DL3500-DH+/MODBUS
COMMUNICATION CONTROLLER APPLICATION NOTE

This application note contains information on the DL3500-Modbus to DH+ interface. The DL3500 model contains two modes of operation, Modbus Master and Modbus Slave, which are selectable by the PC Configuration Software. The latest version is available on the web at http://www.equustek.com/downloads.html

The information contained in this application note is supplementary information specific to Modbus not contained in the regular User's Guide.

Master or Slave mode?

This application note is divided into two parts, Modbus Master and Modbus Slave modes; they correspond to the mode the DL3500 is going to be on the Modbus Network, and which side either DH+ or Modbus the commands will be initiated on.

Master mode is used when a device on the DH+ network is going to initiate all communications with one or many Modbus slave devices. **Please Refer to DL3500-DH+/Modbus Master Application note.**

Slave mode is used when a device on the Modbus network is going to initiate all communications with one or many SLC's, PLC's or other DH+ devices. **Please Refer to DL3500-DH+/Modbus Slave Application note.**

The application notes generally assume that a SLC or other DH+ device which can originate commands to Modbus via a DL3500 in master mode, or responding to Modbus commands via a DL3500 in slave mode. Only devices capable of transmitting DH+ message commands in PLC5 (or PLC3) format and able to receive DH+ message commands in PLC5 format can be used with the DL3500-Modbus/DH+ including SLC's, MicroLogix's, ControlLogix's and HMIs as well as other intelligent devices.

Due to differences between DH+ and Modbus protocols and the universal design of the DL3500 there are differences between the lengths of messages, error handling and addressing which have to be carefully considered by the Systems Designer, Programmer and Installer.

CAUTION:
Incorrect configuration may result in unsafe operation, damage to equipment or safety hazard to personnel.
Read the DL3500 User's Guide and the appropriate application notes carefully before putting a DL3500 on-line.
The hardware and software must be fully tested off-line in a safe "TEST" environment prior to putting the unit on-line in an operational environment.

DL3500-DH+ MODBUS MASTER TO A-B DH+ CONFIGURATION
Use this option when the DL3500 is required to be the master on a Modbus network.

The Modbus Master Application notes contain configuration information for the DL3500-DH+ protocol and should be used in conjunction with the DL3500 User's Guide.

DL3500-DH+ MODBUS SLAVE TO A-B DH+ CONFIGURATION
Use this protocol when the DL3500 is required to be a slave device on a Modbus network.

The Modbus Master Application notes contain configuration information for the DL3500-DH+ protocol and should be used in conjunction with the DL3500 User's Guide.

NOTES:

1. The unit that you have received can be configured as Modbus Master or Modbus Slave.
   Ensure that you understand and carefully follow the specific configuration procedures for the Modbus protocol.

2. **There are significant differences between the configuration, programming and operational requirements of the Modbus Master and Modbus Slave protocols.**

3. If you configure the DL3500 for Modbus Master Operation it must be the only master on the Modbus network. A station on DH+ originates commands to the DL3500-DH+ Modbus Master that then re-transmits them over Modbus to a Modbus Slave device. Other intelligent DH+ devices capable of initiating DH+ messages in PLC5 (or PLC3) format and able to receive PLC5 message commands could also be used as the DH+ "master".

4. Be sure to fully test the hardware and software off-line to ensure that you understand its configuration and operation. Prior to putting the DL3500 on-line in an production process, the operation of the complete system should be fully tested on-line in a safe "test" environment.

5. Due to differences between DH+ and Modbus hardware and software, there are differences between the lengths of messages, error handling and addressing which have to be carefully considered by the Systems Designer, Programmer and Installer.

6. Additional literature regarding DH+, Modbus and PLC products can be obtained from Modicon and A-B. Suggested reference materials for A-B DH+ protocol is shown in section 1.7 of the User's Guide.

CAUTION:

Incorrect configuration may result in unsafe operation, damage to equipment or safety hazard to personnel.
Read the DL3500 User's Guide and the appropriate application notes carefully before putting a DL3500 on-line.
The DL3500 hardware and software must be fully tested off-line in a safe "TEST" environment prior to putting the unit on-line in an operational environment.

Contact Technical Support if you need further information or assistance.

