

MultiHop Register Parameters

Instruction Manual

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1 Input and Output Registers

Inputs (4xxxx)		Outputs (4xxxx)	
Register	Input #	Register	Output #
1	1	501	1
2	2	502	2
3	3	503	3
4	4	504	4
5	5	505	5
6	6	506	6
7	7	507	7
8	8	508	8
9	9	509	9
10	10	510	10
11	11	511	11
12	12	512	12
13	13	513	13
14	14	514	14
15	15	515	15
16	16	516	16

1.1 Supported Modbus **Function** Codes

The supported Modbus function codes are 3 (read multiple), 6 (write single), and 16 (write multiple).

All DX80 Modbus registers are defined as 'holding registers' in the 4xxxx address space. Some older PLCs use the register number space of 4xxxx to imply function code 3 for holding registers. For these systems, add 40000 to our register number and the PLC software uses the correct function code 3 to access our registers.

The supported Modbus function codes are defined below. For more information about Modbus, see www.modbus.org.

Function	Description
3	Reads the contents of a contiguous block of holding registers in a remote device. The request specifies the starting register address and the number of registers.
6	Writes a single holding register in a remote device. The request specifies the address of the register to be written and the single register of data.
16	Writes a block of contiguous holding registers in a remote device. The requested written values are specified in the request data field.

2 Modbus Register Configuration

Change the factory default settings for the inputs, outputs, and device operations using the device Modbus registers. To change parameters, set the data radio network to Modbus mode and assign the data radio a valid Modbus slave ID.

Generic input or output parameters are grouped together based on the device input or output number: input 1, input 2, output 1 etc. Operation type specific parameters (discrete, counter, analog 4 to 20 mA) are grouped together based on the I/O type number: analog 1, analog 2, counter 1, etc. Not all inputs or outputs may be available for all models. To determine which specific I/O is available on your model, refer to the Modbus Input/Output Register Maps listed in the device's datasheet. For more **information** about registers, refer to the [MultiHop Product Manual](#) (p/n 151317).

2.1 00000s Standard Physical Inputs

Registers 1 through 16 are the results registers for inputs 1 through 16.

For a list of the active results registers for your MultiHop radio, refer to your product's datasheet.

2.2 00100s and 00600s Remap Registers

Use these remap registers to map any I/O registers to a contiguous location to allow for easier access from a host system.

600s. Registers 601 through 616 contain the index of registers that are remapped.

100s. Registers 101 through 116 contain the values of the remapped registers.

2.2.1 Remap Registers or Register Aliasing

Use the Remap Registers section of the **Configure** Device screen to map registers to contiguous register locations to optimize Modbus read/write functions.

The screenshot shows a configuration screen titled "Remap Registers" with two main sections: "Alias Registers (601-616)" and "Register Content (101-116)". Each section has a "GET" and "SEND" button above a list of registers. In the Alias Registers section, registers 1 through 16 are all set to "1". In the Register Content section, registers 101 through 107 are set to "0", and registers 108 through 116 are also set to "0".

Alias Registers (601-616)		Register Content (101-116)	
GET	SEND	GET	SEND
1	1	101	0
2	1	102	0
3	1	103	0
4	1	104	0
5	1	105	0
6	1	106	0
7	1	107	0
8	1	108	0
9	1	109	0
10	1	110	0
11	1	111	0
12	1	112	0
13	1	113	0
14	1	114	0
15	1	115	0
16	1	116	0

Before making any changes to the screen, select the desired **MultiHop** Radio ID.

Alias Registers

In the Source Register column, enter the registers to be remapped. These registers are aliased to registers 601 through 616. In the example shown, registers 5, 7, 9, 10, 8, 501, and 502 are aliased to registers 601 through 607.

Register Content

The aliased register contents will be in registers 101 through 116. In the example shown, the values of registers 5, 7, 9, 10, 8, 501, and 502 are stored in registers 101 through 107. Note that we are writing a 1 (one) to registers 106 and 107 (registers 501 and 502).

2.3 00500s Standard Physical Outputs

Registers 501 through 516 are the results registers for outputs 1 through 16.

For a list of the active results registers for your MultiHop radio, refer to your product's datasheet.

2.4 01000s Input Parameters

Data radio inputs have the following generic parameters. These are not global parameters but are associated only with a particular input.

There are currently 16 separate inputs possible; the factory default settings are defined in the I/O specifications. Parameters for Input 1 are at 1001 through 1008. Parameters for input 2 are at 1051 through 1058. Each following input is offset from the previous one by 50 registers.

Parameter Registers for Inputs (4xxxx)									
1	2	3	4	5	6	7	8	9	Parameters
1001	1051	1101	1151	1201	1251	1301	1351	1401	Enable
1002	1052	1102	1152	1202	1252	1302	1352	1402	Sample Interval (high word)
1003	1053	1103	1153	1203	1253	1303	1353	1403	Sample Interval (low word)
1008	1058	1108	1158	1208	1258	1308	1358	1408	Out-of-Sync Enable

Enable

A 1 enables the input and a 0 to disable the particular input.

Out-of-Sync Enable

Set to one (1) to enable the input to continue operating when the device is out of sync with the master radio. Set to zero (0) to disable the input when the device is not synchronized to the master radio. The default value is one (1).

Sample Interval (High Word)

The sample interval (rate) is a 32-bit value (requires two Modbus registers) that represents how often the data radio samples the input. The register value is the number of time units. For example, a Modbus register value of 125 (for a 900 MHz device) represents a sample interval of 5 seconds ($125 \times .040 \text{ seconds} = 5 \text{ seconds}$). A unit of time for a 900 MHz data radio is 40 milliseconds. A unit of time for a 2.4 GHz data radio is 20 milliseconds.

Sample Interval (Low Word)

See Sample Interval (High Word).

1xx4 through 1xx7

See *Switch Power Input Parameters*.

2.4.1 Switch Power Input Parameters

The switch power input parameters are not global parameters but are associated only with a particular input.

There are currently 16 separate inputs possible; the factory default settings are defined in the I/O specifications. Switch power parameters for Input 1 are at 1004 through 1007. Switch power parameters for input 2 are at 1054 through 1057. Each following input is offset from the previous one by 50 registers.

Parameter Registers for Inputs (4xxxx)									
1	2	3	4	5	6	7	8	9	Parameters
1004	1054	1104	1154	1204	1254	1304	1354	1404	Switch Power Enable
1005	1055	1105	1155	1205	1255	1305	1355	1405	Switch Power Warm-up
1006	1056	1106	1156	1206	1256	1306	1356	1406	Switch Power Voltage
1007	1057	1107	1157	1207	1257	1307	1357	1407	Extended Input Read

Extended Input Read

The Extended Input Read is a bit field parameter that allows multiple inputs to be sampled with the same switch power parameters. If the bit field is set to 0x000F, the first four inputs are sampled after the switch power parameters are satisfied. If this parameter is set in the input 1 configuration registers, set inputs 2 through 4 to zero.

Switch Power Enable

The bit mask can select any number of switch power outputs 1 through 4. Switch power enable works with the warm-up and voltage parameters to define the switch power output. Some devices have only two switch power outputs. Refer to your model's datasheet to confirm which switch power outputs are active for your MultiHop radio.

