## 2m.Analysing and understanding PLC functionality

## 2m.1 Introduction

The main part of the Allen-Bradley demo case is the Compact Logix Controller 1769-L35E. The 1769-L35E controller is designed for mid-range applications. It is equipped in the operating system with a pre-emptive multitasking system. This environment supports as many as 8 tasks, but only one can be continuous. A task can have as many as 32 separate programs with their own executable routines and program tags.

## 2m.2 Understanding the CoNET\_Base project

The CompactLogix 1769-L35E controller supports development programs in four languages:

- Ladder Diagram
- Sequential Function Chart
- Function Block Diagram
- Structured Text

The main features of PLC programming are:

- tasks: max. 8 tasks (only one can be continuous)
- programs: max. 32 separate programs in one task with its own routines and program-scoped tags
- routines

**Tasks** – max. 8 tasks (only one can be continuous); all programs assigned to the task execute in the order in which they are grouped; each task has a priority level – from lowest priority of 15 up to the highest priority of 1; the continuous task has the lowest priority.

Programs – max. 32 separate programs in one task; a program contains program tags, a main executable routine and other routines

Routines – a set of logic instructions in a single programming language (e.g. ladder logic)

The basic scenario for creating a new RSLogix5000 project is described in the user manual of the 1m exercises titled 'Configuring the network'. The base PLC program for control of the aerolift system is called CoNET\_base. The main algorithm consist of three tasks (Fig. 2m-1):

- 1. MainTask (continuous)
- 2. Periodic\_10ms (periodic)
- 3. ReadWAGO\_Input (periodic)



Fig. 2m.1.The main window of RSLogix5000 project

Ad1. The MainTask configuration is shown in Fig. 2m-2. To display the configuration simply click MainTask in the project tree. The MainTask is configured as a continuous type. Only one task can be continuous.

Module 5

No Edits Battery OK	rorites 🖌 Add-	+ -+/+ -( )(U) On <b>(</b> Alarms <b>(</b>	(C)- Bit & Timer/Counter & Input/Output & Compare & Compute/Math & N	/love/Logical
Controller CoNet_Base	周陽	5 B B	<b>기밀것 되었 천원 治원</b>	<b>(4)</b>
Controller Tags				
Controller Fault Handler		Local:1:I.Data.0	ן	
Power-Up Handler	0	1		
in tak				
🚽 🔄 🚭 MainProgram				
- 🧟 Program Tags				
			👪 Task Properties - MainTask	<u>_                                    </u>
E			General Configuration Reagram / Phase Schedule Monitor	
Program Tags			deneral comparation [110gram / 11ase Schedule] Monitor[	1
🚯 WriteFreq		Distributed_	Turner	
E ReadWAGO_Input	1	<pre> <distributed_io.< pre=""></distributed_io.<></pre>		
ReadDigitalInput		50	Watchdog: 500.000 ms	
Program rays     ReadProximitySensors				
Unscheduled Programs / Phases			Disable Automatic Dutput Processing To Reduce Task Overhead.	
E Motion Groups			🔲 Inhibit Task	
Add-On Instructions		1		
E − Trepde	(End)			
		·		
			OK Anuluj Zastosuj F	Pomoc
		1		

Fig. 2m.2.The parameters of the MainTask

In the section **Program Tags** you can define the local tags to be used in MainRoutine.

**MainRoutine** contains a main PLC program which is written in ladder diagram (Fig. 2m-3).

RSLogix 5000 - CoNet_Base [1769-L35E]* - [MainProgram - Mail File Edit View Search Logic Communications Tools Window	nRoutine]	_ @ × _ @ ×
Distributed_10:1:C	- & & & F 77 QQ BR 21 - 8 - 8 - 9	
Rem Test No Forces No Force Controller Colde: Baste Controller Tops Controller Controller Tops Controller Controller Tops Controller Controller Controller Program Tags Program Tags Program Tags Program Tags Program Tags Controller Controller Controller Controller	ColdetEtheme(1)321681.1\Backplane\0 ] 論 ColdetEtheme(1)321681.1\Backplane\0 ] 論 rottes (Add-On (Alarms (Bt (Timer/Counter (Input/Output (Compare (Compute/Math (Move/Logical))))))))))))))))))))))))))))))))))))	VAGO_DO: Deta(0)7  FlexMisc. & File/Shift & Sequencer & Equipment  VAGO_DO: Deta(0)7  FowerFlex:O.Start Locat:1:0.Deta:0  PowerFlex:O.Stop  Detributed_DO: Dota(2)D-  Detributed_DO: Dota(2)D-
Controller CoNet, Base     Controller Tags     Controller Tags     Controller Tags     Controller Tags     Controller Salk Handler     Prover-Up Handler     Trass     Program Tags     Prog	roites / Add-On / Alarns / Bt / Timer/Counter / Input/Output / Compare / Compute/Math / MoveAcgical /       Image: Im	File/Misc: { File/Shift { Sequencer { Equipment

Fig. 2m.3. The ladder diagram in MainRoutine

The program allows you to start and stop the PowerFlex inverter. For starting you should turn on the switch marked **Local1:I.Data.0** – this means: bit 0 from Digital Input from digital module in PLC (1769-L35E). To stop – turn on the switch marked

**Distributed\_IO:1:I.0** – this means: bit 0 from Digital Input of the Distributed\_IO module (1734-AENT).

Ad2. The Periodic\_10ms task configuration is shown in Fig. 2m-4. This task is configured as *Periodic* with 100ms period. In this task program *WriteFreq\_Flex40* is defined.



