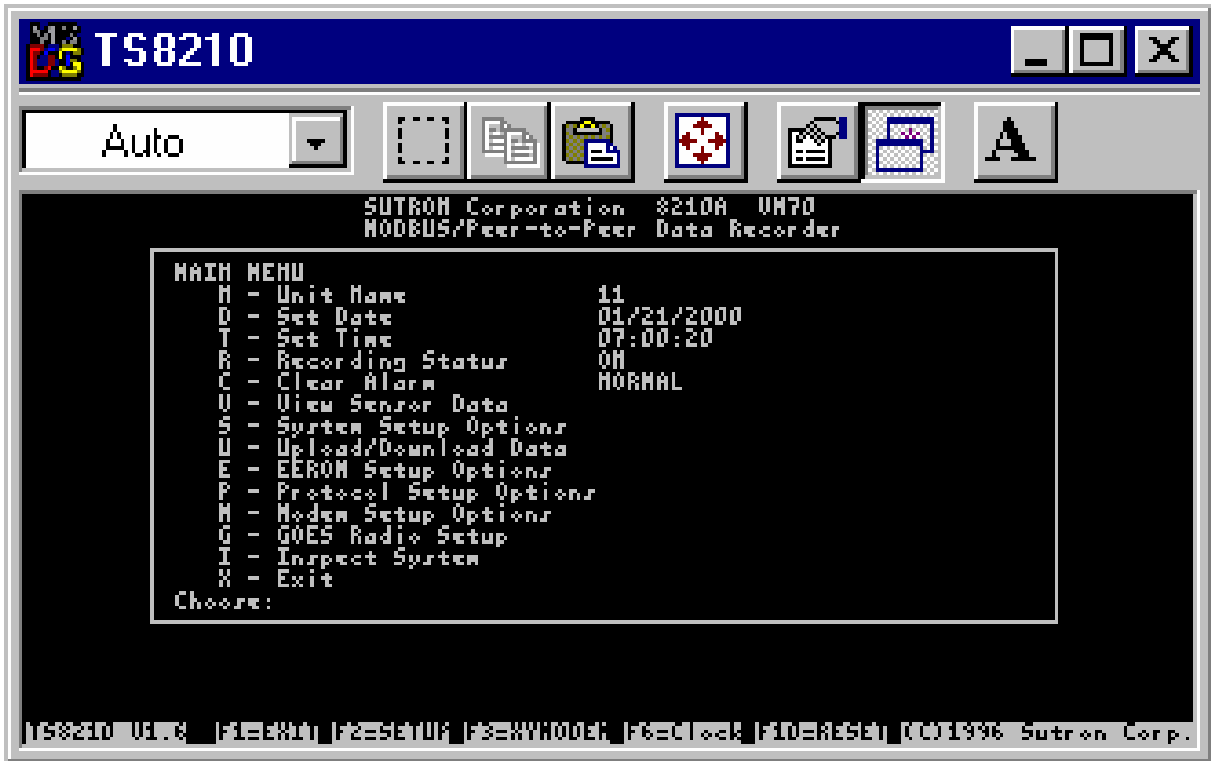


8210 RTU Operating System version 7X Operators Manual



Part No. 8800-1132

Revision A

4/22/02

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Introduction

This manual provides instructions on installing software, setting option switches and operating the 8210 RTU with the MODBUS enhanced 8210 system software option 8200-1072. The topics of this manual shall explain the various operator interface control buttons and menu entries available on the 8210. No attempt is made to explain the generic 8210 menu entries not related to the MODBUS option. That information is available in the 8210 operators manual part number 8800-1059. What this manual will cover is the explicit MODBUS function codes the 8210 supports along with typical byte strings to test the communication capability of the unit.

Software Utilities Required for 8210 Upgrade

Three software programs are required to update the 8210 O/S:

- 1) TS8210.exe on utilities disk part number 6800-1040-1;
- 2) Ramcard.exe included on the same disk;
- 3) Upgrade module with latest V7Xb.upg supplied with the 8200-1072 option;
- 4) PC capable of read/write to a PCMCIA card is assumed.

Note that a 1Meg static Ram type PCMCIA is needed to hold the V7Xb.upg file. Also required is a 8210 revision C motherboard installed with 512K FLASH memory option. The older revision A motherboard will not work with the MODBUS software upgrade. Always use the 8210 to format and erase the PCMCIA before loading the upgrade file. Use the DUMP DATA/Erase Ram Card menu entry to do this. This assumes that version 70 is being loaded, but is applicable to the latest release currently under configuration control.

To load the PCMCIA do the following:

- 1) Load the 6800-1040-1 utilities onto the PC in a unique folder;
- 2) Load the V70b.upg file(or latest release) into the same folder;
- 3) At the PC keyboard type the following ramcard/w v70b.upg<enter>

```

MS-DOS Prompt
7 x 12
(C)Copyright Microsoft Corp 1981-1996.
C:\8200>e
C:\8200>cd\8200sw
C:\8200sw>ramcard/e
RAMCARD File Manager for the 8210      Version 1.0      (C)1995 Sutron Corp
Searching for E:\RAMCARD.RCD ... OK
Erasing all files from Ram Card
C:\8200sw>
C:\8200sw>ramcard/w v70b.upg
RAMCARD File Manager for the 8210      Version 1.0      (C)1995 Sutron Corp
Searching for E:\RAMCARD.RCD ... OK
WRITING ALL FILES MATCHING: V70B.UPG
V70B.UPG      ... OK
C:\8200sw>

```

Figure 1-- Successful ramcard image loaded

To load this file into the 8210 do the following.

