SSI 32R527R
8 & 9-Channel Thin Film Read/Write Device
Preliminary Data

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July, 1990

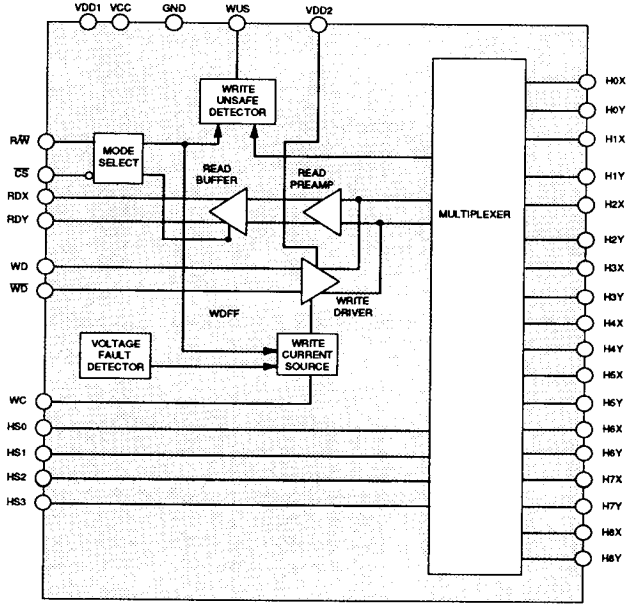
DESCRIPTION

The SSI 32R527R Read/Write devices are bipolar monolithic integrated circuits designed for use with two terminal thin film recording heads. They provide a low noise read amplifier, write current control and data protection circuitry for eight or nine channels. Power supply fault protection is provided by disabling the write current generator during power sequencing. They require +5V and +12V power supplies and are available in a variety of package configurations. A mirror image pinout option is available to simplify flex circuit layout in multiple R/W device applications. The SSI 32R527R provides internal 500Ω damping resistors.

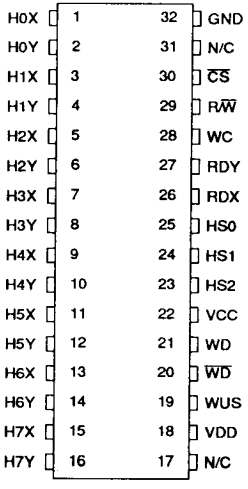
FEATURES

- **High performance:**
  - **Read mode gain = 120 V/V**
  - **Input noise = 0.85 nV/√Hz max.**
  - **Input capacitance = 35 pF max.**
  - **Write current range = 10 mA to 40 mA**
  - **Head voltage swing = 7 Vpp**
  - **Write current rise time = 9 ns**
- **Enhanced system write to read recovery time**
- **Differential ECL-like write data input**
- **Open collector read outputs**
- **Power supply fault protection**
- **Compatible with two & three terminal thin film heads**
- **Write unsafe detection**
- **+5V, +12V power supplies**
- **Mirror image pinout option**

BLOCK DIAGRAM



PIN DIAGRAM



32-LEAD SOW, FLATPACK

CAUTION: Use handling procedures necessary for a static sensitive component.

CIRCUIT OPERATION

The SSI 32R527R addresses up to nine two-terminal thin film heads providing write drive or read amplification. Head selection and mode control is accomplished with pins HSn, $\overline{CS}$ and R/$\overline{W}$, as shown in Tables 1 & 2. Internal resistor pullups, provided on pins $\overline{CS}$ and R/$\overline{W}$ will force the device into a non-writing condition if either control line is opened accidentally.

WRITE MODE

The write mode configures the SSI 32R527R as a current switch and activates the Write Unsafe (WUS) detection circuitry. The Write Data Inputs (WD, $\overline{WD}$) determine the polarity of the head current. There is no internal toggle flip-flop.

