E.1 ORION ITALIA SERIES MODBUS PROTOCOL.

The ORION ITALIA SERIES implement a subset of the AEG Modicon Modbus serial communication standard. Many devices support this protocol directly with suitable interface card, allowing direct connection of relays. The Modbus protocol is hardware-independent; that is, the physical layer can be any of variety of standard hardware configurations. This includes RS232, RS422, RS485, fibber optics, etc. The ORION ITALIA RELAYS include a rear terminal RS422/RS485 port. Modbus is a single master multiple slave protocol suitable for a multi-drop configuration as provided by RS422/RS485 hardware. In this configuration up to 32 slaves can be daisy-chained together on a single communication channel.

The ORION ITALIA SERIES is always a Modbus slave. It cannot be programmed as a Modbus master. The Modbus protocol exists in two versions: Remote Terminal Unit (RTU, binary) and ASCII. Only the RTU version is supported by the Orion Italia Relay. Monitoring, programming and control functions are possible using read and write register commands.

E.2 ELECTRICAL INTERFACE.

The hardware or electrical interface is any of the following:

a. Two-wire RS485 for the rear terminal connector

b. Four-wire RS422 for the rear terminal connector.

In a two-wire RS485 link, data flow is bi-directional. The four-wire RS422 port uses two terminals for receive lines, and two other terminals for transmit lines. As a result, both RS422 and RS485 ports cannot be used at the same time. The data flow is half duplex. That is, data is never transmitted and received at the same time.

RS485 and RS422 lines should be connected in a daisy chain configuration (avoid star connections) with terminating resistors and capacitors installed each end of the link, i.e. at the master end and the slave farthest from the master. That value of the terminating resistors should be equal to the characteristic impedance of the line. This is approximately 120 Ohms for standard 24 AWG twisted pair wire. The value of the capacitors should be 1 nF. Shielded wire should always be used to minimize noise. Polarity is important in RS485 communications. See chapter 2 INSTALLATION of manual instruction for more details.

E.3 DATA FRAME FORMAT AND DATA RATE.

One data frame of an asynchronous transmission to or from a Orion Italia Relay consists of 1 start bit, 8 data bits, not parity and 1 stop bit. This produces a 10 bit frame. This is important for transmission though modems at high bit rates (11 bit data frames are not supported by hayes modems at bit rates of greater than 300 bps).

The rear RS485/RS422 external communication port of the Orion Italia Relay supports operation at 1200,2400,4800 and 9600 baud.

E.4 DATA PACKET FORMAT.

A complete request/response consists of the following bytes transmitted as separate data frames:

Master Query Message:

SLAVE ADDRESS	(1 byte)
FUNCTION CODE	(1 byte)
DATA	(variable number of bytes depending on FUNCTION CODE)
CRC	(2 bytes)

Slave Response Message

SLAVE ADDRESS	(1 byte)
FUNCTION CODE	(1 byte)
DATA	(variable number of bytes depending on FUNCTION CODE)
CRC	(2 bytes)

A message is terminated when no data is received for a period of 3 1/2 character transmission times. Consequently, the transmitting device must not allow gaps between bytes larger than this interval (about 3ms at 9600 baud).

SLAVE ADDRESS: This is the first byte of every message. This byte represents the user-assigned address of the slave device that is to receive the message sent by the master. Each slave device must be assigned a unique address, and only the addressed slave will respond to a message that starts with its address. In a master query message the SLAVE ADDRESS represents the address of the slave to which the request is being sent. In a slave response message the SLAVE ADDRESS is a confirmation representing the address of the slave that is sending the response. A master query message with a SLAVE ADDRESS of 0 indicates a broadcast command. All slaves on the communication link will take action based on the message, but none will respond to the master.

FUNCTION CODE: This is the second byte of every message. Modbus defines function codes of 1 to 127. The Orion Italia Relay implements some of this functions. See section E.7 for details of the function codes supported by the Orion Italia Relay Series Modbus Protocol. In a master query message the FUNCTIONS CODE tells the slave what action to perform. In a slave response message, if the FUNCTION CODE sent from the slave is the same as the FUNCTION CODE sent from the master then the slave performed the function as requested.

DATA: This will be a variable number of bytes on the FUNCTION CODE. This may include actual values, setpoints or addresses sent by the master to the slave or by the slave to the master. See section E.7 for a description of the Orion-supported functions and the data required for each.

CRC: This is a two byte error checking code. CRC is sent LSByte first followed by the MSByte. The RTU version of Modbus includes a two byte CRC-16 (16 bit cyclic redundancy check) with every message. The CRC-16 algorithm essentially treats the entire data stream (data bits only; start, stop and parity ignored) as one continuous binary number. This number is first shifted left 16 bits and then divided by a characteristic polynomial (11000000000000101B). The 16 bit remainder of the division is appended to the end of the message, MSByte first. The resulting message including CRC, when divided by the same polynomial at the receiver will give a zero remainder if no transmission errors have occurred. If a Orion Modbus slave device receives a message in which an error is indicated by the CRC-16 calculation, the slave device will not respond to the message. A CRC-16 error indicates that one or more bytes of the message were received incorrectly and thus the entire message should be ignored in order to avoid the slave device performing any incorrect operation. The CRC-16 calculation is an industry standard method used for error detection. An algorithm is included in section E.5 CRC-16 algorithm to assist programmers in situations where no standard CRC-16 calculation routines are available.

E.5 CRC-16 ALGORITHM

Once the following algorithm is completed, the working register "A" will contain the CRC value to be transmitted. Note that this algorithm requires the characteristic polynomial to be reverse bit ordered. The most significant bit of the characteristic polynomial is dropped, since it does not affect the value of the remainder. The following symbols are used in the algorithm:

Symbols:

-->	data transfer
A	16 bit working register
Alow	low order byte of A
Ahigh	high order byte of A
CRC	16 bit CRC-16 value
i,j	loop counter
(+)	logical EXCLUSIVE-OR operator
N	total number of data bytes
Di	i-th data byte (i=0 to N-1)

G 16 bit characteristic polynomial =1010000000000001(binary) with MSbit dropped and bit order reversed

shr(x) right shit operator (the LSbit of x is shifted into a carry lag, a '0' is shifted into the MSbit of x, all other bits are shifted right one location)

Algorithm:

1.	**FFFF(hex) --> A**	
2.	**O --> i**	
3.	**O --> j**	
4.	**Di (+) Alow --> Alow**	
5.	**j + 1 --> j**	
6.	**shr (A)**	
7.	**Is there a carry ?**	**No: go to step 8**
		Yes: G (+) A --> A and continue
8.	**Is j = 8 ?**	**No: go to 5**
		Yes: continue
9.	**i + 1 --> i**	
10.	**Is i = N ?**	**No: go to 3**
		Yes: continue
11.	**A ----> CRC**	

E.6 MESSAGE TIMING

Communication message synchronization is maintained by timing constraints. The receiving device must measure the time between the reception of characters. If three and one half character times elapse without a new character or completion of the message, then the communication link must be reset (i.e. all slaves start listening for a new query message from the master). Thus at 1200 baud a delay of greater than 3.5 x 1/1200 x 10 = 29.2 msec cause the communication link to be reset. At 9600 baud a delay of greater than 3.5 x 1/9600 x 10 = 3.6 ms will cause the communication link to be reset. Most master query messages will be responded to in less than 50 ms. The maximum time for the Orion Italia Relay to return a slave response message for any function code will never exceed 1 second.

