MPS 3000-10
COMMUNICATION
(Modbus protocol)

LISTING
COMMANDS
EXAMPLES

preliminary

September 9, 2003

INTRODUCTION

This document summarizes the serial link protocol to / from the Motor Protector Controller (MPR).

Features:

* RS485 Hardware.
* Asynchronous serial link.
* Half duplex.
* Format: - **Modbus RTU Mode** (**R**emote **T**erminal **U**nit Mode).
  - Binary,
  - Each character includes 11 bits:
  - 1 Start bit
  - 8 Data bits, least significant bit sent first.
  - 1 Parity bit. (Even Parity)
  - 1 Stop bit.
  - **C**yclical **R**edundancy **C**heck (**CRC**), 16 bits.
* Baud Rates: 1200 / 2400 / 4800 / 9600 / 19200 bits per second..
* Response time of the MPR:
  - Normally, Response Time <= 40mS.
  - For a long frame, Response Time <= 200mS.
* It is not recommended to transmit to the MPR too often, at a faster rate than once per second, as it can slow down MPR time delays.
* After storing setting parameters, it is forbidden to transmit again to the same MPR in less than 1 Sec.
* Broadcast commands: not supported.

notes:

* **It is a must to connect Ground to the MPR Ground Stud before connecting serial link wires. Ignoring this instruction may result in permanent damage to the Serial Link Hardware and can be dangerous.**

* It is recommended to connect 120 OHM resistors on both ends of the serial link.
* When the MPR's serial link is connected to Solcon's Serial Link Adapter designed for parameter settings through an IBM (or compatible) personal computer ,it is not required (and not allowed) to connect the 120 OHM resistors.
* It is a must to turn Off (and On again) control power after changing Baud_Rate or Serial_Link_No (Slave Address). These parameters can be modified only manually and not through the Serial Link.

BASIC STRUCTURE OF THE SERIAL LINK FRAME

Modbus RTU frame have the same principal structure for both the "Query" transmission from the Master to the Slave (MPR) and the Response transmission from the Slave to the Master:

"Sync":	Silent time of at least 3.5 character (3.5 * 11 bit times).	
Byte 1:	Serial Link No. (= Slave Address)	(1..247)
Byte 2:	Function	(3,4,6,8 &16 are supported)
Byte 3:	Data Bytes	($XX)
.	.	($XX)
.	.	($XX)
Byte n-1:	CRC_Low	($XX)
Byte n :	CRC_High	($XX)
"Sync":	Silent time of at least 3.5 character (3.5 * 11 bit times).	

SYNC (Silent Interval)

In RTU mode, messages "synchronize" by a "Silent Interval" of more than 3.5 character times. This Silent Interval separates between transmission frames.
The entire frame must be transmitted as a continuous stream. A silent time of more than 3.5 character times during frame transmission will cause the receiving device to ignore the incomplete frame. Next byte will be assumed as the Serial Link No. of the next frame.
Same result of ignoring the frame can occur if a second message is transmitted before 3.5 character times from the end of the previous one. This will cause the receiving device to consider it as a continuation of the first frame, resulting with CRC error.

SERIAL LINK NO. (SLAVE ADDRESS)

Contains MPR Slave Number (1..247) on the serial link. The MPR default value is 248, which is communication OFF condition. Serial Link No. is used as the first byte in both the "Query" transmission from Master to Slave and in Response transmission from Slave to Master.

Note: Slave address 0, normally used for broadcast transmissions is not supported by the MPR.

FUNCTION

The Function code informs the MPR what is the requested action to take. In normal cases, Function is used as the second byte in both the "Query" transmission from Master to Slave and in Response transmission from Slave to Master.

LIST OF FUNCTIONS SUPPORTED BY THE MPR

Function	Modbas Name	Use in MPR
03	Read Holding Registers.	Read Setting Parameters. Read Actual Data (for Modbus Plus users)
04	Read Input Registers.	Read Actual Data.
06	Preset Single Register.	Write One Setting Parameter. Set Real Time Clock.
08	Diagnostics.	Loopback Diagnostics.
16	Force Multiple Registers	Write Setting Parameters. Set Real Time Clock. Control Commands

DATA

Data field includes information transferred to and from the MPR. The specific data format is changed with Function. When Word data parameters are transmitted, High Byte is transmitted first, followed by the Low Byte.

CRC

The CRC (Cyclic Redundancy Check) two bytes (16 bit) are used to check the entire frame bytes. It is generated in the master device and transmitted as the last two bytes of the frame (Low byte is appended first, followed by the High byte). The slave device generates the CRC bytes again and compares it to the received CRC bytes. If the CRC bytes are not identical, the frame is flushed and no response is transmitted to the master.

MPR MEMORY ORGANIZATION

The MPR memory is organized according to the common Modbus addresses as follows:

MPR Use	Memory Type	Max Query/Response Parameters
Actual Data	3X References	244 Registers, # 1..256, addressed 0..255.
	4X References	244 Registers, # 257..512, addressed 256..511
Setting Parameters	4X References	190 Registers, # 1..238, addressed 0..237
	4X References	5 Registers, # 252..256, addressed 251..255

Notes:

1. Actual Data parameters can be read both at 3X references starting at parameter #1, or (same parameters) at 4X references starting at parameter #257 (100 hex higher). The additional mapping in 4X references is designed for the convenience of Modbus Plus users.
2. MPS3000 can be controlled by writing to setting parameter #753 with function 6 or 16. To control, write to register #753 (address 752) only! (One register write, with function 6 or 16).

ACTUAL DATA (3X References & 4X references)

Actual Data includes measured values such as Voltages, Currents and Power. It includes also Calculated, Logic and Statistic information. All parameters are **word** (two bytes) parameters. The protocol supports Reading (only) of these parameters.
Parameter # is "1 based". The actual parameter address is 1 lower than parameter #. For example the address of Actual parameter #1 is 0 (30000).
The parameters have double mapping, at the following **3x & 4x** references:

Parameter	**# (3x)**	**# (4x)**	**Comment**
I1	1	257	Phase 1 line current - Amp.
I2	2	258	Phase 2 line current - Amp.
I3	3	259	Phase 3 line current - Amp.
I0	4	260	Ground current - Amp.
Vp1	5	261	Phase 1 voltage - Volt
Vp2	6	262	Phase 2 voltage - Volt
Vp3	7	263	Phase 3 voltage - Volt
VL12	8	264	Phase 1 to phase 2 line voltage - Volt
VL23	9	265	Phase 2 to phase 3 line voltage - Volt
VL31	10	266	Phase 3 to phase 1 line voltage - Volt
Drive_Status	11	267	0- Available, 1- Running, 2- not Available.
Trips	12	268	OR of all trips. bit spec: d0: momentary, d1: latched, d2..d15: reserved
Alarms	13	269	OR of all alarms. bit spec: d0: momentary, d1: latched, d2..d15: reserved
Time_To_Trip	14	270	Estimate time to trip - Sec. 64000 means: No trip expected.
Time_To_Start	15	271	Estimate time to start - Sec.
Average_RMS_Current	16	272	Average of the 3 line currents - Amp.
Motor_Load	17	273	Average current - % of FLC
Unbalance	18	274	Unbalance current
Alarm_Fault_Number	19	275	Fault that caused alarm indication (See fault list starting at parameter # 58)
Frequency_10	20	276	10 * frequency - (Hz * 10)
Ph_Seq	21	277	1- correct phase seq., <>1 wrong ph. seq
Temp 1	22	278	(1/10) °C
Temp 2	23	279	(1/10) °C
Temp 3	24	280	(1/10) °C
Temp 4	25	281	(1/10) °C
Temp 5	26	282	(1/10) °C
Temp 6	27	283	(1/10) °C
Parameter	**# (3x)**	**# (4x)**	**Comment**

Temp 7	28	284	(1/10) °C or (1/100) KΩ
Temp 8	29	285	(1/10) °C or (1/100) KΩ
Temp 9	30	286	(1/10) °C or (1/100) KΩ
Temp 10	31	287	(1/10) °C or (1/100) KΩ
Reserved	32	288	

for the next 3 control inputs: open contact reads 1, closed contact reads 0.