- 1) Remove ALL power from the 8210 including the battery.
- Sutron Corp 8210 addendum

- 2) Install the PCMCIA into the 8210 socket.
- 3) Open the 8210 and move the J18 jumper FROM normal TO PCMCIA.
- 4) Install power to the 8210.
- 5) After the 8210 starts, watch the red LED display on the front panel.
- 6) When prompted, move the J18 jumper back to normal.
- 7) Press and HOLD the ON/OFF key
- 8) Press SET to confirm the upgrade process.

IMPORTANT!

After the MODBUS protocol has been selected via the menu options, perform an 8210 reset to activate the MODBUS device driver. This is because SSP is the normal protocol used within the 8210 operating environment.

Motherboard option switches

Verify the four (4) S1 switches are set as needed.

Slot 1 configuration switches are no different as standard version 62 units. The MODBUS option is available on the TERM port or COM port/Slot2 only.

If any switches are changed, the 8210 MUST be reset.

SLOT1 –J4 switch options on 8210

This slot has the same functionality as version 62 regarding installed circuit boards. No MODBUS functionality is provided. Only SSP protocol is available.

S1	S2	Option setting
LEFT(open)	LEFT(open)	NONE
LEFT(open)	RIGHT(closed)	SatLINK hardware support
RIGHT(closed)	LEFT(open)	Speech MODEM (3014) support
RIGHT(closed)	RIGHT(closed)	Radio (6014) hardware support

TABLE 1

SLOT2/COM – J5 or J3 switch options on 8210

This slot supports various options regarding installed circuit boards. MODBUS functionality is provided along with SSP.

S3	S4	Option setting
LEFT(open)	LEFT(open)	NONE
LEFT(open)	RIGHT(closed)	Terminal/TS8210 or EXT modem via COM
RIGHT(closed)	LEFT(open)	Speech MODEM (3014) support
RIGHT(closed)	RIGHT(closed)	Radio (6014) hardware support

TABLE 2

MODBUS version information

The Modicon MODBUS manual version PI-MBUS-300 Rev E was used during the 8210 code upgrade process. The following function codes are supported.

MODBUS function code	8210 Registers supported	Register sensor references
1—Read Digital outputs (0X ref coils) Broadcast not supported	8	OUT 1 to 8
2—Read Digital input status (10000 series ref) Broadcast not supported	12	INP 1 to 12
3—Read HOLDING registers (40000 series ref) Broadcast not supported	37	PEER1 to 29 (6) 8210 clock registers TodaysRain counter/REF
4—Read INPUT registers (30000 series ref) Broadcast not supported	194	All 8210 sensors within the enable sensor menu list
5—Force Digital outputs (0X ref coils) Broadcast supported	8	OUT 1 to 8
6—Preset HOLDING registers (40000 series ref) Broadcast supported	37	PEER1 to 29 (6) 8210 clock registers TodaysRain counter/REF
15—Force Multiple Coils (0X ref coils) Broadcast supported	8	OUT 1 to 8
16—Preset Multiple registers (40000 series ref) Broadcast supported	37	PEER1 to 29 (6) 8210 clock registers TodaysRain counter/REF

Error reporting information.

Function codes not listed above will be returned to the master with the FunctionCode value incremented by 128 per the MODBUS spec. All other data bytes sent to the 8210 will be sent back to the master unchanged.

Changes between version 62 and version 70

Version 70(or newer) supports all the functionality of version 62 EXCEPT the support for the 378K LOGRAM option. Currently the largest log space the 8210 can support is 120K assuming a 1K Tiny Basic memory is used. Note that the Sutron SatLINK GOES transmitter is the only GOES option available in slot1. The obsolete 5000 series transmitter is no longer supported. Support for Sutron SSP operating with PCBASE2 was not changed. No Peer-2-Peer support via SSP is provided with this option.

Changes from V62 to V70

Version 70 was upgraded to provide the following enhancements.

- 1) 8210 sensors were added for additional 4X HOLDING registers without changing any of the default system sensors. This provides the capability of sending the values over GOES.

- 2) Add a 24 hour rain counter named TodaysRain for operating system support. The value is automatically zeroed at midnight of each day. TinyBasic handling this function is no longer needed on all the 8210-XX14 models with this software option.
- 3) Add MODBUS RTU and ASCII serial protocols selectable via menu options. All SSP modes are supported as a default configuration as normal.
- 4) MODBUS slave capability is supported for all communication modes.
- 5) MODBUS communication is typically done with radio on either TERM or COM/slot2, but dialup via the 3014 option is supported via slot2.
- 6) Operating system support for all 16 internal Analog sensors is provided. Note that additional hardware is needed on the motherboard via the Channel B ANALOG input connector and related circuits.
- 7) Alarms are never sent out via MODBUS. It is the masters responsibility to poll the slave 8210 sensor 3X registers often enough to determine sensors above or below a threshold value.

How to make menu entries in the 8210

Use either the front panel keys or serial connection via TS8210 to setup the 8210 menu entries. Refer to the 8210 operators manual for any additional help in this area.

Using TS8210 to setup the 8210 registers

Run the TS8210 program on the PC. Verify the EEROM SERIAL menu setting is set for USER mode with the correct serial bit rate. Connect a serial cable to the side TERM port on the 8210. After sign-on of the PC system, the Sutron main screen should be present on the computer monitor. This screen should resemble that shown in Figure 2 below.

