NXF4000/PPC4000 Modbus Communications

DESCRIPTION

The protocol to be used is Modbus RTU. This is implemented by the master (PC, PLC, BAS, etc.) issuing a poll to the slave (PPC/NXF-4000) and the slave responding with the appropriate message.

A typical format of a poll request is as follows:

DST	FNC	ADR HI	ADR LO	DAT HI	DAT LO	CRC LO	CRC HI

DST refers to the logical address of the slave.

FNC is the function being requested. FNC 03 is a read request. FNC 06 is a write request.

ADR is the address of the register (or starting address of the registers) being read or the address of the register being written to.

The PPC/NXF-4000 Modbus map is divided into two sections. In the first "Read-Only Section", all registers are mapped as HOLDING REGISTERS, FNC 03. In the second "Low-Level User Command and Config", registers are read/write, with read being accomplished with FNC 03, and write being accomplished with FNC 06. Register addresses begin at 40001 but is interpreted as address 00.

DAT is the number of words being requested where a word is an integer consisting of 2 bytes, OR is the word value to be written to the register pointed to by ADR.\

The normal response from a slave, in the case of FNC 03 read, is as follows:

DST	FNC	DBC	DATA…. Hi/Lo	CRC LO	CRC HI

DBC is the data byte count being returned. It must be two times the DAT number from the poll request.

DATA is the data returned and is always a series of 2 byte integers. If 4 words were requested then DBC would be 8 and there would be 8 data bytes or 4 data words containing the requested data.

The normal response from a slave, in the case of FNC 06, is as follows:

DST	FNC	ADR HI	ADR LO	DAT HI	DAT LO	CRC LO	CRC HI

In this case, DAT represents the data written to the register at ADR.

The data communications (baud) rate is menu selectable at the PPC/NXF-4000 from 4800 to 57,600 bits per second, with 8 bits per byte, no parity, and 1 stop bit.

Below is a table of currently available messages provided by the PPC/NXF-4000 followed by a description, where necessary. Shaded areas are registers not available for the PPC4000.

Read-Only Section				
Holding Register	Message Address	Word Requested	Response	Value
40001	00	1	Operational State	Current operational state of the PPC/NXF 4000 (0-16)
40002	01	1	Flame Signal Value	0 - 100
40003	02	2	System On Hours	Upper 16 bits of the 32 bit System Operational Minute Counter
40004	03		" "	Lower 16 bits of the 32 bit System Operational Minute Counter
40005	04	2	Burner on Hours	Upper 16 bits of the 32 bit Burner Running Minute Counter
40006	05		" "	Lower 16 bits of the 32 bit Burner Running Minute Counter
40007	06	2	Completed Burner Cycles	Upper 16 bits of the 32 bit Burner Cycle Counter
40008	07		" "	Lower 16 bits of the 32 bit Burner Cycle Counter
40009	08	1	Current Modulation Rate	0-100% (read only)
40010	09	1	Current Modulation Reason Mode	0 - Self Modulation (AUTOmatic) 1 - Manual mode via Digital Input 2 - Manual mode via keypad 3 - Sequencing slave (follows master's PID) 4 - Low Fire Hold via Keypad 5 - Standby Water 6 - Thermal Shock 7 - Low Stack Temperature Hold 8 - High Fire Hold 9 - Track Modulation
40011	10	1	Current internal temperature of the control	value = degree C (units), -40C to +85C, Actual temp = 1/16th of the value in register
40012	11	1	Current Profile Commission Point	At what profile point is the control currently running, (P0-P23)
40013	12	1	Current Calculated CO2 value	0 - 100%, Actual value = 1/10th of the value in register
40014	13	1	Control Type	0 = PPC-4000 1 = NXF4000
40015	14	1	Current Selected Profile	1 through 4
40016	15	1	Total # of commissioned points in current profile	0 - 24
40017	16	1	Current Profile Commissioned Points Range during AUTO modulation	0 - 22; 22 indicates the range P22 - P23
40018	17	1	Current Digital Input values	Current state for Digital Input 1 thru 15. Bit 0 = DI1, bit 1 = DI2, bit 2 = DI3,.... bit 14 = DI15 [Off = 0, On =1] Note: DI11 thru DI15 not available in PPC4000

