Chapter 18 Develop Your Own Function and Function Block

This section described how to use the Visual Studio 2008 development tool to produce a DLL file of your own Function or Function Block. All the related demo files are included in the PAC's CD-ROM, such as the XP-8xx8-CE6, WP-8xx8, WP-8xx8-CE7, WP-5xx8-CE7, and VP-x2x8-CE7 PAC.

Related demo files:

CD-ROM : \napdos\Win-GRAF\demo-project\user_c_lib\

- \demo_user_c : The VS 2008 project folder, can be used to build the "user_c.dll" file for your own Function and Function Block. (Refer to <u>Section 18.4</u>)
- ..\user_c.dll : The pre-compiled DLL file "user_c.dll" used for the Function ("bytes_to_long") and the Function Block ("long_to_bytes") in this demo. \wp_vp\user_c.dll : for WP-8xx8, WP-8xx8-CE7, VP-x2x8-CE7, and WP-5xx8-CE7. \xpc\user_c.dll : for XP-8xx8-CE6.
- \user : The Win-GRAF Lib folder, including library files of the Function ("bytes_to_long") and the Function Block ("long_to_bytes") in this demo. (Refer to <u>Section 18.3</u>)

Win-GRAF demo file:

CD-ROM : \napdos\Win-GRAF\demo-project\demo_user_c.zip

The standard shipments of ICP DAS Win-GRAF PAC do not include the "user_c.dll" file. If you want to add your own Function and Function Block for working with the Win-GRAF logic, you must build a DLL file and copy it to the same folder as the Win-GRAF driver on the PAC (i.e., \System_disk\Win-GRAF\).

After rebooting the PAC, the Win-GRAF driver will load that DLL file to support your Function and Function Block.

18.1 The Development Process of Your Own Function or Function Block



18.2 Creating the Compiler Development Environment

Download the SDK (Software Development Kit):

The user can download the related SDK on the website:

- For XPAC (XP-8xx8-CE6) <u>ftp://ftp.icpdas.com/pub/cd/xp-8000-ce6/sdk/platformsdk/</u> (pacsdk_ce_x.x.x_vs2008.msi)
- For ViewPAC (VP-x2x8-CE7) and WinPAC (WP-8xx8, WP-8xx8-CE7, WP-5xx8-CE7) <u>ftp://ftp.icpdas.com/pub/cd/winpac/napdos/wp-8x4x_ce50/sdk/platformsdk/</u> (pac270_sdk_yyyymmdd.msi)

18.2.1 Install the SDK of the ViewPAC or the WinPAC

<u>Note</u>: Make sure your PC has been installed the Microsoft VS2008 before doing the following steps.

1. Double click the downloaded SDK file (e.g., pac270_sdk_20121015.msi) to install it to the VS2008.



2. Click the "Next" button.



3. Choose the "Accept" radio button and then click the "Next" button.

na-Oser License Agreement	5
e sure to carefully read and understand the following end-user license agreement, and then indicate whether you accept or do not accept the terms of the agreement.	2
his software will not set up on your computer unless you accept the terms of the a for your future reference, you may print the text of the agreement now using the P utton or obtain the text from the 'MSFT_SDK_EULA_1033.rtf file after installation. Iso receive a copy of this agreement by contacting the Microsoft subsidiary serving country, or write: Microsoft Sales Information Center, One Microsoft Way, Redmono 18052-6399.	greemen PRINT You may your J WA
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4. Click the "Next" button.

PAC270 Setup	the month of the	a special sectors	<u> </u>
Customer Information Please enter your customer information			G
User Name:			
Organization:		17	
,			
	< <u>B</u> ack	Next >	Cancel
	< <u>B</u> ack	Next >	Cancel

5. Click the "Complete" button.



6. Click the "Next" button.



7. Click the "Install" button to install the SDK.



8. After completing the installation, click the "Finish" to quit the procedure.



18.2.2 Install the SDK of the XPAC (XP-8xx7-CE6, XP-8xx7-Atom-CE6)

Note: Make sure your PC has been installed the Microsoft VS2008 before doing the following steps.

1. Double click the downloaded SDK file (e.g., pacsdk_ce_1.4.3_vs2008.msi) to install it to the VS2008.



2. Other steps, refer to Section 18.2.1 – Step (2) to (8).

18.3 Define Function or Function Block

18.3.1 Define Function Lib

This section presents a simple example of creating a library function - "bytes_to_long" that is used to convert four bytes ($0 \sim 255$) to one long integer (32-bit Signed Integer).

