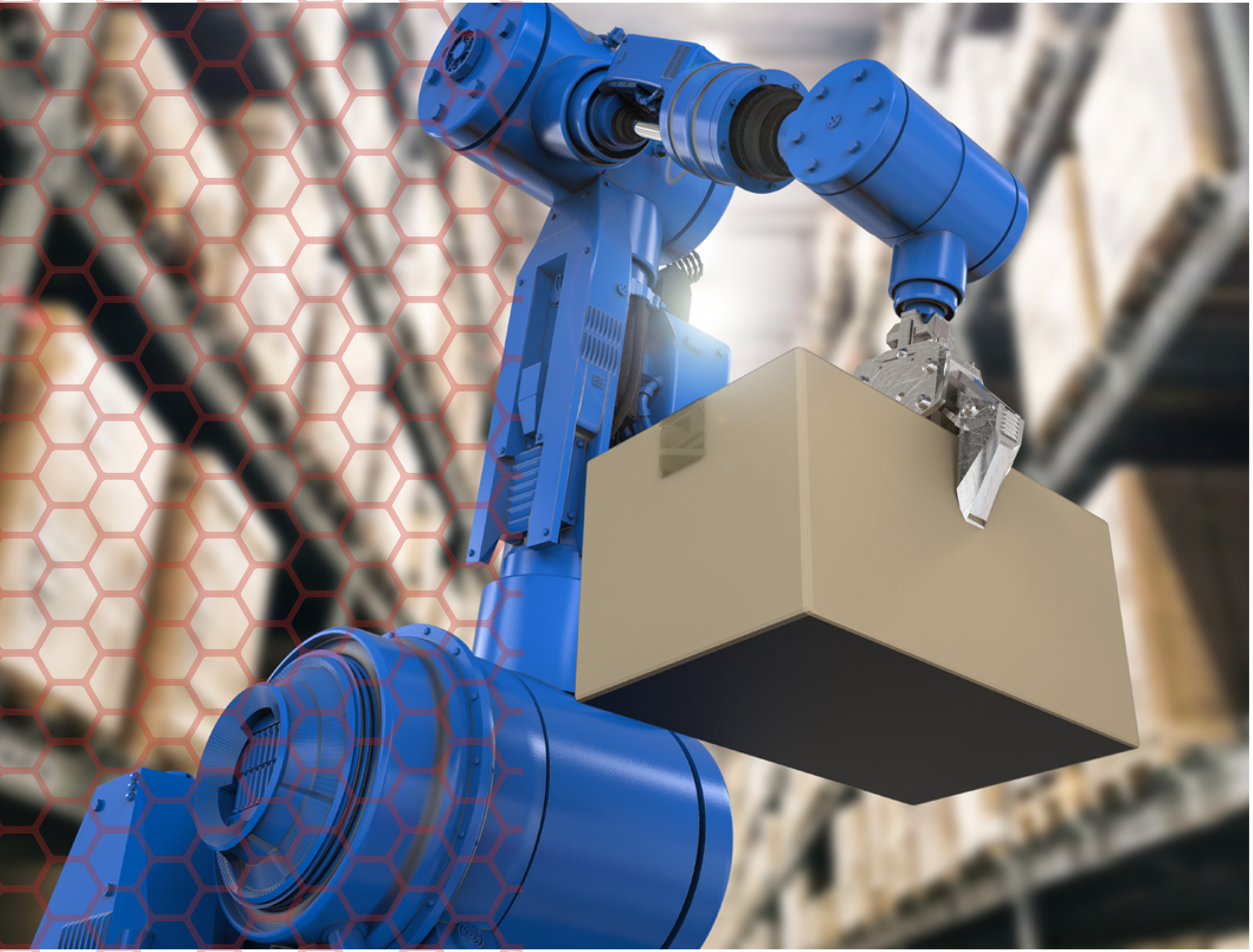
ULTRALIFE®

The digitalization of logistics

Considering recent supply chain pressures, the future of logistics is digital



Introduction

The logistics industry has long been the backbone of modern economies, ensuring a smooth and timely flow of materials, products and equipment through all manner of supply chains. However, recent years have presented pressures and challenges for logistics operations. Technology offers a possible solution, but proper implementation and reliable performance are essential. In this whitepaper, we explore how tech is helping the logistics sector to overcome growing pressures.

In a report published by the British Property Federation (BPF) and logistics development company Tritax Symmetry in late February 2020, it was determined that logistics plays a pivotal role in the UK economy and employment market. In fact, the market's economic productivity was estimated to total £80bn at that time. Neither author of the report could foresee that, within a handful of weeks, logistics would take on even greater importance.

Since the start of the COVID-19 pandemic, delivery and logistics have faced unprecedented pressures to keep industries running and ensure consumers can safely receive goods. This, coupled with supply chain stresses caused by lockdowns and — more recently — component shortages, reaffirmed to many the importance of logistics, and the need for logistics operations to run smoothly and efficiently.

