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SSI 32R2063R/64R/65R
5V, 4-Channel Thin Film Read/Write Device
Advance Information

October 1993

DESCRIPTION

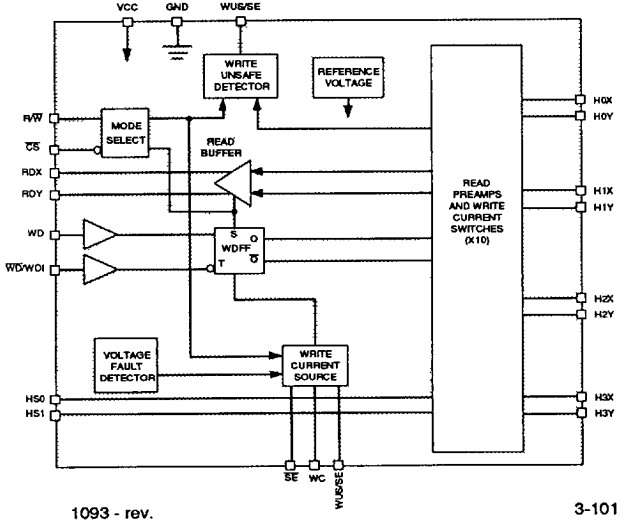
The SSI 32R2063R/64R/65R are Bipolar monolithic integrated circuits designed for use with two-terminal recording heads. They provide a low noise read amplifier, write current control, and data protection circuitry for up to four channels. The SSI 32R2063R option provides internal 350Ω damping resistors. Damping resistors are switched in during Write mode and switched out during Read mode. The SSI 32R2063/64/65 option does not provide a damping resistor. 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 device also offers multiple channel "servo bank write" capability to assist in servo writing operations. Servo write is selected either with a TTL input (32R2063R/32R2064R) or with the WUS/SE pin (32R2065R).

The SSI 32R2063R/64R/65R require only a +5.0V power supply and are available in a variety of packages and gain options.

FEATURES

- **+5V ±10% supply**
- **Low power**
  - **PD = 120 mW Read mode (Nom)**
  - **PD = 7 mW Idle (Max)**
- **High Performance:**
  - **Read mode gain = (U) 150, (W) 250 V/V**
  - **Input noise = 0.56 nV/√Hz (Nom)**
  - **Input capacitance = 16 pF (Nom)**
  - **Write current range = 1-35 mA**
  - **Max write current rise/fall time = 15 nsec (typical head)**
  - **Head voltage swing = 3.4 Vpp min**
- **Servo bank-write capability**
- **Self switching damping resistance**
- **Write unsafe detection**
- **Power supply fault protection**
- **Head short to ground protection**
- **Differential ECL-like (32R2063R) or TTL (32R2064R, 32R2065R) write data inputs**

BLOCK DIAGRAM



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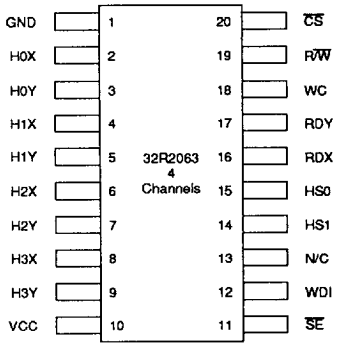
PIN DIAGRAM



20-Lead SOL, VSOP

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

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CIRCUIT OPERATION

The SSI 32R2063R/64R/65R 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 $\overline{SE}$ have internal pull-up resistors to prevent an accidental write condition. HS0 and HS1 have internal pulldown(W)/internal pull up (U) resistors. Internal clamp circuitry will protect the IC from a head short to ground condition in any mode.

TABLE 1a: Mode Select (32R2063R, 32R2064R)

$\overline{CS}$	R/$\overline{W}$	$\overline{SE}$	Mode
0	0	1	Single Channel Write. See Table 2.
0	0	0	Servo Write Channels 0, 1, 2, 3
0	1	X	Single Channel Read. See Table 2.
1	X	X	Idle.

