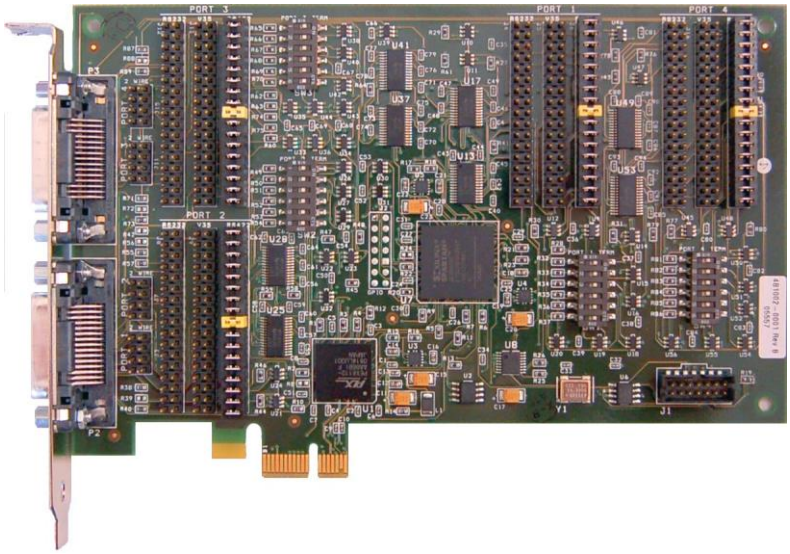
SyncLink GT4E Serial Adapter

Hardware User's Manual



MicroGate Systems, Ltd

http://www.microgate.com

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Overview

The SyncLink GT4E serial adapter is an add-in card for use in systems with a PCI Express expansion slot. The card provides four serial ports for use by the system. A variety of serial protocols and interface standards are supported. Refer to the software documentation included with the card for details on using the card for a specific application.

Features

- Maximum Speeds
  10Mbps synchronous
  8Mbps asynchronous
- SDLC, HDLC, BISYNC, MONOSYNC, ASYNC, raw bit-synchronous, TDM/McASP protocols
- Selectable hardware CRC: CRC-16, CRC-32, None
- DPLL Clock Recovery (x8 and x16 sampling)
- Clock Generation
- Configurable transmit preamble and idle patterns
- Encoding: NRZ,NRZB,NRZ-L,NRZI,NRZ-M,NRZ-S,FM0,FM1,Manchester,differential biphase level
- Selectable interface for RS-232, V.35, RS-422/485, RS-530, RS-449, X.21
- Optional termination for differential inputs
- Full set of control and status signals (DTR,DSR,RTS,CTS,DCD,RI,LL,RL)

Specifications

- MicroGate FPGA serial controller (4 ports)
- PCI Express (x1)
- Bus Master DMA data transfer
- Operating Temperature Range: 0C to 70C standard, -40C to +85C optional
- Storage Temperature Range: -55C to +125C
- Environmental: humidity 0 to 95% non-condensing; alt. - 200 to +20,000 ft
- Mechanical: Standard PCI Express short card; length 6.6", height 4.2", Weight 4.4 Oz
- Power usage: 3.3W max
- Regulatory: FCC, CE, RoHS
- Connectors: DB-25 (male)
- Cable Options: DB-25 (female) to DB-25 (male); DB-25 (female) to 34-pin V.35 (male); DB-25 (female) to 37-pin RS-449 (male); DB-25 (female) to 15-pin X.21 (male)

PCI Express

PCI Express is an expansion slot standard for adding components to a system. PCI Express is not physically compatible with PCI or PCI-X slots. SyncLink cards are physically keyed to prevent insertion into incompatible slots. The SyncLink GT4E is a PCI Express x1 single lane card that works in any of the different PCI Express slots sizes (x1, x4, x8, or x16). PCI Express x1 slots are the shortest and x16 slots are the longest.

Y-Cables

The card has two 60-pin connectors, each carrying two ports. Y-cables are included with the card to convert each 60-pin connector into two standard DB-25 male connectors. Each branch of a Y-cable is labeled with a port number. The Y-cable labeled 1 and 2 should be installed on the 60-pin connector closest to the PCI Express edge connector (gold fingers). The Y-cable labeled 3 and 4 should be installed on the 60-pin connector farthest from the PCI edge connector.

