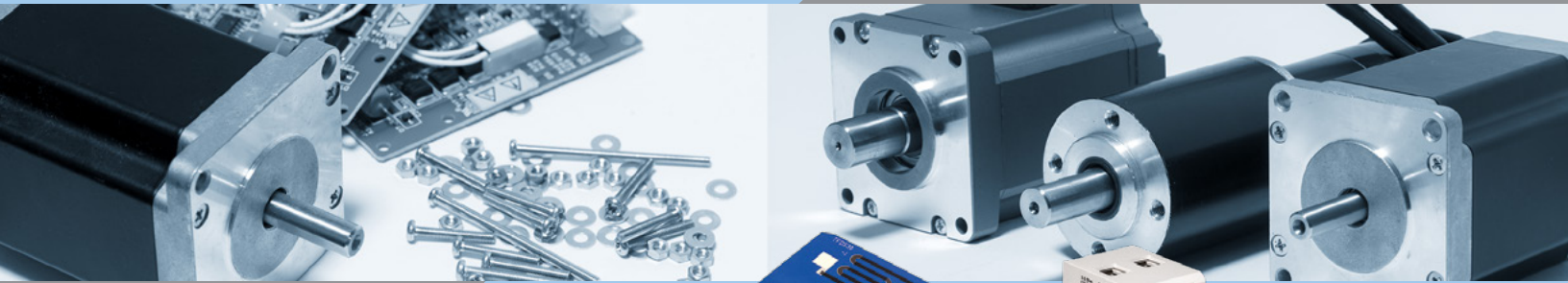


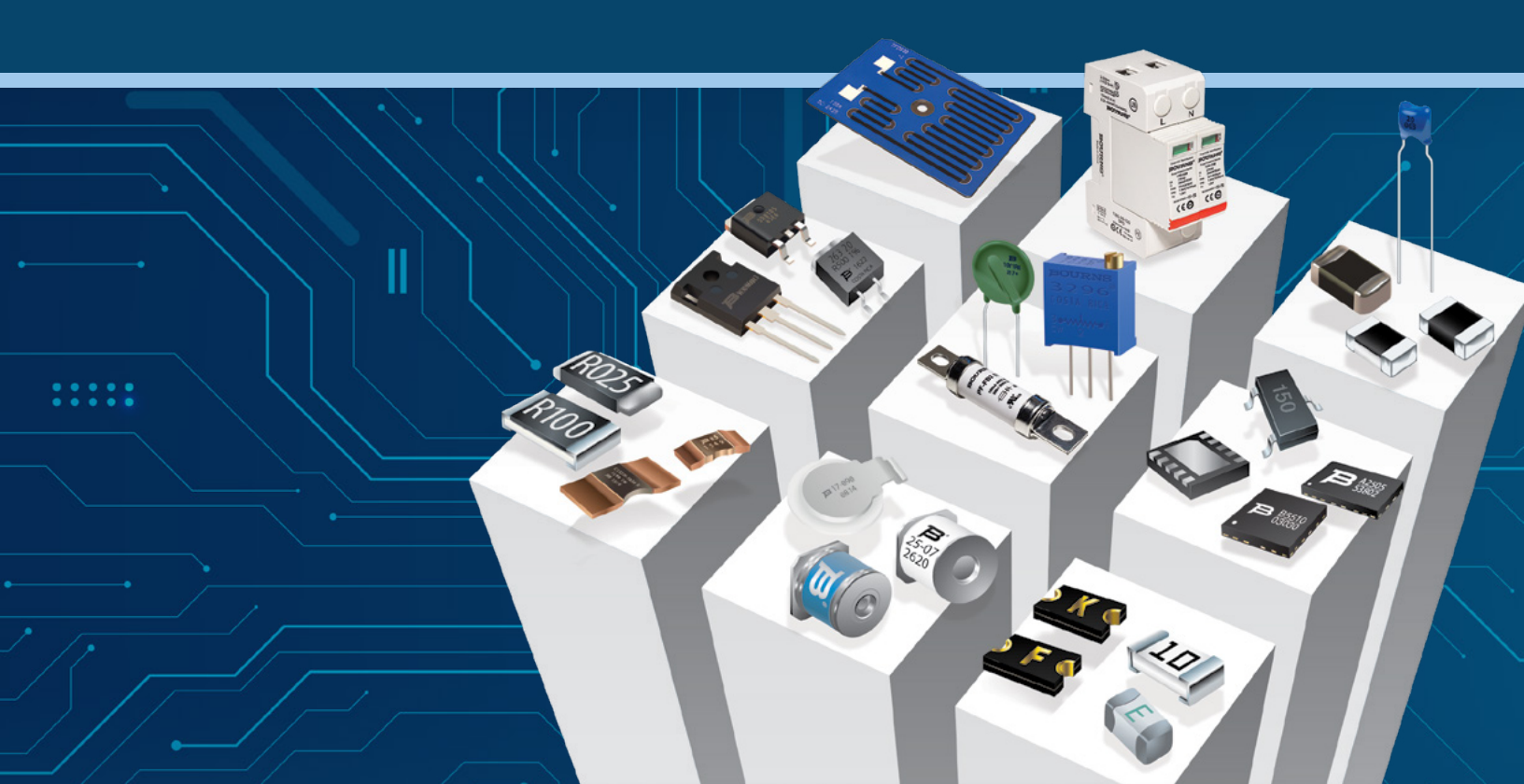


Bourns® Components in Servo Motor Drive Circuits

Enhancing Servo Motor Drive Circuit Reliability and Efficiency Brochure



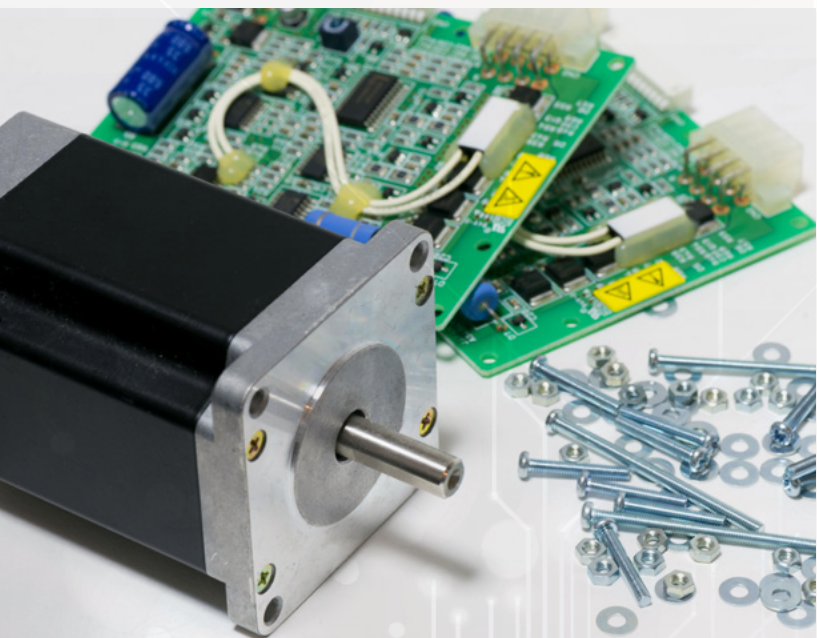
BOURNS®

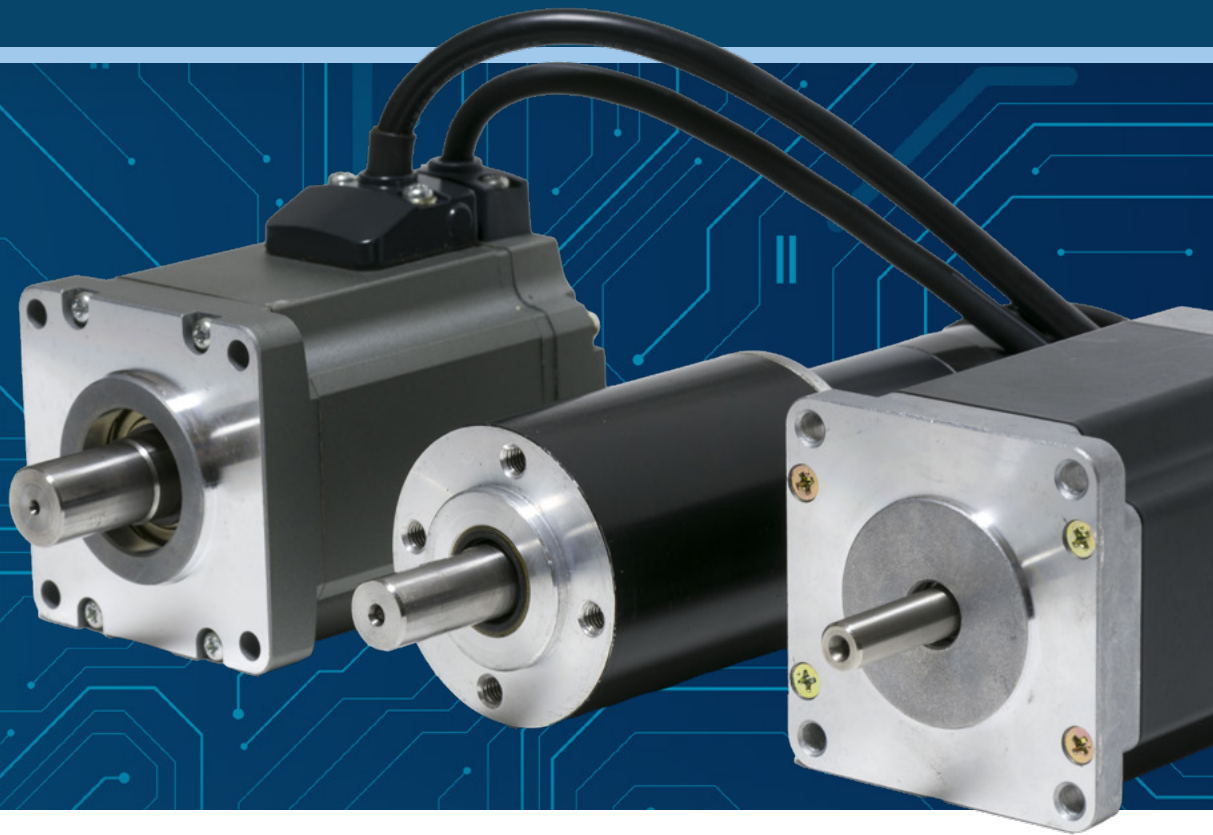


Introduction

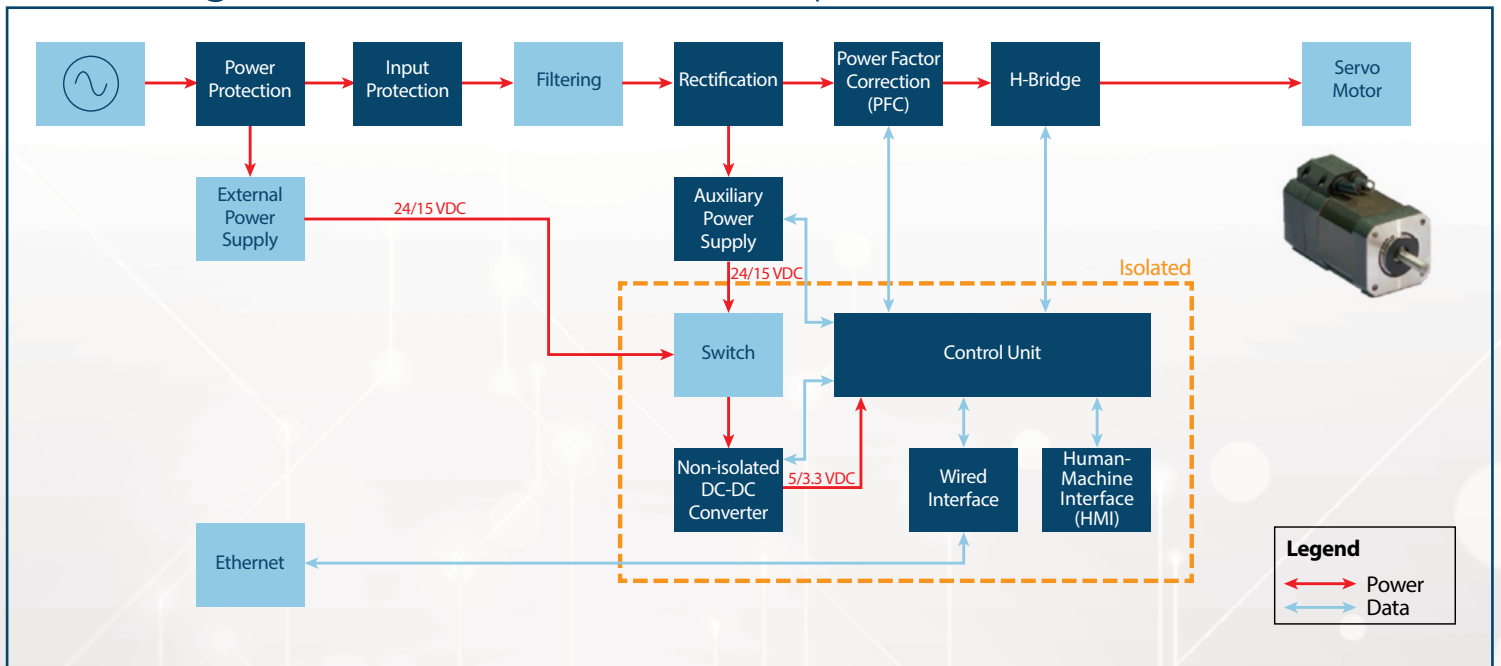
Servo-motor drivers provide precision control of motors. These circuits are critical in the operation and safety of industrial or consumer motors. The main objective of a servo motor drive circuit is to transform low frequency AC