E.7 SUPPORTED FUNTION CODES

The second byte of every message is the function code. Modbus defines function codes of 01h to 7Fh. The Orion Italia Relay Modbus protocol supports some of these functions, as summarized in Table No. E.1

TABLE No. E.1

FUNCTION CODE MODBUS PROT. (HEX)	FUNCTION CODE ORION ITALIA (HEX)	DEFINITION
03	03	READ SETPOINTS
04	04	READ ACTUAL VALUES
10	10	STORE MULTIPLES SETPOINTS

Since some programmable logic controllers only support function codes 03h (or 04h) and 10h, most of the above Modbus commands can be performed by reading from or writing to special addresses in the Orion Italia Relay memory map using these function codes.

E.7.1 FUNCTION CODE 03H or 04H - READ SETPOINTS OR ACTUAL VALUES.

Modbus implementation: Read Holding Registers

Orion Italia Relay implementation: Read Actual Values or Setpoint

The Orion Italia Relay implementation of Modbus views "holding registers" as any setpoint or actual values register in the Orion Italia Relay memory map. Registers are 16 (two byte) values transmitted high order byte first. Thus all Orion Italia Relay setpoints and actual values in the memory map are sent as two byte registers. This function code allows the master to read one or more consecutive setpoints or actual values from addressed slave device.

The slave response to these function codes is the slave address, function code, a count of the number of data bytes to follow, the data itself and the CRC. Each data item is sent as a two byte number with the high order byte sent first. The CRC is sent as a two byte number with the low order byte sent first.

The maximum number of values of Setpoints that can be read in a single message is 87 word (174 bytes). The SMPR-1 Setpoint data starts at address FB14h.

The maximum number of values of Actual Values that can be read in a single message is 121 word (242 bytes). The SMPR-1 Actual Values data starts at address FBC2h.

MESSAGE FORMAT AND EXAMPLE:

Request to read 3 register values starting address FB2Ah from slave device 1.

Master query message	Example(hex)	
SLAVE ADDRESS	01	query message for slave 01 = 01h
FUNCTION CODE	03	read setpoint values
DATA STARTING ADDRESS-high order	FB	data starting at address FB2Ah
DATA STARTING ADDRESS-low order byte	2A	
NUMBER OF REGISTERS-high order byte	00	3 register value = 3 word total

NUMBER OF REGISTER-low order byte	03	
CRC-low order byte	15	CRC calculated by the master
CRC-high order byte	27	

If the function code or the address of any of the requested data is illegal, the slave will not respond the message. Otherwise, the slave will respond as follows:

Slave response message	Example (hex)	
SLAVE ADDRESS	01	response message from slave 1 = 01h
FUNCTION CODE	03	read setpoints values
BYTE COUNT	06	3 register values = 6 bytes total
DATA #1-high order byte	00	register value in address FB2A= 0064h
DATA #1-low order byte	64	
DATA #2-high order byte	00	register value in address FB2C=0064h
DATA #2-low order byte	64	
DATA #3-high order byte	00	register value in address FB2E=0064h
DATA #3-low order byte	64	
CRC-low order byte	10	CRC calculated by the slave
CRC-high order byte	89	

E.7.2 FUNCTION CODE 10H -STORE MULTIPLE SETPOINTS

Modbus implementation: Preset Multiple Register
Orion Italia Relay implementation : Store Multiple Setpoints

This function code allows the master to modify the contest of a one or more consecutive setpoint in the addressed slave device. Setpoint registers are 16 bit (two byte) values transmitted high order byte first.

The maximum number of register values (setpoints) that can be stored in a single message is 87 word (174 bytes). The SMPR-1 Setpoint data starts at address FB14h.

To store the value of one or more setpoints in the internal memory of the SMPR-1, the following steps shall be realized:

a) First shall be read all setpoint group (87 word = 174 bytes) with function 03h.

b) Modify the values of setpoints according to setpoint map.

c) Activate the bits of each setpoint, according to the description inside of SMPR-1 memory map data format. This step is very important in order to the new modified value will be stored effectively in the non volatile memory.

d) Send all setpoint group, 87 word (174 bytes) with function 10h. If you send other number than 87 word (174 bytes) , the SMPR-1 relay will not respond to the message.

The SMPR-1 response to this function code is to echo the slave address, function code, starting address, the number of setpoints stored, and the CRC.

MESSAGE FORMAT AND EXAMPLE:

Request slave device 11h to write the value 00C8h at setpoint address 1100h, and the value 0001h at setpoint address 1101h.

Master query message	Example (hex)
SLAVE ADDRESS	11 query for slave 11h
FUNCTION CODE	10 store multiple setpoint values
DATA STARTING ADDRESS-high order byte	11 data starting at address 1100
DATA STARTING ADDRESS-low order byte	00
NUMBER OF SETPOINTS-high order byte	00 2 setpoint values = 2 word
NUMBER OF SETPOINTS-low order byte	02
BYTE COUNT	04 4 byte of data
DATA #1-high order byte	00 data for address 1100=00C8
DATA #1-low order byte	C8
DATA #2-high order byte	00 data for address 1100=0001
DATA #2-low order byte	01
CRC-low order byte	27 CRC calculated by the master
CRC-high order byte	01

If the function code or the address or value of any of the data, is illegal, the slave will not respond to the message. Otherwise, the slave will respond as follows:

Master query message	Example (hex)
SLAVE ADDRESS	11 query for slave 11h
FUNCTION CODE	10 store multiple setpoint values
DATA STARTING ADDRESS-high order byte	11 data starting at address 1100h
DATA STARTING ADDRESS-low order byte	00
NUMBER OF SETPOINTS-high order byte	00 2 setpoint values = 2 word
NUMBER OF SETPOINTS-low order byte	02
CRC-low order byte	46 CRC calculated by the slave
CRC-high order byte	64

E.7.3 EXECUTE OPERATION

The SMPR-1 Relay supports execution of commands using function code 10h. The operation commands is initiated by writing the bits at address FB14h and using function code 10h. A more detailed description to realize the operation commands is:

a) First shall be read all setpoint group (87 word = 174 bytes) with function 03h.

b) Modify the bits at address FB14h according the operation to be realized:

ADDRESS (hex)	TYPE	DEFINITION
FB14	Unsigned 16 bit integer	Execute operation
	Bit 0 = 1	Open Breaker
	Bit 1 = 1	Close Breaker
	Bit 2 = 1	Remote Reset
	Bit 3 = 1	PC Control (Shall be used to write Setpoints)
	Bit 4 = 1	Not used
	Bit 5 = 1	Data Cleared Kwhr-Kvarh
	Bit 6 = 1	Data Cleared KVA Demand
	Bit 7 = 1	Data Cleared KVAR Demand
	Bit 8 = 1	Write to serial memory (Shall be used to write Setpoints)
	Bit 9 = 1	Data Cleared KW Demand
	Bit 10 = 1	Data Cleared AMPS Demand
	Bit 11 = 1	Data Cleared CAUSE OF LAST TRIP
	Bit 12 = 1	Data Cleared MAINTENANCE DATA
	Bit 13 = 1	Data Cleared OPERATIONS DATA
	Bit 14 = 1	Data Cleared EVENTS
	Bit 15 = 1	Not Used

c) Send all setpoint group, 87 word (174 bytes) with function 10h. If you send other number than 87 word (174 bytes) , the SMPR-1 relay will not respond to the message.

E.8 MEMORY MAP INFORMATION

The data stored in the SMPR-1 is grouped as Setpoints and Actual Values. Setpoints can be read and written by a master computer. Actual Values are read only. All setpoints and Actual Values are stored as one or two bytes values. That is, each register address is the address of one byte value. Addresses are listed in hexadecimal. Data values (Setpoint ranges, increments, factory value) are in decimal.

