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APPLICATION NOTE 4077

How to Interface the DS1862 to a Laser Driver with an Integrated APC Loop

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Abstract: This article describes how to interface the DS1862 XFP Laser Control and Digital Diagnostic IC to a laser driver that contains an integrated average-power-control (APC) loop. The majority of laser drivers with an integrated APC loop also require a voltage-mode interface. This article explains how to produce those required voltages and how to use a digital potentiometer to maintain Tx power-monitoring functionality.

The Current Outputs

The DS1862 XFP Laser Control and Digital Diagnostic IC has two current outputs. BIASSET is an analog current DAC output with 1.5mA maximum output; MODSET is an 8-bit current DAC with 1.2mA full-scale range. For this application, these DAC outputs must be at a voltage level between 0.7V and 3.0V.

Current-to-Voltage Conversion

This method uses an operational amplifier in a differential amplifier configuration to convert the BIASSET and MODSET current DACs to voltage outputs. Besides creating a voltage output, the circuit in **Figure 1** effectively disables the DS1862's integrated APC loop by pulling current directly from the BMD pin. The circuit in **Figure 2** converts the MODSET DAC to a voltage output with 1.09V full-scale range.
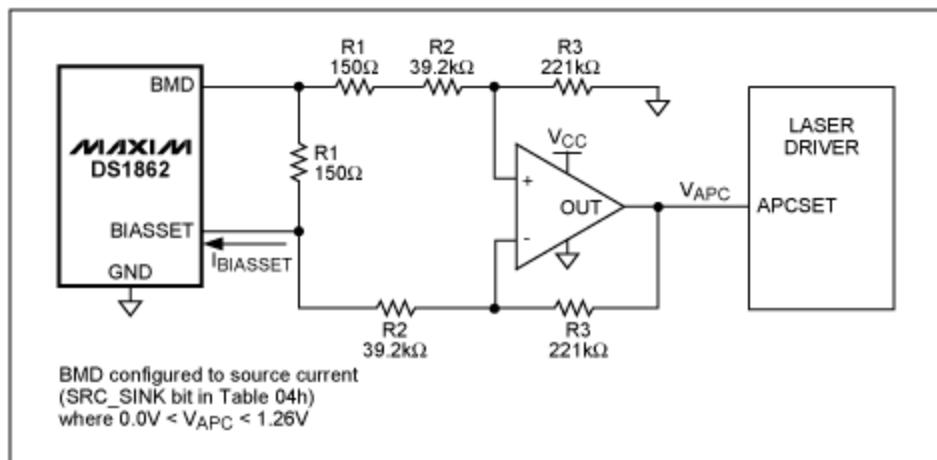

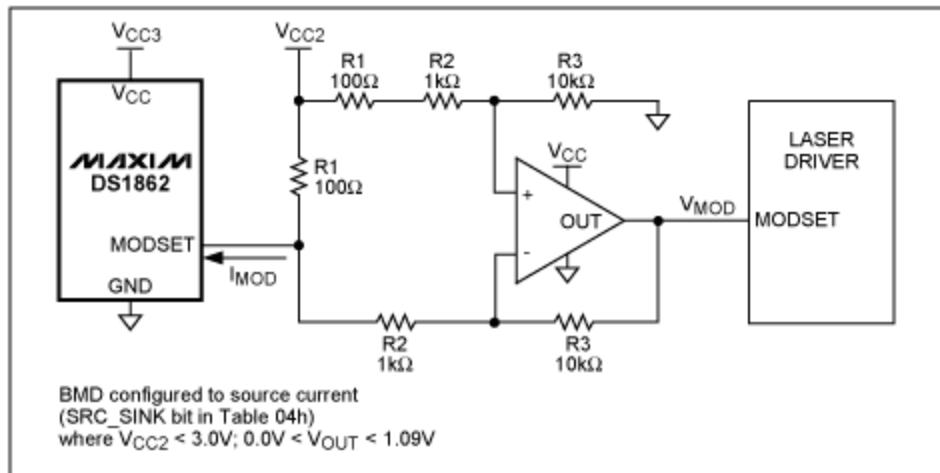
Figure 1. BIASSET current-to-voltage conversion circuit.

Figure 2. MODSET current-to-voltage conversion circuit.

Compact Solution

Using a chip-scale packaged operational amplifier and 0201 resistors will provide the most compact solution. The MAX4233 is a two-channel operational amplifier available in 1.5mm x 2mm 10-bump UCSP™.