mains power into a stable high frequency AC waveform that controls the motor's speed and positioning.

Input power protection is critical to the operation of any circuit, protecting from environmental threats, like lightning and electrical grid fluctuations, and internal load changes, such as inrush currents and stored energy. Bridge rectification converts the input AC waveform into a flat DC voltage utilizing diodes and capacitors. However, due to downstream inductance, the power pulled from the electrical grid is highly reactive. This is remedied by implementing a Power Factor Correction (PFC) circuit, a sub-circuit designed to decrease harmonic content and increase power factor. With four high-speed transistors, the H-bridge is utilized for single-phase motors and converts the DC voltage into a high frequency waveform. The entire process is controlled and monitored by a control unit that incorporates its own protection devices. Bourns offers various product lines that are critical to every part of the operation of the servo motor drive circuit.






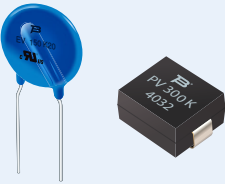

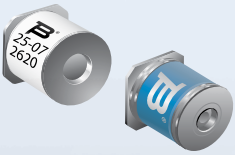


Block Diagram of Circuits that Make Up a Servo Motor Drive Circuit



Power Protection

Product Image	Recommended Products	Specifications & Features	Description
	Surge Protective Devices (SPDs): 1280 Series 1270 Series	<ul style="list-style-type: none"> • Current rating: 25-200 kA, 8/20 μs • 1-4 pole configurations • Voltage ratings up to 690 VAC • Thermal disconnect available with select models • UL 1449 Type 1 + Type 2 • IEC 61643-11, Class I + II 	DIN-Rail mounted SPDs for ultimate overvoltage protection against surge events. These units absorb large amounts of energy before reaching critical systems.