TECHNICAL SUPPORT
Tel : (604) 266-8547
Or E-Mail: info@equustek.com

The following table provides a reference between the different radixes used for your reference

DECIMAL TO OCTAL TO HEXADECIMAL ADDRESS CONVERSION TABLE

DEC	OCT	HEX	DEC	OCT	HEX	DEC	OCT	HEX	DEC	OCT	HEX
00	00	00	16	20	10	32	40	20	48	60	30
01	01	01	17	21	11	33	41	21	49	61	31
02	02	02	18	22	12	34	42	22	50	62	32
03	03	03	19	23	13	35	43	23	51	63	33
04	04	04	20	24	14	36	44	24	52	64	34
05	05	05	21	25	15	37	45	25	53	65	35
06	06	06	22	26	16	38	46	26	54	66	36
07	07	07	23	27	17	39	47	27	55	67	37
08	10	08	24	30	18	40	50	28	56	70	38
09	11	09	25	31	19	41	51	29	57	71	39
10	12	0A	26	32	1A	42	52	2A	58	72	3A
11	13	0B	27	33	1B	43	53	2B	59	73	3B
12	14	0C	28	34	1C	44	54	2C	60	74	3C
13	15	0D	29	35	1D	45	55	2D	61	75	3D
14	16	0E	30	36	1E	46	56	2E	62	76	3E
15	17	0F	31	37	1F	47	57	2F	63	77	3F

APPLICATION NOTE

DL3500-Modbus/DH+ - MASTER PROTOCOL

The information contained in this application note is for the Modbus Master protocol only, and is supplementary to the information in the User's Guide. To use the DL3500 in Modbus Slave Mode follow the procedures in the Modbus Slave application notes. **There are significant differences between the configuration, programming and operational requirements of Modbus Master and Modbus Slave protocols.**

INDEX FOR MODBUS MASTER MODE

1.0   GENERAL

The DL3500 can be configured as a Modbus network "Master". In this mode it enables SLC's and other devices on a DH+ network to initiate various commands to read and write coils, inputs and registers of slave devices on a Modbus network. The Modbus interface can be set for RS232 or RS422/RS485. Typical DH+ stations that can communicate with Modbus via the DL3500 include devices such as PLC3s, PLC5s, SLC5/04s, PCs, HMIs and other intelligent OEM devices. **(Now referred to as PLC's in this document)**
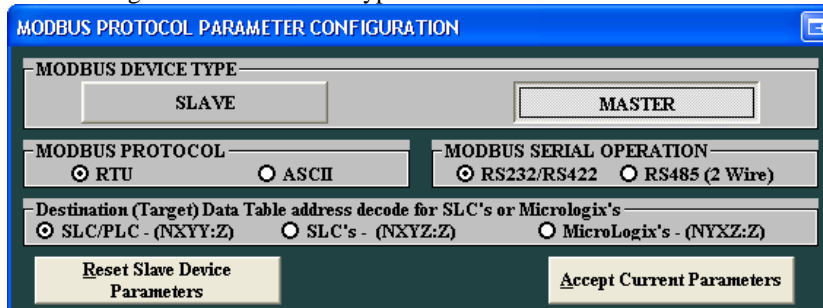<u>**Communication between Modbus and the DL3500 must be initiated from a DH+ PLC.**</u>

The DL3500 must be the only Master on the Modbus network and does not require a Modbus address. The DL3500 is an active station on DH+ and requires a unique DH+ station address number**. The DL3500 can accept PLC3 Word Range Read/Write or PLC5 Typed Read/Write message commands from any station on the DH+ network.**

The Destination Data Table Address or TAG is normally used to address a specific File and Word in another PLC on the network. This address is interpreted by the DL3500 in a specific way and permits data to be mapped from a PLC and a Modbus slave device. This allows the PLC programmer to directly address a specific register in a Modbus slave device without any previous configuration being necessary in the DL3500.

1.1   ADDRESS MAPPING BETWEEN A-B AND MODBUS

The design of the DL3500 Modbus Master and the PLC message command structure allows the DL3500 to use the contents of the Destination Data Table Address in the PLC for direct address mapping to Modbus. The DL3500 decodes the Destination DT Address to access to various Modbus Slave stations, commands and addresses. The actual Modbus station number and addresses ranges that can be accessed depends on the PLC type, DH+ message type and Programming software used.

In the configuration software the type of PLC used is selected. See below.

Modbus Parameters-DL32 V3.10

Destination (Target) Data Table Address Decoding Options for Allan-Bradley PLC5 Type commands (Used by SLC's and PLC's):

PLC's and SLC's - (NXYY:Z)

Use this format if the SLC, PLC, or other device allows up to 999:9999 to be entered for the file:word.

- X – Registers or Coils
  - 0 = 0X,   1 = 1X,   3 = 3X,   4 = 4X
- YY – Slave address
  - 1 to 99
- Z – Register address
  - 1 to 9999

Example: N41:3036 will access register 43036 from Modbus Slave address 1.

SLC's - (NXYZ:Z)

Use this format if the SLC, PLC, or other device allows up to 999:999 to be entered for the file:word.

- X – Registers or Coils
    - 0 = 0X,   1 = 1X,   3 = 3X,   4 = 4X
- Y – Slave address
    - 1 to 9
- Z:Z – Register address
    - Z before the colon ':' – Thousands digit
        - 0 to 9
    - Z after the colon ':' – Ones to Hundreds digits
        - 0 to 999

Example: N413:36 will access register 43036 from Modbus Slave address 1.

NOTE: Z:Z cannot equal 0:0. The minimum value for Z:Z is 0:1.

