![VTC Inc. logo] **VTC Inc.**
Value the Customer™

VM7000
2 OR 4-CHANNEL, 5-VOLT, FERRITE/MIG HEAD, READ/WRITE PREAMPLIFIER
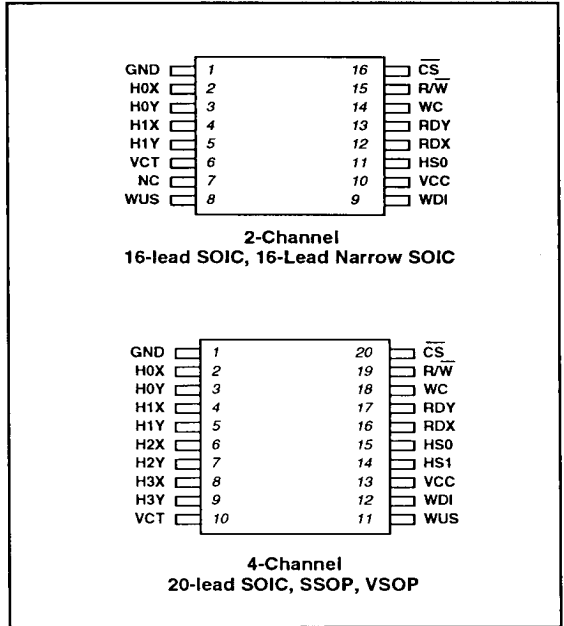
FEATURES

- High Performance
  - Read Gain = 200 V/V typical
  - Input Noise = $0.85 nV/\sqrt{Hz}$ maximum
  - Head Inductance Range = $1 - 5$ μH
  - Write Current Range 15 - 50 mA
  - Input Capacitance = 18 pF maximum
- Very Low Power Dissipation = less than 9 mW typical in Sleep Mode
- Power Up/Down Data Protect Circuitry
- Reduced Write-to-Read Recovery Time
- Single Power Supply = 5 ±10%
- Fault Detect Capability
- Designed for Center-Tapped Ferrite or MIG Heads
- Write Unsafe Detection
- Standard Schottky - Isolated 750Ω Damping Resistor
- Available in 2 or 4-Channels

DESCRIPTION

The VM7000 is a high-performance, very low-power read/write preamplifier designed for use with center-tapped ferrite or MIG recording heads. This circuit will operate on a single 5-volt power supply and is ideally suited for use in battery powered disk drives.

The VM7000 provides write current and data protection circuitry, and low noise read functions for up to four read/write heads. When deactivated, the device enters a *sleep mode* which reduces power dissipation to less than 9 mW typical. Data protection circuitry is provided to ensure that the write current source is totally disabled during power supply power up/power down conditions. Write-to-read recovery time is minimized by eliminating common mode output voltage swings when switching between modes.
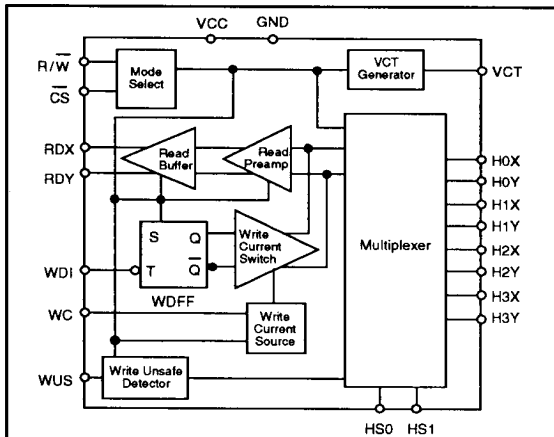
CONNECTION DIAGRAMS

Pin	Signal		Pin	Signal
1	GND		16	$\overline{CS}$
2	H0X		15	R/$\overline{W}$
3	H0Y		14	WC
4	H1X		13	RDY
5	H1Y		12	RDX
6	VCT		11	HS0
7	NC		10	VCC
8	WUS		9	WDI

