DSP4xxFP SA
USER'S MANUAL

A01561 Rev. A

This Manual covers all configurations of the DSP4xxSA Modem with the Serial Number SA700425 and up.

DSP4xxSA User's Manual
A01561 Rev. X

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GDI COMMUNICATIONS, LLC
280 I-80 West Exit 1
PO BOX 1330
Verdi, Nevada 89439
Phone: 775-345-8000
FAX: 775-345-8010
www.sgdi.com


DSP SERIES
PWR RTS CTS TXD RXD DCD DSR ALB DLB
TEST
GDI Communications


4WIRE
2WIRE
RX
TX
DTE
RS-232
10-53 VDC

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GLOSSARY

Anti-Streaming – A function on GDI modems that prevents a Host from transmitting continuously.

DCD – Data Carrier Detect. An EIA RS-232D control signal that can be used to gate RXD to a DTE.

DCE – Data Communications Equipment. A device that converts data from a DTE to a transport stream. For example. The GDI model 400 modem is a DCE that converts RS232 data from a controller to a FSK Telco system.

DTE – Data Terminal Equipment. A device that initiates communication over RS232 lines.

CTS – Clear To Send. An EIA RS-232D control signal that can be used to gate TXD data from a DTE.

Full duplex – A communication system where data can be transmitted in both directions at the same time.

Half duplex - A communication system where data can be transmitted in only one direction at a time.

FSK – Frequency Shift Keying. Communication protocol where data is encoded into binary format and represented by different frequencies.

Host – Any DTE device.

MARK – Signal state of a FSK system that represents a logical "1" value.

Private wire – Telco communication hardware that is leased for private use.

SPACE – Signal state of a FSK system that represents a logical "0" value

0 dBm – Represents the signal level required to produce 1mw in a 600Ω load.

Soft carrier – Signal transmitted at the end of data to quiet the lines and turn the receiver off.

Surface mount parts – Electronic parts that are designed to be soldered to pads instead of vias.

RXD – Receive Data. An EIA RS-232D data signal that transfers information in form of binary data to a DTE.

RTS – Request To send. An EIA RS-232D control signal that can be used to gate TXD to a DTE. The DTE asserts RTS and then waits for the DCE to respond with CTS.

TXD Transmit Data - An EIA RS-232D data signal that transfers information in form of binary data from a DTE.

DSP – Digital Signal Processor

GENERAL DESCRIPTION

The GDI DSP4xxFP is a configurable baud rate modem designed for 4-wire, full-duplex or 2-wire, half-duplex operation over a voice-band leased line or private line.

The modem is uses the latest digital-signal processing (DSP) technology to achieve high performance.

It employs efficient modulation and encoding schemes to achieve fast signal detection training times.

It is backward compatible with Bell 202 and ITU-T V.23 modems.

Employing a fast DSP processor and automatic adaptive equalizer, the DSP419FP/DSP496FP modem is ideally suited for multi-point communication systems that require fast response time, short training time, and minimal throughput delay.

The DSP419FP/DSP496FP modem is specifically designed for harsh environments typically associated in utility substations and industrial facilities.

The DSP419FP/DSP496FP provides the following unique features that make it well suited for utility and industrial applications.

- Packaged in a rugged, compact enclosure for industrial applications.
- Leased-line interface protected with heavy-duty surge protection devices.
- Built-in hardware watchdog timer automatically resets the unit if trouble is detected.
- Operate over voice-band conditioned or unconditioned leased-line and pilot wires.
- Accepts power from a wide range of AC and DC power supplies.
- Asynchronous data rates (selectable) of 19200, 9600, 4800, 2400, and 0-1800 bps.
- Easily accessible DIP switches for user configuration and option selection.
- DB25-F connector for RS-232/V.24 interface, RS-485 interface is optional.
- Local analog, local digital, and remote digital loopback diagnostics.

GENERAL CHARACTERISTICS

Data rate: 19200, 9600, 4800, 2400, 0-1800 (Bell 202T), or 0-1200 bps (V.23) asynchronous

Modem Training Time: 17.4 ms. (fast poll at 19200 bps)
23 ms. (fast poll at 2400/4800/9600 bps)

(RTS-CTS Delay) 8 or 33 ms (Bell 202T)
33 ms (V.23)

Data format: 8 or 9 data bits with 1 or more stop bits, or 7 data bit with parity bit

DTE interface: EIA RS-232/V.24, or RS-485 (2-wire HD or 4-wire FD) compatible

Line conditions: TELCO voice band 4- or 2-wire leased line, conditioned or unconditioned Private metallic circuits up to 9.5 miles at 9600 bps (24 AWG) without cable equalizer. Up to 15.0 miles (24 AWG) with TX and RX cable equalizer. Up to 25 miles for FSK modes.

