MECHATRONICS APPLICATION CENTER

COMMUNICATION WITH THE MCW151-E

INDEX

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0. INTRODUCTION

This document is intended to give a wide overview with all the communication possibilities of the MCW151 board from a practical point of view. The most common configurations are explained giving program examples, cable configuration and practical advices.

The detailed theory and specification is not explained as it already appears in the corresponding manual.

1. HOSTLINK SLAVE

1.0. Introduction

The Hostlink Slave protocol is the simplest way to communicate with a MCW151 with another device (that has to be Hostlink Master, of course), as it requires minimum programming. In fact, the only code needed is to set up the communication mode using SETCOM instruction. As default, the communication mode is set as free protocol:

E.g.: SETCOM (9600,7,2,2,1,5)
- Sets the communication as follows:
- Speed is 9600 baud
- 7 data bits
- 2 Stop bits
- Even parity
- Selected port 1 (RS232 port)
- Communication mode is Hostlink Slave

Other related commands are:

HLS_NODE: Sets the Slave node address. As default the address is 0. Change if a multi-slave communication (Hostlink n: 1) is going to be used.

HLS_MODEL: Defines the Hostlink slave model. As default the value is $FA. Normally it is not necessary to change this value.

From the master point of view, the VR (xxx) variables are equivalent to the CIO registers in a PLC and the TABLE (xxx) variables are equivalent to the DM registers.

1.1. Hostlink Slave with a NT31

The NT31 is one of the most popular Omron screens. Is a touch panel screen with quite high performance and reasonable price and it is ideal for its use in small machines that needs the screen directly attached to the MCW151.

SYSTEM CONFIGURATION:

The systems consist on an NT31-ST121-E connected using the RS422 in Hostlink slave configuration. In the MCW151 side, the only program needed is

SETCOM (9600,7,2,2,2,5)
Vr (0)=1

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To set the Port 2 as Hostlink slave protocol and give to the NT screen the order to go to the first screen (VR (0) has been programmed as control area). The program in the NT screen sends some data to the MCW151 that will be used to adjust the movements to the format of the product to do. A program like that can be used in a labelling machine, for example.

The NT screen only accepts the slave node number =0 (HLS_NODE=0).

HARDWARE CONNECTION:

The communication cable between the MCW151 and the NT is next:

NT31 PORT B	MCW151-E PORT 2
Pin 10 – SD+	Pin 2 – RD+
Pin 11 – RD+	Pin 5 – SD+
Pin 15 – SD-	Pin 1 – RD-
Pin 16 – RD-	Pin 4 – SD-

In the Port 2 configuration switch (SW 2) we have to set RS422 configuration and enable the terminating resistor:

SW2 pin	SETTING
1	OFF
2	OFF
3	ON
4	Not Used

PROGRAMS:

Check the 'NT31_labelling.onw' for the NT screen. For the MCW151 you only need to program:

```
SETCOM (9600,7,2,2,2,5)
Vr (0)=1
```

NUMBER FORMAT:

To have consistency in the format number, we have to program the variables in the NT31 as decimal number in both, the general configuration format and the variable format; otherwise you may mix hexadecimal and decimal formats.

The NT is working with words (16 bits). For positive numbers we have a range of 0 to 65535 and for signed numbers the range is from –32768 to 32767 in two's complement. Some conversions may be needed in the MCW151 basic program to guarantee that we are using the suitable data.

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1.2. Hostlink Slave with a NT4S-SF121B-E

The NTFK Screen family is the only Omron HMI family that support Hostlink n: 1 that is, one master screen communicating with several slaves.

Here there is an example of an application with this screen:

SYSTEM CONFIGURATION:

The system is a machine that has two axis with two MCW151-E. The machine has an NT4S-SF121B-E screen where we have to write the position and speed to go in the master axis and the synchronisation ratio in the slave axis. The current position of both axes is shown in another screen.

HARDWARE CONNECTION:

As it is a multi-point communication we will use RS-422 communication. The connection used is as follows:

NT4S (DB25 connector)	MCW151 n.1 (Port 2)	MCW151 n.2 (Port 2)
Pin 8 – Tx A	Pin 1 – RD-	Pin 1 – RD-
Pin 9 – Tx B	Pin 2 – RD+	Pin 2 – RD+
Pin 11 - GND	Pin 3 – GND	Pin 3 – GND
Pin 22 – Rx A	Pin 4 – SD-	Pin 4 – SD-
Pin 23 – Rx B	Pin 5 – SD+	Pin 5 – SD+

Besides it is necessary to add a **220 Ω resistor between RxB and 0V and another one between RxA and 24 Vdc.**

The switch settings is as follows:

In the NT4S Terminator ON in Transmission and in Reception (Termination SER1 RS485 1=ON, 2=ON)

In the MCW151 the SW2 is set as RS-422 and terminating resistor disabled (1=OFF, 2=OFF, 3=OFF)

PROGRAMS:

Check the programs NT4S.TSW and NT4S_with_MCW151.S3 (for the Screen), NT4S_DRIVE2.BAS (for the MCW151 address 2) and NT4S_DRIVE3.BAS (for the MCW151 address 3).

