Power Management & Supply:

AC/DC Selection Guide

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Infineon technologies

Never stop thinking.

Introduction

TODAY'S MODERN LIFE style leads to a fast growing energy requirement as more and more people are able to afford electronic equipment. Consumers can select from an ever growing range of cellular phones, PDAs, digital cameras, cordless phones, DVD players, VCRs, TV sets, LCD monitors, Notebook and Desktop computers, and home appliances, to mention only a few. The power consumption of these electronic devices continues to rise as a result of ever increasing functions.

ENERGY GENERATION FREQUENTLY pollutes the environment through radioactive waste and CO_2. In order to compensate and reduce the pace of these overly proportional growing energy requirements, we must use the energy more efficiently.

SWITCH MODE POWER SUPPLIES (SMPS) represent today's most efficient energy conversion approach for electronic equipment. Increasing the SMPS efficiency directly leads to energy savings during the equipment's operational time.

SOME ELECTRONIC DEVICES operate only a few hours during the day, and are consequently in standby mode during the rest of the day. Lowering the standby power consumption will save a considerable amount of energy.

A CONTINUOUS TREND towards system miniaturization has accompanied the development of electronic equipment from the very beginning. Simultaneously, the power rating of the devices increases. This means more power on a smaller space - high-power density is the operative word.

THE "POWER & SUPPLY" group of Infineon Technologies focuses its R&D activities on cost effectiveness, low standby power consumption, high efficiency and power density. Today we are proud to serve our customers with technologically leading products in many areas of an off-line SMPS, power MOSFETs (CoolMOS™, OptiMOS®2), Silicon Carbide Schottky diodes (thinQ!™), IGBTs, intelligent SMPS and PFC control ICs, and CoolSET™ (SMPS control IC and CoolMOS™ in one package).

Applications, Requirements and Solutions

Charger
- Cost effectiveness
  Integrated solution CoolSET™
- Low standby
  Active burst mode of CoolSET

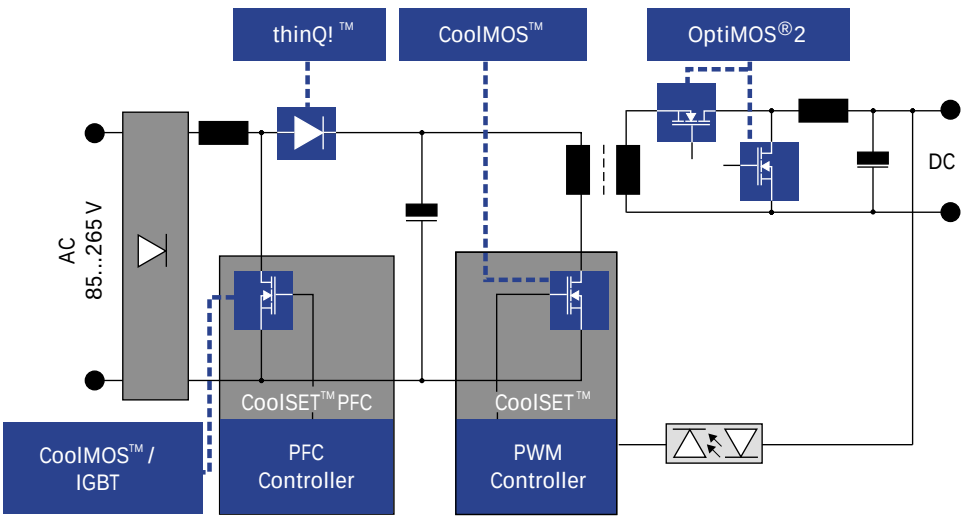
LCD monitor
- High power density
  CoolMOS™ & CoolSET
- Low standby
  Active burst mode of CoolSET
  and ICE3 series controller

Adapter
- High power density
  CoolMOS
  & CoolSET
- Low standby
  Active burst mode of CoolSET
  and ICE3 series controller

Lamp Ballast
- Cost effectiveness
  TDA 486x series
  PFC controller
  Integrated solution PFC CoolSET

Personal computer
- High power density
  CoolMOS
  thinQ!™ Schottky diodes
  OptiMOS®2
  TDA 16888
  ICE1PC series PFC controller
- Low standby
  Active burst mode of CoolSET
  and ICE3 series controller

Server
- Ultra-high power density
  CoolMOS
  thinQ!™ Schottky diodes
  OptiMOS®2
  TDA 16888
  ICE1PC series PFC controller



TV, DVD, VCR, Set-top-box
- Cost effectiveness
  Integrated solution CoolSET
  Charge pump PFC
  Peak load function of ICE3 series
- Low standby
  Active burst mode of ICE3 series
  Frequency reduction of ICE1QS01
- Low EMI
  Quasi-resonant switching

Contents

SMPS ICs

Discretes

SMPS IC Overview

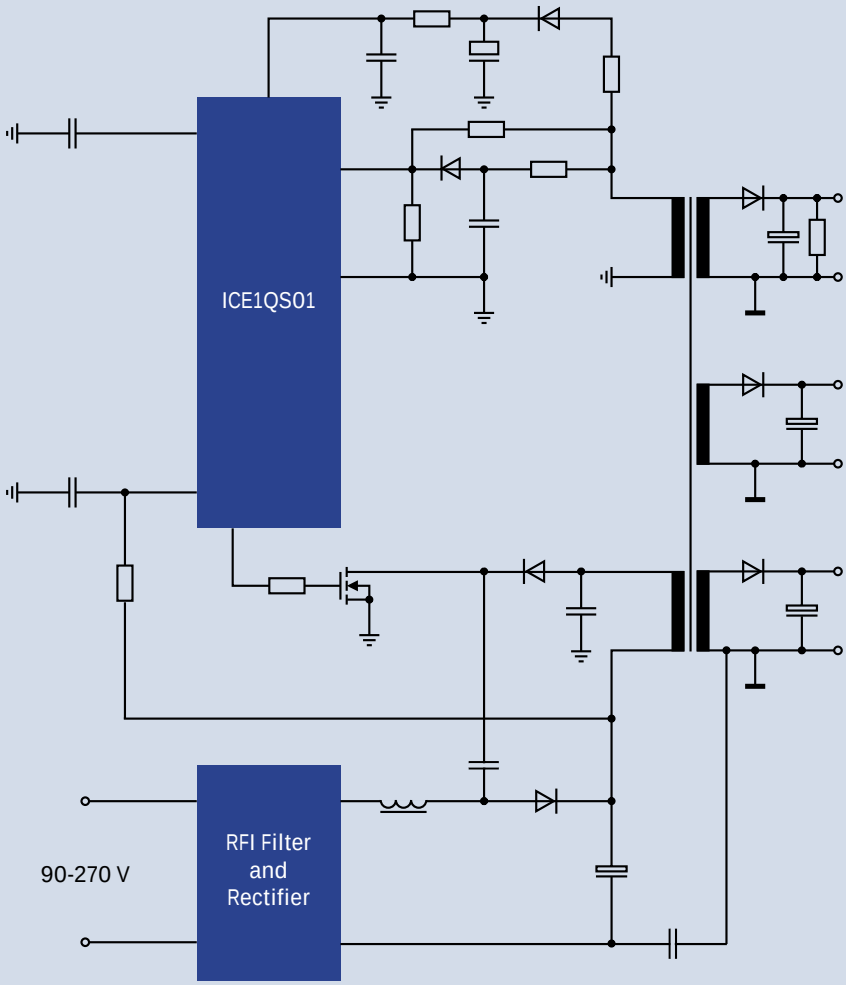
	PWM Controller				
	Quasiresonant			fixed frequency	
	TDA 4605-2 TDA 4605-3	TDA 16846 TDA 16847	ICE1QS01	ICE2A(B)S01	ICE3DS01
	General purpose control IC	Universal, high performance control IC including low power standby and power factor correction	PWM control IC including advanced burst mode, PFC and frequency reduction for best-in-class efficiency ratings	General purpose control IC with ICE2A(B)XXX features	General purpose control IC with enhanced ICEA2(B)S01 features
Typical application	CTV, VCR, adapter	CTV, VCR, set-top-box, adapter	CTV, VCR, adapter	Applications exceeding the max. power range of CoolSET™: charger, adapter, auxiliary supplies, low end CTV, set-top-box, DVD	Applications exceeding the maximum power range of CoolSET™: charger, adapter, aux. supplies, low end CTV, set-top-box, DVD, LCD
General Features					
Operating mode	Quasiresonant	Quasiresonant Fixed frequency Synchronized	Quasiresonant	Fixed frequency	Fixed frequency
Switching frequency	< 200 kHz	< 250 kHzad-justable in fixed frequency mode	< 250 kHz	100 kHz (67 kHz)	110 kHz
Standby frequency	approx. 20 kHz	adjustable	20 kHz	21 kHz	
Maximum duty cycle	unlimited	unlimited	unlimited	72%	72%
Primary regulation without additional components	✓	✓	✓		
Standby power	5 W/400 mW	< 1 W/400 mW	< 1 W/400 mW	< 1 W/no load	100 mW/no load
Low standby power mode active burst mode					480 mW/300 mW
Soft switching for low EMI				✓	✓
Maximum drain-souce voltage	*	*	*	*	*
Power range (85 ... 270 V) without heat sink	*	*	*	*	*
Power range (190 ... 270 V) without heat sink	*	*	*	*	*
Integrated auxiliary power supply					
Integrated 500 V start-up cell					✓
PFC functionality		Charge pump	Charge pump		
Protection Features					
Undervoltage lock-out	✓	✓	✓	✓	✓
Overload and open loop protection	✓	✓	✓	✓	✓
Overvoltage protection	✓	✓	✓	✓	✓
Secondary undervoltage	✓	✓	✓		
Cycle by cycle current limitation	✓	✓	✓	✓	✓
Sophisticated power limitation management	✓	✓	✓	✓	✓
Temporary high-power circuit		TDA 16847			✓
Adjustable peak current limitation via external resistor	✓	✓	✓	✓	✓
Current limitation via internal sense field					
Demagnetization protection	✓	✓	✓		
Thermal shut-down (with auto-restart)				✓	✓
Auto restart mode for all protection features	✓	✓	✓		✓
Latch-off mode					✓
Supply current with active gate (typ.)	11 mA	5 mA	10 mA	6.5 mA	7,2 mA
VCC operating range	7.5 ... 15.5 V	8 ... 16 V	9 ... 20 V	8.5 ... 21 V	8.5 ... 21 V
DIP-package	P-DIP-8	P-DIP-14	P-DIP-8	P-DIP-8	P-DIP-8
SMD-package		P-DSO-14	P-DSO-8	P-DSO-8	P-SO-8

