



"There Is No Substitute for Experience"

DOW-KEY MICROWAVE MS-6101-ENET



CAN Bus Matrix Controller Operator's Manual

Rev 2

THE MICROWAVE SWITCHING TECHNOLOGY SOLUTION COMPANY

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Manual Revision History

The revision history shown below lists all revisions and addendums created for this manual. The revision level increases numerically as the manual undergoes subsequent updates. Addendums are released between revisions and contain important change information that the user should incorporate immediately into the manual. When a new revision is created, all addendum associated with the previous revision of the manual are incorporated into the new revision of the manual. Each new revision includes a revised copy of this history page.

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Updated Error Codes, miscellaneous changes		

Safety Statement and Warning

Only those with the necessary qualifications and knowledge should operate Dow-Key Matrix Products.

Dangerous AC voltage levels and hot surfaces are present within Dow-Key Matrix Products' enclosures. Dow-Key Microwave does NOT recommend opening any Matrix Product enclosure.

NEVER open a Dow-Key Matrix Product's enclosure while the AC Power Cord is connected to the rear panel's Power Entry Module.

ALWAYS allow fifteen minutes between removing AC line voltage from a Dow-Key Matrix Product and removing any element of its enclosure.

CAUTION: For continuous protection from fire, replace fuse in Power Entry Module with the part number identified on the appropriate Dow-Key Matrix Product Data Sheet.

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1 Getting Started

1.1 Introduction

This manual contains important information applicable to all Dow-Key Model Matrix Products, as well as details specific to the MS-6101-ENET.

1.2 How to Use This Manual

First and foremost: read this manual in its entirety before attempting to operate any Dow-Key Matrix Product!

The following Sections contain information regarding the most common Matrix operations.

Adding and Deleting Switches

See Sections 1 and 3.

Setting Switch Positions

See Sections 1 and 3.

Understanding Errors

See Sections 3 and 4

Operating Remotely

See Section 6

Viewing Matrix-specific Data

See Section 3.1.3

1.3 Power-Up Sequence

1.3.1 NOTE:

The LCD will remain blank for approximately 15 seconds after power up.

1.3.2 IP Address Acquisition

If Dynamic IP Address Acquisition has been selected (see Section 3.1.4), the matrix will attempt to do so. Upon success, the IP Address will be shown for approximately 4 seconds. If failed, an error message will be displayed.

This part of the start up process may be skipped by pressing any key.

1 The CAN Bus and Dow-Key Matrix Products

1.1 Basics

All Dow-Key Matrix Products either contain and/or control Dow-Key CAN Bus switches by means of a CAN Bus; to this end, all Dow-Key Matrix Products have a back panel connector allowing an Operator to connect switches to the internal CAN Bus. This section describes the necessary details.

ALL entities (switches) connected to the CAN Bus MUST have a UNIQUE CAN Bus ID Number from 1 to 127 (there is a possibility of ID=0, but this is a very special case described below).

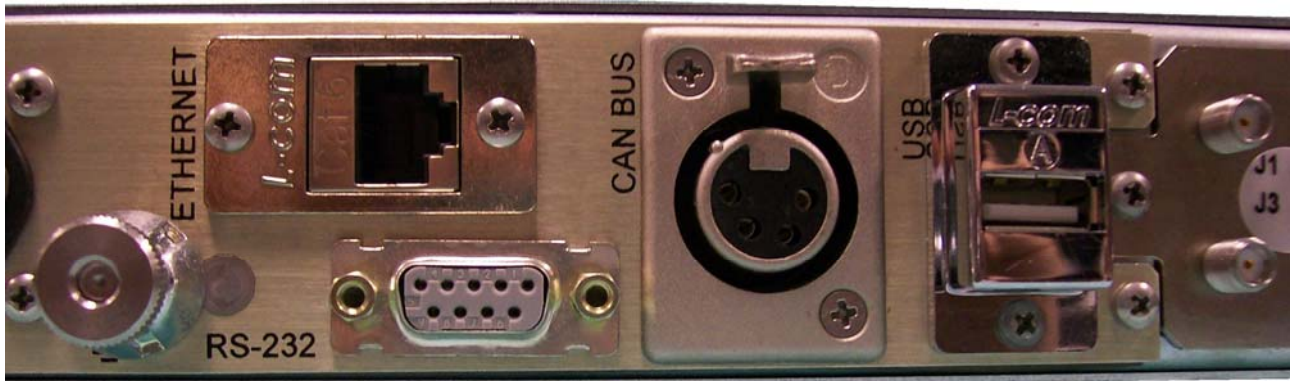
1.2 Matrix Configuration

Dow-Key Matrix Controller has been designed to be as general as possible in regards to how many switches of what positions it may control. Therefore, the matrix must first be informed as to the set of switches it is able to control before it can operate successfully, and this information must be updated as switches are added and deleted. The knowledge of what switches are to be controlled and how many positions each of those switches has is known as the matrix's Configuration Data.

In addition to switch information, the Matrix Configuration also contains other information such as the base MAC address, unit's Serial Number, alarm enabling, Model Name, etc. This information must remain intact for the matrix to operate properly.

1.3 CAN Bus Connections

An Operator may physically connect a switch to a matrix's CAN Bus via the CAN connector on the back panel:



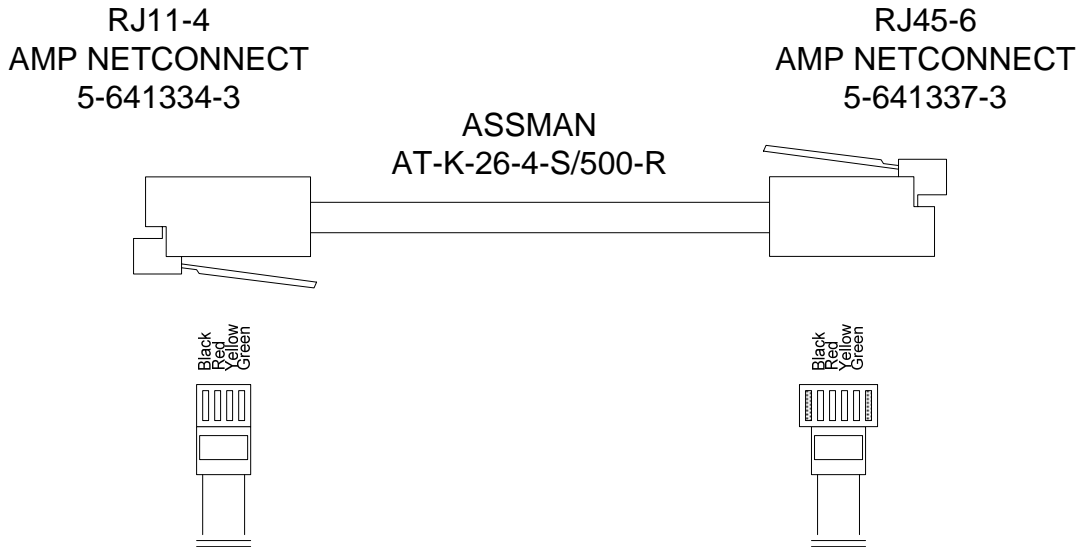
The mating connector is Deltron 701-0400. The pin outs (embossed on connector faces) are:

1. +12 VDC, 7A max (see individual switch data sheets for current draw)
2. CAN LO
3. CAN HI
4. +12 VDC Return (GND)

In the case of the MS-6101-ENET, connect switches to the CAN Bus via the 24 RJ45-6 connectors on its back panel:



This requires straight thru cabling between each back panel connector and switch; the diagram below shows the part numbers and wiring detailing their construction. Note that the switch end of the cable is an RJ11-4; the two outside positions of the RJ45-6 connector (matrix end of the cable) are not used.



NOTE: a single CAN Bus run may be as long as 1000 meters running at 10k/b, the Dow-Key CAN Bus Baud rate. It is wise to hold as a rule of thumb that adding another CAN Bus run shortens the maximum by half, three runs by a third and so on. For example, in a system with 5 CAN Bus Switch cables connected, each could be a maximum of 200 meters.

1.4 Dow-Key CAN Bus Switches

Dow-Key CAN Bus switches are themselves configured as to maximum position, part number, CAN Bus ID Number, etc.

A CAN Bus switch may assume a maximum CAN ID of 127. Individual switches delivered by Dow-Key will be programmed with either ID=0 or ID=1, depending on the particular procedure utilized to manufacture the switch. The matrix provides the means to change CAN Bus ID's at will.

