

Hiway Gateway Implementation Guidelines

HG12-510

**Implementation
Hiway Gateway - 1**

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Implementation Guidelines***

**HG12-510
9/95**

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Revision 01 - September 15, 1995

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About This Publication

This publication provides guidelines for the implementation of Hiway Gateways and the Data Hiway each HG serves. Information is provided about configuring the hiway and box/slot entities, hiway operational test, HG checkpointing and loading operations, coexistence with 4500 and 45000 process computers, and compatibility of LCN and Data Hiway hardware.

This publication supports TDC 3000^X software release 500.



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HIWAY CONFIGURATION AND BOX/SLOT CONFIGURATION

Section 1

This section provides guidelines for building hiway configuration and box/slot configuration entities.

1.1 PURPOSE OF THE HIWAY AND BOX/SLOT ENTITIES

Each hiway entity (point) defines for the LCN system and the Hiway Gateway a Data Hiway and the role of the HG. Each box/slot entity defines for the LCN system and the HG, a box on the Data Hiway, and for process-connected boxes, the box/slot entity defines the each slot in the box.

1.2 HIWAY AND BOX SLOT ENTITIES TO BE BUILT

1.2.1 Hiway Entities

You must build a hiway entity for each Data Hiway connected through an HG to the LCN. Because each LCN can have up-to-20 process networks (each Data Hiway and Universal Control Network is one process network), you may need to build up-to-20 hiway entities.

Hiway entities are reserved entities; that is, they are entities whose names are reserved for use by the system and whose name begins with a dollar sign. The names are in this form:

\$HIWAYnn

where nn is the hiway number (1 through 20).

1.2.2 Box/Slot Entities

You must build one box/slot entity for each box on a Data Hiway, where “box” means any of the following:

- HG—Hiway Gateway
- CB—Basic Controller
- HLPIU—High Level Process Interface Unit
- LLPIU—Low Level Process Interface Unit
- LEPIU—Low Energy Process Interface Unit
- MC or AMC—Multifunction Controller or Advanced Multifunction Controller
- MCRDC—MC Reserved Controller Director
- EC—Extended Controller
- CBRCD—CB Reserved Controller Director
- ECRCD—EC Reserved Controller Director

- DHP—Data Hiway Port
- OPSTA—Operator Station (Basic or Extended)
- H4500—4500 Process Computer
- GCPI—General Purpose Computer Interface

Box/slot entities are reserved entities; that is, they are entities whose names are reserved for use by the system and whose name begins with a dollar sign. The names are in this form:

\$HYnnBxx

where nn is the hiway number (0 through 20) and xx is the hiway box number (1 through 63). Each HG in a pair of redundant HGs uses one hiway box number, so for these you need to build two box/slot entities.

1.3 THE ORDER FOR HIWAY AND BOX/SLOT ENTITY BUILDING

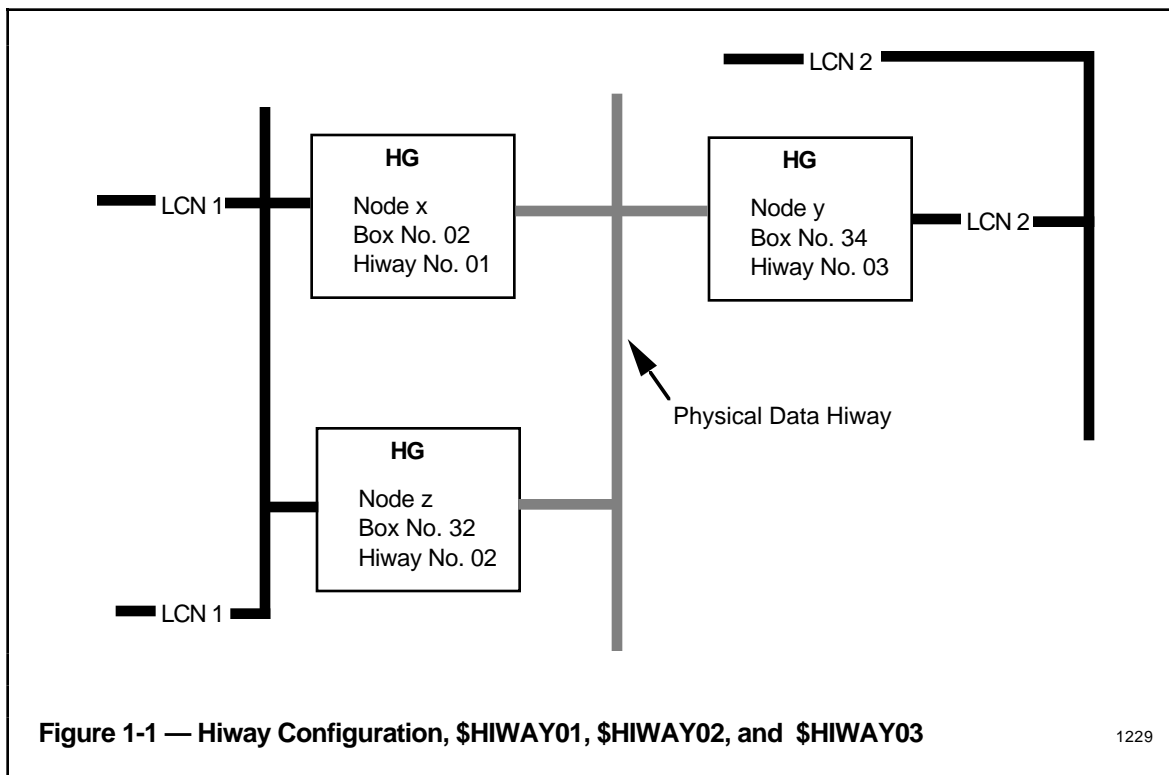
The order in which the Hiway Configuration and Box/Slot Configuration activities are accomplished is important. They are built by selecting HIWAY GATEWAY on the Engineering Main Menu, which calls up the HG Build Type Configuration Menu.

Do these activities in this order:

1. HIWAY CONFIG
2. BOX/SLOT CONFIG for this HG pair.
3. BOX/SLOT CONFIG for the process-connected boxes on this hiway.

The reserved entities that are defined by these tasks must be loaded in this order. This means you must use individual Load commands to load the entities in this order, or you must use a Load Multiple command that loads them in the proper order. For a Load Multiple command, the order in which the entities are loaded is specified by the order that the entity names appear in the selection list file.

You could also load these entities from an exception build source file (.EB file). In the .EB file, entities must be listed in the proper order.