To begin, follow these steps:

1. Click All Programs \rightarrow Win-GRAF \rightarrow Libraries \rightarrow OEM from the Start menu as the figure below. <u>Note:</u> If the Win-GRAF Workbench is opened, the user cannot add or edit Win-GRAF Library.



2. Create a library group named "User" in order to easy maintenance and management.

🖌 Library Manager - User1	Open Library
File Tools Wizard Help Open Library Save Library Use in SAMA Exit	User Advanced Arithmetic 2 Arrays AS-interface BACnet Booleans CANbus CANbus CANopen Clock Comparisons Conversions Conversions Counters DNP3 Embedded HMI Select a library in the list or enter a name for creating a new library.

3. Select the "Function and FBs" tab and click the "New" button.

🖌 Library Manager - User	
File Tools Wizard Help	
Function and FBs I/Os Profiles AS-i Types	
	New
Parameters Description	Delete
A	Store

4. Enter the name and comment, and select the type as a Function and then click the "OK" button.

New item		×
Name: Comment:	bytes_to_long Convert 4 bytes to 1 long	OK Cancel 3
 I/O Dev Function Function 	n Block	
 Profile Type 	2	

5. Declare the prototype of this Function.

The user can declare parameters like this way - "variable name : data type;", and refer to <u>Appendix</u> <u>A</u> for the data type. The content between the "VAR_INPUT" and "END_VAR" are passed-in parameters; the content between the "VAR_OUTPUT " and "END_VAR" is returned parameter. After completing it, click "Store" to save. Then, click "Description" tab to add the technical notes for this Function and then click "Store" to save.



6. Click "Wizard" \rightarrow "Function/Block Source Code" to generate the source code of this Function.

🖌 Library Ma	nager - User
File Tool	Wizard Help
Function and F	Function / Block Source Code
<pre>pytes_to_lor</pre>	ng (* Convert 4 bytes to 1 long *)

7. Select "Windows DLL" and click "Copy" button to copy the source code.

Nizard	×
/* bytes_to_long - Source code (requires t5vm.h include) */ /* Function */	<u>^</u>
/* Argument list */	
#define _P_BYTE1_ ("((T5_PTBYTE)(T5GET_DBDATA8(pBase))+pArgs[0))) #define _P_BYTE2_ ("((T5_PTBYTE)(T5GET_DBDATA8(pBase))+pArgs[1))) #define _P_BYTE3_ ("((T5_PTBYTE)(T5GET_DBDATA8(pBase))+pArgs[2))) #define _P_BYTE4_ ("((T5_PTBYTE)(T5GET_DBDATA8(pBase))+pArgs[3))) #define _P_Q ("((T5_PTLONG)(T5GET_DBDATA3(pBase))+pArgs[4)))	
/* handler */	
T5_DWORDdeclspec(dllexport) BYTES_T0_LONG (T5_WORD wCommand, T5PTR_DB pBase, T5_PTR pClass, T5_PTR plast, T5_PTWORD pArgs) { switch (wCommand) { case T5FBCMD_ACTIVATE : /* enter your code here*/ return 0L; case T5FBCMD_ACCEPTCT : /* dont change that */ return 1L; default : return 0L; }	E
Implementation	
Statically linked	Сору 🍗
Windows DLL	Close

8. Paste the source code into the text editor (e.g., Notepad) and save it as "bytes_to_long.c".

-		
	bytes_to_long.c -記事本	x
	檔案(F) 編輯(E) 格式(O) 檢視(V) 說明(H)	
	/* bytes_to_long – Source code (requires t5vm.h include) */	-
	/* Function */	-
	#include "stdafx.h"	=
	#include "t5vm.h"	
	/* Argument list */	
	#define P_BYIEI (*((IS_PILONG)(ISGEI_DBDAIA32(pBase))+pArgs[U]))	
	<pre>#define _P_BYTE2 (*((T5_PTLONG)(T5GET_DBDATA32(pBase))+pArgs[1]))</pre>	
	<pre>#define _P_BYTE3 (*((T5_PTLONG)(T5GET_DBDATA32(pBase))+pArgs[2]))</pre>	
	#define _P_BYTE4 (*((T5_PTLONG)(T5GET_DBDATA32(pBase))+pArgs[3]))	
	#define PO (*((T5 PTLONG)(T5GET DBDATA32(pBase))+pArgs[4]))	
		-
	t	

18.3.2 Define Function Block Lib

This section uses the similar way as previously described to define the Win-GRAF library of the Function Block (e.g., "long_to_bytes") and then create a file of source code (e.g., "long_to_bytes.c").

