RFL Electronics Inc.

I N S T R U C T I O N D A T A

RFL DS-64NC Wideband Synchronous Data Module

DESCRIPTION

The RFL DS-64NC is a synchronous data channel module that can operate at a selectable data rate. The rate can be any multiple of 8 Kbps, with a maximum limit that depends on the multiplexer type. Ranges are as follows:

T1 Multiplexers and T1-Based Variable-Rate Multiplexers .	8 Kbps to 1.536 Mbps
2MB Multiplexers	8 Kbps to 1.984 Mbps
2MB-Based Variable-Rate Multiplexers . . .	8 Kbps to 1.984 Mbps

Features include the following:

- o User-selectable data rate.
- o Full independent send and receive timing (at the same nominal rate in both directions).
- o One-way or full duplex operation.
- o Choice of RS-449 or CCITT V.35 interface.
- o Local and far-end loopbacks.
- o Clear-channel operation for AMI networks.
- o Test pattern generator and error detector for one-way or loopback testing.
- o Contiguous or alternating time slot assignment.
- o Time Slot 16 can be skipped for CAS multiframe applications (2MB multiplexers only).
- o Remote control configuration and status reporting.
- o Selectable transmit/receive direction.
- o Optional deep buffers for plesiochronous operation.

Note: Please see Application Note on page 51 of this Instruction Data sheet.

SPECIFICATIONS

As of the date this Instruction Data Sheet was published, the following specifications apply to the RFL DS-64NC Wideband Synchronous Data Module. Because all RFL products undergo constant refinement and improvement and, these specifications are subject to change without notice.

DATA PORT

Data Rates:

In a T1 Multiplexer: 8 Kbps to 1.536 Mbps in 8-Kbps increments.
In a T1-Based Variable-Rate Multiplexer: 8 Kbps to 1.536 Mbps in 8-Kbps increments.
In a 2MB Multiplexer: 8 Kbps to 1.984 Mbps in 8-Kbps increments.
In a 2MB-Based Variable-Rate Multiplexer: 8 Kbps to 2.040 Mbps in 8-Kbps increments.

Data Format: no restrictions on data content. Supports clear-channel for AMI networks.

Data Interface: Selected by choosing appropriate Module Adapter:

Using MA-412A Module Adapter: RS-449, configured as DCE.
Using MA-413A Module Adapter: CCITT V.35, configured as DCE.
Using MA-414A Module Adapter: RS-449, configured as DTE.
Using MA-415A Module Adapter: CCITT V.35, configured as DTE.
Using MA-427 LAN Bridge Module Adapter.

Signals Supported:

RS-449: SD, TT, ST, RS, CS, RD, RT, RR, DM, TM and SG.
CCITT V.35: SD, SCT, SCTE, RD, RTS, SCR, CTS, DSR, RLSD, LT and SG.

Timing:

DTE: Synchronizes network to receive timing input. Provides terminal timing output synchronized to network.
DCE: Provides send and receive timing synchronized to the network. Can synchronize network to terminal timing

Transmit And Receive Buffers: 12-Kbyte deep buffers, with user-selectable starting depth; either 256 bits for synchronous operation, or 6000 bits to support plesiochronous operation.

NETWORK INTERFACE

Time Slot Selection: Selectable use of adjacent or alternate time slots. Time Slot 16 can be skipped for CAS usage in a 2MB system.

DS0 Usage: 56 Kbits or 64 Kbits per time slot, with unused bits set to logic one.

Clear-Channel Capability (for AMI network): Alternate time slot usage per AT&T TR-54019, or 56 Kbits per time slot, with eighth bit set to logic one.

STATUS AND DIAGNOSTICS

LED Indicators: Service on/off, transmit activity, receive activity, loopback active, buffer overflow or underflow, and received bit errors (compares bit from test pattern generator and bits known to be set to logic "1").

Loopbacks: Local and far-end loopback capability.

Test Patterns: Generates and detects test patterns for one-way or loopback testing. Patterns are all ones, a single one with fifteen zeroes, or a 2^{15}-1 pseudo-random sequence. Error light flashes when bit errors are detected.

Remote Interface: Compatible with SCL remote command language; allows module configuration and status access.

GENERAL

System Compatibility: The RFL DS-64NC is compatible with all RFL 2000 Intelligent Multiplexers.

Operating Modes: Transmit-only, receive-only, or full-duplex (transmit and receive).

Power Consumption: 2.0 Watts nominal.

Operating Temperature: -20^{o}C to +55^{o}C (-4^{o}F to +131^{o}F).

Humidity: Zero to 90 percent, non-condensing.

INSTALLATION

Before the RFL DS-64NC module can be placed in service, it must be installed in a multiplexer shelf. Installation involves determining the module slot in the Main Shelf or Expansion Shelf where the module will be installed, inserting a Module Adapter into the rear of the shelf behind the module slot, connecting all signal and power wiring to the Module Adapter, checking the settings of all switches, and inserting the module into the front of the shelf.

NOTE

Power supply and time slot considerations may affect the installation of this module into an existing multiplexer shelf. Refer to the portions of your multiplexer operating manual covering "Channel Module Configuration Guidelines" and "Adding More Channels To Existing Systems" for more information.

The following instructions are provided for installing an RFL DS-64NC module into an existing system. If the module was included as part of a system, installation was done at the factory. Otherwise, proceed as follows:

1. Carefully inspect the module for any visible signs of shipping damage.

   If you suspect damage to the module or its Module Adapter, immediately contact RFL's Customer Service Department at the number listed at the bottom of this page.

2. Determine which module slot in the Main Shelf or Expansion Shelf the RFL DS-64NC will be installed in.

   RFL DS-64NC modules occupy one module slot in the Main Shelf or Expansion Shelf. Refer to the "as supplied" drawings furnished with the equipment for more information.

3. Determine which Module Adapter will be used to make connections to the RFL DS-64NC module.

   Each module in the IMUX 2000 multiplexer requires a Module Adapter. The Module Adapter provides the appropriate connector for the desired interface.

   There are five Module Adapters that are compatible with the RFL DS-64NC:

Model Number	Specification Compliance	Configuration	Figure
MA-412A	RS-449	DCE	1
MA-413A	CCITT V.35	DCE	1
MA-414A	RS-449	DTE	1
MA-415A	CCITT V.35	DTE	1
MA-427	IEEE 802.3	LAN	12

   Make sure the Module Adapter you are installing is the correct one for the desired application.

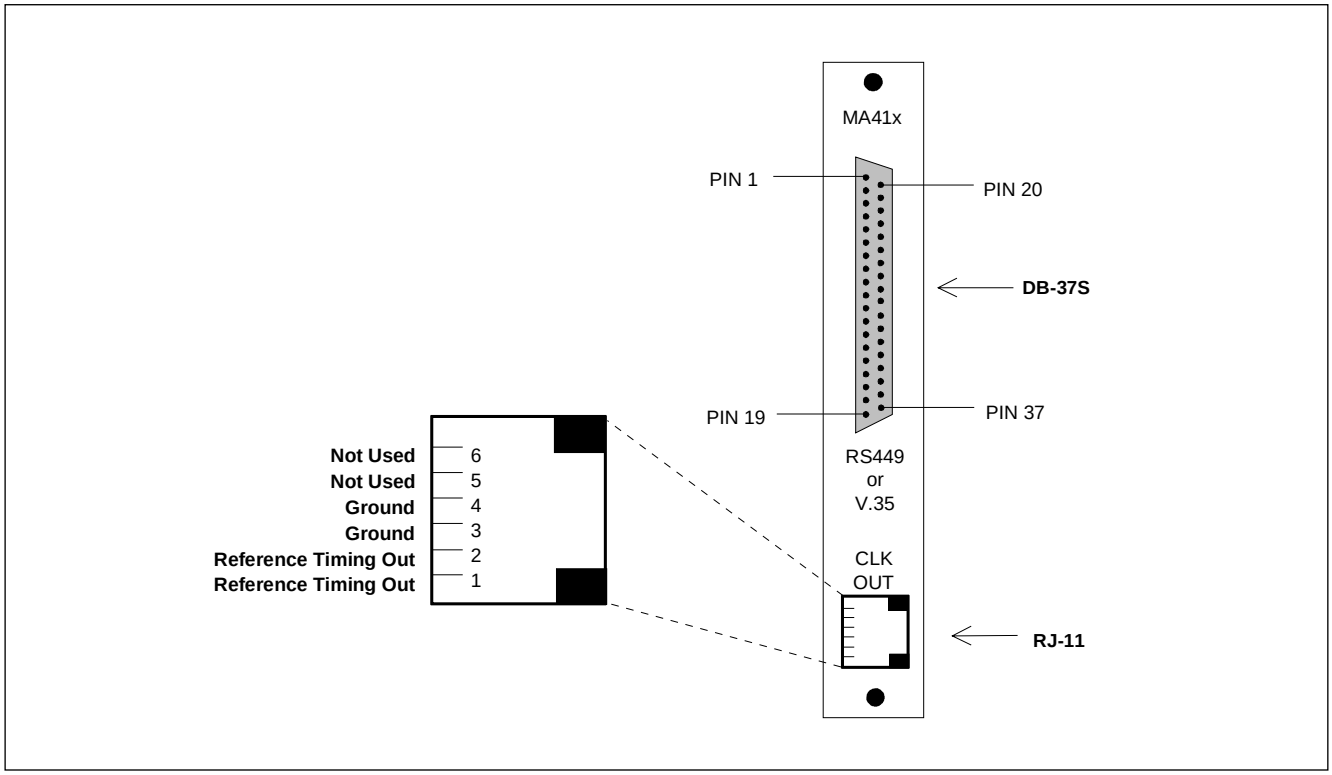

Figure 1. MA-412A, MA-413A, MA-414A and MA-415A Module Adapters

Each Module Adapter has an RJ-11 jack for timing output and a 37-pin D-subminiature connector for data signals (a DB-37S female connector). The timing output may be applied to the timing input on the multiplexer's Common Module to synchronize the system timing to the RFL DS-64NC's receive clock signal.

4. If you are using an MA-412A Module Adapter, check the settings of all jumpers on the jumper block near the motherboard mating connector. (See Figure 2 for location.) If you are using an MA-413A Module Adapter, check the settings of all jumpers on the jumper block near the center of the board. (See Figure 3 for location.)

   The jumpers on MA-412A and MA-413A Module Adapters determine the derivation of the transmit clock signal for the RFL DS-64NC module. Three settings are possible:

NORMAL	**Transmit clock is sent from the Module Adapter to the DTE, and the data is clocked in on the falling edge of the clock signal.**
INVERTED	**Transmit clock is sent from the Module Adapter to the DTE, but the data is clocked in on the rising edge of the clock signal instead of the falling edge.**
EXTERNAL	**Transmit clock is derived from the DTE (the SCTE signal).**

5. If you are using the MA-427 Module Adapter, refer to page 47 for installation instructions.

6. Insert the Module adapter into the rear of the shelf directly behind the module slot where the RFL DS-64NC will be installed.

7. Using Figures 4 through 7 as a guide, connect all power and signal wiring to the Module Adapter.

8. For steps 9 to 24, refer to Figure 8 for switch locations.

9 On the DS-64NC module, use DIP switches S1-1 through S1-6, to set the module address.

For remote access, each channel module in an IMUX 2000 multiplexer must have a distinct module address. Valid module addresses are the numbers "1" to "36", using the code shown in Table 1. The module address is usually set to the number of the physical slot in the shelf that the module will occupy. It can be set to any number from 1 to 36 that is not already being used by another module in the same multiplexer shelf.

10. Set DIP switch S6-2 for either T1-based or E1-based operation.

If the RFL DS-64NC module is being used in an E1 multiplexer (2MB-based, 2.048-mHz clock), place S6-2 in the ON position. If it is being used in a T1 multiplexer (1.544-mHz bus clock, place S6-2 in the OFF position.

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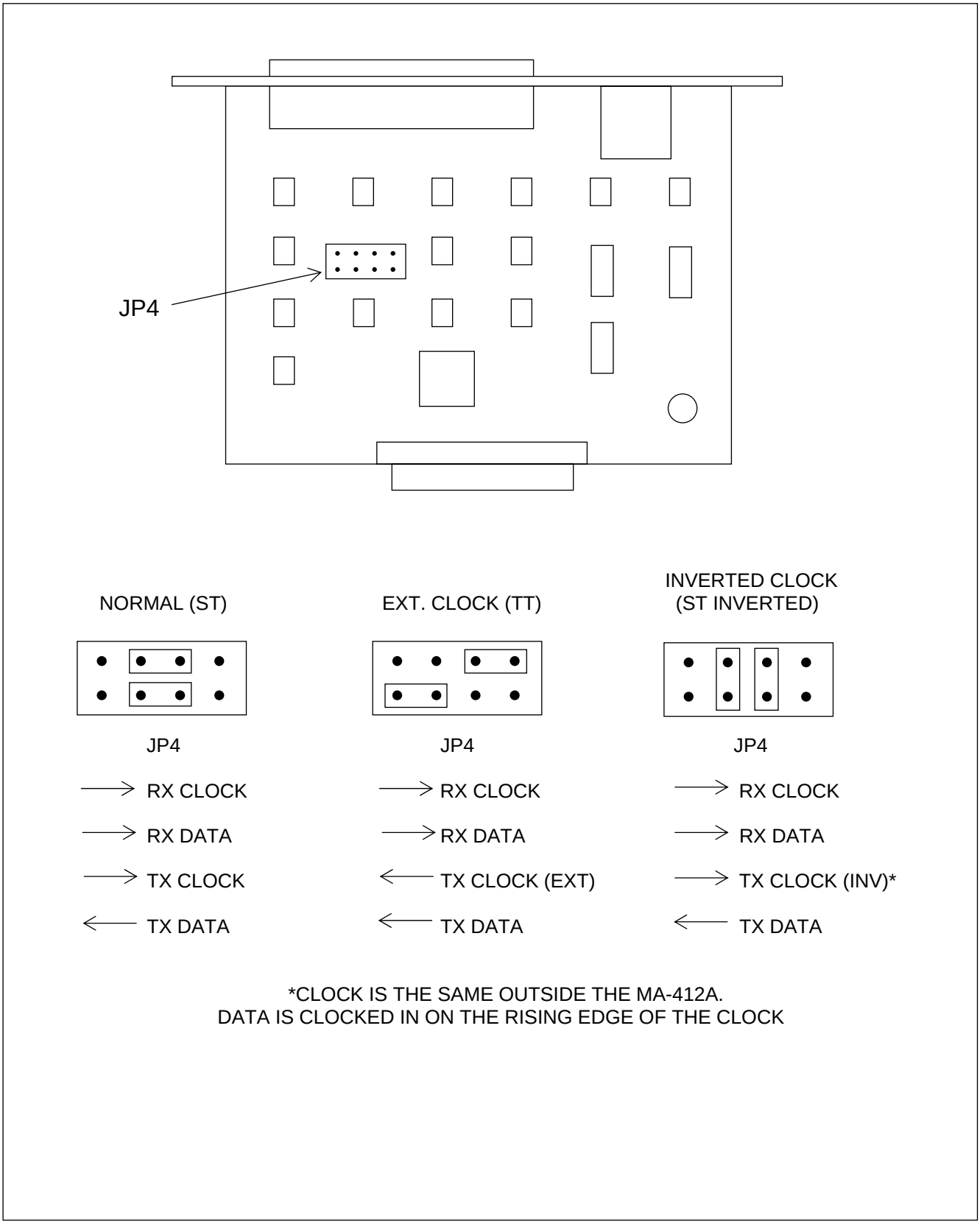

Figure 2. Jumper locations and settings, MA-412A Module Adapter.

