Connecting Mitsubishi PLCs to ConveyLinx modules using CC-Link IEF Basic

Rev 1.4

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1. What is CC-Link IE Field Basic

CC-Link IEF Basic performs cyclic data transmission between master station and slave stations on Ethernet lines. It uses UDP as a transport level and the transmissions are at fix interval about 20ms. Communication with slave stations is organized in groups. Maximum number of slaves per group is 16 stations and the maximum number of groups supported by one master is 4. Master station sends directed broadcast messages in class C network. All slave stations responded with unicast to the master.
Data is organized in four fields with fixed sizes:

- RY – bit field with fixed size of 64 bits, which is written from the master;
- RX – bit field with fixed size of 64 bits, which is written from the slave;
- RWw – WORD field with fixed size of 32 WORDs, which is written from the master;
- RWr – WORD field with fixed size of 32 WORDs, which is written from the slave;

More about CC-Link IE Field Basic protocol can be find at https://www.cc-link.org/ .
More about programming Mitsubishi PLC using CC-Link IEF Basic can be find here: http://dl.mitsubishielectric.com/dl/fa/document/manual/plc/sh081684eng/sh081684engb.pdf.
More about ConveyLinx capabilities please visit: http://www.pulseroller.com/downloads/#files-Control+Literature+_+Drawings-ConveyLinx-Users_Manual_and_Specifications .

2. Programmable controllers, which support CC-Link IEF Basic.

Table 1 shows all Mitsubishi PLC supported CC-Link IEF Basics.

Product series/ Model name	**Function support**	**CPU module FW version**	**GX Works software version**	**Max number of connected slave stations**
MELSEC iQ-R R04CPU, R04ENCPU, R08CPU, R08ENCPU, R16CPU, R16ENCPU, R32CPU, R32ENCPU, R120CPU,R120ENCPU	*CC-Link IEF Basic*	"25" or later	GX Works3 "1.030G" or later	64
	Group number setting	"28" or later	GX Works3 "1.035M" or later	
	Automatic detection of connected devices	-		
MELSEC iQ-F FX5U-32MR/ES, FX5U-32MT/ES, FX5U-32MT/ESS, FX5U-64MR/ES, FX5U-64MT/ES, FX5U-64MT/ESS, FX5U-80MR/ES, FX5U-80MT/ES, FX5U-80MT/ESS, FX5U-32MR/DS, FX5U-32MT/DS, FX5U-32MT/DSS, FX5U-64MR/DS, FX5U-64MT/DS, FX5U-64MT/DSS, FX5U-80MR/DS, FX5U-80MT/DS, FX5U-80MT/DSS FX5UC-32MT/D, FX5UC-32MT/DSS, FX5UC-64MT/D, FX5UC-64MT/DSS, FX5UC-96MT/D, FX5UC-96MT/DSS	*CC-Link IEF Basic*	"1.040" or later	GX Works3 "1.030G" or later	16
	Automatic detection of connected devices	-	GX Works3 "1.035M" or later	
MELSEC-Q Q03UDVCPU, Q04UDVCPU, Q06UDVCPU, Q13UDVCPU, Q26UDVCPU	*CC-Link IEF Basic*	"18112" or later	GX Works2 "1.555D" or later	64
	Group number setting	"19042" or later	GX Works2 "1.565P" or later	
	Automatic detection of connected devices	-		
MELSEC-L L02CPU, L02CPU-P, L06CPU, L06CPU-P, L26CPU, L26CPU-P, L26CPU-BT,L26CPU-PBT	*CC-Link IEF Basic*	"18112" or later	GX Works2 "1.555D" or later	16
	Automatic detection of connected devices	-	GX Works2 "1.565P" or later	

Table 1

3. How to install CSP+

In order to install or delete CSP+ archives there shouldn't be open any project in the environment. From the *Tool* menu select *Profile Management* and then *Register* to install new profile or *Delete* to remove it. The procedure and menu are the same in both GX Works2 and GX Works3 environments.

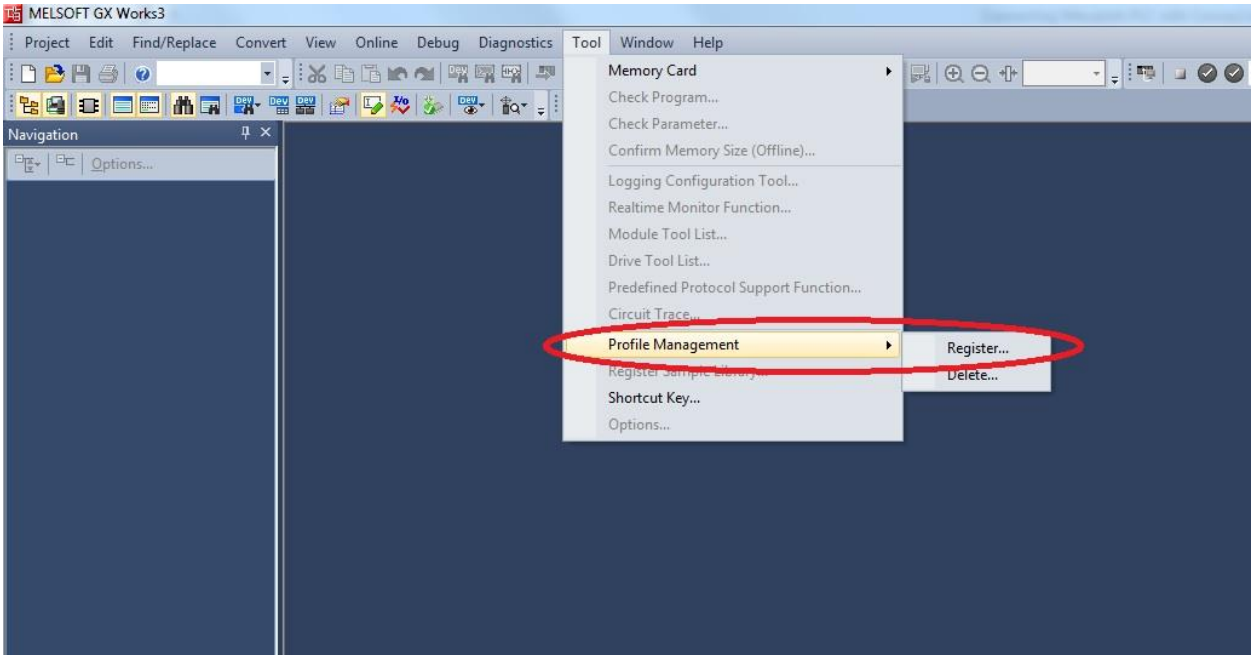
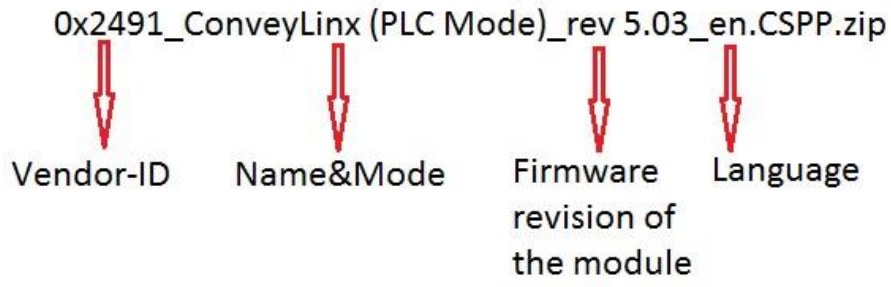


FIGURE 1

The profile is usually coming in an archive (.zip format), because is combining CSP+ file with its icon and graphic files. The format of the ConveyLinx CSP+ will be:



There are two CSP+ files for ConveyLinx modules, one for PLC mode and one for ZPA.

When installing the CSP+ select the archive file.

4. Configuration of the slave stations

4.1. GX Works2

In the example is used Q03UDVCPU. When using CC-Link IEF Basic protocol go to *Navigation* window, expand *Parameter* and then double click on *PLC Parameter.*
The *Q Parameter Setting* window will open. Select IP address, Subnet Mask and Default Router for the Master in this window and then click on *CC-Link IEF Basic Settings* button to *Enable* the protocol and set slave parameters.

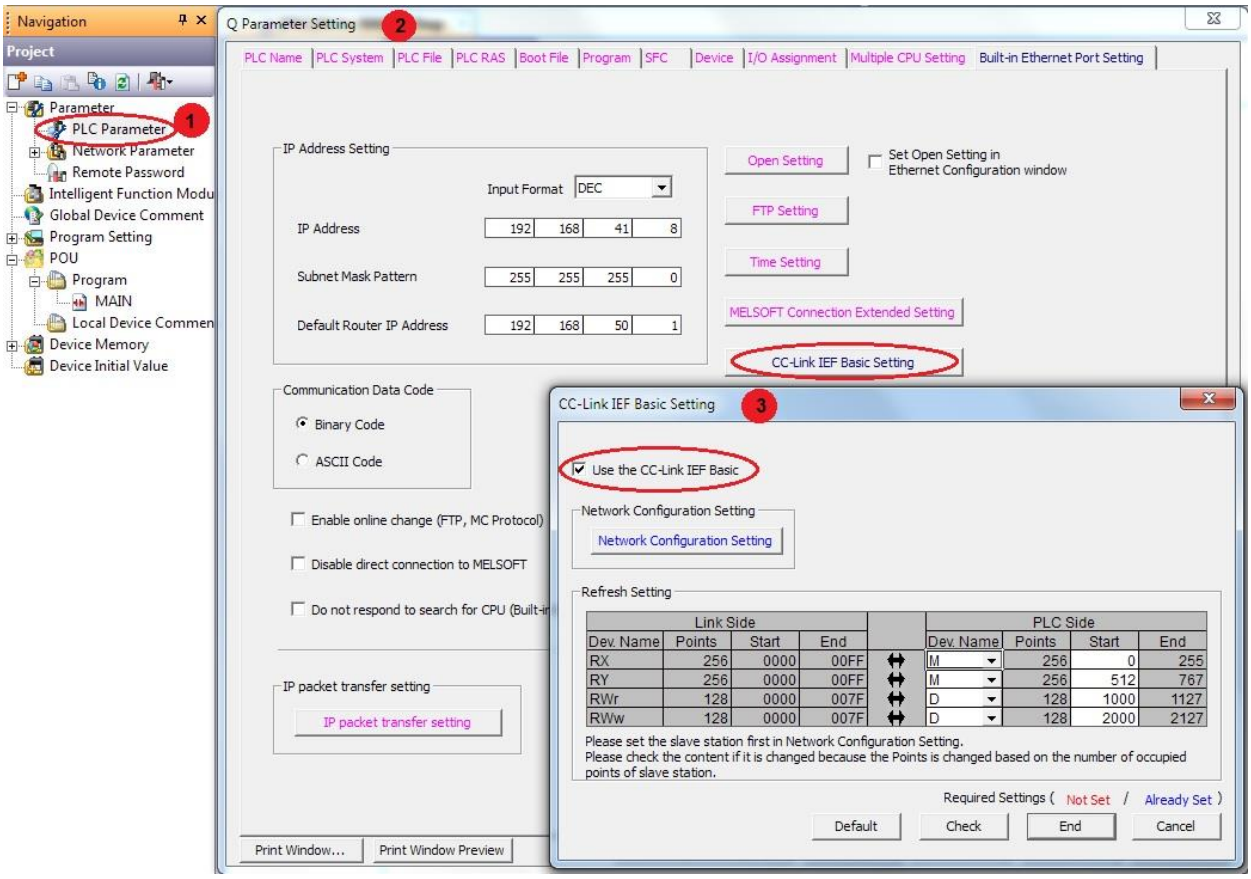


FIGURE 2

To configure the slave stations go to *Network Configuration Settings* button shown in Figure 3.

