



Advanced

StarBus

Features



PROGRAMMING YOUR SERIES-C NETWORK

Back cover

Back cover

Take Us to the Cleaners... Upgrade to Series-C for Peanuts!

Some dealers are never satisfied. You're always requesting that we add bells or whistles to StarBus. Bells that add up to powerful performance when attached to Andover control panels, or when interfacing various RS-232 doo-hickies together!

Our Series-C is the major system upgrade you've been waiting for...

- ◆ Send alarms while already connected to host or terminal
 - ◆ Remote disconnect of any network connection
 - ◆ Full support for Infinity SX8000, CX, CMX
 - ◆ Character pacing for AC256 → Terminal dump
 - ◆ On-line help for every field in every menu!

Even the oldest Busdrivers can be upgraded in only 5 minutes to the feature Andover dealers have requested most: The ability to send alarms to any port while already connected to a host!

How old are Busdrivers at your sites? Are you still using Series-A or B? Now you can bring any StarBus up to the latest performance and features! Just \$59 (or \$49 when in-Busdrivers. That's of \$40 for every



What if we paid Just fax a PO and kits are for units "Next Generation"

What good is this bulletin, if you have a network filled with earlier series models? This offer is strictly limited to our authorized controls dealers only. You lucky stiff!

2nd day shipping? tell us how many with the words on the cover (we have upgrades for both older and newer models). So, sit back and count your profits. Regular price returns when we say so.

Audience

StarBus serves two dissimilar applications: In the office, it acts as a high-end peripheral sharing switch with pop-up connections and background print spooling. In the environmental & industrial controls field, it provides alarming, polling, multiplexing, queueing, and long distance connectivity.

For desktop peripheral-sharing applications, most installers and users need to know only 4 things:

- Key concepts: Page 2 of this introduction illustrates the connect menu.
See the official [white paper](#)
- Rules for laying out and testing the StarBus wire pair
See our bulletin: ['Termination & Testing'](#)
- Initializing or changing a Busdriver's parameters
Printed on the plastic top cover. Thereafter use the [I]NITIALIZE command
- Waking up and commanding a Busdriver to connect or disconnect
Press DISCONNECT CHARACTER 3 times (factory set <Ctrl>A. [H]ELP for basic commands)

The [demo](#) on the HotKey disk is the best way to learn these office applications (type 'STARBUS'). The *User's Guide* provides additional detail on basic commands and the PRIMARY PARAMETERS MENU, which are all accessed from the SCI> command prompt. But most users rarely need to consult the guide, because Busdrivers display the list of basic commands from the prompt (press 'H') – and also contain context sensitive help for each parameter field (press 'H' at any point).

This bulletin was written primarily for the controls dealer or installer, but can also be useful to site programmers and other advanced users. It is most frequently requested by dealers who refer to the programming notes for environmental and industrial controls applications. In this field, StarBus is the leading method for distributing RS-232 conversations within buildings and across campuses.

New Busdrivers incorporate extended commands and features which compliment controls applications. This bulletin describes the advanced features, and provides examples of their use. Most are very easy to use. Setup and function are intuitive from new fields in both INITIALIZATION menus and in APSEQ.EXE, the 'hidden parameters' menu which is available from our Internet site.

Each StarBus feature series is fully compatible with all earlier StarBus versions. If you have just upgraded an existing network, but choose to delay using the new features for awhile, your newer Busdriver will behave exactly like your older Series-A or Series-B stations.

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StarBus was conceived and developed by Harold Weiss and Philip Raymond.

As director of advanced development, Don Houde designed and coded most of the features described in this bulletin. Last winter, Don succumbed to asbestos-induced cancer, shortly after his marriage to a wonderful bride. This bulletin is dedicated to his memory.

Advanced StarBus Features

Series-C Command Reference



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Advanced StarBus Features (Series-C for controls applications)

Features and commands in this bulletin apply to the 'twisted-pair' StarBus only (Series B, C, and Millenium Edition).

StarBus for Ethernet also multiplexes separate RS-232 conversations onto a single bus (an Ethernet). It has a similar command syntax, but is not keystroke compatible with the twisted pair version.

For more information about StarBus for Ethernet, visit:

www.starbus.com/~phil/rs-232.htm/

For document updates or for the latest version of Apseq.exe, please visit:

www.starbus.com/~phil/TechRef/

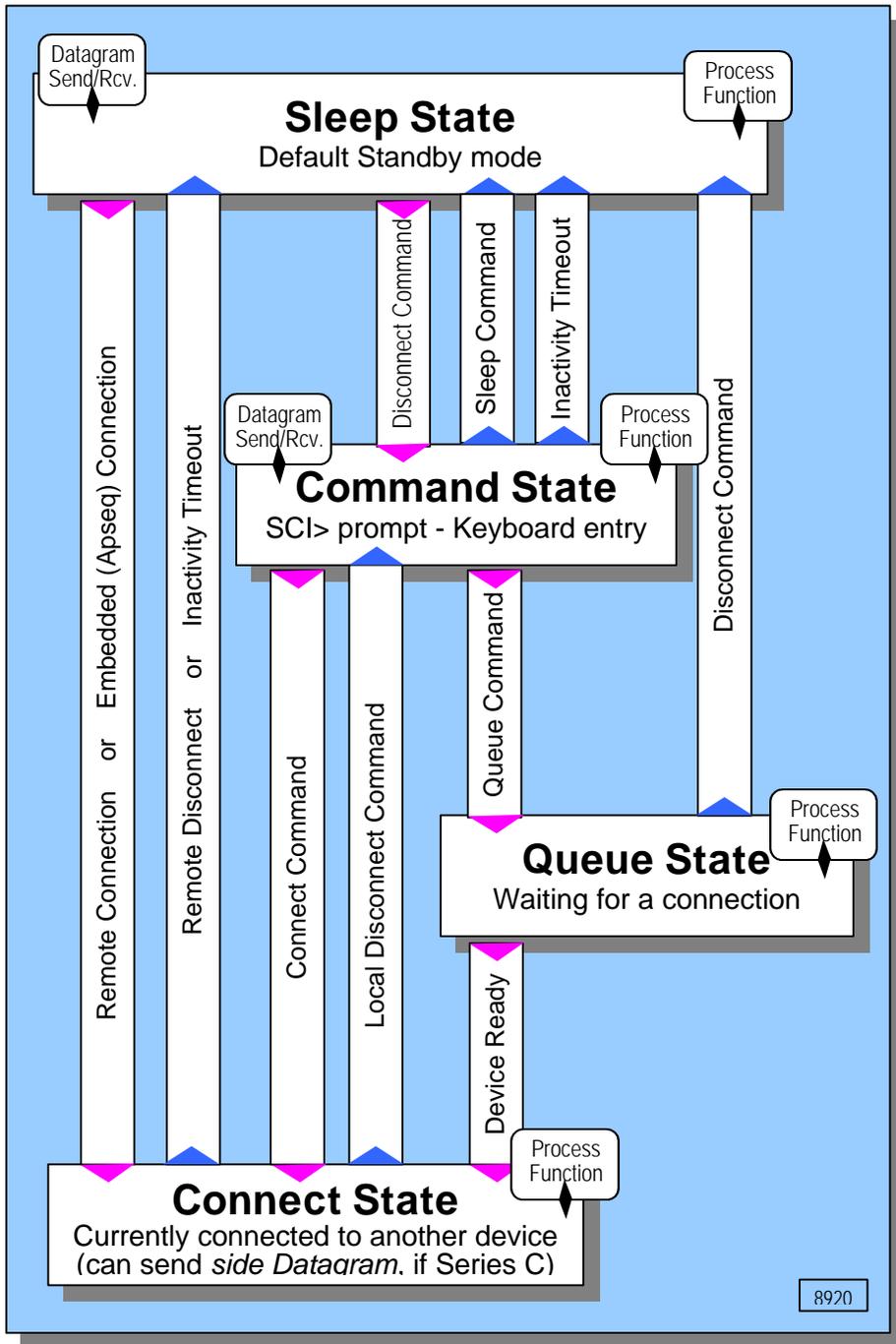
Send your corrections or comments to:
TechRef@StarBus.com

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Other Important Bulletins

- Termination & Testing *Replaces User's Guide, Appendix B*
- Lightning Protection *Don't leave home without it!*
- Andover Applications *Choose either Master or Infinity/SX*
- Installing Repeaters *We also offer a Fiberoptic Repeater*
- StarBus for Ethernet *(formerly called 'HitchHiker')*

-i- Busdriver State-Transition Diagram



1. USING THE APSEQ PROGRAM

Once each Busdriver is installed, most users quickly find the two INITIALIZE PARAMETERS menus which are easily accessed from StarBus command menu: [I] and [I/s]. But users do not readily have access to six 'hidden' parameters that are set via this special DOS utility – or in emergency, by entering NOVRAM memory-write codes into the Busdriver.

