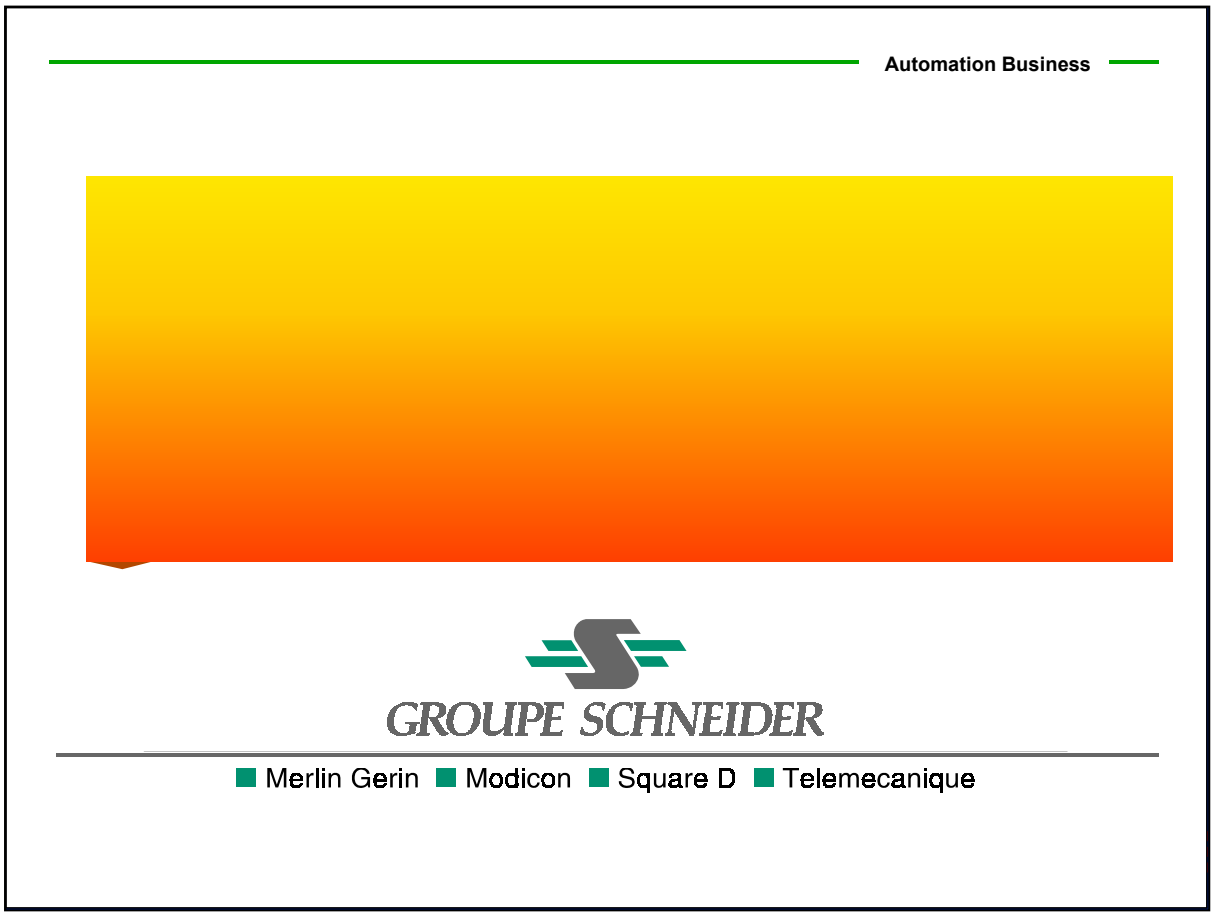
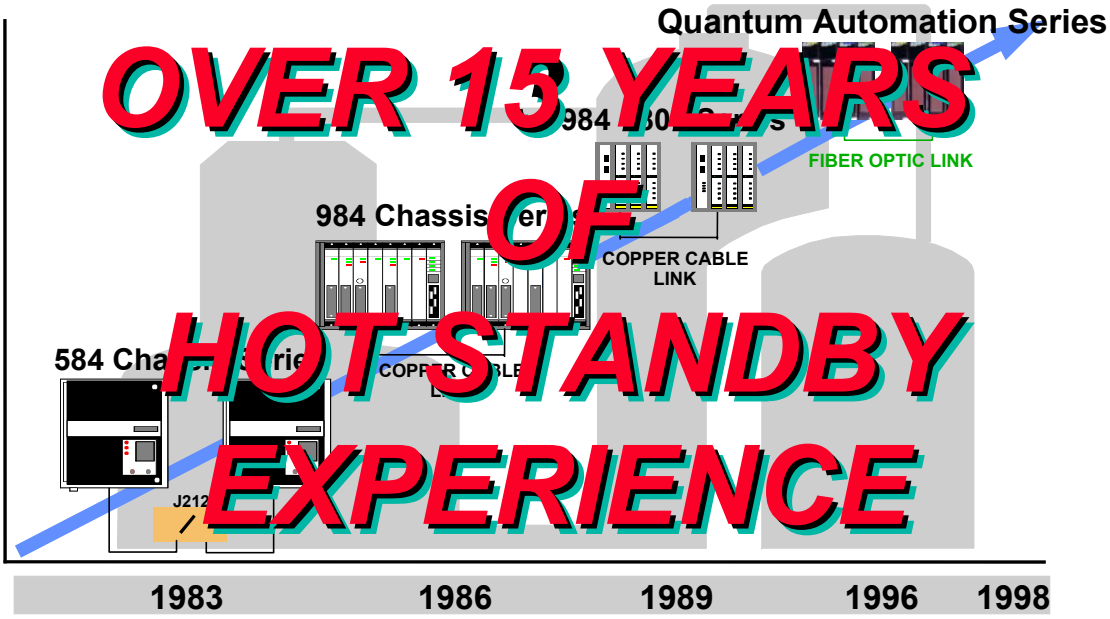


- In this lesson, we will discuss all aspects of the Modicon Hot Standby system as it stands today. The discussion will include the Quantum CHS Hot Standby Module, both 984 and IEC versions, as well as the 984 HSBY Hot Standby Module.

Hot Standby Evolution



- Modicon has been in the forefront of PLC Hot Standby technology for over 15 years.

- A Hot Standby System is based on two identically configured Programmable Logic Controllers linked to each other and to the same Remote I/O network. If one controller fails, the other assumes control of the network.

- It started with the 584 Hot Standby System in 1983. Two identically programmed 584Bs were monitored by the J211/J212 Redundancy Supervisor Hardware and Software. The J211 looked very much like a 584 with a different front door panel. Its sole function was to monitor the two 584Bs for status and switch, using the J212 Switch Box, Primary Control over to the Standby unit in case of a failure in the Primary.

- Next came the 984 Hot Standby System in 1986. The hardware aspect monitoring system was eliminated in favor of a software loadable solution using the 984 HSBY Block. The process resulted in a faster switchover than the old 584 system, with the goal being a Bumpless Transfer.

- Now, we have the Quantum Hot Standby System using the loadable called the Quantum CHS Hot Standby Block which is the subject of this lesson.

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Overview of CHS Hot Standby

- The Quantum Hot Standby system is designed for use where downtime cannot be tolerated.
- Two backplanes are configured with identical hardware, software and firmware.
- One of the PLCs acts as the Primary controller. The Primary updates the Standby controller after each scan.

- We will now discuss the **CHS Hot Standby Module**, the hardware needed to set up the Quantum Hot Standby System, its topology, and Troubleshooting methods.
- We will be using and making extensive references to the **"Modicon Quantum Hot Standby System Planning and Installation Guide"** Part # 840 USE 106 00.
- We will also discuss the use of the **"CHS Hot Standby Kit"** Part # 140 CHS 210 00 for setting up a new Hot Standby System.

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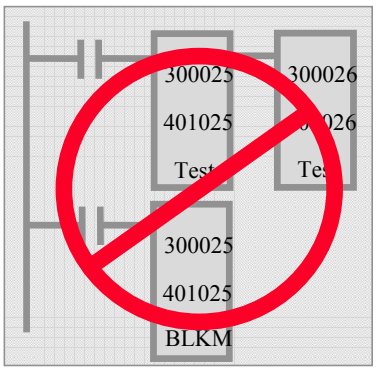
Overview of CHS Hot Standby (cont)

- Primary and Standby states are switchable. Either controller can be put in the Primary state, but the other must be in the Standby state.
- The Remote I/O network is always operated by the Primary controller.
- A Quantum Hot Standby system supports only Remote I/O. It does not support Local I/O.

- The Quantum Hot Standby System is designed for use where downtime cannot be tolerated. The system delivers high availability through redundancy. Two backplanes are configured with identical hardware and software.
- One of the PLCs acts as the Primary Controller. It runs the application by scanning ladder logic and operating Remote I/O.
- The other PLC acts as the Standby Controller. The Primary Controller updates the Standby Controller after each scan. The Standby is ready to assume control within ***one scan*** if the Primary fails.
- Each controller is paired with a **140 CHS 110 00 Hot Standby Module**. The module monitors its own controller and communicates with the other Hot Standby Module. The system monitors itself continuously. If the Primary controller fails, the Hot Standby Module switches control to the Standby, which then becomes the Primary controller. If the Standby controller fails, the Primary continues to operate without a backup.

CHS Hot Standby Features

No ladder logic is required!

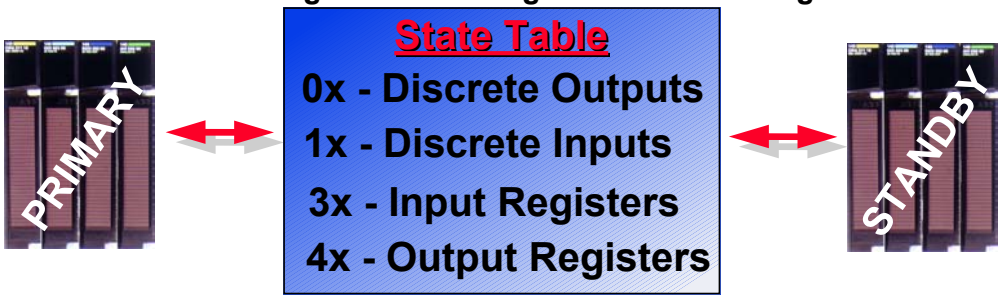


- **Simple configuration for fast start-up and simplified troubleshooting**
  - **Selected as part of PLC configuration**
  - **Separation of control logic and CHS configuration**
    - ✓ **No possibility of configuration corruption**
  - **No guess work setting / clearing command register bits**
    - ✓ **Configuration in simple english statements**

- The Quantum Hot Standby System is the easiest and most flexible system yet designed. The customer does not need to program any Ladder Logic, if he/she so desires, to get the system up and running. Configuration is made easier than ever with easy to fill in configuration screens.

Configuration Extension For Flexibility

- **Configurable state RAM transfers**
  - **Allows flexibility of data transfer**
  - **Fully configurable using configuration extension mode**
    - ✓ **First 12 k of state RAM automatic / default**
    - ✓ **Data blocks configured in multiples of 16**
      (16 inputs, 16 outputs, 1- 4XXXXX & 3XXXXX Min.)
    - ✓ **Up to 64k max. one or multiple scans**
    - ✓ **Address range can be contiguous or non-contiguous**



- The customer has more flexibility than ever in determining what portion(s) of the State RAM will be transferred or not. They don't even have to be contiguous State RAM sections, if desired, saving valuable scan time.

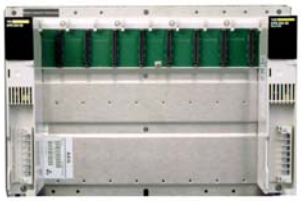
CHS Function for On-Line Visualization

- **Optional CHS ladder logic loadable function block**
- **Allows easy migration for 984/800 HSBY systems**
  - **Easy configuration with DX Zoom**
  - **Automatic state RAM transfer**
    - ✓ **First 12K automatic (All 0x, 1x, 3x and 10k of 4x)**
    - ✓ **Use configuration extension for more transfer options**
  - **On-line parameter setting**
    - ✓ **Use standalone or with configuration extension**

- The customer may, if he/she so desires, use the Quantum Hot Standby CHS Block in Segment 1, Network 1. This situation closely emulates the 984 HSBY Block and allows for a very easy migration from a 984 System to Quantum System while maintaining Hot Standby capability.

MODICON Hot Standby Features

- **Fiber optic link**
  - **Easy hookup & maintenance**
    - ✓**Standard kit length provided (3m)**
    - ✓**Maximum separation to 1Km without repeaters**
    - ✓**Uses standard fiber size, 62.5 micron**
- **Redundant power supplies**

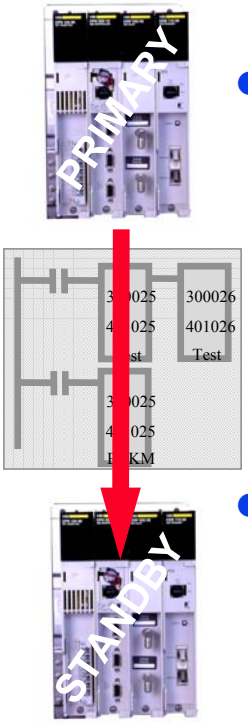


  - **Added availability**
    - ✓ **Available for CPU and remote I/O backplanes**
    - ✓**115 / 230 VAC or 24 VDC**

- The connection used between the CHS Hot Standby Modules is now a Fiber Optic link which is provided in the **"CHS Hot Standby Kit"** Part # 140 CHS 210 00. Longer lengths to 1Km could be used if desired.

- For added high availability, Redundant Power Supplies can be used in both the CPU and Remote I/O Backplanes.

Program Download for Ease of Use

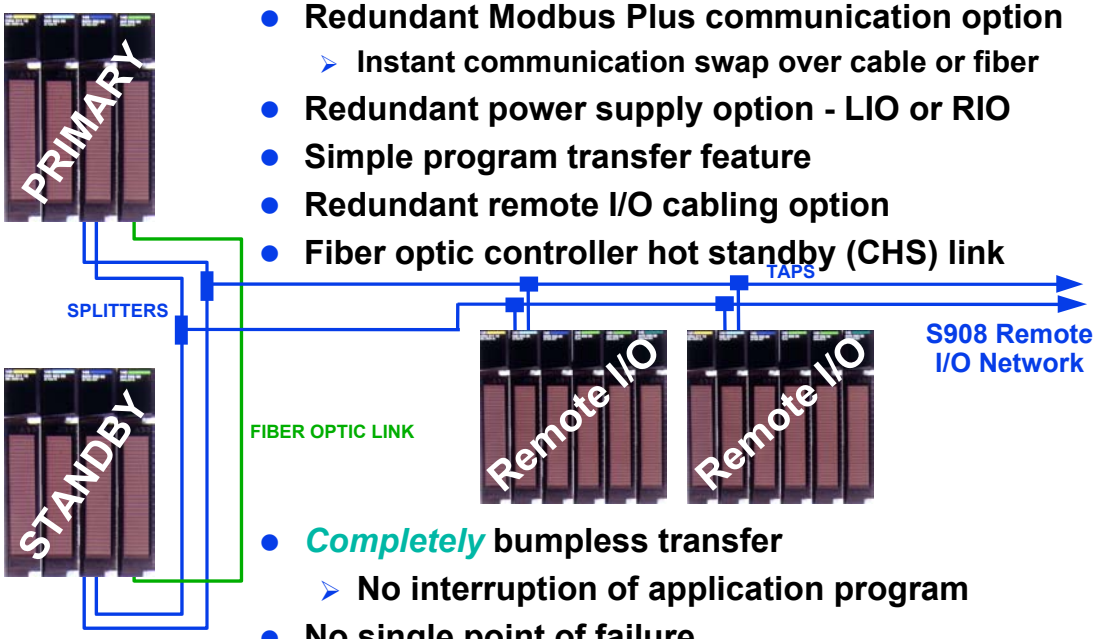


- **Turn the keyswitch and push the button . . . that's all you need to know**
  - **Easy to maintain and transfer online program changes**
  - **Entire program is transferred from the primary to standby controller**
    - ✓ **Minimum scan impact - 3k bytes / scan**
    - ✓ **No programming panel required**
- **Selection of controller state after program transfer**
  - **Off line or run mode**

- Normally, the Primary and Standby CPUs will contain the identical User Program Logic, however, that is not necessary as you shall soon see.

- If a Program Transfer from the Primary to the Standby CPU is desired, a simple keyswitch and Push button combination allows the entire Program to be transferred while the system is running with no interruption of the Program Scan.

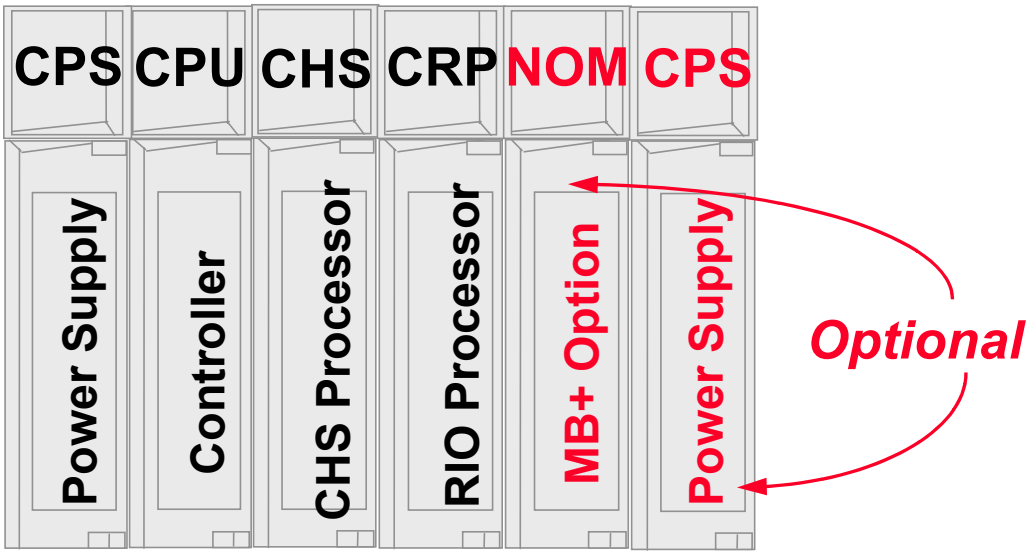
Hot Standby System Overview



- Redundant Modbus Plus communication option
  - Instant communication swap over cable or fiber
- Redundant power supply option - LIO or RIO
- Simple program transfer feature
- Redundant remote I/O cabling option
- Fiber optic controller hot standby (CHS) link
- *Completely* bumpless transfer
  - No interruption of application program
- No single point of failure
- *Simple to configure - easy to use !*

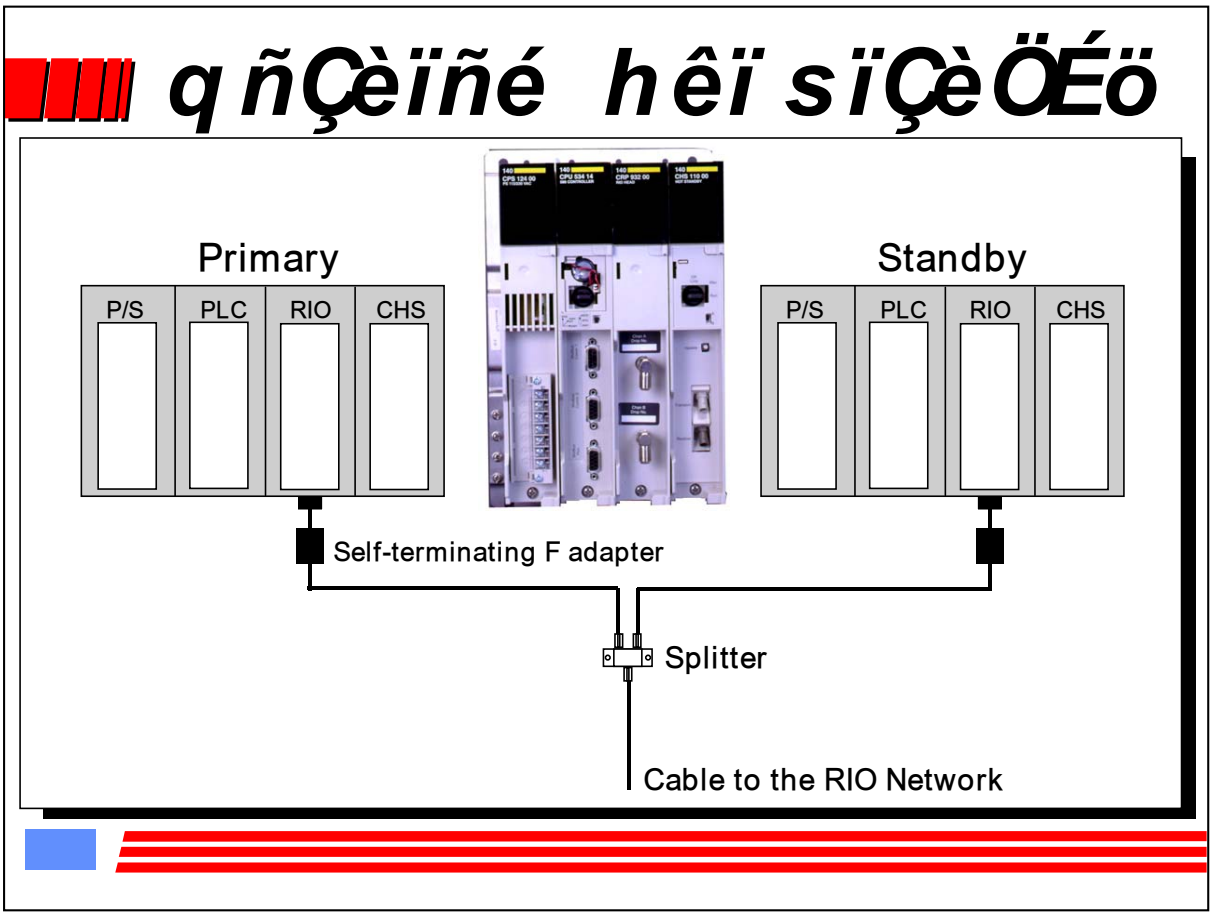
- The above summary of the Quantum Hot Standby System is what we are about to cover in detail.

Required Components - Local System

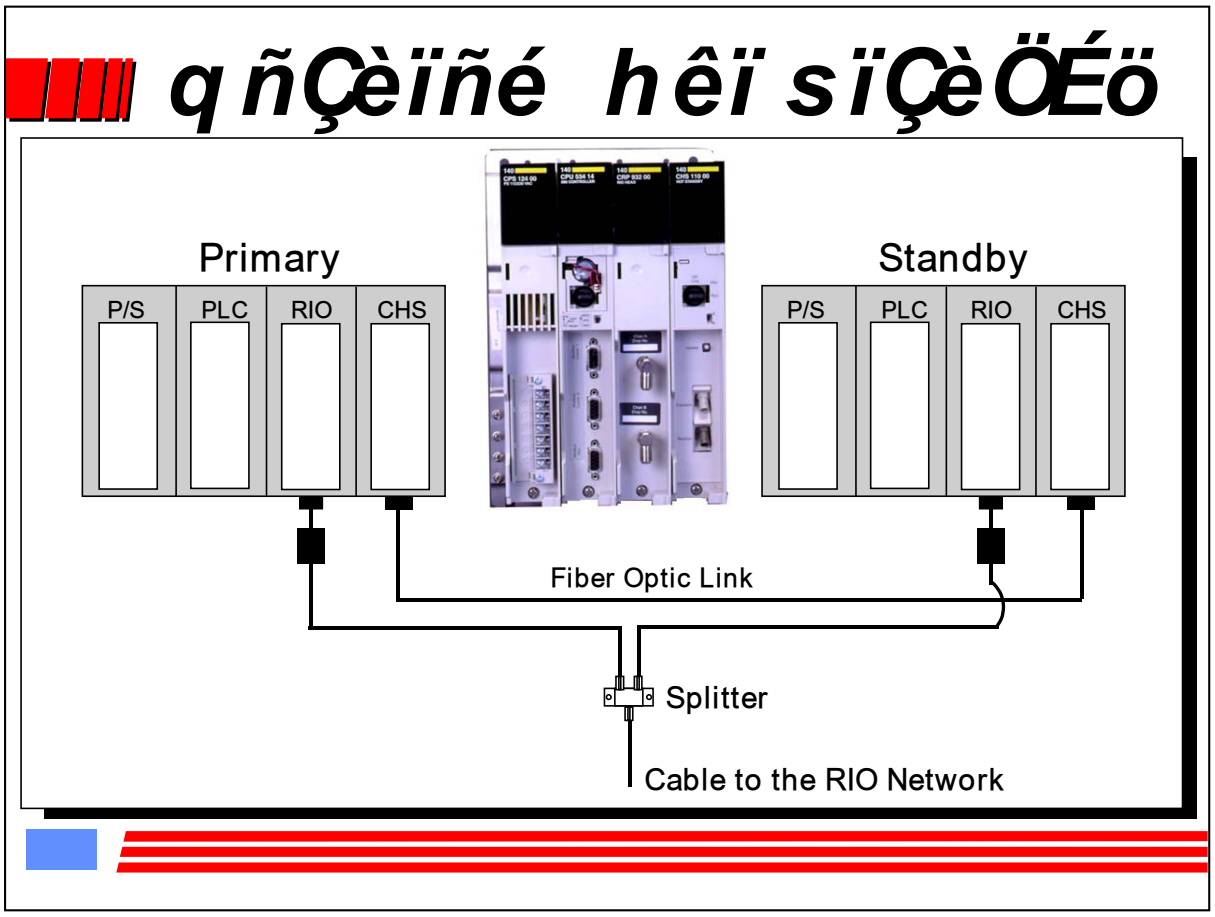


Remote I/O configuration is identical to Quantum or 800 Series RIO systems

- A Quantum Hot Standby System requires two backplanes, each with ***at least*** four slots. The backplane must be equipped with ***identical***, compatible Quantum:
  - Power Supply
  - Programmable Logic Controller
  - CHS 110 Hot Standby Module
  - Remote I/O Head Processor
- As mentioned earlier, for added high availability, a Redundant Power Supply could be used in the CPU Backplane.
- It is also possible to add a Modbus Plus NOM module for added connectivity to a Modbus Plus Network since the Hot Standby System only deals with Remote I/O and ***not*** the Modbus Plus Network.



- The connections also require the installation of a Splitter and the use of self-terminating F adapters between the RIO Head Processors and the RIO Network. There are ***two*** Coaxial Splitters and ***four*** self-terminating F adapters in the Hot Standby Kit.



- Next, the Fiber link is installed to connect the CHS Modules, making sure that each cable is connected to the Transmit on one end and the Receive connection on the other end.

- Later, we will discuss the details of a proper Hot Standby System Installation. The procedure is contained in **Chapter 4** of the **Hot Standby System Planning and Installation Guide**.

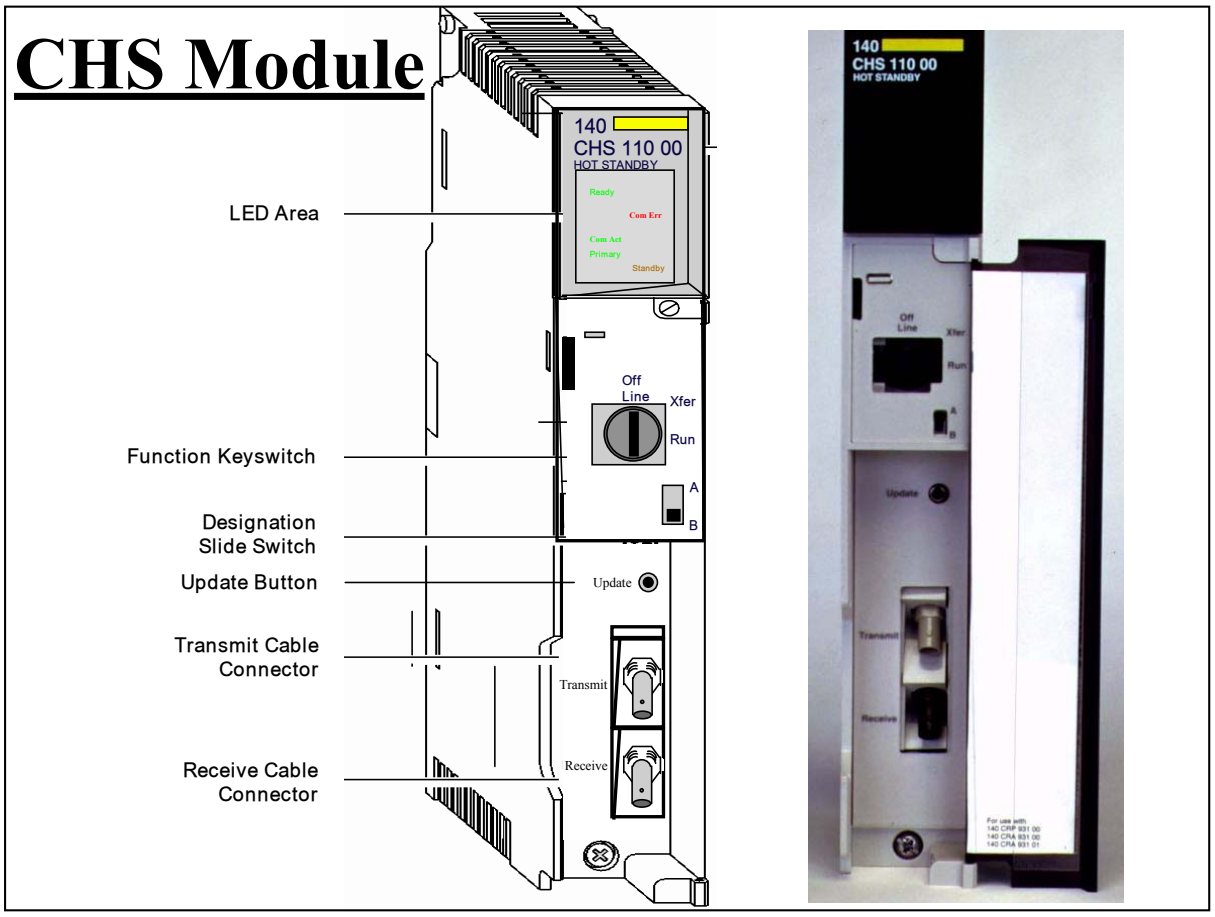
CHS Module Features: 140 CHS 110 00

- **Removeable key switch security for operational modes**
  - **On-Line, Off-Line, Transfer**
- **User program transfer from the primary to the standby controller**
- **Easy connect fiber optic ports**
  - **Uses standard ST connectors**
- **Hot Standby "Kit" includes**
  - **(2) CHS modules, fiber cable, splitters, etc.**
  - **Kit Part Number: 140 CHS 210 00**

- The above screen summarizes the global attributes of the **Quantum CHS Hot Standby Module – Part # 140 CHS 110 00**.

- We will now look at this Module in detail: ……..

CHS Module



- The **Quantum CHS Hot Standby Module** consists of an LED Panel, a three position Function Keyswitch, an A/B slideswitch, an Update Button and the Fiber Optic Cable Ports. We will discuss each of these in sequence.

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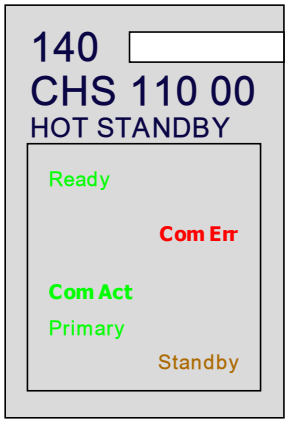
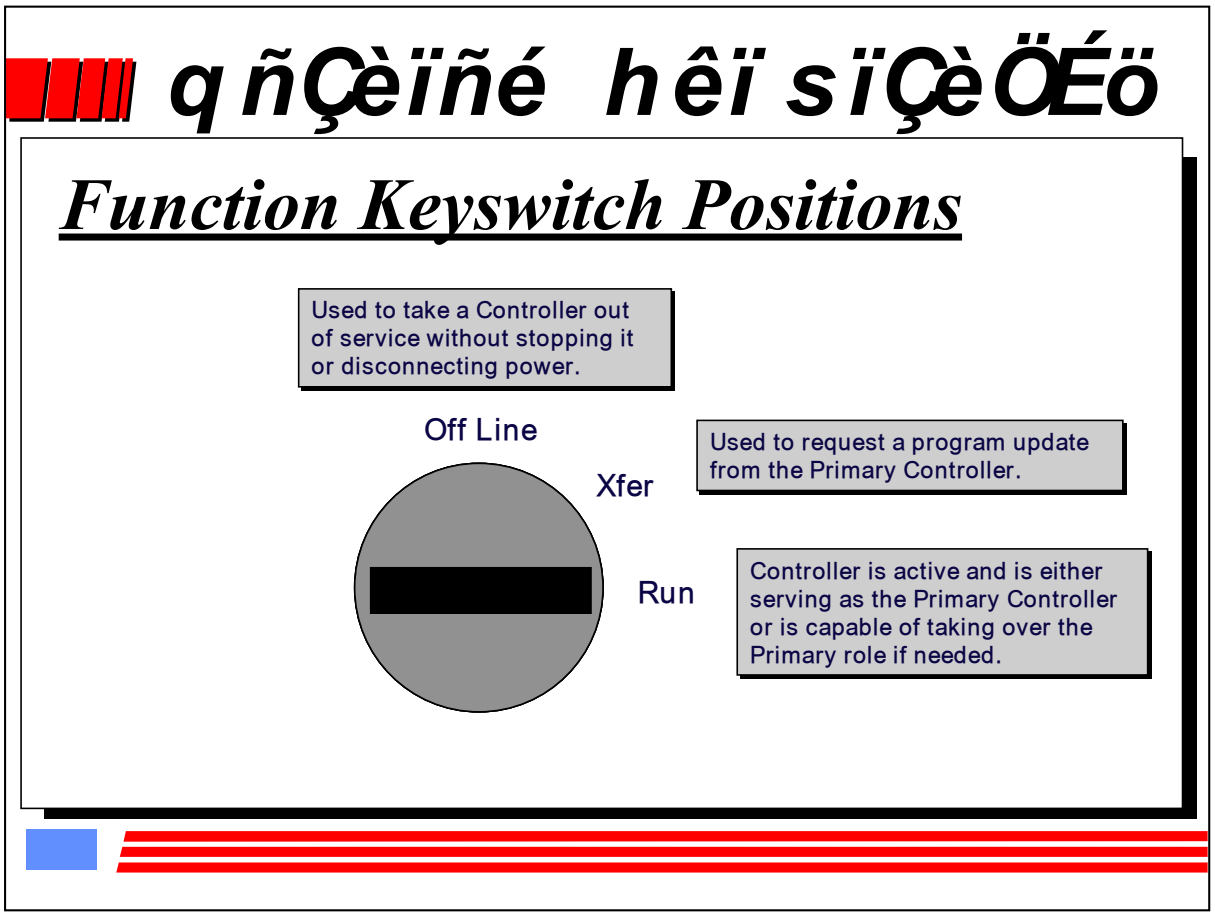
LED Indicators and Descriptions



Indicator	Color	Message
Ready	Green	If steady, power is being supplied to the module and it has passed initial internal diagnostic tests. If blinking, module is trying to recover from an interface error.
Com Act	Green	If steady, CHS 110 modules are communicating. If blinking, an error has been detected.
Primary	Green	Module is supporting primary controller.
Com Err	Red	Module is retrying communications or communications failure has been detected.
Standby	Amber	If steady, module is supporting standby controller which is ready to assume primary role if needed. If blinking, program update is in progress.

- The five status indicators each have one or two modes as listed above. We will discuss in detail the ***Error messages*** listed on **page 74** a little later.

- We will also examine some common LED displays which will make troubleshooting the Hot Standby System easier.



- Beneath the LED display on the face of each CHS 110 control panel is a function keyswitch. It has three positions: **Off Line**, **Xfer (transfer)** and **Run**. You may use this switch to force transfer of control functions or to copy the full program of the Primary Controller to the Standby.

- **Off Line Mode**:
  This mode is used to take a controller out of service without stopping it or disconnecting power. If you turn the key on the Primary unit to **Off Line**, control switches to the Standby. If the Standby controller is taken offline, the Primary continues to operate without a backup.

- **Xfer Mode**:
  This mode is used to request a program update from the Primary Controller. A step-by-step procedure is included on **page 83**. We will perform this procedure together in this class.

  The Primary Controller is able to update the Standby without any interruption in its other functions. If the Primary unit is in **Run** mode and you hold down the Update Button on the Standby unit, the Hot Standby Modules prepare to copy the full program of the Primary Controller to the Standby Unit.

MORE

- The program includes the Configuration Table, I/O Map, Configuration Extensions, Segment Scheduler, User Logic, all .EXE loadables, ASCII messages and the entire State RAM.

- To complete the transfer, while continuing to press the Update Button, turn the key on the Standby to **Xfer**. The **Com Act** LED will go out. Then turn the key to the mode you want the Standby to assume after the update, **Run** or **Off Line**. The **Standby** indicator will ***flash***. Now release the Update Button.

- The **Standby** indicator will continue to ***flash*** during the update and while the Standby unit processes the update. If the unit is set to **Run** mode, the **Standby** indicator will return to a steady Amber. If the unit is set to **Off Line** mode, the **Standby** indicator will go out. Now remove the key.

- If you turn the key on the Primary unit to **Xfer**, the Hot Standby system will ignore your action.

- **Run Mode**:
  When the keyswitch is in this position, the controller is active and is either serving as the Primary controller or is capable of taking over the Primary role if needed.

- The keyswitch on both Hot Standby modules should be in the **Run** position at all times. When the Standby controller is in the **Run** mode, it is actively monitoring the status of the system and ready to take control if the Primary unit fails.

- ***Note:*** For security or convenience, you may disable the function keyswitch with a software override. Once the keyswitch is disabled, you may take the module On or Off Line through software. This can be especially helpful when the module is not easily accessible. ***See page 51 for details.***

- **Designation Slide Switch**:
  A slide switch located below and to the right of the keyswitch is used to designate the controller as **A** or **B**. One unit must be designated as **A** and the other as **B**. The unit designated **A** will power up as the Primary controller, so long as it is ready before or at the same time as unit **B**.

MORE

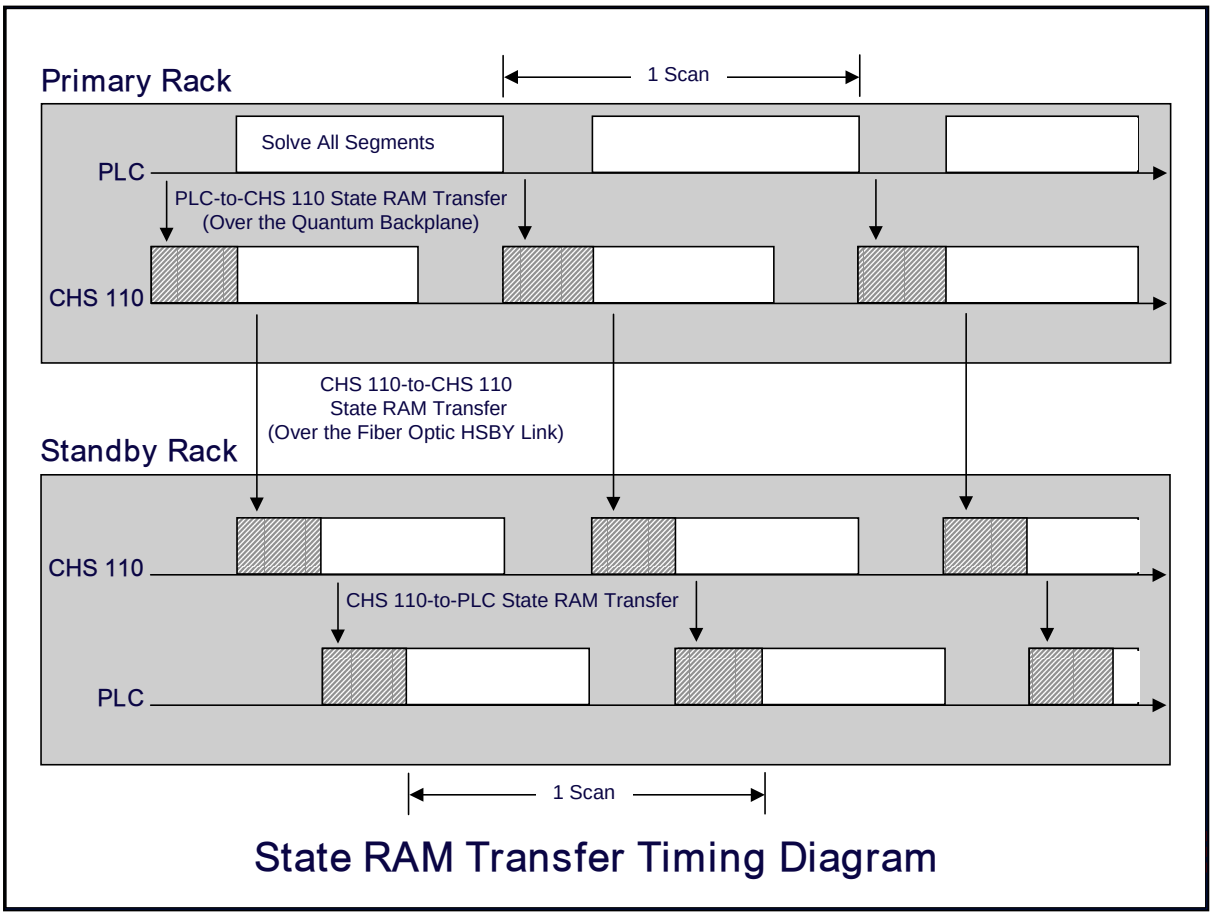
- ***Note:*** If the controllers are given *identical* designations, the system will refuse to acknowledge them both. The first unit to power up will be recognized as the Primary Controller. It will be designated **A** or **B** according to its switch position. The second unit will remain **Off Line** and the **Com Act** indicator will ***flash***, indicating a **Startup Error**.

- Once the system is running, Primary control may be exchanged between the units regardless of which is designated as **A** and which as **B**.

- **Cable Ports**:
  The CHS 110 Hot Standby modules are connected to each other by a Fiber Optic Cable. The cable has two identical strands. Each strand transmits a signal in only one direction. For this reason, each strand must be connected to the upper (transmit) port on one module and the lower (receive) port on the other.

- If the cable is not connected properly, the Hot Standby modules will not be able to communicate and the Hot Standby system will not function. The Primary controller will operate without a backup. The Standby unit will remain Off Line. ***See page 79 for details***.

- A 3m fiber optic cable is provided in the **140 CHS 210 00 Hot Standby Kit**. One strand of that cable is marked. This is the only way to distinguish the two strands.



