Operation and Service Manual

Octal Four-Wire Multiplexer

SIM925

Stanford Research Systems

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Certification

Stanford Research Systems certifies that this product met its published specifications at the time of shipment.

Warranty

This Stanford Research Systems product is warranted against defects in materials and workmanship for a period of one (1) year from the date of shipment.

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General Information

The SIM925 Octal Four-Wire Multiplexer, part of Stanford Research Systems' Small Instrumentation Modules family, is a switch that connects one of eight four-wire input channels to a four-wire output (common). It is possible to bypass all of the channels; connecting the output to the bypass channel allows cascading of multiple modules.

Safety and Preparation for Use

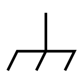
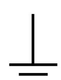
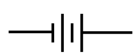
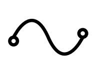
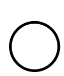
The excitation leads and the (unbuffered) sense leads in the SIM925 are isolated from the Earth, the power-line-outlet ground, the metal chassis of the module, and from each other. No dangerous voltages are generated by the module. However, if a dangerous voltage is applied to an input, it may be present on the output connector, and may cause injury or death.

Do not exceed ±15 *volts to the Earth at each input, output, or bypass terminal.*

Do not install substitute parts or perform unauthorized modifications to this instrument.

The SIM925 is a single-wide module designed to be used inside the SIM900 Mainframe. Do not turn on the power to the mainframe or connect inputs or outputs to the module until the module is completely inserted into the mainframe and locked in place.

Symbols you may Find on SRS Products

Symbol	Description
	Alternating current
	Caution - risk of electric shock
	Frame or chassis terminal
	Caution - refer to accompanying documents
	Earth (ground) terminal
	Battery
	Fuse
	On (supply)
	Off (supply)

Notation

The following notation will be used throughout this manual:

- Front-panel buttons are set as [Button];
  [Adjust ▲▼] is shorthand for "[Adjust ▲] & [Adjust ▼]".
- Front-panel indicators are set as *Overload*.
- Signal names are set as BUSY.
- Signal levels are set as HIGH.
- Remote command names are set as *IDN?.
- Literal text other than command names is set as `OFF`.
- Special ASCII characters are set as ⟨CR⟩.

Specifications

Performance Characteristics

		Min	Typ	Max	Units
Switching	Input channels	8, plus 1 bypass channel			
	Wires per channel	4			
	Switch capacity			10	mA
				10	V DC
	Switch thermal EMF			10	μV
	Order	Break-before-make (default); Make-before-break [1]			
	Speed [2]			50	ms
Channel resistance	Series			2.0	Ω
	Isolation		10		GΩ
Input capacitance	Selected channel [3]			60	pF
	Selected to unselected channel [4]			25	pF
	Unselected channels [3]			25	pF
Active buffer	Bandwidth		1		MHz
	Input noise, 10 Hz		30		$\mathrm{nV}/\sqrt{\mathrm{Hz}}$
	Input noise, 1 kHz		16		$\mathrm{nV}/\sqrt{\mathrm{Hz}}$
	Bias current		5		pA
	Input overload limits	±0.99		±1.04	V
Operating	Temperature [5]	0		40	°C
	Power	+5, ±15			V DC
	Supply current, +5 V		50		mA
	Supply current, ±15 V		10		mA

Conditions:
- [1] Accessible through the remote interface only.
- [2] Break-before-make.
- [3] Between every two leads, and between each lead and the ground.
- [4] Between every two leads.
- [5] Non-condensing.

General Characteristics

Interface	Serial (RS–232) through SIM interface
Connectors	DB–37 (female, front)
	DB–9 (male, rear)
	DB–9 (female, rear)
	DB–15 (male) SIM interface
Weight	1.5 lbs
Dimensions	1.5″ W × 3.6″ H × 7.0″ D

1 Getting Started

This chapter gives you the necessary information to get started quickly with your SIM925 Octal Four-Wire Multiplexer.

In This Chapter

1.1 Introduction to the Instrument

The SIM925 is designed for low-level signal applications. Sets of four leads can be switched with a single command; each set forms a *channel* of the SIM925. Two of the four leads are sense leads, and two are excitation leads. Within each channel, the two sense leads (labeled $+V$ and $-V$) are equivalent, and the two excitation leads (labeled $+I$ and $-I$) are equivalent: the ± signs are strictly notational, and impose no polatiry requirement. However, the sense leads and the excitation leads switch at different times (Section 2.1). Only the sense leads can be buffered. Kelvin-lead measurements are supported with this buffering. If the buffer is switched out, the module forms a simple relay-based, 4-pole/8-throw switch. The bypass connection allows multiple modules to be cascaded, providing unlimited networking possibilities.