MEMORY MAP SECTION	ADDRESS RANGE (hex)	DESCRIPTION	FUNCTION
Commands	FB14 - FB15	Execute operation commands (write only)	03h and 10h
Setpoints	FB14 - FBC1	Read and write	03h and 10h
Actual Values	FBC2 - FCB3	Read only	04h

The maximum number of values of Setpoints that can be read in a single message is 87 word (174 bytes). The SMPR-1 Setpoint data starts at address FB14h.

The maximum number of values of Actual Values that can be read in a single message is 121 word (242 bytes). The SMPR-1 Actual Values data starts at address FBC2h.

SMPR-1 MEMORY MAP (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)							
ADDR (HEX)	**GROUP**	**DESCRIPTION**	**RANGE**	**STEP VALUE**	**UNITS**	**FORMAT CODE**	**FACTORY DEFAULT**
FB14-FB15	Commands	Command Operation	---	---	---	F1	---
FB14-FB15	Setpoints	Command Operation	---	---	---	F1	---
FB16-FB17		Write internal memory	---	---	---	---	---
FB18-FB19		Write internal memory	---	---	---	---	---
FB1A-FB1B		Write internal memory	---	---	---	---	---
FB1C-FB1D		Write internal memory	---	---	---	---	---
FB1E-FB1F		Write internal memory	---	---	---	---	---
FB20-FB21		Write internal memory	---	---	---	---	---
FB22-FB23		Phase O/C curve Phase O/C alarm Phase inst. trips Ground current sensing Ground sensing system Reset type Trip relay Alarm relay	---	---	---	F2	0940h
FB24-FB25		Function Ground Overcurrent Ground O/C curve Ground inst. trips Breaker type Mech. Operations alarm Breaker discrepancy alarm Accumulated KA alarm	---	---	---	F3	4140h
FB26-FB27		Disconnector with fuse	---	---	---	F4	0C01h
FB28-FB29		Sampling frequency VT connection Undervoltage trip Undervoltage alarm Overvoltage trip Overvoltage alarm	---	---	---	F5	000Ch
FB2A-FB2B		Phase CT rating primary	10 - 5000	5	A	F6	100 A
FB2C-FB2D		Ground CT rating primary	10 – 5000	5	A	F7	100 A
FB2E-FB2F		Disconnector nominal current	10 - 5000	5	A	F8	100 A
FB30-FB31		Fuse rated current (Only Disconnector)	5 – 69 70 – 5000	1 5	A	F9	100 A
FB32-FB33		Accumulated KA alarm level (Only Circuit Breaker)	10 - 5000	1	KA	F10	300 KA
FB34-FB35		Electrical Operations number (Only Disconnector)	5 - 9995	5	---	F11	100
FB36-FB37		VT primary voltage	0.10 – 9.99 10.0 – 69.0	0.01 0.10	KV	F12	1000= 10.0KV

SMPR-1 MEMORY MAP (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)							
ADDR (HEX)	**GROUP**	**DESCRIPTION**	**RANGE**	**STEP VALUE**	**UNITS**	**FORMAT CODE**	**FACTORY DEFAULT**
FB38	Setpoint	Phase O/C time dial	1 – 10	1	---	F13	10
FB39		Phase O/C alarm delay	1 – 254	1	sec	F14	1 sec
FB3A		Ground O/C time dial	1 – 10	1	---	F15	10
FB3B		Ground O/C alarm delay	1 – 254	1	sec	F16	1 sec
FB3C		Trip relay pulse time	0.1 – 0.6	0.1	sec	F17	1=0.1 sec
FB3D		Alarm relay pulse time	0.1 – 0.6	0.1	sec	F18	1=0.1 sec
FB3E-FB3F		Mechanical Operations number	5 - 9995	5	---	F19	3000
FB40		Reserved					
FB41		Reserved					
FB42		Reserved					
FB43		Undervoltage trip delay	0.1 – 25.4	0.1	sec	F20	1=0.1 sec
FB44		Undervoltage alarm delay	0.1 – 25.4	0.1	sec	F21	1=0.1 sec
FB45		Overvoltage trip delay	0.1 – 25.4	0.1	sec	F22	1=0.1 sec
FB46		Overvoltage alarm delay	0.1 – 25.4	0.1	sec	F23	1=0.1 sec
FB47		Phase time O/C shift	0.5 – 1.1	0.1	---	F24	10=1.0
FB48		Phase O/C alarm level	0.5 – 3.0	0.1	x P/U	F25	10=1.0 P/U
FB49		Ground O/C alarm level	0.5 – 3.0	0.1	x P/U	F26	10=1.0 P/U
FB4A		Ground time O/C shift	0.5 – 1.1	0.1	---	F27	10=1.0
FB4B		Reserved					
FB4C		Phase inst. trip level	1.0 – 18.0	0.5	x P/U	F28	100=10.0P/U
FB4D		Ground inst. trip level	1.0 – 18.0	0.5	x P/U	F29	100=10.0P/U
FB4E		Breaker discrepancy delay	100 – 2500	10	mSec	F30	100=1000 mS
FB4F		Phase inst. trip delay	0 – 40	1	cycle	F31	0 cycle
FB50		Ground inst. trip delay	0 – 40	1	cycle	F32	0 cycle
FB51		Reserved					
FB52		Reserved					
FB53		Reserved					
FB54		Undervoltage trip level	50 – 100	1	%VT	F33	80 %VT
FB55		Undervoltage alarm level	50 – 100	1	%VT	F34	85 %VT
FB56		Overvoltage trip level	101 – 125	1	%VT	F35	120 %VT
FB57		Overvoltage alarm level	101 – 125	1	%VT	F36	115 %VT
FB58		Ground timed O/C pickup	4 – 150	1	%CT	F37	12 %CT
FB59		Phase timed O/C pickup	8 – 250	1	%CT	F38	25 %CT
FB5A		Reserved					
FB5B		VT nominal secondary volt	55 – 254	1	V	F39	100 V
FB5C		Reserved					
FB5D		Reserved					
FB5E		Reserved					

SMPR-1 MEMORY MAP (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)							
ADDR (HEX)	**GROUP**	**DESCRIPTION**	**RANGE**	**STEP VALUE**	**UNITS**	**FORMAT CODE**	**FACTORY DEFAULT**
FB5F	Setpoint	Reserved					
FB60		Reserved					
FB61		Reserved					
FB62-FB63		AMPS demand KW demand KVAR demand KVA demand Power factor alarm Power factor trip Frequency alarm Frequency trip Positive/negative KW alarm Positive/negative KVAR alarm	---	---	---	F40	0000h
FB64		Amps demand time period	5 – 60	1	min	F41	5 min
FB65		KW demand time period	5 – 60	1	min	F42	5 min
FB66		KVAR demand time period	5 – 60	1	min	F43	5 min
FB67		KVA demand time period	5 – 60	1	min	F44	5 min
FB68		Amps demand alarm level	25 - 200	1	%CT	F45	100 %CT
FB69		Reserved					
FB6A-FB6B		KW demand alarm level	10 - 1E4	10	KW	F46	10=100 KW
			1E4 - 1E5	100			
			1E5 - 6.5E5	1000			
FB6C-FB6D		KVAR demand alarm level	10 - 1E4	10	KVAR	F47	10=100 KVAR
			1E4 - 1E5	100			
			1E5 - 6.5E5	1000			
FB6E-FB6F		KVA demand alarm level	10 - 1E4	10	KVA	F48	10=100 KVA
			1E4 - 1E5	100			
			1E5 - 6.5E5	1000			
FB70		P.F. leading alarm level	0.05 – 1.00	0.01	---	F49	75=0.75
FB71		P.F. lagging alarm level	0.05 – 1.00	0.01	---	F50	75=0.75
FB72		P.F. leading trip level	0.05 – 1.00	0.01	---	F51	70=0.70
FB73		P.F. lagging trip level	0.05 – 1.00	0.01	---	F52	70=0.70
FB74		P.F. alarm delay	1 – 254	1	sec	F53	50 sec
FB75		P.F. trip delay	1 – 254	1	sec	F54	10 sec
FB76-FB77		Underfrequency alarm level	47.0 – 60.0	0.1	Hz	F55	490=49.0 Hz
FB78-FB79		Underfrequency trip level	47.0 – 60.0	0.1	Hz	F56	480=48.0 Hz
FB7A-FB7B		Overfrequency alarm level	50.0 – 63.0	0.1	Hz	F57	510=51.0 Hz
FB7C-FB7D		Overfrequency trip level	50.0 – 63.0	0.1	Hz	F58	520=52.0 Hz
FB7E		Frequency alarm delay	0.1 – 25.4	0.1	sec	F59	50=5.0 sec
FB7F		Frequency trip delay	0.1 – 25.4	0.1	sec	F60	10=1.0 sec

