Chapter 16 Redundancy

16.1 Features and Architecture

The ICP DAS Win-GRAF PAC - XP-8xx8-CE6 series support redundancy:

One redundant system is composed by two Win-GRAF PACs that one PAC's rotary switch is set to 7 (means Main-PAC) and the other one is set to 9 (means Backup-PAC). When one of them is damaged or crashed or need to release its control-right by user-defined event, the PAC control-right will automatically switch to the healthy one.

Features of the Win-GRAF redundancy

1. Better safety:

There are three communication cables (LAN1, LAN2 and Alive Port) connected between two PACs. The redundant system will still control the process well, even if one or two cables are broken or disconnected. As long as one of the three communication cables is fine, the Win-GRAF redundant PACs can still work well with the process.

2. Unique Public IP:

The Win-GRAF redundant system provides a unique public IP address for SCADA/HMI to access it without needing to determine which one is the Active IP.

3. Easy maintenance:

If one of the redundant PACs is damaged someday after starting the process, you can remove the damaged one (Note: Do not shutdown or dismounting the other healthy PAC, keep it running). And then take another spare Win-GRAF PAC with the same model (or a repaired PAC) without downloading the Win-GRAF application, simply adjust its rotary switch to a proper position and then connect all required communication cables (e.g., LAN1, LAN2, Alive port and I/O). Make sure that the original, healthy PAC is still working properly and then power up the spare PAC. Then, the healthy PAC will automatically copy the Win-GRAF app and all its redundant data to that new PAC which is just online. It is easier for maintenance and installation, the operator don't have to worry about whether to install the Win-GRAF app because the healthy PAC will automatically do it for the new online PAC.

Exception: Except the Win-GRAF app if there are a few apps, such as the C, VB.net, C# app or Soft-GRAF HMI app, running in the redundant system, these apps need to pre-installed to the spare Win-GRAF PAC (or a repaired PAC) before installing this PAC to the redundant system.

4. Easy to design the application:

The user has to do is design the application program. Not necessary to specify what data should be redundant between two PACs. The Win-GRAF redundant system will automatically deliver them to the other PAC.

5. Users can design some safety in the app:

For example, if the Active PAC's LAN1 is disconnected (causes the SCADA unable to connect to) or a RS-485 Port is disconnected or damaged, and so on. The user's app can test these events and then switch control right to the other healthy PAC.

6. I/O Redundancy:

If the user chooses <u>iDCS-8830 series I/O</u>, both the PAC and I/O modules can support redundancy.

<u>The architecture of the Win-GRAF redundant system</u> (using XP-8xx8-CE6 as an example): <u>Note:</u> The Win-GRAF redundant PACs support RS-485/RS-422 expansion boards (I-8142i/ I-8144i) plugged into their local slot. Please don't use other kinds of I/O modules.



<u>Note:</u> <u>LAN1</u>: Normal Ethernet Cable, <u>LAN2</u>: Ethernet Crossover Cable, <u>Alive Port</u>: RS-232 Crossover Cable.

2. Two PACs are equipped with DCON I/O modules:



Note: LAN1: Normal Ethernet Cable, LAN2: Ethernet Crossover Cable, Alive Port: RS-232 Crossover Cable. <u>COM3, COM4 (RS-485)</u>: Data+ to Data+ ; Data- to Data- .

3. Two PACs are equipped with Modbus TCP I/O modules:



Note: LAN1: Normal Ethernet Cable, LAN2: Ethernet Crossover Cable, Alive Port: RS-232 Crossover Cable.

4. Two PACs are equipped with iDCS-8830 I/O modules:

This type of achievement provides both CPU and I/O module redundancy.



Note: LAN1 (PAC), LAN1 (iDC-8830), LAN2 (iDC-8830): Normal Ethernet Cable. LAN2 (PAC): Ethernet Crossover Cable, <u>Alive Port</u>: RS-232 Crossover Cable.

- **Note:** Each pair of redundant I/O modules that plugged into the iDCS-8830 must have the same model numbers.
- 5. Two PACs are equipped with other Modbus RTU/ASCII I/O modules:



- Note: LAN1: Normal Ethernet Cable, LAN2: Ethernet Crossover Cable, Alive Port: RS-232 Crossover Cable. <u>COM3, COM4 (RS-485)</u>: Data+ to Data+ ; Data- to Data- .
- 6. It can also equip with two (or more) kinds of I/O modules such as item (2) to (5).

The Win-GRAF redundant system is composed by two PACs. Users need to set one PAC's rotary switch to 7 (called Main-PAC) and set the other one to 9 (called Backup-PAC). **Do not** use two Main PACs or two Backup PACs to make up a redundant system.

16.2 Important Communication Ports and Installation Notes

The Win-GRAF redundant PACs require the following three communication ports to communicate with each other.

1. Alive Port:

The Win-GRAF redundant PACs use one RS-232 Port as the Alive Port (also called Heart-beat Port). This Alive Port must use a RS-232 crossover cable (or NULL Modem Cable), which link with each other as the following figure.



