Continuous Wave Laser
Average Power Controller

ADN2830

FEATURES
- Bias Current Range 4 mA to 200 mA
- Monitor Photodiode Current 50 µA to 1200 µA
- Closed-Loop Control of Average Power
- Laser FAIL and Laser DEGRADE Alarms
- Automatic Laser Shutdown, ALS
- Full Current Parameter Monitoring
- 5 V Operation
- –40°C to +85°C Temperature Range
- 5 mm × 5 mm 32-Lead LFCSP Package

APPLICATIONS
- Fiber Optic Communication

GENERAL DESCRIPTION
The ADN2830 provides closed-loop control of the average optical power of a continuous wave (CW) laser diode (LD) after initial factory setup. The control loop adjusts the laser IBIAS to maintain a constant back facet monitor photodiode (MPD) current and thus a constant laser optical power. The external PSET resistor is adjusted during factory setup to set the desired optical power. R_{PSET} is set at 1.23/I_{AV}, where I_{AV} is the MPD current corresponding to the desired optical power. Programmable alarms are provided for laser fail (end of life) and laser degrade (impending fail).

To provide monitoring of the MPD current, the MPD can be connected to the IMPD pin. In this case, the MPD current is mirrored to the IMPDMON pin to provide a monitor and internally to the PSET pin to close the control loop.

By closing the feedback using IBMON rather than an MPD connected to PSET, the device is configured to control a constant current in the laser rather than a constant optical output power.

REV. B

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ADN2830—SPECIFICATIONS

(VCC = 5 V ± 10%. All specifications T_MIN to T_MAX, unless otherwise noted\(^1\). Typical values as specified at 25°C.)

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<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Conditions/Comments</th>
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<td>VCC</td>
<td>V</td>
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<td>IBIAS during ALS</td>
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<td>40</td>
<td>μA</td>
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<td>ALS Response Time</td>
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<td>MONITOR PD (IMPD)</td>
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<td>Current</td>
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<td>Capacitance</td>
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<td>Input Current</td>
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<td>1.35</td>
<td>V</td>
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<td>ALARM SET (ASET)</td>
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<td>Allowable Resistance Range</td>
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<td>LOGIC INPUTS (ALS, MODE)</td>
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<td>VIH</td>
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<td>ALARM OUTPUTS (Internal 30 kΩ Pull-Up)</td>
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<tr>
<td>VOH</td>
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<td></td>
<td>V</td>
<td></td>
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<tr>
<td>VOL</td>
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<td>IBMON IMPDMON</td>
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<td>A/A</td>
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<td>VCC – 1.2</td>
<td>V</td>
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<td>SUPPLY</td>
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<td>ICC(^3)</td>
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<td>25</td>
<td>mA</td>
<td>IBIAS = 0</td>
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<td>VCC</td>
<td>4.5</td>
<td>5.0</td>
<td>5.5</td>
<td>V</td>
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</table>

NOTES
\(^1\)Temperature range: –40°C to +85°C.
\(^3\)Icc for power calculation is the typical Icc given.
Specifications subject to change without notice.
## ABSOLUTE MAXIMUM RATINGS

(T<sub>A</sub> = 25°C, unless otherwise noted.)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
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<tbody>
<tr>
<td>V&lt;sub&gt;CC&lt;/sub&gt; to GND</td>
<td>7 V</td>
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<td>Digital Inputs (ALS, Mode)</td>
<td>–0.3 V to V&lt;sub&gt;CC&lt;/sub&gt; + 0.3 V</td>
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<tr>
<td>Operating Temperature Range</td>
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<tr>
<td>Industrial</td>
<td>–40°C to +85°C</td>
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<tr>
<td>Storage Temperature Range</td>
<td>–65°C to +150°C</td>
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<td>Junction Temperature (T&lt;sub&gt;J&lt;/sub&gt; Max)</td>
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<tr>
<td>θ&lt;sub&gt;JA&lt;/sub&gt; Thermal Impedance</td>
<td>32°C/W</td>
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</table>

### CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the ADN2830 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

### WARNING!

ESD SENSITIVE DEVICE

### NOTES

1Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those listed in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

2θ<sub>JA</sub> is defined when the part is soldered onto a 4-layer board.
## PIN CONFIGURATION

