1   General Description

This document specifies a proprietary ThermoTek asynchronous, serial communication protocol which allows monitor and control of ThermoTek devices (Chillers) by a User/Host device. The protocol is master/slave type with Chiller acting as the slave and Host system as the master.

2   Settings

2.1   Communications Settings

The transmission rate is 9600 Baud, 8 data bits, no parity, 1 stop bit and XON / XOFF flow control.

2.2   Connector

Depending on the model, the connector may be either a Micro USB connector, a male DB9 connector, or both. If the unit is configured with a 9 pin DBP serial connection, the RS232 pin assignments are as follows:

Pin	Host Function	TMU Function
2	Receive Data	Transmit Data
3	Transmit Data	Receive Data
5	Signal Ground	Signal Ground

2.3   Allowable Characters

Only printable ASCII characters are allowed in this protocol, with the exceptions of the XON (11h) and XOFF (13h) characters.

2.4   Software Flow Control

The software flow control characters XON and XOFF are defined as 11h and 13h respectively. If the Chiller has to temporarily stop the flow of data, it will issue an XOFF command, and when it is

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ready to receive new data again, it will transmit an XON character. If the unit is configured with a RS485 interface, however, that interface does not use XON / XOFF.

3 Message Format

3.1 Timing

The Host controller transmits a message to either request information from or issue a command to the Chiller. The Host should not send a new message until a response from the previous message has been received. However, if the Host sends a message and a full response has not been received within 3 seconds, a new message may be transmitted.

After the response message is received, the Host should wait at least 0.5 seconds before sending the new command message.

The Host must maintain a maximum of 10msec between the characters in the same message. If the Chiller doesn't receive the next character on time, the message will be ignored and the Chiller will not respond.

3.2 Host Message Format

The command message issued by the Host shall be in the following format:

SOC	Device ID	Command Num.	Command Name	*Data*	*Checksum*	CR

3.2.1 SOC (Start of Command)

Every Host message shall start with a **2Eh** representing an ASCII **period (.)**. It is one ASCII character (one byte) in length.

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3.2.2   Device ID

Device ID is used for Chiller identification on multi-drop bus (i.e. RS485). It is two ASCII characters (bytes) long and valid range is **01 – 32**. The default Device ID will be 01.

3.2.3   Command Number

Command Number is two ASCII characters (bytes) long. This number determines what control or monitor function Chiller shall perform. Refer to section 4 for detailed description of all supported commands.

3.2.4   Command Name

Command Name is eight ASCII characters (bytes) long and it describes (in abbreviated form) what control or monitor function Chiller shall perform. Refer to section 4 for detail description of all supported commands.

Note: Chiller software does not check syntax of the Command Name. It just verifies the total length of the message.

3.2.5   Data

Data is an optional field in the message and it is zero to eight ASCII characters (bytes) long. It provides necessary additional information about the command that shall be performed. Refer to section 4 for more details.

3.2.6   Checksum

Checksum field shall be two ASCII hexadecimal bytes representing the sum of all preceding bytes (truncated to 8 bits) of the command starting with SOC. The checksum characters and the carriage return are not counted in the checksum.

3.2.7   CR (Carriage return)

Every Host message shall end with **0Dh** representing an ASCII carriage return. It is one ASCII character (one byte) in length.

3.3 Response Format

The general form of the Chiller response message is:

SOR	Device ID	Command Num.	Error Code	Command Name	Data	Checksum	CR

3.3.1 SOR (Start of Response)

Every Chiller response message shall start with a **23h** representing an ASCII **#.** It is one ASCII character (one byte) in length.

3.3.2 Device ID

Chiller will echo Device ID (two ASCII characters) that is received in command message.

3.3.3 Command Number

The chiller will echo the Command Number (two ASCII characters) that is received in command message.

3.3.4 Error Code

The error Code is one ASCII character (one byte) long and it provides information about the status of the received command message.

