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SSI 32R1203A/1203AR
+5V, 4-Channel, 3-Terminal Read/Write Device

January 1994

DESCRIPTION

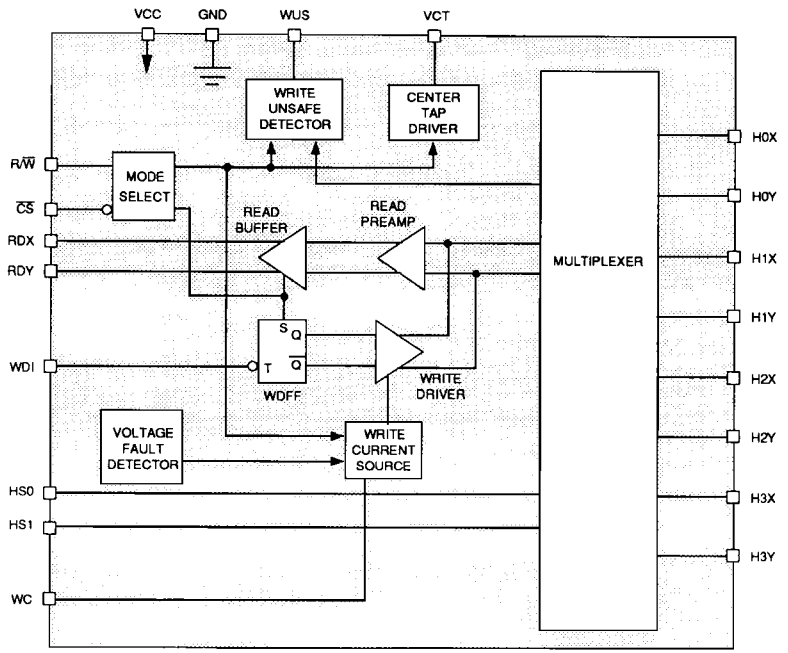
The SSI 32R1203A is a bipolar monolithic integrated circuit designed for use with center-tapped ferrite or MIG recording heads. It provides a low noise read path with a gain of 250 V/V, write current control, and data protection circuitry for as many as 4 channels. Power supply fault protection is provided by disabling the write current generator during power sequencing. A Power Down mode (Idle) is provided to reduce power consumption to less than 10 mW.

The SSI 32R1203A requires only a +5V power supply and is available in a surface mount package.

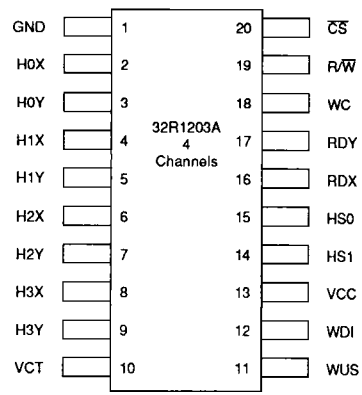
FEATURES

- **+5V only power supply**
- **Low power**
  - **Pd ≤ 225 mW Read mode**
  - **Pd ≤ 10 mW Idle mode**
- **High Performance**
  - **Input noise = 1.2 nV/√Hz max.**
  - **Input capacitance = 19 pF max.**
  - **Write current range = 15 - 50 mA**
  - **Head voltage swing = 6.0 Vpk**
- **250 V/V read gain**
- **Designed for center-tapped ferrite or MIG heads**
- **Power supply fault protection**
- **Includes write unsafe detection**
- **Enhanced Write to Read recovery**

BLOCK DIAGRAM



PIN DIAGRAM



20-Lead SOL, SOV

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

FUNCTIONAL DESCRIPTION

WRITE MODE

A source of recording current is provided to the head center tap by an internal voltage reference, VCT. The current is conducted through the head alternately into an HnX terminal or an HnY terminal according to the state of an internal flip-flop. The flip-flop is triggered by the negative transition of the Write Data Input line (WDI). A preceding Read mode selection initializes the write data flip-flop, WDFF, to pass write current through the "X" side of the head. The write current magnitude is determined by the value of an external resistor Rwc connected between WC terminal and GND, and is given by:

Iw = K/Rwc, where K = Write Current Constant

WRITE MODE FAULT DETECT CIRCUIT

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

- Head open
- Head center tap open
- Head shorted
- Head shorted to ground
- No write current
- WDI frequency too low
- Device in Read or Idle mode

The Write Unsafe output is open-collector and is usually terminated by an external resistor connected to VCC. Two negative transitions on WDI, after the fault is corrected, will clear the WUS flag.

