User Manual for the
HE693CDC200

CsCAN Data Concentrator Module

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PREFACE

This manual explains how to use the Horner APG's CsCAN Data Concentrator Module.

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To obtain warranty service, return the product to your distributor with a description of the problem, proof of purchase, post paid, insured and in a suitable package.

ABOUT PROGRAMMING EXAMPLES

Any example programs and program segments in this manual or provided on accompanying diskettes are included solely for illustrative purposes. Due to the many variables and requirements associated with any particular installation, Horner APG cannot assume responsibility or liability for actual use based on the examples and diagrams. It is the sole responsibility of the system designer utilizing CsCAN Data Concentrator Module to appropriately design the end system, to appropriately integrate the CsCAN Data Concentrator Module and to make safety provisions for the end equipment as is usual and customary in industrial applications as defined in any codes or standards which apply.

Note: The programming examples shown in this manual are for illustrative purposes only. Proper machine operation is the sole responsibility of the system integrator.

Revisions to this manual

1. Renamed the manual *CsCAN Data Concentrator Module*.
2. Revised Section 1.1 Product Description and Section 1.2 Overview.
3. Revised Section 2.4 CsCAN Interface.
4. Revised Figure 2.3 and Section 2.4.1.
5. Revised Section 3.1.1, item 9.
6. Rewrote and re-organized Chapter 3.
7. Added Chapter 4 and Chapter 5.

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CHAPTER 1: INTRODUCTION

1.1 Product Description

The CsCAN Data Concentrator Module (HE693CDC200) is a CsCAN Data Concentrator I/O Module for the Series 90-30 PLC. The CDC200 typically exchanges CsCAN Network data with one or more OCS or RCS Modules (Operator Control Station or Remote Control Station) or with another CDC200 Module. OCS, RCS and CDC200 devices exchange data on the CsCAN Network via CsCAN Analog Global Data (%AQG) messages.

The CsCAN network architecture can support up to 253 nodes with most networks consisting of 80 nodes or less. A single CDC200 can communicate with up to 16 of those nodes. A maximum of 32 words of data (each direction) can be shared with each of the 16 nodes. This data is read from and written to the network through %R registers in the PLC CPU.

1.2 Overview

The CDC200 allows users to exchange data between the PLC and other CsCAN nodes residing on the network. A CsCAN network might consist of a CsCAN Data Concentrator (e.g., CDC200) mounted in a PLC and CsCAN network compatible nodes (e.g. OCS100 and OCS200). Figure 1.1 illustrates a CsCAN network with four remote nodes attached to the CDC200.

