

Nexperia Application Guide



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Introduction

This application guide has been created as a resource to identify specific design issues and the standard products (diodes, bipolar transistors, MOSFETs, ESD protection and Logic devices) required.

The guide covers 50 of the most common applications addressing the following market segments: Automotive, Computing, Communication Infrastructure, Consumer, Industrial (including Lighting and Medical) and Portable.

For each application, you will find the following:

- A** A brief overview of the application: As a few categories are broad, this will help you understand the key concepts and technical challenges involved in the design of the application.
- B** Design Considerations: List of topics to consider to identify the various types of devices (Standard Products) that are likely to be found in the application.
- C** Block Diagram: All diagrams illustrated are typical and your specific application may vary. The purpose of the diagram is to identify the numerous Standard Products that are commonly in the design application.
- D** Product/Value table: This table calls out the general device types found in the application, as well as specific part numbers when possible. These specific part numbers were identified as the most common part numbers used for the application.

Automotive

Active Safety

A Automotive Active Safety includes systems for Brake Assist, Traction Control, Electronic Stability Control (ESC), Anti-Lock Braking Systems (ABS), Electronic Power Steering (EPS), and Lane Detection Control (LDC). These systems have in common multiple processors connected to a wide array of input sensors that output to electrical and hydraulic systems. The diagram below illustrates an ABS system, others similar.

Design considerations

- › What is the operating voltage of the MCU? (selects the correct Logic Family)
- › How many analog inputs sensors are present? (consider an Analog Switch)
- › What is the power requirement of the output solenoid? (selects proper Power MOSFETs)
- › Are there other voltage domains present? (Level Shifter)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)

B

C

Product	Use value
A Power MOSFETs	Drives brake solenoid and motors
A Analog Switch (74VHC14-Q100, 74VHC14-Q100)	Reduces number of analog inputs required on MCU
A Level Shifters (74VHC14-Q100)	Connects different voltage nodes between systems
A ESD Protection (ESD10CAN)	General purpose ESD protection (Pin-to-Pin protection CAN ESD protection LIN ESD Protection)
A P-N Junction Schottky Barrier Diode (PESD5V-010, PESD5V-010)	Reverse battery protection (DC voltage blocking diode) Free-wheeling 3 phase inductor
A TVS Diode (PTVS Family, PTVS33V10U)	Transient voltage surge protection
A Schottky Barrier Diode (PESD5V-010)	Free-wheeling diode for DC-DC inductive load
A General purpose BJT and Matched Pair Transistors (2N2222)	Signal, MOSFET driver, constant current monitor
A Small Signal MOSFET (P or N Channel)	High RDS(on) = 1k used for signal control, low RDS(on) = 1k used for load switch control
A CA-Transistor (low Voltage, PNP/BJT/BJT)	Linear regulator and load switch control

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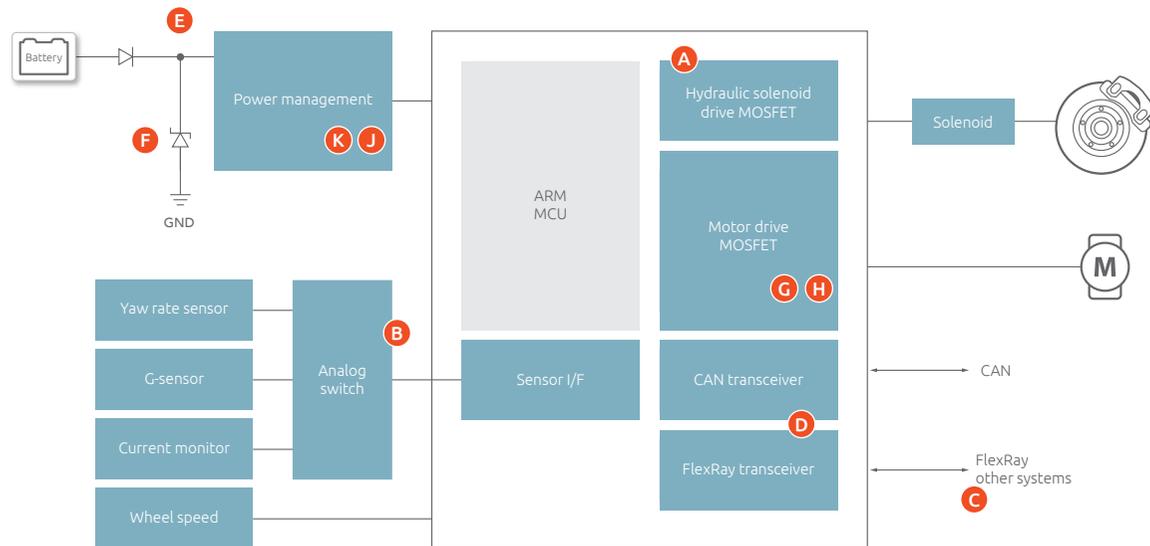


Active Safety

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Design considerations

- › What is the operating voltage of the MCU? (selects the correct Logic family)
- › How many analog inputs sensors are present? (consider an Analog Switch)
- › What is the power requirement of the output solenoid? (selects proper Power MOSFETs)
- › Are there other voltage domains present? (Level Shifter)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Power MOSFETs	Drives brake solenoid and motors
B	Analog Switch (74HEF4067-Q100, HEF4051-Q100)	Reduces number of analog inputs required on MCU
C	Level Shifters (74AVC1T45-Q100)	Connects different voltage nodes between systems
D	ESD Protection (PESD1CAN-U)	General purpose ESD protection FlexRay ESD protection CAN ESD protection LIN ESD Protection
E	PN Rectifier (PNS4001ER) Schottky Barrier Diode (PMEG family, PMEG6010ELR)	Reverse battery protection DC voltage blocking diode Freewheeling 3-phase isolator
F	TVS Diode (PTVS family, PTVS33VP1UP)	Transient voltage surge protection
G	Schottky Barrier Diode (PMEG4050ETP)	Free-wheeling diode for DC-DC and inductive load
H	General purpose RETS and Matched Pair Transistors (PUMH9)	Signal control, MOSFET driver, constant current monitor
J	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch control
K	GA-Transistor (Low Vcesat, PHPT60603PY)	Linear regulator and load switch control

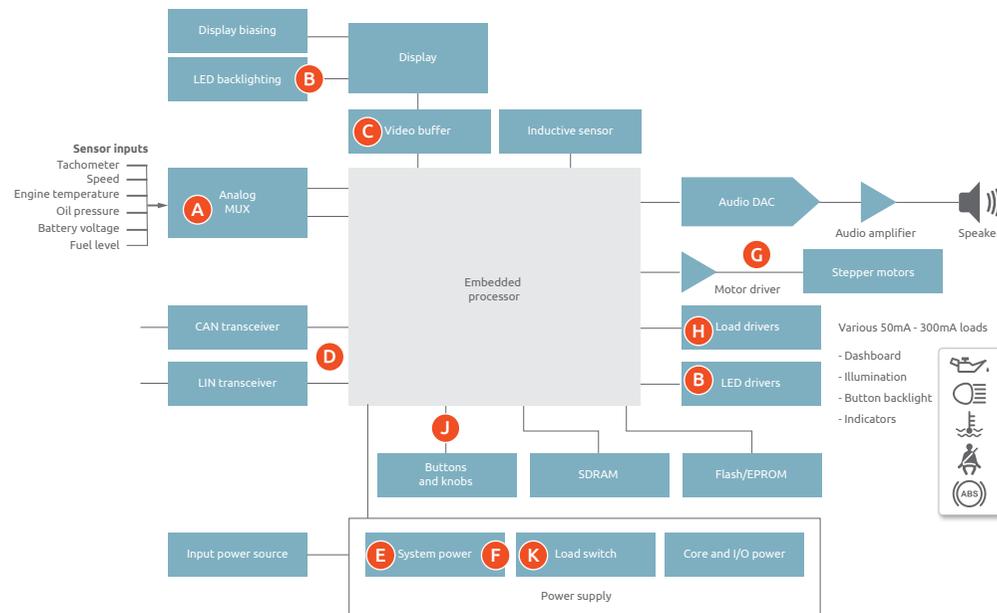


Analog Gauge Replacements

Analog gauge replacements include gauges to the automotive, marine, motorcycle, and personal water craft market. Multiple gauges, also known as an instrument cluster, have a variety of input sensors and output displays, such as LED, LCD, VFD, and mechanical displays.

Design considerations

- › What is the analog input voltage range? (determine analog MUX requirements, # of channels)
- › What is the MCU operating voltage and system rail voltages? (selects Logic family and Level Shifters)
- › What is the display output type? (LED/LCD/VFD require different output voltage/current)
- › Is there a size constraint? (Small gauges may require special device packaging)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Analog Switch (74HC/HEF4051-Q100)	8-channel analog input MUX for multiple sensors
B	LED Driver (NPIC6CS96-Q100)	For driving LEDs, VFD: up to 30V and 100 mA per channel
C	Level Shifter (74AVC1T45-Q100)	Level shifter between low-volt MCU and 5 V sensors
D	ESD Protection	General purpose ESD protection FlexRay ESD protection CAN ESD protection LIN ESD protection
E	PN Rectifier (PNS4001ER) Schottky Barrier Diode (PMEG family)	DC voltage blocking diode
F	TVS Diode (PTVS family)	Transient voltage surge protection
G	Schottky Barrier Diode (PMEG family)	Free-wheeling diode for DC-DC and inductive load
H	General purpose RETS and Matched Pair Transistors	Signal control, MOSFET driver, constant current monitor
J	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch control
K	Transistor (Low Vcesat)	Linear regulator and load switch control

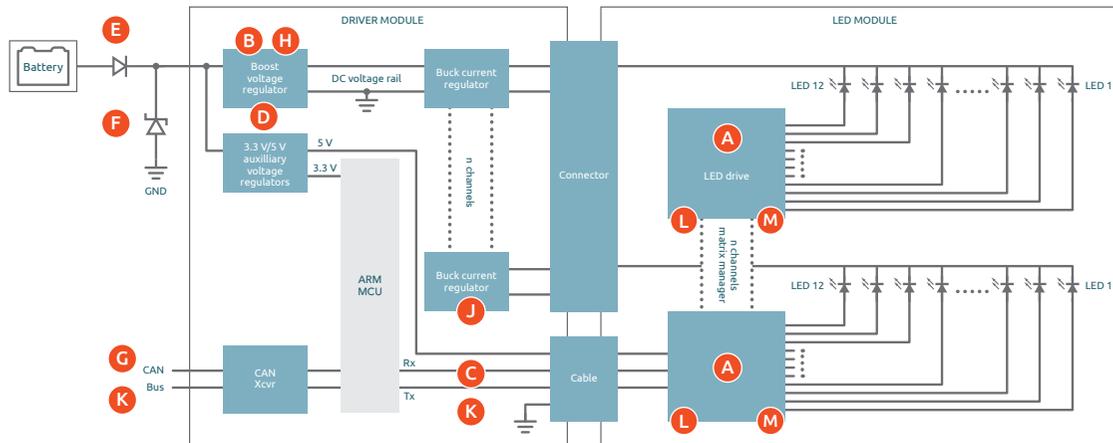


Automotive Lighting

Automotive lighting encompasses several major systems in the car: exterior (headlight/taillight), interior (dome, ambient), and instrumentation (LED backlight). Incandescent lighting is being replaced by LED Lighting, covering a variety of drive methods.

Design considerations

- › What is the wattage of LED? (determines the drive method)
- › Is there an MCU or is this a standalone application? (NPIC LED driver)
- › What is the LED array voltage? (determines MOSFET)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	LED Driver (NPIC6C4894-Q100, 74HCT4094-Q100, 74HCT595-Q100)	Direct drive of low watt LEDs (turn signals, etc.)
B	Power MOSFETs	High power LED driver
C	Level Shifter (74AVC1T45-Q100)	Connection between MCU and high voltage section
D	Transistor (Low Vcesat) (PBSS5260PAPS)	Linear regulator and load switch control and LED dimming control
E	PN Rectifier (PNS40010ER) Schottky Barrier Diode (PMEG6020ELR)	DC voltage blocking diode
F	TVS Diode (PTVS33VP1UP)	Transient voltage surge protection
G	ESD Protection (PESD1CAN-U)	General purpose ESD protection FlexRay ESD protection CAN ESD protection LIN ESD protection
H	Schottky Barrier Diode (PMEG family, PMEG6020ELR)	Free-wheeling diode for DC-DC buck/ Boost converter (asynchronous or synchronous)
J	General purpose RETS and Matched Pair Transistors (PUMH9)	Signal control, MOSFET driver, constant current monitor
K	Small Signal MOSFET (P or N Channel, PMPB215ENEA)	High $R_{DS(on)} > 1 \Omega$ used for signal control, level shifting Low $R_{DS(on)} < 1 \Omega$ used for load switch control
L	MOSFET (P or N channel, e.g. PMPB9SENEA, PMPB100XPEA)	Low $R_{DS(on)} < 1 \Omega$ used for drive of medium power LEDs
M	PBSS series	Low $V_{CE(sat)}$ transistor, 20V – 60V 1A – 2A

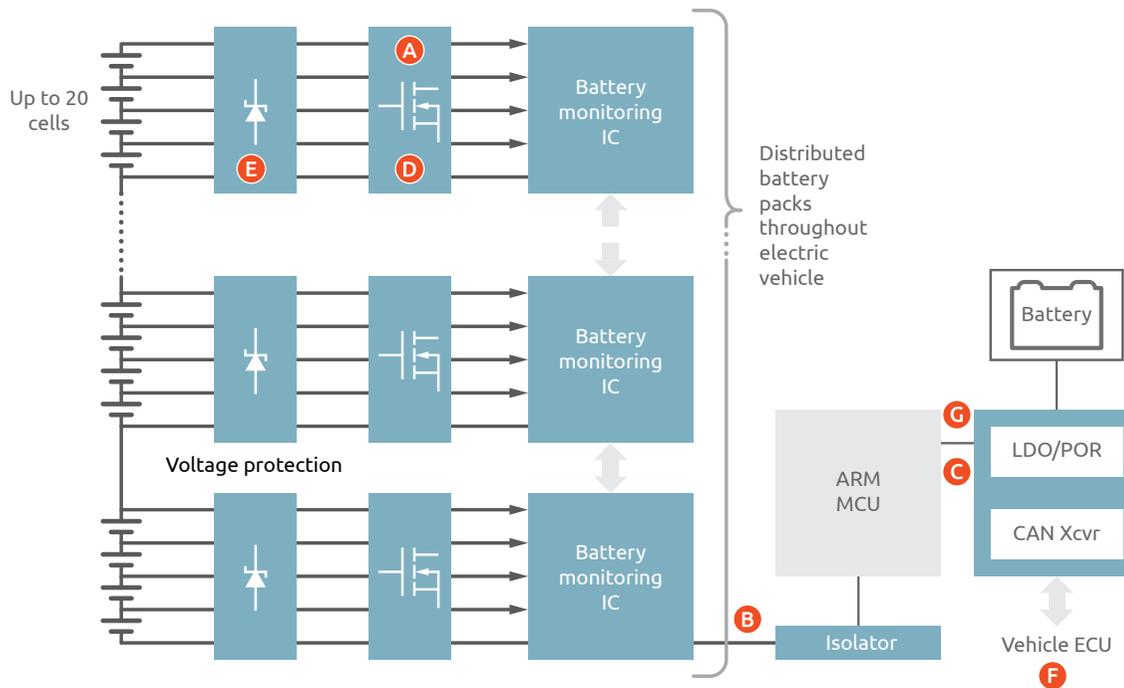


Battery Management for Electric Vehicles

Automotive battery management is critical for hybrid and all-electric vehicles. Battery Management includes the on-board charging system, load management, and battery balance.

Design considerations

- › What is the total number of battery cells? (determines the number of duplicate monitor circuits)
- › What is the IC operating voltage? (HC for 5 V, HEF for 12 V Logic, etc.)
- › Are there multiple voltage supplies (Level Shifters)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Power MOSFETs	Current control for cells
B	Level Shifter (74AVC1T45-Q100)	Level shift between voltage nodes
C	High Voltage Logic (74HEF4001-Q100)	Logic signals at 12 V supply
D	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch control in battery voltage cell balancing
E	TVS Diode (PTVSxP1UTP)	Transient voltage surge protection
F	ESD Protection (PESD1CAN-U)	General purpose ESD protection FlexRay ESD protection CAN ESD protection LIN ESD protection
G	General purpose RETS and Matched Pair Transistors (PUMH9)	Signal control, MOSFET driver, constant current monitor

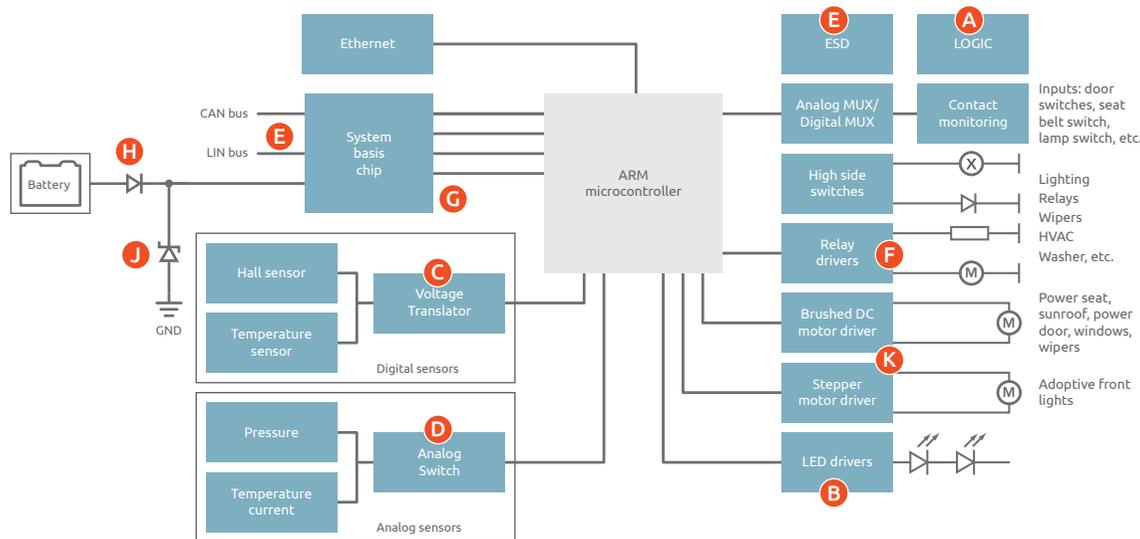


Body Control Module (BCM)

Body control modules are distributed throughout a vehicle to control features such as power seats, power windows, door locks, and other functions with basic motor control. There are multiple BCM's in today's modern vehicle.

Design considerations

- › What voltage do the BCM nodes operate at? (determines Logic family, MOSFET requirements)
- › What is the current requirement of the loads? (determines MOSFET sizes)
- › What is the type and voltage of the inputs? (determines Level Shifters, Analog Switch requirements)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	High Voltage Logic (HEF-Q100 family)	Operates at 12 V
B	LED Driver (NPIC6C596-Q100)	Low cost LED drive solution
C	Level Shifter (74AVC1T45-Q100)	Connecting 12 V sensors to 5 V MCU
D	Analog Switch (-Q100 selection)	For audio control, sensor inputs
E	ESD Protection	General purpose ESD protection FlexRay ESD protection CAN ESD protection LIN ESD protection
F	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch control and LED dimming
G	Transistor (Low Vcesat)	Linear regulator and load switch control and LED dimming control
H	PN Rectifier (PNS4001ER) Schottky Barrier Diode (PMEG family)	DC voltage blocking diode
J	TVS Diode (PTVS Family)	Transient voltage surge protection
K	Power MOSFETs	For motor control

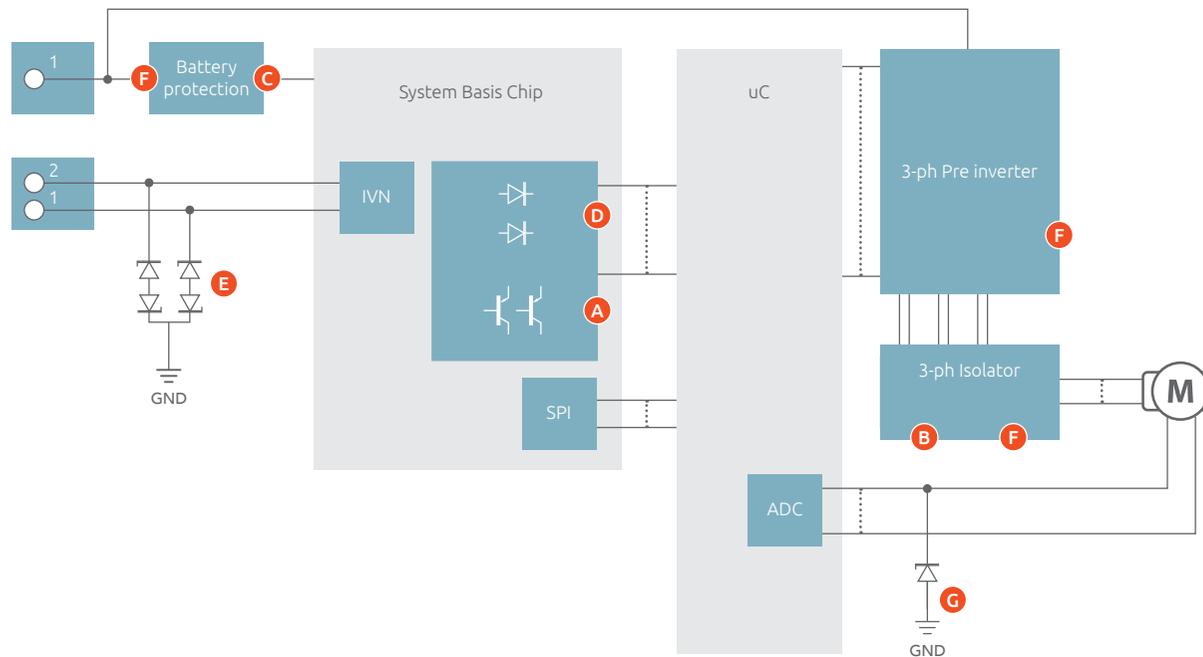


Electrical Power Steering (EPS)

Electrical Power Steering is beginning to replace traditional belt-driven hydraulic power steering systems. Advantages include improved packaging, less parasitic engine losses and improved performance.

Design considerations

- › What is the size of the vehicle? (determines power requirements of MOSFETs)
- › How is the unit ESD protected during both assembly/repair and normal operation?
- › What is the supply voltage? (equal to 12V or greater?)



