The purpose of this Application Note is to show a step by step implementation of an IEC61131-3 application to load in a CTI 2500P-ACP1 advanced co-processor. This application will perform Preventive Maintenance calculation for On/Off devices controlled by the CTI 2500[®] CPU.

INTRODUCTION

In our example, we will have a first motor AM001 with a running contact wired to X1 and a second motor AM102 with a running contact wired to X200. We want to get a Preventive Maintenance (PM) alarm for each motor when its start/stop cycle count exceed 50000 or when its running hour count exceed 10000 hours. The alarm for AM001 will be send to C10 and the alarm for AM102 will be send to C2000.

Device	Running Contact	PM alarm
AM001	X1	C10
AM102	X200	C2000

There will be no change to the CPU Workshop program. C10 and C2000 can be used in CPU to trigger alarm on a HMI/SCADA system.

The CTI CPU and ACP1 will be connected to an Ethernet switch together with the PC where CTI Workbench is installed. A HMI/SCADA can connect too.

CTI Equipment	IP address	Sub Mask
PC with CTI Workbench	10.55.71.80	255.255.255.0
2500-Cx00	10.55.71.81	255.255.255.0
2500P-ACP1	10.55.71.82	255.255.255.0

CREATING THE ACP1 PROJECT IN CTI WORKBENCH

On your engineering PC, where FasTrak WorkShop and CTI Workbench are installed, we will create a new CTI Workbench workspace (PM_workspace) where our project (PREV_MAINT) will be added.

Step	Action	Note
A-1	Open CTI Workbench	From desktop shortcut
A-2	Select "File > New Project List"	From the CTI Workbench menu bar
A-3	Enter "PM_workspace"	This creates your empty workspace or project list
A-4	Select "File > Add New Project"	From the CTI Workbench menu bar
A-5	Enter "PREV_MAINT"	This creates your IEC 61131 project
A-6	Make sure "PREV_MAINT" is in bold	This means it is the Startup project in your workspace
	characters	
A-7	If it is not the case, right click on	From the Project context menu
	"PREV_MAINT" and select "Set As Startup	
	Project"	



SPECIFYING YOUR ACP1 AS THE TARGET SYSTEM

Step	Action	Note
B-1	Select "Tools" then "CTI Product Options"	From the CTI Workbench menu bar
B-2	Click on the "Auto-Detect" button	CTI Product Type field should now read "2500P-ACP1"
B-3	Click on the "Configure" button if the IP	Do not forget to adapt your PC IP address to the same
	address is to be modified	range
B-4	Click on the "Display Runtime Status" button	This shows various information about the ACP1 status

CTi	1	Product Differnation Runtime IP: 30-55, 71, 65, 130 CTI Product Type Permane Version	0 Auto-Onfect 25009-ACP1 • 01.27		
Connecting to Model: 2500P- ACP Status Vo VH Status Vo Deta Cache 5t. Host FLC Mode Most FLC Mode Host FLC Norm Host FLC Norm	Deplay Number Status 10 55 71.03 ACP1 Version 01.27 rd = 0000000 D5 = 50 d × 0401 afo as of 15 51 27 Tuesd stus (vis Data Cache): 1 Error (vis Data Cache) ansfer Error: a1 L-0 Output Disable al L-0 Tixeout	Configure (4) 25 = 00 HR = 00 sy. August 25, 2014 06 840 06 07 07 077 077	date Province	-	
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SETTING THE COMMUNICATION PARAMETERS

Step	Action	Note
B-5	Right click on the "PREV_MAINT" program	This shows the Project context menu
B-6	Select "Communication Parameters"	From the Project context menu
B-7	Select "T5 Runtime" in the top field	From the field list
B-8	Enter "10.55.71.82:1100" in the other field	This is the IP address of your ACP1 on port 1100

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CREATING GLOBAL AND RETAIN VARIABLES AND INITIALIZE VARIABLE ON ACP1 POWER UP

Let's create some global variables and initialize a few variables when the ACP1 starts up.

