Modbus Protocol for MPM–100 and BDS Series Monitors

For BMDM Software Version 4.10 or later,
MPMs with Firmware Version 1.20 or later,
and BDS with Controller Firmware Version 2.20 or later.

TRUST YOUR BATTERIES

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Revision History

Revision	Date of Change	Description of Change	By
7.00	01/21/08	Original document.	LL
7.01	02/28/2009	Minor edits and pagination	ED
7.02	06/10/2011	Added five charger registers supported by DCM 4.15 and controller 3.44 page 12. Added Intertier Resistance 12, 13 and 14 Charger+ cables on page 32	MS
7.03	09/23/2011	Added R test cell and intercell numbers on page 6. Added DCM board offset and Extended intertier information on page 17	MS
7.04	04/24/2012	Added R offset adjustment signature and value on page 6 and a reset alarm note on pages 5 and 29.	MS
7.05	06/23/2015	Added new address and phone number.	MS

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Modbus Protocol for MPM–100 and BDS Series Book 4200–080 Revision 7.05

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1 Modbus™ Protocol (ASCII Frame)

Frame: Colon, Address (H), Address (L), Function (H), Function (L), Data, LRC (H), LRC (L), CR, LF

ASCII Character: Every field in the frame is sent in ASCII character.

Address: Device address is defined as:

MPM:		01H
BDS:	String 1	01H
	String 2	02H
	....	
	String 16	10H

Error Control: LRC

If correct, send requested data back; if error is found, do nothing.

The following binary bytes in the frame are checked:

Address

Function

Data

Bits per Byte: 1 start bit, 7 data bits, 2 stop bits, no parity

Baud Rate: 9600

NOTES:

For example, if function 03H is sent out, we have to convert to 30H (ASCII code of high 4 bits of 03H) and 33H (ASCII code of low 4 bits of 03H).

In the above frame, the first byte (colon) is counted as byte 0 in this document.

2 Register List for Function 3 and 16 Data Address: 0000H – 270EH

Category	Name	Reference	Data Address
Cell Voltage	Cell Voltage 1	40001	0000H
	Cell Voltage 2	40002	0001H
	…	…	…
	Cell Voltage 512	40512	01FFH
Intercell Resistance	Intercell 1	40513	0200H
	…	…	…
	Intercell 48	40560	022FH
	…	…	…
Other Parameters	Overall Voltage	41025	0400H
	Discharge time in seconds (High – Low) *Applied for MPM version 2.00 and later* *Applied for BDS controller version 2.30 and later*	41026 41027	0401H 0402H
	Ground Fault	41028	0403H
	Temperature 1	41029	0404H
	Temperature 2	41030	0405H
	…	…	…
	Temperature 10	41038	040DH
	Intertier Resistance 1 (for MPM)	41039	040EH
	…	…	…
	Intertier Resistance 8 (for MPM)	41046	0415H
	(Not used)	41047	0416H
	(Not used)	41048	0417H
	Test Current 1	41049	0418H
	…	…	…
	Test Current 16	41064	0427H
	Current 1 BDS – String 1 MPM – String 1	41065	0428H
	Current 2 BDS – Float current MPM – String 2	41066	0429H

Category	Name		Reference	Data Address
	Current 3 MPM – String 3		41067	042AH
	Current 4 MPM – String 4		41068	042BH
	Intertier Resistance 1	for BDS	41069	042CH
	…		…	…
	Intertier Resistance 15	for BDS	41083	043AH
	Cell Resistance 1	for single DCM R–test	41084	043BH
	…		…	…
	Cell Resistance 48	for single DCM R–test	41131	046AH
	Current 5	for float current 1 MPM	41132	046BH
	Current 6	for float current 2 MPM	41133	046CH
	Current 7	for float current 3 MPM	41134	046DH
	Current 8	for float current 4 MPM	41135	046EH
	Time–To–Go (Hours × 100) # 1 *For example: Value 720 means 7.2 hours* *Applied for MPM version 2.00 and later* *BDS controller version 2.30 and later*		41136	046FH
	Amp Hour remaining # 1 (High – Low) Integer number *Applied for MPM version 2.00 and later* *Applied for BDS controller version 2.30 and later*		41137	0470H
	Time–To–Go (Hours * 100) # 2 *Value 720 means 7.2 hours* *Applied for MPM version 2.00 and later*		41138	0471H
	Amp Hour remaining # 2 (High – Low) Integer number *Applied for MPM version 2.00 and later*		41139	0472H
	Time–To–Go (Hours X 100) # 3 *For Example: Value 720 means 7.2 hours* *Applied for MPM version 2.00 and later*		41140	0473H

Category	Name		Reference	Data Address
	Amp Hour remaining # 3 (High – Low) Integer number *Applied for MPM version 2.00 and later*		41141	0474H
	Time–To–Go (Hours X 100) # 4 *For Example: Value 720 means 7.2 hours* *Applied for MPM version 2.00 and later*		41142	0475H
	Amp Hour remaining # 4 (High – Low) Integer number *Applied for MPM version 2.00 and later*		41143	0476H
	…		…	…
Current Alarm (<= 95 alarms)	Alarm Type [a] of First Alarm		41153	0480H
	Starting Year / Month of First Alarm		41154	0481H
	Starting Day / Hour of First Alarm		41155	0482H
	Starting Minute / Second of First Alarm		41156	0483H
	…		…	…
	Alarm Type of Last Alarm			
	Starting Year / Month of Last Alarm			
	Starting Day / Hour of Last Alarm			
	Starting Minute / Second of Last Alarm			
	0FFH			
	…		…	…
Status Registers	String ID		41537	0600H
	Firmware Time	Year / Month	41538	0601H
	Firmware Time	Day / Hour	41539	0602H
	Firmware Time	Minute / Second	41540	0603H
	System Status [b]		41541	0604H
	Firmware Control [c]		41542	0605H
	System Status [w]		41543	0606H
	Remaining Time of Next	Day / Hour	41544	0607H

Category	Name		Reference	Data Address
	Historical Log			
	Remaining Time of Next Historical Log	Minute / Second	41545	0608H
	Remaining Time of Next Resistance Test	Day / Hour	41546	0609H
	Remaining Time of Next Resistance Test	Minute / Second	41547	060AH
	Remaining Time of Alarm Disable	Day / Hour	41548	060BH
	Remaining Time of Alarm Disable	Minute / Second	41549	060CH
	Discharge Timer	Day / Hour	41550	060DH
	Discharge Timer	Minute / Second	41551	060EH
	Remaining Time of Load Test	Day / Hour	41552	060FH
	Remaining Time of Load Test	Minute / Second	41553	0610H
	DIP Switch		41554	0611H
	Hardware Diagnostics [d]		41555	0612H
	Indicators [e]		41556	0613H
	Digital Inputs [f]		41557	0614H
	Reset Alarm [g] ***Note**: This register is only used under diagnostics for testing the alarm reset button and will return a "1" state when pressed.*		41558	0615H
	Frame Number – For discharge, resistance, historical alarm and latched alarm.		41559	0616H
	String # / DCM #		41560	0617H
	Contacts [h]		41561	0618H

