SSI 32R2100R/2101R
10 Channel Thin Film Read/Write Devices

Advance Information

DESCRIPTION

The SSI 32R2100R/2101R are BiCMOS monolithic integrated circuits designed for use with two-terminal recording heads. They provide a low noise read amplifier, a high performance write driver, write current control, and data protection circuitry for up to 10 channels. The SSI 32R2100R/2101R option provides internal 250Ω damping resistors. Damping resistors are switched in during write mode and switched out during read mode. The SSI 32R2100/2101 option does not provide damping resistors. The SSI 32R2100 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.

The SSI 32R2100R/2101R requires 5V and 12V power supplies. The SSI 32R2100R provides PECL write data input. The SSI 32R2101R provides TTL write data input.

FEATURES

- 5V ±10%, 12V ±10% supply
- **Low power**
  - **PD = 235 mW read mode (Nom)**
  - **PD = 12 mW Idle (Max)**
- **High Performance:**
  - **Read mode gain = 150, 250 V/V**
  - **Input noise = 0.45 nV/√Hz (Nom)**
  - **Input capacitance = 10 pF (Nom)**
  - **Write current range = 10-40 mA**
  - **Max write current rise/fall time = 7 ns (typical head)**
  - **Head voltage swing = 11 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 (32R2100R) or TTL (32R2101R) write data inputs**

3

32R2100R BLOCK DIAGRAM
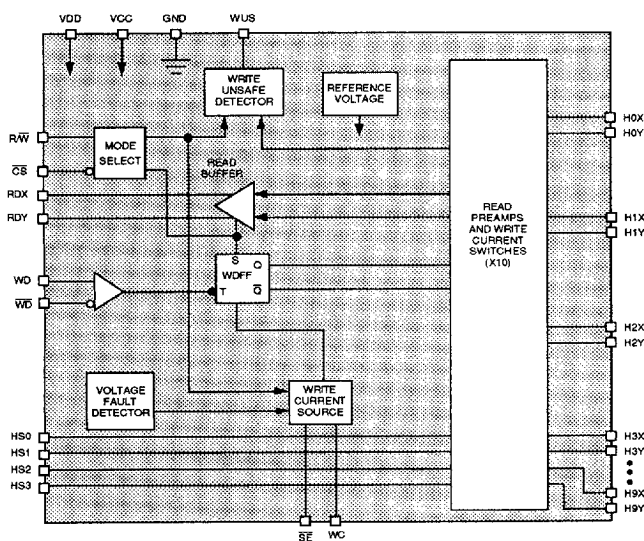
PIN DIAGRAM
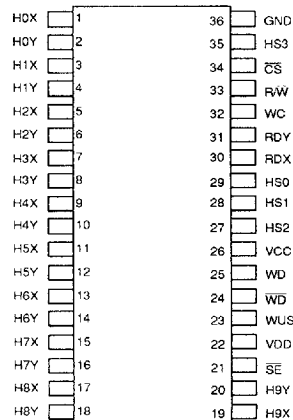
SSI 32R2100R - 36-Lead, 10-Channel SOM

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

0195 - rev.

3-101

SSI 32R2100R/2101R
10 Channel Thin Film
Read/Write Devices

CIRCUIT OPERATION

The SSI 32R2100R/2101R has the ability to address up to 10 two-terminal heads and provide write drive or read amplification. Mode control and head selection are described in Tables 1, 2 and 3. The TTL inputs R/$\overline{\text{W}}$, $\overline{\text{SE}}$ and $\overline{\text{CS}}$ have internal pull-up circuitry to prevent an accidental write condition. HS0, HS1, HS2 and HS3 have internal pulldown circuitry. Internal current limit circuitry will protect the IC from a head short to ground condition in any write mode.

TABLE 1: Mode Select

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

TABLE 2: Head Select*

Head Selected ($\overline{\text{SE}}$ =1)	Head Selected (servo bank write) ($\overline{\text{SE}}$ = 0)	HS3	HS2	HS1	HS0
0	no heads selected	0	0	0	0
1	H0, H1	0	0	0	1
2	H2, H3	0	0	1	0
3	H0, H1, H2, H3	0	0	1	1
4	no heads selected	0	1	0	0
5	H4, H5	0	1	0	1
6	H6, H7,	0	1	1	0
7	H4, H5, H6, H7	0	1	1	1
8	no heads selected	1	0	0	0
9	H8, H9	1	0	0	1

*Do not use invalid Head Select combinations.