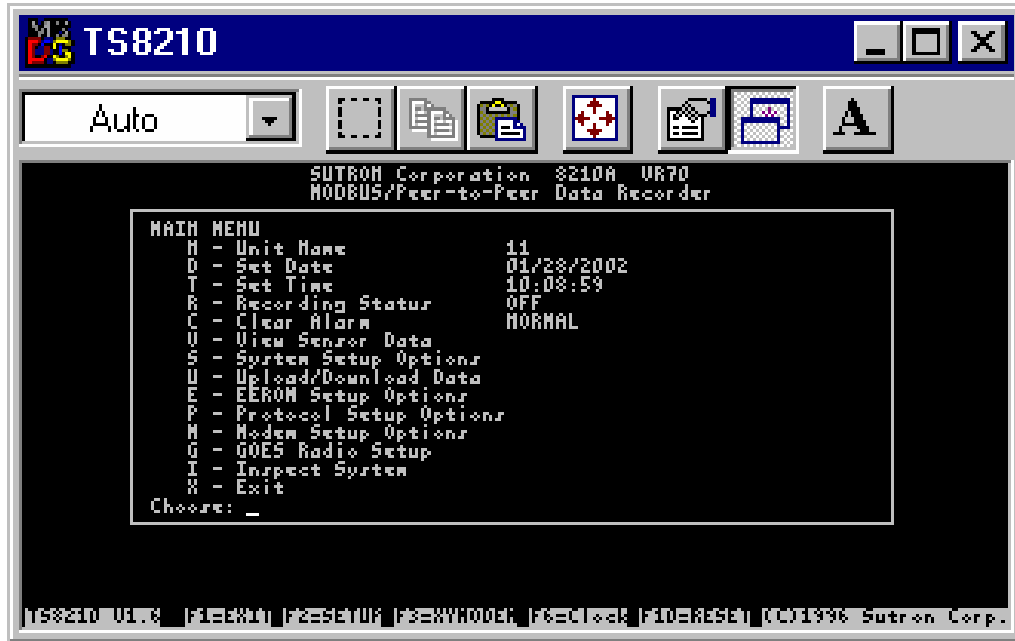


Figure 2 – Opening Menu

Note that this 8210 had a unit ID of 11 during the capture of this screen in Figure 2, so don't panic if you see a blank entry there. Just type N and then enter the unit name as normal. Enter all 8210 menu entries as needed for this site. This unit had no option installed in slot1 and a 6000 series radio in slot2.

Setup the 8210 MODBUS UNIT ID

Just type "N" at the opening menu screen and then enter the two digit unit number as required. MODBUS typically uses a range of 01 to 7F hex as the ID. Don't go higher than 7Fhex for this entry.

External/Internal Radio connections to the 8210

Connect the radio to the DB9 on the either TERM or COM port of the 8210. If using the 6000 series transmitter, then connect to slot2. MODBUS protocol is not provided by the slot1 connection. Typically slot1 is reserved for SatLINK.

Sensor support in version 7X

Virtually all sensors are unchanged from version 62 with the following exceptions.

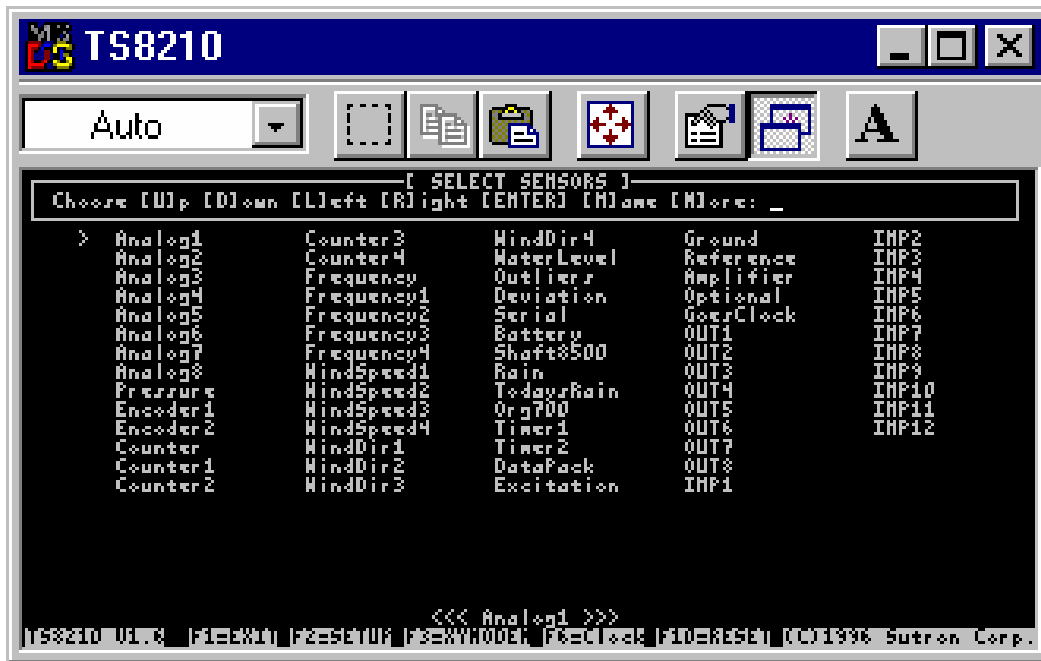


Figure 3 – Sensors

Today's Rain was added to support 24 hour rainfall integration.

Use this sensor to measure the rainfall over a 24 hour period. NO Tiny Basic is required. Just remember to set the SLOPE to 0.01 to measure in inches of rainfall, since each tip is one hundredth of an inch. Be sure to LOG this sensor.

How is this different from the RAIN sensor?