2. Replication Port:

The Win-GRAF redundant PACs use their Ethernet Port (LAN2) as a Replication Port. Both PAC's LAN2 ports use an Ethernet crossover cable to transfer redundant data. Do not use any Ethernet Switch or Hub between them, otherwise it may cause an error or timeout. The LAN2 ports are based on fast Ethernet and dedicated Ethernet ports in order to avoid collisions. So don't connect any external devices, Switches, and Hubs to these two PAC's LAN2.

Main-PAC (LAN2)

The LAN2 port uses an Ethernet crossover cable connected directly between two PAC. (Do not use a normal Ethernet cable).

3. Public IP Port:

The Win-GRAF redundant PAC's Ethernet Port (LAN1) must connect an Ethernet Switch via a normal Ethernet cable. After that, it can be used to communicate with SCADA/HMI or connect and control external Modbus TCP I/O modules, devices or other Ethernet devices. The LAN1 port can switch its IP address automatically. If the PAC is Active, the LAN1 IP address will switch to the "Active_IP" address which defined in the user's Win-GRAF project. And if the PAC is Passive, the LAN1 IP address will switch to the "Active_IP+1" address automatically. The SCADA/HMI can use the "Active_IP" address to communicate with the Win-GRAF redundant system.



PAC Installation Notes (Very Important):

- Before power up PACs, make sure one PAC's rotary switch is set to 7 and the other one is set to 9. The redundant system will be crazy due to the wrong settings.
- 2. When installing the Win-GRAF redundant system at the application field, make sure the following three cables are connected properly (connect all required cables, such as RS-485) before power up PACs. If user power up PACs before connecting these three communication cables, the redundant system will be out of control.
 - A. Connect both PAC's Alive ports by using a crossover cable.
 - B. Connect both PAC's LAN2 ports by using an Ethernet crossover cable.(Do not use any Ethernet Switch/Hub between LAN2 ports.)
 - C. Connect both PAC's LAN1 ports to an Ethernet switch by using a normal Ethernet cable.
- 3. If only one healthy PAC of the redundant system is working properly at the application field, do not power-off or shut it down. Before user power up the other PAC that will be installed into the system, follow the step1 and step2 as mentioned above to set up it first.



Only the Active PAC (i.e., PAC got the control-right) can run the Win-GRAF application. The Passive PAC will not run the Win-GRAF application. It simply receives the redundant data from the Active PAC and wait for getting control-right in the future.

16.3 Description of Win-GRAF Demo Projects

The shipping CD of the Win-GRAF PAC provides these three demo projects – "demo_RDN_1.zip", "demo_RDN_2.zip" and "demo_RDN_3.zip" – related to the redundant system. Refer <u>Chapter 12</u> to restore these files into the Win-GRAF Workbench.

| Project Name | Description |
|--------------|---|
| demo_RDN_1 | Two XP-8xx8-CE6 PACs, using their COM3 to connect three DCON I/O modules. |
| demo_RDN_2 | Two XP-8xx8-CE6 PACs without connecting any I/O module. |
| | Two XP-8xx8-CE6 PACs, using their LAN1 to connect a ET-7050 (Modbus TCP I/O |
| demo_RDN_3 | module) through one Ethernet switch. |

The following sections will describe the "demo_RDN_2" program.

16.3.1 "I/O Board" Settings

demo_RDN_2, demo_RDN_3:

To use redundancy in the PAC, first link the "i_redundancy" in the "I/O Board" window. (Refer <u>Chapter 4</u>).

| III I/O Boards | | |
|--|---|---|
| 0 1 2 3 4 5 6 7 8 9 10 i_redundancy 11 12 1 Note: | Close 10: i_redundancy - Prope Key = 6 Ref = 16#3 Active_IP = 192.168.71.37 Pasive_IP = auto Mask = 255.255.255.0 Gateway_IP = disabled Reserved0 = 0 Reserved1 = 0 Reserved2 = 0 Reserved3 = 0 Reserved4 = 0 | Thes The set the last digit value of the "Active_IP" as 0 or 254 or 255. It should be in 1 to 253. |
| 1 Using the Slot 9 or later. 1 | Li_redundancy Enable Redundancy in the P The following PAC support re XP-8xx8-CE6 XP-9xx8-CE6 WP-5248 | Refer the description for more details. |

Parameters:

Active_IP: The redundant system provides a public IP address for some HMI/SCADA to communicate. (Note: DO NOT set the last digit value of the "Active_IP" as 0 or 254 or 255. It should be in 1 to 253.)

- Passive_IP: Auto, means the LAN1 IP address of the current Passive PAC, it will be automatically set as Active_IP +1 (e.g., if the "Active_IP" is set as "192.168.71.37", the "Passive_IP" will automatically set as "192.168.71.38")
- Mask: The most common settings are either 255.255.255.0 or 255.255.0.0 (depends on the network environment).

