SSI 32R522/522R
4, 6-Channel Thin Film Read/Write Device

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July, 1990

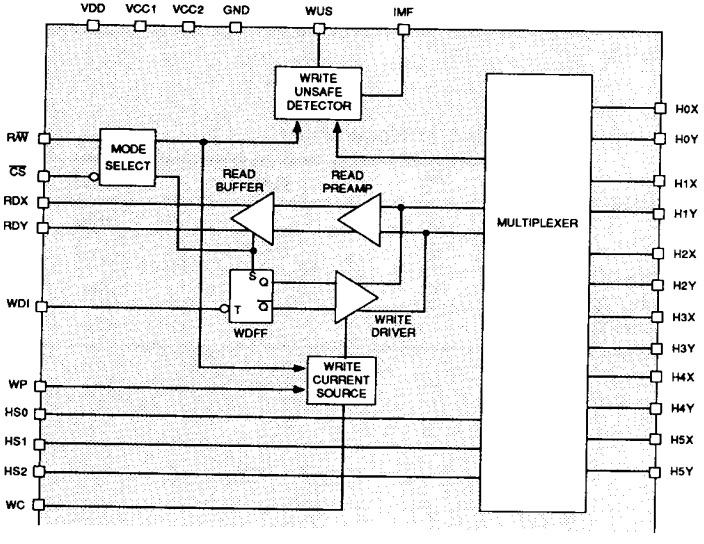
DESCRIPTION

The SSI 32R522/522R 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 as many as six channels. They require +5V and +12V power supplies and are available in a variety of package and channel configurations. The 32R522R option provides internal 1000Ω damping resistors.

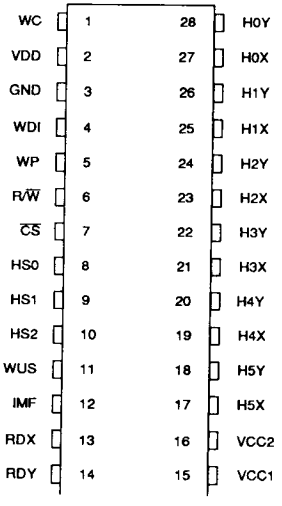
FEATURES

- **High performance:**
  - **Read mode**
  - **Input noise = 1.0nV/√Hz max.**
  - **Input capacitance = 32 pF**
  - **Write current range = 6 mA to 35 mA**
  - **Head voltage swing = 3.4 Vpp**
- **Compatible with two & three terminal thin film heads**
- **Programmable write current source**
- **Write unsafe detection**
- **TTL compatible control signals**
- **+5 & +12V power supplies**

BLOCK DIAGRAM



PIN DIAGRAM



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

CIRCUIT OPERATION

The SSI 32R522 addresses up to six two-terminal thin film heads providing write current 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 $\overline{CS}$, R/$\overline{W}$ and WP will force the device into a non-writing condition if either control line is opened accidentally.

WRITE MODE

The write mode configures the SSI 32R522 as a current switch and activates the Write Unsafe (WUS) detection circuitry. Write current is toggled between the X and Y direction of the selected head on each high to low transition on pin WDI, Write Data Input.

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

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

where Vwc (WC pin voltage) = 1.7V ± 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.

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.

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

A multiple device enable condition can be detected by monitoring the voltage across a resistor connected from VCC to the wire OR'ed IMF (Current Monitor Function) pins. Pin IMF sinks one unit of current when the device is enabled.

To initialize the Write Data Flip Flop (WDFF) to pass current through the Y-direction of the head, pin WDI must be low when the previous read mode was commanded.

READ MODE

The read mode configures the SSI 32R522 as a low noise differential amplifier and deactivates the write current generator and write unsafe 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.

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.

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	X	none

0 = Low level, 1 = High level, X = Don't care

PIN DESCRIPTIONS

NAME	I/O	DESCRIPTION
HS0 - HS2	I	Head Select: selects one of six heads
$\overline{CS}$	I	Chip Select: a low level enables the device
R/$\overline{W}$	I	Read/Write: a high level selects read mode
WP	I	Write Protect: a low level enables the write current source
WUS	O*	Write Unsafe: a high level indicates an unsafe writing condition
IMF	O*	Current Monitor Function: allows multichip enable fault detection
WDI	I	Write Data In: a negative transition toggles the direction of the head current
H0X - H5X H0Y - H5Y	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
VCC1	-	+5V Logic Circuit Supply
VCC2	-	+5V Write Current Supply
VDD	-	+12V
GND	-	Ground

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

ABSOLUTE MAXIMUM RATINGS

PARAMETER		SYMBOL	VALUE	UNITS
DC Supply Voltage		VDD	-0.3 to +14	VDC
		VCC1, 2	-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
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	VDD	12 ± 5%	VDC
	VCC1	5 ± 5%	VDC
	VCC2	5 ± 5%	VDC
Operating Temperature	Tj	+25 to +135	°C

DC CHARACTERISTICS

Unless otherwise specified: recommended operating conditions apply.

