

July, 1990

### DESCRIPTION

The SSI 32R526 is an integrated read/write circuit designed for use with non-center tapped thin film heads in disk drive systems. Each chip controls four heads and has three modes of operation: read, write, and idle. The circuit contains four channels of read amplifiers and write drivers and also has an internal write current source.

A current monitor (IMF) output is provided that allows a multichip enable fault to be detected. An enabled chip's output will produce one unit of current. An open collector output, write select verify (WSV), will go low if the write current source transistor is forward biased. The circuit operates on +5 volt, and -5 volt power and is available in 24-pin Flatpack and 24-pin SOL packages.

### FEATURES

- High performance

Read Mode Gain = 100 V/V

Input Noise = 0.6 nV/√Hz max

Input Capacitance = 65 pF max

Write Current Range = 17 mA to 50 mA

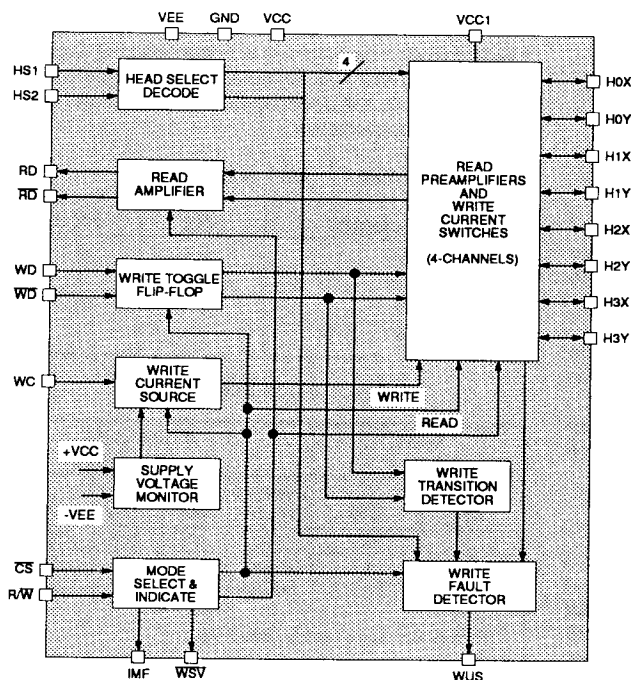
Write Current Rise Time = 12 ns max

Head Voltage Swing = 8.0 Vpp min

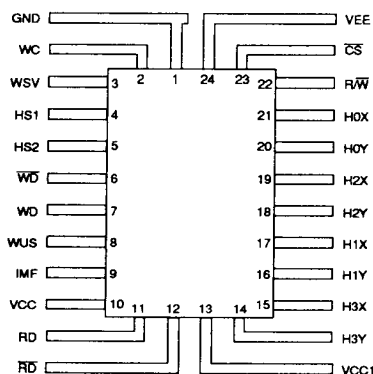
- Write unsafe detection

- -5V, +5V power supplies

### BLOCK DIAGRAM



### PIN DIAGRAM



24-Pin Flatpack

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

# SSI 32R526R

## 4-Channel Thin Film

### Read/Write Device

#### FUNCTIONAL DESCRIPTION

##### WRITE MODE

In Write Mode ( $\overline{R/W}$  and  $\overline{CS}$  low) the circuit functions as a differential current switch. The Head Select Inputs (HS1 and HS2) determine the selected head. The recording current is steered through the head in a direction determined by the state of a toggle flip-flop. The Write Data Inputs ( $WD$ ,  $\overline{WD}$ ) determine the polarity of the head current. The write current magnitude is adjusted by an external resistor  $R_{ex}$  between  $WC$  and  $V_{EE}$ .

$$\left[ \frac{V_{wc}}{R_{ex}} = I_w \left( 1 + \frac{R_h}{90} \right) - I_{offset} \right]$$

##### 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
- Resistive component of head shorted
- Head shorted to ground
- No write current
- Write current transition frequency too low
- Head select input(s) open circuit
- Write mode not logically selected

The Write Unsafe output is open-collector and is usually terminated by an external resistor connected to  $V_{cc}$ .

Additionally, power voltage monitoring circuits are used to detect  $V_{cc}$  and  $V_{ee}$  voltage levels. If either is too low to permit valid data recording, write current is inhibited. With any combination of  $V_{cc}$  and  $V_{ee}$  voltage above the inhibiting levels, logical control of write current is provided by the mode selection inputs.

##### READ MODE

In Read Mode, ( $\overline{R/W}$  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 ( $RD$ ,  $\overline{RD}$ ) are open collector, requiring external load resistors

connected to  $V_{cc}$ . The amplifier gain polarity is non-inverting between  $H_X$ ,  $Y$  inputs and  $RD$  outputs.