Input Protection

Product Image	Recommended Products	Specifications & Features	Description
	Through-hole Metal Oxide Varistors (MOVs): EV Series , CV Series , CVQ Series , MOV-xxD Series , SV Series SMD Metal Oxide Varistors (MOVs): PV Series	<ul style="list-style-type: none"> • Max. voltage: 14-1465 VDC • Max. peak current: 100-15000 A, 8/20 μs • Operating temperature: -55 to +125 °C • Up to 23 mm disc sizes • Through-hole and SMD configurations available • UL 1449 Listed 	Through-hole MOVs are conventional overvoltage protection components that offer an industry-standard form. These components "clamp" excess voltage conditions.
	GMOV™ Hybrid Protector , IsoMOV® Hybrid Protector	<ul style="list-style-type: none"> • Max. voltage: 56-745 VDC • Max. peak current: 6-15 kA, 8/20 μs • Operating temperature: -40 to +125 °C • Disc Size: 10-20 mm • Through-hole components 	Combination of MOV and Gas Discharge Tube (GDT) technology in one package. These components have extremely low leakage current and extended reliability. Great for industrial applications that require minimal downtime.
	Gas Discharge Tubes (GDTs): GDT25-xx-S1 Series 2035-xx-XX Series	<ul style="list-style-type: none"> • Breakdown voltage: 75-800 V • Up to 25 kA peak current, 8/20 μs waveform • Operating temperature: -55 to +125 °C • SMD and through-hole configurations available 	GDTs are a conventional overvoltage protection components with high surge current capacities. These components "crowbar" when excess voltage is present.
	POWrTherm™ NTC Thermistors	<ul style="list-style-type: none"> • Resistance range: 0.7-220 Ω • Max. current: 0.3-15 A • Max. power: 1.6-7 W • Through-hole products with disc diameters up to 25 mm • Operating temperature: -40 to +200 °C 	NTC Thermistors are used as Inrush Current Limiters (ICLs) for systems with DC-bus capacitors or inductive loads such as motor drivers that can draw high current levels on startup. ICLs prevent this event from occurring.
	POWrFuse™ High-Power Fuses	<ul style="list-style-type: none"> • Rated voltage up to 1000 VDC/800 VAC • Rated current: 6-400 A • Interrupt rating up to 160 kA • Designed to UL 248 & IEC 60269 standards • Various mounting types available • Automotive grade fuses offered (ISO 8820-8) 	POWrFuse™ High-Power Fuses are rated at extremely high interrupting currents, providing reliable overcurrent and short-circuit protection.

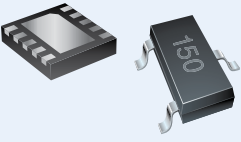


Rectification, PFC, and H-Bridge

Product Image	Recommended Products	Specifications & Features	Description
	Silicon Carbide (SiC) Schottky Barrier Diodes: BSD Series	<ul style="list-style-type: none"> • Max. reverse voltage: 650-1200 V • Max. forward current: 5-10 A • Junction temperature: -55 to +175 °C • Through-hole & surface mount configurations available • Low Q_{rr} 	High efficiency diodes that allow the best performance for high voltage and high power applications with practically no switching losses. Best used for PFC and other switch-mode topologies. Also used in high-efficiency snubber and free-wheeling designs.
	Insulated Gate Bipolar Transistors (IGBTs): BID Series	<ul style="list-style-type: none"> • Max. VCE: 600-650 V • Max current: 12-75 A • Junction temperature: -55 to +175 °C • Through-hole & surface mount configurations available • Trench-Gate Field-Stop technology 	This device uses advanced trench-gate field-stop technology providing greater control of dynamic characteristics while resulting in fewer switching losses. Great for use in active rectifier, PFC, or H-bridge circuits. High speed and low speed grades are available.
	High Current TVS Diodes Model PTVS1-240C-M	<ul style="list-style-type: none"> • Standoff voltage: 15-470 V • Max. peak current: 1-20 kA, 8/20 μs • Offered in through-hole and SMD configurations • Bidirectional 	Power TVS diodes provide outstanding secondary protection for Direct Current (DC) bus applications. TVS diodes provide tighter clamping with superior speed over traditional MOV technology.
	High Power Resistors	<ul style="list-style-type: none"> • Resistance range: 0.02 Ω–130 kΩ • Power rating: 20-50 W • Tolerance: 1 %, 5 % • TO-220, DPAK, and D2PAK configuration options • Low inductance 	Bourns offers a broad range of PWR series high power thick film resistors in standard packages. Great for use in braking for motors and other snubbing circuits.
	Current Sense Resistors: CSS Series CSI Series	<ul style="list-style-type: none"> • Resistance range: 0.2-5 mΩ • Power rating: 1.5-15 W • Tolerance: 1 %, 2 %, 5 % • Temperature coefficient: \pm50 PPM • Surface mount • Low thermal EMF 	Bare metal SMD shunts for precision monitoring of current. All three blocks will incorporate some form of current monitoring for accurate switching characteristics.
	Thick Film on Steel (TFOS)	<ul style="list-style-type: none"> • Power rating: 260 W • Maximum element temperature: 365 °C • Low profile thick-film on steel • Low inductance 	Bourns® Thick Film on Steel offers high power use in braking resistor applications. Available with standard solder pads or push-on terminal connections. Designed to be easily mountable to heat sinks.

