ANALOG DEVICES

Continuous Wave Laser Average Power Controller

Preliminary Technical Data — ADN2830

FEATURES

Bias Current range 4mA to 200 mA
Monitor Photo Diode current 50uA to 1200uA
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
5mm x5mm 32 pin LFCSP package

APPLICATIONS

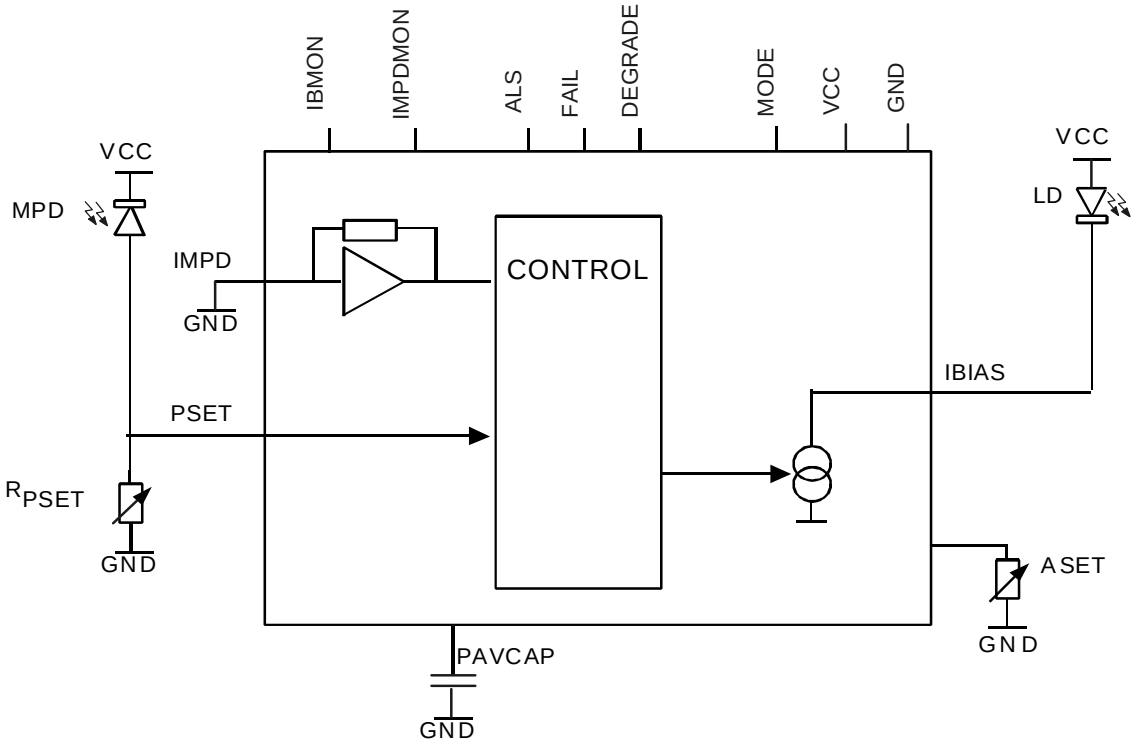
Fiber Optic Communication

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 Photo-Diode (MPD) current and hence 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.



FUNCTIONAL BLOCK DIAGRAM

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Fax: 781/326-8703 **Analog Devices, Inc., 2002**

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(V_{CC} = 5V +/-10%. All specifications T_{MIN} to T_{MAX} unless otherwise noted[1]. Typical values as specified at 25°C)

ADN2830 SPECIFICATIONS

PARAMETER	Min	Typ	Max	Units	Conditions/Comments
LASER BIAS (IBIAS)					
Output current Ibias	4		200	mA	
Compliance Voltage	1.2		Vcc	V	
Ibias during ALS			0.1	mA	
ALS response time		10		µs	
MONITOR PD (IMPD)					
Current	50		1200	µA	
Input voltage			1.6	V	
POWER SET INPUT (PSET)					
Capacitance			80	pF	
Input current	50		1200	µA	
Voltage	1.15	1.23	1.35	V	
ALARM SET (ASET)					
Allowable Resistance Range	1.2		13	KΩ	
Voltage	1.15	1.23	1.35	V	
Hysterisis		5		%	
LOGIC INPUTS (ALS, MODE)					
Vih	2.4			V	
Vil			0.8	V	
ALARM OUTPUTS (Internal 30K Ohm Pull up)					
Voh	2.4			V	
Vol			0.4	V	
IBMON IMPDMON					
IBMON Division Ratio		100		A/A	
IMPDMON Division Ratio		1		A/A	
Compliance Voltage	0		Vcc-1.2	V	
SUPPLY					
Icc[2]		25		mA	Ibias = 0
Vcc	4.5	5.0	5.5	V	