The NT4S.TSW program has two screens. In one you can change the absolute position to go to the driver 2 and the speed of this positioning. You can send the synchronisation ratio to driver 3. With F3 you enable both servos and with F4 you disable both servos.

The second screen shows the absolute position of both axes. You can change from one screen to the other by pushing either F1 of F2.

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NEGATIVE AND POSITIVE NUMBERS:

We are working with words (16 bit) in the NT4S then, the range for unsigned numbers is 0 to 65535; in the MCW151 we are working with floating point numbers then: the decimal part is discarded and in any number bigger than 65535, the NT only consider the 16 less significant bits, e.g. 65536 in the MCW151 is shown as 1 in the MCW151.

For signed numbers the range is from –32768 to 32767 in two's complement, that means that, for negative numbers we obtain:

NT2S	MCW151
0	0
1	1
32767	32767
-1	65535
-2	65534
-32767	32766
-32768	32768

For numbers in the MCW151 outside this range, only the 16 less significant bits are significant.

1.3. Hostlink Slave with a NT2S-SF122B-EV1

The NT2S family is the lowest range of MMI. It is cheap and simple and is adequate in combination with the MCW151 for the cheapest range of machines that includes motion controllers.

SYSTEM CONFIGURATION:

The application example is a feeder in a machine that cuts steel wire cable for the auxiliary automotive industry. The machine has to be very small in size and in price and, at the same time, has to be very fast and easy to change the product to produce (basically the feed length).

The MCW151-E together with the NT2S provides the optimum combination for this application.

HARDWARE CONNECTION:

As the NT2S has only RS232 port, we will use the Port1 in the MCW151-E (mini-Din connector). Besides, we will need an external 5 V supply, this power can be taken from the I/O connector (pin 7 –0V- and pin 8 –5V-). The cable will be as follows:

NT2S PLC Port	MCW151 Port 1	MCW151 I/O connector
Pin 4 (5V supply)		Pin 8 (5V Output)
Pin 5 (0V common)	Pin 7 (SG-1)	Pin 7 (0V Common)
Pin 6 (PLC TxD)	Pin 8 (RD-1)	
Pin 7 (PLC RxD)	Pin 6 (SD-1)	

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PROGRAMS:

Check the programs NT2S.HMI (and .TAG, .REG, .DEF and .KEY for the Screen), NT2S.BAS and UPDATE.BAS (for the MCW151).

The screen program consists on three screens, screen nº. 2 is to enter the length of the piece to do (VR (3) for the MCW151 or IR03 for the NT2S) and screen nº. 3 is to enter the number of pieces to do (VR (4) for the MCW151 or IR04 for the NT2S). You change from one to other screen with the 'NEXT' 'PREV' keys. From any of the screens you can send the order to start the operation (VR (5)=1 for the MCW151 or IR05=1 for the NT2S) by pushing F4.

Once the operation starts the MCW151 changes to the screen nº. 1. TABLE (0), for the MCW151, or DM00, for the NT2S, are registers used to change screens. From screen 1 it is possible to monitor the current position (TABLE (7) for the MCW151 or DM07 for the NT2S) and the number of pieces already done (TABLE (6) for the MCW151 or DM06 for the NT2S).

When the programmed number of pieces has been done, the MCW151 puts VR (5) back to 0, and order to go to screen number 2 and the sequence start again.

Besides, using the LED register, that is TABLE (1) for the MCW151 or DM01 for the NT2S, we give different visual signals depending on the status of the operation.

2. HOSTLINK MASTER

2.0. Introduction

The Hostlink master protocol allows one MCW151 to send basic Hostlink commands to read/write parameters from/to any Hostlink PLC. Multi-slave communication is available. The related commands and parameters are:

SETCOM (x,x,x,x,x,6)	Set communication as Hostlink Master protocol.
HLM_READ (x,x,x,x,x,x,x)	Reads from a Hostlink Slave.
HLM_WRITE (x,x,x,x,x,x,x)	Writes to a Hostlink Slave.
HLM_COMMAND (x,x,x,x,x)	Send a specified Hostlink command.
HLM_STATUS PORT (x)	Returns the status of the command sent to the specified port.
HLM_TIMEOUT	Set the timeout time for the slave response.