State RAM Transfer Timing Diagram

State RAM Transfer

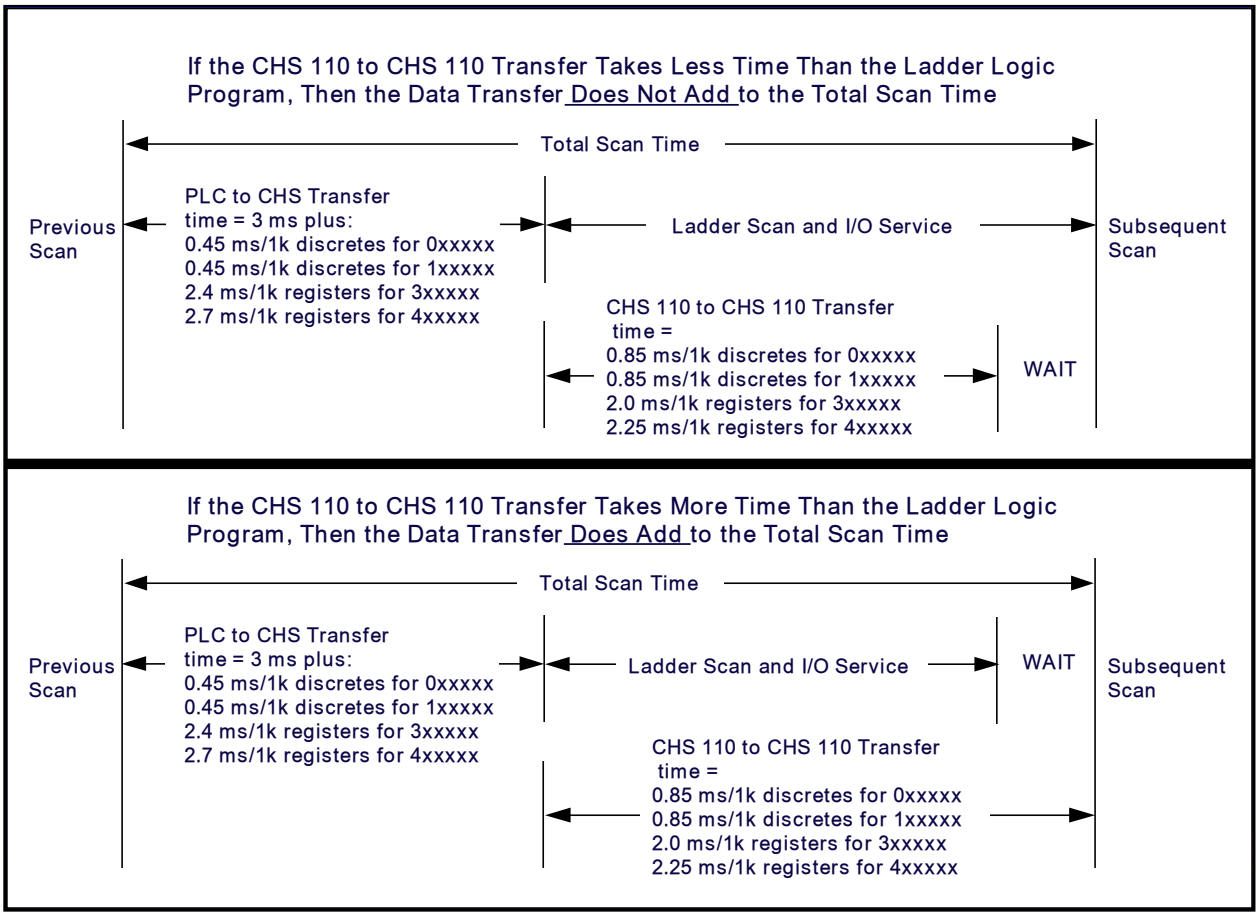
- A Hot Standby system transfers State RAM data from the Primary to the Standby controller while the Primary controller scans and solves the Ladder Logic application program. There are three steps in this transfer process:
  - Primary controller-to-CHS 110 State RAM transfer
  - CHS 110-to-CHS 110 State RAM transfer
  - CHS 110-to-Standby controller State RAM transfer
- The State RAM transfer operation is initiated by the Primary CHS 110 Hot Standby module. The module requests specified State RAM information from the Primary controller.
- At the beginning of each scan, the primary controller transfers the current State RAM data to the CHS 110 Hot Standby module.

MORE

- As soon as the controller-to-CHS 110 transfer finishes, the Primary controller resumes scanning ladder logic and servicing I/O. The State RAM data is simultaneously transferred from the Primary CHS 110 module to the Standby CHS 110 module over the fiber optic link ***at a rate of 10 Megabaud***

- In turn, the Standby CHS 110 module transfers the State RAM data to the Standby controller.

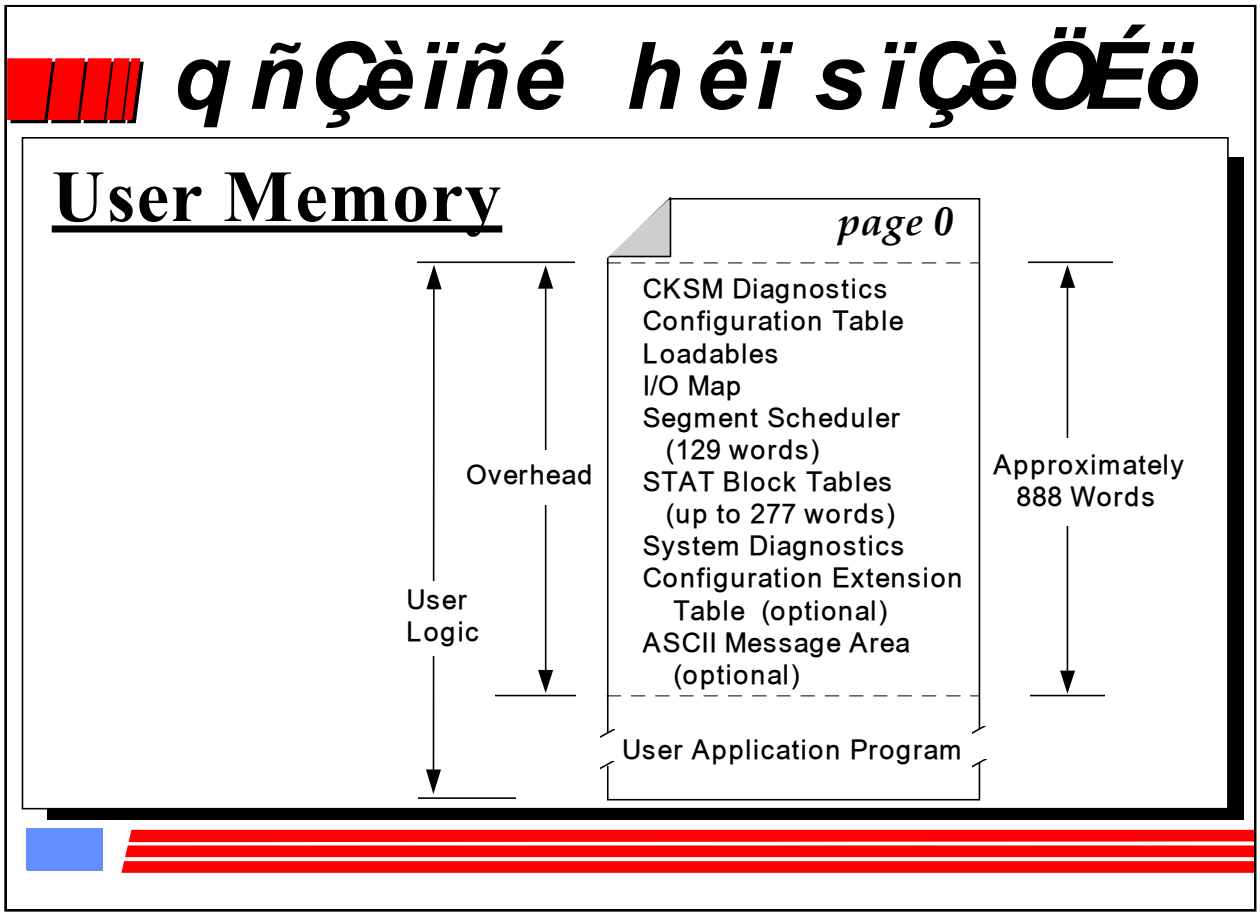
- The timing diagram on the previous page shows how the transfer takes place.



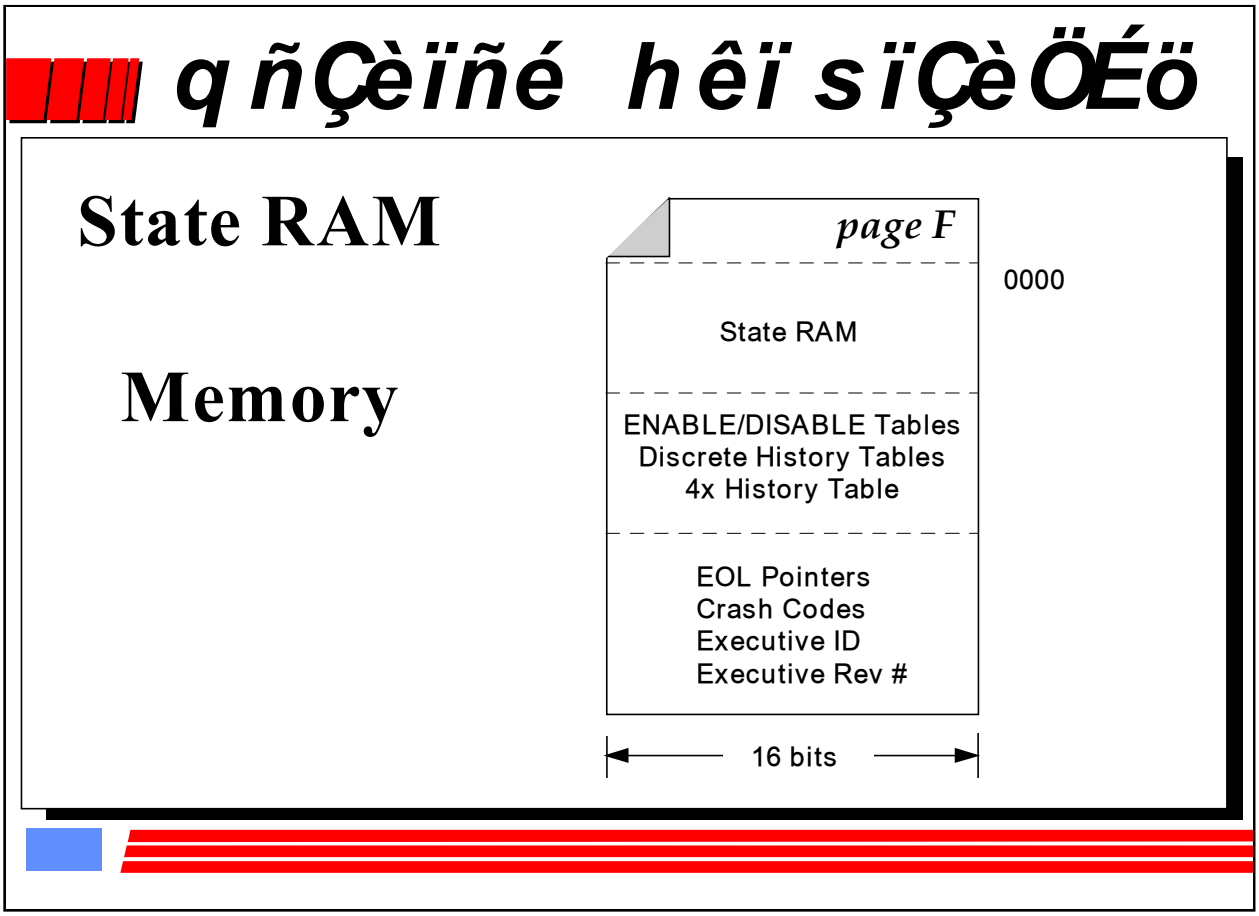
Effect on System Scan Time

- When the ladder logic program being executed by the Primary Controller is longer than the CHS 110-to-CHS 110 transfer, the transfer ***does not*** increase total system scan time. However, if your ladder logic program is relatively short, the scan will finish before the CHS 110-to-CHS 110 data transfer and the data transfer ***will*** increase total system scan time.

- ***Note:*** No matter how long your transfer takes, ***it will not cause the watchdog timer to timeout.***



- This will be a quick discussion review of Memory Allocation prior to discussing the structure of the State RAM area in Memory.



State RAM

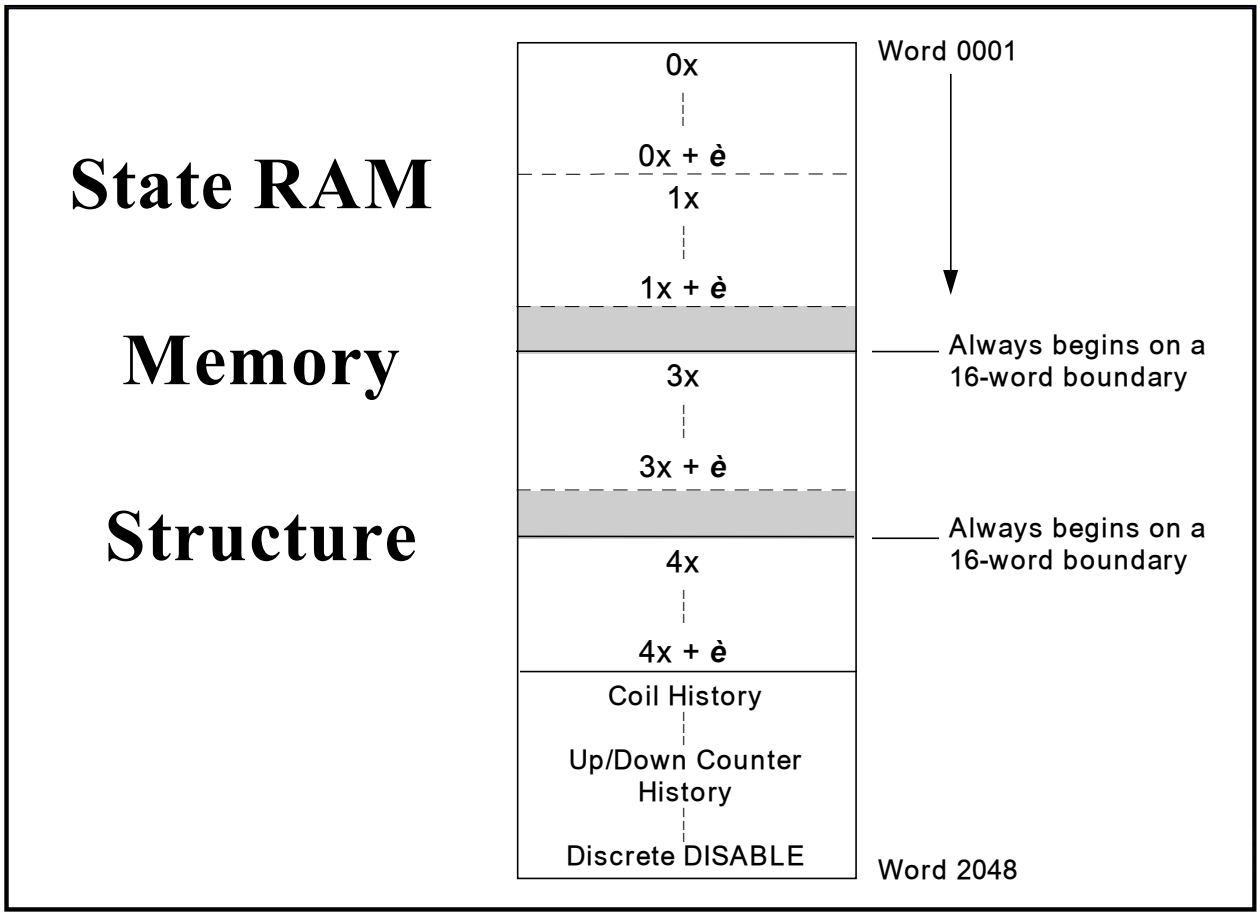
- As part of your PLC's configuration process, you specify a certain number of discrete outputs or coils, discrete inputs, input registers, and output holding registers available for application control. These inputs and outputs are placed in a table of 16-bit words in an area of system memory called ***State RAM***.

Storing Discrete and Register Data in State RAM

- State RAM data is stored in 16-bit words on page F in System Memory. The State RAM table is followed by a discrete history table that stores the state of the bits at the end of the previous scan, and by a table of the current ENABLE/DISABLE status of all the discrete (0x and 1x) values in State RAM.

- Each 0x or 1x value implemented in user logic is represented by one bit in a word in State RAM, by a bit in a word in the history table, and by a bit in a word in the DISABLE table. In other words, for every discrete word in the State RAM table, there is one corresponding word in the history table and one corresponding word in the DISABLE table.

MORE



Storing Discrete and Register Data in State RAM (cont)

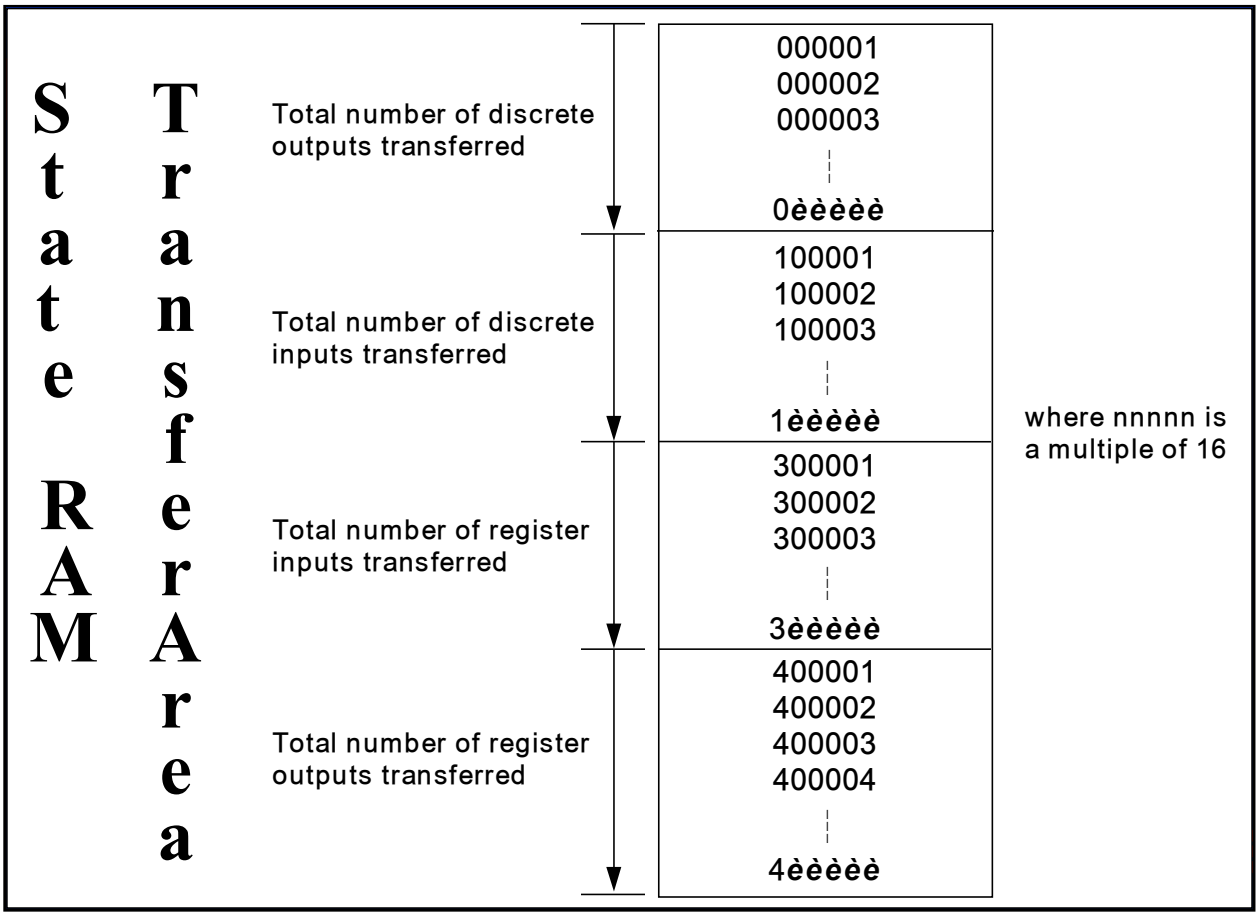
- Counter input states for the previous scan are represented on page F in an up-counter/down-counter history table. Each counter register is represented by a single bit in a word in the table; a value of 1 indicates that the top input was ON in the last scan, and a value of 0 indicates that the top input was OFF in the last scan.

State RAM Structure

- Words are entered into the State RAM table from the top down in the following order:

- Discrete references come before registers, the 0x words first followed by the 1x words. The discrete references are stored in words containing 16 contiguous discrete references.

- The register values follow the discrete words. Blocks of 3x and 4x register values must each begin at a word that is a multiple of 16. For example, if you allocate five words for eighty 0x references and five words for eighty 1x references, you have used words 0001 ... 0010 in State RAM. Words 0011 ...0016 are then left empty so that the first 3x reference begins at word 0017.



State RAM Transfer Area

- The **State RAM Transfer Area** contains all the State RAM values that will be passed between the Primary and Standby controllers. The size of the transfer area may be as large as the total size of your controller's State RAM or a small set of critical I/O reference data types.

- As the simplified block diagram above shows, all 0x references in the State RAM transfer area are transferred first, then all 1x references, followed by all the 3x references, and finally all the 4x references.

- Customizing the State RAM transfer area is one way to reduce scan time. Another way is to place certain registers in a ***nontransfer area***, an area contained within the transfer area but ignored during the actual State RAM transfer.

- ***Note:*** If you are customizing the size of your State RAM transfer area, you must specify the number of each reference data type (0x, 1x, 3x, and 4x) as either **0** or a multiple of **16**. In the case of the 4x registers, there must always be ***at least 16 registers*** allotted.

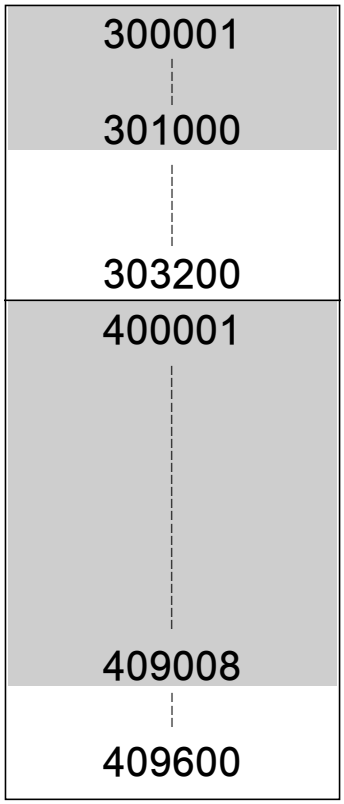
MORE

The Default Transfer Area

- By default, the Hot Standby system will automatically transfer the following from the Primary to the Standby controller on every scan:
    - The first **8192** points of **0xxxxx** output reference data
    - The first **8192** points of **1xxxxx** input reference data
    - A total of **10K registers**, of which **1K** is allotted for **3xxxxx** registers and **9K** is allotted for **4xxxxx** registers

- If you have configured less than 1K of 3xxxxx registers, the remaining space will be used for 4xxxxx registers. Likewise, if you have configured less than 9K of 4xxxxx registers, the remaining will be used for 3xxxxx registers.

- In any case, the number of 4xxxxx registers transferred will be a multiple of 16 *unless* all 4xxxxx registers have been included. The number of 4xxxxx registers may slightly exceed the allotment in order to reach the next highest multiple of 16.

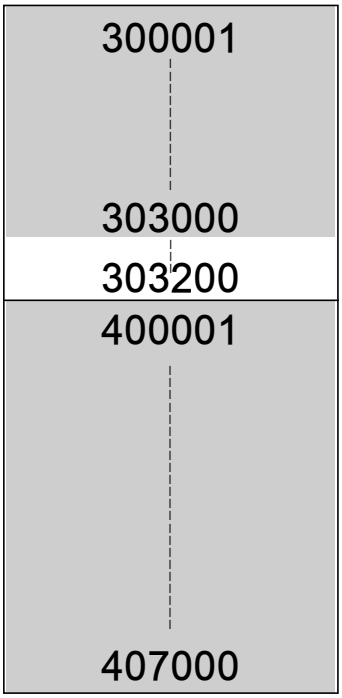


Example 1

If you have 3200 3x and 9600 4x registers, then the full allotment of 1000 3x registers will be transferred.

The actual number of 4x registers transferred will be 9008; that is, the full allotment of 9000 registers plus 8 more to reach the next highest multiple of 16.

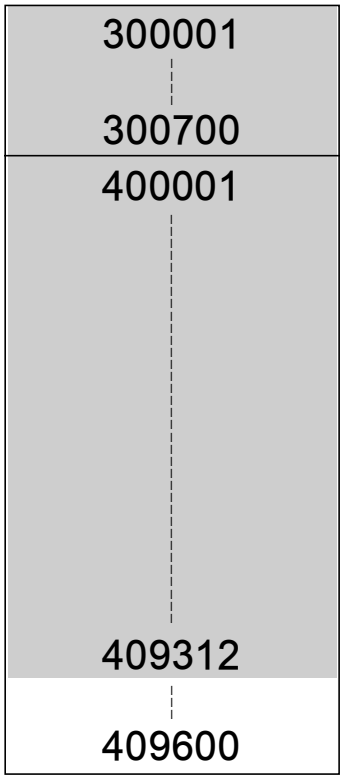
- **The Above Example is for Classroom Discussion**



Example 2

If you have 3200 3x and 7000 4x registers, then all the 4x registers will be transferred. The full allotment of 1000 3x registers will be transferred, plus an additional 2000 3x registers to bring the total number of registers transferred to 10,000. So a total of 3000 3x registers will be transferred.

- **The Above Example is for Classroom Discussion**

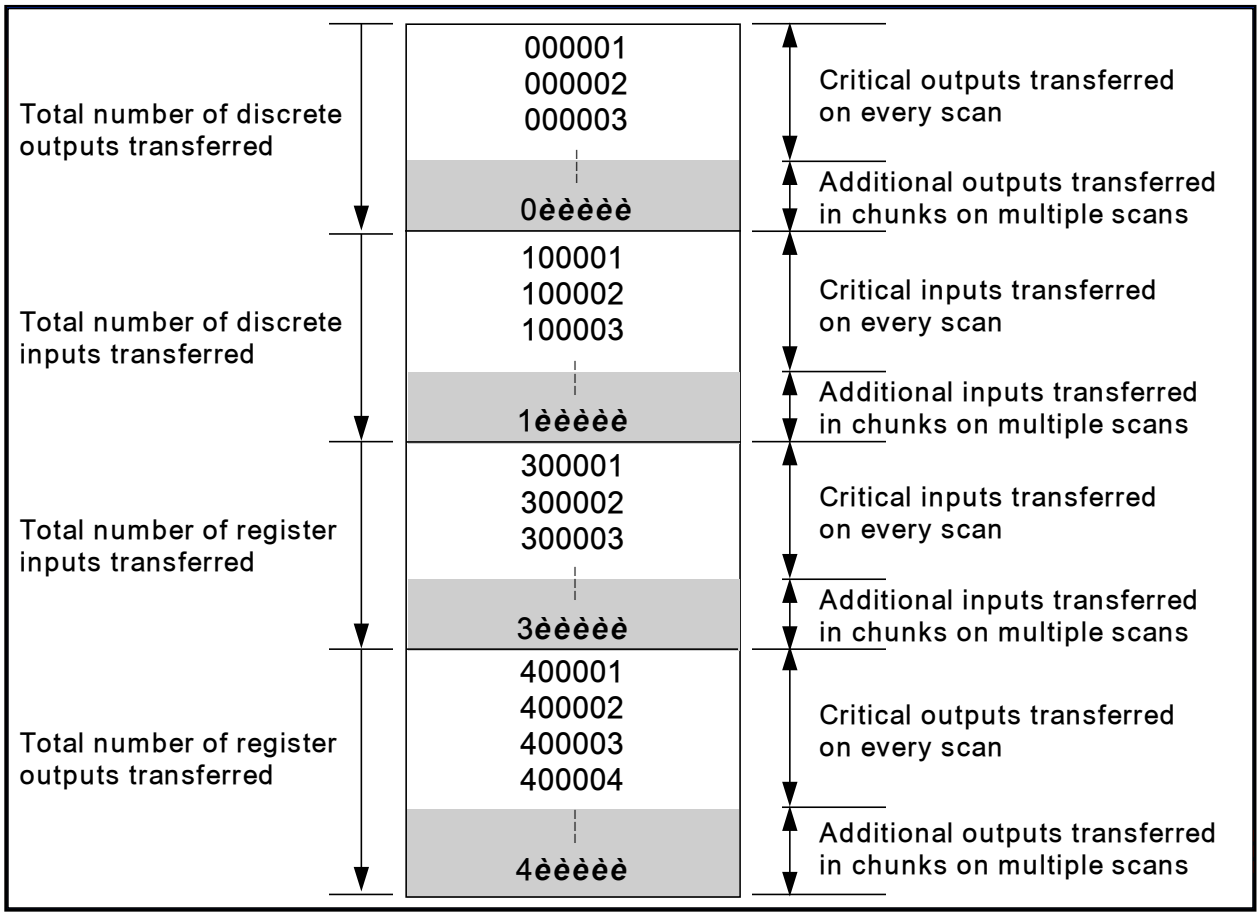


Example 3

If you have 700 3x and 9600 4x registers, then all the 3x registers will be transferred.

The full allotment of 9000 4x registers will be transferred, plus an additional 300 registers to bring the total to 10,000, plus an additional 12 registers to reach the next highest multiple of 16. In all, 9312 4x registers will be transferred.

- **The Above Example is for Classroom Discussion**



Customizing Options

- If you want to set up a custom State RAM transfer area, you should control your system using the **Hot Standby Configuration Extension**. The configuration extension provides three alternatives to the default transfer area:
    - You can define the number of 0xxxxx, 1xxxxx, 3xxxxx, and 4xxxxx reference data types that you want transferred in each scan.
    - You can define a certain amount of reference data types to be transferred on every scan with additional data to be transferred in chunks over multiple scans, beginning with 0xxxxx references and proceeding in turn with 1xxxxx, 3xxxxx, and 4xxxxx registers.
    - You can transfer all the configured reference data types in your system's State RAM on every scan.
- These options allow you to design a transfer area that is as small as 16 4xxxxx output registers or large enough to encompass all of your controller's State RAM (10K, 32K, or 64K, depending on the type of Quantum controllers you are using in your Hot Standby system).

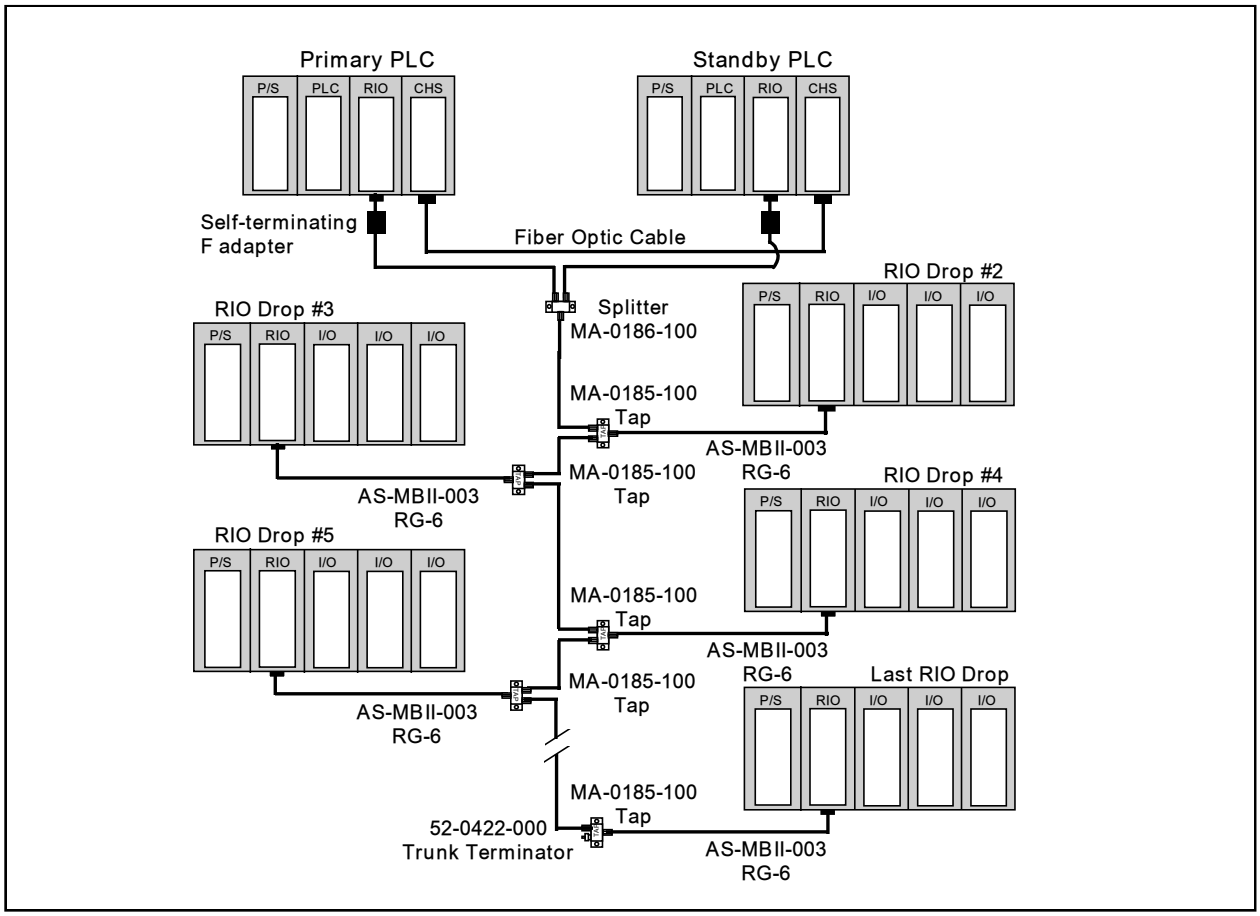
MORE

- The reference data of each type (0x, 1x, 3x, and 4x) is placed in the State RAM transfer area, starting at the lowest reference number (000001 for coils, 100001 for discrete inputs, 300001 for register inputs, and 400001 for register outputs). It is accumulated contiguously up to the amount of each data type you specify. The total number of each reference type in the State RAM transfer area must be a multiple of 16.

- For example, if you indicate that the number of coils in the transfer area is 96, coils 000001 ... 000096 will be transferred from the Primary to the Standby controller. Any 0x references beyond 000096 used in the State RAM will not be transferred.

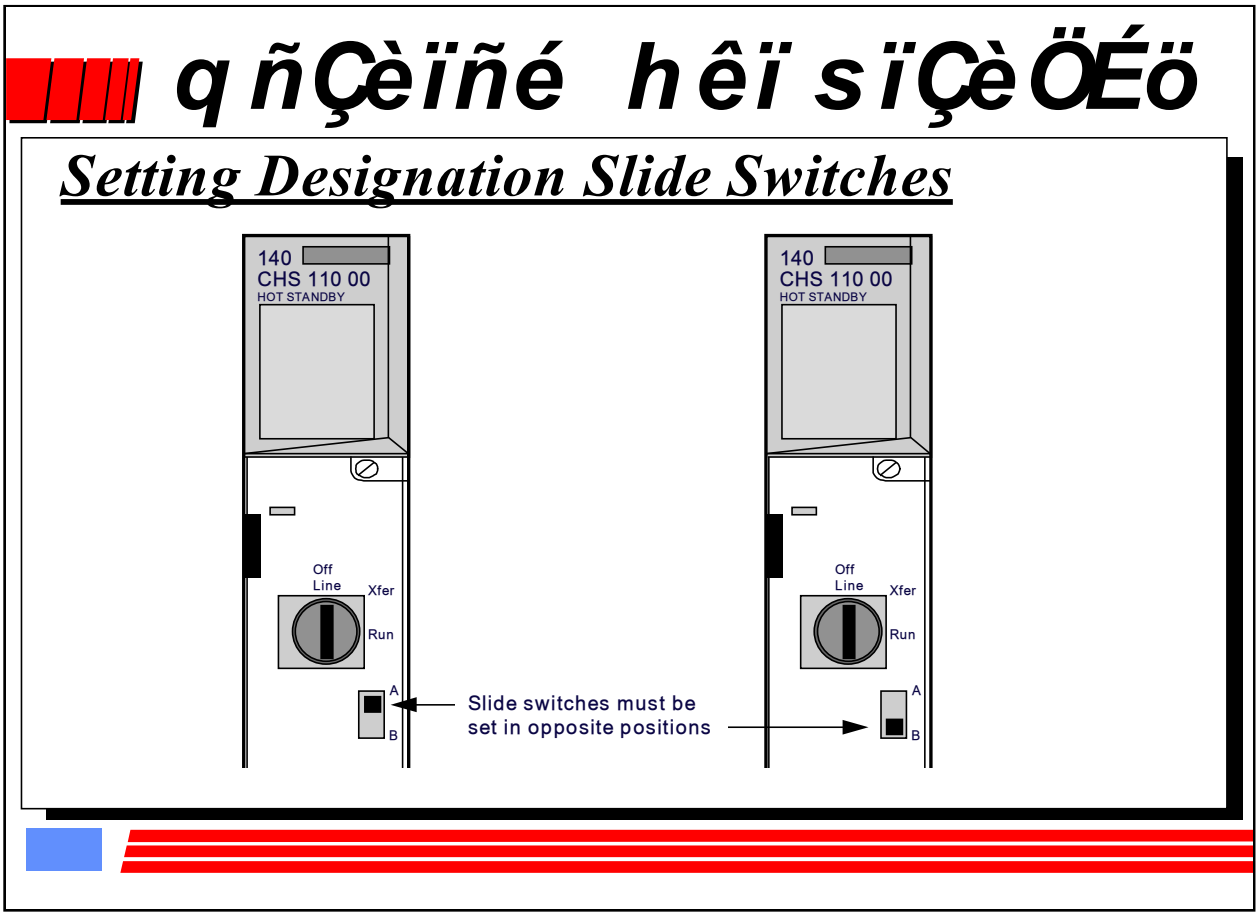
- The additional State RAM data to be sent over multiple scans can also be of any or all of the four reference data types, and must also be specified in multiples of 16. The additional reference data region for each data type starts at the lowest available reference number. For example, if 2048 coils are transferred on every scan (000001 ... 002048), and you schedule 1024 additional coils for transfer over multiple scans, references 02049 ... 003072 will be used for the additional transfer data.

- The additional transfer is handled by specifying the number of scans over which you want to send the additional data. For example, if you specify two scans in which to transfer coils 002049 ... 003072, then coils 002049 ... 002560 will be sent with coils 000001 ... 002048 on one scan and coils 002561 ... 003072 will be transferred with coils 000001 ... 002048 on the next scan.



Remote I/O Cable Topologies

- In each configuration:
    - The cables connecting the RIO Head Processors to the RIO network must be fitted with self-terminating F adapters.
    - An MA-0186-100 coaxial splitter must be installed between the RIO Head Processors and the RIO network.
    - The Remote Drops must be connected to the trunk cable via an MA-0185-100 Tap and a Drop Cable.
    - The last Tap on a trunk cable must be terminated with a 52-0422-000 trunk terminator. Remote Drops must be connected directly to the trunk cable.

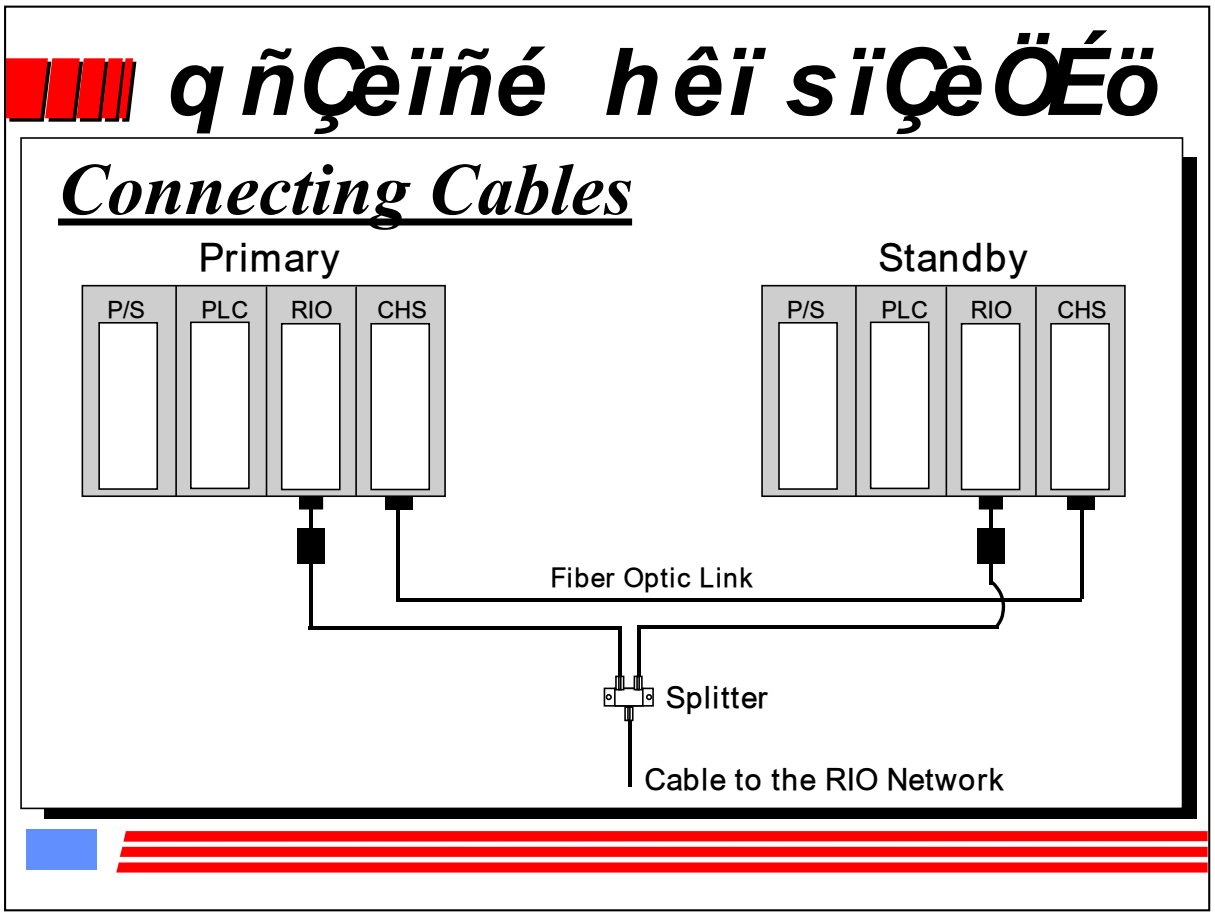


Procedure: Installing a Hot Standby System

Step 1 Install the Power Supplies, Controllers, RIO Head Processors, Hot Standby Modules and any option modules in the Primary and Standby backplanes. Make sure:

- The modules meet the version requirements listed on **page 5** - "Hot Standby System Planning and Installation Guide".
- The modules in the Primary backplane are identical to those in the Standby backplane.
- The rotary address switches on the back of each Controller have been set. *The Controllers may have different addresses*.
- The RIO Heads **are in the same Slot** in each backplane.
- The designation slide switch, as shown above, on one Hot Standby module is set to **A** and the other is set to **B**.

