DATASHEET PRELIMINARY

DMHA14R5V353M4ATA0,

4.5V, 35mF, 600mΩ, -40°C to +85°C

2.25V, 140mF, 150mΩ, -40°C to +85°C

Revision 2.1, May 2024

Note: Product not yet in mass production. Specification may change without notice

Electrical Specifications

Table 1: Absolute Maximum Ratings

Parameter	Name	Conditions	Min	Typical	Max	Units
Terminal Voltage	V_{peak}				4.5	V
Temperature	T_{max}		-40		+85	°C

Table 2: Electrical Characteristics

Note that the DMHA14R5V353M4ATA0 is actually 2 independent cells, with 2 terminals for each cell. Referring to the mechanical drawing, for one cell the negative terminal is labelled (-) and the positive terminal labelled (bal 1), while for the other cell the negative terminal is labelled (bal 2) and the positive terminal labelled (+). The user can connect the 2 cells in series or in parallel, or as 2 individual supercapacitor cells. If connected in series then connect (bal 1) to (bal 2). If connected in parallel then (-) must be connected to (bal 2) and (bal 1) must be connected to (+). The table gives the electrical characteristics for the different configurations.

Parameter	Name	Conditions	Min	Typical	Max	Units
As 2 cells connected in series						
Terminal Voltage	Vn		0		4.5	V
Capacitance	C	DC, 23°C	28	35	42	mF
ESR	ESR	AC, 1kHz		500	600	mΩ
Leakage Current	I_L	4.5V, 23°C 120hrs			2	µA
RMS Current	I_{RMS}	23°C			1	A
Peak Current[1]	I_P	23°C			5	A

[1]Non-repetitive current, single pulse to discharge fully charged supercapacitor.

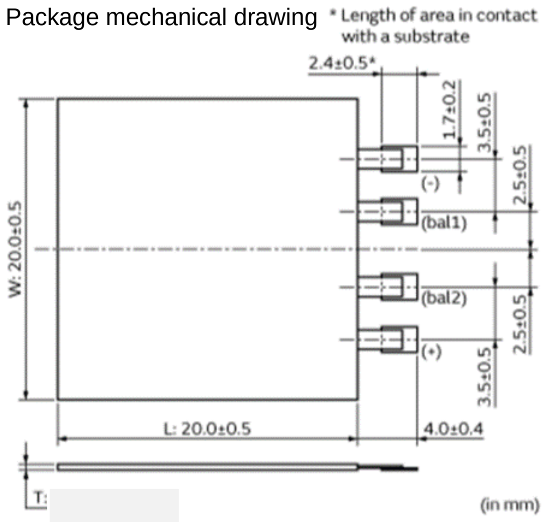
Parameter	Name	Conditions	Min	Typical	Max	Units
As 2 cells connected in parallel						
Terminal Voltage	Vn		0		2.25	V
Capacitance	C	DC, 23°C	112	140	168	mF
ESR	ESR	AC, 1kHz		130	150	mΩ
Leakage Current	I_L	2.25V, 23°C 120hrs			4	µA
RMS Current	I_{RMS}	25°C			2	A
Peak Current[1]	I_P	23°C			10	A
As 2 individual cells, specification for 1 cell.						
Terminal Voltage	Vn		0		2.25	V
Capacitance	C	DC, 23°C	56	70	84	mF
ESR	ESR	AC, 1kHz		250	300	mΩ
Leakage Current	I_L	2.25V, 23°C 120hrs			2	µA
RMS Current	I_{RMS}	25°C			1	A
Peak Current[1]	I_P	23°C			5	A

[1]Non-repetitive current, single pulse to discharge fully charged supercapacitor.

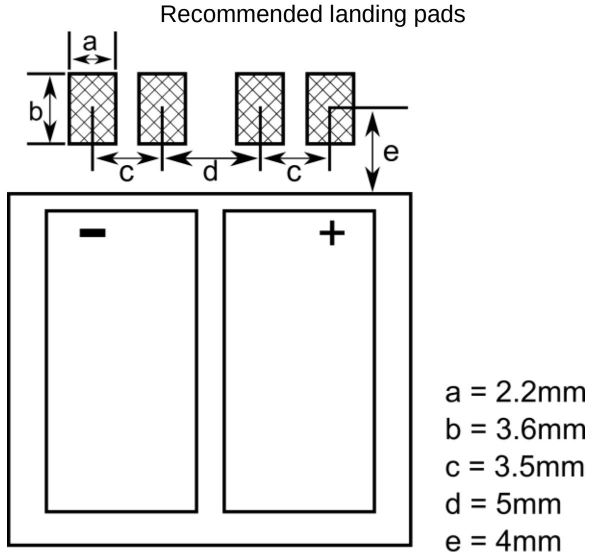
Table 3: Mechanical specification

Length (mm)	Width (mm)	Thickness "T" (mm)	Weight (gm)
20 ± 0.5mm	20 ± 0.5	0.5 (max)	0.23