New Devices

* depending on topology and switching transistor
** supply from independent voltage source

SMPS ICs								
	Combo	PFC Controller		CoolSET™: Controller with CoolMOS™ in One Package				
	PWM + CCM PFC	CCM	DCM		fixed frequency			
TDA 16850-2	TDA 16888	ICE1PCS01	TDA 4862 TDA 4863 TDA 4863-2	ICE1PD265	TDA 16831 TDA 16834	TDA 16822	ICE2A(B)0565x ICE2A(B)0165x ICE2A(B)0265x ICE2A(B)0365x ICE2A(B)0765x	ICE2A180 ICE2A280
Control with special features for CRT monitor applications	High performance power combi controller including PFC and PWM stage	Standalone PFC-controller for boost topology with advanced diode protection	PFC controller for high power factor and active harmonic filter	PFC CoolSET™ DCM PFC controller TDA 4863 combined with a 650 V CoolMOS™	Off-line current mode PWM controller combined with a 650 V avalanche rugged CoolMOS™ in one compact package	Like TDA 1683x with additional integrated protection features OLP, OVP, UVL, softstart	Like TDA 1683x family with the TDA 16822 protection features + low power standby mode and internal leading edge blanking + softstart	Like ICE 2Ax65 but with 800 V avalanche rugged CoolMOS
Monitors, CTVs, adapters, chargers	Industrial, aircon, motor drive, PC, server, adapter	Industrial, PC, motor drive, white goods	Ballast, CTV, PC monitor, adapter	Ballast, adapter	Charger, auxiliary supplies, PC standby supply, adapter, STB, DVD, VCR	Charger, plug in, white goods, adapter, STB, DVD, VCR, PC standby supply	Charger, auxiliary supplies, PC standby supply, plug in, white goods, DVD, STB, VCR	Charger, auxiliary supplies, PC standby supply, plug in, white goods, DVD, STB, VCR
Fixed frequency Synchronized	Fixed frequency Continuous conduction mode	Fixed frequency	Discontinuous conduction mode	Discontinuous conduction mode	Fixed frequency	Fixed frequency	Fixed frequency	Fixed frequency
60 kHz fixed < 130 kHz synchr.	up to 200 kHz	up to 250 kHz	free-running 30 ... 300 kHz	free-running 30 ... 300 kHz	100 kHz	100 kHz	67 kHz	100 kHz
20 kHz	PWM 0kHz/PFC 50%				100 kHz	100 kHz	21 kHz	21 kHz
60%	PWM 50%/PFC 94%	95% @ 125 kHz	98%	98%	50%	72%	72%	72%
< 1 W/no load	< 1 W/no load		n/a	n/a			< 1 W/no load	< 1 W/no load
	✓		✓					
✓	✓			✓	✓	✓	✓	✓
				650 V	650 V	650 V	650 V	800 V
				0-55 W	12, 15, 26, 34 W	17 W	13,17,26,36,130 W	17, 28 W
				0-140 W	17, 24, 36, 34 W	28 W	24,28,38,43,230 W	28, 40 W
✓	✓							
	✓	✓	✓					
✓	✓	✓	✓	✓	✓	✓	✓	✓
✓	✓	✓	✓**			✓	✓	✓
	✓	✓	✓	✓		✓	✓	✓
	output undervoltage protection					✓	✓	✓
✓	PWM✓ PFC✓	✓	✓	✓		✓	✓	✓
✓		✓					✓	✓
✓	✓	✓	✓	✓		✓	✓	✓
					✓			
			✓	✓				
✓					✓	✓	✓	✓
						✓	✓	✓
3 ... 10 mA	15 ... 40 mA	18 @ 125 kHz	4 mA	4 mA	6 ... 7 mA	6.5 mA	6.5 ... 8.5 mA	6.5 ... 8.5 mA
8.5 ... 22 V	14 ... 19 V	10 ... 22 V	12 . 5 ... 20 V	12 . 5 ... 20 V	8.5 ... 17.5 V	8.5 ... 17.5 V	8.5 ... 21 V	8.5 ... 21 V
P-DIP-8	P-DIP-20	P-DIP-8	P-DIP-8		P-DIP-8	P-DIP-8	P-DIP-8	P-DIP-7
	P-DSO-20	P-DSO-8	P-DSO-8	P-DSO-16	P-DSO-14		TO220 I^2-PAK P-DIP-7	

PWM Controller



Application example: 80 W demoboard with ICE1QS01 and primary regulation

TDA 4605-2 / TDA 4605-3

Control IC for Switched-Mode Power Supplies using MOS-Transistor

- Fold back characteristic protects external components
- Burst mode at secondary short-circuit
- Protection against open or a short of the control loop
- Mains undervoltage lock-out
- Soft-start for quiet start-up without noise
- Chip-over temperature protection
- Not for new designs, replaced by TDA 16846

TDA 16846 / TDA 16847

SMPS Controller Supporting Low Power Standby and Power Factor Correction

- Line current consumption with PFC
- Stable and adjustable standby frequency
- Very low start-up current
- Soft-start for quiet start-up
- Freely usable fault comparators
- Synchronization and fixed frequency facility
- Over- and undervoltage lock-out
- Switch off at mains undervoltage
- Temporary high power circuit (only TDA 16847)
- Mains voltage dependent fold back point correction
- Continuous frequency reduction with decreasing load
- Adjustable ringing suppression time

ICE1QS01

SMPS Controller with very few peripheral components, featuring advanced burst mode, frequency reduction and power factor correction

- Line current consumption with PFC
- Stable standby frequency of 20 KHz
- Advanced burst mode < 1 W @ 350 mW sec. power
- Soft-start for noiseless start-up
- Digital frequency reduction for higher efficiency and no-jitter designs
- Over- and undervoltage protection
- Fold-back point correction for stable output power independent of line voltage variations
- Ringing suppression time controlled by output power
- Additional fault comparator optionally useable

TDA 16850-2

SMPS Controller for CRT Monitors

- Controller for fly back topology
- Current mode PWM with spike blanking
- Leading edge triggered pulse width modulation
- Fast, soft switching totem pole gate drive (1 A)
- Soft-start management for safe start-up
- Off mode with power consumption less than 1 W
- Fast and slow peak current limitation
- All protection features available

