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SSI 32R2420
5V, 4-Channel 2-Terminal Read/Write Device

June 1994

DESCRIPTION

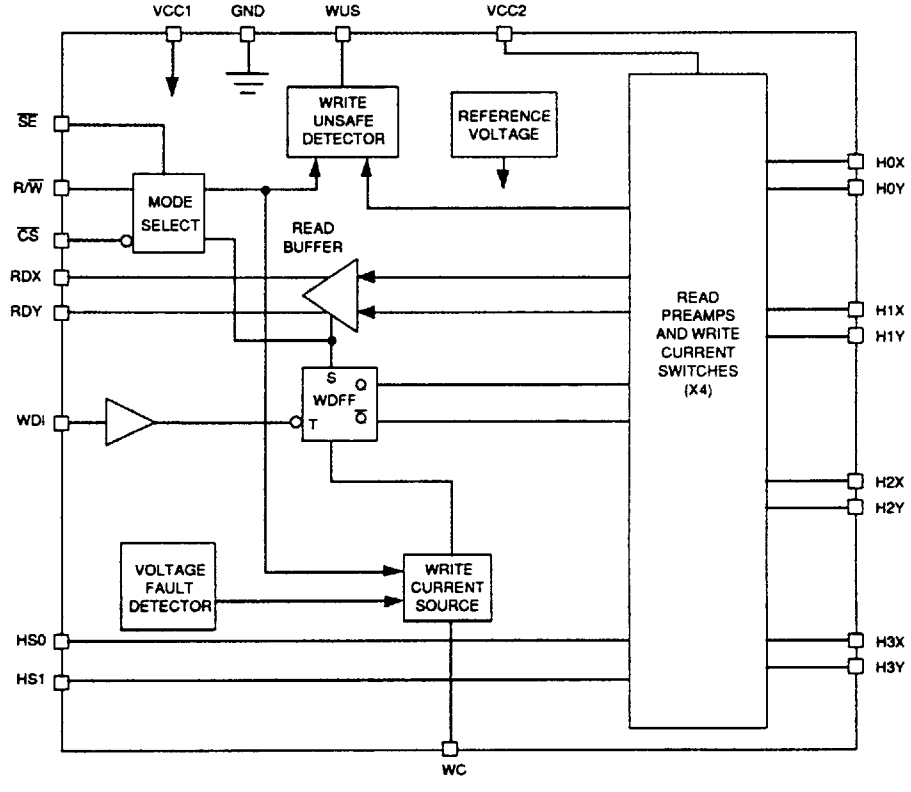
The SSI 32R2420 is a BiCMOS monolithic integrated circuit designed for use with two-terminal recording heads. It provides a low noise read amplifier, write current control, and data protection circuitry for up to four channels. This device has been designed to support servo bank write, TTL or ECL write data input, and write unsafe output through various bond options. In addition, versions of the devices are available with or without internal damping resistors. When configured with damping resistors, the resistor is switched in during Write mode and switched out during Read mode. 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 making the read channel outputs high impedance.

The SSI 32R2420 requires a single 5V power supply and is available in a variety of packages. It is hardware compatible with the SSI 32R4610A and SSI 32R2020R Read/Write devices.

FEATURES

- 5V power supply
- Low power
  - PD = 115 mW Read mode (Nom)
  - PD = 0.17 mW Idle (Max @ $\overline{CS}$ = Vcc)
- High Performance:
  - Read mode gain = 250 V/V
  - Input noise = 0.50 nV/√Hz (Nom)
  - Input capacitance = 9 pF (Nom)
  - Write current range = 2-30 mA
- Bond options for:
  - Self switching damping resistance
  - Servo bank write
  - TTL or ECL write data input
  - Write unsafe detection
- Power supply fault protection

BLOCK DIAGRAM



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CIRCUIT OPERATION

The SSI 32R2420 has the ability to address up to 4 two-terminal heads and provide write drive or read amplification. Mode control and head selection are described in Tables 1 and 2. The TTL inputs R/$\overline{W}$, $\overline{CS}$ and DMP have internal pull-up resistors. The TTL inputs HS0 and HS1 have internal pull down resistors.

