



VTC Inc.
Value the Customer™

VM7140

2, 4 OR 8-CHANNEL, 5-VOLT,
THIN-FILM HEAD, READ/WRITE
PREAMPLIFIER

PRELIMINARY

July, 1993

FEATURES

- High Performance
 - Read Gain = 300 V/V Typical
 - Input Noise = 0.65nV/√Hz max
 - Head Inductance Range = 0.2 – 5 μH
 - Write Current Range 1 - 40 mA
 - Input Capacitance = 33 pF max
- Differential Pseudo ECL Write Data Input
- Very Low Power Dissipation = 3 mW Typical in Sleep Mode
- Power Up/Down Data Protect Circuitry
- Reduced Write-to-Read Recovery Time
- Single Power Supply = 5 V ± 10%
- Fault Detect Capability
- Designed for 2-Terminal Thin-Film or MIG Heads
- Standard Schottky - Isolated 400 Ω Damping Resistor (patent pending)
- Non-Damping Resistor Version Available
- Other Read Gain Options Available
- Available in 2, 4 or 8-Channels

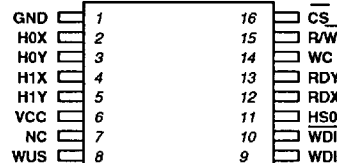
DESCRIPTION

The VM7140 is a high-performance, very low-power read/write preamplifier designed for use with external 2-terminal, thin-film or MIG recording heads with differential pseudo ECL write data Input. This circuit will operate on a single 5-volt power supply and is ideally suited for use in battery powered disk drives.

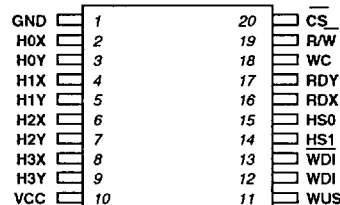
The VM7140 provides write current switching in the write mode and provides a low noise data path in the read mode for up to eight read/write recording heads. When deactivated, the device enters a *sleep mode* that reduces power dissipation to 3 mW. Data protection circuitry is provided to ensure that 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 VM7140 is available in several different packages. Please consult VTC for package availability and additional read mode voltage gains.

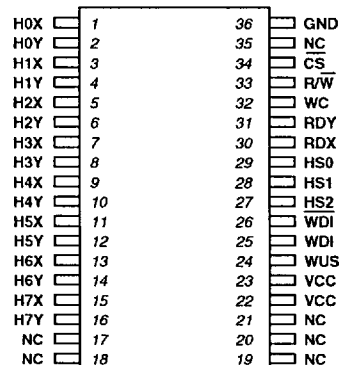
CONNECTION DIAGRAMS



2-Channel
16-lead SOIC

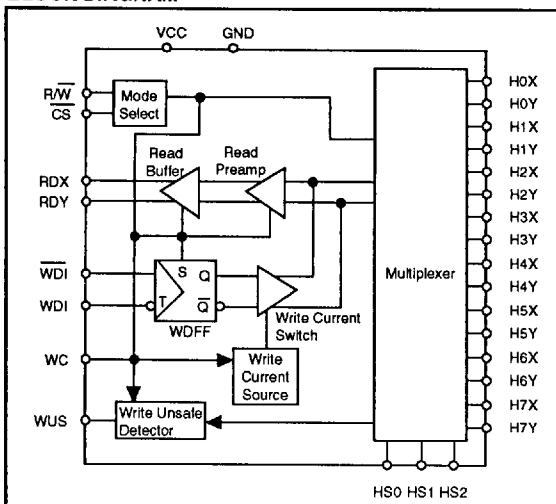


4-Channel
20-lead SOIC, SSOP, VSOP



8-Channel
36-lead SOIC

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Power Supply:

V_{CC} -0.3V to +7V

Write Current I_W 60mA

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_{slg} -65° to 150°C

Thermal Characteristics, θ_{JA} :

16-lead SOIC 100°C/W

20-lead SOIC 80°C/W

20-lead SSOP TBD

RECOMMENDED OPERATING CONDITIONS

Power Supply Voltage:

V_{CC} +5V \pm 10%

Write current (I_W) 1 to 40mA

Head Inductance (L_H) 0.2 to 10 μ H

Junction Temperature (T_J) 25°C to 125°C

CIRCUIT OPERATION

The VM7140 addresses up to four 2-terminal, thin-film 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. The part's operation over a wide range of inductive loads makes it suitable for 2-terminal MIG heads.

Write Mode

In write mode, the VM7140 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, \pm 8%) is:

$$I_W = K_W/R_{WC} + 0.2mA$$

$$= 50/R_{WC} + 0.2mA$$

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, is required to clear the WUS line.

- No write current
- WDI frequency too low
- Read or sleep mode

Read Mode

In read mode, the VM7140 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.