sense leads

excitation leads

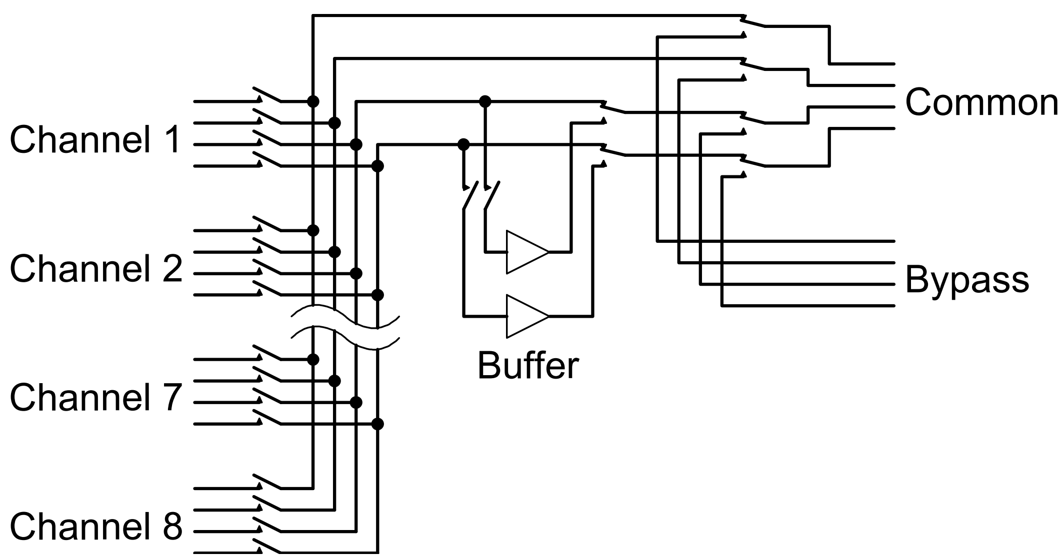


Figure 1.1: The SIM925 block diagram.

The digital control circuitry in the SIM925 is designed with a special clock-stopping architecture. The microcontroller is turned on only when switch settings are being changed, during remote communications, or when an overload condition occurs. This guarantees that no digital noise contaminates low-level analog signals.

remote interface

Switch settings may be changed from the front panel or through the remote interface (RS–232 or GPIB). These settings can also be queried. If armed, the module generates a status signal to alert the user of an overload condition. The SIM925 can be operated outside the SIM900 Mainframe by powering it with its required DC voltages.

1.1.1 Front and rear panels

Figure 1.2: The SIM925 front and rear panels.

1.2 Front-Panel Operation

The seven-segment display indicates the selected channel. When a channel is *selected*, its input relays are latched in the closed position. Use the [Channel ▲▼] buttons to change the selected channel up or down. The display

-

(dash) indicates that all channels' input relays are latched in the open position. *This state is not the same as the bypassed state.*

bypass In order to bypass all input channels and connect the bypass channel to the common output, press the [Bypass] button. The yellow *Bypass* LED will turn on. This connection can be made or broken while an input channel stays selected. The selected input channel will still be indicated on the display, but will be disconnected from the common. Press the [Bypass] button again to disconnect the bypass channel from the common.

buffer A press of the [Buffer] button connects the sense leads of a selected channel to a pair of unity-gain, high-impedance voltage buffers. This action also connects the outputs of the buffers to the common, unless the common is connected to bypass. The green *Buffer* LED is on when the buffer is active. If the magnitude of the voltage (with respect to the chassis ground) on one or both sense leads exceeds the limits in the specification table on Page vi, the red *OVLD* LED turns on. The LED stays on for a minimum of 40 ms; after this time it will turn off if the overload condition has ceased.

1.3 Connections

The SIM interface connector is discussed in Section 1.6.1.

1.3.1 Input connector

The female DB–37 connector on the front panel accommodates the eight input channels. The connector signals are specified in Table 1.1.

Pin	Signal	Description	Pin	Signal	Description
1	$+I$ Ch. 1	Excitation, Channel 1	20	$-I$ Ch. 1	Excitation, Channel 1
2	$+V$ Ch. 1	Sense, Channel 1	21	$-V$ Ch. 1	Sense, Channel 1
3	GND Pass-Thru	Pass-through ground	22	$+I$ Ch. 2	Excitation, Channel 2
4	$-I$ Ch. 2	Excitation, Channel 2	23	$+V$ Ch. 2	Sense, Channel 2
5	$-V$ Ch. 2	Sense, Channel 2	24	$+I$ Ch. 3	Excitation, Channel 3
6	$-I$ Ch. 3	Excitation, Channel 3	25	$+V$ Ch. 3	Sense, Channel 3
7	$-V$ Ch. 3	Sense, Channel 3	26	GND Pass-Thru	Pass-through ground
8	$+I$ Ch. 4	Excitation, Channel 4	27	$-I$ Ch. 4	Excitation, Channel 4
9	$+V$ Ch. 4	Sense, Channel 4	28	$-V$ Ch. 4	Sense, Channel 4
10	$+I$ Ch. 5	Excitation, Channel 5	29	$-I$ Ch. 5	Excitation, Channel 5
11	$+V$ Ch. 5	Sense, Channel 5	30	$-V$ Ch. 5	Sense, Channel 5
12	GND Pass-Thru	Pass-through ground	31	$+I$ Ch. 6	Excitation, Channel 6
13	$-I$ Ch. 6	Excitation, Channel 6	32	$+V$ Ch. 6	Sense, Channel 6
14	$-V$ Ch. 6	Sense, Channel 6	33	$+I$ Ch. 7	Excitation, Channel 7
15	$-I$ Ch. 7	Excitation, Channel 7	34	$+V$ Ch. 7	Sense, Channel 7
16	$-V$ Ch. 7	Sense, Channel 7	35	GND Pass-Thru	Pass-through ground
17	$+I$ Ch. 8	Excitation, Channel 8	36	$-I$ Ch. 8	Excitation, Channel 8
18	$+V$ Ch. 8	Sense, Channel 8	37	$-V$ Ch. 8	Sense, Channel 8
19	GND Pass-Thru	Pass-through ground			

