HP 27122A

PROGRAMMABLE SERIAL INTERFACE REMOTE JOB ENTRY (PSI RJE)

Firmware Reference Manual

Card Assembly: 5061-4920
Date Code: B-2314

HEWLETT PACKARD

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PRINTING HISTORY

The Printing History below identifies the Edition of this Manual and any Updates that are included. Periodically, update packages are distributed which contain replacement pages to be merged into the manual, including an updated copy of this Printing History page. Also, the update may contain write-in instructions.

Each reprinting of this manual will incorporate all past updates; however, no new information will be added. Thus, the reprinted copy will be identical in content to prior printings of the same edition with its user-inserted update information. New editions of this manual *will* contain new information, as *well* as updates.

First Edition.....June 1983

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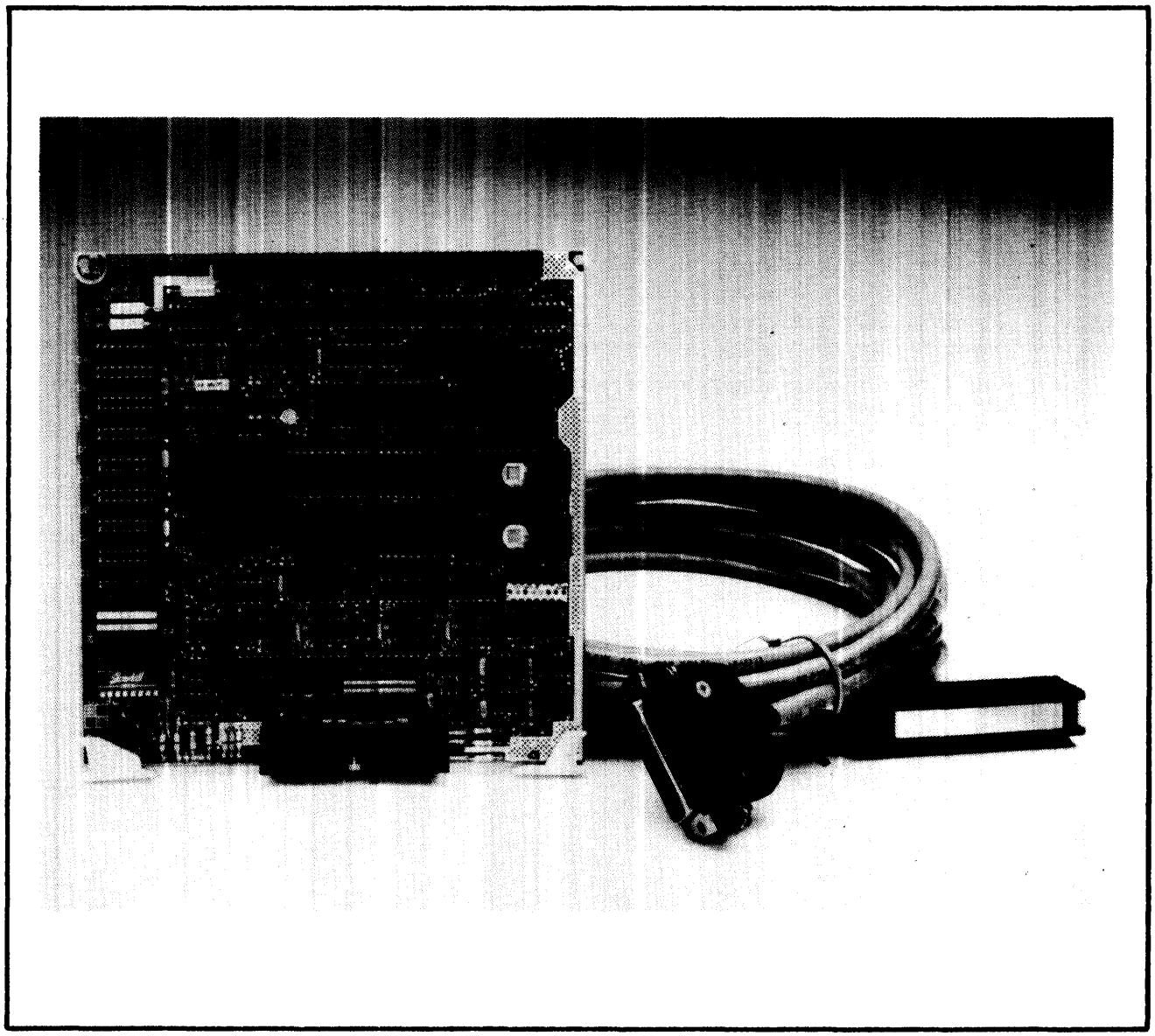


Figure 1-1. HP 27130A RJE PSI

GENERAL INFORMATION

SECTION I

This manual provides information for the Programmable Serial Interface Remote Job Entry (PSI RJE) firmware. Included are a general description, Input/output Channel protocol information, and descriptions of transactions between the host computer and the PSI RJE card.

PHYSICAL DESCRIPTION

The HP 27122A PSI RJE, shown in figure 1-1, consists of a printed-circuit card and an RS-232-C cable. One 80-pin connector connects the card to an Input/Output Adapter and from there to a host computer, and a 50-pin connector connector connects the card to a peripheral device (modem).

FUNCTIONAL DESCRIPTION

The PSI RJE provides serial interface capability, via a modem, between a host computer and a peripheral device. Figure 1-2 shows a Hewlett-Packard computer system using CHANNEL I/O and the PSI RJE. (CHANNEL I/O is a Hewlett-Packard standard defining the physical and electrical characteristics for an I/O system consisting of an I/O channel, an I/O channel adapter, and I/O cards. The PSI RJE is one of the I/O cards.)

Note that the computer system CPU and memory communicate directly along a Memory/Processor Bus (MPB). I/O data to/from peripheral devices reaches the CPU/memory through the I/O channel, the I/O channel adapter, and an I/O card such as the PSI card. The I/O data is received from and transmitted to peripheral devices by the I/O card, which converts device-specific data to a format compatible with the I/O channel, and thus the computer. The I/O channel adapter (see figure 1-2) controls the flow of traffic between the I/O channel and the memory/processor bus.

The PSI RJE card uses several of the Z-80 family of microprocessor components to relieve the host computer of much of the overhead.

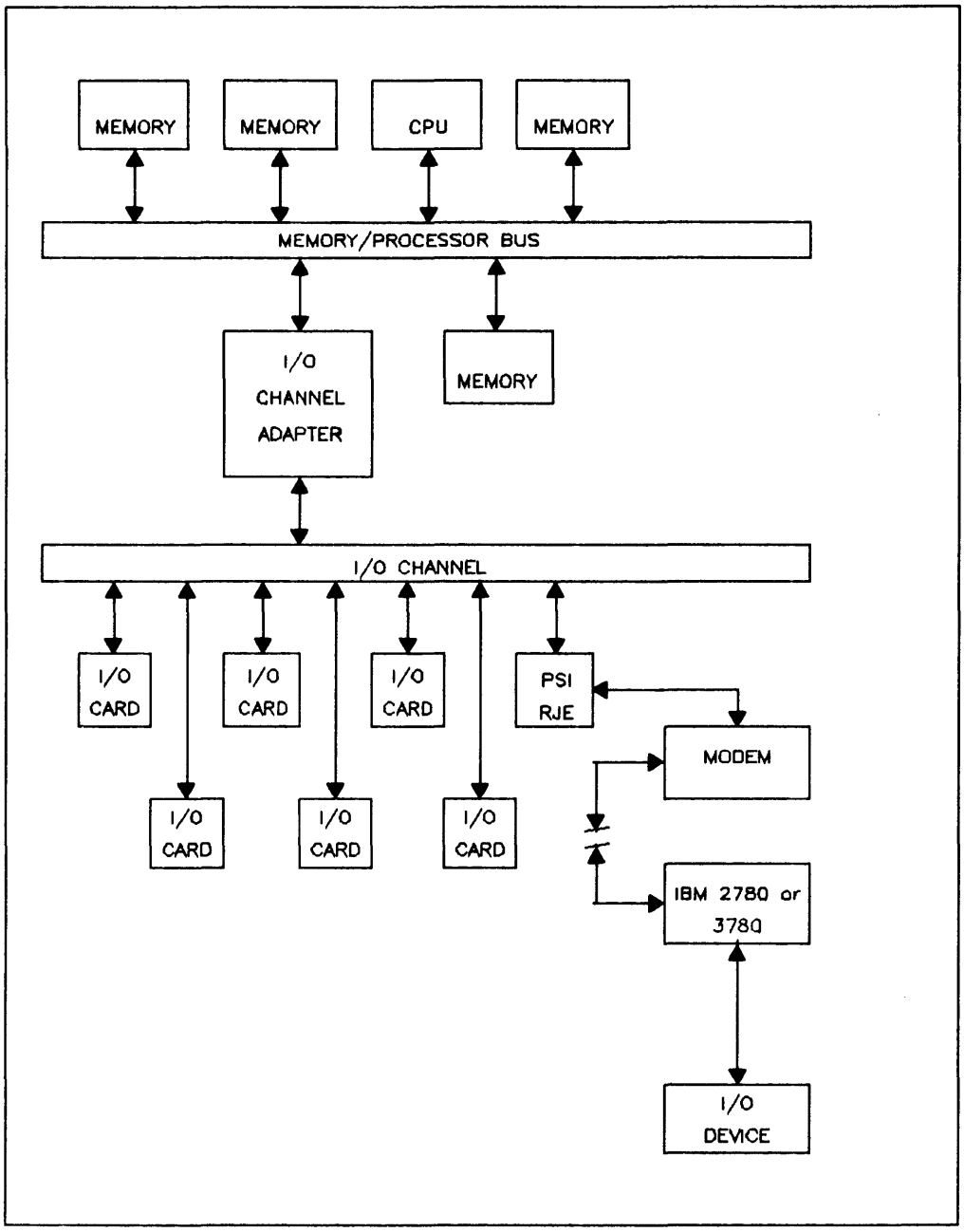


Figure 1-2. PSI RJE in a Typical Hewlett-Packard Computer System

EQUIPMENT SUPPLIED

The HP 27122A PSI RJE consists of the following items (see figure 1-1):

PSI card, part number 5061-4920

Two EPROMs, part numbers 27122-80001 and 27122-80002

Five-meter male (modem) RS-232-C cable, part number 8120-4008

Installation manual, part number 27122-90001

IDENTIFICATION

The Product

Up to five digits and a letter (27122A, for example) are used to identify Hewlett-Packard products. The five digits identify the product; the letter indicates the revision level of the product.

Printed Circuit Card

The printed circuit card is identified by a part number marked on the card. In addition to the part number, the card is further identified by a letter and a four-digit date code (e.g., B-2314). This designation is placed below the part number. The letter identifies the version of the etched circuit on the card. The date code (the four digits following the letter) identifies the electrical characteristics of the card with components mounted. Thus, the complete part number on the PSI RJE card is:

5061-4920
B-2314

If the date code stamped on the card does not agree with the date code on the title page of this manual, there are differences between your card and the card described herein. These differences are described in manual supplements available at the nearest Hewlett-Packard Sales and Service Office (a list of Hewlett-Packard Sales and Service Offices is contained at the back of this manual).

