



mAI085MB Actuator Interface Technical Manual



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Distributive Intelligence

CMC INDUSTRIAL ELECTRONICS LTD
Phone: (604) 421-4425 Toll-Free: (888) 421-4425 Fax: (604) 421-7734
info@cmciel.com www.cmciel.com

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Revision Notes

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Revision A, July 2, 2007

- Add output relay contact ratings, update specifications and port descriptions
- Add the Diagnostics and Upload/Download menu functions

Revision B, July 20, 2007

- Add setup details for ASCII character delays to the upload/download instructions
- Add notes describing the controller network expansion port

1. Overview

The mAI085-MB Actuator Interface is an interface between the control room operator and a network of Actuator Controllers. The interface is capable of controlling up to 100 actuators, either on a single network of up to 31 controllers or through a series of network drops utilizing RS485 repeaters. The interface allows for the pre-setting of setpoints for each of the actuators. An open key opens all of the actuators to their preset setpoints. A close key closes all of the actuators. A clear pushbutton sets all of the actuator setpoints to zero (fully closed).

The interface has optional features that allow the control of a conveying system. Timers are provided which can delay the start of the actuator opening to allow a conveying system to start. A second timer allows the conveying system to purge after closing all of the actuators. Individual timers for each actuator allow for the distance between conveying system entry points. The interface will open and close each actuator in sequence to provide superior blending.

The interface communicates to the actuator controllers using the Modbus RS485 RTU protocol.

A Modbus RS232 RTU communications interface is provided for connection to a host computer or PLC. The status information from all 100 actuators is available to the host computer or PLC over this Modbus network. In addition, the interfaces front panel operators and enunciators are mimicked over this network.

To facilitate configuration of the interface and the attached actuators a menu driven setup system is provided. A table of parameters is saved for each actuator. The system allows the retrieval and downloading of actuator parameters individually or for the entire network. A facility is provided to backup the configuration to a TAB delimited file suitable for editing using Excel.



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2. Description of the Keypad and Indicators

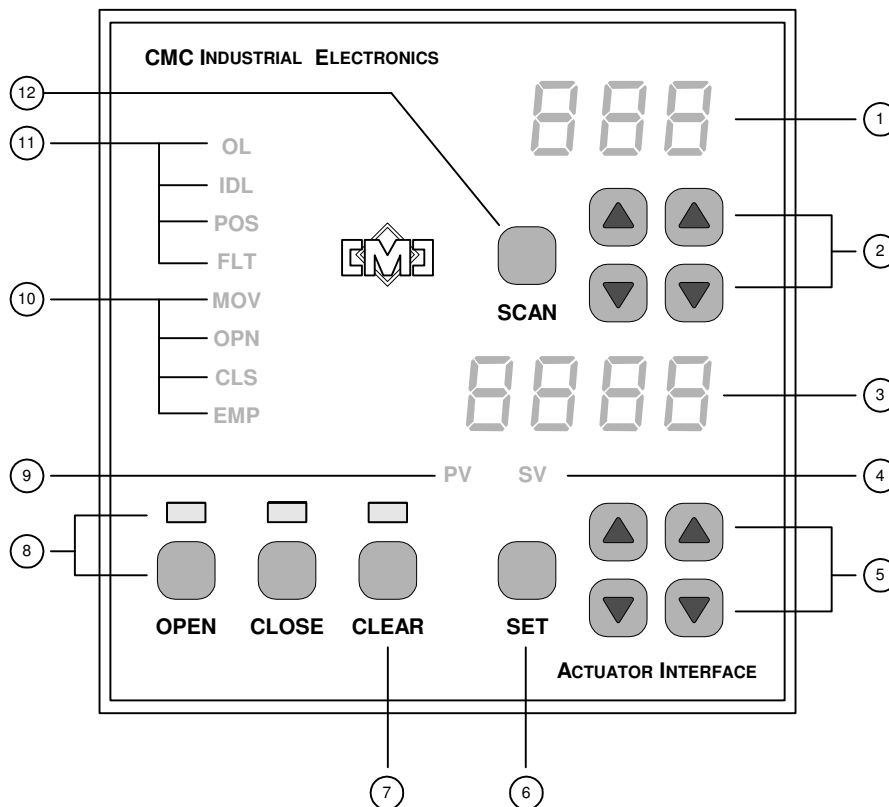


Figure 1 - Keypad and Indicators

ID	Label	Description of Operation
1	Upper Display	Displays the name of the selected actuator.
2	Upper UP / DOWN	Selects which actuator to view.
3	Lower Display	Displays the process value or setpoint of the selected actuator.
4	Setpoint Value	Displaying the actuator setpoint
5	Lower UP /DOWN	First press displays the setpoint of the selected actuator and each subsequent press increases or decreases the setpoint value.
6	Set key	Saves the displayed setpoint only when SV is illuminated

ID	Label	Description of Operation
7	<i>Clear</i> key and lamp	<p>Clears all actuator setpoints. First press illuminates the lamp, the second press clears the setpoints and turns off the lamp. The lamp will turn off automatically after 10 seconds if the key is not pressed the second time and the setpoints will not be cleared.</p> <p>If the <i>CLEAR</i> lamp is illuminated continuously and the operator keyboard does not function, the keyboard has been locked by the Modbus interface. Pressing and holding the CLEAR key for 10 seconds will unlock the keyboard. The <i>CLEAR</i> lamp will extinguish when the keyboard is unlocked. The setpoints will not be cleared during this operation.</p>
8	<i>Open / Close</i> keys and indicators	Opens or closes the actuators to their pre-set values. The indicators display which mode is active.
9	Process Value	Displaying the actuator position
10	Status Indicators	<p>MOV - actuator is currently moving to setpoint</p> <p>OPN – if configured, indicates the actuator is fully open</p> <p>CLS - if configured, indicates the actuator is fully closed</p> <p>EMP - if configured, indicates the bin served by the actuator is empty</p>
11	Fault Indicators	<p>OL – if configured, the actuator has faulted due to excess running current</p> <p>IDL - if configured, the actuator has faulted due to excess idle current</p> <p>POS – the actuator failed to reach the selected position</p> <p>FLT – the actuator controller is not communicating or has a hardware fault</p>
12	Scan key	Press once to scan through all controllers at 1 second intervals. Press the SCAN key again to cancel scanning. Pressing the up or down actuator selection keys also cancels scanning.

Table 1 - Description of Keys and Indicators

3. External Connections

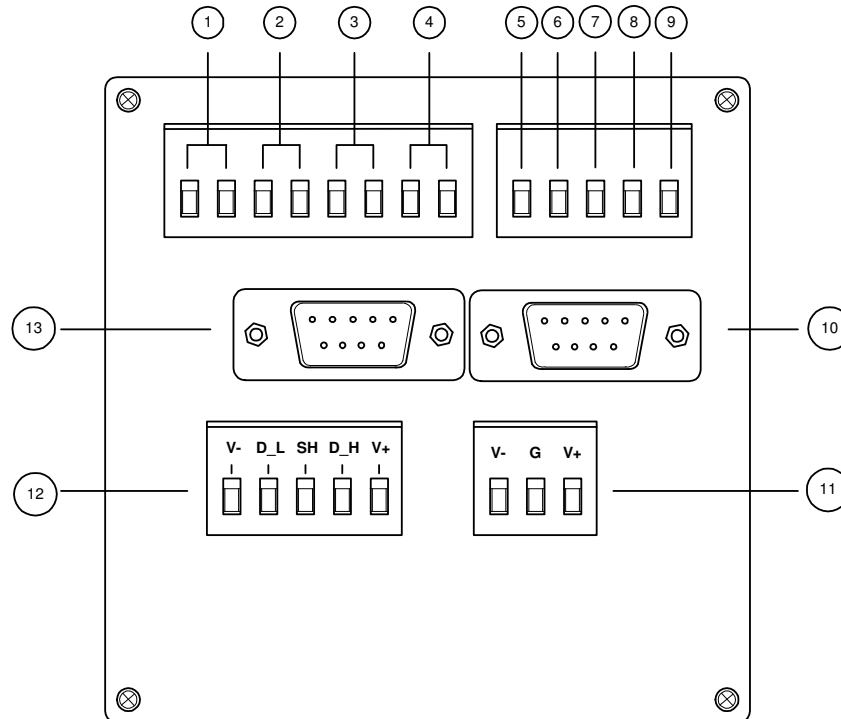


Figure 2 - Terminal Blocks and Connectors

ID	Label	Description
1	Output 1	Contact will close if in open mode or to start the conveying system. Maximum load 1A @24VDC, 0.5A@120VAC
2	Output 2	Contact will close if in close mode or to stop the conveying system. Maximum load 1A @24VDC, 0.5A@120VAC
3	Output 3	Contact will close if all setpoints are at zero. Maximum load 1A @24VDC, 0.5A@120VAC
4	Output 4	Contact will close if the interface has an internal fault. Maximum load 1A @24VDC, 0.5A@120VAC
5	Inputs 1	Energizing will select open mode.
6	Inputs 2	Energizing will select close mode.
7	Inputs 3	Energizing will clear all setpoints to zero.
8	Inputs 4	Energizing will force all actuators closed without affecting open/close mode selection. Blending timers are ignored during a force close.

ID	Label	Description
9	Input Common	Common connection for inputs. Inputs accept 8-32VDC of either polarity, maximum load is 20mA.
10	Modbus Port	Modbus network port - see Appendix for connections details, wired DCE
11	Input Power Terminal	V+ 22 -26 VDC @ 2.0A G Earth Ground V- VDC Common
12	Output Power and Network Connections	V+ 24 VDC fused at 1.75A D_H Data + (non inverted) SH Shield D_L Data - (inverted) V- VDC Common
13	Controller Network Expansion	RS232 connection for repeaters or fiber-optic cable drivers for the controller network. Operates in parallel with the RS-485 port.
	Download / Upload Port	Port for exporting parameters to a comma delimited file - see Appendix B for port wiring details, wired DTE

Table 2 - Description of Terminals and Connections

3.1 Power and Communications

A 2 or 3 pair shielded power and communication cable is utilized. Low capacitance twisted pair cable is recommended. The cable should be sized to ensure voltage drop on the power conductor does not exceed actuator controller input voltage specifications. The mAI085-MB can accommodate up to a maximum of 31 actuator controllers. See drawing 10284 in the Appendix for complete cabling details.

