

# 76V, APD, Dual Output Current Monitor

## General Description

The DS1842A integrates the discrete high-voltage components necessary for avalanche photodiode (APD) bias and monitor applications. A precision voltage-divider network is used in conjunction with an external DC-DC controller and FET to create a boost DC-DC converter. A current clamp limits current through the APD and also features an external shutdown. The precision voltage-divider network is provided for precise control of the APD bias voltage. The device also includes a dual current mirror to monitor the APD current.

## Applications

APD Biasing  
GPON ONU and OLT

## Features

- ◆ 76V Maximum Boost Voltage
- ◆ Current Monitor with a Wide  $1\mu\text{A}$  to  $2\text{mA}$  Range, Fast 50ns Time Constant, and 10:1 and 5:1 Ratio
- ◆ 2mA Current Clamp with External Shutdown
- ◆ Precision Voltage Feedback
- ◆ Multiple External Filtering Options
- ◆ 3mm x 3mm, 14-Pin TDFN Package with Exposed Pad

## Ordering Information

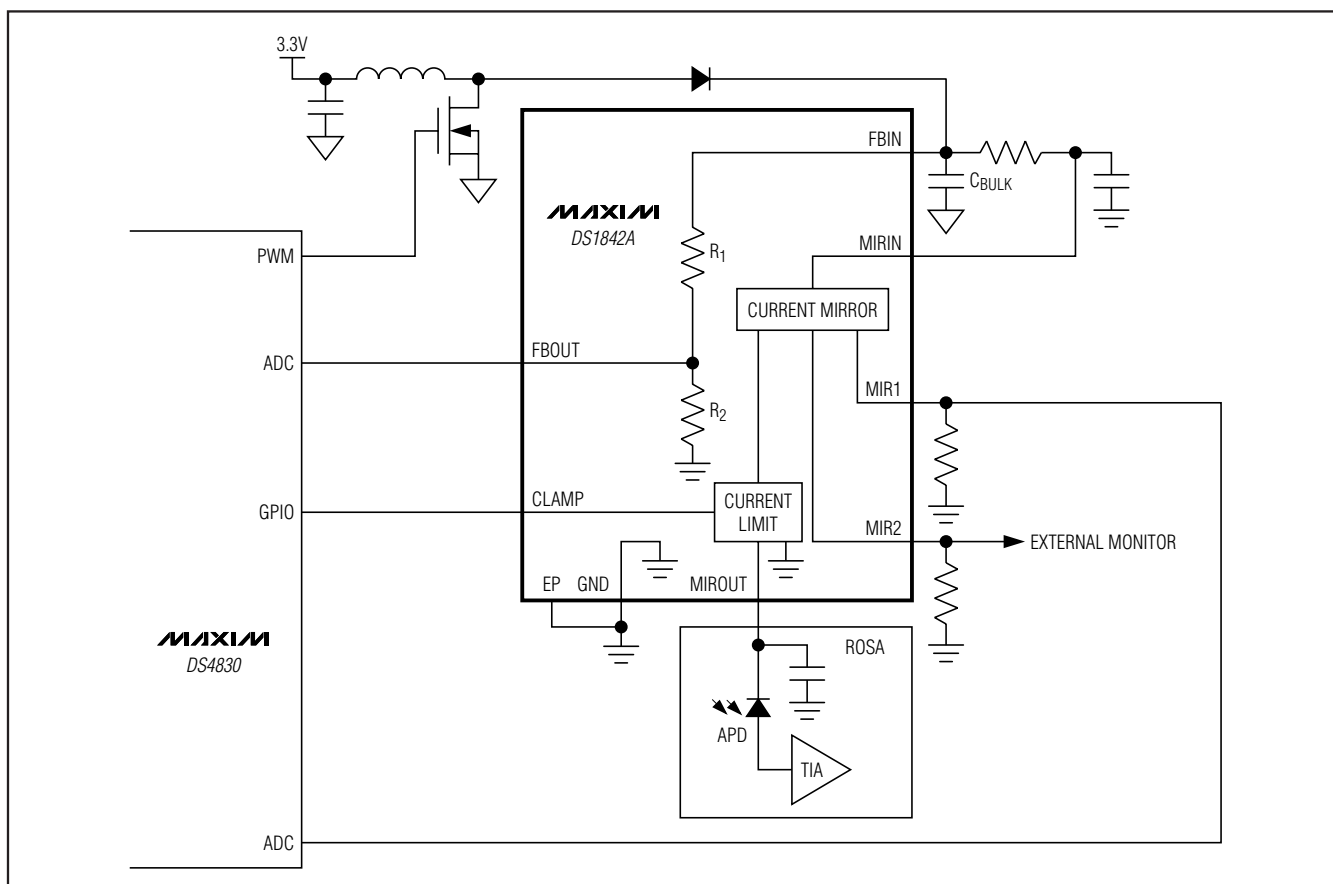
PART	TEMP RANGE	PIN-PACKAGE
DS1842AN+	-40°C to +85°C	14 TDFN-EP*
DS1842AN+T&R	-40°C to +85°C	14 TDFN-EP*

