LX DFMEA Report


AirLink LX60


AirLink LX40

Information

FMEA (Failure Mode Effects Analysis) is a technique to assist in identifying possible points of failure and quantifying the risk. This method is somewhat subjective in estimating potential errors, especially with regard to likelihood of occurrence.

The RPN (Risk Potential Number) is the multiplication of Severity (S), Occurrence (O) and Detection (D).

Severity: this ranking, based on 1 to 10, 10 being the most severe of failure, is what is most important to the operation of the device with regards to the customer.

Occurrence: is the ranking of the probability of a failure occurring during the lifetime of the product, in this failure mode. Ranking is 1 - 10, with least likely ranked at 1, and most likely (definitely) ranked as 10.

Detection: is the probability of the failure being detected, before a failure occurs. Ranking on 1 -10 where highly likely to be detected a 1 and least likely a 10.

The table listing below will take the maximum of the areas being evaluated.

The Red/Amber/Green traffic light limits are set by the values entered below. Set the limits to what is considered appropriate. This is product specific.

Red limit is set for anything equal and above 126.

Green is set for anything equal or below 25.

Amber is between 81 and 125.

	Max RPN	Action RPN
Cell_WiFi	80	10
Interface DMFEA	288	24
Power DMFEA	108	24
GNSS DFMEA	175	24
HW Tech DFMEA	315	16

Instructions

Each worksheet is a listing of the requirements, as listed in the MRD. Fields to fill in:

Function or process: What is expected to happen

Failure: Nature of the failure

Impact: What is the impact of the failure

*Severity (1-10): 1 being least, 10 being most severe

Cause: What caused the failure

*Occurrence (1-10): 1 least likely to occur, 10 most likely to occur

Detection (1-10): 1 easy to detect, 10 most difficult to detect

**RPN: Calculated field (S*O*D)

Action: Aware of risk, what can be done.

*Severity_with action: 1-10

*Occurrence_with action: 1-10

*Detection_with action: 1-10

** RPN: recalculation when actions are applied.

Add possible failure modes as necessary to the section most appropriate.

Example

Requirement - Printing will be 16 pt font.

Process: Expect to see font on device at ~16 pt.

Failure: Font greater than 16 pt.

Impact: Over runs viewing window

Severity: 3

Cause: Instruction to printer communications failed.

Occurrence: 8

Detection: 5

RPN: 120 <- calcuated 3*8*5

Action: Instruction to printer and on drawing

Severity_A: 3

Occurrence: 1

Detection_A: 3

RPN_A: 9 <- calculated 3*1*3

Cellular/Wi-Fi

Req ID	Vers	Requirement Category	Requirement Title	Requirement Description	Function or Process	Failure	Impact	Severity	Cause	Occurance	Detection	RPN	Actions	Severity_after Actions	Occurance_after Actions	Detection_after Actions	RPN_after Actions
01.02.01	1	01 - Air Interfaces & Technologies	Cellular CF3 module support	Support CAT4 WP7xxx modules	Cellular network comm	Cellular module not functioning	No cellular connection or intermitent communication	10	PCB failure	4	2	80	Design qualification, Automated factory test	5	1	2	10
	1	01 - Air Interfaces & Technologies	To provide LTE RF TX / RX	Meet certification, Tx power and Rx sensitivity requirements	Cellular network comm	No function or degraded function	No call or Reduced celluar coverage	10	- Matching circuit (missing/short) - SMA connector failure	4	2	80	Design qualification, Automated factory test	5	1	2	10
01.04.01	1	01 - Air Interfaces & Technologies	To provide WiFi AP Dual Band Support	802.11n/ac Wi-Fi 2.4/5GHz Band Support 1x1 MIMO	WiFi Access Point	No Wireless Network function	Cannot associate, reduced range	9	- Matching circuit (missing/short) - SMA connector failure	4	2	72	Design qualification, Automated factory test, WiFi STA loading test	5	1	2	10
		01 - Air Interfaces & Technologies	To provide WiFi STA Dual Band Support	802.11n/ac Wi-Fi 2.4/5GHz Band Support 1x1 MIMO	WiFi Station	No Wireless Network function	Cannot associate, reduced range	9	- Matching circuit (missing/short) - SMA connector failure	4	2	72	Design qualification, Automated factory test, WiFi AP Test	5	1	2	10

Interfaces

Req ID	Vers	Requirement Category	Requirement Title	Requirement Description	Function or Process	Failure	Impact	Severity	Cause	Occurance	Detection	RPN	Actions	Severity_after Actions	Occurance_after Actions	Detection_after Actions	RPN_after Actions
02.01.01	1	02 - HW Interfaces	Ethernet	Up to 2x RJ45 10/100/1000 Ethernet	Ethernet connection	Ethernet link doesn't negotiate	No Ethernet access to the unit	10	- Design issue - Manufacturing assembly issue	5	2	100	Design qualification, Automated factory test	7	1	1	7
					Ethernet connection	Cannot reach the expected throughput	Slow connection to the unit	6	PCB design	6	7	252	Ethernet compliance test	6	2	2	24
				HiPot testing up to 2.5KV	Ethernet connection	Ethernet link doesn't negotiate at all or at the expected speed	No Ethernet access or reduced Ethernet access	6	Isolation issue	4	7	168	HiPot testing	6	2	1	12
02.03.01	1	02 - HW Interfaces	4-pin Molex Micro-Fit	Input connector with Power, Gnd, Igt, I/O	Mechanical connection	Cannot connect the power cable	Unit not powered	10	Connector damaged	4	2	80	Improve manufacturing process	10	2	1	20
					Power supply	Cable connected but unit doesn't start	Unit not powered	10	Manufacturing assembly issue (On Power, GND or IGN)	5	1	50	Automated Factory test	10	1	1	10
02.03.02	1	02 - HW Interfaces	I/O	1x GPIO on the power connector with Analogue Function, Digital Input and Output.				6		4	4	96					0
02.04.01	1	02 - HW Interfaces	8-pin Molex Micro-Fit (I/O, CAN, RS485)	4x Digital Input (2 Analog capable) paired with the CAN I/F and RS485	Mechanical connection	Cannot connect the 8 pins cable	I/O, CAN bus and RS-485 non accessible	5	Connector damaged	5	1	25	Improve manufacturing process	5	2	1	10
02.06.01	1	02 - HW Interfaces	RS-232	1x DB9 Female Connector offering: RS-232 Serial Port (DCE 8-wire) RING line (pin 9) to be build option, not installed by default Flow control implemented as a hardware solution.	Serial connection	Loss of RS232 Communication	Intermittent or no serial access	7	- Design issue - Manufacturing assembly issue	3	3	63	Design qualification, Automated factory test	7	1	1	7
02.07.01	1	02 - HW Interfaces	I/O Input Specification	Digital Input 0-Vin V High Impedance (10k-100k) 0-1.0V OFF / 3-Vin V ON Sampling rate 250ms Automotive Transient Protection Optional pull-up to Vin to facilitate dry contacts (default to off)	Digital Input	Digital Input doesn't commute	Wrong value reported	4	- Design issue - Manufacturing assembly issue	4	8	128	Design qualification, Automated factory test	4	1	1	4
					Digital Input	Digital Input commutes at a higher or lower threshold	Threshold from datasheet not respected	4	Design issue	4	9	144	Design qualification	4	1	1	4

02.07.02	1	02 - HW Interfaces	I/O Analog Specification	Analogue Input 0-30V range High Impedance (10-100k) Resolution 0.1V with 0.05V accuracy (10 bit resolution) Sampling rate 250ms Automotive Transient Protection No 'error' when compared to power connector GND	Analog Input	Analog input disconnected	No value reported	4	- Design issue - Manufacturing assembly issue	4	8	128	Design qualification, Automated factory test	4	1	1	4
					Analog Input	Analog Input out of range	Wrong value reported	4	Design issue	4	9	144	Design qualification	4	1	1	

02.07.03	1	02 - HW Interfaces	I/O Output Specification	Open Collector Digital Out with optional pull-up to Vin Capable of driving coil and solid state relays Tolerant of up to Vin V, able to sink 150mA Output Low: < 0.7V Output High: Vin or open collector Automotive Transient Protection Optional pull-up to Vi	Digital Output	Output doesn't commute	Wrong output value	4	- Design issue - Manufacturing assembly issue	4	8	128	Design qualification, Automated factory test	4	1	1	4
02.08.01	1	02 - HW Interfaces	USB	USB 2.0 OTG port via Micro AB connector with Ethernet over USB.	USB 2.0	USB link doesn't enumerate	No USB access to the unit	7	- Design issue - Manufacturing assembly issue	5	4	140	Design qualification, Automated factory test	7	1	1	7
					USB 2.0	Cannot reach the expected throughput	Slow connection to the unit	6	PCB design	6	8	288	USB2.0 compliance test	6	2	2	24
02.09.01	1	02 - HW Interfaces	Reset Button	Functionality: - System reset - Factory default	Unit Reset	No action from Reset button	Cannot perform system reset nor factory reset	8	- Design issue - Manufacturing assembly issue	6	2	96	Design qualification, Automated factory test	8	1	1	8
02.10.01	1	02 - HW Interfaces	SIM	4FF SIM with SIM detect	Radio connectivity	Radio cannot connect to the SIM	Radio cannot go on air	9	- Design issue - Manufacturing assembly issue	4	2	72	Design qualification, Automated factory test	9	1	1	9
02.11.01	1	02 - HW Interfaces	Antenna Connections	See Mechanical section for additional info on layout, separation, torque etc Total 3 SMA Connectors (variable number 1-3 will be populated) LTE (All) Active GNSS (MP only) LTE Diversity (Cat 4 only)													

02.12.01	1	02 - HW Interfaces	Antenna Connections	4 x SMA connectors for LTE 1, LTE2, GNSS, WiFI.	Antennas	Increased insertion loss or intermittent connection	Degraded performance or loss of connection to the cellular network, WiFi network or GPS satellites	9	- Design issue -Manufacturing assembly issue - Faulty cables	6	3	162	Design qualification, Automated factory test	9	1	1	9
02.13.01	1	02 - HW Interfaces	6-Axis MEMs Sensor	Self calibrating MEMS sensors for Driver behavior with 3-axis accelerometer and 3-axis gyro	MEMS	Incorrect data reported by MEMS	Wrong acceleration information reported to the unit	5	- Design issue - Manufacturing assembly issue	6	7	210	Design qualification, Drive test, Automated factory test	5	2	2	20
02.14.01	1	02 - HW Interfaces	Bluetooth LE	Bluetooth LE option	Bluetooth	No function or degraded function	Cannot associate, reduced range	4	- Matching circuit (missing/short) - SMA connector failure	5	7	140	Design qualification, Automated factory test	4	2	3	24
02.15.01	1	02 - HW Interfaces	CAN Interface	CAN interface to support J1939 (Heavy Duty) and ISO 15765 (OBDII). Pins required will be: Ground CANHigh CANLow High/Med Speed CAN transceiver Needs to be protected against vehicle transients	CAN	No communication on the CAN bus	No vehicle telemetry accessible on the unit	5	- Design issue - Manufacturing assembly issue	4	7	140	Design qualification, Automated factory test	5	1	1	5
		2 - HW Interfaces	RS485		RS485	Loss of RS485 Communication	Intermittent or no RS485 access	5	- Design issue - Manufacturing assembly issue	4	8	160	Design qualification, Automated factory test	5	1	1	5

Power

Req ID	Vers	Requirement Category	Requirement Title	Requirement Description	Function or Process	Failure	Impact	Severity	Cause	Occurance	Detection	RPN	Actions	Severity_after Actions	Occurance_after Actions	Detection_after Actions	RPN_after Actions
02.20.01	1	02 - HW Interfaces	Voltage Input	7 to 36V continuous (specified guaranteed operating range)	Power to the device	Loss of power or intermittent power	Device does not function properly	9	-Dirty or unstable power supply -Component or PCB failure	6	2	108	-Design validation -Automated factory test	2	4	2	16
						Power supply anomalies (slow ramp, fast ramp, cycling, noise, inrush currents, etc)	Device does not function properly	6	Dirty or unstable power supply	6	3	108	Design validation	1	4	3	12
						Undervoltage lockout causing loss of power	Device does not function properly	3	-Dirty or unstable power supply -Component or PCB failure	4	5	60	-Design validation -Automated factory test	2	3	4	24
				Reverse Polarity Protection and Ground Faults	Power to the device	Loss of power or damaged components	Device inoperational	10	-Incorrect product installation -Component or PCB failure	4	1	40	-Design validation -Automated factory test	1	4	1	4
				Ability to withstand drops to minimum 5V during engine cranking as per SAE J1113	Power to the device	Brownout causing loss of power	Device resets	5	Engine cranking	4	4	80	Design validation	1	3	4	12
02.21.01	1	02 - HW Interfaces	Supply voltage monitoring	Input voltage monitoring and qualification	Monitors input voltage	Loss of voltage monitoring	Device unable to report input voltage nor qualify its stability	5	Component or PCB failure	2	2	20	-Design validation -Automated factory test	1	1	2	2
02.22.01	1	02 - HW Interfaces	Ignition Pin	Ignition sense monitoring	Monitors and controls power state of device	Loss of ignition sense monitoring	Device fails to power-up or shutdown or intermittently powers on/off	8	-Voltage anomalies caused by vehicle transients or wiring -Component or PCB failutre	2	2	32	-Design validation -Automated factory test	1	1	2	2
02.23.01	1	02 - HW Interfaces	Immunity to Conducted Transients on Power and I/O interfaces	Automotive transients (ISO 7637-2 and ISO 16750-2)	Power supply and I/O immunity	-Intermittent or loss of power -Intermittent or loss of I/O functionality	Device does not function properly	8	Voltage anomalies caused by vehicle transients or wiring	3	3	72	Design validation	2	3	3	18

