Developer Notes
Venstar Thermostat Adapter

Version 001

May 23, 2013

Revision History		
Rev	**Date**	**Comments**
001	05/23/13	Initial Release

Table of Contents

1   Firmware Description

1.1   INSTEON Commands Supported

1.1.1   Standard length common INSTEON commands:

All direct commands will be ignored if the sender's ID is not in the I2CS device's database with the exceptions below. The Thermostat Adapter will reply with a NAK and 0xFF in cmd2 to indicate that the ID is not in the database.

Assign to ALL-Link Group Command
Description: Sent when holding down the SET Button for 3 seconds on the device. Blinks the LED green for 4 minutes or until linked to another device.
Example (Hex): AA BB CC 05 03 XX CF 01 YY (where AA.BB.CC is the Thermostat's ID)

SD Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Assign to ALL-Link Group	From Device	Device's ID	0x05, 0x03, 0xXX (Firmware Revision)	Broadcast	0x01	0xYY (Hardware Revision)	Sent when holding down SET Button for 3 seconds. Group number for Thermostat is 0x01

Delete from ALL-Link Group Command
Description: Blinks the LED red for 4 minutes or until unlinked from another device.
Example (Hex): AA BB CC 05 03 XX CF 02 YY (where AA.BB.CC is the Thermostat's ID)

Delete from ALL-Link Group	From Device	Device's ID	0x05, 0x03, 0xXX (Firmware Revision)	Broadcast	0x02	0xYY (Hardware Revision)	Group number for Thermostat is 0x01

INSTEON Engine Version Command
Description: Returns the INSTEON Engine version in the acknowledgement.

INSTEON Engine Version	To device	Sender's ID	Device's ID	Direct	0x0D	0x00	
	Response	Device's ID	Sender's ID	Ack	0x0D	0x02	Indicate i2CS engine version

Ping Command
Description: Returns the exact same message with an acknowledgement.

Ping	To device	Sender's ID	Device's ID	Direct	0x0F	0x00 -> 0xFF (Don't Care Value)	
	Response	Device's ID	Sender's ID	Ack	0x0F	0xFB	

ID Request Command
Description: Same as holding down the SET Button for 3 seconds on the device, but without going into linking mode
Example (Hex): AA BB CC 05 03 XX 0F 0A YY (where DD.EE.FF is the Sender's ID, AA.BB.CC is the Devices's Id)

ID Request	To device	Sender's ID	Device's ID	Direct	0x10	0x00 -> 0xFF (Don't Care Value)	
	Response	Device's ID	Sender's ID	Ack	0x10	Same as sent	
	Sent from Device	Device's ID	0x05 0x0B 0xXX (firmware revision)	Broadcast	0x01	0xYY (Hardware Revision)	Same as holding down SET Button for 3 seconds, but device not in linking mode

1.1.2 Standard length Venstar Thermostat Adapter commands:

SD Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Increase Set Point	To device	Sender's ID	Device's ID	Broadcast	0x15	0x00	Increase current temperature setting by 1 unit
	Response	Device's ID	Sender's ID	Ack	0x15	Same as sent	

SD Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Decrease Set Point	To device	Sender's ID	Device's ID	Broadcast	0x16	0x00	Decrease current temperature setting by 1 unit
	Response	Device's ID	Sender's ID	Ack	0x16	Same as sent	

SD Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
On Status	From device	Device's ID		Direct	0x11	0x00 -> 0xFF (Don't Care Value)	

SD Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Off Status	From device	Device's ID		Direct	0x13	0x00 -> 0xFF (Don't Care Value)	

SD Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Thermostat Status	To device	Sender's ID	Device's ID	Direct	0x6A	See Thermostat Status Info	
	Response	Device's ID	Sender's ID	Ack	0x6A	Same as sent	

Thermostat Status Info

Cmd2	Description	Thermostat Support	Comments
0x00	Temperature returned in ACK	yes	In 1 degree units
0x20	Setpoint returned in ACK	yes	In 1 degree units
0x60	Humidity returned in ACK	yes	In 1 percent units

SD Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Mode Status	To device	Sender's ID	Device's ID	Direct	0x6B	See Mode Status Info	
	Response	Device's ID	Sender's ID	Ack	0x6B	Same as sent	

Thermostat Control Info

Cmd2	Description	Thermostat Adapter 1.1 Support	Comments
0x02	ACK contains 1-byte thermostat mode in Command 2 0x00 = Off 0x01 = Heat 0x02 = Cool 0x03 = Auto 0x04 = Fan 0x05 = Program 0x06 = Program Heat 0x07 = Program Cool 0x08 => 0xFF Unused	yes	Get thermostat mode
0x03	ACK returns temp x 2	yes	Get ambient temperature

