Design Note:

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Rev.2; 04/08

MOST Automotive Transmitter Using the MAX3905 and an Ulm Photonics VCSEL

maxim integrated™

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1 Introduction

Media-Oriented Systems Transport (MOST®) is a growing standard for automotive multimedia networks. The low-cost, fiber-optic-based network interfaces to audio and video devices to provide integration for passenger information and entertainment networks. This discussion focuses on the MOST transmitter. The critical requirements for a MOST transmitter are the optical modulation amplitude (OMA) and average power (P_{AVE}) at the optical output, which are specified in the MOST Advanced Optical Physical Layer Specification Draft 0.9 (Reference 1). For more information on these terms, see Maxim Application Note HFAN-02.2, *Optical Modulation Amplitude (OMA) and Extinction Ratio*.

Lasers and VCSELs (Vertical Cavity Surface-Emitting Lasers) suffer from threshold current and slope efficiency variation over temperature. The laser/VCSEL driver needs to compensate for this variation in order to produce a constant OMA and average power over temperature. The most common method for producing constant P_{AVE} is an automatic power control (APC) loop. In an APC loop, the monitor diode (optically coupled to the laser) generates a current proportional to the average power, and the laser driver adjusts its output current to keep the monitor diode current (and therefore the average power) constant. However, due to space and cost constraints, a closed-loop VCSEL driver that meets MOST specifications is difficult to achieve. The MAX3905 VCSEL driver uses an innovative approach to control the properties of the output current, without the cost and complexity of an APC loop (see MAX3905 data sheet for details). By setting the output current control inputs on the MAX3905 to match the properties of the VCSEL, the VCSEL OMA and average power will meet the MOST specifications.

2 Ulm Photonics' ULM850-01-TN-S05AUT VCSEL

A VCSEL with properties that match well with the output current profile of the MAX3905 is Ulm Photonics' ULM850-01-TN-S05AUT. This VCSEL is suitable for automotive use (ambient temperature range of -40ºC to 105ºC). Ulm Photonics recommends (Reference 2) the VCSEL current profile shown in Figure 1 to achieve OMA and P_{AVE} which meet the MOST specification.

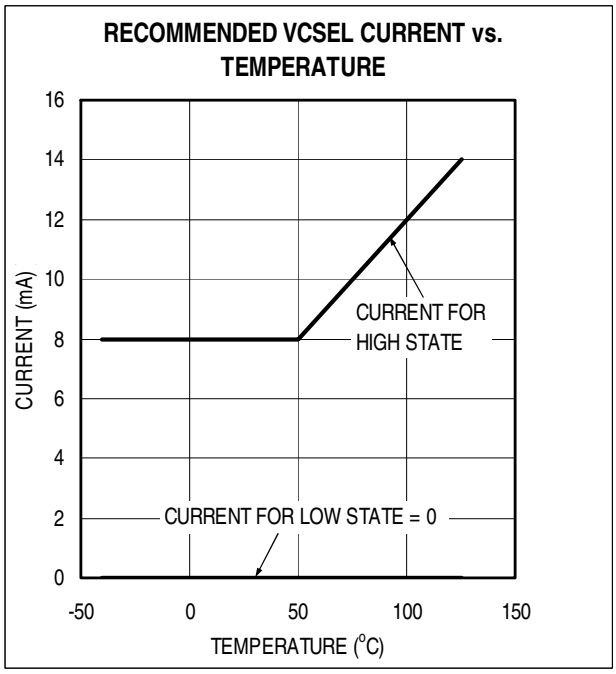

Figure 1. Recommended VCSEL Current Profile, as Prescribed by Ulm Photonics.

3 Achieve Similar Current Profile with MAX3905

While the MAX3905 cannot exactly mimic the current profile given in Figure 1, it can produce a similar profile and hence meet the MOST

specification. The following is a procedure for selecting a similar profile.

3.1 Select Current for Low State

To achieve zero low-state current, a test mode is enabled on the MAX3905. This test mode subtracts the constant current in the DT0 region to produce approximately zero low-state current in that region (Figure 2). Connecting pad 4 to VCC enables this test mode. This pad is labeled "N.C." in the MAX3905 Data Sheet. On the MAX3905 EV Kit, rev A, this test mode is activated by shunting JP4.