The APSEQ program sets the ALTERNATE APPLICATION SEQUENCE, and five other 'hidden' parameters. It interactively reads back and displays each change from the attached Busdriver.

These advanced features do not appear on the two built in INITIALIZE PARAMETERS menus, because improper settings can cause unpredictable behavior. In fact, the default values for these parameters are suitable for most applications. Many dealers and users never require this program.

First, attach a Busdriver to COM1 or COM2 which has been previously used or initialized. Be sure that the communications port is set to the same speed as the Busdriver. Then place the HotKey diskette in drive A (or B) and type A:APSEQ. The MAIN MENU provides simple instructions, and returns after each use to show the new setting.

For Andover Controls dealers, it is not even necessary to run APSEQ.EXE. Although Andover dealers require a special APPLICATION SEQUENCE (shown in menu item [1], below), a built-in StarBus feature can accomplish this without attaching a PC and running this program. Simply press Ctrl-A from within either INITIALIZE menu of each Busdriver even during remote initialization.* It will automatically preconfigure the fields to Andover suggested settings. Even though the ALTERNATE APPLICATION SEQUENCE is not displayed as a configuration field in the initialization menus, the Andover version will become effective when you save and exit (press Ctrl-E).

```

MAIN MENU
-----
Select a parameter to modify OR ALT+ X to quit

[ 1 ] Your ALTERNATE APSEQ is:
      \ <SPACE> RETURN <CTRL>J A P S E Q \

[ 2 ] Your ALTERNATE UNDERSCORE character is: | (7C HEX).
      ...use "|" for most Andover applications.

[ 3 ] Your DATAGRAM TIMEOUT is 30 seconds. This is also the
      factory default setting. Choose from 1 to 255 seconds.

[ 4 ] Your HOME BASE TIMEOUT is 2 seconds. This is also the
      factory default setting. Choose from 1 to 255 seconds.

[ 5 ] Your HOME BASE TRIGGER is <any character> ←
      and is set to PASS FIRST CHARACTER.

                                           (Sections 5.1 & 5.2)

SELECTION: █
    
```

The APSEQ main menu with the Andover recommended Application Sequence

*To initialize a new Busdriver, hold down the SPACE bar from any terminal communications program. To reinitialize a unit, enter "I" or "I/s" from the SCI> prompt.

2. MORE ON PROGRAMMING THE ALTERNATE APPLICATION SEQUENCE

Emergency technique – when you cannot locate Apseq.Exe

-  Even without APSEQ.EXE, an ALTERNATE APPLICATION SEQUENCE may be entered from a terminal or PC. Instructions below use the WRITE PARAMETER command designed for use by application software and not from the keyboard. To avoid corrupting your parameter table, the technique should be used only in an emergency, when you cannot locate APSEQ.
-  The ALTERNATE APPLICATION SEQUENCE is stored in nonvolatile memory. It can be used interchangeably with the permanent applications sequence, which is in effect at all times. Throughout this bulletin, the symbol {AS} refers equally to either sequence.
-  Once programmed, it is effective only at the Busdriver on which it was entered. Remote configuration is only possible if you choose the *custom Andover setting* by pressing <ctrl>A from within either INITIALIZE PARAMETERS menu.

2.1 Keyboard Programming Technique

To program the ALTERNATE APPLICATION SEQUENCE in the absence of the APSEQ.EXE program:

```
{AS} <Ctrl>_ _ W P 2 6 (*...*) Nx Nx-1 Nx-2 ... N1 00 00 ...
```

→ exactly 56 asterisks total of 20 keystrokes

where N is the 2-digit entry for each hex byte of the ALTERNATE APPLICATIONS SEQUENCE, and X is the number of bytes in the new sequence. Bytes are entered in reverse order. Min sequence: 3 bytes. Max sequence: 10 bytes. Pad all sequences to a total of 10 Hex pairs with null (00). The null character is disallowed as part of the programmable sequence. A table of hex codes appears at the end of this bulletin.

There is no response from StarBus...

To verify entry, place the Busdriver in SLEEP state and type: {AS} <Ctrl>_ _ R P 2
StarBus dumps a line of 76 characters. The last 10 pairs of HEX codes are the new ALTERNATE APPLICATIONS SEQUENCE in reverse hex-pair order.

EXAMPLE: To program an ALTERNATE APPLICATION SEQUENCE of 'abcd' (Hex: 61, 62, 63, 64):

```
{AS} <Ctrl>_ _ W P 2 6 (* x56) 6 4 6 3 6 2 6 1 0 0 0 0 0 0 0 0 0 0 0 0
```

equivalent characters: d c b a (12 zeros for 6 unused chars)

To enter this sequence from the keyboard, substitute {SF} {SF} <Ctrl>J for {AS}. This trick sidesteps the {AS} requirement that commands be entered at a high streaming rate.

-  **CAUTION:** Read the instructions above and important notes below before attempting use.
- A much safer method for interactive programming of the ALTERNATE APPLICATION SEQUENCE is the program APSEQ.EXE (section 1), a menu utility distributed with HotKey. Alternatively, you may download from www.starbus.com/~phil/. USAGE: APSEQ @ .

2.1.1 Notes on Manual Programming of Alternate Application Sequence

- a) Key entry programming requires use of the StarBus applications interface. Entry errors may result in overwriting parameter tables, status registers, or feature code. For PC access, we recommend use of the program APSEQ, a menu-driven utility included on your HotKey disk.
- b) The WRITE/READ commands are not generally permitted as a SPECIAL FUNCTION command {SF}. To use {SF} which is more convenient than {AS} when typing from a keyboard, follow two occurrences of the SPECIAL FUNCTION CHARACTER with <Ctrl>J (this emulates the APPLICATION SEQUENCE). Then continue.
- c) You may substitute “|” for <Ctrl>_ _ after {AS} or {SF} (when using “|” the <Ctrl>_ _ J may be optionally omitted).
- d) The factory default ALTERNATE APPLICATION SEQUENCE is identical to the primary {AS} except that printing characters are substituted for 4 control characters:

Permanent {AS}	Ct1	^	q	Z	~	@	e	^	e	P	B
HEX:	1E	71	5A	7E	40	0D	5E	0D	50	42	
Default Alternate	^	q	Z	~	@	M	^	M	P	B	
HEX:	5E	71	5A	7E	40	4D	5E	4D	50	42	

- e) The ALTERNATE APPLICATION SEQUENCE may contain any ASCII character including ENTER, SPACE, BACKSPACE, and ESCAPE. Do not include null (00) or non-ASCII bytes above 7F hex.
- f) The APPLICATION SEQUENCE bytes are programmed and displayed in reverse order, but each pair of hex digits are not reversed. The utility APSEQ.EXE performs this transposition for you, and simplifies entry of sequence from the keyboard (see introductory note on previous page).
- g) A new sequence is terminated on the 10th character (20 paired keystrokes). For sequences of 3 to 9 characters, fill in remaining position with nulls (00 hex) until the 10th character position. The resulting sequence begins with the character which precedes the first null.
- h) Programming a new {AS} uses a direct WRITE command, which is akin to the DOS Debug program. A single error can corrupt the table which stores your current Busdriver parameters. Before beginning, record the current [P] and [P/s] menu settings parameters on paper.
- i) An attempt to program a sequence of fewer than 3 characters, or forgetting to end a sequence with sufficient nulls to bring the total entry to 10 bytes (20 keystrokes) may crash the Busdriver. Even if the Busdriver appears to function properly, you should re-initialize it in the event of a programming accident. This will cause all parameters to return to their factory default settings. Cycle through the parameters to reset the Busdriver. Be sure to reset any SECONDARY [I/s] settings that you may have had in effect for your application, also.

3. QUEUEING

Sometimes a remote Busdriver is BUSY, OFF-LINE, or otherwise unavailable when you attempt a connection. If you are entering keyboard commands from the SCI> prompt, this does not present a problem... StarBus simply responds with the status of the remote station. You can ask for more details by requesting a [N]ETWORK MAP, or you can even force a remote [D]ISCONNECT. But if the Busdriver is driven by a controller or front-end program (using APPLICATION SEQUENCE commands), it can be difficult to deal with the many possible states that may be reported about the remote station.