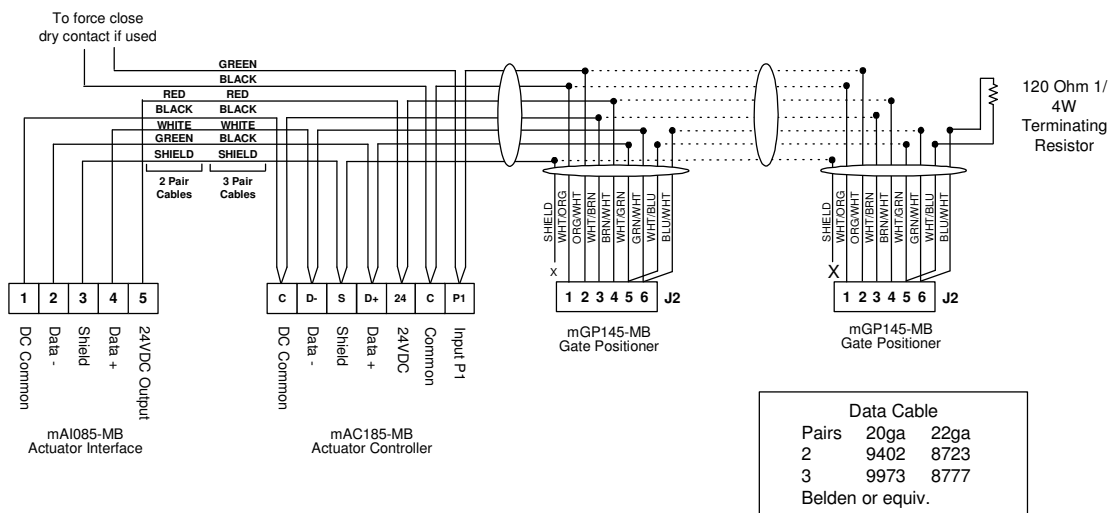


Figure 3 - Recommended Network and Power Connections

3.2 Optional Extended Data Network

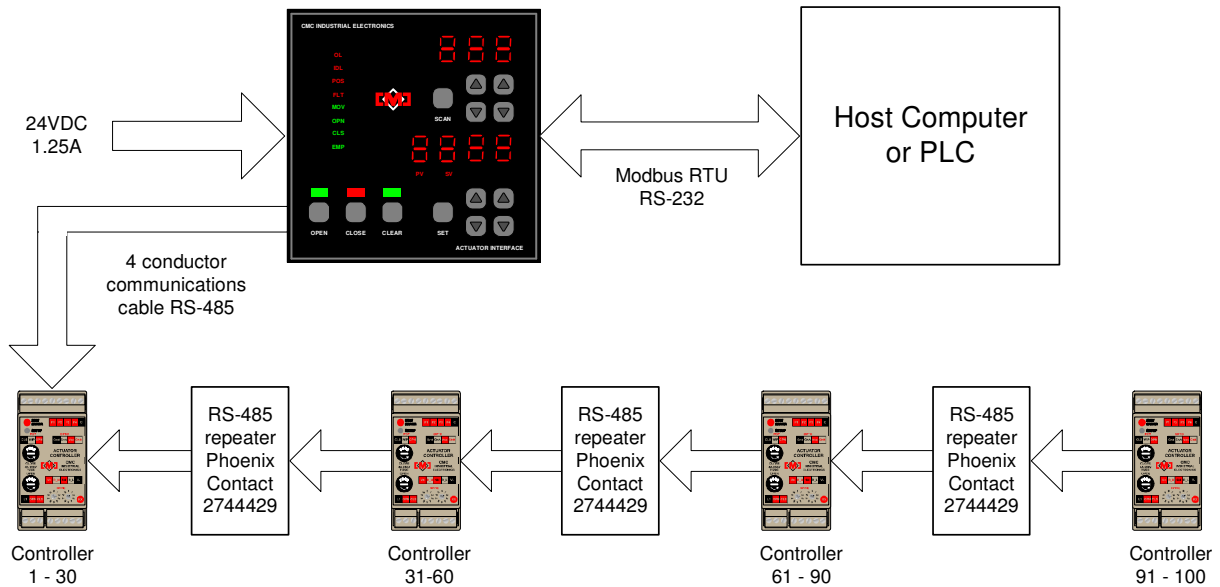


Figure 4 - Extended Data Network

The interface can accommodate up to 100 actuator controllers if RS485 repeaters are used. A typical repeater is the Phoenix Contact Part No. 2744429 optical isolated repeater. Up to 30 controllers can be on a single network segment (31 for the end of line). Using repeaters, a linear network as shown above, or various forms of star or tee networks can be deployed as required. The start of a branch on either a star or tee network must always begin with a repeater.

A network expansion RS232 port is also provided. This port can connect directly to repeaters or fiber-optic cable drivers. Controllers can be connected to both the standard RS485 port and the expansion RS232 port. The port is designated J1 and is a female DB9 connector. It is wired DTE.



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4. Using the Interface

The controller has an easy to use keyboard for selecting and controlling the connected actuators.

4.1 Selecting an Actuator Controller

Use the upper up or down keys to select the actuator. The right keys move between the actuator one at a time. The left keys skip actuators at a time. The upper display indicates which actuator is selected. The *SCAN* key allows the viewing of all connected actuators at one second intervals. Pressing the *SCAN* key or any of the upper up/down keys can cancel scan.

4.2 Changing a Setpoint

The lower up/down keys change the setpoint for the selected actuator. The first press of any of the up or down keys switches the lower display to the setpoint mode and the **SV** lamp will illuminate. The right keys change the setpoint by 1. The left keys change the setpoint by 10. The setpoint will not be saved and sent to the actuator until the *SET* key is pressed. If the *SET* key is not pressed within 10 seconds, the display reverts to **PV** mode and the new setpoint is discarded.

...Caution...

If it is required that all the actuators respond simultaneously to the new setpoints, then first insure that the interface is in *close* mode before making any changes to the setpoints.

The command to move the actuator is only sent when a setpoint has changed or the operating mode is changed from closed to open. Pressing the *SET* key with the same setpoint value as the previous move will not start a move operation.

4.3 Opening the Actuators

Pressing the *OPEN* key opens all actuators with a setpoint above 0. The **OPEN** indicator light will illuminate. The **STATUS** display will indicate the status of the current open operation for the selected actuator.

4.4 Closing the Actuators

Pressing the *CLOSE* key closes all actuators to a setpoint of 0. The **CLOSE** indicator light will illuminate. The **STATUS** display will indicate the status of the current close operation for the selected actuator.

4.5 Clearing the Setpoints

The *CLEAR* key allows the clearing of all actuator setpoints. The first press of the *CLEAR* key illuminates the **CLEAR** lamp. The second press of the key clears all actuator setpoints to 0. If the key is not pressed a second time within 10 seconds, the lamp will extinguish and the setpoints will not

5. Configuration

The mAI085-MB Actuator Interface is configured using a menu driven interface. The operator keyboard changes function during configuration. This section will describe the configuration of the interface. The description will first define the keyboard functions, then describe the configuration menus used.

5.1 Overview of System Configuration

Each actuator connected to the Interface has parameters that control its operation. These parameters are stored in non-volatile memory at each actuator. These parameters can be modified using the keyboard of the Interface. The Interface can also store in its internal non-volatile memory, a copy of the parameters from each actuator.

The following table defines the steps used to set the actuator parameters and calibrate each actuator controller.

Step	Function	Action at Interface	Action at Actuator Controller
1	Load Factory Default Values for the Interface using the Factory Values Menu ..	All internal Interface parameters are overwritten with the factory default values	no action
2	Using the Controller Menu , set the iD and adjust the parameters as required for controller 1.	Parameters for actuator controller 1 are adjusted in the Interface parameter table	no action
3	Using the Controller Menu , Snd the adjusted parameters to controller 1.	no action	Parameters at actuator controller 1 are overwritten with values from the Interface
4	From the Controller Menu , calibrate controller 1, using the CAL function.	no action	Calibration parameters are adjusted by the actuator controller
5	Test the configuration by exercising controller 1	Open and close the gate to several positions including fully open and fully closed and verify the limit switch operation if used	Controller will position the gate

Step	Function	Action at Interface	Action at Actuator Controller
6	From the Controller Menu , use the GEt function to upload the calibrated parameters from controller 1.	Parameters for controller 1 in the Interface parameter table are overwritten with values from the actuator controller	no action
7	From the Controller Menu , use the tPL function to set the values from controller 1 as a template	Parameters for controller 1 in the Interface parameter table are stored in a temporary template register	no action
6	Using the Factory Values Menu , propagate the parameters from controller 1 to the remaining controllers within the Interface.	Parameters for actuator controllers 1-100 in the Interface's parameter table are overwritten with the values from the template	no action
7	From the Main Menu , save the values using the SAv command. Performing the SAv now insures that the Interface's parameter table will not be lost should power need to be cycled during the remaining steps. You may perform a SAv at any time during system setup.	Parameters are saved to non-volatile memory in the Interface	no action
8	From the Main Menu , use the Fnd function to locate the remaining controllers on the network. Exit calibration mode and confirm that all of the installed actuator controllers are present on the network. If installed controllers are not present, check field address settings and wiring and Fnd again until all of the controllers are found.	All active flags are cleared, then set for those actuator controllers located on the network; controller 1 is always set to active	no action

Step	Function	Action at Interface	Action at Actuator Controller
9	From the Main Menu perform a Snd function to send the previously saved parameters to the remaining controllers.	no action	Parameters for all active actuator controllers on the network are overwritten with values from the Interface
10.	From the Controller Menu , set the iD for each of the remaining controllers.	ID parameter is overwritten for each actuator	no action
11	Using the Controller Menu , Calibrate each of the remaining controllers using the CAL function.	no action	Calibration parameters are adjusted by the actuator controller
12	From the Main Menu perform a GEt function to retrieve the calibrated parameters from all of the connected actuator controllers.	Interface parameters are overwritten with the values from all active actuator controllers	no action
13	From the Main Menu , save the parameters using the SAv command	Parameters are saved to non-volatile memory	no action

Once you have completed this sequence, all of the actuator controllers will be calibrated and their parameters saved in the Interface's non-volatile memory. This allows an actuator controller to be replaced and reconfigured with the parameter values saved in the Interface by using the **Snd** command from the **Controller Menu**.

5.2 Configuration Keyboard Functions

To enter configuration mode, press and hold the *SCAN* key for 10 seconds. The upper display will show **LoC**, indicating entry into configuration mode.