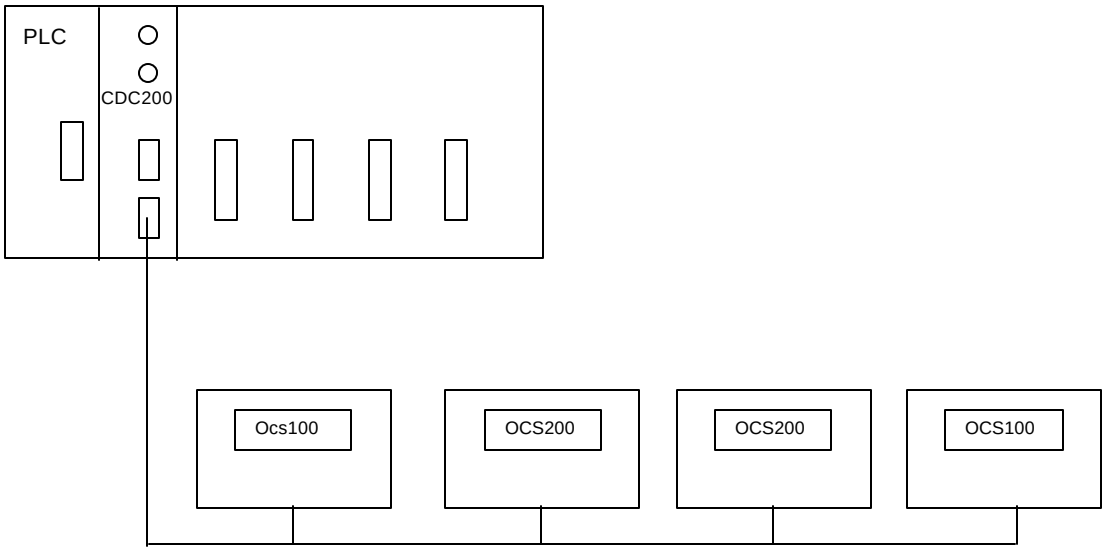

Figure 1.1 CsCAN Network with Four Remote Nodes

NOTES

CHAPTER 2: INSTALLATION

2.1 Mounting Requirements

The CDC200 Module is designed to plug into the backplane of the PLC. For installation information, refer to the PLC manufacturer's installation manual.

2.2 Power requirements

Table 2.1 – Power requirements	
CDC200	
Inrush	180mA @ 5VDC (1.5msec.)
Steady State	160mA @ 5VDC

2.3 Module Installation

1. Remove power from the PLC rack.
2. Install the CDC200 in a free slot.
3. Apply power to the PLC.
4. Configure the parameters with the Hand Held Programmer (HHP) or LogicMaster (LM90).
5. Connect the CAN network to the appropriate port.
6. Start the application.

2.4 CsCAN Interface

CsCAN is a higher layer communication protocol, which is implemented using the CAN (Control Area Network), data link and physical layers.

The CDC200 CAN Interface utilizes a 5-pin Phoenix-type connector (Figure 2-1). When wiring a module in a CAN system, certain wiring rules must be followed in order for the system to work properly. CAN rules and wiring diagrams are provided in the following section.

2.4.1 CAN Port and Wiring

Table 2.2 – CAN Port Pins		
Pin	**Signal**	**Description**
1	V-	Power - *
2	CN_L	Signal -
3	SHLD	Shield
4	CN_H	Signal +
5	V+	Power + *

* Pins 1 and 5 require an external 24Vdc source for CAN Network power.

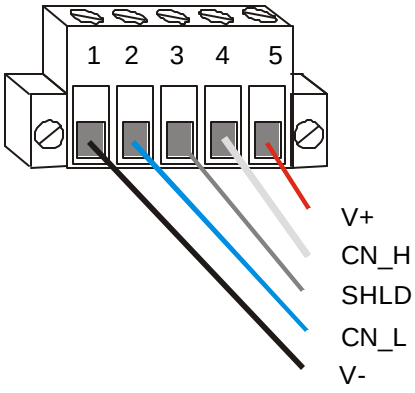

Figure 2.1 – Network Connector for the CDC200 (CAN Port)

