Sequence of Events Recorder

984 Ladder Logic Function Blocks

Users Guide

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1.0 SER SYSTEM OVERVIEW

The Sequence of Events Recorder (SER) provides a permanent record of events which occur within milliseconds of each other, such as the operation of circuit breakers or the shutdown sequences of compressors and other high speed devices. The SER will provide the time of the event, the state of the point, and the point identification.

Multiple SER cards may be synchronized together to provide a distributed event recording system. Interface cards are available to synchronize the SER cards with an external time standard such as a Global Positioning Satellite (GPS) receiver.

1.1 SER FUNCTION BLOCKS

The SER function blocks provide an easy means of both configuring and gathering data from the SER cards. When the controller is reset, the function blocks will configure the SER cards and scan for event data. When an event is detected, the function blocks will build a buffer containing the event data and either send it over Modbus Plus to a receiving drop, or hold the buffer until a host computer polls the PLC for the data.

2.0 INSTALLATION

The 984 Ladder Logic function blocks provided with the SER card are usable in both the Modsoft and Concept programming packages.

2.1 MODSOFT

If you are using the Modsoft programming software, the SER function blocks are loaded into a PLC configuration with the following sequence of key strokes:

1. Select the PLC configuration
2. Press <F7> (Loadable) in order to select the screen shown below.
3. Press <F3> (Directory)
4. Press <F1> (Load). Modsoft pops up a window in which the DOS file name must be entered. If, for example, the loadable file CARD.DAT is stored in the directory C:\MODSOFT\PROGRAMS, then enter C:\MODSOFT\PROGRAMS\CARD.DAT in this window.
5. Modsoft will announce that the Loadable CARD is now accessible.
6. Repeat steps 4. and 5. for CMBP.DAT and CLCK.DAT.
7. Press <Enter> until a window shows the list of currently available loadables.
8. Select the loadable CARD with <CrsUp>, <CrsDn>, and <Enter> key. Press the <CrsDn> key.
9. Press <Enter> until a window shows the list of currently available loadables.
10. Select the loadable CMBP with <CrsUp>, <CrsDn>, and <Enter> key. Modsoft will respond with a window showing the remaining loadable opcodes. Select an opcode not used for CARD. Press the <CrsDn> key.
11. Press <Enter> until a window shows the list of currently available loadables.
12. Select the loadable CLCK with <CrsUp>, <CrsDn>, and <Enter> key. Modsoft will respond with the window showing the remaining loadable opcodes. Select an opcode not used for CARD or CMBP.

After this sequence, the Loadable Configuration screen looks as follows. The opcodes available for use by the loadable depend on the specific 984 PLC in use. Thus, the DX Loadable Configuration may require adjustment of opcodes when the SER ladder logic is ported to a different 984 PLC.

```
Utility           Dir      Edit                                          Quit
F1———————F2———————F3———————F4———————F5———————F6———————F7—Lev 8—F8—OFF——F9———————┐
│                                                                                 │
│      DX Loadable Configuration              ╔═══════════════════════════╗       │
│                                             ║ DX Memory Used: 2112      ║       │
│                                             ║ Total Memory Avail: 13315 ║       │
│     Name   Rev     Size    Opcode           ╚═══════════════════════════╝       │
│     ═══════════════════════════             ═══════════════════════════         │
│     CARD   193     1472      1f                                                 │
│     CMBP   193     336       3f                                                 │
│     CLCK   193     304       5f                                                 │
│                                                                                 │
│                                                                                 │
│                                                                                 │
│                                                                                 │
│                                                                                 │
│                                                                                 │
│                                                                                 │
└Press 'Enter' or '?' to view current loadable selection list———————————————————┘
```

The CARD loadable requires the Time of Day clock to be configured.

```
Utility           OverView I/OMap   Ports    Segmnts  Loadable Cfg Ext  Quit
F1———————F2———————F3———————F4———————F5———————F6———————F7—Lev 8—F8—OFF——F9———————┐
│                        CONFIGURATION OVERVIEW                                   │
│                                  │  Size of Full Logic Area  13867              │
│     PLC  :                       │  No. of I/O Map Words     00015              │
│     PLC Type       984 -    685  ├──────────────────────────────────────        │
│     Exec Pack                914  │  I/O  :    I/O Type       800               │
│     Memory                 16.0K  │  Number of Segments       32                │
│     Extended Memory            K  │  IO Drops / Channel Pairs 1                 │
│     Redundant                  N  │  I/O Modules              1                 │
│     DCP Drop ID                   ├──────────────────────────────────────        │
│    ———————————————————————————   │  Specials  :                                │
│                                   │  Battery Coil             0-----            │
│      Ranges   :                   │  Timer Register           4-----            │
│      0xxxx    00001  - 01536      │>>Time of Day Clock        41500  - 41507<<  │
│      1xxxx    10001  - 10512      │                                             │
│      3xxxx    30001  - 30048      ├──────────────────────────────────────       │
│      4xxxx    40001  - 41872      │  ASCII:                                     │
│      4xxxx for SFC      None      │  Number of Messages       0                 │
│                                   │  Message Area Size        0                 │
│    ———————————————————————————   │  Number of ASCII Ports    0                 │
│      0xxxx for SFC      None      │  Simple ASCII Output                        │
│                                   │  Simple ASCII Input                         │
└I/O Map is the traffic cop which links the I/O modules to program logic.         ┘
```

2.2 CONCEPT

If you are using the Concept programming software, the SER function blocks are loaded into a PLC configuration with the following commands:

1. Copy the loadables (CARD.DAT, CMBP.DAT, CLCK.DAT) to the C:CONCEPT\DAT subdirectory.
2. Start Concept
3. Open your project.
4. Select PROJECT, then select CONFIGURATOR.
5. Select CONFIGURE, then select LOADABLES.
6. From the Loadables screen select UNPACK.
7. From the Unpack Loadable File screen under List Files of Type select DX Loadables (*.dat).
8. Select the C:CONCEPT\DAT subdirectory and then select the CARD.DAT loadable and select OK.

9. Repeat the previous step for the CMBP.DAT and CLCK.DAT loadables.
10. From the Loadables screen select each loadable and select INSTALL.

3.0 SER FUNCTION BLOCKS

The SER Function blocks perform three separate functions. Each of these functions is implemented in a separate loadable.

For every SER module mounted in a PLC, one instance of the SER Card (CARD) function block in ladder logic is required. The purpose of this function block is to upload SER events from the SER module to which it is assigned, and store the events in a SER event buffer in the PLC.

The SER Common Buffer Management (CMBP) function block is responsible for managing a common buffer into which events uploaded by all SER CARD function blocks are placed. When an event buffer is ready to be read, the CMBP function block will turn on an output indicating that data is ready. This output can either be polled by master computer and the data gathered when the CMBP indicates a buffer is ready, or the output may be connected to a MSTR block which will automatically send the event data over Modbus Plus to a BM85E Bridbe Mux, or a PC with a SA85 card. The CMBP function block is used only once in each PLC.

