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Technical Bulletin
SC 370 SMART Modbus Interface

Document Revision History

Document Version	Modbus Map Version	Date	Author	Notes
1	10	9/26/17	JGG	Document Created
2	11	5/10/19	JGG	Updated Modbus Map to V11

SC 370 Smart Controller Modbus RTU

Modbus over RS485

The Vanguard system master controller (VSMC) is configured to be a Modbus slave device. It is configured as follows:

Station ID	2		Parity	None
Baud Rate	9600		Stop Bits	1
Data Bits	8		Flow Control	None

- The controller defaults to Station ID of 2. To change the Station ID, use the web interface or user LED display to change the value and set either the primary or alternate monitoring method to a Modbus option (Ethernet Modbus or RS485 Modbus). If neither primary nor alternate monitoring method is selected as Modbus, the unit will still respond on Station ID 2.
- All other settings are static and cannot be changed.

Ethernet Modbus

The Vanguard system master controller is configured to be a Modbus slave device. It is configured as Station 2 and host TCP socket # 502. The Modbus TCP messages will be detected automatically and responded in the respective format. The Modbus TCP packet format is different from RTU over TCP.

- The controller defaults to Station ID of 2. To change the Station ID, use the web interface or user LED display to change the value and set either the primary or alternate monitoring method to a Modbus option (Ethernet Modbus or RS485 Modbus). If neither primary nor alternate monitoring method is selected as Modbus, the unit will still respond on Station ID 2.
- The Vanguard system's IP address mode can be set to static or dynamic via the 'MONITORING CONFIG -> LO-CAL ETH CONFIG' menu on the Vanguard system 1 controller.
- The Vanguard Modbus RTU over TCP socket #502 will accept incoming connections. However if no data is transmitted through the socket for 5 minutes it will be terminated.

Behavior during Controller Reboots

The Modbus interface (both via RS485 or Ethernet) is disabled during the Vanguard controller power-up diagnostic sequence. Modbus messages will not receive a response during this time-period, which lasts 45 seconds for each system controller. Due to this behavior, it is advised to allow up to 5 minutes for the Vanguard controller to complete its power-up sequence before normal Modbus operation begins.

Behavior notes

- Read Register Access: Any span of registers can be read in one Modbus message with Modbus function code 03 (read). Unmapped address space will return the values 65535 (0xFFFF). Access to restricted address space outside the map areas will cause an error response.

- Write Access: Register writes are performed with function code 16 (write). Vanguard Modbus allows only one register to be written per write command. Only write capable registers process Modbus writes.

- Modbus Error responses contain 3 bytes and 2 crc bytes. Those bytes are – Station ID, Function Code OR'd with 0x80 (to indicate error), and the error code. The error codes are as follows:

  (1) Unsupported Modbus Function Code - Only functions codes 3 (read) and 16 (write) are supported
  (2) Unsupported Register Access - The register or register count exceed the valid map space
  (3) Modbus Msg Size Error - The message size of a read function #3 must be 6 bytes + 2 crc bytes
  (4) Unsupported Argument - The value written to a specified register is invalid

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FAA Compliant Monitoring of the Vanguard Smart Controller with Modbus RTU

This document section is intended as a guide only. Flash Technology and parent company SPX do not assume any responsibility or liability of 3rd party Modbus host monitoring application programs. Please reference FAA Advisory Circular AC 70/7460-1 (Rev L at the time of this document release) for definitive monitoring requirements. Please read the modbus map alarm register descriptions in the Vanguard Smart Modbus Map section prior to reviewing this guidance

It is recommended for the monitoring Modbus host to read the entire Modbus map space to poll the system for monitoring information and diagnostic data. The Modbus host should examine the tower status register #70 to determine if a reportable event has occurred that requires further examination. When a reportable event such as a beacon red night alarm, PD 19hour mode change alarm, marker alarm, or other alarm occurs this register will increment from 0 to overflowing at 0xFFFF(65535d) back to 0. The host should compare the previous tower status state register value to the newly received value.

If the value has changed then further examination of the alarm registers is required to determine the alarm source. NOTAM (Notice to Airmen) worthy alarm points are as follows below.