Package mechanical drawing



Recommended landing pads



Mechanical drawing and recommended landing pad for DMHA14R5V353M4ATA0

Effective Capacitance

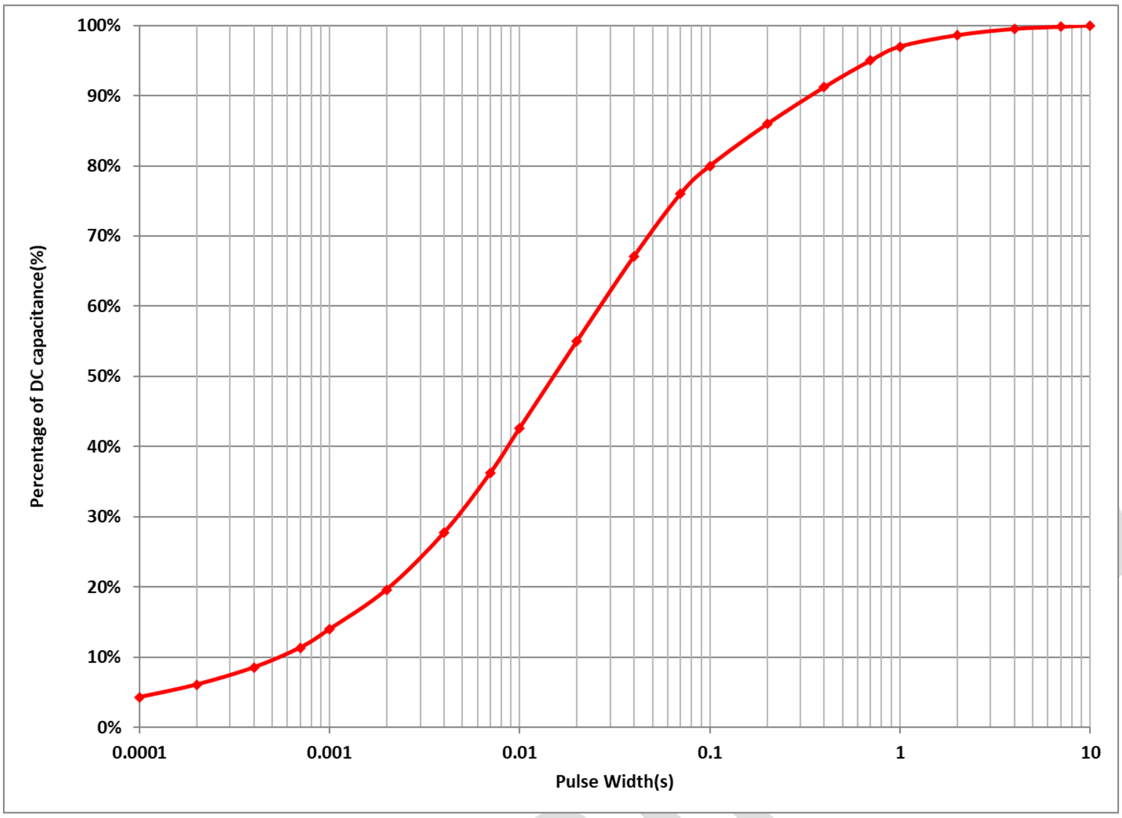


Figure 1: Effective Capacitance

Fig 1 shows the effective capacitance for the DMH @ 23°C. This shows that for a 1msec PW, you will measure 14% of DC capacitance or 4.9mF. At 10msecs you will measure 43% of the DC capacitance, and at 100msecs you will measure 80% of DC capacitance. Ceffective is a time domain representation of the supercapacitor's frequency response. If, for example, you were calculating the voltage drop if the supercapacitor was supporting 1A for 10msecs, then you would use the Ceff(10msecs) = 43% of DC capacitance = 15.1mF, so Vdrop = 1A x ESR + 1A x duration/C = 1A x 600mΩ + 1A x 10ms / 15.1mF = 1.26V. The next section on pulse response shows how the effective capacitance is sufficient for even short pulse widths.

