

# PHILIPS

## Application Guide Book: Game Consoles and Game Controllers

Discretes and MultiMarket ICs

DMI – BL Power

07/08/2002

# Game Consoles

**3 dedicated consoles:**

- **Sony Playstation 2**
- **Nintendo Gamecube**
- **Microsoft Xbox**

**1 multi-purpose platform:**

- **PC**

Sony, Playstation, Nintendo, Gamecube, Microsoft and Xbox are trademarks and property of their respective owners.

# Sony Playstation 2

## Technical

- CPU: Sony "Emotion Engine", 128 bit, 300 MHz
- Graphics processor: Sony "Graphics Synthesizer"
- Memory: 32 MB Direct Rambus
- Memory bus bandwidth: 3.2 GB/s
- Polygon performance: 66 M/s
- Floating Point Performance: 6.2 GFlops
- Media: DVD

## Market

- Introduction: Q4 2000

# Nintendo Gamecube



## Technical

- CPU: IBM PowerPC “Gekko”, 128 bit, 485 MHz
- Graphics processor: ATI Flipper, 128 bit
- Memory: 24 MB (main RAM), 16 MB (graphic RAM)
- Memory bus bandwidth: 2.6 GB/s
- Polygon performance: 12 M/s
- Media: 3 inch Matsushita Optical Disc (1.5 GB)

## Market

- Introduction: Q3 2001

ATI and Matsushita are trademarks and property of their respective owners.

# Microsoft Xbox

## Technical

- CPU: Intel Pentium III, 733MHz
- Graphics processor: nVIDIA X-Chip, 250MHz
- Memory: 128MB (PC800 RDRAM)
- Memory bus bandwidth: 6.4 Gb/s
- Polygon Performance: 125 M/s
- Media: 6x DVD, 10 GB Hard disk
- Network: 10/100Mbps Ethernet

## Market

- Introduction: Q4 2001

# Mainstream PC

**Please refer to:**

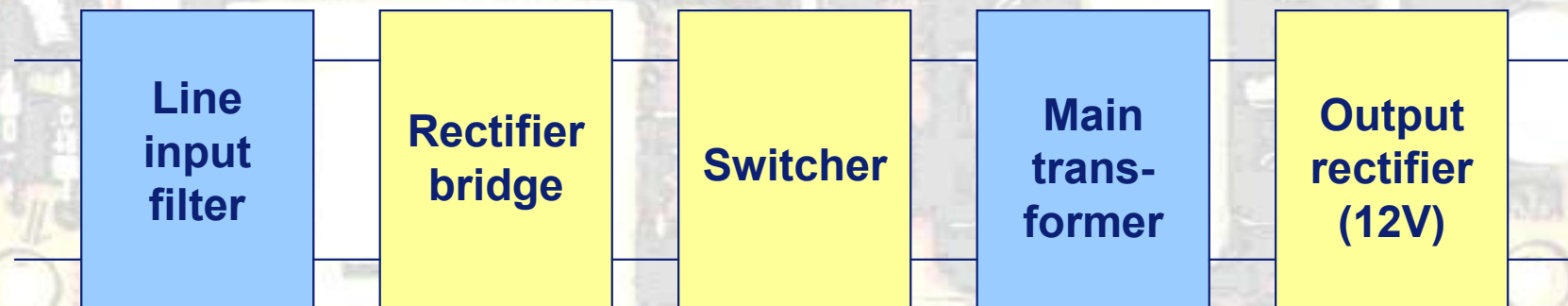
- **PC Mainboard application guide book**
- **PC Silverbox application guide book**