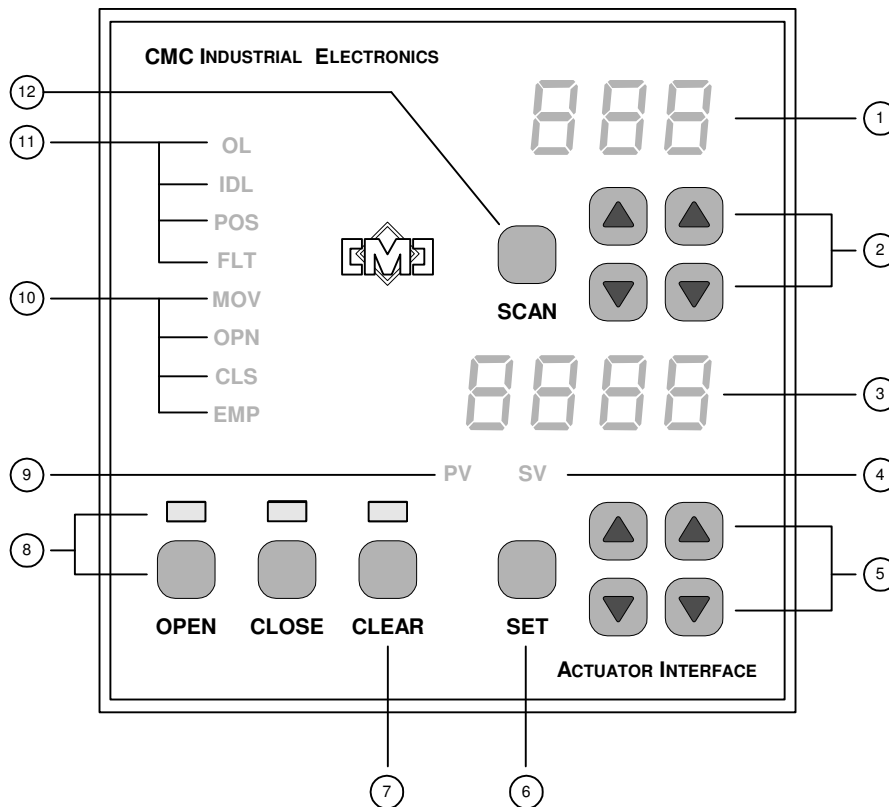


Figure 5 - Configuration Keypad and Indicators

ID	Label	Description of Operation
1	Upper Display	Displays the configuration menu item.
2	Upper <i>UP / DOWN</i>	Selects the configuration menu item.
3	Lower Display	Displays the configuration value. The flashing cursor indicates which digit is being acted on.
4	Setpoint Value	Not used, off.
5	Lower <i>UP / DOWN</i>	For YES/no menu items the right up arrow key is YES and the right down arrow key is no .

For value entries, there is a flashing cursor indicating which digit is being advanced. The left up/down arrow keys move the cursor left and right. The right up/down arrow keys increase and decrease the value.

6	<i>Set</i> key	Not used.
7	<i>Clear</i> key and lamp	Not used .
8	<i>Open / Close</i> keys and indicators	Not used.
9	Process Value	Not used, off.
10	Status Indicators	Not used, all off.
11	Fault Indicators	Not used, all off.
12	Scan key	Press and hold for 10 seconds to enter configuration mode. Press to return to last menu or from the main menu, to exit configuration mode.

5.3 Configuration Menus

There are four level of menus within the configuration system. The keyboard operation remains the same for all of the menus. Menu items are selected using the upper right arrow keys. The SCAN key is used to move back one level in the menu tree. To exit configuration the SCAN key is pressed from the Main Menu.

There are 2 typical responses to a menu item. The first is a Yes/No response. The lower right keys select **YES** (up arrow) and **no** (down arrow). The second is to modify the value displayed by the menu item. The lower arrow keys serve 2 functions when modifying values. The left arrow keys positions the flashing cursor to the digit to be modified. The right arrow keys increase or decrease the value.

Any changes made to the selected items are immediate. The interface has non-volatile storage for the system parameters. A modification to the parameters using the menus does not update this non-volatile storage directly. Be sure to backup any changes using the **SAv** function from the Main Menu before removing power from the interface. Each time power is cycled, the interface restores the saved values from non-volatile memory. Any changes made will be lost if power is cycled before a **SAv** operation has been completed.

5.3.1 Main Menu

The Main Menu allows the selection of several sub-menus and selection of the global parameter functions. All Main Menu items require **YES/no** responses.

Display	Function	Response
LoC	Go to the local interface parameters menu.	YES/no
CtL	Go to the configure actuator controllers menu.	YES/no
bUs	Go to the configure ModBus RS232 interface menu.	YES/no
FAC	Go to the reset factory values Menu	YES/no
SAv	Save the current configuration to non-volatile storage. A YES response will display SUR E in the lower display. A second YES response will save all parameters to non-volatile storage. The lower display will indicate the progress of the operation. When the operation is completed successfully, the lower display will show don E. Should the operation not complete successfully the lower display will show FAI L. If the operation fails, repeat the save. Should repeated attempts to save the parameters fail, the non-volatile storage is damaged and the unit should be replaced.	YES/no
rCL	Recall the last saved configuration from non-volatile storage. This operation is done automatically during normal startup of the interface. The last saved configuration can be recalled by answering YES to this item. A YES response to the SUR E display will restore all interface parameters from non-volatile storage.	YES/no
<p>***** WARNING *****</p> <p>This function will overwrite the current Interface parameter table with the last saved table. All current adjustments to the table will be lost.</p> <p>*****</p>		
Fnd	Find all active controllers on the network. A YES response displays SUR E in the lower display. The second YES response starts the operation. The upper display indicates the actuator controller address and the lower display the result of the query. All 100 addresses are queried (1-100). Each controller, if found, will display YES on the lower display. Unused addresses will show no . Once complete, the lower display shows Don E. The Active flag for each controller is set or cleared during this operation. Each address is tried 5 times.	YES/no
GEt	Gets the operational parameters from all actuator controllers marked active. A YES response displays SUR E in the lower display. The	YES/no



Display	Function	Response
	<p>second YES response starts the operation. The upper display indicates the controller address and the lower display the result of the query. All addresses marked active are queried. Once complete, the lower display shows DonE. Should an active actuator controller not be found, the lower display will show FAiL. Each active address is tried 5 times. If you are uncertain that a controller's parameters have been retrieved, use the GEt function within the "Configure Actuator Controllers Menu" to verify the operation.</p>	
Snd	<p>Send the operational parameters to all active controllers on the network. A YES response displays SURe in the lower display. The second YES response starts the operation. The upper display indicates the controller address and the lower display the result of the query. All addresses marked active are queried. Once complete, the lower display shows DonE. Should an active actuator controller not be found, the lower display will show FAiL. Each address is tried 5 times. If you are uncertain that a controller's parameters have been sent, use the Snd function within the "Configure Actuator Controllers" Menu to verify the operation.</p> <p>***** WARNING *****</p> <p>This function will overwrite all of the actuator controllers locally saved parameters. This may cause unpredictable results in these field devices. Verify the parameters in the mAI085-MB are correct before executing this function.</p> <p>.....</p>	
dnL	Download the sensor data table to a PC. See Appendix A – Editing Sensor data tables on a PC.	YES/no
UPL	Upload the sensor data table from a PC. See Appendix A – Editing Sensor data tables on a PC.	YES/no
dGn	Go to the Modbus Slave Interface Menu.	YES/no

5.3.2 Local Menu

The local menu allows the configuration of parameters specific to the mAI085-MB.

Display	Function	Response
oPn	Selects the Open/Close mode at startup. Selecting YES will start the interface with the OPEN lamp on. Selecting no will start the interface with the CLOSE lamp on. The default value is no .	YES/no
oPL	Selects the open relay output pulse timing. See “Controlling Conveying Systems” for details on output pulse timing. A value of 0 disables this function. The default value is 0.	0-255 seconds
CPL	Selects the close relay output pulse timing. See “Controlling Conveying Systems” for details on output pulse timing. A value of 0 disables this function. The default value is 0.	0-255 seconds
oDL	Selects the open delay. This delay allows for a conveying system to start before beginning to open any actuators. The delay starts when the OPEN key is pressed. See “Controlling Conveying Systems” for details. A value of 0 disables this function. The default value is 0.	0-255 seconds
CDL	Selects the close delay. This delay allows for a conveying system to purge after closing all actuators. The delay starts when the last actuator has been commanded to close. See “Controlling Conveying Systems” for details. A value of 0 disables this function. The default value is 0.	0-255 seconds
SPd	Selects the baud rate for the controller communications network. Changing the baud rate without first setting the baud rates for all of the field devices will result in lost communication to the field devices. The default setting is 19200 baud.	9600, 1920

5.3.3 Actuator Controller Menu

The Actuator Controller Menu allows the configuration of the field actuator controller. In addition this menu allows the setup of internal parameters that affect the open/close timing of the actuator controllers. Additional menu items allow the recall and saving of the parameters from the field device on an individual controller basis.

Provision is made to create a template from a specific controller. This template can then be used to preset any additional controllers. Using the template/copy system can help speed up the configuration process.

A menu selection allows the remote calibration of the field actuator controllers. This function sets the field controller into calibration mode and alerts the operator when the calibration is complete.

Before this menu can be entered, the specific controller to be configured must be selected. When entering this menu the upper display will show **C 0**, indicating controller address 0. Use the upper arrow keys to select the controller to be configured. Selecting **YES** with the lower arrow keys enters the configuration menu for the controller shown in the upper display.