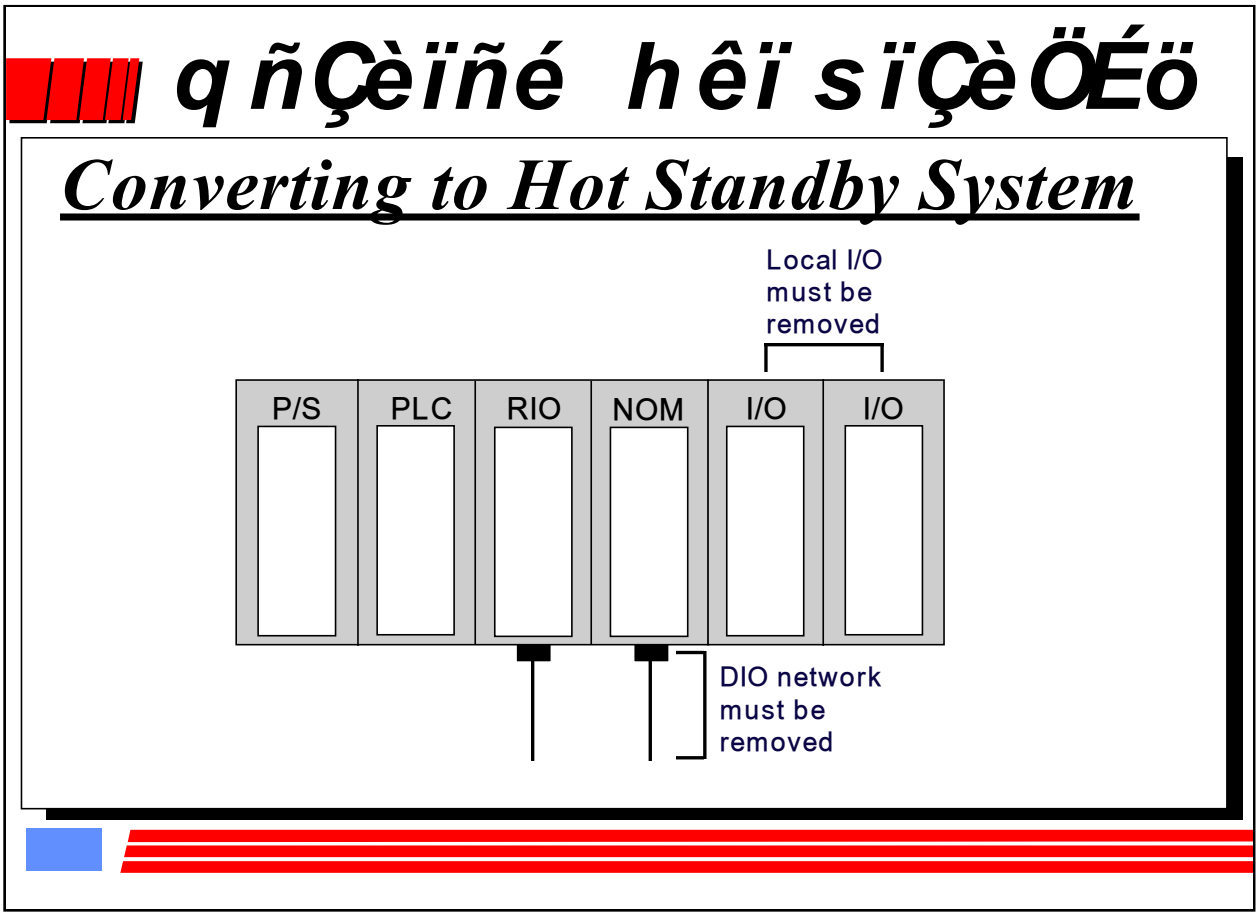
Caution: Before installing any controller in your Hot Standby system, make sure its battery has been disconnected for at least five minutes.



Step 2 Install a Splitter and a self-terminating F adapter between the Primary RIO Head Processor and the RIO network. Connect the coaxial cable link. Then connect the cable between the Splitter, another self-terminating F adapter and the Standby RIO Head Processor.

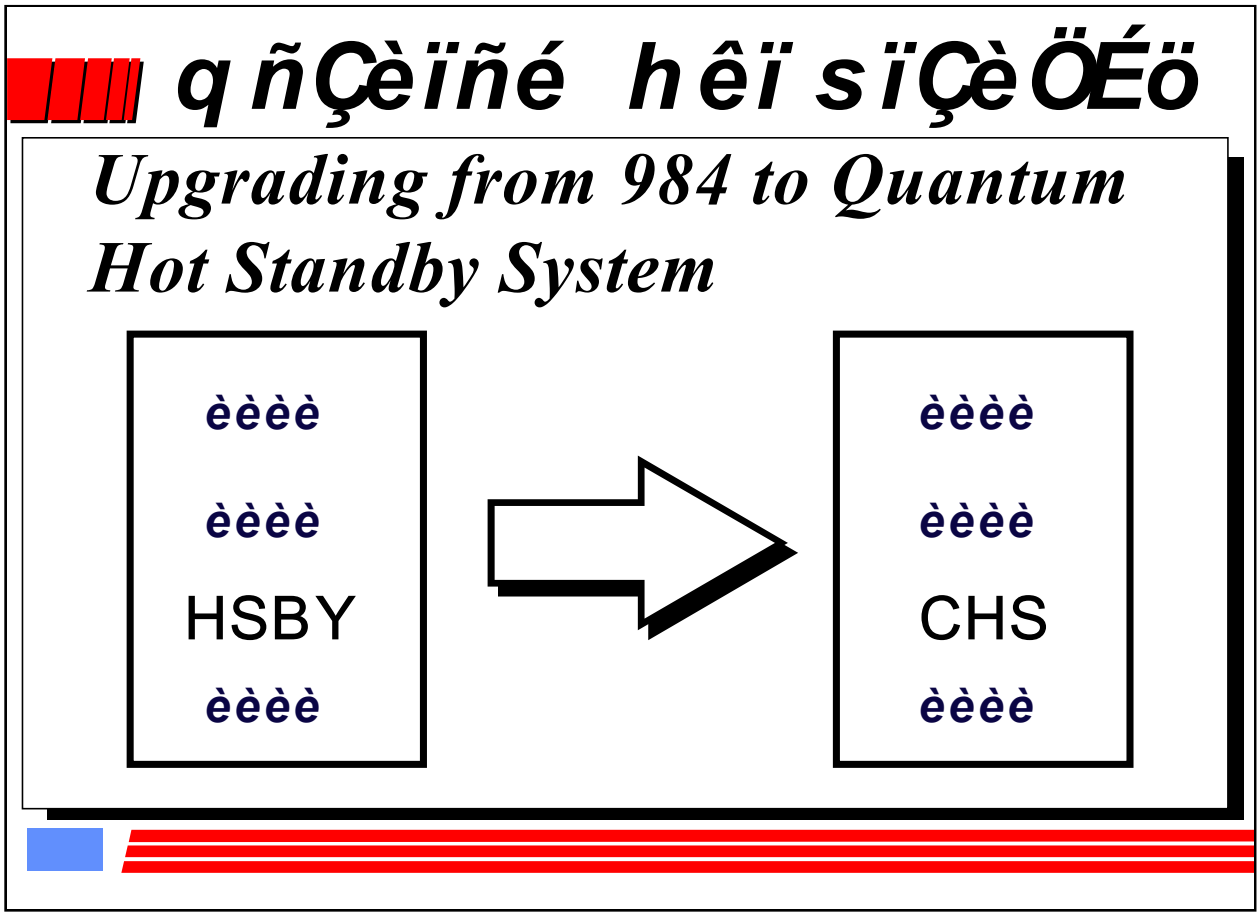
Step 3 Connect the fiber link between the Hot Standby modules, making sure the cable is properly crossed, so that the transmit cable connector of each module is linked to the receive cable connector of the other.

Follow the directions for preparing and attaching these fiber optic cables provided in the **Hot Standby Manual - pages 36 + 37**.



Adding Hot Standby Capability to an Existing System

- To add Hot Standby capability to an existing Quantum system, you must install a second backplane with modules identical to those in the original backplane. Keep the following requirements in mind:
  - You must remove any Local I/O and Distributed I/O networks from the original backplane, as they are not supported at switchover.
  - You need a backplane with at least four slots.
  - The components in both backplanes must meet the version requirements listed on **page 5 of the Hot Standby Manual**.
  - You must install a splitter and a self-terminating F adapter between the original RIO Head Processor and the RIO network. A second cable will run from the splitter to the Standby RIO Head Processor, through a second self-terminating F adapter.
- As a precaution, you should first stop the controller and disconnect power to the system.



- If you are upgrading from a 984 Hot Standby system to a Quantum Hot Standby system, you may port your Ladder Logic Program by first deleting the **HSBY** block, then relocating the program, and then inserting a **CHS** instruction.

The CHS Loadable

- The logic in the **CHS loadable** is the engine that drives the Hot Standby capability in a Quantum control system. The CHS loadable gives you the ability to:
  - Specify the Hot Standby **Command** register, which is used to configure and control Hot Standby system parameters.
  - Define a Hot Standby **Status** register, which can be used to monitor the real machine status of the system.
  - Implement a **CHS** instruction in Ladder Logic.
- Unlike **HSBY** in 984 controllers, the **CHS** instruction *does not* have to be placed in a Ladder Logic program. However, the CHS software **must be loaded** to the Quantum controller on order for a Hot Standby system to be supported.

How to Configure a Quantum Hot Standby System using Modsoft

- In a Quantum PLC system that is programmed via Modsoft, there are two alternative methods available to configure Hot Standby capability. You have a choice of methods. You may control your system via a CHS instruction in ladder logic or you may use a Configuration Extension. Each method has certain advantages:

- **Method 1**
  Program the CHS instruction in ***Network 1, Segment 1*** of your Ladder Logic Program and unconditionally connect the top node to the power rail via a horizontal short.

  This allows you to use the **CHS Zoom Screens** to control the Command and Status registers On-Line while it is running.

- **Method 2**
  Define the Hot Standby Configuration Parameters in a pair of Hot Standby Configuration Extension Screens in Modsoft.

  The Hot Standby Configuration Extension Screens in Modsoft are very easy to use and are very flexible:

  - You can specify the parameters in the Hot Standby Command register in a clear, easy-to-read fashion.

  - You can customize the State RAM data transfer between the Primary and Standby units to help reduce scan time. More on this later.

- If you decide to control your system using the Configuration Extension, you can still program in Ladder Logic a CHS instruction which will give you access to the Modsoft Zoom Screens to access and modify the Command and Status registers while the system is running.

- ***Note:*** If both a Configuration Extension and the CHS instruction are used, the Configuration Extension controls the Hot Standby system. The only function of the CHS instruction is to provide Modsoft Zoom screens. The parameters in the Configuration Extension Screens are applied by the Controllers at startup. Once the Controllers are running, the Zoom screens may be used to access and modify the Command register. The changes will be implemented at runtime, and can be seen in the Status register. However, if the Hot Standby system is later stopped and then restarted, the parameters specified in the Configuration Extension Screens will go back into effect.

Ladder Logic in a Hot Standby System

- All Ladder Logic for Hot Standby functions should be in Segment 1. Network 1 of Segment 1 is reserved exclusively for the CHS instruction block and Ladder Logic directly associated with it.

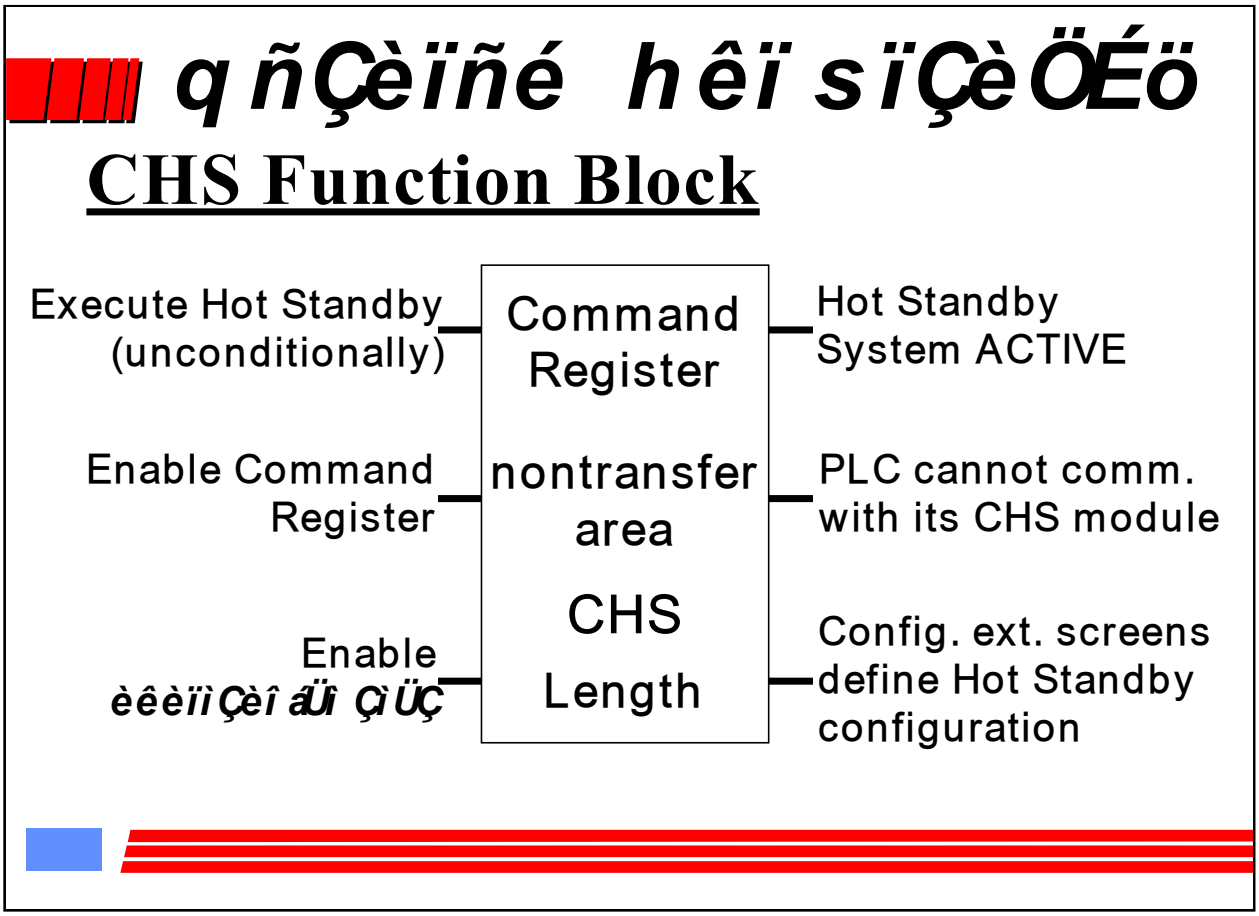
- **Segment 1**
  When your Hot Standby system is running, the Primary Controller scans all segments, while the Standby Controller scans only Segment 1 of the configured Ladder Logic Program. This has three very important implications with respect to the way you configure system logic:

  - You must program all Ladder Logic specific to Hot Standby functions in Segment 1

  - You ***must not*** program I/O control logic in Segment 1

  - You ***must not*** schedule any I/O Drops in Segment 1

- The Standby Controller in a Hot Standby system **must never** execute I/O Logic.



- **Inputs**
  When the CHS instruction is inserted in Ladder Logic to control the Hot Standby configuration parameters, its Top Node must be connected directly to the power rail by a horizontal short. No control logic, such as contacts, should be placed between the rail and the input to the top node.

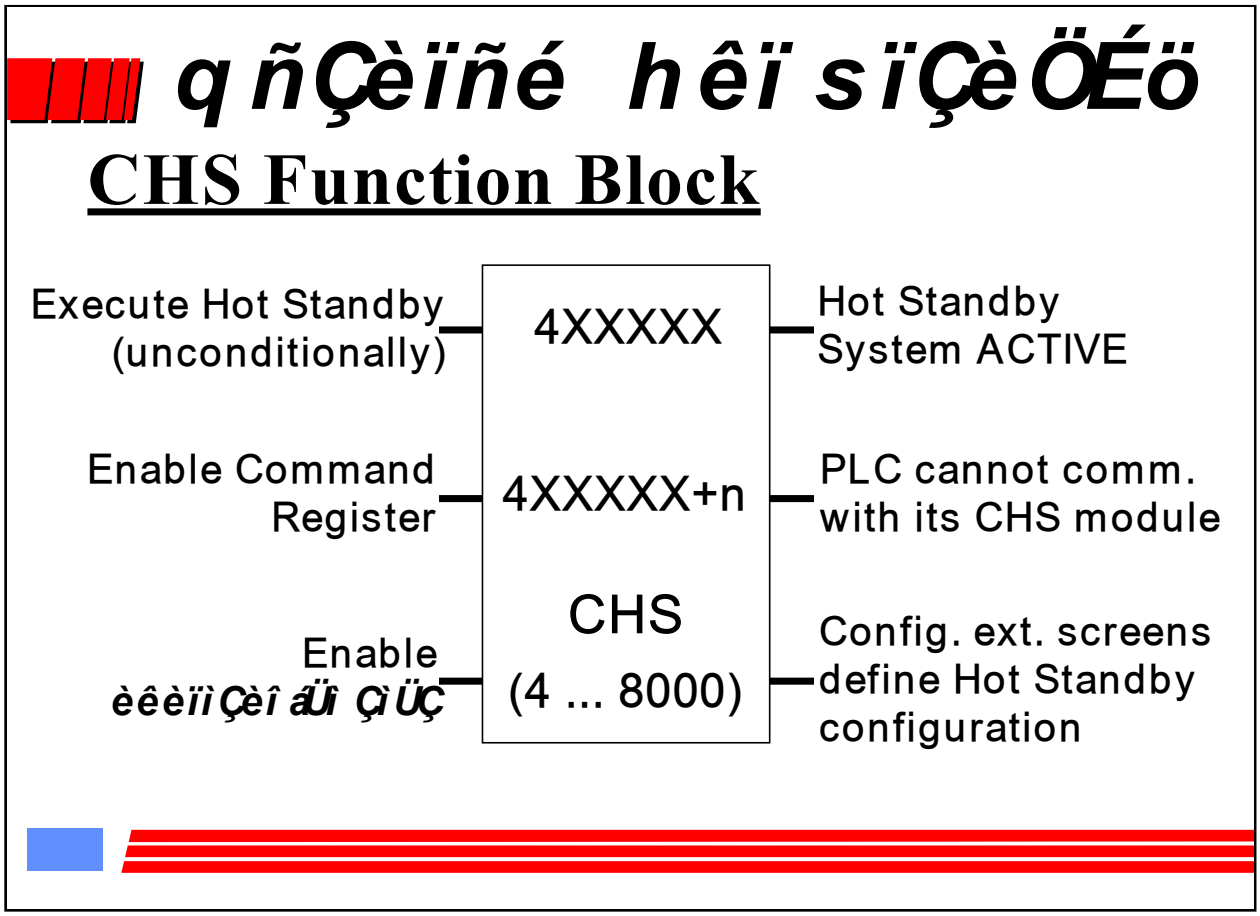
  The middle node enables the Command register. This input must be ON for the Hot Standby system to be functional.

  The bottom input enables the nontransfer area. If this input is OFF, the nontransfer area will not be used, ***and the Hot Standby Status register will not exist***.

- **Outputs**
  The output from the top node goes ON to indicate that Hot Standby is running.

  The middle output goes ON if the system detects a system interface error.

  The bottom output goes ON when the Hot Standby parameters were set via the Configuration Extension Screens in Modsoft. Although these parameters may be changed via the CHS Zoom screen or in the reference data editor (RDE), the original configuration will be re-enabled should power go down.



- **Top Node Content**
  The 4x register entered in the top node is the Hot Standby *Command Register*. Eight bits are used in this register to configure and control Hot Standby system parameters.

  The Hot Standby Command Register must be outside of the *nontransfer area* of State RAM.

- **Middle Node Content**
  The 4x register entered in the middle node is the first register in the *nontransfer area* of State RAM. The nontransfer area must contain at least four registers (to be explained later).

  The 4x registers in the nontransfer area are never transferred from the Primary to the Standby PLC during the logic scans. One reason for scheduling additional registers in the nontransfer area is to reduce the impact of the State RAM transfer on the total system scan time.

- **Bottom Node Content**
  The integer entered in the bottom node defines the *length* of the Hot Standby *nontransfer area* in State RAM. The *length* must be in the range 4 ... 8000 registers.

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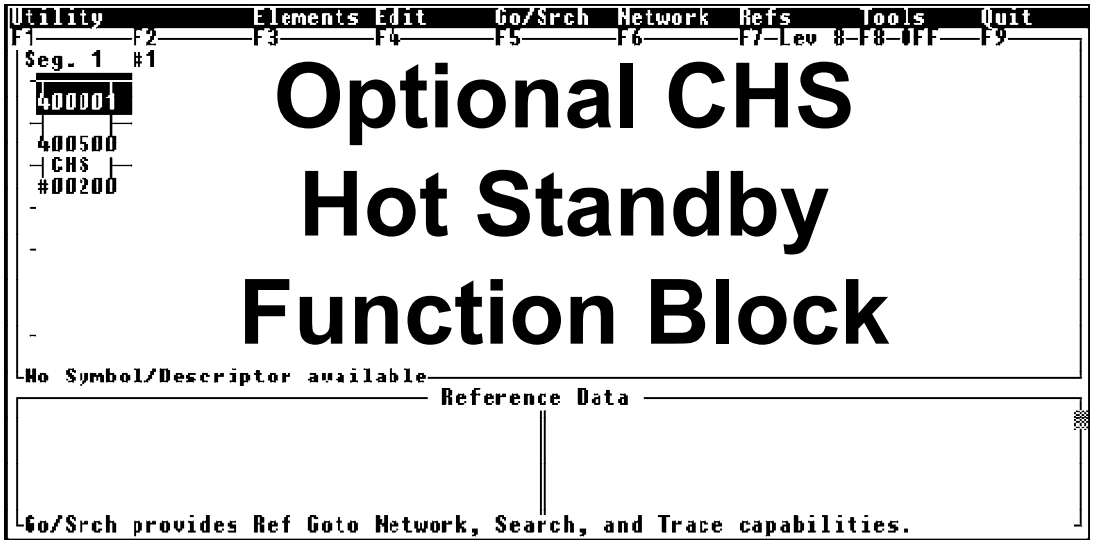
Optional CHS Ladder Logic Function



- As mentioned previously, the **CHS Hot Standby Function Block**, if used, must be placed in **Segment 1, Network 1** and its top input must be tied unconditionally to the Power Rail.
- All logic placed in Segment 1 ***must be related*** to the Hot Standby operation. Segment 1 **should never** contain solvable logic associated with the User Logic Program nor any scheduled I/O polling.

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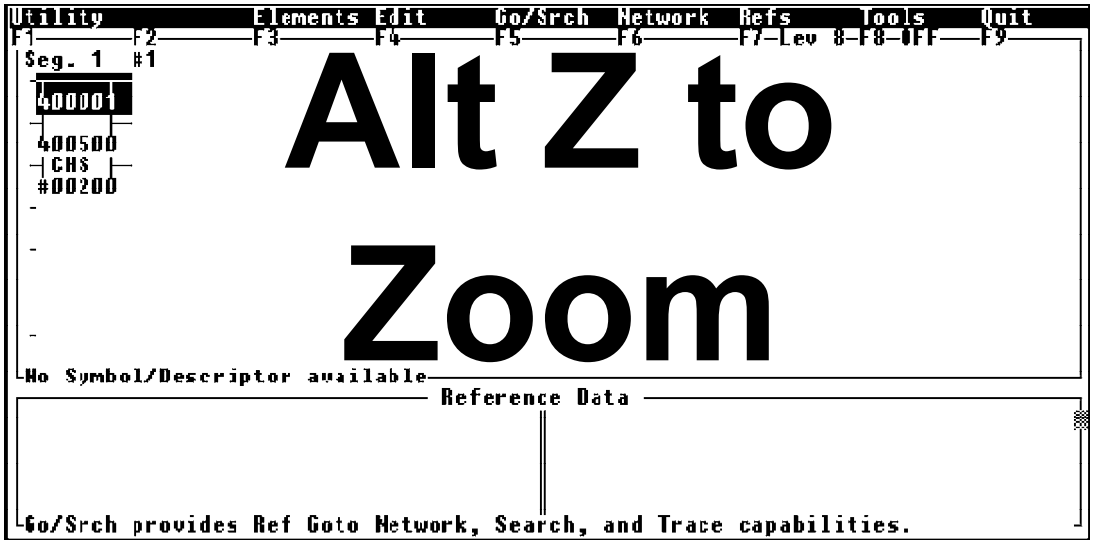
Optional CHS Ladder Logic Function



- The **CHS Hot Standby Function Block** can be used to monitor and make changes, while in On-Line mode, to the Command Register and monitor the Status Register. All that is needed is to put the cursor over the CHS Function block and hit **Alt-Z**.

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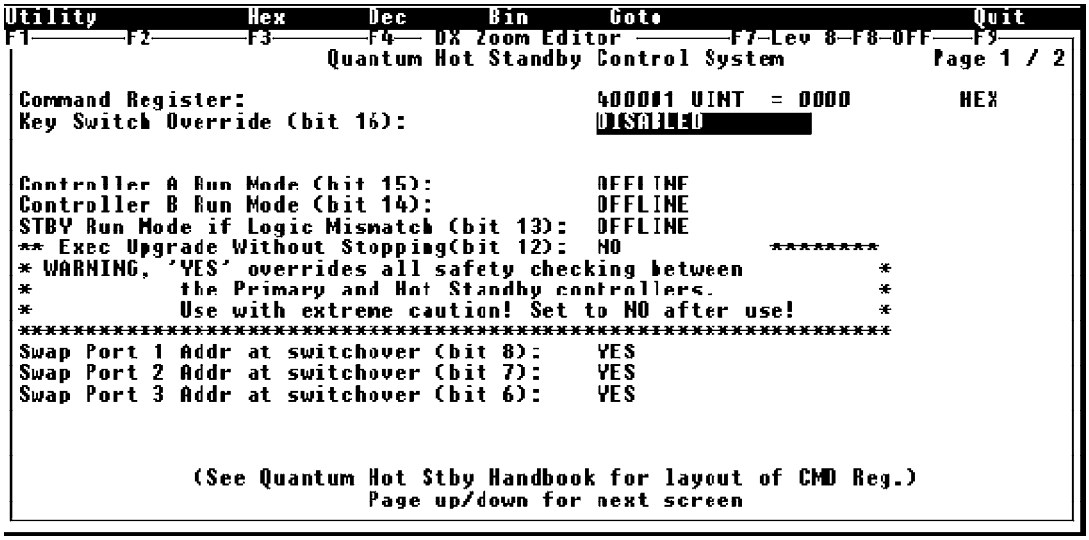
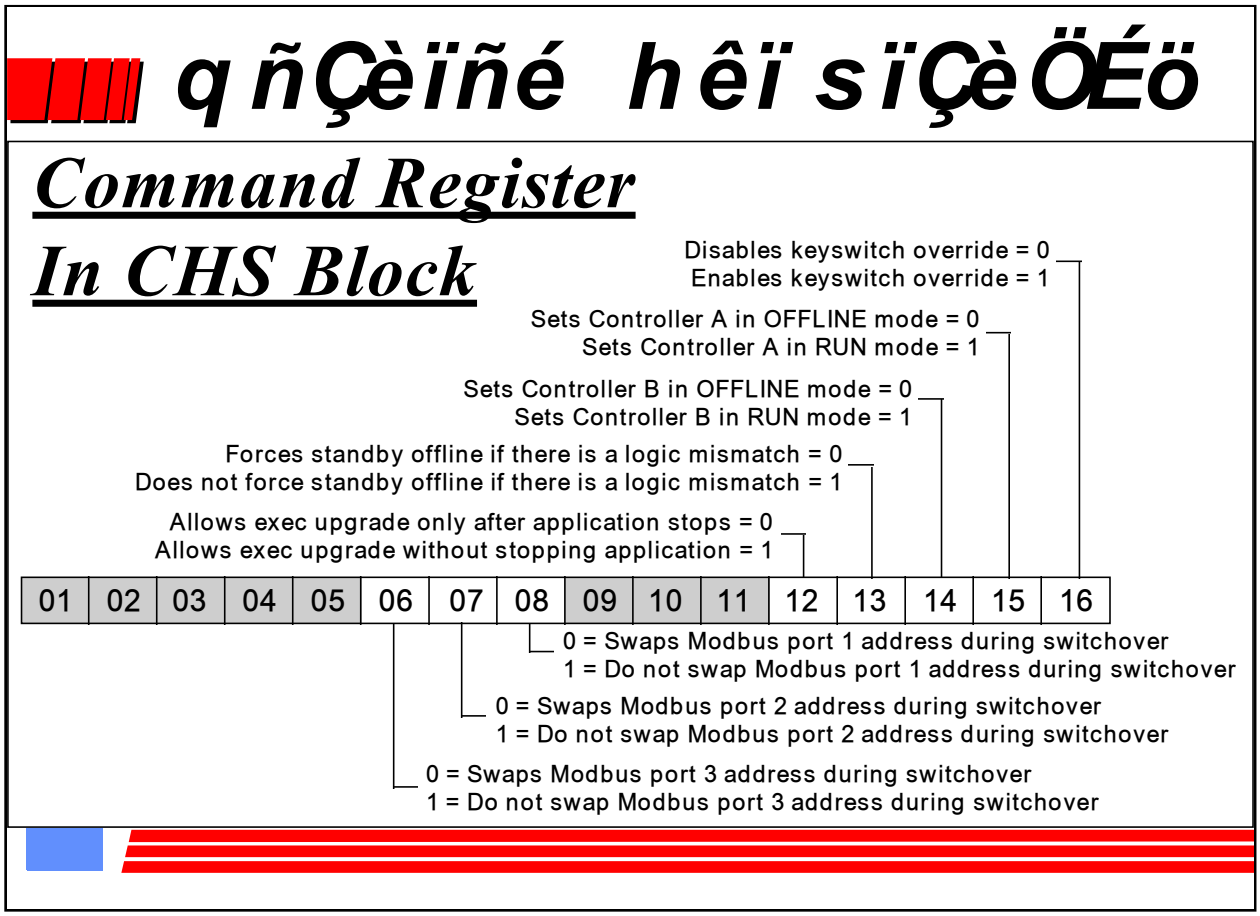
CHS Ladder Logic Function Screen #1



- The first CHS Ladder Logic Function Screen that appears contains the Hot Standby Command Register information. You are now able to modify these 8 bits of information if you want.
- ***Remember:*** If both a Configuration Extension **and** the CHS instruction are used, the Configuration Extension controls the Hot Standby system. The parameters in the Configuration Extension Screens are applied by the Controllers ***at startup***. Once the Controllers are running, the Zoom screens may be used to access and modify the Command register. The changes will be implemented at runtime, and can be seen in the Status register. However, if the Hot Standby system is later stopped and then restarted, the parameters specified in the Configuration Extension Screens will go back into effect.



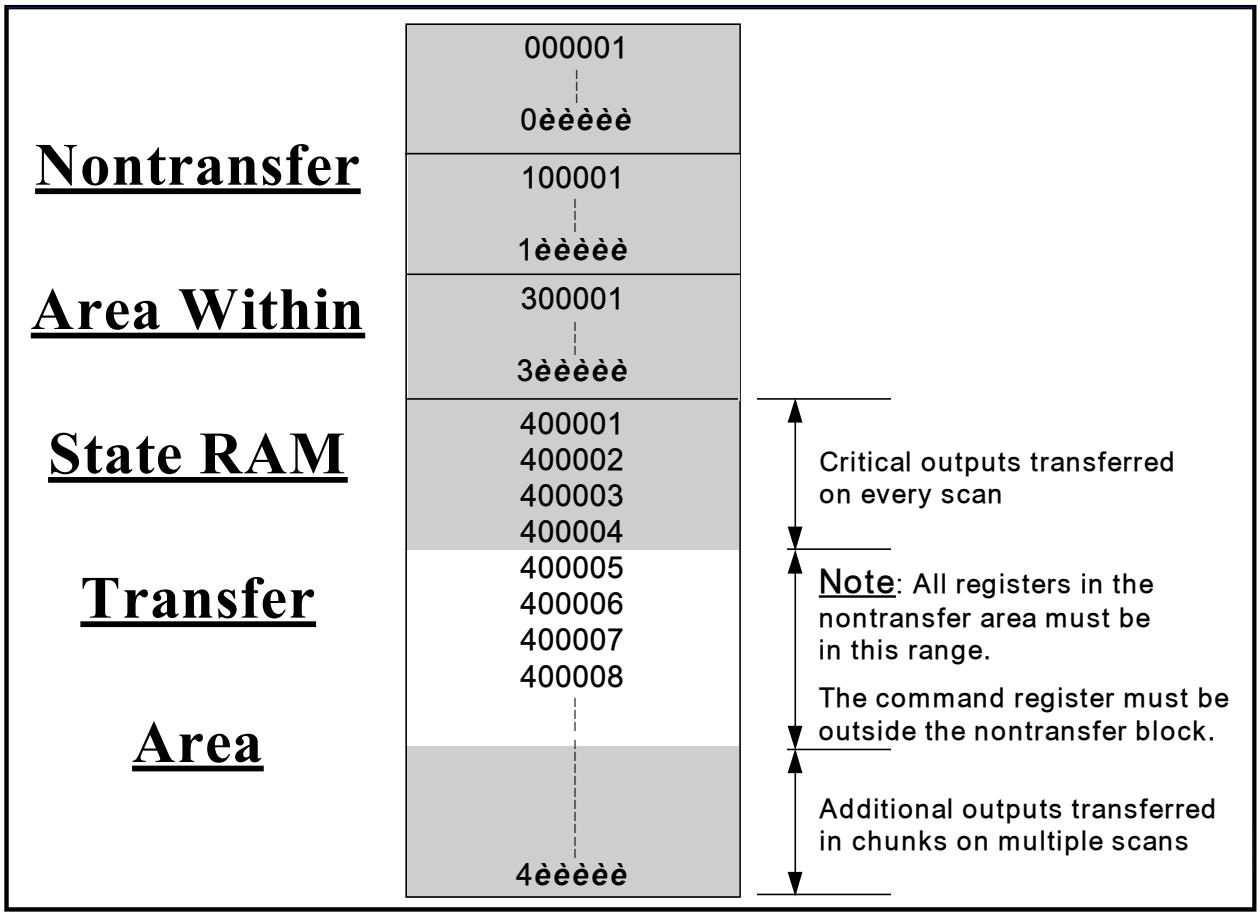
- **The Command Register**
  The Command register is defined in the top node of the CHS instruction block. The bits in this register are used to configure and control various parameters of the Hot Standby system.

  The Command Register must be a 4xxxxx register in the portion of the State RAM transfer area that is transferred from the Primary to the Standby controller on every scan. It also must be outside of the nontransfer area.

  The values set for the bits in this register determine the system parameters at startup. The register can be accessed while the system is running using the Modsoft Reference Data Editor (RDE) or a Zoom screen on the CHS instruction in ladder logic.

The State RAM Transfer Area

- A fixed block of up to 12K words in State RAM is specified as the transfer area. It consists of the following:
    - All the 0xxxxx discrete outputs in State RAM up to a maximum of 8192, including their associated histories.
    - All the 1xxxxx discrete inputs in State RAM up to a maximum of 8192, including their associated histories.
    - If the total number of registers (3x and 4x combined) implemented in State RAM is 10,000 or less, then all the registers plus the up/down counter history table.
    - If the total number of registers (3x and 4x combined) implemented in State RAM is greater than 10,000, then a total of 10,000 will be transferred in accordance with previously described formula.
- The Command Register must be contained within the range of 4x registers in the State RAM transfer area.



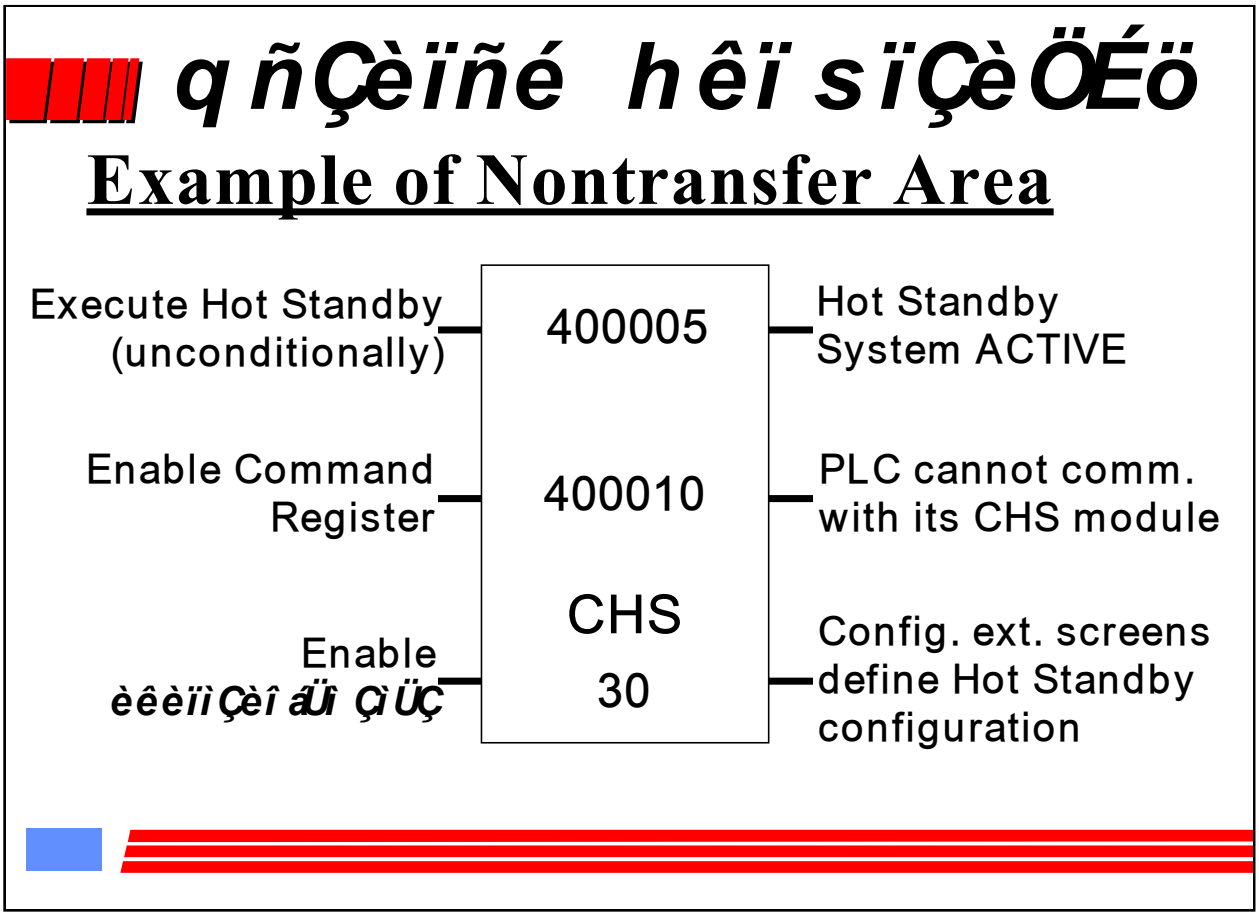
The Nontransfer Area of State RAM

- You must also define a nontransfer area. A nontransfer area:
  - Is a tool to reduce scan time.
  - Is located entirely within the range of 4xxxxx registers in the State RAM transfer area which are transferred on every scan.
  - Consists of a block of four or more 4xxxxx registers.
  - Allows the user to monitor the Status of the Hot Standby system.

Elements of the Nontransfer Area

- The most important part of the nontransfer area is the Hot Standby Status Register. Once the system has been configured and is running, the Status Register becomes a valuable tool for monitoring the machine states of the two controllers.

  The nontransfer area also includes a pair of registers that can be used for programming reverse transfer operations.



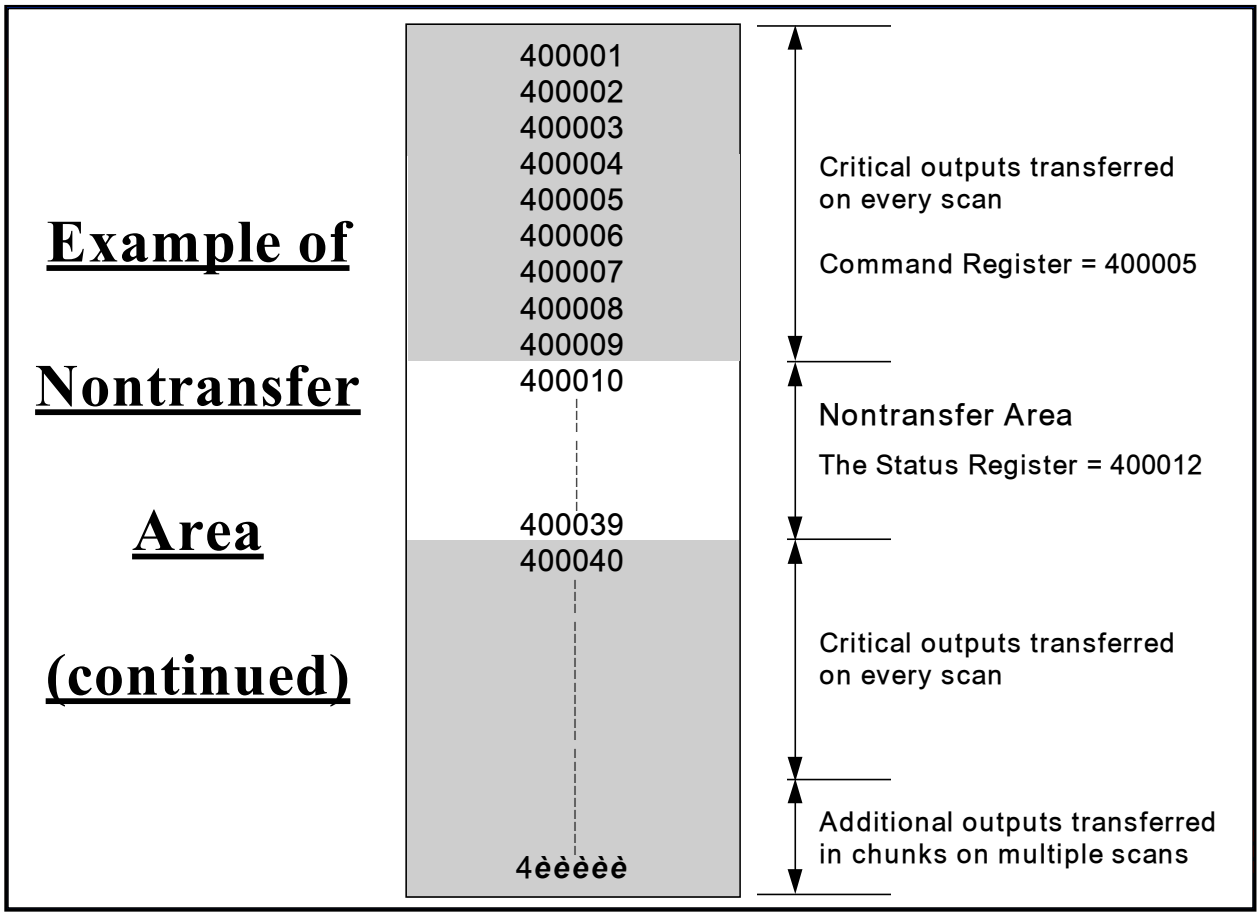
Defining the Nontransfer Area

- The nontransfer area is defined in the middle and bottom nodes of the instruction block. The middle node specifies the first register in the nontransfer area. The bottom node specifies the length of the nontransfer area.

- The nontransfer area must be at least four registers long. The first two registers in the nontransfer area are reserved for reverse transfer functions. The third register in the nontransfer area if the Hot Standby Status Register.

- The fourth register and all other contiguous 4x registers specified for nontransfer will be ignored when the State RAM values of the Primary controller are transferred to the Standby controller.

- In the example illustrated above, the nontransfer area would begin at register 400010, as defined in the middle node. The length would be 30 registers, as defined in the bottom node. Thus the last register in the nontransfer area would be 400039.



- This is a graphic illustration of the Example on the previous page. Note that in this example, the Status Register would be register 400012.