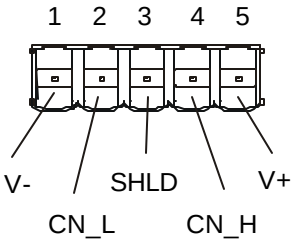

Figure 2.2 – As viewed looking at the OCS100 and OCS200

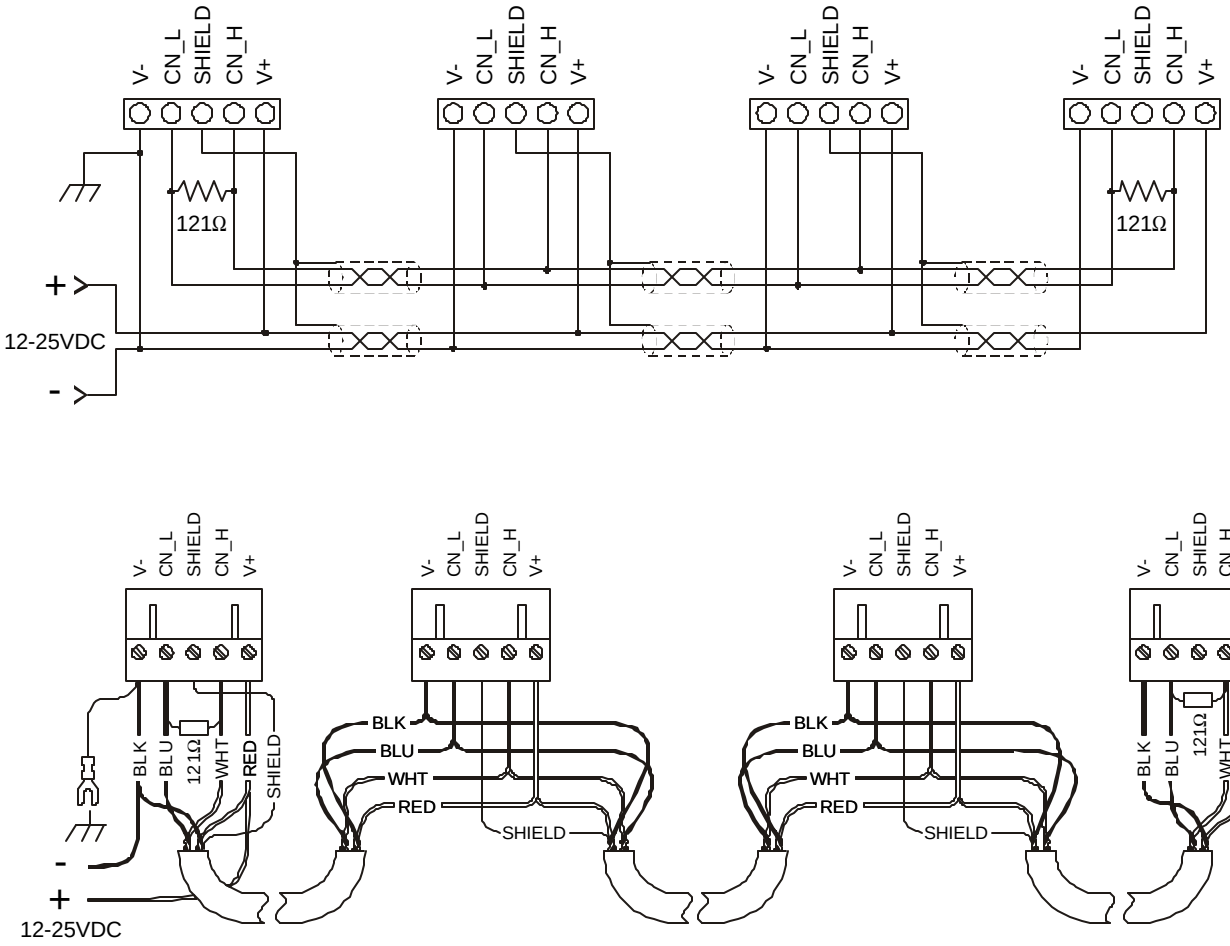

Figure 2.3 – CAN Wiring

a. CAN Wiring Rules (See Figure 2.3.)

1. Wire the CAN network in a daisy-chained fashion such that there are exactly two physical end-points on the network.
2. The two nodes at the physical end-points need to have 121 ohm 1% terminating resistors connected across the CN_L and CN_H terminals.
3. Use data conductors (CN_L and CN_H) that are 24 AWG shielded twisted pair for “thin cable” and 22 AWG shielded twisted pair for “thick cable.” They must also have 120-ohm characteristic impedance. In typical industrial environments, use a Belden wire #3084A (“thin”). Use #3082A (“thick”) for network cable lengths greater than 100 meters environments where noise is a concern. Place data conductors (CN_L and CN_H) into a twisted pair together.
4. Use power conductors (V- and V+) that are 18 AWG twisted-pair for “thin cable” and 15 AWG twisted-pair for “thick cable.” Place power conductors (V- and V+) into a twisted pair together.
5. Connect the V- power conductor to a good earth ground **at one place only** on the network, preferably physical endpoints.
6. For a section of cable between two nodes, the cable shield is connected to the cable shield input at *one end of the cable only.*
7. A CAN network (without repeaters) is limited to 64 nodes (with 63 cable segments) with a maximum cable length of 1500 ft. at 125KBaud.
8. Up to four CAN network segments, which adhere to the above rules, may be connected together using three CAN repeaters. In this manner, a CAN network may be extended to 253 nodes with a total cable distance of 6000 ft. at 125KBaud.