1.4 HIWAY CONFIGURATION

When you build and load a hiway entity, you create reserved entity \$HIWAYn which defines the HG functions defined under subsections 1.4.1 through 1.4.3

1.4.1 Hiway Number

Each pair of HGs (a primary and a secondary) on an LCN is assigned a unique hiway number. The hiway number identifies the hiway database to be used by the HG pair. A physical Data Hiway can interface the LCN through more than one HG pair, in which case, the hiway number is a logical hiway number. Figure 1-1 illustrates this numbering scheme.

1.4.2 Hiway Traffic Director Functions

For the HTD Assignment (parameter HWYHTD), select HTD when the Data Hiway includes a Hiway Traffic Director. Each HTD supports up-to-four preferred-access devices on the hiway. Preferred-access devices include HG pairs (counts as two devices), Operator Stations, 4500 process computers, and General Purpose Computer Interfaces (GPCIs). An expander can be added to an HTD that allows it to support up-to-16 preferred-access devices.

The HTD controls hiway-access priorities. When there are many preferred-access devices on the hiway, the hiway may become quite busy and lower-priority devices may occasionally report "no-hiway grant" errors.

Preferred-access devices can request the HTD to swap the currently active hiway. One or more will do so if the hiway swap algorithm fails (for more information, refer to Section 2). In such a case, the HTD must be manually reset before the hiway can be swapped again. A control is available on the HTD to force a hiway swap.

The HG can perform the HTD functions for this HG pair and one other preferred-access device; therefore, an HTD is not required on a Data Hiway that has only this HG pair and one other preferred-access device. In this case, the HTD Assignment (HWYHTD) is `ThisHG`, `RemoteHG`, or `AddedHG`.

Where the HG does perform the HTD functions, the HTD does not need to be manually reset. This allows periodic hiway swaps. The swap is performed once-per-minute to once-per-day, as configured in the `$HIWAYnn` entity. An HG that performs the HTD functions can support one 1500-meter hiway branch and 26 loads (boxes).

Data Hiways with more than one HG pair must have an HTD.

The wiring used to connect the access request and grant lines to HGs, HTDs, Preferred Access Expanders, and other preferred-access devices is defined in the *Site Planning Manual* in the *Basic System* bookset.

1.4.2.1 Preferred Access Priorities When No HTD is Present

Figure 1-2 shows the customer-supplied wiring and switch we recommend for resolving hiway access requests from preferred-access devices, when the HG is performing the HTD function (no HTD is present). This connection should be made with caution based on hiway loading.

The 3-pole switch is optional. It provides a way to give access to the hiway to another preferred-access device, such as an Operator Station, should the HGs not be granting access. This switch would allow access to the hiway by the other preferred-access device, during periods when the HGs are out of service for some reason, such as updating software or maintenance.

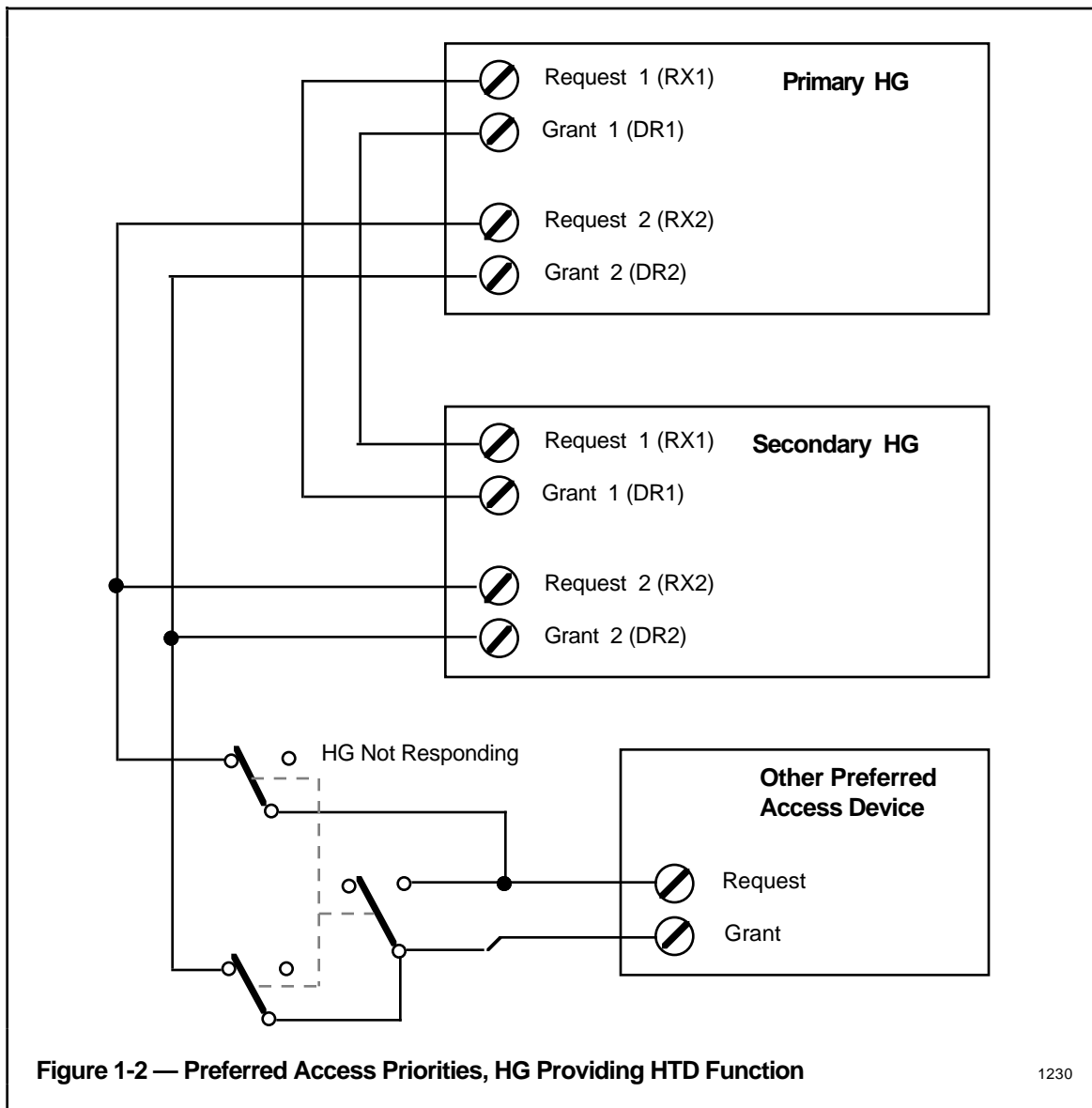
When the HGs are returned to service (OK on the node status display), the switch should be returned to the Normal position. If it is not, messages on the hiway can be garbled.