The magnitude of the write current (0-pk) given by:

$$Iw = \frac{Vwc}{RWC}$$

where Vwc (WC pin voltage) = 1.65V ± 5%, is programmed by an external resistor RWC, connected from pin WC to ground. In multiple device applications, a single RWC resistor may be made common to all devices. The actual head current Ix, y is given by:

$$Ix, y = \frac{Iw}{1 + Rh/Rd}$$

where:
Rh = head resistance + external wire resistance, and
Rd = damping resistance.

Power supply fault protection improves data security by disabling the write current generator during a voltage fault or power supply sequencing. Additionally, the write unsafe detection circuitry will flag any of the conditions listed below as a high level on the open collector output pin, WUS. Two transitions on pin WD and $\overline{WD}$, after the fault is corrected, are required to clear the WUS flag.

- WD frequency too low
- Device not selected
- Device in read mode
- No write current

Power dissipation in Write Mode may be reduced by placing a resistor, Rw, between VDD1 and VDD2. The resistor value should be chosen such that Iw Rw ≤ 3.0V for an accompanying reduction of $(Iw)^2$ Rw in power dissipation. If a resistor is not used, VDD2 should be connected to VDD1. Note that Rw will also provide current limiting in the event of a head short.

READ MODE

The read mode configures the SSI 32R527R as a low noise differential amplifier and deactivates the write current generator and write unsafe detection circuitry. The RDX and RDY outputs are open collectors and are in phase with the "X" and "Y" head ports. The termination resistors for RDX/RDY should be 100Ω to Vcc.

IDLE MODE

The idle mode deactivates the internal write current generator, the write unsafe detector and switches the RDX, RDY outputs into a high impedance state. This facilitates multiple device applications by enabling the read outputs to be wire OR'ed and the write current programming resistor to be common to all devices. If multiple devices are wire OR'ed, series Schottky isolation diodes are recommended to reduce parasitic capacitance without degrading dynamic range.

FIGURE 1: OR'ed Devices w/ Schottky Isolation Diodes

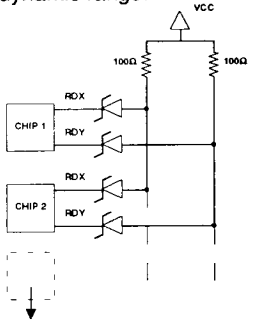


TABLE 1: Mode Select

$\overline{CS}$	R/$\overline{W}$	MODE
0	0	Write
0	1	Read
1	0	Idle
1	1	Idle

TABLE 2: Head Select 0 = Low level 1 = High level

HS3	HS2	HS1	HS0	HEAD
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8

PIN DESCRIPTIONS

NAME	TYPE	DESCRIPTION
HS0 - HS3	I	Head Select
$\overline{CS}$	I	Chip Select: a low level enables the device
R/$\overline{W}$	I	Read/Write: a high level selects Read mode
WUS	O*	Write Unsafe: Open collector output, a high level indicates an unsafe writing condition
WD,$\overline{WD}$	I	Write Data In: a negative polarity passes write current in the x-direction of the head.
H0X - H8X H0Y - H8Y	I/O	X, Y Head Connections: Current in the X-direction flows into the X-port
RDX, RDY	O*	X, Y Read Data: differential read data output, require 100Ω termination resistor to Vcc
WC	*	Write Current: used to set the magnitude of the write current
VCC	-	+5V Logic Circuit Supply
VDD1	-	+12V
VDD2	-	Positive power supply for write current drivers: VDD1 - 3.0V ≤ VDD2 ≤ VDD1
GND	-	Ground

*When more than one R/W device is used, these signals can be wire OR'ed.

ELECTRICAL SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	VALUE	UNITS
DC Supply Voltage		VDD	-0.3 to +14	VDC
		VCC	-0.3 to +7	VDC
Write Current		Iw	100	mA
Digital Input Voltage		Vin	-0.3 to VCC +0.3	VDC
Head Port Voltage		VH	-0.3 to VDD +0.3	VDC
WUS Pin Voltage Range		Vwus	-0.3 to +14	VDC
Output Current	WUS	Iwus	+12	mA
Storage Temperature		Tstg	-65 to +150	°C

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	VALUE	UNITS
DC Supply Voltage	VDD	12 ± 10%	VDC
	VCC	5 ± 10%	VDC
Operating Temperature	Tj	+25 to +135	°C

DC CHARACTERISTICS

Unless otherwise specified, recommended operating conditions apply.