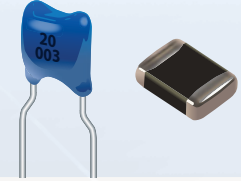
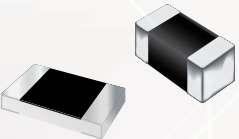
Auxiliary Power Supply and DC/DC Converter

Product Image	Recommended Products	Specifications & Features	Description
	<p>Rectification Diodes: CD214A-B1xR Series, CD214B-S2x Series</p>	<ul style="list-style-type: none"> • Peak reverse voltage: 20-1600 V • Forward current: 0.2-4 A • Peak surge current: 2-150 A • Single/Bridge configurations • Schottky and PN technologies 	DC-DC converters incorporate diodes to rectify output power. Diodes are crucial to the operation of converters. Bourns offers both Schottky and PN variants to suit a wide range of applications.
	<p>TVS Diodes: SMAJ Series, SMLJ Series</p>	<ul style="list-style-type: none"> • Working peak reverse voltage: 2-495 V • Power rating: 400-15000 W • Industry standard SMD configurations • Tight clamping action 	For precision overvoltage protection of low voltage DC buses. Can protect against residual surge energy and electrostatic discharge (ESD). Quick clamping action with several power options and voltages available.
	<p>SMD Varistors: PV Series, ZV HT Series</p>	<ul style="list-style-type: none"> • Working voltage: 14-385 VDC • Peak surge current: 30-1200 A • Standard SMD configurations available • Plastic encapsulated PV varistors as direct cross to through-hole MOVs 	For overvoltage protection in low voltage range as well as for higher voltage protection (up to 385 V for PV series).
	<p>Current Sense Chip Resistors/Shunts: CRM Series, CFN Series, CRE Series</p>	<ul style="list-style-type: none"> • Resistance range: 1 mΩ-1 MΩ • Power rating: 0.1-3 W • Tolerance: 0.5-5 % • Metal and film technologies • Low thermal EMF 	Precision SMD current sense resistors ideally suited for Pulse Width Modulation (PWM) circuits. SMD shunts provide tight tolerances with low temperature drift in small footprints.
	<p>Multifuse® Polymer PTC Resettable Fuses</p>	<ul style="list-style-type: none"> • Rated voltage: 24-250 VDC; AC rated available • Rated current: 62 mA to 50 A • Film and metal technologies • Various fusing characteristics 	Resettable overcurrent protection. Good for low voltage and low current DC buses and inputs. SMD configurations available.
	<p>SinglFuse™ SMD Fuses</p>	<ul style="list-style-type: none"> • Rated voltage: 24-250 VDC; AC rated available • Rated current: 62 mA to 50 A • Film and metal technologies • Various fusing characteristics 	These will act as overcurrent protection devices for critical components. Faster than PTCs, but not resettable. SMD configurations and various technologies available.
	<p>Multiturn Trimpot® Trimming Potentiometers 3314 Series</p> <p>Single-turn Trimpot® Trimming Potentiometers 3224 Series, 3296 Series</p>	<ul style="list-style-type: none"> • Power rating: 0.1-1 W • Resistance range: 10 Ω to 2 MΩ • Number of turns: 1-25 • Surface mount & through-hole configurations offered • Precise adjustability 	Bourns® Trimpot® Trimming potentiometers perform a variety of precision circuit adjustments, allowing the converter to be precisely adjusted as needed. Offered in single or multiturn models, SMT or Through-hole.

