



Factory Robots



Industrial Controls



Factory robotics landscape: from cobots to humanoids connecting the factory floor

Robotic arms

Traditional industrial robots used for a wide range of manufacturing tasks.



SCARA robots



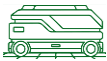
Delta robots



Cartesian/
Gantry

Mobile robots

Autonomous robots that move materials and goods within factories and warehouses.



AMRs

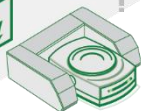


AGVs



Autonomous
carts

CHARGING STATION



AMR: Autonomous Mobile Robot
AGV: Automated Guided Vehicles

Cobots

Collaborative robots designed to work safely alongside people.



Assembly



Screw-driving



Material
handling

Humanoids

Emerging human-form robots designed for flexible manipulation, inspection, logistics, and repetitive factory tasks.



Material
handling



Machine
loading



Inspection &
repetitive tasks

Factory robot platforms: technical specifications and Littelfuse opportunities

	Robotic arms	Cobots	Mobile robots	Humanoids
				
Typical applications	Welding, assembly, machine tending, palletizing	Assembly, screw driving, dispensing	Material transport, line feeding, warehouse logistics	Kitting, tote handling, machine loading, repetitive manual tasks
Power input/Battery	200–480 VAC, often 3-phase	200–240 VAC, single-phase	Battery-powered	On-board/Battery pack
Battery/DC Bus voltage	~300–680 VDC, servo bus	24–60 VDC, 48 VDC common	24–26 V small AMRs, 48 V mainstream/heavy AMRs	48 VDC class common
Charging power	Not applicable	Not applicable	1 kW to 3 kW typical	0.3 to 2 kW+
Motor types	PMSM/AC servo/ BLDC servo	BLDC/PMSM/frameless torque motors	BLDC/PMSM traction motors	BLDC servo/PMSM/frameless torque motors/linear actuators
Motion/Control architecture	Centralized or multi-axis servo inverter	Distributed joint servo drives	Traction drive + steering + navigation control	Zonal* + distributed joint servo drives + main AI compute
Communication	EtherCAT, PROFINET, Ethernet/IP, IO-Link	EtherCAT, PROFINET, Ethernet/IP, CANopen	CAN, CANopen, Wi-Fi, BLE, UWB	EtherCAT, CAN FD, Ethernet, Wi-Fi
Payload/Capability	Medium to very high	Typically, 3–30 kg	Small carts to heavy pallet movers	High dexterity, many degrees of freedom

Littelfuse opportunities across factory robot platforms

 Circuit protection

 Motor drive and motion control

 Battery, BMS, and charging

 Sensing, safety, and HMI

 Connectivity and High-speed interfaces



Expertise Applied | Answers Delivered

* Zonal architecture: local controllers for arms, legs, torso and head linked to central compute.

