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Portable and Corded Power Tools


Appliances


Industrial

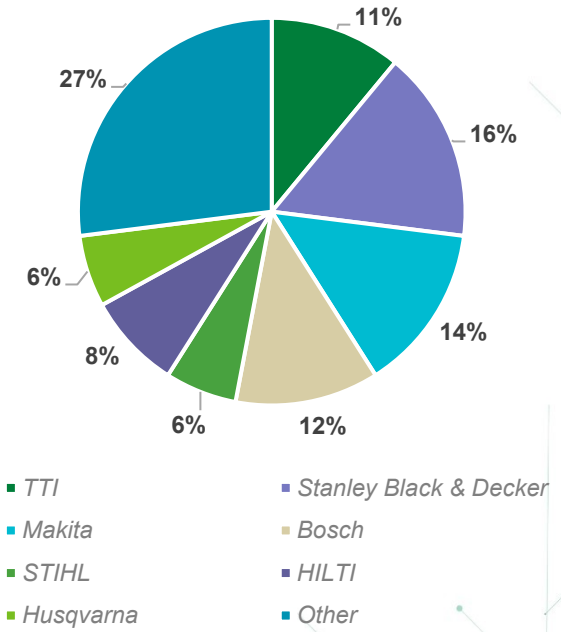
REV0922

Many battery powered devices in very different applications share similar safety and control elements

Global power tool market statistics and drivers

Market Trends and Drivers
The global power tool market is growing at a CAGR of 6.9% between 2021 to 2026. Cordless power tools are the fastest-growing sector of the power tool industry
Cordless power tools are currently experiencing rapid growth and represent 50% of all power tool shipments
Cordless power tool architecture (i.e., control, battery management, and safety) is very similar across other battery-run devices
Portable tools are beginning to adopt Li-ion batteries (from NiCd & NiMH) that are more focused on electronic design / safety in chargers and battery packs
Brushless DC motors are preferred for power tools due to their better reliability / longevity, smaller size, and improved output performance