A safe condition, WUS low, requires alternating voltage spikes on both HnX and HnY that exceed VCT + 1.5V at a rate equal to or higher than the Minimum Rate of WDI for Safe condition.

In addition, the power supply voltage level is monitored by a circuit that inhibits the write current if VCC is too low to permit valid data recording.

READ MODE

In Read Mode, (R/$\overline{W}$ high and $\overline{CS}$ low), the circuit functions as a low noise gain selectable differential amplifier. The read amplifier input terminals are determined by the Head Select inputs. The read amplifier outputs (RDX, RDY) are emitter follower sources, providing low impedance outputs. The amplifier polarity is non-inverting between HnX, HnY inputs and RDX, RDY outputs.

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.

MODE SELECTION AND INDICATION CIRCUIT

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

TABLE 1: Head Select Table

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

TABLE 2: Mode Select Table

Mode Select		Selected Mode	Indicating & Fault Outputs
$\overline{CS}$	R/$\overline{W}$		WUS
1	X	Idle	high
0	1	Read	high
0	0	Write	active

PIN DESCRIPTION

NAME	TYPE	DESCRIPTION
HS0, HS1	I*	Head Select: Logical combinations select one of four Heads. See Table 1
$\overline{CS}$	I	Chip Select: a low level enables device. Has internal pull-up resistor.
R/$\overline{W}$	I*	Read/Write: a high level selects Read mode. Has internal pull-up resistor.
WUS	O*	Write Unsafe: a high level indicates an unsafe writing condition.
WDI	I*	Write Data In: negative transition toggles direction of head current.
H0X-H3X H0Y-H3Y	I/O	X, Y head connections
RDX, RDY	O*	X, Y Read Data: differential read signal output.
WC	-	Write Current: used to set the magnitude of the write current.
VCT	-	Voltage Center Tap: voltage source for head center tap.
VCC	-	+5V
GND	-	Ground
* When more than one R/W device is used, these signals can be wire OR'ed with unselected R/W devices.		

ELECTRICAL SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

All voltages referenced to GND. Currents into device are positive.

PARAMETER		RATING
DC Supply Voltage	VCC	-0.3 to +6 VDC
Digital Input Voltage Range HS1, HS0, WDI, R/$\overline{W}$, $\overline{CS}$		-0.3 to (VCC + 0.3 VDC)
Head Port Voltage Range	VH	-0.3 to (VCC + 3.0 VDC)
Write Current Pin Voltage	Vwc	-0.3 to (VCC + 0.3 VDC)
WUS Pin Voltage Range	Vwus	-0.3 to +6.0 VDC
Write Current Zero–Peak	IW	60 mA
RDX, RDY Output Current	Io	-10 mA
RDX, RDY Pin Voltage		VCC + 0.3 VDC
VCT Output Current Range	IVCT	-60 mA to +10 mA
WUS Output Current Range	Iwus	-0.1 mA to +10 mA
Storage Temperature Range	Tstg	-65 to 150°C
Package Temperature (20 sec Reflow)		215°C

ELECTRICAL SPECIFICATIONS (continued)

RECOMMENDED OPERATION CONDITIONS

PARAMETER		CONDITIONS	MIN	NOM	MAX	UNITS
DC Supply Voltage	VCC		4.75	5.0	5.25	VDC
Head Inductance	Lh		1		15	µH
Write Current Range	IW		15		50	mA
Junction Temperature Range	Tj		+25		+135	°C

DC CHARACTERISTICS

Unless otherwise specified, recommended operating conditions apply.