WRITE MODE

Taking both $\overline{CS}$ and R/$\overline{W}$ low selects write mode which configures the SSI 32R2100R/2101R as a current switch and activates the Write Unsafe (WUS) detector circuitry. On the 32R2100R, 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 32R2101R, 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:

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

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 250Ω damping resistor is switched in across the Hx, Hy ports (32R2100R/2101R only). Unselected heads are at ground potential.

SERVO WRITE MODE

Taking $\overline{SE}$ low and R/$\overline{W}$ low activates servo write mode. This mode allows for writing to multiple channels at once, which is useful during servo formatting. In this mode, the bank of channels will be selected according to Table 2.

In order to properly activate servo write mode, the $\overline{SE}$ pin must be pulled low at least 20 ns before R/$\overline{W}$ is pulled low. This is a safety feature to prevent glitches on the $\overline{SE}$ pin from affecting normal write mode.

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.

HEAD SHORT TO GROUND PROTECTION

The SSI 32R2100R/2101R provides a head short to ground protection circuit in any mode. In idle or read mode, or for an unselected head in write mode, current out of the head port will not exceed 3 mA. If a selected head in write mode is shorted to ground, the write current generator will turn off, and remain off until the user exits write mode and then returns to 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
- Device in servo write mode
- No head current
- Open head
- Head short to ground
- Power supply fault

To prevent false WUS flags, the head inductance and resistance should be less than 1 µH and 50Ω, respectively.

WDI frequency too low is detected if the WDI frequency falls below 1 MHz (typ). Consult the WUS Safe to Unsafe timing for range of frequency detection.

Device in read mode, Device in servo write mode and **Device not selected** will flag WUS if R/$\overline{W}$ is high, if $\overline{SE}$ is low, or $\overline{CS}$ is high.

No head current will flag WUS if Rwc > 50 kΩ.

Head opened will flag WUS if Rh = ∞. To prevent false WUS flags, the open head detect is disabled when write data frequency is greater than 20 MHz.

Head short to ground is described in the preceding paragraph.

Upon entering write mode, WUS is valid within the specified R/$\overline{W}$ timing.

After the low frequency fault condition is removed, one positive transition of WD-$\overline{WD}$ (32R2100R), or one negative transition of WDI (32R2101R) is required to clear WUS.

3

8253965 0010964 862

SSI 32R2100R/2101R
10 Channel Thin Film
Read/Write Devices

READ MODE

The read mode configures the SSI 32R2100R/2101R 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.

In read mode, unselected heads are at ground potential.

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.

In idle mode, all heads are at ground potential.

PIN DESCRIPTION

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

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.
HS0, HS1, HS2, HS3	I	Head Select. Decoded address selects one of 10 channels. See Table 2.
WUS†	O	Write Unsafe. A high level indicates an unsafe writing condition. See WUS section.
WC†	I	Write Current. Sets the write current through the recording head.

HEAD TERMINAL CONNECTIONS

H0X-H9X H0Y-H9Y	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. (32R2101R)
WD, $\overline{WD}$†	I	Differential Write Data In. A positive transition of WD-$\overline{WD}$ changes the direction of current in the recording head. (32R2100R)
RDX,RDY†	O	Differential Read Data Out. Emitter follower output.