Category	Name	Reference	Data Address
	Comm. Error Counts of DCM 1 – 2	41562	0619H
	…	…	…
	Comm. Error Counts of DCM 15 – 16	41569	0620H
	R test cell and intercell number R test cell number – High byte (1-255) R test intercell number – Low byte (1-255)	41570	0621H
	Diagnostic tab number	41571	0622H
	R offset adjustment signature Signature **0X55**	41572	0623H
	R offset adjustment value D15 – '1' for negative '0' for positive D14 – D0 is the value from 0 to 1000. For example, 996 is 99.6	41573	0624H
	…	…	…
	History reading record number	41591	0636H
		41592	0637H
	Resistance record number	41593	0638H
		41594	0639H
	Discharge record number	41595	063AH
	Discharge memory full	41596	063BH
	Resistance memory full	41597	063CH
	History reading memory full	41598	063DH
	Cell Connection 0x0080 – Good 0x00FF – Connection problem. R test, load diagnostic and test current calibration should be disabled. *Applied for BDS40 only.* *Applied for DCM 2.45 or higher* *Applied for BDS Controller 2.31 or higher*	41599	063EH
	Dial Out String #	41600	063FH
Configuration	Total Cell Number	41601	0640H
	Load Test Length / 0	41602	0641H

Category	Name	Reference	Data Address
	Config # / 0	41603	0642H
	Shunt	41604	0643H
	Float Current Multiplier	41605	0644H
	Alarm Latch Selection	41606	0645H
	Cool Down Time Between Load Steps in Seconds *For example: 60 means 1 minute cool–down time*	41607	0646H
	Cool Down Time Between DCMs in Seconds *For example: 60 means 1 minute cool–down time*	41608	0647H
	Intertier Number 1 *Applied for MPM before version 4.01*	41609	0648H
	…	…	…
	Intertier Number 4 *Applied for MPM before version 4.01*	41612	064BH
	Critical Alarm Selection	41613	064CH
	Maintenance Alarm Selection	41614	064DH
	Print Alarm Selection	41615	064EH
	IP Address Part 1 / part 2	41616	064FH
	IP Address Part 3 / part 4)	41617	0650H
	AckSetting (0x0000 – Ack xx – Alarm) *Applied for MPM version 2.00 and later* *Applied for BDS controller version 2.30 and later*	41618	0651H
	Historical Log Period	41619	0652H
	Resistance Test Period	41620	0653H
	Load Test Period	41621	0654H
	Firmware Version [i]	41622	0655H
	PCB Version [i]	41623	0656H

Category	Name		Reference	Data Address
	Cell Mode 0 1 2 3 4 5	2v module 4v module 6v module 8v module 12v module 16v module	41624	0657H
	Station Phone #	Byte 1 / Byte 2	41625	0658H
	...		…	…
	Station Phone # [j]	Byte 19 / Byte 20	41634	0661H
	Alarm Report Selection [k]		41635	0662H
	Parameter Option 1 [l]		41636	0663H
	Parameter Option 2 [l]		41637	0664H
	Control Option [m]		41638	0665H
	Low Cell Voltage for Discharge		41639	0666H
	Low Overall Voltage for Discharge		41640	0667H
	Maximum Discharge Time In minutes		41641	0668H
	High Temperature for Charger		41642	0669H
	Low Temperature for Charger		41643	066AH
	Digital Input Selection [n]		41644	066BH
	Digital Input Connection Selection [o]		41645	066CH
	Log Threshold for Cell Voltage		41646	066DH
	Log Threshold for Overall Voltage		41647	066EH
	Log Threshold for Current		41648	066FH
	Location Name	Byte 1 / Byte 2	41649	0670H
	…		…	…
	Location Name	Byte 19 / Byte 20	41658	0679H
	Battery Name	Byte 1 / Byte 2	41659	067AH
	…		…	…
	Battery Name	Byte 19 / Byte 20	41668	0683H

Category	Name		Reference	Data Address
	String Name	Byte 1 / Byte 2	41669	0684H
	…		…	…
	String Name	Byte 19 / Byte 20	41678	068DH
	Password 1	Byte 1 / Byte 2	41679	068EH
	Password 1	Byte 3 / Byte 4	41680	068FH
	Password 1	Byte 5 / 0	41681	0690H
	Password 2	Byte 1 / Byte 2	41682	0691H
	Password 2	Byte 3 / Byte 4	41683	0692H
	Password 2	Byte 5 / 0	41684	0693H
	Password 3	Byte 1 / Byte 2	41685	0694H
	Password 3	Byte 3 / Byte 4	41686	0695H
	Password 3	Byte 5 / 0	41687	0696H
	Discharge Mode		41688	0697H
	Temperature Name 1	Byte 1 / Byte 2	41689	0698H
	…		…	…
	Temperature Name 1	Byte 19 / Byte 20	41698	06A1H
	…		…	…
	Temperature Name 10	Byte 1 / Byte 2	41779	06F2H
	…		…	…
	Temperature Name 10	Byte 19 / Byte 20	41788	06FBH
	Intertier Number 1		41789	06FCH
	…		…	…
	Intertier Number 15		41803	070AH
	Digital Input Report Selection		41804	070BH
	Digital Input Critical Alarm Selection		41805	070CH
	Digital Input Maintenance Alarm Selection		41806	070DH
	Digital Input Print Alarm Selection		41807	070EH
	Digital Output Trigger 1 – 2		41808	070FH
	Digital Output Trigger 3 – 4		41809	0710H
	Digital Output Trigger 5 – 6		41810	0711H
	Digital Output Trigger 7 – 8		41811	0712H

Category	Name		Reference	Data Address
	Digital Output Enable Selection		41812	0713H
	Digital Output Latch Selection		41813	0714H
	Net mask	Part 1 / Part 2	41814	0715H
	Net mask	Part 3 / Part 4	41815	0716H
	Gateway	Part 1 / Part 2	41816	0717H
	Gateway	Part 3 / Part 4	41817	0718H
	Battery Amp Hour # 1 (High – Low) *Applied for MPM version 2.00 and later* *BDS controller version 2.30 and later*		41818	0719H
Category	**Name**		**Reference**	**Data Address**
	Peukert number # 1 This floating number is stored as an integer at this register. *For example:* *N = 1.13* *1130 is stored* *Applied for BDS controller version 2.30 and later* *Applied for MPM version 2.00 and later*		41819	071AH
	Battery Amp Hour # 2 (High – Low) *Applied for MPM version 2.00 and later*		41820	071BH
	Peukert number # 2 This floating number is stored as an integer at this register. *For example:* *N = 1.13* *1130 is stored* *Applied for MPM version 2.00 and later*		41821	071CH
	Battery Amp Hour # 3 (High – Low) *Applied for MPM version 2.00 and later*		41822	071DH
	Peukert number # 3		41823	071EH

Category	Name	Reference	Data Address
	This floating number is stored as an integer at this register. *For example:* *N = 1.13* *1130 is stored* *Applied for MPM version 2.00 and later*		
	Battery Amp Hour # 4 (High – Low) *Applied for MPM version 2.00 and later*	41824	071FH
	Peukert number # 4 This floating number is stored as an integer at this register. *For example:* *N = 1.13* *1130 is stored* *Applied for MPM version 2.00 and later*	41825	0720H
	Baseline	41826	0721H
	Baseline percentage	41827	0722H
	…	…	…
	R Baseline Signature (= 10308)	41855	073EH
	R Baseline Value (H / L)	41856	073FH
	…	…	…
DCM Configuration	Cell # of DCM 1 / Cell # of DCM 2	41857	0740H
	…	…	…
	Cell # of DCM 15 / Cell # of DCM 16		
	OV # / 0		
	Discharge Current # / Float Current #		
	Temp # 1 / Temp # 2		
	…	…	…
	Temp # 9 / Temp # 10		
	Load Step of DCM 1 – 2		
	…	…	…
	Load Step of DCM 15 – 16		