PWM Controller

ICE2xS01

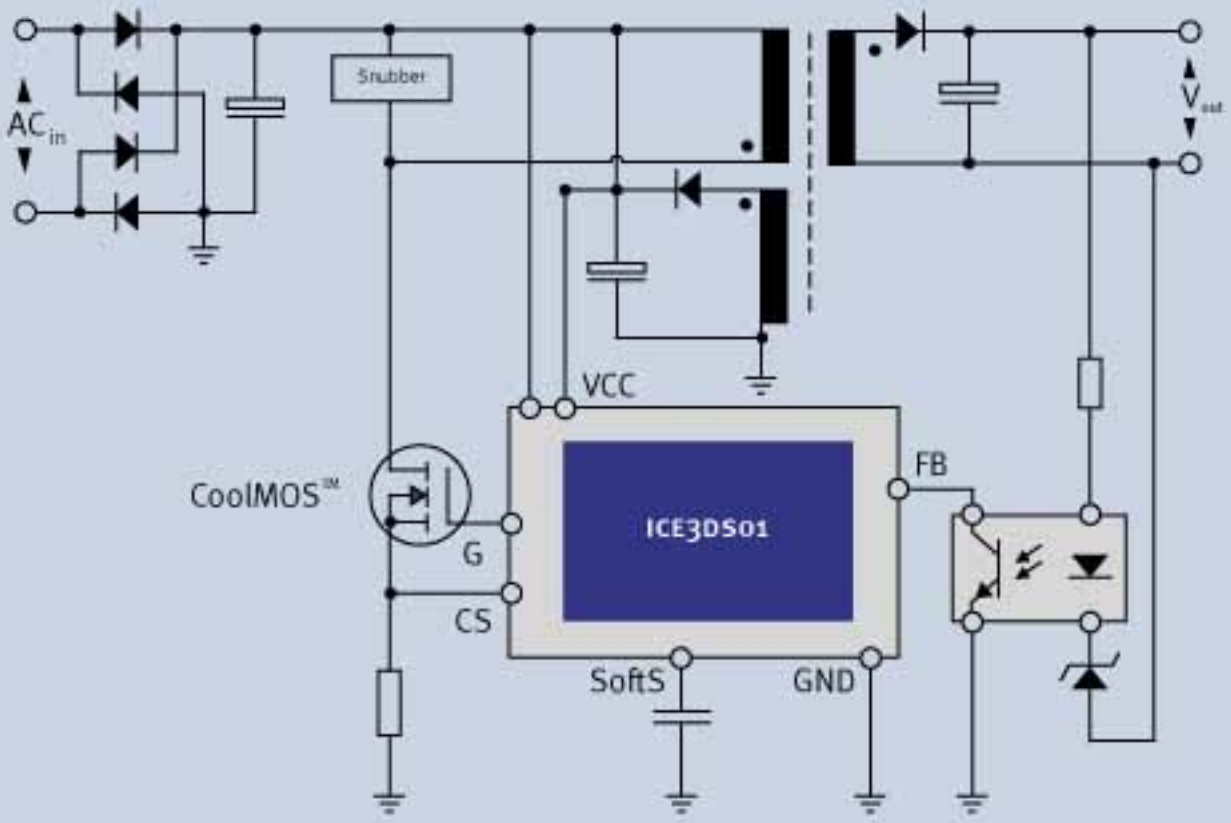
OFF-Line SMPS Current Mode Controller

- PWM – Current Mode Controller
- 67 kHz and 100 kHz fixed frequent operation
- Max duty cycle up to 72%
- Frequency reduction for low standby
- Adjustable soft-start
- Propagation delay compensation
- Internal leading edge blanking
- Fully protected
- P-DIP8 / P-SO8

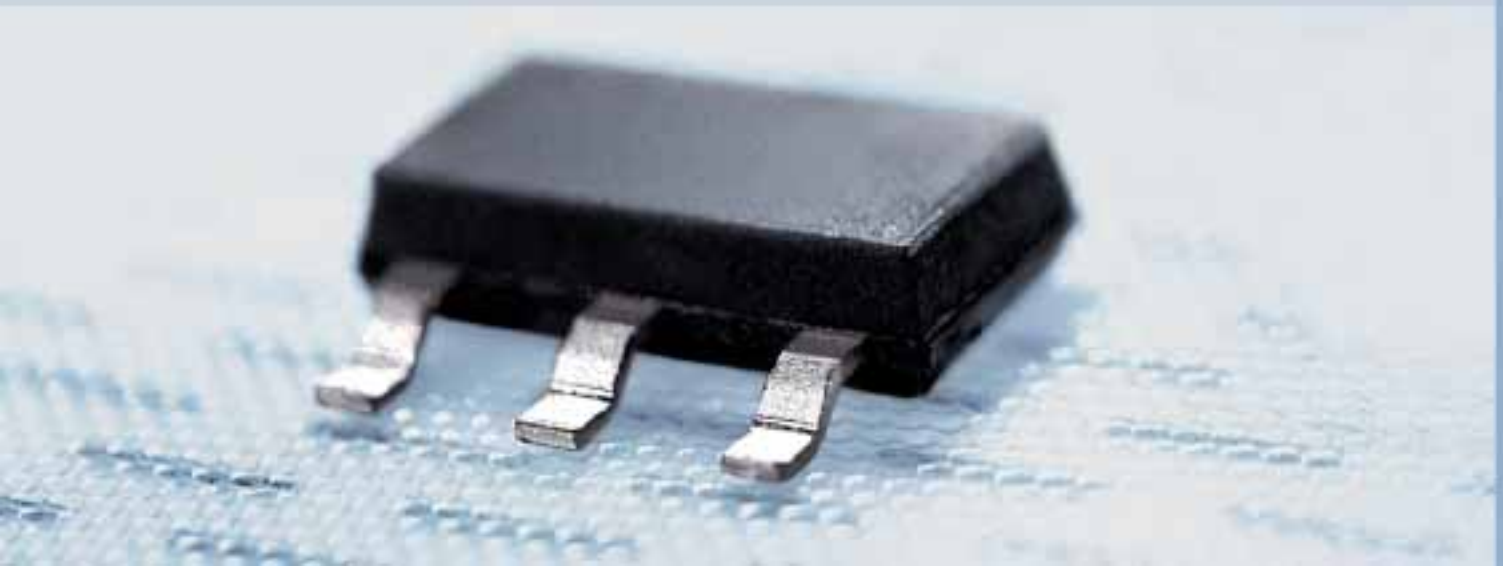
ICE3DS01

OFF-Line SMPS Current Mode Controller

- PWM & 500V start-up cell with one package
- Active burst mode for ultra-low standby power (P_{IN} < 100 mW)
- Short term overload function
- New protection: latched OFF or auto restart
- 110 kHz fixed frequent operation
- Max duty cycle up to 72%
- Adjustable soft-start
- Propagation delay compensation
- Internal leading edge blanking
- Fully protected
- P-DIP8 / P-SO8



Application example: circuit diagram for PWM fly back converter



PFC and Combo Controller

ICE1 PC S01

Stand-alone Power Factor Correction (PFC) Controller in Continuous Conduction Mode

- Easy to use with very few external components
- Average current control
- Programmable operating frequency (50 to 250 kHz)
- Unique set of protection features including brownout protection and boost diode protection
- Precise internal reference voltage
- Unique soft-start
- Enhanced dynamic response
- Leading edge modulation

TDA 4862

Power Factor Controller (PFC) IC for High Power Factor and Active Harmonic Filter

- IC for sinusoidal line-current consumption
- Power factor approaching 1
- Controls boost converter as an active harmonics filter
- Internal start-up with low current consumption
- Zero current detector for discontinuous operation mode
- High current totem pole gate driver
- Trimmed +/- 1.4% internal reference
- Undervoltage lock out with hysteresis
- Very low start-up current consumption
- Pin compatible with world standard
- Output overvoltage protection
- Current sense input with internal low pass filter
- Totem pole output with active shutdown during UVLO
- Junction temperature range -40°C to +150°C
- Available in P-DIP-8 and P-DSO-8 packages

TDA 4863 / TDA 4863-2

Power Factor Controller IC for High Power Factor and Low THD

Additional features to TDA 4862

- Reduced tolerance of signal levels
- Improved light load behaviour
- Open loop protection
- Current sense input with leading edge blanking LEB
- Undervoltage protection

ICE1PD265

PFC CoolSET™ version of TDA 4863

- 650 V avalanche rugged CoolMOS™
- $R_{DS(on)}$ = 1.1 Ω
- P-DSO-16 package
- PFC output power:
  55 W @ V_{IN} = 90 V (T_A = 70°C)
  140 W @ V_{IN} = 180 V (T_A = 70°C)
- Reduced size and assembling costs
- Highest efficiency due to lower power dissipation

