



Working Together for a Greener Society

Future of Power Electronics and the Earth



Selection Guide for xEV

- **ICs (For Power Supply, Motor Drive, Linear Solenoid Drive)**
- **Discrete Devices (Diodes, Power MOSFETs)**

All information in this guide is as of the date of publication. Please make sure that you are using the latest version of the guide.
If you need more product information, please refer to our data sheets.

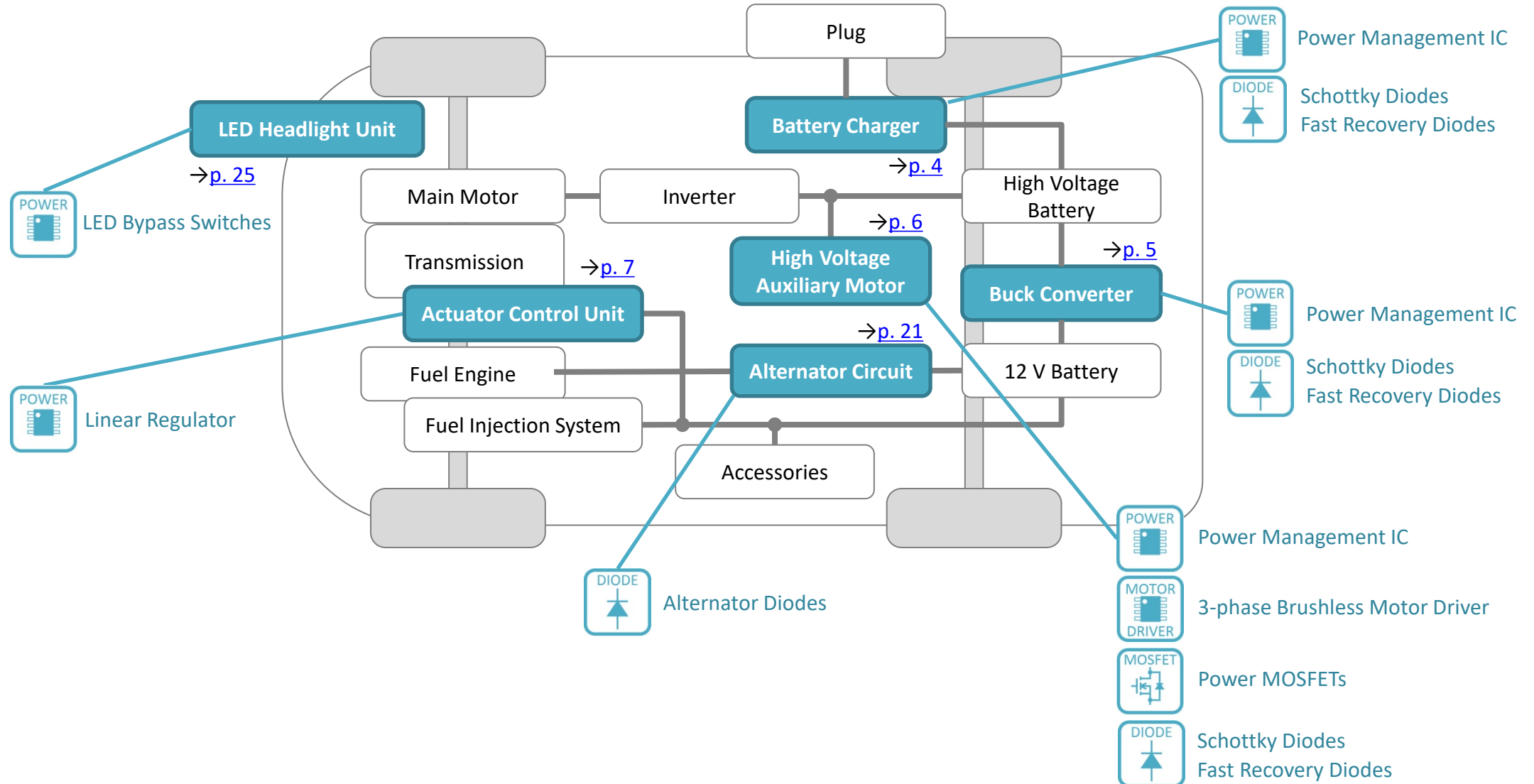
<https://www.sanken-ele.co.jp/en>



Contents

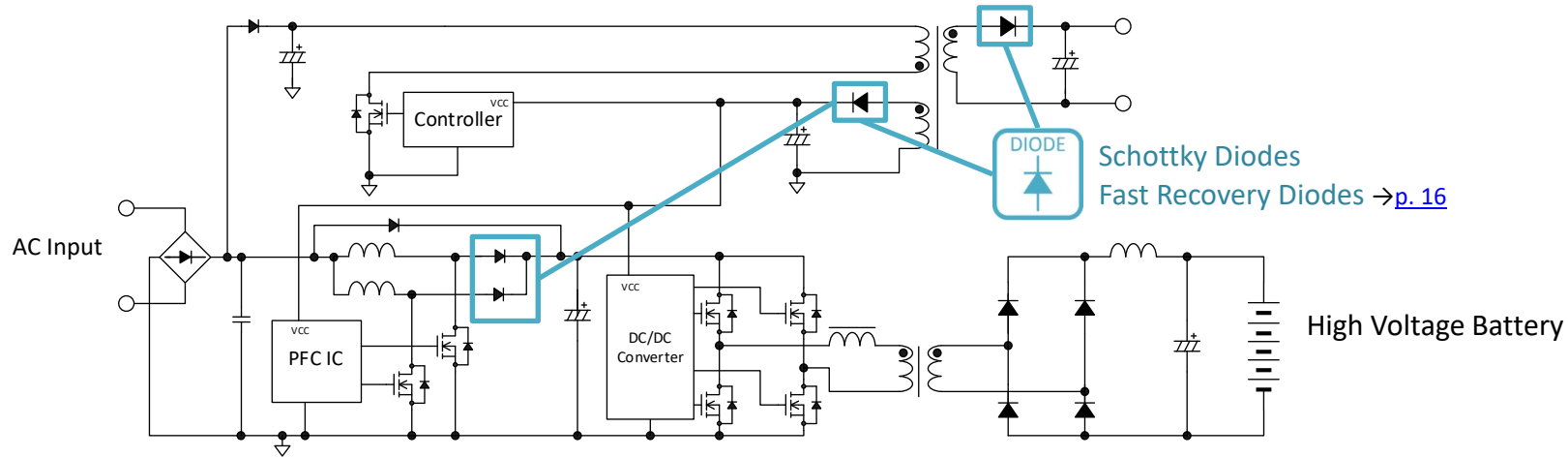
■ xEV System	3
• Battery Charger System	4
• Buck Converter Circuit	5
• High Voltage Auxiliary Motor	6
• Actuator Control Unit (ACU)	7
■ 3-phase Brushless Motor Drivers	8
■ Power Management ICs	13
■ Diodes	15
• TVS Diodes	17
• Schottky Diodes	18
• Fast Recovery Diodes	19
• Auxiliary Switch Diode for Snubbers	20
• Alternator Diodes	21
■ Power MOSFETs	22
• N-channel Power MOSFETs	23
■ Other Devices	24
• LED Headlight Driver (SPF5047)	25
■ Important Notes	26

Sanken provides various devices for xEV system that have a high voltage battery.