Category	Name	Reference	Data Address
	Readings / Load Step of DCM 1 – 2		
	…	…	…
	Readings / Load Step of DCM 15 – 16		
	Readings / Last Load Step of DCM 1 – 2		
	…	…	…
	Readings / Last Load Step of DCM 15 – 16		
	Step Start # of DCM 1 – 2		
	…	…	…
	Step Start # of DCM 15 – 16		
	…	…	…
	Intercell Voltage Cal of Unit 1	41986	07C1H
	Overall Voltage Cal of Unit 1	41987	07C2H
	Current 1 Cal of Unit 1	41988	07C3H
	Current 2 Cal of Unit 1	41989	07C4H
	Ground Fault Cal of Unit 1	41990	07C5H
	Temperature 1 Raw Counts Ref of DCM1/MPM	41991	07C6H
	Intertier Voltage Cal of Unit 1	41992	07C7H
	Test Current Cal of Unit 1	41993	07C8H
	Temperature 2 Raw Counts Ref of DCM1/MPM	41994	07C9H
	Cell Voltage Cal of Unit 2 / Temperature 3 Raw Counts Ref of MPM	41995	07CAH
	Intercell Voltage Cal of Unit 2 / Temperature 4 Raw Counts Ref of MPM	41996	07CBH
	…	…	…
	Ground Fault Cal of Unit 2 / Temperature 8 Raw Counts Ref of MPM	42000	07CFH
	…	…	…
	The following five registers are supported by DCM 4.15 and controller 3.44 and after.		
	Charger cable signature – 42011 enable test	42118	0845H
	Charger + Cable 1 DCM# / DCM intertier channel #	42119	0846H

Category	Name	Reference	Data Address
	Charger + Cable 2 DCM# / DCM intertier channel #	42120	0847H
	Charger - Cable 1 DCM# / DCM intertier channel #	42121	0848H
	Charger - Cable 2 DCM# / DCM intertier channel #	42122	0849H
	Following 22 registers applicable for DCM 2.52,MPM 2.07 and after. *For example, if the user inputs 77F in the Calibration screen, the number stored here should be 25C * 45 = 1125*		
	Temperature 1 Ref of DCM 1/MPM Temp 1	42123	084AH
	Temperature 1 Ref of DCM 1/MPM Temp 2	42124	084BH
	Temperature 1 Ref of DCM 2/MPM Temp 3	42125	084Ch
	Temperature 2 Ref of DCM 2/MPM Temp 4	42126	084DH
	Temperature 1 Ref of DCM 3/MPM Temp 5	42127	084EH
	Temperature 2 Ref of DCM 3/MPM Temp 6	42128	084FH
	Temperature 1 Ref of DCM 4/MPM Temp 7	42129	0850H
	Temperature 2 Ref of DCM 4/MPM Temp 8	42130	0851H
	Temperature 1 Ref of DCM 5	42131	0852H
	Temperature 2 Ref of DCM 5	42132	0853H
	Temperature 1 Ref of DCM 6	42133	0854H
	Temperature 2 Ref of DCM 6	42134	0855H
	Temperature 1 Ref of DCM 7	42135	0856H
	Temperature 2 Ref of DCM 7	42136	0857H
	Temperature 1 Ref of DCM 8	42137	0858H
	Temperature 2 Ref of DCM 8	42138	0859H
	Temperature 1 Ref of DCM 9	42139	085AH
	Temperature 2 Ref of DCM 9	42140	085BH
	Temperature 1 Ref of DCM 10	42141	085CH
	Temperature 2 Ref of DCM 10	42142	085DH
	Temperature 1 Ref of DCM 11	42143	085EH
	Temperature 2 Ref of DCM 11	42144	085FH

Category	Name		Reference	Data Address
LGS Remote Monitoring System Setup	System Type A / A System Type A / 0	Three numeric characters defined from Vertiv's GUI. Two types known as of this writing are 040(BDS40) and 256(BDS256)	42145 42146	0860H 0861H
	Site ID X / X Site ID X / X Site ID X / 0	Five numeric characters defined from Vertiv's GUI.	42147 42148 42149	0862H 0863H 0864H
	Monitor Device Number T / T	Seven numeric characters defined from Vertiv's GUI.	42150	0865H
	Monitor Device Number T / T		42151	0866H
	Monitor Device Number T / T		42152	0867H
	Monitor Device Number T / 0		42153	0868H
	Phone Number Byte1 / Byte 2	Phone number used to call LGS to report alarms or test message once a day at predetermined time.	42154	0869H
	…		…	…
	Phone Number Byte 29 / Byte 30		42168	0877H
	Test time	Hour / Minute Predetermined time to send test message to LGS once a day.	42169	0878H
		For example: 21:05 Hour – 21 Minute – 5		
Alarm Thresholds	High Cell Voltage Alarm Threshold		42241	0861H
	Low Cell Voltage Alarm Threshold		42242	0862H
	High Cell Resistance Alarm Threshold		42243	0863H
	0		42244	0864H
	High Intercell Resistance Alarm Threshold		42245	0865H

Category	Name	Reference	Data Address
	0	42246	0866H
	High Overall Voltage Alarm Threshold	42247	0867H
	Low Overall Voltage Alarm Threshold	42248	0868H
	High Float Alarm Threshold	42249	0869H
	0	42250	....
	High Discharge Current Alarm Threshold	42251	0877H
	0	42252	0878H
	High Ground Fault Alarm Threshold	42253	
	0	42254	08CDH
	Following 20 registers applicable for DCM 2.52, MPM 2.07and after *For example, if threshold is 25℃, the number stored here should be 25C * 45 = 1125*		
	High Temperature 1 Alarm Threshold	42255	08CEH
	Low Temperature 1 Alarm Threshold	42256	08CFH
	...	...	...
	High Temperature 10 Alarm Threshold	42273	08E0H
	Low Temperature 10 Alarm Threshold	42274	08E1H
	High Intertier Resistance Alarm Threshold (for MPM)		
	0		
	(19 registers are not used)		
	Discharge Level		
	Warning Percentage		
	High Intertier Resistance 1 Alarm Threshold (for BDS)		
	0		
	High Intertier Resistance 15 Alarm Threshold (for BDS)		
	0		
	…	…	…

