AVX TransGuard®
Automotive Series

CIRCUIT PROTECTION IN AUTOMOTIVE APPLICATIONS

The following applications and schematic diagrams show where TransGuards® might be used to suppress various transient voltages:

- Automotive Transients
- LIN Bus
- CAN Bus and FlexRay
- Electric Power Steering
- Seat Motor Circuit
- LED Door Lamp
- Drive by Wire
- Keyless Entry
- Voltage Regulator
- Bluetooth
- LED Driver

TransGuard® Automotive Series
AVX Multilayer Transient Voltage Protection
Circuit Protection in Automotive Applications

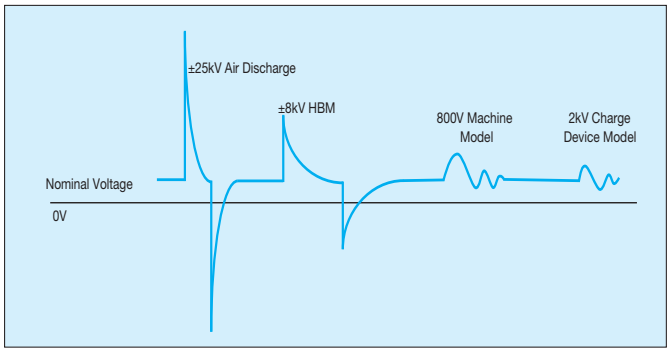
AUTOMOTIVE TRANSIENTS

Todays automobiles are using new technologies based on electronics systems connected by wide variety of networks to provide increased safety, convenience and comfort, to reduce emissions, increase fuel efficiency and more.

During the lifetime these systems are subjected to many overvoltage transient surges. To ensure safe and reliable function it is necessary to protect these sensitive systems againts overvoltage surges.

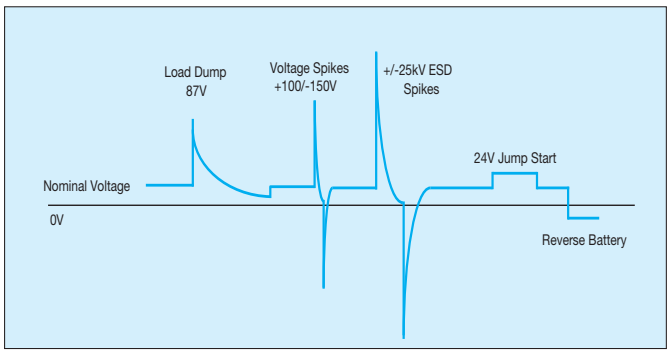
Automotive Power Rail Transients

The transients on automotive power rails are usually medium to high energy transients and are caused by engine start such as Jump start (connecting other cars battery to jump start the engine), Load Dump (sudden load disconnect from alternator) or inductive switching (caused by DC motors on/off switching - e.g. window lifter, wipers, adaptive headlights). These transients are typically bi-directional.



Automotive Data Line Transients

Data lines connecting the automotive systems need to be protected against varisous ESD pulses to ensure sensitive electronics protection. These transients are mainly caused by human interaction with the electronics systems (controls, buttons, ports) or by interaction between systems due to different charge build up. These transients are typically bi-directional and very fast.



AVX MULTILAYER VARISTORS

The EMC requirements of today's automotive electronics are a natural fit for the use of AVX MultiLayer Varistors (MLVs).

AVX AUTOMOTIVE VARISTORS ADVANTAGES

- AEC-Q200 qualified
- Bi-directional protection
- Compact footprint
- Very fast response - sub ns
- EMI/RFI filtering in the off state
- Multiple strikes capability
- No derating over operating temperature range (-55°C to +125°C, 150°C available)
- RoHS compliant
- Optional hybrid termination (Pd/Ag) available

AVX Automotive Series Varistors provide reliable protection against automotive related transients - such as Load Dump, Jump Start and ESD to protect the growing number of electronics systems used in automotive applications. Transient examples:

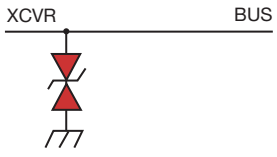
- Load dump (ISO 7637-2-5)
- Jump Start
- ISO 7637 Pulse 1-3
- IEC 61000-4-2, etc.
- AEC-Q200-002
- ISO 10605
- ISO 16750-2
- CI-220
- CI-260

The parts offer fast turn on time, bi-directional protection, excellent multiple strikes capability and in addition also EMI/RFI filtering in the off-state that can improve overall system EMC performance.

High power MLV designs have been revised and miniaturized to allow efficient protection of today's most widely used communication bus designs.

