ML4632

Fiber Optic LED Driver

GENERAL DESCRIPTION

The ML4632 is a fiber optic LED driver suited for network applications up to 20Mbps. The part is capable of driving up to 100mA of current through a Fiber Optic LED from an ECL or TTL level input signal. Its efficient output stage provides a high current that can be programmed for accurate absolute output level as well as automatic temperature compensation. The combination of automatic temperature compensation and a highly accurate current driven design insures precise launch power.

The LED driver's output stage provides fast, well matched rise and fall times through a unique class B output stage that burns supply current only when the LED is on. A positive temperature coefficient of up to 3300ppm/°C can be programmed into the output current to compensate for the negative temperature coefficient of the LED optical output power. An optional peaking circuit may also be employed.

The ECL and TTL inputs are ANDed so one can be used for data and the other for an enable input. An ECL compatible BIAS voltage is also provided for single ended ECL applications.

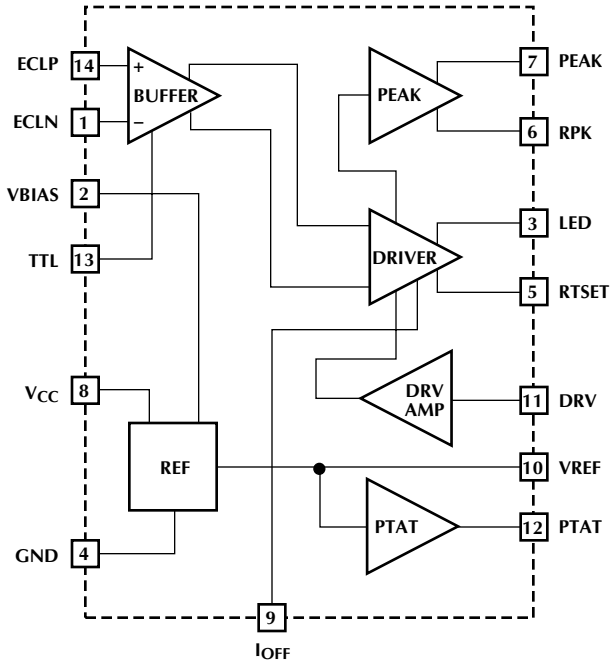
FEATURES

- Current Driven Output for accurate Launch Power
- Programmable output current from 20mA to 100mA
- Programmable temperature coefficient, 0 to 3300ppm/°C
- High Efficiency Output Stage
- Programmable LED pre-bias current
- Low EMI/RFI Noise
- ECL or TTL inputs
- Optional Peaking circuit

APPLICATIONS

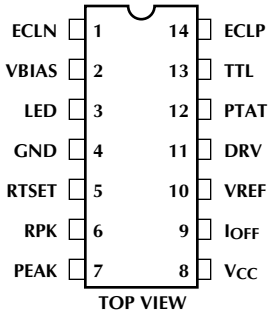
- IEEE 802.3, 10BASE-F
- IEEE 802.5 Fiber Optic Token Ring
- IEEE 802.4 Fiber Optic Token Bus
- Fiber Optic Data Communications and Telecommunications

BLOCK DIAGRAM



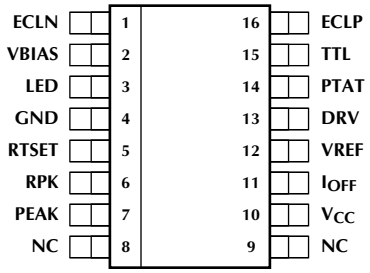
PIN CONFIGURATION

ML4632
14-Pin PDIP (P14)



TOP VIEW

ML4632
16-Pin Wide SOIC (S16W)



TOP VIEW

PIN DESCRIPTION

NAME	FUNCTION
ECLN	Negative ECL data input. Tie to VBIAS for single ended ECL operation or when ECLP is used as an enable. Tie to ground during TTL only operation.
VBIAS	BIAS voltage for single ended ECL operation.
LED	Fiber optic LED drive pin. Connect the LED between this pin and V_{CC}.
GND	Negative power supply. The pin should be tied to the grounded side of RTSET to improve output accuracy and avoid a ground loop.
RTSET	Output current programming pin. Connect a resistor of value V_{DRV}/I_{LED} from this pin to ground to set the high LED output current.
RPK	Peaking circuit bias pin. Connect a resistor of value V_{DRV}/I_{PEAK} from this pin to ground when using the peaking circuit. Leave open circuited when peaking is not used.
PEAK	Peaking circuit output pin. When using peaking, connect this pin to V_{CC} through a resistor of value RRPK. Then connect a capacitor from this pin to the LED cathode. When peaking is not used, open circuit RPK.