Category	Name		Reference	Data Address
Historical Events (128 bytes)	*For BDS and MPM's using firmware 2.00 and later* *These registers can only hold 16 alarm events. If more than 16 events occur, latest one could overwrite oldest events.*		…	…
	Alarm Type A of First Event		42369	0940H
	Start Year / Month of First Event		42370	0941H
	Start Day / Hour of First Event		42371	0942H
	Start Minute / Second of First Event		42372	0943H
	…		…	…
	Alarm Type A of 16th Event			
	Start Year / Month of 16th Event			
	Start Day / Hour of 16th Event			
	Start Minute / Second of 16th Event		42432	097FH
Historical Events (34 bytes)	String ID		42369	0940H
	Discharge Start Date	Year / Month	42370	
	Discharge Start Date	Day / Hour	42371	
	Discharge Start Time	Minute / Second	42372	
	Applied for MPM using firmware earlier than 2.00			
	Discharge Detail	Not used	42373	
	Warning Start Date	Year / Month	42374	
	Warning Start Date	Day / Hour	42375	
	Warning Start Time	Minute / Second	42376	
	Warning Detail		42377	
	Alarm Start Date	Year / Month	42378	
	Alarm Start Date	Day / Hour	42379	
	Alarm Start Time	Minute / Second	42380	
	Alarm Detail	= Alarm Type	42381	
Memo	Reset–Alarm Date	Year / Month	42382	

Category	Name		Reference	Data Address
(262 Bytes = 131 registers)	Reset–Alarm Date	Day / Hour	42383	
	Reset–Alarm Time	Minute / Second	42384	
	Status [p]		42385	
	.....			
	Year / Month		42433	0980H
	Day / Hour		….	….
	Minute / Second			
	Memo (character 1 / character 2)			
	…		…	…
	Memo (character 255 / 0)			
	…		…	…
	Self Test [q] of DCM 1		42625	0A40H
	Firmware Version of DCM 1			
	Hardware Reset Times of DCM 1			
	Firmware Reset Times of DCM 1			
	DIP 1 of DCM 1			
	DIP 2 of DCM 1			
DCM Diagnostics (6 registers X 16 = 96 registers)	….			
	Self Test of DCM 16			
	Firmware Version of DCM 16			
	Hardware Reset Times of DCM 16			
	Firmware Reset Times of DCM 16			
	DIP 1 of DCM 16			
	DIP 2 of DCM 16			
DCM board offset and extended intertier number	Board offset (0xfff – N/A) of DCM 1		42721	0AA0H
	Extended intertier number of DCM 1			
	…			
	Board offset (0xfff – N/A) of DCM 16		42751	0ABEH
	Extended intertier number of DCM 16		42752	0ABFH
	…			

Category	Name	Reference	Data Address
Discharge Summary (3 x 50 = 150 registers)	Year / Month of First Discharge	42881	0B40H
	Day / Hour of First Discharge		
	Minute / Second of First Discharge		
	…	…	…
	Year / Month of 50th Discharge		
	Day / Hour of 50th Discharge		
	Minute / Second 50th First Discharge	43030	0BD5H
	…	…	…
		43073	0C00H
	24 characters,12 registers	44185 … 44196	1058H 1063H
	24 characters,12 registers	44197 … 44208	1064H 106FH
Not used (1112 registers)	24 characters,12 registers Shared by MPM or DCM 1	44209 … 44220	1070H 107BH
Controller Model Number	24 characters,12 registers Shared by MPM or DCM 1	44221 … 44232	107CH 1087H
Controller Serial number	…	…	…
DCM 1 / MPM Model number	24 characters,12 registers	44329 … 44340	10E8H 10F3H
DCM 1/ MPM Serial Number	24 characters,12 registers	44341 … 44352	10F4H 10FFH
	Cell 1 Resistance Threshold	44353	1100H
DCM 6 Model number	…	…	…
DCM 6	Cell 256 Resistance Threshold	44608	11FFH

Category	Name	Reference	Data Address
Serial Number			
Resistance Threshold	Address	44609	1200H
	Code 1 / Code 2		
	Code 3 / Code 4		
Upgrade Controller Firmware (130 bytes)	…	…	…
	Code 127 / Code 128		
	…	…	…
	Address	44737	1280H
	Code 1 / Code 2		
	Code 3 / Code 4		
Upgrade Firmware (66 bytes = 33 registers)	…	…	…
	Code 63 / Code 64		
	…	…	…
	Alarm Type of First Record	44801	12C0H
	Peak Value of First Record		
	Starting Year / Month of First Record		
Historical Alarm (5 records each time)	Starting Day / Hour of First Record		
	Starting Minute / Second of First Record		
	Ending Year / Month of First Record		
	Ending Day / Hour of First Record		
	Ending Minute / Second of First Record		
	Reset Year / Month of First Record		
	Reset Day / Hour of First Record		
	Reset Minute / Second of First Record		
	…	…	…
	Alarm Type of 5th Record		
	Peak Value of 5th Record		
	Starting Year / Month of 5th Record		
	Starting Day / Hour of 5th Record		
	Starting Minute / Second of 5th Record		
	Ending Year / Month of 5th Record		
	Ending Day / Hour of 5th Record		

Category	Name	Reference	Data Address
	Ending Minute / Second of 5th Record		
	Reset Year / Month of 5th Record		
	Reset Day / Hour of 5th Record		
	Reset Minute / Second of 5th Record		
	…	…	…
	Alarm Type of First Record	44865	1300H
	Peak Value of First Record		
	Starting Year / Month of First Record		
Latched Alarm (5 records each time)	Starting Day / Hour of First Record		
	Starting Minute / Second of First Record		
	Latched Year / Month of First Record		
	Latched Day / Hour of First Record		
	Latched Minute / Second of First Record		
	...	...	...
	Alarm Type of 5th Record		
	Peak Value of 5th Record		
	Starting Year / Month of 5th Record		
	Starting Day / Hour of 5th Record		
	Starting Minute / Second of 5th Record		
	Latched Year / Month of 5th Record		
	Latched Day / Hour of 5th Record		
	Latched Minute / Second of 5th Record		
	…	…	…
	First Word of Data	44929	1340H
	Second Word of Data		
	....		
Historical Resistance (64 words each time)	64th Word of Data		
	First Word of Data	44993	1380H
	Second Word of Data		
	…	…	…
Historical	64th Word of Data		

Category	Name	Reference	Data Address
Data (64 words each time)	Data Type **t** of First Record	45057	13C0H
	Year / Month of First Record		
	Day / Hour of First Record		
Discharge Data (10 records each time)	Minute / Second of First Record		
	Value of First Record		
	…	…	…
	Data Type of 10th Record		
	Year / Month of 10th Record		
	Day / Hour of 10th Record		
	Minute / Second of 10th Record		
	Value of 10th Record		
	...	...	...
	Data1 of 1st record	45057	13C0H
	Data2 of 1st record		
	Data3 of 1st record		
Discharge Data (8 records each time.)	Data4 of 1st record		
	...	...	...
	Data1 of 10th record		
	Data2 of 10th record		
	Data3 of 10th record		
	Data4 of 10th record		
	Total 80 bytes per frame. *See note, for discharge format.* *Applied for BDS controller version 2.30 and later* *Applied for MPM version 2.00 and later*		
	Address	45121	1400H
	Code 1 / Code 2		
	Code 3 / Code 4		
Upgrade DCM Firmware	....	...	...
	Code 63 / Code 64		