Step	Action	Note
C-1	Double click on the pre-existing program	This opens the pStartup Program as it is pre-build by
	"pStartup" in the "Exception programs" folder	CTI Workbench
	of your project	
C-2	Under the line	
	<pre>// add your code here</pre>	
	Add the following lines:	
	MAX_CYCLES := 50000; // Max	imum number of Start/Stop or Open/Close cycles
	MAX_HOURS_ON := 10000; // Max DESET ALL - FAISE: // Des	num Running or Open hours
C-3	Right click on "Global variables" in the variable	list on the right hand side of the screen and select "Edit
	Variables as Text" and paste the following tex	t:
	VAR	
	RESET_ALL : BOOL ;	
	(*\$desc=Common reset bit to) reset all PM data*)
	(*\$desc=Max number of On/Of	f cycles to trigger PM alarm*)
	MAX_HOURS_ON : DINT ;	- <u>4</u> ,
	(*\$desc=Max number of hours	9 On to trigger PM alarm*)
<u> </u>	END_VAR	righta list on the right hand side of the series and select
C-4	"Edit Variables as Tayt, " and pasts the following	able list, off the right hand side of the screen and select
	Var	ig text.
	AM001 ON : BOOL ;	
	AM001_CYCLES : DINT ;	
	(*\$embed= <syb>*)</syb>	
	(*\$profile=STRATON*) (*\$prop6=350*)	
	AM001 HOURS ON : DINT ;	
	(*\$embed= <syb>*)</syb>	
	(*\$profile=STRATON*)	
	(*\$prop6=350*)	
	(*\$embed= <svb>*)</svb>	
	(*\$profile=STRATON*)	
	AM102_ON : BOOL ;	
	AM102 MAINT ALM : BOOL ;	
	(*\$profile=STRATON*)	
	END VAR	

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CREATING THE UDFB FOR THE GENERIC DEVICE PM DATA COMPUTATION

Step	Action	Note
D-1	Right click on the "Programs" folder	This shows the Program context menu
D-2	Select "Insert New Program"	From the Program context menu
D-3	Enter "PM_UDFB" in the Name field Enter "Preventive Maintenance" in the Description field Select "ST" for the Programming language Select "UDFB" for the Execution style Click OK You can skip the Parameters window by clicking OK again.	This creates an empty User Defined Function Block program to be programmed in Structured Text where you are going to write the code for the Preventive Maintenance data calculation.
D-4	Double click on the "PM_UDFB" program	This opens the program with the Structured Text editor

This PM_UDFB is handling the logic for a generic On/Off device (it will then have to be instantiated for each real device). Copy the following code in the Program window:

```
// PM UDFB (UDFB) : Preventive Mainteance for On/Off Devices
11
// Purpose : Count leading edge of a signal (e.g. motor contactor)
11
          to get the number of start/stop cycles and cumulates the time On
11
          Should either one of these 2 data :
11
             1. the count (e.g. motor starts)
11
             2. the timer (e.g. motor running hours)
11
          exceeds a limit, a Boolean is set for alarming
          A reset function resets both counter and timer
11
//
          therefore resetting the alarm bit
11
// Author : NAPA International France
11
// Version Date
                 Note
// 1.0 22 Aug 2014 Original version
_____
// DETECT RISING PULSE OF DEVICE FEEDBACK
R DEVICE ( DEVICE ON );
// COUNT DEVICE FEEDBACK RISING PULSES UP TO MAX
CTU_DEVICE_CYCLES (R_DEVICE.Q, RESET_PM_DATA, DEVICE_MAX_CYCLES);
DEVICE CYCLES
              := CTU DEVICE CYCLES.CV;
// CUMULATE DEVICE FEEDBACK TIME ON UP TO MAX
TMU DEVICE (DEVICE ON, TMU DEVICE.Q, T#60s);
CTU_DEVICE_HOURS (TMU_DEVICE.Q, RESET_PM_DATA, DEVICE_MAX_HOURS_ON);
DEVICE ON HOURS
              := CTU DEVICE HOURS.CV;
// SET PREVENTIVE MAINTENANCE ALARM BIT ON THE FIRST LIMIT REACHED
DEVICE MAINT ALM := CTU DEVICE CYCLES.Q OR CTU DEVICE HOURS.Q;
```