It uses the counter hardware to synthesize an artificial rainfall sensor. There is no need to enable the counter sensor to use this Today's Rain sensor.

Use the RAIN sensor for the purpose of alarm rate of change thresholding as you normally would. This function is not changed.

The Today's Rain count will be reset to zero at midnight of every day automatically.

Also, the Today's Rain count will be reset to zero when RECORDING is turned ON, thereby synthesizing a new internal reference count with respect to the present counter value. MODBUS holding register addresses are available to adjust either the count or internal reference count if needed.

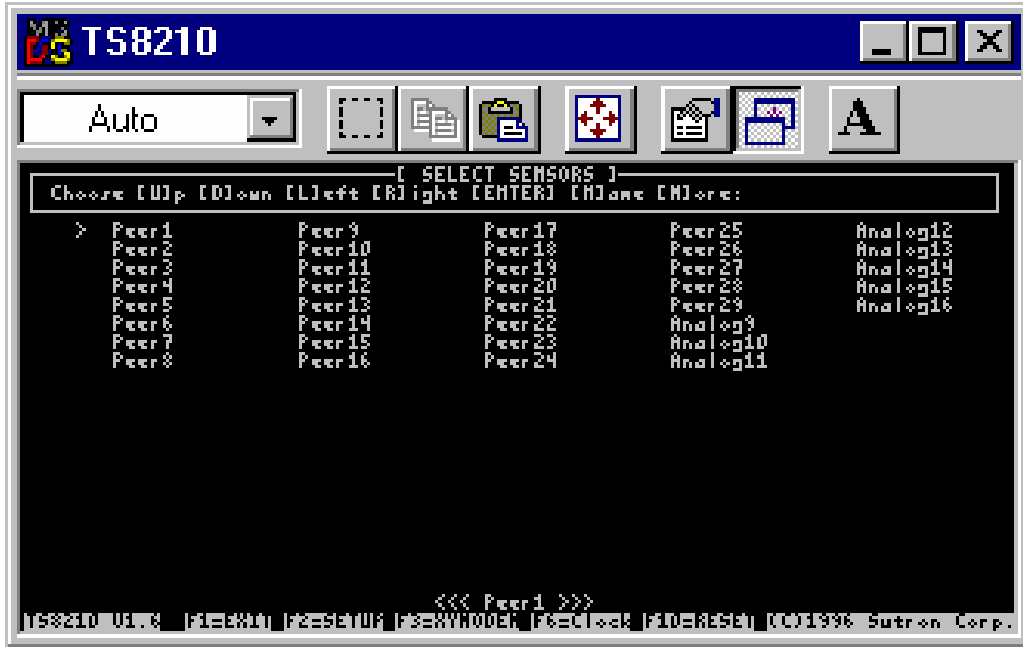


Figure 4 – New sensors added

Additional sensors added for holding registers and Analog 9 to 16 sensors.

For holding registers in MODBUS, extra tags were added for this purpose shown in Figure 4. The 8210 measurement engine does nothing with the PEER1 to PEER29 tags. They are strictly for TinyBasic use. By having them as part of the 8210 database, then their values may be sent via the GOES SatLINK transmitter.

Extra Analog sensors now have operating system support and are configured the same as Analog1. It is assumed that the hardware support is added to the 6461-1170 motherboard to utilize this capability.

MODBUS support using the TERM port

Along with all normal 8210 connectivity provided by the TERM port, the capability to support MODBUS is provided. NOTE the TERM port is the DB9 connection provided on the side of the 8210 chassis.

From the main menu as shown in Figure 2, hit the “E” key to goto EEROM menu.

- Use the USER mode to communicate with TS8210.
- Use PROTOCOL for a direct connection to PCBASE.
- Use MODBUS R (RTU) or MODBUS A (ASCII) for modbus protocol.

Use the EEROM Serial menu entry to enable this setting. Hit the “M” key until the desired serial protocol is selected. Make sure the serial bit rate matches the radio setting to utilize this feature. Hit the “U” key to make changes in this setting. Realize that the DCE DB9 wiring must support wakeup of the 8210 if reception is desired.

Pin number	Function
2	TxDATA OUT of the 8210 INTO the PC

3	RxDATA INTO the 8210 FROM the PC
4	CTS signal INTO the 8210 to WAKEUP the 8210 (normally DTR on PC)
5	common
6&8	RTS OUT of the 8210 INTO the PC (active on transmit mode)
9	Optional +12 volts output (if strap J12 on interconnect is there)

TERM port connector pinout



Figure 5 -- Normal setting for TS8210 connections



Figure 6 -- MODBUS RTU setting for serial port connections



Figure 7 -- MODBUS ASCII setting for serial port connections

MODBUS support using the COM port

The DB9 COM port internal to the 8210 or slot2 is available for MODBUS communication. Note that Sutron SSP is also available in the default communication mode. This is provide customers the same functional modes as all 8210 units NOT equipped with version 70.

Select the configuration switches using TABLE 2 as normal with 8210 units.

From the MAIN menu as shown in Figure 2, hit the “P” key.

Use the PROTOCOL menu in Figure 8 to enable the various protocols. Hit the “B” key to change settings.

Pin number	Function
1	DCD INTO the 8210 (this is the wakeup pulse when +5v active)
2	RxDATA INTO the 8210 FROM the PC
3	TxDATA FROM the 8210 INTO the PC
4	DTR FROM the 8210 INTO the PC
5	common
7	RTS OUT of the 8210 INTO the PC (active on transmit mode)
8	CTS INTO the 8210 FROM the PC

COM DB9 connector pinout



Figure 8 – Protocol for SSP menu screen

This Figure 8 screen shows normal SSP communication(along with TS8210) selected on the COM port. Use this for all 6000 or 3000 series circuit boards to operate within a PCBASE2 environment. This is the default setting after the 8210 is programmed.