For many years, the function of logistics as an essential intermediary in supply chains has been driven by demand forecasts and other operations models to predict a company's performance. However, these models struggle in the face of unpredictability, especially on the scale of a global pandemic. As such, the sector is turning to digitalization in warehouses and in transit to improve efficiencies and agility.

Automating warehouses

The past few years have seen an increase in the amount of automation technologies employed in distribution warehouses. The extent of this automation varies between operators, with some companies such as Ocado famously using advanced picking robots and an automated storage and retrieval system (AS/RS) to rapidly fulfil orders. In other distribution and intralogistics warehouses, automation focusses more on the management of item flow using control software and multi-zone conveying systems.

Others choose to implement a mixture of robotics and conveyors/software, where robots – fixed alongside a standard conveyor line – are used for picking, placing or retrieval. These robots use a vision system to quickly identify and handle items as required and move them to cages, pallets or bays for collection. Yet it is not enough for a robot system to simply be installed; it must also function reliably and safely.

The same requirements are true of mobile robots, such as those in advanced AS/RSs. One of the drivers behind the implementation of an AS/RS is the reduction in warehouse space requirements, while simultaneously improving fulfilment efficiency. A 2017 statistic from Equity Research noted that using an AS/RS could reduce warehouse footprints by as much as 85 per cent. This space-saving benefit relies on the automated systems operating effectively.

Technicians and operations managers can ensure reliability in both stationary and mobile robots with a similar solution, despite the initial differences between the two.

“TO MITIGATE THE EFFECT OF POWER FAULTS, STATIONARY ROBOTS ARE FITTED WITH BACKUP BATTERIES.

Fixed robots are typically powered primarily from mains electricity. This theoretically allows a stable electrical supply for as long as the energy grid network remains operational. However, local power losses and problems do occur that could leave a warehouse without sufficient power. Especially considering that an ever-increasing number of electronic and electromechanical systems are placed within close proximity, raising the risk of electrical interference due to various frequencies acting on the same network, making power faults more likely.

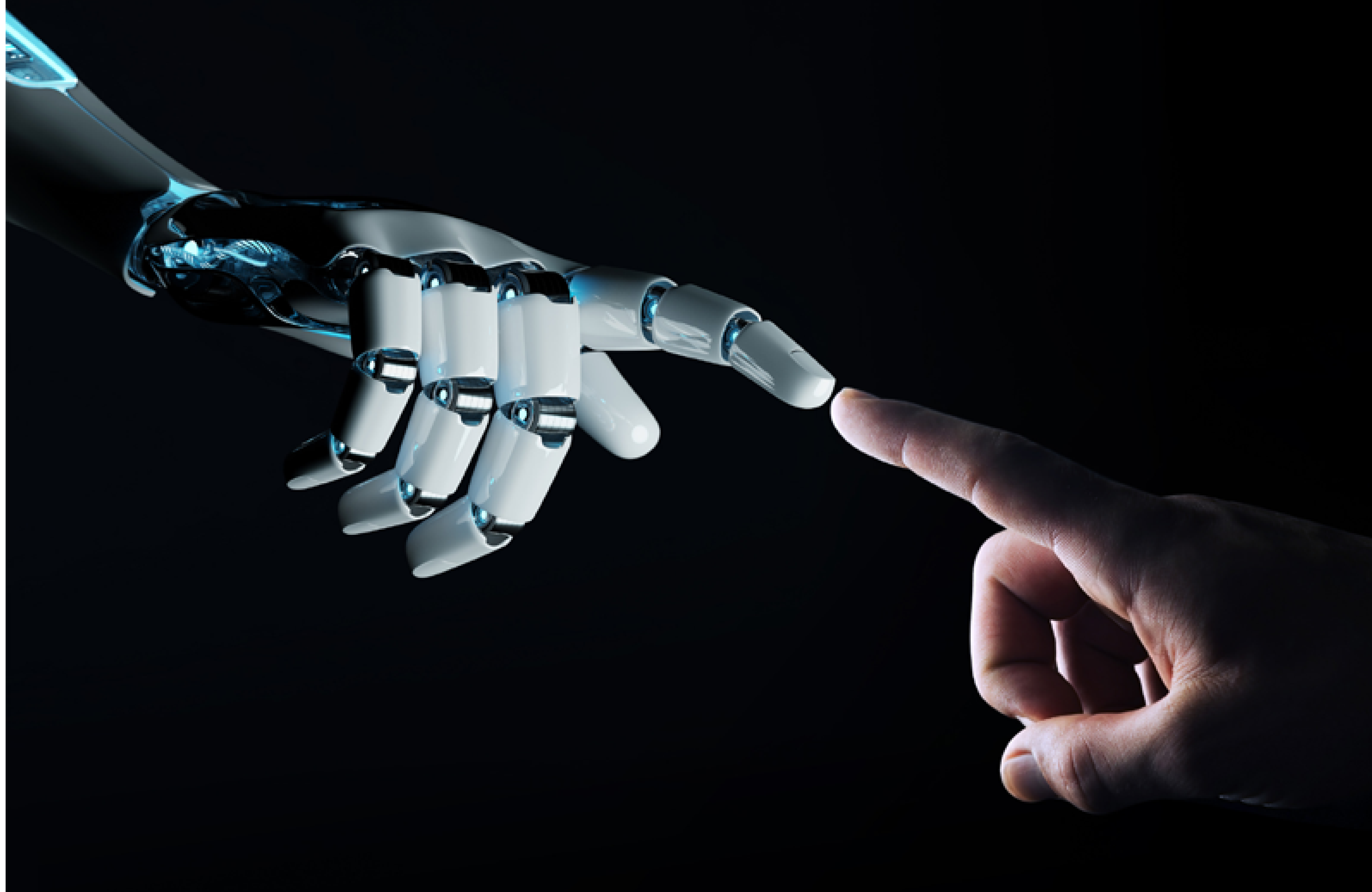
To mitigate the effect of power faults, stationary robots are fitted with backup batteries. These batteries serve as an uninterruptible power supply (UPS) to provide sufficient energy for the unit to safely power down, without damaging workers, goods or other equipment. To reliably perform to this standard, the battery must be able to offer a long service life and provide in-built protection against faults.