# Components of a game console



# Game console power supply

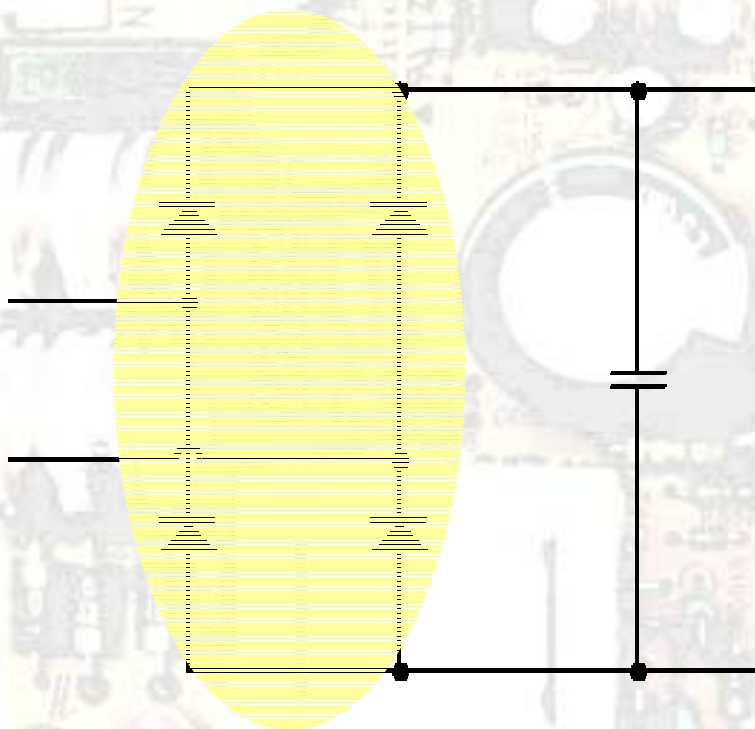
- Power 50 to 100W
- Single line input voltage (region dependence of console)
- Passive filtering (passive PFC)
- Single transistor forward (flyback) converter topology
- Single output voltage; further down conversion on the main board



*The yellow blocks contain  
power semiconductors*



# Rectifier bridge

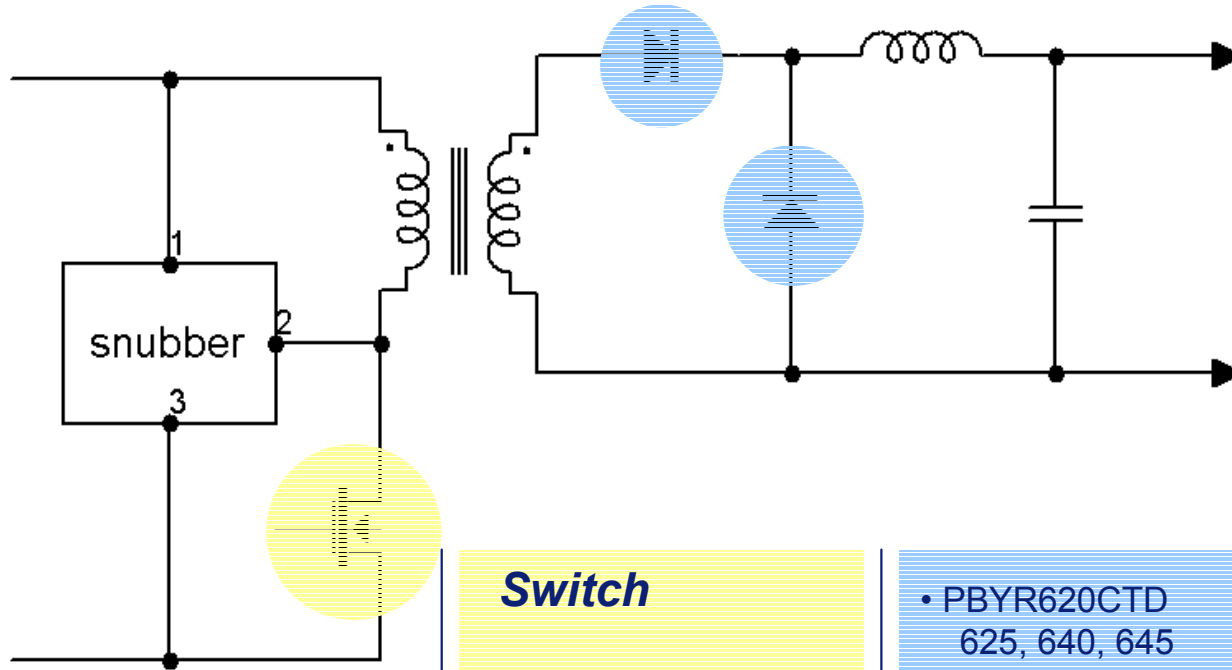


## Rectifier bridge diodes

### Philips Diodes

- BYD13J 600V, 1A, SOD81
- 1N4005ID 600V, 1A, SOD81
- BYD17J 600V, 1A, SOD87
- S1J 600V, 1A, SMA (SOD124)
- BYG50J 600V, 2.1A, SOD106
- BYW54 600V, 1,8A, SOD57
- BYM56C 600V, 3.6A, SOD64

