SIEMENS

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User Manual

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Preface

Task Codes are the command/response messages sent to Series 500™ and Series 505™controllers. These codes are sent

- through the RS-232 and RS-422 communication ports.
- through Special Functions modules such as the NIM.
- across the VMEbus using the interboard messaging service in the SIMATIC® TI575™. Refer to *SIMATIC TI575 Interboard Communication Manual* (PPX:575–8103).

Task Codes are used to initiate modes of operation, and to Read/Write controller data.

This section defines the symbols used to represent the various fields of the task codes. The definitions given in this section apply only when the task code description does not define the symbols used.

NOTE: Symbols defined with the task code descriptions take precedence for that task code.

The following conventions are used throughout this manual:

☞ The use of upper case or lower case symbols is significant.

☞ [ ] (brackets) indicate optional parameters.

☞ ... (a series of periods) means a repetition of zero or more times.

Chapter 1

Task Code Parameter Descriptions

Word Area Address Descriptors

Word Codes

Task Codes that access user word areas within the controller require a word code to identify the desired value(s). Word codes are separated into four categories:

- Category 1. Those that access memory types supported by a discrete machine such as the SIMATIC® TI530C™ or SIMATIC® TI560™.
- Category 2. Those that access Loop and Analog Alarm Variables supported only in batch machines such as the SIMATIC® TI565™, SIMATIC® TI545™ SIMATIC® TI555™, and SIMATIC TI575.
- Category 3. Those that access timeline variables supported by controllers with tunable timelines such as the TI545, TI555, and the TI575.
- Category 4. This category contains the VMEbus word code.

Word codes are represented by different symbols:

- AAAA represents a word code used in task codes initially intended to access memory types in Category 1 by earlier Series 500 and Series 505 controllers. Later controllers also use these task codes to access Category 2 and Category 3 word codes. AAAA may be either 16 or 32-bits long.
- wwww represents a word code used in task codes intended to access Loop and Analog Alarm Variables that are supported only in a batch machine (e.g., TI575, TI565, TI555, and TI545). The word code wwww may be either 16- or 32-bits long:

  If the most significant bit (MSB) is set, then wwww is treated as the address of a real (32-bit) value.

  If the MSB is reset, then wwww is treated as the address of an integer (16-bit) value.

The correspondence between the categories and word code representation for the task codes are described in this chapter. See Table 1-1.

Table 1-1 Word Code Categories

Task Code	Controller	
	Categories	Representation
01-02, 50-51	1,2,3,4	AAAA or wwww
5A, 7E, 7F	1,2,3,4	wwww

Category I Word Code Description

Category 1 user words within the controller are arranged in pages with page sizes dependent on the type of memory.

The first page (Page 0) is accessed by a single word format.

MSB

bits –>	1	2–5	6–16
	0	Word Code	OFFSET

To access successive pages, Word Code F is used as the expansion code and the format becomes:

MSB

bits –>	1	2–5	6	7–16
	0	1 1 1 1	0	PAGE
	0	Word Code	OFFSET	

Word code and page sizes for each memory type are defined in Table 1-2.

Page and Offset. The PAGE and OFFSET fields identify the specific data element of the memory type specified by the word code.

Table 1-2 Memory Type Page Sizes

Word Code	Word Code Definition	Page Size	First Location
0000	Variable Memory (V)	1024	0
0001	Constant Memory (K)	1024	0
0010	Drum Count Preset Memory (DCP)	480	HEX 10
0011	Drum Current Count Memory (DCC)	1024	1
0100	System Status Words Memory (STW)	1024	1
0101	Global Memory (G)	1024	0
0110	Reserved	–	–
0111	Reserved (VMEbus Memory)	–	–
1000	Timer/Counter Preset (TCP) Memory Timer/Counter Current (TCC) Memory	128	1
1001	Reserved	–	–
1010	Drum Step Preset (DSP) Memory Drum Step Current (DSC) Memory	30	1
1011	Word Code Expansion with Expanded Offset		
1100	Word Input Memory (WX)	1024	1
1101	Word Code Expansion		
1110	Word Output Memory (WY)	1024	1
1111	Offset Expansion		

The encoding of the PAGE and OFFSET fields of the word address is dependent upon the value of the WORD CODE field. Equations using the following operations are given below for each memory type.

- a .DIV. b = integer—divide of a by b
- a .MUL. b = integer—multiply of a by b
- a .MOD. b = remainder of a .DIV. b

V/K Encoding

For V and K memory, the PAGE/OFFSET fields are determined by the following equations:

PAGE = (N-1).DIV.1024   OFFSET = (N-1).MOD.1024
(Where N is the data element number, e. g. 4073 in V4073.)

Given PAGE and OFFSET, N is determined by:
N = (PAGE.MUL.1024)+1+OFFSET

G Encoding

For G memory, the data element number is determined by:

*N = Application * 32768 + Application Offset*
Application number for A = 1, B = 2, etc. (0 means current application)
Application Offset ranges from 1 to 32768.

PAGE and OFFSET are then determined as are V and K above.

DCP Encoding

For DCP memory the PAGE/OFFSET fields are determined by the following equations:

PAGE = (N-1).DIV.30   OFFSET = (((N-1).MOD.30)+1).MUL.16+(S-1)
Where N is the drum number and S is the drum step number.

Given PAGE and OFFSET, N is determined by:
N = (PAGE.MUL.30)+(OFFSET.DIV.16)

WX/WY/DCC/STW Encoding

For DCC, STW, WX, and WY memory, the PAGE and OFFSET fields are determined by the following equations:

PAGE = (N-1).DIV.1024
OFFSET = ((N-1).MOD.1024) + 1
(Where N is the data element number, e. g., 53 in WX53.)

Given PAGE and OFFSET, N is determined by the following:
N = (PAGE.MUL.1024)+OFFSET

Word Area Address Descriptors (continued)

TCP/TCC Encoding

The following equations specify the PAGE and OFFSET fields for word addresses referencing TCP/TCC memory.

NOTE: TCP and TCC memory share a single word code. Because of this, the encoding of the OFFSET field is used to distinguish between these word types.

PAGE = (N-1).DIV.128
OFFSET = (N-1).MOD.128 + Z
Where N is the Timer/Counter number and Z is 1 (TCP memory) or 129 (TCC memory).

Given PAGE and OFFSET, N is determined by the following:
N = (PAGE.MUL.128)+((OFFSET-1).MOD.128)+1

DSP/DSC Encoding

The following equations specify the PAGE and OFFSET fields for word addresses referencing DSP/DSC memory.

NOTE: DSP and DSC memory share a single word code. Because of this, the encoding of the OFFSET field is used to distinguish between these word types.

PAGE = (N-1).DIV.30 *OFFSET = ((N-1).MOD.30) + Z*
Where N is the drum number and Z is 1 (DSP memory) or 31 (DSC memory).

Given PAGE and OFFSET, N is determined by the following:
N = (PAGE.MUL.30)+((OFFSET-1).MOD.30)+1

Category 2 Word Code Description

Category 2 word codes are distinguished by bits 2 through 6, all set to 1. To access loop and analog alarm data, use:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
f	1	1	1	1	1	w	w	w	w	n	n	n	n	n	n

Use the single word format to access types defined by word codes 0–E in bits 7–10. Use word code F in bits 7–10 to extend the addressing past 64 variables of a given type, or to reach additional types. The double word format is

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
f	1	1	1	1	1	1	1	1	1	w	w	w	w	w	w
n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

The fields in the category 2 word code follow and are shown in Table 1-3 through Table 1-5.