SMPR-1 MEMORY MAP (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)							
ADDR (HEX)	**GROUP**	**DESCRIPTION**	**RANGE**	**STEP VALUE**	**UNITS**	**FORMAT CODE**	**FACTORY DEFAULT**
FB80-FB81	Setpoint	Positive KW alarm level	10 - 1E4	10	KW	F61	10=100 KW
			1E4 - 1E5	100			
			1E5 - 6.5E5	1000			
FB82-FB83		Negative KW alarm level	10 - 1E4	10	KW	F62	10=100 KW
			1E4 - 1E5	100			
			1E5 - 6.5E5	1000			
FB84-FB85		Positive KVAR alarm level	10 - 1E4	10	KVAR	F63	10=100 KVAR
			1E4 - 1E5	100			
			1E5 - 6.5E5	1000			
FB86-FB87		Negative KVAR alarm level	10 - 1E4	10	KVAR	F64	10=100 KVAR
			1E4 - 1E5	100			
			1E5 - 6.5E5	1000			
FB88		Positive/negative KW alarm delay	1 – 254	1	sec	F65	50 sec
FB89		Positive/negative KVAR alarm delay	1 – 254	1	sec	F66	50 sec
FB8A-FBC1		Reserved					
FBC2-FBC3	Actual Values	Disconnector trip (Only Disconnector)	0 – 9999	1	---	F67	---
FBC4-FBC5		Circuit Breaker trip	0 – 9999	1	---	F67	---
FBC6-FBC7		Timed phase O/C trip	0 – 9999	1	---	F67	---
FBC8-FBC9		Inst. phase O/C trip	0 – 9999	1	---	F67	---
FBCA-FBCB		Timed gorund O/C trip	0 – 9999	1	---	F67	---
FBCC - FBCD		Inst. ground O/C trip	0 – 9999	1	---	F67	---
FBCE-FBCF		Overvoltage trip	0 – 9999	1	---	F67	---
FBD0-FBD1		Undervoltage trip	0 – 9999	1	---	F67	---
FBD2-FBD3		Cause of last trip	0-10,18-21	1	---	F68	---
FBD4-FBD5 FBD6-FBD7		Accumulated KA Phase A	---	--	A	F69	---
FBD8-FBD9 FBDA-FBDB		Accumulated KA Phase B	---	--	A	F69	---
FBDC-FBDD FBDE-FBDF		Accumulated KA Phase C	---	--	A	F69	---
FBE0-FBE1		Closure number	0 – 9999	1	---	F67	---
FBE2-FBE3		Opening number	0 – 9999	1	---	F67	---
FBE4		Event number	0 – 5	1	---	F70	---
FBE5		Last Cause of Event	0 – 35	1	---	F71	---
FBE6		penultimate cause of Event	0 – 35	1	---	F71	
FBE7		antepenultimate cause of Event	0 – 35	1	---	F71	

SMPR-1 MEMORY MAP (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)							
ADDR (HEX)	**GROUP**	**DESCRIPTION**	**RANGE**	**STEP VALUE**	**UNITS**	**FORMAT CODE**	**FACTORY DEFAULT**
FBE8	Actual Values	Next cause of Event	0 – 35	1	---	F71	
FBE9		Oldest cause of Event	0 – 35	1	---	F71	
FBEA-FBEB		Pre-trip Voltage Vax (Last trip)	---	--	V	F72	---
FBEC-FBED		Pre-trip Voltage Vbx (Last trip)	---	--	V	F72	---
FBEE-FBEF		Pre-trip Voltage Vcx (Last trip)	---	--	V	F72	---
FBF0-FBF1		Pre-trip Current Ia (Last trip)	---	--	V	F72	---
FBF2-FBF3		Pre-trip Current Ib (Last trip)	---	--	V	F72	---
FBF4-FBF5		Pre-trip Current Ic (Last trip)	---	--	V	F72	---
FBF6-FBF7		Pre-trip Current Ig (Last trip)	---	--	V	F72	---
FBF8-FBFD		Reserved					
FBFE-FBFF FC00-FC01		Maximum active power demand	---	--	W	F69	---
FC02-FC03 FC04-FC05		Maximum reactive power demand	---	--	VAR	F69	---
FC06-FC07 FC08-FC09		Maximum apparent power demand	---	--	VA	F69	---
FC0A-FC0B FC0C-FC0D FC0E-FC0F		Active or real energy	---	--	KWhrs	F73	---
FC10-FC11 FC12-FC13 FC14-FC15		Reactive energy	---	--	KVarhr	F73	---
FC16-FC17 FC18-FC19		Phase A Maximum demand	---	--	A	F74	---
FC1A-FC1B FC1C-FC1D		Phase B Maximum demand	---	--	A	F74	---
FC1E-FC1F FC20-FC21		Phase C Maximum demand	---	--	A	F74	---
FC22-FC23		Phase A Current (last event)	---	--	A	F72	---
FC24-FC25		Phase B Current (last event)	---	--	A	F72	---
FC26-FC27		Phase C Current (last event)	---	--	A	F72	---
FC28-FC29		Ground Current (last event)	---	--	A	F72	---
FC2A-FC2B		Voltage Vax (last event)	---	--	V	F72	---
FC2C-FC2D		Voltage Vbx (last event)	---	--	V	F72	---
FC2E-FC2F		Voltage Vcx (last event)	---	--	V	F72	---
FC30-FC31		Phase A Current (penultimate event)	---	--	A	F72	---
FC32-FC33		Phase B Current (penultimate event)	---	--	A	F72	---

