SSI 32R2010R
10-Channel Thin Film Read/Write Device

December 1993

DESCRIPTION

The SSI 32R2010R is an integrated read/write circuit designed for use with two terminal heads in disk drive systems. The device contains up to ten channels of read amplifiers and write drivers and also has an internal write current source. An internal 300Ω damping resistor is supplied in Write mode, which is switched to 1 kΩ in Read mode.

The circuit operates on +5V and +12V power supplies and is available in a 10-channel, 36-pin SO package.

FEATURES

- **High performance**
  - **Read Mode Gain = 150 Typ V/V**
  - **Input Noise = 0.58 nV/√Hz typ.**
  - **Input Capacitance = 15 pF typ.**
  - **Write Current Range = 10 mA to 25 mA**
  - **Write Current Rise Time = 4 ns**
  - **Head Voltage Swing = 7 Vpp min**
- **Write unsafe detection**
- **Differential, ECL-like write data input**
- **Open collector read data output**
- **Switch from 300Ω damping resistor to 1 kΩ read input resistance**
- **Power supply fault protection**
- **+5V, +12V power supplies ±10%**

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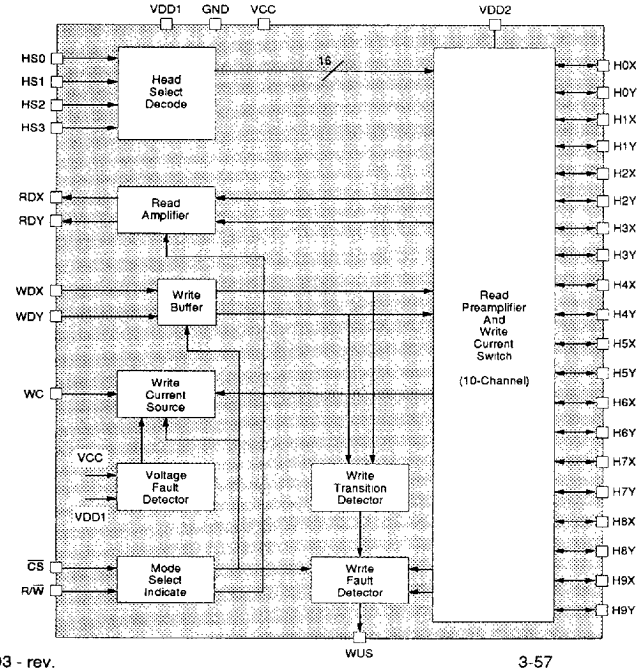
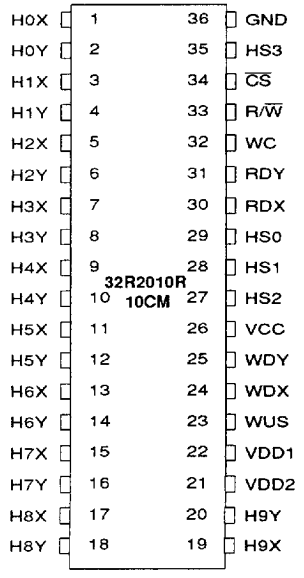
BLOCK DIAGRAM



PIN DIAGRAM



36-Lead SOM

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

FUNCTIONAL DESCRIPTION

The SSI 32R2010R addresses up to 10 channels with logic control inputs which are TTL compatible. Head selection is accomplished as shown in Table 1. Mode selection is accomplished as shown in Table 2. The mode select inputs have internal pull up circuits so that if an input is open it will rise to the upper logic level and force the device into a non-writing condition.

WRITE MODE

In Write Mode (R/$\overline{W}$ and $\overline{CS}$ low) the circuit functions as a current switch. The Head Select Inputs HS0, HS1, HS2 and HS3 determine the selected head. The write data inputs (WDX, WDY) determine the polarity of the head current. When WDX is high and WDY is low, write current is in the X direction. HNX is sinking current.

The write current magnitude is adjusted by an external resistor, Rwc, from WC to GND, and is given by:

$$Iw = Vwc/Rwc$$

Note that actual head current, Ihd, is:

$$Ihd = Iw/(1+\frac{Rh}{Rd}) + Ioffset$$

where Rh is head resistance, Rd is write damping resistance and Ioffset is a constant DC offset current.