- ‘nn...n’ is the variable number; ‘1’ is the first variable

Table 1-3 f – Variable Data Format

0	Integer
1	Real

Table 1-4 wwww – Variable Data

0000	Reserved
0001 = LPV	Loop Process Variable
0010 = LSP	Loop Setpoint
0011 = LMN	Loop Output
0100 = LMX	Loop Bias
0101 = LERR	Loop Error
0110 = LKC	Loop Gain
0111 = LTD	Loop Rate
1000 = LTI	Loop Reset
1001 = LVF	Loop V-flags
1010 = LRSF	RAMP/SOAK flags
1011 = APV	Analog Alarm Process Variable
1100 = ASP	Analog Alarm Setpoint
1101 = AVF	Analog Alarm flags
1110	Reserved
1111	Expansion code (see wwwwww)

Word Area Address Descriptors (continued)

Table 1-5 wwwwww – Extended Variable Type

00xxxx	xxxx is the same as wwww above
010000	Reserved
010001 = LPVL	Loop Process Variable Low Limit
010010 = LPVH	Loop Process Variable High Limit
010011 = APVL	Analog Alarm Process Variable Low Limit
010100 = APVH	Analog Alarm Process Variable High Limit
010101 = LTS	Loop Sample Rate (seconds)
010110 = ATS	Analog Alarm Sample Rate (seconds)
010111 = LHA	Loop High Alarm Limit
011000 = LLA	Loop Low Alarm Limit
011001 = LODA	Loop Orange Deviation Alarm Limit
011010 = LYDA	Loop Yellow Deviation Alarm Limit
011011 = LSPL	Loop Setpoint Low Limit
011100 = LSPH	Loop Setpoint High Limit
011101 = LCFH	Most-significant word of Loop C-flags
011110 = LCFL	Least-significant word of Loop C-flags
011111 = LHHA	Loop High-High Alarm Limit
100000 = LLLA	Loop Low-Low Alarm Limit
100001 = LRCA	Loop Rate-of-Change Alarm Limit (engineering units / minute)
100010 = LADB	Loop Alarm Deadband
100011 = AHA	Analog Alarm High Alarm Limit
100100 = ALA	Analog Alarm Low Alarm Limit
100101 = AODA	Analog Alarm Orange Deviation Alarm Limit
100110 = AYDA	Analog Alarm Yellow Deviation Alarm Limit
100111 = ASPL	Analog Alarm Setpoint Low Limit
101000 = ASPH	Analog Alarm Setpoint High Limit
101001 = ACFH	Most-significant word of Analog Alarm C-flags
101010 = ACFL	Least-significant word of Analog Alarm C-flags
101011 = AHHA	Analog Alarm High-High Alarm Limit
101100 = ALLA	Analog Alarm Low-Low Alarm Limit
101101 = ARCA	Analog Alarm Rate-of-Change Alarm Limit (engineering units/minute)
101110 = AADB	Analog Alarm Alarm Deadband
101111 = AERR	Analog Alarm Error
110000	Reserved
110001 = LKD	Loop Derivative Gain-limiting coefficient

Table 1-5 wwwwww – Extended Variable Type (continued)

110010 = LRSN	Loop RAMP/SOAK Step Number
110011	Reserved
110100 = X	Discrete input, accessed as a word
110101 = Y	Discrete output, accessed as a word
110110 = C	Control relay, accessed as a word
110111 = LACK	Loop Alarm / Alarm Acknowledge flags
111000 = AACK	Analog-alarm Alarm / Alarm Acknowledge flags
111001 = LPET	Loop Peak Elapsed Time Value - Represents the elapsed time from when the process is scheduled until it completes execution (TI545, TI555, TI575)
111010 = APET	Analog Alarm Peak Elapsed Time Value - Represents the elapsed time from when the process is scheduled until it completes execution (TI545, TI555, TI575)
111011 = PPET	SF PGM Peak Elapsed Time Value - Represents the elapsed time from when the process is scheduled until it completes execution (TI545, TI555, TI575)
111100-111110	unassigned; reserved
111111	illegal

Category 3 Word Code Description

Category 3 word codes allow configuration of the TI545, TI555, and TI575 Timeline. Two of the spare category 1 word codes are used to provide expansion to Category 3 words. The first word code used (1101) indicates an 11-bit data type identifier and a 16-bit offset, while the second code (1011) indicates an 11-bit identifier and a 32-bit offset. In both cases, the first offset is 0.

The 2-word format:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
f	1	1	0	1		W			W				W		
n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

Word Area Address Descriptors (continued)

and the 3 word code format:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
f	1	0	1	1	W			W				W			
n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n

The fields in the word code follow:

- **f - Integer/Real Flag** The 0 in the MSB of the first word indicates integer. The 1 in the MSB of the first word indicates floating point, and thus restricts that variable to S-memory only.

- **WWW** The 11-bit word code (3 digit hex number) that specifies one of the following variables:

  000 = FV = Fixed/Variable Scan Type selection. The offset (nnn...n) for this variable is meaningless and is therefore set to zero. FV(0) may contain one of three valid values as follows (note this is the RRRR field in task code 01 or 02):

0000	Fixed Scan
0001	Variable Scan
0002	Variable Scan with Upper-Limit.
0003-FFFF	Invalid ; previous setting retained.

Battery bad power-up always defaults to Variable Scan.

001 = Timeline configuration parameters. These are programmed by the user to select how often the scan is repeated and the maximum time spent in each part of the timeline. Battery bad power up default values are specified by the individual controller product. Each parameter is a 16-bit integer and is represented by a different offset (nnn...nn):

0000 = DS	DS - Discrete Scan Time = 1-255 ms (Valid for FV = 0 or 2). This value specifies how often the I/O Cycle, RLL, SF Module Cycle and Guaranteed Comm is performed.
0001 = LS	Loop Time Slice = 0–255 ms
0002 = AS	Analog Alarm Time Slice = 0–255 ms
0003 = CS	Cyclic SF PGM Time Slice = 0–255 ms
0004 = PS	Priority SF PGM Time Slice = 0–255 ms
0005 = NS	Normal SF PGM Time Slice = 0–255 ms
0006 = SS	Ladder SF Subroutine Time Slice = 0–255 ms
0007 = CN	Normal Communication Time Slice = 0–255 ms
0008 = CP	Priority Communication Time Slice = 0–255 ms
0009 = RS	Ladder SF Subroutine 0 Time Slice = 0–255 ms
000A = NC	Network Communication Time Slice = 0–255ms
002–7FE	Undefined
7FF	Reserved for expansion

NOTE: Writing a value of 0 to a timeline parameter is interpreted as no change to the existing value.

Category 4 VMEbus Word Code Description

The VMEbus word code only accesses VMEbus memory on word boundaries (1 word is 2 bytes). You only access VME A16 and A24 user-data memory. To encode this word code:

0	0	1	1	1	s	s	0	0	A23	A22	A21	A20	A19	A18	A17
A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1

Where

ss = 00 = A16 user address space
01 = A24 user address space
other values for ss are undefined

A23–A1 correspond to VMEbus address lines A23–A1 respectively.

