APPLICATION NOTE

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Product Family: Hx-ECOM100		**Number:**	AN-MISC-028
Subject: Email Theory of Operation and setup instructions.		**Date Issued:**	11/20/08
		Revision:	Original

Technical Assistance: If you have questions regarding this Application Note, please contact us at 770-844-4200 for further assistance.

The ECOM100 Send EMail IBox (ECEMAIL) utilizes the ECOM100 to send SMTP EMail requests to a known SMTP server. The EMail instruction has the following requirements in order to work correctly:

1. **CPU Firmware** - The CPU firmware must support IBoxes, specifically the MDS and MDE PLC instructions. Only the 05, 06, 250-1, 260, and 450 will be able to support IBoxes.

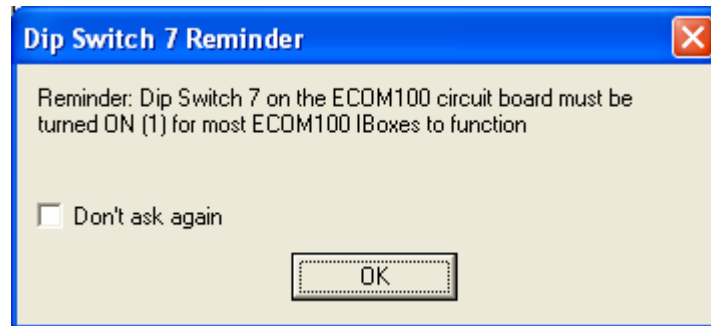| CPU	Firmware
05	v5.10
06	v2.10
250-1 (not old 250 CPUs)	v4.60
260	v2.40
450	v3.30

2. **ECOM100 Firmware must support SMTP Client Protocol for sending EMails** - ECOM100 must be upgraded to the most recent firmware:

ECOM100	Firmware
H0	v4.0.119
H2	v4.0.1031
H4	v4.0.1031

   The firmware that shipped with the initial releases of the ECOM100 did NOT have SMTP client protocol support. Use **NetEdit3** to download (**File->Live Update**) and install the latest firmware.

3. **Slot Placement** - ECOM100 must be in a **local base** on a **valid slot**. The first slot (K0) is **invalid** on **205** systems. Also remember that the slot numbers **start** at **K1** in the **05** and **06** systems. Therefore, only the **405** system can have a Slot value of **K0**.

4. **ECOM100 TCP/IP Configuration** - The ECOM100 must have a valid IP Address, a valid Subnet Mask, and possibly a Gateway IP Address. Using NetEdit3, you can assign fixed values for these parameters or enable the DHCP Server to obtain those parameters automatically, or use the new ECOM100 IBoxes for configuring the TCP/IP parameters (ECIPSUP, …) . If the customer has any questions regarding TCP/IP configuration, they should see their company's network administrator.

5. **Dipswitch 7 on the ECOM100 Must be ON(1)** - This enables Mock Slave Addresses 89 (and 90) for special use by the ECOM100. Mock Slave Address 89 via WX and RX is what the EMAIL and all other ECOM100 IBoxes utilize to interface with the ECOM100. There is a warning dialog that comes up after editing the ECOM100 Configuration IBox to help remind the end user about setting the dipswitch.

6. **ECOM100 SMTP Configuration Must be Initialized (also known as EMail Setup)** - Once you have upgraded the firmware in the ECOM100, there is a link to the EMail Setup page from the ECOM100's main web page accessible via the ECOM100's IP Address.

