

Maxim Philippine Operating Corporation
Special Export Processing Zone
Gateway Business Park
Brgy. Javalera, Gen Trias, Cavite, Philippines



Customer: ECLO LDA

FAR No.: 40045571

FAILURE ANALYSIS REPORT DEVICE TYPE: DS1921G-F5#

DATE: January 9, 2013

A handwritten signature in black ink, appearing to read 'Sumalpong'.

Rane Remie D. Sumalpong
Engineer
Failure Analysis

A handwritten signature in black ink, appearing to read 'Aul Salin'.

Martin Nelson M. Salinas
Engineer,
Failure Analysis

A handwritten signature in black ink, appearing to read 'Jerome L. Escobedo'.

Jerome L. Escobedo
Director,
Failure Analysis

Distribution: Bryan Preeshl; Michael Cairnes; Tracie Johnson; Chris Elipse; Rey Agustin; Ron Jon Aromin

MAXIM PHILIPPINE OPERATING CORPORATION

FAILURE ANALYSIS REPORT

Customer Report #: 40045571

BACKGROUND:

Customer: ECLO LDA
Address: 4-1B, Tv. Venceslau de Morais, Leiria, Leiria, 2400, Portugal
Received: January 3, 2013
Completed: January 9, 2013

Requestor: Michelle Hyland
Phone No.: +353-12235539
Fax No.: not provided
E-mail: Michelle.Hyland@maximintegrated.com

Customer Ref #: not provided
Qty. Returned: 4
Device Type: DS1921G-F5#
Die Type: 90-1921G#F50
RMA #: 150142
Package Type: F5 iButton
Process: E6LA1ES

Reported Failure Mode(s): "They are dead, being impossible to communicate with them using OneWireViewer, only the serial numbers can be read."

Serial Number	ROM ID	Date Code	Lot #	Assembler
1	6C0000002E78E821	1227	MG383607AA	Batangas Assembly
2	3D0000002E717621	1227	MG383607AA	Batangas Assembly
3	520000002E7B0B21	1227	MG383607AA	Batangas Assembly
4	0F0000001BD4D441	1117	MG376815AA	Batangas Assembly

**Note: SN4 is a DS1922L-F5# part.*

Failure Conditions:

☐ Customer's Incoming Electrical Inspection
☐ Qualification/Reliability Evaluation
☐ Field Failure
☐ Internal Evaluation
☐ Production Line
☐ Sample Evaluation
☐ 0 Km/0 Hour
☒ Not Reported (Failure rate and Sample Size not provided)

CONCLUSION:

SN 1 to 3: Units were confirmed as valid electrical failures. Analysis determined that units failed due to depleted battery, which resulted in functional failure. X-ray inspection revealed that the crystal barrel is in contact with the positive terminal of the battery. Internal visual inspection after decanning revealed contact indication of crystal barrel to positive terminal of battery. Battery analysis showed depleted lithium and dry cathode pill.

SN 4: Unit was confirmed as valid electrical failure. Analysis determined that unit failed due to depleted battery, which resulted in functional failure. Battery analysis showed the cause of battery depletion is due to heavy load discharge.

ANALYSIS SUMMARY:

<input type="checkbox"/>	Bake at ___ °C for ___ hrs.	<input checked="" type="checkbox"/>	External Visual
<input checked="" type="checkbox"/>	Curve Trace	<input checked="" type="checkbox"/>	Internal Visual (Low/High Mag.)
<input checked="" type="checkbox"/>	ATE	<input checked="" type="checkbox"/>	Photos Attached
<input checked="" type="checkbox"/>	Bench Test	<input type="checkbox"/>	Passivation Removal
<input type="checkbox"/>	Mechanical Decapsulation	<input type="checkbox"/>	Metal Removal
<input type="checkbox"/>	Chemical Decapsulation	<input type="checkbox"/>	Oxide Removal
<input type="checkbox"/>	Liquid Crystal	<input type="checkbox"/>	Poly Etch
<input type="checkbox"/>	Emission Microscopy	<input type="checkbox"/>	WRIGHT Etch
<input type="checkbox"/>	Cross Section	<input type="checkbox"/>	FIB Cross Section
<input type="checkbox"/>	Scanning Acoustic Microscopy	<input type="checkbox"/>	SEM Inspection
<input type="checkbox"/>	Microprobe	<input checked="" type="checkbox"/>	X-Ray
<input checked="" type="checkbox"/>	Decanning	<input checked="" type="checkbox"/>	Battery Analysis

EXTERNAL VISUAL INSPECTION:

SN 1 to 4: No apparent package anomaly could be observed.