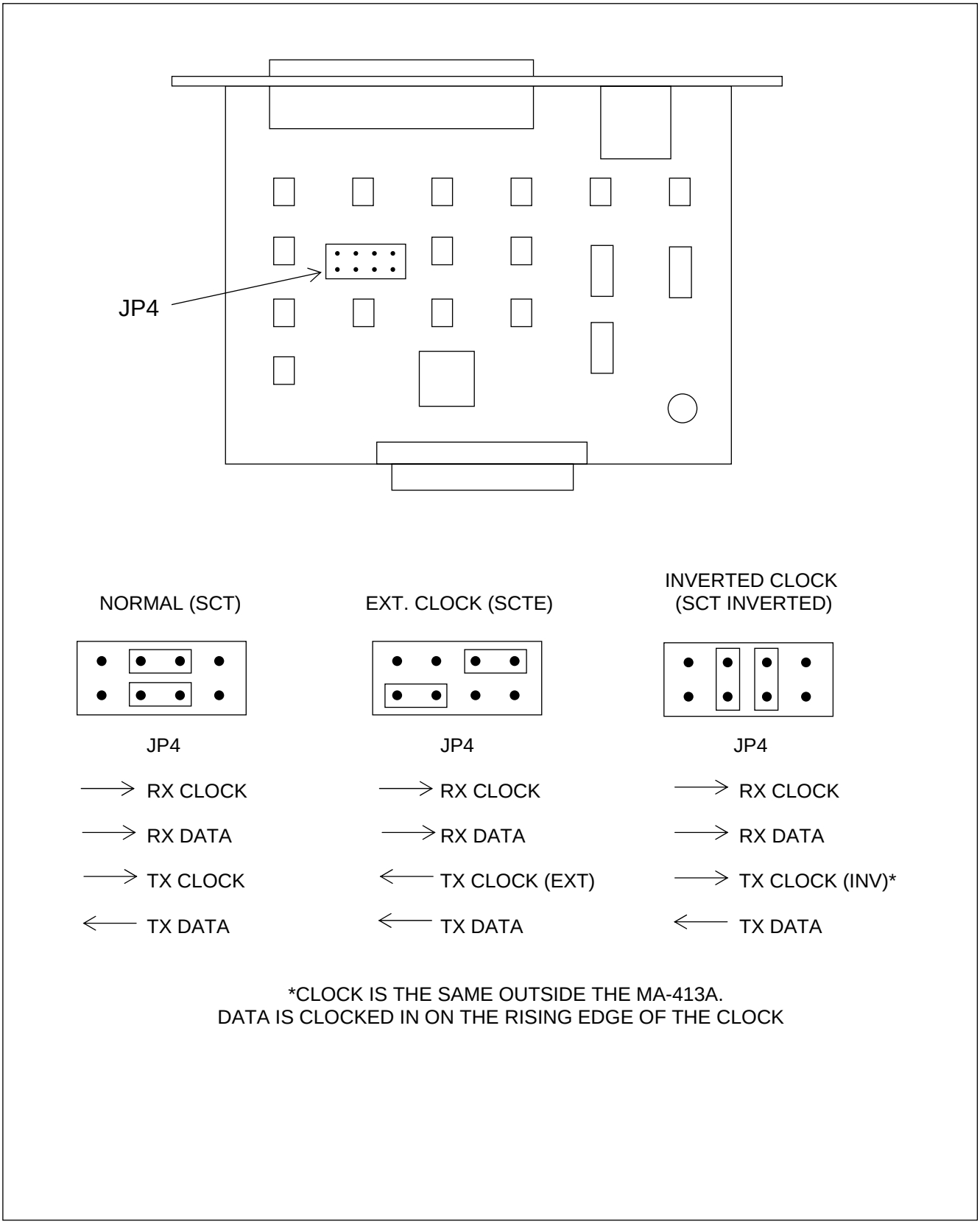

Figure 3. Jumper locations and settings, MA-413A Module Adapter.

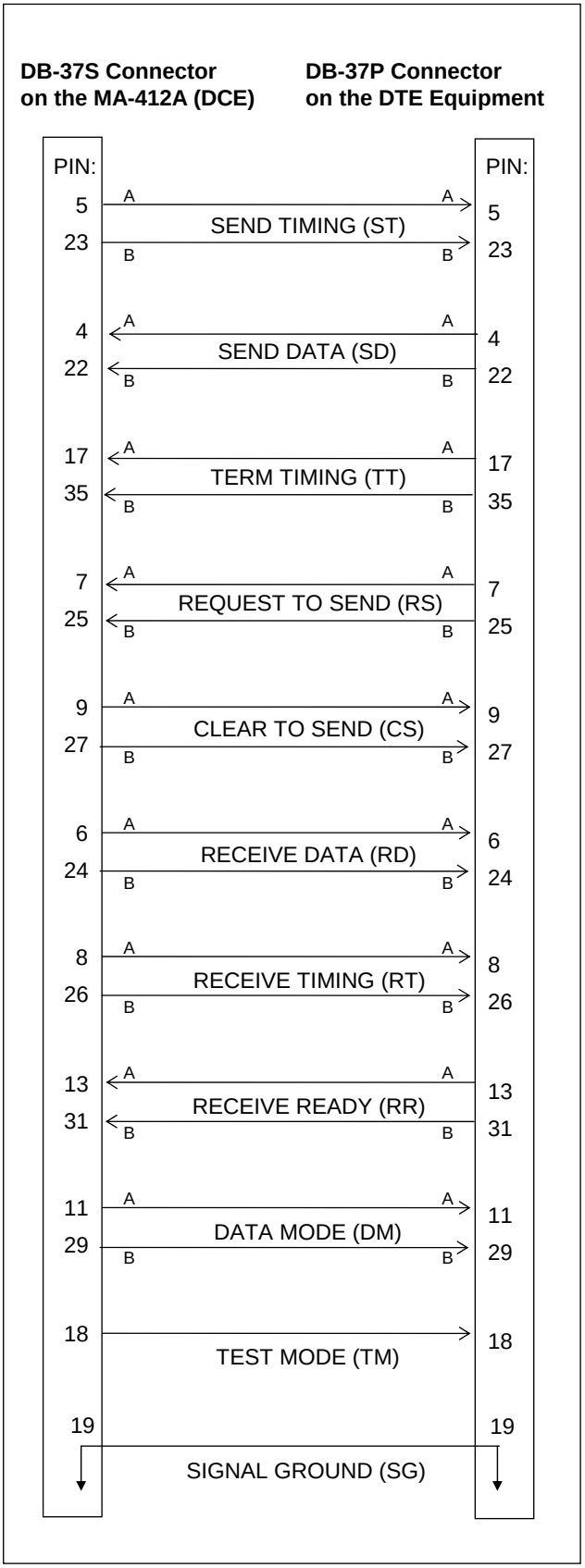

Figure 4. Signal flow between an MA-412A Module Adapter and RS-449 DTE equipment

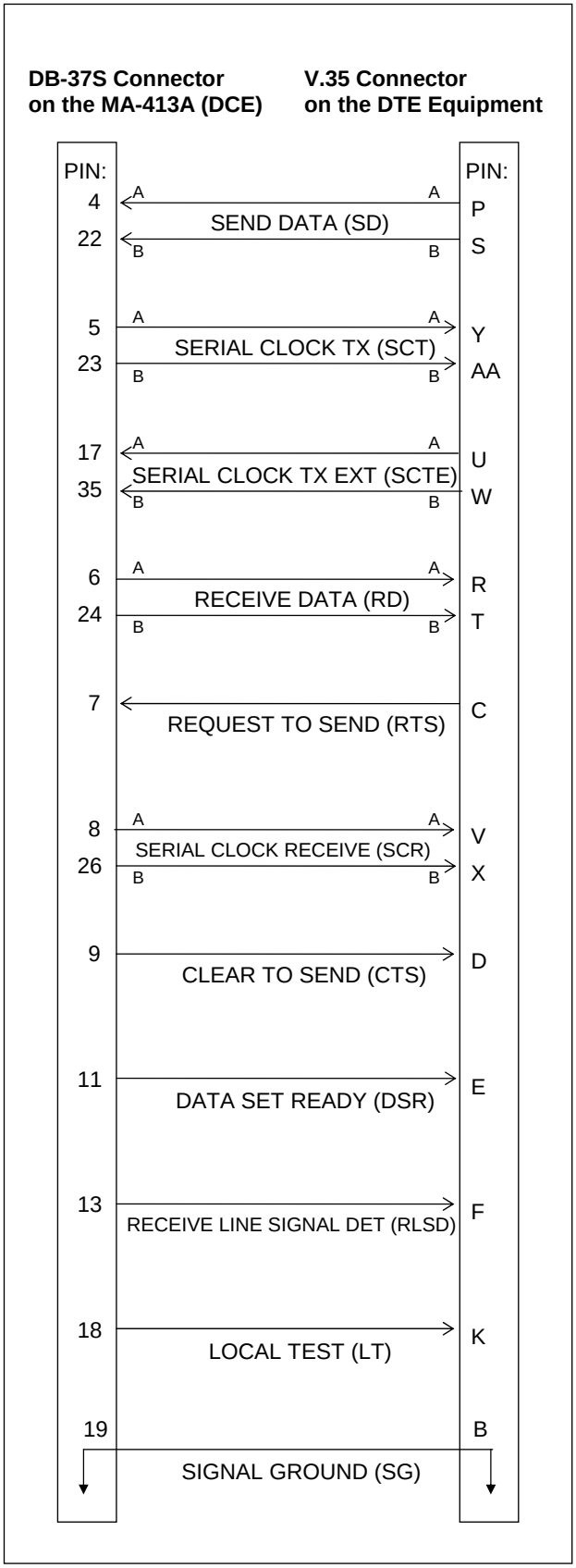

Figure 5. Signal flow between an MA-413A Module Adapter and CCITT V.35 DTE equipment

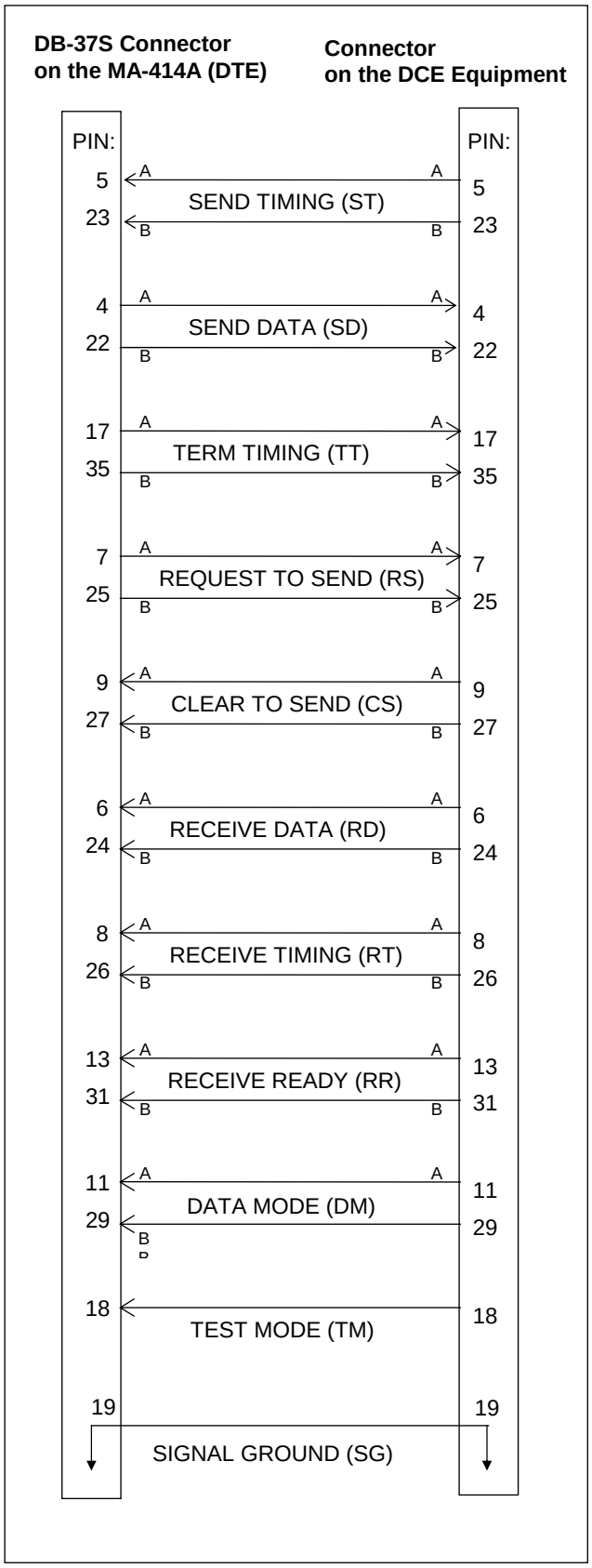

Figure 6. Signal flow between an MA-414A Module Adapter and RS-449 DCE equipment

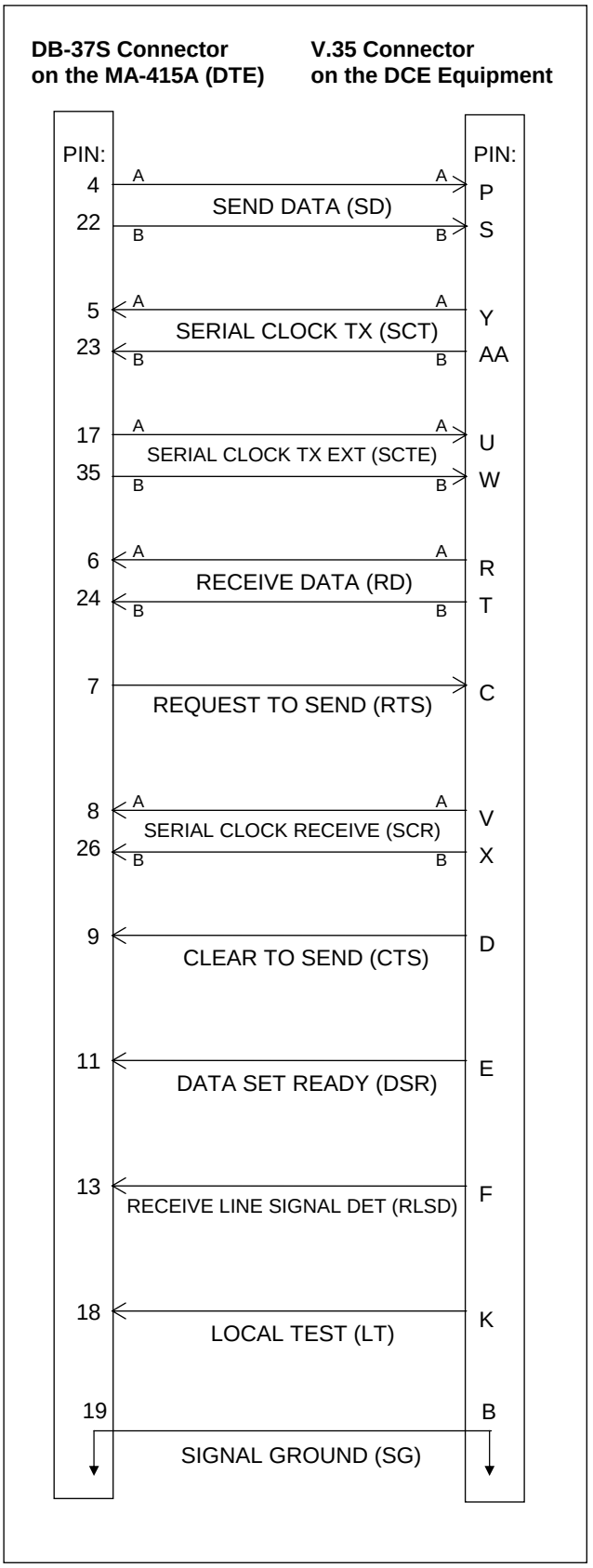

Figure 7. Signal flow between an MA-415A Module Adapter and CCITT V.35 DCE equipment