NOTES:
[1]Temperature Range is as follows: -40°C to +85°C
[2] Icc for power calculation is the typical Icc given.
Specifications subject to change without notice

ABSOLUTE MAXIMUM RATINGS

(T_A = +25°C unless otherwise noted)

V_{CC} to GND..... 7V
Operating Temperature Range
Industrial .....-40°C to +85°C
Storage Temperature Range.....-65°C to +150°C
Junction Temperature (T_J max).....+150°C
θ_{JA} Thermal Impedance[2]..... 32°C/W
32-lead LFCSP Package,
Power Dissipation.....(T_J max - T_A)/θ_{JA} mW
Lead Temperature (soldering for 10sec).....+300°C.

NOTES:
[1]Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only, and 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.
Transient currents of up to 100mA will not cause SCR latch-up
[2]θ_{JA} is defined when the part is soldered onto a four layer board

Ordering Guide

Model	Temperature Range	Package Description
ADN2830ACP-32	-40°C to +85°C	32-Lead LFCSP
ADN2830ACP-32-RL7	-40°C to +85°C	32-Lead LFCSP
ADN2830ACP-32-RL	-40°C to +85°C	32-Lead LFCSP

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.

PIN FUNCTION DESCRIPTION 32 LEAD LFCSP

Pin No.	Pin Name	Function
1	GND	Test Pin. Tie to GND
2	ASET	Alarm current threshold setting pin
3	NC	No Connect
4	PSET	Average Optical Power set pin
5	IMPD	Monitor Photo Diode input
6	IMPDMON	Mirrored current from Monitor Photo Diode
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=stand-alone, High=Parallel current booster.
18	DEGRADE	DEGRADE Alarm output, open collector
19	FAIL	FAIL Alarm output, open collector
20	ALS	Automatic Laser Shutdown
21	VCC3	Supply Voltage
22	GND3	Supply Ground
23	IBMON	Bias current monitor output
24	IBMON	Bias current monitor output
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

GENERAL

Laser diodes have current-in to light-out transfer functions as shown in Figure 2. Two key characteristics of this transfer function are the threshold current, Ith, and slope in the linear region beyond the threshold current, referred to as slope efficiency, LI.

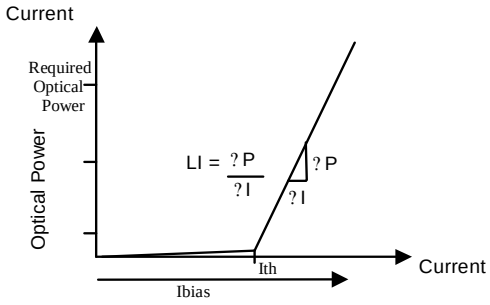


Figure 3. Laser Transfer Function

CONTROL

A monitor photo diode, MPD, is required to control the LD. 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.

Average Power is set using the PSET pin. Potentiometers are connected between these pins and ground. The potentiometer, R_{PSET} , is used to change the average power. PSET is kept 1.23V above GND.

The ratios of current-in-to-current-out are given by the following formulae:

$$R_{PSET} = \frac{1.23V}{I_{av}} \quad (\Omega)$$

where I_{av} is average MPD current.

Note that I_{PSET} will change from device to device. However the control loop will determine actual values. It is not required to know exact values for LI or MPD optical coupling.

LOOP BANDWIDTH SELECTION

Capactitor values greater than 22nF 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 an insulation resistance greater than 100GΩ or a time constant of 1000sec, 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 200:1 to the FAIL alarm threshold. The DEGRADE alarm will be raised at 90% of this level.

Example: I_{FAIL} = 50mA so $I_{DEGRADE}$ = 45mA

$$I_{ASET} = \frac{Ibiastrip}{200} = \frac{50mA}{200} = 250\mu A$$

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

The laser degrade alarm, DEGRADE, is provided to give a warning of imminent laser failure if the laser diode degrades further or environmental conditions continue to stress the LD, eg. 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 LD, resulting in the MPD current dropping to zero.