- 0x0 - No switch power enabled
- 0x1 - Enable SP1
- 0x2 - Enable SP2
- 0x3 - Enable SP1 and SP2
- 0x4 - Enable SP3
- 0x8 - Enable SP4
- 0xC - Enable SP3 and SP4

Switch Power Voltage

The Switch Power Voltage parameter defines the output voltage of the switch power output. This parameter applies only to inputs using switched power. If switch power is not used with an input, use the Continuous Voltage parameter to control the voltage.

Output Voltage	Parameter Value	Output Voltage	Parameter Value
0 V	255	15 V	32
5 V	204	20 V	12
7 V	125	24 V	03
10 V	69		

Switch Power Warm-up

When the data radio supplies power to external sensors, the Switch Power Warm-up parameter defines how long power is applied to the external sensor before the input point is examined for changes. The register value is the number of time units.

A unit of time for a 900 MHz data radio is 40 milliseconds. A unit of time for a 2.4 GHz data radio is 20 milliseconds.

2.5 02000s Output Parameters

The following characteristics are configurable for each output.

Parameters for Output 1 start at 2001 through 2004. Parameters for output 2 start at 2051 through 2054. Each following output is offset from the previous one by 50 registers.

Parameter Registers for Outputs (4xxx)									
1	2	3	4	5	6	7	8	9	Parameters
2001	2051	2101	2151	2201	2251	2301	2351	2401	Enable
2002	2052	2102	2152	2202	2252	2302	2352	2402	Flash Output Enable
2003	2053	2103	2153	2203	2253	2303	2353	2403	Flash Index
2004	2054	2104	2154	2204	2254	2304	2354	2404	Out of Sync Enable

Enable

Set to 1 to enable the output; set to 0 to disable the output.

Flash Index

The Flash Index can have values 1, 2, 3, or 4. For a particular output, the Flash Index 1 through 4 select a certain output pattern as defined in registers 4401, 4411, 4421, or 4431.

Flash Output Enable

The Flash Output Enable, Flash Index, and Output Flash Pattern registers are all used to set up flashing patterns for indicator lights connected to the data radio. Set the Flash Output Enable register to 1 to enable the ability to select an output flash pattern; set to 0 to disable this feature. Select the output pattern using the Flash Index and Output Flash Pattern registers.

Out of Sync Enable

Set to one (1) to enable the output to continue operating when the device is out of sync with the master radio. Set to zero (0) to disable the output when the device is not synchronized to the master radio. The default value is one (1).

2.6 02950s Default Output Parameters

Several device conditions may be used to send outputs to their default state. Use these properties to define the device's default output conditions.

2951 Enable Default Out Of Sync

When a radio is "out of sync," it is not communicating with its parent radio.

Set this value to 1 to enable the default condition when the device is not communicating with its parent radio. Set to 0 to disable.

2952 Enable Default **Communication** Timeout

A "communication timeout" refers to the communication between the host system and this radio. Set this register to 1 to enable the default condition when the host has not communicated with this radio for the period of time defined by the Communication Default IO Timeout.

2953 **Communication** Default I/O Timeout (100 ms/Count)

This parameter defines the host timeout period in 100 millisecond increments. If a host does not communicate within this timeout period, the device outputs are set to the default values.

2954 Enable Default on Power Up

Setting this parameter to 1 sends the device outputs to their default condition when the radio is powered up. Set to 0 to disable this feature.

2.7 03000s Discrete Input Parameters

The Discrete Input Configuration parameters configure certain aspects of the data radio's discrete inputs.

Parameters for Discrete Input 1 start at 3001, and parameters for Discrete Input 2 start at 3021. Each following input is offset from the previous one by 20 registers.

Parameter Registers for Discrete Inputs (4xxxx)				
IN 1	IN 2	IN 3	IN 4	Parameters
3001	3021	3041	3061	PNP/NPN
3002	3022	3042	3062	Sample High
3003	3023	3043	3063	Sample Low
3004	3024	3044	3064	Enable Latch on Change of State
3007	3027	3047	3067	Enable Discrete Input Time Active Counter
3008	3028	3048	3068	Discrete Input Time Active Count
3009	3029	3049	3069	Discrete Input Time Active Count
3013	3033	3053	3073	Enable Rising Edge
3014	3034	3054	3074	Enable Falling Edge
3015-3016	3035-3036	3055-3056	3075-3076	Digital Counter Value

Digital Counter Value

The 32-bit counter results are placed in registers 3015 and 3016 for input #1. To clear or preset the counter value, write a zero value or the preset value into registers 3015 and 3016. Cycling the power sets the counter values back to zero. The host system is responsible for saving the counter values in case of a power failure or power reset condition. A discrete input will not count when the device is not in sync with a parent MultiHop device. To allow for counting when out of sync, set configuration register 1008 to 1 for input #1.

Out of Sync Actions				
IN 1	IN 2	IN 3	IN 4	Description
1008	1058	1108	1158	Enable out-of-sync action. Set to 1 to enable, set to 0 to disable.

Discrete Input Time **Active** Count

These two registers contain the counter value. Register 3xx8 contains the high portion of the active counter and 3xx9 contains the low portion of the active counter. The counter stores a time value in 100 ms increments. This value is reset to zero when the power cycles off.

Enable Discrete Input Time **Active** Counter

The time active counter counts the time a discrete input is in the active state. Set to one (1) to enable the time counter; set to zero (0) to disable the counter. By default, this counter is enabled.

Enable Latch on Change of State

Writing a 1 to this register causes a data "push" (data transmitted to the master radio) on Change of State.

Enable Falling Edge

Enables the sync counter falling edge. Set to 1 to enable, set to 0 to disable.

Enable Rising Edge

Enables the sync counter rising edge. Set to 1 to enable, set to 0 to disable. To count on both rising and falling edges, set both the configuration registers to 1 to enable.

PNP or NPN

Set to 1 to define the input as a PNP (sourcing) input. Set to 0 to define the input as an NPN (sinking) input.

Sample High

The default value is 0, which disables this feature. The value range is 1 through 255. The Sample High parameter refers to the number of samples (1 through 255) a discrete input must be detected high (1) before it is considered to be a change of state.

Sample Low

The default value of 0 disables this feature. The value range is 1 through 255. The Sample Low parameter refers to the number of samples (1 through 255) a discrete input must be detected low (0) before it is considered to be a change of state.

2.8 03300s Analog Input Parameters

The following characteristics are configurable for each of the analog inputs.

Analog input parameters for input 1 start at 3301. Analog input parameters for input 2 start at 3321. Each following input is offset from the previous one by 20 registers.

Registers for Analog Parameters (4xxxx)				Parameters
IN 1 (3301-3320)	IN 2 (3321-3340)	IN 3 (3341-3360)	IN 4 (3361-3380)	
3301	3321	3341	3361	Maximum Analog Value
3302	3322	3342	3362	Minimum Analog Value
3303	3323	3343	3363	Enable Register Full Scale
3304	3324	3344	3364	Temperature Degrees C/F
3305	3325	3345	3365	Temperature Scaling
3306	3326	3346	3366	Thermocouple Type
3307	3327	3347	3367	Temperature Resolution

Registers for Analog Parameters (4xxxx)				Parameters
IN 1 (3301-3320)	IN 2 (3321-3340)	IN 3 (3341-3360)	IN 4 (3361-3380)	
3308	3328	3348	3368	Threshold
3309	3329	3349	3369	Hysteresis
3310	3330	3350	3370	Delta
3311	3331	3351	3371	
3312	3332	3352	3372	
3313	3333	3353	3373	
3314	3334	3354	3374	
3315	3335	3355	3375	
3316	3336	3356	3376	Sample High
3317	3337	3357	3377	Sample Low
3318	3338	3358	3379	Change of State Push Enable
3319	3339	3359	3379	Median Filter Enable
3320	3340	3360	3380	Tau Filter

Change of State Push Enable

Set to one (1) to enable push registers for this input. When the analog input changes state, the register value will be pushed to the master radio if this register is configured to be a push register.