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNITS
VDD Supply Current	Read Mode	-	-	34	mA
	Write Mode	-	-	38 + Iw	mA
	Idle Mode	-	-	14	mA
VCC Supply Current	Read Mode	-	-	52	mA
	Write Mode	-	-	45	mA
	Idle Mode	-	-	42	mA
Power Dissipation (Tj = +135°C)	Read Mode	-	-	670	mW
	Write Mode: Iw = 20 mA, VDD2 = VDD1 VDD2 = VDD1 - 3.0V	- -	- -	900 900	mW
	Idle Mode	-	-	400	mW
Input Low Voltage (VIL)		-	-	0.8	VDC
Input High Voltage (VIH)		2.0	-	-	VDC
Input Low Current (IIL)	VIL = 0.8v	-0.4	-	-	mA
Input High Current (IHL)	VIH = 2.0v	-	-	100	µA
WUS Output Low Voltage (VOL)	Iol = 8 mA	-	-	0.5	VDC
VDD Fault Voltage		8.5	-	10.0	VDC
VCC Fault Voltage		3.5	-	4.2	VDC
Head Current (HnX, HnY)	Write Mode, 0≤VCC ≤3.5V 0≤VDD ≤8.5V	-200	-	+200	µA
	Read/Idle Mode 0≤VCC ≤5.5V 0≤VDD ≤13.2V	-200	-	+200	µA
Data Input Capacitance	WD or $\overline{WD}$ to GND			10	pF
Data Input Current	WD or $\overline{WD}$			150	µA
Differential Data Voltage	WD - $\overline{WD}$	0.2			VDC
WD, $\overline{WD}$ Data Input Voltage Range	Low Level (WD VIL)	VCC -1.9			VDC
	High Level (WD VIH)			VCC + 0.1	VDC

WRITE CHARACTERISTICS
Unless otherwise specified, recommended operating conditions apply, Iw = 20 mA, Lh = 1.0 µH, Rh = 30Ω and f(WD) = 5 MHz.

PARAMETER	CONDITIONS	MIN.	NOM	MAX	UNITS
WC Pin Voltage (Vwc)		-	1.65 ±5%	-	V
Differential Head Voltage Swing		7	-	-	Vpp
Unselected Head Current		-	-	1	mA(pk)
Differential Output Capacitance		-	-	25	pF
Differential Output Resistance		400	500	750	Ω
WD, $\overline{WD}$ Transition Frequency	WUS = low	.85	-	-	MHz
Write Current Range		10	-	40	mA

READ CHARACTERISTICS
Unless otherwise specified, recommended operating conditions apply CL (RDX, RDY) < 20pF and RL1 (RDX, VCC) = RL2 (RDY, VCC) = 100Ω