Table 1.1: Front-panel (input) connector pin assignments, DB–37.

The pass-through ground is not connected to the chassis ground inside the SIM925.

1.3.2 Bypass connector

The female DB–9 connector on the rear panel accommodates the bypass leads. The connector signals are specified in the following table.

Pin	Signal	Description
1	$+I$	Excitation
2	$-I$	Excitation
3	GND Pass-Thru	Pass-through ground
4	$+V$	Sense
5	$-V$	Sense
6	GND Pass-Thru	Pass-through ground
7	GND Pass-Thru	Pass-through ground
8	GND Pass-Thru	Pass-through ground
9	GND Pass-Thru	Pass-through ground

Table 1.2: Bypass connector pin assignments, DB–9 (female).

1.3.3 Common connector

The male DB–9 connector on the rear panel is the output common. The connector signals are specified in the following table.

Pin	Signal	Description
1	$+I$	Excitation
2	$-I$	Excitation
3	GND Pass-Thru	Pass-through ground
4	$+V$	Sense
5	$-V$	Sense
6	GND Pass-Thru	Pass-through ground
7	GND Pass-Thru	Pass-through ground
8	GND Pass-Thru	Pass-through ground
9	GND Pass-Thru	Pass-through ground

Table 1.3: Common connector pin assignments, DB–9 (male).

1.4 Power-On

The instrument retains the selected channel, the state of the bypass, the state of the buffer, and the switching order (Section 2.1) in non-volatile memory. Upon power-on, those settings will be restored to their state before the power was turned off.

All switches retain their latched state after the power has been turned off, until the next time the power is turned on.

The power-on configuration of the remote interface is detailed in Section 3.3.1.

1.5 Restoring the Default Configuration

The default configuration of the SIM925 is no input channel selected, bypass OFF, buffer OFF, switching order set to break-before-make. To reset the module into this configuration, turn the SIM900 Mainframe power on while holding a front-panel button of the SIM925.

The same configuration can also be reached from the remote interface by issuing the *RST command.

1.6 SIM Interface

The primary connection to the SIM925 Octal Four-Wire Multiplexer is the rear-panel DB–15 SIM interface connector. Typically, the SIM925 is mated to a SIM900 Mainframe via this connection, either through one of the internal mainframe slots or the remote cable interface.

It is also possible to operate the SIM925 directly, without using the SIM900 Mainframe. This section provides details on the interface.

1.6.1 SIM interface connector

The DB–15 SIM interface connector carries all the power and communication lines to the instrument. The connector signals are specified in Table 1.4.

Pin	Signal	Direction Src ⇒ Dest	Description
1	SIGNAL_GND	MF ⇒ SIM	Ground reference for signal
2	¬STATUS	SIM ⇒ MF	Status/service request (GND=asserted, +5 V=idle)
3	RTS	MF ⇒ SIM	HW Handshake
4	CTS	SIM ⇒ MF	HW Handshake
5	¬REF_10MHZ	MF ⇒ SIM	10 MHz reference (No connection in SIM925)
6	−5V	MF ⇒ SIM	Power supply (No connection in SIM925)
7	−15V	MF ⇒ SIM	Power supply
8	PS_RTN	MF ⇒ SIM	Power supply return
9	CHASSIS_GND		Chassis ground
10	TXD	MF ⇒ SIM	Async data (start bit="0"= +5 V; "1"=GND)
11	RXD	SIM ⇒ MF	Async data (start bit="0"= +5 V; "1"=GND)
12	+REF_10MHZ	MF ⇒ SIM	10 MHz reference (No connection in SIM925)
13	+5V	MF ⇒ SIM	Power supply
14	+15V	MF ⇒ SIM	Power supply
15	+24V	MF ⇒ SIM	Power supply (No connection in SIM925)

Table 1.4: SIM interface connector pin assignments, DB–15.