Holding Register	Message Address	Word Requested	Response	Value
40022	21	2	Current VFD 1 position in 1/10th degree	Actual position (0-1000); Would indicate 0.0-100.0% if display format is Percent Full Scale
40023	22		Commanded VFD 1 position in 1/10th degree	commanded position (0-1000); Would indicate 0.0-100.0% if display format is Percent Full Scale.
40024	23	2	Current VFD 2 position in 1/10th degree	actual position (0-1000); Would indicate 0.0-100.0% if display format is Percent Full Scale.
40025	24		Commanded VFD 2 position in 1/10th degree	commanded position (0-1000); Would indicate 0.0-100.0% if display format is Percent Full Scale.
40026	25	1	Boiler efficiency	0 – 100%. Range: -1 to 999(0 is 0%, 999 is 99.9%, -1 signals that efficiency is unknown)
40027	26	1	Current O2 Target Value in 1/10th %	Only valid when system is equipped with an O2 probe & it's setup for O2 trim
40030	29	1	Combustion efficiency	0 – 100%. Range: -1 to 999(0 is 0%, 999 is 99.9%, -1 signals that efficiency is unknown)
40036	35	4	O2 Probe Status (see O2 Probe Manual)	Only valid when system is equipped with an O2 probe. Consult NXCESO2 probe bulletin for status explanation
40037	36		O2 Probe Stack Temperature	(see O2 Probe Manual)
40038	37		O2 Probe Ambient Temperature	(see O2 Probe Manual)
40039	38		O2 Probe O2 Level	(see O2 Probe Manual)
40052	51	1	Calibration constant	A number of "counts" ranging from 819 to 860. Used to normalize raw sensor readings
40057	56	1	Z processor firmware major revision	Upper 8 bits are the Z processor firmware major revision
40058	57	1	Z processor firmware minor revision	Lower 8 bits are the Z processor Firmware minor revision
40060	59	1	Sensor 1 measured raw value	Raw A/D measurement of the Primary sensor
40061	60	1	Sensor 2 measured raw value	Raw A/D measurement of the Aux 1 sensor
40062	61	1	Sensor 3 measured raw value	Raw A/D measurement of the Aux 2 sensor
40066	65	1	Sensor 4 measured raw value	Raw A/D measurement of sensor 4 (Note 1)
40067	66	1	Sensor 5 measured raw value	Raw A/D measurement of sensor 5 (Note 1)
40080	79	1	Servo 1 current position	In 0.1 degree increments.
40089	88	1	Servo 2 current position	In 0.1 degree increments.
40098	97	1	Servo 3 current position	In 0.1 degree increments.
40107	106	1	Servo 4 current position	In 0.1 degree increments.
40116	115	1	Servo 5 current position	In 0.1 degree increments.

Holding Register	Message Address	Word Requested	Response	Value
40125	124	1	Servo 6 current position	In 0.1 degree increments.
40134	133	1	Servo 7 current position	In 0.1 degree increments.
40143	142	1	Servo 8 current position	In 0.1 degree increments.
40152	151	1	Servo 9 current position	In 0.1 degree increments.
40161	160	1	Servo 10 current position	In 0.1 degree increments.
40171	170	1	Amplifier Board Type	0 = NONE 1 = IRH 2 = DC 3 = UV 4 = UNUSED 5 = UNUSED 6 = IRL
40173	172	1	Minimum Modulation for Profiles 1 & 2	0 – 100%
40174	173	1	Minimum Modulation for Profiles 3 & 4	0 – 100%
40181	180	4	8 character revision string for Main Microprocessor	
40185	184	1	Helper CPU Major Rev	0-65535
40186	185	1	Helper CPU Minor Rev	0-65535
40187	186	1	VFD CPU Rev	Upper Byte: Major Revision(0-255); Lower Byte: Minor Revision(0-255)
40188	187	1	FSG CPU Rev	Upper Byte: Major Revision(0-255); Lower Byte: Minor Revision(0-255)
40191	190	1	Error Repeat Count	Upper Byte: Error repeat count: 0-255;
40192	191		Lockout History - Current active error number	0 if no active error, error number otherwise (see separate publication on PPC/NXF-4000 Error Codes)
40193	192		Lockout History - Total number of errors detected	Stored Lockout Count
40194	193		Lockout History - Fault 1	Most Recent Fault. Upper 8 bits = Profile Position, lower 8 bits = Operational state when error occurred
40195	194		Lockout History - Fault 1 - Error code	
40196	195		Lockout History - Fault 1 - Time of Fault Occurrence	Upper Byte = Minutes, Lower Byte = Seconds
40197	196		Lockout History - Fault 1 - Date of Fault Occurrence	Upper Byte = Day of the Month, Lower Byte = Hour
40198	197		Lockout History - Fault 1 - Date of Fault Occurrence	Upper Byte = Weekday (0=Sunday), Lower Byte = Month
40199	198		Lockout History - Fault 1 - Year of Fault Occurrence	
40200	199		Lockout History - Fault 2	2nd Most Recent Fault. Upper 8 bits = Profile Position, lower 8 bits = Operational state when error occurred
40201	200		Lockout History - Fault 2 - Error code	
40202	201		Lockout History - Fault 2 - Time of Fault Occurrence	Upper Byte = Minutes, Lower Byte = Seconds

