

# AFCT-5971LZ/ALZ

+3.3V Single Mode Fiber Transceivers for Fast Ethernet/  
EFM Baseline 100BASE-LX10 Standard Compliant



## Characterization Report

### Introduction

The AFCT-5971xxZ transceiver is a high performance, cost effective module for serial optical data communications applications specified for a signal rate of 125 MBd. It is designed for Fast Ethernet applications and complied to EFM baseline 100BASE-LX10 standard over dual single mode fiber.

The module is intended for single mode fiber, operates at a nominal wavelength of 1300 nm. It incorporates Avago's high performance, reliable, long wavelength optical devices and proven circuit technology to give long life and consistent service.

This characterization was performed using AFCT-5971ALZ devices and is therefore representative of both AFCT-5971ALZ (-40°C to +85°C) and AFCT-5971LZ (0°C to +70°C) variants.

The characterization was performed in accordance with Bellcore Specification TA-NWT-000983.

### Summary

- The characterization demonstrates that the AFCT-5971ALZ/LZ complied with the Product Specification
- Typical Receiver Sensitivity: -34dBm

This report details the characterization work performed on the AFCT-5971ALZ SFF Single Mode Transceiver. The report evaluates the AFCT-5971ALZ performance under all conditions against target parameters in the product specification. The following parameters were evaluated over the supply voltage range of 3.1 V to 3.5 V and over a temperature range of -40°C, +25°C and +85°C:

- Output Power
- Extinction Ratio
- Transmitter Supply Current
- Eye Mask
- Receiver Supply Current
- Sensitivity
- Signal Detect Threshold
- Signal Detect Hysteresis.

EFM (IEEE 802.3ah- 2004) mask compliant eye diagrams are also presented.

A reference standard device which was not exposed to the environmental stress was reviewed daily to confirm measurement repeatability of the ATE.

## **Definition of Terms**

### ***Output Power (dBm)***

This measures the optical output of the laser transmitter modulated with a 125Mb/s, EFM baseline wander pattern as specified in IEEE 802.3ah- 2004. The output power is measured at a point after the first connector in order to account for the LC connector loss. To accomplish this, the optical output is coupled to a large area detector by a short patchcord.

### ***Extinction Ratio***

The extinction ratio measures the ratio of the output power of the light in a "1" or the "on" logic state to the output power of the light in a "0" or the "off" logic state.

### ***Transmitter Supply Current (mA)***

This is the current supplied to the transmitter at the stated supply voltage excluding the PECL termination resistances.

### ***Eye Mask***

The eye mask was measured using an Avago 83480A Communications Analyzer with an optical input module through a 125 Mb/ filter as defined in Fast Ethernet standards. The measurements are made using the IEEE 802.3ah mask pattern where no hits are allowed within the eye mask.

### ***Receiver Supply Current (mA)***

This is the current supplied to the receiver at the stated supply voltage excluding the PECL termination resistances.

### ***Sensitivity (dBm)***

This measures the minimum received optical power which returns an error free response (bit error rate of  $1 \times 10^{-10}$ ) to a 125Mb/s, baseline wander pattern. An Avago 8156A optical attenuator was calibrated to display the power level present at the receiver input port. The optical input power to the receiver was reduced until errors were displayed on an Avago 70842B error detector. The optical input power to the device was increased to produce no errors, then subsequently reduced in 0.1 dB steps until zero errors were displayed on the error detector for a BER of  $1 \times 10^{-10}$ . The power level prior to a detected error measurement is recorded as the sensitivity.

### ***Signal Detect Threshold (dBm)***

This is the optical power level that causes the device's Signal Detect circuit to switch on (Logic "low") due to optical signal loss. It is measured by decreasing the optical power from a known point using an Avago 8156A optical attenuator calibrated to display the power level present at the receiver port at which the logic output switches.

### ***Signal Detect Hysteresis (dB)***

This is the difference between the Signal Detect Threshold value and the value at which the signal detect voltage returns to the "high state" in response to an increased optical signal.