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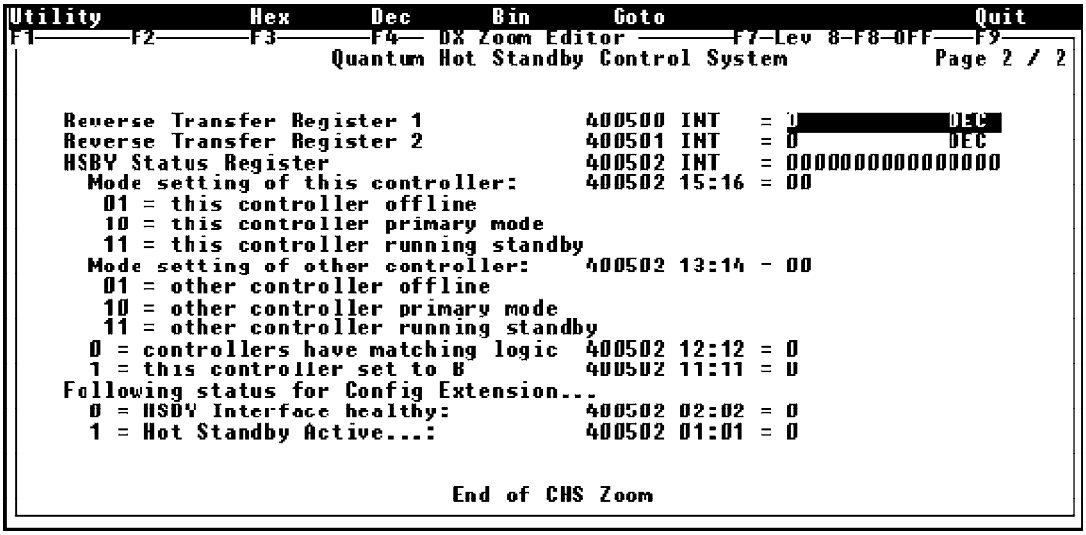
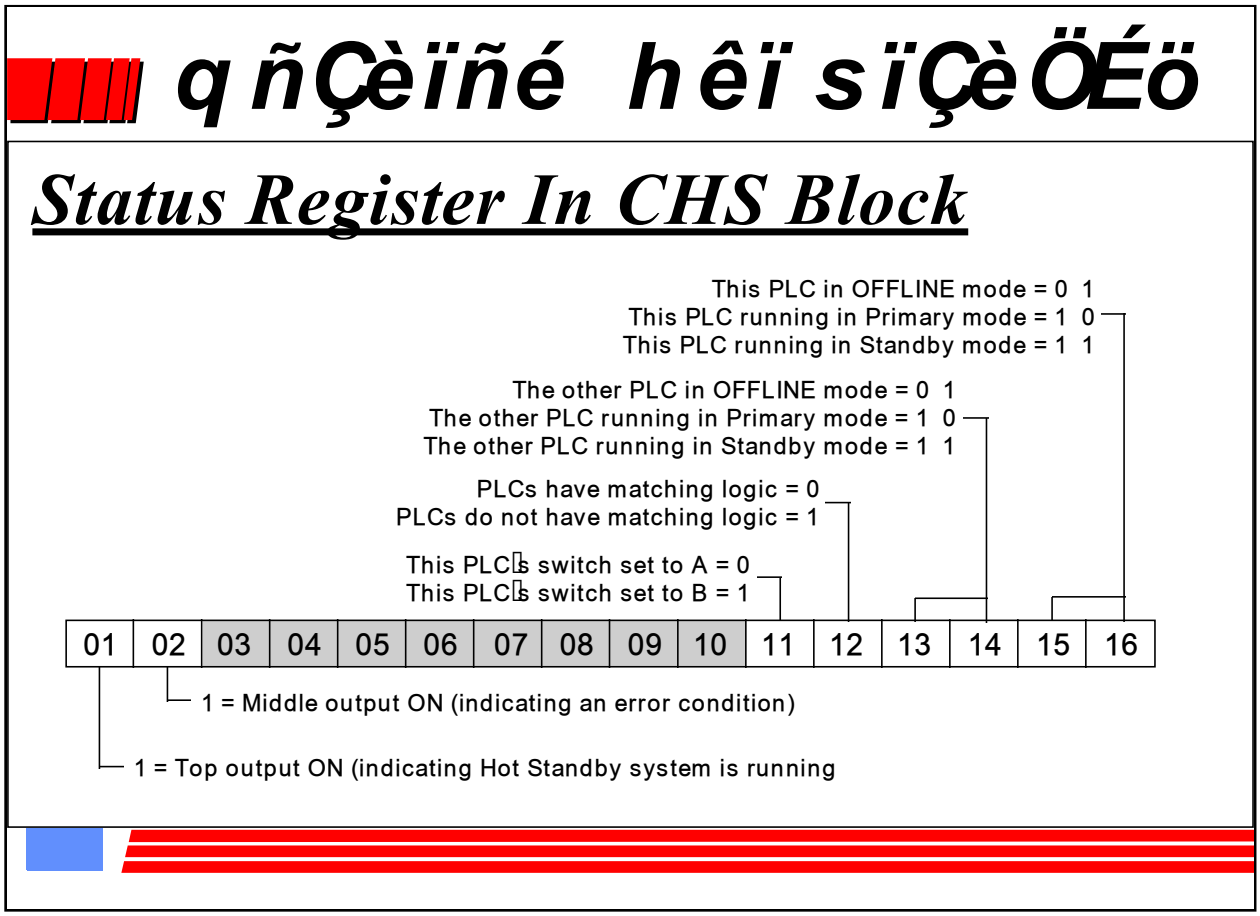
CHS Ladder Logic Function Screen #2



- The second CHS Ladder Logic Function Screen that appears contains the Hot Standby Status Register information. You can monitor, On-line, the current Status of the Hot Standby operation



The Hot Standby Status Register

- The third register in the nontransfer area will be the Status Register. Use this register to monitor the current machine status of the Primary and Standby Controllers.

The Reverse Transfer Registers

- You can use the reverse transfer registers to transmit diagnostic data from the Standby controller to the Primary controller. When you choose to define a nontransfer area, registers 4x and 4x + 1 in the nontransfer block are copied from the Standby to the Primary controller. This is opposite from the normal *forward* State Table transfer from the Primary to the Standby.

- If you choose *not to* use the reverse transfer registers, ***do not*** place the CHS instruction block directly against the power rail in your Ladder Logic Program, so that the input to these registers will not be turned On.

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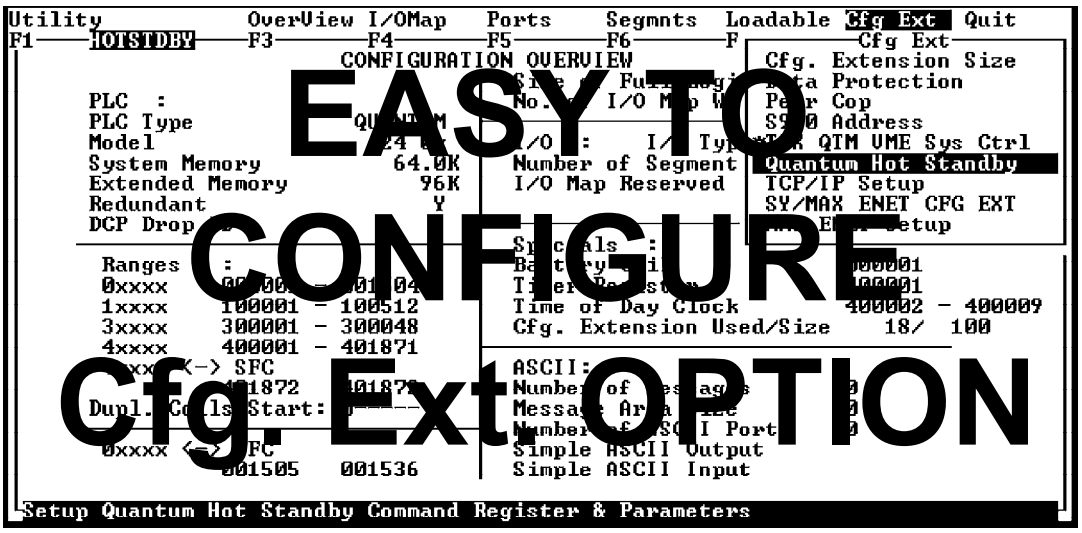
Configuration Extension Selection



EASY TO CONFIGURE Cfg. Ext. OPTION

- To implement a **Configuration Extension**, you must access and complete two Hot Standby Configuration Extension Screens in Modsoft. The first screen (on the next page) is used to define the Command Register parameters. The second screen is used to customize the State RAM transfer process.
- To access the Configuration Extension Screens, go to the **Cfg. Ext.** menu on the **Configuration Overview Screen** and select **Quantum Hot Standby**. This will access the screen on the next page.

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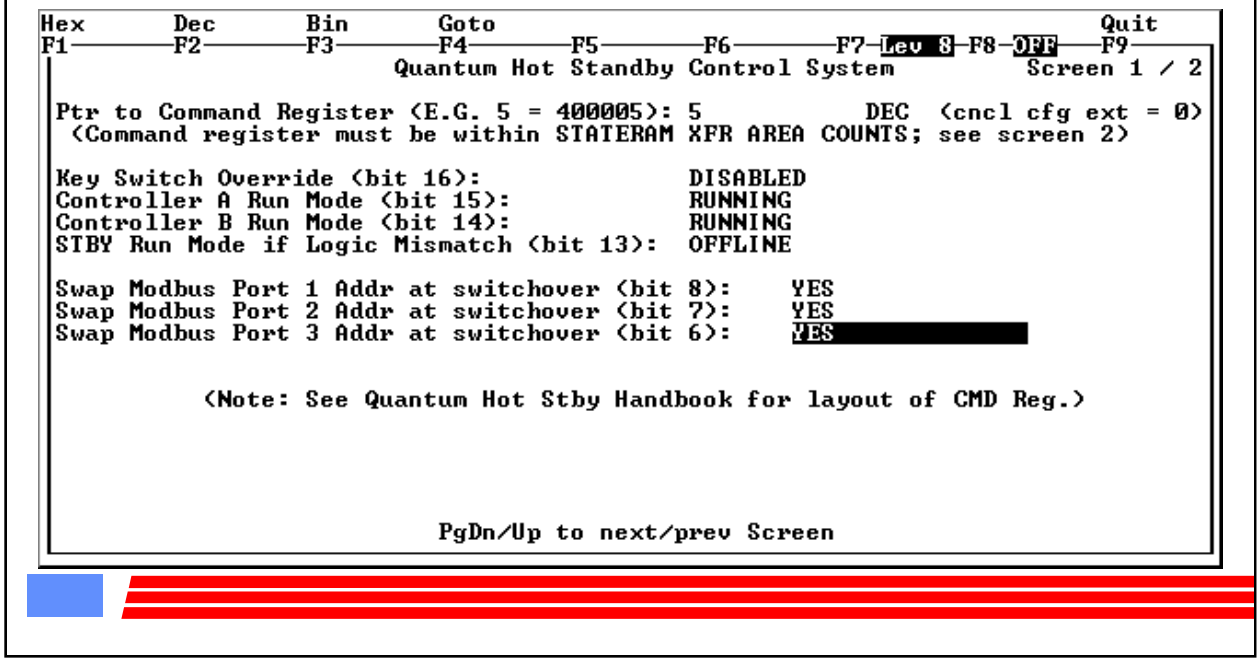
Configuration Extension Screen #1



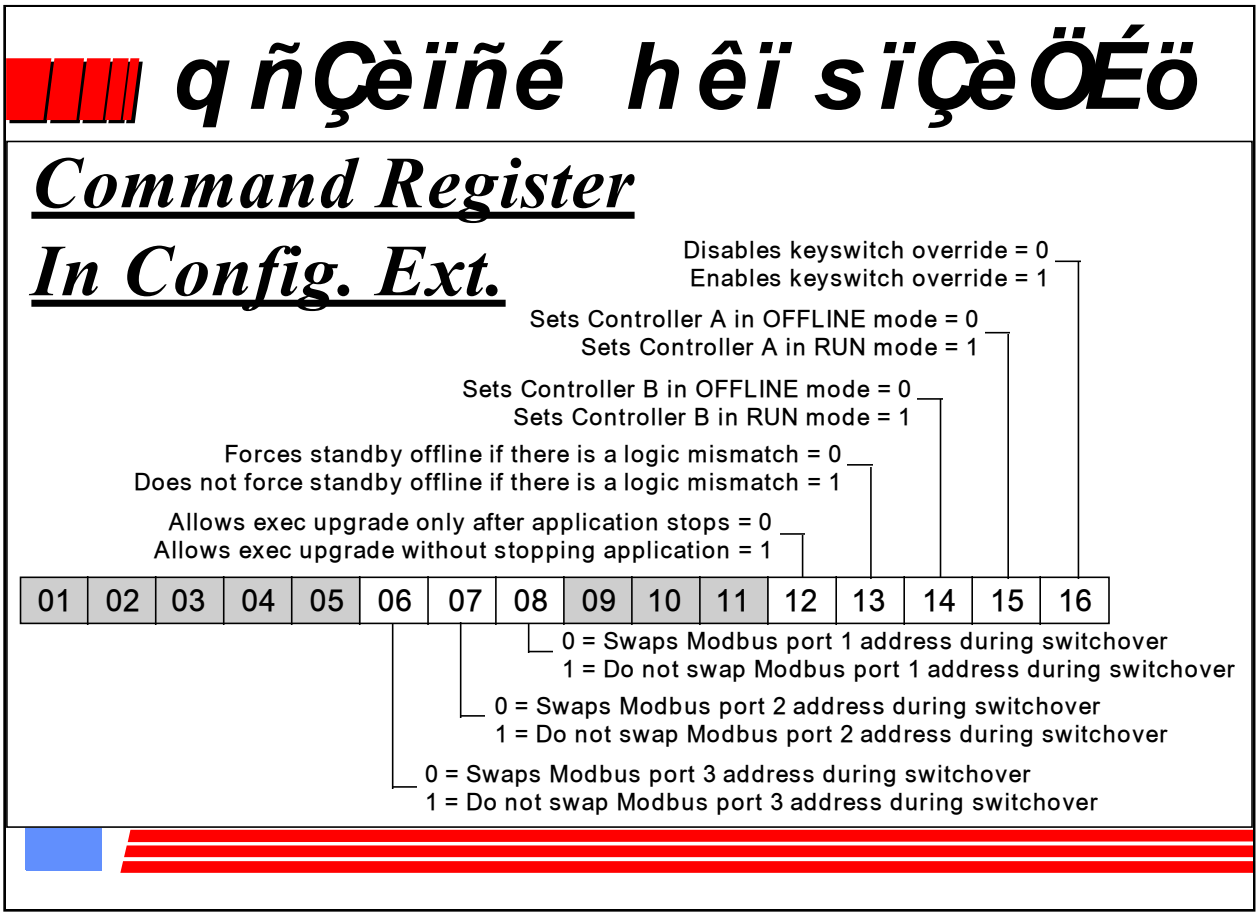
Using a Configuration Extension to Control the Hot Standby System

- The parameters set in these screens will be used by the controllers at startup. They may be changed either by a CHS Zoom or accessing the appropriate register using Modsoft's RDE Editor.

The First Configuration Extension Screen

- Screen #1 (above) has eight entry fields. The default settings for these fields are shown.

- The Command Register is specified in the first entry of screen #1. By default, the Command Register is set to 0. You must enter a number greater than 0 to activate the Configuration Extension. The number you enter becomes the 4x Command Register. For example, if you enter 14, the Hot Standby Command Register is 400014.



Specifying the Command Register

- The Command Register is used to control various parameters of the Hot Standby system.
- The number that you enter in this field can be anything in the range 1 ... *n,* where *n* is the last configured register. However,
  - The Command Register must be part of the area of State RAM that gets transferred from the Primary to the Standby controller on every scan.
  - Therefore, the number you specify for the Command Register must be in the range of 4x registers you specify in the fourth entry field in Configuration Extension #2. If you are using the 12K ONLY option, the Command Register must be one of the first 9000 4x registers.
  - The Command Register must not be within the range of the nontransfer area, which you specify in the first two entry fields of Screen #2.
  - Once you have specified the Command Register, you have activated the Configuration Extension.

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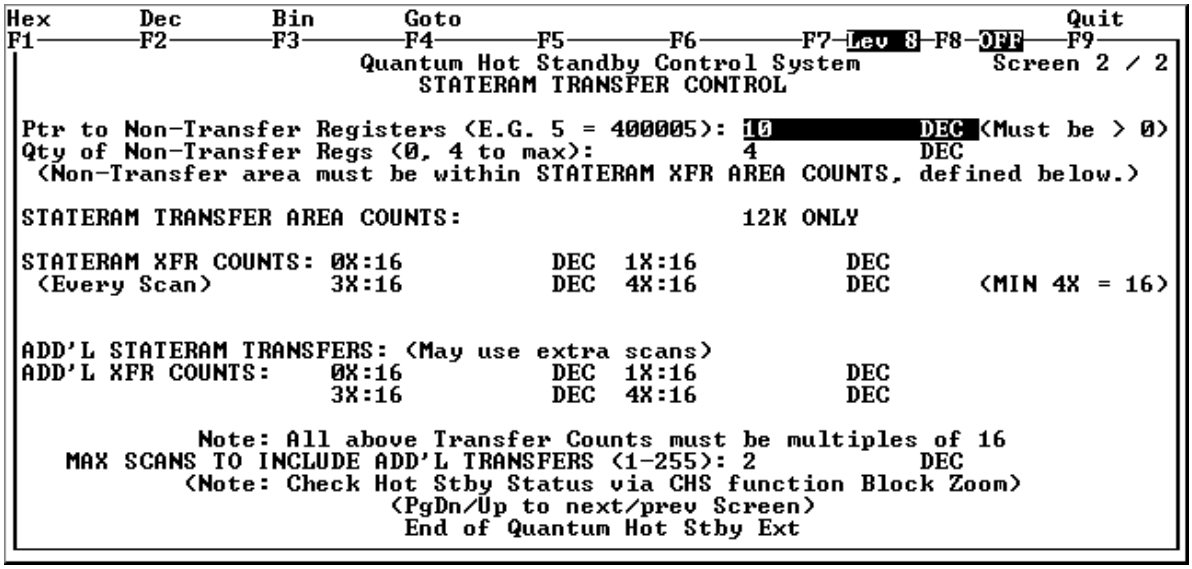
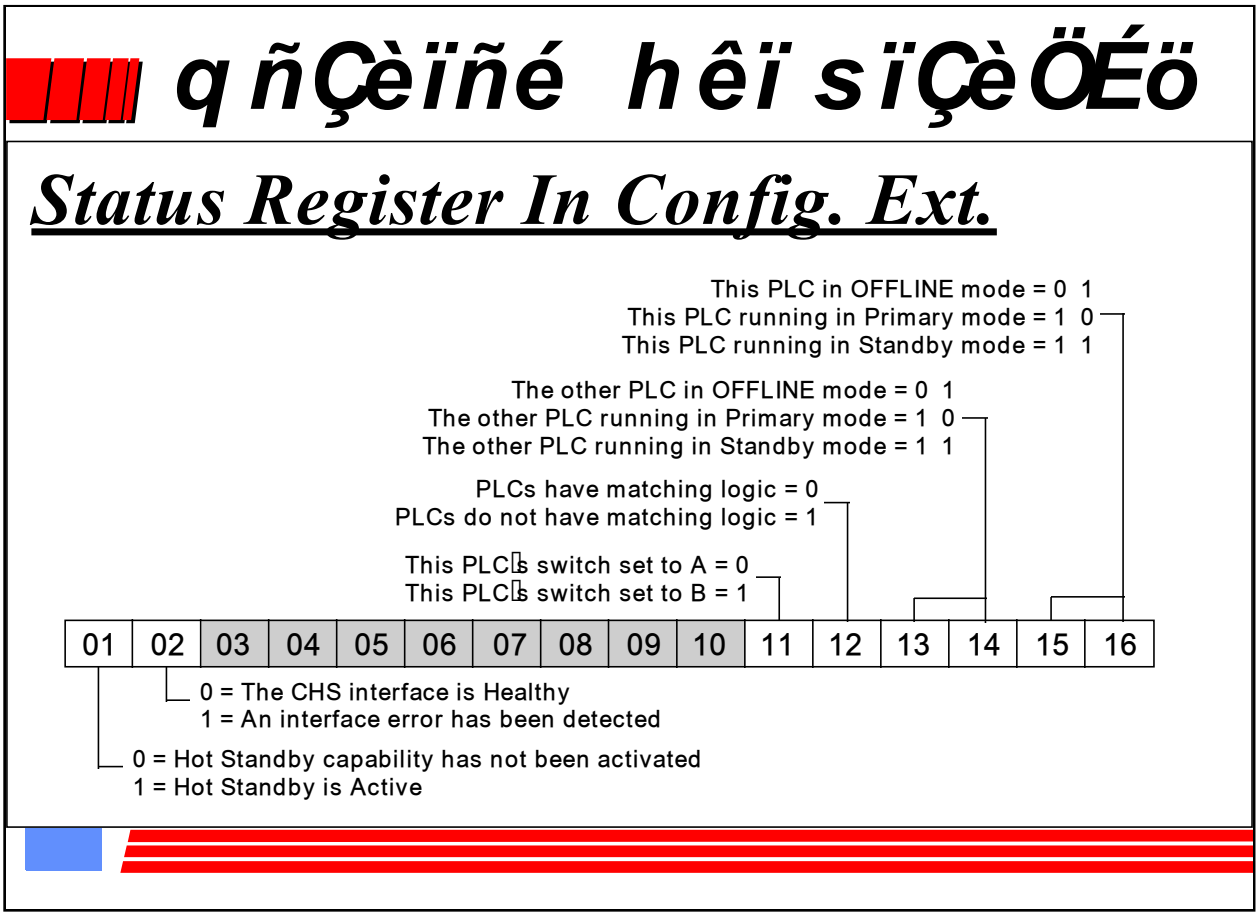
Configuration Extension Screen #2



The Second Configuration Extension Screen

- Using screen #2 (above), you can specify the amount of State RAM to be transferred between the Primary and Standby controllers in every scan. You may also define additional State RAM (0x, 1x, 3x, and 4x registers) that will be transferred in every scan.

- State RAM associated with all critical I/O also should be transferred in every scan. Additional State RAM can be chunked and transferred over multiple scans.



The Hot Standby Status Register

- The third register in the nontransfer area will be the Status Register. Use this register to monitor the current machine status of the Primary and Standby Controllers.

- Bits 1 and 2 are used only in conjunction with a Configuration Extension.

Defining the Transfer Area of State RAM

- **IMPORTANT TO NOTE:**
  If you were using the CHS instruction in Ladder Logic to configure the Hot Standby system, you would be unable to transfer any more than 12K words, even though the total amount of State RAM could be as much as 64K. You would be able to limit the number of 4x registers being transferred by selecting a block of registers as part of the nontransfer area, but you could not limit the number of 0x, 1x, or 3x registers in the transfer area.

- Using the Configuration Extension Screens, you have a great deal more flexibility in determining how much or how little State RAM gets transferred. You also can manage how much gets transferred in pieces over multiple scans.

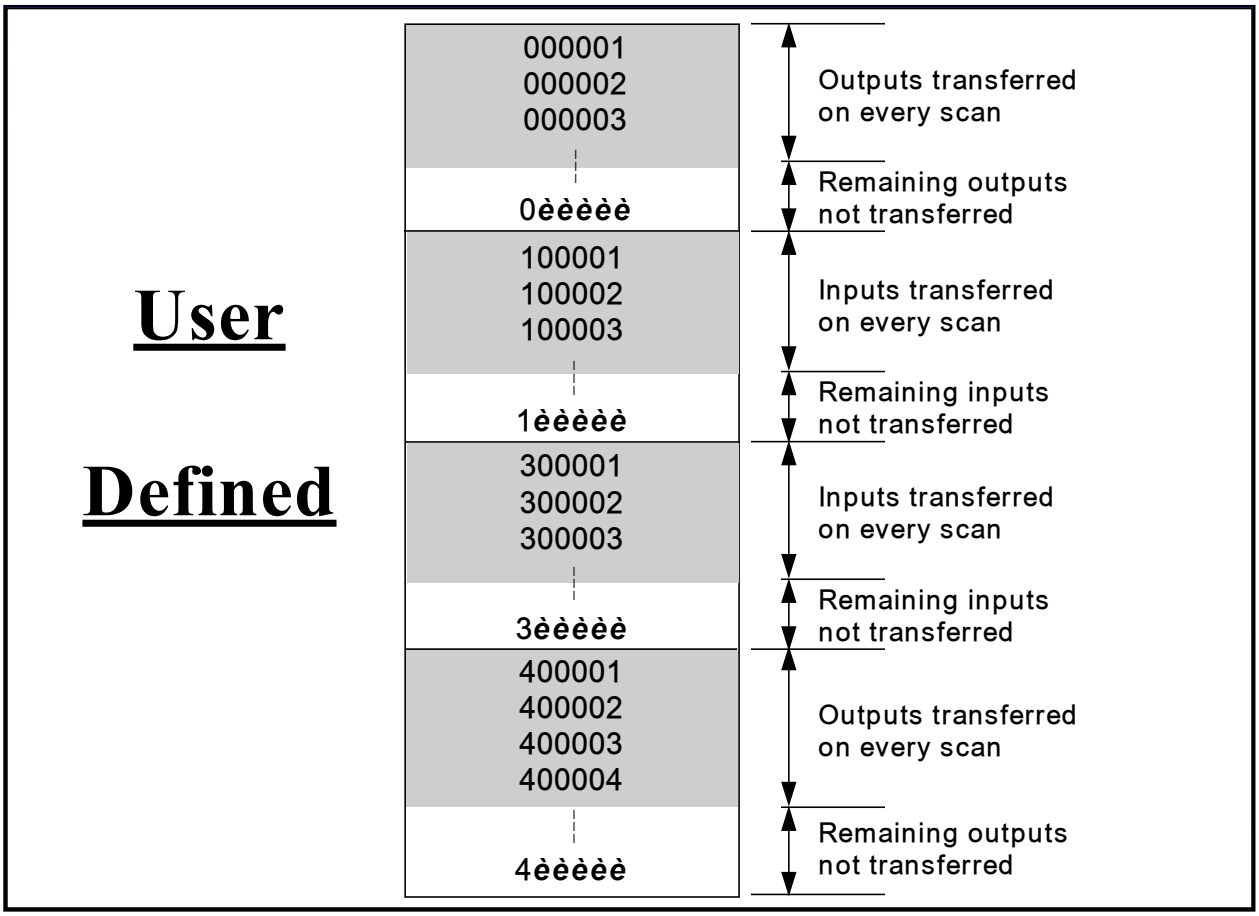
- The parameter you select in the third entry field of screen #2 determines the flexibility you have in defining your State RAM transfer area. You may choose from four options:
  - 12K ONLY
  - USER DEFINED
  - USER DEF (ADD'L)
  - ALL STATE RAM

- The remaining entry fields on Screen #2 will or will not be used depending on which one of these four parameters you choose.

- **12K ONLY**
  The 12K ONLY option mimics the CHS instruction (which we've already seen). No to cover it again. It's described on page 60 in the Hot Standby Manual.

  If you choose the 12K ONLY option, entry fields four through six become irrelevant. You will not be able to customize the transfer area or to transfer additional data in chunks over multiple scans. Any entries in these fields will be ignored.

MORE



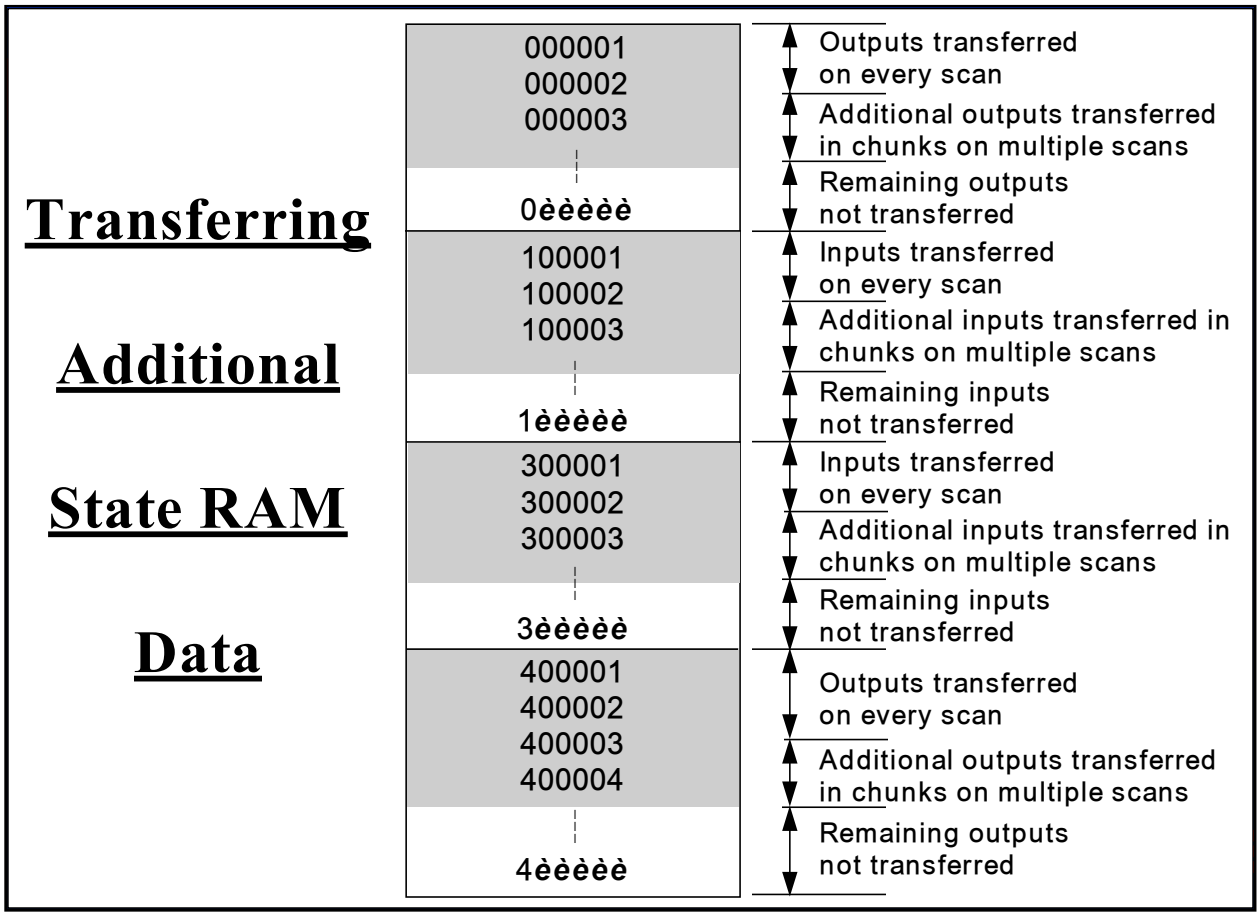
- **USER DEFINED**
  The USER DEFINED option lets you specify the amount of each reference data type that you want transferred on each scan, However, it does not allow you to transfer additional data in chunks.

- Use the fourth entry field in Screen #2 to define the size of the data range. All of the reference data that you specify in this field will be transferred from the Primary to the Standby controller on every scan (except the defined nontransfer area). All reference data items must be 0 or specified in multiples of 16. A minimum of 16 4x registers is required.

- The maximum amount of State RAM to be transferred on every scan can be up to the total amount of available State RAM (10K, 32K, or 64K, depending on the type of Quantum controller).

- Since you are unable to transfer additional data over multiple scans, any values in the fifth and sixth entry fields will be ignored.

MORE



- **USER DEF (ADD'L)**
  The USER DEF (ADD'L) option allows you to customize the transfer area and to specify additional State RAM to be transferred in chunks over multiple scans. When this option is selected, you must complete all the entry fields in Screen #2.

- All of the reference data that you specify in the fourth entry field will be transferred from the Primary to the Standby controller on every scan (except the defined nontransfer area). All reference data items must be 0 or specified in multiples of 16. A minimum of 16 4x registers is required.

- In the fifth entry field, enter the number of 0x, 1x, 3x, and 4x data references that you want transferred as additional State RAM. All reference data items must be specified in multiples of 16. You must enter a value of 16 or greater for at least one of the four reference data types.

CAUTION: If you choose USER DEF (ADD'L), you must specify additional data to be transferred or the controller will not start.

MORE

- **USER DEF (ADD'L) (cont)**
  Use the sixth entry field to specify the number of scans over which you want the additional data transferred. In general, the system divides the number of reference data elements specified in the fifth entry field by the number of scans specified in the sixth entry field. Accordingly, it divides the data into chunks that are transferred contiguously over the specified number of scans. These chunks of data are transferred together with the regular State RAM data that has been scheduled on every scan.

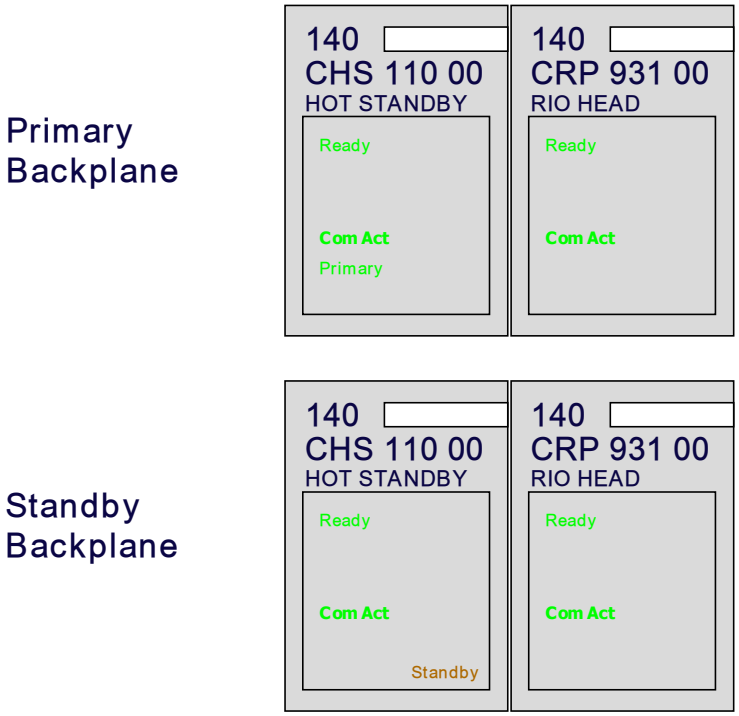
- The system transfers additional data in the following order:
  - All 0x references first
  - All 1x references second
  - All 3x references third
  - All 4x references last

- A minimum of 512 equivalent words of each data type specified in the fifth entry of Screen #2 will be sent in a scan unless there is less than 512 words of that data type left to be transferred. For example, if you specify 528 additional registers to be transferred over three scans, the system will send the data faster than expected. The first 512 additional registers will be transferred in the first scan, and the remaining 16 registers will be transferred in the second scan. On the third scan, the process will begin again, sending 512 additional registers.

- **ALL STATERAM**
  The ALL STATERAM option in the third entry field of Screen #2 transfers all the State RAM configured in your controller (to a maximum of 10K, 32K, or 64K words, depending on your Quantum controller type) on every scan.

- Any values that appear in the fourth, fifth, and sixth entry fields in Screen #2 will be ignored.

Indicators of a Properly Functioning Hot Standby System



REFER TO SECTION 6.1 - “Starting Your Hot Standby System” in your Manual.

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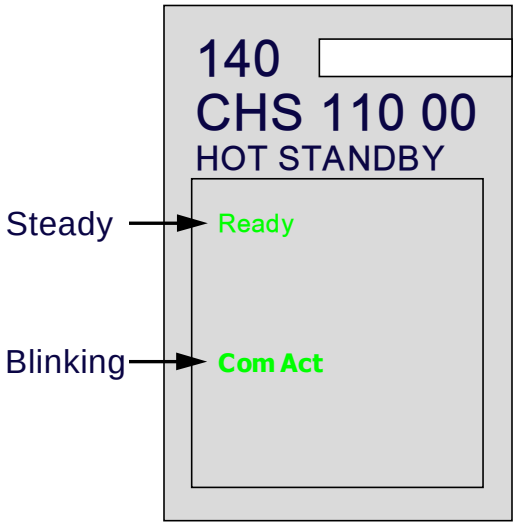
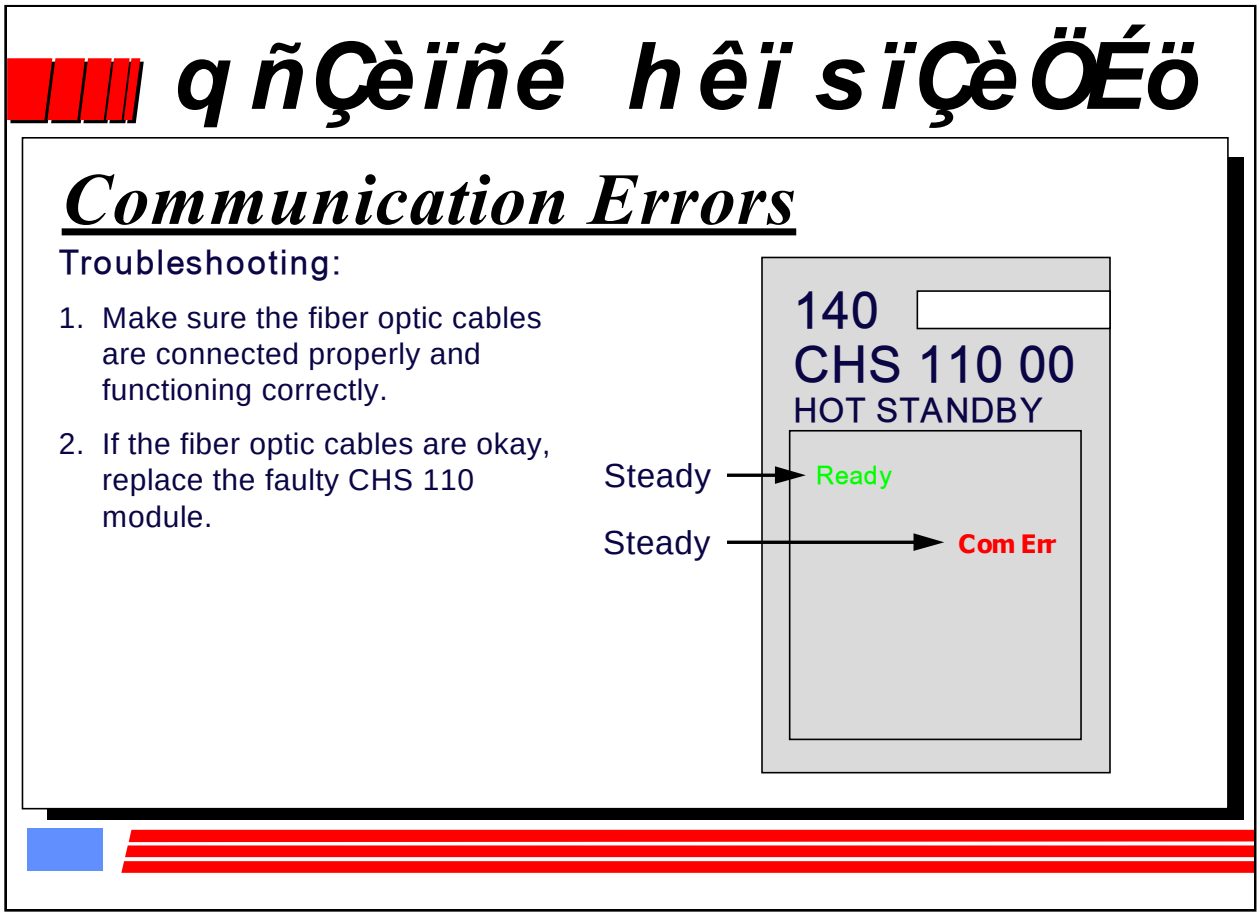
Startup Errors

Troubleshooting:

1. Make sure the designation slide switches on the CHS 110 modules are in opposite positions.
2. Make sure the configuration table in the primary and standby controllers are identical.
3. Make sure the segment schedulers in the primary and standby controllers are identical.
4. Make sure the I/O maps in the primary and standby controllers are identical.



- This Screen can be found in **SECTION 7.2 - "Responding to Errors"** in your Manual.



- This Screen can be found in **SECTION 7.2 - "Responding to Errors"** in your Manual.

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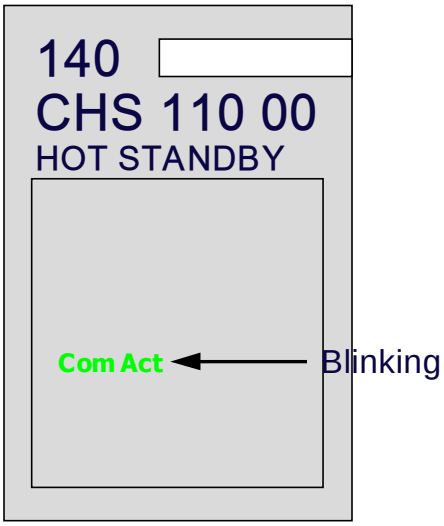
Interface Errors

Troubleshooting:

1. If you used the CHS function block, disable it and restart the system. If the Ready indicator comes On, the problem is the CHS 110 module.

   If you used the configuration extension screen, go offline and change the configuration to a standalone system. Reload the program and Start the system. If the Ready indicator comes On, the problem is in the CHS 110 module.

2. If you have replaced the hot standby module and the problem still occurs, replace the other components, one at a time.



- This Screen can be found in **SECTION 7.2 - "Responding to Errors"** in your Manual.