A CAN Bus switch may have a maximum of 255 positions (0 through 254). 255 is reserved as a return value indicating that the switch is either in an erroneous position, or is reported to the Operator to when a switch fails to respond to a query for current position.

Some switches do not have the means to provide an open, or "closed on none", position (position 0), such as the transfer switch. By design, these switches interpret a command to open as a command to close on position 1.

A switch whose ID is 0 is referred to as a “zero switch”, or also a “0 switch”. A switch whose ID is other than 0 is referred to as an “N switch”.

Zero switches and N switches have different properties:

Only a zero switch may change into an N switch.

An N switch may not change its ID to anything other than 0.

A zero switch will not respond to commands to change or report its position.

A zero switch will not respond to queries as to switch position closure counts.

A zero switch may not be added to a Configuration (see below) as an ID=0.

1.5 Adding and Deleting Switches

See Section 3 for more information.

The following rules apply when adding a switch to the Matrix Configuration (the desired ID to add is referred to as the “target ID”):

- The desired switch to ADD must be connected to the matrix before executing the ADD procedure.
- If the connected switch is a 0 switch AND the target ID is not yet configured AND a switch possessing the target ID is not already connected, then the 0 switch will change its ID to the target ID and the Configuration will be updated.
- If the connected switch is a 0 switch AND the target ID is already configured AND a switch possessing the target ID is not already connected, AND the 0 switch’s number-of-positions data matches that of the Configuration’s, then the 0 switch will change its ID to the target ID.
- If the connected switch is an N switch AND the target ID=N is not yet a configured ID, then the N switch will be added, i.e. the Configuration will be updated.
- If the connected switch is an N switch AND the target ID=N is already a configured ID, AND the N switch’s number-of-positions data matches that of the Configuration’s, then the N switch will be added, i.e. the Configuration will be updated (actually, the ID isn’t really added since the ID is already configured, however a Configuration match is performed).

The following rules apply when deleting a switch from the Configuration (the desired ID to delete is referred to as the “target ID”):

- Only an N switch may be deleted from a Configuration; 0’s are not Configurable .
- If the N switch to delete is connected and is not a Configured ID, AND a zero switch is not connected, then the N switch will be returned to a 0 switch.
- If the N switch to delete is connected and is already a Configured ID, AND a zero switch is not connected, then the N switch will be removed from the Configuration and its ID set to 0 (i.e. turning the N switch into a 0 switch).
- If the N switch to delete is connected and is already a Configured ID, AND a zero switch is connected, then the N switch will be removed from the Configuration, but the N switch’s ID will remain N.
- If the N switch to delete is not connected and is already a Configured ID, then the ID will be removed from the Configuration

NOTE:

THE MATRIX MUST BE POWER CYCLED AFTER MAKING ANY CHANGES TO THE CONFIGURATION BEFORE THOSE CHANGES BECOME FULLY APPARENT.

NOTE:

It's a good idea to keep unused switches stored as 0 switch's. Also, if a switch is to be dedicated to a particular CAN Bus ID, it should be marked such on the switch's enclosure.

1.6 How to...

To find which switches are currently configured to the matrix: select **Main Menu>Switching Operations>Current Positions**.

To find a switch's Firmware Revision: select **Main Menu>System Settings>Switch Information**.

To find a switch's CAN Bus ID : select **Main Menu>System Settings>Find Switch ID**.

To add a switch to the matrix's Configuration: select **Main Menu>System Settings>Add Switch**.

To delete a switch from the Matrix Configuration and/or return its ID to 0: select **Main Menu>System Settings>Delete Switch**.

1.7 Example

Adding a switch to the Configuration usually starts by finding the ID of the physical switch to add. Select **Main Menu>System Settings>Find Switch ID** and follow the instructions in Section 3.1.3 Find Switch ID. **TAKE NOTE OF THE INFORMATION REGARDING SWITCH FIRMWARE REVISION IN STEP 5.**

If the switch's ID is the one desired to add (0 or N), the switch may be left connected and the BACK key may be pressed to return to the Main Menu. To ADD the switch, select **Main Menu>System Settings>Add Switch**. The LCD will indicated if the switch to add is a 0 switch and then prompt the user with the next available-to-configure ID, or the user may enter a different, un-configured ID.

If the switch's ID is not zero, LCD will prompt to add the next available-to-configure, and the user must enter the connected switch's ID.

Suppose a switch's ID has been found to be N=x, but a 0 switch is required to add the switch as N=y: the switch's ID must first be changed to zero. With the N=x switch connected AND with NO OTHER N=x SWITCHES CONNECTED, select **Main Menu>System Settings>Delete Switch**. Enter the ID (N=x) of the connected switch, and its ID will be set to 0.

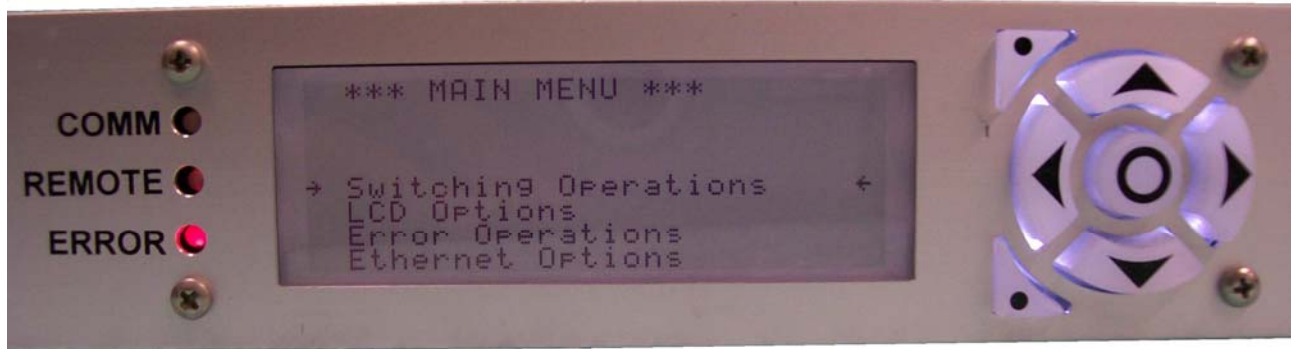
Now the process to add the switch as N=y may be executed via **Main Menu>System Settings>Add Switch**.

Deleting a switch does not require the switch being connected, but when it is its ID will be returned to 0. If it is not connected, it is still removed from the Matrix Configuration Data.

2 LCD/Keypad Operation

2.1 NOTE:

The LCD will remain blank for approximately 15 seconds after power up.



2.2 Features and Use

The figure above shows the 6101's LCD/Keypad (sometimes referred to as the "User Interface", or "UI") at the 6101's top level of UI screens.

The "COMM" LED should normally be blinking green as an indication of normal program execution.

The "REMOTE" LED, normally dark, will illuminate green when the 6101 is in REMOTE Mode (See Section 6).

The "ERROR" LED, normally green, will illuminate red upon the occurrence of an error event, or the persistence of several error conditions (see Section 4).

The LCD in the figure above shows the top level of the 6101's operational screen, which happens to be a menu; the keypad is used to scroll through and select menu items. Other screens encountered allow the operator to modify various parameters' values; all such "data fields" are presented with a currently set or default value blinking, prompting the operator to modify the value. Some screens present multiple data fields, and the keypad is used to navigate around them.

The keypad's keys have multiple functions depending on which screen is being presented.

The keypad's round, center key is referred to as "ENTER" and serves as "set", "select", "done", or "return".

The keypad's arrow keys (pointing the 4 cardinal directions) are referred to as "UP", "DOWN", "LEFT", and "RIGHT".

UP and DOWN serve as "scroll up", "scroll down", "increment", or "decrement". Many data fields' values are modified by UP and DOWN, and many of those allow the pressing and holding of the UP and DOWN keys to cause an acceleration of the incrementing or decrementing.

The keypad's upper left diagonal key is referred to as UP DIAG. This key serves as "back", "clear", or "escape".

The keypad's lower left diagonal key causes no action in the context of any screen.

LEFT and RIGHT serve as "next" and "previous"; these keys are used almost exclusively to navigate around the user data entry fields many screens present.

2.3 Caveats

The UI device may demonstrate a "speed limit" when comes to how rapidly the Operator may actuate keys and still get the correct response on the LCD: the Operator is encouraged to find a comfortable cadence when operating the keypad.