Littelfuse solutions for industrial robotic arms



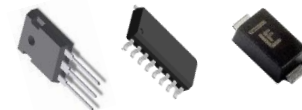
Input protection

AC Fuse, Fuseholder, MOV



Auxiliary power supply

Si/SiC MOSFET,
Gate Driver, TVS Diode



Input rectifier and brake

SiC/Rectifier Diode,
Power Module, SMPD



Switches and Sensing

C&K® Switches,
Carling Technologies, TMR Sensor



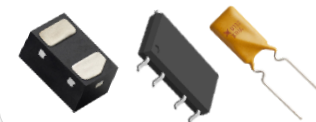
Inverter

Fuse, IGBT (Discrete/Module),
SiC MOSFET, Gate Driver

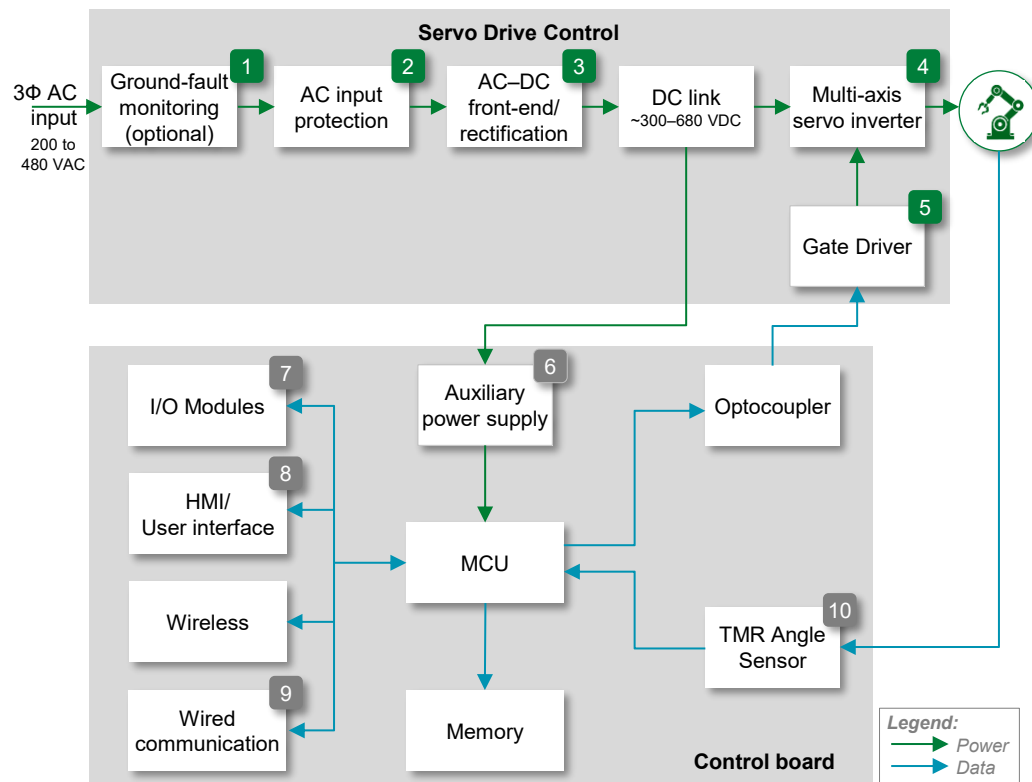


Communication and I/O modules

TVS Diode Array, SSR, PPTC

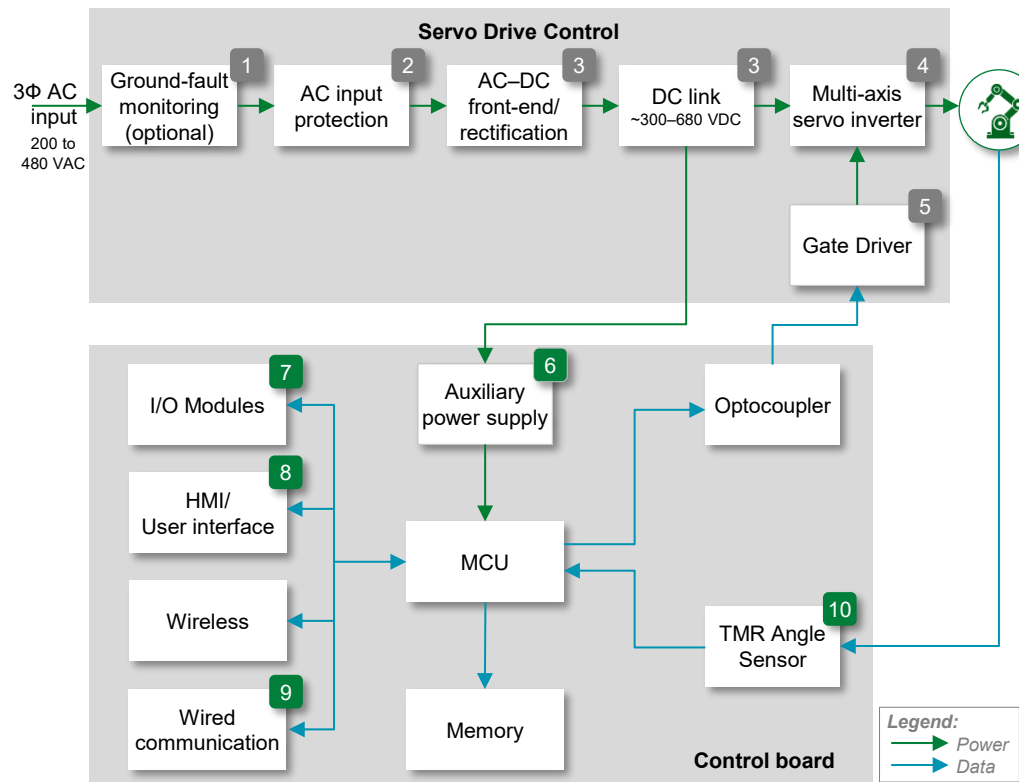


Industrial robotic arms block diagram



	Technology	Function in application	Product series
1	Ground Fault Relay	Detects AC/DC earth leakage/ ground fault current	EL731
	Fuse	Protects the equipment from overload and short-circuit	JLS, JLLS, JLLN, LDC, 606, 504, 505, 607
	Fuseholder	Secures mounting of fuses; allows easy fuse replacement	LFI, LFJ
2	MOV	Protects against damage due to lightning-induced voltage surges	TMOV, UltraMOV
	AC Bridge, Rectifier Diodes/ Diode Module	Converts 200–480 VAC 3-phase input to ~300–680 VDC DC link for servo drives	AC Bridges (650–1200 V), Rectifier Diodes (650–1200 V), 3-Phase Bridge Modules (1200 V)
	Brake Chopper (E/E3/SMPD)	Limits the DC bus voltage by switching the braking energy to a resistor	Boost Chopper IGBT Modules