SMPR-1 MEMORY MAP (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)							
ADDR (HEX)	**GROUP**	**DESCRIPTION**	**RANGE**	**STEP VALUE**	**UNITS**	**FORMAT CODE**	**FACTORY DEFAULT**
FC34-FC35	Actual Values	Phase C Current (penultimate event)	---	--	A	F72	---
FC36-FC37		Ground Current (penultimate event)	---	--	A	F72	---
FC38-FC39		Voltage Vax (penultimate event)	---	--	V	F72	---
FC3A-FC3B		Voltage Vbx (penultimate event)	---	--	V	F72	---
FC3C-FC3D		Voltage Vcx (penultimate event)	---	--	V	F72	---
FC3E-FC3F		Phase A Current (antepenultimate event)	---	--	A	F72	---
FC40-FC41		Phase B Current (antepenultimate event)	---	--	A	F72	---
FC42-FC43		Phase C Current (antepenultimate event)	---	--	A	F72	---
FC44-FC45		Ground Current (antepenultimate event)	---	--	A	F72	---
FC46-FC47		Voltage Vax (antepenultimate event)	---	--	V	F72	---
FC48-FC49		Voltage Vbx (antepenultimate event)	---	--	V	F72	---
FC4A-FC4B		Voltage Vcx (antepenultimate event)	---	--	V	F72	---
FC4C-FC4D		Phase A Current (next event)	---	--	A	F72	---
FC4E-FC4F		Phase B Current (next event)	---	--	A	F72	---
FC50-FC51		Phase C Current (next event)	---	--	A	F72	---
FC52-FC53		Ground Current (next event)	---	--	A	F72	---
FC54-FC55		Voltage Vax (next event)	---	--	V	F72	---
FC56-FC57		Voltage Vbx (next event)	---	--	V	F72	---
FC58-FC59		Voltage Vcx (next event)	---	--	V	F72	---
FC5A-FC5B		Phase A Current (oldest event)	---	--	A	F72	---
FC5C-FC5D		Phase B Current (oldest event)	---	--	A	F72	---
FC5E-FC5F		Phase C Current (oldest event)	---	--	A	F72	---
FC60-FC61		Ground Current (oldest event)	---	--	A	F72	---
FC62-FC63		Voltage Vax (oldest event)	---	--	V	F72	---
FC64-FC65		Voltage Vbx (oldest event)	---	--	V	F72	---
FC66-FC67		Voltage Vcx (oldest event)	---	--	V	F72	---
FC68-FC69 FC6A-FC6B		Phase A Current (Actual Value)	---	--	A	F75	---

SMPR-1 MEMORY MAP (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)							
ADDR (HEX)	**GROUP**	**DESCRIPTION**	**RANGE**	**STEP VALUE**	**UNITS**	**FORMAT CODE**	**FACTORY DEFAULT**
FC6C-FC6D FC6E-FC6F	Actual Values	Phase B Current (Actual Value)	---	--	A	F75	---
FC70-FC71 FC72-FC73		Phase C Current (Actual Value)	---	--	A	F75	---
FC74-FC75 FC76-FC77		Ground Current (Actual Value)	---	--	A	F75	---
FC78		Phase A current scale	---	--	---	F76	---
FC79		Phase B current scale	---	--	---	F76	---
FC7A		Phase C current scale	---	--	---	F76	---
FC7B		Ground current scale	---	--	---	F76	---
FC7C-FC7D FC7E-FC7F		Phase Vax Voltage (Actual Value)	---	--	V	F77	---
FC80-FC81 FC82-FC83		Phase Vbx Voltage (Actual Value)	---	--	V	F77	---
FC84-FC85 FC86-FC87		Phase Vcx Voltage (Actual Value)	---	--	V	F77	---
FC88-FC89		KW, KVAR, Power Factor Sign	---	--	--	F78	---
FC8A-FC8B FC8C-FC8D		Active or real power (Actual Value)	---	--	W	F79	---
FC8E-FC8F FC90-FC91		Reactive power (Actual Value)	---	--	VAR	F79	---
FC92-FC93 FC94-FC95		Apparent power (Actual Value)	---	--	VA	F69	---
FC96-FC97		System Frequency	---	--	Hz	F80	---
FC98-FC99		Power Factor	0.00 – 1.00	0.01	Lag or Lead	F81	---
FC9A-FC9B FC9C-FC9D		Last active power demand (Actual Value)	---	--	W	F69	---
FC9E-FC9F FCA0-FCA1		Last reactive power demand (Actual Value)	---	--	VAR	F69	---
FCA2-FCA3 FCA4-FCA5		Last apparent power demand (Actual Value)	---	--	VA	F69	---
FCA6-FCA7 FCA8-FCA9		Last Phase A demand	---	--	A	F74	---
FCAA-FCAB FCAC-FCAD		Last Phase B demand	---	--	A	F74	---
FCAE-FCAF FCB0-FCB1		Last Phase C demand	---	--	A	F74	---
FCB2-FCB3		Led’s and relay Status	---	--	---	F82	---

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F1	Unsigned 16 bit integer	Command Operation
	Bit 0 = 1	Open Circuit Breaker
	Bit 1 = 1	Close Circuit Breaker
	Bit 2 = 1	Remote reset
	Bit 3 = 1	PC Control (Shall be used to write Setpoints)
	Bit 4 = 1	Reserved
	Bit 5 = 1	Data Cleared Kwhr-Kvarh
	Bit 6 = 1	Data Cleared KVA Demand
	Bit 7 = 1	Data Cleared KVAR Demand
	Bit 8 = 1	Write to internal memory (Shall be used to write Setpoints)
	Bit 9 = 1	Data Cleared KW Demand
	Bit 10 = 1	Data Cleared AMPS Demand
	Bit 11 = 1	Data Cleared CAUSE OF LAST TRIP
	Bit 12 = 1	Data Cleared MAINTENANCE DATA
	Bit 13 = 1	Data Cleared OPERATIONS DATA
	Bit 14 = 1	Data Cleared EVENTS
	Bit 15 = 1	Reserved
F2	Unsigned 16 bit integer	Phase O/C curve, O/C alarm, inst. trip, Ground current sensing, Ground sensing system, reset type, Trip and alarm relay
	Bit 3 2 1 0	Phase O/C Curve
	0 0 0 0	ANSI MODERATELY INVERSE
	0 0 0 1	ANSI NORMALLY INVERSE
	0 0 1 0	ANSI VERY INVERSE
	0 0 1 1	ANSI EXTREMELY INVERSE
	0 1 0 0	IAC SHORT INVERSE
	0 1 0 1	IAC INVERSE
	0 1 1 0	IAC VERY INVERSE
	0 1 1 1	IAC EXTREMELY INVERSE
	1 0 0 0	IEC SHORT INVERSE
	1 0 0 1	IEC-A NORMALY INVERSE
	1 0 1 0	IEC-B VERY INVERSE
	1 0 1 1	IEC-C EXTREMELY INVERSE
	1 1 0 0	DEFINITE TIME #1 (0.025 to 0.55 SEC) Only Version
	1 1 0 1	DEFINITE TIME #2 (0.25 to 5.5 SEC) Only Version
	Bit 5 4	Reserved
	Bit 6	Phase O/C Alarm
	0	Disabled
	1	Enabled
	Bit 7	Reserved

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F2	Unsigned 16 bit integer	Phase O/C curve, O/C alarm, inst. trip, Ground current sensing, Ground sensing system, reset type, Trip and alarm relay
	Bit 8	Phase Instantaneous Trip
	0	Disabled
	1	Enabled
	Bit 10 9	Reserved
	Bit 11	Ground current sensing
	0	Disabled
	1	Enabled
	Bit 12	Ground sensing system
	0	Residual
	1	Zero sequence
	Bit 13	Reset type
	0	Local
	1	Remote
	Bit 14	Trip relay output
	0	Pulsed
	1	Latched
	Bit 15	Alarm relay output
	0	Pulsed
	1	Latched
		Write internal memory: Bit 0 = 1 of FB16h , Bit 0 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F3	Unsigned 16 bit integer	Ground O/C curve, Ground O/C alarm, Ground inst. trip, Breaker type, Mech. Operations alarm, Breaker discrepancy alarm, Accumulated KA alarm
	Bit 3 2 1 0	Ground O/C Curve
	0 0 0 0	ANSI MODERATELY INVERSE
	0 0 0 1	ANSI NORMALLY INVERSE
	0 0 1 0	ANSI VERY INVERSE
	0 0 1 1	ANSI EXTREMELY INVERSE
	0 1 0 0	IAC SHORT INVERSE
	0 1 0 1	IAC INVERSE
	0 1 1 0	IAC VERY INVERSE
	0 1 1 1	IAC EXTREMELY INVERSE
	1 0 0 0	IEC SHORT INVERSE
	1 0 0 1	IEC-A NORMALY INVERSE
	1 0 1 0	IEC-B VERY INVERSE
	1 0 1 1	IEC-C EXTREMELY INVERSE
	1 1 0 0	DEFINITE TIME #1 (0.025 to 0.55 SEC) Only Version
	1 1 0 1	DEFINITE TIME #2 (0.25 to 5.5 SEC) Only Version