Display	Function	Response
ACT	Controller is active and present on the network. This flag is set automatically when the Fnd function is executed. The network can be manually configured using this menu item. The default setting is no , not on the network except for address 1, which is YES .	YES/no
id	Selects the Identification shown in the upper display for this actuator during normal operation. The numbers 0-9 and all 26 letters of the alphabet are represented in the character table. Some character renditions are compromises due to the nature of the 7 segment display. In addition, the -, _ and blank characters are included. The default setting starts with 1 for address 1.	0-9 A-Z - _ blank
SPT	Sets the default setpoint for this actuator on startup. Values from 0 to full scale are permitted.	0-FS
odL	Sets the open delay time for this controller. When set, this timer delays the opening of the actuator. The delay starts after the open delay specified in the Local Menu. This timer can be used to insure accurate blending of materials occurs during conveying system startup. A value of 0 disables this function. The default value is 0.	0-255 seconds
CdL	Sets the close delay time for this controller. When set, this timer delays the closing of the actuator. The delay starts when the CLOSE key is pressed. This timer can be used to insure accurate blending of materials occurs during conveying system shutdown. A value of 0 disables this function. The default value is 0.	0-255 seconds
CpY	Copy the template values to this controller. The template can be loaded from any selected controller using the tPL menu item. Selecting YES copies the template values to this controller and the menu display returns to Act . This function will not operate until a template has been set.	YES/no
tPL	Set the template using this controller. Selecting YES copies this controllers parameters to the template. The menu display returns to ACT .	YES/no



Display	Function	Response
GEt	<p>Get the operational parameters from this controller. A YES response displays SURe in the lower display. The second YES response starts the operation. Once complete, the lower display shows DonE. Should the controller not respond, the lower display will show FAiL..</p> <p>***** WARNING *****</p> <p>This function will overwrite the Interface's saved copy of the parameters. Verify the parameters in the actuator controllers are correct before executing this function.</p> <p>*****</p>	YES/no
Snd	<p>Send the operational parameters to this controller. A YES response displays SURe in the lower display. The second YES response starts the operation. Once complete, the lower display shows DonE. Should the controller not respond, the lower display will show FAiL..</p> <p>***** WARNING *****</p> <p>This function will overwrite the actuator controllers saved parameters. This may cause unpredictable results in this field device. Verify the parameters in the mAI085-MB are correct before executing this function.</p> <p>*****</p>	YES/no
CAL	<p>Place the actuator controller in calibrate mode. The actuator controllers have an automated calibration function. This function sets the primary operational parameters for the controller by exercising the actuator. A YES response displays SURe in the lower display. The second YES response starts the operation. During the calibration sequence, the lower display shows rUn. Pressing YES will stop the calibration sequence. The lower display will show DonE when the sequence ends. If a calibration does not complete the lower display will show FAiL. It is recommended that the results of the field calibration be uploaded to the mAI085-MB using the GEt command. This will allow the verification of the controller parameters using the parameter functions of this menu. In addition, by saving the parameters in the interface, a replacement field device can be easily reprogrammed to match the replaced device using the Snd command.</p> <p>***** WARNING *****</p> <p>The field actuator will move during this operation. Be sure field personnel are notified and that the device is safe to operate before executing this command.</p>	YES/no



Display	Function	Response
	<p>This function will modify the actuator controllers saved parameters. Verify that the calibration sequence completed successfully and that the actuator is operating properly before placing the field device into service. Actuator controllers that do not complete the calibration sequence revert automatically to the pre-calibration parameter table saved in the actuator controller.</p> <p>*****</p>	
Oft - CSP	<p>Allows the adjustment of the field parameters of the actuator controllers. The descriptions of these parameters are listing in the Technical Manual for the mAC/GP1X5-MB actuator controllers and gate positioners. Refer to the mAC/GP1X5-MB Technical Manual for further information.</p>	<p>See mAC/GP1X5 -MB Technical Manual</p>

5.3.4 Modbus Interface Menu

The Actuator Interface allow remote operation and monitoring over a Modbus network. Modbus is an industry standard network protocol for connecting PLC and field devices. The Actuator Controller is a Modbus Slave device and only utilizes the RTU protocol. See “Using the Modbus Network Interface” for further information.

Display	Function	Response
Adr	Selects the Modbus slave address. The default address is 1.	1-125
SPd	Sets the baud rate of the Modbus serial port. The default baud rate is 9600 baud.	300,600, 1200,2400, 4800,9600, 1920
Par	Selects whether parity is active on the serial port. The default is no parity.	YES/no
Odd	Select the type of parity, even or odd. A YES response selects odd parity, a no response selects even parity. The default is even parity if parity has been enabled.	YES/no
Prt	Port Reset Timer; should the Modbus port become disabled due to electrical disturbance. This timer will automatically restart the Modbus Slave port; the timer will reset the port at the entered interval (in seconds) if no valid Modbus messages are received. A setting of 0 disables this function.	0-255

5.3.5 Factory Values Menu

The Interface can be configured to a range of factory preset values. The menu items allow the selection of the actuator controller model, speed of actuator operation and actuator accuracy. When the save function from this menu is executed all of the controller ID's will be reset to A1 – A100 and all of the controllers except controller 1 will be made inactive.

If no selections are made for **tyP**, **SPd** or **ACC** then the values from controller 1 will be used as defaults. If a **SAv** is executed without **tyP**, **SPd** or **ACC** being set, the settings for controller 1 will be propagated to all of the remaining controllers, the controller ID's will be reset to A1 – A100 and all of the controllers except controller 1 will be made inactive.

There are two ways to execute a factory reload. The first is to utilize a preset factory table. This table contains known working values for all of the parameters suitable for most installations. To select the correct tables for the actuator controller you are using, first use **tyP**, **SPd** and **ACC** to select the model of your controller, the running speed of the actuator and the required position accuracy. The required configuration can then be saved using the **Sav** function.

The second method of saving default values uses a template that can be preset with a modified set of values based on an individual actuator controller. To use this function, first setup and test an individual actuator controller. Once the operation of this controller has been verified use the template function (tPL) in the controller menu (CtL) to load the parameter template buffer. To save this template buffer to all of the remaining controllers, do not select a type, speed or accuracy, instead proceed directly to **Sav** function. Once select this function will save the template parameter values to the Interface's parameter table for all 100 controllers.

Note these tables are not automatically sent to the actuator controllers. Use the global **Snd** command to move the Interface's parameter table to the active controllers.

Display	Function	Response
tyP	Selects the model of actuator controller connected to the interface	185,165 145,125, nonE
SPd	Sets the full stroke speed of the actuator in seconds. Use the first value that is longer than your actuators full movement speed.	10,30,60, none
ACC	Select the position accuracy required.	0-10
SAv	Selecting YES will load the selected values to all 100 controller parameter storage locations. Note that the new values are not automatically downloaded to the networked actuator controllers. Use the Snd command to send the parameters to the actuator controllers.	YES/no

***** **WARNING** *****
All existing values will be overwritten and are not recoverable

5.3.6 Diagnostics Menu

The mTI085 has a built in diagnostics system. This menu allows for the diagnosis of the input ports, communications ports and keyboard. Test connectors are required to test the communications port. Press the SETUP key to exit any of the diagnostic tests.

Display	Function	Response
io	Tests the supervisory inputs and outputs. Once selected, energizing a supervisory input will close the corresponding supervisory output, i.e. energizing input closes output 1.	rUn
tP1	Test communications port 1. A loopback test connector that connects pins 2 to 3 and pins 7 to 8 is required. If the test returns a 1 or 2 response, the RTS/CTS signals are not functioning. If the response is 10 – 27 the unit is unable to send or receive characters.	Error message, GOOD or bAd
tP2	Test communications port 2. A loopback test connector that connects pins 2 to 3 and pins 7 to 8 is required. If the test returns a 1 or 2 response, the RTS/CTS signals are not functioning. If the response is 10 – 27 the unit is unable to send or receive characters.	Error message, GOOD or bAd
kYb	Once selected, each press of a keyboard key will return a numeric code. Pressing the SETUP key exits the test and does not display a code.	n/a



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6. The Input / Output System

The mAI085-MB Actuator Interface has 4 discrete inputs and 4 discrete outputs. Figure 2 and Table 2 detail the physical connections to the discrete signals. Each of the signals is described below:

Name	Description
Input 1 Pin 1	Energizing this input will select Open mode and turn on the OPEN indicator on the front panel. Only the positive edge of the input signal is recognized and the input must be de-energized between operations. Once energized, this input does not affect front panel operator function.
Input 2 Pin 2	Energizing this input will select Close mode and turn on the CLOSE indicator on the front panel. Only the positive edge of the input signal is recognized and the input must be de-energized between operations. Once energized, this input does not affect front panel operator function.
Input 3 Pin 3	Energizing this input will clear all of the actuators setpoints. The clear will occur immediately. Only the positive edge of the input signal is recognized and the input must be de-energized between operations. Once energized, this input does not affect front panel operator function.
Input 4 Pin 4	Energizing this input forces all of the actuators closed immediately. The actuators will remain closed regardless of the controller being in Open mode. Open/Close mode is not affected by this input and the actuators will re-open when this input is de-energized if the interface is in Open mode. Open/Close timers are ignored by this input and the force close will override any timing function in progress.
Output 1 Pins 1 & 2	This output can have 2 functions depending on the setting of the oPL timer. If the oPL timer is set to 0, this output will energize whenever the interface is in Open mode. The output remains energized until the mode is changed to Close. If a value has been entered into the oPL timer, this output will energize for the length of time set by the oPL time, each time the Open mode is selected. This form of operation can be used as a start signal for a conveying system.
Output 2 Pins 3 & 4	This output can have several functions depending on the setting of the cPL and cDL timers. If the cPL timer is set to 0, this output will energize whenever the interface is in Close mode. The output remains energized until the mode is changed to Open. If a value has been entered into the cPL timer, this output will energize for the length of time set by the cPL time, each time the Close mode is selected. This form of operation can be used as a stop signal for a conveying system. The energizing of this output will be delayed if a value other than 0 is set in the oDL timer. The oDL timer can be used to purge a conveying system after all of the actuator gates have been closed using the Close mode.



Name	Description
Output 3 Pins 5 & 6	This output will be energized any time all of the actuator setpoints are 0. The output de-energizes whenever a non-zero setpoint is entered into any of the actuators.
Output 4 Pins 7 & 8	This output is energized whenever an internal fault is detected in the mAI085-MB Actuator Interface. Possible faults are invalid parameter table (checksum verification failed during startup), corrupted firmware or damaged hardware. ***** WARNING ***** Operation of the mAI085-MB Actuator Interface may be unpredictable when this contact is energized. *****

7. Controlling Conveying Systems

The mAI085-MB Actuator Interface allows the direct control of simple conveying systems. The interface has several timers that facilitate this control. These timers in conjunction with the discrete output system control the conveying system. The following timers are used:

ID	Description	Menu
oPL	Provides a pulsed output from Output 1 to start a conveying system. If this value is set to 0, Output 1 will remain on continuously whenever the OPEN lamp is on. If a value is set in this timer the output will pulse on for the time selected in seconds each time the OPEN lamp turns on.	LoC
cPL	Provides a pulsed output from Output 2 to stop a conveying system. If this value is set to 0, Output 2 will remain on continuously whenever the CLOSE lamp is on. If a value is set in this timer the output will pulse on for the time selected in seconds each time the CLOSE lamp turns on. The operation of the output will be delayed if a value is entered into the cdL timer.	LoC
odL	Delays the opening of the actuators to allow the conveying system to fully start. Output 1 will energize (or pulse if oPL is set) immediately upon the OPEN lamp illuminating. The actuators will begin to open after this delay in seconds. This timer starts immediately upon entering Open mode.	LoC
cdL	Delays the stopping of the conveying system until all of the gates are closed and the system has been purged. This timer starts after the CLOSE lamp illuminates and all of the gates have been issued close commands. Once this timer expires, Output 2 will energize (or pulse if cPL is set).	LoC
odL	This timer allows for the different location of each actuator along a conveying system. Actuators near the start of the conveying system must open first, with each successive actuator opening a short time latter. This ensures an accurate blend of the material. Each actuator has a timer that delays the opening after the primary delay odL has expired.	CtL
cdL	This timer allows for the different location of each actuator along a conveying system. Actuators near the start of the conveying system must close first, with each successive actuator closing a short time latter. This ensures an accurate blend of the material. Each actuator has a timer that delays the closing when the interface enters Close mode.	CtL

Figure 6 details a typical start/stop sequence for a conveying system.