Error Code	Description
0	Command OK – No Errors
1	Checksum Error
2	Bad Command Number (Command Not used)
3	Parameter/Data Out of Bound

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4	Message Length Error
5	Sensor/Feature not Configured or Used

3.3.5   Command Name

Chiller will echo Command Name (eight ASCII characters) that is received in command message

3.3.6   Data

Data is an optional field in the message response. This field is zero to nine ASCII characters (bytes) long. It contains data for read commands. If the sent command message had data characters, the Chiller will echo them in this field. Refer to Section 4 for more details.

3.3.7   Checksum

Checksum field shall be two ASCII hexadecimal bytes representing the sum of all preceding bytes (8 bit summation, no carry) of the command starting with SOR. It is calculated and formatted the same way as the command message checksum.

3.3.8   CR (Carriage return)

Every Chiller response shall end with **0Dh**, representing an ASCII carriage return. It is one ASCII character (one byte) in length.

3.4 Examples

3.4.1   Watchdog

Host should send following Command Message to the Chiller:

	SOC	Device ID	Command Number		Command Name								CS		CR
Message (ASCII)	.	0	1	0	1	W	a	t	c	h	D	o	g	0	1	CR
Message (Decimal)	46	48	49	48	49	87	97	116	99	104	68	111	103	48	49	13
Message (Hex)	2E	30	31	30	31	57	61	74	63	68	44	6F	67	30	31	0D

Checksum in Command Message is calculated by adding all Hex values of ASCII characters (0x2E + 0x30 + 0x31 + 0x30 + 0x31 + 0x57 + 0x61 + 0x74 + 0x63 + 0x68 + 0x44 + 0x6F + 0x67 = 0x401). Last byte of the checksum (0x01) is converted in two ASCII characters ('0' and '1'). Checksums for all messages are calculated using the same formula.

Appropriate Chiller Response Message would be:

	SOR	Unit ID	Command Number		Error	Command Name								Response				CS		CR
Message (ASCII)	#	0	1	0	1	0	W	a	t	c	h	D	o	g	0	1	0	0	E	7	CR
Message (Dec.)	35	48	49	48	49	48	87	97	116	99	104	68	111	103	48	49	48	48	69	55	13
Message (Hex)	23	30	31	30	31	30	57	61	74	63	68	44	6F	67	30	31	30	30	45	37	0D

From Chiller Response Message it could be concluded that:

a. There was no error in Command message from the Host (Error = 0)
b. Chiller is in Auto Start Mode (CS = 0)
c. Pump is ON (PS = 1)
d. There is no Alarms present (AS = 0)
e. There is no Warnings present (WS = 0)

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3.4.2 Read Supply Temperature

Host should send following Command Message to the Chiller:

	SOC	Device ID		Command Number		Command Name								CS		CR
Message (ASCII)	.	0	1	0	4	r	S	u	p	p	l	y	T	4	6	CR
Message (Decimal)	46	48	49	48	52	114	83	117	112	112	108	121	84	52	54	13
Message (Hex)	2E	30	31	30	34	72	53	75	70	70	6C	79	54	34	36	0D

Example: If the Supply Temperature was +29.5°C, the Chiller Response Message would be:

	SOR	Device ID		Command Number		Error	Command Name								Response					CS		CR
Message (ASCII)	#	0	1	0	4	0	r	S	u	p	p	l	y	T	+	0	2	9	5	6	6	CR
Message (Decimal)	35	48	49	48	52	48	114	83	117	112	112	108	121	84	43	48	50	57	53	54	54	13
Message (Hex)	23	30	31	30	34	30	72	53	75	70	70	6C	79	54	2B	30	32	39	35	36	36	0D

3.4.3 Set Supply Temperature

If Host wants to set Control Temperature to +20.0°C, it should send following Message to the Chiller:

	SOC	Device ID		Command Number	Command Name								Data					CS		CR
Message (ASCII)	.	0	1	1 7	s	C	t	r	l	T	_	_	+	0	2	0	0	F	E	CR
Message (Decimal)	46	48	49	49 55	115	67	116	114	108	84	95	95	43	48	50	48	48	70	69	13
Message (Hex)	2E	30	31	31 37	73	43	74	72	6C	54	5F	5F	2B	30	32	30	30	46	45	0D

Appropriate Chiller Response Message would be:

	SOR	Device ID		Command Number	Error	Command Name								Response					CS		CR
Message (ASCII)	#	0	1	1 7	0	s	C	t	r	l	T	_	_	+	0	2	0	0	2	3	CR
Message (Decimal)	35	48	49	49 55	48	115	67	116	114	108	84	95	95	43	48	50	48	48	50	51	13
Message (Hex)	23	30	31	31 37	30	73	43	74	72	6C	54	5F	5F	2B	30	32	30	30	32	33	0D

4 Appendices:

1. Command Set
2. Command Set Legend
3. Alarm Status Bits

REVISION AMENDMENT PAGE

Revision	Issue Date	Reason for Change	Approval
X1	10/5/17	Original Release	BAH

Appendix 1: Command Set

Command

#	Command	SOC	DEVICE ID	COMMAND NUMBER	COMMAND NAME	COMMAND DATA	CHECK SUM	EOC
1	Serial Watchdog	.	01	01	WatchDog		01	CR
2	Read Control Sensor	.	01	02	rCtrlSen		1E	CR
3	Read Set Temperature	.	01	03	rSetTemp		26	CR
4	Read Supply Temperature	.	01	04	rSupplyT		46	CR
5	Read External RTD (sends plate)	.	01	05	rExtRTD_		E0	CR
6	Read External Thermistor (remote)	.	01	06	rExtThrm		33	CR
8	Read Ambient Temperature	.	01	08	rAmbTemp		0F	CR
9	Read ProcessFlow	.	01	09	rProsFlo		2F	CR
13	Read TE Drive Level	.	01	13	rTECDrLv		B9	CR
14	Read Fan Drive Level	.	01	14	rFanDrLv		F3	CR
15	Set Chiller Status	.	01	15	sStatus_ SS		XX	CR
16	Set Control Sensor	.	01	16	sCtrlSen SN		XX	CR
17	Set Control Temperature	.	01	17	sCtrlT__ +/- t t t t		XX	CR
18	Read Alarm State Level 1	.	01	18	rAlrmLv1		E9	CR
19	Read Alarm State Level 2 - 1	.	01	19	rAlrmLv2 1		1C	CR
19	Read Alarm State Level 2 - 2	.	01	19	rAlrmLv2 2		1D	CR
20	Read Warning State Level 1	.	01	20	rWarnLv1		EE	CR
21	Set High Supply Temp Warn Level	.	01	21	sHiSpTWn +/- t t t t		XX	CR
22	Set Low Supply Temp Warn Level	.	01	22	sLoSpTWn +/- t t t t		XX	CR
23	Set High Ambient Temp Warn Level	.	01	23	sHiAmTWn +/- t t t t		XX	CR
24	Set Low Ambient Temp Warn Level	.	01	24	sLoAmTWn +/- t t t t		XX	CR
25	Set Low Process Flow Warn Level	.	01	25	sLoPFlWn + f f f		XX	CR
26	Set High Supply Temp Alarm Level	.	01	26	sHiSpTAl +/- t t t t		XX	CR
27	Set Low Supply Temp Alarm Level	.	01	27	sLoSpTAl +/- t t t t		XX	CR