One solution is **Datagrams**, which are described later. These one-way messages may be sent without concern for the state of the remote station. The network simply delivers your data to the whenever the target station is powered up and free to receive it. But sometimes, you require a full duplex (2-way) connection, and you do not have the resources to respond to interactive command prompts regarding the state of the remote station...

The solution is QUEUEING. With this special type of connect-request, you inform the local station that you desire to establish a link to a particular remote station. If you cannot be connected immediately, you are placed in a queue for use of the popular station. Furthermore, you may force yourself to the head of the queue, or even demand a list of others waiting in line.

Like all StarBus features, accessing these QUEUE functions does not require application software. Queue commands greatly unburden PC and controller applications from the need to constantly check the network for device availability. For example in the application of shared office equipment, HotKey uses this feature to effect background print spooling.

3.1 Operation

To maintain a queue, the *reserved target* station must be set QUEUEING ENABLED within its SECONDARY PARAMETERS menu.

Users are queued in order of their request for a given port. If a selected port is busy (in a state of CONNECT, WAIT, FUNCTION, etc), it receives the queue response shown below. If free (in a state of READY or OFF-LINE), the queue command will evoke the QUEUE response, followed immediately by the CONNECT response. For this reason, users may opt for automatic "queue if busy", by using the [Q]UEUE command instead of the [C]ONNECT command.

Each Busdriver maintains an independent list of up to 30 remote devices which each desire a connection. Requesting stations are automatically notified and connected in FIFO sequence. A special inactivity timer in the SECONDARY PARAMETERS menu of the target Busdriver can be set to go past an inactive connection more quickly than the regular timer (from StarBus COMMAND state, type I/s or I/s <name>). This QUEUE TIMER supersedes the regular inactivity timers in both the sending and receiving Busdrivers, if it is set to a shorter duration.

The QUEUE state is similar to the CONNECT state. Activity on a serial port is ignored while its attached Busdriver is in QUEUE state, except for {SF} and {AS} command sequences. There are three methods to disengage a Busdriver from a remote QUEUE (not including local reboot):

1. It may locally disengage with the DISCONNECT SEQUENCE or {SF}D or {AS}D .
2. It may be remotely disengaged via REMOTE DISCONNECT from any LEVEL-1 port.
3. It may be eventually CONNECTED to the remote device for which it was queued.

When a Busdriver disconnects or times out from a queue-enabled port, the next station in the queue is connected. They will be notified of the connect with the method determined by a setting in their SECONDARY PARAMETER MENU (see below), and also by the assertion of flow-control. If data transmission from the new user does not start within QUEUE TIMEOUT (set within the SECONDARY PARAMETER MENU of the target port), the user is disconnected and a connection is attempted with the next device in the queue.



The QUEUE command syntax differs between the keyboard/menu version and the APSEQ version. Choose the correct version for your application below.

Examples:

Suppose Harold (Port 3) attempts to connect to LASER (Port 7) and receives the StarBus reply:

```
Station #7 is already connected to station #1.
```

Harold may place himself in the queue for LASER (Port 7) by entering the command:

```
Q LASER or Q 7 e      ← The space is optional - The return is mandatory  
or: {AS} <Ctrl>_ Q C 0 7  ← No spaces; two digits for port number
```

StarBus replies:

```
HAROLD, station #3 added to queue of LASER, station #7.
```

Harold's Busdriver will not accept further data until sensing a connect from LASER. Other users cannot connect to Harold while he is in the QUEUE state. If Susan, Port 1 attempts to connect to Harold, her StarBus responds:

```
HAROLD, station #3 is queued to LASER, station #7.
```

Harold may exit QUEUE state by using the disconnect sequence. If he remains in the QUEUE state, StarBus issues the following message when a connection is established.

<BEL> or HANDSHAKE ENABLE or both (user set) → MUST be set to <BEL> for HotKey users! Susan will then receive a [<Ctrl>G] or a newly enabled handshake, depending on the setting of her own QUEUE CONNECT setting (set from within her SECONDARY PARAMETER MENU).

Susan will not receive the ACI> prompt. She is now in the QUEUE state. A state-flow diagram at the end of this bulletin provides an overview of Busdriver state transitions.

Harold may now transmit and receive data with LASER. If no data is transmitted for 1 minute (QUEUE timer setting of LASER) or for the primary time-out parameter of either port, whichever is shortest, Harold becomes disconnected from LASER, and LASER automatically establishes a connection with the next user in its queue.

3.1.1 Notes on QUEUEING

a) Harold could have bypassed the [C]ONNECT command, entering only the [Q]UEUE command:

```
Q LASER E      or      Q 7 E
```

If the target device is not presently engaged, this command results in a Queue message, a BEEP, and a connection, (all within less than 650 ms). In the event that LASER is busy, HAROLD would be added to the end of its queue.

A program or macro uses APSEQ (instead of the keyboard form): {AS} <Ctrl>_ Q C 0 7. When targeted at a free device, this command results in a connection with only the beep and/or handshake if set, but with no queue or connect text response from the local Busdriver.

b) After attempting a [C]ONNECT to Laser, Harold may determine with whom Laser is presently connected by entering the [W]HO command: W 1 E .

3.2 Queue List and Queue Head (remote use only; requires argument)

QUEUE LIST returns the present status of a remote Busdriver, and lists ports queued to it. The {AS} implementation of this command requires different syntax (shown).

QUEUE HEAD permits a LEVEL-1 user to get into the queue of a remote station as the very next device to be connected, regardless of other ports already in the queue for that remote port.

Syntax: Q/L 7 E (defaults to local port if no argument)

or: {AS} <Ctrl>_ Q <lowercase-L> nn where nn is the 2-digit StarBus port#

Remember that “|” may be substituted for <Ctrl>_ or alternatively, any user selected Alternate Underscore character. Refer to the earlier section on APSEQ.EXE program in this bulletin.

Syntax: Q/H 7 E (keyboard entry only — does not operate as an APSEQ command)

-  A remote port name or number is required. The space before argument is optional.
-  Lines 1 & 2 appear only for commands issued by keyboard from the SCI> prompt.
-  Occasionally the QUEUE LIST shows number of a remote stations, but not its name.

Lines 1 & 2 are displayed only in response to the keyboard command – not the {AS} command:

(Line 1): LASER, station #1 -- status is READY

or: LASER, station #1 -- status is QUEUED to PHIL, station #10
 LASER, station #1 is currently connected to FRANK, station #8.

(In event of a current connection, one of these messages appears on Line #2)

(Line 2): → Currently, no one is queued to LASER, station #1
 or: Here is a list of users queued to LASER, station #1

The remaining lines begin with either the first QUEUED connection (for keyboard commands) or with the current connection (for commands entered from the APPLICATION SEQUENCE):

```
8. FRANK      ← Response to {AS} commands begin with this
19. SALSDESK ← list. Therefore the current connection appears
7. NATHAN     here instead of the first queued station.
16. ???????? ← see note #d, below
2. SUSAN
```

3.2.1 Notes on Queue List and Queue Head

- a) When invoked from {AS}, the **first** listed station is connected and the **second** listed station is next in line. But from a NORMAL command, the presently connected station is revealed in the text message at top, and not as the first entry in the list.
- b) Maximum List: 1 port connected plus 30 ports waiting. **Deleted** ports - though not displayed - are included in this maximum, until purged...
- c) There may be ports in a queue which have been marked for deletion (see QUEUE DELETE below). These ports do not appear in the QUEUE LIST, and will be permanently purged from the queue when the target Busdriver is free from its current connection.
- d) In rare cases, questions marks may be substituted for a station name. This happens if both of the following conditions are true: the queued Busdriver has been re-powered – and its name is not in the requestor’s network image map.
- e) The following error message may appear instead of the above table (begins with period):

```
Station #7 is not enabled for queueing.
or: Station #7 is not responding.
or: Station #7 does not support this feature.
```

3.3 Queue Delete

This feature empties the queue of a local or any remote station, once its present connection is terminated. Use of this function requires LEVEL-1 privileges.

The local Busdriver responds with <SP> <BS> within 300 ms (40ms typical). The response is automatic, and does not indicate that the remote delete was successful - or even that the remote device is present. The QUEUE LIST feature may be used to determine success of a QUEUE DELETE.

3.3.1 ' Reservé Space in Queue by Deleting Yourself

When a user is removed from a queue by the local or remote DISCONNECT, he remains “inactively” in the queue list for the target device. If the user returns to queue before his turn is called, he is *reinstated* into his original place in line, and will receive a connection with his original priority.

If the user does not return to the queue, his place in line will be permanently purged *at the time it would have been his turn*. The purging of an abandoned member occurs in one or two seconds and does not require the full time of the queue timer.