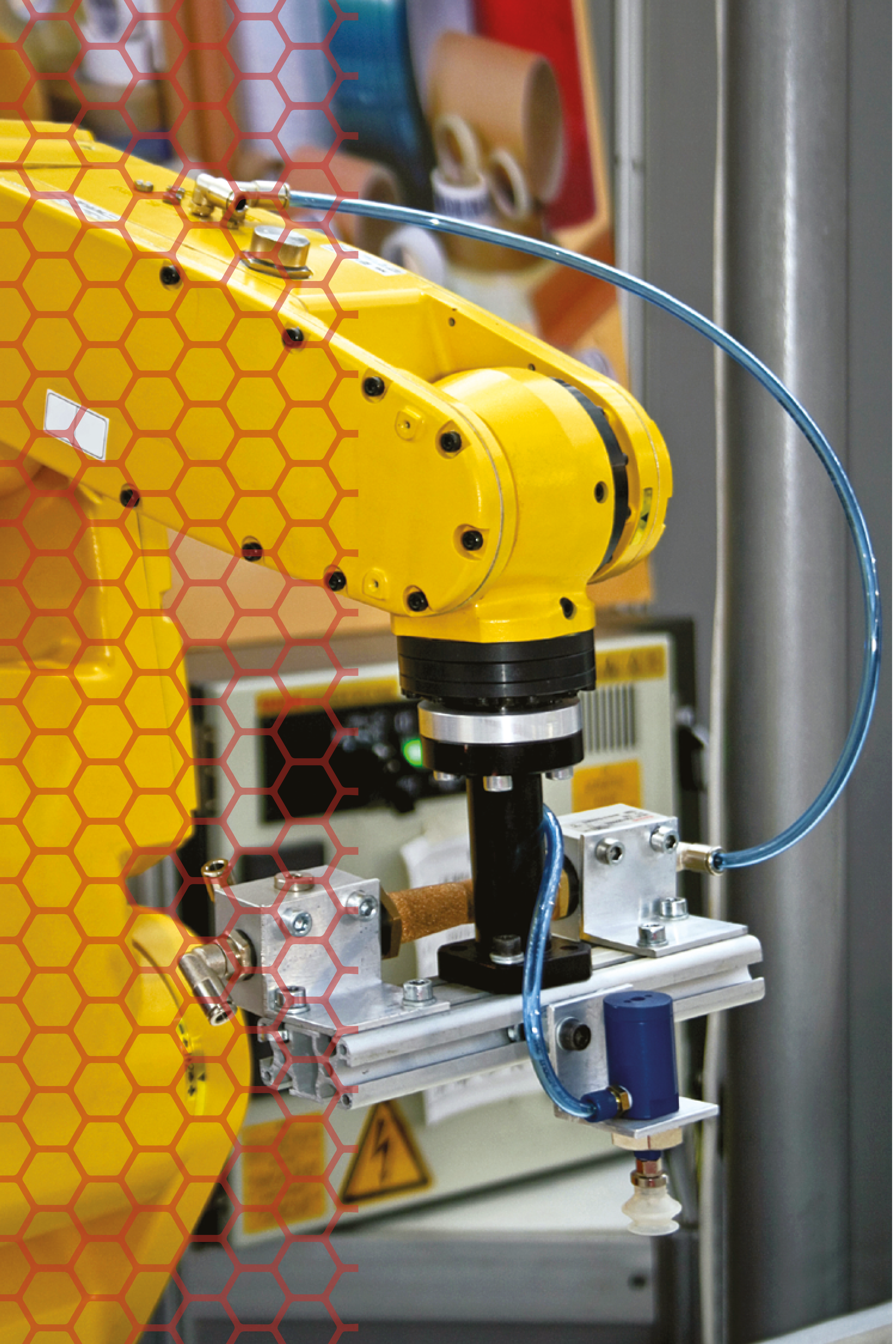
An ideal fit for the requirements of stationary logistics robots is Ultralife’s range of Lithium Iron Phosphate (LiFePO4) batteries. LiFePO4 chemistry ensures a greater energy density and longer runtime than conventional sealed lead acid (SLA) batteries, with the additional benefit of not requiring trickle charging to retain energy. Some of these batteries can be cycled up to 2000 times, with nominal voltages of 6.4V, 12.8V and 25.6V (battery dependent).