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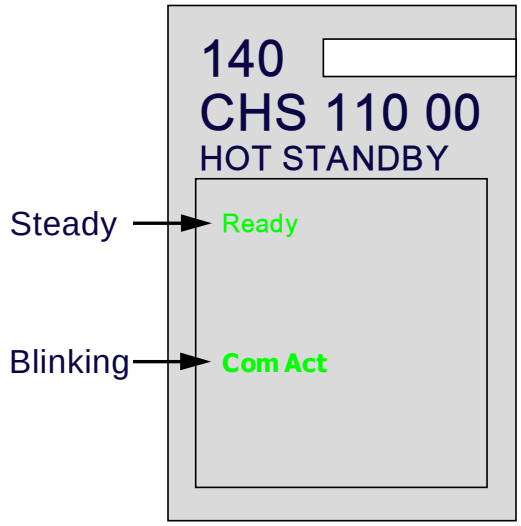
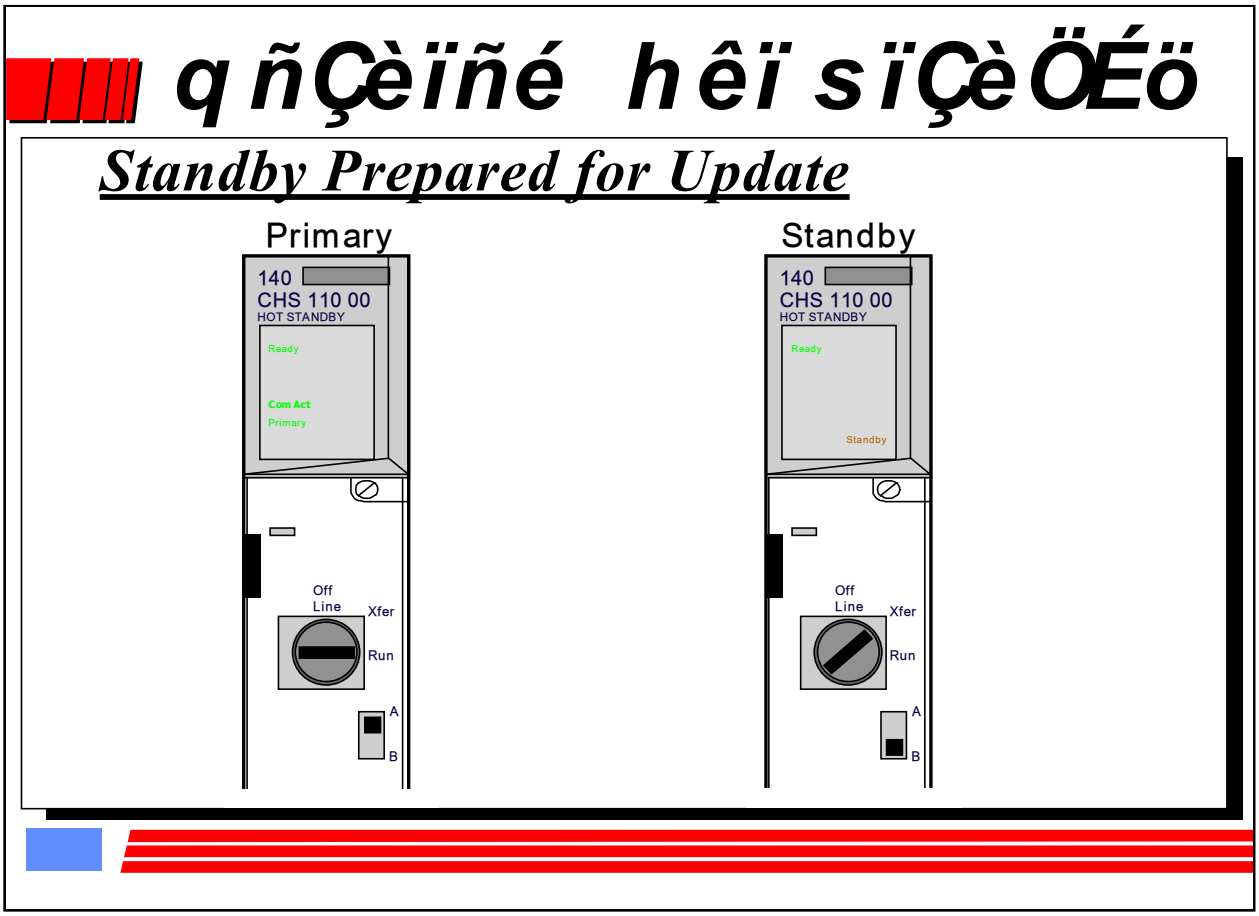
Board-Level Errors

Troubleshooting:

1. This is the same pattern that the module displays for a startup error.
2. Follow the troubleshooting procedures for a startup error.
3. If the module does not recover, replace it.



- This Screen can be found in **SECTION 7.2 - "Responding to Errors"** in your Manual.

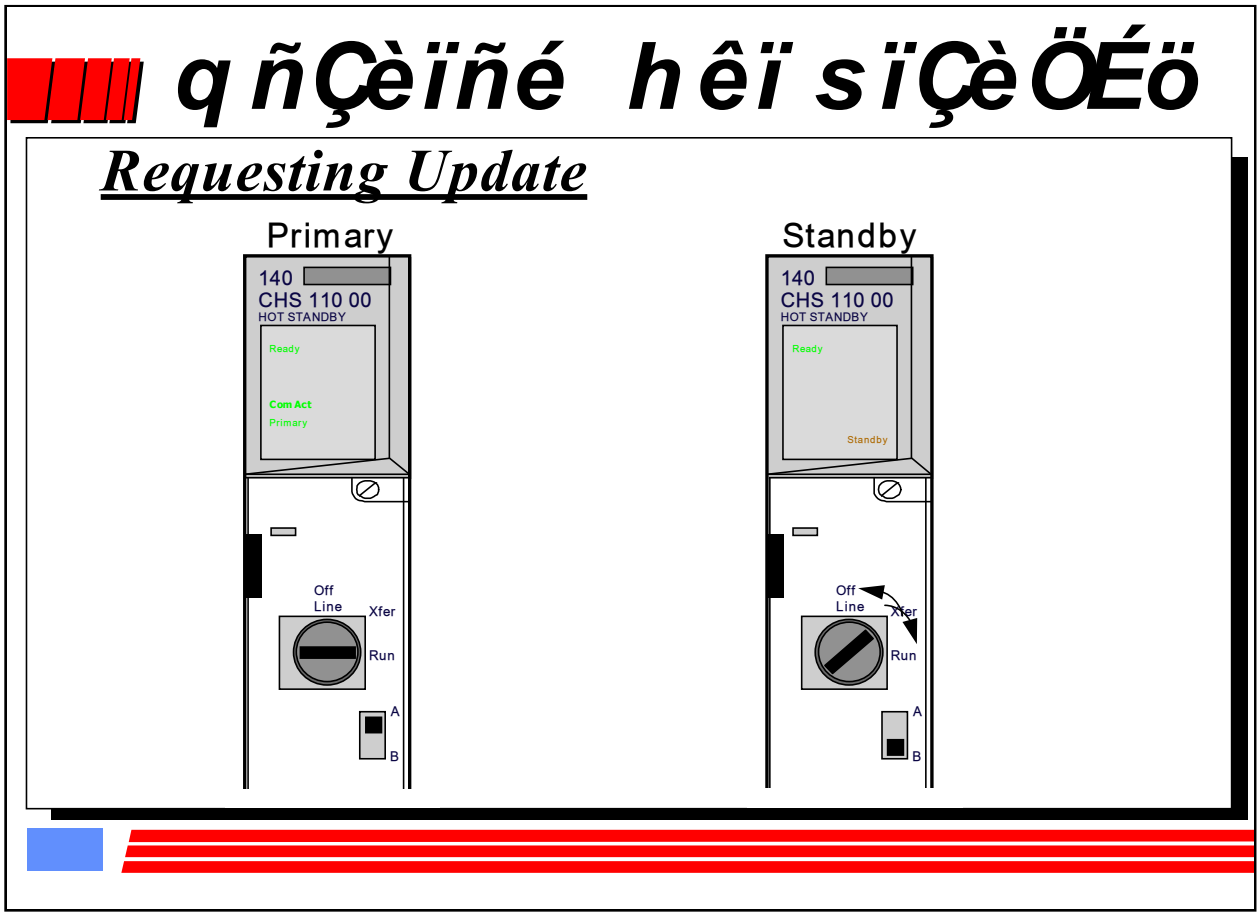


Procedure: Updating the Program in the Standby Controller

Step 1 Put the Primary controller in **Run** mode. Make sure the Standby controller is still stopped and **Off Line**.

Step 2 Push the Update button on the Standby unit. Hold the button down.

Step 3 Turn the key on the Standby CHS 110 module to **Xfer**. This prepares the Standby unit to receive the update.



Step 4 Now turn the key to the mode you want the Standby unit to be in after the update, **Run** or **Off Line**. The amber **Standby** indicator will begin to blink.

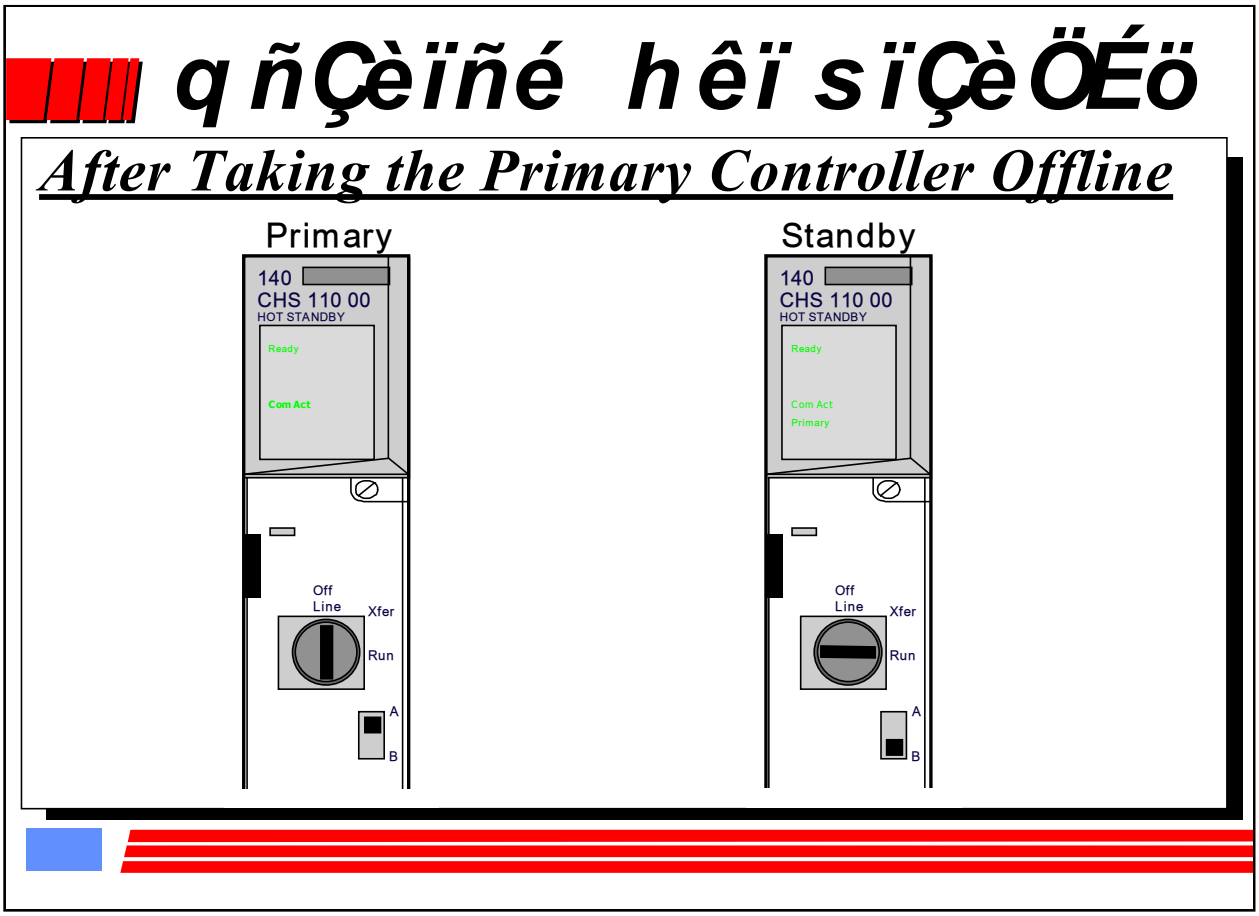
Step 5 Release the update button.

The Primary controller will begin copying its full program to the Standby.

The **Standby** indicator on the Standby unit will continue to blink as the module processes the update. When the update is completed, the CHS 110 Hot Standby module will instruct the Standby controller to return to the mode you have set, **Run** or **Off Line**. If the Standby unit is in **Run** mode, the **Standby** and **Com Act** lights will be lit. If the Standby unit is **Off Line**, neither indicator will be lit.

The Standby now has an identical program to the Primary unit.

Step 6 Remove the key and store it in a secure place.



Forcing a Switchover Manually

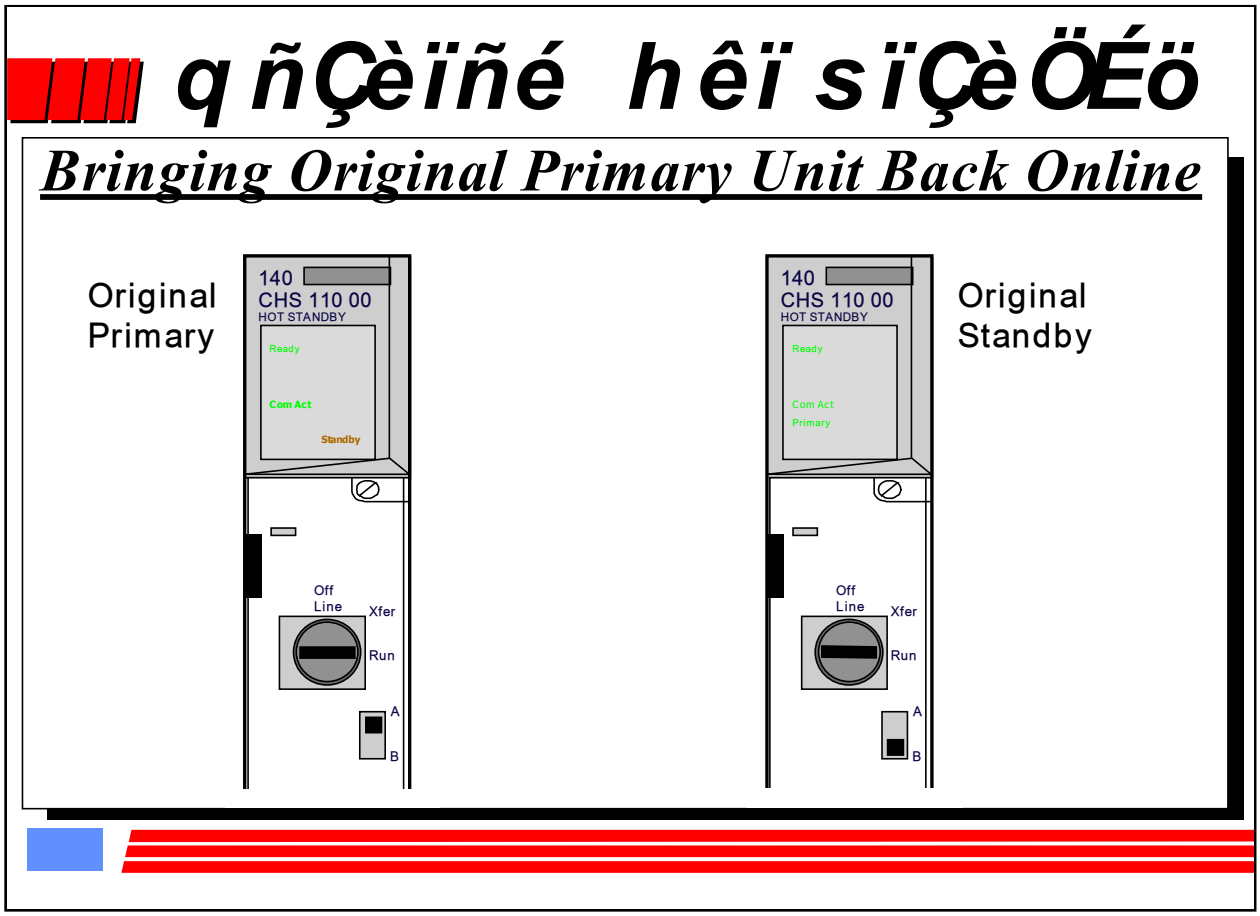
Step 1 Make sure that the Standby controller has been fully programmed. The function keyswitch on the CHS 110 Hot Standby module should be in the **Run** position. The **Standby** indicator on the CHS 110 module should be a steady amber.

Step 2 Make sure that the designation slide switch on one Hot Standby module is in position A and that the switch on the other Hot Standby module is in position B.

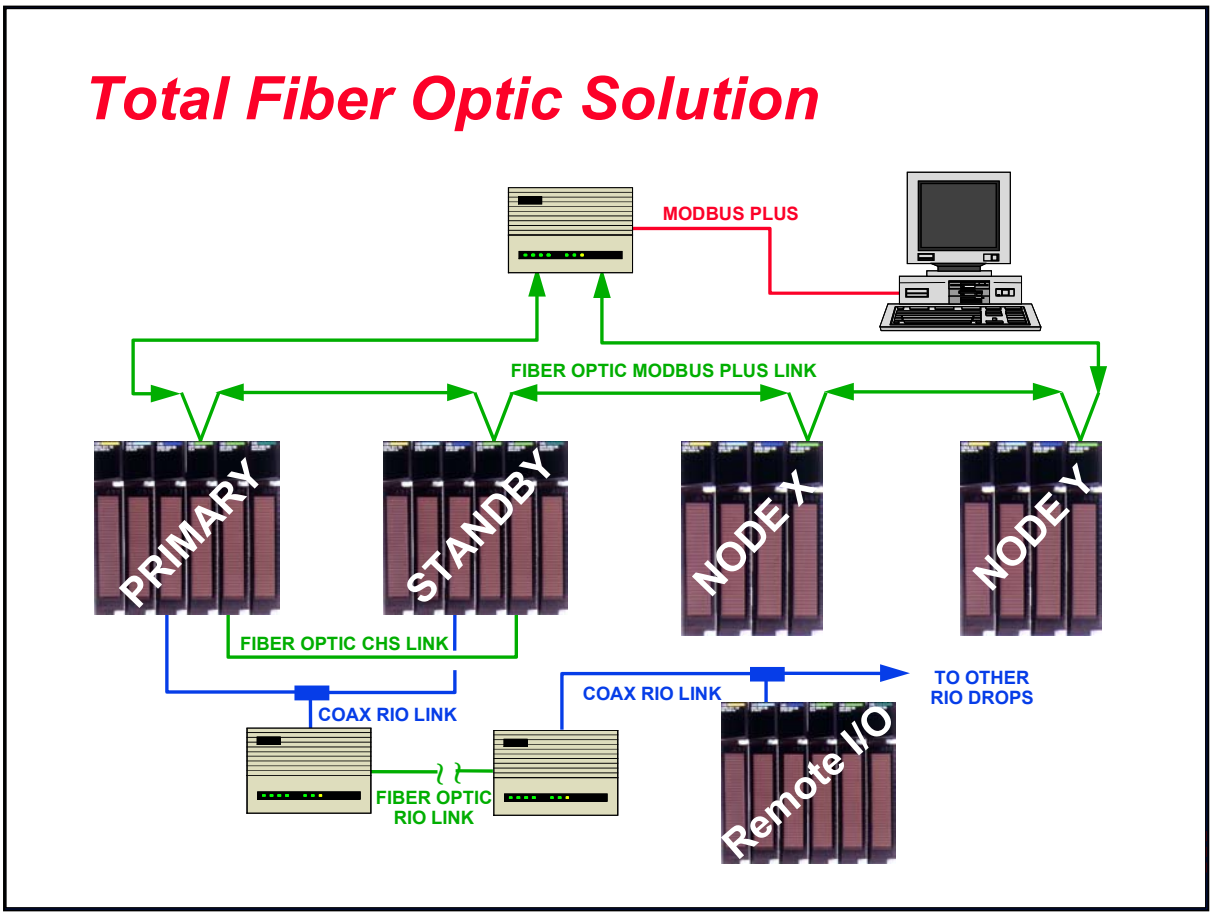
Step 3 Confirm that the keyswitch on both Hot Standby modules has not been overridden by software.

Step 4 Turn the key on the Primary Hot Standby module to **Off Line.**

Step 5 The Standby should now be functioning as the Primary controller. Check to see that all LED indicators are normal and all application devices functioning properly. The **Standby** indicator should be extinguished and the **Primary** indicator should be steady green.

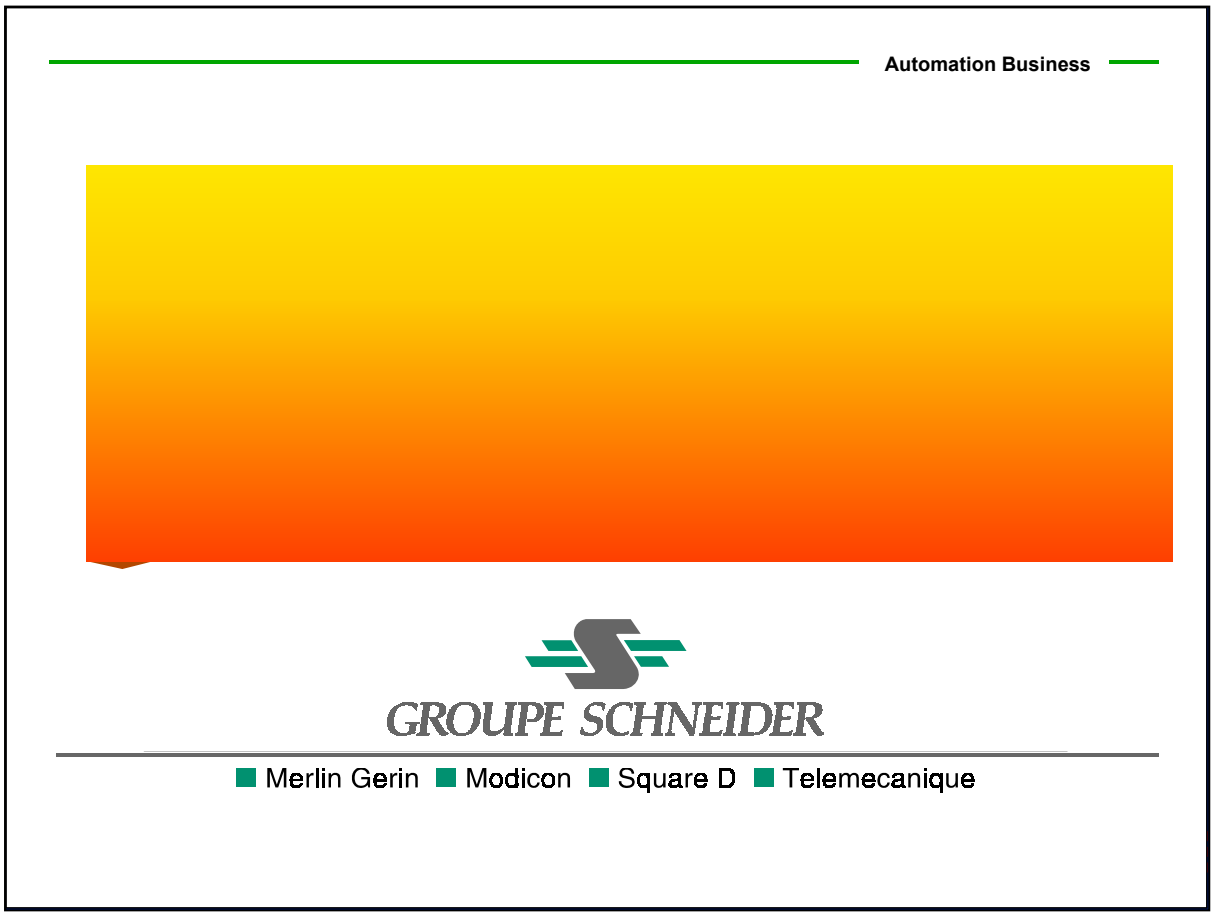


Step 6 Return the key on the original Primary unit to the **Run** position. The **Standby** indicator should come On.



- In conclusion, with the Hot Standby System controlling the Remote I/O and adding the Modbus Plus Communication System w/ Fiber Optics Option, we see here a Total Quantum Fiber Option Solution for those who prefer this latest communication technology.

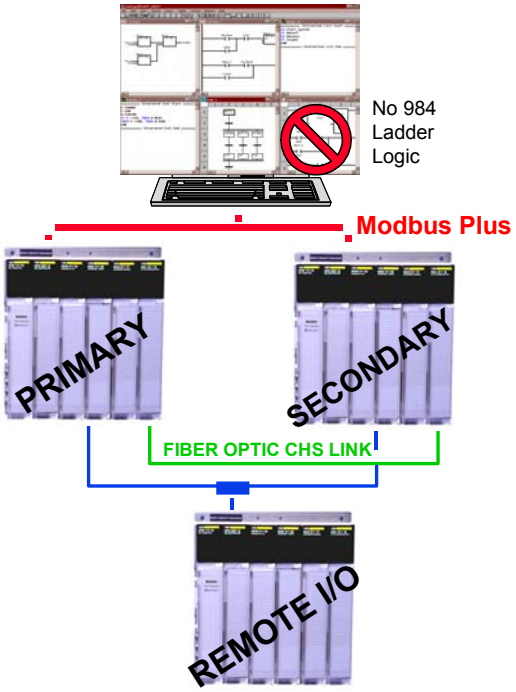
This concludes the Quantum CHS Hot Standby portion of this lecture.



- In this portion of the lesson, we will discuss all aspects of the Quantum IEC Hot Standby System including the similarities and differences from the non-IEC version. A look at the Concept Screens used will be included.

Quantum IEC Hot Standby Architecture

- **Concept Version 2.1**
- **New Quantum controllers**
  - **586: 140CPU53414**
  - **486: 140CPU43412**
- **Existing CHS module hardware and Execs**
- **Existing Remote I/O modules and Execs**
  - **CE marked Version 2.0 or greater**



- As shown above, Quantum IEC Hot Standby involves the use of:
  1. Concept Version 2.1
  2. Two new High End Quantum Controllers
  3. The existing CHS Modules and Execs
  4. The existing RIO Heads with version 2.0 Execs or greater

- All five IEC 1131 languages can be used.

- However, 984 Ladder Logic **cannot** be used.

Quantum IEC Hot Standby - Overview

- IEC Language programs only, no 984 Ladder Logic permitted
- To bring a Standby on-line
  - Primary and Standby controller executives must be equal
  - Primary and Standby IEC Projects must have the same name and the applications must be equal
- On-line changes to the Primary are permitted
  - The Standby controller is taken off-line as soon as the first Primary on-line change is made
  - Primary program must be transferred to the Standby before it can be brought back on-line
- Primary controller on-line changes may include
  - Addition of sections
  - Addition of DFBs, allows pre-qualification of user changes in an office environment
- Not possible to load a new version of the application on Standby, bring it on-line, and transfer control to make it the new Primary
- To upgrade the controller Execs
  - Process must be stopped
  - Primary and Standby must be stopped and downloaded individually

- The above items are the unique exceptions to IEC Hot Standby.

984 Ladder Logic / IEC Languages comparison

- **IEC: The productivity choice of Control System Design Engineers**
- **984 Ladder Logic: The proven environment for plant personnel**

		984 Ladder Logic	IEC 1131-3
Programming	Structured programs	No	Yes
	Reusable code	No	Yes
	Easy program validation	No	Yes
	Changes to a running program	On-line edits to logic	Download changed sections
Memory	Max program size	64 Kwords	2.5 Mbytes with 586 controller
	Program variables	Referenced	Referenced and Unlocated
	Allocation	Fixed	Dynamic structures
	SRAM usage	1 Kword 984 LL = 14Kbyte SRAM	1 Kbyte IEC = 1 Kbyte SRAM
	Resident source code	Yes	No
	Resident code annotation	No	No
I/O Servicing	Remote I/O	Parallel processing of logic and I/O with segment scheduling	End of scan
	Modbus Plus I/O	End of scan	End of scan
	Hardware interrupts	Yes	No
	Timed interrupts	Yes	Yes
	Immediate I/O	Yes	Yes
Hot Standby	Remote I/O Support	Yes	Yes with Concept V2.1
	Program mismatch	Yes	No
	Exec mismatch	Yes	No

- This is just a comparison chart that shows the similarities and differences between 984 Ladder Logic Hot Standby and the IEC version of Hot Standby.

Quantum IEC Hot Standby Definitions

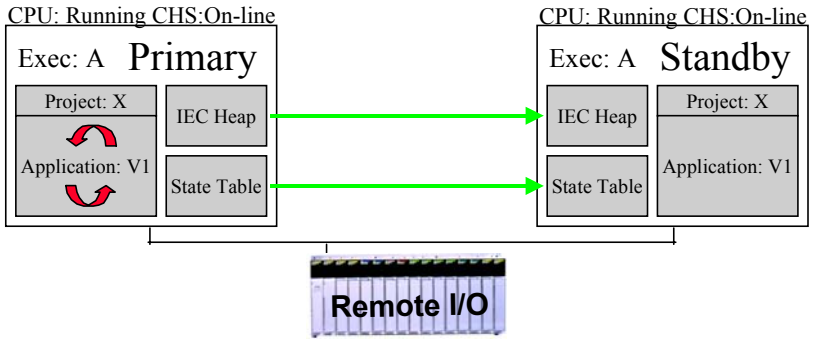
- **Exec:** Quantum controller operating system with integrated IEC language support
- **IEC Heap:** Concept system data mapped to 3X registers for transfer over CHS fiber optic link, including:
  - Non-located IEC variables
  - Pointer lists
  - System and application variables
  - SFC states
  - Other internal attributes
  - 64k words maximum(includes State Ram and above items)
- **State Table:** Quantum controller references for both real world I/O and internal referenced variables
- **Project:** Concept program file containing controller configuration and IEC language control code
- **Application:** IEC language control code

- The most important new term to understand in IEC Hot Standby is **Heap Size**.

- Whereas in 984 Hot Standby, **only the State Ram** is transferred, in IEC Hot Standby the transfer involves a **combined State Ram/Heap Transfer** which can affect the **scan time** dramatically.

Case #1: Normal recommended operation

- Same Project Name, Applications Equal, Execs Equal
- Applications
  - Primary application solves
  - Standby application doesn't solve
- Primary and Standby controller scans lock-stepped
  - State Table transfers
  - IEC Heap transfers
- Transfer of control back and forth from Primary to Standby is bumpless
- The first On-line edit downloaded to the Primary takes the Standby Off-line and the system enters Case #2

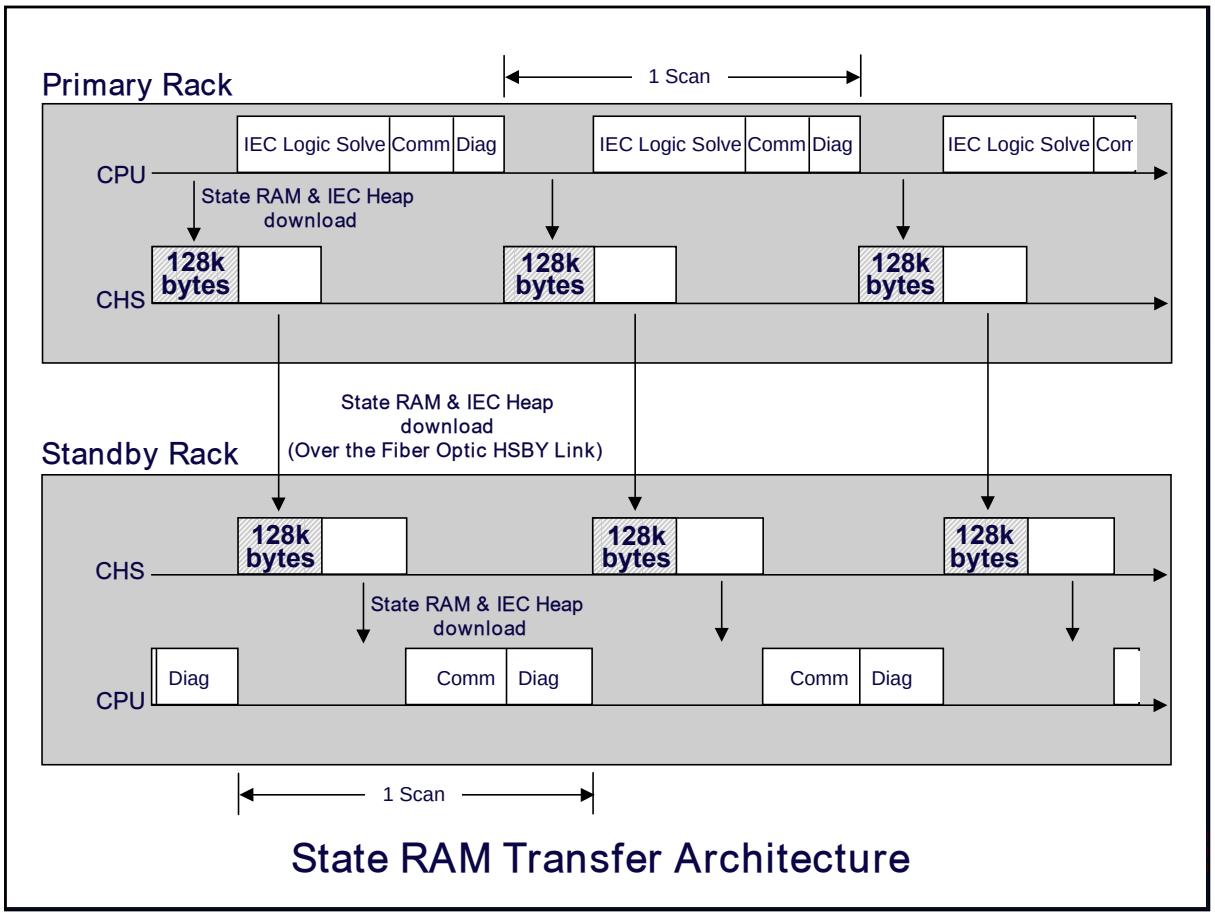


- In 984 Hot Standby, ***it is possible*** to make a change in the application of the Primary without the Standby going Offline. You must declare this in the **Command Register**.

- However, in ***IEC Hot Standby***, as soon as a change is made to the application program in the Primary Unit, the Standby goes **Off-Line**.

- The following examples illustrate this process.

- In the above example, everything is normal; everything is equal.



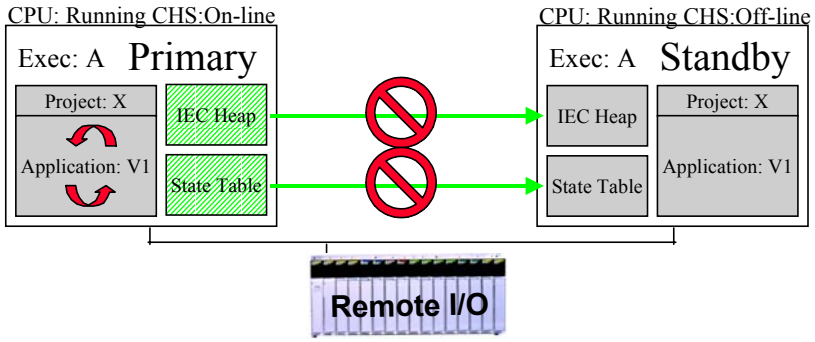
State RAM Transfer Architecture

- At first glance this, so called, **State Ram Transfer Architecture** looks similar to the one we examined in the non-IEC Quantum Hot Standby discussion.

- However, even though the synchronization is the same, the amount of the Transfer is **128K bytes or 64K words**. The Transfer involves the **existing State Ram *plus*** the **IEC Heap**. This can **dramatically** affect scan times.

Case #1b: Standby taken off-line by user

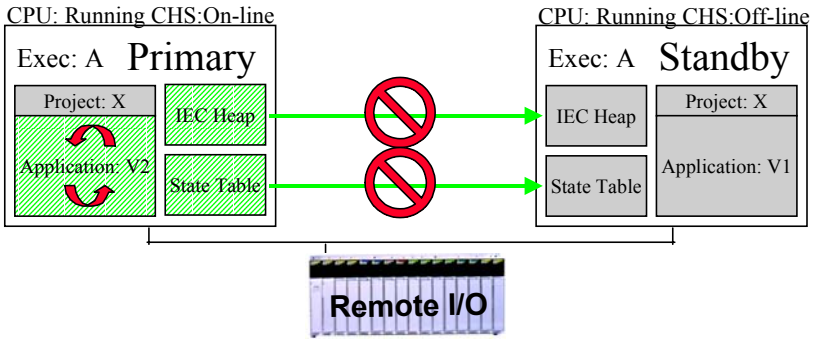
- Same Project Name, Applications Equal, Execs Equal
- Applications
  - Primary application solves
  - Standby application doesn't solve
- Primary and Standby controller scans lock-stepped
  - State Table doesn't transfer
  - IEC Heap doesn't transfer
  - Overall system scan time goes down in comparison to Case #1
- When the Standby is placed back on-line the IEC Heap and State Table will be updated taking the system back to Case #1



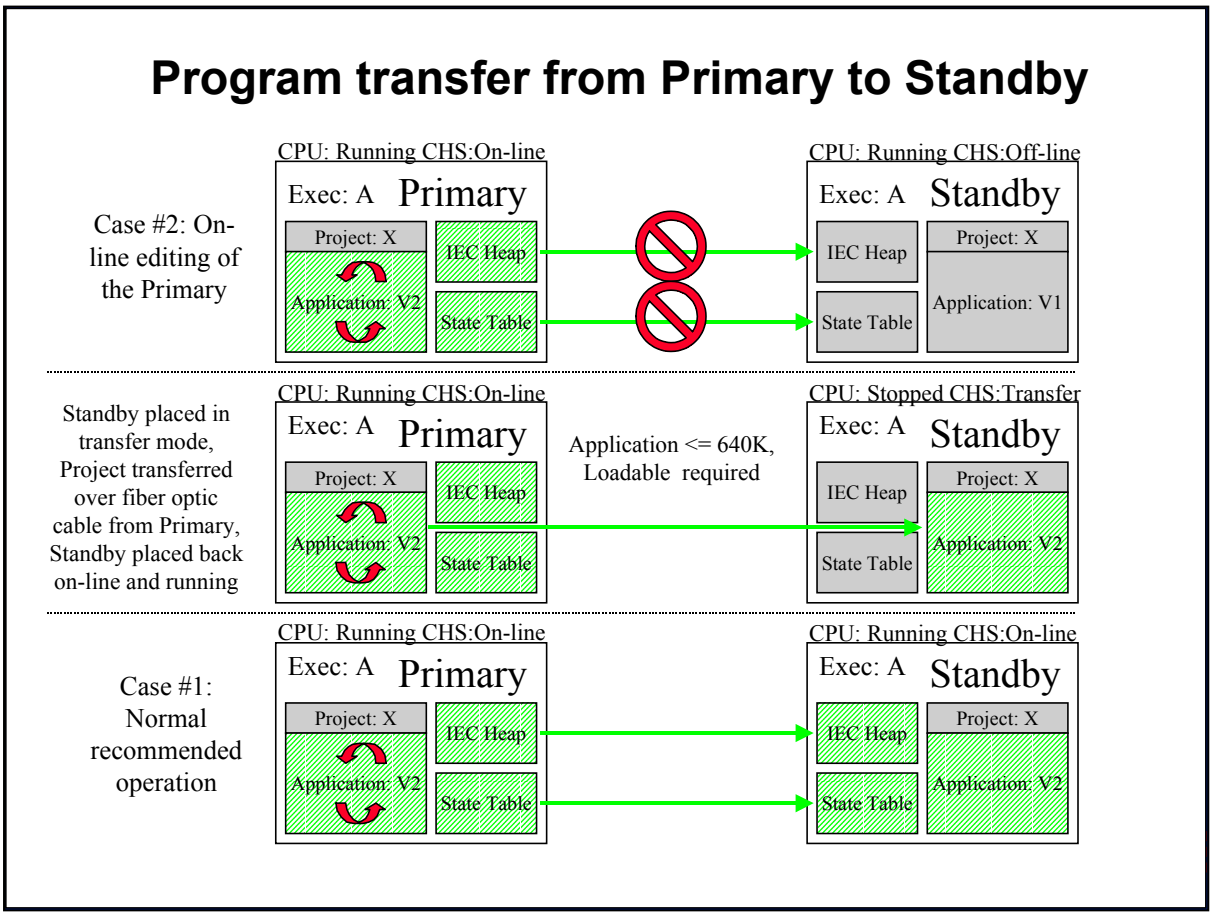
- This is the situation when the user manually takes the Standby Unit Off-line.

Case #2: On-line editing of the Primary

- The first On-line edit downloaded to the Primary takes the Standby Off-line
- Same Project Name, Applications Different, Execs Equal
- Applications
  - Primary application solves
  - Standby application doesn't solve
- Primary and Standby controller scans lock-stepped
  - State Table doesn't transfer
  - IEC Heap doesn't transfer
- It is not possible to bring the Standby On-line, until the Project is transferred from the Primary



- As soon as the user makes a change to the application, the Standby Unit reacts by going Off-line.



- When you are in Case #2, the **only way** to bring the Standby Unit On-line again is by performing a Hot Standby Transfer of the program via the Hot Standby Fiber link.

- Loading the identical program into the Standby unit via direct Modbus/Modbus Plus loading **will not work**.

Quantum IEC Hot Standby controller Exec upgrade procedure

- **The Process being controlled must be stopped**
- Both controllers must be stopped
- Both controllers must have their new Execs loaded
- The Primary controller must have its Project downloaded
  - Note that some Exec upgrades may be due to new versions of Concept and in certain cases the project may have to be converted prior to downloading
  - The Primary controller must be started
- The Project must be loaded to the Standby via the fiber optic CHS link in Transfer mode
- The Standby controller must be started
  - Note that this may be achieved through use of the CHS fiber optic update procedure without the use of Concept
- The IEC Hot Standby System will now come up and run in Case #1: Normal recommended operation

- The above procedure cannot be deviated from. **It must be followed exactly**.

Automation Business

Loading CHS.DAT to Concept Procedure

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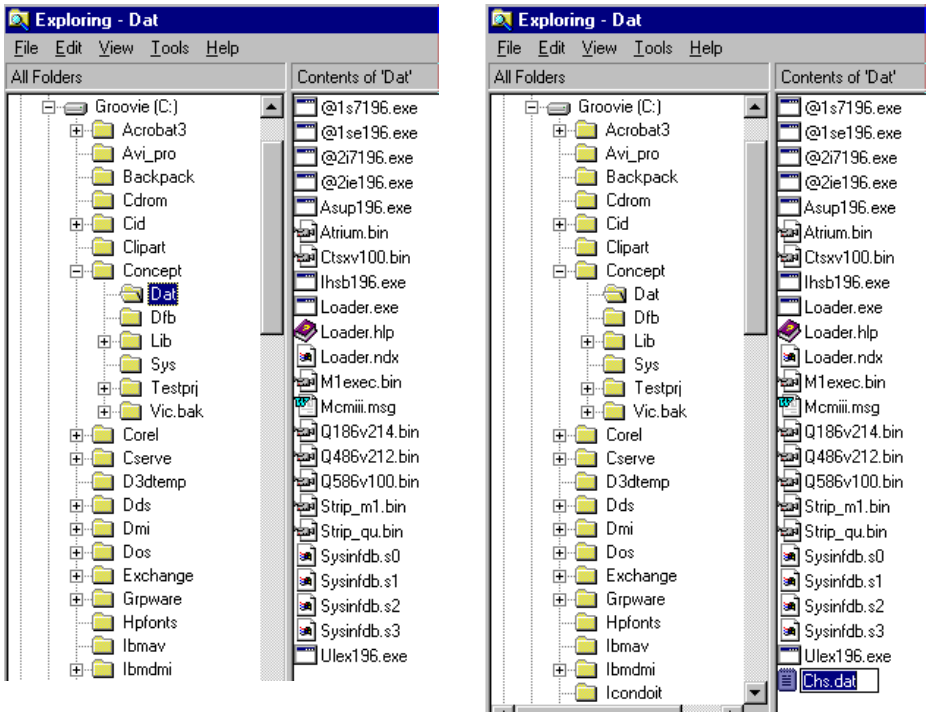
- When setting up for IEC Hot Standby, the first thing that you must do is to get the disk provided in the Quantum Hot Standby Kit and load the file **CHS.dat** into the **Concept.dat** directory.

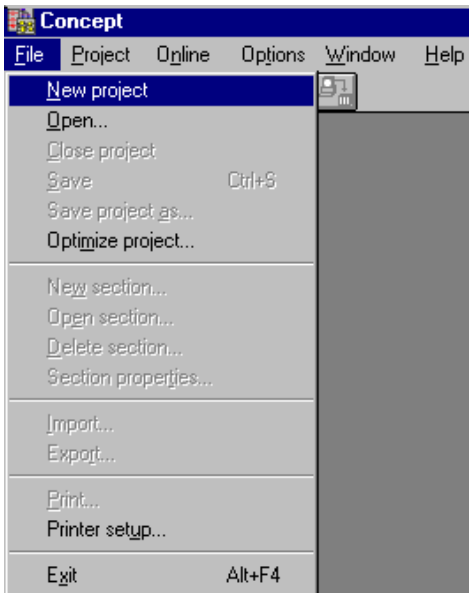
- The following is a step-by-step procedure for this task.