Operating modes: 2-wire half-duplex or 4-wire full-duplex over leased or private line

Modulation: QAM High-speed fast poll mode

FSK, Bell 202T or V.23 compatible

- Mark = 1200 Hz (1300 Hz, V.23)
- Space = 2200 Hz (2100 Hz, V.23)
- Soft Carrier = 900 Hz (Bell 202T only)

Equalizer Automatic, adaptive

Receiver dynamic range: 0 to –30 dBm or –10 to –43 dBm

Operating temperature: -40°C to +85°C

Power supply: Wide range switching power supply:

- DSP419FP/DSP496FP (AC version): 90 to 265 Volts AC, 50/60 Hz, single phase or 90 to 400 VDC
- DSP419FP/DSP496FP-DC (DC version):10 to 60 Volts DC

Surge protection: Leased line, up to 15KV

Carrier control: Constant or switched, DIP switch selectable

Carrier loss recovery: Train on data automatically

Throughput delay: Less than 10 milliseconds for fast polling

Auto RTS: Support DTE without hardware RTS

Anti-streaming: 27-second timer to prevent transmitter lock-up network

Enclosure: Aluminum with removable front and rear panels

Dimensions: 5.7" wide x 8.5" long x 1.50" high

Weight: 1.5 lbs without AC to DC power converter module

Interface connectors

Leased Line: 4-position screw terminal

Data Terminal Equipment: DB-25 female connector (for RS-232 and optional RS-485)

Operating temperature:	-40 to + 85^{o} C
Storage temperature:	-40 to + 85^{o} C
Operating humidity:	5 to 95 %, non-condensing
Line isolation:	1500 V RMS
Surge protection:	Leased line up to 15K VA

INSTALLATION

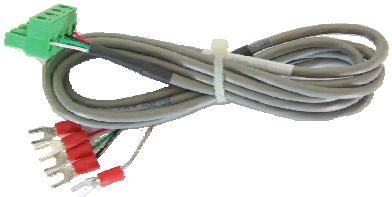
Unpacking the modem:

Check to make sure the following items are in the shipping box:

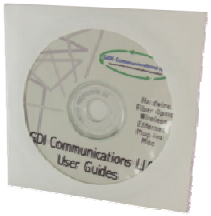
The Modem: DSP4xxFP SA :

The power adapter with the terminal plug:

Transmission line interface cable:



Manual on CD:



Getting Started:

Configure the modem using the two sets of DIP switches and two sets of configuration jumpers on the printed circuit board of the modem labeled S1 and S2, JP3, JP4, JP5 and JP6.

It is important to follow the steps described below, in the order shown, to ensure that you configure your modem properly using the modem DIP switches:

1 **Use DIP switch 1 (S1) to configure the modem for the host DTE interface and network topology. Using S1, select the modem's operating speed to match the host computer or RTU devices and other DTE specific operating parameters.**

2 **Use DIP switch 2 (S2) to select the modem's transmitter output level and receiver dynamic range specific leased line conditions. The S2 settings apply for both high-speed fast-poll (QAM) and low-speed (FSK) modes.**

3 **After you change the DIP switch settings, cycle the power to the modem. This will restart the modem with the new switch settings.**

NOTE: The DIP switch settings will not take effect until after the modem's power is cycled off and then back on.

While the configuration switches can be accessed externally, the modem's PCB has to be removed from the chassis using the following procedures.

1 **Ground yourself to discharge any ESD, which might cause damage to the sensitive devices on the modem board.**

2 **Disconnect and remove all the cables attached to the rear panel connectors.**

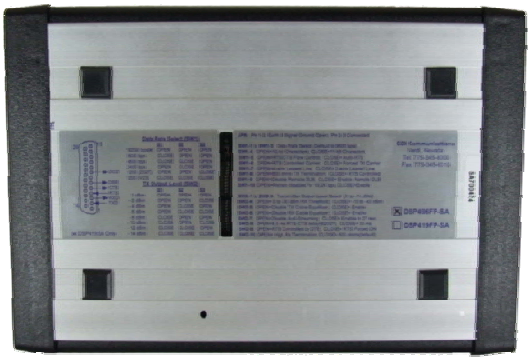
3 **Use a Philips screw driver to remove the rear panel and carefully slide the modem board out of the enclosure from the front panel end. The location of the DIP switches and jumpers for the stand-alone modem are shown in Figure 2 3.**

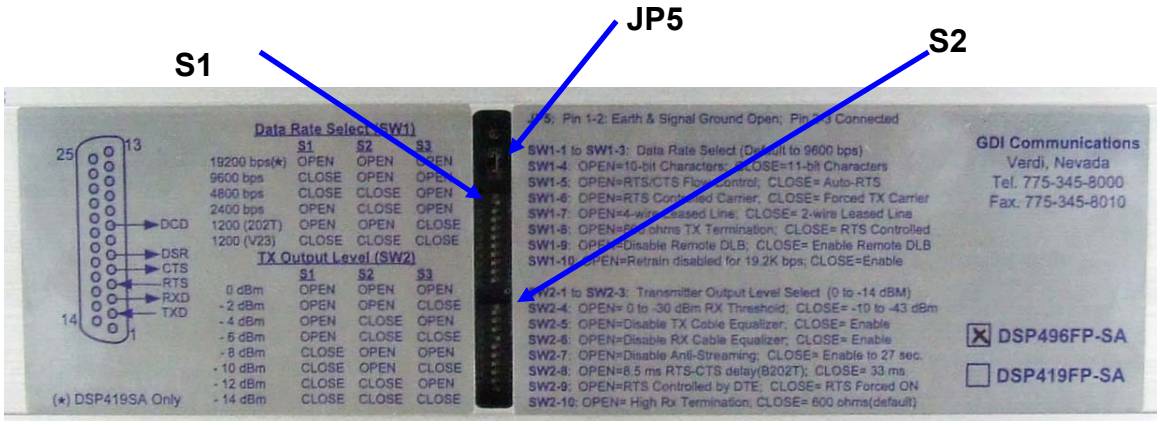
4 **Carefully return the modem board into the enclosure. Then replace the rear panel after the configuration is completed.**

Configuration Switches

Introduction

S1 and S2 are 10-position DIP switches used to configure most options and features of the modem. They can be accessed externally from the bottom panel of the modem.





NOTE: The configuration switches are toggle switches. Use a small sharp pin to firmly press down on one end or the other to close or open the switch.