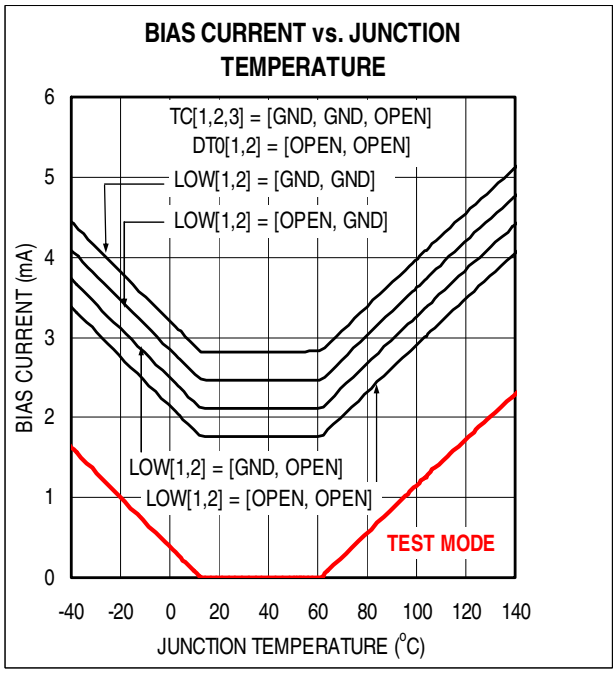

Figure 2. Bias Current vs. Temperature, Including Test Mode.

3.2 Select Temperature Coefficient

A low temperature coefficient is selected to reduce the effect of the low current rising above the threshold current of the VCSEL (since the VCSEL is meant to be modulated below threshold). For this VCSEL, TC[1, 2, 3] = [OPEN, GND, OPEN] is the correct setting (Figure 3).

3.3 Select Modulation Current

In order to emulate the current profile recommended by Ulm Photonics, the maximum modulation current is selected. This modulation is added to the low-state current from Figure 3 to produce the total high current. This setting is MOD[1, 2] = [VCC, VCC] (Figure 4).

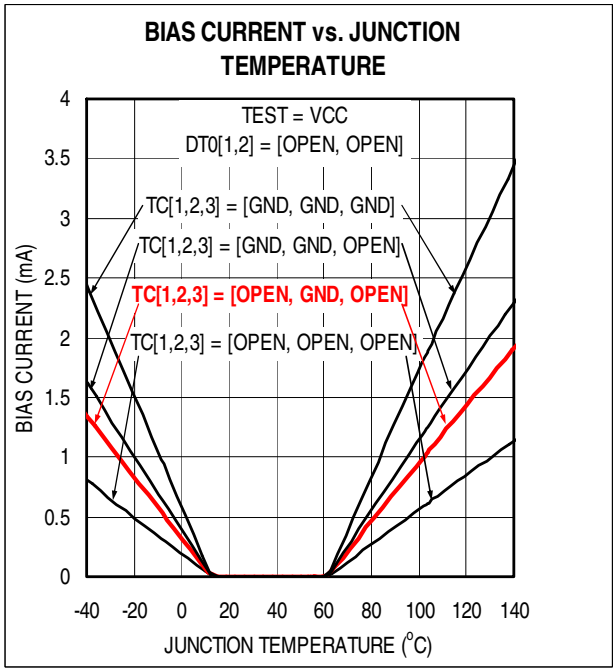

Figure 3. Bias Current vs. Temperature with Test Mode Enabled.

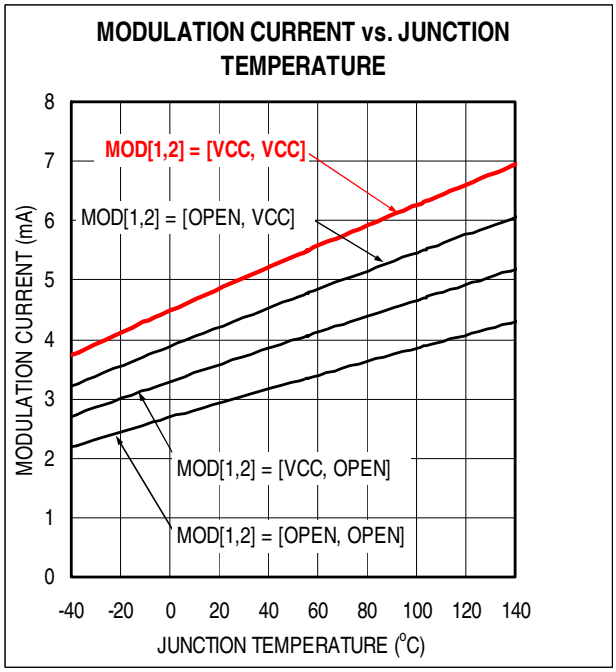

Figure 4. Modulation Current vs. Temperature.

3.4 Select DT0

The temperature DT0 is the center of the temperature-stable low-state current region. This should roughly correspond to the T_0 of the VCSEL. For this VCSEL, the correct setting is DT0[1, 2] = [OPEN, OPEN].

3.5 Comparison of Recommended Current and MAX3905 Output Current

The output current profile of the MAX3905 is compared with the Ulm Photonics recommended profile in Figure 5.