Category	Name	Reference	Data Address
(66 bytes = 33 registers)	...		
	Year / Month of R test	45154	1421H
	Day / Hour of R test	45155	1422H
	Minute / Second of R test	45156	1423H
Latest Resistance test data	Cell Resistance 1	45157	1424H
	Cell Resistance 2	45158	1425H
	...	...	...
	Cell Resistance 256	45412	1523H
	Applied for BDS controller 2.34. *Applied for MPM 2.03 or later*		
	Intercell Resistance 1	45413	1524H
	Intercell Resistance 2	45414	1525H
	...		
	Intercell Resistance 256	45668	1623H
	Intertier Resistance 1	45669	1624H
	Intertier Resistance 2	45670	1625H
	...	...	...
	Intertier Resistance 15	45683	1632H
		49999	270EH
End of Mapping			

2.1 NOTES

a. Alarm Type for both current and historical alarms is defined as:

Bit 15: End symbol (= 0: active; = 1: inactive)

Bit 9–14: Alarm Number

High Cell Voltage	0
Low Cell Voltage	1

High Resistance	2
High Intercell R	3
High Overall Voltage	4
Low Overall Voltage	5
High Float Current	6
Warning	7
Ground Fault	8
High Temperature	9
Low Temperature	10
High Intertier R	29
Discharge	39
Digital Input 1	40
Digital Input 16	55
*Memory Full	56
*Alarm Ack	57
Discharge Current High	58

Bit 0–8: Cell Number (0 – 511)

Cell Number is given the temperature number (0 – 9, which indicates temperature 1 – 10) for temperature alarms. For intertier alarms, Cell Number is given the intertier number (0 – 14, which indicates temperature 1 – 15). For float current alarm, cell number is given the float current number (0 – 3, which indicates float current 1 – 4). For discharge current alarm, cell number is given the discharge current number (0 – 3, which indicates discharge current 1 – 4). After the last record, 0FFH is stuffed into all the remaining spaces of the current and historical memory.

NOTE:

**Cell Number also indicates the type of memory full.*

Cell Number	Memory Full Type
0	Discharge
1	Resistance
2	Historical data
3	
4	

**Applied for MPM version 2.00*

**Applied for BDS controller version 2.30 and later*

b. System Status register (41541)

Bit 15	=	1	:	Alarm disabled
	=	0	:	Alarm enabled
Bit 14	=	1	:	Critical alarm happened
	=	0	:	No critical alarm
Bit 13	=	1	:	Maintenance alarm happened
	=	0	:	No maintenance alarm
Bit 12	=	1	:	Controller is logging discharge data
	=	0	:	Idle
Bit 11	=	1	:	DCM comm. error
	=	0	:	No comm. error
Bit 10	=	1	:	Historical alarm logged
	=	0	:	No historical alarm
Bit 9	=	1	:	Discharge disabled
	=	0	:	Discharge enabled
Bit 8	=	1	:	Discharge in progress
	=	0	:	No discharge in progress
Bit 7	=	1	:	Discharge report logged
	=	0	:	No discharge report
Bit 6	=	1	:	Resistance test in progress
	=	0	:	No resistance test in progress
Bit 5	=	1	:	Resistance values logged
	=	0	:	No resistance values

Bit 4	=	1	:	Warning
	=	0	:	No warning
Bit 3	=	1	:	In diagnostic mode
		0	:	Idle
Bit 2	=	1	:	Memory test finished
	=	0	:	Nothing
Bit 1	=	1	:	Calibration in progress
	=	0	:	Idle
Bit 0	=	1	:	Hardware problem
	=	0	:	No hardware problem

c. Firmware control register (41542)

0000H	:	Start resistance test
0001H	:	Stop resistance test
0002H	:	Start firmware scan
0003H	:	Stop firmware scan
0004H	:	Load on (not used)
0005H	:	Load off
0006H	:	Start diagnostics
0007H	:	Stop diagnostics
0008H	:	Reset alarm
0009H	:	Not used
000AH	:	Start load test
000BH	:	Stop load test
000CH	:	Start EEPROM test
000DH	:	Stop EEPROM test (Not used)
000EH	:	Not used
000FH	:	Stop flash memory test (Not used)
0010H	:	Enable alarm
0011H	:	Disable alarm
0012H	:	Close alarm contact
0013H	:	Open alarm contact
0014H	:	Close charger contact
0015H	:	Open charger contact

0016H	:	Run firmware in PROM
0017H	:	Run firmware in flash memory (Not used)
0018H	:	Set 10 seconds delay for R–test
0019H	:	Set 3 minutes delay for R–test (Not used)
001AH	:	Reboot firmware
001BH	:	Erase discharge data
001CH	:	Enable discharge
001DH	:	Clear EEPROM
001EH	:	Set Historical Log Period
001FH	:	Set Resistance Test Period
0020H	:	Set Load Test Period
0021H	:	Enable DCM battery setup
0022H	:	Let Controller start getting all settings from all DCMs
0023H	:	Start ASCOM
0024H	:	Stop ASCOM
0025H	:	Let Controller start to get alarm threshold from one DCM
0026H	:	Clear Hardware Reset and Firmware Reset Counters
0027H	:	Start R–test in a DCM
0028H	:	Start DCM Address Check
0029H	:	Stop DCM Address Check
002AH	:	Clear DCM Comm. Error Counts
002BH	:	Enable DCM calibration setup
002CH	:	Get IP address
002DH	:	Set IP address
002EH	:	Erase resistance data
002FH	:	Enable resistance test
0030H	:	Erase historical data
0031H	:	Enable historical data
0032H	:	Erase historical alarm data
0033H	:	Do not erase historical alarm data
0034H	:	Start load test in BDS
0035H	:	Stop load test in BDS
0036H	:	Alarm Acknowledgment
0037H	:	Get DCM firmware version, model number and serial number

0038H : Set DCM model number and serial number

0039H : Clear memory on all strings

- ♦ String Configurations
- ♦ History Alarm Events
- ♦ History Alarms
- ♦ Latched Alarms
- ♦ Discharge
- ♦ Historical Readings
- ♦ Resistance Readings

d. Hardware Diagnostics register (41555)

Low Byte	Bit 0	:	Processor (8031)
	Bit 1	:	External RAM
	Bit 2	:	PROM
	Bit 3	:	Not used
	Bit 4	:	A/D
	Bit 5	:	Modem
	Bit 6	:	Dial tone
	Bit 7	:	Not used
High Byte	Bit 8	:	EEPROM
	Bit 9	:	Flash memory
	Bit10–14	:	Not used
	Bit 15	:	= 1 Running the firmware in flash memory
			= 0 Running the firmware in PROM

Except for Bit 15, the value of other bits is defined as

= 0 OK

= 1 Fail

e. Indicator register (41556)

(= 1: on; = 0: off)

MPM:

Bit 0	:	Scan light
Bit 1	:	Alarm light
Bit 3	:	Resistance test light

Bit 4	:	Alarm disable light
Bit 7	:	Error light
Others	:	Not used

BDS:

Bit 0	:	Not used
Bit 1	:	Scan light
Bit 2	:	Maintenance alarm light
Bit 3	:	Critical alarm light
Bit 4	:	Resistance test light
Bit 5–15	:	Not used

f. Only low byte of DIP Switch register (41554) and Digital Inputs registers (41557) are used.

g. Reset Alarm register (41558):

***Note**: This register is only used under diagnostics for testing the alarm reset button and will return a "1" state when pressed.*

Bit 0	=	1 :	ON
	=	0 :	OFF

h. Contacts register (41561)

(= 1: on; = 0: off)

Bit 0 – 9	:	Contact 1 – 10
Bit 10	:	Critical Alarm Contact
Bit 11	:	Maintenance Alarm Contact
Bit 12–15	:	Not used

i. Firmware Version # register (41622) is defined as an integer.