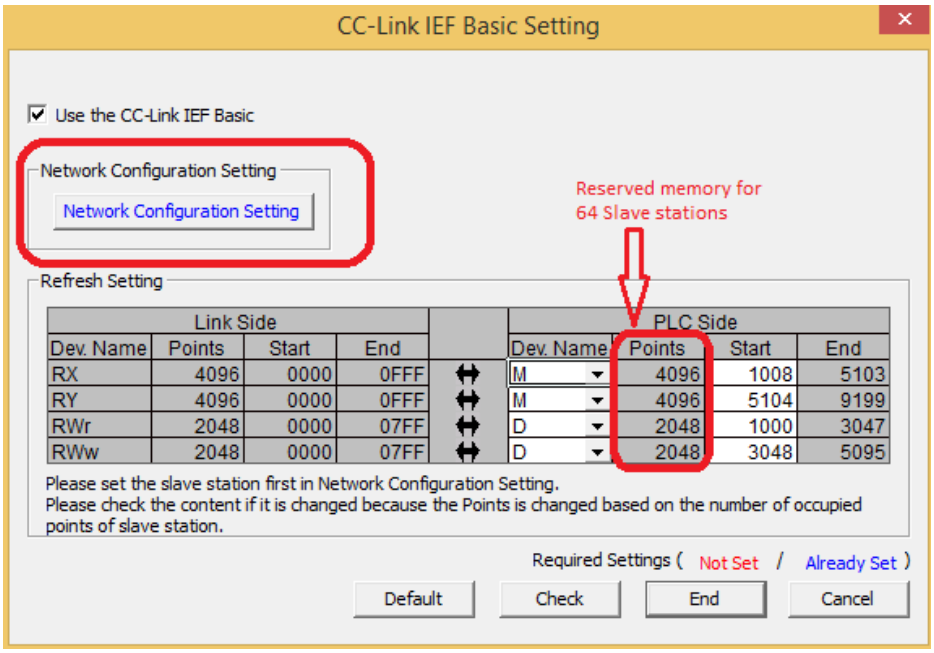


FIGURE 3

CC-Link IEF Basic Configuration window will open.

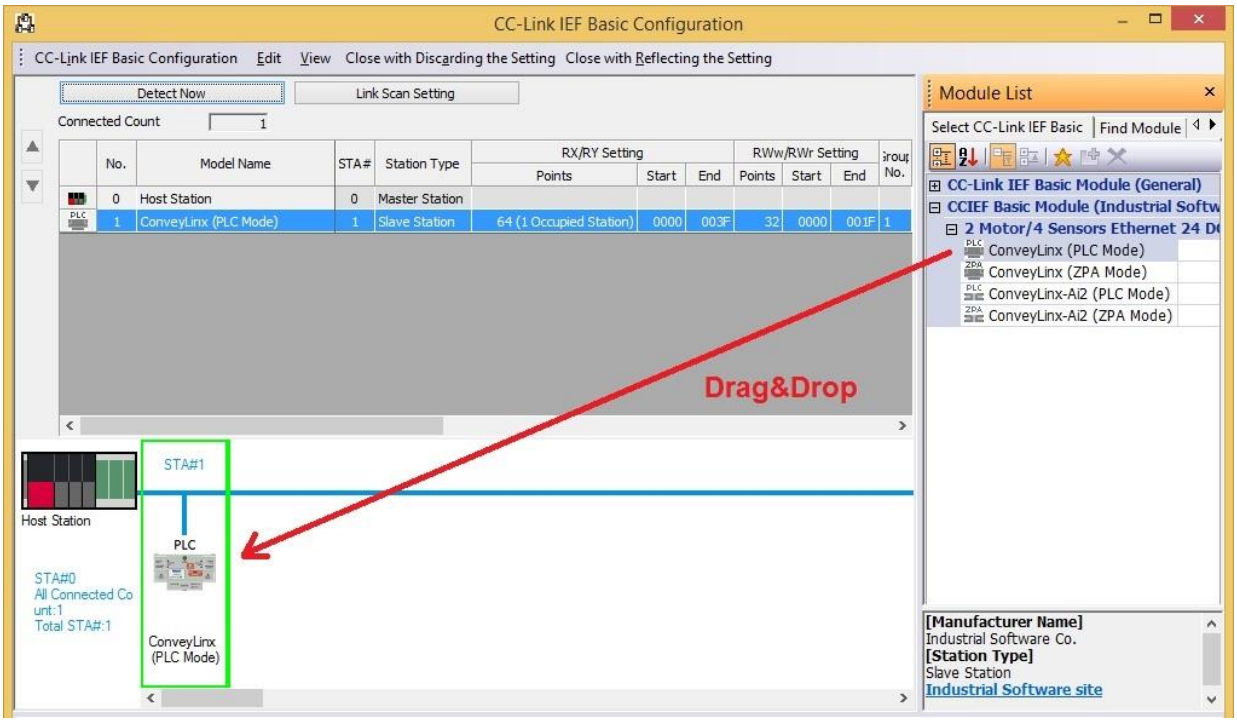


FIGURE 4

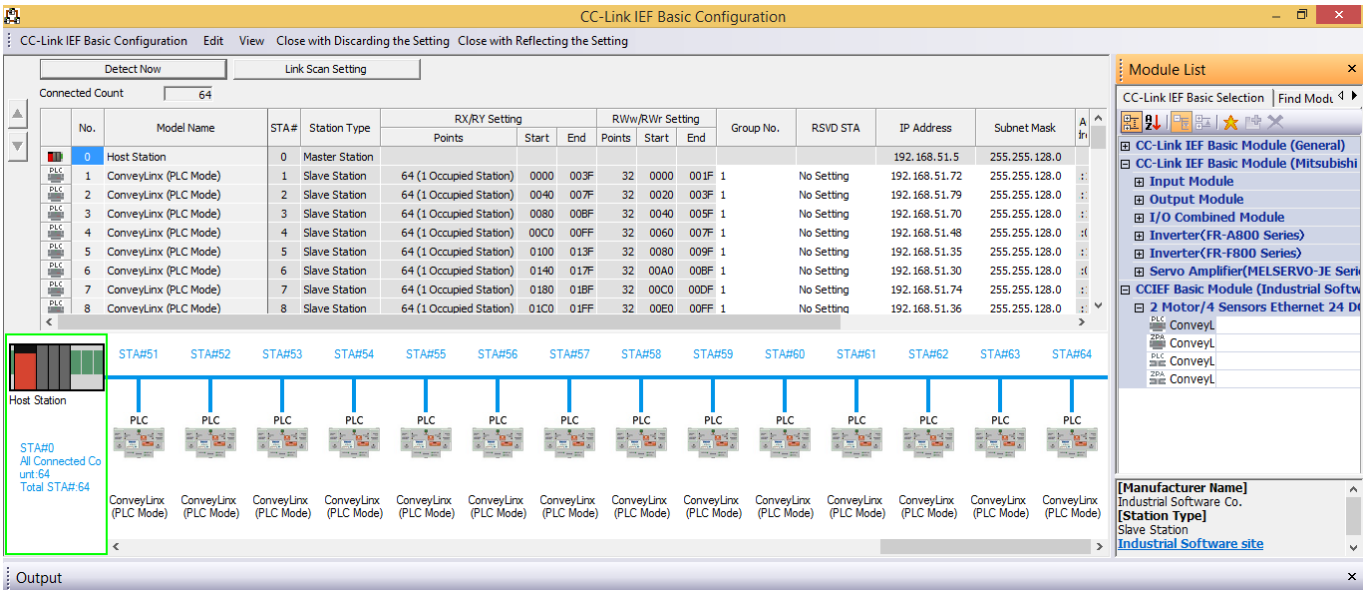


FIGURE 5

Figure 5 shows maximum Slave stations (64 Nodes) connected to single Host station.

The column on right *Module List* contents the installed CSP+. Go to Industrial Software modules and Drag and drop in the field beside host station.

The configuration of the slave is in the table above the topology view. The fields in grey are parameters which are coming from CSP+ file. The data size is CC-Link requirement and the number of occupied stations, supported from ConveyLinx module is one.

Default slave address will be in the same C-class network as the master, starting from one and in the example below 192.168.51.1. This IP can be changed, but is necessary to be in the same network as the master. Shown on figure 6.

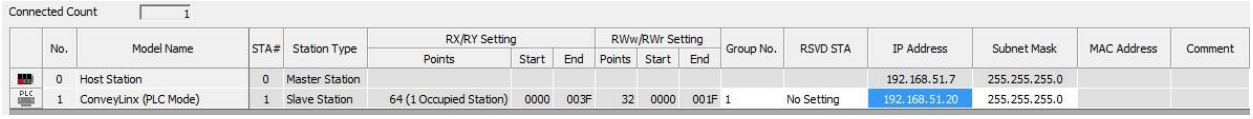


FIGURE 6

Another configuration that should be done is setting the fields of PLC memory where the cyclic data is copied. There is setting for each type of cyclic data: RX, RY, RWw and RWr, regardless of ConveyLinx uses only the WORD-fields RWw and RWr. To configure the memory fields go to *Refresh Settings* property shown in Figure 3. Specify the memory type and start address in the CPU side. In the example in Figure 3 the memory fields are selected for 64 slave modules. RWr (data, written from the slave) will be from D1000 to D1031 for the first slave, from D1032 to D1063 for the second slave, from D1064 to D1095 for the third slave and same way to all other stations. Last station (Station 64) will reserve address from D3016 to D3047. RWw (data, written from the master) will be from D2000 to D2031 for the first slave, from D2032 to D2063 for the second slave and same way to all other stations. Last station will reserve address from D5064 to D5095.

Figure 7 present Memory mapping for 64 Slave stations. Station #2 is in ZPA mode and RWr/RWw data are detailed described on figure 7.

Detailed description of every single WORD field can be found in "Conevylinx-Ai PLC Developers Guide"- Publication ERSC-1510 page 19.

Figure 8 shows same mapping for 64 Slave stations, difference is that station #3 is in PLC mode and RWr/RWw data are detailed described.

Detailed description of every single WORD field can be found in "Conevylinx-Ai PLC Developers Guide"- Publication ERSC-1510 page 49.