OPEN = Switch is OFF CLOSE = Switch is ON
(Open is to the left and Closed is to the right)

Switches will be referred to by their bank number and position number.

For example S1.3 is DIP switch S1, position 3

Modem Data Rate: S1.1 – S1.3

Baud Rate	S1.1	S1.2	S1.3
19200*	OPEN	OPEN	OPEN
9600	CLOSE	OPEN	OPEN
4800	CLOSE	CLOSE	OPEN
2400	OPEN	CLOSE	OPEN
Bell 202T	OPEN	OPEN	CLOSE
V.23	CLOSE	CLOSE	CLOSE

*** 19200 is available only on DSP419FP models**

For modem speeds of 2400 bps or higher, the modem uses QAM modulation automatically.

When the modem is operating at 1200 bps either in Bell 202T or ITU-V.23 mode, the modem uses FSK modulation.

Note: Leased lines with a relatively flat 300-3400Hz bandwidth is required to support 19,200 bps operation.

DTE Async word length: S1.4

OPEN = 10 bit
CLOSE = 11 bit

Switch S1.4 selects whether the async word length is 10 or 11 bits. Any combination of bits may be used as long as it fits in the defined word length.

For instance in 10 bit mode the data word could consist of the following:

1 start bit + 7 databits + 1 parity bit) + 1 stop bit.
or 1 start bit + 8 databits + 1 stop bit.

In 11 bit mode the data word could consist of the following:
1 start bit + 8 data + 1 parity bit + 1 stop bit.

This switch setting is ignored when the modem is set at 1200 bps or less (FSK modulation).

Auto RTS (S1.5)

OPEN = RTS/CTS Flow control
CLOSE = Auto RTS

For serial interfaces that do not provide RTS, i.e. only provide TXD, RXD, SG, set the modem's switch S1.5 to CLOSE to enable auto RTS mode. In this mode, when TXD data is detected by the modem, it turns on its internal RTS and carrier signals at the transmitter. After the training time, the TXD is transmitted. The transmitter turns off if no TXD data is detected for approximately 2 characters.

Transmit Carrier Control (S1.6)

OPEN = RTS controlled carrier
CLOSE = Constant carrier

Constant carrier will force the modem to constantly transmit a modulated carrier. However, the modem still requires RTS to transmit data.

If constant carrier is enabled, the modem forces the transmit carrier active and the RTS-CTS delay is reduced to less than 0.5ms. CTS is ON only if RTS signal is ON.

In RTS controlled carrier mode, the RTS-CTS delay is 23ms for 2400 bps and above.

Constant carrier mode is used in 4-wire point-to-point connections, or at the master modem of a multi-point polling network to reduce the RTS-CTS delay.

Note: Please refer to switch setting S2-9; forced RTS ON for other applications.

2- or 4-wire leased line (S1.7):

OPEN = 4 Wire Leased Line
CLOSE = 2 Wire Leased Line

Switch S1.7 configures the modem for either 4-wire or 2-wire leased line operation.

Transmitter Impedance (S1.8):

OPEN = 600ohm TX Termination
CLOSE = RTS Controlled

In the RTS Controlled mode, the transmitter's termination impedance is 600 ohms only when RTS is asserted. When RTS is not asserted, the transmitter's termination is at a high impedance.

This is can be used in multi-point networks to reduce the load on the transmission line.

This configuration should be used for all slave modems to prevent the transmitting modem from being unnecessarily burdened.
If you use the modem with transmission lines that are transformer-coupled or with an impedance-isolated network (such as a transformer bridge), set switch S1-8 OFF for proper operation.

Remote Digital Loopback (S1.9):

OPEN = Disable Remote DLB
CLOSE = Enable Remote DLB

During instances of channel noise, the modem may mistake a received preamble as a request to go into remote digital loopback. Setting switch S1.9 to OFF prevents the modem from participating in a remote digital loopback with another modem. Switch S1.9 does not prevent the modem from sending a remote digital loopback request to a remote modem.

Re-Train Enabled (S1.10): 19200 bps only

OPEN = Retrain Disabled for 19.2Kbps
CLOSE = Retrain enabled for 19.2Kbps

When operating in high speed mode, the modem's receivers require a special training pattern from the remote transmit modem to synchronize the receive timing before data can be received.

The DSP419FP will only send out a training pattern when it's RTS is raised from the OFF to ON (i.e. Switched Carrier mode). However, if the modem is configured in Constant Carrier mode, or the RTS is ON continuously, no training pattern will be sent.

While in this mode, where constant carrier is present at the receiving modem, there is a possibility that the modem might lose synchronization due to transmission line interferences such as line hits, line drop-outs, or power outage conditions. In order to regain synchronization, the DSP419FP implements a re-train algorithm which allows the receiving modem to send out a re-train request to the remote modem for re-train and re-gain synchronization. This option is most useful for the modem to operate at 19200 bps and constant carrier or constant RTS modes.

Transmit Output Level (S2.1 to S2.3)

Level	S2.1	S2.2	S2.3
0 dBm	OFF	OFF	OFF
~ -2 dBm	OFF	OFF	ON
~ -4 dBm	OFF	ON	OFF
~ -6 dBm	OFF	ON	ON
~ -8 dBm	ON	OFF	OFF
~ -10 dBm	ON	OFF	ON
~ -12 dBm	ON	ON	OFF
-14 dBm	ON	ON	ON

Switches S2.1 through S2.3 adjust the modem's output transmit level.