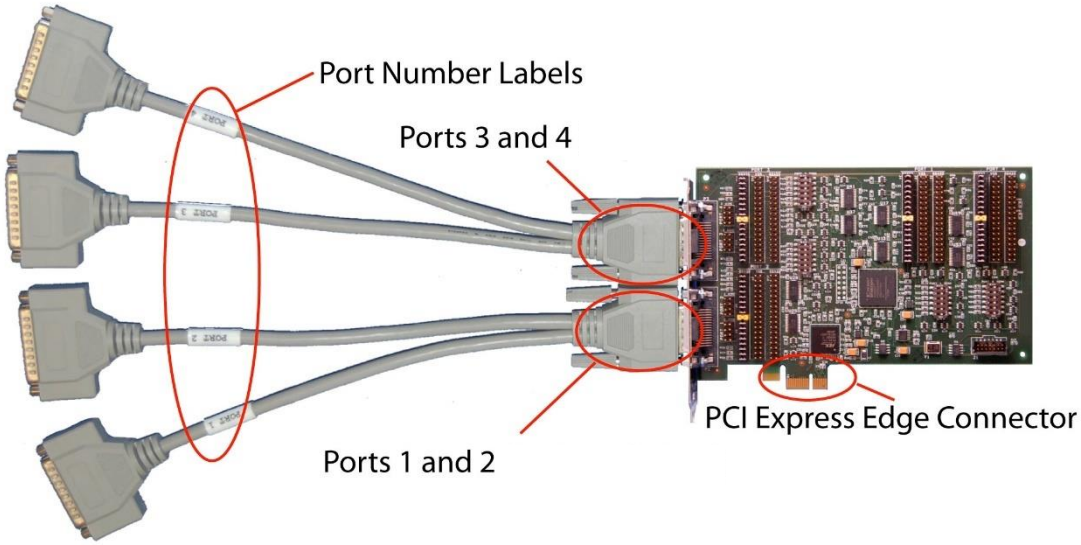


Figure 1 Y-Cables and Port Numbering

Signal Specifications

Each serial signal (control, status, data, or clock) is compatible with an electrical specification that is selected by placement of jumpers on the card. This section briefly describes the specifications supported by the card.

Single Ended Signals (RS-232/V.28)

SyncLink single ended signals are compatible with RS-232 and ITU V.28 standards. Each signal has one connector pin. Single ended signals share a common ground conductor.

The following voltages are measured with respect to ground.

- Maximum Voltage Range: +15 to -15V (between signal and ground)
- +3V to +15V (+5V typical) = control/status signal on or data value of 0
- -3V to -15V (-5V typical) = control/status signal off or data value of 1
- Voltage between -3V to +3V = invalid (indeterminate) state
- Max cable length 50 feet
- Max data rate 20kbps

The maximum data rate of 20kbps is part of the RS-232/V.28 standards. The SyncLink card can operate at speeds up to 120kbps depending on the cable length and loading. Longer cables and increased loading reduces the maximum supported data rate.

Differential Signals (RS-422/RS-485/V.11)

SyncLink differential signals are compatible with RS-422, RS-485 and ITU V.11 standards. Each signal has two connector pins, named A and B. These pins are also named -/+, but this convention can be inverted depending on context and manufacturer. Use A and B to avoid confusion.

A common ground conductor is recommended, but not required, to reduce common mode voltages between cable ends which may result in incorrect or impaired operation.

The following voltages are measured pin A with respect to pin B of each signal. Probing pin A with respect to ground (single probe) gives a positive voltage or ground, corresponding to the positive and negative differential values. Probing pin B with respect to ground gives a positive voltage or ground, with inverted polarity from pin A.

- Maximum Voltage Range: +6 to -6V (between conductors in a pair)
- +200mV to +6V (+2V typical) = control/status signal on or data value of 0
- -200mV to -6V (-2V typical) = control/status signal off or data value of 1
- Voltage between -200mV to +200mV invalid (indeterminate) state
- Max cable length 4000 feet
- Max data rate 10Mbps

Longer cables and increased loading reduces the maximum supported data rate.