In addition to powering stationary robots, batteries can also be used to power their handheld programmers or wireless controllers. Ultralife’s lithium-ion soft packs can provide between 3.6 and 14.8V depending on cell configuration, offering a variety of options to suit different power requirements.

Whilst standard, off-the-shelf batteries are often well-suited to provide back-up power to stationary robots and their controllers; mobile logistics robots or autonomous guided vehicles (AGVs) often rely on batteries as the main source of power, making the specification of the battery of paramount importance. As every warehouse operates differently and faces different conditions – such a temperature and available space – often a custom battery solution is more suitable, as this can be tailored to meet specific requirements.

While mobile and stationary robotic units are a cornerstone of digitalization and automation in warehouse operations, the ability for these systems to effectively locate goods — particularly in an AS/RS — depends upon asset tracking tags. These small devices are also playing a significant role in the digitalization of logistics beyond the warehouse, during distribution.



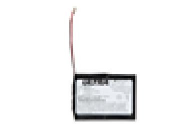
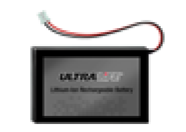


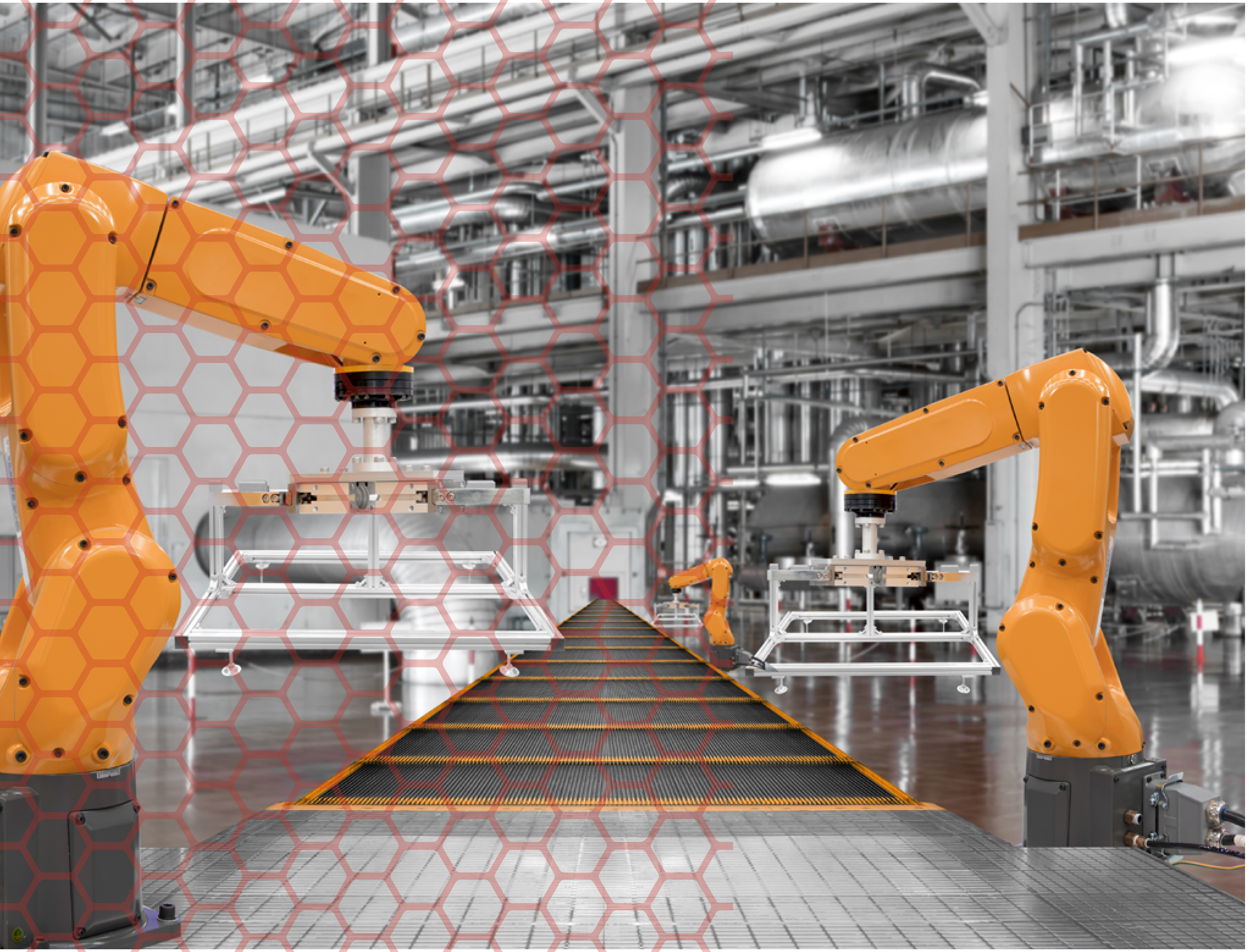
Rechargeable Lithium Iron Phosphate (LiFePO4) Battery Packs