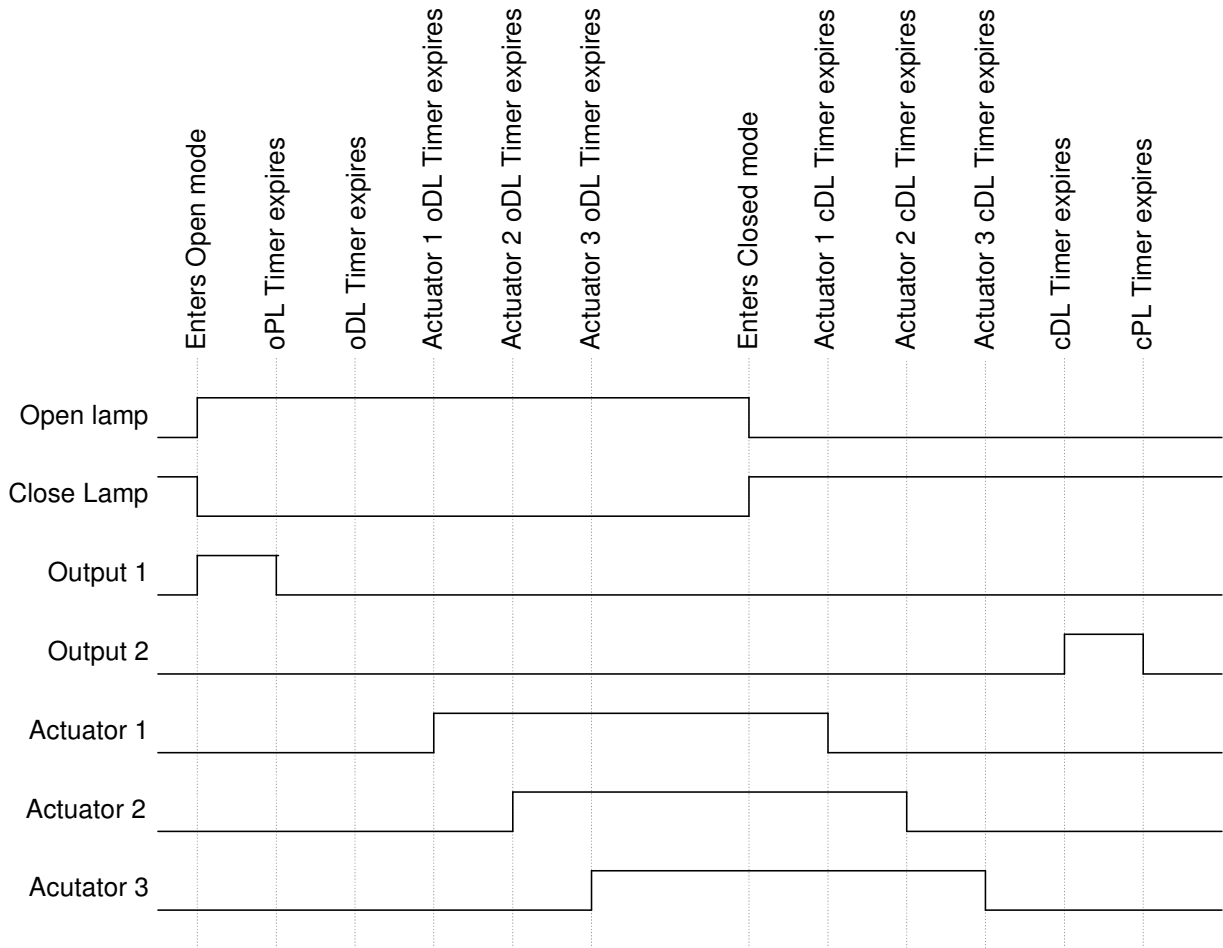


Figure 6 - Conveying System Timing Diagram

8. Using the Modbus Network Interface

The mAI085-MB incorporates a RTU Slave Modbus interface. This interface responds to only 3 Modbus slave commands. The commands are 3 - Read Holding Registers, 6 - Write One Holding Register and 16 - Write Multiple Holding Registers. The Modbus protocol allows a maximum of 125 Register Reads and 100 Register Writes in a single transaction. The following tables provide the register assignments for the Modbus interface. The command register within the interface mimics the operation of the front panel keys and discrete inputs.

8.1 The Modbus Serial Interface

The physical connection is by a RS-232 port. The unit has a DB9 female connector, wired as a DCE device. A modem or pin to pin cable can be used to connect the unit to a standard DTE port. The connector pin-out is:

Pin	Function at DTE device
1	DCD - always +9VDC
2	TX - data from mAI085-MB
3	RX - data to the mAI085-MB
4	DTR - not used
5	Common
6	DSR - always +9VDC
7	RTS - not used
8	CTS - always +9VDC
9	RI - not used

The unit supports 8 bit, even, odd or no parity in RTU mode. A full range of baud rates from 300 -19200 are supported.

8.2 Register Assignments

8.2.1 Read Only Registers

Two registers are assigned to each addressed controller. The mAI085-MB can address up to 100 controllers, starting from address 1 to address 100. Each addressed controller corresponds to the following register table:

Register	Function
40002	Controller 1 Process value
40003	Controller 1 Status
40004	Controller 2 Process value
40005	Controller 2 Status
40006	Controller 3 Process value
40007	Controller 3 Status
~	~
40200	Controller 100 Process value
40201	Controller 100 Status

The controller process value is a 12 bit unsigned integer. The process value will occupy bits 0 - 11 of the process value word. The factory set range of the process value will be from 0 - 100, signifying 0 - 100%. The controller status word definition is as follows:

Bit	Function
0	Input 1 (Force Close) , 1 = input lamp off
1	Input 2 (Closed Limit) , 1 = input lamp off
2	Input 3 (Open Limit) , 1 = input lamp off
3	Input 4 (not assigned), 1 = input lamp off
4	Seek in progress, 1 = seeking
5	Motor running, 1 = running
6	Motor direction, 1 = close
7	not used, always 0
8	Position fault, 1 = did not reach position
9	Over fault, always 0, not implement in mGP145
10	Idle Load fault, always 0 not implement in mGP145
11	Parameter fault, 1 = parameters corrupted
12	Firmware fault, 1 = controller failed
13	Bad command, 1 = last command invalid
14	Calibration mode, 1 = in calibration mode
15	Communications fault, 1 = no communications

8.2.2 Read-Write Registers

Each controller has one register for the setpoint value. The setpoint value will occupy bits 0 - 11 of the setpoint value word. The factory set range of the setpoint value will be from 0 - 100, signifying 0 - 100%. Writing a setpoint to the setpoint register will cause the actuator controller to immediately position the actuator. The value in the setpoint register must change to initiate a move. If the actuator faulted in the last attempted move, a different setpoint value will have to be written to force a new move. The actuator will only move if the interface **OPEN** indicator is on. Open mode can be selected by pressing the *OPEN* key. The interface can be configured to start in open mode from the local menu and open mode can be forced over the Modbus communications system through the interface command register.

Register	Function
40301	Controller 1 setpoint
40302	Controller 2 setpoint
40303	Controller 3 setpoint
~	~
40400	Controller 100 setpoint

8.2.3 mAI085-MB Special Registers

In addition, two special registers have been assigned. These registers are for controlling the mAI085-MB Actuator Interface. The function of these registers is as follows:

Register	R or R/W	Function
40001	R	mAI085-MB status
40300	R/W	mAI085-MB commands

The mAI085-MB status register bit assignments are:

Bit	Function
0	mAI085-MB input 1, 0 = input open
1	mAI085-MB input 2, 0 = input open
2	mAI085-MB input 3, 0 = input open
3	mAI085-MB input 4, 0 = input open
4	mAI085-MB output 1, 0 = output off
5	mAI085-MB output 2, 0 = output off
6	mAI085-MB output 3, 0 = output off

7	mAI085-MB output 4, 0 = output off
8	in open mode, 1 = yes
9	setpoints all cleared, 1 = yes
10	local keyboard disabled, 1 = yes
11	always 0
12	RAM fault, 1 = yes
13	mAI085-MB parameter corruption, 1 = yes
14	mAI085-MB firmware fault, 1 = yes
15	mAI085-MB in calibration, 1 = yes

There are 4 command bits to control the interface. These command bits are active only on the 0 to 1 transition. The bit must be returned to 0 before the command will execute again. Each of the bits acts independently. The mAI085-MB command register bit assignments are:

Bit	Function
0	mAI085-MB to close mode, 1 = yes
1	mAI085-MB to open mode, 1 = yes
2	mAI085-MB, clear all setpoints, 1 = yes
3	mAI085-MB disable local keyboard, 1 = yes
4	mAI085-MB enable local keyboard, 1 = yes
5	not used, always write 0
6	not used, always write 0
7	not used, always write 0
8	not used, always write 0
9	not used, always write 0
10	not used, always write 0
11	not used, always write 0
12	not used, always write 0
13	not used, always write 0
14	not used, always write 0
15	not used, always write 0

9. Specifications

Description	Characteristic
DC Supply	
Voltage	20 - 28VDC
Current	2.0 @ 24VDC
Supervisory Inputs	
Voltage	24VDC
Current	20mA
Supervisory Contacts	
Voltage	32VDC, 120VAC
Current	1.0A @ 24VDC, 0.5A @ 120VAC Resistive
Actuator Controller DC Supply	
Voltage	20 - 28VDC
Current	1.5A @ 24VDC
Actuator Controller Communications	
Standard	RS485 differential
Distance	500m (1640ft.)
Input Load	12k Ω , standard
Termination	120 Ω balanced line
Auxiliary Communications Ports	
Modbus RTU Port	RS-232C, DB9S connector, wired DCE
Download/Upload and Controller Network Expansion port	RS-232C, DB9P connector, wired DTE
Environment	
Temperature	-40 to 70°C (-40 to 158°F)
Relative Humidity	0 to 95% non-condensing
Dimensions	
Height	90mm (3.55")
Width	90mm (3.55")
Depth	127mm (5.0")



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10. Appendix 1 - Editing Controller Setup Tables on a PC

The mAI085 can download and upload the field actuator controller setup tables to a PC over a standard serial port. Using software supplied as part of the Windows operating system and spreadsheet software, such as Excel, the configuration tables can be conveniently edited and sorted. The download (**dnl**) and upload (**UPL**) functions are accessed from the main menu. See **Section 5 – Setup** for details on selecting these functions. Before starting these functions you will need the following:

1. A PC running Windows software;
2. A null-modem serial cable with a 9 pin female connector on both ends;
3. A communication software package, such as HyperTerminal that is supplied with most Windows OS distributions.