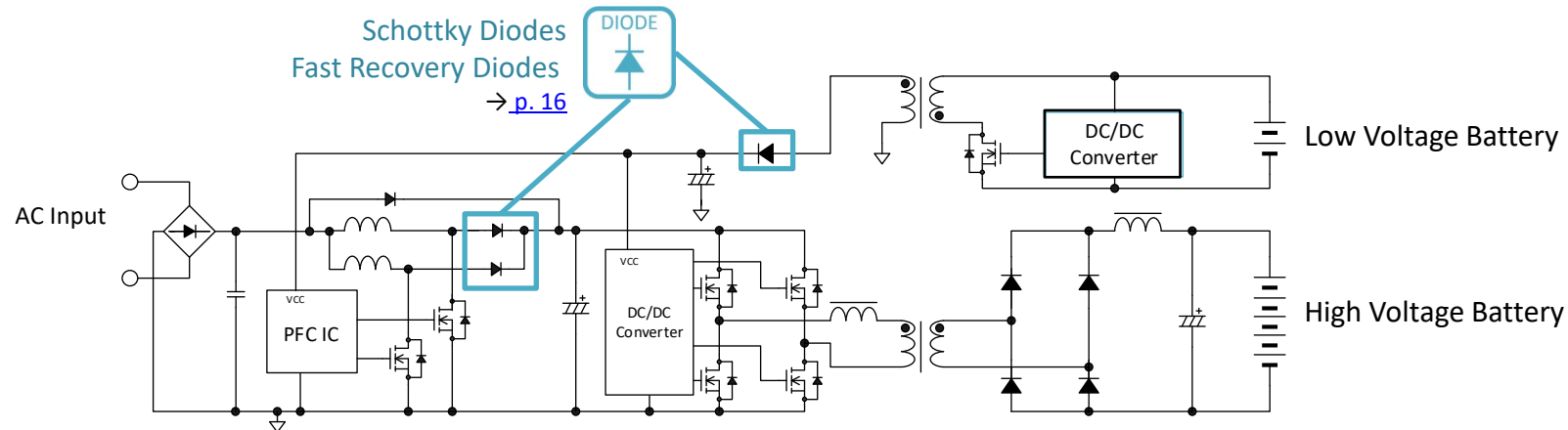


For the battery charging circuit from a power plug, Sanken provides devices such as auxiliary power supply ICs and rectification diodes.

