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Insert No. DLCD-B
Drawing No. LP0535
Released 3/02

MODEL DLCD – DUAL LOOP CONTROLLER w/ DH-485

GENERAL DESCRIPTION

The Model DLCD, Dual Loop Controller with DH-485, has a similar feature set and specifications as the standard Dual Loop Controller. The DLCD provides a connection into an Allen Bradley DH-485 network allowing a fully featured dual loop PID controller to be controlled and monitored by an Allen Bradley PLC (SLC 500 controller, or similar), over a DH-485 network.

The DLCD communications port may be configured for DH-485, or as a programming port allowing complete programming by our Windows® based RLCPro configuration software.

USING THIS DOCUMENT

This document is an addendum to the bulletin describing the standard DLC and describes the use of the DH-485 connection of the DLCD. This document should be read in conjunction with the DLC Bulletin.

ORDERING INFORMATION

MODEL NO.	DESCRIPTION	PART NUMBER
DLCD	Dual Loop Controller w/ DH-485	DLCD0001
	Dual Loop Controller w/ 2 Analog Outputs w/ DH-485	DLCD1001
CBJ	SLC 500 (RJ45) to RJ11 Cable	CBJ11C07
DRRJ11	RJ11 Connector to Terminal Adapter	DRRJ11T6

1.0 Using the DLCD on a DH-485 Network

Overview

The DLCD rapidly exchanges blocks of control and status information for each PID loop with an Integer File that has been allocated in the PLC. Each DLCD is assigned an Integer File by setting the appropriate DIP Switches on the DLCD. By accessing this Integer File, the PLC is able to control and monitor the operation of each PID loop within each DLCD. Most applications will only require information contained in these Control and Status blocks. The ability has been included to upload and download Parameter and Configuration blocks on demand for each PID loop.

Integer File Structure

The Integer File for each DLCD is structured to include Control, Status, Parameter and Configuration blocks for each PID Loop. Control and Status blocks contain data that is transferred automatically by the DLCD on alternate communication scans. Parameter Blocks contain DLCD operating parameters and may be occasionally changed. Configuration Blocks contain system configuration parameters and are rarely changed.

Table 1 gives the overall structure of the Integer File giving the location of the various blocks for each PID loop or channel. The tables in the following sections show the structure of each block and provide a cross-reference from the Allen Bradley Integer File register to the equivalent MODBUS Holding Register in the DLCD.

When using the Integer File tables in the following sections, refer to the Register Table in the DLC Bulletin for register details such as factory setting, limits and description.

Note: Modbus registers provided for reference only.

Nx:	Block	Reference
0..3	Control Block – Channel A	Table 2
4..7	Control Block – Channel B	Table 2
8..11	Status Block – Channel A	Table 5
12..15	Status Block – Channel B	Table 5
16..23	Parameter Block – Channel A	Table 8
24..31	Parameter Block – Channel B	Table 9
32..63	Configuration Block – Channel A	Table 10
64..95	Configuration Block – Channel B	Table 13

Table 1 - Overview of Integer File Structure

Control Block

The Control block contains control values and commands, such as Set Point and Control Mode. The DLCD continually reads the Control Blocks for each PID loop from the PLC providing a means whereby the PLC program can control the DLCD.

	BIT POSITION																REFERENCE/ MODBUS REGISTER
Nx:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
0	Setpoint Channel A																40002
1	Output Power Channel A																40005
2	15	14	13						7	6..5					1	0	Table 3
3													3	2	1	0	Table 4
4	Setpoint Channel B																40018
5	Output Power Channel B																40021
6	15	14	13						7	6..5					1	0	Table 3
7													3	2	1	0	Table 4

Table 2 - Control Block - Channel A and B

BITS	REGISTER NAME	MODBUS REGISTER	
		CH. A	CH. B
15	Control Mode	40041	40049
14	Disable Integral Action	40044	40052
13	Disable Setpoint Ramping	40042	40050
12	*Not Used*	-	-
11	*Not Used*	-	-
10	*Not Used*	-	-
9	*Not Used*	-	-
8	*Not Used*	-	-
7	Auto-tune Request (See Note 2)	-	-
6..5	Auto-tune Code	40013	40029
4	*Not Used*	-	-
3	*Not Used*	-	-
2	*Not Used*	-	-
1	Alarm Output AL2 (See Note 1)	40016	40032
0	Alarm Output AL1 (See Note 1)	40015	40031

