

MODEL 2130

ELMC BRIDGE

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Table of Contents

BRIEF DESCRIPTION	1
ELMC PROTOCOL BACKGROUND	1
ELMC BRIDGE CHARACTERISTICS.....	3
LINEAR NETWORK MODE OF OPERATION.....	4
SELECTIVE BRIDGING OPERATION	8
Selective Bridging Details	8
PERFORMANCE MONITORING.....	9
POWER.....	9
INSTALLATION	10
USE AS ASYNCHRONOUS PORTS	11
USE AS SYNCHRONOUS PORTS	11
CRAFT PORT CONFIGURATION	13
MAIN MENU	13
MENU OPERATION	14
RING OPERATION.....	20
WINDOWS PROVISIONING PROGRAM	23
Main Window.....	23
PROVISIONING VIA THE WINDOWS CRAFT PORT CONNECTION	24
PROVISIONING VIA AN ELMC RS-422 PORT CONNECTION	25
MODEL 2130 ELMC BRIDGE SPECIFICATIONS	27
ELMC BRIDGE CONNECTOR PIN ASSIGNMENTS	29
ALCATEL 4000, 5606 SERIES RADIO, ASYNC ELMC CONNECTIONS, 19.2 KILOBITS.....	30
TABLE 4 CABLE FOR RADIO WIREWRAP BLOCK TO ELMC BRIDGE	30
ALCATEL 6000, 8000 SERIES RADIO ASYNC ELMC CONNECTIONS, 19.2 KILOBITS	30
TABLE 5 CABLE FOR 6000, 8000 SERIES RADIO TO ELMC BRIDGE.....	30
CHANNEL BANK RS-530 INTERFACE (USING A DB25 CONNECTOR).....	31
CHANNEL BANK RS-449 INTERFACE (USING A DB37 CONNECTOR).....	32
CHANNEL BANK V.35 INTERFACE (USING THE M34 CONNECTOR).....	34
TYPICAL DATA PORT INTERFACE	35

BRIEF DESCRIPTION

The model 2130 ELMC Bridge is a packet-data buffering and re-synchronizing device. It is used to interconnect Alcatel ELMC (Extended Link Monitoring and Control) data channels. The bridge has five ports which operate at 19.2 kilobits per second asynchronous RS-422. These ports may be connected to ELMC ports available on Alcatel 4000, 5606, 6000 and 8000 series radios. All five ports may also operate in synchronous DTE mode for connection to a synchronous channel bank card or radio overhead channel. The synchronous connection is used to interconnect bridges along a backbone radio system, where each bridge also services one or more ELMC spurs. Port five may also be operated in DCE synchronous mode, generating 64 kilobit transmit and receive clock. This feature is used to interconnect two or more bridges to yield more ports. An RS-232 serial craft interface is used to configure the unit via a TTY terminal or terminal emulation program. A Windows-based configuration program is also provided that can remotely configure the bridges.

ELMC bridges may be configured to operate in either linear or ring modes. In linear mode, ports 1 and 2 are connected to East and West bound legs respectively. In ring mode, ports 1 and 2 are connected in clockwise and counter clockwise directions respectively. A 64 kilobit synchronous path is generally used for the ring backbone. Ports 3, 4 and 5 are used for local drops (19.2 asynchronous) on the ring and also for spurs. A master ELMC bridge normally provides a break in the ring. A break anywhere else in the ring is sensed by one or more slave ELMC bridges. They then instruct the master bridge to start bridging ELMC packets across ports 1 and 2, thus healing the ring.

The ELMC Bridge may be powered by 24 or 48 volt station battery, using positive or negative ground. The ELMC Bridge is 1.75 inches high (1U) and is designed to mount in a 19 inch rack in either flush or projection mounting configurations.

ELMC PROTOCOL BACKGROUND

The Extended Link Monitoring and Control Protocol was developed for provisioning, monitoring and radio-to-radio communication in Alcatel microwave radios. ELMC information in the radio is transported as packet data. Packets are of two types: polls and responses. Poll packets consist of a header and checksum, while response packets add a data field and a data field checksum to the header.

Many Alcatel radios have an external ELMC connection operating at 19.2 kilobits asynchronous. This connection can be connected to the ELMC Bridge to interconnect linear systems or spurs into N-way junctions between radios. The ELMC Bridge also provides the means to transport ELMC data packets over a synchronous channel bank (or radio overhead channel) to other 2130 Bridges. Linear or ring topologies are used for this backbone transport. This allows ELMC protocol radios to

communicate with other ELMC capable radios across a non-ELMC network. Any port on the bridge may be connected to a radio's 19.2 kbps RS-422 asynchronous ELMC port. Any port on the bridge may be connected to a 56 or 64 kilobit synchronous channel bank card, or radio overhead channel, for backbone transport. Bridge ports will operate as low as 19.2 kilobits in synchronous mode. Such low rates are not recommended for backbones due to resulting traffic congestion.



Figure 1 Front Panel – Lamp Test and Reset Switch

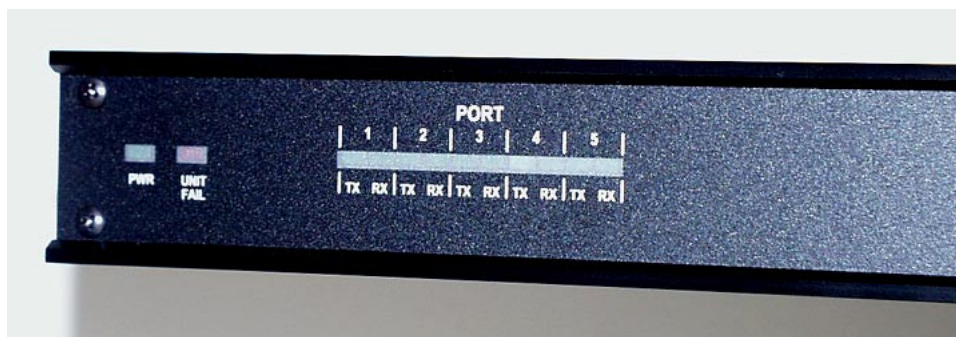


Figure 2 Front Panel - Port Activity Indicators



Figure 3 Rear Panel – Craft and ELMC port connectors

ELMC BRIDGE CHARACTERISTICS

The ELMC Bridge has five RS-422 data ports (DB-15F connectors) and one RS-232 serial craft interface (DB-9F connector). Each of the five data ports can be operated in one of the following two modes:

1. 19.2 kilobit, RS-422, Asynchronous, 8 data bits, no-parity, 1 stop bit.
2. 19.2 to 75 kilobit, RS-422, Synchronous, DTE (accepting transmit and receive clocks).

The clock inputs for each data port are continuously monitored. If **both** transmit and receive clock are absent, the port automatically switches to asynchronous 19.2 kilobit operation. If transmit and receive clock are **both** detected, the port automatically switches to synchronous DTE operation. The loss of transmit clock alone or receive clock alone will not cause a switch from synchronous mode to asynchronous mode. The detection of transmit clock alone or receive clock alone will not cause a switch from asynchronous mode to synchronous mode.

In addition, port five may be operated in DCE mode. An internal slide switch must be operated in order to select DCE mode. The front panel reset button **must** be pressed after changing this switch setting so software in the unit can turn on or turn off the clock generation circuit. In DCE mode, port five generates 64 kHz transmit and receive clocks, and swaps transmit and receive clock and data connections. In DCE mode, port five is compatible with the DTE mode on ports one through five on another bridge. Therefore, a direct flat cable connection can be made between the DCE port five of one bridge and ports one through five (DTE) of another bridge.

The craft port is used to provision the ELMC Bridge and communicates via RS-232 at 19.2 kilobits. Any TTY terminal emulation program (8 data bits, no parity, 1 stop bit, no handshake) may be used with the craft port provisioning program. The ELMC Bridge also maintains performance monitoring counts which may be viewed using the craft port.

ELMC Bridges may be configured and monitored remotely, using the provided Windows based ELMC Bridge Provisioner program. This program communicates with the bridges through any of the bridges' RS-422 ports. An RS-232 to RS-422 converter is required to connect a standard PC serial COM port to an available RS-422 port on any ELMC Bridge in the system. This remote viewing and configuration ability is subject to any Selective Bridging settings in the associated bridges. Selective Bridging is an option used to filter polls and answers on a port by port basis. Selective Bridging is explained in more detail on page 8. ELMC Bridges are configured with their 'own' ELMC address at the factory. This address may be changed in the field.

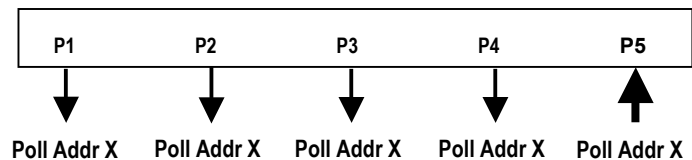
LINEAR NETWORK MODE OF OPERATION

In linear network operation, all five data I/O ports can be used to bridge ELMC packet data. Ports that are connected to channel banks (for transport of ELMC data to remote locations) are automatically configured for synchronous operation. Ports connected to ELMC pins or jacks on Alcatel MDR-4000e, MDR-5606, MDR-6000, MDR-8000 and RDI-3100 series radios are automatically configured for 19.2 kilobit asynchronous operation.