TABLE 1b: Mode Select (32R2065R)

$\overline{CS}$	R/$\overline{W}$	WUS/SE	Mode
0	0	*	Single Channel Write. See Table 2.
0	0	Vcc+1.5*	Servo Write Channels 0, 1, 2, 3
0	1	X	Single Channel Read. See Table 2.
1	X	X	Idle.

*WUS/SE functions as WUS in Write Mode unless it is pulled above Vcc.

TABLE 2: Head Select

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

WRITE MODE

Taking both $\overline{CS}$ and R/$\overline{W}$ low selects Write mode which configures the SSI 32R2063R/64R/65R as a current switch and activates the Write Unsafe (WUS) detector circuitry. On the 32R2063R, head current is toggled between the X and Y side of the selected head on each low to high transition of WD-$\overline{WD}$. On the 32R2064R/65R, 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 (32R2063R/64R/65R). The unselected head potential is kept at ground.

SERVO WRITE MODE

Taking $\overline{SE}$ low and R/$\overline{W}$ low (32R2063R/64R) or taking WUS/SE to Vcc+1.5 (32R2065R) activates Servo Write mode. This mode allows for writing to multiple channels at once, which is useful during servo formatting. In this mode, the write driver will drive channels 0, 1, 2, and 3 simultaneously.

POWER SUPPLY FAULT PROTECTION

A voltage fault detection circuit improves data security by disabling the write current generator during a voltage fault or power startup regardless of mode. Note that WUS does not necessarily turn on to flag a power supply fault condition.

HEAD SHORT TO GROUND PROTECTION

The SSI 32R2063R/64R/65R provides a head short to ground protection circuit in any mode. In Idle or Read Mode, current out of the head port will not exceed 20 mA if any head is shorted to ground. In Write mode, if any head is shorted to ground (regardless if it is selected or not) the write current generator will turn off, the WUS flag will go high, and current will be limited to less than 1 mA out of the head port.

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
- Device in Servo Write mode
- No head current
- Open head
- Head short to ground

WDI frequency too low is detected if the WDI frequency falls below 1.67 MHz (typ). Consult the WUS Safe to Unsafe timing for range of frequency detection.

Device in Read mode, Device in servo Write mode and **Chip disabled** will flag WUS if R/$\overline{W}$ is high, if SE is high, or $\overline{CS}$ is high.

No head current will flag WUS if Rwc = ∞ and the selected head is present.

Head opened will flag WUS if Rh = ∞

Head short to ground is described in the preceding paragraph.

Upon entering Write mode, WUS is valid after two low to high transitions of WD-$\overline{WD}$ (32R2063R), or two high to low transitions of WDI (32R2064R/65R) following the required Read-Write transition time (0.6 µs max).

After the fault condition is removed, two positive transitions of WD-$\overline{WD}$ (32R2063R), or two negative transitions of WDI (32R2064R/65R) are required to clear WUS.

READ MODE

The Read mode configures the devices 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. The unselected head potential is kept at ground.

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. The head potential is kept at ground.

PIN DESCRIPTION

CONTROL/STATUS

NAME	TYPE	DESCRIPTION
$\overline{CS}$	I	Chip Select Input. A logical low level enables the device.
R/$\overline{W}$†	I	Read/Write. A logical high level enables Read mode. A logical low level enables Write mode.
$\overline{SE}$	I	Servo Enable. A low level enables servo bank Write mode. See Servo Enable section (32R2063R, 32R2064R).
HS0,HS1	I	Head Select. Decoded address selects one of 4 channels. See Table 2.
WUS†	O	Write Unsafe. A high level indicates an unsafe writing condition. See WUS section (32R2064R).
WUS/SE†	I/O	Write Unsafe/Servo Enable. When in Servo Bank Write mode, pulling this pin above Vcc enables servo bank write. See Servo Enable section. Otherwise, a high level indicates an unsafe writing condition. See WUS section (32R2065R).
WC	I	Write Current. Sets the write current through the recording head.