TABLE 1: Mode Select

$\overline{CS}$	R/$\overline{W}$	$\overline{SE}$	Mode
0	0	1	Write
0	1	X	Read
1	0	X	Idle
1	1	X	Idle
0	0	0	Servo Write

TABLE 2: Head Select

HS1	HS0	Head
0	0	0
0	1	1
1	0	2
1	1	3

PIN DESCRIPTION

NAME	TYPE	DESCRIPTION
HS0, HS1 †	I	Head Select: selects one of four heads
$\overline{CS}$	I	Chip Select: a high inhibits the chip
R/$\overline{W}$ †	I	Read/Write: a high selects Read mode
WUS †	O	Write Unsafe: a high indicates an unsafe writing condition
WDI/$\overline{WDI}$ †	I	Write Data Input: On TTL versions, a negative transition on WDI changes the direction of the current in the recording head. On ECL versions, a positive transition on the WDI (negative transition on $\overline{WDI}$ changes the direction of the current in the recording head. $\overline{WDI}$ is only present on the ECL versions.
H0X - H3X; H0Y - H3Y	I/O	X, Y Head Connections
RDX, RDY †	O	X, Y Read Data: differential read data output
WC		Write Current: used to set the magnitude of the write current
VCC1	I	Power Supply
GND	I	Ground
$\overline{SE}$	I	Servo Enable: A low input on this line enables the Servo Bank Write mode when $\overline{CS}$ and R/$\overline{W}$ are both low.
WUS/SE	I	Write Unsafe/Servo Enable: Under normal operation, a high level output on this pin indicates a write unsafe condition. When this pin is driven externally above VCC and $\overline{CS}$ and R/$\overline{W}$ are both low, servo Write mode is activated.
DMP	I	Damping Resistor Enable: A high (or open) level on this input enables the switchable damping resistor. A low level on this input disables the damping resistor.

†When more that one R/W device is used, signals can be wire OR'ed

WRITE MODE

Taking both $\overline{CS}$ and R/$\overline{W}$ low selects Write mode which configures the device as a current switch and activates the Write Unsafe (WUS) detector circuitry. Head current is toggled between the X and Y side of the selected head on each high to low transition of the Write Data Input (WDI). Note that a preceding Read to Write transition or Idle to Write transition initializes the Write Data Flip-Flop to pass write current into the "X" side of the device. In this case, the Y side is higher potential than the X side. The magnitude of the write current (0-pk) is given by:

$$Iw = Aw \cdot \frac{Vwc}{Rwc} = K/Rwc$$

where Aw is the write current gain.
RWC is connected from pin WC to GND. Note the actual head current Ix, y is given by:

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

where:

Rh = Head resistance plus external wire resistance
Rd = Damping resistance

In Write mode a 350Ω damping resistor is switched in across the Hx, Hy ports.

VOLTAGE FAULT

A voltage Fault detection circuit improves data security by disabling the write current generator during a voltage fault or power startup in Read or Write mode.

WRITE UNSAFE

Any of the following conditions will be indicated as a high level on the Write Unsafe, WUS, open collector output.

- WDI frequency too low
- Device in Read mode
- Device not selected
- Open head
- Head short to ground

WUS is valid in the write current/head characteristic region defined by 5 < Ih • Lh < 50 mA • μH, and 1 < Rh < 1.25/Ih. After the fault condition is removed, one negative transition on WDI is required to clear WUS.

READ MODE

The Read mode configures the SSI 32R2420 as a low noise differential amplifier and deactivates the write current generator. The damping resistor is switched out of the circuit allowing a high impedance input to the read amplifier. The RDX and RDY output are driven by emitter followers. They should be AC coupled to the load. The HnX, HnY inputs are non-inverting to the RDX, RDY outputs.