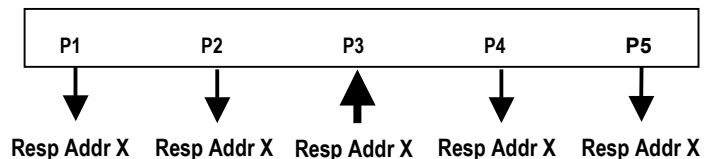
The 2130 Bridge provides three bridging modes for providing the highest possible through-put with the least amount of overhead traffic and collisions. These three bridging modes are: Hub, Switch Polls and Switch All. The ELMC Bridge is shipped in Switch All mode as the factory default.

HUB MODE: The Hub mode of operation is to 'bridge all packets'. A poll or response packet arriving at any one port will be received, buffered and retransmitted out of the other four ports.

1. Poll for address X comes in on Port 5, that poll goes out Ports 1, 2, 3 and 4.



2. Address X response comes in Port 3, that response goes out Ports 1, 2, 4, and 5.



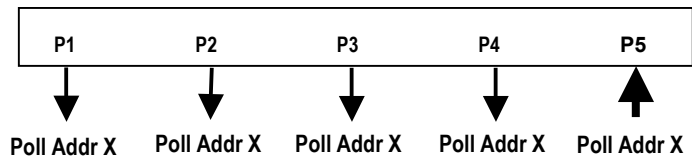
If packets are received at two ports at approximately the same time, the first arriving packet will be re-transmitted out the other ports while the second arriving packet will be buffered. The buffered packet will then be transmitted out the other ports after the first packet has finished. Each port has five receive buffers. Each port is able to hold five full 'received' (incoming poll OR response) packets in the receive buffers.

Packets are assigned an arrival sequence number, so they will begin to leave the bridge in the same order in which they arrived. Note that it is OK for a packet to begin arriving at a port during the transmission of a packet out of that same port since the 2130 Bridge operates in full duplex mode. Since ELMC asynchronous communications (19.2 kbps) are about one-third the typical speed of synchronous communications (64 kbps), complete transmission will not occur until the

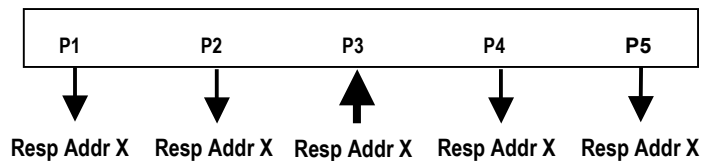
slowest port (async) has finished sending its packet. Synchronous ports generally have some idle time while the 19.2 kbps ports are transmitting the packets. Transmission of each packet begins on all outgoing ports at the same time.

SWITCH POLLS MODE: Switch Polls mode provides ‘switched bridging’ of poll packets, but not response packets. In Switch Polls mode, the bridge saves which ELMC remote addresses are associated with which 2130 Bridge data ports by using the response packet’s source address.

1. First poll for address X comes in on Port 5, the same poll goes out Ports 1, 2, 3 and 4.

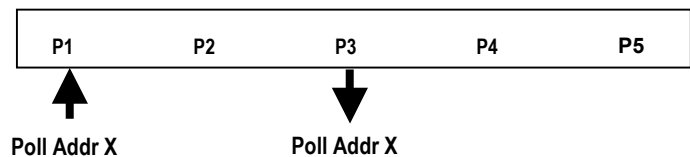


2. Address X response comes in Port 3, the same response goes out Ports 1, 2, 4 and 5.

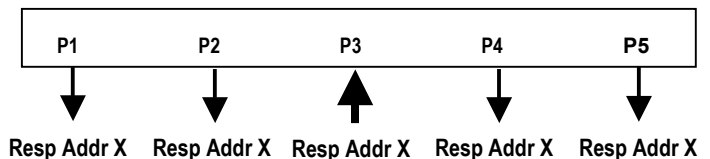


Once a response is received, any poll for that saved address will only be sent to the port from which that address has responded in the past.

3. Another poll comes in for address X, this time on Port 1, the same poll only goes out Port 3.



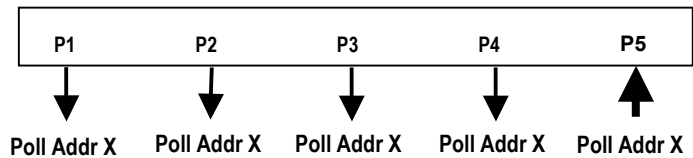
4. Address X response comes in Port 3, the same response goes out Ports 1, 2, 4 and 5.



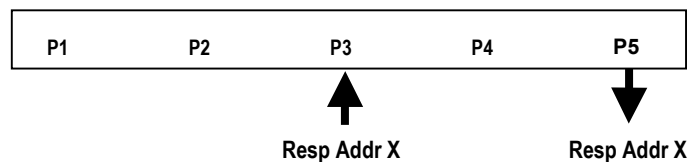
In Switch Polls mode, the response packet is always sent out of each of the other four data ports. This mode reduces the *poll* overhead traffic, but not the *response* overhead traffic.

SWITCH ALL MODE: Switch All mode provides ‘switched bridging’ of both poll and response packets. Polls are intelligently switched as in Switched Polls mode. The ELMC Bridge saves a history of the last 30 polls arriving at each port. It correlates responses with this information by matching type of poll to type of response, and poll address to response address. This correlation allows the software to build a table that contains the data ports associated with a particular poll and response pair. Each poll history entry for a port is aged and discarded after 10 seconds. If a response does not match a poll in address and poll type, then the response is sent out on the other four ports (linear mode).

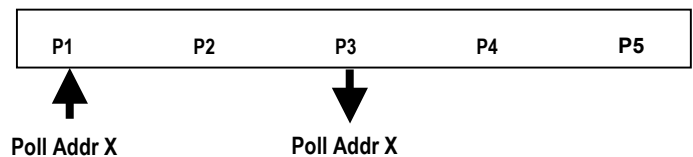
1. First poll for address X comes in on Port 5, same poll goes out Ports 1, 2, 3 and 4.



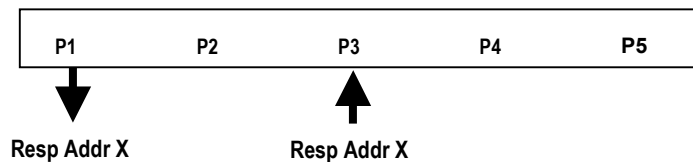
2. Address X response comes in Port 3, same response only goes out Port 5.



3. Another poll comes in for address X, this time on Port 1. The same poll only goes out Port 3.



4. Address X response comes in Port 3 less than 10 seconds later, same response only goes out Port 1.



In Switch All mode, a response to a poll is only sent to the port from which the corresponding poll originated. This reduces traffic and collisions in a large ELMC network. Only packets with valid header checksums are used to generate the routing information.

As ELMC responses arrive at the bridge, the bridge enters the ELMC remote's address and the associated data port into a table. This is called the port/address-binding table. Arriving poll packets have their destination address and poll type saved in a separate poll table. Poll table entries are kept for a maximum of 10 seconds.

An arriving poll with an address that matches the value of a port's port/address-binding table entry is only sent out that port. A poll may be sent to multiple ports if there are multiple matches, but this only happens if two or more ELMC radios are configured with the same address, or if connections have been switched between ports without resetting the unit. If there is no port/address-binding table entry match for the poll, then the poll will be sent out of all the ports except the one on which it arrived.

When a response arrives with an address/poll type matching a poll table entry, the response will be sent out the single port from which the corresponding poll arrived. The response must arrive within 10 seconds of the corresponding poll, otherwise the entry will have timed out and the response will be sent out all ports except the one on which it arrived. A response will not be sent out if it arrives on the same port as its corresponding poll.

The ELMC Bridge will erase its port/address-binding tables and rebuild new tables once every hour. This eliminates stale or incorrect entries. This one hour period begins with the last reset or power-up.

With multiple USI users, two or more polls of the same poll type for the same destination address may show up on two or more ports. The ELMC Bridge software handles this properly, passing a corresponding response on to the appropriate data ports.

NOTE: ELMC radios typically respond to a poll only in the direction from which the poll arrives. If the poll arrives from the West, then the response is sent only to the West, even though there may be additional radios connected to the East. Therefore, there is no guarantee that an ELMC Bridge will see all ELMC traffic originating in a radio spur.