Delta

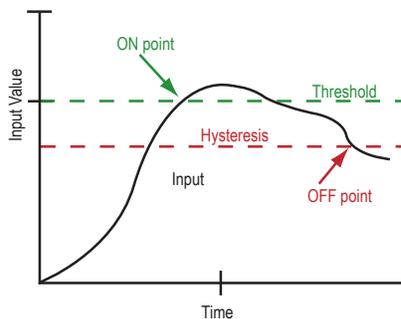
The delta parameter defines the change required between sample points of an analog input before the analog input reports a new value. To turn off this option, set the Delta value to 0.

Enable Register Full Scale

Set to 1 to enable a linear range from 0 to 65535 for specified input range. For a 4 to 20 mA input, a value of 0 represents 4 mA and 65535 represents 20 mA. Set this parameter to 0 to store input readings in unit-specific data. For example, the register data representing a 15.53 mA reading is 15530. For units of current (0 to 20 mA inputs), values are stored as μA (micro Amps) and voltage values are stored as mV (millivolts).

Hysteresis and Threshold

Threshold and hysteresis work together to establish the ON and OFF points of an analog input. The threshold defines a trigger point or reporting threshold (ON point) for a sensor input. Setting a threshold establishes an ON point. Hysteresis defines how far below the threshold the analog input is required to be before the input is considered OFF. A typical hysteresis value is 10% to 20% of the unit's range.



In the example shown graphically, the input is considered on at 15 mA. To consider the input off at 13 mA, set the hysteresis to 2 mA. The input will be considered off when the value is 2 mA less than the threshold.

Maximum Analog Value

The Maximum Value register stores the maximum allowed analog value. The specific units of measure apply to the register value. For example, the register may contain 20000, for 20 mA, or for a voltage input the register may contain 8000, for 8 volts.

Median Filter Enable

Set to zero (0) to turn off the median filter. Set to one (1) to turn on the median filter.

Minimum Analog Value

The Minimum Value register stores the minimum allowed analog value. The specific units of measure apply to the register value. For example, the register may contain 4000, for 4 mA, or for a voltage input the register may contain 2000, for 2 volts.

Sample High and Sample Low

For analog inputs, the sample high parameter defines the number of consecutive samples the input signal must be above the threshold before a signal is considered active. Sample low defines the number of consecutive samples the input signal must be below the threshold minus hysteresis before a signal is considered deactivated. The sample high and sample low parameters are used to avoid unwanted input transitions.

Tau Filter

Set to zero (0) to turn off the tau filter. Set to 1 (weakest filter) through 6 (strongest filter) to turn on the tau filter. (In the DX80 products, the Low Pass Filter is a combination of the median filter and the tau filter.)

2.8 Temperature Parameters

The following parameters are used to configure analog inputs involving temperature and are typically used to configure thermocouple or RTD inputs.

Registers for Analog Parameters (4xxxx)				Parameters
IN 1 (3301-3320)	IN 2 (3321-3340)	IN 3 (3341-3360)	IN 4 (3361-3380)	
3304	3324	3344	3364	Temperature Degrees C/F
3305	3325	3345	3365	Temperature Scaling
3306	3326	3346	3366	Thermocouple Type
3307	3327	3347	3367	Temperature Resolution

Temperature Degrees C/F

Set to 1 to represent temperature units in degrees Fahrenheit, and set to 0 (default) to represent temperature units in degrees Celsius.

Temperature Resolution

Thermocouples and RTDs may record temperatures in either high resolution (tenths of a degree) or low resolution (whole degree).

Write a 0 to select high resolution (default) or a 1 to select low resolution. Choosing high or low resolution changes the range of temperatures that can be written to the register.

Temperature Scaling

Set to 1 to store temperatures the same way as the DX80 devices (measured temp \times 20) represent temperature.

Set to 0 (default) to store temperature values in tenths of a degree (measured temp \times 10).

For example, if the measured temperature is 20.5 degrees, using temperature scaling set to 1 would store the temperature value as 410; using temperature scaling set to 0 would store the temperature as 205.

Thermocouple Type

Write the listed value to this register to select a thermocouple type. The default configuration is set to a Type B thermocouple (0).

Value	Thermocouple Type	Value	Thermocouple Type	Value	Thermocouple Type
0	B	5	J	10	P
1	C	6	K	11	R
2	D	7	L	12	S
3	E	8	M	13	T
4	G	9	N	14	U

2.9 03500s Counter Input Parameters

The following parameters are configurable for the counter input.

Counter Input parameters for Counter Input 1 start at 3501 through 3505. Counter Input parameters for Counter Input 2 start at 3521 through 3525. Each following counter input is offset from the previous one by 20 registers.

Parameter Registers for Counter Inputs (4xxx)	
IN 1	Parameters
3501	Enable Frequency/Event Counter
3502	Enable Read Counter State
3503	Set Preset Value
3504	Counter Preset Value
3505	Counter Preset Value

Counter Preset Value

Registers 3504 (high word) and 3505 (low word) contain the 32-bit value for presetting the counter. Write the 'Counter Preset Value' registers first, then use the 'Set Preset Value' register to execute the counter preset.

Enable Frequency/Event Counter

A counter input can be defined to calculate the frequency of the input in hertz or as a counter that increments with every input change (event counter) from 0 to 1 (for PNP inputs).

Set this parameter to 1 to configure the input to calculate frequency. Set to 0 to configure the counter to count input changes, for example, an event counter or totalizer. Because the counter is reset to zero when power is cycled to the device, it is up to the host system to save count data.

Enable Read Counter State

Manufacturing/test register only

Set Preset Value

Writing this value to 1 signals the data radio to preset the counter with the value stored in Modbus registers 3504 and 3505. When the task is complete, the value is written to 0.

2.10 03600s H-Bridge Output Parameters

The following parameters are configurable for the H-bridge outputs.

Parameters for H-bridge 1 start at 3604 through 3609. Parameters for H-bridge 2 start at 3624 through 3629. Each following H-bridge parameter set is offset from the previous one by 20 registers.

Parameter Registers for H-Bridge Outputs (4xxx)	
H-Bridge 1	Parameters
3604	Enable H-Bridge
3605	H-Bridge Warmup Cap Time
3606	H-Bridge Active Current Time
3607	H-Bridge Switches
3608	H-Bridge Switches
3609	H-Bridge Booster Enabled When Active

Enable H-Bridge

Enable (1) or disable (0) the h-bridge inputs as needed. Disable the h-bridge inputs when using SDI-12 devices.

H-Bridge **Active** Current Time

Set how long, in 40 millisecond increments, the capacitor is switched into and supplying power to the solenoid circuit.