Control_In_1	33	289	Control Input byte no.1: d15..d8: Reserved d7: Discrete Input A (1 = closed) d6: Discrete Input B (1 = closed) d5: Discrete Input C (1 = closed) d4: Discrete Input D (1 = closed) d3: Isolator NC contact (0 = closed) d2: Isolator NO contact (1 = open) d1: Ext fault 2 contact (1 = fault) d0: Ext fault 3 contact (1 = fault)
Control_In_2	34	290	Control Input byte no.2: d15..d8: Reseved. d7: Start A. (0 = start) d6: Start B. (0 = start) d5: Stop. (1 = stop) d4: Local (=1) / Remote (=0) d3: PLC (=1) / Serial port (=0) d2: Remote Reset (0 = Reset) d1: PLC A control. (0 = Start,1 = Stop) d0: PLC B control. (0 = start,1 = stop)
Control_In_3	35	291	Control Input byte no.3 d15..d8: Reseved d7: Low Speed. (0 = Low Speed) d6: Interlock. (1 = Locked) d5: Authorized Key. (0 = Authorized) d4: Emergency Stop. (1 = E. stop) d3..d0: Reserved.
Equivalent_Current	36	292	Motor equivalent current
Analog_In_1_Reading	37	293	0 = min, to 1000 = max.
Analog_In_2_Reading	38	294	0 = min, to 1000 = max.
Analog_In_3_Reading	39	295	0 = min, to 1000 = max.
Analog_In_4_Reading	40	296	0 = min, to 1000 = max.
Total_Run_Time	41	297	Total hours of running motor

Parameter	# (3x)	# (4x)	Comment
Total_Starts	42	298	Total number of starts
Total_Trips	43	299	Total number of fault trips
Thermal_Capacity	44	300	% of thermal capacity used
Trip_Fault_Number	45	301	Fault that caused trip indication (See fault list starting at parameter # 58)
Logic_Status	46	302	Logic status of MPR. 1 indicates: d15..d8: Reseved d7: Trip d6: Alarm d5: Protection Only d4: Drive Available d3: PLC/Serial port input = PLC d2: Local/Remote input = Local d1: Contactor A is energized d0: Contactor B is energized
Pre_Trip_I1	47	303	Line 1 current value just before trip
Pre_Trip_I2	48	304	Line 2 current value just before trip
Pre_Trip_I3	49	305	Line 3 current value just before trip
Pre_Trip_I0	50	306	Ground current value just before trip
Pre_Trip_Vp1	51	307	Phase 1 voltage value just before trip
Pre_Trip_Vp2	52	308	Phase 2 voltage value just before trip
Pre_Trip_Vp3	53	309	Phase 3 voltage value just before trip
Last_Start_Period	54	310	Last start time duration - Tenth Sec.
Last_Start_Peak_I	55	311	Last start peak RMS current
Reserved	56,57	312,313	
In the following fault data:	bit 0 : Momentary. 0 - no Fault, 1 - Fault. bit 1 :Latched. 0 - no Fault, 1 -Fault.		
Max_Start_Time	58	314	Fault no. 1
Too_Many_Starts	59	315	Fault no. 2
U/C_Level_1	60	316	Fault no. 3
U/C_Level_2	61	317	Fault no. 4
Load_Increased	62	318	Fault no. 5
O/C_Level_1	63	319	Fault no. 6
O/C_level_2	64	320	Fault no. 7
Thermal_Level_1	65	321	Fault no. 8
Thermal_Level_2	66	322	Fault no. 9
Unbalance_Level_1	67	323	Fault no. 10
Unbalance_Level_2	68	324	Fault no. 11
Underoltage	69	325	Fault no. 12
O/V_Level_1	70	326	Fault no. 13
Parameter	**# (3x)**	**# (4x)**	**Comment**

O/V_Level_2	71	327	Fault no. 14
Phase_Loss	72	328	Fault no. 15
Phase_Sequence	73	329	Fault no. 16
Gnd_Fault_Level_1	74	330	Fault no. 17
Gnd_Fault_Level_2	75	331	Fault no. 18
Comm_Port_Failed	76	332	Fault no. 19
Internal_Failure	77	333	Fault no. 20
Control_Circuit_Open	78	334	Fault no. 21
Welded_Contactor	79	335	Fault no. 22
External_Fault_1	80	336	Fault no. 23
External_Fault_2	81	337	Fault no. 24
External_Fault_3	82	338	Fault no. 25
T1_Level_1	83	339	Fault no. 26
T1_Level_2	84	340	Fault no. 27
T2_Level_1	85	341	Fault no. 28
T2_Level_2	86	342	Fault no. 29
T3_Level_1	87	343	Fault no. 30
T3_Level_2	88	344	Fault no. 31
T4_Level_1	89	345	Fault no. 32
T4_Level_2	90	346	Fault no. 33
T5_Level_1	91	347	Fault no. 34
T5_Level_2	92	348	Fault no. 35
T6_Level_1	93	349	Fault no. 36
T6_Level_2	94	350	Fault no. 37
T7_Level_1	95	351	Fault no. 38
T7_Level_2	96	352	Fault no. 39
T8_Level_1	97	353	Fault no. 40
T8_Level_2	98	354	Fault no. 41
T9_Level_1	99	355	Fault no. 42
T9_Level_2	100	356	Fault no. 43
T10_Level_1	101	357	Fault no. 44
T10_Level_2	102	358	Fault no. 45
Under_Power_Level_1	103	359	Fault no. 46
Under_Power_Level_2	104	360	Fault no. 47
Low_Power_Factor	105	361	Fault no. 48
Analog_In_1	106	362	Fault no. 49
Analog_In_2	107	363	Fault no. 50
Analog_In_3	108	364	Fault no. 51
Analog_In_4	109	365	Fault no. 52
Reserved	110..115	366..371	

