

VM326

10-CHANNEL, HIGH-PERFORMANCE, THIN-FILM HEAD, READ/WRITE PREAMPLIFIER

July, 1992

FEATURES

- · High Performance:
 - Read mode gain = 150V/V
 - Low input noise = 0.8nV/√Hz maximum
 - Input capacitance = 30pF maximum
 - Write current range = 10mA to 40mA
 - Head inductance range = 200nH to 3µH
 - Head voltage swing = 5.5Vp-p minimum
 - Write current rise time = 5ns
 - Differential ECL write data inputs
- · Low Power Dissipation
- . Enhanced System Write-to-Read Recovery Time
- · Power Supply Fault Protection
- · Schottky Isolated Damping Resistor Standard
- Write Unsafe Detection
- +5V and -5V Power Supply
- Operates Off ±5V Power Supplies

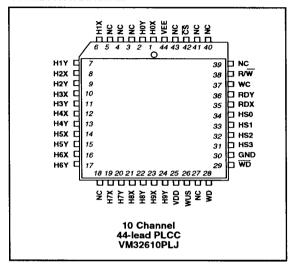
DESCRIPTION

The VM326 is a high-performance, low-power, bipolar monolithic read / write preamplifier designed for use with two-terminal thin-film recording heads. It provides write current control, data protection circuitry and a low-noise read preamplifier for ten channels. When unselected, the device enters a sleep mode, with power dissipation reduced to less than 160 mW. Fault protection is provided so that during power supply sequencing the write current generator is disabled. System write-to-read recovery time is minimized by maintaining the read channel common-mode output voltage in the write mode.

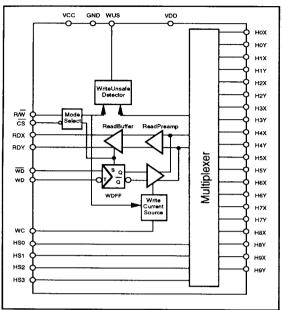
Very low power dissipation from +5V and -5V supplies is achieved through use of high-speed bipolar processing and innovative circuit design techniques. A 400-ohm damping resistor is included on-chip in series with a Schottky diode pair to maintain high input resistance in the read mode.

The VM326 is available in a variety of package configurations including a mirror-image pinout to facilitate multiple device applications. Channel count options are available in 2, 4, 6, 8, 9 and 10 channels in a variety of packages. Please consult VTC for all packaging options.

CONNECTION DIAGRAM



BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

| Power Supply: | |
|---|-------------------------------|
| V _{DD} | 0.3V to +7V |
| V _{EE} | 0.3V to -7V |
| Write Current I _W | |
| Input Voltages: | |
| Digital Input Voltage V _{IN} 0.3 | V to (V _{DD} + 0.3)V |
| Head Port Voltage VH (VFF -0.3 |) to (V _{DD} + 0.3)V |
| WUS Pin Voltage Range Vwus | 0.3V to +14V |
| Output Current: | |
| RDX, RDY: I _O | 10mA |
| WUS: I _{WUS} | |
| Junction Temperature | 150°C |
| Storage Temperature T _{stg} | |
| Thermal Characteristics, Θ_{JA} : | |
| 44-lead PLCC | 60°C/W |
| | |

RECOMMENDED OPERATING CONDITIONS

| DC Power Supply Volta | ge: | |
|-----------------------|---|--------------|
| V _{DD} | | +5V ± 10% |
| V _{EE} | • | 5V ± 10% |
| Junction Temperature | *************************************** | 0°C to 125°C |

CIRCUIT OPERATION

The VM326 addresses ten two-terminal thin film heads, providing write drive or read amplification. Head selection and mode control are accomplished with pins HSn, $\overline{\text{CS}}$ and R/W, as shown in Tables 1 & 2. Internal resistor pullups provided on pins CS and R/W will force the device into a non-writing condition if either control line is opened accidently.