Table 3 - Control Block for Nx:2 and Nx:6 Flags

BITS	REGISTER NAME	MODBUS REGISTER	
		CH. A	CH. B
15	*Not Used*	-	-
14	*Not Used*	-	-
13	*Not Used*	-	-
12	*Not Used*	-	-
11	*Not Used*	-	-
10	*Not Used*	-	-
9	*Not Used*	-	-
8	*Not Used*	-	-
7	*Not Used*	-	-
6	*Not Used*	-	-
5	*Not Used*	-	-
4	*Not Used*	-	-
3	Parameter Read Strobe (See Note 3)	-	-
2	Configuration Read Strobe (See Note 3)	-	-
1	Parameter Write Strobe (See Note 3)	-	-
0	Configuration Write Strobe (See Note 3)	-	-

Table 4 - Control Block for Nx:3 and Nx:7 Flags

Status Block

The Status block contains current operating values and status such as Process Value and Input Status. The DLCD continually writes the Status Block for each PID channel providing a means whereby the PLC can monitor the operating status of the DLCD.

	BIT POSITION																REFERENCE/ MODBUS REGISTER
Nx:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
8	Process Value Channel A																40001
9	Output Power Channel A																40005
10	15..8								7..5			4	3	2	1	0	Table 6
11	15								7	6			3	2	1	0	Table 7
12	Process Value Channel B																40017
13	Output Power Channel B																40021
14	15..8								7..5			4	3	2	1	0	Table 6
15	15								7	6			3	2	1	0	Table 7

Table 5 - Status Block - Channel A and B

BITS	REGISTER NAME	MODBUS REGISTER	
		CH. A	CH. B
15..8	Input Error Status Register	40504	40504
7..5	Auto-Tune Phase	40012	40028
4	Control Output OP2	40016	40032
3	Control Output OP1	40014	40030
2	Set Point Ramping In Progress	40043	40051
1	Alarm Output AL2	40016	40032
0	Alarm Output AL1	40015	40031

Table 6 - Status Block for Nx:10 and Nx:14 Flags

BITS	REGISTER NAME	MODBUS REGISTER	
		CH. A	CH. B
15	Bus Active (See Note 5)	-	-
14	*Not Used*	-	-
13	*Not Used*	-	-
12	*Not Used*	-	-
11	*Not Used*	-	-
10	*Not Used*	-	-
9	*Not Used*	-	-
8	*Not Used*	-	-
7	Auto-Tune In Progress (See Note 4)	-	-
6	Auto-Tune Done (See Note 4)	-	-
5	*Not Used*	-	-
4	*Not Used*	-	-
3	Parameter Block Read Acknowledge (See Note 6)	-	-
2	Configuration Block Read Acknowledge (See Note 6)	-	-
1	Parameter Block Write Acknowledge (See Note 6)	-	-
0	Configuration Block Write Acknowledge (See Note 6)	-	-

Table 7 - Status Block for Nx:11 and Nx:15 Flags

Notes:

1. *Alarm Output Control*
   The Control flags Alarm Output AL1 and AL2 must set TRUE (1) for correct Alarm operation when Control Mode is Automatic (0). Set to 0 to reset an Alarm.
2. *Auto-tune Request*
   Setting the Auto-tune Request flag forces the DLCD to start the auto-tune process. Refer to section Auto-tune Request for more detail on how the PLC program may auto-tune a PID loop in the DLCD.
3. *Read/Write Strobes*
   Setting the Read/Write Strobe flags forces the DLCD to upload or download the appropriate Parameter or Configuration block. Refer to section Transferring Parameter and Configuration Data for more detail on how to transfer these blocks between the PLC and the DLCD.
4. *Auto-tune Status*
   Monitoring the Auto-Tune Done and Auto-Tune In Progress flags allows the PLC program to detect the completion of the Auto-tune process in the DLCD. Refer to section Auto-tune Request for more detail on how the PLC program may auto-tune a PID loop in the DLCD.
5. *Bus Active*
   Each DLCD toggles the Bus Active flag on each communication scan.
6. *Read/Write Acknowledge*
   The DLCD sets the appropriate acknowledge flag once the requested upload or download of the Parameter or Configuration block is complete. Refer to section Transferring Parameter and Configuration Data for more detail on how to transfer these blocks between the PLC and the DLCD.
7. *Data flow is described with respect to the DLCD in exchanges with the PLC. Thus, Read data is data transferred from the PLC to the DLCD and Write data is data transferred from the DLCD to the PLC.*

Parameter Block

The Parameter blocks contain values that may need to be changed while the DLCD is operating, such as PID parameters. Each Parameter Block may be uploaded to or downloaded from the PLC on demand by setting the appropriate request bit in the Control Block. Refer to section Transferring Parameter and Configuration Data to see how this is done.