For example, say the ECOM100's IP Address is 192.168.12.86, the user can actually browse to the ECOM100 using any internet browser. Just enter its IP address as a web page in the address line of your favorite browser as `http://192.168.12.86`. Below is this ECOM100's main web page (note its IP Address in the browser's Address field in **green**). This configuration shows that the ECOM100 has an uninitialized SMTP EMail configuration, which is outlined in **red** below:
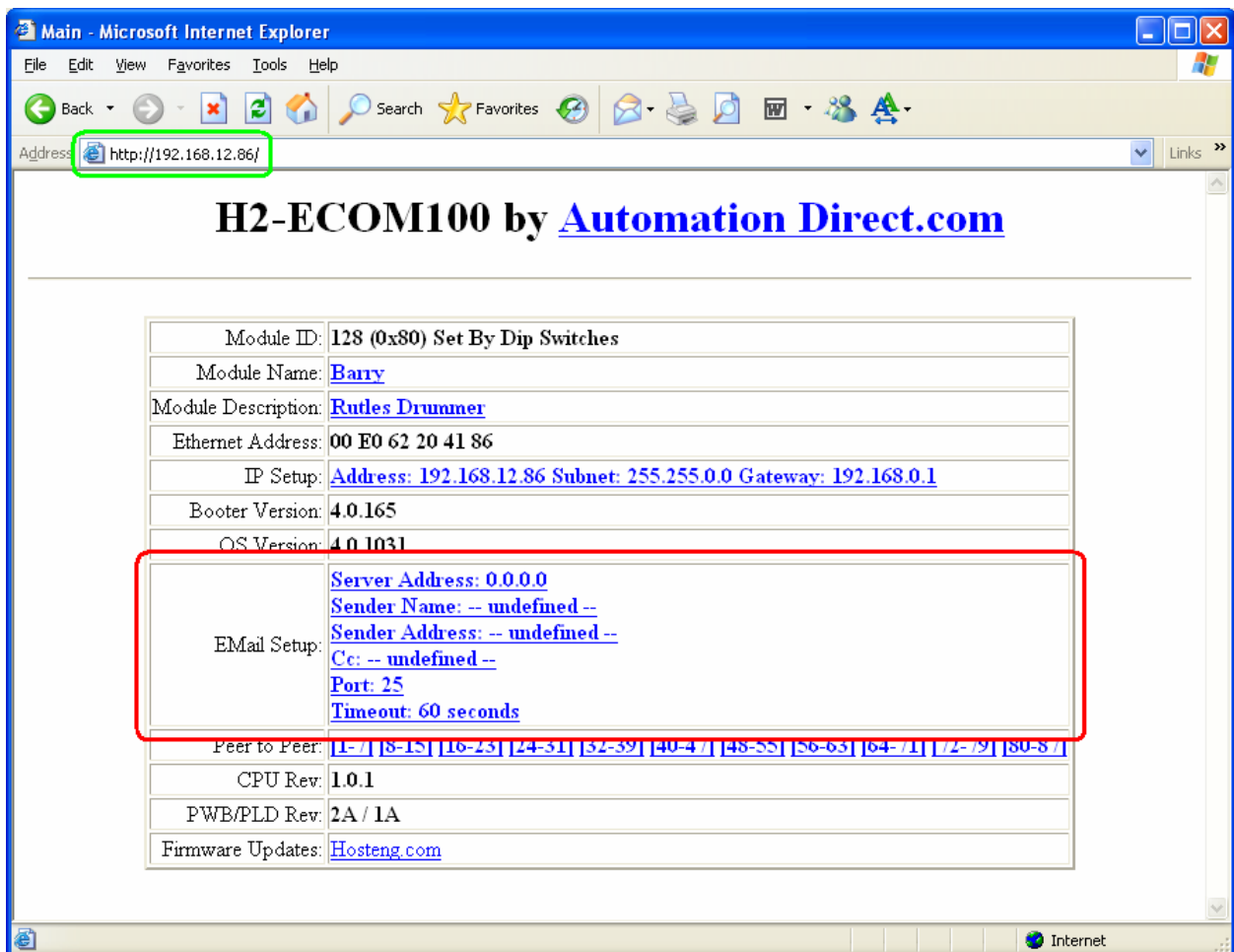

Clicking on any of the links in the box next to the EMail Setup box will take you to its EMail Setup page where you can edit these values.

For example, say the EMail Setup needs to be configured as follows:

Server Address	192.168.0.1
Sender Name	Machine A-42F
Sender Address	PLC@acme.com
Cc list	supervisor@acme.com, maintenance@acme.com, joe@acme.com, joe@yahoo.com (every EMail sent by this ECOM100 will go to everyone in the *Carbon Copy:* list)
SMTP TCP/IP Port	25 (standard SMTP port)
Timeout	90 seconds

