Reliability Prediction Report for the CTF-4G-4TXRX Media Converter, CF-020010-003

Date: **January 26, 2015**

Revision History

Rev.	Date	Reviewers	Description
D1	12/11/2014	Internal	Initial Draft Release for Review
A	12/21/2014	JM, RG	Initial Release
B	1/26/2015	RG	Updated to correct product part number and name

1.0 Objective

This report summarizes the reliability prediction performed on the CTF-4G-4TXRX Media Converter, part number CF-020010-003. The prediction calculates estimated reliability of the product in units of failure rate expressed in failures per million hours (FPMH) and mean time between failure (MTBF). The prediction is based on the quantity, type and quality of components used, environmental factors, applied stresses and other factors significant to overall reliability of the end product. Results of the reliability prediction can serve the following purposes:

- Help satisfy Customer product reliability requirements.
- Help assess the effect of product reliability on system maintenance activity and spares inventory.
- Provide input necessary for unit and system-level Life Cycle Cost analysis.
- Provide input necessary to set in-service performance standards.
- Establish test standards for products requiring a reliability test.
- Identify weak points in the design and assess design trade-offs.
- Provide input necessary for system-level reliability models.

2.0 Executive Summary

Results of the reliability prediction analysis in terms of FPMH and MTBF are shown in the Table 1. The calculated FPMH and MTBF is an integrated value based on operation of the module at various temperatures and duty cycles detailed in paragraph 3.1. The data below represents the steady state failure rate of the products.

Based on the analysis, the CTF-4G-4TXRX Media Converter product has a calculated MTBF of 517,176 hrs. This exceeds the MTBF requirement of 500,000 hrs.

Table 1 - Reliability Prediction Results

DESCRIPTION	PART NUMBER	QTY	FAILURE RATES		
			EA Unit (FPMH)	TOTAL (FPMH)	MTBF (Hrs)
CTF-4G-4TXRX Media Converter	**CF-020010-003**	**1**	**1.934**	**1.934**	**517,176**

3.0 Reliability Prediction Method

Failure rates for individual components and assemblies are calculated using the stress prediction methodology of MIL-HDBK-217F Notice 2. Manufacturers and manufacturer part numbers are taken from the expanded Bill of Materials (BOM) and used to obtain manufacturer datasheets. Manufacturer datasheets define part quality level and other relevant information used to assign the part to a part category defined in MIL-HDBK-217. Where the manufacturer datasheet does not explicitly define these parameters, an estimation is used based on part description, comparison to similar components and/or default assumptions. For each item listed on the BOM part classification, quality level, part and use-environment factors, and quantity are used to determine contribution to overall product failure rate.

Specific ground rules and assumptions used to achieve predicted results are presented in Section 3.1. Summary worksheets that include detailed information for individual components used in all subassemblies are included in Appendix A.

Reliability insignificant components listed on the BOM are not included in the failure rate calculations. Examples are mechanical parts such as screws, standoffs, brackets and adhesives. Similarly documentation structured into the BOM to aid in design or manufacture of the product are also not included.

3.1 Reliability Prediction Assumptions

The following assumptions are used for this analysis:

- Operational environmental factor used: Ground, Benign (G_B). The Ground, Benign environment is defined as: *Nonmobile, temperature and humidity controlled environments readily accessible to maintenance; includes laboratory instruments and test equipment, medical electronic equipment, business and scientific computer complexes, and missile and support equipment in ground silos.*
- Electrical stress data for individual components is assumed to be a worst case value of 50% unless otherwise indicated in Appendix A.
- The prediction is calculated using an integrated operational profile of temperature and duty cycles shown in the Table 2. This profile mimics the anticipated use profile of a fielded converter.

Table 2 - Operating Temperature and Duty Cycle

Operating Temperature	Duty Cycle at Temperature
-40°C	2%
-20°C	5%
+25°C	80%
+40°C	6%
+55°C	5%
+71°C	2%

- Default temperature rise values of 10°C to case and a further 5°C to semiconductor junction are applied to the failure rate calculation for each temperature shown above.
- The Quad Channel Optoelectronic Transceiver, used in the CTF-4G-4TXRX, is a small subassembly module made up of discrete components. Failure rate data for this device is provided by the Original Equipment Vendor (OEM) and is based on RDF 2000, UTE C 80-810, July 2000. Table 3 details the OEM provided failure rate data at each temperature used for this part in the overall CF-020010-003 calculation.

Table 3 - Transceiver Failure Rate Data

Operating Temperature	**Failure Rate (FPMH)**
-40°C	0.249
-20°C	0.250
+25°C	0.278
+40°C	0.274
+55°C	0.292
+71°C	0.320

4.0 Reliability Prediction Analysis

4.1 Prediction Results

The predicted failure rate (FPMH) and MTBF for the CTF-4G-4TXRX Media Converter is summarized in Table 4. The predicted value is an integrated value based on operation of the module at the various temperatures and duty cycles detailed in paragraph 3.1. Contribution to the overall predicted failure rate at each operational temperature and duty cycle is shown in the Table 5 data and graph.

Table 4 - Reliability Prediction Results

DESCRIPTION	PART NUMBER	QTY	FAILURE RATES		
			EA Unit (FPMH)	TOTAL (FPMH)	MTBF (Hrs)
CTF-4G-4TXRX Media Converter	**CF-020010-003**	**1**	**1.934**	**1.934**	**517,176**

Table 5 - Contribution at each Temperature and Duty Cycle

Temp °C	Failure Rate (10^6hrs)	Duty Cycle	Operational Contribution
-40°C	0.440	2%	0.009
-20°C	0.556	5%	0.028
+25°C	1.680	80%	1.344
+40°C	2.731	6%	0.164
+55°C	4.579	5%	0.229
+71°C	8.003	2%	0.160
	Integrated Failure Rate =		**1.934**
	Integrated MTBF =		**517,176**