Figure 9 – Protocol MODBUS RTU menu screen

This Figure 9 screen shows MODBUS RTU communication selected on the COM port. Use this for dialup speech modems or radio support. MODBUS ASCII mode is selected the same way. RESET the 8210 after changes have been completed to ENABLE the MODBUS driver as required.

Receiving debug information with 8210

Debug help is provided by the 8210. Go to the INSPECT SYSTEM/Monitor SSP /VERBOSE message entry to TURN ON the debug screens. Of course, the TS8210 program is needed for this. The TERM port was used to capture this screen.

A typical screen might be as follows.

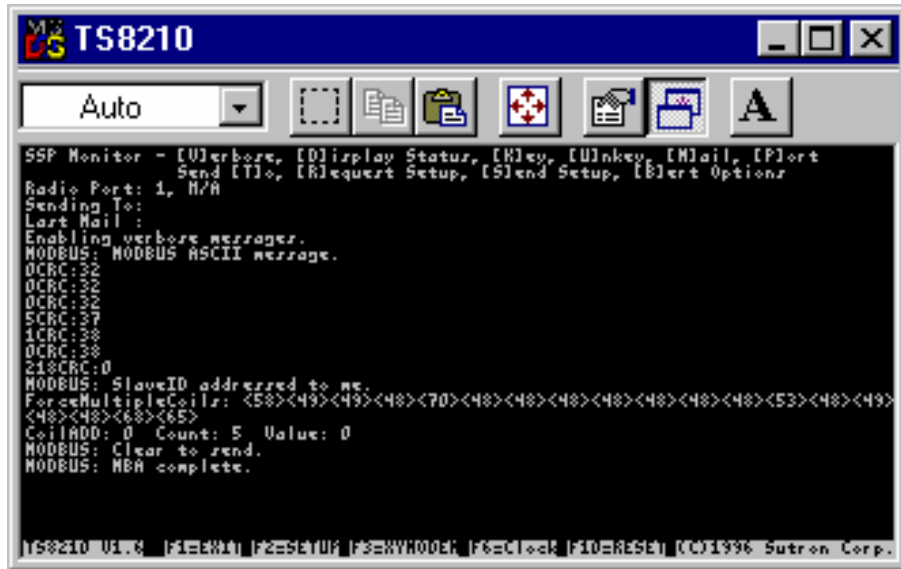


Figure 10 – DEBUG Protocol menu screen

Note the MODBUS: response in figure 10 denoting a MODBUS string is being decoded verses an SSP message. This screen can also be used to debug SSP message strings. The MODBUS device driver gives a unique output denoting the different decoding engine.

The actual bytes received is shown along with the running checksum.

The <58> is the byte code for the string colon; <49> is decimal "1" <48> is decimal "0" and so on.

Use your windows CALCULATOR to help with these byte codes if you can not remember them all. More than likely that won't be necessary.

Also shown is the perceived opcode function the master wishes the 8210 to perform. This particular screen was for a FORCE COIL opcode to set all coils to zero (OFF) state. Note the starting COIL address and COUNT is shown along with the value to set the coils too.

The message "MODBUS: SlaveID addressed to me" was decoded because it was not a broadcast address that was received.

Also shown is whether RTU or ASCII mode is selected. Make sure the master and 8210 slave are set for the same protocol.

The unit will also decode messages not addressed to itself.

The following byte string generated the following screen

```
:12030064000384<CR><LF>
```

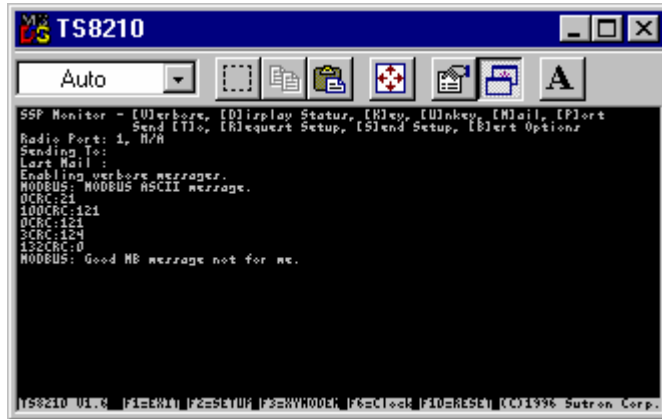
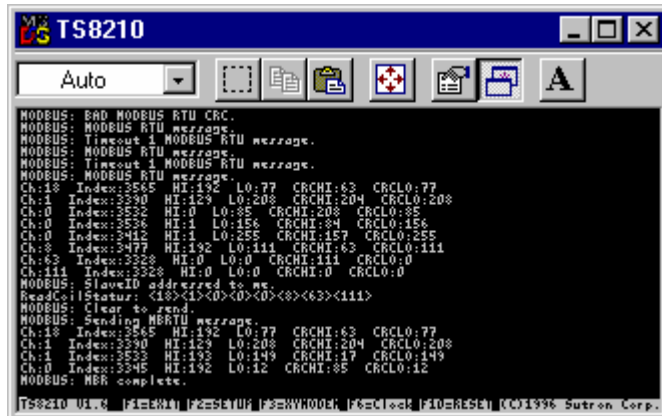


Figure 11- -- Debug screen for another RTU message stream

Figure 12- -- Debug screen for another RTU message stream using RTU mode



Direct connections to the COM port

Use a normal RS-232 cable along with a NULL MODEM adapter to connect to the DB9 COM port. Set the 8210 switches for MODEM on slot 2. Make sure the protocol is set for the correct RTU/ASCII serial stream using the PROTOCOL menu (B) setting. Do a reset to activate the MODBUS device driver. Use the TERM port to connect to TS8210. Make sure the EEROM menu settings for SERIAL mode and USER RATE are set correctly.