POWER SUPPLY

VCC Supply Current (ICC)	Read Mode		33	44	mA
	Idle Mode		1.4	2.0	mA
	Write Mode		31 + Iw	44 + Iw	mA
Power Dissipation	Read Mode		165	227	mW
	Idle Mode		7	10.5	mW
	Write Mode		155 + 5 Iw	230 + 5.5 Iw	mW

DIGITAL I/O

Input Low Voltage $\overline{CS}$, R/$\overline{W}$ WDI, HS0, HS1	VIL				0.8	VDC
Input High Voltage $\overline{CS}$, R/$\overline{W}$ WDI, HS0, HS1	VIH		2.0			VDC
Input Low Current $\overline{CS}$, R/$\overline{W}$ WDI, HS0, HS1	IIL	VIL = 0.4V	-0.4			mA
Input High Current $\overline{CS}$, R/$\overline{W}$ WDI, HS0, HS1	IIH	VIH = 2.7V			20	µA
WUS Output Low Voltage	VOL	IOL = 4.0 mA			0.5	VDC
WUS Output High Current	IOH	VOH = 5.0V			100	µA

WRITE MODE

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNITS
Center Tap Voltage VCT	Write Mode/Idle Mode		Vcc - 0.9		VDC
Head Current (per side)	Write Mode, Voltage Fault $0 \le VCC \le 3.9V$	-200		200	µA
Write Current Range	$1.0\ k\Omega \le Rwc \le 3.3\ k\Omega$	15		50	mA
Write Current Constant "K"		46	50	54	mA-kΩ
Iwc to Head Current Gain			20		mA/mA
Unselected Head Leakage Current				85	µA
RDX, RDY Common Mode Output Voltage		Vcc - 3	Vcc - 2.4	Vcc - 2	VDC
WDI Minimum Pulse Width	PWH VIL ≥ 0.2V		11		ns
See Figure 1	PWL VIN ≥ 2.4V		4		ns

READ MODE

Center Tap Voltage VCT			Vcc - 1.5		VDC
Input Bias Current (per side)	From VCT to HnX or HnY		20	60	µA
Output Offset Voltage	RDX - RDY	-200		+200	mV
Common Mode Output Voltage	$\frac{RDX + RDY}{2}$	2	Vcc - 2.4	3.5	VDC
Common Mode Output Voltage Change from Write to Read Mode		-100		+100	mV

FAULT DETECTION CHARACTERISTICS
Unless otherwise specified recommended conditions apply, Iw = 30 mA, Lh = 5 µH, F(WDI) = 10 MHz.

Minimum Rate of WDI Input for Safe condition		150			kHz
Maximum Rate of WDI Input for Unsafe condition				50	kHz
Minimum voltage value for guaranteed write current turn-on		4.4			VDC
Maximum voltage value for guaranteed write current turn-off				3.9	VDC

ELECTRICAL SPECIFICATIONS (continued)

DYNAMIC CHARACTERISTICS AND TIMING

Unless otherwise specified, recommended operating conditions apply and Iw = 30 mA, Lh = 5 µH, f(WDI) = 5 MHz, CL(RDX, RDY) ≤ 20 pF.

WRITE MODE

PARAMETER	CONDITIONS	MIN	NOM	MAX	UNITS
Differential Head Voltage Swing		6.0	6.4		V(pk)
Unselected Head Transient Current	1 µH ≤ Lh ≤ 9.5 µH			2	mA(pk)
Differential Output Capacitance				15	pF
Differential Output Resistance	(1203AR only)	600		960	Ω

READ MODE

Differential Voltage Gain	Vin = 1 mVrms @ 1 MHz	200	250	300	V/V
Bandwidth (-3dB)	|Zs| < 5Ω, Vin = 1 mVpp	30	60		MHz
Input Noise Voltage	BW = 15 MHz, Lh = 0, Rh = 0		0.85	1.2	nV/√Hz
Differential Input Capacitance	Vin = 1 mVrms, f = 5MHz		16	19	pF
Differential Input Resistance			2		kΩ
Dynamic Range	AC input voltage where gain falls to 90% of its small signal gain value, f = 5 MHz	2			mVpp
Common Mode Rejection Ratio	Vcm = 100 mVpp @ 1 MHz < f < 10 MHz	50	75		dB
Power Supply Rejection Ratio	ΔVcc =100 mVpp @ 1 MHz < f < 10 MHz	45			dB
Channel Separation	Unselected Channels: Vin = 20 mVpp 1 MHz < f < 10 MHz	45	54		dB
RDX, RDY Single Ended Output Resistance				30	Ω
Output Current	AC Coupled Load, RDX to RDY	±1.5			mA