WRITE MODE FAULT DETECT CIRCUIT

Several circuits are dedicated to detecting fault conditions associated with the write mode. A logical high (off) level will be present at the Write Unsafe (WUS) terminal if any of the following write fault conditions are present:

- Open head circuit (Iw ≥ 20 mA)
- Head shorted to ground
- Write current transition frequency too low
- Write mode not logically selected

A head shorted to ground condition results in a pulsating WUS signal.

After the fault condition is removed, two transitions of the write data input lines are required to clear WUS. The Write Unsafe output is open-collector and is usually terminated by an external resistor connected to VCC.

Additionally, power voltage monitoring circuits are used to detect VCC and VDD1 voltage levels. If either is too low to permit valid data recording, write current is inhibited.

READ MODE

In Read Mode, (R/$\overline{W}$ high and $\overline{CS}$ low), the circuit functions as a low noise differential amplifier. The read amplifier input terminals are determined by the Head Select inputs. The read amplifier outputs (RDX, RDY) are open collector, requiring external load resistors connected to VCC. The amplifier gain polarity is non-inverting between HnX, HnY inputs and RDX, RDY outputs.

The switch from write to read modes also changes the resistance across HnX and HnY from its write damping value of 300Ω to its read mode input value of 1 kΩ.

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 internal write current source. This facilitates multi device installations by allowing the read outputs to be wired OR'ed and the write current programming resistor to be common to all devices.

TABLE 1: Head Select

Head Selected	HS3	HS2	HS1	HS0
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1

TABLE 2: Mode Select

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

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PIN DESCRIPTION

CONTROL INPUT PINS

NAME	TYPE	DESCRIPTION
$\overline{CS}$	I	Chip Select Input. A logical low level enables the circuit for a read or write operation. Has internal pull up.
R/$\overline{W}$	I	Read/write select. A logical low level enables the write mode (when $\overline{CS}$ is low). Has internal pull up.
HS0, HS1, HS2, HS3	I	Head select inputs. Logical combinations select one of sixteen heads. See Table 1. Has internal pull down resistors.
HEAD TERMINAL PINS		
H0X-H9X, H0Y-H9Y	I/O	X, Y Head connections: Current in the X-direction flows into the X-port.
DATA INPUT/OUTPUT PINS		
WDX, WDY	I/O	Differential write data input.
RDX, RDY	I/O	Differential Read Data output. These open collector outputs are normally terminated in 100Ω resistors to VCC.
EXTERNAL COMPONENT CONNECTION PINS		
WC	I/O	Resistor connected to GND to provide desired value of write current.
CIRCUIT MONITOR PINS		
WUS	O	Write Unsafe is an open-collector output with the off-state indicating that conditions are not proper for a write operation.
POWER, GROUND PINS		
VCC	I	+5V Logic circuit supply.
VDD1	I	+12V power supply.
VDD2	I	Positive power supply for write current drivers.
GND	I	Power supply common.

ELECTRICAL SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Operation above maximum ratings may permanently damage the device.

PARAMETER	RATING
Positive Supply Voltage, VCC	6 VDC
Supply Voltage, VDD1, 2	13.5 VDC
Operating Junction Temperature	+130°C
Storage Temperature	-65 to +130°C
Package Temperature (20 sec. reflow)	215°C
Input Voltages	
HS0, HS1, HS2, HS3, $\overline{CS}$, R/$\overline{W}$	-0.2 to VCC + 0.2 VDC
Outputs	
Read Data (RDX, RDY)	VCC -2.5 to VCC + 0.3 VDC
Write Unsafe (WUS)	-0.2V to VCC + 0.2V VDC
Current Reference (WC)	-80 mA to 1.0 mA VDC
Head Outputs (Write Mode)	-80 mA to 1.0 mA mA

POWER SUPPLY

Unless otherwise specified, 4.5V ≤ VCC ≤ 5.5V, 10.8V ≤ VDD1, 2 ≤ 13.2V, 0°C ≤ T (ambient) ≤ 70°C.