When used in communication bus designs, MLVs can save approximately 90% of the board area involved with diode/EMC cap solutions. In addition, MLVs offer a FIT rate <0.1, an ability to be used at temperatures up to 150°C and a fast turn on time.

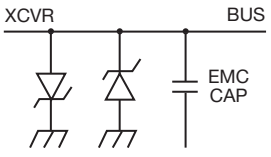
MultiLayer Varistors (MLVs)



MLV PROTECTION METHOD
SINGLE COMPONENT SOLUTION

TVS & EMI

TVS Diodes



DIODE PROTECTION METHOD
THREE COMPONENT SOLUTION

TVS + EMI

MLVs have traditionally been used in inductively generated automotive transient suppression applications such as motors, relays and latches. MLVs offer a large in rush current capability in a small package, high-energy transient suppression and a broad and definable off state bulk EMC capacitance. These, coupled with an extremely low FIT rate and excellent process capability makes MLVs a common device in today's intermediate to high power automotive circuit protection.

AUTOMOTIVE COMMUNICATION BUS

AVX varistors are indeal choice for automotive circuit protection thanks to wide range of automotive qualified parts covering wide range of applications from low capacitance components for high speed data lines/RF circuits up to high energy varistors for load dump and jump start requirements on power lines or low speed data lines such as LIN Bus. AVX also offers automotive varistors for targeted and enhanced EMI filtering that help to improve overall EMC system performance.

Automotive electronic systems are connected by various network systems depending on the data speed requirements. Most common networks include:

LIN (LOCAL INTERCONNECT NETWORK)

LIN Bus operates at slower data speeds up to 20kbps and provides reliable low cost automotive networking. Typical applications are e.g. window lifter, door lock, seat controls, mirror controls, wipers, rain sensors etc.

CAN (CONTROLLER AREA NETWORK)

CAN Bus is is a vehicle bus standard designed to allow microcontrollers and devices to communicate with each other within a vehicle without a host computer. CAN Bus supports data speeds up to 1Mbps. Typical applications are ECU connection to transmission, door locks, adaptive headlights, climate control, etc.

MOST (MEDIA ORIENTED SYSTEMS TRANSPORT)

MOST is standard for high-bandwidth automotive multimedia networking. This network provides excellent Quality of Service and seamless connectivity for audio/video streaming through variety of multimedia interfaces such as DVD player, head set, voice control.