Then right click on "PM_UDFB" in the variable list, on the right hand side of the screen and select "Edit Variables as Text..." and paste the following text:

```
VAR INPUT
   DEVICE ON : BOOL ;
      (*$desc=Device feedback to monitor*)
      (*$embed=<syb>*)
   RESET PM DATA : BOOL ;
      (*$desc=Counter/Timer reset*)
      (*$embed=<syb>*)
   DEVICE MAX CYCLES : DINT ;
      (*$desc=Maximum Off/On cycle count*)
   DEVICE MAX_HOURS_ON : DINT ;
      (*$desc=Maximum hours On count*)
END VAR
VAR OUTPUT
   DEVICE MAINT ALM : BOOL ;
      (*$desc=Device preventive maintenance alarm bit*)
      (*$embed=<syb>*)
```

```
DEVICE_CTR : DINT ;
      (*$desc=Current device Off/On cycle count*)
      (*$embed=<syb>*)
      (*$profile=STRATON*)
      (*$prop6=350*)
   DEVICE ONHOURS : DINT ;
      (*$desc=Current device On cumulative hours*)
      (*$embed=<syb>*)
      (*$profile=STRATON*)
      (*$prop6=350*)
END VAR
VAR
   CTU DEVICE CYCLES : CTU ;
      (*$desc=Up Counter*)
   TMU DEVICE : TMU ;
      (*$desc=Up-Counting Stop Watch*)
   R_DEVICE : R_TRIG ;
      (*$desc=Rising Pulse Detection*)
   CTU DEVICE HOURS : CTU ;
      (*$desc=Up Counter*)
END VAR
```

Now your PM_UDFB program is complete. You still need to create a main program to call one instance of this UDFB for each On/Off device you need.



CREATING THE MAIN PROGRAM CALLING THE UDFB INSTANCES

Step	Action	Note
E-1	Right click on the "Programs" folder	This shows the Program context menu
E-2	Select "Insert New Program"	From the Program context menu
E-3	Enter "Call_PM_UDFBs" in the Name field	This creates a main program to be programmed in
	Enter "For each device" in the Description field	Structured Text where the previous UDFB will be
	Select "ST" for the Programming language	instantiated for each On/Off device.
	Select "Main" for the Execution style	
	Click OK	
	You can skip the Parameters window by clicking	
	OK again.	
E-4	Double click on the "Call_PM_UDFBs" program	This opens the program with the Structured Text
		editor

This Call_PM_UDFBs is calling the previous UDFB for each generic On/Off device. Copy the following code in the Program window:

// This program calls instances of PM_UDFB to compute PM data for each On/Off device

// You can use variable as input parameters AM001_PM (AM001_ON, RESET_ALL, MAX_CYCLES, MAX_HOURS_ON); AM001_CYCLES := AM001_PM.DEVICE_CYCLES; AM001_HOURS_ON := AM001_PM.DEVICE_ON_HOURS; AM001_MAINT_ALM := AM001_PM.DEVICE_MAINT_ALM; // You can also use constant values as input parameters AM102_PM (AM102_ON, RESET_ALL, 50000, 10000); // You need not get all ouputs (count and timer) if you are just interested in alarming bit AM102_MAINT_ALM := AM102_PM.DEVICE_MAINT_ALM;

Then right click on "Call_PM_UDFBs" in the variable list, on the right hand side of the screen and select "Edit Variables as Text..." and paste the following text:

VAR AM001_PM : PM_UDFB ; AM102_PM : PM_UDFB ; END VAR

Now your Call_PM_UDFBs program is complete.