2.4 Miscellaneous

The LCD's backlight will be disabled after 5 minutes unless a key is pressed. Once dark, pressing any key will have no effect other than to re-illuminate the backlight

3 Menu Tree and Matrix Operation in LOCAL Mode

LOCAL Operating Mode means that the matrix is receiving commands from the front panel. The matrix will power up in LOCAL mode until any character is received over any of the Remote connections; the matrix will return to LOCAL Mode upon the pressing of any key (see Section 6).

3.1 *** Main Menu ***

3.1.1 Switching Operations

*** Switching Menu ***

Set Switch Positions

View the currently set position and change the position of a switch who's ID has been configured to the matrix.

Current Positions

View the currently set positions of all switches whose ID's have been configured to the matrix. This screen can show a maximum of 12 switches at a time; press UP or DOWN to view the next set of a maximum of 12. Note: the presentation of switch positions is a "one way" experience in that the operator can only view successively greater ID's. BACK will bring the Operator back to the Switching Menu.

Remember that a switch position reported as 255 is meant to mean "position unknown", and is often the result of a switch not responding to a query for position. Position 0 means "open".

Switching History

View the last 10 switching actions. The latest action is presented first.

Save Positions

Save to non-volatile memory the state of the positions of all switch ID's configured to the matrix, as 1 through 30.

Recall Positions

Recall from non-volatile memory the state of the positions of all switch ID's configured to the matrix, saved as 1 through 30, and set the positions of those switches.

Clear Positions

Cause all switches configured to the matrix to assume their open positions (close on none). Note that all Dow-Key switches have "open" defined but not all switch types have an actual open position, such as a transfer switch. In this case "open" means "close on position 1".

Cycle Positions

Step all switches configured to the matrix through all of their positions. NOTE: the Cycle Position function is intended for use at the Dow-Key factory during the assembly process. In fact, the Cycle Position function will generate errors when commanding a Transfer switch to switch from position 0 to position 1, which may be ignored. For this reason, the Operator is discouraged from exercising Cycle Positions.

3.1.2 Error Operations

View the contents of the Error Log (see Section 4). Each entry is displayed with the most recent being first, showing the Error Record Number (its place in the Error Log), an associated Error Code, an associated Error Data, and a text explanation of the Error.

The Error Data contains various parameters associated with certain Errors. For instance, an Error Code 10 "Switch Did Not Respond" will show the offending switch ID in the Error Data field.

3.1.3 System Settings

*** Settings Menu ***

System Information

View the Dow-Key Matrix Product's Model Number, its Serial Number (set at factory), and the Dow-Key part number and revision level of firmware running on the Matrix Controller.

Add Switch

Add switches to the Matrix Configuration (see Section 1.5).

Delete Switch

Delete switches from the Matrix Configuration (see Section 1.5).

Find Switch ID

Discover and view the ID of any switch by following these steps:

1. Using a matrix with at least one unused CAN Bus connector, and leaving the switch in question unconnected, select **Main Menu>System Settings>Find Switch ID**. The screen will indicate that no switch is connected.
2. Connect the switch in question. The screen will now display the unknown switch ID. NOTE: occasionally, the switch will not immediately report its ID; in this case, simply disconnect and reconnect the switch.
3. Multiple switches may be connected and disconnected one at a time while in this screen.

4. NOTE: this operation “puts the matrix’s switches to sleep” thereby rendering the matrix inoperable during the process. ENTER or CLEAR returns the matrix to normal.
5. NOTE: proper performance of Find Switch ID relies on the behavior of Dow-Key Switch firmware revision 4 and above – revision 3 and below does not allow “putting the switch to sleep”. So, this feature is best executed on a matrix that does not contain switches with firmware revision 3 or less, for those switches will respond with their ID’s as well as the switch in question. The revision of firmware of any switch configured to the matrix may be learned with **Main Menu>System Settings>Switch Information** (see below).

System Temperatures

View current values of a maximum of 4 temperature sensors, and set thresholds at which an Over Temperature alarm should occur. Setting all 4 alarm thresholds to 0 disables Over Temperature alarms and causes the current temperatures to read out 0 as well; this is the recommended setting for Matrix Products that contain no temperature sensors.

Switch Closure Counts

View the number of times any position of any switch configured to the matrix has been closed upon, to a maximum of 1,000,000.

Switch Information

View the Part Number, Serial Number, Firmware Number, Firmware Revision Level, maximum number of positions, its PCBA Code (factory), and Coil Delay Time, of any switch configured to the matrix.

Default Settings

This password protected option is used during the assembly process and is not intended for Operator use.

3.1.4 Ethernet Options

Actual changes to the Ethernet variables referred to below will not take effect nor be shown on the front panel until the matrix has been powered down and back up.

See Sections 5 and 6 for more information regarding use of Ethernet to control the matrix.

*** Ethernet Menu ***

Set/Acquire IP Address

View and/or modify the current IP Address and Acquisition Mode, Static or Dynamic.

Set Subnet Mask

View and/or modify the current Subnet Mask.

Set Gateway

View and/or modify the current Gateway.

Set Port Number

View and/or modify the current Port Number. The factory default is 4589.

Set Timeout

View and/or modify the current Port Number. The factory default is 0.

3.1.5 LCD Options

View and adjust the brightness and contrast of the LCD. Changes made here are persistent over power down and up.

3.1.6 Set RS232 Baud Rate

View and select the Serial Port's Baud rate from a set of preselected values from 1200 to 115,200 b/s (see Section 5).

3.1.7 Set GPIB Address

Not applicable to the MS-6101-ENET.

4 Errors

4.1 Introduction

The Error Log is a 10 deep FIFO that keeps track of the occurrence of Errors. For instance, the reception of an unrecognizable or misspelled Command over a Remote connection (see Section 6), will cause a Syntax Error to occur; if this command were next followed by a ROUTE:PATH Command containing a reference to a non-existent Switch, a Data Out of Range Error will occur. The Error LED will also illuminate RED.

Note that the latest Error is placed 'on top' of the stack.

Once a particular Error has been logged, no further occurrences of it will be entered. So a subsequent misspelled Command would not result in another Syntax Error being logged until the original entry was cleared.

Selecting the 'Error Operations' option from the Main Menu allows the operator to view the contents of the Error Buffer. Entries in the Error Buffer are removed by successive presses of the up or down arrow keys.

Entries in the Error Buffer are also removed by successive SYSTEM:ERROR? Commands, always clearing the oldest remaining entry. In the example above, the Syntax Error would be cleared first.

The Error LED will illuminate green when Error Log is empty unless a persistent error condition exists, such as a Power Supply failure that remains failed.

4.2 Error Codes and Causes

CODE: 0 ERROR: "No More Errors to Report"

The Error Log has been emptied

CODE: 1 ERROR: "Invalid Character"

This Error Code is no longer supported, but is maintained and reserved for legacy reasons.

CODE: 2 ERROR: "Input Buffer Overflow"

This Error Code is no longer supported, but is maintained and reserved for legacy reasons.

CODE: 3 ERROR: "Too Many Commands"

The maximum of 220 characters per command line has been exceeded.

CODE: 4 ERROR: "Syntax Error"

This Error Code is in response to misspellings of commands, including non-numeric characters where numeric characters should be, including unrecognized symbols such as %, &, #, etc.

CODE: 5 ERROR: "Data Out of Range"

The value transmitted is not acceptable. For instance, commanding a 6 position switch to close on position 7. Also, transmitting invalid MAC and IP addresses generates the Error.

- CODE: 6 ERROR: "Illegal Parameter Value"
This Error Code is no longer supported, but is maintained and reserved for legacy reasons.
- CODE: 7 ERROR: "Input Buffer Underflow"
This Error Code is no longer supported, but is maintained and reserved for legacy reasons.
- CODE: 8 ERROR: "Matrix Socket not Avail"
This Error Code is no longer supported, but is maintained and reserved for legacy reasons.
- CODE: 10 ERROR: "Switch Did Not Respond"
A switch exceeded the maximum amount of time to respond to any query a maximum number of re-tries.
- CODE: 11 ERROR: "Switch's Response Invalid"
A switch responded but with the wrong response code. This Error Code is related to wrong internal CAN Bus communication codes.
- CODE: 12 ERROR: "Switch's Position Incorrect"
A switch reported its current position but that position disagrees with the last Change Position the switch received.
- CODE: 13 ERROR: "Switch's Position Unknown"
The switch itself is unable to determine its position, for instance when a [faulty] switch closes on two positions.
- CODE: 20 ERROR: "Matrix is not Configured"
The matrix has either not yet been [factory] configured, or the Configuration has been lost: the matrix is inoperable.
- CODE: 21 ERROR: "Configuration File is Corrupt"
Factory Only: the matrix's Configuration File cannot be processed. E.g. syntax error in the configuration file.
- CODE: 22 ERROR: "Configuration File does not Match Installed Switches"
Factory Only: The configuration file defining all switch types configured inside the matrix does not match the actual installed switch types. This Error Code is generated only at reset and involves only switches that respond.
- CODE: 23 ERROR: "Matrix Contains a 0 ID"
A switch with ID 0 (not a usable CAN Bus address) is connected to the matrix at reset.
- CODE: 30 ERROR: "Command Unrecognized"
A Command String did not contain any valid keywords (e.g. Route, *RST, System, etc.).