1.4.2.2 Preferred Access Priorities When an HTD is Present

On Data Hiways with little traffic, preferred-access priorities are relatively unimportant, but on heavily loaded hiways, the priorities have a significant impact on system behavior. The HTD provides these access priorities:

1. One secure Operator Station.
2. Access for the principal high-level control devices to minimize control loop initializations caused by lack of access to the hiway.

3. Access to remaining devices during the hiway time that is left.



Our recommendations for establishing these priorities are as follows:

1. **One Operator Station**—In systems where a hiway-based Operator Station exists, and there is a need to grant access to that station when the HGs are out of service, that station should be configured at the highest priority. Alarm scanning should not be enabled on that station. If additional Operator Stations are configured above the HGs and 4500 or 45000 process computers, there is a risk that there will be insufficient access to the hiway by control functions, which causes recurrent initialization. As experience in exercising control from the LCN-based system grows, the need for an Operator Station with this priority decreases.

It is not recommended that all users have an Operator Station configured this way, but this configuration does provide access where the user has such a need.

2. High Level Devices—These can be a 4500 or 45000 process computer or the LCN-based modules accessing the hiway through the HG pair. If a 4500 or 45000 is a PMC or PMX system doing control, it should have the higher priority. If LCN-based modules are doing control, the HG pair should have the higher priority.
3. Remaining High Level Noncontrol Devices—Access priorities for such devices are at the third level.
4. Remaining Operator Stations—On a busy hiway, these stations may occasionally display question marks to indicate that insufficient access to the hiway has been granted.

The rules for a Preferred Access Expander connected to the HTD are described in the Basic System's *Site Planning Manual*.

1.4.3 Sequence-of-Events Synchronization

Configure either an HG pair, or a 4500 or 45000 Process Computer to provide sequence-of-events (SOE) synchronization.

Only one HG pair on a physical Data Hiway can be configured for SOE synchronization (Enable selected for SOESYNCH). When a primary HG is configured for SOE synchronization, the secondary HG takes over this function, should the primary fail.

1.5 BOX/SLOT CONFIGURATION

The type of each box on the Data Hiway (including the HG) is defined in this task, as is the box's address on the hiway. Also, several box functions are configured, including the actual box type and board type in each slot.

1.5.1 HG Data Hiway Addresses

Each HG requires one Data Hiway address ("box number" on the configuration form). An HG pair requires two consecutive addresses. The primary HG is assigned the even address and the secondary is assigned the odd address, for example 02 and 03. Each HG retains its assigned address regardless of which one has control. The HG that assumes control writes its address into the memory word "Alarm Reporting Address" of all polled devices (PIUs, DHPs, etc.).

If you add an HG or HGs to an existing Data Hiway, build and load the HG box/slot entities (\$HYnBx) before loading the box/slot entities for the process-connected boxes.

When a system is first started with the Honeywell-supplied HG checkpoint directory (&HGC) the checkpoint data files contain a null hiway database, and the HG temporarily assumes hiway address 4, so that it can test and report on the state of the hiway and the active hiway cable (A or B). In this situation, the HG can use the address normally assigned to an Operator Station, because it does not actually use the hiway until the first box/slot entity for a process-connected box is loaded. For this reason, the first box/slot entity loaded must be the HG's entity.

1.5.2 Other Hiway Address Assignments

Other hiway address assignments ("box number" on the configuration form) are as follows:

Device	Addresses
4500 and 45000 Process Computers	1
First HG pair	2, 3
All Operator Stations, all General Purpose Computer Interfaces and all Personal Computer Interfaces	4
Next HG pair (Added or Remote)	32, 33*
Next HG pair (Added or Remote)	34, 35*

PIUs, MCs, and DHP take two hiway addresses, one of which must be in the range from 5 to 31 and the second of which is 32 greater than the first address.

CBs and ECs can have any unused address in a range of 5 to 63.

The hiway test box can have any unused address in a range of 1 to 63.

No duplicate hiway addresses are permitted except for Operator Stations, General Purpose Computer Interfaces, and Personal Computer Interfaces.

If there is no HTD and no optical hiway coupler, the maximum number of devices on the hiway is 28. If the optical hiway coupler is present, these are further constraints on this rule. See the *Site Planning Manual* in the *Basic System* bookset.

1.5.3 HG Box Assignment

For an HG, the Box Assignment line (parameter BOXASSN) is used to establish the relationship between HGs on the Data Hiway. HGs read the address security word in the other HGs, and each needs to know its role from that of the others. The selections are:

- **ThisHG**—The box number (address) being configured belongs to this HG, not another HG on the same hiway.
- **AddedHG**—The box number (address) being configured belongs to an added HG on the same LCN as **ThisHG**. The added HG is used to share the processing load of **ThisHG**.
- **RemoteHG**—The box number (address) being configured belongs to an HG on this hiway, but on another LCN.

Table 1-1 provides an example of the Box/Slot configuration for the hiway example on Figure 1-1.

*When DHPs are on the hiway served by an HG pair, in order for alarms to function properly, the addresses (box numbers) for the HG pair must be less than 32.

Table 1-1 — Example of Box/Slot Configuration for the HGs on Figure 1-1

Hiway Address*	Box Assignment Node Pair x	Box Assignment Node Pair z	Box Assignment Node Pair y
2	ThisHG	AddedHG	RemoteHG
3	ThisHG	AddedHG	RemoteHG
32	AddedHG	ThisHG	RemoteHG
33	AddedHG	ThisHG	RemoteHG
34	RemoteHG	RemoteHG	ThisHG
35	RemoteHG	RemoteHG	ThisHG

*"Box Number" on the configuration form.

1.5.4 Box Assignment for Process-Connected Boxes

Like the HG, the process-connected boxes have a Box Assignment (BOXASSN) that defines the relationship of the box (CB, MC, EC, DHP, PIU) to the HGs. The following selections are available:

- **ThisHG**—The HG that is configured as `ThisHG` (see subsection 1.5.3) provides support for all of the box's functions. The following conditions apply to the box:
 - Data points can be built and loaded through `ThisHG`.
 - Time-out gates operate.
 - Hiway security is checked by `ThisHG`.
 - Access to the box by LCN nodes is available.
 - The box's data can be checkpointed and loaded.
 - Event processing and change detection (if applicable to the box type) can be configured for the box.
- **AddedHG**—The HG that is configured as `AddedHG` (see subsection 1.5.3) provides support for the box. The following conditions apply to the box:
 - Data points cannot be loaded in the box.