	Product	Use value
A	Low $V_{CE(sat)}$ transistor (PHPT60603PY)	Linear voltage regulation
B	Schottky rectifier (PMEG050V150EPD)	Freewheeling 3-phase isolator
C	Schottky rectifier (PMEG10020ELR)	Reverse polarity protection
D	Schottky rectifier (PMEG4020EPK, PMEG3020EJ)	DC/DC conversion
E	ESD protection (PESD2IVN-U)	CAN ESD protection
F	Power MOSFET	Motor drive / isolator
G	ESD protection (PESD3V3S1UL)	ESD protection on motor connector

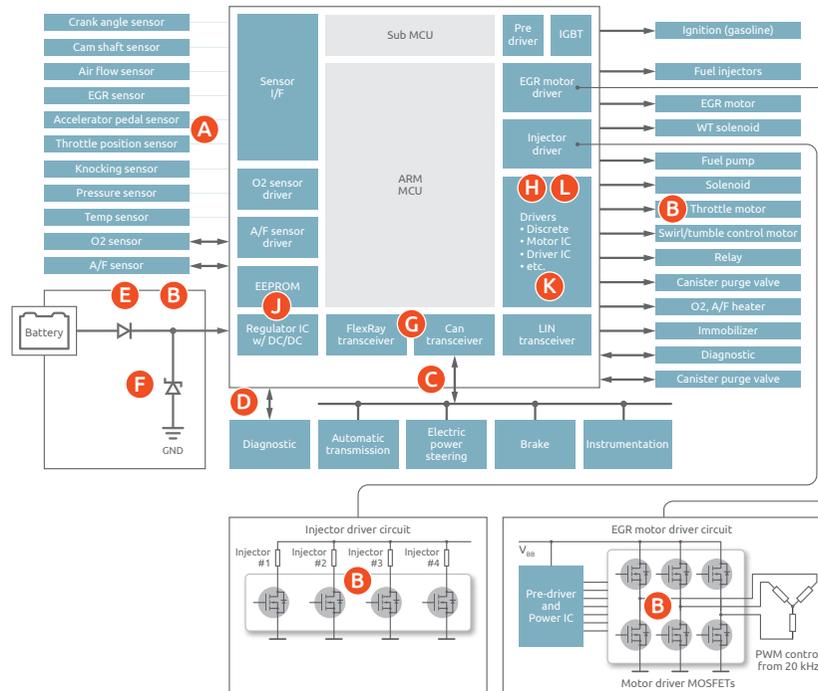


Engine Control Unit (ECU)

The function of the ECU is to meet performance, emissions, and fuel economy requirements. Subsystem components include the fuel injection system and ignition requiring inputs from a large number of sensors.

Design considerations

- › How many sensor inputs? (determines need for Analog MUX Switches)
- › What is the number and type of outputs? (determines MOS devices)
- › What is the operating voltage of ECU? (determines HEF, HC, etc Logic family)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Analog Switch (74HC4066-Q100)	Multiplexing many analog inputs to MCU
B	Power MOSFETs	Control of solenoids, pumps, etc.
C	Level Shifter (74AVC1T45-Q100)	Level shift between various devices
D	High Voltage Logic (HEF -Q100 family)	Direct connect to 12 V supplies
E	PN Rectifier (PNS4001ER) Schottky Barrier Diode (PMEG family)	DC voltage blocking diode
F	TVS Diode (PTVS family)	Transient voltage surge protection
G	ESD Protection	General purpose ESD protection FlexRay ESD protection CAN ESD protection LIN ESD protection
H	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch control
J	Schottky Barrier Diode (PMEG family)	Free-wheeling diode for DC-DC buck/ Boost converter and inductive load
K	General purpose RETS and Matched Pair Transistors	Signal control, MOSFET driver, constant current monitor
L	Transistor (Low Vcesat)	Linear regulator and load switch control

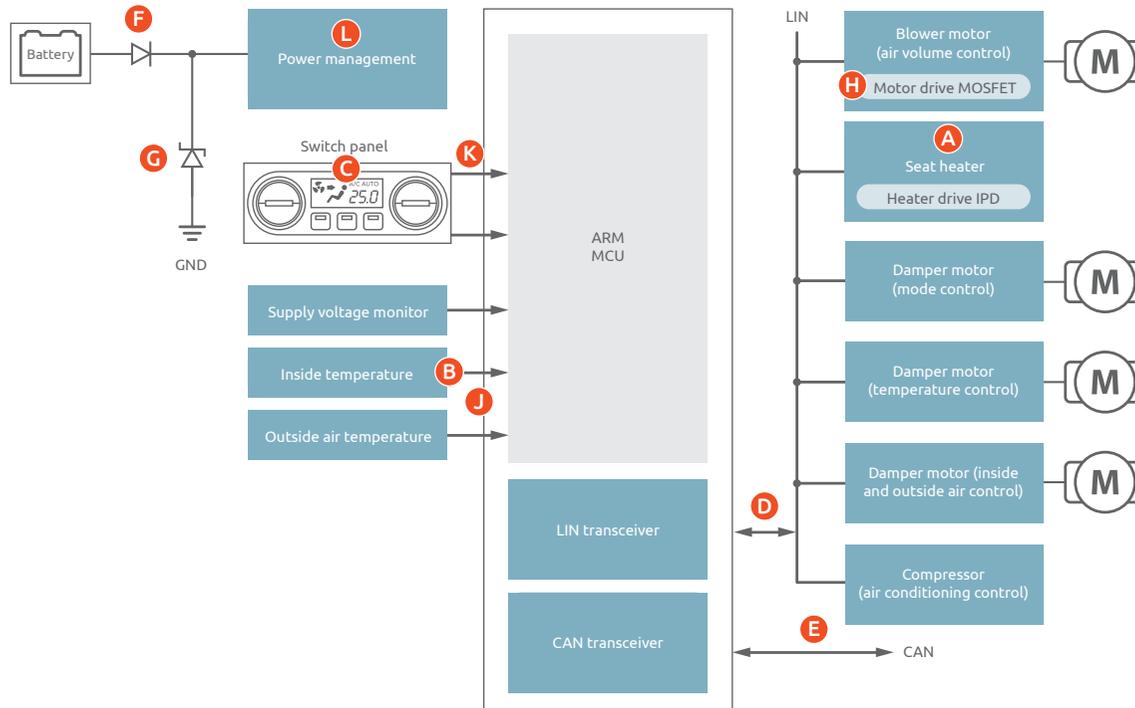


Heating Ventilation Air Conditioning (HVAC)

An automotive HVAC system controls the heating and cooling of the passenger compartment and defrosting the windshield. System control requires monitoring an array of temperature sensors that control fan motors and dampers.

Design considerations

- › How many sensor inputs? (opportunity for Analog Switch)
- › What are voltages of the control system and external devices? (Level Shifters)
- › What is the current draw of the fan and heater motors? (Power MOSFETs opportunity)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Power MOSFETs	Fan and motor drive
B	Analog Switch (74HC4066-Q100)	Temp sensor multiplexing
C	LED Driver (NPIC6C596-Q100)	LED drive for backlighting and panel indicators
D	Level Shifter (74AVC1T45-Q100)	Level shift between MCU and subsystems
E	ESD Protection	General purpose ESD protection FlexRay ESD protection CAN ESD protection LIN ESD protection
F	PN Rectifier (PNS4001ER) Schottky Barrier Diode (PMEG family)	DC voltage blocking diode
G	TVS Diode (PTVS Family)	Transient voltage surge protection
H	Schottky Barrier Diode (PMEG family)	Free-wheeling diode for DC-DC and inductive load
J	General purpose RETS and Matched Pair Transistors	Signal control, MOSFET driver, constant current monitor
K	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch control
L	Transistor (Low Vcesat)	Linear regulator and load switch control

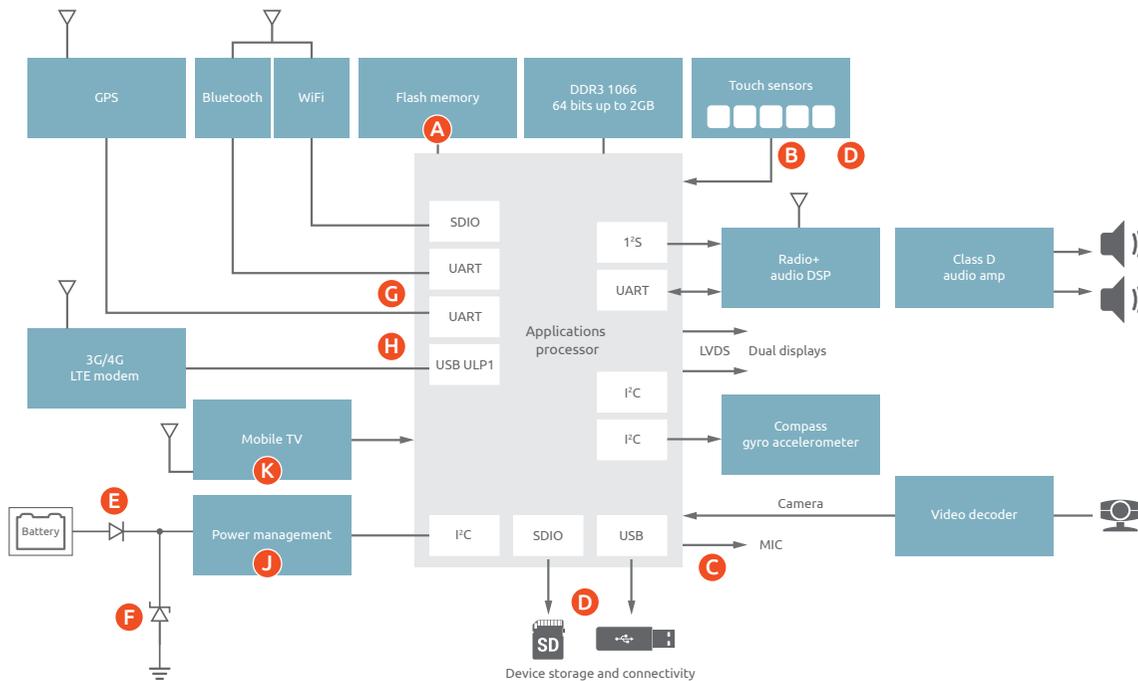


Infotainment

Infotainment systems provide entertainment to the driver and passenger, as well as, navigation and communications. Subsystems include GPS, Audio, WiFi, Bluetooth, and user interface.

Design considerations

- › What is the interface between system modules? (Level Shifters)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Level Shifter (74AVC1T45-Q100)	Connection between modules
B	Analog Switches (74HC4051-Q100)	Touch sensor input array
C	Low Voltage Logic (LVC-Q100 Family)	Low power general purpose logic
D	ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General purpose ESD protection for high speed data lines. CAN ESD protection and protection for various user interfaces
E	PN Rectifier (PNS4001ER) Schottky Barrier Diode (PMEG family)	DC voltage blocking diode
F	TVS Diode (PTVS family)	Transient voltage surge protection
G	General purpose RETS and Matched Pair Transistors	Signal control, MOSFET driver, constant current monitor
H	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch control
J	Transistor (Low Vcesat)	Linear regulator and load switch control
K	Power MOSFETs	Power management

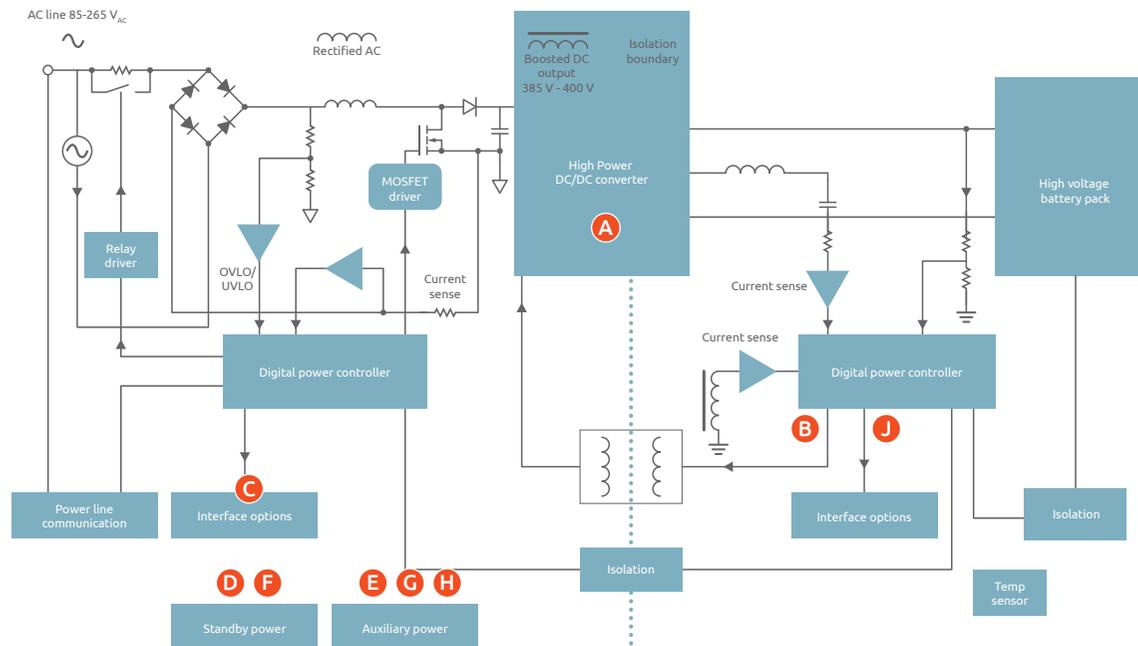


On-Board Charger

An On-Board Charging system maintains and charges the battery array in hybrid and electric vehicles.

Design considerations

- › What is the maximum operating voltage? (determines FET characteristics)
- › What is the MCU operating voltage and system rail voltages? (selects Logic family and Level Shifters)
- › How many cells are in battery array? (determines quantity charging sections)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Power MOSFETs	Battery charging circuits
B	High Voltage Logic (HEF-Q100 Family)	Direct high voltage connections
C	Level Shifter (74AVC1T45-Q100)	Connection between voltage domains
D	ESD Protection	General purpose ESD protection
E	PN Rectifier Schottky barrier diode	DC voltage blocking diode
F	TVS Diode	Transient voltage surge protection
G	Small Signal MOSFETs Pch or Nch	High $R_{DSon} > 1 \Omega$ used for signal control, level shifting Low $R_{DSon} < 1 \Omega$ used for load switch control
H	Schottky Barrier Diode PMEG series	Free-wheeling diode for DC-DC and inductive load
J	General Purpose RETS, & Matched Pair Transistors	Signal control, MOSFET driver, constant current monitor

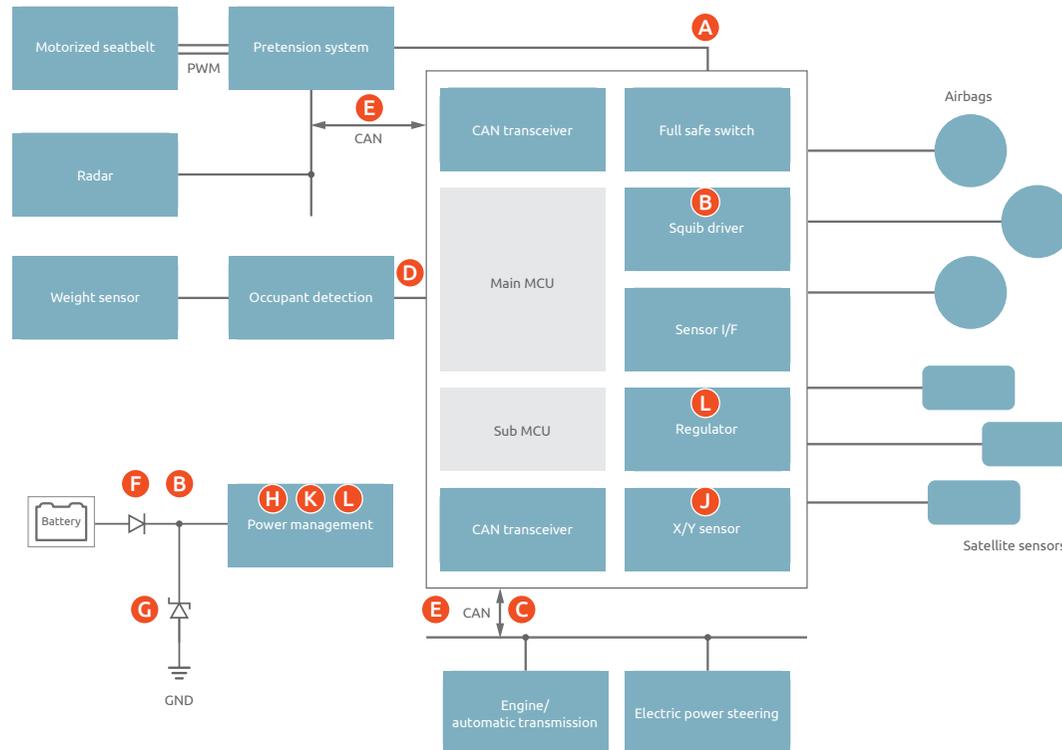


Passive Safety: Airbag

Passive safety systems are devices which require no user input to operate, such as the airbag and self-tensioning seatbelts.

Design considerations

- › How many and what type of input sensors are used? (opportunity for an Analog Switch)
- › What is the current requirement of the output devices? (Power MOSFETs requirements)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)
- › What are the system voltage rails? (Level Shifters)



	Product	Use value
A	High Voltage Logic (HEF-Q100 family)	Operates at unregulated 12 V supply
B	Power MOSFETs	Tensioning motors, squib activation
C	Level Shifter (74AVC1T45-Q100)	Connection of different nodes
D	Analog Switch (74HC4051-Q100)	Analog sensor multiplexing
E	ESD Protection	General purpose ESD protection FlexRay ESD protection CAN ESD protection LIN ESD protection
F	PN Rectifier (PNS4001ER) Schottky Barrier Diode (PMEG family)	DC voltage blocking diode
G	TVS Diode (PTVS Family)	Transient voltage surge protection
H	Schottky Barrier Diode (PMEG family)	Free-wheeling diode for DC-DC and inductive load
J	General purpose RETS and Matched Pair Transistors	Signal control, MOSFET driver, constant current monitor
K	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch control
L	Transistor (Low Vcesat)	Linear regulator and load switch control

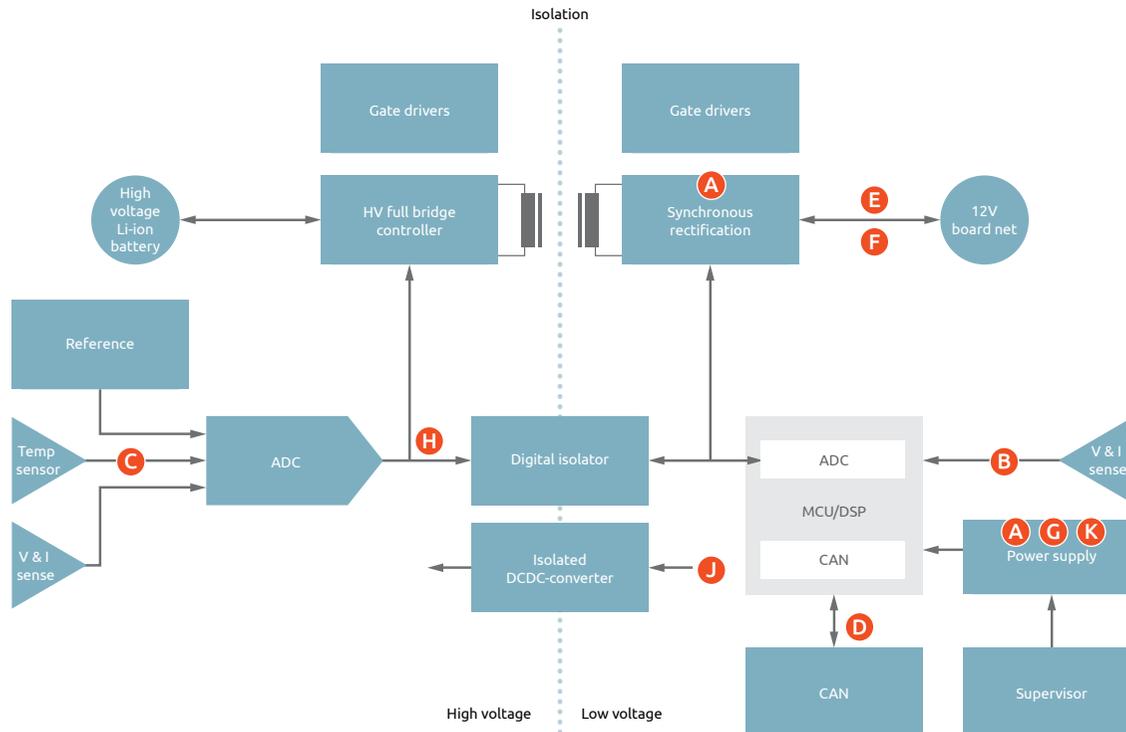


Power Block: DC-DC Converter

Automotive DC-DC converters are used for high-efficiency conversion between the 12 VDC battery voltage and high voltage systems.

