VTC Inc.
Value the Customer™

VM8001
LASER POWER AMPLIFIER

PRELIMINARY July, 1993

FEATURES
- High-Performance Integrated Circuit for Laser Diode Drive and Power Monitoring
- Single +5-Volt Supply
- Voltage-Controlled Read and Write Currents from 10 to 100 mA
- 4 ns Rise and Fall Write Current Pulses With Only 3% Overshoot
- Laser Diode Protection Including Current Shunt and Negative Voltage Clamp
- Power Supply Fault Protection
- Laser Diode Power Sense Amplifier With Two Transimpedance Levels Compatible With Read and Write Modes
- Two External Resistors to Set Read and Write Transconductance and Sense Amplifier Transimpedance
- Packaged in 20-lead PLCC

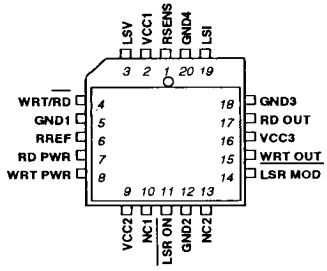
DESCRIPTION
The VM8001 is a laser power amplifier that provides DC read current and pulsed write/erase current to a common-cathode laser diode at output pins RD OUT and WRT OUT, respectively. Separate pins are provided so the read output may be inductively isolated from the write output and the laser diode. The levels of these currents are individually set by analog voltages in the range of 0V to 5V at the WRT PWR and RD PWR pins. Write output pulses are achieved by a TTL signal at the $\overline{\text{LSR MOD}}$ pin. Power-down of the read and write outputs, as well as application of an internal current sink at the WRT OUT pin, occur when the $\overline{\text{LSR ON}}$ TTL input is taken high or when the power supply voltage falls below about 4V. Laser diode protection is also provided by the fact that $\overline{\text{LSR ON}}$ and $\overline{\text{LSR MOD}}$ both float high in the event of a broken connection, thus turning off READ and/or WRITE currents. Also, WRT PWR and RD PWR float low, thus disabling output currents if these connections are broken.

Additionally, the VM8001 contains sense circuitry that produces an output voltage at LSV proportional to an input current at LSI from a laser power monitor photodiode. Two values of transimpedance for the sense circuitry are available, selected by TTL input WRT/$\overline{\text{RD}}$.

Two external resistors, RSENS and RREF, are used to accurately set the transimpedance of the sense circuitry and the transconductance of the write and read stages, respectively. WRT OUT and RD OUT currents vary inversely with the value of RREF, while the transimpedance of the sense amplifier tracks the value of RSENS directly. RSENS and RREF can vary up to ±25% from nominal value.

Please consult VTC for package options and availability.

CONNECTION DIAGRAM



20-lead PLCC

ABSOLUTE MAXIMUM RATINGS

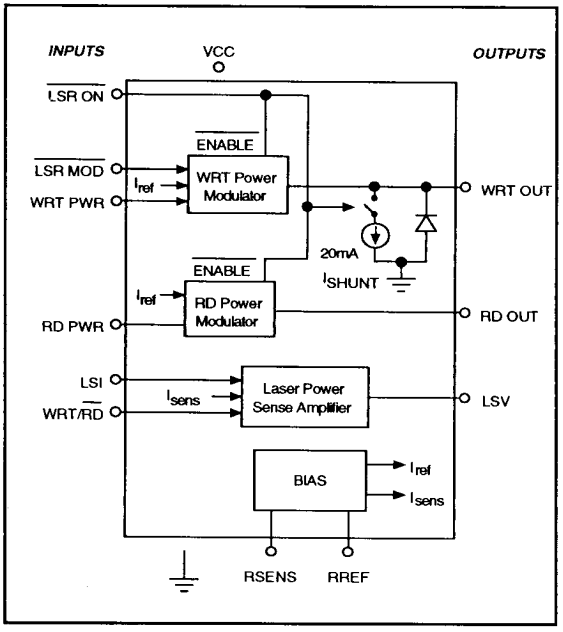
Supply Voltage, V_{CC}	-0.5V to 6V
Voltage Applied to:	
TTL Input	-0.5V to V_{CC} + 0.5V
WRT PWR	-0.5V to V_{CC} + 0.5V
RD PWR	-0.5V to V_{CC} + 0.5V
LSI	-0.5V to 2.5V
WRT OUT	-0.5V to V_{CC} + 0.5V
RD OUT	-0.5V to V_{CC} + 0.5V
Voltage Applied to LSV Pins	-0.5V to V_{CC} + 0.5V
Power Dissipation (maximum)	1000mW
Storage Temperature	-65° to +150°C
Junction Temperature	0° to 150°C
Thermal Resistance, Θ_{JA}	75°C/W