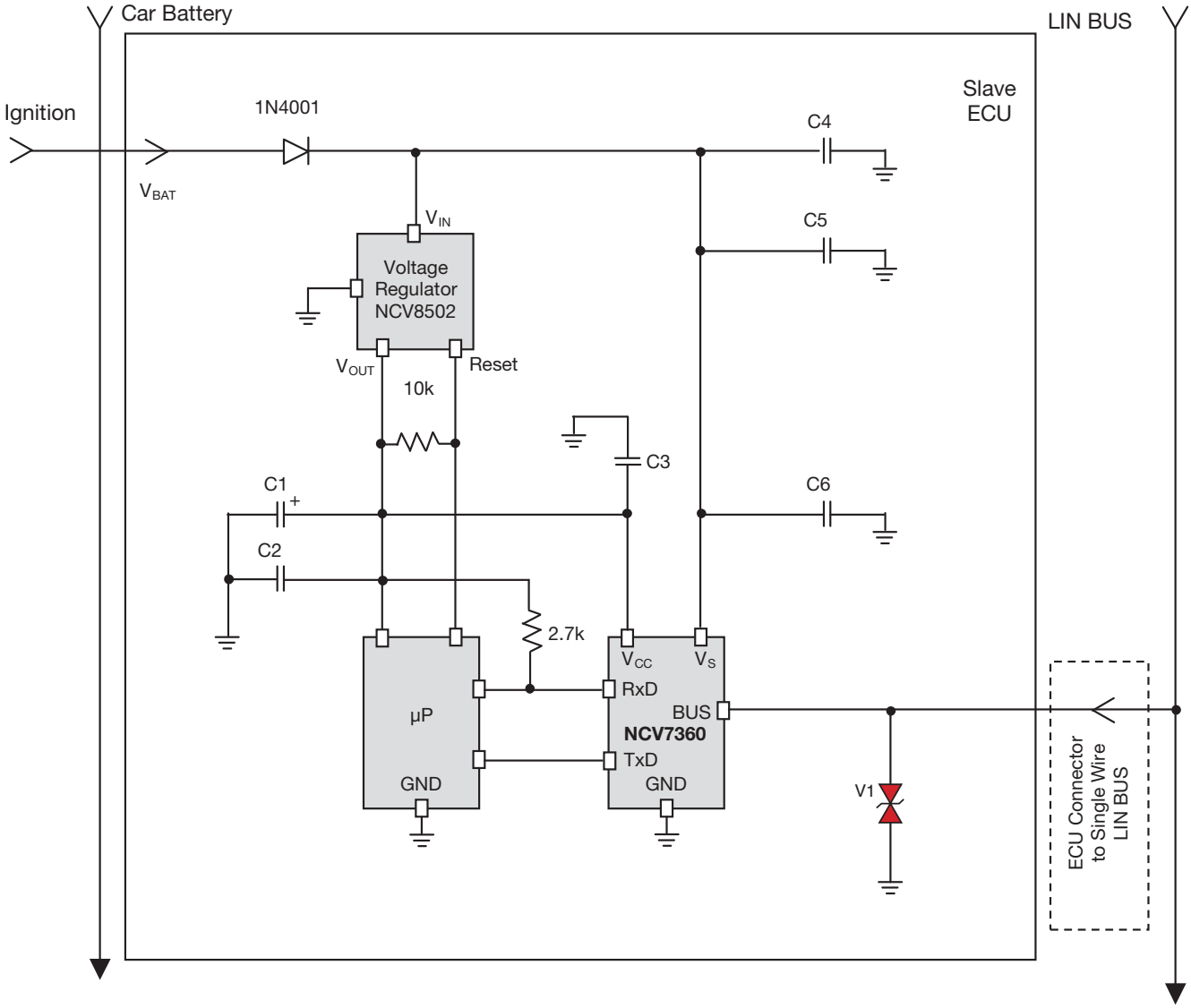
FLEXRAY

FlexRay is an automotive network communications protocol to govern on-board automotive computing. It is designed to be faster and more reliable than CAN and TTP intended for drive-by-wire applications.

Example of suitable AVX series based on data speed and line type is shown below:

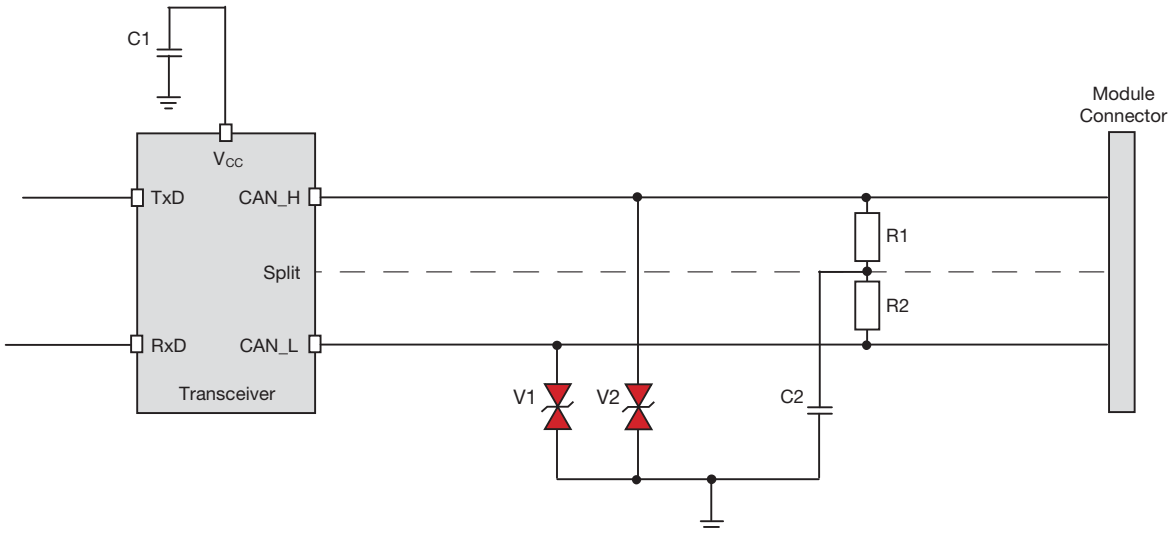
SERIES	BUS	DATA SPEED	
Sub pF AntennaGuard Automotive Series	HDMI	3.2 Gbps	High Speed
	1394a	400 Mbps	
AG/Sub pF AG Automotive Series, Miniature AC	MOST	45 Mbps	
	TTP	25 Mbps	
FlexRay	FlexRay	10 Mbps	Data
CAN, FlexRay, AG Series	TTCAN	1 Mbps	
	CAN	1 Mbps - 50 Kbps	
TransGuard® Automotive Series, StaticGuard Automotive Series, Radial Varistor	Safe-by-Wire	150 Kbps	
	LIN	<20 Kbps	Low Speed
TransGuard® Automotive Series, StaticGuard Automotive Series, Radial Varistor, Miniature MAC, TransFeed Automotive Series	ALL		Power Line
TransFeed Automotive Series, Controlled Capacitance	10-100 Mbps		Cutoff Frequency

