

Hitec MR-C3024 to PC Protocol for RoboNova

Based on Robobasic Version 2.5e

Serial Interface

9600 bps, 8 bit, no parity, 1 stop

Protocol

The interface protocol is mastered by the PC, which sends bytes usually one at a time to the C3204 and expects valid responses in a given timeout. No response from the C3204 gives an error in Robobasic, a bad response gives a different error.

The C3204 also invokes a timeout when it expects to see a byte from the PC. No response or a bad response returns the C3204 to look for a new command.

Command bytes are usually swapped on a byte by byte basis, so the PC may send a null byte to allow the C3204 to send a response, or the C3204 may send an echo of the received byte to acknowledge.

Commands by Value

The following is a complete list of the commands available from PC to C3204.

The first byte of a command determines the type:

Hex Value First Byte	Function	Echo Response
0x00-0x7F	Write Byte to first defined RoboBasic Variable	No
0x80-0x8F	None	Yes
0x90-0x9F	None	Yes
0xA0	Unknown	Yes
0xA1-0xAE	None	Yes
0xAF	Reboot Controller	Yes
0xB0	Unknown Returns 00 or FF	Yes
0xB1	Unknown Write value to 0x4DA	Yes
0xB2	Unknown Write value to 0x4D4 between 1 and 15	Yes
0xB3	Read on chip EEPROM	Yes
0xB4	Write on chip EEPROM	Yes
0xB5-0xBF	None	Yes
0xC0-0xCF	None	Yes
0xD0	Unknown Servo	Yes
0xD1	Unknown Servo	Yes
0xD2	Read Servo Position	Yes
0xD3	Read Group8 Group A	Yes
0xD4	Read Group8 Group B	Yes
0xD5	Read Group8 Group C	Yes
0xD6	Read Group8 Group D	Yes
0xD7	Read Group6 Group A	Yes
0xD8	Read Group6 Group B	Yes

0xD9	Read Group6 Group C	Yes
0xDA	Read Group6 Group D	Yes
0xDB	Read Group6 Group E	Yes
0xDC-0xDF		Yes
0xE0	Port Bit Read	Yes
0xE1	Port Byte Read	Yes
0xE2	ADC Read	Yes
0xE3	Port Bit Write	Yes
0xE4	Port Byte Write	Yes
0xE5	PWM Write	Yes
0xE6	Write Servo Position	Yes
0xE7	Turn On Servo	Yes
0xE8	Turn Off Servo	Yes
0xE9	Servo Speed	Yes
0xEA	Unknown something on AI Motor	Yes
0xEB	Write Synchronous Servo Positions	Yes
0xEC	Download Robobasic Code	Yes
0xED-0xEF	None	Yes
0xF0	Get Controller Information	Yes
0xF1	Write IM EEPROM	Yes
0xF2	Read IM EEPROM	Yes
0xF3	Unknown Set bits 3 and 4 in 0x4D2	Yes
0xF4	Unknown Write/Read IM EEPROM	Yes
0xF5	Read AI Motor Settings	Yes
0xF6	Write AI Motor Settings	Yes
0xF7	Read Data Memory	Yes
0xF8	Write Data Memory	Yes
0xF9	None	Yes
0xFA	Controller Stop	Yes
0xFB	Controller Start	Yes
0xFC	Controller Reset	Yes
0xFD-0xFE	None	Yes
0xFF	Write value FF to first defined RoboBasic Variable	Yes

Command Detail

WRITE_VAR_0	0x00 to 0x7F	Writes value into first defined Robobasic Variable (Data RAM location 0x140)	
	PC to C3024	C3024 to PC	Description
Byte 1	0x00 to 0x7F	None	

UNKNOWN	0xA0	Unknown- Currently undocumented
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	PC to C3024	C3024 to PC	Description
Byte 1	0xA0	0xA0	Command and echo
Byte 2	0xF0	0xF0	Check and echo
Byte 3	0xAF	0xAF	Check and echo
Byte 4 ...			A number of subcommands