BAD PACKET HANDLING: Another configuration setting allows the bridge to drop (discard) bad packets. Choosing 'drop bad packets' means that any arriving packets with bad header or data checksums are discarded after incrementing the error counters. Choosing 'send bad packets' allows a bad packet to be retransmitted, even if the header or checksum is incorrect. Packets that are too long cause Rx Buff Overflow counts, and these are always discarded. This configuration option applies to all bridging modes. Packet collisions (two radios sending packets at the same time) may occur in ELMC channels, causing bad packet checksums and packets that are too long. Most installations should use the 'drop bad packets' setting. 'Drop bad packets' is the factory default.

SELECTIVE BRIDGING OPERATION

Selective bridging allows the user to filter polls and answers for specific ELMC addresses on a port by port basis. The user is able to specify addresses for each port (up to twenty per port). If there are no addresses specified for a particular port, the port works as per the normal configuration settings (Hub, Switch Polls, or Switch All modes). If one or more addresses are specified for a particular port, then only polls for those addresses will be transmitted OUT from that port, and only answers from those addresses will be accepted IN from that port. In addition, no polls of any kind are allowed IN on such a port, and no answers are allowed OUT on such a port.

This feature allows backbone technicians to access one or more specific ELMC devices on a spur, but prevents access from the spur to any ELMC device on the backbone system. This feature also allows segmentation of the backbone ELMC paths into regions. The last radio in the region can be connected to an ELMC Bridge port that limits access to only the last radio's ELMC address.

The selective bridging feature uses five tables, one for each of the 5 ports on the ELMC Bridge. Each entry in the table is either '00000' (reserved default = empty) or a 5 character ELMC address. If the port table is completely empty, the associated port works according to the standard bridging mode setting. If there are any entries other than '00000', then selective bridging is automatically enabled for that port

Selective Bridging Details

For RECEIVED packets *into* a port:

When any packet is received at a port, if the port address table is empty, the packet is passed on to the Hub/Switch Polls/Switch All and transmission logic. If the port address table has any entries, the packet is checked to see if it is a poll or an answer. If it is a poll, it is discarded. If it is an answer, the selective bridging table is checked for a match with the packet's ELMC address. If there is a match, the packet is passed on to the Hub/Switch Polls/Switch All and transmission logic. If there is no address match, the packet is discarded.

For TRANSMITTED packets *out* a port:

When any packet is ready to be transmitted out a port (meets transmission and any Switch Polls/Switch All criteria), if the port address table is empty, the packet is passed on to the Hub/Switch Polls/Switch All and output logic. If the port address table has any entries, the packet is checked to see if it is a poll or an answer. If it is an answer, it is discarded. If it is a poll, the selective bridging table is checked for a match with the packet's ELMC address. If there is a match, the packet is passed on to the transmission logic. If there is no address match, the packet is discarded.

PERFORMANCE MONITORING

The 2130 Bridge maintains the following 16-bit counters for each data port:

- Good packets received count
- Received packets with checksum errors count (header checksum and/or data checksum)
- All receive buffers full, packets tossed count
- Internal communication errors count
- Receive buffer overflow count (packet was too long)
- Good packets transmitted count
- Transmit packet underflow count
- Ring Fault count

The port information displayed also includes the type of clocking (Asynchronous or Synchronous) associated with each port number.

The counter values for each port are available for viewing from the craft interface terminal program. Counter values may also be fetched from remote ELMC Bridges for viewing via an RS-422 port connection. Counter values may be cleared manually and are cleared when the unit is restarted.

The 2130 Bridge also keeps a table of the ELMC response addresses for each port. This information is available for viewing only from the craft interface terminal program.

POWER

Power for the ELMC Bridge is via 24 or 48 volt station battery. The power input is isolated so that the bridge may be used with positive ground or negative ground stations. An external strap connects the proper polarity terminal to chassis ground. See the following installation section for information on the proper connection of the power leads and ground strap.

INSTALLATION

Install this unit in either 24 or 48 volt positive ground or negative ground stations. The factory default is for **positive** ground operation. Power is connected to a 2-terminal barrier strip at the rear of the unit, see Figure 4 and Figure 5 below.



Figure 4. POSITIVE GROUND SYSTEM

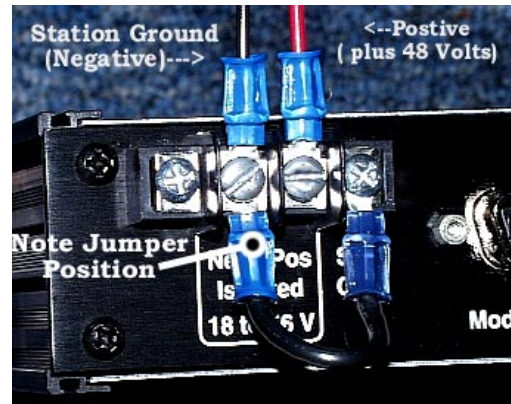


Figure 5. NEGATIVE GROUND SYSTEM

There is an external chassis ground wire (jumper) that must be connected to the station ground terminal at the power input connector. For **positive** ground systems (factory default), the jumper should connect between the chassis (far right mounting screw) and the positive power input terminal, see Figure 4 above. For **negative** ground systems, the jumper should connect between the chassis (far right mounting screw) and the negative power input terminal, see Figure 5 above.

NOTE: This chassis ground jumper is required for proper operation. It insures that the unit's electrical (chassis) ground is connected to the station ground. Do not remove the strap.

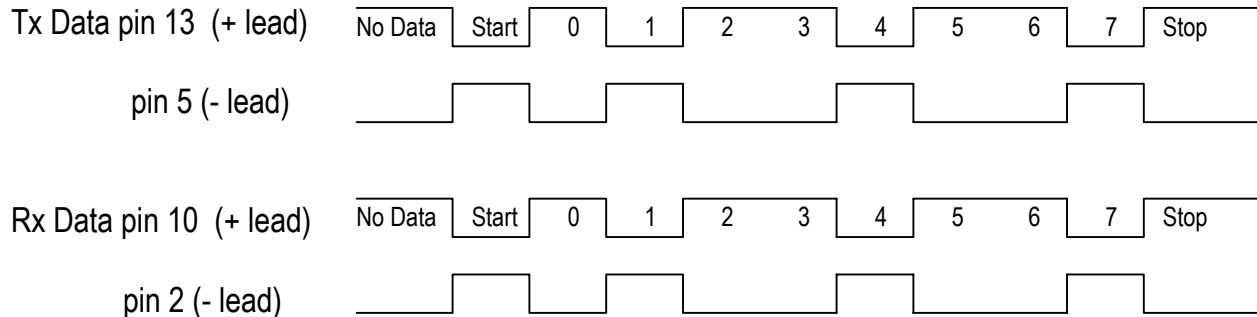
The ELMC bridge is internally protected against reverse polarity power input.

CAUTION:

If the chassis ground jumper is connected incorrectly there will be a short across the station battery! Verify the polarity of your station power before connecting the jumper.

USE AS ASYNCHRONOUS PORTS

All data ports operate at 19,200 bps when used for asynchronous ELMC communications. Two RS-422 differential pairs are used on each connector. The transmit data pair is pin 13 (+ lead) and pin 5 (- lead). The receive data pair is pin 10 (+ lead) and pin 2 (- lead). Asynchronous data timing is diagrammed below.



USE AS SYNCHRONOUS PORTS

All data ports used for synchronous I/O generally operate in DTE (accepting clock from other units) mode. Port five is a special port which can operate in either standard DTE mode (accepting clock from other units) or DCE mode (providing clock to other units). DTE mode is the factory default. DCE mode is used when daisy-chaining two or more bridges together to provide more data ports. In DCE mode a 64 kilohertz transmit and receive clock is generated, and the transmit and receive data pins are internally interchanged. This allows a direct connection between port 5 DCE and another bridge using ports 1,2,3 or 4 DTE.

NOTE: To use port five in synchronous DCE mode, the unit's cover must be removed and an internal slide switch (S1) set manually, see Figure 6. This switch may be set to the DCE position to turn the transmit and receive clock on and to reassign the transmit and receive lines for DCE operation. After changing this switch, you **must** press the front panel reset button, or power down and power up the unit.