	BIT POSITION																REFERENCE/ MODBUS REGISTER	
Nx:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
16	Proportional Band																40007	
17	Integral Time																40008	
18	Derivative Time																40009	
19	Cycle Time (Cooling)								Relative Gain (Cooling)								40141	40142
20	Deadband (Cooling)																40143	
21	Alarm 1 Value																40003	
22	Alarm 2 Value																40004	
23	*Not Used*																-	

Table 8 - Parameter Block – Channel A

	BIT POSITION																REFERENCE/ MODBUS REGISTER	
Nx:	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0		
24	Proportional Band																40023	
25	Integral Time																40024	
26	Derivative Time																40025	
27	Cycle Time (Cooling)								Relative Gain (Cooling)								40241	40242
28	Deadband (Cooling)																40243	
29	Alarm 1 Value																40019	
30	Alarm 2 Value																40020	
31	*Not Used*																-	

Table 9 - Parameter Block – Channel B

Configuration Block

The Configuration blocks contain values that describe the DLCD setup such as Input configuration and as such will not need to be changed during normal operation. These blocks may be uploaded to and downloaded from the PLC on demand by setting the appropriate request bit in the Control Block. Refer to section Transferring Parameter and Configuration Data to see how this is done.

Nx:	BIT POSITION 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0		REFERENCE/ MODBUS REGISTER	
32	Offset Power		40010	
33	Span Correction		40106	
34	Offset Correction		40107	
35	Low Limit (Setpoint)		40108	
36	High Limit (Setpoint)		40109	
37	Ramp Rate (Setpoint)		40110	
38	Process Low (Scaling Points)		40111	
39	Process High (Scaling Points)		40112	
40	Input Low (Scaling Points)		40113	
41	Input High (Scaling Points)		40114	
42	Cycle Time (OP1)		40116	
43	On Delay (AL1)		40135	
44	On Delay (AL2)		40140	
45	Scaling Value Low (Analog Output)		40303	
46	Scaling Value High (Analog Output)		40304	
47	Direct Entry Value (Analog Output)		40307	
48	Ramping Setpoint Value		40045	
49	15 14..8		Table 11	
50	Sensor Failure Power Preset (OP1)		40120	
51	Power Low Limit (OP1)		40118	
52	Power High Limit (OP1)		40119	
53	Dampening Time (OP1)	On/Off Control Hysteresis (OP1)	40121	40122
54	Hysteresis (AL1)	Hysteresis (AL2)	40134	40139
55	Deadband (Analog Output)	Update Time (Analog Output)	40305	40306
56	15 14 13 12 11..8	7 6 5 4..0	Table 12	
57	15..14 13..11 10..0		Table 14	
58	15 14..0		Table 15	
59	Action (AL1)	Action (AL2)	40131	40136
60	*Not Used*		-	
61	*Not Used*		-	
62	*Not Used*		-	
63	*Not Used*		-	