POWER

VCC	I	5V power supply
VDD	I	12V power supply
GND	I	Ground

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 6 Vdc
	VDD	-0.3 to 14.0 Vdc
Write Current	Iw	100 mA
Digital Input Voltage	Vin	-0.3 to VCC + 0.3V
Head Port Voltage	VH	-0.3 to VDD + 0.3V
WUS Pin Voltage	Vwus	-0.3 to VCC + 2V
Output Current RDX,RDY	Io	-6 mA
WUS	Iwus	12 mA
Junction Operating Temperature	Tj	135°
Storage Temperature		-65 to 150°

RECOMMENDED OPERATING CONDITIONS

DC Supply Voltage	VCC	5 ± 10%V
	VDD	12 ± 10%V
Ambient Operating Temperature	Ta	0° < Ta < 75°
Head Inductance	Lh	Lh < 1 μH
Head Resistance, Valid WUS	Rh	Rh < 50 Ω

TEST CONDITIONS
Recommended operating conditions apply.

Write Current, Iw	20 mA
Head Inductance, Lh	1 μH
Head Resistance, Rh	30Ω
WD Frequency	5 MHz
WD, $\overline{\text{WD}}$ rise/fall time (32R2100/2100R)	1 ns
WDI rise/fall time (32R2101/2101R)	1 ns

3

SSI 32R2100R/2101R
10 Channel Thin Film
Read/Write Devices

ELECTRICAL SPECIFICATIONS (continued)

POWER DISSIPATION
Recommended operating conditions apply.

PARAMETER	CONDITIONS		MIN	NOM	MAX	UNIT
VCC Supply Current	Read mode			46	75	mA
	Write mode			18 + 0.2 lw	26 + 0.2 lw	mA
	Servo write mode	2 heads		21 + 0.4 lw	32 + 0.4 lw	mA
	Servo write mode	4 heads		27 + 0.8 lw	43 + 0.8 lw	mA
	Idle mode			0.3	0.7	mA
VDD Supply Current	Read mode			0.4	0.7	mA
	Write mode			8.5 + 1.1 lw	12 + 1.1 lw	mA
	Servo write mode	2 heads		15 + 2.2 lw	20 + 2.2 lw	mA
	Servo write mode	4 heads		31 + 4.4 lw	38 + 4.4 lw	mA
	Idle mode			0.4	0.6	mA
Power Dissipation	Read mode			235	424	mW
	Write mode			192 + 15.2 lw	301 + 15.6 lw	mW
	Servo write mode	2 heads		285 + 28.4 lw	400 + 28.4 lw	mW
	Servo write mode	4 heads		507 + 57 lw	671 + 57 lw	mW
	Idle mode			6.3	12	mW

*Limit servo mode supplies to 4.5V ≤ VCC ≤ 5V and 10.8V ≤ VDD ≤ 12V.

DIGITAL INPUTS

Input High Voltage Vih HSX, $\overline{CS}$, R/$\overline{W}$, $\overline{SE}$, WDI			2			VDC
Input Low Voltage Vil HSX, $\overline{CS}$, R/$\overline{W}$, $\overline{SE}$, WDI					0.8	VDC
Input High Current Iih HSX, $\overline{CS}$, R/$\overline{W}$, $\overline{SE}$, WDI	Vih = 2V				100	μA
Input Low Current Iil HSX, $\overline{CS}$, R/$\overline{W}$, $\overline{SE}$, WDI	Vil = 0.8V		-0.4			mA
WD/$\overline{WD}$ Input High Voltage Vih			2		Vcc-0.2	VDC
WD/$\overline{WD}$ Input Low Voltage Vil			Vih-2		Vih-0.3	VDC
WD/$\overline{WD}$ Input Voltage Difference			0.3		2	V
WD/$\overline{WD}$ Input High Current	Vih = Vcc-0.75V			85	110	μA
WD/$\overline{WD}$ Input Low Current	Vih = Vcc-1.75V			70	100	μA

DIGITAL OUTPUTS

WUS Output Low Voltage Vol	Iol = 2 mA max				0.5	VDC
WUS Output High Current Ioh	Voh = Vcc		-100	0	100	μA

3-106

WRITE CHARACTERISTICS

Test conditions apply unless otherwise specified.