Port, Module, and Board Address Descriptors

Port Descriptors

QQQQ is used to represent a source or destination port within a Series 500/505 PLC and identifies:

A. A local communication port on the PLC

0	1	2 … 7	8	9	10 … 15
0	0	LLLLLL	1	0	pppppp

Where

LLLLLLL Board's LAR [00h ... 3Eh] (TI575 only; 0 for all other PLCs)

pppppp Port number (0 = first port).

B. An Application ID

0	1	2 … 7	8	9	10 … 15
0	0	000000	1	1	aaaaaa

Where

aaaaaa App ID.

Chapter 2
Task Code Definitions

2.1 Task Code Definition

TC01
Read Word Memory Random

Command: 01 AAAA [AAAA] ...
Response: 01 RRRR [RRRR] ...

Response values are returned in respective address positions.

NOTE: For TI545, TI555, and TI575 controllers, the wwww word code descriptor can be used instead of the AAAA, in which case the data descriptor dddd replaces RRRR.

TC02
Write Word Memory Area Random

Command: 02 AAAA RRRR [AAAA RRRR] ...
Response: 02

NOTE: For TI545, TI555, and TI575 controllers, the wwww word code descriptor can be used instead of the AAAA, in which case the data descriptor dddd replaces RRRR.

TC30
Read Operational Status

Command: 30 [xx]
Response: 30 UUUU ...

Where xx = not coded = Return Status Words 1 through 15.
01 = Return Status Words 16 through 30.

Response contains 15 status words with the following definitions:

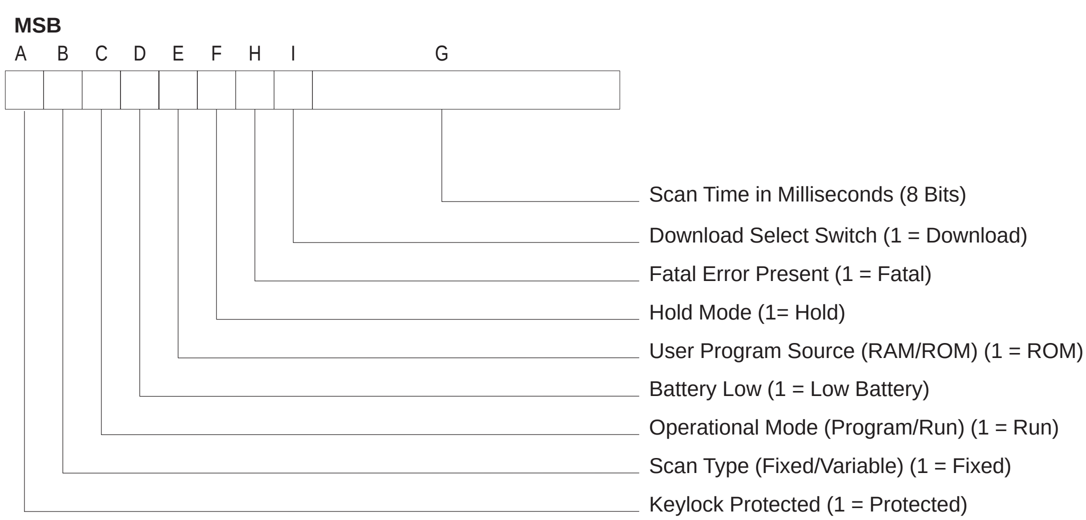


Figure 2-1 Status Word 1

The scan time reported in field G is modulo 256 in earlier controller releases.