Design considerations

- › What is the total system voltage? (determines FET parameters and Logic family)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Power MOSFETs	Power conversion
B	High Voltage Logic (74HEF4001-Q100)	Capable of operating directly on high voltage rails
C	Analog Switch (HEF4066-Q100)	Multiplexing many voltage sensors to MCU
D	ESD Protection	General purpose ESD protection FlexRay ESD protection CAN ESD protection LIN ESD protection
E	PN Rectifier (PNS4001ER) Schottky Barrier Diode (PMEG family)	DC voltage blocking diode
F	TVS Diode (PTVS Family)	Transient voltage surge protection
G	Schottky Barrier Diode (PMEG family)	Free-wheeling diode for DC-DC and inductive load
H	General purpose RETS and Matched Pair Transistors	Signal control, MOSFET driver, Constant current monitor
J	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch control
K	Transistor (Low Vcesat)	Linear regulator and load switch control

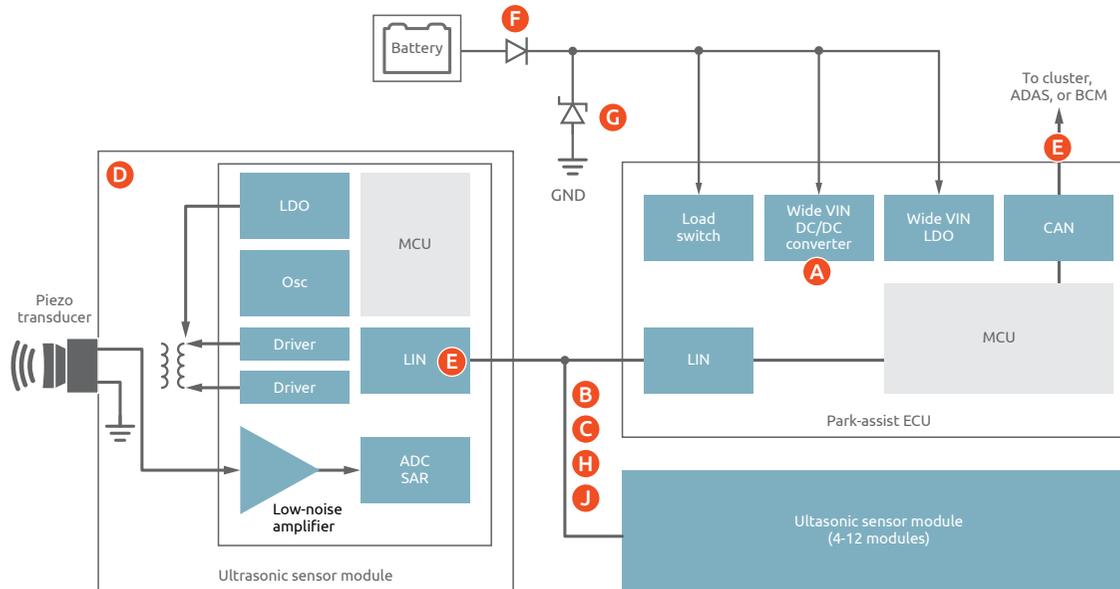


Sensors: Radar, LiDAR, Camera

Automotive sensors provide input to the Driver Assist System (DAS). These systems provides data for the systems that control and monitor blind spots, automatic parking, cruise control, and night vision.

Design considerations

- › How many input sensors? (determines number channels for Analog Switch and Level Shifters)
- › Is there a size constraint with the sensor? (use Mini Logic packaging to reduce footprint)
- › What are the system voltage rails? (Level Shifters)
- › What are the power requirements for the remote sensor? (consider AUP, AXP low power logic)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Power MOSFETs	Power conversion from 12 V supply rail
B	Analog Switch 74HC/HEF4051-Q100)	MUX input from multiple analog sensors to single MCU channel
C	Level Shifter (74AVC8T245-Q100)	Up to 8 channels of bidirectional translation between sensor and control module
D	Mini Logic Packages	Small logic packaging to fit into the sensor
E	ESD Protection	General purpose ESD protection FlexRay ESD protection CAN ESD protection LIN ESD protection
F	PN Rectifier (PNS4001ER) Schottky Barrier Diode (PMEG family)	DC voltage blocking diode
G	TVS Diode (PTVS Family)	Transient voltage surge protection
H	General purpose RETS and Matched Pair Transistors	Signal control, MOSFET driver, constant current monitor
J	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch control

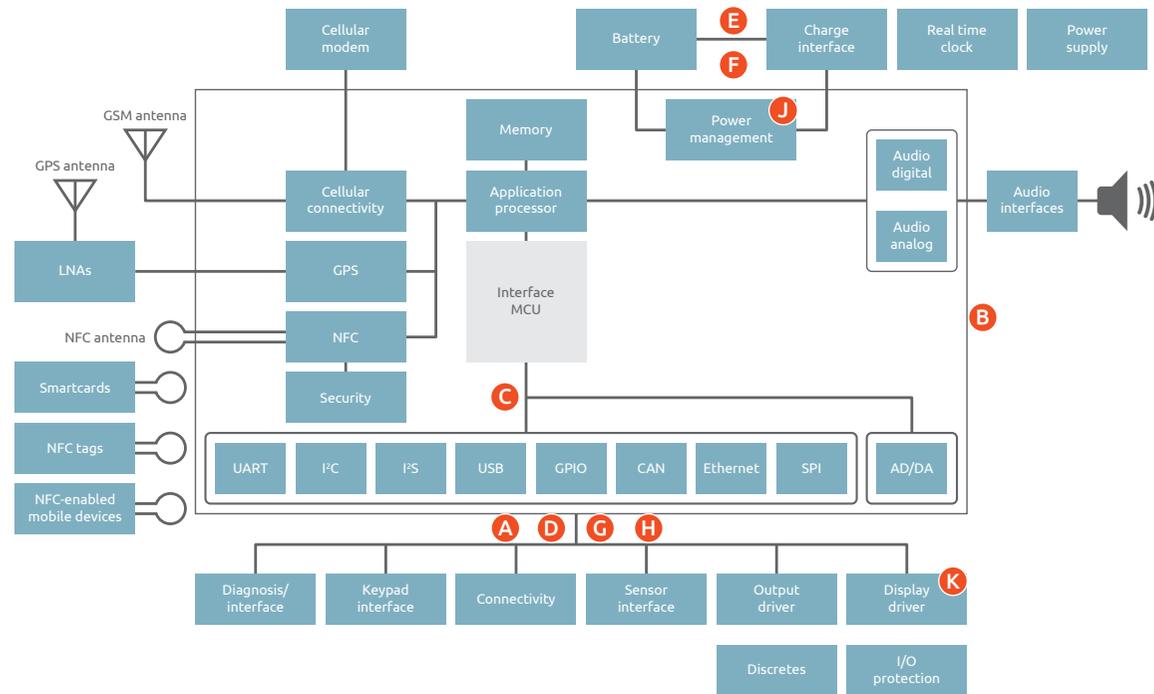


Telematics: e-Call, GPS, V2X

Telematics includes the various communications methods between the vehicle and the outside world, which may include V2x (Vehicle to Vehicle/Infrastructure), GPS, OnStar, cellular, etc.

Design considerations

- › What is the system voltage levels? (Level Shifters)
- › What are the operating frequencies? (selects Logic family)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Level Shifter (74AVC8T245-Q100)	Up to 8 channels of bidirectional translation between sensor and control module
B	Mini Logic Packages	Small logic packaging to fit in the module
C	Analog Switch (74HEF/HC4051)	MUX input from multiple analog sensors to single MCU channel
D	ESD Protection	General purpose ESD protection FlexRay ESD protection CAN ESD protection LIN ESD protection
E	PN Rectifier (PNS4001ER) Schottky Barrier Diode (PMEG family)	DC voltage blocking diode
F	TVS Diode (PTVS family)	Transient voltage surge protection
G	General purpose RETS and Matched Pair Transistors	Signal control, MOSFET driver, constant current monitor
H	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting
J	Transistor (Low Vcesat)	Linear regulator and load switch control
K	LED Driver (NPIC6C596-Q100)	Low cost LED backlight driver



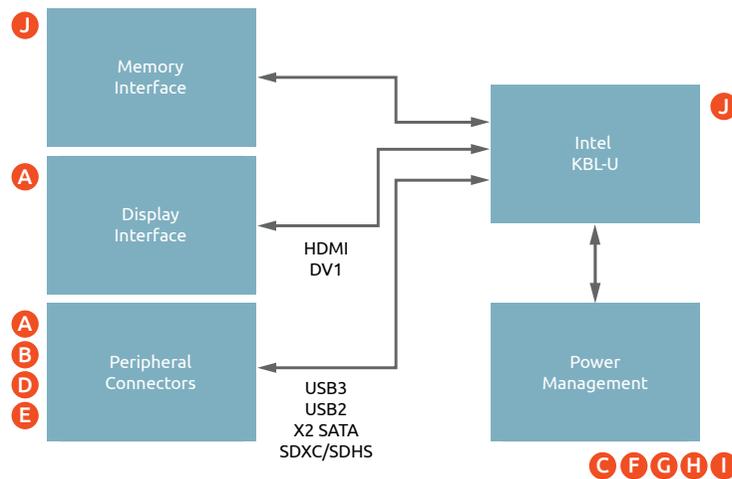


PC Motherboard (Intel Kaby Lake Platform)

Kaby Lake is the codename used by Intel for the newest processor microarchitecture and a followup to the Skylake platform. This platform can be used in both laptop/tablet and desktop/workstation applications, so designs can vary greatly depending on form factor and power consumption requirements.

Design considerations

- › What is the target platform: mobile or desktop? (determines power consumption/packaging needs)
- › How are external connectors protected from ESD?
- › What are the power supply parameters (battery or line powered)? (determines MOSFET in power supplies)
- › What features are added/deleted? (need for custom logic)



	Product	Use value
A	ESD protection (PUSB3FR4)	4-line ESD prot., USB, HDMI, SD-card unidir., 15kV, 0.29pF, Rdyn = 0.27Ohm
B	ESD protection (PESDSV0H1BSF, PESDSV0C1USF)	ESD diode, USB, HDMI bidirec. 15kV, 0.13pF, Rdyn = 0.25Ohm/0.65Ohm
C	TVS diode PTVSxVS1UR	TVS diode for charger input, VBUS 400W @IEC61643-321
D	Common mode filter (PCMFxUSB3S)	CMF & ESD protection 1, 2 or 3 data pairs; -3dB @7GHz
E	PESDxUSB3S	ESD-Protection unidir., 15kV, can replace PCMF
F	MOSFET, FOM optimized, e.g. PMPB20EN	N-Channel FET, DC-DC conversion 30 V, $R_{DS(on)} = 3-20\text{ m}\Omega$
G	P-channel MOSFET, e.g. PMPB15XP	P-Channel FET, load switch in charging path and power train 12 - 30 V $R_{DS(on)} = 15 - 30\text{ m}\Omega$
H	P-ch/N-ch MOSFET, e.g. PMV75UP	General purpose low ohmic load switch 20 - 30 V $R_{DS(on)} = 15 - 100\text{ m}\Omega$
I	N-ch MOSFET, e.g. NX7002AK, NX7002BKM	N-Ch. FET, general purpose usage 60 V, +/-20 V, $R_{DS(on)} = 2.2\ \Omega$
J	74AVC4TD245	4-bit dual supply transceiver 0.8V-3.6V bidirectional, 380Mbit/s

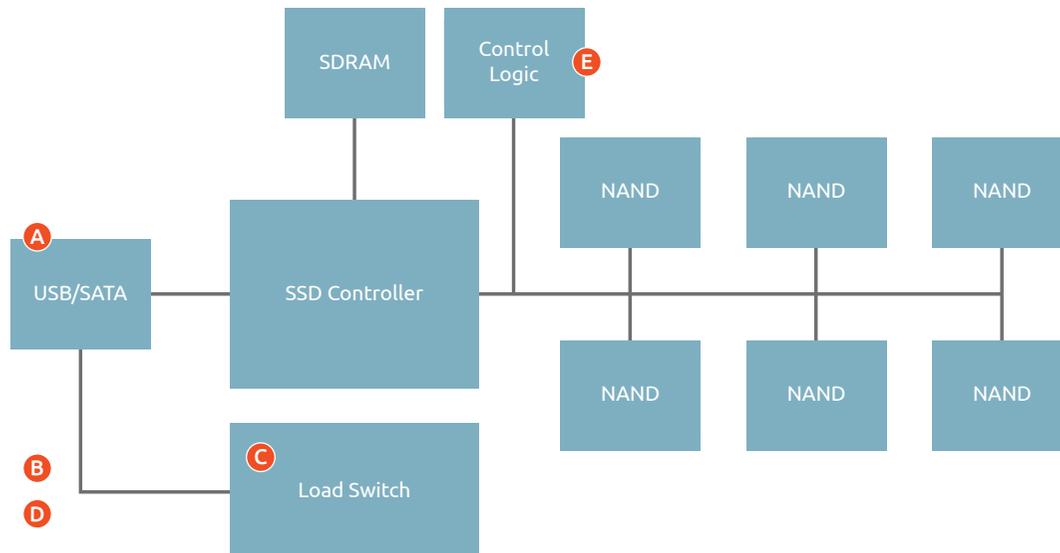


SSD Solid State Drives

SSD Solid State Drives replace the spinning mechanical disks and read heads in a standard HDD (Hard Disk Drive) with solid state memory devices. While cost-per-byte may be higher, benefits include higher performance and higher reliability.

Design considerations

- > Power supply voltages? (logic family)
- > Mobile or professional application? (determines power supply current/voltage/reliability)
- > Size constraints for mobile/tablet applications? (miniature packaging)
- > Protection of connector from ESD?



	Product	Use value
A	ESD protection (PUSB3FR4, PUSB3FR6)	ESD protection for USB/SATA
B	TVS diode (PTVSxVZ1USK)	TVS protection 300W@IEC61643-321
C	MOSFET, low $R_{DS(on)}$ e.g. (PMPB20XNE, PMXB40UNE)	Load switch for power down savings. 20 – 30 V, 10 – 50 mΩ
D	Schottky rectifier (PMEG3010AESB)	Reverse polarity protection, free-wheeling diode 30V, 1A, $V_f=0.415V$
E	74AUP1G08, 74LVC1G32,	Control logic and translation (LVC, AUP, AXP)



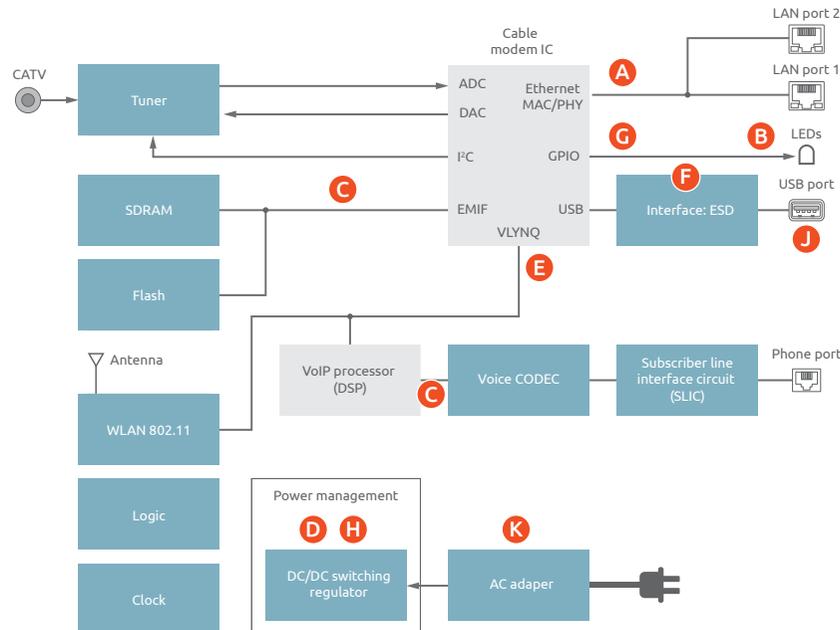


Gateways

Gateways are access points used for a variety of network services: VOIP Gateways, Cable TV Gateways. All connections require ESD protection and high speed switches. Units can be consumer grade or located in large switching hubs. The below diagram illustrates a home gateway.

Design considerations

- › What are the data rates? What data is transmitting? (logic speed, CBT switches)
- › Do you have multiple voltage nodes in the system? (need for Level Shifters)
- › Is Hot Swap a requirement? (Need for AVC(H) Bus Hold on buffers)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	CBT Switch (74CBTLV3257)	For high speed routing of analog or digital signals
B	LED Driver (NPIC6C596)	LED status indicators
C	Level Shifter (74AVC8T245)	Connection between voltage wells
D	Power MOSFETs	Power supplies and DC-DC converters
E	Low Voltage (AUP and LVC families)	General logic needs
F	ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General purpose ESD protection TRESP protection for high speed data lines ESD protection in various user interface
G	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch, DC-DC converter
H	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC adapter
J	TVS Diode (PTVS Family)	Transient voltage surge protection
K	General purpose Transistors, RETs and Switching Transistors	Signal control, MOSFET driver, general purpose switching



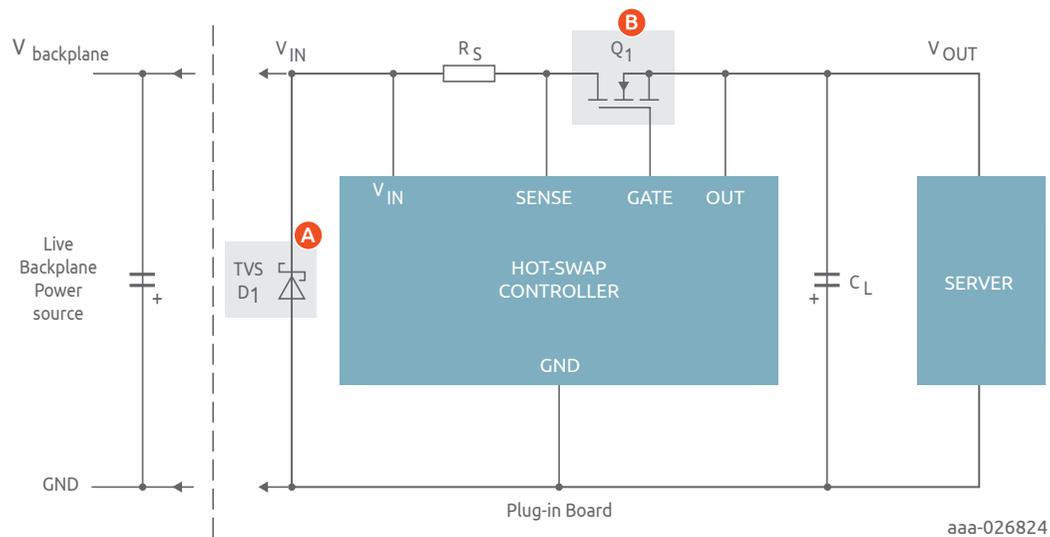
Hot Swap Controller

Our telecommunications infrastructure runs 24/7 and much of it uses 48 V rack-based systems that are permanently live. So the boards and components that drive these systems must be able to be 'hot-swapped' to allow for upgrades and maintenance without ever needing to power down the equipment.

Design considerations

- › When a board is plugged into a live system, it is important the in-rush current is carefully controlled to protect the components on the board and ensure other parts of the system do not experience any power disruption.
- › MOSFETs with a strong linear mode performance and wide safe operating area (SOA) are required to manage this current effectively and reliably
- › TVS protection to prevent the hot-swap controller from any surge strike.

	Product	Use value
A	MOSFETs	In-rush current control, 100 V, ID 75<->120 A, in TO-220AB and D2PAK
B	TVS diodes PTVSxS1UTR series PTVSxP1UTP series	Surge Protection 400 W; VRWM 3.3-64V 600 W; VRWM 3.3-64V in space-saving CFP3/5 package (SOD123W/128)





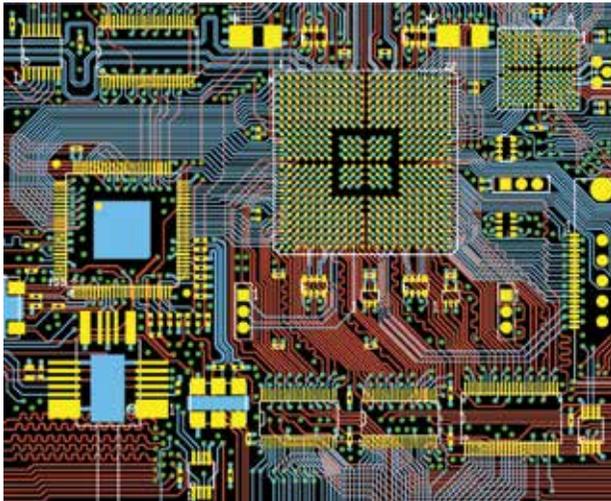


Design House (ODM/JDM/EMS)

Design Houses provide a variety of services in taking a product concept to production. This may also include improving an existing design by reducing material and manufacturing costs. While applications may vary, the design issues below are common:

Design considerations

- › Need to reduce device costs? (smaller packages or multiple single gate devices instead of larger packages)
- › Reduce PCB size? (smaller packages or Combination Logic)
- › Need to reduce overall BOM size? (Configurable Logic and/or Combination Logic)
- › Reduce/eliminate step-down solder mask expenses? (Mini Logic, GX Diamond package, with large pin pitch)
- › Have you reached reel limits on pick/place machines? (Configurable Logic reduces number of unique part types)
- › Reduce significant qualification costs? (Configurable Logic and/or Combination Logic)
- › High reliability requirements? (Mini Logic has higher package reliability specifications)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



Advanced PCB

Product	Use value
Combination Logic	Combines different functions into single package
Configurable Logic	A single device can replace up to 7 different logic functions
Semi-Custom Logic	Create a new "standard" part number for specific needs
Mini Logic Packaging	Has much higher shock and temperature resistance than leaded packages
GX "Diamond" Package	0.8 x 0.8 mm package with 0.4 mm lead pitch
ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General Purpose ESD protection TrEOS protection for high speed data lines ESD protection in various user interface
Small Signal MOSFET (P or N Channel)	High $R_{DSon} > 1 \Omega$ used for signal control, level shifting Low $R_{DSon} < 1 \Omega$ used for load switch control, DC-DC converter
Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, DC Or-ing function, freewheeling, and secondary rectifier in AC/DC for system power
TVS Diode (PTVS family)	Transient voltage surge protection for Vbus power path
General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching
Switching Diode	General purpose high voltage switching diodes. DC blocking
Zener Diode	Voltage reference, linear regulator
Transistor (Low Vcesat)	Linear regulator and load switch control

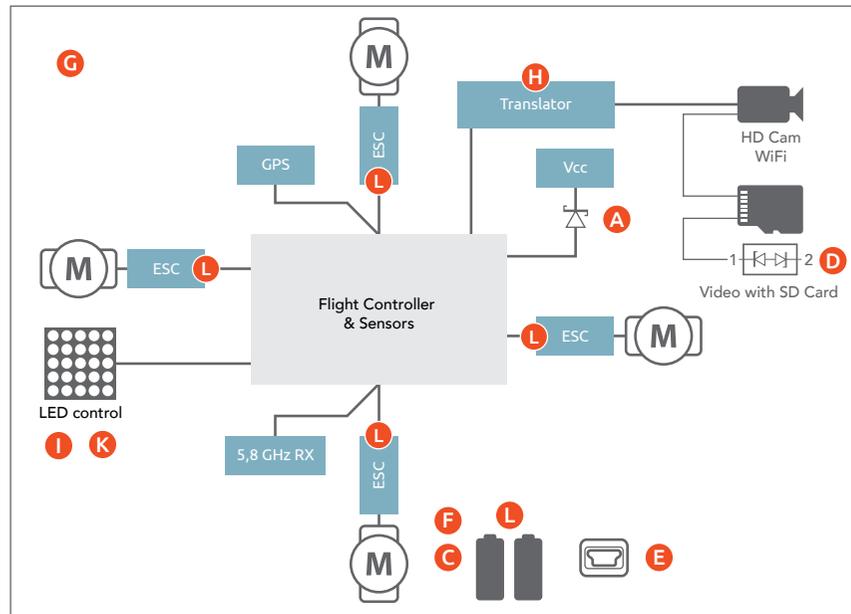


Unmanned aerial vehicles (UAVs) / «Drones»

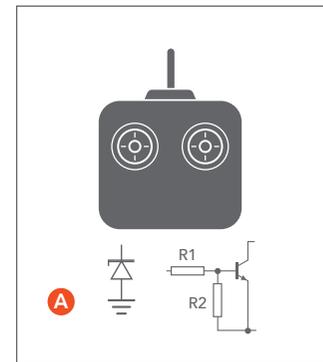
Unmanned aerial vehicles or multi-copters (“Drones”) are consumer devices characterized by 4 (or more) motor/propeller units, a video transmission system and a variety of sensors/inputs to enable fully or semi-autonomous operation. Size and weight are critical factors in design, with low power required for longer flight times.

