5V R/W Preamplifier for 3 Terminal Recording Heads, 2 or 4 Channels

GENERAL DESCRIPTION

The XR-505 is a monolithic disk drive integrated circuit providing read mode preamplification, write current control, and head selection. It requires a single +5V power supply and consumes far less power than similar devices.

Up to four read/write heads can be switched with one device; multiple devices are cascadable. A low noise read signal preamplifier provides two user selectable gain levels.

All digital controls are TTL compatible. The XR-505 is available in 16, 20 and 24 pin SO packages. A 24 Pin DIP version is available for evaluation.

FEATURES

Complete Head Interface Functions, Read and Write
Low Power, Single +5V Operation
High Bandwidth and Dynamic Range
Low Noise Preamplifier
Error Preventing Power Monitor
Pinout Designed for Layout Ease
Digitally Selectable Preamplifier Gain
Digitally Selectable Write Current

APPLICATIONS

Battery operated Winchester disk drives
Low power disk drives
High density floppy disk drives
Digital tape drives
Dedicated servo read/write

ABSOLUTE MAXIMUM RATINGS

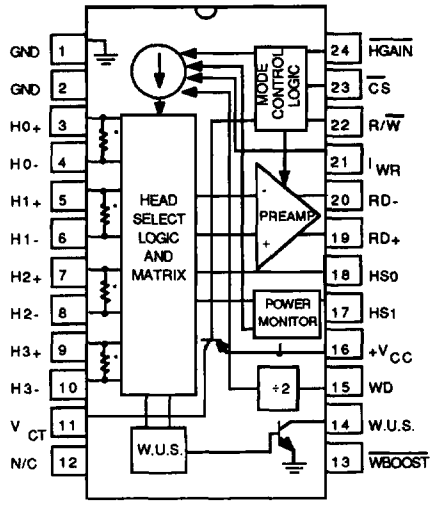
V_{CC}	8 Volts
Digital Inputs	-0.3V to V_{CC} +0.3V
Write Current	70mA
Junction Temperature	150°C
Storage Temperature	-65°C to +150°C

SYSTEM DESCRIPTION

The XR-505 is a low power four channel Winchester Disk Drive Read/Write Amplifier ideally suited for laptop computer system drives and other applications where power consumption is important. Similar in function to other Exar Read/Write amplifiers, the XR-505 provides equivalent or superior performance at one-fourth the power consumption and requires only a single +5V power supply.

The read preamplifier section consists of a 55MHz bandwidth 1nV/ Hz noise level differential amplifier. Preamplifier gain of either 100 V/V or 200 V/V is digitally selectable. The write driver controls up to 5OmA of write current. A full featured power monitor circuit positively disables write mode operation during low voltage fault conditions to preserve data integrity.

PIN ASSIGNMENT



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-505-4D	24 JEDEC SO	0°C to 70°C
XR-505R-4D	24 JEDEC SO	0°C to 70°C
XR-505R-4AD	20 JEDEC SO	0°C to 70°C
XR-505R-4BD	20 JEDEC SO	0°C to 70°C
XR-505R-2AD	16 JEDEC SO	0°C to 70°C
XR-505-2BD	16 JEDEC SO	0°C to 70°C
XR-505R-2AD	16 JEDEC SO	0°C to 70°C
XR-505R-2BD	16 JEDEC SO	0°C to 70°C
XR-505R-2AG	16 JEDEC SO	0°C to 70°C
XR-505R-2BG	16 JEDEC SO	0°C to 70°C
XR-505-4CP	24 DIP	0°C to 70°C

(other versions and packages available upon request)

ELECTRICAL CHARACTERISTICS

Test Conditions: T_A = 25°C, V_{CC} = 4.5V to 5.5V (5.0V nominal), I_W = 25 mA, R_D = 75OΩ, C_L (R_{D+}, R_{D-}) ≤ 20 pF, Lh = 10 µH, Data Rate = 5 MHz, unless specified otherwise.