NAME	FUNCTION
V_{CC}	Positive power supply. +5 volts.
I_{OFF}	Connect a resistor from this pin to V_{CC} to increase the off current to the LED, i.e. 4.3KΩ for 1mA. With this pin open, the default I_{OFF} current is between 0.5–1.0mA.
VREF	A constant 1.2V reference output used to set up DRV.
DRV	A DC input that sets the positive swing on RTSET and the high level output current to the LED.
PTAT	Proportional to Absolute Temperature. A 1.0V reference at 25°C that moves proportional to absolute temperature, also used to set up DRV. (See figure 1)
TTL	TTL data input. Can also be used as an enable during ECL operation. TTL = High (enabled), TTL = Low (disabled).
ECLP	Positive ECL data input controls signal to the LED. Tie to VBIAS during TTL only operation or use as an enable.

ABSOLUTE MAXIMUM RATINGS

Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

V_{CC} ..... –0.3V to 6V
Input Pin Voltages ..... –0.3V to V_{CC} +0.3V
LED Output Current 120mA
PEAK DC Output Current 120mA
Storage Temperature ..... –65°C to +150°C
Lead Temperature (Soldering 10 sec.) ..... 260°C

ELECTRICAL CHARACTERISTICS

Over the recommended operating conditions of T_A = 0°C to 70°C, V_{CC} = 5V ±5%, unless otherwise specified. (Note 1)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
I_{CC}	Supply Current	LED off		25	35	mA
VREF	VREF Voltage	No Load	1.14	1.20	1.26	V
V_{PTAT}	PTAT Voltage	No Load, T_A = 25°C T_A = 85°C	0.9 1.08	1.0 1.2	1.1 1.32	V V
V_{OS}	Driver Offset	VDRV = 1.2V, RTSET = 20Ω			50	mV
 I_{LEDH} I_{LEDL}	LED Current Accuracy High Low	VDRV = VREF, RTSET = 20Ω I_{OFF} = open	 54 0.5	 60 0.7	 66 1.0	 mA mA
t_R	Rise Time	VDRV = VREF, RTSET = 20Ω		4.5		ns
t_F	Fall Time	VDRV = VREF, RTSET = 20Ω		4.5		ns
 t_{PLH} t_{PHL}	Propagation Delay Low to High High to Low	VDRV = VREF, RTSET = 20Ω TTL and ECL		 10.0 10.0		 ns ns
t_{PWD}	Pulse Width Distortion	VDRV = VREF, RTSET = 20Ω		1.0	2.0	ns
V_{PK}	Peaking Voltage	R_{RPK} = 20Ω, C_{PK} = 100pF, R_{PEAK} = 20Ω	1.08	1.2	1.32	V
V_{PKTR}	Peaking Rise Time	R_{RPK} = 20Ω, C_{PK} = 100pF, R_{PEAK} = 20Ω		4.5		ns
V_{PKTF}	Peaking Fall Time	R_{RPK} = 20Ω, C_{PK} = 100pF, R_{PEAK} = 20Ω		4.5		ns
I_{ECL}	ECL Input Current				20	µA
I_{TTL}	TTL Input Current				100	µA
V_{DO}	Dropout Voltage between pin 5 and 3		1.5			V
I_{OFF}	Additional LED Off Current	V_{CC} = 5V, R_{IOFF} = 4.3KΩ	0.8	1.0	1.2	mA
VBIAS	ECL BIAS Voltage	V_{CC} = 5V, T_A = 25°C		3.8		V

Note 1: Limits are guaranteed by 100% testing, sampling or correlation with worst-case test conditions.
Note 2: Low Duty cycle pulse testing is performed at T_A.