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

MONITOR CURRENTS

IBMON 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.

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 this is the only time that DEGRADE will be low while FAIL is high.

MODE

The MODE feature on the allows the user operate more than one ADN2830 in parallel current boosting mode to achieve up to 400mA of bias current. When using the parrallel boosting mode one device is run as the master, the other the slave. The MODE pin on the master is tied to ALS, the mode pin on the slave is tied high (see Figure 8 for reference circuit).

ALARM INTERFACES

A 30k internal pull up resistor is employed to pull the digital high value of the alarm outputs to Vcc. However, the ADN2830 has a feature which allows the user to externally wire resistors in parallel with the 30k pull-up resistors thus enabling the user to interface to non Vcc levels. Non Vcc alarm output levels must be below the Vcc used for the ADN2830.

****Note: The smallest valid value for R_{ASET} is 1.2KΩ, as this corresponds to the I_{BIAS} maximum of 200mA.**

POWER CONSUMPTION

The ADN2830 die temperature must be kept below 125°C. The Oja is 32°C/W when soldered in a four layer P.C.B. The LFCSP package has an exposed paddle and as such needs to be soldered to the P.C.B to achieve this thermal performance.

Tdie = Tambient + θja . P

Icc = Iccmin

P = Vcc.Icc + (Ibias.Vbias_pin)

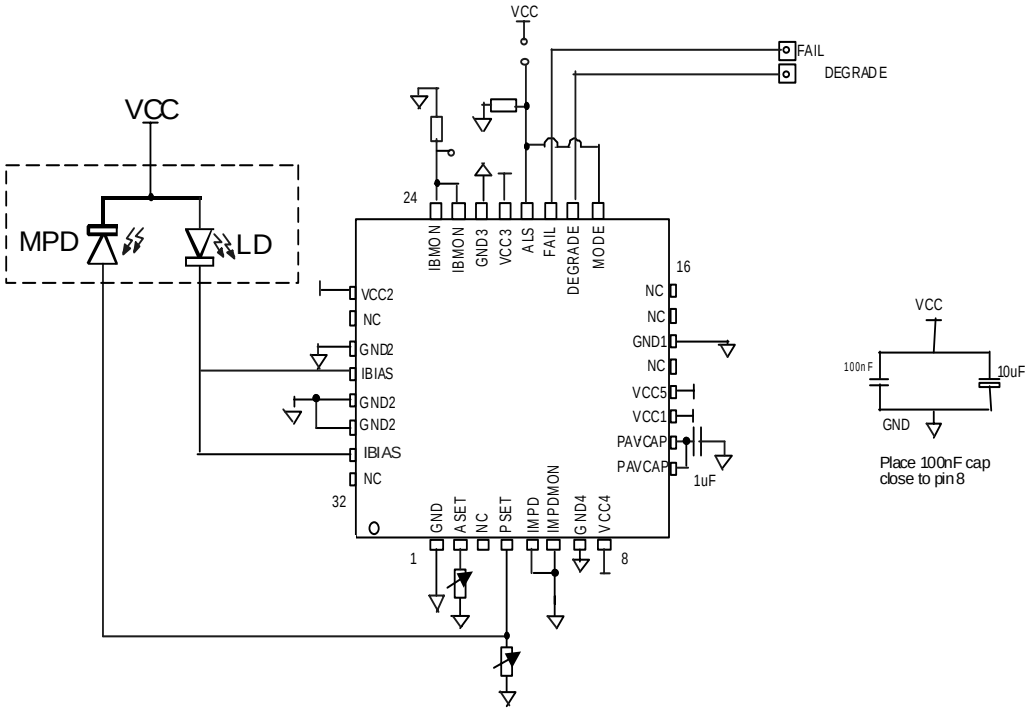


Figure 7. Test Circuit, stand-alone mode, IMPD input not used.