The power tool market is growing at a ~6.9% CAGR



Source: Statista, alliedmarketresearch

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Battery

Battery packs used in power tools & appliances

1 Thermal cell protection

- Thermal cut-off
- setP™

2 Secondary protection

- Fuse
- Battery Protector

3 Battery management unit

- PPTC
- Fuse
- TVS Array

4 Primary protection

- TVS Diode

5 ID communication

- TVS Diode Array
- PPTC

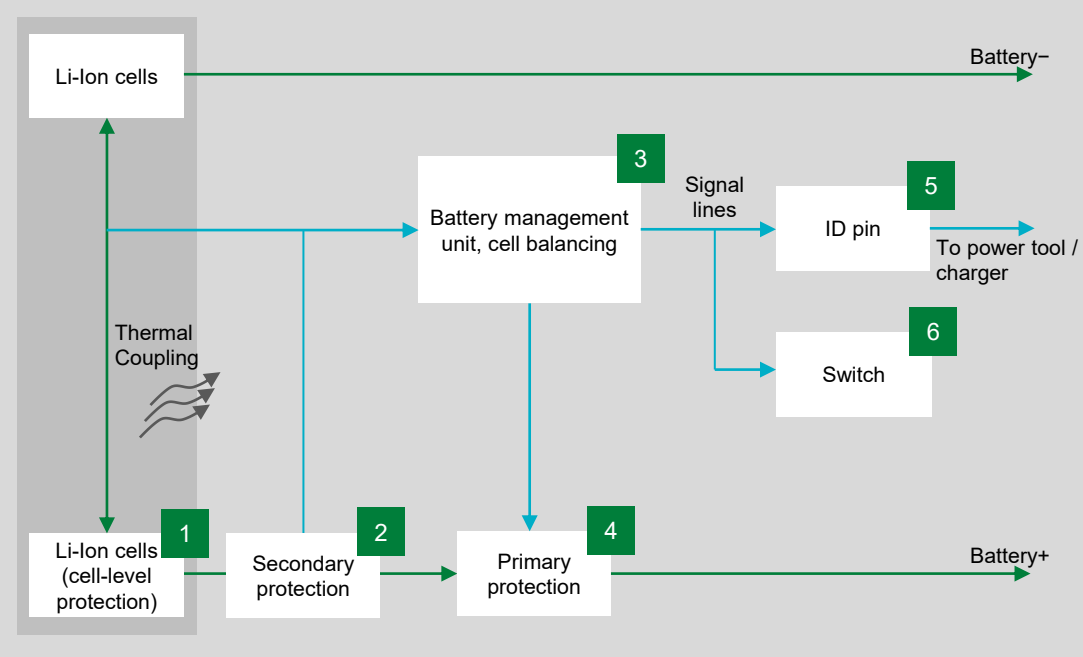
6 Switch

- Tactile Switch

Acronyms:
TVS: Transient Voltage Suppressor
PPTC: Positive Temperature Coefficient Device
NTC: Negative Temperature Coefficient Device
ESD: Electrostatic Discharge

Click on the product series in the table below for more info

Cordless tool battery pack block diagram



	Technology	Product series
1	Thermal Cut-off Device	MHP-TAC
	NTC	KC
2	Fuse *OR* Battery Protector	BF1, 881, 688 *OR* ITV
3	PPTC *OR* Fuse	0805L *OR* 458
	TVS Diode Array	SP1003, SC1006
4	TVS Diode	SMF, SMF4L
5	TVS Diode Array	SP3021,SP1007
	PPTC	zeptoSMDC
6	Switch	KSC441J, PTS645V

Legend:
- *Power*
- *Data*

- ***Secondary protection*** *– Protects cells in the event that the primary safety circuit fails*
- ***Primary protection*** *– Handles all the basic safety functions: overvoltage, undervoltage, overcurrent, under-temperature, or overtemperature*

* *Suitable for premium products or large battery packs. Contact Littelfuse for more information*

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Click on the product series in the table below for more info

Typical products for tools & appliances battery packs

	Technology	Function in Application	Series	Benefits	Features
1	Thermal Cut-off Device (Single cell device)	Resettable overtemperature protection for batteries	MHP-TAC	Voltage rating up to (12 VDC) and smaller size offers resettable overtemperature protection	Multiple activation temperature ratings (72 °C, 77 °C, 82 °C, 85 °C, and 90 °C)
	NTC	Analog temperature monitoring of battery packs during charging and discharging cycles	KC	Provides accurate temperature readings for enabling safe device operation	Insulated lead wires, small form factor, fast thermal response
2	Fuse ***OR*** Battery Protector	Non-resettable overcurrent protection	BF1, 881, 688 ***OR*** ITV	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	Third-party compliance UL/IEC, low internal resistance, shock-safe, vibration resistant
		Non-resettable overcurrent and overcharge protection (on demand activated).		Overcurrent and overcharge protection; controlled disconnection, can be activated by BMS	Surface mountable; UL and TUV certified. 3pin device, Controlled fusible element
3	Fuse ***OR*** PPTC	Non-resettable protection for BMS MOSFET from high currents due to external shorts	0805L ***OR*** 458	Allows space saving	Surface-mountable, UL- and TUV-certified, 3-pin device, controlled fusible element
		Resettable protection for BMS MOSFET from high currents due to external shorts		Reduces customer qualification time by complying with third-party safety standards such as UL/IEC; SMD form-factor allows for compact design	Surface mountable, compatible with lead-free solder processes per IEC standards; PPTC is only for single-cell applications
	TVS Diode Array	Protects control devices from voltage transients	SP1003, SC1006	Protects ICs and other sensitive components	Excellent clamping capability
4	TVS Diode	Protects battery packs from over-voltage conditions due to abnormal charging conditions	SMF, SMF4L	Improves system reliability by protecting downstream components from transients on power lines	Excellent clamping capability
5	PPTC	Overcurrent protection for TVS or Zener diode	SP3021,SP1007	Resets to normal operation after fault is cleared; smaller footprint saves space	Maximum electrical rating: 13 VDC; short circuit current: 82~200 mA; small footprint 0201 size
	TVS Diode Array	ESD protection of I2C input	zeptoSMDC	Small, space-saving design; low capacitance to prevent signal disruption	µDFN-2 (0201) footprint; ±30 kV ESD withstand voltage
6	Tactile switch	Indication of battery status	KSC441J, PTS645V	Saves space; reliable and repeatable haptic performance elevates end users' experience	Microminiature, short travel, PCB mount tactile with a minimum of 100K operations