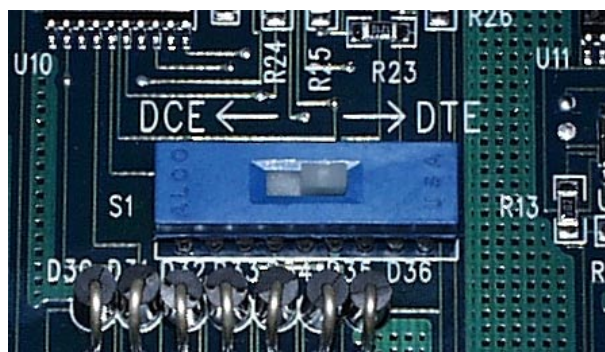
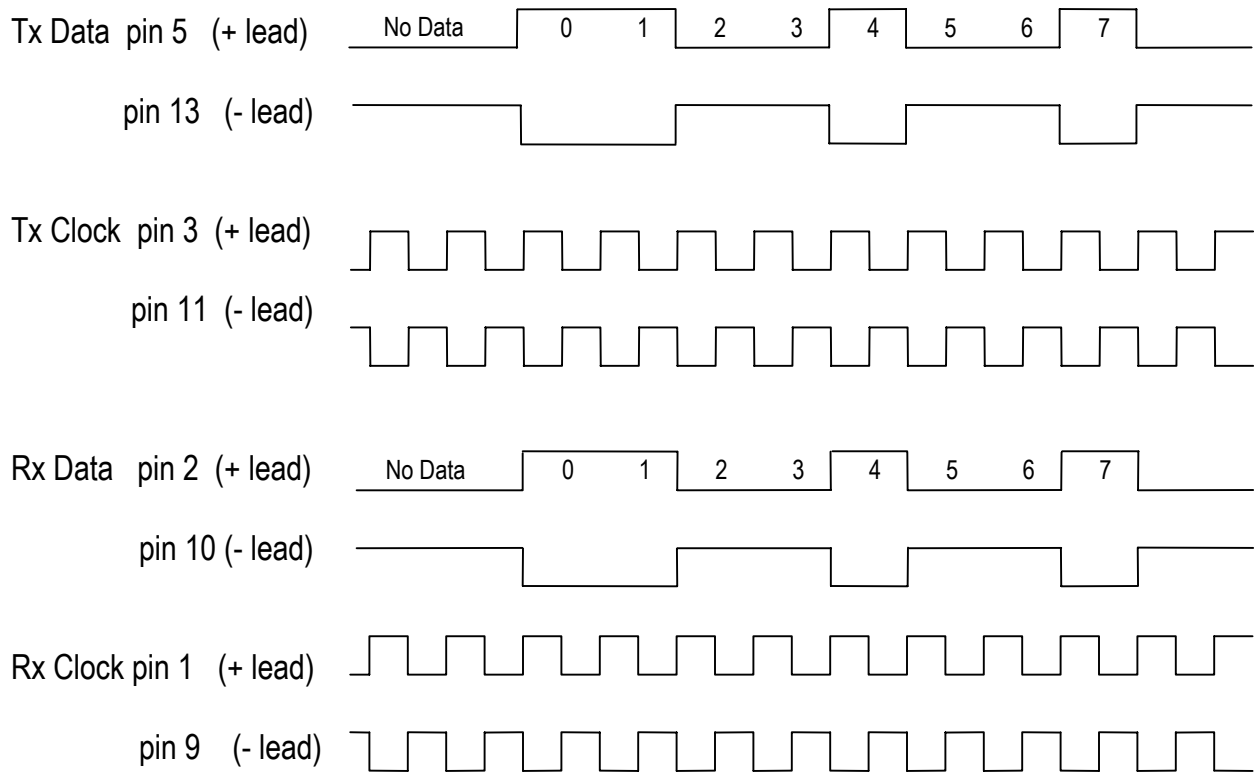


Figure 6. DCE VS. DTE SELECTOR SWITCH

DTE synchronous data flow is diagramed below.



CRAFT INTERFACE:

The craft interface is typically used for a temporary connection to a PC serial COM port in order to configure the unit. A TTY terminal emulation program (e.g. HyperTerminal) is all that is necessary to configure the ELMC Bridge. A simple text based display provides the user interface for all configuration options. A Windows configuration program is also provided (see page 23).

A single DB-9 female connector is used for the craft interface. The pin assignments permit a direct connection to a 9-pin PC serial COM port. A straight-through connected cable with all nine wires will work, however only three wires are required (pins 2, 3, and 5). The cable will require a male DB-9 at the 2130 end and (usually) a female DB-9 at the computer end. The pin assignments are detailed in the table on page 29.

CRAFT PORT CONFIGURATION

The following is a sample configuration menu for the ELMC Bridge using the rear panel craft port, at 19,200 baud, 8-data bits, 1 stop bit, no parity and no handshaking. The connection is straight through from the 2130 to a PC or laptop COM port.

Main Menu

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DTE ports check for TX and RX clock after reset. Ports use
SYNCHRONOUS operation if 64 kilobit clocks are present.
Otherwise, ports switch to RS-422 ASYNCHRONOUS at 19.2 kilobits

- 1) Specify an ELMC address for this bridge. (now TEST1)
- 2) Set bridge to send or drop bad packets. (now Drop)
- 3) Set bridging options. (now Switch All)
- 4) Show Port Statistics.
- 5) Show ELMC addresses detected on each port.
- 6) Clear all port Statistics and ELMC address tables.
- 7) Select linear or ring operation. (now linear)
- 8) Selective bridging tables.
- S) Save changes and reboot.

Enter a number:

When the connection is made properly and a communications program such as Procomm or HyperTerminal is used, the above menu will appear each time the Enter key is pressed.

If the menu does not appear, be sure you have set handshaking to NONE. If double characters appear when you type, be sure the terminal emulation program has the Echo Typed Characters Locally option disabled.

MENU OPERATION

1) Specify an ELMC address for this bridge

```
Specify an ELMC address for this bridge
```

```
-----  
5 characters only, no control characters allowed
```

```
Enter new 5-character ELMC address:
```

Use this menu option to specify the five character address for this bridge. The address is case sensitive, therefore ABC1X is a different address from abc1x. Only alphanumeric characters are allowed (no control characters). You must enter all five characters. The factory default address is entered as 'FN_{NNN}', where 'NNNN' is the last four digits of the unit serial number. For example: If the 2130 Bridge serial number is 0134012, then the factory address would be set to F4012. The user is free to change the bridge address if it conflicts with existing ELMC addresses. Using the factory default address ensures that no two ELMC Bridges have the same address. It also makes it easier to find the address of a remote bridge from purchasing/shipping information.

The ELMC address of a bridge allows remote provisioning of the bridge and remote viewing of bridge performance data.

NOTE: ELMC addresses are case sensitive. For example: Entering an address of "f4012", instead of "F4012", specifies a completely different ELMC Bridge or ELMC radio. Only characters **A** through **Z**, lowercase **a** through **z** and numerals **0** through **9** should be used.

2) Set bridge to send or drop bad packets

```
Set bridge to send or drop bad packets
```

```
-----  
1) Drop bad packets
```

```
2) Send bad packets
```

```
Enter 1 or 2:
```

Use this menu option to specify ignoring (discarding) or sending bad packets. If this option is set to 1 (Drop bad packets) then arriving bad packets will be discarded. Bad packets are those with an invalid header or data checksum.

If this option is set to 2 (Send bad packets) then errored packets will be retransmitted out one or

more ports, depending on the bridging options below. This is true even if the packet has invalid header or data checksums, has an invalid poll type or is an incomplete fragment. However, an overly long packet that overruns an input buffer (158 characters) will be discarded.

3) Set Hub mode, Switch Polls, Switch All bridging options

Set Hub mode, Switch Polls, Switch All bridging options

- 1) Bridge ALL arriving packets to all ports (Hub mode)
- 2) Bridge polls to single destination port, bridge responses to all ports (Switch Polls)
- 3) Bridge polls to single destination port, bridge responses to port(s) from which corresponding polls arrived recently (Switch All).

Enter 1 or 2 or 3:

Select the type of bridging you want to use.

Hub mode causes any packet (poll or response) arriving at one port to be sent out the other four ports. This mode may be used in small networks with few USI Program users. Only Hub mode can be used with ELMC ring configurations. If either Switch Polls or Switch All modes were selected and you change the configuration from linear to ring modes, the program automatically changes the bridging to Hub mode.

Switch Polls mode directs ELMC poll packets to a specific port, if the destination address is known to reside on that port. However, response packets are always passed through to all other ports. The bridge 'remembers' which destination addresses are on which port. This information is kept in a table for each port. The tables may be viewed with the 5th menu option. This mode lowers the poll packet traffic on the network. This mode is not available for ring operation.

Switch All mode provides the most efficient passing of both poll and response packets through large networks. In Switch All mode, the ELMC Bridge keeps track of the destination address as in 'Switch Polls', and sends polls only to the known destination port. In addition, the bridge keeps track of the latest 30 polls arriving on each port (i.e. 150 most recent polls), and sends responses only to the port on which the corresponding poll arrived. The matching routine correlates responses with polls using both the packet 'type' and the ELMC address. Polls and answers for specific addresses are then passed only to the proper port. This type of switching reduces or eliminates unnecessary traffic and packet collisions. This mode is recommended for large linear networks. This mode is not available for ring operation.