SD Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Status Reporting Temperature	From device	Device's ID		Direct	0x6E	0x00 -> 0xFF (Temperature Change x 0.5)	
Status Reporting Humidity	From device	Device's ID		Direct	0x6F	0x00 -> 0xFF (Humidity)	
Status Reporting Mode/Fan Status	From device	Device's ID		Direct	0x70	0x00 = Off 0x01 = Heat 0x02 = Cool 0x03 = Auto 0x04 = Program 0x05 = Program Heat 0x06 = Program Cool … 0x10 = Off-Fan On 0x11 = Heat-Fan On 0x12 = Cool-Fan On 0x13 = Auto-Fan On 0x14= Program-Fan On 0x15 = Program Heat-Fan On 0x16 = Program Cool-Fan On 0x17=> Not Used	
Status Reporting Cool set point	From device	Device's ID		Direct	0x71	0x00 -> 0xFF (Cool set point)	

Status Reporting Heat set point	From device	Device's ID		Direct	0x72	0x00 -> 0xFF (Heat set)	

Get Fan Status	To device	Sender's ID	Device's ID	Direct	0xF0	0x4B	
	Response	Device's ID	Sender's ID	Ack	0xF0	Bit 4 set = Fan On (0x10) Bit 4 clear = Fan Auto (0x00)	

Get Temperature Units Status	To device	Sender's ID	Device's ID	Direct	0xF0	0x49	
	Response	Device's ID	Sender's ID	Ack	0xF0	Bit 0 set = Celsius (0x01) Bit 0 clear = Fahrenheit (0x00)	

SD Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Read Operating Flags	To device	Sender's ID	Device's ID	Direct	0x1F	Operating Flags Command	See Read Operating Flags Table
	Response	Device's ID	Sender's ID	Ack	0x1F	Same as sent	

Read Operating Flags Table	
	bit 0 = N/A
	bit 1 = N/A
	bit 2 = Report Humidity
	bit 4 = N/a
	bit 5 = LED On/Off
	bit 6 = N/A
0	bit 7 = Programming Lock
1	Database Delta

1.1.3 **Extended length Venstar Thermostat Adapter commands:**

Extended Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Thermostat Temperature Up	To device	Sender's ID	Device's ID	Direct	0x68	0x00 -> 0xFF (Temperature Change x 2)	Increase current temperature setting by Temperature Change x 0.5
	Response	Device's ID	Sender's ID	Ack	0x68	Same as sent	

Extended Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Thermostat Temperature Down	To device	Sender's ID	Device's ID	Direct	0x69	0x00 -> 0xFF (Temperature Change x 2)	Decrease current temperature setting by Temperature Change x 0.5
	Response	Device's ID	Sender's ID	Ack	0x69	Same as sent	

Extended Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Thermostat Control	To device	Sender's ID	Device's ID	Direct	0x6B	See Thermostat Control Info	
	Response	Device's ID	Sender's ID	Ack	0x6B	Same as sent	

Thermostat Control Info

Cmd2	Description	Thermostat Adapter 1.1 Support	Comments
0x04	Set mode to Heat and returns 04 in ACK	yes	On Heat
0x05	Set mode to Cool and returns 05 in ACK	yes	On Cool
0x06	Set mode to Auto and returns 06 in ACK	yes	On Auto
0x07	Turn Fan on and returns 07 in ACK	yes	On Fan
0x08	Turn Fan auto mode and returns 08 in ACK	yes	Off Fan
0x09	Set mode to Off and returns 09 in ACK	Yes	Off Mode
0x0A	Set mode to Program Heat and returns 0A in ACK	Yes	On Program Heat
0x0B	Set mode to Program Cool and returns 0B in ACK	Yes	On Program Cool
0x0C	Set mode to Program Auto and returns oC in ACK	yes	On Program Auto

Extended Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Thermostat Set Cool set point	To device	Sender's ID	Device's ID	Direct	0x6C	0x00 -> 0xFF (Temperature x 2)	change current temperature cool set point to Temperature x 0.5
	Response	Device's ID	Sender's ID	Ack	0x6C	Same as sent	

Extended Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Thermostat set heat set point	To device	Sender's ID	Device's ID	Direct	0x6D	0x00 -> 0xFF (Temperature x 2)	change current temperature heat set point to Temperature x 0.5
	Response	Device's ID	Sender's ID	Ack	0x6D	Same as sent	