FIELD BUS CONFIGURATION: DATA EXCHANGE WITH THE CTI CPU

You now need to link a few project variables with the ACP1 cache to/from the CTI CPU. Follow these steps:

Step	Action	Note
F-1	Click on the "Fieldbus Configurations" folder	This open the Fieldbus IO driver editor
F-2	Right click in the editor	This calls the editor context menu
F-3	Select "Insert Configuration"	From the editor context menu
	then select "All"	
	then select "CTI 2500 Data Cache"	
F-4	Right click on "CTI 2500 Data Cache"	This calls the configuration context menu
F-5	Select "Insert Master/Port"	From the configuration context menu
F-6	Enter "10.55.71.81" in the PLC IP address field	Enter the IP address of the CTI 2500 PLC CPU
F-7	Leave the other entries to their default values	5, LAN, not used
F-8	Click "OK"	This create an entry : CTI 2500 IP ="10.55.71.81"
F-9	Right click on "CTI 2500 IP = "10.55.71.81""	This calls the master/port context menu
F-10	Select "Insert Slave/Data Block"	From the master/port context menu
F-11	Select "Common", then "Discrete I/O (XY) [BOOL]"	This creates a read entry starting at X1
	then enter "1"	
	then select "Read From PLC", then click "OK"	
F-12	Right click on "Discrete I/O (XY) [BOOL] (1)"	This calls the slave/data context menu
F-13	Select "Insert Variables"	From the slave/data context menu
F-14	Click on the "" button if the Edit Variable window	This copies the value of X1 to AM001_ON variable.
	then scroll to select AM001_ON	
	then enter "0" in the Offset field, then click OK	
F-15	Select again "Insert Variables"	From the slave/data context menu
F-16	Click on the "" button if the Edit Variable window	This copies the value of X200 to AM102_ON variable.
	then scroll to select AM102_ON	(1+199)
	then enter "199" in the Offset field, then click OK	
F-17	Select "Insert Slave/Data Block"	From the master/port context menu
F-18	Select "Common", then "Control Relay (C) [BOOL]"	This creates a write entry starting at C10
	then enter "10"	
	then select "Write to PLC", then click "OK"	
F-19	Right click on "Control Relay (C) [BOOL] (10)"	This calls the slave/data context menu
F-20	Select "Insert Variables"	From the slave/data context menu
F-21	Click on the "" button if the Edit Variable window	This copies the value of AM001_MAINT_ALM variable to
	then scroll to select AMUU1_MAIN1_ALM	C10.
5.00	then enter "0" in the Offset field, then click OK	
F-22	Select "Common", then "Control Relay (C) [BOOL]"	This creates a write entry starting at C2000
	then colort "Write to DLC" then click "OV"	
F 22	Linen select Write to PLC , then click UK	
F-23	Right click on Control Relay (C) [BOOL] (2000)"	From the clove (deta context menu
F-24	Select insert variables	This applies the visition of AM402, MANNET, ALMAN, in the intervision
F-25	Lick on the "" button if the Edit Variable window	This copies the value of AIVI102_MAIN1_ALM variable to
	then enter "0" in the Officet field then elick OK	
	then enter 0 in the Onset field, then click OK	

COMPILING AND LOADING

You are now ready to compile and load the project to the target ACP1:

Step	Action	Note
G-1	Click on the "Build Startup Project" 🗬 icon in	This compile your project
	the menu bar	
G-2	Click on the "On Line" 🚮 icon in the menu bar	This will connect CTI Workbench to the ACP1
G-3	Click on the "Download changes" 💒 icon in	This will load your project in the ACP1 memory
	the menu bar	
G-4	If the ACP1 status shows "STOP" or "No	This will restart the ACP1 with the new project
	application",	
	Then click on the "Restart" 月 icon in the	
	menu bar	
	and answer "Cold Start" to the prompt	

NOTE: Once successfully compiled any program in your project can be translated from ST to LD or FBD if you are mode familiar with these languages.