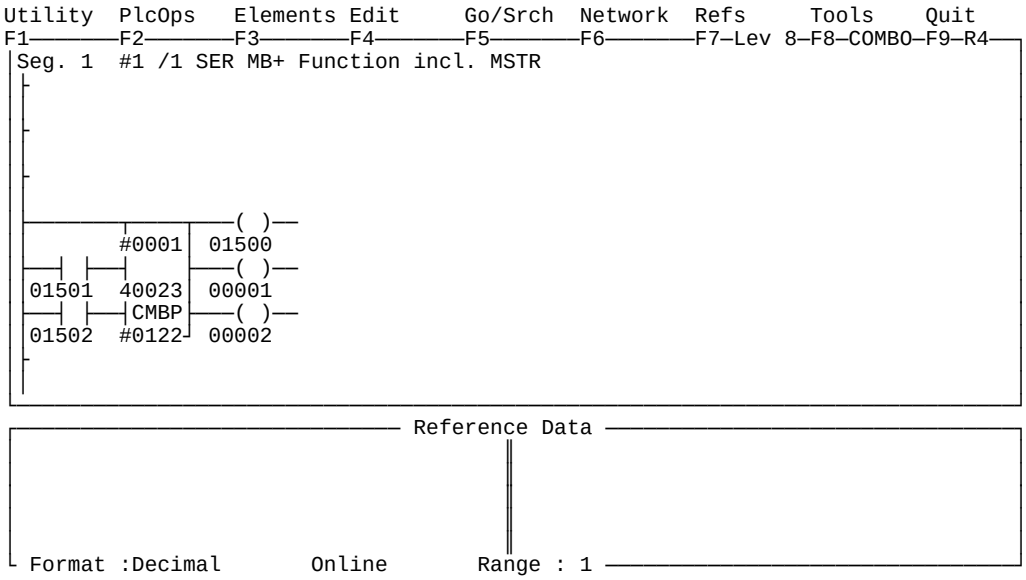
The SER Clock (CLCK) function block is optional. It is also used only once in each PLC. Its purpose is to set the PLC's time of day clock to the time received from a SER card, or to set the time in an SER card to the time in the PLC’s time of day clock.

3.1 SER FUNCTION BLOCK OVERVIEW

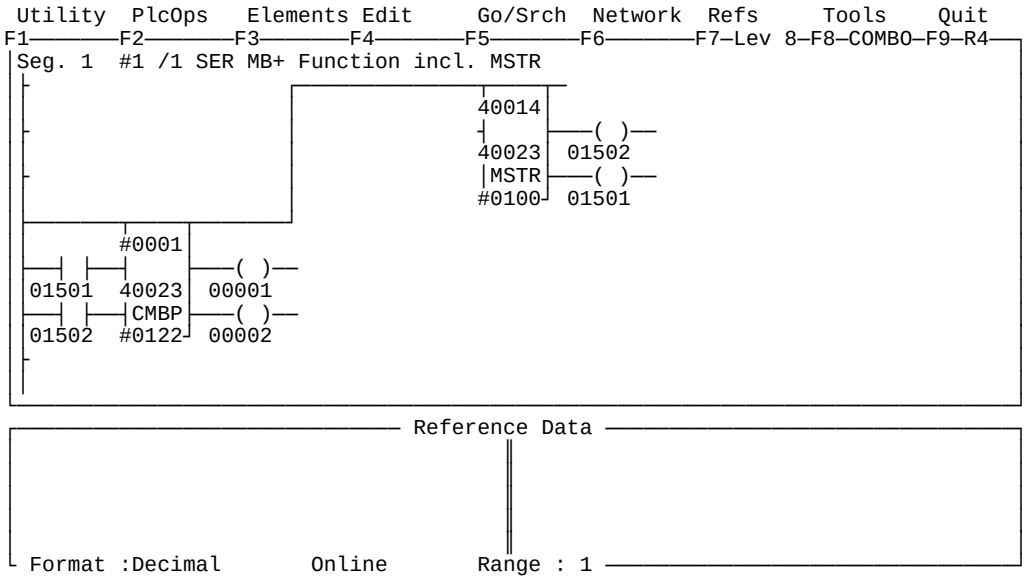
The various function blocks are used in ladder logic as follows.

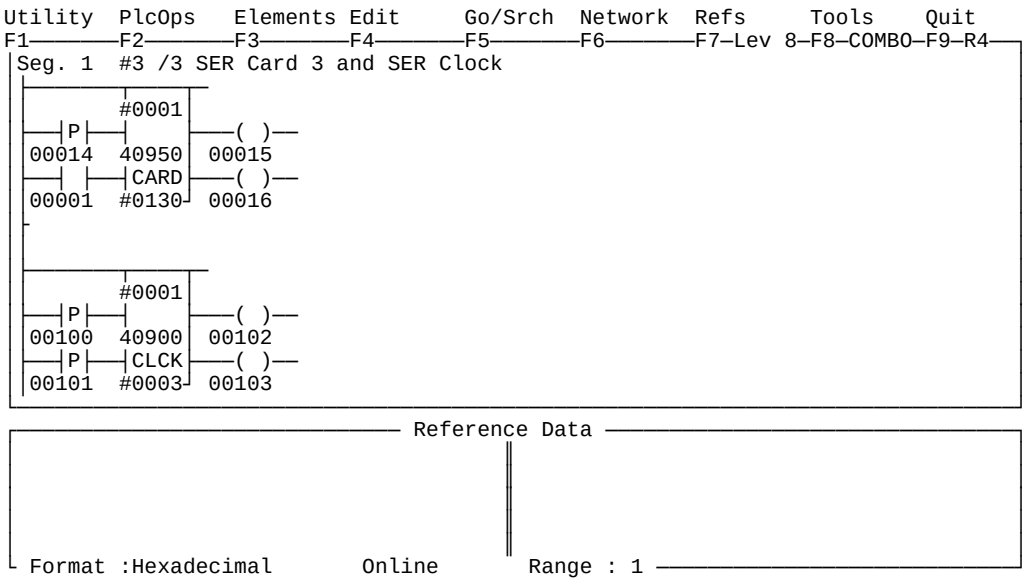
Loadable Name	Function	Description
CMBP	SER Buffer Management	Manages the common SER buffer and provides an output indicating that an event buffer is ready to be read and an input to acknowledge that the buffer has been read. The block can also be configured to control an MSTR function block which sends the SER events from the PLC's SOE event buffer to a BM85 Bridge Mux, or a PC with a SA85 card.
CARD	SER Card Loadable	Uploads the SOE events from a specific SER module to a common buffer used by all SER modules, in the PLC's 4x registers.
CLCK	SER Clock Loadable	Allows the PLC's Time of Day clock to be set with the time from SER module, and vice versa if necessary. The use of this loadable is optional.

The following example shows a CMBP function block being used to manage the event buffer in a polled application. When the event buffer is empty, coil 1500 will be OFF. When the event buffer has data ready to be read, coil 1500 will turn ON. The application responsible for gathering the data will poll the PLC for the state of coil 1500. When the application sees that coil 1500 has been set, it will read the registers that contain the event data. The application will then turn ON and OFF coil 1501 to acknowledge that it has read the data. The CMBP block will then turn off coil 1500 and start building a new event buffer.



The following example shows a CMBP function block being used to manage the event buffer in an unsolicited data transfer application. When an event buffer is ready for transmission, the top output of the CMBP block will turn ON. This will enable the MSTR block, which will then transmit the 4X registers containing the event buffer, to a receiving Modbus Plus device. If the transmission is not successful, the middle output of the MSTR block will turn ON, forcing the CMBP block to retransmit the message. If the transmission is successful, the bottom output of the MSTR block will tun ON, forcing the CMBP block to turn it's top output OFF, and to start building a new event buffer.





3.2 SER CARD FUNCTION BLOCK

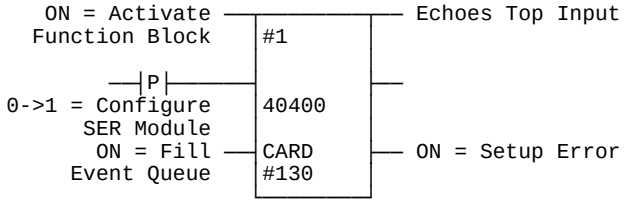
3.2.1 SER CARD FUNCTION BLOCK PROGRAMMING

The SER Card function block can be inserted in ladder logic by selecting CARD from the Modsoft loadable menu. The top node must be set to 1. The middle node indicates the first of 130 4x registers required to setup the function block and to configure the input points on the SER card. The length 130 is entered in the bottom node of the function block. In the example shown below, the registers 40400 through 40529 are used for the function block. Of course, the function block may be used with any 4x register.

NOTE: The registers for each function block must not overlap. With a starting address of 40400 and length of 130 registers as shown above, registers 40400 through 40529 are occupied. The next function blocks may be placed at 40530, 40660, 40790, etc.

The top input must always be set to ON in order for the function block to be active. The middle input should be used with a positive transitional contact. Whenever there is a positive transition, the SER module is configured with the parameters discussed below.