Write Mode

The write mode configures the VM326 as a current switch and activates the Write Unsafe (WUS) detection circuitry. Write current is toggled between the X and Y direction of the selected head on each high-to-low transition of the differential Write Data Inputs (ECL levels).

A preceding read operation initializes the Write data Flip Flop (WDFF) so that upon entering the write mode current flows into the "X" head port.

The write current magnitude is determined by an external resistor connected between the WC pin and VEE. An internally generated 1.71V reference voltage is present at the W/C pin relative to V_{EE} . The magnitude of the write current (0-pk, \pm 8%) is:

$$l_{W} = 1.65 V/ R_{WC}$$

Typically, an adjustment to the calculated head current is required to account for current shunted by the damping resistor. This complication is avoided in the VM326 because the internal damping resistors are series- connected with Schottky diode pairs.

In multiple-device applications, a single R_{WC} resistor may be made common to all devices.

Power supply fault protection improves data security by disabling the write current generator during a voltage fault or power supply sequencing. Additionally, the write unsafe detection circuitry will flag any of the conditions listed below with a high level on the open collector output pin, WUS.

- No write current
- WDI frequency too low
- Open head
- Device in read mode
- Device not selected

Two negative write data transitions, after the fault is corrected, may be required to clear the WUS flag.

Read Mode

The read mode configures the VM326 as a low-noise differential amplifier and deactivates the write current generator and write unsafe detection circuitry. The RDX and RDY outputs are emitter followers and are in phase with the "X" and "Y" head ports. These outputs should be AC coupled to the load. The RDX, RDY common-mode voltage is maintained in the write mode, minimizing the transient between write mode and read mode, substantially reducing the recovery time delay to the subsequent pulse detection circuitry.

Idle Mode

When \overline{CS} is high, virtually the entire circuit is shut down so that power dissipation is reduced to less than 160 mW maximum in *sleep mode*. Multiple devices may have their read outputs wire OR'd together and the write current programming resistor common to all devices.

Table 1: Head Select

| HS3 | HS2 | HS1 | HS0 | HEAD |
|-----|-----|-----|-----|------|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 0 | 2 |
| 0 | 0 | 1 | 1 | 3 |
| 0 | 1 | 0 | 0 | 4 |
| 0 | 1 | 0 | 1 | 5 |
| 0 | 1 | 1 | 0 | 6 |
| 0 | 1 | 1 | 1 | 7 |
| 1 | 0 | 0 | 0 | 8 |
| 1 | 0 | 0 | 1 | 9 |

Table 2: Mode Select

| <u>cs</u> | R/W | MODE |
|-----------|-----|-------|
| 0 | 0 | Write |
| 0 | 1 | Read |
| 1 | Х | ldle |

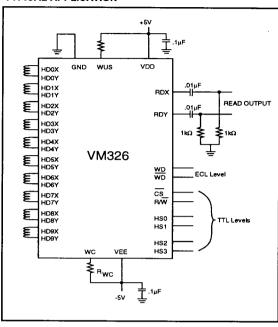
PIN DESCRIPTIONS

| NAME | TYPE | DESCRIPTION |
|------------------------|------------|---|
| HS0-HS3 | * | Head Select: selects one of ten heads |
| cs | 1 | Chip Select: a low level enables the device |
| R/W | 1* | Read/Write: a high level selects Read mode |
| wus | Ŏ* | Write Unsafe: Open collector output, high level indicates an unsafe writing condition |
| WD, WD | i * | Write Data In: a negative transition (WD-WD) toggles the direction of the head current |
| H0X - H9X H0Y - H9Y | 1/0 | X,Y Head Connections |
| RDX, RDY | 0, | X,Y Read Data: differential read data output |
| wc | * | Write Current: used to set the magnitude of the write current |
| GND | - | Ground |
| VDD | - | +5V |
| VEE | • | -5V |

^{*} When more than one R/W device is used, these signals can be wire OR'ed

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TYPICAL APPLICATION



DC CHARACTERISTICS Unless otherwise specified, recommended operating conditions apply.