1.6.2 Direct interfacing

The SIM925 is intended for operation in the SIM900 Mainframe, but users may wish to directly interface the module to their own systems without the use of additional hardware.

The mating connector needed is a standard DB–15 receptacle, such as Tyco part number 747909–2 (or equivalent). Clean, well-regulated supply voltages of ±15.0 V DC, +5.0 V DC must be provided, following the pinout specified in Table 1.4. Ground must be provided on Pin 8, with chassis ground on Pin 9. The ¬STATUS signal may be monitored on Pin 2 for a low-going TTL-compatible output indicating a status message. See Section 3.5 for the description of status messages.

The SIM925 has no internal protection against reverse polarity or overvoltage on the +5 V and the ±15 V power-supply pins. A supply voltage on Pin 13 above 5.5 V is likely to damage the instrument.

1.6.2.1 Direct interface cabling

If the user intends to directly wire the SIM925 independent of the SIM900 Mainframe, communication is usually possible by directly connecting the appropriate interface lines from the SIM925 DB–15 plug to the RS–232 serial port of a personal computer.[1] Connect RXD from the SIM925 directly to RD on the PC, TXD directly to TD, and similarly RTS→RTS and CTS→CTS. In other words, a null-modem-style cable is *not* needed.

To interface directly to the DB–9 male (DTE) RS–232 port typically found on contemporary personal computers, a cable must be made with a female DB–15 socket to mate with the SIM925, and a female DB–9 socket to mate with the PC's serial port. Separate leads from the DB–15 need to go to the power supply, making what is sometimes know as a "hydra" cable. The pin connections are given in Table 1.5.

DB–15/F to SIM925		Name
	DB–9/F	
10 ⟷	3	TxD
11 ⟷	2	RxD
	5	Computer Ground
	to Power Supply	
7 ⟷	−15 V DC	
13 ⟷	+5 V DC	
14 ⟷	+15 V DC	
8,9 ⟷	Ground (Supply return current)	

Table 1.5: SIM925 direct interface cable pin assignments.

1.6.2.2 Serial settings

The initial serial port settings at power-on are: baud rate 9600, 8 bits, no parity, 1 stop bit, and RTS flow control. The baud rate of the SIM925 cannot be changed. The flow control and the parity may be changed with the FLOW and PARI commands.

[1] Although the serial interface lines on the DB–15 do not satisfy the minimum voltage levels of the RS–232 standard, these lines are typically compatible with desktop personal computers.

2 Description of Operation

This chapter provides a number of additional details of the operation of the SIM925.

In This Chapter

2.1 Switching Order

There are two settings for the order in which the input relays of the SIM925 switch, selecting the input channel: break-before-make and make-before-break. The "making" and "breaking" of the connections refers to the excitation leads *only.* The sense leads are always disconnected ("broken") before being connected to a new input channel ("made").

break-before-make

If the order is break-before-make (the default), the two sense leads and the two excitation leads are disconnected from the input to the SIM925 at approximately the same time (within 1 ms of each other). At a typical time of 5 ms later, the two sense leads and the two excitation leads are connected to the new input channel, at approximately the same time (within 1 ms of each other).

make-before-break

From the remote interface, use the MODE command to change the switching order. If the order is changed to make-before-break, the two sense leads are disconnected from the input to the SIM925 at approximately the same time (within 1 ms of each other). At a typical time of 5 ms later, the two sense leads and the two excitation leads are connected to the new input channel at approximately the same time (within 1 ms of each other). The excitation leads remain connected to the old input channel at this time. Another 5 ms (typ.) later, the two excitation leads are disconnected from the old input channel within 1 ms of each other, and the switching sequence is complete.

If the new channel setting is "no channel selected" (CHAN 0) and the mode is break-before-make, the four leads are disconnected at approximately the same time (within 1 ms of each other). If the new channel setting is "no channel selected" and the mode is make-before-break, the two excitation leads are disconnected approximately 5 ms after the two sense leads. If the old channel setting was "no channel selected", all four leads switch to the new input at approximately the same time.

If the remote interface is not available and the switching order setting is stored in the non-volatile memory, use the manual reset procedure (Section 1.5) to change the order to the default.

2.2 Clock Stopping

The microprocessor clock of the SIM925 stops if the module is idle, "freezing" the digital circuitry. The following actions "wake up" the clock:

1. A power-on.
2. A press of a front-panel button.

3. Activity (send or receive) at the remote interface.
4. A buffer input overload.

The clock runs for as long as is necessary to complete a change of settings, or to communicate the output of a query through the remote interface. However, the clock will remain active for as long as the overload condition exists.

This default behavior can be modified with the remote command AWAK. Setting AWAK ON will prevent the clock from stopping. The module returns to AWAK OFF upon power-on.

3 Remote Operation

This chapter describes operating the SIM925 over the serial interface.