+ Denotes a lead(Pb)-free/RoHS-compliant package.

T&R = Tape and reel.

\*EP = Exposed pad.

## Typical Application Circuit



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## ABSOLUTE MAXIMUM RATINGS

Voltage Range on CLAMP Relative to GND .....	-0.3V to +12V	Continuous Power Dissipation (TA = +70°C) TDFN (derate 24.4mW/°C above +70°C).....	1951.2mW
Voltage Range on MIRIN, MIROUT, FBIN MIR1, and MIR2 Relative to GND.....	-0.3V to +80V	Operating Junction Temperature Range .....	-40°C to +150°C
Voltage Range on FBOUR Relative to GND .....	-0.3V to +6.0V	Storage Temperature Range .....	-55°C to +135°C
		Lead Temperature (soldering, 10s) .....	+300°C
		Soldering Temperature (reflow) .....	+260°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## PACKAGE THERMAL CHARACTERISTICS (Note 1)

TDFN

Junction-to-Ambient Thermal Resistance ( $\theta_{JA}$ ) .....	41°C/W
Junction-to-Case Thermal Resistance ( $\theta_{JC}$ ) .....	8°C/W

**Note 1:** Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to [www.maxim-ic.com/thermal-tutorial](http://www.maxim-ic.com/thermal-tutorial).

## ELECTRICAL CHARACTERISTICS

(TA = -40°C to +85°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
CLAMP Voltage	V <sub>CLAMP</sub>		0		11	V
CLAMP Threshold	V <sub>CLT</sub>		1.25	1.8	2.35	V
Maximum MIROUT Current	I <sub>MIROUT</sub>	CLAMP = low	1.8	2.75	3.85	mA
		CLAMP = high			10	μA
MIR1 to MIROUT Ratio	K <sub>MIR1</sub>	15V < V <sub>MIRIN</sub> < 76V, I <sub>MIROUT</sub> > 1μA	0.096	0.100	0.104	A/A
MIR2 to MIROUT Ratio	K <sub>MIR2</sub>	15V < V <sub>MIRIN</sub> < 76V, I <sub>MIROUT</sub> > 1μA	0.192	0.200	0.208	A/A
MIR1, MIR2 Rise Time (20%/80%)	t <sub>RC</sub>	(Note 2)		30		ns
Shutdown Temperature	T <sub>SHDN</sub>	(Note 3)		+150		°C
Hysteresis Temperature	T <sub>HYS</sub>	(Note 3)		5		°C
Leakage on CLAMP	I <sub>IL</sub>		-1		+1	μA
Resistor-Divider Ratio (R <sub>1</sub> /R <sub>2</sub> )	K <sub>R</sub>	TA = +25°C, V <sub>FBIN</sub> = 76V	59.5		60.25	
Resistor-Divider Tempco				±50		ppm/°C
Resistor-Divider End-to-End Resistance	R <sub>RES</sub>	TA = +25°C, V <sub>FBIN</sub> = 76V	308	385	481	kΩ