Manuals

An Installation Manual (part number 27122-90001) is supplied with the HP 27122A product. This manual (part number 27132-90004) and a PSI Hardware Reference Manual (part number 27132-90005) are part of the HP 27132 Technical Reference Package. The name, part number, and publication date are printed on the title page of each manual. If the manual is revised, the publication date is changed.

I/O CHANNEL PROTOCOL

SECTION II

INTRODUCTION

This section explains the implementation of the I/O channel (backplane) protocol for the PSI RJE interface.

TRANSACTIONS

Each transfer between the PSI RJE and the host computer is called a "transaction", and occurs over the I/O channel. Each transaction represents a single read or write (data, status, etc.)

There are seven types of transactions used by the PSI RJE, as follows:

Read Link Data

Write Link Data

Control Link

Read PSI Configuration

Write PSI Configuration

Control PSI

Read Trace Block

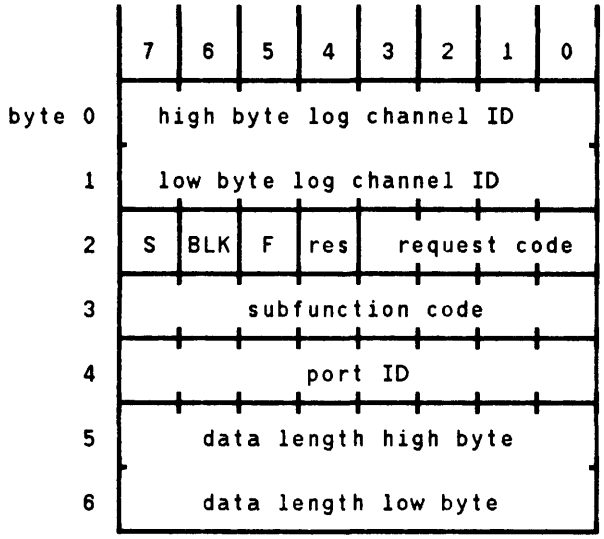
Each read or write is preceded by a Connect Logical Channel (CLC) request block from the host computer, and is followed by a Read Status Result (RSR) block. The CLC request is in response to an SRQ signal, requesting the next order, from the PSI RJE.

The PSI RJE card will support word or byte mode transfers, depending on bit 3 of the order, except IDY (Identify) orders, which are always in byte mode. All data transfer transactions do not support multi-blocked data transfers. The blocking size for PSI RJE is a constant 1024 bytes.

For each of the descriptions of the seven requests listed above, the different fields used in the CLC request and RSR result blocks are enumerated. Fields which are marked "not used" or which are not mentioned are *not* checked by the firmware and need not be sent if they are at the end of a block. (For example, PORT ID and DATA LENGTH fields of a CLC block for CONTROL LINK).

CONNECT LOGICAL CHANNEL (CLC) REQUEST FORMAT

The Connect Logical Channel (CLC) request block has the following format:



where

log channel ID

Assigned by the host for each transaction. The card firmware will keep the ID with each transaction until it is completed.

S bit

Used by all non-blocked read device data requests and by the last block of the blocked read device data request. If the S bit is set, any remaining data in the current read record will be available for the next read request. If the S bit is clear, any data remaining in the current record will be discarded after the read is completed.

BLK

0 = non-blocked data transfer

1 = blocked data transfer

F

Flush data before processing this request. Any data residing in the indicated port's receive buffer is flushed before a read is begun (RDD requests only).

request code

0 = reserved

1 = read device data

2 = write device data

3 = control device

4 = read card information

5 = write card configuration data

6 = control card

7 = not used

8-15 = reserved

subfunction code

The content of this field is dependent on the type of the request.

port ID

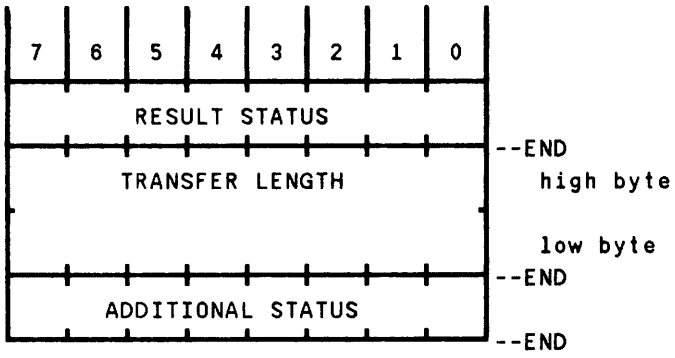
Not used by the PSI RJE card.

data length

Required for all read or write requests. All other requests should contain zeros.

RSR Result Block Format

The format of the Read Status Result Block is:



READ LINK DATA REQUEST

This request has a maximum blocking size of 1024 bytes. If any block is terminated early by the host, all the remaining data in that block is lost. The RSR block will *not* reflect any lost data (i.e., it reflects only what should have been read).

CLC Request Block

```
S              = 0 - DISCARD unread data
               = 1 - SAVE unread data
BLK            = 0
REQUEST CODE   = 1
SUBFUNCTION    = not used
PORT ID        = not used
DATA LENGTH    = maximum host buffer size
```

RSR Result Block

```
RESULT STATUS        = 0   (no error)
  TRANSFER LENGTH    = value,  where value is the number of bytes
                       that should have been read into the host
  ADDITIONAL STATUS  = mask,  where mask describes the record
                       terminator(s):

                         0 = maximum length transferred with no INSEP
                             encountered
                         1 = STX
                         2 = NL
                         4 = EM
                         8 = IRS
                        16 = ITB
                        32 = ETB
                        64 = ETX
                       128 = Zero length block encounterd

RESULT STATUS = 255 (OPEN LINK required)
```

WRITE LINK DATA REQUEST

This request is a single block Write transaction. The blocking size is a constant 1024 bytes.

CLC Request Block

```
S             = not used
BLK           = 0
REQUEST CODE  = 2
SUBFUNCTION   =
                1 - Endrecord
                2 - Endblock
                3 - Endtext
                4 - EOT
PORT ID       = Not used
DATA LENGTH   = Host buffer size
```

RSR Result Block

```
RESULT STATUS      = 0   (no error)
  TRANSFER LENGTH  = value, where valuefg is the number of bytes
                     of data succesfully accepted

RESULT STATUS      = 1   (illegal subfunction)

RESULT STATUS      = 6   (data overrun in host write data(s))
  TRANSFER LENGTH  = value, where value is the number of bytes
                     sucessfully accepted

RESULT STATUS      = 246 (Illegal length request)

RESULT STATUS      = 247 (BISYNC character found in data while
                     double-checking output normal text)
  TRANSFER LENGTH  = value, where value is the number
                        of bytes sucessfully accepted

RESULT STATUS        = 248 (automatic LINE BID failed)

RESULT STATUS        = 254 (link not in correct state)

RESULT STATUS        = 255 (OPEN LINK required)
```

CONTROL LINK REQUEST

This request is a Control transaction. The OPEN LINK subfunction generates a SOLICITED event (see the paragraph SOLICITED EVENTS).

CLC Request Block

```
S            = not used
BLK          = not used
REQUEST CODE = 3
SUBFUNCTION  =
                 0 - No action
                 1 - Open link
                 2 - Close link
                 3 - Send RVI  "Break"
                 4 - Line bid
                 5 - Send EOT
                 8 - <not used>
                10 - SF/SR HIGH
                11 - SF/SR LOW
PORT ID      = not used
DATA LENGTH  = not applicable
```

RSR Result Block

RESULT STATUS = 0 (no error - action STARTED!!)

RESULT STATUS = 1 (illegal subfunction)

RESULT STATUS = 253 (link type not 3780)

RESULT STATUS = 254 (link not in correct state)

RESULT STATUS = 255 (OPEN LINK required)

READ PSI INFORMATION REQUEST

This parameter is a Non-blocked Read transaction.

CLC Request Block

```
S            = not used
BLK          = not used
REQUEST CODE = 4
SUBFUNCTION  =                                          length
                                                       in bytes
               235 - <always zero>                        2
               236 - <always zero>                        2
               237 - Garbled Responses                    2
               238 - Receive Timeouts                     2
               239 - <always zero>                        2
               240 - <always zero>                        2
               241 - <always zero>                        2
               242 - <always zero>                        2
               243 - NAKs Received                        2
               244 - Bad Blocks Received (NAKs Sent)      2
               245 - Blocks Sucessfully Received          2
               246 - Blocks Sucessfully Sent              2
               247 - Firmware Identity                    9
               248 - Link Status                          1
               249 - Last Record Terminator               1
               250 - Last Record Type                     1
               251 - Number of Blocks in Output Queue     1
               252 - Number of Blocks in Input Queue      1
               253 - Last Datacomm Error Encountered      1
               254 - Card Status                          1
               255 - Modem Status                         1
          0  to  48 - same as WRITE PSI CONFIGURATION REQUEST

PORT ID      = not used
DATA LENGTH = Host buffer size
```

RSR Result Block

```
RESULT STATUS     = 0   (no error)
  TRANSFER LENGTH = value,   where value is the number of
                    bytes that should have been read

RESULT STATUS     = 1   (illegal subfunction)
```

WRITE PSI CONFIGURATION REQUEST

This request is a Non-blocked Write transaction. The different fields to be configured are not updated until the data has been validated. One of three different procedures can be performed:

```
Length exactly
Length exactly plus value within range
No validation
```

CLC Request Block

```
S            = not used
BLK          = not used
REQUEST CODE =
```

		validation length	validation range
0	- No Parameter	*	*
1	- Link Type	1	0 to 1
2	- Station Type	1	0 to 1
3	- Link Character Set	1	0 to 2
4	- Modem Connection	1	0 to 2
5	- Transmission mode	1	0 to 2
6	- Maximum Block Size	2	4 to 512
7	- Maximum Output Record Size	2	1 to 509
8	- Maximum Output Records per Block	1	1 to 255
9	- In Header	1	0 to 255
10	- Baud Rate	1	6 to 17
11	- User Text	1	*
12	- Phone Number	30	*
13	- Disconnect	1	0 to 1
14	- Modem Connection Timeout	1	0 to 255
15	- No Activity Timeout	2	0 to 65535
16	- Lost Carrier (DCD) Timeout	1	0 to 255
17	- Transmit Timeout	1	1 to 255
18	- Continue Timeout	1	1 to 255
19	- Receive Timeout	1	2 to 255
20	- Retry Limit	1	1 to 255
21	- Trace Mask	*	*
22	- Interrupt Mask	*	*
23	- Input Text Mode	1	*
24	- Input Record Format	1	*
25	- NL Character	1	*
26	- EM Character	1	*
27	- IRS Character	1	*
28	- IGS Character	1	*
29	- SPACE Character	1	*
30	- In Conversion Table	256	*
31	- Out Conversion Table	256	*
32	- SOH Character	1	*
33	- STX Character	1	*
34	- ETX Character	1	*
35	- DLE Character	1	*

```
                36 - ITB Character                      1      *
                37 - ETB Character                      1      *
                38 - ENQ Character                      1      *
                39 - SYN Character                      1      *
                40 - EOT Character                      1      *
                41 - NAK Character                      1      *
                42 - ACK0 Character                     1      *
                43 - ACK1 Character                     1      *
                44 - WACK Character                     1      *
                45 - RVI Character                      1      *
                46 - PAD Character                      1      *
                47 - Output Text Mode                   1      *
                48 - Output Format Mode                 1      *
PORT ID      = not used
DATA LENGTH = Host buffer size

 * means that validation is not performed
```

RSR Result Block

```
RESULT STATUS      = 0   (no error)
  TRANSFER LENGTH = value, where value is the number of
                    bytes sucessfully received

RESULT STATUS      = 1   (illegal subfunction)

RESULT STATUS      = 2   (illegal configuration parameter value)
  TRANSFER LENGTH = value, where value is the number of
                    bytes received for this parameter

RESULT STATUS      = 3   (illegal configuration parameter length)
  TRANSFER LENGTH = value, where value is the number of
                    bytes received for this parameter

RESULT STATUS      = 254 (link not in correct state to update this
                    parameter)
```

CONTROL PSI REQUEST

This request is a Control transaction.