The EMail Setup page would then be filled out as follows. Hitting the Send button writes the EMail Setup data to ROM in the ECOM100. The Reset button is for restoring the initial values before you did any editing.
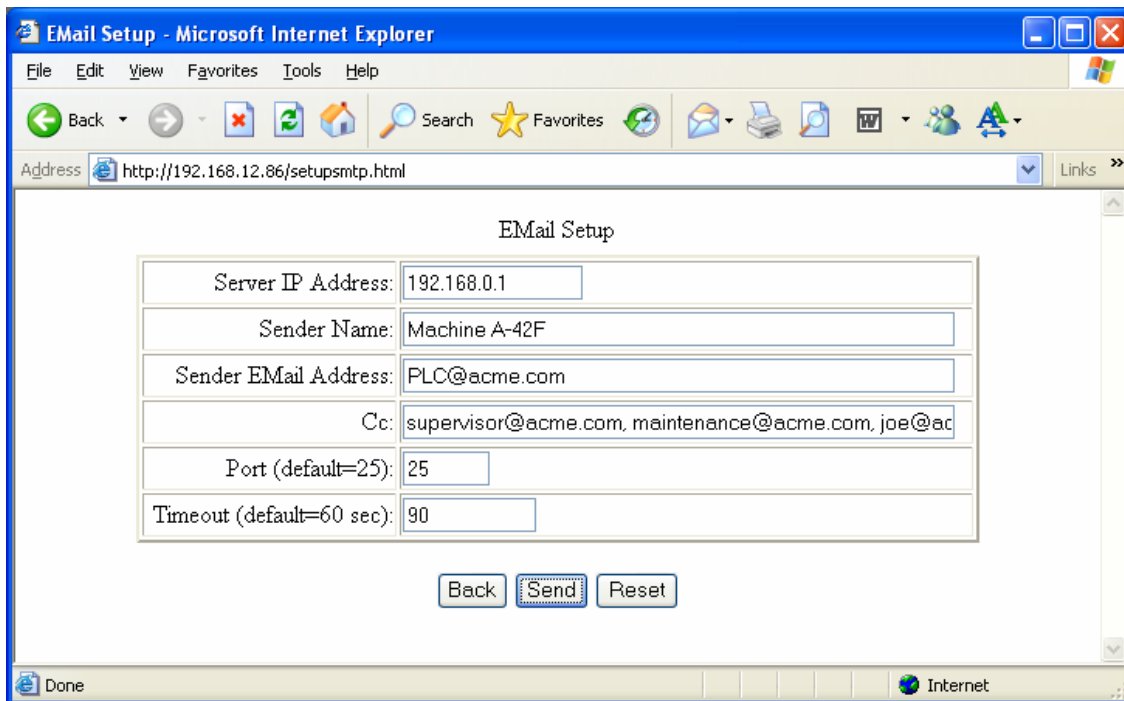
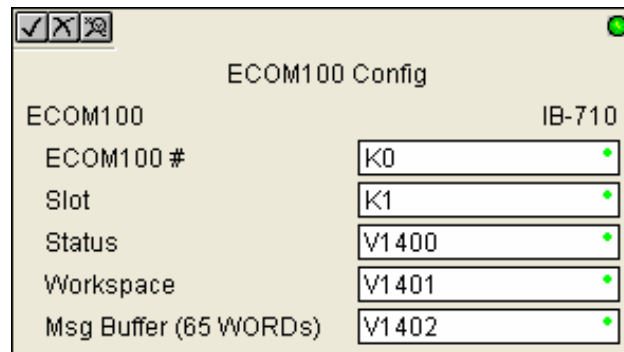During normal execution, the ECOM100 uses a "working copy" of this data. The data on this page is copied from ROM to the "working copy" in RAM at power-up, and the user can modify any field(s) in the "working copy" using the EMail Configuration (EMLCFG) IBox instruction, allowing for dynamic configuration based on events in the ladder program.You can also configure the SMTP parameter using NetEdit3. There is a button for EMail Config… under the ECOM Settings tab.

Some of the EMail Setup parameters are *required*, and some are *optional*. Below is a description each parameter in the SMTP Configuration:

a. Server IP Address ***REQUIRED*** - must be a valid IP address of an SMTP Server accessible from the ECOM100. This implies that the ECOM100's IP Address and Subnet Mask (both part of the normal IP configuration) must be valid also.

b. Sender Name *optional* – a human readable name which will be the "From" field on all recipients of any EMail from the ECOM100.

c. Sender EMail Address ***REQUIRED*** – almost all SMPT servers require this to be a valid EMail *account* on the SMTP server.

d. Cc *optional* – a **comma separated** list of EMail addresses. Due to the limitation of the backplane data length, the EMail instruction from ladder can only generate 128 bytes of data for *all* fields in the ECEMAIL instruction, including the To: Subject: and Body: fields. One way to maximize the Subject: and Body: fields from the ladder program is to enter a common "predefined" list of EMail addresses to be Carbon Copied (Cc:) on *every* sent EMail. Since this list will already be in the ECOM100, the user will not need to have a list of EMail addresses in the EMAIL instruction's To: field, thus maximizing the data bytes for the Subject: and Body: fields of the ECEMAIL instruction.

e. SMTP Port ***REQUIRED*** – By default, most SMTP Servers use TCP/IP Port number 25. It can be changed here, if necessary.

f. Timeout (in seconds) ***REQUIRED*** – The default value is 60 seconds. Since the PLC program is running asynchronously to the processing of all EMails by the SMTP server, a timeout needs to be provided in order to allow for the possibility that the Server could be down, or the Ethernet cable could be disconnected, or the Server is being bombarded with other requests, or …. This will allow the ECOM100 to report a timeout error back to the ladder program if it was unable to complete the operation. Note that this is the time it takes to do the *complete transaction*, so the user may need to increase it if they have a lot of recipients (in the To: and Cc: fields) because the total amount of time taken is directly proportional to the number of recipients.

A good guess for a timeout value is **twice** the wait of a "long" EMail message with "a lot" of recipients, when the server is busy processing other EMail transactions or other services. For some SMTP Servers, this could be 5 minutes (300 seconds).

