Nexperia Application Guide Industrial



Contents

Industrial

eMeters	5
Endpoints	6
Energy Devices	7
Heating Ventilation Air Conditioning (HVAC)	8
Industrial Control	9
Motor Control	10
Point Of Sale (POS)	11
Robotics	12
Smart Uninterruptable Power Supply (UPS)	13
White Goods	14

Industrial / Lighting

Automatic Lighting Control	16
Office Lighting Fixtures	17
Outdoor Street Lighting	18
Products Suitable for 12 VDC	19
Retrofit LED bulb	20
Signage and Display Boards	21

Industrial / Medical

CT Scan Machines	23
ECG/EKG Machines	24
Ultrasonic Machines	25

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 19 of the most common applications addressing the industrial market segment. For each application, you will find the following:

- 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.
- 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.
- 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.





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.

- > 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
Ð	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
0	TVS Diode PTVS64VP1UP	Transient voltage surge protection
J	General purpose Transistors, RETS and Switching Transistors PUMH9	Signal control, MOSFET driver, CP 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.

- > 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
0	Mini Logic Packages	Packaging for small devices
B	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
0	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.

- > 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
O	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
G	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
Œ	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.

- > 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 IBGT gate driver
D	Analog Switch (74LV/LVC4051)	Multiple analog sensor inputs
8	Logic-Low Voltage (AXP/AUP families)	In remote battery backup thermostats, sensors
6	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
•	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
C	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.

- > 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 regu- lator, 24 V output, motor control
8	Analog Switch (74HEF4051)	Analog input MUX for sensors
6	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
Ð	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
0	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.

- > 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
•	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
ß	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
0	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
0	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.

- > 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)
8	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
Ð	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
0	TVS Diode (PTVS family)	Transient voltage surge protection
K	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, GP switching
0	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.

- > 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
8	Analog Switch (74LV/LVC4051)	Analog switch for sensor MUX
6	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
•	Schottky Barrier Diode PMEG family	DC voltage blocking diode, DC Or-ing function, freewheeling, and secondary rectifier in low power AC/DC adapter
0	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
0	Switching Diode	General purpose high voltage switching diodes, DC blocking
M	Zener Diode	Voltage reference, linear regulator

Smart Uninterruptable 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	Ose 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 (NPIC6C596)	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
0	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
0	Switching Diode	General purpose high voltage switching diodes; DC blocking
M	Zener Diode	Voltage reference, linear regulator

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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 protec- tion, battery charging
D	Combination/Configurable Logic	Reduction of BOM and manufacturing costs
0	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

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Industrial / Lighting



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.

- > 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
8	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
6	TVS Diode (PTVS family)	Transient voltage surge protection
G	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching
0	Switching Diode	General purpose high voltage switching diodes. DC blocking
0	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.

- > 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
0	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
0	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



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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.

- > 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
G	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
8	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control and level shifting
6	Switching Diode	General purpose high voltage switching diodes, DC blocking
G	Zener Diode	Voltage reference, linear regulator
Ð	Schottky Barrier Diode (PMEG family)	DC Voltage blocking diode, DC Or-ing function and secondary rectifier in low power AC/DC
0	General purpose Transistors, RETS and Switching Transistors	Signal control, MOSFET driver, general purpose switching

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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.

- > 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
	ß	Small Signal MOSFET (P or N Channel)	High RDSon > 1 Ω used for signal control



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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.

- > 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
8	Zener Diode	Voltage reference, linear regulator
ſ	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.

- > 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
G	Power MOSFETs	VRM voltage regulator, AC/DC power supply
D	Shift Register (74HC595)	Reduces cabling/connector costs by combining signals
8	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, 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
0	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
0	Zener Diode	Voltage reference, linear regulator



Industrial / Medical

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.

- > 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
0	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
ß	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
0	TVS Diode (PTVS family)	Transient voltage surge protection for Vbus power path
0	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

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.

- > 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
8	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
0	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
0	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.

- > 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
8	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
6	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
Ð	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
0	Zener Diode	Voltage reference, linear regulator
M	Transistor (Low Vcesat)	Linear regulator and load switch control
N	Analog Switch (74LVC4066)	Touch screen array input

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Date of release: February 2018

Printed: In the Netherlands