LIN BUS



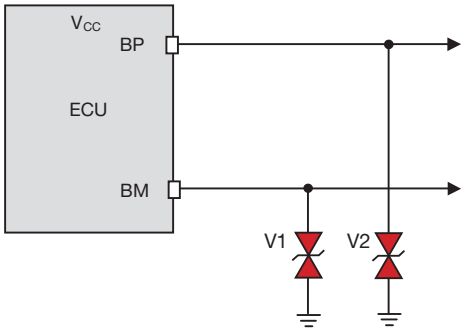
Component	Product	AVX Part number	Specification
V1	Multilayer Varistor	VCAS080518C400RP	0805, 18Vdc, 0.3J, 120A, 550pF typ

CAN BUS



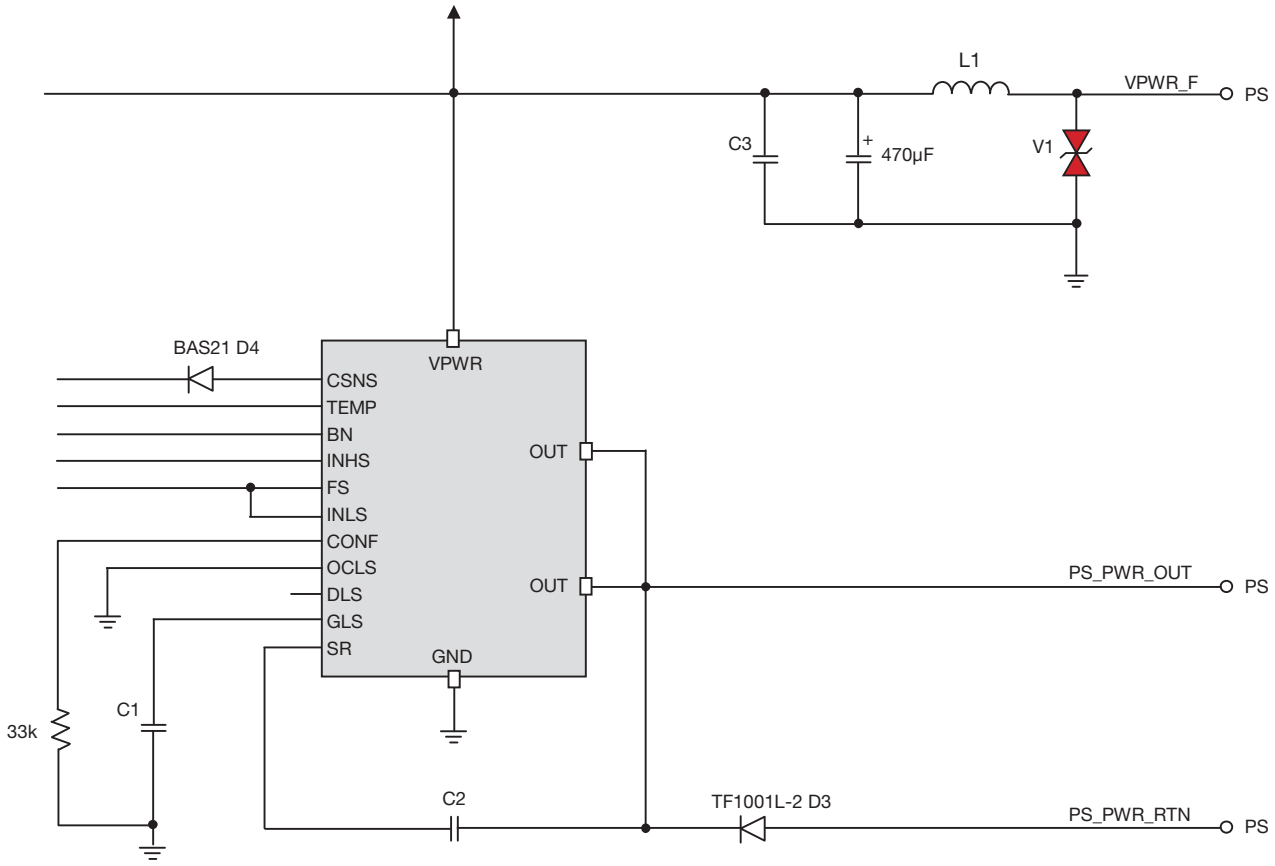
Component	Product	AVX Part number	Specification
V1, V2	Multilayer Varistor	CAN0001RP	0603, 18Vdc, 0.015J, 4A, 22pF max
(V1+V2)	Multilayer Varistor	CAN0002RP	0405 Dual Array, 0.015J, 4A, 22pF max