**Note 2:** Rising MIROUT transition from 10μA to 1mA; V<sub>MIRIN</sub> = 40V, 2.5kΩ load.

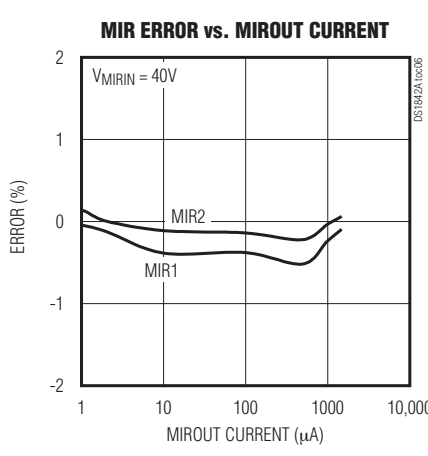
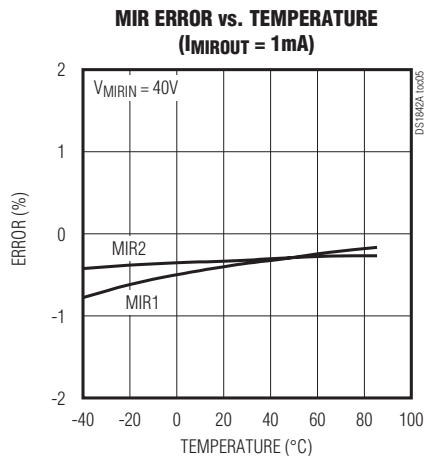
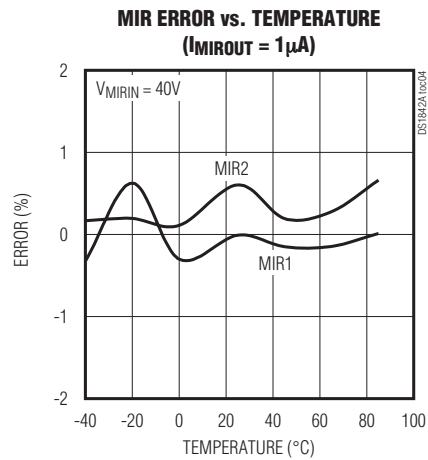
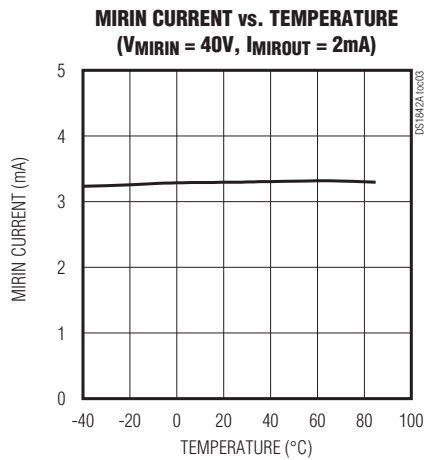
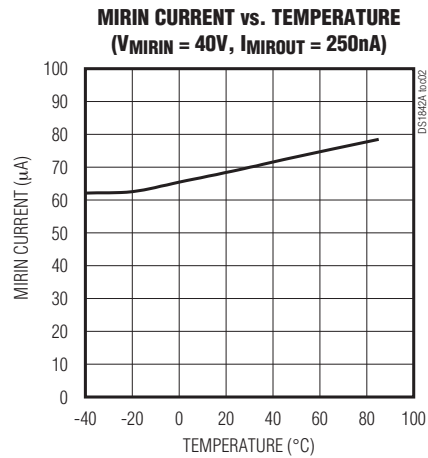
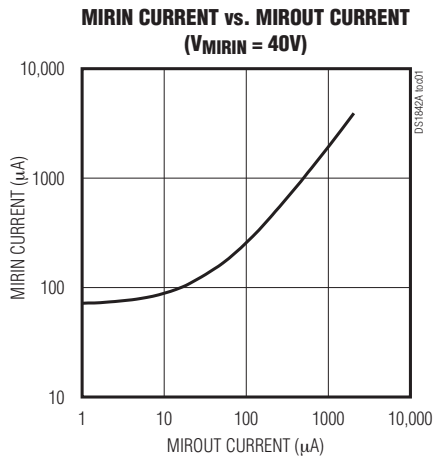
**Note 3:** Not production tested. Guaranteed by design.

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## Typical Operating Characteristics

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)