In This Chapter

3.1 Index of Common Commands

Symbol	Definition
i	Bit number (0–7)
j	Unsigned integer
n	Channel number (1–8); *n* = 0 means "none"
z	Literal token
s	Character string
(?)	Required for queries; illegal for set commands
var	Parameter always required
{*var*}	Required parameter for set commands; illegal for queries
[*var*]	Optional parameter for both set and query forms

Serial Communications

3.2 Alphabetic List of Commands

3.3 Introduction

Remote operation of the SIM925 is through a simple command language documented in this chapter. Both set and query forms of most commands are supported, allowing the user complete control of the amplifier from a remote computer, either through the SIM900 Mainframe or directly via RS–232 (see Section 1.6.2.1).

See Table 1.4 for the specification of the DB–15 SIM Interface Connector.

3.3.1 Power-on configuration

The initial settings for the remote interface are 9600 baud with no parity and no flow control, and with local echo disabled (CONS OFF).

Where appropriate, the power-on default value for parameters is listed in **boldface** in the command descriptions.

3.3.2 Buffers

The SIM925 stores incoming bytes from the host interface in a 64-byte input buffer. Characters accumulate in the input buffer until a command terminator (either ⟨CR⟩ or ⟨LF⟩) is received, at which point the message is parsed and executed. Query responses from the SIM925 are buffered in a 64-byte output queue.

If the input buffer overflows, then all data in *both* the input buffer and the output queue are discarded, and an error is recorded in the CESR and ESR status registers.

3.3.3 Device Clear

The SIM925 host interface can be asynchronously reset to its power-on configuration by sending an RS–232-style ⟨break⟩ signal. From the SIM900 Mainframe, this is accomplished with the SRST command; if directly interfacing via RS–232, then use a serial break signal. After receiving the Device Clear, the interface is reset to 9600 baud and the CONS mode is turned OFF. Note that this *only* resets the communication interface; the basic function of the SIM925 is left unchanged; to reset the multiplexer, use *RST.

The Device Clear signal will also terminate the output of the HELP? command from the SIM925.

3.4 Commands

This section provides syntax and operational descriptions for remote commands.

3.4.1 Command syntax

The four-letter mnemonic (shown in CAPS) in each command sequence specifies the command. The rest of the sequence consists of parameters.

Commands may take either *set* or *query* form, depending on whether the "?" character follows the mnemonic. *Set-only* commands are listed without the "?", *query-only* commands show the "?" after the mnemonic, and *optionally query* commands are marked with a "(?)".

Parameters shown in { } and [ ] are not always required. Parameters in { } are required to set a value, and should be omitted for queries. Parameters in [ ] are optional in both set and query commands. Parameters listed without surrounding characters are always required.

Do *not* send ( ) or { } or [ ] as part of the command.

Multiple parameters are separated by commas. Multiple commands may be sent on one command line by separating them with semicolons (;) so long as the input buffer does not overflow. Commands are terminated by either ⟨CR⟩ or ⟨LF⟩ characters. Null commands and whitespaces are ignored. Execution of the command does not begin until the command terminator is received.

tokens *Token* parameters (generically shown as *z* in the command descriptions) can be specified either as a keyword or as an integer value. Command descriptions list the valid keyword options, with each keyword followed by its corresponding integer value. For example, to set the response termination sequence to ⟨CR⟩+⟨LF⟩, the following two commands are equivalent:

TERM CRLF —or— TERM 3

For queries that return token values, the return format (keyword or integer) is specified with the TOKN command.

3.4.2 Notation

The following table summarizes the notation used in the command descriptions:

Symbol	Definition
i	Bit number (0–7)
j	Unsigned integer
n	Channel number (1–8); *n* = 0 means "none"
z	Literal token
s	Character string
(?)	Required for queries; illegal for set commands
var	Parameter always required
{*var*}	Required parameter for set commands; illegal for queries
[*var*]	Optional parameter for both set and query forms

3.4.3 General commands

HELP(?)

Instrument Help

Outputs a condensed version of Section 3.1 to the remote interface.

HELP may be used with or without the query sign, with the same effects.

AWAK(?) {*z*}

Keep Clock Awake

Set (query) the SIM925 keep-awake mode {to *z* = (**OFF 0**, ON 1)}.

Ordinarily, the clock oscillator for the SIM925 microcontroller is held in a stopped state, and only enabled during processing of events (Section 2.2). Setting AWAK ON forces the clock to stay running, and is useful only for diagnostic purposes.

3.4.4 Configuration commands

These commands govern the operation of the SIM925.

MODE(?) {*z*}

Switching Order

Set (query) the switching order {to *z* = (MBB 0, **BBM 1**)}.

Controls the order of switching during channel changes, as either make-before-break (MBB) or break-before-make (BBM). The order only applies to the excitation leads; the sense connections always break before being made (Section 2.1).

The MODE value is retained in non-volatile memory and is *not* modified by a power-on reset.

CHAN(?) {*n*}

Channel

Set (query) the selected channel {to *n* = (1..8; **0** for all channels off)}.