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F3	Unsigned 16 bit integer	Ground O/C curve, Ground O/C alarm, Ground inst. trip, Breaker type, Mech. Operations alarm, Breaker discrepancy alarm, Accumulated KA alarm
	Bit 5 4	Function Ground Overcurrent
	0 0	Alarm
	0 1	Trip
	1 0	Trip & Alarm
	Bit 7 6	Reserved
	Bit 8	Ground Instantaneous Trip
	0	Disabled
	1	Enabled
	Bit 10 9	Reserved
	Bit 11	Breaker Type
	0	Circuit breaker
	1	Disconnector
	Bit 12	Mechanical operations alarm
	0	Disabled
	1	Enabled
	Bit 13	Reserved
	Bit 14	Breaker discrepancy alarm
	0	Disabled
	1	Enabled
	Bit 15	Accumulated KA alarm
	0	Disabled
	1	Enabled
		Write internal memory: Bit 0 = 1 of FB16h , Bit 1 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F4	Unsigned 16 bit integer	Disconnector with fuses
	Bit 2 1 0	Reserved
	Bit 3	Disconnector with fuses?
	0	Yes
	1	No
	Bit 9 8 7 6 5 4	Reserved
	Bit 11 10	Reserved
	Bit 15 14 13 12	Reserved
		Write internal memory: Bit 0 = 1 of FB16h , Bit 2 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F5	Unsigned 16 bit integer	Sampling frequency, VT connection, Undervoltage trip, Undervoltage alarm, Overvoltage trip, Overvoltage alarm.
	Bit 1 0	Reserved
	Bit 2	Sampling frequency
	0	60 Hz
	1	50 Hz
	Bit 4 3	VT connection
	0 0	None
	0 1	Wye
	1 0	Open delta
	1 1	Delta-delta
	Bit 5	Undervoltage trip
	0	Disabled
	1	Enabled
	Bit 7 6	Reserved
	Bit 8	Undervoltage alarm
	0	Disabled
	1	Enabled
	Bit 9	Overvoltage trip
	0	Disabled
	1	Enabled
	Bit 11 10	Reserved
	Bit 12	Overvoltage alarm
	0	Disabled
	1	Enabled
	Bit 15 14 13	Reserved
		Write internal memory: Bit 0 = 1 of FB16h , Bit 3 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F6	Unsigned 16 bit integer	Phase CT rating primary
		Example: 100 stored as 100
		Write internal memory: Bit 0 = 1 of FB16h , Bit 4 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F7	Unsigned 16 bit integer	Ground CT rating primary
		Example: 100 stored as 100
		Write internal memory: Bit 0 = 1 of FB16h , Bit 5 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F8	Unsigned 16 bit integer	Rating disconnector
		Example: 100 stored as 100
		Write internal memory: Bit 0 = 1 of FB16h , Bit 6 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F9	Unsigned 16 bit integer	Fuse rated current
		Example: 100 stored as 100
		Write internal memory: Bit 0 = 1 of FB16h , Bit 7 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F10	Unsigned 16 bit integer	Accumulated KA alarm level
		Example: 100 stored as 100
		Write internal memory: Bit 0 = 1 of FB16h , Bit 8 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F11	Unsigned 16 bit integer	Electrical operations number
		Example: 100 stored as 100
		Write internal memory: Bit 0 = 1 of FB16h , Bit 9 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F12	Unsigned 16 bit integer, 2 decimal places	VT primary voltage
		Example: 10.00 stored as 1000
		Write internal memory: Bit 0 = 1 of FB16h , Bit 10 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F13	Unsigned 8 bit integer	Phase O/C time dial
		Example: 10 stored as 10
		Write internal memory: Bit 0 = 1 of FB16h , Bit 11 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F14	Unsigned 8 bit integer	Phase O/C alarm delay
		Example: 10 stored as 10
		Write internal memory: Bit 0 = 1 of FB16h , Bit 11 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F15	Unsigned 8 bit integer	Ground O/C time dial
		Example: 10 stored as 10
		Write internal memory: Bit 0 = 1 of FB16h , Bit 12 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F16	Unsigned 8 bit integer	Ground O/C alarm delay
		Example: 10 stored as 10
		Write internal memory: Bit 0 = 1 of FB16h , Bit 12 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F17	Unsigned 8 bit integer, 1 decimal places	Trip relay pulse time
		Example: 0.1 stored as 1
		Write internal memory: Bit 0 = 1 of FB16h , Bit 13 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F18	Unsigned 8 bit integer, 1 decimal places	Alarm relay pulse time
		Example: 0.1 stored as 1
		Write internal memory: Bit 0 = 1 of FB16h , Bit 13 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F19	Unsigned 16 bit integer	Mechanical operations number
		Example: 100 stored as 100
		Write internal memory: Bit 0 = 1 of FB16h , Bit 14 = 1 of FB18h Bit 3 = 1 and Bit 8 = 1 of FB14h
F20	Unsigned 8 bit integer, 1 decimal places	Undervoltage trip delay
		Example: 0.1 stored as 1
		Write internal memory: Bit 1 = 1 of FB16h , Bit 0 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F21	Unsigned 8 bit integer, 1 decimal places	Undervoltage alarm delay
		Example: 0.1 stored as 1
		Write internal memory: Bit 1 = 1 of FB16h , Bit 1 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F22	Unsigned 8 bit integer, 1 decimal places	Overvoltage trip delay
		Example: 0.1 stored as 1
		Write internal memory: Bit 1 = 1 of FB16h , Bit 1 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F23	Unsigned 8 bit integer, 1 decimal places	Overvoltage alarm delay
		Example: 0.1 stored as 1
		Write internal memory: Bit 1 = 1 of FB16h , Bit 2 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F24	Unsigned 8 bit integer, 1 decimal places	Phase time O/C shift
		Example: 0.1 stored as 1
		Write internal memory: Bit 1 = 1 of FB16h , Bit 2 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F25	Unsigned 8 bit integer, 1 decimal places	Phase O/C alarm level
		Example: 0.1 stored as 1
		Write internal memory: Bit 1 = 1 of FB16h , Bit 3 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F26	Unsigned 8 bit integer, 1 decimal places	Ground O/C alarm level
		Example: 0.1 stored as 1
		Write internal memory: Bit 1 = 1 of FB16h , Bit 3 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F27	Unsigned 8 bit integer, 1 decimal places	Ground time O/C shift
		Example: 0.1 stored as 1
		Write internal memory: Bit 1 = 1 of FB16h , Bit 4 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F28	Unsigned 8 bit integer, 1 decimal places	Phase instantaneous trip level
		Example: 10.0 stored as 100
		Write internal memory: Bit 1 = 1 of FB16h , Bit 5 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F29	Unsigned 8 bit integer, 1 decimal places	Ground instantaneous trip level
		Example: 10.0 stored as 100
		Write internal memory: Bit 1 = 1 of FB16h , Bit 5 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F30	Unsigned 8 bit integer, multiply 10	Breaker discrepancy delay
		Example: 1000 stored as 100
		Write internal memory: Bit 1 = 1 of FB16h , Bit 6 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F31	Unsigned 8 bit integer	Phase instantaneous trip delay
		Example: 1 stored as 1
		Write internal memory: Bit 1 = 1 of FB16h , Bit 6 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F32	Unsigned 8 bit integer	Ground instantaneous trip delay
		Example: 1 stored as 1
		Write internal memory: Bit 1 = 1 of FB16h , Bit 7 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F33	Unsigned 8 bit integer	Undervoltage trip level
		Example: 80 stored as 80
		Write internal memory: Bit 1 = 1 of FB16h , Bit 9 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F34	Unsigned 8 bit integer	Undervoltage alarm level
		Example: 85 stored as 85
		Write internal memory: Bit 1 = 1 of FB16h , Bit 9 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F35	Unsigned 8 bit integer	Overvoltage trip level
		Example: 120 stored as 120
		Write internal memory: Bit 1 = 1 of FB16h , Bit 10 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F36	Unsigned 8 bit integer	Overvoltage alarm level
		Example: 115 stored as 115
		Write internal memory: Bit 1 = 1 of FB16h , Bit 10 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F37	Unsigned 8 bit integer	Ground timed O/C pickup
		Example: 12 stored as 12
		Write internal memory: Bit 1 = 1 of FB16h , Bit 11 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F38	Unsigned 8 bit integer	Phase timed O/C pickup
		Example: 25 stored as 25
		Write internal memory: Bit 1 = 1 of FB16h , Bit 11 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F39	Unsigned 8 bit integer	VT secondary voltage
		Example: 100 stored as 100
		Write internal memory: Bit 1 = 1 of FB16h , Bit 12 = 1 of FB1Ah Bit 3 = 1 and Bit 8 = 1 of FB14h
F40	Unsigned 16 bit integer	AMPS demand, KW demand, KVAR demand, KVA demand, Power factor alarm, Power factor trip, Frequency alarm, Frequency trip, Positive/negative KW alarm, Positive/negative KVAR alarm
	Bit 0	Amps demand
	0	Disabled
	1	Enabled
	Bit 1	Alarm Amps demand
	0	Disabled
	1	Enabled
	Bit 2	KW demand
	0	Disabled
	1	Enabled
	Bit 3	Alarm KW demand
	0	Disabled
	1	Enabled
	Bit 4	KVAR demand
	0	Disabled
	1	Enabled
	Bit 5	Alarm KVAR demand
	0	Disabled
	1	Enabled
	Bit 6	KVA demand
	0	Disabled
	1	Enabled
	Bit 7	Alarm KVA demand
	0	Disabled
	1	Enabled
	Bit 8	Power Factor alarm
	0	Disabled
	1	Enabled
	Bit 9	Power Factor trip
	0	Disabled
	1	Enabled
	Bit 10	Frequency alarm
	0	Disabled
	1	Enabled