### ***Temperature (°C)***

The Tests were conducted in a controlled environment with an approximate airflow of 2 m/s, to ensure that the devices under test had settled to the required temperature  $\pm 1^\circ\text{C}$ .

## **Characterization**

### ***General***

Figure 1 depicts the Test Configuration used to collect data presented in the report. The characterization of the AFCT-5971ALZ was performed at 3.1V, 3.3V and 3.5V over the operating temperature range ( $-40^\circ\text{C}$ ,  $+25^\circ\text{C}$  and  $+85^\circ\text{C}$ ) to confirm compliance with the product specification at the supply voltage extremes.

The following parameters were recorded for each device:

- Output Power
- Extinction Ratio
- Transmitter Supply Current
- Eye Mask
- Receiver Supply Current
- Sensitivity
- Signal Detect Threshold
- Signal Detect Hysteresis

Only summaries of the results are shown in this report. All results are available for inspection at Avago.

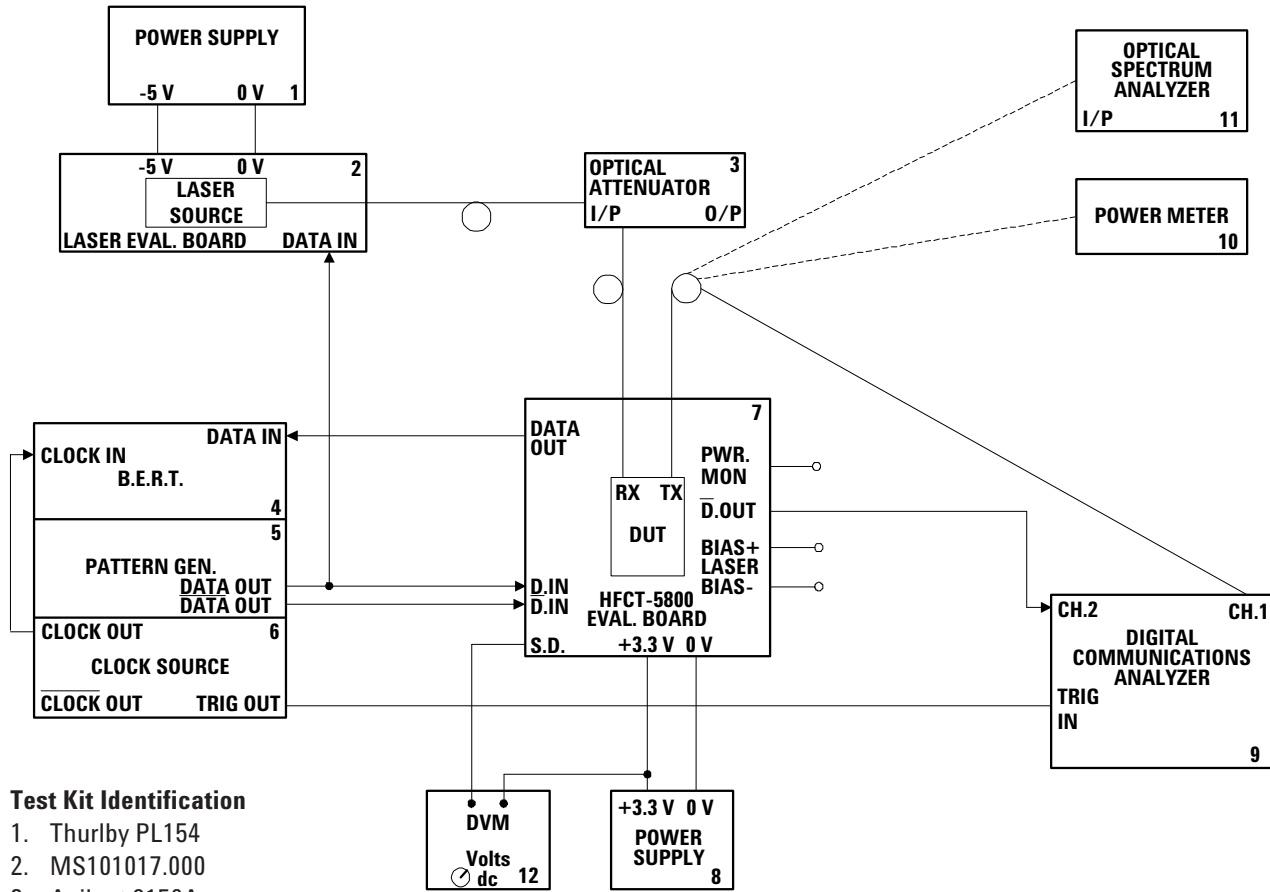


Figure 1. Test Configuration

## Results

Table 1 reports results from the extreme single point and mean measurements against the Product Specification at the minimum and maximum supply voltages (3.1 and 3.5 V) and over the operating temperature range (-40°C, +25°C and +85°C). Table 2 reports the extreme single point and mean measurements against the Product specification at 3.3 V and the operating temperature range (-40°C, +25°C and +85°C).

These results demonstrate that all the devices meet the test limits outlined in the Product Specification.

The tables in Appendix A contain a more detailed set of data featuring results taken for each parameter. Results of each specific measurement are held on file at Avago.

**Table 1. AFCT-5971ALZ Maximum, minimum and mean measured parameters at Vcc = 3.1V and 3.5V over the operating temperature range compared to product specification limits.**

| Parameter                | Unit | Mean   | Minimum | Maximum | Product Specification |     |
|--------------------------|------|--------|---------|---------|-----------------------|-----|
|                          |      |        |         |         | Min                   | Max |