TDA 16888

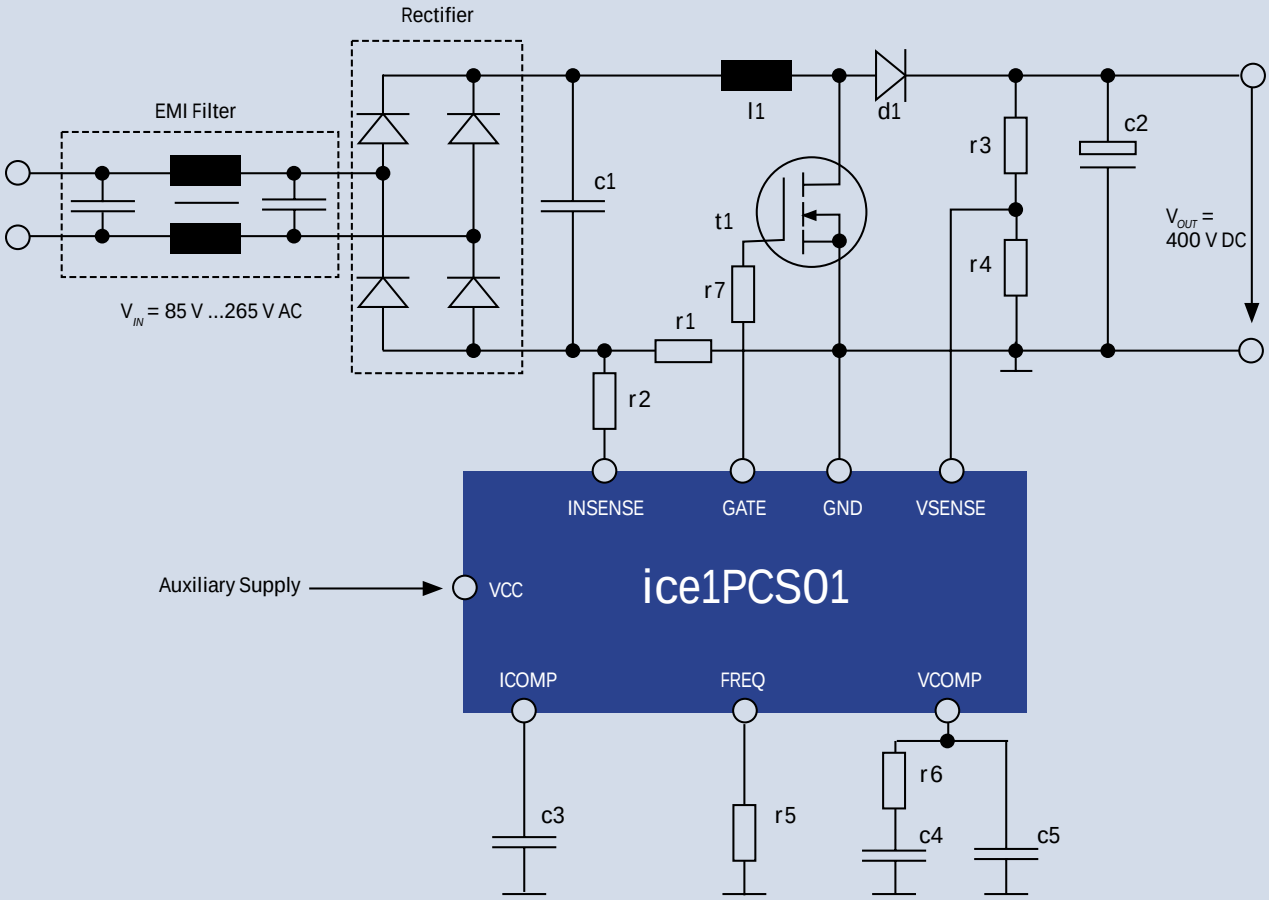
High Performance Power Combi Controller

PFC Section

- IEC 1000-3 compliant
- Additional operation mode as auxiliary power supply
- Fast, soft switching totem pole gate drive (1 A)
- Leading edge triggered pulse width modulation
- Peak current limitation
- Continuous/discontinuous mode possible
- 94% maximum duty cycle

PWM Section

- Improved current mode control
- Fast, soft switching totem pole gate drive (1 A)
- Soft-start management
- Topologies are forward or fly back
- 50% maximum duty cycle



Application example: circuit diagram for PFC boost converter

CoolSET™

TDA 1683x

Off-Line SMPS Controller with 650 V Sense CoolMOS™ on Board (Basic Solution)

General Features

- PWM controller & CoolMOS powerstage within one compact package
- No external sense resistor required
- 650 V avalanche rugged CoolMOS
- Typical $R_{DS(on)}$ = 1.0 Ω...3.5 Ω at Tj = 25°C
- Only 4 active pins
- Standard P-DIP-8 package for output power up to 70 W
- 100 kHz fixed switching frequency
- Max. duty cycle @ 50%
- Current mode control
- Low start-up current

Protection Features (all auto-restarted)

- Undervoltage lock out (UVL)
- Thermal shut-down

TDA 16822

(Enhanced TDA 1683x Version)
Off-Line SMPS Controller with 650 V CoolMOS on Board (High Protection Solution)

- Typical $R_{DS(on)}$ = 3.0 Ω @ Tj = 25°C
- Only 6 active pins

Additionals to TDA 1683x
General Features

- Extended max duty cycle up to 72%
- Adjustable peak current limitation via external resistor
- Overall tolerance of current limiting < + / - 5%
- Current overshoot minimization
- Adjustable soft-start

Protection Features (all auto-restarted)

- Overcurrent (OCP) and open loop protection (OLP)
- Overvoltage protection (OVP) during auto-restart and start-up

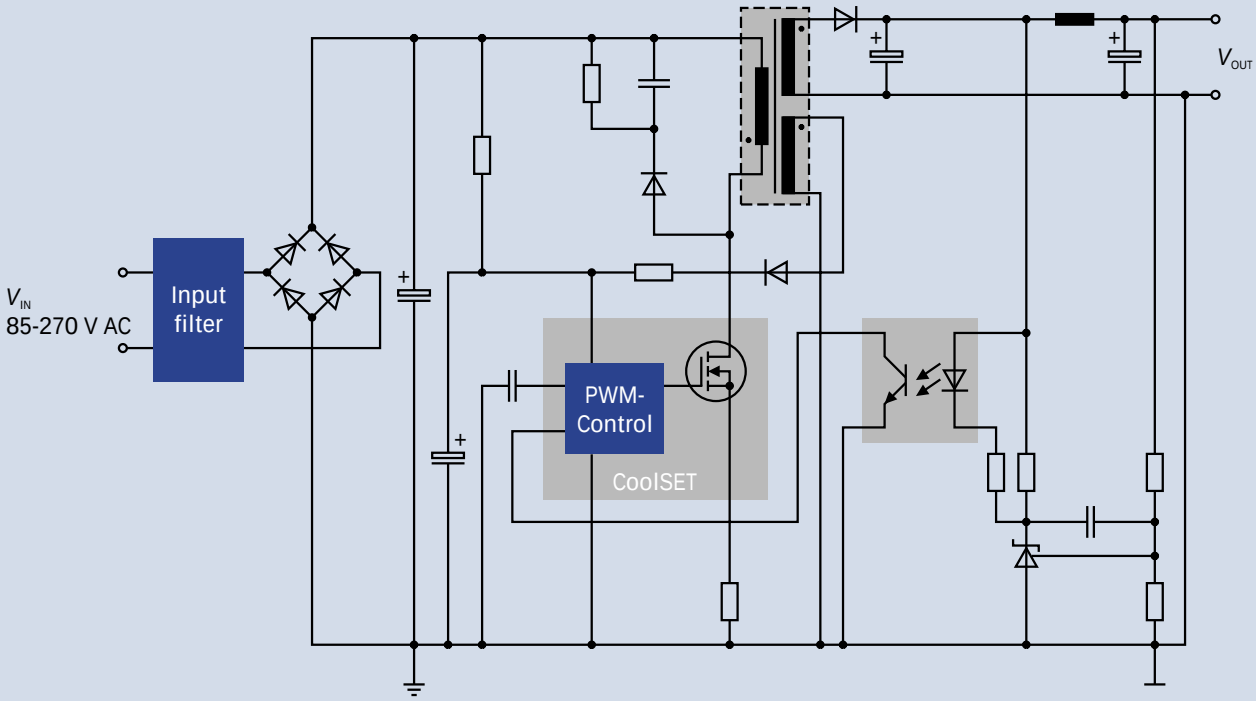
ICE2Axxx / ICE2Bxxx

(Enhanced TDA 16822 Version)
Off-Line SMPS Controller with 650 V/800 V CoolMOS on Board (High Protection & Energy Saving Solution)

- 650 V or 800 V avalanche rugged CoolMOS
- Typical $R_{DS(on)}$ = 0.45 Ω...4.7 Ω at Tj = 25°C

Additional Features to TDA 16822

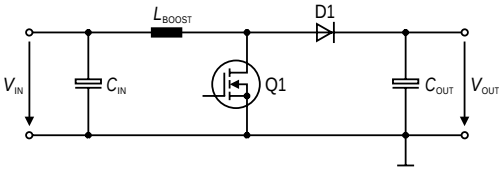
- Frequency reduction for lowest standby power (below 1 W) to meet European requirements
- 100 kHz / 67 kHz switching frequency
- Internal leading edge blanking
- Modulated gate drive for soft switching
- High peak power accuracy
- P-DIP-7, P-DIP-8 or P-TO220-6, I^2-PAK package



Application example: CoolSET™ for off-line switch mode power supplies

SMPS Topologies

Boost Converter

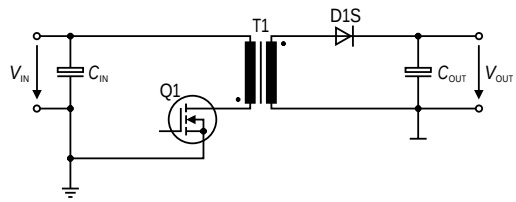


Advantages
- Simple choke
- No problems with magnetic coupling
- Cheap Solution

Disadvantages
- Power transistor drain-source voltage $V_{DS} = V_O > V_I$
- No galvanic isolation between input and output voltage
- Medium loading of the output capacitor

Infineon Parts:
TDA 16888, TDA 4862, TDA 4863, TDA 4863-2, CoolSET™, ICE1PD265, ICE1PCS01, ICE2xS01, ICE3DS01

Flyback Converter

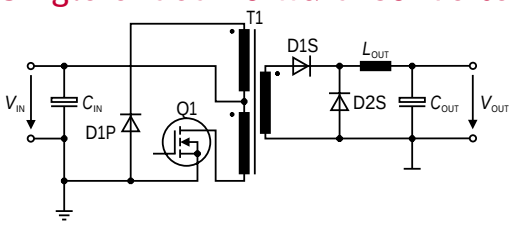


Advantages
- Simple, low part count
- Several output voltages can be regulated simultaneously
- Wide control range for operating voltage changes

Disadvantages
- Power transistor drain-source voltage $V_{DS} = V_{IN} + N (V_{OUT} + V_{D1S})$
- Heavy loading to output capacitor and diode

Infineon Parts:
TDA 16888, TDA 16846, TDA 16850, CoolSET™, ICE2xS01, ICE3OS01, ICE1QS01

Forward Converter
Single Transistor Forward Converter
Single-ended Forward Converter

