



Storage Chart and Maintenance

For 60v & 72v Batteries

QuietKat

Voltage Chart Overview (Attached to back):

This chart is to detail the density of 100% charge and 0% charge of Samsung ICR-18650 26F.

-The first column 'Charge State' is the percentage of total charge.

-The second column is 'Cell Density', this is for the single cell charge state of an 18650 battery; this can be ignored since it is applied to the entire pack and the math is unnecessary for the customer but is listed for technical aspects. If curious it applies to the safety of the total 100% charge an 18650 battery can hold (4.2v) and the total discharge before safety issues occur at 0% (2.5v).

-The third column is 'Battery CV 67v' this in detail means battery charge voltage, this one being for a 60v battery that charges to 67v at 'Full Charge'. Following this column down will outline the percentage 100% down to 0% and the corresponding voltage for that percentage.

-The fourth column is 'Battery CV 68v' this is the exact same as the third column but for a 60v battery that charges to 68v.

-The fifth column is 'Battery CV 84v' this is the same as the last two but for a 72v battery which charges to 84v.

Storage:

-For Samsung ICR-18650 26F batteries, the charge in which you want to store the batteries at are listed on the side of the columns. You will notice two labels for such. This is the rough median for the charge voltage you want to keep the batteries at for long term storing. It is not only a median but a suggested rate from the manufactures.

-Anywhere between 61v and 62v is adequate for storage on a 60v battery (that uses Samsung 26F batteries) up to a year. We do recommend checking the voltage every 2-3 months and see how well the batteries capacity is holding the charge.

-To ensure prolonged battery life, it is recommended using a multimeter or using the display screen to see what voltage they are resting at. (Check every 2-3 months). If the voltage has dropped at all, we recommend one of 2 things. Firstly, charge it back up to its 'storage charge' or

charge it all the way full, and use the battery down to its 'storage charge'. For 4-6-month storage, you may charge to full, but discharge to nominal storage state of charge.

-Deep cycling is not proven in the lithium field; this is because lithium only has so much cycle life, and the more you charge or discharge the battery the more the anode (negative side) inside the battery will begin to 'wear down'. Strenuous cycling will cause this buildup to happen more rapidly. This is the case for battery packs which utilize a BMS (battery management system), because the BMS will auto-balance the cell indifference, and Li-Ion chargers do not use float or trickle charges. This results in the charger constantly 'topping off' the full charge, which speeds up the erosion of the anode.

-It is also advised to not leave the battery connected to the charger for long periods of time. The quicker you can disconnect the battery after a full charge cycle, the better it is for the battery's life. The Li-Ion chargers do not use a trickle or float charge and prolonged charging will wear down the cell's anode.

-Do not store a fully charged battery pack; Discharge or charge the battery to the storage voltage or State of Charge (SOC).

-After storage time, simply recharge the battery to full SOC and allow it to sit on the charger for an extra 30 minutes to 1 hour after a completed charge. This will ensure proper cell balance.

-Never leave your battery on the ground or concrete; this can be damaging to the battery and will deplete the overall life of the cells if keep in those conditions for long periods of time. We always recommend using a piece of insulation to remove contact with the ground.

-Do not store the battery in temperatures exceeding 25°C (77°F). Lithium-Ion can be stored in cool or cold environments (0°C or 32°F) but must always be warmed up to room temperature before charging.

Temperature Effects:

-Temperature will also affect the battery greatly. Lithium batteries do not like the heat, and do not like being charged in extreme temperature variations.

-A good rule of thumb is to always store and charge the battery in room temperature; though they can be stored in lower temperature, but always charged at room temperature.

-The performance of all batteries will drop drastically in low temperature. This will give a higher internal resistance within the battery. This will cause the battery to heat up, but it will also cause the battery to 'drain' quicker than at room temperature; that is because the resistance will cause some warming effect by efficiency loss caused by voltage drop when applying a load current.

-Lithium Ion can perform down to -40°C (-40°F), but only at a reduced discharge rate. Never operate the battery or charge it beyond 50°C (122°F). Storing the battery in the extreme heat will also affect the battery in a way that it will not be able to hold a proper charge.

-The best working conditions are 15°C to 40°C (59°F to 104°F).