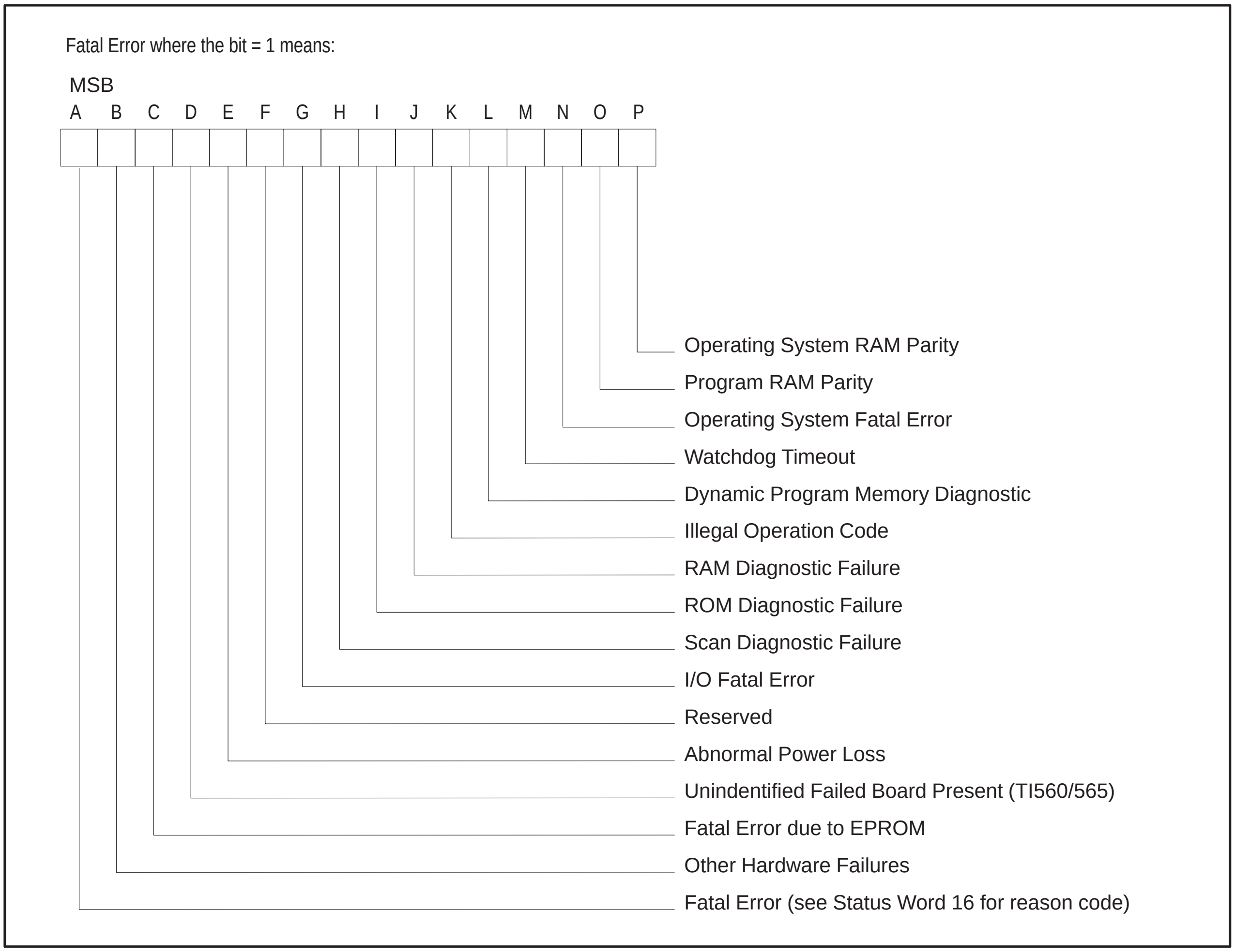


Figure 2-2 Status Word 2

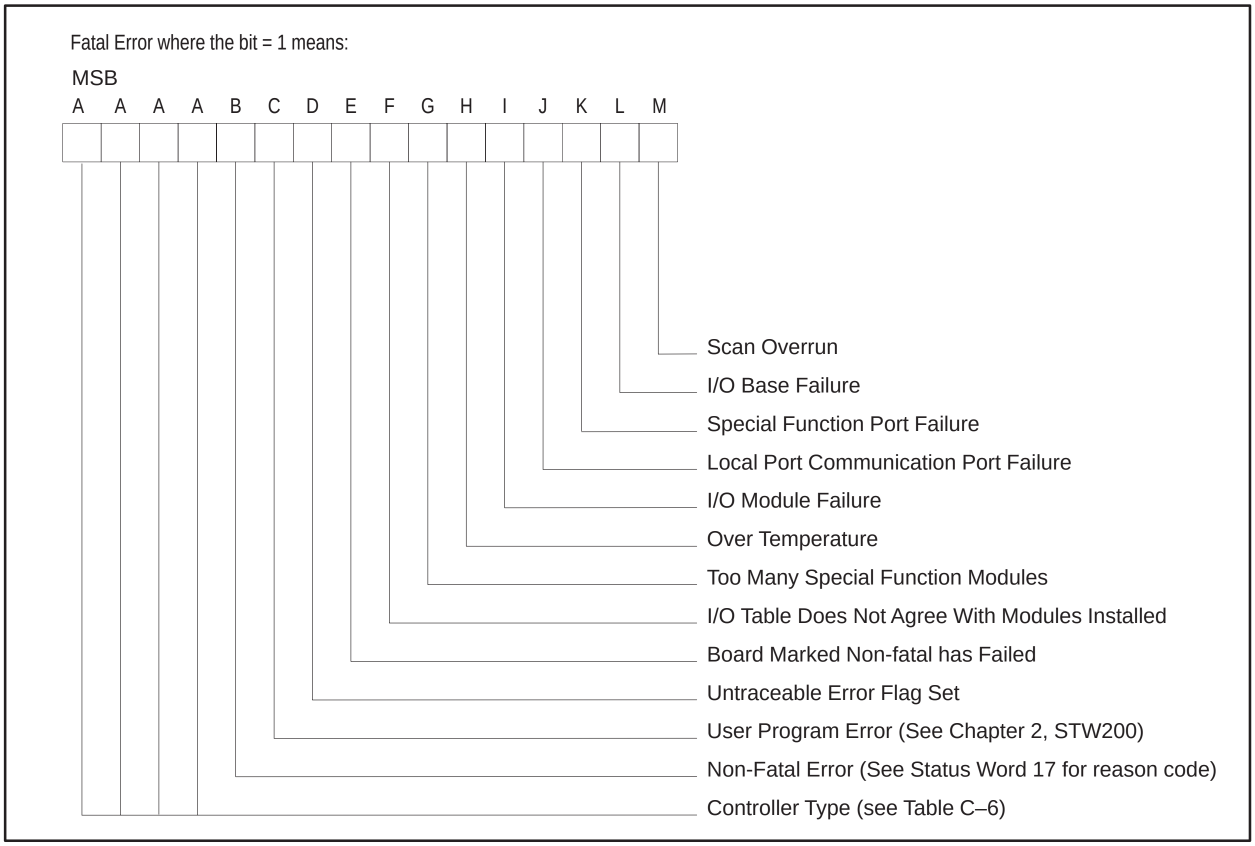


Figure 2-3 Status Word 3

Table 2-1 Controller Type

0000	5TI™
0001	Reserved
0010	SIMATIC® TI520™/TI525™
0011	SIMATIC® TI530™/TI535™
0100	SIMATIC TI545/TI555
0110	SIMATIC TI560/TI565
0111	SIMATIC TI575
1000 – 1101	Future Expansions
1110	Non-Programmable Controller
1111	PM550™

Status Word 4: The Ladder Logic Memory Size. (See also Status Word 7).

Status Word 5: User V memory Size. (See also Status Word 12.)

Status Word 6: Highest configured I/O Point.

Status Word 7: Most significant 16 bits of the Ladder Logic Memory Size. Concatenated with Status Word 4 to indicate memory sizes larger than 65,535 words.

Status Word 8: Remaining I/O points not configured.

Status Word 9: Expanded Controller Type Identification.

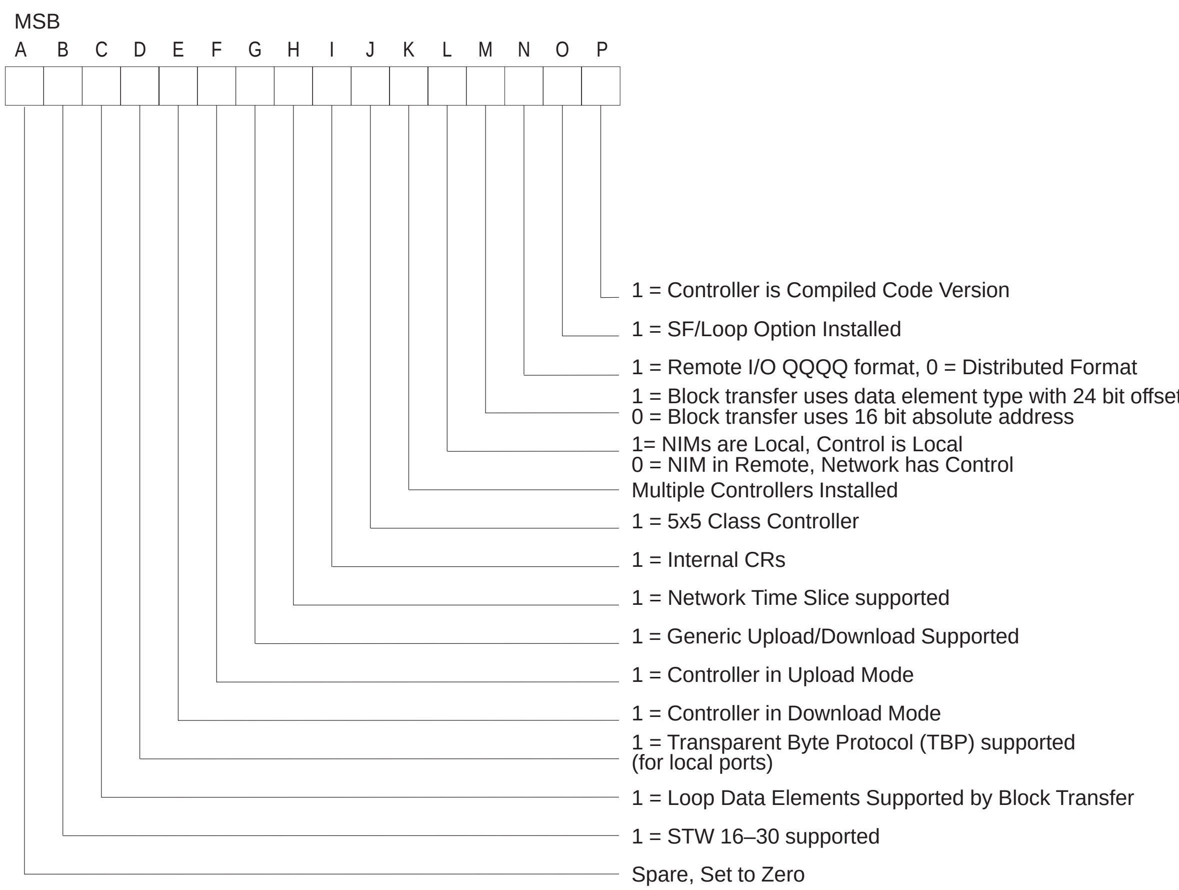


Figure 2-4 Status Word 9

Status Word 10: HBU Mode.