The switch from Write to Read Modes also changes the resistance across  $H_nX$  and  $H_nY$  from its write damping valve of  $100\Omega$  to its Read Mode input valve of  $500\Omega$ .

##### IDLE MODE

Taking  $\overline{CS}$  high selects the idle mode which switches the  $RD$  and  $\overline{RD}$  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.

##### MODE SELECTION AND INDICATION CIRCUIT

Logical control inputs which select mode and head channel are TTL compatible. Their functions are described in Tables 1 and 2.

Selection of the write mode is indicated by a low (on) state of the Write Select Verify (WSV) terminal. The open collector output is usually terminated by an external resistor connected to  $V_{cc}$ .

The selection of either the write or read mode is indicated by the flow of a unit of current into the Current Monitor (IMF) terminal. By summing the currents from multiple circuits, the user can determine that one, and only one, circuit is active.

Table 1: Head Select Table

| Head Selected | HS2 | HS1 |
|---------------|-----|-----|
| 0             | 0   | 0   |
| 1             | 0   | 1   |
| 2             | 1   | 0   |
| 3             | 1   | 1   |

Table 2: Mode Select Table

| Mode Select     |                  | Selected Mode | Indicating & Fault Outputs |     |     |
|-----------------|------------------|---------------|----------------------------|-----|-----|
| $\overline{CS}$ | $\overline{R/W}$ |               | IMF                        | WSV | WUS |
| 1               | X                | Idle          | off                        | off | off |
| 0               | 1                | Read          | on                         | off | off |
| 0               | 0                | Write         | on                         | on  | on* |

\*Provided that no fault is detected.

# SSI 32R526R

## 4-Channel Thin Film

### Read/Write Device

1

#### PIN DESCRIPTIONS

| NAME                                      | TYPE | DESCRIPTION  |
|---|------|--|
| <b>CONTROL INPUT PINS</b>                 |      |  |
| $\overline{CS}$                           | 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.   |
| HS1,HS2                                   | I    | Head Select inputs. Logical combinations (Table 1) select one of four heads.   |
| <b>HEAD TERMINAL PINS</b>                 |      |  |
| H0X - H3X<br>H0Y - H3Y                    | I/O  | Connection to read/write magnetic head terminals   |
| <b>DATA INPUT/OUTPUT PINS</b>             |      |  |
| WD, $\overline{WD}$                       | I    | Differential Write Toggle inputs used to write data patterns on the disk   |
| RD, $\overline{RD}$                       | I    | Differential Read Data pattern output amplified play back from the disk. These outputs are normally terminated in 100 $\Omega$ resistors to Vcc.   |
| <b>EXTERNAL COMPONENT CONNECTION PINS</b> |      |  |
| WC  | I    | Resistor connected to VEE to provide desired value of write current  |
| <b>CURRENT MONITOR PINS</b>               |      |  |
| WSV                                       | O    | Write Select Verify is an open collector output with the on state indicating that the circuit has been selected for a write operation. It is normally terminated to +Vcc through a resistor. |
| WUS                                       | O    | Write Unsafe is an open collector output with the off state indicating that conditions are not proper for a write operation.   |
| IMF                                       | O    | High impedance output sinks a unit of monitor current when the chip is enabled.  |
| <b>POWER, GROUND PINS</b>                 |      |  |
| Vcc                                       | I    | Positive power supply voltage for circuit functions  |
| Vcc1                                      | I    | Positive power supply voltage for head current   |
| VEE                                       | I    | Negative power supply voltage  |
| GND                                       | I/O  | Power supply common  |

# SSI 32R526R

## 4-Channel Thin Film

### Read/Write Device

#### ELECTRICAL CHARACTERISTICS

Unless otherwise specified,  $4.75 \leq V_{CC} \leq 5.25$ ,  $-5.50 \leq V_{EE} \leq -4.75V$ ,  $0^\circ \leq T$  (junction)  $\leq 125^\circ C$ .