4. STARBUS DATAGRAM FEATURE

 **ABOUT DATAGRAMS:** Some components of this feature have been resident in StarBus since Series-B and even late Series-A versions. But new enhancements greatly expanded the power and flexibility of Datagrams. For example, Series-B added the ALTERNATE APPLICATION SEQUENCE and GROUP DATAGRAMS. Now Series-C adds the ability to send 3rd party Datagrams while already engaged in a full-duplex connection to another address.

 Any version of StarBus can be user-upgraded with an inexpensive kit which installs in only 5 minutes per unit. Just tell us how many Busdrivers are marked “Next Generation” on the cover, so that we can send the correct mix of feature upgrade chips for your site.

In its native mode, StarBus provides a full-duplex (2-way) communications link between any number of Busdriver pairs on a single pair of multi-drop wires.

QUEUEING offers a special way to reserve a full-duplex connection (Section 3), but it results in the same type of connection. It simply directs the issuing station to wait in line for the target address.

A special DATAGRAM feature permits application software to transmit addressed bursts of half-duplex data into a Busdriver without establishing a connection and without concern for the state of the remote unit at the time of transmission. The receiving Busdriver may be simultaneously issuing Datagrams initiated by its attached computer, alarm, or controller.

If the receiving Busdriver is engaged in a traditional connection – or is set to a slower speed than the sum of all incoming Datagrams, then Datagrams will be queued and retrieved from respective senders in a fair sequence. That is, Busdrivers contain sequencer logic which ensures that a single source cannot monopolize a popular target, even if it was first to queue many Datagrams.

Queued retrieval is an autonomous function of StarBus. No user interaction is required.

Since each source Busdriver has an independent 1kB data buffer, sending devices with no capability to detect flow control will operate properly in typical alarm applications. But flow control must be inherent to devices on networks with heavy traffic applications, such as a NetBIOS implementation. On such networks recipient devices must be enabled for hardware (DTR) flow control.

4.1 General Description

Datagrams are sent from a SOURCE Busdriver to a TARGET Busdriver. They are initiated via either command (top of next pg), or via pre-configured address (see HOME BASE in this section).

Busdrivers may be in either the COMMAND or SLEEP state to send or receive Datagrams. Generally the COMMAND (or SCI>) state is used only by keyboard devices. Datagrams are initiated by programs or script files and rarely from a keyboard, except for test purposes. Since programs can also access other commands from the SLEEP state, it is generally unnecessary for Datagram senders to awaken their Busdriver to COMMAND state.

If, for some reason, a Busdriver happens to be in COMMAND state, it will transfer from the COMMAND to the SLEEP state after 3 minutes without normal COMMAND activity. This causes a capital-Z to be sent into the attached device, which may echo the “Z” back into the Busdriver.

This could interfere with a Datagram command or the data itself. One solution is to guarantee the SLEEP state by proceeding all Datagram commands with the SLEEP command (Z E). An alternative method of suppressing the “Z” is described in another section.

The state of a Busdriver can be determined with the QUERY STATE command: {AS} <Ctrl>M (See the User’s Guide or Technical Reference). The SLEEP state is a Busdriver’s most common standby state. There are three ways that a Busdriver can arrive in the SLEEP state.

1. has not been used in a full-duplex (CONNECT) circuit since powered
- or: 2. has been placed in SLEEP from the COMMAND state (“Z” command)
- or: 3. is not engaged in a connection, and has not been used for 3 minutes.

 **HOTKEY USERS:** The HotKey QUICK CONNECT feature always leaves the Busdriver in SLEEP state after the termination or timeout of any connection).

Datagrams initiated from a Busdriver in the CONNECT or FUNCTION state are ignored. However a busy target *queues* incoming Datagrams, and effects flow control upon their senders if traffic is sufficient to fill the sender’s buffers (approx 1 Kbyte each).

If multiple sources attempt to send concurrently, the target Busdriver queues their Datagrams (a reservation list is maintained by the busy target while the actual data is buffered at the respective senders). When a target becomes available, Datagrams are retrieved from the sending Busdrivers.

For single Datagrams, retrieval occurs in the originally queued order. But if a station sends multiple Datagrams, its subsequent Datagrams are serviced in round-robin sequence, thus assuring attention to slow or infrequent senders.

Datagrams queued for a popular target are passed to its RS-232 cable as a continuous datastream without pauses, unless senders use a special command which instructs the receiving Busdriver to add a pause between incoming Datagrams before passing data into the attached RS-232 device.

4.2 Command Syntax

 Busdrivers can be configured to initiate Datagrams to a pre-defined address any time that the RS-232 port sees data *that is not preceded by {AS}*. In such cases, no command is used! The HOME BASE is configured from the INITIALIZE SECONDARY PARAMETERS menu.

 <Ctrl>_ (1F hex) follows {AS} in Datagram commands and the QUEUE CONNECT command. If a terminal or controller cannot issue this character, you may program an ALTERNATE UNDERSCORE CHARACTER using the APSEQ.EXE program described in this bulletin. This alternate character is factory set to “|” (7C Hex) – and is identical to using <Ctrl>_.

Alternatively, you may simulate an application sequence from the keyboard by substituting {SF} <Ctrl>J for the 10 character {AS}. “{SF}” indicates two presses of the user selected SPECIAL FUNCTION CHARACTER.

The list of Datagram commands is at the top of the next page ...

you may substitute ' | ' for this character (see 4.4.1-b at right)
 use zero for the Tag character (see facing page, near top)

```
{AS} <Ctrl>_ Q d ## t BEGIN Datagram  (## = Busdriver address 01-50, g1-g9, g0)
{AS} <Ctrl>_ Q d g# t Begin GROUP Datagram  (# = 0-9; Use '0' for all groups)
{AS} <Ctrl>_ Q s BBB t SNOOZE          (target station inserts RS-232 pause of B x 12ms)
{AS} <Ctrl>_ Q x      END Datagram      (frees target to receive from other senders)
{AS} <Ctrl>_ Q y ## t SWITCH TARGET  (can also be used as BEGIN)
{AS} <Ctrl>_ Q y g# t SWITCH GROUP   ( "   "   "   " )
{AS} <Ctrl>_ Q z BBB  END and SNOOZE  (target station delays for BBB x 12ms)
{AS} <Ctrl>_ Q C ##  QUEUE then CONNECT to address ##  (stand in line, if station busy)
```

(After a *QUEUE CONNECT* is established, StarBus will enable the use-selected handshake method. You may select an additional notification method from INIT SECONDARY PARAMETERS menu)

 The last line above is the QUEUE command (section 3). Note that the command letters are both capital (QC). It is not a Datagram command, and is included here for reference only.

A Datagram is initiated with a BEGIN DATAGRAM or SWITCH TARGET command followed by the two digit target address, tag and data. A Datagram is closed with the END DATAGRAM command or with SWITCH TARGET or END & SNOOZE. A detailed example and command structure follows.

A **Group Address** [g#] permits simultaneous Datagram transmission to more than one station. Selected *target* Busdrivers are set to group 1-9, ALL or NONE from within its INITIALIZE PRIMARY PARAMETERS menu. Target stations set to ALL receive all group-address Datagrams, while using address “g0” at the sender ensures receipt by Busdrivers set to *any* group (except NONE).

4.3 Components Of A Typical Datagram

{AS}	<Ctrl>_ Q d	{addr}	{Tag}	{Data}	{AS}	<Ctrl>_ Q x
Applicat'n Sequence	Begin Datagram	Destination	Zero	Data	Applicat'n Sequence	Normal End Datagram

 The command <Ctrl>_Qy (SWITCH TARGET), may be substituted for <Ctrl>_Qd (BEGIN DATAGRAM). If a sender has not already begun a Datagram, the commands are identical.

 Guard delays of 180ms (3 sec max) are required before each of the two {SF} characters.

 Group capable Busdrivers may send & receive single-party Datagrams with earlier Series-A Busdrivers, but they cannot send or receive group Datagrams with the older stations.