Direct connections to the TERM port

Use a normal RS-232 cable to connect to the DB9 TERM port.

Make sure the EEROM SERIAL menu settings is set for MODBUS mode and USER RATE are set correctly. Use the (M) key to change the protocol and the (U) key to set the bit rate.

Setting the 8210 switches for MODEM on slot 2 will allow TS8210 to be used as a monitor.

Make sure the protocol is set for PROTOCOL serial stream using the PROTOCOL menu (B) setting and the COM BAUD RATE is set correctly for TS8210.

Simple SCADA connections to the TERM port

Use a RS-232 cable with the following connections to connect to the DB9 TERM port on the side of the 8210.

Make sure the EEROM SERIAL menu settings is set for MODBUS mode and USER RATE are set correctly. Use the (M) key to change the protocol and the (U) key to set the bit rate. Basically this ties the RTS line from the PC to the wakeup pin on the 8210. Most SCADA systems will communicate via RTS/CTS in this way.

DB9 male pin	DB9 female pin	FUNCTION
1	1	DCD Input FROM the 8210 TO the PC (not used)
2	2	Rx data FROM the 8210 TO the PC input
3	3	Tx data output FROM the PC TO the 8210
4	7	
5	5	Common voltage line
6	6	DSR input to the PC (tied to pin 8 by 8210)
7		N/C
8	8	Tied to pin 6
9		+12 volts FROM the 8210 (do not connect to PC ring indicator)

Response of the 8210 to a BAD MODBUS function

MODBUS requires the 8210 slave response to a bad function code set bit 8 of the function code. The following MODBUS ASCII data string will attempt an exception COIL read from slave address 11hex which is not supported by the 8210:

```
:1107E8<CR><LF><>
```

A required RESPONSE from the 8210 would be:

```
:118768<CR><LF><>
```

MODBUS support for digital outputs on the 8210

All eight (8) digital output lines are mapped to MODBUS 0X address references via function 01. 8210 digital output 1 line is addressed as COIL zero in MODBUS parlance. Limit the range of coils to read to a maximum of eight.

MODBUS address	8210 digital OUTPUT register
referred as COIL 0 MODBUS address 1	Digital OUTPUT 1 sense line
referred as COIL 1 MODBUS address 2	Digital OUTPUT 2 sense line
referred as COIL 2 MODBUS address 3	Digital OUTPUT 3 sense line
referred as COIL 3 MODBUS address 4	Digital OUTPUT 4 sense line
referred as COIL 4 MODBUS address 5	Digital OUTPUT 5 sense line
referred as COIL 5 MODBUS address 6	Digital OUTPUT 6 sense line (internal only)
referred as COIL 6 MODBUS address 7	Digital OUTPUT 7 sense line (internal only)
referred as COIL 7 MODBUS address 8	Digital OUTPUT 8 sense line (internal only)

The following MODBUS ASCII data string will READ all eight coil values from slave address 11hex:

```
:110100000008E6<CR><LF><>
```

A typical RESPONSE might be:

```
:110101F8F5<CR><LF><>
```

This has ONE byte returned with OUT4 to OUT8 set to logic ONE (ON) and OUT1 to OUT3 (OFF).

MODBUS support for digital inputs on the 8210

All twelve (12) digital input lines are mapped to MODBUS 100X address references via function 02.

8210 digital input 1 line is addressed as discrete input register zero(hex) in MODBUS parlance.

NOTE these are internal connections ONLY and not available on the side terminals of the 8210.

The upper most input bits are NOT readable here because they form the upper address bits of the PCMCIA card.

The 8210 motherboard logic provides a pullup resistor resulting in LOGIC 1 as the default state.

MODBUS address	8210 digital INPUT register
referred as DISCRETE INPUT 10001	Digital INPUT (INP 1 sense line)
referred as DISCRETE INPUT 10002	Digital INPUT (INP 2 sense line)
referred as DISCRETE INPUT 10003	Digital INPUT (INP 3 sense line)
referred as DISCRETE INPUT 10004	Digital INPUT (INP 4 sense line)
referred as DISCRETE INPUT 10005	Digital INPUT (INP 5 sense line)
referred as DISCRETE INPUT 10006	Digital INPUT (INP 6 sense line)
referred as DISCRETE INPUT 10007	Digital INPUT (INP 7 sense line)
referred as DISCRETE INPUT 10008	Digital INPUT (INP 8 sense line)
referred as DISCRETE INPUT 10009	Digital INPUT (INP 9 sense line)
referred as DISCRETE INPUT 10010	Digital INPUT (INP 10 sense line)
referred as DISCRETE INPUT 10011	Digital INPUT (INP 11 sense line)
-referred as DISCRETE INPUT 10012	Digital INPUT (INP 12 sense line)

The following MODBUS ASCII data string will READ all twelve register values from slave address 11hex:

```
:11020000000CE1<CR><LF><>
```

A typical RESPONSE might be:

```
:1102020FFCE0<CR><LF><>
```

This has TWO bytes returned with INP3 to INP12 set to logic ONE (ON) and INP1 and INP2 (OFF).