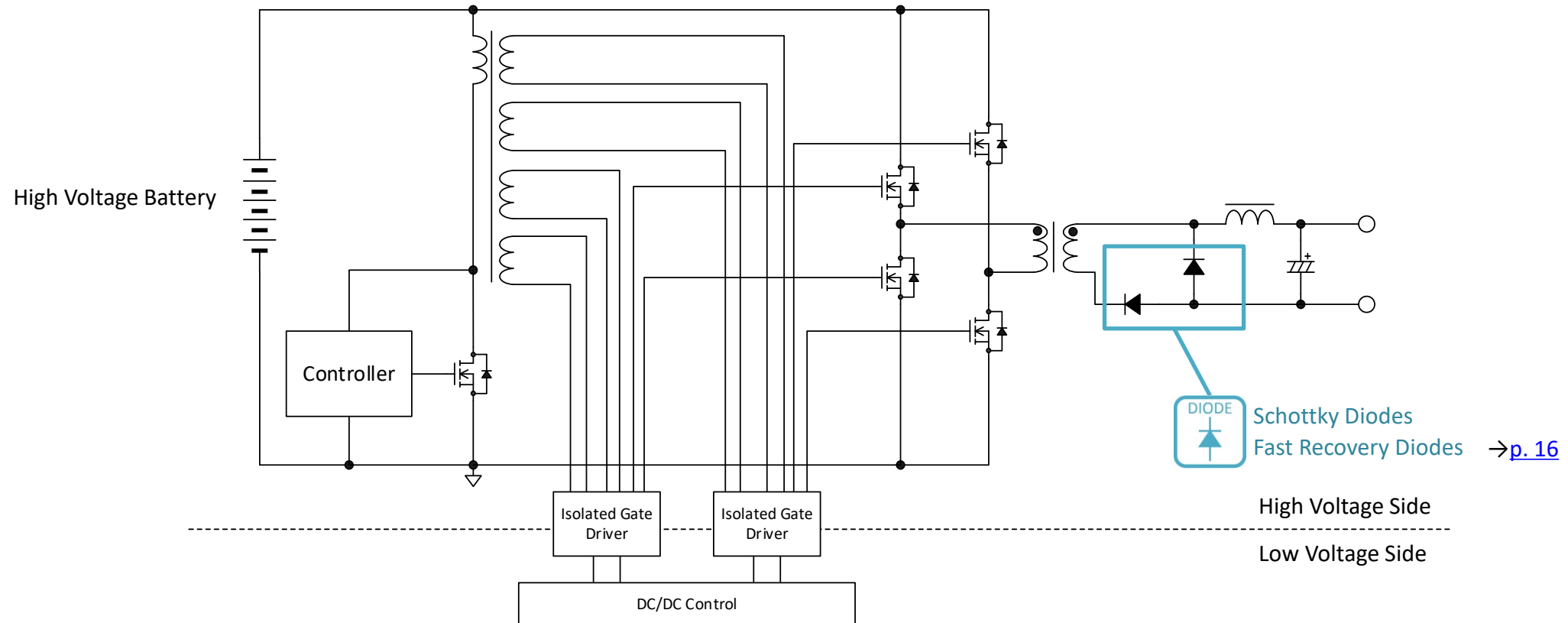
Auxiliary Power Supply Using AC Input



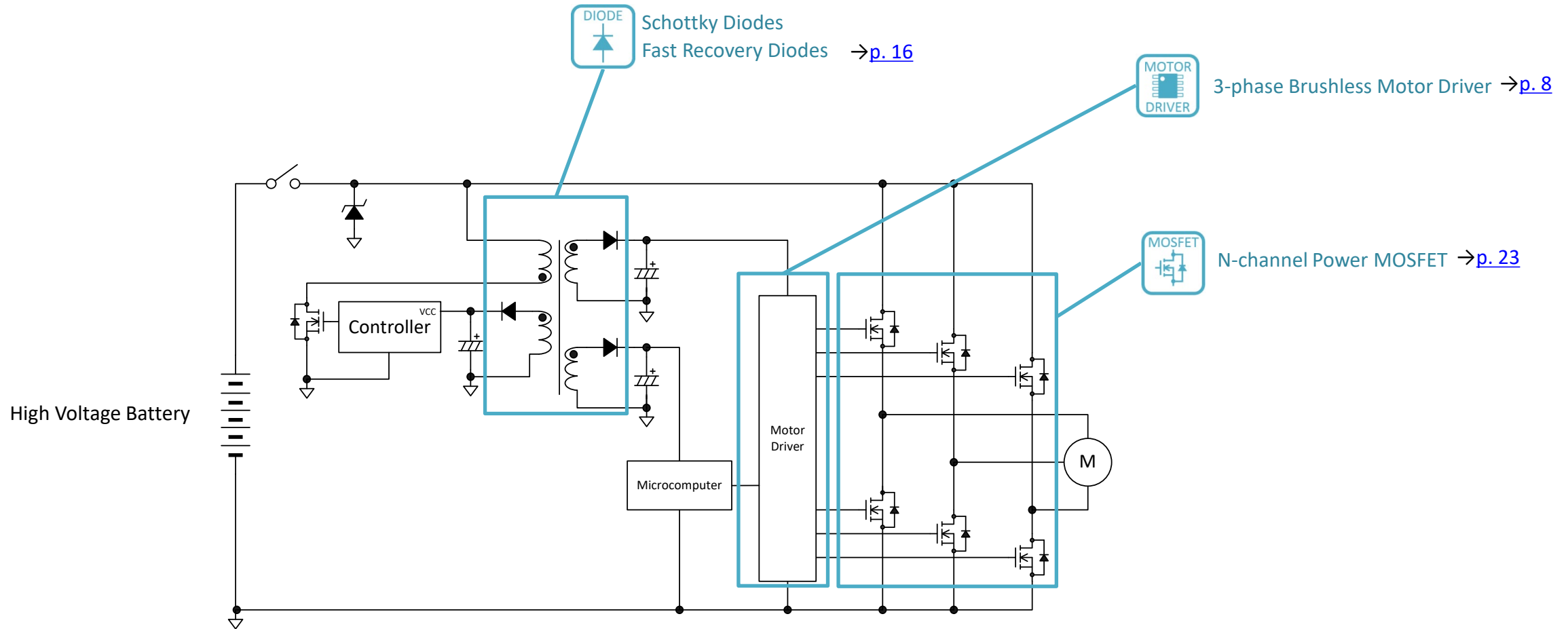
Auxiliary Power Supply Using Battery



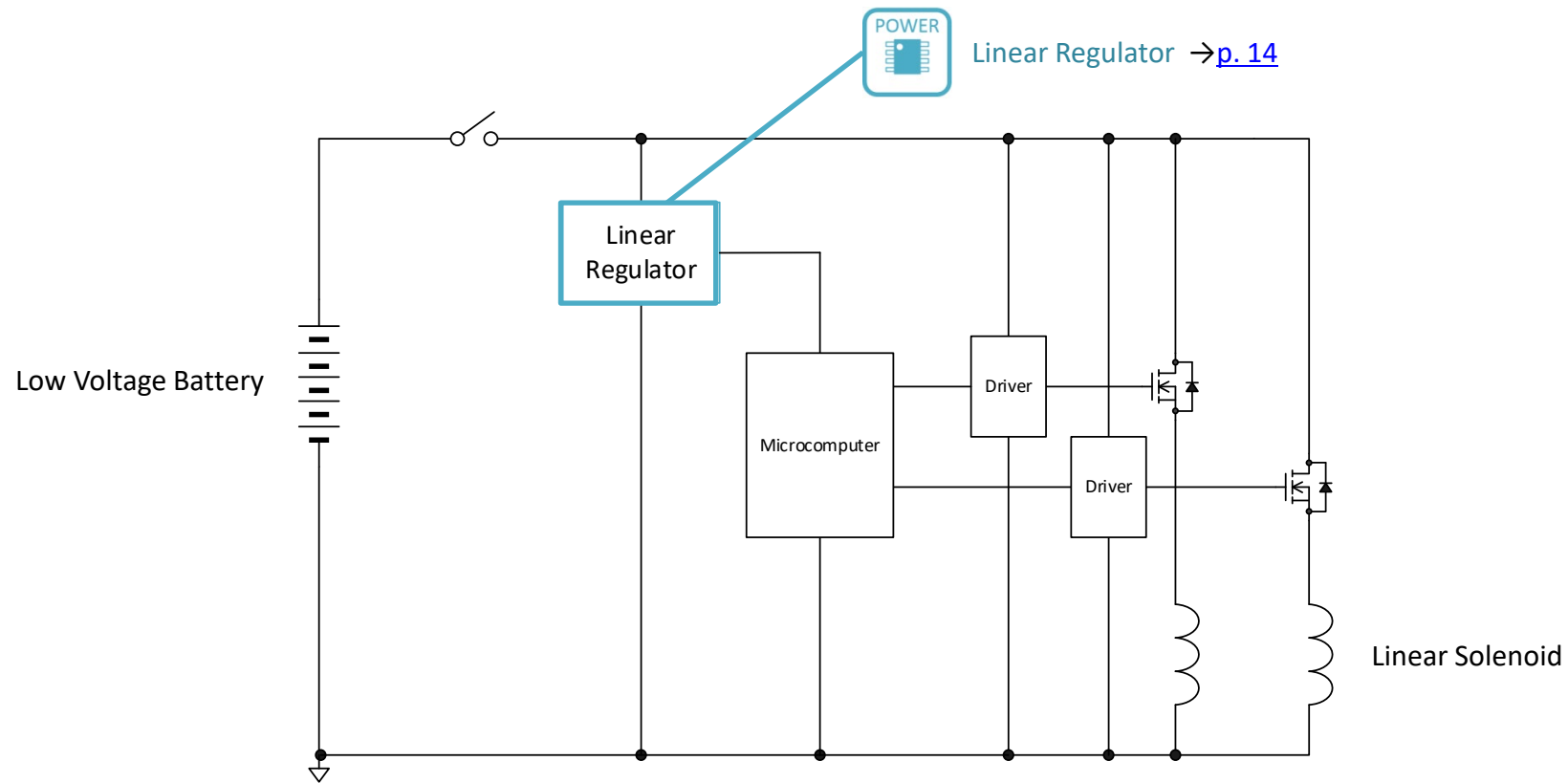
For the buck converter circuit from a high voltage battery, Sanken provides devices such as power management ICs and rectification diodes.



For the high voltage auxiliary motor circuit, Sanken provides devices such as power management ICs, motor drive ICs, and discrete devices.



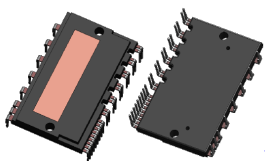
For the Actuator Control Unit (ACU) of a linear solenoid valve in the transmission, Sanken provides linear regulators.



Sanken's motor drivers for automotive applications are AEC-Q100 or AQC-324 qualified high-quality ICs. Sanken provides the optimal ICs according to the application and system of the DC motors.

SAM2 Series (Built-in Power MOSFETs)

DIP30 (LF2540 / LF2541)



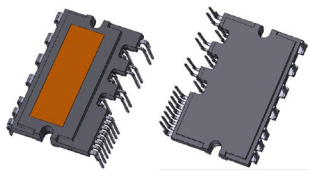
[→p. 9](#)

- Built-in IGBTs (650 V, 30 A to 50 A / 1200 V, 5 A to 15 A)
- Isolation Voltage: 2500 V (for 1 min)
- Built-in Thermistor
- Built-in Bootstrap Diodes

Applications:
High Voltage Auxiliary Circuit (Compressor, etc.)

SAM4 Series (Built-in Power MOSFETs)

DIP27 (LF4550)



[→p. 10](#)

- Built-in IGBTs (700 V, 30 A to 50 A)
- Isolation Voltage: 2500 V (for 1 min)
- Direct Bonding Copper (DBC) Structure with Excellent Heat Dissipation
- Built-in Thermistor
- Built-in Bootstrap Diodes

Applications:
High Voltage Auxiliary Circuit (Compressor, etc.)