FLEXRAY



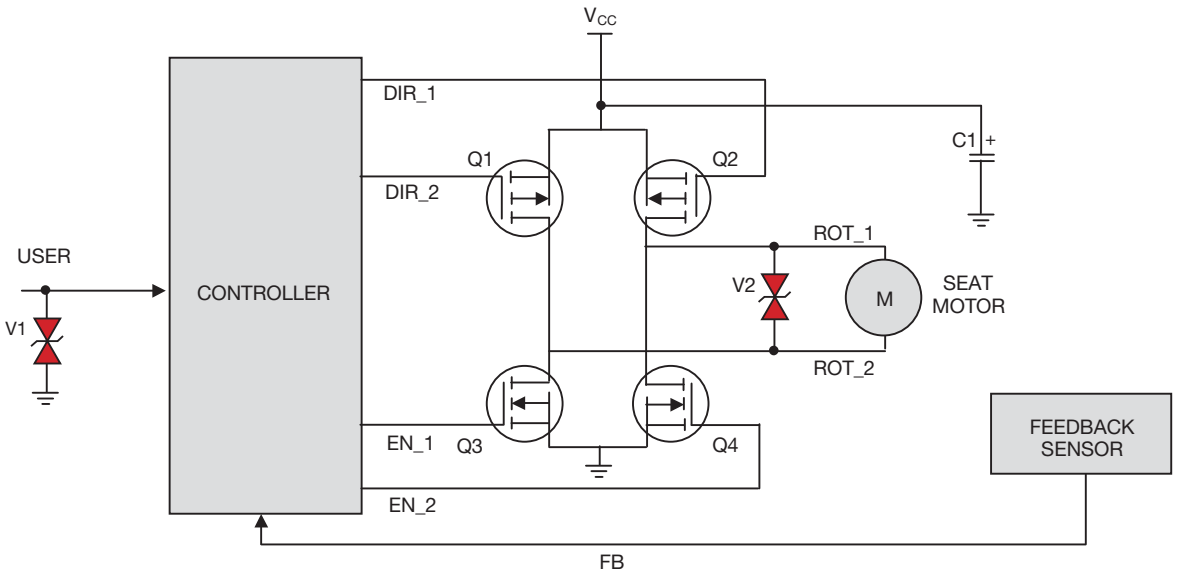
Component	Product	AVX Part number	Specification
V1, V2	Multilayer Varistor	FLX0005WP	0402, 18Vdc, 0.02J, 4A, 17pF max

ELECTRIC POWER STEERING



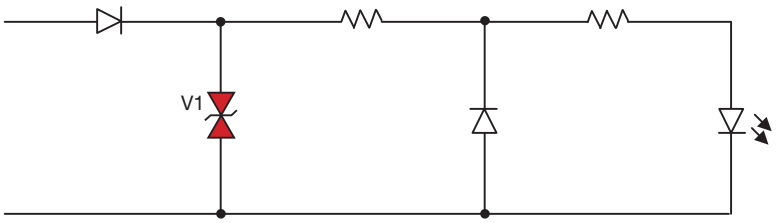
Component	Product	AVX Part number	Specification
V1	Multilayer Varistor	VCAS121018J390RP	1210, 18Vdc, 1.5J, 500A, 3100pF typ

SEAT MOTOR CIRCUIT



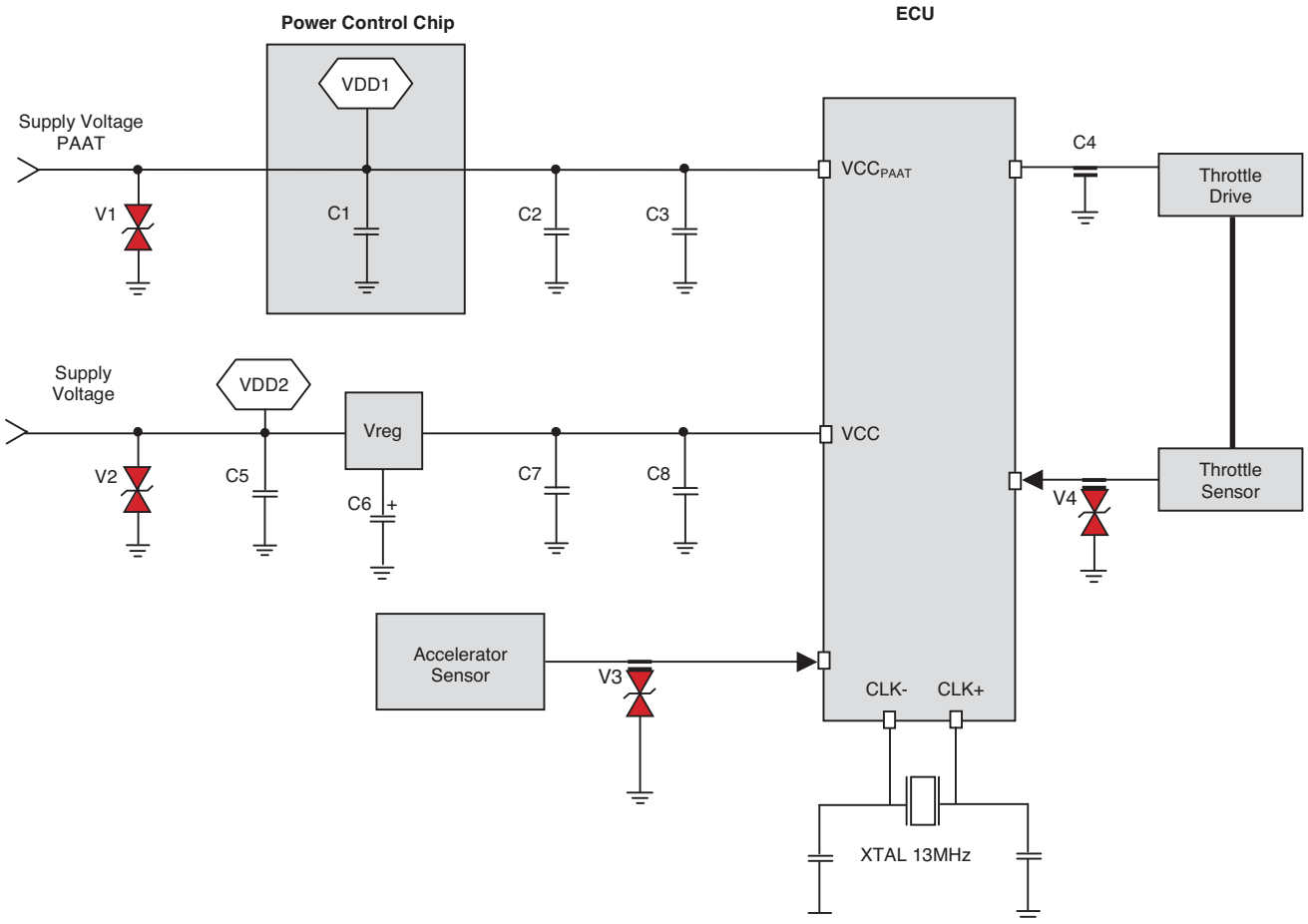
Component	Product	AVX Part number	Specification
V1	Multilayer Varistor	VCAS040218X400WP	0402, 18Vdc, 0.05J, 20A, 65pF typ
V2	Multilayer Varistor	VCAS121018J390RP	1210, 18Vdc, 1.5J, 500A, 3100 pF typ

