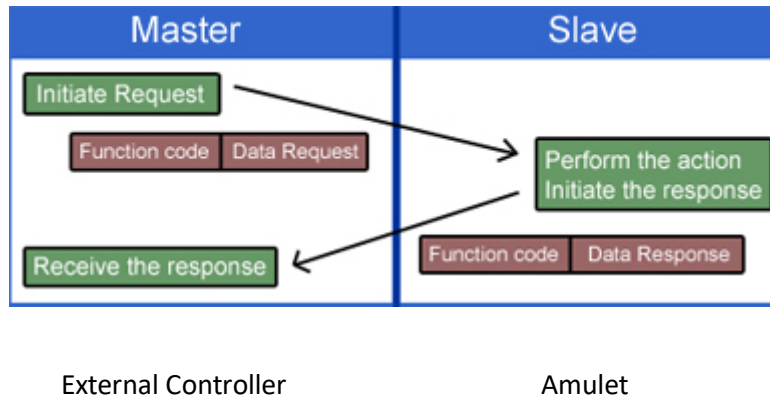


MODBUS RTU messages are a simple 16-bit CRC (Cyclic-Redundant Checksum). The simplicity of these messages is to ensure reliability. Due to this simplicity, the basic 16-bit MODBUS RTU register structure can be used to pack in floating point, tables, ASCII text, queues, and other unrelated data.



Every MODBUS packet consists of 4 field:

- 1) The Address Field
- 2) The Command Field
- 3) The Data Field
- 4) Checksum Field

By default, the Amulet ID is 01 and the host processor's ID is 02

When the Amulet is the slave, the external processor can read and write to "virtual dual-port" RAM which resides on the Amulet side. The Amulet has 256 byte variables, 256 word variables, 256 26-character string variables and a 6 byte deep RPC buffer. Amulet Widgets can have **href** commands that start with **Amulet:InternalRAM** to access these "virtual dual-port" RAM variables.

The Host processor can send the following commands:

- A "Get Internal RAM byte variable" request.
- A "Get Internal RAM word variable" request. (word = 2 bytes)
- A "Get Internal RAM string variable" request.
- A "Get Internal RAM color variable" request. (color = 4 bytes)
- A "Get Internal RAM byte array" request.
- A "Get Internal RAM word array" request. (word = 2 bytes)
- A "Get Internal RAM color array" request. (color = 4 bytes)
- A "Get Internal RAM RPC buffer" request.
- A "Set Internal RAM byte variable" command.
- A "Set Internal RAM word variable" command. (word = 2 bytes)
- A "Set Internal RAM string variable" command.
- A "Set Internal RAM color variable" command. (color = 4 bytes)

- A "Set Internal RAM byte variable array" command.
- A "Set Internal RAM word variable array" command. (word = 2 bytes)
- A "Set Internal RAM color variable array" command. (color = 4 bytes)
- A "Jump to specific page" command.

Message	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7...	Byte n-2	Byte n-1	Byte n
Get Byte Variable	0x01	0x20	Variable Index	CRC LSByte	CRC MSByte	None	None	None	None	None
Address Op Address 16-bit CRC										

Amulet Response	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7...	Byte n-2	Byte n-1	Byte n
Amulet Response	0x01	0x20	Variable Index	Value	CRC LSByte	CRC MSByte	None	None	None	None
Amulet sends back the Value at the specified address location.										

Set Byte Variable	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7...	Byte n-2	Byte n-1	Byte n
Set Byte Variable	0x01	0x30	Variable Index	Value	CRC LSByte	CRC MSByte	None	None	None	None

Amulet Response	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7...	Byte n-2	Byte n-1	Byte n
Amulet Response	0x01	0x30 (ACK)	CRC LSByte	CRC MSByte	None	None	None	None	None	None

If the message is valid, the Amulet LCD module slave will either return the requested data (if a "Get" request) or confirm the message (if a "Set" command). If there is a CRC error, the Amulet will not respond at all. If the opcode is not a valid Amulet opcode, the Amulet will respond with a NAK and the "Illegal Function" error code #1.

The NAK is defined as the opcode with the Most Significant Bit set. Normally, the slave would respond back with the opcode sent to them, but in the case of an error, instead of the opcode, the slave would respond with the MSBit set plus the opcode sent to them. For instance, if the master was requesting a byte variable that did not exist, the opcode used to request a byte is 0x20. If an error existed, the slave would respond with 0xA0 (0x80 + 0x20) with the following byte being the error code.

List of error codes:

Error Code	Name	Explanation	Amulet Action if Error Sent By Host	Will Amulet Send?
01	Illegal Function	Opcode used was invalid	ignore	yes
02	Illegal Data Address	Variable number used was invalid	ignore	no
03	Illegal Data Value	Implied length of array is incorrect (array overflow)	ignore	yes
04	Slave Device Fail	Slave Device in failure mode	ignore	no
05	Ack	Positive Acknowledgement	ignore	no
06	Slave Busy	Slave currently too busy to process command	resend last message	no
07	Nak	Negative Acknowledgement	resend last message	no
08	Memory Parity Error	Not currently used	ignore	no

Example commands:

Host Command	Dir.	Amulet Response	Description
0x01 0x20 0x01 0x08 0x00	>>		Get byte variable 1
	<<	0x01 0x20 0x01 0x38 0x00 0x14	Return byte of byte var 1

Host Command	Dir.	Amulet Response	Description
0x01 0x30 0x01 0xFE 0x81 0x83	>>		Set byte variable 1 to 0xFE
	<<	0x01 0x30 0x00 0xC4	Ack set byte variable 1 to 0xFE

Host Command	Dir.	Amulet Response	Description
0x01 0x20 0x04 0xC8 0x03	>>		Get byte variable 4 (no such variable)
	<<	0x01 0xA0 0x05 0x68 0x03	Error (ACK) Move on.