ELECTRICAL VERIFICATION:

ATE Test:

SN 1 to 4: Units were tested on ATE at room temperature (25°C) and failed on Battery Trip Point (VBAT) and other test parameters.

Curve Trace:

SN 1 to 4: No I/V curve anomaly.

Bench Test:

SN 1 to 4: Units were bench tested using DS9090K Evaluation Kit and 1-Wire viewer software. Units were verified failing on bench showing CRC16 error. Temperature and clock could not be read and synchronized.

ANALYSIS DETAILS:

X-Ray:

SN 1 to 3: X-ray inspection revealed crystal barrel to positive battery terminal short. *Refer to figures 1 and 2.*

SN 4: X-ray inspection did not reveal any apparent anomaly.

Decanning/Internal Visual Inspection/Battery Voltage Measurement:

SN 1 to 3: Units were decanned for internal visual inspection. Internal visual inspection revealed indication of crystal barrel to positive battery terminal short. Discolored crystal could also be observed during internal visual inspection. Battery voltages of the units were found to be depleted. *Refer to figures 3 to 5.*

SN 4: Unit was decanned for internal visual inspection. Internal visual inspection did not reveal any apparent anomaly. Battery voltage of the unit was found to be depleted. *Refer to the table below for the battery voltage measurements.*

Serial Number	Battery Voltage
KGU (DS1921)	3.434 V
KGU (DS1922)	3.359 V
SN 1 (DS1921)	0.252 V
SN 2 (DS1921)	0.133 V
SN 3 (DS1921)	0.014 V
SN 4 (DS1922)	0.217 V
ATE Test Limits (DS1921)	Min = 2.80 V Max = 3.50 V
ATE Test Limits (DS1922)	Min = 2.70 V Max = 3.65 V

Battery Analysis:

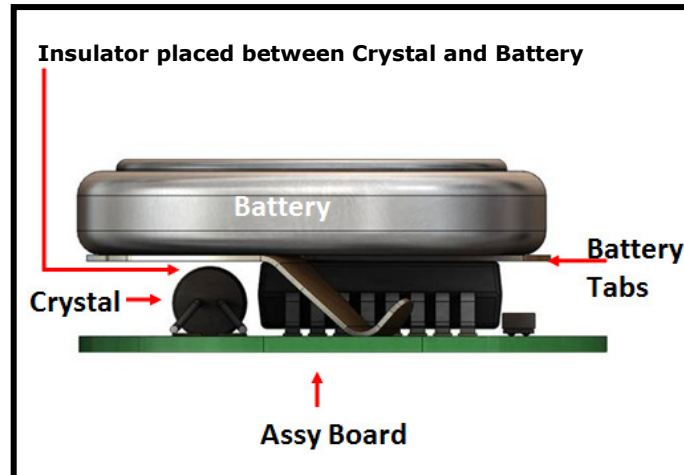
SN 1 and 4 were chosen as representative sample for battery analysis.

SN 1 and 4: Battery of the units was decanned to expose the internal structure of the battery. Internal visual inspection on the batteries revealed dry cathode pill, no lithium on battery can, and dark separator which indicate heavy load discharge. *Refer to figures 6 to 14.*

DISCUSSION:

SN 1 to 3: Units were confirmed as valid electrical failures. Analysis determined that units failed due to depleted battery, which resulted in functional failure. X-ray inspection revealed that the crystal barrel is in contact with the positive terminal of the battery. Internal visual inspection after decanning revealed contact indication of crystal barrel to positive terminal of battery. Battery analysis showed depleted lithium and dry cathode pill. The cause of depleted battery is most likely due to crystal to battery short.