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After linking the "i_redundancy" in the "I/O Boards" window, it will auto add 12 "BOOL" input channels in the "Variables" window that can be used to display the current state of the redundant system.

| Variables | | | | | | | | | | |
|--|-------------|----------------|------------|---------------------------------------|---------|--|----------|---------|-------------|------|
| 🍸 Name | | 1 | ype [| Dim. Attrib. | Syb. | Init value | User | Tag | Description | |
| 🖂 👹 %IX10 - i_redunda | incy | | | i i i i i i i i i i i i i i i i i i i | 1 | | | | 1 | ^ |
| %IX1U.U=IS_Main_Acti | /e ctivo | B | OOL | Input | | | | | | |
| is_Backup_Active | | B | OOL | Input | | | | | | |
| %IX10.3=is_Backup_re | ady r | | 001 | Input | | | | | | |
| %IX10.4=is_first_cycle | _just_afte | Double-o | click it t | to add a | variat | ble | | | | |
| %IX10.5=is_Main_LAN | 1_ok | name to | each c | hannel. | | | | | | |
| %IX10.6-IS_Backup_L %IX10.7=is_Alive_port | | B | 001 | Input | | | | | | |
| %IX10.8=is_Passive_r | eady | B | OOL | Input | | | | | | |
| %IX10.9=is_Active_LA | N1_ok | В | OOL | Input | | | | | | _ |
| %IX10.10=is_Passive_ | LAN1_ok | B | OOL | Input | | | | | | 1000 |
| %IXTU.11 | | 10 | OOE | input | | | | | | > |
| 10 Drivers New Spy1 | RDN contro | Variables | Retain an | id timer 🦯 | | | | | | |
| Ch.0 (is_Main_Active): | Is the | Main-PAC | (rotary | switch: | 7) acti | ive now | ? | | | |
| | TRUE: | Active , | FALSE: | Passive | | | | | | |
| Ch.1 (is_Backup_Active): | Is the | Backup-PA | AC (rota | ary switch | า: 9) a | ctive no | w? | | | |
| | TRUE: | Active , | FALSE: | Passive | | | | | | |
| Ch.2 (is Main ready): | Is the | Main-PAC | ready? | , | | | | | | |
| | If Ch.: | 2 returns F | ALSE. T | The possi | ble re | ason co | uld be t | he fol | lowing. | |
| | (1) Th | e Ethernet | cable (| (LAN2) be | etwee | n Main | and Ba | ckup P | AC is brol | ken. |
| | (2) Th | e Main PA | C is dea | d or dan | naged | | | | | |
| | (3) Th | e rotarv sv | vitch of | the Mai | n PAC | is not s | et at 7. | | | |
| Ch.3 (is Backup ready): | ls the | Backup-PA | AC read | v? | | | | | | |
| | If Ch.3 | returns F | ALSE. T | , he possik | ole rea | ason cou | uld be t | he foll | owing. | |
| | (1) Th | e Ethernet | cable | (LAN2) be | etwee | n Main | and Ba | ckup P | AC is brok | ken. |
| | (2) Th | e Main PA | C is dea | d or dan | naged | | | | | - |
| | (3) Th | e rotarv sv | vitch of | the Mai | n PAC | is not s | et at 9. | | | |
| Ch.4 (is first cycle just aft | er swit | ch): For A | ctive P | AC only. | | | | | | |
| | – True: | , Now is in | the firs | , t cvcle iu | st afte | er switch | ning. | | | |
| | False: | Now is no | t in the | first cvcl | e afte | er switch | ning. | | | |
| Ch.5 (is Main LAN1 ok): | Is the | LAN1 port | of the | Main-PA | C ok? | | 0 | | | |
| ····· (··_···· ······/· | TRUF: | OK FAI | SE: Fail | l or Fther | net ca | able is d | isconne | ected. | | |
| Ch.6 (is Backup LAN1 ok): | Is the | LAN1 port | of the | Backup-F | PAC ol | </td <td></td> <td></td> <td></td> <td></td> | | | | |
| (_ | TRUE: | OK . FAL | .SE: Fail | l or Ether | net ca | able is d | isconne | ected. | | |
| Ch.7 (is Alive port ok): | True : | The comm | nunicat | ion of the | e Alive | e Port is | ok. | | | |
| | False: | The comm | nunicat | ion of the | e Alive | e port fa | ils or | | | |
| | | the Passiv | e PAC i | s dead or | dam | aged. | | | | |
| Ch.8 (is Passive ready): | Is the | Passive PA | C read | v now? | | | | | | |
| | lf Ch.8 | returns F | ALSE. T | he possik | ole rea | ason cou | uld be t | he foll | owing. | |
| | (1) Th | e Fthernet | cable | (I AN2) he | otwee | n Main | and Ba | -kun P | AC is brol | (en |
| | (2) Th | e Passive P | PAC is d | lead or da | amag | -d | | in ap 1 | | (em |
| | (3) Th | e rotary sw | vitch se | etting of t | he Pa | ssive PA | C is inc | orrect | | |
| Ch.9 (is Active LAN1 ok) | ls the | LAN1 nort | of the | Active-P | AC ok | ? | | 2 | | |
| | TRUF | | SF: Fail | l or Fther | net c | able is d | isconne | ected | | |
| Ch 10 (is Passive I AN1 of |)·ls the | I AN1 nort | of the | | | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ | | | | |
| CITE (12_1 02214C_FUIT_OK | | | SE Fail | l or Ether | net c | n Ale is d | isconne | hatad | | |
| | HOL. | UN, TAL | | | | | | cu. | | |

demo_RDN_1: To connect DCON I/O modules via PAC's COM3 (RS-485).