DC Capacitance variation with temperature

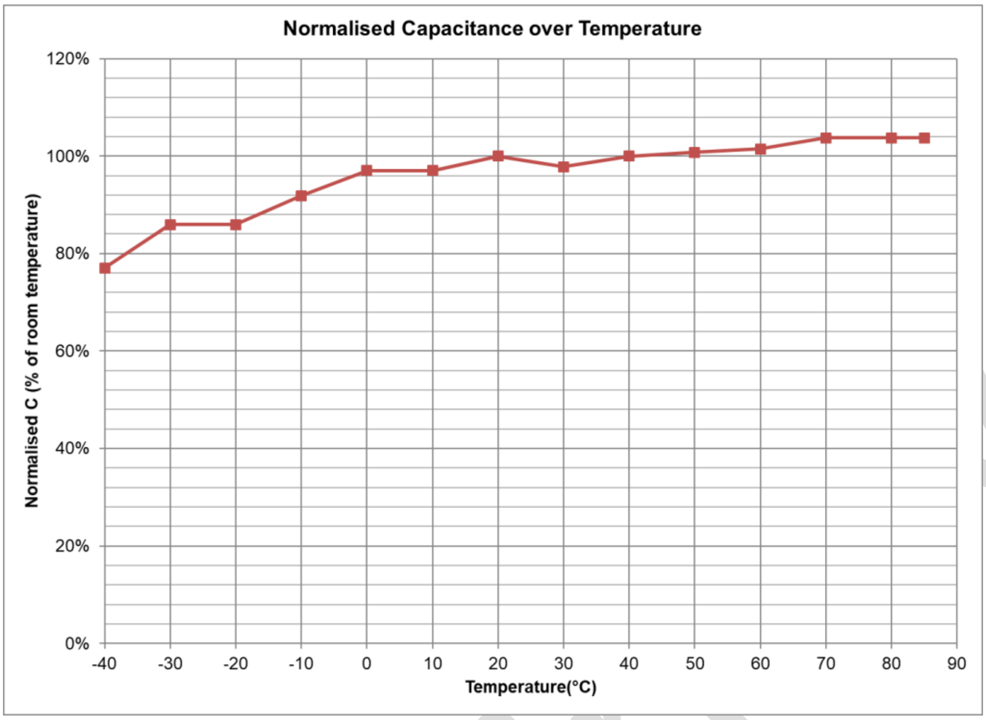


Figure 2: Capacitance change with temperature

Fig 2 shows that typically the capacitance at -40°C is ~0.75 x C at room temp, and that C at 85ºC is ~1.1 x C at room temperature.