MicroLogix's and SLC's - (NYXZ:Z)

Use this format if the SLC, PLC, or other device allows up to 255:255 to be entered for the file:word.

- Y – Slave address
    - 0 = slave address 1,   1 = slave address 2,   2 = slave address 3
- X – Registers or Coils
    - 0 = 0X,   1 = 1X,   3 = 3X,   4 = 4X
- Z:Z – Register address
    - Z before the colon ':' – Thousands digit
        - 0 to 9
    - Z after the colon ':' – Ones to Hundreds digits
        - 0 to 255

Example: N43:36 will access register 43036 from Modbus Slave address 1.

NOTES: 1. Z:Z cannot equal 0:0. The minimum value for Z:Z is 0:1.
2. Slave address 3 cannot access registers or coils above 5255.

For more information about using PLC-5 Typed Commands with the decoding formats shown above, refer to section 1.2.4 of this manual.

1.1.1   DESTINATION DATA TABLE ADDRESS FORMAT

If a PLC is being used to generate messages for the DL3500 to convert and send to a Modbus network, values are entered into the Destination Data Table Address of the PLC's DH+ Message Command in the format below. MMI's and other applications would have a similar destination address structure for reading and writing data to and from a PLC (refer to your OEM application documentation).

When a PLC is communicating with other devices over the DH+ network, the destination data table address (DDTA) has different meanings depending on whether it is communicating with another PLC *or* if it is communicating with a DL3500 Modbus Master. Below are descriptions of the different meanings for the DDTA.

> The usual format of the destination data table address (DDTA) is: **T F : e**
> T, F, and e are explained below.

Communicating with another PLC on the DH+ network

- T = File Type   (O = output, I = input, B = binary, N = integer, etc.)
- F = File Number   (0 - 63, 0-255, 0 - 999, or 0 - 9999) [*]
- e = Word Number   (0 - 255, 0 - 999 or 0 – 9999) [*]

Communicating with a DL3500 Modbus Master on the DH+ network using PLC-3 commands

Data and Control Functions

- T = Modbus Command   (B, N, S, F)
- F = Modbus Slave Address   (1 - 255)
- e = Modbus Coil/Register   (1 - 9999)

Diagnostic Functions   (Dxyyy:zzzz)

- T = Modbus Command   (D)
- F = Sub-function Command / Slave Address   (xyyy)
- e = Sub-function Command / Data   (zzzz)

For more details about mapping the data and control functions and the diagnostic functions using PLC-3 commands, see section 1.2.3

Communicating with a DL3500 Modbus Master on the DH+ network using PLC-5 commands

Data and Control Functions (includes Diagnostic Function)

- T = Not used [**]
- F = PLC-5 Decoding Format   (NXYY:Z, NXYZ:Z, or NYXZ:Z Format)
- e = PLC-5 Decoding Format   (NXYY:Z, NXYZ:Z, or NYXZ:Z Format)

For more details about mapping the data and control functions and the diagnostic functions using PLC-5 commands, see sections 1.1 and 1.2.4

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[*]   Depends on PLC type.
[**] To avoid errors when downloading your program to the PLC, a file type is needed so that a legal format for the DDTA is used.

1.2   DH+ AND MODBUS COMMANDS

1.2.1   DH+ MESSAGE COMMANDS

The DL3500-DH+ set to Modbus Master Mode can generate Modbus protocol functions on receipt of the following DH+ message commands:

- PLC-3 Word Range Read or Word Range Write Commands
- PLC-5 Typed Read or Typed Write Commands
- PLC-5 Word Range Read and Writes

A-B PLCs can generate the following commands:

- SLC's   PLC-5 Typed Read/Write Commands
- PLC-3   PLC-3 Word Range Read/Write Commands
- PLC-5   PLC-3 Word Range Read/Write Commands and PLC-5 Typed Read/Write Commands

1.2.2   MODBUS COMMANDS

The Modbus commands and addresses that can be generated depend on the specific DH+ message command received. The DL3500-DH+ in Master Mode is designed to work with DH+ message commands including PLC-5 Typed Read and Write and PLC-3 Word Range Read and Write. Use the PLC-3 Word Range Read and Write commands whenever possible because the larger address field of these commands provides the additional flexibility necessary to generate the full range of Modbus commands and addresses.

1.2.3   PLC-3 WORD RANGE COMMANDS (PLC-3's and 5's)

MODBUS DATA AND CONTROL COMMANDS USING PLC-3 WORD RANGE READ / WRITE COMMANDS

On receiving a PLC-3 Word Range Read or Word Range Write Message Command (MC) a DL3500 Modbus Master decodes the command's Destination Data Table Address (DDTA) File type (character). Then, dependent on whether the DH+ message is a read or a write it can generate the appropriate Modbus command as shown in the table below.