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F40	Unsigned 16 bit integer	AMPS demand, KW demand, KVAR demand, KVA demand, Power factor alarm, Power factor trip, Frequency alarm, Frequency trip, Positive/negative KW alarm, Positive/negative KVAR alarm
	Bit 11	Frequency trip
	0	Disabled
	1	Enabled
	Bit 12	Positive / negative KW Alarm
	0	Disabled
	1	Enabled
	Bit 13	Reserved
	Bit 14	Positive / negative KVAR Alarm
	0	Disabled
	1	Enabled
	Bit 15	Reserved
		Write internal memory: Bit 2 = 1 of FB16h , Bit 0 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F41	Unsigned 8 bit integer	Amps demand time period
		Example: 5 stored as 5
		Write internal memory: Bit 2 = 1 of FB16h , Bit 1 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F42	Unsigned 8 bit integer	KW demand time period
		Example: 5 stored as 5
		Write internal memory: Bit 2 = 1 of FB16h , Bit 1 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F43	Unsigned 8 bit integer	KVAR demand time period
		Example: 5 stored as 5
		Write internal memory: Bit 2 = 1 of FB16h , Bit 2 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F44	Unsigned 8 bit integer	KVA demand time period
		Example: 5 stored as 5
		Write internal memory: Bit 2 = 1 of FB16h , Bit 2 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F45	Unsigned 8 bit integer	Amps demand alarm level
		Example: 100 stored as 100
		Write internal memory: Bit 2 = 1 of FB16h , Bit 3 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F46	Unsigned 16 bit integer, multiply 10	KW demand alarm level
		Example: 100 stored as 10
		Write internal memory: Bit 2 = 1 of FB16h , Bit 4 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F47	Unsigned 16 bit integer, multiply 10	KVAR demand alarm level
		Example: 100 stored as 10
		Write internal memory: Bit 2 = 1 of FB16h , Bit 5 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F48	Unsigned 16 bit integer, multiply 10	KVA demand alarm level
		Example: 100 stored as 10
		Write internal memory: Bit 2 = 1 of FB16h , Bit 6 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F49	Unsigned 8 bit integer, 2 decimal places	Power Factor leading alarm level
		Example: 0.75 stored as 75
		Write internal memory: Bit 2 = 1 of FB16h , Bit 7 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F50	Unsigned 8 bit integer, 2 decimal places	Power Factor lagging alarm level
		Example: 0.75 stored as 75
		Write internal memory: Bit 2 = 1 of FB16h , Bit 7 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F51	Unsigned 8 bit integer, 2 decimal places	Power Factor leading trip level
		Example: 0.70 stored as 70
		Write internal memory: Bit 2 = 1 of FB16h , Bit 8 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F52	Unsigned 8 bit integer, 2 decimal places	Power Factor lagging trip level
		Example: 0.70 stored as 70
		Write internal memory: Bit 2 = 1 of FB16h , Bit 8 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F53	Unsigned 8 bit integer	Power Factor alarm delay
		Example: 50 stored as 50
		Write internal memory: Bit 2 = 1 of FB16h , Bit 9 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F54	Unsigned 8 bit integer	Power Factor trip delay
		Example: 10 stored as 10
		Write internal memory: Bit 2 = 1 of FB16h , Bit 9 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F55	Unsigned 16 bit integer, 1 decimal places	Underfrequency alarm level
		Example: 49.0 stored as 490
		Write internal memory: Bit 2 = 1 of FB16h , Bit 10 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F56	Unsigned 16 bit integer, 1 decimal places	Underfrequency trip level
		Example: 48.0 stored as 480
		Write internal memory: Bit 2 = 1 of FB16h , Bit 11 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F57	Unsigned 16 bit integer, 1 decimal places	Overfrequency alarm level
		Example: 51.0 stored as 510
		Write internal memory: Bit 2 = 1 of FB16h , Bit 12 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F58	Unsigned 16 bit integer, 1 decimal places	Overfrequency trip level
		Example: 52.0 stored as 520
		Write internal memory: Bit 2 = 1 of FB16h , Bit 13 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F59	Unsigned 8 bit integer, 1 decimal places	Frequency alarm delay
		Example: 5.0 stored as 50
		Write internal memory: Bit 2 = 1 of FB16h , Bit 14 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F60	Unsigned 8 bit integer, 1 decimal places	Frequency trip delay
		Example: 1.0 stored as 10
		Write internal memory: Bit 2 = 1 of FB16h , Bit 14 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F61	Unsigned 16 bit integer, multiply 10	Positive KW alarm level
		Example: 100 stored as 10
		Write internal memory: Bit 2 = 1 of FB16h , Bit 15 = 1 of FB1Ch Bit 3 = 1 and Bit 8 = 1 of FB14h
F62	Unsigned 16 bit integer, multiply 10	Negative KW alarm level
		Example: 100 stored as 10
		Write internal memory: Bit 3 = 1 of FB16h , Bit 0 = 1 of FB1Eh Bit 3 = 1 and Bit 8 = 1 of FB14h
F63	Unsigned 16 bit integer, multiply 10	Positive KVAR alarm level
		Example: 100 stored as 10
		Write internal memory: Bit 3 = 1 of FB16h , Bit 1 = 1 of FB1Eh Bit 3 = 1 and Bit 8 = 1 of FB14h
F64	Unsigned 16 bit integer, multiply 10	Negative KVAR alarm level
		Example: 100 stored as 10
		Write internal memory: Bit 3 = 1 of FB16h , Bit 2 = 1 of FB1Eh Bit 3 = 1 and Bit 8 = 1 of FB14h
F65	Unsigned 8 bit integer	Positive / negative KW delay
		Example: 50 stored as 50
		Write internal memory: Bit 3 = 1 of FB16h , Bit 3 = 1 of FB1Eh Bit 3 = 1 and Bit 8 = 1 of FB14h
F66	Unsigned 8 bit integer	Positive / negative KVAR delay
		Example: 50 stored as 50
		Write internal memory: Bit 3 = 1 of FB16h , Bit 3 = 1 of FB1Eh Bit 3 = 1 and Bit 8 = 1 of FB14h