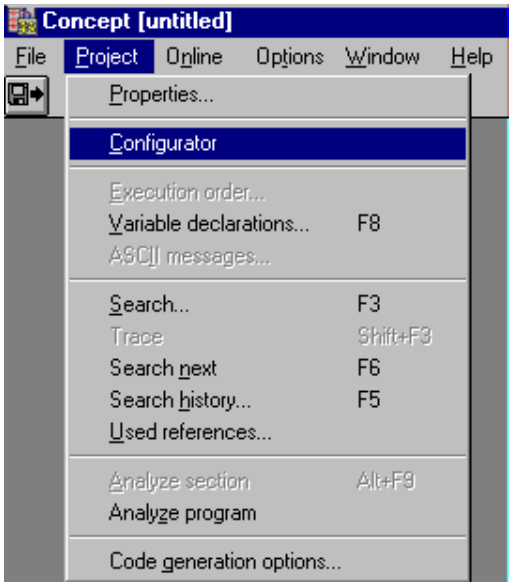
Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure



- The illustration on the left shows where to access the **Concept.dat** directory.
- Load **CHS.dat** into this directory from Drive A.

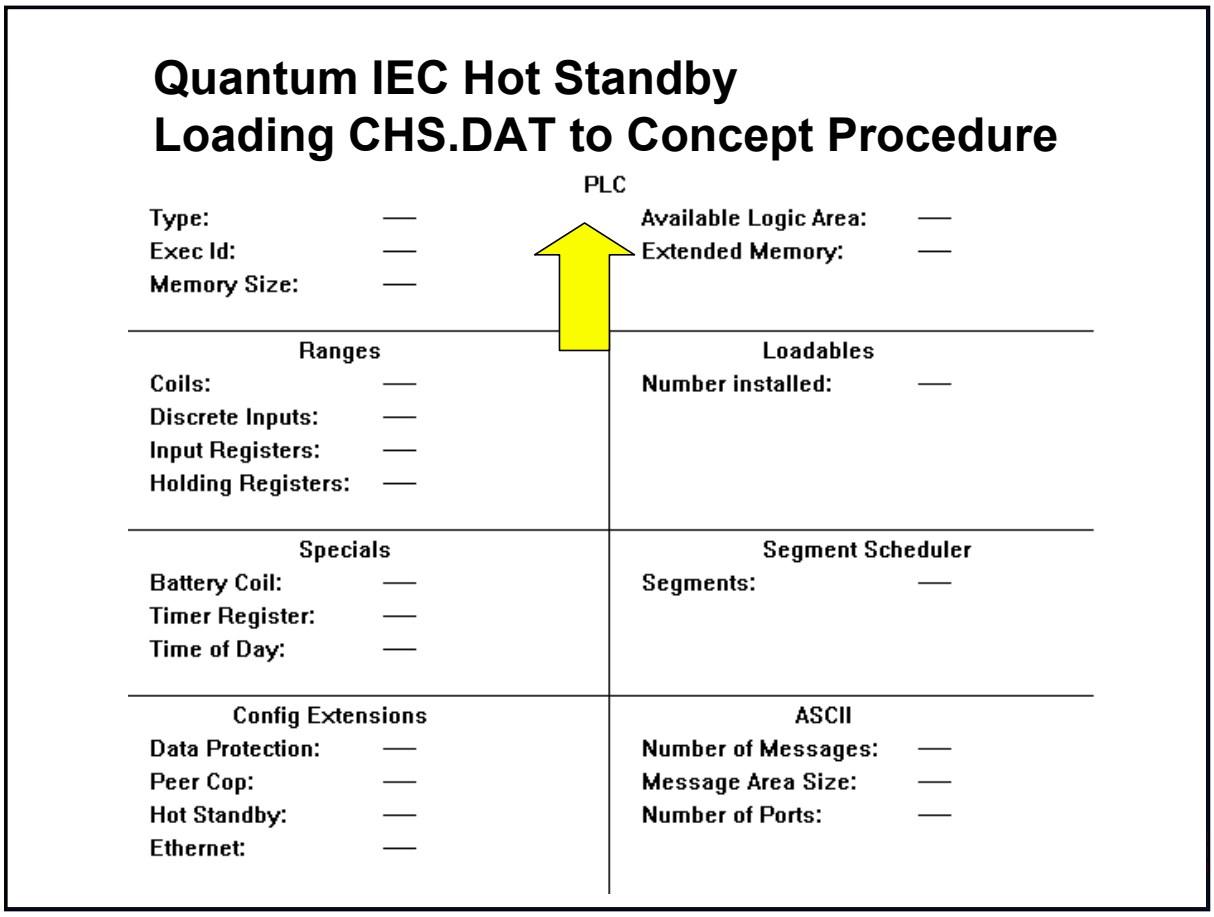
Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure





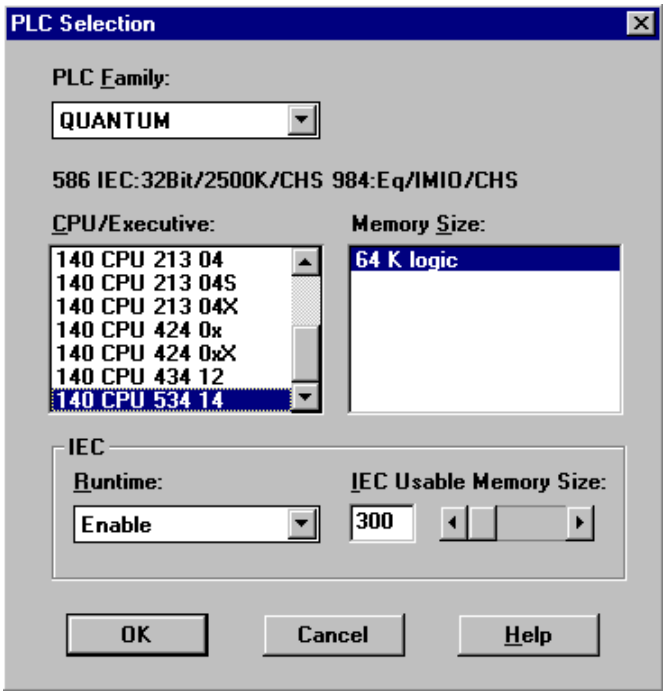
- Now, open Concept 2.1 software and go **File – New project**.
- Then, go **Project – Configurator**.

Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure



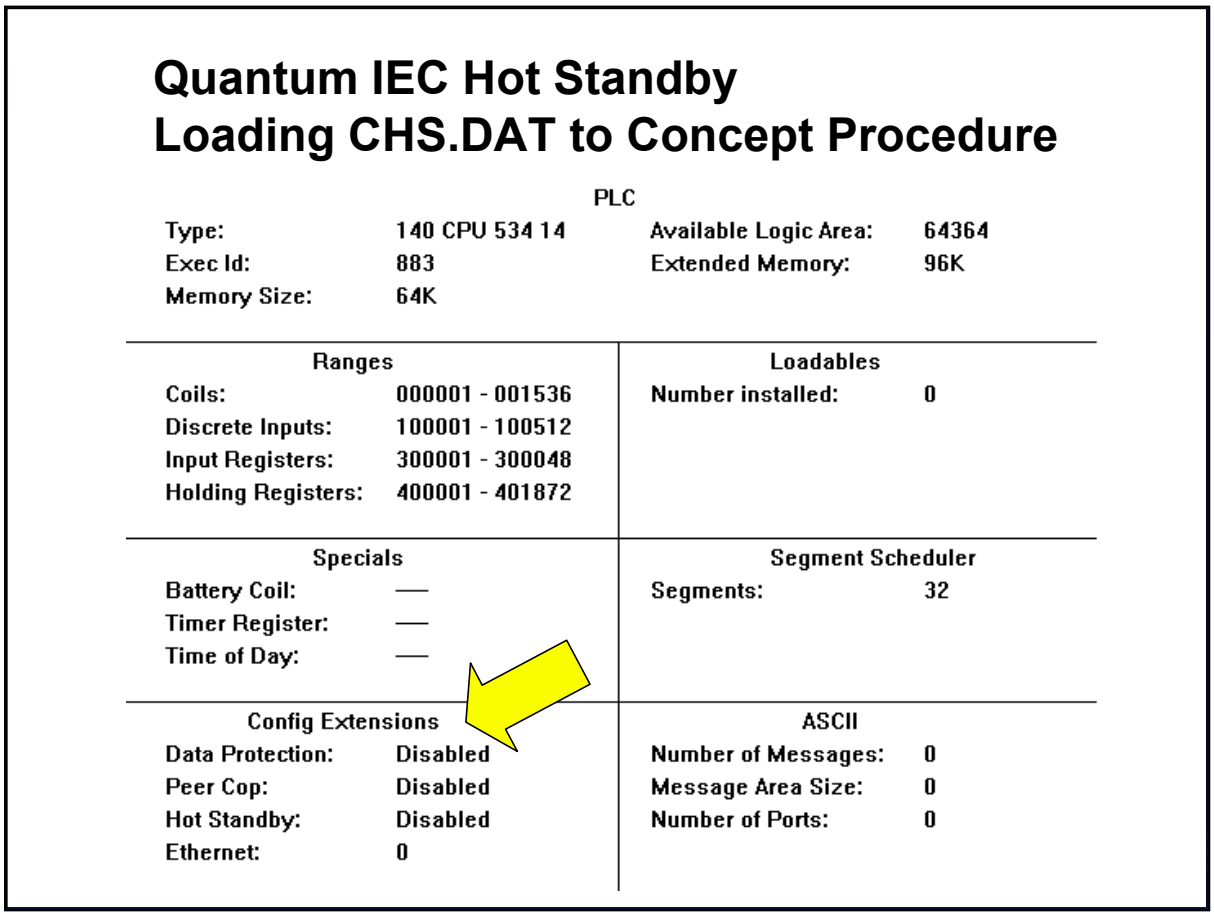
- This brings up a blank **Configurator Screen**
- Now, double-click in the **PLC** area.

Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure



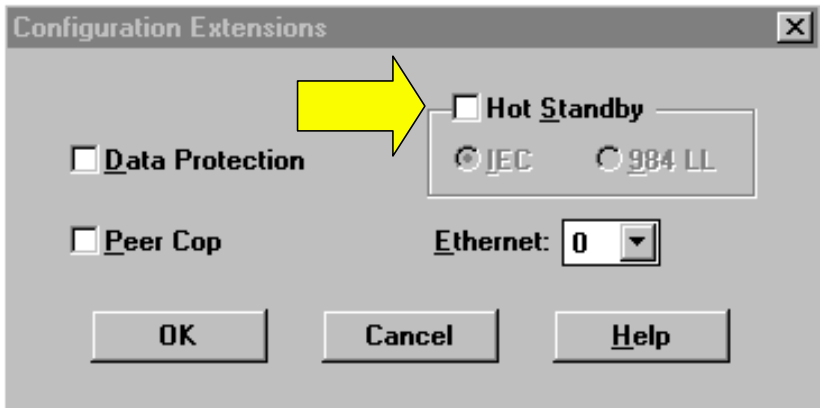
- This brings up the **PLC Selection screen**.
- Select **Quantum** and the **140 CPU 534 14** version.
- For now, leave IEC Usable Memory at **300K**.
- Click **OK**.

Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure



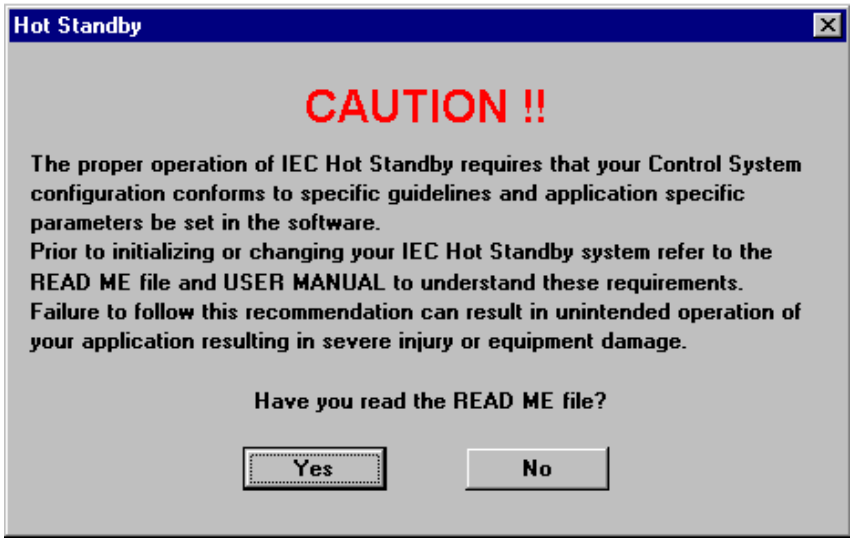
- This brings you back to the **Configurator** screen.
- Now, double-click in the **Config Extensions** Area.

Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure



- This brings you to the **Configuration Extensions** screen.
- Select **Hot Standby**.

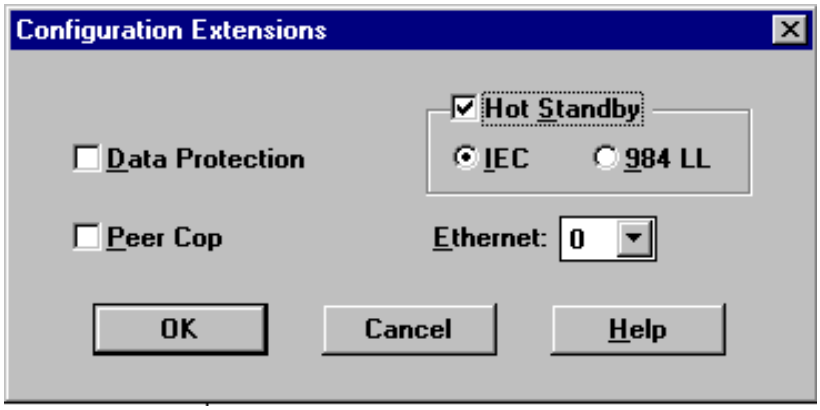
Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure



- This will immediately bring up a Caution screen which asks you whether or not you have read the Read Me File and understand all the particular requirements associated with IEC Hot Standby.

- Click **Yes**.

Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure



- The Caution screen will disappear and the **Hot Standby** selection will be checked.

- Click **OK**.

Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure

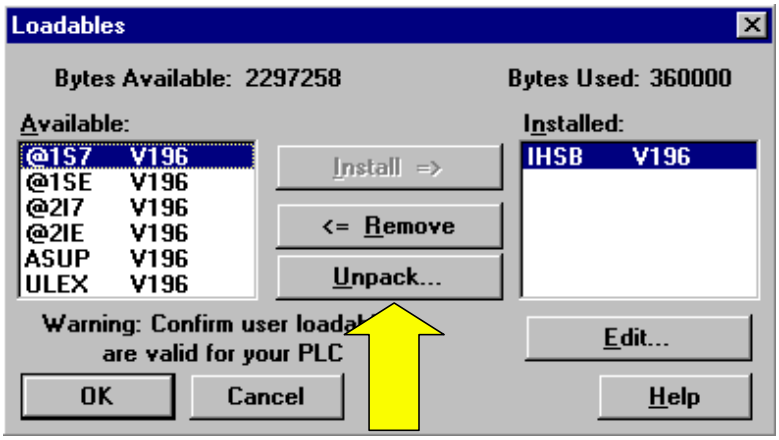
PLC

Type:	140 CPU 534 14	Available Logic Area:	64322
Exec Id:	883	Extended Memory:	96K
Memory Size:	64K		

Ranges		Loadables	
Coils:	000001 - 001536	Number installed:	1
Discrete Inputs:	100001 - 100512		
Input Registers:	300001 - 300048		
Holding Registers:	400001 - 401872		
IEC HSBY Registers:	300049 - 355049		
Specials		**Segment Scheduler**	
Battery Coil:	—	Segments:	32
Timer Register:	—		
Time of Day:	—		
Config Extensions		**ASCII**	
Data Protection:	Disabled	Number of Messages:	0
Peer Cop:	Disabled	Message Area Size:	0
Hot Standby:	Enabled	Number of Ports:	0
Ethernet:	0		

- This brings you back to the **Configurator** screen.
- Now, notice that under **Loadables** there is **1** enabled. This must be the **CHS Loadable**. Right? Wrong!!
- Double-click in the **Loadables** Area.

Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure

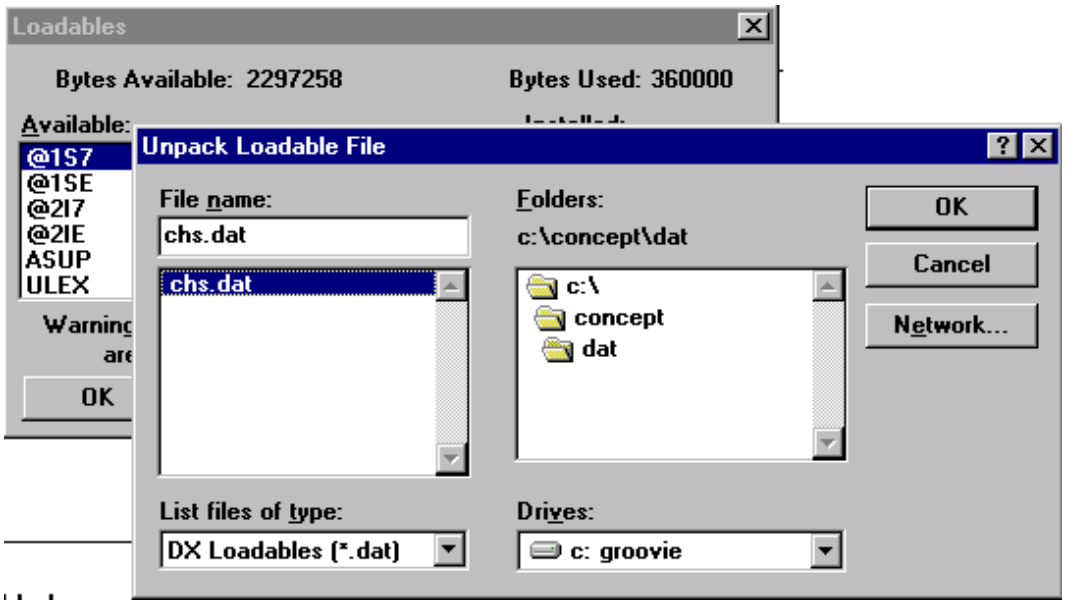


- This brings you to the **Loadables** screen.

- Notice that the one installed Loadable is the **IHSB (IEC Hot Standby)** Loadable and that the **CHS** Loadable is not in the Available List. That is because the CHS Loadable must be unpacked first to make it available.

- Click on **Unpack**.

Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure

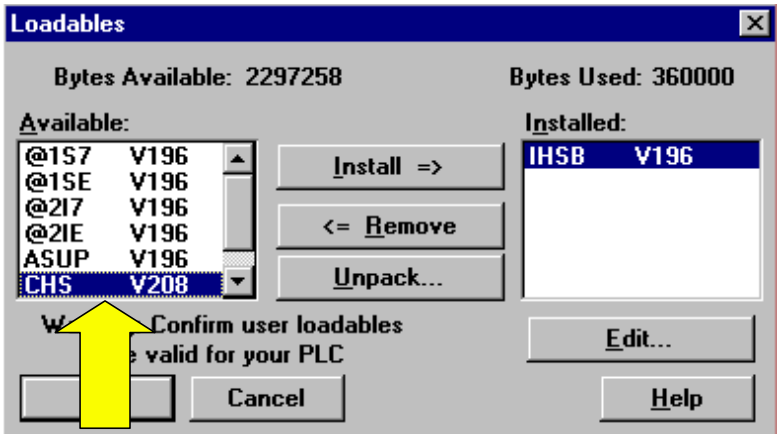


- This brings up a browser screen that is already pointing to the **Concept.dat** directory.

- However, the *List files of type* selection will be referencing the **(*exe)** types. Select the **DX Loadables (*dat)** types and that will bring up the **CHS.dat** for selection.

- Click **OK**.

Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure

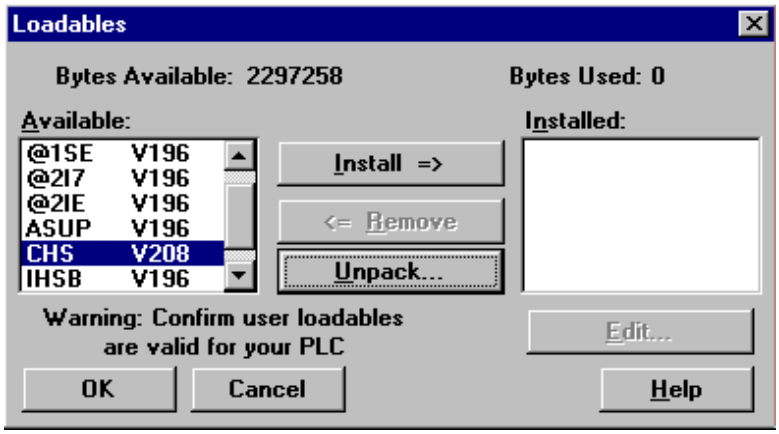


- This brings you back to the **Loadables** screen and **CHS V208** will be available to install.

- However, there is one thing that you must be aware of. The **CHS** Loadable ***must*** be installed on the list ***before*** the **IHSB** Loadable.

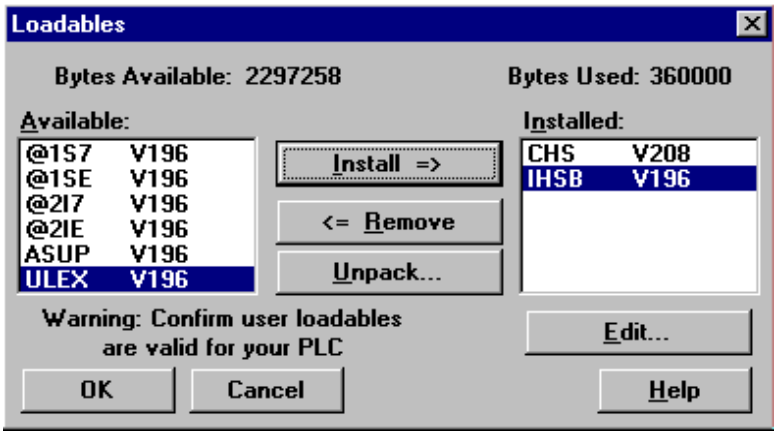
- To accomplish this, the **IHSB** Loadable must be ***un-installed***.

Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure



- Select the **IHSB** Loadable and Click **Remove**. This puts the **IHSB** in the Available List.

Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure



- Now, install the **CHS** Loadable followed by the **IHSB** Loadable. This puts them into the proper order on the list.

- Click **OK.**

Quantum IEC Hot Standby
Loading CHS.DAT to Concept Procedure

PLC

Type:	140 CPU 534 14	Available Logic Area:	63489
Exec Id:	883	Extended Memory:	96K
Memory Size:	64K		

Ranges		Loadables	
Coils:	000001 - 001536	Number installed:	2
Discrete Inputs:	100001 - 100512		
Input Registers:	300001 - 300048		
Holding Registers:	400001 - 401872		
IEC HSBY Registers:	300049 - 355049		
Specials		**Segment Scheduler**	
Battery Coil:	—	Segments:	32
Timer Register:	—		
Time of Day:	—		
Config Extensions		**ASCII**	
Data Protection:	Disabled	Number of Messages:	0
Peer Cop:	Disabled	Message Area Size:	0
Hot Standby:	Enabled	Number of Ports:	0
Ethernet:	0		

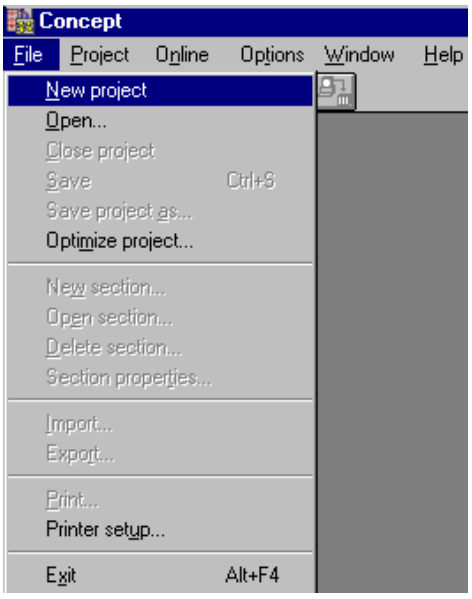
- This brings you back to the **Configurator** screen.
- Notice that there are now **2** Loadables installed.
- This completes the installation of **CHS.dat** into **Concept.**

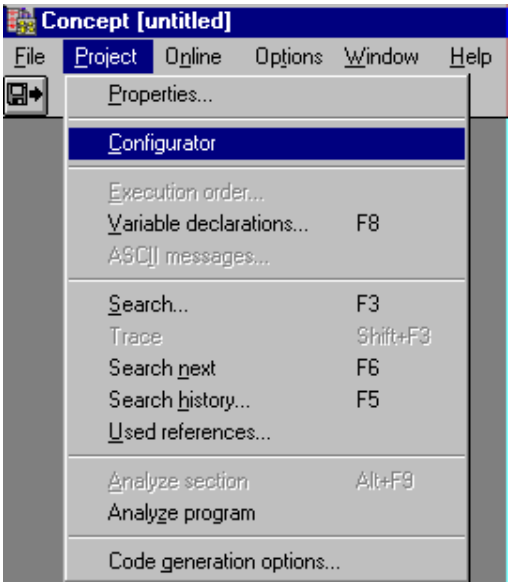
New Hot Standby Project Procedure

Merlin Gerin Modicon Square D Telemecanique

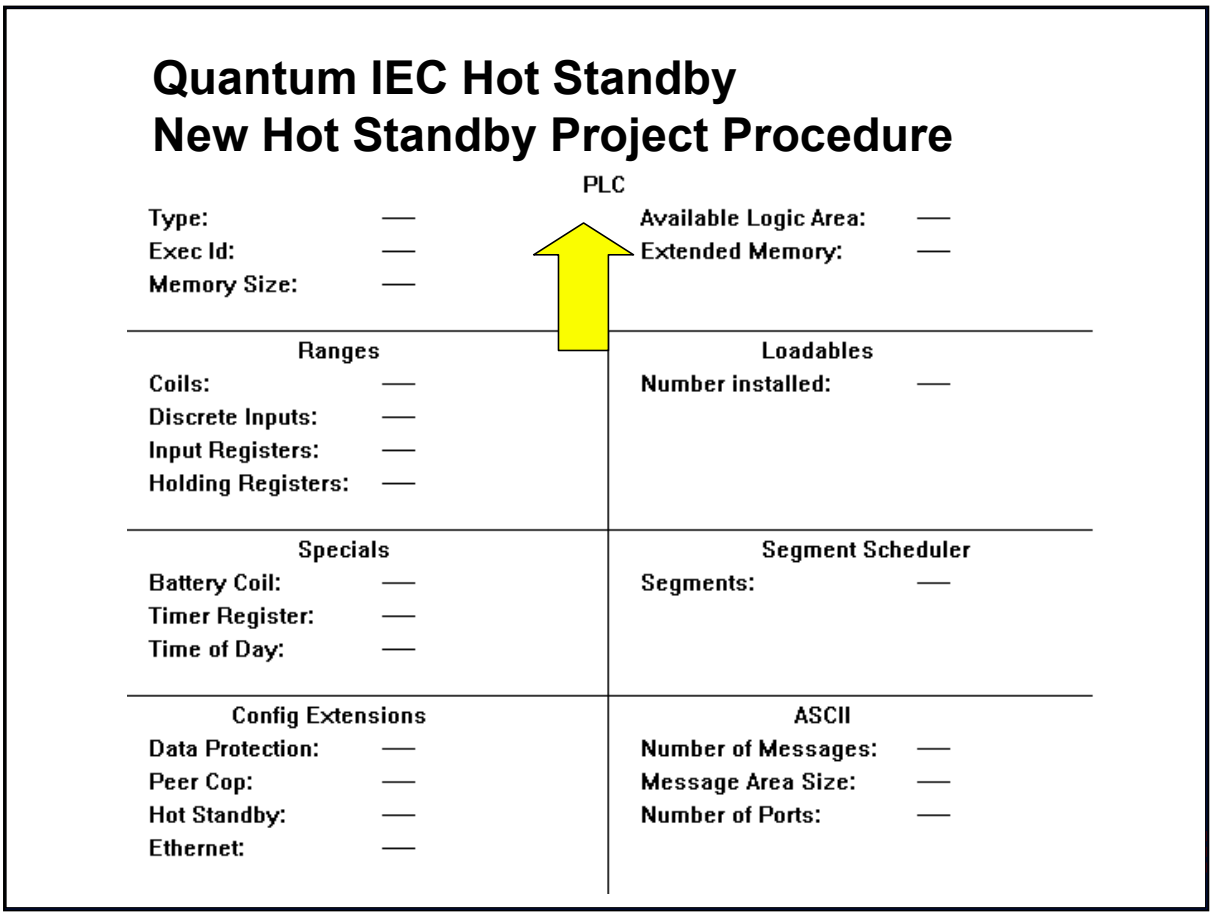
- The next procedure involves starting up a New Project with Hot Standby.
- This procedure is being done mostly as an exercise to familiarize you with the steps necessary to accomplish this task and may not necessarily reflect the average customer inquiry.

Quantum IEC Hot Standby
New Hot Standby Project Procedure





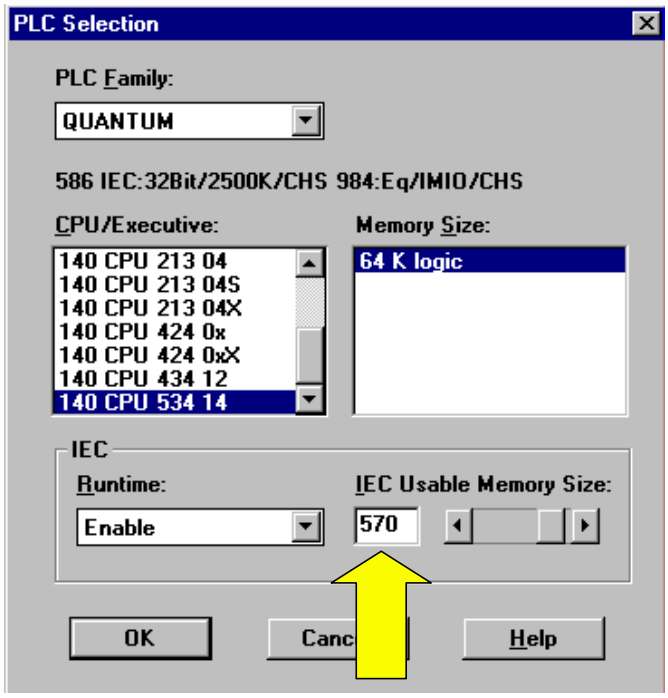
- Open Concept 2.1 software and go **File – New project**.
- Then, go **Project – Configurator**.



- This brings up a blank **Configurator Screen**.

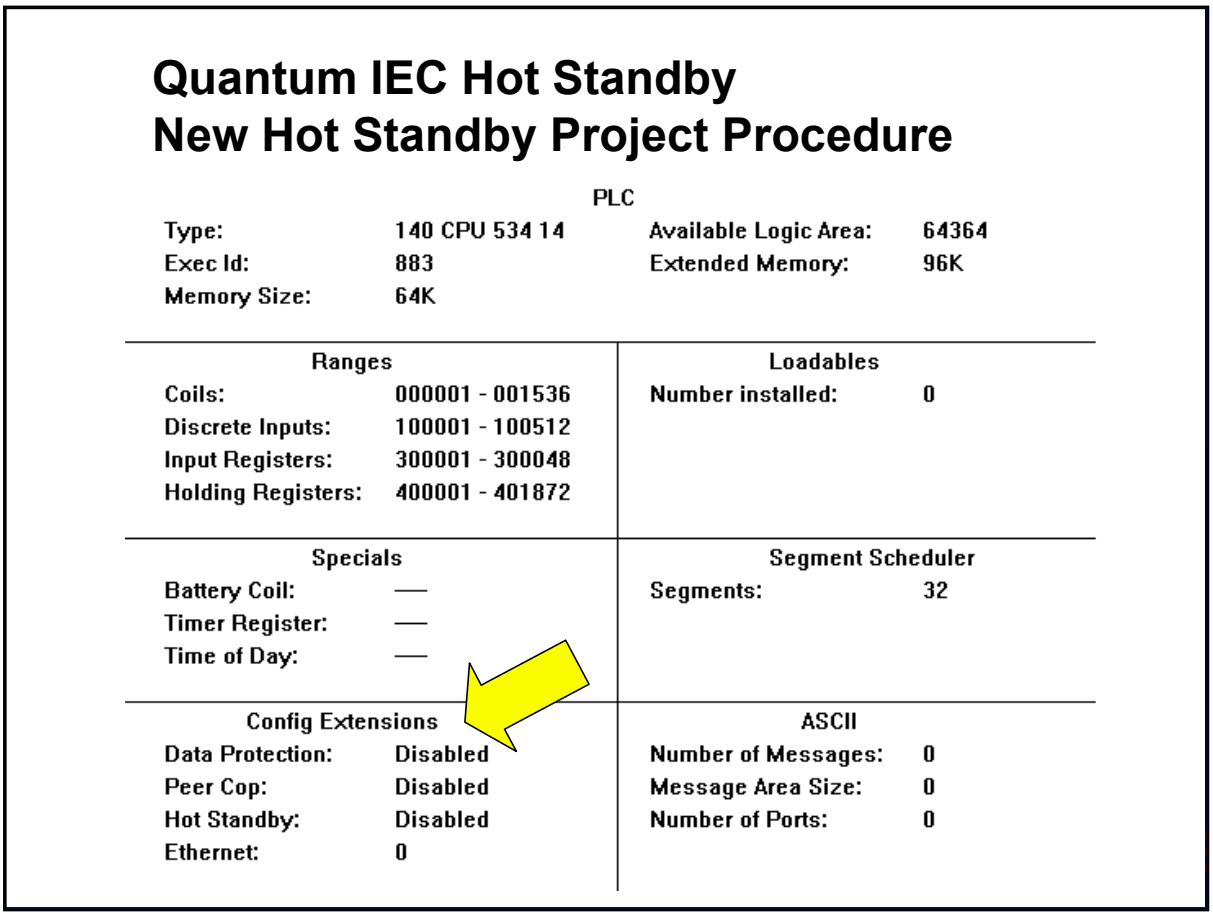
- Now, double-click in the **PLC** area.

Quantum IEC Hot Standby
New Hot Standby Project Procedure



- This brings up the **PLC Selection screen**.
- Select **Quantum** and the **140 CPU 534 14** version.
- Change the IEC Usable Memory to **570K**.
- Click **OK**.

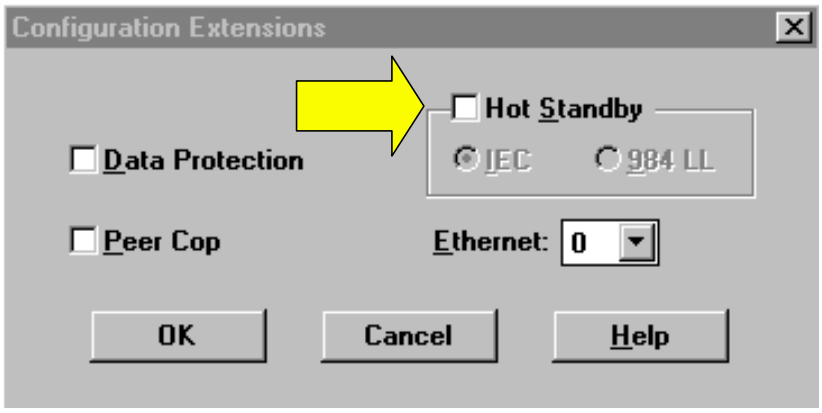
Quantum IEC Hot Standby
New Hot Standby Project Procedure



- This brings you back to the **Configurator** screen.

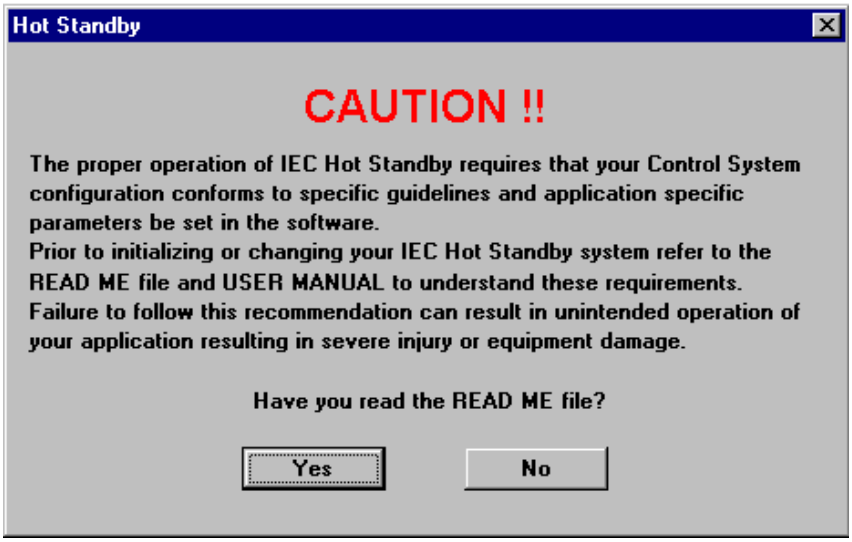
- Now, double-click in the **Config Extensions** Area.

Quantum IEC Hot Standby
New Hot Standby Project Procedure



- This brings you to the **Configuration Extensions** screen.
- Select **Hot Standby**.

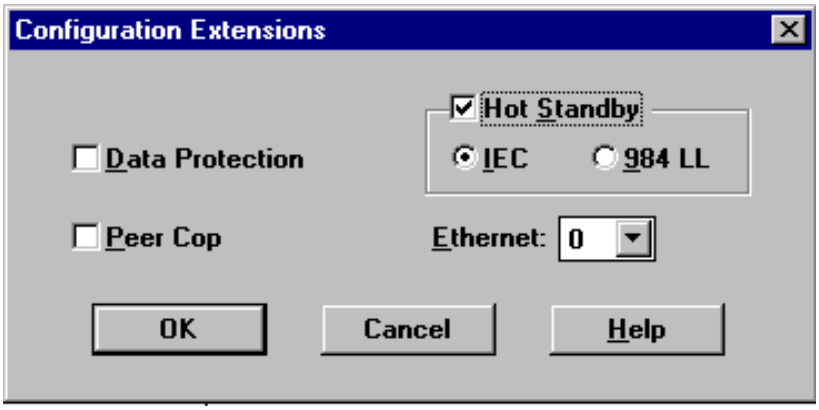
Quantum IEC Hot Standby
New Hot Standby Project Procedure



- This will immediately bring up a Caution screen which asks you whether or not you have read the Read Me File and understand all the particular requirements associated with IEC Hot Standby.

- Click **Yes**.

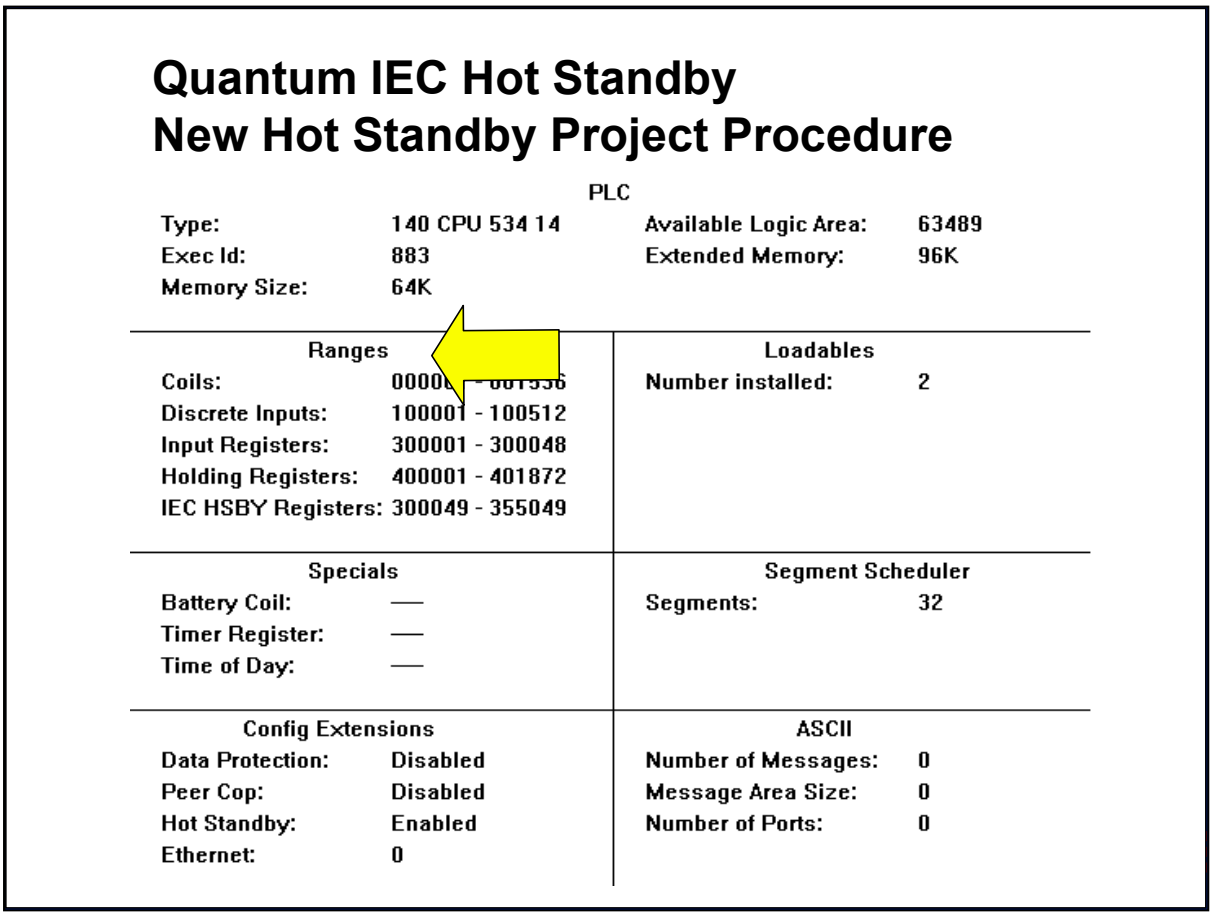
Quantum IEC Hot Standby
New Hot Standby Project Procedure



- The Caution screen will disappear and the **Hot Standby** selection will be checked.

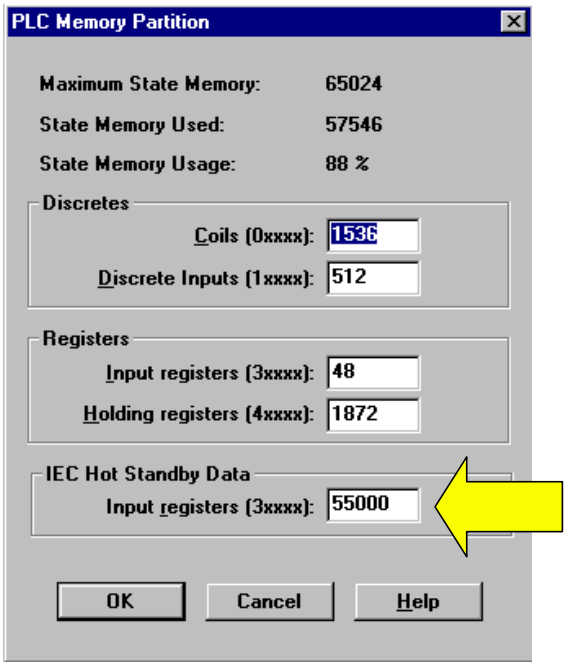
- Click **OK**.