RECOMMENDED OPERATING CONDITIONS

Supply Voltage V_{CC}	+4.75V to +5.25V
Operating Ambient Temperature	0° to 70°C
Operating Junction Temperature	0° to 125°C
Reference Resistor	8 to 12.5 kΩ
Sense Gain Resistor	8 to 12.5 kΩ
Write Current	0 to 100 mA
Read Current	0 to 100 mA
RD OUT and WRT OUT Applied V	1.4V to 2.5V
RD PWR and WRT PWR Input Range	0V to 5V

OPTICAL CIRCUITS

BLOCK DIAGRAM

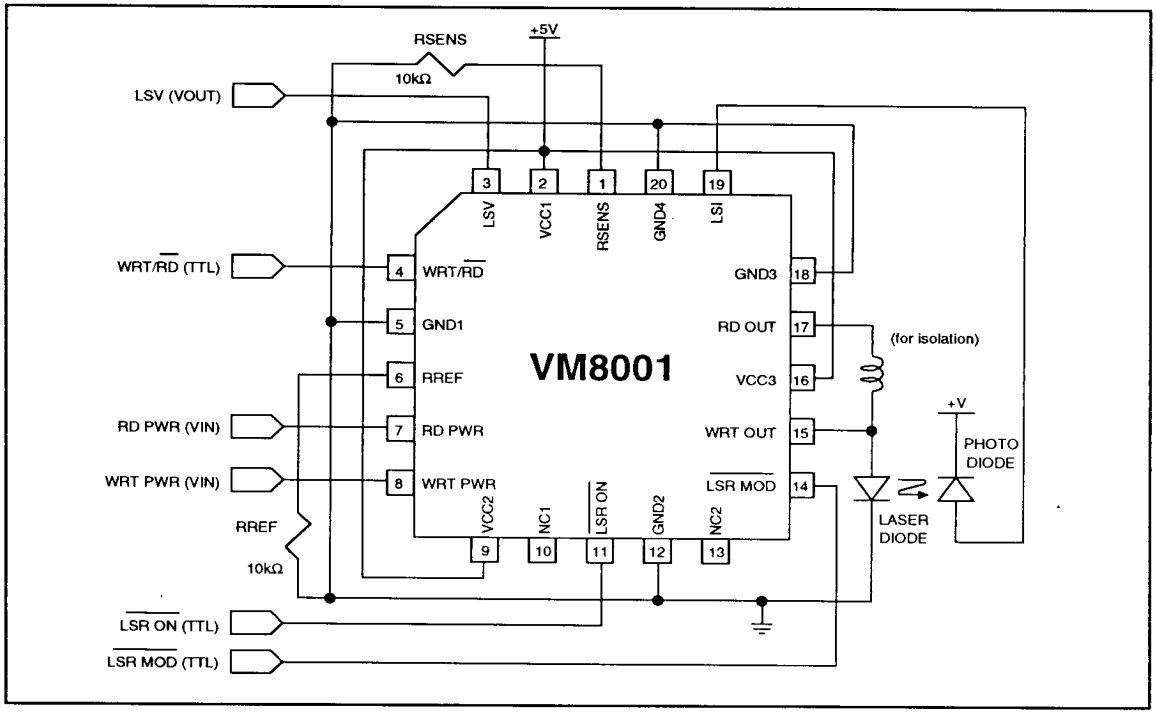


PIN DESCRIPTIONS

NAME	TYPE	DESCRIPTION
$\overline{\text{LSR MOD}}$	I	Laser Modulation. This TTL input provides digital control of the current used to write data bits on the media. When $\overline{\text{LSR MOD}}$ is in the low state, current from the WRT OUT pin is enabled to flow into the laser diode.
$\overline{\text{LSR ON}}$	I	Laser On. This TTL input provides protection for the laser diode system during power up. When $\overline{\text{LSR ON}}$ is in the high state or an open circuit, the WRT OUT output is shunted to ground by an internal 20 mA current and the outputs WRT OUT and RD OUT are disabled.
WRT/$\overline{\text{RD}}$	I	Write/Not Read. This TTL input provides digital control of the gain of the laser sense amplifier. When WRT/$\overline{\text{RD}}$ is in the low state, read mode gain is selected and when WRT/$\overline{\text{RD}}$ is in the high state, write mode gain is selected.
WRT PWR	I	Write Power. This input is a DC coupled, quasi static analog signal which controls the peak-to-peak analog level of modulation for the WRT OUT current output signal during write and erase operations. The value of transconductance is controlled by the value of the external resistor from the RREF pin to GND.
RD PWR	I	Read Power. This input is a DC coupled, quasi static analog signal which controls the static analog level for the RD OUT current output signal during read mode. The value of transconductance is controlled by the value of the external resistor from the RREF pin to GND.
LSI	I	Laser Sense Current. This input is a positive unipolar DC-coupled analog current provided directly from the laser power photodiode detector.