- Hiway security is checked. For correct operation of the hiway-security check, the box configured as `ThisHG` must know of the existence of the `AddedHG` box on the hiway.
- `RemoteHG`—The HG that is configured as `ThisHG` provides limited support for a box configured as a `RemoteHG`. This box is fully supported by the HG that is configured as `RemoteHG` (see subsection 1.5.3). The following conditions apply to the box:
 - Data points can be built and loaded in the box.
 - Hiway security is checked.
 - Access to the box by LCN nodes is available.
 - The box's data can be checkpointed and loaded.
 - Event processing and change detection cannot be configured for the box.

In a Universal Automatic Control (UAC) system, controllers (CBs, MCs, and ECs) and associated Reserve Controller Directors must be assigned to the same HG for correct UAC status and command handling.

- `H4500`—The HG that is configured as `ThisHG` (see subsection 1.5.3) provides limited support for the box that depends on additional configuration entries. The box is shared by a 4500 or 45000 process computer or a similar preferred-access device on the hiway. The following conditions apply to the box:
 - Data points can be built and loaded in the box.
 - Hiway security is checked.
 - Access to the box by LCN nodes is available.
 - The box's data can be checkpointed and loaded.
 - Event processing and change detection can be configured for the box. The 4500 or 45000 process computer is expected to handle events and change detection.

1.5.5 Event Processing and Change Detection—Box Mastership

1.5.5.1 Event Processing

If event processing is not accomplished by the HG, no alarm annunciation from the box is available on the LCN. This means that alarm status information is not available for the Group Display or any other displays. Only one HG should be configured to do the event processing for a box (see the conditions under each of the selections in subsection 1.5.4). Also, select `Enable` on the Event Processing line (`EVENTPRC`) for this box, if its alarm information is to be processed by the HG. Event processing can't be configured for an HG configured as `RemoteHG`, but LCN nodes have access to its status information.

The assignment of event processing (EVENTPRC = Enable) for PIUs, MCs, and DHPs determines which device receives the reports from these boxes. A PIU and a DHP can report to only one device (HG or 4500 computer). Different PIUs and different DHPs can report to different HGs.

1.5.5.2 Change Detection

The HG configured as ThisHG must be the detector of change flags. The Change Detection selections (CHNGFLG = NotConfig, Detect, or Set) determine whether the HG is to be a detector of change flags, or should ignore changes. Operator Stations on the hiway are always setters of change flags. A 4500 process computer is always a setter of change flags for the boxes it accesses.

As a setter, the HG sets the box-change flags for any write to a box by the HG. In MCs this causes an entry in the change circular list. Also a Universal Station makes entries in the change journal for changes that the US makes. Database changes made by an HG are recorded in the 4500 computer. HGs don't detect changes made by other hiway devices. This could result in the HG not having the correct algorithm number, alarm configuration, or PV source configuration (MC only) for a box's slot. Calling up a Detail Display at a Universal Station causes the HG's process database to be updated.

Only one device on a hiway can be a detector of changes. As a detector, the HG doesn't set any change flags on the hiway.

HIWAY OPERATIONAL TESTS Section 2

This section describes the hiway security diagnostic program and the hiway swap algorithm.

2.1 HIWAY SECURITY DIAGNOSTIC PROGRAM

The hiway security diagnostic program verifies that the configured addresses are accessible and that the Data Hiway is operational. This program runs when the Hiway Configuration Entity (\$HIWAYn) is loaded in the HG.

2.2 THE HIWAY SWAP ALGORITHM

The hiway swap algorithm (HSA) is a cable-quality evaluator that runs in HGs and hiway-based Operator Stations. A diagnostic scan of each cable occurs every five seconds. A cable swap is forced if one of the following occurs:

- 25% or more of the boxes do not respond to four consecutive scans.
- 50% or more of the boxes do not respond to two consecutive scans.
- 100% or more of the boxes do not respond on one scan.

If the HSA determines that it is necessary to declare that an HG providing HTD functions has failed, further swapping is disabled.

The Hiway Status Display indicates which hiway cable (A or B) is currently in service, and through the HIWAY COMMANDS pick, allows an operator to enable and disable hiway swapping. If the HSA has declared that the HG providing HTD functions has failed, the DISABLE SWAP pick is automatically selected. An attempt to select ENABLE SWAP when the cable failure persists, causes another HSA failure to be reported.

The secondary HG in an HG pair that is providing HTD functions does not cause cable swapping. If the secondary is active and the HSA detects a failure on the active cable, the swap pick and the active cable indicator (A or B) change color to indicate the failure.

When an HTD is on the Data Hiway, swapping is not disabled as the HSA detects a cable failure because cable swaps are handled by the HTD.

2.2.10 Box Control States

When the control state for a box changes from FULL to another state, the mode for all data points in that box that are in the CAS mode and are controlled from LCN-based modules is changed to the SHED mode, indicated by the point's SHEDMODE parameter. Internal box cascades are not affected.

For a box to be in the FULL control state, both the "hiway control state" and individual "box control state" must be set to FULL control. Consequently, by changing the hiway control state from FULL to another state, an operator can simultaneously shed control for all points on the hiway in the event that the LCN-based primary becomes unreliable.

HG CHECKPOINTING AND LOADING OPERATIONS

Section 3

This section describes and provides guidelines for the use of HG checkpoints, HG loading, and box data restoration operations.

3.1 HG CHECKPOINTING

HG checkpointing is the periodic saving of the HG database for subsequent reloading of the HG and its associated process-connected boxes. Both automatic and demand checkpointing are available. For general information about checkpointing, refer to Section 23 of the *Engineer's Reference Manual* in the *Implementation/Startup and Reconfiguration - 2* binder.

After you build points and load them in an HG and the boxes, you need to request a demand checkpoint of the HG and box database. Further, if you change ranges or tuning in existing points, you can save the new data by demand checkpointing. The checkpointed data is in checkpoint files on HMs, cartridges, or floppy disks (automatic checkpoints are stored only on an HM).

HG demand checkpoint data is saved through the SAVE DATA target on the Network Status display. These functions save the following data in the HG checkpoint files:

- HG Resident Data
 - A new engineering units descriptor
 - New alarm-enable status
 - A newly built point
- Box Resident Data
 - New alarm limits
 - New alarm types
 - New PV engineering range limits
 - New algorithm

For more detail on the SAVE DATA functions, see subsection 3.1.3.