A corrective action was already implemented on DS1921 devices by adding an insulator in a form of Kapton tape in between the crystal and battery tab to prevent crystal to battery short. The units were not included in the corrective action since this was implemented on August 2012 and the units were assembled last week of December 2011. *Below is the DS1921 assembly photo.*



SN 4: Unit was confirmed as valid electrical failure. Analysis determined that unit failed due to depleted battery, which resulted in functional failure. Battery analysis showed the cause of battery depletion is due to heavy load discharge.

Figure 1.

SN 1:

Magnification: n/a

X-ray photo showing the crystal barrel shorted to the connection of positive terminal of the battery.

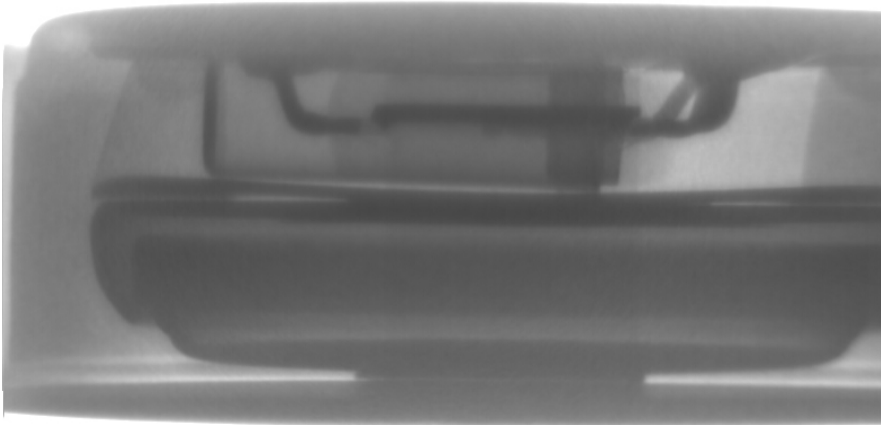


Figure 2.

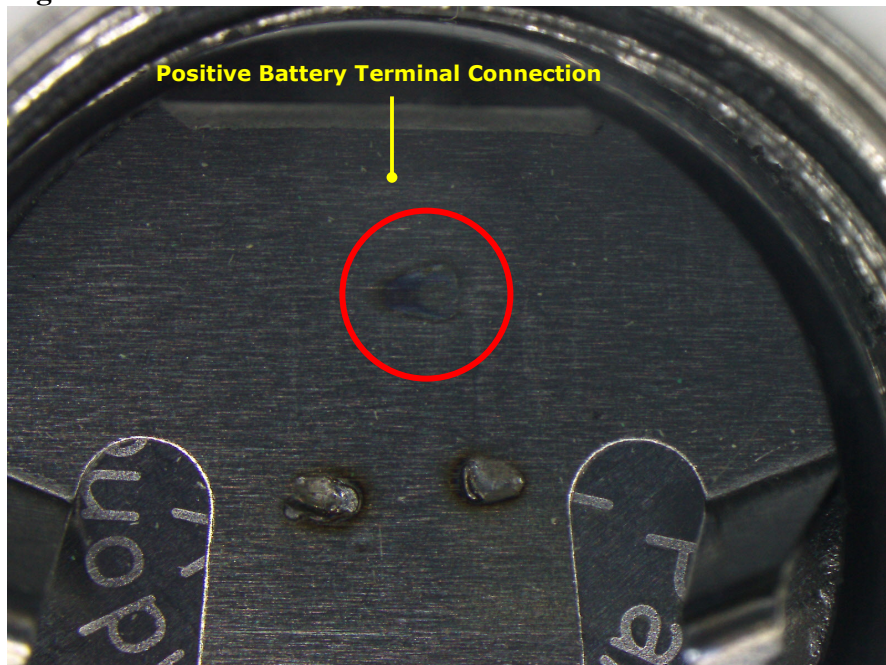
SN 2:

Magnification: n/a

X-ray photo showing the crystal barrel shorted to the connection of positive terminal of the battery.



Figure 3.



SN 1:
Magnification: 12X

Optical photo showing the indication of crystal barrel to positive terminal of the battery short after decanning.