Extended Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Notes
Set Operating Flags	To device	Sender's ID	Device's ID	Extended Direct	0x20	Operating Flags Command	See Set Operating Flags Table below. Data14 contains checksum
	Response	Device's ID	Sender's ID	Ack	0x20	Same as sent	

Set Operating Flags Table (bold denotes default settings after factory reset)	
0	Report Humdity on change
1	**Do Not Report Humidity on Change**
...	
4	Programming lock On
5	**Programming lock off**
6	**LED On**
7	LED Off

Extended Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Data 1 (1 byte)	Data 2 (1 byte)
Read Data	To device	Sender's ID	Device's ID	Extended Direct	0x2E	0x00	0x00 -> 0xFF (Group/Button)	See Read Data Info
	Response	Device's ID	Sender's ID	Standard Ack	0x2E	0x00	Same as sent	N/A

Read Data Info

Data 2	Description
0x00	Data 2: 0 is for Read Data (Responder unit will send back a Data 2: 1 below)
0x01	Data2: 1 return of data Data3: Mode Data4: Humidity Data5:Temperature Data6: Cool Setpoint Data7: Heat Setpoint Data8 : LED Data9 Fan Mode Data10: N/A Data11: N/A Data12: N/A Data 13: N/A Data 14: N/A
Notes	All temp data is not x2; LED 00=Off, 01=On (Red or Green), 02=(Red); Fan 00=Auto, 10=On

Read Data Info								
Data 3	Data 4 (1 byte)	Data 5	Data 6	Data 7	Data 8	Data 9	...	Data 14
0x00	0x00	0x00	0x00	0x00	0x00	0x00		0x00

Extended Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Data 1 (1 byte)	Data 2 (1 byte)
Get Database	To device	Sender's ID	Device's ID	Extended Direct	0x2F	0x00	0x00 -> 0xFF (Don't Care Value)	See Get Database Info
	Response	Device's ID	Sender's ID	Standard Ack	0x2F	0x00	N/A	N/A
	From device	Device's ID	Sender's ID	Extended Direct	0x2F	0x00	Same as sent	See Returned Extended Get Database Info

Get Database Info									
Data 2 (1 byte)	Data 3	Data 4	Data 5	Data 6	Data 7	Data 8	Data 9	Data 10	Data 11
0x00	0x00 -> 0xFF (Hi Byte Address)	0x00 -> 0xFF (Lo Byte Address)	0x00 -> 0xFF (# of Records, 0x00 dumps all records)	N/A	N/A	N/A	N/A	N/A	N/a

Returned Extended Get Database Info (will continue to be sent until # of records is sent or until the first never been used record is sent)									
Data 2 (1 byte)	Data 3	Data 4 (1 byte)	Data 5	Data 6	Data 7	Data 8	Data 9	…	Data 13
0x01	0x00 -> 0xFF (Hi Byte Address)	0x00 -> 0xFF (Lo Byte Address)	0x00	Byte 1 of record	Byte 2 of record	Byte 3 of record	Byte 4 of record		Byte 8 of record

Extended Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Data 1 (1 byte)	Data 2 (1 byte)
Set Database	To device	Sender's ID	Device's ID	Extended Direct	0x2F	0x00	0x00 -> 0xFF (Don't Care Value)	See Set Database Info
	Response	Device's ID	Sender's ID	Standard Ack	0x2F	0x00	N/A	N/A

Set Database Info									
Data 2 (1 byte)	Data 3	Data 4 (1 byte)	Data 5	Data 6	Data 7	Data 8	Data 9	Data 13	Data 14
0x02	0x00 -> 0xFF (Hi Byte Address)	0x00 -> 0xFF (Lo Byte Address)	0x01 -> 0x08 (# of bytes to write, over 0x08 is an error and ignored)	Byte 1 of data	Byte 2 of data	Byte 3 of data	Byte 4 of data	Byte 8 of data	Checksum

Extended Command	Message Direction	From Address (3 bytes)	To Address (3 bytes)	Message type	Cmd1 (1 byte)	Cmd2 (1 byte)	Data 1 (1 byte)
Set Temperature Units	To device	Sender's ID	Device's ID	Direct	0xF1	Bit 0 set = Celsius (0x01) Bit 0 clear = Fahrenheit (0x00)	0x00 -> 0xFF
	Response	Device's ID	Sender's ID	Ack	0xF1	Same as sent	

Set Temperature Units Info								
Data 2	Data 3	Data 4	Data 5	Data 6	Data 7	Data 8	Data 9	Data 10 -> Data 13	Data 14
0x00 -> 0xFF	0x00 -> 0xFF	0x00 -> 0xFF	0x00 -> 0xFF	0x00 -> 0xFF	0x00 -> 0xFF	0x00 -> 0xFF	0x00 -> 0xFF	0x00 -> 0xFF	Checksum

Checksum Information

Data14 will contain a 2s compliment of cmd1 through 2nd to last data record in the last data record.