CODE: 36 ERROR: "ID is Out of Range"

A non-existent switch has been referred to. For example *Route:Switch11 8* when Switch 11 does not exist.

CODE: 50 ERROR: "Unable to Acquire IP Address"

The matrix failed to acquire an IP Address during reset when Dynamic IP Address Acquisition is enabled (check the Ethernet cable, etc.)

CODE: 51 ERROR: "Fan Stall "

One or more fans have stalled (only when this alarm has been enabled at factory).

CODE: 52 ERROR: "Internal Temperature Exceeds Threshold"

One or more temperature sensors has exceeded its alarm threshold (only when this alarm has been enabled at factory).

CODE: 53 ERROR: "Power Supply Failure"

In dual power supply designs, one of the power supplies has failed (only when this alarm has been enabled at factory).

5 Ethernet, RS-232, USB Ports; REMOTE Mode

The MS-6101-ENET enters the REMOTE Operating Mode upon receiving any character over either one of its 3 remote ports; a screen declaring this state will be displayed and the front panel's REMOTE LED will be illuminated green. The matrix will remain in REMOTE Operating Mode until any key is pressed.

The MS-6101-ENET may be remotely controlled over an Ethernet port, an RS-232 port, or USB port. See section 6 for the set of Remote Mode Commands.

5.1 Ethernet Connections

The MS-6101-ENET's Ethernet port has been set to a default IP Address of

200.169.200.181

The IP port number has been set to a default value of

10

In the simplest case, as may be when first setting up the MS-6101-ENET the Matrix may be controlled with a laptop or other similar computer, referred to as the *remote computer*. Assuming that the remote computer is running some late version of Microsoft Windows®, ensure that the following items are observed:

Ethernet Connection

1. Connect the remote computer directly to the Matrix via an Ethernet crossover cable, or
2. Connect the remote computer to the Matrix through a hub device via a straight through Ethernet cable.

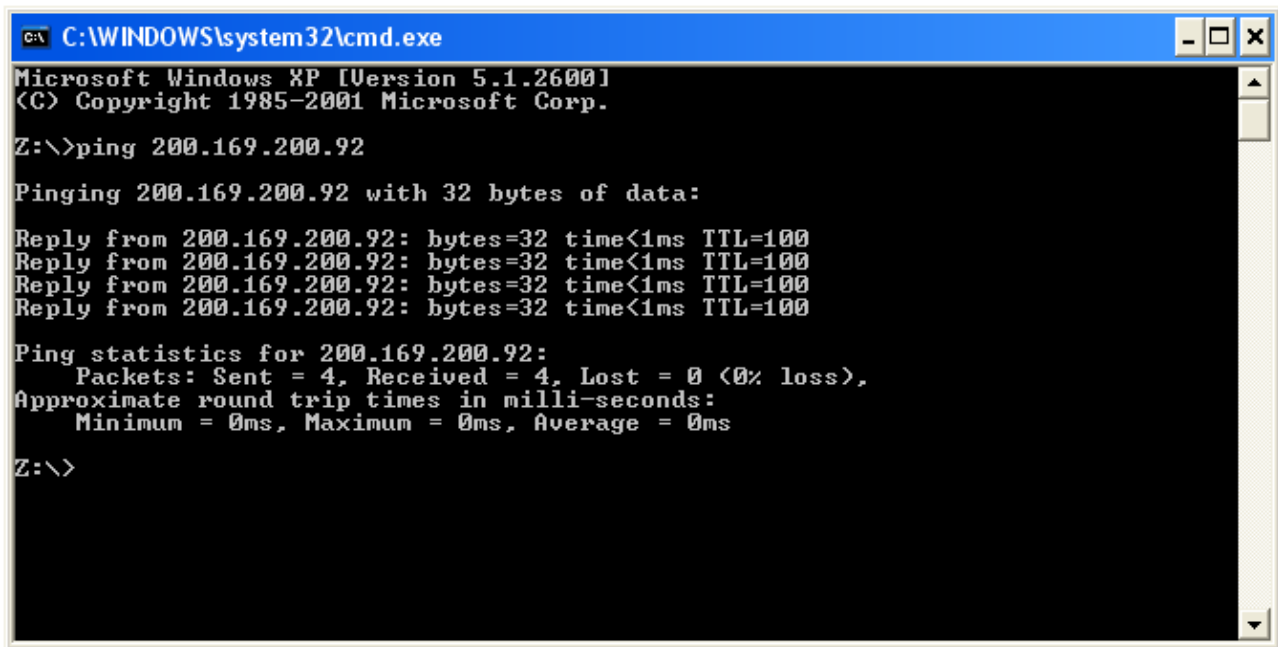
Remote Computer's Port Settings

1. Disable any wireless port that may exist.
2. Set the Ethernet port's IP address. If the Matrix's IP address is still at its default value, the remote computer port's IP address could be set to:
200.169.200.180.

Remote Computer's Windows® Settings

1. Disable any Firewall that may be running.

The Matrix should now respond to "pinging". Bring up a DOS command window by typing "cmd" the Operating System's Run box. Type "ping" followed by the matrix's current IP address and the following should appear as on the following page.



```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

Z:\>ping 200.169.200.92

Pinging 200.169.200.92 with 32 bytes of data:

Reply from 200.169.200.92: bytes=32 time<1ms TTL=100
Reply from 200.169.200.92: bytes=32 time<1ms TTL=100
Reply from 200.169.200.92: bytes=32 time<1ms TTL=100
Reply from 200.169.200.92: bytes=32 time<1ms TTL=100

Ping statistics for 200.169.200.92:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

Z:\>
```

5.2 RS-232 Port

The MS-6101-ENET's RS-232 port's Baud rate may be selected from a set (see Section 3.1.6); however, the remaining parameters are fixed at these values:

No parity

8 bit data

1 stop

No handshaking (control none)

The matrix may now be controlled by issuing Remote Mode Commands using a communication application such as HyperTerm.

USB Port

Connecting the MS-6101-ENET to a PC's USB port should result in a "Found New Hardware" event. Follow the instructions until prompted for the new hardware device's driver, which may be located on the CD shipped with the matrix.

After installation, the matrix's USB port will appear as a virtual serial port.

6 Remote Operation Command Set

6.1 Introduction to SCPI

SCPI is a command structure that is based on the IEEE-488.2 specification which Dow-key has adapted to work with Ethernet and RS-232 controls. The model 5345 and 5346 has internal software loaded that uses SCPI command structure. SCPI is the abbreviation of Standard Commands for Programmable Instruments. These commands are standard messages for the (remote) control of programmable instruments, which are sent by the Ethernet and/or RS-232 controller. The principal objective of SCPI is to make the programming of a test system easier for the user. When the basic concepts and command structure of SCPI is understood, it will be easy for the user to write or modify a control program for the matrix.

The Socket Type of the matrix is server while your remote control computer is the client.

NOTE: Not all commands for SCPI are compatible with Ethernet and RS-232, only the ones stated in this document.

6.2 Command Syntax

[ROUTE]:SWITCh<id>[:VALue] <number>|MAX

- *Square brackets* [] indicate optional keywords or parameters.
- *Braces* { } enclosure parameter choices with a command string
- *Triangle brackets* < > enclose parameters for which you must substitute a value.
- *Vertical bar* | separates multiple parameter choices.

The command syntax shows most commands as a mixture of upper and lower case letters. The upper case letters indicate the abbreviated spelling for the command. For shorter program lines, the abbreviated form is used. For better program readability, the long form is used. For example, in the above syntax statement, ROUT and ROUTE are both acceptable forms. Since both upper and/or lower case letters are acceptable, ROUTE, rout and Rout are all acceptable. Other forms, such as RO and ROU are not acceptable and will generate an error.