| PARAMETER | | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|------------------|---|------|-----|---------------------|-------|
| | | Read Mode | | | 31 | |
| VDD Supply Current | מסי | Write Mode | | | 30 + IW | mA |
| | | Idle Mode | | | 12 | |
| | | Read Mode | | | 78 | |
| VEE Supply Current | l _{CC} | Write Mode | | | 57 + I _W | mA |
| | | Idle Mode | | | 16 | |
| | | Read Mode | | 450 | 600 | |
| Power Dissipation (T _{.1} = 125°C) | PD | Write Mode: I _W = 20mA | | 550 | 700 | mW |
| (1) = 125 0) | | Idle Mode | | 95 | 160 | |
| Input Low Voltage | V _{IL} | | | | 0.8 | ٧ |
| Input High Voltage | VIH | | 2.0 | | | ٧ |
| Input Low Current | IIL | V _{IL} = 0.8V | -0.4 | | | mA |
| Input High Current | ЧH | V _{IH} = 2.0V | | | 100 | μА |
| WD, WD Input High Voltage | V _{IH} | ECL | -1.0 | | - 0.7 | ٧ |
| WD, WD Input Low Voltage | V _{IL} | ECL | -1.9 | | - 1.6 | ٧ |
| WD, WD Input High Current | Iн | V _{IH} = - 0.7V | | | 100 | μА |
| WD, WD Input Low Current | Ι _Ι L | V _{IH} = - 1.6V | | | 80 | μА |
| WUS Output Low Voltage | VOL | I _{OL} = 8mA | | | 0.5 | ٧ |
| VDD Fault Voltage | V _{DDF} | | 3.8 | | 4.3 | V |
| VEE Fault Voltage | V _{EEF} | | -4.3 | | -3.8 | ٧ |
| Head Current (Hay Hay) | IH | Write Mode, 0 < V _{CC} ≤ 3.8V 0 < V _{DD} < 9V | -200 | | +200 | μА |
| Head Current (HnX, HnY) | '' | Read / Idle Mode, 0 < V _{CC} < 5.5V -5.5V < V _{DD} < 0 | -200 | | +200 | μ., |

READ CHARACTERISTICS Unless otherwise specified, recommended operating conditions apply C_L (RDX, RDY) < 20pF and R_L (RDX, RDY) = $1k\Omega$.

| PARAMETER | SYM | CONDITIONS | MIN | TYP | MAX | UNITS |
|--------------------------------|------------------|---|------|------|------|--------|
| Differential Voltage Gain | AV | V _{IN} = 1mVp-p @300KHz | 125 | | 175 | V/V |
| Bandwidth | BW | -1dB iZs i < 5Ω V _{IN} = 1mVp-p @300KHz | 25 | | | |
| | DAA | -3dB lZs l < 5Ω V _{IN} = 1mVp-p @300KHz | 45 | | | MHz |
| Input Noise Voltage | e _{in} | BW = 15MHz, L _H = 0, R _H = 0 | | 0.65 | 0.8 | nV/√Hz |
| Differential Input Capacitance | CIN | V _{IN} = 1mVp-p, f = 5MHz | | 23 | 30 | pF |
| Differential Input Resistance | R _{IN} | V _{IN} = 1mVp-p, f = 5MHz (25°C < T _A < 125°C) | 500 | 1000 | | Ω |
| Dynamic Range | DR | AC input voltage where the gain falls to 90% of the gain @ 0.2mVrms input, f = 5MHz | 2 | | | mVrms |
| Common Mode Rejection Ratio | CMRR | V _{IN} = 0VDC + 100mVp-p @5MHz | 54 | * | | dB |
| Power Supply Rejection Ratio | PSRR | 100mVp-p @5MHz on V _{DD} 100mVp-p @5MHz on V _{CC} | 54 | | | dB |
| Channel Separation | cs | Unselected channels driven with 100mVp-p @5MHz Selected Channels V _{IN} = 0mVp-p | 45 | | | dB |
| Output Offset Voltage | vos | | -250 | | +250 | mV |
| RDX,RDY Common Mode | Voor | Read Mode | -2.8 | -2.3 | -2.0 | ., |
| Output Voltage VOCM | Write Mode | -2.8 | -2.3 | -2.0 | V | |
| Single-Ended Output Resistance | R _{SEO} | f = 5MHz | | | 30 | Ω |
| Output Current | 0 | AC Coupled Load, RDX to RDY | 3.2 | | | mA |