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CHAPTER 3: CONFIGURATION

Before the CDC200 Module can be used, it must be configured via LogicMaster 90 (LM90) or a Hand-Held Programmer (HHP). If LM90 is used, the CDC200 is to be configured as a Foreign Module with a Module ID of 3; 8 %Is, 0 %AIs; 8 %Qs; and 0 %AQs as shown in Figure 3.1 below.

3.1 LM90 Configuration

The following procedure should be employed when using LM90 to configure a PLC for a CDC200 module.

1. Install the CDC Interface module into the PLC as described in the manufacturer's documentation.
2. Connect the serial port of the PC to the PLC's main programming port.
3 Execute the LM90 software.
4. Enter the Configuration Package from the Main Menu <F2>.
5. Select the proper folder.
6. Choose I/O Configuration from the Configuration Menu <F1>.
7. Cursor over to the slot containing the CDC Interface module.
8. Select Other <F8> and Foreign <F3>.
9. The Foreign Module configuration screen appears as follows:

```
Catalog #: FOREIGN

Module ID  :   3
%I Ref Adr :   %Ixxxx  Byte 1     : 00000001  Byte 9     : xx
%I Size    :     8     Byte 2     : xxxxxxxx  Byte 10    : xx
%Q Ref Adr :   %Qxxxx  Byte 3     : xx        Byte 11    : xx
%Q Size    :     8     Byte 4     : xx        Byte 12    : xx
%AI Ref Adr:  %AI0001  Byte 5     : xx        Byte 13    : 00
%AI Size   :     0     Byte 6     : xx        Byte 14    : 00
%AQ Ref Adr:   %AQ001  Byte 7     : xx        Byte 15    : 00
%AQ Size   :     0     Byte 8     : xx        Byte 16    : 00
%R Ref Adr :   %R0001  %R Ref Adr :   %R0001
%R(in) Size:     0     %R(out)Size:     0
```

Figure 3.1 – CDC200 LM90 Configuration Software Configuration

The %I Ref Adr and %Q Ref Adr values can be set for any desired PLC reference addresses as long as they are on 8-bit boundaries (1, 9, 17, 25, etc.). The remainder of this document assumes that %I1 and %Q1 are the %I Ref Adr and %Q Ref Adr values respectively.

3.2 Configuration Parameter Values

The configuration parameter values (Byte 1 through Byte 16) need to be filled in as follows:

Table 3.1 – CDC200 Configuration Parameter Values

Byte Number	Min	Max	Parameter Name	Description
1	1	1	Reserved	Must always be 00000001
2	1	16	NumIds	Number of Remote Node Network IDs to Receive Data from and Number of CDC Network IDs used to Transmit Data
3	1	253	RxFirstId	First Remote Node Network ID
4 (lo byte) 5 (hi byte)	1	9968	RxFirstR	First Remote->CDC %R Register Number
6	1	32	RxNumRs	Number of Remote->CDC %Rs per Network ID
7	1	253	TxFirstId	First CDC Network ID
8 (lo byte) 9 (hi byte)	1	9968	TxFirstR	First CDC->Remote %R Register Number
10	1	32	TxNumRs	Number of CDC->Remote %Rs per Network ID
11	0	1	TxOptimized	CDC->Remote Global Data Optimized Flag
12	0	3	NetBaud	CsCAN Network Baud Rate (0 = 125K; 1 = 250K; 2 = 500K; 3 = 1M)
13 thru 16	0	0	Reserved	Not used for CDC200; should be set to 0

Note: All **Min** and **Max** values are shown in decimal. On the LM90 Foreign Module screen (**Fig. 3.1**), configuration parameter Bytes 1 and 2 are entered and displayed in binary while Bytes 3 through 16 are entered and displayed in hexadecimal.