Parameter	**# (3x)**	**# (4x)**	**Comment**

Clk_Hour	116	372	Setting can be done at # 252
Clk_Minute	117	373	Setting can be done at # 253
Clk_Month	118	374	Setting can be done at # 254
Clk_Date	119	375	Setting can be done at # 255
Clk_Year	120	376	Setting can be done at # 256
Power	121	377	Power_Multiplier = 1 : units: KW Power_Multiplier = 10 : units: (1/10) KW
Reactive_Power	122	378	Power_Multiplier = 1 : units: KVAR Power_Multiplier = 10 : units: (1/10) KVAR
Power_Multiplier	123	379	
Power_Factor	124	380	Power factor*1000 (Integer parameter, + >> I lagging)
Reserved	125..144	381..400	
Energy (KWH)	145 & 146	401..402	Energy in KWH, DWORD parameter LS-Word transmitted first (145)
Reserved	147..148	403..404	
Minimum Voltage	149	405	Min. Voltage at Start & Run since last Reset
Maximum Voltage	150	406	Max. Voltage at Start & Run since last Reset
Minimum Current	151	407	Min. Current at Run since last Reset
Maximum Current	152	408	Max. Current at Run since last Reset
Minimum Voltage	153	409	Min. mains Frequency since last Reset
Maximum Voltage	154	410	Max. mains Frequency since last Reset
Reserved	155..160	411..416	
Trip_Array(10)	161..170	417..426	List of last 10 Trip (See fault list starting at parameter # 58)
Trip_Hour_Array(10)	171..180	427..436	List of time (Hour) of the last 10 trips
Trip_Minute_Array(10)	181..190	437..446	List of time (Minute) of the last 10 trips
Trip_Month_Array(10)	191..200	447..456	List of date (Month) of the last 10 trips
Trip_Date_Array(10)	201..210	457..466	List of date (Date) of the last 10 trips
Trip_Year_Array(10)	211..220	467..476	List of date (Year) of the last 10 trips
Trip_Pointer	221	467..476	Pointer for the 10 cyclic above arrays
Reserved	222..224		
Group_Actual_Data	237..256	493..512	Group of 20 actual parameters selected by setting parameters 219..238

Note: It is never allowed to read more than 120 actual parameters together.

Example 1:

To read Actual parameters 1.. 3 (I1,I2 & I3 Currents , addressed as 0..2) of MPR # 18 (it's Serial Link No. = 18), the host computer should send following frame:

				Another Possibility (Modbus Plus users)
byte 1:	Serial Link No.	($12)		($12)
byte 2:	Function	($04)	(04, Read Actual Data)	**($03)**
byte 3:	Starting Address High	($00)	(Start from address 0)	**($01)**
byte 4:	Starting Address Low	($00)		($00)
byte 5:	No. of Points High	($00)	(3 parameters)	($00)
byte 6:	No. of Points Low	($03)		($03)
byte 7:	CRC_Low	($XX)		($XX)
byte 8:	CRC_High	($XX)		($XX)

The MPR response, when Currents are 400, 402, 398 Amp, respectively, is:

byte 1:	Serial Link No.	($12)		($12)
byte 2:	Function	($04)		**($03)**
byte 3:	Byte Count	($06)	(3 word parameters)	($06)
byte 4:	Data High, parameter # 1	($01)	(400)	($01)
byte 5:	Data Low, parameter # 1	($90)		($90)
byte 6:	Data High, parameter # 2	($01)	(402)	($01)
byte 7:	Data Low, parameter # 2	($92)		($92)
byte 8:	Data High, parameter # 3	($01)	(398)	($01)
byte 9:	Data Low, parameter # 3	($8E)		($8E)
byte 10:	CRC_Low	($XX)		($XX)
byte 11:	CRC_High	($XX)		($XX)

Note: $xx indicates Hexadecimal byte.

SETTING PARAMETERS (4X References)

Setting parameters include all parameters that can be set manually. These parameters determine the modes of operation of the MPR. They also set protections level. All parameters are **word** (two bytes) parameters**.** The protocol supports both Reading and Modifying of (most of) these parameters.

Any one of these parameters must be set with care. Harmful results can occur to the motor by inadequate settings of some parameters.

The parameters have the following **4x** references:

Parameter	**#**	**Range**	**Default**
page 0 - System Parameters Settings			
Line_Volts (Vn)	1	100..22000	480 (Volt)
Line_Frequency	2	50 / 60 Hz	60 Hz
VT_Primary	3	90 and 100..22000	90 (not used)
VT_Secondary	4	95 and 100..660	90 (not used)
Motor_FLC	5	1..2000	100 (Amp)
CT_Primary	6	1..2000	100 (Amp)
Gnd_CT_Primary	7	1..2000	100 (Amp)
Gnd_Fault_Level_1	8	1..100%	5 (% of FLC)
G/F_Level_1_Delay	9	1..60	10 (Sec)
Gnd_Fault_Level_2	10	1..100%	10 (% of FLC)
G/F_Level_2_Delay	11	0..20 (0 - 2Sec)	5 (0.5 Sec)
Gnd_Fault_at_Start	12	1..100%	100 (% of FLC)
Current_Inhibit	13	40..100 and 101 (@10%)	101 (Off)
Starting_Method	14	0 - Direct On Line 1 - Star / Delta 2 - Reversing 3 - Two Speed (A = high, B = low) 4 – No Start Process (Transformer protection)	0 (DOL)
Next two parameters have two options each, according to type of starter. *The second option is selected only for two speed motor.*			
Max_Time_In_Star	15	1..60 Sec.	10 (Sec.)
Low_Spd_Motor_FLC	-"-	1..2000	not in default
Transition_Time	16	5..200 (* 0.01 Sec	20 (200mSec)
Low_Spd_Curve_Multiplier	-"-	1..240 (*0.5 Sec.)	not in default
Star_To_Delta_At	17	70..200 % of FLC	150 % of FLC
Config._Output_A_Relay	18	0 – Contactor A 1- Alarm 2 – Alarm Fail Safe 3 – Tripping / Alarm (Relay operates by group of faults as set in Tripping/Alarm page). 4 - Number Of Starts Pre Alarm 5 – Under Voltage Start Prevent 6 – KWH Pulse Relay	3 (Overload Trip)

Parameter	#	Range	Default
Out_A_Relay_Delay	19	0..250 (0 - 2Sec)	0 (Sec)
Config._Output_B_Relay	20	0 - Contactor B 1 – Trip 2 – Trip fail safe 3 – Tripping / Alarm (Relay operates by group of faults as set in Tripping/Alarm page). 4 - Number Of Starts Pre Alarm 5 – Under Voltage Start Prevent 6 – (I > 0) After Trip	3 (Ground Fault Trip)
Out_B_Relay_Delay	21	0..250 (0 - 250Sec)	0 (Sec)
Config._Output_C	22	0 – Alarm Fail Safe 1 - Alarm 2 - Conractor A 3 - Contactor B 4 - Start / Run	0 - Alarm Fail Safe
Output_C_Delay	23	0..250 Sec.	0 (no delay)
Config._Output_D	24	0 - Trip 1 - Trip Fail Safe	0 - Trip
Output_D_Delay	25	0..250 Sec.	0 (no delay)
Config._Input_A	26	0 – Contactor A N/C 1 – Authorized Key 2 – Low Speed of Two Speed 3 – Emergency Restart 4 – External Fault 1 5 – External Fault 2 6 – External Fault 3 7 – Remote Reset 8 – Low Speed Switch	1 (Authorized Key)
Config._Input_B	27	0 – Contactor A N/O 1 – Authorized Key 2 – Low Speed of Two Speed 3 – Emergency Restart 4 – External Fault 1 5 – External Fault 2 6 – External Fault 3 7 – Remote Reset 8 – Low Speed Switch	4 (External Fault 1)
Config._Input_C	28	0 – Contactor B N/C 1 – Authorized Key 2 – Low Speed of Two Speed 3 – Emergency Restart 4 – External Fault 1 5 – External Fault 2	5 (External Fault 2)