WRITE CHARACTERISTICS Unless otherwise specified, recommended operating conditions apply, $l_W = 20 mA$, $L_H = 1.0 \mu H$, $R_H = 30 \Omega$ and $f_{DATA} = 5 MHz$.

| PARAMETER | SYM | CONDITIONS | MIN | TYP | MAX | UNITS |
|---------------------------------|-----------------|-----------------------------------|-----|------|-----|--------|
| WC Pin Voltage | Vwc | | | 1.71 | | V |
| Differential Head Voltage Swing | V _{DH} | I _W = 40mA | 5.5 | | | Vp-p |
| Unselected Head Current | luH | | | | 1 | mA(pk) |
| Differential Output Capacitance | COUT | | | | 25 | pF |
| Differential Output Resistance | ROUT | | 3.2 | | | kΩ |
| WDI Transition Frequency | fDATA | WUS = Low | 1.7 | | | MHz |
| Write Current Range | lw | 41.25Ω < R _{WC} < 165Ω | 10 | | 40 | mA |
| Write Current Tolerance | ΔlW | I _W range 10mA to 40mA | -8 | - | +8 | % |

SWITCHING CHARACTERISTICS (See Figure 1) Unless otherwise specified, recommended operating conditions apply, $I_W = 20mA$, $L_H = 1.0\mu H$, $R_H = 30\Omega$ and $f_{DATA} = 5MHz$.

| PARAMETER | SYM | CONDITIONS | MIN | TYP | MAX | UNITS |
|---------------------------|--------------------------------|--|-----|-----|-----|-------|
| Read to Write Mode | tRW | Delay to 90% of write current | | | 0.6 | μs |
| R/W to Read Mode | twR | Delay to 90% of 100mV, 10MHz Read Signal envelope or to 90% decay of write current | | | 0.6 | μѕ |
| CS to Select | tIR | Delay to 90% of write current or to 90% of 100mV, 10MHz Read signal envelope | | | 0.6 | μs |
| CS to Unselect | t _{IW} | Delay to 10% of write current | | | 0.6 | μs |
| HS0, 1, 2, 3, to Any Head | tHS | Delay to 90% of 100mV, 10MHz Read signal envelope | | | 0.4 | με |
| Safe to Unsafe | t _{D1} | 50% WDI to 50% WUS | 0.6 | | 3.6 | μs |
| Unsafe to Safe | t _{D2} | 50% WDI to 50% WUS | | | 1 | μs |
| Prop. Delay | t _{D3} | From 50% points, $L_H = 0$, $R_H = 0$ | | | 32 | ns |
| Asymmetry | ASYM | WDi has 50% duty cycle & 1ns rise/fall time, L _H = 0, R _H = 0 | | | 1 | ns |
| Rise / Fall Time | t _r /t _f | 10%-90% points, I _W = 20mA L _H = 0, R _H = 0 | | | 5 | ns |
| Rise/Fall Time | t _r /t _f | 10%-90% points, $I_W = 20 \text{mA}$ $L_H = 600 \text{nH}, R_H = 20 \Omega$ | | | 12 | ns |

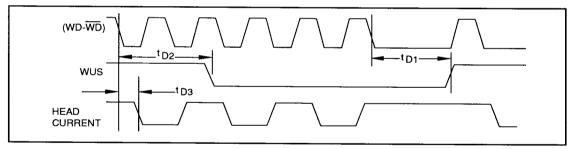


Figure 1: Write Mode Timing Diagram