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SSI 32R524R
8-Channel Thin Film Read/Write Device

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November 1991

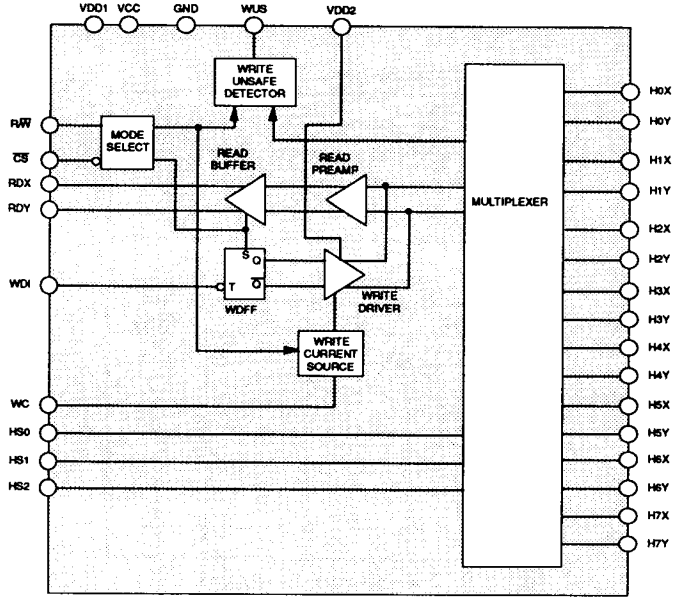
DESCRIPTION

The SSI 32R524R Read/Write device is a bipolar monolithic integrated circuit designed for use with two terminal thin film recording heads. It provides a low noise read amplifier, write current control and data protection circuitry for eight channels. Power supply fault protection is provided by disabling the write current generator during power sequencing. System write to read recovery time is significantly improved by controlling the read channel common mode output voltage shift in the write mode. It requires +5V and +12V power supplies and is 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 32R524R provides internal 740Ω damping resistors.

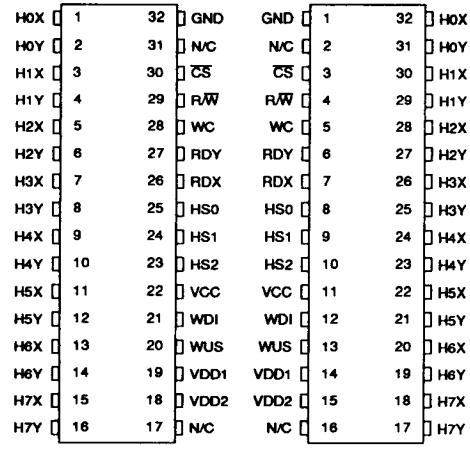
FEATURES

- **High performance:**
  - **Read mode gain = 100V/V**
  - **Input noise = 0.75 nV/√Hz max.**
  - **Input capacitance = 60 pF max.**
  - **Write current range = 20 to 60 mA**
  - **Head voltage swing = 7 Vpp**
  - **Write current rise time = 9 nsec**
- **Enhanced system write to read recovery time**
- **Power supply fault protection**
- **Plug compatible to the SSI 32R501, SSI 32R511 & SSI 32R512**
- **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 **32-LEAD SOW MIRROR**

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

CIRCUIT OPERATION

The SSI 32R524R addresses eight 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 32R524R as a differential current switch and activates the Write Unsafe (WUS) detection circuitry. Write current is toggled between the X and Y directions of the selected head on each high to low transition on pin WDI, Write Data Input.

A preceding read operation initializes the Write Data Flip Flop (WDFF) to pass write current in the X-direction of the head, which is defined as entering from the Y-side and flowing to the X-side.
The magnitude of the write current (0-pk) given by:

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

where K (Write Current Constant) = 70 ± 5%, is programmed by an external resistor RWC, connected from pin WC to ground. The actual head current Ix, y is given by:

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

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 negative transitions on pin WDI, after the fault is corrected, are required to clear the WUS flag.

- Open head
- WDI 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 power dissipation reduction of $(Iw)^2$ Rw. 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 32R524R as a low noise differential amplifier and deactivates the write current generator and write unsafe detection circuitry. The RDX and RDY outputs are emitter followers and are in phase with the "X" and "Y" head ports. These outputs should be AC coupled to the load. The RDX, RDY common mode voltage is maintained in the write mode, minimizing the transient between write mode and read mode, substantially reducing the write to read recovery time in the subsequent Pulse Detection circuitry.

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.