BPAS(?) {*z*}

Bypass

Set (query) the rear-panel bypass channel {to *z* = (**OFF 0**, ON 1)}.

BUFR(?) {*z*}

Buffer

Set (query) the sense-lead active buffer {to *z* = (**OFF 0**, ON 1)}.

RELY *j*,*z*

Relay

Set relay number *j* to *z*=(OFF 0, ON 1).

This command provides direct control over the relay hardware in the SIM925. Setting a relay ON closes the switch, while OFF opens the switch. RELY is a low-level command that directly controls the relay hardware, independent of the CHAN, BPAS, and BUFR commands. To return the SIM925 to a "simple" channel configuration, issue a CHAN set command. There is no corresponding low-level query for RELY.

Relay numbers are:

Value *j*	Signals	Definition
1	±I Ch. 1	(K201) Channel 1 Excitation
2	±V Ch. 1	(K202) Channel 1 Sense
3	±I Ch. 2	(K203) Channel 2 Excitation
4	±V Ch. 2	(K204) Channel 2 Sense
5	±I Ch. 3	(K205) Channel 3 Excitation
6	±V Ch. 3	(K206) Channel 3 Sense
7	±I Ch. 4	(K207) Channel 4 Excitation
8	±V Ch. 4	(K208) Channel 4 Sense
9	±I Ch. 5	(K209) Channel 5 Excitation
10	±V Ch. 5	(K210) Channel 5 Sense
11	±I Ch. 6	(K211) Channel 6 Excitation
12	±V Ch. 6	(K212) Channel 6 Sense
13	±I Ch. 7	(K213) Channel 7 Excitation
14	±V Ch. 7	(K214) Channel 7 Sense
15	±I Ch. 8	(K215) Channel 8 Excitation
16	±V Ch. 8	(K216) Channel 8 Sense
17	±V Ch. *n*	(K217) Buffer Amplifier Input
18	±V Ch. *n*	(K218) Buffer Amplifier Output
19	±I & ±V	(K219 & K220) Bypass

3.4.5 Status commands

The Status commands query and configure registers associated with status reporting of the SIM925. See Section 3.5 for the status model.

*CLS

Clear Status

*CLS immediately clears the ESR, CESR, and the OVLD bit in the SB register.

*STB? [*i*]	Status Byte Query the Status Byte Register [bit *i*]. Execution of the *STB? query (without the optional bit *i*) always causes the ¬STATUS signal to be deasserted. Note that *STB? *i* will *not* clear ¬STATUS, even if bit *i* is the only bit presently causing the ¬STATUS signal. *STB? clears the OVLD bit (Section 3.5.1) in the SB register.
*SRE(?) [*i*,] {*j*}	Service Request Enable Set (query) the Service Request Enable Register [bit *i*] {to *j*}.
*ESR? [*i*]	Standard Event Status Query the Standard Event Status Register [bit *i*]. Upon execution of *ESR? , the returned bit(s) of the ESR register are cleared.
*ESE(?) [*i*,] {*j*}	Standard Event Status Enable Set (query) the Standard Event Status Enable Register [bit *i*] {to *j*}.
CESR? [*i*]	Communication Error Status Query the Communication Error Status Register [bit *i*]. Upon executing a CESR? query, the returned bit(s) of the CESR register are cleared.
CESE(?) [*i*,] {*j*}	Communication Error Status Enable Set (query) the Communication Error Status Enable Register [bit *i*] {to *j*}.
PSTA(?) {*z*}	Pulse ¬STATUS Mode Set (query) the Pulse ¬STATUS mode {to *z* = (**OFF 0**, ON 1)}. When PSTA ON is set, all new service requests will only *pulse* the ¬STATUS signal LOW (for a minimum of 1 μs). The default behavior is to latch ¬STATUS LOW until a *STB? query is received.
LBTN?	Last Button Query the number of the last button pressed. The response is 1, 2, 3, or 4, corresponding to [Channel ▲], [Channel ▼], [Bypass], and [Buffer]. 0 is returned if no button was pressed since the last LBTN? .

OVLD?

Buffer Overload

Query the current overload state of the sense-lead active buffer. The response is 1 if an overload condition exists, `0` otherwise.

This command complements the status bit described in Section 3.5.1. Once cleared by *STB? or *CLS, the overload status bit will stay cleared even though the overload condition may persist.

3.4.6 Interface commands

The Interface commands provide control over the interface between the SIM925 and the host computer.

NOTE(?) *n* {, *s*}

Arbitrary Note

Set (query) an arbitrary note in location *n*.

Beginning with firmware revision level 1.33, the SIM925 has ten (10) non-volatile memory blocks *n* = (`0..9`) for storing arbitrary configuration notes. The content of each note {*s*} is an arbitrary character string of up to 16 characters length, with the following restrictions:

- No commas (“`,`”) or semicolons (“`;`”) may be in *s*.
- Any whitespace characters (space, tab) are automatically removed from *s* before storage by the SIM925.
- All alphabetic characters (`a..z`) are automatically converted to uppercase (`A..Z`) before storage.