Clock Polarity

Synchronous serial communications (HDLC/Bisync/Monosync) may use separate clock signals to control the timing of data signals. One clock cycle equals one bit. There are two clock edges (rising and falling) for each clock cycle. On one edge, the transmit data output changes. On the other edge, the receive data input is sampled. The assignment of clock edges to transmit data transition and receive data sampling is referred to as clock polarity.

SyncLink USB clock polarity is compatible with RS-232/RS-422/V.24/V.28/V.11:

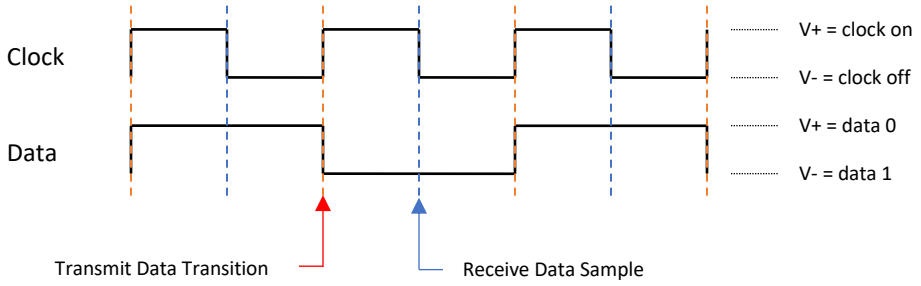
RS-232/V.28 Single Ended Signals

- +3V to +15V (+5V typical) = clock on
- -3V to -15V (-5V typical) = clock off
- On to Off edge (falling edge) = receive data sample (bit center)
- Off to On edge (rising edge) = transmit data transition (bit edge)

RS-422/RS-485/V.11 Differential Signals

- +200mV to +6V (+2V typical) = clock on
- -200mV to -6V (-2V typical) = clock off
- On to Off edge (falling edge) = receive data sample (bit center)
- Off to On edge (rising edge) = transmit data transition (bit edge)

Most serial communications equipment uses the above clock polarity, but some non-standard equipment may use the opposite polarity. For differential signals, inverting the conductors of each clock signal pair will alter the polarity.



Measured with respect to ground for single ended signals.
Measured pin A with respect to pin B for differential signals.

Data and Clock Polarity

Serial Interface Selection

The serial adapter supports different interface types which are selected by placement of jumpers on the card. Each port has three rows of headers (pins sticking up from the card). Each row is labeled with a port number and an interface type (RS-232, V.35, RS-422/485). Place jumpers on the header row labeled with the desired interface type. The interface type must match that of the connected communications equipment.

Interface selection is preset at the factory as specified by the ordering code. The selection may be changed by moving the jumpers to the desired header row as described above. Use pliers to remove the jumpers from the current position, carefully working the jumpers loose from the headers. Take care to not damage the card or cause injury.

Some interface types require a conversion cable in addition to a specific jumper setting to provide the necessary connector type. Refer to the Serial Pin Assignments section for more details.