7. **ECOM100 Config IBox instruction (ECOM100) must be located at the top of the ladder program**, along with any other ECOM100, CTRIO or other configuration IBoxes. The ladder program must have one ECOM100 IBox instruction for every ECOM100 module that use IBox instructions, such as ECEMAIL. The ECOM100 IBox does have some ladder logic which performs resource sharing and success/error handling that must be executed every scan, hence the need to put it at the top of the ladder program. Below is a screen shot of the ECOM100 Configuration IBox instruction editor:

a. ECOM# - a K value in the range 0-255. It must be **unique for each ECOM100** module in the PLC. The ECOM# is how each ECOM100 Client instruction identifies which ECOM100 they are working with, e.g. the ECOM100 EMail instruction identifies its ECOM100 via the ECOM#.

b. Slot - also a K value which designates which slot in the local base the ECOM100 resides in. If the slot value is incorrect, the EMAIL instruction will not work.

c. Status – a unique User V memory register as an output parameter which the ECOM100 module uses to report status back to the main program. When successful, this value will be set to 0 by the ECOM100 module. The user's ladder program *can* look at this value BUT MUST NEVER CHANGE IT.

d. Workspace – an internal state variable for this specific instruction. It must be a **unique** User V memory register used for storing internal state information of that specific ECOM100. Its value means nothing to the user program but may be helpful in debugging problems over the phone. This V memory location MUST NEVER BE CHANGED by the user program, and actually should not even be referenced by the user ladder program, except here and internally in other ECOM100 Client IBoxes referencing this ECOM100 Config IBox, like ECEMAIL.

e. Message Buffer – a reserved 65 word buffer for use by the ECOM100 Client instructions such as ECOM100 EMail. This buffer must be unique for each ECOM100 instruction (two different ECOM100s require 2 different ECOM100 IBoxes and 2 different 65 word buffers!). Again, this buffer MUST NEVER BE CHANGED by the user program, and should not even be referenced by the ladder program, except here.

8. **The ECOM100 Send EMail IBox (ECEMAIL IB-711) must be properly configured** and its execution is edge triggered, not straight power flow. In order to reduce the possibility of generating thousands of EMail messages, the box is *LEADING EDGE TRIGGERED* (like CTR instructions), so if you put SP1 (always on), it actually will NEVER execute because you must have a LOW state then a HIGH state in order to queue up an EMail. Below is a screen shot of the ECEMAIL IBox instruction editor:

a. ECOM # - a K value in the range 0-255. It must match one of the ECOM100 Config IBox's ECOM# at the top of the program. If it does not match, then the program is invalid and cannot be downloaded (this is checked BEFORE putting the PLC into Pause mode on a Run mode edit).

b. Workspace – an internal state variable for this specific instruction. It must be a unique User V memory register used for storing internal state information of this specific ECEMAIL instruction. Its value means nothing to the user program but may be helpful in debugging problems over the phone. This V memory location MUST NEVER BE CHANGED by the user program, and actually should not even be referenced by the user ladder program, except here.

c. Success – a user output bit parameter to report success.

d. **Error** – a user output bit parameter to report an error situation – see the Error Code parameter for more detailed information.

e. **Error Code** – a user output User V memory register to report the error code reported by the ECOM100. This value will be 0 if the *Success* bit is on, but will be non-zero if the *Error* bit is on. For a list of possible error/status codes and their meaning, see the Appendix.

Note - the Success bit, Error bit, and Error Code all get reset whenever the ECEMAIL instruction begins execution, so their values are only maintained until the next time the instruction is executed.

f. To: - **comma separated** list of **valid** EMail addresses of where the EMail is to be sent. Note that this EMail will also be sent to everyone in the Cc: working copy. Hence, this field is **optional**.

g. Subject: – optional EMail subject field – DO NOT USE DOUBLE QUOTES " OR DOLLAR SIGNS $ in this field UNLESS they are formatted properly using the VPRINT/PRINT formatting rules (e.g. dollar sign/double quotes $" to get a double quote, and two dollar signs $$ to get one dollar sign).

h. Body: - PRINT/VPRINT formatted message, so you MUST put text within double quotes and PLC variable references outside of double quotes, just like the PRINT/VPRINT instructions. The same formatting rules exist for PLC variable formatting. See PRINT/VPRINT instruction for more details.

Note that the complete length of the data sent by the EMAIL instruction (utilizing the WX mechanism) is limited to 128 bytes. This includes the To: field data, the Subject: field data, the Body: field data, along with up to 25 characters of overhead. Hence, the total number of characters the user can enter into these three text fields is about 100 characters. The editor will tell the user if the total length is too long. This is the primary reason why you can define a separate Cc: list in the ECOM100 itself, along with the From EMail Address and the From Name.

9. **Look at the Error Information provided by ECEMAIL IBox Instruction** – The ECEMAIL has three parameters that provide status information on the outcome of the Send EMail IBox (ECEMAIL): the Success bit, the Error bit, and the Error Code register.

Below is a table showing what may be causing the EMail to "not be working" based on these parameters.