The following DDTA format is used for mapping PLC-3 Word Range
Read/Write commands to Modbus commands:

x y : z

Where   x = File Type   y = File Number   z = Word Number

Data and Control Commands

Destination Data Table Address				Modbus		
Message Type	File Type x	File Number (Slave Address) y	Word Number (Register) z	Modbus Command	Description	Register/Coil Reference
Read	B	1-255	1-9999	01	Read Coil Status	0X
Read	F	1-255	1-9999	02	Read Input Status	1X
Read	N	1-255	1-9999	03	Read Holding Registers	4X
Read	S	1-255	1-9999	04	Read Input Registers	3X
Write	F	1-255	1-9999	05	Force Single Coil	0X
Write	S	1-255	1-9999	06	Pre-set Single Register	4X
Write	B	1-255	1-9999	15	Force Multiple Coils	0X
Write	N	1-255	1-9999	16	Pre-set Multiple Registers	4X
Write	F, S, B, N	0	1-9999	5, 6, 15, 16	Broadcast Command	0X and 4X

Note: For Modbus command 05, set the first word of data in the PLC data table to FF00 (hex) to turn the coil **ON** and 0000 to turn the coil **OFF**.

1.2.3.1 MODBUS DIAGNOSTICS COMMANDS

MODBUS DIAGNOSTIC COMMANDS USING PLC-3 WORD RANGE R/W COMMANDS

Diagnostic Sub-functions

Destination Data Table Address				Modbus		
Message Command	File Type **x**	File Number **y**	Word Number **z**	Modbus Command	Diagnostic Sub-function	Description
Read	D	00	Data Value	08	00	Return Data Query (Loop-back)
Write	D	00	0 – 255	08	01	Restart Communications
Read	D	09	02	08	02	Return Diagnostic Register
Write	D	01	Char (Dec)	08	03	Change ASCII Input Delimiter
Write	D	09	04	08	04	Force Listen Only Mode
Write	D	09	10	08	10	Clear Counters and Diagnostic Registers
Read	D	09	11	08	11	Return Bus Message Count
Read	D	09	12	08	12	Return Bus Communication Error Count
Read	D	09	13	08	13	Return Bus Exception Error Count
Read	D	09	14	08	14	Return Slave Message Count
Read	D	09	15	08	15	Return Slave No Response Count
Read	D	09	16	08	16	Return Slave NAK Count
Read	D	09	17	08	17	Return Slave Busy Count
Read	D	09	18	08	18	Return Bus Character Overrun Count
Read	D	09	19	08	19	Return IOP Overrun Count (884)
Write	D	09	20	08	20	Clear Overrun Counter and Flag (884)

1.2.4 PLC-5 TYPED R/W & WORD RANGE R/W (PLC-5's and SLC's)

MODBUS DATA AND CONTROL COMMANDS USING PLC-5 TYPED READ / WRITE COMMANDS

On receiving a PLC-5 Typed Read or Word Range Write Message Command (MC) a DL3500-DH+ Modbus Master decodes the command's Destination Data Table Address (DDTA) File type (character). Then, depending on whether the DH+ message is a read or a write command, it can generate the appropriate Modbus command as shown below.

1.2.4.1 PLC5 TYPED COMMANDS USING NXYY:Z DECODE

Use this format if the SLC, PLC, or other device allows up to 999:9999 to be entered for the file:word. This format allows access to all Modbus registers and coils for slaves 1 to 99.

Data and Control Commands – NXYY:Z

Destination Data Table Address				Modbus		
Message Type	Register / Coil Reference **X**	Slave Address **YY**	Register / Coil Address **Z**	Modbus Command	Description	Register/Coil Reference
Read	0	01-99	1-9999	01	Read Coil Status	0X
Read	1	01-99	1-9999	02	Read Input Status	1X
Read	4	01-99	1-9999	03	Read Holding Registers	4X
Read	3	01-99	1-9999	04	Read Input Registers	3X
Write	1	01-99	1-9999	05	Force Single Coil	0X
Write	3	01-99	1-9999	06	Pre-set Single Register	4X
Write	0	01-99	1-9999	15	Force Multiple Coils	0X
Write	4	01-99	1-9999	16	Pre-set Multiple Registers	4X

Note: Leading zeros in the Destination Data Table Address can be left out.

1.2.4.2   PLC5 TYPED COMMANDS USING NXYZ:Z DECODE

Use this format if the SLC, PLC, or other device allows up to 999:999 to be entered for the file:word. This format allows access to all Modbus registers and coils for slaves 1 to 9.