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT	CONDITIONS
I_{CC}	Supply Current		25	35	mA	V_{CC} = 5.5V, Read
			20	30	mA	V_{CC} = 5.5V, Write Mode I_W = 0
P_D	Power Dissipation		0.5	1	mW	Idle Mode. V_{CC} = 5.5V
			125	170	mW	Read Mode. V_{CC} = 5.5V,
			100	150	mW	Write Mode: I_W = 0mA. V_{CC} = 5.5V
V_{CT}	Center Tap Voltage		2.1		V	Read Mode. V_{CC} = 5V
			4.5		V	Write Mode. V_{CC} = 5V
V_{PM}	Power Monitor Protection	3.7	4.0	4.4	V	V_{CC} to Disable Write
DIGITAL CHARACTERISTICS						
WUS	Write Unsafe Output					
V_{OL}	Saturation Voltage		0.2	0.5	V	I_{OL} = 8mA
I_{OH}	Leakage Current			100	µA	V_{OH} = 5V
V_{IL}	Input Low Voltage			0.8	V	
V_{IH}	Input High Voltage	2.0			V	
I_{IL}	Input Low Current	-0.4			mA	V_{IL} = 0.8V
I_{IH}	Input High Current			100	µA	V_{IH} = 2.0V
WRITE CHARACTERISTICS						
	Write Current Accuracy	-7	±2	7	%	Error from $I_W = \frac{0.47V}{R_W}$ See Fig.2
	Recommended Write Current Range	10		40	mA	
WBOOST	Write Current Boost Factor	1.20	1.25	1.30	I/I	$\overline{\text{WBOOST}}$ = Low
	Differential Head Voltage Swing	7.0	8.2		V	Peak (Inductive Load), L_h =10µH Iw = 40mA
	DC Swing	3.5	4		V	DC Load, One Side
	Unselected Differential Head Current			85	µA	
	Unselected Transient Current			2	mA	Peak
	Differential Output Capacitance			15	pF	
	Differential Output Resistance	10			kΩ	XR-505
		635	750	865	Ω	XR-505R
WUS	WD Rate/Transition Freq.	125			kHz	
K_I	Current Source Factor		1			$K_I = I_W$/(Current through R^W^)
K	Write Current Constant	440	470	500	mV	K = 1000 I_w • R_w
	Write Protection Shut-off Leakage Current	-200		+200	µA	Per Side, V_{CC} ≤ 3.7V
V_{OS}	Preamplifier Output Offset Voltage	-20		+20	mV	Write or Idle Mode

SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT	CONDITIONS
V_{CM}	Preamplifier Output Common Mode Voltage		1.5		V	Write Mode
	Preamplifier Output Leakage Current	-100		+100	µA	Write or Idle Mode, $R_{D}+ = R_{D}- = 6V$
READ MODE						
A_V	Differential Voltage Gain	85	100	115	V/V	$\overline{HGAIN}$= High, V_{IN} = 1mVp-p at 300 kHz, $R_L+ = R_L- = 1k\Omega$
		170	200	230	V/V	$\overline{HGAIN}$ = Low
	Dynamic Range	-3		+3	mV	DC input voltage where gain drops 10% $V_{in} = V_i + 0.5$ mVp-p at 300 kHz.
R_{IN}	Differential Input Resistance	2	8		kΩ	XR-505
		500	650	850	Ω	XR-505R
C_{IN}	Differential Input Capacitance			20	pF	
e_{ni}	Input Noise Voltage		1.0	1.5	$nV/\sqrt{Hz}$	$L_h = 0$, $R_h = 0$, BW = 15MHz
BW	Bandwidth	30	60		MHz	-3dB Point, $\|Z_s\| \pm 5\Omega$, V_{in}= 1mVp-p
I_B	Input Bias Current		10	45	µA	
CMRR	Common Mode Rejection Ratio	60	80		dB	$V_{CM} = V_{CT}$ + 100 mVp-p at 5MHz
PSRR	Power Supply Rejection Ration	60	80		dB	100mVp-p at 5 MHz Superimposed on V_{CC}
	Channel Separation	45	60			Unselected Channel: V_{IN} = 100 mVp-p at 5 MHz. Selected Channel V_{IN} = 0
V_{OS}	Output Offset Voltage	-200	150	+200	mV	
ΔV_{OS}	Output Offset Voltage Change	-100	120	+100	mV	Switching Between Any Two Heads
V_{CM}	Common Mode Output Voltage	1.25	1.50	1.75	V	
ΔV_{CM}	V_{CM} Change from Write to Read	-200	+100	+200	mV	Common Mode Output Voltage Change from Write to Read or Read to Write
	Head Current Leakage	-200		+200	µA	Per Side
R_O	Single Ended Output Resistance			30	Ω	f = 5 MHz
I_O	Output Current	2.1			mA	AC Coupled, Source or Sink