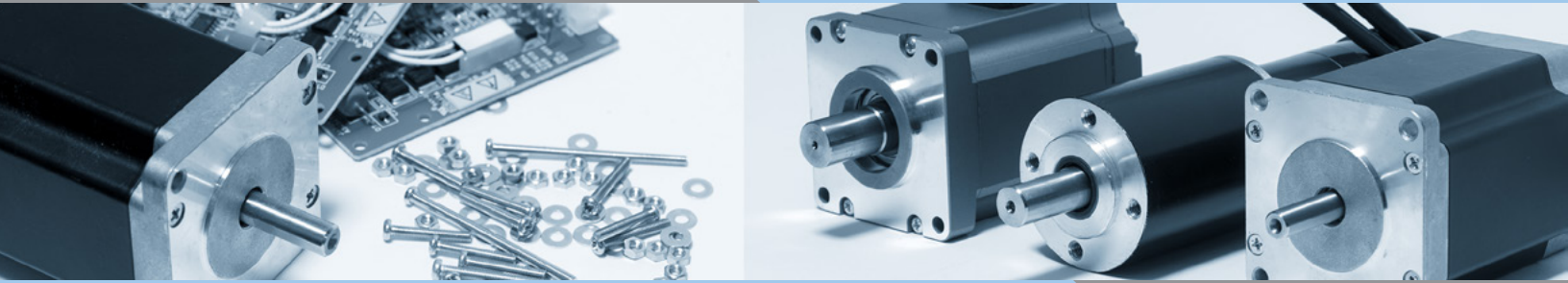
Wired Interface

Product Image	Recommended Products	Specifications & Features	Description
	TVS Diode Arrays: CDDFN10-3304NA CDSOT23-SM712	<ul style="list-style-type: none"> Working peak reverse voltage: 2.2-70 V Typical capacitance: 0.02-500 pF Protection for up to eight lines in a single package Surface mount with DFN packages 	Ultra-low capacitance overvoltage protection of several data lines. Bourns offers an extensive line of diode arrays for all types of industrial communication protocols.
	TBU® High-Speed Protectors (HSPs)	<ul style="list-style-type: none"> Max. impulse voltage: 40-850 V Max. RMS voltage: 28-425 V Trigger current: 50-500 mA Protect up to two data lines in a single package Uni- and bidirectional options 	TBU® HSPs are resettable, ultra-fast overcurrent protection devices. Offered in dual and single DFN packaging, the TBU® HSP guards against power cross, lightning, and other energy surges on communication lines, up to rated limits.
	GDTs with FLAT® Technology	<ul style="list-style-type: none"> Breakdown voltage: 90-500 VDC Temperature range: -55 to +105 °C Low capacitance <2.9 pF Compact, surface mount package 	Overvoltage protection against surge. Compact disc shape perfect for small designs. Low capacitance makes for light loading on communication lines.

Human-Machine Interface

Product Image	Recommended Products	Specifications & Features	Description
	Multilayer Varistors (MLVs): ZV SMD Series , ZV Through-hole Series , ZVE Series	<ul style="list-style-type: none"> Rated voltage: 11–170 VDC Surge current rating: 30–1200 A Response time: <1 ns Temperature range: -55 to +150 °C Case sizes 0603–2220 Designed to suppress ESD events 	Multilayer SMD varistors available in small SMD form factor (down to 0603).
	ChipGuard® ESD Suppressors	<ul style="list-style-type: none"> Working voltage: 3.3-56 V Low capacitance Response time: <0.5 ns Standards: IEC 61000-4-2 & 61000-4-3 ESD protection in small footprints 	MOV-based Electrostatic Discharge (ESD) protection in a small, SMD form factor.

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