Modem Receive Dynamic Range (S2.4):

OPEN = 0 to -30dBm
CLOSE = -10 to -43dBm

For a strong receive signal, set S2.4 to OPEN. For a weak receive signal level, set S2.4 to CLOSE.

TX Cable Equalizer (S2.5): Fast-Poll Mode Only

OPEN = Disabled
CLOSE = Enabled

RX Cable Equalizer (S2.6):

OPEN = Disabled
CLOSE = Enabled

To improve or extend the modem's polling performance over long transmission lines, enable the modem's Compromise Cable Equalizer when the distance exceeds 4 to 5 miles. The cable equalizer is active only when the modem is in QAM fast-poll mode.

Anti-streaming (S2.7):

OPEN = Disabled
CLOSE = Enabled

Typically, anti-streaming is used in multi-point applications to prevent a malfunctioning remote controller from transmitting indefinitely. When anti-streaming is active, the modem will transmit for a maximum of 27 seconds. On the next ON-to-OFF transition of RTS, the anti-streaming function resets.

RTS-CTS Delay (S2.8):

OPEN = 8.5ms
CLOSE = 33ms

In Bell 202 mode, switch S2.8 determines the duration of the RTS-CTS delay in Bell 202 mode.
In V.23 mode, the RTS-CTS delay is fixed at 33 ms.

Constant RTS ON (S2.9):

OPEN = Disabled
CLOSE = Enabled

When constant RTS ON is Disabled, RTS is controlled externally by the attached DTE device.

When Constant RTS ON is enabled, RTS is set to "ON" internally and the external signal is ignored.

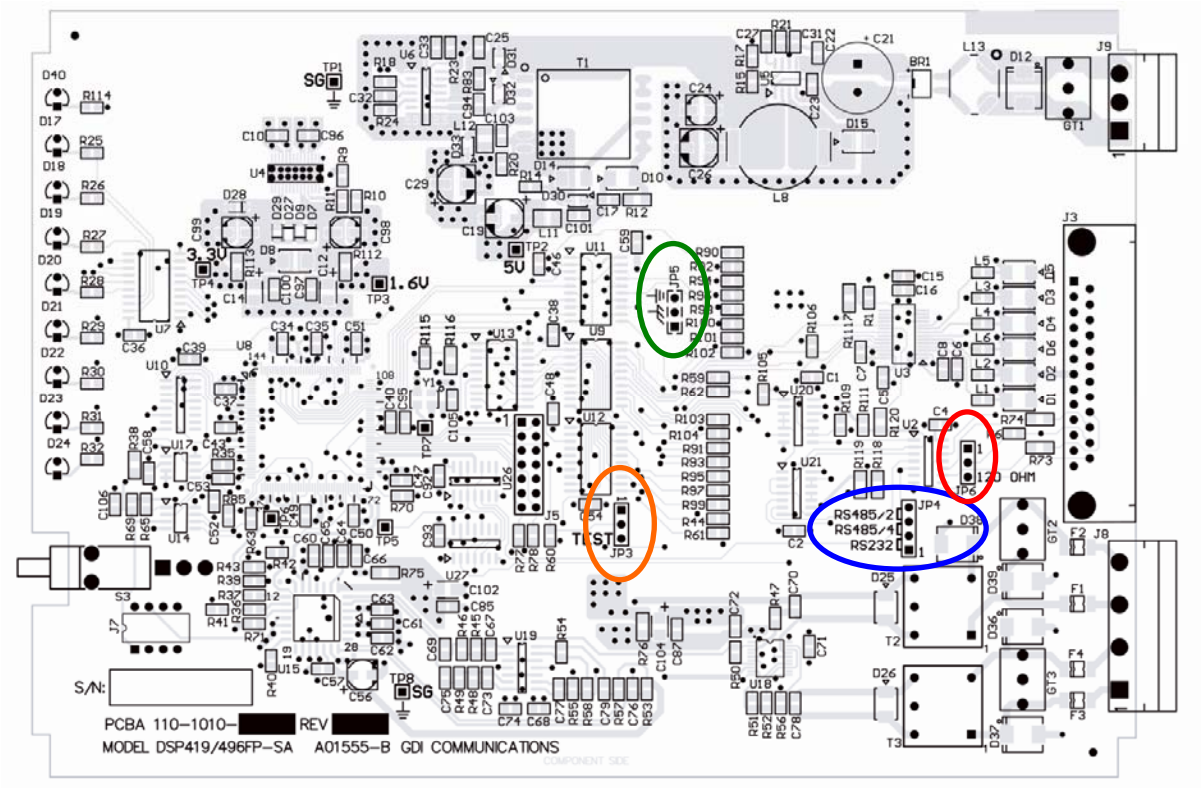
RTS, CTS and carrier is being transmitted constantly, allowing the DTE to operate with the modem without supplying RTS signal.

Receiver Termination(S2.10)

OPEN = High Impedance
CLOSE = 600ohms

Default Settings

Configuration Jumpers



RS-232 or RS-485 Jumper JP4:

Jumper block JP4 is use to configure the DTE interface to RS-232 or RS-485.