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SYMBOL	PARAMETER	MIN	TYP	MAX	UNIT	CONDITIONS
SWITCHING CHARACTERISTICS						
R/W	Read to Write		0.1	1	µS	Note 1
	Write to Read		0.1	1	µS	Notes 2,3
CS	Start-up Delay		0.1	1	µS	Notes 1,2
	Inhibit Delay		0.1	1	µS	Note 3
	Head Switching Delay		0.1	1	µS	Note 2, Switching between any heads.
WUS	Write Unsafe					
	Safe to Unsafe	1.6		8.0	µS	I_W = 25 mA, See Figure 1, TD1
	Unsafe to Safe		0.2	1	µS	I_W = 25 mA, See Figure 1, TD2
I_W	Head Current					
	Propagation Delay		2	25	nS	Note 4, See Figure 1, TD3
	Asymmetry		0.1	2	nS	Note 5
	Rise or Fall Time		1	20	nS	10% to 90% or 90% to 10% point

Note 1: Delay to 90% of I_W.

Note 2: Delay to 90% of 100 mVp-p 10 MHz Read Signal Envelope.

Note 3: Delay to 90% Decay of I_W.

Note 4: From 50% Points. L_h = 0H, R_h =0Ω

Note 5: Write Data with 1 nS rise and fall times and 50% duty cycle.

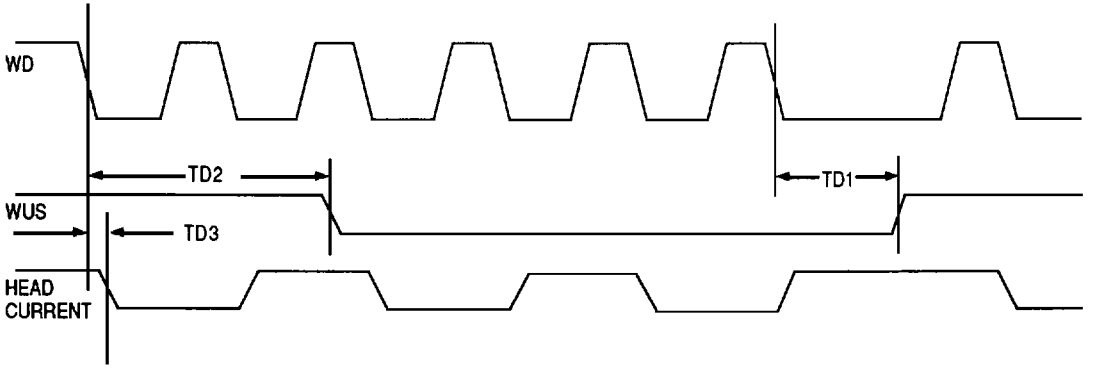

Figure 1. Write Mode Timing Diagram

XR-505 PIN DESCRIPTION

PIN	SYMBOL	DESCRIPTION
$\overline{CS}$	Chip Select	Low enables device operation
R/$\overline{W}$	Read/Write Select	High selects read mode Low selects write mode
WD	Write Data Input	
$\overline{HGAIN}$	High Gain Select	Low selects preamp gain of 200V/V High selects preamp gain of 100V/V
WUS	Write Unsafe Output	Open collector output. High indicates write fault condition
HS0, HS1	Head Select	Selects head for Read/Write operation
V_{CC}	+5V Supply Input	
R_{D+}, R^D-	Read Preamplifier	Differential preamplifier output
I_{WR}	Write Current	Resistor to ground programs peak write current level
$\overline{WBOOST}$	Write Current Boost	Low Selects, I_W Boost of $I_W = 1.25 \cdot \frac{0.47}{R_W}$ High Selects Nominal I^W = 0.47 / R^W