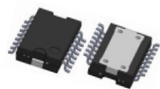
SPF6102/SPF6001 (External Power MOSFETs)

SPF6102
HSOP48



[→p. 11](#)

SPF6001
HSOP16



[→p. 12](#)

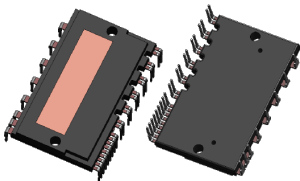
- 3-phase type (SPF6102) and single-phase (SPF6001) are available
- Built-in Bootstrap Diodes
- Built-in Auxiliary Power Supply
- Enable Function

Applications:

- Electronic Power Steering (EPS)
- Integrated Starter Generator (ISG) Hybrid System
- Radiator Pump
- Fan for Air Conditioner

SAM265Mx0AA1/AS3, SAM212MxxAF1 Series

Package



- DIP30
- LF2540 (Long Lead Type)
 - LF2541 (Short Lead Type)

Features

- AQG-324 Qualified
- Pb-free (RoHS Compliant)
- Isolation Voltage: 2500 V (for 1 min)
- Built-in Thermistor
- Built-in Bootstrap Diodes
- CMOS-compatible Input (3.3 V or 5 V)
- Fault Signal Output at Protection Activation
- Shutdown Signal Input
- Adjustable OCP Hold Time
- Protection Functions

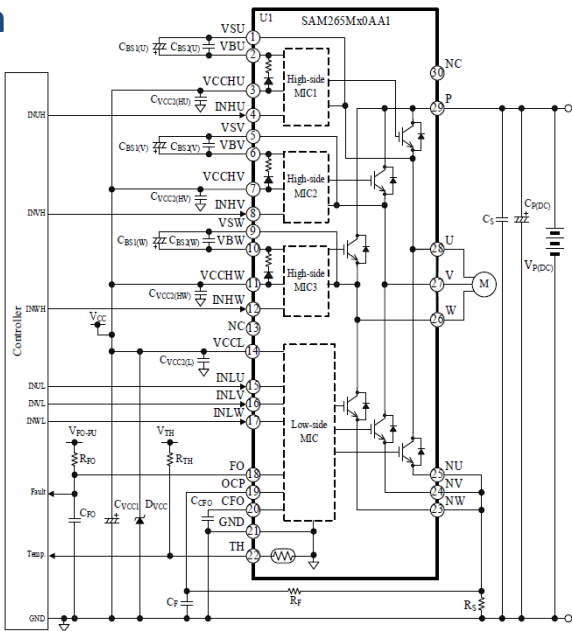
Undervoltage Lockout for Power Supply

- VBx Pin (UVLO_VBx): Auto-restart

- VCCL Pin (UVLO_VCCL): Auto-restart

Overcurrent Protection (OCP): Auto-restart

Typical Application



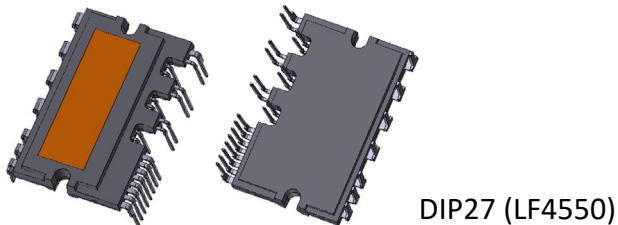
Selection Guide

Part Number	V _{CES}	I _C	V _{CE(SAT)} (Typ.)
SAM265M30AA1	650 V	30 A	1.7 V
SAM265M50AA1	650 V	50 A	1.7 V
SAM265M50AS3	650 V	50 A	1.8 V
SAM212M05AF1*	1200 V	5 A	1.4 V (TBD)
SAM212M10AF1*	1200 V	10 A	1.7 V (TBD)
SAM212M15AF1	1200 V	15 A	1.7 V

* Under development

SAM4 Series

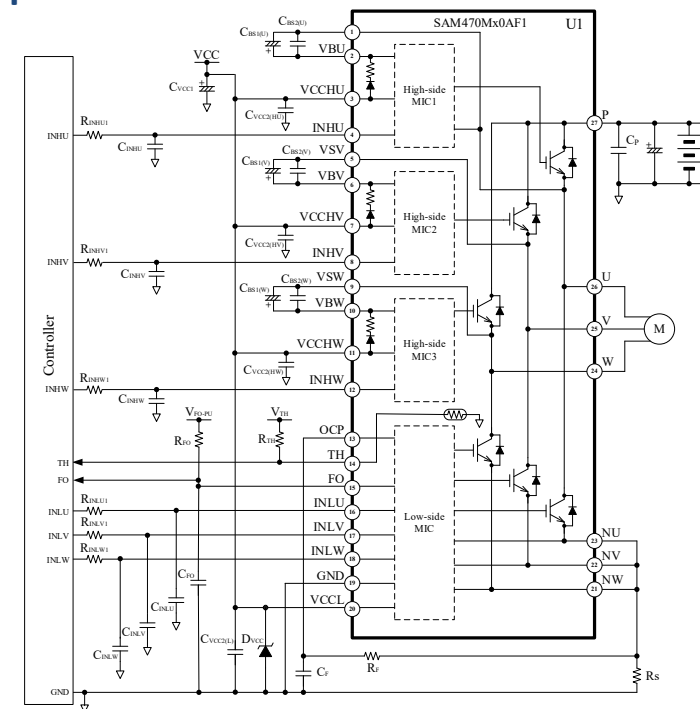
Package



Features

- AQG-324 Qualified
- Pb-free (RoHS Compliant)
- Isolation Voltage: 2500 V (for 1 min)
- Direct Bonding Copper (DBC) Structure with Excellent Heat Dissipation
- Built-in Thermistor
- Built-in Bootstrap Diodes
- CMOS-compatible Input (3.3 V or 5 V)
- Fault Signal Output at Protection Activation
- Protection Functions
 - Undervoltage Lockout for Power Supply
 - VBx Pin (UVLO_VBx): Auto-restart
 - VCCL Pin (UVLO_VCCL): Auto-restart
 - Overcurrent Protection (OCP): Auto-restart

Typical Application



Selection Guide

Part Number	V_{CES}	I_C	$V_{CE(SAT)}$ (Typ.)
SAM470M30AF1	700 V	30 A	1.55 V
SAM470M50AF1	700 V	50 A	1.70 V

SPF6102

Package

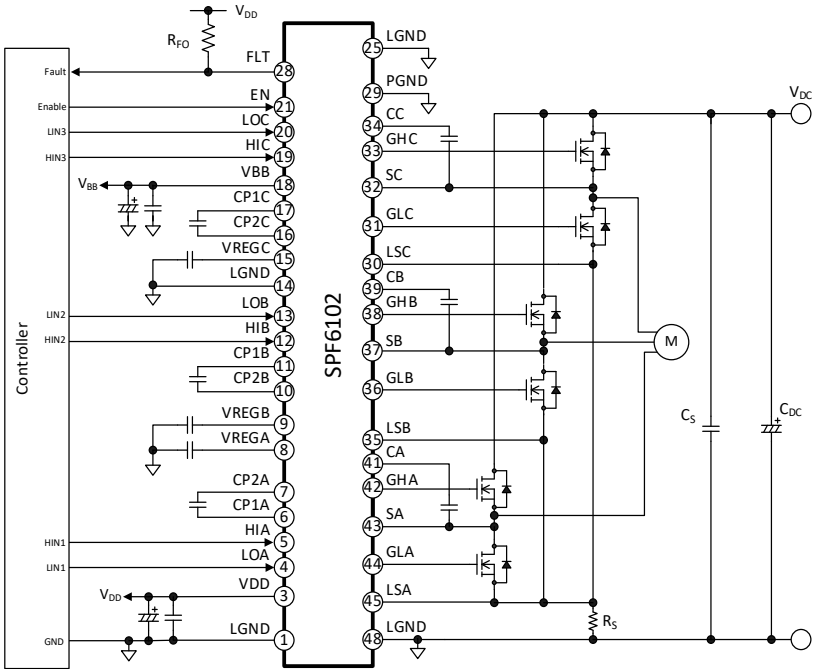
HSOP48



Features

- AEC-Q100 Qualified
- Pb-free (RoHS Compliant)
- Built-in Bootstrap Diodes
- Built-in Auxiliary Power Supply (VREGx)
- Enable Function (All Phases Shutdown with EN = Logic Low)
- Fault Signal Output at Protect Circuit Activated
- Protections
 - Simultaneous On-state Prevention
 - VBB Pin Overvoltage Protection (VBB_OVP)
 - Under Voltage Protection
 - VBB Pin (VBB_UVLO)
 - VDD Pin (VDD_UVLO)
 - VREGx Pin (VREGx_UVLO)
 - Thermal Shutdown (TSD)

Typical Application



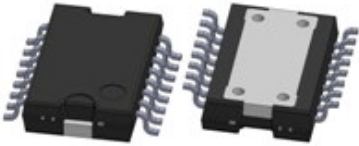
Specifications

Part Number	V _{DC}	V _{BB}	On-resistance of Internal Driver
SPF6102	150 V	35 V	Sink: 4 Ω (typ.) Source: 5 Ω (typ.)