For example, 120 indicates Version 1.20. PCB Version # register (41623) is defined as an letter, such as A, B, or C.

j. Station Phone Number (41625 – 41634) is terminated by two bytes:

0DH, 0AH.

k. Alarm Report Selection register (41635), Alarm Latch register (41606), Critical Alarm Selection (41613), Maintenance Alarm Selection (41614) and Print Alarm Selection (41615)

Bit 0	:	= 1	Enable high cell voltage alarm
		= 0	Disable

Bit 1	:	= 1	Enable low cell voltage alarm
		= 0	Disable
Bit 2	:	= 1	Enable high overall voltage alarm
		= 0	Disable
Bit 3	:	= 1	Enable low overall voltage alarm
		= 0	Disable
Bit 4	:	= 1	Enable high temperature alarm
		= 0	Disable
Bit 5	:	= 1	Enable low temperature alarm
		= 0	Disable
Bit 6	:	= 1	Enable high internal resistance alarm
		= 0	Disable
Bit 7	:	= 1	Enable high intertier resistance alarm
		= 0	Disable
Bit 8	:	= 1	Enable high float current alarm
		= 0	Disable
Bit 9	:	= 1	Enable high intercell resistance alarm
		= 0	Disable
Bit 10	:	= 1	Enable high discharge current alarm
		= 0	Disable
Bit 11–13	:	Not used	
Bit 14	:	= 1	Enable discharge
		= 0	Disable
Bit 15	:	Not used	

I. Parameter Option 1&2 register (41636 and 41637)

(= 1: has; = 0: no):

Bit 0–3	:	Current 1–4
Bit 4–7	:	The number of temperatures
Bit 8–11	:	Float current 1–4
Bit 12–15	:	Not used
Bit 16–25	:	Intertier resistance 1–10
Bit 26	:	R–test dual mode
Bit 27–31	:	Not used

m. Control Option register (41638)

Bit 0	:	= 1	Enable auto call out
		= 0	Disable auto call out
Bit 1	:	= 1	Report problem discharge only
		= 0	Report all discharge
Bit 2	:	= 1	Select "Load Test" in Charger setup
		= 0	Select "Thermal Runaway Detection" in Charger setup
Bit 3	:	= 1	Disable discharge
		= 0	Enable discharge
Bit 4	:	= 1	Disable historical log
		= 0	Enable historical log
Bit 5	:	= 1	Disable R–test
		= 0	Enable R–test
Bit 6	:	= 1	Disable load test
		= 0	Enable load test
Bit 7	:	= 1	Average R–test mode
		= 0	Standard R–test mode
Bit 8	:	= 1	Temperature compensation
		= 0	Normal

NOTE:
Applied for Controller version after 3.26 and DCM version after 3.27

Test		Bit 7	Bit 8
	Normal (no retest)	0	0
Standard	Extend (up to 4 times retest)	0	1
	Normal (8 times)	1	0
Average	Extend (16 times)	1	1

Bit 9	:	= 1	Enable Telco MUX
		= 0	Disable Telco MUX
Bit 10	:		Used by software for intercell
Bit 11	:	= 1	Enable extended intertier average test
		= 0	Disable extended intertier average test
Bit 12	:	= 1	Use multiple alarm thresholds for R

		= 0	Use single alarm threshold for R
Bit 13	:	= 1	A/D 50hz
		= 0	A/D 60hz
Bit 14	:	= 1	Use day interval to do auto R test and log history data
		= 0	Use absolute date and time to do auto R test and log history data
Bit 15	:	= 1	Discrete R test enabled
		= 0	No discrete R test

n. Digital Input Selection register (41644)

Bit = 1: Selected; Bit = 0: Not selected.

o. Digital Input Connection Selection register (41645)

Bit = 1: Open; Bit = 0: Close.

p. Status register (42385) of Alarm Events

Bit 0:	= 1	Resistance test in progress
	= 0	No resistance test in progress
Bit 1 – 15:	Not used	

q. Self Test register of DCM Diagnostics

Bit 0	:	Processor (8031)
Bit 1	:	External RAM
Bit 2	:	PROM
Bit 3	:	PIO
Bit 4	:	A/D
Bit 5–14	:	Not used
Bit 15	:	“1” – Running from PROM
		“0” – Running from Flash

r. Historical Resistance is stored in the following structure (record):

For MPM configurations:

Year / Month of First Record

Day / Hour of First Record

Minute / Second of First Record

Resistance of First Cell in First Record

…

Resistance of Last Cell in First Record

Intertier Resistance 1 in First Record

…

Intertier Resistance 10 in First Record

…

Year / Month of Last Record

Day / Hour of Last Record

Minute / Second of Last Record

Resistance of First Cell in Last Record

…

Resistance of Last Cell in Last Record

Intertier Resistance 1 in Last Record

Intertier Resistance 10 in Last Record

For BDS configurations:

Year / Month of First Record

Day / Hour of First Record

Minute / Second of First Record

Resistance of First Cell in First Record

…

Resistance of Last Cell in First Record

Intercell Resistance of First Cell in First Record

…

Intercell Resistance of Last Cell in First Record

Intertier Resistance 1 in First Record

...

Intertier Resistance 12 or Charger+ cable 1 in First Record

Intertier Resistance 13 or Charger+ cable 2 in First Record

Intertier Resistance 14 or Charger- cable 1 in First Record

Intertier Resistance 15 or Charger- cable 2 in First Record

……

Year / Month of Last Record

Day / Hour of Last Record

Minute / Second of Last Record

Resistance of First Cell in Last Record

…

Resistance of Last Cell in Last Record

Intercell Resistance of First Cell in Last Record

…

Intercell Resistance of Last Cell in Last Record

Intertier Resistance 1 in Last Record

…

Intertier Resistance 12 or Charger+ cable 1 in Last Record

Intertier Resistance 13 or Charger+ cable 2 in Last Record

Intertier Resistance 14 or Charger- cable 1 in Last Record

Intertier Resistance 15 or Charger- cable 2 in Last Record

Here is the detail information about the algorithm to extract the historical resistance data.

NOTE:

When reading in the first frame, if the first byte of the frame is FF, that means, there is no data available. Then, go to step 1.7.

1. Extract data: Must follow the following steps to get the historical resistance data.

   1.1 Calculate the number of bytes for getting one record.

   Record size:

   BDS products = Total cell count * 4 + 36 (cell, intercell and intertier resistance)
   MPM products = Total cell count * 2 + 26 (cell and intertier resistance)

   1.2 Use function 16 to set Frame Number register (41559) to 0.

   1.3 Use function 3 to get a frame of 64 registers for the historical resistance (starting address is 44929). In the procedure to get a record, check whether you have received enough bytes for one record (a record may require more than one frame). If yes, the next byte in the frame will be the first byte of next record. Parse the data according to the product type (see record structure). Convert data to resistance values (see sections 2 and 3)

   1.4 Increment Frame Number.

1.5 If Frame Number >= 85, stop, go to 1.7.

1.6 Repeat 1.2 – 1.5.

1.7 Using function 16 to set Firmware Control register (41542) to 002E to let the hardware erase all old records, or set this register to 002F to prevent the hardware from erasing the data.