NOTE: Each command must be terminated with a carriage return (0x0D) followed by a line feed (0x0A).

e.g. "ROUT:SWITx n\r\n"
"ROUT:SWITx n;SWITx?\r\n"

Where "\r" stands for carriage return (0x0D) and "\n" stands for line feed (0x0A).

6.3 Command Separators and Conventions

- A colon (:) is used to separate a command keyword from a lower level keyword.
- A blank space is used to separate a parameter from a command keyword.
- A comma (,) is used if a command requires more than one parameter.
- A semicolon (;) is used to combine multiple commands into one message string. Commands from the same subsystem are permitted to skip repeating the upper-level keyword.
Eg. "Route:Switch1 8; Switch2 5; Switch3 2"
- A colon is used when linking commands from different subsystems into one message string, allowing a new upper-level keyword to be introduced.
Eg. "Route:Switch1 8; Switch2 5; Switch3 2; System:Error?"
- When linking multiple commands the maximum number of characters supported is 220. The limit of 220 characters is valid in transmission and receiving.
- All messages are in ASCII format (numeric values are represented in decimal format with exception of the MAC address which is expressed in hex format).
- Timing, sequences and action requirements are only shown where applicable and are under the TIMING sub-paragraphs on each command description.

6.4 Common Commands

6.4.1 *IDN?

Syntax

*IDN?

Result

A string is returned which consists of the following parts:

Vendor model

vendor

Name of the vendor

model

Matrix model number

Possible Error Codes

None

Example

"*IDN?"

Result

"DOW-KEY MS-6101-ENET"

6.4.2 *OPC

Syntax

*OPC?

Description

This query returns an ASCII character "1" when all pending operations have been finished.

Result

ASCII character "1"

Possible Error Codes

None

Example 1

"*OPC?"

Result

"1"

Example 2

:SWIT1 4; SWIT2 4; *OPC?

Result

"0"

Timing

In example 2 the matrix did not have the time to execute the command. Hence a "0" is returned. A subsequent *OPC? will return a "1" as shown in example 1. The timing to execute a command depends on the length of the command (in case of concatenated commands).

As a rule of thumb electromechanical switches require approximately 30ms to switch position. It is safe to consider some safety margin and increase this timing to 40-50 ms when developing the control software.

6.4.3 *RST

Syntax

*RST

Description

This command performs a device reset. This will set the matrix such that all switches are in their default states. For SPnT switches, the default state is: all RF ports open. For transfer switches, the default state is: position 1 closed.

Possible Error Codes

None

Timing

As a rule of thumb electromechanical switches require approximately 30ms to switch position. It is safe to consider some safety margin and increase this timing to 40-50 ms before issuing any other command after a *RST.

6.5 System Commands

The following contains the system commands of SCPI that the Ethernet and RS-232 control is compatible with.

6.5.1 SYST:ERR?

Syntax

*SYSTem:ERRor?

Description

Query the instrument's error queue. A record of up to N errors is stored in the instrument's error queue. Errors are retrieved in first-in first-out (FIFO) order. The first error returned is the first error that was stored. Each additional error up to N is read by N subsequent queries (one for each error). For this instrument N=10. The error queue has to be read until no more errors are returned, otherwise the error status is not cleared.

Note: some of the listed error codes are here for backwards compatibility with legacy products and other are reserved for future applications. Not all error codes are applicable to this matrix

Result

String with the following syntax:

code, message

code: Numeric value with the error code (0 if no error).

Example

"SYST:ERR?"

Result was "1, INVALID CHARACTER", check for more errors

Description: This Error Code is no longer supported, but is maintained and reserved for legacy reasons.

"SYST:ERR?"

Result was "2, INPUT BUFFER OVERFLOW", check for more errors.

Description: This Error Code is no longer supported, but is maintained and reserved for legacy reasons.

"SYST:ERR?"

Result was "3, TOO MANY COMMANDS", check for more errors.

Description: The maximum of 220 characters per command line has been exceeded.

SYST:ERR?"

Result was "4, SYNTAX ERROR", check for more errors.

Description: This Error Code is in response to misspellings of commands, including non-numeric characters where numeric characters should be, including unrecognized symbols such as %, &, #, etc SYST:ERR?"

SYST:ERR?"

Result was "5, DATA OUT OF RANGE", check for more errors.

Description: The value transmitted is not acceptable. For instance, commanding a 6 position switch to close on position 7. Also, transmitting invalid MAC and IP addresses generates the Error.

SYST:ERR?"

Result was "6, ILLEGAL PARAMETER VALUE", check for more errors.

Description: This Error Code is no longer supported, but is maintained and reserved for legacy reasons.

SYST:ERR?"

Result was "7, INPUT BUFFER UNDERFLOW", check for more errors.

Description: This Error Code is no longer supported, but is maintained and reserved for legacy reasons.

SYST:ERR?"

Result was "8, MATRIX SOCKET NOT AVAIL", check for more errors.

Description: This Error Code is no longer supported, but is maintained and reserved for legacy reasons.

SYST:ERR?"

Result was "10, SWITCH DID NOT RESPOND", check for more errors.

Description: A switch exceeded the maximum amount of time to respond to any query a maximum number of re-tries.

SYST:ERR?"

Result was "11, SWITCH'S RESPONSE INVALID", check for more errors.

Description: A switch responded but with the wrong response code. This Error Code is related to wrong internal CAN Bus communication codes.

SYST:ERR?"

Result was "12, SWITCH'S POSITION INCORRECT", check for more errors.

Description: A switch reported its current position but that position disagrees with the last Change Position the switch received.

SYST:ERR?"

Result was "13, SWITCH'S POSITION UNKNOWN", check for more errors.

Description: The switch itself is unable to determine its position, for instance when a [faulty] switch closes on two positions.

SYST:ERR?"

Result was "20, MATRIX IS NOT CONFIGURED", check for more errors.

Description: The matrix has either not yet been [factory] configured, or the Configuration has been lost: the matrix is inoperable.

SYST:ERR?"

Result was "21, CONFIGURATION FILE IS CORRUPT", check for more errors.

Description: Factory Only: the matrix's Configuration File cannot be processed. E.g. syntax error in the configuration file.

SYST:ERR?"

Result was "22, CONFIGURATION FILE DOES NOT MATCH INSTALLED SWITCHES", check for more errors.

Description: Factory Only: The configuration file defining all switch types configured inside the matrix does not match the actual installed switch types. This Error Code is generated only at reset and involves only switches that respond.

SYST:ERR?"

Result was "23, MATRIX CONTAINS A 0 ID", check for more errors.

Description: A switch with ID 0 (not a usable CAN Bus address) is connected to the matrix at reset.

SYST:ERR?"

Result was "30, COMMAND UNRECOGNIZED", check for more errors.

Description: A Command String did not contain any valid keywords (e.g. Route, *RST, System, etc.).

SYST:ERR?"

Result was "36, ID IS OUT OF RANGE", check for more errors.

Description: A non-existent switch has been referred to. For example *Route: Switch11 8* when Switch 11 does not exist.

SYST:ERR?"

Result was "50, UNABLE TO ACQUIRE IP ADDRESS", check for more errors.

Description: The matrix failed to acquire an IP Address during reset when Dynamic IP Address Acquisition is enabled (check the Ethernet cable, etc.)

SYST:ERR?"

Result was "51, FAN STALL", check for more errors.

Description: One or more fans have stalled (only when this alarm has been enabled at factory).

SYST:ERR?"

Result was "52, UNABLE TO ACQUIRE IP ADDRESS", check for more errors.

Description: One or more temperature sensors has exceeded its alarm threshold (only when this alarm has been enabled at factory).

SYST:ERR?"

Result was "53, POWER SUPPLY FAILURE", check for more errors.

Description: In dual power supply designs, one of the power supplies has failed (only when this alarm has been enabled at factory).

SYST:ERR?"

Result was "0"NO ERROR"", No more errors, error queue is empty.

6.5.2 SYST:IPADDRESS?

Syntax

SYSTem:IPADDRESS?

Description

Returns the matrix IP address

Result

xxx.yyy.zzz.aaa

Possible Error Codes

None

6.5.3 SYST:IPADDRESS xxx.yyy.zzz.aaa

Syntax

SYSTem:IPADDRESS xxx.yyy.zzz.aaa

Description

Sets system IP address to xxx.yyy.zzz.aaa

Possible Error Codes

5

Factory Default Value

200.169.200.180

Power On Behavior

Keeps last value

***RST Effect**

None

Timing

In order for the new IP address to take effect the matrix needs to be power cycled.