H-Bridge Switches

Use these two parameters as a bit mask to set the ON and OFF conditions of the h-bridge switch.

	DO4	DO3	DO2	DO1	SP4	SP3	SP2	SP1
3607 Rising Switch (ON)	0	0	1	0	0	0	0	1
3608 Falling Switch (OFF)	0	0	0	1	0	0	1	0

H-Bridge Warm Up Cap Time

Similar to the switch power warm up time, the h-bridge capacitor warm up time is the time allotted, in 40 millisecond increments, to charge the capacitor used to activate the h-bridge and latching solenoid.

H-Bridge Booster Enabled When **Active**

To use this parameter, contact the applications engineers at Banner Engineering Corp. This parameter leaves the boost voltage on while the capacitor discharges into the solenoid. While this can supply more power to the solenoid circuit, it may also brown-out the radio device.

2.10.1 03600s Switch Power Output Parameters

The Power Output Configuration parameters provide the basic operation for each power output. These parameters are not associated to specific inputs.

Efficient power management technology enables some FlexPower devices to include an internal power supply, called switch power (SP), that briefly steps up to power sensors requiring 5, 10, or 15 V power (ideally, 4 to 20 mA loop-powered sensors). When the switch power output cycles on, the voltage is boosted to the voltage needed to power the sensor for a specific warmup time. This warmup time denotes how long the sensor must be powered before a reliable reading can be taken. After the warmup time has passed, the input reads the sensor, then the switch power shuts off to prolong battery life. The switch power voltage, warm-up time, and sample interval are configurable parameters.

Parameters for SP 1 start at 3601 through 3603. Parameters for SP 2 start at 3621 through 3623. Each following switch power is offset from the previous one by 20 registers.

Parameter Registers for Switch Power Outputs (4xxxx)				
SP1	SP2	SP3	SP4	Parameters
3601	3621	3641	3661	Continuous Voltage Setting
3602	3622	3642	3662	Default Output State
3603	3623	3643	3663	Hold Last State Enable

Continuous Voltage Setting

Use this voltage parameter to set the output voltage when supplying continuous power through the SP# terminals (not associated with inputs). The Continuous Voltage parameter cannot be used if any input uses switch power. To set a continuous voltage on the SP output, also turn on the default output condition "default on power up." This will turn on this continuous voltage output when the radio powers up.

Output Voltage	Parameter Value	Output Voltage	Parameter Value
0 V	255	15 V	32
5 V	204	20 V	12
7 V	125	24 V	03
10 V	69		

Default Output State

The Default Output State parameter represents the default condition of the switch power output. When communication is lost to the host or the wireless link is lost for the I/O data radio, the data radio can set the outputs and switch power outputs in this default state.

When set to 0, the switch power is turned off. When set to 1, the switch power is set to the voltage established by the Continuous Voltage Setting.

Hold Last State Enable

Set Hold Last State Enable to 1 to set the switch power output to its last known value when communications are lost.

Set this parameter to 0 to disable the Host Last State Enable and use the Default Output State settings.

2.11 03700s Discrete Output Parameters

The following characteristics are configurable for each of the discrete outputs.

Parameters for Output 1 start at 3701 through 3703. Parameters for Output 2 start at 3721 through 3723. Each following input is offset from the previous one by 20 registers.

Parameter Registers for Discrete Outputs (4xxxx)				
OUT 1	OUT 2	OUT 3	OUT 4	Parameters
3701	3721	3741	3761	Default Output State
3702	3722	3742	3762	Hold Last State Enable
3703	3723	3743	3763	Enable Switch Power Logic

Default Output State

The Default Output State parameter represents the default condition of the discrete output. When an error condition exists, the outputs are set to this user-defined output state, either a 0 or a 1.

Enable Switch Power Logic

Hold Last State Enable

Set the Hold Last State to 1 to set the output to its last known value before the error occurred. Set this parameter to 0 to disable the Hold Last State and use the Default Output State setting during an error condition.

2.12 04000s Analog Output Parameters

The following characteristics are configurable for each of the analog outputs.

Parameters for Analog Output 1 start at 4001 through 4005. Parameters for Analog Output 2 start at 4021 through 4025. Each following input is offset from the previous one by 20 registers.

Parameter Registers for Analog Outputs (4xxxx)				
OUT 1	OUT 2	OUT 3	OUT 4	Parameters
4001	4021	4041	4061	Maximum Analog Value
4002	4022	4042	4062	Minimum Analog Value
4003	4023	4043	4063	Enable Register Full Scale
4004	4024	4044	4064	Hold Last State Enable
4005	4025	4045	4065	Default Output State

Default Output State

The Default Output State parameter represents the default condition of the analog output. When an error condition exists, the outputs are set to this 16-bit user-defined output state.

Enable Register Full Scale

Set to 1 to enable a linear range from 0 to 65535 for specified input range. For a 4 to 20 mA output, a value of 0 represents 4 mA and 65535 represents 20 mA. Set this parameter to 0 to store readings in unit-specific data. For example, the register data representing a 15.53 mA reading is 15530. For units of current (0 to 20 mA outputs), values are stored as μ A (micro Amps) and voltage values are stored as mV (millivolts).

Hold Last State Enable

Set the Hold Last State to 1 to set the output to its last known value before the error occurred. Set this parameter to 0 to disable the Hold Last State and use the Default Output State setting during an error condition.

Maximum Analog Value

The Maximum Analog Value register stores the maximum allowed analog value. The specific units of measure apply to the register value. For example, the register may contain 20000, for 20 mA, or for a voltage output the register may contain 8000, for 8 volts.

Minimum Analog Value

The Minimum Analog Value register stores the minimum allowed analog value. The specific units of measure apply to register value. For example, the register may contain 4000, for 4 mA, or for a voltage output the register may contain 2000, for 2 volts.

2.13 04150s Initialization Controls

4151 Reset Device

Write a 1 to this register to trigger a device reset of the parameters selected by the next three registers.

4152 Default I/O **Configuration**

Returns all I/O configuration parameters to their factory default settings.

4153 Default System Parameters

Returns all system-level parameters to their factory default settings.

4154 **Initialize** Variables from the Serial Number

Returns all variables that are normally calculated (or seeded) from the serial number to values seeded from the serial number.

2.14 04400s Output Flash **Pattern** Parameters

Setting the flash pattern establishes an on and off pattern that can be used for a discrete output or switch power.

Flash patterns are established by selecting specific timeslots to turn the output on or off. While originally the flash pattern was designed to turn on and off an indicator light, the flash pattern can be set for any discrete output or switch power. Each slot represents one frame size, which may vary from radio to radio. The default frame is 40 milliseconds. Users may configure up to four different flash patterns.

4401-4408 Flash **Pattern** Index 1.

4411-4418 Flash **Pattern** Index 2.

4421-4428 Flash **Pattern** Index 3.

4431-4438 Flash **Pattern** Index 4.

2.15 04500s M-GAGE Parameters

The following characteristics are configurable for the M-GAGE devices.

4501 Set Baseline

Write a 1 to this register to set the baseline. The baseline function of the M-GAGE stores the ambient magnetic field values of the X, Y, and Z axes as a baseline value. Once this baseline is established, any deviation in the magnetic field represents the presence of a ferrous object and will be reflected in the M-GAGE register. The more disruption in the magnetic field, the larger the M-GAGE register value.