The bottom input must be connected to a contact controlled by the middle output of the SER Common Buffer Management (CMBP) function block. This contact ensures that the SER Card function blocks cannot add SOE events from the SER module to the common SER event buffer while that buffer is being transmitter. As soon as the event data has been transmitted, the middle output of the CMBP function block, and subsequently the bottom input of the SER Card function blocks, are turned ON again, enabling the SER Card function blocks to upload new SER events from the SER modules.



The top output echoes the top input of the function block.

The bottom output is turned ON for illegal function block setup parameters.

3.2.2 SER CARD FUNCTION BLOCK PARAMETERS

The SER Card parameters can be entered using the Modsoft reference editor or the loadables template. These parameters can also be changed as needed by the ladder logic program during its execution. Please note that the addresses for the parameters are relative to the register address in the middle node of the function block as shown above.

The following template pages can be invoked in Modsoft using the key combination <Alt>-Z when the ladder logic cursor is placed on the SER Card function block. Templates are not supported by Concept.

```
Utility           Hex      Dec      Bin      Goto                        Quit
F1———————F2———————F3———————F4—— DX Zoom Editor ———————F7—Lev 8—F8—OFF———F9———————
|                                                                  Page 1 / 14
|         SER Module Setup V1.96 by Monaghan Engineering, Inc. (C) 1998
|              ————————————————————————————————————————————
|
|                         CARD FUNCTION BLOCK-I/O MAP LINK
|   SER Card's First 1x Addr. in I/O Map [xxxx] 40497  INT   = 1           DEC
|   SER Card's First 0x Addr. in I/O Map [xxxx] 40498  INT   = 1           DEC
|
|                  CARD FUNCTION BLOCK-CMBP FUNCTION BLOCK LINK
|   Register in Middle Node of CMBP Loadable    40499  INT   = 23          DEC
|
|   Card Number (0-31)                          40500  INT   = 0           DEC
|
|                          INPUT POINT PARAMETERIZATION
|   Parameterize 0=All Points Individually      40503  INT   = 1
|                1=Copy Point #1 Parameters
|   Re-parameterize Points on Power Reset 0=No  40504  INT   = 1
|                                         1=Yes
|   Input Filter (0-Off 1-On)                   40505  BIT16 = 0
|   Time Sync Master (0-Off 1-On)               40505  BIT15 = 0
|
|
└———————————————————————————————————————————————————————————————————————————
```

Address of First 1x Input in I/O Map

Range: depends on number of 1x inputs in PLC configuration

Offset: +97

Usage: The SER Card function block must read the values from the SER module through 1x inputs. In this case, the 1x inputs used by the SER module are 10001 through 10064. Please note that the address entered here must match a 1x address as entered in the PLC's I/O map for the SER module. The first 32 inputs, in this case 10001 through 10032, are used to report the status of each of the 32 status inputs. 10033 through 10064 are used for internal purposes.

Note: This value must vary for all SER Card function blocks, and must not be changed by ladder logic.

Address of First 0x Output in I/O Map

Range: Depends on number of 0x outputs in PLC configuration

Offset: +98

Usage: The SER Card function block must write commands to the SER module. For this purpose, the function block needs to know the 0x outputs reserved in the PLC's I/O map for communication with the SER module. The registers are reserved for internal use. In this case, the 0x outputs used are 00001 through 00064.

Note: This value must vary for all SER Card function blocks, and must not be changed by ladder logic.

Base Register of CMBP Function Block

Range: Depends on number of 4x registers in PLC configuration

Offset: +99

Usage: Every SER Card function block must store the events uploaded from the associated SER modules in the same event buffer. The address entered in this field is the register address in the middle node of the CMBP function block which manages this common buffer. In this case, this address is 40023, as can also be seen in the above ladder logic.

Note: This value must be identical for all SER Card function blocks, and must not be changed by ladder logic.

Card Number
Range: 0..31
Offset: +100
Usage: The card number identifying on which card the event originated.
Note: This value must vary for all SER Card function blocks, and must not be changed by ladder logic.

Parameterize All Points Individually/Copy Point #1 Parameters
Range: 0, 1
Offset: +103
Usage: For a value of 0, all 32 points are parameterized with the parameters entered individually for every point. However, if all 32 points operate with the same parameters, these parameters need to be entered only once for point 1. For a value of 1, the parameters for point 1 are used to parameterize all 32 points.
Note: This value can be set in ladder logic, or through Modbus Plus as needed prior to triggering the middle input of the function block in order to configure the SER module.

Re-parameterize Points on Power Reset
Range: 0, 1
Offset: +104
Usage: Whenever an SER input point is parameterized by the CARD function block, the function block sets an internal flag to mark the parameterization of that point. Since the SER module cannot preserve any parameterizations through a power cycle, all point parameters are reset to their default values after a power cycle. Therefore, the function block re-parameterizes all points of the SER cards which have been parameterized before, as indicated by the internal flags, if this register is set to 1. If re-parameterization is not desired, this register must be set to 0. In this case, all SER card input points use their default parameters after a power cycle. In addition, the internal flag marking previous parameterization, is reset.
Note: This value can be set in ladder logic, or through Modbus Plus. The value will affect point parameterization only when the Power On Reset event is received from the SER card. Whenever a point is re-parameterized, the parameters currently stored in the three parameter registers associated with that point are used.

Input Filter
Range: 0, 1
Offset: +105 Bit 16
Usage: For a value of 0, the input points will be passed to the processor immediately when they change. For a value of 1, the filter value for each point will be used to filter the inputs before they are passed to the processor.
Note: This value can be set in ladder logic, or through Modbus Plus as needed prior to triggering the middle input of the function block in order to configure the SER module.

Time Sync Master
Range: 0, 1
Offset: +105 Bit 15
Usage: For a value of 0, the SER card will receive time sync messages from a time sync master. For a value of 1, the SER card will act as a Time Sync Master, and send out time sync messages to other cards..
Note: This value can be set in ladder logic, or through Modbus Plus as needed prior to triggering the middle input of the function block in order to configure the SER module.

All 32 points can be configured individually with a template as follows. These values can also be changed in ladder logic or through Modbus Plus, depending on a specific application.

```
Utility           Hex      Dec      Bin      Goto                        Quit
F1———————F2———————F3———————F4—— DX Zoom Editor ———————F7—Lev 8—F8—OFF——F9———————┐
|                                                                    Page 2 / 14 |
|         SER Module Setup V1.96 by Monaghan Engineering, Inc. (C) 1998          |
|                  ————————————————————————————————————————————               |
|   DIGITAL INPUT #1                                                            |
|     Contact Filter Time (0-65535ms)          40400  INT   = 10          DEC   |
|     Contact Debounce Time (0-65535ms)        40401  INT   = 20          DEC   |
|     Chatter Count (0-255)                    40402  01:08 = 4           DEC   |
|     Scan Status (0-On 1-Off)                 40402  BIT16 = 0                 |
|                                                                               |
|   DIGITAL INPUT #2                                                            |
|     Contact Filter Time (0-65535ms)          40403  INT   = 4000        DEC   |
|     Contact Debounce Time (0-65535ms)        40404  INT   = 5000        DEC   |
|     Chatter Count (0-255)                    40405  01:08 = 6           DEC   |
|     Scan Status (0-On 1-Off)                 40405  BIT16 = 0                 |
|                                                                               |
|   DIGITAL INPUT #3                                                            |
|     Contact Filter Time (0-65535ms)          40406  INT   = 10          DEC   |
|     Contact Debounce Time (0-65535ms)        40407  INT   = 20          DEC   |
|     Chatter Count (0-255)                    40408  01:08 = 10          DEC   |
|     Scan Status (0-On 1-Off)                 40408  BIT16 = 0                 |
|                                                                               |
|                                                                               |
└———————————————————————————————————————————————————————————————————————————┘
```

The following set of parameters can be entered for all 32 points.