6.5.4 SYST:TCPPOPT?

Syntax

SYSTem:TCPPOPT?

Description

Returns the matrix TCP Port number

Result

n

Possible Error Codes

None

6.5.5 SYST:TCPPOPT x

Syntax

SYSTem:TCPPOPT x

Description

Sets the matrix TCP Port number to x

Possible Error Codes

5

Factory Default Value

10

Power On Behavior

Keeps last value

***RST Effect**

None

Timing

In order for the new IP address to take effect the matrix needs to be power cycled.

6.5.6 SYST:GATEWAY?

Syntax

SYSTem:GATEWAY?

Description

Returns the matrix gateway address.

Result

xxx.yyy.zzz.aaa

Possible Error Codes

None

6.5.7 SYST:GATEWAY xxx.yyy.zzz.aaa

Syntax

SYSTem:GATEWAY xxx.yyy.zzz.aaa

Description

Sets matrix gateway address to xxx.yyy.zzz.aaa.

Possible Error Codes

5

Factory Default Value

200.169.0.0

Power On Behavior

Keeps last value

***RST Effect**

None

Timing

In order for the new Gateway to take effect the matrix needs to be power cycled.

6.5.8 SYST:MASK?

Syntax

SYSTem:MASK?

Description

Returns the matrix subnet mask address.

Result

xxx.yyy.zzz.aaa

Possible Error Codes

None

6.5.9 SYST:MASK xxx.yyy.zzz.aaa

Syntax

SYSTem:MASK xxx.yyy.zzz.aaa

Description

Sets matrix subnet mask to xxx.yyy.zzz.aaa.

Possible Error Codes

5

Factory Default Value

255.255.255.0

Power On Behavior

Keeps last value

***RST Effect**

None

Timing

In order for the new Mask to take effect the matrix needs to be power cycled.

6.5.10 SYST:MACADDRESS?

Syntax

SYSTem:MACADDRESS?

Description

Returns the matrix mac address.in hex format

Result

aa.bb.cc.dd.ee.ff

Possible Error Codes

None

6.5.11 SYST:SERIALNUMBER?

Syntax

SYSTem:SERIALNUMBER?

Description

Returns the matrix serial number.

Result

n

Possible Error Codes

None

6.5.12 SYST:TIMEOUT?

Syntax

SYSTem:TIMEOUT?

Description

Returns the Time out setting for the TCP/IP connection (n is in seconds). n = 0 means no Time out is set.

Result

n

Possible Error Codes

None

6.5.13 SYST:TIMEOUT x

Syntax

SYSTem:TIMEOUT x

Description

Sets the Time out setting for the TCP/IP connection (n is in seconds). x = 0 means no Time out is set.

Possible Error Codes

5

Factory Default Value

0

Power On Behavior

Keeps last value

***RST Effect**

None

6.6 Switch [Module] Command Set

The following contains the switch [module] commands of SCPI that the Ethernet and RS-232 control is compatible with.

6.6.1 :SWITCh<id>[:VALue] <number>

Syntax

[ROUTE]:SWITCh<id>[:VALue] <number>

Description

This command is used to control the position of the switches. The switch specified by the numeric suffix <id> is set to position <number>. Switch positions are specified in a 0 to N fashion, therefore legal values for <number> are from 0 to the maximum number of position for the switch. For example, a SP10T switch has 10 positions, 0 thru 10. Position 0 means no position is closed (open switch).

6.6.2 Setting switch x to position n

x = switch [module] address.

n = position to set and must be within the switches parameter. (Example: SP10T valid positions are 0 thru 10 only).

Examples:

- ROUTE:SWITCHx n
- ROUT:SWITCHx n
- ROUTE:SWITx n
- ROUT:SWITx n
- :SWITCHx n
- :SWITx n
- ROUTE:SWITCHx:VALUE n
- ROUTE:SWITCHx:VAL n
- :SWITx:VAL n

Possible error codes

5, 10, 12, 13

Factory default value

N/A

Power on behavior

Keeps last value

*RST effect

SPnT switch: will open all positions

Transfer switch: will close position 1

Timing

The timing to execute a command depends on the length of the command (in case of concatenated commands). As a rule of thumb electromechanical switches require approximately 30ms to switch position. It is safe to consider some safety margin and increase this timing to 40-50 ms when developing the control software. Multiple switch commands are not executed in a sequential manner but rather in parallel.

6.6.3 Requesting Switch x current position

x = switch [module] address.

Examples:

- ROUTE:SWITCHx?
- ROUT:SWITx?
- :SWITx?

Result

Returns the position of switch x

Possible Error Codes

10, 11, 12, 13

Timing

The timing to execute a command depends on the length of the command (in case of concatenated commands). As a rule of thumb electromechanical switches require approximately 30ms to switch position. It is safe to consider some safety margin and increase this timing to 40-50 ms before issuing this command after setting a new switch position. Multiple switch commands are not executed in a sequential manner but rather in parallel.

6.7 DHCP Command Set

The following contains the DHCP (Dynamic Host Configuration Protocol) commands of SCPI that the Ethernet control is compatible with.

6.7.1 SET:DHCP ON or SET:DHCP OFF

Syntax

SET:DHCP ON | OFF

Description

Turns DHCP mode ON or OFF

Possible Error Codes

5

Factory Default Value

ON

Power On Behavior

Keeps last value

*RST Effect

None

*Timing

In order for the new DHCP settings to take effect the matrix needs to be power cycled

6.7.2 GET:DHCP

Syntax

GET:DHCP

Description

Returns DHCP mode

Result

ON or OFF

Possible Error Codes

None

	Command Syntax	Response	Action
1	SYST:IPADDRESS?	xxx.yyy.zzz.aaa	Returns system IP address
2	SYST:IPADDRESS xxx.yyy.zzz.aaa		Sets system IP address to xxx.yyy.zzz.aaa
3	SYST:TCPPOORT?	n	Returns TCP port number
4	SYST: TCPPOORT x		Sets TCP port number to x
5	SYST:GATEWAY?	xxx.yyy.zzz.aaa	Returns system gateway address
6	SYST: GATEWAY xxx.yyy.zzz.aaa		Sets system gateway address to xxx.yyy.zzz.aaa
7	SYST:MASK?	xxx.yyy.zzz.aaa	Returns system subnet mask address
8	SYST:MASK xxx.yyy.zzz.aaa		Sets system subnet mask address to xxx.yyy.zzz.aaa
9	SYST:MACADDRESS?	xx.yy.zz	Returns system MAC address
10	SYST:SERIALNUMBER?	n	Returns system serial number
11	SYST:TIMEOUT?	n	Returns Time out setting for TCP/IP connection (n is in seconds)
12	SYST:TIMEOUT x		Sets Time out setting for TCP/IP connection (x is in seconds)
13	SYST:ERR? or SYST:ERROR?	-4,SYNTAX ERROR	Returns system error number and error description. (The response shown in this table is just an example).
15	*IDN?	DowKey 5345 or Dowkey 5346	Gives string with: Vendor and model
16	*OPC?	1 or 0	Gives 1 if previous operation was completed and gives 0 if previous operation is still not complete.
17	*RST		Opens all switches.
18	ROUTE:SWITCHx y or :SWITCHx y		Closes position y on switch x
19	ROUTE:SWITCHx? or :SWITCHx?	n	Gives current position of switch x
20	SET:DHCP ON or SET:DHCP OFF		Turns DHCP mode ON or OFF
21	GET:DHCP	ON or OFF	Returns DHCP mode

Note:

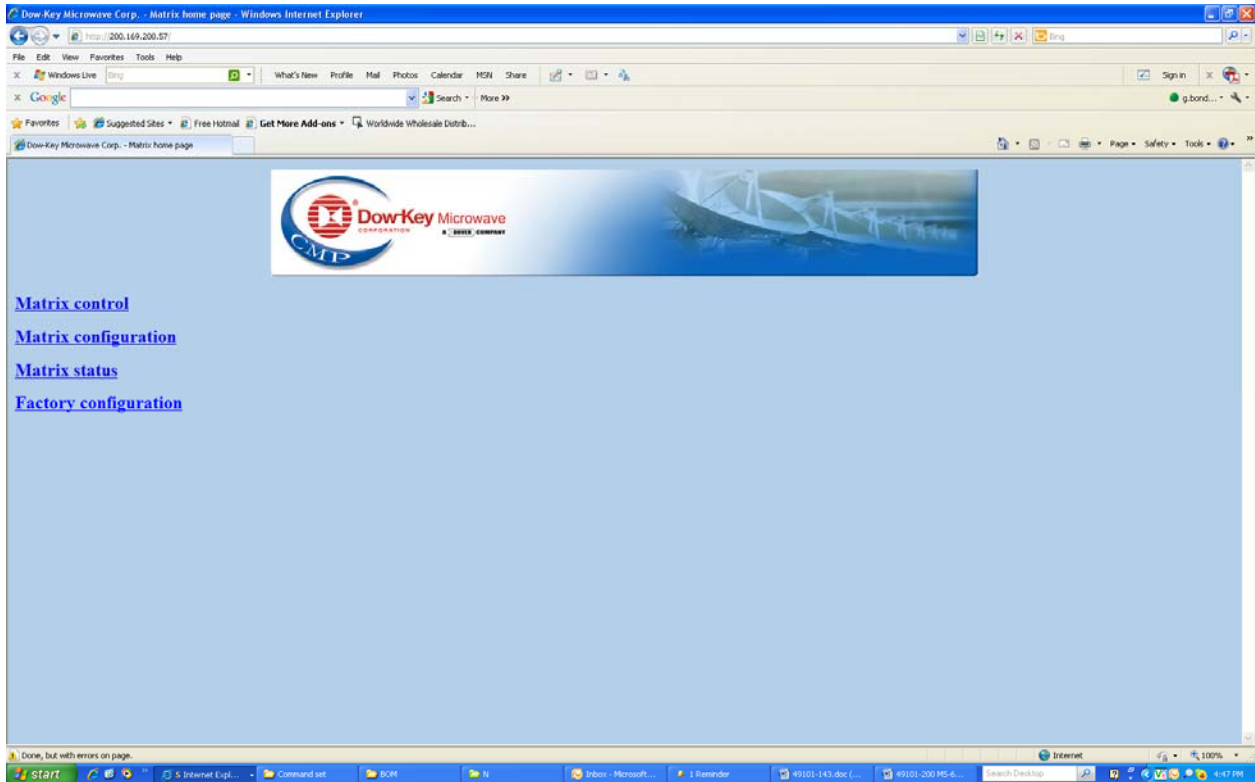
1. Commands are **NOT** case sensitive
2. Every command and response on the Ethernet port should have "\r\n" in the end.
3. Multiple commands with same header can be given in a single command line
e.g. SYST:IPADDRESS?;TCPPOORT?;SERIALNUMBER 2 or ROUTE:SWITCH1 2;SWITCH1?;
note that the commands have to separated by ';'.
4. In command SYST:TIMEOUT? The returned value n is in seconds. The default value is 0. 0 = no timeout.

Remote Command Summary

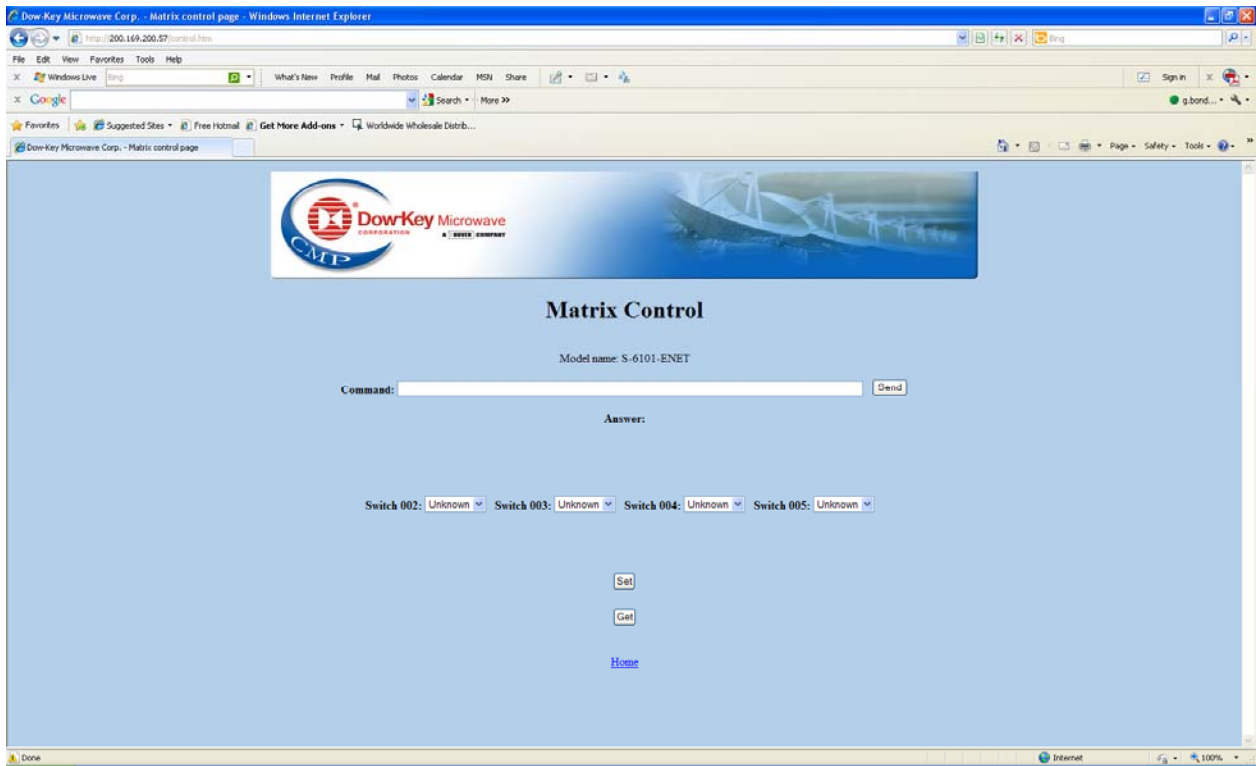
7 Web Page Server Control

7.1 Web Page Server Control

The MS-6101-ENET may be controlled by way of web pages served by the matrix over its Ethernet port. With the matrix properly connected to an Ethernet (see Section), type the matrix's current IP address into a browsers Address Bar. The following page should appear:

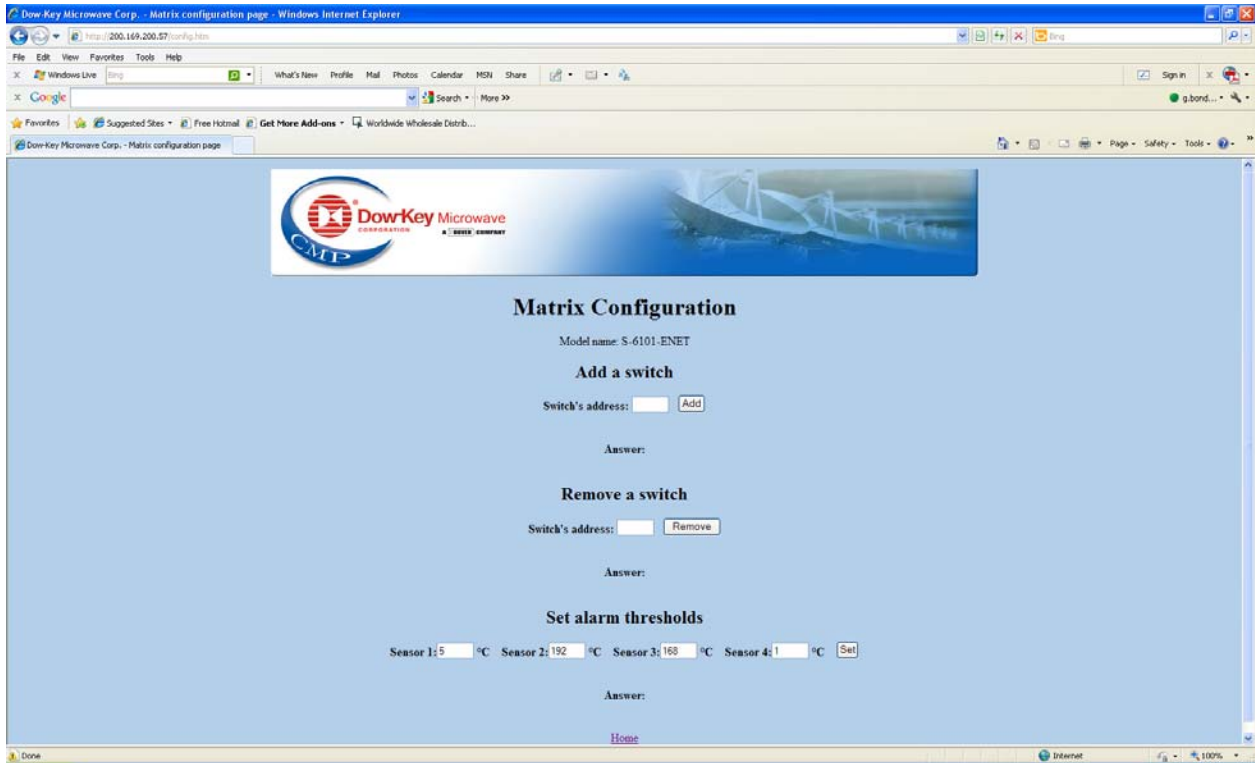


The Operator may select Matrix Control, Matrix Configuration, or Matrix Status; Factory Configuration is reserved for the sole use by Dow-Key Microwave.