Parameter	#	Range	Default
		6 – External Fault 3 7 – Remote Reset 8 – Low Speed Switch	
Config._Input_D	29	0 – Contactor B N/O 1 – Authorized Key 2 – Low Speed of Two Speed 3 – Emergency Restart 4 – External Fault 1 5 – External Fault 2 6 – External Fault 3 7 – Remote Reset 8 – Low Speed Switch	7 (Remote Reset)
Protection_Only	30	0..1 (No / Yes)	1 (Yes)
Reserved	31..38		
Page 1 - Voltage Settings			
U/V_Level	39	50..95 % of Rated	80 (% Rated)
U/V Delay	40	2..100 (*0.1 Sec)	50 (5 Sec)
U/V_Start_Prevent	11	50..95 % of Rated	50 (% Rated)
O/V_Level_1	42	100..120 (% of Rated)	115 (% Rated)
O/V_Level_2	43	100..120 (% of Rated	120 (% Rated)
O/V_Level_2_delay	44	1..100 Sec.	1 (Sec.)
Reserved	45..48		
Page 2 - Current Settings			
Max_Start_Time	49	1..250 Sec.	10 (Sec.)
Number_Of_Starts	50	1..10	10
Starts_Period	51	1..30min.	30 (min.)
Start_Inhibit	52	1..60min.	15 (min.)
U/C_Level_1	53	10..90% FLC	50 (% of FLC)
U/C_Level_1_Delay	54	1..60Sec	2 (Sec)
U/C_Level_2	55	10..90 % of FLC	40 (% of FLC)
U/C_Level_2_Delay	56	1..60 Sec.	5 (Sec.)
Load_Increase	57	60..150 % of FLC	120 (% of FLC)
O/C_Level_1-Jam	58	10..50 (*10% FLC)	40 (4 FLC)
O/C_Level_1_Delay	59	5..100 (*0.1Sec.)	20 (2Sec.)
O/C_Level_2-Short	60	40..120 (*10% of FLC)	80 (8 FLC)
O/C_Level_2_Delay	61	0..40 (*0.1Sec.)	5 (0.5 Sec.)
Unbalance_Level_2	62	10..40	15 (%)
Unbal_Level_2_Min_Time	63	1..30 Sec.	5 (Sec.)
Unbal_Level_2_Max_Time	64	20..120 Sec.	30 (Sec.)
Reserved	65..68		

Parameter	#	Range	Default
Page 3 - Overload			
Curve Multplier	69	1..15	6
Overload_Pickup	70	60..130 % of FLC	105 (% of FLC)
Hot_Cold_Ratio	71	20..100 %	50 (%)
Run_Cool_Time_Constant	72	1..240 minutes	10 min.
Stop_Cool_Time_Constant	73	1..240 minutes	30 min.
Unbalance_K_Factor	74	0..15	5
RTD_Bias	75	0-Off,1-by T1..T3,2-by T1..T6	0 (Off)
RTD_Bias_Minimum	76	10°C...RTD_Bias_Middle	40 (°C)
RTD_Bias_Middle	77	RTD_Bias_Min… Max	130 (°C)
RTD_Bias_Maximum	78	RTD_Bias_Middle...250(°C)	150 (°C)
Thermal_Level_1	79	50..99 % of thermal capacity	80 (%)
Stall_Time_Factor	80	20..100 %	50 (%)
Reserved	81..88		
Page 4 - Power Settings			
Rated_Pwr_Factor_at_FLC	89	50..99 (for 0.5 to 0.99)	88 (0.88)
Under_Power_Level_1	90	5.. 99	45 (%)
Under_Power_Level_1_Del	91	1..120 Sec.	30 (Sec.)
Under_Power_Level_2	92	5.. 99	25 (%)
Under_Power_Level_2_Del	93	1..120 Sec.	30 (Sec.)
Low_Power_Factor	94	20..98 (Power Factor * 100)	80 (0.8)
Low_Power_Factor_Delay	95	1..120 Sec.	30 (Sec.)
KWH_Per_Pulse	96	0 (off) ..100 KWH per pulse	0 (Off)
Reserved	97..102		
Page 5 - Temperature Settings			
RTD_type	103	0: Copper 1: Pt100 2: Ni120	1 (Pt100)
T_7_10_type	104	0: RTD 1: PTC 2: NTC	0 (RTD)
T1_Level_1	105	0..250 °C	120 °C
T1_Level_2	106	0..250 °C	140 °C
T2_Level_1	107	0..250 °C	120 °C
T2_Level_2	108	0..250 °C	140 °C
T3_Level_1	109	0..250 °C	120 °C
T3_Level_2	110	0..250 °C	140 °C
T4_Level_1	111	0..250 °C	120 °C
T4_Level_2	112	0..250 °C	140 °C
T5_Level_1	113	0..250 °C	120 °C
T5_Level_2	114	0..250 °C	140 °C
T6_Level_1	115	0..250 °C	120 °C
T6_Level_2	116	0..250 °C	140 °C
T7_Level_1	117	0..250 °C or (1/10)K	80 °C or (1/10)K

Parameter		Range	Default
T7_Level_2	118	0..250 °C or (1/10)K	100 °C or (1/10)K
T8_Level_1	119	0..250 °C or (1/10)K	80 °C or (1/10)K
T8_Level_2	120	0..250 °C or (1/10)K	100 °C or (1/10)K
T9_Level_1	121	0..250 °C or (1/10)K	80 °C or (1/10)K
T9_Level_2	122	0..250 °C or (1/10)K	100 °C or (1/10)K
T10_Level_1	123	0..250 °C or (1/10)K	80 °C or (1/10)K
T10_Level_2	124	0..250 °C or (1/10)K	100 °C or (1/10)K
Reserved	125..128		
Page 6 – Analog I/O			
Analog_Out_Type	129	0 (0..20mA or 0..1mA) 1 (4..20mA)	1 (4..20mA)
Analog_Out_1_Parameter	130	0 - I1 1 - I2 2 - I3 3 - Average (RMS) of I1..I3 4 - Max (RMS) of I1..I3 5 - I0 (Ground fault current) 6 - Vp1 (Phase voltage) 7 - Vp2 8 - Vp3 9 - Average (RMS) of VP1..Vp3 10 - VL12 (Line Voltage) 11 - VL23 12 - VL31 13 - Average (RMS) of VL12..VL31 14 - Power 15 - Power_actor 16 - Thermal_Capacity 17 - max of T1..T3 18 - max of T4..T6 19 - max of T7..T9 20- max of T9..T10	3 (Average of I1..I3)
Analog_Out_1_Min	131	0..200%	0 %
Analog_Out_1_Max	132	0..250%	200 %
Analog_Out_2_Parameter	133	Same range as for 1	
Analog_Out_2_Min	134	0..200%	0 %
Analog_Out_2_Max	135	0..250%	200 %
Analog_Out_3_Parameter	136	Same range as for 1	
Analog_Out_3_Min	137	0..200%	0 %
Analog_Out_3_Max	138	0..250%	200 %
Analog_Out_4_Parameter	139	Same range as for 1	
Parameter	**#**		**Default**