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Cordless tool

Key elements of cordless power tool

1 DC input protection

- Fuse
- TVS Diode
- Reed Switch

2 Power bridge protection

- NTC
- setP™

3 Power Bridge and Gate Driver

- MOSFET

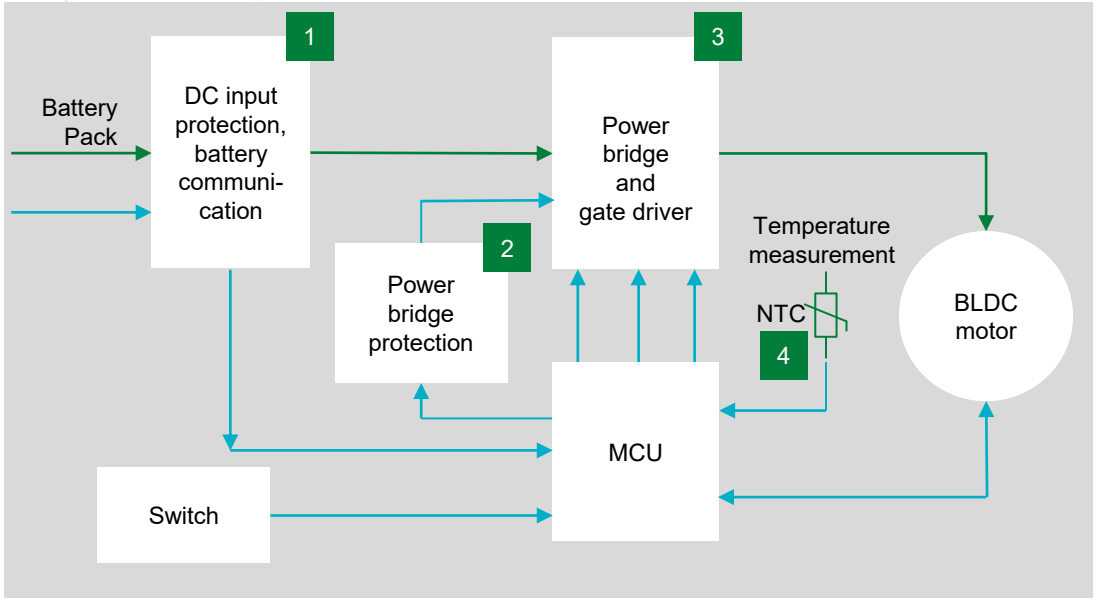
4 Temperature protection

- NTC

Acronyms:
NTC: Negative Temperature Coefficient
TVS: Transient Voltage Suppressor

Click on the product series in the table below for more info

BLDC motor protection architecture



	Technology	Series
1	Fuse	501
	TVS Diode	SMAJ, SMBJ, 5KP
	Reed Switch	MDSR-10, 59166
2	NTC	KC
	Digital Temperature Indicator	setP™
3	MOSFET	Gen2 / Gen4
4	NTC	RB