HEAD TERMINAL CONNECTIONS

H0X-H3X H0Y-H3Y	I	X,Y Head Connections

DATA INPUT/OUTPUT

WDI†	I	Write Data In. A negative transition of WDI changes the direction of current in the recording head (32R2064R, 32R2065R).
WD,$\overline{WD}$†	I	Differential Write Data In. A positive transition of WD-$\overline{WD}$ changes the direction of current in the recording head (32R2063R).
RDX,RDY†	O	Differential Read Data Out. Emitter follower output.

POWER

VCC	I	+5 V power supply
GND	I	Ground

† When more than one Read/Write device is used, signals can be wire OR'ed.

ELECTRICAL SPECIFICATIONS

Current maximums are currents with the highest absolute value

ABSOLUTE MAXIMUM RATINGS

Operation beyond the maximum ratings may damage the device.

PARAMETER			RATING
DC Supply Voltage		VCC	-0.3 to 7V
Write Current*		Iw	60 mA
Digital Input Voltage		Vin	-0.3 to VCC+0.3V
Head Port Voltage		VH	-0.3 to VCC+0.3V
WUS Pin Voltage		Vwus	VCC+0.3V
Output Current	RDX,RDY	Io	-6 mA
	WUS	Iwus	+8 mA
Junction Operating Temperature			+135°C
Storage Temperature			-65 to +150°C

RECOMMENDED OPERATING CONDITIONS

PARAMETER		CONDITIONS
DC Supply Voltage	VCC	5 ± 10%V
Ambient Operating Temperature		0° < Ta < 75°C

TEST CONDITIONS

Recommended operating conditions apply.

PARAMETER	CONDITIONS
Write Current, Iw	1-35 mA
Head Inductance, Lh	1 µH
Head Resistance, Rh	30Ω
WD Frequency	5 MHz
WD,$\overline{WD}$ rise/fall time (32R2063R)	1ns
WDI rise/fall time (32R2064R/2065R)	1 ns

*Maximum servo write current or ambient temperature needs to be regulated to prevent the junction temperature from exceeding 135°C.

POWER DISSIPATION

Recommended operating conditions apply.

PARAMETER	CONDITIONS		MIN	NOM	MAX	UNIT
VCC Supply Current	Read Mode	(U)		24	32	mA
		(W)		28	38.2	mA
	Write Mode	Single Channel		(28+Iw)	(39+Iw)	mA
		Servo Write		(61+ 4Iw)	(83+ 4Iw)	mA
	Idle Mode			0.7	1.1	mA
Power Dissipation	Read Mode			140	209	mW
	Write Mode	Single Channel		(140+ 5.3 Iw)	(210+ 6 Iw)	mW
		Servo Write		(305+ 20 Iw)	(450+ 22.5 Iw)	mW
	Idle Mode			4	7	mW

DIGITAL INPUTS

Input High Voltage Vih HSX, CS/, R/$\overline{W}$, $\overline{SE}$, WDI		2.0			VDC
Input Low Voltage Vil HSX, CS/, R/$\overline{W}$, $\overline{SE}$, WDI				0.8	VDC
Input High Current Iih HSX, CS/, R/$\overline{W}$, $\overline{SE}$, WDI	Vih = 2.0V			100	µA
Input Low Current Iil HSX, CS/, R/$\overline{W}$, $\overline{SE}$, WDI	Vil = 0.8V	-0.4			mA
WD, WD/ Input High Voltage Vih		Vcc-1.0		Vcc-0.5	VDC
WD, WD/ Input Low Voltage Vil		Vih-2.5		Vih-1.0	VDC
WD-WD/ Input Voltage Difference	0.5	0.5	1.0	1.5	V
WD,WD/ Input High Current	Vih = Vcc-0.75V		85	120	µA
WD,WD/ Input Low Current	Vih = Vcc-1.75V		65	100	µA
WUS Output Low Voltage Vol	Iol = 2 mA max		0.35	0.5	VDC

ELECTRICAL SPECIFICATIONS (continued)

WRITE CHARACTERISTICS

Test conditions apply unless otherwise specified.