Host Station No	RWr		RWw	
	Start	End	Start	End
STA#1	D1000	D1031	D3048	D3079
STA#2	D1032	D1063	D3080	D3111
STA#3	D1064	D1095	D3112	D3143
....	....	....	....	....
....	....	....	....	....
STA#63	D2984	D3015	D5032	D5063
STA#64	D3016	D3047	D5064	D5095

RWr	Host Station 2 (**ZPA Mode**) RWr
D1032	Local Status Upstream Zone
D1033	Local Status Downstream Zone
D1034	Arrival Count Local Upstream Zone
D1035	Departure Count Local Upstream Zone
D1036	Arrival Count Local Downstream Zone
D1037	Departure Count Local Downstream Zone
D1038	Module Status Diagnostic 1
D1039	Module Status Diagnostic 2
D1040	Current Upstream Zone Tracking Word 1
D1041	
D1042	Current Upstream Zone Tracking Word 2
D1043	
D1044	Current Downstream Zone Tracking Word 1
D1045	
D1046	Current Downstream Zone Tracking Word 2
D1047	
D1048	Current Release Count for Upstream Zone
D1049	Current Release Count for Downstream Zone
D1050	Get Tracking Forward Direction Word 1
D1051	Get Tracking Forward Direction Word 2
D1052	Get Tracking Reverse Direction Word 1
D1053	RESERVED
D1054	RESERVED
D1055	RESERVED
D1056	RESERVED
D1057	RESERVED
D1058	RESERVED
D1059	RESERVED
D1060	RESERVED
D1061	RESERVED
D1062	RESERVED
D1063	RESERVED

RWw	Host Station 2 (**ZPA Mode**) RWw
D3080	Set Local Upstream Zone Tracking Word 1
D3081	Set Local Upstream Zone Tracking Word 2
D3082	Set Local Downstream Zone Tracking Word 1
D3083	Set Local Downstream Zone Tracking Word 2
D3084	Accumulation Control for Local Upstream Zone
D3085	Accumulation Control for Local Downstream Zone
D3086	Set Left MDR Speed
D3087	Set Right MDR Speed
D3088	Release and Accumulate on Next Arrival for Local Upstream Zone
D3089	Release and Accumulate on Next Arrival for Local Downstream Zone
D3090	Set Status for Upstream Induct
D3091	Set Status for Downstream Discharge
D3092	Set Induct Tracking Forward Direction Word 1
D3093	Set Induct Tracking Forward Direction Word 2
D3094	Set Induct Tracking Reverse Direction Word 1
D3095	Set Induct Tracking Reverse Direction Word 2
D3096	Clear Motor Error
D3097	Reserved
D3098	RESERVED
D3099	ConveyStop Command
D3100	Clear Sensor Jam Command for Local Upstream Zone
D3101	Clear Sensor Jam Command for Local Downstream Zone
D3102	Direction & Accumulation Mode Control for Local Upstream Zone
D3103	Direction & Accumulation Mode Control for Local Upstream Zone
D3104	MergerMode
D3105	RESERVED
D3106	RESERVED
D3107	RESERVED
D3108	RESERVED
D3109	RESERVED
D3110	RESERVED
D3111	RESERVED

FIGURE 7

Host Station No	RWr		RWw	
	Start	End	Start	End
STA#1	D1000	D1031	D3048	D3079
STA#2	D1032	D1063	D3080	D3111
STA#3	D1064	D1095	D3112	D3143
....	....	....	....	....
....	....	....	....	....
STA#63	D2984	D3015	D5032	D5063
STA#64	D3016	D3047	D5064	D5095

RWr	Host Station 3 (PLC **Mode**) RWr
D1064	ConveyStop Status
D1065	Sensor Port Inputs
D1066	Sensor Detect
D1067	Module Voltage
D1068	Left Motor Current
D1069	Left Motor Frequency
D1070	Left Motor Temperature
D1071	Left Motor Status
D1072	Right Motor Current
D1073	Right Motor Frequency
D1074	Right Motor Temperature
D1075	Right Motor Status
D1076	Left Motor Port Digital I/O Status
D1077	Right Motor Port Digital I/O Status
D1078	Upstream Module Status
D1079	Downstream Module Status
D1080	Current Tracking Word 1 for Adjacent Upstream Module
D1081	Current Tracking Word 2 for Adjacent Upstream Module
D1082	RESERVED
D1083	Left Motor Servo Position
D1084	Right Motor Servo Position
D1085	Left Motor Servo Status
D1086	Right Motor Servo Status
D1087	RESERVED
D1088	RESERVED
D1089	RESERVED
D1090	RESERVED
D1091	RESERVED
D1092	RESERVED
D1093	RESERVED
D1094	RESERVED
D1095	RESERVED

RWw	Host Station 3 (PLC **Mode**) RWw
D3112	ConveyStop Command
D3113	Set Left Motor Port Digital Control
D3114	Set Right Motor Port Digital Control
D3115	Sensor Port Digital Control
D3116	Left Motor Run / Reverse
D3117	Left Motor Brake Method
D3118	Reserved
D3119	Right Motor Run / Reverse
D3120	Right Motor Brake Method
D3121	Reserved
D3122	Left Motor Speed Reference
D3123	Right Motor Speed Reference
D3124	Left Motor Acceleration Ramp
D3125	Left Motor Deceleration Ramp
D3126	Right Motor Acceleration Ramp
D3127	Right Motor Deceleration Ramp
D3128	Clear Motor Error
D3129	Set Status to Downstream Module
D3130	Set Status to Upstream Module
D3131	Sensor Port Input Signal Condition Mask
D3132	Set Discharge Tracking Word 1
D3133	Set Discharge Tracking Word 2
D3134	RESERVED
D3135	Left Motor Servo Command Pulses
D3136	Left Motor Servo Command Word
D3137	Right Motor Servo Command Pulses
D3138	Right Motor Servo Command Word
D3139	RESERVED
D3140	RESERVED
D3141	RESERVED
D3142	RESERVED
D3143	RESERVED

FIGURE 8

4.2. GX Works3

In the example is used PLC R04CPU. To enable using CC-Link IEF Basic protocol go to *Navigation* window, expand *Parameter*, then *R04CPU* and double click on *Module Parameter*.

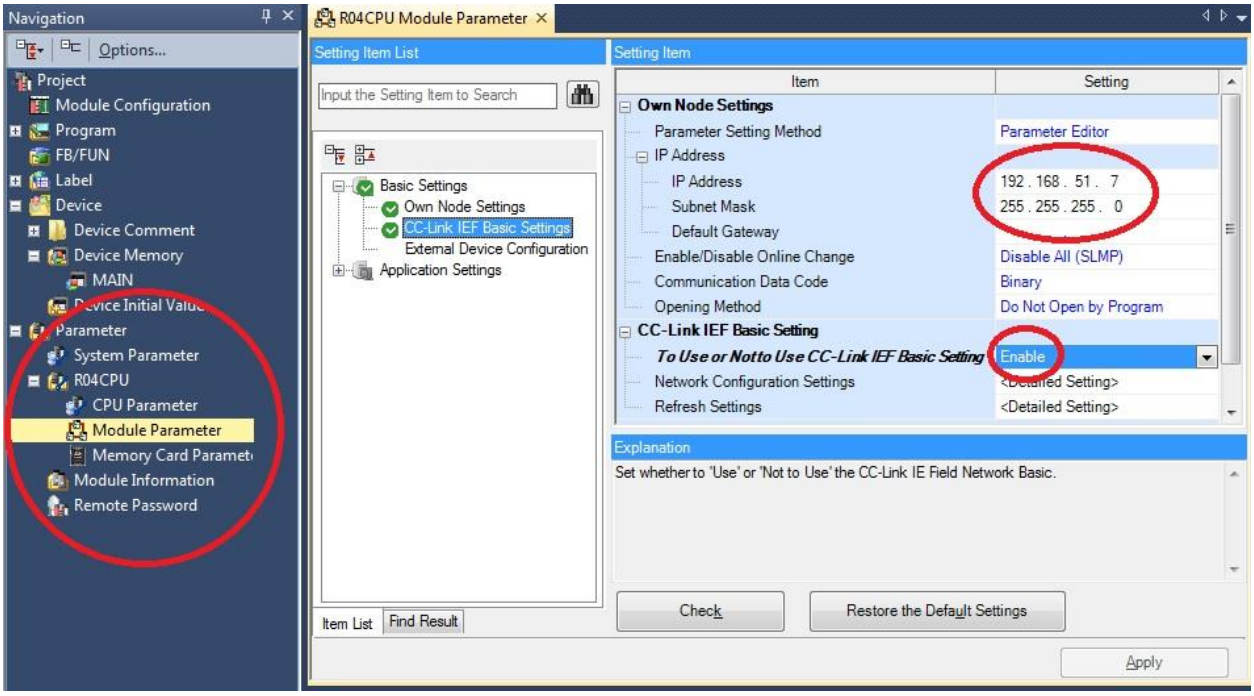


FIGURE 9

The *R04CPU Module Parameter* window will open, then in *CC-Link IEF Basic Settings* switch to *Enable* in the *To Use or Not to Use CC-Link IEF Basic Setting* property.

Select IP address for the Master in this window too, or if it is not set here it will take the default setting of network 192.168.3.XXX and subnet mask 255.255.255.0.

To configure the slave stations go to *Network Configuration Settings* property.

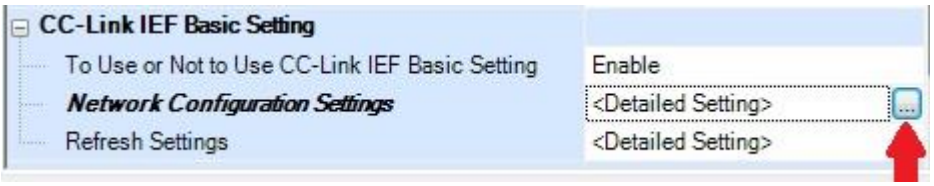


FIGURE 10

The same *CC-Link IEF Basic Configuration* window as in Figure 4 will open.

The column on right *Module List* contents the installed CSP+. Go to Industrial Software modules and Drag&Drop in the field beside host station.

The configuration of the slave is in the window above. The fields in grey are parameters which are coming from CSP+ file. The data size is CC-Link requirement and the number of occupied stations, supported from ConveyLinx module is one.

Default slave address will be in the same C-class network as the master, starting from one and in the example below 192.168.51.1. This IP can be changed, but is necessary to be in the same network as the master.