REBOOT	PC to C3024	C3024 to PC	Description
	0xAF		Force processor into Bootloader
Byte 1	0xAF	0xAE	Command and echo different !
Byte 2	0x62	0x42	Get 'b' and echo 'B'
Byte 3	0x6F	0x4F	Get 'o' and echo 'O'
Byte 4	0x6F	0x4F	Get 'o' and echo 'O'
Byte 5	0x74	0x54	Get 't' and echo 'T'

Unknown	PC to C3024	C3024 to PC	Description
	0xB0		Unknown
Byte 1	0xB0	0xB0	Command and echo
Byte 2	Null 0x00	0x00 or 0xFF	Unknown

Unknown	PC to C3024	C3024 to PC	Description
	0xB1		Unknown
Byte 1	0xB1	0xB1	Command and echo
Byte 2	Value	Value	Value and echo

Unknown	PC to C3024	C3024 to PC	Description
	0xB2		Unknown
Byte 1	0xB2	0xB2	Command and echo
Byte 2	Value	Value	Value and echo

READ EEPROM	0xB3	Read from processor on chip EEPROM	
	PC to C3024	C3024 to PC	Description
Byte 1	0xB3	0xB3	Command and echo
Byte 2	Address Low	Address Low	
Byte 3	Address High	Address High	
Byte 4	Null 0x00	Value	Return value read

Write EEPROM	0xB4	Write to processor on chip EEPROM	
	PC to C3024	C3024 to PC	Description
Byte 1	0xB3	0xB3	Command and echo
Byte 2	Address Low	Address Low	
Byte 3	Address High	Address High	
Byte 4	Value	Value	

READ_SERVO_?	0xD0	Unknown Servo move may be a read of group of 24	
	PC to C3024	C3024 to PC	Description
Byte 1	0xD2	0xD2	Command and echo
Byte 2 ...			

READ_SERVO_?	0xD1	Unknown Servo move almost same as D0, except different servo on state	
	PC to C3024	C3024 to PC	Description
Byte 1	0xD2	0xD2	Command and echo
Byte 2 ...			

READ_SERVO	0xD2	Reads a servo position from a C3024	
	PC to C3024	C3024 to PC	Description

Byte 1	&hD2	&hD2	Command and echo
Byte 2	Servo Number (1 byte)	Servo Number (1 byte)	Servo Number and echo
Byte 3	0x00 Null	Servo Position (1 byte)	Read servo zero position 10 to 190 (0x0A to 0xBE) Midpoint = 100 (0x64)

READ_GROUP8_A	0xD3	Reads positions of group of 8 servo group A from a C3024	
	PC to C3024	C3024 to PC	Description
Byte 1	0xD3	0xD3	Command and echo
Byte 2 to 9	0x00 Null	Servo Position (1 byte)	Read servo position 10 to 190 (0x0A to 0xBE) Midpoint = 100 (0x64)

READ_GROUP8_B	0xD4	Reads positions of group of 8 servo group B from a C3024	
	PC to C3024	C3024 to PC	Description
Byte 1	0xD4	0xD4	Command and echo
Byte 2 to 9	0x00 Null	Servo Position (1 byte)	Read servo position 10 to 190 (0x0A to 0xBE) Midpoint = 100 (0x64)

READ_GROUP8_C	0xD5	Reads positions of group of 8 servo group C from a C3024	
	PC to C3024	C3024 to PC	Description
Byte 1	0xD5	0xD5	Command and echo
Byte 2 to 9	0x00 Null	Servo Position (1 byte)	Read servo position 10 to 190 (0x0A to 0xBE) Midpoint = 100

			(0x64)
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READ_GROUP8_D	0xD6	Reads positions of group of 8 servo group D from a C3024	
	PC to C3024	C3024 to PC	Description
Byte 1	0xD6	0xD6	Command and echo
Byte 2 to 9	0x00 Null	Servo Position (1 byte)	Read servo position 10 to 190 (0x0A to 0xBE) Midpoint = 100 (0x64)