ESR variation with temperature

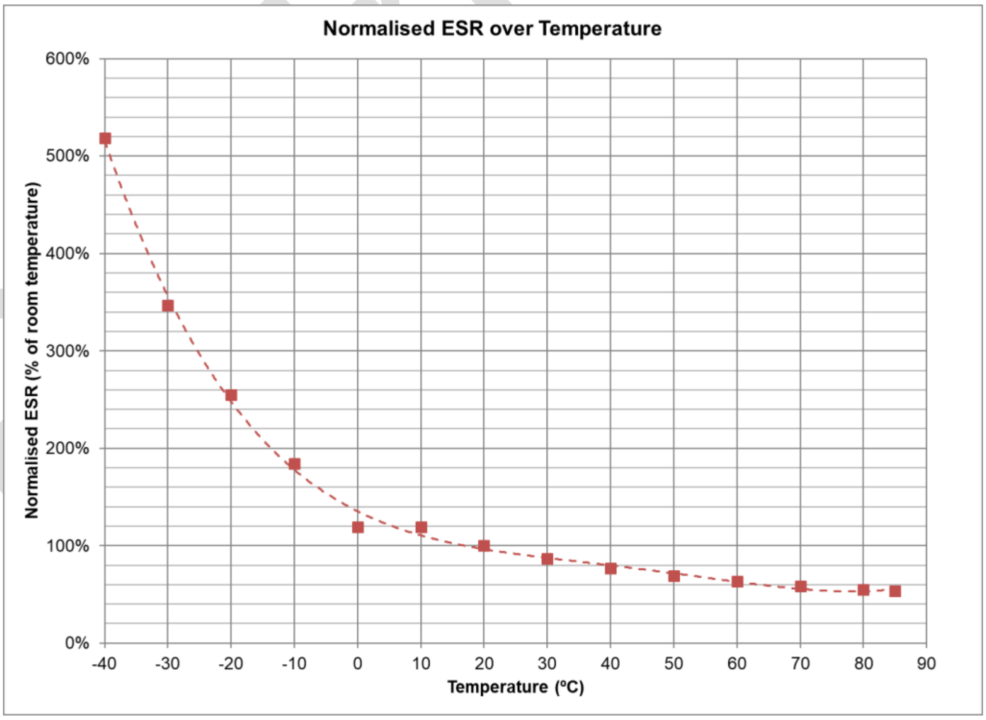


Figure 3: ESR change with temperature

Fig 3 shows that typically the ESR at -40°C is ~5.2 x ESR at room temp, and that ESR at 80ºC is ~0.53 x ESR at room temperature.

Leakage Current

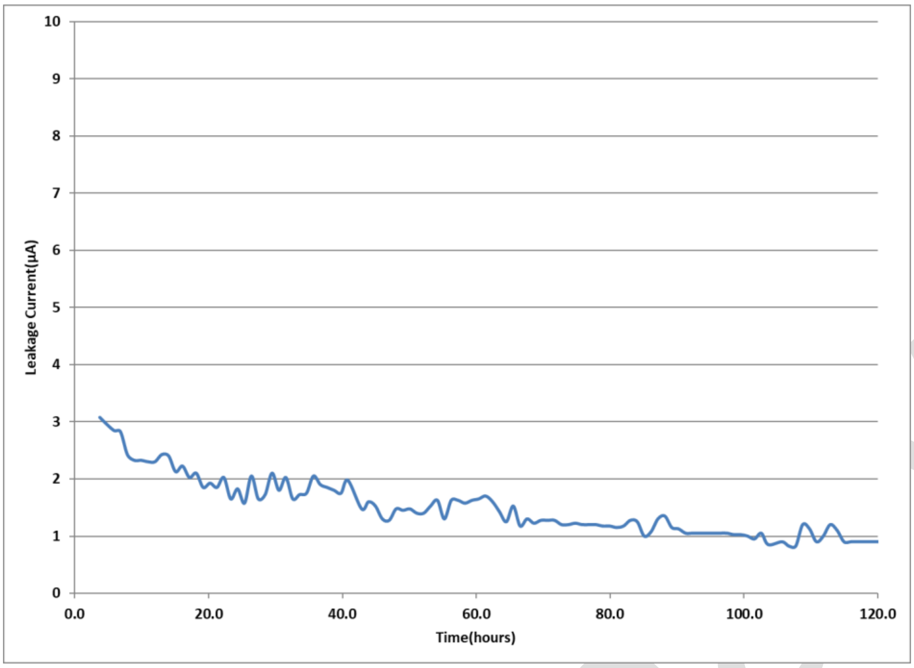


Fig 4: Leakage Current

Fig 4 shows the leakage current for DMHA14R5V353M4ATA0 at room temperature. The leakage current decays over time, and the equilibrium value leakage current will be reached after ~120hrs at room temperature. The typical equilibrium leakage current is 1µA at room temperature.