0001	Active with no Standby (Stand Alone)
0002	Active with Off-line Standby
0003	Active with On-line Standby
0004	Standby On-line with healthy Active
0005	Standby Off-line with healthy Active

Status Word 11 (Valid only if Word 10 = 2 or 5)**:** Reason for Off-line.

0000	No special reason (entered on power up)
0001	Off-line due to hardware mismatch
0002	Off-line due to user command
0003	Off-line due to active unit in PROGRAM mode
0004	Off-line requesting on-line but inhibited by user program in active unit
0005	Off-line due to failure in standby
0006	Off-line due to loss of HBU communications

Status 12: Most significant 16 bits of the User V memory size. Concatenated with Status Word 5 to indicate memory sizes larger than 65535 words.

Status Word 13 and 14: Operational status of each card in a multicard chassis. The numbered bits below represent the corresponding physical slot within the controller. If the bit is 0, a card is installed and functional. If the bit is 1, the card is failed or not present.

MSB WORD 13 LSB

x	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

WORD 14

x	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16

Status Word 15: Peak discrete scan for a TI545, TI555, or TI575. It has no meaning for the other controllers. It is the peak time required to execute the I/O Cycle, RLL and SF Cycle for a TI545, TI555, or TI575.

Status Word 16: Provides the reason for fatal error if bit "A" in Status Word 2 is set. Error numbers range from 0 to 65535.

Status Word 17: Provides the reason for non-fatal error if bit "B" in Status Word 3 is set. Error numbers range from 0 to 65535.

Status 18 thru 30: Undefined and are set to zero.

TC32 Program to Run Mode

Command: 32
Response: 32

TC33 Go to Program Mode

Command: 33 xx
Response: 33 xx

xx if 00 freezes the outputs
if FF clears the discrete outputs and freezes the word

TC34 Execute Power-up

Command: 34 [xx]
Response: 34

Field xx is added for multi-PLC/multi-application systems (e.g., TI575) and has the following characteristics:

If xx is not coded or xx = 00, then the restart is for this application only.

If xx = 01, then the restart is coordinated across locked applications.

If xx = 02, then the restart is coordinated across all applications independent of dependencies.

If xx is not specified then 00 is assumed unless the PLC is in the FAULT mode, then 02 is assumed for multiple application PLCs. If the PLC is in the fault mode and xx is specified, it must be 02 or the restart is disallowed.

If the battery is bad, 34 xx or 34 is not allowed in the RUN or HOLD mode.

TC35
Execute Complete (Warm) Start

Command: 35 [xx]
Response: 35

Field xx is added for multi-PLC/multi-application systems (e.g., TI575) and has the following characteristics:

If xx is not coded or xx = 00, then the restart is for this application only.

If xx = 01, then the restart is coordinated across locked applications.

If xx = 02, then the restart is coordinated across all applications independent of dependencies.

If xx is not specified then 00 is assumed unless the TI575 is in the FAULT mode, then 02 is assumed.

If the PLC is in the fault mode and xx is specified, it must be 02 or the restart is disallowed.

If the PLC is in the fault mode, xx = 02, and the battery is bad, then the PLC memory is cleared.

TC36
Execute Partial (Hot) Start

Command: 36 [xx]
Response: 36

Field xx is added for multi-PLC/multi-application systems (e.g., TI575) and has the following characteristics.

If xx is not coded or xx = 00, then the restart is for this application only.

If xx = 01, then the restart is coordinated across locked applications.

If xx = 02, then the restart is coordinated across all applications independent of dependencies.

If xx is not specified then 00 is assumed unless the TI575 is in the FAULT mode, then 02 is assumed.

If the PLC is in the fault mode and xx is specified, it must be 02 or the restart is disallowed.

If the PLC is in the fault mode, xx = 02, and the battery is bad, then the PLC memory is cleared.

TC50
Read User Word Area Block

Command: 50 AAAA
Response: 50 RRRR [RRRR] ...

As many locations are returned that can fit in the task code length or until the end of the memory type is reached.

NOTE: For the TI545, TI555, and TI575 controllers, the wwww word code descriptor can be used instead of the AAAA in which case the data descriptor dddd replaces RRRR.

TC51
Write User Word Area Starting at Address

Command: 51 AAAA RRRR [RRRR] ...
Response: 51

As many locations can be written that fit in the task code length, or until the end of the memory type is reached.

NOTE: For the TI545, TI555, and TI575 controllers, the wwww word code descriptor can be used instead of the AAAA in which case the data descriptor dddd replaces RRRR.

TC58 Set Controller Time of Day Clock

Command: 58 GGGG HHHH IIII JJ
Response: 58

Where GGGG = Year/Month =

bit	1	8	9	16
	xxxx	xxxx	xxxx	xxxx
	tens	ones	tens	ones
	Year		Month	

HHHH = Day/Hour =

bit	1	8	9	16
	xxxx	xxxx	xxxx	xxxx
	tens	ones	tens	ones
	Day		Hour	

IIII = Min/Sec =

bit	1	8	9	16
	xxxx	xxxx	xxxx	xxxx
	tens	ones	tens	ones
	Minute		Second	

JJ= Day of Week =

bit	1	8
		xxxx
	spare	

TC59 Write Discrete I/O Status via Data Element Type

Command: 59 TT JJJJJJ NN [nnnn] II [II] ...
Response: 59

Where TT = Data Element Type Identifier

Value	Data Element Type
06	Discrete Input Packed (X)
07	Discrete Output Packed (Y)
08	Control Register Packed (CR)

JJJJJJ = 24 bit offset (first data element is 0)

NN = Number of bits = 1 – 208 [short form]
= 255 indicates extended count in nnnn

nnnn = Extended Number of bits. Only included if NN = 255. (For use with line lengths greater than 72 characters.)

II = Group of 8 discrete bits. The starting bit identified by JJJJJJ is the LSB of the first II and increasing discrete addresses are in increasing bit position significance. Pattern is repeated in each byte.

TC5A Write Block

Command: 5A wwww dddd [dddd] ...
Response: 5A

Description: Write block beginning at the address specified by wwww.

NOTE: When writing loop or analog alarm data, the data corresponding to undefined loops and analog alarms is ignored. It must be present in the block as a placeholder.

Task Code Definition (continued)

TC6B
Read Discrete I/O Status Using Data Element Type

Command: 6B TT JJJJJJ NN [nnnn]
Response: 6B II [II] ...

Where

TT =	Data Element Type Identifier (See TC 59)
JJJJJJ =	24 bit offset (first data element is 0)
NN=	Number of bits = 1 – 248 [short form]
=	255 indicates extended count in nnnn
nnnn =	Extended Number of bits. Only included if NN = 255. (For use with line lengths greater than 72 characters.)
II =	Group of 8 discrete bits. The starting bit identified by JJJJJJ is the LSB of the first II and increasing discrete addresses are in increasing bit position significance. Pattern is repeated in each byte. Unused bits are cleared if number returned is not a multiple of 8.

TC71
Read Controller Time of Day Clock

Command: 71
Response: 71 GGGG HHHH IIII JJ

For GGGG HHHH IIII JJ definition, see Task Code 58.