- Register #72 [Controller Alarms]
    - o Bit 1: Indicates power to the tower is off (POWER FAIL).
    - o Bit 4: Indicates a photodiode alarm, which is a 19 hour mode change failure (PD ALARM).
    - o Bit 6: GPS Sync Failure - Flashing devices out of sync on wind turbine site are grounds for issuing an FAA NOTAM.
    - o Bit 7: Indicates that a device has been discovered for which the system has not been configured (CFG ALARM).
    - o Bit 12: Tower Sync - On towers with multiple flashing devices, those devices must receive operating mode (day or night) and flash sync from the master system controller. Flashing devices out of sync on a tower are grounds for issuing an FAA NOTAM.
    - o Bit 13: Indicates that IR (Infrared) is not available or supported by the attached beacon (IR N/A). NOTAM worthy when system must have functioning infrared lighting.
    - o Bit 14: Bind Alarm. Indicates a communication issue between the beacon and controller. Beacon COMM failures are NOTAM worthy.
- Register #74 [Beacon White Day Alarms]
    - o Bit 0-5 set indicates a Beacon 1-6 White Day Alarm, respectively. Beacon Tier White Day Alarms trigger on 4 missed flashes. Note that 4 good flash periods are required to restore the alarm.
- Register #76 [Beacon White Night Alarms]
    - o Bit 0-5 set indicates a Beacon 1-6 White Night Alarm, respectively. Note that 4 good flash periods are required to restore the alarm. NOTAM Worthy for White towers only.
- Register #78 [Beacon Red Night Alarms]
    - o Bit 0-5 set indicates a Beacon 1-6 Red Night Alarm, respectively. Beacon Tier Red Night Alarms trigger on 4 missed flashes. Note that 4 good flash periods are required to restore the alarm.
- Register #80 [Beacon Communication Alarms]
    - o Bit 0-5 set indicates a Beacon 1-6 Communication Alarm, respectively.
- Register #82 [Marker Alarms]
    - o Bit 0-5 set indicates a Marker Tier 1-6 Alarm, respectively. The exact marker which has faulted can be found by writing the correct value to register 240 and then reading from register 296. Marker Tier Alarm is NOTAM worthy on A0 systems, A1 and above systems with flashing markers, or E1 and above systems with flashing markers. Marker Tier Alarms trigger on 4 bad marker periods. Note that 4 good marker periods are required to restore the alarm.
- Register #84 [Market Tier Communication Alarms]
    - o Bit 0-5 set indicates a Marker Tier 1-6 Communication Alarm, respectively. Marker Tier Alarm is NOTAM worthy on A0 systems, A1 and above systems with flashing markers, or E1 and above systems with flashing markers.
- Register #87 [Beacon Infrared Alarms]
    - o Bit 0-5 set indicates a Beacon 1-6 Infrared Alarm, respectively. NOTAM worthy when system must have functioning infrared lighting.
- Register #301 [Auxiliary Interface Lights On / Off Command]
    - o If a radar system is controlling the Vanguard System, then upon reading register 301 it must be insured to be the same command written to the that register. A failure of lights on represents a NOTAM event.

FAA Advisory Circular AC 70/7460-1 Relevant Sections

- Section 2.4 Light Failure Notification details the steps of when and how to file NOTAM issues and restorations with the FAA.
- Section 4.8 Monitoring Obstruction Lights details monitoring requirements
- Section 13.5.3 Marking and Lighting Wind Turbines, Lighting Standards details light synchronization requirements.
- Section 14 Aircraft Detection Lighting systems details using a radar system through the Vanguard Smart Auxiliary Modbus or Dry Contact interfaces

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SC370 Modbus Specification Map (V11).

Implemented Modbus Map

The following tables detail the data that can be read using Modbus function code 03, and the values that can be written one register at a time by using Modbus function code 16.   Unmapped address space will return the values 65535 or 61166.

Modbus Info Registers			
Register Address	Read/Write	Register Name	Description / Values
0	R	Modbus Map Version Number	(version) 0-65535