3	SiC MOSFET (650–1200 V) OR HV IGBT Discrete/Module (Up to 1200 V)	Main power-switching stage for multi-axis servo motor control	SiC MOSFET XFS IGBT 1200V (Under development; Contact Sales), SMPD Package, CBI Modules
	Semiconductor Fuse	Protection against short circuit at rectifier or inverter stages	PSR, L50QS, L70QS, L60QS
	Gate Driver	Controls MOSFET/IGBTs	IXD60xx, IXD704, IX4352NE, IX3407B

Industrial robotic arms block diagram *continued...*



	Technology	Function in application	Product series
6	Si/SiC MOSFET	Semiconductor switch	SiC MOSFET/ 1.5 kV Si MOSFET/ 650V X3 Ultra Junction
	Gate Driver	Drives SiC MOSFETs and discrete IGBTs	IXD 609, IXD704, IX4310T, IX4352NE
	TVS Diode	Protects semiconductor switches from voltage transient	SMF, SMFA
7	Solid State Relay	Switches low-current output loads (valves, relays, etc.)	CPC19xx
	PPTC	Resettable protection for 24 V I/O lines and auxiliary outputs	RUEF, RGEF, 1812L
	TVS Diode	Transient protection for 24 V I/O modules	SMBJ, SMCJ, SMDJ
8	C&K® Switch	Various functions (drive configuration, on/off, test button, parameter setting, mode selection, input/output selection, etc.)	TDA, RTE, RTA, AYZ, KSC2, KSC3, KSC4, SUM (Under development; Contact Sales)
	Carling Technologies		L Series, V Series, AV/AVH
9	TVS Diode Array	ESD protection for I/O, Ethernet, CAN, USB, encoder lines	SP3213, SP3400, SM15/SP712, SP0201B, SP2525NUTG, SP3025-04HTG
10	TMR Sensor	Joint angle / position feedback, end-effector position sensing, mode sensing, safety interlock detection.	LF53464-08TMR, LF53466-08TMR