RREF	—	A resistor connected between the RREF pin and GND controls the value of transconductance in the Write and Read Power Modulators. The transconductance value varies inversely with the value of the resistor.
RSENS	—	A resistor connected between the RSENS pin and GND controls the value of transimpedance of the Laser Power Sense Amplifier. The transimpedance value varies directly with the value of the resistor.
WRT OUT	O	Write Current Output. A high-speed current pulse is sourced from this pin to drive the laser power to a write or erase level. The magnitude of the current is set by the voltage level at the WRT PWR input pin. Output current pulses are enabled by a low logic level at the $\overline{\text{LSR MOD}}$ input pin. Laser protection at the WRT OUT pin includes the reverse voltage clamp diode and current shunt enabled by either a logic high at the $\overline{\text{LSR ON}}$ pin or a supply fault condition (see Block Diagram).
RD OUT	O	Read Current Output. A DC read current is sourced from this pin to drive the laser power to a read level. The magnitude of the current is set by the voltage level at the RD PWR input pin.
LSV	O	Laser Sense Voltage Output. This output is an analog voltage which is proportional to the current into the Laser Sense Current (LSI) pin.
VCC1 - 3	—	+5V power supply pins.
GND1 - 4	—	Device ground pins.

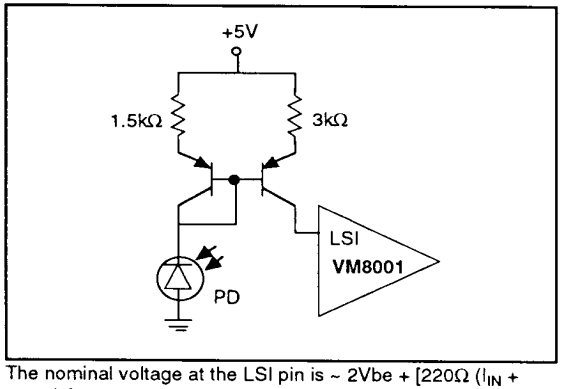
OPTICAL CIRCUITS

TYPICAL APPLICATION



USE OF THE VM8001 WITH A COMMON ANODE PHOTODIODE

The VM8001 provides the LSI input to sense current from a photodiode and provides feedback to the laser amplifier. The configuration this was designed for was for the current from the photodiode to flow into the LSI pin. Some photodiode and laser diode parts are built with a common anode that prevents this configuration from being realized. It is possible to use a couple external transistors to build a current mirror and use these assemblies. A circuit that has been found to work is given below.



The nominal voltage at the LSI pin is ~ 2Vbe + [220Ω (I_{IN} + 200μA)].

ELECTRICAL CHARACTERISTICS: Unless otherwise specified, the following apply over the recommended operating ranges. All voltages are measured with respect to GND and positive current flows into the device pin.