#### ABSOLUTE MAXIMUM RATINGS

| PARAMETER                                | RATING                            | UNIT       |
|--|-----------------------------------|------------|
| Positive Supply Voltage, $V_{CC}$        | 6                                 | VDC        |
| Negative Supply Voltage, $V_{EE}$        | -6                                | VDC        |
| Operating Junction Temperature           | -20 to +130                       | $^\circ C$ |
| Storage Temperature                      | -65 to 130                        | $^\circ C$ |
| Lead Temperature (Soldering, 10 sec)     | 260                               | $^\circ C$ |
| <b>Input Voltages</b>                    |                                   |            |
| Head Select (HS)                         | -0.4 to $V_{CC} + 0.3$            | V          |
| Chip Enable ( $\overline{CS}$ )          | -0.4 to $V_{CC} + 0.3$            | V          |
| Read Select ( $R/\overline{W}$ )         | -0.4V to $V_{CC} + 0.3$           | V          |
| Write Data ( $WD, \overline{WD}$ )       | - $V_{EE}$ to 0.3                 | V          |
| Head Inputs (Read Mode)                  | -0.6 to 0.4                       | V          |
| <b>Outputs</b>                           |                                   |            |
| Read Data ( $RD, \overline{RD}$ )        | $V_{CC} - 2.5$ to $V_{CC} + 0.3$  | V          |
| Write Unsafe (WUS)                       | -0.4V to $V_{CC} + 0.3$ and 20 mA | V          |
| Write Select Verify ( $\overline{WSV}$ ) | -0.4V to $V_{CC} + 0.3$ and 20 mA | V          |
| Current Monitor (IMF)                    | -0.4 to $V_{CC} + 0.3$            | V          |
| Current Reference (WC)                   | -100 mA to 1.0 mA                 | mA         |
| Head Outputs (Write Mode)                | -100 mA to 1.0 mA                 | mA         |

#### POWER SUPPLY

| PARAMETER                            | CONDITIONS | MIN | NOM | MAX                     | UNIT |
|--------------------------------------|------------|-----|-----|-------------------------|------|
| Power Dissipation                    | Idle       |     |     | 187                     | mW   |
|                                      | Read       |     |     | 540                     | mW   |
|                                      | Write mode |     |     | $550 + 10.5 \times I_w$ | mW   |
| Positive Supply Current ( $I_{CC}$ ) | Idle Mode  |     |     | 15                      | mA   |
|                                      | Read Mode  |     |     | 35                      | mA   |
|                                      | Write Mode |     |     | 35                      | mA   |

# SSI 32R526R

## 4-Channel Thin Film

### Read/Write Device

1

#### POWER SUPPLY (Continued)

| PARAMETER                      | CONDITIONS | MIN | NOM | MAX                  | UNIT |
|--------------------------------|------------|-----|-----|----------------------|------|
| Positive Supply Current (ICC1) | Idle Mode  |     |     | 5                    | mA   |
|                                | Read Mode  |     |     | 5                    | mA   |
|                                | Write Mode |     |     | 20 + I <sub>w</sub>  | mA   |
| Negative Supply Current (IEE)  | Idle Mode  |     |     | -15                  | mA   |
|                                | Read Mode  |     |     | -60                  | mA   |
|                                | Write Mode |     |     | -50 - I <sub>w</sub> | mA   |

#### DC CHARACTERISTICS

| PARAMETER   | CONDITIONS                                | MIN   | NOM | MAX       | UNIT |
|---|---|-------|-----|-----------|------|
| Chip Select High Voltage (VHCS)                       | Idle Mode                                 | 2.0   |     |           | V    |
| Chip Select Low Voltage (VLCS)                        | Read or Write Mode                        |       |     | 0.8       | V    |
| Chip Select Low Current (ILCS)                        | VLCS = 0.4V                               |       |     | -0.40     | mA   |
| Chip Select High Current (IHCS)                       | VHCS = 2.7V                               |       |     | 20        | μA   |
| Read Select High Voltage (VHR/ $\overline{W}$ )       | Read or Idle Mode                         | 2.0   |     |           | V    |
| Read Select Low Voltage (VLR/ $\overline{W}$ )        | Write or Idle Mode                        |       |     | 0.8       | V    |
| Read Select high Current (IHR/ $\overline{W}$ )       | VHR/ $\overline{W}$ = 2.0V                |       |     | 20        | μA   |
| Read Select Low Current (ILR/ $\overline{W}$ )        | VLR/ $\overline{W}$ = 0V                  |       |     | -0.40     | mA   |
| Head Select High Voltage (VHHS)                       |   | 2.0   |     |           | V    |
| Head Select Low Voltage (VLHS)                        |   |       |     | 0.8       | V    |
| Head Select High Current (IHHS)                       | VHHS = 2.7V                               |       |     | 0.25      | mA   |
| Head Select Low Current (ILHS)                        | VLHS = 0.4V                               |       |     | 0.25      | mA   |
| WUS, $\overline{WSV}$ Low Level Voltage               | ILUS = 8 mA<br>(denotes safe condition)   |       |     | 0.5       | V    |
| WUS, $\overline{WSV}$ High Level Current              | VHUS = 5.0V<br>(denotes unsafe condition) |       |     | 100       | μA   |
| IMF on Current  |   | 2.2   |     | 3.7       | mA   |
| IMF off Current                                       |   |       |     | 0.02      | mA   |
| IMF Voltage Range                                     |   | 0.5   |     | VCC + 0.3 | V    |
| VCC Fault Voltage                                     |   |       |     | 3.5       | V    |
| VEE Fault Voltage                                     |   |       |     | -3.5      | V    |
| Differential Data Voltage,<br>(WD - $\overline{WD}$ ) |   | 0.20  |     |           | V    |
| Data Input Voltage Range                              |   | -1.87 |     | +0.1      | V    |
| Data Input Current (per side)                         | Chip Enabled                              |       |     | 150       | μA   |
| Data Input Capacitance                                | per side to GND                           |       |     | 10        | pF   |