Table 1. Module address settings, RFL DS-64NC Wideband Synchronous Data Module

Module Address	S1-1	S1-2	S1-3	S1-4	S1-5	S1-6
1	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	ON	OFF	ON	OFF
11	OFF	OFF	ON	OFF	ON	ON
12	OFF	OFF	ON	ON	OFF	OFF
13	OFF	OFF	ON	ON	OFF	ON
14	OFF	OFF	ON	ON	ON	OFF
15	OFF	OFF	ON	ON	ON	ON
16	OFF	ON	OFF	OFF	OFF	OFF
17	OFF	ON	OFF	OFF	OFF	ON
18	OFF	ON	OFF	OFF	ON	OFF
19	OFF	ON	OFF	OFF	ON	ON
20	OFF	ON	OFF	ON	OFF	OFF
21	OFF	ON	OFF	ON	OFF	ON
22	OFF	ON	OFF	ON	ON	OFF
23	OFF	ON	OFF	ON	ON	ON
24	OFF	ON	ON	OFF	OFF	OFF
25	OFF	ON	ON	OFF	OFF	ON
26	OFF	ON	ON	OFF	ON	OFF
27	OFF	ON	ON	OFF	ON	ON
28	OFF	ON	ON	ON	OFF	OFF
29	OFF	ON	ON	ON	OFF	ON
30	OFF	ON	ON	ON	ON	OFF
31	OFF	ON	ON	ON	ON	ON
32	ON	OFF	OFF	OFF	OFF	OFF
33	ON	OFF	OFF	OFF	OFF	ON
34	ON	OFF	OFF	OFF	ON	OFF
35	ON	OFF	OFF	OFF	ON	ON
36	ON	OFF	OFF	ON	OFF	OFF

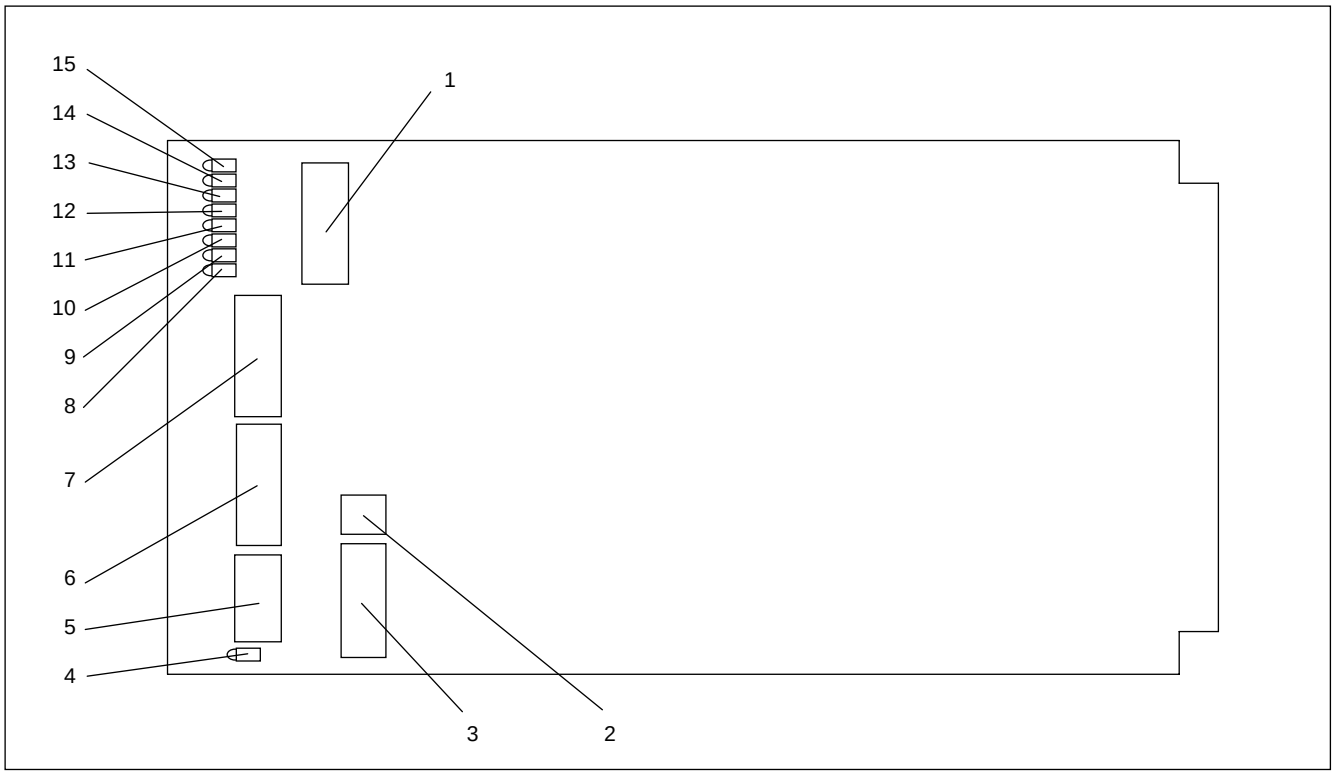

Figure 8. Controls and indicators, RFL DS-64NC Wideband Synchronous Data Module

Table 2. Controls and indicators, RFL DS-64NC Wideband Synchronous Data Module

Item	Name/Description	Function
1	DIP switch S4	Sets data rate for the module. (See Table 3 on page 16 for typical settings, and Table 12 on page 38 for a list of all possible settings.
2	DIP switch S6	S6-1 (CAS) - Controls use of Time Slot 16: ON Time Slot 16 reserved for signaling. This position should only be used when the module is in an E1 (2MB) multiplexer using CAS signaling. OFF Time Slot 16 available for payload.
		S6-2 (E1) – Sets the module for T1 or E1 use: ON Module is set for use in an E1 multiplexer (2MB-based, 2.048-mHz bus clock).. OFF Module is set for use in a T1 multiplexer (1.544-mHz bus clock).
3	DIP switch S1	Sets the module address for remote access, using the code shown in Table 1.
4	SRVC indicator (green)	Lights when the module is in service (service switch is turned on, or the module is remotely activated. Blinks when a configuration error occurs. (1) A configuration error is when the user has selected a combination of data rate and starting time slot that will not permit all the data to fit into the available time slots, given the current settings for system usage (T1 or 2MB) and bits per time slot (56K or 64K). While the error exists, the module will remain out-of-service.

Table 2. continued - Controls and indicators, RFL DS-64NC Wideband Synchronous Data Module

Item	Name/Description	Function
5	DIP switch S5	S5-1 (TERM) - Sets module termination: **UP** Module is used in a drop/insert multiplexer. (2) **DOWN** Module is used in a terminal multiplexer.
		S5-2 (AUX) - Set to **UP** position
		S5-3 (REMOTE) - Controls remote configuration feature: **UP** Remote configuration disabled (local configuration only) **DOWN** Remote configuration enabled.
		S5-4 (SRVC) - Controls service: **UP** Service on - module active. **DOWN** Service off - module inactive.
6	DIP switch S2	S2-1 (BUFF) - Sets the starting depth for the transmit and receive buffers: **UP** 256 bits (for synchronous operation). **DOWN** 6000 bits (for plesiochronous operation).
		S2-2 (AUX) - Sets the number of bits per time slot: **UP** 64 kilobits. **DOWN** 56 kilobits (3)
		S2-3 (ALT) - Selects sequential or alternating time slots: **UP** Module is set to use sequential time slots. **DOWN** Module is set to use alternating time slots.
		S2-4 thru S2-8 (TIME SLOT) - Sets the starting time slot, using the codes shown in Tables 5 and 6 on page 18 of this Instruction Data Sheet.
7	DIP switch S3	S3-1 and S3-2 (LPBK) - Selects loopback mode. (See page 23 for settings)
		S3-3 thru S3-5 (TEST) - Selects test pattern. (See page 24 for settings)
		S3-6 (RX ON) - Controls receive side of module: **UP** Receive side is off (disabled). **DOWN** Receive side is on (enabled). Note: Please see Application Note on page 51 of this Instruction Data sheet.
		S3-7 and S3-8 (TX MODE) - Selects transmit mode. (For more information, see step 17 of installation procedure.)

Table 2. continued - Controls and indicators, RFL DS-64NC Wideband Synchronous Data Module

Item	Name/Description	Function
8	FAIL indicator (red)	Lights if a DSP failure occurs. (1)
9	FE ERR indicator (yellow)	Reserved for future use.
10	NE ERR indicator (yellow)	Flashes when a near-end error is detected. (1)
11	RX SYNC indicator (red)	Reserved for future use.
12	RX OUT indicator (green)	Lights when receive data activity is detected. (1)
13	LPBK indicator (yellow)	Lights when payload or loacl equipment loopback tests are in progress. Blinks when Equipment loopback tests are initiated from the far end. (1)
14	TX BUFF indicator (yellow)	Flashes when the transmit FIFO buffer overruns or underruns. (1)
15	TX IN indicator (green)	Lights when receive data activity is detected. (1)

1. For indicators, “lights” means the indicator is continuously on. “Blink means a rhythmic on/off cycle (one half-second on, one half-second off). “Flash” means momentary, irregular flashes.

2. When the module is in a terminal multiplexer, this switch should always be in the OFF position. When the module is in a drop/insert multiplexer, place this switch in the OFF position to transmit in the A direction and receive from the B direction; place this switch in the ON position to transmit in the B direction and receive from the A direction. Refer to the RFL IMUX 2000 manual for guidelines on setting channel module transmit and receive directions.

3. When using 56 Kbits per time slot, be sure to allow for the additional number of time slots needed to hold the total amount of data. This will affect the choice of starting time slot. Table 12 on page 38 of this Instruction Data Sheet lists the number of time slots required for each available data rate, when operating at either 56 Kbits or 64 Kbits per time slot.

11. Set DIP switch S6-1 to determine how Time Slot 16 will be used.

    If the RFL DS-64NC module is being used in an E1 (2MB) multiplexer using CAS signaling, place S6-1 in the ON position to reserve Time Slot 16 for signaling. For all other applications, place S6-1 in the OFF position to make Time Slot 16 available for payload.

12. Set DIP switch S4 to the desired data rate for the module.

    The ten switches in S4 represent the binary value of the nominal rate of the data interface, divided by 2000 bps. The most-significant digit is represented by S4-1, and the least-significant digit by S4-10. Setting a switch in the ON position represents a zero, and setting it in the OFF position represents a one.

>> text continues on page 16 <<

For example, suppose you want to set the data rate to 8 Kbps, or 8000 bits per second. 8000 divided by 2000 equals 4; since the number "4" in ten-bit binary is "0000000100". S4 would be set as follows:

Switch	Value	Setting	Set Value
S4-1	512	UP	0
S4-2	256	UP	0
S4-3	128	UP	0
S4-4	64	UP	0
S4-5	32	UP	0
S4-6	16	UP	0
S4-7	8	UP	0
S4-8	4	DOWN	4
S4-9	2	UP	0
S4-10	1	UP	0
TOTAL			4

To set the data rate to 192 Kbps (or 192,000 bits per second), divide 192,000 by 2000, which equals 96. Since the number "96" in ten-bit binary is "0001100000". S4 would be set as follows:

Switch	Value	Setting	Set Value
S4-1	512	UP	0
S4-2	256	UP	0
S4-3	128	UP	0
S4-4	64	DOWN	64
S4-5	32	DOWN	32
S4-6	16	UP	0
S4-7	8	UP	0
S4-8	4	UP	0
S4-9	2	UP	0
S4-10	1	UP	0
TOTAL			96

Since the data rate must be a multiple of 8000 bps, the two lowest digits (S4-9 and S4-10) will always be in the ON position. In fact, the RFL DS-64NC interprets these two positions as "00" regardless of their actual setting, so they may be ignored.

Note that although the data rate for the RFL DS-64NC can be any increment of 8 Kbps, the data will be placed into an integer multiple of 56-Kbps or 64-Kbps time slots. For example, if the RFL DS-64NC is set up to use all eight bits of each time slot in each frame (64 Kbits per time slot), at a data rate of 128 Kbps the data occupies two time slots. At any data rate from 136 Kbps to 192 Kbps it occupies three time slots; from 200 Kbps to 256 Kbps it occupies four time slots, and so on.

If the RFL DS-64NC is set up to use seven bits of each time slot in each frame (56 Kbits), it will have a lower maximum data rate, and will run out of available time slots sooner, For example, at a data rate of 112 Kbps the data occupies two time slots. At any data rate from 120 Kbps to 168 Kbps it occupies three time slots; from 176 Kbps to 224 Kbps it occupies four time slots, and so on.

Table 3 gives some examples of common data rate settings, with the number of time slots these rates occupy at both 64 Kbps and 56 Kbps per slot. Table 12 on page 38 of this Instruction Data Sheet lists all possible switch settings, and the time slot usage for each data rate.

Table 3. Examples of typical data rate settings.

	DIP Switch SW4 Settings										Time Slots Occupied @	Time Slots Occupied @
Data Rate	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	64 Bits/Slot	56 Bits/Slot
8 Kbps	U	U	U	U	U	U	U	D	U	U	1	1
64 Kbps	U	U	U	U	D	U	U	U	U	U	1	2
128 Kbps	U	U	U	D	U	U	U	U	U	U	2	3
256 Kbps	U	U	D	U	U	U	U	U	U	U	4	5
384 Kbps	U	U	D	D	U	U	U	U	U	U	6	7
512 Kbps	U	D	U	U	U	U	U	U	U	U	8	10
768 Kbps	U	D	D	U	U	U	U	U	U	U	12	14

Note: U = UP, D = Down

13. Set DIP switch S2-2 to select the desired number of bits per time slot.
    Place S2-2 in the ON position for 64 Kbits per time slot.
    Place S2-2 in the OFF position for 56 Kbits per time slot.