Another configuration that should be done is setting the fields of PLC memory where the cyclic data is copied. There is setting for each type of cyclic data: RX, RY, RWw and RWr, regardless of ConveyLinx uses only the WORD-fields RWw and RWr. In *R04CPU Module Parameter* window under *CC-Link IEF Basic Settings* go to *Refresh Settings* property:

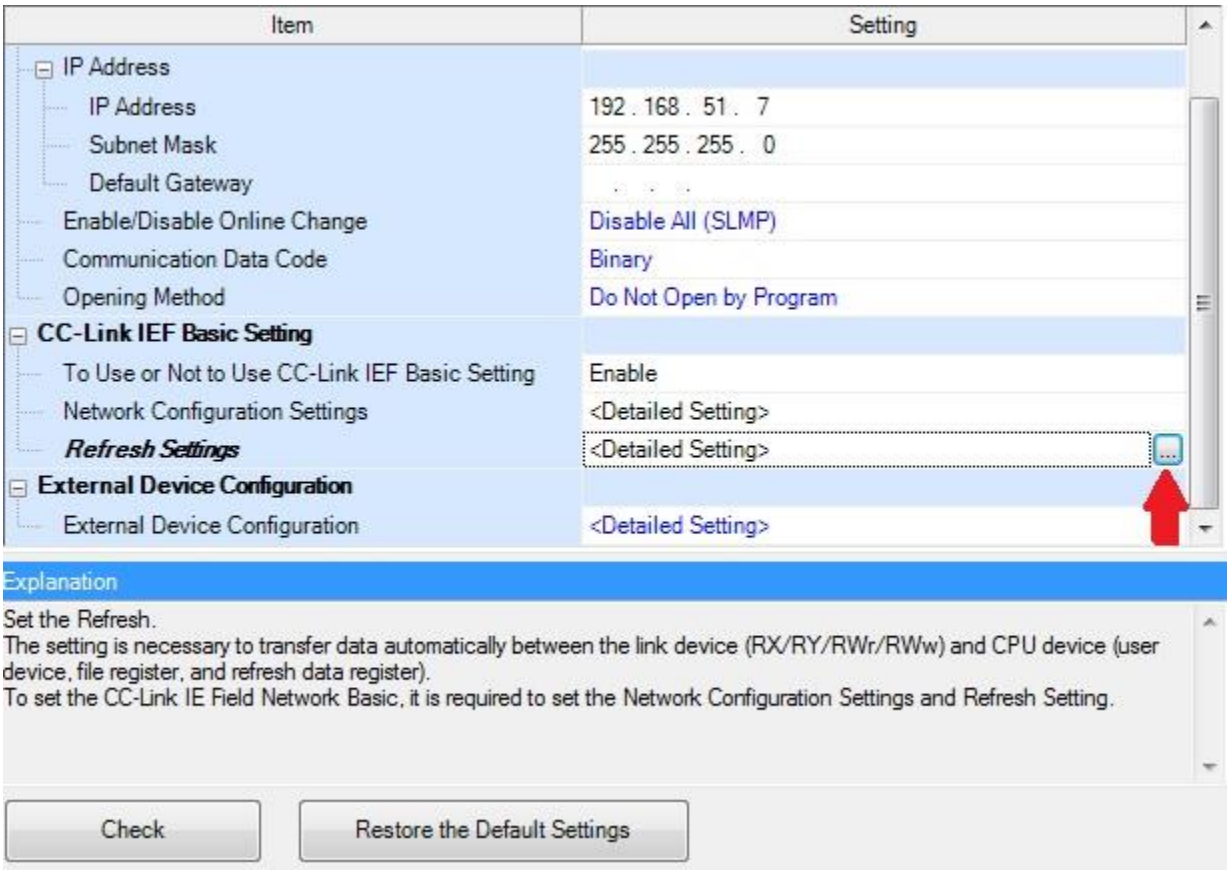


FIGURE 11

The table same as *"Refresh Settings"* in Figure 3 with memory fields will open. Specify the memory type and start address in the CPU side. In the example in Figure 3 the memory fields are selected for 64 slave modules. RWr (data, written from the slave) will be from D1000 to D1031 for the first slave, from D1032 to D1063 for the second slave, from D1064 to D1095 for the third slave and same way to all other stations. Last station (Station 64) will reserve address from D3016 to D3047. RWw (data, written from the master) will be from D2000 to D2031 for

the first slave, from D2032 to D2063 for the second slave and same way to all other stations. Last station will reserve address from D5064 to D5095.

Figure 7 present Memory mapping for 64 Slave stations. Station #2 is in ZPA mode and RWr/RWw data are detailed described on figure 7.

Detailed description of every single WORD field can be found in "Conevylinx-Ai PLC Developers Guide"- Publication ERSC-1510 page 19.

Figure 8 shows same mapping for 64 Slave stations, difference is that station #3 is in PLC mode and RWr/RWw data are detailed described.

Detailed description of every single WORD field can be found in "Conevylinx-Ai PLC Developers Guide"- Publication ERSC-1510 page 49.

5. Online Monitoring

After writing the configuration to the PLC, diagnostic of the current status of the connection can be seen in menu *Diagnostics -> CC-Link IEF Basic Diagnostics* ***for both GX Works2 and GX Works3***.

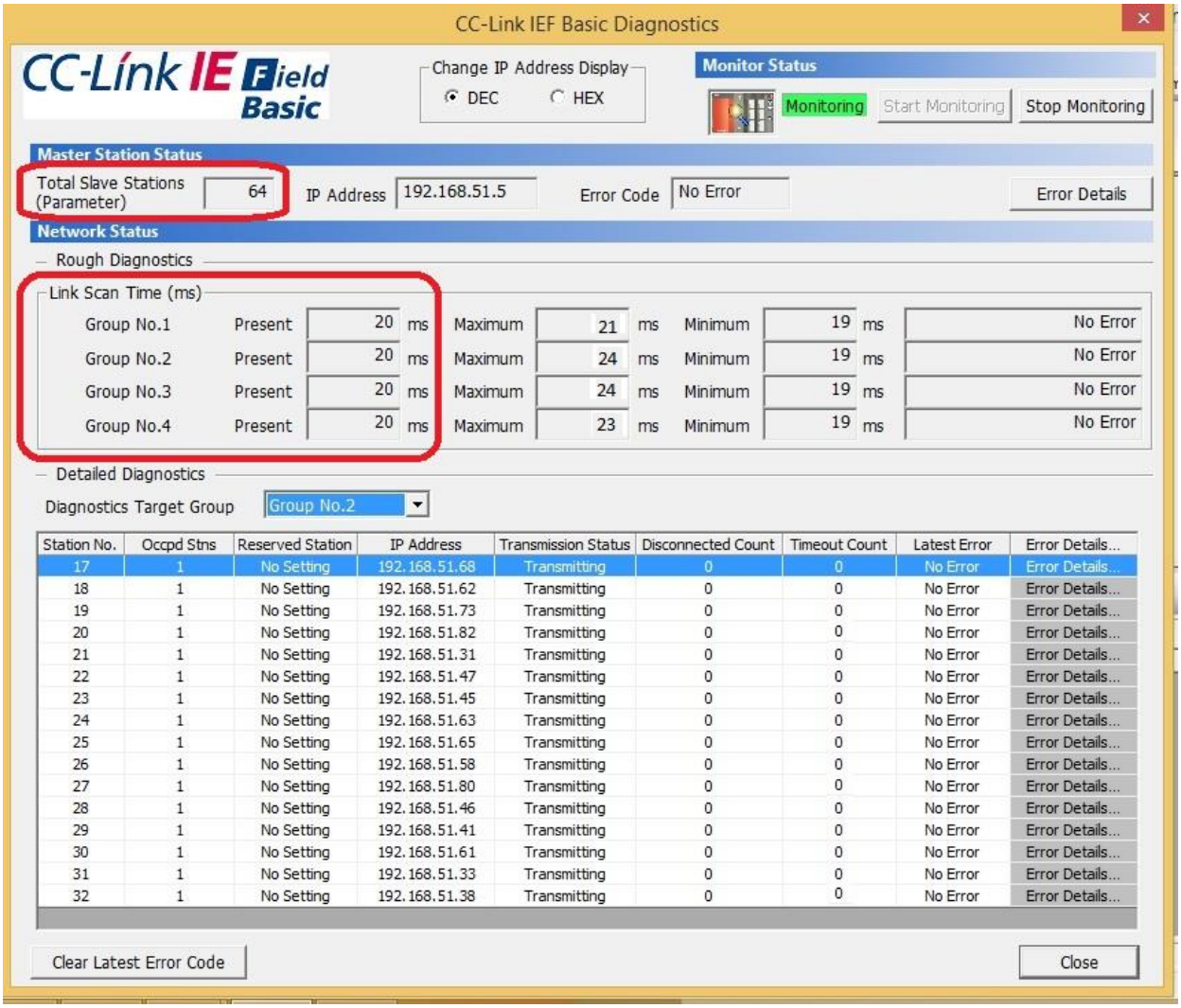
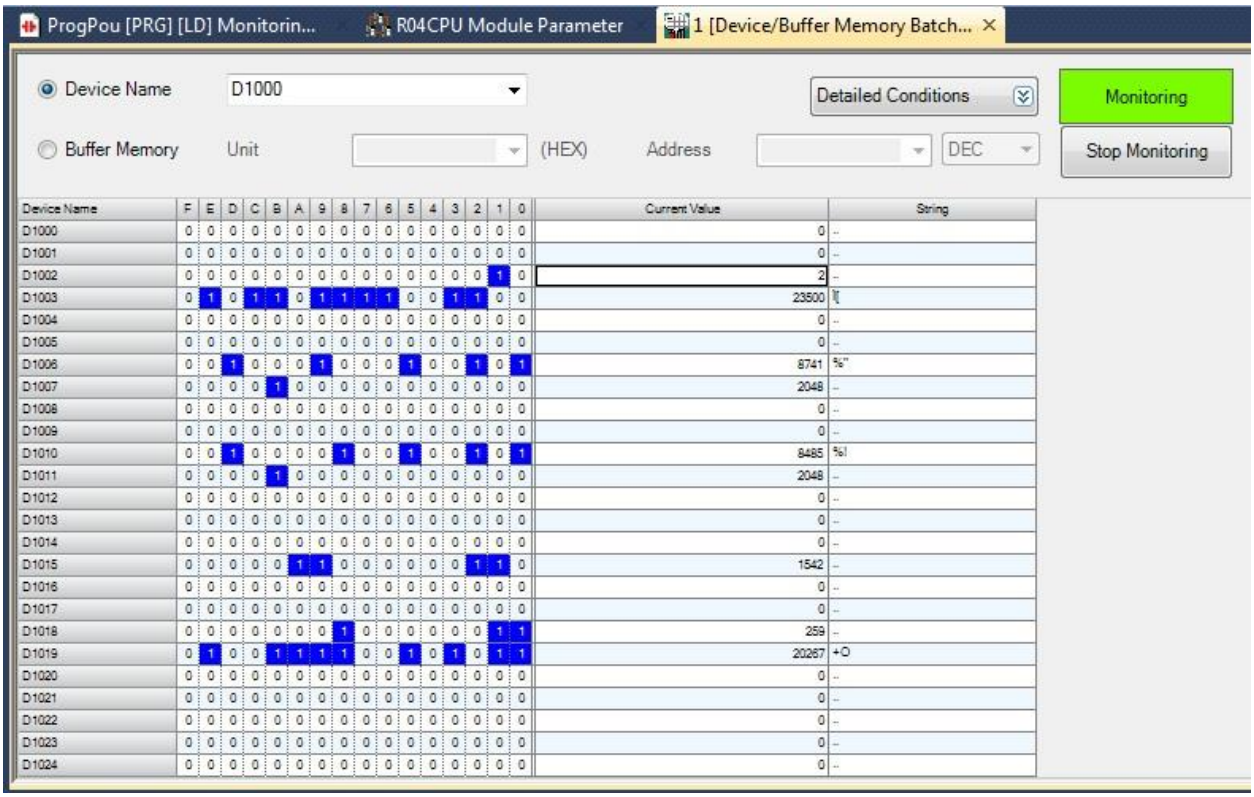


FIGURE 12

To see the data between master and slaves go to menu *Online -> Monitor -> Device/Buffer Memory Batch Monitor* and in the field *Device Name* write the type and address of the memory.