READ_GROUP6_A	0xD7	Reads positions of group of 6 servo group A from a C3024	
	PC to C3024	C3024 to PC	Description
Byte 1	0xD7	0xD7	Command and echo
Byte 2 to 7	0x00 Null	Servo Position (1 byte)	Read servo position 10 to 190 (0x0A to 0xBE) Midpoint = 100 (0x64)

READ_GROUP6_B	0xD8	Reads positions of group of 6 servo group B from a C3024	
	PC to C3024	C3024 to PC	Description
Byte 1	0xD8	0xD8	Command and echo
Byte 2 to 7	0x00 Null	Servo Position (1 byte)	Read servo position 10 to 190 (0x0A to 0xBE) Midpoint = 100 (0x64)

READ_GROUP6_C	0xD9	Reads positions of group of 6 servo group C from a C3024	
	PC to C3024	C3024 to PC	Description
Byte 1	0xD9	0xD9	Command and

			echo
Byte 2 to 7	0x00 Null	Servo Position (1 byte)	Read servo position 10 to 190 (0x0A to 0xBE) Midpoint = 100 (0x64)

READ_GROUP6_D	0xDA	Reads positions of group of 6 servo group D from a C3024	
	PC to C3024	C3024 to PC	Description
Byte 1	0xDA	0xDA	Command and echo
Byte 2 to 7	0x00 Null	Servo Position (1 byte)	Read servo position 10 to 190 (0x0A to 0xBE) Midpoint = 100 (0x64)

READ_GROUP6_E	0xDB	Reads positions of group of 6 servo group E from a C3024	
	PC to C3024	C3024 to PC	Description
Byte 1	0xDB	0xDB	Command and echo
Byte 2 to 7	0x00 Null	Servo Position (1 byte)	Read servo position 10 to 190 (0x0A to 0xBE) Midpoint = 100 (0x64)

PORTBIT_IN	0xE0	Reads a bit value from a C3024 Port	
	PC to C3024	C3024 to PC	Description
Byte 1	0xE0	0xE0	Command and echo
Byte 2	Bit Number (1 byte)	Bit Number (1 byte)	Bit and echo (Bit allocation below)
Byte 3	0x00 Null	Port Value (1 byte) 0 = Low 1 = High	Read Bit value

PORTBYTE_IN	0xE1	Reads a byte value from a C3024 Port	
	PC to C3024	C3024 to PC	Description
Byte 1	0xE1	0xE1	Command and echo
Byte 2	Byte Number (1 byte)	Byte Number (1 byte)	Port and echo (byte allocation below)
Byte 3	0x00 Null	Port Value (1 byte)	Read byte value

Bits and Bytes		Need to check this again !
Byte Number	Bit Number	Port Allocation
0	0x00 to 0x07	A.0, A.1, A.2, A.3, A.4, A.5, A.6, A.7
1	0x08 to 0x0F	B.0, B.1, B.2, B.3, B.4, B.5, B.6, B.7
2	0x10 to 0x17	C.0, C.1, C.2, C.3, C.4, C.5, C.6, C.7
3	0x18 to 0x1F	E.7, E.6, D.7, D.6, D.5, G.2, G.1, G.0
4	0x20 to 0x27	F.0, F.1, F.2, F.3, F.4, F.5, F.6, F.7
5	0x28 to 0x2F	D.2,D.3, D.4, E.0, E.1,E.2, E.3, E.4
6	0x30 to 0x32	G.3, G.4

ADC_IN	0xE2	Reads a byte value from a C3024 ADC port	
	PC to C3024	C3024 to PC	Description
Byte 1	0xE2	0xE2	Command and echo
Byte 2	AD Port Number (1 byte)	AD Port Number (1 byte)	AD Port and echo
Byte 3	0x00 Null	AD Port Value (1 byte)	Read AD byte value

PORTOUT	0xE3	Writes a bit value to a C3024 Port	
	PC to C3024	C3024 to PC	Description
Byte 1	0xE3	0xE3	Command and echo
Byte 2	Port Number (1 byte)	Port Number (1 byte)	Port and echo
Byte 3	Port Value (1 byte) 0 = Low 1 = High	Port Value (1 byte) 0 = Low 1 = High	Write Bit value and echo