Design considerations

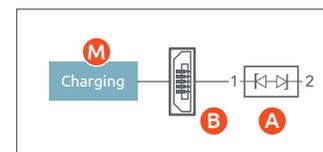
- › What is the battery voltage? (Sets parameters for MOSFETs, transistors, etc.)
- › Are there size constraints? (miniature device packaging)
- › Professional/consumer application? (high reliability packaging/Q100 specs)
- › Are there multiple voltage supplies? (translators)
- › How many external sensors? (analog switches)



Onboard drone



External Radio Transmitter



External battery charging system

	Product	Use value
A	Schottky rectifier (PMEG3020EPA)	Schottky, freewheeling for reverse polarity protection
B	MOSFET PMVxx (PMPBxxx)	MOSFETs, N & P-Ch; as load switches for USB port
C	Low V _{CEsat} transistor (PB55x140T)	Load switch, MOSFET driver
D	ESD protection (IP4340CX15)	ESD & EMI for µSD card
E	ESD protection (PUSB3FR4 PESD5V0F1BL)	TrEOS USB3 and USB2.0 ESD protection
F	TVS diode (PTVSxxV0S1UR)	Battery TVS surge protection
G	Switching diode (BAS316)	Gen. purpose high speed switching diode
H	74AVC8T245BQ	8 bit transceiver for Video processor-MCU connection
I	GP transistor (BC817)	Gen. purpose BJT, LED control
J	74HC4067BQ	16 bit analog mux/demux for battery management
K	NPIC6C596	LED array control
L	Power MOSFET	Low R _{DS(on)} , high current. 25 V - 30V, up to 100 A LFPAK56 (SOT669)
M	Power MOSFET	Synchronous rectifier for fast-charger 30 V, up to 60 A LFPAK56/33/56D (SOT669, SOT1210, SOT1205)

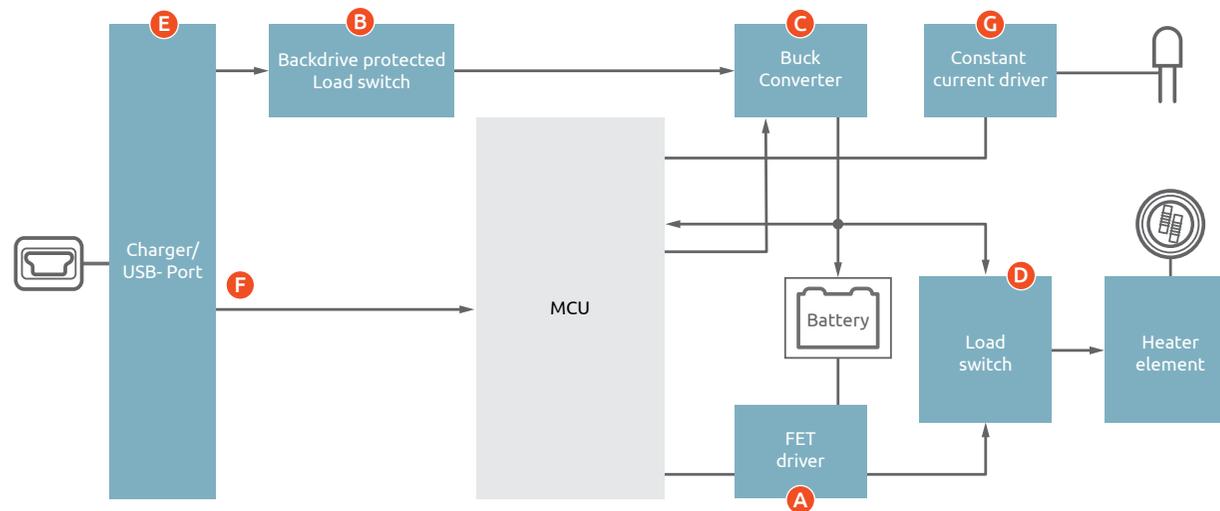


E-Cigarettes

E-Cigarettes use heat to vaporize liquids into an inhalable form. E-cigarettes replace conventional cigarettes with a more socially acceptable alternative. They may have a lower impact to health depending on the liquids/chemicals used.

Design considerations

- › Battery voltage? (sets load switch/ MOSFET requirements)
- › ESD protection on all exposed connectors?
- › Multiple LED indicators? (LED drive circuit)



	Product	Use value
A	74LVC1G125, 74LVC1G04	MOSFET drive
B	P-channel low $R_{DS(on)}$ MOSFET, (PMPB27EP)	Backdrive protected charger switch
C	N-channel low $R_{DS(on)}$ MOSFET, (PMPB13XNE)	Push-pull stage buck converter
D	P-channel low $R_{DS(on)}$ MOSFETs, (PMPB15XP, PMCM4401VP, PMCM6501VPE)	Heater element load switch
E	TVS diode (PTVSxVZ1USK)	Surge protection on supply line
F	ESD protection (PESD5V0V2UAM)	USB data line protection
G	LED driver (NCR401T)	Constant current drive for indicator LEDs

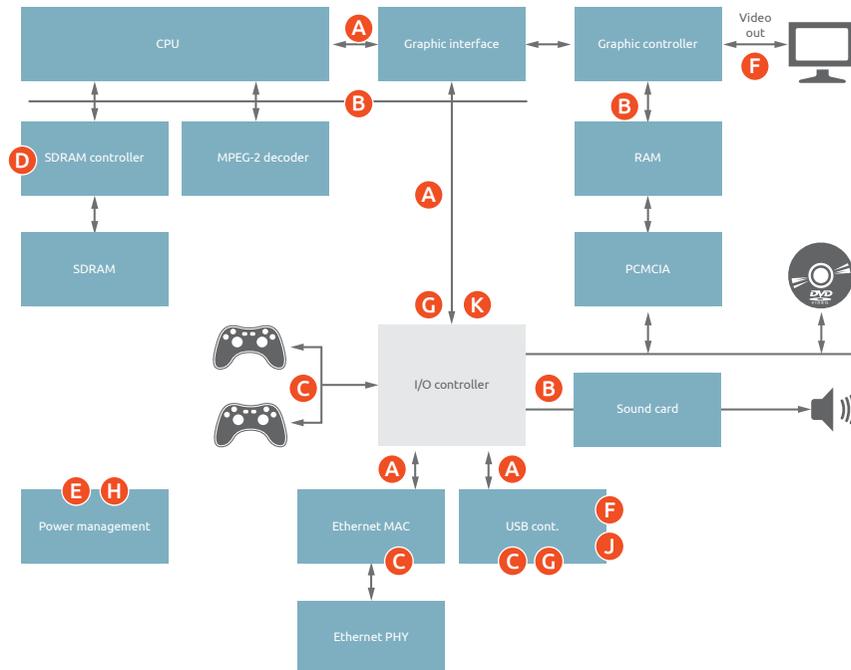


Gaming

Gaming systems include consumer devices (set-top and portable games) as well as professional gaming systems (slot machines, etc.). All are essentially custom-purpose computers with proprietary software stacks.

Design considerations

- › Are there any size constraints? (portable devices may require special small packaging)
- › What is the supply voltage? (floor units have no power issues, portable will have battery life issues: AXP/AUP Low Voltage Logic)
- › Do you have multiple voltage supplies in the device? (Level Shifters)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Level Shifter (74AVC2T45)	Translation between voltage domains
B	Low Voltage Logic (AXP, AUP Family)	For portable gaming power reduction
C	Analog Switch (74LV/LVC4051)	Mux multiple analog signal in game controller to single ADC
D	CBT Switch (CBT family)	Switching between large memory banks
E	Power MOSFETS	Internal VRM (voltage regulator), battery charging, USB PD, AC/DC power supply, LED lighting, motor control
F	ESD Protection, Single and Multi-Line (PUSB3, PESD, PCMF Family)	General purpose ESD protection; TrEOS protection for super high speed data lines ESD protection; USB/SD card interface ESD protection; common mode filter with ESD for differential data lines communication
G	Small Signal MOSFET (P or N Channel)	Leadless FETs in DFN and WLCSP; High RDSon > 1 Ω used for signal control, level shifting; Low RDSon < 1 Ω used for load switch, reverse protection, DC-DCs, back-light LED drive/dimming, camera flash
H	Schottky Barrier Diode (PMEG family)	Leadless Schottky diodes in DSN and DFN packages; DC Voltage blocking diode, DC Or-ing Function. Freewheeling, reverse protection, BL booster and secondary rectifier in low power AC/DC adapter
J	TVS Diode (PTVS Family)	Transient voltage surge protection for Vbus power path
K	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, GP switching

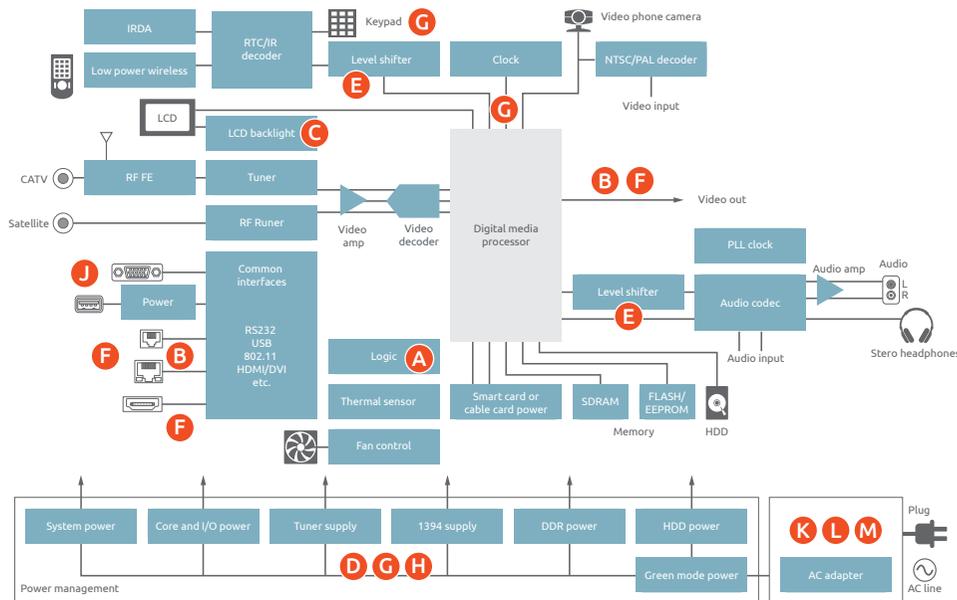


Set-Top Box

Set-Top Boxes accept a variety of analog or digital inputs and output the audio and video through a variety of formats to a television or monitor. These boxes are no longer the exclusive design of the cable TV supplier but are also designed or outsourced by companies selling TV programming through the web. These units are always on, therefore low power management is critical. Due to high volumes, reducing BOM component count and manufacturing cost is key.

Design considerations

- › What are the power requirements? (selects Logic family)
- › Are there size constraints? (packaging)
- › How important is cost reduction? (small packaging, Configurable and Combination Logic)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Low Voltage Logic (AXP, AUP Families)	Lowest power for "always on"
B	CBT Switch (74CBTLV3257)	High speed routing for fiber in and HDMI out signals
C	Logic- LED Driver (NPIC6C596)	Lowest cost per channel for driving LEDs
D	Power MOSFETs	AC/DC power supply, VRM voltage regulator, USB-PD
E	Level Shifter (AXP, AUP Family)	Interconnecting MCU to CODECs, etc.
F	ESD Protection, single and multi-line (PUSB3FR4, PCMF1USB3S, PESD5V0C1USF, PESD5V0H1BSF)	General purpose ESD protection. TrEOS protection for high speed data lines; ESD protection in various user interface like USB, HDMI and media storage system; common mode filter with ESD for differential data lines communication
G	Small-signal MOSFET (PMXB40UNE, PMXB65UPE, PMPB23XNE)	High RDson > 1 Ω used for signal control, level shifting Low RDson < 1 Ω used for load switch, DC-DC converter
H	Schottky Barrier Diode (PMEG4015EPK)	DC voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC adapter
J	TVS Diode (PTVSxVS1UR)	Transient voltage surge protection
K	General purpose Transistors, RETs, Switching Transistors PDTD series	Signal control, MOSFET driver, general purpose switching
L	Switching Diode (BAW101)	General purpose high voltage switching diodes. DC blocking.
M	Zener Diode (BZX series)	Voltage reference, linear regulator

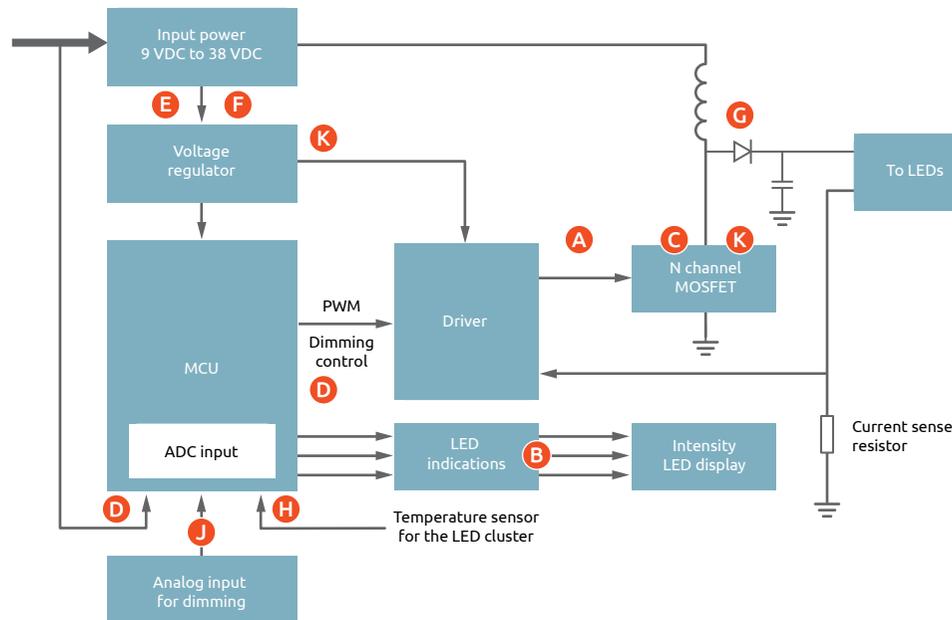


LED Lighting with Dimming Control

Dimming control for residential LED lighting requires compatibility with a wide variety of dimmers and light switches. Power supply range is from 110 VAC to low DC voltage for the dimming control circuit. Power efficiency must be maintained at all brightness levels. The below diagram illustrates a smart wall dimmer for LEDs.

Design considerations

- › What wattage LEDs are being driven? (determines drive method)
- › Do the fixtures have a dedicated Micro or is this a standalone application (NPIC for standalone)
- › What is the maximum voltage supply? (determines component voltage ratings)



	Product	Use value
A	High Voltage Logic (HEF family)	Can operate directly on 15 V supplies
B	LED Driver (NPIC6C596)	Lowest cost per channel for driving low wattage LEDs
C	Power MOSFETs	LED boost circuit, LED current balancing (linear mode), AC/DC power supply
D	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for Load switch, DC-DC converter
E	Switching Diode	General purpose high voltage switching diodes, DC blocking
F	Zener Diode	Voltage reference, linear regulator
G	Schottky Barrier Diode (PMEG family)	Secondary rectifier in AC/DC converter
H	General purpose Transistors, RETS and Switching Transistors	Signal control, general purpose switching
J	Logic- Analog Switch (74HEF4051)	Reduces the number of ADC channels on the MCU
K	Transistor (Low Vcesat)	Bleeding transistor, load switches

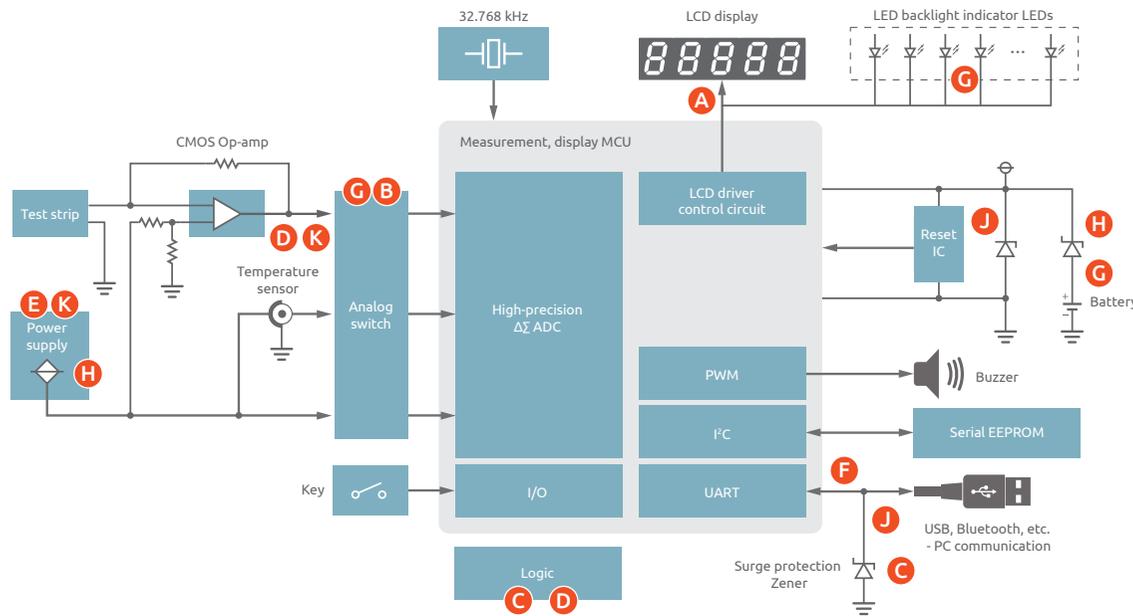


Blood Glucose Meter

Blood glucose meters are used in both the professional (hospitals, labs) and consumer space (home diabetes monitoring). An array of sensors measure a small blood sample. The majority of products are small and battery powered.

Design considerations

- › What are the size constraints? (small packaging)
- › What is the power supply? (low voltage/low power logic)
- › How many sensors are used and what type? (analog switch arrays)
- › How many external connectors are used? (ESD protection)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	LED Driver (NPIC6C596)	LED backlight and indicator control
B	Analog Switch (74LV/LVC4051)	Switch MUX for multiple analog sensors
C	Low Power Logic (AXP, AUP Family)	For low power logic needs
D	Logic- Mini Logic Packages	For small size and high reliability
E	Power MOSFETs	Battery charging, AC/DC power supply
F	ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General purpose ESD protection TRESP protection for high speed data lines ESD protection in USB interface
G	Small Signal MOSFET (P or N Channel)	Leadless FETs in DFN and WLCSPP; High RDSon > 1 Ω used for signal control, Level shifting; Low RDSon < 1 Ω used for load switch, reverse protection, LED drive/dimming,
H	Schottky Barrier Diode (PMEG family)	Leadless Schottky diodes in DSN and DFN packages. DC voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC adapter
J	TVS diode (PTVS family)	Transient voltage surge protection for Vbus power path
K	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, GP switching

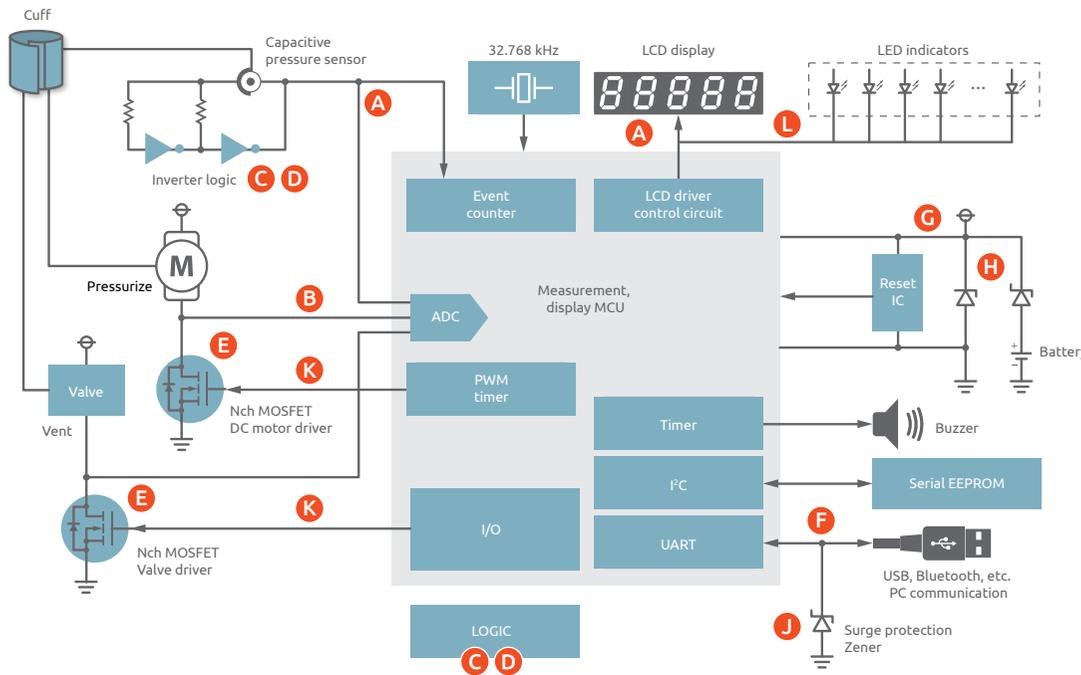


Blood Pressure Monitor

Blood pressure meters (sphygmomanometers) range from professional models, used in labs and hospitals to small, consumer units for home use. A motor driven airpump inflates a cuff that constricts blood flow while an array of transducers (mechanical and optical) measure heart rate and blood pressure. Power consumption and size are important in the home consumer market. The below diagram illustrates a portable blood pressure monitor.