Analog_Out_4_Min	140	0..200%	0 %
Analog_Out_4_Max	141	0..250%	200 %
Analog_In_1_Type	142	0 - (0..20mA, 0..1mA) 1 - (4..20mA)	1 (4..20mA)
Analog_In_1_Level	143	0..200 0..100 Trip if IN is below setting 101..200 Trip if IN is above (setting-100).	150 (above 50)
Analog_In_1_Delay	144	0..250 Sec.	10 (Sec.)
Analog_In_2_Type	145	0..1	1 (4..20mA)
Analog_In_2_Level	146	0..200	150 (above 50)
Analog_In_2_Delay	147	0..250 Sec.	10 (Sec.)
Analog_In_3_Type	148	0..1	1 (4..20mA)
Analog_In_3_Level	149	0..200	150 (above 50)
Analog_In_3_Delay	150	0..250 Sec.	10 (Sec.)
Analog_In_4_Type	151	0..1	1 (4..20mA)
Analog_In_4_Level	152	0..200	150 (above 50)
Analog_In_4_Delay	153	0..250 Sec.	10 (Sec.)
Reserved	154..160		

Page 7 - Tripping / Alarm Options

For each one of the following setup bytes, every bit have special function:

d15..d8: Reserved.
d7: Trip
d6: Alarm
d5: Auto Reset
d4: Panel Reset
d3: Remote Reset
d2: Output A relay
d1: Output B relay
d0: Reserved

For each bit: 0 = Disabled, 1 = Enabled.

Max_Start_Time_Setup	161	$58
Too_Many_Starts_Setup	162	$18
U/C_Level_1_Setup	163	$58
U/C_Level_2_Setup	164	$18
Load_Increased_Setup	165	$58
O/C_Level_1_Setup	166	$D8
O/C_level_2_Setup	167	$D8
Thermal_Level_1_Setup	168	$58
Thermal_Level_2_Setup	169	$D8
Unbalance_Level_1_Setup	170	$58
Parameter		**Default**

Unbalance_Level_2_Setup	171	$D8
Underoltage_Setup	172	$58
O/V_Level_1_Setup	173	$58
O/V_Level_2_Setup	174	$D8
Phase_Loss_Setup	175	$D8
Phase_Sequence_Setup	176	$F8
Gnd_Fault_Level_1_Setup	177	$58
Gnd_Fault_Level_2_Setup	178	$C0
Comm_Port_Failed_Setup	179	$38
Internal_Failure_Setup	180	$40
Control_Circuit_Open_Setup	181	$18
Welded_Contactor_Setup	182	$18
External_Fault_1_Setup	183	$18
External_Fault_2_Setup	184	$18
External_Fault_3_Setup	185	$18
T1_Level_1_Setup	186	$18
T1_Level_2_Setup	187	$18
T2_Level_1_Setup	188	$18
T2_Level_2_Setup	189	$18
T3_Level_1_Setup	190	$18
T3_Level_2_Setup	191	$18
T4_Level_1_Setup	192	$18
T4_Level_2_Setup	193	$18
T5_Level_1_Setup	194	$18
T5_Level_2_Setup	195	$18
T6_Level_1_Setup	196	$18
T6_Level_2_Setup	197	$18
T7_Level_1_Setup	198	$18
T7_Level_2_Setup	199	$18
T8_Level_1_Setup	200	$18
T8_Level_2_Setup	201	$18
T9_Level_1_Setup	202	$18
T9_Level_2_Setup	203	$18
T10_Level_1_Setup	204	$18
T10_Level_2_Setup	205	$18
Under_Pwr_Level_1_Setup	206	$18
Under_Pwr_Level_2_Setup	207	$18
Low_Power_Fctor_Setup	208	$18
Analog_In_1_Setup	209	$18
Analog_In_2_Setup	210	$18
Analog_In_3_Setup	211	$18
Parameter	**#**	**Default**

Analog_In_4_Setup	212		$18
Reserved	213..215		

Page 8 - Communication Settings

Baud_Rate	216	12/24/48/96/192 (*100)	192 = 19200 baud
Address_Number	217	1..247 and 248 (off)	248 (to lock out)
Comm_Param_Save_Lock	218	0 (not locked), 1(locked)	1 (locked)
Modbus_#_Array	219..238	1..221 (# of parameter)	(default # are:
		1-I1, 2-I2, 3-I3, 8-VL12, 9-VL23, 10-VL31,	
		22-T1, 23-T2, 24-T3, 25-T4, 26-T5, 27-T6,	
		33-Control_In_1, 44-Thermal_Capacity,	
		121-Power, 122-Reactive_Power, 123-Power_Multiplier,	
		124-Power_Factor,	
		145-Energy LS_word, 146-Energy MS-word)	
Do NOT use	239..251		

Setting (only) of Real Time Clock (Read at actual data, #116..#120). Set only one reg. each time.

Clk_Hour - Setting	252	Read Hour at # 116	.
Clk_Minute - Setting	253	Read Minute at # 117	.
Clk_Month - Setting	254	Read Month at # 118	.
Clk_Date - Setting	255	Read Date at # 119	.
Clk_Year - Setting	256	Read Year at # 120	.

Notes:

1. Parameter # is "1 based". The address is 1 lower than parameter #. For example, address of parameter #1 is 0 (40000).
2. For all Setpoints, it is a must to use values within the listed limits.
   Care must be taken when Preset Single / Multiple Register Functions (6 / 16) are used to adjust one or more Setting parameters. Harmful results may occur by setting one or more parameters incorrectly or out of the specified range.
3. Preset of one Setting parameter (using Function 06) can be done at any time.
   Preset of one or more setting parameters, using Function 16, can be performed only when motor is stopped. Exception response (06 = Busy) is returned by the MPR if an attempt to write setting parameters is done while the motor is not stopped.
4. After storing setting parameters (using function 16), *it is forbidden* to transmit again to the same MPR in less than 1 Sec.
5. Communication parameters 216 to 218 can only be read through serial link. They can be preset only manually.
6. MPR may be locked (at production time) to protection only. In this case, parameter # 30 (Protection_Only) is locked to " Yes" and cannot be changed through the serial link nor manually.
7. It is the user responsibility to read and check all changed setting parameters after presetting.
8. It is never allowed to read more than 120 Setting parameters together.
9. Clock Registers (Hour, Minute, Month, Date, Year) can be set (starting at #252) only one by one, using function 6 or function 16.