Recommended Littelfuse solutions for cobots



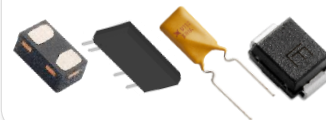
Input protection

AC Fuse, MOV



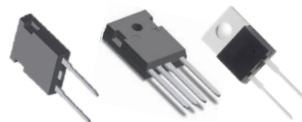
Communication and I/O module

TVS Diode Array, SSR, PPTC, TVS Diode



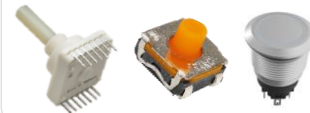
AC-DC conversion

Si Diode, Si MOSFET, Schottky Diode



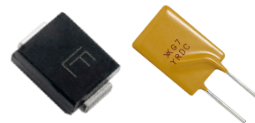
HMI/User interface

C&K® Switches, Carling Technologies



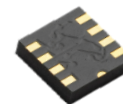
DC PDU

TVS Diode, PPTC

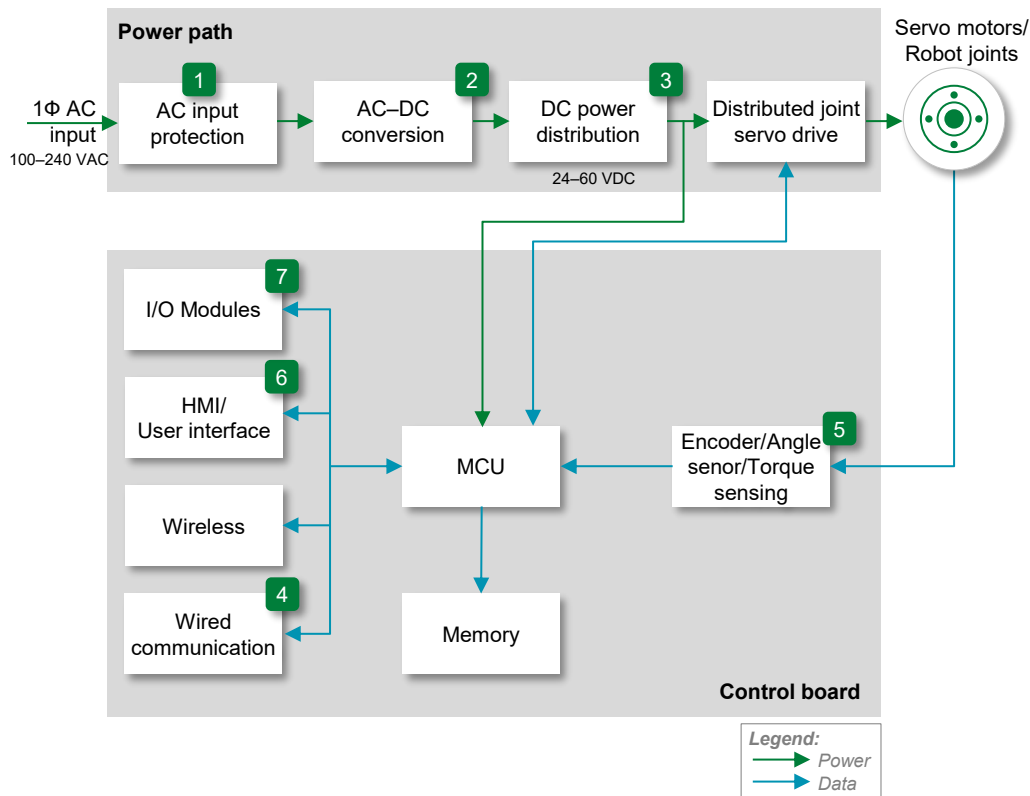


Position sensing

TMR Sensor

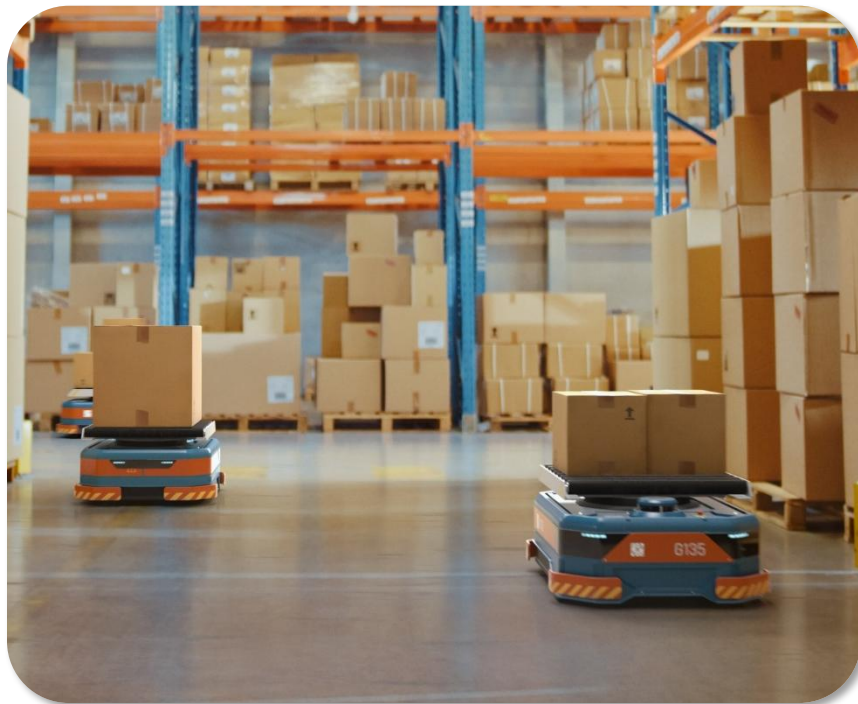


Cobots block diagram



	Technology	Function in application	Product series
1	Fuse	Protects cobot controller / AC-DC PSU from overload and short circuit	215 , 875 , 807 , 373
	MOV	Protects against line transients and surge events	TMOV , UltraMOV , C-III
2	Si Diode	Input rectification	DSEI , DSEP , DPG ,
	SiC MOSFET OR IGBT	Switching device inside flyback / LLC / PFC AC-DC converter	SiC MOSFET OR Discrete IGBT
	Schottky Diode	Low-voltage output rectification / blocking in power supply units	MBR , DST
3	TVS Diode	Protects 24–60 VDC bus, and low-voltage rails from transients	SMDJ , SMF
	PPTC	Resettable overcurrent protection for 24 V / 12 V / 5 V auxiliary rails	RUEF , RGEF , 1812L
4	TVS Diode Array	ESD protection for I/O, Ethernet, CAN, USB, encoder lines	SP3213 , SP3400 , SM15/SP712 , SP0201B , SP2525NUTG , SP3025-04HTG
5	Polymer ESD	ESD protection for WiFi or BLE module antenna	PESD
6	C&K® Switches	Mode select, service, setup, enable function	TDA , RTE , RTA , AYZ , KSC2 , KSC3 , KSC4
	Carling Technologies		L Series , AV/AVH
7	Solid State Relay	Switches low-current output loads (valves, relays, etc.)	CPC19xx
	PPTC	Resettable protection for 24 V I/O lines and auxiliary outputs	RUEF , RGEF
	TVS Diode	Transient protection for 24 V I/O modules	SMBJ , SMCJ , SMDJ
8	TMR Sensor	Joint angle sensing, position feedback, mode sensing, trigger activation, safety interlocks	LF53464-08TMR , LF53466-08TMR