PARAMETER	CONDITIONS	MIN	MAX	UNITS
VDD Supply Current	Read Mode	-	34	mA
	Write Mode	-	38	mA
	Idle Mode	-	9	mA
VCC Supply Current	Read Mode	-	62	mA
	Write Mode	-	49+IW	mA
	Idle Mode	-	49	mA
Power Dissipation (Tj=+135°C)	Read Mode	-	800	mW
	Write Mode, Iw = 35 mA	-	950	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 (IIH)	VIH = 2.0V	-	100	µA

DC CHARACTERISTICS (Continued)

PARAMETER	CONDITIONS	MIN	MAX	UNITS
RDX, RDY Common Mode Output Voltage	Read Mode	3	5	VDC
WUS Output Low Voltage (VOL)	Iol = 8 mA	-	0.5	VDC
IMF Output Current	$\overline{CS}$ = 0	0.73	1.23	mA
	$\overline{CS}$ = 1	-	0.02	mA

WRITE CHARACTERISTICS
Unless otherwise specified: recommended operating conditions apply, Iw = 10 mA, Lh = 1.5 µH, Rh = 30Ω and f(Data) = 5 MHz.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
WC Pin Voltage (Vwc)		1.61	1.7	1.79	V
Differential Head Voltage Swing		3.4	-	-	Vpp
Unselected Head Current	Iw = 50 mA	-	-	1	mA(pk)
Differential Output Capacitance		-	-	30	pF
Differential Output Resistance	32R522R	800	1000	1350	Ω
	32R522	2400	-	-	Ω
WDI Transition Frequency	WUS=low	1.7	-	-	MHz
Write Current Range		6	-	35	mA

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

PARAMETER		CONDITIONS	MIN	MAX	UNITS
Differential Voltage Gain		Vin = 1 mVpp @ 300 KHz	75	125	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	-	1.0	nV/√Hz
Differential Input Capacitance		Vin = 1 mVpp, f = 5 MHz	-	32	pF
Differential Input Resistance	32R522R	Vin = 1 mVpp, f = 5 MHz	460	-	Ω
	32R522	Vin = 1 mVpp, f = 5 MHz	770	-	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 VDD 100 mVpp @ 5 MHz on VCC	54	-	dB

READ CHARACTERISTICS (Continued)

PARAMETER	TEST CONDITIONS	MIN.	MAX.	UNITS
Channel Separation	Unselected channels driven with 100 mVpp @ 5 MHz, Vin = 0 mVpp	45	-	dB
Output Offset Voltage		-300	+300	mV
Single Ended Output Resistance	f = 5 MHz	-	30	Ω
Output Current	AC Coupled Load, RDX to RDY	3.2	-	mA

SWITCHING CHARACTERISTICS
Unless otherwise specified: recommended operating conditions apply, IW = 10 mA, Lh = 1.5 µH, Rh = 30Ω and f(Data) = 5 MHz. Reference Figure 1.

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 100 mV, 10 MHz 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 100 mV, 10 MHz Read signal envelope	-	1	µs
$\overline{CS}$ to Unselect	Delay to 90% of write current	-	1	µs
HSn				
HS0, 1, 2 to any Head	Delay to 90% of 100 mV, 10 MHz Read signal envelope	-	0.4	µs
WUS				
Safe to Unsafe-TD1		0.6	3.6	µs
Unsafe to Safe-TD2		-	1	µs
IMF				
Propagation Delay	Delay from 50% point of $\overline{CS}$ to 90% of IMF current	-	0.6	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	-	0.5	ns
Rise/Fall Time	10% - 90% points, Lh=0µh, Rh=0Ω	-	10	ns