Click on the product series in the table below for more info

Select Littelfuse products for BLDC motor protection

	Technology	Function in Application	Series	Benefits	Features
1	Fuse	Protects the battery and downstream controller from damage due to inrush current, motor shorting or external shorts at contacts	501	Reduces customer qualification time by complying with third party safety standards such as UL/IEC	Third-party compliance with UL/IEC; low internal resistance; shock safe; vibration-resistant
	TVS Diode	Protect battery pack from voltage transients	SMAJ, SMBJ, 5KP	Improves system reliability by protecting downstream components from transients on power lines	Excellent clamping capability
	Reed Switch	Provides control signal to turn the motor on or off	MDSR-10, 59166	Contamination resistant, compact design	Switch up to 200Vdc or 0.5A at up to 10W, 10^{12} Ohms insulation resistance
2	NTC	Temperature sensing of Power MOSFET	KC	Provides accurate temperature (component/ambient) for enabling safe device operation	High reliability; small form factor; fast thermal response
	Digital Temperature Indicator	FET overheating indication	setP™	Reliable overheating indication, regardless of power being delivered	Compact footprint 0805; multipoint measurement (device configuration in series)
3	MOSFET	Part of the inverter of brushless DC motor for high-frequency switching	Gen2 / Gen4 (from 36 V)	Improves system efficiency and enables compact design	Very low $R_{ds(on)}$; high current capability
4	NTC	Temperature sensing to prevent motor damage due to overheating	RB	Provides accurate temperature (component / ambient) for enabling safe device operation	High reliability; small form factor; fast thermal response

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Charger

Functional elements in power tool charger

1 AC input primary protection

- Fuse
- MOV
- NTC

2 Rectification, high frequency converter

- MOSFET
- TVS Diode

Acronyms:
MOV: Metal Oxide Varistor
NTC: Negative temperature co-efficient
TVS: Transient Voltage Suppressor

3 Secondary side rectification

- Schottky Diode

5 DC output protection

- TVS Diode

5 Wireless communication

- TVS Diode Array

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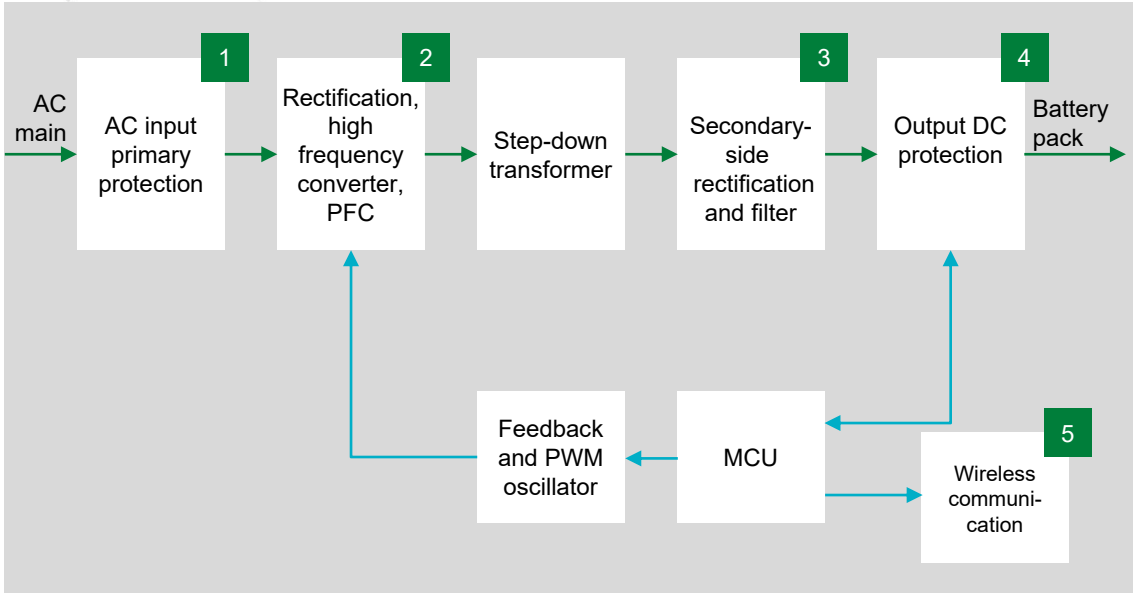
Click on the product series in the table below for more info

Power tool charger protection architecture



Legend:
Power
Data

	Technology	Series
1	Fuse	5X20mm Fuse, TR, TE
	MOV	LA, CIII, TMOV
2	MOSFET	X2-class
	TVS Diode	P6KE, P6SMB
3	Schottky Diode	MBR, DST
4	TVS Diode	SMBJ
5	TVS Diode Array	SP3021, SP1007