4.4 Datagram Structure

1. BEGIN: 1E 71 5A 7E 40 0D 5E 0D 50 02 1F 51 64
 or from keyboard: <guard> {SF} <guard> {SF} 1F 51 64
 where <guard> is any delay from 1/5 second to 3 second

2. ADDR: 2 ASCII bytes, one for each digit of the target address (address must be in range: 01-50). To send Datagrams to a GROUP, use “g#” where # is 0-9.
3. TAG: Use zero (30H). If <CR> is substituted for ‘0’, the Busdriver will strip linefeeds <LF> from any <CR><LF> pair in the ensuing Datagram (see section 4.8 for more details).
4. DATA: Data of 246 bytes or less is most efficient, but may actually be any length.
5. END: 1E 71 5A 7E 40 0D 5E 0D 50 02 1F 51 78
 or from the keyboard: <guard> {SF} <guard> {SF} 1F 51 78

4.4.1 Reminder - Legal Substitutions:

- a) An ALTERNATE APPLICATION SEQUENCE may be used in place of the permanent one. Configuration is described earlier. It may range from 3 to 10 characters.
- b) The character <Ctrl>_ (1F hex) follows {AS} in all Datagram commands. Some terminals or controllers may not be able to issue this character. You may program an ALTERNATE UNDERSCORE CHARACTER using the APSEQ.EXE program shown at the beginning of this bulletin. This alternate character is factory set to “|” (7C Hex) and is identical to using <Ctrl>_ .
- c) {SF} <Ctrl>J may also be substituted for the 10 character {AS}, where {SF} indicates two presses of the user selected SPECIAL FUNCTION CHARACTER.

4.5 Buffering Action and Capacity

When receiving a Datagram, data from other senders is automatically queued within Busdrivers of the respective senders. Although the senders may continue to transmit their messages, this data is not seen by the target until the active Datagram has ended or expired (30 seconds of inactivity).

If large Datagrams are sent to a busy station, the sending devices will receive their respective user-configured handshake signals. The active sender achieves 9 Kbytes of buffering within the two Busdrivers, while 3 Kb is available for each queued sender (50% of these figures apply to Busdrivers with serial numbers below 910000).

Datagrams are extremely robust and flexible. 49 stations may simultaneously send Datagrams to any one Busdriver - or to any number of target Busdrivers which might each be simultaneously sending their own Datagrams.

4.6 Appearance in the Network Map

Busdrivers transmitting a Datagram appear as Txx in the NETWORK MAP of remote stations, where “xx” is the address to which Datagrams are being sent.

Busdrivers receiving a Datagram appear as Rxx in the NETWORK MAP of remote stations, where “xx” is the address from which Datagrams are being received.

Since a Busdriver can simultaneously send and receive Datagrams, its status may indicate both modes. This map was generated from JULIANNE, station #5 (her status displays FUNCTION). Note that PHIL, station 9, is simultaneously transmitting and receiving Datagrams (*what a guy!*)

SCI> n

NETWORK STATUS

#	NAME	STATUS	- P R O T O C O L S -				ECHO	LVL	TIME	BUF-DEL
1.	LASER	BUSY-10	19.2k	EVEN (7)	BOTH	Off	2	1 hr	38	
2.	LASER2	READY	19.2k	EVEN (7)	BOTH	Off	2	30 m	38	
3.	MODEM-96	OFF-LINE	9600	NONE (8)	DTR	Off	2	05 m	HOST	
4.	HAROLD	T09	38.4k	NONE (8)	DTR	Off	1	NONE	38	
5.	JULIANNE	FUNCTION	9600	NONE (8)	XOFF	On	1	NONE	38	
6.	SALES	R09	19.2k	ODD (7)	BOTH	Off	2	NONE	38	
7.	MODEM-24	Q-01	2400	NONE (8)	DTR	Off	2	15 m	HOST	
8.	TERMINAL	NON-EXIST	----	----	---	---	-	----	-	
9.	PHIL	T06, R04	38.4k	NONE (8)	DTR	Off	1	NONE	38	
10.	SHARON	BUSY-01	9600	NONE (8)	XOFF	Off	1	NONE	38	

Addresses range from 1 to 50, and do not need to be continuous. However, the poller must be properly initialized for the correct MAX POLLING ADDRESS. If a station #11 were added to the network above, it would not be accessible unless the POLLER were changed from 10 to 15 (the setting should remain as low as possible).

4.7 Notes about Datagrams

a) Upper/lower case must be observed in Datagram commands and the QC (QUEUE) command:

```
<Ctrl>_Qd (1F 51 64)   <Ctrl>_Qx (1F 51 78)   <Ctrl>_Qy (1F 51 79)
<Ctrl>_Qs (1F 51 73)   <Ctrl>_Qz (1F 51 7A)   <Ctrl>_QC (1F 51 79)
```

c) Once a Datagram is open, additional BEGIN DATAGRAM commands will be ignored, even if addressed to a different target. There is, however a special command which can be used to both end the existing Datagram and begin a new Datagram: Substitute <Ctrl>_Qy (Switch Target) for <Ctrl>_Qd (Begin Datagram).

d) A Datagram will be automatically ended under 3 conditions:

1. The sender (i.e. the device attached to the source Busdriver) pauses for 30 seconds or more. If the sender resumes transmission without issuing a new BEGIN DATAGRAM command, data will be discarded as would any data sent into the SLEEP state.
2. The sender issues a DISCONNECT (awakening the local Busdriver).
3. The source Busdriver loses power, or is disconnected from the network wire for more than 10 seconds. This causes the source to leave the Datagram-transmit state. The target Busdriver will end its receive-Datagram state in 10 seconds if other Datagrams or queue-connections are pending.

e) A Busdriver set to POLLER/1, should not send or receive Datagrams. Doing so may interfere with the polling of the entire network.

f) Initialize Busdrivers which will be sending Datagrams to Local Echo: DISABLED and Max Buffer Delay: 38 ms (these normal default settings, are particularly important for stations which will be sending Datagrams).

g) Guardband delays of 200ms are required before each {SF} character. The delay may not exceed 3 seconds each.

4.8 Datagram Tag Character (Useful for Master-to-Infinity Alarming)

The TAG CHARACTER is a byte within each Datagram initiation command reserved for future upgrade features. The use of a non-zero byte flags your Busdriver to use Datagram features that may be added in the future. If the Busdriver does not recognize the value, it will inform you that you may be using a non-resident feature, and will execute the command as normal Datagram.

For most applications, the TAG CHARACTER should be zero (30 Hex). But one special feature already makes use of this field. If you use <CR> (0D Hex) instead of zero, the Busdriver scans data being sent out to the remote unit, and strips away any linefeed characters (0A Hex) that are preceded by carriage return. The effect at the remote station, is to reduce double-spaced output to single-spaced output.

At the end of each display, a Master issues both <CR> and <LF>. Early Infinity SX8000 software interpret LF as an additional CR, preventing chained messages. A StarBus feature overcomes this inherent incompatibility. StarBus now supports the use of masters with Infinity.

Normally, the message in an alarm is preceded by zero (the datagram tag character). By substituting <CR> for "0" as the tag character in your alarm drum, StarBus will search and remove the <LF> character from each message line within the outgoing alarm data which follows. The feature operates until the datagram is ended, and must be reenabled for successive alarm/datagrams by substituting <CR> for the normal tag character.

5. HOMEBASE ADDRESS

So far, we have described two methods to address data: normal full-duplex connections (immediate or QUEUED) and Datagrams (one-way connections or GROUP broadcasts). The HOME BASE is simply a *favorite target port or group address*, which you pre-configured from the INITIALIZE SECONDARY PARAMETERS menu [I/s n]. Once set, it is unnecessary to use any commands, unless you wish to send data to an address other than the HOME BASE port.

If this field has been configured, a Busdriver that is not currently engaged in a connection will automatically open a Datagram to the HOME BASE address, even if no {AS} command is issued. A dumb RS-232 device could simply begin sending its unsolicited alarm or printer report without any command, and without waiting for the target address to be ready for its message. If left at the default value of NONE, data that is not preceded by a valid command is simply discarded.

The HOME BASE may be set to a normal address (1-50), a GROUP (1-9), ALL groups, or NONE.



A Series-C Busdriver can send a Datagram to any address even while already engaged in a regular connection to another port. But the HOME BASE setting does not apply in this case, because unaddressed data is already flowing to the presently connected remote unit.

5.1 Trigger Character

You may optionally select a TRIGGER character to begin a homebase message. If you do this, your Busdriver discards unaddressed data until it sees the preset trigger character. Then it begins sending data to the homebase address, until there is a pause. You also determine two related parameters: (1) the length of the pause which ends the homebase datagram, and (2) whether the trigger character is sent with the ensuing data, or is the last character in the (discarded) data.

The TRIGGER CHARACTER and PASS/DISCARD option are set from within the APSEQ.EXE program contained on your HotKey disk. Factory presets for these are: ANY CHARACTER, and PASS.

5.2 Two Datagram Timeouts

Since HOMEBASE datagrams do not require special programming on the attached device, it may be convenient to have them close automatically. We have found that a very short timeout is convenient for these datagrams. In this manner, other devices can get their own messages to a popular recipient. But, if no other stations need the remote station, the homebase will simply reopen when the sending unit resumes transmitting

On the other hand, it is important that the HOMEBASE TIMEOUT be long compared to the time between characters, so that a message is not interrupted with data interspersed from other senders.

