

SL24xxSU / SL24xxSE: 24-pin DIP

Features

- Over-Voltage and Current Protection: 70V and 200mA
- Parallel Phone Detection and Caller ID Detection
- EEPROM Included
- Supports the use of an External Clock
- DSP Based Hardware Modem
- 5.0V Tolerant I/O at Modem Interface to Host
- Power-Down Mode
- Low Power Consumption: 26mA at 3.3V Supply
- Built-in Safety Devices – No need to add any external safety device when modem is integrated into a system
- Modem Support for Nordic and Non-Nordic Countries in the Same Compact Form.
- Hardware Escape and Interrupt
- 24 –pin DIP Package: 1.40” x .90” (35.0 x 25.0mm)



Figure 1: 24-pin DIP Package

Product Description

The SL24xx modem is the newest series of embedded modems from Wintec. The modem integrates Silicon Laboratories' third generation ISModem chipset, which includes Si2493/57/34/15/04 DSP and Si3018 Direct Access Arrangement (DAA), and the supporting and safety devices into a compact 1.4"x0.9", dual-in-line (DIP) module format. It is one of the smallest embedded modems that meets global telephone line standards and with safety devices such as Fuse and SiDactor built-in, most applications do not need to add further safety features except an RJ-11 connector to the final product. The DIP pins on the module are placed on the popular 0.1" grid.

The SL24xxSU/SE modem operates in serial mode and its interface to the host is configured as serial UART (Universal Asynchronous Receiver Transmitter) interface. The selection of serial or parallel interface in ISModem chipset is determined by the state of AOUT pin in its DSP chip during the rise of RESET#. The on-chip 50-Kohm pull-up at AOUT pin ensures the modem is powered up in serial mode operation.

The SL24xx modem uses the AT command set to control the functionality and its internal register settings. It can be easily integrated into a system to function as a low cost communication link to the outside world. The DAA device in the modem is programmable to meet international telephone line interface requirements, with compliance to FCC, CTR21, and other country specific PTT specifications, such as the AC/DC termination, ring impedance, on-hook/off-hook intrusion detection, caller ID, loop voltage/loop current monitoring, over-current detection, ring detection, and the switch-hook function. The modem contains 15 signals, including Power and Ground, TIP and RING, and 11 I/Os.

Functional Block Diagram

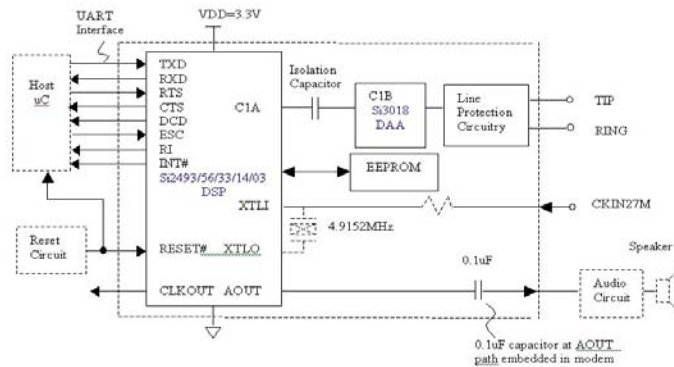


Figure 2: Functional Block Diagram

Protocol and Baud Rate

Besides being able to operate at a maximum connection speed of 56 Kbps, 33.6 Kbps, 14.4 Kbps, or 2.4 Kbps in full-duplex mode, all SL24xxSU/SE modems support ITU-T fall-back modes with speeds down as low as 300 bps. It is also possible to use extended AT commands to set various baud rates. Table 1 summarizes the protocol and baud rate supported by SL24xxSU/SE modem.

Features	SL24xxSU/ SL24xxSE (Commercial)
Serial Mode Operation	All
Parallel Mode Operation	All
V.42 Error Correction	All
V.42bis Data Compression	SL24 93/57/34/15 SU SL24 93/57/34/15 SE
MNP2-4 Error Correction	All
MNP5 Data Compression	SL24 93/57/34/15 SU SL24 93/57/34/15 SE
V.92 download 56K bps Max upload 48K bps Max	SL24 93 SU SL24 93 SE
V.90 download 56K bps Max upload 33.6Kbps Max	SL24 57 SU SL24 57 SE
V.34 33.6K bps Maximum	SL24 93/57/34 SU SL24 93/57/34 SE
V.32bis 14.4K bps Maximum	SL24 93/57/34/15 SU SL24 93/57/34/15 SE
V.32 9.6K bps Maximum	SL24 93/57/34/15 SU SL24 93/57/34/15 SE
V.23 1200 bps	SL24 93/57/34/15 SU SL24 93/57/34/15 SE
V.22bis 2.4K bps Maximum	All
Bell212A 1200 bps	All
V.21 300 bps	All
Bell 103 300 bps	All