4) Show Port Statistics

```
Show Port Statistics
```

```
-----  
ELMC packet counts, cleared on reset, power-up, or manually.
```

Port #	Clock- ing	RX Pkts Good	RX Bad Cksum	Buff Full Tossed	Int Com Error	RX Buff Overflow
1	ASYNC	0	0	0	0	0
2	ASYNC	0	0	0	0	0
3	ASYNC	2	0	0	0	0
4	ASYNC	2	0	0	0	0
5	SYNC	0	0	0	0	0

Port #	Clock- ing	TX Pkts Good	TX Pkts Underflow	Ring Fault
1	ASYNC	1	0	0
2	ASYNC	1	0	0
3	ASYNC	2	0	0
4	ASYNC	2	0	0
5	SYNC	1	0	0

```
Press any key to continue
```

Use this menu option to view the performance monitoring counts for this bridge. The display is broken-up into two parts, with the receive section on top and the transmit section on the bottom. Each section shows the port number, type of connection (asynchronous vs. synchronous) and various performance and error counts.

The number of good packets received (*RX Pkts Good*), and the number of receive packets with bad checksums (*RX Bad Cksum*), are both displayed. There are five receive buffers for each port. If those five buffers are all full and another packet arrives, then that sixth packet is tossed and the *Buff Full Tossed* count is incremented. If an arriving packet exceeds the receive buffer size (158 characters), then the *RX Buff Overflow* count is incremented. The *Int Com Error* count is a diagnostic aid for certain internal hardware/software errors, such as a port processor resetting because of a watchdog timeout.

The number of good packets transmitted for each port is displayed in the lower section (*TX Pkts Good*). 'TX Pkts Underflow' counts incorrectly transmitted packets. This may be due to a transmit clock that disappears in the middle of transmitting a packet (external error), or data arriving too fast or too slow in the serial transmit circuits (internal software or hardware error).

Lost of transmit and receive clocks for over 1 millisecond causes an automatic switch to

Each ELMC address is exactly five alphanumeric characters long. ELMC addresses are case sensitive! Use option number six to manually force a clear of the detected addresses table. This table clears automatically once per hour. However performance counts are only cleared manually or upon reset.

6) Clear all port Statistics and ELMC address tables

Use this menu option to manually force all performance monitoring counts and detected ELMC addresses back to zero. The detected ELMC addresses are automatically cleared with menu item 6, or upon reset, power-up or once every hour. The performance counts are cleared with menu item 6, or upon reset or power-up. Performance counts are not cleared every hour.

7) Select linear or ring operation

```
Select linear or ring operation
```

- ```

1) Linear operation using ports 1,2,3,4,5
2) Ring operation as master, port 1 for CW, port 2
 for CCW, ports 3,4,5 for local drops
3) Ring operation as slave, port 1 for CW, port 2
 for CCW, ports 3,4,5 for local drops
```

```
Enter 1 or 2 or 3:
```

For linear systems, type a 1 then press the Enter key. For ring systems, type a 2 if the unit is to be the ring-master, or type a 3 if the unit is to be one of the ring slaves. There can only be one ring-master in an ELMC ring. See the following Ring Operation section for more detail.

For linear systems, it does not matter which ports are used for the backbone connection and which ports are used for drops to ELMC spurs. However using ports 1 and 2 for the backbone connection is recommended, because later conversion to an ELMC ring configuration is possible without changing connections. For linear systems, it is recommended that port 1 be connected Westbound, and port 2 be connected Eastbound.

## 8) Selective bridging tables

### Selective bridging tables

```

Port 1 Port 2 Port 3 Port 4 Port 5

00000 00000 00000 00000 TEST0 TEST1 00000 00000 00000 00000
00000 00000 00000 00000 TEST2 00000 00000 00000 00000 00000
00000 00000 00000 00000 00000 00000 00000 00000 00000 00000
00000 00000 00000 00000 00000 00000 00000 00000 00000 00000
00000 00000 00000 00000 00000 00000 00000 00000 00000 00000
00000 00000 00000 00000 00000 00000 00000 00000 00000 00000
00000 00000 00000 00000 00000 00000 00000 00000 00000 00000
00000 00000 00000 00000 00000 00000 00000 00000 00000 00000
00000 00000 00000 00000 00000 00000 00000 00000 00000 00000
00000 00000 00000 00000 00000 00000 00000 00000 00000 00000
00000 00000 00000 00000 00000 00000 00000 00000 00000 00000
```

Enter a port number or any other key to continue

Select this menu option to add or remove specific filter addresses for each of the five ports. If you enter a number from 1 to 5, you get another prompt line for you to enter the desired 5 character ELMC address. If the address is not yet assigned to the port, it will be. If the address is already assigned to the port, it will be removed. Each port table can hold up to twenty ELMC addresses.

### S) Save the changes and reboot.

Select this menu item to save the current configuration settings and reboot the bridge. Any menu changes will be lost if you cycle the power or perform a manual reset before selecting this option. The unit takes about 8 seconds to complete the configuration update, reset and resume operation.

## **RING OPERATION**

For ring systems, Ports **1** and **2** **MUST** be used for the ring transport. Ports 3,4 and 5 are connected to local ELMC equipment on the ring and to ELMC radio spurs.

When operating in ring mode, the bridge shows an additional line near the top of the main menu screen. The line shows one of two states for the master, and one of three states for a slave. This line displays '**Bridge State: M\_Term**' for a ring-master with a normally function ring. For ring-slaves, the line normally displays '**Bridge State: S\_Bridge**'.

- M\_Term**      The normal state for ring-master, acting as terminal, no bridging on ports 1:2.
- M\_Bridge**      Ring-master received one or more S\_Fault pings from a slave or slaves, and is providing bridging between ports 1:2. Master will not go back to M\_Term state until it sees S\_Term pings from a slave.
- S\_Bridge**      The normal state for all ring slave bridges, bridging between ports 1:2. A slave sends no pings in this mode. The slave only listens for the 'Term' pings from the master (or other slaves).
- S\_Fault**      This ring-slave has detected a break or 'fault' [no pings on a port], the slave stops bridging ports 1:2, watches and waits for pings to arrive again on the faulted port.
- S\_Term**      The ring-slave is again receiving pings on the faulted port, and now sends Term messages to let the master know things are OK. It is still providing a break on the faulted port, so only pings are sent and received on the faulted port. It is now waiting to see Term pings from the master (the master has stopped bridging), which will switch the slave to (normal) Bridge mode.

The following main menu example is for an ELMC Bridge configured as a Ring Master with an unbroken ring:

```
ELMC Bridge model 2130 Rev 1.2m FIAL Incorporated Copyright (c) 2001
```

```

 Bridge State: M_term
```

```
DTE ports check for TX and RX clock after reset. Ports use
SYNCHRONOUS operation if 64 kilobit clocks are present.
Otherwise, ports switch to RS-422 ASYNCHRONOUS at 19.2 kilobits
```

- 1) Specify an ELMC address for this bridge. (now TEST1)
- 2) Set bridge to send or drop bad packets. (now Drop)
- 3) Set bridging options. (now Hub mode)
- 4) Show Port Statistics.
- 5) Show ELMC addresses detected on each port.
- 6) Clear all port Statistics and ELMC address tables.
- 7) Select linear or ring operation. (now ring master)
- 8) Selective bridging tables.
- S) Save changes and reboot.

```
Enter a number:
```

## **Recommended procedure to change from linear operation to ring.**

Pre-configure the linear system so that the ELMC bridges interconnect to each other using ports 1 and 2. Leave the endpoints (terminals) of the linear system disconnected. The convention is for port 1 on each bridge to be connected to the West (which will be called clockwise - CW), and port 2 on each bridge to be connected to the East (which will be called counter-clockwise - CCW). The bridge at the West end will become the ring-master, currently its Port 1 is unused.

Configure the bridge at the West end of the linear system as a ring-master. Its port 1 is still unused at this point (i.e. disconnected) and its port 2 is connected to the rest of the linear system.

Now interconnect the ends of the linear system to make a ring, i.e. connect the ring-master's port 1 to port 2 of the bridge at the East end of the linear system. At this point the system is a ring, however the ring-master is providing the break, and the other bridges are in linear mode.

Configure each bridge past the ring-master in the Eastward direction (CCW) as a ring-slave. This may be accomplished remotely with the Windows configuration program, a PC Com port, and an RS-232 to RS-422 converter. Using the remote configuration program, all changes take place immediately and are saved automatically, therefore the ELMC ring is never dropped. If you make these changes with the craft interface, you must manually save the changes with menu item eight.



Saving changes with the craft interface causes the bridge to restart, dropping any traffic through the bridge for 8 seconds. When all bridges except the ring-master have been configured as ring-slaves, the system is operating in ring mode.

### **Recommended procedure to change from ring operation to linear.**

Make sure there are initially no breaks in the ring. The craft interface of the ring master should show **Bridge State: M\_Term** on the craft interface main menu screen.

Change each ring-slave bridge from ring-slave mode to linear mode. The linear bridges will continue to bridge packets between their ports 1 and 2. This may be accomplished remotely with the Windows configuration program, a PC Com port, and an RS-232 to RS-422 converter. Such configuration changes take place immediately and are saved automatically. This may also be accomplished using the serial craft port. In that case, changes must be saved manually using menu item eight. Saving changes via the craft port causes the bridge to restart, dropping any traffic through the bridge for 8 seconds.