Design considerations

- › What are the size constraints? (small packaging)
- › What is the power supply? (low voltage/low power logic)
- › How many sensors are used and what type? (analog switch arrays)
- › How many external connectors are used? (ESD protection)



	Product	Use value
A	Level Shifter (74AXP1T45)	Low power voltage translation between supply rails
B	Analog Switch (74LC/LVC4051)	Switch MUX for multiple analog sensors
C	Low Power Logic (AXP, AUP Family)	For low power logic needs
D	Mini Logic Packages	For small size and high reliability
E	Power MOSFETs	Battery charging, AC/DC power supply, motor control
F	ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General purpose ESD protection TRESP protection for high speed data lines ESD protection in USB interface
G	Small signal MOSFET (P or N channel)	Leadless FETs in DFN and WLCSF. High RDSon > 1 Ω used for signal control, level shifting; Low RDSon < 1 Ω used for load switch, reverse protection, LED drive/dimming, motor control
H	Schottky Barrier Diode (PMEG family)	Leadless Schottky diodes in DSN and DFN packages. DC voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC adapter
J	TVS Diode (PTVS family)	Transient voltage surge protection for Vbus power path
K	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching
L	Logic-LED Driver (NPIC6C596)	LED backlight display and indicator control

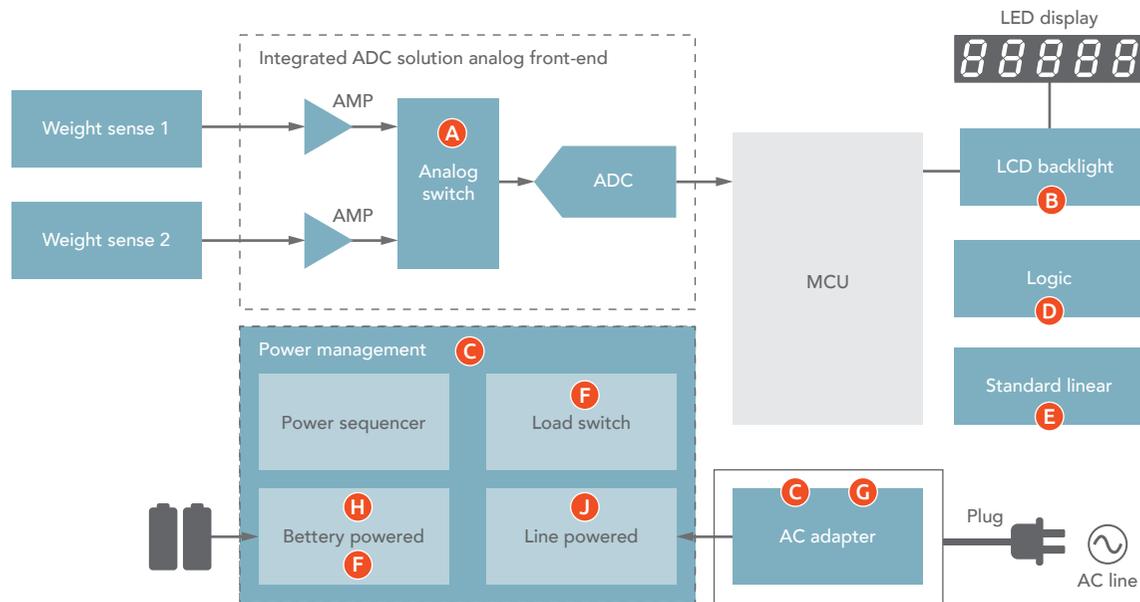


Digital Scales

Digital scales can be found in both commercial (retail) and consumer (home health) markets. They may be line powered or battery powered and have a wide range of price points. Many work in harsh environments. The below diagram illustrates a home bathroom scale.

Design considerations

- › What is your power supply? (batteries require low power/voltage devices)
- › What type of display do you use? (NPIC drive for LED/backlights)
- › What are the outside interfaces? (ESD protection)
- › Is size a constraint? (small packaging for consumer products)



	Product	Use value
A	Analog Switch (74LV/LVC4051)	Analog MUX from load cells
B	LED Driver (NPIC6C596)	Lowest cost per channel for driving LEDs
C	Power MOSFETs	Battery charging
D	Logic (HC, LVC, AUP Family)	HC for line powered, LVC/AUP for battery applications
E	ESD Protection, Single and Multi-Line (PUSB3, PESD Family)	General purpose ESD protection TrEOS protection for high speed data lines ESD protection in various Interfaces
F	Small signal MOSFET (P or N channel)	Leadless FETs in DFN and WLCSP. High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for Load switch, reverse protection, LED drive/dimming
G	Schottky Barrier Diode (PMEG Family)	Leadless Schottky diodes in DSN and DFN packages. DC voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC adapter
H	TVS Diode (PTVS Family)	Transient voltage surge protection for Vbus power path
J	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching

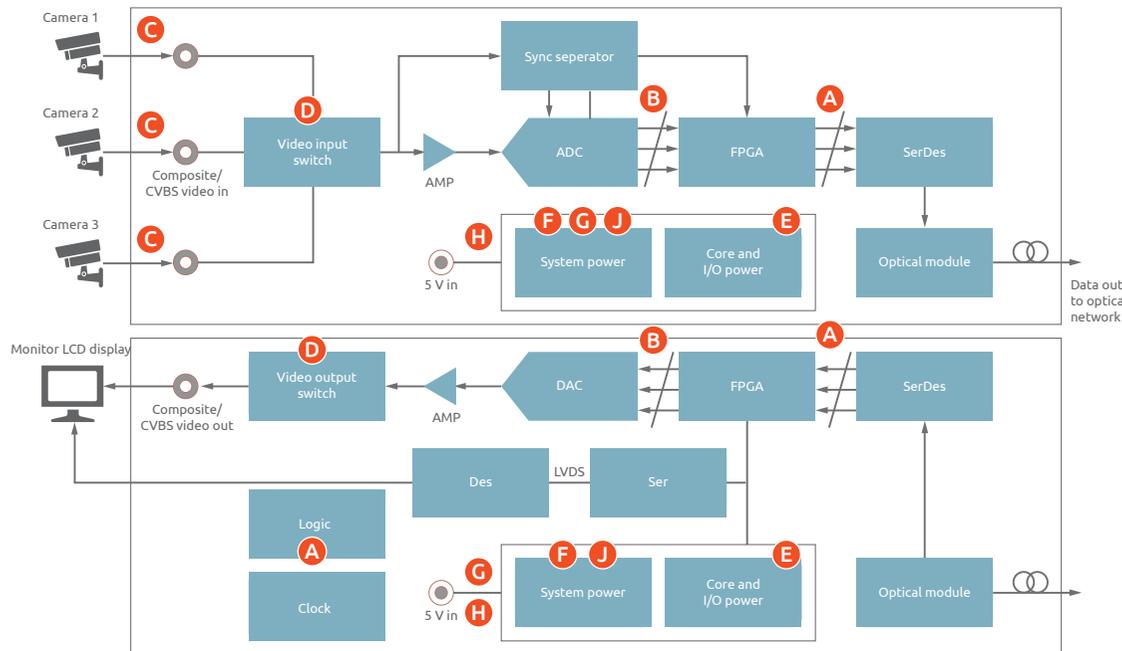


CCTV Security Camera

CCTV cameras are used in both commercial and consumer applications. Cameras are often line powered and must have wide temperature range operation.

Design considerations

- › What is the voltage supply? (device selection)
- › What is the operating environment? (wide temp range)
- › Are there space constraints? (small package size)
- › How does the camera communicate? (digital or analog switching)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Low Voltage Logic (LVC family)	General logic
B	Level Shifter (74AVC1T45)	Level shift between camera and control
C	Power MOSFETs	Low voltage LED driver, LED boost circuit, motor control, PoE power over Ethernet, IR-LED illumination, VRM voltage regulator, battery backup (protection & charging)
D	CBT Switch (CBT family)	Digital video switching of multiple cameras
E	ESD Protection, Single and Multi-Line (PUSB3, PESH and PCMF family)	General purpose ESD protection
F	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting; Low RDSon < 1 Ω used for load switch, DC-DC converter, motor control
G	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC adapter
H	TVS Diode (PTVS family)	Transient voltage surge protection for Vbus power path
J	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching



Industrial

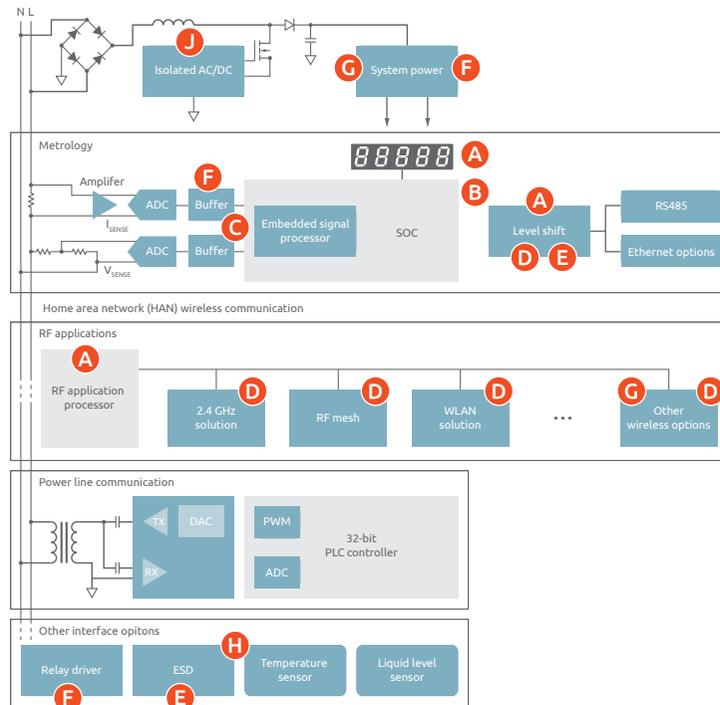


eMeters

Energy meters are used to monitor utility usage for homes and businesses. Units must operate on battery backup (when power is lost) and use a variety of methods to communicate data back to the host. High reliability and temperature range are key.

Design considerations

- › What are the power and battery requirements? (selects Logic family)
- › What is the operating environment? (Q100, high vibration packaging, etc.)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Low Voltage Logic (AXP, AUP, LVC family)	Maximum battery standby life
B	LED Driver (NPIC6C596)	Lowest cost per channel for driving LED backlight and indicators
C	Analog Switch (74HEF4051)	Analog MUX for multiphase coils
D	Level Shifter (74AVC2T45)	Between voltage domains
E	ESD Protection, Single and Multi-Line PUSB3FR4	General purpose ESD protection TrEOS protection for high speed data lines; ESD protection in various user interface
F	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch, LED drive/dimming
G	Schottky Barrier Diode PMEG4015EPK	DC voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC adapter
H	TVS Diode PTVS64VP1UP	Transient voltage surge protection
J	General purpose Transistors, RETS and Switching Transistors PUMH9	Signal control, MOSFET driver, GP switching

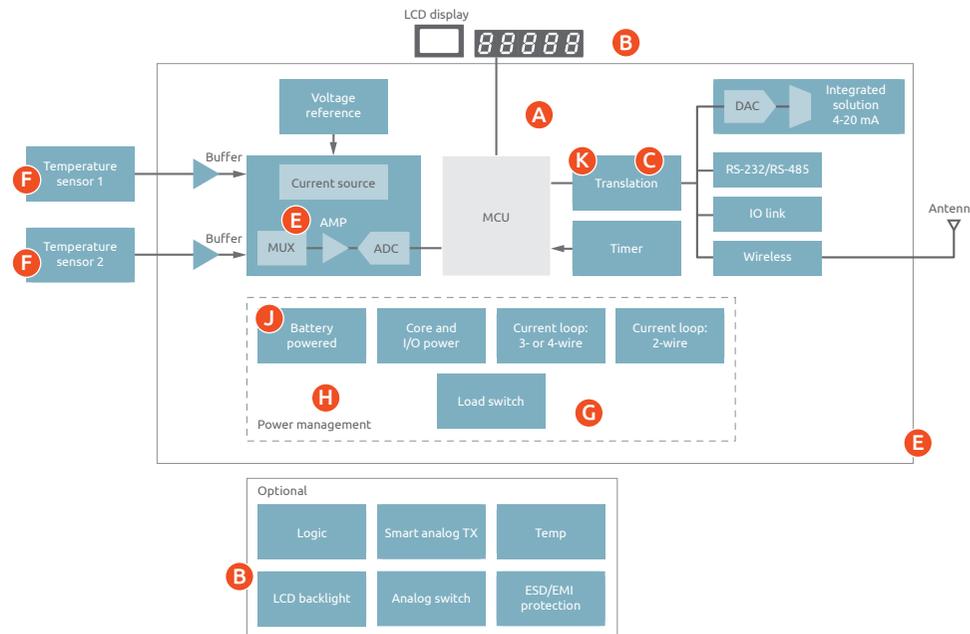


Endpoints

An endpoint device is an Internet-capable hardware appliance on a connected TCP/IP network. PCs, tablets, smart phones are all endpoints, as are Internet of Things (IoT) products. Low power and protection from ESD is critical in these designs. The diagram below illustrates a remote temperature logging endpoint.

Design considerations

- › What are the voltage and power requirements? (selects Logic family)
- › What is the MCU operating voltage and system rail voltages? (selects Logic family and Level Shifters)
- › How is the connector and system protected from ESD and voltage transient events? (ESD protection)



	Product	Use value
A	Low Voltage Logic (AXP, AUP, LVC family)	Lowest power logic families
B	LED Driver (NPIC6C596)	Lowest cost per channel for driving LED backlights and indicators
C	Level Shifter (74AXP1T57)	Wide range, lowest power translation
D	Analog Switch (74LV/LVC4051)	Analog MUX for multiple sensors
E	Mini Logic Packages	Packaging for small devices
F	ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General purpose ESD protection TrEOS protection for high speed data lines. ESD protection in various user interface
G	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch, LED drive/dimming
H	Schottky Barrier Diode (PMEG family)	DC Voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC adapter and backlight boost diode)
J	TVS Diode (PTVS family)	Transient voltage surge protection
K	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching

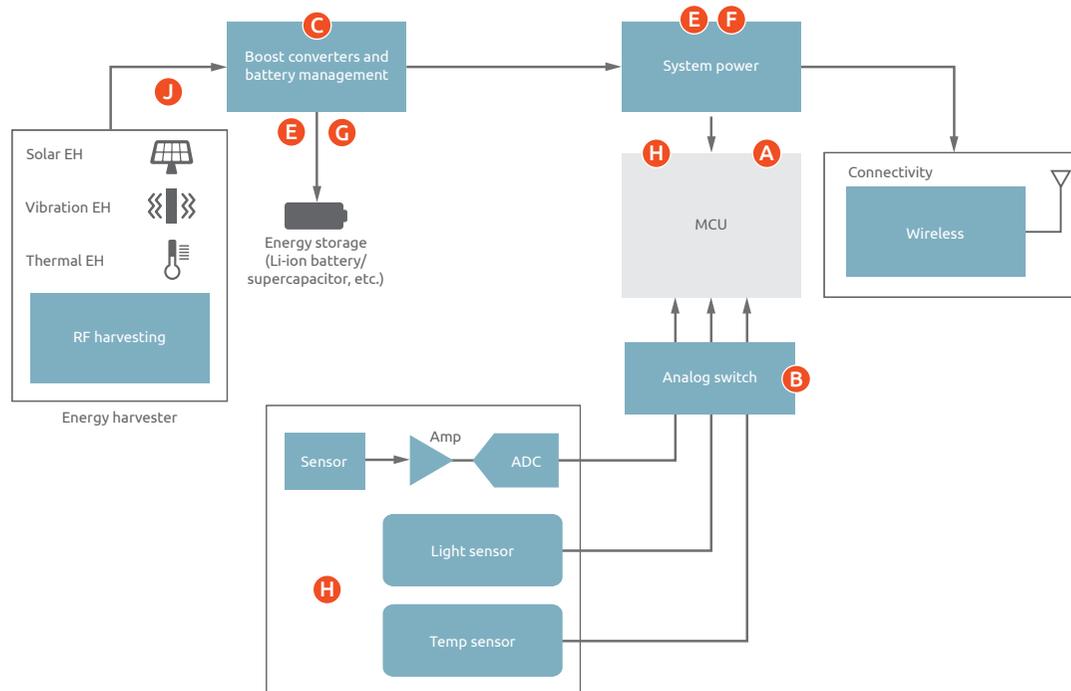


Energy Devices

Energy devices include storage devices, solar arrays, generators, means of harvesting electricity, and the Electric Grid in general that creates and distributes electrical power. Key requirements are high reliability in harsh conditions and protection from ESD. The below diagram illustrates a low power energy harvesting system.

Design considerations

- › What is the system voltage and power requirements? (selects Logic family)
- › What are the operating conditions (temp/vibration)? (Q100 or special packaging)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Logic (AUP, LVC, HC, HEF families)	Based on power needs
B	Analog Switch (74LV/LVC4051)	Analog switches for sensor inputs
C	Power MOSFETs	Boost converters
D	ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General purpose ESD protection
E	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch, DC-DC converter
F	Schottky Barrier Diode (PMEG family)	DC Voltage Blocking Diode, DC Or-ing function, free-wheeling and bypass diodes
G	TVS Diode (PTVS family)	Transient Voltage Surge protection
H	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching

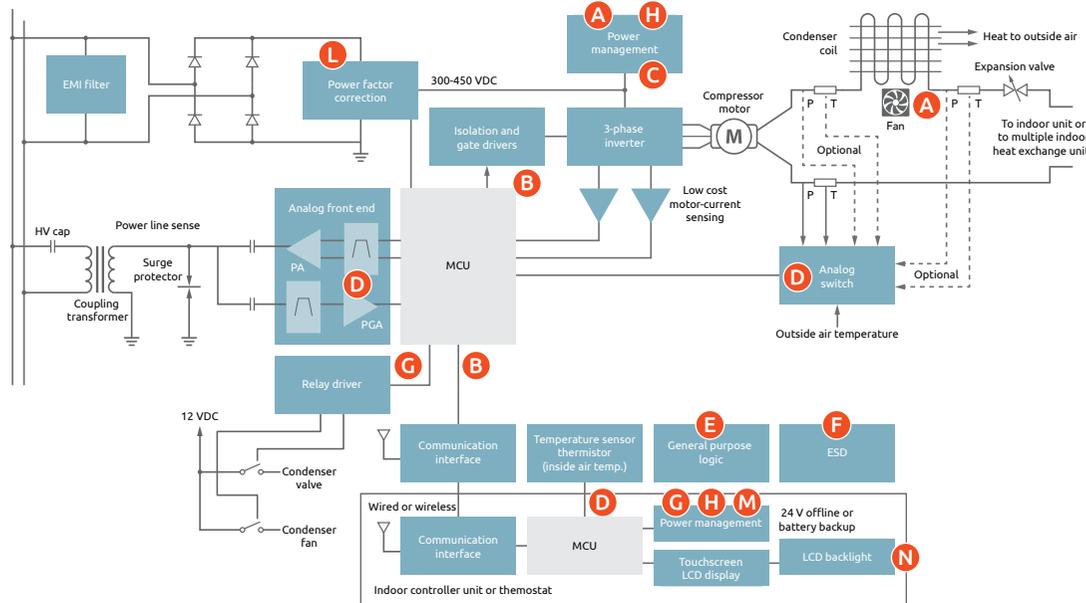


Heating Ventilation Air Conditioning (HVAC)

HVAC units target both the residential and commercial markets. Units may be located outside a home or building, requiring devices with an extended temperature range and high reliability. Power is not critical in the main unit, however, modern day advances in thermostats may have packaging/size limitations.

Design considerations

- › What is the MCU operating voltage and system rail voltages? (selects Logic family and Level Shifters)
- › What type of fan motors, compressors are used? (Power MOSFETs)
- › What are the temperature requirements? (Q100 product for extended temperatures)
- › How many sensors are in the system? (each require ESD, analog switching)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Power MOSFETs	Motor control, AC/DC power supply, solenoid valve control
B	Level Shifter (74AVC4T245)	Between control boards
C	Transistor (Low Vcesat)	Linear regulator and MOSFET or IGBT gate driver
D	Analog Switch (74LV/LVC4051)	Multiple analog sensor inputs
E	Logic-Low Voltage (AXP/AUP families)	In remote battery backup thermostats, sensors
F	ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General purpose ESD protection TRES protection for high speed data lines ESD protection in various user interface
G	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch, DC-DC converter
H	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, DC Or-ing function, free-wheeling, secondary rectifier in AC/DC for system power and boost diode for backlight display
J	TVS Diode (PTVS family)	Transient voltage surge protection
K	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching
L	Switching Diode	General purpose high voltage switching diodes, DC blocking
M	Zener Diode	Voltage reference, linear regulator
N	LED Driver (NPIC6C596)	LCD backlight

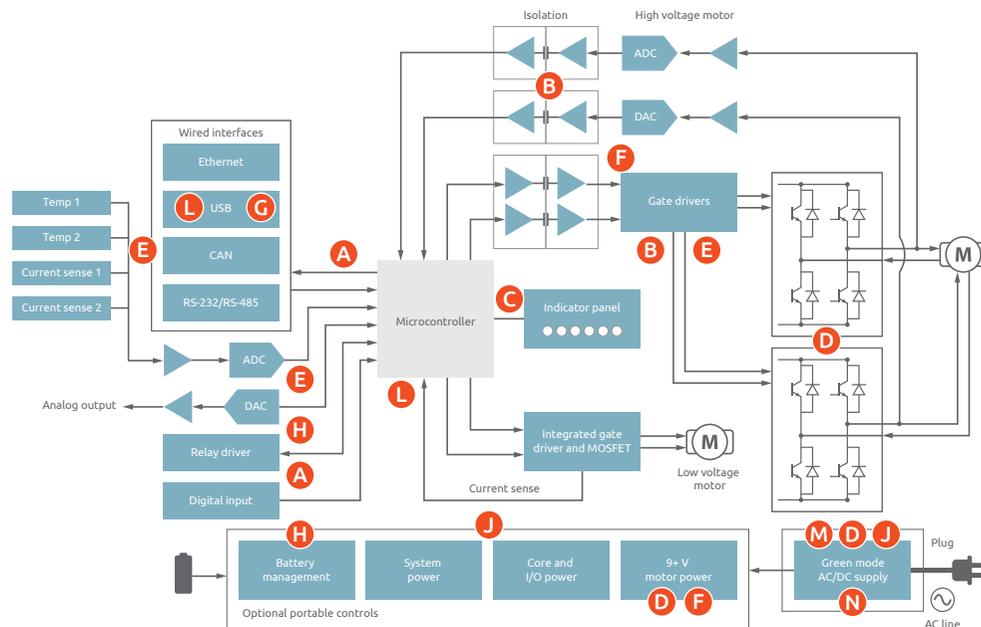


Industrial Control

Industrial Control covers a wide variety of applications including conveyor belts, processing equipment, refrigeration, and manufacturing control. All these systems have the following in common: wide array of input sensors, low-to-high end computing power, and a variety of output drives, such as, motors, relays, light, etc.