# SSI 32R526R

## 4-Channel Thin Film

### Read/Write Device

#### ELECTRICAL CHARACTERISTICS (Continued)

##### READ MODE

Tests performed with 100Ω load resistors from RD and  $\overline{RD}$  through series isolation diodes to VCC.

| PARAMETER                       | CONDITIONS  | MIN       | NOM | MAX       | UNIT  |
|---------------------------------|---|-----------|-----|-----------|-------|
| Differential Voltage Gain       | Vin = 1m Vpp, f = 300 KHz   | 75        |     | 125       | V/V   |
| Voltage Bandwidth (-3dB)        | Zs < 5Ω, Vin = 1m Vpp -3dB  | 55        |     | 100       | MHz   |
|                                 | f midband = 300 KHz -1dB  | 20        |     | 100       | MHz   |
| Input Noise Voltage             | Zs = 0Ω, Vin = 0V,<br>Power Bandwidth = 34 MHz  |           |     | 0.6       | nV√Hz |
| Differential Input Capacitance  | Vin = 0V, f = 5 MHz   |           |     | 65        | pF    |
| Differential Input Resistance   | Vin = 0V, f = 5 MHz   | 250       |     | 1000      | Ω     |
| Dynamic Range                   | DC input voltage where AC<br>gain falls to 90% of the gain<br>with .5m Vpp input signal | -2.0      |     | 2.0       | mV    |
| Common Mode Rejection Ratio     | Vin = 100m Vpp, 0V DC<br>1 MHz ≤ f ≤ 10 MHz   | 50        |     |           | dB    |
|                                 | f = 20 MHz  | 46        |     |           | dB    |
| Power Supply Rejection Ratio    | VCC or VEE = 100m Vpp<br>1 MHz ≤ f ≤ 10 MHz   | 65        |     |           | dB    |
|                                 | f = 20 MHz  | 40        |     |           | dB    |
| Channel Separation              | The three unselected<br>channels are driven with<br>Vin = 20m Vpp<br>1 MHz ≤ f ≤ 10 MHz | 46        |     |           | dB    |
|                                 | f = 20 MHz  | 37        |     |           | dB    |
| Output Offset Voltage           |   | -360      |     | 360       | mV    |
| Output Leakage Current          | Idle Mode   |           |     | 0.01      | mA    |
| Output Common Mode Voltage      |   | VCC - 0.9 |     | VCC - 0.3 | V     |
| Single Ended Output Resistance  |   | 10        |     |           | KΩ    |
| Single Ended Output Capacitance |   |           |     | 10        | pF    |

##### WRITE MODE

|                                 |  |     |      |      |     |
|---------------------------------|--|-----|------|------|-----|
| Current Tolerance               | Current set to nominal value<br>by Rx = 425 to 180Ω, Tj = 50°C | -8  |      | +8   | %   |
| (Iw) (Rh) Product               |  | 0.3 |      | 1.25 | V   |
| Differential Head voltage swing | Iw = 45 mA   | 8.0 |      |      | Vpp |
| Ioffset                         |  |     | 6.0  |      | mA  |
| Write Current Voltage           | Rex = 46Ω  |     | 2.25 |      | V   |

# SSI 32R526R

## 4-Channel Thin Film

### Read/Write Device

1

#### WRITE MODE (continued)

| PARAMETER                                       | CONDITIONS   | MIN | NOM | MAX | UNIT     |
|---|--|-----|-----|-----|----------|
| Unselected Head Transient Current               | $I_w = 45 \text{ mA}$ , $L_h = 0.5 \mu\text{H}$ , $R_h = 20\Omega$ , non-adjacent heads tested to minimize external coupling effects |     |     | 1   | mAp      |
| Current Range ( $I_w$ )                         |  | 17  |     | 50  | mA       |
| Differential Output Resistance, $R_d$           |  | 70  | 100 | 130 | $\Omega$ |
| Differential Output Capacitance                 |  |     |     | 30  | pF       |
| WD, $\overline{\text{WD}}$ Transition Frequency | WUS = low  | 5.0 |     |     | MHz      |