NOTE

Don't try to copy checkpoint data from an HM to a floppy disk, because more than one floppy may be needed, and if the data for a unit is split between two floppies, it can't be reloaded. Instead, attain a backup checkpoint on a floppy by requesting a demand checkpoint to floppies.

3.1.1 HG Database Organization

To users, the HG database is a set of data points related to a Data Hiway, and to its HG; but within the TDC 3000^X System this database is not one contiguous collection of data in one location. Part of the database is in the HG and part of it is in the process-connected boxes on the Data Hiway.

If you generally understand how the data is distributed, you can understand some of the safeguards and restrictions built into the system to ensure the validity of the data. In the remainder of this HG Checkpointing subsection, enough is defined about data partitioning, restrictions, and safeguards, so that you can successfully use them.

Because data partitioning for an HG point, the behavior of some of the displays and functions can be affected. For example:

- The data stored in a box cannot appear on the HG point's Detail or Group display if the box is not running; however, its detail display shows the HG the point it is associated with, and the box and slot number it is associated with.
- If a box's power is lost, almost all of point's status information is lost from the Detail display. Only the few parameters stored in the HG remain.

When an HG point is loaded, it is assigned an internal name and the nodes on the network recognize it by this internal name. If this point is deleted and then reloaded, the nodes will probably not know it by its new internal name. To recover you may have to reload the area database.

To get HGs and the hiways running with minimal trouble, it is important to follow the sequences defined in the *System Startup Guide* (Floppy Drives or Cartridge Drive) and it is especially important for HG points to follow the HG checkpointing guidelines in the remainder of this section.

3.1.2 The HG Checkpoint Database

The HG Checkpoint database consists of a group of files that are written by the HG checkpointing software. Safeguards are provided to prevent accidental overwriting of valid checkpoint files. These are described later in this subsection.

The names of the files are as follows:

HG0hhHG _r .CP	Contains the data that resides in the HG.
HG0hhbb _r .CP	Contains the data that resides in the box.
HG0hhMAS.CP	Contains the Master Revision file.
HG0hhbbL.CP	Contains a MC's logic block data.

Where:

- hh is the hiway number (1 through 20).
- bb is the box number.
- r is the revision level of this file, $r = 1$ or 2 . The first time the file is saved, $r = 1$, the second time, $r = 2$, and then it alternates each time the file is saved.

3.1.3 Checkpointing and Box-Save and Box-Load Functions and Guidelines

The HG checkpoint data is saved through the SAVE DATA function on the Network Status display. Step-by-step instructions for this function are provided in the *Process Operations Manual*, in the *Process Operations* binder.

Before proceeding with that function, you should review the following guidelines:

- **Checkpoint File Formatting**—If you need to save an HG checkpoint on a cartridge or floppy disk, we recommend that you create at least 240 files on it to be used for the checkpoint volume or directory. Otherwise, a file access error could occur. Use the Utilities' Create Volume and Create Directory commands to do this (see *Command Processor* in the *Implementation/Engineering Operations - 1* binder). The HG checkpoint volume on an HM is established during Volume Configuration activity in Network Configuration. The size of that volume is established by the number of HG pairs you configured (about 1414 kb for each hiway). Both the HG data and the box data in the checkpoint files must reside on the same medium (HM or floppy).
- **Storage Space Needed for HG Checkpoint Files**—One of the checkpointing safeguards is that when checkpoint files are stored on a cartridge, floppy disk, or in an HM, any previously stored HG checkpoint data is retained until the new storage operation is successfully completed, the old data is then discarded. The number of files mentioned above for an HG checkpoint is twice the maximum number of files for an HG on a hiway with 63 devices. If the hiway has that many devices, and some are the types that have the most data, the two copies of the data can occupy almost 1000 kb—about the capacity of a 1000 kb floppy. This is the exception; typical HG checkpoints should fit on one floppy.
- **Early in the Life of Your System, and Periodically, Save HG Checkpoint Data on a Cartridge or Floppy**—Even though automatic checkpointing is available (see Section 21 of the *Process Operations Manual*) we recommend that you periodically use the SAVE DATA function on the Network Status display to save checkpoint data on cartridges or floppies from all of your HGs, during the time you are implementing your system and until you are satisfied that it is stable. This backs up the checkpoint files from HM. Just how often must be locally decided, but in the early days, you should consider saving the data at least once a day. You should also make a copy on a floppy disk of every data file you store on a floppy or in the HM. The checkpoint cartridges or floppies should be marked with the date and time the data was checkpointed, and they should be stored in a safe location. When you make backup copies of cartridges or floppies, the two copies should be kept in separate locations.

3.1.3.1 HG Demand Checkpoint Procedure

1. Check the guidelines above.
2. If you are checkpointing to a cartridge or floppy disk, mount a formatted user cartridge or user floppy in a drive.
3. On the Operator's Keyboard, select SYSTEM STATUS, then on the System Status display, select GATEWAYS. The Gateways Status display appears.

4. Select the primary node number of the HG pair you wish to save data for, and select **NETWK STATUS**.
5. Select the **SAVE DATA** target and follow the prompts on the display or refer to the procedures for the Hiway Status display in the *Process Operations Manual* to complete the operation. If you have a problem, refer to subsection 3.2.4 in this publication. When the data is successfully saved, the Hiway Status display should show the status of all boxes as "Saved."

NOTE

It is possible to save data for individual hiway boxes, but before you can do so, you must have saved a complete checkpoint for the HG and all boxes.

6. Use the appropriate hiway and box commands on the Hiway Status display to set up the hiway control state and to start box processing (see the *Process Operations Manual*).

3.1.4 HG Checkpoint Inhibiting

The Hiway Status display has checkpoint enable and disable picks that affect automatic checkpointing of the HG data and box data. This status is saved when the data is checkpointed and is restored when the HG or the boxes are reloaded. The system has no control over the checkpoint enable or inhibit status, and there is no such status for demand checkpoints. If you execute a **SAVE DATA** command, the demand checkpoint takes place regardless of the enable/disable status.

3.2 HG AND BOX LOADING

3.2.1 Guidelines for Reloading Hiway Gateways

We recommend that you use the following major steps in the order given (for step-by-step procedures, refer to the *Process Operations Manual*):

1. From the Gateways Status display select **LOAD NODE**, then proceed to load the HG, using your latest, valid HG checkpoint (usually on an HM, but the checkpoint could be on a cartridge or floppy).