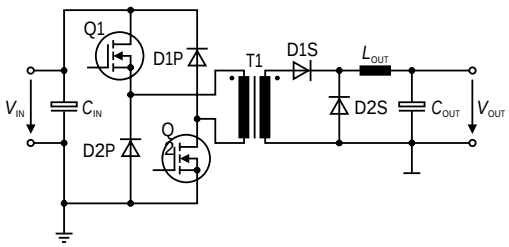


Advantages
- Demagnetizing the core is no problem
- Simple circuitry

Disadvantages
- Power transistor drain-source voltage $V_{DS} > 2\ V_I$
- Demagnetizing winding is necessary
- Good magnetic coupling is necessary between primary and demagnetizing windings

Infineon Parts:
TDA 16888, TDA 4916 GG

Two-Transistor Forward Converter
Diagonal Half-Bridge Converter
Dual-ended Forward Converter

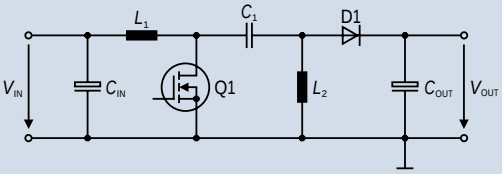


Advantages
- MOSFET drain-source voltage $V_{DS} = V_I$
- Core demagnetization is no problem
- The transformer may have a high level of stray inductance

Disadvantages
- Galvanic-isolated driving is necessary

Infineon Parts:
TDA 16888, TDA 4916 GG

Basic Non-Isolated Sepic Converter

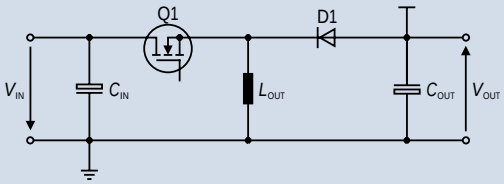


Advantages
- Transformer is replaced by two chokes
- Common ground connection
- No polarity inversion low voltage stress for the MOSFET
- Output voltage is above or below the input voltage

Disadvantages
- Voltage at the diode is $V_{IN} + V_{OUT} + V_{D1}$

Infineon Parts:
TDA 16888, CoolSET™, ICE2xS01, ICE3DS01

Buck-Boost Converter
Single Transistor
Buck-Boost Converter

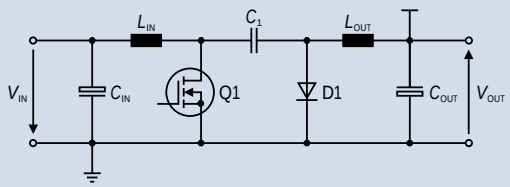


Advantages
- Simple choke
- No problems with magnetic coupling

Disadvantages
- Power transistor drain-source voltage $V_{DS} = V_I + V_O$
- No galvanic isolation between input and output voltage
- Heavy loading of output capacitor
- Input must “float”
- Output voltage negative in relation to input voltage

Infineon Parts:
CoolSET™, ICE2xS01, ICE3DS01

Basic Non-Isolated Cuk Converter



Advantages
- High efficiency
- Input / output current continuous
- Output voltage is inverse to input voltage

Disadvantages
- High peak currents in power components
- High ripple current in capacitor

Infineon Parts:
TDA 16888, CoolSET™, ICE2xSO1, ICE3DS01

N-Channel MOSFETs

N-Channel Enhancement 400 V*

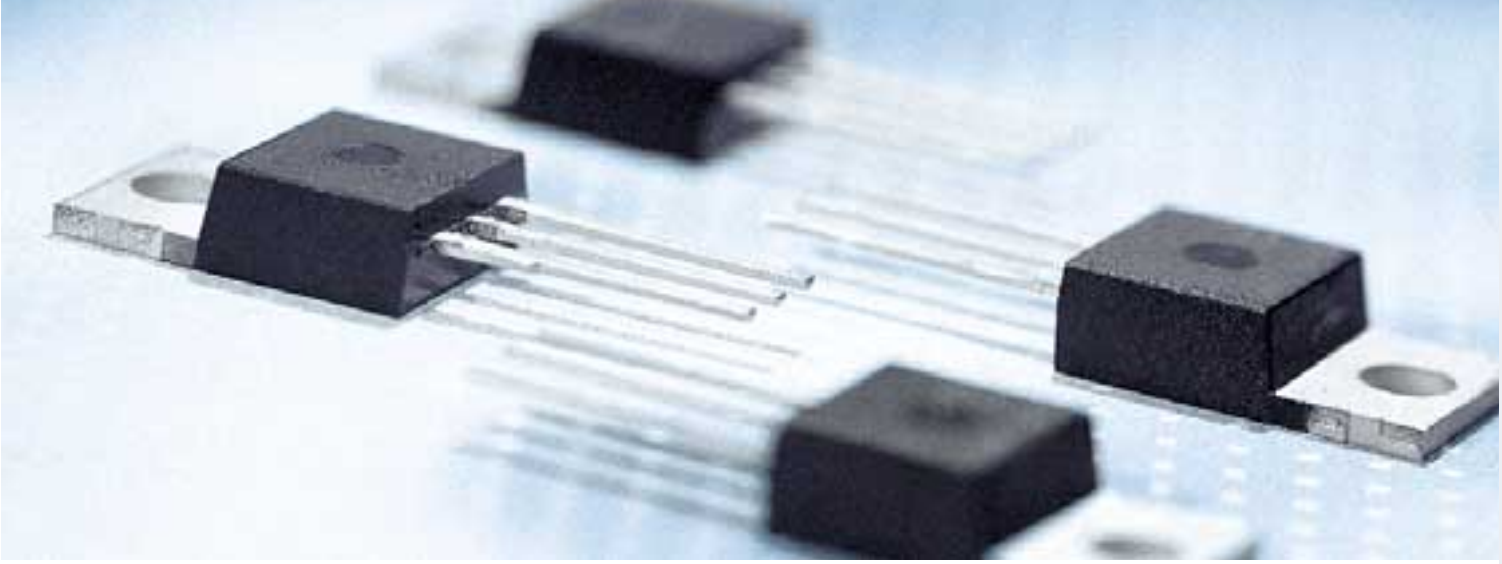
Package	$R_{DS(on)\ max.}$ [Ω] @ V_{GS} = 10 V	$V_{GS(th)}$ [V]	I_D [A]	max. Q_g [nC]	Type
TO-218	0.3	2.1...4.0	15.0	112	BUZ323
	0.35	2.1...4.0	12.5	100	BUZ325
	0.5	2.1...4.0	10.5	72	BUZ326
TO-220 (3-leg) D^2-PAK	0.4	2.1...4.0	12.5	72	BUZ61
	0.5	2.1...4.0	11.0	72	BUZ61A
	1.0	2.1...4.0	5.5	45	BUZ60
	1.8	2.1...4.0	3.0	21	BUZ76
	2.5	2.1...4.0	2.6	21	BUZ76A
SOT-223	3.0	2.1...4.0	0.36	–	BSP298
	25.0	1.5...2.5	0.32	–	BSP324

* not for new design

N-Channel Enhancement 500 V*

Package	$R_{DS(on)\ max.}$ [Ω] @ V_{GS} = 10 V	$V_{GS(th)}$ [V]	I_D [A]	typ. Q_g [nC]	Type
TO-218	0.4	2.1...4.0	13.5	125	BUZ338
	0.6	2.1...4.0	9.5	150	BUZ330
	0.8	2.1...4.0	8.0	72	BUZ331
TO-220 (3-leg) D^2-PAK	0.8	2.1...4.0	8.0	72	BUZ40B
	1.5	2.1...4.0	4.5	45	BUZ41A
	2.0	2.1...4.0	4.0	31	BUZ42
	3.0	2.1...4.0	2.4	25	BUZ74
	4.0	2.1...4.0	2.1	25	BUZ74A
SOT-223	4.0	2.1...4.0	0.4	–	BSP299

* not for new design



N-Channel 500 V (CoolMOS™)

Package	$R_{DS(on)\ max.}$ [Ω] @ V_{GS} = 10 V	$V_{GS(th)}$ [V]	I_D [A]	typ. Q_g [nC]	Type
TO-262	0.19	2.1...3.9	21.0	95	SPI21N50C3
	0.28	2.1...3.9	16.0	66	SPI16N50C3
	0.38	2.1...3.9	11.6	49	SPI12N50C3
	0.6	2.1...3.9	7.6	32	SPI08N50C3
TO-247	0.07	2.1...3.9	52.0	275	SPW52N50C3
	0.11	2.1...3.9	32.0	175	SPW32N50C3
	0.19	2.1...3.9	21.0	95	SPW21N50C3
	0.28	2.1...3.9	16.0	66	SPW16N50C3
	0.38	2.1...3.9	11.6	49	SPW12N50C3
D-PAK	0.6	2.1...3.9	7.6	32	SPD08N50C3
	0.95	2.1...3.9	4.5	22	SPD04N50C3
	1.4	2.1...3.9	3.2	15	SPD03N50C3
	3.0	2.1...3.9	1.8	9	SPD02N50C3
TO-220 FullPAK	0.19	2.1...3.9	21.0	95	SPA21N50C3
	0.28	2.1...3.9	16.0	66	SPA16N50C3
	0.38	2.1...3.9	12.0	49	SPA12N50C3
	0.6	2.1...3.9	7.6	32	SPA08N50C3
	0.95	2.1...3.9	4.5	22	SPA04N50C3
TO-220 (3-leg) D^2-PAK	0.19	2.1...3.9	21.0	95	SPP/B21N50C3
	0.28	2.1...3.9	16.0	66	SPP/B16N50C3
	0.38	2.1...3.9	11.6	49	SPP/B12N50C3
	0.6	2.1...3.9	7.6	32	SPP08N50C3
	0.95	2.1...3.9	4.5	22	SPP/B04N50C3