Holding Register	Message Address	Word Requested	Response	Value
40203	202		Lockout History - Fault 2 - Date of Fault Occurrence	Upper Byte = Day of the Month, Lower Byte = Hour
40204	203		Lockout History - Fault 2 - Date of Fault Occurrence	Upper Byte = Weekday (0=Sunday), Lower Byte = Month
40205	204		Lockout History - Fault 2 - Year of Fault Occurrence	
40206	205		Lockout History - Fault 3	3rd Most Recent Fault. Upper 8 bits = Profile Position, lower 8 bits = Operational state when error occurred
40207	206		Lockout History - Fault 3 - Error code	
40208	207		Lockout History - Fault 3 - Time of Fault Occurrence	Upper Byte = Minutes, Lower Byte = Seconds
40209	208		Lockout History - Fault 3 - Date of Fault Occurrence	Upper Byte = Day of the Month, Lower Byte = Hour
40210	209		Lockout History - Fault 3 - Date of Fault Occurrence	Upper Byte = Weekday (0=Sunday), Lower Byte = Month
40211	210		Lockout History - Fault 3 - Year of Fault Occurrence	
40212	211		Lockout History - Fault 4	4th Most Recent Fault. Upper 8 bits = Profile Position, lower 8 bits = Operational state when error occurred
40213	212		Lockout History - Fault 4 - Error code	
40214	213		Lockout History - Fault 4 - Time of Fault Occurrence	Upper Byte = Minutes, Lower Byte = Seconds
40215	214		Lockout History - Fault 4 - Date of Fault Occurrence	Upper Byte = Day of the Month, Lower Byte = Hour
40216	215		Lockout History - Fault 4 - Date of Fault Occurrence	Upper Byte = Weekday (0=Sunday), Lower Byte = Month
40217	216		Lockout History - Fault 4 - Year of Fault Occurrence	
40218	217		Lockout History - Fault 5	5th Most Recent Fault. Upper 8 bits = Profile Position, lower 8 bits = Operational state when error occurred
40219	218		Lockout History - Fault 5 - Error code	
40220	219		Lockout History - Fault 5 - Time of Fault Occurrence	Upper Byte = Minutes, Lower Byte = Seconds
40221	220		Lockout History - Fault 5 - Date of Fault Occurrence	Upper Byte = Day of the Month, Lower Byte = Hour
40222	221		Lockout History - Fault 5 - Date of Fault Occurrence	Upper Byte = Weekday (0=Sunday), Lower Byte = Month
40223	222		Lockout History - Fault 5 - Year of Fault Occurrence	
40224	223		Lockout History - Fault 6	6th Most Recent Fault. Upper 8 bits = Profile Position, lower 8 bits = Operational state when error occurred
40225	224		Lockout History - Fault 6 - Error code	
40226	225		Lockout History - Fault 6 - Time of Fault Occurrence	Upper Byte = Minutes, Lower Byte = Seconds