Example of Checksum:

01 02 03 04 05 06 1F 2F 00 01 02 0F FF 08 E2 01 08 B6 EA 00 1B 01 11
From 01.02.03 to 04.05.06
a record at 0FFF (A valid boundary)
08 bytes a record that 04.05.06 will control
Group 1 the responder is 08.B6.EA (00 1B 01 DNC)
11 is the check sum

Int	Hex	
47	2F	
0	00	
1	01	
2	02	
15	0F	
255	FF	
8	08	
226	E2	
1	01	
8	08	
182	B6	
234	EA	
0	00	
27	1B	
1	01	
1007	3EF	Sum
	10	Compliment (Last byte)
	11	Add 1

1.2 Memory Map

1.2.1 All-Link Database (AL /L) Overview

The AL /L starts at the top of external (serial) EEPROM and grows downward. In the Thermostat, top of memory is 0x0FFF. Each AL /L Record is 8 bytes long, so the first record starts at 0x0FF8, the second record starts at 0x0FF0, and so on down to 0x0300 for a total of 416 links. In what follows, the 3-byte INSTEON Address contained in a record is called the *Device ID* or sometimes just the *ID*. The high byte (MSB) of the Device ID is *ID2*, the middle byte is *ID1*, and the low byte (LSB) is *ID0*.

1.2.2 Thermostat External EEPROM Structure Overview

Location		Comments
0x0FF8	0xA2 01 AA BB CC FF FE 00	All-Link Database Record
0x0FF0		
0x0FD8		
……		
0x0300		Last Record, 416 total links allowed
0x02XX	N/A	Addressing below 0x0300 is ignored by database

1.2.3 AL /L Record Format

Thermostat AL Record Format

Database entries with Record Control Bit 6: 0 = Responder and Group 1 will control the local load.

Linear ALL-Link Database (AL /L) Record Format		
Field	**Length (bytes)**	**Description**
Record Control	1	Record Control Flag Bits: Bit 7: 1 = Record is in use, 0 = Record is available Bit 6: 1 = Controller (Master) of Device ID, 0 = Responder to (Slave of) Device ID Bit 5: Not used Bit 4: Not used Bit 3: Not used Bit 2: Not used Bit 1: 1 = Record has been used before, 0 = 'High-water Mark' Bit 0: Not used
Group	1	ALL-Link Group Number this Device ID belongs to
ID	3	Device ID (ID2, ID1, ID0 in that order)
Data 1	1	Not used
Data 2	1	Not used
Data 3	1	Not used

To add a record to an AL /L, you search for an existing record that is marked available. (Available means the same as empty, unused or deleted.) If none is available, you create a new record at the end of the AL /L.

An unused record will have bit 7 of the *Record Control* byte set to zero. The last record in an AL /L will have bit 1 of the *Record Control* byte set to zero.

1.2.4 Overwriting an Empty AL /L Record

If you found an empty record, you simply overwrite it with your new record data.

Change bit 7 of the *Record Control* byte from zero to one to show that the record is now in use.

Set bit 6 of the *Record Control* byte to one if the device containing the AL /L is an INSTEON Controller of the INSTEON Responder Device whose *ID* is in the record. If instead the device containing the AL /L is an INSTEON Responder to the INSTEON Controller Device whose *ID* is in the record, then clear bit 6 of the *Record Control* byte to zero. In other words, within an AL /L, setting bit 6 means "I'm a Controller," and clearing bit 6 means "I'm a Responder."

Put the ALL-Link Group number in the *Group* field, and put the *Device ID* in the *ID* field. Finally, set the *Data 1*, *Data 2*, and *Data 3* fields appropriately for the *Record Class* you are storing.

1.2.5 Creating a New AL /L Record

To create a new record at the end of the AL /T, find the record with bit 1 of the *Record Control* byte set to zero, indicating that it is the last record in the AL /L. Flip that bit to one.