WC Request Block

```
S            = not used
BLK          = not used
REQUEST CODE = 6
SUBFUNCTION  =
                 0 - no action
                 1 - Discard  "Flush current record"
                 2 - Flush Input queue
                 3 - Flush Output queue
                 4 - Flush Trace queue

                 5 - Reset Parameters
PORT ID      = not used
DATA LENGTH  = not applicable
```

RSR Result Block

RESULT STATUS = 0 (no error)

RESULT STATUS = 254 (link not in correct state)

READ TRACE BLOCK REQUEST

The Read Trace Block (RTB) request is a Read Transaction. The RJE PSI Trace facility keeps buffers in 1024 byte blocks. This is done to help the host keep a steady stream of RTB requests without interfering (or stopping) the ongoing collection of trace information.

NOTE

If the DATA LENGTH is less than 1024, that amount will be transferred and the remaining trace data in that block will be discarded.

CLC Request Block

```
S              = not used (unread data always discarded)
BLK            = 1
REQUEST CODE   = 7
SUBFUNCTION    = not used
PORT ID        = not used
DATA LENGTH    = maximum host buffer size
```

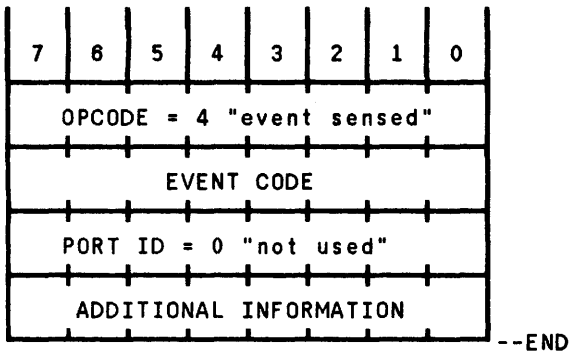
RSR Result Block

```
RESULT STATUS      = 0   (no error)
  TRANSFER LENGTH  = value,  where value is the number of bytes
                     of trace information read
```

SOLICITED EVENTS

The protocol can initiate an event at any time an read transaction order is given and a bit in the INTERRUPT MASK configuration parameter is set to one.

The format of an event block is:



Event Codes

```
EVENT CODE                = 255 - OPEN LINK completion
  ADDITIONAL INFORMATION = value,  where value equals:
                             0 - link sucessfully opened
                             1 - modem connection timer timed out
```

PROTOCOL ERROR

There are several conditions which cause a protocol error condition to exist on the card. There are two flavors of protocol errors: recoverable and unrecoverable.

Recoverable protocol errors are caused by:

* Unexpected order arrived (e.g., expecting RD but got WD)
* Undefined order (e.g., opcodes 1, 10, 11, 12, 13, 14, 15)
* A WC Request Block smaller than 3 bytes long
* Starting an already active transaction
* An unexpected WTC [end] (e.g., not in a Write transaction)
* An WTC [end] of wrong size (e.g., two bytes instead of three)

These conditions when sensed, cause the current active transaction (whatever it is) to be aborted and a PER ARQ status will interrupt the host. The firmware will automatically go into pause state, except that the firmware will NEVER SRQ for an order. A RES command from the host followed by an RTS order will start the backplane firmware to operate again.

REQUEST FEATURES

SECTION III

This section describes the requests sent by the PSI RJE firmware to the host computer in order to initiate some action (read data, write data, etc.).

Each request is defined under three headings: *Description*, *Request Subfunction*, and *Result Code*. The *Description* explains the function of the request. The *Request Subfunction* defines a field in the request that helps the firmware to decode the specific action to take on a particular request. For example, a WRITE CARD CONFIGURATION request uses the *Request Subfunction* to tell the firmware which parameter to configure. The *Result Code* defines the resulting status that can be returned when the RJE PSI finishes processing the request. Default parameter values are shown underlined. For example:

LINK TYPE - 2780/3780 (parameter 2780 is the default)

Seven requests, divided into two logical groups, are defined. The first group deals with operations on the data link and includes the following requests:

READ LINK DATA (RLD)
WRITE LINK DATA (WLD)
CONTROL LINK (CL)

The second group deals with functions which are internal to the firmware and which are not directly associated with the link operation. This group includes the following requests:

READ PSI INFORMATION (RPI)
WRITE PSI CONFIGURATION (WPC)
CONTROL PSI (CP)
READ TRACE BLOCK (RTB)

GLOSSARY OF TERMS

The following terms are used throughout this section:

ACK - BISYNC - Positive Acknowledge
BCC - Block Check Count (CRC-16)
CRC - Cyclic Redundancy Check
DCD - Data Carrier Detect
DLE - BISYNC - Data Link Escape
DSR - Data Set Ready
DTR - Data Terminal Ready
EM - End-of-Media (2780)
ENQ - BISYNC - Enquiry
EOT - BISYNC - End Of Transmission
ETB - BISYNC - End Text Block
ETX - BISYNC - End of Text
IGS - Inter-Group Separator (3780)
IRS - Inter-Record Separator
ITB (US) - BISYNC - Intermediate Block (Unit Separator)
NAK - Negative Acknowledge
NL - New Line (3780)
PAD - BISYNC - Trailing Pad
RQB - Request Block (Transaction)
RSR - Read Status Result (Transaction)
RTS - Request To Send
RVI - BISYNC - Reverse Interrupt
SOH - BISYNC - Start Of Heading
STX - BISYNC - Start of Text
SYN - BISYNC - Synchronous Idle
TID - Transaction ID
TTD - BISYNC - Temporary Test Delay
WACK - BISYNC - Wait before Acknowledge (Transmit)
WTC - Write Transparent Control Order (Transaction)

READ LINK DATA (RLD)

Description

This request transfers message text characters from the RJE PSI Input queue to the host computer. The current PSI configuration (set by the WRITE PSI CONFIGURATION request) determines what pre-processing (if any) will be performed on the message data.

Stripping of link control sequences (e.g., STX, ETB/X, etc.), removing record separator sequences (e.g., IRS, EM, ITB BCC, etc.), character code translation, expanding IGS sequences, and BINARY (transparent) functions are provided by this request.

NOTE

Escape code sequences for both carriage control and device selection are not recognized by this request, and are treated as ordinary text passed to the host inside a record/block.

If more data is requested than exists between the current buffer position and the next end-of-record, only the available text is transferred. If there is more text available than is requested, only the text needed to fulfill the request is transferred. The text left over, between where the request left off and the end-of-record, is saved.

INPUT TEXT MODE and INPUT RECORD FORMAT parameters configure the operation of READ LINK DATA (RLD) requests. These parameters are bit masks that select individual options. INPUT TEXT MODE configures:

* Whether translation is to be performed on the data.

* Whether to disable expansion and optional record termination (NL/EM/IRS) if transparent (binary) data is received.

READ LINK DATA requests will always stop on count or at [DLE] ITB, [DLE] ETB, or [DLE] ETX sequences.

Optional record terminators can be added to the block mode list. NL, EM, IRS can be individually selected.

The request will always terminate on the following conditions: on count, a [DLE] ITB, a [DLE] ETB, or a [DLE] ETX. Optional record terminators NL, EM, or IRS can be individually selected. RLD will delimit the record at the *first* occurence of an optional or mandatory terminating condition with one exception: If an optional terminator is followed immediately by a mandatory terminator (e.g., EM [DLE] ITB or IRS [DLE] ETB), both are reported in the RESULT CODE and the LAST RECORD TERMINATOR status parameter (see the paragraph READ PSI INFORMATION). If a record ends with two optional terminators (e.g., xxxxEMNLyyyy), RLD will end on the first terminator (EM). The next RLD will result in a zero-length record ending with the second terminator (NL).

NOTE

When character set translation is enabled, it is the *last* operation performed on all data. This makes the READ LINK DATA formatter use the untranslated data. Therefore, NL, EM, IRS, IGS, and SPACE parameters (see the paragraph WRITE PSI CONFIGURATION) must be part of the same character set that the LINK CHARACTER SET parameter selects. If the NL, EM, IRS, and IGS parameters are *not* enabled for use (e.g., in expansion or as a record terminator), they will be translated along with the data.

INPUT RECORD FORMAT is used to specify the following additional information about the records:

* Whether to enable expansion of IGS sequences into SPACEs
* Whether to terminate on NL characters.
* Whether to terminate on EM characters.
* Whether to terminate on IRS characters.

NOTE

Expansion of IGS sequences takes place *before* the character set translation occurs.

NOTE

RJE PSI will discard any block header information (e.g., SOH???STX...).

Input queue status (data available/number of blocks queued) can be queried via a READ PSI INFORMATION request.

If the INPUT queue is empty and a READ LINK DATA request is given, the request will idle (i.e., wait) until a block is received from the remote. If, while the RLD is waiting for a block, the link state goes to CLOSED because of some abnormal condition (e.g., a retry limit is exceeded), the RLD will abort itself.

Information will be kept concerning the type of record/block terminator(s) encountered in the most recent READ LINK DATA request. This information can be accessed via a READ PSI INFORMATION request to the LAST RECORD TERMINATOR parameter.

The configuration parameters used by the READ LINK DATA functions are as follows (see the paragraph WRITE PSI CONFIGURATION):

LINK CHARACTER SET
MAX BLOCK SIZE
SOH
STX
ETX
DLE
NL
EM
IGS
IRS
ITB
SYN
PAD
INPUT TEXT MODE
INPUT RECORD FORMAT
IN CONVERSION TABLE

The last three parameters are used exclusively by this request. The rest of the parameters are used in other requests.