| III I/O Boards | X | |
|---|--|--|
| 0 1 2 3 4 5 6 7 8 | 9: DCON - Properties Key = 6 Ref = 16#5 Port = 3 Baud_rate = 9600 Host watchdog_timeout = 5000 Checksum_enabled = 0 Delay_ms_between_polls = 0 Reserved0 = 0 Reserved1 = 0 Reserved2 = 0 | Connect DCON I/O modules by PAC's COM3 and the Baud rate is 9600. |
| 9 DCON 10 i_redundancy 11 i_redundancy_rs485 12 13 14 11 i_redundancy_rs485 - Pi 15 Ref = 16#3A 16 Ch00 Port_No = 3 Ch00 Timeout = 30 Ch01 Fort_No = 0 | Open COM3 and set the | Setting Description Setting Description ote DCON I/Os (I-7000 series modules , RU-87PE on properties ''N.8.1''. I stop bit'' Jes to ''N.8.1''. |
| Ch01_Timeout = 30 Ch02_Port_No = 0 Ch02_Timeout = 30 Ch03_Port_No = 0 Ch03_Timeout = 30 Ch04_Port_No = 0 Ch04_Timeout = 30 Ch05_Port_No = 0 Ch05_Timeout = 30 Ch06_Port_No = 0 Ch06_Timeout = 30 i_redundancy_rs485 Detect the RS-485 port state of The following PAC support redur XP-9xx8-CE6 XP-9xx8-CE6 WP-5248 | timeout as 30 seconds. Setting Description Passive the passive PAC of a redundant system. Idancy. | Aundancy_rs485" is used to if the RS-485 port of the ve PAC can receive data. |

Important Notice:

- 1. Please must also use the "i_redundancy" or the "i_redundancy_rs485" will not work.
- 2. The "i_redundancy_rs485" will only open the related RS-485 ports to receive data in the passive PAC. It doesn't send any data.
- 3. The "i_redundancy_rs485" is used to detect whether the Passive PAC's RS-485 port can receive data.

Parameters:

Ch00_Port_No ~ Ch15_Port_No :

The used RS-485 port number of the Passive PAC. Can be 0 or 1 to 33 depends on the PAC model. Set 0 means disable it.

Ch00_Timeout ~ Ch15_Timeout :

The unit is second. Can be 1 to 60 seconds.

If there is no data received in the timeout interval of the related RS-495 port, the status will reset as FALSE.

16-ch Boolean Inputs :

It used to represent state of RS-485 ports in the passive PAC.

TRUE : The related RS-485 port open ok and can receive data.

FALSE: The related RS-485 port open fail or receive no data in the timeout interval.

16.3.2 Declaring Variables (demo_RDN_2)

Users can view or add variables in the "Variable" window (refer Section 2.3).

| Name | Data Type | Description |
|----------------------|-----------|--|
| Year1 | DINT | |
| Month1 | DINT | |
| Day1 | DINT | |
| WeekDay1 | DINT | Used in the "PAC_Time" program: |
| Hour1 | DINT | They are used to get the the sisystem time. |
| Minute1 | DINT | |
| Second1 | DINT | |
| Set_new_time | BOOL | Set it as "TRUE" to set up new system time. |
| Year_to_set | DINT | |
| Month_to_set | DINT | |
| Day_to_set | DINT | Used in the "PAC_Time" program: |
| Hour_to_set | DINT | They are used to set the PAC's system time. |
| Minute_to_set | DINT | |
| Second_to_set | DINT | |
| DINT_1 | DINT | |
| DINT_2 | DINT | Used in the "Retain_and_timer" program: |
| REAL_1 | REAL | Set them as retain variables. |
| REAL_2 | REAL | |
| TMR_1 | TIME | Timer |
| TMR_2 | TIME | limer |
| retain_done | BOOL | TRUE: Retain variables are well set up; FALSE: Not set up yet. |
| on_line_change_cycle | DINT | Non-zero, means this is the first cycle just after On-Line change. |
| tmp_bool | BOOL | It used to return the Retain status. |
| TMR_1_last_state | BOOL | TRUE: Ticking ; FALSE: Sleeping. |
| TMR_2_last_state | BOOL | TRUE: Ticking ; FALSE: Sleeping. |
| To_tick_TMR_1 | BOOL | Set it as TRUE to start TIMER1. |
| To_tick_TMR_2 | BOOL | Set it as TRUE to start TIMER2. |
| To_stop_TMR_1 | BOOL | Set it as TRUE to stop TIMER1. |
| To_stop_TMR_2 | BOOL | Set it as TRUE to stop TIMER2. |

16.3.3 Introduction of the "demo_RDN_2" Demo Project

This project includes one LD program and one ST program.