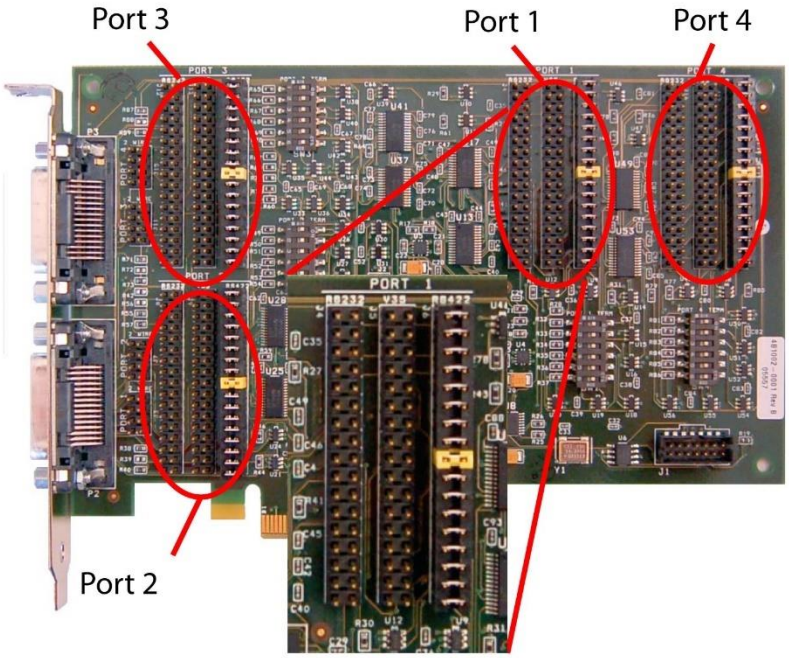


Figure 2 Interface Selection Jumpers

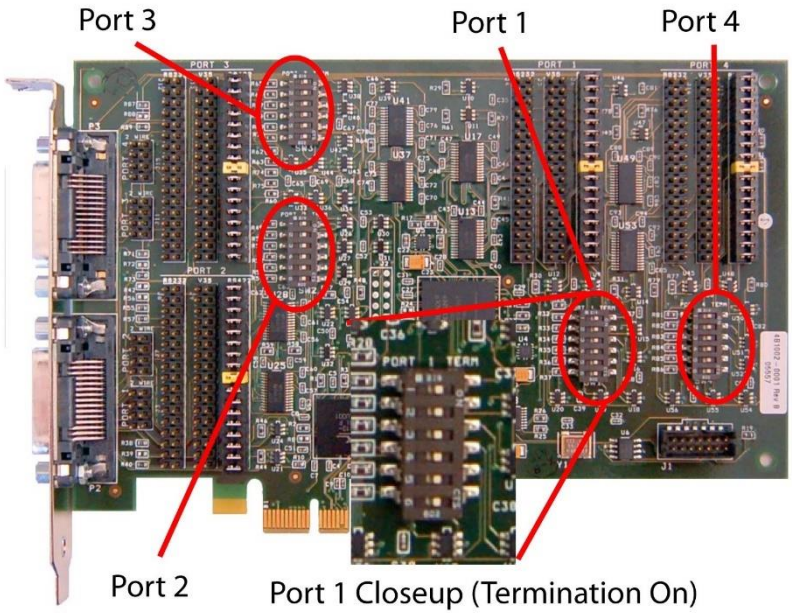
Differential Input Termination

Each port on the card has optional termination of RS-422/485 differential inputs controlled by a six position switch labeled with a port number and the word 'TERM'. Each position is labeled with a number (1 at top through 6 at bottom). The on position is to the right and is labeled 'ON'. When a switch is in the ON position, the associated differential input is terminated with 120 ohms. By default all inputs are terminated for all ports. Termination settings do not affect single ended (RS-232/V.28) inputs.

Termination increases signal reliability at high speeds (generally 1Mbps or more). At high speeds, inputs at each end of a cable should be terminated. For a multi-drop setups (more than 2 devices on a cable), do not terminate receivers connected to the middle of the cable. At slower speeds, the termination can usually remain without problem. Removing termination at slower speeds may allow the use of longer cables.

To disable termination on an input, move the associated switch position to OFF.

Switch Position	Signal Name
1	TxC (Transmit Clock)
2	RxC (Receive Clock)
3	RxD (Receive Data)
4	CTS (Clear to Send)
5	DSR (Data Set Ready)
6	DCD (Data Carrier Detect)



Port 1 Closeup (Termination On)

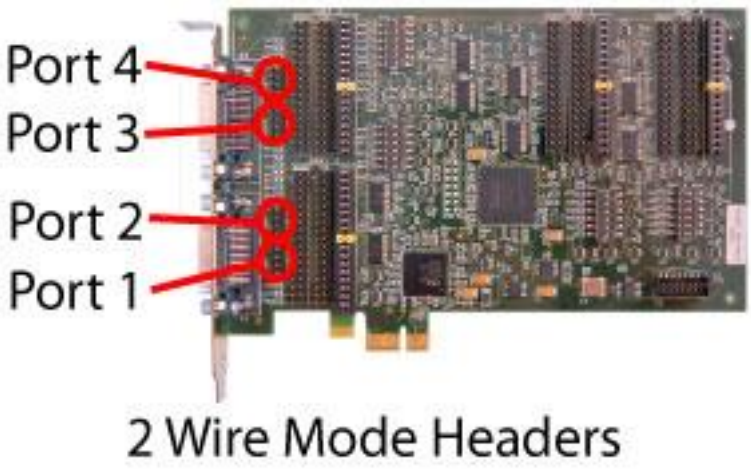
2 Wire Mode Jumpers

Some RS-485 applications use a single differential wire pair to carry data instead of separate pair for transmit and receive data. This arrangement is sometimes called ‘2 wire’ and is useful for minimizing wiring for connecting multiple end points. Only one end point sends data at any time, and all other end points can receive the data.