Refer to the <u>Previous Section</u> to open "Library Manager" (All programs → Win-GRAF → Libraries → OEM) and open the library group - "User", and then click "New" button to add a Function Block.

W. Library Manager - User	
File Tools Wizard Help	
Function and FBs I/Os Profiles AS-i Types	
<pre>[] bytes_to_long *Convert 4 bytes to 1 long *)</pre>	New 🔪
	Rename
Parameters Description	Delete
۸ (۲۰۰۰) (۲۰۰۰) (۲۰۰۰) (۲۰۰۰) (۲۰۰۰) (۲۰۰۰) (۲۰۰۰) (۲۰۰۰) (۲۰۰۰) (۲۰۰۰) (Store

2. Enter the name and comment, and select the "Function Block" type and then click the "OK" button.

N	ew item	VIAL DE LE LE MARTIN		×
ſ	Name:	long_to_bytes		
	Comment:	Convert 1 long to 4 bytes		Lancel 3
	 I/O Devi Function Function Profile Type 	ice Block	1	

3. Declare the prototype of this Function Block.

The user can declare parameters like this way - "variable name : data type;", and refer to <u>Appendix</u> <u>A</u> for the data type. The content between the "VAR_INPUT" and "END_VAR" is passed-in parameter; the content between the "VAR_OUTPUT" and "END_VAR" are returned parameters. After completing it, click "Store" to save. Then, click "Description" tab to add the technical notes for this Function Block and then click "Store" to save.

Parameters Description		Delete
VAR_INPUT Long_Val_: DINT; 3 END_VAR VAR_OUTPUT Byte1_: USINT; Byte2_: USINT; Byte3_: USINT; Byte4_: USINT; END_VAR	*	Store Reset Changes 2

4. Click "Wizard" \rightarrow "Function/Block Source Code" to generate the source code of this Function Block.

K Library Manager - User	
File Tool Wizard Help	
Function and F Function / Block Source Code	
<pre>[F] bytes_to_long (* Convert 4 bytes to 1 long *)</pre>	New
Blong_to_bytes (* Convert 1 long to 4 bytes *)	
	Kename
Parameters Description	Delete

5. Select "Windows DLL" and click "Copy" button to copy the source code.

/* long_to_bytes - Source code (requires t5vm.h include) */ /* Function block */	<u>^</u>
/* Argument list */	
#define_P_LONG_VAL_ (*((T5_PTLONG)(T5GET_DBDATA32(pBase))+pArgs[0])) #define_P_BYTE1_ (*((T5_PTBYTE)(T5GET_DBDATA8(pBase))+pArgs[1])) #define_P_BYTE2_ (*((T5_PTBYTE)(T5GET_DBDATA8(pBase))+pArgs[2])) #define_P_BYTE3_ (*((T5_PTBYTE)(T5GET_DBDATA8(pBase))+pArgs[3])) #define_P_BYTE4_ (*((T5_PTBYTE)(T5GET_DBDATA8(pBase))+pArgs[4]))	E
/* private block data */	
typedef struct	
<pre>1 T5_DWORD dwData; /* TODO: replace dwData by the items you need */ }_str_FB_LONG_T0_BYTES;</pre>	
/* handler */	
T5_DWORDdeclspec(dllexport) LONG_T0_BYTES (T5_W0RD wCommand, T5PTR_DB pBase, T5_PTR pClass, T5_PTR pInst, T5_PTR pInst, T5_PTW0RD pArgs)	
_str_FB_LONG_TO_BYTES *pData;	
pData = (_str_FB_LONG_TO_BYTES *)pInst; switch (wCommand)	
case T5FBCMD_ACTIVATE :	-
Implementation	
Statically linked	Сору 📐
Windows DLL	Close