Table 10 - Configuration Block – Channel A

Nx:	BIT POSITION 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0		REFERENCE/ MODBUS REGISTER	
64	Offset Power		40026	
65	Span Correction / Remote Setpoint Ratio Multiplier		40206	
66	Offset Correction / Remote Setpoint Bias Offset		40207	
67	Low Limit (Setpoint)		40208	
68	High Limit (Setpoint)		40209	
69	Ramp Rate (Setpoint)		40210	
70	Process Low (Scaling Points)		40211	
71	Process High (Scaling Points)		40212	
72	Input Low (Scaling Points)		40213	
73	Input High (Scaling Points)		40214	
74	Cycle Time (OP1)		40216	
75	On Delay (AL1)		40235	
76	On Delay (AL2)		40240	
77	Scaling Value Low (Analog Output)		40311	
78	Scaling Value High (Analog Output)		40312	
79	Direct Entry Value (Analog Output)		40315	
80	Ramping Setpoint Value		40053	
81	15 14..8		Table 11	
82	Sensor Failure Power Preset (OP1)		40220	
83	Power Low Limit (OP1)		40218	
84	Power High Limit (OP1)		40219	
85	Dampening Time (OP1)	On/Off Control Hysteresis (OP1)	40221	40222
86	Hysteresis (AL1)	Hysteresis (AL2)	40234	40239
87	Deadband (Analog Output)	Update Time (Analog Output)	40313	40314
88	15 14 13 12 11..8	7 6 5 4..0	Table 12	
89	15..14 13..11 10..0		Table 14	
90	15 14..0		Table 15	
91	Action (AL1)	Action (AL2)	40231	40236
92	*Not Used*		-	
93	*Not Used*		-	
94	*Not Used*		-	
95	*Not Used*		-	

Table 13 - Configuration Block – Channel B

BITS	REGISTER NAME	MODBUS REGISTER	
		CH. A	CH. B
15	Remote/Local Setpoint Select	40046	-
	Channel B Assignment (Input)	-	40198
14..8	Rounding (Input)	40104	40204

Table 11 - Configuration Block for Nx:49 and Nx:81 Flags

BITS	REGISTER NAME	MODBUS REGISTER	
		CH. A	CH. B
15..14	Local/Remote Set Point Transfer Mode (Input)	-	40199
13..11	Mode (Analog Output)	40302	40310
10..0	Assignment (Analog Output)	40301	40309

Table 14 - Configuration Block for Nx:57 and Nx:89 Flags

BITS	REGISTER NAME	MODBUS REGISTER	
		Ch. A	Ch. B
15	Reset (AL2)	40137	40237
14	Reset (AL1)	40132	40232
13	Enable Standby (AL2)	40138	40238
12	Enable Standby (AL1)	40133	40233
11..8	Digital Input Filter (Input)	40105	40205
7	Temperature Scale (Input)	40102	40202
6	Control Action (OP1)	40117	40217
5	Filter (Analog Output)	40308	40316
4..0	Process Decimal Point (Scaling Points)	40115	40215

Table 12 - Configuration Block for Nx:56 and Nx:88 Flags

BITS	REGISTER NAME	MODBUS REGISTER	
		CH. A	CH. B
15	Resolution (Input)	40103	40203
14..0	Input Type (Input)	40101	40201

Table 15 - Configuration Block for Nx:58 and Nx:90 Flags

2.0 Setting the DIP Switches

Overview

The DIP Switches and the Default Serial Terminal set the DLCD serial communication operating mode to either DH-485 mode or MODBUS mode. DH-485 mode allows the DLCD to be connected to a DH-485 network. MODBUS mode allows programming of the DLCD using RLCPro.

DH-485 Mode

Integer File

Each DLCD is assigned a unique Integer File in the PLC that the DLCD uses to transfer data. Switch A (SWA) sets the target Integer file in the range N7..N70.

Note N8 and N9 are invalid Integer File numbers and therefore cannot be used.

INTEGER FILE	SWITCH POSITION						COMMENT
	1	2	3	4	5	6	
N7	DN	DN	DN	DN	DN	DN	Valid File Number
N8	DN	DN	DN	DN	DN	UP	*Invalid File Number*
N9	DN	DN	DN	DN	UP	DN	*Invalid File Number*
N10	DN	DN	DN	DN	UP	UP	Valid File Number
N11	DN	DN	DN	UP	DN	DN	Valid File Number
..							Valid File Number
N70	UP	UP	UP	UP	UP	UP	Valid File Number

Table 16 - Integer File settings using DIP Switch A

DLCD Address

Each device on a DH-485 network must have a unique address. Switch B (SWB) allows the DLCD address to be set in the range 0..31.

DLCD Address	Switch Position				
	1	2	3	4	5
0	DN	DN	DN	DN	DN
1	DN	DN	DN	DN	UP
2	DN	DN	DN	UP	DN
3	DN	DN	DN	UP	UP
..					
31	UP	UP	UP	UP	UP

Table 17 - Selections for DLCD Address using DIP Switch B

PLC Address

The DLCD transfers data with a target PLC. Switch B (SWB) allows the address of the target PLC on the DH-485 network to be set in the range 0..7.