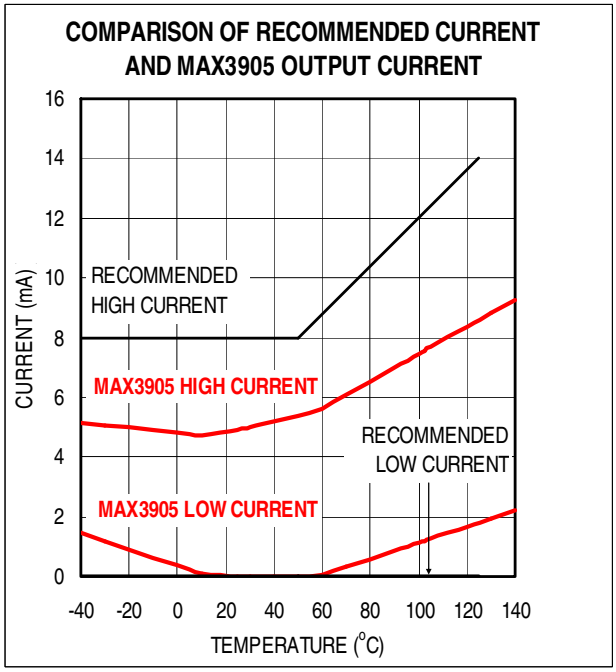

Figure 5. Comparison of Ulm Photonics - Recommended Current and MAX3905 Output Current.

4 Measured Performance

4.1 OMA Performance

The optical modulation amplitude of the MAX3905 with the Ulm Photonics VCSEL meets the MOST OMA specification with a typical margin of greater than 5dB (Figure 6). This gives the module designer flexibility to account for VCSEL coupling loss and VCSEL variation.

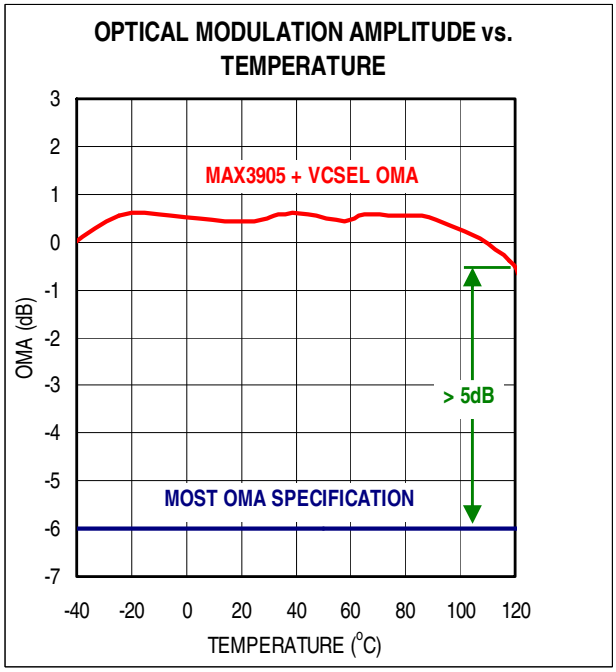

Figure 6. Optical Modulation Amplitude vs. Temperature.

4.2 P_{AVE} Performance

The average power of the MAX3905 with the Ulm Photonics VCSEL meets the MOST P_{AVE} specification (Figure 7). This configuration produces a relatively high average power with margin for optical loss.

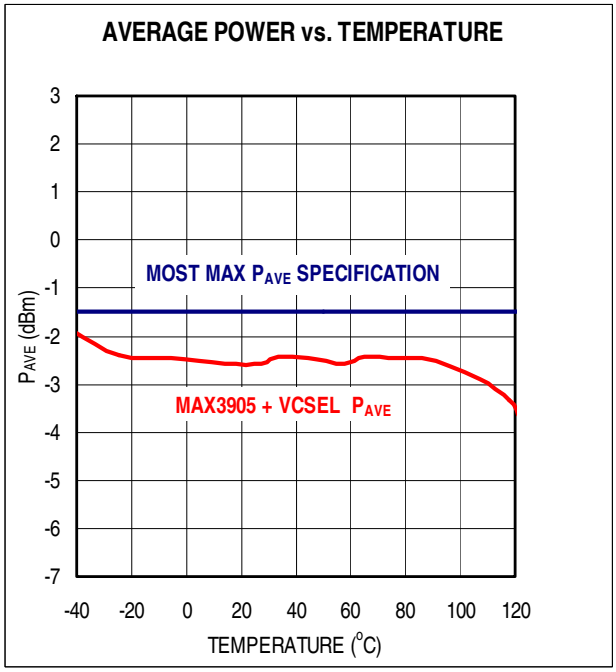

Figure 7. Average Power vs. Temperature.

5 Wirebonding Connections and Diagram

The MAX3905 chip topography is shown in Figure 8, with the TEST pad at pad 4. The wirebond connections are shown in Table 1.