Tower Configuration Registers			
Register Address	Read/Write	Register Name	Description / Values
7	R/W	Flash Specification	Flash Specification: FAA (0), ICAO (1), ICAO 4K White Night (2), CAR 621 (3)
8	R/W	Beacon Enable/Disable	Bit value 0:Not Enabled, 1:Enabled Bit0=BCN1, Bit1=BCN2, Bit2=BCN3, Bit3=BCN4, Bit4=BCN5, Bit5=BCN6 When set to "not Enabled", corresponding system's beacon communication alarm will not be generated and beacon will be turned off if beacon is connected and communicating.
9	R/W	GPS Delay	0-3000 (milliseconds)
10	R/W	Tower Type	Red (1), White (2), Dual (3)
11	R/W	Beacons	1-6
12	R	Marker Tiers	0-6, Reads total Number of non-zero Marker's Per Tier below
13	R/W	Markers Per Tier 1	0-4
14	R/W	Markers Per Tier 2	0-4
15	R/W	Markers Per Tier 3	0-4
16	R/W	Markers Per Tier 4	0-4
17	R/W	Markers Per Tier 5	0-4
18	R/W	Markers Per Tier 6	0-4
19	R/W	Markers Enabled	Not Enabled (0), Enabled (1)
20	R/W	Catenary Level	Catenary Level: 1: Middle, 2: Top, 3: Bottom System 1: Bits(1,0) System 2: Bits (3,2) System 3: Bits (5,4) System 4: Bits (7,6) System 5: Bits (9,8) System 6: Bits (11,10) E.g.: catenary level for System1 (Top), System2 (Middle), System3 (Bottom), System 4 (Middle) = 0x0076 Value will be returned as 0 if not enabled for Catenary.
21	R/W	IR Enable	Not Enabled (0), Enabled (1)
22	R/W	IR Alarm is Night Alarm	IR Alarm only generates IR Alarm (0), IR Alarm generates IR Alarm and Night Alarm (1)
23	R/W	FPM Red	20, 30, 40, 60
24	R/W	FPM White	40, 60
25	R/W	Marker Mode	Steady (0), Flashing(1)
26	R/W	Red Flash Mode	Legacy (0), Efficiency (1)
27	R/W	Catenary Enable	Not Enabled (0), Enabled (1)
28	R/W	AOL Beacons setting	Bit value 0:Not AOL, 1:AOL Bit0=BCN1, Bit1=BCN2, Bit2=BCN3, Bit3=BCN4, Bit4=BCN5, Bit5=BCN6
29	R/W	GPS Enable	Not Enabled (0), Enabled (1)

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QLI Test and Results Registers			
Register Address	Read/Write	Register Name	Description / Values
30	R/W	QLI Control	Bit 0 (Read Only) – 1 indicates Auto Fast QLI is in progress Bit 1 – not implemented Bit 2 – not implemented Bit 3 (Read Only) – 1 indicates the QLI has completed and the results are ready Bit 4 (Writeable) – Set to 1 to cancel any running QLI Bit 5 (Writeable) – Set to 1 to start an Automatic Fast QLI
31	R	QLI Stage	1 – QLI Inactive 2 – QLI Set Day Mode 3 – QLI Beacon Day Pretest 4 – QLI Beacon Day Alarm 5 – QLI Beacon Day Alarm Check 6 – QLI Beacon Day Restore 7 – QLI Beacon Day Restore Check 8 – QLI Set White Night Mode 9 – QLI White Night Pretest 10 – QLI White Night Alarm 11 – QLI White Night Alarm Check 12 – QLI White Night Restore 13 – QLI White Night Restore Check 14 – QLI Set Red Night 15 – QLI Red Night Pretest 16 – QLI Red Night Alarm 17 – QLI Red Night Alarm Check 18 – QLI Red Night Restore 19 – QLI Red Night Restore Check 20 – QLI Set PD Alarm 21 – QLI PD Alarm 22 – QLI PD Restore 23 – QLI PD Restore Check 24 – QLI Complete 25 – QLI Set Day Mode Hold 26 – QLI Beacon White Night Restore Hold 27 – QLI Beacon Red Night Restore Hold 28 – QLI Marker Tier Restore Hold 29 – QLI PD Restore Hold 30 – QLI PD Complete Hold Manual QLI stages 50 – QLI Not Running 51 – QLI Day Inhibit 52 – QLI Day Restore 53 – QLI White Night Inhibit 54 – QLI White Night Restore 55 – QLI Red Night Inhibit 56 – QLI Red Night Restore Manual Sequential QLI specific stages 60 – SEQQLI Set Day Mode 61 – SEQQLI Beacon 1 Day Pretest 62 – SEQQLI Beacon 1 Day Alarm 63 – SEQQLI Beacon 1 Day Alarm Check 64 – SEQQLI Beacon 1 Day Restore 65 – SEQQLI Beacon 1 Day Restore Check 66 – SEQQLI Beacon 2 Day Pretest 67 – SEQQLI Beacon 2 Day Alarm 68 – SEQQLI Beacon 2 Day Alarm Check 69 – SEQQLI Beacon 2 Day Restore 70 – SEQQLI Beacon 2 Day Restore Check 71 – SEQQLI Beacon 3 Day Pretest 72 – SEQQLI Beacon 3 Day Alarm 73 – SEQQLI Beacon 3 Day Alarm Check 74 – SEQQLI Beacon 3 Day Restore

			75 – SEQQLI Beacon 3 Day Restore Check
			76 – SEQQLI Beacon 4 Day Pretest
			77 – SEQQLI Beacon 4 Day Alarm
			78 – SEQQLI Beacon 4 Day Alarm Check
			79 – SEQQLI Beacon 4 Day Restore
			80 – SEQQLI Beacon 4 Day Restore Check