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNIT
Write Current Voltage Vwc		2.4	2.5	2.6	V
Write Current Gain Aw	Iw = Aw•Vwc/Rwc		20		V
Write Current Constant "K"	Iw = K/Rwc	48.5	50	51.5	V
Differential Head Voltage Swing	Iw = 20 mA	4.2	3.6		Vpp
	Open Head, Iw = 20 mA	3.4	5.0		Vpp
Head Differential Rd	32R2063R/64R/65R	310	350	390	Ω
Load Resistance	32R2063	2400	3000	3600	Ω
WD Pulse Width	PWH	5			ns
(Write mode)	PWL	10			ns
WD Pulse Width	PWH	5			ns
(Servo Write)	PWL	20			ns
WD, $\overline{WD}$ Pulse Width	PWH	5			ns
(Write, Servo Write) 32R2063R	PWL	5			ns
Head Current HnX,HnY		-200		200	µA
Unselected Head Voltage				0.3	VDC
Unselected Head Current	DC			100	µA
VCC Fault Voltage	Iw ≤ 0.2 mA	3.5	4.0	4.2	V

SERVO WRITE CHARACTERISTICS

Write Current Range		5		25	mA
Write Current Matching	Between channels		±10%		
WUS/SE Input Voltage	Servo bank write enabled (32R2065R)	Vcc + 1.5			V

READ CHARACTERISTICS

Test 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	(U)	110	150	190	V/V
		@1 MHz	(W)	200	250	300	V/V
Voltage BW	-1dB	|Zs| < 5Ω, Vin = 1 mVpp		20	35		MHz
	-3dB			45	70		MHz
Input Noise Voltage		BW = 15 MHz, Lh = 0, Rh = 0			0.56	0.75	nV/√Hz
Input Noise Current					3		pA/√Hz
Differential Input Capacitance		Vin = 1 mVpp, f = 5 MHz			16	22	pF
Differential Input Resistance		Vin = 1 mVpp, f = 5 MHz 32R2063/64/65		720	1200		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		55			dB
Power Supply Rejection Ratio		100 mVpp @ 5 MHz on VCC		50			dB
Channel Separation		Unselected channels driven with Vin = 0 VDC + 100 mVpp		50			dB
Output Offset Voltage		Shorted head	(U) 150 Av	-200		+200	mV
			(W) 250 Av	-300		+300	mV
Single Ended Output Resistance		f = 5 MHz			25	50	Ω
Output Current		AC coupled load, RDX to RDY		0.9	1.4		mA
RDX, RDY Common Mode Output Voltage				0.4 • Vcc	0.5 • Vcc	0.6 • Vcc	VDC

ELECTRICAL SPECIFICATIONS (continued)

SWITCHING CHARACTERISTICS

Test conditions apply unless otherwise specified.

PARAMETER		CONDITIONS		MIN	NOM	MAX	UNIT
R/$\overline{W}$	Read to Write	R/$\overline{W}$ to 90% of write current	U		0.1	0.3	µs
			W		0.2	0.6	µs
	Read to Write	Rh = 10Ω, Lh = 1.5 µH Iw = 10 mA			0.07	0.15	µs
	Write to Read	R/$\overline{W}$ to 90% of 100 mV Read signal envelope			0.1	0.6	µs
$\overline{CS}$	Unselect to Select	CS to 90% of 100 mV 10 MHz Read signal envelope			0.4	1	µs
	Select to Unselect	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	0.6	µs
WUS	Safe to Unsafe (TD1)	Write mode, loss of WD transitions; Defines max WD period for WUS operation		0.6	2.0	3.6	µs
	Unsafe to Safe (TD2)	Fault cleared: from second WD transition			0.2	1.0	µs
WDI	Frequency Range	Valid WUS		1.67		25	MHz
Head Current		Lh = 0, Rh = 0					
	WDI to Ix - Iy (TD3)	from 50% points			3	10	ns
	Asymmetry	WDI has 1 ns rise/fall time				1.0	ns
	Rise/fall Time	10% to 90% points Iw = 15 mA, Rh = 0, Lh = 0			4	6	ns
		Iw = 15 mA, Rh = 30Ω, Lh = 1 µH				15	ns