PARAMETER	*SYM*	*CONDITIONS*	*MIN*	*TYP*	*MAX*	*UNITS*
VCC Fault Voltage	V_{CCF}	(note 1)	3.8	4.1	4.35	V
Power Supply Current	I_{CC}	WRT PWR = RD PWR = 5V, V_{CC} = 5.25V, R_{REF} = R_{SENS} = 10K		240	275	mA
		WRT PWR = RD PWR = 0V		20	30	
Digital Input Signals ($\overline{\text{LSR MOD}}$, $\overline{\text{LSR ON}}$, WRT/$\overline{\text{RD}}$ pins):						
Input Low Voltage	V_{IL}				0.8	V
Input High Voltage	V_{IH}		2.0			V
Input Low Current	I_{IL}	V_I = 0.8V, V_{CC} = 5.25V	-200			µA
Input High Current	I_{IH}	V_I = 2.7V, V_{CC} = 5.25V		0	20	µA
		V_I = 5.25V, V_{CC} = 5.25V		0	1000	
Open Input	V_{OPEN}		2			V
External Resistors:						
RREF Bias Voltage	V_{RREF}			2.5		V
RSENS Bias Voltage	V_{RSENS}			2.5		V
RREF Gain Scale (note 2)	GS	R_{REF} = 8.0K	22	25	28	%
		R_{REF} = 12.5K	-22	-20	-18	
RSENS Gain Scale (note 2)	GS	R_{SENS} = 8.0K	-22	-20	-18	%
		R_{SENS} = 12.5K	22	25	28	
Laser Sense Amplifier Input (LSI pin):						
Input Signal Range	I_{LSI}	WRT/$\overline{\text{RD}}$ = High	0	360	1200	µA
		WRT/$\overline{\text{RD}}$ = Low	0	65	200	
Input Bias Voltage	V_{LSI}	I_{LSI} = 1200µA		1.8	2	V
Input Impedance	Z_{LSI}	I_{LSI} = 0		480		Ω
		I_{LSI} = 1200µA		260	400	
Input Capacitance	C_{LSI}			5		pF

Note 1: When $V_{CC} < V_{CCF}$ WRT OUT and RD OUT are off and WRT OUT is pulled toward ground with an internal current sink.
Note 2: Relative to gain at $R_{REF} = R_{SENS}$ = 10kΩ.

ELECTRICAL CHARACTERISTICS (continued): Unless otherwise specified, the following apply over the recommended operating ranges. All voltages are measured with respect to GND and positive current flows into the device pin.

PARAMETER	*SYM*	*CONDITIONS*	*MIN*	*TYP*	*MAX*	*UNITS*
Laser Sense Amplifier Output (LSV pin):						
Max Output Voltage	V_{MAX}	I_{LOAD} = -2mA, V_{CC} = 4.75V	3.7	3.85		V
Offset Voltage	V_{MIN}	I_{LOAD} = 2mA, R_{SENS} = 10K, T_A = 25°C	100	200	300	mV
Offset Voltage Drift	T_{CVMIN}	I_{LOAD} = 2mA, R_{SENS} = 10K	-250		250	µV/°C
Output Linearity	V_{LIN}	Best fit method	-1	0.25	1	%
Output Impedance	Z_{OUT}	I_{LOAD} = ±2mA		0.5		Ω
Current Drive	I_{OUT}	V_{OUT} VMIN to VMAX	-2		+2	mA
Output Noise Voltage	e_{OUT}	BW = 3.5MHz		0.7	10	mV RMS
Slew Rate	SR	R_{LOAD} = 2K to GND	10	15		V / µS
Laser Sense Amplifier:						
Transimpedance	R_m	WRT/$\overline{RD}$ = High, T_A = 25°C	2.4	2.65	2.9	kΩ
		WRT/$\overline{RD}$ = Low, T_A = 25°C	14.3	15.9	17.5	
Transimpedance Drift	TCR_m		-400		400	ppm/°C
Bandwidth	BW	-3dB point	3	8		MHz
Peaking	PKNG			1.3	3	dB
Output Recover Time	RCVRY	WRT/$\overline{RD}$ H - L and L - H, Output settling to ±20mV		260	500	ns
Laser Current Amplifier Inputs (RD PWR and WRT PWR pins):						
Input Resistance	R_{IN}		18	24		kΩ
Input Bias Current	I_{IB}	V_{IN} = 5V		0.2	0.28	mA
Input Capacitance	C_{IN}			2		pF
Bandwidth	BW	V_{IN} = 3V	2	5		MHz
Laser Current Amplifier Output (RD OUT pin):						
Output Current	I_{OUT}	RD PWR = 0.5V, T_A = 25°C, RREF = 10K	-12	-10	-8	mA
		RD PWR = 5V, T_A = 25°C, RREF = 10K	-110	-100	-90	
Output Current Drift	TCI_{OUT}	RD PWR = 5V, RREF = 10K	-100		100	µA/°C
Output Current Linearity	I_{LIN}	RD PWR 0.5V to 5V (best fit method)	-1		1	%
Output Off Current	I_{OFF}	RD PWR open	-3	0	+3	mA
		RD PWR = 5V, $\overline{LSR\ ON}$ = High	-10	0	10	µA
	I_{OFFPSF}	V_{CC} = 3.8V, RD_PWR = WRT_PWR = 4V	-10	0	10	µA
Output Resistance	R_{OUT}	RD PWR = 5V	275	350		Ω
Output Capacitance	C_{OUT}			TBD		pF