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNIT
Power Dissipation (Does not include power dissipation through RDX, RDY load resistors)	Idle mode		195	295	mW
	Read mode		440	775	mW
	Write mode		350 + 10 Iw	530 + 11.2 Iw	mW
Positive Supply Current ICC (Includes RDX, RDY currents)	Idle Mode		13	20	mA
	Read Mode		27	35	mA
	Write Mode		22	26	mA
Positive Supply Current IDD1	Idle Mode		10	12	mA
	Read Mode		32	42	mA
	Write Mode		23	28	mA
Positive Supply Current IDD2	Idle Mode		0.5	2	mA
	Read Mode		1	1.5	mA
	Write Mode		1 + Iw	2 + Iw	mA

DC CHARACTERISTICS

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNIT
High-level Input Voltage VIH ($\overline{CS}$, R/$\overline{W}$, HS0, HS1, HS2, HS3)		2.0		-	V
Low-level Input Voltage VIL ($\overline{CS}$, R/$\overline{W}$, HS0, HS1, HS2, HS3)				0.8	V
High-level Input Current IIH ($\overline{CS}$, R/$\overline{W}$, HS0, HS1, HS2, HS3)	VIH = 2.7V			100	µA
Low-level Input Current IIL ($\overline{CS}$, R/$\overline{W}$, HS0, HS1, HS2, HS3)	VIL = 0.4V			-400	µA
High-level Output Voltage VIH (WDX, WDY)		Vcc - 1.0		Vcc - 0.72	V
Low-level Output Voltage VIL (WDX, WDY)		Vcc - 1.87		Vcc - 1.625	V
WUS, Low Level Voltage	ILUS = 4 mA (denotes safe condition)			0.5	V
WUS, High Level Current	VHUS = 5.0V (denotes unsafe condition)			100	µA

WRITE MODE

Test Conditions (Unless otherwise specified). VCC = 4.5 to 5.5V, Ta = 0 to +70°C, VDD = 10.8 to 13.2V, Lh = 470 nH, Rh = 25Ω, WD Tr, Tf < 2 ns, Iw = 20 mA.

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNIT
Current Range, Iw		10		25	mA
Write Current Voltage, Vwc		1.95	2.05	2.15	V
Differential Head voltage Swing		7.0	7.6		Vpp
Ioffset			0.5		mA
Unselected Head Transient Current	Non adjacent heads tested to minimize external coupling effects			1	mA(pk)
Head Damping Resistance		240	300	360	Ω
Differential Output Capacitance				20	pF

ELECTRICAL SPECIFICATIONS (continued)

FAULT DETECTION CHARACTERISTICS

Test conditions same as Write Mode above (unless otherwise specified.)

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNIT
VCC Value for Write Current Turn off	Ih < 1 mA	3.7	4.0	4.3	V
VDD Value for Write Current Turn off	Ih < 1 mA	8.8	9.5	10.2	V
WDX, WDY Transition Frequency	WUS = Low (Guaranteed safe)	1.0			MHz

READ MODE

Tests performed with 100Ω load resistors from RDX and RDY to VCC. Test conditions same as Write mode (unless otherwise specified.)