Data and Control Commands – NXYZ:Z

| Destination Data Table Address | | | Modbus | | |
Message Type	Register / Coil Reference **X**	Slave Address **Y**	Register / Coil Address **Z:Z**	Modbus Command	Description	Register/Coil Reference
Read	0	1-9	0-9 : 0-999	01	Read Coil Status	0X
Read	1	1-9	0-9 : 0-999	02	Read Input Status	1X
Read	4	1-9	0-9 : 0-999	03	Read Holding Registers	4X
Read	3	1-9	0-9 : 0-999	04	Read Input Registers	3X
Write	1	1-9	0-9 : 0-999	05	Force Single Coil	0X
Write	3	1-9	0-9 : 0-999	06	Pre-set Single Register	4X
Write	0	1-9	0-9 : 0-999	15	Force Multiple Coils	0X
Write	4	1-9	0-9 : 0-999	16	Pre-set Multiple Registers	4X

Notes: 1.   Leading zeros in the Destination Data Table Address can be left out.
2.   Register/Coil Address
- Z before the colon ':' – Thousands digit
- Z after the colon ':' – Ones to Hundreds digits

1.2.4.3   PLC5 TYPED COMMANDS USING NYXZ:Z DECODE

Use this format if the SLC, PLC, or other device allows up to 255:255 to be entered for the file:word. This format allows access to certain Modbus registers and coils for slaves 1 to 3.

Data and Control Commands – NYXZ:Z

| Destination Data Table Address | | | Modbus | | |
Message Type	Slave Address **Y**	Register / Coil Reference **X**	Register / Coil Address **Z:Z**	Modbus Command	Description	Register/Coil Reference
Read	0-2	0	0-9 : 0-255	01	Read Coil Status	0X
Read	0-2	1	0-9 : 0-255	02	Read Input Status	1X
Read	0-2	4	0-9 : 0-255	03	Read Holding Registers	4X
Read	0-2	3	0-9 : 0-255	04	Read Input Registers	3X
Write	0-2	1	0-9 : 0-255	05	Force Single Coil	0X
Write	0-2	3	0-9 : 0-255	06	Pre-set Single Register	4X
Write	0-2	0	0-9 : 0-255	15	Force Multiple Coils	0X
Write	0-2	4	0-9 : 0-255	16	Pre-set Multiple Registers	4X

Notes: 1.   Leading zeros in the Destination Data Table Address can be left out.
2.   Register/Coil Address
- Z before the colon ':' – Thousands digit
- Z after the colon ':' – Ones to Hundreds digits
- Register and coil addresses range from 1-255, 1000-1255, 2000-2255, etc.
3.   Slave Address
- 0 = slave address 1,   1 = slave address 2,   2 = slave address 3
4.   Slave address 3 cannot access registers or coils above 5255.

1.2.4.4 MODBUS DIAGNOSTIC COMMANDS

MODBUS DIAGNOSTIC COMMANDS USING PLC-5 TYPED READ / WRITE COMMANDS

When using PLC-5 Typed Read / Write commands, the Diagnostic commands have the following PLC-3 address format:

$$DXyyy:ZZZZ$$

Diagnostic Sub-functions

Destination Data Table Address				Modbus		
Message Command	X	Slave Address yyy	Sub-function or Data Field ZZZZ	Modbus Command	Diagnostic Sub-function	Description
Read	0	1-255	Data	08	00	Return Data Query (Loop-back)
Write	0	1-255	Data	08	01	Restart Communications
Read	9	1-255	2	08	02	Return Diagnostic Register
Write	1	1-255	Char (Dec)	08	03	Change ASCII Input Delimiter
Write	9	1-255	4	08	04	Force Listen Only Mode
Write	9	1-255	10	08	10	Clear Counters and Diagnostic Registers
Read	9	1-255	11	08	11	Return Bus Message Count
Read	9	1-255	12	08	12	Return Bus Communication Error Count
Read	9	1-255	13	08	13	Return Bus Exception Error Count
Read	9	1-255	14	08	14	Return Slave Message Count
Read	9	1-255	15	08	15	Return Slave No Response Count
Read	9	1-255	16	08	16	Return Slave NAK Count
Read	9	1-255	17	08	17	Return Slave Busy Count
Read	9	1-255	18	08	18	Return Bus Character Overrun Count
Read	9	1-255	19	08	19	Return IOP Overrun Count (884)
Write	9	1-255	20	08	20	Clear Overrun Counter and Flag (884)

1.2.5 BROADCAST COMMAND

A-B's DH+ network does not typically support Broadcast. However, using a PLC message command with the Destination Data Table Address containing a File Address of 0 in the write commands specified in sections 1.3.1 and 1.3.2 above will generate a Modbus Broadcast command to all Modbus Slave stations. The DL3500-DH+ will not get an "ACK" response to a Broadcast command from any Modbus slave device.

Note: This is not supported for section 1.2.4.3 PLC-5 Typed commands using the NYXZ:Z decode option.

1.3   DH+ MESSAGE COMMAND

To read and write to slave devices on Modbus it is necessary to program DH+ message instructions in one (or more) active PLC's on the DH+ network. You can use either PLC-3, PLC-5 Word Range Read / Write or PLC-5 Typed Read / Write communication commands. Below is an example of a message that uses RSLogix to write 10 words of data starting from N7:0 to Modicon holding registers 40001 to 40010 in slave device 4 using PLC-5 NXYZ:Z decoding format.