FUNCTIONAL DESCRIPTION

The ML4632 accepts ECL and TTL input signals and generates a high speed, high accuracy output current which is independent of supply voltage variations. The output current is programmable from 20mA to 100mA. A temperature coefficient can be programmed into the output current and a peaking circuit can be added with a few external components.

The input of the LED driver accepts both ECL and TTL signals. The ECL input stage is a standard NPN differential pair with a common mode range of between 3V and 4.5V with a +5V supply. A bias voltage VBIAS is available for biasing either ECL input for single-ended operation. The TTL input has a standard switching range of between 0.8V and 2.0V. These inputs are ANDed so that the extra input can be used as an enable.

Output current to the LED is set by connecting the appropriate resistance from RTSET to ground. With the VREF and DRV pins tied together, the high level output voltage at RTSET will be 1.2V. The current through the LED. The output current with RTSET set to 20Ω will be

$$I_{LED}\ (HIGH) = 1.2V/R_{TSET} = 1.2V/20\Omega = 60mA.$$

The low level output current is set internally by a resistor at approximately 0.7mA. This current prebiases the LED and results in faster optical rise times. The value of this current can be increased by connecting a resistor from the I_{OFF} pin to V_{CC}. The additional current will be equal to $(V_{CC} - 0.7V)/R_{IOFF}$.

The voltage input at the DRV pin appears across the RTSET pin when the LED is turned on. The current in RTSET is directed through the LED. Therefore the voltage set at DRV along with the RTSET resistor sets current through the LED.

A temperature coefficient of between 0ppm/°C and 3300ppm/°C can be programmed into the high level output current to compensate for the drop in LED optical output power at high temperatures. This is accomplished by driving the DRV pin from a resistor divider between the VREF and PTAT pins.

When DRV is tied directly to PTAT, the peak voltage at RTSET will be 1.0V at 25°C and have a 3300ppm/°C temperature coefficient. At 85°C, PTAT is 1.2V and equal to VREF. An arbitrary temperature coefficient less than 3300 ppm/°C can be set by using a resistor divider between PTAT and VREF to set the voltage at DRV, as shown in figure 1.

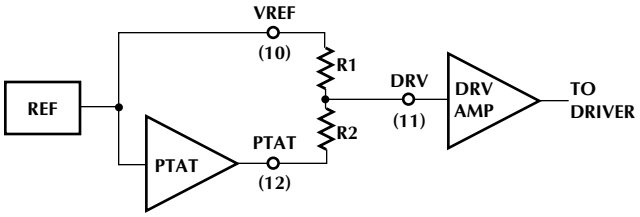


Figure 1. Current for Programming Output Temperature Coefficient

In this configuration the temperature coefficient is

$$TC_{ILED} = (3300ppm/°C)\frac{R1}{R1+R2}, \text{ and}$$

$$I_{LED\ (HIGH)} = \frac{1V + 0.2V\left(\frac{R2}{R1+R2}\right)}{RTSET}$$

The output current will be a linear function of temperature. A plot of I_{LED} versus temperature for several values of the programming resistance, R1 and R2, in figure 2.

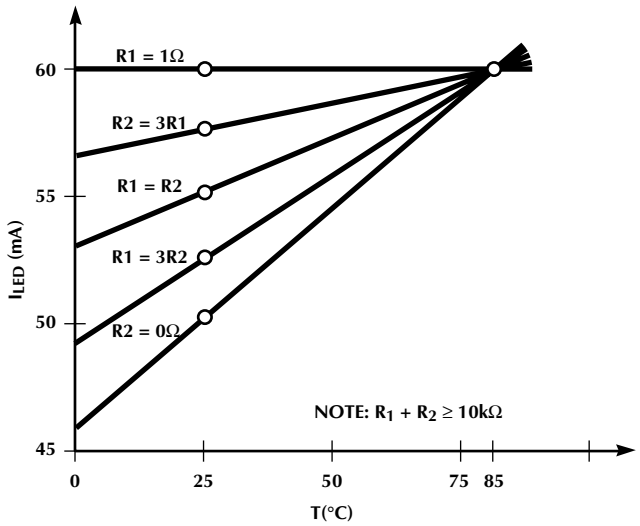


Figure 2. I_{LED} vs T, R_{TSET} = 20Ω

The ML4632 output stage conducts full load current only when the LED is on, and even then power dissipation in the part is low because most of the +5V supply voltage is dropped across the LED and external resistor R_{TSET}. Even with a low power design, the LED driver junction temperature will rise above ambient due to quiescent power dissipation and won't exactly match the LED junction temperature since it is also self-heating. Therefore, the effectiveness of a temperature compensated design will be related to component power dissipations, thermal conductance of the PC board and packaging, and the proximity of the LED driver to the LED.