Error Bit	Success Bit	*Decimal* Error Code	Meaning
0	0	n/a	**No Success, but No Error** ECEMAIL is still processing the request OR ECEMAIL has NEVER received any power since going to RUN mode.
0	1	0	**Success!** ECEMAIL has submitted successfully the EMail to the SMTP Server. This just means the SMTP Server has the EMail for processing, it does NOT mean that the EMail has been sent or that the EMail has been received. The SMTP Server may be waiting to process other outgoing EMail, or the recipient's POP3 Server or the recipient's EMail Client may only process EMail once every 30 minutes, etc.
0	1	non-zero	**Success but Error Code is set – INVALID** This result state cannot validly occur. It CAN occur if the ladder logic is writing to the Success Bit OR the Error bit OR the Error Code parameter somewhere else in the program. **Check the Cross Reference View** to ensure none of these parameters are being used in an OUT or Output type parameter in any other instruction. *If they are being written to, have the user edit their program to make sure these 3 parameters are only written to by this one instruction.* *If they are being "reused" to preserve bit or word memory, edit the program so that this instruction has its own Error Bit, Success Bit, and Error Code parameters so that we can figure out the TRUE result of this IBox. Bit-Of-Word can be used for the bits, or even unused GX or GY bits can be used as bits.*
1	0	2-1999	**Error!** An error occurred in trying to execute the ECEMAIL IBox. Look at the Appendix for a complete list of error Status Code values. The Status Code values can be categorized as *Normal Status (0-1)*, *Internal ECOM100 (2-99)*, *SMTP Protocol (100-999)*, or *ECEMAIL IBox Ladder Logic (1000-1999)*
1	0	0, 1, 2000-65535	**Error processing, but Error Code has INVALID value** This result state cannot validly occur. It CAN occur if the ladder logic is writing to the Success Bit OR the Error Bit OR the Error Code parameter somewhere else in the program. **Check the Cross Reference View** to ensure none of these parameters are being used in an OUT or Output type parameter in any other instruction.

			Error AND Success Bits Set - INVALID
1	1	n/a	This result state cannot validly occur. It CAN occur if the ladder logic is writing to the Success Bit OR the Error Bit OR the Error Code parameter somewhere else in the program. **Check the Cross Reference View** to ensure none of these parameters are being used in an OUT or Output type parameter in any other instruction.

10. **SMTP Message Tracing using *SMTP Viewer* Tool** – DirectSOFT Rel 5 provides a utility for looking at the actual SMTP protocol traffic between the ECOM100 Module and the user's SMTP Server.

Before you launch the SMTP Viewer tool, make sure the user's PC is connected to the same network as the ECOM100 and SMTP Server (if you can use a DirectSOFT link to the ECOM100 then you are there!). To launch SMTP Viewer, launch DirectSOFT Rel 5, then go to the **PLC->Tools** menu and select the SMTP Viewer utility then hit the Run button:
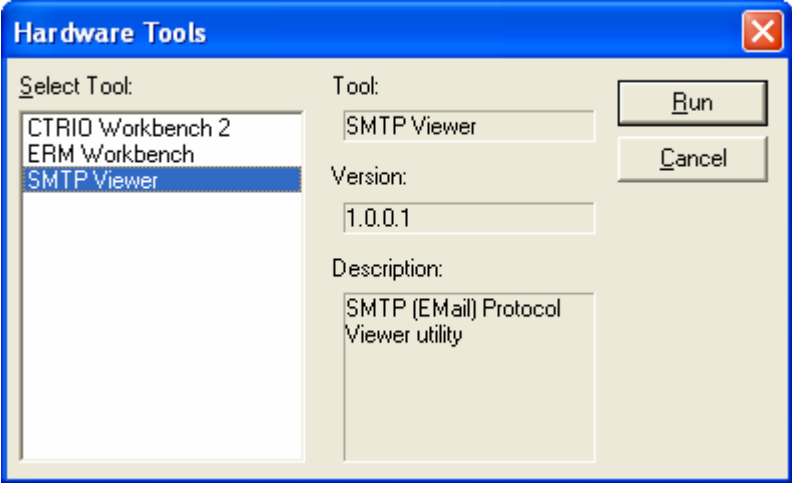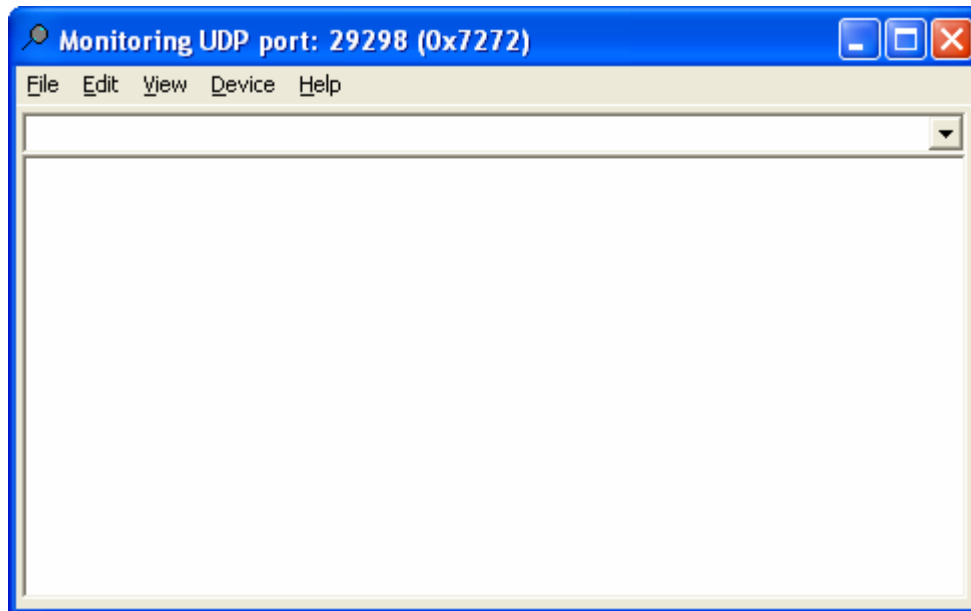
This will try to bring up the SMTP Viewer, but you may get a Windows Security Alert warning dialog because the Viewer utility does packet sniffing


Hit the | Unblock | button to allow this program to look at Ethernet packets.