Disconnect the ring-master's port 1 connection ( important! ), physically breaking the ring

Change the ring-master's mode back to a linear bridge. Be sure to leave the ring physically broken, or packets will start to circulate endlessly.

## WINDOWS PROVISIONING PROGRAM

A Windows provisioning program for PCs allows you to change basic configuration options and view the performance monitoring statistics. The Windows program can be operated in two ways:

- 1) Connection from PC COM port to ELMC Bridge craft port. Allows provisioning of only the locally connected ELMC Bridge.
- 2) Connection from PC COM port via RS-232/RS422 adapter to RS-422 ports one through five on the ELMC Bridge. Allows provisioning and monitoring of the local Bridge or of remote ELMC Bridges. By connecting to one of five RS-422 ports on the local ELMC Bridge and entering the unique ELMC address of the remote 2130, you can fetch the remote bridge's configuration information and statistics and send new configuration data to the remote ELMC Bridge. This functions in either asynchronous or synchronous modes of operation.

### Main Window

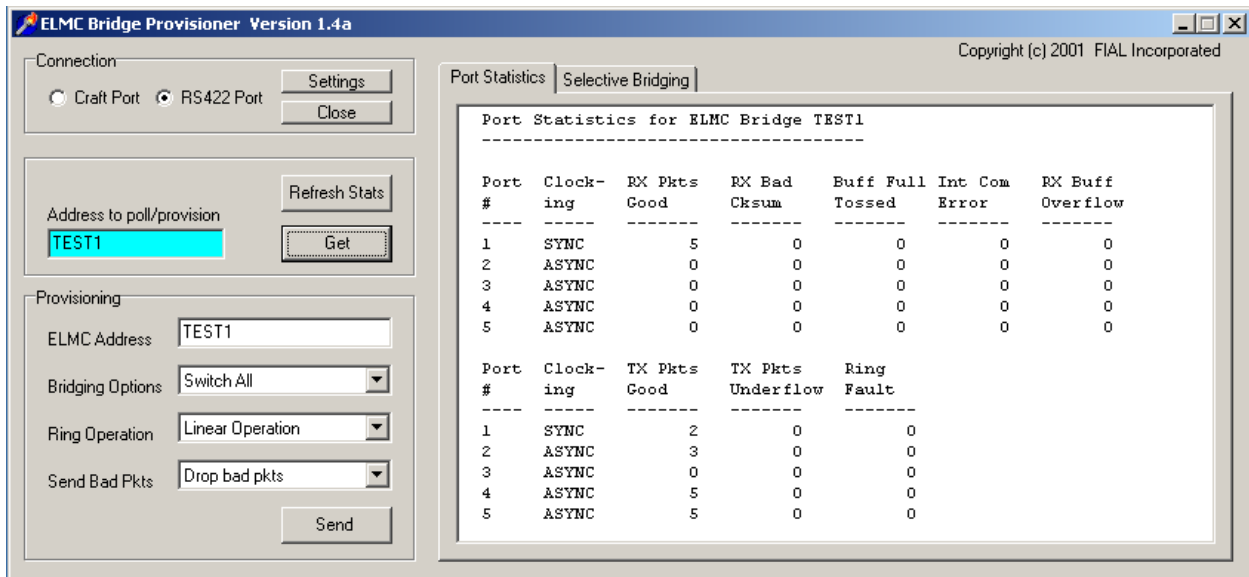
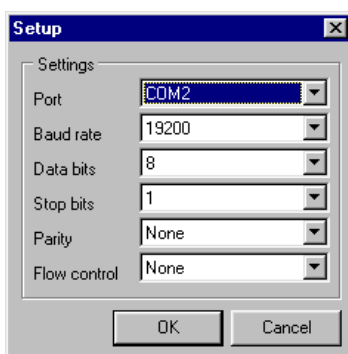


Figure 7. WINDOWS PROVISIONING DIALOG

The ELMC Bridge Provisioning program window is divided into four sections: *Connection*, *Address to Poll/Provision*, *Provisioning*, and *Port Statistics/Selective Bridging*. Use the Connection section to first specify the type of electrical interface used to connect from your PC to the ELMC Bridge. Select either the Craft Port or the RS-422 Port option. The Craft Port choice is used to provision a local bridge using an RS-232 connection between the PC and the bridge craft port. The RS-422

Port connection is for any of the five 15-pin D-sub connectors on the rear panel and must be used with an external RS-232 to RS-422 converter. The RS-422 Port connections may be used for accessing the local bridge or any remote ELMC Bridge.

For either type selected, you must specify the PC's COM port in the Settings dialog. Click the Settings button to open this dialog window and select the appropriate COM port number. You should leave the other settings at the factory defaults (19,200 bps, 8 data bits, 1 stop bit, no parity, no flow control). If you change these, the connection will not work. Both the craft port and RS-422 port connections use the same baud rate, data bits, stop bits, parity and flow control parameters.



**Figure 8. COM PORT SETTINGS DIALOG**

### **PROVISIONING VIA THE WINDOWS CRAFT PORT CONNECTION**

To provision the ELMC Bridge using the Craft Port interface, click the Craft Port radio button. Next, click the Settings button and make sure the proper COM port number is selected. Remember that the address is case sensitive. Click the **Get** button (in the *Address to Poll/Provision* section) to retrieve the current configuration data from the ELMC Bridge connected to your PC.

#### **CAUTION:**

It is up to you to make sure you do not create duplicate ELMC addresses, either for other 2130 ELMC Bridges or any ELMC enabled radios on the network. Creating duplicate ELMC addresses may cause serious network problems.

If you wish to change the ELMC address, just overwrite the current entry in the *Provisioning* section. If you wish to change the Bridging Options or Send Bad Packets settings, you must

choose from the selections in the drop-down lists. Click the **Send** button to transfer and save the new parameters to the ELMC Bridge.

Port Statistics are only available when using the RS-422 provisioning connection, or the TTY (HyperTerminal) serial craft port connection. The Refresh Stats button is disabled if the Windows Craft Port connection is selected. The *Address to Poll/Provision* entry field also only applies to the RS-422 provisioning connection and is disabled for Craft Port provisioning. The Port Statistics section displays the same data as displayed by the Craft Port *Show Port Statistics* menu option (see page 16).

## PROVISIONING VIA AN ELMC RS-422 PORT CONNECTION

To provision the 2130 using an RS-422 Port interface, click the RS-422 Port radio button. As in the Craft Port connection above, click the Settings button and make sure the proper COM port number is selected. You will need a converter between RS-232 and RS-422, unless you have a COM port with a special RS-422 interface. The pin connections are shown on page 29.

Next, enter the target ELMC Bridge address in the *Address to Poll/Provision* entry field. ELMC addresses are case sensitive. The address *RAK59* is different from the address *rak59*. You may specify the address of the ELMC Bridge to which you are connected, or the address of any ELMC Bridge in the network.

Click the **Get** button to retrieve the current configuration data from the target 2130. If the target 2130 is accessible and responds, its current configuration data will be displayed in the appropriate fields in the Provisioning section. If the target 2130 address does not respond within 10 seconds, an information dialog window pops up notifying you that there was no response.

Make any desired changes to the ELMC address, Bridging Options, Ring Operation or Send Bad Packets settings. Click the **Send** button to download and save the new parameters to the target ELMC Bridge. Caution: If you change the address, then you next must change the contents of the *Address to Poll/Provision* entry field to the new address if you wish to continue working with the same unit. Save new addresses carefully. If you forget the address of a unit, someone must visit the unit to learn its address.

Click the **Refresh Stats** button to retrieve a snapshot of the current performance monitoring statistics from the target ELMC Bridge. The performance counts will be displayed in the **Port Statistics** tabbed section. Clicking the Refresh Stats button again will retrieve any updated counts. Note that the TX and RX Pkts Good counts will increase each time you click the Refresh Stats button, even if there is no other ELMC network activity. This happens because the performance statistics requests and responses are transported as ELMC packets and counted as

such by the target ELMC Bridge.

Click on the **Selective Bridging** tab to view or edit the selective bridging address tables for the specified ELMC bridge. Select the port to view from the *Get table for port* drop down list, then press the **Get** button. The entries for the selected table will be displayed to the right.

To add or delete an entry, select the desired port from the *Add/Remove address to port* drop down list, enter the ELMC address in the *Address to add/remove in Selective Bridging table* edit box, then press the **Send** button. You should see the old address removed, or the new address added, from the appropriate port in the display on the right side of the window.

