



# **Echelon Corporation Qualification Report**

## **RoHS-Compliant Transceiver Modules and Control Modules**

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## Scope of Report

This report covers the Echelon transceiver modules and control modules in the table below. Echelon’s approach to qualifying these products can be described as an envelope qualification. Echelon has a great deal of products and several manufacturers. Because of this complexity, qualifying slightly different versions of similar products was impractical. Instead Echelon chose to qualify the most difficult and representative assemblies. This approach involved making and testing five (5) different qualification vehicles (A-E). The table below provides the Echelon model number and description of the various transceiver module and control module products. It then lists the relevant qualification vehicles that apply to that particular model number. The results for the different qualification vehicles are then provided in the subsequent pages.

Model Number	Description	Relevant Qualification Vehicles
50010R-10	TPT/XF-78	A
50020R-10	TPT/XF-1250	A
50040R-02	LPT-11	A, B, & E
55010R-00	TP/XF-78 CONTROL MODULE	C & D
55010R-10	TP-78F FLASH CNTRL MODULE	A & E
55020R-01	TP/FT-10 CONTROL MODULE	C & D
55020R-10	TP/FT-10F FLASH CONTROL MODULE	C & D

## Qualification Vehicle A

Description of Product	Circuit card
PCB material	RoHS-compliant epoxy glass (NEMA FR-4) 4 Layers (1 oz. Cu inner layers and 1.5 oz. Cu outer layers)
PCB Dimensions	1.6" x 2.4" x 0.062" (nominal)
Board Finish	Enthone AlphaSTAR™ Immersion Silver, 6-12 microinches thickness
Solder	SAC305 (96.5% Sn, 3.0% Ag, 0.5% Cu)
Component types	Both SMT and through-hole components
Manufacturing line	A

Test	Conditions	Sample Size	Results
HALT	85°C, 85% R.H. 400 hours Powered but not monitored	30 units (RoHS)	<i>0 failures:</i> -Functional Test -Visual inspection
Thermal Cycling (500)	-25°C to +100°C 20°C/min. ramp-up 20°C/min. ramp-down 10 min. soak 32.5 min./cycle 500 cycles	2 units (RoHS) 2 units (non-RoHS Control*)	<i>0 failures found:</i> -Functional Test -Visual inspection
Thermal Cycling (1000)	-25°C to +100°C 20°C/min. ramp-up/ramp-down 10 min. soak 32.5 min./cycle 1000 cycles	5 units (RoHS) 5 units (non-RoHS Control*)	<i>0 failures found:</i> -Functional Test (done on 2 RoHS and 2 non-RoHS units) -Visual inspection (done on same 2 RoHS and 2 non-RoHS units as functional test) -Pull tests** (done on 3 RoHS and 3 non-RoHS units)
3-Point Bend Test	2% (0.048") deflection on long side (2.4") in both directions	4 units (RoHS) 4 units (non-RoHS Control*)	<i>0 failures found:</i> -Functional test (done on 2 RoHS and 2 non-RoHS units) -Visual inspection (done on same 2 RoHS and 2 non-RoHS units as functional test) -Cross-sections** (done on 2 RoHS and 2 non-RoHS units)
Vibration	3-axis vibration (simultaneous) 2-5000Hz frequency (random) 20g acceleration (peak) 2 hours	4 units (RoHS) 2 units (non-RoHS Control*)	<i>0 failures found:</i> -Functional test -Visual inspection -Cross-sections**

\*Non-RoHS controls used non-RoHS components, non-RoHS PCB's and 63/37 Sn/Pb solder.

\*\*Indicated test was performed on selected, high-risk components on the board, not on every component.

## Qualification Vehicle B

Description of Product	Circuit card SIP
PCB Material	RoHS-compliant epoxy glass (NEMA FR-4) 4 Layers (1 oz. Cu inner layers and 1.5 oz. Cu outer layers)
PCB Dimensions	0.72" x 1.10" x 0.026" (nominal)
Board Finish	Enthone Entek® Plus CU-106A(X) HT
Solder	SAC305 (96.5% Sn, 3.0% Ag, 0.5% Cu)
Component types	SMT components only
Manufacturing line	A

Test	Conditions	Sample Size	Results
HALT	85°C, 85% R.H. 400 hours Powered but not monitored	30 units (RoHS)	0 failures: -Functional Test -Visual inspection
Thermal Cycling (500)	-25°C to +100°C 20°C/min. ramp-up 20°C/min. ramp-down 10 min. soak 32.5 min./cycle 500 cycles	1 unit (RoHS) 1 unit (non-RoHS Control*)	0 failures found: -Functional Test -Visual inspection
Thermal Cycling (1000)	-25°C to +100°C 20°C/min. ramp-up/ramp-down 10 min. soak 32.5 min./cycle 1000 cycles	5 units (RoHS) 5 units (non-RoHS Control*)	0 failures found: -Functional Test (done on 2 RoHS and 2 non-RoHS units) -Visual inspection (done on same 2 RoHS and 2 non-RoHS units as functional test) -Pull tests** (done on 3 RoHS and 3 non-RoHS units)
3-Point Bend Test	2% (0.022") deflection on long side (1.10") in both directions	4 units (RoHS) 4 units (non-RoHS Control*)	0 failures found: -Functional test (done on 2 RoHS and 2 non-RoHS units) -Visual inspection (done on same 2 RoHS and 2 non-RoHS units as functional test) -Cross-sections** (done on 2 RoHS and 2 non-RoHS units)

\*Non-RoHS controls used non-RoHS components, non-RoHS PCB's and 63/37 Sn/Pb solder.

\*\*Indicated test was performed on selected, high-risk components on the board, not on every component.

## Qualification Vehicle C

Description of Product	PCI Card
PCB Material	RoHS-compliant epoxy glass (NEMA FR-4) 6 Layers (1/2 oz. Cu inner layers and 1 oz. Cu outer layers)
PCB Dimensions	2.54" x 4.72" x 0.062" (nominal)
Board Finish	Enthone AlphaSTAR™ Immersion Silver, 6-12 microinches thickness
Solder	SAC305 (96.5% Sn, 3.0% Ag, 0.5% Cu)
Component types	Both SMT and through-hole components
Manufacturing line	B

Test	Conditions	Sample Size	Results
HALT	85°C, 85% R.H. 400 hours Powered but not monitored	30 units (RoHS)	0 failures: -Functional Test -Visual inspection
Thermal Cycling (500)	-25°C to +100°C 20°C/min. ramp-up 20°C/min. ramp-down 10 min. soak 32.5 min./cycle 500 cycles	2 units (RoHS) 2 units (non-RoHS Control*)	0 failures found:** -Functional Test -Visual inspection
Thermal Cycling (1000)	-25°C to +100°C 20°C/min. ramp-up/ramp-down 10 min. soak 32.5 min./cycle 1000 cycles	5 units (RoHS) 5 units (non-RoHS Control*)	0 failures found:*** -Functional Test (done on 2 RoHS and 2 non-RoHS units) -Visual inspection (done on same 2 RoHS and 2 non-RoHS units as functional test) -Pull tests**** (done on 3 RoHS and 3 non-RoHS units) -Cross-sections**** (done on 3 RoHS and 3 non-RoHS units)
3-Point Bend Test	2% (0.094") deflection on long side (4.72") in both directions	4 units (RoHS) 4 units (non-RoHS Control*)	0 failures found: -Functional test (done on 2 RoHS and 2 non-RoHS units) -Visual inspection (done on same 2 RoHS and 2 non-RoHS units as functional test) -Cross-sections**** (done on 2 RoHS and 2 non-RoHS units)

## Qualification Vehicle C (Continued)

Vibration	3-axis vibration (simultaneous) 2-5000Hz frequency (random) 20g acceleration (peak) 2 hours	4 units (RoHS) 4 units (non-RoHS Control*)	<i>0 failures found:</i> -Functional test -Visual inspection -Cross-sections****
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\*Non-RoHS controls used non-RoHS components, non-RoHS PCB's and 63/37 Sn/Pb solder.

\*\*There were internal component failures in 1 RoHS and 1 non-RoHS unit. These were unrelated to the PCBA materials or inherent PCBA reliability.

\*\*\* Components with Alloy 42 leadframes could withstand 500 but not 1000 accelerated temperature cycles (both RoHS and non-RoHS). This is related to the high stiffness of the Alloy 42 leadframe. In one representative product that Echelon has been shipping for 7 years, no failure analysis performed on a returned unit has ever seen an issue with eutectic solder joints made to Alloy 42 leadframe components. It can be inferred that the severity of the accelerated temperature cycling is greater than the actual use-case conditions of the parts.

\*\*\*\*Indicated test was performed on selected, high-risk components on the board, not on every component.

## Qualification Vehicle D

Description of Product	Type II PC Card
PCB Material	RoHS-compliant epoxy glass (NEMA FR-4) 4 Layers (1 oz. Cu inner layers and 1.5 oz. Cu outer layers)
PCB Dimensions	1.91" x 3.03" x 0.018" (nominal)
Board Finish	Enthone Entek® Plus CU-106A(X) HT
Solder	SAC305 (96.5% Sn, 3.0% Ag, 0.5% Cu)
Component types	SMT components only
Manufacturing line	B