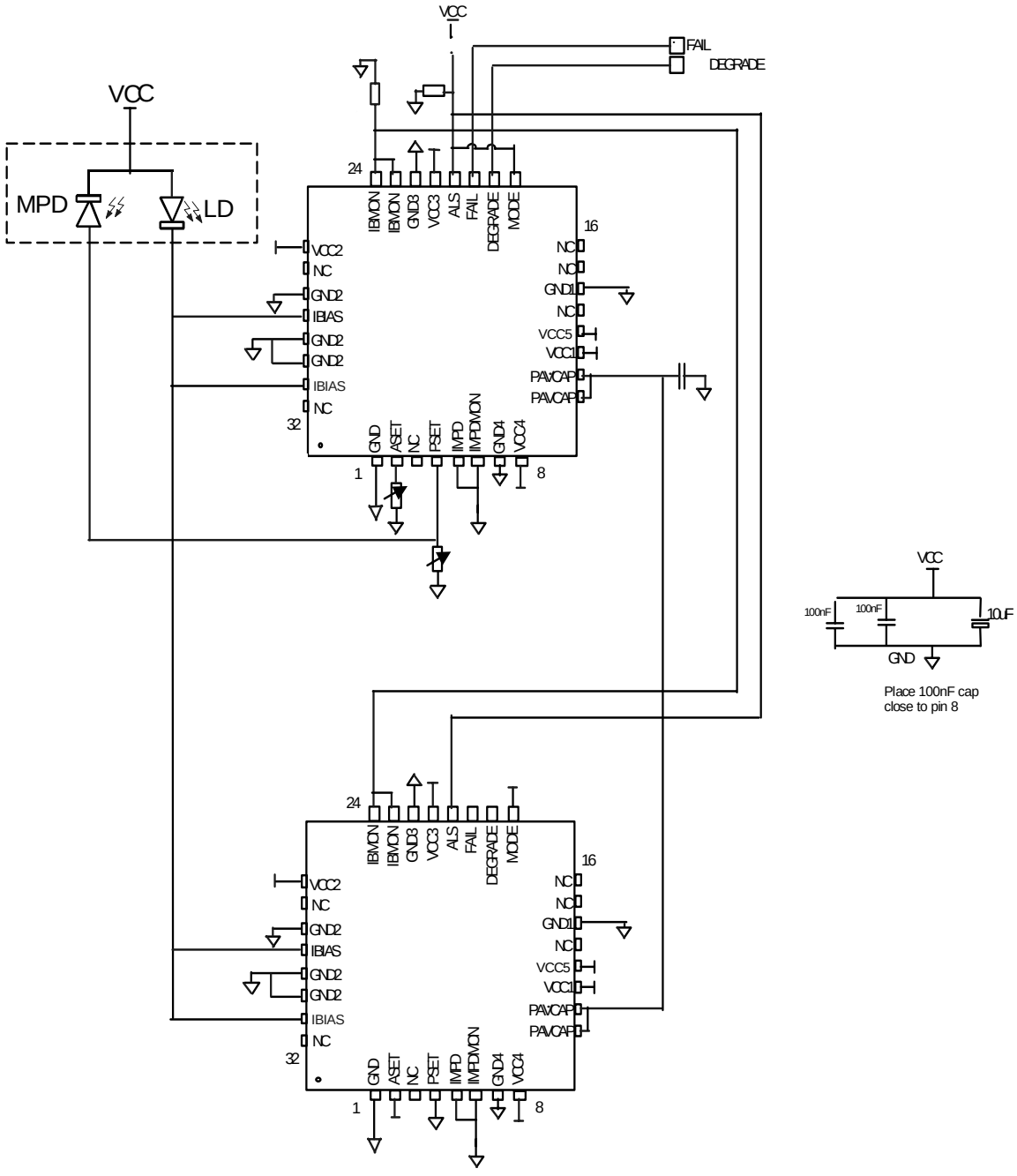
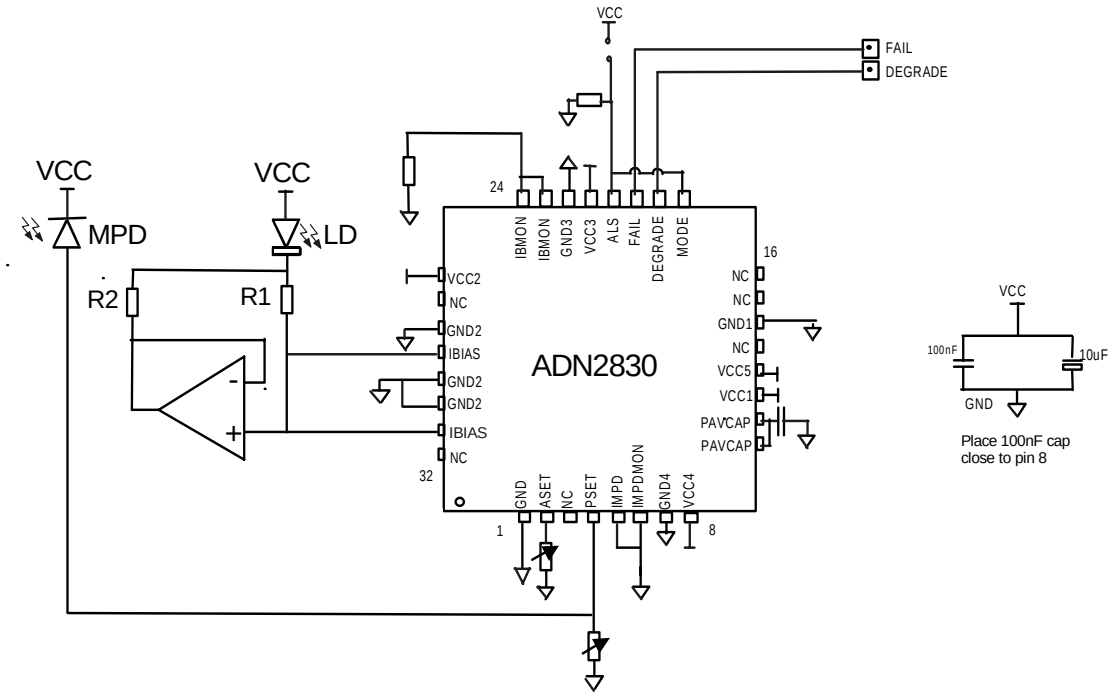