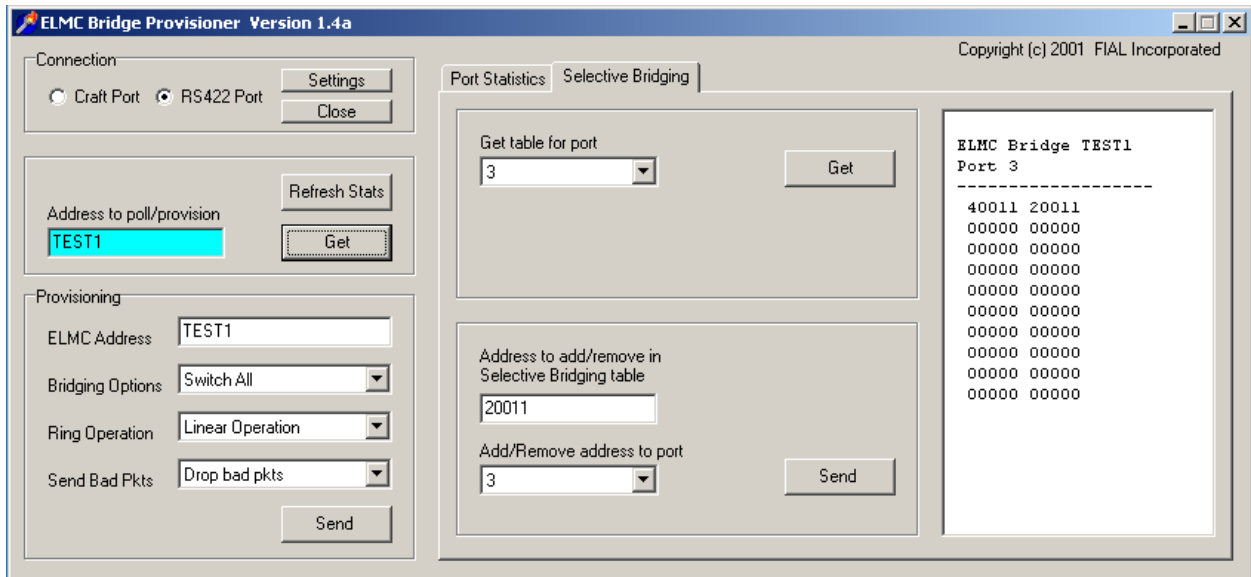


Figure 9. SELECTIVE BRIDGING DIALOG

## MODEL 2130 ELMC BRIDGE SPECIFICATIONS

### PHYSICAL

Height: 1 and 23/32 in. (1U)

Width: 19 in.

Depth: 11 in.

Weight: 5.5 lbs.

### POWER REQUIREMENTS

Supply Voltage: 18 volts to 56 volts, positive or negative ground

Supply Current: 200 ma @18 volts

Supply Fuse: internal 1 Amp 250 Volt 2AG fuse

Connections: barrier terminal strip - rear panel

### ELMC PORT CONNECTORS:

There are five DB-15 female ELMC data port connectors. Each data port is DTE (accepts clock). The fifth port can be configured for either DTE or DCE (outputs clock) mode via internal switch & configuration program. The factory default is DTE.

### RS-422 SYNCHRONOUS SIGNALS:

- Idle condition: + data line is more negative than the - data line during the inter-packet interval.
- Clock phase: Data changes on positive going edge of the + clock. Data is stable on the negative going edge of the + clock.
- All packets start with a \$8E sync character. All packets end with a \$8F EOT character. These two characters unused in the ELMC protocol, and will not occur within a packet.
- For DTE, the following are outputs from 2130: Return Clock and Transmit Data. DTE inputs are Receive Clock, Receive Data, and Transmit Clock. Maximum external clock rate is 75 kHz.
- For DCE, the following are outputs from the 2130: Receive Clock, Receive Data and Transmit Clock. DCE inputs are Return Clock, and Transmit Data. Only port 5 can be set to DCE operation. The DCE Clock rate is fixed at 64 kHz. A port 5 internal jumper allows using a return clock input to clock in the transmit data. This corrects for data vs. clock skew when long cables (over 1500 feet) are used.

## **RS-422 ASYNCHRONOUS SIGNALS:**

- Idle condition: + data line is more positive than the - data line during the inter-packet interval.
- 8 data bits, 1 stop bit, no parity, no handshake
- At the end of each packet, a pause of two character times (idle or mark condition) is enforced before starting transmission of the next packet.

## **ELMC ports receive-data input termination:**

121 Ohms differential:

(+ data input biased to +5 with 1K )

(- data input biased to gnd. with 1K)

## **FRONT PANEL INDICATORS**

One Green Power Indicator

One Red Unit-Fail Indicator

Port 1 (green LEDs): TX data, RX data

Port 2 (green LEDs): TX data, RX data

Port 3 (green LEDs): TX data, RX data

Port 4 (green LEDs): TX data, RX data

Port 5 (green LEDs): TX data, RX data

TX and RX LEDs flash when data is being transmitted or received. If the lamptest button is depressed and held down, all LEDs light for one second. After one second, ports in asynchronous mode will light both TX and RX LEDs continuously. Ports in synchronous mode will flash the TX LED if TX clock is present and will flash the RX LED if RX clock is present.

## **ENVIRONMENTAL**

Operating Temp: 0 to 70 degrees C.

Humidity Range: 5% to 95% R.H. non-condensing

## **MOUNTING**

The 2130 ELMC Bridge mounts in a standard 19 inch rack. Mounting ears provide for a 5 1/8 inch projection out from the mounting surface. The mounting ears may be relocated to threaded holes near the front for flush mounting or 2 inch projection mounting.

## ELMC BRIDGE CONNECTOR PIN ASSIGNMENTS

### ELMC RS-422 SYNCHRONOUS DATA PORT CONNECTIONS:

| Signal Name    | Pin #<br>(+ lead) | Pin #<br>(- lead) |
|----------------|-------------------|-------------------|
| Receive Clock  | 1                 | 9                 |
| Receive Data   | 2                 | 10                |
| Transmit Clock | 3                 | 11                |
| Return Clock   | 4                 | 12                |
| Transmit Data  | 5                 | 13                |

**TABLE 1 PIN ASSIGNMENT (DB-15F)**

### ELMC RS-422 ASYNCHRONOUS DATA PORT CONNECTIONS:

| Signal Name   | Pin #<br>(+ lead) | Pin #<br>(- lead) |
|---------------|-------------------|-------------------|
| Receive Data  | 10                | 2                 |
| Transmit Data | 13                | 5                 |

**TABLE 2 PIN ASSIGNMENT (DB-15F)**

### ELMC RS-232 ASYNCHRONOUS CRAFT PORT CONNECTIONS:

| Signal Name              | Pin # |
|--------------------------|-------|
| Data out from 2130 to PC | 2     |
| Data in from PC to 2130  | 3     |
| Ground                   | 5     |

**TABLE 3 PIN ASSIGNMENTS (DB-9F)**



**Alcatel 4000, 5606 series radio, async ELMC connections, 19.2 kilobits**

Cable must be wirewrapped at radio end, DB15 Male at bridge end.

| <b>J102 on Radio<br/>Alcatel Radio Pin #</b> | <b>description</b>                   | <b>Bridge DB15<br/>Pin #</b> |
|----------------------------------------------|--------------------------------------|------------------------------|
| WW-block pin 63                              | <b>+ data</b> from radio to Bridge ► | 10                           |
| WW-block pin 64                              | <b>- data</b> from radio to Bridge ► | 2                            |
|                                              |                                      |                              |
| WW-block pin 61                              | ◄ <b>+ data</b> to radio from Bridge | 13                           |
| WW-bock pin 62                               | ◄ <b>- data</b> to radio from Bridge | 5                            |

**TABLE 4 Cable for radio Wirewrap block to ELMC Bridge**

**Alcatel 6000, 8000 series radio ASYNC ELMC connections, 19.2 kilobits**

Cable must be DB9 Male at radio end, DB15 male at bridge end.

| <b>J309 on 6000 Radio,<br/>J318 on 8000 Radio<br/>Alcatel Radio Pin #</b> | <b>Description</b>                   | <b>Bridge Pin #</b> |
|---------------------------------------------------------------------------|--------------------------------------|---------------------|
| DB9 pin 2                                                                 | <b>+ data</b> from radio to Bridge ► | DB15 pin 10         |
| DB9 pin 7                                                                 | <b>- data</b> from radio to Bridge ► | DB15 pin 2          |
|                                                                           |                                      |                     |
| DB9 pin 1                                                                 | ◄ <b>+ data</b> to radio from Bridge | DB15 pin 13         |
| DB9 pin 6                                                                 | ◄ <b>- data</b> to radio from Bridge | DB15 pin 5          |