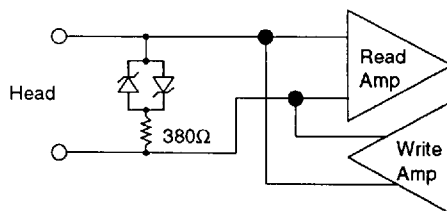
Sleep Mode

When CS is high, initially all circuitry is shut down so that power dissipation is reduced to 3 mW 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.

Diode Connected Damping Resistor (patent pending)

The VM7140 has damping resistors isolated by Schottky diodes as an option. The diodes effectively remove the resistor from the circuit during the read mode, however during the write mode with the higher level input signal, the resistor provides damping for the write current waveform.

Input Structure:



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Table 1: Head Select

HS2	HS1	HS0	HEAD
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3

Table 2: Mode Select

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

PIN DESCRIPTIONS

NAME	I/O	DESCRIPTION
HS0-HS2	I*	Head Select: selects one of up to 8 heads
H0X-H7X H0Y-H7Y	I/O	X, Y Head terminals
WDI, \overline{WDI}	I*	Write Data Input: PECL input signal, negative transition toggles direction of head current
CS	I	Chip select: high level signal puts chip in sleep mode, low level wakes chip up
R/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

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

** Although both VCC connections are recommended, only one connection is required as both are connected internally.

WRITE CHARACTERISTICS Recommended operating conditions apply unless otherwise specified; $L_H = 1\mu H$, $R_H = 30\Omega$, $I_W = 20mA$, $f_{DATA} = 5MHz$.

PARAMETER	SYM	CONDITIONS	MIN	TYP (Note 1)	MAX	UNITS
WC Pin Voltage	V_{WC}			2.5		V
I_{WC} to Head Current Gain	A_I			20		mA/mA
Write Current Constant	K_W	$K_W = (V_{WC})(A_I)$	46	50	54	V
Write Current Range	I_W	$1.258K < R_{WC} < 60k\Omega$	1		40	mA
Write Current Tolerance	ΔI_W	$I_W = 10 - 40mA$	-8	-1	+8	%
Differential Head Voltage Swing	V_{DH}		4.5	5.4		Vp-p
WDI Transition Frequency for Safe Condition	f_{DATA}	WUS = low	1			MHz
Differential Output Capacitance	C_O				15	pF
Differential Output Resistance	R_O		3200			Ω
Unselected Head Transient Current	I_{UH}	$I_W = 15mA$		0.15	1	mA(pk)
RDX, RDY Common Mode Output Voltage	V_{CM}			$V_{CC}-2.7$		V

Note 1: Typical values are given at $V_{CC} = 5V$ and $T_A = 25^\circ C$.

DC CHARACTERISTICS Recommended operating conditions apply unless otherwise specified.

PARAMETER	SYM	CONDITIONS	MIN	TYP (Note 1)	MAX	UNITS
Supply Current	I_{CC}	Read Mode		$34 + .05 I_W$	$51 + .05 I_W$	mA
		Write Mode		$44 + 1.05 I_W$	$52 + 1.05 I_W$	
		Idle Mode		0.6	3	
Power Dissipation	PD	Read Mode, $I_W = 20\text{mA}$		165	286	mW
		Write Mode, $I_W = 20\text{mA}$		320	402	
		Idle Mode		3	17	
Input High Voltage	V_{IH}		2		$V_{CC} + 0.3$	V
Input Low Voltage	V_{IL}		-0.3		0.8	V
WDI, $\overline{\text{WDI}}$ Input High Voltage	V_{IH}	Pseudo ECL	$V_{CC} - 1.0$		$V_{CC} - 0.7$	V
WDI, $\overline{\text{WDI}}$ Input Low Voltage	V_{IL}	Pseudo ECL	$V_{CC} - 1.9$		$V_{CC} - 1.6$	V
Input High Current	I_{IH}	$V_{IH} = 2.7\text{V}$			80	μA
Input Low Current	I_{IL}	$V_{IL} = 0.4\text{V}$	-160			μA
WDI, $\overline{\text{WDI}}$ Input High Current	I_{IH}				100	μA
WDI, $\overline{\text{WDI}}$ Input Low Current	I_{IL}				80	μA
WUS Output Low Voltage	V_{OL}	$I_{OL} = 4.0\text{mA}$		0.35	0.5	V
WUS Output High Current	I_{OH}	$V_{OH} = 5.0\text{V}$		13	100	μA
VCC Value for Write Current Turn Off		$I_H < 0.2\text{mA}$	3.7	4.0	4.3	V

Note 1: Typical values are given at $V_{CC} = 5\text{V}$ and $T_A = 25^\circ\text{C}$.

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READ CHARACTERISTICS Recommended operating conditions apply unless otherwise specified; C_L (RDX, RDY) < 20pF, R_L (RDX, RDY) = 1k Ω .