TC7D Read SF/Loop Processor Mode

Command: 7D

Response: 7D 00*mm ffff nnnn ssssssss rrrrrrrr wwww xxxx yyyy zzzz vvvv rrrr qqqq*

Description: TC7D returns the current operational mode of the Loop/SF processor (or the Loop/SF function on single board controllers such as the TI545). The fields returned follow:

mm Mode Descriptor.

1... .... Loop card is following CPU's operational mode
.1.. .... Loop card is in PROGRAM mode.
..1. .... Loop card is in RUN mode.
...1 .... Loop card is in HOLD mode.
.... 1... Loop card is in FAULT mode.
.... .000 Unused.

ffff	Fatal Error vector
nnnn	Non-fatal error vector
ssssssss	Size of S-memory in bytes.
rrrrrrrr	Number of bytes of S-memory available.
wwww	Maximum number of loops supported.
xxxx	Maximum number of analog-alarms supported.
yyyy	Maximum number of SF Programs supported.
zzzz	Maximum number of SF Subroutines supported.
vvvv	Control Block ID of the last undefined SF Program or SF Subroutine that the user tried to execute. 0000 is returned if no attempt has been made to execute an undefined SF Program or SF Subroutine.
rrrr	Control Block ID of the last restricted SF Program that the user tried to invoke from RLL. 0000 is returned if no attempt has been made to invoke a restricted SF Program from RLL
qqqq	Control Block ID of the first disabled control block in S-memory. 0000 is returned if there are no disabled control blocks.

TC7E Read Random

Command: 7E wwww [wwww] ...

Response: 7E dddd [dddd] ...

Description: Read values given the the wwww fields. wwww may be either normal Series 500 word codes or SF/Loop word codes.

NOTE: Real values for undefined loops or analog alarms are returned as a NAN (Not A Number). Integer values for undefined loop or analog alarms are returned as zero.

If an error occurs when reading a variable, TC7E returns an error response:

00 *ee wwww*

Where ee is the error code and wwww is the word code on which the error occurred. Note that wwww may be 16-, 32-, or 48-bits long. If the error occurred because wwww was a partial word code at the end of the task code then TC7E returns a full-sized word code padded on the end with zeros.

TC7F
Read Block

Command: 7F *wwww* [nn]
Response: 7F *dddd [dddd]* ...

Description: Read nn values beginning at the address specified by *wwww*. *wwww* may be either a normal Series 500 word code or an SF/Loop word code. If nn is not specified, then as many values as can fit in the task code buffer are returned.

NOTE: Real values for undefined loops or analog alarms are returned as a NAN. Integer values for undefined loops or analog alarms are returned as zero.

TC88
Select Number of SF Module Task Codes Per Scan

Command: 88 CN [CN] ...
Response: 88

Where C = Channel Number = 1, 2, 3, ... 8 or F
N = Number of Task Codes per Scan = 1, 2, 3, ... 8

NOTE: This allows a different number of task codes per scan for each channel, but all SF modules on that channel are allowed the same number. If an un-installed channel is programmed, a range error is returned.

The hex value of F for the channel number is a wild card and indicates the I/O channel over which the request is received. If this request is from any communication port (local or remote) other than an SF module, it is rejected as containing invalid data.

TC89
Read Number of SF Module Task Codes Per Scan

Command: 89 [C0] ...
Response: 89 CN [CN] ...

Where C = Channel Number = 1, 2, 3, ... 8 or F
N = Number of Task Codes per scan = 1, 2, 3, ... 8

NOTE:

- Multiple CNs are returned in the order of the coded C0s.
- If C0 is note-coded in the request, then one CN is returned for each of the installed channels in order of channel number (2 per RCC).
- If the channel is coded as F, the N for the channel over which the request is received is returned.
- If the requester is on a local port and codes the channel as F, then an invalid data error is returned.
- If an uninstalled channel is coded, a range error is returned.

The following restart/reset conditions apply.

- Cold/Warm/Hot Restarts: Use previous value
- Power-up with Low Battery: Default to 2 task codes per scan
- PLC Clear: Default to 2 task codes per scan

TC8D
Subcommand 00 – Read I/O Base Enable/Disable Status

Used to determine which bases are disabled in the system. All supported channels are returned.

Command: 8D 00
Response: 8D 00 cc mmmm [cc mmmm] ... (all supported channels returned).

Where cc Channel number.

mmmm Bit mask representing which bases are enabled/disabled.
MSB = base 15; LSB = base 0 ;
Bit set = base enabled; Bit cleared = base disabled.

TC8D Subcommand 01 – Write Mask to Controller

Used to write I/O base enable/disable mask to controller.

Command: 8D 01 cc mmmm [cc mmmm] ...

Where	cc	Channel number to write mask to. Range: 1 thru maximum channel number supported.
	mmmm	Mask representing which bases to enable/disable Bit set indicates base is to be enabled. Bit cleared indicates base is to be disabled. MSB = base 15; LSB = base 0;

Response: 8D 01 cc mmmm [cc mmmm] ...

Where	cc	Channel number being modified.
	mmmm	Mask representing which active bases were disabled. Bit set indicates that base was active. MSB = base 15; LSB = base 0;

Error Response: 00 0E Cannot disable base because Run out of ROM is selected.

TC8D Subcommand 02 – Read I/O Base Configuration

Used to determine which bases are configured in the system. All supported channels are returned.

Command: 8D 02
Response: 8D 02 cc mmmm [cc mmmm] ... (all supported channels returned).

Where	cc	Channel number.
	mmmm	Bit mask representing configuration status. MSB = base 15; LSB = base 0 ; Bit set = base configured; Bit cleared = base not configured.

TC93 Assign/Deassign Port

Used to specify application-to-port assignments. This task code has three subcommands:

00	Read port assignments.
01	Assign port to application.
02	Deassign port.

TC93 Subcommand 00 – Read Port Assignments

Used to determine which applications a port is assigned to.

Command: 93 00 QQQQ

Where QQQQ Port ID of the port whose assignments are to be read.

Response: 93 [aa cc] ...

Where aa Application ID of the application assigned to the port.

cc Connection type as follows:

- 00 = Exclusive connection. Only a single application may have an exclusive connection to a port.
- 01 = Shared connection. Multiple applications may have shared connections to a port.

TC93 Subcommand 01 – Assign Port to Application

Used to assign a port to an application.

Command: 93 01 QQQQ aa [cc]

Where QQQQ Port ID of the port to be assigned.

aa Application ID of the application to be assigned.

cc Connection type as follows:

- 00 = Exclusive connection. Only a single application may have an exclusive connection to a port.
- 01 = Shared connection. Multiple applications may have shared connections to a port.

If cc is not coded, then exclusive is assumed.

Response: 93

TC93 Subcommand 02 – Deassign Port

Used to delete a port assignment.

Command: 93 02 QQQQ [aa]

Where QQQQ Port ID of the port to be deassigned.

aa Optional application ID of the application whose connection is to be deassigned. If not coded or 00h then the requester is deassigned.

Response: 93

TC94 Configure Port

This task code is used to set the attributes (e.g., baud rate, character size, parity, number of stop bits, and protocol) of a local port. This task code has two subcommands:

00 Read local port configuration.

01 Set local port configuration.

TC94 Subcommand 00 – Read Port Configuration

This task code is used to read the configuration of a port.

Command: 94 00 QQQQ

Where QQQQ Port ID of the port whose configuration is to be read.