Note that in Idle or Write mode, the read amplifier is deactivated and RDX, RDY outputs become high impedance. This facilitates multiple R/W applications (wired-OR RDX, RDY) and minimizes voltage change when switching from Write to Read mode. Note also that the write current source is deactivated for both the Read and Idle mode.

IDLE MODE

Taking $\overline{CS}$ high selects the Idle mode which switches the RDX and RDY outputs into a high impedance state and deactivates the device. Power consumption in this mode is held to a minimum.

ELECTRICAL SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Operation above maximum ratings may permanently damage the device.

PARAMETER		RATING
DC Supply Voltage	VCC1	-0.3 to +7 VDC
	VCC2	-0.3 to +7 VDC
Write Current	Iw	30 mA
Digital Input Voltage	Vin	-0.3 to VCC1 +0.3 VDC
Head Port Voltage	VH	-0.3 to VCC2 +0.3 VDC
Output Current: RDX, RDY	Io	-10 mA
	WUS	+8 mA
Storage Temperature	Tstg	-55 to +150°C

RECOMMENDED OPERATING CONDITIONS

PARAMETER		RATING
DC Supply Voltage		5 ±10% VDC
Recommended Head Load Range	Lh	0.3 - 5 µH
WUS Operating Range, Iw • Lh		5 - 50 mA • µH
Head Differential Load Capacitance		15 pF max
Ambient Operating Temperature*	Ta	0 - 70°C

* Derating is required when in Servo Write mode.

DC CHARACTERISTICS

Recommended operating conditions apply unless otherwise specified.

PARAMETER		CONDITIONS	MIN	NOM	MAX	UNIT
Supply Current	VCC1	Read		23	32	mA
		Write		6 + 1.2 • Iw	10 + 1.3 • Iw	mA
		Servo		7 + 4.4 • Iw	12 + 4.7 • Iw	mA
		Idle, $\overline{CS}$ = Vcc		5	30	µA
		Idle, $\overline{CS}$ = 2.7V		250	450	µA
Power Dissipation		Read		115	180	mW
		Write		30 + 6 • Iw	55 + 7 • Iw	mW
		Servo		35 + 22 • Iw	66 + 26 • Iw	mW
		Idle, $\overline{CS}$ = 2.7V		1.25	2.5	mW
		Idle, $\overline{CS}$ = Vcc		0.03	0.17	mW

DIGITAL INPUTS

PARAMETER		CONDITIONS	MIN	NOM	MAX	UNIT
Input Low voltage	VIL				0.8	VDC
Input High Voltage	VIH		2			VDC
Input Low Current		VIL = 0.4	-0.4	-0.13		mA
Input High Current		VIH = 2.7V		0	20	µA
WUS Output Low Voltage	VOL	Iol = 2 mA max		.35	0.5	VDC

WRITE CHARACTERISTICS

Recommended operating conditions apply unless otherwise specirfied.

Fault Voltage	VCC1	Iw < 0.2 mA		2.5	2.75	VDC
Write Current Gain	Aw	Iw = 2-5 mA	21	25	30	mA/mA
		Iw = 5-30 mA	20	23	26	mA/mA
Write Current Error		Rwc = 2 kΩ, head to head @ Write mode	-5		+5	%
		Rwc = 2 kΩ, head to head @ Servo mode	-5		+5	%
		Rwc = 2 kΩ, Write to Servo	-7		+7	%
Write Current Voltage	Vwc		1.2	1.3	1.4	V
Differential Head Voltage Swing		Open head, $\overline{SE}$ = 1	4	4.8		Vpp
		Open head, Vcc = 5V, $\overline{SE}$ = 0	4	4.8		Vpp
Unselected Head Current		AC			1	mA (pk)
		DC			0.1	mA
Head Differential Load		R version	300	400	500	Ω
Resistance	Rd	Non-R version	2400	3000	3600	Ω
WDI Pulse Width		Vil ≤ 0.8V, Vih ≥ 2V PWH	5			ns
		$t_f = t_r$ = 1 ns PWL	10			ns
Write Current Range	Iw		2		30	mA

ELECTRICAL SPECIFICATIONS (continued)

READ CHARACTERISTICS

Recommended operating conditions apply unless otherwise specified. CL (RDX, RDY) < 20 pF, RL (RDX, RDY) = 1 kΩ.