4502 Disable Axes

A bit-wise register (0000). Write a one to disable the selected axis where bit 0 is the x axis, bit 1 is the y axis, and bit 2 is the z axis.

4503 Disable **Compensation** Median Filter

Write a 1 to this register to disable the compensation median filter.

4504 Disable Sensing Median Filter

Write a 1 to this register to disable the sensing median filter.

4505 Low Pass Filter

The filters T0 through T6 are parameter settings that define the degree of input digital signal filtering for analog inputs. T0 is the least amount of filtering. T6 is the highest filter setting and has the least amount of fluctuation between readings. Write the following values to select a low pass (tau) filter.

Low Pass (Tau) Filter	Register Value	Low Pass (Tau) Filter	Register Value
T0	0	T4	4
T1	1	T5	5
T2	2	T6	6
T3	3		

4506 Sample High

The sample high counter parameter defines the number of consecutive samples the input signal must be above the threshold before a signal is considered active. The default value is 0, which disables this feature. The value range is 1 through 255. The Sample High parameter refers to the number of samples (1 through 255) a discrete input must be detected high (1) before it is considered to be a change of state.

4507 Sample Low

The default value of 0 disables this feature. The value range is 1 through 255. The Sample Low parameter refers to the number of samples (1 through 255) a discrete input must be detected low (0) before it is considered to be a change of state.

4509 Delta

Rate of change filter.

4510 Threshold and 4511 Hysteresis

Threshold and hysteresis work together to establish the ON and OFF points of an analog input. The threshold defines a trigger point or reporting threshold (ON point) for the M-GAGE™ input. The hysteresis value establishes how much below the active threshold (ON point) an analog input is required to be before the input is considered OFF. A typical hysteresis value is 10% to 20% of the unit's range.

The M-GAGE's threshold and hysteresis ranges are 0 to 65,535.

The factory default threshold setting is 150 and default hysteresis is 30 (the sensor detects an OFF condition at threshold minus hysteresis, or $150 - 30 = 120$). With the default settings, once the magnetic field reading is above 150, an ON or "1" is stored in the lowest significant bit (LSB) in the Modbus register. When the M-GAGE reading drops below the OFF point (threshold minus hysteresis), the LSB of the Modbus register is set to "0."

To determine your threshold, take M-GAGE readings of the test objects at the distance they are likely to be from the sensor. For example, if a car reads 150, a bicycle 15, and a truck reads 250, setting the threshold to 200 will detect only trucks of a specific size. Magnetic field fluctuations vary based on the amount of ferrous metal present and the distance from the sensor.

4512 Baseline (**Drift**) Filter Time

Baseline filter time. When the Baseline Filter is on and the magnetic field readings are below the baseline filter threshold setting, an algorithm is used to slowly match the device's baseline to the current ambient magnetic field. This helps to account for the natural fluctuations in the magnetic field.

4513 Baseline (**Drift**) Filter Threshold

Baseline filter threshold is used with the baseline filter time to account for the natural fluctuations on the magnetic field.

4514 Baseline (**Drift**) Filter Tau

Baseline filter's low pass filter.

4521 Baseline **Difference** Signal Value Total

A combination of the x-, y-, and z-axis baseline different signal values.

4522–4524 Baseline **Difference** Signal Value [x-axis]

4522 [x-axis]—The difference between the ambient magnetic field and the current magnetic field reading for the x axis.

4523 [y-axis]—The difference between the ambient magnetic field and the current magnetic field reading for the y axis.

4524 [z-axis]—The difference between the ambient magnetic field and the current magnetic field reading for the z axis.

4525–4527 Baseline Value

4525 [x-axis]—Ambient magnetic field reading for the x axis.

4526 [y-axis]—Ambient magnetic field reading for the y axis.

4527 [z-axis]—Ambient magnetic field reading for the z axis.

4528–4530 Raw Signal Value

4528 [x-axis]—The actual magnetic field reading for the x axis.

4529 [y-axis]—The actual magnetic field reading for the y axis.

4530 [z-axis]—The actual magnetic field reading for the z axis.

2.16 04800s Ultrasonic Input Parameters

The following characteristics are configurable for the Ultrasonic input devices.

0001 Temperature Measured

Temperature is measured in 0.1 °C increments.

0002 Distance Measured

Distance is measured in mm.

- The least significant bit indicates threshold status
- Value 65535 or 65534: Alarm, No Reflection Detected
- Value 65533 or 65532: Alarm, Reflection Mismatch
- Value 65531 or 65530: Alarm, Thermistor Error

1051 Enable

Write a 1 to enable the ultrasonic sensor. Write a 0 to disable.

1053 Sample Interval

The sample interval (rate) defines how often the data radio samples the input. The register value is the number of time units. For example, a Modbus register value of 125 (for a 900 MHz device) represents a sample interval of 5 seconds (125×0.040 seconds = 5 seconds).

A unit of time for a 900 MHz data radio is 40 milliseconds. A unit of time for a 2.4 GHz data radio is 20 milliseconds.

4801 Drive Pulses

Defines the number of cycles the transducer is pulsed.

4808 Receive Pulses

Defines the number of cycles that must be seen to recognize a reflection.

4810 Max Scale Value

The Maximum Value register stores the maximum allowed analog value. The specific units of measure apply to the register value. For example, the register may contain 20000, for 20 mA, or for a voltage input the register may contain 8000, for 8 volts.

4811 Min Scale Value

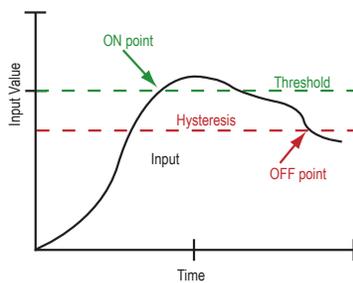
The Minimum Value register stores the minimum allowed analog value. The specific units of measure apply to the register value. For example, the register may contain 4000, for 4 mA, or for a voltage input the register may contain 2000, for 2 volts.

4812 Enable Register Full Scale

Set to 1 to enable a linear range from 0 to 65535 for specified input range. For a 4 to 20 mA input, a value of 0 represents 4 mA and 65535 represents 20 mA. Set this parameter to 0 to store input readings in unit-specific data. For example, the register data representing a 15.53 mA reading is 15530. For units of current (0 to 20 mA inputs), values are stored as μ A (micro Amps) and voltage values are stored as mV (millivolts).

4813 Threshold and 4814 Hysteresis

Threshold and hysteresis work together to establish the ON and OFF points of an analog input. The threshold defines a trigger point or reporting threshold (ON point) for a sensor input. Setting a threshold establishes an ON point. Hysteresis defines how far below the threshold the analog input is required to be before the input is considered OFF. A typical hysteresis value is 10% to 20% of the unit's range.



In the example shown graphically, the input is considered on at 15 mA. To consider the input off at 13 mA, set the hysteresis to 2 mA. The input will be considered off when the value is 2 mA less than the threshold.

4815 Delta

The delta parameter defines the change required between sample points of an analog input before the analog input reports a new value. To turn off this option, set the Delta value to 0.