Contact Filter Time
- Range: 0..65535
- Offset: +0, +3, +6, +9, +12, ...
- Default: 20 ms
- Usage: The purpose of the contact filter time is to eliminate false event messages caused by noise. The filter time is the amount of time that a point must stay in a new state in order to be recognized as an event. As an example, if the filter time for a point is set to 25 milliseconds, then when the input changes state it must remain in the new state for 25 milliseconds before and event message is generated. If the input returns to the previous state in less than 25 milliseconds, the filter is reset and the next time the state changes it will again have to remain in that state for 25 milliseconds before an event message is generated. The time that is associated with the event is the time at which the point first changed, not the time when the filter recognized the event. If two input points that different input filter values were to change at the same time, the event messages would be generated at different times but the time that was contained in the event message would be identical.
- Note: This value can be set in ladder logic, or through Modbus Plus as needed prior to triggering the middle input of the function block in order to configure the SER module.

Contact Debounce Time
- Range: 0..65535
- Offset: +1, +4, +7, +10, +13, ...
- Default: 10 ms
- Usage: The purpose of the contact debounce time is to prevent multiple events from being generated from a single contact closure. The debounce time is the amount of time that input processing is disabled for a point after an event has been recorded
- Note: This value can be set in ladder logic, or through Modbus Plus as needed prior to triggering the middle input of the function block in order to configure the SER module.

Chatter Count
- Range: 0..255
- Offset: 8 MSB bits of +2, +5, +8, +11, +14, ...
- Default: 10

Usage: This parameter determines the maximum number of status changes allowed per minute before the point is taken off scan. Once a point is taken off scan, it will be put on scan again after being at least one minute below the chatter count.

Examples: Point A is taken off scan at 07:14:52.253
--> Point A goes back on scan at 07:16:00.000
Point B is taken off scan at 07:14:05.745
--> Point B goes back on scan at 07:16:00.000

Note: This value can be set in ladder logic, or through Modbus Plus as needed prior to triggering the middle input of the function block in order to configure the SER module.

Scan Status

Range: 0, 1

Offset: LSB bit of +2, +5, +8, +11, +14, ...

Default:0 (on scan)

Usage: A point can be taken off scan manually for maintenance and testing by setting the scan status to 1 (off scan), and then reconfiguring that point or set of points.

Note: This value can be set in ladder logic, or through Modbus Plus as needed prior to triggering the middle input of the function block in order to configure the SER module.

The following template page shows the function block status. It is to be used for read-only.

```
Utility           Hex      Dec      Bin      Goto                        Quit
F1———————F2———————F3———————F4—— DX Zoom Editor ———————F7—Lev 8—F8—OFF——F9———————┐
│                                                                      Page 13 / 14
│        SER Module Setup V1.96 by Monaghan Engineering, Inc. (C) 1998
│              ————————————————————————————————————————————————————
│   SER Loadable Status (Bit ON = Error)      40528  INT   = 0000000000000000
│      7   Top Node Must Be Constant 1-32  12   Illegal Low Point Number
│      8   TOD Clock Not Configured        13   Illegal SER MB+ Block Addr
│      9   Illegal Configuration Op        14   Illegal 0x I/O Map Address
│     10   High Point < Low Point          15   Illegal 1x I/O Map Address
│     11   Illegal High Point Number       16   Illegal Table Length
│
│   SER Time Quality  00: Good  01: Fair      40526 15:16 = 00
│                    10: Poor  11: Bad
│
│   SER Sync Status ( 0 = Sync  1 = No Sync)  40524 INT   = 0           DEC
│
│   CARD Loadable Version                     40527 INT   = 196
│   SER Card Firmware Version                 40525 INT   = 290         DEC
│
│
└———————————————————————————————————————————————————————————————————————
```

SER Module Status

Range: ---

Offset: +128

Usage: This register contains the SER Card function block status. Its primary purpose is to aid debugging during the programming and testing of the ladder logic program. Whenever a bit is turned on, a certain error condition is present.

Bit	Error Condition
16 (LSB)	Table length in bottom node of function block must be set to 130.
15	The 0x address entered in the function block is outside the valid 0x addresses as configured in the PLC's configuration. For example, if the inputs 10001 through 10512 are configured, the highest valid 1x address would be 10449, since the SER module requires 64 1x inputs.
14	The 0x address entered in the function block is outside the valid 0x addresses as configured in the PLC's configuration. For example, if the outputs 00001 through 01536 are configured, the highest valid 0x address would be 01473, since the SER module requires 64 0x outputs.
13	The 4x address entered is not the base address in the middle node of the SER Modbus Plus function block.
9	The selected configuration operation must be 0 (configure all points individually) or 1 (configure all points with parameters from point 1). Other values are not allowed.
8	The Time of Day Clock must be configured.
7	The card number must be a value from 0 to 31.

Note: This value is read-only.

SER Time Quality
Range: 00-11 in the two LSB bits
Offset: +126
Usage: This register contains the current quality of the SER time stamps, in the two MSB bits. The values are as follows:

Bit	Quality
1 2 3-16	
0 0 x..x	Good, accuracy is GMT +/- 1ms
0 1 x..x	Fair, accuracy is GMT +/- 50ms
1 0 x..x	Poor, accuracy is GMT +/- 50ms or worse
1 1 x..x	Bad, no time reference available

Note: This value is read-only.

SER Sync Status
Range: 0, 1
Offset: +124
Usage: This register contains the current sync status for the SER card. For a value of 0, the card is receiving time sync messages. For a value of 1, the card is not receiving time sync messages.
Note: This value is read-only.

CARD Loadable Version
Range: --
Offset: +127
Usage: This register contains the version of the CARD loadable.
Note: This value is read-only.

SER Card Firmware Version
Range: --
Offset: +125
Usage: This register contains the version of the firmware in the SER card.
Note: This value is read-only.

3.3 SER BUFFER MANAGEMENT FUNCTION BLOCK

The SER Common Buffer Management function block (CMBP) can be programmed to operate in a slave mode where the event data is gathered by a host computer by polling the PLC. The CMBP block can also operate in a master mode by using an MSTR block to send the event data to another Modbus Plus node.

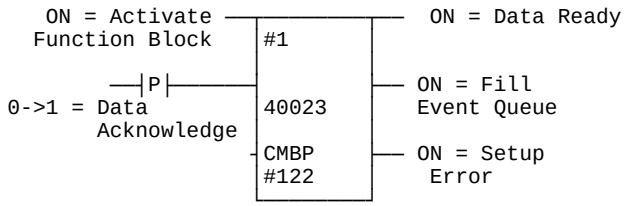
3.3.1 SER BUFFER MANAGEMENT FUNCTION BLOCK PROGRAMMING SLAVE MODE

The SER Common Buffer Management function block can be inserted in ladder logic by selecting CMBP from the Modsoft loadable menu. The top node must always be set to #1. The middle node indicates the first of 122 4x registers required to manage the common event buffer. The length 122 is entered in the bottom node of the function block. In the example shown below, the registers 40023 through 40145 are used for the function block. Of course, the function block may be used with any 4x register.

The top input must always be set to ON in order for the function block to be active.

The middle input should be used with a positive transitional contact (—┤P├—). This input functions as a buffer acknowledge input. When the CMBP function block is being used in a polled application, after the host computer has read the buffer, it will then turn on and then turn off this input to force the CMBP block to start building a new buffer. After the event buffer has been acknowledged, the middle output will be turned ON in order to enable the SER Card function blocks to upload new events from the SER modules.

The bottom input is not used in a polled application.



Once the event buffer is full, or the time delay after putting an event in the buffer is up, the top output is turned ON to indicate that an event buffer is ready.

The middle output is set to ON when the event buffer not full. This enables the SER Card function blocks to upload events from the SER modules, and to store them in the event buffer. Once the event buffer is full, or the time delay after putting an event into the event buffer is up, the middle output is turned OFF in order to ensure the integrity of the event buffer.

The bottom output is turned on for illegal function block setup parameters.