Note: All = SL2493SU / SL2457SU / SL2434SU / SL2415SU / SL2404SU /
SL2493SE / SL2457SE / SL2434SE / SL2415SE / SL2404SE

Table 1: Summary of protocol and baud rate supported by SL24xxSU/SL24xxSE embedded modems

All modems also support V.42 and MNP2-4 error correction and V.42bis and MNP5 compression protocol, except for SL2404SU/SE. The SL2404SU/SE modem supports modulations and protocols of Bell 103, V.21, Bell212A, and V.22bis.

The error correction protocol ensures error-free delivery of asynchronous data sent between the host and the remote end. The error control groups data into frames with checksums determined by the contents of each frame. The receiving modem checks the frames and sends acknowledgements to the transmitting modem. When it detects a faulty frame, the receiving modem requests a re-transmission. Frame length varies according to the amount of data transmitted or the number of re-transmission requests from the far end.

The use of asynchronous compression protocol enables the SL24xxSU/SE modem to achieve DTE (Data Terminal Equipment, host-to-modem) rates greater than the maximum line (modem-to-modem) speed. With the support of ITU-T V.42bis compression protocol, the SL24xxSU/SE modem can be operated at a maximum DTE rate up to 307.2 kbps under the standard serial UART format.

Compliance to Global Telephone Standards

Wintec's SL24xxSU modems have passed the following homologation:

- (a) FCC Part 68
- (b) FCC Part 15
- (c) IC-CS03
- (d) ETSI TS 103 021-1,2,3 v.1.1.2 2003-09 (originally CTR21)
- (e) ESD
- (f) UL certification in progress

CTR21 is a consortium of 21 countries that have developed a common PTT (Post Telegraph & Telephone) modem specifications. CTR21 includes the following countries: Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Liechtenstein, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

FCC includes the following countries: Caribbean, Central America, China, Hong Kong, Malaysia, Mexico, Saudi Arabia, South American, Taiwan, United Arab Emirates, and the United States.

Power-On State / Operation

On reset, the SL24xxSU/SE modem defaults to command mode and accepts AT commands. All register settings are reverted to the default values stored in the program memory residing in the modem chipset. After the device is configured, an outgoing modem call can be made by way of the ATDT# (tone dial) or ATDP# (pulse dial) command. If handshake is successful, the modem replies with a response code and immediately enters data mode. The "ATO" command can also be used to enter data mode. In data mode, AT commands are no longer accepted. The modem reverts to command mode if the modem connection is terminated, or through the use of +++ escape sequence.

Upon power-up, the host UART baud rate can be automatically detected using the auto-baud feature (default). A pull-down resistor $\geq 10K$ ohms can be placed between pin 18 (EESDIO) of SI2493/57/34/15/04 DSP and GND on the modem module per customer request to set the DTE rate at 19.2Kbps baud at power-up. If the SL24xxSU/SE modem is unable to negotiate a V.42 link with a remote modem, it falls back to wire mode. The error correction (ITU-T V.42) and data compression (ITU-T V.42bis) are not active in wire mode.

Pin Definition of SL24xxSU/SL24xxSE:

Pin 1	No Connect (NC)	Pin 24	TIP
Pin 2	No Connect (NC)	Pin 23	RING
Pin 3	No Pin (NP)	Pin 22	No Pin (NP)
Pin 4	No Pin (NP)	Pin 21	No Pin (NP)
Pin 5	No Pin (NP)	Pin 20	ESC (tied to GND, if un-used; 3.3V output)
Pin 6	No Pin (NP)	Pin 19	RI (3.3V output)
Pin 7	No Pin (NP)	Pin 18	INT# (3.3V output; open, if un-used)
Pin 8	DCD (3.3V output)	Pin 17	AOUT (built-in capacitor on module; open if unused)
Pin 9	RTS (5V tolerant input)	Pin 16	RXD (3.3V output)
Pin 10	CKIN27M (3.3V I/O)	Pin 15	TXD (5V tolerant input)
Pin 11	GND	Pin 14	CTS (3.3V output)
Pin 12	VDD33 (3.3V supply)	Pin 13	RESET# (5V tolerant input)

The connection order of TIP and RING is exchangeable. A polarity rectifier in SL24xxSU/SE can automatically correct the polarity of TIP and RING before being input to DAA.