14. Set DIP switch S2-3 to select sequential or alternating time slots.
    Place S2-3 in the ON position for sequential time slots.
    Place S2-3 in the OFF position for alternating time slots.

15. Determine the number of time slots required for the data by dividing the data rate set during step 12 of this procedure by the number of bits per time slot set during step 13. Round up to the next whole number.

16. Set DIP switches S2-4 through S2-8 to select the desired starting time slot.

The RFL DS-64NC occupies one or more time slots of the multiplexer's aggregate signal, depending upon the data rate selected. Select any time slot as the starting position - data will then be placed into the required number of time slots, using either sequential or alternate time slots, as selected by DIP switch S2-3 during step 14 of this procedure. Make sure that there are enough time slots above the starting time slot to hold all the data (as calculated in step 15), and that none of these slots are currently occupied by data from any other channel module in the system.

For example, suppose the data rate for the RFL DS-64NC module is 448 Kbps, and Time Slot 10 is selected as the starting time slot. The data will require seven 64-Kbps time slots. If S2-3 is set for sequential time slots, data will occupy Time Slots 10, 11, 12, 13, 14, 15 and 16; if S2-3 is set for alternating time slots, data will occupy Time Slots 10, 12, 14, 16, 18, 20 and 22.

Table 5 on the next page shows the switch settings for selecting the starting time slot when the RFL DS-64NC is used in a T1-based multiplexer; Table 6 shows the switch settings for use in a 2MB-based multiplexer. Note that in a T1 system, the time slots are numbered from "1" to "24", and all are available for payload. In a 2MB system, the time slots are numbered from "0" to "31", with Time Slot 0 always reserved for framing, and Time Slot 16 also reserved if the system is configured for CAS multiframe.

Time slot assignment does not wrap around back to the beginning. If the selected starting time slot does not allow enough room for all the necessary time slots within the limit of the transmission link, a configuration error will occur. The RFL DS-64NC will report an ALERT condition to the shelf Common Module, and will not go into service.

17. Set DIP switches S3-7 and S3-8 to select the desired transmit mode.

Four different transmit modes are possible, as shown in Table 4.

Table 4. Transmit modes, RFL DS-64NC Wideband Synchronous Data Module

S3-7 Setting	S3-8 Setting	Transmit Modes
UP	UP	Transmit side is off at all times.
UP	DOWN	Transmit side only operates when CTS (Clear-To-Send) is asserted (polling mode).
DOWN	UP	Transmit side operates at all times; RTS/CTS handshake is operational.
DOWN	DOWN	Transmit side operates at all times; CTS is forced on.

Table 5. Starting Time slot selection in a T1-based multiplexer

Time Slot	S2-4	S2-5	S2-6	S2-7	S2-8
1	UP	UP	UP	UP	UP
2	UP	UP	UP	UP	DOWN
3	UP	UP	UP	DOWN	UP
4	UP	UP	UP	DOWN	DOWN
5	UP	UP	DOWN	UP	UP
6	UP	UP	DOWN	UP	DOWN
7	UP	UP	DOWN	DOWN	UP
8	UP	UP	DOWN	DOWN	DOWN
9	UP	DOWN	UP	UP	UP
10	UP	DOWN	UP	UP	DOWN
11	UP	DOWN	UP	DOWN	UP
12	UP	DOWN	UP	DOWN	DOWN
13	UP	DOWN	DOWN	UP	UP
14	UP	DOWN	DOWN	UP	DOWN
15	UP	DOWN	DOWN	DOWN	UP
16	UP	DOWN	DOWN	DOWN	DOWN
17	DOWN	UP	UP	UP	UP
18	DOWN	UP	UP	UP	DOWN
19	DOWN	UP	UP	DOWN	UP
20	DOWN	UP	UP	DOWN	DOWN
21	DOWN	UP	DOWN	UP	UP
22	DOWN	UP	DOWN	UP	DOWN
23	DOWN	UP	DOWN	DOWN	UP
24	DOWN	UP	DOWN	DOWN	DOWN

Table 6. Starting time slot selection in a 2MB-based multiplexer

Time Slot	S2-4	S2-5	S2-6	S2-7	S2-8
0**	UP	UP	UP	UP	UP
1	UP	UP	UP	UP	DOWN
2	UP	UP	UP	DOWN	UP
3	UP	UP	UP	DOWN	DOWN
4	UP	UP	DOWN	UP	UP
5	UP	UP	DOWN	UP	DOWN
6	UP	UP	DOWN	DOWN	UP
7	UP	UP	DOWN	DOWN	DOWN
8	UP	DOWN	UP	UP	UP
9	UP	DOWN	UP	UP	DOWN
10	UP	DOWN	UP	DOWN	UP
11	UP	DOWN	UP	DOWN	DOWN
12	UP	DOWN	DOWN	UP	UP
13	UP	DOWN	DOWN	UP	DOWN
14	UP	DOWN	DOWN	DOWN	UP
15	UP	DOWN	DOWN	DOWN	DOWN
16**	DOWN	UP	UP	UP	UP
17	DOWN	UP	UP	UP	DOWN
18	DOWN	UP	UP	DOWN	UP
19	DOWN	UP	UP	DOWN	DOWN
20	DOWN	UP	DOWN	UP	UP
21	DOWN	UP	DOWN	UP	DOWN
22	DOWN	UP	DOWN	DOWN	UP
23	DOWN	UP	DOWN	DOWN	DOWN
24	DOWN	DOWN	UP	UP	UP
25	DOWN	DOWN	UP	UP	DOWN
26	DOWN	DOWN	UP	DOWN	UP
27	DOWN	DOWN	UP	DOWN	DOWN
28	DOWN	DOWN	DOWN	UP	UP
29	DOWN	DOWN	DOWN	UP	DOWN
30	DOWN	DOWN	DOWN	DOWN	UP
31	DOWN	DOWN	DOWN	DOWN	DOWN

* In an E1 (2MB multiplexer, Time Slot 0 is always reserved for framing. In an E1 based variable-rate multiplexer, it may be used to carry payload.

** Time Slot 16 is reserved for signaling and multi-frame synchronization in the E1 CAS signaling format. If CCS signaling is used, Time Slot 16 is available for payload. Setting DIP switch S6-1 in the ON position causes the multiplexer to skip Time Slot 16 when filling either sequential or alternating time slots.

18. Set DIP switch S3-6 to enable or disable the receive side of the module.

    Place S3-6 in the ON position to disable the receive side of the module.
    Place S3-6 in the OFF position to enable the receive side of the module.

19. Set DIP switch S5-1 to select the desired transmit/receive direction.

    Place S5-1 in the ON position if the RFL DS-64NC is being used in a drop/insert multiplexer and you want the module to transmit in the B direction and receive from the A direction. Place S5-1 in the OFF position if the RFL DS-64NC is being used in a drop/insert multiplexer and you want the module to transmit in the A direction and receive from the B direction. If the RFL DS-64NC is being used in a terminal multiplexer, S5-1 <u>must</u> be placed in the OFF position.

20. Set DIP switch S2-1 to select the desired starting depth for the transmit and receive buffers.

    Place S2-1 in the ON position for a buffer depth of 256 bits (synchronous operation)
    Place S2-1 in the OFF position for a buffer depth of 6000 bits (plesiochronous operation)

21. Place DIP switches S3-1 and S3-2 in the ON position to set the RFL DS-64NC for normal operation.

    S3-1 and S3-2 are used during loopback testing. See page 23 of this Instruction Data Sheet for more information on loopback testing.

22. Place DIP switches S3-3 through S3-5 in the ON position to disable the RFL DS-64NC's test pattern generator.

    S3-3 through S3-5 control the RFL DS-64NC's test pattern generator. See page 24 of this Instruction Data Sheet for more information on the test pattern generator.

23. If you plan to operate the RFL DS-64NC under **<u>local</u>** control, perform the following steps:

    a. Set the RFL DS-64NC to local control by placing DIP switch S5-3 in the ON position.

    b. Turn service on by placing DIP switch S4-5 in the ON position.

    c. Slide the module into the selected module slot until it is firmly seated.

    d. Go to step 25.

24. If you plan to operate the RFL DS-64NC under **remote** control, perform the following steps:

    a. Set the RFL DS-64NC to local control by placing DIP switch S5-3 in the ON position.

    b. Turn service off by placing DIP switch S5-4 in the OFF position.

    c. Slide the module into the selected module slot until it is firmly seated.

    d. Wait 15 seconds for the RFL DS-64NC's parameter settings to be loaded into the shelf's Common Module.

    e. Pull the module out of the shelf, and place DIP switch S5-3 in the OFF position.
    Do not move DIP switch S5-4.

    f. Slide the module back into the shelf.

    g. Verify the RFL DS-64NC's configuration through remote control by issuing a "CONFIG?" query. (See page 26 of this Instruction Data Sheet for an explanation of the "CONFIG?" response.)

    h. Turn service on through remote control by issuing a "SRVC=ON" command.
    The RFL DS-64NC's operating parameters can now be changed by remote control. See page 26 of this Instruction Data Sheet for more information.

    i. Go to step 25.

25. On the Module Record Card (located to the right of the shelf), record the channel bank type, time slot, and any other pertinent information.

The RFL DS-64NC is now installed.

CIRCUIT DESCRIPTION

Figure 10 is a functional block diagram, showing all switches and indicators on the RFL DS-64NC Wideband Synchronous Data Module.

TIMING

Transmit-side and receive-side timing are completely independent of each other. The module includes two DDS (direct digital synthesis) clock generators that have a maximum jitter output of 30.52 ns peak-to-peak (6%, or 0.06 UI, maximum at 1.984 Mbps).

The timing outputs can be set to any integer multiple of 8 Kbps. The maximum data rate is determined by the number of payload time slots in the multiplexed signal. In a T1 or T1-based variable-rate system there are 24 time slots, for a maximum data rate of 1.536 Mbps. In a 2MB system there are 31, for a maximum data rate of 1.984 Mbps; if CAS multiframe is in use, there are 30 for a maximum data rate of 1.920 Kbps. A 2MB-based variable-rate system provides a maximum data rate of 2.040 Mbps.

The RFL DS-64NC also includes a master-clock synthesizer, at either 1.544 mHz or 2.048 mHz. The synthesizer is frequency-locked to one of the timing inputs at the data interface. This allows network timing to follow the data rate precisely, within the tolerance specified by the network.

BUFFERING

The transmit-side and receive-side each have first-in, first-out (FIFO) buffers with a depth of 12,000 bits. The starting depth of these buffers can be set either to 256+bits for normal synchronous operation, or to half the full depth (6000 bits) for plesiochronous operation. The buffer can be re-centered by remote control.

The current depth of each FIFO (transmit side and receive side) is maintained in a performance register, that can be read by remote control (See page 26 of this Instruction Data Sheet for more information). This may be used to implement "intelligent" reset algorithms, such as "reset at midnight unless already within 1/8 of center." This status information is available through the multiplexer's remote port.

TIME SLOT ASSIGNMENT

The RFL DS-64NC may be placed in either of two modes: seven bits per time slot (56-x-n Kbps) or eight bits per time slot (64-x-n Kbps). In the seven-bit mode, the eighth bit is set to logic one, and is monitored for errors at the receive side (See the “Diagnostics” section on page 24 of this Instruction Data Sheet for more information). The user specifies the starting time slot number, and whether adjacent or alternate time slots are to be used.

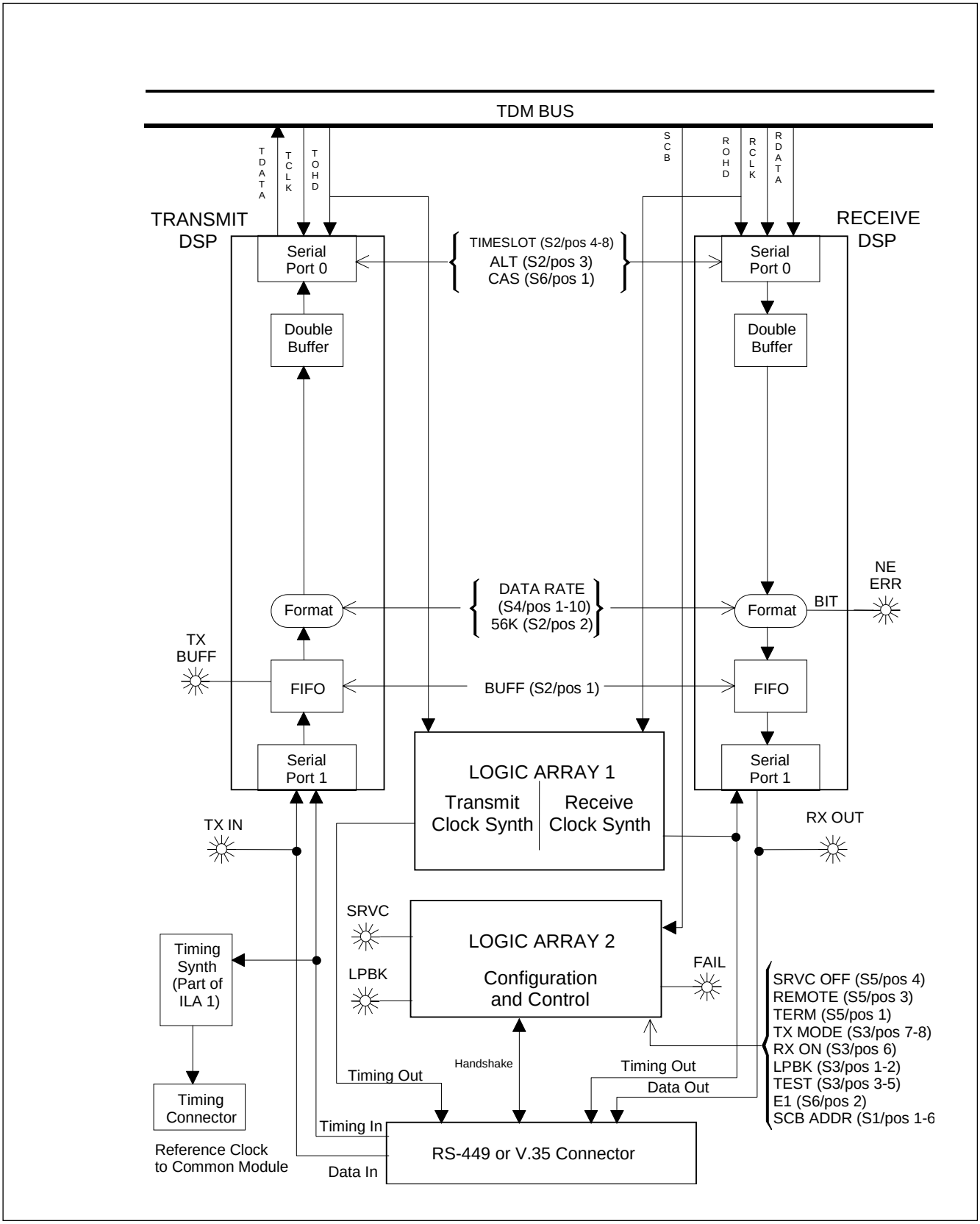

Figure 9. Bock diagram, RFL DS-64NC Wideband Synchronous Data Module

Adjacent time slots will normally be used, but some sub-rate services require the use of alternate time slots. Also, alternate time slot assignment can be used to solve ones-density problems in 64-x-n systems when the payload includes other kinds of channels that can be interleaved with the RFL DS-64NC's data.