2-Channel
16-lead SOIC, 16-Lead Narrow SOIC

Pin	Signal		Pin	Signal
1	GND		20	$\overline{CS}$
2	H0X		19	R/$\overline{W}$
3	H0Y		18	WC
4	H1X		17	RDY
5	H1Y		16	RDX
6	H2X		15	HS0
7	H2Y		14	HS1
8	H3X		13	VCC
9	H3Y		12	WDI
10	VCT		11	WUS

4-Channel
20-lead SOIC, SSOP, VSOP

TWO/FOUR TERMINAL
& SERVO PREAMPLIFIERS

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BLOCK DIAGRAM

ABSOLUTE MAXIMUM RATINGS

Power Supply:
V_{CC} .... -0.3V to +7V
Write Current I_W 70mA
Input Voltages:
Digital Input Voltage V_{IN} .... -0.3V to (V_{CC} + 0.3)V
Head Port Voltage V_H .... -0.3V to (V_{CC} + 0.3)V
WUS Pin Voltage Range V_{WUS} .... -0.3V to +6V
Output Current:
RDX, RDY: I_O ....-10mA
WUS: I_{WUS} .... +12mA
Junction Temperature .... 150°C
Storage Temperature T_{stg} .... -65° to 150°C
Thermal Characteristics, Θ_{JA}:
16-lead SOIC .... 80°C/W
20-lead SOIC .... 80°C/W

RECOMMENDED OPERATING CONDITIONS

Power Supply Voltage:
V_{CC} ....+5V ± 10%
Write current (I_W) .... 15 to 50mA
Head Inductance (L_H) .... 1 to 5μH
Write Data Frequency Range........................... 24Mbits/sec
Junction Temperature (T_J) .... 0°C to 125°C

CIRCUIT OPERATION

The VM7000 addresses up to four 3-terminal, center-tapped ferrite or MIG recording heads, providing switched write current in the write mode, or data amplification in the read mode. Head selection and mode control is determined by the head select lines, HS1, HS2 and mode control lines, CS, R/W as shown in Tables 1 and 2. Internal resistor pullups, provided on the CS and R/W lines, will force the device into a non-write condition if either control line opens up.

Write Mode

In the write mode, the VM7000 acts as a write current switch with the write unsafe (WUS) detection circuitry activated. Write current is toggled between the X and Y side of the selected head on each high to low transition on the Write Data Flip-Flop (WDFF) so that upon switching to the write mode, the write current flows into the "X" side of the head.

The write current magnitude is determined by an external resistor (R_{WC}) connected between the WC pin and Ground. An internally generated reference voltage is present at the WC pin. The magnitude of the write current (0-PK, ± 8%) is:

$$I_W = 50/R_{WC}$$

Power supply fault protection ensures data security on the disk by disabling the write current source during a power supply voltage fault or by supply power up/down conditions. Additionally, the write unsafe (WUS) detection circuitry will flag any of the conditions listed below, as a high level on the WUS line. Two negative transitions on the WDI pin, after the fault is corrected, are required to clear the WUS line.

- No write current
- WDI frequency too low
- Read or sleep mode
- Open head or center-tap
- Head shorted or shorted to ground
- Center Tap shorted to ground

Read Mode

In the read mode, the VM7000 acts as a low noise differential amplifier for signals coming off the disk. The write current generator and write unsafe circuitry is deactivated. The RDX, RDY pins are emitter follower outputs and are in phase with "X" and "Y" head ports. These outputs should be AC coupled to the load. The RDX, RDY common mode output voltage is constant, minimizing the transient between read and write mode thereby, substantially reducing the recovery time in the pulse detector circuit connected to these outputs.

Sleep Mode

When CS is high, initially all circuitry is shut down so that power dissipation is reduced to 9mW typical in the "Sleep Mode". Switching the CS line low "wakes up" the chip and the device will enter the read or write mode, depending on the status of the R/W line.