Once the SMTP Viewer comes up, it should look like this. It should definitely say "Monitoring UDP Port: 29298 (0x7272)":

Now select the ECOM100 device via its TCP/IP Address (you can use NetEdit3 to find the module's TCP/IP Address if you do not know it). Select the **Device->Select Device** menu item to bring up the Select Device dialog:
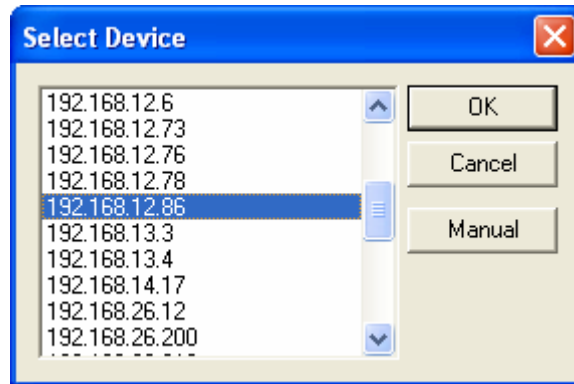

Choose the ECOM100's TCP/IP Address (in the example above it's 192.168.12.86), then hit the OK button. This will not do anything until you enter the proper command at the top of the SMTP Viewer Combo Box.

Type "emailtrace" (no quotes) in the command Combo Box at the top then hit the <enter> key:
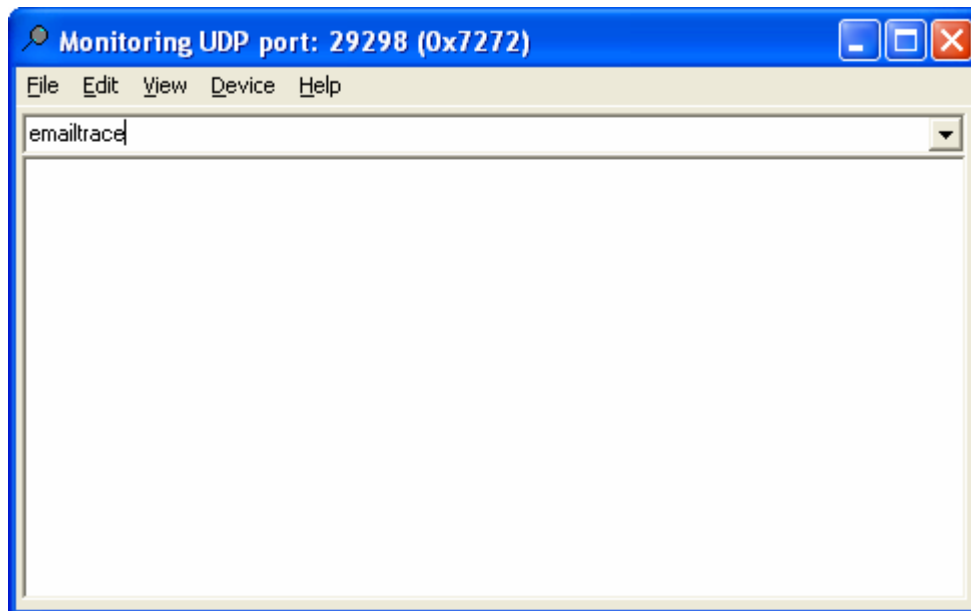
After hitting <enter>, you will see the status of the logging show up in the log area. It should read "EMail Trace **On**".
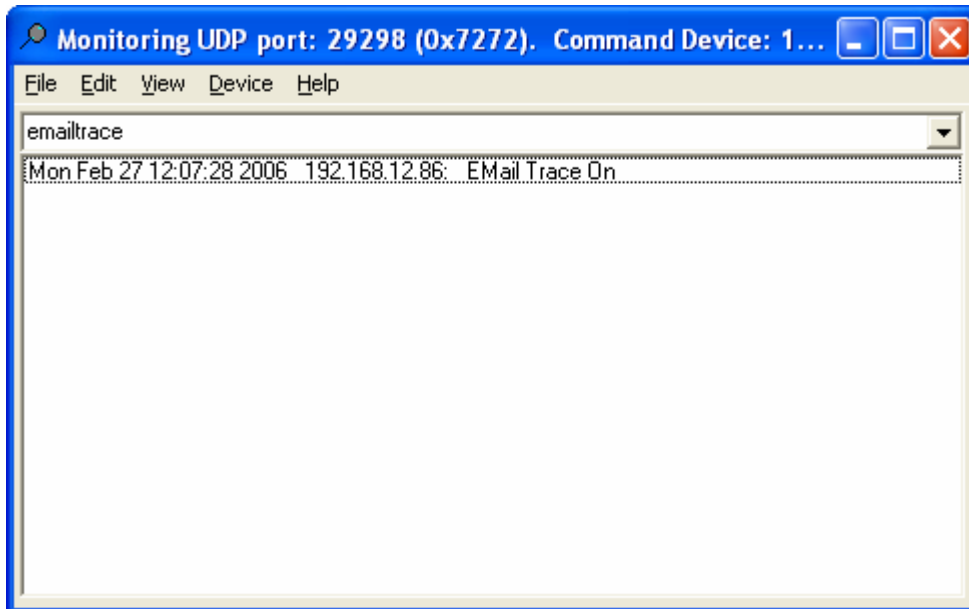
If it reads "EMail Trace **Off**", type in the `emailtrace` command again to toggle tracing back on.