LD Program – "PAC_Time"

It used to get/set the system time of PAC.



LD Program – "RDN_control"

When an error occurs on the Active PAC's LAN1 and if the Passive PAC is ready and its LAN1 is healthy, then the Active PAC will wait for a short time to reboot, and then the other PAC will take the control-right.

| (* Switch to Passive PAC if Passive is ready a | nd its LAN1 is ok however | r Active LAN1 communication has problem *) - : | |
|--|--|--|--------------------|
| is_Active_LAN1_ok | Inst_TON N TON Q Inst_TON Q DT ET | is_Passive_ready | is_Passive_LAN1_ok |

ST Program – "Retain_and_timer"

(* "on_line_change_cycle" is declared as DINT (nonezero means it is in the cycle jsut after doing on line change).
 "retain_done" is declared as BOOL and inited as FALSE.
 "tmp_bool" is declared as BOOL. *)

```
on_line_change_cycle := GetSysInfo (_SYSINFO_CHANGE_CYCLE);
if (retain_done = FALSE) or
  (is_first_cycle_just_after_switch = TRUE) or
  (on_line_change_cycle <> 0) then
   retain_done := TRUE; (*just do it one time *)
   tmp_bool := Retain_Var( DINT_1, 1); (* retain a DINT variable *)
   tmp_bool := Retain_Var( DINT_2, 2);
   tmp_bool := Retain_Var( REAL_1, 3); (* retain a REAL variable *)
   tmp_bool := Retain_Var( REAL_2, 4);
```

```
(* if Retain variables havn't been inited yet, use default value *)
if (DINT_1 < -1000000) or (DINT_1 > 1000000) or
   (DINT_2 < -2000000) or (DINT_2 > 2000000) or
   (REAL_1 < -9.9E10) or (REAL_1 > 9.9E10) or
   (REAL_2 < -9.9E10) or (REAL_2 > 9.9E10) then
DINT_1 := 0;
DINT_2 := 0;
REAL_1 := 0.0;
REAL_2 := 0.0;
end_if;
end_if;
```

```
(* is_first_cycle_just_after_switch :
    TRUE : just in the cycle after switching.
    FALSE : other cycle *)
```

```
if is_first_cycle_just_after_switch then
```

(* The Timer ticking state is not auto-redundant. So we have to process them here. Ticking timer in the cycle just after switching if its last state is "ticking" *)

if TMR_1_last_state then
 tStart(TMR_1);
 end_if;
 if TMR_2_last_state then
 tStart(TMR_2);
 end_if;
end_if;

(* Timer operation *)

```
if To_tick_TMR_1 then
 To_tick_TMR_1 := FALSE ;
 tStart(TMR 1);
 TMR_1_last_state := TRUE ;
end if;
if To_tick_TMR_2 then
 To tick TMR 2 := FALSE;
 tStart(TMR_2);
 TMR 2 last state := TRUE ;
end if;
if To_stop_TMR_1 then
 To_stop_TMR_1 := FALSE ;
 tStop(TMR 1);
 TMR 1 last state := FALSE;
end if;
if To stop TMR 2 then
 To_stop_TMR_2 := FALSE ;
 tStop(TMR 2);
 TMR_2_last_state := FALSE ;
end_if ;
```

16.4 Test Demo Programs



demo_RDN_2: Two PAC (XP-8xx8-CE6) without connecting any I/O modules.

- Hardware installation (using XP-8xx8-CE6 as an example): Refer <u>Section 16.2</u> – PAC Installation notes, make sure three communication ports of the PAC have been connected properly and the rotary switch is set to 7 (Main-PAC) or 9 (Backup-PAC).
- 2. If there is no redundancy app in the redundant system yet (that is, no control-right switching procedures), start the Main-PAC (7) first and then start the Backup-PAC (9), in that case the Active PAC will be the Main-PAC.

(Later, users can run the Win-GRAF driver on a PAC's monitor to see which one is the Active PAC.)



(1) First, look up the LAN1 IP address of the current Active PAC (factory defaults: IP=192.168.255.1, Mask=255.255.255.0, refer Section 1.3), and make sure that your PC is on the same network domain (e.g., IP=192.168.255.x).



(2) At the first time to download the Win-GRAF redundancy application, users Must modify the communication IP address (refer <u>Section 2.3.5</u> - "Communication Parameters") to the LAN1 IP address of the current Active PAC.

| Communication Settings | |
|---|--|
| T5 Runtime OK 192.168.255.1:502 Cancel 192.168.255.1:502 wse 192.168.71.37:502 Help | Note: If the user wants to set the timeout value (default: 3 seconds), see Section 2.3.5. (E.g. Set the IP to "192.168.255.1:502(10)" which means the timeout is 10 seconds. |

3. Recompile the "demo_RDN_2" project and then download it to the Active PAC (refer Section 2.3.4 and Section 2.3.5 for details). After that, the LAN1 of the Active PAC will be automatically set as the Active IP (i.e., "192.168.71.37" in this example program, refer Section 16.3.1) and the LAN1 of the Passive PAC will be set as the Active IP + 1 (i.e., "192.168.71.38") automatically.