Setup for the DL3500 Modbus Master using the RSLogix message instruction

Entering either a "PLC-5 Typed Read/Write" or "PLC-3 Word Range Read/Write" in the *Communication Command* determines the kind of decoding scheme will be used and what kind of Modbus command will be executed. For more information on the types of decoding schemes, see section 1.2.3 for PLC-3 commands and section 1.2.4 for PLC-5 commands. If using PLC-3 commands, the DL3500 Modbus Master interprets the "N" of the Destination Data Table Address to be Modbus command 03 if a "PLC-3 Word Range Read" command is issued and Modbus command 16 if a "PLC-3 Word Range Write" command is issued.

Below is a description of the message parameters used to read or write data to slave devices on the Modbus network.

This PLC

Communication Command:	Determines whether the command is a "PLC-3 Word Range Read/Write" or a "PLC-5 Typed Read/Write".
Data Table Address:	Starting address of the A-B file and word where data is written or read.
Size in Elements:	The number of words from the starting A-B address used in reading or writing data.
Port Number:	The DH+ port that is connected to the DL3500 Modbus Master.

Target Device

Data Table Address:	The Modbus command, slave station, and registers/coils are entered here in the chosen decoding format.
Local DH+ Node:	The node of the DL3500 Modbus Master.
Local / Remote:	The network path that the DL3500 Modbus Master is connected through.

Check that the Modbus Slave Station address and Modbus Registers required can be entered into the specific PLC's Destination Data Table Address field using PLC programming software.

1.3.1 A-B TO MODBUS EXAMPLES

Below are some examples for writing the destination data table address using the formats discussed in this manual. These examples are to aid the programmer in setting up an Allan-Bradley PLC, SLC, or other device on the DH+ network as a Modbus master. These examples *only* show the destination data table address and do not show the source data table address.

1.3.1.1 PLC-3 Word Range Commands

Examples

1. Integer - Writing to Modicon registers 40001 to 40010 in slave 5
2. Integer - Reading from Modicon registers 32201 to 32205 in slave 21
3. Binary - Writing to Modicon coil 00010 in slave 3
4. Binary - Writing to Modicon coils 00021 to 00036 in slave 6
5. Binary - Reading from Modicon coils 10101 to 10132 in slave 15

	DH+ Message Instruction			Modbus Network Message Generated			
	Communication Command	Size In Elements	Destination DTA File:Word	Modbus Command	Slave Address	Register / Coil Start Address	Register / Coil End Address
1.	Write	10	N5:1	16	5	40001	40010
2.	Read	5	S21:2201	04	21	32201	32205
3.	Write	1	F3:10	05	3	00010	00010
4.	Write	1	B6:21	15	6	00021	00036
5.	Read	2	F15:101	02	15	10101	10132

Note: When mapping binary files using Modbus commands 01, 02, and 15, the DL3500 Modbus Master maps 16 consecutive coils for every 1 element. Therefore 2 elements will map 32 consecutive coils.

1.3.1.2 PLC-5 Typed Commands (NXYY:Z)

Examples

1. Integer - Writing to Modicon registers 40001 to 40010 in slave 5
2. Integer - Reading from Modicon registers 32201 to 32205 in slave 21
3. Binary - Writing to Modicon coil 00010 in slave 3
4. Binary - Writing to Modicon coils 00021 to 00036 in slave 6
5. Binary - Reading from Modicon coils 10101 to 10132 in slave 15

	DH+ Message Instruction			Modbus Network Message Generated			
	Communication Command	Size In Elements	Destination DTA File:Word	Modbus Command	Slave Address	Register / Coil Start Address	Register / Coil End Address
1.	Write	10	N405:1	16	5	40001	40010
2.	Read	5	N321:2201	04	21	32201	32205
3.	Write	1	B103:10	05	3	00010	00010
4.	Write	1	B6:21	15	6	00021	00036
5.	Read	2	B115:101	02	15	10101	10132

Note: When mapping binary files using Modbus commands 01, 02, and 15, the DL3500 Modbus Master maps 16 consecutive coils for every 1 element. Therefore 2 elements will map 32 consecutive coils.

1.3.1.3 PLC-5 Typed Commands   (NXYZ:Z)

Examples

1.	Integer	-	Writing to Modicon registers 40001 to 40010 in slave 5
2.	Integer	-	Reading from Modicon registers 32201 to 32205 in slave 9
3.	Binary	-	Writing to Modicon coil 00010 in slave 3
4.	Binary	-	Writing to Modicon coils 00021 to 00036 in slave 6
5.	Binary	-	Reading from Modicon coils 10101 to 10132 in slave 9

	DH+ Message Instruction			Modbus Network Message Generated			
	Communication Command	Size In Elements	Destination DTA File:Word	Modbus Command	Slave Address	Register / Coil Start Address	Register / Coil End Address
1.	Write	10	N450:1	16	5	40001	40010
2.	Read	5	N392:201	04	9	32201	32205
3.	Write	1	B130:10	05	3	00010	00010
4.	Write	1	B60:21	15	6	00021	00036
5.	Read	2	B190:101	02	9	10101	10132

Note: When mapping binary files using Modbus commands 01, 02, and 15, the DL3500 Modbus Master maps 16 consecutive coils for every 1 element. Therefore 2 elements will map 32 consecutive coils.