Recommended Littelfuse solutions for AGVs or AMRs



Battery protection

Fuse, PPTC, Battery Protector,
TVS Diode, CSR, C&K® Switch



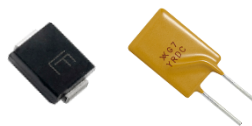
Current/Position/ Speed sensing

CSR, TMR



DC-DC converter

TVS Diode, PPTC



HMI/User interface

C&K® Switch, Carling Technologies



Motor control

Fuse, TVS Diode

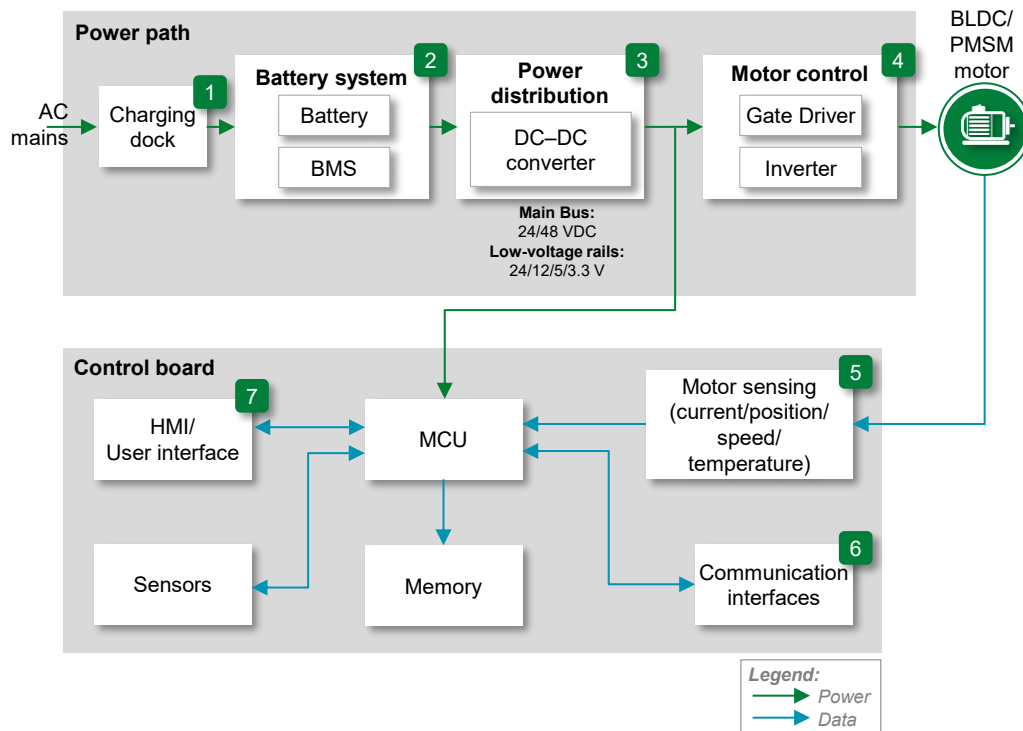


Communication interfaces

TVS Diode Array

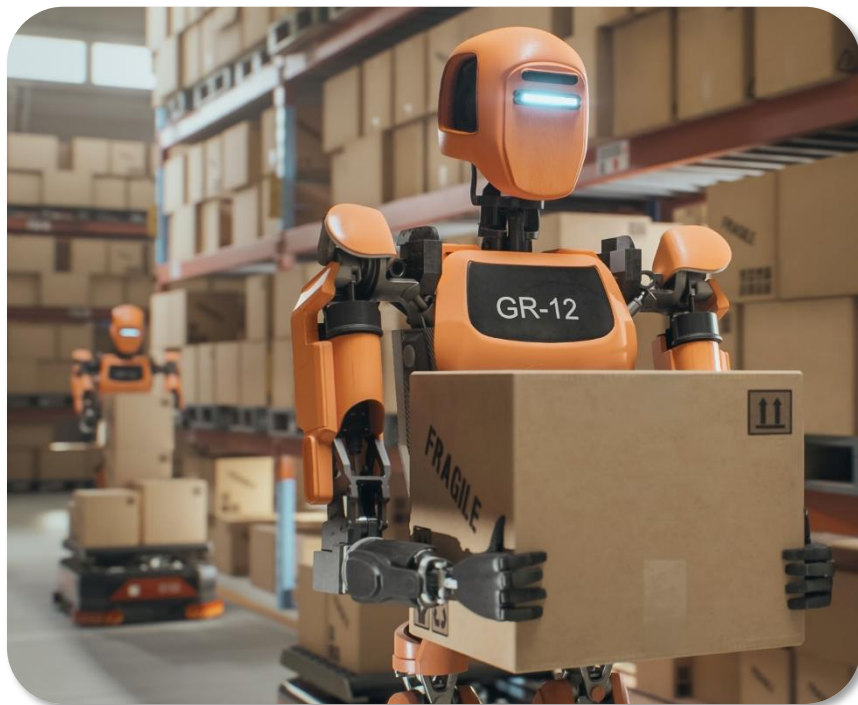


AGVs or AMRs block diagram



	Technology	Function in application	Product series
1	Charging Solutions		
	Fuse	Main pack fault isolation (high-energy short protection)	MIDI 70V, MAXI 58V
2	Fuse/PPTC	Branch circuit overcurrent protection	438A, 437A/1812L
	Battery Protector	Secondary protection	ITV
	TVS Diode	DC bus surge and switching transient protection	TPSMD, TP5.0SMDJ, TPSMB-L
	CSR	Pack charge/discharge current monitoring (BMS feedback)	WSTM-A, L4CL
	C&K® Switch	User control, service disconnect, and safety interlock	ZMS, LCS, KSC, ZMV, ATS