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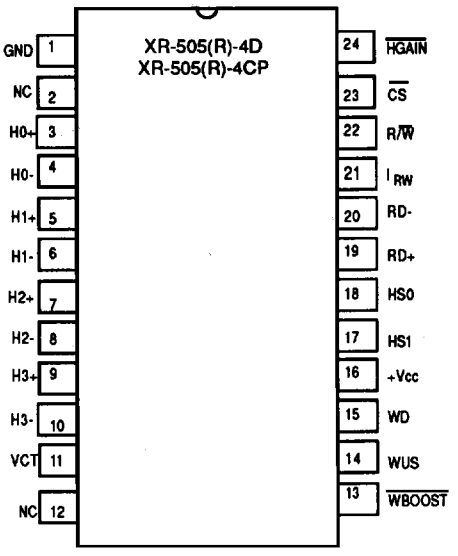
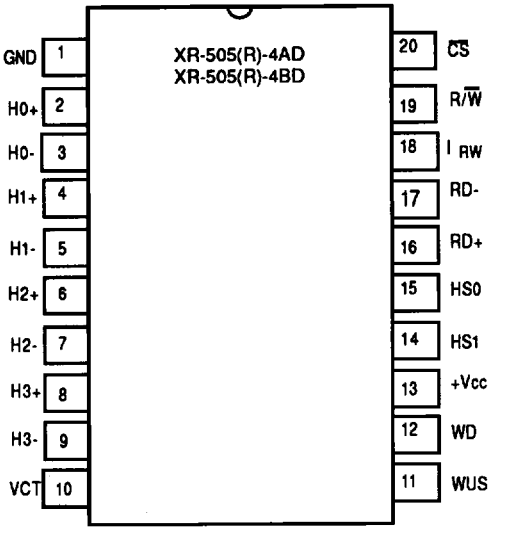
XR-505 DIGITAL CONTROLS

CONTROL PIN						FUNCTION
$\overline{CS}$	R/$\overline{W}$	$\overline{HGAIN}$	$\overline{WBOOST}$	HS1	HS0	
1	X	X	X	X	X	Device Disabled
0	0	X	0	0	0	Write Mode, Head 0, Iw = Boost
0	0	X	0	0	1	Write Mode, Head 1, Iw = Boost
0	0	X	0	1	0	Write Mode, Head 2, Iw = Boost
0	0	X	0	1	1	Write Mode, Head 3, Iw = Boost
0	0	X	1	0	0	Write Mode, Head 0, Iw = Normal
0	0	X	1	0	1	Write Mode, Head 1, Iw = Normal
0	0	X	1	1	0	Write Mode, Head 2, Iw = Normal
0	0	X	1	1	1	Write Mode, Head 3, Iw = Normal
0	1	0	X	0	0	Read Mode, Head 0, Preamp A^V = 200
0	1	0	X	0	1	Read Mode, Head 1, Preamp A^V = 200
0	1	0	X	1	0	Read Mode, Head 2, Preamp A^V = 200
0	1	0	X	1	1	Read Mode, Head 3, Preamp A^V = 200
0	1	1	X	0	0	Read Mode, Head 0, Preamp A^V = 100
0	1	1	X	0	1	Read Mode, Head 1, Preamp A^V = 100
0	1	1	X	1	0	Read Mode, Head 2, Preamp A^V = 100
0	1	1	X	1	1	Read Mode, Head 3, Preamp A^V = 100





XR-505 Packaging Options

Device	HGain	WBoost	Package
XR-505(R)-4D	100/200	1.0/1.25	24 SO
XR-505(R)-4AD	100	1.0	20 SO
XR-505(R)-4BD	200	1.0	20 SO
XR-505(R)-2AD	100	1.0/1.25	16 SO
XR-505(R)-2BD	200	1.0/1.25	16 SO
XR-505(R)-2AG	100	1.0/1.25	16 SO
XR-505(R)-2BG	200	1.0/1.25	16 SO
XR-505(R)-4CP	100/200	1.0/1.25	24 DIP

"G" Package is 150 mil JEDEC SO