NOTE

Before you proceed with step 2, be aware that all reloaded points will go to **MANual** mode after they are loaded, and that boxes with nonvolatile memories (MC, EC, A-MC, and CB) do not need to be loaded.

2. On the Network Status display, select one or more boxes and use the LOAD DATA command to load data in the boxes on the hiway. As each box is loaded, its status is shown as "restored." If it is not loaded, an error code is shown.
3. Use the procedure under subsection 3.1.3 (Demand Checkpoint Procedure) to save the new HG checkpoint data in the HG checkpoint volume on an HM. The same procedure is used to save the data on a cartridge or floppy, when making a backup for the checkpoint data on the HM.

CAUTION

Do not try to load both HGs in an HG pair concurrently—one of the HGs will fail. Complete loading one of the HGs as the primary, then the other HG can be loaded as the secondary.

3.2.2 How HG Checkpointing Relates to the Box-Save and Box-Load Functions

The SAVE DATA function on the Network Status display stores both the HG resident data and the box resident data in the HG checkpoint files in the HG checkpoint volume in an HM or on a cartridge or floppy disk. You should also save the boxes from the Hiway Status display, so that you can be sure that each box has been successfully saved by observing the "restored" status as each box is loaded.

The SAVE BOXES function on Network Status displays saves the data from only one or from all of the boxes on the hiway. The box data can be saved only if a complete save (HG and all box data) has already been accomplished on the checkpoint volume or directory (HM, cartridge, or floppy). If so, the new box data replaces the older box data.

The SAVE DATA function on the Network Status display is similar to the Hiway Save function on Operator Stations connected to the Data Hiway. It is also similar to the Upline-Load function in SUPERVISORY/TOTAL Systems and in PMX Systems.

The following chart indicates the hiway and box states that allow box-data SAVE DATA commands and box LOAD DATA commands to be successfully executed from the Gateways and Hiway Status displays.

Hiway or Box State	SAVE DATA	LOAD DATA
Hiway control state	Any but TEST	Any but TEST
Box control state	Any but TEST	BASIC CTRL
Box processing status	OK (including partial and soft failures)	OK (CB, EC, PIU), RESET (PIU) IDLE (A-MC, MC)
Box assignment	ThisHG	ThisHG

A successful box-data save replaces the older data for the box(es) in the checkpoint file, provided the box and HG data have already been successfully saved in the checkpoint files. A successful box LOAD DATA reloads the data in the box(es) from the checkpoint files, and the box control states, which are included in the checkpoint data, are restored. When a LOAD DATA loads the HG, the hiway control state is set to Basic control.

NOTE

If a logic block in an MC is not configured through an HG, you must do a separate save of all of the MC's data to ensure the integrity of the HG checkpoint files.

3.2.3 HG and Box Loading Options

On the Gateways Status display, if you select OPERATOR PROGRAM and execute a LOAD NODE command, the HG is loaded with the selected personality image and checkpoint data, but the process-connected boxes are not loaded. Then when you execute a LOAD DATA command from the Hiway Status display, the selected process-connected box is loaded from the defined checkpoint source, or if you select ALL BOXES, all process-connected boxes are loaded (even though the HG is a box on the hiway, it is not loaded).

If you use the Gateways Status display to load only the HG, you can checkpoint both the HG data and any data in the process-connected boxes by executing a SAVE DATA command from the Hiway Status display. This technique can be used to start operation of an HG and then pick up existing box data from the hiway.

3.2.4 Error Recovery

The following error messages may appear on the Gateways Status display or on the Hiway Status display when you attempt to save HG checkpoint and box checkpoint data, when you attempt to load an HG or boxes, or when you attempt to save box checkpoint data:

- FILE ERROR—See subsection 3.2.4.2.
- BAD REQUEST—A request was made for a box configured as AddedHG or RemoteHG, and not ThisHG.
- CONFLICT—The HG is busy with another save or load operation.
- NO VOLUME—Either no medium (cartridge or floppy) is mounted in the drive specified, or the volume doesn't exist on the HM, or no checkpoint files were found on the specified medium (cartridge, floppy, or HM).
- BAD STATE—The box was not in a proper state to accept the command. See subsection 3.2.2.
- ??????????????—A communication error or some other error occurred that prevents the Universal Station from displaying the correct status.

Some operations might terminate because of an error, such as a cartridge or floppy not mounted or a bad medium, and a message such as `FAIL;HGnn` appears. This doesn't mean the HG failed, it's the operation that failed.

3.2.4.1 Recommended Actions for Error Recovery

1. Use the `SCREEN PRINT` function to print a copy of the Gateways Status display or the Hiway Status display. If boxes are involved, you may need to print more than one display to document both the HG status and box status.
2. Check the Real Time Journal print out(s) on the printer. This information will be useful if you need to consult with Honeywell about the problem. Error messages that result from these operations are in this form:

```
D$ CP CHPNT xx yy zz
```

5001 through 5063, where the last two digits are the number of the box that is involved, or 60nn, where nn is the HG file number, or 0 = the system "crashed."

Provides a cause-of-error indication.

Indicates the internal HG module name.

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3.2.4.2 Recovery From a FILE ERROR

A `FILE ERROR` message is caused by one of the following:

- An attempt to load a box that was not previously checkpointed.
- Needed checkpoint files were not found on the medium (cartridge, floppy, or HM) that was specified.
- A hiway error occurred as access to a box was attempted.
- On a `SAVE DATA` operation, the medium was full (too few files formatted) or the directory was too small to accept the data.
- An error occurred as access to the medium was attempted.

You should use the `Catalog (cat)` command in the Engineering Personality's Utilities to check the number of available files and sectors for the HG checkpoint data. Use the command's detail (`-d`) option. See *Command Processor Operation* in the *Implementation/Engineering Operations - 1* binder.

You can determine if checkpoint data for a specific box is on the medium by using the Utilities List File Attributes (`LS`) command to find information for the `HG0hhbbr.CP` file for the box. See subsection 3.1.2. It may be useful to check the time stamps that are in the catalog data to see if incompatible time stamp may be causing a problem. For example, box data should not be older than HG data.

LCN COEXISTENCE WITH 4500 AND 45000 PROCESS COMPUTERS

Section 4

This section describes the requirements for and consequences of coexistence of Honeywell 4500 and 45000 process computer on Data Hiways connected to an LCN by HGs.