In the SL24xxSU/SL24xxSE modem, a capacitor has already been added to the AOUT pin to avoid the AOUT pin from being accidentally pulled to ground by an external pull-down resistor after power-on reset. This ensures the SL24xxSU/SE modem always powers up to serial mode operation. There is no need to add an external capacitor to the AOUT pin on the main-board. This is different from the dual mode SLM24xx DIP modem, where an external capacitor must be connected to the AOUT pin on the main-board to select the serial mode. In case the main board of the SL24xxSU/SE modem already has an external capacitor at the AOUT path, a 0-ohm resistor can be used as the capacitor BOM.

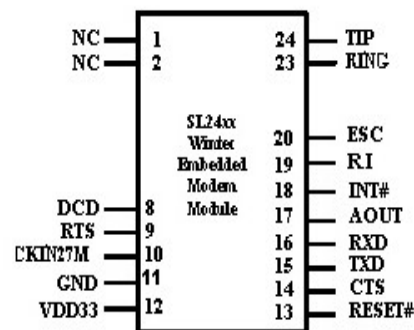


Figure 3: SL Modem Pin Diagram

Interface Signal Description:

The serial interface of SL24xxSU/SE can be directly connected to the UART port at host or to a RS-232 interface though a level conversion IC. RS stands for “recommended standard”. As the original standard was established before the days of TTL logic, it is not surprising to see that the standard does not use 5V/3.3V and ground logic level. Instead, a high level for driver output is defined as +5V to +15V and a low level for driver output is defined as being between -5V and -15V. The receiver logic level was defined to have a 2V noise margin. As such, a high level for the receiver is defined as +3 to +15V and a low level is -3 to -15V.

For RS-232 communication, a low level (-3V to -15V) is defined as logic 1 and is referred to as “marking”. A high level (+3 to +15V) is defined as logic 0 and is referred as “spacing”. The flow control signal is asserted if it is in logic 0 state. There is no “#” or “~” symbol appended to the serial interface signal to indicate it is asserted in logic 0 to avoid confusion. The serial mode interface signals in the SL24xxSU/SE modems are:

TXD: Transmitted Data; generated by DTE (PC or host), received by DCE (modem).

RXD: Received Data; output by DCE, received by DTE.

RTS: Request to Send. When DTE is ready to transmit data to DCE, RTS is turned on (“ON” refer to a high in RS-232, or logic “0”). An “ON” condition maintains the DCE in receive mode. After RTS is asserted, the DCE must assert CTS (Clear to Send) before communication commence.

CTS: Clear To Send. CTS is used along with RTS to provide handshaking between the DTE and the DCE. After the DCE sees an asserted RTS, it turns CTS ON when it is ready to communicate.

DTR: Data Terminal Ready. DTR indicates the readiness of DTE. This signal is turned ON by DTE when it is ready to transmit or receive data from the DCE.

DSR: Data Set Ready. DSR is turned on by DCE to indicate it is connected to telecommunication line.

DCD: Data Carrier Detect. DCD is turned on when DCE is receiving a signal from a remote DCE. This signal remains ON as long as a suitable carrier signal can be detected. SL24xxSU/SE modem asserts DCD after it receives a carrier signal from a remote modem. The serial interface pin DCD (data carrier detect) remains asserted as long as the modem is connected.

RI: Ring Indicator. When RI is asserted, it indicates that a ringing signal is being received on the communication channel.

ESC: Escape. A level-sensitive input from host. A high to this pin returns the modem to Command mode. In the 9-bit data transfer (9N1), a 1 detected on the 9th data bit also returns the modem to Command mode if such function is enabled via the \B6 AT commands. The escape sequence “+++” can return the modem to Command mode too.

INT#: Active low interrupt output to host.

RESET#: Active low system reset. A counterpart soft reset can be generated by using the AT command.

Timing Diagram:

The UART interface synchronizes on the start bits of incoming characters. It then samples the data bit field and stop bits. The UART interface can accommodate character lengths of 8, 9, 10, and 11 bits, giving data fields of 6, 7, 8, or 9 bits. The default character length is 8-bit. The timing diagram and timing requirements of the SL24xxSU/SL24xxSE modem is shown in Figure 3:

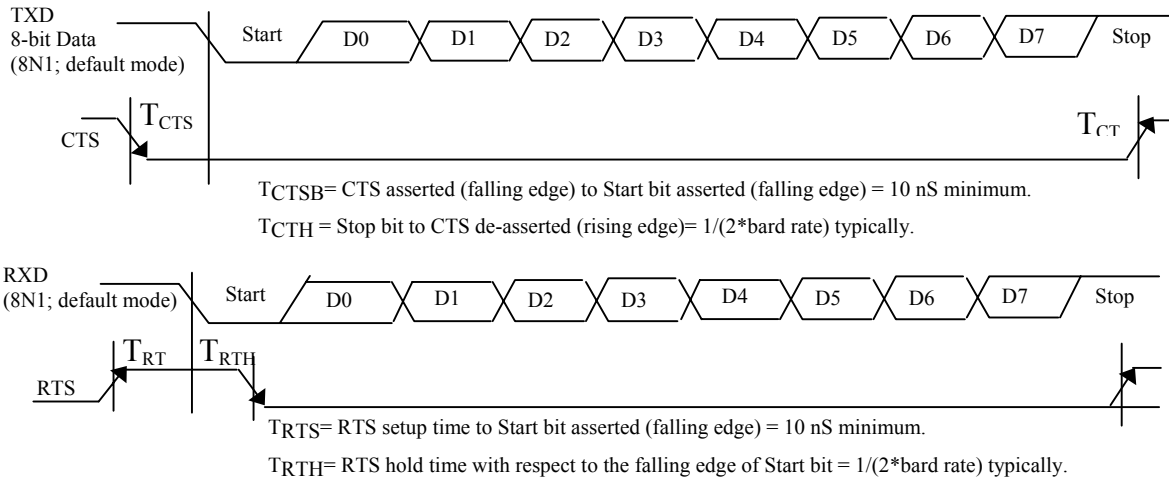


Figure 4: Serial mode timing diagram and timing requirement

Outstanding Features

Besides the capability to be programmable to meet global telephone line interface requirements, the SL24xxSU/SL24xxSE modems also show various outstanding features:

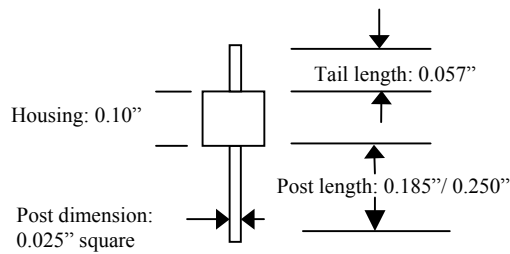
1. Hardware escape and interrupt. The built-in hardware interrupt (INT#) and escape (ESC) pins on the SL24xxSU/SE module enable a fast response to an external event, which is highly desirable for timing critical application such as point-of-sales (POS) devices. In addition, the INT# pin can be used to indicate the FIFO status or to detect off-hook intrusion, ... etc.
2. Supports the use of an external clock, which enables the user to select the option without a crystal on the module to lower height or to reduce the number of components on the module to save on costs.
3. The modem accepts the basic AT command set, along with many enhanced AT commands (A complete list of the AT command set is available in the SiLabs' Programmer User Guide). The SL24xxSU/SE modem includes an optional EEPROM chip, which enables users to implement special communication protocols, to customize their own AT command set, or to perform firmware/revision upgrade at field, etc.
4. Modem support Nordic and non-Nordic countries in the same compact 1.4"x0.9" form factor. User can choose either SL24xxSU or SL24xxSE to meet their applications need and cost target.
5. Built-in safety devices. In the SL24xxSU, the Fuse and SiDactor are built-in and in the SL24xxSE, the SiDactor and cross-bar device are built-in. Users no longer need to add any external safety device when the modem is integrated into the system.
6. SL24xxSU/SE is a DSP based hardware modem, which is different from the soft modem that relies on the computing power of the system processor to emulate the communication protocols. Error correction protocol minimizes errors during data transfer between the host and a remote end.
7. Over-current protection, up to 70V and 200mA. The over-current protection is to protect the modem from being accidentally plugged into a digital phone line. Many digital PBX lines have a low impedance, high current voltage source cross the two terminals of an RJ-11 jack which is normally the TIP and RING on an analog phone line. When an analog modem is plugged into a digital line, it goes off hook and draws excessive current, which could potentially damage the hook switch components. The ISModem chipset can detect the over-current conditions to generate an interrupt to the host to force the modem into high impedance mode or on-hook before damage occurs.
8. Parallel phone detection and caller ID detection. The SL24xxSU/SE modem can detect when another telephone, modem or other device is using the phone line. It can also detect the first burst ring and echo it to the host for caller ID decode.
9. Low Power consumption: The nominal operational current is only 26mA at a 3.3V supply. In addition, the SL24xxSU/SE modem can enter the sleep state after a pre-programmed time of inactivity to save power. It awakes on ring.
10. Power down mode. Once the PDN bit in the control register is written, the modem will enter power down mode. It can be powered back through the assertion of the RESET# pin.
11. Automatic baud rate detection: This feature (auto-baud) allows the host to start transmitting data at any standard DTE rate from 300bps to 307.2Kbps. This feature is enabled by default. The automatic fallback to match far-end communication speeds range from 56Kbps to 300 bps. This feature is also enabled by default.
12. 5V tolerant I/O at the modem interface to the host.