3.3 Configuration Parameter Description

The HE693CDC200 uses the Series 90-30 PLC's I/O configuration parameters, which can be configured using either a hand held programmer or a PC running LM90. The parameters are defined in Table 3.1 above.

3.3.1 CsCAN Network ID Configuration

There are 2 contiguous ranges of CsCAN Network IDs, configured for the CDC200.

The 1st range of Network IDs is defined by the **RxFirstId** and **NumIds** configuration parameters. The CDC200 monitors Network Messages from the Remote Nodes in this range, and will copy %AQG data received from them into PLC %R Registers.

The 2nd range of Network IDs is defined by the **TxFirstId** and **NumIds** configuration parameters. Using the Network IDs in this range, the CDC200 transmits PLC %R Registers to the network, as %AQG data.

3.3.2 PLC %R Register Configuration

There are 2 contiguous blocks of PLC %R registers, configured for the CDC200.

The 1st block of PLC %R Registers is defined by the **RxFirstR**, **RxNumRs** and **NumIds** configuration parameters. **RxFirstR** is the 1st %R of the block, while the total number of %Rs in the block, is (**RxNumRs** x **NumIds**). **RxNumRs** defines the number of %AQGs from each Remote Node, which will be copied into PLC %Rs, while **NumIds** is the number of Remote Nodes. The 1st PLC %R register, which will receive %AQG data from a specific Remote Node, can be found using the following formula:

X = **RxFirstR** + [(remote_node_network_id - **RxFirstId**) * **RxNumRs**]

The CDC200 continously monitors %AQG data received from the Remote Nodes, and when received, copies it into the 1st block of %R registers.

The 2nd block of PLC %R Registers is defined by the **TxFirstR**, **TxNumRs** and **NumIds** configuration parameters. **TxFirstR** is the 1st %R of the block, while the total number of %Rs in the block, is (**TxNumRs** x **NumIds**). **TxNumRs** determines the number of %Rs for each CDC Network ID, which will be transmitted to the network as %AQG data, while **NumIds** is the number of CDC Network IDs. The 1st PLC %R register, which will be transmitted as %AQG data using a specific Network ID, can be found using the following formula:

X = **TxFirstR** + [(cdc_network_id - **TxFirstId**) * **TxNumRs**]

The CDC200 continously checks the 2nd block of %R registers for change of state. The %R data is only transmitted as %AQG data to the Remote Nodes, if it changes state, or if a Remote Node requests the data to be sent.

3.3.3 %AQG Transmit Data Type Configuration

The **TxOptimized** configuration parameter determines how the CDC200 transmits its %AQG Analog Global Data. If **TxOptimized** is 0 (false), %AQG Global Data is sent in Legacy Format, otherwise it is sent in Optimized Format. Global Data transmission using Optimized Format is about 25% faster than with Legacy Format. All OCS, RCS and CDC200 devices are capable of transmitting and receiving Global Data in Legacy Format. Optimized Format requires OCS/RCS firmware Version 9.00 or later, or CDC200 firmware Version 1.70 or later.

3.3.4 CsCAN Network Baud Rate Configuration

The **NetBaud** configuration parameter selects the desired CsCAN Network Baud rate.

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CHAPTER 4: DIAGNOSTIC COMMAND AND STATUS BITS / DIAGNOSTIC LEDs

The CDC200 uses 8 %Q bits and 8 %I bits for diagnostics command and status, as defined in the following table:

Table 4.1 – CDC200 Module %Q Command Bits and %I Status Bits

%Q Command Bits		%I Status Bits	
%Q Bit	**%Q Bit Description**	**%I Bit**	**%I Bit Description**
%Q1	Not Used	%I1	1 = Network Power Test failed
%Q2	1 = Send periodic heartbeats	%I2	1 = Network Response Test failed
%Q3	1 = Check Remote Node's heartbeat	%I3	1 = Network Duplicate ID test failed
%Q4	Not Used	%I4	1 = Remote Node Heartbeat Test failed
%Q5	0 to 15 selects which Remote Node will have its heartbeat monitored (%Q5 is the lo bit)	%I5	1 = Static RAM Memory Test failed
%Q6		%I6	1 = BIOS Flash Checksum Test failed
%Q7		%I7	1 = CDC Engine Flash CRC Test failed
%Q8		%I8	1 = Configuration Data Test failed or Configuration Data Not Received

For future compatibility, the ladder program should not reference the unused %Q registers (%Q1 & %Q4).

4.1 Module Diagnostics - %I5 to %I8

Diagnostics associated with %I5-%I7 (Module Hardware Tests) are executed only at power-up while the %I8 diagnostic (Configuration Data Test) executes dynamically during operation. If any of the %I5-%I7 tests fail, the module either needs repair or needs new firmware to be loaded. At power-up, the %I8 bit will be ON, indicating that the module has not yet received configuration data from the PLC. Then, when the PLC sends configuration data to the module, the data is checked for validity, and the %I8 bit is turned OFF if the data is all within limits or turned ON if that data contains at least 1 parameter with an illegal value.

4.2 Network Diagnostics - %I1 to %I4 and %Q1 to %Q8

Diagnostics associated with %I1-%I3 (CsCAN Network Tests) are executed at power-up, and are also executed dynamically during operation. The %I1 and %I2 Network Tests self-recover, when the corresponding fault is corrected. However, the %I3 (Network Duplicate ID) fault requires manual intervention, before the CDC200 module will talk on the CsCAN Network again.

To correct a Network Duplicate ID fault, either the CDC Module's **TxFirstId** and/or **NumIds** configuration parameters must be changed, or the the offending Remote Node's Network ID setting must be changed. Then, either downloading a new configuration to the CDC, or power-cycling its 90-30 rack, will re-run the CsCAN Network Tests, and will clear the Network Duplicate ID fault, if the condition no longer exists.

If the %Q2 command bit is active, the CDC will send a heartbeat message to the Network once per second, unless there is a critical fault (%I1, %I3, %I5, %I6, %I7 or %I8).

If the %Q3 command bit is active, the CDC continuously checks one of the Remote Node's for signs of life. The Remote Node to be checked is determined by the value (0 to 15) in the %Q5 to %Q8 command bits and corresponds to one of the (up to 16) Remote Nodes in the range implied by the **RxFirstId** and **NumIds** configuration parameters. When %Q3 1st becomes active or when the %Q5 to %Q8 value changes, the %I4 status bit is ON, indicating that the selected Remote Node is dead. The %I4 bit then stays ON until either a heartbeat message or a global data message is received from the selected Remote Node. After the %I4 bit goes OFF, indicating that the selected Remote Node is alive, another heartbeat or global data message must be received at least every 2 seconds or the %I4 status bit comes ON again.

4.3 Diagnostic LEDs

The MS and NS diagnostic LEDs indicate the status of the module and the network respectively. The following table shows the possible LED states and their meanings:

Table 4.2 – CDC200 Module Diagnostic LEDs

Diagnostic LED	State	Meaning
MS (Module Status)	Solid Red	Static RAM, BIOS Flash or CDC Engine Flash Test failed
	Blinking Red	Configuration Data Test failed or Module Not Configured
	Blinking Green	PLC is in STOP Mode
	Solid Green	All Module Tests passed
NS (Network Status)	Solid Red	Network Power, Network Response or Network Duplicate ID Test failed
	Blinking Green	Remote Node Heartbeat Test failed
	Solid Green	All Network Tests passed

CHAPTER 5: EXAMPLE NETWORK

This chapter describes an example CsCAN Network, which connects 1 CDC200 to 8 OCS remote nodes.