PARAMETER		CONDITIONS	MIN	NOM	MAX	UNIT
Differential Voltage Gain		Vin = 1 mVpp @1 MHz	200	250	300	V/V
Voltage BW	-1 dB	|Zs| < 5Ω, Vin = 1 mVpp	20	45		MHz
	-3 dB		40	70		MHz
Input Noise Voltage		BW = 15 MHz, Lh = 0, Rh = 0		0.5	0.75	nV/√Hz
Input Noise Current				3		pA/√Hz
Differential Input Capacitance		Vin = 1 mVpp, f = 5 MHz		9	14	pF
Differential Input Resistance		Vin = 1 mVpp, f = 5 MHz	500	750	1800	Ω
Dynamic Range		AC input voltage where gain falls to 90% of its small signal gain value, f = 5 MHz	2	5		mVpp
Common Mode Rejection Ratio		Vin = 0 VDC + 100 mVpp @ 5 MHz	45	60		dB
Power Supply Rejection Ratio		100 mVpp @ 5 MHz on VCC	40	70		dB
Channel Separation		Unselected channels driven with Vin = 0 VDC + 100 mVpp	45	60		dB
Output Offset Voltage		Head shorted	-250		+250	mV
		Head loaded 200Ω	-400		+400	mV
Single Ended Output Resistance		f = 5 MHz		60	100	Ω
Output Current		AC coupled load, RDX to RDY	1	2		mA
RDX, RDY Common Mode Output Voltage			Vcc - 1	Vcc - 1.35	Vcc - 1.7	VDC

SWITCHING CHARACTERISTICS

Recommended operating conditions apply unless otherwise specified. Rwc = 2 kΩ, Lh = 1 µH, Rh = 30Ω f(Data) = 5 MHz.

PARAMETER			CONDITIONS	MIN	NOM	MAX	UNIT
R/$\overline{W}$	Read to Write		R/$\overline{W}$ to 90% of write current; WUS valid		0.3	1	µs
	Write to Read		R/$\overline{W}$ to 90% of 100 mV Read signal envelope		0.4	1	µs
$\overline{CS}$	Unselect to Select		$\overline{CS}$ to 90% of 100 mV 10 MHz Read signal envelope		0.6	2	µs
	Select to Unselect		$\overline{CS}$ to 10% of write current		0.4	1	µs
HS0,1 to any Head			To 90% of 100 mV 10 MHz Read signal envelope		0.2	1	µs
WUS*	Safe to Unsafe	TD1	Write mode, loss of WDI transitions; Defines max WDI period for WUS operation	0.6	2	3.6	µs
	Unsafe to Safe	TD2	Fault cleared: from first negative WDI transition		0.2	1	µs
WDI	Frequency Range		Valid WUS	1.67		25	MHz
Head Current			Lh = 0, Rh = 0		25	40	ns
	WDI to Ix - Iy	TD3	from 50% points				
	Asymmetry		WDI has 1 ns rise/fall time			1.5	ns
	Rise/fall Time		10% to 90% points Rwc = 2 kΩ, Rh = 0, Lh = 0		2	9	ns
			Rwc = 2 kΩ, Rh = 30Ω, Lh = 1 µH		14	18	ns

* 5 < Iw • Lh < 50 mA • µH, 1 < Rh ≤ 1.25/Iw, WUS available in bonding option.