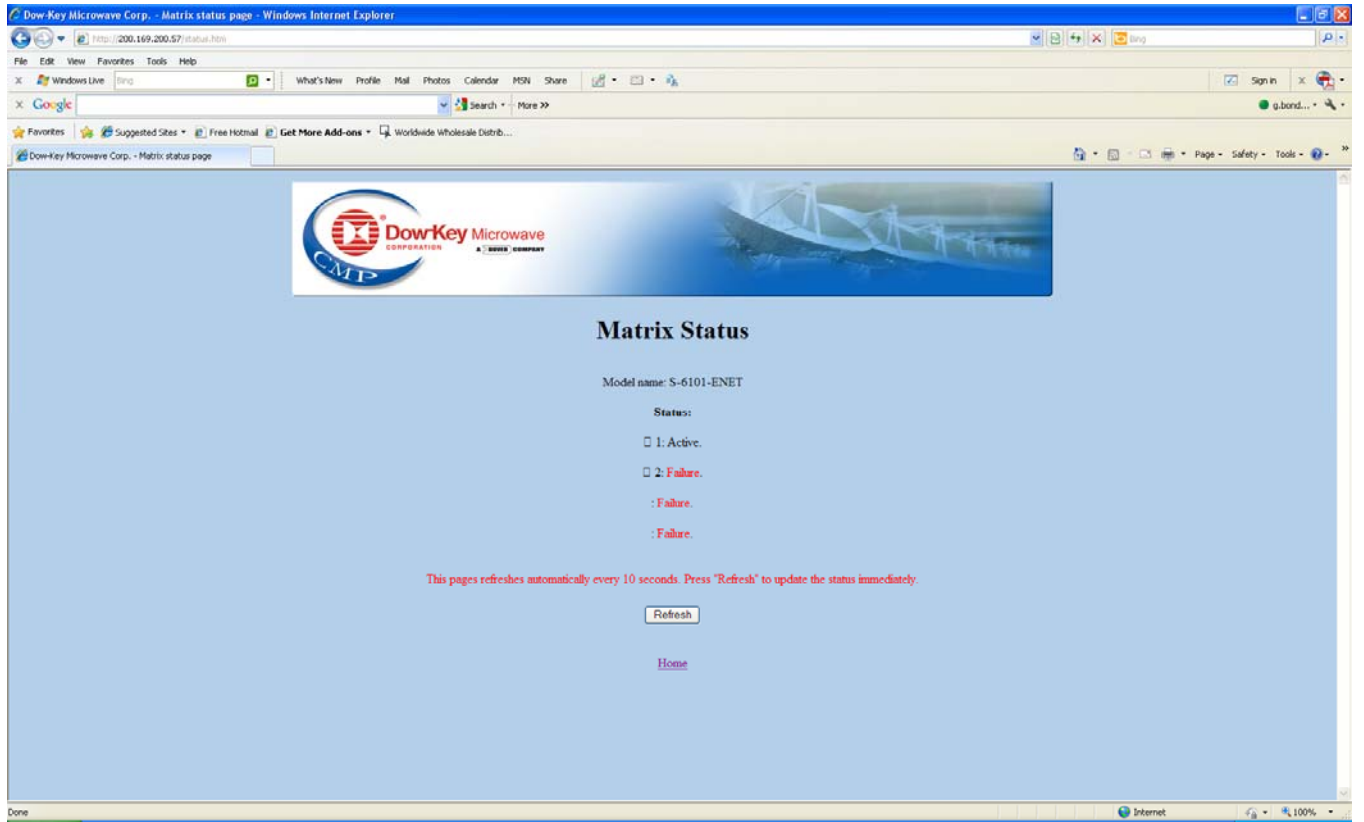
Remote mode commands may be typed into the Command text box and then clicking Send.

The bottom half displays the current position of all switches currently configured to the matrix. Their positions may be set by selecting one from a switch's drop down box and then clicking Set. Get returns the position of that switch.



Switches may be added and deleted from the Matrix Configuration using this page. Also, any enabled alarm sources (fans, etc.) are displayed along with their status and threshold values.

The temperature alarm is disabled by setting all 4 temperature alarm thresholds to 0.

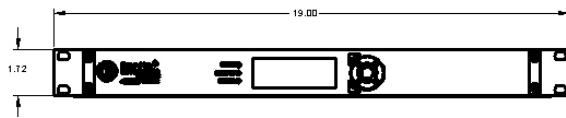
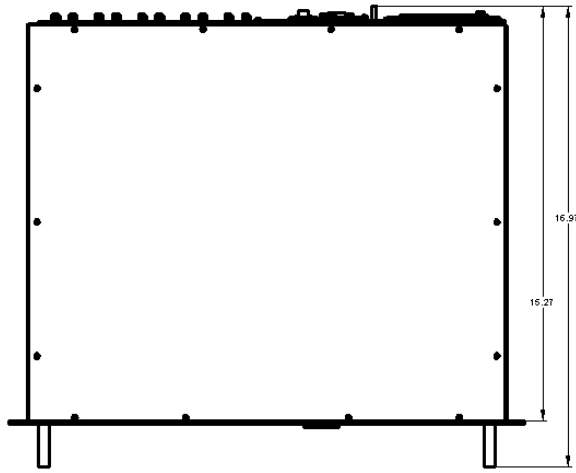
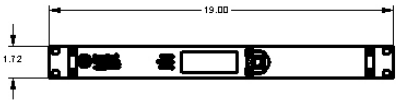
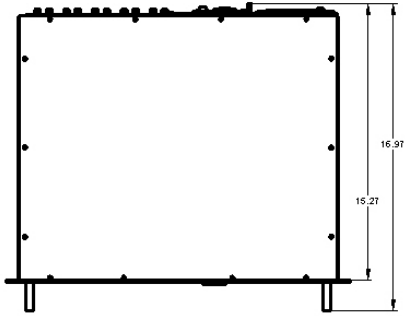


This page displays the current status of alarm sources. If no alarm source is enabled, none will be displayed.

8 Appendix A: Specifications

8.1 MS-6101-ENET Data Sheet

Dimensions	
Unit Width	19" rack mount
Unit Height	1RU (1.75 inches)
Unit Depth	17"
Housing	Rack mount
Weight	<10 lbs
Input Power	110 ~ 240 VAC
Average Power	35 Watts (100 Watts max)
Temperature:	
Operating	0° to +50° Celsius
Storage	-20° to +65° Celsius
Control Interface	Ethernet (TCP/IP), RS232, USB
Fault and Error Reporting	Ethernet, RS232, USB, Visual
Humidity	10% ~ 80% non-condensing at 35° Celsius



9 Appendix B: Maintenance and RMA's

9.1 Contents of Shipping Container

Part Number	Description
MS-6101-ENET	Switch Matrix Controller
40203-005	AC Power Cable
DK 49101-200	MS-6101-ENET Switch Matrix Controller Operator's Manual

9.2 Return of Material

The MS-6101-ENET was carefully inspected both electrically and mechanically before shipment. After unpacking all items from the shipping carton, check for any obvious signs of physical damage that may have occurred during transit. Report any damage to the shipping agent immediately. Save the original packing cartons for possible future reshipment.

Should it become necessary to return the matrix for repair, carefully pack the unit in its original packing carton or the equivalent, and follow these instructions:

1. Call the Repair Department at 1-805-650-2322 for a Return Material Authorization (RMA) number,
2. Advise as to the warranty status of the matrix,
3. Write ATTENTION REPAIR DEPARTMENT and the RMA number on the shipping label.