SWITCHING CHARACTERISTICS

PARAMETER		CONDITIONS	MIN	NOM	MAX	UNITS
R/W	Read to Write	R/W to 90% of write current		50	400	ns
	Write to Read	R/W to 90% of 100 mV 10 MHz read signal envelope or to 10% IW		0.15	1.0	µs
CS	Unselect to Select	$\overline{CS}$ to 90% of 100 mV 10 MHz read signal envelope		1.0	2.0	µs
	Select to Unselect	$\overline{CS}$ to 10% Ih		0.05	0.6	µs
HS0, 1 to any Head		To 90% of 100 mV 10 MHz read signal envelope			0.6	µs
WUS	Safe to Unsafe (TD1)	(1203A only)	3.5		20	µs
		(1203AR only)	7.0		30	µs
	Unsafe to Safe (TD2)	Write mode, after fault cleared after 2nd transition			350	ns
Head Current		Rh = 0, Lh = 0				
	Prop. Delay (TD3)	From 50% points		25	40	ns
	Asymmetry	WDI has 50% Duty Cycle and 1 ns Rise/Fall Time			2	ns
	Rise/Fall Time	10% - 90% Points		4	20	ns

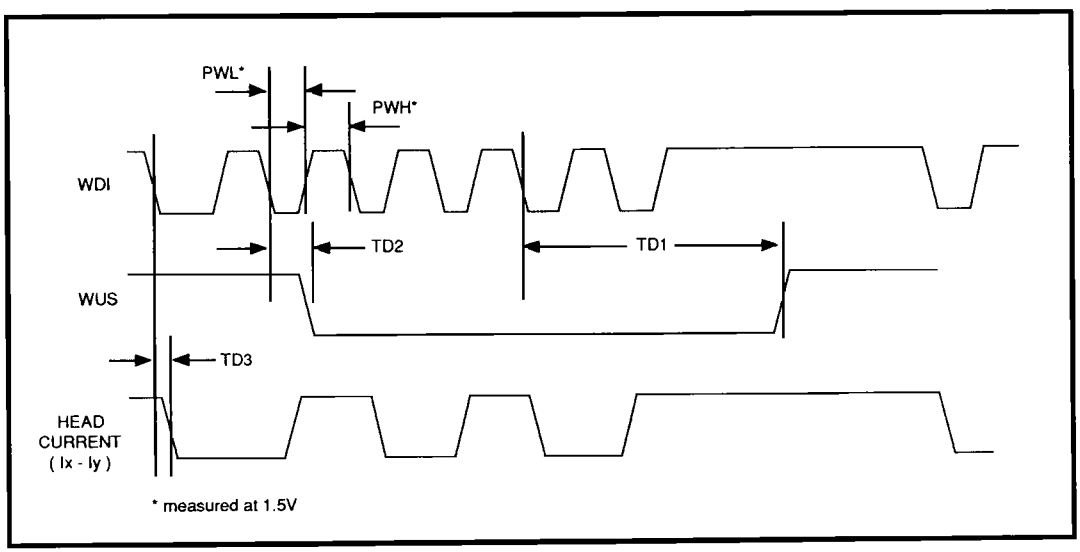
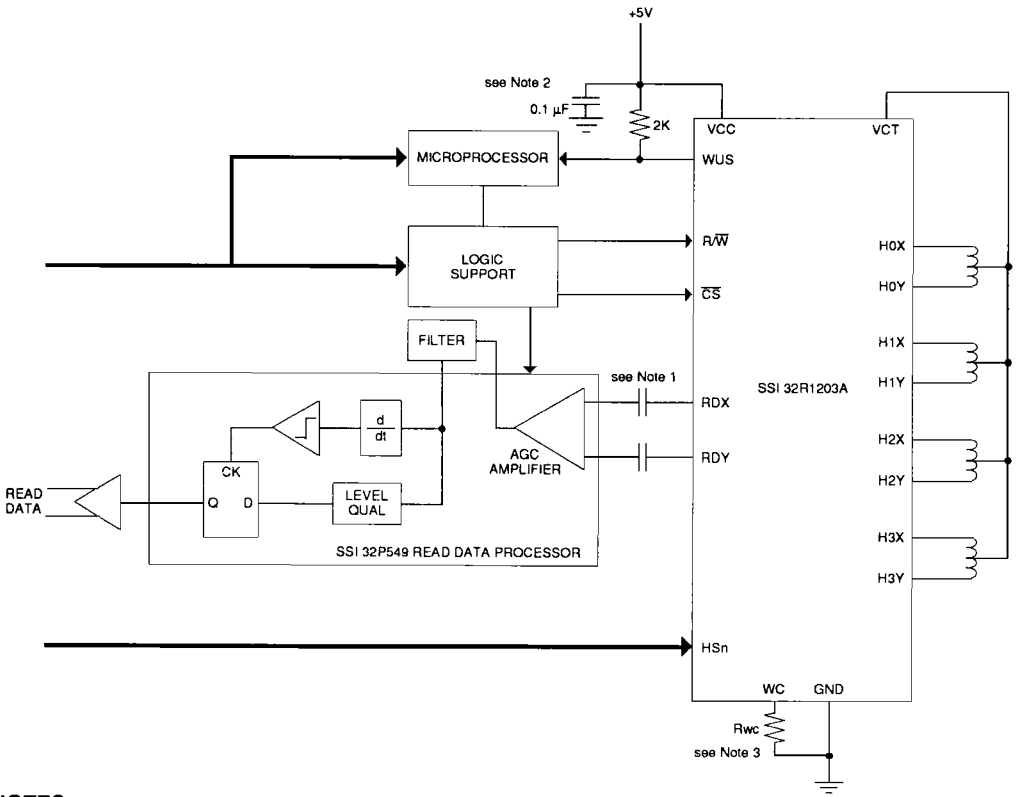