BYTEOUT	0xE4	Writes a byte value to a C3024 Port	
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	PC to C3024	C3024 to PC	Description
Byte 1	0xE4	0xE4	Command and echo
Byte 2	Port Number (1 byte)	Port Number (1 byte)	Port and echo
Byte 3	Port Value (1 byte)	Port Value (1 byte)	Write byte value

PWM	0xE5	Writes a PWM value to a C3024 Port	
	PC to C3024	C3024 to PC	Description
Byte 1	0xE5	0xE5	Command and echo
Byte 2	PWM Port Number (1 byte)	PWM Port Number (1 byte)	PWM Port and echo
Byte 3	PWM Port Value (1 byte) 0 -> 0xFF	PWM Port Value (1 byte) 0 -> 0xFF	Write PWM Port value

SERVO	0xE6	Writes a position value to a C3024 Servo	
	PC to C3024	C3024 to PC	Description
Byte 1	0xE6	0xE6	Command and echo
Byte 2	Servo Number (1 byte)	Servo Number (1 byte)	Servo Number and echo
Byte 3	Servo Value (1 byte)	Servo Value (1 byte)	Write servo value and echo 10 to 190 (0x0A to 0xBE) Midpoint = 100 (0x64)

SERVO_ON	0xE7	Turns on a C3024 Servo	
	PC to C3024	C3024 to PC	Description
Byte 1	0xE7	0xE7	Command and echo
Byte 2	Servo Number (1 byte)	Servo Number (1 byte)	Servo Number and echo

SERVO_OFF	0xE8	Turns off a C3024 Servo	
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	PC to C3024	C3024 to PC	Description
Byte 1	0xE8	0xE8	Command and echo
Byte 2	Servo Number (1 byte)	Servo Number (1 byte)	Servo Number and echo

SERVO_SPEED	0xE9	Set speed of all C3024 Servos	
	PC to C3024	C3024 to PC	Description
Byte 1	0xE9	0xE9	Command and echo
Byte 2	Servo Speed (1 byte) 0 -> 0x0F	Servo Speed (1 byte) 0 -> 0x0F	Servo Speed and echo

AI_MOTOR_?	0xEA	Unknown on AI Motor	
	PC to C3024	C3024 to PC	Description
Byte 1	0xEA	0xEA	Command and echo
Byte ..			

SYNC_MOVE	0xEB	Writes a position value to a C3024 Servo Synchronous motion. PTP should be on	
	PC to C3024	C3024 to PC	Description
Byte 1	0xEB	0xEB	Command and echo
Byte 2	PTP (1 byte) On = 1, Off = 0	PTP (1 byte) On = 1, Off = 0	PTP Value and echo
Byte 3	First servo Number (1 byte)	First servo Number (1 byte)	First servo number and echo 0 to 31 (&h00 to &h1F)
Byte 4	Last servo Number (1 byte)	Last servo Number (1 byte)	Last servo number and echo 1 to 32 (&h01 to &h20)
Byte 5 to end Repeats for number of servos (last-first)	Servo Value (1 byte)	Servo Value (1 byte)	Write servo value and echo 10 to 190 (&h0A to &hBE) Midpoint = 100 (&h64)

C3024_Download	0xEC	Used for download to program EEPROM, seems to go to high speed	
	PC to C3024	C3024 to PC	Description
Byte 1	0xEC	0xEC	Command and echo
Re-open port at high speed			
Byte 2	Length Low (1 byte)	Length Low (1 byte)	Length low and echo includes bytes 1 to 3
Byte 2	Length High (1 byte)	Length High (1 byte)	Length high and echo
Byte 3	'?' 0x3F	Response (0x21)	
Bytes 4 though length padded to 128 byte boundary	Byte value	none	Send bytes
Byte 129	Checksum?	None	Send checksum
Byte 130 if program longer than 128	'?' 0x3F	Response (0x21)	Loop around sending 128Byte packets till all done