Holding Register	Message Address	Word Requested	Response	Value
40227	226		Lockout History - Fault 6 - Date of Fault Occurrence	Upper Byte = Day of the Month, Lower Byte = Hour
40228	227		Lockout History - Fault 6 - Date of Fault Occurrence	Upper Byte = Weekday (0=Sunday), Lower Byte = Month
40229	228		Lockout History - Fault 6 - Year of Fault Occurrence	
40230	229		Lockout History - Fault 7	7th Most Recent Fault. Upper 8 bits = Profile Position, lower 8 bits = Operational state when error occurred
40231	230		Lockout History - Fault 7 - Error code	
40232	231		Lockout History - Fault 7 - Time of Fault Occurrence	Upper Byte = Minutes, Lower Byte = Seconds
40233	232		Lockout History - Fault 7 - Date of Fault Occurrence	Upper Byte = Day of the Month, Lower Byte = Hour
40234	233		Lockout History - Fault 7 - Date of Fault Occurrence	Upper Byte = Weekday (0=Sunday), Lower Byte = Month
40235	234		Lockout History - Fault 7 - Year of Fault Occurrence	
40236	235		Lockout History - Fault 8	8th Most Recent Fault. Upper 8 bits = Profile Position, lower 8 bits = Operational state when error occurred
40237	236		Lockout History - Fault 8 - Error code	
40238	237		Lockout History - Fault 8 - Time of Fault Occurrence	Upper Byte = Minutes, Lower Byte = Seconds
40239	238		Lockout History - Fault 8 - Date of Fault Occurrence	Upper Byte = Day of the Month, Lower Byte = Hour
40240	239		Lockout History - Fault 8 - Date of Fault Occurrence	Upper Byte = Weekday (0=Sunday), Lower Byte = Month
40241	240		Lockout History - Fault 8 - Year of Fault Occurrence	
40242	241		Lockout History - Fault 9	9th Most Recent Fault. Upper 8 bits = Profile Position, lower 8 bits = Operational state when error occurred
40243	242		Lockout History - Fault 9 - Error code	
40244	243		Lockout History - Fault 9 - Time of Fault Occurrence	Upper Byte = Minutes, Lower Byte = Seconds
40245	244		Lockout History - Fault 9 - Date of Fault Occurrence	Upper Byte = Day of the Month, Lower Byte = Hour
40246	245		Lockout History - Fault 9 - Date of Fault Occurrence	Upper Byte = Weekday (0=Sunday), Lower Byte = Month
40247	246		Lockout History - Fault 9 - Year of Fault Occurrence	
40248	247		Lockout History - Fault 10	10th Most Recent Fault. Upper 8 bits = Profile Position, lower 8 bits = Operational state when error occurred
40249	248		Lockout History - Fault 10 - Error code	

Holding Register	Message Address	Word Requested	Response	Value
40250	249		Lockout History - Fault 10 - Time of Fault Occurrence	Upper Byte = Minutes, Lower Byte = Seconds
40251	250		Lockout History - Fault 10 - Date of Fault Occurrence	Upper Byte = Day of the Month, Lower Byte = Hour
40252	251		Lockout History - Fault 10 - Date of Fault Occurrence	Upper Byte = Weekday (0=Sunday), Lower Byte = Month
40253	252		Lockout History - Fault 10 - Year of Fault Occurrence	
40256	255	1	Unit of measurement	0= ENGLISH, 1=Metric
40258	257	1	Sensor 1 Type & Range	
40259	258	1	Sensor 2 Type & Range	
40260	259	1	Sensor 3 Type & Range	
40261	260	1	Sensor 4 Type & Range	
40262	261	1	Sensor 5 Type & Range	
40263	262	1	Setpoint 1 sensor usage	Lower byte - 0: Sensor 1 not selected, 1: Sensor 1 selected
40264	263	1	Setpoint 1 Derivative & Integral	Upper byte: Derivative [0-100] Lower byte: Integral [0-100]
40265	264	1	Sensor 1 set point value	
40266	265	1	Sensor 1 Cut In value	
40267	266	1	Sensor 1 Cut Out value	
40269	268	1	Sensor 1 Margin Alarm value	
40270	269	1	Sensor 1 Limit Alarm value	
40273	272	1	Sensor 2 set point value	
40274	273	1	Sensor 2 Cut In value	
40275	274	1	Sensor 2 Cut Out value	
40277	276	1	Sensor 2 Margin Alarm value	
40278	277	1	Sensor 2 Limit Alarm value	
40281	280	1	Sensor 3 set point value	
40282	281	1	Sensor 3 Cut In value	
40283	282	1	Sensor 3 Cut Out value	
40285	284	1	Sensor 3 Margin Alarm value	
40286	285	1	Sensor 3 Limit Alarm value	
40289	288	1	Sensor 4 set point value	
40290	289	1	Sensor 4 Cut In value	
40291	290	1	Sensor 4 Cut Out value	
40293	292	1	Sensor 4 Margin Alarm value	