3.3.1 SER BUFFER MANAGEMENT FUNCTION BLOCK PROGRAMMING MASTER MODE

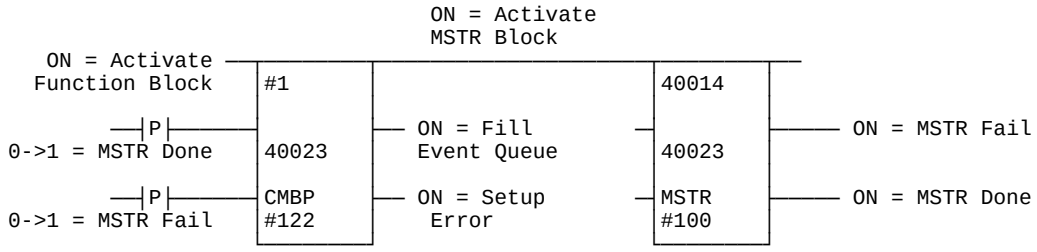
The SER Common Buffer Management function block can be inserted in ladder logic by selecting CMBP from the Modsoft loadable menu. The top node must always be set to #1. The middle node indicates the first of 122 4x registers required to manage the common event buffer. The length 122 is entered in the bottom node of the function block. In the example shown below, the registers 40023 through 40145 are used for the function block. Of course, the function block may be used with any 4x register.

The top input must always be set to ON in order for the function block to be active.

The middle input should be used with a positive transitional contact (—┤P├—). This input functions as a buffer acknowledge input. When the CMBP function block is being used with an MSTR function block,

the bottom output of the MSTR, successful completion, is connected to the middle input of the CMBP. After the positive transition of the middle input to the CMBP function block, the middle output will be turned ON in order to enable the SER Card function blocks to upload new events from the SER modules.

The bottom input should be used with a positive transitional contact (—┤P├—). This input functions as a buffer retransmit input. This input is used with an MSTR block to force the event buffer to be retransmitted if the MSTR block does not successfully complete a transmission. The middle output of the MSTR, unsuccessful completion, is connected to the bottom input of the CMBP. After the positive transition of the bottom input to the CMBP block, the top output will be turned off for the time configured for the Send Delay for the First Event. The top output will then be turned back on to re-trigger the MSTR block.



Once the event buffer is full, or the time delay after putting an event in the buffer is up, the top output is turned ON in order to activate the MSTR function block. The top output remains ON until the MSTR function block feeds back a transmission completion through the middle input.

The middle output is set to ON when no Modbus Plus transmission is active. This enables the SER Card function blocks to upload events from the SER modules, and to store them in the event buffer. Once the event buffer is full, or the time delay after putting an event into the event buffer is up, the middle output is turned OFF in order to ensure the integrity of the event buffer.

The bottom output is turned on for illegal function block setup parameters.

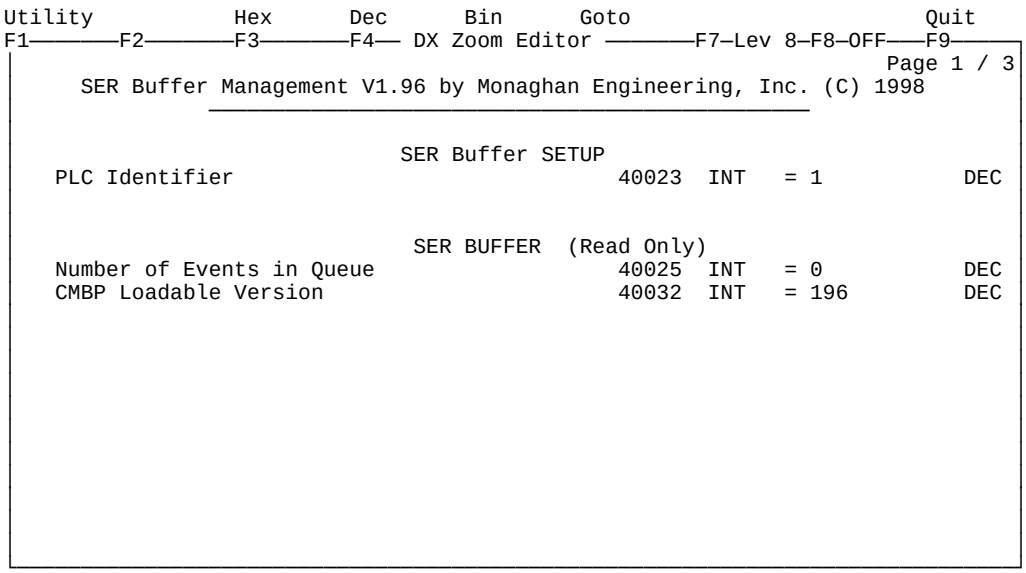
There is always a MSTR function block associated with the CMBP function block when it is used in master mode. The address in the middle node of the MSTR function block must be equal to the address in the middle node of the CMBP function block. The table length in the bottom node of the MSTR function block must be set to 100.

All parameters in the MSTR function block are set using the MSTR template

3.3.2 SER BUFFER MANAGEMENT FUNCTION BLOCK PARAMETERS

The SER Modbus Plus parameters can be entered using the Modsoft reference editor or the loadables template. These parameters can also be changed as needed by the ladder logic program during its execution. Please note that the addresses for the parameters are relative to the register address in the middle node of the function block as shown above.

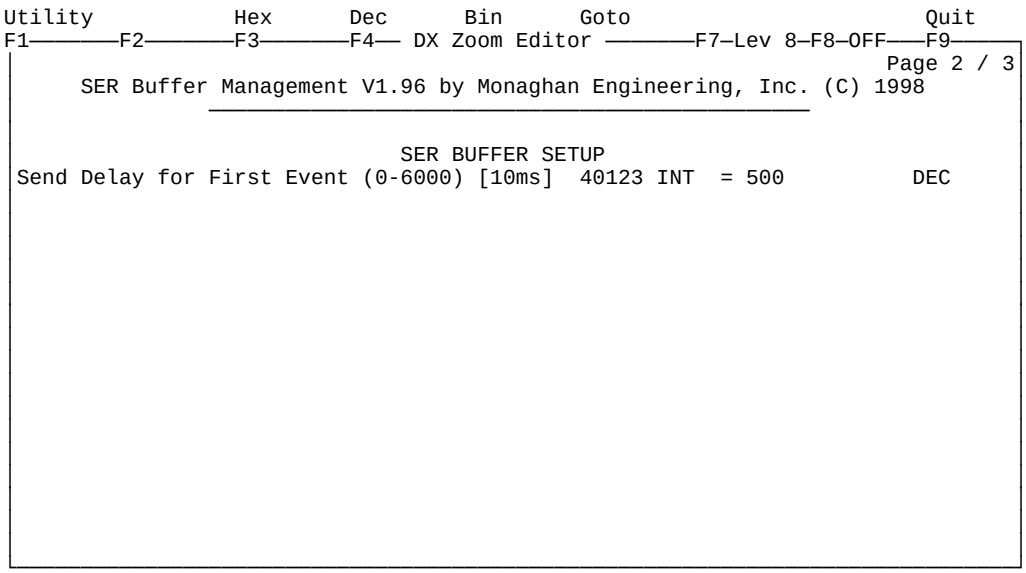
The following template pages can be invoked in Modsoft using the key combination <Alt>-Z when the ladder logic cursor is placed on the SER Modbus Plus function block.



PLC Identifier
Range: 0..32767
Offset: +22
Usage: Any input point must be identified by PLC in addition to SER module number and the actual point number in order to ensure proper system-wide identification. In case, all events are tagged as events from PLC 2, regardless of the SER module within PLC 2.
Note: This value must be unique for all PLCs in the SER system in order to properly identify SOE events, and should not be changed by ladder logic.

Number of Events in Queue
Range: 0..30
Offset: +2
Usage: This register contains the current number of events in the event buffer. For every new event in the event buffer, the register is incremented by 1. When the event buffer is acknowledged, the register is set to 0. Since the event buffer may hold a maximum of 30 events, the values ranges between 0 and 30.
Note: This value is read-only.

CMBP Loadable Version
Range: --
Offset: +9
Usage: This register contains the version of the CMBP loadable.
Note: This value is read-only.