Mode	Jumper
RS-232	**1 - 2, (default)**
4 Wire RS-485	**2 - 3.**
2 Wire RS-485	**3 - 4.**

RS-485 Receiver Termination Jumper JP6:

Termination	Jumper
Hi Impedance	**1 – 2**
120 ohms	**2 – 3**

Chassis Ground Jumper JP5:

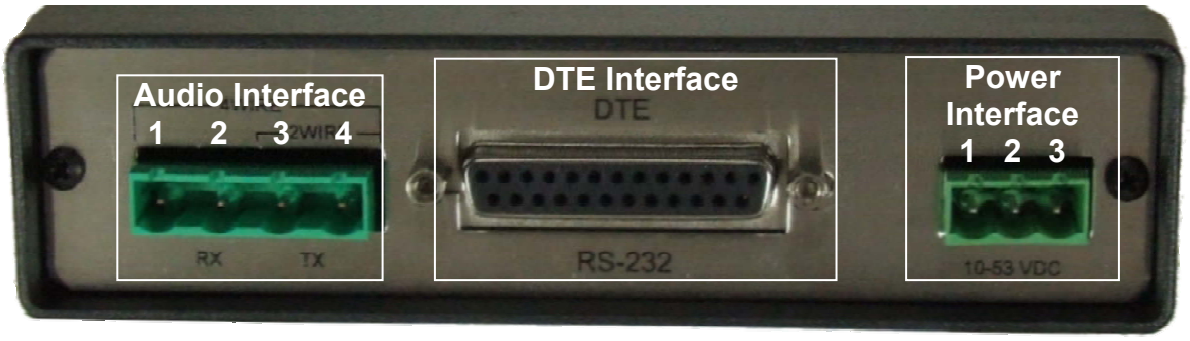
Jumper block JP5 can be used to connect the chassis ground and the modem's signal ground together.

Mode	Jumper
Chassis Ground is isolated from Signal Ground	**1 – 2**
Chassis Ground is connected to Signal Ground	**2 - 3**

Production Test Enable JP3 (Pin 2&3)

Jumper block JP3 is used for factory testing only. JP3 must be in position 1 - 2 for normal operation.

Rear Panel Connections



Connecting the Modem's power:

The power adapter supplied with the modem is prewired with the proper terminal plug for the modem. However, it is possible to use the terminal plug with other power sources. The pinout for the power connector is as follows:

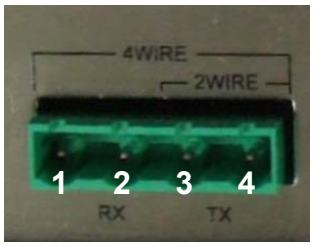
Pin	Function
1	**DC +**
2	**Chassis Ground**
3	**DC -**

Connecting to the DTE:

The DB25 connector is wired to the standard pinout of most RS232 interfaces. However, not all the signals are present. The pinout for the DTE interface DB25 is as follows:

Pin	Signal	Direction	Description
1	CG	- -	Chassis Ground
2	TXD	Input	RS-232 Transmit Data
3	RXD	Output	RS-232 Receive Data
4	RTS	Input	Request To Send
5	CTS	Output	Clear To Send
6	DSR	Output	Data Set Ready
7	SG	- -	Signal Ground
8	CD	Output	Carrier Detect
22	RXD+	Output	RS-485 Receive Data
23	RXD-	Output	RS-485 Receive Data
24	TXD+	Input	RS-485 Transmit Data
25	TXD-	Input	RS-485 Transmit Data

Connecting to a Transmission Line:

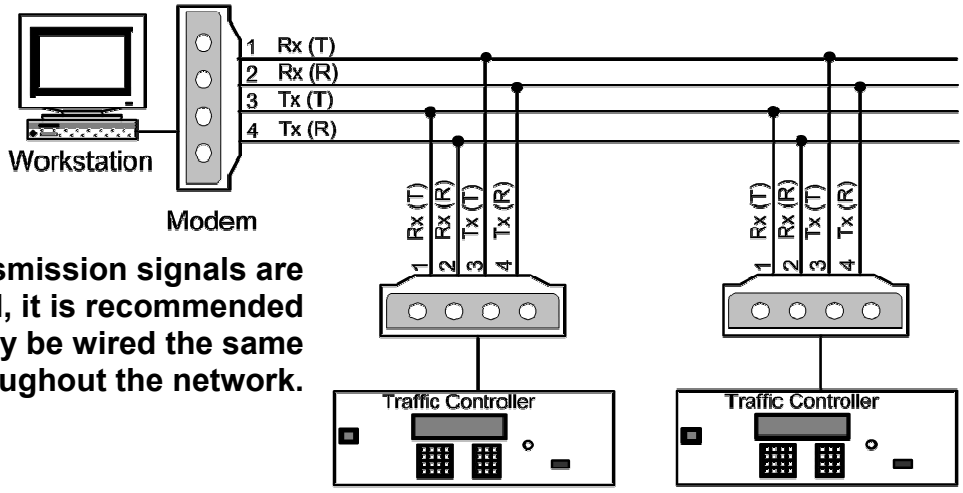


The modem can be connected in either a 2 wire (S1.7 Closed) or a 4 wire (S1.7 Open) network. Pins 3 and 4 are the output terminals and pins 1 and 2 are the input terminals.

Pin	Signal	Direction	Description
1	Rx (T)	Input	Receive Audio (Tip)
2	RX (R)	Input	Receive Audio (Ring)
3	Tx (T)	Output	Transmit Audio (Tip)
4	Tx (R)	Output	Transmit Audio (Ring)

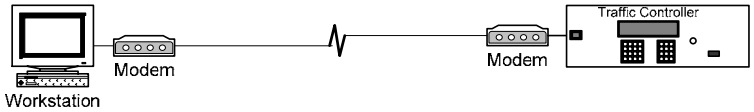
For 2 wire networks, S1.7 must be closed and the transmission line cable pair is connected to terminals 3 and 4 on all modems in the network.

For 4 wire networks, S1.7 must be open and the transmission line cable pairs are connected between inputs and outputs as depicted in the following graphic.