The GT4e card by default has separate transmit and receive data signals on different pins of the serial connector. Jumpers can be installed to connect transmit and receive pins together for use in a 2 wire environment. The jumpers are located next to the serial connector and are labeled with the port number and the text ‘2 WIRE’.

WARNING

The 2 wire jumpers should **never** be installed on ports configured for RS-232 to avoid damaging the card. The jumpers should only be installed when configured for RS-422/RS-485 **and** the application requires a common cable pair for transmit and receive data.



Jumpers are placed horizontally across the header pins. Each signal requires two jumpers to connect the two conductors of each differential pair. The drawing below identifies the header pins. Usually only TxD and RxD are connected (jumpers installed across pins 1 - 2 and 3 – 4).

View from top : Pin 1 = upper left

TxD (-/A) (1)	◯ ◯	(2) RxD (-/A)
TxD (+/B) (3)	◯ ◯	(4) RxD (+/B)
DTR (-/A) (5)	◯ ◯	(6) DSR (-/A)
DTR (+/B) (7)	◯ ◯	(8) DSR (+/B)

2-Wire Header Pin Numbering

Serial Connector Pin Assignments

The serial connectors on the end of each banch of the Y-cable are DB-25 (25 pins) male connectors. The assignment of signals to the connector pins is controlled by the interface selection jumpers on the card. For interface types that use a connector different than DB-25 an adapter cable purchased from MicroGate is required. The following sections describe the jumper settings and cables for each supported standard.

RS-232

The RS-232 standard uses single ended signals on a DB-25 connector. The adapter DB-25 connector follows this standard when the port jumpers are installed for RS-232. Use any straight through 25 conductor DB-25M to DB-25F cable (such as MicroGate Part # CMF000) to connect the adapter connector to the communications equipment.

The maximum data rate supported by the adapter when using RS-232 is 128Kbps. Cable length and signal loading may reduce the maximum usable data rate from this value.

RS-232 DB-25 Male DTE			
Signal Name	**Electrical Desc**	**Pin #**	**Direction**
Earth/Shield Ground		1	
TxD, Transmit Data	RS-232/V.28	2	Output
RxD, Receive Data	RS-232/V.28	3	Input
RTS, Request to Send	RS-232/V.28	4	Output
CTS, Clear to Send	RS-232/V.28	5	Input
DSR, Data Set Ready	RS-232/V.28	6	Input
Signal Ground		7	
DCD, Data Carrier Detect	RS-232/V.28	8	Input
TxC, Transmit Clock	RS-232/V.28	15	Input
RxC, Receive Clock	RS-232/V.28	17	Input
LL, Local Loopback Control	RS-232/V.28	18	Output
DTR, Data Terminal Ready	RS-232/V.28	20	Output
RL, Remote Loopback Control	RS-232/V.28	21	Output
RI, Ring Indicator	RS-232/V.28	22	Input
AuxClk, DTE Clock Output	RS-232/V.28	24	Output

RS-232 Cable (Part# CMF000)

V.35

V.35 uses both single ended and differential signals on a 34-pin block connector. To use this standard, select the V.35 jumper and use the MicroGate V.35 cable (Part # 2534GT, picture shown below).

LL, RL, and RI signals are available on the DB25 connector but are not available (NC = no connect) on the 34-pin block connector when using the V.35 cable.

Maximum data rate supported by the adapter when using V.35 is 10Mbps. Cable length and signal loading may reduce the maximum usable data rate from this value.