# Forward converter



## Switch

### Philips MOSFETs

- none

## Remarks

- Rule of thumb: use 1A output rectifiers for 1A rated maximum output current, two-in-one-package solution is preferred
- In the absence of a good heatsink, often output rectifiers with a much higher rating are applied

## Ultrafast output rectifier

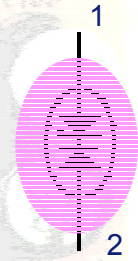
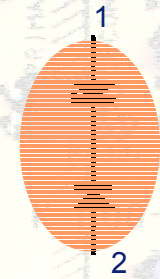
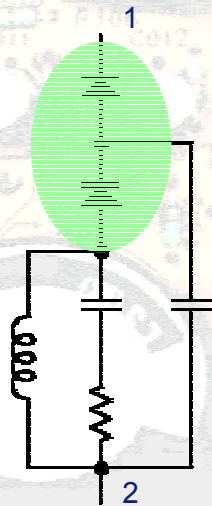
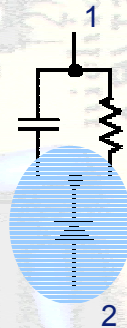
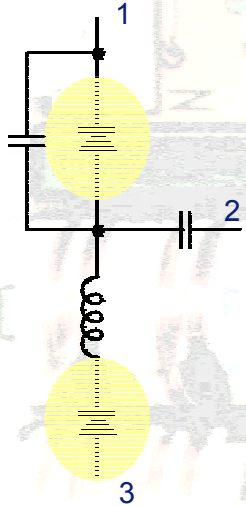
- BYQ28x-200 200V, 2\*5A
- BYQ30x-200 200V, 2\*8A
- BYW29x-100 .. 200 100 .. 200V, 8A
- BYV32x-100 .. 200 100 .. 200V, 2\*10A

## Schottky output rectifier

- 1PS74SB23 25V, 1A, SOT457
- 1PS74SB43 40V, 1A, SOT457
- BAT720 40V, 0.5A, SOT23
- BAT760 20V, 1A, SOD323
- 1PS70SB20 40V, 0.5A, SOT323
- PMEG2010EV 20V, 1A, SOT666

- PBYR620CTD 20V, 2\*3A DPAK  
625, 640, 645 25, 40, 45V
- PBYR725 25V, 7.5A DPAK / TO220AC /  
745 45V SOD100 / SOD113
- PBYR1025CTD 25V, 2\*5A DPAK  
1045 45V
- PBYx1025 25V, 10A DPAK / D2PAK /  
1040, 1045, 40, 45, TO220AC / SOD113  
1060, 10100 60, 100V
- PBYx1525 25V, 2\*7.5A D2PAK / TO220AB  
1545 45V
- PBYx1620 20V, 16A D2PAK / TO220AC  
1625, 1645 25, 45V SOD100
- PBYR2040 40V 2\*10A D2PAK / TO220AB  
2045, 20100 45, 100V
- PBYx2520 20V, 2\*12.5A TO220AB / D2PAK  
2525, 2545 25, 45V SOT186

# Snubber circuit options



## LCCDD

### Philips Diodes

- BYD33J .. M
- BYD37J .. M
- BYG70J .. M
- BYV26C .. E
- BYV36C .. E

## RCD

### Philips Diodes

- BYD33J .. M
- BYD37J .. M
- BYG70J .. M
- BYV26C .. E
- BYV36C .. E

## RLCD CD

### Philips Diodes

- BYD33J .. M
- BYD37J .. M
- BYG70J .. M
- BYV26C .. E
- BYV36C .. E

## Double D

### Philips Diodes    Philips TVS

- |               |              |
|---------------|--------------|
| • BYD33J .. M | • BZD23-Cxxx |
| • BYD37J .. M | • BZD27-Cxxx |
| • BYG70J .. M | • BZG04-Cxxx |
| • BYV26C .. E | • BZT03-Cxxx |
| • BYV36C .. E | • BZW03-Cxxx |