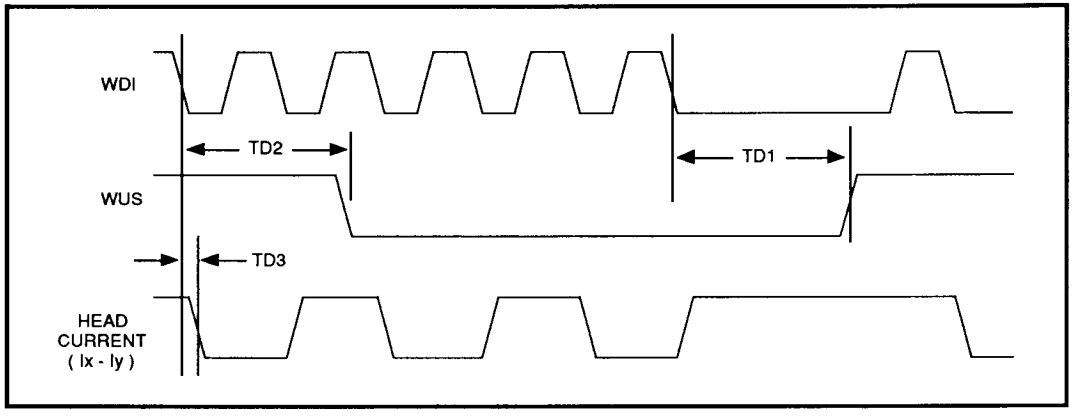


FIGURE 1: Write Mode Timing Diagram

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.)		0.76	1.0	$nV/\sqrt{Hz}$
Differential Input Resistance (Min.)	32R522R	602	645	Ω
	32R522	1245	1455	Ω
Differential Input Capacitance (Max.)		25	28	pF

TABLE 4: Key Parameters Under Worst Case Input Impedance Conditions

PARAMETER		Tj = 25°C	Tj = 135°C	UNITS
Input Noise Voltage (Max.)		0.63	0.82	$nV/\sqrt{Hz}$
Differential Input Resistance (Min.)	32R522R	460	526	Ω
	32R522	770	960	Ω
Differential Input Capacitance (Max.)		30	32	pF

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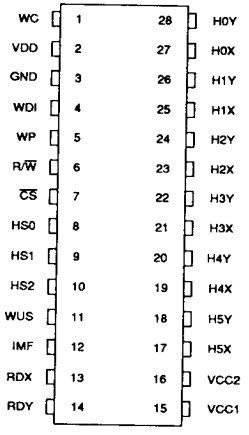
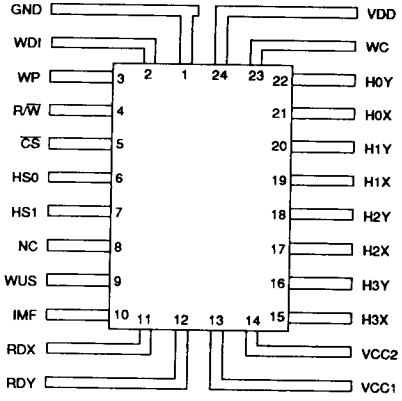
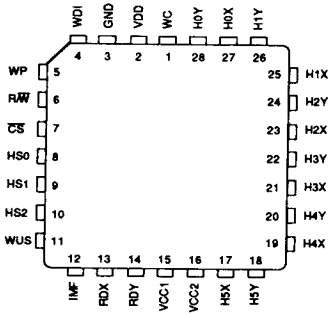
PACKAGE PIN DESIGNATIONS
(TOP VIEW)



28 - LEAD SOL



24 - LEAD FLATPACK



28 - LEAD PLCC

THERMAL CHARACTERISTICS: θja	
24 - Lead FLAT PACK	105°C/W
28 - Lead SOL	70°C/W
28 - Lead PLCC	65°C/W

ORDERING INFORMATION

PART DESCRIPTION	ORDER NO.	PKG. MARK
SSI 32R522 - Read/Write IC 4 - Channel Flat Pack 6 - Channel SOL 6 - Channel PLCC	SSI 32R522 - 4F SSI 32R522 - 6L SSI 32R522 - 6CH	32R522 - 4F 32R522 - 6L 32R522 - 6CH
SSI 32R522R- w/Internal Damping Resistors 4 - Channel Flat Pack 6 - Channel SOL 6 - Channel PLCC	SSI 32R522R - 4F SSI 32R522R - 6L SSI 32R522R - 6CH	32R522R - 4F 32R522R - 6L 32R522R - 6CH

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