Wrap-around of time slot assignments is not allowed. If the starting time slot is set too high for the requested data rate, the RFL DS-64NC will not operate. In 2MB applications, Time Slot 16 can be skipped to allow for CAS signaling.

LOOPBACKS

Loopbacks connect the data and timing signals from one direction to the other direction in place of the payload. Loopbacks do not force the RFL DS-64NC into full-duplex operation if it isn't already; payload loopback will work in a half-duplex configuration, but equipment loopback will not. (See Figure 10.)

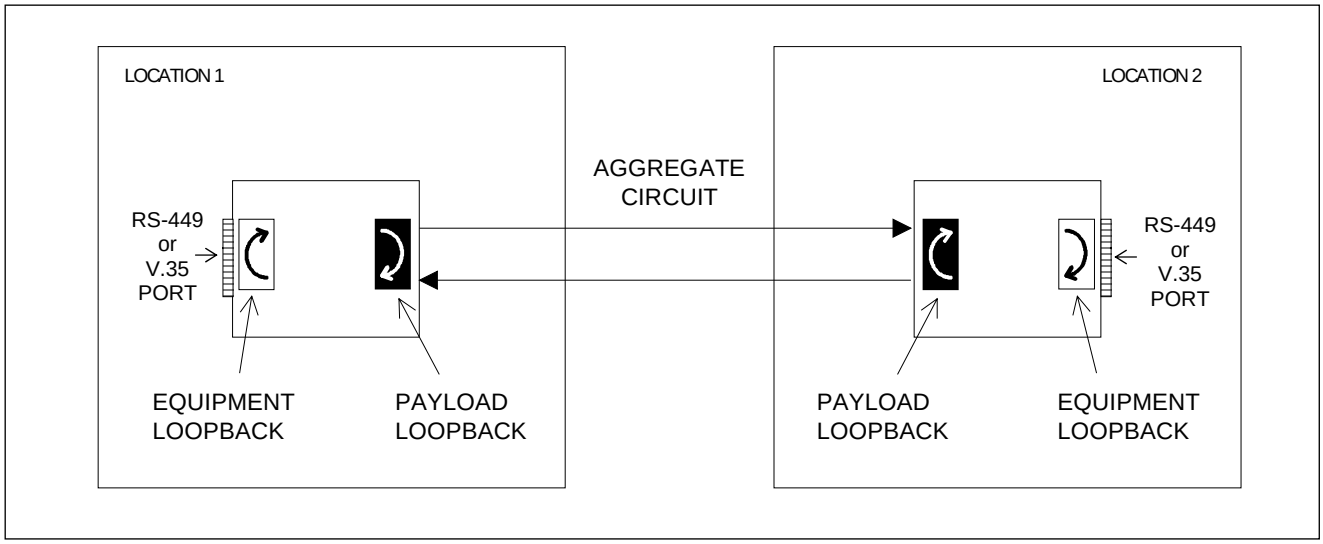

Figure 10. Loopbacks

PAYLOAD LOOPBACK (Local)

A payload loopback, exercises channel module logic up to the bus interface. Incoming data from the RS-449 or CCITT V.35 port is looped back to the same port. This loopback may only be activated at the near end (by switch or remotely). Receive timing becomes frequency-locked to transmit timing. This type of loopback is used to check out the performance of the RFL DS-64NC itself.

EQUIPMENT LOOPBACK (Local Or Far End)

An equipment loopback turns receive-side data around to the transmit side at the line interface. This loopback may be activated from either the near end or the far end, either by switch or remotely. If the backplane buses in the shelf are not frequency-locked when this loopback is in effect, the transmit-side FIFO will slip periodically. Activation of the far-end equipment loopback is implemented in-band by replacing the payload data with fixed loop-up signals; de-activation is implemented by replacing the payload data with fixed loop-down signals.

A far-end equipment loopback is used to test the data transmission link. Activating a local equipment loopback is equivalent to the far-end multiplexer requesting a far-end loopback; that is, a local equipment loopback returns the receive data signal back to the far end of the circuit.

DIAGNOSTICS

TEST PATTERN GENERATOR

The RFL DS-64NC contains test pattern generators on both its transmit and receive sides, and a synchronizer on its receive side. The payload may be replaced with a test pattern for diagnostic purposes, either in a one-way end-to-end mode or in a loopback mode.

The following test patterns are provided:

1. Off (no pattern).

2. All logic ones.

3. One logic one, followed by fifteen logic zeros.

4. 2^{15}-1 pseudo-random sequence.

Also, when the RFL DS-64NC is operating in its 56-Kbps mode, the eighth bit of each byte is set to logic one; these bits are monitored on the receive side for errors, whether the data is live or test. A front-panel indicator shows when errors occur, and the errors are accumulated in a performance register. (See next page.)

The RFL DS-64NC can be set either to generate or to verify a test pattern. However, when a loopback is active and the module is set to generate a test pattern, it will simultaneously verify the same pattern.

PERFORMANCE REGISTERS

The RFL DS-64NC maintains performance registers that keep track of seven conditions and event histories:

1. Current transmit-side FIFO depth.

2. Transmit-side FIFO underrun count since last reset.

3. Transmit-side FIFO overrun count since last reset.

4. Current receive-side FIFO depth.

5. Receive-side FIFO underrun count since last reset.

6. Receive-side FIFO overrun count since last reset.

7. Receive-side bit error count since last reset.

These registers can be read and reset via the remote port on the multiplexer, using “P” codes and “S” codes with SCL (**S**imple **C**ontrol **L**anguage). Details on these codes appear on page 26 of this Instruction Data Sheet. A full description of SCL can be found in the RFL IMUX 2000 manual.

ALERTS AND ALARMS

The following conditions cause the RFL DS-64NC to report ALERT signals to the shelf Common Module:

CONFIGURATION ERROR — The user has selected a combination of data rate and starting time slot that will not permit all the data to fit into the time slots available, given the current settings for system usage (T1 or 2MB) and payload bits per time slot (56 Kbits or 64 Kbits).

I/O ERROR — An error is detected on the transmit clock output, the receive clock output, the receive data output, or handshake output pins.

In addition, the RFL DS-64NC will report ALARM signals to the shelf Common Module if any hardware or software failures are detected on the module.

REMOTE CONTROL INTERFACE

When the RFL DS-64NC is installed in an IMUX 2000 multiplexer, it can be operated under local or remote control. When under remote control, most of the module setup parameters can only be changed through the RS-232 remote port on the shelf Common Module. See the IMUX 2000 instruction manual for information on using the remote control interface.

The remote control interface for the RFL DS-64NC involves two sets of codes: "P" (parameter) codes, and "S" (status) codes. The RFL DS-64NC reports itself as a "**Type 73**" module.

"P" CODES

"P" codes, when used in the parameter field on an SCL "SET" command, allow the user to set certain parameters on the RFL DS-64NC by remote control, just like setting the DIP switches on a module under local control. "P" codes also appear in the response to a "CONFIG?" query, providing a list of the RFL DS-64NC's current parameter settings. A typical RFL DS-64NC response to a "CONFIG?" query looks like this:

*** OK**
CHANNEL CARD 3, TYPE 73
UNDER REMOTE CONTROL
SVCE = ON
P01 = 4 (B00000100)
P02 = 3 (B00000011)
P03 = 128 (B10000000)
P04 = 0 (B00000000)
P05 = 27 (B00011011)
P06 = 0 (B00000000);

There are six "P" codes for the RFL DS-64NC: "P1" through "P6". Each "P" code is displayed as a decimal number from 0 to 255, followed by its eight-bit binary equivalent in parenthesis. The binary display is more useful for both setting and interpreting most of the "P" codes, since each binary digit (0 or 1) used in "P2" through "P5" corresponds to the on or off setting of a particular DIP switch.

The binary representation is also more useful with "P6"; however, the digits of "P6" do not correspond to any switches on the RFL DS-64NC. Instead, "P6" is used to select and reset the values contained in the performance registers. This feature is only available through remote access.

"P1" represents the starting time slot selection. This is the only "P" code where the decimal number is easier to use; simply issue a command in the following form:

<*multiplexer address*>:<*module address*>**:SET:P1 = N;**

Where "N" is the decimal value of the desired time slot. This would be a number from 1 to 24 in T1-based systems, or 0 to 31 in 2MB-based systems.

NOTE

When using binary numbers with a "SET" command, they must be preceded by the letter "B", as shown in the following example:

<*multiplexer address*>**:**<*module address*>**:SET:P2 = B00000011;**

In addition to the "P" codes, it is also possible to turn service on or off for the RFL DS-64NC by sending one of the following commands in the parameter field of a "SET" command:

SRVC = ON
SRVC = OFF

Table 7 lists the meaning of the "P" codes for the RFL DS-64NC.

Table 7. Remote configuration settings ("P" Codes)

Code	Digit(s) and Switch Equivalent	Value[1]	Description
SRVC	. . .	ON	Turns service on (module enabled).
		OFF	Turns service off (module disabled).
P1	B00000000 ---↑↑↑↑↑ **TIME SLOT SELECT**	T1: 1 to 24 2MB: 0 to 31	From left to right, these five bits represent the binary value of the desired starting time slot. See page 18 for a complete list of values.
	B00000000 ↑↑↑----- 	. . .	Not used. These positions must be set to 0.
P2	B00000000 -------↑ **ARD2[3]**	0	Sets the RFL DS-64NC for use in a T1-based multiplexer (1.544 mHz bus clock)
		1	Sets the RFL DS-64NC for use in an E1(2MB-based) multiplexer (1.544 mHz bus clock)
	B00000000 ------↑- **CAS**	0	When the RFL DS-64NC is installed in a T1-based multiplexer, this is the required setting. In a 2MB-based multiplexer, this setting allows Time Slot 16 to be used for payload.
		1	Reserves Time Slot 16 for CAS multiframe signaling (2MB-based multiplexers only).
	B00000000 -----↑-- **TERM**	0	Optional setting for drop/insert multiplexers. [2]
		1	Required setting in a terminal multiplexers.
	B00000000 ----↑--- **ALT**	0	RFL DS-64NC is set to use sequential time slots.
		1	RFL DS-64NC is set to use alternating time slots.
	B00000000 ↑↑↑↑---- 	. . .	Not used. These positions must be set to 0.
P3	B00000000 ↑↑↑↑↑↑↑↑ **DATA RATE** **(least significant bits)**	. . .	Set the eight least-significant digits of the binary value for the desired data rate, divided by 2000. (From left to right, these correspond to DIP switches S4-3 through S4-10, as described in step 10 of the installation procedure)
P4	B00000000 ------↑↑ **DATA RATE** **(most significant bits)**	. . .	Set the two most-significant digits of the binary value for the desired data rate, divided by 2000. (From left to right, these correspond to DIP switches S4-1and S4-2, as described in step 10 of the installation procedure)
	B00000000 -----↑-- 	. . .	Not used. This position must be set to 0.

>> Table continues on next page <<

Table 7. Remote configuration settings (“P” Codes) - continued.

Code	Digit(s) and Switch Equivalent	Value[1]	Description
P4	B00000000 --↑↑↑--- **TEST**	000	No test.
		001	Generate all ones. [3]
		010	Generate PRNG. [3]
		011	Generate 1:15 ones. [3]
		100	No test.
		101	Verify all ones.
		110	Verify PRNG.
		111	Verify 1:15 ones.
	B00000000 ↑↑------ **LPBK**	00	No loopback-normal operation.
		01	Activates payload loopback (near end).
		10	Activates equipment loopback (near end).
		11	Activates remote loopback (equipment loopback at far end).
P5	B00000000 -------↑ **56K**	0	Sets the RFL DS-64NC to 64 Kb per time slot.
		1	Sets the RFL DS-64NC to 56 Kb per time slot.
	B00000000 ------↑- **BUFF**	0	Sets the RFL DS-64NC’s transmit and receive buffers for a starting depth of 256 bits (for synchronous operation).
		1	Sets the RFL DS-64NC’s transmit and receive buffers for a starting depth of 6000 bits (for plesiochronous operation).
	B00000000 ----↑↑-- **TX MODE**	00	Transmit side off at all times.
		01	Transmit side only operates when CTS is asserted (polling mode).
		10	Transmit side operates at all times; RTS/CTS handshake is operational.
		11	Transmit side operates at all times; CTS is forced on.
	B00000000 ---↑---- **RX ON**	0	Disables the receive side of the RFL DS-64NC.
		1	Enables the receive side of the RFL DS-64NC.
	B00000000 ↑↑↑----- 	. . .	Not used. These positions must be set to 0.

>> Table continues on next page <<

Table 7. Remote configuration settings ("P" Codes) – continued.

Code	Digit(s) and Switch Equivalent	Value[1]	Description
P6	B00000000 ---↑↑↑↑↑ **REGISTER SELECT** **(No switch equivalent)**	00000	Selects a performance register for inspection (inspection and resetting if desired) Inspection is done with a "STATUS?" query. See Table 8 on page 32 for more information.) Current receive FIFO depth.
		00001	Receive FIFO underrun count since last reset.
		00010	Receive FIFO overrun count since last reset.
		00011	Receive bit error count since last reset.
		10000	Current transmit FIFO depth.
		10001	Transmit FIFO underrun count since last reset.
		10010	Transmit FIFO overrun count since last reset.
	B00000000 --↑----- **RESET** **(No switch equivalent)**	. . .	Changing this digit from zero to one resets the currently selected performance register. On most registers, it resets the count to zero. On a FIFO depth register, it resets it to the selected starting depth. (See "REGISTER SELECT" and "BUFF" codes described above.) IMPORTANT: This digit should be changed back to zero immediately after performing a reset, so that it can be used again. The one-to-zero transition has no effect on the card.
	B00000000 ↑↑------	. . .	Not used.

1. These are the only legal values for setting the parameters. Setting any parameter to a value outside its specified range will produce an unpredictable result.

2. If the RFL DS-64NC is installed in terminal multiplexer, this bit should always be set to "1". If the RFL DS-64NC is installed in a drop/insert multiplexer, set this digit to "1" to transmit in the A direction and receive from the B direction. Set this digit to "0" to transmit in the B direction and receive from the A direction. (For guidelines on setting channel module direction, see the RFL IMUX 2000 Instruction Manual.)

3. These test modes also verify the same pattern if any loopback is active at the same time.

“S” CODES

“S” codes appear in response to a “STATUS?” query. There are four “S” codes for the RFL DS-64NC. Like the “P” code, each “S” code is a number displayed in both decimal and binary form.

A typical response to a “STATUS?” query looks like this:

*** OK**
CHANNEL CARD 3, TYPE 73
>>> **(***ALERT or ALARM message here, if there is one***)** <<<
S01 = 0 (B00000000)
S02 = 51 (B00110011)
S03 = 69 (B01000101)
S04 = 3 (B00000011);

These codes provide information on the status of several conditions on the RFL DS-64NC:

1. Presence of a **configuration error**; that is, a combination of data rate and starting time slot that will not permit all data to fit into the time slots available, given the current settings for system usage (T1 or 2MB) and bits per time slot (56K or 64K).

