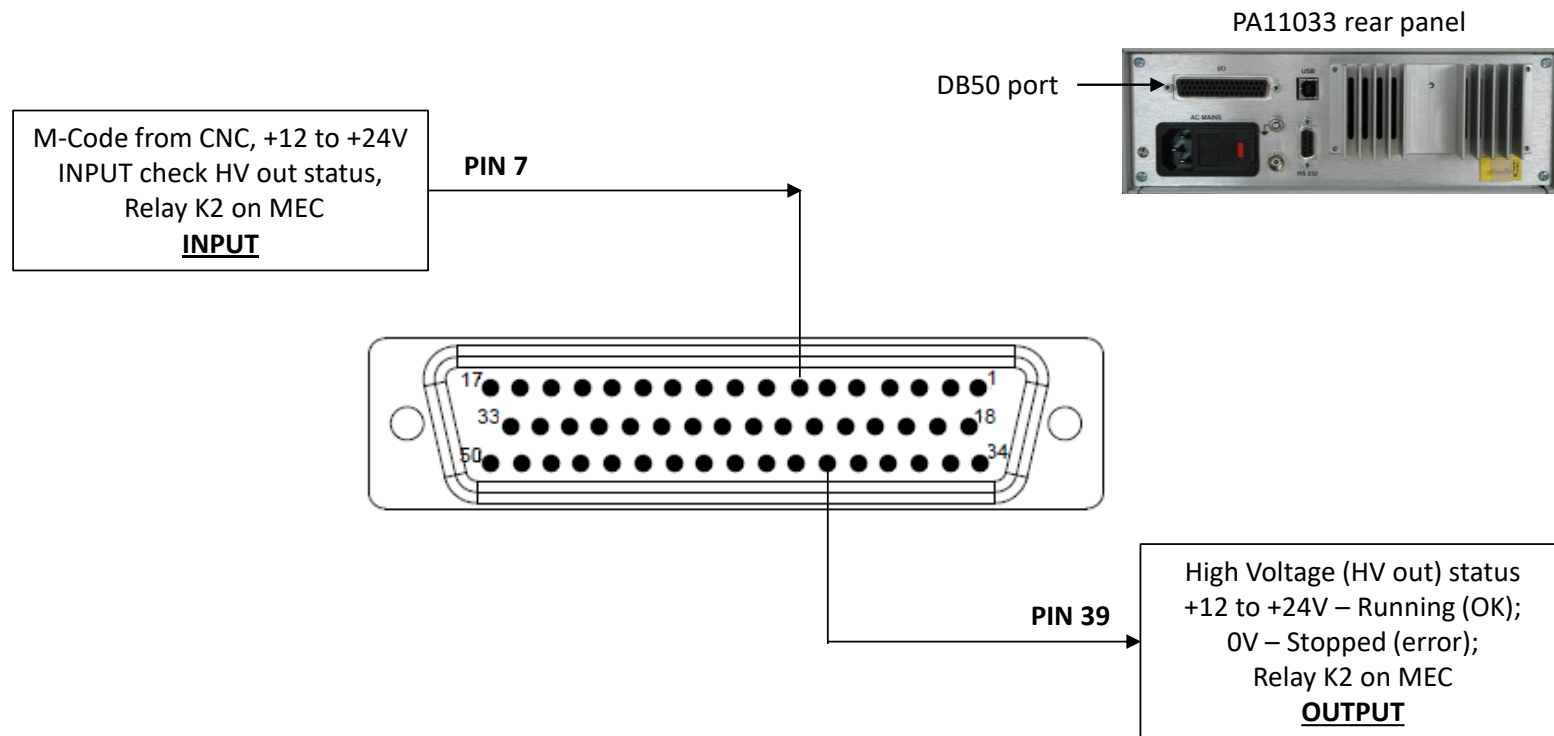
The following figure shows a basic representation of one of the internal relays on MEC-PA11033A.



RELAY K1 (Main power)



RELAY K2 (HV out)



RELAY K3 (MEC alarm)