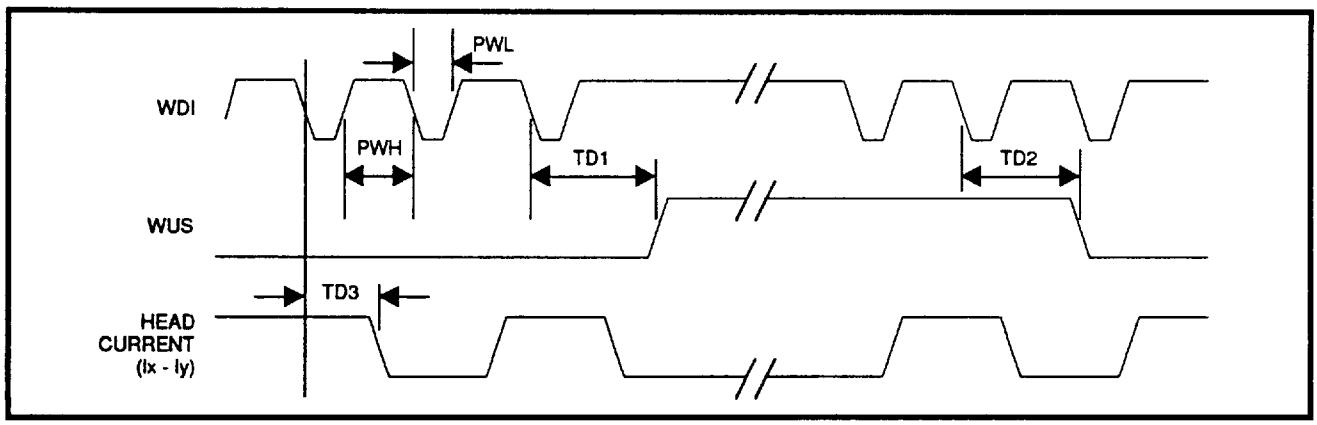

FIGURE 1: Write Mode Timing Diagram

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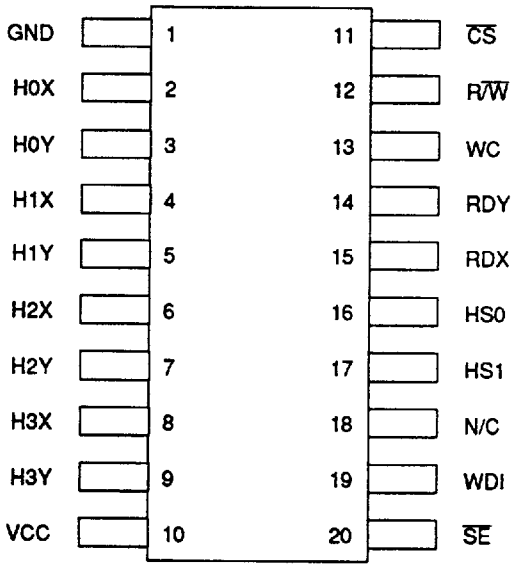
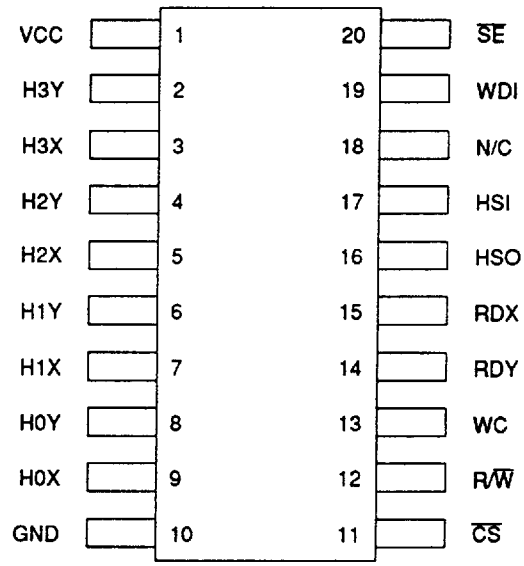
PACKAGE PIN DESIGNATIONS
(Top View)



20-Lead VSOP

32R2420RW-4CV (VSOP)
32R2420W-4CV (VSOP)

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



20-Lead VSOP
(Inverted)

32R2420RIW-4CV
32R2420IW-4CV

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