Example 2 :
To Read Setting parameters 49 - 51, addressed as 48 - 50 (Max_Start_Time, Number_Of_Starts, Starts_Period) of MPR # 96, the host computer should send following frame:

byte 1:	Serial Link No.	($60)	
byte 2:	Function	($03)	(Read Setting Parameters)
byte 3:	Starting Address High	($00)	(48, Address of first parameter)
byte 4:	Starting Address Low	($30)	
byte 5:	No. of Registers High	($00)	(3 parameters to read)
byte 6:	No. of Registers Low	($03)	
byte 7:	CRC_Low	($XX)	
byte 8:	CRC_High	($XX)	

The MPR normal response:

byte 1:	Serial Link No.	($60)	
byte 2:	Function	($03)	
byte 3:	Byte Count	($06)	
byte 4:	Data High	($00)	(Max_start_time = 30 Sec.)
byte 5:	Data Low	($1E)	
byte 6:	Data High	($00)	(Number_Of_Starts = 10)
byte 7:	Data Low	($0A)	
byte 8:	Data High	($00)	(Starts_Period = 30)
byte 9:	Data Low	($1E)	
byte 10:	CRC_Low	($XX)	
byte 11:	CRC_High	($XX)	

Example 3 :

To write one setting parameter (Gnd_CT_Primary = 100A) to Setting Parameter # 7 (addressed as 6) of MPR # 5, the host computer should send following frame:

byte 1:	Serial Link No.	($05)	
byte 2:	Function	($06)	(06, Write one setting parameter)
byte 3:	Starting Address High	($00)	(06)
byte 4:	Starting Address Low	($06)	
byte 5:	Preset Data High	($00)	(100)
byte 6:	Preset Data Low	($64)	
byte 7:	CRC_Low	($XX)	
byte 8:	CRC_High	($XX)	

The MPR normal response, is an echo of the query:

byte 1:	Serial Link No.	($05)
byte 2:	Function	($06)
byte 3:	Starting Address High	($00)
byte 4:	Starting Address Low	($06)
byte 5:	Preset Data High	($00)
byte 6:	Preset Data Low	($64)
byte 7:	CRC_Low	($XX)
byte 8:	CRC_High	($XX)

Example 4 :

To write few Setting Parameters (VT_Primary = 6300V, VT_Secondary = 110V, Motor_FLC = 405A, CT_Primary = 500A) to Setting Parameters # 3-6 (Addressed as 2-5) of MPR # 32, the host computer should send following frame:

byte 1:	Serial Link No.	($20)	(32)
byte 2:	Function	($10)	(16, Preset multiple setting parameters).
byte 3:	Starting Address High	($00)	(First parameter address is 2)
byte 4:	Starting Address Low	($02)	
byte 5:	No. of Registers High	($00)	(Four parameters to preset)
byte 6:	No. of Registers Low	($04)	
byte 7:	Byte Count	($08)	(8, 2 bytes for each one of the 4 parameters)
byte 8:	Data High	($18)	(Parameter # 11 = 6300)
byte 9:	Data Low	($9C)	
byte 10:	Data High	($00)	(Parameter # 12 = 110)
byte 11:	Data Low	($6E)	
byte 12:	Data High	($01)	(Parameter # 13 = 405)
byte 13:	Data Low	($95)	
byte 14:	Data High	($01)	(Parameter # 14 = 500)
byte 15:	Data Low	($F4)	
byte 16:	CRC_Low	($XX)	
byte 17:	CRC_High	($XX)	

The MPR normal response:

byte 1:	Serial Link No.	($20)
byte 2:	Function	($10)
byte 3:	Starting Address High	($00)
byte 4:	Starting Address Low	($02)
byte 5:	No. of Registers High	($00)
byte 6:	No. of Registers Low	($04)
byte 7:	CRC_Low	($XX)
byte 8:	CRC_High	($XX)

Note:
Even if the preset data value is beyond the allowed range for one or more setting parameters, then a Normal response will be returned. The MPR program ***does not*** check the value of each parameter. If one or more parameters are beyond the allowed limit, harmful result may occur.
It is the user responsibility to read and check all setting parameters after presetting.

CONTROL REGISTER WRITE (4X Reference)

The MPS3000 incorporates **one** Control register intended for control function.

Address: The Control register is register # 753 addressed as 752 (40752).

In order to control the MPS3000 using the Control register:

* Use Function 6 or function 16.
* Use Address_High (page) = 2
* Use Address_Low = 240 (0F0H).
* Write to one register only.
* Use data_high (ms-byte of data) = 5AH.
* Data_low Bits resolution of the control register (ls-byte of data):

bit	**function**	**Comment**
d0	Stop	Write "1" (ON) to stop. (relevant for MPS3000-C only)
d1	Start A	Write "1" (ON) to Start Contactor A (relevant for MPS3000-C only)
d2	Start B	Write "1" (ON) to start Contactor B (relevant for MPS3000-C only)
d3..d6	Reserved	
d7	Reset	Write "1" (ON) to Reset.

Notes:
1. Control Register Read is not possible. To read the MPS3000 status, read Logic_Status (Actual parameter # 46).
2. Bytes 2..8 of the control frame must be exactly as in the following example. Otherwise, an error message is returned.
3. Hardwired Stop input, overrides the communication.

Example 5 :

To reset MPS3000 # 5, using function 6, the host computer should send the following Query frame:

byte 1:	Serial Link No.	($05)	
byte 2:	Function	($06)	(06, Write one setting parameter)
byte 3:	Starting Address High	($02)	($02F0)
byte 4:	Starting Address Low	($F0)	
byte 5:	Preset Data High	($5A)	($5A80)
byte 6:	Preset Data Low	($80)	
byte 7:	CRC_Low	($XX)	
byte 8:	CRC_High	($XX)	

The MPR normal response, is an echo of the query:
($05,$06,$02,$F0,$5A,$80,$XX,$XX)

Example 6- Control Register Write :

To start MPS3000 # 11, the host computer should send the following Query frame:

byte 1:	Serial Link No.	($0B)	
byte 2:	Function	($10)	Bytes 2..8 must be as in this example!!!
byte 3:	Starting Address High	($02)	
byte 4:	Starting Address Low	($F0)	
byte 5:	No. of Registers High	($00)	
byte 6:	No. of Registers Low	($01)	
byte 7:	Byte Count	($02)	
byte 8:	Data High	($5A)	
byte 9:	Data Low	($02)	Bit 1 is set, to start A.
byte 10:	CRC_Low	($XX)	
byte 11:	CRC_High	($XX)	

The MPS3000 normal response:

byte 1:	Serial Link No.	($0B)
byte 2:	Function	($10)
byte 3:	Starting Address High	($02)
byte 4:	Starting Address Low	($F0)
byte 5:	No. of Registers High	($00)
byte 6:	No. of Registers Low	($01)
byte 7:	CRC_Low	($XX)
byte 8:	CRC_High	($XX)

DIAGNOSTICS

Modbus Function 08 , as implemented in the MPR, supports only Subfunction $0000. It provides for "loopback" (Return Query Data) feature, for checking the Communication Serial Link between the master and the MPR.
To request MPR # 1 to return Query data, the master should send following Query frame:

byte 1:	Serial Link No.	($01)	
byte 2:	Function	($08)	(08, Loopback diagnostics).
byte 3:	Subfunction High	($00)	(0, the only supported Subfunction)
byte 4:	Subfunction Low	($00)	
byte 5:	Data High	($37)	(Just an example, any value will do)
byte 6:	Data Low	($A5)	
byte 7:	CRC_Low	($XX)	
byte 8:	CRC_High	($XX)	

The normal (if no Exception) response is the echo of the Query:

byte 1:	Serial Link No.	($01)
byte 2:	Function	($08)
byte 3:	Subfunction High	($00)
byte 4:	Subfunction Low	($00)
byte 5:	Force Data High	($37)
byte 6:	Force Data Low	($A5)
byte 7:	CRC_Low	($XX)
byte 8:	CRC_High	($XX)

EXCEPTION RESPONSES

When the master sends a query frame to an MPR, one of the following four responses from the MPR is possible:

1. When no communication error is detected in the query, and no mistake is found by the communication program module in the MPR, a Normal response is returned.