V.35 Male DTE				
Signal Name	**Electrical Desc**	**DB25 Pin #**	**V.35 Block Pin #**	**Direction**
Earth/Shield Ground		1	A	
TxD (-/A), Transmit Data	RS-422/V.11	2	P	Output
RxD (-/A), Receive Data	RS-422/V.11	3	R	Input
RTS, Request to Send	RS-232/V.28	4	C	Output
CTS, Clear to Send	RS-232/V.28	5	D	Input
DSR, Data Set Ready	RS-232/V.28	6	E	Input
Signal Ground		7	B	
DCD, Data Carrier Detect	RS-232/V.28	8	F	Input
RxC (+/B), Receive Clock	RS-422/V.11	9	X	Input
AuxClk (+/B), DTE Clock Output	RS-422/V.11	11	W	Output
TxC (+/B), Transmit Clock	RS-422/V.11	12	AA	Input
TxD (+/B), Transmit Data	RS-422/V.11	14	S	Output
TxC (-/A), Transmit Clock	RS-422/V.11	15	Y	Input
RxD (+/B), Receive Data	RS-422/V.11	16	T	Input
RxC (-/A), Receive Clock	RS-422/V.11	17	V	Input
LL, Local Loopback Control	RS-232/V.28	18	NC	Output
DTR, Data Terminal Ready	RS-232/V.28	20	H	Output
RL, Remote Loopback Control	RS-232/V.28	21	NC	Output
RI, Ring Indicator	RS-232/V.28	22	NC	Input
AuxClk (-/A), DTE Clock Output	RS-422/V.11	24	24	Output

V.35 Cable (Part# 2534GT)

RS-422/RS-449/RS-485/RS-530

RS-422, RS-485 and ITU V.11 define electrical properties of differential signals but not connector type or pin assignments. Configure a port to RS-422/485/530 to use all differential signals.

RS-530 defines differential signals on a DB-25 connector. Use a straight through 25 conductor DB-25M to DB-25F cable, such as MicroGate Part # CMF000.

RS-449 defines differential signals on a DB-37 connector. Use MicroGate RS-449 cable (Part # 2537FM).

Maximum data rate is 10Mbps. Cable length and signal loading may reduce the maximum data rate.

RS-422/RS-530/RS-449 Male DTE				
Signal Name	**Electrical Desc**	**DB25/RS-530 Pin**	**DB37/RS-449 Pin**	**Direction**
Earth/Shield Ground		1	1	
TxD (-/A), Transmit Data	RS-422/V.11	2	4	Output
RxD (-/A), Receive Data	RS-422/V.11	3	6	Input
RTS (-/A), Request to Send	RS-422/V.11	4	7	Output
CTS (-/A), Clear to Send	RS-422/V.11	5	9	Input
DSR (-/A), Data Set Ready	RS-422/V.11	6	11	Input
Signal Ground		7	19	
DCD (-/A), Data Carrier Detect	RS-422/V.11	8	13	Input
RxC (+/B), Receive Clock	RS-422/V.11	9	26	Input
DCD (+/B), Data Carrier Detect	RS-422/V.11	10	31	Input
AuxClk (+/B), DTE Clock Output	RS-422/V.11	11	35	Output
TxC (+/B), Transmit Clock	RS-422/V.11	12	23	Input
CTS (+/B), Clear to Send	RS-422/V.11	13	27	Input
TxD (+/B), Transmit Data	RS-422/V.11	14	22	Output
TxC (-/A), Transmit Clock	RS-422/V.11	15	5	Input
RxD (+/B), Receive Data	RS-422/V.11	16	24	Input
RxC (-/A), Receive Clock	RS-422/V.11	17	8	Input
LL, Local Loopback Control	RS-232/V.28	18	10	Output
RTS (+/B), Request to Send	RS-422/V.11	19	25	Output
DTR (-/A), Data Terminal Ready	RS-422/V.11	20	12	Output
RL, Remote Loopback Control	RS-232/V.28	21	14	Output
DSR (+/B), Data Set Ready	RS-422/V.11	22	29	Input
DTR (+/B), Data Terminal Ready	RS-422/V.11	23	30	Output
AuxClk (-/A), DTE Clock Output	RS-422/V.11	24	17	Output

RS-530 Cable (Part# CMF000)

RS-449 Cable (Part# 2537FM)

X.21

X.21 is an interface standard using differential signals on a DB-15 connector. To use this standard, install the RS-422/485 jumpers on a port and use the MicroGate X.21 cable (Part # 2515FM).