QLI Test and Results Registers (Continued)			
Register Address	Read/Write	Register Name	Description / Values
31	R	QLI Stage (Continued)	81 – SEQQLI Beacon 5 Day Pretest
			82 – SEQQLI Beacon 5 Day Alarm
			83 – SEQQLI Beacon 5 Day Alarm Check
			84 – SEQQLI Beacon 5 Day Restore
			85 – SEQQLI Beacon 5 Day Restore Check
			86 – SEQQLI Beacon 6 Day Pretest
			87 – SEQQLI Beacon 6 Day Alarm
			88 – SEQQLI Beacon 6 Day Alarm Check
			89 – SEQQLI Beacon 6 Day Restore
			90 – SEQQLI Beacon 6 Day Restore Check
			91 – SEQQLI Set White Night Mode
			92 – SEQQLI Beacon 1 White Night Pretest
			93 – SEQQLI Beacon 1 White Night Alarm
			94 – SEQQLI Beacon 1 White Night Alarm Check
			95 – SEQQLI Beacon 1 White Night Restore
			96 – SEQQLI Beacon 1 White Night Restore Check
			97 – SEQQLI Beacon 2 White Night Pretest
			98 – SEQQLI Beacon 2 White Night Alarm
			99 – SEQQLI Beacon 2 White Night Alarm Check
			100 – SEQQLI Beacon 2 White Night Restore
			101 – SEQQLI Beacon 2 White Night Restore Check
			102 – SEQQLI Beacon 3 White Night Pretest
			103 – SEQQLI Beacon 3 White Night Alarm
			104 – SEQQLI Beacon 3 White Night Alarm Check
			105 – SEQQLI Beacon 3 White Night Restore
			106 – SEQQLI Beacon 3 White Night Restore Check
			107 – SEQQLI Beacon 4 White Night Pretest
			108 – SEQQLI Beacon 4 White Night Alarm
			109 – SEQQLI Beacon 4 White Night Alarm Check
			110 – SEQQLI Beacon 4 White Night Restore
			111 – SEQQLI Beacon 4 White Night Restore Check
			112 – SEQQLI Beacon 5 White Night Pretest
			113 – SEQQLI Beacon 5 White Night Alarm
			114 – SEQQLI Beacon 5 White Night Alarm Check
			115 – SEQQLI Beacon 5 White Night Restore
			116 – SEQQLI Beacon 5 White Night Restore Check
			117 – SEQQLI Beacon 6 White Night Pretest
			118 – SEQQLI Beacon 6 White Night Alarm
			119 – SEQQLI Beacon 6 White Night Alarm Check
			120 – SEQQLI Beacon 6 White Night Restore
			121 – SEQQLI Beacon 6 White Night Restore Check
			122 – SEQQLI Set Red Night Mode
			123 – SEQQLI Beacon 1 Red Night Pretest
			124 – SEQQLI Beacon 1 Red Night Alarm
			125 – SEQQLI Beacon 1 Red Night Alarm Check
			126 – SEQQLI Beacon 1 Red Night Restore
			127 – SEQQLI Beacon 1 Red Night Restore Check
			128 – SEQQLI Beacon 2 Red Night Pretest
			129 – SEQQLI Beacon 2 Red Night Alarm
			130 – SEQQLI Beacon 2 Red Night Alarm Check
			131 – SEQQLI Beacon 2 Red Night Restore
			132 – SEQQLI Beacon 2 Red Night Restore Check
			133 – SEQQLI Beacon 3 Red Night Pretest
			134 – SEQQLI Beacon 3 Red Night Alarm

			135 – SEQQLI Beacon 3 Red Night Alarm Check
			136 – SEQQLI Beacon 3 Red Night Restore
			137 – SEQQLI Beacon 3 Red Night Restore Check
			138 – SEQQLI Beacon 4 Red Night Pretest
			139 – SEQQLI Beacon 4 Red Night Alarm
			140 – SEQQLI Beacon 4 Red Night Alarm Check
			141 – SEQQLI Beacon 4 Red Night Restore
			142 – SEQQLI Beacon 4 Red Night Restore Check
			143 – SEQQLI Beacon 5 Red Night Pretest
			144 – SEQQLI Beacon 5 Red Night Alarm
			145 – SEQQLI Beacon 5 Red Night Alarm Check