Table 1: Mode Select

HS0	HS1	HEAD
0	0	0
1	0	1
0	1	2
1	1	3

Table 2: Head Select

$\overline{CS}$	$R/\overline{W}$	MODE
0	0	Write/Awake
0	1	Read/Awake
1	X	Sleep

PIN DESCRIPTIONS

NAME	I/O	DESCRIPTION
HS0-HS1	I*	Head Select: selects one of up to 4 heads
H0X-H3X H0Y-H3Y	I/O	X, Y Head terminals
WDI	I*	Write Data Input: TTL input signal, negative transition toggles direction of head current
$\overline{CS}$	I	Chip select: high level signal puts chip in sleep mode, low level wakes chip up
$R/\overline{W}$	I*	Read/Write select: High level selects read mode, low-level selects write mode
WUS	O*	Write unsafe: Open collector output: high level indicates writes unsafe condition
WC		Write current adjust: A resistor adjusts level of write current
RDX-RDY	O*	Read data output: differential output data
VCC		+5 volt supply
GND		Ground
VCT	O	Voltage source for head center-tap

* May be wire-OR'ed for multi-chip usage.

DC CHARACTERISTICS Recommended operating conditions apply unless otherwise specified.

PARAMETER	SYM	CONDITIONS	MIN	TYP	MAX	UNITS
Supply Current	I_{CC}	Read Mode			42	mA
		Write Mode			$45 + I_W$	
		Idle Mode			3	
Power Dissipation	PD	Read Mode		150	232	mW
		Write Mode, $I_W = 30mA$		335	413	
		Idle Mode		7	16.5	
Input High Voltage	V_{IH}		2		$V_{CC} +0.3$	V
Input Low Voltage	V_{IL}		-0.3		0.8	V
Input High Current	I_{IH}	$V_{IH} = 2.7V$			80	μA
Input Low Current	I_{IL}	$V_{IL} = 0.4V, V_{CC} = 5.5V$	-160			μA
WUS Output Low Voltage	V_{OL}	$I_{OL} = 4.0mA$			0.5	V
WUS Output High Current	I_{OH}	$V_{OH} = 5.0V$			100	μA
VCC Value for Write Current Turn Off		$I_W < 1mA$	3.7		4.3	V

VM7000

READ CHARACTERISTICS Recommended operating conditions apply unless otherwise specified; C_L (RDX, RDY) $\leq$ 20pF.

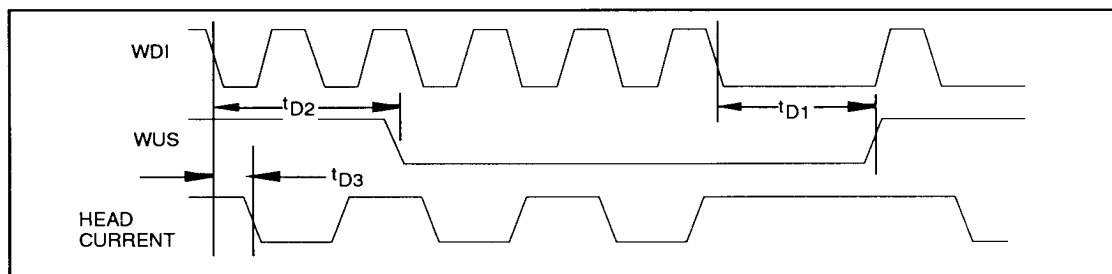| PARAMETER	SYM	CONDITIONS	MIN	TYP	MAX	UNITS
Differential Voltage Gain	A_V	V_{IN} = 1mVrms, 1MHz	167	200	233	V/V
Bandwidth	BW	-1dB $\mid$ Zs $\mid$ < 5Ω, V_{IN} = 1mVp-p	25			MHz
		-3dB $\mid$ Zs $\mid$ < 5Ω, V_{IN} = 1mVp-p	35			MHz
Input Noise Voltage	e_{in}	BW = 17MHz, L_H = 0, R_H = 0		0.50	0.80	nV/$\sqrt{Hz}$
Differential Input Capacitance	C_{IN}	V_{IN} = 1mVp-p, f = 5MHz		14	18	pF
Differential Input Resistance	R_{IN}	V_{IN} = 1mVp-p, f = 5MHz	500	1200		Ω
Dynamic Range	DR	AC input voltage where the gain falls to 90% of the gain @ 0.2mVrms input, f = 5MHz	3			mVrms
Common Mode Rejection Ratio	CMRR	V_{IN} = 100mVp-p @5MHz	50			dB
Power Supply Rejection Ratio	PSRR	100mVp-p @5MHz on V_{CC}	45			dB
Channel Separation	CS	Unselected channels driven with 20mVp-p @5MHz Selected Channels V_{IN} = 0mVp-p	45			dB
Output Offset Voltage	V_{OS}		-250		+250	mV
RDX,RDY Common Mode Output Voltage	V_{OCM}	Read Mode		1.8		V
Common Mode Output Voltage Difference, Read vs. Write	ΔV_{OCM}				350	mV
Single-Ended Output Resistance	R_{SEO}	f = 5MHz			40	Ω
Output Current	I_O	AC Coupled Load, RDX to RDY	±1.5			mA
Center Tap Voltage	V_{CT}			2.7		V
Input Bias Current (per side)	I_{BIAS}				80	µA