APSEQ.EXE offers independent timeouts for both types of datagrams: those that you initiate with the OPEN DATAGRAM or SWITCH TARGET command, and those which are opened automatically by the homebase feature. The factory default for DATAGRAM TIMEOUT is 30 seconds and HOMEBASE TIMEOUT is 2 seconds. If the attached device is liable to read from a floppy disk during the course of a long HomeBase Datagram, consider lengthening the latter parameter.

6. GROUP ADDRESSING

For each Busdriver, a GROUP ADDRESS (1~9, or ALL) may be optionally set from the INITIALIZE PRIMARY PARAMETERS menu [I]. The Busdriver responds not only to connections and Datagrams addressed to its STATION NO. but also Datagrams addressed to its GROUP. This is useful for sending data to redundant alarm printers, or short messages to multiple front-end applications.

The GROUP ADDRESS parameter is a *Datagram 'receive' setting*. Each Busdriver may send to any group, whether or not they are a member of that group.

When data is sent to a GROUP ADDRESS (instead of to a specific station) all devices in that group receive it provided they were not engaged in a full-duplex connection at the beginning of the broadcast. Think of GROUP DATAGRAMS as live radio broadcasts. They are neither queued nor stored, though some buffering occurs to ensure delivery to recipients of different RS-232 speeds.

Stations that are sending datagrams receive the group broadcast even while sending a message to another station. If you do not wish to receive group broadcasts while sending to another station, use a traditional full-duplex connection instead of a Datagram to establish the desired connection. Busdrivers do not receive Group Datagrams if they are engaged in a traditional connection.

6.1 Theory of Operation

With regular Datagrams, a reverse link is established for flow control (even though the data is sent in only one direction), and for an internal confirmation that the message was received and delivered to the target device. But with GROUP DATAGRAMS, a design decision was made *not* to pass a reverse-channel handshake. A group broadcast must not be stopped because one printer is out of paper or is much slower than other recipients. Think of GROUP Datagrams as a radio broadcast. To receive them, a Busdriver must be tuned to the correct station (i.e. a member of the group); and must not be engaged in a regular full-duplex connection at the onset of the broadcast (tuned to AM instead of FM). Furthermore, it must also not fall more than 3 KB behind the pace of the sending Busdriver, either because it is set to a slower RS-232 speed or because of excessive flow control. Unlike a radio signal, you can receive back-to-back transmissions of many senders, even though they had broadcast simultaneously.

Because of these restrictions, receipt of GROUP Datagrams is not guaranteed. With singularly-targeted Datagrams (whether by command or by the HOME BASE method), data is queued and an invisible reverse channel confirmation is issued. But with GROUP Datagrams, recipients may be set to slower RS-232 speeds, or may be handshaking OFF for long periods, or may be engaged in a regular connection at the time of a broadcast. You can be reasonably assured of receipt, if you use a Busdriver only to wait for GROUP broadcasts (for example, a bank of printers).



GROUP and HOME BASE are different concepts. The GROUP ADDRESS setting instructs a Busdriver to receive Datagrams targeted at a specific group (or ALL groups). The HOME BASE setting informs your Busdriver to send data in the absence of address or commands, and that you want this unaddressed data to get to a pre-configured 'favorite' target.

The features may be combined: The HOME BASE field can be set to target a group address



In the event that a member of the group is a known to be a slower device, be sure to set the RS-232 speed of the sender at or below the slow recipient's effective RS-232 speed.



A station will not receive its own outgoing GROUP broadcast.

7. ADDITIONS TO THE PARAMETERS MENUS

7.1 Polling Speed

When Busdriver is initialized as POLLER or POLLER/1, two extra parameter fields appear:

1. Set MAX POLL ADDRESS to the highest address which will be used on the network. This parameter can be increased if more stations are added in the future. This feature optimizes the polling speed for the network size.
2. Set POLLING to FAST for almost all StarBus sites. This setting is slowed only for sites with our old-style StarBus repeaters (those built into the same size box as a Busdriver). In this event, set this parameter to the maximum number of repeaters that a Poller must traverse to the electrically furthest Busdriver. Generally, this means is half the number of older repeaters – rounded up (assuming the POLLER is on the center-most thread of a bus-configured network).

Repeaters extend a bus by 4,000 feet, or a star configurations with spokes exceeding 500 ft.

7.1.1 Restrictions on the use of POLLER/1

The POLLER/1 setting performs double duty. The Busdriver behaves as a full-duplex communications station to the attached device, yet also performs the systems control and maintenance functions of a poller.

Most installations use the POLLER/1 setting, thereby saving the cost of an additional Busdriver. Three issues should be considered when opting for this setting.

- a) POLLER/1 should not be used on networks with 15 or more Busdrivers, unless it can be determined that 15 or more units will never be in use at one time.
- b) The POLLER/1 must never send nor be the target of a DATAGRAM or HOME BASE Datagram.
- c) Attach the POLLER/1 Busdriver to a device which communicates primarily in one direction (such as a printer), or is no faster than 2400 bps (such as a modem). Higher speeds are acceptable for mostly-one-way devices.

If a unit is set to POLLER (not POLLER/1), the fields after “USER NAME” have no meaning and do not require initialization. Use the dedicated POLLER setting for networks with 15 or more Busdrivers, or networks in which every address may at some point send or receive Datagrams.

7.2 Silence Command Echo

Normally the field Echo Commands is used to specify whether a Busdriver will echo typed characters to the console screen when in the CHANGE PARAMETERS MENU. A new option, “SILENT”, enables this CHANGE PARAMETERS echo (which is generally desirable), but suppresses non-error responses to StarBus commands from all states:

1. Responses indicating successful CONNECT and DISCONNECT
2. Responses for entry into a QUEUE (although the alert which indicates a subsequent connection is preserved)

3. The SCI> prompt and preceding <CR><LF> <CR><LF>
4. The “Z” issued when a Busdriver puts itself into SLEEP state

Requested responses (such as NETWORK MAP or QUERY STATE) operate normally. Also, warnings and errors are generated normally, such as these examples:

- The CONNECT command accepts a maximum of 2 arguments
 - LASER, station #19 is currently connected to PATRICK, station #42
- or:
- No station “LARRI” responding

The SILENT mode can be useful in preventing echo-back of the prompt and connect messages when a Busdriver is attached to a controller or other non-user program. If the programmed device is half-duplex (causes an echo into the Busdriver), these characters might be interpreted as a command or sent to an attached device. Worse yet, if the Busdriver is in COMMAND STATE, an indefinite ring/echo might be established.

7.3 Ignore Sleep Xoff

The SECONDARY PARAMETERS MENU is entered by typing I/s or I/s {remote name}. For general office communications, it is not necessary to adjust the parameters accessed from this menu.

The field Ignore Sleep XOFF appears in the SECONDARY PARAMETERS MENU. Setting this parameter to YES causes the Busdriver to ignore the XOFF handshake while in SLEEP state, even if XOFF or X+C is the current mode of handshake.

The setting is useful for Busdrivers which deliver short DATAGRAMS to their attached device.

8. MODEM CONSIDERATIONS

8.1 Modem Speed Detect

Older Busdrivers had to be attached to a device with constant RS-232 speed. This meant that modems could be used at only one single speed, unless they had the ability to decouple their RS-232 speed from the telephone line speed (this feature is found in newer MNP and V32 modems).

Upon receiving a phone call, modems report “CONNECT xxxx”, where xxxx is the speed of the telephone connection. If no parameter is shown, the connection is established at 300 bps. As you might expect, a modem reports the new connect speed *before switching to it* – using the speed of the previous connection, or any more recent RS-232 commands issued into its RS-232 port.

An option in the SECONDARY PARAMETERS MENU causes a Busdriver to scan for this message whenever it is asleep. When a new call is received, the local Busdriver resets its RS-232 speed to the new connection speed!

8.2 Important Information about Flow Control

Some equipment – especially modems – use RTS (pin 8) instead of DTR (pin 20) as one of the hardware handshake signals. Over the years the proper selection of which signal should be used has troubled many equipment manufacturers. One solution is to use XON/XOFF software handshake with such equipment.

But, in many applications hardware handshake provides an important benefit. The solution in these cases, is to move a signal from one pin to another ...