See the MCW151 manual for detail about those commands.

With this configuration is the MCW151 in Hostlink master who manages all the information exchange. As the communication commands may take a quite long time to execute, if the communication flux in an application is big, it is recommended to use a separate task just for the communication.

2.1. Hostlink Master communicating with a MCW151 in Hostlink Slave

When we have a machine with more than one MCW151 and you need to share information between them, the best solution is to communicate them using Hostlink protocol. This communication needs less wiring and is more flexible than other solutions like using digital I/O.

RS422 communication is preferred as it is more robust and can be used to communicate more than two units.

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One of the units will be programmed with Hostlink master protocol, and the rest as Hostlink slave protocol. The master unit will be responsible of writing, reading, and managing the information to the slaves. From the slave point of view, the communication is transparent.

SYSTEM CONFIGURATION

In the example we will have three MCW151 that will move in synchronisation. The synchronisation ratio must be modified depending on some conditions that depend on the torque in the three axes following a certain algorithm.

The MCW151 master reads the torque in the slaves via Hostlink, which performs the algorithm and writes the resultant synchronisation ratio to the slaves.

HARDWARE CONNECTION:

The cable between the MCW151 are (Port 2)

MCW151 Master	MCW151 Slave 1	MCW151 Slave 2
Pin 1 – RD-	Pin 4 – SD-	Pin 4 – SD-
Pin 2 – RD+	Pin 5 – SD+	Pin 5 – SD+
Pin 3 – GND		
Pin 4 – SD-	Pin 1 – RD-	Pin 1 – RD-
Pin 5 – SD+	Pin 2 – RD+	Pin 2 – RD+

In the Port 2 configuration switch (SW 2) we have to set RS422 configuration and enable the terminating resistor just in the first and last unit:

SW2 pin	MASTER	SLAVE 1	SLAVE 2
1	OFF		
2	OFF		
3	ON	OFF	ON
4	Not Used		

PROGRAMS:

In the Slave unit 1 we have to set:

```
SETCOM (9600,7,2,2,2,5)
HLS_NODE=1
```

And in the Slave unit 2:

```
SETCOM (9600,7,2,2,2,5)
HLS_NODE=2
```

In the master, the communication setting will be:

```
SETCOM (9600,7,2,2,2,6)
HLS_NODE=0
```

See the programs: TORQUE_MASTER.BAS, TORQUE_SLAVE1.BAS, TORQUE_SLAVE2.BAS and MASTER_MOVEMENT.BAS.

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2.2. Hostlink Master communicating with a CPM2C PLC in Hostlink

The CPM2C is one of the smallest PLC. For small machines it is the perfect solution for controlling the sequence while the MCW151 is controlling the position.

SYSTEM CONFIGURATION:

The application will consist in a machine with a CPM2C PLC connected with a MCW151 using RS232 port in Hostlink protocol. As the CPM2C does not directly support Hostlink master, the MCW151 will handle the communication.

HARDWARE CONNECTION:

To communicate with the PLC and, at the same time, program and debug the application in the MCW151, we will use the 'Splitter cable' and the cable 'CS1W-CN118', that connects to the peripheral port in the PLC:

DESCRIPTION	MCW151 Side (mini DIN male)	Port 0 (mini DIN female)	Port 1 (DB-9 female)
Not used	Pin 1		
RS-1 (Out)	Pin 2		Pin 4
SD-0 (Out)	Pin 3	Pin 3	
SG-0	Pin 4	Pin 4	
RD-0 (In)	Pin 5	Pin 5	
SD-1 (Out)	Pin 6		Pin 2
SG-1	Pin 7		Pin 9
RD-1 (In)	Pin 8		Pin 3

Splitter cable pin-out:

The cable from the splitter (DB-9) to the communication (you have to make by yourself) is:

DESCRIPTION	DB-9 from Splitter	CS1W-CN118 (PC side)
RD-1 (In)	Pin 3	Pin 2 (SD)
SD-1 (Out)	Pin 2	Pin 3 (RD)
SG-1	Pin 9	Pin 9 (Common)
RTS CTS		Pin 4 & Pin 5 Join together.

PROGRAMS:

Not special programming is necessary in the PLC side as it has Hostlink slave as standard communication. In the MCW151, check the program CPM2C_TEST.BAS, this is only a test program that writes to some PLC area, read the data again, and shows the result in the terminal screen in the MP II.

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3. FREE PROTOCOL

3.0. Introduction

The MCW151 has the possibility of create, using BASIC instructions, a customized protocol to communicate serially with any device. To create in this way your own protocol is very complex and, normally, alternative solutions are preferred. But, at the same time, this possibility gives a great flexibility that makes possible to match a wider variety of application.