Click on the product series in the table below for more info

Potential Littelfuse products for power tool charger

	Technology	Function in Application	Series	Benefits	Features
1	Fuse	Protects the power stage from overcurrent	5X20mm Fuse, TR, TE	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	Third-party compliance with UL/IEC; low internal resistance; shock-safe; vibration-resistant
	MOV	Protects power unit from voltage surges such as lighting and transients	LA, CIII, TMOV	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	High energy absorption capability: 40–530 J (2 ms)
2	MOSFET	High switching speed in power supply units	X2-class	Fast response time and lower heat signature	Low $R_{ds(on)}$, dv/dt ruggedness
	TVS Diode	Protects the power unit from voltage transients	P6KE, P6SMB	Improves system reliability by protecting downstream components from transients on power lines	Excellent clamping capability
3	Schottky Diode	Rectification and blocking in power supply units	MBR, DST	Enables the design of high efficiency power supplies	Ultra-low forward voltage drop; high-frequency operation
4	TVS Diode	Surge protection	SMBJ	Improves system reliability by protecting downstream components from transients on power lines	Excellent clamping capability
5	TVS Diode Array	ESD protection of wireless communication	SP3021, SP1007	Small, space-saving design; low capacitance to prevent signal disruption	µDFN-2 (0201) footprint; ±30 kV ESD withstand voltage

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Corded tool

Corded power tool control & protection opportunities

1 AC primary protection

- Fuse
- MOV

2 Rectifier and filter

- Rectifier Bridge
- Rectifier Diode
- SCR
- NTC

3 Power stage, gate drive

- setP™
- Gate Driver
- IGBT

4 AC Switching

- TRIAC

Acronyms:
TRIAC: Triode For Alternating Current
IGBT: Insulated-gate Bipolar Transistor
MOV: Metal Oxide Varistor

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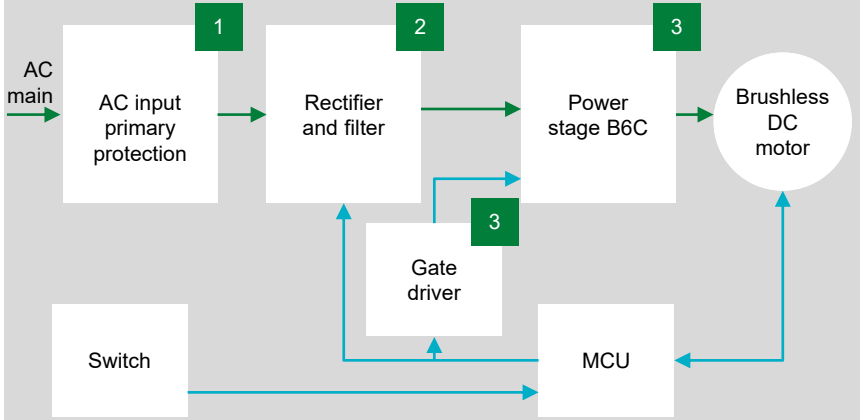
Click on the product series in the table below for more info

Corded power tool control & protection opportunities

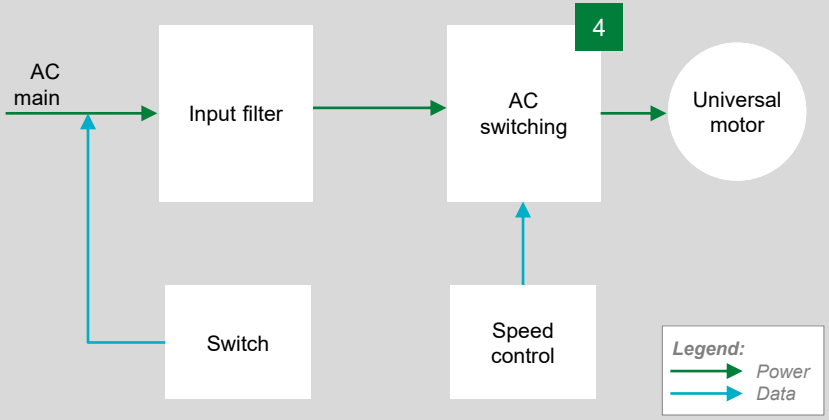
Brushless DC motor



	Technology	Series
1	Fuse	5X20mm Fuse, TR, TE
	MOV	LA, CIII, TMOV
2	NTC	KC
	Rectifier Bridge ***OR**** Rectifier Diode SCR	GB025-xxN01 ***OR**** DLA40 CLA15