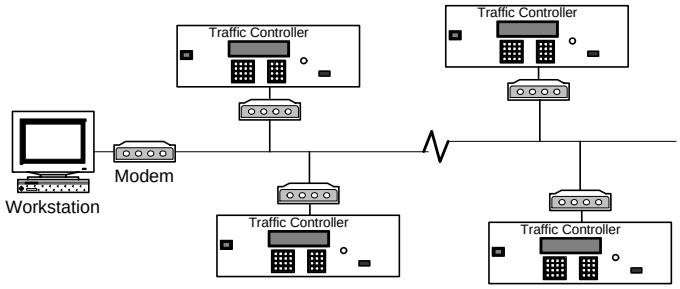


While the transmission signals are not polarized, it is recommended that they be wired the same throughout the network.

NOTE: The modem does not support leased-line operation with DC shielding current.



Point-to-Point Network Using the DSP4xxFP SA Modem



Multipoint Polling Network Using the DSP4xxFP SA Modem

Front Panel Indicators and Test Switch

The front panel indicators can be used to trouble shoot network connection and configuration issues. The "Test" button invokes the local modems data loop back modes. When the indicators light is on, the associated signal is asserted or active.

In the case of the Control signals RTS, CTS, DCD, and DSR, when the indicator is on, the signal is at the maximum signal level. Typically +12vdc. When the indicator is off, the signals are at the minimum level. Typically -12vdc. But, the signal level maximum and minimum levels will vary based on the device that is attached to the modem.

The TXD and RXD indicators will blink, indicating data activity on the Transmit and Receive paths of the modem.

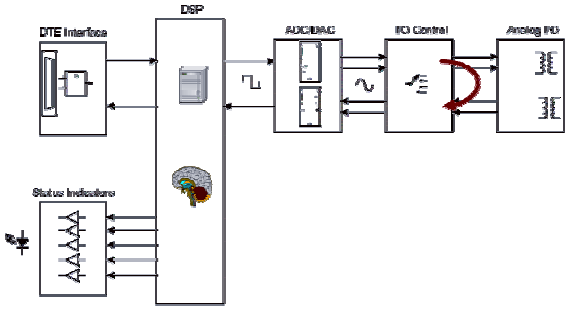
All indicators monitor the DTE side of the modem.

The PWR indicator turns on only when the internal regulated power supplies of the modem are operational.

TEST Switch

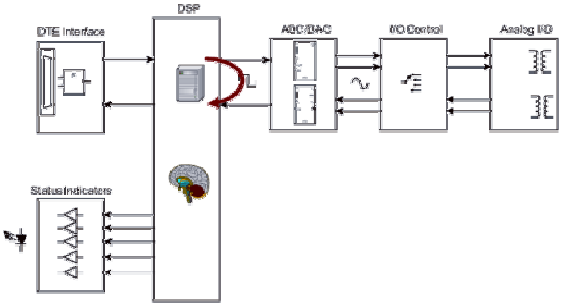
The front panel of the modem has a momentary push button switch for initiating the loopback modes.

Analog LoopBack:
Press the TEST switch once.
The ALB LED should be ON.
In this mode, the transmit data is looped back to the DTE as receive data.
This test will verify the modem transmitter, receiver, and its RS-232 interface along with the RS-232 cable.



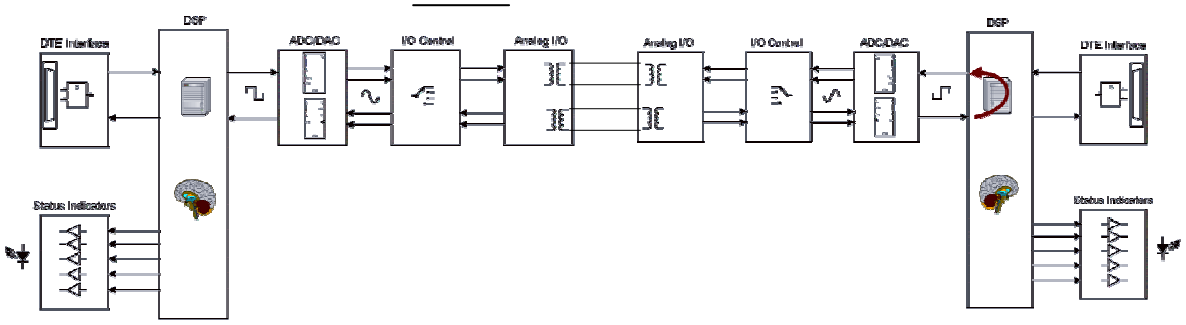
Digital LoopBack:
Press the TEST switch twice.
The DLB LED should be ON.

In this mode, the transmit data is looped back to the DTE as receive data.
This test will verify the modem's RS-232 interface along with the RS-232 cable.



Remote digital loopback:
Set the remote modem's S1.9 switch to "Close."
Set the local modem's RTS signal to low.
Then press the TEST switch three times.
Both the ALB and DLB LEDs of the local modem should be ON.
Then raise the local modem's RTS signal to start the test.
The ALB and DLB LEDs of the remote modem should go ON if it responds to the remote digital loopback request.

This test will verify both modems' transmitters, receivers, and the leased line.