SPF6001

Package

HSOP16



Features

- AEC-Q100 Qualified
- Pb-free (RoHS Compliant)
- Built-in Bootstrap Diodes
- Built-in Auxiliary Power Supply (VREG)
- Enable Function (All Phases Shutdown with EN = Logic Low)
- Fault Signal Output at Protect Circuit Activated
- Protections

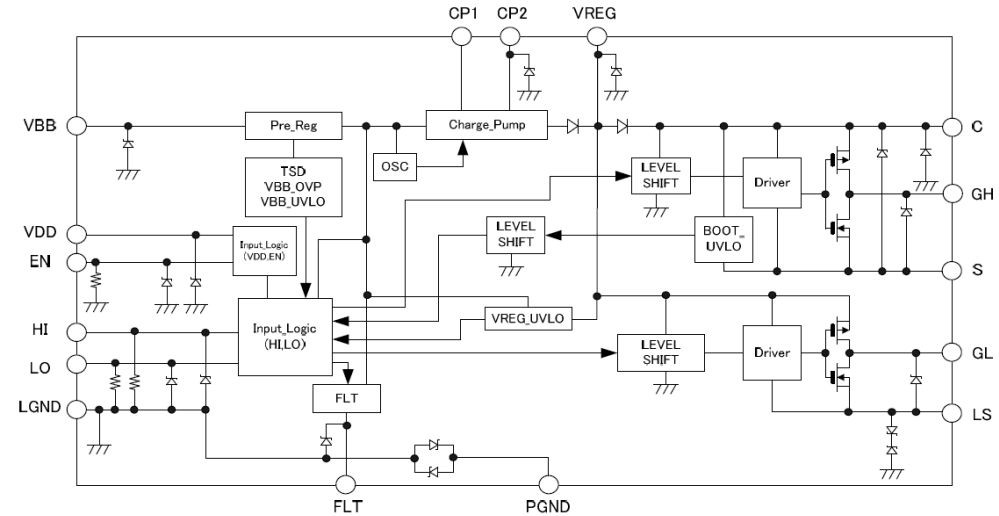
VBB Pin Overvoltage Protection (VBB_OVP)

Under Voltage Protection

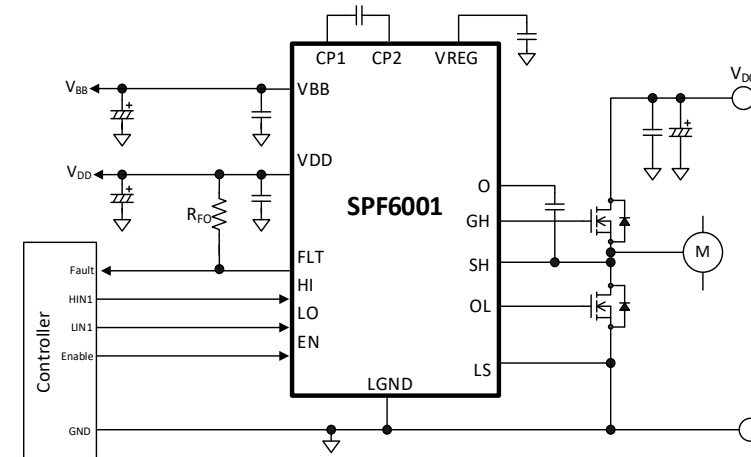
- VBB Pin (VBB_UVLO)
- VDD Pin (VDD_UVLO)
- VREG Pin (VREG_UVLO)

Thermal Shutdown (TSD)

Block Diagram



Typical Application



Sanken's power management ICs for automotive applications are AEC-Q100 qualified high-quality ICs. Sanken provides the optimal ICs according to the application and system of a power supply.

Two Outputs Linear Regulator

◆SPF3000 Series

- One Input, Two Outputs Linear Regulator
- Built-in Power MOSFET

$$I_O = 0.2 \text{ A to } 0.4 \text{ A}$$

$$V_{IN} = 35 \text{ V}$$

HSOP16 [→p. 14](#)



For the buck converters used in:

- Inverter
- On Board Charger (OBC)
- Battery Management System (BMS)

SPF3000 Series

Package

SOP16



Features

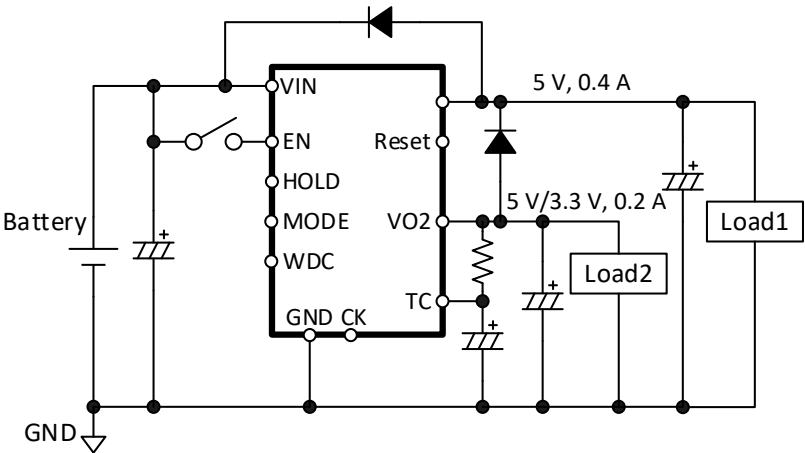
- One Input, Two Outputs Linear Regulator
- AEC-Q100 Qualified
- Pb-free (RoHS Compliant)
- High Accuracy Output Voltage (Output 1: $\pm 2\%$)
- Power-on Reset Function
- Built-in Watchdog Timer
- Enable Function
- Protections
 - Overcurrent Protection: Drooping
 - Thermal Shutdown (Output 1)

Applications

For the buck converters used in:

- Inverter
- On Board Charger (OBC)
- Battery Management System (BMS)

Typical Application



Selection Guide

Part Number	Output 1		Output 2		V_{IN} (max.)	P_D
	I_O	V_O	I_O	V_O		
SPF3006	0.4 A	5.0 V	0.2 A	5.0 V	35 V	3 W
SPF3009	0.4 A	5.0 V	0.2 A	3.3 V		

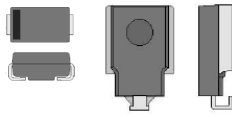
Sanken provides the optimal diodes according to the automotive application. The TVS diodes have high surge capability, and protect automotive electronic units, especially from the surge generated during load dump conditions and voltage transients induced by inductive loads. These are provided in high thermal dissipation package. We provide various fast recovery diodes and an auxiliary switch diode for snubbers, all for switching power supplies.

Features

- AEC-Q101 Qualified
- $T_j = 175\text{ }^{\circ}\text{C}$ Capability Suitable for High Reliability and Automotive Requirement
- Flammability UL94V-0 (Equivalent)
- Bare Lead Frame: Pb-free (RoHS Compliant)

TVS Diodes

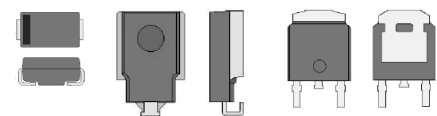
- $P_D = 1\text{ W to }6\text{ W}$
- For Circuit using 12 V or 24 V Battery
- Meets the Surge Protection Requirements in ISO7637-2



[→p. 17](#)

Schottky Diodes

- $V_{RM} = 40\text{ V to }150\text{ V}$
- $I_{F(AVG)} = 1\text{ A to }45\text{ A}$



[→p. 18](#)

Fast Recovery Diodes

- $V_{RM} = 200\text{ V to }600\text{ V}$
- 1 A to 3 A



[→p. 19](#)

Auxiliary Switch Diode for Snubbers

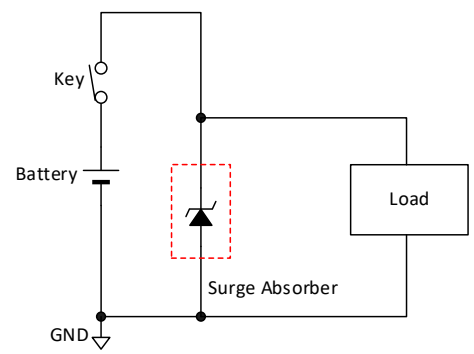
- $V_{RM} = 100\text{ V}$
- 1 A



[→p. 20](#)

Typical Application

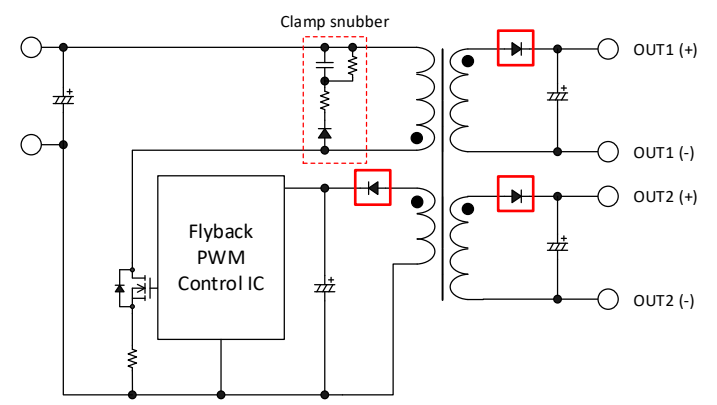
◆TVS Diodes



◆Schottky Diodes

◆Fast Recovery Diodes

◆Auxiliary Switch Diode for Snubbers



Our alternator diodes have excellent characteristics that support applications, including automotive-grade devices durable for harsh environments such as engine compartments.

You can effectively allocate diodes in a limited space by using two types in pairs, diodes with the suffix “S” and the suffix “R”, which have opposite polarities.

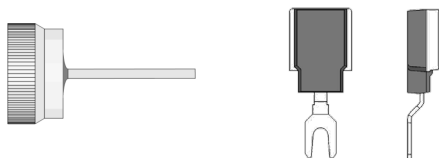
Supplied in two types of packages: press-fit and SG-10.

Features

- High Surge Capability (JASO A-1/JASO D-1 Standard Compliant)
- $T_j = 160\text{ }^{\circ}\text{C}$ to $235\text{ }^{\circ}\text{C}$ Capability Suitable for High Reliability and Automotive Requirement
- Thermal Fatigue Capability: 5,000 cyc.
- RoHS Compliant

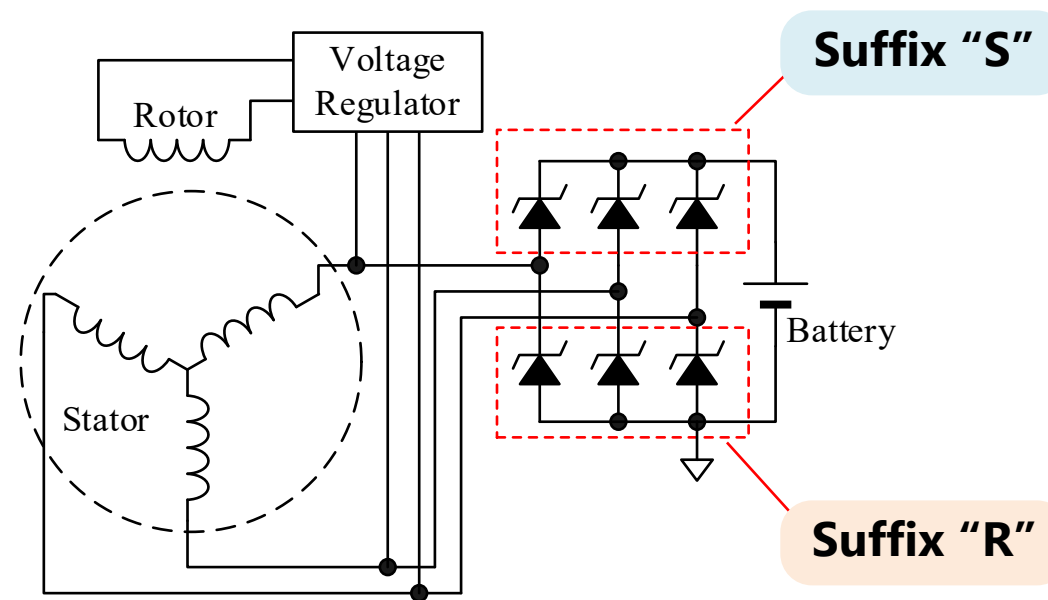
Schottky Diodes

- $V_{RM} = 17\text{ V}$ to 200 V
- $I_{F(AVG)} = 30\text{ A}$ to 50 A
- Alternator Circuit for the 12 V/24 V Automotive Battery



[→p. 21](#)

Typical Application

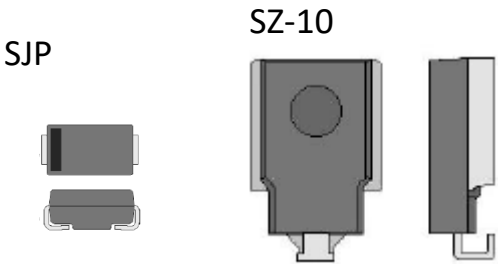


TVS Diodes

Features

- AEC-Q101 Qualified
- Meets the Surge Protection Requirements in ISO7637-2
- for High Reliability and Automotive Requirement
- SZ-10 Series: $T_j = 175\text{ }^{\circ}\text{C}$ Capability Suitable
- Flammability UL94V-0 (Equivalent)
- Bare Lead Frame: Pb-free (RoHS Compliant)