Request Subfunction

```
SUBFUNCTION = Not used
```

Result Code

```
RESULT CODE = maximum length transferred with no terminator
              encountered
              NL
              EM
              IRS
              ITB
              ETB
              ETX
              zero length block
              link not in correct state
              OPEN LINK required
```

WRITE LINK DATA (WLD)

Description

This request transfers message text characters from the host to the RJE PSI Output queue. The current configuration and the request's subfunction, determine what pre-processing is performed on the text. Character code translation, binary (transparent) text, automatic record separator insertion (e.g., IRS, EM, ITB), space truncation, and space compression (3780 links only) are provided. After any pre-processing, the text is blocked into bisynchronous transmission frames with the appropriate link control characters (e.g., STX, ETB/X, etc.) enveloping the text.

Data flow on point-to-point 2780/3780 links is organized into *messages*. A message starts when one side gains control of the link and ends when an EOT is sent. Within a message, one or more files can be sent. A file is composed of zero or more blocks ending with ETB, and one block (the last) ending with ETX.

On 2780 links, only one message at a time can be transmitted over the link, so one side waits while the other sends a message. On 3780 links, one side can interrupt the other side's message to send a file or message. This is called a *Reverse (Processor) Interrupt*, and signals the transmitting station to prematurely end its message. The other station then sends a message before the original transmitting station has time to finish its message.

On 3780 links, PSI RJE can accept a block of data, from the remote, as the acknowledgement to a block ending with ETX (i.e., conversational reply). PSI RJE will continue accepting the remote's blocks until it sends an EOT.

The request subfunction can signal: end-of-record (ENDRECORD), end-of-block (ENDBLOCK), end-of-file (ENDTEXT), and end-of-message (EOT). ENDRECORD and ENDBLOCK only affect the formatting of host data. ENDTEXT and EOT act like an ENDBLOCK with some side effects:

> ENDTEXT/EOT will terminate the block with an ETX, signalling end-of-file. After the WRITE LINK DATA (ENDTEXT/EOT) request completes, the output configuration parameters are unlocked so that the format of the next file can be set. After the block (terminated because of an EOT subfunction) is transmitted to the remote, an EOT is sent allowing the remote to bid for control of the link.

On 2780 links, the EOT subfunction *must* be used to allow the remote a chance to send a message, because CONTROL LINK (send EOT) requests are illegal when PSI RJE is in control of the link.

On 3780 links with conversational replies, both ENDTEXT and EOT subfunctions can allow the remote to break in and send a message. If a conversational reply occurs immediately after a block (that was terminated because of an EOT subfunction) is transmitted, PSI RJE does not send the EOT.

The OUTPUT TEXT MODE and OUTPUT RECORD FORMAT parameters, in conjunction with the WRITE LINK DATA's Subfunction, determine what specific actions take place on each request. The parameters are bit masks that select individual options. OUTPUT TEXT MODE configures overall output functions depending on:

* Whether the text will be transmitted under BISYNC normal or binary protocol.

* Whether or not character code translation, keyed on OUTPUT CONVERSION TABLE, is performed on the host data.

* Whether to check to determine if any BISYNC control characters are embedded in normal text.

Each WLD request is interpreted as a whole record of data. Records are buffered until an end-of-block condition is detected. The buffered records are enveloped and queued to be transmitted.

A raw record is translated, then formatted, and its formatted length is added to the length of those records already buffered and formatted. If the sum is greater than the maximum size of the block, the buffered data is queued, terminated with an ETB, and a new empty buffer is immediately started.

Next, the record is appended to the (empty) buffer, and, if the request subfunction is not ENDRECORD, the buffer is queued, ending with ETB or ETX, and a new buffer is started with the next WLD. If the space remaining in the buffer is less than any legal record (e.g., less than MAX RECORD SIZE plus any Record Control characters appended if configured for fixed length records), the block is queued ending in ETB and a new buffer is started with the next WRITE LINK DATA (WLD).

Finally, if the number of buffered records is equal to the MAX RECORDS PER BLOCK parameter, the buffer is queued, ending with an ETB, and a new buffer is started with the next WLD.

NOTE

The decision to transmit data under BISYNC normal or binary protocol is independent of the decisions directing the formatting of the data.

NOTE

When character set translation is enabled, it is the *first* operation performed on any data. This makes the WRITE LINK DATA formatter use translated data. Therefore, NL, EM, IRS, IGS, and SPACE parameters (see the paragraph WRITE PSI CONFIGURATION) must be part of the same character set that the LINK CHARACTER SET parameter selects (i.e., they are never translated).

If a WLD request is given while the Output queue is full, the WLD request will idle until more space becomes available. If the link goes CLOSED or IDLE because of an abnormal condition (e.g., a retry limit is exceeded), the WLD request will abort itself.

The OUTPUT RECORD FORMAT parameter gives the following additional information about formatting the record:

* Whether the formatted record will be of fixed or varying length.

* For varying length only, whether trailing spaces are to be truncated.

* On a 3780 link only, whether the record will have spaces compressed.

* Whether to append a NL character.

* Whether to append an EM character.

* Whether to append an IRS character.

* On a 2780 link only, whether to append an ITB (or DLE ITB) sequence.

NOTE

Record terminators can be selected, but the order in which they are appended is predetermined, as follows: NL, followed by EM, followed by IRS, followed by ITB. If ITB is selected and the record is the last one in a block, the ITB sequence is not appended.

PSI RJE will not accept a zero length record when OUTPUT RECORD FORMAT selects variable length records with *only* an ITB (2780 links only) sequence appended as a record terminator (i.e., zero length ITB records are illegal).

For record mode with fixed length records, a number of spaces equal to MAX RECORD SIZE are appended before adding any record terminators.

The Output status (space for one record/block available or number of blocks queued) can be queried via the READ PSI INFORMATION request.

If the link state is IDLE and a CONTROL LINK (open link) request is given, an automatic LINE BID is performed on the next WLD request (see the paragraph CONTROL LINK). If the line bid fails, the WLD is aborted before any Direct Memory Access (DMA) transfers take place.

On a 3780 link, RJE PSI will never automatically generate a conversational reply.

RJE PSI does not support transmitting block header information (e.g. SOH ??? STX ...).

The configuration parameters used by the WRITE LINK DATA request are (see the paragraph WRITE PSI CONFIGURATION):

LINK CHARACTER SET
MAXIMUM BLOCK SIZE
STX
ETX
DLE
NL
IGS
IRS
ETB
IGS
IRS
ETB
SYN
PAD
OUTPUT RECORD SIZE
OUTPUT TEXT MODE
OUTPUT RECORD FORMAT
OUT CONVERSION TABLE

The last four parameters are used exclusively by this request. The rest of the parameters are used by this request and other requests.

Request Subfunction

SUBFUNCTION = ENDRECORD/ENDBLOCK/ENDTEXT/EOT

Result Code

```
RESULT CODE = normal completion
              illegal subfunction
              host write data overrun
              illegal length request
              BISYNC character found in data
              automatic LINE BID failed
              link not in correct state
              OPEN LINK required
```

CONTROL LINK

Description

The CONTROL LINK (CL) request commands the RJE PSI firmware to perform specific actions on the link, depending on the request's subfunction.

OPEN LINK. An OPEN LINK request commands the firmware to start operation. All parameters are checked to insure a consistent setup. Also, *all* data in the INPUT and OUTPUT queues are discarded. Once the firmware is correcly configured, the firmware attempts to establish a connection. The MODEM configuration parameter (see the paragraph WRITE PSI CONFIGURATION) details the type of equipment used in the link and the procedure to initiate the connection. An OPEN LINK will always reset the statistics kept for READ PSI INFORMATION. This request can only be given when the link status is CLOSED.

CLOSE LINK. A CLOSE LINK request terminates all activity on the link by sending a DLE EOT to the remote, after any currently transmitting or receiving text block is finished. Any other queued blocks will be kept. An automatic hang-up on a modem link is executed and all automatic disconnects (e.g., NO ACTIVITY or LOST CARRIER) are disabled. This request can be given at any time but if the link status is already CLOSED, no action is taken.

LINE BID. The LINE BID request enables the next WLD to bid for and gain control of the link (see the paragraph WRITE LINK DATA). This request can only be executed when the link is in the IDLE state.

SEND EOT. This request is only legal when the link is in REMOTE IN CONTROL state. In REMOTE IN CONTROL state, the EOT is sent the first opportunity PSI RJE has to transmit (e.g., send an EOT instead of an ACK in response to a block). This request must not be used indiscriminately because of the difficulty in restarting data flow after an unexpected EOT. Once the EOT is sent, the link will go into the IDLE state.

SF/SR-HIGH. This request causes the SF/SR (V.24 111) line to go to the ON condition. This request can be given at any time.

SF/SR-LOW. This request causes the SF/SR (V.24 111) line to go to the OFF condition. This request can be given at any time.

Request Subfunction

```
SUBFUNCTION = no action
              OPEN LINK
              CLOSE LINK
              LINE BID
              SEND EOT
              SFSR-HIGH
              SFSR-LOW
```

Result Code

```
RESULT CODE = illegal subfunction
              OPEN LINK required
              link not in correct state
              type not 3780
```

READ PSI INFORMATION (RPI)

The READ PSI INFORMATION (RPI) request allows you to query different fields within the firmware, depending on the request's subfunction, at any time during RJE PSI operation.

Description

48 through 1 - Configuration Parameters. These subfunctions allow you to query the current state of the configuration parameters set in the WRITE PSI CONFIGURATION request. A READ PSI INFORMATION request with the same subfunction as a parameter set with a WRITE PSI CONFIGURATION, will give back the current setting of the configuration parameter.

-LINK TYPE
-LINK CHARACTER SET
-STATION
-MODEM CONNECTION
-TRANSMISSION MODE
-MAXIMUM BLOCK SIZE
-MAXIMUM OUTPUT RECORD SIZE
-MAXIMUM OUTPUT RECORDS PER BLOCK
-BAUD RATE
-PHONE NUMBER
-DISCONNECT
-MODEM CONNECTION TIMEOUT
-NO ACTIVITY TIMEOUT
-LOST CARRIER (DCD) TIMEOUT
-TRANSMIT TIMEOUT
-CONTINUE TIMEOUT
-RECEIVE TIMEOUT
-RETRY LIMIT
-INTERRUPT MASK
-TRACE MASK
-INPUT TEXT MODE
-INPUT RECORD FORMAT
-NL CHARACTER
-EM
-IRS
-IGS
-SPACE
-IN CONVERSION TABLE
-OUT CONVERSION TABLE
-SOH CHARACTER
-STX
-ETX
-DLE
-ITB (IUS)
-ETB
-ENQ
-SYN
-EOT
-NAK

-ACK0
-ACK1
-WACK
-RVI
-PAD
-OUTPUT TEXT MODE
-OUTPUT RECORD FORMAT

These subfunctions allow you to query some of the internal status conditions of the interface.