2. Transmit and receive side DDS **phase-locked loop (PLL) status**; if one of these PLLs is not locked, it indicates either a hardware failure or a signal failure.

3. Shelf **reference PLL status**; when not locked, this indicates either a hardware failure, or loss of Terminal Timing (in DCE operation) or Receive Timing (in DTE operation).

4. **I/O pin errors**; the RFL DS-64NC module monitors the output signals for transmit clock, receive clock, receive data, and handshaking, and reports if any of these deviates from its expected value. Which signals these represent depends on whether the module is equipped with a DCE or DTE module adapter.

5. Transmit and receive side **data activity.**

6. Presence of a **loopback** initiated by the far end.

7. Current status of the **performance registers**: receive bit error count, transmit and receive side FIFO overrun and underrun counts, and FIFO depths.

Table 8 lists the meaning of all the RFL DS-64NC module “S” codes.

Table 8. Remote status messages (“S” Codes)

Code	Digit(s)	Value	Description
S1	B00000000 _____↑↑↑	. . .	Not currently used; will always read zero.
	B00000000 ____↑___	0	No configuration error detected.
		1	Configuration error detected; module is out of service.
	B00000000 ___↑____	0	Transmit side DDS PLL locked.
		1	Transmit side DDS PLL not locked.
	B00000000 __↑_____	0	Receive side DDS PLL locked.
		1	Receive side DDS PLL not locked.
	B00000000 _↑______	0	Shelf reference PLL locked.
		1	Shelf reference PLL not locked.
	B00000000 ↑_______	. . .	Not currently used; will always read zero.
S2	B00000000 _______↑	. . .	Transmit clock output pin: Send Timing (DCE); not used in a DTE configuration.
		0	No error detected.
		1	Error detected.
	B00000000 ______↑_	. . .	Receive clock output pin: Receive Timing (DCE) or Transmit Timing (DTE).
		0	No error detected.
		1	Error detected
	B00000000 _____↑__	. . .	Receive data output pin: Receive Data (DCE) or Send Data (DTE).
		0	No error detected.
		1	Error detected
	B00000000 ____↑___	. . .	Handshake signal output pin: Clear-to-Send (DCE) or Request-to-Send (DTE).
		0	No error detected.
		1	Error detected.
	B00000000 ___↑____	0	Transmit activity detected.
		1	No transmit activity detected.
	B00000000 __↑_____	0	Receive activity detected.
		1	No receive activity detected.
	B00000000 _↑______	0	No loopback initiated from far end.
		1	Loopback initiated from far end.
	B00000000 ↑_______	. . .	Not currently used; will always read "0".

>> Table continues on next page <<

Table 8. Remote status messages ("S" Codes) - continued.

Code	Digit(s)	Value	Description
S3	B00000000 ↑↑↑↑↑↑↑↑	(1)	Performance register value. Shows the contents of the currently selected performance register. (For more information, see the section on reading the "S" code for the performance registers below.) (2)
S4	B00000000 ---↑↑↑↑↑	00000	Indicates which performance register is currently selected : Current receive FIFO depth
		00001	Receive FIFO under run count since last reset
		00010	Receive FIFO overrun count since last reset
		00011	Receive bit error count since last reset
		10000	Current transmit FIFO depth
		10001	Transmit FIFO under run count since last reset
		10010	Transmit FIFO overrun count since last reset
	B00000000 ↑↑↑-----	. . .	Not currently used; will always read zero.

1. Any eight-digit number.

2. There is a brief delay (1 - 2 ms) after issuing a "SET" command before the Common Module updates the status codes. Users with network control software should allow for this delay when issuing a "STATUS?" query after selecting a performance register.

READING THE S CODE FOR THE PERFORMANCE REGISTERS

As shown in Table 8, "S3" represents the contents of the currently selected performance register. For five of the seven registers (the over run, under run, and error counts) this is a simple counter. Either the decimal or binary representation may be useful. These counters saturate at 255; if the count goes higher, they will continue to read 255 until they are reset.

The other two performance registers show the current transmit-side and receive-side FIFO buffer depths. Each FIFO has a maximum depth of 12,000 bits. In order to derive this number, look at the binary value of "S3" and separate the digits into two four-digit binary numbers, like this:

For example, suppose "S3" reads "**B10000101**". In this case, "n" is 1000, and "f" is 0101.

Calculate the decimal value of n:

n = 1000 (binary)
= 8 (decimal)

To get a rough estimate of the FIFO depth, simply take the value 2^n. The actual depth is somewhere between the value of 2^n and the value of 2^{n+1} (See Table 9).

Table 9. Approximate FIFO Depth Calculation

Binary Value of "n"	Decimal Equivalent	FIFO Depth Range
0000	0	1 bit
0001	1	2 - 3 bits
0010	2	4 - 7 bits
0011	3	8 - 15 bits
0100	4	16 - 31 bits
0101	5	32 - 63 bits
0110	6	64 - 127 bits
0111	7	128 - 255 bits
1000	8	256 - 511 bits
1001	9	512 - 1023 bits
1010	10	1024 - 2047 bits
1011	11	2048 - 4095 bits
1100	12	4096 - 8191 bits
1101	13	8192 - 12000 bits

In this example, where "n" is 1000, Table 9 shows that the FIFO depth is somewhere between 256 bits and 511 bits. To calculate the precise FIFO depth, start with a binary number that is a "1" followed by "n" (in this case, 8) zeroes:

100000000

Substitute the four "f" digits for the four zeroes immediately to the right of the 1. In this case, "f" = 0101, so "100000000" becomes "101010000". This is the binary value of the FIFO depth in question. Binary 101010000 equals decimal 336, so the precise current depth of this buffer is 336 bits.

If “n” is less than 4, (meaning there are less than four zeroes to the right of the 1), discard extra zeroes from the right side of “f ”. For example, if “S3” reads “B00111010”, then “n” is 0011 binary (3 decimal), and “f ” is 1010. In this case, the starting binary number is a “1” followed by three zeroes:

1000

There are less than four zeroes to substitute here, so discard the rightmost digit of “f ”, leaving “101”. Replacing the three zeroes in “1000” with the three remaining digits of “f ” gives “1101”, which is equal to the decimal number 13. This means the current depth of this buffer is 13 bits.

VERIFICATION

Once the RFL DS-64NC has been configured and installed, it should be tested for proper operation before it is place into service. There are three ways you can do the testing:

1. Local testing using payload loopback.

2. Local testing using far-end equipment loopback.

3. End-to-end testing.

TEST PROCEDURE

1. For local testing, turn on the desired loopback by seting DIP switches S3-1 and S3-2.
Four different loopback modes are possible, as shown in Table 10.

Table 10. Loopback testing modes, DS-64NC Wideband Synchronous Data Module

S3-1 Setting	S-2 Setting	Loopback Mode
UP	UP	No loopback (normal operation)
UP	DOWN	Payload loopback (near end)
DOWN	UP	Equipment loopback (near end)
DOWN	DOWN	Remote loopback (equipment loopback at far end)

2. Activate the desired test pattern generator by setting DIP switches S3-3 through S3-5. Four different test pattern modes are possible, as shown in Table 11.

Table 11. Test pattern modes, DS-64NC Wideband Synchronous Data Module

S3-3 Setting	S3-4 Setting	S3-5 Setting	Test Pattern Mode
UP	UP	UP	No test
UP	UP	DOWN	Generate all ones. Will also verify the same pattern if any loopback is active at the same time.
UP	DOWN	UP	Activates 15-bit pseudo-random number generator (PRNG). Will also verify the same pattern if any loopback is active at the same time.
UP	DOWN	DOWN	Generate one "one" and 15 "zeroes" (1:15). Will also verify the same pattern if any loopback is active at the same time.
DOWN	UP	UP	No test
DOWN	UP	DOWN	Verifies all ones pattern.
DOWN	DOWN	UP	Verifies PRNG pattern.
DOWN	DOWN	DOWN	Verifies 1:15 pattern

3. If this is an end-to-end test, repeat step 2 at the other end of the circuit so that the multiplexer's RFL DS-64NC module will produce the same test pattern.

4. Make sure the NE ERR indicator (near-end error) is not flashing.

   If you are running a loopback test, check the NE ERR indicator on the DS-64NC module initiating the test. If this is an end-to-end test, check the NE ERR indicator on the receiving-end DS-64NC module.

   If no errors are observed, the test is complete. Deactivate the loopback, if one was used.

   If this was an end-to-end test, repeat the procedure in the opposite direction by reversing the data transmit and receive directions and verify the test pattern modes on the two modules.

TROUBLESHOOTING PROCEDURE

Check that the configuration is appropriate for the transmission system in use. If using end-to-end testing, verify that the transmit and receive configurations are identical. If a configuration error is found, correct it and repeat the test procedure above. If no configuration error is found, proceed as follows:

1. Activate a payload loopback on the module indicating errors.

2. Generate a test pattern on that module.

   If errors are detected (NE ERR indicator flashes), the module is faulty. Replace it with a spare.

   If no errors are detected, got o step 3.

3. Activate a far-end equipment loopback.

   If errors are not detected on the near-end module, the fault is either at the far-end module, the transmission facility, or the multiplexer common equipment.

4. Activate a payload loopback on the far-end module.

   If no errors are detected, the problem lies in the transmission facility or the multiplexer common equipment. Refer to the Troubleshooting section in your multiplexer operation manual for system analysis procedures.

DATA RATE SELECTION TABLE

Table 12 provides a complete listing of all available data rates for a DS-64NC module. Data rates not listed in the table are not valid. The table also lists the number of time slots occupied by a data signal at each rate, when the module is set up to use either 64 Kb or 56 Kb per time slot.

NOTE

THE ONLY VALID FREQUENCY SETTINGS ARE IN 8 KHZ INCREMENTS.

Table 12. Data rate selection, RFL DS-64NC Wideband Synchronous Data Module

	DIP Switch SW4 Settings										Time Slots Occupied @	Time Slots Occupied @
Data Rate	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	**64 Bits/Slot**	**56 Bits/Slot**
8 Kbps	U	U	U	U	U	U	U	D	U	U	1	1
16 Kbps	U	U	U	U	U	U	D	U	U	U	1	1
24 Kbps	U	U	U	U	U	U	D	D	U	U	1	1
32 Kbps	U	U	U	U	U	D	U	U	U	U	1	1
40 Kbps	U	U	U	U	U	D	U	D	U	U	1	1
48 Kbps	U	U	U	U	U	D	D	U	U	U	1	1
56 Kbps	U	U	U	U	U	D	D	D	U	U	1	1
64 Kbps	U	U	U	U	D	U	U	U	U	U	1	2
72 Kbps	U	U	U	U	D	U	U	D	U	U	2	2
80 Kbps	U	U	U	U	D	U	D	U	U	U	2	2
88 Kbps	U	U	U	U	D	U	D	D	U	U	2	2
96 Kbps	U	U	U	U	D	D	U	U	U	U	2	2
104 Kbps	U	U	U	U	D	D	U	D	U	U	2	2
112 Kbps	U	U	U	U	D	D	D	U	U	U	2	2
120 Kbps	U	U	U	U	D	D	D	D	U	U	2	3
128 Kbps	U	U	U	D	U	U	U	U	U	U	2	3
136 Kbps	U	U	U	D	U	U	U	D	U	U	3	3
144 Kbps	U	U	U	D	U	U	D	U	U	U	3	3
152 Kbps	U	U	U	D	U	U	D	D	U	U	3	3
160 Kbps	U	U	U	D	U	D	U	U	U	U	3	3
168 Kbps	U	U	U	D	U	D	U	D	U	U	3	3
176 Kbps	U	U	U	D	U	D	D	U	U	U	3	4
184 Kbps	U	U	U	D	U	D	D	D	U	U	3	4
192 Kbps	U	U	U	D	D	U	U	U	U	U	3	4
200 Kbps	U	U	U	D	D	U	U	D	U	U	4	4
208 Kbps	U	U	U	D	D	U	D	U	U	U	4	4
216 Kbps	U	U	U	D	D	U	D	D	U	U	4	4
224 Kbps	U	U	U	D	D	D	U	U	U	U	4	4
232 Kbps	U	U	U	D	D	D	U	D	U	U	4	5
240 Kbps	U	U	U	D	D	D	D	U	U	U	4	5

Note: U = UP, D = DOWN

<< table continues on next page >>

Table 12. Data rate selection, RFL DS-64NC Wideband Synchronous Data Module - continued.

	DIP Switch SW4 Settings										Time Slots Occupied @	Time Slots Occupied @
Data Rate	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	**64 Bits/Slot**	**56 Bits/Slot**
248 Kbps	U	U	U	D	D	D	D	D	U	U	4	5
256 Kbps	U	U	D	U	U	U	U	U	U	U	4	5
264 Kbps	U	U	D	U	U	U	U	D	U	U	5	5
272 Kbps	U	U	D	U	U	U	D	U	U	U	5	5
280 Kbps	U	U	D	U	U	U	D	D	U	U	5	5
288 Kbps	U	U	D	U	U	D	U	U	U	U	5	6
296 Kbps	U	U	D	U	U	D	U	D	U	U	5	6
304 Kbps	U	U	D	U	U	D	D	U	U	U	5	6
312 Kbps	U	U	D	U	U	D	D	D	U	U	5	6
320 Kbps	U	U	D	U	D	U	U	U	U	U	5	6
328 Kbps	U	U	D	U	D	U	U	D	U	U	6	6
336 Kbps	U	U	D	U	D	U	D	U	U	U	6	6
344 Kbps	U	U	D	U	D	U	D	D	U	U	6	7
352 Kbps	U	U	D	U	D	D	U	U	U	U	6	7
360 Kbps	U	U	D	U	D	D	U	D	U	U	6	7
368 Kbps	U	U	D	U	D	D	D	U	U	U	6	7
376 Kbps	U	U	D	U	D	D	D	D	U	U	6	7
384 Kbps	U	U	D	D	U	U	U	U	U	U	6	7
392 Kbps	U	U	D	D	U	U	U	D	U	U	7	7
400 Kbps	U	U	D	D	U	U	D	U	U	U	7	8
408 Kbps	U	U	D	D	U	U	D	D	U	U	7	8
416 Kbps	U	U	D	D	U	D	U	U	U	U	7	8
424 Kbps	U	U	D	D	U	D	U	D	U	U	7	8
432 Kbps	U	U	D	D	U	D	D	U	U	U	7	8
440 Kbps	U	U	D	D	U	D	D	D	U	U	7	8
448 Kbps	U	U	D	D	D	U	U	U	U	U	7	8
456 Kbps	U	U	D	D	D	U	U	D	U	U	8	9
464 Kbps	U	U	D	D	D	U	D	U	U	U	8	9
472 Kbps	U	U	D	D	D	U	D	D	U	U	8	9
480 Kbps	U	U	D	D	D	D	U	U	U	U	8	9

Note: U = UP, D = DOWN

<< table continues on next page >>

Table 12. Data rate selection, RFL DS-64NC Wideband Synchronous Data Module - continued.