**Pin No.** | **Mnemonic** | **Function** |
---|---|---|
1 | GND | Supply Ground |
2 | ASET | Alarm Current Threshold Set Pin |
3 | NC | No Connect |
4 | PSET | Average Optical Power Set Pin |
5 | IMPD | Monitor Photodiode Input |
6 | IMPDMON | Mirrored Current from Monitor Photodiode—Current Source |
7 | GND4 | Supply Ground |
8 | VCC4 | Supply Voltage |
9 | PAVCAP | Average Power Loop Capacitor |
10 | PAVCAP | Average Power Loop Capacitor |
11 | VCC1 | Supply Voltage |
12 | VCC5 | Supply Voltage |
13 | NC | No Connect |
14 | GND1 | Supply Ground |
15 | NC | No Connect |
16 | NC | No Connect |
17 | MODE | Mode Select: Tied to ALS = Standalone, High = Parallel Current Booster |
18 | DEGRADE | DEGRADE Alarm Output |
19 | FAIL | FAIL Alarm Output |
20 | ALS | Automatic Laser Shutdown |
21 | VCC3 | Supply Voltage |
22 | GND3 | Supply Ground |
23 | IBMON | Bias Current Monitor Output—Current Source |
24 | IBMON | Bias Current Monitor Output—Current Source |
25 | VCC2 | Supply Voltage |
26 | NC | No Connect |
27 | GND2 | Supply Ground |
28 | IBIAS | Laser Diode Bias Current |
29 | GND2 | Supply Ground |
30 | GND2 | Supply Ground |
31 | IBIAS | Laser Diode Bias Current |
32 | NC | No Connect |

**EP** | **Exposed Pad** | The exposed pad on the bottom of the package must be connected to $V_{CC}$ or the GND plane. 

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THE EXPOSED PAD ON THE BOTTOM OF THE PACKAGE MUST BE CONNECTED TO $V_{CC}$ OR THE GND PLANE.
GENERAL
Laser diodes have current-in to light-out transfer functions as shown in Figure 1. Two key characteristics of this transfer function are the threshold current, $I_{TH}$, and slope in the linear region beyond the threshold current, referred to as slope efficiency ($LI$).

$LI = \frac{\Delta P}{\Delta I}$

Figure 1. Laser Transfer Function

CONTROL
A monitor photodiode (MPD) is required to control the laser diode. The MPD current is fed into the ADN2830 to control the power, continuously adjusting the bias current in response to the laser’s changing threshold current and light to current ($LI$) slope (slope efficiency).

The ADN2830 uses automatic power control (APC) to maintain a constant power over time and temperature.

The average power is controlled by the $R_{PSET}$ resistor connected between the PSET pin and ground. The PSET pin is kept 1.23 V above GND. For an initial setup, the $R_{PSET}$ resistor can be calculated using the following formula.

$$R_{PSET} = \frac{1.23 \, V}{I_{AV}}$$

where $I_{AV}$ is average MPD current.

Note the $I_{PSET}$ will change from device to device. It is not required to know exact values for LI and MPD optical coupling.

LOOP BANDWIDTH SELECTION
Capacitor values greater than 22 nF are used to set the actual loop bandwidth. This capacitor is placed between the PAVCAP pin and ground. It is important that the capacitor is a low leakage multilayer ceramic with an insulation resistance greater than 100 GΩ or a time constant of 1000 sec, whichever is less.

ALARMS
The ADN2830 has two active high alarms, DEGRADE and FAIL. A resistor between ground and the ASET pin is used to set the current at which these alarms are raised. The current through the ASET resistor is a ratio of $(N \times 200):1$ to the FAIL alarm threshold ($N$ is the number of ADN2830s in parallel). The DEGRADE alarm will be raised at 90% of this level.

Example:

$$I_{FAIL} = 50 \, mA, \quad N = 1 \Rightarrow I_{DEGRADE} = 45 \, mA$$

$$I_{ASET} = \frac{I_{BIASSTRIP}}{N} = \frac{50 \, mA}{200} = 250 \, \mu A$$

$$R_{ASET} = \frac{1.23 \, V}{I_{ASET}} = \frac{1.23}{250 \, \mu A} = 4.92 \, k\Omega$$

The laser degrade alarm, DEGRADE, gives a warning of imminent laser failure if the laser diode degrades further or environmental conditions continue to stress the laser diode, e.g., increasing temperature.