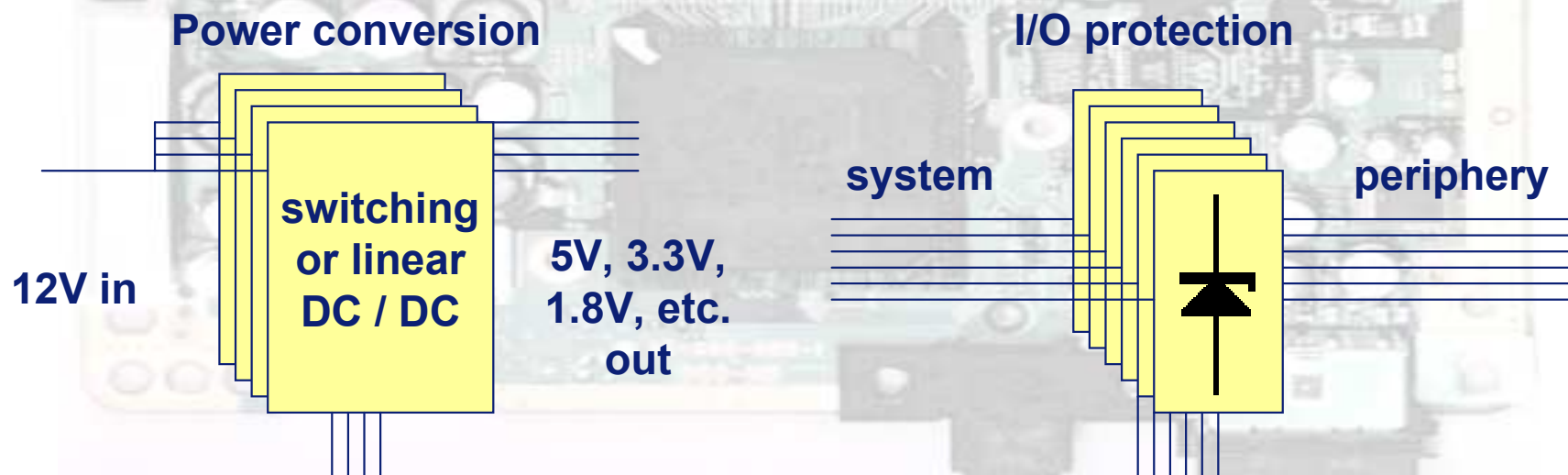
## ZenBlock™

### Philips ZenBlock

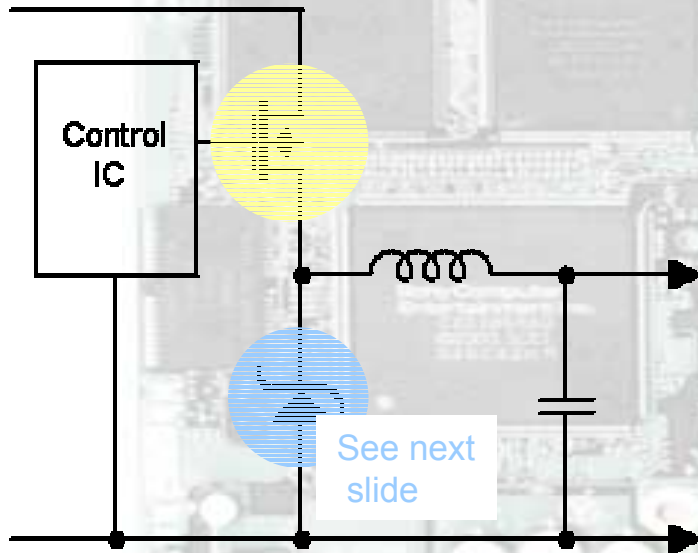
- BZD142-xxx
- BZD142W-xxx
- BZG142-xxx
- BZT142-xxx
- BZW142-xxx