BATTERIES	PART NUMBER	NOMINAL VOLTAGE	RATED CAPACITY	RATED ENERGY	WEIGHT	NOMINAL HEIGHT (MM)	NOMINAL WIDTH (MM)	NOMINAL DEPTH (MM)
	URB12450-U1-SMB	12.8V	45.6Ah	583.7Wh	5.46kg	182.1	208.5	136.4
	URB24200-U1-SMB	25.6V	22.8Ah					
	URB-X5	12.8V	21.6Ah	276.5Wh	3.67kg	317.0	120.5	75.5
	URB0023	25.6V	54.0Ah	1382.4Wh	15.9kg	103.1	445.8	438.2
	URB0016-SMB							
	URB1270	12.8V	7.5Ah	96.0Wh	1.11kg	97.0	152.0	65.0
	URB12200		20Ah	256.0Wh	2.87kg	165.0	181.0	76.0
	URB12350		32Ah	409.6Wh	4.61kg	176.0	195.0	127.0
	URB12550		55.8Ah	714.2Wh	7.87kg	200.0	256.0	132.0
	URB12550-22NF		52.7Ah	675.0Wh	7.53kg	208.0	228.0	138.0
	URB121000		100Ah	1280.0Wh	13.91kg	219.0	340.0	170.0

Rechargeable Lithium-ion (Li-ion) Soft Packs

BATTERIES	PART NUMBER	NOMINAL VOLTAGE	RATED CAPACITY	RATED ENERGY	WEIGHT	NOMINAL HEIGHT (MM)	NOMINAL WIDTH (MM)	NOMINAL DEPTH (MM)
	UBBL07	3.7V	6.1Ah	22.6Wh	160g	70.0	60.0	20.0
	UBBL19-FL UBBL19-C1	3.6V	2.3Ah	8.3Wh	52g	67.0	19.1	23.2
	UBBL20-FL UBBL20-C1	7.2V		16.6Wh	100g		38.0	21.0
	UBBL21-FL UBBL21-C1	10.8V		24.8Wh	151g		56.5	22.0
	UBBL22-FL UBBL22-C1 UBBL22-C2-TH	14.4V	2.8Ah	40.3Wh	192g		75.0	
	UBBL23-FL UBBL23-C1	3.6V	4.6Ah	16.6Wh	100g		38.0	21.2
	UBBL24-FL UBBL24-C1 UBBL24-FL-TH UBBL24-C2-TH	7.2V	5.2Ah	37.4Wh	191g		75.0	21.5
	UBBL25-FL UBBL25-C1 UBBL25-FL-TH UBBL25-C2-TH UBBL25-C3-TH	11.1V		57.7Wh	295g		56.5	41.0
	UBBL26-FL UBBL26-C1	14.8V	5.2Ah	77.0Wh	393g		75.0	

BATTERIES	PART NUMBER	NOMINAL VOLTAGE	RATED CAPACITY	RATED ENERGY	WEIGHT	NOMINAL HEIGHT (MM)	NOMINAL WIDTH (MM)	NOMINAL DEPTH (MM)
	UBBL39-FL UBBL39-C1	3.6V	2.9Ah	10.4Wh	52g	67.0	19.1	23.2
	UBBP06-FL UBBP06-C1 UBBP06-C2		4.4Ah	15.8Wh	81g	51.8	71.4	10.92
	UBP001	3.7V	1.8Ah	6.7Wh	41g	36.0	54.0	11.0
	UBP002		0.9Ah	3.3Wh	24g			6.20
	UBBP01		1.8Ah	6.7Wh	46g	51.5	71.0	5.8



Digitalizing distribution

Although its meaning has morphed over the years, the core tenet of digitalization is to improve the agility of a business by leveraging data collection technologies and software developments. This allows a shift from analogue practices into digital processes and computerized data that can be much more comprehensive and available in real-time.

For example, a logistics company may have historically used phone calls between drivers and their managers to ascertain driver location, and also used a pen-and-paper approach to inventory management. In a digitalized business, driver location could be tracked with a vehicle GPS connected to an operations management software.