#### SWITCHING CHARACTERISTICS $R_h = 0$ , $L_h = 0$ (Unless otherwise specified)

|  |   |  |  |      |               |
|--|---|--|--|------|---------------|
| Idle to Read/Write Transition Time                 |   |  |  | 0.4  | $\mu\text{s}$ |
| Read/Write to Idle Transition Time                 |   |  |  | 0.4  | $\mu\text{s}$ |
| Read to Write Transition Time                      | VLCS = 0.8V, Delay to 90% of $I_w$  |  |  | 0.4  | $\mu\text{s}$ |
| Write to Read Transition Time                      | VLCS = 0.8V, Delay to 90% of 20 MHz Read Signal envelope, $I_w$ decay to 10%  |  |  | 0.4  | $\mu\text{s}$ |
| Head Select Switching Delay                        | Read or Write Mode  |  |  | 0.2  | $\mu\text{s}$ |
| Head Current Transition Time 10% to 90%            | $I_w = 40 \text{ mA}$ , $L_h = 0.56 \mu\text{H}$ , $R_h = 20\Omega$   |  |  | 12   | ns            |
| Head Current Overshoot                             | $I_w = 40 \text{ mA}$ , $L_h = 0.56 \mu\text{H}$ , $R_h = 20\Omega$ , relative to total current change  |  |  | 15   | %             |
| Head Current Switching Time Symmetry               | $I_w = 40 \text{ mA}$ , $L_h = 0.56 \mu\text{H}$ , $R_h = 20\Omega$ , WD & $\overline{\text{WD}}$ transitions 2nS, switching time symmetry 0.2 nS |  |  | 0.5  | ns            |
| WSV Transition Time                                | Delay from 50% of write select swing to 90% of final WSV voltage, Load = $2\text{K}\Omega // 20 \text{ pF}$                                       |  |  | 0.3  | $\mu\text{s}$ |
| Unsafe to Safe Delay After Write Data Begins (WUS) | $f_{\text{WDI}} = 10 \text{ MHz}$   |  |  | 0.2  | $\mu\text{s}$ |
| Safe to Unsafe Delay, (WUS)                        | Head open or shorted to GND, no write current, head select input open   |  |  | 0.5  | $\mu\text{s}$ |
| Safe to Unsafe Delay, (WUS)                        | Non-switching write data  |  |  | 0.5  | $\mu\text{s}$ |
| IMF Switching Time                                 | Delay from 50% of CS to 90% of final IMF current  |  |  | 0.25 | $\mu\text{s}$ |

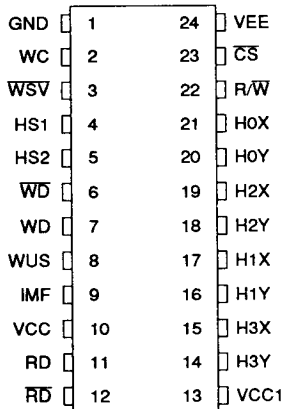
# SSI 32R526R

## 4-Channel Thin Film

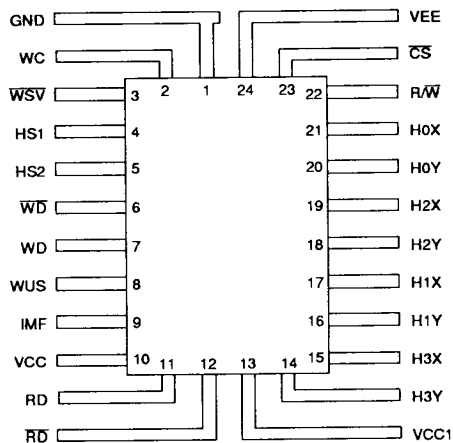
### Read/Write Device

#### PACKAGE PIN DESIGNATIONS

(TOP VIEW)



24-Pin SOL



24-Pin Flatpack

#### ORDERING INFORMATION

| PART DESCRIPTION | ORDERING NO.   | PKG. MARK  |
|------------------|----------------|------------|
| SSI 32R526R      |                |            |
| 24-Pin Flatpack  | SSI 32R526R-4F | 32R526R-4F |
| 24-Pin SOL       | SSI 32R526R-4L | 32R526R-4L |

**Preliminary Data:** Indicates a product not completely released to production. The specifications are based on preliminary evaluations and are not guaranteed. Small quantities are available, and Silicon Systems should be consulted for current information.

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