Send Delay for First Event [10ms]

Range: 0..6000 (0..60 seconds)

Offset: +100

Usage: When an event is placed in the event buffer, the event buffer ready output is delayed by this delay factor, whose unit is 10ms. For example a value of 500 indicates a delay of 5 seconds. If within 5 seconds another event is placed in the event buffer, the delay timer is reset. However, the current event buffer is sent when (a) the delay time is up, and no additional event has been placed in the event buffer, or (b) the delay time is not up yet, but the event buffer has been filled entirely, i.e. there are 30 events in the event buffer. In this case, the event buffer is sent as soon as the 30th event is stored in the event buffer. If the delay time is set to 0, every event is sent out immediately.

Note: This value may be changed by ladder logic, depending on the specific application.

3.4 SER CLOCK FUNCTION BLOCK

The use of SER Clock loadable is only necessary if:

- the application requires the PLC's time of day clock to be set from an external time standard
- the SER modules are operated without an external time standard, and therefore require the SER clocks to be set with the PLC's time of day clock

Absence of the SER Clock loadable does not affect the operation of the SER Card function blocks or the SER Common Buffer Management function block.

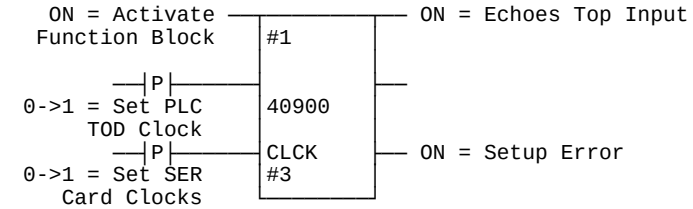
3.4.1 SER CLOCK FUNCTION BLOCK PROGRAMMING

The SER Clock function block can be inserted in ladder logic by selecting CLCK from the Modsoft loadable menu. The top node must always be set to #1. The middle node indicates the first of three 4x registers required for this function block. The length 3 is entered in the bottom node of the function block. In the example shown below, the registers 40900 through 40902 are used for the function block. Of course, the function block may be used with any 4x register.

The top input must always be set to ON in order for the function block to be active.

The middle input should be used with a positive transitional contact. When the contact is triggered, the PLC's time of day clock is set with the time from the SER module specified in the function block configuration.

The bottom input should be used with a positive transitional contact. When the contact is triggered, the function block writes the current time from the PLC's time of day clock to the SER card specified in the function block configuration.



The top output echoes the top input.

The bottom output is turned ON for illegal function block setup parameters.

3.4.2 SER CLOCK FUNCTION BLOCK PARAMETERS

The SER Clock parameters can be entered using the Modsoft reference editor or the loadables template. These parameters can also be changed as needed by the ladder logic program during its execution. Please note that the addresses for the parameters are relative to the register address in the middle node of the function block as shown above.

The following template pages can be invoked in Modsoft using the key combination <Alt>-Z when the ladder logic cursor is placed on the SER Clock function block.

In this example, the SER Clock Loadable uses the CARD function block at 40400-40529 to set the PLC's time of day clock, or the SER card's internal clock. Once the SER card's clock is set, the SER card will send the new time to all other SER cards. Therefore, this SER card associated with the function block at address 40400, must be set up to contain the master clock.

```
Utility          Hex      Dec      Bin      Goto                        Quit
F1———————F2———————F3———————F4—— DX Zoom Editor ———————F7—Lev 8—F8—OFF——F9———————
|                                                                    Page 1 / 2
|           SER Clock Setup V1.96 by Monaghan Engineering, Inc. (C) 1998
|                ————————————————————————————————————————————
|
|                                SER MASTER CLOCK
|   SER Card Function Block Address            40900  INT   = 400         DEC
|
|
|                          SER CLOCK STATUS (Read Only)
|   SER Clock Status (Bit Set = Error)         40902  INT   = 0000000000000000
|       14   Invalid SER Card Function Block Address Entered
|       15   Time of Day Clock Not Configured
|       16   Illegal Table Length
|
|
|
|
|
|CLCK Loadable Version                         40901  INT   = 196         DEC
|
|———————————————————————————————————————————————————————————————————————————
```

SER Card Function Block Address
Range: Depends on number of 4x registers in PLC configuration
Offset: +8
Usage: The SER Clock function block must know the base register address of the CARD function block associated with the SER card containing the master clock.
Note: This address should not be changed by ladder logic.

SER Clock Status
Range: ---
Offset: +0
Usage: This register contains the SER Clock function block status. Its primary purpose is to aid debugging during the programming and testing of the ladder logic program. Whenever a bit is turned on, a certain error condition is present.

Bit	Error Condition
16 (LSB)	Table length in bottom node of function block must be set to 3.
15	The time of day clock has not been configured in the PLC's configuration.
14	No SER Card function block address has been entered.
13	There is no CARD function block located at the entered address.
12	Both the middle and the bottom input are turned on simultaneously. It is not possible to set both clocks at the same time.

Note: This value is read-only.

3.5 EVENT BUFFER STRUCTURE

The event buffer consists of two parts, the header and the buffer proper. The header is located in the first 10 registers of the Modbus Plus message. The first register contains the PLC identification, and the third register contains the number of events following. The tenth register contains the SER Loadable version number. The other seven registers are presently unused.

The actual events are stored immediately following the header. The first event will be stored in registers 11 through 13, the second event in registers 14-16, and the nth event in registers (n-1)*3+10 through (n-1)*3+12. These three registers per event are used as follows:

NOTE: The bit descriptions in this section follow the standard numbering convention with Bit 0 as the LSB on the right and Bit 15 as the MSB on the left. This differs from the Modicon description used everywhere else in this manual with Bit 16 as the LSB on the right and Bit 1 as the MSB on the left.

Register	Bits	Usage
1	11-15	SER Card Identification (0..31) (from SER Card Function Block)
1	10	Current Status Value (0 or 1, from SER module)
1	5-9	Status Identifier (0..31, from SER module)
1	0-4	Event Type
		1: Status Change
		2: Point On Scan
		3: Point Off Scan
		4: Chatter On Scan
		5: Chatter Off Scan
		6: Power On Reset
		7: External Time Sync Lock
		8: External Time Sync Lost
		9: SER Card Event Buffer Overflow (from SER module)
		10: Scan Buffer Overflow
		11: Time Resync Old Time
		12: Time Resync New Time
		13: Hourly Time Update
		14:Time Resync New Date
		15:Reconfigure
		Events 1 – 12
2	10-15	Seconds (0..59, from SER module)
2	0-9	Milliseconds (0..999, from SER module)
		Events 13 – 15
2	9-13	Hour (0..23)
2	4-8	Day (1..31)
2	0-3	Month (1..12)
		Events 1 – 12
	14-15	Time Quality
3	8-12	Hours (0..23, from SER module)
3	0-5	Minutes (0..59, from SER module)
		Events 13 – 15
3	14-15	Time Quality
3	0-12	Year (0..4095)

Example:

Offset	Value	Description
0	23	Message originated in PLC 23
1	x	unused
2	2	Message contains two events
3	x	unused
4	x	unused
5	x	unused
6	x	unused
7	x	unused
8	x	unused
9	100	Loadable version 1.00
10	15873 = 00111 1 10000 00001	Identifier of first event SER card 7 Current status 1 Status point 16 Event type 1 (status change)
11	39228 = 100110 0100111100	Second/milliseconds of event 38 seconds/316 milliseconds
12	4399 = 000 10001 00 101111	Hours/minutes of event 17 hours/47 minutes => Status point 16 on SER card 7 of PLC 23 changed to value 1 at 17:47:38.316
13	15873 = 00101 0 00000 01001	Identifier of second event SER card 5 Current status not used Status point not used Event type 9 (SER buffer overflow)
14	39228 = 100110 0101110010	Second/milliseconds of event 38 seconds/370 milliseconds
15	4399 = 000 10001 00 101111	Hours/minutes of event 17 hours/47 minutes => Buffer overflow on SER card 5 of PLC 23 at 17:47:38.370

4.0 GPS FUNCTION BLOCK

The GPS loadable performs 4 different functions:

1. When the middle input to the block is active or when the GPS loadable detects that the GPS 100 00 card has gone through a power on reset sequence the loadable will transfer the PLC time of day clock to the GPS 100 00 card.