Stock management could be similarly digitalized with radio frequency identification (RFID) tagging of items, which frequently transmit location data to management software. This allows much more accurate views of important operational data, in an automatic and timely manner.

Use of asset tracking has become increasingly important in logistics since the onset of the COVID-19 pandemic. Whereas previous predictive models were able to handle the expected shifts in supply chains under normal circumstances, the unpredictable nature of the pandemic meant that agility became essential — and, consequently, so too did asset tracking and tracing.

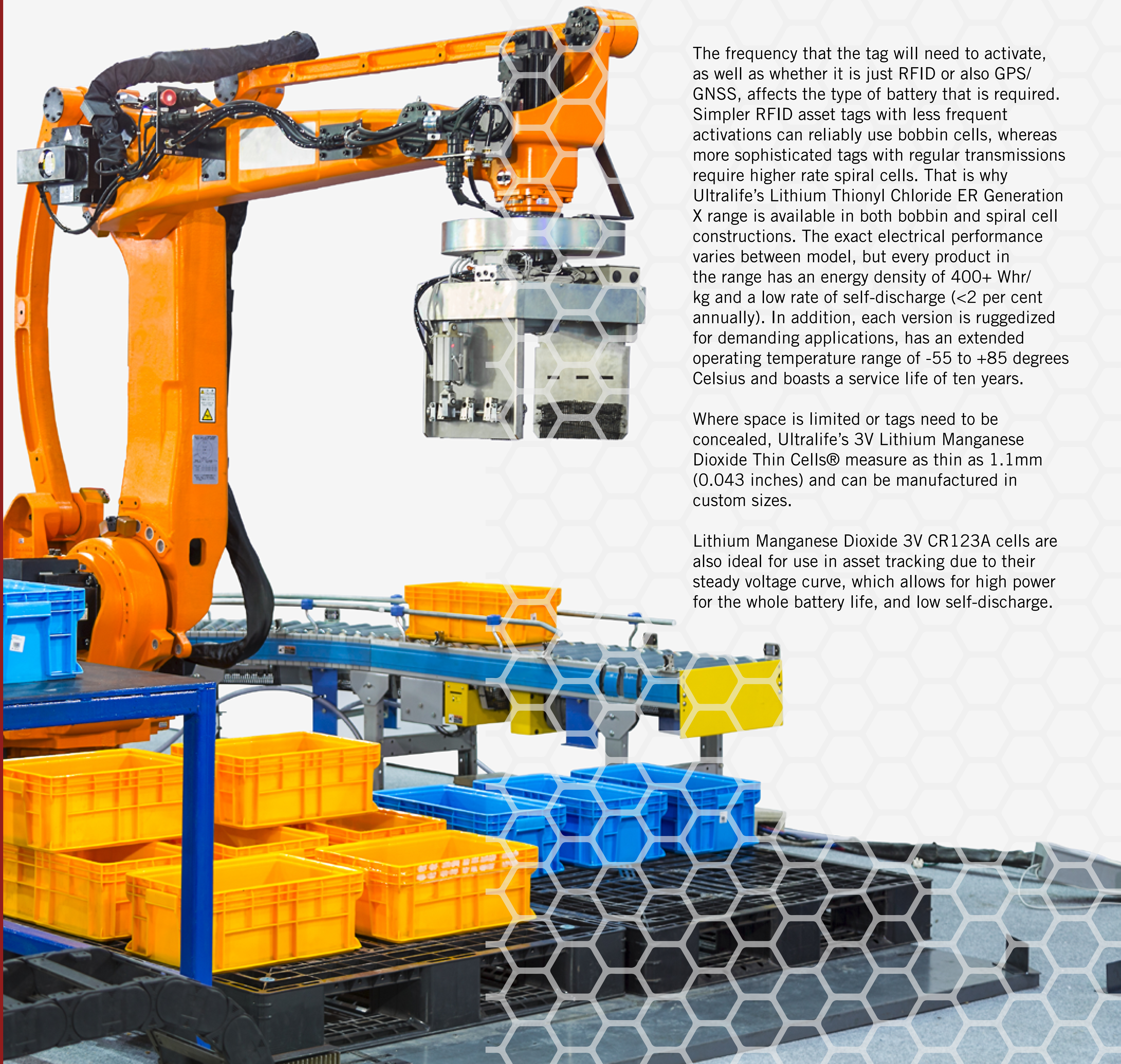
RFID is the backbone of many asset tracking and tracing applications. The technology is far faster than most alternatives, with scanners able to read up to 300 tags per second depending on the frequency of the RFID tag. If the tag is within reading distance, a signal can be transmitted back to IT systems. More sophisticated RFID tags also feature GPS or global navigation satellite system (GNSS) devices to provide constant location updates. This functionality allows accurate monitoring of assets through a supply chain, which helps operators to stay on top of operations in even unpredictable circumstances.