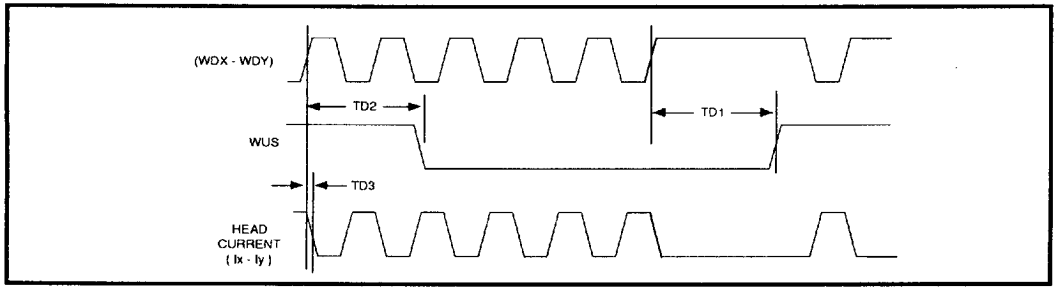
PARAMETER		CONDITIONS	MIN	NOM	MAX	UNIT
Differential Voltage Gain		Vin = 1 mVpp, f = 300 kHz	120	150	180	V/V
Voltage Bandwidth	-3 dB	Zs < 5Ω, Vin = 1 mVpp	50	65		MHz
	-1 dB	Zs < 5Ω, Vin = 1 mVpp	20	35		MHz
Input Noise Voltage		Zs = 0Ω , Vin = 0V, Power Bandwidth = 20 MHz		0.58	0.75	nV/√Hz
Differential Input Capacitance		Vin = 0V, f = 5 MHz		15	20	pF
Differential Input Resistance		Vin = 0V, f = 5 MHz	400		1500	Ω
Dynamic Range @ 5 MHz		Input voltage where AC gain falls to 90% of the gain	4			mVpp
Common Mode Rejection Ratio		Vin = 100 mVpp, 0V DC f = 5 MHz	60	90		dB
Power Supply Rejection Ratio		VCC or VDD = 100 mVpp f = 5 MHz	55	75		dB
Channel Separation		Unselected channels are driven with Vin = 20 mVpp @ 5 MHz	60	90		dB
Output Offset Voltage		Rh = 0, Lh = 0	-250		250	mV
Output Leakage Current		Idle Mode			20	µA
Output Common Mode Voltage		Rh = 0, Lh = 0	VCC - 0.9	VCC - 0.5	VCC - 0.3	V
Output Voltage Compliance		Adjust RDX, Y load voltage source for <5% THD of either output.	VCC - 1.6		VCC	V

SWITCHING CHARACTERISTICS

Test conditions same as Write Mode plus RDX, Y connected VCC through 100Ω resistors, WUS with 1 kΩ to VCC.

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNIT
Idle to Read/Write Transition Time	Delay to 10 or 90% of Read Output or Write Current		75	150	ns
Read/Write to Idle Transition Time			85	150	ns
Read to Write Transition Time	VLCS = 0.8V, Delay to 90% of Iw		85	150	ns
Write to Read Transition Time	VLCS = 0.8V, Delay to 90% of 10 MHz Read Signal, 100 mV envelope		350	600	ns
Head Select Switching Delay	Read or Write Mode			500	ns
Head Current Rise and Fall Times 10% to 90%	Iw = 25 mA, Lh = 0 nH Rh = 0Ω		2.5	4.0	ns
	Iw = 15 mA, Lh = 1 µH Rh = 45Ω		6		ns
Head Current Rise and Fall Difference				0.5	ns
Head Current Switching Delay Difference (Asymmetry)	WDX, WDY transitions 2 ns, switching time asymmetry 0.2 ns			0.5	ns
Head Current Propogation Delay TD3	50% WD to 50% Iw		8	15	ns
Unsafe to Safe Delay After Write Data Begins WUS TD2	f(data) = 5 MHz Write Mode (After 2 transitions of WD)			200	ns
Unsafe to Safe Delay After Write Mode Selected WUS				0.5 +Tw*	µs
Safe to Unsafe Delay WUS TD1	After Write Mode fault condition occurs			1.5	µs
Safe to Unsafe Delay WUS	After exiting Write Mode			0.5	µs

*Tw is the period of the write data input.



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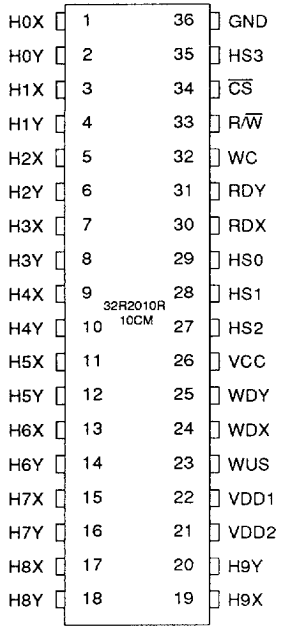
10-Channel Thin Film Read/Write Device

PACKAGE PIN DESIGNATIONS

(Top View)



36-Lead SOM

THERMAL CHARACTERISTICS: θja

36-Lead SOM	75°C/W

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

ORDERING INFORMATION

PART DESCRIPTION	ORDER NUMBER	PACKAGE MARK
SSI 32R2010R 36-lead SOM	32R2010R-CM	32R2010R-10CM

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