In the example in Figure 13 *Device Name* D1000 shows RWr cyclic data.



Device Name	F	E	D	C	B	A	9	8	7	6	5	4	3	2	1	0	Current Value	String
D1000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	..
D1003	0	1	0	1	1	0	1	1	1	1	0	0	1	1	0	0	23500	%[
D1004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1005	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1006	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	1	8741	%"
D1007	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2048	..
D1008	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1009	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1010	0	0	1	0	0	0	0	1	0	0	1	0	0	1	0	1	8485	%I
D1011	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2048	..
D1012	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1015	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	1542	..
D1016	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1018	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	259	..
D1019	0	1	0	0	1	1	1	1	0	0	1	0	1	0	1	1	20267	+O
D1020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1021	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1022	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1023	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..
D1024	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	..

FIGURE 13

RWw data can be reaching in the same manner:

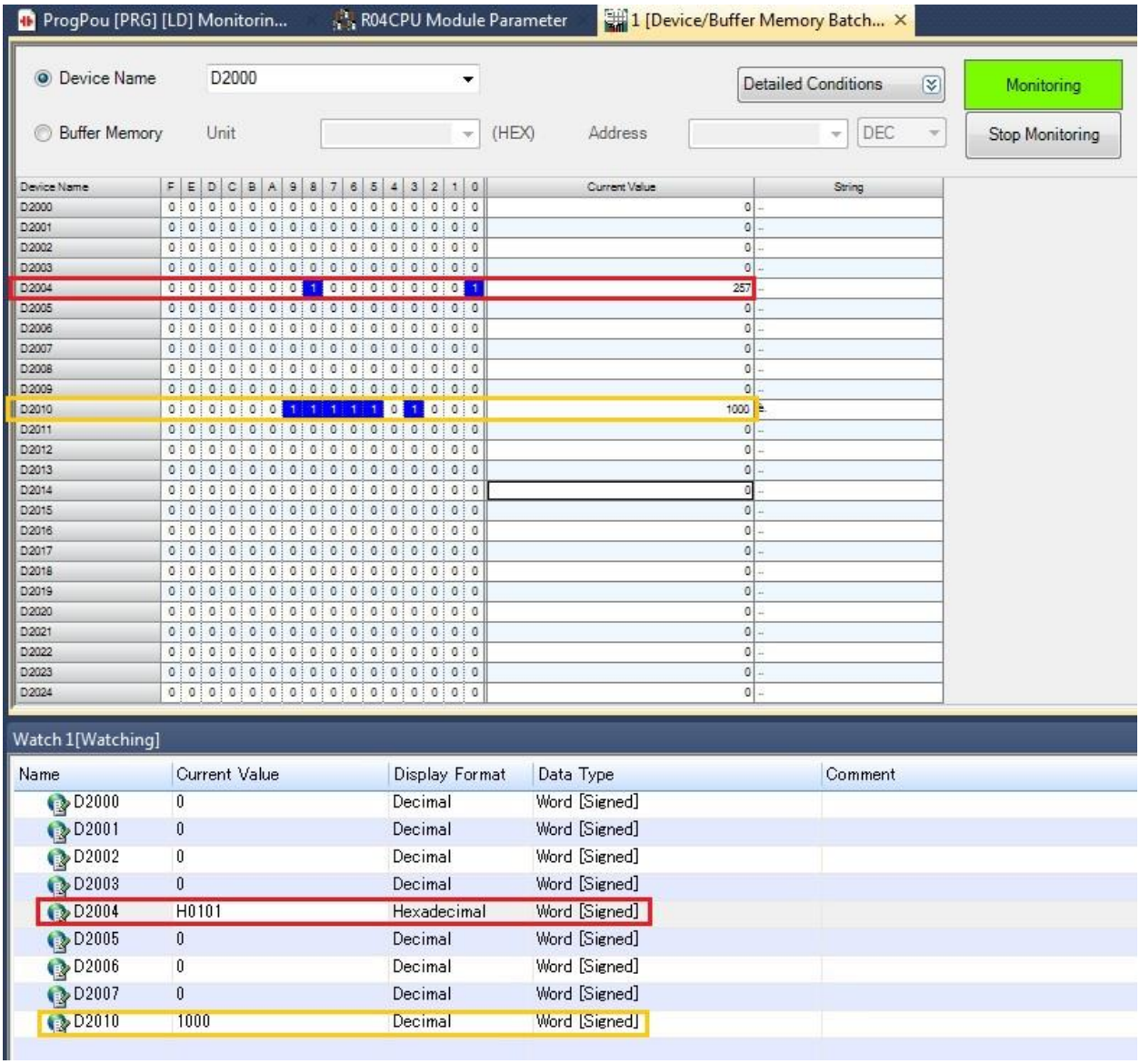


FIGURE 14

In order to modify the data, which is send from the master, write to the same memory WORD-field in the *Watch* window.

6. ConveyLinx in ZPA mode

ZPA Mode is the default mode of any ConveyLinx that has been configured by the *Auto-Configuration Procedure*. In this mode, each ConveyLinx has established logical connections to its neighboring ConveyLinx modules in order to operate conveyor with Zero Pressure Accumulation (ZPA) functionality. No external controller is required for the conveyor to function and operation is as described in *ConveyLinx User's Guide* (publication *ERSC*-1000).

When a ConveyLinx is in its default ZPA mode, an external networked PLC or PC controller can connect to the ConveyLinx and perform the following:

- Instruct either or both the upstream and downstream zone to accumulate the next load that arrives
- Receive indication that a new load has arrived at either zone
- Receive indication that a load has departed from either zone
- Read tracking data associated with load at accumulated zone
- Update tracking data associated with load at accumulated zone
- Instruct accumulated zone to release load and accumulate on next load arrival
- Change the MDR speed for either zone
- Remove accumulation control and return zone to normal operation
- Read fault and error status of either zone or motor

Table 2 shows cyclic data in ZPA mode, described in WORD-fields. Detailed description of every single WORD field can be found in "Conevylinx-Ai PLC Developers Guide"- Publication ERSC-1510 page 19.

RWr in ZPA mode		
Index	Name	
0	Local Status Upstream Zone	
1	Local Status Downstream Zone	
2	Arrival Count Local Upstream Zone	
3	Departure Count Local Upstream Zone	
4	Arrival Count Local Downstream Zone	
5	Departure Count Local Downstream Zone	
6	Module Status Diagnostic 1	
7	Module Status Diagnostic 2	
8	Current Upstream Zone Tracking Word 1	
9	Current Upstream Zone Tracking Word 2	
10	Current Downstream Zone Tracking Word 1	
11	Current Downstream Zone Tracking Word 2	
12	Current Release Count for Upstream Zone	
13	Current Release Count for Downstream Zone	
14	Get Tracking Forward Direction Word 1	
15	Get Tracking Forward Direction Word 2	
16	Get Tracking Reverse Direction Word 1	
17	Get Tracking Reverse Direction Word 2	
18	Sensor Port Inputs	
19	RESERVED	
20	ConveyStop Status	
21	RESERVED	
22	RESERVED	
23	RESERVED	
24	Left Motor Actual Speed (m/sec)*1000	#1, #2
25	Right Motor Actual Speed (m/sec)*1000	#1, #2
26	Motor Voltage	#1, #2
27	Temperature Left	#1, #2
28	Temperature Right	#1, #2
29	DFCI Index number	#1, #2
30	DFCI Value Low WORD	#1, #2
31	DFCI Value High WORD	#1, #2

RWw in ZPA mode	
Index	Name
0	Set Local Upstream Zone Tracking Word 1
1	Set Local Upstream Zone Tracking Word 2
2	Set Local Downstream Zone Tracking Word 1
3	Set Local Downstream Zone Tracking Word 2
4	Accumulation Control for Local Upstream Zone
5	Accumulation Control for Local Downstream Zone
6	Set Left MDR Speed
7	Set Right MDR Speed
8	Release and Accumulate on Next Arrival for Local Upstream Zone
9	Release and Accumulate on Next Arrival for Local Downstream Zone
10	Set Status for Upstream Induct
11	Set Status for Downstream Discharge
12	Set Induct Tracking Forward Direction Word 1
13	Set Induct Tracking Forward Direction Word 2
14	Set Induct Tracking Reverse Direction Word 1
15	Set Induct Tracking Reverse Direction Word 2
16	Clear Motor Error
17	RESERVED
18	RESERVED
19	ConveyStop Command
20	Clear Sensor Jam Command for Local Upstream Zone
21	Clear Sensor Jam Command for Local Downstream Zone
22	Direction & Accumulation Mode Control for Local Upstream Zone
23	Direction & Accumulation Mode Control for Local Downstream Zone
24	MergerMode

Table 2

#1 - ***Indexs with this mark are ConveylinxAI supported only;***

#2 – ***ConveyLinxAi diagnostic fields – for more information go to section 9 on page 31.***

Examlpe 1. Product accumulation.

For this example, the PLC must establish an appropriate connection to *Module B* utilizing Input ZPA Assembly and Output ZPA Assembly as shown in Figure 19. Let's assume that Input data from Module B are shown at **Device Name 1000 to 1031** and Output data are shown at **Device Name 3048 to 3079**. Please refer to Figure 7.

UPSTREAM ZONE EXAMPLE

We want to accumulate any Product that arrives on the upstream zone of *Module B*.

1. Set bit 0 in *Accumulation Control for Local Upstream Zone* **Device Name** (RWw) **3052** to instruct this zone to accumulate any Product that arrives.
2. Monitor *Arrival Count Local Upstream Zone* **Device Name** (RWr) **1002** and *Departure Count Local Upstream Zone* **Device Name 1003**. On the leading edge when these two values become not equal, the PLC knows there is a new arrival. Note that as long as a Product is physically occupying the upstream zone, these two values will not be equal.
3. When the PLC is ready to release the Product in the upstream zone, it should reset bit 0 in *Accumulation Control for Local Upstream Zone* **Device Name 3052**. This will signal *Module B* to release any Product accumulated and not accumulate the next Product that arrives at *Module B* upstream zone.

Figure 15 is Ladder logic view of Example 1.