28	Set High Ambient Temp Alarm Level	.	01	28	sHiAmTAl +/- t t t t		XX	CR
29	Set Low Ambient Temp Alarm Level	.	01	29	sLoAmTAl +/- t t t t		XX	CR
30	Set Low Process Flow Alarm Level	.	01	30	sLoPFlAl + f f f		XX	CR
34	Read High Supply Temp Warn Level	.	01	34	rHiSpTWn		F5	CR
35	Read Low Supply Temp Warn Level	.	01	35	rLoSpTWn		00	CR
36	Read High Ambient Temp Warn Level	.	01	36	rHiAmTWn		E2	CR
37	Read Low Ambient Temp Warn Level	.	01	37	rLoAmTWn		ED	CR
38	Read Low Process Flow Warn Level	.	01	38	rLoPFlWn		EE	CR
39	Read High Supply Temp Alarm Level	.	01	39	rHiSpTAl		E2	CR
40	Read Low Supply Temp Alarm Level	.	01	40	rLoSpTAl		E4	CR
41	Read High Ambient Temp Alarm Level	.	01	41	rHiAmTAl		C6	CR
42	Read Low Ambient Temp Alarm Level	.	01	42	rLoAmTAl		D1	CR
43	Read Low Process Flow Alarm Level	.	01	43	rLoPFlAl		D2	CR
46	Read PWM and Relay Status	.	01	46	rPulWdMo		13	CR
48	Read PID Status	.	01	48	rPIDStat		E6	CR
49	Read Unit Up Time	.	01	49	rUpTime_		21	CR
50	Read Fan 1 Speed	.	01	50	rFanSpd1		D3	CR
51	Read Fan 2 Speed	.	01	51	rFanSpd2		D5	CR
52	Read Fan 3 Speed	.	01	52	rFanSpd3		D7	CR
53	Read Fan 4 Speed	.	01	53	rFanSpd4		D9	CR
61	Read Lifetimer	.	01	61	rLifeTmr		XX	CR
62	Read TEC1A Voltage and Current	.	01	62	rTEC1AVC 1 A		XX	CR
62	Read TEC1B Voltage and Current	.	01	62	rTEC1BVC 1 B		XX	CR
62	Read TEC2A Voltage and Current	.	01	62	rTEC2AVC 2 A		XX	CR
62	Read TEC2B Voltage and Current	.	01	62	rTEC2BVC 2 B		XX	CR
62	Read TEC3A Voltage and Current	.	01	62	rTEC3AVC 3 A		XX	CR
62	Read TEC3B Voltage and Current	.	01	62	rTEC3BVC 3 B		XX	CR
64	Set User Max PSDrive1	.	01	64	sUMxPSD1 1 n n n		XX	CR
64	Set User Max PSDrive2	.	01	64	sUMxPSD2 2 n n n		XX	CR
66	Read Alarm Bits	.	01	66	rAlrmBit		XX	CR
67	Read Hsink1 Temperature	.	01	67	rHSnkTmp 1		XX	CR
67	Read Hsink2 Temperature	.	01	67	rHSnkTmp 2		XX	CR
67	Read Hsink3 Temperature	.	01	67	rHSnkTmp 3		XX	CR
69	Read Plate1 Temperature	.	01	67	rPlatTmp 1		XX	CR
69	Read Plate2 Temperature	.	01	67	rPlatTmp 2		XX	CR
69	Read Plate3 Temperature	.	01	67	rPlatTmp 3		XX	CR
74	Read Images Revision	.	01	74	rImgRev_		XX	CR
75	Read SysProc FW Revision	.	01	75	rSysPRev		XX	CR
76	Read GUI FW Revision	.	01	76	rGuiPRev		XX	CR
80	Read Serial Number	.	01	80	rSerNum_		XX	CR
98	Set RS232 port to USB	.	01	98	sR232Prt 0		XX	CR
98	Set RS232 port to DB9	.	01	98	sR232Prt 1		XX	CR