-This is a rough temperature effect on the batteries from *The Battery University*:

-0°C at 40% charge will retain 98% after 1 year.

-25°C at 40% charge will retain 96% after 1 year.

-40°C at 40% charge will retain 85% after 1 year.

-60°C at 40% charge will retain 75% after 1 year.

-0°C at 100% charge will retain 94% after 1 year.

-25°C at 100% charge will retain 80% after 1 year.

-40°C at 100% charge will retain 65% after 1 year.

-60°C at 100% charge will retain 60% after 3 months.

Operations:

-Full charge storage is also problematic; since at full charge the electro-chemical reactions are at its strongest and most dangerous. It is only dangerous for quick pressure changes during transport and for the life of the battery. This is due to the degradation of the internals of the battery, as the anode (negative side) will begin to wear down faster at full charge; and if the charger is left connected to the battery for long periods of time. For normal everyday use, charging to 100% is completely fine, and should only be avoided during shipment and storage of the battery. Just remember to unplug the charger from the battery when it reaches full charge. This will help in the long run for the life cycle to stay consistent.

-Operation can reduce Lithium Ion batteries as well. This will play into deep cycling theories. When operating the unit, it is best to not allow the unit to fully 'Drain' or 'Die'. This can be damaging to the life cycle of the batteries. For the best life cycles, you will want to charge the battery when it drops to 15% or 20% above 0%. 5% is fine as well, but you will want to avoid fully discharging and draining the battery. Occasionally is perfectly fine, though if you want to get the most out of your battery it is best to follow these procedures.

-If the battery fully discharges and turns off automatically, re-charge the battery pack within 12 hours. Failure to do so could shorten the battery life cycle. A rule of thumb to consider is to not allow the battery to fall below 5% or 55.5v for a 60v battery. To retain the most battery life cycle, recharge the battery between 15% and 20% SOC, and try not to drain the battery entirely.

-Do not try to utilize a battery pack that has turned off automatically until it has been recharged.

-Lithium-Ion will degrade over time, but you can slow this by only charging the SOC up to 90% instead of 100%; and recharging it when it reaches 20% from empty. 100% full charge is fine, if you use the battery within a short time from full charge completion. (I.e. 3-4 days from a full charge.)

-Keep out of extreme heat or direct sunlight. When the internal temperature of the battery pack is in excess of 75°C (167°F) there will be damage to the battery's capacity and a reduction in battery life cycle. With a much greater risk of fire or explosion.

-Never submerge or soak the battery in liquids of any type. The battery pack should always remain dry.

-In case of fire, do NOT use CO2 to extinguish fire. Use CCI4 or Class D extinguisher to extinguish fire. You can use sand or soil to help extinguish the fire as well, only use water to ensure the fire doesn't spread to surrounding areas.

Quick Overview:

To reiterate: Store the batteries at 60% to 70% of full charge, in or below room temperature. And always charge them in room temperature and allow the batteries to warm up to the room before charging them. Do not operate, store, or charge them in extreme heat. They will work in extreme cold, but you will not be able to travel far on them. Try to avoid total discharge and try not to let the chargers sit on the battery too long after a completed charge. If you have further questions about storage, charging, or operating in order to help benefit the lithium batteries life; please contact us at QuietKat Customer Service. We will be happy to help and answer any questions you may have.

Density Chart	Charge State	Cell Density	Battery CV 67V	Battery CV 68v	Battery CV 84v
	100%	4.2v	67v	68v	84v
	90%	4.08v	65.07v	66.05v	81.6v
	80%	4.0v	63.8v	64.76v	80v
Samsung Storage	-70%	3.93v	62.68v	63.62v	78.6v
Samsung Storage	-60%	3.87v	61.72v	62.65v	77.4v
	50%	3.82v	60.92v	61.84v	76.4v
	40%	3.79v	60.45v	61.36v	75.8v
	30%	3.77v	60.13v	61.03v	75.4v
	20%	3.73v	59.49v	60.38v	74.6v
	15%	3.7v	59.01v	59.9v	74v
	10%	3.68v	58.69v	59.57v	73.6v
	5%	3.5v	55.82v	56.66v	70v
	0%	2.5v	39.87v	40.47v	50v