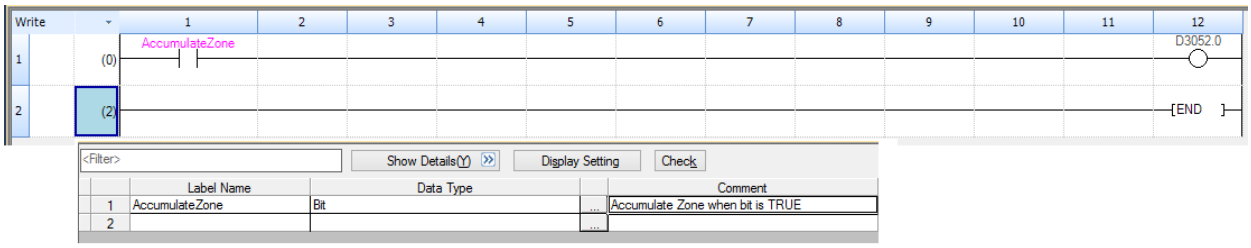


FIGURE 15

Example 2. Wake-up most upstream Zone using PLC (Upstream Accept Interface).

This example describes how to use a PLC to control the "wake-up" to the most upstream zone of a ConveyLinx controlled conveyor. Figure 16 shows a typical example configuration.

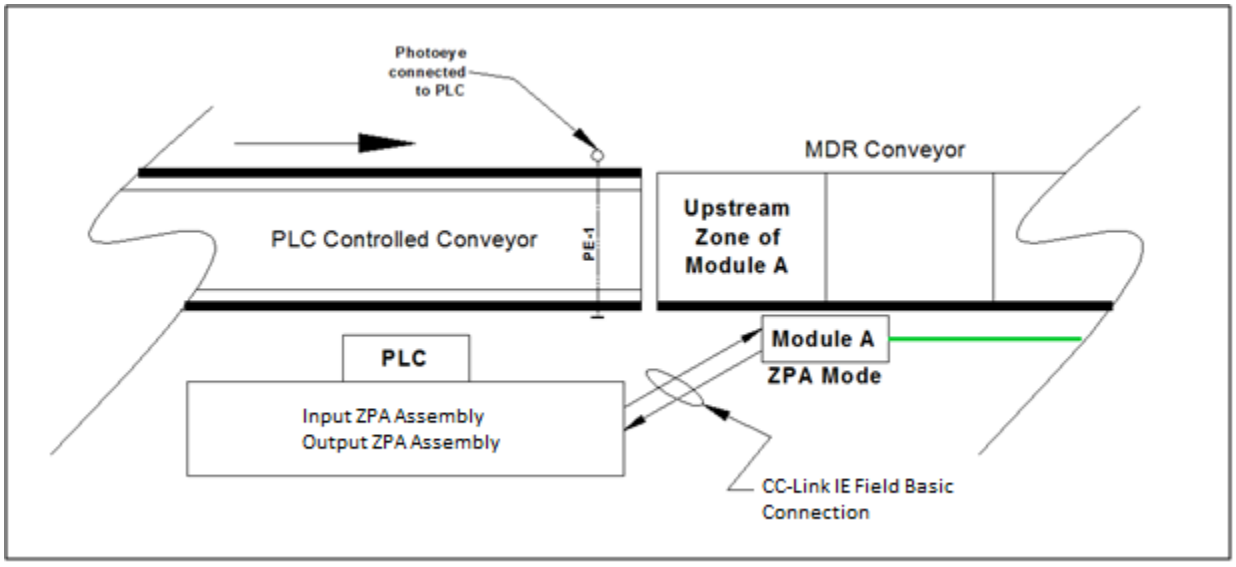


FIGURE 16 - UPSTREAM ACCEPT INTERLOCK EXAMPLE

For this example, the PLC must establish a connection with *Module A*. Let's assume that Input data from Module B are shown at **Device Name 1000 to 1031** and Output data are shown at **Device Name 3048 to 3079.** Figure 17 is Ladder logic view of Example 2.

When PLC is ready to transfer a Product from the PLC controlled conveyor to the Upstream Zone of the MDR Conveyor, the PLC logic must:

1. Write a "4" into *Set Status for Upstream Induct* **Device Name 3058**. This will cause the upstream zone of *Module A* to run to accept Product.
2. When Product clears *PE-1*, write tracking data to *Set Induct Tracking Forward Direction Word 1/2* **Device Name 3060/3061**.
3. When Product clears *PE-1,* write a "1" to *Set Status for Upstream Induct* **Device Name 3058**.

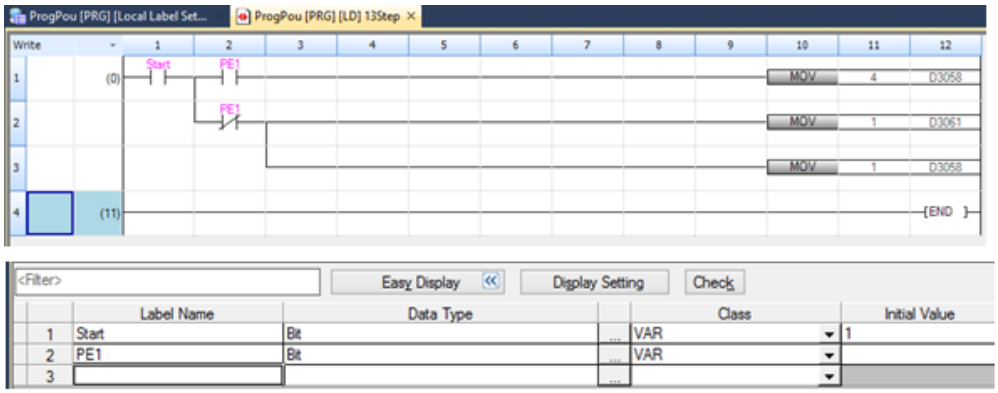


FIGURE 17

Example 3. Lane Full Interface (Downstream Discharge Interface) with most downstream Zone.

This example shows how to control the discharge of a Product from the most downstream zone of a ConveyLinx controlled conveyor. Figure 18 shows a typical example.

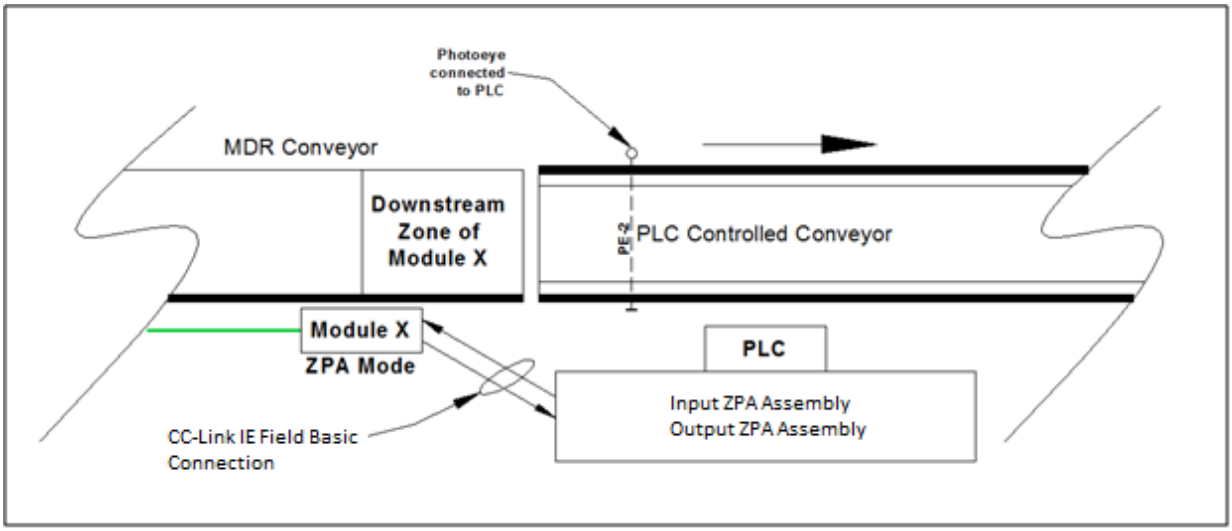


FIGURE 18 - DOWNSTREAM DISCHARGE INTERFACE EXAMPLE

For this example, the PLC must establish a connection with *Module X*. Let's assume that Input data from Module B are shown at **Device Name 1032 to 1063** and Output data are shown at **Device Name 3030 to 3111.** Figure 19 is Ladder logic view of Example 3.

1. To hold any Product that arrives at *Module X* downstream zone, the PLC writes a "5" to *Set Status for Downstream Discharge* **Device Name 3091**. This tells *Module X* that downstream conditions are "full and stopped", so it will not try to release any loads downstream.
2. When the PLC controlled conveyor is ready to accept a Product from the MDR downstream zone, it writes a "1" to *Set Status for Downstream Discharge* **Device Name 3091**. This tells *Module X* that downstream conditions are clear and if it has a Product on its downstream zone, it will run to release it downstream.
3. When the Product clears the local sensor in *Module X* Downstream Zone, the tracking data for that Product will be populated in *Get Tracking Forward Direction Word 1/2* **Device Name 1046/1047**. PLC can detect Product leaving the local sensor by monitoring *Local Status Downstream Zone* **Device Name 1033.** On the leading edge of changing the value from *0x0104* (or *0x0105)* to *0x0101* (or *0x0102),* PLC detect that Product left the local sensor of *Module X.*
4. When Product arrives at *PE-2*, the PLC writes a "5" to *Set Status for Downstream Discharge* **Device Name 3092**. This tells *Module X* that the Product successfully transferred. If this is not done, then *Module X* will produce an Arrival jam condition.

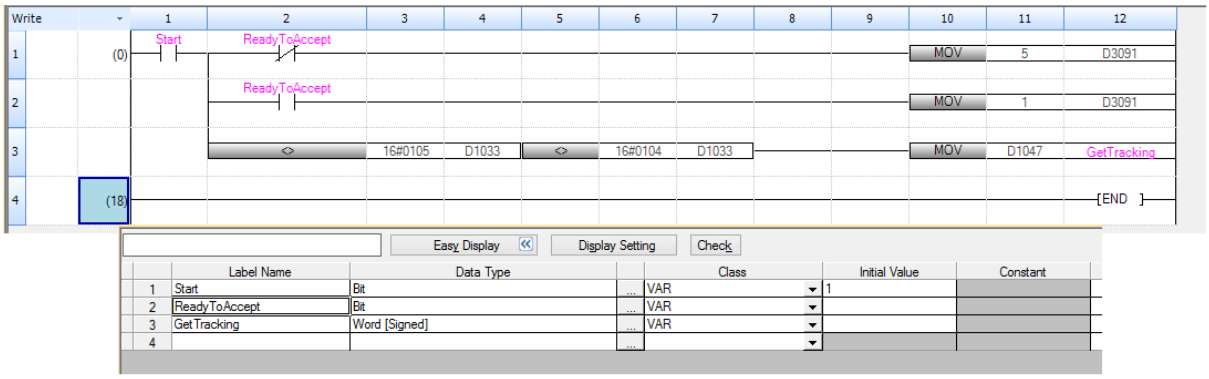


FIGURE 19

Example 4. Product accumulation and tracking control using PLC:

Figure 20 shows a typical arrangement of an upstream or downstream zone on a *Module* in ZPA mode that is not the most upstream or most downstream zone in a given network. This example will show how to cause a Product to accumulate, how to detect a Product has arrived, how to set Tracking and finally how to release the Product.