| Output Power             | dBm  | -10.53 | -12.68  | -8.44   | -15                   | -8  |
| Extinction Ratio         | dB   | 13.02  | 9.19    | 15.7    | 6                     | -   |
| Tx Supply Current        | mA   | 50.96  | 38      | 69      | -                     | 140 |
| Rx Supply Current        | mA   | 104    | 96      | 112     | -                     | 140 |
| Sensitivity              | dBm  | -33.22 | -36.05  | -32.03  | -                     | -25 |
| Signal Detect Threshold  | dBm  | -39.34 | -40.08  | -38.1   | -45                   | -   |
| Signal Detect Hysteresis | dBm  | 1.67   | 1.49    | 1.79    | 0.5                   | 4   |

**Table 2. AFCT-5971ALZ Maximum, minimum and mean measured parameters at Vcc = 3.3V over the operating temperature range compared to product specification limits.**

| Parameter                | Unit | Mean   | Minimum | Maximum | Product Specification |     |
|--------------------------|------|--------|---------|---------|-----------------------|-----|
|                          |      |        |         |         | Min                   | Max |
| Output Power             | dBm  | -10.68 | -12.01  | -8.42   | -15                   | -8  |
| Extinction Ratio         | dB   | 13.3   | 9.92    | 15.62   | 6                     | -   |
| Tx Supply Current        | mA   | 51.18  | 38      | 68      | -                     | 140 |
| Rx Supply Current        | mA   | 103.2  | 100     | 107     | -                     | 140 |
| Sensitivity              | dBm  | -34.4  | -35.76  | -32.04  | -                     | -25 |
| Signal Detect Threshold  | dBm  | -39.36 | -40.02  | -38.48  | -45                   | -   |
| Signal Detect Hysteresis | dBm  | 1.76   | 1.49    | 1.89    | 0.5                   | 4   |

## Eye Diagram

A typical output eye diagram for an AFCT-5971ALZ at +25°C and 3.3V is displayed in Figure 2. The eye mask was measured through a filter as defined by the IEEE 802.3ah- 2004

Also shown in Figure 3. is a typical unfiltered transmitter output at +25°C and 3.3 V.

## Conclusions

The AFCT-5971ALZ characterization was completed and showed that all the critical parameters meet the Product Specification.