The ML4632 also provides for peaking of the LED output current. Peaking is used to counteract the effects of the LED junction capacitance. By creating a controlled overshoot and undershoot in the output current waveform, charge is transferred to and from the LED capacitance on the rising and falling edges of the output, speeding up rise and fall times.

To provide peaking current, a second output stage is biased up with a resistor from RPK to ground and another from PEAK to V_{CC}. When these bias resistors are set equal to each other, a pulse will be generated across the R_{PEAK} resistor with a magnitude equal to the voltage on the DVR pin. A coupling capacitor transfers the rising and falling edges of the output current waveform.

A typical application is shown in figure 3. When the resistors R_{RPK} and R_{PEAK} are both set to 20Ω, a pulse will be generated at the PEAK pin of magnitude 1.2V and equivalent resistance 20Ω (assuming V_{DRV} = 1.2V).

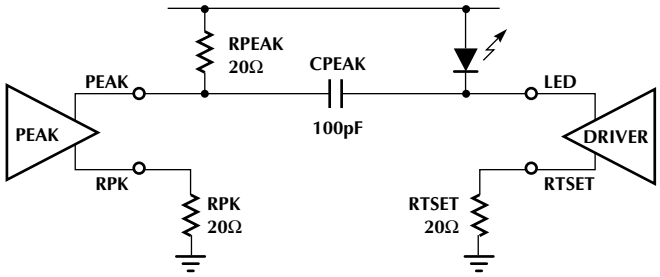
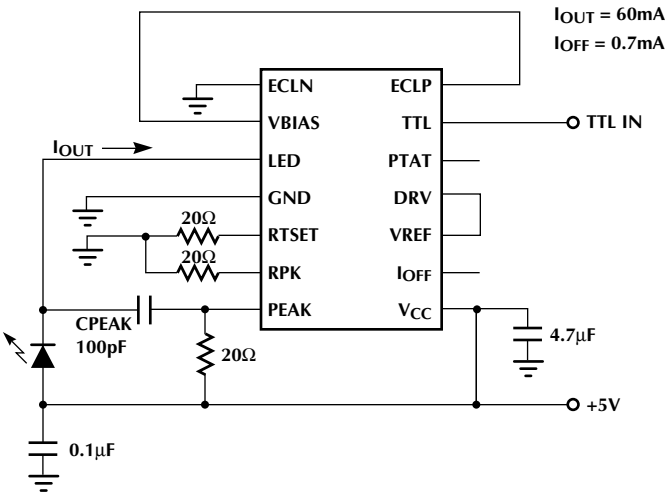