5.1 Example Network LM90 Configuration

Figure 5.1 shows the LM90 configuration for the example network.

```
Catalog #: FOREIGN

Module ID  :   3
%I Ref Adr :   %I0001  Byte 1     : 00000001  Byte 9     : 00
%I Size    :     8     Byte 2     : 00001000  Byte 10    : 10
%Q Ref Adr :   %Q0001  Byte 3     : 01        Byte 11    : 00
%Q Size    :     8     Byte 4     : 01        Byte 12    : 00
%AI Ref Adr:  %AI0001  Byte 5     : 00        Byte 13    : 00
%AI Size   :     0     Byte 6     : 10        Byte 14    : 00
%AQ Ref Adr:   %AQ001  Byte 7     : 09        Byte 15    : 00
%AQ Size   :     0     Byte 8     : 81        Byte 16    : 00
%R Ref Adr :   %R0001  %R Ref Adr :   %R0001
%R(in) Size:     0     %R(out)Size:     0
```

Figure 5.1 - Example Network Configuration Screen

5.2 Example Network Configuration Parameter Values

The configuration parameter values (Byte 1 through Byte 16) for the example network are described in the following table.

Table 5.1 – Example Network Configuration Parameter Values

Byte Number	Decimal Value	Parameter Name	Description
1	1	Reserved	Must always be 00000001
2	8	NumIds	Receive Data from 8 Remote Node Network IDs and Transmit Data Using 8 CDC Network IDs
3	1	RxFirstId	First Remote Node Network ID is 1
4 (lo byte)	1	RxFirstR	First Remote->CDC %R Register Number is %R1
5 (hi byte)			
6	16	RxNumRs	16 Remote->CDC %Rs per Network ID
7	9	TxFirstId	First CDC Network ID is 9
8 (lo byte)	129	TxFirstR	First CDC->Remote %R Register Number is %R129
9 (hi byte)			
10	16	TxNumRs	16 CDC->Remote %Rs per Network ID
11	0	TxOptimized	Transmit CDC->Remote Global Data in Legacy Format
12	0	NetBaud	Set CsCAN Network Baud Rate for 125K
13 thru 16	0	Reserved	Not used for CDC200; set to 0