Response: 94 QQQQ pppp bbbbbbbb cc pp ss ff

QQQQ	Port ID of the port whose configuration is to be read.
pppp	Port protocol as follows: 0000 none 0001 TTY (e.g., a printer port). 0002 TBP secondary (includes NITP). 0003 TBP host (includes NITP).
bbbbbbbb	Baud rate.
cc	Character size not including any parity bits. Typically 7 or 8.
pp	Parity as follows: 00 No parity. 01 Even parity. 02 Odd parity. 03 Mark parity. 04 Space parity.
ss	Number of stop bits as follows: 00 Bit synchronous. 01 1 stop bit. 02 1.5 stop bits. 03 2 stop bits.
ff	Flow control as follows: 1... .... DSR/DTR. .1.. .... XON/XOFF.

TC94 Subcommand 01 – Set Port Configuration

This task code is used to set the port configuration.

Command: 94 01 QQQQ pppp bbbbbbbb cc pp ss ff

Where

QQQQ — Port ID of the port to be configured.

pppp — Port protocol as follows:
- 0000 none
- 0001 TTY (e.g., a printer port).
- 0002 TBP secondary (includes NITP).
- 0003 TBP host (includes NITP).

bbbbbbbb — Baud rate.

cc — Character size, not including any parity bits; typically 7 or 8.

pp — Parity as follows:
- 00 No parity.
- 01 Even parity.
- 02 Odd parity.
- 03 Mark parity.
- 04 Space parity.

ss — Number of stop bits as follows:
- 00 Bit synchronous.
- 01 1 stop bit.
- 02 1.5 stop bits.
- 03 2 stop bits.

ff — Flow control as follows:
- 1... .... DSR/DTR.
- .1.. .... XON/XOFF.

Response: 94

TC99
Write VME Memory Area Block/Random

Task code 99 provides a flexible mechanism to write to a VME address.

Command: 99 {am offset ccxx de...de} ...

Where

am = Access mode

00 = Short user access	A16 VME address modifier code $29
01 = Short supervisory access	A16 VME address modifier code $2D
02 = Medium user data	A24 VME address modifier code $39
03 = Medium user program	A24 VME address modifier code $3A
04 = Medium supervisory data	A24 VME address modifier code $3D
05 = Medium supervisory program	A24 VME address modifier code $3E

offset = oooooooo 32-bit offset into either A16 or A24 space.

cc = Number of elements of size xx to be written.

xx = Size of data element to be written.

00 = Byte operation.
01 = Word operation.
02 = Long word operation.

de = Data element of size xx to be written.

Response: 99

Examples:

9900 00000120 0100 FF write 1 byte to A16 user space.
9902 00002000 0500 FF FF FF FF FF write 5 bytes to A24 user data space using byte operations (i.e., writing 1 byte at a time).

TC9A Read VME Memory Area Block/Random

Task code 9A provides a flexible mechanism to read from a VME address.

Command: 9A {am offset ccxx } ...

Where

am = Access mode

00 = Short user access	A16 VME address modifier code $29
01 = Short supervisory access	A16 VME address modifier code $2D
02 = Medium user data	A24 VME address modifier code $39
03 = Medium user program	A24 VME address modifier code $3A
04 = Medium supervisory data	A24 VME address modifier code $3D
05 = Medium supervisory program	A24 VME address modifier code $3E

offset = oooooooo 32-bit offset into either A16 or A24 space.

cc = Number of elements of size xx to be read.

xx = Size of data element to be read.

00 = Byte operation.
01 = Word operation.
02 = Long word operation.

Response: 9A de...de

Where de = Data element of size xx that was read.

Examples:

9A00 00000120 0100 read 1 byte from A16 user space.
9A02 00002000 0500 read 5 bytes from A24 user data space using byte operations (i.e., reading 1 byte at a time).

Chapter 3
Communication Protocols

3.1 Overview

The Series 505 controllers support two serial communication protocols on the RS-232 and RS-422 communication ports.

- All Series 505/500: Non-Intelligent Terminal Protocol (NITP)
- TI545/TI565/TI575: Transparent Byte Protocol (TBP).

Additionally, the TI575 supports the Interboard Communication Protocol (IBC). Task codes are requested using any of the applicable protocols.

This chapter describes the operation of the NITP and the TBP protocols. Refer to *SIMATIC TI575 Interboard Communication Manual* (PPX:575–8103) for a description of the IBC protocol.

3.2 Non-Intelligent Terminal Protocol (NITP)

NITP Format

NITP is a simple, character-oriented method of data link communications using standard 7-bit ASCII codes. Both command and response messages consist of starting and ending delimiters, a character count or message length field, the body of the message, and an error-checking code field as shown in Figure 3-1.

:	Character Count	Message Body	ECC	;

Figure 3-1 Command and Response Messages

NITP Character Set

NITP uses the subset of standard ASCII codes (see Table 3-1) to communicate with a wide variety of host devices, from ASCII terminals to more intelligent machines.

Table 3-1 Standard ASCII Codes

7-bit ASCII Code	Displayed Character	7-bit ASCII Code	Displayed Character
30	0	39	9
31	1	3A	:
32	2	3B	;
33	3	41	A
34	4	42	B
35	5	43	C
36	6	44	D
37	7	45	E
38	8	46	F

NOTE: ASCII characters, except those in the NITP character set (e.g., a carriage return or line feed), may be sent to control special network devices between the ending delimiter and the next beginning delimiter. The controller ignores these characters.

Hexadecimal values must be translated into two ASCII codes or characters: For example, 0E (hex) equals 30 (ASCII 0) 45 (ASCII E).

Message Delimiters

A colon (:) marks the beginning of a message and a semicolon (;) marks the end of a message. Any characters between a colon and the next semicolon are interpreted as valid; any characters between a semicolon and the next colon are ignored. This allows the host to use any parameters required by its software between lines of output. When transmitting data to the host, the PLC sends carriage return and line feed characters after the terminating semicolon in order to scroll the response on ASCII terminals. More intelligent host devices can be set to filter out the carriage return and line feed.

Character Count

To aid in error control, the colon (:) at the beginning of the message is followed by a two-character count field representing the total number of printable characters in the message, including the colon, character count, message body, error checking code, and the terminating semicolon. The two characters represent an 8-bit hexadecimal value so that a count of 50 characters is represented as 3332 (32 hex). The maximum length of NITP messages is 72 characters.

Message Body

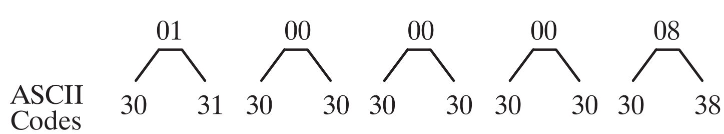
The message body consists of ASCII character pairs from the NITP character set, each representing a single binary byte value.

Error-checking Code

Following the message body is an ASCII four-character error-checking code (ECC) in the form of a 16-bit hexadecimal number that is included at the end of the message just before the semicolon terminator. The ECC is a checksum computed by both the sending and receiving stations:

1. Divide the character count and the message body into blocks of four characters, left-justified and zero-filled. The beginning and ending delimiters are not included in the calculation.
2. Treat each block as a four-digit hexadecimal number.
3. Sum the resulting numbers (blocks).
4. Take the two's complement of the sum to get the ECC.