Response

#	Response	SOR	DEVICE ID	COMMAND NUMBER	ERROR	COMMAND NAME	COMMAND DATA	CHECK SUM	EOR
1	Serial Watchdog	#	01	01	0	WatchDog	CS PS AS WS	XX	CR
2	Read Control Sensor	#	01	02	0	rCtrlSen	SN	XX	CR
3	Read Set Temperature	#	01	03	0	rSetTemp	+/- t t t t	XX	CR
4	Read Supply Temperature	#	01	04	0	rSupplyT	+/- t t t t	XX	CR
5	Read External RTD (sends plate)	#	01	05	0	rExtRTD_	+/- t t t t	XX	CR
6	Read External Thermistor (remote)	#	01	06	0	rExtThrm	+/- t t t t	XX	CR
8	Read Ambient Temperature	#	01	08	0	rAmbTemp	+/- t t t t	XX	CR
9	Read ProcessFlow	#	01	09	0	rProsFlo	+ f f f f	XX	CR
13	Read TE Drive Level	#	01	13	0	rTECDrLv	z z z , r	XX	CR
14	Read Fan Drive Level	#	01	14	0	rFanDrLv	z z z	XX	CR
15	Set Chiller Status	#	01	15	0	sStatus_	SS	XX	CR
16	Set Control Sensor (supply only)	#	01	16	0	sCtrlSen	SN	XX	CR
17	Set Control Temperature	#	01	17	0	sCtrlT__	+/- t t t t	XX	CR
18	Read Alarm State Level 1	#	01	18	0	rAlrmLv1	A0 A1 A2 A3 A4 A5	XX	CR
19	Read Alarm State Level 2 - 1	#	01	19	0	rAlrmLv2	1 B0 B1 B2 B3 B4 B5 B6 B7	XX	CR
19	Read Alarm State Level 2 - 2	#	01	19	0	rAlrmLv2	2 C0 C1 C2 C3 C4 C5 C6 C7	XX	CR
20	Read Warning State Level 1	#	01	20	0	rWarnLv1	W0 W1 W2 W3	XX	CR
21	Set High Supply Temp Warn Level	#	01	21	0	sHiSpTWn	+/- t t t t	XX	CR
22	Set Low Supply Temp Warn Level	#	01	22	0	sLoSpTWn	+/- t t t t	XX	CR
23	Set High Ambient Temp Warn Level	#	01	23	0	sHiAmTWn	+/- t t t t	XX	CR
24	Set Low Ambient Temp Warn Level	#	01	24	0	sLoAmTWn	+/- t t t t	XX	CR
25	Set Low Process Flow Warn Level	#	01	25	0	sLoPFlWn	+ f f f f	XX	CR
26	Set High Supply Temp Alarm Level	#	01	26	0	sHiSpTAl	+/- t t t t	XX	CR
27	Set Low Supply Temp Alarm Level	#	01	27	0	sLoSpTAl	+/- t t t t	XX	CR
28	Set High Ambient Temp Alarm Level	#	01	28	0	sHiAmTAl	+/- t t t t	XX	CR
29	Set Low Ambient Temp Alarm Level	#	01	29	0	sLoAmTAl	+/- t t t t	XX	CR
30	Set Low Process Flow Alarm Level	#	01	30	0	sLoPFlAl	+ f f f f	XX	CR
34	Read High Supply Temp Warn Level	#	01	34	0	rHiSpTWn	+/- t t t t	XX	CR
35	Read Low Supply Temp Warn Level	#	01	35	0	rLoSpTWn	+/- t t t t	XX	CR
36	Read High Ambient Temp Warn Level	#	01	36	0	rHiAmTWn	+/- t t t t	XX	CR
37	Read Low Ambient Temp Warn Level	#	01	37	0	rLoAmTWn	+/- t t t t	XX	CR
38	Read Low Process Flow Warn Level	#	01	38	0	rLoPFlWn	+ f f f f	XX	CR