Quantum IEC Hot Standby
New Hot Standby Project Procedure



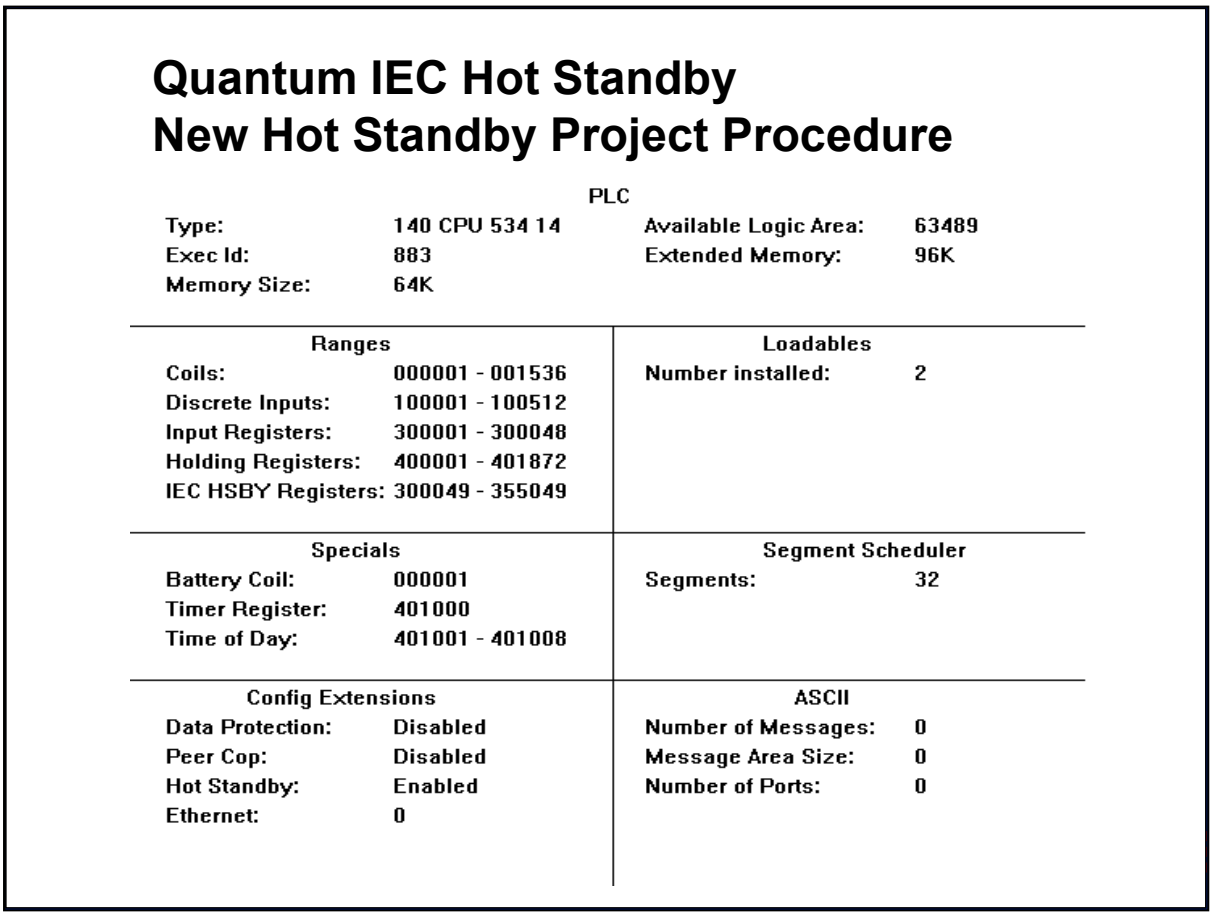
- This brings you back to the **Configurator** screen.
- You will notice that **Hot Standby** is now enabled and that there is a **2** under installed **Loadables**.
- Now, double-click on **Ranges**

Quantum IEC Hot Standby
New Hot Standby Project Procedure



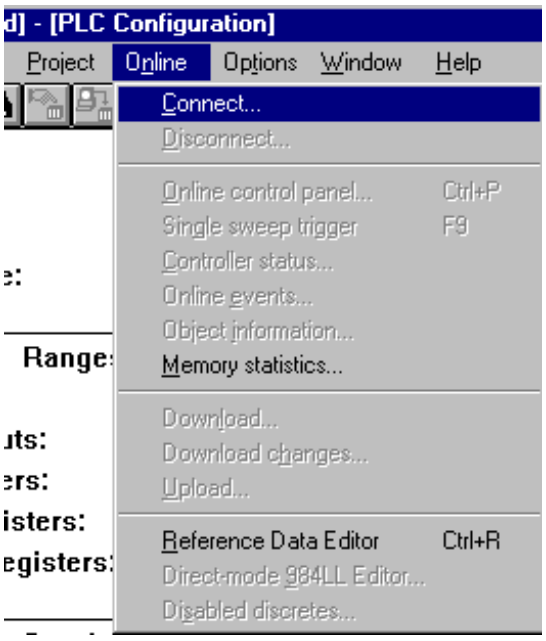
- This brings you to the **PLC Memory Partition** screen.
- Under **IEC Hot Standby Data**, enter **55000** if it is not already there. This represents the **Heap** size.
- Click **OK**.

Quantum IEC Hot Standby
New Hot Standby Project Procedure



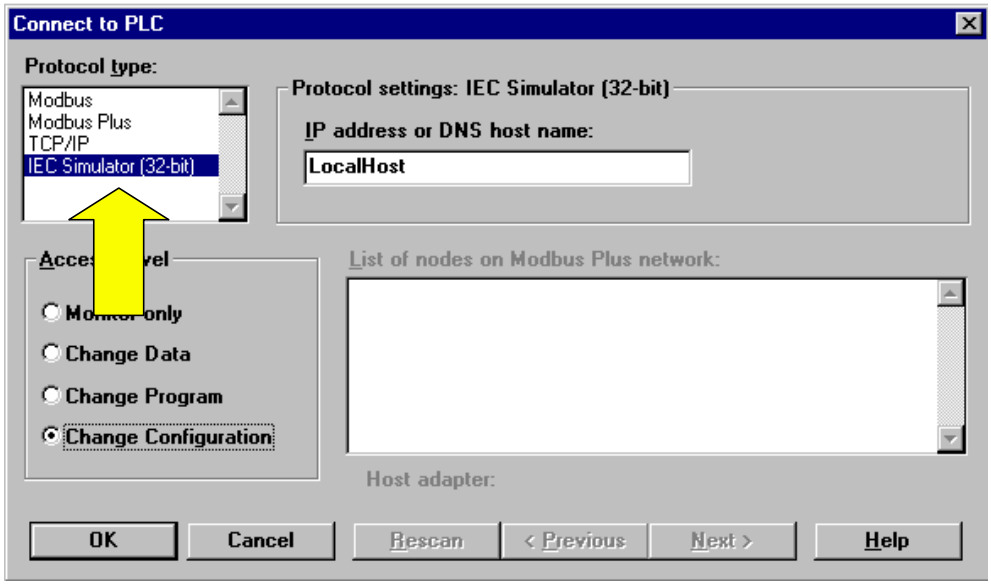
- This brings you back to the **Configurator** screen.
- You may now fill in the remaining parts of the **Configurator** screen such as **Specials** and **ASCII** (if available).
- The next step is to **Connect to the PLC**.

Quantum IEC Hot Standby
New Hot Standby Project Procedure



- Now, go **Online – Connect**.

Quantum IEC Hot Standby
New Hot Standby Project Procedure

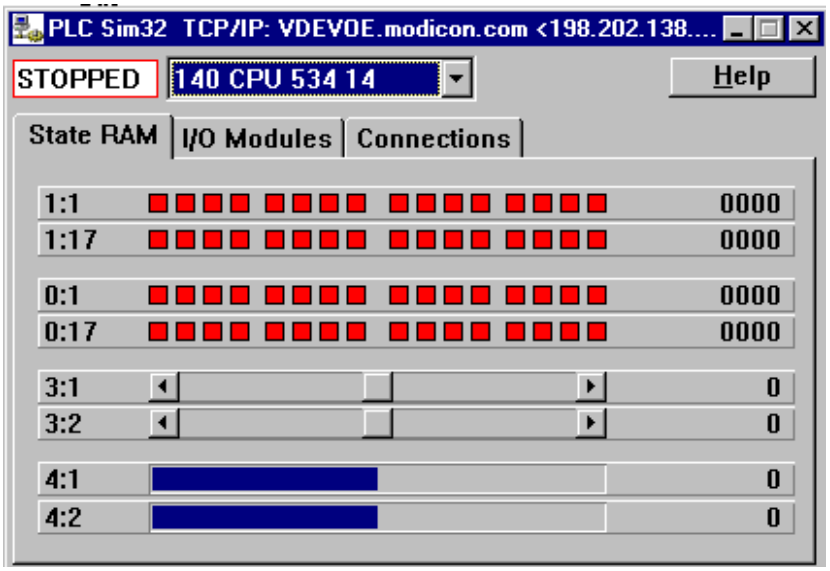


- This brings you to the **Connect to PLC** screen.

- If you are connected directly to the Quantum, select the appropriate communication protocol for your system. In the example above, however, we are selecting the **IEC Simulator (32 bit).**

- Click **OK**.

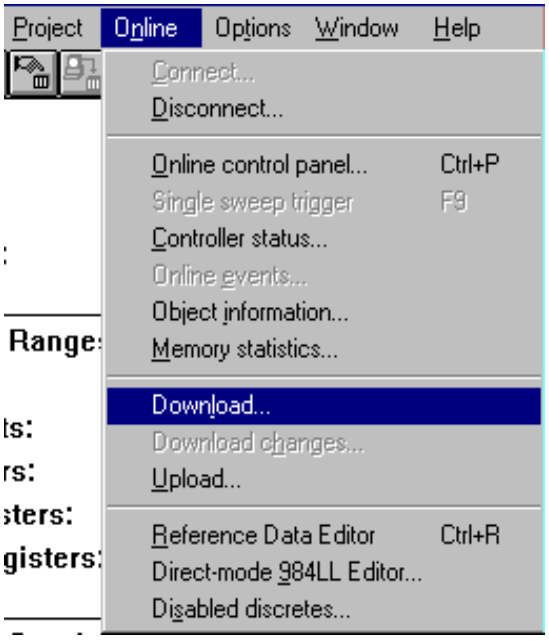
Quantum IEC Hot Standby
New Hot Standby Project Procedure



- This brings up the **32 bit Simulator** in a Stopped mode. This will serve well as the PLC for this exercise.

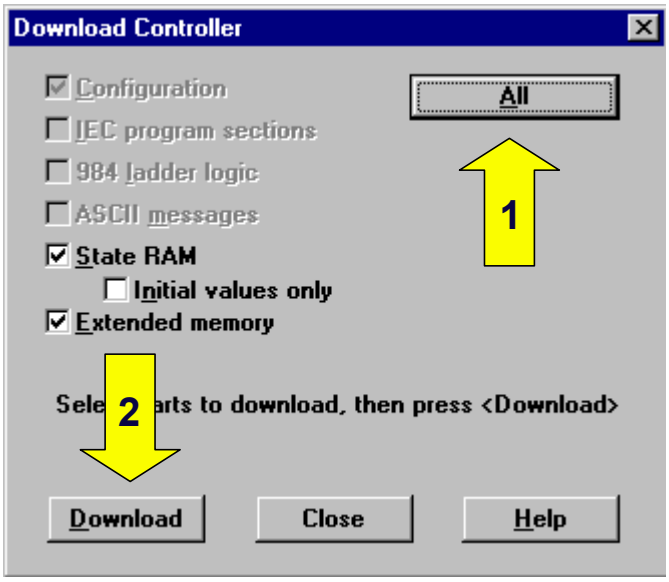
- Now, go back to Concept.

Quantum IEC Hot Standby
New Hot Standby Project Procedure



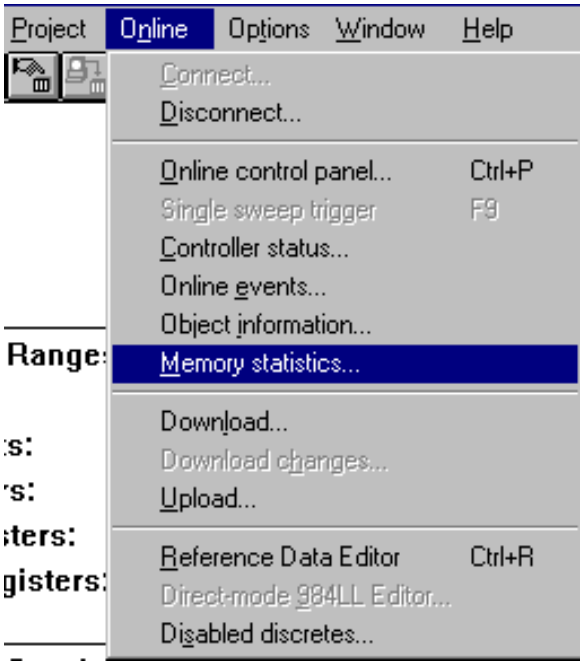
- Now, go **Online – Download**.

Quantum IEC Hot Standby
New Hot Standby Project Procedure



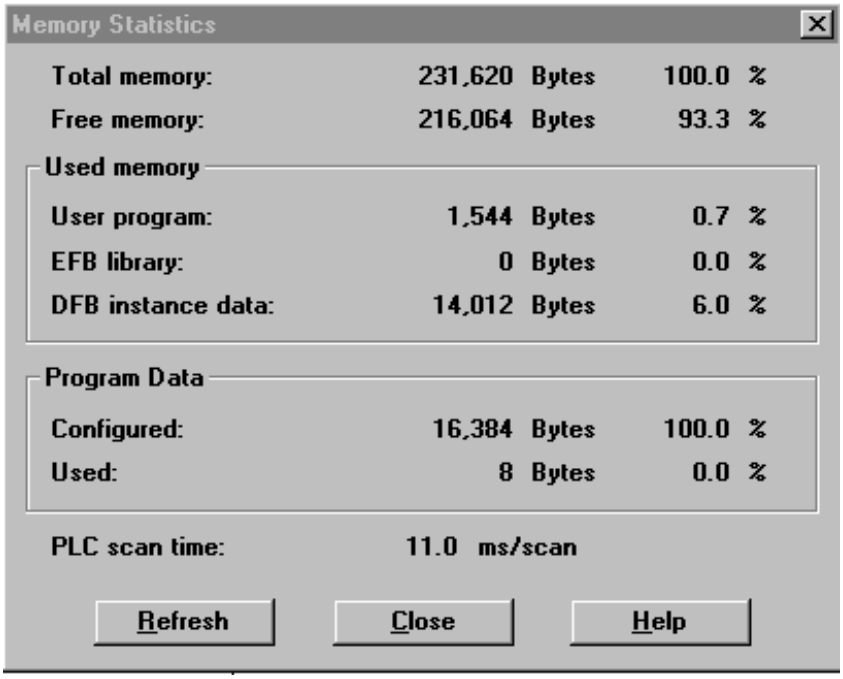
- This brings you to the **Download Controller** screen.
- Select **All** and then click **Download**.

Quantum IEC Hot Standby
New Hot Standby Project Procedure



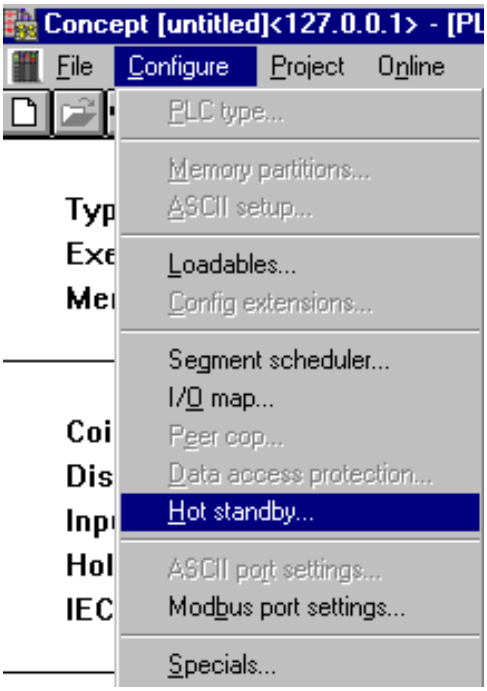
- After a successful **Download**, select **Online – Memory Statistics**.

Quantum IEC Hot Standby
New Hot Standby Project Procedure



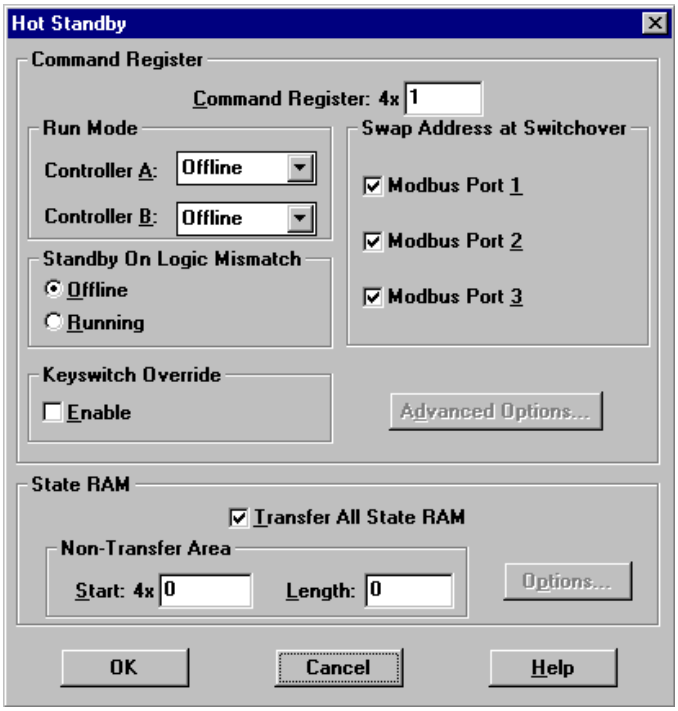
- This brings you to the **Memory Statistics** screen.
- This shows that you are Connected and that a successful Download took place.
- The numbers reflected here are not real in any sense since there is no User Program involved, however, now you know how to get here.
- Close this window.

Quantum IEC Hot Standby
New Hot Standby Project Procedure



- Next, select **Configure – Hot Standby**.

Quantum IEC Hot Standby
New Hot Standby Project Procedure



- This brings you to the **Hot Standby Command Register** screen.

- We have already discussed all of these Hot Standby settings in the **non-IEC Hot Standby (Modsoft)** screens, so there is no need to cover them again. However, notice how they are presented here in a much easier to understand order.

- This is the end of the **New Hot Standby Project** procedure.

Automation Business

Quantum IEC Hot Standby Standalone Configuration

Merlin Gerin Modicon Square D Telemecanique

- Now it's time to discuss a real-world situation. One which may illicit customer inquiries since there is very little available documentation on the subject.

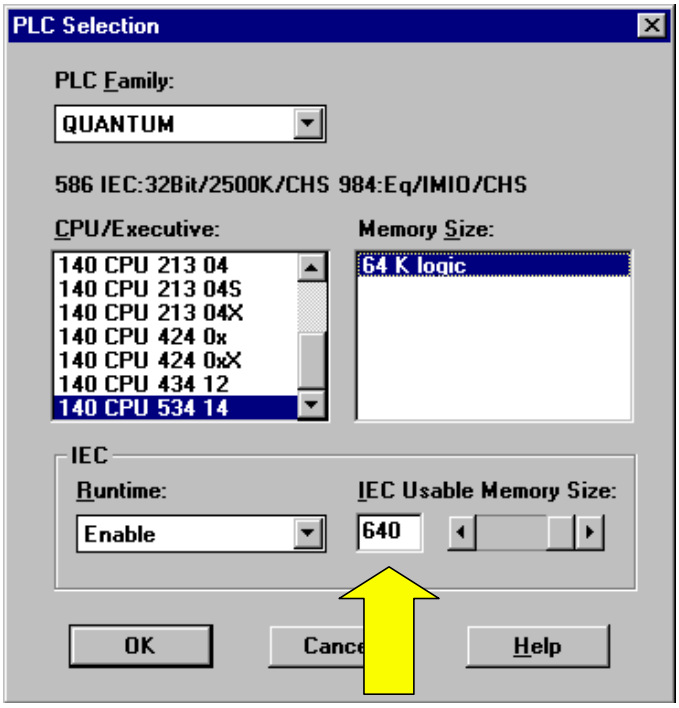
- When a customer decides that he wants to use Quantum IEC Hot Standby, he will have already developed his application (program) and he wants to know if he can use Hot Standby and how does he implement it.

- This procedure assumes these facts and can get a bit involved, so it is important that you and the customer follow this procedure exactly.

- **To configure IEC Hot Standby for Concept 2.1**

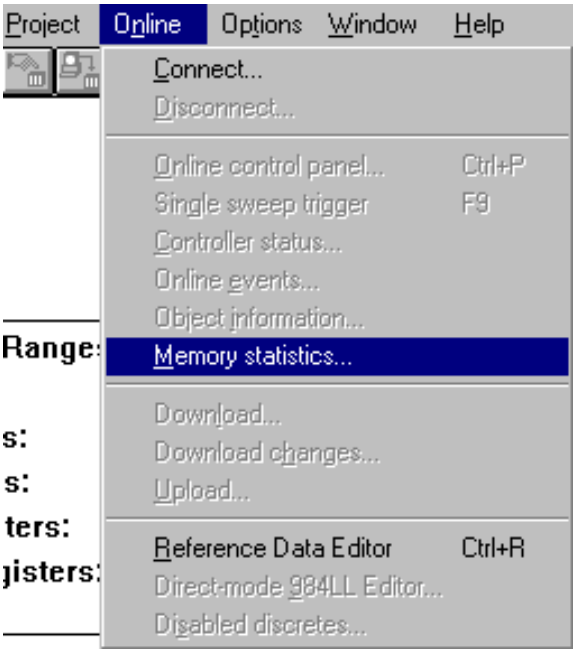
  You must configure and download your program to a Standalone CPU first. This will give you all of the necessary setup information needed to configure the Hot Standby settings.

Quantum IEC Hot Standby Standalone Configuration



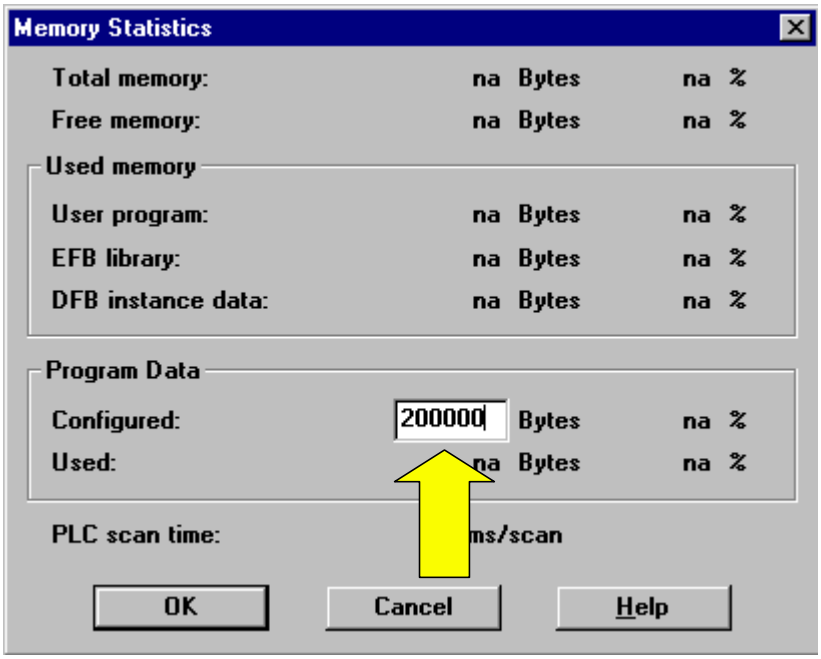
- Starting with the **Configurator** screen, double-click in the **PLC** Area.
- Under **IEC Usable Memory Size** enter **640K**.
- Click **OK**.

Quantum IEC Hot Standby Standalone Configuration



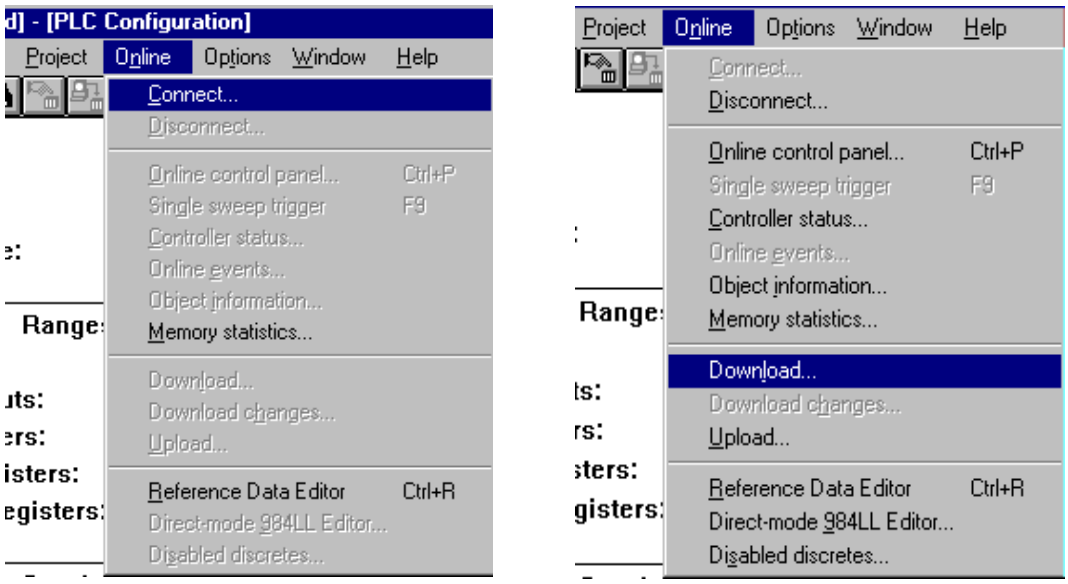
- Then, go **Online – Memory Statistics** while disconnected.

Quantum IEC Hot Standby Standalone Configuration



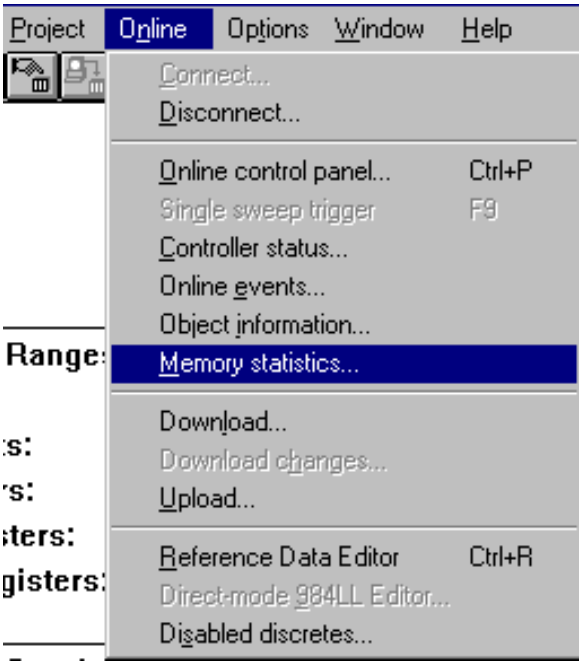
- Change the **Configured Program Data** to **200,000**.
- Click **OK**.

Quantum IEC Hot Standby Standalone Configuration



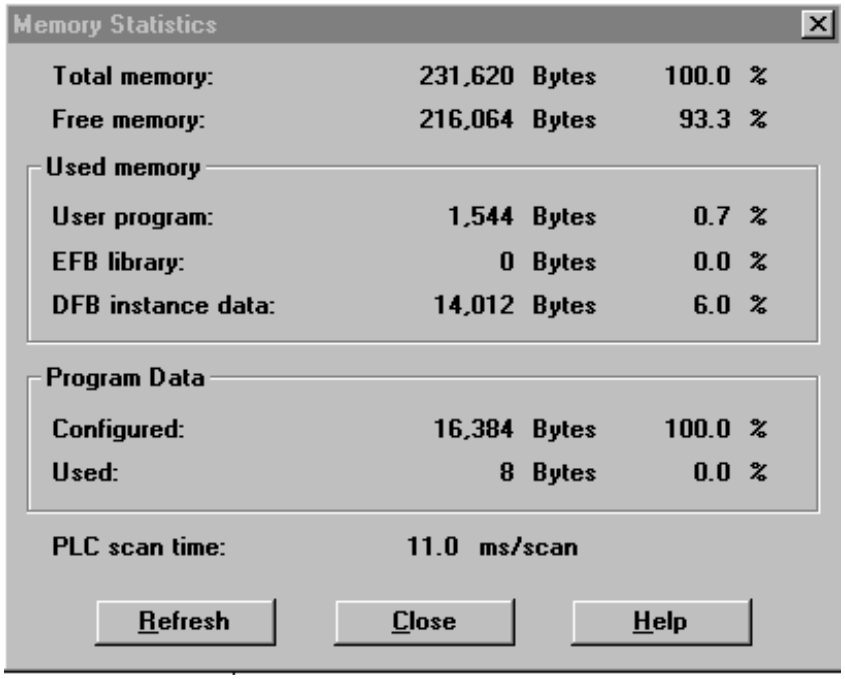
- Next, go **Online – Connect**, then **Online – Download**.

Quantum IEC Hot Standby Standalone Configuration



- After a successful Download, go **Online – Memory Statistics.**

Quantum IEC Hot Standby Standalone Configuration



- Write down the following information:
  - Total Memory
  - Free Memory
  - User Program
  - EFB Library
  - DFB Instance Data
  - Configured Program Data
  - Used Program Data

Standalone Evaluation

1. If your User Program + EFB Library is > 570K, your application is too big for IEC Hotstandby in Concept 2.1 on all controllers.

2. If your DFB instance data + Used Program Data is More than 110k bytes, your application is too big. (*** it is possible to configure more than 55000 3x registers for IEC-HSBY, therefore this value can be increased to at least 120k bytes. But actually the user can't set up more than what's free in State RAM, and if 44000 registers are already used, for example, for I/O, the maximum size for IEC-Hotstandby data memory would be 20000*2 bytes, instead of the full 120kbytes ***)

Quantum IEC Hot Standby Setup

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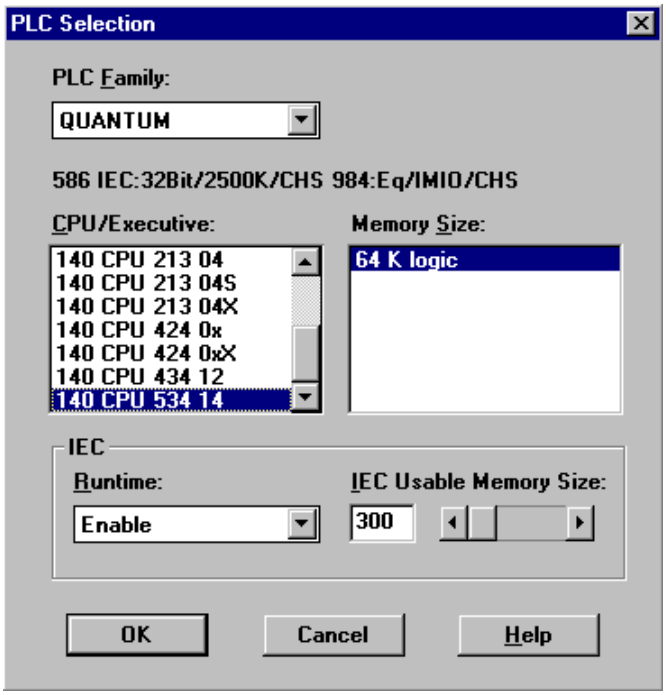
- **If you are OK with the previous page, proceed with the IEC Hot Standby Setup Procedure.**
- **Otherwise, you are done.**

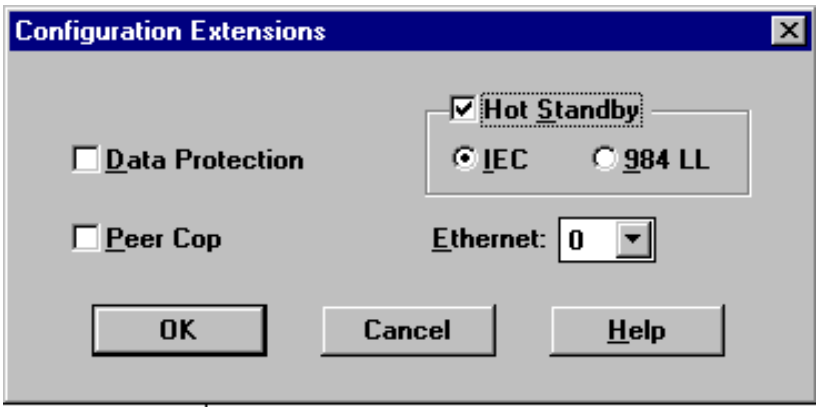
Quantum IEC Hot Standby Setup



Hot Standby Setup

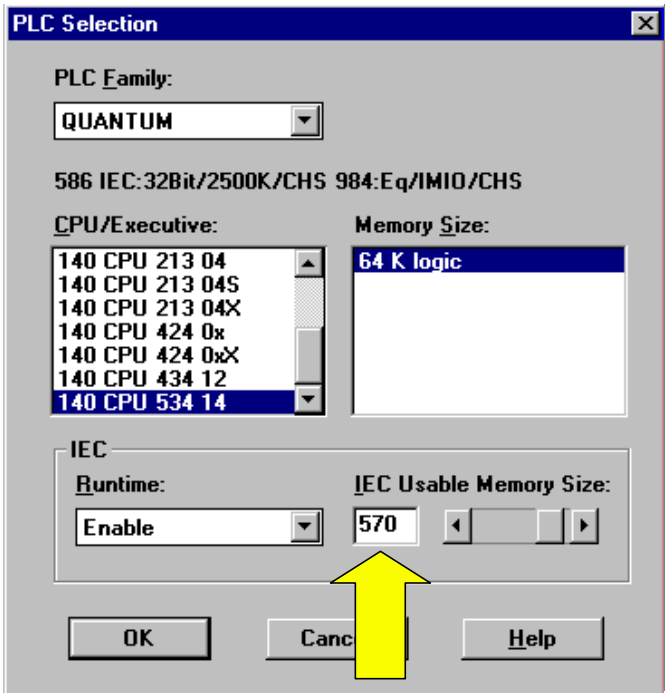
- Before you add Hot Standby to your system, select the **IEC Usable Memory Size** to the smallest possible value. This is **300K**.

Quantum IEC Hot Standby Setup



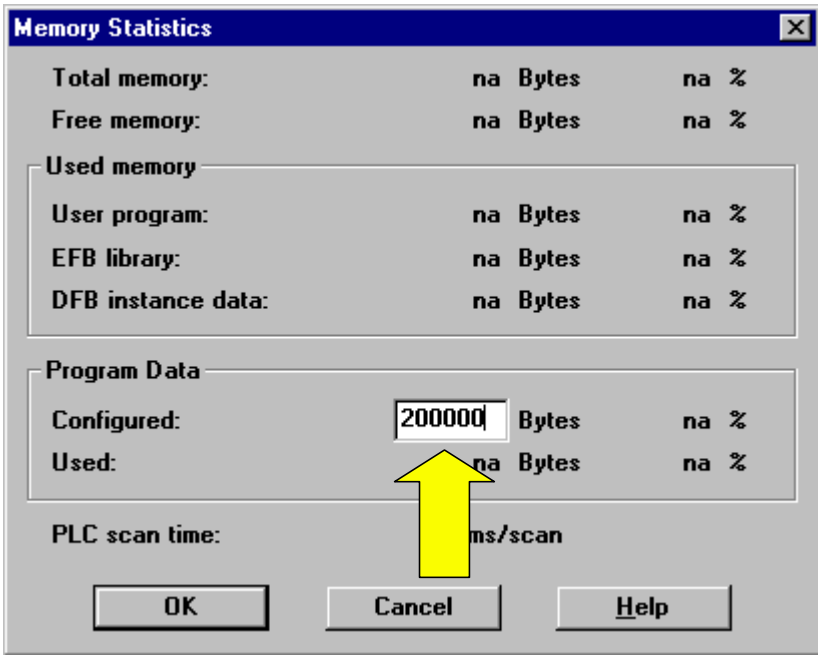
- Add **IEC Hot Standby** in the **Configuration Extensions** screen.

Quantum IEC Hot Standby Setup



- Now, you should select the ***maximum*** for the **IEC Usable Memory Size**, which is **570K** for both the 534 and 434 Controllers. Because now the configurator does automatically adjust the **IHSB loadable heap** to this size.

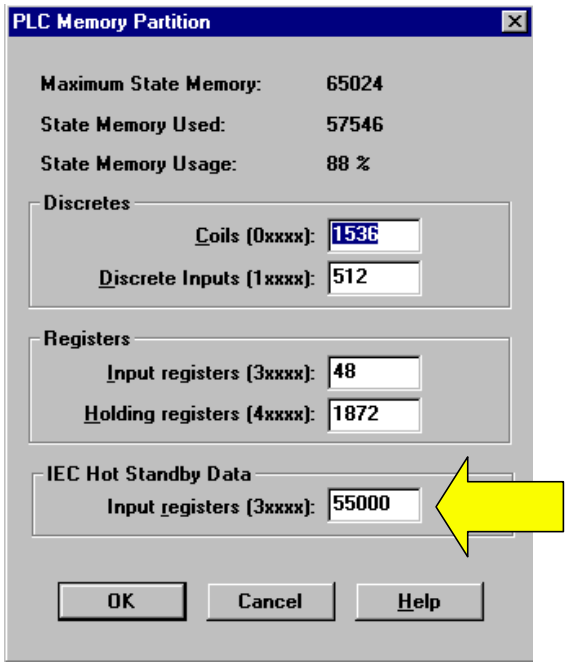
Quantum IEC Hot Standby Setup



- In **Offline** mode, go to **Online – Memory Statistics** and enter in a number that is **Used Program Data + 20%**. Enter this into the **Configured Program** section.

- ***EDITORIAL NOTE: The graphic above does not reflect a valid entry for this description. It was the only picture that was available.***

Quantum IEC Hot Standby Setup



- Go to the **Ranges** section of the **Configuration Screen** and use the following equation to enter in the number of necessary **3X** registers:

  (Configured Program Data + DFB Instance Data + 50) / 2.

- After a successful **Download**, go to **Online – Memory Statistics** and view the recommended settings.

- Transfer the Program from the Primary to the Standby Quantum via the Hot Standby Transfer Link.

- You now have a Quantum IEC Hot Standby System.

- **This is the end of the discussion of the IEC Hot Standby System.**

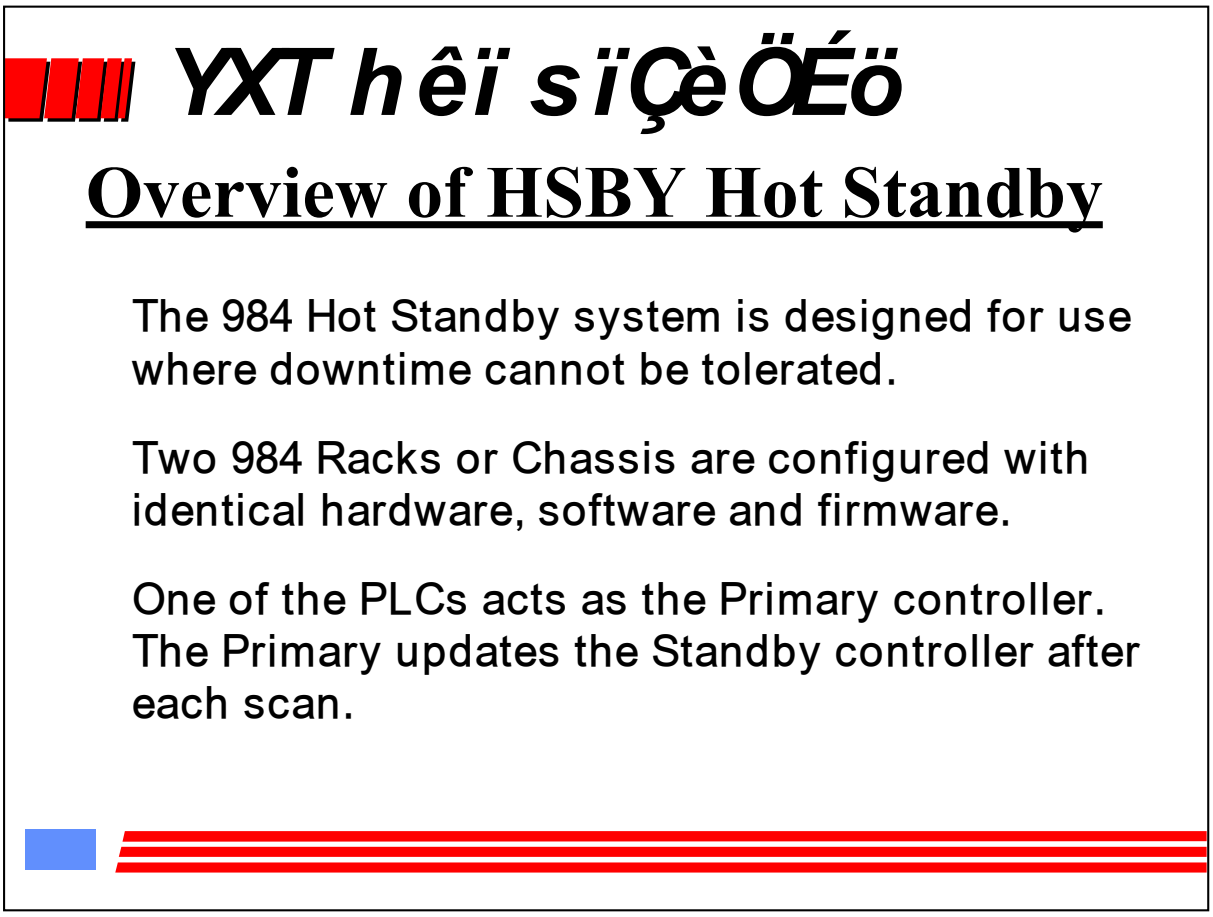
YXT hêï sïÇèÖÉö

- We will now discuss the 984 HSBY Hot Standby Module, the hardware needed to set up the 984 Hot Standby System, its topology, and Troubleshooting methods.

- We will be using and making extensive references to the:
  “Modicon 984 Hot Standby System Installation and Maintenance Manual”
  Part # GM-S911-001 Rev. B

  and the

  “Modicon 984 Hot Standby System Programming Manual”
  Part # GM-S911-002 Rev. C.



- The 984 Hot Standby System is designed for use where downtime cannot be tolerated. The system delivers high availability through redundancy. Two Chassis or Racks are configured with identical hardware and software.
- One of the PLCs acts as the Primary Controller. It runs the application by scanning ladder logic and operating Remote I/O.
- The other PLC acts as the Standby Controller. The Primary Controller updates the Standby Controller after each scan. The Standby is ready to assume control within ***one scan*** if the Primary fails.

YXT hêï sïÇèÖÉö

Overview of HSBY (cont)

Primary and Standby states are switchable. Either controller can be put in the Primary state, but the other must be in the Standby state.

The Remote I/O network is always operated by the Primary controller.