Figure 8. Test Circuit,
second ADN2830 used in parallel current boosting mode to achieve 400mA max IBIAS.



* For digital control, replace Rpset with a digital pot from Analog Devices.
  ADN2850 10-bit resolution, 50ppm/'C TC, EEPROM
  AD5242 8-bit resolution, 50ppm/'C TC
* Total current to laser = IBIAS + IBIAS*R1/R2
* For best accuracy, size R1 to have maximum voltage drop across it within the headroom constraints.
* For 250mA extra IBIAS (450mA total) from AMP1, use AD8591 amplifier.
* For 350mA extra IBIAS (550mA total) from AMP1, use Analog Devices SSM2211 amplifier.

Figure 9. The ADN2830 configured with current multiplier.

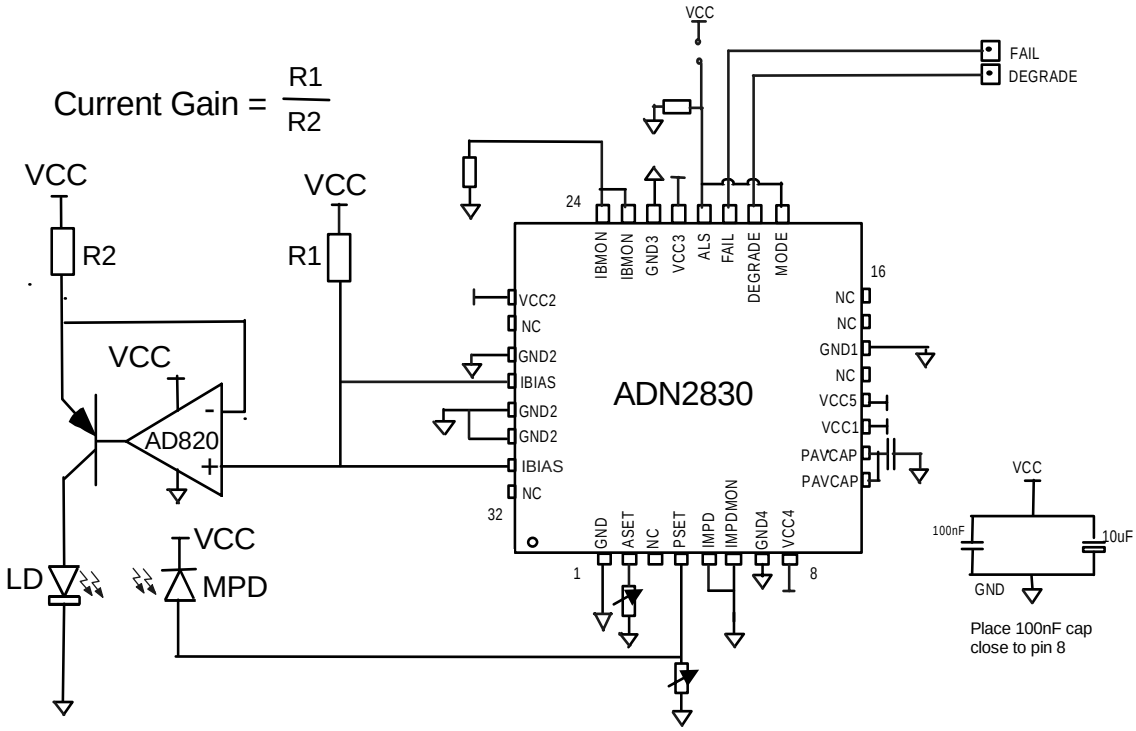


Figure 9. The ADN2830 configured as Average Power Controller (Bias Current Sourced)..

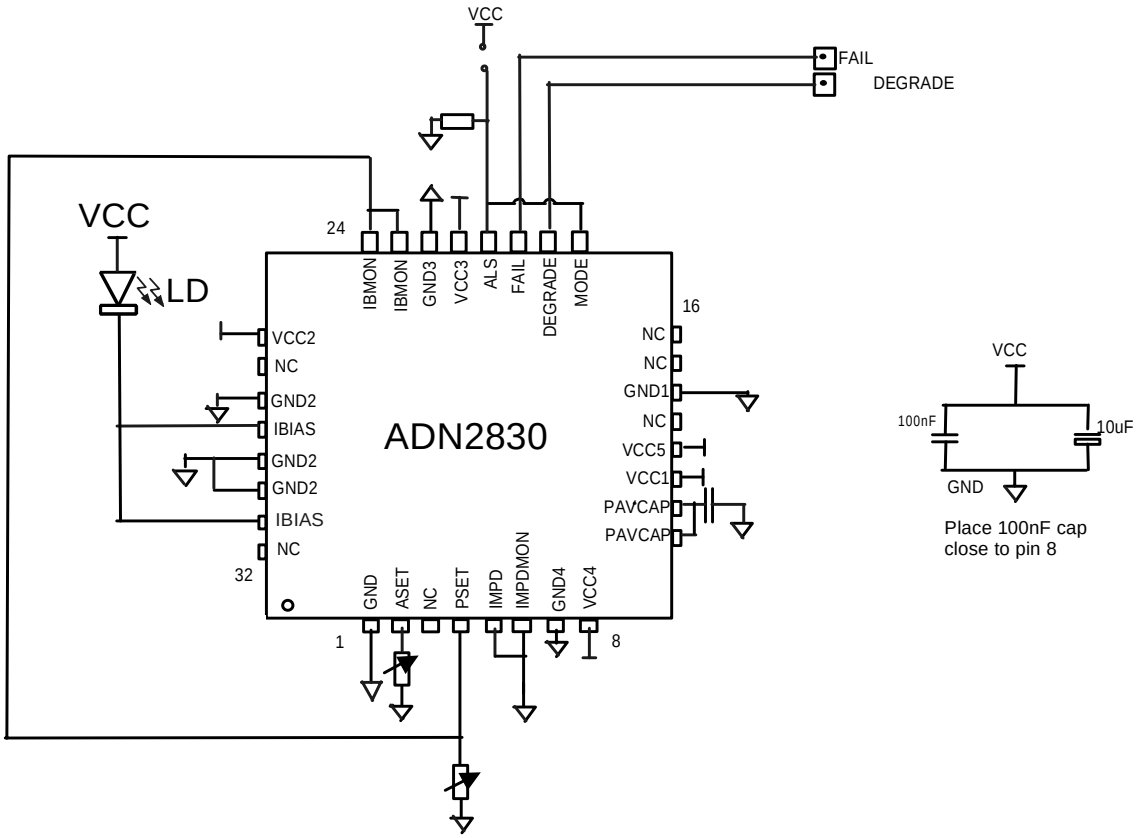


Figure 11. The ADN2830 configured as a controlled current source by feeding back the bias monitor current to Rpset.

OUTLINE DIMENSIONS

Dimensions shown in mm.

32-Lead (5x5) LFCSP (Exposed Paddle)

Exposed Paddle should be soldered to the most negative supply of the ADN2830