

# S950 Sysex Implementation

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## 1 General notes

The purpose of the interface is to allow a computer to control all S950 functions, to process and synthesize samples, and to allow the S950 to replay samples developed for other samplers, e.g., the Prophet 2000.

The S950 is always a slave; it will never send unless it is told to. This means all data transfers out of the S950 must use two-way communication. The S950 can however receive with an incoming connection only. Reception of sample dump is speeded up with a two-way connection.

Programs and samples are requested by number. In the case of programs this will correspond to the number on the PLAY menu decreased by one. For samples the number will be the order in which they are in the S950's RAM. The program/name catalog sent by the S950 has a number against each name, starting with 0.

When the S950 receives a sample, the name it shows will be that number. Programs are received with an alphanumeric name.

Sample transfer is according to the standard described in the Prophet 2000 manual. This uses *system exclusive common* which does not include a manufacturer's prefix code. As it does not include a MIDI channel code, any samples sent, or request for samples would be responded to by all samplers on the same MIDI line. The *system exclusive common reception enable* and *disable* messages—which do not include a MIDI channel number—can be used to select one of several S950's on the same line.

A further enhancement of the standard sample dump protocol is that when closed loop transmission is used, gaps between blocks may be as long as 10 seconds rather than the 20 msec specified. This allows the computer to use its disk in the middle of a long file. This variation maintains full compatibility with the standard.

There are several parameters associated with an S950 sample that are not included in the Prophet 2000 sample dump. These may be sent with the Akai exclusive *sample parameters* messages.

The use of the above enhancements will not prevent the S950 from being completely compatible with the Prophet 2000 sample dump format.

The machine code execution facility allows the operating system within the S950's memory to be altered by MIDI messages.

History:

- [9/6/86] Revised for ROM version 1.2.
- [29/1/87] Corrections to byte numbering in drum settings and sample parameters.

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- [9/2/87] Further corrections to byte numbering and EOX codes. Filter ADSR added to keygroup.
- [15/2/87] Note-on velocity release added to keygroup (ONRV in KBITS). Note: additions of 9/2 and 15/2 use bits that were previously reserved as 0. This maintains upward compatibility.
- [19/3/87] Velocity crossfade curve modification (VTMX and ENVTMX in KBITS) added to keygroup.
- [19/3/87] Add note explaining bug when loading samples at rates less than 7.0 KHz.
- [17/8/88] MDCLOK added to overall settings (OVS) to allow higher MIDI clock rate.
- [17/8/88] MIDI program select number MDPG NR added to program structure, also MPVLD to validate it.

## 1.1 Coding of DB DW DD

DB represents an 8 bit parameter in the S900's memory. It is sent as two MIDI bytes:

First byte	0	d6	d5	d4	d3	d2	d1	d0
Second byte	0	0	0	0	0	0	0	d7

where d0 is the parameter's least significant bit.

DW represents a 16 bit quantity. It is sent as four MIDI bytes:

First byte	0	d6	d5	d4	d3	d2	d1	d0
Second byte	0	0	0	0	0	0	0	d7
Third byte	0	d14	d13	d12	d11	d10	d9	d8
Fourth byte	0	0	0	0	0	0	0	d15

DD represents a 32 bit quantity. It is sent as eight MIDI bytes:

First byte	0	d6	d5	d4	d3	d2	d1	d0
Second byte	0	0	0	0	0	0	0	d7
Third byte	0	d14	d13	d12	d11	d10	d9	d8
Fourth byte	0	0	0	0	0	0	0	d15
		0	d22	d21	d20	d19	d18	d17
		0	0	0	0	0	0	d23
		0	d30	d29	d28	d27	d26	d25
Eighth byte	0	0	0	0	0	0	0	d31

## 1.2 Signed and unsigned

Parameters described as signed are represented in two's complement form, e.g., DB value of -1 equals 0FFh.

## 1.3 ASCII characters

Where a value is shown as a character in single quotes it is in ASCII form with the MSB=0, e.g., 'A' equals 41h.

## 1.4 *Undefined and reserved*

*Reserved* values are for possible future enhancements and must be transmitted as shown. *Undefined* values have no operational effect and might as well be filled with 0s.

## 1.5 Time out

When receiving Akai exclusive data, after the first six bytes have been received, the remaining bytes must be separated by no more than 2 seconds. This provision protects the S950 from hanging in the event of incomplete messages.