Table 1. Wirebond Connections.

PAD NUMBER	PAD NAME	CONNECTION
4	TEST (N.C.)	VCC
11	DT01	OPEN
12	DT02	OPEN
13	MOD2	VCC
14	MOD1	VCC
21	TC1	OPEN
22	TC2	GND
23	TC3	OPEN
24	LOW1	OPEN
25	LOW2	OPEN

6 Conclusion

The performance of the MAX3905 VCSEL Driver and the ULM850-01-TN-S05AUT VCSEL meets the MOST Advanced Optical Physical Layer specification with margin. The two devices provide a complete physical layer solution for the MOST automotive optical transmitter.

7 References

1. MOST Advanced Optical Physical Layer Draft 0.9.

2. Application Note: "VCSELs for Automotive Applications," Ulm Photonics, February 2005.

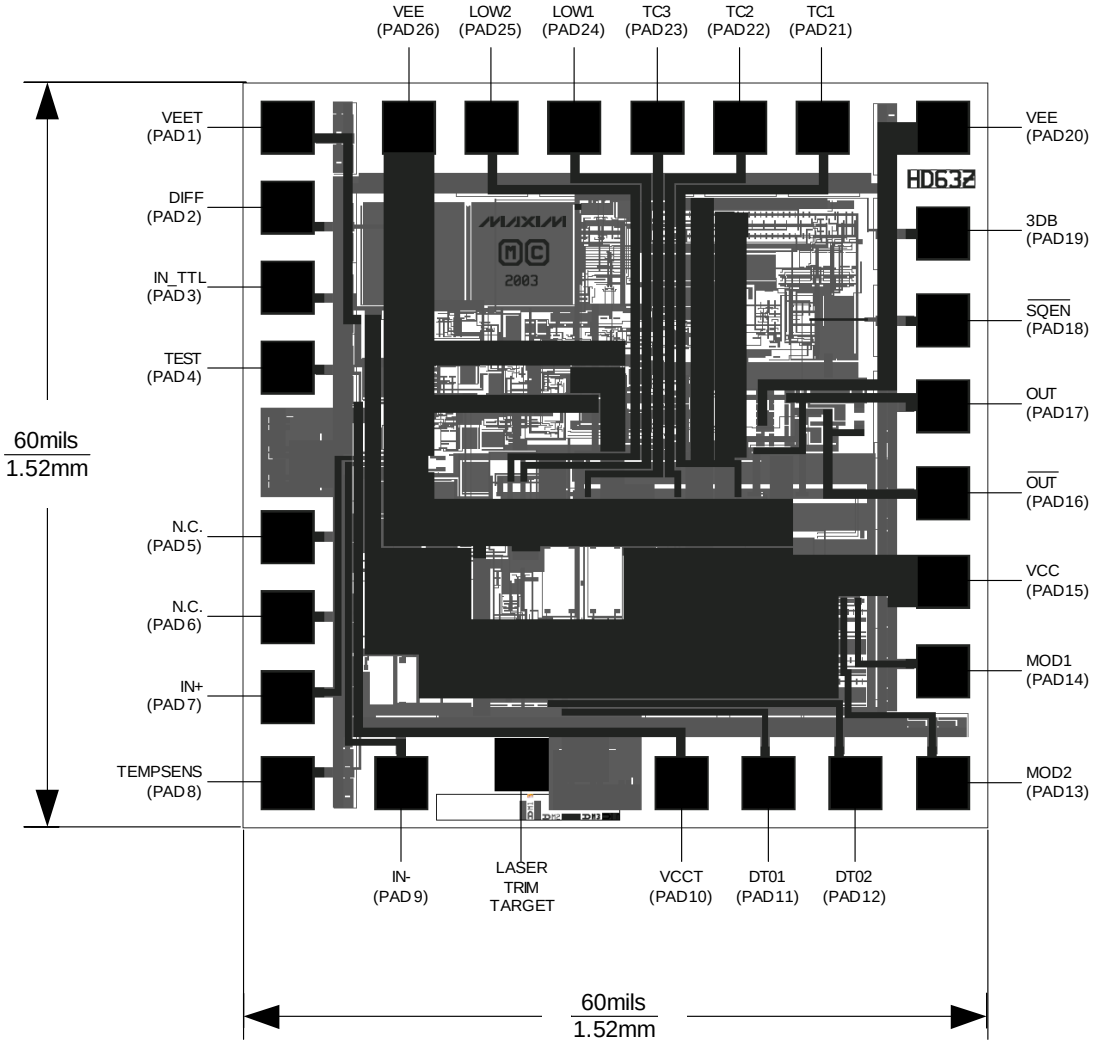

Figure 8. MAX3905 Chip Topography

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