*Alternative using half-controlled rectifier bridge

Universal motor



	Technology	Series
3	Gate Driver	LF2103
	IGBT	Gen X3™
	Digital Temperature Indicator	setP™
4	TRIAC	Qxx25xHx, QJxx25xHx

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Click on the product series in the table below for more info

Select Littelfuse products for tool protection

	Technology	Function in Application	Series	Benefits	Features
1	Fuse	Protects power stage from overcurrent	5X20mm Fuse, TR, TE	Reduces customer qualification time by complying with third party safety standards such as UL/IEC	Third-party compliance UL/IEC; low internal resistance; shock safe; vibration resistant
	MOV	Protects the power unit from voltage surges such as lighting and transients	LA, CIII, TMOV	Reduces customer qualification time by complying with third-party safety standards such as UL/IEC	High energy absorption capability: 40–530 J (2 ms)
2	NTC	Temperature sensing of Power MOSFET	KC	Provides accurate temperature (component / ambient) for enabling safe device operation	High reliability; small form factor; fast thermal response
	Rectifier Bridge ***OR*** Rectifier diode SCR	Converts AC line voltage supplied to the drive to DC ***OR*** Alternative using a half-controlled rectifier bridge	GB025-xxN01	Space and weight savings; low forward voltage drop	Isolation voltage: 2500 V; reduced weight; epoxy meets UL 94V-0
			DLA40	Very low leakage current, low forward voltage drop	Single thyristor with two gate polarities; RoHs compliant; TO-236 (D2Pak-HV) package
			CLA15	Plannar passivated chip; long-term stability; two gate current polarities usable	Single thyristor with two gate polarities; RoHs compliant; TO-236 (D2Pak-HV) package
3	Gate Drivers	Provides required drive current to discrete MOSFETS or IGBTs	LF2103	Efficient and fast FET switching	1.5 A peak output current; wide operating voltage range
	IGBT	Discrete switching for power control	Gen X3™	Lowest on-state resistances among its competitors along with low gate charges and superior dv/dt performance	Helps reduce switching losses and electromagnetic interference
	Digital Temperature Indicator	FET overheating indication	setP™	Reliable overheating indicators, regardless of power being delivered	Compact footprint 0805; multipoint measurement (device configuration in series)
4	Triac	AC switching to control the motor	Qxx25xHx, QJxx25xHx	Solid-state switching with no audible noise and no contact bounce during operation; compact design	Ability to withstand high voltage and high surge current

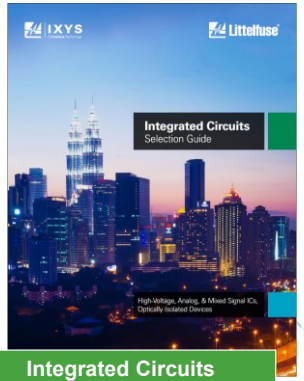
Additional information can be found at Littelfuse.com

Explore the world of Littelfuse products and applications with eCatalogs (ecatalogs.littelfuse.com)

Circuit Protection Selection Guide

Sensor Selection Guide

Power Semiconductor Product Catalog



Integrated Circuits Selection Guide

Click on images for more information

Small Appliances Spotlight

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Local resources supporting our global customers

Legend

- *Sales*
- *R&D*
- *Manufacturing*

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We are an industrial technology manufacturing company empowering a sustainable, connected, and safer world

Application Expertise

Our engineers partner directly with customers to help speed up product design and meet their unique needs

Global Customer Service

Our global customer service team is with you to anticipate your needs and ensure a seamless experience

Compliance and Regulatory Expertise

We help customers in the design process to account for requirements set by global regulatory authorities

Testing Capabilities

We help customers get products to market faster and we offer certification testing to global regulatory standards

GLOBAL MANUFACTURING

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