				Lightning surges (IEC 61000-4-5) and high voltage transients	Power supply and I/O immunity	-Intermittent or loss of power -Intermittent or loss of I/O functionality	Device does not function properly or inoperational	8	Voltage anomalies caused by coupled lightning surges	2	1	16	Design validation	6	2	1	12
				ESD (IEC 61000-4-2)	Power supply and I/O immunity	-Intermittent or loss of power -Intermittent or loss of I/O functionality	Device does not function properly	5	Voltage anomalies caused by electrostatic discharge	3	3	45	Design validation	2	3	3	18
				EFT (IEC 61000-4-4)	Power supply and I/O immunity	-Intermittent or loss of power -Intermittent or loss of I/O functionality	Device does not function properly	6	Voltage anomalies caused by electrical fast transients in environment	3	4	72	Design validation	2	3	4	24
				Conducted Immunity (IEC 61000-4-6)	Power supply and I/O immunity	-Intermittent or loss of power -Intermittent or loss of I/O functionality	Device does not function properly	6	Voltage anomalies caused by noisy electromagnetic environment or cabling	3	4	72	Design validation	2	3	4	24
02.24.01	1	02 - HW Interfaces	Standby Mode	Entry/Exit from Standby mode based upon: Low Voltage (with qualification period) Periodic Timers GPIO Input (with qualification period) (only power connector I/O line)	Standby/Off mode	Unable to enter low power standby mode	Higher than expected power consumption	8	Component or PCB failure	2	1	16	-Design validation -Automated factory test	1	2	1	2
						Unable to exit low power standby mode	Device inoperational	9	Component or PCB failure	2	1	18	-Design validation -Automated factory test	1	2	1	2
02.26.01	1	02 - HW Interfaces	Disabling Interfaces	Ability to power down data interfaces if not in use: USB / Serial / ETH (1/2-port) / GNSS / Wi-Fi / CAN / MEMS	Reducing power consumption	Unable to power down unused interfaces	Higher than expected power consumption	4	Component or PCB failure	2	7	56	-Design validation -Automated factory test	1	1	7	7

GNSS

Req ID	Vers	Requirement Category	Requirement Title	Requirement Description	Function or Process	Failure	Impact	Severity	Cause	Occurance	Detection	RPN	Actions	Severity_after Actions	Occurance_after Actions	Detection_after Actions	RPN_after Actions
02.30.01	1	02 - HW Interfaces	Dedicated GNSS System	Dedicated GNSS module supporting 48 channels with GPS, GLONASS, BeiDou2 and Gallileo.	GNSS	Cannot get a fix	Localisation unavailable	7	- Matching circuit (missing/short) - SMA connector failure - Design issue - Manufacturing assembly issue	5	5	175	Design qualification, Automated factory test	6	2	2	24
02.30.02	1	02 - HW Interfaces	WP Module GNSS System	Build option to use the WP radio module in lieu of standalone. This is because there is no HL module for EMEA so a WP will be soldered down.	GNSS	Cannot get a fix	Localisation unavailable	7	- Matching circuit (missing/short) - SMA connector failure - Design issue - Manufacturing assembly issue	5	5	175	Design qualification, Automated factory test	6	2	2	24
02.31.01	1	02 - HW Interfaces	GNSS System updates	Field updgradable GNSS firmware.	GNSS			6		4	7	168		6	2	2	24