Packages



Selection Guide

P_D	Part Number	V_Z (min.)	V_Z (max.)	I_{RSM}	I_R	Package	ISO7637-2
1 W	SJPZ-K20	18.8 V	21.2 V	—	10 μ A	SJP	Pulse 1 to 3
	SJPZ-K28	25.0 V	31.0 V	2 A	10 μ A		
2 W	SJPZ-N18	16.8 V	19.1 V	—	1 μ A		
	SJPZ-N27	25.1 V	28.9 V	—	1 μ A		
	SJPZ-N33	31.0 V	35.0 V	—	1 μ A		
5 W	SZ-10N27	24.0 V	30.0 V	70 A	10 μ A	SZ-10	Pulse 5a
6 W	SZ-10NN27	24.0 V	30.0 V	90 A	10 μ A		
	SZ-10NN40	36.0 V	44.0 V	70 A	10 μ A		

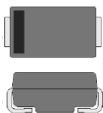
Schottky Diodes

Features

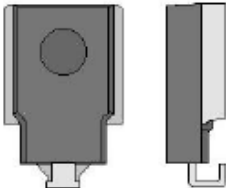
- AEC-Q101 Qualified
- Guaranteed Avalanche Energy for SZ-10EF
- Flammability UL94V-0 (Equivalent)
- Bare Lead Frame: Pb-free (RoHS Compliant)

Packages

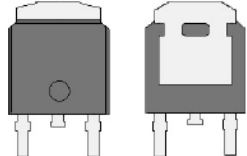
SJP



SZ-10



TO252



Selection Guide

Package	V _{RM}	I _{F(AVG)}	Part Number	I _{FSM} (50 Hz Half-wave)	V _F	
					V _F (max.)	I _F Condition
SJP	40 V	1 A	SJPB-D4	30 A	0.55 V	1 A
		2 A	SJPE-H4	40 A	0.60 V	2 A
		2 A	SJPB-H4	50 A	0.55 V	2 A
		3 A	SJPB-L4	60 A	0.55 V	3 A
	60 V	1 A	SJPB-D6	20 A	0.68 V	1 A
		2 A	SJPB-H6	40 A	0.69 V	2 A
		3 A	SJPB-L6	50 A	0.70 V	3 A
	90 V	1 A	SJPB-D9	20 A	0.85 V	1 A
		2 A	SJPB-H9	40 A	0.85 V	2 A
	150 V	3 A	SJPE-L15	40 A	0.95 V	3 A
		5 A	SJPE-T15	75 A	0.95 V	5 A
SZ-10	80 V	45 A	SZ-10EF	300 A	0.82 V	45 A
TO252	150 V	10 A	SPEG-21015	80 A	0.98 V	5 A
		15 A	SPEG-21515	90 A	0.98 V	6.5 A

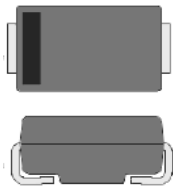
Fast Recovery Diodes

Features

- AEC-Q101 Qualified
- Flammability UL94V-0 (Equivalent)
- Bare Lead Frame: Pb-free (RoHS Compliant)

Package

SJP



Selection Guide

V _{RM}	I _{F(AVG)}	Part Number	I _{FSM} (50 Hz Half-wave)	V _F		t _{rr} I _F : I _R = 1 : 1
				V _F (max.)	I _F Condition	
200 V	1.0 A	SJPL-D2	25 A	0.98 V	1.0 A	50 ns
	1.5 A	SJPX-F2	30 A	0.98 V	1.5 A	30 ns
	2.0 A	SJPL-H2	25 A	0.98 V	2.0 A	50 ns
	3.0 A	SJPL-L2	60 A	0.98 V	3.0 A	50 ns
300 V	2.0 A	SJPX-H3	20 A	1.3 V	2.0 A	30 ns
400 V	1.5 A	SJPL-F4	25 A	1.3 V	1.5 A	50 ns
	3.0 A	SJPL-L4	30 A	1.3 V	3.0 A	50 ns
500 V	1.0 A	SJPD-D5	20 A	1.4 V	1.0 A	40 ns
	3.0 A	SJPD-L5	50 A	1.4 V	3.0 A	50 ns
600 V	2.0 A	SJPL-H6	30 A	1.5 V	2.0 A	50 ns
	2.0 A	SJPX-H6	20 A	1.5 V	2.0 A	30 ns

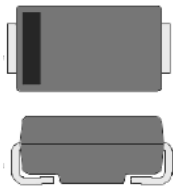
Auxiliary Switch Diode for Snubbers

Features

- Reduces Noise
- Bare Lead Frame: Pb-free (RoHS Compliant)
- Flammability: Equivalent to UL94V-0
- AEC-Q101 Qualified

Package

SJP



Selection Guide

Part Number	V_{RM}	$I_{F(AV)}$	T_J (Max.)	V_F (Max.)	I_R (Max.)	$H \cdot I_R$ (Max.)	t_{rr}
SARS-A1001N	100 V	1 A	150 °C	0.9 V	5 μ A	50 μ A	0.6 μ s to 1.5 μ s

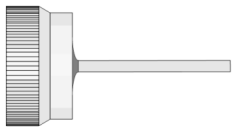
Alternator Diodes

Features

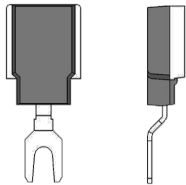
- High Surge Capability (JASO A-1/JASO D-1 Standard Compliant)
- $T_J = 160\text{ }^{\circ}\text{C}$ to $235\text{ }^{\circ}\text{C}$ Capability Suitable for High Reliability and Automotive Requirement
- Thermal Fatigue Capability: 5,000 cyc.
- RoHS Compliant

Package

Press-fit



SG-10



Selection Guide

Part Number	Package	V_{RM}	$I_{F(AVG)}$	T_J (Max.)	V_Z	V_F (Max.)	I_R (Max.)	Standards Compliance
SG-17VLZ40	Press-fit	32 V	50 A	235 $^{\circ}\text{C}$	36 V~44 V	1.25 V	1 μA	JASO D-1
SG-17VLZ		17 V	50 A	235 $^{\circ}\text{C}$	20 V~26 V	1.20 V	1 μA	JASO A-1
SG-K17VLEFG		17 V	50 A	200 $^{\circ}\text{C}$	20 V~26 V	0.67 V	20 μA	JASO A-1
SG-17NNJ23		17 V	45 A	210 $^{\circ}\text{C}$	20 V~26 V	0.92 V	1 μA	JASO A-1
SG-10LZ40*	SG-10	32 V	30 A	160 $^{\circ}\text{C}$	36 V~44 V	1.20 V	50 μA	JASO D-1
SG-10LXZ23*		17 V	35 A	160 $^{\circ}\text{C}$	20 V~28 V	1.05 V	50 μA	JASO A-1
SG-10LZ23*		17 V	30 A	160 $^{\circ}\text{C}$	20 V~28 V	1.20 V	50 μA	JASO A-1
SG-10L*		200 V	30 A	160 $^{\circ}\text{C}$	—	1.20 V	250 μA	Non-compliant

* Not compliant with Thermal Fatigue Capability: 5,000 cyc.

SanKen provides various power MOSFETs according to the automotive application.

The high-quality power MOSFETs have low on-resistance, and are optimal for the automotive applications including inverters and switch.