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

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

0 = Low level, 1 = High level

PIN DESCRIPTION

NAME	TYPE	DESCRIPTION
HS0 - HS2	I	Head Select: selects one of eight heads
$\overline{CS}$	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
WDI	I	Write Data In: a negative transition toggles the direction of the head current
H0X - H7X H0Y - H7Y	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
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
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		VDD1, 2	-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 VDD2 +0.3	VDC
WUS Pin Voltage Range		Vwus	-0.3 to +14	VDC
Output Current	RDX, RDY	Io	-10	mA
	WUS	Iwus	+12	mA
Storage Temperature		Tstg	-65 to +150	°C

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	VALUE	UNITS
DC Supply Voltage	VDD1	12 ± 10%	VDC
	VDD2	≥VDD1 - 3.0V	VDC
	VCC	5 ± 10%	VDC
Junction Temperature	Tj	+25 to +135	°C

DC CHARACTERISTICS
Unless otherwise specified, recommended operating conditions apply.

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNITS
VDD1 Supply Current	Read Mode	-	-	50	mA
	Write Mode	-	-	45	mA
	Idle Mode	-	-	25	mA
VDD2 Supply Current	Read Mode	-	-	200	µA
	Write Mode	-	-	Iw+0.4	mA
	Idle Mode	-	-	200	µA
VCC Supply Current	Read Mode	-	-	60	mA
	Write Mode	-	-	50	mA
	Idle Mode	-	-	45	mA
Power Dissipation (Tj = +135°C)	Read Mode	-	-	900	mW
	Write Mode Iw = 40mA, VDD2 = VDD1	-	-	1300	mW
	Write Mode Iw = 60mA, VDD1 - VDD2 = 3.0V	-	-	1425	mW
	Idle Mode	-	-	500	mW
Input Low Voltage (VIL)		-	-	0.8	VDC
Input High Voltage (VIH)		2.0	-	-	VDC
Input Low Current (IIL)	VIL = 0.8v	-0.8	-	-	mA
Input High Current (IHL)	VIH = 2.0v	-	-	100	µA
WUS Output Low Voltage (VOL)	Iol = 8mA	-	-	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≤VDD1 ≤8.5V	-200	-	+200	µA
	Read/Idle Mode 0≤VCC ≤5.5V 0≤VDD1 ≤13.2V	-200	-	+200	µA

WRITE CHARACTERISTICS
Unless otherwise specified, recommended operating conditions apply, Iw = 40 mA, Lh = 500 nH, Rh = 30Ω and f(WDI) = 5 MHz.

PARAMETER	CONDITIONS	MIN.	NOM	MAX	UNITS
Write Current Constant "K"		66.5	-	73.5	V
Differential Head Voltage Swing		7	-	-	Vpp
Unselected Head Current		-	-	1	mA(pk)
Differential Output Capacitance		-	-	35	pF
Differential Output Resistance		400	740	1000	Ω
WDI Transition Frequency	WUS = low	1.0	-	-	MHz
Write Current Range		20	-	60	mA

READ CHARACTERISTICS
Unless otherwise specified, recommended operating conditions apply, CL (RDX, RDY) < 20 pF and RL (RDX,RDY) = 1 kΩ.

PARAMETER		CONDITIONS	MIN	NOM	MAX	UNITS
Differential Voltage Gain		Vin=1 mVpp @ 300 kHz	80	100	120	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	-	0.55	0.75	nV/√Hz
Differential Input Capacitance		Vin = 1 mVpp, f = 5 MHz	-	-	60	pF
Differential Input Resistance		Vin = 1 mVpp, f = 5 MHz	220	-	-	Ω
Dynamic Range		DC input voltage where gain falls to 90% of its 0 VDC value, Vin = VDC +0.5 mVpp, f = 5 MHz	-3	-	3	mV
Common Mode Rejection Ratio		Vin = 0 VDC+100 mVpp @ 5 MHz	54	-	-	dB
Power Supply Rejection Ratio		100 mVpp @ 5 MHz on VDD1 100 mVpp @ 5 MHz on VCC	54	-	-	dB
Channel Separation		Unselected channels driven with 100 mVpp @ 5 MHz, Vin = 0 mVpp	45	-	-	dB
Output Offset Voltage			-360	-	+360	mV
RDX, RDY Common Mode		Read Mode	Vcc-2.2V	Vcc-1.9V	Vcc-1.6V	VDC
Output Voltage		Write Mode	-	2.9	-	VDC
Single Ended Output Resistance		f = 5 MHz	-	-	30	Ω
Output Current		AC Coupled Load, RDX to RDY	3.2	-	-	mA