39	Read High Supply Temp Alarm Level	#	01	39	0	rHiSpTAl	+/- t t t t	XX	CR
40	Read Low Supply Temp Alarm Level	#	01	40	0	rLoSpTAl	+/- t t t t	XX	CR
41	Read High Ambient Temp Alarm Level	#	01	41	0	rHiAmTAl	+/- t t t t	XX	CR
42	Read Low Ambient Temp Alarm Level	#	01	42	0	rLoAmTAl	+/- t t t t	XX	CR
43	Read Low Process Flow Alarm Level	#	01	43	0	rLoPFlAl	+ f f f f	XX	CR
46	Read PWM and Relay Status	#	01	46	0	rPulWdMo	y y y . r	XX	CR
48	Read PID Status	#	01	48	0	rPIDStat	+/- t t t t . k	XX	CR
49	Read Unit Up Time	#	01	49	0	rUpTime_	m m m m m m	XX	CR
50	Read Fan 1 Speed	#	01	50	0	rFanSpd1	h h h h	XX	CR
51	Read Fan 2 Speed	#	01	51	0	rFanSpd2	h h h h	XX	CR
52	Read Fan 3 Speed	#	01	52	0	rFanSpd3	h h h h	XX	CR
53	Read Fan 4 Speed	#	01	53	0	rFanSpd4	h h h h	XX	CR
61	Read Lifetimer	#	01	61	0	rLifeTmr	h h h h h : m m	XX	CR
62	Read TEC1A Voltage and Current	#	01	62	0	rTEC1AVC	1 A v v v v , i i i i	XX	CR
62	Read TEC1B Voltage and Current	#	01	62	0	rTEC1BVC	1 B v v v v , i i i i	XX	CR
62	Read TEC2A Voltage and Current	#	01	62	0	rTEC2AVC	2 A v v v v , i i i i	XX	CR
62	Read TEC2B Voltage and Current	#	01	62	0	rTEC2BVC	2 B v v v v , i i i i	XX	CR
62	Read TEC3A Voltage and Current	#	01	62	0	rTEC3AVC	3 A v v v v , i i i i	XX	CR
62	Read TEC3B Voltage and Current	#	01	62	0	rTEC3BVC	3 B v v v v , i i i i	XX	CR
64	Set User Max PSDrive1	#	01	64	0	sUMxPSD1	1 n n n	XX	CR
64	Set User Max PSDrive2	#	01	64	0	sUMxPSD2	2 n n n	XX	CR
66	Read Alarm Bits	#	01	66	0	rAlrmBit	(8 16-bit hex words each followed by a space)	XX	CR
67	Read Hsink Temperature	#	01	67	0	rHSnkTmp	1 +/- t t t t	XX	CR
67	Read Hsink Temperature	#	01	67	0	rHSnkTmp	2 +/- t t t t	XX	CR
67	Read Hsink Temperature	#	01	67	0	rHSnkTmp	3 +/- t t t t	XX	CR
67	Read Plate Temperature	#	01	67	0	rPlatTmp	1 +/- t t t t	XX	CR
67	Read Plate Temperature	#	01	67	0	rPlatTmp	2 +/- t t t t	XX	CR
67	Read Plate Temperature	#	01	67	0	rPlatTmp	3 +/- t t t t	XX	CR
74	Read Images Revision	#	01	74	0	rImgRev_	0 P S S T 2 5 7 M G z z z z	XX	CR
75	Read SysProc FW Revision	#	01	75	0	rSysPRev	0 P S S T 2 5 7 S P _ y y y y	XX	CR
76	Read GUI FW Revision	#	01	76	0	rGuiPRev	0 P S S T 2 5 7 U 1 _ x x x x	XX	CR
80	Read Serial Number	#	01	80	0	rSerNum_	sn sn sn sn sn sn	XX	CR
98	Set RS232 port to USB	#	01	98	0	sR232Prt	0	XX	CR
98	Set RS232 port to DB9	#	01	98	0	sR232Prt	1	XX	CR