4816 Sample High and 4817 Sample Low

For discrete inputs, the sample high parameter defines the number of consecutive samples the input signal must be high before a signal is considered active. Sample low defines the number of consecutive samples the input signal must be low before a signal is considered low. The sample high and sample low parameters are used to create a filter to avoid unwanted input transitions. The default value is 0, which disables this feature. The value range is 1 through 255.

4818 Change of State Push Enable

Set to one (1) to enable push registers for this input. When the analog input changes state, the register value will be pushed to the master radio if this register is configured to be a push register.

4819 Median Filter Enable

Set to zero (0) to turn off the median filter. Set to one (1) to turn on the median filter.

4820 Low Pass (Tau) Filter

Set to zero (0) to turn off the tau filter. Set to 1 (weakest filter) through 6 (strongest filter) to turn on the tau filter. (In the DX80 products, the Low Pass Filter is a combination of the median filter and the tau filter.) Write the following values to select a low pass (tau) filter.

Low Pass (Tau) Filter	Register Value	Low Pass (Tau) Filter	Register Value
T0	0	T4	4
T1	1	T5	5
T2	2	T6	6
T3	3		

4823 Window Range

Measured in mm.

When ultrasonic teach is active, the threshold is set to the distance measured minus the window range.

4825 Ultrasonic Teach

Write a 1 to initiate a threshold teach.

When ultrasonic teach is active, the threshold is set to the distance measured minus the window range.

4826 Invert Digital Logic

If the set distance measures below the threshold, the transition has an LSB of 1.

If the clear distance measures below the threshold, the transition has an LSB of 0.

4827 Boost Enable

Controls the ultrasonic transducer power level.

Set to 0 for low power level, a longer battery life, less noise, and a shorter range.

Set to 1 for higher power levels, a shorter battery life, more noise, and a longer range.

4828 Ultrasonic **Sensitivity** Control

Adjusts ultrasonic reflection sensitivity.

Write a 0 to disables the control feature

Start control at 0x8000 to match default

Control below 0x8000 is more sensitive

Control above 0x8000 is less sensitive

4831 Set Alarm as Logic 0

If set, an alarm is treated is if it is below the threshold.

If cleared, an alarm is treated is if it is above the threshold.

7909-7912 Push Registers

7909 Push Register 1 — Pushes the value of register 0002 (Distance Measured).

7910 Push Register 2 — Pushes the value of register 0001 (Temperature in 0.1 °C increments).

7911 Push Register 3 — Pushes the value of register 4813 (Current threshold setting).

7912 Push Register 4 — Pushes the value of register 4823 (Current teach window range).

2.17 Configuration Examples

2.17.1 Configuring an Analog IN to use SP3

Example 1: Enable the first analog input to power an external sensor using switched power 3 and change the parameters based on the requirements of the external sensor. This data radio model has analog 1 associated to input 5.

The parameters to adjust and their Modbus registers are:

- Sample interval (reg 1202 hi word, 1203 low word): Change from factory default of 1 second to 15 minute sample interval
- Switch Power Enable (reg 1204): Turn on switch power 3 for this input, using the bit mask
- Switch Power Warm-up (reg 1205): Based on the sensor requirements, turn on the switched power for a certain time before it is sampled.
- Switch Power Voltage (reg 1206): Set the voltage for the sensor operation.

The values to set in the registers are:

- Sample Interval: 15 min, (900 seconds)
- Switch Power Enable: 0x4
- Switched Power Warm-up: 1 second
- Switched Power Voltage: 15 Volts

Set the following registers to the values shown.

Modbus Register	Value	Description
1202	0	
1203	22,500	This register contains the number of 40 ms time units. $900 \text{ seconds} \div 0.040 \text{ seconds} = 22,500$
1204	4	Enable switch power 3 for this input, see parameter description for bit mask.
1205	25	Set warm-up time to 1 second, the register contains the number of 40 ms time units. $1 \text{ seconds} \div 0.040 \text{ seconds} = 25$
1206	32	Set switch power voltage to 15 V. Value from table next to parameter description.

2.17.2 Configuring for Acclima SDI-12 Sensors

Table 1: Acclima SDI-12 Parameter Registers

SDI-12 Device Register (Acclima)	Register Enable (1)	Decimal Point Move (0-7)	Move Right (0) or Left (1)	Signed (1) or Unsigned (0)	16 bit (0) or 32 bit (1)
1 Volumetric water content	ON	2	Left	Unsigned	32 bit
2 Temperature	ON	1	Left	Signed	32 bit
3 Soil Permittivity	ON	2	Left	Unsigned	32 bit
4 Soil Conductivity	ON	2	Left	Unsigned	32 bit

Table 2: Acclima SDI-12 Results Registers

Acclima Register No.	Results Registers (high:low)	Integer Conversion Multiplier	Sample Reading	Actual Value
1 Volumetric water content	11101:11102	×100	0:124	1.24%
2 Temperature	11103:11104	×10	0:238	23.8 °C
3 Soil Permittivity	11105:11106	×100	0:402	4.02

Acclima Register No.		Results Registers (high:low)	Integer Conversion Multiplier	Sample Reading	Actual Value
4	Soil Conductivity	11107:11108	×100	0:123	1.23 dS/m

2.17.3 Configuring for Decagon 5T3 SDI-12 Sensors

Table 3: Decagon SDI-12 Parameter Registers

SDI-12 Device Register (Decagon 5T3)	Register Enable (1)	Decimal Point Move (0-7)	Move Right (0) or Left (1)	Signed (1) or Unsigned (0)	16 bit (0) or 32 bit (1)
1	Volumetric water content	2	Left	Unsigned	32 bit
2	Soil Conductivity	2	Left	Unsigned	32 bit
3	Temperature	1	Left	Signed	32 bit

Table 4: Decagon SDI-12 Results Registers

Decagon Register No.		Results Registers (high:low)	Integer Conversion Multiplier	Sample Reading	Actual Value
1	Volumetric water content	11101:11102	×100	0:124	1.24%
2	Soil Conductivity	11103:11104	×100	0:123	1.23 dS/m
3	Temperature	11105:11106	×10	0:238	23.8 °C

2.18 Manufacturer Parameter Registers

The following are the device-specific and manufacturer parameters for the MultiHop radio devices. These registers are all within the 4xxxx range.

2.18 04100s Manufacturing Information

Address (4xxxx)	Name	Format
4101–4104	Serial number, digits 1–8	ASCII, read only
4111–4113	Model number, digits 1–6	ASCII, read only
4121–4123	Production date, digits 1–6	ASCII, read only

2.18 04200s Device Name

Address (4xxxx)	Name	Format
4201–4209	Name characters 1-18	ASCII

2.18 04300s Software Information

Address (4xxxx)	Name	Format
4301–4303	RF firmware p/n	ASCII, read only
4304–4305	RF firmware version	ASCII, read only
4306–4308	RF EEPROM part number, digits 1–6	ASCII, read only
4309–4310	RF EEPROM version number, characters 1–3	ASCII, read only
4311–4313	LCD firmware p/n	ASCII, read only
4314–4315	LCD firmware version	ASCII, read only
4316–4318	LCD EEPROM part number, digits 1–6	ASCII, read only

Address (4xxxx)	Name	Format
4319–4320	LCD EEPROM version number, characters 1–3	ASCII, read only

2.18 06400s Message Parameters

Strings stored in ASCII format are read as two characters per Modbus register. The lower numbered Modbus register contains the right-most characters in the string. Within a given Modbus register, the upper byte contains the ASCII character that goes to the right of the character in the lower byte.