1.3.1.4 PLC-5 Typed Commands   (NYXZ:Z)

Examples

1.	Integer	-	Writing to Modicon registers 40001 to 40010 in slave 1
2.	Integer	-	Reading from Modicon registers 32201 to 32205 in slave 2
3.	Binary	-	Writing to Modicon coil 00010 in slave 3
4.	Binary	-	Writing to Modicon coils 00021 to 00036 in slave 2
5.	Binary	-	Reading from Modicon coils 10301 to 10332 in slave 3

	DH+ Message Instruction			Modbus Network Message Generated			
	Communication Command	Size In Elements	Destination DTA File:Word	Modbus Command	Slave Address	Register / Coil Start Address	Register / Coil End Address
1.	Write	10	N40:1	16	1	40001	40010
2.	Read	5	N132:201	04	2	32201	32205
3.	Write	1	B210:10	05	3	00010	00010
4.	Write	1	B100:21	15	2	00021	00036
5.	Read	2	B210:101	02	3	10101	10132

Note: When mapping binary files using Modbus commands 01, 02, and 15, the DL3500 Modbus Master maps 16 consecutive coils for every 1 element. Therefore 2 elements will map 32 consecutive coils.

1.4   COMMUNICATIONS SEQUENCE

The DL3500-DH+ receives message commands from a PLC over its DH+ port, converts them to the appropriate Modbus message and sends them out on its serial port. The Modbus Slave response is received, translated into an appropriate DH+ response and then returned to the originating PLC.

Modbus Master/Slave protocol does not permit multiple messages on the Modbus network. The DL3500 processes one message at a time out of its Modbus port, although it can handle multiple requests from PLC's on the DH+ network, the programmer should ensure a response is received before initiating another request. The DL3500 unit will respond to the DH+ interface with appropriate error messages in the event of detectable errors on Modbus such as timeouts.

1.5   MODBUS MESSAGE DATA LENGTH CONSIDERATIONS

The following shows the maximum number of holding registers that can be sent or received in a single Modbus message when using the DL3500 gateway. The limits are because of the different structure of Modbus and A-B DH+ protocols, and also due to the internal memory structure of the DL3500.
- Up to 100 Modbus Holding Registers can be read in a single transaction
- Up to 100 Modbus Holding Registers can be written in a single transaction

1.6   MODBUS MASTER USING BM85 MODBUS PLUS / MODBUS BRIDGE MUX

The DL3500-DH+ Modbus Master will also communicate with Modicon PLCs and other devices on Modbus Plus when connected to one of the four Modbus ports of a NW-BM85-000 Modbus Plus/Modbus Network Bridge Mux (see DL3500 users guide for cable drawings).

If PLCs and other stations on DH+ are required to initiate communications with one or more Modicon PLCs on Modbus Plus then the BM85's Bridge Mux port connecting it to the DL3500-DH+ must be configured in **Slave mode**.

The serial communications parameters for the Bridge Mux Modbus port interface to the DL3500-DH+ must be the same as those set in the DL3500.

1.7   DH+ AND MODBUS - GENERAL

Each addressed slave station must be a unique address on Modbus and the DL3500-DH+ must be the only Master Station on the Modbus network. Any station on the DH+ network can be a "Master" that can address any Modbus Slave Station from 1 - 255. This means that effectively the Modbus network can have multiple A-B PLC Modbus Masters with the DL3500 acting as a traffic cop.

Modbus (Slave) station address numbers may be the same as DH+ station address numbers provided that all Slave Station addresses are unique on Modbus, and all DH+ network addresses are unique on the DH+ network.

2.0   MODBUS MASTER NETWORK APPLICATIONS

2.0.1   MASTER TO MODBUS SLAVE NETWORK

MODBUS SLAVE NETWORK

MODBUS MASTER

```
+-------------+          +-------------+          +-------------+
|   Modicon   |          |   Modbus    |          |  DL3500     |
|     PLC     |          |    Slave    |          |   Master    |
|   Addr 03   |          |   Addr 05   |          |             |
+-------------+          +-------------+          +-------------+
```