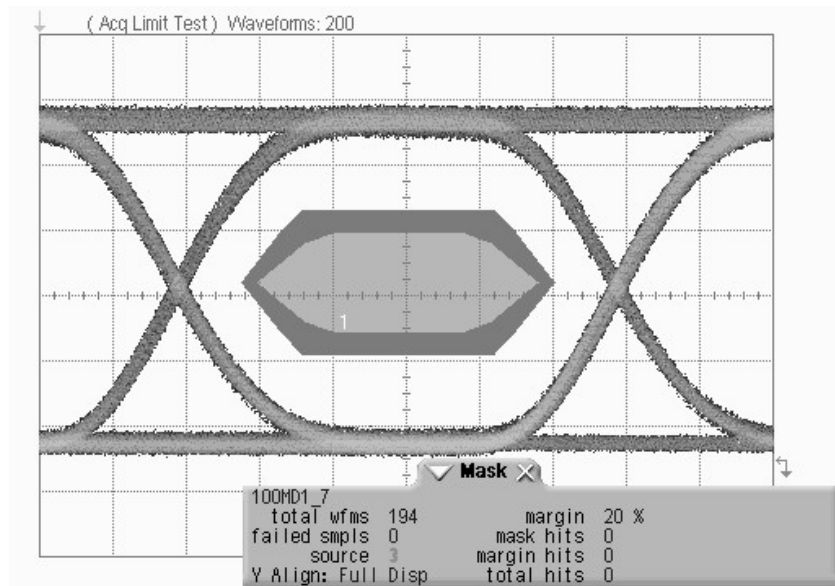


Figure 2. Typical AFCT-5971ALZ Output Eye Diagram at +25°C and 3.3V

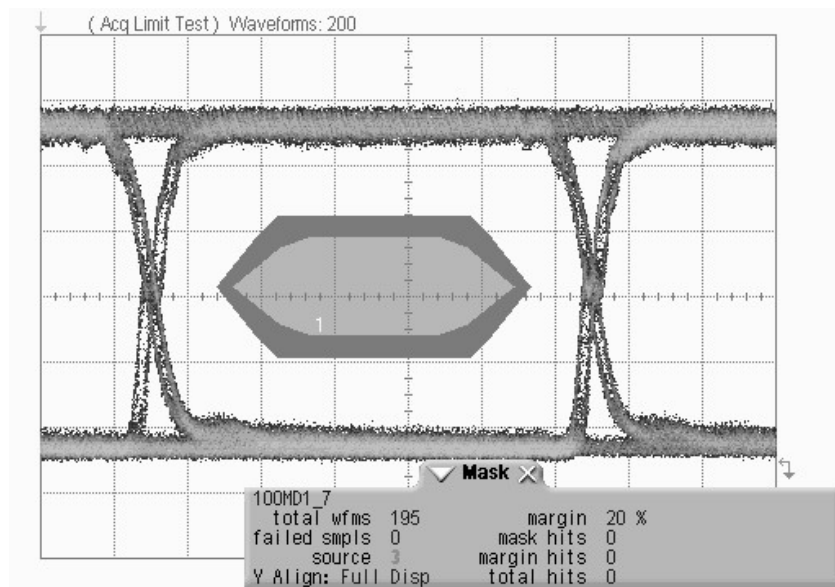


Figure 3. Typical Unfiltered AFCT-5971ALZ Output Eye Diagram at +25°C and 3.3V

## Appendix A. AFCT-5971ALZ measured at +25°C, -40°C and +85°C at 3.1V

### Characterization Results at -40°C, 3.1V

| Parameter                               | Unit | Mean   | Minimum | Maximum |
|---|------|--------|---------|---------|
| Transmitter Supply Current <sup>1</sup> | mA   | 40.8   | 38      | 44      |
| Receiver Supply Current <sup>1</sup>    | mA   | 96.6   | 96      | 98      |
| Output Power                            | dBm  | -10.96 | -12.68  | -9.45   |
| Extinction Ratio                        | dB   | 10.86  | 9.19    | 13.06   |
| Eyemask <sup>2</sup>                    |      | Pass   | Pass    | Pass    |
| Sensitivity                             | dBm  | -35.36 | -35.87  | -34.44  |
| Signal Detect Threshold                 | dBm  | -39.43 | -39.91  | -38.83  |
| Signal Detect Hysteresis                | dB   | 1.68   | 1.6     | 1.8     |