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNIT
Write Current Voltage Vwc			2		V
Write Current Gain Awc	Iw = Aw•Vwc/Rwc		25		mA/mA
Write Current Constant "K"	Iw = K/Rwc	46	50	54	V
Differential Head Voltage Swing	Open Head, Iw = 20 mA	11	13		Vp-p
Head Differential Rd	32R2100R/2101R	200	250	300	Ω
Load Resistance	32R2100/2101	1000	1500	2000	Ω
WD Pulse Width	PWH	5			ns
	PWL	5			ns
Unselected Head Voltage				0.1	VDC
Unselected Head Current				0.2	mA
VCC Fault Voltage	Iw ≤ 0.2 mA	3.9	4.1	4.3	V
VDD Fault Voltage	Iw ≤ 0.2 mA	8.5	9.3	10	V
Head Current HnX, HnY	VCC, VDD low voltage fault condition	-0.2		0.2	mA

SERVO WRITE CHARACTERISTICS

Write Current Range		10		20	mA
Write Current Matching	Between channels		±10%		

READ CHARACTERISTICS

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

Differential Voltage Gain	Vin = 1 mVpp @1 MHz				
	32R2100RU/2101RU	120	150	180	V/V
	32R2100RW/2101RW	210	250	290	V/V
Voltage BW -1 dB	$|Zs|$ < 5Ω, Vin = 1 mVpp	45			MHz
-3 dB		85			MHz
Input Noise Voltage	BW = 20 MHz, Lh = 0, Rh = 0		0.45	0.63	nV/√Hz
Input Noise Current	BW = 20 MHz, Lh = 0, Rh = 0		4	10	pA/√Hz
Differential Input Capacitance	Vin = 1 mVpp, f = 5 MHz		10	14	pF
Differential Input Resistance	Vin = 1 mVpp, f = 5 MHz				
	32R2100/2101	500	750	1800	Ω
	32R2100R/2101R	500	750	1800	Ω

3

SSI 32R2100R/2101R
10 Channel Thin Film
Read/Write Devices

READ CHARACTERISTICS (continued)

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

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNIT
Dynamic Range	AC input voltage where gain falls to 90% of its small signal gain value, f = 5 MHz	2	3		mVp-p
Common Mode Rejection Ratio	Vin = 0 VDC + 100 mVp-p @ 5 MHz	50	60		dB
Power Supply Rejection Ratio	100 mVpp @ 5 MHz on VCC	50	70		dB
Channel Separation	Unselected channels driven with Vin = 0 VDC + 100 mVpp	50	60		dB
Output Offset Voltage AV = 150	Lh = 0, Rh = 0	-150		150	mV
AV = 250	Lh = 0, Rh = 0	-250		250	mV
Single Ended Output Resistance	f = 5 MHz		30		Ω
Output Current Peak to Peak	AC coupled load, RDX to RDY	3	6		mA
RDX, RDY Common Mode Output Voltage			Vcc-2.2		VDC

SWITCHING CHARACTERISTICS

Test conditions apply unless otherwise specified.

|						
R/$\overline{\text{W}}$	Read to Write	R/$\overline{\text{W}}$ to 90% of write current			0.15	μs
	Write to Read	R/$\overline{\text{W}}$ to 90% of 100 mV Read signal envelope			0.20	μs
$\overline{\text{CS}}$	Unselect to Select	CS to 90% of 100 mV 10 MHz Read signal envelope			0.20	μs
	Select to Unselect	CS to 10% of write current			0.15	μs
HS0,1, 2, 3 to any Head		To 90% of 100 mV 10 MHz Read signal envelope			0.15	μs
WUS	Safe to Unsafe (TD1)	Write mode, loss of WD transitions; Defines max WD period for WUS operation	0.6	2	3.6	μs
	Unsafe to Safe (TD2)	Fault cleared: from first WD transition		0.1	0.2	μs
WDI	Frequency Range	Valid WUS	1		100	MHz
Head Current		Lh = 0, Rh = 0				
WD - $\overline{\text{WD}}$ to Ix - Iy (TD3)		50% to 50%		3	5	ns
WDI to Ix - Iy (TD3)		1.5V to 50%		4	6	ns
Asymmetry		WD has 1 ns rise/fall time			0.5	ns
Rise/fall Time		10% to 90% points Iw = 20 mA, Rh = 0, Lh = 0			3	ns
		Iw = 20 mA, Rh = 20Ω, Lh = 600 nH			7	ns