QLI Test and Results Registers (Continued)			
Register Address	Read/Write	Register Name	Description / Values
31	R	QLI Stage (Continued)	146 – SEQQLI Beacon 5 Red Night Restore
			147 – SEQQLI Beacon 5 Red Night Restore Check
			148 – SEQQLI Beacon 6 Red Night Pretest
			149 – SEQQLI Beacon 6 Red Night Alarm
			150 – SEQQLI Beacon 6 Red Night Alarm Check
			151 – SEQQLI Beacon 6 Red Night Restore
			152 – SEQQLI Beacon 6 Red Night Restore Check
			153 – SEQQLI Marker Tier 1 Red Night Pretest
			154 – SEQQLI Marker Tier 1 Red Night Alarm
			155 – SEQQLI Marker Tier 1 Red Night Alarm Check
			156 – SEQQLI Marker Tier 1 Red Night Restore
			157 – SEQQLI Marker Tier 1 Red Night Restore Check
			158 – SEQQLI Marker Tier 2 Red Night Pretest
			159 – SEQQLI Marker Tier 2 Red Night Alarm
			160 – SEQQLI Marker Tier 2 Red Night Alarm Check
			161 – SEQQLI Marker Tier 2 Red Night Restore
			162 – SEQQLI Marker Tier 2 Red Night Restore Check
			163 – SEQQLI Marker Tier 3 Red Night Pretest
			164 – SEQQLI Marker Tier 3 Red Night Alarm
			165 – SEQQLI Marker Tier 3 Red Night Alarm Check
			166 – SEQQLI Marker Tier 3 Red Night Restore
			167 – SEQQLI Marker Tier 3 Red Night Restore Check
			168 – SEQQLI Marker Tier 4 Red Night Pretest
			169 – SEQQLI Marker Tier 4 Red Night Alarm
			170 – SEQQLI Marker Tier 4 Red Night Alarm Check
			171 – SEQQLI Marker Tier 4 Red Night Restore
			172 – SEQQLI Marker Tier 4 Red Night Restore Check
			173 – SEQQLI Marker Tier 5 Red Night Pretest
			174 – SEQQLI Marker Tier 5 Red Night Alarm
			175 – SEQQLI Marker Tier 5 Red Night Alarm Check
			176 – SEQQLI Marker Tier 5 Red Night Restore
			177 – SEQQLI Marker Tier 5 Red Night Restore Check
			178 – SEQQLI Marker Tier 6 Red Night Pretest
			179 – SEQQLI Marker Tier 6 Red Night Alarm
			180 – SEQQLI Marker Tier 6 Red Night Alarm Check
			181 – SEQQLI Marker Tier 6 Red Night Restore
			182 – SEQQLI Marker Tier 6 Red Night Restore Check
			183 – SEQQLI Beacon 1 Day Restore Hold
			184 – SEQQLI Beacon 2 Day Restore Hold
			185 – SEQQLI Beacon 3 Day Restore Hold
			186 – SEQQLI Beacon 4 Day Restore Hold
			187 – SEQQLI Beacon 5 Day Restore Hold
			188 – SEQQLI Beacon 6 Day Restore Hold
			189 – SEQQLI Beacon 1 White Night Restore Hold
			190 – SEQQLI Beacon 2 White Night Restore Hold
			191 – SEQQLI Beacon 3 White Night Restore Hold
			192 – SEQQLI Beacon 4 White Night Restore Hold
			193 – SEQQLI Beacon 5 White Night Restore Hold
			194 – SEQQLI Beacon 6 White Night Restore Hold

			195 – SEQQLI Beacon 1 Red Night Restore Hold 196 – SEQQLI Beacon 2 Red Night Restore Hold 197 – SEQQLI Beacon 3 Red Night Restore Hold 198 – SEQQLI Beacon 4 Red Night Restore Hold 199 – SEQQLI Beacon 5 Red Night Restore Hold 200 – SEQQLI Beacon 6 Red Night Restore Hold 201 – SEQQLI Marker Tier 1 Red Night Restore Hold 202 – SEQQLI Marker Tier 2 Red Night Restore Hold 203 – SEQQLI Marker Tier 3 Red Night Restore Hold 204 – SEQQLI Marker Tier 4 Red Night Restore Hold 205 – SEQQLI Marker Tier 5 Red Night Restore Hold 206 – SEQQLI Marker Tier 6 Red Night Restore Hold 207 – SEQQLI Completed No Failures 208 – SEQQLI Completed With Failures