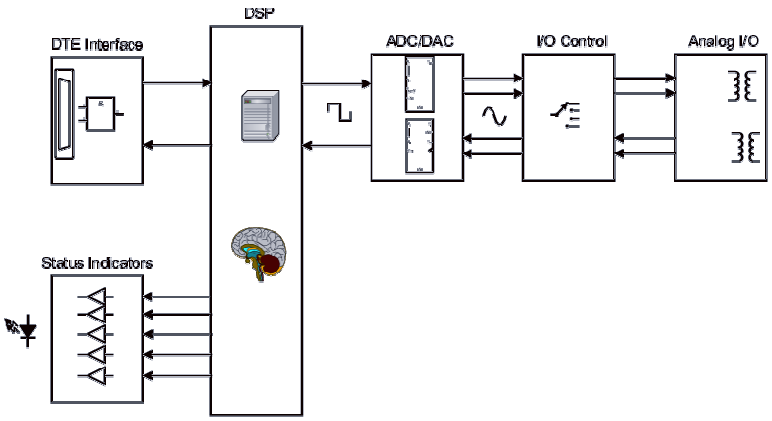


Adjustments

The DSP4xxFP MODEMs do not require adjusting.

Theory of Operation

Systems Description (include block diagram).



The DSP chip forms the main processing and control functions of the modem. This IC is programmed to modulate/demodulate the transmission signal, process handshaking signals, control the status lights, process the configuration switches, and monitor the power.

Data is transmitted from the DTE, through the DTE Interface, to the DSP. The DSP then converts the raw RS-232 data into a modulated bit stream which is then delived to the Digital to Analog converter. The Analog signal is then conditioned for transmisison out the Analog I/O.

Data received on the Analog I/O is fed to the Analog to Digital converter and the delivered to the DSP. The DSP then demodulates the signal and routes it out to the DTE.

The I/O control configures the transmission line interface for the topology that the modem is being used in.

MAINTENANCE

Preventative Maintenance

The DSP4xxSA series of modems do not require maintenance.

Trouble analysis

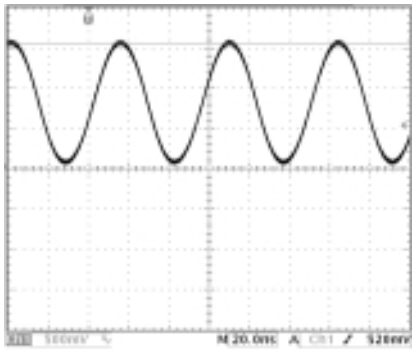
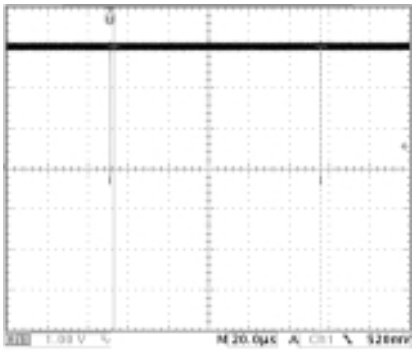
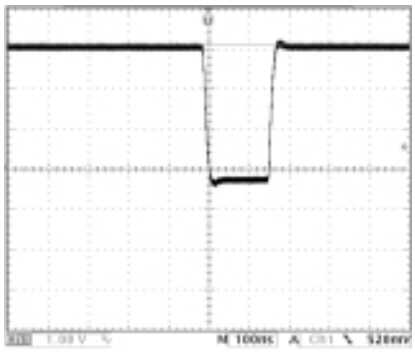
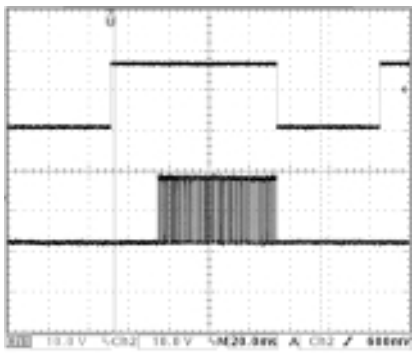
If you encounter a problem with your modem, be sure the switches on the modem are set to the appropriate positions. If a switch is halfway between an on and off setting, the modem will not operate properly.

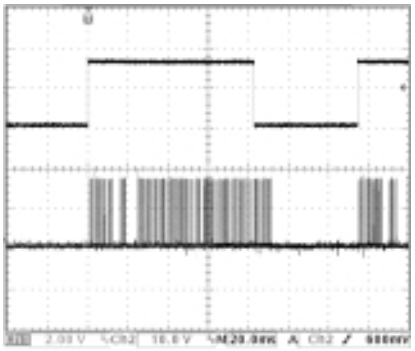
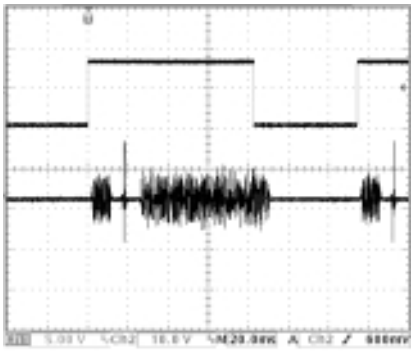
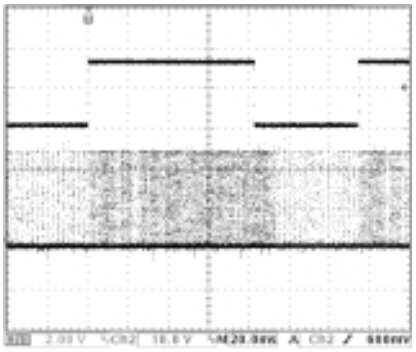
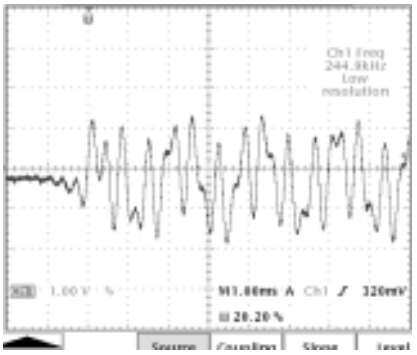
Trouble Shooting Chart

In the event you encounter a problem using your GDI modem, refer to the troubleshooting information in this appendix.