Now get the PLC Ladder Program to send another EMail and monitor the SMTP Viewer trace. Below is a sample trace of a *successful EMail transmission*. The data in each row has information about the individual SMTP packets between the ECOM100 and the SMTP Server. Each row includes the date/time stamp of that packet, the TCP/IP address of the sender, and a description of the SMTP packet.
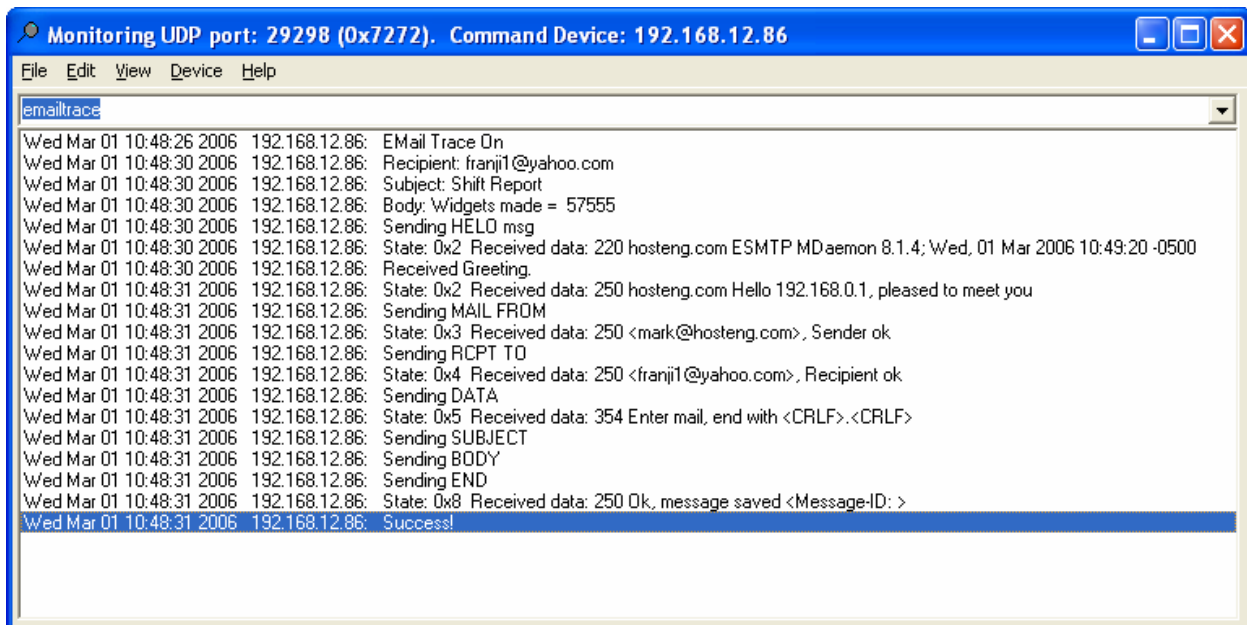
This next screen shot is an example of a trace of an ECEMAIL IBox that timed out. Note that since the TCP/IP *connection* to the server (192.168.0.1 on Port 25) was never established, the ECOM100 never sent out any SMTP packets, which explains why the log is so short.
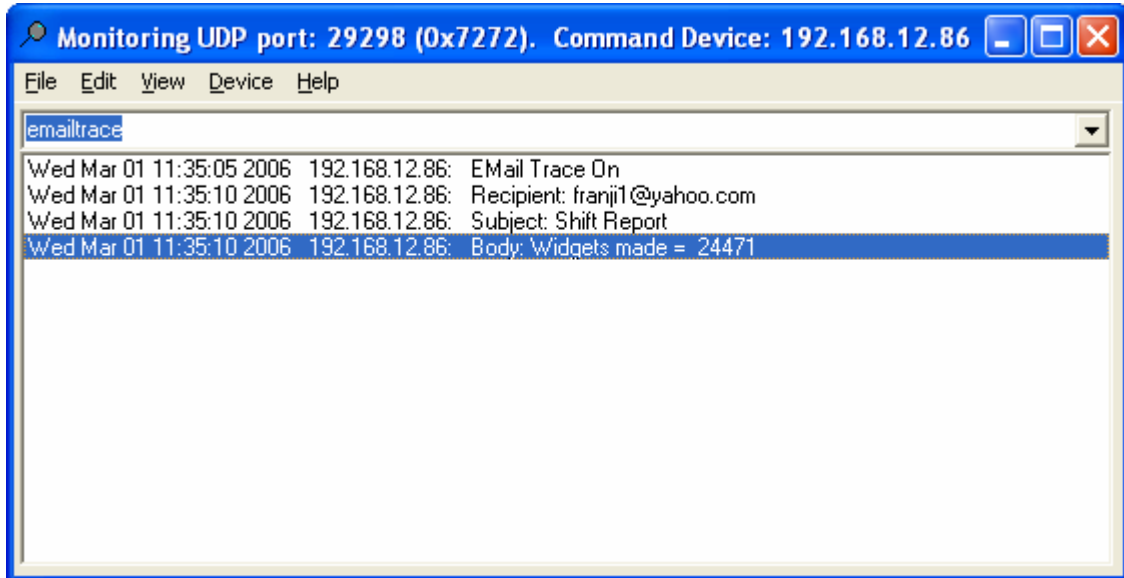
If there are any specific SMTP protocol errors, they would show up here, along with possible SMTP error codes, which are documented in the Appendix.