Appendix 2: Legend

No	Symbol	Description	Unit	Range	Example
1	CS	Control Status Mode		0-4	0 - Auto-start, 1 - Standby, 2 - Run, 3 - Safety, 4 - Test
2	PS	Pump Status Flag		0-1	0 - Pump OFF, 1 - Pump ON
3	AS	Alarm Status Flag		0-1	0 - No Alarm, 1 - Alarm Present
4	WS	Warning Status Flag		0-1	0 - No Warning, 1 - Warning Present
5	SN	Control Sensor		0-3	0 - Supply temp, 1 - Return temp , 2 - Ext RTD, 3 - External termistor
6	tttt	Temp Data Format	degC	000.0 - 999.9	tttt = 0152 -> 15.2 degC
6	tttt - read only	Temp Data Format (%)	degC	00.00 - 99.99	tttt = 0152 -> 1.52 degC, when last name character replaced with '%'
7	ffff	Flow Data Format	lpm	000.0 - 999.9	ffff = 0032 -> 3.2 lpm
8	iiii	Current Data Format	ADC	0.000 - 9.999	iiii = 0215 -> 2.15 ADC
9	ES	External Sensor Status		0 - 1	0 - External Sensors Disabled, 1 - External Sensors Enabled
10	zzz	Format for %		0-100	zzz = 063 - 63%
11	r	Relay Status		C, H	C - Cool Mode, H - Heat Mode
12	SS	Chiller Status		0 - 1	0 - Standby, 1 - Run
10	zzz	Format for %		0 - 1	0 - External Sensors Disabled, 1 - External Sensors Enabled
17	yyy	PWM output		1-255	yyy = 190 -> PWM output (duty cycle) is 190
18	k	PID Mode Flag		0 - 9	
19	mmmmmm	Unit Up Time	min	000000 - 999999	mmmmmm = 001234 -> 1234 minutes
20	hhhh	Fan Speed	Hz	0000 - 9999	hhhh = 0131 -> 131 Hz
	nn, nnn, nnnn	Numeric Data Format		0-9 each digit	decimal value per number of digits
	aa, aaaa	Hex Address Format		0-F each digit	hex value per number of digits
	dd, dddd	Hex Data Format		0-F each digit	hex value per number of digits
	ofs	Temp Data Offet	degC	68	ofs = 068 -> 0.68 degC
	sn	Serial Number		alphanumeric	6-digit serial number
	gggg	ADC Channel Gain		0-19999	gggg = 9999 -> 0.9999, 1gggg = 11000 -> 1.1000
	oooo	ADC Channel Offset		-999 - 19999	oooo = +1234 -> 1234

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Appendix 3: Alarm & Warning Status Bits

Char	Value	Alarm
A0	0	No Alarm
	1	Ambient Temp. Sensor Alarm
	2	High Control Temperature Alarm
	4	PT7 High Temperature Alarm
	8	Low Control Temperature Alarm
A1	0	No Alarm
	1	Supply Temp Sensor Alarm (Latched)
	2	External RTD Sensor Alarm
	4	Return Temperature Sensor Alarm
	8	External Thermistor Sensor Alarm
A2	0	No Alarm
	1	Low Coolant Level Alarm (Latched)
	2	Low Process Flow Alarm
	4	Low Plant Flow Alarm
	8	Current Sensor 1 Alarm
A3	0	No Alarm
	1	PT7 Low Temperature Alarm
	2	High Ambient Temperature Alarm
	4	Low Ambient Temperature Alarm
	8	External Connector Not Installed
A4	0	No Alarm
	1	Default High Temperature Alarm
	2	Default Low Temperature Alarm
	4	No Process Flow Alarm
	8	Fan Failure Alarm
A5	0	No Alarm
	1	Current Sensor 2 Alarm
	2	Internal 2.5V Reference Alarm
	4	Internal 5V Reference Alarm
	8	System Error Alarm (Global)