Design considerations

- › What are your operating conditions? (selects Logic family and temp requirements)
- › What is the MCU operating voltage and system rail voltages? (selects Logic family and Level Shifters)
- › How many input/output devices on a typical system? (Analog Switch or MUX)
- › How is the connector and system protected from ESD and voltage transient events? (for ESD Protection)
- › What are the voltage/current requirements of the output devices (parameters for Power MOSFETs)



	Product	Use value
A	Level Shifter (AXPnT family)	Translates all nodes from 0.7 to 5.5 V
B	Transistor (Low Vcesat)	Linear regulator and IGBT gate driver
C	LED Driver (NPIC6C596)	Low cost indicator panel and small relay control
D	Power MOSFETs	AC/DC power supply, VRM voltage regulator, 24 V output, motor control
E	Analog Switch (74HEF4051)	Analog input MUX for sensors
F	SS FETs	Gate drivers for PowerFETs
G	ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General purpose ESD protection; TrEOS protection for high speed data lines; ESD protection in various user Interface like USB
H	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting; Low RDSon < 1 Ω used for load switch, DC-DC converter, and gate drivers
J	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, DC Or-ing function, freewheeling, and secondary rectifier in AC/DC for system power
K	TVS Diode (PTVS family)	Transient voltage surge protection
L	General purpose Transistors, RETs and Switching Transistors	Signal control, MOSFET driver, general purpose switching
M	Switching Diode	General purpose high voltage switching diodes. DC blocking
N	Zener Diode	Voltage reference, linear regulator

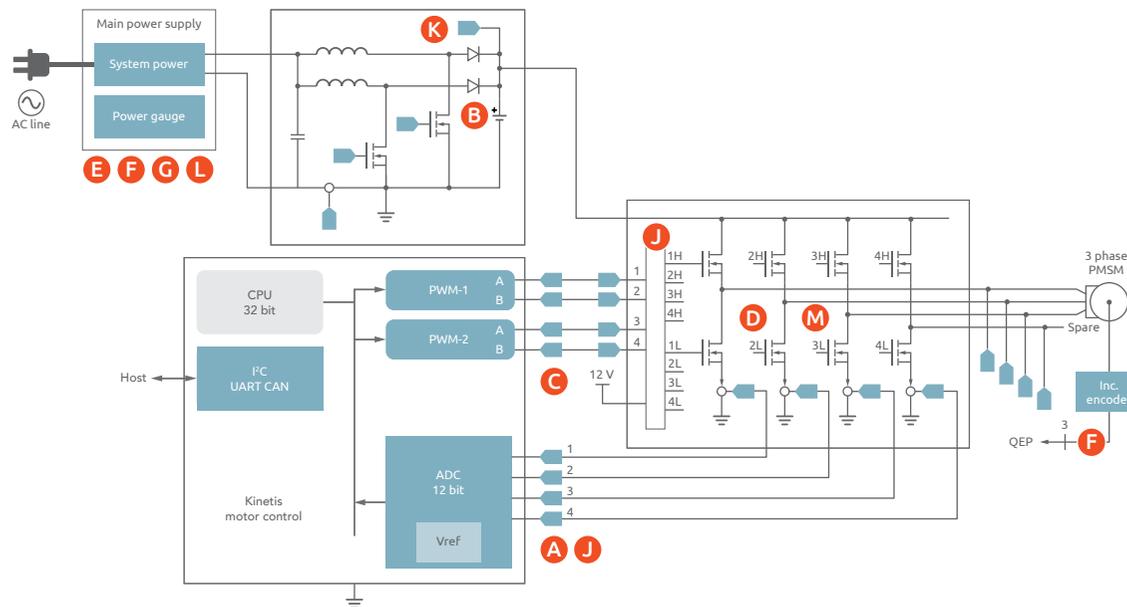


Motor Control

The wide variety of motor controls require different driving methods. All utilize a similar structure: input sensors to monitor speed/torque, temperature, etc that are feed to the MCU which provide the output to a variety of PowerFETs.

Design considerations

- › What is the current and voltage supplied to the the FET? (determines Logic family and MOSFET type)
- › Do they have a dedicated Micro or is this a standalone application? (may require Level Shifters)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Analog Switch (74HEF4051)	Analog switch for sensor MUX
B	Diodes	Back EMF protection
C	High Voltage Logic (HEF, HC families)	High voltage logic for highest noise immunity
D	Power MOSFETs	Motor speed regulation, AC/DC power supply, battery protection, battery charging, brushless motors
E	ESD Protection, Single and Multi-Line PUSB3FR4	General purpose ESD protection; TrEOS protection for high speed data lines; ESD protection in various user interface like USB
F	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting; Low RDSon < 1 Ω used for load switch, DC-DC converter, and motor control
G	Schottky Barrier Diode (PMEG4015EPK)	DC voltage blocking diode, DC Or-ing function, freewheeling, and secondary rectifier in AC/DC for system power
H	TVS Diode (PTVS64VP1UP)	Transient voltage surge protection
J	General purpose Transistors, RETS and Switching Transistors PDTD series	Signal control, MOSFET driver, general purpose switching
K	Switching Diode (BAW101)	General purpose high voltage switching diodes, DC blocking
L	Zener Diode (BZX series)	Voltage reference, linear regulator
M	Transistor (Low Vcesat)	Linear regulator and IGBT gate driver

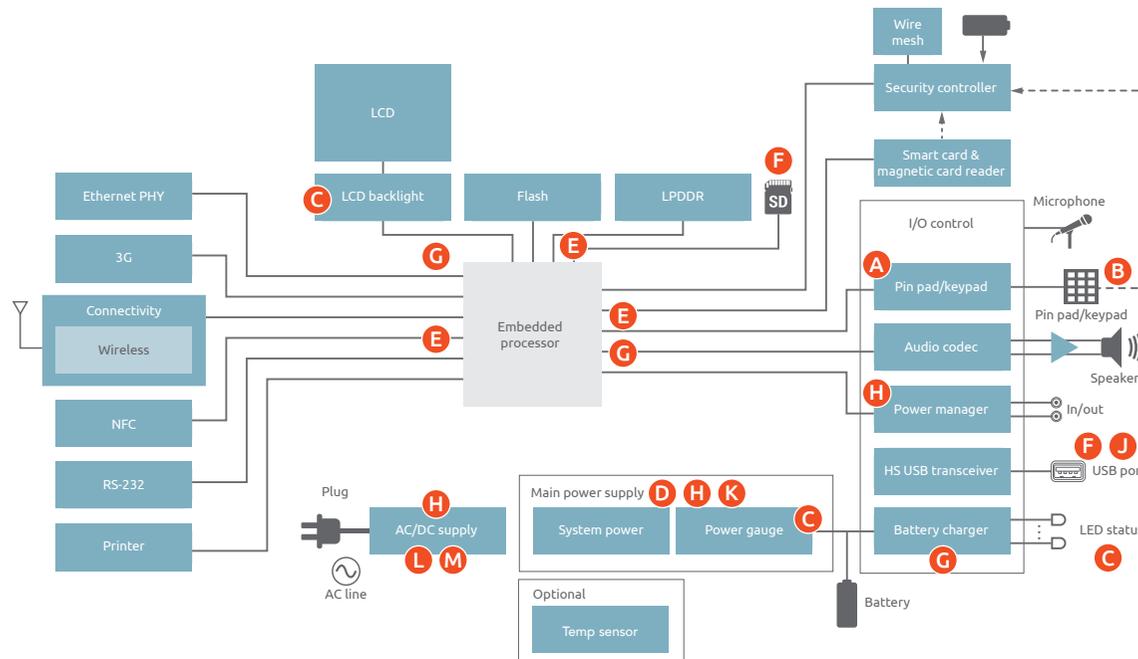


Point Of Sale (POS)

POS systems include all standard cash registers found in a retail environment, as well as, Point-of-Sale (POS) portable devices used by rental car companies, etc. All units have an user interface as well as a variety of inputs from bar code scanners, etc. High reliability due to the continual use is important.

Design considerations

- › What is the operating voltage? Portable or line powered? (selects Logic family)
- › How many peripherals are interconnected? (requires Level Shifters)
- › How many ports are used? (requires ESD protection)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Low Voltage Logic (AXP, LVC families)	Low power for stationary, ultra-low power for portable applications
B	PESD	Protection at all connections (particularly portable)
C	LED Driver (NPIC6C596)	LED backlight and indicator lights
D	Power MOSFETs	AC/DC power supply, VRM voltage regulation, PoE (power over Ethernet)
E	Level Shifter (74AVC4T245)	Between peripherals, CPU, sensors, etc.
F	ESD Protection, Single and Multi-Line (PUSB3, PESD and PCMF family)	General purpose ESD protection TrEOS protection for super high speed data lines ESD protection USB/SD card interface ESD protection; common mode filter with ESD for differential data lines communication
G	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting; Low RDSon < 1 Ω used for load switch, DC-DC converter, backlight and battery management
H	Schottky Barrier Diode (PMEG family)	Leadless Schottky diodes in DSN and DFN packages; DC Voltage Blocking Diode, DC Or-ing function; Reverse battery protection, and secondary rectifier in low power AC/DC adapter
J	TVS Diode (PTVS family)	Transient voltage surge protection
K	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, GP switching
L	Switching Diode	General purpose high voltage switching diodes, DC blocking
M	Zener Diode	Voltage reference, linear regulator

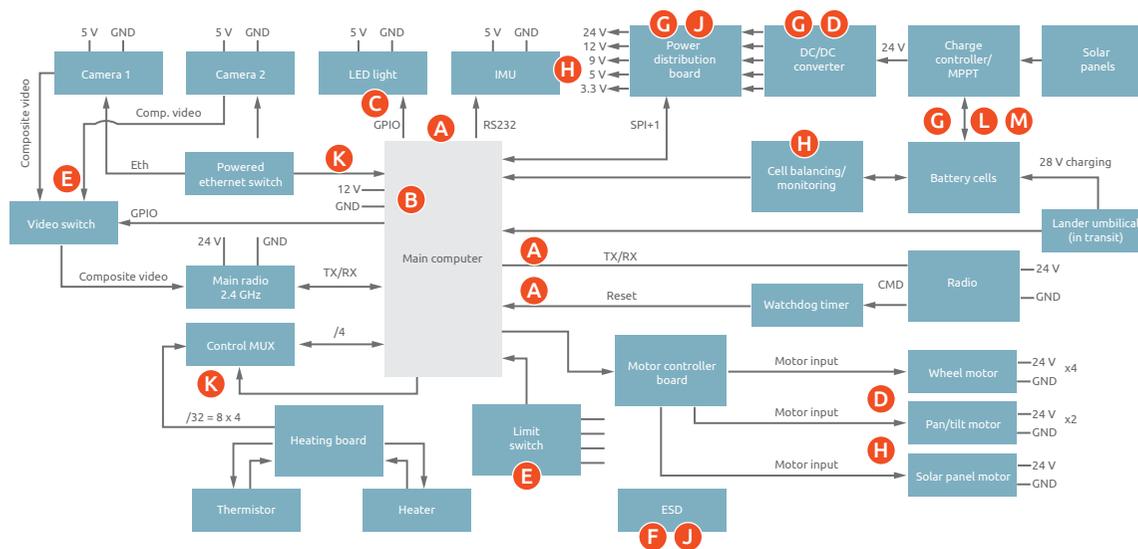


Robotics

This category includes industrial robots (assembly lines), as well as growing consumer market applications, such as home vacuum cleaners, lawn mowers, etc. Industrial robots have large power supplies, however most robots are battery powered, requiring low power devices that can withstand harsh mobile environments. The below diagram illustrates a mobile reconnaissance robot.

Design considerations

- › Is the robot line powered or battery powered? (selects Logic family)
- › What is the MCU operating voltage and system rail voltages? (selects Logic family and Level Shifters)
- › What size motors/actuators are used? (Power MOSFETs requirements)
- › Are there size constraints? (packaging)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Logic- Level Shifter (AXPnT family)	Translates between all nodes from 0.7 to 5.5 V
B	Logic (HC, LVC, AUP families)	HC for line powered, LVC/AUP for mobile applications
C	Logic- LED Driver (NPIC6C596)	LED indicator, IR LED illumination
D	Power MOSFETs	Motor control, VRM (voltage regulator) AC/DC power supply, PoE (power over Ethernet), battery protection, battery charging
E	Analog Switch (74LV/LVC4051)	Analog switch for sensor MUX
F	ESD Protection, Single and Multi-Line (PUSB3, PESD and PCMF family)	General purpose ESD protection. TrEOS protection for high speed data lines. ESD protection in Various user Interface like USB
G	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, Level shifting Low RDSon < 1 Ω used for load switch, DC-DC converter, battery management and motor control
H	Schottky Barrier Diode PMEG family	DC voltage blocking diode, DC Or-ing function, freewheeling, and secondary rectifier in low power AC/DC adapter
J	TVS Diode (PTVS family)	Transient voltage surge protection for Vbus power path
K	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching
L	Switching Diode	General purpose high voltage switching diodes, DC blocking
M	Zener Diode	Voltage reference, linear regulator

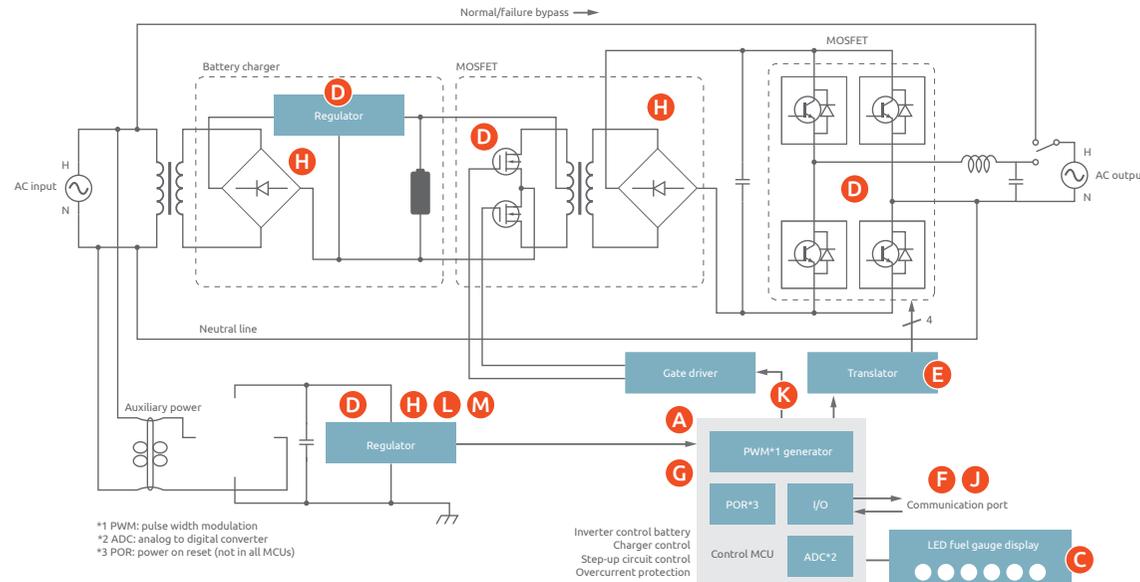


Smart Uninterruptible Power Supply (UPS)

Smart UPS systems are used in both commercial and consumer applications that provide continuous power to computing equipment. Systems can range from inexpensive home devices to large systems for server farms. Immunity to noise and harsh environments are key factors to consider in a design.

Design considerations

- › What are in the input/output powers and board voltages? (select Logic family and FET requirements)
- › Is packaging size an issue? (may consider Mini Logic)
- › What is the interface to the user? (may require a NPIC for the LEDs)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	High Voltage Logic (HEF, HC family)	Highest noise immunity. Connects directly to the FET
B	Transistor (Low Vcesat)	MOSFET driver, load switch
C	LED Driver (NPIC6CS96)	Lowest cost per channel for driving LEDs
D	Power MOSFETs	AC/DC power supply, Inverter power train, battery protection, battery charging, fan (motor control)
E	Level Shifter (74AVC2T45)	Communications between high and low voltage domains
F	ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General purpose ESD protection. ESD protection in various user interface like USB, communication port for cascaded system
G	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting; Low RDSon < 1 Ω used for Load switch, DC-DC converter and battery management
H	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, DC Or-ing function and secondary rectifier in AC/DC for system power
J	TVS Diode (PTVS family)	Transient voltage surge protection for Vbus power path
K	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching, current mirror
L	Switching Diode	General purpose high voltage switching diodes; DC blocking
M	Zener Diode	Voltage reference, linear regulator

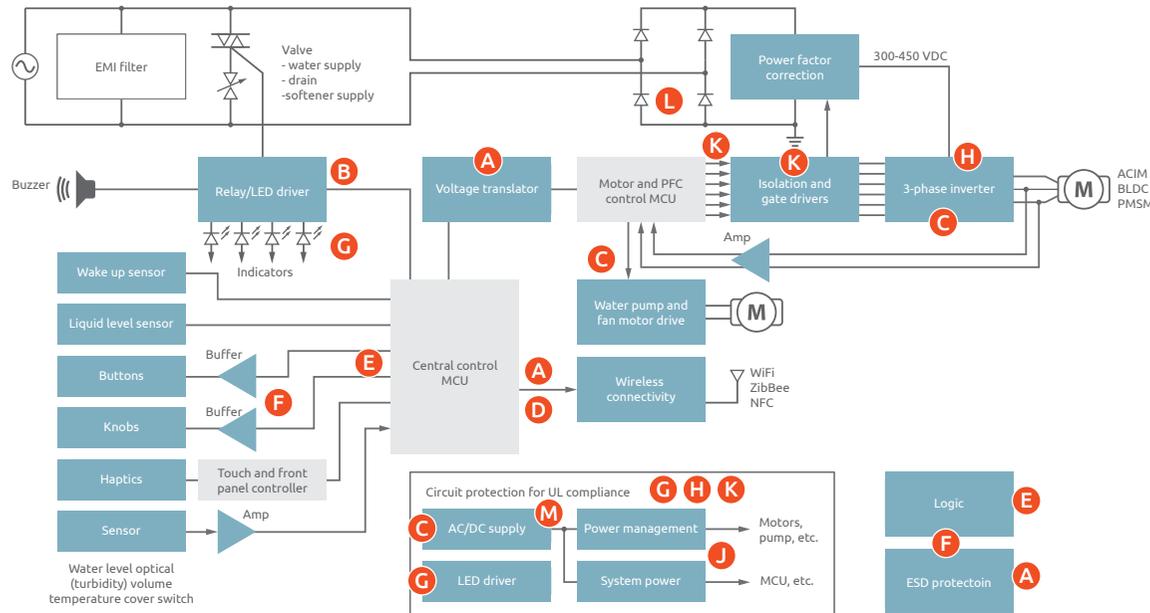


White Goods

White Goods is the generic name for large home appliances such as washer/dryers, refrigerators, etc. These devices all share a common set of input sensors (temperatures, water level, etc.) and outputs to a motor, relay drive, etc. Modern designs utilize a sophisticated user interfaces (LCDs, touch screens, etc.). As consumer products are cost sensitive cost is important. The below diagram illustrates a washing machine.

Design considerations

- › What are your input sensors? (consider an Analog Switch)
- › Do you have a stand-by power requirement? (Low Power Logic)
- › What types of outputs do you drive? (Power MOSFETs)
- › What are your cost targets? (reduce BOMs with Configurable, Combination Logic and packaging)
- › How is the user interface protected from ESD?



	Product	Use value
A	Level Shifter (74AXP1T57)	Communication between high and low voltage domains
B	LED Driver (NPIC6C596)	Lowest cost per channel for driving LEDs for indicators
C	Power MOSFETs	AC/DC power supply, VRM voltage regulator, motor control, battery protection, battery charging
D	Combination/Configurable Logic	Reduction of BOM and manufacturing costs
E	Analog Switch (74HC4066)	Input sensors
F	ESD Protection, Single and Multi-Line (PESD Family)	General purpose ESD protection in various user interface.
G	Small Signal MOSFET (P or N Channel)	High RDson > 1 Ω used for signal control, Level shifting Low RDson < 1 Ω used for load switch, DC-DC converter, motor control
H	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, free-wheeling diode, DC Or-ing function and secondary rectifier in AC/DC for system power
J	TVS Diode (PTVS family)	Transient voltage surge protection
K	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching
L	Switching Diode	General purpose high voltage switching diodes, DC blocking
M	Zener Diode	Voltage reference, linear regulator



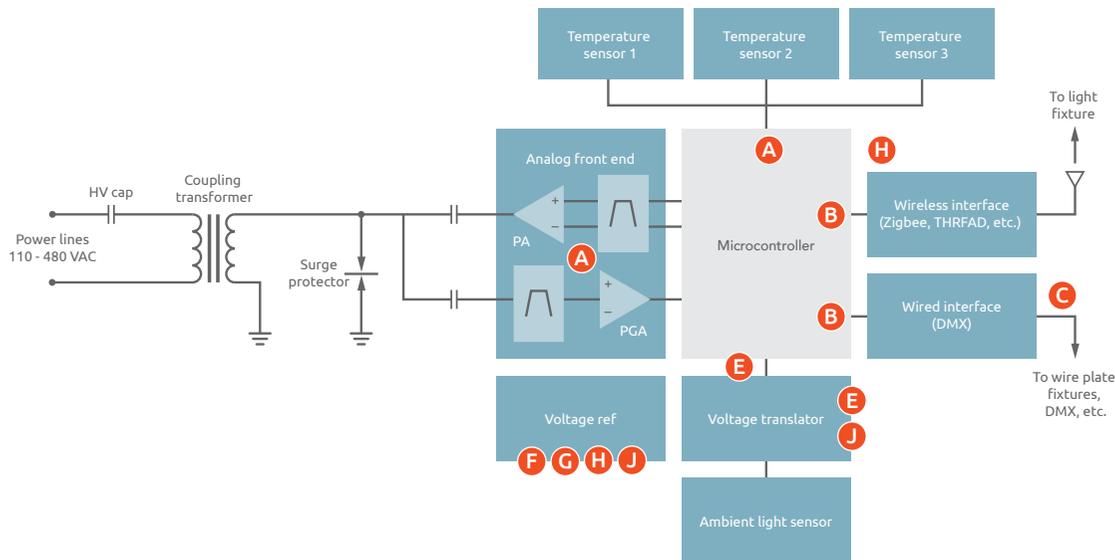


Automatic Lighting Control

Automatic light switching is used to conserve energy in residential and commercial applications. Sensors read the surrounding ambient light and the MCU controls the light level. These systems are used to control any lighting source, such as a LED/CFL lamp, and power savings can be significant. The below diagram illustrates lighting control for a residence or commercial building.