2. If the MPR does not receive the query frame (for example because of disconnected serial link cable) then no response is returned by the MPR. After proper time, the master will cause a timeout condition.

3. If the MPR receives the query, but a faulty CRC bytes and / or Parity bits are detected, then no response is returned by the MPR. After proper time, the master will cause a timeout condition.

4. If no communication error is detected in the query, but the DMP communication program module finds an error such as illegal Function, data address or data value, or if the MPR is Busy, then an Exception response is returned. The Exception response includes Exception Code to inform the master about the type of the error.

Exception Code Response Frame:
Exception response frame holds fix number of 5 bytes. The first one, the Slave Address field is the Serial link number (transmitted in the query frame and identical to MPR Serial Link No.). The second byte, the Function field returns the echo of the transmitted query function, but with the Most Significant Bit set to "1" (adding $80 to the transmitted function code). The third byte is the Exception Code informing about the type of error. Last two bytes are the CRC bytes.

Exception Codes supported by the MPR:

Exception Code	Type	Comment
01	Illegal Function	Requested Function is not supported. Functions 3,4,6, 8 or 16 are supported.
02	Illegal Data Address	Data address is not allowable.
03	Illegal Data Value	Data Value is not in allowable range.
06	MPR Busy	Trying to Preset Multiple Registers while motor is not stopped (using Function 16). The master should transmit the message again later. Note: After using function 16 to store setting parameters, it is forbidden to transmit again to the same MPR after less than 1Sec.

Example 7:

Master is trying to write 100 to setting parameter # 230 of MPR 16. The MPR incorporates less than 230 regs. Illegal Data Address Exception code will be returned:

Query:

byte 1:	Serial Link No.	($10)	(16)
byte 2:	Function	($06)	(06, Preset Single Register).
byte 3:	Starting Address High	($00)	
byte 4:	Starting Address Low	($E6)	($E6 = 230, Non existent Register)
byte 5:	Preset Data High	($00)	
byte 6:	Preset Data Low	($64)	($64 = 100)
byte 7:	CRC_Low	($XX)	
byte 8:	CRC_High	($XX)	

Exception response:

byte 1:	Serial Link No.	($10)	
byte 2:	Function	($86)	(Original + $80)
byte 3:	Exception Code	($02)	(Illegal Data Address)
byte 4:	CRC_Low	($XX)	
byte 5:	CRC_High	($XX)	

Note:
There are cases where the MPR returns Normal response, but the requested action cannot be performed, or is modified by the MPR. Few examples are:

Requested Action	**Performed Action**
Writing Setting parameter to Serial_Link_No	Ignored.
Writing meaningless discrete (coil) commands	Limiting to allowed range.
Start command (Function 06 or 16) while Stop Hardwired Input is open	Command ignored

It is the user responsibility to verify that the requested action was performed, by reading the value of the modified parameters, status of the command Coils or Logic_Status Actual parameter.

NOTES AND ADDRESSES <u>FOR SOLCON'S USE ONLY</u>

Write $A5 to LINE_FREQUENCY to force normal 3 phase power calculation.

Note: After using function 16 to store setting parameters, it is forbidden to transmit again to the same MPR in less than 50mS + (number of parameters to store) * 10mS.
This note override similar note to wait more than 1Sec in the above text.

Parameter	**#**	**Address**	**Comments**
Version_ CRC_low	37	36	Read with Function 03. Located at Page 0.
Version_ CRC_high	38	37	Notes: 1.Valid only after *Default Setting*. 2. Parameter can be destroyed by using Function 16 and using first_address = 3..5.

Following parameters are actual parameters. Read with Function 04.

Tester_1	32	31	Gets I_Low_Gain_1 value at I>> int.
I_Positive_Seq_bit	125	124	
I_Negative_Seq_bit	126	125	
V_avg_1_bit	129	128	
V_avg_2_bit	130	129	
V_avg_3_bit	131	130	
I_avg_1_bit	132	131	
I_avg_2_bit	133	132	
I_avg_3_bit	134	133	
I_avg_0_bit	135	134	
I_avg_low_gain_1_bit	136	135	
I_avg_low_gain_2_bit	137	136	
I_avg_low_gain_3_bit	138	137	
Reserved	139	138	
I_Low_Gain_1	140	139	low gain line currents, in Amp.
I_Low_Gain_2	141	140	low gain line currents, in Amp.
I_Low_Gain_3	142	141	low gain line currents, in Amp.
KWH_Pulse_Counter	143	142	
Auto_offset_bit_avg (1)	226	225	
…			
Auto_offset_bit_avg (1)	235	234	

Following parameters are stored at upper Eeprom (>=100H). Read with function 04, Setting byte 2 of the Query frame (Starting Address High) to 01H.

Parameter	#	Address	Comments
Total_Run_Time	1	0	Reads parameter at Eeprom + 100H.
Total_Starts	2	1	Total number of starts
Total_Trips	3	2	Total number of trips
Thermal_Capacity	4	3	
Trip_Fault_Number	5	4	# of fault that caused trip.
Logic_Status	6	5	
Trip_I1	7	6	
Trip_I2	8	7	
Trip_I3	9	8	
Trip_I0	10	9	
Trip_VP1	11	10	
Trip_VP2	12	11	
Trip_VP3	13	12	
Last_Start_Period	14	13	
Last_Start_Peak_I	15	14	
Power_Fail_spare_1	16	15	
KWH	17,18	16	Dword, Ls-word first (#17)
Reserved	19..31	18..30	
Default_Page	32	31	Ls-byte of word parameter # 32
Default_Select	32	31	MS-byte of word parameter # 32
Trip_array(10)	33..37	32..36	Srored last 10 Trips 10 bytes are 5 words,
Clock_Hour(10)	38..42	37..41	Stored time at relevant (0..9) trip
Clock_Minute(10)	43..47	42..46	
Clock_Month(10)	48..52	47..51	
Clock_Date(10)	53..57	52..56	
Clock_Year(10)	58..62	57..61	

Note: In above arrays of 10 bytes each, Modbus transmit them as words, where bytes are swapped. IE Array(1) is sent first, then Array(0) etc. (Reason for swapping is that in modbus MS-byte is sent first while in 80c196kc LS-byte is saved at the lower address).