Charge Current

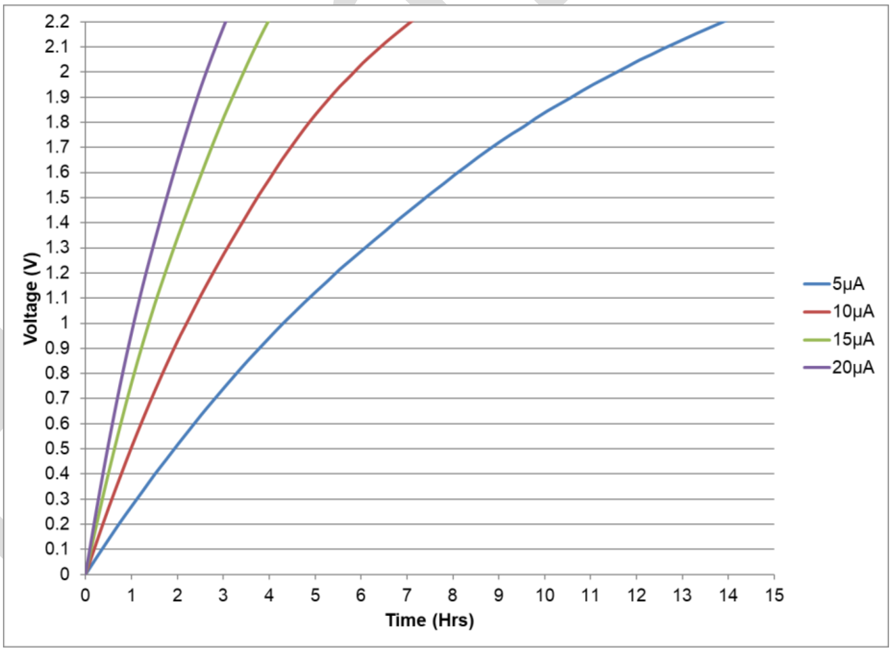
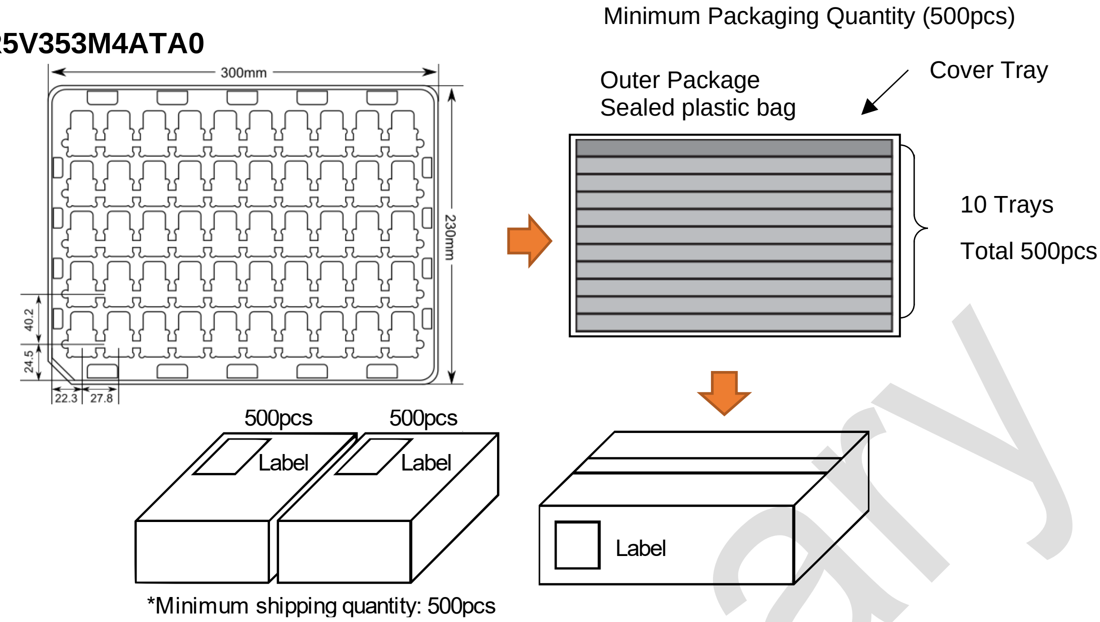


Fig 5: Charging an DMHA14R5V353M4ATA0 with low current

The corollary to the slow decay in leakage currents shown in Fig 4 is that charging a supercapacitor at very low currents takes longer than theory predicts. At higher charge currents, the charge rate is as theory predicts. For example, charging a single cell, it should take 0.070F x 2.2V / 5µA = 8.6 hrs to charge a 70mF supercapacitor to 2.2V at 5µA, but Fig 5 shows it took 13.8hrs.

Packaging

DMHA14R5V353M4ATA0



CAP-XX uses sustainable packaging. All our packaging material are recyclable. The clear product trays are made from Polystyrene. ESD safe bubble wraps and bags are made from LDPE. The shipping boxes are corrugated cardboard. Please ensure all packaging is disposed in accordance with the relevant recycling procedures of the region where CAP-XX products are used.