PARAMETER	SYM	CONDITIONS	MIN	TYP (Note 1)	MAX	UNITS
Differential Voltage Gain	AV	$V_{IN} = 1\text{mVrms}$, 1MHz; Note 2	120	150	180	V/V
Bandwidth	BW	-1dB Z_s < 5 Ω , $V_{IN} = 1\text{mVp-p}$	40	55		MHz
		-3dB Z_s < 5 Ω , $V_{IN} = 1\text{mVp-p}$	65	85		
Input Noise Voltage	e_{in}	BW = 17MHz, $L_H = 0$, $R_H = 0$		0.5	0.7	nV/ $\sqrt{\text{Hz}}$
Differential Input Capacitance	C_{IN}	$V_{IN} = 1\text{mVp-p}$, $f = 5\text{MHz}$		33	45	pF
Differential Input Resistance	R_{IN}	$V_{IN} = 1\text{mVp-p}$, $f = 5\text{MHz}$	380	1000		Ω
Dynamic Range	DR	AC input where A_V is 90% of gain at 0.2mVrms input	2	5		mVrms
Common Mode Rejection Ratio	CMRR	$V_{IN} = 100\text{mVp-p}$ @ 5MHz	50	70		dB
Power Supply Rejection Ratio	PSRR	100mVp-p @ 5MHz on V_{CC}	45	66		dB
Channel Separation	CS	Unselected channel driven with 20mVp-p @ 5MHz	40	45		dB
Output Offset Voltage	V_{OS}		-300	2	+300	mV
RDX,RDY Common Mode Output Voltage	V_{OCM}	Read Mode		$V_{CC}-2.7$		V
Read to Write Common Mode Output Voltage Difference	ΔV_{OCM}		-350	-45	350	mV
Single-Ended Output Resistance	R_{SEO}			22	35	Ω
Output Current	I_O	AC Coupled Load, RDX to RDY	± 1.5			mA

Note 1: Typical values are given at $V_{CC} = 5\text{V}$ and $T_A = 25^\circ\text{C}$.

Note 2: A_V is mask programmable for nominal values of: 150 and 300V/V.

SWITCHING CHARACTERISTICS Recommended operating conditions apply unless otherwise specified; $I_W = 20\text{mA}$, $f_{\text{DATA}} = 5\text{MHz}$, $L_H = 1\mu\text{H}$, $R_H = 30\Omega$, C_L (RDX, RDY) $\leq 20\text{pF}$ (see Figure 1).

PARAMETER	SYM	CONDITIONS	MIN	TYP (Note 1)	MAX	UNITS
R/W Read to Write Delay	t_{RW}	$\overline{R/W}$ to 90% I_W		0.06	1.0	μs
R/W Write to Read Delay	t_{WR}	$\overline{R/W}$ to 90% of 100mV, 10MHz read signal envelope		0.15	1.0	μs
\overline{CS} Unselect to Select Delay	t_{IR}	\overline{CS} to 90% I_W or 90% of 100mV, 10MHz read signal envelope		0.23	0.6	μs
\overline{CS} Select to Unselect Delay	t_{RI}	\overline{CS} to 10% of I_W		0.02	0.6	μs
HS0, 1, any Head Delay	t_{HS}	HS0, 1 to 90% of 100mV, 10MHz read signal envelope		0.23	0.6	μs
WUS Safe to Unsafe Delay	t_{D1}		0.6	2.1	3.6	μs
WUS Unsafe to Safe Delay	t_{D2}				1.0	μs
Head Current Propagation Delay (TD3)	t_{D3}	$L_H = 0$, $R_H = 0$, from 50% points		12	30	ns
Head Current Asymmetry	ASYM	50% duty cycle on WDI, 1ns rise/fall time; $L_H = 0$, $R_H = 0$		0.04	0.5	ns
Head Current Rise/Fall Time	t_r / t_f	10% to 90% points				ns
		$L_H = 0$, $R_H = 0$		2	5	
		$L_H = 1\mu\text{H}$, $R_H = 30\Omega$		12	16	

Note 1: Typical values are given at $V_{CC} = 5\text{V}$ and $T_A = 25^\circ\text{C}$.

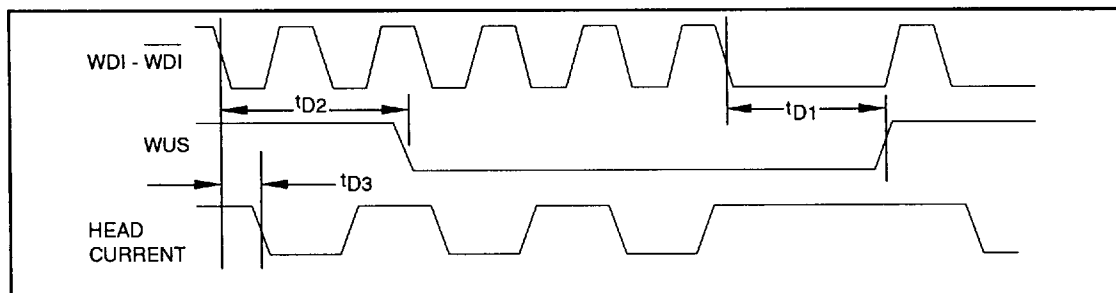


Figure 1: Write Mode Timing Diagram