silicon systems®
A TDK Group Company

SSI 32R2040
14-Channel Two-Terminal Read/Write Device

Advance Information

1

January 1993

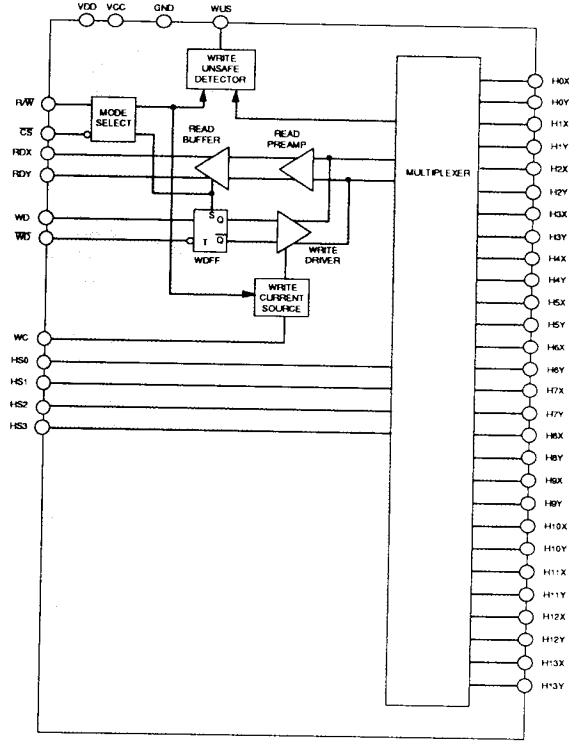
DESCRIPTION

The SSI 32R2040 Read/Write device is a bipolar monolithic integrated circuit designed for use with two-terminal thin-film recording heads. It provides a low noise read amplifier, write current control and data protection circuitry for up to 14 channels. 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 controlling the read channel common mode output voltage shift in the write mode. The SSI 32R2040 requires +5V and +12V power supplies, and it offers power and performance improvements over the SSI 32R5281R.

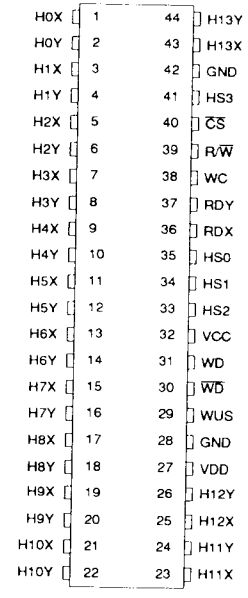
FEATURES

- **High performance:**
  - **Read mode gain = 150 V/V**
  - **Input noise = 0.80 nV/√Hz max.**
  - **Input capacitance = 22 pF max.**
  - **Write current range = 10 mA to 40 mA**
  - **Head voltage swing = 7 Vpp**
  - **Write current rise time = 9 ns**
- **Enhanced system write to read recovery time**
- **Differential ECL-like Write Data input**
- **Power supply fault protection**
- **Write unsafe detection**
- **+5V, +12V power supplies**

BLOCK DIAGRAM



PIN DIAGRAM



44-LEAD SOM

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

0193

SSI 32R2040
14-Channel Two-Terminal Read/Write Device

CIRCUIT OPERATION

The SSI 32R2040 addresses up to 14 two-terminal thin film heads providing write 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 $\overline{CS}$ and R/$\overline{W}$ will force the device into a non-writing condition if either control line is opened accidentally.

WRITE MODE

The write mode configures the SSI 32R2040 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 low to high transition on the WD, Write Data input. (See figure 1.)

A preceding read operation initializes the Write Data Flip Flop (WDFF) to pass write current in the X-direction of the head, i.e., into the X-port of the head. HnX will be biased higher than HnY.

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

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

where Vwc (WC pin voltage) = 1.65V ± 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.

Power supply fault protection improves data security by disabling the write current generator during a voltage fault or power supply sequencing. Additionally, the write unsafe detection circuitry will flag any of the conditions listed below as a high level on the open collector output pin, WUS. Up to two positive transitions on the WD, Write Data input line, after the fault is corrected, are required to clear the WUS flag.

- WD frequency too low
- Device not selected
- Open head
- Device in read mode
- No write current

READ MODE

The read mode configures the SSI 32R2040 as a low noise differential amplifier and deactivates the write current generator and write unsafe detection 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. The RDX, RDY common mode voltage is maintained at the write mode value, minimizing the transient between write mode and read mode, substantially reducing the write to read recovery time in the subsequent Pulse Detection circuitry.

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*

HS3	HS2	HS1	HS0	HEAD
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13

0 = Low level 1 = High level

*Unused heads should be left open.