For example, to record a note in location 2, send the command:

```
NOTE 2,Last Cal_12JAN05
```

To retrieve this note, send the query:

```
NOTE? 2
```

and the response will be:

```
LASTCAL_12JAN05
```

(note the space removal, and conversion to uppercase letters).

***RST** — Reset

Reset the SIM925 to its default configuration.

*RST sets the following:

- Clock oscillator to stop during idle time (AWAK OFF).
- Channel changes to break-before-make (MODE BBM).
- No channel selected (CHAN 0).
- Bypass channel disconnected (BPAS OFF).
- Buffer amplifier disconnected (BUFR OFF).
- The token mode to OFF.

***IDN?** — Identify

Query the device identification string.

The identification string is formatted as:

`Stanford_Research_Systems,SIM925,s/n******,ver#.###`

where SIM925 is the model number, ****** is a 6-digit serial number, and #.### is the firmware revision level.

***TST?** — Self Test

There is no internal self-test in the SIM925 after the power-on, so this query always returns 0.

***OPC(?)** — Operation Complete

Sets the OPC flag in the ESR register.

The query form *OPC? writes a 1 into the output queue when complete, but does not affect the ESR register.

CONS(?) {*z*} — Console Mode

Set (query) the console mode {to *z* = (**OFF 0**, ON 1)}.

CONS causes each character received at the input buffer to be copied to the output queue.

LEXE?

Execution Error

Query the Last Execution Error code. Valid codes are:

Value	Definition
0	No execution error since last LEXE?
1	Illegal value
2	Wrong token
3	Invalid bit

LCME?

Command Error

Query the Last Command Error code. Valid codes are:

Value	Definition
0	No command error since last LCME?
1	Illegal command
2	Undefined command
3	Illegal query
4	Illegal set
5	Missing parameter(s)
6	Extra parameter(s)
7	Null parameter(s)
8	Parameter buffer overflow
10	Bad integer
11	Bad integer token
12	Bad token value
14	Unknown token

TOKN(?) {*z*}

Token Mode

Set (query) the token query mode {to *z* = (**OFF 0,** ON 1)}.

If TOKN ON is set, then queries to the SIM925 that return tokens will return a text keyword; otherwise they return a decimal integer value. Thus, the only possible responses to the TOKN? query are ON and 0.

TERM(?) {*z*}

Response Termination

Set (query) the ⟨term⟩ sequence {to *z* = (NONE 0, CR 1, LF 2, **CRLF 3,** or LFCR 4)}.

The ⟨term⟩ sequence is appended to all query responses sent by the module, and is constructed of ASCII character(s) 13 (carriage return) and/or 10 (line feed). The token mnemonic gives the sequence of characters.

3.4.7 Serial communication commands

Note that the SIM925 can only support a single baud rate of 9600.

FLOW(?) {z} — Flow Control

Set (query) flow control {to z = (NONE 0, **RTS 1,** XON 2)}.

PARI(?) {z} — Parity

Set (query) the parity {to z = (**NONE 0,** ODD 1, EVEN 2, MARK 3, SPACE 4)}.

3.5 Status Model

status registers The SIM925 status registers follow the hierarchical IEEE–488.2 format. A block diagram of the status register array is given in Figure 3.1.

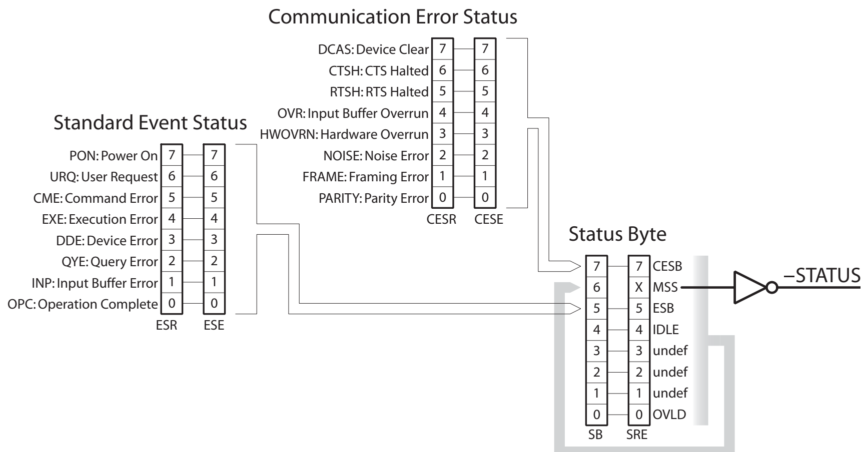


Figure 3.1: Status register model for the SIM925 Octal Four-Wire Multiplexer.