N-Channel 600 V (CoolMOS™)

Package	$R_{DS(on)\ max.}$ [Ω] @ V_{GS} = 10 V	$V_{GS(th)}$ [V]	I_D [A]	typ. Q_g [nC]	Type
TO-262	0.19	2.1...3.9	20.7	87.0	SPI20N60C3
	0.28	2.1...3.9	15.0	63.0	SPI15N60C3
	0.38	3.5...5.5	11.0	41.5	SPI11N60S5
	0.38	2.1...3.9	11.0	45.0	SPI11N60C3
	0.6	3.5...5.5	7.3	27.0	SPI07N60S5
	0.6	2.1...3.9	7.3	21.0	SPI07N60C3
TO-247	0.07	2.1...3.9	47.0	252.0	SPW47N60C3
	0.10	2.1...3.9	35.0	170.0	SPW35N60C3
	0.16	2.1...3.9	24.3	104.9	SPW24N60C3
	0.19	3.5...5.5	20.7	79.0	SPW20N60S5
	0.19	2.1...3.9	20.7	87.0	SPW20N60C3
	0.28	2.1...3.9	15.0	63.0	SPW15N60C3
	0.38	3.5...5.5	11.0	41.5	SPW11N60S5
	0.38	2.1...3.9	11.0	45.0	SPW11N60C3
D-PAK I-PAK	0.6	3.5...5.5	7.3	27.0	SPD/U07N60S5
	0.6	2.1...3.9	7.3	21.0	SPD/(U*)07N60C3
	0.75	2.1...3.9	6.2	25.2	SPD06N80C3
	0.95	3.5...5.5	4.5	17.6	SPD/U04N60S5
	0.95	2.1...3.9	4.5	19.0	SPD/(U*)04N60C3
	1.4	3.5...5.5	3.2	12.4	SPD/U03N60S5
	1.4	2.1...3.9	3.2	13.0	SPD/(U*)03N60C3
	3.0	3.5...5.5	1.8	7.3	SPD/U02N60S5
	3.0	2.1...3.9	1.8	9.5	SPD/(U*)02N60C3
	6.0	2.3...3.7	0.8	3.9	SPD01N60C3
	6.0	2.3...3.7	0.8	3.9	SPU01N60C3
SOT-223	0.95	3.5...5.5	0.8	17.6	SPN04N60S5
	1.4	3.5...5.5	0.7	12.4	SPN03N60S5
	1.4	2.1...3.9	0.7	13.0	SPN03N60C3
	3.0	3.5...5.5	0.4	7.3	SPN02N60S5
	3.0	2.1...3.9	0.4	9.5	SPN02N60C3
	6.0	2.3...3.7	0.3	3.9	SPN01N60C3
TO-220 FullPAK	0.19	2.1...3.9	20.7	87.0	SPA20N60C3
	0.28	2.1...3.9	15.0	63.0	SPA15N60C3
	0.38	2.1...3.9	11.0	45.0	SPA11N60C3
	0.6	2.1...3.9	7.3	21.0	SPA07N60C3
	0.75	2.1...3.9	6.2	25.2	SPA06N60C3
	0.95	2.1...3.9	4.5	19.0	SPA04N60C3
	1.4	2.1...3.9	3.2	13.0	SPA03N60C3
TO-220 (3-leg) D^2-PAK	0.16	2.1...3.9	24.3	104.9	SPP24N60C3
	0.19	3.5...5.5	20.7	79.0	SPP/B20N60S5
	0.19	2.1...3.9	20.7	87.0	SPP/B20N60C3
	0.28	2.1...3.9	15.0	63.0	SPP15N60C3
	0.38	3.5...5.5	11.0	41.5	SPP/B11N60S5
	0.38	2.1...3.9	11.0	45.0	SPP/B11N60C3
	0.6	3.5...5.5	7.3	27.0	SPP/B07N60S5
	0.6	2.1...3.9	7.3	21.0	SPP/B07N60C3

* available on request - please contact your local Infineon Sales Partner

N-Channel 600 V (CoolMOS™)

Package	$R_{DS(on)\ max.}$ [Ω] @ V_{GS} = 10 V	$V_{GS(th)}$ [V]	I_D [A]	typ. Q_g [nC]	Type
TO-220 (3-leg) D^2-PAK	0.75	2.1...3.9	6.2	25.2	SPP06N60C3
	0.95	3.5...5.5	4.5	17.6	SPP/B04N60S5
	0.95	2.1...3.9	4.5	19.0	SPP/B04N60C3
	1.4	3.5...5.5	3.2	12.4	SPP/B03N60S5
	1.4	2.1...3.9	3.2	13.0	SPP/B03N60C3
	3.0	3.5...5.5	1.8	7.3	SPP/B02N60S5
	3.0	2.1...3.9	1.8	9.5	SPP/B02N60C3

N-Channel 600 V CFD (CoolMOS™ with fast body diode)

Package	$R_{DS(on)\ max.}$ [Ω] @ V_{GS} = 10 V	$V_{GS(th)}$ [V]	I_D [A]	typ. Q_g [nC]	Type
TO-220 (3-leg)	0.22	3.0...5.0	20.0	88.0	SPP20N60CFD
	0.44	3.0...5.0	11.0	46.0	SPP11N60CFD
TO-247	0.22	3.0...5.0	20.0	88.0	SPW20N60CFD
	0.44	3.0...5.0	11.0	46.0	SPW11N60CFD

N-Channel Enhancement 600 V*

Package	$R_{DS(on)\ max.}$ [Ω] @ V_{GS} = 10 V	$V_{GS(th)}$ [V]	I_D [A]	Type
SOT-223	45	1.5...2.5	0.12	BSP125

* not for new design

N-Channel 650 V (CoolMOS™)

Package	$R_{DS(on)\ max.}$ [Ω] @ V_{GS} = 10 V	$V_{GS(th)}$ [V]	I_D [A]	typ. Q_g [nC]	Type
TO-220 FullPAK	0.19	2.1...3.9	20.7	87.0	SPA20N65C3
	0.38	2.1...3.9	11.0	45.0	SPA11N65C3
	0.60	2.1...3.9	7.3	21.0	SPA07N65C3
TO-262	0.19	2.1...3.9	20.7	87.0	SPI20N65C3
	0.38	2.1...3.9	11.0	45.0	SPI11N65C3
	0.60	2.1...3.9	7.3	21.0	SPI07N65C3
TO-220 (3-leg)	0.19	2.1...3.9	20.7	87.0	SPP20N65C3
	0.38	2.1...3.9	11.0	45.0	SPP11N65C3
	0.60	2.1...3.9	7.3	21.0	SPP07N65C3

N-Channel 800 V (CoolMOS™)

Package	$R_{DS(on)\ max.}$ [Ω] @ V_{GS} = 10 V	$V_{GS(th)}$ [V]	I_D [A]	typ. Q_g [nC]	Type
TO-220 (3-leg)	0.29	2.1...3.9	17	91	SPP17N80C3
	0.45	2.1...3.9	11	50	SPP11N80C3
	0.65	2.1...3.9	8	40	SPP08N80C3
	0.9	2.1...3.9	6	27	SPP06N80C3
	1.3	2.1...3.9	4	20	SPP04N80C3
	2.7	2.1...3.9	2	9	SPP02N80C3
TO-220 FullPAK	0.29	2.1...3.9	17	91	SPA17N80C3
	0.45	2.1...3.9	11	50	SPA11N80C3
	0.65	2.1...3.9	8	40	SPA08N80C3
	0.9	2.1...3.9	6	27	SPA06N80C3
	1.3	2.1...3.9	4	20	SPA04N80C3
	2.70	2.1...3.9	2	9	SPA02N80C3
D^2-PAK	0.29	2.1...3.9	17	91	SPB17N80C3
TO-247	0.29	2.1...3.9	17	91	SPW17N80C3
	0.45	2.1...3.9	11	50	SPW11N80C3
D-PAK	0.9	2.1...3.9	6	27	SPD06N80C3
	1.3	2.1...3.9	4	20	SPD04N80C3
	2.70	2.1...3.9	2	9	SPD02N80C3
TO-262	0.65	2.1...3.9	8	40	SPI08N80C3

N-Channel Enhancement 800 V*

Package	$R_{DS(on)\ max.}$ [Ω] @ V_{GS} = 10 V	$V_{GS(th)}$ [V]	I_D [A]	typ. Q_g [nC]	Type
TO-218	1.0	2.1...4.0	7.5	175	BUZ305
	1.5	2.1...4.0	6.0	128	BUZ355
	2.0	2.1...4.0	5.0	128	BUZ356
	3.0	2.1...4.0	3.0	43	BUZ307
	4.0	2.1...4.0	2.6	43	BUZ308
TO-220 (3-leg) D^2-PAK	2.5	2.1...4.0	4.0	110	BUZ81
	3.0	2.1...4.0	3.0	43	BUZ80A
	4.0	2.1...4.0	2.6	43	BUZ80
	8.0	2.1...4.0	1.5	38	BUZ78
SOT-223	20.0	2.1...4.0	0.19	–	BSP300

