VTC Inc.
Value the Customer™

VM7000

T-52-38

5-VOLT FERRITE/MIG HEAD READ/WRITE PREAMPLIFIER

July, 1991

FEATURES

- High Performance
  - Read Gain = 200 V/V typical
  - Input Noise = 0.85nV/√Hz maximum
  - Head Inductance Range = 2 – 15 µH
  - Write Current Range 15 - 50 mA
  - Input Capacitance = 22 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
- Optional Internal Head Damping Resistor
- Designed for Center-Tapped Ferrite or MIG Heads
- Write Unsafe Detection
- Standard Schottky - Isolated 750Ω Damping Resistor

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.

The VM7000 is available in 2 or 4 channels and comes in several different packages. Please consult factory for package availability.

ABSOLUTE MAXIMUM RATINGS

Power Supply:
- V_{CC} ..... -0.3 to +7VDC

Write Current I_W 70mA

Input Voltages:
- Digital Input Voltage V_{IN} ..... -0.3 to (V_{CC} + 0.3)VDC
- Head Port Voltage V_H ..... -0.3 to (V_{CC} + 0.3)VDC
- WUS Pin Voltage Range V_{WUS} ..... -0.3 to +6VDC

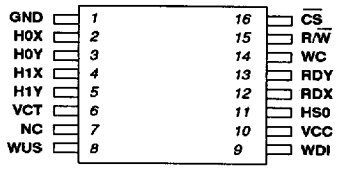
Output Current:
- RDX, RDY: I_O ..... -10mA
- WUS: I_{WUS} ..... +12mA

Junction Temperature ..... 150°C

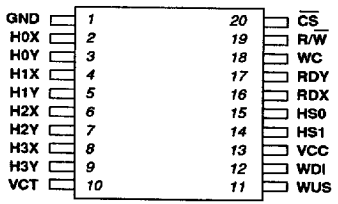
Storage Temperature T_{stg} ..... -65° to 150°C

Thermal Characteristics, Θ_{JA}:
- 16-lead SOIC ..... 80°C/W
- 20-lead SOIC ..... 80°C/W

CONNECTION DIAGRAMS



16-lead SOIC
.150" and .300" body



20-lead SOIC

RECOMMENDED OPERATING CONDITIONS

Power Supply Voltage:
- V_{CC} ..... +5V ± 10%

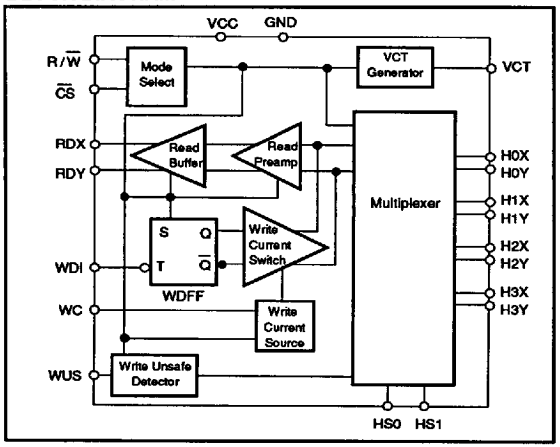
Write current (I_W) ..... 15 to 50mA

Head Inductance (L_H) ..... 2 to 15µH

Write Data Frequency Range 24mB/s

Junction Temperature (T_J) ..... 0°C to 125°C

BLOCK DIAGRAM



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, $\overline{CS}$, R/$\overline{W}$ as shown in Tables 1 and 2. Internal resistor pullups, provided on the $\overline{CS}$ and R/$\overline{W}$ 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 (RWC) 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:

$$IWC = 50/RWC$$

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 $\overline{CS}$ is high, initially all circuitry is shut down so that power dissipation is reduced to 9mW typical in the "Sleep Mode". Switching the $\overline{CS}$ line low "wakes up" the chip and the device will enter the read or write mode, depending on the status of the R/$\overline{W}$ 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
HOX-HX3 HOY-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			40	mA
		Write Mode			45 + I_W	mA
		Idle Mode			3	mA
Power Dissipation	PD	Read Mode		150	220	mW
		Write Mode, I_W = 30mA		335	413	mW
		Idle Mode		7	16.5	mW
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	VDC
WUS Output High Current	I_{OH}	V_{OH} = 5.0V			100	µA
VCC Value for Write Current Turn Off		I_H < 1mA	3.7		4.3	V

READ CHARACTERISTICS Recommended operating conditions apply unless otherwise specified; C_L (RDX, RDY) ≤ 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 |Zs| < 5Ω, V_{IN} = 1mVp-p	25			MHz
		-3dB |Zs| < 5Ω, V_{IN} = 1mVp-p	35			MHz
Input Noise Voltage	e_{in}	BW = 17MHz, L H = 0, R H = 0		0.60	0.85	nV/√Hz
Differential Input Capacitance	C_{IN}	V_{IN} = 1mVp-p, f = 5MHz		16	18	pF
Differential Input Resistance	R_{IN}	V_{IN} = 1mVp-p, f = 5MHz	600	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		VDC
Common Mode Output Voltage Difference, Read vs. Write	ΔV_{OCM}				350	mV
Single-Ended Output Resistance	R_{SEO}	f = 5MHz			30	Ω
Output Current	I_O	AC Coupled Load, RDX to RDY	±1.5			mA
Center Tap Voltage	V_{CT}			2.7		VDC
Input Bias Current (per side)	I_{BIAS}				120	µA

WRITE CHARACTERISTICS Recommended operating conditions apply unless otherwise specified; L_H = 5µH, 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} < 3.3KΩ	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}			VCC -0.25		V
Head Current (per side)	I_H	0 ≤ VCC ≤ 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 = 5µH, C_L (RDX, RDY) ≤ 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 evelope			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	ASYM	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