Figure 1: Write Mode Timing Diagram

WRITE CHARACTERISTICS Recommended operating conditions apply unless otherwise specified; $L_H = 5\mu H$, $I_W = 30mA$, $f_{DATA} = 5MHz$, $T_A = 25°C$.

PARAMETER	SYM	CONDITIONS	MIN	TYP	MAX	UNITS
WC Pin Voltage	V_{WC}			2.5		V
Differential Head Voltage Swing	V_{DH}		4.8			V
Unselected Head Current	I_{UH}				1	mA(pk)
Write Current Range	I_W	$1.0K < R_{WC} < 3.3k\Omega$	15		50	mA
Write Current Tolerance	ΔI_W	I_W range 10mA to 40mA	-8		+8	%
Differential Output Capacitance	C_{IN}				10	pF
Differential Output Resistance	R_{IN}		750			Ω
Center Tap Voltage	V_{CT}			V_{CC}-0.25		V
Head Current (per side)	I_H	$0 \leq VCC \leq 3.5V$	-200		200	μA
Write Current Constant	K_W			50		V
RDX, RDY Leakage Current	I_L		-100		100	μA
RDX, RDY Common Mode Output Voltage	V_{CM}			1.8		V
I_{WC} to head current gain				20		mA/mA

SWITCHING CHARACTERISTICS Recommended operating conditions apply unless otherwise specified; $I_W = 30mA$, $f_{DATA} = 5MHz$, $L_H = 5\mu H$, C_L (RDX, RDY) $\leq 20pF$, $T_A = 25°C$.

PARAMETER	SYM	CONDITIONS	MIN	TYP	MAX	UNITS
R/$\overline{W}$ Read to Write	t_{RW}	R/$\overline{W}$ to 90% I_W			1.0	μs
R/$\overline{W}$ Write to Read	t_{WR}	R/$\overline{W}$ to 90% of 100mV, 10MHz read signal envelope			1.0	μs
$\overline{CS}$ Unselect to Select	t_{IR}	CS to 90% I_W or 90% of 100mV, 10MHz read signal envelope			0.6	μs
$\overline{CS}$ Select to Unselect	t_{RI}				0.6	μs
HS0, 1, any Head	I_W	HS0, 1 to 90% of 100mV, 10MHz read signal envelope			0.6	μs
WUS Safe to Unsafe	TD1	f = 5MHz	1.6		8	μs
WUS Unsafe to Safe	TD2				1.0	μs
Head Current Propagation Delay (TD3)	TD3	$L_H = 0$, $R_H = 0$			30	ns
Head Current Asymmetry	A_{SYM}	50% duty cycle on WDI, 1ns rise/fall time; $L_H = 0$, $R_H = 0$			2	ns
Head Current Rise/Fall Time	t_r / t_f	10% to 90% points			20	ns
Minimum WDI Rate for Safe Condition				1.0		MHz

TWO/THREE TERMINAL & SERVO PREAMPLIFIERS

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