Hardware/Mechanical

Req ID	Vers	Requirement Category	Requirement Title	Requirement Description	Function or Process	Failure	Impact	Severity	Cause	Occurance	Detection	RPN	Actions	Severity_after Actions	Occurance_after Actions	Detection_after Actions	RPN_after Actions
13.01.01	1	13 - Mechanical/Environmental/Reliability	Housing	PCABS Rugged injection moulded plastic casing.	To protect circuit card assembly and provide mechanical support for external interfaces.	Deformation or cracking during lifecycle	PCB/PCA failure. Interfaces unusable.	10	Thermal stress	4	3	120	Design validation, Accelerated life testing	4	2	2	16
						Deformation or cracking during lifecycle	PCB/PCA failure. Interfaces unusable.	10	Product dropped or exposed to mechanical stress	7	1	70	Vibration and shock test Drop test	4	2	2	16
13.03.01	1	13 - Mechanical/Environmental/Reliability	SIM Access	SIM Door with retaining mechanism requiring a tool for access	To ensure SIM communication remains intact.	SIM door opens and SIM disengages	Loss of cellular	10	Product dropped or exposed to thermal/mechanical stress	4	2	80	Temperature stress test. Vibration and shock test. Drop test.	4	2	2	16
13.07.01	1	13 - Mechanical/Environmental/Reliability	Antenna connectors	Antenna connectors will be SMA must withstand installation torque without damage	To ensure antenna connections are engaged.	Antenna disconnected.	Loss of cellular	10	Product dropped or exposed to thermal/mechanical stress	4	4	160	SMA connectors torque tested as part of design validation.	4	1	2	8
			Interface connect	Communication Connectors must be able to maintain integrity after multiple insertions (RJ45, DB9, 2x4, USB).	To provide wired communication.	Wired communication cannot be established.	Cannot transfer data over the hardwire interfaces.	10	Thermal stress	3	2	60	Design validation, Accelerated life testing	4	2	2	16
			Power connector	Power connector must be able to maintain uninterrupted power to the device.	To provide power to the device.	Power interrupted to the device.	Unit fails to power up or is intermittently powered.	10	Thermal stress	4	4	160	Design validation, Accelerated life testing	4	2	2	16
			Heat Sinking	The heatsink for the main processor must always maintain contact with the internal components.	To allow the device to operate to high temperatures.	Thermal overstress to electrical components.	PCB/PCA degradation or damage.	9	Thermal stress	5	7	315	Design validation, Accelerated life testing	4	2	2	16
			Ground Interface	Heatsinks must be connected to the device ground.	To ensure a discharge path for ESD.	ESD overstress to electrical components.	PCB/PCA degradation or damage.	7	Thermal stress	2	9	126	Design validation, Accelerated life testing. ESD stress testing.	4	2	2	16

Document History

Revision number	Release date	Changes
1	January 2021	First release

Legal Notice

Limitation of Liability

The information in this document is subject to change without notice and does not represent a commitment on the part of Sierra Wireless. SIERRA WIRELESS AND ITS AFFILIATES SPECIFICALLY DISCLAIM LIABILITY FOR ANY AND ALL DIRECT, INDIRECT, SPECIAL, GENERAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS OR REVENUE OR ANTICIPATED PROFITS OR REVENUE ARISING OUT OF THE USE OR INABILITY TO USE ANY SIERRA WIRELESS PRODUCT, EVEN IF SIERRA WIRELESS AND/OR ITS AFFILIATES HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES OR THEY ARE FORESEEABLE OR FOR CLAIMS BY ANY THIRD PARTY.

Notwithstanding the foregoing, in no event shall Sierra Wireless and/or its affiliates aggregate liability arising under or in connection with the Sierra Wireless product, regardless of the number of events, occurrences, or claims giving rise to liability, be in excess of the price paid by the purchaser for the Sierra Wireless product.

Patents

This product may contain technology developed by or for Sierra Wireless Inc. This product includes technology licensed from QUALCOMM®. This product is manufactured or sold by Sierra Wireless Inc. or its affiliates under one or more patents licensed from MMP Portfolio Licensing.

Copyright

Trademarks

Sierra Wireless®, AirLink®, AirVantage® and the Sierra Wireless logo are registered trademarks of Sierra Wireless.

Other trademarks are the property of their respective owners.

Contact Information

Sales information and technical support, including warranty and returns	Web: sierrawireless.com/company/contact-us/ Global toll-free number: 1-877-687-7795 6:00 am to 5:00 pm PST
Corporate and product information	Web: sierrawireless.com