PLC ADDRESS	SWITCH POSITION		
	6	7	8
0	DN	DN	DN
1	DN	DN	UP
2	DN	UP	DN
..			
7	UP	UP	UP

Table 18 - Selections for PLC Address using DIP Switch B

Example 1

This example shows the DIP Switch settings for a DLCD operating in DH-485 mode with the following configuration.

PLC Address : 1
DLCD Address : 8
Integer File : 10 (N10)

1	2	3	4	5	6		1	2	3	4	5	6	7	8
				UP	UP			UP						UP
DN	DN	DN	DN				DN		DN	DN	DN	DN	DN	

INTEGER FILE — SWA; DLCD, PLC — SWB: ADDRESS

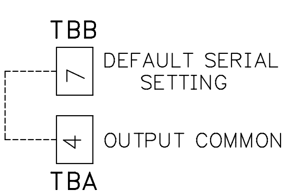
Communication Settings

The DLCD has a fixed baud rate of 19200 when used in DH-485 mode.

MODBUS Mode

In MODBUS mode, the DLCD responds to MODBUS RTU frames and therefore allows programming using RLCPro (refer to DLC Bulletin for detailed information on using RLCPro with the DLCD). To configure the DLCD for MODBUS without changing the DIP switches, use the Default Serial Setting Terminal.

DEFAULT SERIAL SETTING CONNECTIONS



If using software selectable serial settings and the serial settings are unknown or forgotten, they can be temporarily reset to the defaults by connecting the "Default Serial Setting" terminal 7 to "Output Common" terminal 4 with a jumper.

Serial Communication Defaults:

Protocol: RTU **Data Bits:** 8
Address: 247 **Parity:** none
Baud Rate: 9600

Alternatively, set all DIP switches Down as shown in Example 2. The DLCD leaves the factory in this state, and is therefore ready to be programmed using RLCPro.

Example 2

This example shows the DIP Switch settings for a DLCD operating in MODBUS mode with the default serial settings.

1	2	3	4	5	6		1	2	3	4	5	6	7	8
DN	DN	DN	DN	DN	DN		DN	DN	DN	DN	DN	DN	DN	DN

INTEGER FILE — SWA; DLCD, PLC — SWB: ADDRESS

EXAMPLE APPLICATIONS

Transferring Parameter and Configuration Data

Parameter and Configuration blocks can be uploaded to and downloaded from the PLC Integer File by setting the appropriate read/write strobe in the relevant Control block. On completion of the data transfer the DLCD sets the corresponding acknowledge bit in the Status block.

Figure 1 shows a fragment of a Program File, captured from Rockwell's RSLogix 500 that shows how the strobe and acknowledge flags may be used to download a configuration block to the DLCD.

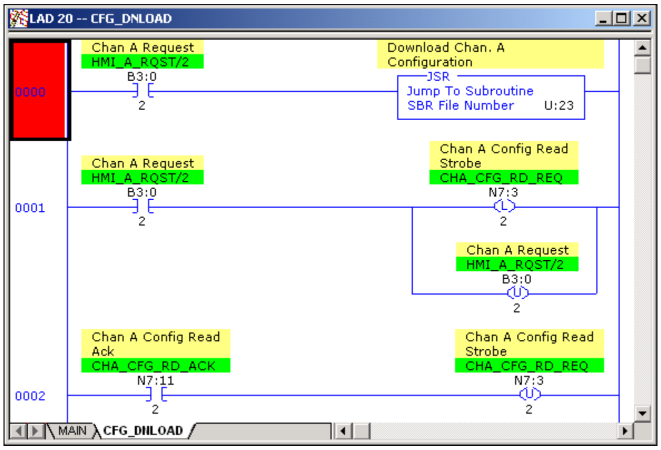


Figure 1 - Configuration Block Download

Figure 2 shows a fragment of a program file, captured from RSLogix 500 that shows how the strobe and acknowledge flags may be used to upload a configuration block from the DLCD.