The X.21 signal names are different than those used by the adapter and other interface standards. The mapping of the X.21 signals to the adapter signals are shown in the table below.

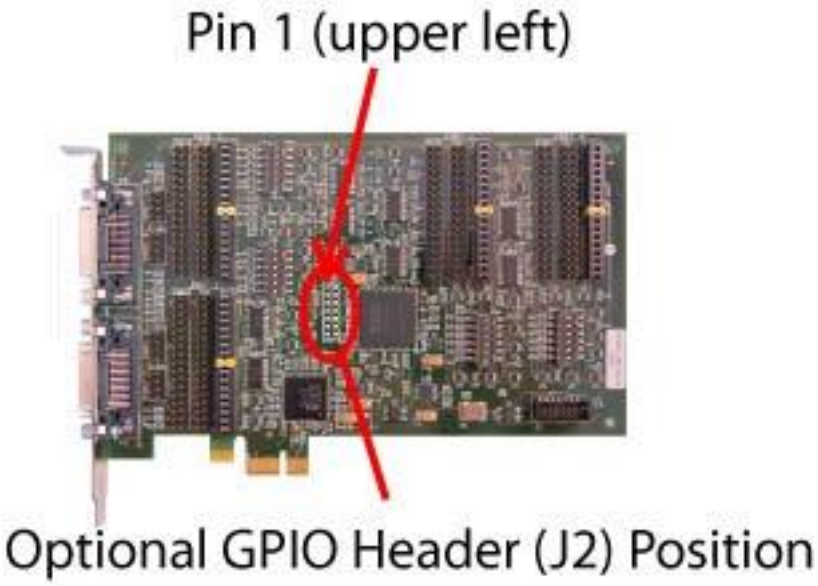
The maximum data rate supported by the adapter when using X.21 is 10Mbps. Cable length and signal loading may reduce the maximum usable data rate from this value.

X.21 Male DTE				
Signal Name	**Electrical Desc**	**DB25 Pin #**	**DB15 Pin #**	**Direction**
Earth/Shield Ground		1	1	
T(-/A), Transmit Data	RS-422/V.11	2	2	Output
R(-/A), Receive Data	RS-422/V.11	3	4	Input
I(-/A), Indicator (DSR/DCD)	RS-422/V.11	6,8	5	Input
Signal Ground		7	8	
S(+/B), Clock Input (TxC, RxC)	RS-422/V.11	9,12	13	Input
I(+/B), Indicator (DSR/DCD)	RS-422/V.11	10,22	12	Input
X(+/B), Clock Output (AuxClk)	RS-422/V.11	11	14	Output
T(+/B), Transmit Data	RS-422/V.11	14	9	Output
S(-/A), Clock Input (TxC, RxC)	RS-422/V.11	15,17	6	Input
R(+/B), Receive Data	RS-422/V.11	16	11	Input
C(-/A), Control (DTR)	RS-422/V.11	20	3	Output
C(+/B), Control (DTR)	RS-422/V.11	23	10	Output
X(-/A), Clock Output (AuxClk)	RS-422/V.11	24	7	Output

X.21 Cable (Part# 2515FM)

General Purpose I/O Signals

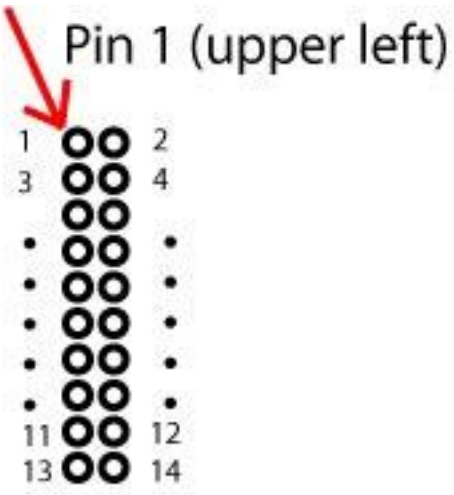
The serial card has an optional 14 pin header that provides general purpose input/output (GPIO) signals for application specific uses. These signals are controlled by an application using the serial API (Windows and Linux). Each signal can be configured to be either an input or an output. Inputs can be monitored and outputs can be controlled.