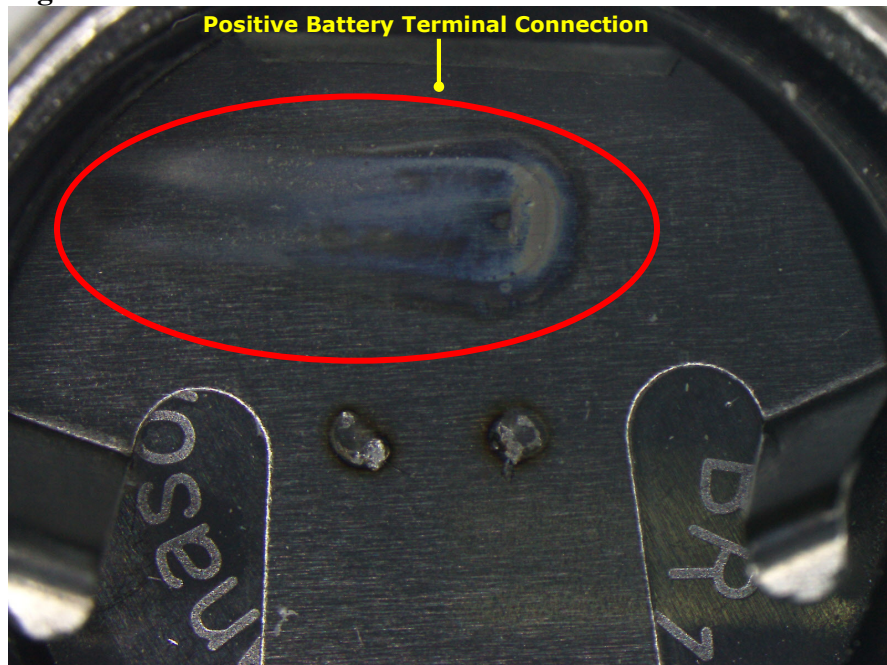
Figure 4.



SN 2:
Magnification: 12X

Optical photo showing the indication of crystal barrel to positive terminal of the battery short after decanning.

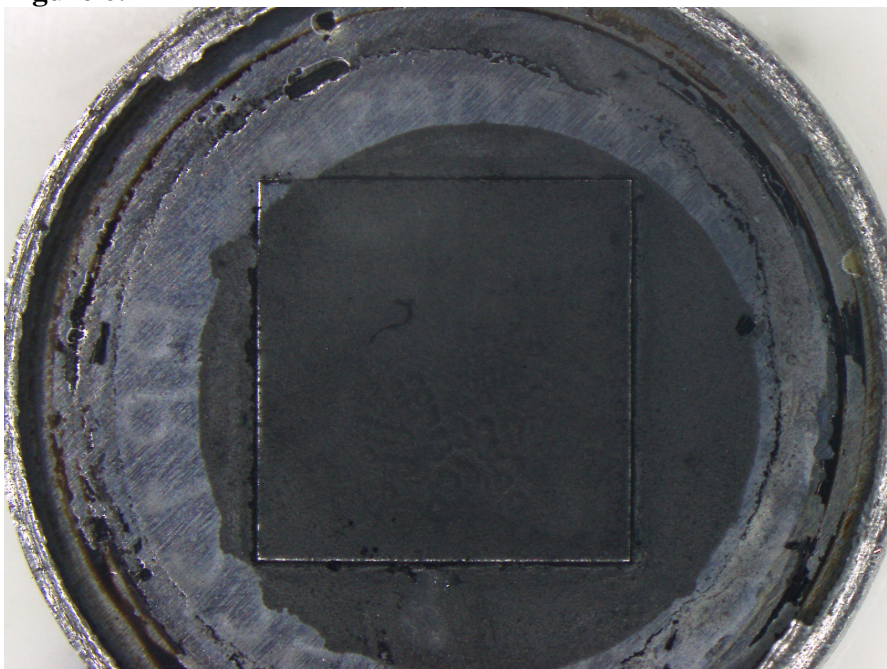
Figure 5.



SN 3:
Magnification: 12X

Optical photo showing the indication of crystal barrel to positive terminal of the battery short after decanning.