Honeywell supports coexistence on a Data Hiway of LCN-based systems, and 4500 and 45000 process computers configured as SUPERVISORY/TOTAL (PMC 450, ECOS 4 or later) systems, or as PMXII R2 (ECOS HH or later) systems (PMC/PMX systems). To assure the intended operation of such coexisting systems, certain Hiway and Box/Slot configuration rules must be followed. These rules comply with the functional definitions under subsections 1.4 through 1.5.

4.1 REQUIREMENTS FOR COEXISTENCE

The HG pair is a preferred-access device on the Data Hiway and so is the PMC/PMX system. Both must have certain parameters properly configured for coexistence. The following conditions must result from this configuration:

- Only one preferred-access device (HG or PMC/PMX) does control through the boxes.
- At least one of the preferred-access devices is configured for alarm reporting.
- Only one of the preferred-access devices can detect change flags. In this situation, it must be the HG pair.
- Only one of the preferred-access devices can synchronize sequences of events.

4.2 SEQUENCES OF EVENTS SYNCHRONIZATION

- By the HG—If the HG pair is to serve as the preferred-access device that synchronizes sequences of events, Hiway Configuration parameter SOESYNCH (see subsection 1.5.3) must contain `Enable`, and no other preferred-access device (including PMC/PMX) can synchronize sequences of events.
- By the PMX/PMC System—If the PMC/PMX system is to serve as the preferred-access device that synchronizes sequences of events, the SOE synchronization must be `Enable` (accomplished through the HDWASN program), and no other preferred-access device (including the HG pair) can synchronize sequences of events.

In any case, all PIUs that generate sequences of events must be synchronized by the same preferred-access device.

4.3 BOX/SLOT CONFIGURATION HG

If an AM is to do control through an HG pair that coexists on a Data Hiway with a PMC or PMX system as defined above, the box assignment parameter, BOXASSN, must contain ThisHG.

If the PMC/PMX system is to do control through the boxes on the hiway, BOXASSN must contain H4500.

4.4 CONFIGURATION OF PROCESS-CONNECTED BOXES

The effect of LCN Box/Slot parameters and PMC/PMX box configuration values where HGs and the PMC/PMX system coexist on a Data Hiway is as follows:

- BOXASSN (LCN, see subsection 1.5.4)

ThisHG The HG pair configured as ThisHG is doing control through this box.

H4500 The PMC/PMX system is doing control through this box. The HG that is configured as ThisHG is providing only limited support to this box.

- PMC/PMX Box Assignment (configured through the HDWASN program)

HG The HG is doing control through this box.

H4500 The 4500/45000 is doing control through this box.

- EVENTPRC (LCN, see subsection 1.5.5)

Enable Event processing is accomplished by the HG pair and alarm status information from the box is available on the LCN.

Disable Event processing is not accomplished by the HG pair and no alarm status information from this box is available on the LCN.

- PMC/PMX Event Processing (configured through the HDWASN program)

Enable This box uses the hiway exception report function to communicate with the PMC/PMX system.

Disable This box does not use the hiway exception report function to communicate with the PMC/PMX system.

4.4.1 Change Setting and Detection

Where LCN systems coexist with PMC/PMX systems, the **PMC/PMX** system is the **setter** of the change flags that indicate when changes to the database in the process-connected boxes have been made and the **HG** pair is a **detector** of those changes (see subsection 1.5.5).

For each of the process-connected boxes that is shared by the HG and the PMC/PMX system, the CHNGFLAG in Box/Slot configuration must contain `Detect`, and for each of these boxes, the PMC/PMX system must be configured (by running the HDWASN program) as `Setter`.

4.5 SUPPORTED LCN AND PMC/PMX COEXISTENCE CASES

Honeywell supports these two cases for coexistence of LCN-based system and PMC/PMX systems on a Data Hiway:

- **Case 1**—The **PMC/PMX** system does control through the process-connected boxes and alarms are reported on the LCN. The HG detects changes to the database in the shared process-connected boxes and control from LCN-based modules or gateways is not allowed.

PMX/PMX system—in control, exception reports disabled, setter of change flags.

HG—not in control, alarming enabled, detector of change flags.

- **Case 2**—**LCN**-based modules or gateways (usually AMs) do control through the process-connected boxes and alarms are reported on the LCN. This case applies where the process-connected boxes are not controlled from the PMC/PMX system but that system remains operational for noncontrol functions.

HG—in control, alarming enabled, detector of change flags.

PMX/PMX system—not in control, exception reports disabled, setter of change flags.

Tables 4-1 and 4-2 summarize the functions supported for these two cases. The "LCN-Based System" and "PMC/PMX System" columns list functions available, if applicable, in each of the boxes on the Data Hiway.

4.6 LCN/DATA HIWAY HARDWARE COMPATIBILITY

Tables 4-1 and 4-2 define which Data Hiway devices and boards are compatible with LCN-based systems.

Table 4-1— Case 1 Functions, PMC/PMX System Doing Control

Function	LCN-Based System	PMC/PMX System
Database Building		
Build Data Points in a box	Yes	Yes
Build points in HG or PMC/PMX only	Yes	Yes
Process Values		
From report-by-exception boxes	Yes (1)	Yes (4)
From response-only boxes	Yes	Yes
Box trend data	Yes	Not Supported
Alarm Status		
From report-by-exception boxes	Yes (1)	Yes (4)
From response-only boxes	Yes (1)	Yes
Event Handling		
From report-by-exception devices (PIUs)	Yes (1)	No (4)
Sequences of Events	Yes (1)	No
MC circular alarm and message list	Yes (1)	Not Supported
EC circular alarm list	Yes (1)	Not Supported
Control		
Operator level (SP, MODE, OUT)	Yes	Yes
Engineering-level tuning	Yes	Yes
Higher level (AM or BPL)	No (2)	Yes
Time-out gates	No (2)	Yes
Cascade requests	No	Yes
Change Flags	Detector (3)	Setter
Box Loading		
HG checkpoint	Yes	No (HG function)
Box save and restore	Yes	Yes
Load trend program	Yes	Not supported
Sequence programs	Yes	No
Hiway Security	Yes	Yes
Box Commands	Yes	Yes
Notes		
(1) EVENTPRC for each process-connected box = Enable		
(2) BOXASSN for each process-connected box = H4500		
(3) CHNGFLAG for each process-connected box = Detect		
(4) Scheduled only		