255 - MODEM STATUS.

```
MODEM STATUS = mask

  where mask is a combination of:

    1 = DSR (V.24 108) active
    2 = RING (V.24 125) active
    4 = SIGNAL QUALITY (V.24 110) active
    8 = SIGNAL RATE (V.24 112) active
   16 = SEC. DCD (V.24 122) active
   32 = DCD (V.24 109) active
   64 = SEC. CTS (V.24 121) active
  128 = CTS (V.24 106) active
```

254 - CARD STATUS.

```
CARD STATUS = mask

  where mask is a combination of:

    1 = Input data available
    2 = link in RVI-PENDING-FROM-REMOTE
    4 = Space for 1 output record
    8 = Link in CLOSED state
   16 = Link in IDLE state
   32 = Link in STATION-IN-CONTROL state
   64 = Link in REMOTE-IN-CONTROL state
  128 = Trace data available
```

The CARD STATUS displays the interrupt status. If this parameter is ANDed with the INTERRUPT MASK parameter, the set of conditions that are ready to interrupt is calculated.

253 - LAST DATACOMM ERROR.

LAST DATACOMM ERROR = *value*

where *value* has to be defined

252 - BLOCKS IN INPUT QUEUE.

BLOCKS IN INPUT QUEUE = *value*

where *value* is in the range 0 to 255

251 - BLOCKS IN OUTPUT QUEUE.

BLOCKS IN OUTPUT QUEUE = *value*

where *value* is in the range 0 to 255

250 - LAST RECORD TYPE.

LAST RECORD TYPE = *value*

where *value* is one of:

0 = none
1 = normal data
2 = transparent data

249 - LAST RECORD TERMINATOR.

LAST RECORD TERMINATOR = *mask*

where *mask* is any combination of:

```
  0 = End on count
  2 = NL
  4 = EM
  8 = IRS
 16 = ITB
 32 = ETB
 64 = ETX
128 = Zero length block encountered
```

248 - LINK STATUS.

LINK STATUS = *value*

where *value* is one of:

```
  2 = RVI-PENDING-FROM-REMOTE
  4 = OPEN LINK PENDING
  8 = CLOSED
 16 = IDLE
 32 = STATION-IN-CONTROL
 64 = REMOTE-IN-CONTROL
```

The LINK STATUS parameter tracks the current state of the link. At powerup or after a CONTROL LINK (close link), the link state is CLOSED. A CONTROL LINK (open link) causes the link state to go to OPEN LINK PENDING until the request succeeds or fails.

After any CONTROL LINK(open link) sucessfully completes, the link state goes to IDLE. When a line bid completes, the link state will go to STATION-IN-CONTROL. On 3780 links, when a legal RVI BISYNC Control Character from the remote is detected, the link state will go from STATION-IN-CONTROL to RVI-PENDING-FROM-REMOTE. On 3780 links, when the remote performs a Conversational Reply, the link state will go from STATION-IN-CONTROL to REMOTE-IN-CONTROL. After any EOT is sent (e.g., WRITE LINK DATA (eot) or CONTROL LINK (send eot)) or received, the link state will go to IDLE. If the link is IDLE and the remote sucessfully bids for the line, the link state will go to REMOTE-IN-CONTROL.

247 - FIRMWARE IDENTITY.

FIRMWARE IDENTITY = *string* where <string> is an 11 byte array:

BYTE	VALUE	MEANING
1	4	PSI hardware code
2	1	RJE firmware code
3	?	High order byte of firmware date code
4	?	Low order byte of firmware date code
5	42H	Flags byte: In-channel multiplexed with 8- or 16-bit data path
6	1	Max ports supported = 2
7	2	Max requests per port=3
8	04H	High order byte of maximum block size
9	00H	Low order byte of maximum block size
10	?	High order byte of Engineering Reference Specification (ERS) data code
11	?	Low order byte of ERS date code

246 Through 235 - Statistics. These subfunctions allow you to query kept by the firmware on the number of times a specific condition on the link has occurred.

NOTE

All these subfunctions return a *value* in the range 0 to 65535.

SUBFUNCTION 246 - BLOCKS SUCESSFULLY SENT *value*

SUBFUNCTION 245 - BLOCKS SUCESSFULLY SENT *value*

SUBFUNCTION 244 - BAD BLOCKS RECEIVED (NAKs SENT) *value*

SUBFUNCTION 243 - NAKs RECEIVED *value*

SUBFUNCTION 242 - *always zero*

SUBFUNCTION 241 - *always zero*

SUBFUNCTION 240 - *always zero*

SUBFUNCTION 239 - *always zero*

SUBFUNCTION 238 - RECEIVE TIMEOUTS *value*

SUBFUNCTION 237 - GARBLED REPONSES *value*

SUBFUNCTION 236 - *always zero*

SUBFUNCTION 235 - *always zero*

Request Subfunction

```
SUBFUNCTION = LINK TYPE
              LINK CHARACTER SET
                .
                .
                .
              GARBLED RESPONSES
```

Result Code

```
RESULT CODE = illegal subfunction
```

WRITE PSI CONFIGURATION (WPC)

The WRITE PSI CONFIGURATION (WPC) request assigns values to the various configuration parameters supported by the firmware, depending on the request's subfunction. Usually, updating a parameter does not cause side affects in other parameters except for LINK TYPE, LINK CHARACTER SET, MAX BLOCK SIZE, and OUTPUT TEXT MODE. It is recommended that these five parameters be assigned first before any other parameters are configured.

The special character (i.e., *, +, or @) after the keyword denotes when it is legal to assign a value to that particular parameter.

An asterisk (*) means that the parameter can only be updated when the link is CLOSED, and takes affect when an OPEN LINK (see the paragraph CONTROL LINK) request is given.

A parameter with a plus sign (+) can be updated only while an end-of-file condition exists. An end-of-file condition is asserted at powerup and after a WRITE LINK DATA request with an ENDTEXT or EOT subfunction. Once any WRITE LINK DATA request or a CONTROL LINK request with a Line Bid subfunction is started, these parameters cannot be updated until the next end-of-file condition.

An at-sign (@) means the parameter can be changed anytime regardless of the link status.

Description (By Subfunction)

1 - LINK TYPE *.

LINK TYPE * = *value*

where *value* is one of:

0 - 2780
1 - 3780

This parameter determines which communications protocol and buffer pre-processing rules will be used during the upcoming connection.

This parameter can only be updated during a LINK CLOSED state. Upon changing, new default values are placed in the MAX BLOCK SIZE, MAX RECORD SIZE, and MAX RECORDS PER BLOCK parameters. If OUTPUT RECORD FORMAT is configured to enable space compression and 2780 link is chosen, space compression is disabled automatically.

2 - STATION TYPE *.

STATION TYPE * = *value*

where *value* is one of:

0 - secondary
1 - primary

This parameter selects the timeout used when a line bid collision occurs (i.e., both ENQ simultaneously). If PSI RJE is a secondary station, it waits three seconds after a collision to retry. A primary station waits two seconds before retrying. This can only be updated during a LINK CLOSED state.

3 - LINK CHARACTER SET *.

LINK CHARACTER SET = *value*

where *value* is one of:

0 - EBCDIC
2 - user

This parameter selects which encoding system the BISYNC control characters will use for the upcoming connection.

Option *EBCDIC* places defaults into the BISYNC, Record, and String Control Characters. Option *user* leaves everything untouched. Update access to the BISYNC Control Characters is allowed only during link CLOSED state.

This parameter can only be changed during link CLOSED state

4 - MODEM CONNECTION *.

MODEM CONNECTION = *value*

where *value* is one of:

0 - auto-answer without ring
1 - manual orginate
2 - auto-answer with ring

This parameter determines how PSI RJE will handshake with the modem to start a connection. This can only be updated during link CLOSED state.

5 - TRANSMISSION MODE *.

TRANSMISSION MODE = *value*›

where value is one of:

0 - half duplex modem
1 - full duplex modem

This parameter selects the type of telecommunications equiptment used to implement the link. This can only be updated during link CLOSED state.

6 - MAXIMUM BLOCK SIZE *.

MAX BLOCK SIZE = *value*

where *value* is the size in bytes:

minimum = 4, maximum = 512
default: 2780 link = 400, 3780 link 512

This is the maximum number of bytes after the [DLE] STX. This includes any IRS, NL, EM characters; any IGS sequences; and any ITB/ETB/ETX. Each ITB/ETB/ETX counts as one position in the MAX BLOCK SIZE; but the two CRC bytes, any PADs, any preceeding DLEs, and the [DLE] STX byte(s) are *not* counted. That is, only the underlined character(s) shown below are counted:

... [DLE] ITB CRC CRC PADs [DLE] STX ... [DLE] ETB

For received text blocks from the link, if block length is greater than the MAX BLOCK SIZE parameter (e.g., a receive buffer overrun), the whole block is discarded and its reception is negatively acknowledged (NAK). This parameter can only be updated during link CLOSED state.

7 - MAXIMUM OUTPUT RECORD SIZE *.

MAX OUTPUT RECORD SIZE = *value*

where *value* is the size in bytes:

minimum = 1, maximum = MAXIMUM BLOCK SIZE-3
default = 80

This parameter is used by the record formatting feature of WRITE LINK DATA. This parameter can only be updated during link CLOSED state.

8 - MAXIMUM OUTPUT RECORDS PER BLOCK *.

MAX OUTPUT RECORDS PER BLOCK = *value*

where *value* is:

minimum = 1, maximum = 255
default: 2780 link = 4, 3780 link = 255

This parameter determines the upper limit on the number of formatted records (see the paragraph OUTPUT FORMAT) that will be placed in any BISYNC block. The actual number of records placed in any block varies with the user data given in WRITE LINK DATA requests and the setting of OUTPUT RECORD FORMAT, MAX BLOCK SIZE, and MAX RECORD SIZE parameters. This parameter can only be updated during link CLOSED state.

10 - BAUD RATE *.

BAUD RATE = *value*

where *value* is one of:

0 - external
1 - reserved
2 - reserved
3 - reserved
4 - reserved
5 - reserved
6 - reserved
7 - reserved
8 - reserved
9 - 1200
10 - 1800
11 - 2400
12 - 3600
13 - 4800
14 - 7200
15 - 9600
16 - 19200
17 - 38400
18 - reserved
19 - reserved
20 - reserved

This parameter selects where timing information for the communications link is generated. The external option is recommended for any synchronous modem. The other options are reserved for future expansion. This parameter can only be updated during link CLOSED state.

14 - MODEM CONNECTION TIMEOUT @.

MODEM CONNECTION TIMEOUT = *value*

where *value* is the time in seconds:

minimum = 0, maximum = 255
default = 25

A zero value disables and a non-zero value enables this timer. This parameter defines the upper limit on the time taken to attempt a modem connection. What the time limit guards against varies with the setting of the MODEM CONNECTION parameter:

Auto-answer with ring - the timer starts when IC (V.24 125) goes to the ON state and stops when DSR (V.24 107) goes ON. If FULL-DUPLEX equipment is chosen, then DCD (V.24 109) must also go ON.