| PCIVFETCE5B1 OK × | PCIVETCE5B1 | OK × |
|---|---|------|
| IP Information IPv6 Information | IP Information IPv6 Information | |
| Internet Protocol (TCP/IP) Address Type: Static IP Address: 192.168.71.37 | Internet Protocol (TCP/IP) Address Type: Static IP Address: 192.168.71.38 | |
| Subnet Mask: 255.255.255.0 Default Gateway: | Subnet Mask: 255.255.255.0 Default Gateway: | |
| The LAN1 IP and Mask of the Active PAC after running the "demo_RDN_2". | The LAN1 IP and Mask of the Passive PAC . | |

4. Right now, Win-GRAF will show "Communication error" because the current Active PAC IP (e.g., 192.168.71.37) and the communication IP settings on the workbench (e.g., 192.168.255.1) are not on the same network domain. So, stop the connection and change the communication IP of this "demo_RDN_2" project to "192.168.71.37" (refer Section 2.3.5 "Communication Parameters") and then check if the PC's IP is on the same network domain (e.g., "192.168.71.x"). Then, this project will always link to the Active PAC whenever the user wants to debug it or change it.

| Communication error | | |
|--|--|--|
| Stop the connection. | Communication Settings | |
| Note: If the user wants to set the timeout value (default: 3 seconds), see <u>Section 2.3.5</u> . (E.g. Set the IP to "192.168.71.37:502(10)" which means the timeout is 10 seconds. | T5 Runtime 192.168.71.37:502 192.168.255.1:502 192.168.71.37:502 | OK Cancel Browse <u>H</u> elp |

5. After re-connecting with the PAC, click "NewSpy1" to open the spy list window and you can see the current Active PAC is the Main-PAC.

Note:

Don't switch control-right if the Passive PAC is not ready (i.e., "is_Passive_ready" = FALSE) because it cannot receive the redundant data from the Active PAC. The user can click the "Redundancy" button () to switch control-right for testing.

Ella Edit Winne Land During Table Window Hale



| orkspace | E E E E NewSpy1.spl | | | | | |
|---------------------------|----------------------------------|-------|--|--|--|--|
| - demo_rdn_2 [RUN] | H Name | Value | Description | | | |
| Exception programs | Hour1 | 12 | | | | |
| Programs | Minute1 | 35 | | | | |
| PAC Time | I∔ Second1 | 21 | | | | |
| BDN_control | is_Main_Active | TRUE | The Main-PAC is active. | | | |
| 🔤 📷 Retain_and_timer | is_Backup_Active | FALSE | | | | |
| 🗄 🛅 Watch (for debugging) | is_Main_ready | TRUE | The Main-PAC and Backup-PAC | | | |
| Soft Scope | is_Backup_ready | TRUE | are ready and their I ANI are | | | |
| | is_first_cycle_just_after_switch | FALSE | are ready and their LAN1 are | | | |
| | is_Main_LAN1_ok | TRUE | working properly. | | | |
| Binding Configuration | is_Backup_LAN1_ok | TRUE | | | | |
| 🚽 🖇 🚽 🚽 🚽 | is_Alive_port_ok | TRUE | The Alive Dert (DC 222) | | | |
| 🕂 😭 Variables | is_Passive_ready | TRUE | The Alive Port (RS-232) | | | |
| E Types | is_Active_LAN1_ok | TRUE | communication is ok. | | | |
| | is Passive LAN1_ok | TRUE | The Passive PAC is ready. | | | |
| | DINT_1 | 0 | The Active and Dessive DAC's | | | |
| | DINT_2 | 0 | The Active and Passive PAC's | | | |
| | REAL_1 | 0.0 | LAN1 are working properly. | | | |
| | REAL_2 | 0.0 | me | | | |
| | TMB_1 | t#Os | | | | |
| | TMR_1_last_state | FALSE | TRUE: ticking , FALSE: sleep | | | |
| | To_tick_TMR_1 | FALSE | Set TRUE to start ticking timer1 | | | |
| | To_stop_TMR_1 | FALSE | Set TRUE to stop the ticking of timer1 | | | |
| | TMB_2 | t#Os | | | | |
| | TMR_2_last_state | FALSE | TRUE: ticking , FALSE: sleep | | | |
| | To_tick_TMR_2 | FALSE | Set TRUE to start ticking timer2 | | | |
| | To stop TMR 2 | FALSE | Set TRUE to stop the ticking of timer2 | | | |

 Enter values for "DINT_1", "DINT_2", "REAL_1" and "REAL_1" variables and then set the "To_tick_TMR_1" and "To_tick_TMR_2" as TRUE (it will auto reset to FALSE) to start the "TMR_1" and "TMR_2" ticking. Now, the status of TIMER will change from FALSE to TRUE.