GET_CONTROLLER_INFO	0xF0	Read controller information	
	PC to C3024	C3024 to PC	Description
Byte 1	0xF0	0xF0	Command and echo
Byte 2	0x00 Null	Controller Number (1 byte)	Read controller number
Byte 3	Controller Number (1 byte)	Version Number High (1 byte)	Echo controller number and read version number high
Byte 4	Version Number High (1 byte)	Version Number Low (1 byte)	Echo version number high and read version number low
Byte 5	Version Number Low	Total memory size	Echo version number low and

	(1 byte)	(1 byte)	read total memory
Byte 6	Memory size (1 byte)	Total variables (1 byte)	Echo memory size and total variables
Byte 7	Total variables (1 byte)	Number stacks (1 byte)	Echo total variables and read number stacks

WRITE_IM	0xF1	Write to a Intermediate Byte code Program Memory location	
	PC to C3024	C3024 to PC	Description
Byte 1	0xF1	&hF1	Command and echo
Byte 2	Low Address (1 byte)	Low Address (1 byte)	Low Address and echo
Byte 3	High Address (1 byte)	High Address (1 byte)	High Address and echo
Byte 4	IM memory value (1 byte)	IM memory value (1 byte)	memory value and echo

READ_IM	0xF2	Read from an Intermediate Byte code Program Memory location	
	PC to C3024	C3024 to PC	Description
Byte 1	0xF2	0xF2	Command and echo
Byte 2	Low Address (1 byte)	Low Address (1 byte)	Low Address and echo
Byte 3	High Address (1 byte)	High Address (1 byte)	High Address and echo
Byte 4	0x00 Null	Data memory value (1 byte)	Read Data memory value

UNKNOWN	0xF3	tbd	
	PC to C3024	C3024 to PC	Description
Byte 1	0xF3	0xF3	Command and echo
Byte 2 ..			

UNKNOWN	0xF4	Something on IM Program memory	
	PC to C3024	C3024 to PC	Description
Byte 1	0xF4	0xF4	Command and echo
Byte 2 ..			

AI_MOTOR_READ	0xF5	Read parameters of AI Motor	
	PC to C3024	C3024 to PC	Description
Byte 1	0xF5	0xF5	Command and echo
Byte 2 ..			tbd

AI_MOTOR_WRITE	0xF6	Write parameters of AI Motor	
	PC to C3024	C3024 to PC	Description
Byte 1	0xF6	0xF6	Command and echo
Byte 2 ..			

READ_DATA	0xF7	Read a data memory location	
	PC to C3024	C3024 to PC	Description
Byte 1	0xF7	0xF7	Command and echo
Byte 2	Low Address (1 byte)	Low Address (1 byte)	Low Address and echo
Byte 3	High Address (1 byte)	High Address (1 byte)	High Address and echo
Byte 4	0x00 Null	Data memory value (1 byte)	Read Data memory value

WRITE_DATA	0xF8	Writes a data memory location	
	PC to C3024	C3024 to PC	Description
Byte 1	0xF8	0xF8	Command and echo
Byte 2	Low Address (1 byte)	Low Address (1 byte)	Low Address and echo
Byte 3	High Address (1 byte)	High Address (1 byte)	High Address and echo

Byte 4	Data memory value (1 byte)	Data memory value (1 byte)	Write Data memory value and echo
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C3024_STOP	0xFA	Controller Stop	
	PC to C3024	C3024 to PC	Description
Byte 1	0xFA	0xFA	Command and echo

C3024_RUN	0xFB	Controller Run	
	PC to C3024	C3024 to PC	Description
Byte 1	0xFB	0xFB	Command and echo

C3024_RESET	0xFC	Controller Reset	
	PC to C3024	C3024 to PC	Description
Byte 1	0xFC	0xFC	Command and echo

SET_VAR_0	0xFF	Writes 0xFF into first defined Robobasic Variable (Data RAM location 0x140)	
	PC to C3024	C3024 to PC	
Byte 1	0xFF	0xFF	