QLI Test and Results Registers (Continued)			
Register Address	Read/Write	Register Name	Description / Values
32	R	System 1 Results	Bit 0 – Beacon 1 not tested (0), was tested in White Day (1) Bit 1 – Beacon 1 passed pretest (0), failed pretest (1) Bit 2 – Beacon 1 passed inhibit (0), failed inhibit (1) Bit 3 – Beacon 1 passed restore (0), failed restore (1) Bit 4 – Beacon 1 not tested (0), was tested in White Night (1) Bit 5 – Beacon 1 passed pretest (0), failed pretest (1) Bit 6 – Beacon 1 passed inhibit (0), failed inhibit (1) Bit 7 – Beacon 1 passed restore (0), failed restore (1) Bit 8 – Beacon 1 not tested (0), was tested in Red Night (1) Bit 9 – Beacon 1 passed pretest (0), failed pretest (1) Bit 10 – Beacon 1 passed inhibit (0), failed inhibit (1) Bit 11 – Beacon 1 passed restore (0), failed restore (1) Bit 12 – Marker 1 not tested (0), was tested in Red Night(1) Bit 13 – Marker 1 passed pretest (0), failed pretest (1) Bit 14 – Marker 1 passed inhibit (0), failed inhibit (1) Bit 15 – Marker 1 passed restore(0), failed restore (1)
33	R	System 2 Results	See description for Register 32
34	R	System 3 Results	See description for Register 32
35	R	System 4 Results	See description for Register 32
36	R	System 5 Results	See description for Register 32
37	R	System 6 Results	See description for Register 32
38	R	System 1 Expanded Results	Bit 0 – Beacon 1 not tested (0), was tested for IR Alarm (1) Bit 1 – Beacon 1 passed pretest (0), failed pretest (1) Bit 2 – Beacon 1 passed inhibit (0), failed inhibit (1) Bit 3 – Beacon 1 passed restore (0), failed restore (1)
39	R	System 2 Expanded Results	See description for Register 38
40	R	System 3 Expanded Results	See description for Register 38
41	R	System 4 Expanded Results	See description for Register 38
42	R	System 5 Expanded Results	See description for Register 38
43	R	System 6 Expanded Results	See description for Register 38

Tower Override			
Register Address	Read/Write	Register Name	Description / Values
60	R/W	Mode Override Control	Read: Override Mode Off (0), White Day (1), White Night (2), Red Night (3) Write: White Day (1), White Night (2), Red Night (3), Cancel Override Mode (4) NOTE: A write to the Override Time register is required while writing the Override Control Register. If commanding a cancel override, the override time register is irrelevant however.
61	R/W	Mode Override Time	0-65535, Override Time in Minutes.

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		Tower Monitoring Interface	
Register Address	Read/Write	Register Name	Description / Values
70	R	Tower Status State	0-254 (Increments indicate a reportable status event such as an alarm occurred)
71	R	Tower Configuration State	0-254 (Increments indicate a tower configuration change occurred)
72	R	Controller Alarms/Indications	Bit 0: Indicates system powered up Bit 1: Indicates power to the tower is off (**POWER FAIL**) Bit 2: Reserved Bit 3: Indicates low tower DC power (**LOW DC**) Bit 4: Indicates a photodiode alarm, which is a 19 hour mode change failure (**PD ALARM**) Bit 5: Indicates Tower 485 com failure (**SYS COMM**) Bit 6: Indicates GPS sync failure (**GPS ALARM**) Bit 7: Indicates that a device has been discovered for which the system has not been configured (**CFG ALARM**) Bit 8: Indicates Override Mode Bit 9: Indicates system is running a Lighting Inspection Test (**LI TEST MODE**) Bit 10: Reserved Bit 11: Reserved Bit 12: Indicates on multi-beacon systems that a failure to sync has occurred (**TWR SYNC**) Bit 13: Indicates that IR (Infrared) is not available or supported by the attached beacon (**IR N/A**) Bit 14: Indicates possible cross talk in PLC communication (**BIND ALARM**)
73	R	Controller Alarms/Indications Changed	Bit mapped alarm indications changed (same bit map as register 72)
74	R	Beacon White Day Alarms (**DAY ALARM**)	Bit 0-5 set indicates a Beacon 1-6 White Day Alarm, respectively
75	R	Beacon White Day Alarms Changed	Corresponding bits are sets to 1 when an alarm transition occurs. (Reserved)
76	R	Beacon White Night Alarms (**WNIGHT ALARM**)	Bit 0-5 set indicates a Beacon 1-6 White Night Alarm, respectively
77	R	Beacon White Night Alarms Changed	Corresponding bits are sets to 1 when an alarm transition occurs. (Reserved)
78	R	Beacon Red Night Alarms (**RNIGHT ALARM**)	Bit 0-5 set indicates a Beacon 1-6 Red Night Alarm, respectively
79	R	Beacon Red Night Alarms Changed	Corresponding bits are sets to 1 when an alarm transition occurs. (Reserved)
80	R	Beacon Communication Alarms (**BCN COMM**)	Bit 0-5 set indicates a Beacon 1-6 Communication Alarm, respectively
81	R	Beacon Communication Alarms Changed	Corresponding bits are sets to 1 when an alarm transition occurs. (Reserved)
82	R	Marker Alarms (**MKR ALARM**)	Bit 0-5 set indicates a Marker Tier 1-6 Alarm, respectively The exact marker which has faulted can be found by writing the correct value to register 240 and then reading from register 296.
83	R	Marker Alarms Changed	Corresponding bits are sets to 1 when an alarm transition occurs. (Reserved)
84	R	Marker Tier Communication Alarms (**MKR COMM**)	Bit 0-5 set indicates a Marker Tier 1-6 Communication Alarm, respectively
85	R	Marker Tier Communication Alarms Changed	Corresponding bits are sets to 1 when an alarm transition occurs. (Reserved)
86	R	Current Tower Lighting Operating Mode	Day (1), White Night (2), Red Night (3)
87	R	Beacon Infrared Alarms (**IR ALARM**)	Bit 0-5 set indicates a Beacon 1-6 Infrared Alarm, respectively
88	R	Beacon Infrared Alarm Changed	Corresponding bits are sets to 1 when an alarm transition occurs. (Reserved)