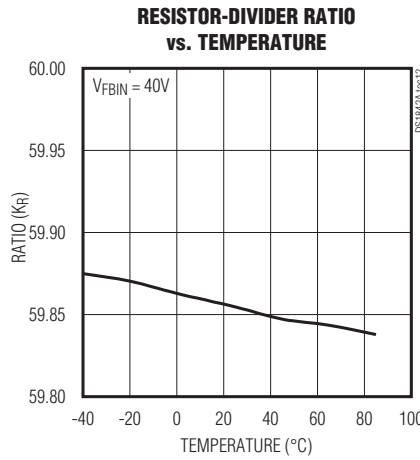
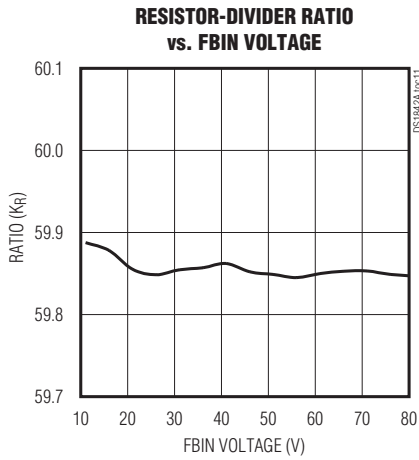
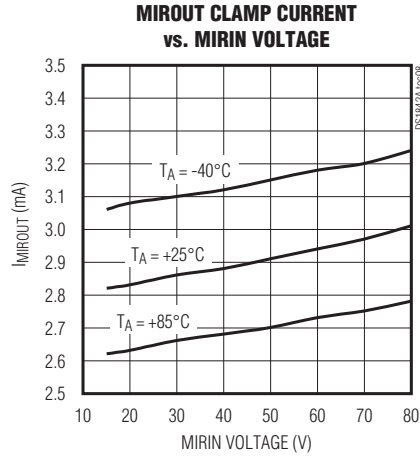
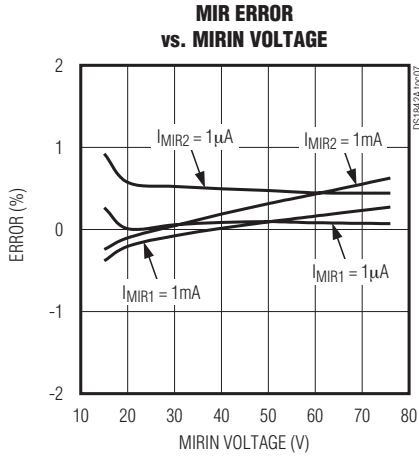
DS1842A



# 76V, APD, Dual Output Current Monitor

## Typical Operating Characteristics (continued)

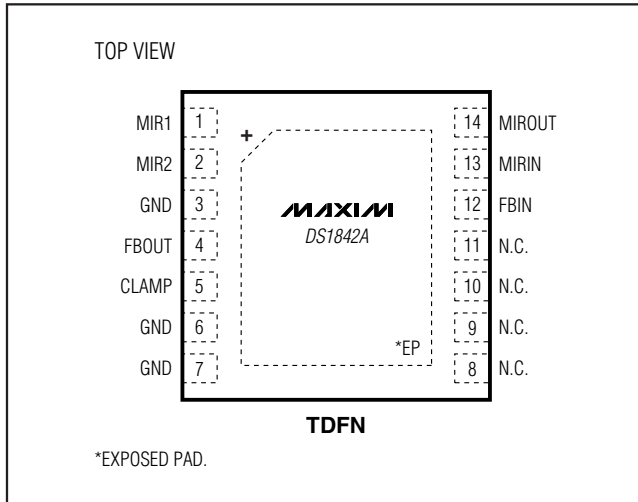
( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)



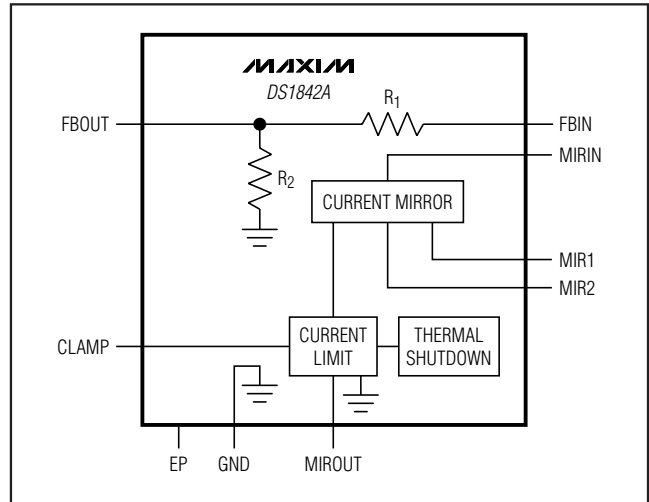
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**DS1842A**

## Pin Configuration



## Block Diagram



## Pin Description

PIN	NAME	FUNCTION
1	MIR1	Current Mirror Monitor Output, 10:1 Ratio
2	MIR2	Current Mirror Monitor Output, 5:1 Ratio
3, 6, 7	GND	Ground Connection for Device. Connect directly to ground plane.
4	FBOUT	Feedback Output. Resistor-divider output.
5	CLAMP	Clamp Input. Disables the current mirror output (MIROUT).
8–11	N.C.	No Connection
12	FBIN	Feedback Input. Resistor-divider input.
13	MIRIN	Current Mirror Input
14	MIROUT	Current Mirror Output. Connect to APD bias pin.
—	EP	Exposed Pad. Connect directly to the same ground plane as GND.