Data Memory Map

Address	Usage	Values	Derivation
&h140 to &h1FD	IM Variables	ANY	Map to variables in IM byte code
&h300	? servo 0		Set zero
&h301	? servo 1		Set zero
&h302	? servo 2		Set zero
&h303	? servo 3		Set zero
&h304	? servo 4		Set zero
&h305	? servo 5		Set zero
&h306	? servo 6		Set zero
&h307	? servo 7		Set zero
&h308	? servo 8		Set zero
&h309	? servo 9		

&h30A	? servo 10		
&h30B	? servo 11		
&h30C	? servo 12		Set zero
&h30D	? servo 13		Set zero
&h30E	? servo 14		Set zero
&h30F	? servo 15		
&h310	? servo 16		
&h311	? servo 17		
&h312	? servo 18		Set zero
&h313	? servo 19		Set zero
&h314	? servo 20		Set zero
&h315	? servo 21		Set zero
&h316	? servo 22		Set zero
&h317	? servo 23		
&h318	? servo 24		
&h319	? servo 25		
&h31A	? servo 26		
&h31B	? servo 27		
&h31C	? servo 28		
&h31D	? servo 29		
&h31E	? servo 30		
&h31F	? servo 31		
&h320	? servo 0		Set zero
&h321	? servo 1		Set zero
&h322	? servo 2		Set zero
&h323	? servo 3		Set zero
&h324	? servo 4		Set zero
&h325	? servo 5		Set zero
&h326	? servo 6		Set zero
&h327	? servo 7		Set zero
&h328	? servo 8		Set zero
&h329	? servo 9		Set zero
&h32A	? servo 10		Set zero
&h32B	? servo 11		Set zero
&h32C	? servo 12		Set zero
&h32D	? servo 13		Set zero
&h32E	? servo 14		Set zero
&h32F	? servo 15		Set zero
&h330	? servo 16		Set zero
&h331	? servo 17		Set zero
&h332	? servo 18		Set zero
&h333	? servo 19		Set zero
&h334	? servo 20		Set zero
&h335	? servo 21		Set zero
&h336	? servo 22		Set zero
&h337	? servo 23		Set zero
&h338	? servo 24		Set zero
&h339	? servo 25		

&h33A	? servo 26		
&h33B	? servo 27		
&h33C	? servo 28		
&h33D	? servo 29		
&h33E	? servo 30		
&h33F	? servo 31		
&h340	? servo 0		Set zero
&h341	? servo 1		Set zero
&h342	? servo 2		Set zero
&h343	? servo 3		Set zero
&h344	? servo 4		Set zero
&h345	? servo 5		Set zero
&h346	? servo 6		Set zero
&h347	? servo 7		Set zero
&h348	? servo 8		Set zero
&h349	? servo 9		Set zero
&h34A	? servo 10		Set zero
&h34B	? servo 11		Set zero
&h34C	? servo 12		Set zero
&h34D	? servo 13		Set zero
&h34E	? servo 14		Set zero
&h34F	? servo 15		Set zero
&h350	? servo 16		Set zero
&h351	? servo 17		Set zero
&h352	? servo 18		Set zero
&h353	? servo 19		Set zero
&h354	? servo 20		Set zero
&h355	? servo 21		Set zero
&h356	? servo 22		Set zero
&h337	? servo 23		Set zero
&h338	? servo 24		Set zero
&h339	? servo 25		
&h33A	? servo 26		
&h33B	? servo 27		
&h33C	? servo 28		
&h33D	? servo 29		
&h33E	? servo 30		
&h33F	? servo 31		
&h3C0			Set zero
&h4CA			Real time
&h4CB			Real time
&h4CC			Real time
&h4D2			Status byte
&h4D4			

&h4E7			Set zero
&h4E8			Set zero
&h4EB			Real time
&h4EC			Real time
&h4ED			Real time
&h4F2	Checksum High		Read controller
&h4F3	Checksum Low		Read controller