Manual Originate - If FULL-DUPLEX equipment is chosen, the timer starts when DSR (V.24 107) goes ON and stops when DCD (V.24 109) goes ON.

Auto-answer without ring - same as Manual Originate

This parameter can be updated at anytime.

15 - NO ACTIVITY TIMEOUT @.

NO ACTIVITY TIMEOUT = *value*

where *value* is the time in seconds:

minimum = 0, maximum = 65535 seconds (18 hours, 12 minutes, 15 seconds)
default = 26 seconds

A zero value disables and a non-zero value enables this timer. This timer starts when DSR (V.24 107) is in the ON state, and no text characters are being exchanged on the send or receive data lines. It stops when either DSR (V.24 107) goes OFF, or text is sent/received. This parameter can be updated at anytime.

16 - LOST CARRIER TIMEOUT @.

LOST CARRIER TIMEOUT = *value*

where *value* is the number of 10 millisecond counts performed:

minimum = 0 (0 milliseconds), maximum = 255 (2.55 seconds)
default = 40 (400 milliseconds)

A zero value disables and a non-zero value enables this timer. This timer is only active when the TRANSMISSION MODE parameter is set to full-duplex modem. When active, the timer starts when DCD (V.24 109) goes through an ON to OFF state transition, and stops when DCD returns to the ON state.

This parameter is also used during connection as the DSR(V.24 107) hold time. When DSR(V.24 107) is first sensed active, PSI RJE waits for this timeout to expire before polling the DSR(V.24 107) line again to determine if it is still active. This allows for a smooth connection with modems that have transients on the DSR(V.24 107) line during the early phases of connection.

This parameter can be updated at anytime.

17 - TRANSMIT TIMEOUT @.

TRANSMIT TIMEOUT = *value*

where *value* is the time in seconds:

minimum = 1, maximum = 255
default = 1

This parameter selects the period within which two SYN characters must be inserted into a transmitted message. This should be left at one second for most BISYNC connections. This parameter can be updated at anytime.

18 - CONTINUE TIMEOUT @.

CONTINUE TIMEOUT = *value*

where *value* is the timeout in seconds:

minimum = 1, maximum = RECEIVE TIMEOUT-1
default = 2

This timer is used to prevent a receive timeout from occurring on the remote. This specifies the delay before sending a TTD after an ACK is received from the remote and there is no data ready to send. This also specifies the delay before sending WACKs to the remote; this should be left at two seconds for most BISYNC connections. This parameter can be updated at anytime.

19 - RECEIVE TIMEOUT @.

RECEIVE TIMEOUT = *value*

where *value* is the time in seconds:

minimum = 2, maximum = 255
default = 3

This timeout specifies the period in which SYN characters must be received, indicating a transmission is in progress. The set time must be greater than the CONTINUE TIMEOUT setting, and should be left at three seconds for most BISYNC connections. This parameter can be updated at anytime.

20 - RETRY LIMIT @.

RETRY LIMIT = *value*

where *value* is:

minimum = 1, maximum = 255
default = 7

This parameter is used whenever the BISYNC protocol calls for retrying a sequence. The sequence is repeated RETRY LIMIT number of times before an automatic disconnect is asserted. This parameter can be updated at anytime.

22 - TRACE MASK @.

TRACE MASK = *mask*

where *mask* is any combination of:

0 = None
1 = transmitted control characters
2 = transmitted data characters
4 = received control characters
8 = received data characters
16 = Frontplane state transitions
32 = Backplane/Midplane state transitions
64 = Midplane state transitions only

This parameter specifies what information should be collected into the trace buffers that are read with the READ TRACE BLOCK request.

If TRACE MASK is initially zero and a non-zero mask is written to it, then you must read back the TRACE MASK parameter through the READ PSI INFORMATION request. If the TRACE MASK is non-zero, then tracing has started. If the TRACE MASK is still zero, then the Trace queue is full and the Trace facility did not turn on. One or more READ TRACE BLOCK requests or a CONTROL LINK (flush trace queue) request will free enough space to enable the Trace facility to turn on when a non-zero mask is again written to TRACE MASK. This parameter can be updated at anytime.

23 - INPUT TEXT MODE @.

INPUT TEXT MODE = *mask*

where *mask* is any combination of:

2 = Enable record mode or disable block mode
4 = Enable translation on received data
8 = Disable EM/NL/IRS EOR termination and IGS expansion of transparent text
4 = Translation enabled

Input Text Mode enables or disable translation of any received data. If transparent (binary) text is received from the remote and the disable EM/NL/IRS and IGS expansion bit is set, then PSI RJE will ignore the configuration in the INPUT RECORD FORMAT parameter. If this condition arises, READ LINK DATA requests will still terminate on one of the following: count, STX, ITB, ETB, ETX, and zero length block.

This parameter selects overall READ LINK DATA formatter functions.

NOTE

Any terminating sequence (e.g., ETB) is stripped from the character string before it is sent to the host.

This parameter can be updated at anytime.

24 - INPUT RECORD FORMAT @.

```
INPUT RECORD FORMAT = mask

  where mask is any combination of:

    1 = Enable expansion of IGS sequences into SPACEs
    2 = Terminate on NL character
    4 = Terminate on EM character
    8 = Terminate on IRS character
  default = 14: No expansion/terminate on NL, EM, IRS
```

Input Record Format decribes the format and selects additional conditions that will terminate a READ LINK DATA request.

NOTE

Any terminating sequence (e.g., DLE ITB) is stripped from the character string before it is sent to the host.

The disable EM/NL/IRS and IGS expansion bit of INPUT TEXT MODE will override the configuration in this parameter if READ LINK DATA is accessing transparent (binary) data from the remote.

This parameter can be updated at anytime.

25 to 27 RECORD CONTROL CHARACTERS *.

RECORD CONTROL CHARACTERS = *value*

where *value* is:

minimum = 0, maximum = 255
default is as follows:

SUBFUNCTION	NAME		LINK CHARACTER SET option EBCDIC	user
25	---	NL ----------	15	**
26	---	EM ----------	19	**
27	---	IRS ---------	1E	**

** = current value is not changed

These parameters select the encoding used for each record control character. Defaults are placed into all three parameters whenever the LINK CHARACTER SET parameter is set to option EBCDIC. The user option does not change the encodings. These parameters can be updated at any time, but it is recommended that the default be used.

28 to 29 - STRING CONTROL CHARACTERS @.

STRING CONTROL CHARACTERS = *value*

where *value* is;

minimum = 0, maximum = 255
default is as follows:

SUBFUNCTION	NAME		LINK CHARACTER SET option EBCDIC	user
28	IGS	------	1D	**
29	SPACE	----	40	**

** = current value is not changed

These parameters define the encoding used for the Inter-Group Separator (IGS) and SPACE characters.

The IGS character is used to signify that a successive string of spaces has been compressed. This parameter is only used on 3780 links with space expansion/compression features enabled for READ/WRITE LINK DATA requests.

The SPACE character is used in WRITE LINK DATA requests with fixed length records. If a record does not have exactly the same number of characters as in the MAX RECORD SIZE parameter, SPACE characters are appended until the record is at maximum size.

Defaults are automatically placed in these two parameters whenever LINK CHARACTER SET is set to option EBCDIC. The user option does not change the current encodings. These parameters can be updated at any time, but it is recommended that the default be used.

30 - OUT CONVERSION TABLE @.

OUT CONVERSION TABLE = *string*

where *string* is a 256, 8-bit per position, one-dimension array

This parameter defines the actual character set translation.

CAUTION

AFTER POWER-UP, THE TABLE IS UNDEFINED AND MUST BE INITIALIZED BEFORE IT IS USED TO TRANSLATE CHARACTERS FOR WRITE LINK DATA REQUESTS. WHEN TRANSLATION IS BEING PERFORMED, THE ORIGINAL CHARACTER'S ORDINAL VALUE (0 THROUGH 255) IS USED TO INDEX INTO THE TABLE TO SELECT THE ENCODING FOR THE TRANSLATED CHARACTER.

The Out Conversion table can be updated, in its entirety only, any time.

31 - IN CONVERSION TABLE @.

IN CONVERSION TABLE = *string*

where *string* is a 256, 8-bit per position, one dimension array

This parameter defines the table used for character set translation by READ LINK DATA requests.

CAUTION

AFTER POWER-UP, THIS TABLE IS UNDEFINED AND MUST BE INITIALIZED BEFORE USE. THE BLOCKS RECEIVED FROM THE LINK CAN BE TRANSLATED DEPENDING ON IF INPUT TEXT MODE ENABLES IT. THE ORDINAL VALUE (0 THROUGH 255) OF THE RECEIVED CHARACTER IS USED TO INDEX INTO THE TABLE FOR THE TRANSLATED CHARACTER GIVEN TO THE HOST.

The In Conversion table can be updated, in its entirety only, any time.

32 to 46 - BISYNC CONTROL CHARACTERS *.

BSYNC CONTROL CHARACTERS = *value*

where *value* is:

minimum = 0, maximum = 255
defaults are listed below:

SUBFUNCTION	NAME	EBCDIC	user
32	SOH ----------	01	**
33	STX ----------	02	**
34	ETX ----------	03	**
35	DLE ----------	10	**
36	ITB (IUS) -------	1F	**
37	ETB ----------	26	**
38	ENQ ----------	2D	**
39	SYN ----------	32	**
40	EOT ----------	36	**
41	NAK ----------	3D	**
42	ACK0 ----------	70	**
43	ACK1 ----------	61	**
44	WACK ----------	6B	**
45	RVI ----------	7C	**
46	PAD ----------	FF	**

** = current value left unchanged

NOTE

ACK0, ACK1, WACK, RVI characters actually define the second character of their sequence; the first is a DLE (i.e., DLE 70 is the EBCDIC ACK0 sequence).

These parameters define the encodings used for the BISYNC link control characters. These are critical for proper communications link functioning. If the LINK CHARACTER SET parameter is set to EBCDIC, default values are placed into these parameters and they cannot be updated at any time. The user option leaves the parameters untouched and allows user updating only during link CLOSED state. Most BISYNC connections will use the default values.

47 - OUTPUT TEXT MODE +.

OUTPUT TEXT MODE = *mask*

where *mask* is any combination of:

1 - Enable BISYNC binary/transparent protocol and disable BISYNC normal protocol
2 - Enable Record mode and disable Block mode
4 - Enable translation on raw data
8 - Disable double-checking for BISYNC Control characters in the data
Default = 4: Translation and double-checking enabled

This parameter configures overall WRITE LINK DATA pre-processing functions on the data. The normal option will envelope and send normal text BISYNC records/blocks (i.e., STX ... ETB/X) to the link. The binary option envelopes transparent text BISYNC records/blocks (i.e., DLE STX ... DLE ETB/X).