Design considerations

- › What are your input sensors? How many monitor points? How many outputs? (analog MUX)
- › Are the lights driven directly or remotely? (location of Power MOSFETs)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Analog Switch (74HC4051)	Analog MUX for input sensors
B	Logic-Level Shifter (74AXP1T125)	Communication between high and low voltage domains
C	ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General purpose ESD protection. TrEOS protection for High Speed data lines. ESD protection in Various user Interface like USB
D	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, Level shifting Low RDSon < 1 Ω used for load switch, DC-DC converter
E	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC adapter and free-wheeling diode
F	TVS Diode (PTVS family)	Transient voltage surge protection
G	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching
H	Switching Diode	General purpose high voltage switching diodes. DC blocking
J	Zener Diode	Voltage reference, linear regulator

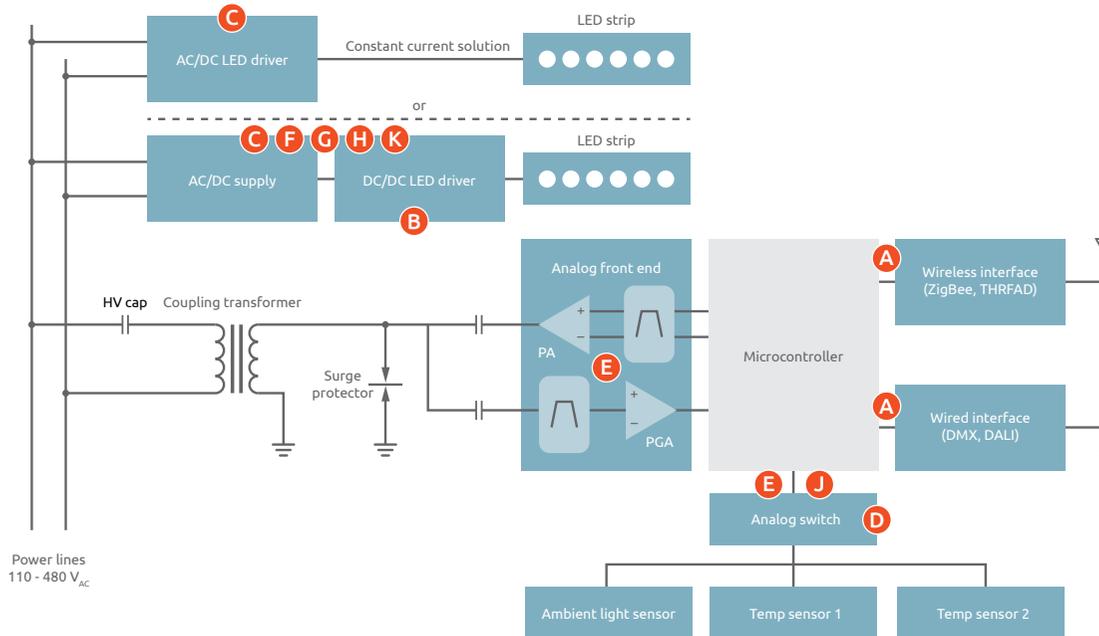


Office Lighting Fixtures

Industrial and office lighting differs from residential lighting as it typically uses custom, high power fixtures. Also known as high bay lights, these units combine light drive (typically LEDs but also gas discharge) and energy management control in a single unit. The below diagram illustrates an intelligent light fixture.

Design considerations

- › What are your input sensors? How many monitor points? How many outputs? (analog MUX)
- › Are the lights driven directly or remotely? (location of Power MOSFETs)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Level Shifter (74AVC1T45)	Connection between power domains
B	LED Driver (NPIC6C596)	Lowest cost per channel for driving LEDs
C	Power MOSFETs	VRM voltage regulator, AC/DC power supply
D	Analog Switch (74LV4051)	MUXing multiple sensor signals to single ADC
E	Small Signal MOSFET (P or N Channel)	High RDson > 1 Ω used for signal control and level shifting
F	Switching Diode	General purpose high voltage switching diodes, DC blocking
G	Zener Diode	Voltage reference, linear regulator
H	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC
J	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching
K	TVS Diode (PTVS Family)	Transient voltage surge protection

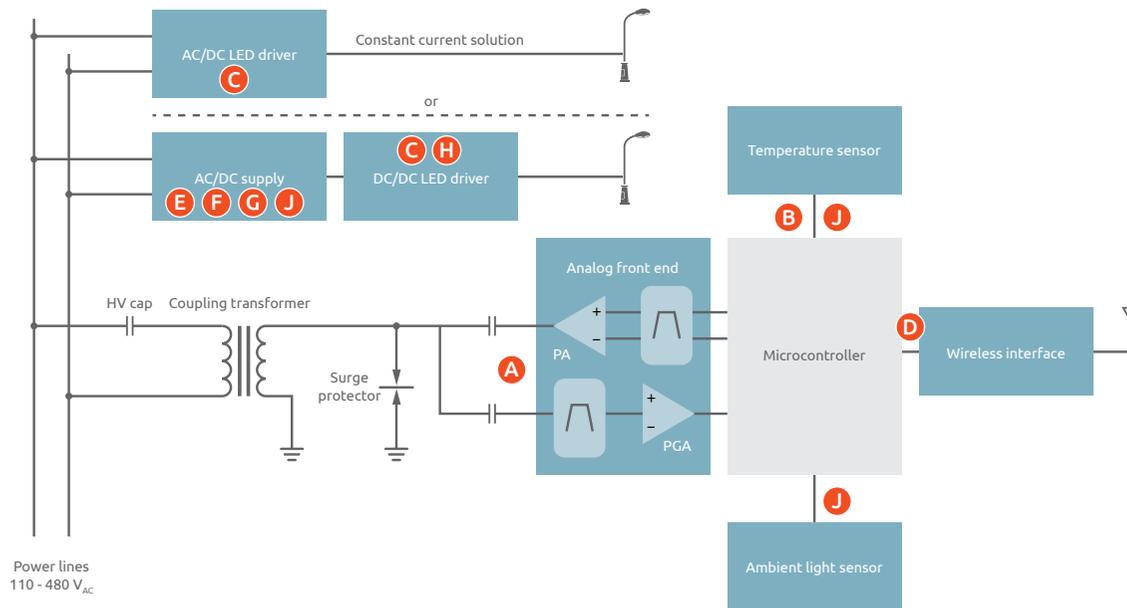


Outdoor Street Lighting

Cities and municipalities are replacing gas discharge street lights with higher-efficiency, longer lasting LED fixtures. Lighting fixtures are designed for harsh environments and high reliability with cloud-based monitoring. The below diagram illustrates an LED street light.

Design considerations

- › What wattage LEDs? (determines drive method)
- › Is this a monitored or non-monitored application? (complexity of micro)
- › What is the maximum voltage supply in the control circuits?



	Product	Use value
A	Analog Switch (74HC4051)	Analog MUX for input sensors
B	High Voltage Logic (HEF family)	Highest noise margin and high reliability logic
C	Power MOSFETs	LED boost circuit, current balancing (linear mode), solar charging, battery charging, battery protection
D	Level Shifter (AVC, AXP family)	Communication between high and low voltage domains
E	Small Signal MOSFET (P or N Channel)	High RDson > 1 Ω used for signal control and level shifting
F	Switching Diode	General purpose high voltage switching diodes, DC blocking
G	Zener Diode	Voltage reference, linear regulator
H	Schottky Barrier Diode (PMEG family)	DC Voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC
J	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching

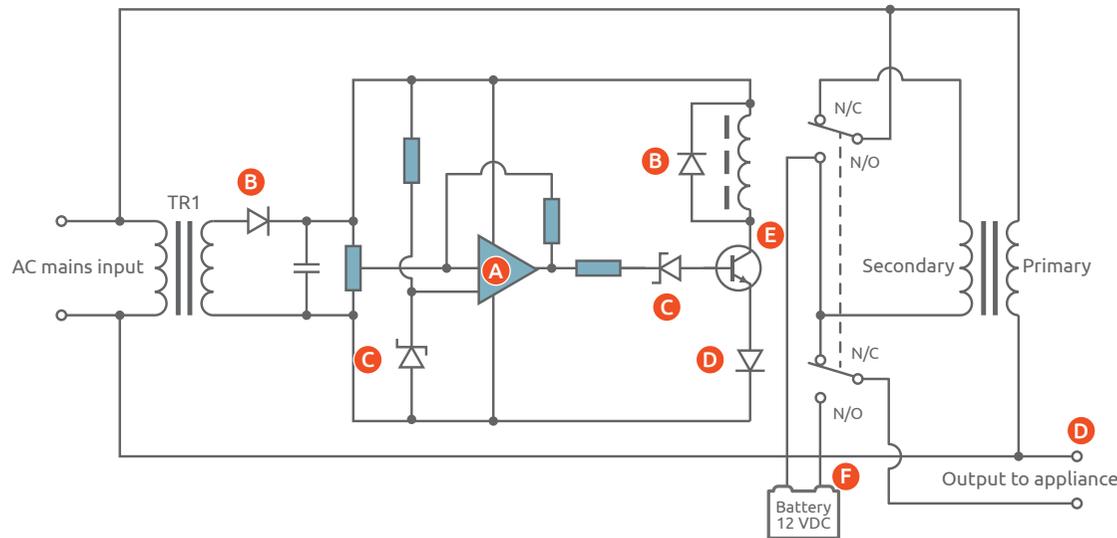


Products Suitable for 12 VDC

The recreational market (camping, motor homes, automotive) requires devices that can operate at both AC mains and 12 VDC (depending if they are line powered or battery powered). Devices may include refrigerators, whites goods, televisions, etc. The below diagram illustrates a power supply for a 12 V appliance with auto switch from mains to battery.

Design considerations

- › What are the current requirements? (size of FETs)
- › Simple or advanced control? (complexity of control circuit)
- › What are the environmental/temperature requirements? (Q100, high vibration packaging, etc.)



	Product	Use value
A	High Voltage Logic (HEF family)	Can operate directly on 12 V supply
B	Switching Diode	General purpose high voltage switching diodes, DC blocking
C	Zener Diode	Voltage reference, linear regulator
D	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode and secondary rectifier
E	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching
F	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control

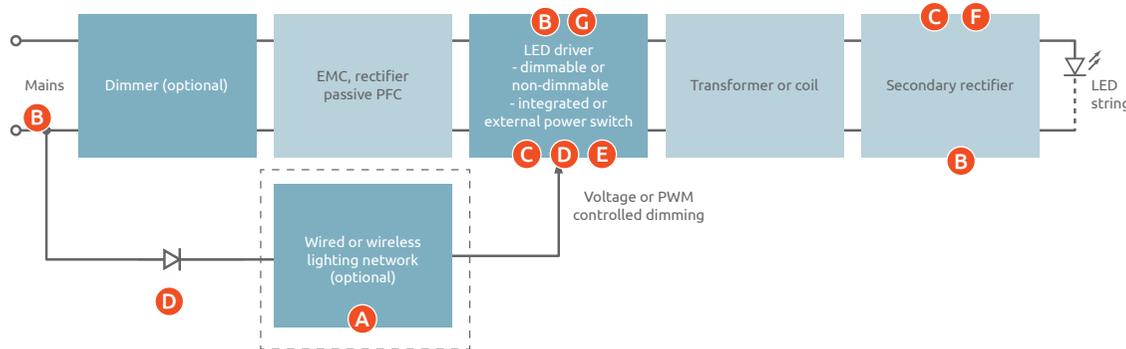


Retrofit LED bulb

Residential lighting LED bulbs install in an existing lamp fixture. Cost is critical. The below diagram illustrates a smart dimmable LED bulb.

Design considerations

- › What wattage LEDs? (determines drive method)
- › Does the fixture stand alone or communicate with other fixtures/controllers? (complexity may require logic)
- › What is the maximum voltage supply?



	Product	Use value
A	High Voltage Logic (HEF, HC family)	For smart fixtures
B	Power MOSFETs	Low voltage LED driver, LED boost circuit
C	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, Level shifting Low RDSon < 1 Ω used for load switch, DC-DC converter
D	Switching Diode	General purpose high voltage switching diodes, DC blocking
E	Zener Diode	Voltage reference, linear regulator
F	Schottky Barrier Diode (PMEG family)	Secondary rectifier
G	General purpose Transistors, RETS and Switching Transistors	Signal control, general purpose switching

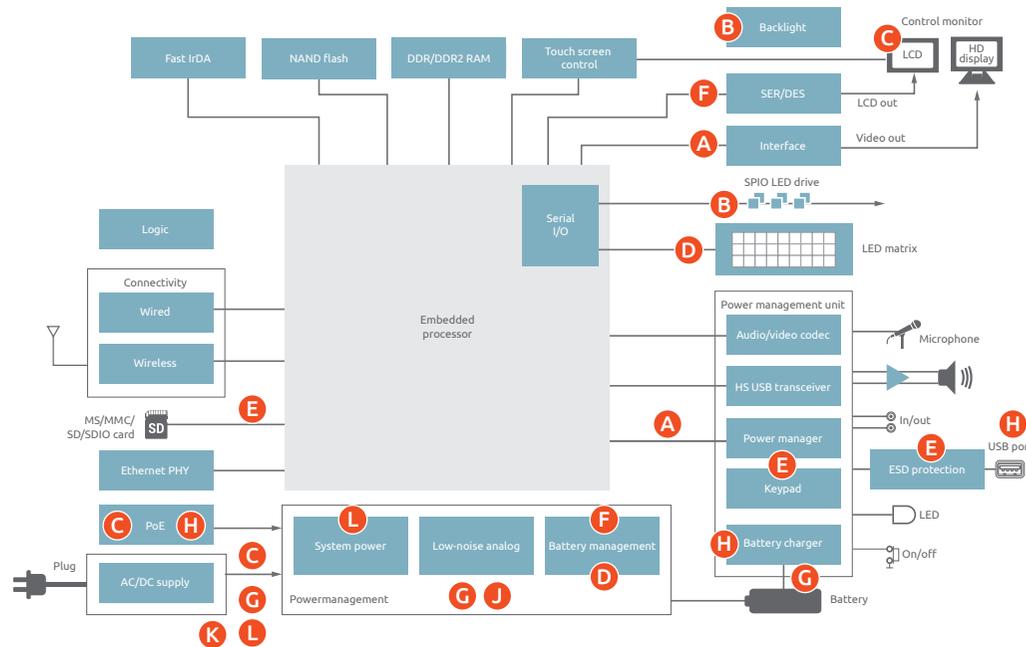


Signage and Display Boards

Signage and display boards use a matrix of LEDs to display text, static and motion images. Sizes range from small business displays to large stadium scoreboards. Designs range from simple to complex.

Design considerations

- › What wattage LEDs? (determines drive method)
- › What is the maximum voltage supply? (Power MOSFETs)
- › Do you have multiple power domains? (translators)
- › How can you reduce manufacturing costs? (configurable, combination logic)
- › Do you have high cabling costs? (shift registers)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Level Shifter (74AXP1T125)	Connection between power domains
B	LED Driver (NPIC6C596)	Lowest cost per channel for driving LEDs
C	Power MOSFETs	VRM voltage regulator, AC/DC power supply
D	Shift Register (74HC595)	Reduces cabling/connector costs by combining signals
E	ESD Protection, Single and Multi-Line (PUSB3, PESP and PCMF family)	General purpose ESD protection; TrEOS protection for High Speed data lines; ESD protection in various user Interface like USB, display port, HDMI and media storage system; common mode filter with ESD for differential data lines communication
F	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control, level shifting; Low RDSon < 1 Ω used for load switch, DC-DC converter, motor control
G	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC adapter
H	TVS Diode (PTVS family)	Transient voltage surge protection
J	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching
K	Switching Diode	General purpose high voltage switching diodes, DC blocking
L	Zener Diode	Voltage reference, linear regulator



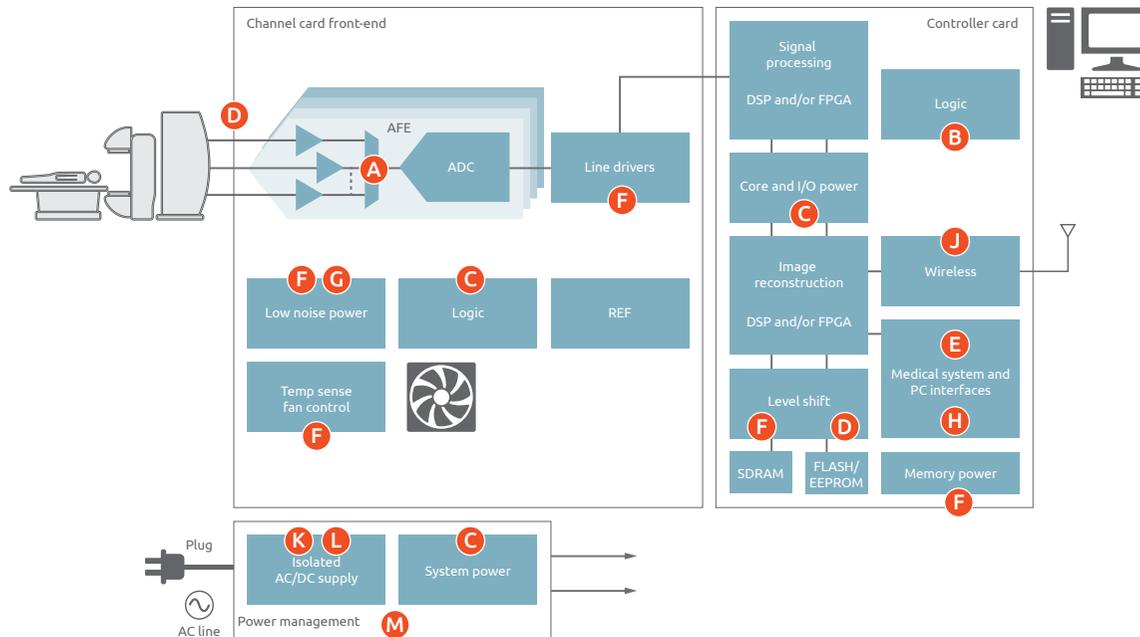


CT Scan Machines

CT (Computerized Tomography) Scanners use multiple X-ray scans to produce an internal three-dimensional image of the patient. These machines are large, expensive, and operate at high voltages, requiring considerable protection of the electronic devices.

Design considerations

- › Is reliability an issue? (consider Q100 grade to reduce shut down costs)
- › How do you protect from high voltages and ESD? (ESD and TVS devices)
- › What are the major systems within the unit? (needs for translators between modules)
- › What are the high voltage operating requirements? (Power MOSFETs specifications)



	Product	Use value
A	Analog Switch (74HEF4051/4066)	Analog channel MUXing from sensor arrays
B	High Voltage Logic (HC, AHC, HEF family)	5 volt plus logic for high noise margins
C	Power MOSFETs	Internal VRM (voltage regulator), AC/DC power supply, motor control, high voltage supplies
D	Level Shifter (74AVC1T45)	Translation between control modules
E	ESD Protection, Single and Multi-Line (PUSB3, PESD Family)	General purpose ESD protection TrEOS protection for High Speed data lines ESD protection in various user Interface
F	Small signal MOSFET (P or N channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch, DC-DC converter
G	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, DC Or-ing function, freewheeling, and secondary rectifier in AC/DC for system power
H	TVS Diode (PTVS family)	Transient voltage surge protection for Vbus power path
J	General purpose Transistors, RETs and Switching Transistors	Signal control, MOSFET driver, general purpose switching
K	Switching Diode	General purpose high voltage switching diodes, DC blocking.
L	Zener Diode	Voltage reference, linear regulator
M	Transistor (Low Vcesat)	Linear regulator and load switch control

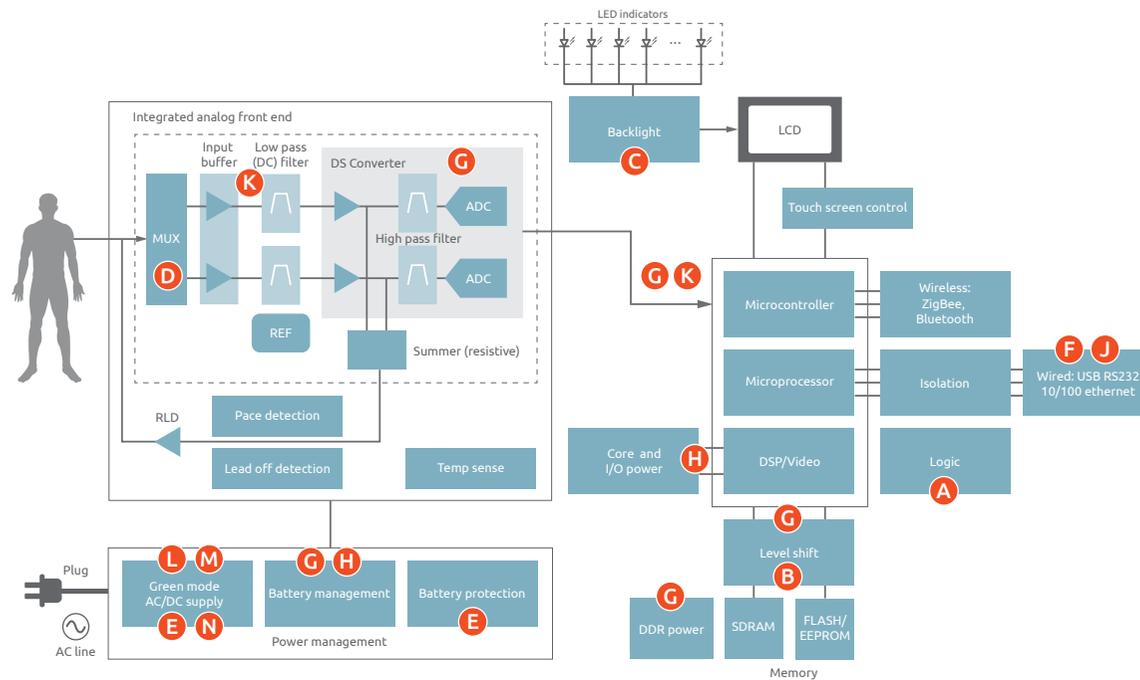


ECG/EKG Machines

An ECG (electrocardiogram/elektrokardiogramm) measures the health of the heart by monitoring its electrical voltages. Units vary from high end (lab/office grade) to consumer grade. Units may be battery or line powered, however, all must be designed carefully to prevent electricity from backflowing into the body.