6. Paste the source code into the text editor (e.g., Notepad) and save it as "bytes_to_long.c".

o long_to_bytes.c - 韵事本	x
榴巽(1) 編輯(E) 格式(O) 檢視(V) 說明(H)	
₩include "stdafx.h" #include "t5vm.h" /* long_to_bytes – Source code (requires t5vm.h include) */ /* Function block */	• 11
/* Argument list */	
<pre>#define _P_LONGVAL (*((T5_PTLONG)(T5GET_DBDATA32(pBase))+pArgs[0])) #define _P_BYTE1 (*((T5_PTLONG)(T5GET_DBDATA32(pBase))+pArgs[1])) #define _P_BYTE2 (*((T5_PTLONG)(T5GET_DBDATA32(pBase))+pArgs[2])) #define _P_BYTE3 (*((T5_PTLONG)(T5GET_DBDATA32(pBase))+pArgs[3]))</pre>	Ŧ

18.4 Edit the Logic of the Function and Function Block

- <u>Note:</u> Please make sure your PC has installed the Visual Studio 2008 and WinPAC/XPAC SDK before operating the following steps.
 - As the figure below, copy these source code files of the Function and the Function Block (described in <u>Section 18.3</u>) to the VS 2008 project folder on your PC. (Or, get the VS 2008 sample project folder from the CD-ROM: \napdos\Win-GRAF\demo-project\user_c_lib\demo_user_c)



 Then, make sure your VS 2008 project settings are correct for your PAC. (<u>Note:</u> the settings are different between different controllers.) For WP-8xx8, WP-8xx8-CE7, VP-x2x8-CE7, and WP-5xx8-CE7, it must set to "PXA270 (ARMV4I)".



For XP-8xx8-CE6, it must set to "XPacSDK (x86)".

🤣 T5BLOCKS - Microsoft Visual Studio (Administrator)								
File Edit View Project Build Debug Data Tools VMware Test Analyze Window Help								
🗄 🖥 🕶 🗃 🖬 📓 📓 👗 🕋 🛍 🔊 🗸 🍽 🗸 💭 Release 😽 XPacSDK_CE (x86) 🔹 🧭 m_license								
XPacSDK_CE x86 Device								
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i 🕼 🚯 🚱 🔩 🕸 🧿 💐 🖅 🐂 📥 🌆 i 🚱 🥛 i 🕨 💷 🖾 🔶 🗐 📮 🗐 Hex 🚳 🗔 🗸 🕛								
Solution Explorer - T5BLOCKS - T × bytes_to_long.c T5BLOCKS.cpp stdafx.h long_to_bytes.c								
Global Scope)								
Solution 'T5BLOCKS' (1 project) T5BLOCKS T5BLOCKS Header Files Solution 'T5BLOCKS Header Files Solution 'T5BLOCKS' (1 project) Solution 'T5BLOCKS' (1 project) S								
in resource.h #include "t5vm.h"								

 Here, we will add C source files of the Function and Function Block to the VS 2008 project. Mouse right-click on the "Source Files" folder and click "Add" → "Existing Item...", select the previously copied C source files and click the "Add" button.



18.4.1 Edit the "T5BLOCKS.cpp"

Fill out your "libinfo" and "libVer" information in the "T5BLOCKS.cpp" file. The information will show on the Win-GRAF driver dialog on the PAC (as the figure below).



If you have some operations to process when a new Win-GRAF project starts or stops. Please edit the "Project_Begin" and "Project_End" functions in the "T5BLOCKS.cpp" file.



18.4.2 Edit the Logic of the Function (In this example is "bytes_to_long. c")

First, add your logical expression for this Function in the switch case statement –"T5FBCMD_ACTIVE".



Then, add this Function name (e.g., "BYTES_TO_LONG") into the switch case statement of the "T5Blocks_GetBlockName" functions in the "T5BLOCKS.cpp" file.

Note: The number of the case label (e.g., case 1) must start from "1" and continue with contiguous numbers.



18.4.3 Edit the Logic of the Function Block (In this example is "long_to_bytes.c")



Finally, remember to add the Function Block name (e.g., "LONG_TO_ BYTES") into the switch case statement of the "T5Blocks_GetBlockName" functions in the "T5BLOCKS.cpp" file.



<u>Note:</u> The number of the case label (e.g., case 1) must start from "1" and continue with contiguous numbers.