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F67	Unsigned 16 bit integer	Example: 510 stored as 510
F68	Unsigned 16 bit integer	Cause of last trip (up to 21)
	0	No trip
	1	Timed overcurrent Phase A
	2	Timed overcurrent Phase B
	3	Timed overcurrent Phase C
	4	Timed overcurrent Ground
	5	Instantaneous overcurrent Phase A
	6	Instantaneous overcurrent Phase B
	7	Instantaneous overcurrent Phase C
	8	Instantaneous overcurrent Ground
	9	Overvoltage
	10	Undervoltage
	18	Power Factor lead
	19	Power Factor lag
	20	Underfrequency
	21	Overfrequency
F69	Unsigned 32 bit integer	Unsigned long value
	1st 16 bit	High order word of long value = high-word
	2nd 16 bit	Low order word of long value = low-word
		PC value = 65536 * high-word + low-word
F70	Unsigned 8 bit integer	Example: 10 stored as 10
F71	Unsigned 8 bit integer	Cause of event (up to 35)
	0	No event
	1	Timed overcurrent Phase A [trip]
	2	Timed overcurrent Phase B [trip]
	3	Timed overcurrent Phase C [trip]
	4	Timed overcurrent Ground [trip]
	5	Instantaneous overcurrent Phase A [trip]
	6	Instantaneous overcurrent Phase B [trip]
	7	Instantaneous overcurrent Phase C [trip]
	8	Instantaneous overcurrent Ground [trip]
	9	Overvoltage [trip]
	10	Undervoltage [trip]
	11	Phase overcurrent [alarm]
	12	Ground overcurrent [alarm]

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F71	Unsigned 8 bit integer	Cause of event (up to 35)
	13	Overvoltage [alarm]
	14	Undervoltage [alarm]
	15	Accumulated KA [alarm]
	16	Breaker discrepancy [alarm]
	17	Mechanical Operations [alarm]
	18	Power Factor lead [trip]
	19	Power Factor lag [trip]
	20	Underfrequency [trip]
	21	Overfrequency [trip]
	22	Power factor lead [alarm]
	23	Power factor lag [alarm]
	24	Underfrequency [alarm]
	25	Overfrequency [alarm]
	26	High KW demand [alarm]
	27	High KVAR demand [alarm]
	28	High KVA demand [alarm]
	29	High Ph-A Current demand [alarm]
	30	High Ph-B Current demand [alarm]
	31	High Ph-C Current demand [alarm]
	32	Positive KW power [alarm]
	33	Negative KW power [alarm]
	34	Positive KVAR power [alarm]
	35	Negative KVAR power [alarm]
F72	Unsigned 16 bit integer	Unsigned 16 bit = WORD
		PC value = WORD and 03FFh
		If Bit 12 = 1 of WORD then PC value = PC value / 10 ,
		If Bit 13 = 1 of WORD then PC value = PC value / 100 ,
		If Bit 14 = 1 of WORD then PC value = PC value * 1000 ,
		If Bit 15 = 1 of WORD then PC value = PC value
F73	Unsigned 48 bit integer	Unsigned extra-long value
	1st 16 bit	Extra-high order word of long value = extra-word
	2nd 16 bit	High order word of long value = high-word
	3rd 16 bit	Low order word of long value = low-word
		PC value = [65536 * extra-word + high-word + low-word / 65536] * 1000

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F74	Unsigned 32 bit integer	Unsigned long value
	1st 16 bit	High order word of long value = high-word
	2nd 16 bit	Low order word of long value = low-word
		PS value = Phase CT rating primary => data format = F6
		PC value = [high-word + low-word / 65536] * [PS / 2777.515437]
F75	Unsigned 32 bit integer	Unsigned long value
	1st 16 bit	High order word of long value = high-word
	2nd 16 bit	Low order word of long value = low-word
		CS value = Current scale => data format = F76
		PS value = Phase CT rating primary => data format = F6
		if CS = 1 then PC value = [high-word + low-word / 65536] * [PS / 2777.515437]
		if CS dif 1 then PC value = [high-word + low-word / 65536] * [PS * 0.01843374]
F76	Unsigned 8 bit integer	Current scale = CS
	CS = 1	Scale 1
	CS different 1	Scale 2
F77	Unsigned 32 bit integer	Unsigned long value
	1st 16 bit	High order word of long value = high-word
	2nd 16 bit	Low order word of long value = low-word
		VTprim value = VT primary voltage => data format = F12
		VTsec value = VT nominal secondary volt => data format = F39
		PC value = [high-word + low-word / 65536] * 9.94368911 * [VTprim / VTsec]
F78	Unsigned 16 bit integer	KW, KVAR, Power Factor Sign
	Bit 1 0	Reserved
	Bit 2	KW sign
	0	Positive
	1	Negative
	Bit 3	KVAR sign
	0	Positive
	1	Negative
	Bit 9 8 7 6 5 4	Reserved
	Bit 10	Power Factor sign
	0	Lagging
	1	Leading
	Bit 15 14 13 12 11	Reserved

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
F79	Unsigned 32 bit integer	Unsigned long value
	1st 16 bit	High order word of long value = high-word
	2nd 16 bit	Low order word of long value = low-word
		Sign = data format => F78
		PC value = [Sign] [65536 * high-word + low-word]
F80	Unsigned 16 bit integer	Unsigned 16 bit = WORD
		PC value = WORD * 0.1
F81	Unsigned 16 bit integer	Unsigned 16 bit = WORD
		Sign = data format => F78
		PC value = [Sign] [WORD * 0.01]
F82	Unsigned 16 bit integer	Led's and Output Relay Status
	Bit 0	Led Alarm Status
	0	Off
	1	On
	Bit 1	Led Trip Status
	0	Off
	1	On
	Bit 2 4	Breaker Status
	0 0	Breaker Open
	1 0	Breaker Closed
	X 1	Breaker Earthed
	Bit 3	Led ¨Switch Current¨ Status
	0	Off
	1	On
	Bit 5	Trip Relay Status
	0	Off
	1	On
	Bit 6	Alarm Relay Status
	0	Off
	1	On
	Bit 7	Service Relay Status
	0	Off
	1	On
	Bit 8	Closing Relay Status
	0	Off
	1	On

SMPR-1 MEMORY MAP DATA FORMATS (Revision 21/03/2000 Software 19/06/1999 & 04/02/2000)		
FORMAT CODE	**TYPE**	**DEFINITION**
	Bit 9	Input 1 Status
	0	Open
	1	Close
	Bit 15 14 13 12 11 10	Reserved