Features

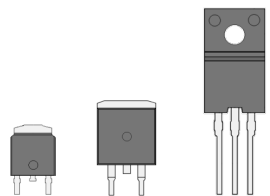
- AEC-Q101 Qualified
- Bare Lead Frame: Pb-free (RoHS Compliant)
- Guaranteed Avalanche Energy

Applications

- Motor Drive
- Injection Switch
- Power Management Circuit

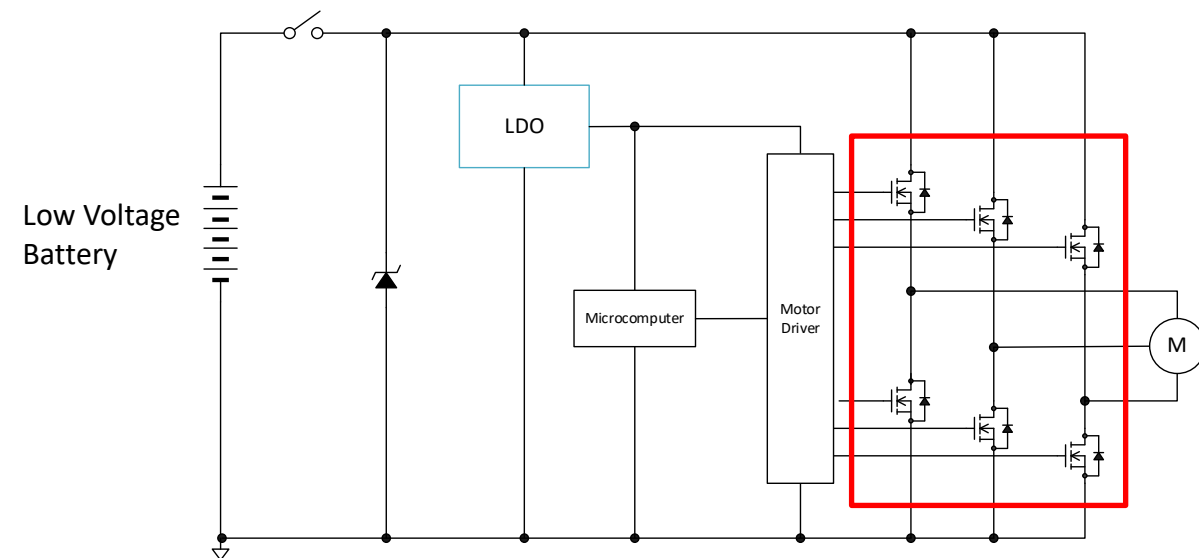
N-channel Power MOSFETs

- $V_{DS} = 40\text{ V to }300\text{ V}$
- $I_D = \pm 20\text{ A to } \pm 100\text{ A}$



[→p. 23](#)

Typical Application



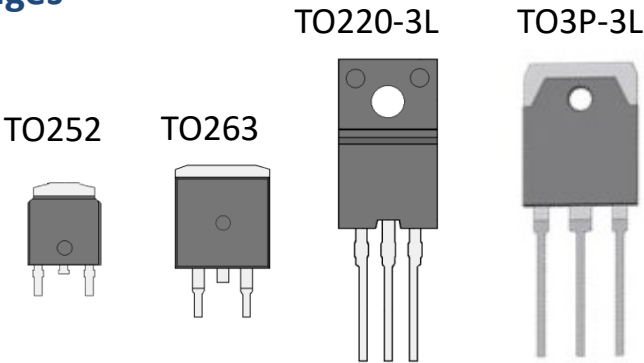
$V_{DSS} = 40\text{ V to }300\text{ V}$, $I_D = \pm 20\text{ A to } \pm 100\text{ A}$

N-channel Power MOSFETs

Features

- $V_{DSS} = 40\text{ V to }300\text{ V}$
- Low On-resistance
- AEC-Q101 Qualified
- Bare Lead Frame: Pb-free (RoHS Compliant)
- Guaranteed Avalanche Energy

Packages



Selection Guide

V _{DSS}	I _D	Part Number	Package	P _D	V _{GSS}	V _{TH} (max.)	C _{iss}	C _{rss}	R _{DS(ON)} (max.)
							V _{DS} = 10 V, V _{GS} = 0 V		
40 V	±70 A	2SK3801	TO3P-3L	100 W	±20 V	4.0 V	5100 pF	860 pF	6 mΩ
		FLD470	TO220F-3L	35 W					
60 V	±70 A	2SK3711	TO3P-3L	130 W	±20 V	4.0 V	8000 pF	1000 pF	6 mΩ
	±100 A	2SK4161D	TO3P-3L	132 W	±20 V	4.0 V	10000 pF	1000 pF	4.8 mΩ
100 V	±20 A	DKG1020	TO252	40 W	±20 V	2.5 V	2200 pF	110 pF	52 mΩ
300 V	±15 A	SUK3015	TO263	89 W	±20 V	2.5 V	1800 pF	85 pF	150 mΩ

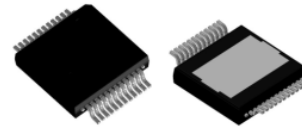
LED Headlight Driver

Sanken's LED headlight driver is a bypass switch for the highbrightness matrix LEDs used in applications such as automotive headlights. Each LED has open and short detections that can send fault flags to the CPU.

◆SPF5047

- 4 Series LED Bypass Switches
- $V_{POS} = -65\text{ V}$, $R_{DS(ON)} = 120\text{ m}\Omega$
- LED Open / Short Detection

HSOP24

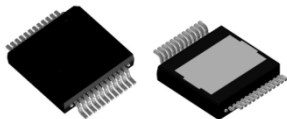


[→p. 25](#)

SPF5047

Package

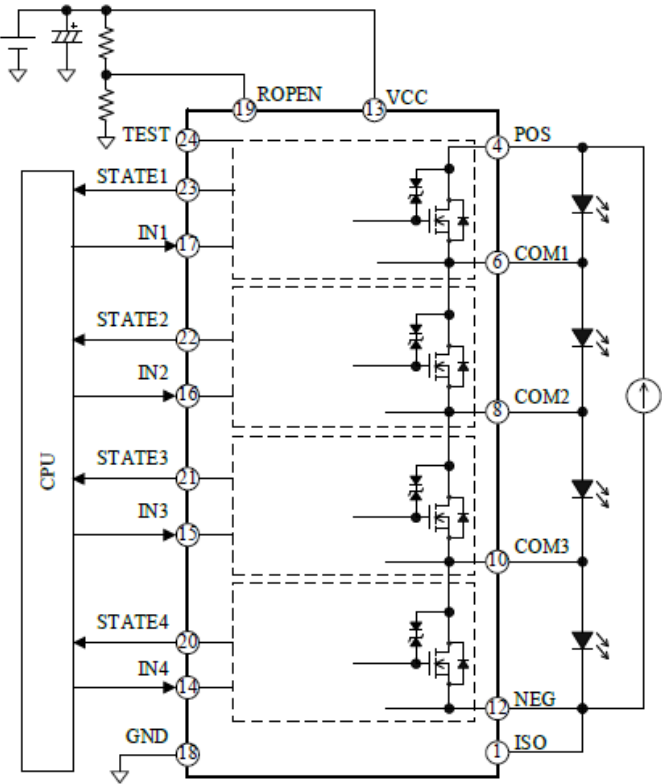
HSOP24



Features

- Four Series LED Bypass Switches
- Drives Up to 16 LEDs in Series (with 4 ICs; at VF of an LED is approx. 3 V)
- Low Noise:
No charge-current-induced noise occurs as each gate driver uses a negative power source which requires no charge-pump circuit.
- High Efficiency:
Optimized trade-offs between switching loss and switching noise allow highly-accurate control in tr and tf.
- Fault Flag Reporting
- LED Open Detection
- LED Short Detection

Typical Application



Specifications

Part Number	V _{POS}	I _{OUT}	R _{DS(ON)}
SPF5047	-65 V (max.)	2 A (max.)	120 mΩ (typ.)

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