It is no surprise that RFID has become so widely adopted for many applications. In a 2019 survey, Zebra Technologies found that 52 per cent of organizations were using RFID in some capacity. An additional 34 per cent were planning on using RFID in the coming years.

RFID asset tracking offers a myriad of benefits to logistics managers, but it is not without its challenges — primarily for the design engineers developing the tags. Asset tags need to be discrete and lightweight, durable to withstand potential vibration and impact during transportation and long-lasting. The mechanical considerations can be reasonably addressed with overall device design, but it becomes more complex when we consider the battery to meet the long-lasting power requirement.

From a battery perspective, asset tags are surprisingly demanding. Balancing a long operational life with a compact, lightweight design requires careful selection of chemistry to deliver high energy density. Ensuring safety during transport also requires a rugged enclosure for the battery, as well as an extended operating temperature to withstand different environmental temperatures. However, even with this, the battery should feature integrated safety functions to minimize danger from electrical faults occurring over the course of a long service life subject to periodic damage.

Then there is the need for the tag to periodically transmit a signal, whether for a regular location update or to check for an RFID reader. This requires a battery that can remain in a low energy "sleep" state for a long period of time, but can quickly provide a pulse of energy as required.

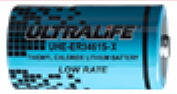
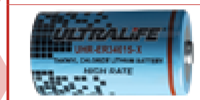


The frequency that the tag will need to activate, as well as whether it is just RFID or also GPS/GNSS, affects the type of battery that is required. Simpler RFID asset tags with less frequent activations can reliably use bobbin cells, whereas more sophisticated tags with regular transmissions require higher rate spiral cells. That is why Ultralife's Lithium Thionyl Chloride ER Generation X range is available in both bobbin and spiral cell constructions. The exact electrical performance varies between model, but every product in the range has an energy density of 400+ Whr/kg and a low rate of self-discharge (<2 per cent annually). In addition, each version is ruggedized for demanding applications, has an extended operating temperature range of -55 to +85 degrees Celsius and boasts a service life of ten years.

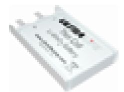
Where space is limited or tags need to be concealed, Ultralife's 3V Lithium Manganese Dioxide Thin Cells® measure as thin as 1.1mm (0.043 inches) and can be manufactured in custom sizes.

Lithium Manganese Dioxide 3V CR123A cells are also ideal for use in asset tracking due to their steady voltage curve, which allows for high power for the whole battery life, and low self-discharge.