# Game console main board

- Local voltage down conversion for processor, graphics, memory chips, etc.
- Use step down (Buck) converters and linear regulators
- Use various (low power) protection devices (TVS) for peripheral connections (e.g. USB)
- See also: PC Motherboard DC/DC Conversion application guide book



# Step down converter



## Remarks

- Economy solution: uses simple controller IC
- Dual Schottky diodes may be used in parallel

## MOSFET (Power)

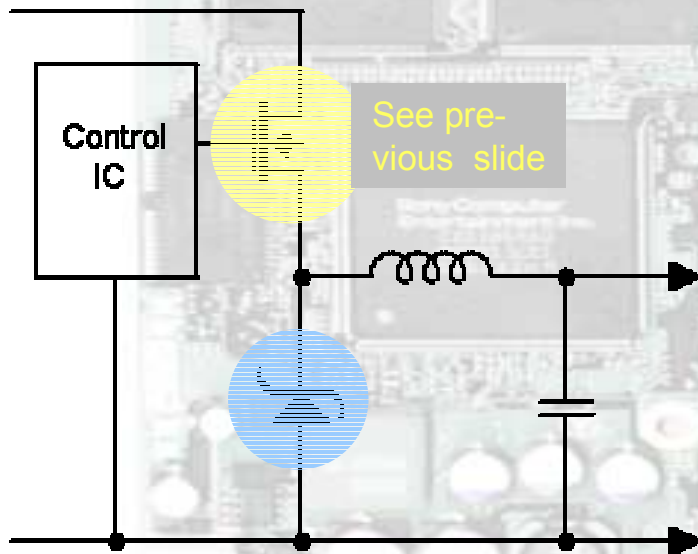
• PHB95N03LT	25V, 7mΩ	D <sup>2</sup> PAK
• PHB83N03LT	25V, 9mΩ	D <sup>2</sup> PAK
• PHx69N03LT	25V, 12mΩ	*)
• PHx55N03LT	25V, 14mΩ	*)
• PHx50N03LT	25V, 16mΩ	*)
• PHx45N03LT	25V, 21mΩ	*)
• PHD24N03LT	25V, 56mΩ	DPAK

\*) available in DPAK, D<sup>2</sup>PAK and TO220AB

## MOSFET (MiniMOS)

• SI4466DY	20V, 9mΩ	SO8
• SI9925DY	20V, 50mΩ	SO8
• SI4466DY	20V, 100mΩ	SO8
• BSP030	30V, 30mΩ	SOT223
• PHN103T	30V, 30mΩ	SO8
• BSH108	30V, 120mΩ	SOT23
• BSP100	30V, 100mΩ	SOT223
• SI4420DY	30V, 9mΩ	SO8
• SI4410DY	30V, 13.5mΩ	SO8
• SI4416DY	30V, 18mΩ	SO8
• SI9410DY	30V, 30mΩ	SO8
• SI9936DY	30V, 50mΩ	SO8