PIN DESCRIPTION

NAME	TYPE	DESCRIPTION
HSO - HS3	I	Head Select
$\overline{CS}$	I	Chip Select: a low level enables the device
R/$\overline{W}$	I	Read/Write: a high level selects Read mode
WUS	O*	Write Unsafe: Open collector output, a high level indicates an unsafe writing condition
WD, $\overline{WD}$	I	Differential Write Data inputs: a positive transition on WD toggles the direction of the head current
H0X - H13X H0Y - H13Y	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
VCC	-	+5V Logic Circuit Supply
VDD	-	+12V
GND	-	Ground

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

ELECTRICAL SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Operation outside these rating limits may permanently damage the device.

PARAMETER		SYMBOL	RATING
DC Supply Voltage		VDD	-0.3 to +13.5 VDC
		VCC	-0.3 to +6 VDC
Write Current		Iw	100 mA
Digital Input Voltage		Vin	-0.3 to VCC +0.3 VDC
Head Port Voltage		VH	-0.3 to +8 VDC
Differential Port Voltage	|HnX - HnY|	ΔVH	6 VDC
WUS Pin Voltage Range		Vwus	-0.3 to VCC VDC
Output Current	RDX, RDY	Io	-10 mA
	WUS	Iwus	+12 mA
Storage Temperature		Tstg	-65 to +150°C

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	RATING
DC Supply Voltage	VDD	12 ± 10% VDC
	VCC	5 ± 10% VDC
Operating Temperature	Tj	+25 to +135°C

DC CHARACTERISTICS
Unless otherwise specified, recommended operating conditions apply.

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNITS
VDD Supply Current	Read Mode	-	36	44	mA
	Write Mode	-	25 + Iw	29 + Iw	mA
	Idle Mode	-	3.5	4	mA
VCC Supply Current	Read Mode	-	22	29	mA
	Write Mode	-	14	18	mA
	Idle Mode	-	9	11.5	mA
Power Dissipation (Tj = +135°C)	Read Mode	-	540	740	mW
	Write Mode	-	370+10.35•Iw	490 +11.6•Iw	mW
	Idle Mode	-	87	115	mW
WD, $\overline{WD}$ Input Low Current (IIL1)	VIL1 = VCC -1.625V			80	µA
WD, $\overline{WD}$ Input High Current (IIH1)	VIH1 = VCC -0.72V			100	µA
WD, $\overline{WD}$ Input Low Voltage (VIL1)		VCC -1.870		VCC -1.625	VDC
WD, $\overline{WD}$ Input High Voltage (VIH1)		VCC -1.00		VCC -0.720	VDC
R/$\overline{W}$, $\overline{CS}$, HS0-HS3 Input Low Current (IIL2)	VIL2 = 0.8V	-0.4			mA
R/$\overline{W}$, $\overline{CS}$, HS0-HS3 Input High Current (IIH2)	VIH2 = 2.0V			100	µA
R/$\overline{W}$, $\overline{CS}$, HS0-HS3 Input Low Voltage (VIL2)				0.8	VDC
R/$\overline{W}$, $\overline{CS}$, HS0-HS3 Input High Voltage (VIH2)		2.0			VDC
WUS Output Low Voltage (VOL)	Iol = 8 mA	-	-	0.5	VDC
VDD Fault Voltage		9.0	-	10.3	VDC
VCC Fault Voltage		3.5	-	4.2	VDC

DC CHARACTERISTICS (continued)

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNITS
Head Current (HnX, HnY)	Write Mode, 0 ≤ VCC ≤ 3.5V 0 ≤ VDD ≤ 9.0V	-200	-	+200	µA
	Read/Idle Mode, 0 ≤ VCC ≤ 5.5V 0 ≤ VDD ≤13.2V	-200	-	+200	µA

WRITE CHARACTERISTICS

Unless otherwise specified, recommended operating conditions apply, Iw = 20 mA, Lh = 500 nH, Rh = 30Ω and f(WD) = 5 MHz.