A serial protocol programmed in this way is not safe and not any critical operation of the machine should rely in this communication.

Examples can be: Temperature controllers, PLC from different makers or, as in the example, with an inverter.

3.1. MODBUS Master protocol with 3G3MV inverter

With a single MCW151 it is possible to command two MV inverters. This feature can be very useful, for example, in a small machine that needs to be fully commanded by a NT screen connected to the PORT 1. PORT 1 will be programmed as Hostlink slave protocol.

The machine has the controlled servomotor to make the motion part (flying shear) and two MV inverters, one to set the line speed and the second one to evacuate the cut material. From the screen it is programmed the length to cut, the line speed and the evacuation speed and the MCW151 will write this speeds to the MV inverters, connected to the PORT 2 via MODBUS. PORT 2 is programmed as a free protocol. In this case, if the communication with the inverters fails, simply, the machine does not change its speed and the operator has to retry. Retries and timeout errors can be programmed via basic program.

SYSTEM CONFIGURATION:

The system has two axes with one MCW151-E and two 3G3MV. The program example does not intend to simulate any specific application (like the explained above), simply to give you the communication subroutine already made and a system to easily make your own test.

The modbus protocol is the same for al the Omron inverter family with very little variation, then, this example can be easily adapted to the rest of inverter family.

HARDWARE CONNECTION:

The cable between the devices is:

MCW151 (PORT 2)	3G3MV node 2	3G3MV node 3
Pin 1 -- RD-	S-	S-
Pin 2 -- RD+	S+	S+
Pin 3 -- GND		
Pin 4 -- SD-	R-	R-
Pin 5 -- SD+	R+	R+

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The communication switch in the MCW151 is set to RS422 (SW2.1=OFF and SW2.2=OFF) and the terminating resistor is enabled (SW2.3=ON).

PROGRAMS:

The configuration in both inverters is explained in the MODBUS program as a comment:

And the program with the communication subroutine is in the MODBUS.BAS program. For easy testing the required information for the communication is written in VR's variables. In this way is easy to make test and to transmit/receive registers using the terminal screen in the 'Motion Perfect II' software tool. At the same time, you can use another program to set the modbus commands while MODBUS.BAS is dealing with the communication.

The program RAMPS.BAS, (running in parallel with MODBUS.BAS) is reading the speed in both inverters and changing the sense of rotation when the motor reaches the programmed frequency.

4. DEVICENET COMMUNICATION (MCW151-DRT only)

4.0. Introduction

When a fast transfer of information is needed between several MCW151 and a master is needed, we can use the DEVICENET communication bus. DEVICENET is an industrial communication bus that has a speed up to 500 Kbps.

The MCW151-DRT is the Device-net version of the MCW151 board, the PORT 2 is a Device-net slave port that is dip-switch configurable and support polling and explicit messages. The polling area can be configured as 2-word in/2-word out or 4-word in/4-word out; one '.eds' file for each mode will be available.

4.1. Application example:

There are two ways to communicate a Device-net master with a Device-net slave: Polling and explicit messages. Polling is an automatic read/write of certain registers every certain time, and explicit messages is an explicit request of write or read registers following a certain protocol.

If possible, the simplest solution is to use just the polling transmission, as it is easiest that using explicit messages communication. On the contrary, explicit messages are more flexible, but needs some programming.

The next example shows how to configure a system to use polling communication.

SYSTEM CONFIGURATION:

As a master we used a CS1G PLC with a DRM21 Device-net master board. The DRM21 board is set as address 63 and the speed to 500 Kbps.

As a slave we used a MCW151-DRT configured as slave nº 1, speed is 500Kbps and polling area is set as 4 word in / 4 word out.

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HARDWARE CONNECTION:

The slave is a MCW151-DRT with the next setting via dip-switch:

SW nº.	Setting	Description
1	ON	Slave address set to 01
2	OFF	
3	OFF	
4	OFF	
5	OFF	
6	OFF	
7	ON	Polling set as 4 word in / 4 word out
8	OFF	Not used
9	OFF	Speed set to 500 Kbps
10	ON	

The communication cable is next:

DRM21 connector	MCW151-DRT Port 2	Description
1	1	+V in (24 Vdc)
2	2	CAN-H
3	3	Shield
4	4	CAN-L
5	5	-V in (0 Vdc)

Besides, we connect a DRS1-T terminal resistor between CAN-H and CAN-L.

PROGRAMS:

The only special program needed for the device-net communication is the device-net configurator program: DEVICENET4+4.PNF. In this example we will use just the polling communication programmed as 4 word in / 4 word out.

From the PLC point of view you just read and write from/to the programmed memory area, from the MC point of view the communication is transparent too: read/write from/to the VR variables.

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