Holding Register	Message Address	Word Requested	Response	Value
40294	293	1	Sensor 4 Limit Alarm value	
40297	296	1	Sensor 5 set point value	
40298	297	1	Sensor 5 Cut In value	
40299	298	1	Sensor 5 Cut Out value	
40301	300	1	Sensor 5 Margin Alarm value	
40302	301	1	Sensor 5 Limit Alarm value	
40336	335	1	Valve proving TESTTIME 1 & 2	Test times range: 1 - 252 1 = 1x5 = 5sec; 15 = 15x5 = 75sec
40337	336	1	Valve proving TEST METHOD and DURATION	Test Method : 0 = 2-Valve; 1 = 3-Valve_NO; 2 = 3-Valve_NC Test Duration : 0 = At PRE_PURGE 1 = At POST_PURGE
40347	346	10	PCV Setpoint string	22 character string
40358	357	10	PCV measured value string	22 character string
40481	480	1	Max Modulation Rate & Name 1	Lower Byte Profile name: 0 - 11 (see manual)
40482	481	1	Max Modulation Rate & Name 2	Lower Byte Profile name: 0 - 11 (see manual)
40483	482	1	Max Modulation Rate & Name 3	Lower Byte Profile name: 0 - 11 (see manual)
40484	483	1	Max Modulation Rate & Name 4	Lower Byte Profile name: 0 - 11 (see manual)
40900	899	1	Post Purge Time & Prove permissive input	Upper Byte: Post Purge time = 0 – 60seconds; 5sec increment Lower Byte: Prove permissive input (0=NO, 1=YES).
40901	900	1	PTFI Time & Recycle	Upper Byte: PTFI time – see manual Lower Byte: Recycle input [0=NO,1=YES]
40902	901	1	MTFI Time & Intermittent Pilot	Upper Byte: 0 – interrupted pilot 1 – Intermittent pilot Lower Byte: MTFI Time – see manual
40903	902	1	Profile Select & FFRT Time	Upper Byte: Profile selected [0=DIGITAL_IP, 1=KEYPAD_PROFILE_1, 2= KEYPAD_PROFILE_2, 3=KEYPAD_PROFILE_3, 4=KEYPAD_PROFILE_4] Lower Byte: FFRT selected [0= 1 Second, 1= 2 Seconds, 2= 3 Seconds, 3= 4 Seconds]
40904	903	1	Prove Airflow	Upper Byte: 1:YES or 0:NO
40906	905	1	Purge Time	0 – 60 mins; 5sec increment

Lower Level User Command and Configuration				
41001	1000	1	Reset	Setting this to 1 performs a reset operation. Register will always read 0. Will return modbus exception response with exception code, indication that the user is disallowed to perform additional reset [RESET LOCK]
41002	1001	1	Burner Control On/Off	True,False (1,0). Setting this to 1 turns the burner on.
41003	1002	1	Burner Control Low Fire	True,False (1,0). Setting this to a 1 sets the control to Low Fire.
41004	1003	1	Burner Control Lead Lag	True,False (1,0). Setting this to a 1 makes the control into a sequence master (When sequencing is enabled).
41005	1004	1	Burner Control Auto Manual	True,False (1,0). Setting this to a 1 sets the control to manual modulation mode.
41018	1017	1	Manual Modulation Rate	Value of the manual modulation rate (has no effect until the control is in Manual Modulation Mode). write-only

Interpreting Input Sensor "Raw" Values

The calibration constant is factory set to achieve the proper reading at 4mA and 20 mA. It is based on the actual hardware in the product and the A/D reference voltage in the micro controller at the time of manufacture. It has a range of 819 to 860 counts and is accessible from register 51 (40052). This should be the first value read in and used for all pressure and temperature calculations.

The calibration constant is used to convert the actual "raw" sensor reading to meaningful pressure or temperature values. The pressure sensors are all 0 psig at the 4 mA and below reading. For the two temperature sensors, 32-350 and 32-752, the maximum range of each is 318 and 720 degrees respectively.

If the calibration constant represents 20 mA input then 1/5 of that represents 4 mA input or 0.2 times the calibration constant.

To convert a pressure or temperature "raw" reading to actual units, use the following:

(([“Raw” Reading /calibration constant] - 0.2) / 0.8) * Sensor Range) + Sensor Offset where Reading is the value returned from modbus register 40060, 40061 or 40062.

SENSOR TYPE	SENSOR RANGE	SENSOR OFFSET
TS350-2, -4, -8	318	32
TS752-2, -4, -8	720	32
BLPS-15	15	0
BLPS-25	39.7	-14.7
BLPS-30	30	0
BLPS-200	200	0
BLPS-300	300	0

Note 1: Sensors 4 or 5 do not reference this calibration constant and thus only raw signal values are applicable.

WARRANTIES

FIREYE guarantees for *one year from the date of installation or 18 months from date of manufacture* of its products to replace, or, at its option, to repair any product or part thereof (except lamps and photocells) which is found defective in material or workmanship or which otherwise fails to conform to the description of the product on the face of its sales order. **THE FOREGOING IS IN LIEU OF ALL OTHER WARRANTIES AND FIREYE MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESS OR IMPLIED.** Except as specifically stated in these general terms and conditions of sale, remedies with respect to any product or part number manufactured or sold by Fireye shall be limited exclusively to the right to replacement or repair as above provided. In no event shall Fireye be liable for consequential or special damages of any nature that may arise in connection with such product or part.