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Vanguard Controller Board Diagnostics			
Register Address	Read/Write	Register Name	Description / Values
90	R/W	Vanguard Controller Select Register	1-6, indicates/selects which system data is reflected below
91	W	System wide reboot	Reboots all controllers for the entire site. Only applicable on controller 1 (as set in register 90). Writing any value will cause the reboot.
92 – 122	R	Vanguard Controller Board Firmware Revision String	ASCII string, null terminated
123 – 138	R	Vanguard Controller Board Univer-sally Unique Identifier	Binary data identifier
139	R	Vanguard Controller Board Input Power Voltage A2D	An A2D value representing the line voltage powering the con-troller board and tower
140	R	Vanguard Controller Internal Tem-perature A2D	An A2D value representing the cabinet temperature
141	R	Vanguard Controller Photodiode A2D	An A2D value representing the photodiode voltage
142			

Beacon Settings and Diagnostics			
Register Address	Read/Write	Register Name	Description / Values
160	R/W	Beacon Select Register	1-6, indicates/selects which system beacon data is reflected be-low
162 – 192	R	Beacon Firmware Revision String	ASCII string, null terminated
193 – 208	R	Beacon Universally Unique Identifier	Binary data identifier
209	R	Beacon White String 0 Voltage A2D	An A2D value representing White String 0 Voltage. Some flash head revisions will not have a white string 0 and will read 0 a2d counts. When the flash head features IR support, this white string 0 register will show the IR string voltage A2D
210	R	Beacon White String 0 Current A2D	An A2D value representing White String 0 Current. Some flash head revisions will not have a white string 0 and will read 0 a2d counts. When the flash head features IR support, this white string 0 register will show the IR string current A2D
211	R	Beacon White String 1 Voltage A2D	An A2D value representing White String 1 Voltage
212	R	Beacon White String 1 Current A2D	An A2D value representing White String 1 Current
213	R	Beacon White String 2 Voltage A2D	An A2D value representing White String 2 Voltage
214	R	Beacon White String 2 Current A2D	An A2D value representing White String 2 Current
215	R	Beacon White String 3 Voltage A2D	An A2D value representing White String 3 Voltage
216	R	Beacon White String 3 Current A2D	An A2D value representing White String 3 Current
217	R	Beacon White String 4 Voltage A2D	An A2D value representing White String 4 Voltage
218	R	Beacon White String 4 Current A2D	An A2D value representing White String 4 Current
219	R	Beacon White String 5 Voltage A2D	An A2D value representing White String 5 Voltage
220	R	Beacon White String 5 Current A2D	An A2D value representing White String 5 Current
221	R	Beacon Red String 0 Voltage A2D	An A2D value representing Red String 0 Voltage
222	R	Beacon Red String 0 Current A2D	An A2D value representing Red String 0 Current
223	R	Beacon Red String 1 Voltage A2D	An A2D value representing Red String 1 Voltage
224	R	Beacon Red String 1 Current A2D	An A2D value representing Red String 1 Current
225	R	Beacon Input Power Voltage A2D	An A2D value representing the Input Power Voltage Level
226	R	Beacon Internal Temperature A2D	An A2D value representing the temperature inside the flash head core
227	R	Beacon Red Mode Status	Beacon Mode: Beacon red mode status Flashing (0), Steady (1).
228	R	PLC Communications Quality	PLC Communications Quality with the beacon expressed in per-centage