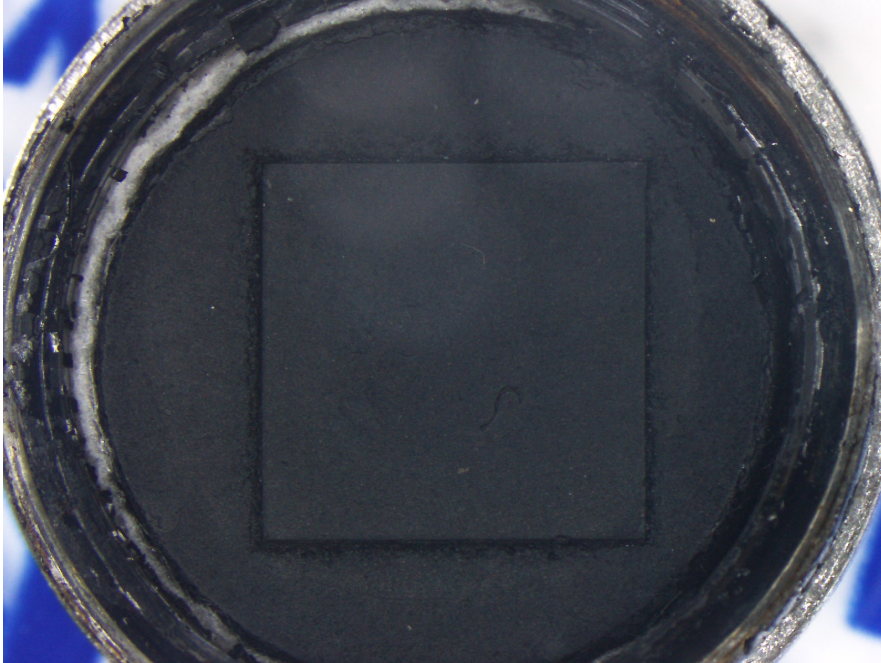
Figure 6.



SN 1:
Magnification: 12X

Optical photo showing no lithium on the battery can.

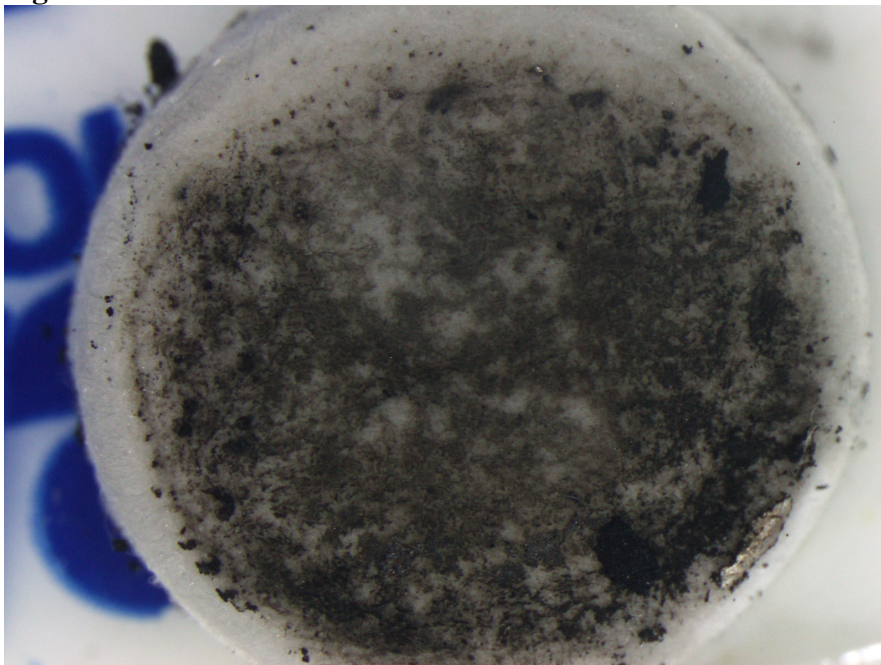
Figure 7.



SN 1:
Magnification: 12X

Optical photo showing dry cathode pill.