## 1.6 RS232-C

The S950 can receive either through MIDI or through RS232-C. The switch from one to the other can be made manually (page 5 of the MIDI menu), or by Akai exclusive overall settings reception, or if an entire disk is loaded on which the overall settings was saved. (This is done automatically when *entire memory* is saved.)

Specification for RS232-C:

Connector	25 pin "D". S950 is female.
Levels	High +3V to +15V, low -3V to -15V.
Bits	8
Parity	none
Stop bits	1
Baud rate	300, 600, 1200, 2400, 4800, 9600, and 19200. Also many non-standard rates up to 100000. The default baud rate is 300.
Protocol	Hardware handshake using CTS/RTS. Handshake need not be used on rates below 50000 baud, in which case RTS is used.

The S950 is configured as DCE and should be connected to most computers with a non-switching cable with the following pin connections:

Pin	S950	Computer	
1	FG	FG	Frame ground
2	RXD	TXD	Data in to S950
3	TXD	RXD	Data out of S950
4	CTS	RTS	Clear to send
5	RTS	CTS	Request to send
7	GND	GND	Signal ground

## 2 Recognized by the S950

### 2.1 Exclusive Akai

Mnemonic	Description
RDRS	Request for drum settings
DRS	Drum settings
ROVS	Request for overall settings
OVS	Overall settings
RPRGM	Request for program
PRGM	Program
CODE	Machine code (8086 code or data for S950's RAM)
RCODE	Request for machine code
EXEC	Execute (call machine code or other subroutine)
RCAT	Request for program/sample name catalog
RSPRM	Request for sample parameters
SPRM	Sample parameters
SECRE	System exclusive common reception enable
SECRD	System exclusive common reception disable

### 2.2 System Exclusive Common

Mnemonic	Description
RSD	Request sample dump
SD	Sample dump
ASD	Abort sample dump
NAKS	Not acknowledge sample block (request retransmission)
ACKS	Acknowledge sample block (or sample header)

## 3 Transmitted by the S950

### 3.1 Exclusive Akai

Mnemonic	Description
DDRS	Drum settings
DOVS	Overall settings
DPR	Program
DSP	Sample parameters
CAT	Program/sample name catalog
CODE	Machine code or data

### 3.2 System Exclusive Common

Mnemonic	Description
SD	Sample dump
ASD	Abort sample dump
NAKS	Not acknowledge sample block (request retransmission)
ACKS	Acknowledge sample block (or sample header)

## 4 Detailed specification of S950 messages

### 4.1 Sample Dump Format

#### 4.1.1 Sample Dump

Byte #	Range	Description
0	F0h	System exclusive code
1	7Eh	Common non-realtime identifier
2	1	SD sample dump code
3	0..31	Sample number LS
4	0	Sample number HS. Always 0 since we can have only 32 samples.
5	8..16	Bits per word. S950 transmits 12, but can accept 9 to 14.
6..8	0..127	Sampling period in nsec. S950 accepts 15259 to 500000.
9..11	0..127	Total words in sample. S950 accepts 200 to 475020.
12..14	0..127	Loop start point. If $i = \text{total} - 5$ , assume non looping.
15..17	0..127	Loop end. S950 takes this as end point.
18	0..1	0=looping, 1=alternating (one shot if loop length $i \neq 5$ ).

Next follows a variable number of sample blocks. Each has the same format:

Byte #	Range	Description
0	0..127	Block number LSbyte (block number MSbyte is not sent).
1	0..127	MS of data word: $0 \ d11 \ d10 \ d9 \ d8 \ d7 \ d6 \ d5$
2	0..127	LS of data word: $0 \ d4 \ d3 \ d2 \ d2 \ d0 \ 0 \ 0$
3..120	0..127	as 1, 2 above.
121	0..127	Checksum, being the exclusive OR of the preceding 120 bytes.

A final byte follows the last block:

Byte #	Range	Description
??	F7h	End of exclusive code

## 4.2 System Common Messages

### 4.2.1 Handshakes

Byte #	Range	Description
0	F0h	System exclusive code
1	7Eh	Common non-realtime identifier
2	<i>ff</i>	Function code: <i>ACKS=7Fh</i> Acknowledge sample block or header <i>ASD =7Dh</i> Abort sample dump <i>NAKS=7Eh</i> Not acknowledge (request retransmission of block)
3	F7h	End of exclusive code