PARAMETER		CONDITIONS	MIN	NOM	MAX	UNITS
Differential Voltage Gain		Vin=1mVpp @ 300 KHz Tj = 25°C	85	-	150	V/V
Bandwidth	-1dB	|Zs|<5Ω, Vin=1 mVpp @ 300 kHz	25	-	-	MHz
	-3dB	|Zs|<5Ω, Vin=1 mVpp @ 300 kHz	45	-	-	MHz
Input Noise Voltage		BW = 15 MHz, Lh = 0, Rh = 0	-	0.62	0.85	nV/√Hz
Differential Input Capacitance		Vin = 1 mVpp, f = 5 MHz	-	-	35	pF
Differential Input Resistance		Vin = 1 mVpp, f = 5 MHz	280	320	-	Ω
Dynamic Range		AC peak-to-peak input voltage where gain falls to 90% of its small signal value, f = 5 MHz	6	-	-	mV
Common Mode Rejection Ratio		Vin = 0 VDC+100 mVpp				
		1 MHz<f< 10 MHz	54	-	-	dB
		10 MHz<f< 20 MHz	48	-	-	dB
Power Supply Rejection Ratio		VPD or Vcc @ 100mVpp				
		1 MHz<f< 10 MHz	54	-	-	dB
		10 MHz<f< 20 MHz	40	-	-	dB
Channel Separation		All unselected channels driven with 100 mVpp				
		1 MHz<f< 10 MHz	43	-	-	dB
		10 MHz<f< 20 MHz	37	-	-	dB
Output Offset Voltage			-300	-	+300	mV
RDX, RDY Common Mode Output Voltage		Read Mode	VCC - 1.1		VCC - .3	VDC
		Write Mode	-	VCC	-	VDC
Single Ended Output Resistance		f = 5 MHz	10	-		KΩ

READ CHARACTERISTICS (Continued)

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNITS
Output Current		-	6	-	mA
Single Ended Output Capacitance	f = 5 MHz	-	-	10	pF

SWITCHING CHARACTERISTICS (See Figure 1)
Unless otherwise specified, recommended operating conditions apply, Iw = 20 mA, Lh = 1.0 µH, Rh = 30Ω and f(WD) = 5 MHz.

PARAMETER	CONDITIONS	MIN	MAX	UNITS
R/$\overline{W}$				
R/$\overline{W}$ to Write Mode	Delay to 90% of write current	-	0.6	µs
R/$\overline{W}$ to Read Mode	Delay to 90% of 100mV 10MHz Read signal envelope or to 90% decay of write current	-	0.6	µs
$\overline{CS}$				
$\overline{CS}$ to Select	Delay to 90% of write current or to 90% of 100mV 10MHz Read signal envelope	-	0.6	µs
$\overline{CS}$ to Unselect	Delay to 10% of write current	-	0.6	µs
HSn				
HS0, 1, 2 to any Head	Delay to 90 % of 100mV 10MHz Read signal envelope	-	0.4	µs
WUS				
Safe to Unsafe - TD1		0.6	3.6	µs
Unsafe to Safe - TD2		-	1	µs
Head Current				
Prop. Delay - TD3	From 50 % points, Lh=0µh, Rh=0Ω	-	32	ns
Asymmetry	WD has 50 % duty cycle and 1ns rise/fall time, Lh=0µh, Rh=0Ω	-	1	ns
Rise/Fall Time	10% - 90% points, Lh=0µh, Rh=0Ω	-	9	ns

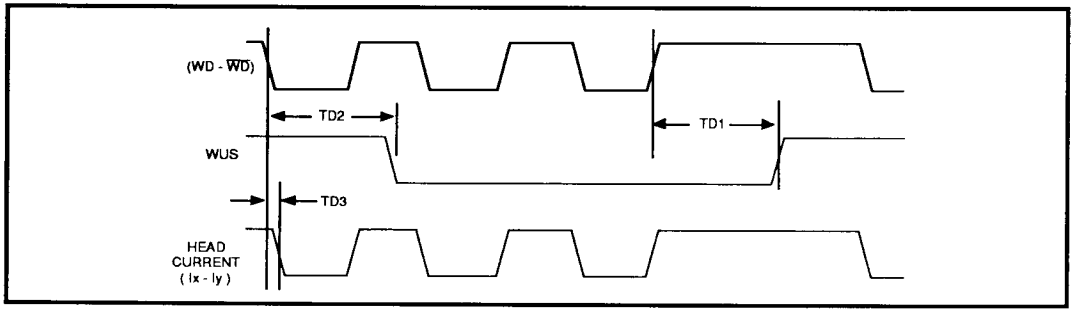


FIGURE 1: Write Mode Timing Diagram

APPLICATIONS INFORMATION

The specifications, provided in the data section, account for the worst case values of each parameter taken individually. In actual operation, the effects of worst case conditions on many parameters correlate. Tables 3 & 4 demonstrate this for several key parameters. Notice that under the conditions of worst case input noise, the higher read back signal resulting from the higher input impedance can compensate for the higher input noise. Accounting for this correlation in your analysis will be more representative of actual performance.