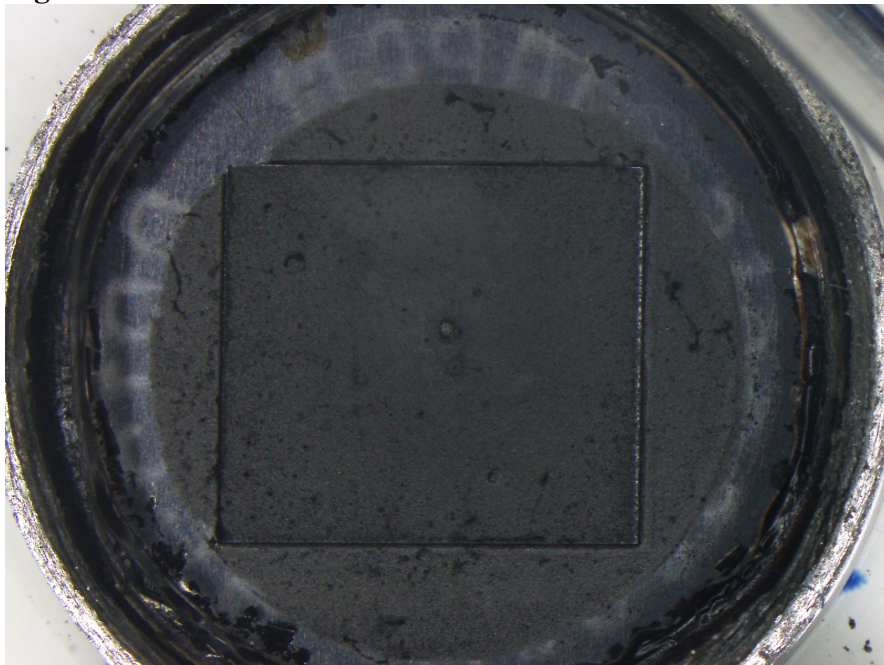
Figure 8.



SN 1:
Magnification: 12X

Optical photo showing dark separator indicating heavy load discharge.

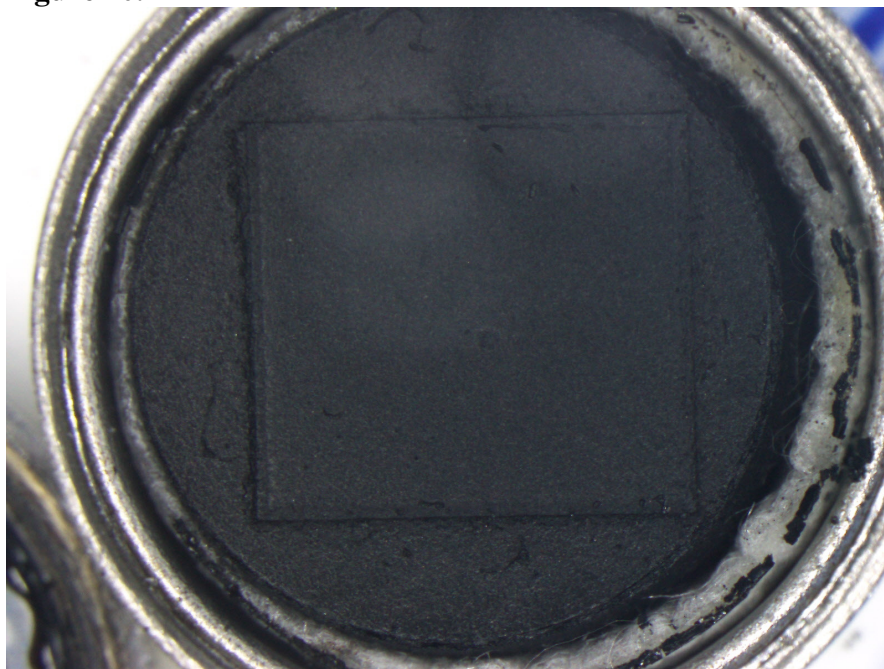
Figure 9.



SN 4:
Magnification: 12X

Optical photo showing no lithium
on the battery can.

Figure 10.



SN 4:
Magnification: 12X

Optical photo showing dry cathode
pill.

