UDP command mode

Introduction

Starting with firmware version 2.62, all Copley EtherCAT based *plus* drives support a mode in which the drive will accept serial port commands transmitted over the drive's Ethernet ports.

This mode allows multiple drives to be easily wired using standard Ethernet wiring and switches, and controlled from a PC without the need for an EtherCAT master.

Drive commands are formatted using either the binary serial format, or the ASCII format. The commands and responses are transmitted using standard UDP packets on the Ethernet interface.

Configuration

To enable UDP command mode, two parameters need to be set on the drive:

Parameter 0x121 (Network configuration) should be set to the value 0x0200. This configures the drive to listen for UDP packets addressed to it.

Parameter 0x11F (IP address) should be set to a valid IPV4 address for the Ethernet network that the drive is attached to.

IP addresses are normally written out as a series of four decimal values separated by periods such as:

    192.168.1.1

When passed to parameter 0x11F, the four decimal values should be packed into a single 32-bit value in little endian format. That is, the right most digit in the IP address is the most significant byte in the 32-bit value. The IP address 192.168.1.1 would be formatted as 0x0101A8C0.

Binary serial commands

Copley's binary serial command protocol is documented in an application note which can be downloaded from the following location:

   http://www.copleycontrols.com/Motion/pdf/Binary-Serial.pdf

As described in that applications note, binary serial commands sent over the serial port start with a 4 byte header consisting of a node number, checksum byte, command op-code, and number of words of data to follow. Following that header are zero or more 16-bit words of data. Each data word is transmitted most significant byte first.

When binary serial commands are sent via the UDP interface, the node number and checksum are dropped. The header sent with the UDP data consists of two bytes; the command opcode first and the number of words of data second. That's followed by the command data sent as a series of words transmitted most significant byte first.

This serial command (header plus data) should be sent to the drive as a UDP packet addressed to the drive's IP address and port number 19660. The drive will process the command and send a UDP packet back to the originating IP address and port number containing the drive's response to the command.

Binary serial responses from the drive are formatted as a two byte header consisting of an error code and number of words of data, followed by the response data sent as a sequence of 16-bit words sent most significant byte first.

ASCII commands

The drive will also listen on UDP port 19658. UDP packets sent to this address will be treated as ASCII formatted strings. The drive will process the ASCII command and send a UDP packet containing the ASCII formatted response.

For details on Copley's ASCII command structure, please see the following document:

http://www.copleycontrols.com/Motion/pdf/ASCII_ProgrammersGuide.pdf

IP Address assignment

It's possible to use a simple UDP based protocol to query any Copley drives on a network and set their IP addresses. To do so, broadcast a UDP packet to port 19659. The contents of this packet must consist of 5 32-bit words sent in little endian format.

Word	Value
1	Constant 0x6c706f43
2	Constant 0x49207965
3	Constant 0x74657350
4	Drive serial number, or 0xFFFFFFFF
5	IP address to assign, or 0xFFFFFFFF

The first three words are just constant values. They are used to prevent the drive's IP address from accidentally being changed due to other network traffic which just happens to broadcast to the same UDP port. If the drive sees a UDP packet to this port which doesn't contain these 'magic numbers', it will ignore the packet.

The serial number field identifies which drive or drives are being targeted by the command. If this field is set to 0xFFFFFFFF, then the message is addressed to all drives on the network and all drives will send a response packet. For any other value, only the drive who's serial number matches the value in the message will respond to the packet.

The IP address field can be used to set a drive's IP address. The drive receiving the packet will update it's current IP address field to the passed value if the serial number matched. In the case of a serial number of 0xFFFFFFFF, the drive's IP address will not be changed.

If the IP address contained in the packet is not zero, then all drives responding to the packet will use this IP address in the header of their UDP response packet. If the passed IP address is zero, then drives will respond using their currently programmed IP address. Note that if the drive's IP address is invalid for the local network, then the master may not be able to receive the response.

Any drive which responds this UDP packet will send a response packet containing the following data:

Word	Value
1	Constant 0x6c706f43
2	Constant 0x49207965
3	Constant 0x74656750
4	Drive serial number
5	IP address

The response starts with three constants (note that the third is slightly different then the transmit constant), followed by the drive's serial number and IP address.

The master can check to see what drives are listening on the network by sending a packet with the serial number set to 0xFFFFFFFF. Since this is a broadcast to all drives, none of the drives will update their IP address upon receiving the packet. All drives will respond with a message containing their serial numbers and currently programmed IP address.

If the IP address sent with such a broadcast packet is non-zero, then all drives will use that IP address in the IP header of the response packet. This can be useful because on many systems it's not possible for the master to receive a response if the IP address of the transmitting drive is not valid for the network. Sending a valid IP address for the network in a broadcast packet will cause all responding drives to use that address in the header fields of the response packet which should allow the master to receive their responses. Note that this IP address is used in the Ethernet packet header only, the actual programmed IP address will still be sent in the UDP data as described above.

After querying the network, the master can then assign IP addresses to individual drives by addressing packets to their individual serial numbers.

Version 4.14 firmware updates

Version 4.14 firmware added some new features to the UDP interface on the drives.

Starting with this firmware version the drives now integrate a simple Ethernet switch internally. Any message received from one of the drive's Ethernet port which isn't specifically addressed to that drive's MAC address will be retransmitted out the other Ethernet port. This allows the drives to be daisy chained if desired.

Version 4.14 firmware also adds support for DHCP client mode. This feature is enabled by setting bit 0 of the network configuration parameter (0x121). When DHCP support is enabled, the drive firmware will attempt to obtain an IP address from a DHCP server on the network. Once an IP address is received from that server, the drive will update the value of the IP address saved to flash in parameter 0x11F and will request the same IP address from the DHCP server on the next power up.

Revision History

Date	Version	Revision
5/5/2020	Rev 00	Initial release