APCSET Voltage Calculation

The output voltage from the op amps shown in Figure 1 is calculated in Equations 1 and 2. Two DS1862 registers (APC$_c$ <7:0> and APC$_f$ <1:0>) adjust the current into the BIASSET pin.

$$I_{BIASSET} = (5.859 \mu A)(APC_c < 7:0 >) + (1.465 \mu A)(APC_f < 1:0 >) \qquad \text{(Eq. 1)}$$

$$V_{APC} = \frac{(I_{BIASSET} \times R1)(R3)}{R1 + R2} \qquad \text{(Eq. 2)}$$

Using the values shown in Figure 1, the maximum voltage into APCSET is 1.26V when the DAC current is 1.5mA.

The BMD output has an output impedance of up to 700Ω. In Figure 1, R1 must be < 180Ω so that the voltage at the DAC pin never falls below 0.7V.

To create a stable output voltage, the leakage current into the differential amplifier must be minimized. In Figure 1, the relationship of R2 >> R1 must be maintained to minimize the ratio of current into the differential amplifier versus the current from the BMD pin. As 39.2kΩ is more than 200 times larger than 150Ω, this satisfies the requirement. To further minimize offset and gain errors, 1% tolerance should be used.

MODSET Voltage Calculation

The output voltage from the operational amplifier shown in Figure 2 is calculated in Equation 3.

$$V_{MOD} = \frac{(I_{MOD} \times R1)(R3)}{R1 + R2} \qquad \text{(Eq. 3)}$$

Using the values shown in Figure 2, the maximum voltage into MODSET is 1.09V. To minimize offset and gain errors, 1% tolerance should be used. Further, R1 must be selected so that the voltage at the DAC pin never falls below 0.7V. If V_{CC2} is 1.8V, this is achieved by selecting R1 < 825Ω.

Compact Solution

Using an operational amplifier in a chip-scale package and 0201 resistors will provide the most compact solution. The MAX4233, a two-channel operational amplifier available in 1.5mm by 2mm, 10-bump UCSP, would suit the application well.

Tx Power-Monitoring Considerations

Some applications require monitoring Tx power. That application cannot be achieved by using the circuit in Figure 1, because BIASSET must be connected to BMD through a resistor. With BMD used in this manner, the laser's monitor diode cannot be connected to the DS1862. Therefore, another device must be used to apply a voltage to the laser driver's APCSET pin.

The circuit in **Figure 3** illustrates one approach. This circuit uses the DS1855 digital potentiometer to set the voltage on the laser driver's APCSET pin. Pin H0 of the DS1855 is connected to the laser driver's voltage reference (V_{REF}). In this circuit, the laser's monitor diode can be connected to the DS1862's BMD pin in either sink or source mode.
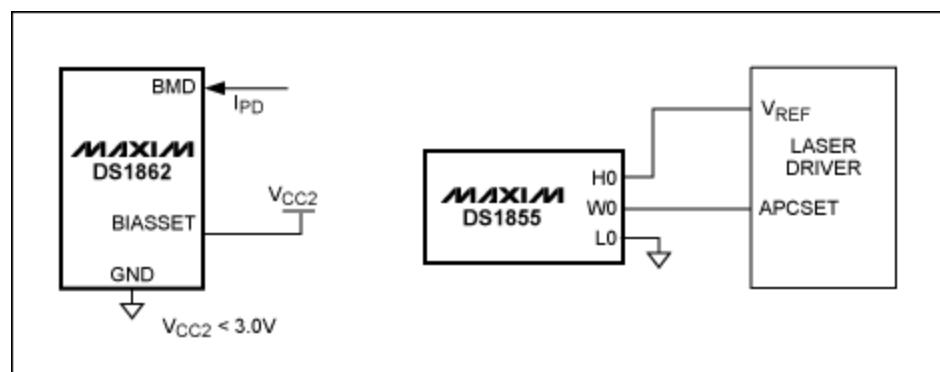

Figure 3. BIASSET current-to-voltage conversion circuit.

Conclusion

A small, simple circuit can be implemented to convert the DS1862's current DAC outputs into voltage outputs. Where Tx power monitoring is required, one option uses the DS1855 digital potentiometer in combination with the laser driver's reference output.

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Related Parts		
DS1855	Dual Nonvolatile Digital Potentiometer and Secure Memory	Free Samples
DS1862	XFP Laser Control and Digital Diagnostic IC	Free Samples