8253965 0010969 344
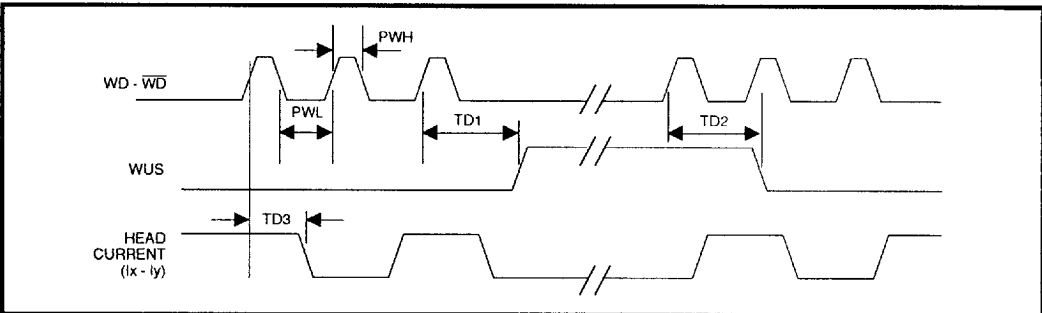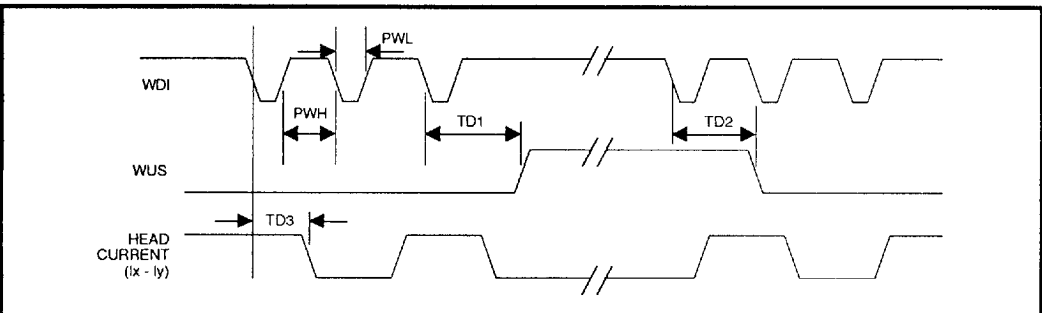
FIGURE 1: Write Mode Timing Diagram (32R2100R)

FIGURE 2: Write Mode Timing Diagram (32R2101R)

SSI 32R2100R/2101R
10 Channel Thin Film
Read/Write Devices

PACKAGE PIN DESIGNATIONS
(Top View)

SSI 32R2100R		
HOX 1	36	GND
HOY 2	35	HS3
H1X 3	34	$\overline{CS}$
H1Y 4	33	R/$\overline{W}$
H2X 5	32	WC
H2Y 6	31	RDY
H3X 7	30	RDX
H3Y 8	29	HS0
H4X 9	28	HS1
H4Y 10	27	HS2
H5X 11	26	VCC
H5Y 12	25	WD
H6X 13	24	$\overline{WD}$
H6Y 14	23	WUS
H7X 15	22	VDD
H7Y 16	21	$\overline{SE}$
H8X 17	20	H9Y
H8Y 18	19	H9X

SSI 32R2100R
36-Lead, PECL Input
10-Channel SOM

SSI 32R2101R		
HOX 1	36	GND
HOY 2	35	HS3
H1X 3	34	N/C
H1Y 4	33	$\overline{CS}$
H2X 5	32	R/W
H2Y 6	31	WC
H3X 7	30	RDY
H3Y 8	29	RDX
H4X 9	28	HS0
H4Y 10	27	HS1
H5X 11	26	HS2
H5Y 12	25	VCC
H6X 13	24	WDI
H6Y 14	23	WUS
H7X 15	22	VDD
H7Y 16	21	$\overline{SE}$
H8X 17	20	H9Y
H8Y 18	19	H9X

SSI 32R2101R
36-Lead, TTL Input
10-Channel SOM

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

8253965 0010971 TT2