Char	Value	Alarm
B0	0	No Alarm
	1	Reserved (Not Used)
	2	Reserved (Not Used)
	4	Reserved (Not Used)
	8	Reserved (Not Used)
B1	0	No Alarm
	1	ADC System Error Alarm
	2	I2C System Error Alarm
	4	EEPROM System Error Alarm
	8	Watchdog System Error Alarm
B2	0	No Alarm
	1	Reserved (Not Used)
	2	Reserved (Not Used)
	4	Reserved (Not Used)
	8	Reserved (Not Used)
B3	0	No Alarm
	1	ADC Reset Error Alarm
	2	ADC Calibration Error Alarm
	4	ADC Conversion Error Alarm
	8	Reserved (Not Used)
B4	0	No Alarm
	1	IO Expender Acknowledge Error Alarm
	2	PSA IO Expender Acknowoledge Alarm
	4	RTC Acknowledge Error Alarm
	8	Reserved (Not Used)
B5	0	No Alarm
	1	I2C SCL Low Error Alarm
	2	I2C SDA Low Error Alarm
	4	EEPROM 1 (U201) Acknowledge Alarm
	8	EEPROM 2 (U200) Acknowledge Alarm
B6	0	No Alarm
	1	Reserved (Not Used)
	2	Reserved (Not Used)
	4	Reserved (Not Used)
	8	Reserved (Not Used)
B7	0	No Alarm
	1	EEPROM 1 (U201) Read Error Alarm
	2	EEPROM 1 (U201) Write Error Alarm
	4	EEPROM 2 (U200) Read Error Alarm
	8	EEPROM 2 (U200) Write Error Alarm

Char	Value	Alarm
C0	0	No Alarm
	1	External RTD Sensor Open Alarm
	2	External RTD Sensor Short Alarm
	4	Return Temp Sensor Open Alarm
	8	Return Temp Sensor Open Alarm
C1	0	No Alarm
	1	Global Supply Temp Sensor Alarm
	2	Supply Temp Sensor Locked Alarm
	4	Supply Temp Sensor Open Alarm
	8	Supply Temp Sensor Short Alarm
C2	0	No Alarm
	1	Internal 2.5V Reference High Alarm
	2	Internal 2.5V Reference Low Alarm
	4	Internal 5V Reference High Alarm
	8	Internal 5V Reference Low Alarm
C3	0	No Alarm
	1	External Therm. Sensor Open Alarm
	2	External Therm. Sensor Short Alarm
	4	Ambient Temp Sensor Open Alarm
	8	Ambient Temp Sensor Short Alarm
C4	0	No Alarm
	1	Reserved (Not Used)
	2	Reserved (Not Used)
	4	Reserved (Not Used)
	8	Reserved (Not Used)
C5	0	No Alarm
	1	Current Sensor 1 Open Alarm
	2	Current Sensor 1 Short Alarm
	4	Current Sensor 2 Open Alarm
	8	Current Sensor 2 Short Alarm
C6	0	No Alarm
	1	Rear Left Fan Noise Alarm
	2	Rear Right Fan Noise Alarm
	4	Front Left Fan Noise Alarm
	8	Front Right Fan Noise Alarm
C7	0	No Alarm
	1	Rear Left Fan Open Alarm
	2	Rear Right Fan Open Alarm
	4	Front Left Fan Open Alarm
	8	Front Right Fan Open Alarm

Char	Value	Warning
W0	0	No Alarm
	1	Low Process Flow Warning
	2	Process Fluid Level Warning
	4	Switch to Supply Temp as Control Temp Warning
	8	Reserved (Not Used)
W1	0	No Alarm
	1	High Control Temp Warning
	2	Low Control Temp Warning
	4	High Ambient Temp Warning
	8	Low Ambient Temp Warning
W2	0	No Alarm
	1	Reserved (Not Used)
	2	Reserved (Not Used)
	4	Reserved (Not Used)
	8	Reserved (Not Used)
W3	0	No Alarm
	1	Reserved (Not Used)
	2	Reserved (Not Used)
	4	Reserved (Not Used)
	8	Reserved (Not Used)