DC GPIO Specifications

Vil (input low) = -0.5V min, 0.8V max
Vih (input high) = 2.0V min, 5.5V max
Vol (output low) = 0.4V max
Voh (output high) = 2.4V min
Iol (output low) = 24mA max
Iil (output high) = -24mA max
Input Current = +/- 10uA max
GPIO signals are 3.3V TTL compatible and inputs are 5V tolerant.

GPIO Pin Assignments	
Pin #	**Description**
1	Ground
2	GCK0 Dedicated special purpose LVTTL input – Leave unconnected
3	GPIO[6]
4	GPIO[0]
5	GPIO[7]
6	GPIO[1]
7	GPIO[8]
8	GPIO[2]
9	GPIO[9]
10	GPIO[3]
11	GPIO[10]
12	GPIO[4]
13	GPIO[11]
14	GPIO[5]



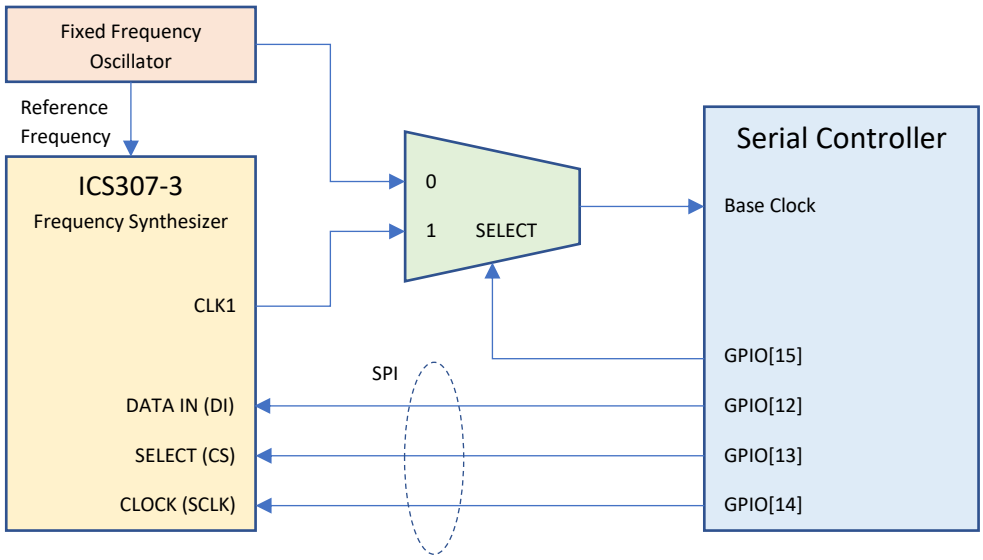
GPIO Header (J2) Pin Numbering

The GT adapter has a total of 12 general purpose I/O signals (GPIO[0] to GPIO[11]). By default on power up all GPIO signals are configured as inputs (direction control = 0). Refer to the serial API documentation for details on configuring and using GPIO signals.

WARNING: Take care when connecting to GPIO signals to prevent damage to the serial card. Outputs should only be connected to inputs and not other outputs. Voltage limits as shown above should not be exceeded.

Frequency Synthesizer

The serial controller requires a base clock which is used by the baud rate generator (BRG) to create data clocks. A data clock may be output on the AUXCLK signal or used internally for a synchronous data clock, an asynchronous sampling clock, or for DPLL clock recovery.



The card has a fixed frequency oscillator and a variable frequency synthesizer. Either source can supply the base clock. The oscillator is used as the synthesizer reference clock input. Serial controller GPIO signals program the synthesizer through an SPI interface and select between the oscillator and synthesizer outputs. The base clock is common to all ports in the controller.

The synthesizer is made by Integrated Device Technologies (IDT). Refer to the documentation available from IDT (www.idt.com) for details on programming the synthesizer. An IDT supplied program (Versaclock) generates programming data (132 bit value) for a specific frequency output. The CLK1 output of the synthesizer is used, CLK2 and CLK3 are unconnected. Sample code for programming the synthesizer through the GPIO portion of the serial API is available from Microgate. The maximum synthesizer frequency supported by the serial controller is 66MHz.

The default oscillator frequency is 14.7456MHz. Other frequencies are available by special order. By default the serial controller uses the oscillator as the base clock.