Table 4-2 — Case 1 Functions, Control from the LCN

Function	LCN-Based System	PMC/PMX System
Database Building		
Build Data Points in a box	Yes	Yes
Build points in HG or PMC/PMX only	Yes	Yes
Process Values		
From report-by-exception boxes	Yes (1)	Yes (4)
From response-only boxes	Yes	Yes
Alarm Status		
From report-by-exception boxes	Yes (1)	Yes (4)
From response-only boxes	Yes (1)	Yes
Event Handling		
From report-by-exception devices (PIUs)	Yes (1)	No
Sequences of Events	Yes (1)	No
MC circular alarm and message list	Yes (1)	No
EC circular alarm list	Yes (1)	Not Supported
Control		
Operator level (SP, MODE, OUT)	Yes	Yes
Engineering-level tuning	Yes	Yes
Higher level (AM or BPL)	Yes (2)	No
Time-out gates	Yes (2)	No
Cascade requests	Yes	No
Change Flags	Detector (3)	Setter
Box Loading		
HG checkpoint	Yes	No (HG function)
Box save and restore	Yes	No
Load trend program	Yes	Not supported
Sequence programs	Yes	No
Hiway Security	Yes	Yes
Box Commands	Yes	Yes
Notes		
(1) EVENTPRC for each process-connected box = Enable		
(2) BOXASSN for each process-connected box = H4500		
(3) CHNGFLAG for each process-connected box = Detect		
(4) Scheduled only		

LCN/DATA HIWAY HARDWARE COMPATIBILITY Section 5

Tables 5-1 and 5-2 define which Data Hiway devices and boards are compatible with LCN-based systems.

Table 5-1 — LCN Compatibility with Basic System Releases

Hiway Device	Release/Issue	LCN Support by HG	Support by PMX	Support by PMC	Support by 615 Op Stn (7)
CB	1A	No	No	No	No
	1C	Yes	Yes (2)	Yes (2)	Yes
	1D	Yes	Yes	Yes	Yes
HLPIU	R310/R320	No	Yes	Yes	Yes
	R320A	No	Yes	Yes	Yes
	R320B	Yes	Yes (5)	Yes (5)	Yes (5)
MC (8)	R15	No	No	No	No
	R20D	Yes (3, 4)	Yes	No	No
	R30F	Yes (3)	Yes	No	No
	R30G	Yes	Yes	No	No
	R30H	Yes	Yes	No	No
	R30I	Yes	Yes	No	No
MC RCD	—	Yes	Yes	No	No
LE PIU	R310/320	Yes	Yes	Yes	Yes
	R320A	Yes			
AU	—	No	Yes	No	No
DHP	1	No (6)	No (6)	No (6)	No (6)
	2	Yes (6)	Yes (1)	Yes (1)	Yes (1)
EC	1	Yes	No	Yes	Yes
EC RCD	1	Yes	No	Yes	Yes
HTD	00	No	Yes	Yes	Yes
	01	Yes	Yes	Yes	Yes

Notes:

- (1) Requires 615 diskette for configuration. On-line displays appear like HL PIU points.
- (2) UAC, CB configuration are not compatible; errors occur on fail over.
- (3) Normal mode support not available for LCN-based systems.
- (4) Event-initiated processing not available for LCN-based system.
- (5) Digital command disagree function (on PROM card) not available.
- (6) DHP 1 must be upgraded to DHP 2.
- (7) Mastership of circular-list handling between the 520 Op Station and HG must be configured for only one master per box assigned. Also, for proper alarm functions, point configuration in the HG and any Basic System Op Station must be identical.
- (8) For proper operation of the hiway manual function by the LCN-based system, R20A of the MC Hiway Logic card is required.

Table 5-2 — HG Compatibility with Hiway Device Boards

Hiway Device	Boards that Affect Compatibility	Board Part Number	Earliest Revision Level (4)	Order as Replacement
Basic Cont. 1C (5)	Memory Hiway #2	30731829-006, 30750218-005, 30731814-004	All All Issue 8	3070218-509 30750218-509 Contact TAC
Basic Controller ID	Memory Hiway #2	30750218-008, 30750218-009 30731814-004	Issue 8 Issue 12 Issue 8	30750218-509 30750218-509 Contact TAC
Basic Cont. RCD	ROM	30750218-003	Issue 4	30750218-503
Extended Controller	ROM	30751044-004, 30751044-007	Issue 9 Issue 12	30751044-507 30751044-507
Extended Cont. RCD	ROM	30750218-007	Issue 8	30750228-507
Multifunction Controller	ROM Hiway Logic	82408443-004 82408330-001	Issue 11 (1) (30H Firmware) Issue 7 (20A Firmware)	82408443-004 82408330-001
Multifunction Cont. RCD	ROM	82498443-005	Issue 7	82408443-005
DHP II	ROM Comm. Logic	30751044-006 30752787-002	Issue 12	30751044-506 30752787-502
HTD	Hiway Director	30733159-002	Issue 8	30733159-502
Preferred Access Exp.	PAE Logic	30735173-002	Issue 2	30735173-502
HL PIU (A11)	PROM/RAM	4DP7APXPM15 (0099B Firmware)	Rev B (2)	4DP7APXPM155 (3)
LL PIU	PROM/RAM	4DP7APXPM15 (0022J Firmware)	Rev B (2)	4DP7APXPM333
LE PIU	PROM/RAM	4DP7APXPM23	Rev D	4DP7APXPM233
<p>Notes:</p> <ol style="list-style-type: none"> (1) MC firmware releases 30G and 30F are compatible, but the normal mode function is not supported in those releases. (2) R320 and R320A HL PIUs are not compatible with the HG. Kits to upgrade R320 and R320A to R320B are as follows: R310/320 upgrade without A/D Converter—P-ZHL11 R310/320 upgrade with A/D Converter—P-ZHL12 R320A to R320B—P-ZHL13 (3) Use part numbers to order replacement boards. Use the kit number specified under (2) to upgrade to R320B. (4) If an existing box has the revision or issue number, or a higher revision or issue number, no upgrade is required. (5) CB IC indicates a hiway error in the diagnostic word after a UAC switchover. Basic Stations overwrite this error with the correct address, so it is not visible to the operator. The HG does not do this, so any UAC system using LCB IC that is added to an LCN system should have the CB upgraded to 1D. 				

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Publication Number: **HG12-510**

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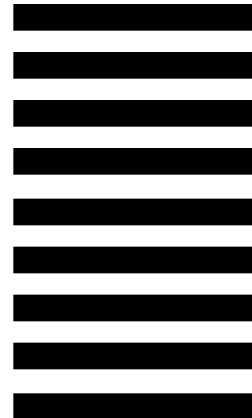
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