* not for new design

Standard N-Channel Depletion

Package	V_{DS} [V]	$R_{DS(on)}$ [Ω]	$V_{GS(th)}$ [V]	I_D [A]	Type
SOT-23	60	8.0	-3.5...-2.4	0.230	BSS159N
	100	12.0	-2.9...-1.8	0.170	BSS169
	250	30.0	-2.1...-1.0	0.100	BSS139
	600	700.0	-2.7...-1.6	0.016	BSS126
SOT-223	200	3.5	-2.1...-1.0	0.660	BSP149
	240	6.0	-2.1...-1.0	0.350	BSP129
	600	60.0	-2.1...-1.0	0.120	BSP135

High-frequency IGBT (> 40 kHz) & DuoPack™

High Speed IGBT 600 V

Package	Continuous current at T_c=100°C, [A]	T_c=25°C, [A]	E_{off} typ at T_j=150°C	Type
D^2-PAK	15	27	0.2	SGB15N60HS
TO-220 (3-leg)	20	36	0.24	SGP20N60HS
	30	41	0.48	SGP30N60HS
TO-247	20	36	0.24	SGW20N60HS
	30	41	0.48	SGW30N60HS

High Speed IGBT DuoPack™ 600 V (IGBT + EmCon™ Diode)

Package	Continuous current at T_c=100°C, [A]	T_c=25°C, [A]	E_{off} typ at T_j=150°C	Type
D^2-PAK	6	12	0.08	SKB06N60HS
	15	27	0.2	SKB15N60HS
TO-247	20	36	0.24	SKW20N60HS
	30	41	0.48	SKW30N60HS

High Speed2 IGBT 1200 V

Package	Triangular peak current at T_c=100°C, [A]	T_c=25°C, [A]	E_{off} typ at T_j=25°C, [mJ]	Type
D^2-PAK	1.3	3.2	0.09	IGB01N120H2
	3.9	9.6	0.15	IGB03N120H2
TO-220 (3-leg)	1.3	3.2	0.09	IGP01N120H2
	3.9	9.6	0.15	IGP03N120H2
TO-220 Full-PAK	1.7	5.7	0.15	IGA03N120H2
TO-247	3.9	9.6	0.15	IGW03N120H2

High Speed2 IGBT DuoPack™ 1200 V (IGBT + EmCon™ Diode)

Package	Triangular peak current at T_c=100°C, [A]	T_c=25°C, [A]	E_{off} typ at T_j=25°C, [mJ]	Type
D^2-PAK	1.3	3.2	0.09	IKB01N120H2
	3.9	9.6	0.15	IKB03N120H2
TO-220 (3-leg)	1.3	3.2	0.09	IKP01N120H2
	3.9	9.6	0.15	IKP03N120H2
TO-220 Full-PAK	1.7	5.7	0.15	IKA03N120H2
TO-247	3.9	9.6	0.15	IKW03N120H2

All IGBTs in North America are sold through eupec

LightMOS 600V IGBT with Monolithically Integrated Diode

Package	Continuous current at T_c=100°C, [A]	T_c=25°C, [A]	E_{off} typ at T_j=25°C, [mJ]	Type
D-PAK	3.0	4.5	0.028	ILD03N60
D^2-PAK	3.0	4.5	0.028	ILB03N60
TO-220 (3-leg)	3.0	4.5	0.028	ILP03N60
TO-220 FullPAK	2.2	3.0	0.028	ILA03N60

Silicon Carbide Schottky Diodes (thinQ!™)

thinQ!™ 300 V

Package	V_{RRM} [V]	I_F [A]	Q_C [nC]	Type
D^2-PAK	300	10	23	SDB10S30
	300	2 x 10	23	SDB20S30
TO-220 (2-leg)	300	10	23	SDT10S30
TO-220 (3-leg)	300	10	23	SDP10S30
	300	2 x 10	23	SDP20S30

thinQ!™ 600 V

Package	V_{RRM} [V]	I_F [A]	Q_C [nC]	Type
D^2-PAK	600	6	21	SDB06S60
TO-220 (2-leg)	600	2	5	SDT02S60
	600	4	13	SDT04S60
	600	5	18	SDT05S60
	600	6	21	SDT06S60
	600	2x6	21	SDT12S60
	600	8	26	SDT08S60
	600	2 x 5	29	SDT10S60
TO-220 (3-leg)	600	4	13	SDP04S60
	600	6	21	SDP06S60
D-PAK	600	4	13	SDD04S60

Alphanumeric Listing

Product Name	Product Description	Voltage Class	Page
BSP125	N-Channel Enhancement MOSFET	600 V	21
BSP129	N-Channel Depletion MOSFET	240 V	23
BSP135	N-Channel Depletion MOSFET	600 V	23
BSP149	N-Channel Depletion MOSFET	200 V	23
BSP298	N-Channel Enhancement MOSFET	400 V	18
BSP299	N-Channel Enhancement MOSFET	500 V	18
BSP300	N-Channel Enhancement MOSFET	800 V	23
BSP324	N-Channel Enhancement MOSFET	400 V	18
BSS126	N-Channel Depletion MOSFET	600 V	23
BSS139	N-Channel Depletion MOSFET	250 V	23
BSS159	N-Channel Depletion MOSFET	50 V	23
BSS169	N-Channel Depletion MOSFET	100 V	23
BUZ305	N-Channel Enhancement MOSFET	800 V	23
BUZ307	N-Channel Enhancement MOSFET	800 V	23
BUZ308	N-Channel Enhancement MOSFET	800 V	23
BUZ323	N-Channel Enhancement MOSFET	400 V	18
BUZ325	N-Channel Enhancement MOSFET	400 V	18
BUZ326	N-Channel Enhancement MOSFET	400 V	18
BUZ330	N-Channel Enhancement MOSFET	500 V	18
BUZ331	N-Channel Enhancement MOSFET	500 V	18
BUZ338	N-Channel Enhancement MOSFET	500 V	18
BUZ355	N-Channel Enhancement MOSFET	800 V	23
BUZ356	N-Channel Enhancement MOSFET	800 V	23
BUZ40B	N-Channel Enhancement MOSFET	500 V	18
BUZ41A	N-Channel Enhancement MOSFET	500 V	18
BUZ42	N-Channel Enhancement MOSFET	500 V	18
BUZ60	N-Channel Enhancement MOSFET	400 V	18
BUZ61	N-Channel Enhancement MOSFET	400 V	18
BUZ61A	N-Channel Enhancement MOSFET	400 V	18
BUZ74	N-Channel Enhancement MOSFET	500 V	18
BUZ74A	N-Channel Enhancement MOSFET	500 V	18
BUZ76	N-Channel Enhancement MOSFET	400 V	18
BUZ76A	N-Channel Enhancement MOSFET	400 V	18
BUZ78	N-Channel Enhancement MOSFET	800 V	23
BUZ80	N-Channel Enhancement MOSFET	800 V	23
BUZ80A	N-Channel Enhancement MOSFET	800 V	23
BUZ81	N-Channel Enhancement MOSFET	800 V	23
BUZ81	N-Channel Enhancement MOSFET	800 V	23
IGA03N120H2	HighSpeed2 IGBT*	1200 V	24
IGB01N120H2	HighSpeed2 IGBT*	1200 V	24
IGB03N120H2	HighSpeed2 IGBT*	1200 V	24
IGP01N120H2	HighSpeed2 IGBT*	1200 V	24
IGP03N120H2	HighSpeed2 IGBT*	1200 V	24
IGW03N120H2	HighSpeed2 IGBT*	1200 V	24
IKA03N120H2	HighSpeed2 IGBT* DuoPack™	1200 V	24
IKB01N120H2	HighSpeed2 IGBT* DuoPack	1200 V	24
IKB03N120H2	HighSpeed2 IGBT* DuoPack	1200 V	24
IKP01N120H2	HighSpeed2 IGBT* DuoPack	1200 V	24
IKP03N120H2	HighSpeed2 IGBT* DuoPack	1200 V	24
IKW03N120H2	HighSpeed2 IGBT* DuoPack	1200 V	24
ILA03N60	LightMOS	600 V	25
ILB03N60	LightMOS	600 V	25
ILD03N60	LightMOS	600 V	25
ILP03N60	LightMOS	600 V	25
SDB06S60	thinQ!™	600 V	25
SDB10S30	thinQ!	300 V	25
SDB20S30	thinQ!	300 V	25
SDD04S60	thinQ!	600 V	25
SDP04S60	thinQ!	600 V	25
SDP06S60	thinQ!	600 V	25
SDP10S30	thinQ!	300 V	25
SDP20S30	thinQ!	300 V	25
SDT02S60	thinQ!	600 V	25
SDT04S60	thinQ!	600 V	25
SDT05S60	thinQ!	600 V	25
SDT06S60	thinQ!	600 V	25
SDT08S60	thinQ!	600 V	25
SDT10S30	thinQ!	300 V	25
SDT10S60	thinQ!	600 V	25
SDT12S60	thinQ!	600 V	25
SDT20S30	thinQ!	300 V	25
SGB15N60HS	HighSpeed IGBT*	600 V	24
SGP20N60HS	HighSpeed IGBT*	600 V	24
SGp30N60HS	HighSpeed IGBT*	600 V	24
SGW20N60HS	HighSpeed IGBT*	600 V	24
SGW30N60HS	HighSpeed IGBT*	600 V	24
SKB06N60HS	HighSpeed IGBT* DuoPack™	600 V	24
SKB15N60HS	HighSpeed IGBT* DuoPack	600 V	24
SKW20N60HS	HighSpeed IGBT* DuoPack	600 V	24
SKW30N60HS	HighSpeed IGBT* DuoPack	600 V	24
SPA02N80C3	CoolMOS™ Transistor	800 V	22
SPA03N60C3	CoolMOS Transistor	600 V	20
SPA04N50C3	CoolMOS Transistor	500 V	19
SPA04N60C3	CoolMOS Transistor	600 V	20
SPA04N80C3	CoolMOS Transistor	800 V	22
SPA06N60C3	CoolMOS Transistor	600 V	20
SPA06N80C3	CoolMOS Transistor	800 V	22
SPA07N65C3	CoolMOS Transistor	650 V	21
SPA07N60C3	CoolMOS Transistor	600 V	20
SPA08N50C3	CoolMOS Transistor	500 V	19
SPA08N80C3	CoolMOS Transistor	800 V	22
SPA11N60C3	CoolMOS Transistor	600 V	20
SPA11N65C3	CoolMOS Transistor	650 V	21
SPA11N80C3	CoolMOS Transistor	800 V	22
SPA12N50C3	CoolMOS Transistor	500 V	19
SPA15N60C3	CoolMOS Transistor	600 V	20
SPA16N50C3	CoolMOS Transistor	500 V	19
SPA17N80C3	CoolMOS Transistor	800 V	22
SPA20N60C3	CoolMOS Transistor	600 V	20
SPA20N65C3	CoolMOS Transistor	650 V	21
SPA21N50C3	CoolMOS Transistor	500 V	19
SPD/(U*)02N60C3	CoolMOS Transistor	600 V	20
SPD/(U*)03N60C3	CoolMOS Transistor	600 V	20
SPD/(U*)04N60C3	CoolMOS Transistor	600 V	20
SPD/(U*)07N60C3	CoolMOS Transistor	600 V	20
SPD/U02N60C5	CoolMOS Transistor	600 V	20
SPD/U03N60C5	CoolMOS Transistor	600 V	20
SPD/U04N60C5	CoolMOS Transistor	600 V	20
SPD/U07N60C5	CoolMOS Transistor	600 V	20
SPD01N60C3	CoolMOS Transistor	600 V	20
SPD02N50C3	CoolMOS Transistor	500 V	19
SPD02N80C3	CoolMOS Transistor	800 V	22
SPD03N50C3	CoolMOS Transistor	500 V	19
SPD04N50C3	CoolMOS Transistor	500 V	19
SPD04N80C3	CoolMOS Transistor	800 V	22
SPD06N80C3	CoolMOS Transistor	600 V	20
SPD06N80C3	CoolMOS Transistor	800 V	22
SPD08N50C3	CoolMOS Transistor	500 V	19
SPI07N60C3	CoolMOS Transistor	600 V	20
SPI07N60S5	CoolMOS Transistor	600 V	20
SPI07N65C3	CoolMOS Transistor	650 V	21
SPI08N50C3	CoolMOS Transistor	500 V	19
SPI08N80C3	CoolMOS Transistor	800 V	22
SPI11N60C3	CoolMOS Transistor	600 V	20
SPI11N60S5	CoolMOS Transistor	600 V	20
SPI11N65C3	CoolMOS Transistor	650 V	21
SPI12N50C3	CoolMOS Transistor	500 V	19
SPI15N60C3	CoolMOS Transistor	600 V	20
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SPI20N65C3	CoolMOS Transistor	650 V	21
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SPN01N60C3	CoolMOS Transistor	600 V	20
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SPP/B20N60C3	CoolMOS Transistor	600 V	20
SPP/B21N50C3	CoolMOS Transistor	500 V	19
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SPP08N50C3	CoolMOS Transistor	500 V	19
SPP08N80C3	CoolMOS Transistor	800 V	22
SPP11N65C3	CoolMOS Transistor	650 V	21
SPP11N80C3	CoolMOS Transistor	800 V	22
SPP11N60CFD	CoolMOS Transistor	600 V	21
SPP15N60C3	CoolMOS Transistor	600 V	20
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SPW11N60CFD	CoolMOS Transistor	600 V	21
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SPW47N60C3	CoolMOS Transistor	600 V	20
SPW52N50C3	CoolMOS Transistor	500 V	19
SPW11N60C3	CoolMOS Transistor	600 V	20