OFFSET & GAIN

Following Manual Offset parameters are saved at Eeprom + 180H as **shortint** parameters.
Modbus transmit them as words, where bytes are swapped. IE Offset_bit (1) is sent first, then Offset_bit(0) etc. (Reason for swapping is that in modbus MS-byte is sent first while in 80c196kc LS-byte is saved at the lower address). Every one of the following 22 parameters should be calculated from the transmitted word and treated then as Shortint.

Parameter	#	Address	Comments
Offset_bit(0)	65	64	LS-byte. Used for Checksum.
First 12 are offsets:			
Offset_bit(1)	65	64	Ms-byte. Used for Temp. 1.
Offset_bit(2)	66	65	LS-byte. Used for Temp. 2.
Offset_bit(3)	66	65	MS-byte. Used for Temp. 3.
Offset_bit(4)	67	66	LS-byte. Used for Temp. 4.
Offset_bit(5)	67	66	MS-byte. Used for Temp. 5.
Offset_bit(6)	68	67	LS-byte. Used for Temp. 6.
Offset_bit(7)	68	67	Ms-byte. Used for Temp. 7.
Offset_bit(8)	69	68	LS-byte. Used for Temp. 8.
Offset_bit(9)	69	68	MS-byte. Used for Temp. 9.
Offset_bit(10)	70	69	LS-byte. Used for Temp. 10.
Offset_bit(11)	70	69	Ms-byte. Used for Power
Offset_bit(12)	71	70	Ls-byte. Used for DIP SWITCH d0 – set for Copper d1 – set for Thermistors at T7 – T1 d2 – set for Protection Only d1 – set for Dead Sea
From here all are gains:			
Offset_bit(13)	71	70	Ms-byte. Used for V1
Offset_bit(14)	72	71	Ls-byte. Used for V2
Offset_bit(15)	72	71	Ms-byte. Used for V3
Offset_bit(16)	73	72	Ls-byte. Used for I1
Offset_bit(17)	73	72	Ms-byte. Used for I2
Offset_bit(18)	74	73	Ls-byte. Used for I3
Offset_bit(19)	74	73	Ms-byte. Used for I0
Offset_bit(20)	75	74	Ls-byte. Used for ILG1
Offset_bit(21)	75	74	Ms-byte. Used for ILG2
Offset_bit(22)	76	75	Ls-byte. Used for ILG3

Read / Write offset,Gain and Dip Switches Parameters

A special (Solcon internal) Function 0 is declared to enable read / write of all offset (1..11) / gain(13..22) / dip switches(12) parameters together (only together). This function is operative only with three bytes of Passwords.
The first (1)..(11) are offsets. 12 is dip switch. 13..22 are all gains.
Every one of the 22 parameters should be treated as Shortint.
Allowed range for all offset / gain parameters is:
For temp (1..10): Max is ± 8 for PT100, Max is 18 for Copper or Nickel.
For Power (11): Max is ± 10 for power offset.
For (13..22): Max is ± 25 (2.5%) for V and I gain.

The "Query" frame sent by the host:

byte 1: Serial Link No.	($20)	
byte 2: Function	($00)	(0, Read/Write Gain parameters function)
byte 3: Password1	($70/$71)	(For Read, Password1 = 112. For write, Password1 = 113)
byte 4: Password2	($57)	(Password2 = 87)
byte 5: Password3	($D6)	(Password3 = 214)
byte 6: T1-Offset	($dd)	
byte 7: T2-Offset	($dd)	
byte 8: T3-Offset	($dd)	
byte 9: T4-Offset	($dd)	
byte10: T5-Offset	($dd)	
byte11: T6-Offset	($dd)	
byte12: T7-Offset	($dd)	
byte 13: T8-Offset	($dd)	
byte 14: T9-Offset	($dd)	
byte 15: T10-Offset	($dd)	
byte 16: Power-Offset	($dd)	
byte17: Dip Switch	($dd)	
byte18: V1- Gain	($dd)	
byte19: V2- Gain	($dd)	
byte 20: V3- Gain	($dd)	
byte 21: I1 - Gain	($dd)	
byte 22: I2 - Gain	($dd)	
byte 23: I3 - Gain	($dd)	
byte 24: I0 - Gain	($dd)	
byte 25: ILG1 - Gain	($dd)	
byte26 : ILG2 - Gain	($dd)	
byte 27: ILG3 - Gain	($dd)	
byte 28: CRC_Low	($XX)	
byte 29: CRC_High	($XX)	

In the above, if Password1 = 112 (Read Gain Parameters), then all offset/gain parameter of the query

frame are ignored.
For Write Gain Parameters function (Password1 = $71), the normal response is the echo of Query.
For Read Gain Parameters function (Password1 = $70), only first 5 bytes are the Echo of the Query frame. Offset/Gain data bytes are the valid offset/gain data bytes of the MPR3000.

Example. To Read all gain parameters of MPR #23, the host Should send the following frame:

byte 1: Serial Link No.	($17)	
byte 2: Function	($00)	(Read/Write Gain parameters function)
byte 3: Password1	($70)	(For Read, Password1 = 112)
byte 4: Password2	($57)	(Password2 = 87)
byte 5: Password3	($D6)	(Password3 = 214)
byte 6: T1-Offset	($0)	
byte 7: T2-Offset	($0)	
…		byte(8) to byte(24), all = 0.
byte 25: ILG1 - Gain	($0)	
byte 26: ILG2 - Gain	($0)	
byte 27: ILG3 - Gain	($0)	
byte 28: CRC_Low	($XX)	
byte 29: CRC_High	($XX)	

The MPR3000 normal response (with offset gain and dip switches show the read values) is:

byte 1: Serial Link No.	($17)	
byte 2: Function	($00)	(Read/Write Gain parameters function)
byte 3: Password1	($70)	(For Read, Password1 = 112)
byte 4: Password2	($57)	(Password2 = 87)
byte 5: Password3	($D6)	(Password3 = 214)
byte 6: T1-Offset	($dd)	
byte 7: T2-Offset	($dd)	
…		byte(8) to byte(24)
byte 25: ILG1 - Gain	($dd)	
byte 26: ILG2 – Gain	($dd)	
byte 27: ILG3 - Gain	($dd)	
byte 28: CRC_Low	($XX)	
byte 29: CRC_High	($XX)	

Example. To Write (-1,2,-3,4,-19,5,8…) gain parameters to MPR #20, the host Should send:

byte 1: Serial Link No.	($14)	
byte 2: Function	($00)	(Read/Write Gain parameters function)
byte 3: Password1	($71)	(For Write, Password1 = 113)
byte 4: Password2	($57)	(Password2 = 87)
byte 5: Password3	($D6)	(Password3 = 214)
byte 6: T1-Offset	($FF)	(-1)
byte 7: T2-Offset	($02)	(+2)
byte 8: T3-Offset	($FD)	(-3)
byte 9: T4-Offset	($04)	(+4)
byte10: T5-Offset	($ED)	(-19)
byte11: T6-Offset	($05)	(+5)
byte12: T7-Offset	($08)	(+8)
… byte(13) to byte(24)		
byte 25: ILG1 - Gain	($dd)	
byte 26: ILG2 – Gain	($dd)	
byte 27: ILG3 - Gain	($dd)	
byte 28: CRC_Low	($XX)	
byte 29: CRC_High	($XX)	

The normal response is the echo of the Query.