7. Make sure the Passive PAC is ready (i.e., is_Passive_Ready is TRUE), remove the LAN1 cable of the Main-PAC or turn off and on (restart) the Main-PAC. Wait for a short time (refer the "RDN_control" program), the Main-PAC will automatically reboot and give control-right to the Backup-PAC, Now. Then, the Active PAC belongs to the Backup-PAC and all the values you set before still exist and the Timer is still ticking.



(Note: After that, plug in the LAN1 cable of the Main-PAC and then later both the status of "is_Main_LAN1" and "is_Passive_LAN1" variables will become "TRUE".)

demo_RDN_3:

Two XP-8xx8-CE6 PACs, using their LAN1 to connect a ET-7050 (Modbus TCP I/O module) through the Ethernet switch.



- Refer the ET-7000 manual to set up the IP address and required settings (refer <u>Section 5.2.1</u>). Manual: <u>http://ftp.icpdas.com/pub/cd/6000cd/napdos/et7000_et7200/document/</u>
- Open and download the "demo_RDN_3" project. Before downloading, set the communication IP (refer <u>Section 2.3.5</u> "Communication Parameters") to the current LAN1 IP of the Active PAC (refer <u>Section 16.4</u> – Test demo programs - step 2 to 4).

In the "I/O Drivers" window, here we enable a Modbus TCP Master to connect an ET-7050 module (Modbus TCP Slave, Addr. = 1) and create some data blocks to read/write the DI and DO data (refer <u>Section 5.2</u>). Users can open this "demo_RDN_3" project for more details.

| | - | | | Ue 😰 G | 3 🖬 30 | 田島る | t. | | | |
|---|---|---|------------------|-------------|--------------|--|---|--|--|------------------|
| Workspace demo_rdn_3 Exception programs Programs PAC_Time RDN_control Watch (for debugging) Soft Scope | | Image: Second system Image: Second system <th>To enabl connect create so the DI/D</th> <th>e a Moc an ET-7(ome dat O data,</th> <th>lbus TCP N 050 modul a blocks tc refer the <u>S</u></th> <th>Master to le and p read/wri Section 5.2</th> <th>te <u>2</u>.</th> | | | | To enabl connect create so the DI/D | e a Moc an ET-7(ome dat O data, | lbus TCP N 050 modul a blocks tc refer the <u>S</u> | Master to le and p read/wri Section 5.2 | te <u>2</u> . |
| Soft Scope | and the second se | | | Address | NIL D | 6 - 14 - 16 - 14 | Period (ma) | Pariad an array | Timeout (me) | 1 M 1 20 51 |
| Initial values | ¢,ø | Request | Slave/Unit | Address | IND Rem | Activation | r enou mist | Fenou on enor | rineoucins | Number of trials |
| Initial values | ¢ | Request <2> Read Input Bits | 1 | 1 | 12 | Periodic | 50 | 5000 | 1000 | Number of trials |
| Soft Scope Initial values NewSpy1 Binding Configuration | ¢ | Request <2> Read Input Bits <15> Write Coil Bits | 1 1 | 1 1 | 12 6 | Periodic On Change | 50 0 | 5000 0 | 1000 1000 | Number of trials |
| Soft Scope Initial values Values Su NewSpy1 Sinding Configuration Sg Global defines Variables | <u>بة</u> 11 | Request <2> Read Input Bits <15> Write Coil Bits <1> Read Coil Bits | 1 1 1 1 | 1 1 1 | 12 6 6 | Periodic On Change Periodic | 50 0 50 50 | 5000 0 5000 5000 | 1000 1000 1000 | Number of trials |