LED DOOR LAMP



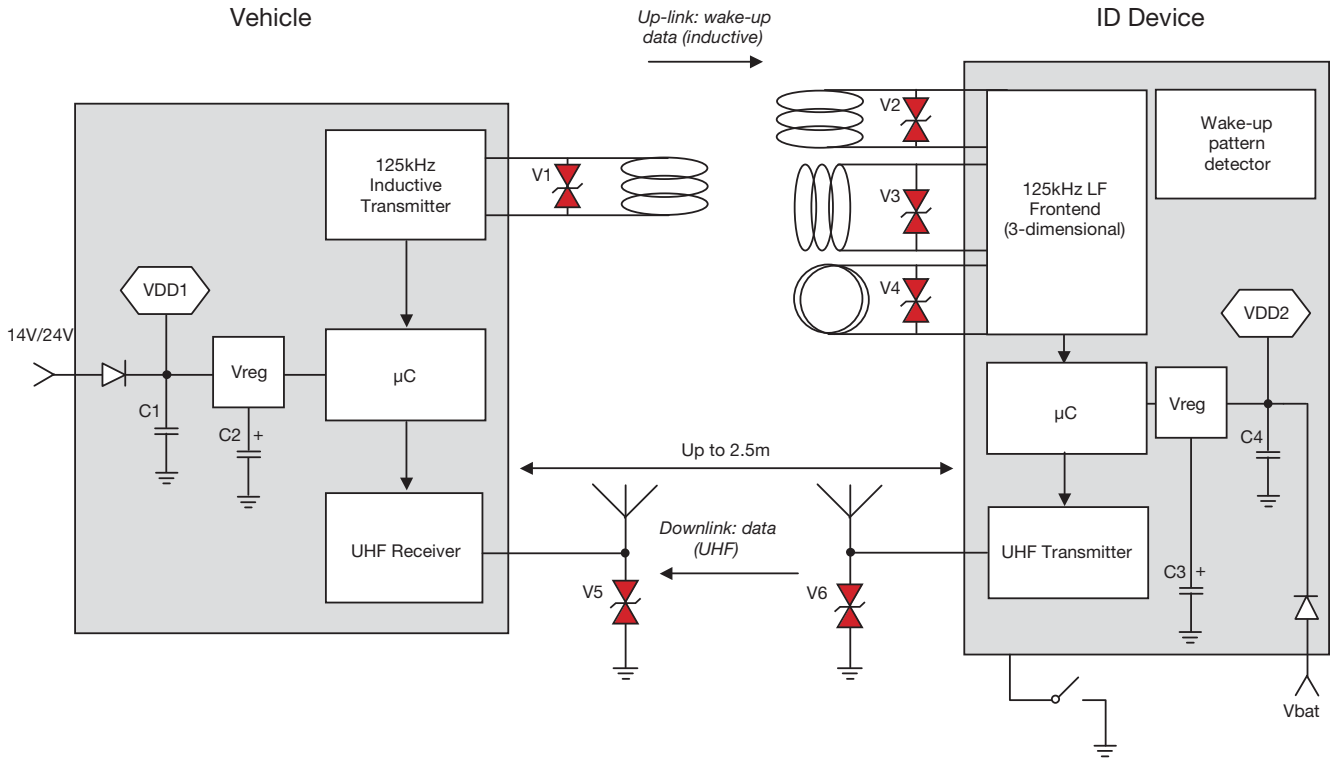
Component	Product	AVX Part number	Specification
V1	Multilayer Varistor	VCAS120618D400RP	1206, 18Vdc, 0.4J, 150A, 900pF typ

DRIVE BY WIRE – THROTTLE



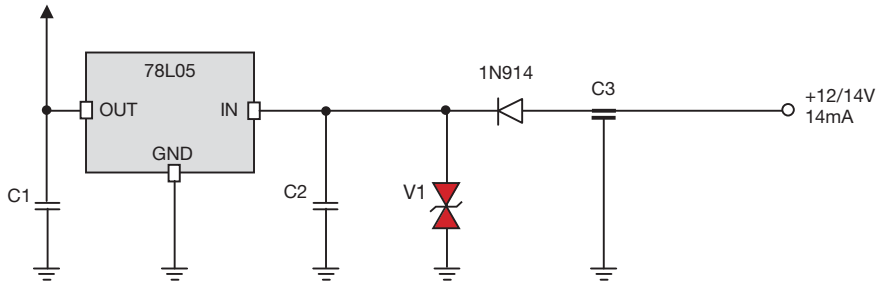
Component	Product	AVX Part number	Specification
V1, V2	Multilayer Varistor	VCAS080518C400DP	0805, 18Vdc, 0.3J, 120A, 550pF typ
V3, V4	TransFeed	V2AF118X500Y3DDP	0805, 18Vdc, 0.05J, 20A, 75pF typ