The following instructions assume you are using HyperTerminal for communications and Excel for editing:

10.1 Setting up HyperTerminal

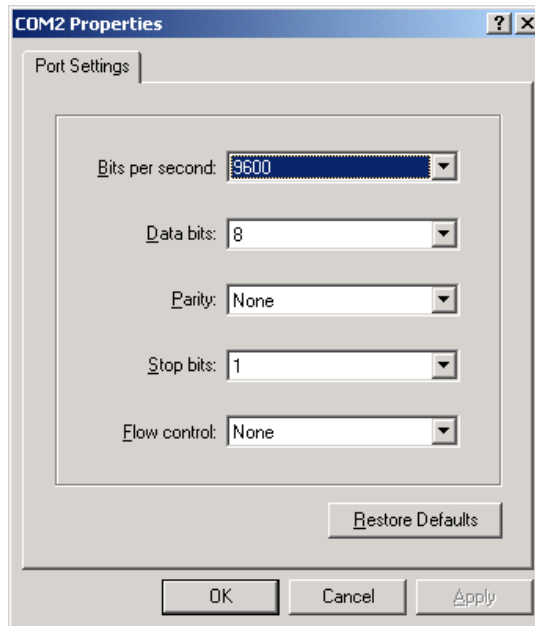
1. Open HyperTerminal;
2. Enter the name Direct for the connection name as below then click **OK**;



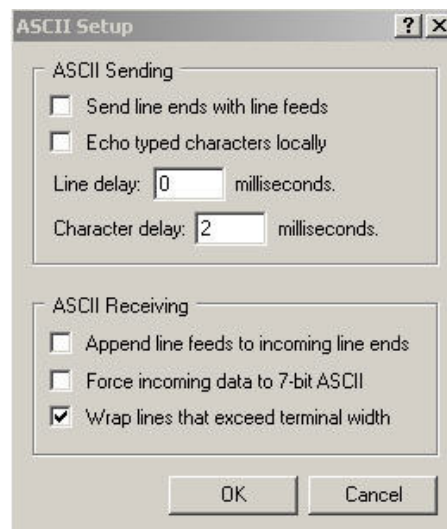
3. Select the communications port you are using and then click **OK**;



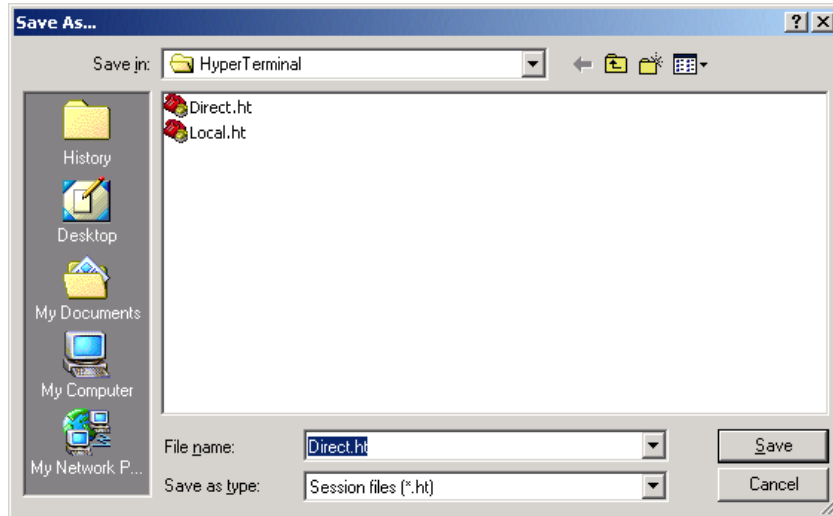
4. Set the communications port settings as shown and then click **OK**. The settings are **Bits per second** - 9600, **Data bits** - 8, **Parity** - None, **Stop bits** -1, **Flow control** - None;



5. On some computers it may be necessary to add a short delay to each transmitted character when uploading configurations to the mTI085. From the **File** menu in HyperTerminal, select **Properties**. On the next screen select the **Settings** tab. On the next screen click the **ASCII Setup** button. Set the **Character delay** field to 2 milliseconds and then click **OK**;



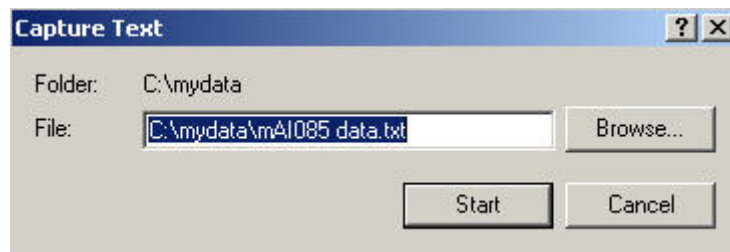
6. You will now be at the main HyperTerminal Screen. Select **File** and then **Save** and the screen below will appear. Click **Save** to save this configuration as Direct.ht. You can now open HyperTerminal from the Direct Icon anytime you require this connection.



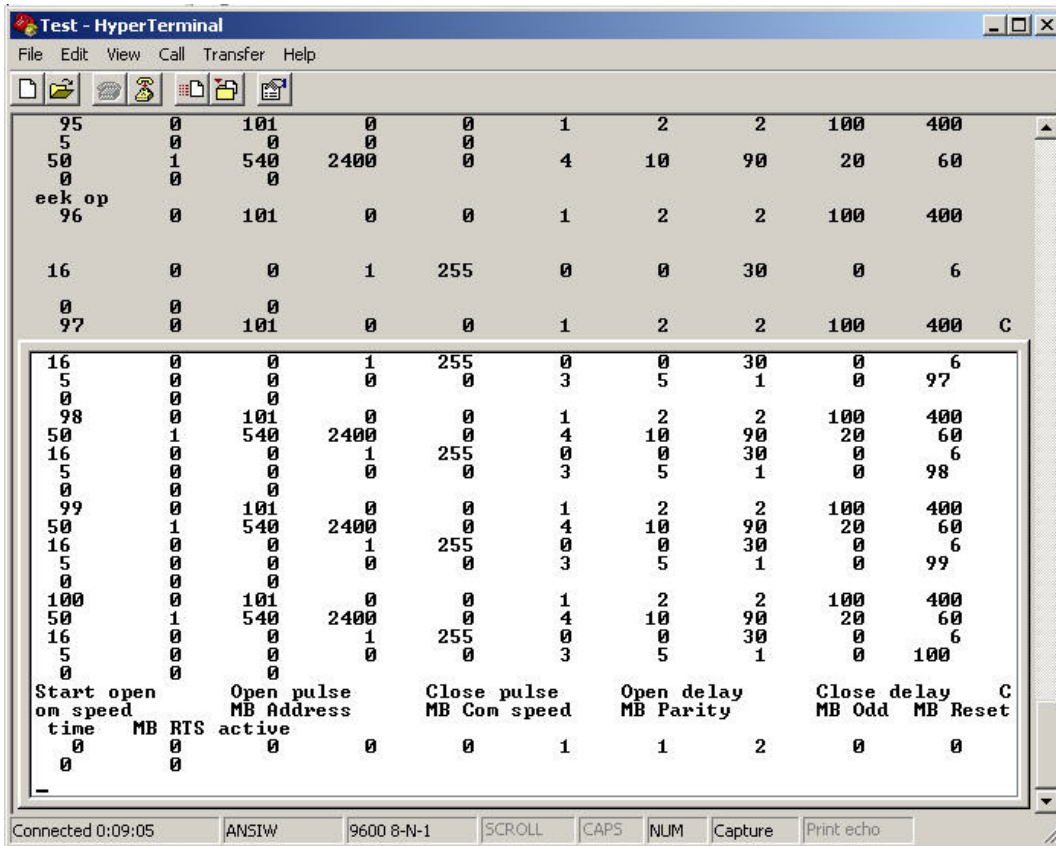
You are now ready to download the configuration file.

10.2 Downloading the Configuration to the PC

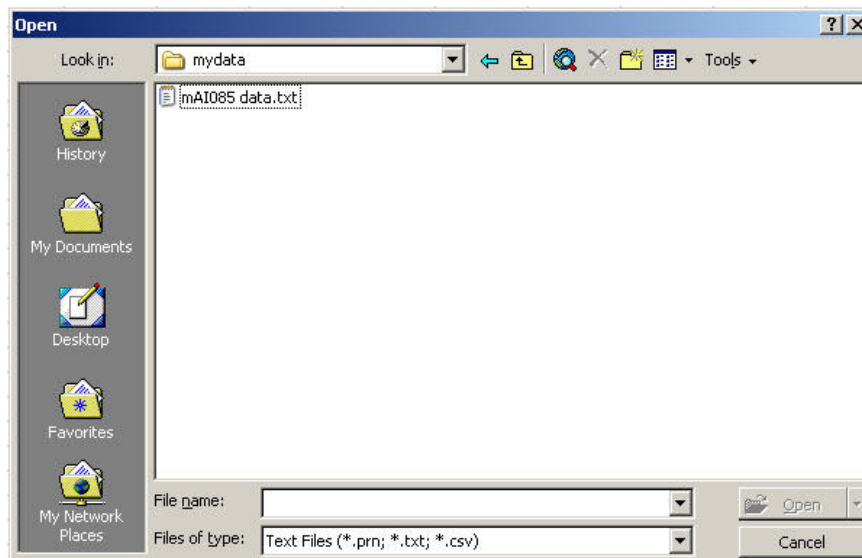
1. Select **dnL** from the Main Menu;
2. From HyperTerminals menu, click on Transfer and then Capture Text. Enter the path and file name where you want to store the configuration file as shown below. Note HyperTerminal appends data to existing files. You must delete the file each time you do a download or use a different file name. When you have completed entering the name, click Start;