3. Click "NewSpy1" to open the spy list, now the Main-PAC is Active.

| 8 🖬 🕑 8 🕒 🔁 🗙 | | 98 😨 🙆 🖻 | 🛐 🕒 🕍 🚰 RUN 🛛 🚥 🖬 🛱 🗰 📽 🚳 🍅 |
|---------------------------|----------------------------------|-------------|---|
| Workspace | e e NewSpy1.spl | | |
| 🖻 🚽 🕨 demo_rdn_3 (RUN) | Name Name | Value | Description |
| 🗄 🗇 📴 Exception programs | is_Main_Active | TRUE | The Main DAC is Active |
| 🖨 🖓 🔁 Programs | is_Backup_Active | FALSE | The Main-PAC is Active. |
| PAC_Time | ↓ is_Main_ready | TRUE | |
| BDN_control | is_Backup_ready | TRUE | |
| Retain_and_timer | is_first_cycle_just_after_switch | FALSE | |
| 🖻 🛁 Watch (for debugging) | is_Main_LAN1_ok | TRUE | |
| Soft Scope | is_Backup_LAN1_ok | TRUE | It allows to avritate DAC construct visitet |
| - Initial values | is_Alive_port_ok | TRUE | It allows to switch PAC control-right |
| 🖉 😼 NewSpy1 💊 | is_Passive_ready | TRUE | only when the Passive PAC is ready. |
| Dinding Configuration | is_Active_LAN1_ok | TRUE | |
| §g Global defines | is_Passive_LAN1_ok | TRUE | |
| | DINT_1 | 1 | Setup as Retain variable in the program "Retain_and_timer" |
| I 🛃 Types | DINT_2 | 3000 | Setup as Retain variable in the program "Retain_and_timer" |
| | REAL_1 | 0.0 | Setup as Retain variable in the program "Retain_and_timer" |
| | REAL_2 | 0.0 | Setup as Retain variable in the program "Retain_and_timer" |
| | TMB_1 | t#Os | |
| | To_tick_TMR_1 | FALSE | Set TRUE to start ticking timer1 |
| | To_stop_TMR_1 | FALSE | Set TRUE to stop the ticking of timer1 |
| | ET7050_COM_err | 0 | 0: No error (comm. ok) , Communication error of the ET-7060 |
| | ET7050_DO_0_ReadBack | FALSE | Relay_0 ~ 5 of the ET-7060 |
| | ET7050_DO_1_ReadBack | FALSE | Relay_0 ~ 5 of the ET-7060 |
| | ET7050_D0_2_ReadBack | FALSE | Relay_0 ~ 5 of the ET-7060 |
| | ET7050_DO_3_ReadBack | FALSE | Relay_0 ~ 5 of the ET-7060 |
| | ET7050_DO_4_ReadBack | FALSE | Relay_0 ~ 5 of the ET-7060 |
| | ET7050_DO_5_ReadBack | FALSE | Relay_0 ~ 5 of the ET-7060 |
| | ET7050_D0_0 | FALSE | Relay_0 ~ 5 of the ET-7060 |
| | ET7050_DO_1 | FALSE | Relay_0 ~ 5 of the ET-7060 |
| | ET7050_D0_2 | FALSE | Relay_0 ~ 5 of the ET-7060 |
| | ET7050_DO_3 | FALSE | Relay_0 ~ 5 of the ET-7060 |
| | ET7050_DO_4 | FALSE | Relay_0 ~ 5 of the ET-7060 |
| | ET7050_DO_5 | FALSE | Relay_0 ~ 5 of the ET-7060 😽 😽 |
| | | 10.07C2.000 | |
| | New Spy 1 10 Drivers PAC Time | BDN control | Retain and timer Variables |

4. Enter some values for these retain variables (DINT_1, DINT_2, REAL_1 and REAL_2) and set "To_tick_TMR_1" as "TRUE" to start Timer. If set "ET-7050_Dox" as "TRUE", the "ET-7050_DOx_ReadBack" will return "TRUE". If disconnect the Ethernet cable from the ET-7050 module, the "ET-7050_COM_error" will return a non-zero value that means communication error. 5. Make sure the Passive PAC is ready (i.e., "is_Passive_Ready" is "TRUE"), remove the LAN1 cable from the Main-PAC or turn it off and on (restart), and wait a short time (refer the "RDN_control" program), the Main-PAC will automatically reboot and give control-right to the Backup-PAC.

demo_RDN_1: Two XP-8xx8-CE6 PACs, using their COM3 to connect three DCON I/O modules.

In the "demo_RDN_1" demo project (as the figure above), before linking "I-7000" and "I-87KW" DCON remote I/O modules, users need to configure each of I/O modules by using "DCON Utility". Refer the description in <u>Chapter 8</u> and visit the "DCON Utility" web page to download the software and user manual: <u>www.icpdas.com/products/dcon/introduction.htm</u>

Please restore and open this demo project for more details and refer <u>Section 16.3.1</u> for "I/O Board" settings.

16.5 What Kinds of Data Can be Automatically Backed up to the Passive PAC?

In the Win-GRAF redundant system, not all of the data in the Active PAC can be automatically backed up to the Passive PAC.

What Can be Backed Up Automatically:

- 1. The user's Win-GRAF applications.
- 2. The execution step of programs.
- 3. Value of variables.
- 4. Private data of Function Block instance.
- 5. The PAC's RTC (Real Time Clock) time.
- 6. Retain memory.
- 7. Schedule-control configuration (refer Chapter 17).

What are NOT Backed Up Automatically?

The following are the most common items that cannot be automatically backed up to the Passive PAC.

- 1. The status of Timer variable (Ticking or Sleeping).
- Files in the Active PAC (e.g., files located in the path "\system_disk" or "\Micro_SD", or files not belong to the Win-GRAF applications, such as C, VB.net, C#, and Soft-GRAF applications). These files cannot be backed up automatically. So all of them should be pre-installed in a spare (or repaired) PAC before mounting this PAC in the redundant system).

(Exclusive of user designed Win-GRAF application and schedule-control configuration, which can be backed up automatically.)

- 3. If using the COM_OPEN() function to open the serial port, it will not be automatically opened again after switching PAC control-right.
- 4. The PAC's EEPROM memory cannot be backed up automatically.

All the items which unable to back up automatically, users can use the following similar procedures to deal with them. (Refer the "Retain_and_timer" program in the "demo_RDN_2" project)

| if is_first_cycle_just_after_switch then | |
|--|--|
| (* Just in the cycle after switching. *) | |
| end_if ; | |