DH+ STN 01

DH+

```
+-------------+          +-------------+          +-------------+
|    A-B      |          |     PC      |          |    A-B      |
|  SLC-5/04   |          |     HMI     |          |  SLC-5/04   |
|   Stn 3     |          |   Stn 4     |          |   Stn 5     |
+-------------+          +-------------+          +-------------+
```
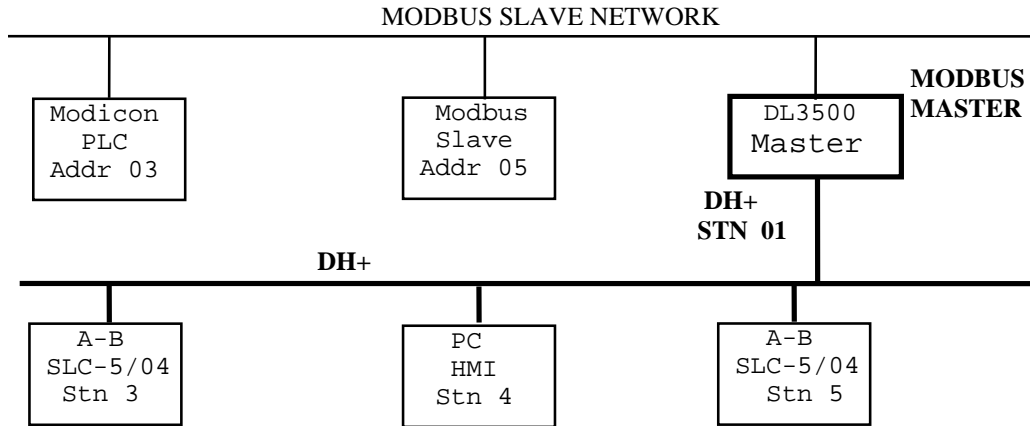
NOTE:

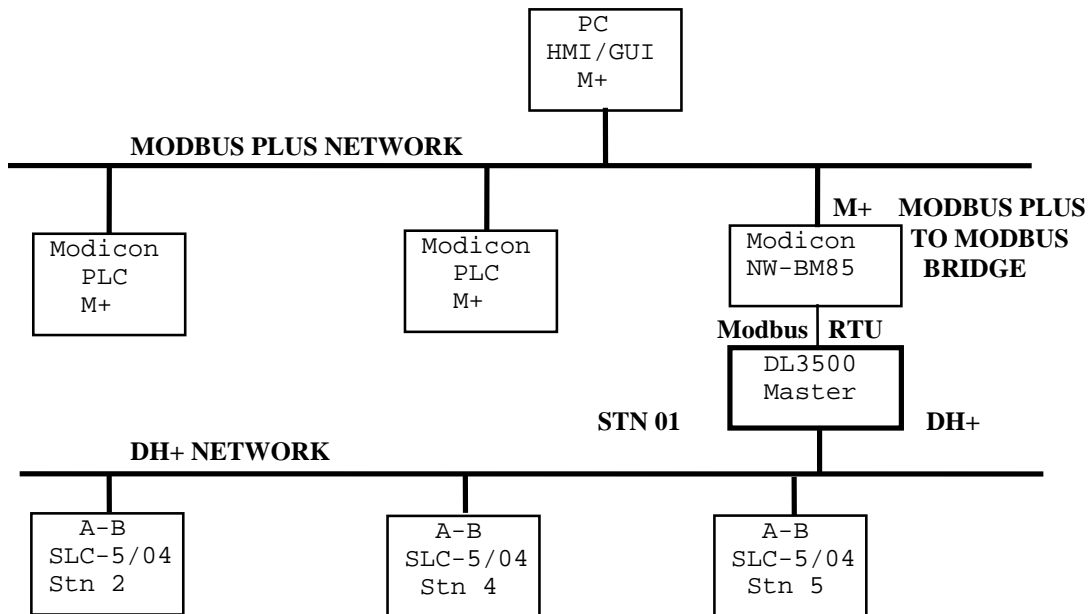PLC5s, SLC5/04s and HMIs on the A-B DH+ network can be programmed to communicate with any Slave device on the Modbus Slave network. Modbus and DH+ addresses can be the same.

2.0.2   MASTER TO MODBUS PLUS VIA BM85 MODBUS BRIDGE

```
+-------------+
|     PC      |
|  HMI/GUI    |
|     M+      |
+-------------+
```

MODBUS PLUS NETWORK

M+ MODBUS PLUS TO MODBUS BRIDGE

```
+-------------+          +-------------+          +-------------+
|   Modicon   |          |   Modicon   |          |   Modicon   |
|     PLC     |          |     PLC     |          |   NW-BM85   |
|     M+      |          |     M+      |          |             |
+-------------+          +-------------+          +-------------+
```

Modbus | RTU

```
                                                  +-------------+
                                                  |  DL3500     |
                                                  |   Master    |
                                                  |             |
                                                  +-------------+
```

STN 01   **DH+**

DH+ NETWORK

```
+-------------+          +-------------+          +-------------+
|    A-B      |          |    A-B      |          |    A-B      |
|  SLC-5/04   |          |  SLC-5/04   |          |  SLC-5/04   |
|   Stn 2     |          |   Stn 4     |          |   Stn 5     |
+-------------+          +-------------+          +-------------+
```

NOTE:

PLC5s, SLC5/04s and HMIs on the DH+ network can be programmed to communicate with any station on the Modbus Plus network