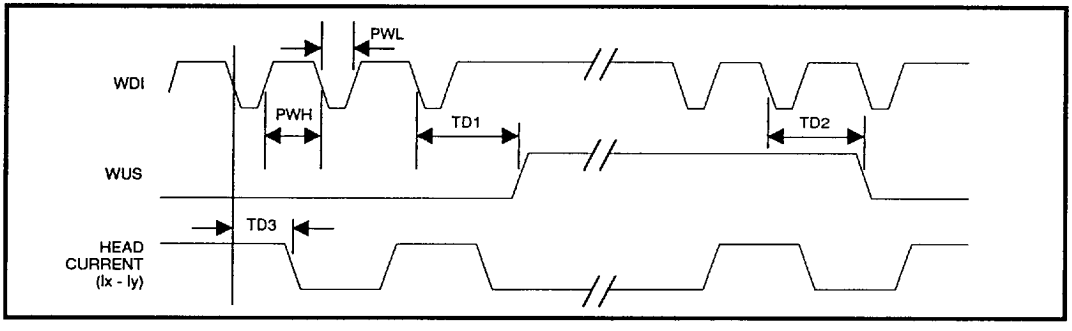


FIGURE 1a: Write Mode Timing Diagram 32R2064R, 32R2065R

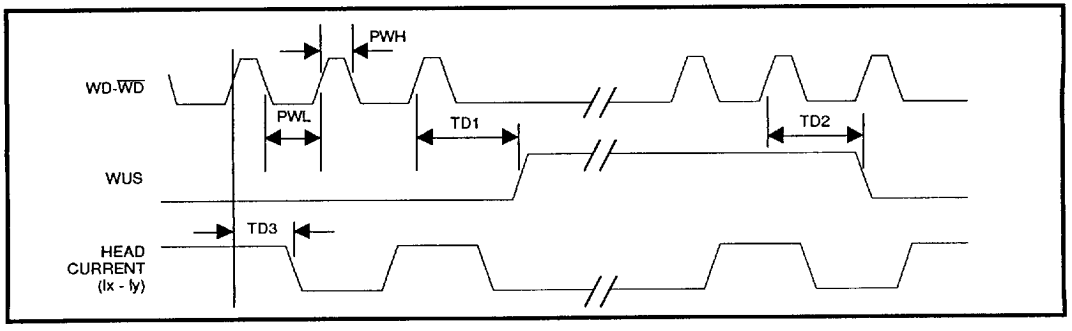
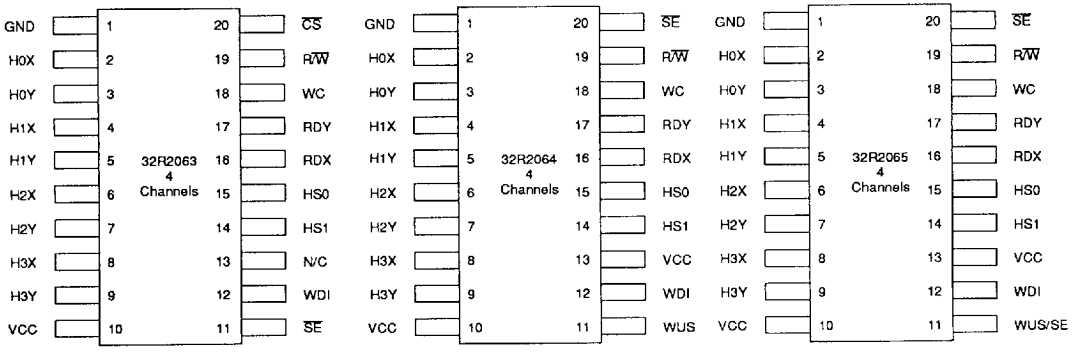


FIGURE 1b: Write Mode Timing Diagram 32R2063R

PACKAGE LEAD DESIGNATION

(Top View)

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



20-Lead SOL, VSOP **20-Lead SOL, VSOP** **20-Lead SOL, VSOP**

Advanced Information: Indicates a product still in the design cycle, and any specifications are based on design goals only Don not use for final design.

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