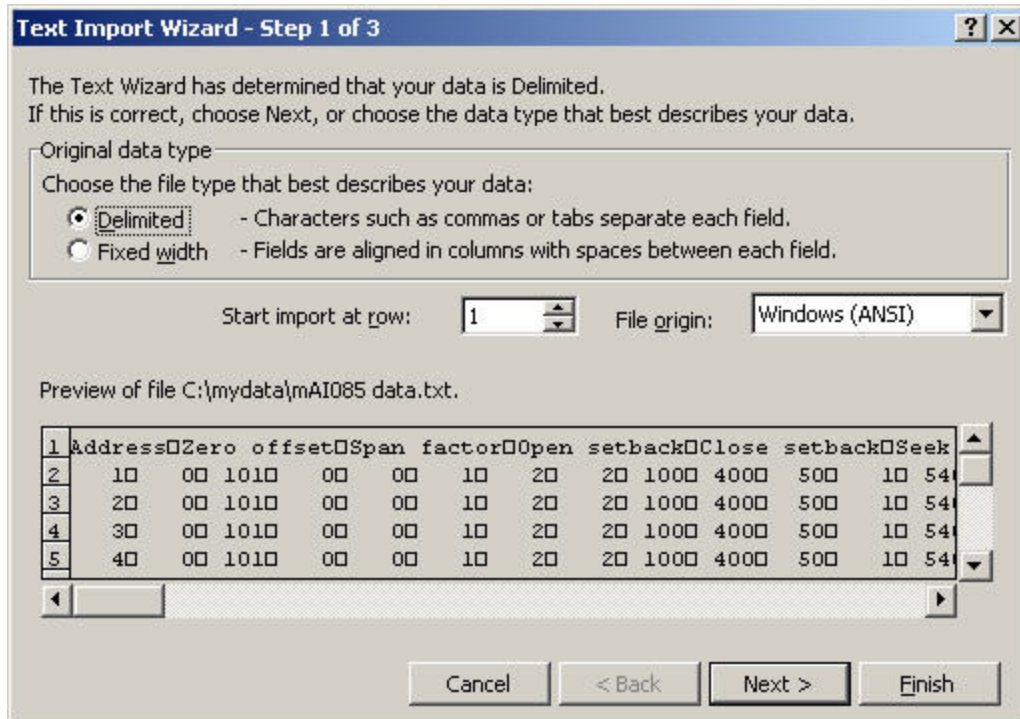
3. On the mTI085 press YES and the YES again to the SurE prompt. The mTI085 will begin dumping the configuration file to HyperTerminal. When the transfer is complete, the mAI085MB will show **donE** and your PC screen will appear as:



- From the HyperTerminal menu, select Transfer and then Capture Text, then Stop. You have now created a ".txt" file containing the configuration data.
- Open Excel and select File and then Open. You will have to change the type of file to open in the highlighted dialog box as shown below. You want to open files of type ".txt". Once you have selected file type ".txt", select your data file and then click Open.

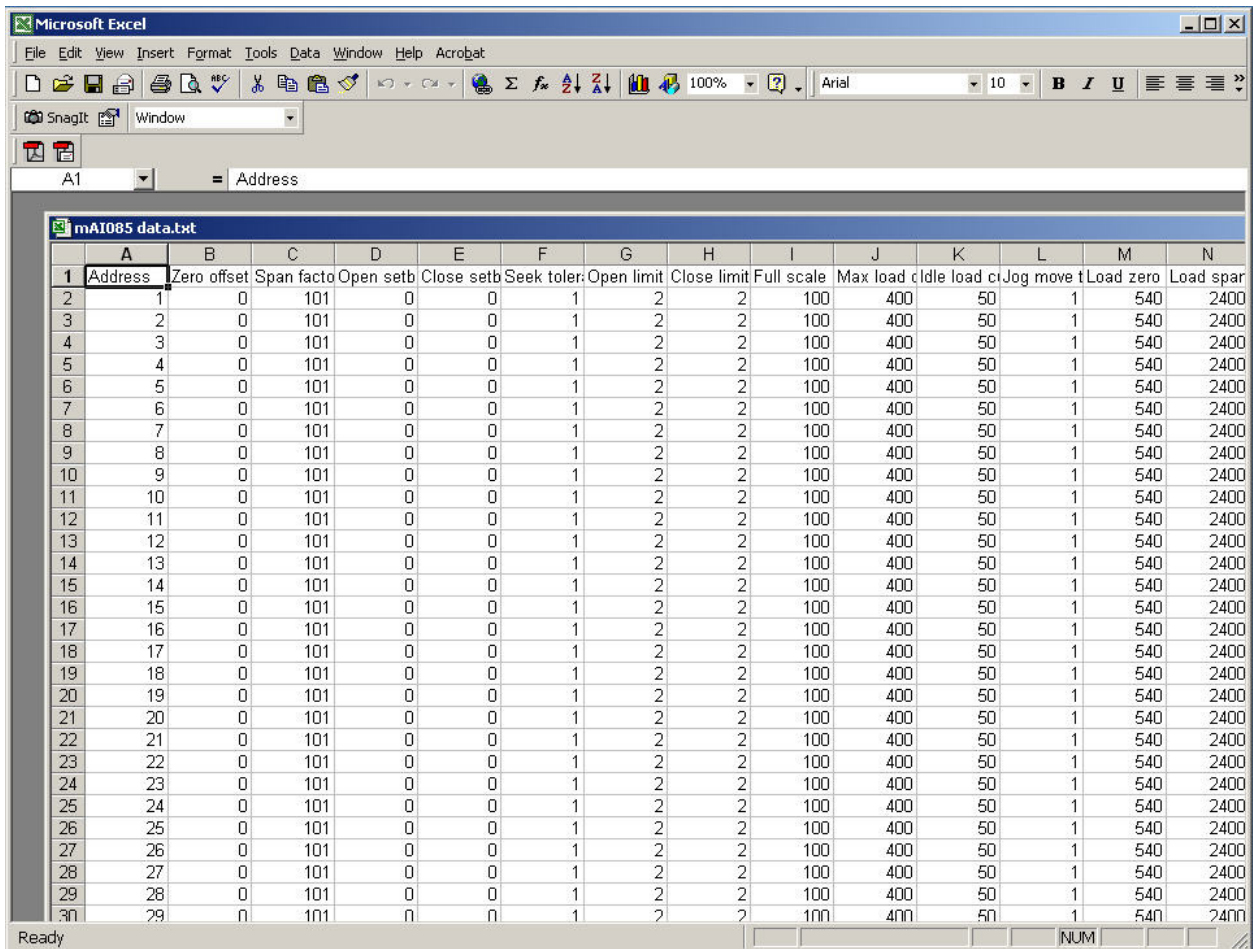


- Excel will display a data import dialog. The data from the mAI085MB is pre-formatted to be automatically imported into Excel. Just click Finish to import the data.



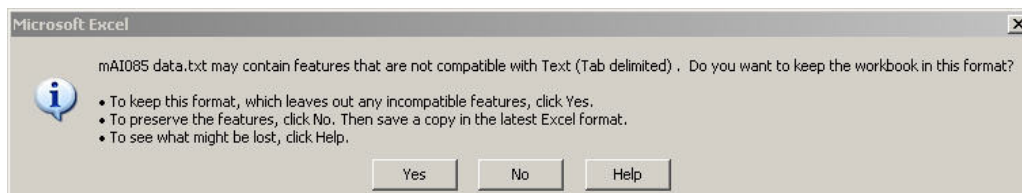
- Adjust the width of the columns A so you can see the headings. Edit the data as required. A sample of an Excel spreadsheet is shown below. The columns correspond directly with the menu prompts from the **CtL** menu. There are 2 sections to the file. The first is the controller setup parameters. The second is the setting saved under the **LoC** menu. Do not modify the headings rows. These rows are discarded when uploaded to the mAI085MB.

Note that the mAI085MB does not verify the entries you have made. Do not change the format of the spreadsheet in anyway and do not enter field longer than the maximum allowed lengths. Always download and upload the entire controller range. The mAI085MB can be reset to factory values using the Fac option from the main menu.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Address	Zero offset	Span facto	Open setb	Close setb	Seek toler	Open limit	Close limit	Full scale	Max load	Idle load	Cl Jog move	t Load zero	Load spar
2	1	0	101	0	0	1	2	2	100	400	50	1	540	2400
3	2	0	101	0	0	1	2	2	100	400	50	1	540	2400
4	3	0	101	0	0	1	2	2	100	400	50	1	540	2400
5	4	0	101	0	0	1	2	2	100	400	50	1	540	2400
6	5	0	101	0	0	1	2	2	100	400	50	1	540	2400
7	6	0	101	0	0	1	2	2	100	400	50	1	540	2400
8	7	0	101	0	0	1	2	2	100	400	50	1	540	2400
9	8	0	101	0	0	1	2	2	100	400	50	1	540	2400
10	9	0	101	0	0	1	2	2	100	400	50	1	540	2400
11	10	0	101	0	0	1	2	2	100	400	50	1	540	2400
12	11	0	101	0	0	1	2	2	100	400	50	1	540	2400
13	12	0	101	0	0	1	2	2	100	400	50	1	540	2400
14	13	0	101	0	0	1	2	2	100	400	50	1	540	2400
15	14	0	101	0	0	1	2	2	100	400	50	1	540	2400
16	15	0	101	0	0	1	2	2	100	400	50	1	540	2400
17	16	0	101	0	0	1	2	2	100	400	50	1	540	2400
18	17	0	101	0	0	1	2	2	100	400	50	1	540	2400
19	18	0	101	0	0	1	2	2	100	400	50	1	540	2400
20	19	0	101	0	0	1	2	2	100	400	50	1	540	2400
21	20	0	101	0	0	1	2	2	100	400	50	1	540	2400
22	21	0	101	0	0	1	2	2	100	400	50	1	540	2400
23	22	0	101	0	0	1	2	2	100	400	50	1	540	2400
24	23	0	101	0	0	1	2	2	100	400	50	1	540	2400
25	24	0	101	0	0	1	2	2	100	400	50	1	540	2400
26	25	0	101	0	0	1	2	2	100	400	50	1	540	2400
27	26	0	101	0	0	1	2	2	100	400	50	1	540	2400
28	27	0	101	0	0	1	2	2	100	400	50	1	540	2400
29	28	0	101	0	0	1	2	2	100	400	50	1	540	2400
30	29	0	101	0	0	1	2	2	100	400	50	1	540	2400