8.2.1 Newer Modems with Correction/compression

Newer modems that include compression and error correction do not make use of this StarBus feature. Instead, find the command which instructs the modem to maintain a constant RS-232 (or ‘DTE’) speed, regardless of the telephone connect speed. In Hayes V-series modems, this is caused Automatic Speed Buffering. For most brands, it is the factory default setting.

In this case, however, it is critical to select the proper StarBus handshake setting. The modem will use handshake to synchronize the effective StarBus throughput. For most controls applications, you can use XON/XOFF, because data is composed of ASCII characters and the hex-pair representation of upper bytes. But in some cases, it will be necessary to use hardware handshake (called DTR in the Busdriver INITIALIZE PRIMARY PARAMETER menu).

Unfortunately, most modems use CTS/RTS for hardware handshake (pins 5 and 4 on a 25-pin connector), while StarBus uses CTS/DTR (pins 5 and 20); the convention most frequently used with PCs and printers. To use hardware handshake between a modem and StarBus, it is necessary to move the modem pin 4 (or pin 7 on a 9-pin connector) to StarBus pin 20.

8.2.2 Older Modems with No Correction/Compression

The concept of flow control does not apply to older modems with no compression or error correction. These devices (typically capable of 300–1200 and 2400 baud) simply convert digital activity at the RS-232 port to analogue signals into the telephone interface – and visa versa. Set HANDSHAKE of its Busdriver to NONE. This permits the local and remote users to directly flow control each other, and prevents the XOFF character from being misinterpreted as a handshake.



There is no convention for the reporting speed of a modem when first powered up. Some manufacturers use 300 or 1200 bps, while others use the highest speed of the model. You should perform a test for this speed – and then set the attached Busdriver to it.

Likewise, be sure to power both the Busdriver and the modem from the same electrical outlet, so that they are not likely to lose power at different times.

The network map always reports the originally programmed speed (set with the INIT command). This should be set to the modem’s powerup default RS-232 speed, so the modem and Busdrivers will be at the same speed should they lose power.

8.3 Setting the StarBus Front Panel Switch

Each Busdriver has a front panel switch labeled COMPUTER/TERMINAL and PERIPHERAL. This ‘NULL MODEM’ switch sets the Busdriver for local mating to either DTE equipment (a PC or most printers) - or DCE equipment (a modem or some controller alarm ports). When interfacing with a modem, set this to PERIPHERAL. This is preferable to using a null modem cable, because most of these reverse only the receive and transmit signals (pins 2 & 3) but do not reverse the CTS / DTR handshake signals (pins 5 & 20). That causes loss of data when using HARDWARE handshake. Limit the use of NON-straight-through cables to computers or peripherals that do not conform to the RS-232 specification, and may call for cables with special jumpers or crossovers within them.

9. EXTENDED HANDSHAKE MODES



These features is useful for applications that require CARRIER DETECT (CD) or non-buffering (pass-through) handshake. They are also useful for controllers that use the CTS pin to signal the presence of a front-end login.

9.1 General

This specification describes the operation of each StarBus handshake mode, including the controller application modes: PASS, CONNECT and X+C. These special modes offer important benefits for modem and controller applications.

Incorrect handshake settings and improper wiring are the source of most network dysfunctions. Establishing correct settings for HANDSHAKE can be frustrating. Both the network Busdrivers and the attached computing devices must be configured properly for flawless communications. In some cases, they must be set to apparently conflicting modes. An incorrect setting can pose as the proper one if buffer filling tests are not performed at the time of installation.

Two techniques can help to swiftly configure the correct HANDSHAKE setting:

- (1) Use a crib sheet for a particular application. For example, installers of Andover Controls Infinity or Master controllers should refer to the appropriate applications brochure. Likewise, there is a special bulletin for engineers installing StarBus at 3M Company manufacturing plants.
- (2) Understand the intrinsic operation of the two basic modes: DTR and XOFF, and logically determine the proper settings. A superb tutorial is on the HotKey Diskette in the file READ.ME.

In many applications, senders of small or infrequent Datagrams may be immune from handshake problems, since the amount of transient data will never exceed the combined buffers of the sending and receiving Busdrivers. For example, StarBus will never handshake an alarm station which sends bursts of 300 characters spaced 5 minutes apart to a receiving station, if the receiving station will not be occupied in a normal connection for more than 15 minutes at a time.

9.2 Notes about Special Handshake Modes

The PASS setting forces the CTS pin at a remote station to reflect the DTR signal of the locally attached computer or peripheral during the connection, thus permitting instantaneous handshake of a device across a network. Of course, when using this setting, users lose the advantage of StarBus's own buffer capacity (typically, 4k Bytes per connection; 1k Byte for Datagrams).

The CONNECT setting is special. It substitutes the meaning CONNECTION DETECTED (CD) for the signal normally used by CTS. Since StarBus uses pin 5 or 20 (depending on the position of the front panel switch), use of this feature typically requires a special cable which moves the signal to pin 8 (CD) on the attached equipment.

The CONNECT handshake setting should not be confused with the CONNECT state of a Busdriver.

9.3 Xoff Sensitivity When Receiving Datagrams

In its default mode, Busdrivers adhere to the selected handshake protocol even when receiving a Datagram. An assumption is made that flow control will be reenabled prior to the next connection. When used with hardware handshake, the assumption is a certainty, but for some XON/XOFF devices, the assumption is invalid. When the next Datagram arrives (or if a regular connection is made), the StarBus may still be in a state of XOFF.

You can set a Busdriver to ignore XOFF if received during the SLEEP or RECEIVE DATAGRAM states. This special setting will only affect a Busdriver whose handshake is set to a mode which acknowledges XON/XOFF characters.

To enable XOFF suppression enter the INITIALIZE SECONDARY PARAMETERS MENU (type "I/s" from the command prompt); press ENTER until viewing the question "IGNORE SLEEP XOFF"; then tap the space bar to select "Yes". Press <Ctrl>E to save the new setting.

The Ignore Sleep/XOFF setting is automatically selected for controls dealers who follow the OEM configuration procedure outlined on page 7 of Appendix I.

9.4 Definition Of Handshake Modes

For purposes of illustration, it is assumed that the local Busdriver has its switch set to COMPUTER/TERMINAL so that DTR is an input to the Busdriver and CTS is an output. The following paragraphs define the operation of both hardware handshake (CTS and DTR signals) and software handshake (XON and XOFF characters) for the various settings of the handshake parameter.

9.4.1 XOFF

XON and XOFF characters are used for flow control both into and out of the Busdriver. Additionally, if the remote unit is set to "PASS", CTS reflects the state of DTR at the remote station (the input from a computer to the remote Busdriver); otherwise CTS is high.

9.4.2 DTR

DTR and CTS signals are used for input and output flow control, respectively.

9.4.3 BOTH

DTR and CTS operate the same as for "DTR" handshake. Additionally, the Busdriver will recognize XON and XOFF (but not itself issue) these characters for flow control. NOTE: This setting functions the same as commercial versions of StarBus.

9.4.4 ONE WAY

XON and XOFF are issued by the Busdriver to control flow, but are accepted as normal data characters when received from the locally attached device. If the remote unit is set to "PASS", Cts reflects its DTR signal; otherwise CTS is held high.

9.4.5 CONNECT

When not engaged in a normal connection, CTS is low. When connected, CTS is high, unless the remote station is set to "PASS". If the remote station is set to "PASS", CTS reflects the state of DTR at that station.

9.4.6 Pass

When a Busdriver is not engaged in a normal connection, or when connected to a remote station set to "DTR" or "BOTH", CTS is high. When connected to a remote station set to any other handshake mode, CTS at the remote station reflects the state of DTR on the local Busdriver.

This setting permits reconfiguration of the DTR pin (5 or 20) for use as a remote signal status, such as DCD at a modem.

9.4.7 X+C

A combination of "XOFF" and "CONNECTED" settings. XON and XOFF characters are used to control flow both into and out of the Busdriver. When placed in the COMMAND state, the Busdriver sets Transmit On (as if an XON character had been received). CTS behaves the same as for the "CONNECT" setting (see section 2.4.5, above).

9.4.8 NONE

CTS is high except when connected with a remote Busdriver set to "PASS". In that case, CTS reflects the state of DTR at the remote station.

 For older modems which do not include compression or error correction, use handshake NONE. This permits your computer to directly flow control the remote system, and prevents the XOFF character from being misinterpreted as a local handshake.

For newer compression modems (typically 9600 - 56 kbps), such as MNP, v.32, or Hayes V-Series, please ask for our special bulletin "APPENDIX B".