The double checking for BISYNC Control Characters is performed, then OUTPUT TEXT MODE selects BISYNC normal protocol and doesn't explicitly disable it. The double checking is performed after the translation but before other formatting (e.g., compression). This parameter can be updated while an end-of-file condition exists. A end-of-file condition is asserted at powerup and after a WRITE LINK DATA request with a ENDTEXT or EOT subfunction. Once any WRITE LINK DATA request sucessfully completes (i.e., normal or overrun completions), this parameter cannot be updated until the next end-of-file condition.

48 - OUTPUT RECORD FORMAT +.

OUTPUT RECORD FORMAT = *mask*

where *mask* is any combination of:

1 - Enable varying length records and disable fixed length records
2 - Enable truncation of trailing spaces (varying length records only)
4 - Enable space compression (3780 links only)
8 - Append a NL character at end-of-record.
16 - Append a EM character at end-of-record.
32 - Append an IRS character at end-of-record.
64 - Append an ITB sequence at end-of-record (2780 links only).

Default = 0: Fixed length with no EOR characters

If an illegal combination of mask bits (e.g. enabling space compression on a 2780 link) is attempted, the WRITE PSI CONFIGURATION (WPC) request will be rejected. This parameter can be updated only while an end-of-file condition exists. An end-of-file condition is asserted at powerup and after a WRITE LINK DATA request with a ENDTEXT or EOT subfunction. Once any WRITE LINK DATA request successfully completes (i.e. normal or overrun completions), this parameter cannot be updated until the next end-of-file condition.

Request Subfunction

```
SUBFUNCTION = none
              LINK TYPE
              LINK CHARACTER SET
```

NOTE

None means no configuration parameter is updated.

Result Code

```
RESULT CODE = illegal subfunction
              link not in correct state to update this parameter
              parameter value invalid
              parameter length invalid
```

CONTROL PSI (CP)

This request controls the various formatting functions, queue operation, and other features the firmware presents to the host depending on the request's subfunction. Most requests can be given at any time except where noted.

Description

FLUSH INPUT QUEUE. This request discards all the data in the Input queue, and can only be given when the link status is not REMOTE IN CONTROL.

CAUTION

A READ LINK DATA request must not be outstanding, and the link must not be in REMOTE-IN-CONTROL state, when the FLUSH OUTPUT QUEUE request is executed.

FLUSH OUTPUT QUEUE. This request discards all the data in the Output queue, and can only be given when the link status is not STATION IN CONTROL or RVI PENDING FROM REMOTE.

CAUTION

A WRITE LINK DATA request must not be outstanding, and the link must not be in STATION-IN-CONTROL or RVI-PENDING-FROM-REMOTE, when the FLUSH TRACE QUEUE request is executed.

FLUSH TRACE QUEUE. This request discards all the data in the Trace queue.

CAUTION

A READ TRACE BLOCK request must not be outstanding nor the Trace Facility enabled when the FLUSH TRACE QUEUE request is issued.

RESET PARAMETERS. This request will reset all the status and configuration parameters (see the paragraphs READ PSI INFORMATION and WRITE PSI CONFIGURATION) back to their initial/default state as if the PSI RJE had just been powered on. Any frontplane activity will stop immediately and DTR will drop. All queues will be flushed and the Trace facility will be reset; all link and trace data is lost.

CAUTION

There must be no other requests outstanding when the RESET PARAMETERS request is issued, otherwise an Interface Failure will result.

Request Subfunction

```
SUBFUNCTION = no action
              FLUSH INPUT QUEUE
              FLUSH OUTPUT QUEUE
              FLUSH TRACE QUEUE
              RESET PARAMETERS
```

Result Code

```
RESULT CODE = illegal subfunction
              link not correct state for this request
```

READ TRACE BLOCK (RTB)

Description

The READ TRACE BLOCK (RTB) request reads one 1024-byte trace block produced by the firmware. The TRACE MASK parameter (see the paragraph WRITE PSI CONFIGURATION) commands which information is to be traced. The trace block is filled with encoded data and it is the responsibility of the user to format this data for the desired output device (e.g., for a printer). The firmware keeps a circular queue of trace blocks (at least four) and it is the responsibility of the user to maintain a steady stream of RTBs to avoid loss of trace data. The block at the tail of the queue will act as a circular buffer if no empty buffers remain. The rate at which RTBs are needed to prevent loss of data is determined by which information is being traced.

Trace Facility. The Trace Facility has a 20-bit up-counter that increments 10 times a second. This counter is broken into two fields: the most significant 14 bits and the least significant 6 bits. These two fields are used to provide a time stamp for the line trace feature.

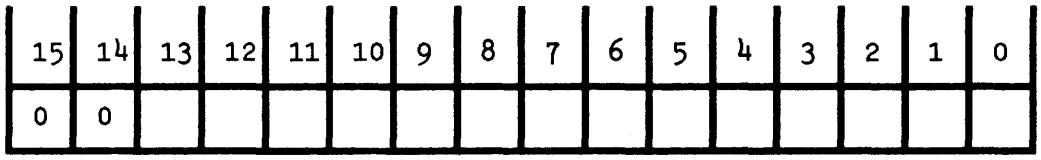
When the TRACE-MASK goes from zero to non-zero, the Trace Facility is enabled. If the TRACE-MASK still stays zero after it has been configured to non-zero, a CONTROL PSI(flush trace queue) or a READ TRACE BLOCK request must be given to free space in order to start up the Trace Facility. Once the Trace Facility is enabled, the 20-bit timer is zeroed and a Start-trace entry is placed in the first block.

When the TRACE-MASK goes from non-zero to zero, the Trace Facility is disabled. An End-trace entry will be placed at the end of the valid trace data in the currently unfilled block, which is then releaed to be read by the READ TRACE BLOCK request. This block will be 1024 bytes long but any data after the End-trace entry will be garbage.

NOTE

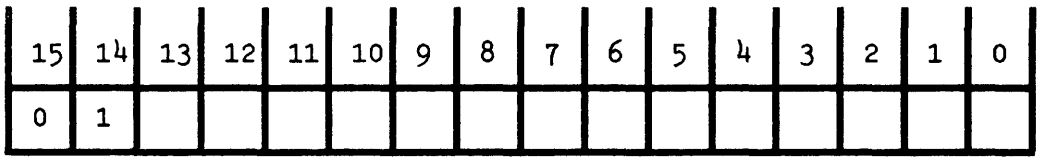
If the TRACE-MASK is zero and is configured to zero, then no action takes place.

Trace Entry Definitions. The different entries are distinguished via a frequency encoding opcode scheme (i.e., 13 opcodes can be defined in 8 bits). The format of the entries depend in this opcode. PSI RJE has defined these opcodes and their formats as follows:



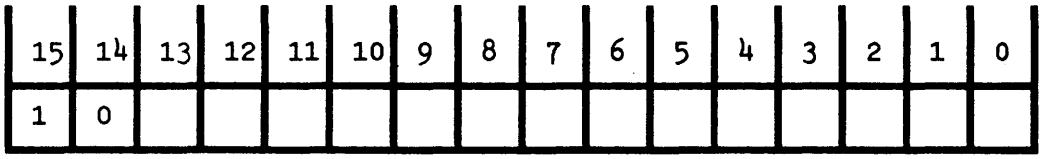
15 through 14 - Receive line character opcode
13 through 8 - Least significant 6-bits of 20-bit counter
7 through 0 - Received character

The entry above can be produced each time a byte is received from the remote. The receive control or data bits inside the TRACE-MASK determine if an entry is produced.



15 through 14 - Transmitted line character opcode
13 through 8 - Least significant 6-bits of 20-bit counter
7 through 0 - Transmit character

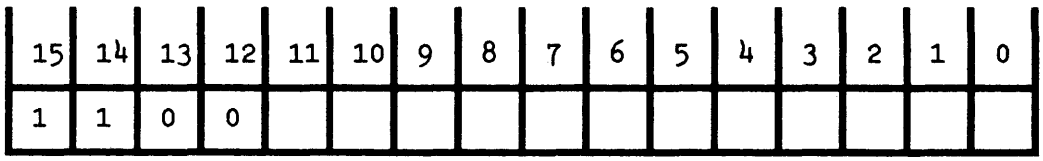
The entry above can be produced each time a byte is transmitted to the remote. The transmitted control or data bits within the TRACE-MASK determine whether an entry is produced.



15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	0														

15 through 14 - Most significant 14-bits of 20-bit counter opcode
13 through 0 - Most significant 14-bits of 20-bit counter

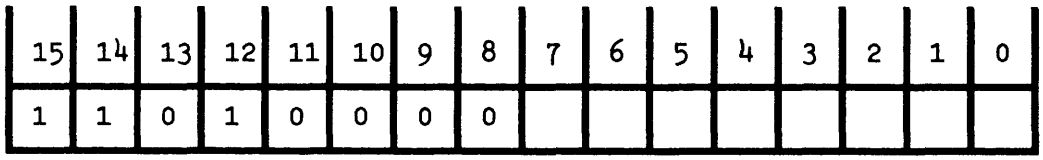
The entry above is produced whenever the least significant 6 bits of the 20-bit counter roll over to zero, thereby incrementing the upper 14 bits (i.e., once every 6.4 seconds). It is also placed after any Buffer-overwrite entry.



15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	0												

15 through 12 - Protocol Event opcode
11 through 0 - Event Code

The entry above can be produced every time the backplane or frontplane firmware changes state. The frontplane and backplane state machine transition bits in the TRACE-MASK determine if an entry is produced. The meaning of the 12-bit event code is discussed in the paragraph PROTOCOL EVENT DEFINITIONS.



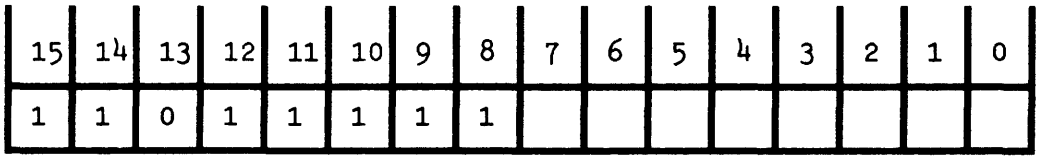
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	1	0	0	0	0								

15 through 12 - Overflow opcode
11 through 8 - Block overwrite
7 through 0 - Number of times this block has been overwritten minus one

If more trace data is being produced than is being read by the READ TRACE BLOCK request, an overrun condition occurs. The PSI RJE Trace Facility will not release the last 1024-byte block to the RTB transaction, but will overwrite it like a circular buffer until an empty block is returned from an RTB completion. Do *not* use CONTROL LINK (flush trace queue). The first entry in this block will be this one, followed immediately by a most significant 14-bit entry. Each successive time this block is overwritten, the count field is incremented and a new most significant 14-bit entry is produced.