# Step down converter



## Schottky diode

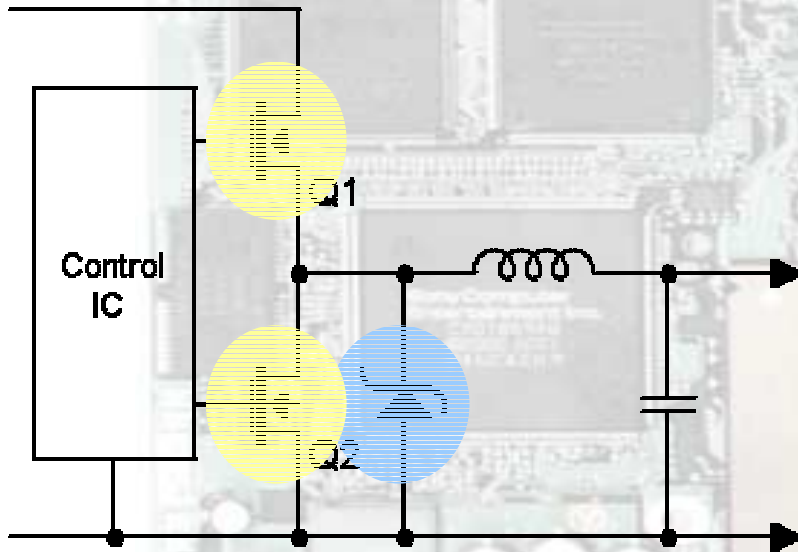
• PBYR620CTD	625/640/645	20/25/40/45V	2*3A	DPAK
• PBYR725	745	25/45V	7.5A	*)
• PBYR1025CTD	1045	25/45V	2*5A	DPAK
• PBYx1025	1040/1045/1060	25/25/40/45V	10A	*)
• PBYx1525	1045	25/45V	2*7.5A	*)
• PBYx1620	1625/1645	20/25/45V	16A	*)
• PBYx2025		25V	20A	*)
• PBYR2040	2045	40/45V	2*10A	*)
• PBYx2520	2525/2545	20/25/45V	2*12.5A	*)
• 1PS74SB23	25V, 1A, SOT457			
• 1PS74SB43	40V, 1A, SOT457			
• BAT720	40V, 0.5A, SOT23			
• BAT760	20V, 1A, SOD323			
• 1PS70SB20	40V, 0.5A, SOT323			
• PMEG2010EV	20V, 1A, SOT666			

\*) available in packages like DPAK, D<sup>2</sup>PAK, TO220, SOT186

## Remarks

- Economy solution: uses simple controller IC
- Dual Schottky diodes may be used in parallel

# Step down converter



## MOSFET (Power)

• PHB95N03LT	25V, 7mΩ	D <sup>2</sup> PAK
• PHB83N03LT	25V, 9mΩ	D <sup>2</sup> PAK
• PHx69N03LT	25V, 12mΩ	*)
• PHx55N03LT	25V, 14mΩ	*)
• PHx50N03LT	25V, 16mΩ	*)
• PHx45N03LT	25V, 21mΩ	*)
• PHD24N03LT	25V, 56mΩ	DPAK

\*) available in DPAK, D<sup>2</sup>PAK and TO220AB

## Schottky diode

• PBYR325CTD	25V, 2*1.5A	DPAK
340, 345	40, 45V	
• PBYR620CTD	20V, 2*3A	DPAK
625, 640, 645	25, 40, 45V	
• 1PS74SB23	25V, 1A, SOT457	
• 1PS74SB43	40V, 1A, SOT457	
• BAT760	20V, 1A, SOD323	
• PMEG2010EV	20V, 1A, SOT666	

## Hyperfast bipolar diode

• BYD1100	100V, 1.7A	SOD87
• BYV1100	100V, 1.7A	SOD81
• BYG85B	100V, 2.3A	SOD106
• BYV2100	100V, 2.3A	SOD57
• BYV4100	100V, 4.2A	SOD64

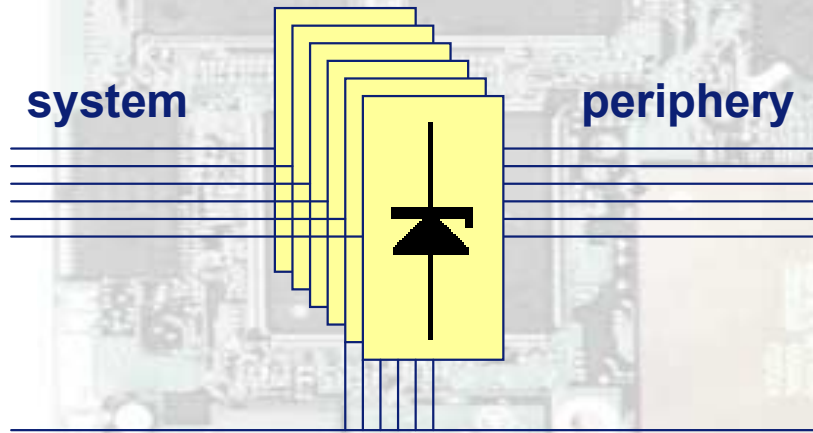
## Remarks

- More efficient solution (low loss)
- Required ratings for high side and low side MOSFETs are generally different (depend on input voltage / output voltage ratio)
- Only a small (Schottky) diode is required