Figure 3. Application of the Peaking Circuit

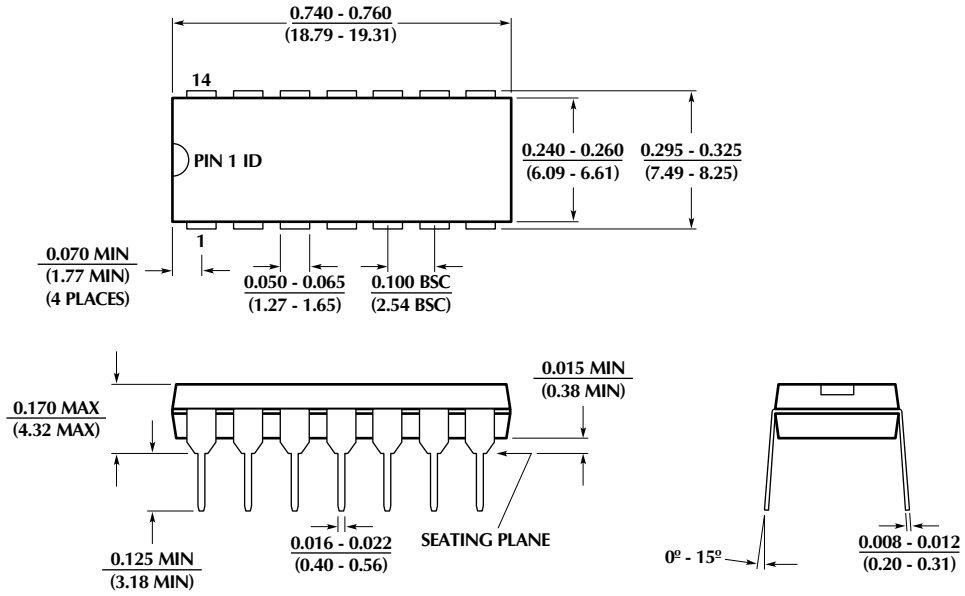
The peaking current is coupled through the 100pF capacitor, C_{PEAK}, which will transfer 120pC of charge to and from the LED on each cycle of output current. The peaking circuit shown provides approximately a 70% overshoot current into a 0Ω LED impedance. Peaking currents will be slightly lower for real LED's.



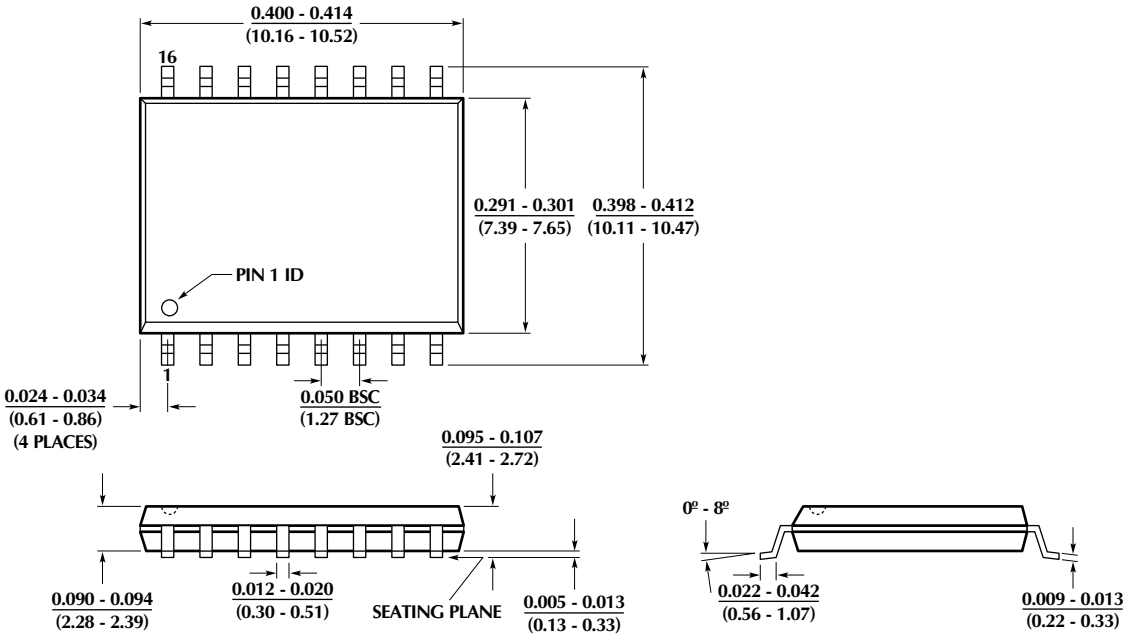
Note: The LED, PEAK and V_{CC} traces should be very short and shielded with a GND plane to reduce ringing and overshoot at the LED.

TTL Driven Implementation
(No Temp. Comp)

Package: P14
14-Pin PDIP



Package: S16W
16-Pin Wide SOIC



ORDERING INFORMATION

PART NUMBER	TEMPERATURE RANGE	PACKAGE
ML4632CP	0°C to 70°C	14-Pin PDIP (P14)
ML4632CS	0°C to 70°C	16-Pin Wide SOIC (S16W)

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