	DIP Switch SW4 Settings										Time Slots Occupied @	Time Slots Occupied @
Data Rate	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	**64 Bits/Slot**	**56 Bits/Slot**
488 Kbps	U	U	D	D	D	D	U	D	U	U	8	9
496 Kbps	U	U	D	D	D	D	D	U	U	U	8	9
504 Kbps	U	U	D	D	D	D	D	D	U	U	8	9
512 Kbps	U	D	U	U	U	U	U	U	U	U	8	10
520 Kbps	U	D	U	U	U	U	U	D	U	U	9	10
528 Kbps	U	D	U	U	U	U	D	U	U	U	9	10
536 Kbps	U	D	U	U	U	U	D	D	U	U	9	10
544 Kbps	U	D	U	U	U	D	U	U	U	U	9	10
552 Kbps	U	D	U	U	U	D	U	D	U	U	9	10
560 Kbps	U	D	U	U	U	D	D	U	U	U	9	10
568 Kbps	U	D	U	U	U	D	D	D	U	U	9	11
576 Kbps	U	D	U	U	D	U	U	U	U	U	9	11
584 Kbps	U	D	U	U	D	U	U	D	U	U	10	11
592 Kbps	U	D	U	U	D	U	D	U	U	U	10	11
600 Kbps	U	D	U	U	D	U	D	D	U	U	10	11
608 Kbps	U	D	U	U	D	D	U	U	U	U	10	11
616 Kbps	U	D	U	U	D	D	U	D	U	U	10	11
624 Kbps	U	D	U	U	D	D	D	U	U	U	10	12
632 Kbps	U	D	U	U	D	D	D	D	U	U	10	12
640 Kbps	U	D	U	D	U	U	U	U	U	U	10	12
648 Kbps	U	D	U	D	U	U	U	D	U	U	11	12
656 Kbps	U	D	U	D	U	U	D	U	U	U	11	12
664 Kbps	U	D	U	D	U	U	D	D	U	U	11	12
672 Kbps	U	D	U	D	U	D	U	U	U	U	11	12
680 Kbps	U	D	U	D	U	D	U	D	U	U	11	13
688 Kbps	U	D	U	D	U	D	D	U	U	U	11	13
696 Kbps	U	D	U	D	U	D	D	D	U	U	11	13
704 Kbps	U	D	U	D	D	U	U	U	U	U	11	13
712 Kbps	U	D	U	D	D	U	U	D	U	U	12	13
720 Kbps	U	D	U	D	D	U	D	U	U	U	12	13

Note: U = UP, D = DOWN

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Table 12. Data rate selection, RFL DS-64NC Wideband Synchronous Data Module - continued.

	DIP Switch SW4 Settings										Time Slots Occupied @	Time Slots Occupied @
Data Rate	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	**64 Bits/Slot**	**56 Bits/Slot**
728 Kbps	U	D	U	D	D	U	D	D	U	U	12	13
736 Kbps	U	D	U	D	D	D	U	U	U	U	12	14
744 Kbps	U	D	U	D	D	D	U	D	U	U	12	14
752 Kbps	U	D	U	D	D	D	D	U	U	U	12	14
760 Kbps	U	D	U	D	D	D	D	D	U	U	12	14
768 Kbps	U	D	D	U	U	U	U	U	U	U	12	14
776 Kbps	U	D	D	U	U	U	U	D	U	U	13	14
784 Kbps	U	D	D	U	U	U	D	U	U	U	13	14
792 Kbps	U	D	D	U	U	U	D	D	U	U	13	15
800 Kbps	U	D	D	U	U	D	U	U	U	U	13	15
808 Kbps	U	D	D	U	U	D	U	D	U	U	13	15
816 Kbps	U	D	D	U	U	D	D	U	U	U	13	15
824 Kbps	U	D	D	U	U	D	D	D	U	U	13	15
832 Kbps	U	D	D	U	D	U	U	U	U	U	13	15
840 Kbps	U	D	D	U	D	U	U	D	U	U	14	15
848 Kbps	U	D	D	U	D	U	D	U	U	U	14	16
856 Kbps	U	D	D	U	D	U	D	D	U	U	14	16
864 Kbps	U	D	D	U	D	D	U	U	U	U	14	16
872 Kbps	U	D	D	U	D	D	U	D	U	U	14	16
880 Kbps	U	D	D	U	D	D	D	U	U	U	14	16
888 Kbps	U	D	D	U	D	D	D	D	U	U	14	16
896 Kbps	U	D	D	D	U	U	U	U	U	U	14	16
904 Kbps	U	D	D	D	U	U	U	D	U	U	15	17
912 Kbps	U	D	D	D	U	U	D	U	U	U	15	17
920 Kbps	U	D	D	D	U	U	D	D	U	U	15	17
928 Kbps	U	D	D	D	U	D	U	U	U	U	15	17
936 Kbps	U	D	D	D	U	D	U	D	U	U	15	17
944 Kbps	U	D	D	D	U	D	D	U	U	U	15	17
952 Kbps	U	D	D	D	U	D	D	D	U	U	15	17
960 Kbps	U	D	D	D	D	U	U	U	U	U	15	18

Note: U = UP, D = DOWN

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Table 12. Data rate selection, RFL DS-64NC Wideband Synchronous Data Module - continued.

Data Rate	DIP Switch SW4 Settings										Time Slots Occupied @ 64 Bits/Slot	Time Slots Occupied @ 56 Bits/Slot
	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10		
968 Kbps	U	D	D	D	D	U	U	D	U	U	16	18
976 Kbps	U	D	D	D	D	U	D	U	U	U	16	18
984 Kbps	U	D	D	D	D	U	D	D	U	U	16	18
992 Kbps	U	D	D	D	D	D	U	U	U	U	16	18
1000 Kbps	U	D	D	D	D	D	U	D	U	U	16	18
1008 Kbps	U	D	D	D	D	D	D	U	U	U	16	18
1016 Kbps	U	D	D	D	D	D	D	D	U	U	16	19
1024 Kbps	D	U	U	U	U	U	U	U	U	U	16	19
1032 Kbps	D	U	U	U	U	U	U	D	U	U	17	19
1040 Kbps	D	U	U	U	U	U	D	U	U	U	17	19
1048 Kbps	D	U	U	U	U	U	D	D	U	U	17	19
1056 Kbps	D	U	U	U	U	D	U	U	U	U	17	19
1064 Kbps	D	U	U	U	U	D	U	D	U	U	17	19
1072 Kbps	D	U	U	U	U	D	D	U	U	U	17	20
1080 Kbps	D	U	U	U	U	D	D	D	U	U	17	20
1088 Kbps	D	U	U	U	D	U	U	U	U	U	17	20
1096 Kbps	D	U	U	U	D	U	U	D	U	U	18	20
1104 Kbps	D	U	U	U	D	U	D	U	U	U	18	20
1112 Kbps	D	U	U	U	D	U	D	D	U	U	18	20
1120 Kbps	D	U	U	U	D	D	U	U	U	U	18	20
1128 Kbps	D	U	U	U	D	D	U	D	U	U	18	21
1136 Kbps	D	U	U	U	D	D	D	U	U	U	18	21
1144 Kbps	D	U	U	U	D	D	D	D	U	U	18	21
1152 Kbps	D	U	U	D	U	U	U	U	U	U	18	21
1160 Kbps	D	U	U	D	U	U	U	D	U	U	19	21
1168 Kbps	D	U	U	D	U	U	D	U	U	U	19	21
1176 Kbps	D	U	U	D	U	U	D	D	U	U	19	21
1184 Kbps	D	U	U	D	U	D	U	U	U	U	19	22
1192 Kbps	D	U	U	D	U	D	U	D	U	U	19	22
1200 Kbps	D	U	U	D	U	D	D	U	U	U	19	22

Note: U = UP, D = DOWN

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Table 12. Data rate selection, RFL DS-64NC Wideband Synchronous Data Module - continued.

	DIP Switch SW4 Settings										Time Slots Occupied @	Time Slots Occupied @
Data Rate	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	**64 Bits/Slot**	**56 Bits/Slot**
1208 Kbps	D	U	U	D	U	D	D	D	U	U	19	22
1216 Kbps	D	U	U	D	D	U	U	U	U	U	19	22
1224 Kbps	D	U	U	D	D	U	U	D	U	U	20	22
1232 Kbps	D	U	U	D	D	U	D	U	U	U	20	22
1240 Kbps	D	U	U	D	D	U	D	D	U	U	20	23
1248 Kbps	D	U	U	D	D	D	U	U	U	U	20	23
1256 Kbps	D	U	U	D	D	D	U	D	U	U	20	23
1264 Kbps	D	U	U	D	D	D	D	U	U	U	20	23
1272 Kbps	D	U	U	D	D	D	D	D	U	U	20	23
1280 Kbps	D	U	D	U	U	U	U	U	U	U	20	23
1288 Kbps	D	U	D	U	U	U	U	D	U	U	21	23
1296 Kbps	D	U	D	U	U	U	D	U	U	U	21	24
1304 Kbps	D	U	D	U	U	U	D	D	U	U	21	24
1312 Kbps	D	U	D	U	U	D	U	U	U	U	21	24
1320 Kbps	D	U	D	U	U	D	U	D	U	U	21	24
1328 Kbps	D	U	D	U	U	D	D	U	U	U	21	24
1336 Kbps	D	U	D	U	U	D	D	D	U	U	21	24
1344 Kbps	D	U	D	U	D	U	U	U	U	U	21	24
1352 Kbps	D	U	D	U	D	U	U	D	U	U	22	25
1360 Kbps	D	U	D	U	D	U	D	U	U	U	22	25
1368 Kbps	D	U	D	U	D	U	D	D	U	U	22	25
1376 Kbps	D	U	D	U	D	D	U	U	U	U	22	25
1384 Kbps	D	U	D	U	D	D	U	D	U	U	22	25
1392 Kbps	D	U	D	U	D	D	D	U	U	U	22	25
1400 Kbps	D	U	D	U	D	D	D	D	U	U	22	25
1408 Kbps	D	U	D	D	U	U	U	U	U	U	22	26
1416 Kbps	D	U	D	D	U	U	U	D	U	U	23	26
1424 Kbps	D	U	D	D	U	U	D	U	U	U	23	26
1432 Kbps	D	U	D	D	U	U	D	D	U	U	23	26
1440 Kbps	D	U	D	D	U	D	U	U	U	U	23	26

Note: U = UP, D = DOWN

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Table 12. Data rate selection, RFL DS-64NC Wideband Synchronous Data Module - continued.

	DIP Switch SW4 Settings										Time Slots Occupied @	Time Slots Occupied @
Data Rate	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	**64 Bits/Slot**	**56 Bits/Slot**
1448 Kbps	D	U	D	D	U	D	U	D	U	U	23	26
1456 Kbps	D	U	D	D	U	D	D	U	U	U	23	26
1464 Kbps	D	U	D	D	U	D	D	D	U	U	23	27
1472 Kbps	D	U	D	D	D	U	U	U	U	U	23	27
1480 Kbps	D	U	D	D	D	U	U	D	U	U	24	27
1488 Kbps	D	U	D	D	D	U	D	U	U	U	24	27
1496 Kbps	D	U	D	D	D	U	D	D	U	U	24	27
1504 Kbps	D	U	D	D	D	D	U	U	U	U	24	27
1512 Kbps	D	U	D	D	D	D	U	D	U	U	24	27
1520 Kbps	D	U	D	D	D	D	D	U	U	U	24	28
1528 Kbps	D	U	D	D	D	D	D	D	U	U	24	28
1536 Kbps (1)	D	D	U	U	U	U	U	U	U	U	24	28
1544 Kbps	D	D	U	U	U	U	U	D	U	U	25	28
1552 Kbps	D	D	U	U	U	U	D	U	U	U	25	28
1560 Kbps	D	D	U	U	U	U	D	D	U	U	25	28
1568 Kbps	D	D	U	U	U	D	U	U	U	U	25	28
1576 Kbps	D	D	U	U	U	D	U	D	U	U	25	29
1584 Kbps	D	D	U	U	U	D	D	U	U	U	25	29
1592 Kbps	D	D	U	U	U	D	D	D	U	U	25	29
1600 Kbps	D	D	U	U	D	U	U	U	U	U	25	29
1608 Kbps	D	D	U	U	D	U	U	D	U	U	26	29
1616 Kbps	D	D	U	U	D	U	D	U	U	U	26	29
1624 Kbps	D	D	U	U	D	U	D	D	U	U	26	29
1632 Kbps	D	D	U	U	D	D	U	U	U	U	26	30
1640 Kbps	D	D	U	U	D	D	U	D	U	U	26	30
1648 Kbps	D	D	U	U	D	D	D	U	U	U	26	30
1656 Kbps	D	D	U	U	D	D	D	D	U	U	26	30
1664 Kbps	D	D	U	D	U	U	U	U	U	U	26	30
1672 Kbps	D	D	U	D	U	U	U	D	U	U	27	30
1680 Kbps	D	D	U	D	U	U	D	U	U	U	27	30

Note: U = UP, D = DOWN

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Table 12. Data rate selection, RFL DS-64NC Wideband Synchronous Data Module - continued.

	DIP Switch SW4 Settings										Time Slots Occupied @	Time Slots Occupied @
Data Rate	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	**64 Bits/Slot**	**56 Bits/Slot**
1688 Kbps	D	D	U	D	U	U	D	D	U	U	27	31
1696 Kbps	D	D	U	D	U	D	U	U	U	U	27	31
1704 Kbps	D	D	U	D	U	D	U	D	U	U	27	31
1712 Kbps	D	D	U	D	U	D	D	U	U	U	27	31
1720 Kbps	D	D	U	D	U	D	D	D	U	U	27	31
1728 Kbps	D	D	U	D	D	U	U	U	U	U	27	31
1736 Kbps	D	D	U	D	D	U	U	D	U	U	28	31
1744 Kbps	D	D	U	D	D	U	D	U	U	U	28	32
1752 Kbps	D	D	U	D	D	U	D	D	U	U	28	32
1760 Kbps	D	D	U	D	D	D	U	U	U	U	28	32
1768 Kbps	D	D	U	D	D	D	U	D	U	U	28	32
1776 Kbps	D	D	U	D	D	D	D	U	U	U	28	32
1784 Kbps	D	D	U	D	D	D	D	D	U	U	28	32
1792 Kbps	D	D	D	U	U	U	U	U	U	U	28	32
1800 Kbps	D	D	D	U	U	U	U	D	U	U	29	. . .
1808 Kbps	D	D	D	D	U	U	D	U	U	U	29	. . .
1816 Kbps	D	D	D	D	U	U	D	D	U	U	29	. . .
1824 Kbps	D	D	D	D	U	D	U	U	U	U	29	. . .
1832 Kbps	D	D	D	D	U	D	U	D	U	U	29	. . .
1840 Kbps	D	D	D	D	U	D	D	U	U	U	29	. . .
1848 Kbps	D	D	D	D	U	D	D	D	U	U	29	. . .
1856 Kbps	D	D	D	D	D	U	U	U	U	U	29	. . .
1864 Kbps	D	D	D	D	D	U	U	D	U	U	30	. . .
1872 Kbps	D	D	D	D	D	U	D	U	U	U	30	. . .
1880 Kbps	D	D	D	D	D	U	D	D	U	U	30	. . .
1888 Kbps	D	D	D	D	D	D	U	U	U	U	30	. . .
1896 Kbps	D	D	D	D	D	D	U	D	U	U	30	. . .
1904 Kbps	D	D	D	D	D	D	D	U	U	U	30	. . .
1912 Kbps	D	D	D	D	D	D	D	D	U	U	30	. . .
1920 Kbps (2)	D	D	D	D	U	U	U	U	U	U	30	. . .