2. When the bottom input to the block is active the loadable will transfer the GPS 100 00 time to the PLC time of day clock.

3. The GPS loadable continuously updates the time registers, GPS receiver status registers and the GPS position and velocity registers.

4. The GPS loadable continuously monitors the user entered GPS receiver I/O options for a change. When a change is detected, the loadable will download the new I/O options to the GPS 100 00 card.

4.1 INSTALLATION

The GPS Loadable is loaded into a PLC configuration with the following sequence of key strokes:

1. Select the PLC configuration
2. Press <F7> (Loadable) in order to select the screen shown below.
3. Press <F3> (Directory)

4. Press <F1> (Load). Modsoft pops up a window in which the DOS file name must be entered. If, for example, the loadable file GPS1.DAT is stored in the directory C:\MODSOFT\PROGRAMS, then enter C:\MODSOFT\PROGRAMS\GPS1.DAT in this window.
5. Modsoft will announce that the Loadable GPS1 is now accessible.
6. Press <Enter> until a window shows the list of currently available loadables.
7. Select the loadable GPS with <CrsUp>, <CrsDn>, and <Enter> key. Press the <CrsDn> key.
8. Press <Enter> until a window shows the list of currently available loadables.

After this sequence, the Loadable Configuration screen looks as follows. The opcodes available for use by the loadable depend on the specific Quantum PLC in use. Thus, the DX Loadable Configuration may require adjustment of opcodes when the GPS ladder logic is ported to a different Quantum PLC.

```
Utility           Dir      Edit                                          Quit
F1———————F2———————F3———————F4———————F5———————F6———————F7—Lev 8—F8—OFF——F9———————┐
│                                                                                 │
│      DX Loadable Configuration                 ╔═══════════════════════════╗    │
│                                                ║ DX Memory Used: 1688      ║    │
│                                                ║ Total Memory Avail: 45932 ║    │
│     Name   Rev     Size    Opcode              ╚═══════════════════════════╝    │
│     ═══════════════════════════════                                             │
│     GPS1   193     1688      5f                                                 │
│                                                                                 │
│                                                                                 │
│                                                                                 │
│                                                                                 │
│                                                                                 │
│                                                                                 │
│                                                                                 │
└Press 'Enter' or '?' to view current loadable selection list———————————————————┘
```

4.2 GPS FUNCTION BLOCK PROGRAMMING

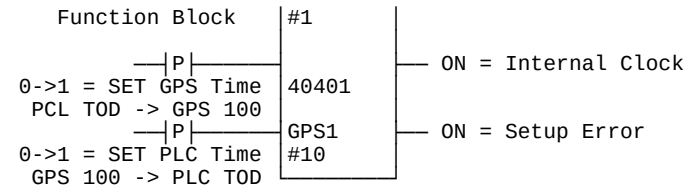
The GPS function block can be inserted in ladder logic by selecting GPS1 from the Modsoft loadable menu. The top node must always be set to #1. The middle node indicates the first of 50 4x registers required for this function block. The length 10 is entered in the bottom node of the function block. In the example shown below, the registers 40401 through 40450 are used for the function block. Of course, the function block may be used with any 4x register.

The top input must always be set to ON in order for the function block to be active.

The middle input should be used with a positive transitional contact. When the contact is triggered, the GPS 100 00 cards clock is set with time from the PLC time of day clock.

The bottom input should be used with a positive transitional contact. When the contact is triggered, the PLC's time of day clock is set with the time from the GPS 100 00.

```
ON = Activate ——┐          ┌—— ON = External Time Reference Sync
```



The top output is turned ON when the GPS 100 00 card is synchronized with an external time standard.

The middle output is turned ON when the GPS 100 00 is using its internal crystal clock.

The bottom output is turned ON for illegal function block setup parameters.

4.3 GPS FUNCTION BLOCK PARAMETERS

The GPS parameters can be entered using the Modsoft reference editor or the supplied template. These parameters can also be changed as needed by the ladder logic program during its execution. Please note that the addresses for the parameters are relative to the register address in the middle node of the function block as shown above.

The following template pages can be invoked in Modsoft using the key combination <Alt>-Z when the ladder logic cursor is placed on the GPS function block.

In this example, the GPS loadable uses the GPS function block at 40401-40450.

```
Utility           Hex      Dec      Bin      Goto                        Quit
F1———————F2———————F3———————F4—— DX Zoom Editor ———————F7—Lev 8—F8—OFF——F9———————┐
│                                                                    Page 1 / 5  │
│             GPS Setup V1.00 by Monaghan Engineering, Inc. (C) 1997             │
│               ————————————————————————————————————————————                   │
│                                                                                │
│                          GPS FUNCTION BLOCK-I/O MAP LINK                       │
│   GPS Card's First 3x Addr. in I/O Map [xxxx] 40401  INT   = 1           DEC   │
│   GPS Card's First 4x Addr. in I/O Map [xxxx] 40402  INT   = 1           DEC   │
│                                                                                │
│                      GPS FUNCTION BLOCK OUTPUT REGISTER LINK                   │
│         GPS Loadable's First 0x Addr. [xxxx] 40403  INT   = 1001        DEC   │
│                                                                                │
│                        GPS LOADABLE ERROR STATUS (Read Only)                   │
│   GPS Error Status (Bit Set = Error)          40406  INT   = 0000000000000000  │
│       12   Invalid 3X register setting                                         │
│       13   Invalid 4X register setting                                         │
│       14   Invalid 0X register setting                                         │
│       15   Time of Day Clock Not Configured                                    │
│       16   Illegal Table Length                                                │
│                                                                                │
│   GPS Loadable Version                        40415  INT   = 100         DEC   │
│   GPS Card Firmware Version                   40416  INT   = 290         DEC   │
└————————————————————————————————————————————————————————————————————————————┘
```

Address of First 3x Input in I/O Map

Range: depends on number of 3x inputs in PLC configuration

Offset: +0

Usage: The GPS function block must read the values from the GPS module through 3x inputs. In this case, the 3x inputs used by the GPS module are 30001 through 3006. Please note that the address entered here must match a 3x address as entered in the PLC's I/O map for the GPS module.

Address of First 4x Input in I/O Map

Range: depends on number of 4x inputs in PLC configuration

Offset: +1

Usage: The GPS function block must write the commands to the GPS module through 4x registers. In this case, the 4x registers used by the GPS module are 41001 through 41003.

Address of First 0x Output

Range: Depends on number of 0x outputs in PLC configuration
Offset: +2
Usage: The GPS function block will output status information to a group of 0X registers for easy use in ladder logic programming. The starting register for this group is defined here. The starting 0X register must be the start of a 16 bit word ((16 * n) +1). Acceptable values are starting resisters such as 1, 17, 33, 49, 65 …. If a zero is entered as the starting register, the function block will disable this feature.

GPS Error Status

Range: ---
Offset: +4
Usage: This register contains the GPS function block error status. Its primary purpose is to aid debugging during the programming and testing of the ladder logic program. Whenever a bit is turned on, a certain error condition is present.

Bit	Error Condition
16 (LSB)	Table length in bottom node of function block must be set to 50.
15	The time of day clock has not been configured in the PLC's configuration.
14	An invalid 0X register has been entered.
13	An invalid 4X register has been entered.
12	An invalid 3X register has been entered.
11	Both the middle and the bottom input are turned on simultaneously. It is not possible to set both clocks at the same time.

Note: This value is read-only.

GPS Loadable Version Number

Range: ---
Offset: +14
Usage: This register contains the GPS function block version number.
Note: This value is read-only.