### 4.2.2 Request Sample Dump

Byte #	Range	Description
0	F0h	System exclusive code
1	7Eh	Common non-realtime identifier
2	0	<i>RSD</i> Request sample dump code
3	0..31	Sample number, according to order in S950 RAM (see General Notes)
4	0	Undefined
5	F7h	End of exclusive code

## 4.3 Akai Exclusive Messages

### 4.3.1 Request Settings

Byte #	Range	Description
0	F0h	System exclusive code
1	47h	Akai identifier
2	0..15	MIDI channel number
3	<i>gg</i>	Function code: <i>RDRS =0</i> Request for drum settings <i>ROVS =1</i> Request for overall settings <i>RPRGM=2</i> Request for program <i>RCAT =3</i> Request for name catalog <i>RSPRM=4</i> Request for sample parameters <i>SECRE=5</i> Sysex common reception enable <i>SECRD=6</i> Ditto disable
4	64	S950 identifier
5	0..31	Program/sample number, where applicable
6	0	Reserved
7	F7h	End of exclusive code

### 4.3.2 Machine Code

Byte #	Range	Description
0	F0h	System exclusive code
1	47h	Akai identifier
2	0..15	MIDI channel number
3	14	<i>CODE</i> Function code for machine code or data
4	64	S950 identifier
5	X	Undefined
6	0	Reserved (must be 0)
7..10	DW	Absolute address in S950 memory where first machine code will be placed; this must be in segment 0. In I
11..14	DW	Number of data bytes to follow
15..??	DB	Variable length executable machine code or data. The S950 uses a NEC 71016 processor which is compati
??	0..127	Checksum, exclusive OR of preceding bytes without 0 to 6. The S950 does not check the checksum on inc
16	F7h	End of exclusive code

### 4.3.3 Request for Machine Code

Byte #	Range	Description
0	F0h	System exclusive code
1	47h	Akai identifier
2	0..15	MIDI channel number
3	14	<i>R</i> CODE Request for S950 machine code or data
4	64	S950 identifier
5	X	Undefined
6	0	Reserved (must be 0)
7..10	DW	Absolute address in S950 memory of first machine code data requested. A special address, <i>00FDh</i> has the
11..14	DW	Number of bytes of machine code requested
15	0..127	Checksum, exclusive OR of bytes 7-14
16	F7h	End of exclusive code

### 4.3.4 Execute Function

Byte #	Range	Description
0	F0h	System exclusive code
1	47h	Akai identifier
2	0..15	MIDI channel number
3	13	<i>EXEC</i> Function code for execute
4	64	S950 identifier
5	X	Undefined
6	0	Reserved
7..10	DW	Absolute address of subroutine to which near call will be made on receipt of EOX following valid checksum
11	0..127	Checksum
12	F7h	End of exclusive code

### 4.3.5 Name Catalog

Byte #	Range	Description
0	F0h	System exclusive code
1	47h	Akai identifier
2	0..15	MIDI channel number
3	11	<i>CAT</i> Function code for name catalog
4	64	S950 identifier
5	X	Undefined
6	0	Reserved

Each catalog entry is a block of 12 bytes:

Byte #	Range	Description
n	P or S	Type, either program (P) or sample (S)
n+1	0..31	Program/sample number, the order it appears in S950 memory.
n+2..n+11	0..127	ASCII characters of name

These bytes follow the last block:

Byte #	Range	Description
??	0..127	Checksum, exclusive OR of preceding bytes without 0 to 6
??	F7h	End of exclusive code

### 4.3.6 Drum Settings

Byte #	Range	Description
0	F0h	System exclusive code
1	47h	Akai identifier
2	0..15	MIDI channel number
3	7	<i>DRS</i> Function code for drum settings
4	64	S950 identifier
5	X	Undefined
6	0	Reserved
7,8	DB	<i>DRUMON</i> 0/255 for drum inputs on/off
8,9	DB	<i>DRUMSENS</i> 0/1 for low/high sensitivity; affects all inputs
10..49	0	Reserved

Here follow eight blocks of 60 MIDI bytes, one for each drum input. Each block is as follows:

Name	Type	Normal	Description
DINP	DB	0	0..7 (constant) According to drum input number
DRMDCH	DB	0	0..15 MIDI channel that drum input simulates
DPITCH	DB	60	24..127 MIDI coded pitch
DSENS99	DB	50	1..99 User's input sensitivity
DTT40	DB	20	1..40 Trigger threshold
DTTFS	DB	68	Must be 8 + DTT40*3
	DW	X	Undefined
	DD	0	Reserved
DATTIME	DW	12	Attack capture time in units of .25 msec. Take biggest value during this period after thresh
DONTIME	DW	120	On time duration in units of .25 msec
DRCTIME	DW	80	Recovery time in units of .25 msec
DSENSES	DW	33	Must be DSENS99*171/256
	DW	X	Undefined
	DW	X	Undefined
DENVHOLD	DW	1040h	Must be 1040h + DINP*512 (constant)
DADCMUX	DW	3040h	Must be 3040h + DINP*256 (constant)

Byte #	Range	Description
531	0..127	Checksum, exclusive OR of preceding 480 bytes
532	F7h	End of exclusive code

### 4.3.7 Overall Settings

Byte #	Range	Description
0	F0h	System exclusive code
1	47h	Akai identifier
2	0..15	MIDI channel number
3	8	<i>OVS</i> Function code for overall settings
4	64	S950 identifier
5	X	Undefined
6	0	Reserved

Next follows a block of 80 MIDI bytes giving the overall settings data:

Name	Type	Normal	Description
PRONAME	DB	'DEFAULT PR'	Name of current program. (This element consists of 10 data bytes which are sent as
	DD	x	Undefined
	DW	x	Undefined
MDXTCH	DB	0	0..15 MIDI transmit channel for AKAI exclusive
	DB	0	Reserved
	DW	x	Undefined
RSCHNL	DW	1	0..16 Reception simulator channel
RSKEY	DW	60	24..127 Reception simulator MIDI key
RSVEL	DW	64	0..127 Reception simulator velocity
	DB	x	Undefined
BASMCH	DB	128	0..15 S950 basic MIDI reception channel; MSB is set if S950 is set of OMNI ON
MLEN	DB	0	0 to disable reception of loudness on continuous controller #7, any other value to enable
MIRS2	DB	1	1..2 Select controller MIDI/RS232
MPEN	DB	60	0 to disable MIDI program change reception, any other value to enable
	DW	20727	Reserved
	DW	7238	Reserved
PWRANGE	DB	7	Pitch wheel range (semitones up or down)
RSBAUD	DW	960	Nominal RS232 baud rate in Hz*10 (e.g., 960 means 9600 baud)
MDCLOK	DB	0	MIDI clock control: 0= 31250 Hz -8= 62500 Hz -20=125000 Hz
	DB	0	Reserved

These final bytes follow:

Byte #	Range	Description
87	0..127	Checksum, exclusive OR of preceding 80 bytes
88	F7h	End of exclusive code

#### 4.3.8 Program

Byte #	Range	Description
0	F0h	System exclusive code
1	47h	Akai identifier
2	0..15	MIDI channel number
3	9	PRGM Function code for program & keygroups
4	64	S950 identifier
5	0..31	Program number. When the S950 is sending a program this will be the same number as requested. When
6	0	Reserved

Next follows a block of 76 MIDI bytes giving the program parameters:

Name	Type	Normal	Description
PRNAME	DB	'??????????'	Name of current program. (This element consists of 10 data bytes which are sent as 20 M
	DD	x	Undefined
	DW	x	Undefined
KTILT	DW	0	-50..+50 Keyboard tilt (key versus loudness)
	DW	x	Undefined
POSXEN	DB	x	Undefined
	DB	0	0/1 Positional crossfade disable/enable
NOKG	DB	255	Reserved
	DB	1	1..31 Number of keygroups in this program
MDPGNM	DW	x	Undefined
	DB	0	0..127 Program number for MIDI program change command
MPVLD	DB	255	0 means MDPGNM invalid (old S900 format)
	DW	0	Reserved
	DD	0	Reserved
	DD	0	Reserved

Here follow one or more blocks defining the keygroups. Each block uses 140 MIDI bytes and is defined as follows:

Name	Type	Normal	Description
UMK	DB	127	Upper MIDI key (limit of keyrange in this keygroup)
LMK	DB	24	Lower MIDI key (may be the same as UMK)
VST	DB	128	Velocity switch threshold
ATK	DB	0	0..99 Attack time (logarithmic coding)
DCY	DB	80	0..99 Decay time
SSTN	DB	99	0..99 Sustain level (.375 dB/step; 0=-96 dB)
RLSE	DB	30	0..99 Release time
FVI	DB	10	0..99 Filter/velocity interaction
FKI	DB	50	0..99 Filter key tracking (50 gives 1 octave/octave)
AVI	DB	0	0..99 Attack/velocity interaction
RVI	DB	0	-50..+50 Velocity/release interaction
LVI	DB	30	0..99 Loudness/velocity interaction (0=no dynamics)
PVI	DB	0	0..99 Pitch-warp/velocity interaction
PAO	DB	0	-50..+50 Pitch warp initial offset
PST	DB	99	0..99 Pitch warp recovery time
VBDLY	DB	64	0..99 LFO buildup time
VBRATE	DB	64	0..99 LFO rate
VBDPTH	DB	0	0..99 LFO depth
KBITS	DB	4	Odd control bits. Coding is as follows:
TRD		bit 0	0/1 Transpose enable/disable
VCXF		bit 1	0/1 Velocity crossfade disable/enable
VBDSYN		bit 2	0/1 Vibrato desync off/on
OST		bit 3	0/1 One shot trigger mode off/on
ONRV		bit 4	0/1 Velocity release from note off/note on
ENVTHX		bit 5	0/1 Enable/disable velocity release crossfade curve modification (see VTHX)
OPVOICE	DB	255	Output: 0..7=MONO, 8=LEFT, 9=RIGHT, 255=ANY
KMDCHN	DB	0	0..15 Keygroup MIDI channel offset; this will be added to BASMCH (see Overall Settings) to
AFDI	DB	0	Aftertouch LFO depth modulation
MWDI	DB	50	Modulation wheel LFO depth modulation

Note: LFO depth modulation is the sum of VBDPTH + (aftertouch\*AFDI) + (modwheel\*MWDI), with a maximum of +/- three semitones

VCFAMNT	DB	0	0..50 Amount of filter's ADSR applied to filter frequency
NAMEFS	DB	'TONE '	Name of first sample
VCFAK	DB	20	0..99 Filter ADSR attack time
VCFDY	DB	20	0..99 Filter ADSR decay time
VCFST	DB	20	0..99 Filter ADSR sustain level
VCFRL	DB	20	0..99 Filter ADSR release time
VTHX	DB	64	0..127 Velocity value at which loud/soft mix is 50% in velocity crossfade type sample. This va
	DB	x	Undefined
	DW	x	Undefined
TROFFS	DW	0	Signed transpose offset, units of 1/16 semitone
FLTFS	DB	99	0..99 Filter
LORDFS	DB	0	-50..+50 Signed loudness, units of .375 dB
NAMESS	DB	'TONE '	Name of second sample
	DD	x	Undefined
	DD	x	Undefined
TROFSS	DW	0	Signed transpose offset, units of 1/16 semitone
FLTSS	DB	99	0..99 Filter
LORDSS	DB	0	-50..+50 Signed loudness, units of .375 dB
	DW	x	Undefined

These final bytes follow the last keygroup:

Byte #	Range	Description
??	0..127	Checksum, exclusive OR of preceding bytes without 0 to 6
??	F7h	End of exclusive code

### 4.3.9 Sample Parameters

Byte #	Range	Description
0	F0h	System exclusive code
1	47h	Akai identifier
2	0..15	MIDI channel number
3	10	SPRM Function code for sample parameters
4	64	S950 identifier
5	0..31	Sample number
6	0	Reserved

Next follows a block of 120 MIDI bytes giving the sample parameters:

Name	Type	Normal	Description
SNAME	DB	'TONE '	Name of sample
	DD	x	Undefined
	DW	x	Undefined
SLNGTH	DD	1800	Total number of words in sample. Note that for velocity-crossfade type this will be the sum of
SMRATE	DW	11773	Original sample rate in Hz (=2.5*bandwidth)
SNOMP	DW	960	Nominal pitch, unsigned in 1/16 semitones (960=C3)
SDFLDO	DW	0	Signed loudness offset
SRPLMD	DB	'L'	Replay mode: 'O/L/A'=one shot/looping/alternating
	DB	0	Reserved
SEND	DD	1800	End point relative to start of sample
SSTART	DD	0	First replay point relative to start of sample
SLOOP	DD	45	Length of loop or alternative part
	DW	x	Reserved
VC	DB	0	0/255 Velocity crossfade/normal type sample
NOREV	DB	'N'	'R/N' Sample waveform has/has not been reversed
	DD	x	Undefined
	DD	x	Undefined
	DD	x	Undefined
	DD	x	Undefined

These final bytes follow:

Byte #	Range	Description
127	0..127	Checksum, exclusive OR of preceding bytes without 0 to 6
128	F7h	End of exclusive code