2. Process the data for BDS: The data received from the hardware is the raw data. It has to be processed before displaying.

   2.1 Internal Resistance = Raw data / BDSConstant

   Where

   BDSConstant = 2.097152 X 8.065 (2V o 4V cell)

   = 0.065536 * 5.235 (Others)

   2.2 Intercell Resistance = Raw data / 8.192

   2.3 Intertier Resistance = Raw data / 2.048

3. Process the data for MPM

   3.1 Internal Resistance = Raw data / BDSConstant

   Where

   BDS Constant = 2.097152 (2V cell)

   = 5.24288 (4V cell)

   = 1.31072 (6V cell)

   = 1.31072 (8V cell)

   = 0.65536 (12V cell)

   3.2 Intertier Resistance = Raw data / 2.048

s. Historical Data is stored in the following structure:

Year / Month of First Record

Day / Hour of First Record

Minute / Second of First Record

Cell Voltage of First Cell in First Record

….

Cell Voltage of Last Cell in First Record

Overall Voltage in First Record

Current 1 in First Record

….

Current 8 in First Record

Temperature 1 in First Record

….

Temperature 10 in First Record

Ground Fault in First Record

…….

Year / Month of Last Record

Day / Hour of Last Record

Minute / Second of Last Record

Cell Voltage of first Cell in Last Record

….

Cell Voltage of Last Cell in Last Record

Overall Voltage in Last Record

Current 1 in Last Record

….

Current 8 in Last Record

Temperature 1 Last First Record

….

Temperature 10 in Last Record

Ground Fault in Last Record

t. Data Type in Discharge Data

Bit 15:	End symbol
	= 0: new record;
	= 1: End
Bit 13–14:	Status defined as follows.
Bit 14=1, Bit 13=0:	Discharge start (attached on the first record)
Bit 14=0, Bit 13=1:	Discharge end (attached on the last record)
Bit 14=0, Bit 13=0:	Discharge in progress (attached on all middle records)
Bit 10–12:	Parameter type
Bit 12=0, Bit 11=0, Bit 10=0:	Cell voltage
Bit 12=1, Bit 11=0, Bit 10=0:	Overall voltage
Bit 12=0, Bit 11=1, Bit 10=0:	Discharge current 1
Bit 12=1, Bit 11=1, Bit 10=0:	Temperature
Bit 12=0, Bit 11=0, Bit 10=1:	Not used
Bit 12=0, Bit 11=1, Bit 10=1:	Discharge current 2
Bit 12=1, Bit 11=0, Bit 10=1:	Discharge current 3
Bit 12=1, Bit 11=1, Bit 10=1:	Discharge current 4
Bit 9:	= 0: Discharge data
	Load test data
Bit 0–8:	= 1: Cell number (0 – 511)

Cell Number is given the temperature number (0 – 9, which indicates temperature 1 – 10) for temperature alarms. After the last record, 0FFH is stuffed into all remaining spaces of the memory.

u. Discharge format definition applied for MPM 2.00 and BDS controller 2.14:

Discharge Begin

Data Type:	2 bytes (Same as old format)
Data/Time:	6 bytes (YY/MM/DD/HH/MM/SS)

Discharge Ending

Data Type:	2 bytes (Same as old format)
Data/Time:	6 bytes (YY/MM/DD/HH/MM/SS)

Discharge Data

Data Type:	2 bytes (Same as old format)
Time Stamp:	4 bytes (NEW! Time stamp in seconds)
Data Value:	2 bytes (H/L)

The address of Modem Multiplexer Box is 0FFH. Its memory mapping is shown below:

Name	Logic Address
Device Channel Number	0000H

Device Channel Number is a number between 1 – 16.

v. Latest Resistance Test Data.

NOTE:

BDS firmware 2.32 or MPM firmware 2.00 or later.

Data extraction is the same as resistance extraction (see section R) except there is only one record (the latest one). The frame number address is the same also.

w. System Status register (41543)

Bit 15	=	Reserved for future use
Bit 14	=	Reserved for future use
Bit 13	=	Reserved for future use
Bit 12	=	Reserved for future use
Bit 11	=	Set if String 4 is in Alarm (MPM 2.25 or later)
Bit 10	=	Set if String 3 is in Alarm (MPM 2.25 or later)
Bit 9	=	Set if String 2 is in Alarm (MPM 2.25 or later)
Bit 8	=	Set if String 1 is in Alarm (MPM 2.25 or later)
Bit 7	=	Reserved for future use
Bit 6	=	Reserved for future use

Bit 5	=		Reserved for future use
Bit 4	=		Reserved for future use
Bit 3	=		Reserved for future use
Bit 2	=		Reserved for future use
Bit 1	=		Reserved for future use
Bit 0	=	1 :	Load test is in progress
	=	0 :	No load test

3 Function and Data Fields of Commands Sent by Master

Function			**Data**	
Name	**Byte 3**	**Byte 4**	**Values**	**Byte #**
Read Holding Registers (Function 3)	30H	33H	First byte of starting address (H)	Byte 5
			First byte of starting address (L)	Byte 6
			Second byte of starting address (H)	Byte 7
			Second byte of starting address (L)	Byte 8
			First byte of number of points (H)	Byte 9
			First byte of number of points (L)	Byte 10
			Second byte of number of points (H)	Byte 11
			Second byte of number of points (L)	Byte 12
Preset Multiple Registers (Function 16)	31H	30H	First byte of starting address (H)	Byte 5
			First byte of starting address (L)	Byte 6
			Second byte of starting address (H)	Byte 7
			Second byte of starting address (L)	Byte 8
			First byte of number of points (H)	Byte 9
			First byte of number of points (L)	Byte 10
			Second byte of number of points (H)	Byte 11
			Second byte of number of points (L)	Byte 12
			Byte count (H)	Byte 13
			Byte count (L)	Byte 14
			First byte of value 1 (H)	Byte 15
			First byte of value 1 (L)	Byte 16
			Second byte of value 1 (H)	Byte 17
			Second byte of value 1 (L)	Byte 18
			.....	.....

NOTES:

1. The starting address, number of points, and data values that are to be set each have 2 bytes. The first byte is the high byte; the second byte is the low byte.

2. (H) indicates the ASCII code of high 4 bits of hex number; (L) indicates the ASCII code of low 4 bits of hex number.

4 Function and Data Fields of Response Sent by Slave

Function			**Data**	
Name	**Byte 3**	**Byte 4**	**Values**	**Byte #**
Read Holding Registers (Function 3)	30H	33H	Byte count (H)	Byte 5
			Byte count (L)	Byte 6
			First byte of value 1 (H)	Byte 7
			First byte of value 1 (L)	Byte 8
			Second byte of value 1 (H)	Byte 9
			Second byte of value 1 (L)	Byte 10
			.....	.....
Preset Multiple Registers (Function 16)	31H	30H	First byte of starting address (H)	Byte 5
			First byte of starting address (L)	Byte 6
			Second byte of starting address (H)	Byte 7
			Second byte of starting address (L)	Byte 8
			First byte of number of points (H)	Byte 9
			First byte of number of points (L)	Byte 10
			Second byte of number of points (H)	Byte 11
			Second byte of number of points (L)	Byte 12

5 Using the Commands

In the communication frames, only integer numbers can be transmitted. The transformation between integer number and decimal number is necessary when the computer receives and sends the data.