There are two categories of registers in the SIM925 status model:

Event Registers : These read-only registers record the occurrence of defined events. If the event occurs, the corresponding bit is set to 1. Upon querying an event register, all set bits within it are cleared. These are sometimes known as "sticky bits," since once set, a bit can only be cleared by reading its value. Event register names end with SR.

Enable Registers : These read/write registers define a bitwise mask for their corresponding event register. If a bit position is set in an event register while the same bit position is also set in the enable register, then the corresponding summary bit message is set. Enable register names end with SE.

3.5.1 Status Byte (SB)

The Status Byte is the top-level summary of the SIM925 status model. When masked by the Service Request Enable Register, a bit set in the Status Byte causes the ¬STATUS signal to be asserted on the rear-panel SIM interface connector.

Weight	Bit	Flag
1	0	OVLD
2	1	undef (0)
4	2	undef (0)
8	3	undef (0)
16	4	IDLE
32	5	ESB
64	6	MSS
128	7	CESB

OVLD : Overload Bit. Indicates whether an overload event has occured at the input of the sense-lead active buffer. The command *STB? clears the bit. If the overload condition ceases, the bit remains latched until cleared by *STB? or *CLS. If the bit is cleared by *STB? while the overload condition persists, the bit will remain cleared until the overload condition ceases and reoccurs. Use OVLD? to query the current state of the overload.

IDLE : Indicates that the input buffer is empty and the command parser is idle. Can be used to help synchronize SIM925 query responses.

ESB : Event Status Bit. Indicates whether one or more of the enabled events in the Standard Event Status Register is true.

MSS : Master Summary Status. Indicates whether one or more of the enabled status messages in the Status Byte Register is true.

CESB : Communication Error Summary Bit. Indicates whether one or more of the enabled flags in the Communication Error Status Register has become true.

3.5.2 Service Request Enable (SRE)

Each bit in the SRE corresponds one-to-one with a bit in the SB register, and acts as a bitwise AND of the SB flags to generate MSS. Bit 6 of the SRE is undefined—setting it has no effect, and reading it always returns 0. This register is set and queried with the *SRE(?) command.

At power-on, this register is cleared.

3.5.3 Standard Event Status (ESR)

The Standard Event Status Register consists of 8 event flags. These event flags are all "sticky bits" that are set by the corresponding events, and cleared only by reading or with the *CLS command. Reading a single bit (with the *ESR? *i* query) clears only bit *i*.

Weight	Bit	Flag
1	0	OPC
2	1	INP
4	2	QYE
8	3	DDE
16	4	EXE
32	5	CME
64	6	URQ
128	7	PON

OPC : Operation Complete. Set by the *OPC command.

INP : Input Buffer Error. Indicates data has been discarded from the input buffer.

QYE : Query Error. Indicates data in the output queue has been lost.

DDE : Device-Dependent Error. Always 0.

EXE : Execution Error. Indicates the error in a command that was successfully parsed. Out-of-range parameters are an example.

CME : Command Error. Indicates a command parser-detected error.

URQ : User Request. Indicates that a front-panel button was pressed.

PON : Power On. Indicates that an off-to-on transition has occurred.

3.5.4 Standard Event Status Enable (ESE)

The ESE acts as a bitwise AND with the ESR register to produce the single-bit ESB message in the Status Byte Register (SB). The register can be set and queried with the *ESE(?) command.

At power-on, this register is cleared.

3.5.5 Communication Error Status (CESR)

The Communication Error Status Register consists of 8 event flags; each of the flags is set by the corresponding event, and cleared only by reading the register or with the *CLS command. Reading a single bit (with the CESR? *i* query) clears only bit *i*.

Weight	Bit	Flag
1	0	PARITY
2	1	FRAME
4	2	NOISE
8	3	HWOVRN
16	4	OVR
32	5	RTSH
64	6	CTSH
128	7	DCAS

PARITY : Parity Error. Set by serial parity mismatch on the incoming data byte.

FRAME : Framing Error. Set when an incoming serial data byte is missing the STOP bit.

NOISE : Noise Error. Set when an incoming serial data byte does not present a steady logic level during each asynchronous bit-period window.

HWOVRN : Hardware Overrun. Set when an incoming serial data byte is lost due to internal processor latency. Causes the input buffer to be flushed, and resets the command parser.

OVR : Input Buffer Overrun. Set when the input buffer is overrun by the incoming data. Causes the input buffer to be flushed, and resets the command parser.

RTSH : Undefined for the SIM925. A command error. Indicates a parser-detected error.

CTSH : Undefined for the SIM925.

DCAS : Device Clear. Indicates that the SIM925 received the Device Clear signal (an RS–232 ⟨break⟩). Clears the input buffer and the output queue, and resets the command parser.

3.5.6 Communication Error Status Enable (CESE)

The CESE acts as a bitwise AND with the CESR register to produce the single-bit CESB message in the Status Byte Register (SB). The register can be set and queried with the CESE(?) command.

At power-on, this register is cleared.