Address (4xxxx)	Name	Format
6401	Device address	Hex
6402	Parent address	Hex, read only

Storing a Model Number

For example, the model number 148691 is stored as shown below.

Address (4xxxx)	Name	Modbus Register Value (in hex)	Character Representation
4111	Model number digits 6-5	0x3139	1 9
4112	Model number digits 4-3	0x3638	6 8
4113	Model number digits 2-1	0x3431	4 1

Parameters Stored as Numbers

Parameters stored as number values (not ASCII) read out directly as 16-bit values. Examples of parameters of this type include the Parent Address or Device Address.

Address (4xxxx)	Name	Value (in hex)	Value (decimal)
6401	Device address	0x002A	42
6402	Parent address	0x0023	35

2.19 Device and System Parameters

2.19.1 06000s Device Parameters

6001 Is Master (Read Only)

Typically configured from the DIP switches, writing a 1 to this register sets the radio to be the MultiHop master radio.

6004 Is Repeater (Read Only)

Typically configured from the DIP switches, writing a 1 to this register sets the radio to be the MultiHop repeater radio.

2.19.2 06050s **Battery** Monitoring Parameters

Use the **battery** monitor parameters to monitor and set a threshold based on the incoming device voltage (on some models).

The incoming voltage is approximately 3.6 V dc from a **battery** input or 4.2 V dc from the 10 to 30 V dc input. These parameters allow users to determine which power source is powering the MultiHop device.

6051 Enable **Battery** Read

Set to zero to disable the battery read function. Set to 1 to enable the **battery** read function.

6052 **Battery** Read Sample Interval

Use this parameter to set the time interval at which the incoming voltage is read. Sample Interval (in seconds) = 0.040 seconds × 2^{RegValue}. Default register value: 9 (20 seconds).

6053 **Battery** Voltage Threshold

Use this parameter to define the incoming voltage threshold at which register 44061 will be set to a zero or one. Set this value in number of 100 mA increments. The default value is 38 (or 3.8 V).

6054 Hardware Reference Select

Use this parameter to allow for the correct calibration reference for different hardware platforms. Set to zero for 3.0 V PCB Vcc. Set to one for 3.3 V PCB Vcc. Default value is zero.

6061 **Battery** Threshold Reading

When zero (0), the incoming voltage is below the threshold defined by parameter 6053 (powered by battery). When one (1), the incoming voltage reading is above the defined threshold (powered by a solar panel or 10 to 30 V dc).

6062 **Battery** Voltage Reading

Actual incoming voltage reading in units of 100 mV.

2.19.3 06360s Network System Binding

6362-6363 Binding Mode Extended **Pattern**: Master to Children

Seeded from serial number. 32-bit value.

6364-6365 Binding Mode Extended **Pattern**: Child from Master

Seeded from serial number. 32-bit value.

2.19.4 06400s Messages

6401 Device Address (Read only)

The Device Address is seeded from serial number.

6402 Parent Address (Read only)

Device address of the parent radio. Normally this is automatically filled in when the child chooses a parent radio.

6403 **Destination** Address (Default)

Broadcast. Typically, the Destination Address is set to force a routing when the radios are operating in transparent mode. This default value (FFFF) broadcasts the message if the recipient is not in the routing table. Enter a specific destination address to force a routing. Default: 0xFFFF

6404 **Destination** Address (Current)

The Destination Address is where messages are routed to. This value is automatically filled in by the system.

6405 System Master Device Address

Stores the Device Address of the network's master radio.

6451 External Site Survey Control

To begin a Site Survey from a host system, write a one (1) to the child radio's 46451 register. After 100 data packets have been sent between the parent and child radios, the system automatically writes a zero (0) to this register to end the Site Survey.

6452 Green Count

After the Site Survey is finished, the "green" signal strength count is written to this register on the child radio.

6453 Yellow Count

After the Site Survey is finished, the "yellow" signal strength count is written to this register on the child radio.

6454 Red Count

After the Site Survey is finished, the "red" signal strength count is written to this register on the child radio.

6455 Miss Count

After the Site Survey is finished, the number of "missed" data packets is written to this register on the child radio.

2.19.5 06500s and 06800s **Application** Modes6502 Modbus **Offset** (Start)

The Modbus Slave ID to start at for numbering devices. By default, begin numbering at 11.

6503 Modbus Number of Slaves

The maximum number of Modbus slaves. By default, the maximum number is 50, allowing slave IDs of 11 through 61 for network formation.

6504 Modbus Slave **Destination** Address Index 1, 6505 Modbus Slave **Destination** Address Index 2, through 6553 Modbus Slave **Destination** Address Index 50

These registers act as the translation table between the Modbus Slave ID (set by the rotary dials) and the Device Address (5-digit address derived from the serial number) of all Modbus slaves within the data radio network. This information is filled in by the system. For example, Address Index 1 will contain the device address of the first slave in the network. This is Slave ID 11 when using the default Modbus Offset.

6801 Modbus Rotary Switch BCD Disable

Defaults to decimal coding on the rotary switches, which means only rotary dial positions 0 through 9 are recognized. Default 0

6804 Modbus Address Override

Overrides the Modbus address specified on the rotary dials.

6805 Enable Modbus Nack

Controlled by the master radio. The master radio can determine if a device is in the radio network. If a device has dropped out of the network, the master will NACK the packet of data destined for that device to avoid having the host system spend time waiting for an acknowledgement. Default: 0

6808 Current Modbus Address

The Slave ID as selected by the rotary dials. This register is populated automatically by the rotary dials.

6831 Input Push Register Index 1, 6832 Input Push Register Index 2, etc

A total of 20 push register indices are available (up through 6850). For a slave or repeater, these define which registers to push to the master device. This allows a slave/repeater to send local input data back to the master without having to wait to be asked for the data.

6871-6872 Push Register Report Interval

Establishes how often, in frames/slots, to push data to the master. Select values between 1 and 4.2×10^2 (1 to FFFFFFFF). 6871 is the high word and 6872 is the low word. This is typically a slave or repeater parameter.

6873-6874 Health Heartbeat Time

The Health Heartbeat Time parameter works in conjunction with each slave/repeater push interval time (6871–6872) to create device status information in the master device. This allows the user to monitor the health of each device in the MultiHop network.

For example, if each slave/repeater push interval time is set to 60 seconds, the master Health Heartbeat Time should be set to a value two to three times greater (120 to 180 seconds). Every 180 second interval, the master device verifies a push message is received from each device. If a message is received, the status is good (1). If no message is received, the status is bad (0).

The Health Heartbeat Time register value is defined in MultiHop frames. The factory default for one frame is 40 ms. A value of 4500 in the 6874 is equal to 180 seconds (4500×0.040 seconds).

Read the individual status registers for each Modbus slave device by sending a Modbus read command to the particular slave device at register 7904. For example, to read the status register of slave 24, send a Modbus read command to slave ID 24 register address 7904, the contents will be either 0 (bad) or 1 (good).

The individual status data can be read by device address (not Modbus address) starting at Modbus register 12701. The master radio register 12701 holds the number of devices in the system. The following registers 12702+ contain the status information for those devices.