3	TVS Diode	Protects 24–60 VDC bus and low-voltage rails from transients	SMDJ, SMF
	PPTC	Resettable overcurrent protection for 24 V / 12 V / 5 V auxiliary rails	RUEF, RGEF, 1812L
4	Fuse	Protects from inrush, motor short, or external short	501
	TVS Diode	Motor drive transient/EMI protection	5.0SMDJ, SMDJ, 5KP
5	TMR	Position sensing	LF53464, LF53466
	CSR	Current sensing	WSTC
6	TVS Diode Array	ESD protection for high-speed interfaces	SP3213, SP1006, AQ24COM-02, AQ24COM-01
7	C&K® Switch	HMI/user interface, service switch, battery/service disconnect	KSC2, KSC3, KSC4
	Carling Technologies		V-Series, W-Series

Recommended Littelfuse solutions for humanoid



Battery protection

Fuse, PPTC, Battery Protector,
TVS Diode, CSR, C&K® Switch



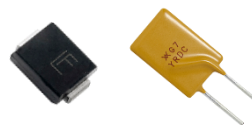
Current/Position/ Speed sensing

CSR, TMR



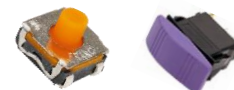
DC-DC converter

TVS Diode, PPTC



HMI/User interface

C&K® Switch, Carling Technologies



Motor control

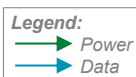
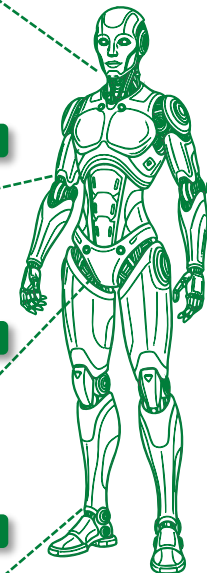
Fuse, TVS Diode