Non-rechargeable Lithium Thionyl Chloride (LiSOCI2) 'ER Generation X' Cells

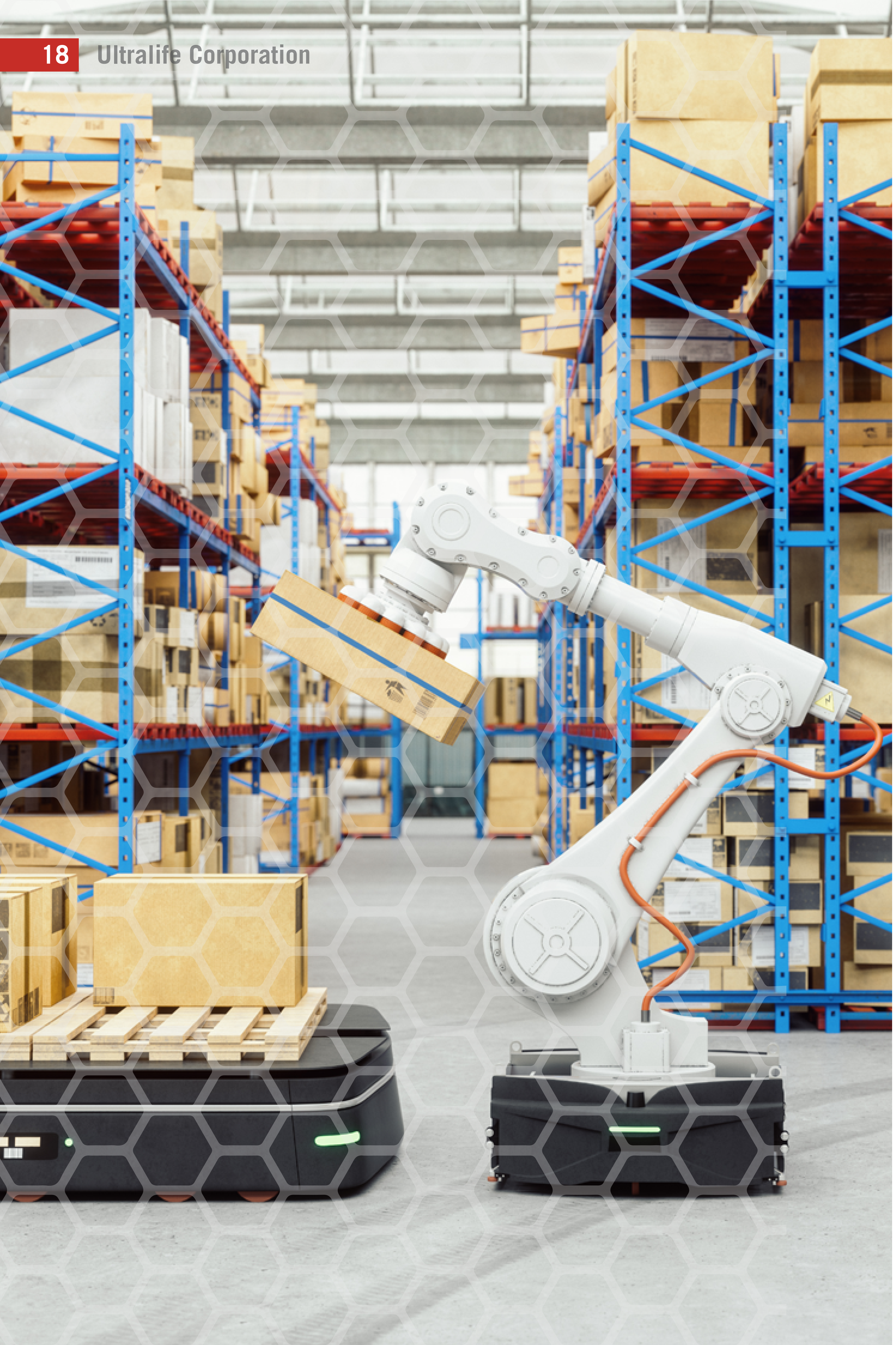
CELLS	PART NUMBER	NOMINAL VOLTAGE	RATED CAPACITY	RATED ENERGY	WEIGHT	DIAMETER (MM)	NOMINAL HEIGHT (MM)
	UHE-ER14250-X 1/2 AA-Bobbin	3.65V	1.2Ah	4.32Wh	10g	14.3	25.0
	UHE-ER14505-X AA-Bobbin		2.4Ah	8.8Wh	18g		50.0
	UHE-ER18505-H A-Bobbin		4.0Ah	14.4Wh	28g	18.4	51.0
	UHE-ER26500-X C-Bobbin		7.5Ah	27.4Wh	56g	25.5	49.8
	UHE-ER34615-X D-Bobbin		16.0Ah	58.4Wh	104g	32.8	61.0
	UHR-ER14505-X AA-Spiral		2.0Ah	7.3Wh	19g	14.3	50.5
	UHR-ER18505-X A-Spiral		3.0Ah	11.0Wh	35g	18.4	51.0
	UHR-ER26500-X C-Spiral		6.5Ah	23.7Wh	58g	25.5	49.8
	UHR-ER34615-X D-Spiral		14.5Ah	52.9Wh	108g	32.8	61.0

Non-rechargeable Lithium Manganese Dioxide (LiMnO2) Thin Cells®

CELLS	PART NUMBER	NOMINAL VOLTAGE	RATED CAPACITY	RATED ENERGY	WEIGHT	NOMINAL HEIGHT (MM)	NOMINAL WIDTH (MM)	NOMINAL DEPTH (MM)
	CP114951	3.0V	380mAh	1.1Wh	4.0g	1.0	48.75	51.0
	CP124920		165mAh	0.5Wh	1.7g	1.2		20.0
	CP243238		700mAh	2.1Wh	5.7g	2.4	37.00	42.00
	CP301322		115mAh	0.3Wh	1.1g	3.2	13.5	22.5
	CP301030		150mAh	0.5Wh	1.4g	3.0	11.2	30.0
	CP403838		1500mAh	4.5Wh	15.0g	4.2	47.0	43.5
	CP502520		600mAh	1.8Wh	4.5g	5.0	24.0	25.0
	CP502537		1200mAh	3.6Wh	9.5g		23.8	42.0
	CP603145		1900mAh	5.7Wh	15.7g	6.0	31.0	45.0

Non-rechargeable Lithium Manganese Dioxide CR123A Cells

CELLS	PART NUMBER	NOMINAL VOLTAGE	RATED CAPACITY	RATED ENERGY	WEIGHT	DIAMETER (MM)	NOMINAL HEIGHT (MM)
	UB123A	3.0V	1.5Ah	4.5Wh	17g	17.0	34.5
	CR123A				16g		



Conclusion

The role of the logistics industry to the global economy cannot be understated, and even more so in the wake of COVID-19. The pandemic illuminated opportunities for enhanced efficiency and improved agility, with batteries playing a vital role in supporting logistics, intralogistics, and warehouse operators. Ultralife Corporation, and its subsidiary companies Accutronics and SouthWest Electronic Energy, are primed to help operators, logistics robotics developers and asset tracker designers to ensure these advancing technologies are fully and reliably powered.

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