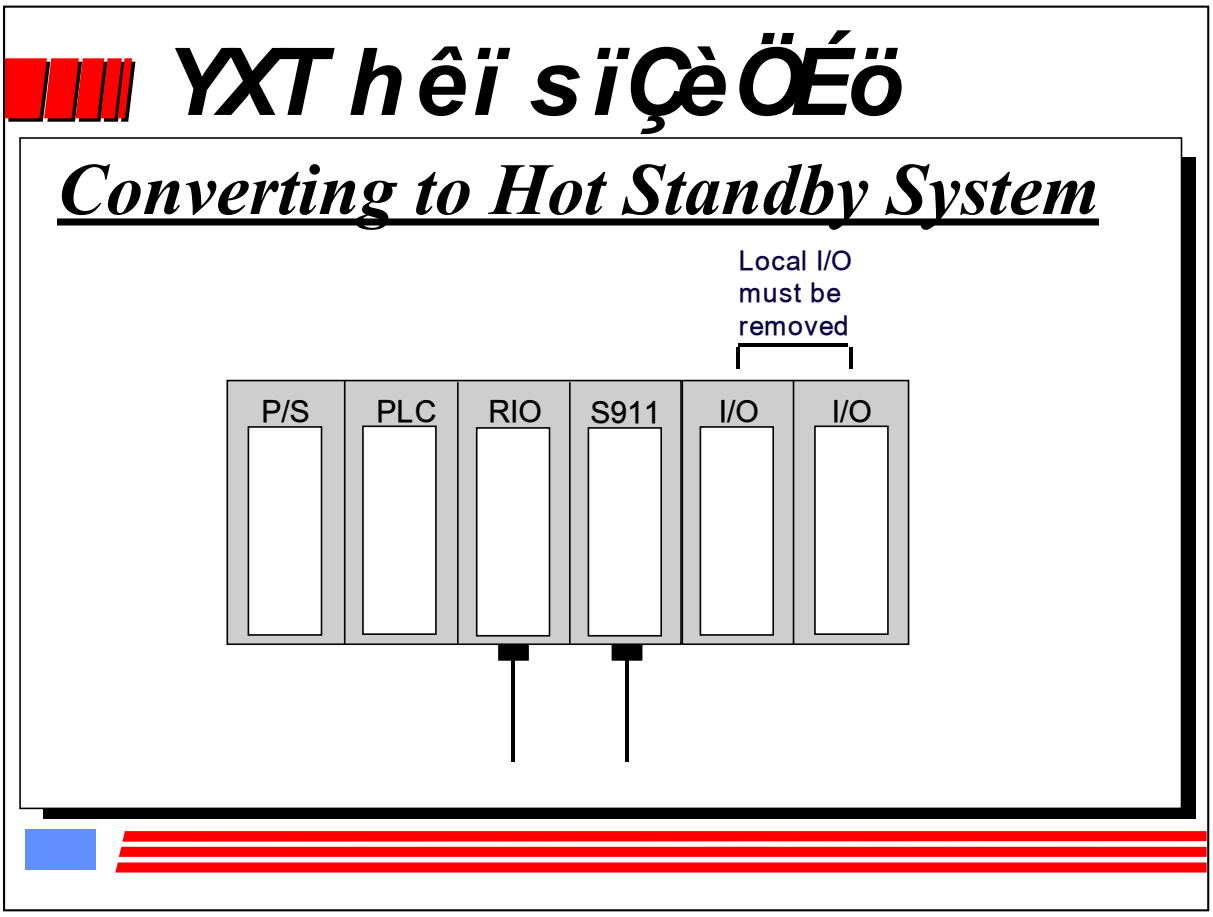
A 984 Hot Standby system supports only Remote I/O. It does not support Local I/O.

- A 984 Hot Standby System consists of two PLC Mainframes that control 800-series Remote I/O. Hot Standby capability can be achieved in four types of 984 mainframes:

  * **the 984A**
  * **the 984B**
  * **the 984X**
  * **the 984-680**

- Each controller is paired with an **S911 Hot Standby Module**. The module monitors its own controller and communicates with the other Hot Standby Module. The system monitors itself continuously. If the Primary controller fails, the Hot Standby Module switches control to the Standby, which then becomes the Primary controller. If the Standby controller fails, the Primary continues to operate without a backup.

- A 984 Hot Standby System is intended for Remote I/O Control only. It ***does not*** support Local I/O. If your Primary Controller is set up to run Local I/O and a switchover occurs, the Local I/O ***will not be*** controlled when the Standby takes over. **Therefore, never plan to control critical I/O locally.**



Adding Hot Standby Capability to an Existing System

- To add Hot Standby capability to an existing 984 system, you must install a second chassis or Primary Rack with modules identical to those in the original chassis or rack. Keep the following requirements in mind:
  - You must remove any Local I/O from the original chassis or rack, as they are not supported at switchover.
  - The components in both chassis or racks must be the same version in both hardware and firmware.
  - You must install a splitter and a self-terminating F adapter between the original RIO Head Processor and the RIO network. A second cable will run from the splitter to the Standby RIO Head Processor, through a second self-terminating F adapter.
- As a precaution, you should first stop the controller and disconnect power to the system.

MORE

NOTE:

- If later, you decide to upgrade from a 984 Hot Standby system to a Quantum Hot Standby system, you may port your Ladder Logic Program by first deleting the **HSBY** block, then relocating the program, and then inserting a **CHS** instruction block.

The HSBY Loadable

- The logic in the HSBY loadable software is the engine that drives the Hot Standby capability in a 984 control system. The HSBY loadable gives you the ability to:
    - Specify the Hot Standby **Command** register, which is used to configure and control Hot Standby system parameters.
    - Define a Hot Standby **Status** register, which can be used to monitor the real machine status of the system.
    - Implement an **HSBY** instruction in Ladder Logic.
- Unlike **CHS** in Quantum controllers, the **HSBY** instruction ***does*** have to be placed in a Ladder Logic program for 984 Hot Standby to be supported.

How to Configure a 984 Hot Standby System

- In a 984 PLC system that is programmed via Modsoft, you will configure Hot Standby capability via an HSBY instruction in ladder logic.
    - **Method**
      Program the HSBY instruction in Network 1, Segment 1 of your Ladder Logic Program and unconditionally connect the top node to the power rail via a horizontal short.

      Define the Hot Standby Configuration Parameters in a series of Hot Standby Configuration Screens in Modsoft.

Ladder Logic in a Hot Standby System

- All Ladder Logic for Hot Standby functions should be in Segment 1. Network 1 of Segment 1 is reserved exclusively for the HSBY instruction block and Ladder Logic directly associated with it.

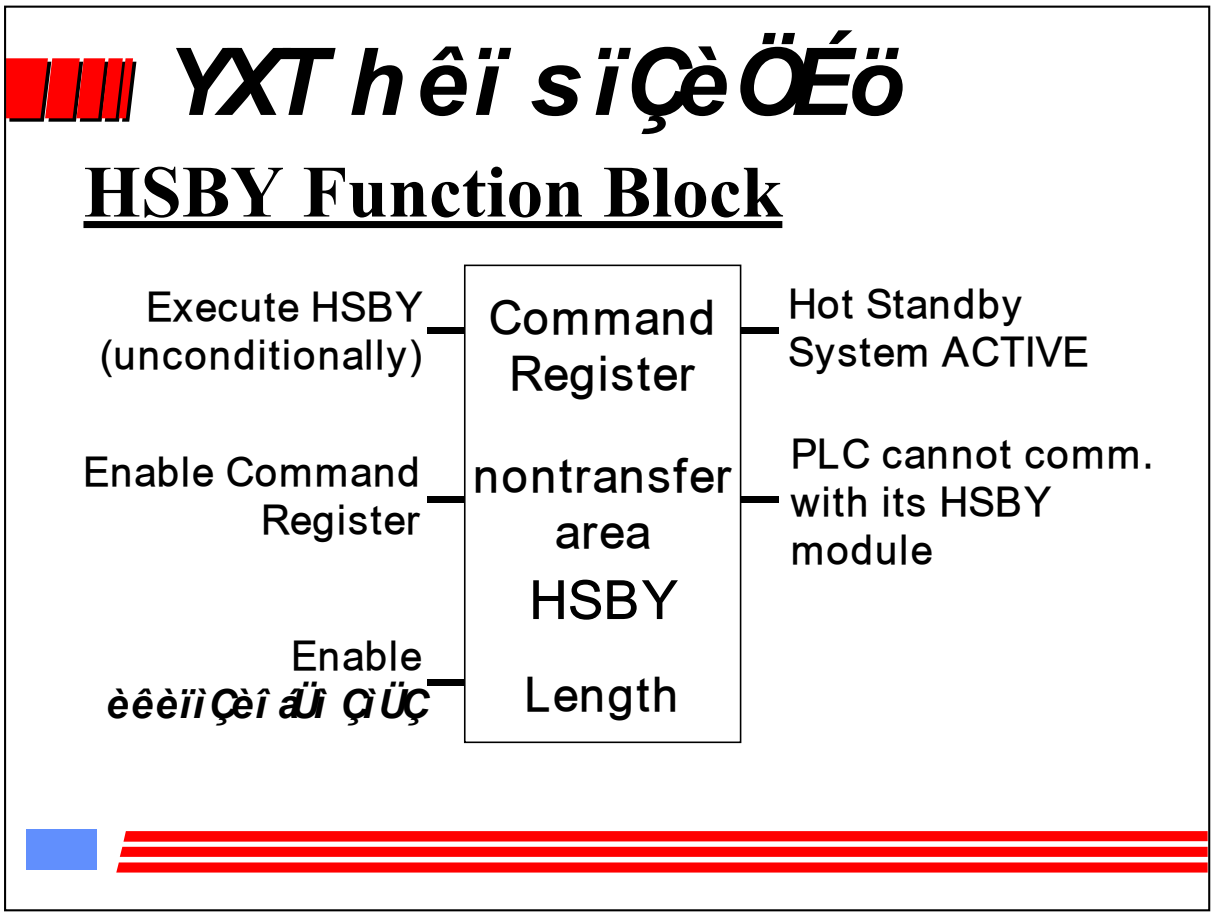
- **Segment 1**
  When your Hot Standby system is running, the Primary Controller scans all segments, while the Standby Controller scans only Segment 1 of the configured Ladder Logic Program. This has three very important implications with respect to the way you configure system logic:

  - You must program all Ladder Logic specific to Hot Standby functions in Segment 1

  - You must not program I/O control logic in Segment 1

  - You must not schedule any I/O Drops in Segment 1

- The Standby Controller in a Hot Standby system must never execute I/O Logic.



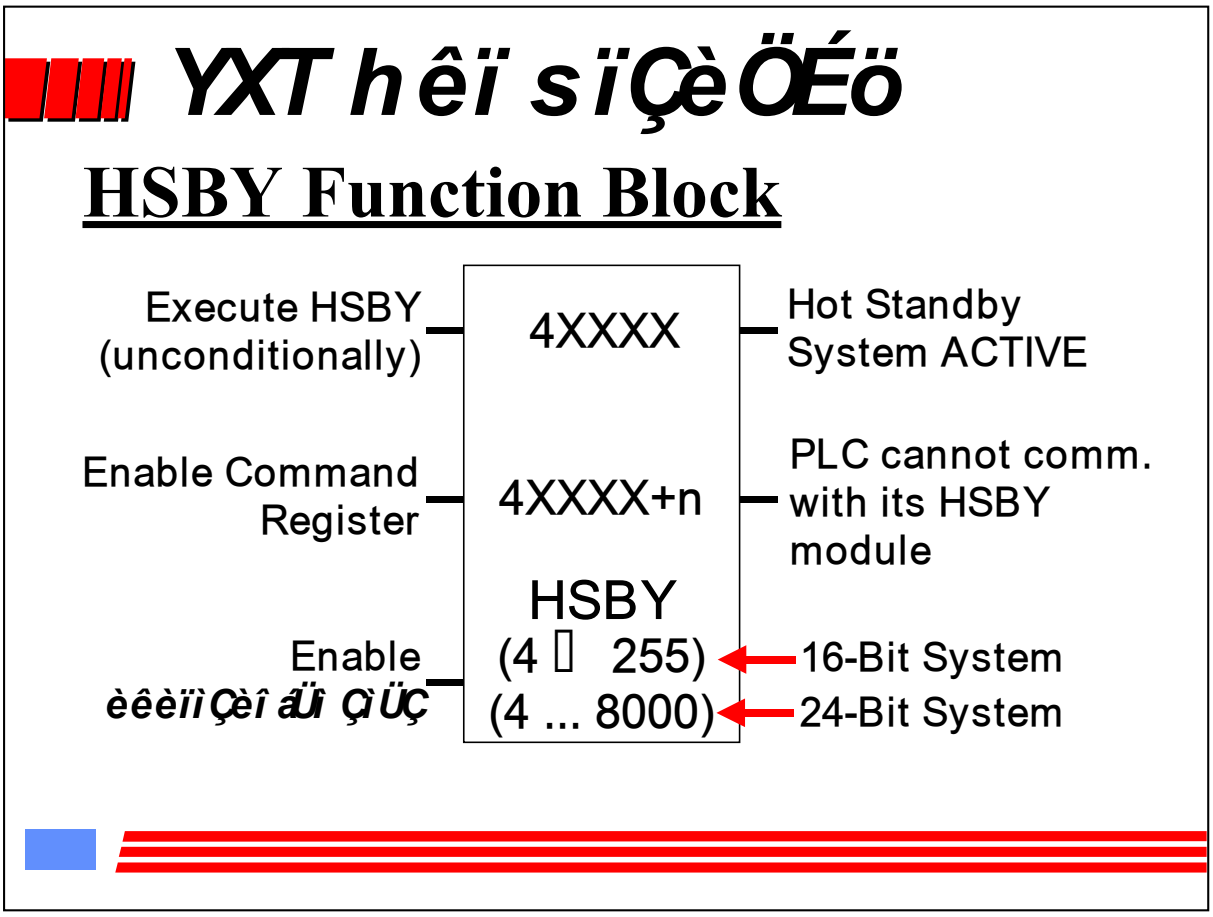
- **Inputs**
  When the HSBY instruction is inserted in Ladder Logic to control the Hot Standby configuration parameters, its Top Node must be connected directly to the power rail by a horizontal short. No control logic, such as contacts, should be placed between the rail and the input to the top node.

  The middle node enables the Command register. This input must be ON for the Hot Standby system to be functional.

  The bottom input enables the nontransfer area of State RAM. This input can be built with one or more horizontal shorts and/or one or more contacts.

- **Outputs**
  The output from the top node goes ON to indicate that Hot Standby is running.

  The middle output line, MAINFRAME FAULT, goes ON if the controller cannot communicate with its S911 Hot Standby Module.



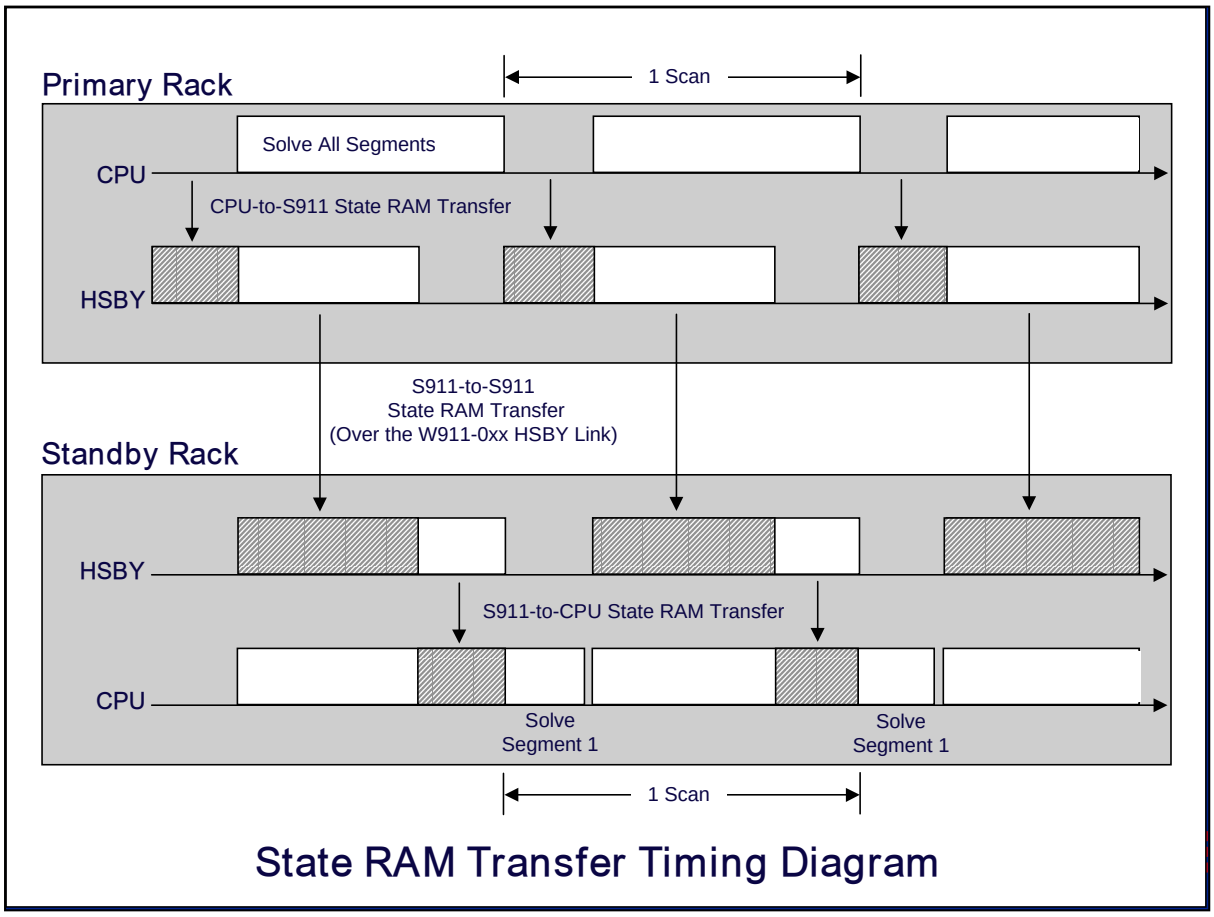
- **Top Node Content**
  The 4x register entered in the top node is the ***HSBY Command Register***. Eight bits are used in this register to configure and/or control Hot Standby system parameters.

  The Hot Standby Command Register must be outside of the *nontransfer area* of State RAM.

- **Middle Node Content**
  The 4x register entered in the middle node is the first register in the *nontransfer area* of State RAM. The nontransfer area must contain at least four registers (to be explained later).

  The 4x registers in the nontransfer area are never transferred from the Primary to the Standby PLC during the logic scans. One reason for scheduling additional registers in the nontransfer area is to reduce the impact of the State RAM transfer on the total system scan time.

- **Bottom Node Content**
  The integer entered in the bottom node defines the *length* of the Hot Standby *nontransfer area* in State RAM. The *length* must be in the range 4 ... 255 registers in 16-bit PLCs and 4 … 8000 registers in 24-bit PLCs.



State RAM Transfer Timing Diagram

State RAM Transfer

- A Hot Standby system transfers State RAM data from the Primary to the Standby controller while the Primary controller scans and solves the Ladder Logic application program. There are three steps in this transfer process:
  - Primary controller-to-S911 State RAM transfer
  - S911-to-S911 State RAM transfer
  - S911-to-Standby controller State RAM transfer
- The State RAM transfer operation is initiated by the Primary S911 Hot Standby module. The module requests specified State RAM information from the Primary controller.
- At the beginning of each scan, the primary controller transfers the current State RAM data to the S911 Hot Standby module.

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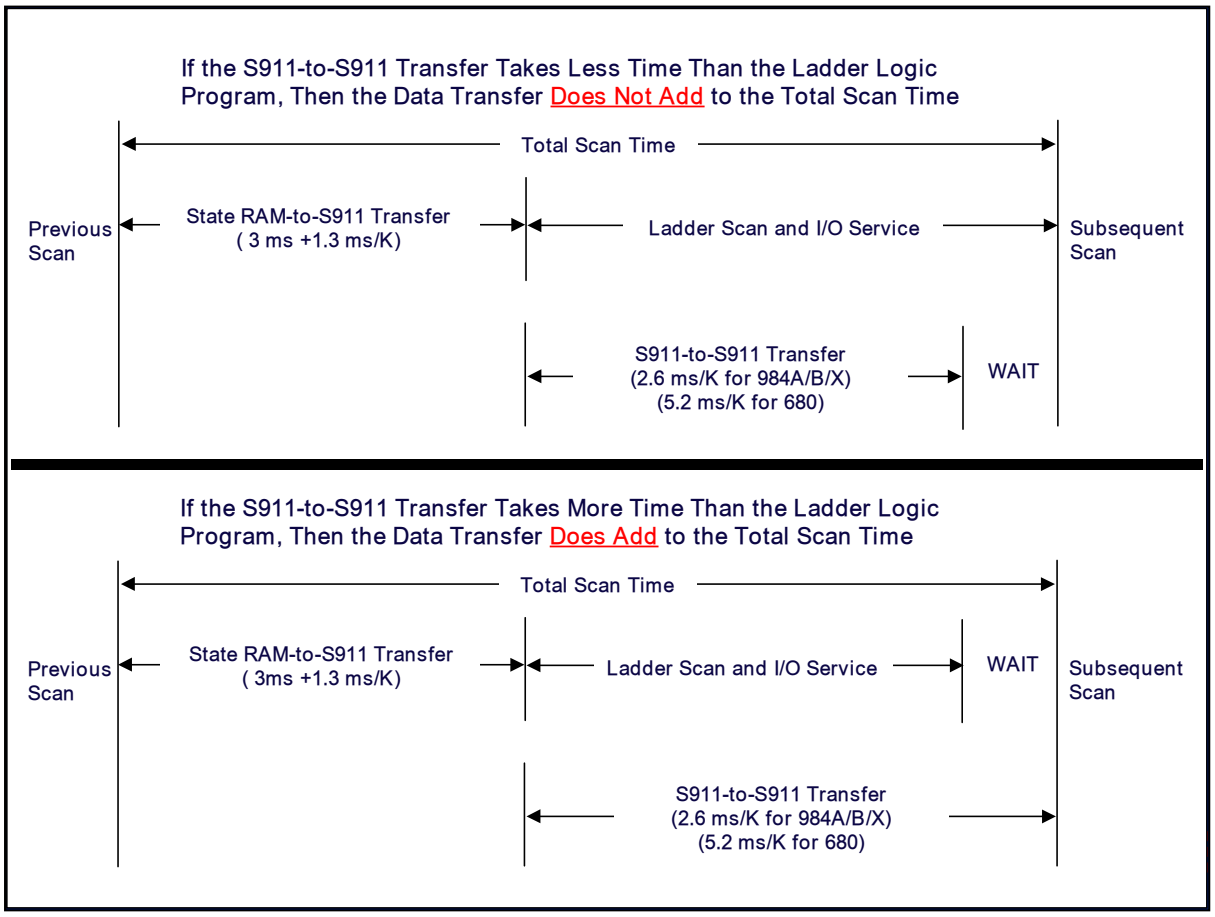
- As soon as the controller-to-S911 transfer finishes, the Primary controller resumes scanning ladder logic and servicing I/O. The State RAM data is simultaneously transferred from the Primary S911 module to the Standby S911 module over the W911 cable.

- In turn, the Standby S911 module transfers the State RAM data to the Standby controller.

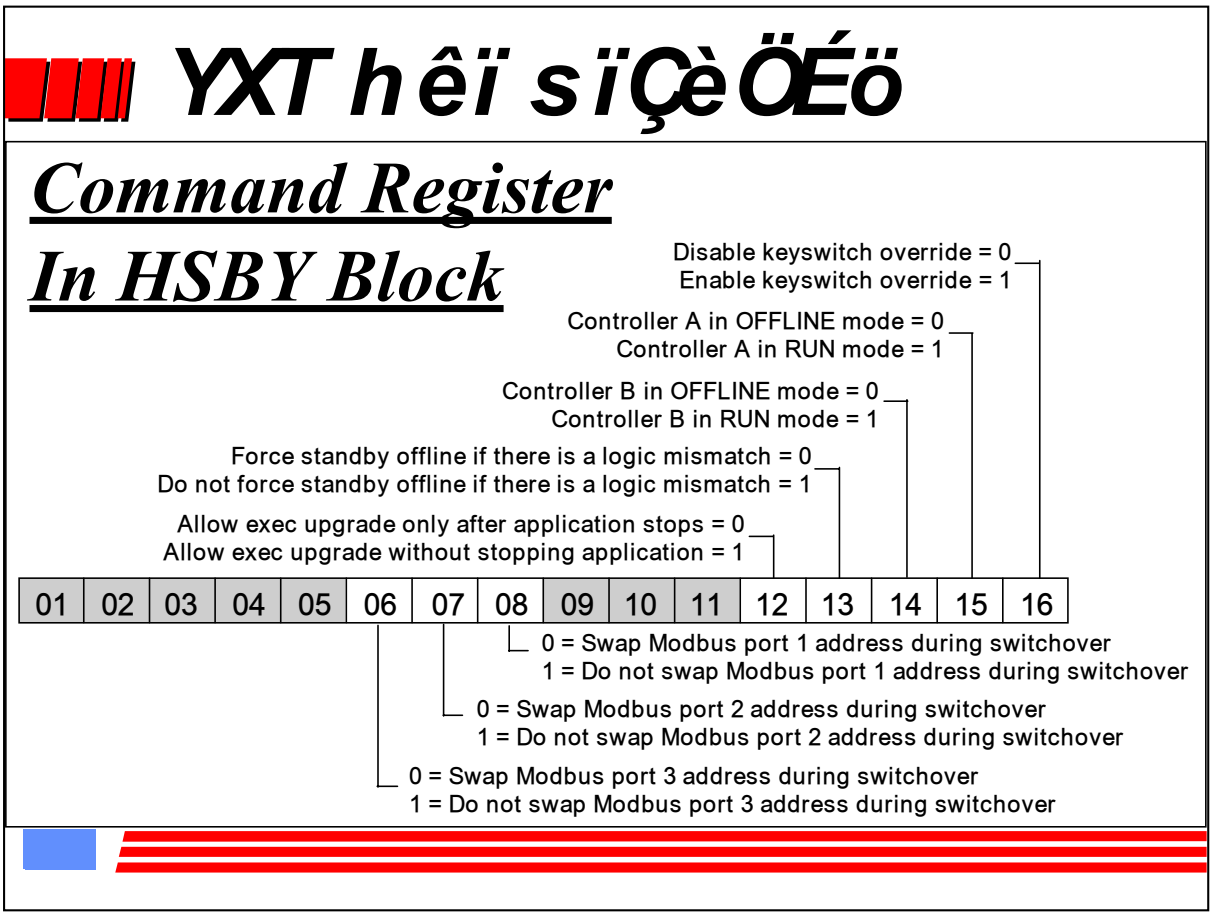
- The timing diagram on the previous page shows how the transfer takes place.



Effect on System Scan Time

- When the ladder logic program being executed by the Primary Controller is longer than the S911-to-S911 transfer, the transfer ***does not*** increase total system scan time. However, if your ladder logic program is relatively short, the scan will finish before the S911-to-S911 data transfer and the data transfer ***will*** increase total system scan time.

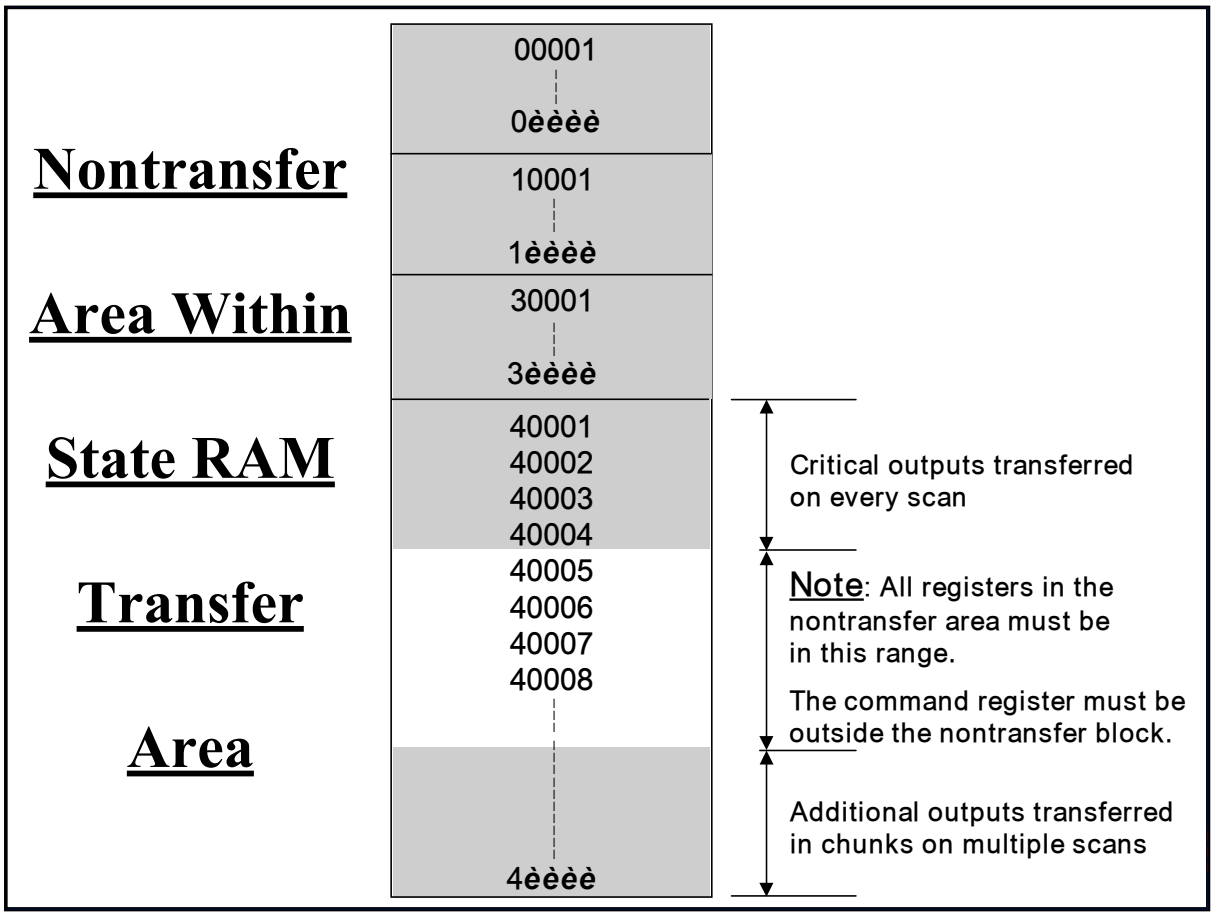
- ***Note:*** No matter how long your transfer takes, it ***will not*** cause a watchdog timeout.



- **The Command Register**
  The Command register is defined in the top node of the HSBY instruction block. The bits in this register are used to configure and control various parameters of the Hot Standby system.

  The Command Register must be a 4xxxx register in the portion of the State RAM transfer area that is transferred from the Primary to the Standby controller on every scan. Therefore it must be ***outside of the nontransfer area***.

  The values set for the bits in this register determine the system parameters at startup. The register can be accessed while the system is running using the Modsoft Reference Data Editor (RDE).



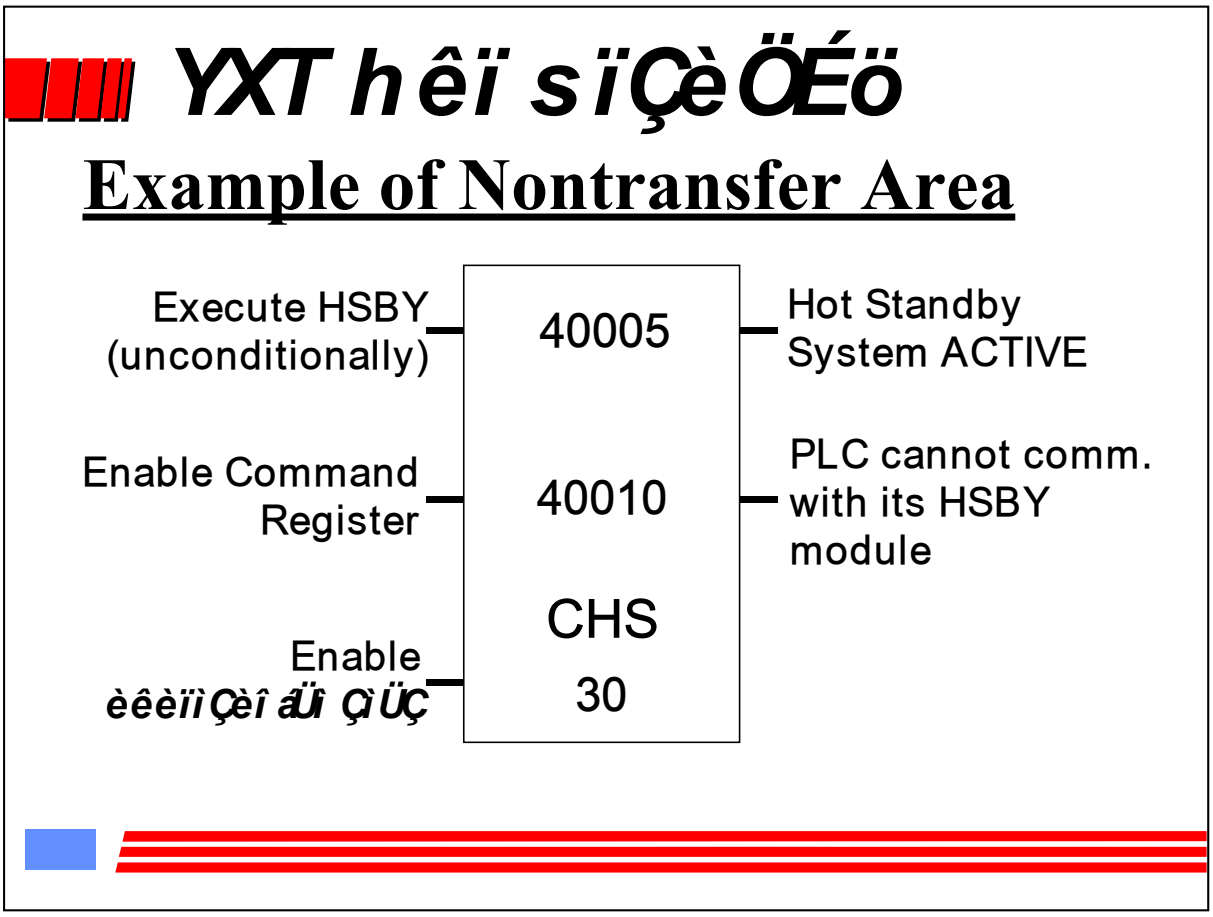
The Nontransfer Area of State RAM

- You must also define a nontransfer area. A nontransfer area:
  - Is a tool to reduce scan time.
  - Is located entirely within the range of 4xxxx registers in the State RAM transfer area which are transferred on every scan.
  - Consists of a block of four or more 4xxxx registers.
  - Allows the user to monitor the Status of the Hot Standby system.

Elements of the Nontransfer Area

- The most important part of the nontransfer area is the Hot Standby Status Register. Once the system has been configured and is running, the Status Register becomes a valuable tool for monitoring the machine states of the two controllers.

  The nontransfer area also includes a pair of registers that can be used for programming reverse transfer operations.



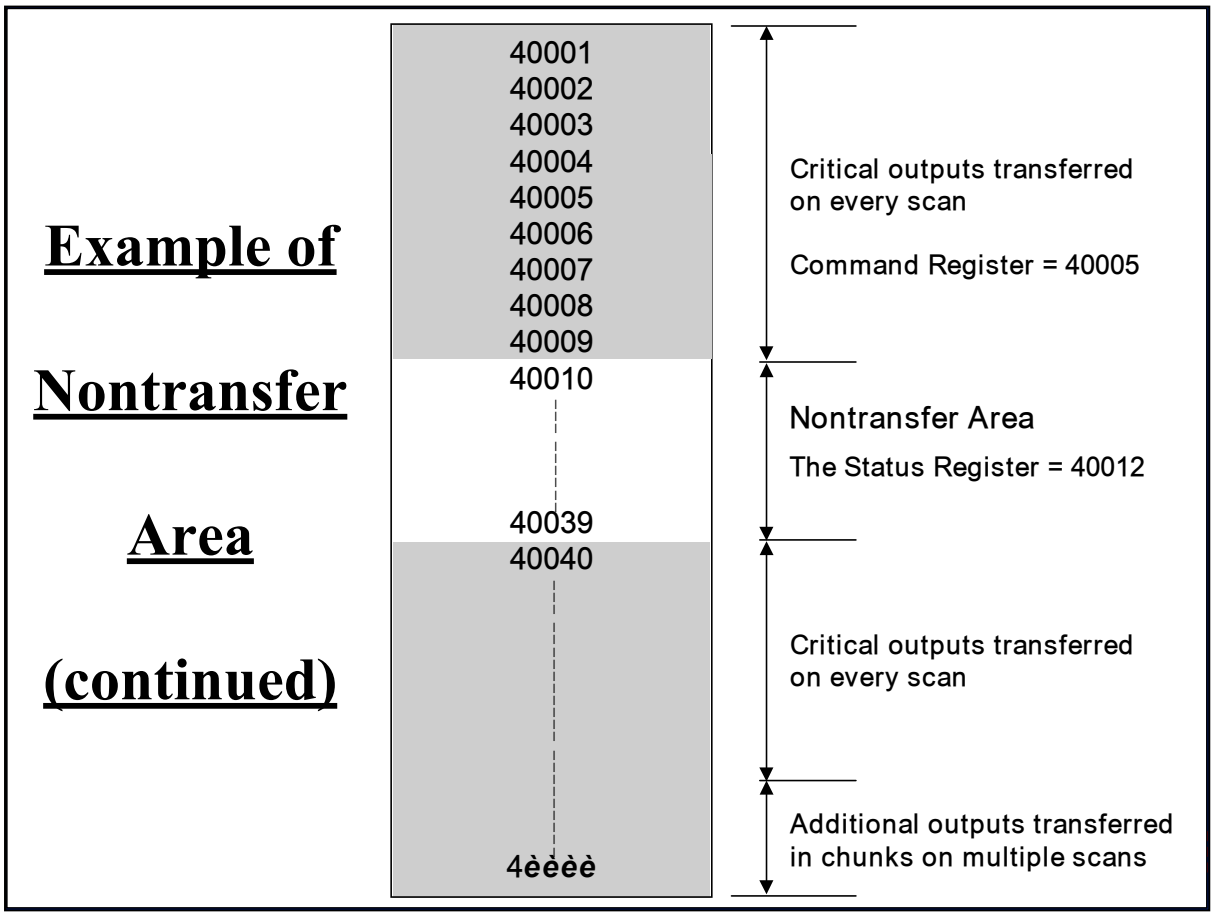
Defining the Nontransfer Area

- The nontransfer area is defined in the middle and bottom nodes of the instruction block. The middle node specifies the first register in the nontransfer area. The bottom node specifies the length of the nontransfer area.

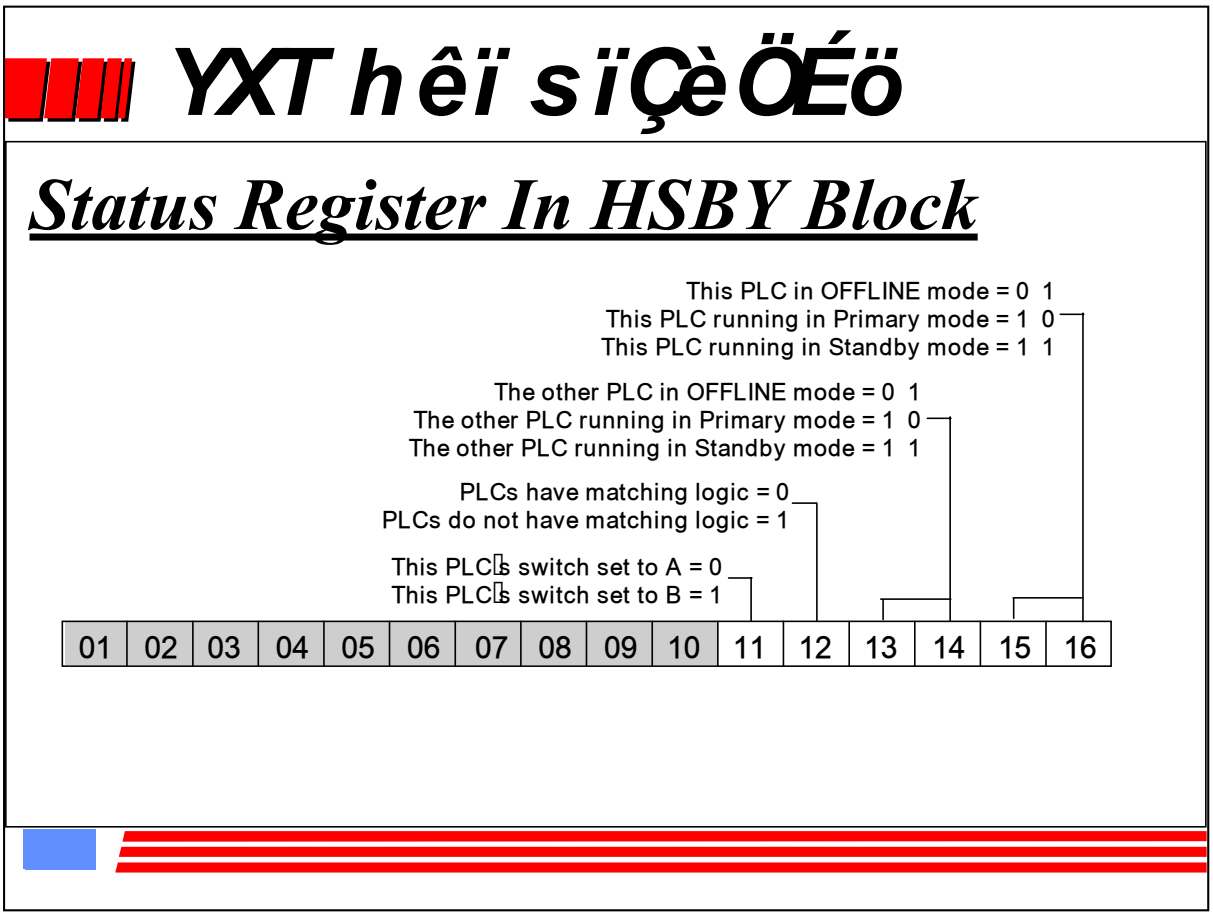
- The nontransfer area must be at least ***four registers*** long. The first two registers in the nontransfer area are reserved for reverse transfer functions. The third register in the nontransfer area if the Hot Standby Status Register.

- The fourth register and all other contiguous 4x registers specified for nontransfer will be ignored when the State RAM values of the Primary controller are transferred to the Standby controller.

- In the example illustrated above, the nontransfer area would begin at register 40010, as defined in the middle node. The length would be 30 registers, as defined in the bottom node. Thus the last register in the nontransfer area would be 40039.



- This is a graphic illustration of the Example on the previous page. Note that in this example, the Status Register would be register 40012.



The Hot Standby Status Register

- The third register in the nontransfer area will be the Status Register. Use this register to monitor the current machine status of the Primary and Standby Controllers.

The Reverse Transfer Registers

- You can use the reverse transfer registers to transmit diagnostic data from the Standby controller to the Primary controller. When you choose to define a nontransfer area, registers 4x and 4x + 1 in the nontransfer block are copied from the Standby to the Primary controller. This is opposite from the normal *forward* State Table transfer from the Primary to the Standby.

- If you choose *not to* use the reverse transfer registers, ***do not*** place the HSBY instruction block directly against the power rail in your Ladder Logic Program, so that the input to these registers will not be turned On.

This concludes the discussion of Modicon Hot Standby Systems