SWITCHING CHARACTERISTICS (See Figure 1)
Unless otherwise specified, recommended operating conditions apply, Iw = 40 mA, Lh = 500 nH, Rh = 30Ω and f(WDI) = 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	5.0	µs
Unsafe to Safe - TD2		-	1	µs
Head Current				
Prop. Delay - TD3	From 50% points, Lh=0µh, Rh=0Ω	-	32	ns
Asymmetry	WDI 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
Rise/Fall Time	10%-90% points, R(HnX, HnY)=10Ω	-	10	ns

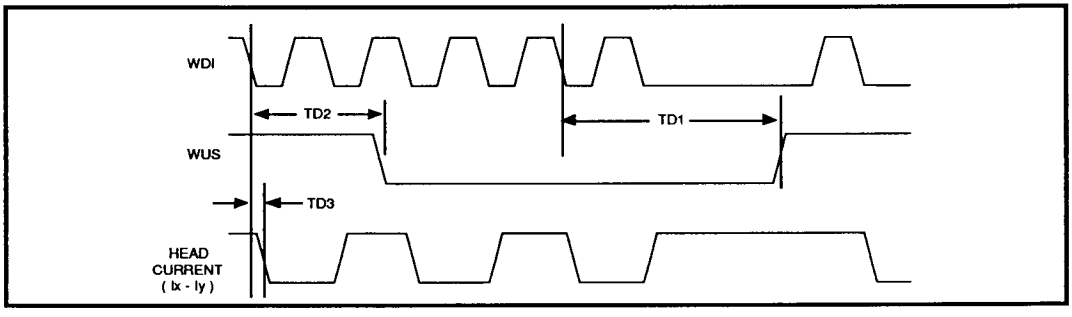


FIGURE 1: Write Mode Timing Diagram

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.)	0.5	0.75	nV/√Hz
Differential Input Resistance (Min.)	292	318	Ω
Differential Input Capacitance (Max.)	43	48	pF

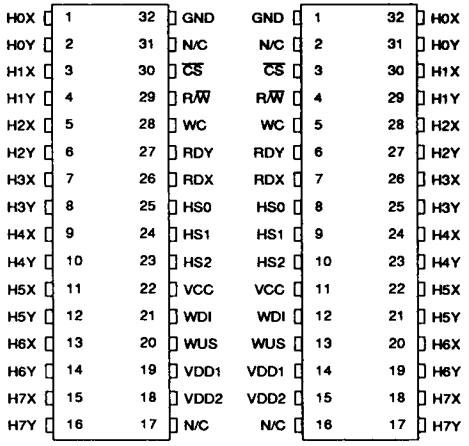
TABLE 4: Key Parameters Under Worst Case Input Impedance Conditions

PARAMETER	Tj = 25°C	Tj = 135°C	UNITS
Input Noise Voltage (Max.)	0.45	0.6	nV/√Hz
Differential Input Resistance (Min.)	220	260	Ω
Differential Input Capacitance (Max.)	55	60	pF

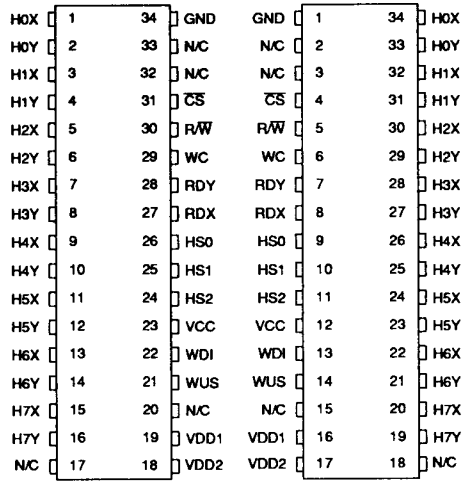
SSI 32R524R
8-Channel Thin Film
Read/Write Device

PACKAGE PIN DESIGNATIONS

(Top View)



32-LEAD SOW **32-LEAD SOW MIRROR**



34-LEAD SOL **34-LEAD SOL MIRROR**

THERMAL CHARACTERISTICS: θja

32-Lead SOW	55°C/W
34-Lead SOL	50°C/W

ORDERING INFORMATION

PART DESCRIPTION		ORDER NO.	PKG. MARK
SSI 32R524R	8-Channel SOW	32R524R-8W	32R524R-8W
	8-Channel SOL	32R524R-8L	32R524R-8L
SSI 32R524RM	8-Channel SOW	32R524RM-8W	32R524RM-8W
	8-Channel SOL	32R524RM-8L	32R524RM-8L

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