A bit-packed version of the status data is available starting at register 12981. The master radio register 12981 holds the number of device in the system, register 12982 holds the status bit fields for devices 0-15, 12983 holds the status bit fields for devices 16-31.

When dealing with device addresses, device order is based on the order they first sync to the master device. That ordered list is stored starting at Modbus registers 7001 in the master radio. Modbus register 7001 holds the count of the number of devices in the network, with the following registers 7002 and greater holding the device address of the MultiHop radio. The order of this list defines how the status bits or words are stored in the master radio.

6875 Report Interval Random Modulus

The interval, in frames, that the report interval is offset by. This randomizes the reporting interval time so that devices set to the same report interval do not continuously collide when reporting push data.

2.19.6 07000s Network **Formation**

Used by the Master radio only, the Network Formation parameter values are populated as slaves and repeaters join the radio network.

7001 Number of Devices in the **Formation** table

How many devices are in the network.

7002 Device Address Index 1

Device address for the first device that joins the network.

7003 Device Address Index 2

Device address for the second device that joins the network. A total of 50 devices may be a part of the radio network.

7302 Device MacTo Index 1

Device address for the first radio in the routing path to get to the device defined in index 1.

7303 Device MacTo Index 2

Device address for the first radio in the routing path to get to the device defined in index 2. A total of 50 devices may be a part of the radio network.

2.19.7 07900s Master as a Slave Network Registers

The data stored in these registers act as a "window" into the push/poll registers.

These registers "cache" the register values associated with register 6807. When enabling push registers, the host system redirects the register reads to this register area (7909, 7910). The host still requests a specific slave ID but with registers 7909 and 7910. The master data radio intercepts the read request and returns the cached data it collects from the push data.

7901 Device Address

Device address

7902 MacTo

Device address in the first step along the routing path to communicate with the device listed in register 7901.

7904 Status

-

7909 Push Register 0, 7910 Push Register 1, through 7924 Push Register 16

Contents of the push registers of the slave listed in register 7901.

3 Technical Notes

3.1 Network Information Registers

The Master device network table maintains three pieces of data for every device in the system: Device or MAC Address, Route MAC Address, and Route MACWhen. Repeater data radios contain this same network information about all child radios connected through it to the master device.

MAC Address

Unique identifier for a data radio. The MAC Address is the lower 16-bits of the serial number (also referred to as the Device Address).

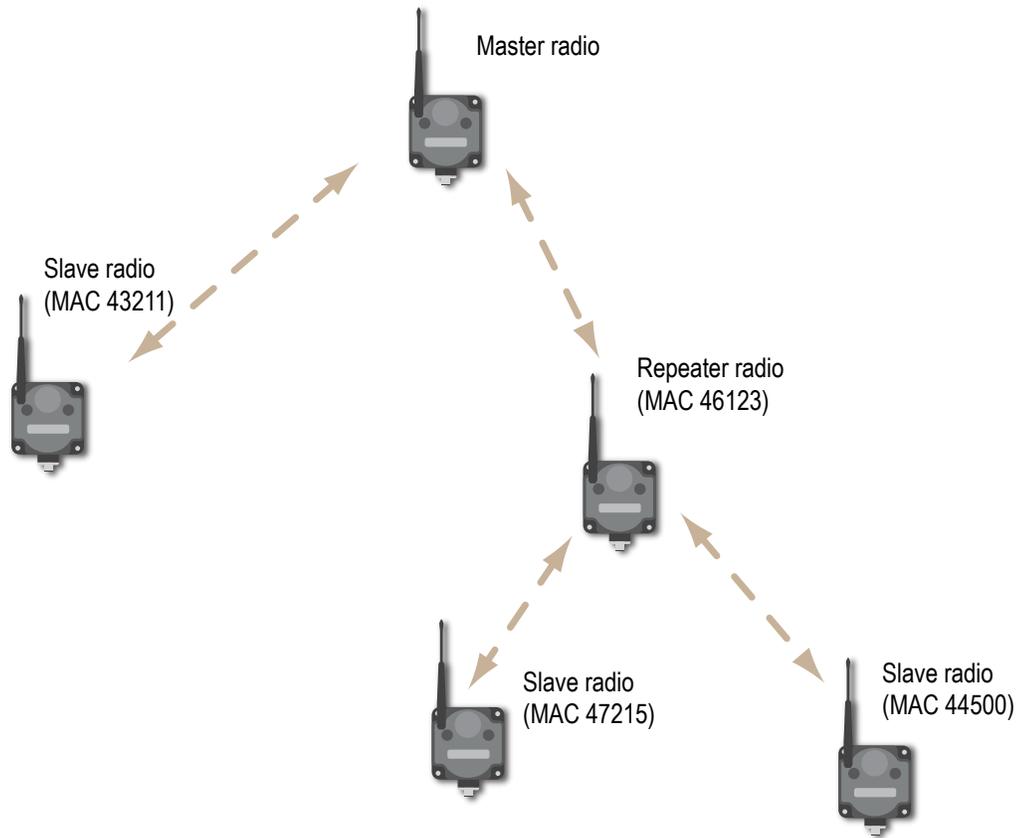
Route MAC Address

Connection information; lists the MAC Address of the first hop for a routed message from the parent. When the Route MAC Address and the MAC Address are the same, that device is directly linked to the parent device for whom the formation table is formed. (See examples below).

Route MACWhen

Defines how often this parent can communicate to the child specified by the Route MAC Address entry.

- Route MACWhen = 128. Every timing slot is available to talk to a device (there are a total of 128 communication slots).
- Route MACWhen = 4. The device is available for 4 of 128 timing slots. This setting is typically used for battery-powered devices.



Network Formation Table for the Master			
Index	MAC Address (7002-7051)	Route MAC Address (7302-7351)	Route MACWhen (7602-7651)
1	43211	43211	128
2	44500	46123	32

Network Formation Table for the Master			
Index	MAC Address (7002-7051)	Route MAC Address (7302-7351)	Route MACWhen (7602-7651)
3	47215	46123	32
4	46123	46123	32

Network Formation Table for the Repeater (Address 46123)			
Index	MAC Address (7002-7051)	Route MAC Address (7302-7351)	Route MACWhen (7602-7651)
1	47215	47215	4
2	44500	44500	4

Register 7001

Number of devices in the network formation table (MAC Address section)

Registers 7002–7051

Index 1 through index 50 for the MAC Address

Register 7301

Number of devices in the network formation table (Route MAC Address section)

Registers 7302–7351

Index 1 through index 50 for the device Route MAC Address

Register 7601

Number of devices in the network formation table (Route MACWhen section)

Registers 7602–7651

Index 1 through index 50 for the Route MACWhen

Register 6502

Modbus Offset. The starting Modbus Slave ID for the wireless system is defined in the master device at register 6502. Factory default is set to 11.

Registers 6504–6553

Modbus Slave ID to Device Address List. Register 6504 contains the MAC Address of the first wireless Modbus Slave ID. The first wireless Slave ID, factory default is 11, is defined by register 6502. If register 6504 contains the MAC Address of Modbus Slave 11, register 6505 contains the MAC Address of Modbus Slave 12, et cetera.

The example table is shown with a starting Modbus Slave ID of 11.

Register	Slave ID	Device Address
6504	11	43987
6505	12	56109
6506	13	12354

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