The following MODBUS ASCII data string will READ four register values starting at address 8 from slave address 11hex:

```
:110200080004E0<CR><LF><>
```

A typical RESPONSE might be:

```
:1102010FDD<CR><LF><>
```

This has ONE byte returned with INP9 to INP12 set to logic ONE (ON).

MODBUS support for holding registers on the 8210

All HOLDING registers are mapped to MODBUS 400X address references via function 03.

8210 register 40001 is addressed as register zero in MODBUS parlance.

NOTE these are either the 8210 clock registers or PEERXX registers of the 8210. All values returned are 16 bit HEX notation in accordance with MODBUS requirements.

The 8210 will not accept a range greater than eight for this function call.

MODBUS address	8210 digital OUTPUT register
1 –referred as HOLDING register 40001	8210 HOUR register value
2 –referred as HOLDING register 40002	8210 MINUTE register value
3 –referred as HOLDING register 40003	8210 SECOND register value
4 –referred as HOLDING register 40004	8210 YEAR register value
5 –referred as HOLDING register 40005	8210 MONTH register value
6 –referred as HOLDING register 40006	8210 DAY register value
7 –referred as HOLDING register 40007	8210 rain gauge counter value
8 –referred as HOLDING register 40008	8210 TODAYSRAIN reference value
9 –referred as HOLDING register 40101	PEER1 holding register value
10–referred as HOLDING register 40102	PEER2 holding register value
11–referred as HOLDING register 40103	PEER3 holding register value
12–referred as HOLDING register 40104	PEER4 holding register value
13–referred as HOLDING register 40105	PEER5 holding register value
14–referred as HOLDING register 40106	PEER6 holding register value
15–referred as HOLDING register 40107	PEER7 holding register value
16–referred as HOLDING register 40109	PEER8 holding register value
17–referred as HOLDING register 40110	PEER9 holding register value
18–referred as HOLDING register 40111	PEER10 holding register value
19–referred as HOLDING register 40112	PEER11 holding register value
20–referred as HOLDING register 40113	PEER12 holding register value
21–referred as HOLDING register 40114	PEER13 holding register value
22–referred as HOLDING register 40115	PEER14 holding register value
23–referred as HOLDING register 40116	PEER15 holding register value
24–referred as HOLDING register 40117	PEER16 holding register value
25–referred as HOLDING register 40118	PEER17 holding register value
26–referred as HOLDING register 40119	PEER18 holding register value
27–referred as HOLDING register 40120	PEER19 holding register value
28–referred as HOLDING register 40121	PEER20 holding register value
29–referred as HOLDING register 40122	PEER21 holding register value
30–referred as HOLDING register 40123	PEER22 holding register value
31–referred as HOLDING register 40124	PEER23 holding register value
32–referred as HOLDING register 40125	PEER24 holding register value
33–referred as HOLDING register 40126	PEER25 holding register value
34–referred as HOLDING register 40127	PEER26 holding register value

35—referred as HOLDING register 40128	PEER27 holding register value
36—referred as HOLDING register 40129	PEER28 holding register value
37—referred as HOLDING register 40130	PEER29 holding register value

The following MODBUS ASCII data string will READ the date and time values from slave address 11hex:

```
:110300000006E6<CR><LF><>
```

A typical RESPONSE might be:

```
:11030C000C000F001F07CF000C0010<LRC><CR><LF>
```

Meaning 12:15:31 on Dec 16, 1999

The following MODBUS ASCII data string will READ the rain gauge counter and Today's Rain reference from slave address 11hex:

```
:110300060002E6<CR><LF><>
```

A typical RESPONSE might be:

```
:110304000C0002<LRC><CR><LF>
```

Meaning 12-2=10 tips OR 0.1inch of rain has been accumulated on this gauge since the midnight hour.

Note at the midnight hour this same response would be as follows assuming no additional rain fell at this site.

```
:110304000C000C<LRC><CR><LF>
```

Meaning 12-12=0 tips OR 0 inch of rain has been accumulated at this site.

MODBUS support for input registers on the 8210

All sensors are mapped to MODBUS 300X address references via function 04.

Analog1 8210 register 1 or MODBUS 30001 is addressed as register zero in MODBUS parlance.

All values returned by the 8210 are in 16 bit HEX notation in accordance with MODBUS requirements.

The MODBUS response **will read the last measured value** from the 8210 database entry. No LOG readings are possible due to the quick response time required by the MODBUS protocol.

The 8210 will not accept a range greater than six for this function call.

Analog input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
Analog 1 (register 1)	30001	Analog 2 (register 2)	30002
Analog 3 (register 3)	30003	Analog 4 (register 4)	30004
Analog 5 (register 5)	30005	Analog 6 (register 6)	30006
Analog 7 (register 7)	30007	Analog 8 (register 8)	30008
Analog 9 (register 187)	30187	Analog 10 (register 188)	30188
Analog 11 (register 189)	30189	Analog 12 (register 190)	30190
Analog 13 (register 191)	30191	Analog 14 (register 192)	30192
Analog 15 (register 193)	30193	Analog 16 (register 194)	30194

Analog wind direction registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
Wind Dir 1 (register 26)	30026	Wind Dir 2 (register 27)	30027
Wind Dir 3 (register 28)	30028	Wind Dir 4 (register 29)	30029

Internal 8210 registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
Battery (register 34)	30034	Reference (register 44)	30044
Excitation (register 42)	30042	Ground (register 43)	30043
Datapack (register 41)	30041	Timer1 (register 39)	30039
Timer2 (register 40)	30040	Amplifier (register 45)	30045
Optional (register 46)	30046	GoesClock (5000 series register 47)	obsolete