Storage

CAP-XX recommends storing supercapacitors in their original packaging in an air-conditioned room, preferably at < 30°C and < 60% relative humidity. CAP-XX supercapacitors can be stored at any temperature not exceeding their maximum operating temperature but storage at continuous high temperature and humidity is not recommended and will cause premature ageing.

Do not store supercapacitors in the following environments:

- High temperature / high humidity
- Direct sunlight
- In direct contact with water, salt, oil or other chemicals
- In direct contact with corrosive materials, acids, alkalis or toxic gases
- Dusty environment
- In environments subjected to shock and vibration

Cautions before use

CAP-XX supercapacitors are “burned in” during production, and have a defined polarity, as shown by the positive terminal marked on the face of the product. Reversing the polarity of the device will not damage the device but may cause a rise in the ESR and will void the warranty. Please verify the orientation of the supercapacitor in accordance with the product markings before assembly.

CAP-XX supercapacitors are heat-sensitive. Over-heating of the supercapacitor may result in a degradation of performance and useful life.

CAP-XX supercapacitors must only be used within their rated voltage range. Over-voltage may cause swelling and eventually, product failure.

CAP-XX supercapacitors are fully discharged when shipped. Devices should be handled and soldered in a discharged state.

Soldering and Assembling

CAP-XX supercapacitors are designed for direct soldering onto the PCB. Soldering the terminals to the PCB will ensure the highest contact reliability and lowest contact resistance. Do NOT solder directly to the device casing. This will cause permanent internal damage to the supercapacitor.

CAP-XX supercapacitors are NOT SUITABLE for infrared reflow soldering, hot-air reflow soldering, or wave soldering. They should be mounted as a secondary operation, using a manual soldering iron, a hot bar soldering jig, conductive adhesive, ultrasonic welding or laser welding.

CAP-XX recommends the use of a water-soluble flux, or a no-clean (low residue) flux, and low temperature solder compounds.

Please solder under the following conditions:

- Solder Type: Resin flux cored solder wire (ø1.2mm)
- Solder: Lead-free solder: Sn-3Ag-0.5Cu
- Soldering iron temperature at 350°C±10°C
- Solder iron wattage: 70W or less
- Soldering time: 3 to 4sec.
- The same terminal should be soldered 3 or less times.

If a hot-air gun is used to reflow the solder during a re-mount or de-mount, care must be taken to prevent excessive heating of the package adjacent to the solder terminals. Allow at least 15 sec between successive soldering attempts for the device to cool down.

Please consult CAP-XX if you wish to wash the device after soldering.

Vibration and Shock Testing

Shock

CAP-XX has undertaken tests to determine the effects of repeated shocks on both the mechanical integrity and electrical performance of its supercapacitors:

Charge to rated voltage at 500mA for min. 30min

- Type: Half-Sine
- Amplitude: 500G
- Duration: 1ms
- No. of cycles: 3 in each direction (18 in total)
- No. of axes: 3, orthogonal

Results: No electrical or mechanical degradation observed.

Note that this test was undertaken on the standard product with adhesive mounting tape (Nitto No.5000NS). To achieve the highest levels of resistance to shock, CAP-XX recommends the use of an adhesive mounting tape on the underside of the device.

Vibration

CAP-XX has undertaken tests to determine the effects of sustained vibration on both the mechanical integrity and electrical performance of its supercapacitors:

Charge to rated voltage at 500mA for min. 30min

- Type: Sinusoidal
- Frequency: 10 ～ 500Hz/10G
- Amplitude: 1.5mm
- Sweep Rate: 1octave/min
- No. of cycles: 10 in each direction
- No. of axes: 3, orthogonal

Results: No electrical or mechanical degradation observed.

Note that this test was undertaken on the standard product with adhesive mounting tape (Nitto No.5000NS). To achieve the highest levels of resistance to shock, CAP-XX recommends the use of an adhesive mounting tape on the underside of the device.

Drop Test

CAP-XX has undertaken tests to determine the effects of repeated drops on both the mechanical integrity and electrical performance of its supercapacitors:

Supercapacitor is discharged

- Mount product to 150g box with adhesive mounting tape (Nitto No.5000NS)
- Drop the box from 0.25m / 0.5m / 1.0m / 1.5m
- Repeat 3 times for 6 sides (18 in total)

Results: No electrical or mechanical degradation observed.