Appendix – ECEMAIL *Decimal* Status Codes

This list of status codes is based on the list in the *ECOM100 Mock Slave Address 89 Command Specification*.

ECOM100 Status codes can be classified into 4 different areas based on its **decimal** value:

0-1	Normal status - no error
2-99	Internal ECOM100 errors
100-999	Standard TCP/IP protocol errors (SMTP, HTTP, etc.)
1000+	IBox ladder logic assigned errors (SP Slot Error, etc.)

For the ECOM100 Send EMail IBox, the list of status codes below are specific to this IBox:

Normal Status (0 - 1)

0	**Success** – ECEMAIL completed successfully
1	**Busy** - ECEMAIL IBox logic sets the Error register to this value when the ECEMAIL starts a new request

Internal ECOM100 Errors (2 – 99)

10 - 19	**Timeout Errors** - last digit shows where in ECOM100's SMTP state logic the timeout occurred; *regardless of the last digit*, the SMTP conversation with the SMTP Server timed out
	SMTP Internal Errors (20 – 29)
20	TCP Write Error
21	No Sendee
22	Invalid State
23	Invalid Data
24	*Invalid SMTP Configuration*
25	Memory Allocation Error

ECEMAIL IBox Ladder Logic Assigned Errors (1000+)

1001	**SP Slot Error** – the SP error bit for the ECOM100's slot turned on. Possibly using RX or WX instructions on the ECOM100 and walking on the ECEMAIL execution. User should use ECRX and ECWX IBoxes.

SMTP Protocol Errors – SMTP (100 – 999)

1xx	*informational replies*
2xx	*success replies*
200	(nonstandard success response).
211	System status, or system help reply
214	Help message.
220	<domain> Service ready. Ready to start TLS.
221	<domain> Service closing transmission channel.
* 250	OK, queuing for node <node> started. Requested mail action okay, completed.
251	OK, no messages waiting for node <node>. User not local; will forward to <forward-path>
252	OK, pending messages for node <node> started. Cannot VRFY user (e.g., info is not local), but will take message for this user and attempt delivery.
253	OK, messages pending messages for node <node> started.
3xx	*(re)direction replies*
354	Start mail input; end with <CRLF>.<CRLF>
355	Octet-offset is the transaction offset.
4xx	*client / request error replies*
421	<domain> Service not available, closing transmission channel
432	A password transition is needed
450	Requested mail action not taken: mailbox unavailable. ATRN request refused.
451	Requested action aborted: local error in processing. Unable to process ATRN request now.
452	Requested action not taken: insufficient system storage
453	You have no mail.
454	TLS not available due to temporary reason. Encryption required for requested authentication mechanism.
458	Unable to queue messages for node <node>.
459	Node <node> not allowed: <reason>.
5xx	*server / process error replies*
500	Syntax error, command unrecognized. Syntax error.
501	Syntax error in parameters or arguments
502	Command not implemented
503	Bad sequence of commands
504	Command parameter not implemented
521	<domain> does not accept mail
530	Access denied. Most issue a STARTTLS command first. Encryption required for requested authentication mechanism.
534	Authentication mechanism is too weak.
538	Encryption required for requested authentication mechanism.
550	Requested action not taken: mailbox unavailable
551	User not local; please try <forward-path>
552	Requested mail action aborted: exceeded storage allocation
553	Requested action not taken: mailbox name not allowed
554	Transaction failed

* 250 is success in SMTP. **ECOM100 reports this as a status code of 0**, success.