KEYLESS ENTRY



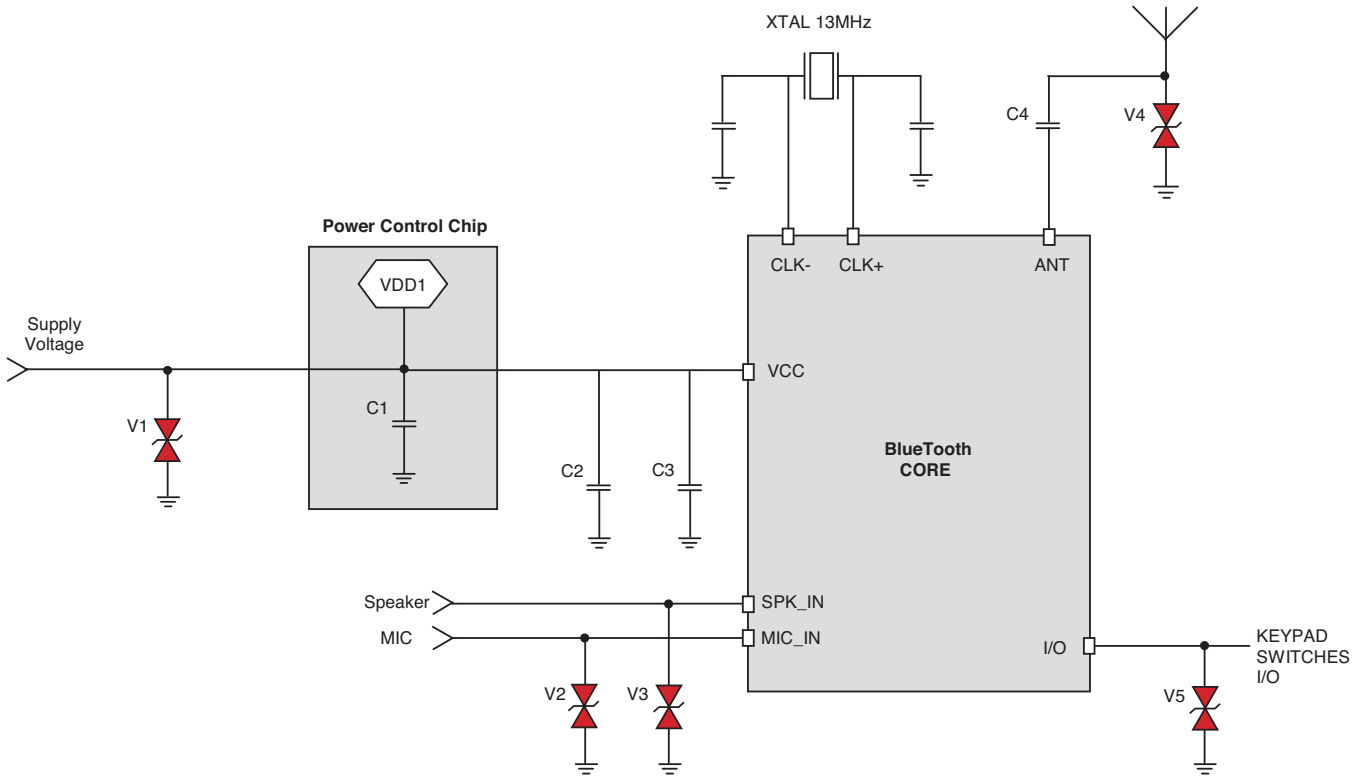
Component	Product	AVX Part number	Specification
V1, V2, V3, V4	Multilayer Varistor	MAV0010DP	0603, 52Vac, 110 Pk-Pk @ 125kHz, 0.015J, 2A, 22pF Max
V5, V6	Multilayer Varistor	VCAS04AG183R0YATWA	0402, 18Vdc, 3pF Max

VOLTAGE REGULATOR



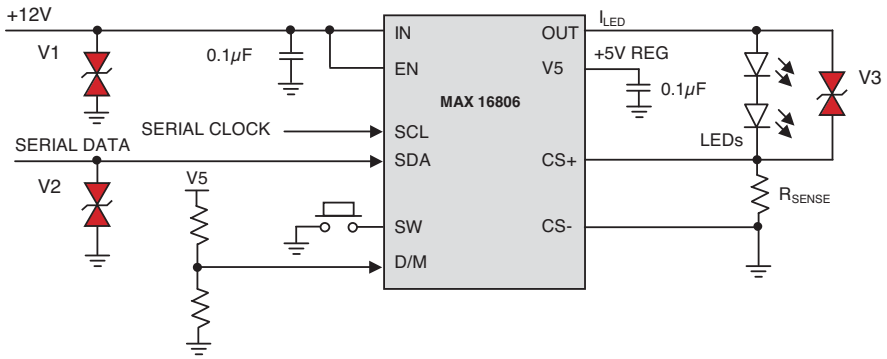
Component	Product	AVX Part number	Specification
V1	Multilayer Varistor	VCAS080518C400DP	0805, 18Vdc, 0.3J, 120A, 550pF typ

BLUETOOTH



Component	Product	AVX Part number	Specification
V1	Multilayer Varistor	VCAS080518C400DP	0805, 18Vdc, 0.3J, 120A, 550pF typ
V2, V3	Multilayer Varistor	VCAS060314A300DP	0603, 14Vdc, 0.1J, 30A, 350pF typ
V4	Multilayer Varistor	VCAS06AG183R0YAT3A	0603, 18Vdc, 3pF max
V5	Multilayer Varistor	VCAS040218X400WP	0402, 18Vdc, 0.05J, 20A, 65pF typ

LED DRIVER



Component	Product	AVX Part number	Specification
V1	Multilayer Varistor	VCAS120618E380	1206, 18Vdc, 0.5J, 200A, 930pF
V2	Multilayer Varistor	VCAS060318A400	0603, 18Vdc, 0.1J, 30A, 150pF
V3	Multilayer Varistor	VCAS06LC18X500	0603, 18Vdc, 0.05J, 30A, 50pF