Design considerations

- › What is your power source? (sets logic type)
- › Do you have space constraints? (small packaging)
- › How are external connections protected? (ESD Protection)
- › How are multiple control boards interconnected? (translation)



	Product	Use value
A	Low Voltage Logic (LVC, AUP Family)	5 V for line power, 3.3V for battery applications
B	Level Shifter (74AVC4T45)	Interconnecting multiple boards
C	LED Driver (NPIC6c596)	LED indicators and LCD backlight
D	Analog Switch (74LV/LVC4051)	Analog MUX for multiple sensors
E	Power MOSFETs	Battery charging
F	ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General purpose ESD protection TrEOS protection for High Speed data lines ESD protection in various user Interface
G	Small signal MOSFET (P or N channel)	High RDSon > 1 Ω used for signal control, level shifting Low RDSon < 1 Ω used for load switch, DC-DC converter
H	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, DC Or-ing function, freewheeling, and secondary rectifier in AC/DC for system power
J	TVS Diode (PTVS family)	Transient voltage surge protection for Vbus power path
K	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching
L	Switching Diode	General purpose high voltage switching diodes, DC blocking
M	Zener Diode	Voltage reference, linear regulator
N	Transistor (Low Vcesat)	Linear regulator and load switch control

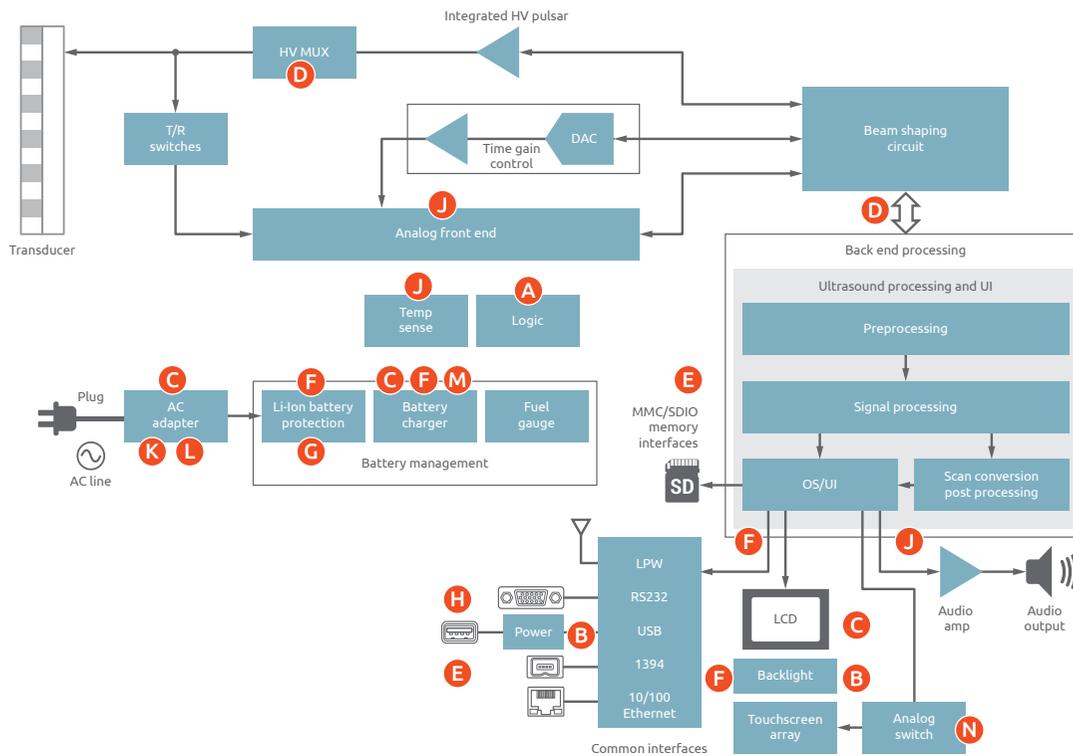


Ultrasonic Machines

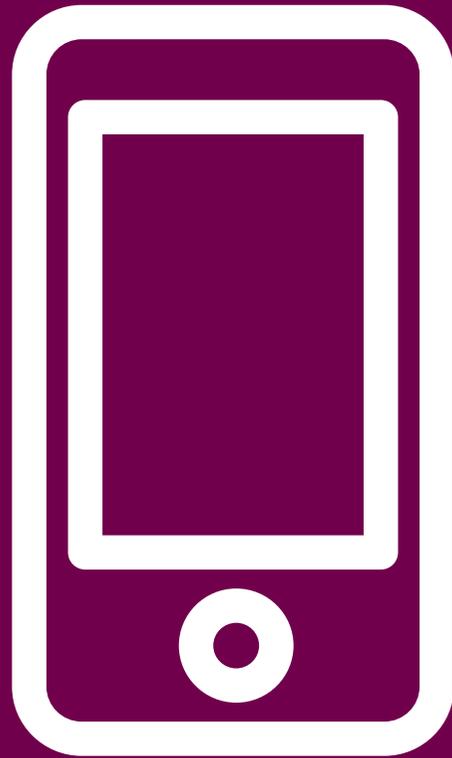
Ultrasonic machines use high frequency sound waves to image inside the body. They are used for fetal monitoring and vascular examinations among other uses.

Design considerations

- › What is your electronics voltage supply? (type of logic and translators)
- › How are external connectors protected? (ESD Protection)
- › Do you have a reliability requirement? (packaging and Q100)



	Product	Use value
A	Low Voltage Logic (LVC family)	For general purpose logic
B	LED Driver (NPIC6C596)	LED backlight and indicator control
C	Power MOSFETs	AC-DC power supply, transducer drivers
D	Level Shifter (AVC family)	Interconnections between boards in system
E	ESD Protection, Single and Multi-Line (PUSB3, PESD family)	General purpose ESD protection TrEOS protection for High Speed data lines ESD protection in various user interface
F	Small signal MOSFET (P or N channel)	High RDSon > 1 Ω used for signal control, Level shifting; Low RDSon < 1 Ω used for load switch, DC-DC converter
G	Schottky Barrier Diode (PMEG family)	DC voltage blocking diode, DC Or-ing function, freewheeling, and secondary rectifier in AC/DC for system power
H	TVS Diode (PTVS family)	Transient voltage surge protection for Vbus power path
J	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching
K	Switching Diode	General purpose high voltage switching diodes, DC blocking
L	Zener Diode	Voltage reference, linear regulator
M	Transistor (Low Vcesat)	Linear regulator and load switch control
N	Analog Switch (74LVC4066)	Touch screen array input



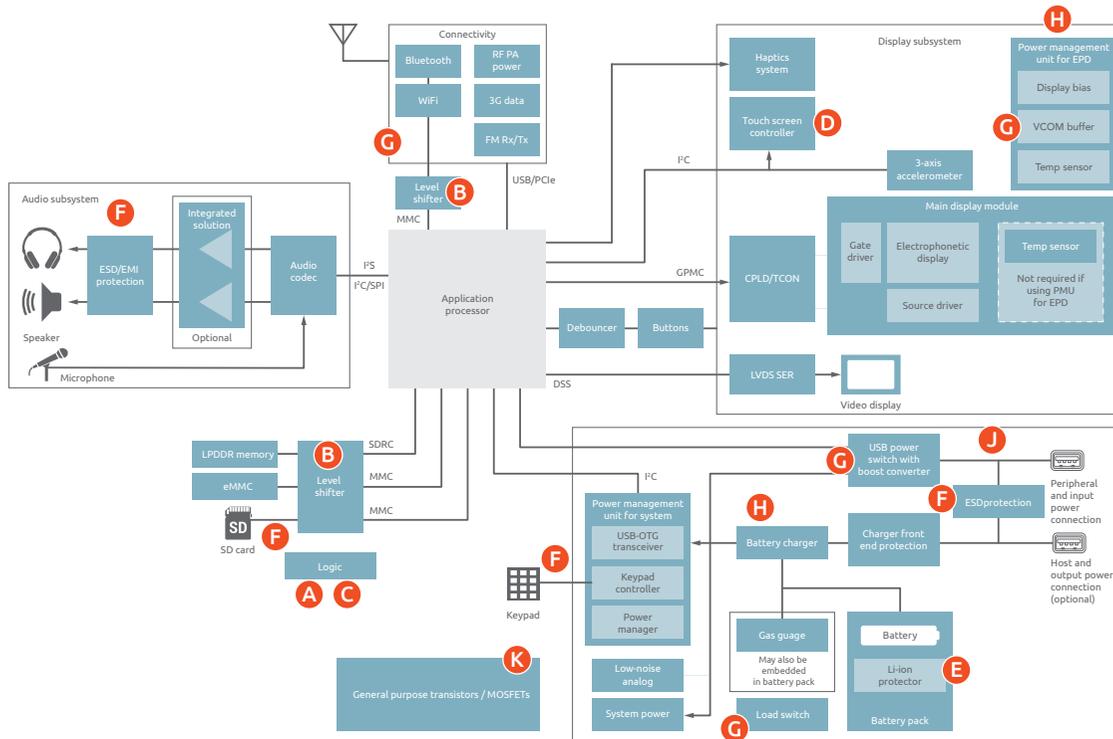


eReader/Tablet PC

E-Readers and Tablet PCs are targeted for lower cost, longer battery life with less functionality than a traditional laptop computer. Display quality and small package design are key factors to a successful product.

Design considerations

- › What is the system supply voltage? (establishes Logic family)
- › What are the battery life goals? (AUP or AXP logic for lowest power/longest life)
- › What are your size constraints? (low profile Logic/FET packages)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Low Voltage Logic (AXP, AUP family)	Lowest power/voltage for longer battery life
B	Level Shifter (74AXP1T57)	Lowest power translation between power domains
C	Mini Logic Packages	Small footprint and height to fit into small spaces
D	Analog Switch (74LV/LVC4066)	16 channel MUX for touch sensor array
E	Power MOSFETs	Charger/power adapter
F	ESD Protection, Single and Multi-Line (PUSB3FR4, PCMF1USB3S, PESDSV0C1USF, PESDSV0H1BSF)	General purpose ESD protection; TrEOS protection for super high speed data lines ESD protection; USB/SD card interface ESD protection; common mode filter with ESD for differential data lines communication
G	Small Signal MOSFET (P or N Channel, PMXB40UNE, PMXB65UPE, PMPB23XNE)	Leadless FETs in DFN and WLCSFP; High RDSon > 1 Ω used for signal control, level shifting; Low RDSon < 1 Ω used for load switch, reverse protection, DC-DCs, back-light LED drive/dimming, camera flash
H	Schottky Barrier Diode (PMEG family, PMEG3010AESB, PMEG4015EPK)	Leadless Schottky diodes in DSN and DFN packages; DC Voltage blocking diode, DC Or-ing function. Freewheeling, reverse protection, BL booster and secondary rectifier in low power AC/DC adapter
J	TVS Diode (PTVS family, PTVSxVZ1USK)	Transient voltage surge protection for Vbus power path
K	General purpose Transistors / MOSFETs, RETS and Switching Transistors	Signal control, MOSFET driver, GP switching

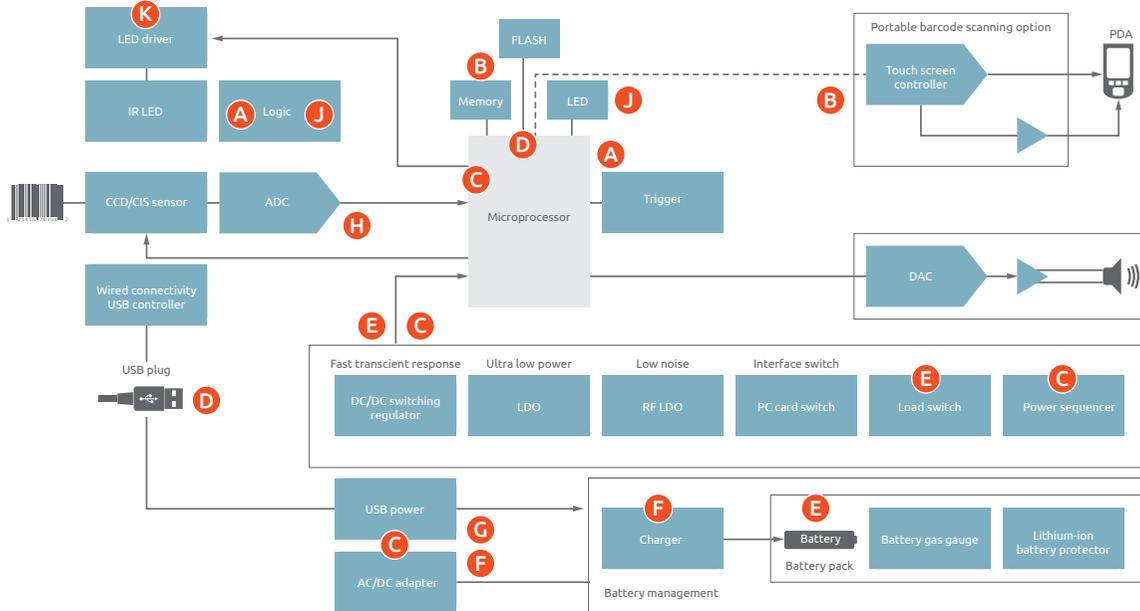


Point-Of-Sale (POS) Reader

POS barcode readers are used in a variety of retail point of sale transactions used by restaurants, car rental, package delivery, insurance adjusters, and tradeshow. These devices require small size and low power consumption for long battery life.

Design considerations

- › What is the battery life requirement? (selects low voltage Logic family)
- › Are their size constraints? (small packaging options)
- › Are there multiple power supply rails? (requires Level Shifters to connect)
- › Is the scanner short/long range? (determines power of laser and FET size)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Low Voltage Logic (AXP, AUP family)	Lowest power for long battery life
B	Level Shifter (74AUP1T45)	Translators across voltage supply rails
C	Power MOSFETs	Battery charging, battery protection, AC/DC power supply, POE (power over Ethernet)
D	ESD Protection, Single and Multi-Line (PUSB3, PESD, PCMF family)	General purpose ESD protection; TrEOS protection for super high speed data lines ESD protection; USB/SD card interface ESD protection; common mode filter with ESD for differential data lines communication
E	Small Signal MOSFET (P or N Channel)	Leadless FETs in DFN and WLCSP; High RDSon > 1 Ω used for signal control, level shifting; Low RDSon < 1 Ω used for load switch, reverse protection, DC-DCs, back-light LED drive/dimming, camera flash
F	Schottky Barrier Diode (PMEG family)	Leadless Schottky diodes in DSN and DFN packages; DC Voltage blocking diode, DC Or-ing function. Freewheeling, reverse protection, BL booster and secondary rectifier in low power AC/DC adapter
G	TVS Diode (PTVS family)	Transient voltage surge protection for Vbus power path
H	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, GP switching
J	Logic- Mini Logic	Small packaging
K	Logic- LED Driver (NPIC6C596)	Low cost LED driver



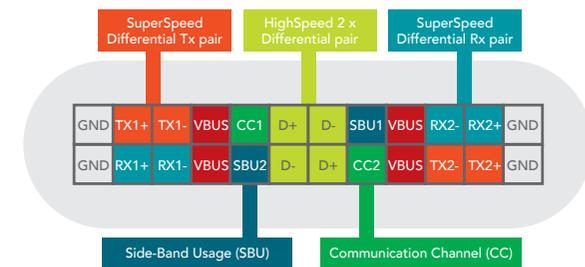
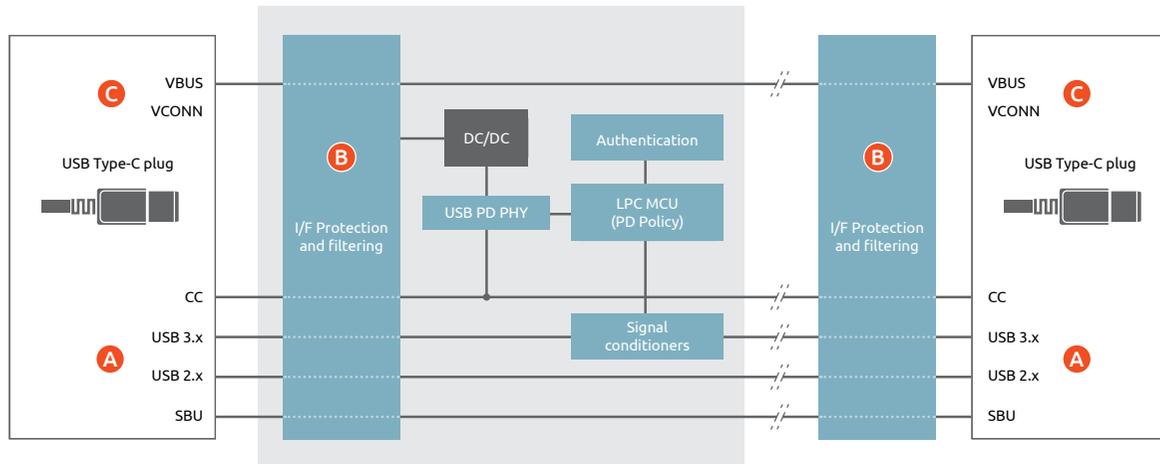
USB Type-C Connector

USB Type-C is the latest revision of the Universal Serial Bus. It utilizes a new 24-pin reversible connector and can provide power up to 3.0A at 5V. Data is backwards compatible with USB3.1 with speeds up to 10Gbps.

Design considerations

- › ESD protection on connector? (turnkey solutions tested for speed)

	Product	Use value
A	Common mode filter PCMFxUSB3S	Common mode filter + ESD protection
B	ESD protection PESDSV0C1USF	20kV ESD protection for high speed
C	TVS diode PTVSxVZ1USK	1200W @IEC61000-4-5 TVS diode for VBUS



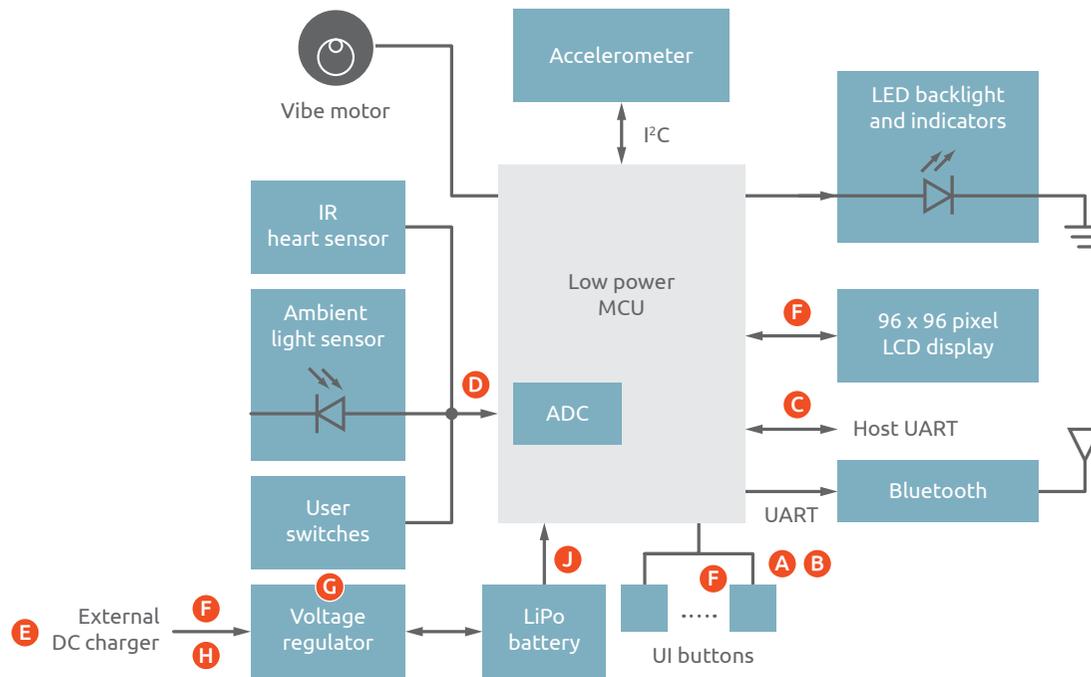


Wearables

Wearables include a variety of products worn on the wrist (smart watches, fitness monitors) to smart shoes, smart clothing, etc. All have extreme size constraints and require long battery life.

Design considerations

- › What are the size constraints? (small packaging options required)
- › What is the power supply and battery life expectations? (sets Logic family and power requirement)
- › How is the connector and system protected from ESD and voltage transient events? (ESD Protection)



	Product	Use value
A	Low Voltage Logic (AXP family)	Lowest voltage, lowest power logic available
B	Mini Logic Packages	Small footprint and height to fit into small spaces (GX "Diamond" package)
C	Level Shifter (74AXP1T125)	Ultra low power translator between sensors and MCU
D	Analog Switch (74LV/LVC4051)	8-channel MUX for touch switch array input
E	MOSFETs	Battery charging
F	ESD Protection, Single and Multi-Line (PUSB3FR4, PESD1USB3S, PESD5V0C1USF)	General purpose ESD protection TrEOS protection for high speed data lines. ESD protection in USB interface
G	Small Signal MOSFET (P or N Channel, PMCMxxx)	Leadless FETs in DFN and WLCSP; High RDson > 1 Ω used for signal control, level shifting; Low RDson < 1 Ω used for load switch, reverse protection, DC-DCs, backlight LED drive/dimming
H	Schottky Barrier Diode (PMEG family, PMEGx10(A)ESB)	Leadless Schottky diodes in DSN and DFN packages. DC Voltage Blocking Diode, DC Or-ing function and secondary rectifier in low power AC/DC Adapter
J	TVS Diode (PTVS family, PTVSxVZ1USK)	Transient voltage surge protection for Vbus power path

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