Test	Conditions	Sample Size	Results
HALT	65°C, 85% R.H. 1000 hours Powered but not monitored	30 units (RoHS)	0 failures:* -Functional Test -Visual inspection
Thermal Cycling (500)	-25°C to +100°C 20°C/min. ramp-up 20°C/min. ramp-down 10 min. soak 32.5 min./cycle 500 cycles	2 unit (RoHS) 2 unit (non-RoHS Control**)	0 failures found: -Functional Test -Visual inspection
Thermal Cycling (1000)	-25°C to +100°C 20°C/min. ramp-up/ramp-down 10 min. soak 32.5 min./cycle 1000 cycles	5 units (RoHS) 5 units (non-RoHS Control**)	0 failures found:*** -Functional Test (done on 2 RoHS and 2 non-RoHS units) -Visual inspection (done on same 2 RoHS and 2 non-RoHS units as functional test) -Pull tests**** (done on 3 RoHS and 3 non-RoHS units)
3-Point Bend Test	2% (0.061") deflection on long side (3.03") in both directions	4 units (RoHS) 4 units (non-RoHS Control**)	0 failures found: -Functional test (done on 2 RoHS and 2 non-RoHS units) -Visual inspection (done on same 2 RoHS and 2 non-RoHS units as functional test) -Cross-sections**** (done on 2 RoHS and 2 non-RoHS units)

\*There were internal component failures in one unit after 500 hours and in another after 1000. These were unrelated to the PCBA materials or inherent PCBA reliability.

\*\*Non-RoHS controls used non-RoHS components, non-RoHS PCB's and 63/37 Sn/Pb solder.

\*\*\*Components with Alloy 42 leadframes could withstand 500 but not 1000 accelerated temperature cycles (both RoHS and non-RoHS). This is related to the high stiffness of the Alloy 42 leadframe. In one representative product that Echelon has been shipping for 7 years, no failure analysis performed on a returned unit has ever seen an issue with eutectic solder joints made to Alloy 42 leadframe components. It can be inferred that the severity of the accelerated temperature cycling is greater than the actual use-case conditions of the parts.

\*\*\*\*Indicated test was performed on selected, high-risk components on the board, not on every component.

## Qualification Vehicle E

Description of Product	PCBA from larger product
PCB Material	RoHS-compliant epoxy glass (NEMA FR-4) 8 Layers (1 oz. Cu inner layers and 1.5 oz. Cu outer layers)
PCB Dimensions	2.28" x 5.04" x 0.063" (nominal)
Board Finish	Enthone Entek® Plus CU-106A(X) HT
Solder	SAC305 (96.5% Sn, 3.0% Ag, 0.5% Cu)
Component types	Both SMT and through-hole components
Manufacturing line	A

Test	Conditions	Sample Size	Results
HALT	65°C, 85% R.H. 1000 hours Powered but not monitored	22 units (RoHS) 3 units (non-RoHS Control*)	0 failures: -Functional Test -Visual inspection
Thermal Cycling (500)	-25°C to +100°C 20°C/min. ramp-up 20°C/min. ramp-down 10 min. soak 32.5 min./cycle 500 cycles	2 units (RoHS) 2 units (non-RoHS Control*)	0 failures found: -Functional Test -Visual inspection
Thermal Cycling (1000)	-25°C to +100°C 20°C/min. ramp-up/ramp-down 10 min. soak 32.5 min./cycle 1000 cycles	5 units (RoHS) 5 units (non-RoHS Control*)	0 failures found:** -Functional Test (done on 2 RoHS and 2 non-RoHS units) -Visual inspection (done on same 2 RoHS and 2 non-RoHS units as functional test) -Pull tests*** (done on 3 RoHS and 3 non-RoHS units) -Cross-sections*** (done on 3 RoHS and 3 non-RoHS units)
3-Point Bend Test	2% (0.101") deflection on long side (5.04") in both directions	4 units (RoHS) 4 units (non-RoHS Control*)	0 failures found: -Functional test (done on 2 RoHS and 2 non-RoHS units) -Visual inspection (done on same 2 RoHS and 2 non-RoHS units as functional test) -Cross-sections*** (done on 2 RoHS and 2 non-RoHS units)



## Qualification Vehicle E (Continued)

Vibration	3-axis vibration (simultaneous) 2-5000Hz frequency (random) 20g acceleration (peak) 2 hours	4 units (RoHS) 4 units (non-RoHS Control*)	<i>0 failures found:</i> -Functional test -Visual inspection -Cross-sections***
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\*Non-RoHS controls used non-RoHS components, non-RoHS PCB's and 63/37 Sn/Pb solder.

\*\* Components with Alloy 42 leadframes could withstand 500 but not 1000 accelerated temperature cycles (both RoHS and non-RoHS). This is related to the high stiffness of the Alloy 42 leadframe. In one representative product that Echelon has been shipping for 7 years, no failure analysis performed on a returned unit has ever seen an issue with eutectic solder joints made to Alloy 42 leadframe components. It can be inferred that the severity of the accelerated temperature cycling is greater than the actual use-case conditions of the parts.

\*\*\*Indicated test was performed on selected, high-risk components on the board, not on every component.