WC Pin Voltage (Vwc)	10 ≤ Iw ≤ 40 mA	1.57	1.65	1.73	V
Differential Head Voltage Swing		7	-	-	Vpp
Unselected Head Current		-	-	1	mA(pk)
Differential Output Capacitance		-	-	25	pF
Differential Output Resistance		-	2000	-	Ω
WDI Transition Frequency	WUS = low	1.7	-	-	MHz
	WUS = high	-	-	500	kHz
Write Current Range		10	-	40	mA

READ CHARACTERISTICS

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

PARAMETER		CONDITIONS	MIN	NOM	MAX	UNITS
Differential Voltage Gain		Vin=1mVpp @ 300 kHz	120	150	180	V/V
Bandwidth	-1dB	|Zs|<5Ω, Vin=1 mVpp	25	40	-	MHz
	-3dB	|Zs|<5Ω, Vin=1 mVpp	35	55	-	MHz
Input Noise Voltage		BW = 15 MHz, Lh = 0, Rh = 0	-	0.57	0.80	nV/√Hz
Differential Input Capacitance		Vin = 1 mVpp, f = 5 MHz	-	15	22	pF
Differential Input Resistance		Vin = 1 mVpp, f = 5 MHz	750	1000	-	Ω
Dynamic Range		Peak-to-peak AC input voltage where gain falls to 90% of its small signal value, f = 5 MHz	2.0	-	-	mVpp
Common Mode Rejection Ratio		Vcm = 100 mVpp AC Coupled @ 5 MHz	54	-	-	dB
Power Supply Rejection Ratio		100 mVpp @ 5 MHz on VDD 100 mVpp @ 5 MHz on VCC	54	-	-	dB
Channel Separation		Unselected channels driven with 100 mVpp @ 5 MHz, Vin = 0 mVpp	45	-	-	dB

READ CHARACTERISTICS (continued)

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNITS
Output Offset Voltage		-400	-	+400	mV
RDX, RDY Common Mode Output Voltage	Read Mode	2.3	2.9	3.5	VDC
Single Ended Output Resistance	f = 5 MHz	-	-	30	Ω
Output Current	AC Coupled Load, RDX to RDY	3.2	-	-	mA

SWITCHING CHARACTERISTICS (See Figure 1)
Unless otherwise specified, recommended operating conditions apply, Iw = 20 mA, Lh = 500 nH, Rh = 30Ω and f(WD) = 5 MHz.

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	-	-	0.6	µs
$\overline{CS}$ to Unselect	Delay to 90% of write current	-	-	0.6	µs
HSn					
HS0, 1, 2, 3 to any Head	Delay to 90% of 100 mV 10 MHz Read signal envelope	-	-	0.4	µs
WUS					
Safe to Unsafe - TD1		-	0.6	2.0	µs
Unsafe to Safe - TD2		-	-	1	µs
Head Current					
Prop. Delay - TD3	From 50% points, Lh=0 µh, Rh=0Ω	-	-	32	ns
Asymmetry	WD has 50% duty cycle and 1ns rise/fall time, Lh=0 µh, Rh=0Ω	-	-	0.5	ns
Rise/Fall Time	10% - 90% points, Lh=0 µh, Rh=0Ω	-	-	5	ns
Rise/Fall Time	10% - 90% points, Lh=1 µh, Rh=35Ω	-	TBD	-	ns

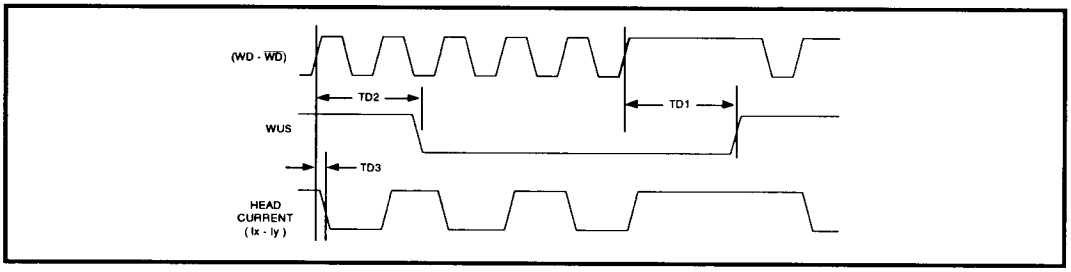
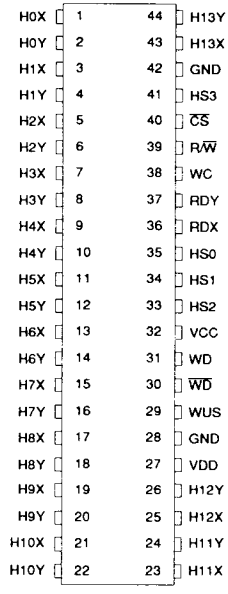


FIGURE 1: Write Mode Timing Diagram

PACKAGE PIN DESIGNATIONS
(Top View)

THERMAL CHARACTERISTICS: θja

44-Lead SOM	40°C/W



44-Lead SOM

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

Silicon Systems, Inc., 14351 Myford Road, Tustin, CA 92680 (714) 573-6000, FAX (714) 573-6914