The laser fail alarm, FAIL, is activated when:

- The ASET threshold is reached.
- The ALS pin is set high. This shuts off the modulation and bias currents to the laser diode, resulting in the MPD current dropping to zero.

DEGRADE will only be raised when the bias current exceeds 90% of the ASET current.

MONITOR CURRENTS
IMON and IMPDMON are current controlled current sources from VCC. They mirror the bias and MPD current for increased monitoring functionality. An external resistor to GND gives a voltage proportional to the current monitored. If the IMPDMON function is not used, the IMPD pin must be grounded and the monitor photodiode must be tied directly to the PSET pin.

AUTOMATIC LASER SHUTDOWN
When ALS is logic high, the bias current is turned off. Correct operation of ALS can be confirmed by the fail alarm being raised when ALS is asserted. Note that this is the only time DEGRADE will be low while FAIL is high.

MODE
The MODE feature on the ADN2830 allows the user to operate more than one ADN2830 in parallel current boosting mode to achieve up to $N \times 200$ mA of bias current ($N$ is the number of ADN2830s in parallel). When using parallel boosting mode, one device is run as the master, the other as the slave. The MODE pin on the master is tied to ALS and the MODE pin on the slave is tied high (see Figure 3 for reference circuit).

ALARM INTERFACES
The FAIL and DEGRADE outputs have an internal 30 kΩ pull-up resistor that is used to pull the digital high value to VCC. However, the alarm output may be overdriven with an external resistor allowing the alarm interfacing to non-VCC levels. Non-VCC alarm output levels must be below the VCC used for the ADN2830.

*The smallest value for $R_{ASET}$ is 1.2 kΩ, as this corresponds to the IBIAS maximum of $N \times 200$ mA.
**POWER CONSUMPTION**

The ADN2830 die temperature must be kept below 125°C.

The exposed paddle should be connected in such a manner that it is at the same potential as the ADN2830 ground pins. Power consumption can be calculated using the following formulas.

\[
T_{\text{DIE}} = T_{\text{AMBIENT}} + \theta_{JA} \times P \\
I_{\text{CC}} = I_{\text{CCMIN}} \\
P = V_{\text{CC}} \times I_{\text{CC}} + (I_{\text{BLAS}} \times V_{\text{BLAS,PIN}})
\]

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**Figure 2. Test Circuit, Standalone Mode, IMPD Input Not Used**

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Figure 3. Test Circuit, Second ADN2830 Used in Parallel Current Boosting Mode to Achieve 400 mA Max IBIAS
ADN2830

Figure 4. The ADN2830 Configured with Current Multiplier

Figure 5. The ADN2830 Configured as Average Power Controller (Bias Current Sourced)
Figure 6. The ADN2830 Configured as a Controlled Current Source by Feeding Back the Bias Monitor Current to $R_{PSET}$
OUTLINE DIMENSIONS

Figure 7. 32-Lead Lead Frame Chip Scale Package [LF CSP_WQ]
5 mm × 5 mm Body, Very Very Thin Quad
(CP-32-7)
Dimensions shown in millimeters

ORDERING GUIDE

<table>
<thead>
<tr>
<th>Model</th>
<th>Temperature Range</th>
<th>Package Description</th>
<th>Package Option</th>
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<td>ADN2830ACPZ32</td>
<td>−40°C to +85°C</td>
<td>32-Lead Lead Frame Chip Scale Package [LF CSP_WQ]</td>
<td>CP-32-7</td>
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<tr>
<td>ADN2830-EVALZ</td>
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<td>Evaluation Board</td>
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1 Z = RoHS Compliant Part.

REVISION HISTORY

3/12—Rev. A to Rev. B

Added EPAD Notation ................................................. 4
Updated Outline Dimensions ....................................... 10
Changes to Ordering Guide ......................................... 10

6/03—Rev. 0 to Rev. A

Changes to Absolute Maximum Ratings ........................... 3
Updated Outline Dimensions ....................................... 10

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