5.1 Data Transformation

Parameters	Transformation	
	Before Send	**After Receive**
Overall voltage (volts)		$\div 2^{4}$
Cell voltage (volts)		$\div 2^{10}$
Discharge and test current (amps)		$\times$ Shunt $\div 2^{7}$
Float current (mamps)		$\times$ FConstant *
Internal resistance (μΩ)		÷ RConstant **
Intertier resistance (μΩ)		$\times 10^{3} \div 2^{11}$
Intercell resistance (μΩ)		$\times 10^{3} \div 2^{13}$
Temperature		see below
Calibration for overall voltage	$\times 2^{17}$	$\div 2^{17}$
Calibration for cell voltage	$\times 2^{24}$	$\div 2^{24}$
Calibration for discharge & float current	$\times 2^{18}$	$\div 2^{18}$
Calibration for test current	$\times 2^{17}$	$\div 2^{17}$
Calibration for intertier voltage	$\times 2^{18}$	$\div 2^{18}$
Calibration for temperature	$\times 2^{17}$	$\div 2^{17}$
Calibration for intercell resistance	$\times 2^{20}$	$\div 2^{20}$
Threshold of overall voltage	$\times 2^{4}$	$\div 2^{4}$
Threshold of cell voltage	$\times 2^{10}$	$\div 2^{10}$
Threshold of float current	÷ FConstant *	$\times$ FConstant *
Threshold of temperature	$\times 2^{7}$ *= DCM 2.51 MPM 2.06 and earlier* $\times$ 45 = *DCM 2.52 MPM 2.07 and after*	$\div 2^{7}$ *= DCM 2.51 MPM 2.06 and earlier* ÷ 45 = *DCM 2.52 MPM 2.07 and after*
Threshold of internal resistance	$\times$ Rconstant **	÷ Rconstant **

Parameters	Transformation	
	Before Send	**After Receive**
Threshold of intertier resistance	$\times 2^{11} \div 10^{3}$	$\times 10^{3} \div 2^{11}$
Threshold of intercell resistance	$\times 2^{13} \div 10^{3}$	$\times 10^{3} \div 2^{13}$
Discharge level in voltage mode	$\times 2^{4}$	$\div 2^{4}$
Discharge level in current mode	$\div$ Shunt $\times 2^{7}$	$\times$ Shunt $\div 2^{7}$

**The constant to transform the float current, Fconstant, is defined as follows:*

Fconstant = 100 × Float Current Multiplier ÷ 2^{7}

***The constant to transform the internal resistance, RConstant, is defined as follows:*

MPM RConstant =

$2^{21} \div 10^{6}$ (2 volts module)

$2^{19} \div 10^{5}$ (4 volts module)
$2^{17} \div 10^{5}$ (6 volts module)
$2^{16} \div 10^{5}$ (12 volts module)

BDS RConstant =

$2^{21} \div 10^{6} \times 8.065$ (2 and 4 volts module)

$2^{16} \div 10^{6} \times 5.235$ (Others)

When the firmware processes the temperature, the unit of the temperature is always Centigrade (°C). Therefore, in the U.S., the temperature and its constants need to be converted from Centigrade (°C) to Fahrenheit (°F) when the computer receives the value from the firmware, and converted from (°F) to (°C) before the computer sends the value to the firmware. Also, when the computer receives the temperature value (16 bits), before converting from (°C) to (°F) if necessary, the following transformation has to be done:

If Bit 15 (Most significant bit) = 0

Temperature = Received value / 128 (Temperature >= 0)

DCM 2.52, MPM 2.07 and after

Temperature = Received value / 45 (Temperature >= 0)

If Bit 15 (Most significant bit) = 1

*Temperature = –1 * (Received value – 32768) / 128 (Temperature < 0)*

DCM 2.52, MPM 2.07 and after

*Temperature = –1 * (Received value – 32768) / 45 (Temperature < 0)*

The peak value of Temperature uses a different definition in MPM and BDS configurations. When the computer receives the peak value of temperature, the following transformation has to be done:

Peak value = Received value / 128 – 100 (in MPM)

Peak value = Received value / 128 (in BDS)

DCM 2.52, MPM 2.07 and after

Peak value = Received value / 45

The discharge current uses the following format:

bit 15	=	1:	Discharge current > 0
		0:	Discharge current < 0
bit 0–14	=		Absolute value

6 Examples

Here are some examples to show how to use the Modbus Protocol to get the data from the MPM.

6.1 Read A Single Register

Here is an example of a frame to obtain Overall Voltage of Battery 2. The master should send the following frame to the slave:

:020306000001 <LRC> CR LF

The slave should respond with the following frame:

:020302 <OV Raw Value (2 Bytes)> <LRC> CR LF

Thus,

Overall Voltage = OV Raw Value ÷ 2^{4}

6.2 Read Multiple Registers

Here is an example of a frame to obtain Cell Voltage 1 to 30 of Battery 1. The master should send the following frame to the slave:

:01030000001E <LRC> CR LF

The slave should respond with the following frame:

:01033C <CV1 Raw Value> <CV2 Raw Value> . . .

<CV30 Raw Value> <LRC> CR LF

Thus, for Cell x (x = 1, 2, . . . , 30),

Cell Voltage x = CV x Raw Value ÷ 2^{10}

6.3 Read Current Alarms

To get the current alarms in registers starting from register 41793, End Symbol (Bit 15) of Alarm Type must be checked when reading each record (4 registers). If it is 0, this record contains current alarm information; if it is 1, there are no more current alarms after this point.

6.4 Read Historical Alarms

Because the historical alarms are stored in a cyclic queue which is composed of registers 43073 – 44671, the position of new alarms may be located before the old alarms. Thus, all 100 records must be checked. If End Symbol (Bit 15) of Alarm Type is 0, this record (8 registers) contains a historical alarm information; If it is 1, go to check next record.

6.5 Read Current Resistances

Just like 7.2, the current resistances can be derived from registers 40513 – 41023.

6.6 Read Historical Resistances

To get the historical resistances in registers starting from register 44709, the Year / Month register of each record must be checked first. If Bit 15 (MSB) of the Year / Month register is 0, this record contains historical resistances; if it is 1, there is no more historical resistance after this point. Reference section R and V or more details.

6.7 Read Discharge

Function 04H must be used to get discharge data. Before reading each record (5 registers), End Symbol (Bit 15) of Data Type should be checked. If it is 0, this record contains discharge information; if it is 1, there is no more discharge data after this point.

7 References

This document may be found on the Vertiv Web site in the Technical Library/Modbus Register Maps section under MPM–100. Access Vertiv on the Web at: http://www.vertivco.com

Consult the following source for assistance with the Modbus protocol:

Modicon Modbus Protocol Reference Guide.

Modicon, Inc., Industrial Automation Systems, 1 High Street, North Andover, MA 01845

Modicon, Inc. is on the Web at: http://www.modicon.com

Consult the following source for third party test software to access all of the MPM Modbus registers:

Wintech Software, P.O. Box 907, Lewisburg, WV 24901

Wintech is on the Web at http://www.win–tech.com

The test software is Modscan.