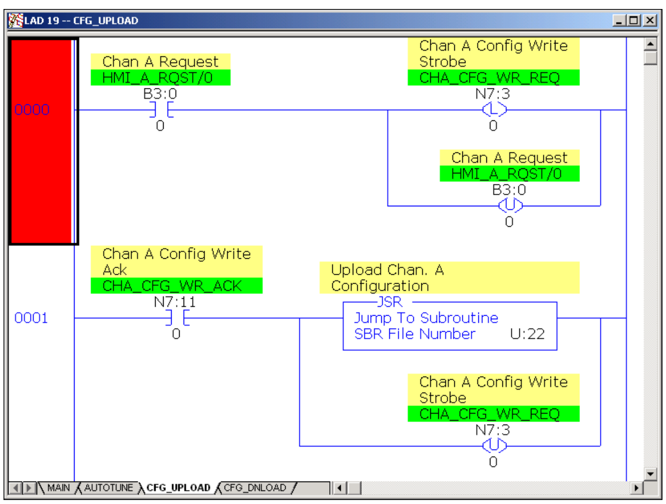


Figure 2 - Configuration Block Upload

Auto-tune Request

The Auto-tune Request flag allows the PLC program to start the auto-tune process in the DLCD. While auto-tuning, the DLCD sets the Auto-tune In Progress bit and when complete, sets the Auto-tune Done bit. By monitoring this bit, the PLC program is able to detect when the auto-tune process is complete.

Figure 3 shows a fragment of a program file, captured from RSLogix 500 that shows how the request flag and done flag may be used to start the auto-tune process in the DLCD.

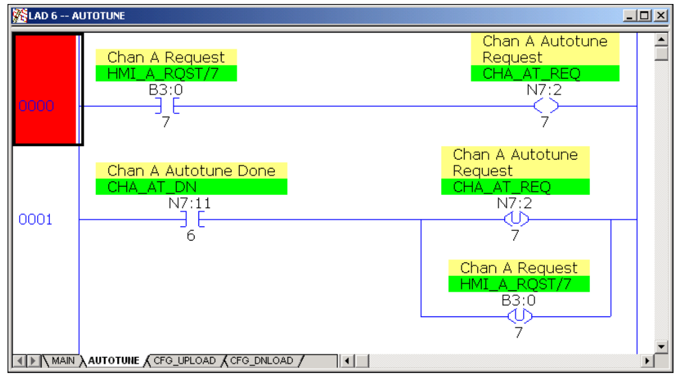
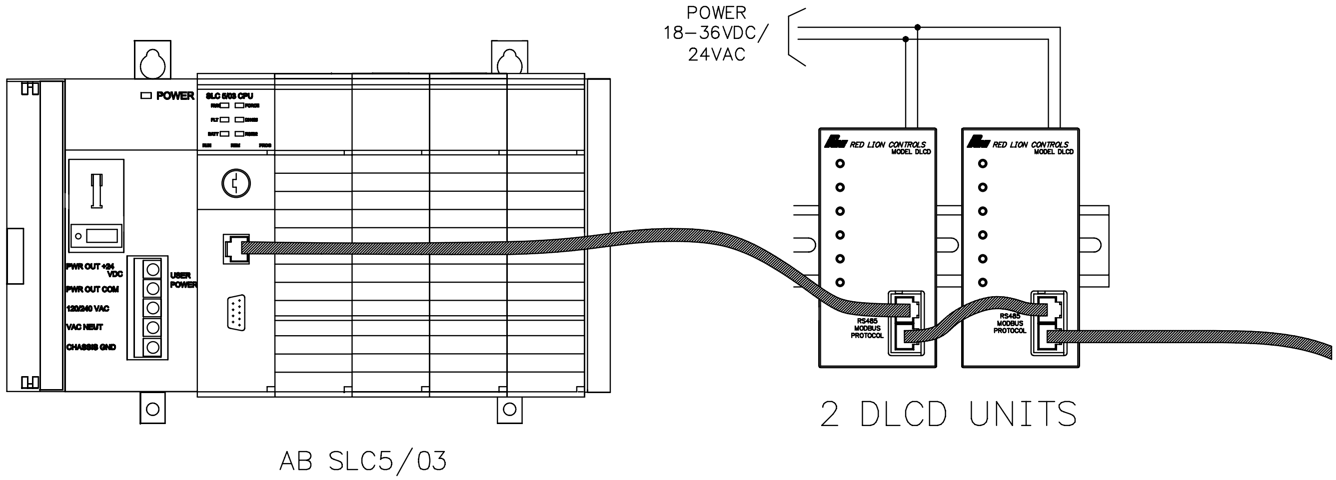