Fig. 2m.4. The parameters of the Periodic\_10ms task

The program allows control of the inverter frequency. Voltage from the adjuster on the panel is read by an analog input, processed and served as a control signal to the inverter. A detailed program in a ladder diagram is shown in Fig. 2m-5. The digital input *Local1:I.Data.1* is defined as ALW\_ON tag in the *WriteFreq\_Flex40->ProgramTags* section. The variables: *AnalogIn1, FREQ* and *ControlFREQ* are also defined in this section (Fig. 2m-5). Variables are used to calculate a control frequency to the inverter.

orites 🖌 Add-On 🗼 Alarms 🖌 Bit 🗼 Timer/Counter 🔏 Input/Output 🔏 Compare 🔏 Compute/Math 🔏 Move/Logical 🔏 File/Misc. 🔏 File/Shift 🥻 Sec							
	Scoge: Scoge: Show Show All						
I		Name 🛆	Alias For	Base Tag	Data Type	Style	Description
I		ALW_ON	Local:1:1.Data.1(C)	Local:1:I.Data.1(C)	BOOL	Decimal	
I		⊞-AnalogIn1			DINT	Decimal	
I					INT	Decimal	
I		⊞-FREQ			DINT	Decimal	
I	٦						
I							

Fig. 2m.5. The variables of WriteFreq\_Flex40->ProgramTags

Module 5

RSLogix 5000 - CoNet_Base [1769-L35E]* - [WriteFreq_Flex40 - Fle Edit View Search Logic Communications Tools Window I	WriteFreq] Help	X 
Image: Source and Sou		
No Forces	الله الله الله الله الله الله الله الله	jical & FileMisc. & File/Shift & Sequencer & Equipment
Controller Collet, Base Controller Tags Controller Fault Handler Proyen Tags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags MainTags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintags Maintag	2     ALW_ON       4.000411 (2004)     ALW_ON       5.00000 (2004)     ALW_ON	Local 1:0 Data 2 Local 1:0 Data 2 Move Move Source Local 21.0h1Data 0 e Divide Divide Source A Analogint 0 e Dest FRE0 0 e Move Move Source 600 Dest FRE0 0 e
Type Ledder Diagram (Main) Description	4.W_ON 4.Locat 11 Data.1> 5.Locat 11 Data.1> 5.Locat 11 Data.1> 5.Locat 11 Data.1> 5.Locat 11 Data.1> 5.Locat 11 Data.1> 5.Locat 11 Data.1>	Move Source FRED Dest PowerFlex:O.FreqCommand 0 + Move Source 0 Dest PowerFlex:O.FreqCommand 0 +
Ready 🚺 Start 🛛 🎯 🄏 🛛 👸 RSLogix 5000 - CoNet 🦉 okno_task pe	eriodic10ms	Rung 0 of 6 APP VER
		J 🔤 🗠 🈏 👽 10.49

Fig. 2m.6.The WriteFreq program

Ad3. The ReadWAGO\_Input task configuration is shown in Fig.2m-6. The task is configured as *Periodic* with 25ms period. In this task program *ReadProximitySensors* is defined. The program is very simple – signals from digital inputs are read and moved to the variable SensorInput, which is defined in the *ReadDigitalInput->ProgramTags* section (Fig. 2m-7).

vorites 🖌 Add-On 🥻 Alarms 🔏 Bit 🔏 Timer/Counter 🔏 Input/Output 🐔 Compare 🥻 Compute/Math 🐔 Move/Logical 🐔 File/Misc. 🤾 File/Shift							
	Sc	oge: 🕞ReadDigitalInput 💌 Show Shi	w All				
		Name 🛆	Alias For	Base Tag	Data Type	Style	Des
		ALW_ON			BOOL	Decimal	
		+-SensorInput			INT	Binary	

Fig. 2m.7. The variables of ReadDigitalInput->ProgramTags

Module 5

RSLogix 5000 - CoNet_Base [1769-L35E]* - [ReadDigitalInput - File Edit View Search Logic Communications Tools Window Help	ReadProximitySensors]	<u>_@</u> _
Relagis 5000 - Cottel, Base [1769-1356] - [ReadflogitalTingut - File Edit View Search Logic Communications Tools Window Help     Distributed_Ort.c      Rem Test     Controller Test Mode     Distributed_Ort.c      Rem Test     Controller Tags     Controller Tags     Controller Tags     Controller Fault Handler     Power-Up Handler     Task     MainTask     MainTa	ReadProximitySensors)	FlieShtt & Sequencer & Equement     MOV     Move WAGO_ICI.Deta[0]     0 +     Dest Sensorippt     Zer00_000_000_000
Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkouine Mañkou	General Configuration     Program / Phase Schedule     Monitor       Type:     Periodic     Image: Configuration       Periodic     Image: Configuration     Periodic       Periodic     Image: Configuration     Image: Configuration       Priority:     10     Image: Configuration       Vatchdog:     500.000     ms       Image: Disable Automatic Output Processing To Reduce Task Overhead       Image: Inhibit Task	

Fig.2m.8. The parameters of ReadWAGO\_Input task

## 2m.3 Running the application.

To run the prepared program, first you should download it to the PLC. To do this first you can go online and next download (Fig. 2m-9). The project will be automatically checked, loaded and start running. In *on-line* mode you can monitor all current process values.



Fig. 2m.9. The 'Go Online' context menu