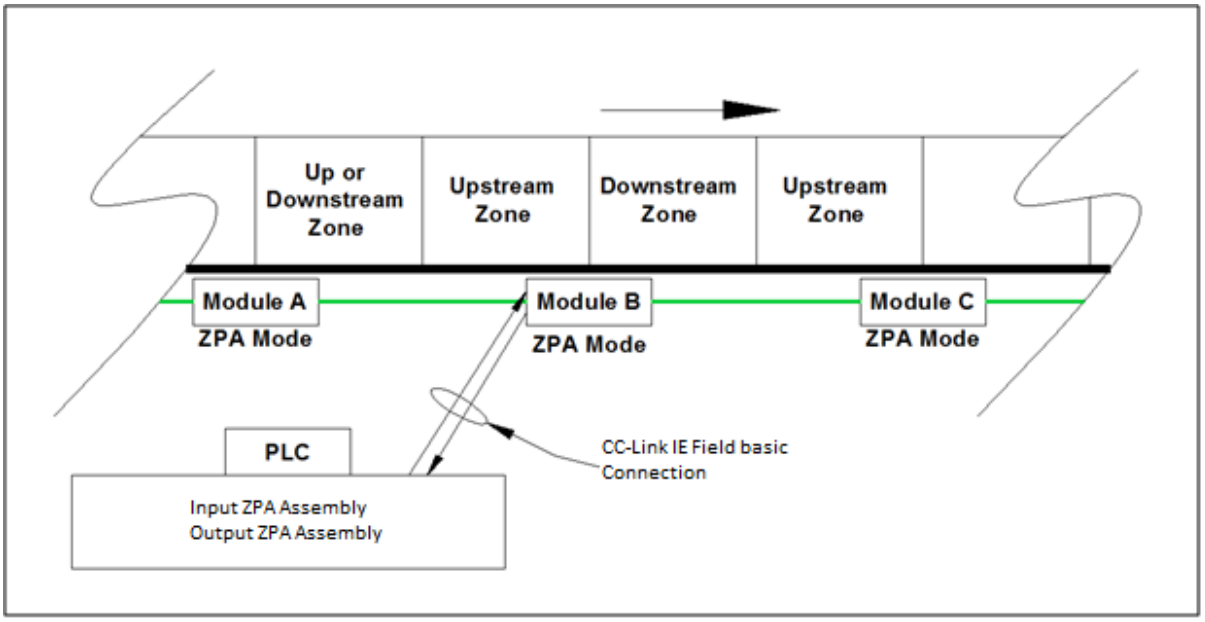


FIGURE 20 - BASIC ACCUMULATE / RELEASE CONTROL EXAMPLE

For this example, the PLC must establish an appropriate connection to *Module B* utilizing Input ZPA Assembly and Output ZPA Assembly as shown in Figure 20. Let's assume that Input data from Module B are shown at **Device Name 1000 to 1031** and Output data are shown at **Device Name 3048 to 3079**. Please refer to Figure 7.

UPSTREAM ZONE EXAMPLE

We want to accumulate any Product that arrives on the upstream zone of *Module B*.

1. Set bit 0 in *Accumulation Control for Local Upstream Zone* **Device Name** (RWw) **3052** to instruct this zone to accumulate any Product that arrives.
2. Monitor *Arrival Count Local Upstream Zone* **Device Name** (RWr) **1002** and *Departure Count Local Upstream Zone* **Device Name 1003**. On the leading edge when these two values become not equal, the PLC knows there is a new arrival. Note that as long as a Product is physically occupying the upstream zone, these two values will not be equal.
3. Upon a successful arrival of a Carton in the upstream zone, then tracking data in *Current Upstream Zone Tracking Word 1* **Device Name 1008** and *Current Upstream Zone Tracking Word 2* **Device Name 1009** will be valid for the newly arrived Carton.
4. The PLC may then decide that this tracking data is to be updated. The PLC can then write new tracking data to registers *Set Local Upstream Zone Tracking Word 1* **Device Name 3048** and *Set Local Upstream Zone Tracking Word 2* **Device Name 3049**
5. When the PLC is ready to release the Product in the upstream zone, it should read the value in the *Current Release Count for Upstream Zone* **Device Name 1012**, add 1 to this value, and then write this new value to Release *and Accumulate on Next Arrival for Local Upstream Zone* **Device Name 3056**. When *Module B* sees this new value in this register, it will release the Product in the upstream zone and automatically accumulate the next new Product that arrives. Please note that if the downstream conditions from *Module B* are full when this new value is written, *Module B* will remember that it was instructed to release and will release the Product when downstream conditions become clear without any further signal from the PLC.
6. The PLC can detect when the Product has departed the sensor on *Module B* upstream zone by examining the values in *Arrival Count Local Upstream Zone* **Device Name 1002** and *Departure Count Local Upstream Zone* **Device Name 1003**. On the leading edge of when these two values are equal, the PLC will know that the Product has departed the zone sensor in *Module B* upstream zone.

If the PLC wants to cancel the accumulation control for *Module B* upstream zone:

PLC can reset bit 0 in *Accumulation Control for Local Upstream Zone* **Device Name 3052**. This will signal *Module B* to release any Product accumulated and not accumulate the next Product that arrives at *Module B* upstream zone.

Please note that if any new tracking data has been written to *Set Local Upstream Zone Tracking Word 1* and/or *Set Local Upstream Zone Tracking Word 2* and accumulation control is then canceled by resetting bit 0, this data will NOT be assigned to the Carton when it is released. The ONLY way to pass tracking data to a Carton is by following Step 5 above.

DOWNSTREAM ZONE EXAMPLE

*Downstream Zone example is identical to Upstream Zone example shown above except the **Device Names** used are different. Please refer to Figure 7.*

Figure 21 is Ladder logic view of Example 4.

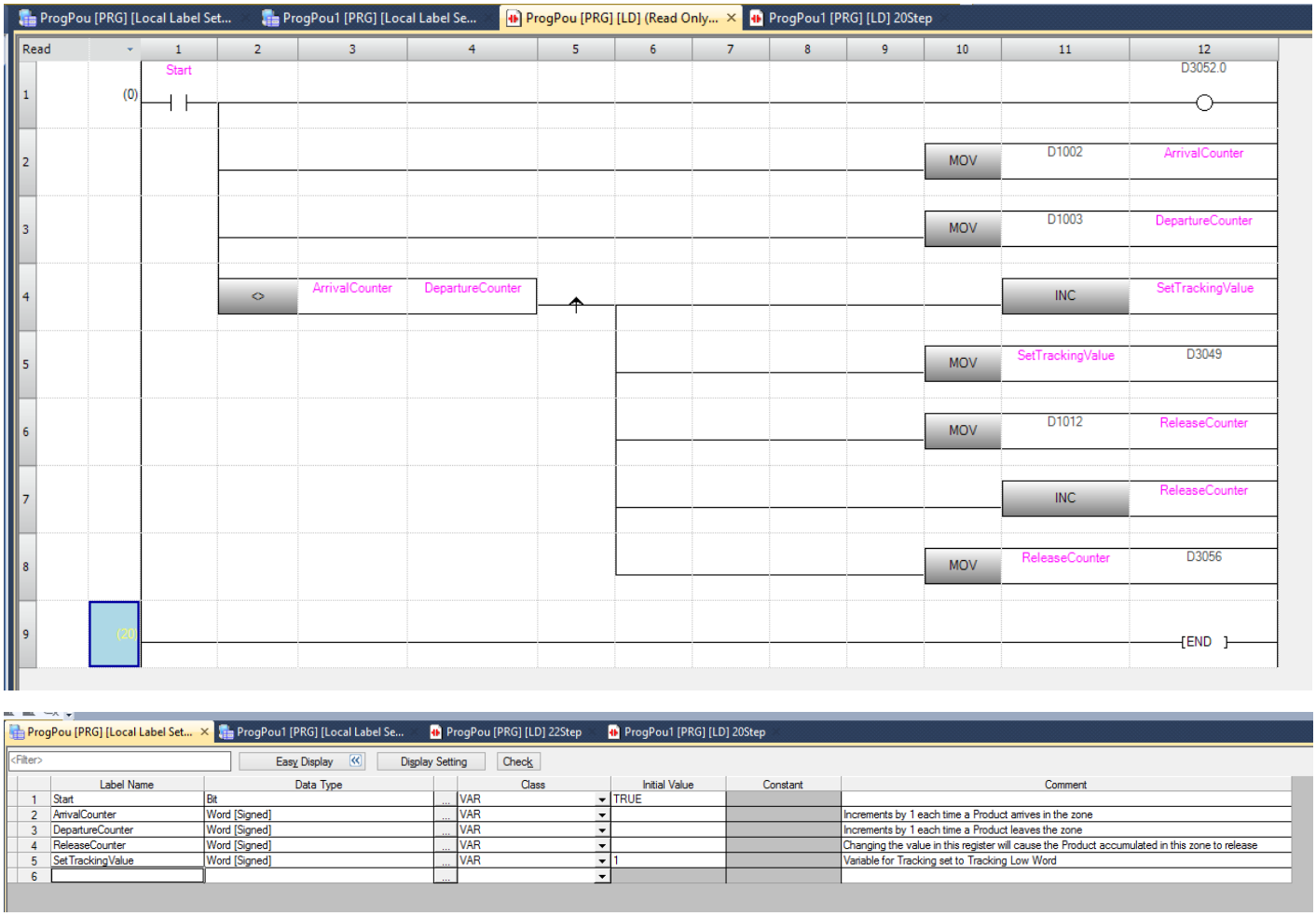


FIGURE 21

7. ConveyLinx in PLC mode

In PLC I/O Mode, the ConveyLinx suspends all automatic ZPA functionality and its input, output and motor control functions are explicitly controlled by a networked external logic controller. The external controller reads from and writes to the ConveyLinx's internal data registers over the Ethernet network using Ethernet I/P or Modbus TCP protocol in order to initiate all ConveyLinx functionality.