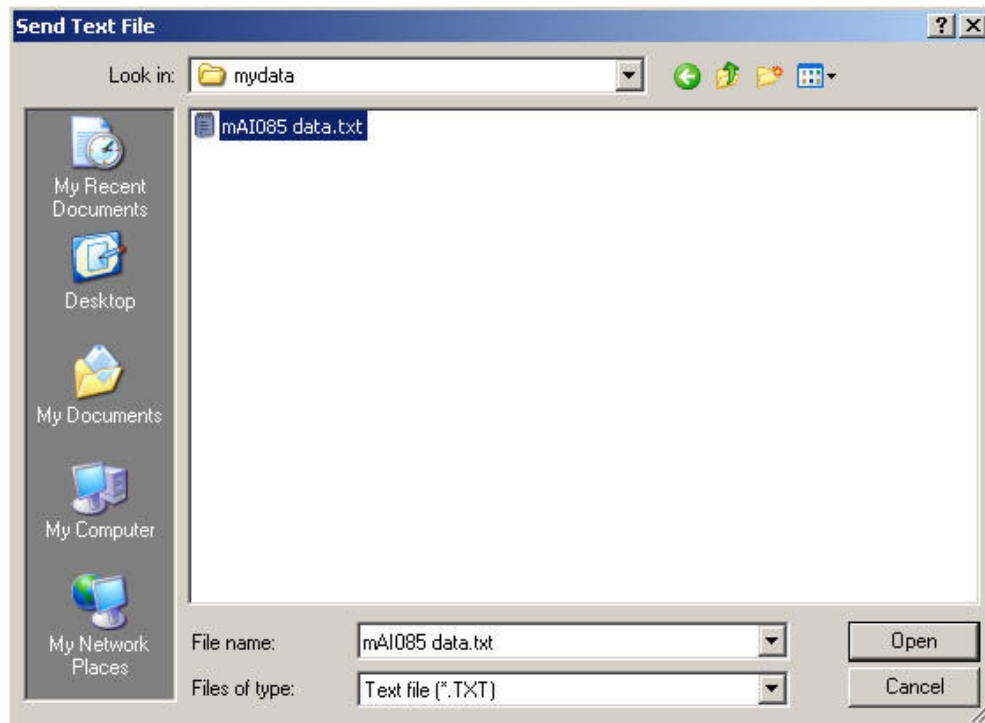
- When finished, save the file as a “.txt” file. Excel will prompt you to change the type of file when you save or exit, as it defaults to the “.xls” file format. Always answer to not change format of the file. The screen sample below shows a typical dialog.



Note you must click on Yes at this dialog to save your file as a “.txt” file.

10.3 Uploading the Configuration to the mAI085MB

- To upload the file to the mAI085, select **UPL** from the main menu of the mAI085MB. HyperTerminal should be open and the cable connected.
- Select Transfer and then Send Text File from the HyperTerminal menu. Select the file from the dialog box, but do not double click on the file, or click Open yet.



3. On the mTI085 select **YES**, and then **YES** again to the **SurE** prompt. The lower display will show **128**. Click on Open on the HyperTerminal dialog to start the transfer. The lower display will count down as the sensor data is received.
4. When the transfer is complete. The lower display will show **donE**. Select **Sav** from the Main menu of the mAI085MB to save your uploaded data.

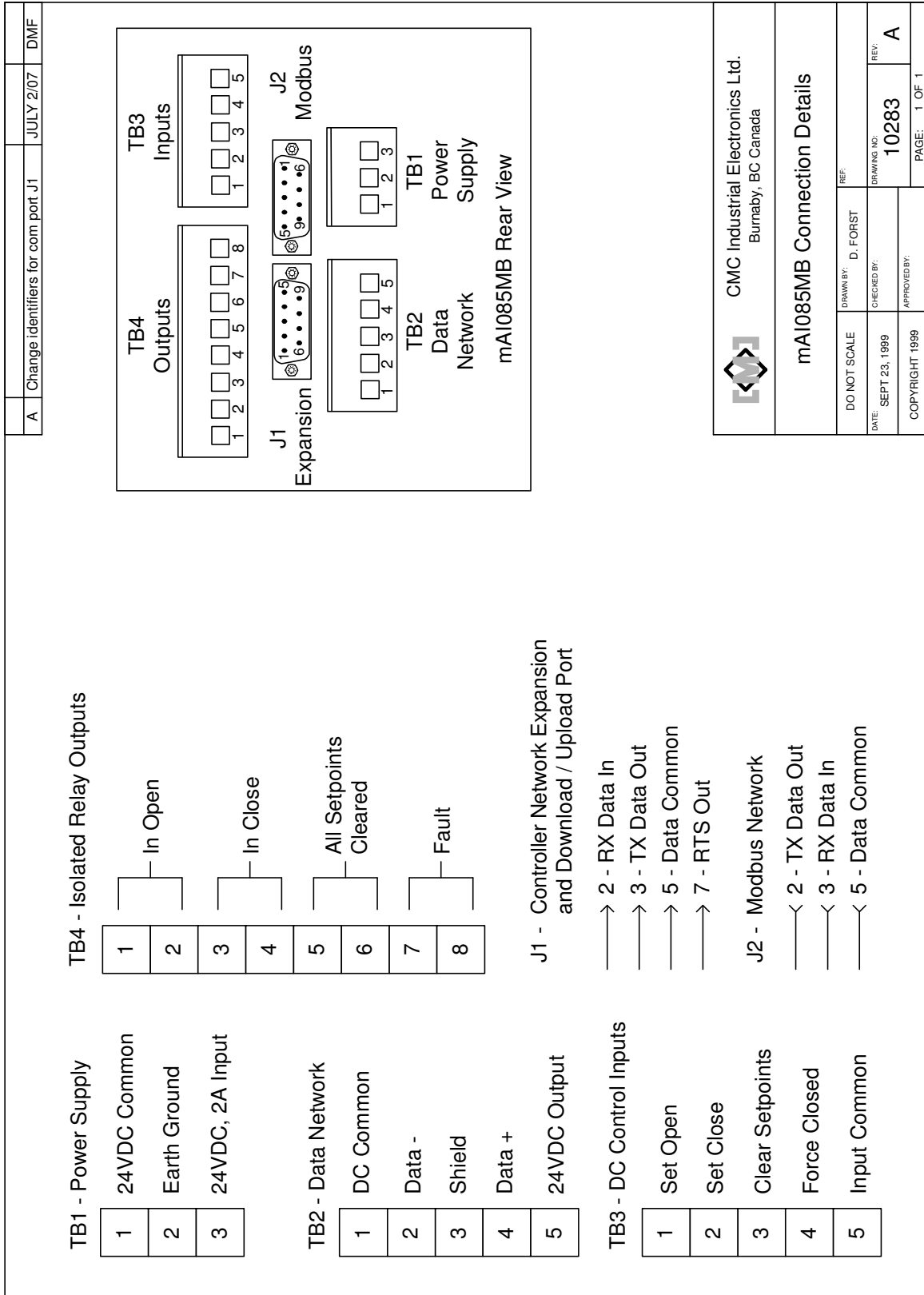


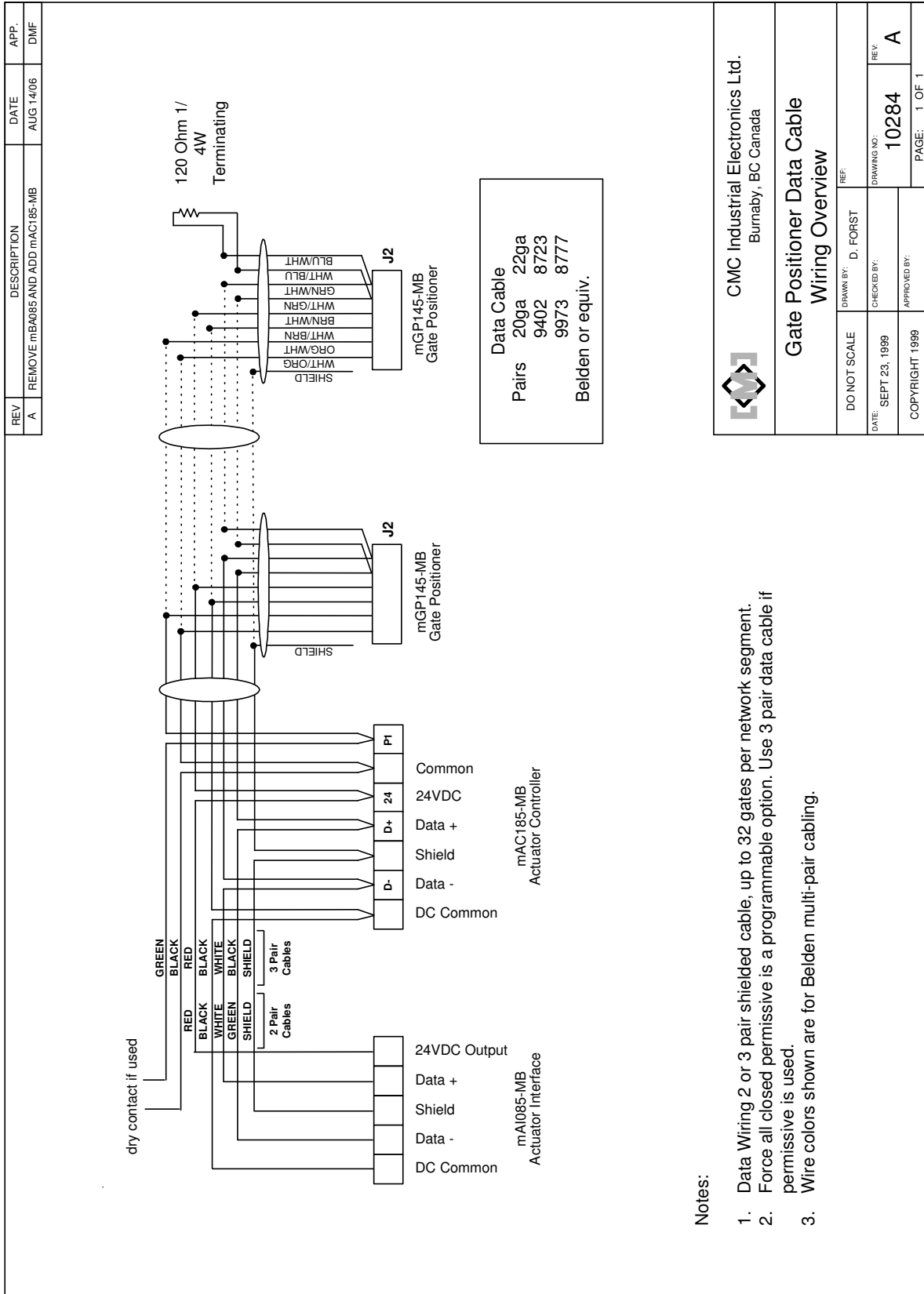
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11. Appendix 2 - Drawings

Drawings included in this appendix are:

Drawing Number	Description
10283	mAI085-MB Connection details
10284	Gate Positioner Data Cable Wiring Overview





 <p>CMC Industrial Electronics Ltd. Burnaby, BC Canada</p>	
<p>Gate Positioner Data Cable Wiring Overview</p>	
DO NOT SCALE	REF:
DRAWN BY: D. FORST	
CHECKED BY:	DRAWING NO: 10284
DATE: SEPT 23, 1999	REV: A
COPYRIGHT 1999	APPROVED BY:
	PAGE: 1 OF 1



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