**TABLE 5 Cable for 6000, 8000 Series radio to ELMC Bridge**

**Channel Bank RS-530 Interface (using a DB25 connector)**

| <b>PIN</b> | <b>SIGNAL</b>                   | <b>DESCRIPTION</b> |
|------------|---------------------------------|--------------------|
| 1          | SHIELD                          | FRAME GROUND       |
| 2          | TRANSMITTED DATA A              | TDA (RS422)        |
| 3          | RECEIVED DATA A                 | RDA (RS422)        |
| 4          | REQUEST TO SEND A               | RTSA (RS422)       |
| 5          | CLEAR TO SEND A                 | CTSA (RS422)       |
| 6          | DCE READY A                     | DSRA (RS422)       |
| 7          | GROUND                          | GND                |
| 8          | RECEIVED LINE SIGNAL DETECTOR A | RLSDA (RS422)      |
| 9          | RECEIVE CLOCK B                 | RCB (RS422)        |
| 10         | RECEIVED LINE SIGNAL DETECTOR B | RLSDB (RS422)      |
| 11         | TERMINAL TIMING CLOCK A         | TTA (RS442)        |
| 12         | TRANSMIT CLOCK B                | TCB (RS422)        |
| 13         | CLEAR TO SEND B                 | CTSB (RS422)       |
| 14         | TRANSMIT DATA B                 | TDB (RS422)        |
| 15         | TRANSMIT CLOCK A                | TCA (RS422)        |
| 16         | RECEIVE DATA B                  | RDB (RS422)        |
| 17         | RECEIVE CLOCK A                 | RCA (RS422)        |
| 18         | LOCAL LOOPBACK                  | LL (RS423)         |
| 19         | REQUEST TO SEND B               | RTSB (RS422)       |
| 20         | DTE READY A                     | DTRA (RS422)       |
| 21         | REMOTE LOOPBACK                 | RL (RS423)         |
| 22         | DCE READY B                     | DSRB (RS422)       |
| 23         | DTE READY B                     | DTRB (RS422)       |
| 24         | TERMINAL TIMING A               | TTA (RS422)        |
| 25         | TEST MODE                       | TM (RS423)         |

**Cable connections from channel bank card to ELMC ports 1, 2, 3, 4 & 5 (DTE mode only)**

| <b>RS-530 Pin</b> | <b>Description</b>    | <b>ELMC Port Pin</b> |
|-------------------|-----------------------|----------------------|
| 3                 | RX Data A (+ lead) →  | 2                    |
| 16                | RX Data B (- lead) →  | 10                   |
| 17                | RX Clock A (+ lead) → | 1                    |
| 9                 | RX Clock B (- lead) → | 9                    |
| 2                 | ← TX Data A (+ lead)  | 5                    |
| 14                | ← TX Data B (- lead)  | 13                   |
| 15                | TX Clock A (+ lead) → | 3                    |
| 12                | TX Clock B (- lead) → | 11                   |

**RS-530 NOTE:** If you cannot strap or configure your channel bank card for a clear channel (always transmitting and receiving), or if this is not the default, then you will have to jumper additional lines together in the RS-530 plug. You may have to interconnect DCE READY (A and B pair) to both DTE READY (A and B pair) and to REQUEST TO SEND (A and B pair).

**Channel Bank RS-449 Interface (using a DB37 connector)**

| <b>PIN</b> | <b>SIGNAL</b>          | <b>DESCRIPTION</b> |
|------------|------------------------|--------------------|
| 1          | SHIELD                 | FRAME GROUND       |
| 2          | SIGNAL RATE INDICATOR  | SI (V.24)          |
| 3          | NOT USED               |                    |
| 4          | SEND DATA A            | SDA (RS422)        |
| 5          | SEND TIMING A          | STA (RS422)        |
| 6          | RECEIVE DATA A         | RDA (RS422)        |
| 7          | REQUEST TO SEND A      | RTSA (RS422)       |
| 8          | RECEIVE TIMING A       | RTA (RS422)        |
| 9          | CLEAR TO SEND A        | CTSA (RS422)       |
| 10         | LOCAL LOOPBACK         | LL (V.24)          |
| 11         | DATA MODE A (DSR)      | DMA (RS442)        |
| 12         | TERMINAL READY A (DTR) | TRA (RS422)        |
| 13         | RECEIVER READY A (DCD) | RRA (RS422)        |
| 14         | REMOTE LOOPBACK        | RLB (V.24)         |
| 15         | INCOMING CALL (RI)     | IC (V.24)          |
| 16         | SIGNAL RATE SELECTOR   | SI (V.24)          |
| 17         | TERMINAL TIMING A      | TTA (RS422)        |
| 18         | TEST MODE              | TM (V.24)          |
| 19         | SIGNAL GROUND          | SG                 |
| 20         | RECEIVE COMMON         | RC                 |
| 21         | NOT USED               |                    |
| 22         | SEND DATA B            | SDB (RS422)        |
| 23         | SEND TIMING B          | STB (RS422)        |
| 24         | RECEIVE DATA B         | RDB (RS422)        |
| 25         | REQUEST TO SEND B      | RTSB (RS422)       |
| 26         | RECEIVE TIMING B       | RTB (RS422)        |
| 27         | CLEAR TO SEND B        | CTSB (RS422)       |
| 28         | TERMINAL IN SERVICE    | IS (V.24)          |
| 29         | DATA MODE B            | DMB (RS422)        |
| 30         | TERMINAL READY B       | TRB (RS422)        |
| 31         | RECEIVER READY B       | RRB (RS422)        |
| 32         | SELECT STANDBY         | SS (V.24)          |
| 33         | SIGNAL QUALITY         | SQ (V.24)          |
| 34         | NEW SIGNAL             | NS                 |
| 35         | TERMINAL TIMING B      | TTB (RS422)        |
| 36         | STANDBY INDICATOR      | SB (V.24)          |
| 37         | SEND COMMON            | SC                 |

**Cable connections from channel bank card to ELMC ports 1, 2, 3, 4 & 5 (DTE mode only)**

| <b>RS-449 Pin</b> | <b>Description</b>    | <b>ELMC Port Pin</b> |
|-------------------|-----------------------|----------------------|
| 6                 | RX Data A (+ lead) →  | 2                    |
| 24                | RX Data B (- lead) →  | 10                   |
| 8                 | RX Clock A (+ lead) → | 1                    |
| 26                | RX Clock B (- lead) → | 9                    |
| 4                 | ← TX Data A (+ lead)  | 5                    |
| 22                | ← TX Data B (- lead)  | 13                   |
| 5                 | TX Clock A (+ lead) → | 3                    |
| 23                | TX Clock B (- lead) → | 11                   |

**RS-449 NOTE:** If you cannot strap or configure your channel bank card for a clear channel (always transmitting and receiving), or if this is not the default, then you will have to jumper additional lines together in the RS-449 plug. You may have to interconnect wires on the RS-449 connector so that REQUEST TO SEND (A and B) is always asserted, in other words, the SEND DATA (A and B) is always being transmitted.

### Channel Bank V.35 Interface (Using the M34 Connector)

| PIN | NAME | DESCRIPTION                 | TYPE              |
|-----|------|-----------------------------|-------------------|
| A   | FG   | Frame Ground                |                   |
| B   | SG   | Signal Ground               |                   |
| P   | SDA  | Send Data A                 | Differential      |
| S   | SDB  | Send Data B                 | Differential      |
| R   | RDA  | Receive Data A              | Differential      |
| T   | RDB  | Receive Data B              | Differential      |
| C   | RTS  | Request To Send             | Unbalanced (v.24) |
| D   | CTS  | Clear To Send               | Unbalanced        |
| E   | DSR  | Data Set Ready              | Unbalanced        |
| H   | DTR  | Data Terminal Ready         | Unbalanced        |
| F   | RLSD | Received Line Signal Detect | Unbalanced        |
| U   | TCEA | Transmit Clock Ext A        | Differential      |
| W   | TCEB | Transmit Clock Ext B        | Differential      |
| Y   | TCA  | Transmit Clock A            | Differential      |
| AA  | TCB  | Transmit Clock B            | Differential      |
| V   | RCA  | Receive Clock A             | Differential      |
| X   | RCB  | Receive Clock B             | Differential      |
| J   | LL   | Local Loopback              | Unbalanced        |
| BB  | RLB  | Remote Loopback             | Unbalanced        |
| K   | TM   | Test Mode                   | Unbalanced        |
| L   |      | Test Pattern                | Unbalanced        |

Cable connections from channel bank card to ELMC ports 1, 2, 3, 4 & 5 (DTE mode only)

| V.35 Pin | Description           | ELMC Port Pin |
|----------|-----------------------|---------------|
| R        | RX Data A (+ lead) →  | 2             |
| T        | RX Data B (- lead) →  | 10            |
| V        | RX Clock A (+ lead) → | 1             |
| X        | RX Clock B (- lead) → | 9             |
| P        | ← TX Data A (+ lead)  | 5             |
| S        | ← TX Data B (- lead)  | 13            |
| Y        | TX Clock A (+ lead) → | 3             |
| AA       | TX Clock B (- lead) → | 11            |

**V.35 NOTE:** If you cannot strap or configure your channel bank card for a clear channel (always transmitting and receiving), you will have to jumper additional lines together on the channel bank card. You may have to interconnect 'Data Set Ready' to both 'Data Terminal Ready' and 'Request To Send'.

# Typical Data Port Interface