NOTE

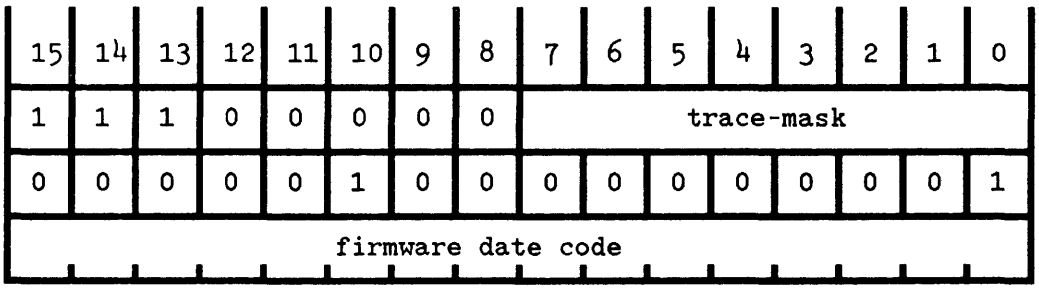
The first time a block is overwritten the count field is zero (0).



15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	1	1	1	1	1								

15 through 12 - Overflow opcode
11 through 8 - 20-bit counter overflow
7 through 0 - <not used>

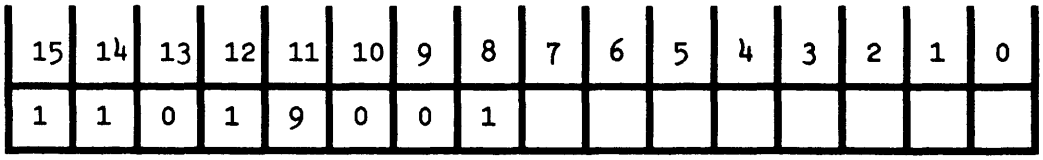
The entry above is produced every time the 20-bit counter rolls over to zero. This should occur once every 29 hours, 7 minutes, 37.5 seconds.



15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	0	0	0	0	0	trace-mask							
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
firmware date code															

15 through 12 - Trace Facility opcode
11 through 8 - Start trace entry
7 through 0 - Initial TRACE-MASK value
15 through 8 - CARD ID from IDY block (4)
7 through 0 - FIRMWARE ID from IDY block (1)
15 through 0 - FIRWARE DATE CODE from IDY block

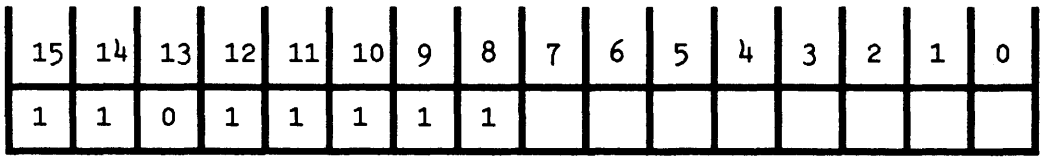
The entry above is the first entry of the first block after the Trace Facility is enabled.



15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	1	9	0	0	1								

15 through 12 - Trace Facility opcode
11 through 8 - Change of TRACE_MASK while enabled entry
7 through 0 - New TRACE-MASK value

The entry above is produced whenever a non-zero TRACE-MASK is again configured to a non-zero value.



15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	1	1	1	1	1								

15 through 12 - Trace Facility opcode
11 through 8 - End of valid trace data entry
7 through 0 - Not used

As mentioned before, the entry above marks the last valid trace entry and is the last block of data produced when the Trace Facility is disabled.

Protocol Event Definitions. The format of the twelve bits in the Protocol Event entry is:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	0	x	x	x	x	x	x	x	x	x	x	x	x

General Format

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	0	0	s	s	s	s	e	e	e	e	e	e	e	e

PSI RJE Format

where,

xxxxxxxxxxxx are 12 bits of protocol dependent code. The PSI RJE subdivides these 12 bits into two fields: a four-bit state machine code, ssss, and an eight-bit event code, eeeeeeee . This is done because the same events are used in different state machines, thus it is necessary to determine which state machine is being affected in order to accurately decode the current state.

The meanings of the four-bit state machine codes are as follows:

```
VALUE    MNEMONIC    MEANING

 0       BP__SM    - Standard Interface Protocol
 1       RLD__TSM  - Read Link Data Transaction
 2       WLD__TSM  - Write Link Data Transaction
 3       CL__TSM   - Control Link Transaction
 4       RPI__TSM  - Read PSI Information Transaction
 5       WPC__TSM  - Write PSI Configuration Transaction
 6       CP__TSM   - Control PSI Transaction
 7       RTB__TSM  - Read Trace Block Transaction
 8       << NOT USED >>
 9       Parameter Access (this is special -- see below)
 A       RJE__SM   - 2780/3780 RJE Frontplane Protocol
 B       << NOT USED >>
 C       << NOT USED >>
 D       << NOT USED >>
 E       << NOT USED >>
 F       << NOT USED >>
```

The Parameter Access code (9) isn't a state machine. Instead, it is a special entry produced by the READ PSI INFORMATION and WRITE PSI CONFIGURATION transactions to trace which of the defined status and/or configuration parameters is being accessed through them. The eight-bit code for this entry is different than the other entries; it contains the subfunction number assigned to that parameter.

Otherwise, the meaning of the eight-bit event codes are as follows:

```
VALUE  MNEMONIC          MEANING

        *** Backplane Independent Events ***

  1    AB_CMD           ; ABort subchannel request
  2    SC_CMD           ; Subchannel Connect
  3    RES_CMD          ; RESume paused subchannel
  4    PSE_ORD          ; PauSE subchannel
  5    DIS_ORD          ; DISconnect subchannel
  6    RSR_END          ; Read Status-Result END condition
  7    WIC_END          ; Write In-channel Control END condition
  8    RD_ORD           ; Read Data ORDer arrived
  9    RD_END           ; Read Data END condition
  A    WD_END           ; Write Data END condition
  B    RTS_ORD          ; Read Transparent Status ORDer arrived
  C    RTSABORT         ; RTS(abort) just sent to host
  D    WTC_RES          ;**   WTC{RESume tid}
  E    WTC_END          ;**   WTC{END data transfer phase}
  F    WTCABORT         ;**   WTC{ABORT tid}
 10    PERROR           ; Protocol ERROR (recoverable)
 11    SOMETHING        ; Something happened

        *** Transaction State Machine OPcodes ***

 12    TOP_INIT         ; INITial call - RQB has arrived
 13    TOP_END          ; Unexpected WTC(end) received
 14    TOP_ABRT         ; Transaction aborting now
 15    TOP_XOK          ; data Xfer completed OK
 16    TOP_XOVR         ; data Xfer OVerRan
 17    TOP_XUNR         ; data Xfer UNderRan
 18    TOP_RDI          ; Read Data Immediate

        *** Transaction State Machine Action Codes ***

 19    TAC_NONE         ; NOthiNg rEady
 1A    TAC_CEND         ; Control END:  RTS{cont} RS,d
 1B    TAC_XEND         ; data Xfer END: RTS/WTC{end} RS,d
 1C    TAC_ABRT         ; ABoRT transaction: RTS{abort}
 1D    TACERROR         ; ERROR in rqb
 1E    TAC_WBR          ; Write Buffer immediately Ready
 1F    TAC_RBIR         ; Read Buffer Immediately Ready
 20    TAC_RBDR         ; Read Buffer Delayed Ready
```

```
        *** Transaction Dependent Events ***

21      RTB__RDY        ; RTB: Stop idling because TRACE__Q is not empty
22      WLD__FIN        ; WLD: Stop idling because link abnormally closed
23      WLD__RDY        ; WLD: Stop idling because both
                        ;      OUTPUT__Q and RAM__POOL aren't full
24      WLD__BID        ; WLD: Request frontplane to line bid
25      LBID__OK        ; WLD: Line Bid request suceeded
26      LBID__BAD       ; WLD: Line Bid request failed
27      RLD__FIN        ; RLD: Stop idling because abnormally closed
28      RLD__RDY        ; RLD: Stop idling because INPUT__Q is not empty

        *** 2780/3780 RJE Frontplane Events ***

29      RING__AA        ; Auto-answer with Ring(IC)
2A      MAN__ORG        ; Manual Orginate call out
2B      NORINGAA        ; Auto-answer without Ring(IC)
2C      AUTODIAL        ; Automatically Dial number
2D      DTR__HELD       ; Open a hold link
2E      MODEM__TO       ; Modem Connection timeout
2F      CLOSELINK       ; User wants to close the link
30      RING__HI        ; Ring(IC) modem line is active
31      DSR__HI         ; DSR(DM) modem line is active
32      LOST__XXX       ; DSR(DM) or DCD(CD) dropped inactive
                                or lost external timing
33      NOACT__TO       ; No Activity timeout
34      PLEASEBID       ; Line Bid the remote
35      SENDDONE        ; PSI RJE has finished transmitting characters
36      R__JUNK         ; Received JUNK from BISYNC I/O
```

NOTE

BISYNC I/O is a set of firmware Interrupt Service routines which handle the transmitting of characters to the link, and the deciphering of characters received from the link.

```
37      R__DLEEOT       ; Received DLE EOT from BISYNC I/O
38      R__EOT          ; Received EOT from BISYNC I/O
39      R__ENQ          ; Received ENQ from BISYNC I/O
3A      R__TTD          ; Recevied TTD from BISYNC I/O
3B      R__WACK         ; Received WACK from BISYNC I/O
3C      R__RVI          ; Received RVI from BISYNC I/O
3D      R__ACK0         ; Received ACK0 from BISYNC I/O
3E      R__ACK1         ; Received ACK1 from BISYNC I/O
3F      R__NAK          ; Received NAK from BISYNC I/O
40      R__SOHSTX       ; Received [DLE] STX/SOH from BISYNC I/O
41      BLKABORT        ; Received ENQ at end of data block
42      BUFOVRUN        ; Text overran receive buffer
43      BAD__CRC        ; Recieved [DLE] ETB/ETX with bad CRC
44      GOOD__BLK       ; Received [DLE] ETB/ETX with good CRC
```

```
45    TIMEOUT          ; General Purpose timeout
46    RTRYDONE         ; Some retry limit has been exceeded
47    END_MESG         ; Transmit message finished - send EOT
48    BAD_ACK          ; Wrong alternating acknowldge received
49    DATAVAIL         ; Buffers available in OUTPUT_Q
4A    ROOMAVAIL        ; RAM and INPUT_Q have room available
4B    YES              ; YES
4C    NO               ; NO
```

Miscellaneous. The least significant six bits of the 20-bit counter field of the received or transmitted character entry is concatenated with the current most significant 14-bits of the 20-bit counter to yield the character's time stamp.

Request Subfunction

SUBFUNCTION = Not used

Result Code

RESULT CODE = none

ASCII CHARACTERS AND BINARY CODES

APPENDIX A

	0	1	2	3	4	5	6	7
0	NUL	DLE	sp	0	@	P	`	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	'	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	l	|
D	CR	GS	-	=	M	]	m	}
E	SO	RS	.	>	N	^	n	~
F	SI	US	/	?	O	_	o	DEL

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W

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