Communication interfaces

TVS Diode Array





	Technology	Function in application	Product Series
1	Charging Solutions		
2	Fuse	Main pack fault isolation (high-energy short protection)	MIDI 70V , MAXI 58V
	Fuse/PPTC	Branch circuit overcurrent protection	438A , 437A/1812L
	Battery Protector	Secondary protection	ITV
	TVS Diode	DC bus surge and switching transient protection	TPSMD , TP5.0SMDJ , TPSMB-L
	CSR	Pack charge/discharge current monitoring (BMS feedback)	WSTM-A , L4CL
	C&K® Switch	User control, service disconnect, and safety interlock	ZMS , LCS , KSC , ZMV , ATS
3	TVS Diode	Protects 24–60 VDC bus, and low-voltage rails from transients	SMDJ , SMF
	PPTC	Resettable overcurrent protection for 24 V / 12 V / 5 V auxiliary rails	RUEF , RGEF , 1812L
4	TVS Diode	Motor drive transient/EMI protection	SMAJ , SMBJ , 5KP
	TMR	Position sensing	LF53464 , LF53466
	CSR	Current sensing	WSTC
5	TVS Diode Array	ESD protection for high-speed interfaces	SP3213 , SP1006 , AQ24COM-02 , AQ24COM-01
6	C&K® Switch	HMI/user interface, service switch, battery/service disconnect	KSC2 , KSC3 , KSC4
	Carling Technologies		V-Series , W-Series