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Marker Settings and Diagnostics			
Register Address	Read/Write	Register Name	Description / Values
240	R/W	Marker Tier Select Register	1-6, indicates/selects which system Marker Tier data is reflected below
242 – 272	R	Marker Board Firmware Revision String	ASCII string, null terminated
273 – 288	R	Marker Board Universally Unique Identifier	Binary data identifier
289	R	Marker Output 1 Current Draw A2D	An A2D value representing the current draw of Marker Output 1
290	R	Marker Output 2 Current Draw A2D	An A2D value representing the current draw of Marker Output 2
291	R	Marker Output 3 Current Draw A2D	An A2D value representing the current draw of Marker Output 3
292	R	Marker Output 4 Current Draw A2D	An A2D value representing the current draw of Marker Output 4
293	R	Marker Drive Voltage A2D	An A2D value representing the voltage that is driving all the Marker Outputs
294	R	Marker Input Power Voltage A2D	An A2D value representing the Input Power Voltage Level
295	R	Marker Internal Temperature A2D	An A2D value representing the Marker Box Internal Temperature
296	R	Individual Marker Status	If a marker alarm is detected in Tower Monitoring (register 82), the specific marker that failed can be determined here: Bit 0 – A '1' indicates that Marker 1 is in alarm Bit 1 – A '1' indicates that Marker 2 is in alarm Bit 2 – A '1' indicates that Marker 3 is in alarm Bit 3 – A '1' indicates that Marker 4 is in alarm
297	R	PLC Communications Quality	PLC Communications Quality with the marker expressed in percentage

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Auxiliary Interface Registers			
Register Address	Read/Write	Register Name	Description / Values
300	R/W	Auxiliary Interface Control Type	0: Disabled, 1: Modbus, 2: DC Input
301	R/W	Command Lights On/Off	0: Lights on, 1: Lights off
302	R	Lights-On Confirmation	0: Idle 1: Pending (Command has been sent to Beacon) 2: ON Success (Beacon has confirmed a Lights On command) 3: OFF Success (Beacon has confirmed a Lights Off command) 4: Failed (Command has not be confirmed within 10 seconds)
303	R/W	'Heartbeat' Configuration	0: Disabled (1 – 99): not valid inputs – 100 (10.0s) minimum time required. 100 - 65535: the time in multiples of 100 milliseconds to default lights on if not 'kicked'
304	W	'Heartbeat'	Write value of 0x55AA. If register is not written to within the time configured in Register 303, then lights will be turned on until commanded to be off again
305	R/W	Confirmation Relay Output Configuration	0: Disabled 1: MODE relay output 2: COMM ALARM relay output 3: GPS SYNC ALARM relay output 4: PHOTODIODE ALARM relay output 5: MARKER ALARM relay output 6: NIGHT ALARM relay output 7: DAY ALARM relay output
306	R	Last Beacon Status	Bit 0) Beacon 1 - 0: Lights on, 1: Lights off Bit 1) Beacon 2 - 0: Lights on, 1: Lights off Bit 2) Beacon 3 - 0: Lights on, 1: Lights off Bit 3) Beacon 4 - 0: Lights on, 1: Lights off Bit 4) Beacon 5 - 0: Lights on, 1: Lights off Bit 5) Beacon 6 - 0: Lights on, 1: Lights off
307	R	Last Marker Status	Bit 0) Marker Tier 1 - 0: Lights on, 1: Lights off Bit 1) Marker Tier 2 - 0: Lights on, 1: Lights off Bit 2) Marker Tier 3 - 0: Lights on, 1: Lights off Bit 3) Marker Tier 4 - 0: Lights on, 1: Lights off Bit 4) Marker Tier 5 - 0: Lights on, 1: Lights off Bit 5) Marker Tier 6 - 0: Lights on, 1: Lights off

System Settings			
Register Address	Read/Write	Register Name	Description / Values
321	R/W	RTC Timestamp Date*	RTC Time in Day/Month/Year Bits 15 to 11: Day 1-31 Bits 10 to 7: Month 1 - 12 Bits 6 to 0: Year Value in the range of 18-99 to be expressed as 2018-2099
322	R/W	RTC Timestamp Time*	RTC Time in Hours:Minutes. 24 Hour format. Bits 15 to 8: Hours 0-23 Bits 7 to 0: Min 0 – 59
323	R/W	Daylight Savings Time	Daylight Savings Time. Not Enabled (0), Enabled (1) When set to Enabled then daylight savings time will be adjusted as per the schedule. If a new time is set then it is assumed that the time is set according to the adjusted daylight savings clock.

Note: Date and time will be set to RTC only after receiving the date and time together. If date is received first it will be latched for up to 30 sec and updated after the time received. If time is received then it will be updated to RTC immediately. It may take up to 5 seconds to reflect the new time to RTC.