5.3 Example Network Diagram

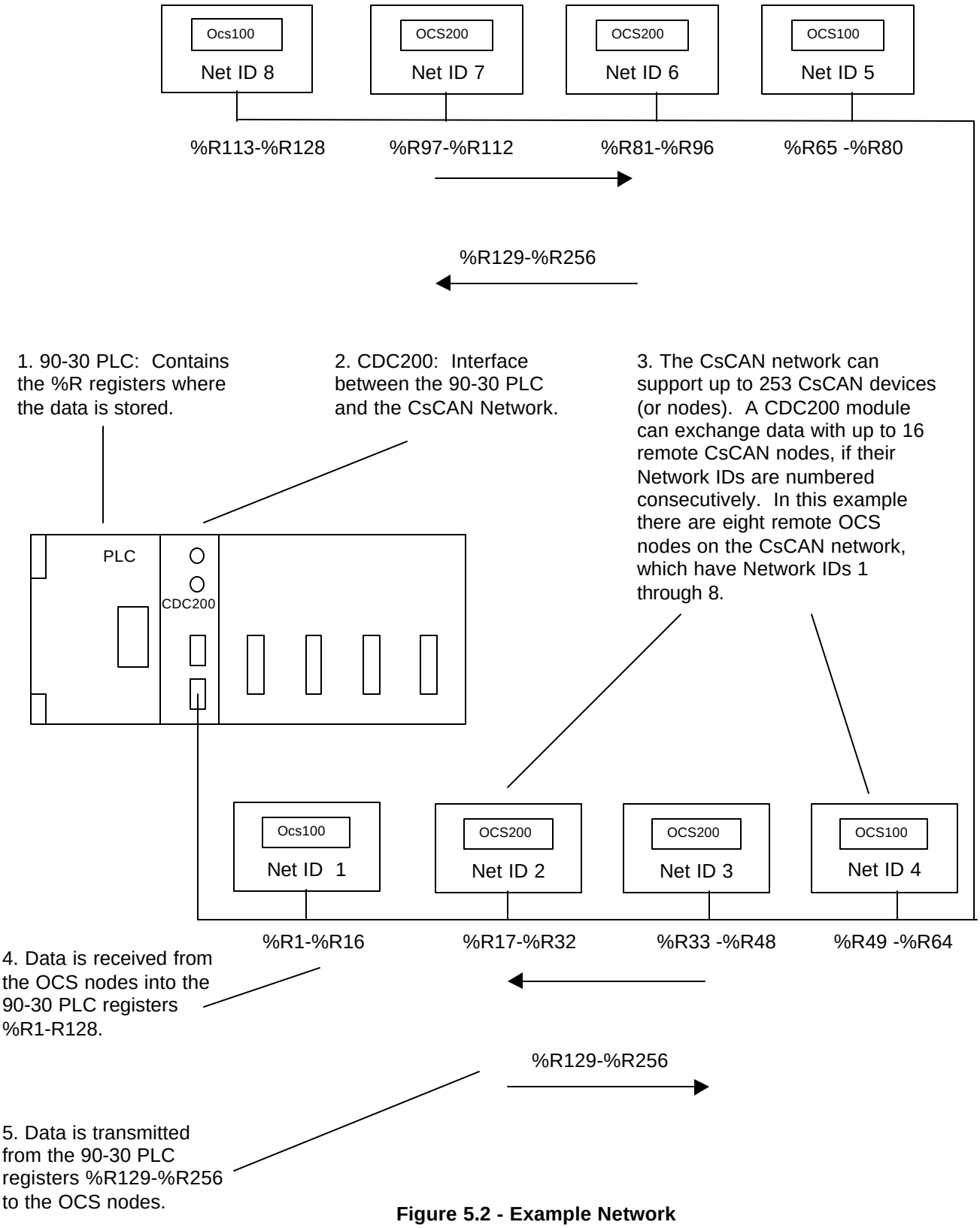

Figure 5.2 - Example Network

5.4 Example Network Data Exchange

The following table show how data is exchanged between the CDC and the OCS Nodes, using the example network.

Table 5.2 – Example Network Data Exchange Map

Series 90-30 PLC Registers	Data Direction	CsCAN Network Global Data Messages	
		Network ID	Global Data
%R1 thru %R16	← Received by CDC from Remote CsCAN Nodes into 90-30 PLC registers	1	%AQG1 thru %AQG16
%R17 thru %R32		2	%AQG1 thru %AQG16
%R33 thru %R48		3	%AQG1 thru %AQG16
%R49 thru %R64		4	%AQG1 thru %AQG16
%R65 thru %R80		5	%AQG1 thru %AQG16
%R81 thru %R96		6	%AQG1 thru %AQG16
%R97 thru %R112		7	%AQG1 thru %AQG16
%R113 thru %R128		8	%AQG1 thru %AQG16
%R129 thru %R144	→ Transmitted by CDC to Remote CsCAN Nodes from 90-30 PLC registers	9	%AQG1 thru %AQG16
%R145 thru %R160		10	%AQG1 thru %AQG16
%R161 thru %R176		11	%AQG1 thru %AQG16
%R177 thru %R192		12	%AQG1 thru %AQG16
%R193 thru %R208		13	%AQG1 thru %AQG16
%R209 thru %R224		14	%AQG1 thru %AQG16
%R225 thru %R240		15	%AQG1 thru %AQG16
%R241 thru %R256		16	%AQG1 thru %AQG16

In the example network, the CDC receives %AQG data from OCS Nodes 1 through 8 into 90-30 PLC registers %R1 through %R128. Similarly, the CDC transmits %AQG data from 90-30 PLC registers %R129 through %R256, using CsCAN Network IDs 9 through 16. In effect, the CDC behaves as though it were 8 different CsCAN Nodes, whose Network IDs are 9 through 16.

NOTES