Single-phase charger for AGVs, AMRs, and humanoids



Input protection

Fuse, MOV



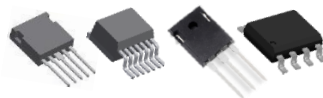
Output protection

Fuse



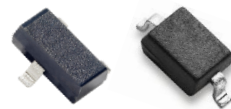
Power conversion

Rectifier Bridge, SiC MOSFET,
SiC Diode, Gate Driver



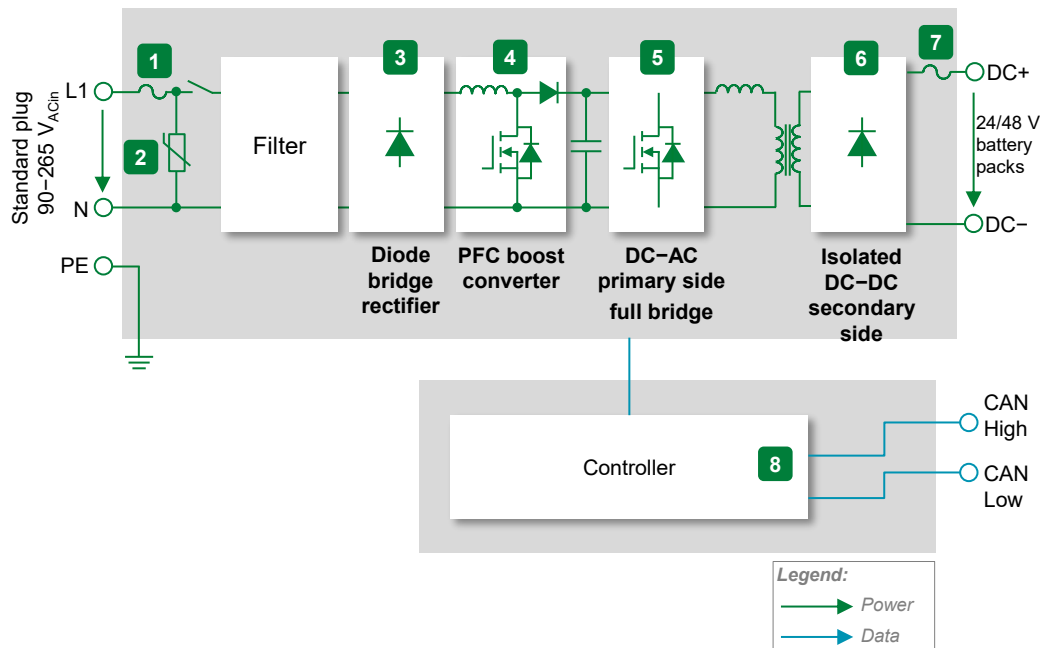
Control board

TVS Diode Array



Single-phase charger for AGV, AMR, and humanoid block diagram

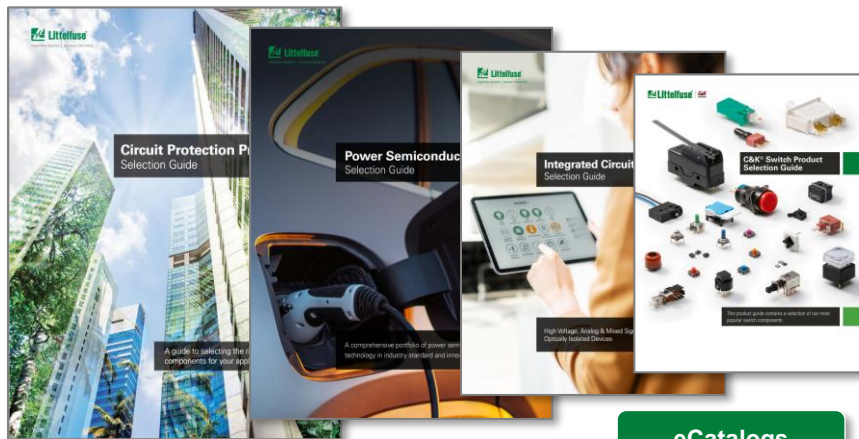
 Click the product series in the table below for more info



	Technology	Function in application	Product series
1	Fuse	Primary overcurrent protection of EV equipment	606 , 505 , 607
2	MOV	Protects from power fluctuations or surges	TMOV , Xtreme , UltraMOV
3	Rectifier Bridge	Converts AC voltage to DC voltage	FBO40-12N , VBO21-08NO7
	Rectifier Bridge + Boost		VUM33-06PH
4	SiC MOSFET	High-frequency switching	650 V SiC MOSFET
	Si/SiC Schottky Diode	High-frequency switching and rectification	LSIC2SD , DHG , DSEI , DSEPxx
	Gate Driver	Efficient switching of MOSFETs	IX4340 , IXD60x , IX4352NE
5	Gate Driver	Primary side of the DC-DC converter	IX4340 , IXD60x
	SiC MOSFET	Efficient switching of MOSFETs	650 V SiC MOSFET , 650 V H-bridge SMPD (Under development; Contact Sales)
6	Fast Diode (Passive Rectification)	Secondary side output passive rectification of DC-DC converter	DSA240X150NA , DSEI60-02A
7	Fuse	Prevent reverse current from forklift battery pack to charging equipment in case of short circuit at output of charger	Mega-120 , MIDI-70 , CNN , CNNE
8	TVS Diode Array	Protects CAN bus from ESD, EFT, and voltage transience	AQ24CANA

Additional information can be found at [Littelfuse.com](https://www.littelfuse.com)

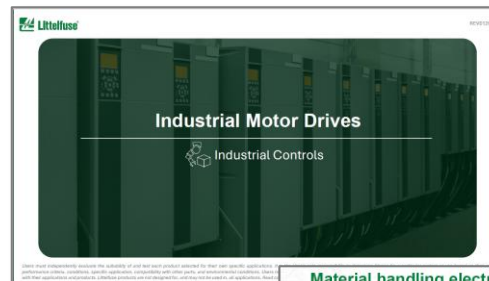
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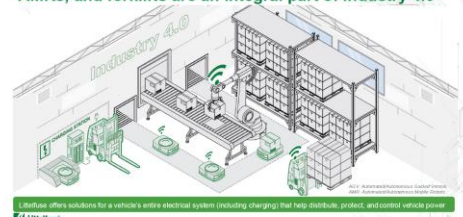
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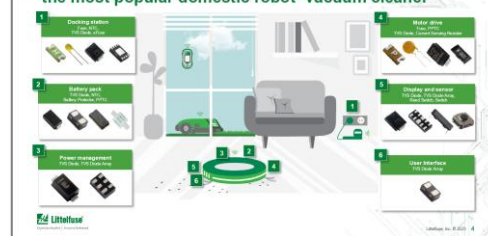
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Material handling electric vehicles such as AGVs, AMRs, and forklifts are an integral part of Industry 4.0



Recommended Littelfuse solutions for the most popular domestic robot-vacuum cleaner



Local resources supporting our global customers



Partner for tomorrow's electronic systems





Expertise Applied | Answers Delivered

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