FIGURE 1: Write Mode Timing Diagram



NOTES

1. Limit DC current from RDX and RDY to 100 µA and load capacitance to 20 pF. In multi-chip application these outputs can be wire-OR'ed.
2. The power bypassing capacitor must be located close to the 32R1203A with its ground returned directly to device ground, with as short a path as possible.
3. To reduce ringing due to stray capacitance this resistor should be located close to the 32R1203A. Where this is not desirable a series resistor can be used to buffer a long WC line.

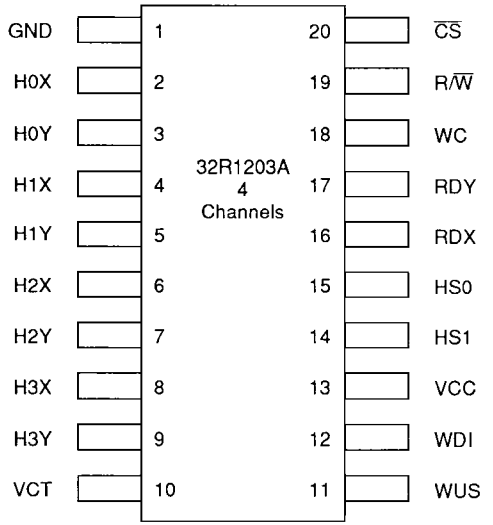
FIGURE 2: Applications Information

PACKAGE PIN DESIGNATIONS

(Top View)

THERMAL CHARACTERISTICS: θjA

20-Lead SOL, SOV	96° C/W



20-Lead SOL, SOV

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

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ORDERING INFORMATION

PART DESCRIPTION	ORDERING NUMBER	PACKAGE MARK
SSI 32R1203A		
20-Lead SOL	SSI 32R1203A-CL	SSI 32R1203A-CL
20-Lead SOV	SSI 32R1203A-CV	SSI 32R1203A-CV
SSI 32R1203AR		
20-Lead SOL	SSI 32R1203AR-CL	SSI 32R1203AR-CL
20-Lead SOV	SSI 32R1203AR-CV	SSI 32R1203AR-CV

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Notes: