

**COMMUNICATIONS PROTOCOL**  
**WAYNE MILLER ASSOCIATES SERIAL/PARALLEL INTERFACE**  
**MODEL WMA-039**

WLM080706-1

rev 7.1, 10/17/06

Copyright 2006 by Wayne Miller Associates. All rights reserved.

**SCOPE**

The model WMA-039 serial/parallel interface provides a link between an asynchronous serial controller and a remote device requiring a parallel interface. It provides 14 parallel control lines and three parallel status input lines. The protocol, described herein, embodies numerous features to make it a powerful and useful addition to any system in which it is employed:

- Simple two wire communications interface, with no flow control required.
- Support of RS-485 and RS-422, with RS-232 as an option.
- Individual unit addressing with up to 26 different addresses available, permitting multiple units to be operated from a single controller.
- Validation check byte, insuring integrity of transmission.
- Error trapping with invalid framing codes, making invalid transmissions easy to identify and troubleshoot.
- Non-volatile storage of operational parameters and data, permitting flexibility of operational scenarios.
- Available PC-based software for evaluating and testing, using a standard PC com port.

**SYSTEM AND TERMINOLOGY EXPLANATION**

The serial/parallel converter (herein referred to as the unit) is a module that provides an asynchronous serial interface to control and monitor a hardware block that requires a parallel interface. The basic unit provides 14 parallel control lines and three parallel monitor lines, making it suitable to control a wide variety of hardware types. The instruction set permits controlling the outputs in different groupings, simplifying the software interface for different applications. The interface is equipped with non-volatile storage capability, permitting the user to define and change the power-up state of the unit.

All of the operational parameters are controlled and monitored through an asynchronous serial interface bus. The unit and the communications protocol are designed so that all commands to a unit are through an address structure, permitting the use of a multi-drop bus. Each unit's address can be set and changed through bus controls.

The 14 control lines are each assigned a designator, C13 down to C0. The three monitor lines are each assigned a designator, S2 down to S0. The methods for controlling and monitoring these lines is defined under the section titled COMMAND DEFINITIONS.

## COMMUNICATION PROTOCOL

The communications standard is RS-485, 2-wire, multi-drop, where the drivers in the unit are only be active when sending a response (otherwise they will be Hi-Z). There are no terminating networks in the unit. The unit is also available with an RS-232 interface, and a 4-wire RS-422 interface. The protocol is the same for all three types of interface, however the electrical restrictions of RS-232 does not permit a multi-drop bus.

- ◆ BAUD 19200
- ◆ ONE START BIT
- ◆ 8 DATA BITS
- ◆ NO PARITY
- ◆ ONE STOP BIT
- ◆ NO FLOW CONTROL

## DEFINITION OF COMMAND AND RESPONSE FRAMES

All communications to the WMA-039 are in the form of a command sent by the host controller, followed by a response from the WMA-039. All characters in both the command and the response frames are defined as ASCII printable, where decimal values of ASCII characters are shown in parentheses throughout this document. The command/response structure is as shown in the Table below. The bytes are transmitted in the order given, from top to bottom

<b>Command:</b>	<b>Number of bytes</b>		<b>Response:</b>	<b>Number of bytes</b>
header	1		header	1
devaddress	1		devaddress	1
command	1		response	1
data	variable, as needed		data	variable, as needed
terminator	1		terminator	1
checkbyte	1		checkbyte	1

### NOTES:

A command transmission will elicit a response transmission if and only if:

- The header and terminator bytes are present, AND
- The devaddress matches that of the unit, AND
- The bytes are received in the defined order, AND
- A checkbyte is received.

The response transmission will begin within 20 milliseconds after the end of the command transmission. Commands requiring the unit to write to non-volatile data storage may have longer latency times, and may delay the response transmission to as much as 150 milliseconds.

## DEFINITION OF TERMS

Numbers in parentheses are decimal values of ASCII characters.

**header:** Start of transmission frame. One byte, (123).

**devaddress:** The permissible device addresses are (64) - (90), where (64) is reserved as a default address. This permits up to 26 unique unit addresses to be active. A response transmission echoes the devaddress used in the command that prompts it.

**command:** The permissible command set is within the range of (65) - (90). The fourteen commands that are defined for the unit are described

**response:** The permissible response set is within the range of (65) - (99). The response byte will be defined as follows in order of priority, with the highest priority listed first:

- ◆ If the command that prompts the response is valid and is accompanied by a valid data field, the response byte will be the same as the command byte.
- ◆ If the checkbyte is not correct for the command transmission, the response byte will be (99), and the response data field will be null.
- ◆ If the command that prompts the response is not defined, the response byte will be (98), and the response data field will be null.
- ◆ If the data field in the command transmission is not valid for the command byte, the response byte will be (97), and the response data field will be null.

**data:** The permissible range of characters used in data fields is (43) - (90). The data fields are as defined in the text that accompanies the definitions of the commands. In instances where the response data is in the same format as the command data, the response data will be the actual status of the unit following the execution of the command, providing a verification that the command was fully executed. The bytes are transmitted from Left to Right as listed in the definitions provided below.

**terminator:** End of transmission frame. One byte, (125).

**checkbyte:** The checkbyte is derived from the transmission frame from the Header to the Terminator, inclusive, and will always be in the range of (32) - (126). The algorithm for deriving the checkbyte is as follows:

```
checkbyte = 0
for i = 1 to N      // N is the number of bytes in the transmission frame
    checkbyte = checkbyte + byte(i) - 32  //byte(i) is the i'th byte
    if checkbyte > 94 then checkbyte = checkbyte - 95 //modulo 95
next i
checkbyte = checkbyte + 32
```

## COMMAND DEFINITIONS

Numbers in parentheses are decimal values of ASCII characters.

**(73):** Device Identifier "**I**". The command data field will be null. The response data field will consist of ten ASCII characters. This data field is: "WMA-S39-xx", where "xx" is a two-character field that represents the revision of the unit.

**(83):** Status "**S**". The command data field will be null. The response data field will contain three bytes representing, in order, S2, S1, S0. Each byte can be either (48) to represent '0', or (49) to represent '1'.

**(70):** Full Control "**F**". The command data field will contain 14 bytes, each either (48) to represent '0', or (49) to represent '1', with C13 sent first and C0 sent last. The response data field will be in the same format as the command data field. The effect of this command on non-volatile storage will depend upon the Command Option setting.

**(71):** Full Control Status "**G**". The command data field will be null. The response data field will contain 14 bytes, each either (48) to represent '0', or (49) to represent '1', with C13 sent first and C0 sent last.

**(67):** Device Address Clear "**C**". The command data field will contain one byte, the same as the devaddress byte. The response data field will echo the devaddress byte. The result of this command will be to set the address of the unit to the default address (64). The intended use for this command is to provide an intermediate step for address changes. This command does not write to non-volatile storage, so that cycling the power following this command will restore the original devaddress to the unit.

**(68):** Device Address Change "**D**". The devaddress for this command must be (64). The command data field will be one byte long, representing the new address for the unit, which must be in the range (65) - (90). The response data field will be in the same format as the command data field. Care must be taken when using this command if there are multiple units on the bus so as not to assign duplicate addresses. This command writes to non-volatile storage.

**(79):** Command Option Control "**O**". The command data field will contain one byte: either (49) to **set** NV store or (48) to turn **off** NV store. If NV Store is **set**, all subsequent control commands will immediately be written to non-volatile storage. If NV store is **off**, they will not. The state of the Command Option does not affect the Write to Non-volatile Storage Command. The response data field will be (49) if the write operation left the Option **set**, and (48) if it left it **off**. This command writes to non-volatile storage.

**(87):** Write to Non-volatile Storage "**W**". This command causes the currently active control parameters to be written to non-volatile storage. The command data field will be null. The response data field will be (49) if the write was successful, and (48) if it was not. The current operating parameters of the unit will not be affected, regardless of whether the write was successful. This command writes to non-volatile storage.

**(82):** Restore from Non-volatile Storage "**R**". This command causes the unit to reload the operating parameters from non-volatile storage. The command data field will be null and response data field will contain 14 bytes and be in the same format as the Control Command data field. This command does not write to non-volatile storage.

### COMMAND SUMMARY

<i>Command</i>	<i>Char</i>	<i>Data Bytes</i>	<i>NV write</i>	<i>Response Data</i>	<i>Data Bytes</i>
Identify	<b>I</b>	0	No	"WMA-S39-xx"	10
Status	<b>S</b>	0	No	(48) to (55)	1
Full Control	<b>F</b>	14	**	Same as Control	14
Full Control Status	<b>G</b>	0	No	Same as Control	14
Address Clear	<b>C</b>	1	No	Unit Address	1
Address Change	<b>D</b>	1	Yes	New Address	1
Command Option	<b>O</b>	1	Yes	(48) or (49)	1
Write to NV	<b>W</b>	0	Yes	(48) or (49)	1
Restore from NV	<b>R</b>	0	No	Same as Control	14

Characters in **Bold** are ASCII characters.

\*\*Write to NV is determined by the state of the Command Option parameter.  
Numbers in parentheses are decimal values of ASCII characters.

### SUMMARY OF COMMAND DATA FIELDS

<b>Command</b>	<b>Char</b>	<b>Command Data Field</b>
Control Commands	<b>F, P, M, X, U</b>	String consisting of "0" and "1" characters, sent MSB first.
Address Clear	<b>C</b>	Current unit address in the range "A" - "Z"
Address Change	<b>D</b>	New unit address in the range "A" - "Z"
Command Option	<b>O</b>	"1" = auto store to NV, "0" = no auto store to NV

Characters in **Bold** are ASCII characters.