## Detailed Description

The DS1842A contains discrete high-voltage components required to create an APD bias voltage and to monitor the APD bias current. The device's mirror outputs are a current that is a precise ratio of the output current across a large dynamic range. The mirror response time is fast enough to comply with GPON Rx burst-mode monitoring requirements. The device has a built-in current-limiting feature to protect APDs. The

APD current can also be shut down by CLAMP or thermal shutdown. The resistor-divider is used in conjunction with a DC-DC boost controller and FET to precisely create the APD bias voltage.

### Current Mirror

The DS1842A has two current mirror outputs. One is a 10:1 mirror connected at MIR1, and the other is a 5:1 mirror connected to MIR2.

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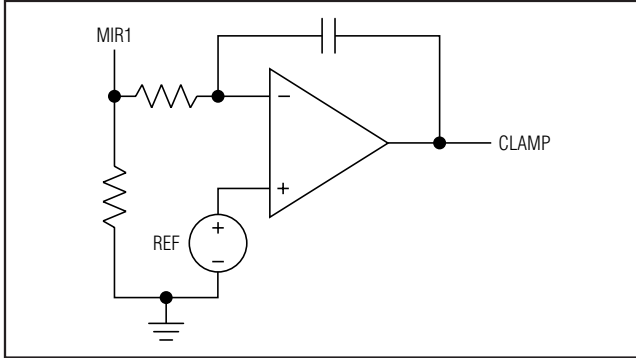


Figure 1. Current Clamp from Current Feedback

The mirror output is typically connected to an ADC using a resistor to convert the mirrored current into a voltage. The resistor to ground should be selected such that the maximum full-scale voltage of the ADC is reached when the maximum mirrored current is reached. For example, if the maximum monitored current through the APD is 2mA with a 1V ADC full scale, and the 10:1 mirror is used, then the correct resistor is approximately 5k $\Omega$ . If both MIR1 and MIR2 are connected together, the correct resistor is 1.6k $\Omega$ .

The mirror response time is dominated by the amount of capacitance placed on the output. For burst-mode Rx systems where the fastest response times are required (approximately a 50ns time constant), a 3.3pF capacitor and external op amp should be used to buffer the signal sent to the ADC. For continuous mode applications, a 10nF capacitor is all that is required on the output.

### Current Clamp

The DS1842A has a current clamping circuit to protect the APD by limiting the amount of current from MIROUT. There are three methods of current clamping available:

#### 1) Internally Defined Current Limit

The device's current clamp circuit automatically clamps the current when it exceeds the maximum MIROUT current.

#### 2) External Shutdown Signal

The CLAMP pin can completely shut down the current from MIROUT. The CLAMP pin is active high.

#### 3) Precise Level Set by External Feedback Circuit

A feedback circuit is used to control the level applied to the CLAMP pin. Figure 1 shows an example feedback circuit.

### Thermal Shutdown

As a safety feature, the DS1842A has a thermal-shutdown circuit that turns off the MIROUT and MIRIN currents when the internal die temperature exceeds TSHDN. These currents resume after the device has cooled.

### Precision Voltage-Divider

The DS1842A includes a resistor-divider to use as the feedback network for the boost converter. The DS1842A resistor-divider ratio,  $K_R$  ( $R_1/R_2$ ), is tightly controlled, allowing the boost converter output to be set with very high precision.  $K_R$  can pair with the DS1875's internal DC-DC boost controller.  $K_R$  can also be easily modified by adding external series/parallel resistors; however, the temperature coefficient of the external resistors must be considered.

### Package Information

For the latest package outline information and land patterns (footprints), go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages). Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

PACKAGE TYPE	PACKAGE CODE	OUTLINE NO.	LAND PATTERN NO.
14 TDFN-EP	T1433+2	<a href="#">21-0137</a>	<a href="#">90-0063</a>