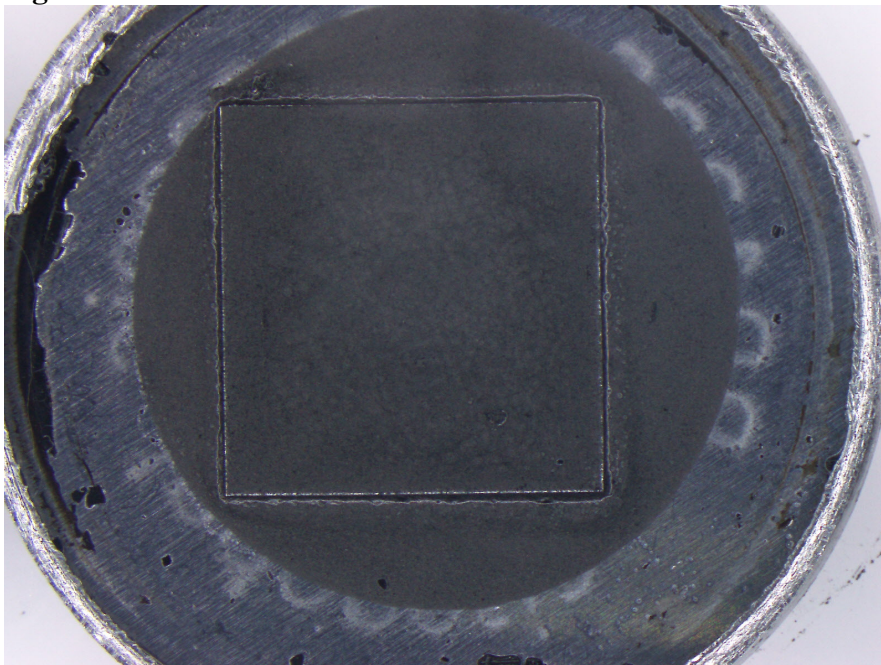
Figure 11.



SN 4:
Magnification: 12X

Optical photo showing dark separator indicating heavy load discharge.

Figure 12.



KGU:
Magnification: 12X

Optical photo showing lithium present on the battery can.

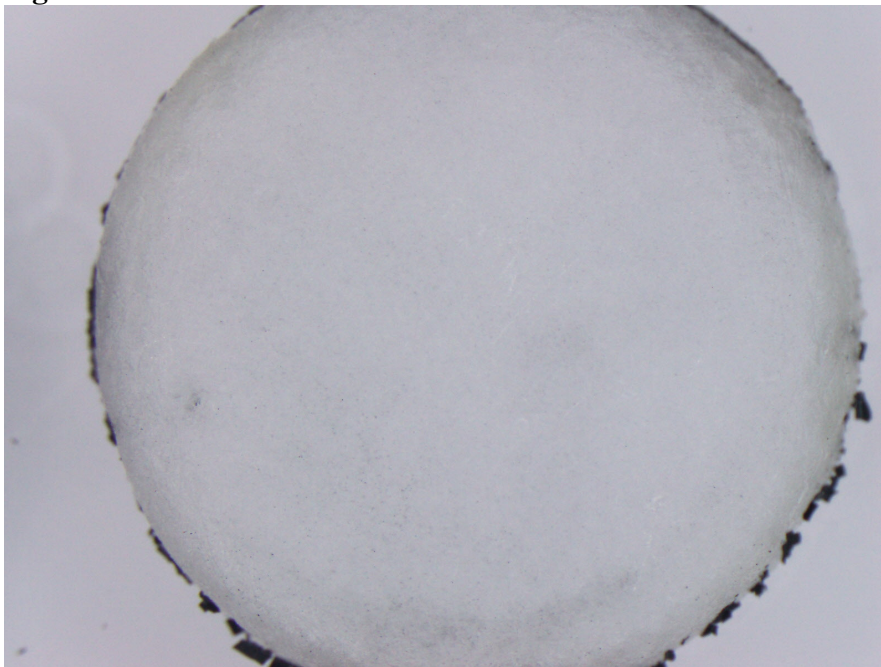
Figure 13.



KGU:
Magnification: 12X

Optical photo showing moist
cathode pill.

Figure 14.



KGU:
Magnification: 12X

Optical photo showing white
separator of a known good unit
(KGU).