If…	Perform These Procedures…
No LEDs are ON at the front panel	Check the power supply source. Be sure the input power to the modem's power connector is between 10 to 60VDC . The MR LED should be on if the modem is powered up properly and when it is not in any loopback test mode.
Modem does not respond to the attached DTE and the all LEDs are off.	Check the connecting RS-232 or RS-485 cable between the DTE and the modem. The MR/DSR LED (Modem Ready/Data Set Ready) on the front panel should be ON when the modem is idle.
Modem does not receive data, and the DCD and RXD LEDs are off.	Check the DIP switches of both modems to make sure that the same data rate and operating parameters are identical on both modems. The receive line pair may be disconnected from the modem. Make sure the transmission line connection to the modem is accurate and secure. The receive signal level may be below the CD threshold. Set switch S1-5 ON to see whether configuring the modem for a –43 dBm threshold resolves the problem. If this problem remains unresolved, perform a local ALB loopback test to determine if the modem's receiver is functioning correctly.
The RTS, CTS, and TXD LEDs do not blink.	The attached terminal or DTE may not be sending data to the modem. Verify that data is being transmitted. If data is being transmitted, make sure the RS-232 cable is sound and securely connected to the modem and terminal or DTE.

Wave Forms.

Signal	Characteristic	Waveform
INT Clock (TP7)	**18.432Mhz**	
WDI Watch Dog Interrupt	**U17 Pin6**	
WDI Watch Dog Interrupt	**U17 Pin6**	
RTS TO TXD	**RS232**	

RTS to DIN	**ADAC Converter**	
RTS TO Output/Input	**Output Looped back to Input**	
RTS to DOUT	**ADAC Converter**	
Fast Poll Output	**Output Transformer**	

Voltage Measurements.

TP	Measurement	tolerance
TP2	+5vdc	±.2vdc
U18 Pin 5	-5vdc	±.2vdc
TP4	+3.3vdc	±.1vdc
TP3	+1.8vdc	±.1vdc

Alignment Procedures.

As there are no adjustments, the DSP4xxFP SA modem does not require alignment.

Parts List

Electrical Interconnection Details & Drawings

The DSP4xxFP SA is a single board modem design and has no interconnections.

Appendix A – Configuration Switch Overview Chart

DIP Switches	Switch Settings	
	Close	**Open**
DIP Switch S1		
S1-1 to S1-3: Modem Data Rate (*) 19200bps for model DSP419FP only	**19200 (*)**: SW1=OPEN, SW2=OPEN, SW3=OPEN **9600**: SW1=**CLOSE**, SW2=OPEN, SW3=OPEN **4800**: SW1=**CLOSE**, SW2=**CLOSE**, SW3=OPEN **2400**: SW1=OPEN, SW2=**CLOSE**, SW3=OPEN **Bell 202T**: SW1=OPEN, SW2= OPEN, SW3=**CLOSE** **V.23**: SW1=**CLOSE**, SW2=**CLOSE**, SW3=**CLOSE**	
S1-4: DTE Async Character	11 bit	10 bit
S1-5: Auto RTS	Enable	Disable
S1-6: Transmit Carrier Control	Constant On	Controlled by RTS
S1-7: 2- or 4-wire leased line	2-wire half duplex	4-wire full duplex
S1-8: Transmitter Impedance	Controlled by RTS	600 ohms
S1-9: Remote Digital Loopback	Enable	Disable
S1-10: Re-Train Enabled (19200 bps only)	Enable	Disable
DIP Switch S2		
S2-1 to S2-3: Transmit Output Level	From -14 to 0 dBm See chart below	
S2-4: Modem Receive Dynamic Range	-10 to -43dBm	0 to -30dBm
S2-5: TX Cable Equalizer	Enabled	Disabled
S2-6: RX Cable Equalizer	Enabled	Disabled
S2-7: Anti-streaming	Active	Inactive
S2-8: RTS-CTS Delay (Bell 202T only)	33 msec	8.5ms
S2-9: Forced RTS ON	Active	Inactive
S2-10: Receiver Termination	600 ohms (Default)	Hi Impedance (Hi-Z)

To Select…	Set Switch S1-1 to…	Set Switch S1-2 to…	Set Switch S1-3 to…
19,200 bps (**Note**)	OPEN	OPEN	OPEN
9600 bps	**CLOSE**	OPEN	OPEN
4800 bps	**CLOSE**	**CLOSE**	OPEN
2400 bps	OPEN	**CLOSE**	OPEN
Bell 202T	OPEN	OPEN	**CLOSE**
V.23/1200	**CLOSE**	**CLOSE**	**CLOSE**

For modem speeds of 2400 bps or higher, the modem uses QAM modulation automatically. When the modem is operating at 1200 bps either in Bell202T or ITU-V.23 mode, the modem uses FSK modulation.

Note: Leased lines with a relatively flat 300-3400Hz bandwidth is required to support 19,200 bps operation.

GDI COMMUNICATIONS, L.L.C.
TRAFFIC EQUIPMENT MANUFACTURER ♦ SPECIALIZING IN COMMUNICATIONS

280 I-80 WEST EXIT 1
P.O. BOX 1330
VERDI, NEVADA 89439
TELEPHONE: 775-345-8000 F AX: 775-345-8010