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Now you can monitor the behavior of your programs with CTI Workbench in Online mode.

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You can use FasTrak WorkShop[®] and create a Data Window to modify X1 and X200 and see what happens to C10 and C2000.

ACP1 INTERNAL GRAPHICS

Suppose you don't have a HMI/SCADA system to get the Preventive Maintenance alarms (C10 and C2000). You can create a special Graphic with CTI Workbench and load it in the ACP1. This will allow some simple, local monitoring.

Step	Action	Note	
H-1	Right click on the "Programs" folder	This shows the Program context menu	
H-2	Select "Insert New Item"	From the Program context menu	
H-3	Select "Graphics" in the "Available Items"	This will create a new Graphic PM_VIEW in your	
	column	project	
	Then click OK		
	Enter "PM_VIEW" in the Name field		
	Enter "Preventive Maintenance" in the		
	Description field		
	Then click OK		
H-4	Double click on the "PM_VIEW" graphic	This will open your empty graphic in the Graphic editor of CTI Workbench	
H-5	Drag and drop graphical item "Grey Round	This will add a switch (to show the device On	
	Switch" from the list on the right hand side	feedback)	
	under "Switches" to your graphic		
H-6	Double click on this switch item in your graphic	This will display its Graphic Item Properties	
H-7	Double click on the "Variable symbol"	This will call the CTI Workbench variable browser	
H-8	Select "AM001_ON" from the list	This will attach the switch to AM001 On feedback	
H-9	Drag and drop graphical item "Triangle" from	This will add a switch (to show the device On	
	the list on the right hand side under "Shapes"	тееараск)	
11.40	to your graphic	This will display its Council is these Descention	
H-10	Double click on this triangle item in your	This will display its Graphic Item Properties	
<u>н_11</u>	Braphic Double click on the "Variable symbol"	This will call the CTI Workbench variable browser	
п-11 H_12	Select "AMOO1_MAINT_ALM" from the list	This will attach the triangle to AM001 PM alarm	
11-12	Select red in the "TRUE color" property		
	Select grey in the "FALSE color" property		
H-13	Right click on your graphic background	This will display the Graphic context menu	
H-14	Select "Generate HTML Graphic"	From the Graphic context menu	
H-15	Click on "Next"	You can use the "Create Folder" to create a new folder	
	Then navigate to the folder where you want to		
	store the generated HTML files (you can keep		
	the default location)		
H-16	Click on "Next"	This specify the name of the file in the target (ACP1)	
	Then enter your HTML file name	system and how to connect to it, as well as other	
	Leave "K5NET5.DLL" in the Target name field	attributes such as its size	
	Use "10.55.71.83:1100" for Connection settings		
	Leave the other fields to their default values		
H-17	Click on "Next"	This will create the HTML file from your PM_VIEW	
	Then aliah an "Concente" hutter	graphic	
	Then click on Generate button		
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ACP1:			
Repeat step G-1 to G-4.		AM001 👝 🥼	
The PM VIEW graphic can now be used in			
Workhe	ench on line as well as with the X5Viewer tool		
See how the graphic animates when you change		AM102	
values in a EasTrak WorkShon® Data Window			
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CONCLUSION

Suggestions if you want to go further:

- Have the RESET_ALL signal read from the CPU (ex: C3)
- Have the AM001_CYCLES and AM001_HOURS_ON written to the CPU (ex: V2000 and V2002 long integers)
- Add these data on the PM_VIEW Graphic

This completes this ACP1 step by step introduction illustrated by the Preventive Maintenance application.

If you have question about this Application Note, or if you want this CTI Workbench "Preventive Maintenance" application project backup sent to you by e-mail, do not hesitate to contact <u>support@NAPA.fr</u>

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