### Characterization Results at +25°C, 3.1V

| Parameter                               | Unit | Mean   | Minimum | Maximum |
|---|------|--------|---------|---------|
| Transmitter Supply Current <sup>1</sup> | mA   | 47.9   | 45      | 50      |
| Receiver Supply Current <sup>1</sup>    | mA   | 99     | 98      | 100     |
| Output Power                            | dBm  | -10.45 | -11.59  | -8.99   |
| Extinction Ratio                        | dB   | 12.43  | 11.2    | 13.24   |
| Eyemask <sup>2</sup>                    |      | Pass   | Pass    | Pass    |
| Sensitivity                             | dBm  | -34.88 | -35.81  | -32.44  |
| Signal Detect Threshold                 | dBm  | -39.23 | -39.71  | -38.53  |
| Signal Detect Hysteresis                | dB   | 1.71   | 1.49    | 1.80    |

### Characterization Results at +85°C, 3.1V

| Parameter                               | Unit | Mean   | Minimum | Maximum |
|---|------|--------|---------|---------|
| Transmitter Supply Current <sup>1</sup> | mA   | 63.2   | 59      | 67      |
| Receiver Supply Current <sup>1</sup>    | mA   | 100.9  | 100     | 101     |
| Output Power                            | dBm  | -10.08 | -10.65  | -8.44   |
| Extinction Ratio                        | dB   | 14.98  | 14.60   | 15.54   |
| Eyemask <sup>2</sup>                    |      | Pass   | Pass    | Pass    |
| Sensitivity                             | dBm  | -34.94 | -36.06  | -31.97  |
| Signal Detect Threshold                 | dBm  | -39.06 | -39.51  | -38.33  |
| Signal Detect Hysteresis                | dB   | 1.67   | 1.60    | 1.80    |

1. Excludes output load current

2. Mask coordinates (X1, X2, X3, Y1, Y2, Y3, Y4) = (0.18, 0.29, 0.35, 0.35, 0.38, 0.4, 0.55)

## AFCT-5971ALZ measured at +25°C, -40°C and +85°C at 3.5V

### Characterization Results at -40°C, 3.5V

| Parameter                               | Unit | Mean   | Minimum | Maximum |
|---|------|--------|---------|---------|
| Transmitter Supply Current <sup>1</sup> | mA   | 48.3   | 45      | 51      |
| Receiver Supply Current <sup>1</sup>    | mA   | 110    | 109     | 111     |
| Output Power                            | dBm  | -10.5  | -11.37  | -8.78   |
| Extinction Ratio                        | dB   | 13.02  | 11.83   | 13.94   |
| Eyemask <sup>2</sup>                    |      | Pass   | Pass    | Pass    |
| Sensitivity                             | dBm  | -33.92 | -34.68  | -32.53  |
| Signal Detect Threshold                 | dBm  | -39.61 | -39.89  | -39.08  |
| Signal Detect Hysteresis                | dB   | 1.68   | 1.59    | 1.80    |

### Characterization Results at +25°C, 3.5V

| Parameter                               | Unit | Mean   | Minimum | Maximum |
|---|------|--------|---------|---------|
| Transmitter Supply Current <sup>1</sup> | mA   | 48.3   | 45      | 51      |
| Receiver Supply Current <sup>1</sup>    | mA   | 110    | 109     | 111     |
| Output Power                            | dBm  | -10.5  | -11.37  | -8.78   |
| Extinction Ratio                        | dB   | 13.02  | 11.83   | 13.94   |
| Eyemask <sup>2</sup>                    |      | Pass   | Pass    | Pass    |
| Sensitivity                             | dBm  | -33.92 | -34.68  | -32.53  |
| Signal Detect Threshold                 | dBm  | -39.61 | -39.89  | -39.08  |
| Signal Detect Hysteresis                | dB   | 1.68   | 1.59    | 1.80    |