The following MODBUS ASCII data string will READ the battery voltage register 34 value from slave address 11hex:

```
:110400210001C9<CR><LF><>
```

A typical RESPONSE might be:

```
:11040205984C<CR><LF>
```

Meaning 0598(hex) or 1432(decimal) or 14.32
volts(rightdigits=2 in this case)

Digital input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
Pressure port (register 9)	30009	Counter0[rain] (register 12)	30012
Encoder 1 (register 10)	30010	Counter1 (register 13)	30013
Encoder 2 (register 11)	30011	Counter2 (register 14)	30014
		Counter3 (register 15)	30015
		Counter4 (register 16)	30016
Frequency0 (register 17)	30017		
Frequency1 (register 18)	30018	Windspeed1 (register 22)	30022
Frequency2 (register 19)	30019	Windspeed2 (register 23)	30023
Frequency3 (register 20)	30020	Windspeed3 (register 24)	30024
Frequency4 (register 21)	30021	Windspeed4 (register 25)	30025

Extra sensor input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
WaterLevel (register 30)	30030	Outliers (register 31)	30031
Deviation (register 32)	30032	Serial (register 33)	30033
Shaft8500 (register 35)	30035	Rain alarm reg (register 36)	30036
		TdyRain counter (register 37)	30037

SDI sensor 0 input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
SDI 0 value 1 (register 68)	30068	SDI 0 value 5 (register 72)	30072
SDI 0 value 2 (register 69)	30069	SDI 0 value 6 (register 73)	30073
SDI 0 value 3 (register 70)	30070	SDI 0 value 7 (register 74)	30074
SDI 0 value 4 (register 71)	30071	SDI 0 value 8 (register 75)	30075

SDI sensor 1 input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
SDI 1 value 1 (register 77)	30077	SDI 1 value 5 (register 81)	30081
SDI 1 value 2 (register 78)	30078	SDI 1 value 6 (register 82)	30082
SDI 1 value 3 (register 79)	30079	SDI 1 value 7 (register 83)	30083
SDI 1 value 4 (register 80)	30080	SDI 1 value 8 (register 84)	30084

SDI sensor 2 input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
SDI 2 value 1 (register 86)	30086	SDI 2 value 5 (register 90)	30090
SDI 2 value 2 (register 87)	30087	SDI 2 value 6 (register 91)	30091
SDI 2 value 3 (register 88)	30088	SDI 2 value 7 (register 92)	30092
SDI 2 value 4 (register 89)	30089	SDI 2 value 8 (register 93)	30093

SDI sensor 3 input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
SDI 3 value 1 (register 95)	30095	SDI 3 value 5 (register 99)	30099
SDI 3 value 2 (register 96)	30096	SDI 3 value 6 (register 100)	30100
SDI 3 value 3 (register 97)	30097	SDI 3 value 7 (register 101)	30101
SDI 3 value 4 (register 98)	30098	SDI 3 value 8 (register 102)	30102

SDI sensor 4 input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
SDI 4 value 1 (register 104)	30104	SDI 4 value 5 (register 108)	30108
SDI 4 value 2 (register 105)	30105	SDI 4 value 6 (register 109)	30109
SDI 4 value 3 (register 106)	30106	SDI 4 value 7 (register 110)	30110
SDI 4 value 4 (register 107)	30107	SDI 4 value 8 (register 111)	30111

SDI sensor 5 input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
SDI 5 value 1 (register 113)	30113	SDI 5 value 5 (register 117)	30117
SDI 5 value 2 (register 114)	30114	SDI 5 value 6 (register 118)	30118
SDI 5 value 3 (register 115)	30115	SDI 5 value 7 (register 119)	30119
SDI 5 value 4 (register 116)	30116	SDI 5 value 8 (register 120)	30120

SDI sensor 6 input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
SDI 6 value 1 (register 122)	30122	SDI 6 value 5 (register 126)	30126
SDI 6 value 2 (register 123)	30123	SDI 6 value 6 (register 127)	30127
SDI 6 value 3 (register 124)	30124	SDI 6 value 7 (register 128)	30128
SDI 6 value 4 (register 125)	30125	SDI 6 value 8 (register 129)	30129

SDI sensor 7 input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
SDI 7 value 1 (register 131)	30131	SDI 7 value 5 (register 135)	30135
SDI 7 value 2 (register 132)	30132	SDI 7 value 6 (register 136)	30136
SDI 7 value 3 (register 133)	30133	SDI 7 value 7 (register 137)	30137
SDI 7 value 4 (register 134)	30134	SDI 7 value 8 (register 138)	30138

SDI sensor 8 input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
SDI 8 value 1 (register 140)	30140	SDI 8 value 5 (register 144)	30144
SDI 8 value 2 (register 141)	30141	SDI 8 value 6 (register 145)	30145
SDI 8 value 3 (register 142)	30142	SDI 8 value 7 (register 146)	30146
SDI 8 value 4 (register 143)	30143	SDI 8 value 8 (register 147)	30147

SDI sensor 9 input registers

8210 sensor value	MODBUS address	8210 sensor value	MODBUS address
SDI 9 value 1 (register 149)	30149	SDI 9 value 5 (register 153)	30153
SDI 9 value 2 (register 150)	30150	SDI 9 value 6 (register 154)	30154
SDI 9 value 3 (register 151)	30151	SDI 9 value 7 (register 155)	30155
SDI 9 value 4 (register 152)	30152	SDI 9 value 8 (register 156)	30156