10. TABLE OF ASCII CODES

DEC	HEX	ASC	CTRL	DEC	HEX	ASC	DEC	HEX	ASC	DEC	HEX	ASC
0	00	NUL	@	32	20	SP	64	40	@	96	60	`
1	01	SOH	A	33	21	!	65	41	A	97	61	a
2	02	STX	B	34	22	"	66	42	B	98	62	b
3	03	ETX	C	35	23	#	67	43	C	99	63	c
4	04	EOT	D	36	24	\$	68	44	D	100	64	d
5	05	ENQ	E	37	25	%	69	45	E	101	65	e
6	06	ACK	F	38	26	&	70	46	F	102	66	f
7	07	BEL	G	39	27	'	71	47	G	103	67	g
8	08	BS	H	40	28	(	72	48	H	104	68	h
9	09	HT	I	41	29	)	73	49	I	105	69	i
10	0A	LF	J	42	2A	*	74	4A	J	106	6A	j
11	0B	VT	K	43	2B	+	75	4B	K	107	6B	k
12	0C	FF	L	44	2C	,	76	4C	L	108	6C	l
13	0D	CR	M	45	2D	-	77	4D	M	109	6D	m
14	0E	SO	N	46	2E	.	78	4E	N	110	6E	n
15	0F	SI	O	47	2F	/	79	4F	O	111	6F	o
16	10	DLE	P	48	30	0	80	50	P	112	70	p
17	11	DC1	Q	49	31	1	81	51	Q	113	71	q
18	12	DC2	R	50	32	2	82	52	R	114	72	r
19	13	DC3	S	51	33	3	83	53	S	115	73	s
20	14	DC4	T	52	34	4	84	54	T	116	74	t
21	15	NAK	U	53	35	5	85	55	U	117	75	u
22	16	SYN	V	54	36	6	86	56	V	118	76	v
23	17	ETB	W	55	37	7	87	57	W	119	77	w
24	18	CAN	X	56	38	8	88	58	X	120	78	x
25	19	EM	Y	57	39	9	89	59	Y	121	79	y
26	1A	SUB	Z	58	3A	:	90	5A	Z	122	7A	z
27	1B	ESC	[	59	3B	;	91	5B	[	123	7B	{
28	1C	FS	/	60	3C	<	92	5C	\	124	7C	|
29	1D	GS	]	61	3D	=	93	5D	]	125	7D	}
30	1E	RS	^	62	3E	>	94	5E	^	126	7E	~
31	1F	US	_	63	3F	?	95	5F	_	127	7F	DEL

11. Partial List: Advanced Controls Features

Controls users can now configure both StarBus parameter menus and the ALTERNATE APPLICATION SEQUENCE to dealer recommended settings with a single keystroke (Andover dealers, type CTRL-A from either INITIALIZE PARAMETERS menu...3M sites type CTRL-T). Then, simply assign each Busdriver a unique name and number. It is not necessary to run the DOS utility APSEQ.EXE.

Will this station be used with SX8000 (Y/N)? [n]

Pre-configured for use with Andover Controllers.
Check each parameter against latest bulletin;
then press CTRL-E to save parameters.

Busdrivers can now transmit a Datagram to any station, even while engaged in a full-duplex connection! In controls applications, this means that a controller can send alarms even when a user or front-end is logged onto the same port. No special syntax is required to send a 'sideways' alarm.

A new command allows you to forcefully disconnected two remote stations: {AS} <ctrl>F D xx

A CHAR DELAY parameter allows the receiving station to pace RS-232 output. This cannot be achieved by inserting RS-232 delays at the sender (for example via Procomm), because the sending Busdriver buffers data into packets and then multiplexes them onto the network..

APSEQ.EXE now programs 6 parameters. It also reads back each one from the local Busdriver. The menu interface is shown in section 1. The next paragraph summarizes the newer parameters:

A Programmable DATAGRAM TIMEOUT and HOMEBASE TIMEOUT help StarBus adapt to virtually any situation. The Homebase TRIGGER CHARACTER prevents transmission unless begun with a character you preset. Also, you select whether this trigger character is included in transmitted data. Finally, the DATAGRAM COMMAND CHARACTER is user configurable from this program.

With the HOMEBASE setting, you can send unaddressed data to a predefined port. Previously, data had to be addressed or sent during an established connection. Now, reports arrive at the proper station without initialization or macro programming. HOMEBASE can even send data older units!

GROUP ADDRESSING supports broadcasting or redundant alarms. Each Busdriver can have both a unique and group address (set from the INITIALIZE menu). You may even HOMEBASE to a group!

MODEM SPEED DETECT tells a Busdriver to match its RS-232 speed after a modem answers any call. It is not needed for new v.32 modems. Activate it from the SECONDARY PARAMETERS menu.

A master "Pass Key" permits dealers to determine the network diagnostic password of any station. For step-by-step details, download our bulletin: *Termination & Testing*.

Commands issued with the APPLICATION SEQUENCE no longer require control characters. Use either capital or control characters for CONNECT, DISCONNECT, QUEUE, BEGIN DATAGRAM, etc.

In earlier versions, the DISCONNECT command would awaken a Busdriver if already disconnected (like pressing disconnect characters). Now you will never accidentally awaken a Busdriver. The new DISCONNECT command guarantees moving into the SLEEP state, even if already asleep.

It is no longer necessary to add POLLER delays when adding newer repeaters. Now you can daisy-chain repeaters for a 'super-network' of up to 20 miles, without any impact on performance at all!

11.1 Feature History

The [V]ersion command shows series and release date (of the local Busdriver only): C-YYMMDD

- Ver 3.01** Last feature release prior to Series-A: Adds queueing (section 3). In combination with HotKey software, StarBus now supports multi-target spooling.
- A-890723** First version for control applications: DATAGRAM/ALARM feature (one way, queued transmission) supports unsolicited alarms. Extended HANDSHAKE modes.
- A-891016** User set ALTERNATE APPLICATION SEQUENCE and ALTERNATE UNDERSCORE CHARACTER (default = bar "|"). These support OEM Datagram commands.
- A-891212** RECIPIENT PAUSE (Qx and Qz). These Datagram commands insert a timed delay into the data at the recipient. New SILENT option in the field ECHO COMMANDS.
- A-900102** Repaired "DROP DTR ON DISCONNECT" feature (bug affected version A-891212)
- B-900722** **Series-B:** HOME BASE addressing, GROUP DATAGRAMS, APSEQ.EXE parameters
B-900809 <Fix> ... The early release (#B-900722) would sometimes hang during power-up.
- B-901011** Added BUFFER DELAY settings (ACK2, ACK4 ... 24 ms); configurable MAX POLL
B-901014 COUNT and PACKET LENGTH improves short packet turnaround (added for 3M).

Next Generation Hardware Platform (introduced in 1991)

Features below were introduced with Next Generation Busdrivers, but are also available as a feature chip upgrade for older units. "Next Generation" refers to an improved hardware platform, independent of the feature 'series' or version. Next Generation units are compatible with older units, but have more memory, faster polling, increased noise immunity and support longer maximum wire lengths.

The feature space of older generation models is almost fully exploited (s/n < 910000). Therefore, they do not contain on-line help for initialization parameters. Currently this is the only operational difference between an upgraded older unit and newer units. But at some future date, it may no longer be possible to offer new features upgrades to older Busdrivers.

- B-910301** First Next Generation version (also available as upgrade to older Busdrivers). Improved POLLER/1. New LINE ANALYZER modes support 115.2k streaming (B=Buffered, U=Unbuffered). Critical tuning of polling speeds. Improved HOST MODE now sends on same poll cycle if output data is pending.
- B-910329** Merge '3M features' into mainstream (<Ctrl>T custom INIT added in B-911111).
B-910418 MODEM SPEED DETECT (enabled via INIT SECONDARY PARAMETERS [I/s] menu).
- B-910620** Supports CR as a Datagram TAG character (instead of 0). This strips LF from outgoing Datagrams, and allows Andover Masters to chain displays to Infinity SX.
B-911111
- B-920115** Fixed bug which interfered with X+C handshake during Datagrams.
- B-920503** When using a controller with an internal modem, the attached Busdriver is no longer restricted to the baud rate of the modem.
- B-930101** New Group Datagram kernal; Retry/recovery; 60% increase in speed-saturation point. Context-sensitive HELP screens (Next Generation hardware platform only).
- B-930808** New RS-232 CHAR DELAY and LINE DELAY. These aid upload to AC8 or AC256.
B-930915 Substitute 2 new DISCONNECT / SPECIAL characters: '\$' and '%' (special order).
- C-950101** **MAJOR RELEASE:** Series C includes major new features, including SIDEWAYS
C-970101 DATAGRAMS and REMOTE DISCONNECT from Application Sequence commands.