### Characterization Results at +85°C, 3.5V

| Parameter                               | Unit | Mean   | Minimum | Maximum |
|---|------|--------|---------|---------|
| Transmitter Supply Current <sup>1</sup> | mA   | 63.7   | 54      | 69      |
| Receiver Supply Current <sup>1</sup>    | mA   | 111.2  | 110     | 112     |
| Output Power                            | dBm  | -10.29 | -11.06  | -8.44   |
| Extinction Ratio                        | dB   | 15.13  | 14.64   | 15.7    |
| Eyemask <sup>2</sup>                    |      | Pass   | Pass    | Pass    |
| Sensitivity                             | dBm  | -32.15 | -32.98  | -30.99  |
| Signal Detect Threshold                 | dBm  | -39.33 | -39.81  | -38.11  |
| Signal Detect Hysteresis                | dB   | 1.66   | 1.5     | 1.7     |

1. Excludes output load current

2. Mask coordinates (X1, X2, X3, Y1, Y2, Y3, Y4) = (0.18, 0.29, 0.35, 0.35, 0.38, 0.4, 0.55)

## AFCT-5971ALZ measured at +25°C, -40°C and +85°C at 3.3V

### Characterization Results at -40°C, 3.3V

| Parameter                               | Unit | Mean   | Minimum | Maximum |
|---|------|--------|---------|---------|
| Transmitter Supply Current <sup>1</sup> | mA   | 41     | 38      | 44      |
| Receiver Supply Current <sup>1</sup>    | mA   | 101    | 100     | 103     |
| Output Power                            | dBm  | -11    | -12.01  | -9.73   |
| Extinction Ratio                        | dB   | 11.21  | 9.92    | 13.2    |
| Eyemask <sup>2</sup>                    |      | Pass   | Pass    | Pass    |
| Sensitivity                             | dBm  | -35.39 | -35.76  | -35.05  |
| Signal Detect Threshold                 | dBm  | -39.69 | -40.03  | -39     |
| Signal Detect Hysteresis                | dB   | 1.73   | 1.59    | 1.80    |

### Characterization Results at +25°C, 3.3V

| Parameter                               | Unit | Mean   | Minimum | Maximum |
|---|------|--------|---------|---------|
| Transmitter Supply Current <sup>1</sup> | mA   | 49     | 47      | 51      |
| Receiver Supply Current <sup>1</sup>    | mA   | 103    | 102     | 104     |
| Output Power                            | dBm  | -10.71 | -11.72  | -10.30  |
| Extinction Ratio                        | dB   | 13.51  | 12.57   | 14.26   |
| Eyemask <sup>2</sup>                    |      | Pass   | Pass    | Pass    |
| Sensitivity                             | dBm  | -34.92 | -35.45  | -34.27  |
| Signal Detect Threshold                 | dBm  | -39.12 | -39.59  | -38.49  |
| Signal Detect Hysteresis                | dB   | 1.83   | 1.69    | 1.89    |

### Characterization Results at +85°C, 3.3V

| Parameter                               | Unit | Mean   | Minimum | Maximum |
|---|------|--------|---------|---------|
| Transmitter Supply Current <sup>1</sup> | mA   | 63     | 57      | 68      |
| Receiver Supply Current <sup>1</sup>    | mA   | 105    | 104     | 107     |
| Output Power                            | dBm  | -10.33 | -10.79  | -8.42   |
| Extinction Ratio                        | dB   | 15.18  | 14.68   | 15.62   |
| Eyemask <sup>2</sup>                    |      | Pass   | Pass    | Pass    |
| Sensitivity                             | dBm  | -32.89 | -34.61  | -32.04  |
| Signal Detect Threshold                 | dBm  | -39.12 | -39.59  | -38.49  |
| Signal Detect Hysteresis                | dB   | 1.74   | 1.50    | 1.89    |

1. Excludes output load current

2. Mask coordinates (X1, X2, X3, Y1, Y2, Y3, Y4) = (0.18, 0.29, 0.35, 0.35, 0.38, 0.4, 0.55)

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