ELECTRICAL CHARACTERISTICS (continued): Unless otherwise specified, the following apply over the recommended operating ranges. All voltages are measured with respect to GND and positive current flows into the device pin.

PARAMETER	*SYM*	*CONDITIONS*	*MIN*	*TYP*	*MAX*	*UNITS*
Laser Current Amplifier Output (WRT OUT pin):						
Output Current	I_{OUT}	WRT PWR = 0.5V, T_A = 25°C, R_{REF} = 10K	-12	-10	-8	µA
		WRT PWR = 5V, T_A = 25°C, R_{REF} = 10K	-110	-100	-90	
Output Current Drift	TCI_{OUT}	WRT PWR = 5V, R_{REF} = 10K	-100		100	µA/°C
Output Current Linearity	I_{LIN}	WRT PWR 0.5V to 5V Best fit method	-1		1	%
Output Off Current	I_{OFF}	WRT PWR open	-3	-0.2	+3	mA
		WRT PWR = 5V, $\overline{\text{LSR ON}}$ = High	-3	-0.2	+3	
Current Shunt	I_{SHUNT}	$\overline{\text{LSR ON}}$ = High, WRT OUT = 1V	5	20		mA
		V_{CC} = 3.8V, WRT OUT = 1V	4	20		
		V_{CC} = 1.8V, WRT OUT = 1V	1	2.5		mA
Negative Voltage Clamp	V_{CLAMP}	$\overline{\text{LSR ON}}$ = High, -15mA at WRT OUT	-1.5	-1.0		V
Output Resistance	R_{OUT}	WRT PWR = 5V, DC	275	350		Ω
Output Capacitance	C_{OUT}			TBD		pF
Output Current Rise Time	t_r	WRT PWR = 5V	2	4	7	ns
Output Current Fall Time	t_f	WRT PWR = 5V	2	4	7	ns
Output Current Overshoot	OS	WRT PWR = 5V	-10	3	10	%
Output Pulse Prop Delay	t_{PD}	$\overline{\text{WRT PWR}}$ = 5V, Measure from $\overline{\text{LSR MOD}}$ edges		6	10	ns
Clamp On Prop Delay	t_{PD}	Measure from $\overline{\text{LSR ON}}$ L-H to write waveform decay 90% complete		40	100	ns
Clamp Off Prop Delay	t_{PD}	Measure from $\overline{\text{LSR ON}}$ H-L to write waveform 90% complete, $\overline{\text{WRT PWR}}$ = 5V		450	1000	ns
		Measure from $\overline{\text{LSR ON}}$ H-L to write waveform 90% complete, WRT PWR = 0.5V		2	5	µS