## MOSFET (MiniMOS)

• SI4466DY	20V, 9mΩ	SO8
• SI9925DY	20V, 50mΩ	SO8
• SI4466DY	20V, 100mΩ	SO8
• BSP030	30V, 30mΩ	SOT223
• PHN103T	30V, 30mΩ	SO8
• BSH108	30V, 120mΩ	SOT23
• BSP100	30V, 100mΩ	SOT223
• SI4420DY	30V, 9mΩ	SO8
• SI4410DY	30V, 13.5mΩ	SO8
• SI4416DY	30V, 18mΩ	SO8
• SI9410DY	30V, 30mΩ	SO8
• SI9936DY	30V, 50mΩ	SO8
• PHN210T	30V, 100mΩ	SO8 dual
• PHN203	25V, 30mΩ	SO8 dual

# I/O protection



## Peripheral ports:

- Game controller
- USB
- Network (ethernet UTP)
- Firewire (IEEE 1394)
- AV
- Expansion slots
- etc.

## TVS diodes

Product	$P_{RSM}^*$	stand-off voltage	package
• BZD27-Cxxx	150W	7.5V ... 510V	SOD87
• BZG04-xxx	300W	8.2V ... 220V	SOD106

\*) based on a 10/1000  $\mu$ s exponential pulse

See also presentation "Protection Devices @ BLGA"



# Game controls

**Please refer to the Game Controls  
application guide book**

# Media reader/writer

**Please refer to the DVD  
application guide book**

# Game Controllers

The background of the slide features three different types of game controllers. At the top center is a racing steering wheel with a black and orange color scheme. In the bottom left is a grey and blue game pad. In the bottom right is a grey joystick with a blue base. The text is overlaid on this background.

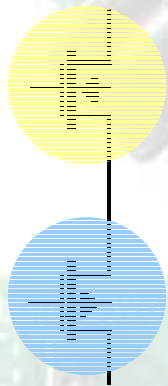
**Three main categories:**

- **Game pad**
- **Joystick**
- **Steering wheel**

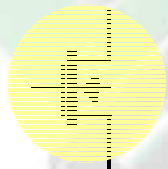
**Only the devices with (force) feedback function contain power semiconductors.**

# Force feedback game controllers

## Analogue control



## PWM control



Small motors take care of the feedback. Motor control is either analogue or PWM. Generally, integrated power semiconductor components are used for this purpose. Discrete power semiconductors that are also appropriate for this job are listed below.

### N-channel MOSFETs

- SI4466DY 20V, 9mΩ SO8
- SI9925DY 20V, 50mΩ SO8
- SI4466DY 20V, 100mΩ SO8
- BSP030 30V, 30mΩ SOT223
- PHN103T 30V, 30mΩ SO8
- BSH108 30V, 120mΩ SOT23
- BSP100 30V, 100mΩ SOT223
- PHN210T 30V, 100mΩ SO8 dual
- PHN203 25V, 30mΩ SO8 dual
- SI4420DY 30V, 9mΩ SO8
- SI4410DY 30V, 13.5mΩ SO8
- SI4416DY 30V, 18mΩ SO8
- SI9410DY 30V, 30mΩ SO8
- SI9936DY 30V, 50mΩ SO8

### P-channel MOSFETs

- BSH105 20V, 250mΩ SOT23
- BSH103 30V, 500mΩ SOT23
- PHP225 30V, 250mΩ SO8 dual

### Complementary MOSFETs

- PHC21025 30V, \*) SO8

\*) N = 100mΩ, P = 250mΩ

# Game controller power supply

Force feedback game controllers generally require an external power supply. The wall adapters come either as conventional linear or as switch mode power supply. Focus is on the switch mode wall adapter.

- Power approximately 25W
- Single line input voltage
- Passive filtering (passive PFC)
- Single transistor forward or flyback converter topology

**See: Compact AC/DC  
application guide book**