For example, consider a message whose body is the Read Word Memory Random Task Code (TC01) reading V1 and V9:



The total character count is calculated by adding together the number of characters in the message, the four characters for the ECC, the two characters for the character count, and the two characters used to delimit the message. The total character count for a message containing “0100000008” :

Starting Delimiter	:	=	01	(1)*
Character Count		=	02	(2)
Message Body – 0100000008		=	0A	(10)
Error-checking Code		=	04	(4)
Ending Delimiter	;	=	01	(1)
Total Character Count			12	(18)

* Numbers in parentheses are the corresponding decimal values.

After determining the total character count, insert the character count at the beginning of the message body as “120100000008”. The ECC is given by:

Two’s complement of (1201 + 0000 + 0008) = EDF7

so that the complete message is the character string:

:120100000008EDF7;

or

ASCII Codes	3A	31	32	30	31	30	30	30	30	30	30	30	38	45	44	46	37	3B
Characters	:	1	2	0	1	0	0	0	0	0	0	0	8	E	D	F	7	;

NOTE: If the number of characters in the concatenated character count and message body string is not evenly divisible by 4, then the fill characters “00” are added to the end of the string for use in the ECC calculation. These fill characters are not actually placed in the final message.

Table 3-2 summarizes the NITP message structure:

Table 3-2 NITP Message Structure

Field	Contents	No. of Characters
Beginning delimiter	Colon (:)	1
Character count	Hexadecimal	2
Body of Message	Hexadecimal	72 (maximum)
Error Checking Code	Hexadecimal	4
Terminator	Semicolon (;)	1

3.3 Transparent Byte Protocol

Transparent Byte Protocol (TBP) is a message protocol for point-to-point communications using 8-bit characters transmitted serially. Compared to NITP, TBP improves the efficiency of the information exchange between a controller and an operator interface device.

UART Initialization Requirements

In order to support TBP information exchange, the communications controlling device, Universal Asynchronous Receiver-Transmitter (UART), is initialized to the following conditions:

- 8 data bits per character
- no parity
- 1 start bit
- 1 stop bit

Message Format

The TBP message format is implemented as:

3F RL LL TC dd dd ... dd CK SM

The 3F or ASCII question mark is the first character of all TBP messages. The first byte serves as the protocol identifier that allows the NITP messages to be distinguished from the TBP messages. Therefore, any device supporting TBP initializes the UART (described above). If the protocol is NITP, the first byte received is hexadecimal BA or the ASCII colon sent with odd parity. If the protocol is TBP, the first byte is hexadecimal 3F or the ASCII question mark. Any other first character causes the message to be discarded.

Initiator

The initiator of a request message may choose to use either protocol (NITP or TBP). The responder must respond to the initiator in like protocol. In the case that the request was made using TBP and the responder does not support TBP, no response to the request is made.

Responder

For the responder that supports TBP, a request made using NITP is acknowledged using NITP. Since the NITP character set is limited to 20 characters, the responder makes provisions to check parity even though the UART is set up as defined above.

RL Byte

The RL byte defines the request/response maximum length in bytes. In a message that is a task code request, the RL byte specifies the maximum length of the task code response. In the task code request, the RL byte is a binary number ranging from 6 (hexadecimal 06) to 256 (hexadecimal 00) with 255 being represented by hexadecimal FF. In the task code response, the RL byte defines the maximum length of response that the device supports. Only two values are allowed for the RL byte in the response. The values are 73 (hexadecimal 49) or 256 (hexadecimal 00).

With this definition, a responding device with a maximum buffer size of 72 bytes indicates this restriction to the requesting device. In the event that the request has overflowed the 72 byte buffer length, the responding device returns error code hexadecimal 09 (incorrect amount of data sent with request).

LL Byte

The LL byte defines the message byte count including the 3F and the CKSM. The byte count is a hexadecimal number ranging from a minimum of 6 (hexadecimal 06) to a maximum of 256 (hexadecimal 00) with 255 represented by hexadecimal FF.

TC Byte

The TC byte is a hexadecimal number ranging from 00 to FF that identifies the task code command/response message.

The dd dd ... dd bytes is a hexadecimal number representing the data associated with the task code request/response.

The CK and SM bytes form hexadecimal numbers ranging from 0 to 255. The checksum bytes are generated by the sending device using the Fletcher checksum one's complement as defined by the following equation. The exclamation point preceding the sum of the terms in parentheses in the equation for CK means to take the one's complement of the resulting sum.

$$CK = !(B1 + B2 + B3 + ...+ Bn + SM)$$
$$SM = (n)B1 + (n - 1)B2 + (n - 2)B3 + ... + Bn$$

When a carry results from adding two bytes, the carry is added into the sum or the sum is incremented by one. For instance, if the message consisted of the following bytes:

3F 49 06 30

CK is calculated as !(3F + 49 + 06 + 30 + 15) = 2C.
SM is calculated as 4*3F + 3*49 + 2*06 + 30 = 15.
The transmitted message becomes: 3F 49 06 30 2C 15.

The receiver calculates both the CK and the SM checksum bytes, for example:

$$CK = B1 + B2 + B3 + ...+ Bn$$
$$SM = (n)B1 + (n - 1)B2 + (n - 2)B3 + ... + Bn$$

When a carry results from adding two bytes, the carry is added into the sum or the sum is incremented by one. For the transmitted message from the above example, the receiver produces the following results:

CK is calculated as 3F + 49 + 06 + 30 + 2C + 15 = FF.

SM is calculated as 6*3F + 5*49 + 4*06 + 3*30 + 2*2C + 15 = FF.

If the checksum calculated by the receiver does not equal hexadecimal FF, an error has occurred and the message is discarded.

Message Timeouts

The receiver starts a timer upon receiving of the first character of a message. If the entire message is not received before the timer times out, the message is discarded and the receiver is initialized to receive the next message. The timeout value is baud rate dependant and message length dependant. The values for the maximum length message are shown in Table 3-3, along with the baud rate and character times.

Table 3-3 Maximum Length Message Values

Baud Rate	Character Time (ms)	Message Timeout Value (sec)
19,200	0.521	0.150
9,600	1.042	0.300
2,400	4.167	1.200
1,200	8.333	2.400
300	33.333	9.600

Message Turn Around Time

After receiving a message, the response is not initiated for 0.25 ms. This turn-around time ensures that the transmitting device has had time to set up the receiver. The same delay applies between receiving the response and the beginning of a new message.

Minimum Time Between Requests

After a request message has been sent, the requester waits a minimum of one message timeout, plus one turn around delay, before attempting another transmission. This allows the receiver to timeout the first message and re-initialize to receive. The time required to execute the request is determined separately and may be much longer.

Application Note for Parity Checking NITP Message

Since a device that supports TBP must also support NITP, use lookup tables to avoid reprogramming the UART to send and receive 7 bits of data with odd parity. For transmission, the hexadecimal "nibble" value is used as an index into the table that contains the hexadecimal representation of the ASCII character. The values of the ASCII characters used in NITP are listed in Table 3-4.

Table 3-4 ASCII Character Values for NITP

ASCII Character (or "Nibble")	Hexadecimal Representation With Parity
0	B0
1	31
2	32
3	B3
4	34
5	B5
6	B6
7	37
8	38
9	B9
A	C1
B	C2
C	43
D	C4
E	45
F	46
:	BA
;	3B
<CR>	0D
<LF>	8A

For reception, make a copy of the received character, mask the parity bit, and convert it to a hexadecimal nibble. Using this nibble value as an index into the transmit table, compare the received character with the table value. If they do not match, an error occurred.