18.4.4 Trying to Compile the Project

1. Click "Build" > "Build Solution" to generate a DLL file.

🌮 T5BLOCKS - Microsoft Visual Studio (Administrator)												
File	Edit	View	Project	Build	Debug	Data	Tools	VMware	e Tes	st	Analyze	Window
: 🛅 🗸	1	iii 🔁	Ø 🐰	*	Build Solu	tion 🔪		F7	se	Ŧ	XPacSDK	CE (x86)
XPac	SDK_C	E x86 De	evice		Rebuild So	olution	Ctrl+A	lt+F7				
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	100	199 E.			Build T5BL	OCKS				-	≞ Ļ ≡ ~⊒	Hex 😭
Solutio	on Expl	orer - So	olution 15		Rebuild T	5BLOCK	S		g.c ^{.y} T	5BI	LOCKS.cpp	stdafx.h
	9 🖻	- 4 <u>0</u>			Deploy T5	BLOCKS						
Sc	lution	'T5BLO	CKS' (1 pr		Clean T5B	LOCKS			in th	ne	below	

2. After a successful compilation, copy the "USER_C.dll" file to the path "\System_disk\Win-GRAF\" in your PAC, and then reboot it.

C:\Users\Grady\Desktop\T5BLOCKS\T5BLOCKS\XPacSDK_CE	(x86)\Release	- 4 9 ∄				
🚽 組合管理 ▼ 🟢 檢視 ▼ 💷 Open with KUSO EXIF Viewer 😿 共用	🔮 燒錄					
名稱	修改日期	類型				
M T5BLOCKS.obj	2014/10/22 下午 05	Object File				
T5BLOCKS.pch	2014/9/9 下午 06:38	Precompile				
T5BLOCKS.pdb	2014/10/22 下午 05	PDB 檔案				
T5BLOCKS.res	2014/10/9 下午 04:25	Compiled I				
SUSER_C.dll	2014/10/22 下午 05	應用程式擴				
USER_C.pch	2014/10/9 下午 04:24	Precompile				
🕐 vc80.idb	2014/10/22 下午 05	IDB 檔案				
vc80.pdb	2014/10/22 下午 05	PDB 檔案				
USER_C.dll 修改日期: 2014/10/22 下午 05:21 建立日期: 2014/10/9 下午 05:28 應用程式擴充 大小: 5.50 KB						

18.5 Test your own Function and Function Block

1. Copy the "user_c.dll" file to the same folder as the Win-GRAF driver (i.e., \System_disk\Win-GRAF\) on the PAC by using FTP. And, reboot the PAC.

If a proper DLL file is detected by the Win-GRAF Driver, its dialog will show as below.

XP-8xx8-ATOM-CE6 driver Version 1.01 , Aug.07,2014 build 7 This product is licensed. Project: demo_rdn_1, Extra_port: None Elapsed time : 0. 0: 1:14	Win-	GRAF-XP-8xx8-ATOM-CE6	OK
This product is licensed. Project: demo_rdn_1, Extra_port: None Elapsed time : 0. 0: 1:14		XP-8xx8-ATOM-CE6 driver Version 1.01 , Aug.07,2014 build 7	
Project: demo_rdn_1, Extra_port: None Elapsed time : 0. 0: 1:14		This product is licensed.	
Elapsed time : 0, 0; 1;14		Project: demo_rdn_1, Extra_port: None	
		Elapsed time : 0, 0: 1:14	
Add DLL version here.	1	Add DLL version here.	
Add Your DLL information here.		Add Your DLL information here.	

2. Open the Win-GRAF project that includes your own Function and Function Block, and then compiles and download this project to the Win-GRAF PAC.

In addition, there are some available files in the Win-GRAF PAC's CD-ROM for users to test.

- (1) WP-8xx8, WP-8xx8-CE7, VP-x2x8-CE7 and WP-5xx8-CE7:
 - \napdos\Win-GRAF\demo-project\user_c_lib\wp_vp\user_c.dll
- (2) XP-8xx8-CE6:

\napdos\Win-GRAF\demo-project\user_c_lib\xpc\user_c.dll

- (3) Copy the Win-GRAF Library folder -"User" to the following path on your PC. C:\Win-GRAF\DATA\HWDEF\
- (4) Open the Win-GRAF sample project "demo_user_c.zip", and then compiles and download this project to the Win-GRAF PAC. (Refer to <u>Section 13.1</u> to open the Win-GRAF project from a zip).