Note: U = UP, D = DOWN

<< table continues on next page >>

Table 12. Data rate selection, RFL DS-64NC Wideband Synchronous Data Module - continued.

	DIP Switch SW4 Settings										Time Slots Occupied @	Time Slots Occupied @
Data Rate	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	**64 Bits/Slot**	**56 Bits/Slot**
1928 Kbps	D	D	D	D	U	U	U	D	U	U	31	. . .
1936 Kbps	D	D	D	D	U	U	D	U	U	U	31	. . .
1944 Kbps	D	D	D	D	U	U	D	D	U	U	31	. . .
1952 Kbps	D	D	D	D	U	D	U	U	U	U	31	. . .
1960 Kbps	D	D	D	D	U	D	U	D	U	U	31	. . .
1968 Kbps	D	D	D	D	U	D	D	U	U	U	31	. . .
1976 Kbps	D	D	D	D	U	D	D	D	U	U	31	. . .
1984 Kbps (3)	D	D	D	D	D	U	U	U	U	U	31	. . .
1992 Kbps	D	D	D	D	D	U	U	D	U	U	32	. . .
2000 Kbps	D	D	D	D	D	U	D	U	U	U	32	. . .
2008 Kbps	D	D	D	D	D	U	D	D	U	U	32	. . .
2016 Kbps	D	D	D	D	D	D	U	U	U	U	32	. . .
2024 Kbps	D	D	D	D	D	D	U	D	U	U	32	. . .

NOTES:

1. This is the highest rate available when the DS-64NC module is installed in a T1 multiplexer or a T1-based variable-rate multiplexer.

2. This is the highest rate available when the DS-64NC module is installed in a 2MB multiplexer using CAS signaling.

3. This is the highest rate available when the DS-64NC module is installed in a 2MB multiplexer using CCS signaling.

4. U = UP, D = DOWN

MA-427 LAN BRIDGE MODULE ADAPTER

The MA-427 LAN Bridge module adapter provides a high performance, remote, self-learning Ethernet bridge. It is used for bridging applications or as a LAN extender or segmenter over bit stream type infrastructures for data channel modules such as the RFL DS-64NC.

FEATURES

1. High performance Ethernet bridge/extender
2. Fully compatible with IEEE 802.3
3. 10baseT LAN interface with unshielded twisted pair (UTP) RJ-45
4. Support for full and half duplex Ethernet applications
5. Transparent simplex, half duplex, or full duplex support on the WAN interface
6. WAN link rate of up to 10 Mbps sync or up to 115.2 kbps async
7. Switch-selectable filtering with 15,000 frames per second filtering and forwarding rate
8. 256 frame buffer
9. 10,000 MAC address table
10. Automatic learning and aging of MAC addresses
11. Switch-selectable enhanced compression

INSTALLATION AND OPERATION

The installation of the MA-427 is comprised of three parts: verification of switch settings, connecting the MA-427 LAN Bridge to your LAN, and verification of LAN-to-LAN operation.

Verification Of Switch Settings

Verify that the MA-427 LAN Bridge's switches are set to the defaults described in Table 13. Refer to Figure 11 to locate the switches on the board.

Table 13. MA-427 LAN Bridge SW2 Settings

Switch	Default Settings	Switch Options
COMPR (Compression)[1]	Down	Down = Compression OFF Up = Compression ON
FILTER[1]	Down	Down = Filter and forward (bridge) OFF Up = Filter and forward (bridge) ON
WMODE (WAN)	Down[2]	Down = Synchronous Up = Asynchronous
MODE 4	Down[3]	Future Application
MODE 3	Down[3]	
MODE 2	Down[3]	
MODE 1	Down[3]	
MODE 0	Up[3]	

Notes:
1. The compression and filter switch must each have the same setting as their corresponding switch on the far side of the network.
2. To insure proper operation with the DS-64NC, do not change the WMODE switch from its default setting.
3. To insure proper operation, do not change the MODE 0-4 switches from their default settings.

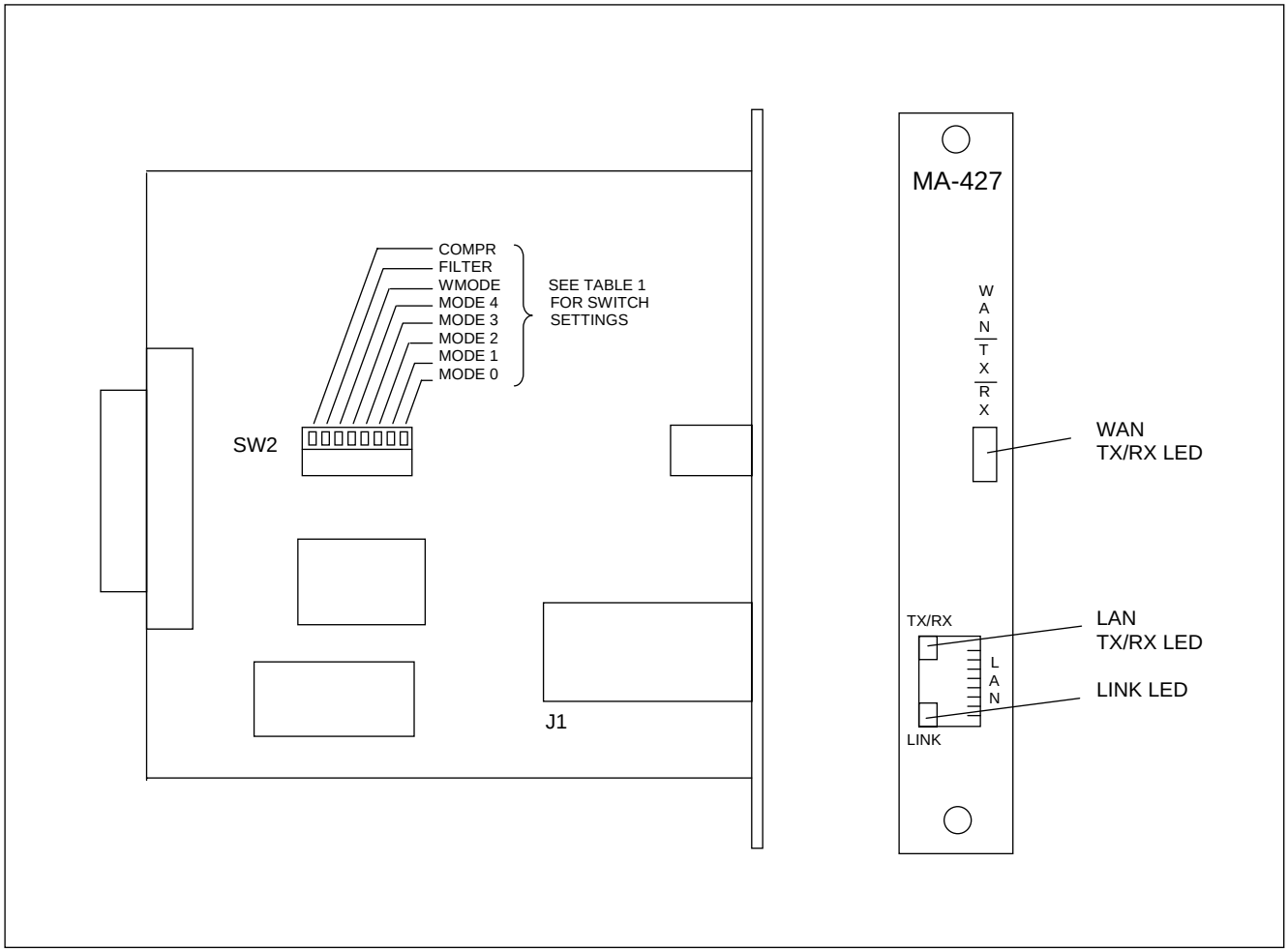

Figure 11. MA-427 LAN Bridge Module Adapter

Filtering

Over time the MA-427 LAN Bridge will automatically learn and store a table with up to 10,000 MAC addresses of devices on the WAN. When the filter is on, the MA-427 LAN Bridge will use the MAC address table to only allow frames destined for another LAN over the WAN. When the filter is off, all frames are sent over the WAN.

Connecting The MA-427 LAN Bridge To Your LAN

You should connect the MA-427 LAN Bridge to a hub or Ethernet switch using a straight-through cable such as a Black Box 10 ft. straight-through cable (P/N EVSA85-0010).

If you connect the MA-427 directly to a PC or a network interface card (NIC), the RJ-45 cable must implement a UTP crossover function, such as Black Box 10 ft. crossover cable (P/N EVCRA85-0010).

Table 14 provides information for straight-through and crossover cable pin connections. Figure 12 shows the locations of pins 1 and 8 on the RJ-45 connector and on the MA-427.

Table 14. Straight-Through and Crossover RJ-45 UTP Cable Pin Connections

Straight-Through RJ-45 UTP Cable Pin Connections			
MA-427		HUB or Ethernet switch	
Pin	Function	Pin	Function
1	TX+	1	TX+
2	TX-	2	TX-
3	RX+	3	RX+
4	Not Used	4	Not Used
5	Not Used	5	Not Used
6	RX-	6	RX-
7	Not Used	7	Not Used
8	Not Used	8	Not Used

Crossover RJ-45 UTP Cable Pin Connections			
MA-427		PC or NIC	
Pin	Function	Pin	Function
1	TX+	1	RX+
2	TX-	2	RX-
3	RX+	3	TX+
4	Not Used	4	Not Used
5	Not Used	5	Not Used
6	RX-	6	TX-
7	Not Used	7	Not Used
8	Not Used	8	Not Used

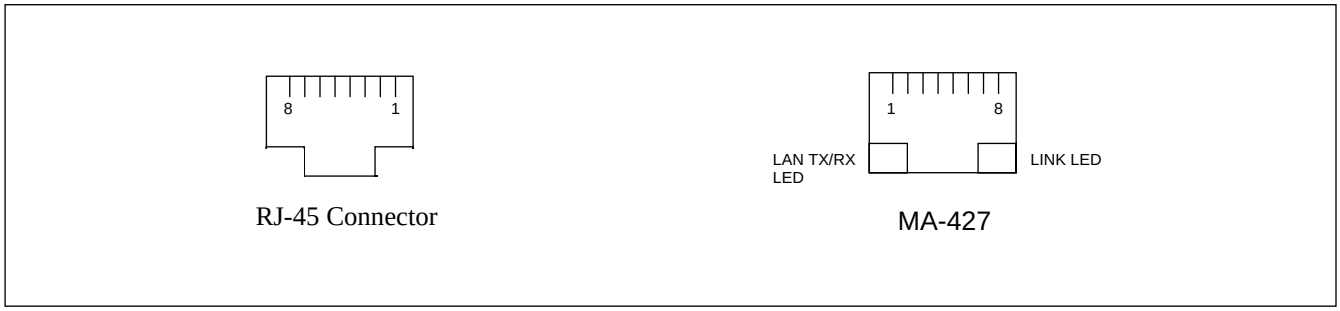

Figure 12. Pins 1 and 8 on RJ-45 connector and on MA-427 LAN Bridge

Verifying LAN-to-LAN Operation

Once you have completed the installation, verify that the MA-427 LAN Bridge is operating properly by checking LAN-to-LAN operation with your network administrator. You can also verify the operation of the MA-427 by checking its LEDs. Table 15 describes the LEDs and their state under normal operating conditions when connected to a functioning LAN.

Table 15. MA-427 LAN Bridge LEDs

LED	Color	State	Function	Normal State
WAN TX/RX	Yellow	On	Indicates transmission of data to or receiving data from the WAN	This LED will flash on and off when connected to a functioning WAN
		Off	Indicates transmission of data to or receiving data from the WAN	
LAN TX/RX	Yellow	On	Indicates no transmission of data to or receiving data from the LAN	This LED will flash on and off when connected to a functioning LAN
		Off	Indicates transmission of data to or receiving data from the LAN	
LINK	Green	On	Indicates connection to LAN	This LED should always be on when connected to a functioning LAN
		Off	Indicates no connection to LAN	

Troubleshooting

Use the table below to troubleshoot any problems you encounter during installation or operation of the MA-427 LAN Bridge.

Table 16. Troubleshooting Problems and Solutions for the MA-427 LAN Bridge

Problem	Probable Cause	Solution
LINK LED is not on	No LAN connection	Remove and reconnect the RJ-45 cable connected to the MA-427 port.
	Wrong cable for device connection	Check that the proper cable is being used. Use UTP RJ-45 for hub or Ethernet switch. Use UTP RJ-45 with crossover for PC or NIC. See Table 14 on page 49.
	Problem with LAN	See your network administrator
	T1/E1 link is not working	Contact your T1/E1 service provider
No LAN-to-LAN communication (data is not being sent or received)	No LAN connection	Verify that the LINK LED is on. If it is not, see “LINK LED is not on” above
	Incompatible switch settings	Verify that the COMPR switch settings are the same at both ends of the network. Verify that the FILTER switch settings are the same on both ends of the network. Verify that the WMODE and MODE 0-4 switches are set to their defaults. See Table 13 on page 48.
	Problem with LAN	See your network administrator
	Synchronous data link is not working	Check the operation of the DS-64NC using the DS-64NC troubleshooting procedure on page 37
WAN TX/RX LED and LAN TX/RX LED are always on	MODE 0 switch is in the DOWN position	Set the MODE 0 switch to the UP position. See Figure 11 on page 48 for the switch location.

APPLICATION NOTE

DS-64NC (ASSEMBLY NO 9547-1686 REVISION F & G) WHEN SUBJECTED TO INTERMITTENT TRAFFIC

The DS-64NC is designed to pass either continuous or burst type traffic in bi-directional and unidirectional modes. Severe T1 disruptions can affect the software running on the receive DSP such that the receive function may cease working until the DSP is rebooted. The latest version (revision F and G) of the DS-64NC will perform this reboot function automatically if it senses that traffic has been interrupted for more than 1.6 seconds. This prevents any permanent loss of traffic in the field. This rebooting operation has consequences in two different applications:

The system may be set up for unidirectional operation. As one end of this type of system never sees any traffic, the rebooting circuit would cause it to reboot approximately every 6 seconds. This is undesirable as traffic in the other direction is momentarily lost. In this configuration, the mode switches or NMS settings on the cards must be set for unidirectional use. The module that has its receiver turned off (S3-6, see item 7 in Table 2) will not reboot. The other end will reboot correctly if traffic is lost in that direction.

Some applications have traffic that, by it's nature, has gaps longer than 1.6 seconds. This is typically seen in MA-427 LAN systems providing Ethernet bridging. If a gap in traffic is long enough to cause a reboot, it is possible to lose data sent during the reboot process. The automatic resend feature of Ethernet will force the data to be resent and no traffic should be permanently lost.

During the reboot process, the LED's on the front of the module flash. This is considered normal operation.

NOTICE

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