Appendix 1. Modem Header Specification:

(A) Pin Header Specification:

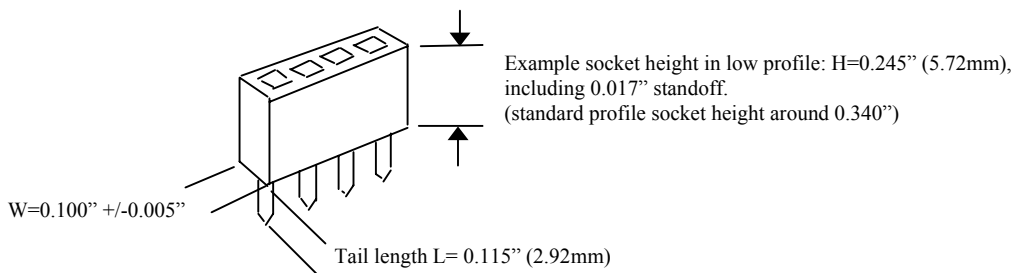
1. Pin Coating: 3-6 micro-inch gold flash (30 micro-inch gold plating is also available)
2. Post dimension: 0.025" per side, square pin
3. Two post lengths are available:
 - Post length: 0.185" for low profile socket (mate height ranges from 0.245" to 0.200" including standoff)
 - Post length: 0.250" for standard socket (mate height ranges from 0.340" to 0.245" including standoff)
 - For other different lengths are also available per customer's request.
4. Housing insulator: 0.10"
5. Tail length: 0.057"
6. Pin pitch: 0.1"

(B) Pin Header Drawing:



(C) Socket:

The mate (socket, receptacle) for DIP pin is a single-in-line socket strip with 0.100" (2.54mm) centered to match with 0.025" (0.64mm) square mating posts. Some mate examples could be 0.100" Box Receptacle, 0.100" Board Mount Socket, or Socket stripes. Both surface mount and through-hole board mount versions could be used, however through-hole provides more precise position control in socket assembly.



Appendix 2. Evaluation Board

A companion evaluation board is available and recommended for evaluating the functionality of the SL24xxSU/SE modem and the AT command set used in the ISModem chipset. It has been found very helpful for customers to start with the evaluation board. The part number for the SL24xxSU evaluation board is SL24xxSUEVB, where “xx” is 93, 57, 34, 15, or 04.

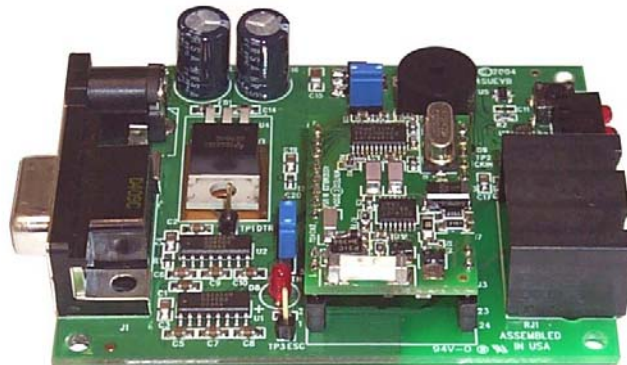


Figure 5: SL24xxSU Evaluation board

Ordering Information

Speed	Part Number	Description
2400 bps	SL2404SU	Si2404 Global Modem Module
	SL2404SE	Si2404 Global Modem Module – Nordic*
14.4 Kbps	SL 2415SU	Si2415 Global Modem Module
	SL 2415SE	Si2415 Global Modem Module – Nordic*
33.6 Kbps	SL2434SU	Si2434 Global Modem Module
	SL2434SE	Si2434 Global Modem Module – Nordic*
56 Kbps V.90	SL2457SU	Si2457 Global Modem Module
	SL2457SE	Si2457 Global Modem Module – Nordic*
56 Kbps V.92	SL2493SU	Si2493 Global Modem Module
	SL2493SE	Si2493 Global Modem Module – Nordic*
Evaluation Board	SL24xxEVB-U	Si24xx Global Modem Module
	SL24xxEVB-E	Si24xx Global Modem Module – Nordic*