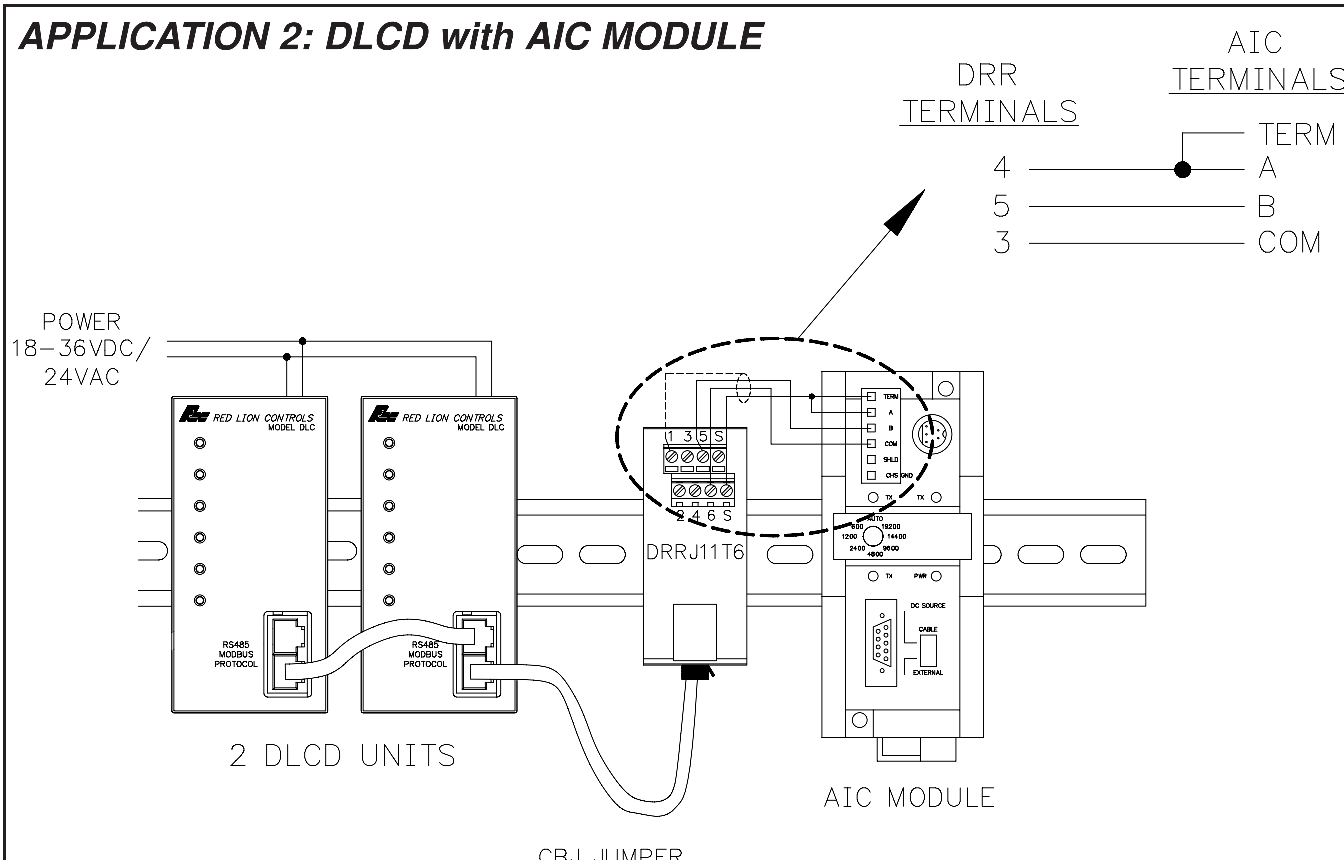
Figure 3 - Auto-tune Request

APPLICATION 1: SLC 5/03 AND DLCD



Example showing direct connection of multiple DLCD units and a SLC 5/03, using Red Lion Cable Jumper (CBJ11BD5) and SLC 500 to RJ11 Cable (CBJ11C07).

APPLICATION 2: DLCD with AIC MODULE



Example showing direct connection of multiple DLCD units to Red Lion DIN Rail Mounted Terminal Connector (DRJ11T6) allowing a variety of connection options using the AIC Module from Allen Bradley.

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