GPS 100 00 Card Firmware Version Number

Range: ---
Offset: +15
Usage: This register contains the GPS 100 00 card firmware version number.
Note: This value is read-only.

```
Utility          Hex      Dec      Bin      Goto                       Quit
F1────────F2────────F3────────F4── DX Zoom Editor ───────F7─Lev 8─F8─OFF───F9────
                                                                    Page 2 / 5
              GPS Setup V1.00 by Monaghan Engineering, Inc. (C) 1997

                                   GPS I/O OPTIONS
    GPS Function Block I/O Options              40404  INT   = 0          DEC
        Bit 1 = 0  Position Output – XYZ Earth Centered Earth Fixed
                1  Position Output – Latitude Longitude Altitude
        Bit 2 = 0  Altitude – Height Above Ellipsoid Current Datum
                1  Altitude – Mean Sea Level Geoid WGS-84
        Bit 3 = 0  Velocity – XYZ Earth Centered Earth Fixed
                1  Velocity – East North Up
```

GPS Function Block I/O Options

Range:--

Offset: +3

Usage: The I/O options register controls the data format of the position, altitude and velocity data.

4.4 GPS FUNCTION BLOCK 4X DATA AREA

The GPS function block maintains a data area within the function blocks register space. The data area contains the current time of day in the same format as the standard controller's time of day clock, extended time information and GPS status, position and velocity information. The time information is updated every scan cycle for precision timing applications. The GPS information is read from the internal registers of the GPS 100 00 card. This information is updated approximately every 30 scan cycles.

```
Utility          Hex      Dec      Bin      Goto                       Quit
F1────────F2────────F3────────F4── DX Zoom Editor ───────F7─Lev 8─F8─OFF───F9────
                                                                    Page 3 / 5
              GPS Setup V1.00 by Monaghan Engineering, Inc. (C) 1997

                                 GPS TIME INFORMATION

           Day of Week                  400406 INT    = 1           DEC
           Month                        400407 INT    = 1           DEC
           Day                          400408 INT    = 1           DEC
           Year                         400409 INT    = 84          DEC
           Hour                         400410 INT    = 0           DEC
           Minute                       400411 INT    = 50          DEC
           Second                       400412 INT    = 54          DEC
           Millisecond                  400413 INT    = 351         DEC
           Long Year                    400414 INT    = 1984        DEC
           Time Quality                 400431 INT    = 0           DEC
             Good Quality = 0
             Fair Quality = 1
             Poor Quality = 2
             Bad Quality = 3
```

The address of each register is indicated as an offset from the address in the middle node of the GPS function block.

Day of Week
Range: 1 = Sunday, 2 = Monday, … 7 = Saturday
Offset: +5
Usage: The current day of the week.

Month of Year
Range: 1 - 12
Offset: +6
Usage: The current month of the year.

Day of Month
Range: 1 - 31
Offset: +7
Usage: The day of the month

Year
Range: 0 - 99
Offset: +8
Usage: The current year.

Hour
Range: 0 - 23
Offset: +9
Usage: The current hour.

Minute
Range: 0 - 59
Offset: +10
Usage: The current minute.

Second
Range: 0 - 59
Offset: +11
Usage: The current second.

Millisecond
Range: 0 - 999
Offset: +12
Usage: The current millisecond.

Year
Range: 1984 - 65536
Offset: +13
Usage: The current hour of the day.

```
Utility           Hex      Dec      Bin      Goto                          Quit
F1———————F2———————F3———————F4—— DX Zoom Editor ———————F7—Lev 8—F8—OFF——F9———————┐
|                                                                      Page 4 / 5 |
|              GPS Setup V1.00 by Monaghan Engineering, Inc. (C) 1997             |
|                 ————————————————————————————————————————————                  |
|                                                                                 |
|                         GPS STATUS POSITION AND VELOCITY                        |
|                                                                                 |
|           GPS Receiver Status                400417 INT   = 0            DEC    |
|             0 = Doing position fixes                                            |
|             1 – Don't have GPS time yet                                         |
|             3 = Position dilution of precision is too high                      |
|             8 = No usable satellites                                            |
|             9 = Only 1 usable satellite                                         |
|             10 = Only 2 usable satellites                                       |
|             11 = Only 3 usable satellites                                       |
|             12 = The chosen satellite is unusable                               |
|                                                                                 |
|           X / Latitude                        400419 FLT32 =  0.                |
|           Y / Longitude                       400421 FLT32 =  0.                |
|           Z / Altitude                        400423 FLT32 =  0.                |
|           X / East Velocity                   400425 FLT32 =  0.                |
|           Y / North Velocity                  400427 FLT32 =  0.                |
|           Z / Up Velocity                     400429 FLT32 =  0.                |
└—————————————————————————————————————————————————————————————————————————————┘
```

GPS Status

Range: 0 - 12

Offset: +16

Usage: The GPS status register contains information about the satellite tracking status of the GPS receiver.

0 = Doing position fixes

1 = Don't have GPS time yet

3 = Position dilution of precision is too high

8 = No usable satellites

9 = Only 1 usable satellite

10 = Only 2 usable satellites

11 = Only 3 usable satellites

12 = The chosen satellite is unusable

X / Latitude Position (Single Precision)

Range: -

Offset: +18 & +19

Usage: The current X position in Earth Centered Earth Fixed coordinates or the current Latitude depending on the setting of the GPS I/O options register bit 1.

Y / Longitude Position (Single Precision)

Range: -

Offset: +20 & +21

Usage: The current Y position in Earth Centered Earth Fixed coordinates or the current Longitude depending on the setting of the GPS I/O options register bit 1.

Z / Altitude Position (Single Precision)

Range: -

Offset: +22 & +23

Usage: The current Z position in Earth Centered Earth Fixed coordinates or the current Altitude depending on the setting of the GPS I/O options register bit 2.

X / East Velocity (Single Precision)

Range: -

Offset: +24 & +25
Usage: The current X velocity in Earth Centered Earth Fixed coordinates or the current East velocity depending on the setting of the GPS I/O options register bit 3.

Y / North Velocity (Single Precision)
Range: -
Offset: +26 & +27
Usage: The current Y velocity in Earth Centered Earth Fixed coordinates or the current North velocity depending on the setting of the GPS I/O options register bit 3.

Z / Up Velocity (Single Precision)
Range: -
Offset: +28 & +29
Usage: The current Z velocity in Earth Centered Earth Fixed coordinates or the current Up velocity depending on the setting of the GPS I/O options register bit 3.

4.5 GPS FUNCTION BLOCK 0X DATA AREA

The GPS function block will output status information to a group of 0X registers for easy use in ladder logic. The starting register 0X is defined in the function block configuration.

One Pulse per Second
Offset: +0
Usage: This 0X register will transition from a 0 to a 1 for one scan cycle at the start of every second.

One Pulse per Minute
Offset: +1
Usage: This 0X register will transition from a 0 to a 1 for one scan cycle at the start of every minute.

One Pulse per Hour
Offset: +2
Usage: This 0X register will transition from a 0 to a 1 for one scan cycle at the start of every hour.

One Pulse per Day
Offset: +3
Usage: This 0X register will transition from a 0 to a 1 for one scan cycle at the start of every day.

One Pulse per Week
Offset: +4
Usage: This 0X register will transition from a 0 to a 1 for one scan cycle at the start of every week.

One Pulse per Month
Offset: +5
Usage: This 0X register will transition from a 0 to a 1 for one scan cycle at the start of every month.

One Pulse per Year
Offset: +6
Usage: This 0X register will transition from a 0 to a 1 for one scan cycle at the start of every Year.

Good Time Quality
Offset: +7
Usage: This 0X register will set to a 1 when the accuracy of the time from the GPS 100 00 card is 1 mS or less.

Fair Time Quality

Offset: +8
Usage: This 0X register will set to a 1 when the accuracy of the time from the GPS 100 00 card is between 1 mS and 50 mS.

Poor Time Quality
Offset: +8
Usage: This 0X register will set to a 1 when the accuracy of the time from the GPS 100 00 card is worse then 50 mS.

Bad Time Quality
Offset: +9
Usage: This 0X register will set to a 1 when the GPS 100 00 card has gone through a power on reset sequence and has not received an initial time update from an external time reference of the PLC time of day clock through the GPS function block.