TABLE 3: Key Parameters Under Worst Case Input Noise Conditions

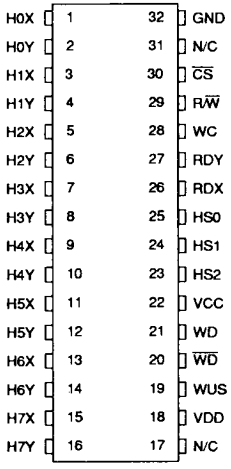
PARAMETER	Tj = 25°C	Tj = 135°C	UNITS
Input Noise Voltage (Max.)	0.70	0.85	nV/$\sqrt{Hz}$
Differential Input Resistance (Min.)	320	340	Ω
Differential Input Capacitance (Max.)	32	34	pF

TABLE 4: Key Parameters Under Worst Case Input Impedance Conditions

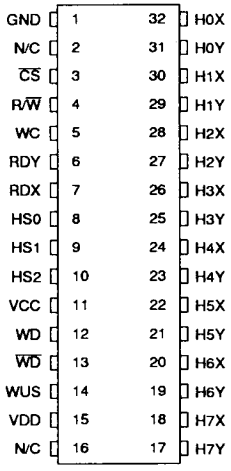
PARAMETER	Tj = 25°C	Tj = 135°C	UNITS
Input Noise Voltage (Max.)	0.58	0.71	nV/$\sqrt{Hz}$
Differential Input Resistance (Min.)	260	290	Ω
Differential Input Capacitance (Max.)	33	35	pF

SSI 32R527R
8 & 9-Channel Thin Film Read/Write Device

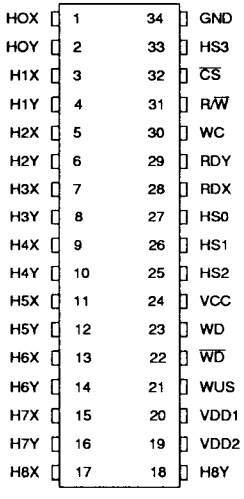
PACKAGE PIN DESIGNATIONS (Top View)



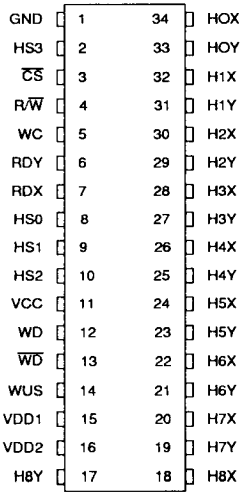
8-Channel 32-Lead SOW



8-Channel 32-Lead SOW Mirror



9-Channel 34-Lead SOL



9-Channel 34-Lead SOL Mirror

THERMAL CHARACTERISTICS: Øja

32-Lead SOW	55°C/W
34-Lead SOL	50°C/W

ORDERING INFORMATION

PART DESCRIPTION	ORDER NO.	PKG. MARK
SSI 32R527R with Internal Damping Resistor		
8-Channel SOW	SSI 32R527R-8CW	32R527R-8CW
9-Channel SOL	SSI 32R527R-9CL	32R527R-9CL
SSI 32R527RM Mirror Image with Damping Resistor		
8-Channel SOW	SSI 32R527RM-8CW	32R527RM-8CW
9-Channel SOL	SSI 32R527RM-9CL	32R527RM-9CL

Preliminary Data: Indicates a product not completely released to production. The specifications are based on preliminary evaluations and are not guaranteed. Small quantities are available, and Silicon Systems should be consulted for current information.

Silicon Systems, Inc., 14351 Myford Road, Tustin, CA 92680 (714) 731-7110, FAX (714) 731-5457