When a ConveyLinx is in PLC I/O mode, all automatic functions of detecting loads and running motors are suspended by the local ConveyLinx on-board logic and the external controller must explicitly read inputs and write data output to cause motors to run. The following items are available for external controller when ConveyLinx is in PLC I/O Mode:

- Status of all available digital inputs on Sensor and Control ports (8 total inputs)
- Module voltage reading
- Left and Right motor status of frequency, current, and calculated temperature
- Left and Right motor diagnostic error status word
- Control of Control Port digital outputs
- Ability to independently run both Left and Right motors
- Ability to set speed, acceleration, deceleration, PI Mode, and Braking method for Left and Right motors
- Ability to configure one or both motor ports to digital output mode
- Ability to remotely clear fatal motor error condition
- Ability to instruct module to E-Stop motor outputs

Cyclic data in PLC mode, described in WORD-fields:

RWr PLC mode		
Index	Name	
0	ConveyStop Status	
1	Sensor Port Inputs	
2	Sensor Detect	
3	Module Voltage	
4	Left Motor Current	
5	Left Motor Frequency	
6	Left Motor Temperature	
7	Left Motor Status	
8	Right Motor Current	
9	Right Motor Frequency	
10	Right Motor Temperature	
11	Right Motor Status	
12	Left Motor Port Digital I/O Status	
13	Right Motor Port Digital I/O Status	
14	Upstream Module Status	
15	Downstream Module Status	
16	Current Tracking Word 1 for Adjacent Upstream Module	
17	Current Tracking Word 2 for Adjacent Upstream Module	
18	RESERVED	
19	Left Motor Servo Position	
20	Right Motor Servo Position	
21	Left Motor Servo Status	
22	Right Motor Servo Status	
23	Left Motor Actual Speed (m/sec)*1000	#1
24	Right Motor Actual Speed (m/sec)*1000	#1
25	RESERVED	
26	RESERVED	
27	RESERVED	
28	RESERVED	
29	DFCI Index number	#1, #2
30	DFCI Value Low WORD	#1, #2
31	DFCI Value High WORD	#1, #2

RWw PLC mode	
Index	Name
0	ConveyStop Command
1	Set Left Motor Port Digital Control
2	Set Right Motor Port Digital Control
3	Sensor Port Digital Control
4	Left Motor Run / Reverse
5	Left Motor Brake Method
6	RESERVED
7	Right Motor Run / Reverse
8	Right Motor Brake Method
9	RESERVED
10	Left Motor Speed Reference
11	Right Motor Speed Reference
12	Left Motor Acceleration Ramp
13	Left Motor Deceleration Ramp
14	Right Motor Acceleration Ramp
15	Right Motor Deceleration Ramp
16	Clear Motor Error
17	Set Status to Downstream Module
18	Set Status to Upstream Module
19	Sensor Port Input Signal Condition Mask
20	Set Discharge Tracking Word 1
21	Set Discharge Tracking Word 2
22	RESERVED
23	Left Motor Servo Command Pulses
24	Left Motor Servo Command Word
25	Right Motor Servo Command Pulses
26	Right Motor Servo Command Word

Table 3

#1 - ***Indexs with this mark are ConveylinxAI supported only;***

#2 – ***ConveyLinxAi diagnostic fields – for more information go to section 9 on page 31.***

Example 5. MDR Control:

In the example in Figure 22 when the left sensor is blocked left MDR is running. Let's assume that Input data from Module B are shown at **Device Name 1000 to 1031** and Output data are shown at **Device Name 3048 to 3079.**

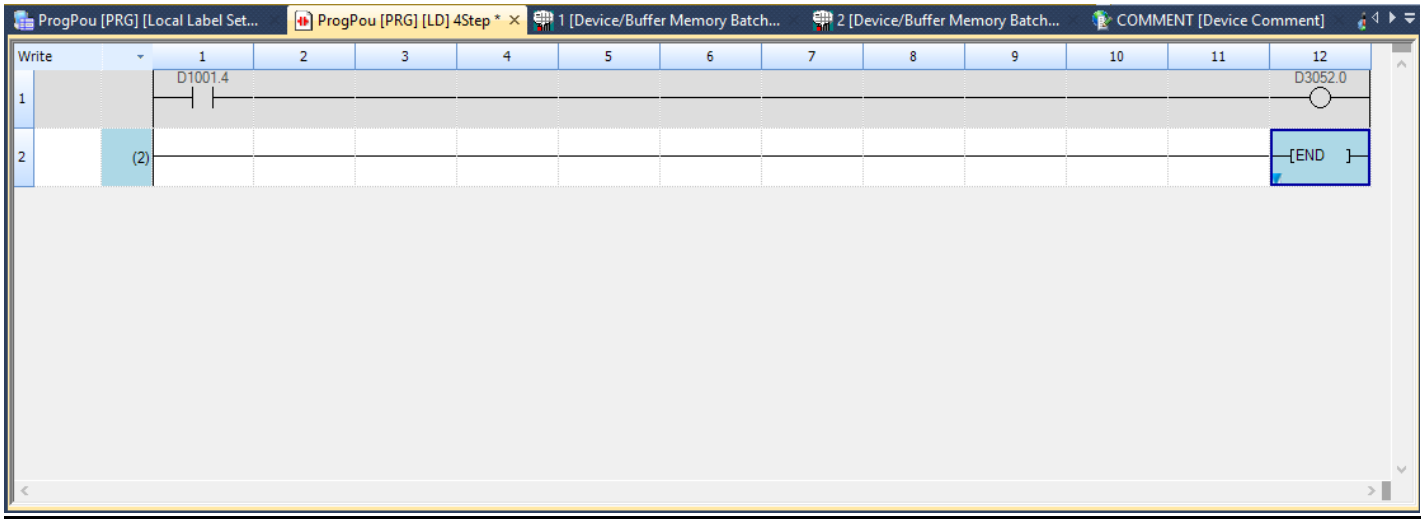


FIGURE 22

8. ConveyLinx in PLC mode with ConveyLogix program

When a ConveyLinx is in PLC mode it can run local program made by ConveyLogix software, an external networked PLC can connect to the ConveyLinx and perform the following:

- PLC can access **User** defined Outputs and Inputs (16 total Outputs, 16 total Inputs).

ConveyLogix tool provide a convenient way of writing and loading custom programming package using your choice of ladder, function block or structured text.

Software application ConveyLogix can be downloaded at PulseRoller website - http://www.pulseroller.com/downloads/index.php#files-Software+_+Firmware+Downloads-Software-ConveyLogix
Programmer's guide is visible in Help menu of the application.

Cyclic data in PLC mode with ConveyLogix, described in WORD-fields (Table 4):

RWr PLC mode with Conveylogix	
Index	Name
0	Input[0]
1	Input[1]
2	Input[2]
3	Input[3]
4	Input[4]
5	Input[5]
6	Input[6]
7	Input[7]
8	Input[8]
9	Input[9]
10	Input[10]
11	Input[11]
12	Input[12]
13	Input[13]
14	Input[14]
15	Input[15]

RWw PLC mode with Conveylogix	
Index	Name
0	Output[0]
1	Output[1]
2	Output[2]
3	Output[3]
4	Output[4]
5	Output[5]
6	Output[6]
7	Output[7]
8	Output[8]
9	Output[9]
10	Output[10]
11	Output[11]
12	Output[12]
13	Output[13]
14	Output[14]
15	Output[15]

Table 4

Table 5 is part of ConveyLogix's Programmer's guide. When PLC establish an appropriate connection to *Module with Conveylogix program* it can monitor "ToPLCArray[16]" data and update "FromPLCArray[16]" data.

ConveyLinx Controller Tags

Controller Tag Name	Type	Modbus Register(s)
Input Controller Tags		
Inputs	DINT	See ConveyLinx Inputs Tag
FromUpstreamState	INT	134
FromUpstreamTracking	DINT	139, 140
FromDownstreamState	INT	232
FromPLC	DINT	266, 267
FromPLCArray	INT[16]	13200 – 13215
MyIPAddress	DINT	26, 27
ServoReadyLeft	BOOL	11 – bit 0
ServoReadyRight	BOOL	16 – bit 0
FirstLadderExec	BOOL	---
Output Controller Tags		
Outputs	DINT	See ConveyLinx Outputs Tag
ToUpstreamState	INT	116
ToDownstreamState	INT	196
ToDownstreamTracking	DINT	201, 202
ToPLC	DINT	268, 269
ToPLCArray	INT[16]	13100 - 13115
SensorPolarity	INT	34
SpeedLeftMTR	INT	40
SpeedRightMTR	INT	64
ServoControlLeft	INT	8
ServoControlRight	INT	13
ServoResetLeft	BOOL	9 – bit 0

Table 5

ConveyLogix program can be written in ConveyLinx module only when the module is in PLC mode.

Switching between PLC mode data and PLC mode with ConveyLogix data should be done as follows:

1. **Disconnect CC-Link IE Field Basic master**
2. **Write ConveyLogix program to ConveyLinx module using ConveyLogix software**
3. **Reconnect CC-Link IE Field Basic master**

9. ConveyLinxAi diagnostic fields

9.1. RWr diagnostic fields with cyclic index (in short DFCI) in PLC mode (only for ConveyLinxAi)

In the last three addresses of RWr WORD field, when ConveyLinxAi is in PLC mode, is added additional diagnostic structure, called DFCI item. One DFCI item has an index (size of WORD) and DWORD value. The DFCI index is at data field RWr29 and the DFCI value at data fields RWr30 (Low) and RWr31 (High). In Table 6 is shown the structure of the described DFCI item.

RWr field	Description
RWr29	DFCI Index number
RWr30	DFCI Value Low WORD
RWr31	DFCI Value High WORD

Table 6

DFCI item cyclically changes its data. It starts with Index 0 (Error Counter Left Motor) than increments on every 2 cycles of master-slave CC-Link communication to Index 13 (Undervoltage Counter Right Motor) and again go to Index 0. Table 7 is showing the diagnostic parameter on each DFCI Index. In order to collect and monitor all DFCI items on master side, the logic should watch for 14 changeable indexes, followed with the corresponding diagnostic data.

DFCI Index	DFCI item value parameter
0	Error Counter Left Motor
1	Error Counter Right Motor
2	Operating Time Left Motor
3	Operating Time Right Motor
4	Time in Current Limit Left Motor
5	Time in Current Limit Right Motor
6	Time in Overheat Left Motor
7	Time in Overheat Right Motor
8	ON/OFF Cycles Left Motor
9	ON/OFF Cycles Right Motor
10	Overvoltage Counter Left Motor
11	Overvoltage Counter Right Motor
12	Undervoltage Counter Left Motor
13	Undervoltage Counter Right Motor

Table 7

9.2. RWr diagnostic fields with cyclic index (in short DFCI) plus additional diagnostic in ZPA mode (only for ConveyLinxAi)

In ZPA mode DFCI items are the same as described in Table 7, also located at WORD fields RWr29, RWr30, RWr31, but there is additional information about actual speed of the motor, motor voltage and temperature from RWr22 to RWr28. In spite of DFCI item is changed on every 2 cycles of master-slave communication, the additional ZPA diagnostic is as shown on Table 8:

RWr field	Description
RWr24	Left Motor Actual Speed (m/sec)*1000
RWr25	Right Motor Actual Speed (m/sec)*1000
RWr26	Motor Voltage
RWr27	Temperature Left
RWr28	Temperature Right
RWr29	DFCI Index number
RWr30	DFCI Value Low WORD
RWr31	DFCI Value High WORD

Table 8

All DFCI items have meaningful value the size of DWORD, accept for Index 0 (Error Counter Left Motor) and Index 1 (Error Counter Right Motor), which have meaningful value the size of WORD located at RWr30 field.

When ConveyLinxAi slave station is in PLC mode with ConveyLogix program running inside diagnostic fields are still available and are the same as in normal PLC mode.