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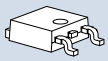
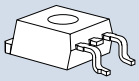
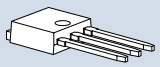
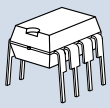
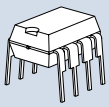
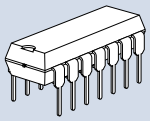
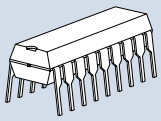
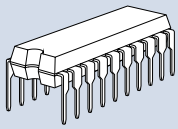
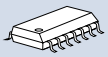
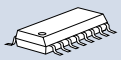
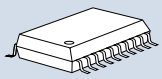
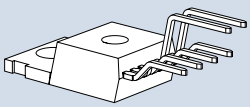
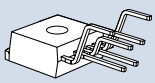
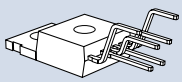
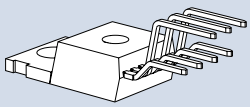
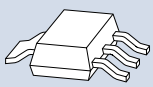
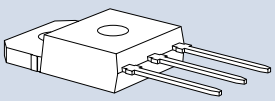
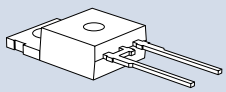
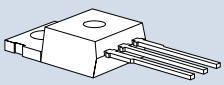
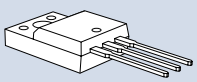
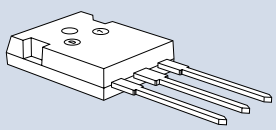
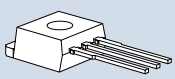
D-PAK (P-TO252-3-1) 	D^2-PAK (P-TO263-3-2) 	I-PAK (P-TO251-3-1) 	P-DIP-7 
P-DIP-8 	P-DIP-14 	P-DIP-16 	P-DIP-20 
P-DSO-8 	P-DSO-14 	P-DSO-16 	P-DSO-20 
P-TO220-6-3 	P-TO220-6-46 	P-TO220-6-47 	P-TO220-7 
SOT-23 (P-SOT23-3) 	SOT-223 (P-SOT223-4) 	TO-218 (P-TO218-3-1) 	TO-220 (2-leg) (P-TO220-2-2) 
TO-220 (3-leg) (P-TO220-3-1) 	TO-220 FullPAK (P-TO220-3-31) 	TO-247 (P-TO247-3-1) 	TO-262 (P-TO262-3-1) 

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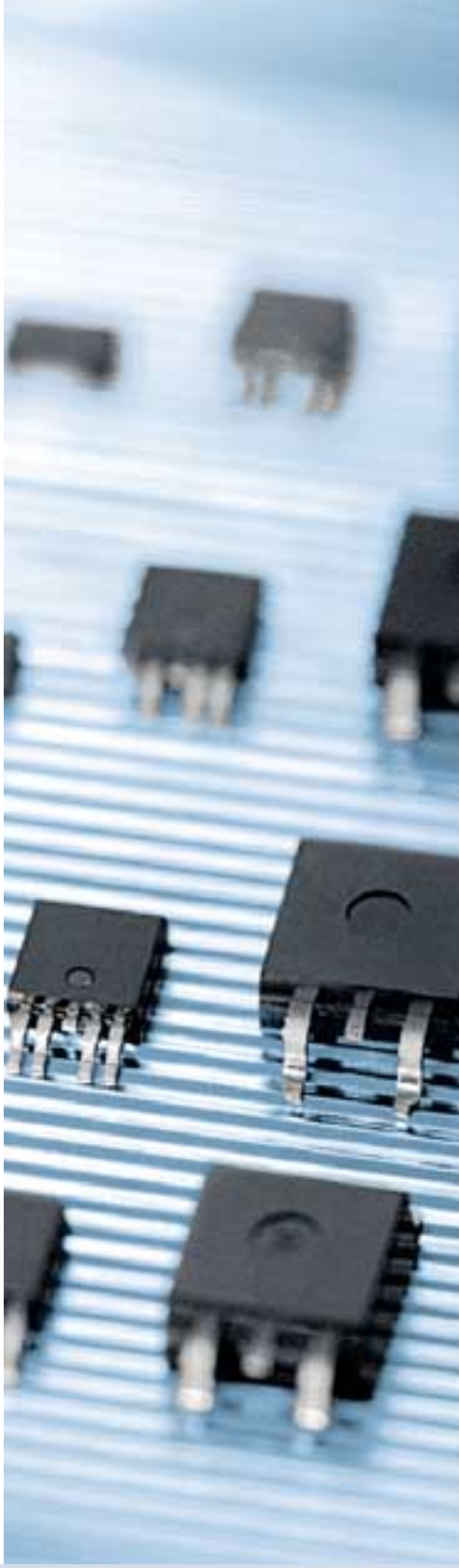

Edition March 2004

Published by
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Ordering No. B152-H8202-G1-X-7600
Printed in Germany
WS 030410.

Z&P 2003068